U.S. Environmental Protection Agency

Region II

Lower Passaic River Study Area

Diamond Alkali Superfund Site Operable Unit 4

Essex, Bergen, and Passaic Counties, New Jersey

April 2021

Superfund Proposed Plan

EPA ANNOUNCES PROPOSED PLAN

This Proposed Plan describes the remedial alternatives considered to address sediments acting as sources of contamination that inhibit recovery in the upper 9 miles of the Lower Passaic River Study Area (LPRSA) and identifies the preferred remedial alternative along with the rationale for this preference. The LPRSA is Operable Unit 4 (OU4) of the Diamond Alkali Superfund Site (the Site) and encompasses the entire Lower Passaic River (LPR) from Newark Bay at river mile (RM) 0 to the Dundee Dam at approximately RM 17.7.

In March 2016, EPA issued a Record of Decision (ROD) selecting a final remedy for sediments, and an interim action for the water column, in the lower 8.3 miles of the LPRSA (OU2 of the Site, from Newark Bay to RM 8.3), where a large majority of the contamination in the LPR is concentrated. The ROD for the lower 8.3 miles requires bank-to-bank remediation with a sediment remediation goal (RG) of 8.3 parts per trillion (ppt) for dioxin (specifically 2,3,7,8-tetrachlorodibenzo-p-dioxin [2,3,7,8-TCDD], the most toxic form of dioxin). That remedy, which includes a bank-to-bank engineered cap preceded by sediment dredging so the cap can be placed without increasing the potential for flooding, and to allow for continued commercial use of a federally authorized navigation channel in the 1.7 miles of the river closest to Newark Bay,

MARK YOUR CALENDAR

Public Comment Period:

April 15 – May 14, 2021

EPA will accept written comments on the Proposed Plan during the public comment period. Written comments should be addressed to:

Diane Salkie, Remedial Project Manager
Environmental Protection Agency
290 Broadway, 18th Floor
New York, New York 10007-1866
e-mail: salkie.diane@epa.gov

Public Meeting:
April 27, 2021 at 6:00 P.M.: Virtual Public meeting
One may find meeting participation details using the following links:

www.epa.gov/superfund/diamond-alkali and www.ourpassaic.org.

Alternately, one may participate by telephone using the following conference line number:
315-565-0493; Code: 88557323# for **English** or
315-565-0493; Code: 7960512# for **Spanish**

Please register in advance of the virtual meeting by accessing:
https://epa_proposed_plan_lprsa.eventbrite.com
or contacting Shereen Kandil, Community Involvement Coordinator, at: Kandil.Shereen@epa.gov or (212) 637-4333.

Anyone interested in receiving materials for the public meeting in hard copy should either email or call Shereen Kandil with such a request by April 23, 2021.

609883

and accommodate reasonably anticipated future recreational use above RM 1.7, is currently in the remedial design (RD) phase. The lower 8.3-mile ROD and supporting information are part of the publicly available administrative record for OU2.

This Proposed Plan was developed by the U.S. Environmental Protection Agency (EPA), the lead agency for the Site, in consultation with the New Jersey Department of Environmental Protection (NJDEP). In addition, in 2002, EPA formed a partnership with the US Army Corps of Engineers (USACE), NJDEP, the National Oceanic and Atmospheric Administration, and the U.S. Fish and Wildlife Service, known as the Partner Agencies, to conduct a joint study that would bring each agency's authorities to bear on the complex LPRSA. EPA has consulted with the Partner Agencies, who are key state and federal stakeholders in the LPR, Newark Bay, and New York-New Jersey Harbor Estuary. Another key stakeholder in the Site is a very active and involved Community Advisory Group (CAG). EPA has briefed the CAG throughout every stage in Site history since the CAG's inception in 2009.

EPA's response at the Site began in the 1980s, initially at a former manufacturing facility located at 80-120 Lister Avenue, Newark, New Jersey. Apart from some initial sampling in the river in the 1980s, the investigation of the LPRSA began in 1994, when Occidental Chemical Corporation (OCC) agreed to an administrative order on consent (AOC) with EPA to perform a remedial investigation and feasibility study (RI/FS) to investigate a six-mile stretch of the LPR encompassing the Lister Avenue facility. The purpose of the RI/FS was to characterize conditions and determine risks within the study area and evaluate remedial alternatives to address those risks. EPA halted the six-mile study and in 2002, EPA expanded the scope of the investigation to include the entire LPRSA.

While that work was underway, EPA identified additional potentially responsible parties (PRPs) for the LPRSA, and a number of PRPs, comprising companies that owned or operated facilities from which hazardous substances were potentially discharged to the river, formed the Cooperating Parties Group (CPG). In 2004, EPA signed a settlement agreement with the CPG in which the settling parties agreed to pay for EPA to perform the LPRSA RI/FS. In 2007, the CPG entered into a new agreement with EPA, in which the settling parties agreed to take over the performance of the LPRSA RI/FS from EPA, with EPA oversight. Since 2007, the members of the CPG have continued to change from time to time.

EPA is issuing this Proposed Plan as part of its public participation responsibilities under Section 117(a) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (CERCLA) and Section 300.430(f)(2) of the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The nature and extent of the contamination in the upper 9 miles of the LPRSA and the remedial alternatives summarized in this Proposed Plan are described in greater detail in two documents, the 2019 *Remedial Investigation Report, Lower Passaic River Study Area* (RI Report*)* and the 2020 *Upper 9-Mile Source Control Interim Remedy Feasibility Study Report* (IR FS Report). Those and other documents are part of the publicly available administrative record file for OU4 and are located in the information repository for the Site. EPA encourages the public to review those documents to gain a more comprehensive understanding of the Site and the Superfund activities that have been conducted at the Site.

The findings of the RI Report support an adaptive, multi-phased approach to remediating contamination in the upper 9 miles of the LPRSA. The initial phase of cleanup, described in this Proposed Plan, would address source sediments in the upper 9 miles that have elevated contaminant concentrations and act as a reservoir for potential migration of contamination to the water column, other areas of the sediment bed, and biota.

Therefore, the sediment source control action would be an interim remedy (IR) for the upper 9 miles of the LPRSA. This action would be followed by a period of monitoring to evaluate the response of the river system to the IR and track the recovery of sediments, the water column, and biota. Following the period of system response and system recovery monitoring, EPA will issue a final ROD to document risk-based cleanup levels and any additional actions to address remaining unacceptable risks, in both sediments in the upper 9 miles and surface water throughout the LPRSA. Information learned during the IR and the system response and system recovery monitoring that follow the IR, along with identifying project uncertainties, providing a mechanism for how these uncertainties would be addressed, and modifying the conceptual site model as necessary, would inform selection of the final remedy in the final ROD. The ultimate objective of the adaptive management approach would be to select, implement, and demonstrate the success of a final remedy.

EPA's preferred alternative, Alternative 3, for the sediment source control IR consists of dredging and capping to:

- Control sediment sources of 2,3,7,8-TCDD and polychlorinated biphenyls (PCBs) by remediating surface sediments (within 6 inches of the sediment bed) with elevated concentrations
- Achieve a post-IR 2,3,7,8-TCDD surface area-weighted average concentration (SWAC) of 75 ppt from RM 8.3 to RM 15
- Achieve a post-IR total PCB SWAC equal to or below the established total PCB background concentration of 0.46 parts per million (ppm) from RM 8.3 to RM 15
- Control subsurface sediments (greater than 6 inches below the sediment bed) from becoming sources of 2,3,7,8-TCDD and PCBs through erosion

A SWAC is an average of sample data that weights each sample point relative to the area it represents and is intended to estimate the mean contaminant concentration over a certain area when sample density is not necessarily uniform throughout the area. EPA would use SWAC as the measurable goal to demonstrate that the IR is effective in remediating sediment sources. To achieve target post-IR SWACs, remedial action levels (RALs) guide remediation. Surface sediments with 2,3,7,8-TCDD concentrations above the 2,3,7,8-TCDD surface RAL would be remediated by dredging and capping. Surface sediments with total PCB concentrations above a surface RAL of 1 ppm would also be remediated by dredging and capping. Subsurface RALs would also be established to guide the remediation of sediments in erosional areas. Based on the current estimated SWACs, the preferred alternative would immediately reduce the 2,3,7,8-TCDD SWAC from RM 8.3 to RM 15 by approximately 92 percent and the total PCB SWAC by approximately 82 percent.

In the IR FS, areas of active remediation, known as remedial footprints, were delineated for each alternative based on sediment concentration mapping and mapping of erosional areas developed from the RI sediment and bathymetry data. Bathymetry refers to the elevation of the river bottom (analogous to topography on land) and is typically expressed as the water depth relative to a fixed datum (e.g., the North American Vertical Datum of 1988). Bathymetry is measured using acoustic signals to determine the depth of water over the sediment bed and create a topographic map of the bed. Alternative-specific RALs were also derived in the IR FS through the process of delineating the alternative-specific remedial footprints. The final IR remedial footprint would be determined based on the results of pre-design investigation (PDI) sediment sampling that would be conducted at high spatial density during the IR RD phase and additional bathymetric surveying information that would provide current understanding of erosion and deposition. The PDI sediment sampling results would also be used to determine the final RALs to be adhered to during the IR. During the IR, sediments throughout the final IR remedial footprint would be removed to the depths necessary to accommodate a sediment cap that is resistant to erosion and contaminant migration.

A source control IR would support adaptive management of the overall cleanup of sediments in the upper 9 miles of the LPRSA and surface water throughout the LPRSA. EPA anticipates that under the adaptive management approach (see Appendix D of the IR FS Report), the design and implementation of the IR, followed by post-IR response and recovery assessment monitoring, would systematically incorporate new information to reduce final remedy uncertainties (e.g., what specific actions would be needed to attain final cleanup in a reasonable timeframe), and provide a framework for future remedial action decisions and confirmation of final remedy completion that are consistent with CERCLA and the NCP.

EPA, in consultation with NJDEP, may modify the preferred alternative or select another alternative presented in this Proposed Plan based on new information and/or public comments. The final decision regarding the selected IR alternative will be made after EPA has taken into consideration all public comments. Therefore, EPA is soliciting comment on all the information and alternatives summarized in this Proposed Plan.

Community Role in the Selection Process

This Proposed Plan is being issued to inform the public of EPA's preferred alternative for sediment source control in the upper 9 miles of the LPRSA and to solicit public comments pertaining to all of the IR alternatives evaluated, including the preferred alternative. Changes to the preferred alternative, or a change from the preferred alternative to another alternative, may be made if public comments and/or additional data indicate that such a change would result in a more appropriate IR. The final decision regarding the selected IR alternative will be made after EPA has taken into consideration all public comments. This Proposed Plan has been made available to the public for a public comment period that is from April 15 – May 14, 2021

A virtual public meeting will be held during the public comment period on **April 27, 2021** at 6:00 p.m. regarding the investigations of the upper 9 miles of the LPRSA, the IR alternatives considered, and the preferred alternative, and to receive public comments. The public meeting will include a formal presentation by EPA of the preferred alternative and other options considered for the sediment source control IR.

Information on the public meeting and submitting written comments can be found on page 1. Comments received at the public meeting, as well as written comments, will be documented in the Responsiveness Summary in the IR ROD. The IR ROD is the document that will formalize the selection of the IR for the upper 9 miles of the LPRSA.

SITE DESCRIPTION

The LPR and Newark Bay are part of the New York/New Jersey Harbor Estuary. The LPR refers to the tidal portion of the river (i.e., from Newark Bay to Dundee Dam) and its watershed, which includes the major tributaries Saddle River, Third River, and Second River. See Figure 1. Dundee Dam isolates the Upper Passaic River (UPR) from the tidal mixing that influences the lower portions of the river.

Notably, two RM systems have been developed for the LPRSA. A RM system was developed by USACE that follows the navigation channel of the LPR. RM 0 in the USACE system is just offshore of Kearny Point, and RMs continue upriver to the Dundee Dam, which is at RM 17.7 in this system. RM 8.3, which designates the upriver extent of OU2 and the downriver extent of the upper 9-mile reach of the LPRSA covered by this Proposed Plan, is named in the USACE RM system. The RI RM system followed the geographic centerline of the

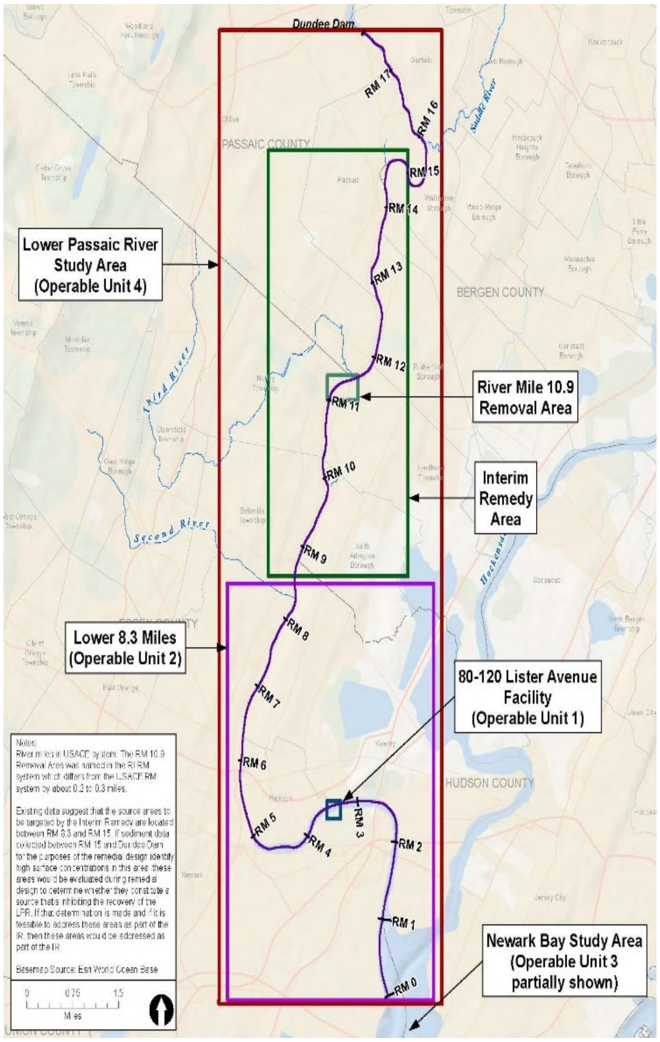

Figure 1: Map of the Lower Passaic River (Source: IR FS Report)

river (which was developed by EPA and used for the RI evaluations). In the RI RM system, RM 0 is defined by an imaginary line between two marker lighthouses at the confluence of the LPR and Newark Bay: one in Essex County just offshore of Newark; and the other in Hudson County just offshore of Kearny Point. RMs in the RI RM system then continue upriver to Dundee Dam (at RM 17.4 in the RI RM system). The two RM systems are about 0.2 to 0.3 miles apart. RM designations in this Proposed Plan are in the USACE system unless otherwise specified.

