Superfund Program
Proposed Plan

U.S. Environmental Protection Agency
Region 2

Quanta Resources Superfund Site

Edgewater, New Jersey

July 2010

MARK YOUR CALENDAR

PUBLIC COMMENT PERIOD:
July 21, 2010 - August 19, 2010, U.S. EPA will accept written comments on the Proposed Plan during the public comment period.

PUBLIC MEETING:
August 3, 2010 at 7:00 P.M.
U.S. EPA will hold a public meeting to explain the Proposed Plan and all of the alternatives presented in the Feasibility Study. Oral and written comments will also be accepted at the meeting. The meeting will be held at the American Legion Hall, 1165 River Road, Edgewater, New Jersey.

For more information, see the Administrative Record at the following locations:

U.S. EPA Records Center, Region 2
290 Broadway, 18th Floor
New York, New York 10007-1866
(212-637-4308)
Hours: Monday-Friday – 9 AM to 5 PM

Edgewater Free Public Library
49 Hudson Avenue
Edgewater, New Jersey 07020
(201-224-6144)

EPA ANNOUNCES PROPOSED PLAN

This Proposed Plan identifies the preferred alternative for addressing the land portions of the Quanta Resources Superfund site, and provides the rationale for that preference. Soil and groundwater at the site are contaminated with a variety of chemicals, including remnants from a coal-tar processing facility and from other industrial operations. The bulk of the contamination is found in several source areas in the soil, primarily zones of concentrated non-aqueous phase liquid (NAPL) coal tar, and at several arsenic hotspots. EPA is recommending Remedial Alternative 4a, which relies primarily on *in-situ* solidification/stabilization of NAPL and arsenic, to address the land portions of the site. Portions of the NAPL are under buildings at a neighboring property, 115 River Road, and under Alternative 4a, the buildings would be preserved and the NAPL would be managed in place beneath them, with the expectation that the NAPL under these buildings would be addressed at a future time. The presence of NAPL coal tar, the presence of multiple industrial operations adjacent to the site, and several other factors prompted EPA to undertake a technical impracticability analysis as part of the evaluation of remedial measures to address contaminated groundwater. EPA concluded that the characteristics of the site make groundwater restoration technically impracticable. As explained below, EPA's preferred alternative for groundwater includes the construction of a contaminant barrier to treat groundwater before it reaches the Hudson River, along with active measures to address sources contaminating the groundwater.

This Proposed Plan summarizes the data considered in making this recommendation. This document is issued by EPA, the lead agency for site activities. EPA, in consultation with the New Jersey Department of Environmental Protection (NJDEP), the support agency for site activities, will select the final remedy for the site after reviewing and considering all information submitted during a 30-day public comment period. EPA, in consultation with NJDEP, may modify the preferred alternative or select another response action presented in this Proposed Plan based on new information or public comments. Therefore, the public is encouraged to review and comment on all the information presented in this Proposed Plan.

EPA is issuing this Proposed Plan as part of its community relations program under Section 117(a) of the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA, or Superfund). This Proposed Plan summarizes information that can be found in greater detail in several reports, included in the Administrative Record, in particular the August 2008 *Operable Unit 1 Draft Remedial Investigation Report* (RI Report), the June 2010 *Operable Unit 1 Supplemental Remedial Investigation Report* (SRI Report) and the July 2010 *Draft Final Feasibility Study* *for Operable Unit 1* (FS Report). EPA and NJDEP encourages the public to review these documents to gain a more comprehensive understanding of the site and Superfund activities that have been conducted at the site.

SITE DESCRIPTION

The Quanta Resources site on River Road at the intersection of Gorge Road in Edgewater Borough, Bergen County, New Jersey, consists of contamination from a several former industrial facilities that once operated at that location. The former Quanta property, a vacant lot, occupies approximately 5.5 acres of land, and is the remnant of an industrial facility that once covered approximately 15 acres. **Figure 1** overlays the formerly industrialized waterfront area, with extensive tank farms, railway corridors and Hudson River piers over the current plan-view map of the area. It is important to understand both the current and former tenancy for the site and neighboring properties, and the key aspects of that tenancy are summarized below. Locations discussed throughout this document include the following:

Quanta Property - The land portion known as Block 95, Lot 1 in the Edgewater, New Jersey tax map.

