

**FOURTH FIVE-YEAR REVIEW REPORT
DIAMOND ALKALI SUPERFUND SITE
ESSEX COUNTY, NEW JERSEY**



Prepared by

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

June 2016

Approved by:

A handwritten signature in black ink, appearing to read "Walter E. Mugdan", is written over a horizontal dashed line.

**Walter E. Mugdan, Director
Emergency and Remedial Response Division**

Date:

June 23, 2016

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Executive Summary

This is the fourth five-year review for the Diamond Alkali Superfund Site, Operable Unit 1 (OU1), located in the City of Newark, Essex County, New Jersey. The purpose of this five-year review is to review information to determine if the remedy is and will continue to be protective of human health and the environment. The triggering action for this statutory five-year review is the signature of the previous five-year review on June 8, 2011.

The interim remedy at OU1 currently protects human health and the environment in the short-term because all exposure pathways are addressed by engineering and access controls. However, in order for the remedy to be protective in the long-term, a plan to implement recommendations resulting from the review of the 2015 remedy evaluation report needs to be developed. While not the subject of this FYR, a final remedy for OU1 will be selected in the future.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site Name: Diamond Alkali Company		
EPA ID: NJD980528996		
Region: 2	State: NJ	City/County: City of Newark/Essex County
SITE STATUS		
NPL Status: Final		
Multiple OUs? Yes	Has the site achieved construction completion? No	
REVIEW STATUS		
Lead agency: EPA <i>[If "Other Federal Agency", enter Agency name]:</i> Click here to enter text.		
Author name (Federal or State Project Manager): Elizabeth Butler		
Author affiliation: EPA		
Review period: 6/8/2011 - 6/22/2016		
Date of site inspection: 9/23/2015		
Type of review: Statutory		
Review number: 4		
Triggering action date: 6/8/2011		
Due date (five years after triggering action date): 6/8/2016		

Issues/Recommendations
OU(s) without Issues/Recommendations Identified in the Five-Year Review:
N/A

Issues and Recommendations Identified in the Five-Year Review:

OU(s): 1	Issue Category: Remedy Performance			
	Issue: Pursuant to the Consent Decree, an evaluation of the interim remedy was completed on 11/24/15 but next steps have not yet been identified.			
	Recommendation: Complete the review of the remedy evaluation report with the Partner Agencies (New Jersey Department of Environmental Protection, National Oceanic and Atmospheric Administration, U.S. Fish and Wildlife Service), and develop a plan to implement recommendations.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	PRP	EPA/State	12/30/2016

Protectiveness Statement(s)

<i>Operable Unit:</i> 1	<i>Protectiveness Determination:</i> Short-term Protective
The interim remedy at OU1 currently protects human health and the environment in the short-term because all exposure pathways are addressed by engineering and access controls. However, in order for the remedy to be protective in the long-term, a plan to implement recommendations resulting from the review of the 2015 remedy evaluation report needs to be developed.	

Introduction

The purpose of a five-year review 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 and is functioning as intended by the decision documents. The methods, findings, and conclusions of reviews are documented in the five-year review. In addition, five-year review reports identify issues found during the review, if any, and document recommendations to address them.

This is the fourth five-year review for Operable Unit 1 (OU1) of the Diamond Alkali Superfund Site (site), located in the City of Newark, Essex County, New Jersey. This five-year review was conducted by the Environmental Protection Agency (EPA) Remedial Project Manager (RPM) Elizabeth Butler. The review 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 300.430(f)(4)(ii), and in accordance with the *Comprehensive Five-Year Review Guidance*, OSWER Directive 9355.7-03B-P (June 2001). This report will become part of the site file.

The triggering action for this statutory review is the previous five-year review. A five-year review is required at this site due to the fact that hazardous substances, pollutants or contaminants remain at the site above levels that allow for unlimited use and unrestricted exposure. The site consists of four operable units. The 80-120 Lister Avenue properties are OU1; the sediment of the lower 8.3 miles of the Lower Passaic River is OU2; the 17-mile Lower Passaic River Study Area is OU3; and the Newark Bay Study Area is OU4. The interim remedy for OU1 is currently in long term operation and maintenance. EPA issued a Proposed Plan for the sediments of OU2 on April 11, 2014 and issued a Record of Decision for OU2 on March 3, 2016. OU3 and OU4 are still in the Remedial Investigation/Feasibility Study (RI/FS) phase. The Record of Decision for the OU1 interim remedy anticipated that the bedrock groundwater aquifer could be an additional operable unit at some time in the future. OU1 is the subject of this five-year review. EPA uses OU numbers for managing its investigation and remediation in phases. The second five-year review (June 8, 2011) identified OU2 as the Lower Passaic River and OU3 as the Newark Bay Study. EPA concluded that renumbering the OUs as they are described here will best support the management of the project from this point forward.

Site Chronology

See Table 1 for the site chronology.

Background

Physical Characteristics

The Diamond Alkali site consists of two properties located on 80 and 120 Lister Avenue adjacent to the Passaic River in the Ironbound neighborhood of Newark, New Jersey. Newark is a city of more than 275,000 residents, located in Essex County, and the Ironbound is a neighborhood of approximately 50,000 residents, located in the East Ward of Newark. The Ironbound covers approximately four square miles and is home to a sizeable Portuguese and Brazilian population. The site is bounded by industrial properties and the Passaic River. However, the surrounding area is also interspersed with residences, including Newark Public Housing. The two properties total approximately 5.8 acres and have been designated as OU1. For the purposes of this review, only the properties within the boundaries of OU1 are being

considered. Since the adjacent properties are also industrial and have their own contamination issues, they are being investigated under cleanup programs overseen by the New Jersey Department of Environmental Protection (NJDEP). However, since the extent of contamination did extend beyond the property boundaries into the Passaic River, the Diamond Alkali Superfund Site also includes the Lower Passaic River Study Area, the Newark Bay Study Area, and the areal extent of contamination, along with the facility property. The Lower Passaic River Study Area (LPRSA) is located in (flows through) Essex, Hudson, Passaic and Bergen Counties.