The LPR is in a highly developed urban area. The predominant adjacent land uses from the mouth of the LPR (RM 0) to approximately RM 4 are industrial and commercial. Adjacent land use above approximately RM 4 begins to also include residential and recreational uses. The upper portions of the LPR generally feature steeper and hardened shorelines on the west bank with limited areas of riparian vegetation. Moving upriver from RM 8.3, land use increasingly transitions to commercial and recreational, with pockets of residential use. A four-lane highway (Highway 21) runs parallel to the river along the western bank between approximately RM 7 and RM 14. A strip of parkland runs along much of the eastern shoreline between approximately RM 7 and RM 14, with six parks and recreation areas of note and four boathouses/crew facilities. The east bank tends to be less modified, consisting of more natural shoreline, residential areas, and parks. In the parks on the eastern shore, access to the riverbank is possible in some clearings and areas where vegetation growth is limited, and the riverbank is not too steep. Above approximately RM 14, the river becomes narrower, shallower, and the adjacent uses become more residential. Pulaski Park is located on the western bank between approximately RM 15.5 and RM 16. Much of the shoreline between approximately RM 16 and Dundee Dam is vegetated with several points of public access to the water.

The New Jersey Surface Water Quality Standards classify the LPR from its mouth to the Second River as saline-estuarine 3. The LPR from Second River to Dundee Dam is classified as freshwater 2 non-trout and saline-estuarine 2.

SITE BACKGROUND

The LPRSA is a part of the Diamond Alkali Superfund Site. EPA's response at the Site began at a former manufacturing facility located at 80-120 Lister Avenue (RM 3.4) in Newark, New Jersey. The manufacturing process associated with the release of 2,3,7,8-TCDD from the Lister Avenue facility started in the late 1940s.[1] In the 1950s and 1960s, the facility was operated by the Diamond Alkali Company (later purchased by and merged into Occidental Chemical Corporation, or OCC). Between March 1951 and August 1969, the Diamond Alkali Company manufactured the chemical 2,4,5-trichlorophenol and the herbicides 2,4-dichlorophenoxyacetic acid and 2,4,5-trichlorophenoxyacetic acid, ingredients in the defoliant "Agent Orange." A by-product of the manufacturing was 2,3,7,8-TCDD. These substances have all been found in LPR sediments and fish/crab tissue.

Based on investigations by EPA and NJDEP, the Diamond Alkali Site was placed on the National Priorities List in 1984. After further investigations and several emergency response actions that addressed dioxin found on nearby properties, EPA issued a ROD in 1987 to select an interim containment remedy for the Lister Avenue facility (OU1). The remedy consisted of demolishing a warehouse and other structures on site; installing subsurface walls around the site to contain the contaminated soils and materials; capping the site; and collecting and treating the contaminated groundwater.

In 1994, OCC agreed to an AOC with EPA to investigate a six- mile stretch of the LPR encompassing the Lister Avenue facility. This investigation found contaminants that originated from the Lister Avenue facility, in particular 2,3,7,8-TCDD and pesticides, throughout the six miles, with the highest concentrations adjacent to the facility. This investigation also found many other contaminants not clearly linked to operations at the Lister Avenue facility and indicated that contaminated sediments moved into and out of the six-mile stretch, leading to the conclusion that a more comprehensive study was required. EPA halted the six-mile study, and in 2002, EPA expanded the scope of the investigation to include the entire LPRSA.

While working with OCC on the Lister Avenue facility and the first studies of the river, EPA also identified other PRPs for the LPRSA. As noted above, a number of companies that owned or operated facilities from which hazardous substances were potentially discharged to the river formed the CPG, and in 2004, EPA signed a settlement agreement with CPG members in which the settling parties agreed to pay for EPA to perform the LPRSA (OU4) RI/FS. The settlement agreement was amended in 2005 and 2007, adding more parties to reach a total of over 70 settling parties. From 2004 to 2007, EPA investigated contamination in sediments and water of the LPR, and investigated the major tributaries, combined sewer overflows (CSOs), and storm water outfalls (SWOs) to the river. In 2007, CPG members entered into a new AOC with EPA, in which the settling parties agreed to take over the performance of the LPRSA RI/FS from EPA, with EPA oversight.

During the comprehensive investigation of the LPRSA, the sediments of the lower eight miles were found to be a major source of contamination to the overall LPR and to Newark Bay (OU3). Unlike many rivers, where remediation is typically performed from upstream to downstream because flow is in only one direction, the tides in the LPR move water, suspended sediments, and contaminants back and forth twice a day, and therefore the mass and volume of contaminated sediments dictated the focus of investigations. EPA undertook a targeted RI and focused FS (FFS) of the lower 8.3 miles, while the comprehensive LPRSA RI/FS was on-going. In March 2016, EPA selected

[1] EPA has previously identified that the Diamond Alkali Company began operating at 80 Lister Avenue in 1951 (2014 *Focused Feasibility Study Report for the Lower Eight Miles of the Lower Passaic River*). While this is accurate, the manufacturing of dichlorodiphenyltrichloroethane (DDT) and phenoxy herbicides began in or about 1946, by Kolker Chemical Works, Inc., a corporate predecessor of Diamond Alkali. Reconstruction of historical records suggests that releases of 2,3,7,8-TCDD likely began in the late 1940s (2018 *Reconstruction of Historical 2,3,7,8-Tetrachlorodibenzo-p-dioxin Discharges from a Former Pesticide Manufacturing Plant to the Lower Passaic River*, from Chemosphere, Volume 212, Robert Parette et al., pages 1125-1132).

the remedy for OU2, which includes the construction of an engineered cap over the river bottom of the lower 8.3 miles of the LPRSA, dredging of the river bottom from bank to bank prior to placement of the cap, and implementation of institutional controls (ICs) designed to protect the engineered cap.

Two removal actions have been conducted in the LPRSA. In June 2008, EPA and OCC signed an AOC for a non-time-critical removal action to remove 200,000 cubic yards (cy) of contaminated sediments from the river adjacent to the 80-120 Lister Avenue facility. Dredging, dewatering, and transport off site of the first 40,000 cy of sediments (known as Phase 1) was completed in 2012. The remainder of the project is being incorporated into the lower 8.3-mile remedial action. In June 2012, EPA and the CPG signed an AOC for a time-critical removal action to address the risks posed by high concentrations of dioxins, PCBs, and other contaminants found at the surface of a mudflat on the east bank of the river at RM 10.9 (note that the RM 10.9 designation is in the RI RM system) in Lyndhurst, New Jersey. This action is referred to as the "RM 10.9 Removal". Dredging and capping at RM 10.9 were completed between 2013 and 2014 and monitoring of the performance of the cap continues for this area.

SITE CHARACTERISTICS

The LPRSA has been methodically evaluated through various investigations. The results of these studies are detailed in the RI and IR FS Reports, prepared by the CPG pursuant to the 2007 RI/FS AOC, and in the lower 8.3-mile ROD and its administrative record. Tables 1 and 2 summarize 2,3,7,8-TCDD and total PCB data, respectively, for the upper 9 miles of the LPRSA, for surface and subsurface sediments. The major processes controlling contaminant fate and transport in the LPRSA are illustrated in the discussion below and in the conceptual site model (CSM) description.

Table 1. 2,3,7,8-TCDD in Sediments (parts per trillion)

Statistic	Depth (feet): 0.0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 Feet to End
River Mile 8.3 - 15					
Minimum	0.4	0.01	0.01	0.02	0.04
Maximum	51,100	57,176	30,500	29,800	18,849
Mean	2,094	3,426	3,186	3,332	1,576
Median	260	402	272	315	107
River Mile 15 - Dundee Dam					
Minimum	0.03	0.03	0.04	0.03	0.02
Maximum	0.8	0.2	6.7	12	9
Mean	0.3	0.09	1.4	3	3
Median	0.3	0.07	0.07	0.2	0.2

Table 2. Total PCBs in Sediments (parts per million)

Statistic	Depth (feet): 0.0 to 0.5	0.5 to 1.5	1.5 to 2.5	2.5 to 3.5	3.5 Feet to End
River Mile 8.3 - 15					
Minimum	0.002	0.0001	0.000004	0.000003	0.000003
Maximum	34	35	34	34	22
Mean	2.9	4.2	4.6	4.7	3
Median	0.9	1.3	1.6	1.6	0.7
River Mile 15 - Dundee Dam					
Minimum	0.01	0.000002	0.000003	0.00001	0.000002
Maximum	2.9	0.6	0.3	0.5	0.6
Mean	0.3	0.2	0.1	0.2	0.2
Median	0.09	0.01	0.0004	0.1	0.03

Physical Characteristics

The LPR varies considerably from the mouth at Newark Bay moving upstream to Dundee Dam. The water depth and cross-sectional area decrease moving upstream, with a marked constriction at RM 8.3. At that location, there is also a pronounced change in sediment texture within the riverbed. The riverbed from RM 0 to RM 8.3 is dominated by fine-grained sediments. Above RM 8.3, the riverbed is dominated by coarser sediments with smaller areas or pockets of fine-grained sediments, often located outside the channel. The inside bends of the river generally accumulate finer sediments, while the outside bends generally experience little or no sediment accumulation and in some cases experience erosion due to higher shear stresses. In the vicinity of structures such as bridge abutments and at tributary confluences, sediments tend to be coarse or absent due to associated turbulence that prevents long-term accumulation of fine sediments (or any sediments). About 85 percent of the fine-grained sediment surface area (90 percent by volume) of the LPR is located below RM 8.3. As discussed in the OU2 ROD, wider beds of contaminated sediments accumulated below RM 8.3 than above it is due to a combination of a wider cross-section and a deeper navigation channel.

Hydrodynamics of the LPR are governed by the freshwater discharge, tides, estuarine circulation, and changes in mean water level caused by storm surges moving into Newark Bay and the LPR from the Atlantic Ocean. Denser saline waters from Newark Bay enter the LPR as a salt wedge in the lower portion of the water column tending to flow in the upstream direction beneath fresher water flowing in the seaward direction, producing a two-layer flow pattern. The interface between fresh and brackish waters in the LPR, referred to as the salt front (at the upstream extent of the salt wedge), moves several miles during each tidal cycle and typically resides within the lower 10 miles, but it can extend upstream beyond approximately RM 14 under extreme low-flow conditions.

The salt front typically coincides with the region of maximum turbidity known as the estuarine turbidity maximum (ETM). The ETM results from a combination of resuspension of bottom sediments by tidal currents and the convergence of bottom water transport around the salt front. The geometry and density gradients in the LPR (under normal flow conditions) result in higher resuspension rates and higher suspended sediment concentrations during flood (rising) tides compared to ebb (falling) tides (referred to as tidal asymmetry). Tidal asymmetry, coupled with estuarine circulation, increases sediment retention in the LPR and provides a mechanism for contaminant transport in the upstream direction within the salt wedge and in the downstream direction in fresher surface layer waters.

The estuarine circulation, tidal asymmetry, and freshwater flow affect sediment transport over time scales longer than tidal cycles. During low river flow conditions, tidal asymmetry and estuarine circulation are dominant, leading to import of sediments from Newark Bay, net upstream transport within the salt wedge, and trapping of sediments within the LPR. In moderate river flow conditions, sediment transport is more impacted by river flow, and sediments accumulated in the ETM and in unconsolidated surface sediments that are easily eroded are generally flushed downstream and into Newark Bay. During high river flow conditions, the riverbed may experience scour and the system as a whole exports sediments and erodes even beyond the easily erodible unconsolidated surface sediments. These processes promote a continual redistribution of contaminants associated with fine-grained sediments.

CONCEPTUAL SITE MODEL

Deposition and erosion in the LPR have been assessed through the analysis of a series of high-resolution bathymetry surfaces developed from multi-beam survey data obtained over a six-year period from 2007 to 2013, including a high flow associated with Hurricane Irene in August 2011. Flow over Dundee Dam reached 24,700 cubic feet per second (cfs) following Hurricane Irene. As a point of comparison, the annual average flow at Dundee Dam is approximately 1,200 cfs.

Contaminant concentrations in the LPR are largely driven by variations in sediment type and depositional/erosional history. Two contaminants found throughout the LPRSA that have shown unacceptable risk based on risk assessments and would be addressed through a sediment source control IR are 2,3,7,8-TCDD and PCBs. Other contaminants found in the LPRSA, but not contributing to human health and/or ecological risk to the same degree, include DDx (DDT and its derivatives), PAHs, and metals (including mercury). Contaminants are generally found in greatest concentrations in fine-grained sediments such as the RM 10.9 mudflat, which was found to contain surface sediment 2,3,7,8-TCDD levels exceeding 50,000 ppt and total PCB levels exceeding 33.9 ppm in some instances prior to the RM 10.9 Removal. Variations in spatial patterns for PCBs, total DDx, and mercury suggest these contaminants may also be impacted by other sources, including from the UPR, Newark Bay, tributaries, and/or watershed sources. Figure 2, located at the end of this Proposed Plan, demonstrates the nature and extent of 2,3,7,8-TCDD and PCB contamination in surface sediments in the LPRSA.

Continuing contaminant sources to recently deposited sediments of the LPR are the internal sediment inventory (e.g., resuspended contaminated sediments within the LPR), tidal exchange with Newark Bay, flows from above Dundee Dam, CSOs and SWOs, overland flow, groundwater, and various other point and non-point sources. The contaminated fine-grained sediments already within the LPR are the most significant continuing contaminant source and will be addressed to a large degree by the bank to bank capping of RM 0 to RM 8.3. In comparison, UPR and Newark Bay contributions of contaminants are small, and all other sources are minor. The IR focusing on source control that is the subject of this Proposed Plan targets sediments with higher contaminant concentrations in the upper 9 miles of the LPRSA.

Dundee Lake and other UPR sediments are isolated from hydrodynamic impacts and sediment transport from the LPR by Dundee Dam. The concentrations of the contaminants detected in recently deposited sediments collected from the UPR immediately above Dundee Dam are representative of current background conditions for the LPR.

