RECORD OF DECISION

Operable Unit 1

Quanta Resources Corporation Site,

Edgewater Borough, Bergen County, New Jersey

United States Environmental Protection Agency

Region 2

September 2011

Decision Summary

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DECLARATION STATEMENT

RECORD OF DECISION

SITE NAME AND LOCATION

Quanta Resources Corporation Superfund Site (EPA ID# NJD000606442)
Edgewater Borough, Bergen County, New Jersey
Operable Unit 1 - Soil and Groundwater

STATEMENT OF BASIS AND PURPOSE

This decision document presents the Selected Remedy for the upland source areas, soils and groundwater on the Quanta Resources Corporation site in Edgewater, Bergen County, New Jersey. The Selected Remedy was chosen in accordance with the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), as amended, and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the Administrative Record file for the site.

The State of New Jersey concurs with the Selected Remedy.

ASSESSMENT OF THE SITE

The response actions selected in this Record of Decision (ROD) are necessary to protect public health or welfare or the environment from actual or threatened releases of hazardous substances from the site into the environment.

DESCRIPTION OF THE SELECTED REMEDY

The response action described in this document represents the first phase, or operable unit, for the site. It addresses the nonaqueous phase liquid (NAPL) and arsenic source areas, soil and groundwater, and is considered a final action for the OU1 portions of the site.

The Selected Remedy described in this document involves the solidification/stabilization of NAPL and arsenic source areas in the soil, capping and institutional controls to prevent exposure to residual soil contamination, installation of a groundwater containment system for arsenic as a contingency, and a subaqueous reactive barrier in the Hudson River to treat contaminated groundwater before being discharged to the surface water of the Hudson River. The components of the Selected Remedy include:

- On-site solidification/stabilization of an estimated 150,000 cubic yards of contaminated soil containing arsenic and NAPL, primarily by *in-situ* solidification/stabilization (ISS);
- Treatment of a portion of the Deep NAPL through ISS, passive NAPL collection for other areas of the Deep NAPL, and long-term monitoring;
- Installation of a vapor mitigation system and basement sealing at 115 River Road;
- Construction of a temporary barrier wall at 115 River Road to isolate untreated free-phase NAPL from the Hudson River and sediments;
- When 115 River Road is demolished or redeveloped in the future, ISS for the untreated free-phase NAPL remaining under the buildings;
- Capping of contaminated soils remaining on site at concentrations greater than the Remediation Goals for residential direct contact with a multilayer cap;
- Installation of a subaqueous reactive barrier (SRB) in Hudson River sediments, coordinated with a future Hudson River remedy (Operable Unit 2 of the site);
- Continued vapor intrusion monitoring at 115 River Road Buildings and other affected properties, and installation of additional vapor intrusion mitigation systems at other properties as indicated by monitoring data;
- Operation and maintenance for the active components of the remedy, such as the Deep NAPL collection system and vapor intrusion systems, monitoring of the site over the long term to ensure the protectiveness of the Remedy, and institutional controls; and
- Implementation of a long-term sampling and analysis program to monitor the contamination at the site in order to assess groundwater migration, and the effectiveness of the remedy over time.

EPA evaluated alternatives for restoration of groundwater to Applicable or Relevant and Appropriate Requirements (ARARs) and concluded that no practicable alternatives could be implemented. Consequently, EPA is invoking an ARAR waiver for the groundwater at the site due to technical impracticability.

DECLARATION OF STATUTORY DETERMINATIONS

Part 1 - Statutory Requirements

The Selected Remedy is protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to the remedial actions to the extent practicable given the subsurface conditions found at the sites, and is cost effective. EPA has determined that the Selected Remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at the sites. In addition, EPA is invoking an ARAR waiver due to technical impracticability for groundwater at these sites since groundwater remediation is not practicable.

Part 2 - Statutory Preference for Treatment

The Selected Remedy meets the statutory preference for the use of remedies that involve treatment as a principal element.

Part 3 - Five-Year Review Requirements

This remedy will result in hazardous substances, pollutants, or contaminants remaining on the Quanta Resources site above levels that would allow for unlimited use and unrestricted exposure. Pursuant to Section 121(c) of CERCLA, a statutory review will be conducted within five years of the initiation of the remedial action to ensure that the remedy is, or will be, protective of human health and environment.

ROD DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary section of this ROD. Additional information can be found in the Administrative Record file for the site.

- Chemicals of concern and their respective concentrations may be found in the "Site Characteristics" section.

- Potential adverse effects associated with exposure to site contaminants may be found in the "Summary of Site Risks" section.

- A discussion of cleanup levels for chemicals of concern may be found in the "Remedial Action Objectives" section.

- A discussion of principal threat waste is contained in the "Principal Threat Waste" section of this document.

- Current and reasonably-anticipated future land use assumptions are discussed in the "Current and Potential Future Site and Resource Uses" section.

- A discussion of potential land uses that will be available at the site as a result of the Selected Remedy is discussed in the "Current and Potential Future Site and Resources Uses" and "Selected Remedy" sections.

- Estimated capital, annual operation and maintenance (O&M), and total present worth costs are discussed in the "Description of Alternatives" section.

- Key factors that led to selecting the remedies (*i.e.*, how the Selected Remedy provides the best balance of tradeoffs with respect to the balancing and modifying criteria, highlighting criteria key to the decisions) may be found in the "Comparative Analysis of Alternatives" and "Statutory Determinations" sections.

Walter E. Mugdan, Director
Emergency and Remedial
Response Division
EPA - Region 2

Sept. 29, 2011
Date

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SITE NAME, LOCATION AND BRIEF DESCRIPTION

The Quanta Resources site is located at River Road and the intersection of Gorge Road, Edgewater, New Jersey. At the center of the site is a 5.5-acre vacant lot, referred to as the Quanta property, surrounded by a number of developed and undeveloped parcels, portions of which are also considered part of the site. Sections of River and Gorge Roads have been constructed on top of the site. The land portion of the site is approximately 24 acres. The site also includes an area of sediment contamination in the Hudson River. The extent of the Hudson River sediments affected by the site will be determined as part of an ongoing Operable Unit 2 (OU2) Remedial Investigation and Feasibility Study (RI/FS) that is separate from this response action.

Figure 1 (in Appendix I) shows the site location. The site is characterized by contamination from a variety of industries that operated there from at least the 1870s to 1981. These industries included coal tar processing, chemical manufacturing, and waste oil storage. The 5.5-acre Quanta property is a remnant of an industrial coal tar facility that once covered approximately 15 acres. The Quanta property is also referred to as 163 River Road (its previous mailing address).

The Quanta Resources site, Superfund identification number NJD000606442, is on the U.S. Environmental Protection Agency's (EPA's) National Priorities List (NPL). EPA is the lead agency for site activities and the New Jersey Department of Environmental Protection (NJDEP) is the support agency. EPA has used its enforcement authority under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) to direct a group of Potentially Responsible Parties (PRPs) to perform response actions at the site.

SITE HISTORY AND ENFORCEMENT ACTIVITIES

Prior to the mid-1800s, the site and surrounding areas were tidal Hudson River marshlands. Development of rail lines and industry along the banks of the Hudson River prompted the systematic filling in of these marshlands. Beginning after the Civil War, this area, known as Shadyside (incorporated as Edgewater in 1899), became home to some of the earliest chemical operations in New Jersey. Edgewater Borough is a long, narrow strip of land below the Palisades along the Hudson River. Industrialization was brought about by the confluence of the railroads, deep-water piers on the Hudson River which facilitated shipping of in-bound raw materials and out-bound finished goods, and skilled and unskilled labor from the metropolitan area.

Heavy industry began to leave the Borough of Edgewater in the 1960s, marking the beginning of a 30-year transformation of Edgewater into a residential community and retail shopping destination. The southern end of Edgewater where the site is situated has been part of this trend.

Industrial History

Of the many historical industrial operations in the area, three are of particular interest at this site--Barrett Manufacturing Company (coal tar), General Chemical Company (the principal source of arsenic), and Quanta Resources (including other waste oil facilities that operated at the site).

Barrett Manufacturing Company

From at least 1876, a large portion of the site was used to process coal tar and to produce paving and roofing materials. That facility included all of the current Quanta property, extended west to Old River Road in one location, included areas now under (New) River and Gorge Roads, and to the north on portions the Waterford Towers and City Place developments (see **Figure 2**). The facility was bisected by railroad tracks running north-south, in alignment with (New) River Road. As early as 1911, the facility was a substantial chemical works, with tar tanks, tar stills, a tar paper factory, an anhydrous ammonia factory (a byproduct of coal tar processing), pitch cooling operations, pitch tanks, an acid house, a machine shop, and a boiler house. In addition, the waterfront was fitted to receive barges and ships for delivery of raw materials and shipping of finished products. Barrett became part of Allied Chemical and Dye Corporation in 1920. Allied Chemical and Dye Corporation ended operations at the site in 1971.

General Chemical Company

A location just north of Barrett has been identified as the first chemical producer in the area, the Hudson River Dye Wood Mills, which began to manufacture sulfuric acid (oil of vitriol) as early as 1843. In 1862, James L. Morgan and his partners bought the Hudson River Dye Wood Mills site, and built a new sulfuric acid plant, based on the lead chamber process. The Hudson River Chemical Works produced sulfuric acid for coal oil and the rapidly emerging petroleum refining industry in the metropolitan area. The plant also supplied hydrochloric acid, caustic soda and soda ash. Organic products included textile dyes extracted from dyewoods. The facility was later named the Hudson River Chemical and Dyewood Co., followed by the General Chemical Company, which operated from 1900 until about 1967, producing acids, alums, sodium compounds, and sulfuric acid. During the early period of manufacture, sulfuric acid was produced through the roasting of pyrite (an ore rich in sulfur but also contained metals such as arsenic and lead), which generated waste cinders that can contain one percent or more of arsenic.

Oil Recycling Operations
James Frola and Albert Von Dohln purchased Allied Chemical's remaining land holdings in Edgewater in 1974. From approximately 1974 to 1981, the property was leased by several entities involved in the oil recycling business, the last of which was Quanta Resources, Inc. Quanta operated the facility until 1981, when NJDEP stopped business activities after discovering that several storage tanks at the site contained waste oil contaminated with polychlorinated biphenyls (PCBs). The property has not been in use since 1981.

Figure 3 shows the overlay of the industrialized waterfront area from 1940 with a recent plan-view map of the area. The photograph shows extensive tank farms, railway corridors and Hudson River piers in use at the time, when both Barrett and General Chemical were operating at the site. Many of the tanks from 1947 (shown in **Figure 4**) survived into the 1970s when they were used for waste oil storage.

In addition, the following former industrial operations were immediately adjacent to the NPL site (see **Figure 5** for relative location):

Celotex Corporation
From 1967 to 1971, properties north of the coal tar plant were operated by Celotex Corporation for the manufacture of gypsum wall board. After 1971, Celotex leased the property to a variety of smaller enterprises. The Celotex Industrial Park was used for film developing, warehousing, trucking, auto body work, and a scrap metal yard. In the early 1980s, All County Environmental Service Corporation operated a hazardous waste treatment, storage, reclamation and disposal business on the property under a Resource, Conservation and Recovery Act (RCRA) permit. The operation

reused existing above-ground tanks to store liquid wastes, which were subsequently shipped off site for final disposal. All industrial operations ceased in the mid-1980s.

Spencer Kellogg & Sons, Inc. (now 115 River Road LLC)
Spencer Kellogg & Sons, Inc. was once a major seed-oil processor in the United States. Its Edgewater facility, just south of Barrett, was one of its largest plants. This facility began operations in about 1910, producing linseed, castor and coconut oils. The two brick buildings at 115 River Road are original Spencer-Kellogg buildings from 1910. The company became part of Textron in 1961. The southern section of the facility was sold to Lever Brothers (discussed below) in the 1960s. Seed-oil processing ceased in 1981.

Lever Brothers
This industrial property had a variety of uses prior to it becoming a Lever Brothers facility in the 1920s. The company, also known as Unilever, used the facility to manufacture soaps, vegetable shortening, and other consumer products. From the 1950s until it closed in 2003, the property was a research and development facility.

Early Regulatory History - Quanta Property
From approximately 1974 to 1981, the property was leased by Gaess Environmental Services Corporation, followed by Hudson Oil Refining and Edgewater Terminals, which were owned or controlled by Russell Mahler. In 1979, Quanta Resources, Inc. purchased the assets of Mahler's operations, including the lease at the site, and received a temporary operating permit issued by NJDEP. Inspections revealed the poor condition of the site, and NJDEP issued an administrative order to Quanta in May 1981, directing the company to cease operations and to take measures to prevent spills and start removing surface contamination. Waste oil sampling revealed the presence of PCBs in several aboveground storage tanks (ASTs), originally estimated at 387,000 gallons. Quanta Resources filed for bankruptcy on October 6, 1981, and ceased work at the site several months later.

NJDEP subsequently approached the property owners, James Frola and Albert von Dohln, to stabilize the site and develop response actions to address on-site contamination, issuing an administrative order in November 1983. NJDEP and EPA also began developing contingency plans to implement an EPA-led removal action, and for EPA to assume the lead for the site pursuant to CERCLA.

At the time of its closure in 1981, the Quanta property contained 61 ASTs, at least 10 underground storage tanks (USTs), process equipment, septic tanks, and underground piping. The total storage capacity of the tanks has been estimated at over nine million gallons. EPA and NJDEP concluded that the property owners could not meet the requirements of the 1983 administrative order, and EPA initiated a federally funded removal action in 1984. By April 1985, EPA had sent more than one million gallons of PCB-contaminated waste oil off site for incineration.

In September and October 1985, EPA issued a series of Administrative Orders on Consent (AOCs) to Allied and a group of other potentially responsible parties (PRPs) to perform or fund further removal actions, and to reimburse EPA for its past costs. In addition to Allied (now known as Honeywell), the PRPs included a number of companies that had sent waste oil to the site.

Several removal actions were performed at the site from 1984 to 1988, under EPA oversight, to stabilize and dismantle the site. The removal actions focused on the cleaning and decommissioning of the ASTs and USTs. An estimated 1.35 million gallons of waste oil, 1.5 million gallons of coal tar and petroleum/oily wastes, and several hundred thousand gallons of contaminated water were removed from storage tanks and disposed of or recycled. Some underground piping and shallow soils were also removed (estimated at approximately 2,000 tons).

A preliminary assessment/site inspection was performed in 1981 and again in 1985, as the site was evaluated for listing on the NPL, but it did not qualify under the Hazard Ranking System in place at that time. While it was not placed on the NPL, EPA retained regulatory responsibility for the stabilized site within its Removal Program and, through the AOCs with the PRPs, maintained security fencing, periodic inspections and an adsorbent boom to capture floating oil sheens from the neighboring Hudson River mudflat. Site conditions were reassessed by EPA in 1992 through the collection and analysis of soil, sediment, and groundwater samples from the site. The reassessment found little change to the site or the surrounding area. In 1993, EPA reached a separate settlement with a group of PRPs that established an escrow fund to pay for additional removal actions, as necessary.

Spencer Kellogg & Sons., Inc.
The Textron/Spencer-Kellogg facility was cited by EPA and the U.S. Coast Guard for several vegetable oil spills in 1980 and 1981, and agreed to cease operations on December 31, 1981. At the time of its closure, the Spencer-Kellogg property, also known as 115 River Road, contained 5.5 million gallons of oil storage capacity in a series of 18 ASTs. All the tanks were dismantled by 1986.

The 115 River Road property was purchased by Thomas Heagney in 1984, and redevelopment began in 1986. After inspecting the site and reviewing past activities, EPA issued a Site Inspection Report in June 1991, concluding that no additional measures were required based upon the vegetable oil processing operations; however, this report did acknowledge the presence of coal tar in the subsurface soils and in the Hudson, emanating from the neighboring Quanta site. The property was redeveloped as commercial space and it has been continuously occupied since 1989, housing between 50 and 60 small commercial businesses, including the Palisades Child Care Center.

Redevelopment Activities

The "New" River Road and Celotex Redevelopment
A plan to relocate and expand River Road, approximately in alignment with the existing railroad right-of-way, was proposed in the early 1990s. The two-lane "old" River Road was unsuitable to support the type of high-density construction that was contemplated for the area, as Edgewater was becoming a desirable residential locale.

In 1995, the Borough of Edgewater acquired a portion of the Quanta property under eminent domain for the "new" River Road. Also in 1995, EPA entered into an AOC with Bergen County and a private developer (who was paying for the road improvements), to allow the County to safely construct a road over a portion of the site. In accordance with the AOC, Bergen County placed a liner over the existing ground surface, which provided a demarcation between original site soils and the new fill and isolated the older soils during the road work, protecting construction workers. Rather than excavating into contaminated soil to install storm drains, fill material was placed on top of the liner to raise the grade of the finished roadway and make room for utilities.

Several large-scale redevelopment projects soon followed. Redevelopment of the Celotex property by the development company

Edgewater Enterprises began in the late 1990s, beginning with an investigation and remediation phase under the direction of NJDEP. The site remediation included the removal of hotspots of contaminated soil to meet criteria established by NJDEP, followed by capping of the entire site.

In 2000-2002, Edgewater Enterprises discovered what is now referred to as the High Concentration Arsenic Area (HCAA), in the footprint of the former General Chemical acid plant. After excavating a small portion of it and performing some preliminary investigations, Edgewater Enterprises petitioned NJDEP to leave it capped in place. Concurrent with these events, the Quanta site was proposed and then placed on the NPL. The HCAA is on both the Quanta and former Celotex lots, and EPA concluded that a remedy for the Quanta site would likely need to consider remedies for the whole HCAA as part of a comprehensive site action. EPA concluded that development decisions being made on Celotex may limit EPA's ability to select a remedy for the site, so in 2003 the developer agreed to an AOC with EPA whereby capping would be allowed temporarily; however, if EPA required access to implement a remedy under Superfund, the developer would need to provide access to the area to facilitate the implementation of that remedy. An impermeable liner and several feet of fill material have been placed over the HCAA on Celotex, along with the entrance roadway to the City Place development. Development rights for the undeveloped portion of this lot were subsequently acquired by the development company K. Hovnanian, though it has, thus far, been unable to develop the property.

By about 2004, most of the City Place development on Celotex had been built, with the exception of the southern portion adjacent to the Quanta property, which awaits the issuance of this Record of Decision (ROD) before further redevelopment plans can be undertaken.

Former Lever Brothers Redevelopment

The former Lever Brothers property was purchased in 2004 by i.Park Edgewater, LLC. It is being redeveloped for mixed-use municipal, residential and commercial purposes, including the new Edgewater Borough Hall. NJDEP is the lead agency for directing cleanup activities for this development, with the exception of the "northern portion" adjacent to 115 River Road, where EPA has identified Quanta-related contamination problems. Similar to the former Celotex property, a portion of the former Lever Brothers redevelopment plans have been deferred until the selection of the OU1 remedy for Quanta.

NPL Listing and Current Status
In 1996, EPA and one PRP, the successor to Barrett Manufacturing Company, AlliedSignal (formerly Allied Chemical Company, now Honeywell), entered into an AOC under EPA's removal authority to improve site security, further investigate the extent of site problems, and develop further response actions for the site. A second AOC was signed in 1998 designating steps to investigate and address the ongoing coal tar sheens in the mudflats of the Hudson River in front of the site. The studies performed under these AOCs, along with an ecological risk assessment of Hudson River sediments performed by the EPA, finally led to the proposal of the site to the NPL. On January 11, 2001, EPA proposed inclusion of the site on the NPL, and on September 9, 2002, EPA placed the site on the NPL.

In December 2002, shortly after the NPL listing was made final, the PRPs and Three Y LLC (the owner of Block 93, Lots 1, 2 and 3) sued EPA over the inclusion of these properties within the scope of the site in its NPL listing. These lots are west of (new) River Road but were originally part of the Barrett and Allied coal tar facilities (see **Figure 5**). EPA prevailed and the lawsuit was dismissed in June 2004.

The RI/FS for this remedy, Operable Unit 1 (OU1), has been performed by the environmental consulting firm CH2M Hill, working for Honeywell and 22 other PRPs (generator PRPs related to the waste oil operation), under an AOC with EPA signed in 2003. An OU2 RI/FS (under a separate order with Honeywell) is evaluating the nature and extent of site contamination in Hudson River sediments and surface water.

HIGHLIGHTS OF COMMUNITY PARTICIPATION

Since the placement of Quanta Resources site on the NPL in 2002, public interest in the site has been high.

In 2002, EPA began an outreach program in Edgewater to communicate site conditions, provide updates and solicit community interests and concerns. During the RI/FS, EPA worked with community leaders to educate the interested parties in the Superfund process and the specific problems at the site. In addition, a group of Edgewater residents formed the Quanta Community Advisory Group of Edgewater (QCAGE). EPA has provided the QCAGE with briefings, to allow the group to act as a public forum for community members to present and discuss their needs and concerns related to the Superfund decision-making process.

EPA also has updated elected officials quarterly during the RI/FS process.

One key component of EPA's outreach was to solicit views and assumptions about reasonably anticipated future land use. As previously noted, development plans are already in place for a number of properties affected by the site. EPA consulted with property owners, the QCAGE, and borough officials in assessing the current and potential future land uses to consider for the site, and with the NJDEP regarding groundwater use.

On July 21, 2010, EPA released the Proposed Plan and supporting documentation for this action, the final remedy for OU1, to the public for comment. EPA made these documents available to the public in the administrative record repositories maintained at the EPA Region 2 office (290 Broadway, New York, New York), and the Edgewater Free Public Library (49 Hudson Avenue, Edgewater, New Jersey), and made a smaller group of documents available online (http://www.epa.gov/region02/superfund/npl/quanta/). EPA published a notice of availability for these documents in the *Record*, and opened a public comment period on the documents from July 21, 2010 to August 19, 2010. The display ad was published on July 21, July 28, and August 2, 2010.

On August 3, 2010, EPA held a public meeting at the American Legion Post at 1165 River Road in Edgewater, to inform local officials and interested citizens about the Superfund process, to review the planned remedial activities at the site, and to respond to any questions from area residents and other attendees. This meeting was followed on August 4, 2010, by less formal public availability sessions, also at the American Legion Post.

Several attendees of the August 3 and 4 meetings asked that EPA extend the comment period beyond 30 days. EPA was also told that the quantity and technical complexity of the information being presented made it difficult for anyone without an environmental science background to understand it, and several QCAGE members asked for additional assistance to better understand EPA's proposal. At the August 4, 2010 meeting EPA announced that it would extend the comment period at least another 30 days beyond August 19, 2010, and announced the date of a subsequent public meeting, September 13, 2010, also at the American Legion Post. EPA issued press releases announcing these additional public outreach efforts that received extensive reporting, and subsequent newspaper notices published on September 7 and September 9, 2010 in the *Record*.

The September 13, 2010, public meeting also included a presentation by EPA, addressing several specific requests from the QCAGE, asking EPA to speak about particular topics not adequately covered in the August meetings. The community was again invited to make comments at this meeting. Transcripts for the two "oral comment" meetings, August 3, 2010 and September 13, 2010, are included as part of the Responsiveness Summary. At this meeting, EPA also announced that it would make available a technical advisor, through its Technical Assistance Services for Communities (TASC) program, to work with the QCAGE and other interested parties, to better understand EPA's preferred alternative and the other remedial alternatives that EPA had considered.

EPA extended the comment period to November 18, 2010, to allow the TASC advisor, Dr. Peter deFur, enough time to review site documents, meet with community members, and present them with a written report (found at this link http://estewards.com/assets/4cd85bc6dabe9d5e24000022/tasc_r2quanta_rifs_pp_community_presentation_draft_11410_with_edits.pdf). His report was presented to the community at two public information sessions held on November 4 and November 9, 2010 at the Edgewater Community Center, 1167 River Road in Edgewater.

EPA received written comments (including email communications) from 70 commenters and several hours of oral comments from the public meetings. Responses to the comments received at the public meeting are included in the Responsiveness Summary (see Appendix V). The transcripts and public comments are found in Attachment C and Attachment D of Appendix V, respectively.

SCOPE AND ROLE OF OPERABLE UNIT

As at many Superfund sites, the problems at the Quanta Resources site are complex. EPA has organized the work into two operable units (OUs) to make it more manageable:

Operable Unit 1:	The land portions of the site and the groundwater.
Operable Unit 2:	Sediments and surface water in the Hudson River.

The first operable unit (OU1), the subject of this ROD, addresses soils contaminated with high concentrations of NAPL and arsenic that constitute a principal threat. EPA defines a principal threat as "…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". This operable unit also addresses soil contamination and groundwater contamination attributable to the site. The total land area of OU1 encompasses approximately 24 acres. There are no surface water bodies at or near the site except the Hudson River--surface water in the form of runoff from OU1 discharges to the Hudson River through storm sewers or overland flow. This is considered a final action to address this operable unit.

The second operable unit addresses sediment and surface water contamination attributable to the site that has been found in the Hudson River. A tidally influenced mud flat-marsh associated with the Hudson River borders OU1 immediately to the east of the wooden bulkhead and shoreline. These river sediments and the surface water comprise Operable Unit 2 (OU2). OU2 is expected to be the final response action for the site.

SUMMARY OF SITE CHARACTERISTICS

Overview

The vacant Quanta property contains exposed former tank and building foundations visible at several locations on the property. The property also includes the remains of a former oil-water separator, a wooden bulkhead along the edge of the Hudson River, and the remains of wooden docks. A chain-link fence is maintained around the property east of River Road, except for along the boundary with the Hudson River. There are rare incidents of trespassing and fencing and site signs have been repaired or replaced periodically. The property attracts a deer population; the deer probably reside at the site because it is one of the few vacant lots in this high-traffic area.