Site Geology/Hydrogeology

The geology of the site consists of non-indigenous fill, an organic silt layer comprising native wetland and river bottom sediments, and glaciofluvial deposits. The top of the fill layer was the former site grade before remediation. The thickness of the non-indigenous fill varies, and it is thickest where the organic silt layer is thinnest. The thickness of the native organic silt layer also varies, but it generally decreases from the south to the north and has been observed to be absent in 2 locations near the floodwall. The organic silt layer is expected to reduce the hydraulic connection between the fill and the underlying sand layer. The glaciofluvial deposits underlying the organic silt layer include sands, silty sands, and silty gravels, with minor interbedded silt and clay, gravel, and sandy gravel.

The dominant groundwater flow direction is to the north towards the Passaic River. The groundwater at the site occurs in the fill layer above the organic silt layer and in the sand layer below the organic silt layer.

Land and Resource Use

The Diamond Alkali site was used for manufacturing by numerous industrial companies for over 100 years. From the mid-1940s to 1969, activities at the site included chemical and pesticides manufacturing. All manufacturing operations at the site ceased in 1983. The site is currently fenced and has an electronic, automated security system. Contaminated soils and debris are contained within the fenced area under an impermeable cap. Current use of the site includes ongoing operations and maintenance activities associated with the interim remedy. There is a deed notice for the site protecting the interim remedy.

The current land use for the area is industrial, but neighboring areas have a dense residential population. The Ironbound section of Newark is both highly industrialized and densely populated and is burdened with numerous environmental justice concerns. The Passaic River is used for rowing and fishing. Although several properties in the area have been redeveloped since the last five-year review, the immediate area continues to be industrial and will continue to be so according to the 2015 Newark Zoning & Land Use Regulations. Due to the number of former manufacturing facilities in the area, there are area-wide contamination issues. The groundwater aquifer underlying the site is currently not used as a drinking water source.

History of Contamination

The mid-1940s marked the beginning of the manufacturing operations related to the current site conditions, including the production of p,p'-dichlorodiphenyltrichloroethane (DDT) and phenoxy herbicides by Kolker Chemical Works, Inc. Kolker was acquired by the Diamond Alkali Company (subsequently known as the Diamond Shamrock Chemicals Company) in 1951, and from 1951 to 1969 Diamond Alkali owned and operated a pesticide manufacturing plant at 80 Lister Avenue. Subsequent owners used the property until 1983. In 1983, as a result of EPA's National Dioxin Strategy targeting facilities that produced 2,4,5-trichlorophenol and/or its pesticide derivatives, EPA and NJDEP sampling at the site revealed high levels of dioxin.

Dioxin, especially the dioxin congener known as 2,3,7,8-tetrachlorodibenzo-p-dioxin or TCDD, is an extremely toxic chemical and an unwanted byproduct of the manufacture of certain chemicals which were produced at the site. Operations at the site and an explosion in 1960 caused contamination of soils, sediments and groundwater. Dioxin, pesticides and other hazardous substances have been found in the soil at 80 Lister Avenue and, to a lesser extent, at 120 Lister Avenue. Other properties in the area also had dioxin-contaminated soils and debris. Dioxin, pesticides, volatile organic compounds (VOCs) and other hazardous substances have been found in groundwater at the site. The sediments of the Lower Passaic River and Newark Bay are contaminated with dioxins, PCBs, mercury, DDT, pesticides, metals and other hazardous substances from the site and from industrial activities of numerous companies in the area since the 1800s.

Initial Response

The discovery of dioxin in 1983 led to the 80 Lister Avenue property being secured by a fence and by 24-hour security guard service. Exposed soils on the property were covered with geofabric to prevent potential migration of contamination. At other properties, dioxin-contaminated soils and debris were removed by excavation, vacuuming, and other means, and were transferred to 120 Lister Avenue for storage. This work was initiated by the EPA and NJDEP in 1983. EPA proposed the site for the National Priorities List (NPL) in September 1983, and it was finalized on the NPL on September 21, 1984. Also in 1984, NJDEP and Diamond Shamrock Chemicals Company entered into two Administrative Orders on Consent (AOC), the first for the investigations and immediate response work at 80 Lister Avenue and the second for investigations and response work at 120 Lister Avenue. On August 1, 1987, EPA published a notice of completion of the RI/FS and of the Proposed Plan identifying EPA's preferred interim remedy. This publication started the period for public comment.

Basis for Taking Action

The results of the Remedial Investigation completed in 1987 for OU1 indicated that the site was contaminated by a large number of hazardous substances including dioxin, semi-volatile compounds, VOCs, herbicides, pesticides, PCBs, and metals. The contamination was widespread and affected most media, including soils, groundwater, air, surface water and building structures. The chemicals that were determined to present the greatest risks due to their toxicities and concentrations were TCDD and DDT. The greatest potential human health risk was to the worker from exposure to TCDD through direct contact with surface soils. Other routes of exposure to the hazardous substances included migration of hazardous substances to the Passaic River, migration of hazardous substances to deeper aquifers, and migration of airborne hazardous substances. A quantitative evaluation of direct on-site risks was not performed since these risks were controlled by the initial response actions taken. The total risks from exposure to groundwater were quantified for TCDD and DDT and the total combined risks exceeded the risk range of 10^{-4} to 10^{-6} identified in the NCP.