EPA investigated potential sources of contaminants to the LPR, including atmospheric deposition, groundwater, industrial point sources, the UPR, Newark Bay, major tributaries, CSOs, and SWOs. Based on analyses discussed in the lower 8.3-mile targeted RI and FFS, direct atmospheric deposition, groundwater discharge, and industrial point sources of contaminants currently are not significant contributors of contaminant mass in the recently deposited sediments or water column of the LPR. The UPR, Newark Bay, the three main tributaries, and CSOs and SWOs were sampled between 2005 and 2011. A mass balance of suspended sediments and contaminant loads was performed with the data as part of the analysis from the lower 8.3-mile ROD. The results indicate that the tributaries, CSOs, and SWOs are minor contributors of contamination to recently deposited sediments, since they are minor contributors of sediment particles compared to the UPR and Newark Bay, and the mass of contaminants delivered by those particles is low compared to the sediments of the LPR main stem. For contaminants such as 2,3,7,8-TCDD, total PCBs, and mercury, concentrations on sediment particles from the tributaries, CSOs, and SWOs are clearly lower than those on LPR surface sediments. Contributions to the recently deposited sediments of the LPR were summarized in the lower 8.3-mile ROD.

As presented in the lower 8.3-mile ROD, resuspension of LPR sediments contributes well over 90 percent of the dioxin in recently deposited sediments of the LPR, followed by Newark Bay (approximately 5 percent) and the UPR (3 percent or less). Resuspension of LPR sediments contributes approximately 80 percent of PCBs in recently deposited sediments, followed by the UPR (approximately 10 percent) and Newark Bay (less than 10 percent).

A detailed discussion of the LPRSA CSM is presented in the RI Report, as well as the lower 8.3-mile ROD and the OU2 administrative record.

SCOPE AND ROLE OF THE ACTION

Although the RI Report documented investigations that were developed and implemented for the entire LPRSA, the analysis of the proposed sediment source control IR is focused on the upper 9 miles of the LPRSA. The rationale for undertaking a source control IR is supported by the CSM for the upper 9 miles, which is derived from RI data and evaluations of contaminant distributions, sediment characteristics, and sediment and contaminant fate and transport. The CSM allowed EPA to identify areas of the riverbed with high contaminant concentrations that act as ongoing sources to the water column, the remainder of the sediment bed, and biota. Remediating these sources will immediately reduce SWACs, accelerate recovery of the water column and the remaining areas of the sediment bed, and reduce exposure to biota. The IR would be performed using an adaptive management approach that will support a final ROD, consistent with CERCLA and the NCP.

For this proposed source control IR, sediment sources are defined as sediments in the upper 9 miles of the LPRSA that:

- have elevated concentrations (2,3,7,8-TCDD concentrations in the range of 200 to 400 ppt and above and total PCB concentrations of 1 ppm and above)
- have a low potential for recovery through ongoing natural processes such as the accumulation of cleaner sediments at the surface
- act as a reservoir for potential migration of contamination to surface water and biota, thereby inhibiting overall abiotic and biotic recovery in the system

Existing data suggest the source areas to be targeted by the proposed IR are located between RM 8.3 and RM 15. However, the PDI will generate data throughout the upper 9 miles of the LPRSA. Surface RALs will also be applied to the area between RM 15 and Dundee Dam.

Concentrations in surface sediments represent an exposure to biota. However, because the specific relationship between sediment concentrations and tissue concentrations is not fully understood at this time, it is not possible to determine at present whether contaminant concentrations in biota would be reduced in direct proportion to the reductions in sediment concentrations. As such, EPA will use reduction in SWAC as the measurable goal to determine effectiveness of the IR. EPA expects that ecological exposure and tissue concentrations would be reduced in response to the IR, which is expected to result in a reduction in ecological and human health risk. A comprehensive food web model is under development for the LPRSA, which will be used to understand the relationship between sediments and tissue. This food web model should be complete by the time an IR is implemented, such that long-term reductions in risk could be evaluated and communicated during the post-IR monitoring period and inform decision-making for the final remedy.

Sediment and surface water data collected during the RI and post-remediation data collected in the RM 10.9 Removal area suggest reasonable thresholds for classifying source sediments for the IR are 2,3,7,8-TCDD concentrations in the range of 200 to 400 ppt and above and total PCB concentrations of 1 ppm and above. In the design and implementation of the IR, sediments to be targeted as source would be specifically defined by final RALs.

Implementation of a source control IR would provide several expected benefits: a greater than 90 percent reduction in the average surficial sediment concentration of 2,3,7,8-TCDD, one of the dioxins/furans that are the primary contaminants causing risk to human health; significant reduction of ecological and human health risk; and alignment of remedial activities between the upper 9 miles and the lower 8.3 miles of the LPRSA. An IR would also address other contaminants in sediments that are collocated with 2,3,7,8-TCDD and PCBs in the IR footprint. Remediation in both reaches of the river within a similar timeframe would accelerate overall risk reduction and recovery for the entire LPR. In addition, an alignment of construction schedules for the two reaches may allow opportunity to share resources (e.g., a sediment processing facility) for increased efficiency.

The adaptive management approach would provide a mechanism for interpreting and responding to new data and potential changed understanding of system conditions. Incorporating structured adaptive management into the remediation would ensure that data collected during the monitoring phases of the project can be used to reduce uncertainties associated with selecting a protective final remedy for the LPRSA. The adaptive management approach would define how key project uncertainties would be addressed through additional data collection and how the system response to the IR and long-term system recovery would be integrated into a structured final remedy-selection process to ensure that the goal of protecting human health and the environment is achieved, consistent with CERCLA and the NCP.

In addition to the food web model, a suite of numerical models that describe hydrodynamic and sediment and contaminant fate and transport processes in the LPR has been developed by EPA, and by performing parties with EPA oversight. This suite of models would be refined using newly generated data and information and would be used to predict system conditions in the future and inform the final ROD for the LPRSA. While the numerical models would provide important predictive tools, EPA would rely on actual data collected during various monitoring phases to understand Site conditions and make decisions.

Figure 3, located at the end of this Proposed Plan, presents a highly conceptualized depiction of the adaptive approach to cleanup of the upper 9 miles of the LPRSA. The adaptive approach would include assessing completion of the IR in terms of the following adaptive elements: attaining IR Remedial Action Objectives (RAOs) and adequately removing sediment sources; system response to the IR in terms of an accelerated recovery trajectory; and overall longer-term recovery of the system. Longer-term recovery of the system following the IR would be assessed against risk-based preliminary remediation goals (PRGs) developed in parallel with the IR design, and data collection would be prioritized to allow for selection of final RGs and a final remedy to attain the final RGs in a reasonable timeframe through the final ROD. The adaptive approach would culminate with verifying attainment of final RGs after implementation of the final remedy.

PRINCIPAL THREAT WASTE

The identification of principal and low-level threats is made on a site-specific basis to help streamline and focus waste management options by categorizing the suitability of the waste for treatment or containment. Principal threat wastes are those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur. They include liquids and other highly mobile materials (e.g., solvents) or materials having high concentrations of toxic compounds. No "threshold level" of toxicity/risk has been established to equate to "principal threat". However, where toxicity and mobility of source material combine to pose a potential risk of 1×10^{-3} or greater, generally treatment alternatives should be evaluated. The NCP states that EPA expects to use treatment to address principal threats posed by a site whenever practicable.

The dioxin, PCB, and other contaminant concentrations in sediments throughout the LPRSA are present at levels contributing to significant risks (greater than 1×10^{-3}) for humans consuming fish and crab caught in the LPRSA. As previously stated, the action described in this Proposed Plan is developed to control sediments that have elevated contaminated concentrations and act as a reservoir for potential migration of contamination to the water column, other areas of the sediment bed, and biota. Although the engineering and sediment transport modeling work done as part of the IR FS has determined that the source area sediments, despite their toxicity, under current conditions, may be reliably contained, EPA nevertheless considers the most highly contaminated sediments as principal threat wastes.

EPA does not believe that treatment of all the sediments in the upper 9 miles of the LPRSA is practicable or cost effective given the high volume of sediments and the number of contaminants that would need to be addressed and lack of applicable in-situ (i.e., in-place) treatment technologies. However, as discussed below, EPA has considered treatment as a component of dredged material management.

SUMMARY OF SITE RISKS

Baseline human health and ecological risk assessments were conducted for the LPRSA to estimate the risks associated with exposure to contaminants based on current and likely future uses of the LPR. These baseline risk assessments are detailed in the RI Report.

Baseline Human Health Risk Assessment

A Baseline Human Health Risk Assessment (BHHRA) was conducted to assess the cancer risks and noncancer health hazards associated with exposure to contaminants of potential concern (COPCs) present in the LPRSA. The risk assessment was conducted using the standard EPA risk assessment process comprised of Hazard Identification, Exposure Assessment, Toxicity Assessment, and Risk Characterization (see text box).

People can be exposed to COPCs present within the upper 9 miles of the LPRSA mainly through consumption of fish and crabs. Recreational exposure to accessible surface sediments and surface water during boating, wading, fishing, or swimming in the LPR and worker exposures to accessible surface sediments do not pose unacceptable cancer risks or noncancer hazards.[2] For each assumed use, a reasonable maximum exposure (RME), which uses conservative exposure values, was evaluated to estimate cancer risks and noncancer hazard.

At RME exposure levels, which represent an upper bound by definition, the potential cancer risks and noncancer hazards to recreational anglers who are assumed to regularly consume their catch (i.e., eat approximately 56 LPRSA fish meals per year or approximately 30 meals per year of 6 crabs per meal) exceed the values used by EPA for determining whether a site poses unacceptable risk (see Table 3).

Consumption of fish and crab constitutes the predominant source of human health risk. The dominant potential contaminants of concern (COCs) for the fish and crab consumption scenarios are TCDD-TEQ (TEQ, or toxic equivalency, expresses the aggregate risk based on the cumulative effect of several tetra dioxin compounds) and PCBs, with methylmercury, pesticides, and, to a lesser extent, inorganic arsenic and inorganic mercury, contributing to risk. The primary human health risk drivers are 2,3,7,8-TCDD and PCBs. Other bioaccumulative compounds, including pesticides and mercury, also contribute to human health risk—but to a lesser extent. Background risks from consuming fish from the upstream area above Dundee Dam also exceed EPA's risk management goals due to levels of PCBs, pesticides, and mercury in background fish.

[2] An analysis of direct contact exposure to accessible surface sediments by 3-mile river segments in the BHHRA indicates that it is only in RM 6 to RM 9, and specifically the east bank of this river segment, that direct contact poses potential noncancer hazards in excess of a hazard index equal to 1 (maximum hazard index of 5), due primarily to TCDD-TEQ, which contributes more than 90% of noncancer hazards. Further analysis of the TCDD-TEQ data indicates that no elevated direct contact hazard is associated with the sediments in the portion of the east bank RM 6 to RM 9 above RM 8.3.

What is Human Health Risk and How is it Calculated?

A Superfund baseline human health risk assessment is an analysis of the potential adverse health effects caused by hazardous substance releases from a site in the absence of any actions to control or mitigate the hazardous substances under current- and future-land uses. A four-step process is utilized for assessing site-related human health risks for reasonable maximum exposure scenarios.

Hazard Identification: In this step, the chemicals of potential concern (COPCs) at the site in various media are identified based on such factors as toxicity, concentration and fate and transport of the contaminants in the environment, concentrations of the contaminants in specific media, mobility, persistence and bioaccumulation.

Exposure Assessment: In this step, the different exposure pathways through which people might be exposed to the COPCs in the various media identified in the previous step are evaluated. Examples of exposure pathways include incidental ingestion of and dermal contact with contaminated surface water and sediments. Factors relating to the exposure assessment include, but are not limited to, the concentrations in specific media that people might be exposed to and the frequency and duration of that exposure. Using these factors, a "reasonable maximum exposure" scenario, which portrays the highest level of human exposure that could reasonably be expected to occur, is calculated. A "central tendency exposure" scenario, which portrays the average or typical level of human exposure that could occur, is calculated when the reasonable maximum exposure scenario results in unacceptable risks, as discussed below under *Risk Characterization.*

Toxicity Assessment: In this step, the types of adverse health effects associated with chemical exposures and the relationship between magnitude of exposure and severity of adverse effects are determined. Potential health effects are chemical-specific and may include the risk of developing cancer over a lifetime or other noncancer health hazards, such as changes in the normal functions of organs within the body (*e.g.*, changes in the effectiveness of the immune system). Some chemicals are capable of causing both cancer and noncancer health hazards.

Risk Characterization: This step summarizes and combines outputs of the exposure and toxicity assessments to provide a quantitative assessment of site risks for all COPCs. Exposures are evaluated based on the potential risk of developing cancer and the potential for noncancer health hazards. The likelihood of an individual developing cancer is expressed as a probability. For example, a 10^{-4} cancer risk means a "one-in-ten-thousand excess lifetime cancer risk;" or one additional cancer may be seen in a population of 10,000 people as a result of exposure to site contaminants under the conditions identified in the Exposure Assessment. Current Superfund regulations for exposures identify the range for determining whether remedial action is necessary as an individual excess lifetime cancer risk of 10^{-4} to 10^{-6}, corresponding to a one-in-ten thousand to a one-in-a-million excess cancer risk. For noncancer health effects, a "hazard index" (HI) is calculated. The key concept for a noncancer HI is that a threshold (measured as an HI of less than or equal to 1) exists below which noncancer health hazards are not expected to occur. The goal of protection is 10^{-6} and an HI of 1 for a noncancer health hazard. Cumulative risks that exceed a 10^{-4} cancer risk or an HI of 1 require remedial action at the site.

Table 3. Summary of BHHRA

Receptor	Fish Consumption		Crab Consumption	
	Cancer Risk	Non-Cancer Hazard	Cancer Risk	Non-Cancer Hazard
Child	$1x10^{-3}$	193	$4x10^{-4}$	50
Adolescent	$2x10^{-3}$	127	$5x10^{-4}$	33
Adult	$3x10^{-3}$	123	$9x10^{-4}$	32
Adult/Child	$4x10^{-3}$	---	$1x10^{-3}$	---

Baseline Ecological Risk Assessment

The Baseline Ecological Risk Assessment (BERA) evaluated the potential for adverse effects to ecological receptors from exposure to contaminants within the LPRSA. The BERA was conducted in accordance with EPA's 1997 *Ecological Risk Assessment Guidance for Superfund* and its updates. The ecological receptors evaluated included:

- Benthic invertebrate community
- Blue crab
- Mollusks
- Fish – benthic omnivores (mummichog, other forage fish, and common carp), invertivores (white perch, channel catfish, brown bullhead, white catfish, and white sucker), and piscivores (American eel, largemouth bass, smallmouth bass, and northern pike)
- Birds – spotted sandpiper, great blue heron, and belted kingfisher
- Mammals – river otter and mink
- Zooplankton
- Amphibians/reptiles
- Aquatic plants

The potential for unacceptable risk was assessed using empirical and modeled data collected from a variety of chemical and biological sampling events and surveys conducted as part of the LPRSA RI. A step-by-step process included an initial screening level ecological risk assessment, which identified media-specific chemicals of potential ecological concern (COPECs). Site-specific exposure data and a range of effect-level thresholds

What Is Ecological Risk and How Is It Calculated?