Topography at the Quanta property is generally flat and at a lower elevation than the surrounding properties and River Road, sometimes resulting in standing water over a portion of the property. The elevation of the Quanta property corresponds to the land surface during the various periods of industrial use (prior to 1982); whereas the higher elevations at City Place and at River Road are from more recent fill material. The only substantial vertical relief on the Quanta property consists of a concrete embankment along the west and northwestern property boundaries, forming the transition to higher elevations on River Road and the former Celotex property. Farther to the east, a sheer boulder wall approximately 12 feet high is present along the boundary between Quanta and the former Celotex property to the north.

The 115 River Road and i.Park properties are at a similar elevation to the Quanta lot (that is, nearer to the ground surface prior to 1982). The 115 River Road property is entirely covered with asphalt, buildings or similar capping material, and the i.Park property is fenced, restricting access to any potentially contaminated soil on these lots under current conditions. With the exception of a few small sections of Block 93 Central and North, the remainder of the area investigated is developed or, in the case of the undeveloped portion of City Place, covered with fill material and capped with a layer of asphalt.

Cultural Resources

As part of the RI/FS, the site was surveyed for areas of archeological or historical importance, to avoid damaging cultural resources during the study phase and to assess whether remedial actions might affect them. The survey found that little remains of the historically important era of industrial growth and prosperity that defined Edgewater for over 100 years. The former Spencer Kellogg and Sons property (115 River Road) was recognized in 1984 as a unique example of an earlier era of industrial waterfront development, and for this reason was placed on New Jersey's Register of Historic Places. Because the property was slated for construction, the unique features of these buildings were recorded and archived by the National Park Service prior to redevelopment[1].

Geology and Hydrogeology

Geology

The site is located in the Triassic Lowlands, marked by the Watchung Mountains: low, north-south-trending hills, and locally represented by the cliffs of the Palisades. Bedrock at the site is known as the Stockton Formation composed of a mixture sandstone, silty mudstone, siltstone, shale, and conglomerate. The Stockton Formation is overlain by as much as 80 feet of unconsolidated deposits near the site. At the upland portion of the site, the following overburden stratigraphy is generally observed (listed in order encountered from ground surface):

- **Fill material.** Up to 35 feet of fill material consisting of a mixture of gravel, sand, and silt with brick, wood, concrete fragments, coal, cinders, and slag.

1 For more information please see the recordation records at the Library of Congress: http://loc.gov/pictures/item/nj0988/

- **Peat/clayey peat.** Up to 25 feet of organic peat or "meadow mat" with varying amounts of clay, fine sand, and silt. The peat/clayey peat deposits are discontinuous and have been observed primarily in borings completed near River Road, Block 93, and the former Lever Brothers property.
- **Soft organic silt.** Up to 68 feet of soft grey-to-black organic silt containing wood, roots, and shell fragments. This unit is also included in the estuarine and salt marsh deposits. The soft organic silt is typically present only within 100 feet of the shoreline throughout the entire study area and represents former river sediments that were buried during shoreline filling. It pinches out to the west and against the bedrock high to the northwest on the former Celotex property.
- **Shallow native sand.** Up to 21.5 feet of fine to medium/coarse sand with varying amounts of gravel and fines. In the central portions of the Quanta property and the northern portion of the former Lever Brothers property where the peat/clayey peat and soft organic silt are absent, the shallow native sand resides directly beneath the fill unit.
- **Silty clay (confining unit).** Up to 35 feet of continuous silty clay with varying amounts of fine sand. The silty clay represents a lake-bottom unit that underlies the estuarine and salt marsh deposits. The silty clay serves as a confining unit and an aquitard between both the overlying native sand and fill units and the underlying deep sand deposits. It is found across most of the site with an undulating surface that dips eastward in close proximity to the existing shoreline and pinches out towards the north against a bedrock high at the former Celotex property.
- **Deep sand.** Up to approximately 32 feet of fine to coarse sand, sand with varying amounts of silt and clay, and silt and clay with varying amounts of sand. The deep sand represents a lacustrine fan unit that lies beneath the confining silty clay unit. Like the overlying silty clay confining unit, the deep sand dips eastward under the Hudson River and pinches out towards the north against the bedrock high present on the former Celotex property and to the west against the rising Palisades ridge.
- **Till.** Up to 12 feet of a very dense, low permeability, reddish-brown to reddish-yellow silty sand and sand with gravel, cobbles, and boulders.
- **Bedrock.** The Stockton Formation composes the underlying bedrock formation at the site and is found at depths

ranging from 8.5 feet (at the bedrock high in the south-central portion of the former Celotex property) to 86 feet below ground surface (bgs). Its appearance in core samples collected during the RI consisted of variably consolidated alternating sandstone and siltstone lenses with a variety of colors, including, red, white, pink, brown-gray, and brown-yellow. Towards the east and southeast bedrock dips dramatically forming the Hudson River channel.

Figure 6 shows the base map of the geologic cross sections. Geologic cross-sections of the site geology are provided in **Figures 7A** - **7G**. Three-dimensional views of OU1 overburden stratigraphy are provided in **Figure 8**. **Figure 9** and **Figure 10** present contour maps of the top of the silty clay confining unit and the top of bedrock, respectively.

Hydrogeology

The water table on the Quanta property and 115 River Road is shallow, within about two feet of the ground surface. The direction of the shallow unconfined groundwater flow (above the confining unit) is generally to the east and south, with an area of radial flow on the Quanta property, under an average hydraulic gradient of 0.0068 foot/foot during low-tide conditions and 0.0066 foot/foot during high-tide conditions. Flow direction remains consistent between daily tidal events (low and high tides); however, the hydraulic gradient is slightly steeper during low-tide conditions.

A tidal response is pronounced in monitoring wells adjacent to the Hudson River north and south of the area of the wooden bulkhead, which diverts groundwater flow on the Quanta property to the north and south. The wooden bulkhead is present at the Quanta property but not at Celotex, and it is unclear where the bulkhead ends on the 115 River Road property. While the bulkhead predominantly redirects shallow groundwater flow, seepage has been observed across the bulkhead during low tide, and lower hydraulic heads at several wells adjacent to the bulkhead and indications of groundwater upwelling in sediments suggest groundwater leakage occurs across the structure. There is evidence of multiple bulkheads behind the observable bulkhead, which is about 25 to 30 feet deep, buried in the organic silt layer.

Most shallow groundwater at the shoreline flanks the bulkhead to the north and south before moving into the sediments at OU2 and eventually upwelling to the surface water, in zones of preferential discharge identified during the RI. Groundwater flow through the shallow native sand can travel unimpeded under the bulkhead on the southern end of the site.

The radial groundwater flow pattern in shallow unconfined groundwater is the result of localized recharge associated with low-lying unpaved areas in the central portion of the Quanta property, where less-permeable peat deposits slow the percolation of rainwater. The wooden bulkhead, along with the bedrock high at the former Celotex property, drives a southerly component to flow. This flow component may be further amplified by relatively recent fill material added at River Road and on the former Celotex property, which creates steeper gradients from these areas onto the Quanta property.

South of the site on the central former Lever Brothers property, shallow groundwater has a northerly flow component, resulting in an area of groundwater convergence. At this area of convergence, groundwater from the south and the north meets and then flows toward the Hudson, and this convergence point represents a shallow groundwater dividing line between the two sites (depicted as orange colored dotted line in **Figure 11**). This area of convergence is coincident with a pair of west-to-east-trending storm drain lines that outfall to the Hudson River, though the storm drains do not appear to be the cause of the ground-water convergence.

While the bulkhead and other factors divert shallow groundwater flow at the site southward, much of the groundwater above the clay confining unit flows beneath the bulkhead in the organic silt and shallow sand. Groundwater within the deep sand hydrostratigraphic unit flows uniformly east-southeast, and the hydraulic heads measured within this unit are more readily influenced by tidal conditions than are those in the shallow unconfined groundwater. The vertical hydraulic gradients measured between the unconfined and deep sand units indicate that the two units are not connected hydraulically.

Although surface water and sediments are being investigated pursuant to a separate RI/FS, mitigating any risk posed by potential constituent flux from groundwater (OU1) to surface water (OU2) is a critical element for the development of remedial goals for OU1. The presence of a wooden bulkhead along the shoreline largely affects groundwater flow to surface water. This structure causes groundwater flowing eastward to flow north and south once it reaches the shoreline; however, flow does occur through the bulkhead to some degree, at discrete areas along its length. Once groundwater moves into the deep sediments of the Hudson River, it is driven upward through the sediments and discharges to surface water. Areas of potential groundwater upwelling have been identified north of and adjacent to the bulkhead along the shoreline. Further south, beyond the bulkhead, upward forces of groundwater flow are not as pronounced. In this area, vertical gradients are more subdued and generally flat, and groundwater discharge occurs slightly farther offshore (see **Figure 12**).

There are no surface water features on the upland portions of the site except storm sewers, and periodic ponding of water on several properties.

Investigation Summary

The Remedial Investigation for OU1, including a Human Health Risk Assessment (HHRA) has been performed by CH2M Hill for the site's PRP group, with oversight by EPA. A draft Remedial Investigation Report was submitted in August 2008 and, after a series of supplemental studies were completed, a Supplemental Remedial Investigation Report (SRI) was submitted in June 2010.

EPA reviewed and approved the HHRA (discussed below) concurrent with the SRI. A screening-level ecological risk assessment (SLERA) concluded that no further OU1 ecological risk evaluation would be required. A baseline ecological risk assessment (BERA) for the Hudson River is being conducted as part of the OU2 RI/FS.

Screening levels for contaminants of concern (COCs) were developed during the RI, to assess constituent concentrations and assure that the nature and extent of site contamination could be determined. The screening criteria used during the RI are further discussed in Sections 4.2 and 4.3 of the SRI, and summarized in Tables 1 and 2 of this ROD.

The predominant site contaminants, coal tar constituents and arsenic, are commonly found in urban settings. These constituents have also been identified as primary site contaminants in site investigations performed on nearby projects (*e.g.*, Celotex, Lever Brothers). A number of these neighboring site investigations have led to remedial actions and redevelopment of adjacent properties. This work was performed at the direction of NJDEP, generally following a brownfields model for remediation of soil that combines engineering controls (capping) and institutional controls with selective hotspot removal or treatment.

Because of the former land use, the screening levels for constituents of concern at the site were exceeded in most of the study area, and the RI did not attempt to characterize the "full extent" of constituent exceedances. Rather, a key RI goal was to distinguish general urban "background" contamination from constituents that are attributable to operations at the Quanta site. Historical operations with which site contamination sources are associated include coal-tar-processing operations and, subsequently, oil-recycling operations. In addition, a former acid plant, located on the northern portion of the Quanta property and the southern portion of the former Celotex property, contributed to the presence of unburned or partially burned pyritic ore remnants in soil that represent a source of inorganic constituents in soil, particularly arsenic. In addition to soil and groundwater, the RI also evaluated the potential for vapor intrusion in a number of occupied buildings on the site.

Nature and Extent of Contamination – Non-Aqueous Phase Liquid (NAPL)

NAPL is found throughout the site, and is made up of aromatic volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs). Most of the SVOCs are polycyclic aromatic hydrocarbons (PAHs). A broad spectrum of coal tar materials is found at the site, from light-end, low-viscosity liquids to solid tar. Solid tar is most frequently in the form of a black, soft to stiff, semi-plastic to plastic material. Much of the NAPL has elevated viscosity and interfacial tension, making it denser and indicating a lower propensity to migrate. These data support observations that NAPL that collected in select monitoring wells was "thick" and difficult to penetrate with sampling and measurement devices.

Higher concentrations of NAPL are identified as "free-phase" NAPL, because in these areas the wastes contain enough mass to fill the soil pore spaces with coal tar liquids and to collect as a separate layer in groundwater monitoring wells. This is contrasted with "residual" NAPL, which indicates areas where the soils are only stained with NAPL, but no separate liquid is present. NAPL constituents (PAHs) extend beyond the lateral extent of NAPL, in the form of staining or odors, and as adsorbed and dissolved-phase VOCs and SVOCs in soil and groundwater, as discussed in the section on soil and groundwater contamination, below.

Extensive characterization, using soil borings correlated with geophysical sampling techniques, and visual observations in test pits and in groundwater monitoring wells, shows that most of the NAPL mass at the site is present in six discrete NAPL zones (NZ-1 through NZ-6). The NAPL zones are depicted in **Figure 13**. The NAPL in each of these zones is composed primarily of coal tar[2], though each zone's NAPL has somewhat distinct physical characteristics. While most of the mass appears to be found in the NAPL zones, NAPL is found throughout the site as residual NAPL or thin, discontinuous pockets of free-phase NAPL that have not been found to be contiguous with the defined NAPL zones.

Much of the site NAPL is denser than water (dense non-aqueous phase liquid, or DNAPL), so it sinks through the water column rather than floats on the water table. NAPL is found throughout all the unconfined units, but the silty-clay confining layer has acted as a vertical boundary: the NAPL has been found as much as a foot into, but not through, the clay. NAPL is found within the lateral extent of the current Quanta property and extends west across River Road and onto the eastern portions of Block 92.01 and Blocks 93 North, Central, and South. Site-related NAPL also extends southward into the former Lever Brothers property, and north onto the former Celotex property. The extent of NAPL detections is depicted as the olive-green line on **Figure 13**.

Depictions of NAPL show that it is consistent with the former locations of above-ground tanks (see **Figure 14**). NZ-1 and NZ-2 are close to the surface and are more or less continuous zones of NAPL; whereas the deeper NAPL zones NZ-3, NZ-4, NZ-5 and NZ-6 tend to be present as a series of closely spaced discontinuous lenses. Below is a brief description of each of the NAPL zones. **Figures 15A** through **15G** show the cross-sectional views of the NAPL zones.

NAPL Zone 1 **–** NAPL in NZ-1 is present in the southern portion of the Quanta property and west beneath River Road into the eastern portions of Blocks 93 North and Central. It extends south beneath the 115 River Road property and into a limited area along the northern boundary of the former Lever Brothers property. Most of NZ-1 is within one and three feet of the ground surface to a depth of approximately 10 to 12 feet below ground surface (bgs). NZ-1 has a high viscosity and interfacial tension that

2 With the exception of a light nonaqueous-phase liquid (LNAPL) at monitoring well MW-7 at the northeastern former Lever Brothers property, NAPL samples collected were identified through chemical analysis as primarily consisting of coal tar constituents, though fingerprinting NAPL sources is difficult. A fuel tank that resided in the proximity of monitoring well MW-7 may be the source of a separate LNAPL release at this location.

would generally limit its migration; however, over the many years since releases began, the less-permeable meadow mat deposits have generally limited its downward vertical migration, confining it to within the fill layer near the water table. In an isolated area, NZ-1 NAPL has migrated to the depth of the silty-clay confining unit, approximately 23.5 feet bgs. In this area, the meadow mat boundary was not present, apparently removed to install an underground storage tank that has since been removed.

NAPL Zone 2 – NAPL in NZ-2 is present along the site shoreline, from the northern Quanta property boundary southward, beneath the 115 River Road building, and into portions of the northeast corner of the former Lever Brothers property. It extends approximately 250 feet inland and is bound at the east by the shoreline. NAPL in NZ-2 is not homogeneous; it has been found to have varying physical characteristics; portions of NZ-2 have lower viscosities and interfacial tension, indicating a greater potential for migration. NAPL in this zone extends throughout the fill unit and into the upper portions of the organic silt deposits with sporadic occurrences within the underlying till to the north. It has been found between approximately 4 and 25 feet bgs; the bulk of the NAPL at NZ-2 is above a depth of approximately 15 feet bgs. The wooden bulkhead along the shoreline has impeded the flow of NAPL, causing it to accumulate behind the bulkhead and seep laterally north and south beyond the extents of the bulkhead.

NAPL Zone 3 – NAPL in NZ-3 extends from the central portion of the Quanta property south into the former Lever Brothers property, and is beneath NZ-1; it extends laterally beyond the extent of this shallower NAPL zone from a depth of approximately 15 feet bgs to a few feet into the top of the silty-clay confining unit at approximately 22 to 25 feet bgs. Due to its lower interfacial tension (8.2 dynes per square centimeter (dynes/cm^2)) and viscosity (3.49 centistokes (3.49 cSt)), NAPL in NZ-3 has migrated downward and laterally to a natural depression in the top of the undulating silty-clay confining unit, which is limiting further migration. NZ-3 is probably a more mobile fraction of NZ-1. While much of the mass of NZ-3 is contained by a natural depression in the confining unit, it is not fully bounded from further migration to the south; however, its presence as thin, discontinuous lenses southeastward indicates that, under current conditions, NAPL at NZ-3 is not migrating beyond the natural depression in the top of the silty-clay confining unit.

NAPL Zone 4 – NZ-4 consists of NAPL beneath the northwestern portion of the former Lever Brothers property and across River Road into Blocks 93 Central and South. NAPL in NZ-4 is present in two separate layers, one approximately 10 to 15 feet bgs and the other approximately 20 to 32 feet bgs. The first lens occurs mostly in the fill layer or into the top few feet of the peat unit. The second lens penetrates the peat near monitoring well MW-123 but is sporadic and discontinuous. Interfacial tension (16.65 dynes/cm^2) and viscosity (13.1 cSt at 122°F) of this NAPL are similar to that of NAPL in NZ-2 at monitoring well MW-116B. NAPL saturation in the vicinity of monitoring well MW-123 is high, as evidenced by the presence of 14.2 feet of NAPL in this well. In all directions along the periphery of NZ-4 a consistent rise in the elevation of the peat and silty clay is present preventing further lateral migration. Unlike the other NAPL zones, NZ-4 cannot be historically linked to a tank farm from the period of coal tar plant operations; it is possible that, similar to NZ-3, NZ-4 originally emanated from NZ-1.

NAPL Zone 5 – NAPL at NZ-5 is adjacent to the Hudson River in the southeastern portion of the former Celotex property, from the shoreline up to 130 feet inland to the west and 120 feet north of the Quanta/former Celotex property boundary. It is present at depths of up to 40 feet bgs, with the majority residing between 20 and 25 feet bgs, at the interface between the fill and soft organic silt units. The interfacial tension and viscosity of a NAPL sample collected from monitoring well MW-135 is the lowest for all NAPL samples from the site, with the exception NAPL at monitoring well MW-107 in NZ-3, indicating that it has the potential for mobility. NAPL zones NZ-2 and NZ-5 are connected, with NZ-5 being present as thinner deposits and at a lower saturation levels than NAPL behind the bulkhead at NZ-2 to the south. NAPL zones NZ-2 and NZ-5 are at the same elevation; although NZ-5 has had approximately 10 feet of fill material and asphalt placed over it during redevelopment of the former Celotex property.

NAPL Zone 6 – NAPL Zone 6 comprises NAPL observed at the intersection of Gorge and River Roads, from the northeast corner of Block 93 North, the southwest corner of the former Celotex property, the northwest corner of the Quanta property, and the southeast corner of Block 92.01. A tank farm resided immediately above NZ-6 during the time of coal tar processing. It is present at depths ranging from 8.4 to 15 feet bgs, just beneath the water table. Most NAPL in this zone is found at 10 feet bgs. The NAPL remains at least 10 feet above the surface of the silty-clay between the fill and underlying native sand or peat. Its failure to accumulate in monitoring well MW-126, which is screened within the most concentrated NAPL interval observed within NZ-6, suggests that NAPL saturation levels in this area are lower than in other NAPL zones. A natural depression in the silty clay surface in this portion of the site underlies NZ-6.

Solid Tar and Tar Boils

Solid tar has been observed in several places at the site, most frequently in the form of a black, soft-to-stiff, semiplastic-to-plastic material at discrete depth intervals, with a thickness ranging from 0.3 foot to approximately six feet. Most solid tar has been observed in the fill deposits at the Quanta property and to the west, at Block 93 North. Solid tar was found within fill material in only one boring on Block 94, and no other site-related NAPL was identified on Block 94. Surfacing of semi-plastic tar during warmer weather, referred to as "tar boils" as depicted in **Figure 13**, typically occur in areas that coincide with solid tar.

Nature and Extent of Contamination - Soil

Industrial fill material from as early as the mid-1800s can contain varying levels of PAHs and heavy metals (from sources such as cinder and coal ash), and can contribute to the presence of hazardous constituents in groundwater. Constituents of concern (COCs) detected in soil include aromatic VOCs, SVOCs (predominantly PAHs), and metals (principally arsenic and lead). COCs identified less frequently include chlorinated VOCs, pesticides, and PCBs.

VOCs and SVOCs

Soil sampling events conducted in and around the site have indicated the presence of PAHs in unsaturated and saturated soil. PAHs were not detected above screening criteria in soil samples collected from geologic units beneath the silty-clay aquitard. Exceedances of aromatic VOCs, particularly benzene, in unsaturated soils appear to lie within the extent of the historical site operations, whereas the extent of benzene in saturated soil extends slightly farther south, outside the footprint of former operations, in the direction of groundwater flow.

In general, the distribution of PAHs, aromatic VOCs, and other NAPL-related constituents (*e.g.*, select non-PAH SVOCs) was observed to be coincident with the presence of NAPL. However, concentrations of PAHs beyond the limits of former site operations have also been observed consistently above screening criteria.

Chlorinated VOCs were detected intermittently in soil samples, predominantly in saturated soil samples, across the site. Chlorinated VOCs were detected less frequently in soil at the Quanta property than at the adjacent properties, with the majority of the detections in soils at the former Lever Brothers and former Celotex properties. The infrequent and low-level detections along with the irregular distribution of chlorinated solvents in soil suggest that chlorinated VOCs do not come from a site-related source.

Inorganics

Some of the highest concentrations of metals are found in areas of former pyrite roasting associated with the former acid plant; however, concentrations of metals throughout the site, in areas not associated with the former acid plant operations have been observed consistently above screening criteria outside these areas because of the ubiquitous heterogeneous fill containing coal, cinders, and slag. The elevated arsenic concentrations in soil near the site of the former acid plant, identified as the High Concentration Arsenic Area (HCAA), have been well delineated. Because the acid plant would have generated many tons of waste pyrite cinders during its operation, RI studies were developed to fingerprint a remnant pyrite waste or signature. Sampling of fill material across the site did not identify areas of dumped waste ore except in one location; in the area of the north-central Lever Brothers property in the vicinity of monitoring well MW-107 (see **Figure 16**). Elevated arsenic concentrations in soil outside the two pyritic source zones are associated with isolated hotspots in the heterogeneous fill, and also contain concentrations of PAHs above screening criteria. The origin of these hotspots is not known, but is presumed to be site-related.

Beyond the pyritic source zones, the extent and distribution of lead in soil has been defined and is different than that of arsenic (**Figures 17** and **18**, respectively). The distribution of lead is more widespread at the former Celotex property.

Pesticides and PCBs

Pesticides in soil within OU1 represent isolated, noncontiguous release scenarios that are the likely result of the historical use of pesticides. The detected PCB concentrations above the screening criteria occur primarily in the vadose zone, typically ranging from non-detect to 3.2 mg/kg. Detected PCB concentrations exceeding screening criteria in deeper soils are limited (only five sample locations in four isolated areas).

Nature and Extent of Contamination – Groundwater

COCs identified in groundwater consist primarily of SVOCs (predominantly PAHs), aromatic VOCs, metals (*i.e.*, arsenic, lead, iron), ammonia, and, to a much lesser extent, chlorinated VOCs, pesticides, and PCBs. The extent of site-related constituents in groundwater includes all areas investigated as part of the Quanta RI (**Figures 19** through **22**), but groundwater contamination above screening criteria, with similar constituents, has been identified from remedial investigations of all neighboring properties; thus, it was not possible to "delineate" groundwater contamination to the limits of applicable screening criteria. For example, site-related constituents in groundwater, including PAHs, VOCs, and metals, are present in the northeast corner of the former Lever Brothers property, and farther south, beyond the zone of ground-water convergence.

Groundwater at the site is classified as a source of potable water; however, it is not currently used as a drinking water source. Groundwater contamination above drinking water criteria has been identified across the site, but also from remedial investigations of neighboring properties. Thus, while there are site-related groundwater problems, and site groundwater contamination is substantially elevated in neighboring areas, it was not possible to establish the limits of groundwater contamination associated with the Quanta site. The extent of site-related constituents in groundwater includes all areas investigated as part of the RI.

VOCs and SVOCs

Naphthalene and benzo(a)pyrene were selected as representative PAHs for the purpose of depicting the extent of PAH contamination in groundwater. The more soluble naphthalene extends further downgradient from known areas of NAPL than benzo(a)pyrene. In general, naphthalene in groundwater covers an area similar in shape and slightly greater than the portion of the OU1 area on which evidence of NAPL has been identified (except where off-site sources of naphthalene are present). Similarly, the extent of dissolved-phase benzo(a)pyrene is limited to within the total lateral extent of NAPL—again, with the exception of areas where off-site sources are present.

With the exception of naphthalene, the presence of dissolved-phase PAHs exceeding applicable screening criteria was not found in monitoring wells screened in the deep sand unit, indicating that most dissolved-phase PAHs are confined to the shallow fill and native sand deposits above the silty-clay aquitard.

The extent of non-PAH SVOCs at OU1 are similar to the extent of PAHs. Non-PAH SVOCs at OU1 consist primarily of phenolics (*e.g.*, phenol and 2,4-dimethylphenol), dibenzofuran, and carbazole. Non-PAH SVOCs exceeded the applicable ground-water screening criteria in a lower percentage of ground-water samples than PAHs and are found primarily in the central portions of the site. Non-PAH SVOCs do not extend beyond the footprint of the naphthalene plume.

The distribution in groundwater of benzene, a representative aromatic VOC, is consistent with the known distribution of site-related NAPL. However, with a greater solubility in groundwater, benzene exceedances in groundwater extend farther downgradient of NAPL source material than naphthalene. The areal extents of other site-related VOCs in groundwater at OU1 are located within the lateral extent of benzene.