Former Quanta Resources Property - The land portions of Block 95, Lot 1, and Block 93 North, as well as the portion of River Road between these lots.

Former Barrett Property - The maximum extent of Barrett Manufacturing Company, including all of the former Quanta Resources property plus lots to the north, including the southern portion of Block 91, Lot 1.

Former Celotex Property - The land portion of Block 91, Lot 1 (north of the Quanta property); contains “City Place” and “The Promenade” developments.

Former Acid Plant - A chemical plant that produced acids, alums, sodium compounds, and sulfuric acid at the southern portion of the former Celotex property and the northwest portion of the current Quanta property from at least 1843 until 1957.

115 River Road Property - The land portion of Block 96, Lot 3.01 (south of the Quanta property).

Former Lever Brothers Property - The land portion of Block 99, Lots 1, 3, and 4 (south of the 115 River Road property). Excepting the portion to be addressed by the Quanta OU1 remediation, this property is being remediated and redeveloped by i.Park Edgewater, LLC under the direction of the New Jersey Department of Environmental Protection.

Block 93 – A series of separate properties west of River Road, evaluated in the RI as three separate units, Block 93 North, Block 93 Central, and Block 93 South.

Figure 2 shows the extent of Operable Unit 1 (OU1). The total land area of OU1 encompasses approximately 24 acres. OU1 includes the observed extent of site-related NAPL and coal tar constituents detected in soil and groundwater related to former operations. A tidally influenced mud flat–marsh associated with the Hudson River borders OU1 immediately to the east of the wooden bulkhead. These river sediments, which consist of silt to clayey silt greater than 50 feet thick, and the surface water comprise Operable Unit 2 (OU2) and are being evaluated and addressed under a separate RI/FS.

SITE HISTORY

Prior to the mid-1800s, the site and surrounding areas were tidal marshlands associated with the Hudson River. Development of rail lines and industry along the banks of the Hudson River prompted the systematic filling in of these marshlands. Industrial fill material from this era contains varying levels of polycyclic aromatic hydrocarbons (PAHs) and heavy metals (from sources such as cinder and coal ash), and contribute to the presence of constituents in groundwater.

Beginning after the Civil War, this area, known as Shadyside (incorporated 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 that facilitated shipping of in-bound raw materials and out-bound finished goods, and skilled and unskilled labor in 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 industrial operations in the area, three are of particular interest at this site: Barrett Manufacturing Co. (coal tar), General Chemical Company (principal source of arsenic), and Quanta Resources and other waste oil handlers that operated at the site.

Barrett Manufacturing Company
From approximately 1872 to 1971, a large portion of the site was used to process coal tar and to produce paving and roofing materials.

General Chemical Company
To the north of Barrett, there was a chemical plant and a variety of other industrial operations. The chemical plant was used to produce acids, alums, sodium compounds, and sulfuric acid. The General Chemical Company operated from at least 1900 until 1957, though sulfuric acid production may have begun as early as the 1840s on this lot. Sulfuric acid was produced through the roasting of pyrite ore in the lead chamber process, which produces waste cinders that can contain one percent or more of arsenic.

Oil Recycling Operations
In 1974, a portion of the site was leased for waste oil storage and recycling. In 1977, that portion of the site was leased to companies owned and controlled by Russell Mahler, who collected and re-refined waste oil from up and down the eastern United States. In 1980, Quanta Resources Inc. purchased the assets of Mahler's operations, including the lease at the site. Quanta operated the facility until 1981, when NJDEP stopped all activities upon its discovery that storage tanks at the site contained waste oil contaminated with polychlorinated biphenyls (PCBs).