A Superfund baseline ecological risk assessment is an analysis of the potential adverse health effects to biota caused by hazardous substance releases from a site in the absence of any actions to control or mitigate these under current and future land and resource uses. The process used for assessing site-related ecological risks includes:

Problem Formulation: In this step, the contaminants of potential concern (COPCs) at the site are identified. Assessment endpoints are defined to determine what ecological entities are important to protect. Then, the specific attributes of the entities that are potentially at risk and important to protect are determined. This provides a basis for measurement in the risk assessment. Once assessment endpoints are chosen, a conceptual model is developed to provide a visual representation of hypothesized relationships between ecological entities (receptors) and the stressors to which they may be exposed.

Exposure Assessment: In this step, a quantitative evaluation is made of what plants and animals are exposed to and to what degree they are exposed. This estimation of exposure point concentrations includes various parameters to determine the levels of exposure to a chemical contaminant by a selected plant or animal (receptor), such as area use (how much of the site an animal typically uses during normal activities); food ingestion rate (how much food is consumed by an animal over a period of time); bioaccumulation rates (the process by which chemicals are taken up by a plant or animal either directly from exposure to contaminated soil, sediments or water, or by eating contaminated food); bioavailability (how easily a plant or animal can take up a contaminant from the environment); and life stage (e.g., juvenile, adult).

Ecological Effects Assessment: In this step, literature reviews, field studies or toxicity tests are conducted to describe the relationship between chemical contaminant concentrations and their effects on ecological receptors, on a media-, receptor- and chemical-specific basis. In order to provide upper and lower bound estimates of risk, toxicological benchmarks are identified to describe the level of contamination below which adverse effects are unlikely to occur and the level of contamination at which adverse effects are more likely to occur.

Risk Characterization: In this step, the results of the previous steps are used to estimate the risk posed to ecological receptors. Individual risk estimates for a given receptor for each chemical are calculated as a hazard quotient (HQ), which is the ratio of contaminant concentration to a given toxicological benchmark. In general, an HQ above 1 indicates the potential for unacceptable risk. The risk is described, including the overall degree of confidence in the risk estimates, summarizing uncertainties, citing evidence supporting the risk estimates and interpreting the adversity of ecological effects.

were used to derive risk estimates (expressed as hazard quotients) to identify the potential for unacceptable ecological risk under baseline conditions using multiple lines of evidence. COPECs with hazard quotients greater than or equal to 1.0 based on effect-level toxicity reference values were identified as preliminary ecological COCs. Ecological risk drivers were identified based on a comparison to background concentrations as described in the BERA and the uncertainty of the assessment used in the BERA. In addition to ecological risk drivers, a weight-of-evidence approach was evaluated to draw conclusions about the benthic invertebrate community using a sediment quality triad approach. The triad approach integrates sediment chemistry, toxicity, and benthic community assessment information.

Unacceptable risk to ecological species based on exceedances of a range of effect-level thresholds for various ecological receptor groups and lines of evidence was primarily driven by exposure to polychlorinated dibenzo-*p*-dioxins and polychlorinated dibenzofurans, total dioxin and dioxin-like compound TEQ, total PCBs, PCB TEQ, and total DDx; these were the ecological risk drivers identified in the BERA. An evaluation limited to just the upper 9 miles of the LPRSA resulted in the same list of ecological risk drivers as in the BERA for the entire LPRSA.

It is EPA's current judgment that the Preferred Alternative identified in this Proposed Plan, or one of the other active measures considered in the Proposed Plan, is necessary to protect public health or welfare or the environment from actual or threatened releases of pollutants or contaminants from this site which may present an imminent and substantial endangerment to public health or welfare.

REMEDIAL ACTION OBJECTIVES

RAOs provide a general description of what a remedial action is intended to accomplish. RAOs for the sediment source control IR in the upper 9 miles of the LPRSA are as follows:

RAO 1—Addressing Surface Sediment Source Areas

Control surface sediment sources containing elevated concentrations of 2,3,7,8-TCDD and PCBs, by remediating these sources and thereby reducing the SWACs of 2,3,7,8-TCDD and total PCBs from RM 8.3 to RM 15. Achieve a post-IR 2,3,7,8-TCDD SWAC from RM 8.3 to RM 15 of not more than 85 ppt and achieve a post-IR total PCB SWAC from RM 8.3 to RM 15 that is at or below the established total PCB background concentration of 0.46 ppm.

RAO 2—Addressing Subsurface Sediment Source Areas

Control subsurface sediment from becoming a source of 2,3,7,8-TCDD and PCBs. Sediment between RM 8.3 and RM 15 with a demonstrated potential for erosion will be remediated to prevent the exposure of subsurface concentrations above the subsurface RALs.

The RAO 1 footprint will be remediated first followed by the RAO 2 footprint. Existing data suggest the source areas to be targeted by the proposed IR are located between RM 8.3 and RM 15. However, the PDI will generate data throughout the upper 9 miles of the LPRSA. If sediment data that support IR design and are collected between RM 15 and Dundee Dam identify surface concentrations in excess of a final surface RAL (as specified in the IR design for RM 8.3 to RM 15), these areas would be addressed as part of the IR.

EPA defines the source areas for the proposed IR as sediments having elevated concentrations. These sediments have a low potential for recovery, and act as a reservoir for potential migration of contamination to surface water and biota, thereby inhibiting overall abiotic and biotic recovery in the system. Sediments with low recovery potential are those with 2,3,7,8-TCDD and/or total PCB concentrations greater than current water column particulate concentrations, which for 2,3,7,8-TCDD is a range of 200 to 400 ppt. Water column particulates influence system recovery through transport and deposition. Addressing source sediments would greatly reduce the 2,3,7,8-TCDD and total PCB SWACs (and reduce SWACs for other collocated contaminants that are addressed by the remediation footprint), which would in turn reduce concentrations on suspended water column particulates, reduce concentrations in surface sediments where water column particulates are deposited, reduce sources to biota, and accelerate system recovery.

The not-to-exceed SWAC for 2,3,7,8-TCDD of 85 ppt represents an over 90 percent reduction compared to the current SWAC from RM 8.3 to RM 15, and is approximately an order of magnitude higher than the OU2 sediment remediation goal for 2,3,7,8-TCDD of 8.3 ppt. EPA, in consultation with NJDEP, determined that the 85 ppt not to exceed SWAC is an appropriate objective for a sediment source control IR for the upper 9 miles of the LPRSA that would be followed by longer-term monitoring and selection and implementation of a final remedy in an adaptive approach. Final cleanup levels will be determined in the final ROD for the LPRSA.

SUMMARY OF REMEDIAL ALTERNATIVES

CERCLA Requirements

Section 121(b)(1) of CERCLA, 42 U.S.C. § 9621(b)(1), mandates that remedial actions must be protective of human health and the environment, be cost-effective, and use permanent solutions and alternative treatment technologies and resource recovery alternatives to the maximum extent practicable. CERCLA Section 121(d), 42 U.S.C. § 9621(d), further specifies that a remedial action must require a level or standard of control of the hazardous substances, pollutants, and contaminants that at least attains applicable or relevant and appropriate requirements (ARARs) under federal and state laws, unless a waiver can be justified pursuant to CERCLA Section 121(d)(4), 42 U.S.C. § 9621(d)(4).

This Proposed Plan presents EPA's preferred sediment source control IR alternative for the upper 9 miles of the LPRSA and evaluates whether it satisfies the various mandates of CERCLA. Interim actions must be protective of human health and the environment, cost-effective, and consistent with the final remedy. The IR alternatives evaluated in the IR FS Report utilize the same technologies (i.e., dredging and capping) to achieve different SWAC targets. The IR alternatives, except for the statutorily-required No Action alternative and/or Alternative 5 (SWAC target of 125 ppt for 2,3,7,8-TCDD), are all protective of human health and the environment, comply with ARARs, are cost-effective, and would not be incompatible with nor preclude a final remedy, thus satisfying the requirements of CERCLA. As discussed below, most alternatives include the use of treatment technologies as part of dredged materials management and incorporate sediment capping materials designed to prevent the migration of contained contamination.

The alternatives evaluated for the IR (except for the No Action alternative) focus on sediment source control, consistent with the intent and purpose of the IR. Four active alternatives were developed for the IR based on reduction in 2,3,7,8-TCDD and total PCB SWACs. Brief descriptions of the alternatives evaluated for the IR are given below.

Common Elements of the Active Alternatives

All of the active alternatives (i.e., alternatives other than No Action) contain common elements, as described below.

Dredging and Sediment Management: For each alternative, sediments would be removed to the depths necessary to accommodate sediment capping. Dredge depths are anticipated to be 2 to 3 feet, including allowable overdredging. For the purpose of the IR FS cost estimate, EPA assumed a removal depth of 2.5 feet (2-foot target dredge depth plus 0.5-foot overdredge allowance to account for typical dredge precision) for all alternatives using mechanical dredging methods, and that dredged sediments would be transported via barge to a nearby commercial facility for processing. Following dewatering of the sediments on the barge and stabilization at the processing facility, sediments would be transported via railcar and/or truck for offsite disposal at licensed disposal facilities determined based on the chemical constituents of the sediments and the acceptance criteria of the facilities. For the cost estimate, EPA assumed disposal at a Subtitle C landfill facility. Precautions would be taken during transport to prevent the release of contamination; specific actions would be identified during design and implementation to reduce and minimize releases during transportation.

It is assumed that dredging would be feasible within the entirety of the IR footprint, and all possible effort would be taken to perform active dredging throughout the IR footprint. If, during IR design, portions of the IR footprint are identified to have significant constraints (e.g., utility crossings, bridge abutments, or critical shoreline structures) limiting or precluding dredging and capping, thin-layer capping and/or the in-situ placement of reactive amendments would be considered as alternate technologies for those areas.

Dredging without capping is an approach that includes removal of sediments to a surface that does not require capping to isolate remaining sediments. During the IR design, EPA expects to assess data using the following principles to determine if dredging without capping would be appropriate:

- Would be considered within the dredge footprint developed to meet the sediment source control IR RAOs.
- Would be considered where native material is visually observed in the sediment cores collected in the PDI.
- Would be considered where the costs associated with deeper dredging to reach native sediments and backfill placement (backfill would be accomplished by placing sand only and would not require long-term performance monitoring) are not higher than the cost of dredging to the

nominal dredge depth, capping, and long-term cap monitoring. [3]

- Would be evaluated where the depth to native material over an area of 0.25 or more contiguous acres yields the cost condition described in the bullet above, as determined using the depth to native material of at least two adjacent PDI cores.
- Would be implemented in a manner compatible with engineering, constructability, sediment stability, and safety constraints that may affect short-term effectiveness and implementability (e.g., dredging without capping may not be possible in areas where sensitive infrastructure could be undermined by deeper dredging).

A cost comparison model would be developed prior to the PDI, so that the principles above could be applied and appropriate data collected to inform a detailed evaluation during the IR design of the potential application of dredging without capping. As part of the IR design, the cost comparison model would be updated using refined cost data (e.g., from remediation contractors and disposal facilities) and based on location-specific conditions that may vary for portions of the IR footprint area (e.g., dredging and capping costs associated with deeper and/or steeper portions of the river). The updated cost comparison model would be used to determine the cost comparison for discrete areas of remediation. Dredging without capping would be implemented for those discrete areas where dredging without capping would cost no more than dredging with capping.

Capping: Common sediment cap types include engineered granular caps, composite caps, and reactive caps. Typical cap configurations may include sand, armoring, geotextile, and reactive layers. The primary functions of a sediment cap are:

- Physical isolation of contaminated sediments from human and ecological receptors.
- Stabilization of contaminated sediments and prevention of resuspension and transport to other areas.
- Reduction of the flux of dissolved contaminants into the water column.

For each alternative, sediment capping would be implemented following dredging. All capped areas would be pre-dredged to result in no net loss of water depth and/or increase in flooding potential once the cap is installed. It is assumed that cap material would be transported via barge and placed mechanically. Upstream of RM 13.9, land-based cap material placement is assumed to accommodate fixed, low-clearance bridge constraints that preclude barge and tug operations upstream of RM 13.9.

Consistent with the RM 10.9 Removal design (2013 *River Mile 10.9 Removal Action Final Design Report*), a 1-foot isolation layer was evaluated over a 100-year time frame in the IR FS to determine the cap composition that would be effective at limiting migration of underlying sediment contaminants. An evaluation of potential armor size and thickness was performed with flows associated with a 100-year return period, consistent with EPA guidance[4]. For the purposes of the FS-level cap stability analysis, armor was assumed to be placed throughout the cap footprint, to a thickness of 1 foot. Armor thickness would be refined in the IR design. In shoal areas, habitat reconstruction material similar to existing substrate would be placed as the top 1 foot of the cap. Further consideration and refinement of the ecological and recreational function of the cap would be considered during the IR design, at which time its specific composition would be determined. Cap

[3] Dredging without capping can provide a high degree of long-term effectiveness and permanence, as compared to dredging and capping, in areas where it is technically feasible. Other factors may be considered during IR design in evaluating the feasibility of implementing dredging without capping.

[4] https://semspub.epa.gov/work/HQ/174471.pdf

type and thickness may vary depending on location and armoring requirements. Bathymetric data, geomorphic evaluations, and hydrodynamic and sediment transport model results would be used to determine erosional areas that would require armored cap placement. Additional design considerations, such as the addition of reactive amendments to the cap and ensuring that an engineered cap would not exacerbate erosion adjacent to the cap, would be established during IR design. Data and lessons learned from cap construction, cap construction monitoring, and physical and chemical cap performance monitoring at the RM 10.9 Removal area would be relied on to inform the cap design during the IR design phase. Placement of caps on slopes greater than 3:1 would require additional geotechnical analyses and design considerations. For the IR FS, it was assumed that cap thicknesses would vary from approximately 2 feet (in low-energy areas) to approximately 2.5 feet (in areas subject to greater erosion potential). A 2.5-foot cap was assumed throughout the IR footprint for the purpose of the IR FS cost estimate.

In addition, it is assumed that a residuals management cover (RMC) would be placed outside of the dredge and cap footprint for each alternative, as a mechanism to mitigate potential impacts of dredge residuals that might redeposit on the sediment bed outside the remediation area. RMC would potentially also be placed immediately following dredging if capping were to be delayed. The IR FS assumes that RMC would be placed to an extent equivalent to 20% of the remediated area.