Remedial Actions

Remedy Selection

The Feasibility Study identified the following remedial action objectives for OU1:

- Eliminate, to the maximum extent practicable, potential exposures to on-site surface soils at the site.
- Reduce mass transport of chemicals in the groundwater to potential concentration levels less than 5×10^{-5} ug/l for dioxin and 0.23 ug/l for DDT at the nearest off-site well at some

time in the future. These values were identified at the time of the ROD as recommended exposure levels for ingestion of water.

- Remove the source of potential particulate dioxin emissions associated with existing buildings by containing or eliminating potential emissions of particulates by containing or demolishing buildings and structures.
- Reduce potential mass transport of chemicals from the site to the Passaic River.
- Implement remediation without significant risk to site workers and off-site populations.

An interim remedy for OU1 was selected and documented in a September 30, 1987 Record of Decision (ROD). The components of the ROD consisted of the following:

- Construct a slurry trench cutoff wall encircling the properties tying into the silt layer underlying the properties.
- Construct a flood wall to protect the properties from the 100-year flood.
- Disassemble and decontaminate all non-porous permanent structures and materials to the maximum extent practicable for off-site reuse, recycling or disposal.
- Transport off-site for treatment or disposal drums containing hazardous substances but containing less than 1 part per billion (ppb) of dioxin.
- Demolish all remaining structures on-site and secure all materials contaminated above 1 ppb of TCDD on-site. Secured materials shall be segregated to the maximum extent practicable to afford access to and facilitate removal of the more highly contaminated materials, should such removal be selected as a remedy at a later date.
- Stabilize and immobilize the contents of the remaining drums of dioxin-contaminated materials.
- Locate and plug inactive underground conduits and reroute active systems.
- Haul, empty, spread and compact the contaminated materials presently stored at 120 Lister Avenue, and decontaminate the shipping containers for off-site reuse, recycling or disposal.
- Install, operate, and maintain a groundwater withdrawal system designed to maintain a hydraulic gradient preventing the migration of groundwater within the slurry wall.
- Install, operate, and maintain a treatment system for groundwater and other aqueous liquids.
- Construct a surficial cap consisting of suitable materials designed to meet the requirements of the Resource Conservation and Recovery Act.
- Implement suitable monitoring, contingency, operation and maintenance, and site security plans to ensure the protection of human health and the environment during and after the installation of the selected alternative.
- Place and cap on-site all sludge generated from the wastewater treatment processes until such time that an alternative method of sludge management is approved.
- Perform a Feasibility Study every 24 months following the installation of the selected interim remedy to develop, screen and assess remedial alternatives and to assess the performance of the selected remedy.

The remedy is considered an interim action because of the limited options at the time of the ROD for final disposition of dioxin-contaminated wastes that are listed as hazardous substances under the Resource Conservation and Recovery Act (RCRA), and strong opposition within the community to either treating the dioxin listed wastes on-site or permanently disposing of them at 80-120 Lister Avenue. The remedy review cycle (“perform a Feasibility Study every 24 months”) is meant to identify whether new disposal or treatment options are available that would

allow EPA to evaluate a final remedy that includes removing the contained wastes from the site. As discussed below, EPA is currently reviewing the 2015 remedy evaluation report, which was prepared in fulfillment of this requirement of the 1987 ROD.

Remedy Implementation

A Consent Decree (CD) was filed on December 4, 1989 between Occidental Chemical Corporation (OCC), Chemical Land Holdings (CLH), NJDEP, and EPA requiring OCC to undertake cleanup activities at the site. The U.S. District Court approved the CD on November 19, 1990. OCC is a successor to the Diamond Shamrock Chemical Company. Therefore, OCC is a PRP for the site.

During development of the remedial design plans, OCC initiated activities at the site in 1995 by performing certain initial components of the remedy. These actions included removal of the steel pile from 120 Lister Avenue (structural material from the warehouse demolition, steel tanks and miscellaneous steel). This steel pile was sampled and material that met the EPA criteria for off-site disposal was disposed at an off-site facility. Any material that was not deemed acceptable by the receiving facility was placed on-site at the 80 Lister Avenue property for final disposal during future construction activities. In addition, of the 635 drums at the site, the contents of 261 drums were not listed dioxin wastes. The contents were processed through the temporary treatment plant and disposed off-site. The empty drums were returned to the warehouse, cut in half and staged. Disposal of these drums was to be addressed during future construction activities. The remaining 374 drums were considered listed dioxin waste. These drums were grouped into water-soluble liquids, non-aqueous liquids and solids/sludges and stored at the warehouse for disposal during future construction activities.

As required under the CD with EPA and the NJDEP, OCC submitted remedial design plans for construction of the interim remedy of OU1. Prior to approving the design plans, EPA, at the request of the Community Advisory Group (CAG), explored the potential for implementing an alternative to the interim remedy selected in 1987. EPA considered innovative technologies as well as on-site and off-site thermal treatment options. EPA met with the CAG extensively during the summer of 1998. Due to the nature of the material to be remediated (listed dioxin waste), new innovative technologies were deemed inappropriate and no off-site option was available. One alternative, on-site incineration, was deemed technically appropriate; however, the community preferred the on-site containment remedy to incineration.

On September 23, 1999, EPA and NJDEP approved the Final Modified (100%) Remedial Design Report and CLH began construction in the spring of 2000. The flood wall and slurry trench cutoff wall were constructed. The warehouse and other structures at the site were demolished. The contents of the drums and shipping containers were stabilized and immobilized and then disposed in the contaminated area of the site. The empty drums and shipping containers were either recycled or crushed and disposed in the contaminated area of the site. The surficial cap, the stormwater management system, the groundwater withdrawal system and the groundwater treatment plant were constructed in accordance with the approved remedial design plans. Additionally, the CD required the use of institutional controls to restrict the use of the property to industrial and/or commercial uses that will not alter or impact the remedy in place. The required deed notice was completed and filed on June 27, 2007.