In addition, the following industrial operations were immediately adjacent to the NPL site operations:

Celotex Corporation
The General Chemical Company and other properties just north of the coal tar plant was operated by Celotex Corporation for the manufacture of gypsum wall board from approximately 1967 to 1971, after which time Celotex leased out the industrial space to a variety of smaller enterprises, including a vacuum truck company, and a metal reclaiming/refinishing plant.

Spencer-Kellogg & Sons, Inc.
This company began operations in around 1910, manufacturing edible oils such as linseed, castor and coconut oils, at a facility just south of Barrett. Some of the buildings at 115 River Road are the original Spencer-Kellogg buildings, though the tank farm and manufacturing facilities were dismantled in the 1960s.

Lever Brothers.
This industrial property had a variety of uses prior to the Lever Brothers facility, which was built in the 1930s. Lever Brothers (later known as Unilever) primarily handled soaps and edible oil products, and the facility was used for research until about 2003.

Early Regulatory History
At the time when NJDEP closed the facility in 1981, the Quanta property contained 61 aboveground storage tanks (ASTs), at least 10 underground storage tanks (USTs), septic tanks, and underground piping. The total storage capacity of the tanks was over 9 million gallons. The property has not been in use since 1981. Following its shutdown, NJDEP requested that EPA address site contamination pursuant to CERCLA.

Several removal actions were performed at the site from 1984 to 1988 by a group of potentially responsible parties (PRPs), under EPA oversight. PRPs included Allied Chemical Company (now Honeywell), which was the successor to Barrett, and a number of companies that had sent waste oil to the site. The removal actions focused on the cleaning and decommissioning of the ASTs and USTs. Several million gallons of product were removed and disposed of or recycled. Some underground piping and shallow soils were also removed.

The site was considered for listing on the National Priorities List (NPL) in the late 1980s but it did not qualify using the Hazard Ranking System in place at that time. EPA retained regulatory responsibility for the stabilized site within its Removal Program, and through an administrative order 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 "New" River Road and Redevelopment
Redevelopment of 115 River Road, the former Spencer-Kellogg property, began in about 1986, and it was built out as commercial space, including a day care center, by 1989, and it has been continuously occupied since that time, housing between 50 and 60 small commercial businesses.

A plan to relocate and expand River Road, approximately in alignment with an 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, which was becoming a desirable residential waterfront locale.

In 1995, the Borough of Edgewater acquired a portion of the Quanta property for a right-of-way for the "new" River Road. In 1996, EPA entered into an Administrative Order on Consent (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. Bergen County concluded that it would be best to avoid excavation altogether, and instead imported fill material to raise the grade, allowing utilities to be placed in this fill material rather than burying them below grade. In addition, Bergen County placed a liner over the existing ground surface, which provided a demarcation between original site soils and the new fill and, more importantly, isolated the older soils during the road work, protecting construction workers.

Several large-scale redevelopment projects soon followed. Redevelopment of the Celotex property began in the late 1990s, beginning with a lengthy investigation and remediation phase under the direction of NJDEP.

In 1996, EPA and one PRP, the Barrett successor 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 required 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.

In 2000-2002, the Celotex developer found what is now referred to as the High Concentration Arsenic Area (HCAA), in the footprint of the former General Chemical acid plant, and after excavating a small portion of it and performing some preliminary investigations, petitioned NJDEP to leave it capped in place. The HCAA is found on both the Quanta and former Celotex lots, and 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 (at the time of the OU1 remedy selection), the developer would need to provide access to the area to facilitate the implementa- tion 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.

By about 2004, most of 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 EPA's OU1 remedy selection before any further actions can be taken.

NPL Listing and Current Status

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.

The RI/FS for 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.

The former Lever Brothers property was purchased from Unilever in 2004 by i.Park Edgewater, LLC. It is currently in the process of being redeveloped for mixed-use residential and commercial purposes. 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 the RI/FS 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.

Public Participation

Since placement on the NPL, interest in the site from members of the community, stakeholders, and elected officials has been high. EPA has provided periodic briefings, availability sessions, and mailings to interested parties. In addition, EPA has participated in meetings held by the Quanta Community Advisory Group, which serves as a public forum for community members to present and discuss their needs and concerns related to the Superfund decision-making process.