Institutional Controls: ICs refer to non-engineering measures intended to ensure the protectiveness of a remedy and to affect human activities to prevent or reduce the potential for exposure to contaminated media. Potentially applicable ICs for each of the IR alternatives for the upper 9 miles of the LPRSA can be grouped into the following technologies:

Governmental controls – A commercial fishing ban may be implemented by NJDEP to restrict harvesting and consumption of fish and seafood. Other governmental controls may be implemented to protect the integrity of the IR or a specific IR element by prohibiting activities that could disturb or otherwise compromise its performance. Under the Code of Federal Regulations (22 CFR Part 165) a regulated navigation area (RNA) may be established to regulate vessel navigation by the appropriate government agency within a defined boundary. Examples of RNA restrictions include limitations on anchoring, spudding, or grounding vessels in capped areas.

Proprietary controls – A proprietary control is a private contractual mechanism contained in the deed or other document transferring a property. On privately owned lands, restrictive covenants can be effective in maintaining the long-term integrity of capping or other containment actions and can be used to help control exposure scenarios (e.g., residential versus recreational uses of land). Proprietary controls may be required for siting of upland facilities that are part of the proposed IR and/or IR components such as capped areas within private or publicly owned, leased, or used in-waterway lands (i.e., tidelands or riparian grant lands). Such proprietary controls are referred to as "land use restrictions."

Deed notices – A deed notice could be filed and recorded that would describe restrictions on property to protect capped areas and could remain in effect until the federal or state government states in writing that a change in site condition(s) warrants its removal.

Public advisories – Fish and crab consumption advisories are an IC subject to informed voluntary compliance by the public. There is currently a NJDEP fish and crab consumption advisory for the LPR (Dundee Dam to Newark Bay).[5] This advisory recommends restrictions on consumption of fish

[5] https://www.nj.gov/dep/dsr/Fish_Advisories_2019.pdf

and shellfish and bans on collection of blue crabs from the entire LPR. It is assumed that the advisory would remain in effect during and, as necessary, following the proposed IR. Possible modifications to this advisory would be reviewed and evaluated with NJDEP throughout the IR, based on long-term monitoring data.

Signs to warn vessel operators of critical remedy area boundaries (e.g., sediment caps) could be installed to provide added protection and notify vessel operators of applicable RNA restrictions. Signage could also be used to warn vessel operators and other potential users of risks and provide information about pertinent advisories.

Monitoring: For each alternative, monitoring associated with the IR and overall cleanup of the upper 9 miles of the LPRSA would consist of data collection with respect to current conditions/PDI, IR construction, post-IR confirmation, operations and maintenance (O&M), and long-term monitoring. Anticipated monitoring activities are summarized below:

- The current conditions sampling program, which is being performed pursuant to the 2007 RI/FS AOC, includes the following data that would also be relevant to the IR:
  - Continuous monitoring of surface water quality using deployed sensors
  - Periodic sampling of surface water for physical and chemical parameters across varying river flow conditions
  - Comprehensive sampling of fish and crab tissue
  - Bathymetric surveying
- EPA anticipates a PDI sampling program would include:
  - Sediment sampling on a spatially dense grid (approximately 2,000 locations) from RM 8.3 to Dundee Dam to evaluate surface and subsurface conditions (the density of the sampling grid may be less in areas of coarse sediments)
  - A second round of sediment sampling to refine the delineation of the IR footprint and reduce variability in the PDI dataset, which would be based on results from the first round of sampling
  - Bathymetric surveying
  - Debris identification surveying
  - Supporting surveys (e.g., geotechnical, habitat, cultural, fish spawning)
- Construction monitoring would be anticipated to include confirmatory bathymetric surveys, water quality monitoring, and some limited scope of sediment sampling. Construction monitoring would also be anticipated to include sediment coring to physically verify the thickness and composition of cap layers as prescribed by the IR design. Performance metrics would be established during the IR design to ensure achievement of dredging and capping extents and other construction requirements. Water quality and sediment sampling would be used to understand and mitigate potential issues associated with dredging releases.
- Post-IR confirmation sampling would include sufficient sediment samples to provide a statistically unbiased estimate of the post-IR SWACs and would include not less than 400 (and not more than 800) sediment sample locations at which 3-point composite samples would be collected. The calculated post-IR SWACs would be statistically assessed to verify that the RAO 1 SWAC goals had been attained. In the event that the RAO 1 SWAC goals were not attained based on the statistical assessment, the construction monitoring conducted during the IR would be evaluated with respect to compliance with the construction requirements specified by the IR design (i.e., water quality monitoring, bathymetric surveys, discharge monitoring, inspection surveys, sediment monitoring) and the overall distribution of concentrations in the post-IR dataset would be evaluated to determine if any sediment sources remain. A multiple lines of evidence framework would be applied in this case to determine if the IR had met its intent and could be concluded to be

complete or if additional source removal is necessary. The statistical testing methodology and multiple lines of evidence framework for evaluating IR completion are described in Appendix H of the IR FS Report.

- O&M monitoring of cap areas would be conducted following construction to ensure long-term effectiveness. Bathymetry surveys and chemical sampling would be performed to assess the stability and chemical isolation performance of the cap and any potential need for maintenance to ensure continued performance (e.g., replacement of eroded cap material and/or armor stone). For cost estimating purposes, EPA assumes cap O&M monitoring would continue for 30 years after the end of IR construction, and also that some amount of cap material would need to be replaced during this 30-year period.
- Long-term monitoring would be performed following IR completion. For cost estimating purposes, EPA assumes long-term monitoring would continue for 30 years after IR construction, which would include both system response and recovery assessment monitoring following the IR and the portion of additional long-term monitoring that would occur within the 30-year timeframe after a final remedy is selected. (While not addressed in this Proposed Plan, long-term monitoring following selection of a final remedy and issuance of the final ROD will likely be needed in perpetuity.)

The CPG is performing current conditions sampling of biota and surface water under the 2007 RI/FS AOC. Those data and the PDI data would establish pre-IR baseline conditions for comparison to post-IR data and provide data to support the IR design. Details of various monitoring components would be established in the IR design, and data and lessons learned from cap construction, cap construction monitoring, and/or physical and chemical cap performance monitoring at the RM 10.9 Removal area would be relied on to inform those details. As necessary (i.e., as part of the current conditions sampling under the 2007 RI/FS AOC and as part of PDI and long-term monitoring), monitoring would include comprehensive laboratory analysis of samples so that appropriate decisions can be made related to all risks and a protective final remedy.

Since contamination would remain after the IR above levels that allow for unlimited use and unrestricted exposure, five-year reviews would be conducted to monitor the contaminants and evaluate the need for future actions.

Remedial Alternatives

The following summaries of the IR alternatives are based on the assumptions and analyses in the IR FS Report, which rely on the available data for the upper 9 miles of the LPRSA collected during the RI and documented in the RI Report. The 85 ppt target 2,3,7,8-TCDD SWAC alternative directly addresses the IR RAOs. The 75 ppt and 65 ppt target 2,3,7,8-TCDD SWAC alternatives also address the RAOs, but with the lower SWAC targets for 2,3,7,8-TCDD allowing EPA to assess whether a lower SWAC target would accomplish meaningfully greater sediment source control or provide meaningfully greater acceleration of system recovery. The attainable post-IR SWAC for total PCBs is controlled by the established total PCB background concentration of 0.46 ppm, and the available data suggest that a total PCB RAL of 1 ppm will result in a SWAC at or below this concentration. Therefore, the 85 ppt, 75 ppt, and 65 ppt target 2,3,7,8-TCDD SWAC alternatives all incorporate a surface RAL of 1 ppm. The 125 ppt target 2,3,7,8-TCDD SWAC alternative (Alternative 5) was also evaluated to allow comparison to a smaller IR footprint and better frame the comparison between the other active alternatives. To ensure a smaller footprint, the 1 ppm total PCB surface RAL was not applied for the 125 ppt target 2,3,7,8-TCDD SWAC alternative (i.e., applying the 1 ppm total PCB surface RAL would drive the remediation footprint to a size more consistent with the other active alternatives). In deriving alternative-specific footprints in the IR FS, RAO 1 was applied first to address sediments until the target 2,3,7,8-TCDD SWAC was attained. RAO 2 was then applied sequentially after attaining the target 2,3,7,8-TCDD SWAC, addressing additional area characterized as erosional and further lowering the resulting SWAC. Table 4 provides a summary of the SWACs, RALs, and technical specifications for all active alternatives evaluated.

ARARs can be location-specific, action-specific, or chemical-specific. There are no chemical-specific ARARs for sediments, and because the IR is not intended to address surface water (a final remedy for surface water throughout the LPRSA will be established in the final ROD for the entire OU4), chemical-specific ARARs for surface water do not apply for the IR. Since there is no active remediation associated with Alternative 1 (No Action), action-specific and location-specific ARARs do not apply to this alternative. The same location-specific and action-specific ARARs would apply to Alternatives 2, 3, 4, and 5. Key potential location-specific ARARs for Alternatives 2, 3, 4, and 5 include the Endangered Species Act, the Migratory Bird Treaty Act, the Coastal Zone Management Act, the Rivers and Harbors Act, and the Wetland Act of 1970/Freshwater Wetlands Protection Act, and key potential action-specific ARARs include the requirements of the Clean Water Act that would apply to dredging and capping, the RCRA requirements that would apply to management of dredged materials, the New Jersey Pollution Control Act, the Clean Air Act, and the Hazardous Materials Transportation Act.

Alternative 1: No Action

Present Value (PV) Capital Cost: $0
PV Annual O&M Cost: $0
Total PV Cost: $0
Construction Time: 0 years
Time to Achieve RAOs: N/A

CERCLA requires that the No Action alternative be considered as a baseline for comparison with the other alternatives. The No Action alternative would not include any remedial measures or monitoring.

Alternative 2: 2,3,7,8-TCDD SWAC of 85 ppt, Total PCB RAL of 1 ppm

PV Capital Cost: $392 Million
PV Annual O&M Cost[6]: $0.93 Million
Total PV Cost: $420 Million
Construction Time: 4.3 years
Time to Achieve RAOs: 7.3 years

Alternative 2 includes dredging and capping between RM 8.3 and 15 in the remedial footprint delineated during the IR FS (which would be refined during IR design based on the PDI). Alternative 2 targets source sediments with high concentrations of 2,3,7,8-TCDD and total PCBs,

Table 4 Comparison of General Characteristics of IR Alternatives

Alternative	Target Dioxin SWAC (ppt)	Dioxin RAL (ppt)	Post-IR Dioxin SWAC (ppt) and % SWAC Reduction	Area (acres)	Volume (cy)	Construction Duration (years)	Cost ($M)
1	-----	-----	932 (0%)	-----	0	-----	0
2	85	260	80 (91%)	90	363,000	4.3	420
3	75	205	70 (92%)	96	387,000	4.6	441
4	65	164	60 (94%)	104	419,000	4.9	468
5	125	346	121 (87%)	62	250,000	3.2	321

[6] PV total annual and periodic O&M costs averaged over the 30-year post-construction monitoring period to estimate the PV annual O&M cost.

achieving a post-IR target 2,3,7,8-TCDD SWAC of 85 ppt and implementing a total PCB RAL of 1 ppm for surface sediments (0 to 0.5 ft) to address RAO 1. The delineation of the remedial footprint to attain a 2,3,7,8-TCDD SWAC of 85 ppt results in a surface RAL for 2,3,7,8-TCDD of 260 ppt.[7] Alternative 2 also includes additional dredging and capping in areas with erosional potential and high subsurface sediment concentrations (0.5 to 1.5 ft) to address RAO 2. Areas with high subsurface concentrations were delineated in the IR FS by applying subsurface RALs that are twice the surface RALs (520 ppt for 2,3,7,8-TCDD and 2 ppm for total PCBs).[5] The inclusion of additional areas to address RAO 2 results in a 2,3,7,8-TCDD SWAC of 80 ppt and a total PCB SWAC of 0.29 ppm. Figure 4, located at the end of this Proposed Plan, shows the area targeted under Alternative 2 (areas in red).

Alternative 2 includes all of the common engineering assumptions and considerations described above. Dredged materials would be processed at one or more nearby commercial processing facilities, for off-site disposal at licensed disposal facilities. Following completion of the IR, system response and recovery assessment monitoring and adaptive management would be implemented to assess progress towards PRGs[8] developed in parallel with the IR design and ultimately, RGs that will be established and documented in a final ROD.

Based on the estimated technical specifications for the IR alternatives shown in Table 4, Alternative 2 would target approximately 363,000 cy of contaminated sediments across a total area of approximately 90 acres. For the IR FS, it is assumed that an approximate equivalent quantity of clean fill materials would be imported for cap, armoring, backfill, and RMC placement.

The estimated construction time frame is approximately 4.3 years, considering the anticipated seasonal fish window (i.e., the annual period of time that dredging is permitted due to fish spawning/migration), typical winter shutdown periods, and assumed production rates.

Alternative 3: 2,3,7,8-TCDD SWAC of 75 ppt, Total PCB RAL of 1 ppm

PV Capital Cost:	**$413 Million**
PV Annual O&M Cost:	**$0.94 Million**
Total PV Cost:	**$441 Million**
Construction Time:	**4.6 years**
Time to Achieve RAOs:	**7.6 years**

Alternative 3 includes dredging and capping between RM 8.3 and 15 in the remedial footprint delineated during the IR FS (which would be refined during IR design based on the PDI). Alternative 3 targets source sediments with high concentrations of 2,3,7,8-TCDD and total PCBs, achieving a post-IR target 2,3,7,8-TCDD SWAC of 75 ppt and implementing a total PCB RAL of 1 ppm for surface sediments (0 to 0.5 ft) to address RAO 1. The delineation of the remedial footprint to attain a 2,3,7,8-TCDD SWAC of 75 ppt results in a surface RAL for 2,3,7,8-TCDD of 205 ppt. Alternative 3 also includes additional dredging and capping in areas with erosional potential and high

[7] The final RALs for surface and subsurface sediments would be defined in the IR design. The application of a multiplier of 2 to the surface RALs to derive subsurface RALs is supported by an analysis of erosion potential and represents a site management decision agreed to by EPA and NJDEP for the purpose of the proposed IR. This site management decision represents an uncertainty that could affect the rate and degree of natural recovery post-IR if subsurface sediments are exposed. The effect of this site management decision will be discerned through chemical and physical monitoring of the sediment bed post-IR. That information will be used in developing the final, protective remedy as part of the Site's adaptive management framework consistent with CERCLA and the NCP's nine criteria. During the IR design, the subsurface RAL multiplier will be evaluated based on more current bathymetry data and will not exceed 2.