On August 23, 2001, representatives from the New Jersey Division of Criminal Justice visited the site to inform Tierra Solutions, Inc. (TSI) of a high pH problem with water being discharged from the site's stormwater drainage channels to the Passaic River. TSI promptly took corrective

measures to stop the discharge and, based upon an investigation, determined that contact of drainage water with the sand layer portion of the cap was causing the increase in pH. To resolve the situation, TSI submitted a proposed design modification to the surficial cap, which would restrict stormwater from percolating through the sand layer thereby reducing the volume of site drainage with elevated pH levels. EPA and NJDEP approved the proposal and implementation of the design modification was completed on September 13, 2002. Additionally, TSI implemented two phases of additional stormwater management controls to further segregate stormwater draining from the sand layer under the cap to prevent its flow into the drainage channels.

In November 2001, elevated zinc concentrations were found in treated effluent water from the groundwater treatment system. Again, TSI took corrective measures to reduce the zinc concentrations. It was determined that ferrous sulfate powder, a chemical used to adjust the pH of the treated groundwater, contained elevated concentrations of zinc. Therefore, TSI replaced the powder with a ferrous sulfate solution with low zinc concentrations which corrected the zinc exceedance problem.

In February 2002, the 24-hour security guard was replaced with an electronic, automated security system. In November 2003, TSI submitted the Supplemental Hydraulic Performance Evaluation Progress Report documenting the attainment of hydraulic gradients preventing the migration of groundwater from the materials contained within the slurry trench cutoff wall and the flood wall and the establishment of inward hydraulic gradients, in accordance with the CD. EPA agreed with the conclusions reached in this report at a May 12, 2004 meeting with TSI, thereby triggering TSI's notification to EPA of the completion of all construction activities at the site required by the CD. TSI submitted this notification on June 2, 2004.

System Operations/Operation and Maintenance

TSI is conducting long-term monitoring and maintenance activities according to the Operations and Maintenance Plan approved by EPA on September 23, 1999, and the interim update Operations and Maintenance Quality Assurance Project Plan approved by EPA on April 30, 2013. The required inspection and monitoring activities include performance of the following activities on a monthly basis unless noted otherwise:

- Inspection of the surface of the surficial cap.
- Inspection of the perimeter and interior drains.
- Inspection of the floodwall, curbswall and fencing along curbswall.
- Inspection of the paved and gravel roadways.
- Inspection of the entrance gate and perimeter fencing.
- Inspection of the piezometers, gas vents and extraction wells.
- Inspection of the interior rooms inside the groundwater treatment building.
- Inspection of the automated security system.
- Methane gas monitoring of the 14 gas vents.
- Groundwater depth measurements.

These efforts are documented in monthly progress reports submitted to EPA and NJDEP.

Since operations of the groundwater treatment system began, all treated effluent and process water was batched into storage tanks on site and sampled prior to discharge to the Passaic River as required. Upon receipt of validated data achieving the limitations of the New Jersey Pollutant Discharge Elimination System Discharge to Surface Water Permit Equivalent (NJPDES DSW)

dated May 2, 2000, the treated groundwater was discharged. Starting April 1, 2014, the treated groundwater was directly discharged to the Passaic River. At the beginning of each month, the effluent is sampled and analyzed and the results are validated to confirm that the constituent concentrations are within the limitations of the NJPDES DSW Permit Equivalent. Also, in accordance with the NJPDES DSW Permit Equivalent a Discharge Monitoring Report is submitted monthly to both NJDEP and EPA.

To further evaluate the effectiveness of the groundwater withdrawal system, groundwater levels are measured and recorded monthly using the site piezometers. Due to variability in observed monthly water level elevations, annual average water level elevations are calculated to observe long-term trends that are not subject to short-term changes. An annual update report is provided detailing the groundwater level measurements, extraction rates, and extraction volumes associated with the groundwater withdrawal system.

As a result of the ongoing monitoring of system operations, several updates have been made to the system over time. In an effort to further control the pH problems encountered with the water drained from the sand layer under the cap, TSI implemented a pilot study including the use of a carbon dioxide pH adjustment system in the collection tank from October 2004 through January 2005. The results of the pilot were evaluated and it was determined to be effective; therefore, the final carbon dioxide pH adjustment system was installed and began full-time operations in January 2007. Because site conditions may change over time, monitoring of the system continues, to evaluate its effectiveness.

As part of the Phase I Removal Action design, a limited survey of the site was conducted in August 2009. This survey found that the elevations of certain benchmarks, extraction wells, and piezometers have changed since the original 2001 survey, and it is expected that this condition occurred primarily due to natural settlement of the surficial cap. Four of the existing vibrating wire piezometers (IP-1 through IP-4) were determined to no longer be useable to monitor monthly groundwater levels because the measuring point elevations of these piezometers are inaccessible and cannot be resurveyed. The remaining piezometers continue to perform adequately, providing accurate and reliable data.

In June 2011, repairs were done for the groundwater treatment system (GWTS) of the sand layer drainage collection system. The groundwater withdrawal system (GWWS) was shut down in October 2011 and resumed normal operations in November 2011 during the installation of the tiebacks along the floodwall for the Phase 1 Removal Action. After the Phase 1 Removal Action, a video inspection was performed of three piezometers along the floodwall concluding that the inner casings were intact but that the steel outer casings needed to be straightened. In October 2012, the three casings were straightened and re-sealed to the cap with bentonite. A second video inspection was performed concluding that both the inner and outer casings were then in good condition. In April 2013, Tierra performed redevelopment activities and replaced the extraction well pumps at eight of the GWWS extraction wells.

Beginning in June 2013, procedures were established, as outlined in the Waste Characterization Quality Assurance Project Plan, according to which residuals generated at the site are then characterized and disposed of at off-site treatment and/or disposal facilities, as needed. Prior to disposal, the residual materials are placed in U.S. Department of Transportation - approved 55-gallon drums and stored in the groundwater treatment system warehouse storage.