Chlorinated VOCs were detected at their highest concentrations in the deep sand groundwater and in shallow groundwater upgradient of site-related constituents in groundwater (*e.g.*, aromatic VOCs, PAHs, and non-PAH SVOCs) at the foot of the Palisades. The lateral and vertical distribution of these compounds throughout the site, as well as the relationship of hydraulic heads between the shallow unconfined and deep sand units, indicates that the source of these chlorinated VOCs is not the result of a release or releases related to site-specific historical operations.

Inorganics

Inorganic constituents are present throughout the site groundwater, with arsenic being the most widespread. Due to the presence of arsenic in soil and groundwater across the site and at adjacent properties above the applicable soil standards, the RI focused on identifying soils that represented sources of arsenic to groundwater. There are many interdependent factors regarding geochemistry and arsenic phase associations at the site, including a number of different geochemical environments within the site that affect arsenic solubility. The RI studies included lengthy investigations to interpret the relationship between saturated zone geochemistry, arsenic soil concentrations and groundwater mobility across the site, an effort that did not lead to agreement between EPA and the PRPs. EPA has concluded that, given the uncertainties, there may not be a threshold below which arsenic in soil would not be considered a source to groundwater. Soils across the site, including areas that appear to contain nothing more than anthropogenic fill may, under certain circumstances, be a source to groundwater. The RI, on the other hand, makes the case, through several different lines of evidence, that the arsenic (and PAH) plumes from the source areas are substantially attenuated before groundwater releases to surface water.

Due to differences in the nature and extent of the pyritic sources versus those of the regional fill material, and because lead, unlike arsenic, is not redox sensitive and is expected to be relatively immobile at the site, the distribution of dissolved lead in groundwater is distinctly different than that of arsenic and iron. Thus, the portions of the site where lead concentrations are greater than the New Jersey Groundwater Quality Standard (GWQS) of 5 µg/L are almost exclusively within the footprint of the former acid plant.

Ammonia, a byproduct of coal tar distillation, was stored at the site during historical coal-tar operations, but its distribution systems (*i.e.*, piping systems) and potential use in manufacturing are not known. Ammonia concentrations above the lowest screening criterion cover the majority of the site; however, exceedances do not extend downgradient as far as the Hudson River. The distribution of ammonia concentrations observed in groundwater is consistent with the location of previous storage areas as identified on historical maps, suggesting its source is related to the former coal tar operations.

Pesticides and PCBs

Groundwater sampling results indicate that low concentrations of pesticides were detected within the interior portions of the Quanta property. These concentrations represent isolated, noncontiguous ground-water concentrations that are the result of the historical use of pesticides. The PCB Aroclor-1260 was detected in one location on the former Celotex property, and this detection is not considered site-related.

Studies of Groundwater Restoration Potential
As part of the RI, EPA assessed the potential of restoring the groundwater to its designated use as a potable water source. The objective of this evaluation was to determine whether it is technically practicable, from an engineering perspective, to restore groundwater at the site within a reasonable timeframe. This evaluation considered factors such as the volume and duration of the release of site-related constituents, the chemical properties of those constituents, and the volume and depth of contaminated media. Site-specific hydrogeologic characteristics including the relative complexity of the geology, the nature of unconsolidated sediments, the degree of heterogeneity, and the presence of low hydraulic conductivity materials at the site were also assessed as they relate to groundwater restoration potential. Finally, factors related to the highly developed urban setting were also included in this assessment.

NAPL
With a release history dating back to the late 1800s, the volume of soil containing NAPL and NAPL-related constituents at the site extends beyond the boundaries of former site operations and is estimated to be close to 1 million cubic yards. Spanning an area of approximately 24 acres and extending to depths of up to 30 feet bgs, the volume and depth of NAPL-contaminated media present significant challenges to restoring groundwater at the site.

In upland soils, NAPL distribution and mobility is density-driven and controlled largely by the NAPL viscosity and the lithologic interfaces and capillary barriers, because the majority of NAPL is denser than water (DNAPL) and typically immiscible and non-wetting. As such, it can be found accumulated at lithologic interfaces where NAPL pressure, or the displacement pressure, is insufficient to exceed the pore entry pressure of the underlying unit. In this situation, NAPL will tend to pool in the depressions in the surfaces of these units, where it is relatively immobile, but also difficult to remove. A change in any of the characteristics mentioned above will result in a shift in NAPL architecture and may result in a change in NAPL mobility if lithologic and capillary barrier conditions allow.

Using extensive investigative work (*i.e.*, the completion of over 105 soil borings, 126 laser-induced fluorescence (TarGOST®) borings, and the collection of groundwater and NAPL samples from 72 monitoring wells), the location, nature, and extent of NAPL at OU1 has been defined to the extent practicable. The comprehensive investigative work has resulted in a reasonable bounding of site-related NAPL and the definition of the six discrete NAPL zones (NZ-1 through NZ-6) where the majority of source material is located. Regardless of the large effort expended to characterize these source materials, uncertainties in the estimate of the total NAPL mass present at the site will always remain because of the effects of geologic heterogeneity and the spatial heterogeneities in NAPL distribution. At many NAPL sites such as this, characterization of the location, distribution, and amount of DNAPL causing continued groundwater contamination is difficult and often inaccurate, and removal (*i.e.*, excavation, extraction) or in-situ destruction of DNAPL, even when reasonably well characterized, has proven difficult in saturated zones with any significant degree of heterogeneity. DNAPL constituents partition slowly into the aqueous phase, usually under mass-transfer controlled conditions, resulting in a dissolved groundwater contaminant plume.

For coal tar NAPLs, the primary constituents of concern are PAHs, with a broad range of solubilities and susceptibility to biological degradation. The contaminant phase (*i.e.*, DNAPL) as well as the long duration of the release and the volume and depth of impacts are significant contaminant-related factors that will affect the technical practicability of completely addressing site-related sources to groundwater. Furthermore, the abundance of high adsorption potential, low-volatility and low-solubility semivolatile organic compounds (SVOCs) (primarily PAHs) present as components of the NAPL at OU1 and the relatively low potential of these constituents to decay biotically or abiotically, are also significant additional contaminant-related factors that contribute to the difficulty of addressing these sources and ultimately restoring groundwater.

Arsenic

The widespread distribution of metals in soils across the site and the redox-sensitive nature of arsenic represent important contaminant-related factors that affect the technical practicability of restoring groundwater at the site. The distribution of arsenic at OU1 is consistent with the location of former pyritic roasting operations associated with the former acid plant and with the sporadic distribution of smaller arsenic hotspots present throughout the historic fill, also being present at neighboring properties.

Beyond the area of the former pyritic roasting operations, and across all the properties in the area, fill deposits comprised of varying amounts of coal, cinders, slag, typically with elevated levels of arsenic and other metals, are ubiquitous. These anthropogenic deposits resulted from the infilling to raise the topographic elevation of the tidal wetlands that dominated this area along the banks of the Hudson River until the mid 1800s. As a result of leaching and dissolution that is promoted by NAPL and other sources of dissolved organics in groundwater, arsenic concentrations both within and beyond OU1 exceed drinking water standards. Soils with levels of arsenic that exceed site-specific risk criteria or that have been determined to be significant sources to groundwater contamination have been identified across the site; however, due to the nature and ubiquity of the anthropogenic historic fill throughout this area of Edgewater, concentrations of metals unrelated to operations associated with the former acid plant have also been consistently observed above risk criteria outside of these areas. While pyritic material could be physically removed or treated, the presence of additional sources in fill material present over the entire area of OU1 as well as at adjacent properties would continue to leach arsenic to the groundwater because of the geochemical factors described above. Therefore, any permanent restoration of groundwater conditions at the site must also either remove the fill material sources or undertake to control the site geochemistry throughout OU1. In addition to the limitations imposed by the extensive infrastructure (*i.e.*, utilities, roadways, existing buildings) currently in place at or near the site, a remedy that considered removal of fill would be bounded by Quanta-related activities or contaminants, whereas fill material is present through this part of Edgewater and would remain. Permanent modification of geochemical conditions is impracticable as long as organic material, including naturally occurring organic material (peat) which has been present in the area since before original filling and development, remains present at quantities sufficient to maintain a chemically reducing environment.

Hydrogeologic Factors

The hydrogeologic characteristics that have been observed at the site and which would limit the effectiveness of subsurface remediation include the complex geology (interbedded and discontinuous strata), the heterogeneous nature of the soils, and the presence of low permeability fine-grained materials such as clays and peat. Soil in the area of former site operations consists predominantly of heterogeneous fill material and deposits of native sand, peat, and organic silt in contact with shallow groundwater. The stratigraphy and heterogeneity of the fill and native deposits are significant engineering challenges for the implementation of the technologies that were considered at the site, and would pose difficulty for any technology requiring uniform injection of chemical reactants into the subsurface or bulk extraction of groundwater. Small or inconsistent radii of influence for injection and/or extraction wells could complicate the design and widespread implementation of any such technology to the extent that the technology's effectiveness would be limited. The success of *in-situ* technologies as well as excavation would also be challenging, as it would rely on overcoming the difficulty of identifying and accessing all thin discontinuous stringers of contamination that are inherently present in interbedded and heterogeneous hydrologic settings such as this. Although both excavation and select *in-situ* technologies would work well at addressing a large majority of both the organic and inorganic sources at the site as discussed below, their success at restoring groundwater would depend on identifying and addressing even the smallest residual sources. Residuals remaining after treatment would still provide ongoing sources of constituents to groundwater.

Nature and Extent of Contamination – Vapor Intrusion

Vapor intrusion studies have been conducted during the RI at a number of properties, particularly 115 River Road, where testing of indoor air began in 2002 and has been performed regularly since that time. Sampling has also been performed at the occupied buildings on Block 93 and, by representatives of i.Park, at the northern-most occupied building of that property.

These studies indicate that vapor intrusion exposures are a pathway of concern for the tested properties, though unacceptable vapor levels have not yet been detected in occupied spaces. Air samples collected from beneath building slabs have identified elevated levels of volatile site contaminants, primarily naphthalene, at 115 River Road and at several buildings on Block 93 (Tomaso's Restaurant and the Medical Arts building), though with the exception of 115 River Road, there have been no elevated levels in indoor air spaces. At 115 River Road, measurable indoor air detections have been found intermittently in several unoccupied basement spaces and, rarely, in a few other occupied spaces. The detected levels have not exceeded EPA's guidelines for exposure to indoor air. These detections led to several changes at 115 River Road including sealing of basement slabs and changes in the heating and air conditioning systems that influence how fresh air is drawn into the building. EPA, in collaboration with the State of New Jersey, has been monitoring the results from the vapor intrusion testing, which is currently performed at least annually in 115 River Road and several other occupied buildings. The PRP group has worked with the owner of 115 River Road to monitor and modify the buildings to ensure that they can be safely occupied until a remedy for the site can be selected and implemented.

Nature of Contamination – River Sediment
The OU2 RI will fully address site-related contamination in Hudson River sediment; however, several key components of an OU1 response action require a basic understanding of the conditions in OU2. At the shoreline of the site, the western shore of the Hudson is a wide mudflat at low tide, extending approximately to the end of the local piers at the former Celotex property and at 115 River Road. At high tide, water depth is between 4 and 6.5 feet. Sediments at the shoreline of the site are approximately 30 feet thick at the bulkhead line and are substantially thicker further out in the river, as the bedrock dips.

During historical site operations, ocean-going vessels and local barge traffic regularly served the Edgewater waterfront, including the shoreline of the site. Historic documentation associated with the Spencer-Kellogg (115 River Road) pier identified a target dredged depth of 30 feet for ocean-bound traffic. Dredging has not occurred for these areas for many years, resulting in the relatively new sediment deposits filling in this formerly dredged area.

The OU2 RI includes background studies on typical constituent concentrations within the broader lower Hudson River estuary, with the goal of delineating site-derived PAHs and arsenic. Results to date have identified an area in front of the site, bounded on the north by former Celotex property pier, and extending to an area south of the 115 River Road pier, and encompassing much, if not all of the mudflat within this area. The bounding of site-related sediment contamination is not complete: the approximate areal extent of this area, and whether there are other areas of site-derived sediment contamination, is still to be determined. A preliminary assessment of PAH contamination in the sediments is shown on **Figure 23**.

Within the area of sediment contamination described above, free-phase NAPL and/or NAPL staining are found in river sediment borings. Many of the thicker layers of free-phase NAPL are found below about 30 feet (extending to depths of as much as 50 to 80 feet). This might be expected from the operating history of the site, with 30 feet aligning with the formerly dredged depth of the river. This suggests a pattern of coal tar releases directly from barges or other river vessels during site operations, with newly introduced cleaner river sediments deposited in the years since operations ceased. As described above, the likelihood of historic and ongoing NAPL releases to OU2 from NZ-2 and NZ-5 is high, though some component of the free-phase NAPL in the Hudson was discharged directly into the river.

Borings found free-phase NAPL throughout the newer sediments as well (sediments shallower than 30 feet in front of the site). This NAPL appears to come either directly from the Quanta site (discharging from or around the bulkhead), or free-phase NAPL has traveled up from the deeper sediments into the shallower sediments. Oily sheens and periodic eruptions of coal tar deposits are a daily occurrence in the OU2 sediments, and are only partly managed by the existing booms placed around these areas.

CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

The land use surrounding the site is commercial or residential. The southern part of Edgewater (where the site is situated) has been the subject of new development over the past 15 to 20 years, since the construction of the "new" River Road in the 1990s, which bifurcates the original site. A number of newly developed properties (commercial/residential high rises, for the most part) surround the site, and additional plans are in place for other properties in the area, including the Quanta property, as discussed in the previous section. The 5.5-acre Quanta property is fenced and currently vacant.

Site Uses

Below is a brief summary of the current status and expected future use for properties affected by site.

- **Former Lever Brothers (i.Park):** South of the 115 River Road property is the former Lever Brothers property. This property currently is owned by i.Park Edgewater, LLC, and is in the early stages of cleanup and redevelopment. Several large, vacant buildings and structures on the former Lever Brothers property date from its historical operations, as well as several paved driveways and parking lots. A large parking lot exists on the northeastern portion of the property. The topography is very flat. The central portion of the property currently is undergoing redevelopment to be a future site for the Borough of

Edgewater municipal building. The redevelopment plans for this property include mixed use municipal, commercial and residential redevelopment, including the new Edgewater Municipal Building. NJDEP is directing cleanup efforts that are required for this property, except at the northern border adjacent to 115 River Road. The area where the northern-most buildings are planned is affected by the Quanta site, and EPA has met with the developer and NJDEP to coordinate the implementation of the Quanta remedy before these buildings are constructed.

- **115 River Road:** The majority of this property (the former Spencer-Kellogg and later Textron facility) is improved with a large multi-tenant building and a smaller parking/office building. The main 115 River Road building consists of two attached buildings that, together, extend approximately 800 feet from end to end and are between 30 and 60 feet wide. The western portion of this building located between River Road and the Hudson River is approximately 500 feet long and dates back to 1910. The main building is approximately 30 to 40 feet high and is divided into 10 different tenant-occupied subunits. The second office building, constructed in the 1990s, consists of an approximately 300-foot-long expansion of the main building and extends over the Hudson River on a pier. A smaller two-story brick building, approximately 100 feet by 25 feet and approximately 30 feet high, is north of the main 115 River Road building. The 115 River Road property is developed as commercial space, including a child care center. It recently received a variance for residential use (condominiums) on the pier building along with a restaurant and banquet hall. These changes in use, if they were to occur, would be performed as part of a future development. In New Jersey, properties with child care centers require an environmental review to make sure that properties are safe for children. Since 2002, when the site was placed on the NPL, EPA and the state of New Jersey collected (or directed the collection of) many rounds of air samples and wipe (dust) samples within the main building of 115 River Road to ensure that conditions have not changed, and these data have been used by the Palisades Child Care Center in its relicensing process. The child care center received a short-term license renewal in 2011 from the State of New Jersey.

- **Quanta Property:** This property is currently owned by Three Y LLC, who purchased it in 2008. This property has been the subject of a number of different development discussions over the years, from a ferry terminal to recreational use to mixed use redevelopment. The current owner plans several high-rise buildings with a mixed use of commercial and residential space.

- **City Place (former Celotex):** The City Place development, on the former Celotex property, includes residential and commercial space and a 122-room hotel. Substantial filling has raised the ground surface five to over 15 feet above the original grade. The portions of the property over the HCAA consist of landscaping and a paved roadway. The southern portion that is considered part of the NPL site consists of a partially paved and unpaved sloping temporary parking lot. Farther north of the temporary parking area is an unfinished multilevel parking garage, surrounded by a fenced construction zone. The developer K.Hovnanian controls the development rights to the undeveloped southern portion of the City Place property, and residential condominiums have been proposed for it. This project has been on hold pending the selection and implementation of a remedy for Quanta.

- **Block 93 North (Lots 1,2 & 3):** Three lots on Block 93 (Lots 1, 3, and the northern portion of Lot 2) are located between Old River Road and River Road, and are part of the former Barrett Manufacturing Company property. For purposes of the RI, these lots combined are referred to as Block 93 North. This property is mainly a sloped grassy area with concrete AST pads and an L-shaped concrete wall. Some vegetation and trees exist along the northern portion of the property. Lot 2 is a former railroad right-of-way that is partially paved, with some grass and gravelly areas. Debris, portions of a chain-link fence, and remnants of railroad track are present at Lot 2. A restaurant on Lot 1 was vacant for a period of time and has now been refurbished and reopened as Tomaso's Restaurant. Topography is generally flat with minimal standing water. This parcel contains Tomaso's Restaurant and is owned by Three Y, LLC, with plans for a hotel to be constructed on these lots. This parcel also is awaiting the selection and implementation of the Quanta remedy prior to redevelopment.

- **Block 93 Central (143 Old River Road, Block 93, Lots 1.01, 2, 3.03 and 3.04):** The central portion of Block 93 is adjacent to the former Barrett property, but the lots were never occupied by operations associated with oil recycling or coal-tar processing. It is occupied by several vacant buildings, including the multi-story Faesy & Bestoff Corporation building to the south of Tomaso's Restaurant on old River Road. Most of the remainder of the property is paved, and the topography is flat. This property was once part of the Spencer Kellogg & Sons operation, and subsequently a facility for Faesy & Bestoff, Inc. a pesticides/farm chemicals company. The two buildings on the property are currently vacant. The current owner has plans to redevelop the existing buildings into a residential complex.

- **Block 93 South (Lot 4):** The southern portion of Block 93 is occupied by a Bergen County municipal utilities authority pump station, a multi-tenant medical office building, and a paved parking area. The topography is flat. The lot was once part of the Lever Brothers operation.

- **Block 92.01:** This parcel is at the northwest corner of the Gorge Road and River Road intersection and is the location of Waterford Towers, a high-rise apartment building for seniors. A small section of this parcel was part of the former Barrett facility.

- **Block 94:** This parcel is west of the old River Road at the foot of the Palisades. It was once occupied by Barrett Tar, but may not have been used for industrial operations.

Groundwater Use

In evaluating Superfund sites with groundwater contamination, EPA assesses potential beneficial uses of groundwater. Neither the shallow overburden nor deeper bedrock groundwater at the site is currently in use. The aquifer is classified by the state of New Jersey as Class IIA, a potential source of drinking water; however, there are no public or private drinking water wells in the area. Drinking water in Edgewater is provided by a public water supply (United Water New Jersey, relying primarily on a series of surface water reservoirs). EPA does not anticipate the groundwater in the vicinity of the site will be used as drinking water in the future.

Surface Water Use

While this remedy does not address surface water, the current and future uses of the Hudson are relevant to the selection of the OU1 remedy. The lower Hudson River has supported a long history of industrial activities, with sediment contamination resulting from many years of both point source and nonpoint source discharges. The River is in constant use for commercial and recreational boating and fishing. Fish consumption advisories are in place for this section of the Hudson River.

SUMMARY OF SITE RISKS

As part of the RI/FS, a baseline risk assessment was conducted to determine the current and future effects of contaminants on human health and the environment. The area is a mix of commercial and residential properties, and future use is expected to remain consistent with current zoning. In addition, although groundwater is not currently used as a potable water supply, its designation by the State as a Class IIA aquifer required it be considered as a future potable water supply. Therefore, the baseline risk assessment focused on health effects on both current and potential future exposure scenarios with surface soil, subsurface soil, and groundwater.

Human Health Risk Assessment (HHRA)

An HHRA conducted for most of OU1 (with the exception of River and Gorge Roads, Block 94, and Block 92.01) identified contaminants of concern (COCs) for three media:

- Surface soil (0 to 2 feet bgs)
- Subsurface soil (0 to 10 feet bgs)
- Groundwater (above and below the silty-clay confining layer)

Risks above acceptable levels for one or more current or future receptors as a result of exposure to soil or groundwater were calculated on all properties evaluated. Primary risk drivers include naphthalene, arsenic, and carcinogenic PAHs. Along with these primary risk drivers, tar boils identified during the RI should be addressed during a remedial action, because direct contact with this material is expected to exceed acceptable risk levels (CH2M Hill, 2008). **Table 3** summarizes the exposure pathways and scenarios, which included incidental ingestion of and dermal contact with contaminated soil, and future ingestion of groundwater as a potable water supply for current and future commercial workers and construction workers and current and potential future residents (adults, adolescents, and children). Due to the presence of the Palisades Child Care Center at 115 River Road, children in a day care scenario were also evaluated at this property.

If a cumulative excess lifetime cancer risk (ELCR) level of 1×10^{-4} is exceeded for a given medium, the constituents that pose an individual ELCR greater than 1×10^{-6} for a potential receptor-property combination were identified as COCs. If a target-organ-specific hazard index (HI) exceeds 1.0, the constituents that act on that target organ are evaluated, and any constituent with an individual hazard quotient (HQ) greater than 1.0 was identified as a COC. **Table 4** presents the COCs identified for surface soil, subsurface soil, and shallow groundwater, along with the exposure point concentrations for each area. Cancer and noncancer toxicity values for all chemicals evaluated in the HHRA are presented in **Tables 5 and 6**, respectively, with the cancer classification and the systemic target organ identified. Chemicals which are known to act through a mutagenic mode of action (MMOA), such as PAHs, and for which children who are exposed at an early life stage have an increased susceptibility to develop cancer, have been evaluated consistent with the process outlines in EPA's Children's Supplement to the Cancer Guidelines by applying appropriate Age-Dependent Adjustment Factors.

Preliminary remediation goals (PRGs) were calculated for COCs in surface soil, subsurface soil (2 to 10 feet bgs), and shallow groundwater (within 10 feet of the surface). PRG development is presented in Section 2.3 of the FS. The HHRA identified arsenic and PAHs (primarily benzo(a)pyrene, dibenzo(a,h)anthracene, benzo(b)fluoranthene, benzo(a)anthracene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, and naphthalene) as the primary risk drivers for most media and receptors evaluated. **Tables 7** and **8** present the relative risk contributions for each of these constituents for cancer risk and noncancer hazard, respectively. As presented in Table 5, cancer risks estimated for each area exceed the upperbound of EPA's acceptable risk range, with the greatest risks for soils estimated for future residential use of the Quanta Resources property (cancer risks of 4×10^{-2}). Noncancer hazards also exceeded EPA's benchmark of a hazard index of greater than 1, with the greatest hazard associated with exposure to construction workers at the Quanta Resources property. On the basis of the HHRA conclusions, the remedial alternatives will target these primary risk drivers, as well as NAPL (a source of PAHs and aromatic VOCs). Although the complete list of COCs will be considered, it is believed that if the primary risk drivers and NAPL are adequately addressed, the site remedial action objectives (RAOs) will be achieved.
The results from site studies have indicated that vapors of site-related chemicals, primarily naphthalene and benzene, have been detected in the subslab of three buildings (115 River Road, 163 River Road [Tomaso's Restaurant], and 103 River Road [Medical Arts Building]) above conservative health-based screening levels. Indoor air samples at 115 River Road

indicated that naphthalene has at times been detected, though below levels of concern. The detections of this chemical did not follow the standard profile for vapor intrusion, which may suggest an indoor source of this chemical, which can also be found in certain cleaning products. Indoor air results at the other two buildings did not indicate any indoor air impacts. Future changes in site conditions (*e.g.*, land use, condition of the building, and condition of the subsurface groundwater/ NAPL/source area) would require a reevaluation of the vapor intrusion pathway.

The focus of this operable unit is to address coal tar NAPL and the HCAA, which are principal threat wastes at the site. Coal tar constituents and arsenic are toxic to ecological receptors and humans through direct contact, incidental ingestion, and inhalation. Potential exposure from the NAPL and HCAA could result in adverse health effects to ecological receptors and humans. It is, therefore, important that steps be taken to reduce or eliminate the volume of NAPL present at the site. Further information about the nature and extent of contamination found at the site is included in the Administrative Record.

Screening Level Ecological Risk Assessment (SLERA)
As part of the risk assessment, exposure to ecological receptors was considered by performing a screening level ecological risk assessment. This assessment did not identify concerns for any ecological receptors for OU1. Ecological receptors are a major focus for the surface water and sediments of the Hudson River (OU2), where a comprehensive baseline ecological risk assessment (BERA) is being performed as part of the OU2 RI.

Conclusion
Based upon the results of the site studies to date, EPA has determined that actual or threatened releases of hazardous substances from the site, if not addressed by the preferred alternative or one of the other active measures considered, may present a current or potential threat to human health and the environment.

REMEDIAL ACTION OBJECTIVES

The following Remedial Action Objectives (RAOs) address the human health risks and environmental concerns at the Quanta Resources site. The RAOs are organized into three categories-principal threat waste, soil, and groundwater.

