**Passaic River**

**Site Description**

The Diamond Alkali Superfund Site includes: (i) the former pesticides/herbicides manufacturing facility, and adjacent property, located at 80 and 120 Lister Avenue in Newark, New Jersey (OU1 of the Diamond Alkali Superfund Site); (ii) the adjoining Lower Passaic River Study Area (LPRSA; OU2 of the Diamond Alkali Superfund Site) which extends from Newark Bay to the Dundee Dam seventeen miles upstream; and (iii) while not discussed herein, the Newark Bay Study Area (NBSA; OU3 of the Diamond Alkali Superfund Site) which includes the Bay, itself, as well as portions of its several tributaries other than the Passaic River (those portions to be determined pursuant to an Administrative Order by Consent [AOC] signed in 2004 between EPA and Occidental Chemical Corporation [OCC, successor to Diamond shamrock Chemicals Company (DSCC, f/k/a Diamond Alkali Company)] covering the NBSA).

**Administrative Background**

OCC and EPA entered into an AOC in 1994 pursuant to which Tierra Solutions, Inc. (Tierra, f/k/a Chemical Land Holdings, Inc.; performing on behalf of OCC pursuant to a private agreement) began conducting a Remedial Investigation and Feasibility Study (RI/FS) within the then-designated six-mile Passaic River Study Area (PRSA, a portion of today's seventeen-mile LPRSA). While Tierra undertook numerous activities toward fulfilling the 1994 AOC obligations, EPA effectively suspended the work in 2004. Specifically, EPA formed a partnership with the United States Army Corps of Engineers (USACE), the New Jersey Department of Transportation (NJDOT) – Office of Maritime Resources, National Oceanic and Atmospheric Administration (NOAA), U.S. Fish and Wildlife Service (USFWS), and New Jersey Department of Environmental Protection (NJDEP) to conduct their own study of the Lower Passaic River. The goals of the Lower Passaic River Restoration Project (LPRRP) were to establish a plan to cleanup and restore the 17-mile tidal stretch of the LPRSA (which subsumed the 6-mile PRSA described above), remediate impacted sediments, improve water quality, restore degraded shorelines, restore and/or create new habitats, and enhance human use.

In conjunction with this, EPA entered into an AOC, effective in June 2004, with 31 potentially responsible parties, including OCC, requiring a total payment of $10,000,000 to resolve their potential liability for performance of the LPRRP RI/FS,

and for past response costs and future response costs incurred in connection with the RI/FS for the LPRSA (EPA, 2004).

Effective November 9, 2005, the EPA's June 2004 AOC was amended to include 12 additional companies to share in the estimated cost of the LPRRP. As part of the amendment, all of the companies (both the new parties and the earlier settlers) agreed to pay EPA $750,000 in additional funding for the LPRRP RI/FS if such additional funds were needed to complete the study (EPA, 2006a). This amendment brought the total collective payment obligation of the 43 (31 + 12) responsible parties to $10,750,000.

On May 8, 2007, EPA announced that it entered into an agreement with 73 companies, known as the “Cooperating Parties,” considered potentially responsible for contaminants in the Lower Passaic River, to pay for and perform the Superfund portion of the comprehensive study of the river. This “May 2007 Settlement Agreement” is separate from the June 2004 agreement and its November 2005 and March 2007 amendments. This latest settlement requires the Cooperating Parties to take over the Superfund portion of the LPRRP and to complete the ongoing RI/FS of the Lower Passaic River. The work to be performed will be closely monitored by EPA in consultation with the USACE, NJDOT, NJDEP, NOAA and USFWS. Under this 2007 Agreement, the companies will also pay for the EPA’s costs in overseeing the study. The cost of the work to be performed has been estimated at $37 million, plus the costs associated with the EPA’s oversight (EPA, 2007a).

On August 27, 2007, the EPA announced that it had entered into a second amendment to the June 2004 AOC that adds an additional 29 settling parties to the settling parties already bound by the existing agreement. The settling parties (31 PRPs from the original AOC entered into in June 2004, 12 responsible parties from the November 2005 amendment to the 2004 AOC, and 29 additional parties being added to the second amendment of the 2004 AOC) are collectively responsible for paying an additional $2,400,000 (in addition to the $10,750,000 that has already been paid under the settlement agreement) to EPA for the LPRRP RI/FS (EPA, 2007c). The amendment to the AOC raises the total payment of future response costs from $10,000,000 to $13,150,000 to fund the EPA’s performance of portions of the RI/FS; the amendment made another $2,400,000 available to the EPA for the aspects of the RI/FS that they are performing. The new settling parties are resolved from paying any past response costs incurred through June 2004, as well as certain future response costs incurred in connection with the RI/FS.

**Threats and Contaminants**

The contaminants of concern within the LPRSA site are thought to include polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons, heavy metals and dioxins.