[8] PRGs would be developed in parallel with the IR design; PRGs would not be used to evaluate the performance of the IR itself, but would be used to evaluate longer-term system recovery following the IR.

subsurface sediment concentrations (0.5 to 1.5 ft) to address RAO 2. Areas with high subsurface concentrations were delineated in the IR FS by applying subsurface RALs that are twice the surface RALs (410 ppt for 2,3,7,8-TCDD and 2 ppm for total PCBs). The inclusion of additional areas to address RAO 2 results in a 2,3,7,8-TCDD SWAC of 70 ppt and a total PCB SWAC of 0.27 ppm. Figure 4, located at the end of this Proposed Plan, shows the additional area targeted under Alternative 3 (areas in green) compared with Alternative 2 (areas in red), which includes an additional 6 acres of footprint from RM 8.3 to RM 15, located mostly below RM 12.

Alternative 3 includes all of the common engineering assumptions and considerations described above. Dredged materials would be processed at one or more nearby commercial processing facilities, for off-site disposal at licensed disposal facilities. Following completion of the IR, system response and recovery assessment monitoring and adaptive management would be implemented to assess progress towards PRGs developed in parallel with the IR design and ultimately, RGs that will be established and documented in a final ROD.

Based on the estimated technical specifications for the IR alternatives shown in Table 4, Alternative 3 would target approximately 387,000 cy of contaminated sediments across a total area of approximately 96 acres. For the IR FS, it is assumed that an approximate equivalent quantity of clean fill materials would be imported for cap, armoring, backfill, and RMC placement.

The estimated construction time frame is approximately 4.6 years, considering the anticipated seasonal fish window, typical winter shutdown periods, and assumed production rates.

Alternative 4: 2,3,7,8-TCDD SWAC of 65 ppt, Total PCB RAL of 1 ppm

PV Capital Cost:	**$440 Million**
PV Annual O&M Cost:	**$0.95 Million**
Total PV Cost:	**$468 Million**
Construction Time:	**4.9 years**
Time to Achieve RAOs:	**7.9 years**

Alternative 4 includes dredging and capping between RM 8.3 and 15 in the remedial footprint delineated during the IR FS (which would be refined during IR design based on the PDI). Alternative 4 targets source sediments with high concentrations of 2,3,7,8-TCDD and total PCBs, achieving a post-IR target 2,3,7,8-TCDD SWAC of 65 ppt and implementing a total PCB RAL of 1 ppm for surface sediments (0 to 0.5 ft) to address RAO 1. The delineation of the remedial footprint to attain a post-IR 2,3,7,8-TCDD SWAC of 65 ppt results in a surface RAL for 2,3,7,8-TCDD of 164 ppt. Alternative 4 also includes additional dredging and capping in areas with erosional potential and high subsurface sediment concentrations (0.5 to 1.5 ft) to address RAO 2. Areas with high subsurface concentrations were delineated in the IR FS by applying subsurface RALs that are twice the surface RALs (328 ppt for 2,3,7,8-TCDD and 2 ppm for total PCBs). The inclusion of additional areas to address RAO 2 results in a 2,3,7,8-TCDD SWAC of 60 ppt and a total PCB SWAC of 0.24 ppm. Figure 4, , located at the end of this Proposed Plan, shows the additional area targeted under Alternative 4 (areas in blue) compared with Alternative 3 (areas in green) and Alternative 2 (areas in red), which includes an additional 8 acres of footprint from RM 8.3 to RM 15, located mostly below RM 13.

Alternative 4 includes all of the common engineering assumptions and considerations described above. Dredged materials would be processed at one or more nearby commercial processing facilities, for off-site disposal at licensed disposal facilities. Following completion of the IR, system response and recovery assessment monitoring and adaptive management would be implemented to assess progress towards PRGs developed in parallel with the IR design and ultimately, RGs that will be established and documented in a final ROD.

Based on the estimated technical specifications for the IR alternatives shown in Table 4, Alternative 4 would target approximately 419,000 cy of contaminated sediments across a total area of approximately 104 acres. For the IR FS, it is assumed that an approximate equivalent quantity of clean fill materials would be imported for cap, armoring, backfill, and RMC placement.

The estimated construction time frame is approximately 4.9 years, considering the anticipated seasonal fish window, typical winter shutdown periods, and assumed production rates.

Alternative 5: 2,3,7,8-TCDD SWAC of 125 ppt

PV Capital Cost:	**$294 Million**
PV Annual O&M Cost:	**$0.89 Million**
Total PV Cost:	**$321 Million**
Construction Time:	**3.2 years**
Time to Achieve RAOs:	**N/A**

Alternative 5 includes dredging and capping between RM 8.3 and 15 in the remedial footprint delineated during the IR FS. Alternative 5 targets source sediments with high concentrations of 2,3,7,8-TCDD, achieving a post-IR target 2,3,7,8-TCDD SWAC of 125 ppt. For this alternative, PCBs are not specifically targeted to ensure a smaller IR footprint for comparison purposes; therefore, no total PCB RAL was applied in the IR FS. The delineation of the remedial footprint to attain a post-IR 2,3,7,8-TCDD SWAC of 125 ppt results in a surface (0 to 0.5 ft) RAL for 2,3,7,8-TCDD of 346 ppt. Alternative 5 also includes additional dredging and capping in areas with erosional potential and high subsurface sediment concentrations (0.5 to 1.5 ft) to address RAO 2. Areas with high subsurface concentrations were delineated in the IR FS by applying a subsurface RAL that is twice the surface RAL (692 ppt for 2,3,7,8-TCDD). Inclusion of these additional areas in the IR footprint results in a 2,3,7,8-TCDD SWAC of 121 ppt and a total PCB SWAC of 0.49 ppm.

Alternative 5 includes all of the common engineering assumptions and considerations described above. Dredged materials would be processed at one or more nearby commercial processing facilities, for off-site disposal at licensed disposal facilities. Following completion of the IR, system response and recovery assessment monitoring and adaptive management would be implemented to assess progress towards PRGs developed in parallel with the IR design and ultimately, RGs that will be established and documented in a final ROD.

Based on the estimated technical specifications for the remedial alternatives shown in Table 4, Alternative 5 would target approximately 250,000 cy of contaminated sediments across a total area of approximately 62 acres. For the IR FS, it is assumed that an approximate equivalent quantity of clean fill materials would be imported for cap, armoring, backfill, and RMC placement.

The estimated construction time frame is approximately 3.2 years, considering the anticipated seasonal fish window, typical winter shutdown periods, and assumed production rates.

COMPARATIVE ANALYSIS OF ALTERNATIVES

In this section, the IR alternatives are evaluated in detail to determine which would be the most effective in attaining the RAOs for the upper 9-mile sediment source control IR and in achieving the goals of CERCLA. The alternatives are compared to each other based on the nine criteria set forth in the NCP at 40 CFR 300.430(e)(9)(iii) (see box below) to assess the relative performance of the alternatives in accomplishing sediment source control.

Overall Protection of Human Health and the Environment

A primary requirement of CERCLA is that the selected remedial action be protective of human health and the environment. In evaluating an

THE NINE SUPERFUND EVALUATION CRITERIA

1. Overall Protection of Human Health and the Environment evaluates whether an alternative eliminates, reduces, or controls threats to public health and the environment through institutional controls, engineering controls, or treatment.

2. Compliance with Applicable or Relevant and Appropriate Requirements (ARARs) evaluates whether the alternative meets federal and state environmental statutes, regulations, and other requirements that pertain to the site, or whether a waiver is justified.

3. Long-term Effectiveness and Permanence considers the ability of an alternative to maintain protection of human health and the environment over time.

4. Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.

5. Short-term Effectiveness considers the length of time needed to implement an alternative and the risks the alternative poses to workers, the community, and the environment during implementation.

6. Implementability considers the technical and administrative feasibility of implementing the alternative, including factors such as the relative availability of goods and services.

7. Cost includes estimated capital and annual operations and maintenance costs, as well as present value cost. Present value cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.

8. State/Support Agency Acceptance considers whether the State agrees with the EPA's analyses and recommendations, as described in the RI/FS and Proposed Plan.

9. Community Acceptance considers whether the local community agrees with EPA's analyses and preferred alternative. Comments received on the Proposed Plan are an important indicator of community acceptance.

interim remedy, as opposed to a final remedy, EPA may conclude that an alternative is protective if it achieves and maintains adequate protection of human health and the environment in relation to the limited scope and goals of a remedial action.

Alternatives 2, 3, and 4 would provide overall protection of human health and the environment by remediating source sediments with high concentrations to achieve the RAOs and accelerating the recovery of sediment and water column contaminant concentrations. These alternatives would reach post-IR surface sediment SWACs for 2,3,7,8-TCDD of less than 85 ppt and for total PCBs of less than 0.46 ppm and would control subsurface sediments from becoming sources. Alternative 1, the No Action alternative, would not provide overall protection of human health and the environment. Alternative 5, while it has the ability to accelerate recovery and progress towards overall protection of human health and the environment, would not accelerate recovery to the same degree as Alternative 2, 3, or 4 and would not achieve the RAO 1 requirement to reach a post-IR surface sediment SWAC for 2,3,7,8-TCDD of 85 ppt.

Remediation of sediments within the IR footprint for Alternatives 2, 3 and 4 would be anticipated to achieve the following:

- Attainment of RAO 1, post-IR target SWACs of 85 ppt for 2,3,7,8-TCDD and 0.46 ppm for total PCBs (subject to post-construction confirmation of IR completion in accordance with the IR remedy completion framework).
- Remediation of sediments with high concentrations of 2,3,7,8-TCDD and total PCBs, reducing the potential for these contaminated sediments to resuspend and become sources of contamination to the water column, to other areas of the sediment bed, and to biota.
- Reduction of 2,3,7,8-TCDD surface sediment SWAC of greater than 90 percent and reduction of total PCB surface sediment SWAC of greater than 80 percent.
- Accelerated recovery of surface sediment concentrations of 2,3,7,8-TCDD, total PCBs, and other contaminants following IR completion.
- Accelerated recovery of surface water concentrations of 2,3,7,8-TCDD, total PCBs, and other contaminants following IR completion.

- Recovery of fish and crab tissue concentrations of 2,3,7,8-TCDD, total PCBs, and other contaminants resulting from reduced concentrations in sediments and the water column.
- Reduced potential for human health exposure to 2,3,7,8-TCDD, total PCBs, and other contaminants resulting from sediment, water column, and fish and crab tissue concentration reductions.

Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

Any alternative considered by EPA must comply with all federal and state environmental standards, requirements, criteria or limitations, unless they are waived under certain specific conditions.

Since there is no active remediation associated with Alternative 1 (No Action), action-specific and location-specific ARARs do not apply. This alternative would not contribute significantly toward eventual achievement of federal and state surface water ARARs.

There are no chemical-specific ARARs for sediments. Alternatives 2, 3, 4, and 5 would satisfy location-specific ARARs (key potential location-specific ARARs include the Endangered Species Act, the Migratory Bird Treaty Act, the Coastal Zone Management Act, the Rivers and Harbors Act, and the Wetland Act of 1970/Freshwater Wetlands Protection Act) and action-specific ARARs (key potential action-specific ARARs include the requirements of the Clean Water Act that would apply to dredging and capping, the RCRA requirements that would apply to management of dredged materials, the New Jersey Water Pollution Control Act, the Clean Air Act, and the Hazardous Materials Transportation Act). The active alternatives could require one or more ARAR waivers during construction (i.e., chemical-specific ARARs related to surface water quality) to meet the threshold criterion of compliance with ARARs.

Alternatives 2, 3, 4, and 5 would be anticipated to comply with the ARARs through appropriate engineering design and agency review processes. Confirmation of ARARs compliance is typically demonstrated during remedial design and through the remedial action work plan (e.g., environmental protection plan, construction quality control plan, waste management plan, transportation and disposal plan, stormwater pollution and spill prevention plan, and best management practices [BMPs]) as well as monitoring during the construction period.

A final remedy for surface water throughout the LPRSA (in addition to a final remedy for sediments in the upper 9 miles) will be established in the final ROD for the entire OU4. While Alternatives 2, 3, 4, and 5 would be anticipated to improve water quality, ARARs for water quality may not be achieved following completion of any of the active IR alternatives. It is anticipated that the final ROD for OU4 will evaluate achievement of surface water ARARs.

Long-Term Effectiveness and Permanence

This criterion takes into account the residual risk remaining at the conclusion of remedial activities, and the adequacy and reliability of containment systems and ICs.

Alternatives 2, 3, and 4 achieve a high degree of performance for this criterion. All three of these alternatives would provide source control that would reduce concentrations in the water column and promote accelerated recovery in the unremediated areas of the sediment bed. Dredging and capping would reduce the surface SWAC from RM 8.3 to RM 15 by 91 to 94 percent for 2,3,7,8-TCDD and 81 to 84 percent for total PCBs for these three alternatives.

The surface RALs for 2,3,7,8-TCDD under Alternatives 2, 3, and 4 are to varying degrees within or below the range of concentrations (200 to 400 ppt) that define source sediments that inhibit recovery. The 2,3,7,8-TCDD surface RAL of 164 ppt for Alternative 4 is less than the low end of this range, indicating this alternative may include areas in the active footprint that are currently subject to recovery on their own and not consistent with the definition of source sediments for the IR. The 2,3,7,8-TCDD surface RAL of 260 ppt for Alternative 2 is within the range of concentrations defined as source, while the 2,3,7,8-TCDD surface RAL of 205 ppt for Alternative 3 coincides with the low end of the range of concentrations defined as source. Thus, Alternative 3 provides the greatest certainty of meeting the IR source control objective, without including areas that are or may already be experiencing natural recovery.

The areas and volumes of sediment removal increase incrementally from Alternative 2 to Alternative 4 to meet the progressively lower 2,3,7,8-TCDD SWAC targets, without a commensurate degree of incremental 2,3,7,8-TCDD and PCB mass removal. While the overall remedial acreage and volume increases by more than 15 percent from Alternative 2 to Alternative 4, the increase in mass of 2,3,7,8-TCDD and PCBs removed from the top 0.5 ft of the sediment bed is much more modest, increasing by less than 2 and 4 percent, respectively.