Principal Threat Waste
Principal threat wastes are considered source materials, *i.e.*, materials that include or contain hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to groundwater, surface water, or as a source for direct exposure. 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. CERCLA expects EPA to consider, and select where appropriate, treatment as a significant component of site remedies that address principal threats. The six NAPL zones contain principal threat wastes, to varying degrees, as discussed below. In addition, EPA considers the HCAA and other arsenic hotspots to be principal threats at the site, as discussed below. EPA has established the following RAOs for principal threat waste:

- Remove, treat, or contain principal threat waste, to the extent practicable;
- Prevent exposure to NAPL and arsenic source material that poses an unacceptable human health risk;
- Prevent current or potential future migration of free-phase NAPL to the Hudson River or to areas that would result in direct contact exposure;
- Mitigate free-phase NAPL that poses a potential source of vapor intrusion and resulting inhalation exposure within existing or potential future structures; and
- Mitigate NAPL and arsenic principal threats as a source of groundwater contamination, to the extent practicable.

Exposure through direct contact, ingestion, or inhalation is plausible for NZ-1 and NZ-2, and the potential is likely that future use of the site could result in exposure if appropriate remedial actions are not implemented. Direct exposure to NAPL in NZ-3, NZ-4 or NZ-6 is unlikely, even under a construction scenario, given their depth (generally deeper than 10 feet below ground surface). Without additional remedial effort, there is the potential for the migration of free-phase NAPL to sediment and surface water in the Hudson River from NZ-2 and NZ-5. Release of free-phase NAPL from NZ-1, NZ-3, NZ-4, and NZ-6 to sediments is not plausible. The results of vapor intrusion studies conducted during the RI conclude that ongoing monitoring and temporary measures have been sufficient to ensure that vapor intrusion does not currently pose an unacceptable human health risk; however, without additional remedial effort, there is the potential for vapor migration and exposure from free-phase NAPL to areas with existing or potential future buildings.

EPA has concluded that, while the six NAPL zones all contain principal threat waste, the overall effectiveness of satisfying the RAOs, and most of the mass, will be addressed through actions that target NZ-1, NZ-2/NZ-5, and portions of NZ-3 that appear to be a continuation of NZ-1 (that is, within approximately five feet of the bottom of NZ-1). EPA considered using the same remedial technologies to address all the NAPL zones (*i.e.*, the remainder of NZ-3, NZ-4 and NZ-6 —collectively referred to as the "deep NAPL"). EPA concluded that such an approach would be substantially more difficult to implement successfully, at a much higher cost, and would be highly disruptive for the community. Furthermore, EPA believes that the environmental benefits of treating NZ-1, NZ-2 & NZ-5, and portions of NZ-3 would be substantial and measureable, whereas the additional benefits accrued by using the same approach to the deep NAPL, while not insignificant, would be relatively small, and should be balanced against the extensive areas of residual NAPL and thin, lenses of free-phase NAPL (that is, areas of NAPL outside the six NAPL zones) that would still remain untreated. Of the RAOs for source areas, only the last RAO regarding mitigating sources to groundwater is relevant to the deep NAPL; the RAOs for direct contact and for free-phase migration of NAPL to sediments do not apply. Thus, less intrusive remedial technologies, coupled with monitoring and mitigating the release of contaminated groundwater to surface water, were considered for the deep NAPL zones.

EPA also considers a portion of the arsenic soil contamination to be a principal threat, as discussed in more detail in the Remediation Goals section, below.

Soil:

- Prevent or minimize potential human exposure through direct contact, ingestion, dust inhalation, or vapor intrusion that presents unacceptable risk from exposure to contaminated soil attributable to the site; and
- Prevent or minimize potential erosional transport off site or to the Hudson River of contaminated soils at concentrations posing unacceptable risk.

The Quanta property is currently unoccupied and fenced, minimizing exposure to contaminated soil under existing conditions. Developed areas of the site (such as 115 River Road) have, for the most part, existing engineering controls, such as building foundations and paved parking areas that currently mitigate direct contact or ingestion. New development of affected properties may result in potential direct-contact or ingestion exposure from soil if appropriate remedial actions are not implemented. Thus, there is a potential for exposure to soils by receptors (*e.g.*, construction/utility workers, commercial workers, trespassers [including children], and residents) that may present an unacceptable risk under existing or future conditions if not addressed appropriately by the remedial action selected for the site.

Possible erosion of surficial soil not covered with asphalt, concrete paving, or vegetation could result in the off-site migration of contaminants in soil at concentrations posing unacceptable risks through direct contact and ingestion. Although this potential risk is minimal under existing conditions, future use may render the site more susceptible to erosion and transport.

Groundwater:

- Prevent or minimize potential exposure by contact, ingestion, or inhalation/vapor intrusion that presents unacceptable risk from exposure to contaminated groundwater attributable to the site; and

  Prevent migration and preferential flow of site contaminants in groundwater to sediments and surface water of the Hudson River at levels posing an unacceptable risk to human health or ecological receptors.

The shallow aquifer (above the clay confining unit) has been identified by New Jersey as Class IIA (a potential source of drinking water); therefore, applicable or relevant and appropriate requirements (ARARs) for groundwater include the NJDEP Groundwater Quality Criteria (NJAC 7:9-6), the Safe Drinking Water Act maximum contaminant levels (MCLs), and the New Jersey Secondary Drinking Water Standards (NJAC 7:10-7). In developing RAOs for groundwater, EPA expects to return usable groundwater to its beneficial use wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site.

Potential for Groundwater Restoration

EPA also acknowledges that groundwater restoration, in this case to drinking water standards, is not always achievable, due to limitations in remedial technologies and other site-specific factors. While evaluating potential remedial technologies for the FS, EPA and the PRPs also evaluated the technical feasibility of aquifer restoration and the need to waive ARARs for technical impracticability (TI).

A stand-alone "Draft Final Technical Impracticability Evaluation Report—Operable Unit 1, Quanta Resources Site, Edgewater, NJ," (CH2M Hill, July 2010), was prepared to assess whether it is technically practicable, from an engineering perspective, to restore groundwater at the site within a reasonable timeframe. Within the TI Evaluation Report, factors such as the volume and duration of the release of site-related constituents were considered in evaluating the potential for groundwater restoration at the site. The chemical properties of these constituents, and the volume and depth of contaminated media were also considered. Site-specific hydrogeologic characteristics including the relative complexity of the geology, the nature of unconsolidated sediments, the degree of heterogeneity, and the presence of low hydraulic conductivity materials at the site were assessed as they relate to groundwater restoration potential. Finally, factors related to the highly developed urban setting were also included in this assessment. These factors are summarized below.

Contaminant-related factors:

- The widespread presence of NAPL (primarily as DNAPL), and recalcitrant DNAPL-related constituents;
- The long history of industrial use and associated releases at the site;
- The volume and depth of contaminated media; and
- The presence of arsenic in soil and groundwater, and the co-location of arsenic and DNAPL.

Hydrogeologic factors:

- The complex geology consisting of interbedded and undulating layers of sands, silts and clays with discontinuous peat deposits; and
- Heterogeneous soil conditions and the presence of low permeability materials such as silts and clays.

Site-setting factors:

- The highly urbanized environment with significant surficial and subsurface infrastructure.

In addition, the presence of off-site sources and regional characteristics would undermine a successful restoration within OU1. These sources would recontaminate the area and continue to render groundwater unusable as a potable source for reasons beyond the scope of the Quanta site remedy. Even at the site, residuals are expected to remain after treatment or removal, in the form of thin layers of NAPL lying between or outside the NAPL zones, or as soil contamination. These residuals would continue to contribute to the aqueous plume of inorganic and organic constituents and prevent remediation of the groundwater to applicable drinking water standards.

Please note that conventional water resource planning practices would not lead to the use of groundwater in the area as a potable water source, either by a private or municipal user, irrespective of the presence of site-related contamination. Factors that have been considered in making this conclusion include the saline content of the groundwater, given its proximity to the Hudson River, as well as the absence of any suitable water-bearing unit that would allow the construction or extraction of a potable water source in accordance with New Jersey regulations. This conclusion only applies to the shallow groundwater, above the clay confining layer, where site-related contamination has been found, and not to deeper groundwater. Please note that there are no potable wells in the vicinity of the property, and water supply planning for the area does not identify any groundwater supply needs in the vicinity of the site. Moreover, a reliable municipal water supply is readily available. Therefore, the potable groundwater use exposure pathway is expected to remain incomplete for the reasonably foreseeable future.

Based upon the findings of the potential for aquifer restoration, EPA has concluded that a waiver of the groundwater ARARs will be required due to technical impracticability. The RAOs for groundwater at the site were developed to minimize further migration of the contaminant plume and mitigate impacts to the downgradient receptors. The TI Evaluation Report documents the specific ARAR being waived, the area where a TI waiver is needed, and is included in the Administrative Record for the site.

When restoration of groundwater to beneficial uses is not practicable, EPA expects to address sources to the extent practicable, particularly when addressing groundwater sources also supports further risk reduction for the site as a whole. With an ARARs waiver, EPA also expects to prevent further migration of the plume and prevent exposure to the contaminated groundwater. The RAOs for the source areas and for groundwater have been developed to satisfy these expectations.

The primary RAO with regard to groundwater is to prevent unacceptable risks in surface water and sediments through migration of groundwater constituents. The potential for groundwater constituents to migrate to surface water, sediments, and underlying organic silts in the Hudson River at levels posing unacceptable risk is being evaluated in the OU2 BERA; however, given that the groundwater sources are expected to remain after the completion of this action, containment or treatment of potential aqueous releases is expected to be a component of any remedy that is selected for the site.

Groundwater is not used as a source of potable water in this area, so exposure to contaminated groundwater through direct contact, ingestion, or inhalation would only occur as a result of direct exposure to the very shallow water table, which is as little as one to two feet below the ground surface.

These RAOs were developed for the shallow, unconfined groundwater; deeper groundwater, below the clay confining unit, and in the bedrock, is unaffected by the site. Like the shallow unconfined groundwater that is contaminated by the site, deeper groundwater units are also not currently used as a source of drinking water. The waiver of ARARs does not apply to this deeper groundwater.

REMEDIATION GOALS

To meet the RAOs defined above, EPA has identified remediation goals to aid in defining the extent of contaminated media requiring remedial action. In general, remediation goals establish media-specific concentrations of site contaminants that will pose no unacceptable risk to human health and the environment. For this site, remediation goals have also been developed to establish criteria to define the source areas deemed principal threat waste at the site, areas for which EPA has concluded treatment should be considered as part of the remedy.

Source Area (Principal Threat) Remediation Goals

Remediation goals for addressing the source areas will vary based on the upon the treatment method selected. Performance-based remediation goals for specific technologies are discussed in the descriptions of the different alternatives. After reviewing the RI, EPA has identified the six NAPL zones, where most of the mass of free-phase NAPL is found, and the multiple arsenic source areas in addition to the HCAA, as the source areas, or principal threats, for the site.

Further delineation to refine the boundaries of the principal threat NAPL zones is expected during the remedial design phase. The RI also identified frequent NAPL detections, such as thin lenses, stringers or staining with NAPL at multiple layers in the upper unconsolidated strata. While not of the same magnitude as the delineated NAPL zones, these other detections still constitute a significant mass of NAPL; however, EPA has not included NAPL detections outside the six NAPL zones in the definition of source areas. EPA has concluded that this material is too diffuse and wide-spread, and that it is technically impracticable to characterize the extent of this material to make treatment or excavation possible.

With regard to arsenic, EPA has identified a risk-based principal threat criterion of 390 parts per million (390 ppm) for arsenic contamination in the shallow, unsaturated soils (approximately the first four feet of surface soil) and 1,000 ppm for deeper soils and the HCAA, as the source areas for arsenic. These remediation goals have been developed in consultation with NJDEP, based upon EPA's principal threat guidance for assessing toxicity and NJDEP's Immediate Environmental Concern (IEC) Guidance. Similar to NAPL, arsenic in soils is ubiquitous throughout the study area. Levels not exceeding these source area remediation goals but exceeding risk-based soil remediation goals (discussed below) still need to be addressed as part of this remedy, as discussed under soils, below.

Soil Remediation Goals

Risk-based soil remediation goals were developed based on the potential exposure risks for ingestion, dermal contact, and inhalation human health exposure pathways. The human health exposure pathways that have been evaluated included both residential and nonresidential exposures. Soil remediation goals were selected as the lower of the risk-based concentrations and the New Jersey Soil Remediation Standards for residential or nonresidential land use.

Soil remediation goals are presented in **Table 9**. Soils that exceed these values, but are not in areas identified as source areas, can generally be managed in place with engineering controls (capping) and proper land-use restrictions. As described earlier, most if not all the properties investigated during the RI were found to have exceedances of these soil remediation goals, as would be expected for this type of former industrial property.

Groundwater Remediation Goals

Remediation goals were developed for groundwater based on the RAOs discussed earlier. The lower of the EPA federal MCLs, NJDEP Groundwater Quality Criteria, and site-specific, risk-based concentrations was selected as the remediation goal. The remediation goals for groundwater are listed in **Table 10**. Consistent with the RAOs for groundwater, these remediation goals will be used for developing use restrictions and other actions to prevent exposure, and for assessing mitigation of the aqueous plume (preventing it from reaching the surface sediments or surface water of the Hudson River), but not for achieving restoration of the groundwater. Benthic organisms in shallow sediments are an important component to the Hudson River ecosystem, and protecting this biotic zone of shallow sediments is also a remedial goal. The OU2 RI will determine the thickness of this biotic sediment zone; for the purpose of selecting an OU1 groundwater remedy, this zone is assumed to be no more than the top two feet of the sediments.

DESCRIPTION OF ALTERNATIVES

CERCLA requires that each remedial alternative be protective of human health and the environment, be cost effective, comply with other statutory laws, and utilize permanent solutions and alternative treatment technologies and resource recovery technologies to the maximum extent practicable. In addition, the statute includes a preference for the use of treatment as a principal element for the reduction of toxicity, mobility or volume of hazardous substances. Remedial alternatives for the Quanta Resources site are presented in this section.

Detailed descriptions of the remedial alternatives can be found in the FS Report.

Common Elements

Many of these alternatives include common components. Because any combination of remedial alternatives will result in some contaminants remaining on the site above levels that would allow for unrestricted use, five-year reviews will be conducted. In addition, institutional controls such as a deed notice or a restrictive covenant will be required for the affected properties as one component of maintaining the long-term protectiveness of the implemented remedy.

All the alternatives, with the exception of the no further action alternative, include soil capping and institutional controls to prevent exposure to low-level threat waste and residual concentrations of COCs, and vapor intrusion mitigation to eliminate the exposure pathway to indoor air. **Figure 24** depicts the areas that will be capped as part of each active alternative. Operating vapor mitigation systems and maintaining the integrity of capping controls over the long term will require expenditures for operation and maintenance (O&M) and institutional controls. These responsibilities would be performed by land owners of the various parcels, in collaboration with the parties implementing the remedy, either PRPs or EPA. Costs for O&M are included with each alternative. Additional, alternative-specific O&M costs (beyond what is required here) are discussed with each alternative description.

Long-term O&M and monitoring are required, to varying degrees, for all the remedial alternatives, because long-term management of residual wastes is a component of all the remedial alternatives considered. Consistent with the NCP, EPA uses 30 years as the cost estimating timeframe for O&M and monitoring programs when developing remedial alternative costs in an FS; however, when wastes are left on a site at the completion of a remedy, the management of those wastes becomes a permanent, ongoing requirement of the remedy, without a time limit.

Please refer to **Table 11** for a summary of all the remedial alternatives.

Groundwater Remedial Alternatives

The groundwater alternatives provide for a mitigation barrier, using different remedial techniques, to contain, capture, or passively treat aqueous-phase coal tar constituents and metals. As such, all the groundwater alternatives are meant to be permanent, long-term containment/treatment remedies for the groundwater, addressing potential release of groundwater contaminants to the Hudson River and sediments. These actions, in addition to the soil/source area response actions, were developed to support an ARARs waiver for the on-site groundwater. EPA guidance requires that alternative measures must be taken to ensure that a final remedy is protective in the wake of a technical impracticability determination. Three groundwater alternatives were evaluated. These groundwater alternatives, to some degree, are interchangeable among the site-wide alternatives; however, for reasons described in the separate site-wide alternatives below, particular groundwater alternatives fit more appropriately with certain overall response measures. (Please note that some of the site-wide remedial alternatives incorporate remedies for the HCAA that are, in essence, targeted groundwater remedies.)

Alternative G1 – Passive Treatment Using Funnel-and-Gate/Permeable Reactive Barrier (PRB) System

Alternative G1 would be designed to capture and treat contaminated groundwater in place or "*in situ*" with a permeable reactive barrier (PRB), probably in combination with a funnel-and-gate system. A passive system would be placed along the shoreline, penetrating vertically from the ground surface down to the silty-clay confining unit to provide for treatment of the groundwater. The funnel-and-gate system would include an impermeable barrier installed along the shoreline, funneling groundwater through treatment gates prior to its discharge to the Hudson River. The PRB would include placement of reactive media and backfill material into a trench oriented to intercept and passively treat dissolved-phase organic and inorganic constituents. Reactive media could include a combination of materials such as zero-valent iron, organoclay and granular activated carbon. A number of passive treatment materials are currently on the market; selection of PRB system components would take place during remedial design.

During remedial design, it would be necessary to assess the treatment capacity of the reactive media, as the treatment capacity will eventually be used up, allowing breakthrough. Systems can be designed to be regenerated, restoring the treatment capacity of the existing media, or the media can be removed and replaced. Other design considerations include devising a comprehensive groundwater capture system (so that contaminated groundwater passes through, rather than around or over the top of the treatment zones) and managing NAPL fouling. Monitoring of the passive treatment system would be conducted to predict when treatment media replacement is required. Site groundwater conditions would be monitored to verify that site-related groundwater contamination is being captured, and that the footprint of the site-related groundwater contamination is not increasing. The treatment zone would be placed as close to the waterfront as feasible, maximizing the capture area for contaminated groundwater; however, maximizing the capture area leaves little area downgradient to monitor the performance of the PRB to demonstrate that it is performing as intended. Also, principal threat and aqueous-phase coal tar constituents and arsenic are found in Hudson River sediments, so it may not be possible to reliably measure performance by monitoring the diminution of the downgradient plume. EPA expects that this issue would be mitigated to some degree, but it would not be resolved by an OU2 sediment remedial action.

Institutional controls (groundwater use restrictions in the form of a classification exception area [CEA]) would be put in place to prevent future exposure to groundwater. In addition, access to the passive treatment system would be required over the long term, for maintenance, monitoring, and periodic regeneration/ replacement of the reactive media.

Alternative G2 – Hydraulic Containment with a Cutoff Wall and Groundwater Extraction/Treatment System

Groundwater Alternative G2 would capture contaminated groundwater, followed by *ex-situ* treatment prior to discharge. The groundwater would be captured through the use of an impermeable barrier installed along the shoreline and groundwater extraction wells installed upgradient of the barrier to manage groundwater flow. The groundwater treatment system is assumed to include the following, which would be used to treat groundwater at approximately 25 gallons per minute (25 gpm) before it is discharged to the Hudson River, consistent with all permit requirements:

- Pumping and equalization of influent water;
- Removal of NAPL (*e.g.*, oil-water separation);
- Advanced oxidation and chemical treatment (coagulation and flocculation);
- Solid-liquid separation (*e.g.*, inclined plate clarifier, dissolved air flotation);
- Sludge dewatering (*e.g.*, rotary drum vacuum filter, filter press); and
- Effluent polishing (*e.g.*, granular activated carbon, ion exchange resins).

The optimal groundwater extraction rates required and the final configuration of the extraction wells and cutoff wall would be determined during design. As with Alternative G1, NAPL is expected to enter the groundwater collection system and would need to be managed to prevent fouling, collected and removed. (It is not expected that a substantial mass of NAPL would be collected in this way, because pumping of the groundwater would have little influence on the NAPL.)

Site groundwater conditions would be monitored to verify that site-related groundwater contamination is being captured, and that the footprint of the site-related groundwater contamination is not increasing. The cutoff wall would be placed as close to the waterfront as feasible, maximizing the containment area for contaminated groundwater; however, as with Alternative G1, groundwater outside the cutoff wall (within Hudson River sediments) would continue to be exposed to principal threat coal tar constituents (and to a lesser degree arsenic sorbed to sediments), so it may not be possible to reliably measure performance by monitoring the diminution of the downgradient plume. EPA expects that this issue would be mitigated to some degree, but not resolved by, an OU2 sediment remedial action. Alternative G2 would be expected to meet the Groundwater Remediation Goals in monitoring wells outside the cut-off wall, though monitoring would be compromised by contaminants in the deep sediments.

Institutional controls (groundwater use restrictions in the form of a classification exception area [CEA]) would be put in place to prevent future exposure to groundwater. In addition, access to the groundwater collection system and the treatment works would be required over the long term, for operation, maintenance, and monitoring.

Alternative G3 – Subaqueous Reactive Barrier (SRB)
Groundwater Alternative G3 would treat contaminated groundwater as it flows through a horizontally placed SRB before being discharged to the surface water of the Hudson River. Implementation of Alternative G3 would take place in OU2 sediments, and would be coordinated with a remedial action to address contaminated sediments. It would not be implemented until after selection of the OU2 remedy.

The SRB would consist of a permeable subaqueous reactive mat to treat COCs as the pore water discharges by advection through the sediments to the surface water of the river. SRBs can include geotextiles, liners, and other permeable elements in multiple layers that include the addition of material to attenuate the flux of constituents (*e.g.*, the reactive core of granular activated carbon or organoclay) sandwiched between permeable layers. Reactive core materials would be encapsulated between carrier textiles that adhere together to provide integrity.

A groundwater model incorporating site-specific conditions would be required to predict the expected effectiveness and operation and maintenance (O&M) requirements of the SRB. Bench-scale testing would be performed to assess the sorptive capacity of the core material. Reactive barrier treatment may be reversible if adsorption sites are completely used up, allowing desorption to occur; therefore, monitoring of the SRB would be conducted periodically to predict when replacement would be required, monitor for blockages and to ensure the effectiveness of the SRB. The SRB would be expected to meet the groundwater remediation goals in seep water.

The final design of the SRB, including the size and material, would be highly dependent on the upwelling zones and the pore water concentrations, along with other requirements of an SRB that may be part of the OU2 remedy. (The SRB can be thought of as a stand-alone action installed independent of the OU2 sediment remedy; however, a concurrent sediment action that might also use the SRB is likely.) The risks associated with the constituents found in the pore water are being assessed as part of the OU2 BERA. The SRB may need to be secured in place by a layer of sand or sand-gravel mix, along with an armor layer to protect the SRB from hydraulic scour conditions due to storm surge flows, if deemed necessary based on the results of the OU2 sediment stability study. Benthic organisms in the shallow sediments are an important component to the Hudson River ecosystem, so the SRB would be covered with a layer of clean sediment that would support this biologically active zone.

Site groundwater conditions would be monitored to verify that site-related groundwater contamination is being captured and treated prior to discharge to surface water, and that the extent and volume of the site-related groundwater contamination is not increasing. Institutional controls (groundwater use restrictions in the form of a CEA) would be applied to prevent future exposure to groundwater.

Site-wide Remedial Alternatives

115 River Road

Free-phase NAPL associated with NZ-1, NZ-2 and NZ-3 is located below the buildings at 115 River Road. While developing remedial alternatives, the FS evaluated technologies that could treat or excavate the NAPL wastes underneath the buildings. The methods considered included the technologies that were found to be most appropriate for the rest of the site (discussed below in this section) as well as a number of other techniques that have been used successfully at other sites. Implementing treatment or even excavation beneath buildings is plausible under certain conditions; however, the age of construction (c. 1910) and manner of support (the buildings rest on wooden pilings) raised questions about the structural stability of the buildings if subjected to this kind of action. While the buildings are in good condition, these studies determined that *in-situ* technologies, or even partial excavation, to address the NAPL could not be implemented without compromising the structural stability of the buildings.

Because the buildings are fully occupied and the building interiors themselves are not affected by site contamination, only the areas beneath them, the FS evaluated alternatives allowing for the preservation of the buildings: these are the "a" alternatives. The "b" alternatives demolish the buildings to access the underlying NAPL zones.

As discussed previously, the remedial alternatives discussed below take different approaches for addressing the deep NAPL (NZ-4, NZ-6, and the more diffuse portions of NZ-3) than for NZ-1, NZ-2/5 and the central portion of NZ-3. Because they are at greater depths and are more diffuse, the deep NAPL zones are more difficult to remediate; for these same reasons, they contain less mass, pose a low toxicity potential through direct exposure, and pose little potential for further NAPL migration beyond their current boundaries. Thus, remediating the deep NAPL does less to achieve the goals of the source area RAOs, compared to the other NAPL zones and the arsenic hotspots. For the deep NAPL, the remedial alternatives focus on passive technologies with monitoring, actions that, when coupled with actions that address vapor intrusion potential and migration of contaminated groundwater to surface water, address the source area RAOs as they pertain to the deep NAPL. Please note that, for the "a" alternatives where the 115 River Road buildings are not demolished, the buildings themselves become an integral part of the remedy and, therefore, future construction or improvements at those buildings would need to be assessed for their affect on the protectiveness of the remedy, and EPA would have a long-term oversight function of this property.

River Road

Settling has been a recurring issue for River Road at the Quanta Resources site. Engineering studies conducted during the RI/FS concluded that the settling was a structural issue that is independent from the site contamination. EPA has concluded that the settling issues probably cannot be addressed by Bergen County independent of an OU1 remedy, so EPA plans to coordinate the implementation of that aspect of the remedy with structural road repairs initiated by the County.