**Cleanup Approach Update Since 2004**

***Field Sampling***

As part of the LPRRP RI/FS, several field investigation tasks have been completed by EPA within the Lower Passaic River. These tasks have provided information for the planning of future tasks, and in updating the conceptual site model (CSM). These tasks include (Malcolm Pirnie, 2006a):

- A bathymetric survey was conducted for the project in 2004. This survey covered much of the 17-mile stretch of the river, extending to river mile 15.8. The results of this survey have been combined with historical bathymetric survey results to update the CSM.

- Geophysical surveys, including side scan sonar (SSS), sub-bottom profiling, and a magnetometer survey, were conducted in 2005 to support characterization of the nature of the river bottom sediment type, selection of coring locations, and the function and structure of potential restoration sites.

- Geotechnical sediment coring was conducted in 2005 to obtain confirmatory "ground truth" samples to calibrate and verify the SSS and sub-bottom profiling geophysical surveys.

- Sediment Transport Studies – Sediment erosion measurements were conducted in May 2005 using two devices: 1) Gust Microcosm to understand erosion at the surface and at very low shear stresses and 2) Sedflume to understand erosion at depth and at greater shear stresses. Gust Microcosm studies were conducted at six sites. Sedflume studies were performed at 15 locations. About 8 surface sediment samples [0 to 0.2 inches (0 to 0.5 cm)] were also collected for Be-7 and Th-234 analysis.

The following are more recent field activities as discussed in the June 2006 Field Sampling Plan (Malcolm Pirnie, 2006b):

- A Sediment Profiling Imaging (SPI) survey of the Lower Passaic River was performed over a 5-day period in June 2005. SPI was used to characterize the Lower Passaic River's benthic biological and physical habitat (e.g., sediment particle size, the Redox Potential Discontinuity depth, and infaunal usage) and provide preliminary information on the benthic habitats from river mile 7 to river mile 17.4. The SPI survey suggests that the freshwater river section has greater habitat diversity than the brackish river section.

- A Belted Kingfisher (*Ceryle alcyon)* population field monitoring program was implemented from April 2006 through June 2006 by the EPA, USACE, and NJDOT Office of Maritime Resources. The purpose was to identify active belted kingfisher burrows along the banks and riparian zones of the Lower Passaic River, characterize the suitability of available habitat for breeding belted kingfishers using the USFWS habitat suitability index model, and to determine reproductive success, including clutch size, egg hatchability, and fledgling success.

***Environmental Dredging and Sediment Decontamination Technology Pilot Study***

Over a six day period in December 2005, the EPA, USACE, and NJDOT performed a dredging pilot study on the Lower Passaic River. The pilot study was part of an evaluation of both environmental dredging and sediment decontamination technologies. The results of the pilot study were intended to help guide future evaluations and potential selection of dredging techniques for any dredging that might be performed in the Lower Passaic River. The goals of the pilot study were to evaluate dredging equipment performance, monitor sediment resuspension, and to evaluate sediment decontamination and treatability. NJDOT contracted Jay Cashman, Inc. and Cable Arm, Inc. to perform the dredging.

The pilot study involved the removal of 4,200 cubic yards (cy) of sediment from the upper 3 feet of a 1.5-acre area in the Harrison Reach of the Passaic River near downtown Newark. The dredge prism consisted of three cut lines approximately 300 feet long at elevations of 11 feet, 13 feet, and 15 feet below mean low water. The dredging was conducted in 10 to 15 feet of water at low tide (World Dredging Mining & Construction [WDM&C], 2005).

As stated in an article in WDM&C, "Dredging was conducted within five days of operation. However, dredging was canceled on December 9th due to poor weather conditions (heavy snow, ice, and gale force winds) that impacted the water quality

sampling program. Overall, dredging occurred at a rate of approximately 1000 $yd^3$ per 12-hr workday using an 8.0 $yd^3$ mechanical clamshell dredge bucket. The dredge bucket was specifically manufactured for this pilot study by Cable Arm, Inc. The bucket was equipped with *Clam-Vision* depth transducer (.001%) to ensure precision dredging to grade, Ross 835 depth penetration transducers to reduce overfilling of bucket, and bucket closure sensors to ensure bucket was sealed and closed prior to removal. The system was also linked to *ClamVision* software. The *ClamVision* displayed a 3D, color coded surface derived from existing hydrographic survey data. Each bite was recorded and color coded based on bite depth or bites left. An information box provided instant feedback showing current depth, final project depth, target depth, current bucket depth, and an indication that the bucket was closed and sealed. The dredging was executed in accordance with the contract plans and specifications issued by NJDOT. The design was prepared to test production-rate remedial dredging. The specifications required that dredging accuracy be achieved to +/- 6.0 in. tolerance. The dredge was operated with a lift speed of approx. 2.0 ft / sec. through the water column. A rinse tank was used to clean the dredge between each cycle" (WDC&M, 2005).