Extraction Well EW-9 is functional but has been out of service since January 2014, since it

restricts flow from the riverside extraction wells. Therefore, it will remain off-line to facilitate flow from the riverside extraction wells. Extraction Well EW-5 has also been out of service since October 2014 due to malfunctions and will require further investigation. In April 2015, the Support Gravel and Lower Garnet layers of filter media were replaced with ¼” Flint media and the Upper Garnet and Anthracite layers were replaced with “Next™ Sand” to improve removal of solids not captured in the Clarifier. The inclined plate clarifier component of the GWTS was replaced with a new one of higher capacity in June 2015.

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.

Progress Since Last Five-Year Review

- *Protectiveness statement(s) from previous FYR* - The interim remedy for OU1 protects human health and the environment from exposures to hazardous substances contained within the properties at 80 and 120 Lister Avenue in the short-term because all exposure pathways are addressed by engineering and access controls. For the site to be protective in the long-term, additional groundwater data need to be collected to better determine trends and further evaluate the protectiveness of the groundwater withdrawal system and the slurry wall.
- *Issue identified in previous FYR* - A chemical groundwater monitoring program has been initiated since the completion of the previous five-year review. Three annual groundwater sampling events have been performed to date measuring water level elevations and analyzing for VOCs, metals, and 2,3,7,8-TCDD. This data is undergoing evaluation for further optimization of the groundwater withdrawal system and to better determine the effectiveness of the groundwater withdrawal system and slurry wall.
- *Other comments on Operation, Maintenance, Monitoring and Institutional Controls* - OU1 has ongoing operations, maintenance, and monitoring activities as part of the selected remedy. As anticipated by the decision documents, these activities are subject to routine modification and adjustment. Since the remedy is an interim remedy, the Consent Decree requires a remedy review. That work plan needs to be finalized and the study implemented.
- *Progress on recommendations* - A fourth round of groundwater chemical monitoring data was submitted in December 2011 and a summary evaluation report of the four annual sampling events was submitted in March 2012. TSI recommended discontinuing the groundwater sampling activities; however, EPA determined that the program should continue until further notice. Therefore, TSI submitted the report for a fifth round of groundwater chemical monitoring data in May 2014. The results of these sampling events are discussed in the data review section. The report for the next groundwater sampling event is scheduled to be submitted by May 2016, too late to be included in this review.
- *Progress on remedy evaluation* - On May 28, 2015, EPA approved TSI’s remedy evaluation work plan (REWP). At the conclusion of the study, TSI submitted the

remedy evaluation report on November 24, 2015. Review of that report is ongoing.

Five-Year Review Process

Administrative Components

The five-year review team included Elizabeth Butler (EPA-RPM), Michael Scorca (EPA-Hydrologist), Marian Olsen (EPA-Human Health Risk Assessor), Chuck Nace (EPA-Ecological Risk Assessor), David Kluesner (EPA-Community Involvement Coordinator) and Sophia Rini (EPA-Community Involvement Coordinator). This is a PRP-lead site.

Community Involvement

TSI, NJDEP and the Passaic River CAG were notified of the initiation of the five-year review in July 2015. Activities to further involve the community in the five-year review were discussed in a September 2015 meeting between the RPM and the Community Involvement Coordinators. A notice was placed on September 29, 2015 in the Project News section of the www.ourpassaic.org website indicating that a five-year review was being conducted, linking readers to the data being evaluated and inviting written comments before November 13, 2015. It also indicated that once the five-year review is completed, the results will be made available on the website. No comments were submitted. The results will also be made available at the local site repository, which is at the Newark Public Library, 5 Washington Street, Newark, New Jersey 07102. In addition, efforts will be made to reach out to local public officials to inform them of the results.

Document Review

The documents, data and information which were reviewed in completing this five-year review are summarized in Table 2.

Data Review

The ROD states that the groundwater withdrawal and treatment system was designed to maintain a hydraulic gradient preventing the migration of groundwater from the volume contained within the slurry wall. Extraction (with treatment) of the groundwater was intended to lower groundwater levels within the wall and establish inward hydraulic gradients. Since the slurry wall was tied into the confining organic silt layer, separating the non-indigenous fill from the underlying sand layer, groundwater gradients have been measured both horizontally across the slurry wall and vertically through the silt layer.

The combined withdrawal of the ten individual extraction wells since 2002 (when full-time pumping began) has ranged from 671,696 to 1,235,243 gallons per year, which is an overall average flow rate of about 1.278 to 2.350 gallons per minute. The total withdrawal in 2014 was 1,059,843 gallons (2.016 gallons per minute).

Groundwater levels are measured monthly in 21 monitoring wells and continuous water-level recorders have been installed in 11 wells. Review of water-level measurements indicates that the groundwater levels have declined several feet since the capping was completed.

Horizontal hydraulic gradients across the slurry trench cutoff wall in the shallow Fill Unit wells have been monitored at six paired well clusters along the perimeter of the site. Generally, gradients have been directed inward, with the exception of a frequently outward gradient at GCP-4. Analysis of water-level recorder data at cluster GCP-4 indicate that the horizontal gradient in 2013 was outward about 70 percent of the time and inward about 30 percent of the time. The slurry wall is still considered effective in containing the groundwater because it continues to separate the hydraulic systems inside and outside the wall. This is demonstrated by

differences in tidal responses -- well GCP 4-2 (outside the slurry wall) exhibits a much greater response to the tidal fluctuations in the Passaic River than GCP 4-1 (inside the slurry wall) which exhibits much steadier water levels. The greater tidal response outside the wall resulted in water levels at GCP 4-2 during low tides that were typically lower than the stable water levels at GCP 4-1 within the wall. During high tides, water levels outside the wall rose and the direction of the gradients in 2013 at the GCP-4 cluster were typically directed inward.