The following alternatives were evaluated:

Alternative 1 – No Action

Capital Cost:	$0
Annual O&M Costs:	$0
Total Present Worth:	$0
Implementation Timeframe:	Not Applicable

The NCP requires that a "No Action" alternative be developed as a baseline for comparing other remedial alternatives. Under this alternative, there would be no remedial actions conducted at the site to control or remove site contaminants or NAPL, or to prevent exposure at the site. No further remedial action would be taken for groundwater, and contaminants in groundwater would continue to reach the Hudson River. Vapor intrusion mitigation would not be provided for 115 River Road or other buildings. Alternative 1 does not include monitoring or institutional controls.

Because this alternative would result in contaminants remaining on site above health-based levels, CERCLA requires that the site be reviewed every five years. If justified by the review, remedial actions may be implemented to remove or treat the wastes.

Alternative 2 – Source Area Containment, Preserving 115 River Road (with Groundwater Alternative G1)

Capital Cost:	$32,270,000
Annual O&M Costs:	$1,428,900
Total Present Worth:	$41,490,000
Implementation Timeframe:	2 Years

Alternative 2 includes the following remedial components: Groundwater Alternative G1; capping/engineering controls, NAPL monitoring; institutional controls; vapor mitigation/ retrofitting of buildings at 115 River Road; and operation and maintenance (O&M). **Figure 25** depicts the plan view of this alternative. The primary goal of this alternative is containment through capping and passive groundwater treatment. **Figures 25A** through **25E** show the cross-section view of this alternative.

Groundwater Alternative G1 includes installation of a passive *in-situ* groundwater remedy to capture and treat aqueous-phase NAPL and metals prior to release into the Hudson River and sediments.

Capping/Engineering Controls
Capping would occur in areas where site-related constituents exceed remediation goals in surface soil, to prevent direct contact and to prevent erosion of contaminated soil. The engineered cap would be placed over the Quanta property and affected areas on the 115 River Road, Block 93 North, Block 93 Central, and Block 94 properties, replacing existing asphalt or other cover material.

The engineered cap for affected areas on the 115 River Road, Block 93 North, Block 93 Central, and Block 94 properties would vary, but examples might consist of a six-inch sub-base underlayment and a four-inch thick paved surface, or six inches of underlayment and a two-foot thick soil cover and vegetation, depending on future land use. Cap design would be consistent with NJDEP's *Guidance Document for the Remediation of Contaminated Soils*.

Deed restrictions would be required to maintain protectiveness and functional integrity of the cap. Fill may be brought in to bring the vegetative cap on the Quanta property up to the same elevation as the adjacent properties (*i.e.*, the former Celotex property and River Road) for redevelopment purposes; however, this action is not considered a component of the alternative.

The current building foundations on the 115 River Road, Block 93 North, Block 93 Central, Block 93 South, and former Lever Brothers properties would remain in place as engineering controls unless replaced in the future by similar or more protective surfaces. The existing surfaces of River and Gorge Roads would also remain in place. These existing surfaces would be inspected and maintained to ensure their continued effectiveness as engineering controls.

Institutional Controls
Alternative 2 relies on institutional controls to prevent exposure to site contaminants. The institutional controls for Alternative 2 include land-use, construction, and groundwater use restrictions. Land-use restrictions would apply for all areas at which COCs remain in place in exceedance of remedial goals. Deed notices for each affected property would be prepared in accordance with NJDEP Technical Requirements for Site Remediation (NJAC 7:26E). As part of the land use restriction, biennial certifications would be submitted to NJDEP while the engineering and institutional controls remain in place. Institutional controls would require that appropriate engineering controls are used to ensure the continued protection

of human health and the environment before, during, and after potential redevelopment.

Future activities at the site may require the installation of deep foundations (such as piling or drilled shafts [caissons]) for building construction due to the presence of compressive soils in the subsurface. Institutional controls would also require construction techniques that limit the potential of vertical migration of NAPL along the pile. Future construction restrictions would be included in a deed notice submitted to and approved by NJDEP.

NJDEP would be requested to establish a groundwater Classification Exception Area (CEA) in accordance with NJDEP regulations (NJAC 7:26E-8.3) to prohibit future use of the groundwater within this area, and to restrict the installation of wells (other than for monitoring or remediation purposes) in the area for the duration of the CEA.

NAPL Monitoring

Alternative 2 makes use of existing monitoring wells to perform long-term monitoring of NAPL contamination. Monitoring wells would be sampled to assess the extent of NAPL contamination and to evaluate whether NAPL wastes have migrated beyond the limits anticipated at the time that the remedy was selected.

Vapor Mitigation, Retrofitting of 115 River Road Buildings

The buildings would be modified with a vapor mitigation system, such as a sub-slab depressurization system, and the basements and lowest building spaces would be evaluated and sealed as necessary to ensure that the buildings remain protective for continued occupancy. In addition, water table or NAPL infiltration may be a concern in future (for instance, if development of neighboring properties raises the water table at 115 River Road), so this remedial alternative would include a sump system capable of handling aqueous or NAPL contamination that would be installed to maintain air void space beneath the building, as needed to implement a vapor mitigation system and maintain the protectiveness of the remedy.

Continued vapor intrusion monitoring would be performed for 115 River Road buildings and other affected properties. Additional vapor intrusion mitigation systems at the other properties would be implemented as indicated by the monitoring data.

Operation and Maintenance (O&M)
In addition to the O&M associated with Alternative G1 (discussed above), a long-term monitoring and maintenance program would be implemented to ensure that the integrity and effectiveness of the engineering controls is maintained. These buildings would require monitoring to ensure the long-term effectiveness of the action.

Long-term O&M of the cap and associated storm-water management facilities would be required to ensure that their functional integrity is maintained. O&M would generally include routine inspection, mowing to control vegetative growth, clearing of accumulated sediment/debris from drainage channels, and repairing cover vegetation and soils damaged by erosion, differential settlement, and/or other factors.

Alternative 3 – Source Area Containment with NAPL Recovery, Preserving 115 River Road (with Groundwater Alternative G2)

Capital Cost:	$42,300,000
Annual O&M Costs:	$2,477,720
Total Present Worth:	$63,640,000
Implementation Timeframe:	2 Years

Alternative 3, includes the same components as Alternative 2, with the addition of NAPL recovery wells and off-site NAPL treatment and disposal to manage free-phase NAPL, and a targeted groundwater containment wall around the HCAA.

In Alternative 3, principal threat free-phase NAPL would be recovered, to the extent practicable, from recovery wells or recovery trenches.

The primary goals of this alternative are containment through capping and hydraulic groundwater containment, with passive reduction of NAPL mass.

Figure 26 shows the plan view for this alternative. Cross-sectional views of this alternative are found in **Figures 26A** through **26E**.

NAPL Recovery Wells, Off-site Treatment and Disposal
Free-phase NAPL would be recovered, from recovery wells or recovery trenches. For purposes of the FS, the NAPL recovery system was assumed to be 10 vertical recovery wells installed at locations where free-phase NAPL has been identified. The recovery system would be developed to address NZ-1, NZ-2/5, and

the deep NAPL zones to the extent practicable. Recovered NAPL would be extracted from the recovery wells and collected and stored in a centralized area. The remediation goal for NAPL extraction would be to reach a point at which no measureable free-phase NAPL collects in the well or trench; however, over time, NAPL collection systems can stop producing extractable quantities of NAPL, yet there can still be measurable quantities of NAPL in the vicinity of the collection system, so an alternative remedial endpoint may ultimately be necessary. This remediation goal would be refined during remedial design testing. In addition, methods for enhancing the performance of a NAPL recovery system would be evaluated during remedial design, to determine whether the use of enhancements, such as heating or surfactants, would improve the performance of the extraction system. The goal of the enhancement methods is to achieve significant mass reduction over a shorter period of time than would be expected from the extraction tests performed on site NAPL during the RI.[3]

Off-site disposal options for collected NAPL may include recycling or treatment as necessary prior to land disposal. Testing would be required to determine if this waste stream constitutes a hazardous waste. For cost-estimating purposes, off-site disposal of NAPL was assumed to be via recycling.

Groundwater Alternative G2 – Hydraulic Containment with a Cutoff Wall and Groundwater Extraction/Treatment System

Groundwater Alternative G2 uses hydraulic containment, extraction and treatment through the use of an impermeable barrier installed along the shoreline and downgradient of the HCAA with groundwater extraction wells installed upgradient of the barrier to manage groundwater flow, followed by *ex-situ* treatment of extracted groundwater prior to discharge to the Hudson River.

Hydraulic Containment of the HCAA

A vertical cutoff wall (slurry wall or metal sheeting), tied into the clay confining layer or the bedrock, would be installed on the downgradient edge of the HCAA to provide a barrier to groundwater flow, establishing containment of the HCAA. To maintain hydraulic gradients, groundwater behind the cutoff wall would be collected, treated, and discharged either to the Hudson River or to the municipal sewer system.

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3 Treatability testing performed during the FS investigated whether NAPL could be collected from the subsurface using wells or trenches and pumping. Further information on this work can be found in the 2008 RI Report.

Institutional Controls
Similar to Alternative 2.

Capping/Engineering Controls
Similar to Alternative 2.

Vapor Mitigation, Enhancement of 115 River Road Buildings
Similar to Alternative 2.

Operation and Maintenance (O&M)
The hydraulic containment system for the HCAA and the NAPL recovery system (Alternative G2) would require regular O&M to maintain the groundwater and NAPL recovery systems, and to monitor performance. Similar to Alternative 2, this alternative includes the maintenance of existing roads and parking surfaces and soil capping. Engineering controls that would reduce the potential for vapor intrusion under future conditions are incorporated into this alternative, along with institutional controls to prevent exposures to soil or groundwater.

Alternative 4a – NAPL and Arsenic *In-Situ* Solidification/ Stabilization (ISS), Hydraulic Containment of HCAA, Preserving 115 River Road Buildings (with Groundwater Alternative G3)

Capital Cost:	$54,410,000
Annual O&M Costs:	$1,660,680
Total Present Worth:	$72,240,000
Implementation Timeframe:	2-3 Years

Alternative 4a includes the following remedial components: Groundwater Alternative G3 (subaqueous reactive barrier [SRB]); *in-situ* solidification/stabilization; hydraulic containment of the HCAA; capping/engineering controls; vapor mitigation, enhancement of 115 River Road buildings; and O&M. The primary goals of this alternative are treatment of principal threats through ISS, containment of low level threats through capping, and passive groundwater treatment.

In Alternative 4a, principal threat NAPL would be treated through a combination of free-phase NAPL recovery, shallow excavation, and ISS. NZ-1, NZ-2, NZ-5, the previously identified core area of NZ-3, and tar boils would be remediated entirely; the deep NAPL would also be addressed, though less comprehensively, as discussed below.

Figure 27 depicts the plan view of the areas to be treated with ISS as part of this alternative. **Figures 27A** through **27E** depict the cross-section view of this alternative.

***In-Situ* Solidification/Stabilization (ISS)**

ISS reduces the mobility of principal threat waste by sequestering contaminants to eliminate the potential for NAPL and arsenic mobility and reduce leaching to the groundwater. In addition to immobilizing arsenic in a solid matrix, for this alternative the goal of ISS is also to chemically convert arsenic to render it less toxic. This alternative protects the river from potential future NAPL and arsenic discharges from OU1. Free-phase NAPL present at NZ-1, NZ-2/5, portions of NZ-3 and tar boils, and arsenic hotspots that constitute a principal threat waste at the site would be solidified/stabilized, relying on several methods described below. Effective sequestering mixes would need to treat free-phase NAPL, arsenic, and areas where these two wastes overlap; different ISS mixes and methods would be required for different areas of the site.

The majority of the site would be treated in place or "*in situ.*" Prior to *in-situ* mixing, the area would be cleared of vegetation and excavated for surface and subsurface debris removal (*e.g.*, large boulders, tank pads, conduits, and concrete), as these materials could interfere with the ISS process. Soil where tar boils have been observed, and areas of soft, plastic, or hard tars in the vadose zone would be excavated to a depth of approximately four feet. It is assumed that the depth of debris removal would be to about four feet, with deeper debris removed as necessary.

ISS of NAPL in NZ-2 and NZ-5 would entail treatment behind the bulkhead, performed in sequenced or alternating patterns to protect bulkhead tie backs and prevent shoreline instability during curing. Isolating the shoreline by driving sheet piles on the river side of the bulkhead may also be required to successfully implement ISS, primarily to prevent loss of ISS soil amendments through the bulkhead and into the river. All NAPL in NZ-2 and NZ-5 beginning at the bulkhead would be solidified in order to prevent future NAPL migration to the Hudson River. Further away from the bulkhead area, augers or other mixing equipment would be advanced to the target depths below ground surface, based on NAPL zone characterization and principal threat criteria, resulting in the solidification of all of NZ-1 (excepting the 115 River Road building footprints) and the central core of NZ-3. Upon target depths being reached, reagents would be injected and mixed within the soil column to treat the material between the ground surface and the target depth. Augers would be advanced and retracted through the treatment area several times in an overlapping pattern to provide for complete mixing. The selection of mixing equipment would be determined during final design. Dust, vapor, and noise management controls would be put in place to protect workers and the community during construction activities.

The type of ISS described above, adding mass stabilizing agents (*e.g.,* Portland cement, fly ash, etc.), is a common and well-established method, and appears to be the most appropriate solidification/stabilization (S/S) process for most of the site, though other methods may also be effective.[4] Remediation goals for solidification would require satisfying three performance measures: minimum unconfined compressive strength (UCS) of 40 pounds per square inch (40 PSI); maximum permeability of $1x10^{-6}$ centimeters per second; and leachability testing for site-related constituents. Leachability testing would require site-specific development during remedial design, using EPA's Synthetic Precipitation Leaching Procedure, the ANSI/ANS 16.1 method, or other appropriate methods. EPA would develop specific leaching values and select specific analytical methods in the design phase pending results of treatability studies. EPA would seek a 90 percent or greater reduction of leaching potential as a point of departure for S/S performance. Different ISS technologies (such as the stabilization process discussed below, for the HCAA) would require different performance measures, though the overall ISS performance would need to be comparable (*i.e.*, similar leaching performance, from one ISS technology to the next). During implementation of the full-scale remedial action, these performance measures would be used for the purposes of mix optimization, quality assurance, and verification that the remedy is effective.

Treatability testing would be conducted prior to full scale implementation to optimize the ISS mix and demonstrate a correlation between leachability and UCS and permeability performance criteria. Once this correlation is established, UCS and permeability would be used as the primary field criteria during implementation. Areas that fail to meet the performance criteria will be excavated and disposed off site.

As described earlier, the structural integrity of the 115 River Road buildings would be compromised by attempting to implement ISS beneath them. Under Alternative 4a, free-phase NAPL underneath the 115 River Road buildings would be left in place.

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4 For example, portland cement-type solidification results in expansion of the treated material by as much as 30 percent, limiting its usefulness in less open areas where expansion is not technically possible.

A barrier wall, constructed through jet grouting or installing steel sheeting at the shoreline, would isolate the untreated NAPL from the Hudson River and sediments.

Solidification/stabilization would be implemented close to the building foundations to leave as little untreated material as possible but without compromising the structural integrity of the buildings. The results of a stability analysis would determine the distance required to be maintained between the treatment zone and the existing buildings.

Because the buildings would remain in place, vapor intrusion and response measures to maintain the building in such a way that will continue to prevent inhalation and direct contact with the NAPL would be required for the building (discussed below). Relocation of occupants in 115 River Road during *in-situ* solidification/stabilization would not be required for health and safety reasons; however, during remedy implementation, the performing party may conclude that temporary relocation of certain tenants in 115 River Road could result in a quicker, more efficient implementation timeframe for the remedy, rather than attempting to maintain all the tenants in place, or restricting work hours to evenings or weekends. The FS includes a construction sequencing plan to assess how to minimize the disruption to the 115 River Road tenants during a projected remediation. The FS assumes that the child care center at 115 River Road would be relocated prior to implementation of the Remedial Action, because of the difficulties of implementing a remedial action around this special population.

Of the deep NAPL zones, portions of NZ-3 are in close proximity to NZ-1, with little vertical separation (five feet or less) between the two units. For areas where the NAPL zones are effectively stacked on top of one another, and accessible to ISS treatment (that is, in areas not obstructed by surface impediments), the ISS auger mixing would be implemented to a deeper depth to also treat portions of the deeper NAPL material.

Much of these deep NAPL zones (and all of NZ-6) are substantially deeper and more fragmented, and thus less amenable to ISS. (Large areas of the deep NAPL are also found beneath River Road or other surface features.) For areas where the NAPL zones are not accessible to ISS treatment, NAPL extraction, as described in Alternative 3, would be used to target the more concentrated and potentially more mobile NAPL zones within the deep NAPL.

Several of the arsenic hotspots would be treated with ISS along with the NAPL zones. Arsenic principal threat hotspots on the Block 93 property would be solidified/stabilized either *in situ* or *ex situ* on the main part of the site. Arsenic sources adjacent to the Hudson River would be solidified/stabilized along with NZ-5 preventing potential future migration of arsenic to the Hudson River. Principal-threat NAPL on the Block 93 property could also be solidified/stabilized either *in situ* or *ex situ*. Principal-threat NAPL (portions of NZ-1) under River Road would be addressed up to the right-of-way to the extent practicable independent of Bergen County, and then further response actions would be coordinated with Bergen County, to be performed in collaboration with the County when future repairs/maintenance of the River Road are called for. Thus, ISS would be performed under River Road, but the work would be performed in stages and in such a way to minimize traffic congestion on River Road.

Groundwater Remedial Alternative G3 - Subaqueous Reactive Barrier (SRB)

Groundwater Alternative G3 would treat contaminated groundwater as it flows through a horizontally placed SRB before being discharged to the surface water of the Hudson River.

Hydraulic Containment of the HCAA (Contingency)

Arsenic contamination in the HCAA would also be treated with ISS, as discussed in more detail below; however, a vertical cutoff wall with extraction wells for hydraulic containment of the HCAA (as described in Alternative 3), is included here as a contingency. Treating HCAA soils with ISS would require a different approach from other places at the site, because auger mixing, described above, and volume expansion commonly associated with solidification would result in lengthy closures of the active roadway and building entrances on the southern side of City Place. Methods other than solidification using surface auger mixing have been evaluated. For example, horizontal drilling from the Quanta property could be employed to inject amendments into the soils to stabilize and render insoluble the arsenic and other metals in the HCAA. However, vertical drilling may be necessary to achieve the performance measures for *in-situ* treatment. If stabilization can be demonstrated to be permanent under existing and future site conditions, HCAA stabilization has some advantages over hydraulic containment, because in addition to reducing mobility, the treatment shows the potential of converting the arsenic to a less toxic form. Stabilization of the HCAA as an alternative to the hydraulic containment wall would be further evaluated in remedial design.

Institutional Controls
Similar to Alternative 2.

Capping/Engineering Controls
The solidification/stabilization areas on the former Celotex property (NZ-5), Block 93, the former Lever Brothers property, and 115 River Road (portion of NZ-1) would be graded and capped similar to their previous conditions (*e.g.*, parking lots). On the Quanta property, stabilized areas would be capped with either fill material or asphalt. In addition, areas that do not require ISS, but where site-related constituents exceed remediation goals in surface soil, would be capped with an engineered cap to prevent direct contact and to minimize erosion by controlling surface water runoff.

Vapor Mitigation, Retrofitting of 115 River Road Buildings
As with Alternative 2, the basements of the 115 River Road buildings would be modified with a vapor mitigation system, such as a sub-slab depressurization system, and the basements and lowest building spaces would be evaluated and sealed as necessary to ensure that the building remains protective for continued occupancy.

Continued vapor intrusion monitoring would be performed for 115 River Road buildings and other affected properties (*i.e.*, Tomaso's Restaurant and the Medical Arts Building). Additional vapor intrusion mitigation systems at the other properties would be implemented as indicated by the monitoring data.

Operation and Maintenance (O&M)
As with Alternative 2, this alternative includes the maintenance of existing roads and parking surfaces and soil capping and ongoing maintenance of the protective measures added to the 115 River Road buildings. Engineering controls that would reduce the potential for vapor intrusion under future conditions are incorporated into this alternative, along with institutional controls to prevent exposures to soil or groundwater. An OU1 monitoring plan would also be developed for the site to confirm the continued effectiveness of the remedy to protect human health and the environment, including the Hudson River. This monitoring plan would include ISS-treated areas, the deep NAPL and, in particular, the NAPL zones isolated beneath the 115 River Road buildings.

In the event that HCAA stabilization cannot be demonstrated and hydraulic containment is implemented for the HCAA, this alternative would also require the operation and maintenance of the groundwater treatment system installed for the hydraulic containment of the HCAA.

Alternative 4b – NAPL and Arsenic *In-Situ* Solidification/Stabilization (ISS), Hydraulic Containment of HCAA, Demolishing 115 River Road Buildings (with Groundwater Alternative G3)

Capital Cost:	$152,880,000
Annual O&M Costs:	$1,560,680
Total Present Worth:	$168,820,000
Implementation Timeframe:	2-3 Years

Alternative 4b, depicted in **Figure 28**, includes the remedial measures included in Alternative 4a, except occupants of the buildings at 115 River Road would be relocated and the buildings would be demolished to allow for *in-situ* treatment of the material below the building foundations. Alternative 4a would treat or remove approximately 150,000 cubic yards of contaminated material; by demolishing the buildings, Alternative 4b would be able to access an additional 8,000 cubic yards of NZ-1 and NZ-2 that are within the footprint of the buildings. The primary goals of this alternative are treatment of principal threats through ISS, containment of low level threats through capping, and passive groundwater treatment.

The capital cost of this alternative includes costs associated with demolition and replacement of the 115 River Road buildings, relocation of tenants, lost rent to the building owner, differential rent to relocated business, and other legitimate relocation costs, along with the remedial costs of ISS for additional material. O&M costs are less than Alternative 4a, as vapor mitigation, enhancement, and long-term monitoring are no longer necessary with the demolition of 115 River Road buildings

Alternative 5a: NAPL *In-Situ* Chemical Oxidation (ISCO), Arsenic Solidification/Stabilization, Preserving 115 River Road Buildings (with Groundwater Alternative G2)

Capital Cost:	$226,450,000
Annual O&M Costs:	$2,407,720
Total Present Worth:	$365,640,000
Implementation Timeframe:	7 Years

Alternative 5a includes the following remedial components: Groundwater Alternative G2 (Hydraulic Containment with a Cutoff Wall and Groundwater Extraction/Treatment System); *in-situ* chemical oxidation (ISCO); in-situ stabilization/solidification (ISS) and hydraulic containment of the HCAA; capping/engineering controls; vapor mitigation, enhancement of 115 River Road buildings; and O&M.

In Alternative 5a, principal threat NAPL would be treated through a combination of free-phase NAPL recovery, shallow excavation, and ISCO. NZ-1, NZ-2, NZ-5, the previously identified core area of NZ-3, and tar boils would be remediated entirely; the deep NAPL would also be addressed, though less comprehensively, as discussed below.

Figure 29 depicts the plan view of the areas to be treated with ISCO as part of this alternative. **Figures 29A** through **29E** depict the cross-section view of this alternative. ISCO treats organic constituents and would be effective for treating NAPL, but not arsenic or other metals. The primary goals of this alternative are treatment of principal threats through ISCO and ISS, containment of low level threats through capping and hydraulic groundwater containment.

***In-Situ* Chemical Oxidation (ISCO)**
Chemical treatment reagents would be injected using a direct-push technology with locations placed on a grid throughout the targeted NAPL zones. Based on the results of a bench-scale treatability test conducted for the site, the FS assumptions for Alternative 5a/b assume a catalyzed hydrogen peroxide (CHP) reagent, which would be injected at an oxidant-to-contaminant mass ratio of 20:1, with annual reinjections for five years. A pilot test would be performed during remedial design to accurately determine reagents and full-scale implementation requirements. Other reagents could also be tested to determine their effectiveness at treating the NAPL. Oxidation would be the primary mechanism for destruction of VOCs and SVOCs, though volatilization would also occur. Implementation of engineering controls to control the generation and migration of vapors during subsurface ISCO chemical reactions would be required to protect the community and ecological receptors in the Hudson River, because extensive off-gassing is anticipated from this process. The presence of subsurface features and nearby utility corridors (along River Road) could provide preferential vapor pathways, creating potential vapor intrusion risks and complicating the effectiveness of vapor mitigation measures.

Introduction of ISCO using direct push injections may be complicated or, in some areas, prevented by the presence of boulders or other subsurface obstructions, particularly on the Quanta and former Celotex properties.

The potential for mobilization of currently residual (non-mobile) NAPL as a result of the heat of reaction would need to be thoroughly evaluated prior to field implementation. Engineering controls would need to be robust enough to mitigate the potential risk of NAPL mobilization, including but not limited to installation of a barrier wall along the shoreline, a careful sequencing of injection locations, and control of the injection rate. The ISCO bench-scale tests also suggested that arsenic might be mobilized by ISCO treatments, and this would also need to be monitored and managed during field implementation.

Alternative 5a would not attempt to treat the NAPL under the 115 River Road buildings--the potential for structural destabilization as a result of ISCO injection near buildings or other surface features and subsurface utilities is a concern, because ISCO would also oxidize wooden pilings that make up building foundations and the bulkhead. Additional evaluation during remedial design would be required to determine setbacks from these structures. Prior to any injection, a barrier cutoff wall would be installed along the shoreline to prevent NAPL migration during implementation and to provide the necessary structure support if the bulkhead is compromised by ISCO.

Because the buildings would remain in place, vapor intrusion and containment response measures would be required for the buildings (discussed below). Relocation of occupants in nearby buildings, including 115 River Road, as part of Alternative 5a would not be required for health and safety reasons, though it might be used as described in Alternative 4a. The FS includes a construction sequencing plan to assess how to minimize the disruption to the 115 River Road tenants during a projected remediation. The FS assumes that the child care center at 115 River Road would be relocated prior to implementation of the Remedial Action, because of the difficulties of implementing a remedial action around this special population.