SITE CHARACTERISTICS

Surface Features and Land Use

Surface features and current land use of properties studied in OU1 are described in the following subsections.

Quanta Property

The Quanta property is vacant and fenced. Exposed remnants of tank and building foundations are visible at several locations. The property 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. Oil-absorbent booms are maintained in the

Hudson to contain observed sheens on surface water. The booms are inspected and replaced periodically, and oil-saturated booms are removed and put into containers for off-site disposal.

Topography at the property is generally flat and at a lower elevation than the surrounding properties and River Road, resulting in standing water over a portion of the property during much of the year. 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.

Former Celotex Property

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 Celotex 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.

115 River Road Property

The majority of this property (the former Spencer-Kellogg 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 buildings. 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.

Former Lever Brothers Property

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 are 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 a Borough of Edgewater municipal building.

Block 93 North

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.

Block 93 Central

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 & Besthoff 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.

Block 93 South

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.

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.

Surface Water

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.

There are no surface water features on OU1 except storm sewers, and periodic ponding of water on several properties.

Geology and Hydrogeology

Geology

Bedrock at the site is known as the Stockton Formation, composed of a mixture of sandstone, silty mudstone, siltstone, shale, and conglomerate. At the site, the Stockton Formation is overlain by as much as 80 feet of unconsolidated deposits. Several important geologic layers within the unconsolidated deposits are the fill layer at the surface and the silty clay confining unit. The geologic layers vary in thickness across the site. For more detail about the geology of the site, please refer to the RI Reports or go to the Quanta website, http://www.epa.gov/region2/superfund/npl/quanta.

Hydrogeology

The water table on the Quanta property and 115 River Road is quite 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.

A tidal influence has been observed in groundwater 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. Below the water table and mean surface water level, the bulkhead's boards appear to be relatively competent. 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 Hudson River sediments and eventually upwelling to the surface water at zones of preferential discharge. Groundwater flow through the shallow native sand can travel unimpeded under the bulkhead on the southern end of the site.

The dominant flow pattern in shallow unconfined groundwater is west to east, from the Palisades towards the Hudson River; however, a radial flow pattern is seen at the site, the result of several factors: the bedrock outcropping at Celotex; recent fill material at River Road and at Celotex combined with localized recharge at low-lying unpaved areas in the middle of the Quanta property; and the wooden bulkhead. These factors drive a southerly component to flow.

South of the site on the central former Lever Brothers property, shallow groundwater has a northern low 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 groundwater dividing line between the two sites (See **Figure 2**).

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 unit (beneath the clay confining unit) flows uniformly east-southeast. The vertical hydraulic gradients measured between the unconfined and deep sand units indicate that the two units are not connected hydraulically.

Although the investigation of Hudson River sediments is not yet complete and is not the subject of this Proposed Plan, addressing risks from contaminated groundwater (OU1) to surface water (OU2) is a critical element of OU1. Once groundwater moves from OU1 to OU2, it is driven upward through the sediments and discharges to surface water. Areas of groundwater upwelling have been estimated in OU2.

INVESTIGATION SUMMARY

The Remedial Investigation for OU1 was conducted by a PRP group for the site with oversight by EPA. The predominant site contaminants, coal tar constituents and arsenic, are commonly found in urban settings and have been identified as primary site contaminants in site investigations that have been performed on nearby projects. Thus, a key remedial investigation goal was not to identify the limits of site contamination, but distinguish between general urban background soil and groundwater levels from issues that are attributable to the site. Historical operations include coal-tar processing operations and, subsequently, waste 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, has been demonstrated to be a source of metals, particularly arsenic and lead in soil and groundwater.