Since the confining silt layer is expected to reduce the hydraulic connection between the Fill Unit and the underlying Glacial Sand layer, vertical hydraulic gradients in the Fill Unit and Sand layer wells have been monitored at four paired well clusters along the northern and southern boundaries of the site. Along the southern boundary of the site, where the organic silt layer is about ten feet thick, vertical hydraulic gradients between the Fill Unit and Sand layers in 2013 were generally upward at cluster GCP-8 and generally downward at cluster GCP-6. However, the confining layer is still considered effective in this area of the site due to its thickness. The vertical hydraulic gradients along the Passaic River boundary of the site, where the silt layer beneath the Fill Unit is thin to locally absent, change with the tidal fluctuations, but the Sand layer exhibits a greater response to the fluctuations than the Fill Unit. As with the southern boundary of the site, in 2013 there was a frequently upward gradient at one well cluster and a frequently downward gradient at the other well cluster. Analysis of water-level data at the two clusters indicate that the vertical gradients were estimated to be upwards 22 percent of the time and downwards 78 percent of the time at cluster GCP-1 and upwards 66 percent of the time and downwards 34 percent of the time at cluster GCP-3.

Groundwater-quality samples at individual monitoring wells were collected in 2008, 2009, 2010, 2011, and 2013. Results of the groundwater sampling rounds confirm that the general delineation of contaminants has been generally similar, with only a few wells showing distinct changes in concentration trends. The VOCs most frequently observed during the sampling rounds were chlorobenzene and benzene, and other commonly detected VOCs included chloroform, toluene, ethylbenzene, 1,2-dichlorobenzene, 1,3-dichlorobenzene, 1,4-dichlorobenzene, and 1,2,4-trichlorobenzene.

The groundwater data from those 5 sampling rounds collected between 2008 and 2013 were further evaluated resulting in the following observations and trends. Discussion below evaluates data from wells inside the slurry wall and wells outside the slurry wall separately.

VOCs were observed in shallow ground water within the Fill Unit inside the slurry wall at wells GCP-1-1, 2-1, 3-1, 5-1, 6-1, and 9-1 (see Attachment 1). VOCs have never been detected at GCP-4-1, 7-1, or 8-1. Dioxin has been detected within the Fill Unit inside the slurry wall at wells GCP-1-1, 2-1, 3-1, and 9-1. Dioxin has never been detected at GCP-5-1, 6-1, 7-1 and 8-1. VOC concentrations in GCP-6-1 and 9-1 indicate decreasing trends. Dioxin concentrations in GCP-1-1 and 2-1 generally show decreasing trends. Chlorobenzene and dioxin have both demonstrated a noticeable decreasing trend at well GCP-3-1.

VOC were observed in four Fill Unit wells just outside the slurry wall, including GCP-5-2, 6-3, 8-2, and 9-2. VOC concentrations in wells GCP-6-3, 8-2, and 9-2 are currently higher outside the slurry wall than in adjacent wells inside the wall. Dioxin was observed in only one well (GCP-9-2) in the Fill Unit outside the wall and it shows a generally decreasing trend in concentration.

VOC contaminants were observed in three of the four Glacial Sand Unit wells at concentrations much higher than the wells screened in the Fill Unit at the same cluster. Dioxin was observed

consistently at well GCP-1-2, which is in the Sand Unit along the northern floodwall, at higher levels than its paired Fill Unit well, and during one sampling round at well GCP-8-3, which is in the Sand Unit along the southern boundary. Dioxin was not detected at the other two wells in the Sand Unit.

Based on all of the above data and observed trends, operations of the groundwater withdrawal system have resulted in a decrease in groundwater levels within the slurry wall since remedy construction was completed, generally inward horizontal gradients across the slurry wall, and a separation of hydraulic systems inside and outside of the slurry wall. An additional review of the above data and trends is currently occurring through the remedy evaluation process. Since there were very few remedial options available at the time of the remedy selection, the ROD and the CD called for a periodic evaluation of the remedy. The primary purpose of this evaluation is to develop, screen and assess remedial alternatives and to assess the performance of the selected remedy.

Site Inspection

The inspection of the site was conducted on September 23, 2015. In attendance were Elizabeth Butler, EPA; Michael Scorca, EPA; Sophia Kelley, EPA; Jay Nickerson of the NJDEP; and Dave VanEck of the NJDEP. The purpose of the inspection was to assess the protectiveness of the remedy. All aspects of the remedy were intact and operating as intended.

Interviews

During the five-year review process, interviews were conducted with the parties affected by the site, including TSI, the Passaic River CAG and NJDEP. The purpose of the interviews was to document any perceived problems or successes with the remedy that has been implemented to date. An interview with TSI was conducted on September 23, 2015 immediately following the site inspection. In addition, a meeting was held on July 29, 2015 during which TSI provided a presentation to EPA and NJDEP and answered questions on the history and protectiveness of the remedy; a separate conference call with NJDEP was held on June 23, 2015; and a presentation was provided including a question and answer session to the Passaic River CAG on September 10, 2015. Interviews are summarized below.

Concerns and questions brought up during the interviews included the functionality of certain extraction wells, the high concentrations of chlorobenzene in some of the monitoring wells, the effectiveness of the containment system, the process and timelines for determining the final remedy and any impacts of the new developments surrounding the property. Successes mentioned during the interviews included the improvements to the GWTS as a result of various upgrades and the improvements to the GWWS in both the pumping and the inward and upward gradients being achieved. The performance of all of the wells continues to be monitored on a regular basis. Five rounds of groundwater samples have been collected for chemical analyses, and the data from those events are undergoing review by EPA. Although the chemical data is being used as a tool to assist with the determination of the hydraulic migration gradients, the Consent Decree only requires showing hydraulic gradients preventing the migration of groundwater from the volume contained within the slurry wall as the performance measure.