Free-Phase NAPL Extraction
Based on the bench-scale tests, ISCO performance may be limited by the high oxidant demand posed by the large mass of VOCs and SVOCs, which may be significantly greater than the amount of oxidant that could be effectively delivered to the subsurface in

a field application. Delivering oxidants into areas of free-phase NAPL may also result in rapid, heat-producing chemical reactions and off-gassing, which would be difficult to control in the subsurface. For these reasons, it is expected that a portion of the free-phase NAPL, hard tars, and tar boils would not be amenable for treatment using ISCO, and these wastes would be excavated or collected via extraction wells for off-site treatment and disposal prior to implementation of ISCO. For purposes of this FS, the NAPL recovery system is assumed to be similar to the system described for Alternative 3.

Limited Excavation of Shallow NAPL
Soil where tar boils have been observed, and areas of soft, plastic, or hard tars, would be excavated to a depth of approximately four feet. The typical depth to groundwater on site is approximately four feet bgs, and due to the limited ability to effectively deliver oxidants in the unsaturated zone, these soils would be addressed through excavation. Potential risk associated with soils below four feet would be managed through ISCO. Soil underneath the 115 River Road buildings would not be excavated; potential exposure pathways would be addressed similar to Alternative 4a.

It is anticipated that the excavated soils would need to be disposed of off site as hazardous waste. On-site stabilization of soils would be necessary prior to disposal to meet land disposal restrictions of the Resource Conservation and Recovery Act (RCRA). Soil would be stockpiled, stabilized, and then disposed of at an off-site landfill.

Deep NAPL
The deep NAPL is spread out over a wide area and is more diffuse than NZ-1 or NZ-2/NZ-5, so while the NAPL concentrations are less, it would take a similar level of oxidant application, over a greater area, with a diminished expectation of success. ISCO would still require NAPL extraction, but excavation would not be available at depth. Some of the concerns regarding mobilization of NAPL as a result of ISCO treatment are even more pronounced at depth. For these reasons, ISCO would be applied to the deep NAPL in a few limited areas, similar to the application of ISS to the deep NAPL. Other deep NAPL areas would be addressed in a manner similar to Alternative 4a/4b.

Groundwater Remedial Alternative G2 – Hydraulic Containment with a Cutoff Wall and Groundwater Extraction/Treatment System
The groundwater would be captured through the use of an impermeable barrier installed along the shoreline and

groundwater extraction wells installed upgradient of the barrier to manage groundwater flow. The treated groundwater would be discharged to the Hudson River.

ISS and Hydraulic Containment of the HCAA
Arsenic principal threat hotspots and portions of the HCAA not covered by the roadway would be treated *in situ* with ISS, or excavated, stabilized, and consolidated on the Quanta property, similar to Alternative 4a/4b. ISCO would not treat arsenic, so arsenic principal threat hotspots co-located with free-phase NAPL zones would be treated with ISS rather than by ISCO. The hydraulic barrier for the HCAA would be the same as described in Alternative 4a/4b, including the contingency for using stabilization in lieu of hydraulic containment.

Institutional Controls
Similar to Alternative 2.

Capping/Engineering Controls
The ISCO-treated areas on the former Celotex property (NZ-5), Block 93, the former Lever Brothers property, and 115 River Road (portion of NZ-1) would be graded and restored to their previous conditions (parking lots). On the Quanta property, treated areas would be capped with either clean fill material or asphalt. It is assumed that ISCO would treat the NAPL to remediate free-phase NAPL, but it would not be expected to reach the soil remediation goals in all areas, so capping would still be required for these areas. All areas where site-related constituents exceed remediation goals in surface soil would be capped with an engineered cap to prevent direct contact and to minimize erosion by controlling surface water runoff. The cap would be placed over the Quanta property and the remaining remedial areas on 115 River Road, Block 93 North, Block 93 Central, and Block 94, replacing the existing asphalt or other material. Caps are assumed to be composed of materials described for Alternative 2.

Vapor Mitigation, Enhancement of 115 River Road Buildings
As with Alternative 2, the basements of the 115 River Road buildings would be modified with a vapor mitigation system, such as a sub-slab depressurization system, and the basements and lowest building spaces would be evaluated and sealed as necessary to ensure that the building remains protective for continued occupancy.

Continued vapor intrusion monitoring would be performed for 115 River Road buildings and other affected properties. Additional vapor intrusion mitigation systems at the other properties will be implemented as indicated by the monitoring data.

Operation and Maintenance (O&M)
As with Alternative 2, this alternative includes the periodic maintenance of existing roads and parking surfaces and soil capping. The HCAA hydraulic containment system, and engineering controls that would reduce the potential for vapor intrusion under future conditions are incorporated into this alternative, along with institutional controls to prevent exposures to soil or groundwater.

Alternative 5b – NAPL *In-Situ* Chemical Oxidation (ISCO), Arsenic Solidification/Stabilization, Hydraulic Containment of the HCAA, Demolishing 115 River Road Buildings (with Groundwater Alternative G2)

Capital Cost:	$335,090,000
Annual O&M Costs	$2,307,720
Total Present Worth	$480,260,000
Implementation Timeframe:	7 Years

Alternative 5b, depicted in **Figure 30**, includes the remedial measures included in Alternative 5a, except occupants of the buildings at 115 River Road would be relocated and the buildings would be demolished to allow for *in-situ* treatment of the material below the building foundations. Alternative 5a would treat or remove approximately 150,000 cubic yards of contaminated material; by demolishing the buildings, Alternative 5b would be able to access an additional 8,000 cubic yards of the NAPL zones that are within the footprint of the buildings. The primary goals of this alternative are treatment of principal threats through ISCO and ISS, containment of low level threats through capping and hydraulic groundwater containment.

The cost differences between Alternatives 5a and 5b are similar to those described for Alternative 4b. O&M costs are half as much as Alternative 5a because vapor mitigation, enhancement, and long-term monitoring are no longer necessary with the demolition of the 115 River Road buildings.

Alternative 6a: NAPL and Arsenic Excavation for Off-site Transportation and Disposal, Preserving 115 River Road (with Groundwater Alternative G3)

Capital Cost:	$184,550,000
Annual O&M Costs:	$2,311,680

Total Present Worth: $205,920,000
Implementation Timeframe: 3 Years

Alternative 6a includes the following remedial components: Groundwater Alternative G3 (SRB), excavation of principal threat NAPL waste; excavation of the HCAA and arsenic hotspots; and capping of residual soils. This alternative also includes the maintenance of existing roads and parking surfaces and implementation of institutional controls and vapor mitigation measures.

In Alternative 6a, NZ-1, NZ-2, NZ-5, the previously identified core area of NZ-3, and tar boils would be remediated entirely; additional excavations would be limited to areas where the shallower and deep NAPL zones are stacked relatively closely. Other deep NAPL would be addressed through passive extraction, as described in Alternative 4a/4b.

Figure 31 depicts the plan view of the areas to be excavated as part of this alternative. **Figures 31A** through **31E** depict the cross-section view of this alternative. The primary goals of this alternative are removal from the site of principal threats through excavation, containment of low level threats through capping and passive groundwater treatment.

Excavation
Soil where tar boils have been observed, and areas of soft, plastic, or hard tars in the vadose zone would be excavated to a depth of four feet. The remaining accessible portions of NAPL zones posing a principal threat would be excavated and disposed of off site. NZ-1, NZ-2, NZ-5, the core area of NZ-3 and tar boils would be excavated entirely; the deep NAPL would also be addressed, though less comprehensively, as discussed below. Soil underneath the 115 River Road buildings would not be excavated, and the NAPL below the buildings would be addressed through institutional and engineering controls, and vapor mitigation efforts for the buildings, as discussed below.

Excavations below four feet would require dewatering. Water extracted for dewatering would be treated on site and discharged to the Hudson River. Excavation depths of 20 feet can be achieved with readily available excavation equipment, and deeper excavation is possible with more-specialized, though still readily available, equipment. Excavation of soils may require the use of shoring (*e.g.*, sheet piles) or an alternative method to protect utility lines, building foundations, etc.

Verification sampling would be used to determine the extent of excavations. Storm-water diversion, soil erosion controls, and air monitoring would also be required, as would controls for mitigating the potential risk of NAPL mobilization to the river as a consequence of the excavation. After the source areas are removed, the excavated areas would be backfilled and compacted with clean fill material.

Air monitoring would be employed during excavation to manage dust and vapors, and emission control techniques such as using dust and odor suppressants and minimizing the open working area of the excavation would be employed as needed to maintain a safe work environment and to minimize adverse effects (unpleasant odors) for workers and the community. Relocation of occupants in nearby buildings is not anticipated; however, contingency plans would be developed during remedial design in the event that air monitoring suggests temporary relocation is needed. Mitigation measures to reduce adverse affects to the community from increased truck traffic would need to be evaluated and incorporated into the remedial design. The FS assumes that the child care center at 115 River Road would be relocated prior to implementation of the Remedial Action, because of the difficulties of implementing a remedial action around this special population.

Based on a comparison of the NAPL chemical characteristics and soil concentrations, it is anticipated that the excavated soils would be classified as hazardous waste. Treatment of soils prior to land disposal would be required, and for cost-estimating purposes, on-site stabilization of soils was assumed, prior to transportation and disposal, to meet RCRA land disposal restrictions[5].

The potential for structural destabilization as a result of excavation near buildings or other surface features and subsurface utilities would require additional evaluation during remedial design. Prior to any excavation, a barrier cutoff wall would be installed along the shoreline to prevent NAPL migration during implementation and to provide the necessary structural support.

Soils underneath the 115 River Road building would not be excavated; therefore, the potential exposure pathway under the

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5 Several hazardous waste landfills in North America receive, stabilize, and dispose of soil that is considered hazardous waste under RCRA. These facilities would likely accept the tar- and arsenic-contaminated soil from the site for treatment prior to disposal.

building to the Hudson River sediments would be addressed through a subsurface cut-off wall or through angled jet grouting to the confining layer from the sides of the building and vertical jet grouting through the building foundation.

Because the buildings would remain in place, vapor intrusion and containment response measures would be required for the building (discussed below). Relocation of occupants in nearby buildings, including 115 River Road, during excavation on neighboring properties would not be required for health and safety reasons; however, temporary relocation of particular tenants in 115 River Road may result in a quicker, more efficient implementation timeframe for the remedy, rather than attempting to maintain occupants in place, or restricting remedial work hours to evenings or weekends.

Deep NAPL

For areas that are accessible, additional deep NAPL would also be excavated under this alternative. Deeper excavations (beyond the 20 to 25 feet required for NZ-2/NZ-5) can be performed, though the level of effort is much greater, requiring additional sheeting or shoring to protect buildings and other infrastructure, and substantially greater dewatering. In addition, at a number of areas, the excavation of 10 to 15 feet of NAPL-free soil would be required before reaching the deep NAPL zones. Under this alternative, additional excavations would be limited to areas where the shallower and deep NAPL zones are stacked relatively closely. Other deep NAPL would be addressed through passive extraction, as described in Alternative 4a/4b.

Groundwater Remedial Alternative G3 - Subaqueous Reactive Barrier (SRB)

Groundwater Alternative G3 would treat contaminated groundwater as it flows through a horizontally placed SRB before being discharged to the surface water of the Hudson River.

Arsenic Source Areas

The arsenic hotspots and the HCAA would be excavated to meet the source area remediation goals. This would require establishing a temporary entrance and exit road way for City Place, presumably on the north side of the property, so that the existing roadway can be dismantled to allow for excavation. Several of the City Place buildings would need to temporarily close entrances that face south, to allow for the cleanup. As with the NAPL source remediation around 115 River Road, temporary relocation of businesses would not be required to safely implement the excavation. None of the utilities are routed through the excavation, though some minor modifications to the buildings may be required (*e.g.*, rerouting HVAC air intakes that might be present at ground level, or rerouting emergency exits away from the south side). The HCAA excavation would also temporarily remove a number of parking spaces in front of these buildings.

Institutional Controls
Similar to Alternative 2.

Capping/Engineering Controls
Because an excavation remedy would address principal threats but not all soils in excess of the soil remediation goals, residual soils would be left in place beneath a soil cap. Institutional controls would be implemented for all properties to protect against future exposure from residuals left in place following excavation. The cap would be placed over the Quanta property and the remaining remedial areas on 115 River Road, Block 93 North, Block 93 Central, and Block 94, replacing existing asphalt or other material. Caps are assumed to be composed of materials described for Alternative 2.

Vapor Mitigation, Enhancement of 115 River Road Buildings
As with Alternative 2, the basements of the 115 River Road buildings would be modified with a vapor mitigation system, such as a subslab depressurization system, and the basements and lowest building spaces would be evaluated and sealed as necessary to ensure that the building remains protective for continued occupancy.

Continued vapor intrusion monitoring would be performed for 115 River Road buildings and other affected properties. Additional vapor intrusion mitigation systems at the other properties would be implemented as indicated by the monitoring data.

Operation and Maintenance (O&M)
As with Alternative 2, this alternative includes the maintenance of existing roads and parking surfaces and soil capping. Engineering controls that would reduce the potential for vapor intrusion under future conditions are incorporated into this alternative, along with institutional controls to prevent exposures to soil or groundwater.

Alternative 6b - NAPL and Arsenic Excavation for Off-Site Transportation and Disposal, Demolishing 115 River Road (with Groundwater Alternative G3)

Capital Cost:	$288,280,000
Annual O&M Costs:	$2,311,680
Total Present Worth:	$308,521,000
Implementation Timeframe:	3 Years

Alternative 6b, depicted in **Figure 32**, includes the remedial measures included in Alternative 6a, except occupants of the buildings at 115 River Road would be relocated and the buildings would be demolished to allow for excavation of the material below the building foundations. Alternative 6a would excavate approximately 150,000 cubic yards of contaminated material; by demolishing the buildings, Alternative 6b would be able to access an additional 8,000 cubic yards of NZ-1 and NZ-2 that are within the footprint of the buildings. The primary goals of this alternative are removal from the site of principal threats through excavation, containment of low level threats through capping, and passive groundwater treatment.

The cost differences between Alternatives 6a and 6b are similar to those described for Alternative 4b. O&M costs are less than for Alternative 6a because vapor mitigation, enhancement, and long-term monitoring are no longer necessary with the demolition of the 115 River Road buildings.

COMPARATIVE ANALYSIS OF ALTERNATIVES

In selecting a remedy, EPA considered the factors set out in CERCLA §121, 42 U.S.C. §9621, by conducting a detailed analysis of the viable remedial response measures pursuant to the NCP, 40 CFR 300.430(e)(9)(iii) and OSWER Directive 9355.3-01. The detailed analysis consisted of an assessment of the individual response measure against each of nine evaluation criteria and a comparative analysis focusing upon the relative performance of each response measure against the criteria.

Threshold Criteria *- The first two criteria are known as "threshold criteria" because they are the minimum requirements that each response measure must meet in order to be eligible for selection as a remedy.*

1. Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled, through treatment, engineering controls, and/or institutional controls.

All of the alternatives except Alternative 1 (No Action) would provide adequate protection of human health and the environment by eliminating, reducing, or controlling risk by addressing principal threats that pose a direct-contact risk coupled with engineering controls (including vapor mitigation), and institutional controls. Note that all the remedial alternatives require engineering and institutional controls for residual soil contamination above levels that would allow for unrestricted use. That condition is not unique for the site, as this holds true for all properties in this section of Edgewater.

Groundwater at the site is not currently in use. The Groundwater Alternatives G1 (Containment/Passive Treatment), G2 (Hydraulic Containment) and G3 (Subaqueous Reactive Barrier [SRB]) rely on institutional controls to prevent future use of the groundwater, G2 relies on containment to mitigate the potential for release of contaminated groundwater to surface water (the Hudson River); whereas G1 and G3 treat contaminated groundwater before it is discharged into the Hudson River.

Because both G1 and G2 rely on treatment at the shoreline, and groundwater passes through the deep OU2 sediments prior to discharge to surface water, the SRB in G3 is, overall, more protective than either of the other groundwater alternatives. The presence of extensive areas of NAPL and, to some degree, metals contamination in the sediments of OU2 will recontaminate groundwater treated passively in G1, or groundwater arriving into the system from neighboring areas in the case of G2, whereas the SRB will address aqueous-phase contaminants from OU1 and OU2 prior to release to the surface water, and by so doing achieve the RAO of mitigating groundwater releases to shallow sediments and surface water. Alternatives G1 and G2 do so for the site groundwater at the shoreline, but would need to rely on some future OU2 action to actually meet the RAO that protects the Hudson River.

Alternatives 2 (NAPL and Arsenic Containment) and 3 (NAPL and Arsenic Containment with NAPL Collection) would mitigate the potential human health risks associated with exposure to contaminated soils through capping, and through institutional controls such as land-use restrictions. These two alternatives do little to satisfy the principal threat RAOs.

Arsenic-contaminated soils and NAPL would remain in place untreated above the principal threat remediation goals. The protection would persist only as long as the cap was actively maintained, and a breach of the cap could re-establish human and ecological exposure routes.

Alternatives 4a/4b (NAPL and Arsenic *In-Situ* Solidification/ Stabilization (ISS)) and 5a/5b (NAPL *In-Situ* Chemical Oxidation [ISCO] and Arsenic ISS) would address principal threat NAPL and arsenic through treatment and, therefore, would protect both human and environmental receptors from contact with the most highly contaminated segments of the site soil. As with the containment Alternatives 2 and 3, capping and institutional controls such as land-use restrictions are required in addition to treating the principal threats, to prevent human health risks associated with exposure to contaminated soils.

Alternatives 6a/6b (Excavation and Off-site Disposal, SRB) would remove principal threat NAPL and arsenic and, therefore, would protect both human and ecological receptors from contact with the most highly contaminated segments of the site soil. As with the containment Alternatives 2 and 3, capping and institutional controls such as land-use restrictions are required, in addition to excavating the principal threats, to mitigate human health risks associated with exposure to contaminated soils.

Ongoing vapor intrusion monitoring has not indicated any current indoor air concerns at the 115 River Road buildings, or other occupied buildings within the study area. Alternatives 4a, 5a, and 6a rely on enhancements to the 115 River Road buildings to ensure protectiveness over the long term, including vapor mitigation, engineered enhancements to the building foundations as necessary, and land-use controls to ensure the long-term operation and maintenance of the building in a protective manner. Alternatives 4b, 5b, and 6b relocate occupants and demolish the 115 River Road buildings to address through treatment the underlying free-phase NAPL, eliminating this exposure consideration, though vapor intrusion would still be a future-use concern due to the deep NAPL that remains.

Because Alternative 1 (No Action) is not protective of human health and the environment, it was eliminated from consideration under the remaining evaluation criteria.

2. Compliance with applicable or relevant and appropriate requirements (ARARs)

Section 121(d) of CERCLA and NCP §300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations which are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA section 121(d)(4). Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those State standards that are identified by a state in a timely manner and that are more stringent than Federal requirements may be applicable. Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site. Only those State standards that are identified in a timely manner and are more stringent than Federal requirements may be relevant and appropriate.

Compliance with ARARs addresses whether a remedy will meet all of the applicable or relevant and appropriate requirements of other Federal and State environmental statutes or provides a basis for an invoking waiver.

Principal Threat Wastes

RCRA is a federal law that mandates procedures for managing, treating, transporting, storing, and disposing of hazardous wastes. All portions of RCRA that are applicable or relevant and appropriate would be met by Alternatives 4, 5, and 6. Past industrial activities at the Spencer Kellogg & Sons property (115 River Road) qualified it for listing on New Jersey's Register of Historic Places. Archival documentation was conducted at the property prior to its redevelopment in the

1980s, and it is expected that no extant features of the Spencer Kellogg facility remain, except the brick buildings themselves; however, under Alternatives 4b, 5b, and 6b, these buildings would be demolished. If the buildings are demolished, it may be necessary to develop an approach to mitigate the consequences of the remedial action. It is expected that such an approach would involve performing additional historical research and, possibly, additional recordation of the structures prior to demolition.

To varying degrees, Alternatives 3 through 6 rely on collecting and treating contaminated water and need to meet the technical requirements of a New Jersey Permit Discharge Elimination System permit, either for pretreatment and discharge to a municipal sewer system or for treatment for release to surface water. Alternatives 4, 5 and 6, may generate air emissions. Alternative 4 would generate air emissions from the in situ mixing of ISS constituents; Alternative 5 would generate air emissions from the off-gassing of ISCO; and Alternative 6 would generate air emissions from excavation. Based upon testing during remedial design, each of these alternatives may be required to meet the technical requirements of an air permit under the Clean Air Act and comparable New Jersey requirements.

Soils

Alternatives 2 through 6 would be completed in compliance with chemical-, action- and location-specific ARARs.

Since action-specific ARARs apply to actions taken, they are not applicable to the no action alternative. Alternatives 2 through 6 would comply with action-specific ARARs. Among the major ARARs applicable to the remedial action for soils, all portions of RCRA (and, to the degree relevant, the Toxic Substances Control Act that regulates PCBs) that are applicable or relevant and appropriate to a soil response action would be met by Alternatives 2 through 6. The State of New Jersey has developed State-wide, residential direct contact soil cleanup standards for properties where residential-type exposures might occur. Based upon the RI, there are few locations within the Quanta study area where the State soil standards are not exceeded, due to contamination emanating from the site, from other sites, or from other anthropogenic sources. In developing remedial alternatives for the site, EPA has assumed that residential-type exposures are plausible throughout the site in the future, and that capping to prevent direct contact will be required throughout. These remediation goals for direct contact can be found in **Table 1**.

Groundwater
While groundwater is not currently in use, applicable drinking water standards are exceeded throughout the study area and neighboring properties for a variety of constituents. In evaluating potential groundwater remedies that could restore the aquifer, EPA concluded that no remedial methods are likely to achieve the groundwater ARARs; therefore, an ARAR waiver due to technical impracticability of the groundwater restoration is being invoked for the site. The widespread presence of NAPL and recalcitrant coal tar constituents, including coal tar PAHs beyond the limits of the six NAPL zones, and ubiquitous arsenic contamination, confounds the effort to remediate soils as a source to groundwater. The Groundwater Alternatives G1 (Containment/Passive Treatment), G2 (Hydraulic Containment) and G3 (SRB) rely on containment or treatment to mitigate the potential for release of contaminated groundwater to surface water (the Hudson River) in excess of surface water criteria.

Alternative G3 requires the disturbance of sediments in the Hudson River. ARARs for implementing a remedial action in sediments will be fully evaluated in the OU2 remedy, and Alternative G3 would not be implemented until the OU2 remedy is selected. Relevant ARARs, such as State and Federal statutes that govern dredging activities (such as the Clean Water Act, the Rivers and Harbors Act and the Army Corps of Engineers permitting program, the Fish and Wildlife Coordination Act, and State and Federal laws protecting wetlands and floodplains) would be met by Alternative G3.

***Primary Balancing Criteria** - The next five criteria, criteria 3 through 7, are known as "primary balancing criteria". These criteria are factors with which tradeoffs between response measures are assessed so that the best option will be chosen, given site-specific data and conditions.*

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3. Long-term effectiveness and permanence
A similar degree of long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once clean-up levels have been met. This criterion includes the consideration of residual risk that will remain on-site following remediation and the adequacy and reliability of controls.

Groundwater Alternative G1 (Containment/Passive Treatment), and Alternative G2 (Hydraulic Containment) appear to offer a similar level of long-term effectiveness and permanence, though each of these alternatives may be susceptible to fouling with coal tar NAPL. As a result, pairing these groundwater alternatives with remedial alternatives that effectively treat or remove NAPL (Alternatives 4, 5 and 6) is preferable to those that primarily contain the coal tar (Alternatives 2 and 3). Alternative G2 is probably more effective in the long term than G1, because in the case of NAPL fouling, the passive media in G1 would need to be dug out and replaced, whereas G2 would be constructed to allow for regular maintenance from the surface and could be more effectively flushed out and refitted. In Alternative G3, portions of the SRB may also become fouled over time such that groundwater cannot pass through blocked sections; the source of the fouling would be free-phase NAPL already in the OU2 sediments. (This consideration will require further evaluation in the OU2 RI/FS). The subaqueous treatment media in Alternative G3 would need to cover a large enough surface area within the sediments to account for potential blockages and circumvention of the flow of contaminated groundwater to unblocked areas, though NAPL fouling is expected to block only small areas of the SRB; aqueous-phase contaminants would still pass through unblocked segments of the SRB to reach the surface water. All the groundwater alternatives would require long-term monitoring to ensure effectiveness and protectiveness. Alternative 6a/6b offers the highest degree of long-term effectiveness for the area, because principal threat waste (free-phase NAPL and arsenic) would be physically removed from the site.

In-situ solidification/stabilization used in Alternative 4a/4b (and used to a lesser degree in Alternative 5a/5b) is considered effective over the long term. ISS relies on several mechanisms: by sequestering and immobilizing contaminants in a solid matrix; by chemically reacting with site-related constituents to make them less toxic and/or less mobile; by acting as a physical barrier to contaminant transport; or a combination of these methods. Solidification/stabilization technologies have a long track-record with metals such as arsenic, but have also been successful in treating organics including petroleum and coal tar NAPLs. Refinement of the appropriate treatment mixes to match the site contaminants needs to be ascertained through bench and pilot testing during remedial design. These types of bench and pilot tests use standardized methods and are considered reliable predictors of system performance. Further tests of remedy reliability would involve performance testing during implementation and long-term monitoring after implementation. This technology would not remove the contaminants but would immobilize them irreversibly on site. This technology would significantly reduce the potential for treated material to act as an ongoing source to groundwater or as a vapor intrusion concern.