The IR footprint and RALs are derived by addressing the highest sediment concentrations first followed by lower concentrations until the target SWAC is reached. Therefore, the highest concentrations on average are targeted by the alternative with the smallest footprint. Progressively lower concentrations are targeted as remedial area is added to achieve the lower SWACs of the alternatives with increasingly larger footprints. The average 2,3,7,8-TCDD concentration targeted in the IR footprint is 2,870 ppt for Alternative 2. It is 220 ppt in the 6 acres added for Alternative 3 (which is within the range of concentrations considered source sediments for the IR) and 170 ppt in the further 8 acres added for Alternative 4 (which is below the range of concentrations considered source sediments for the IR). The change in the distribution of post-IR concentrations relative to pre-IR concentrations is similar for Alternatives 2, 3, and 4 (i.e., the distribution of remaining concentrations is similarly skewed towards lower concentrations for each alternative).

Alternatives 2, 3, and 4 all target LPR sediments classified as fine-grained sediments. However, the additional areas of sediments targeted under Alternatives 3 and 4 (compared with Alternative 2) include sediments that are progressively coarser. Because the contamination in the LPR is more closely associated with fine-grained sediments, the increasing volume of coarser sediments addressed by the alternatives with larger footprints, and particularly Alternative 4, may not represent source material.

Alternatives 2, 3, and 4 are expected to provide similar degrees of recovery potential based on numerical modeling of several recovery metrics, including average water column concentrations, total water column loads, gross and net erosion flux, and the average concentration on depositing fine sediments over the 10 year period following IR construction, and would result in similarly accelerated recovery of the sediments and water column. Reductions of erosion flux of contaminants from the sediment bed for each alternative would result in reduced concentrations on depositing fine sediments and downstream loads of 2,3,7,8-TCDD and PCBs. The projected recovery half-lives for 2,3,7,8-TCDD and PCBs (a representation of recovery trajectory) for Alternatives 2, 3, and 4 are similar, indicating they would yield similarly accelerated recovery.

Reduction in Toxicity, Mobility, or Volume Through Treatment

This criterion addresses the statutory preference for selecting remedial actions that employ treatment technologies that permanently and/or significantly reduce the toxicity, mobility, or volume of hazardous substances as their principal element.

For Alternative 1 (No Action), only natural recovery processes would potentially reduce contaminant concentrations in sediments and surface water. Under Alternative 1, there would be no reduction of toxicity, mobility, or volume through treatment.

The active alternatives would use two treatment components to reduce the toxicity and/or mobility of contaminants: solidification/stabilization during processing after removal; and in-situ sequestration via capping including a carbon amendment. The degree to which reductions would be achieved would be proportional to the contaminant mass removed and the area of the cap footprint. The mass fraction of 2,3,7,8-TCDD removed from the upper 0.5 ft of the sediment bed ranges from 92 to 94 percent of the total surface mass from RM 8.3 to 15, and ranges from 80 to 85 percent of the total mass for the upper 2.5 ft of the sediment bed for the three alternatives (Alternatives 2, 3, and 4) that achieve the threshold criteria. The mass fraction of total PCBs removed from the upper 0.5 ft of the sediment bed ranges from 82 to 85 percent of the total surface mass from RM 8.3 to 15, and ranges from 64 to 68 percent of the total mass for the upper 2.5 ft of the sediment bed for the three alternatives that achieve the threshold criteria. The area over which an erosion and chemical migration resistant cap that would reduce the mobility of contaminants would be placed to isolate remaining sediments would be 90 acres for Alternative 2, 96 acres for Alternative 3 (7 percent larger than Alternative 2), and 104 acres for Alternative 4 (8 percent larger than Alternative 3).

Short-Term Effectiveness

This criterion addresses the effects of each alternative during construction and implementation until RAOs are met. It considers risks to the community as well as on-site workers and the environment, available mitigation measures, and the time frame for achieving the response objectives.

Alternatives 2, 3, and 4 would achieve the RAOs in approximately 7.3, 7.6, and 7.9 years, respectively, following the start of construction, based on estimated respective construction durations of 4.3, 4.6, and 4.9 years and the IR completion assessment process taking approximately 3 years for any alternative. The IR completion assessment process will include implementation of sediment sampling, validation and analysis of results, potential additional sampling to address uncertainty in the data or the need for additional data for statistical interpretation, and the decision-making process following completion of data collection activities. The 3-year timeframe for the IR completion assessment process represents a period of measurement, after which it can be stated the RAOs have been achieved. Despite this 3-year timeframe, Alternatives 2, 3, and 4 would be designed and implemented to attain the RAOs at the completion of construction.

The estimated construction durations vary with the area and volume of the remedial footprints, with construction activities assumed to occur 24 hours per day, 6 days per week during the construction season. Appropriate health and safety plans and contingency plans would be in place during implementation of an IR to protect workers and the community.

Alternative 2, which has the smallest IR footprint (of the alternatives that achieve the threshold criteria) and the shortest estimated construction duration, would have the fewest short-term impacts on and risks to workers, communities, and the ecosystem, in a relative comparison with the alternatives with larger footprints. These impacts are expected to arise in general proportion to the size of the remedial footprint of the remedial alternatives. The extent to which habitat and ecological disturbance may increase in proportion to the IR footprint is uncertain and would depend on final delineation of the IR footprint using the PDI data. Alternative 4, the alternative with the largest IR footprint (approximately 14 acres larger than Alternative 2) and longest estimated construction duration (approximately 0.6 years longer than Alternative 2), would have the greatest short-term impacts.

While Alternatives 2, 3, and 4 are all estimated to be complete within approximately 5 years, the larger the footprint, the greater the potential that work would extend into another construction season if delays are encountered, which would result in another season of worker risks and community impact.

Resuspension of contaminants during construction would be expected to be generally similar for Alternatives 2, 3, and 4, based on model projections of annual average water column concentrations. During active construction, average annual water column concentrations for Alternatives 2, 3, and 4 are projected to be higher than the No Action alternative. For all of the alternatives, annual average water column concentrations at the completion of active construction would be expected to be generally lower than pre-construction concentrations.

At RM 15, there is little projected impact of IR implementation, as the average annual and cumulative net upstream water column load would be expected to be nearly the same for Alternatives 2, 3, and 4 as compared to No Action. At RM 8.3, the implementation of an IR is projected to increase the downstream loads of 2,3,7,8-TCDD and total PCBs in the water column during construction, compared to the No Action alternative, with similar increases for Alternatives 2, 3, and 4. At the conclusion of active construction, the water column loads for Alternatives 2, 3, and 4 at RM 8.3 would be expected to be at or near the projected load under No Action. The implementation of an IR is projected to have a small impact on the water column loads at RM 0, evidenced in the projections of total load, which are generally similar for all alternatives over the construction period.

Implementability

This criterion considers the technical and administrative feasibility of implementing each alternative, including availability of services and materials needed during construction.

There are no implementability issues for Alternative 1 (No Action), which does not involve any active remediation.

The technologies and methods to perform the active alternatives are well established. Necessary equipment, materials, facilities, and transportation capacity would be available for the active alternatives with sufficient lead times. The active alternatives would require BMPs during implementation to manage dredge residuals and potential recontamination. Construction of the IR would face implementability challenges in the upper 9 miles of the LPRSA due to the urban environment. Specific challenges that could impact dredging and would need to be considered during IR design and implementation include utility crossings, existing shoreline structures, in-water bridge structures, and hard river bottom. For example, designing and implementing the IR where the footprint abuts hardened or engineered shoreline could require significant effort to avoid damaging engineered shoreline structures or to rebuild or replace failing structures, and/or result in lower production rates or unanticipated delays. Alternative 2 would abut an estimated 37,792 linear feet of hardened shoreline, compared with 39,551 and 41,454 linear feet that would be abutted by Alternatives 3 and 4, or 5 and 10 percent additional hardened shoreline, respectively.

The transport of materials up and down the LPR would also present implementability challenges due to low clearance and/or narrow bridges, which could necessitate custom or specialized equipment, as well as transiting tugs and barges through the lower 8.3 miles during active remediation of that reach of the river. Implementation of the IR could require additional removal in and/or around the RM 10.9 Removal area, which could introduce additional implementability challenges associated with protecting the existing armored cap over that previously remediated area. The extent of remediation in and/or around the RM 10.9 area will be determined during the IR design when the IR footprint is finalized.

Among the active alternatives, the larger the remedial footprint, the greater challenges and constraints, because of the need to dredge in more areas and over a longer time frame. Although implementability challenges would be similar in type for all active alternatives, the degree of the challenges can be anticipated to increase in general proportion to the size of the remedial footprint. It is anticipated that any of the alternatives can be designed to address these challenges.

Cost

Cost estimates are summarized in Table 4. A discount rate of 7 percent was used in the PV calculations, consistent with EPA guidance.

Alternatives that achieve the RAOs (Alternatives 2, 3, and 4) are estimated to have a PV cost of $420 million, $441 million, and $468 million, respectively. There are no remedial response costs associated with Alternative 1. Alternative 5 is estimated to cost $321 million. Costs that are assumed to be the same for the active alternatives include the PDI and IR design, long-term monitoring, and periodic sediment sampling (which includes remedy completion confirmation sampling). Other costs vary with area, volume, and construction duration. The cost estimate assumes that long-term monitoring and maintenance will occur over a 30-year period following completion of construction, including both system response and system recovery assessment monitoring following the IR and additional long-term monitoring to be specified when a final remedy is selected under a final ROD.

Alternatives 2, 3, and 4 all achieve the RAOs for the IR, but with an additional cost of $21 million and $48 million for Alternatives 3 and 4, respectively, compared with Alternative 2.

State Acceptance

NJDEP concurs with EPA's preferred alternative.

Community Acceptance

Community acceptance of the preferred alternative will be addressed in the Interim ROD (Responsiveness Summary) following review of the public comments received on the Proposed Plan.

PREFERRED ALTERNATIVE

EPA's preferred alternative is Alternative 3. Alternative 3 would target surface sediments (0 to 0.5 ft) with high concentrations of 2,3,7,8-TCDD and total PCBs between RM 8.3 and 15 through dredging and capping to address RAO 1, achieving a post-IR 2,3,7,8-TCDD SWAC of 75 ppt and implementing a total PCB surface RAL of 1 ppm. Alternative 3 would also include dredging and capping of areas between RM 8.3 and 15 that are vulnerable to erosion and have elevated subsurface concentrations of 2,3,7,8-TCDD and total PCBs to address RAO 2. Dredging would be performed to the depth(s) necessary to construct a sediment cap that would not diminish water depth or exacerbate flooding. The IR FS Report assumed a uniform dredge depth of 2.5 feet followed by the placement of a uniformly 2.5-foot thick cap. Dredged material would be processed and disposed off-site. The specific composition and thickness of the cap would be determined in the IR design, and dredge depth and cap composition/thickness may vary in portions of the remediation footprint. Principles of dredging without capping would be applied in the IR design to determine if any areas would be dredged to reach a native surface without the need for an engineered cap and associated O&M, which could improve the overall permanence of the IR. Appropriate and necessary ICs would be implemented in conjunction with the IR.

Surface sediments with 2,3,7,8-TCDD concentrations above the surface RAL (205 ppt based on the IR FS) and with total PCB concentrations above the surface RAL of 1 ppm would be remediated. For subsurface sediments, sediments in areas characterized as erosional and having concentrations in excess of the subsurface RALs would be remediated. In the IR FS, the subsurface RALs were established at twice the surface RALs, as a site management decision by EPA in consultation with NJDEP, supported by an analysis of erosion probability using available bathymetric data. That analysis, which is presented in the IR FS Report, demonstrates that a subsurface RAL multiplier of 2 is appropriate given the probability of erosion exposing subsurface concentrations in RAO 2 footprint areas. During IR design, the PDI data and newer bathymetry information would be used to establish the comprehensive distribution of 2,3,7,8-TCDD and total PCB concentrations and erosional areas, establish the final IR footprint, derive the 2,3,7,8-TCDD surface RAL, and verify the subsurface RAL multiplier. The final footprint would be established by attaining RAO 1 first and then sequentially including additional area to attain RAO 2. The subsurface RAL multiplier would not exceed 2.

Combining areas addressed by Alternative 3 to attain RAO 2 with areas addressed to attain RAO 1, and based on existing data, EPA estimates that this alternative would achieve a 2,3,7,8-TCDD SWAC of approximately 70 ppt (i.e., lower than the 75 ppt SWAC target due to sequentially addressing RAO 2 after RAO 1) and a total PCB SWAC of 0.27 ppm (compared to background of 0.46 ppm). Based on current estimates of SWACs from existing data, the preferred alternative would reduce the 2,3,7,8-TCDD SWAC in the upper 9 miles of the LPR by approximately 92% and the total PCB SWAC by approximately 82%. Based on existing data and the IR footprint derived in the IR FS, the preferred alternative would result in remediation of approximately 387,000 cy of contaminated sediments over approximately 96 acres. Alternative 3 construction would take an estimated 4.6 years to complete, with an additional 3 years anticipated to perform the IR completion determination process.

During implementation of a selected IR, the above technical specifications would be updated in the IR design using the PDI data. With the development of the final IR footprint in the IR design using the PDI data, EPA anticipates that the actual post-IR 2,3,7,8-TCDD SWAC would be lower than the SWAC target of 75 ppt; however, the degree to which the actual post-IR SWAC would be lower than the SWAC target would be determined in the IR design.

Existing data suggest the source areas to be targeted by the proposed IR are located between RM 8.3 and RM 15. However, if sediment data that support IR design and are collected between RM 15 and Dundee Dam identify surface concentrations in excess of a surface RAL (specified in the IR design for RM 8.3 to RM 15), these areas would be addressed as part of the IR.

The proposed IR would be determined by EPA to be complete via a statistical methodology based around post-IR confirmatory sediment sampling, or otherwise using a weight of evidence framework that incorporates information from the IR design, IR implementation, and post-IR sampling phases. A specific decision process would be utilized in this weight of evidence framework to determine completion (Appendix H of the IR FS Report).

The proposed sediment source control IR would support adaptive management of the overall remedy for the upper 9 miles of the LPRSA. The design and implementation of the IR, followed by post-IR response and recovery assessment monitoring, would reduce final remedy uncertainties and provide a framework for future remedial action decisions and confirmation of final remedy completion that are consistent with CERCLA and the NCP. Additional current conditions data collected in the upper 9 miles of the LPR, not available as of the time of this Proposed

Plan, would inform the adaptive management decisions. EPA expects that data would continue to be collected during the IR design, IR implementation, and the period of post-IR monitoring, and ultimately inform the protective final remedy in a final ROD.