One of the goals of the project was to monitor the amount of suspended sediment due to dredging operations. A monitoring program utilized fixed moorings and shipboard monitoring from four boats. Before the pilot study started, a three dimensional hydrodynamic and sediment transport model was developed using Computational Fluid Dynamics. The model was developed to determine where to position water column monitoring equipment, to estimate the mass flux of sediment leaving the study area, and to evaluate the impact of dredging without engineering controls (WDM&C, 2005). The water quality monitoring program began in November, five days prior to dredging. Water quality samples were collected and six moorings were deployed on December 1$^{st}$. Each mooring was equipped with two Conductivity-Temperature-Depth probes, two Optical Back Scatter sensors, and an Acoustic Doppler Current Profiler. Collectively the four boats monitored the water for stratification and stability, particle concentration and size, total suspended solids, particulate and dissolved organic carbon, chloride/bromide, filtered and unfiltered metals, low level mercury, dioxins/furans, PCB congeners, and pesticides. Samples collected during dredging were to be compared to the background samples.

SPI was used to evaluate residuals within the dredging area. As stated in the article in WDM&C (2005), SPI "was used as a method to visually identify the depth of residuals inside the dredging area and immediately downriver and downslope. A total of 15 SPI pictures (nine within the dredging area, two upstream, two in channel

downslope and two downstream) were taken on December 13, 2005. Additional SPI evaluations will be conducted six months following dredging to determine the re-establishment of the benthic community in the area" (WDM&C, 2005).

Overall, the Environmental Dredging Pilot Study was completed between November 30 and December 13, 2005. The results of the dredging operations, resuspension monitoring program, and decontamination technology evaluation were recently issued (October 2007) by EPA in draft form.

As part of the Sediment Decontamination Technology Pilot Study, funded and implemented by the EPA and NJDOT New York/New Jersey (NY/NJ) Sediment Decontamination Program (EPA, 2006b), dredged sediment was transported to the Bayshore Recycling Inc. facility located in Keasbey, NJ. The sediment was off-loaded to the Valgocen, a 730-foot bulk carrier vessel that served as a temporary storage location and material handling facility.

Approximately 2,200 cy of Passaic River sediment were scheduled to be treated using a BioGenesis patented sediment washing process at the Bayshore Recycling Inc. facility as part of the Sediment Washing Technology Evaluation. The sediment washing process removes metals and organics from sediment particles by applying a biodegradable detergent to the soil through high pressure water jets. The decontaminated soil may be used in several land-based applications, such as upland remediation and landscaping.

On March 24, 2006, the EPA hosted an event in Woodbridge, NJ to demonstrate the soil washing process patented by BioGenesis Enterprises, Inc. This process has been used to treat approximately half of the dredged sediment from the Passaic River Dredging Pilot Study (EPA, 2005). BioGenesis completed processing of navigationally dredged material and the Passaic River sediments in May 2006.

In addition to the above, approximately 2,200 cy of Passaic River sediment were scheduled to be treated using a thermal destruction process developed by Endesco Clean Harbors to be performed at the International-Matex tank terminal located in Bayonne, NJ. This is part of the Thermal Destruction Technology Evaluation. Endesco Clean Harbors uses their patented Cement-Lock thermal destruction technology, a process that uses a rotary kiln operating at 2600°F, to melt the sediment. The melted sediment is rapidly cooled to immobilize the inorganic compounds producing a glassy granular material called "Ecomelt." Construction-grade cement is an end product of the treatment process. The cement could potentially be used in the construction of

sidewalks, parking lots and driveways. Gas Technology Institute/Endesco completed the thermal treatment of the dewatered Passaic River sediment in November 2006.

***2007 Draft Focused Feasibility Study***

In June 2007, the EPA, along with a partnership of five other federal and state agencies, announced six early action alternatives under consideration for cleaning up the Lower Passaic River. The partner agencies have developed a Focused Feasibility Study to evaluate a range of alternatives that might be implemented as an early action to control the major source of pollution. The options were developed with input from the USACE, USFWS, NOAA, NJDEP and NJDOT. Any accelerated cleanup action would take place at the same time as the ongoing RI/FS of the 17-mile tidal stretch of the river that started in mid-2007 (EPA, 2007b). The six alternatives and their estimated costs are as follows:

- Removing fine-grained sediment from the lower eight miles by dredging ($2 - $2.3 billion)
- Capping the sediments in the lower eight miles by placing clean materials on top of impacted sediments ($0.9 - $1.1 billion)
- Reconstructing a current federally-recognized navigation channel by using a combination of capping and backfilling for the lower eight miles of the river ($1.5 - $1.9 billion)
- Constructing a new navigational channel for current use and capping the lower eight miles ($1.3 - $1.6 billion)
- Constructing a new navigation channel for new uses that will develop in the future once the river is restored, then capping the lower eight miles of the river ($1.4 - $1.8 billion)
- Constructing a new navigational channel for future use; dredging fine-grained materials from a one-mile stretch with the highest concentration of contamination and from another one-mile zone where the most erosion takes place, then capping the entire eight mile stretch ($1.5 - $1.8 billion)

The EPA is expected to propose its preferred cleanup remedy in Summer 2008 (Diskin, 2007).

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