The use of ISS would also leave solidified blocks of treated soil in the subsurface. Future development of the site would require the installation of construction piles that would support buildings, and installing piles through the treated soil could weaken the long-term effectiveness of the solidification remedy if done improperly, by spreading contamination during the drilling process or by allowing greater groundwater contact with the waste after drilling, potentially causing a weakening of the solidified material. There are methods of safely installing pilings through solidified material; thus the installation of pilings, if needed for future development, needs to be implemented with EPA oversight using methods preapproved by the Agency.

In-situ chemical oxidation, presented in Alternative 5a/5b, would be irreversible if successfully implemented and thus would have a high degree of long-term effectiveness. Because ISCO cannot treat harder tars and concentrated free-phase NAPL pockets within the NAPL zones, Alternative 5a/5b incorporates shallow excavation and passive NAPL collection to increase the likelihood of success and, thereby, the long-term effectiveness and permanence of these alternatives. (ISCO also cannot treat metals, which are treated with solidification/stabilization in Alternative 5a/5b.) During implementation, NAPL that currently has low mobility may become mobilized through the heat of reaction, and would require engineering controls to prevent the movement of NAPL on the site or into the Hudson River and sediments. There is also some uncertainty about how many injections would be required to achieve remediation goals.

Alternative 2 is the least effective active alternative in the long term because it leaves the largest quantity of residual risk at the site, relying primarily on caps and other engineering controls and on institutional controls to eliminate exposure pathways. Institutional controls can be effective if they are enforced and can eliminate the exposure pathway; however, the source still remains, and capping and institutional controls require careful O&M and continual enforcement to maintain effectiveness. Alternative 2 also relies on Groundwater Alternative G1 (Containment/Passive Treatment) to address the continued transport of free-phase NAPL and aqueous-phase contaminants to the OU2 sediments, which is the least effective of the groundwater remedies over the long term.

Alternative 3 is slightly more effective than Alternative 2, because at least a portion of the free-phase NAPL would be collected and removed from the site. Performance testing of passive NAPL collection indicated that it would remove some mass from the subsurface, but over a relatively long implementation time frame (an estimated 10 to 15 years). At best, 10 to 20 percent of the mass could be removed in this way.

Alternatives 4b, 5b, and 6b, which rely on relocation of occupants and demolition of the 115 River Road buildings to treat the free-phase NAPL beneath it would be more effective and permanent over the long-term than the comparable building preservation alternatives (4a, 5a, 6a). The primary long-term benefit, treatment or removal of additional NAPL, represents a relatively small additional volume (about 5 percent of the NAPL mass is directly under the building foundations); however, demolition is also considered more reliable by eliminating the need for long-term maintenance of the buildings and by not having to rely on a cutoff wall or barrier between OU1 and OU2 at the shoreline. The buildings at 115 River Road, while older structures, are well built and can be enhanced as described in Alternatives 4a, 5a, and 6a to ensure protectiveness over the long term (requiring vapor mitigation systems, engineered enhancements to the building foundations such as sealing cracks and the installation of sumps, if necessary to maintain the performance of the vapor mitigation systems, which require a vadose zone void space to be effective). In addition, land use controls and restrictions on construction and improvements would be required to ensure that the long-term operation and maintenance of the building is implemented in a protective manner.

In summary, for the buildings at 115 River Road, the long-term protectiveness of Alternatives 4a, 5a, and 6a, relies on a far more hands-on approach, but with sufficient controls in place and attentiveness to O&M, these buildings can remain protective over the long term. The cut-off wall methods, such as jet grouting, that would be required at the shoreline at 115 River Road are well-developed and reliable technologies, though monitoring during implementation would be more involved than for the demolition approach.

If the buildings were left standing as part of the selected remedy, the buildings themselves are not expected to be static, as they would eventually be renovated or demolished in the course of normal business. The decision of whether and how to address sub-foundation NAPL zones that might become exposed in the future would need to be resolved. The issue of addressing the remaining NAPL at that time may be complicated by the fact that the rest of the site would presumably be redeveloped and occupied and further remediation would pose different exposure concerns than those contemplated in the FS.

4. Reduction of toxicity, mobility, or volume through treatment

Reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy. Alternative 1 provides no reduction in toxicity, mobility or volume. Alternative 2 (NAPL and Arsenic Containment) and Alternative 3 (NAPL and Arsenic Containment, with NAPL Recovery) would not achieve substantial reduction in toxicity, mobility, or volume. While Alternative 3 employs passive NAPL recovery that would collect some component of the NAPL volume, the groundwater alternatives paired with these alternatives (*i.e.*, G1 for Alternative 2 and G2 for Alternative 3) may in fact do more to manage the mobility of NAPL than passive NAPL collection.

Alternative 4a/4b would reduce contaminant mobility and toxicity through ISS, a process that would not reduce the volume of waste but would irreversibly sequester the contaminants (coal tar constituents or metals) within a stable mass. Bench-scale and pilot tests would be required to ensure that the resulting matrix would have the needed long-term stability, but solidification/stabilization is a well-established remedial technology. For the HCAA, where a stabilization process is contemplated, ISS would be devised to chemically convert arsenic to a less toxic form. If remedial design testing shows it to be irreversible, it would be preferable to hydraulic containment of the HCAA.

By demolishing buildings, Alternative 4b would access about 5 percent more volume of NAPL than would Alternative 4a. Under Alternative 4a, the ISS technology implemented near the 115 River Road buildings would result in a concrete-like matrix, and NAPL remaining under the buildings would, to some degree, be contained: ISS would be applied to the soils as close to the building foundations as feasible; the building itself would be enhanced and maintained as if it were an engineered cap; and through jet grouting or a similar technology, a solidified barrier would be placed between the remaining OU1 NAPL and the Hudson River and sediments.

Alternative 5a/5b would result in a reduction of toxicity, mobility, and (in the case of NAPL) volume through treatment by excavation and the *in-situ* chemical oxidation (ISCO) of free-phase NAPL and by ISS for arsenic. Similar to Alternative 4b, by demolishing buildings, Alternative 5b would make accessible for treatment incrementally more free-phase NAPL than Alternative 5a.

Alternative 6a/6b would result in a reduction in mobility and volume at the site and, to the degree that treatment is required prior to land disposal, a reduction of toxicity, by excavating, and transporting the principal threat wastes for off-site disposal. Similar to Alternatives 4b and 5b, Alternative 6b would address marginally more waste than its counterpart. Overall, Alternative 6a/6b does not satisfy CERCLA's statutory preference for treatment as a principal element.

Because ISCO appears to be more limited in its ability to treat the more highly contaminated NAPL, Alternative 5a/5b would address this criterion less effectively than Alternative 4a/4b. Similarly, Alternative 5a appears likely to leave more material untreated than Alternatives 4a and 6a around 115 River Road, because the destructive consequences to the wooden pilings that support the buildings may require that ISCO step further away from the building foundations than either of the other remedies would require.

5. Short-Term Effectiveness

Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community and the environment during construction and operation of the remedy until cleanup levels are achieved.

There are no short-term effectiveness issues associated with the No Action alternative. The least short-term adverse impacts would be anticipated from Alternatives 2 and 3. Alternative 6 (a or b) presents the greatest short-term consequences for the area because it relies primarily on excavation and off-site transportation and requires the most handling of contaminated material, resulting in higher air emissions (vapor, dust and odors) than the other alternatives. Alternative 5 (a or b), while an *in-situ* process, would generate heat and off-gassing vapors at the ground surface that could have adverse short-term consequences and would need to be managed. Alternative 4 (a or b) would also generate some fugitive emissions, but at much smaller levels that would be easier to manage than either Alternatives 5 or 6.

Alternatives 4 through 6 would cause an increase in truck traffic, noise, odors, vibration, and potentially dust in the surrounding community, with Alternative 6 requiring many times the number of trucks compared to either Alternative 4 or 5. Engineering controls (dust and odor suppression technologies), personal protective equipment and safe work practices would be used to address potential impacts to workers and the community.

The primary environmental concern during remedy implementation would be the release of free-phase NAPL to the Hudson River and sediments. NAPL releases are occurring today; however, one consequence of some of the clean-up technologies discussed here could be increased mobility of NAPL. The risk of release during implementation of Alternative 5 (ISCO) is considered to be higher than any of the other alternatives. Environmental releases associated with Alternatives 4 or 6 are principally limited to wind-blown dust and surface water runoff. Any potential environmental impacts associated with dust and runoff would be minimized with proper installation and implementation of dust and erosion control measures and by performing the excavation and off-site disposal with appropriate health and safety measures to limit the amount of material that may migrate to a potential receptor. Air monitoring would be implemented to protect workers and the community.

No time is required for implementation of Alternative 1. The time required for implementation of Alternatives 2 and 3 is estimated at two years. Alternative 4a is estimated to take about two to three years to implement. Alternative 5a is estimated to take about seven years to implement, and Alternative 6a, about three years. There are many additional, complicating factors for Alternatives 4/5/6 that make it difficult to predict actual remedial performance times; for example, providing suitable alternative access to the City Place development during remedial construction may require additional time, with Alternative 6 resulting in substantially longer and more invasive disruption, and Alternative 4a requiring much less disruption. The times listed here can only account for the time that the work would take place: for example, the ISCO process is expected to include a period of NAPL extraction and soil excavation, followed by a series of ISCO treatments over as much as five years, hence the seven-year timeframe.

The implementation timeframe for the building demolition alternatives, Alternatives 4b, 5b, and 6b is listed as the same, because the additional work (building demolition and addressing the sub-foundation NAPL) is not extensive; however, these alternatives are expected to take substantially longer, at least a year or more, than their non-demolition counterparts, because of the administrative and legal hurdles of obtaining the right to demolish the building, either through negotiated sale or condemnation, and the relocation of the tenants.

River Road is the primary north-south transportation route for Edgewater. Alternatives 2 and 3 would provide the least disruption to vehicular traffic on River Road. Alternatives 4, 5 or 6 would minimize traffic disruption on River Road by aligning remedial work to be performed at the same time as repair or maintenance work that would otherwise be required by Bergen County for the affected stretch of River Road. There is no difference in the short-term effects of remediation between Alternatives 4, 5 and 6 for the remediation that needs to be completed at River Road. This may result in a remedial action that is substantially complete within the timeframes discussed here, except for the portion that needs to be coordinated with the needs of Bergen County.

6. Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered.

There are no implementability issues associated with the No Action alternative.

Logistics

All alternatives would have access challenges that would have to be addressed with all property owners. For Alternatives 4a, 5a, and 6a, scheduling and sequencing of treatment or removal of NAPL beneath 115 River Road parking lot would be necessary to limit the adverse impacts to the current occupants. Building stability analyses and design of appropriate controls would be required prior to treatment or removal of soils adjacent to the building, and to make changes to the building’s infrastructure (such as the installation of a vapor mitigation system) while the building is occupied.

The logistics for the building demolition alternatives, Alternatives 4b, 5b, and 6b, are substantially more involved than their non-demolition counterparts. Under CERCLA, EPA would be able to acquire the property for purposes of demolition, though the legal steps can be time-consuming. There are between 50 and 60 commercial tenants currently in the building, and these tenants would need to be relocated.

Similar challenges are presented by the HCAA, on which the entrance road for the City Place development has been constructed. This is the primary entrance to this residential and commercial complex, and more intrusive actions, such as Alternative 6a or 6b, which involve excavation of the HCAA, would require the development of alternate ingress and egress routes for this property. After Alternatives 2 and 3, Alternative 4a/4b appears to offer the least disruption to the ongoing use of the entrance road.

Subsurface Obstructions
Large boulders and stone on the former Celotex property at NZ-5 would complicate the implementation of all active remedial technologies in this area. Installation of NAPL recovery wells (Alternative 3) would require drilling technology able to penetrate bouldery fill. Installation of a funnel-and-gate system (Alternative 2) or cutoff wall (Alternatives 3 and 5) would require removing overlying bouldery fill prior to barrier placement. *In-situ* solidification/stabilization (Alternatives 4 and 5) would also require excavation of subsurface boulders prior to mixing. *In-situ* chemical oxidization (Alternative 5) may require either excavating boulders or using drilling technologies able to penetrate the fill material.

Remedial Design Testing and Remedial Performance Monitoring
Alternatives 4 and 5 would require bench- and pilot-scale testing prior to implementation. All alternatives would require storm-water controls and fence-line monitoring for dust and emissions during implementation. (Even Alternatives 2 and 3 that primarily rely on capping would entail the handling of contaminated soils and would require monitoring and dust controls.)

Temporary controls to prevent mobilization of free-phase NAPL to the Hudson River and sediment would be required during implementation of *in-situ* alternatives or deep excavation (Alternatives 4, 5, and 6) near the shoreline (at NZ-2 and NZ-5).

As part of a pre-design task, water flow patterns would need to be modeled for adequate control in alternatives involving placement of barriers to groundwater flow or *in-situ* solidification/stabilization (Alternatives 2, 3, 4, and 5).

115 River Road buildings would require air monitoring and engineering controls as well as temporary parking accommodations during implementation of the active alternatives. These controls would be more complicated for Alternatives 5 and 6, because these alternatives have the potential to generate more vapor or dust than the other alternatives. Still, engineering practices to control dust, odor, noise and other construction issues are readily implemented and very effective for the types of remedies considered here, and all of the remedial components can be implemented without causing health and safety concerns for tenants at 115 River Road or for other nearby buildings. For Alternatives 4a, 5a and 6a, the FS includes a construction sequencing plan to assess how to minimize the disruption to the 115 River Road occupants during a projected remediation. During the remedial action, the implementing parties may conclude that temporary relocation of particular tenants in 115 River Road could result in a quicker, more efficient implementation timeframe for the remedy, rather than attempting to maintain a tenant in place, or restricting work hours to evenings or weekends.

Alternative 4 poses additional implementability considerations with soil expansion, and effective distribution of reagent to target treatment areas.

For Alternative 5, ISCO is expected to have limited effectiveness on some of the tar-like or thicker NAPL zones, and requires an excavation component to remove some of these highly contaminated zones so that ISCO can be effective on the remainder. Effective distribution of oxidants to the target treatment areas is also an implementation consideration for Alternative 5.

Preservation of 115 River Road Buildings

While there are implementation issues regarding the demolition of the buildings (discussed above), preserving the buildings and leaving the NAPL wastes in place pose separate implementation issues. The buildings themselves become an integral part of the remedy. To ensure long-term protectiveness, the 115 River Road buildings need to be retrofitted with vapor mitigation systems, and the building slabs need to be regularly inspected for cracks or other openings, and sealed as necessary. For the vapor mitigation systems to function properly, there needs to be a vadose zone (soils not saturated with groundwater) in the subsurface, and a sump system may be needed to maintain a zone of separation between the water table (and subsurface NAPL) and the building foundations. In addition, through jet grouting or other related technologies, a competent containment wall will need to be built underneath the building at the shoreline to isolate the NAPL and groundwater from Hudson River sediments. Construction or improvements are restricted and subject to EPA review and approval to ensure long-term effectiveness of the remedy.

Groundwater Remedies
Alternatives G1 (Containment/Passive Treatment) and G2 (Hydraulic Containment) need to be placed along the shoreline, where a number of remnant structures, such as old piers and bulkheads, already exist. Installing the cut-off walls and treatment features associated with these alternatives will pose implementation challenges. Maintaining the functionality of these alternatives after construction offers an additional challenge, because coal tar NAPL may foul the treatment components (either the treatment media in G1 or the water collection/pumping system in G2) that are meant to treat aqueous-phase contaminants. The implementability of these technologies is at least partly dependent upon the degree to which NAPL in NZ-2 and NZ-5 is adequately addressed.

Alternatives 4 and 6 rely on a subaqueous reactive barrier (SRB) to be placed in the river sediments as part of an expected OU2 remedy. Based upon the data collected to date, a remedial action that would address contaminated sediments is expected for OU2, though the scope of an OU2 remedial action can only be projected at this stage. It is possible, though unlikely, that an OU2 remedy would not be compatible with the SRB. The type of fouling or saturation of the reactive media, described above for G1, would also be a concern for the SRB, though in this case the source of the NAPL would be from deep sediments already in the Hudson sediments rather than from OU1. Long-term management of the SRB, which would monitor performance and repair sections of the SRB (for instance, by replacing a section that has become fouled with coal tar), would be required.

7. Cost
Includes estimated capital and O&M costs, and net present worth value of capital and O&M costs.

The estimated capital cost, O&M, and present worth cost are discussed in detail in the FS Report. The cost estimates are based on the best available information.

Alternatives 5b and 6b represent the highest present worth cost alternatives, at $480 million and $308 million, respectively. The present worth cost for 5a and 6a are $365 million and $205 million, respectively. These alternatives require extensive capital equipment and labor for construction and operation. The next highest present worth cost alternative is Alternative 4b, at $169 million and 4a at $72 million. Alternatives 2 and 3 are the lowest cost alternatives, at $41 million and $63 million, respectively.

The added cost of demolishing the 115 River Road buildings (the "b" alternatives) is substantial, but it is primarily derived from the cost of relocating tenants, demolishing the buildings and then compensating the land owner for replacing the existing buildings with new buildings of comparable value.

Modifying Criteria *- The final two evaluation criteria, criteria 8 and 9, are called Amodifying criteria@ because new information or comments from the state or the community on the Proposed Plan may modify the preferred response measure or cause another response measure to be considered.*

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8. State acceptance
Indicates whether based on its review of the RI/FS reports and the Proposed Plan, the state supports, opposes, and/or has identified any reservations with the selected response measure.

The State of New Jersey concurs with EPA's Selected Remedy in this Record of Decision.

9. Community acceptance
Summarizes the public's general response to the response measures described in the Proposed Plan and the RI/FS reports. This assessment includes determining which of the response measures the community supports, opposes, and/or has reservations about.

EPA solicited input from the community on the remedial alternatives proposed for OU1 at the Quanta Resources site and received extensive oral and written comments. The attached Responsiveness Summary addresses the comments received during the public comment period. The community (residents, nearby property owners and business neighbors of the site) had widely varied positions, from support to strong reservations about EPA's Proposed Plan. EPA received written and oral comments from the representatives of several local environmental groups indicating that the preferred remedy was not thorough enough to address the site problems, and was not protective enough of the Hudson River. The Borough of Edgewater did not submit a single unified position, but the Mayor and the members of the Borough Council expressed impatience with EPA's slow investigation and remedy selection process.

While the comments received did not coalesce around a single remedial alternative or area of concern, EPA has identified several issues emphasized by the community that have resulted in changes to remedial components of the Selected Remedy or require further clarification by the Agency:

- A number of commenters believe that *in-situ* solidification/ stabilization as a treatment technology may not be protective over the long term for treating arsenic or coal tar wastes;
- A number of commenters were concerned about the effectiveness of the preferred groundwater containment remedy, a subaqueous reactive barrier over the long term; and
- A number of commenters expressed concerns about the ongoing use of 115 River Road, and how that might affect the protectiveness of the remedy.

To the extent that these issues are not addressed here, they are discussed in EPA's comprehensive response to the comments received during the public comment period in the Responsiveness Summary, Appendix V.

PRINCIPAL THREAT WASTE

EPA's findings to date indicate the presence of principal threat wastes at the Quanta Resources site. Principal threat wastes are considered source materials, *i.e.*, materials that include or contain hazardous substances, pollutants or contaminants that act as a reservoir for migration of contamination to groundwater, surface water, or as a source for direct exposure. 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. By utilizing treatment as a significant component of the remedy, the statutory preference for remedies that employ treatment as a principal element is satisfied.

SELECTED REMEDY

Based upon consideration of the results of the site investigations, the requirements of CERCLA, the detailed analysis of the response measures, and public comments, EPA has determined that a hybrid of Alternative 4a and Alternative 4b is the appropriate final remedy for the source areas, soils and groundwater at the site; the preservation of the buildings at 115 River Road (Alternative 4a) will remain as an interim action, with Alternative 4b, which will treat the contaminated NAPL zones under the buildings, as the final remedy. This clarifies the intent of the Proposed Plan--EPA has concluded that Alternative 4b is the best remedy for the site over the long term, but acknowledges that the demolition of the 115 River Road buildings can be deferred and the remedy can remain protective in the interim, and that immediate demolition of these buildings may not be in the best interests of the site or the community. This remedy best satisfies the requirements of CERCLA Section 121 and the NCP's nine evaluation criteria for remedial alternatives, 40 CFR § 300.430(e)(9)(iii).

The Selected Remedy described in this document involves the solidification/stabilization of NAPL and arsenic source areas, capping and institutional controls, coupled with the installation of a groundwater containment remedy, a subaqueous reactive barrier in the Hudson River to mitigate contaminated groundwater releases. The components of the Selected Remedy include:

Treatment of Source Areas with Solidification/Stabilization (S/S) (Arsenic and Coal Tar NAPL)

On-site solidification/stabilization of an estimated 150,000 cubic yards of contaminated soil containing arsenic and NAPL, primarily by *in-situ* solidification/stabilization (ISS).

Remedial Components:

- The following Source Areas will be subject to treatment:
    - For Coal Tar NAPL
        - All of NZ-1, including areas beneath River Road and beneath the buildings at 115 River Road;
        - All of NZ-2 and NZ-5;

        - Portions of NZ-3 contiguous with (that is, adjacent to or separated by no more than five feet from) NZ-1 or NZ-2 and NZ-5.

    - For Arsenic:
        - All of the High Concentration Arsenic Area;
        - Other shallow arsenic hotspots (within the first four feet of ground surface) exceeding 390 ppm and deeper hotspots exceeding 1,000 ppm total arsenic.

- Free-phase NAPL present at NZ-1, NZ-2/5, portions of NZ-3 and tar boils, and arsenic hotspots that constitute a principal threat will be solidified/stabilized and the treated soils will then remain on site, or be excavated for disposal off site. The majority of the site will be treated with *in-situ* solidification/stabilization (ISS).

- Prior to *in-situ* treatment, the area subject to ISS will be cleared of vegetation and excavated for surface and subsurface debris removal not compatible with ISS treatment (*e.g.*, large boulders, tank pads, conduits, and concrete). These materials will be transported and disposed of off site.

- EPA expects that portland cement-based solidification will be the primary ISS method for the site. EPA will require that material solidified through this method satisfies the following performance measures: minimum unconfined compressive strength (UCS) of 40 pounds per square inch (40 PSI); maximum permeability of $1x10^{-6}$ centimeters per second; and leachability testing using EPA's Synthetic Precipitation Leaching Procedure, the ANSI/ANS 16.1 method, or other appropriate methods. EPA will develop leaching levels and select a specific analysis in the design phase pending results of the treatability studies.

- During Remedial Design, specific leaching levels for site-related constituents will be developed. EPA expects to achieve a 90 percent or greater reduction in leachability for the majority of the site constituents; however, this remediation goal is not applicable to all constituents. EPA will consider the following factors when evaluating leachability as a criterion for remedial performance:
    - during remedial design, representative baseline concentrations of site constituents will be

established, against which performance will be measured;

- a percent reduction criteria is not appropriate for constituents with low baseline concentrations;
- the ability to consistently achieve the leaching remediation goal for certain low molecular weight and high vapor pressure organic constituents may be limited, whereas reduction in permeability for the solidified soil matrix can still demonstrate acceptable reduction in mobility;
- broader contaminant groupings for benchmarking leachability reduction, such as total hydrocarbons, may more appropriately reflect a percentage-reduction based remediation goal for total NAPL, rather than specific constituents within the NAPL;
- given the heterogeneity of the NAPL, metals and site geology, no single leaching test result can be considered representative, and statistical methodology and multiple tests will be needed to assess the variability of leaching results; and
- The effectiveness of leachability improvement additives needs to be balanced against the primary performance criteria of the solidified mass (i.e., unconfined compressive strength and permeability).

- Treatability testing will be conducted prior to full-scale implementation to optimize the ISS mixes and demonstrate a correlation between leachability and UCS and permeability performance criteria. Once this correlation is established, UCS and permeability will be used as the primary performance measurement methods and to demonstrate that S/S meets the remediation goals during implementation. Leachability testing will be performed periodically during the Remedial Action to maintain the integrity of the remedy. Areas that fail to meet the performance criteria will be excavated and disposed of off site.

- ISS of NAPL in NZ-2 and NZ-5 requires treatment behind and around the bulkhead, essentially encasing it in a solidified matrix. This work will be performed in a sequenced or alternating pattern to protect bulkhead tie backs and prevent shoreline instability during cement curing. Because *in-situ* auger mixing cannot be used around the bulkhead, resulting in a less homogeneous solidified matrix, a vertical barrier, consisting of either a sheet pile cut-off wall or a slurry wall is needed as an additional barrier between the solidified NAPL and the Hudson River and sediments. Isolating the site from the shoreline by driving sheet piles on the river side of the bulkhead is also required to prevent loss of ISS materials into the river prior to cement curing.

- Away from the bulkhead area, augers or other mixing equipment will be advanced to the target depths below ground surface, based on NAPL zone characterization. Upon target depths being reached, reagents will be injected and mixed within the soil column to treat the material between the ground surface and the target depth.

- Certain areas of the site requiring solidification or stabilization treatment are isolated from the bulk of the site requiring treatment. During remedial design, EPA may conclude that the long-term management of the site will be improved by consolidating these areas, primarily on the Quanta property. Thus, portions of the principal-threat NAPL and arsenic on the Block 93 will be solidified/stabilized either *in situ* or *ex situ* on the main part of the site.

- Principal-threat NAPL (portions of NZ-1) under River Road will be addressed up to the right-of-way to the extent practicable independent of Bergen County, and then further response actions would be coordinated with Bergen County, to be performed in collaboration with the County when future repairs or maintenance of the River Road are called for. Thus, ISS will be performed under River Road, but the work will be performed in stages and in such a way to minimize traffic congestion on River Road, to the extent practicable.