Institutional Controls Verification

Although not identified in the 1987 Record of Decision, the CD required the use of institutional controls to restrict the use of the property to industrial and/or commercial uses that will not alter or impact the remedy in place. The required deed notice was completed and filed on June 27, 2007, and it is still in place. It precludes any use of the site that would involve any excavation or any

new activities involving hazardous substances. It also requires any use of the site to allow for the continued operations and maintenance of the groundwater withdrawal and treatment systems and the stormwater management system, and must be consistent with all of the current documents.

Technical Assessment

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

The review of documents listed in Table 2, the inspection of the site, and the review of the existing data indicate that the remedy is functioning as intended by the 1987 ROD. The interim remedy is designed to provide protection of human health and the environment through the on-site containment of wastes. Under the remedy, the site is being kept secure and hazardous wastes at the site are being contained and prevented from leaving the properties via engineering controls including the surficial cap, the slurry trench cutoff wall and the flood wall around the properties, and the groundwater withdrawal and treatment system.

Operation and maintenance activities, with routine evaluation and modification as needed, have been effective. Monthly inspections ensure that any issues are timely noted and equipment updated as necessary. The cap and the surrounding area are undisturbed and the fence and security around the site are intact and these combined activities interrupt potential exposures. Additionally, institutional controls prohibiting any future disturbance of the remedy are in place and effective.

The groundwater data from the monitoring of the levels and the chemical contaminants demonstrate that there are separate hydraulic systems inside and outside the slurry wall, as shown by the tidal responses, and that the horizontal gradients across the wall are generally inward. Therefore, the combination of the slurry wall, flood wall and the groundwater withdrawal system continue to be effective in preventing migration of the groundwater from the volume contained within the slurry wall.

Although no specific opportunities for optimization were observed during this review, further evaluations are being conducted as part of the remedy evaluation that is underway. The primary purpose of this evaluation is to develop, screen and assess remedial alternatives and to assess the performance of the selected remedy. Any potential opportunities to increase the effectiveness of the interim remedy, as identified by the review of the report, will be considered and implemented as appropriate.

The City of Newark supplies public water throughout the City. There are no drinking water supply wells located in the vicinity of this site. The NJDEP requires approval of drinking water supply wells and will not allow groundwater, which has been contaminated by this site, to be used as a drinking water supply. The deed notice also requires any use of the site to allow for the continued operations and maintenance of the groundwater withdrawal and treatment systems.

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

There have been no changes in the physical conditions of the site over the past five years that affect the protectiveness of the remedy. The interim remedy for the site addressed risks related to on-site and off-site exposure to Chemicals of Concern (COCs) including TCDD- and DDT-contaminated debris, material, and soil by containment. Remedial actions addressed exposures to dioxin-contaminated buildings and particulate emissions from the buildings; ingestion of contaminated groundwater; and transport of contaminants from the site to the Lower Passaic

River. The remedial actions mitigate migration of dioxin to the Passaic River and deeper aquifers through groundwater transport and surface water runoff by capturing the runoff and pumping and treating the groundwater. In addition, the actions taken at the site to cover the soils at the property result in the interruption of potential exposures.

The deed notice restricts use of the site to industrial and/or commercial uses. The site is currently being evaluated as part of the Lister Avenue Brownfields Development Area; however, any redevelopment opportunities considered will need to ensure that the protectiveness of the remedy is not impacted.

Changes in Standards and To Be Considered

The risk assessment developed in 1985 evaluated direct human exposure to TCDD in soils where the surficial cap was employed to interrupt this pathway. The concentration in soil for TCDD of 1 ppb developed by the Centers for Disease Control (CDC) and the New Jersey Department of Health was applied. The remedial actions at the site have interrupted potential exposures. As described below, the toxicity of dioxin was updated with the development of an oral reference dose (RfD) for TCDD. The industrial concentration at a Hazard Quotient = 1 is 7.2×10^{-4} ppm or 0.72 ppb, which is lower than the 1 ppb concentration applied in 1985. However, the capping of the facility has interrupted direct exposures to the soil.

Changes in Exposure Pathways, Toxicity, and Other Contaminant Characteristics

The ROD identified a cleanup level for TCDD of 1 ppb in soil based on recommendations from CDC and NJDEP. EPA's dioxin reassessment has been developed and undergone review for many years, with the participation of scientific experts in EPA and other federal agencies, as well as scientific experts in the private sector and academia. The Agency followed current guidelines and incorporated the latest data and physiological/biochemical research into the reassessment. On February 17, 2012, EPA released the final human health non-cancer dioxin reassessment, publishing an oral non-cancer toxicity value, or RfD, of 7×10^{-10} mg/kg-day for TCDD in EPA's Integrated Risk Information System (IRIS). The dioxin cancer reassessment will follow thereafter. EPA does not expect the cancer reassessment will result in the need for additional cleanup. The dioxin RfD was approved for immediate use at Superfund sites to ensure protection of human health.

Other chemicals identified in the risk assessment as chemicals of concern included 2,4-dimethylphenol (2,4-D), DDT and 2,4,5-trichlorophenoxy acetic acid (2,4,5-T). The ROD did not identify specific remedial action levels for these chemicals. The toxicity information for these chemicals has not changed since the previous five-year review.

Since the original risk assessment, new toxicity values for these chemicals were included on the EPA's consensus IRIS toxicity database. However, these potential new toxicity values do not impact the protectiveness of the remedial actions, since the cap is designed to prevent direct exposure to the contaminants through ingestion and dermal contact.

EPA will continue to monitor the reassessment of dioxin and other COC toxicity over the next five years, the period covered by the next five-year review.