RATIONALE FOR SELECTION OF PREFERRED ALTERNATIVE

The selection of the preferred alternative is accomplished through the evaluation of the criteria as specified in the NCP. Based on the information above, EPA believes the preferred alternative meets the threshold criteria and provides the best balance of tradeoffs relative to the other alternatives with respect to the balancing and modifying criteria. It would satisfy the following statutory requirements of CERCLA 121(b): (1) be protective of human health and the environment; (2) comply with ARARs; (3) be cost-effective; (4) utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and (5) satisfy the statutory preference for treatment as a principal element to the extent practicable or explain why the preference will not be met. With respect to the two modifying criteria (state acceptance and community acceptance), NJDEP concurs with EPA's preferred alternative and community acceptance will be evaluated after the public comment period.

Alternative 3, with a post-IR target 2,3,7,8-TCDD SWAC of 75 ppt, meets the threshold criteria of Overall Protection of Human Health and the Environment and Compliance with ARARs. This alternative effectively achieves sediment source control based on the definition of source sediments for the IR and would yield accelerated recovery of the LPR system. The IR would be followed by a period of system response and system recovery assessment monitoring to evaluate the response of the system to the sediment source removal and track the recovery of sediments, the water column, and biota.

Alternative 3 would attain the IR RAOs, including achieving a post-IR 2,3,7,8-TCDD SWAC of not more than 85 ppt and a post-IR total PCB SWAC equal to or less than background, at a cost of $441 million, which is $21 million more than Alternative 2, and $27 million less than Alternative 4.

Following are the key factors that lead EPA to propose this sediment source control IR alternative over the others:

- The IR is for sediment source control. Source sediments are defined as those with concentrations between 200 and 400 ppt of 2,3,7,8-TCDD. The 2,3,7,8-TCDD surface RAL is 260 ppt for Alternative 2, 205 ppt for Alternative 3, and 164 ppt for Alternative 4. The RAL for Alternative 3 aligns with the lower end of the range of concentrations representing source. The RAL for Alternative 2 is within but not at the lower end of this range, while the RAL for Alternative 4 is below the range and therefore would be expected to capture sediments that are not source sediments and themselves likely to be recovering. Alternative 3 therefore would most effectively address source sediments consistent with the intent and purpose of the IR.
- The average 2,3,7,8-TCDD concentration addressed by the footprint for Alternative 2 is 2,870 ppt, while the average concentration addressed in the additional 6 acres added for Alternative 3 is 220 ppt, and the average concentration addressed in the yet additional 8 acres added for Alternative 4 is 170 ppt. Given the average concentration in the additional footprint area for Alternative 3 is within the range of concentrations defined as source and the average concentration in the additional footprint area for Alternative 4 is below the range, this further demonstrates that Alternative 3 is most suitable to accomplish sediment source control per the intent and purpose of the IR while Alternative 4 would go beyond source control, addressing areas that may be experiencing natural recovery.

- Contaminant concentrations generally correlate with sediment type in the LPR, with higher concentrations tending to be found in finer-grained sediments. Progressively larger IR footprints would capture progressively coarser sediments. Alternative 2 would capture sediments that are on average approximately 60 to 65 percent fine-grained, while the additional sediments captured by Alternative 3 (beyond Alternative 2) are on average approximately 40 percent fine-grained and the yet additional sediments captured by Alternative 4 (beyond Alternative 3) are on average approximately 35 percent fine-grained. Based on the distribution of 2,3,7,8-TCDD concentrations in sediment samples from the upper 9 miles of the LPRSA in comparison to the grain size of the samples, it appears that relatively high concentrations are associated with sediments that are on the order of 40 to 60 percent fine-grained (resulting from higher concentrations in the fine-grained fraction of those sediments) while the likelihood of high contaminant concentrations diminishes significantly when the sediments are only 35 percent fine-grained. This indicates that implementing Alternative 3 would address additional source material beyond that addressed by Alternative 2, even if the additional sediments captured by Alternative 3 are relatively coarser, whereas Alternative 4 would include yet coarser-grained sediments not likely to exhibit high contaminant concentrations indicative of source sediments. This shows that Alternative 3's additional footprint includes more comprehensive control of source material while minimizing inclusion of non-source material.
- The estimated acceleration in recovery for Alternatives 2, 3, and 4 (as expressed by the half-lives of 2,3,7,8-TCDD and total PCBs) is similar. While Alternative 5 would accelerate recovery compared to No Action, Alternatives 2, 3, and 4 would further accelerate recovery with this rate of recovery being very consistent across the alternatives.
- Alternative 3 would be cost-effective in that it provides overall effectiveness (taking into account long-term effectiveness and permanence; reduction in toxicity, mobility, or volume through treatment; and short–term effectiveness) proportional to its cost.

For further information on Diamond Alkali OU4 Superfund Site, please contact:

Diane Salkie
Remedial Project Manager
(212) 637-4370
salkie.diane@epa.gov

Shereen Kandil
Community Relations Coordinator
(212) 637-4333
kandil.shereen@epa.gov

The public liaison for EPA Region 2 is:
George H. Zachos
Regional Public Liaison
Toll-free (888) 283-7626, or (732) 321-6621
U.S. EPA Region 2
2890 Woodbridge Avenue, MS-211
Edison, New Jersey 08837-3679

The administrative record file, which contains copies of the Proposed Plan and supporting documentation, is available at the following locations:

Newark Public Library
5 Washington Street, Newark, NJ 07101
(973) 733-7784
Hours: Mon, Tues, Thurs, Fri: 9:00 AM - 500 PM
Wed: 12:00 PM – 8:00 PM; Sat: 10:00 AM – 2:00 PM

Elizabeth Public Library
11 South Broad Street, Elizabeth, NJ 07202
(908) 354-6060
Hours: Tues – Fri: 10:00 AM – 6:00 PM
Sat, 10:00 AM – 2:00 PM

EPA Region 2, Superfund Records Center
290 Broadway, 18th Floor, New York, NY 10007
(212) 637-4308
Hours: Mon - Fri, 9:00 AM - 5:00 PM

Information can also be found on the internet:

www.epa.gov/superfund/diamond-alkali

http://www.OurPassaic.org

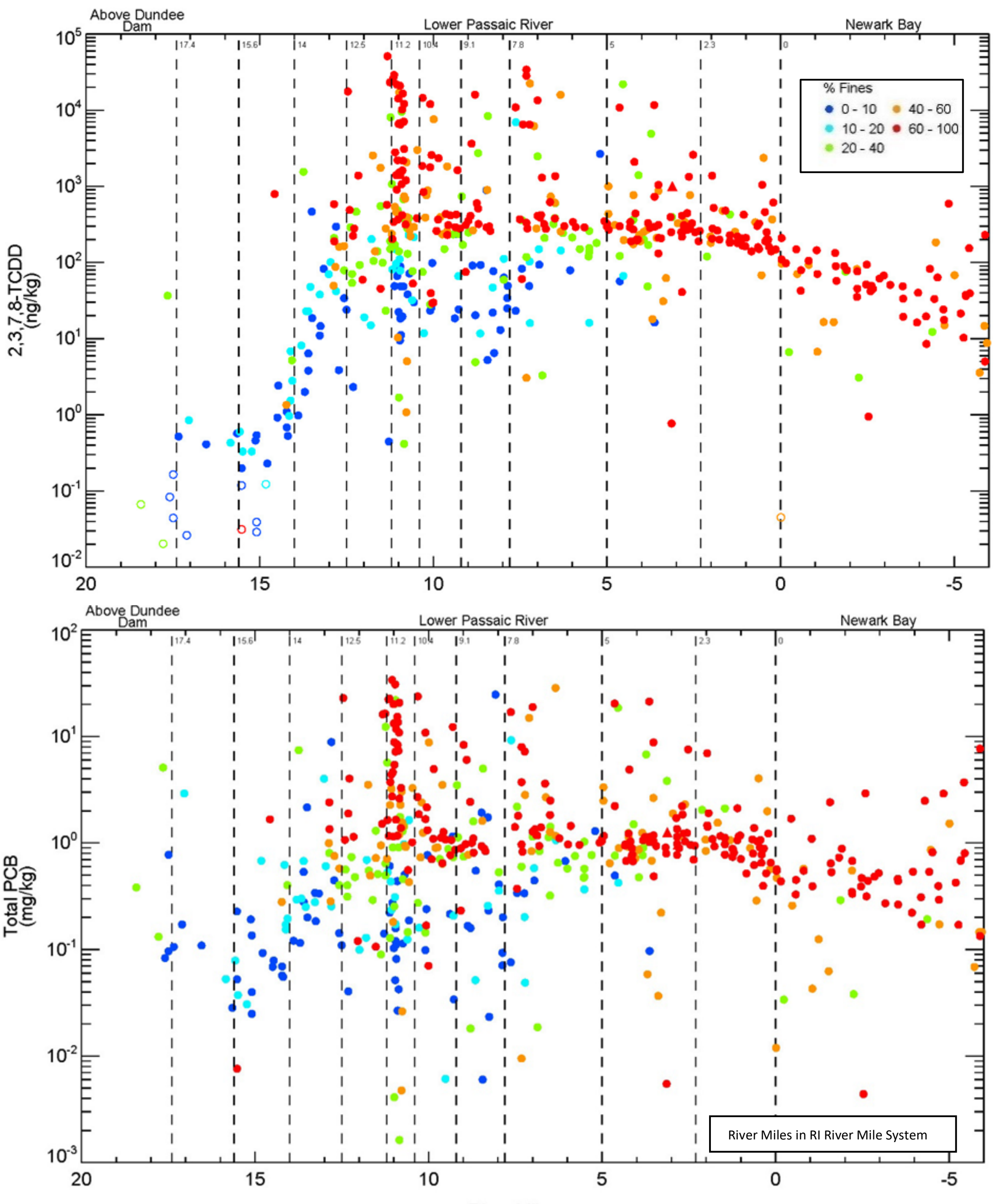

Figure 2: Post-2005 2,3,7,8-TCDD and Total PCB Surface Sediment Concentrations in the Lower Passaic River (Source: IR FS Report)

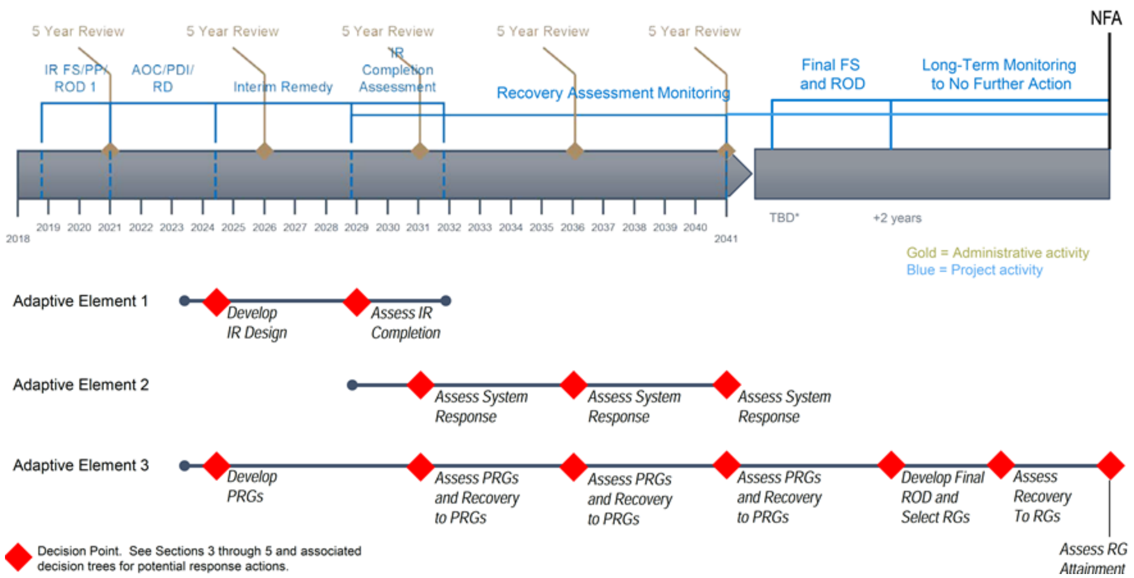

Figure 3: Conceptual Adaptive Management Approach for the Upper 9-Mile Cleanup (Source: IR FS Report)

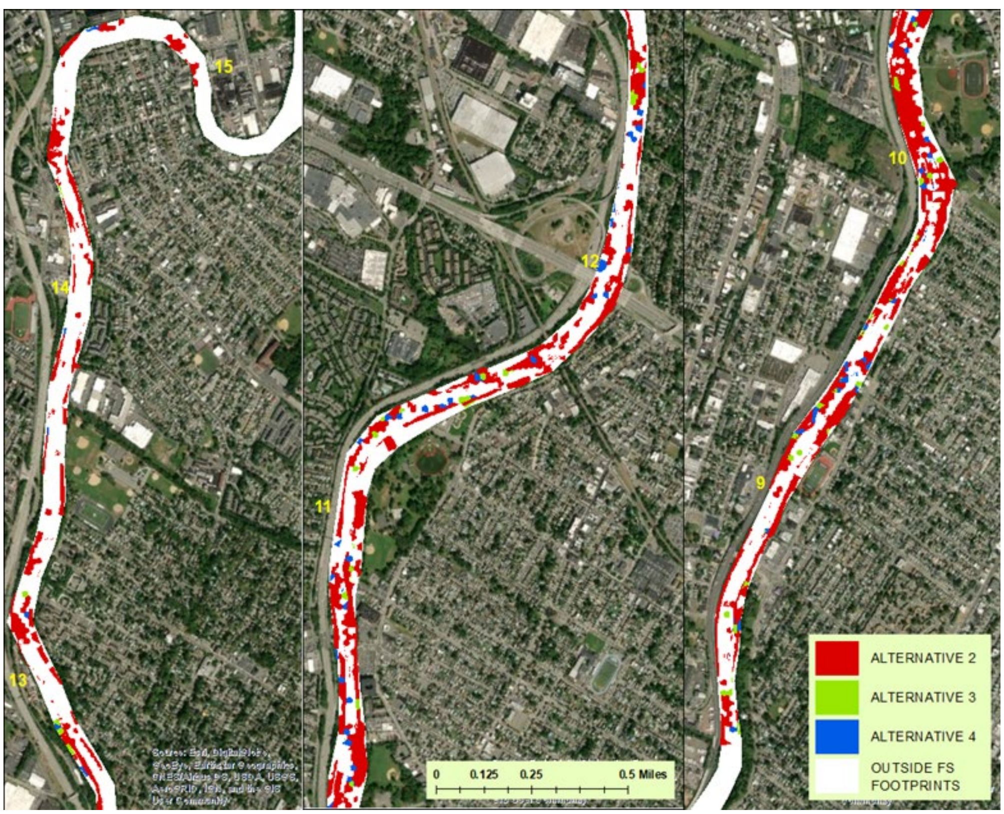

Figure 4: Comparison of Footprints between Alternatives 2, 3, and 4