- Arsenic contamination in the HCAA will also be treated with ISS or, if ISS fails to meet the performance measures established for ISS, as a contingency, a vertical cutoff wall with extraction wells for hydraulic containment of the HCAA will be installed. Treating HCAA soils with ISS requires a different approach from other places on the site due to the active roadway to City Place. Horizontal drilling from the Quanta property would be employed to inject stabilization amendments into the soils to stabilize and render insoluble the arsenic and other metals in the HCAA. Vertical drilling may also be necessary to achieve the performance measures for ISS.

- During Remedial Design, stabilization technologies will be subjected to further site-specific testing to simulate existing and future site conditions, to demonstrate that HCAA stabilization can be shown to irreversibly mitigate the mobility and toxicity of the arsenic. Furthermore, arsenic soil contamination that presents an acute threat in the event of direct contact exposure as defined by New Jersey's Immediate Environmental Concern (IEC) Guidance[6], will be treated in such a way that it reduces the toxicity to below non-acute levels, as defined by the IEC Guidance.

- Different ISS methods, including stabilization of the HCAA, will need to meet similar leaching performance criterion to portland cement-based solidification set by EPA during remedial design.

- The Selected Remedy requires excavation and transportation of contaminated soil and debris not suitable for on-site solidification/stabilization treatment to an off-site facility for disposal, with treatment as necessary prior to disposal.

- If, during Remedial Design or Remedial Action, components of free-phase NAPL or arsenic-contaminated soil are shown to be incompatible with solidification/stabilization, these wastes will be excavated for transportation and off-site disposal, with treatment as necessary to meet land disposal requirements. EPA has concluded that hard tars/tar boils are not suitable for S/S and need to be excavated and removed from the site for disposal.

- EPA anticipates redevelopment of the site with construction that requires supporting piles or columns that need to be placed through solidified material. Construction pile installation can only take place in such a way that it does not compromise the long-term protectiveness of the remedy, does not exacerbate or spread residual contamination at the site, and requires prior review and approval from the Agency. With the exception of construction piles, EPA expects that subsequent site uses will have no contact with solidified/stabilized material (see "Residual Soils" discussion, below).

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6 "Acute effect" means that an adverse human health effect could result from an exposure of less than two weeks.

- Further details of the solidification/stabilization remedy component can be found in the discussion of 115 River Road, below.

Deep NAPL

Treatment of a portion of the Deep NAPL through ISS, passive NAPL collection for other areas of the Deep NAPL, and long-term monitoring.

Remedial Components:

- As described under "Treatment of Source Areas", portions of NZ-3 that are at close proximity to NZ-1 and that are accessible to ISS (that is, in areas not obstructed by surface impediments and NZ-1 and NZ-3 are five feet or less vertical distance from each other), ISS auger mixing will be used to treat these areas. With the removal of the 115 River Road buildings in the final remedy, EPA expects that this will solidify the majority of the mass of NZ-3.

- For remaining areas of NZ-3 and NZ-4, free-phase NAPL collection from recovery wells or recovery trenches will be performed, to the extent practicable. For purposes of the FS, the NAPL recovery system was assumed to be 10 vertical recovery wells installed at locations where free-phase NAPL has been identified. Recovered NAPL will be collected and stored. The remediation goal for NAPL extraction will be to reach a point at which no measureable free-phase NAPL collects in the well or trench; however, over time, NAPL collection systems can stop producing extractable quantities of NAPL, yet there can still be measurable quantities of NAPL in the vicinity of the collection system, so an alternative remedial endpoint may ultimately be necessary. This remediation goal will be refined during remedial design testing. In addition, methods for enhancing the performance of a NAPL recovery system will be evaluated during remedial design, to determine whether the use of heating, surfactants, or other enhancements would improve the performance of the collection network. The goal of the enhancement methods is to achieve significant mass reduction over a shorter period of time than would be expected from the extraction tests performed during the RI/FS.

- NAPL collection may also be considered as a preliminary treatment for areas of the NAPL zones identified for ISS, if removing extractable NAPL aids in the long-term effectiveness of the ISS remedy.

- The FS assumed that NAPL collection can take place in the deep NAPL independent of ISS (e.g., before, during or after ISS implementation). Testing during Remedial Design will determine an appropriate implementation sequence, to assure that ISS is not an impediment to NAPL collection.

- Off-site disposal options for collected NAPL may include recycling or treatment as necessary prior to land disposal. For cost-estimating purposes, off-site disposal of NAPL was assumed to be via recycling. Testing will be required to determine if this waste stream constitutes a hazardous waste.

- No free-phase NAPL collection is anticipated for NZ-6, because no free-phase liquids have been observed that could be collected. If monitoring of NZ-6 identifies free-phase NAPL in the future, EPA will reevaluate the need for adding this deep NAPL remedy component in NZ-6.

- Long-term monitoring will be required for all the Deep NAPL, as discussed in more detail in the Monitoring Section, below.

Interim Action: 115 River Road Buildings

Installation of a vapor mitigation system and basement sealing at 115 River Road; construction of a temporary barrier wall at 115 River Road along the shoreline to isolate untreated free-phase NAPL from the Hudson River and sediments.

Remedial Components:

- A barrier wall, constructed through jet grouting or installing steel sheeting at the shoreline, to isolate the untreated NAPL and constituents from the Hudson River and sediments.

- Solidification/stabilization will be implemented close to the building foundations to leave as little untreated source material as possible without compromising the structural integrity of the buildings. The results of a stability analysis during Remedial Design will determine the distance required to be maintained between the treatment zone and the existing buildings.

- A vapor mitigation system, such as a sub-slab depressurization system, and other building modifications will be implemented to ensure that the buildings remain protective for continued occupancy. This may include the installation of a sump system, if needed to maintain the vapor mitigation system, prevent NAPL infiltration, or otherwise maintain the protectiveness of the remedy. New construction or improvements to the existing buildings will need to be assessed for their affect on the protectiveness of the remedy, and EPA will have a long-term oversight function at these buildings.

- As part of the interim action for 115 River Road, the day care center at 115 River Road will be relocated prior to implementation of the Remedial Action.
- Relocation of occupants in 115 River Road during ISS is not anticipated for health and safety reasons; however, during remedy implementation, the performing party may conclude that temporary relocation of certain tenants in 115 River Road could result in a quicker, more efficient implementation of the remedy.
- Continued vapor intrusion monitoring will be performed for 115 River Road buildings as part of the interim action.

Final Action: 115 River Road Buildings
When 115 River Road is demolished or redeveloped in the future, ISS for the untreated free-phase NAPL remaining under the buildings.

Residual Soils
Capping of contaminated soils remaining on site at concentrations greater than the Remediation Goals for residential direct contact (see **Table 1**) with a multilayer cap as approved by EPA.

Remedial Components:

- Hardscape (*i.e.*, that part of the site consisting of structures, parking areas and walkways, made with hard materials) could be used in place of capping.

Groundwater
Installation of a subaqueous reactive barrier (SRB) in Hudson River sediments, coordinated with a future OU2 remedy.

Remedial Components:

- The action will treat contaminated groundwater as it flows through a horizontally placed SRB before being discharged to the surface water of the Hudson River. Implementation of Alternative G3 will take place in Hudson River sediments, coordinated with a remedial action to address contaminated sediments. It will not be implemented until after selection of the OU2 remedy;

- The SRB would consist of a permeable subaqueous reactive mat to treat aqueous-phase contamination in groundwater before it reaches the shallow sediments and surface water;

- During Remedial Design, a groundwater model will be developed to predict the expected effectiveness and operation and maintenance (O&M) requirements of the SRB, along with bench-scale testing to assess the sorptive capacity of the core material. The final design of the SRB, including the size and material, would be highly dependent on the upwelling zones and the pore water concentrations, along with other requirements of an SRB that may be part of the OU2 remedy. The SRB can be thought of as a stand-alone action installed independent of the OU2 sediment remedy; however, a concurrent sediment action that might also use the SRB is likely; and

- The SRB may need to be secured in place by a layer of sand or sand-gravel mix, along with an armor layer to protect the SRB from hydraulic scour conditions due to storm surge flows, if deemed necessary based on the results of the OU2 sediment stability study. The SRB will be covered with a biotic sediment layer to support the biologically active zone of shallow Hudson River sediments.

Operation and Maintenance of the Remedy, Monitoring, and Institutional Controls

Operation and maintenance for the active components of the remedy, such as the Deep NAPL collection system and vapor intrusion systems, monitoring of the site over the long term to assure the protectiveness of the Remedy, and institutional controls; implementation of a long-term sampling and analysis program to monitor the contamination at the site in order to assess groundwater migration, and the effectiveness of the remedy over time.

Remedial Components:

- The Selected Remedy requires engineering controls that would mitigate the potential for exposure through vapor intrusion for future construction, along with institutional controls to prevent exposures to soil or groundwater;

- In addition to the Deep NAPL collection system, in the event that HCAA stabilization cannot be demonstrated and hydraulic containment is implemented for the HCAA, this alternative will require the long-term O&M of the groundwater treatment system installed for the hydraulic containment of the HCAA;

- An OU1 monitoring plan will confirm the continued effectiveness of the remedy to protect human health and the environment, including the Hudson River. This monitoring plan will include ISS-treated areas, the deep NAPL and, in particular, the NAPL zones isolated beneath the 115 River Road buildings as part of the interim remedy;

- The SRB will require monitoring to verify that site-related groundwater contamination is being captured prior to discharge to surface water, and to predict when replacement would be required;

- Continued vapor intrusion monitoring will be performed for 115 River Road buildings and other affected properties. Additional vapor intrusion mitigation systems at the other properties would be implemented as indicated by the monitoring data;

- Institutional controls such as a deed notice or restrictive covenant on affected properties will be required to aid in the long-term protectiveness of the remedy;
- Institutional controls, including a Classification Exception Area, to restrict the installation of wells and the use of groundwater in an area of groundwater contamination will be required; and

- Implementation of a long-term groundwater sampling and analysis program to monitor the nature and extent of groundwater contamination at the site, in order to confirm that footprint of the site-related groundwater contamination is not increasing.

Additional Remedy Considerations

The Selected Remedy was chosen over other alternatives because it is expected to achieve substantial and long-term risk reduction through on-site solidification/stabilization, and is expected to be consistent with the reasonably anticipated future land use, which is mixed use commercial/residential. The

Selected Remedy reduces the risk within a reasonable time frame, at a cost comparable to other alternatives and is reliable over the long term.

Remediation Goals

The Selected Remedy will achieve the remediation goals that are protective for the principal threat source areas by meeting the performance goals for solidification/stabilization, and for soils by capping to prevent direct contact with soils exceeding NJDEP soil remediation standards for residential use.

The groundwater Alternative G3 is a treatment remedy to prevent the release of site constituents into shallow sediments and surface water of the Hudson River. Remediation goals for SRB performance are groundwater standards; a determination of the applicability of surface water criteria will be part of the OU2 remedy. While it is EPA's mandate to restore groundwater wherever practicable, EPA did not pursue aquifer restoration at this site because of these factors: (1) even after the Selected Remedy is implemented, the presence of NAPLs distributed over a wide area renders ineffective the active remedies available for treating groundwater; (2) the presence of 10 to 15 feet of anthropogenic fill throughout the study area, and the presence of adjacent (non-NPL) remediation sites with residual contamination, results in a high likelihood of ongoing, low-level sources that will result in groundwater concentrations in excess of drinking water standards; and (3)the presence of NAPL in the Hudson River sediments will be at least partly remedied in an OU2 Remedial Action, but complete source mitigation appears unlikely, leaving an ongoing source, and in any case, an active groundwater remedial action such as pump and treat cannot be implemented in the Hudson. Because no active remedy can offer the potential for aquifer restoration, EPA is invoking an ARAR waiver for the groundwater at this site, due to technical impracticability. This technical impracticability conclusion is predicated upon the selection of an active remediation of the subsurface soil source areas, such as EPA's selected remedy Alternative 4, that utilizes a permanent solution for the groundwater source areas to the extent practicable, coupled with an active remedy to treat the groundwater, Alternative G3. The groundwater remedy also requires long-term monitoring of the groundwater to ensure that human health and the environment are protected, and institutional controls, such as a Classification Exception Area, well restrictions, and deed notices, as appropriate, to prevent exposure to contaminated groundwater.

As noted in the Short-Term Effectiveness section of the comparative analysis of alternatives, EPA expects that the Selected Remedy for soils would be performed in two to three years. Even with the remedy changes discussed below, this timeframe is still appropriate for the majority of the remedial action, understanding that certain aspects of the remedy are dependent upon outside factors: the final remedy for the source material under the 115 River Road buildings is dependent upon a collaboration between EPA and the property owner as to an appropriate timeframe for redevelopment of 115 River Road (for planning purposes, EPA is expecting this period to be no more than 10 years from the date of the Record of Decision); the groundwater action, which is dependent upon the selection of a remedy for OU2; and the remediation of NAPL under River Road.

In developing remedial alternatives for the site, EPA has assumed that residential-type exposures are plausible throughout the site in the future, and that capping to prevent direct contact will be required throughout all site areas where levels exceeding concentrations in **Table 1** are found.

Because redevelopment plans on the site anticipate new occupied buildings, EPA considered the potential for vapor intrusion of VOCs from residual contamination. EPA concluded that vapor intrusion may pose a human health concern under various future-use scenarios. While the Selected Remedy would be expected to substantially reduce the potential for vapor intrusion, vapor mitigation systems would need to be evaluated for any buildings to be built in the future.

The land use for deep NAPL at NZ-4 and NZ-6 includes roadways (River Road, Gorge Road) and already-developed commercial properties. Should there be a change in land use that affects these areas, EPA would need to reevaluate whether further actions may be required to address these areas to maintain the protectiveness of the remedy.

STATUTORY DETERMINATIONS

As was previously noted, CERCLA §121(b)(1) mandates that a remedial action must be protective of human health and the environment, cost-effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Section 121(b)(1) also establishes a preference for remedial actions which employ treatment to permanently and significantly reduce the volume, toxicity or mobility of the hazardous substances, pollutants, or contaminants at a site. CERCLA §121(d) further specifies that a remedial action must attain a degree of cleanup that satisfies ARARs under federal and state laws, unless a waiver can be justified pursuant to CERCLA §121(d)(4). For the reasons discussed below, EPA has determined that the Selected Remedy meets the requirements of CERCLA Section 121.

Protection of Human Health and the Environment

The Selected Remedy, Alternative 4b combined with groundwater Alternative G3, will adequately protect human health and the environment by eliminating all significant direct-contact risks to human health and the environment associated with contaminated soil. In addition, this action will eliminate and/or reduce sources of contamination to the groundwater, and prevent further releases to the Hudson River through groundwater transport. This action will result in the reduction of exposure levels to acceptable risk levels within EPA's generally acceptable risk range of 10^{-4} to 10^{-6} for carcinogens and at or below a HI of 1 for noncarcinogens. Implementation of the Selected Remedy will not pose unacceptable short-term risks or adverse cross-media impacts.

Compliance with ARARs

The remedial actions will comply with all federal and state requirements that are applicable or relevant and appropriate (ARAR) to their implementation. A comprehensive ARAR discussion is included in the FS and a complete listing of ARARs is included in **Table 12** of this ROD. Because no active remedy can offer the potential for aquifer restoration, EPA is invoking an ARAR waiver for an area of contaminated groundwater affected by site contaminants, due to technical impracticability.

Source Areas and Soils

At the completion of the response action for the source areas and contaminated soils, the Selected Remedy will meet the standards of all applicable ARARs, including:

- Action-specific ARARs. Compliance with action-specific ARARs will be achieved by conducting all remedial action activities in accordance with the following:
  - o RCRA – Requirements codified at 40 CFR Part 262 govern packaging, labeling, manifesting and storage of hazardous waste;
  - o RCRA – Requirements codified at 40 CFR Part 263 govern off-site transport of hazardous waste;
  - o RCRA – Requirements codified at 40 CFR Part 264 govern on-site storage of hazardous waste;

- RCRA – Land disposal restrictions (LDRs), codified at 40 CFR Part 268, allow for land disposal of soils exhibiting hazardous characteristics only after treatment to meet LDR standards;
- Hazardous Materials Transportation Law, 49 U.S.C. § 5101 *et seq*. – Hazardous wastes that are transported off site must meet Department of Transportation regulations set forth in 49 CFR Parts 105, 107, 171-178;
- Clean Water Act (CWA) – Section 402 of the CWA, 33 U.S.C. § 1342, and its regulations codified at 40 CFR Part 122, govern discharge of storm water from construction sites of more than one acre;
- National Ambient Air Quality Standards for Hazardous Air Pollutants, codified at 40 CFR Part 50, establish maximum concentrations for fugitive dust emissions and particulates;
- New Jersey Hazardous Waste Management Regulations – Requirements codified at N.J.A.C. 7:26G establish standards for generation, accumulation, on-site management, and transportation of hazardous wastes;
- NJDEP Technical Requirements for Site Remediation – portions of these requirements, codified at N.J.A.C. 7:26E, specify technical standards to be followed at sites undergoing remediation pursuant to New Jersey remediation programs;
- New Jersey Air Quality Regulations – Requirements codified at N.J.A.C. 7:27 are relevant to the managing the generation and emission of air pollutants, including during remedial actions;

- Chemical-Specific ARARs:
  - New Jersey Soil Remediation Standards for residential and nonresidential land use, N.J.A.C. 7:26D, for direct contact with soil contamination.

- Location-Specific ARARs:
  - National Historic Preservation Act – Pursuant to Section 106 of the National Historic Preservation Act, potentially significant cultural resources at the site must be identified.

- To Be Considered Material (TBCs). The following requirements will be considered by EPA during design and implementation of the Selected Remedy, and will be complied with to the extent practicable:

- EPA's 1985 Statement of "Policy on Floodplains and Wetlands Assessments for CERCLA Action";
- NJDEP Guidance for Remediation of Contaminated Soils.
- NJDEP standards for soil erosion and sediment control, N.J.A.C. 2:90-1.1, describes the recommended approach and standards to be used for soil erosion and sediment control plans;
- NJDEP Immediate Environmental Concern Technical Guidance, August 2011;
- NJDEP 1998 Revised *Guidance Document for the Remediation of Contaminated Soils* *http://www.nj.gov/dep/srp/regs/soilguide/*;
- Executive Order 11988, "Floodplain Management" – Requires the consideration of impacts to floodplains in order to avoid adversely impacting floodplains wherever possible and to ensure the restoration and preservation of such land areas as natural undeveloped floodplains.

* Other Pertinent Requirements
  - Occupational Safety and Health Act (OSHA) – Occupational Safety and Health Standards for Hazardous Response and General Construction Activities (29 CFR Parts 1904, 1910, 1926) are intended to protect workers from harm related to occupational exposure to chemical contaminants, physical hazards, heat or cold stresses, noise, etc. OSHA is considered to be a "non-environmental law" whose standards and requirements apply of their own force, not as a result of the CERCLA ARAR system (55 FR 8680, March 8, 1990). For this reason, remediation activities at the Site will be subject to the requirements of OSHA;
  - Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970, 42 U.S.C. 4601 et seq., and its implementing regulations at 49 CFR Part 24 governs agency conduct of relocation of persons displaced from their homes, businesses or forms by federal and federally-assisted programs; and
  - EPA guidance document, "Superfund Response Actions: Temporary Relocations Implementation Guidance" provides guidance to EPA concerning implementation of relocation activities when necessary.

Groundwater

For groundwater, in addition to selecting a groundwater containment action as part of the Selected Remedy (Alternative G3), EPA is invoking an ARAR waiver due to technical impracticability. The list of site contaminants addressed by the ARAR waiver and non-site related contaminants within the ARAR waiver boundary are included in **Tables 13** and **14**, respectively. The basis for EPA's determination of technical impracticability is stated in the Selected Remedy section of this Decision Summary. Vertically, the ARAR waiver includes all groundwater from the water table down to an elevation that corresponds to five feet below the silty clay confining unit or to the top of bedrock, whichever is encountered first. The lateral extent of the ARAR waiver, an area of approximately 20 acres, and the elevation of the base of the zone are depicted in **Figure 33**. Usage of the groundwater within this area will be restricted through institutional controls, preventing exposure to contamination in excess of State and Federal drinking water standards. Long-term groundwater monitoring will be conducted to evaluate the extent of the contaminant plume, evaluate reductions in contaminant concentrations, if any, and assure that the groundwater conditions that served as the basis for the remedy selection do not change over time.

For Alternative G3, the subaqueous reactive barrier (SRB) will not be placed in Hudson River sediments until after an OU2 sediments remedy has been selected; thus, additional ARARs may be identified in the selection of the OU2 remedy.

- Action Specific ARARs:

  Federal Surface Water Quality Criteria and State Surface Water Quality Standards will be included in the design specifications to ensure compliance with the Clean Water Act (CWA) and State Water Pollution Control Act during the implementation of the SRB, and during OU1 upland activities that are adjacent to the Hudson River. In performing the remedial action, EPA will comply with the substantive requirements of New Jersey regulations that govern the management and regulation of dredging activities, which require best practices to minimize the release of sediment contamination into the water column (this will be further evaluated when selecting a remedy for OU2).

- Chemical-Specific ARARs
  - Federal MCLs and NJDEP Groundwater Quality Criteria for exposure to groundwater.

- Location-Specific ARARs
  - Since the Hudson River is located within a coastal management zone, and since groundwater remedial action

may affect a coastal use or resource, the federal Coastal Zone Management Act requires that the remedy be undertaken in a manner consistent, to the maximum extent practicable, with New Jersey's Coastal Management Program.

Cost Effectiveness

In the lead agency's judgment, the Selected Remedy is cost-effective and represents a reasonable value for the money to be spent. In making this determination, the following definition was used: "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness." (NCP §300.430(f)(1)(ii)(D)). EPA evaluated the "overall effectiveness" of those alternatives that satisfied the threshold criteria (*i.e.*, were both protective of human health and the environment and ARAR-compliant). Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness). Overall effectiveness was then compared to costs to determine cost-effectiveness. EPA has estimated the present worth cost for the final remedy, a hybrid of Alternative 4a and 4b, to be $78 million; however, the estimated present worth cost of implementing the final remedy is dependent upon a number of factors such as how long the 115 River Road buildings remain in place. The costs include the savings of operation and maintenance costs with the end of the interim remedy balanced against the additional remedial action costs of treating NAPL left under the buildings. Please refer to **Table 15** for a summary of remedy costs for the Selected Remedy.

In contrast, the estimated present worth of Alternative 5a is $366 million, and for Alternative 6a, $206 million[7]. The Selected Remedy thus is less expensive and provides the same level of protection of human health and the environment as Alternative 5a. EPA considered the cost-effectiveness of Alternative 4 when compared to Alternative 6 particularly in terms of protection of human health and the environment and long-term permanence, issues raised by a number of commenters on the Proposed Plan. EPA has concluded that while Alternative 6,

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7 EPA developed a present-worth cost for the hybrid Alternative 4 (interim remedy deferring the 115 River Road building demolition, but requiring demolition/subsurface NAPL treatment at a future time in collaboration with the property owner) but did not develop hybrid costs for Alternatives 5 and 6. In this section, cost effectiveness is compared between Alternatives 4a, 5a, and 6a.

or a substantially more involved hybrid Alternative 4/6 proposed by one commenter and referenced by several others, when compared with the Selected Remedy, could be perceived as having a higher level of protectiveness and long-term effectiveness and permanence (by removing substantial quantities of wastes from the site rather than treating them on site), in fact, there would be no measureable difference in protectiveness or long-term permanence relative to the Selected Remedy, at a substantially greater cost.

Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Practicable

EPA has determined that the Selected Remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at the site. Of those alternatives that are protective of human health and the environment and comply with ARARs to the extent practicable, EPA has determined that the Selected Remedy provides the best balance of trade-offs among the alternatives with respect to the five balancing criteria, while also considering the statutory preference for treatment as a principal element, the bias against off-site treatment and disposal, and State and community acceptance.

The Selected Remedy treats source materials constituting principal threats at the site, achieving significant reductions in coal tar mobility and arsenic mobility and toxicity, while also substantially mitigating groundwater sources at the site. The Selected Remedy satisfies the criteria for long-term effectiveness by solidification/stabilization of wastes and capping that will effectively reduce the mobility of and potential for direct contact with contaminants remaining on site. The Selected Remedy presents substantially fewer short-term risks compared with other treatment/excavation alternatives. There are also fewer implementability issues, setting the Selected Remedy apart from other treatment/ excavation alternatives evaluated.

Preference for Treatment as a Principal Element

By utilizing on-site solidification/stabilization treatment to the extent practicable, the statutory preference for remedies that employ treatment as a principal element is satisfied.

Five-Year Review Requirements

Because the remedy will result in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within five years after initiation of the remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

DOCUMENTATION OF SIGNIFICANT CHANGES

The Proposed Plan for the Quanta Resources site was released for public comment on July 21, 2010. EPA received a request to extend the public comment period from the Community Advisory Group, and extended the comment period from 30 to 60 days, and then, based upon the high level of interest in the site, extended the comment period an additional 45 days beyond that date. The comment period closed on November 5, 2010.

The Proposed Plan identified a modified version of Alternative 4a as EPA's preferred alternative.

EPA reviewed all verbal and written comments submitted during the public comment period. In response to the community input, EPA has made the following modifications to the remedy presented in the Proposed Plan:

- The Selected Remedy requires the eventual treatment of the NAPL beneath the buildings at 115 River Road (Alternative 4b);
- A vertical barrier, consisting of either a sheet pile cut-off wall or a slurry wall, is needed as an additional barrier between the solidified NAPL and the Hudson River sediments; and
- If, during Remedial Design or Remedial Action, components of free-phase NAPL or arsenic-contaminated soil are shown to be incompatible with solidification/stabilization, these wastes will be excavated for transportation and off-site disposal, with treatment as necessary to meet land disposal requirements.