In the future, if buildings are constructed on site, soil vapor extraction should be evaluated. The deed notice and other site controls will prohibit any future re-development of the site from

interfering with the integrity of the cap and the other components of the interim remedy.

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

There is no information that calls into question the protectiveness of the remedy. EPA continues to evaluate the hydraulic gradients that demonstrate the effectiveness of the interim remedy, along with the monitoring well data collected since 2009 as a secondary measure of remedy performance.

Technical Assessment Summary

Based upon the results of the five-year review, the remedy is functioning as intended by the ROD. The interim remedy was designed to provide protection of human health and the environment through the on-site containment of wastes. Under the remedy, the site is being kept secure and hazardous wastes at the site are being contained now and into the future via engineering and institutional controls and the ongoing operations and maintenance activities. The interim remedy is undergoing a remedy evaluation. Based on the results of the evaluation, recommendations will be determined and implemented, as appropriate. The physical conditions of the site have not changed over the past five years and the groundwater and soil use at the site are not expected to change in the next five years. Given that the exposure pathways have been eliminated, there are no current impacts to ecological and human receptors.

Issues, Recommendations and Follow-Up Actions

OU(s): 1	Issue Category: Remedy Performance			
	Issue: Pursuant to the Consent Decree, an evaluation of the interim remedy was completed on 11/24/15 but next steps have not yet been identified.			
	Recommendation: Complete the review of the remedy evaluation report with the Partner Agencies (New Jersey Department of Environmental Protection, National Oceanic and Atmospheric Administration, U.S. Fish and Wildlife Service), and develop a plan to implement recommendations.			
Affect Current Protectiveness	Affect Future Protectiveness	Party Responsible	Oversight Party	Milestone Date
No	Yes	PRP	EPA/State	12/30/2016

In addition, the following are suggestions that could improve the effectiveness of remedy while the review of the remedy evaluation report is ongoing:

- Continue to investigate the malfunctions of EW-5, so that it can be repaired and put back into service.
- Continue steps to optimize the flows and treatment of the extraction system.
- Consider enhancing the monitoring well system to further assess the hydraulic containment system.
- Continue the chemical groundwater monitoring program.

Protectiveness Statement

Protectiveness Statement(s)	
<i>Operable Unit:</i> 1	<i>Protectiveness Determination:</i> Short-term Protective
<i>Protectiveness Statement:</i> The interim remedy at OU1 currently protects human health and the environment in the short-term because all exposure pathways are addressed by engineering and access controls. However, in order for the remedy to be protective in the long-term, a plan to implement recommendations resulting from the review of the 2015 remedy evaluation report needs to be developed.	

Next Review

The next five-year review report for OU1 of the Diamond Alkali Superfund Site is required five years from the completion date of this review.

Tables

Table 1: Chronology of Site Events	
Event	Date(s)
Manufacturing facility at 80 Lister Avenue, Newark, NJ began producing chemicals and pesticides.	1940s
Diamond Alkali Company (subsequently known as Diamond Shamrock Chemicals Company) owned and operated a pesticides manufacturing facility at 80 Lister Avenue. In 1960 an explosion occurred.	1951-1969
80 Lister Avenue went through a series of new ownerships and production processes.	1970-1983
NJDEP and EPA collected dioxin samples at the site; dioxin detected in the Passaic River and at 80 Lister Avenue. Diamond Alkali proposed by EPA for listing on the Superfund NPL. NJDEP instituted fish advisories for the Passaic River and Newark Bay.	1983
Pre-NPL responses taken to restrict access to the site and the contaminants.	1983
Final NPL listing.	1984
NJDEP and Diamond Shamrock Chemicals Company entered into two AOCs for investigation and immediate response work at 80 and 120 Lister Avenue, including excavation and vacuuming of dioxin-contaminated soils from nearby properties and securing exposed on-site soils under geofabric.	1984
Remedial Investigation/Feasibility Study complete.	1987
EPA selected an interim remedy for the 80 and 120 Lister Avenue portion of the site, documented in a ROD.	1987
Federal court approved a CD among OCC, CLH, EPA and NJDEP to implement the ROD.	1990
Remedial design start.	1993
EPA, at the request of the CAG, explored the potential for implementing an alternative to the interim remedy selected in the ROD. An alternative was not found.	1996-1999
Remedial design complete.	1999
On-site remedial action construction start.	2000
RA Construction completion.	2001
Construction completion date.	2004
Previous five-year reviews.	2001, 2006, 2011

Table 2: Documents, Data and Information Reviewed in Completing the Five-Year Review	
Document Title, Author	Submittal Date
Record of Decision for the Diamond Shamrock Superfund Site, Newark, NJ, EPA	1987
Consent Decree (Civil Action No. 89-5064 (JWB)), United States District Court District of New Jersey	1990
Final Report for Remedial Construction, Diamond Alkali Superfund Site, Newark, NJ, TSI/BBL	2004
Remedy Evaluation Work Plan, Diamond Alkali Superfund Site, Newark, NJ, TSI	2015
Monthly Progress Reports, Diamond Alkali Superfund Site, Newark, NJ, TSI	2011-2015
Discharge Monitoring Reports, Diamond Alkali Superfund Site, Newark, NJ, TSI	2011-2015
Current Groundwater Level Graphs and Extraction Rates Memos, Diamond Alkali Superfund Site, Newark, NJ, TSI	2011-2015
Final Quality Assurance Project Plan, Groundwater Quality Monitoring Program, Diamond Alkali Superfund Site, Newark, NJ, TSI/EDS	2008
Groundwater Sampling Event Reports, Diamond Alkali Superfund Site, Newark, NJ, TSI/ARCADIS	2011-2014
Operations and Maintenance Quality Assurance Project Plan, Diamond Alkali Superfund Site, Newark, NJ, TSI/EDS	2012