NATURE AND EXTENT OF CONTAMINATION

Non-Aqueous Phase Liquid (NAPL)

Coal tar NAPL is found across the site, and is made up aromatic volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs). Most of the SVOCs are polycyclic aromatic hydrocarbons (PAHs). The combination VOCs and SVOCs look like, and in many cases, act like oily wastes. For example, like oil, most PAHs do not dissolve easily in water. There is a broad spectrum of NAPL concentrations at the site. Higher concentrations of NAPL are identified as free-phase NAPL, because in these areas the wastes are concentrated enough to collect as a separate layer in groundwater monitoring wells. At the lesser end of the spectrum, residual NAPL indicates areas where the soils are only stained with NAPL, but no separate liquid is present.

Much of the site NAPL is denser than water (dense non-aqueous phase liquid, or DNAPL), so it sinks through rather than floats on the water table surface. 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 constituents 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.

Most of the NAPL mass at the site is present in six discrete NAPL zones (NZ-1 through NZ-6). 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 through NZ-6 tend to be present as a series of closely spaced discontinuous lenses separated by NAPL-free zones. The NAPL zones are depicted in **Figure 2**. More detailed descriptions of the NAPL zones can be found in the RI Reports and or http://www.epa.gov/region2/superfund/npl/quanta. While most of the mass is found in the NAPL zones, NAPL is found throughout the site as residual NAPL or thin, discontinuous pockets of free-phase NAPL.

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, semi-plastic-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 3**, typically occur in areas that coincide with solid tar.

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 periodically 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 any occupied space. 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 in some cases modify the buildings to ensure that it can be safely occupied until a remedy for the site can be selected and implemented.

Soil

In addition to the presence of NAPL, other chemical contaminants have been identified in soil samples collected from throughout the study area, predominantly coal tar constituents and metals. PAHs are ubiquitous in unsaturated and saturated soil across the site and on neighboring properties, as deep as the unconfined units where NAPL was also detected, but not beneath the silty-clay unit. Exceedances of aromatic VOCs, particularly benzene, in unsaturated soils generally align with the extent of the historical site operations, whereas benzene in saturated soil extends slightly farther south, in the direction of groundwater flow.

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, because of the fill, which contains 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 ore 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.

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 hot spots is not known, but is presumed to be site-related.

Chlorinated VOCs were detected intermittently in soil samples, predominantly in saturated soil samples, across the site, and are not associated with the Quanta site. Pesticides in soil are sporadic and isolated, and are the likely result of the historical use of pesticides. The detected PCB concentrations, slightly above the screening criteria, occur primarily in the vadose zone. In deeper soils, PCBs that exceeded the lowest screening criterion are limited (only five sample locations in four isolated areas).

Groundwater

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 ground- water contamination is substantially elevated in neighboring areas, it was not possible to establish the limits of groundwater contamination. The extent of site-related constituents in groundwater includes all areas investigated as part of the RI.

Coal tar constituents in groundwater are primarily confined to the shallow fill and native sand deposits above the silty-clay unit. There are hundreds of different coal tar constituents, so benzene and the PAHs naphthalene and benzo(a)pyrene were selected as representative of the coal tar NAPL effects in ground-water. Benzene and naphthalene extend further downgradient from known areas of NAPL than benzo(a)pyrene, which is less soluble. Benzene is the most wide-spread VOC, and areal extents of other site-related VOCs in groundwater are located within the lateral extent of benzene.

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 environ-ments within the site that affect arsenic solubility. 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 circum- stances, be a source to groundwater.

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 NJ Groundwater Quality Standard (GWQS) of 5 parts per billion (5 ppb) are almost exclusively within the footprint the former acid plant.

Chlorinated VOCs were detected at their highest concentrations in the deep sand groundwater and in shallow groundwater upgradient of site-related constituents in groundwater, indicating that the source of these chlorinated VOCs is not site related. Low concentrations of pesticides were detected in groundwater within the interior portions of the Quanta property. The PCB Aroclor-1260 was detected in one location on the former Celotex property, and this detection is not considered site-related.

River Sediment

The OU2 RI will fully address PAH- and arsenic-contamination in Hudson River sediment and organic silt; however, several key components of this Proposed Plan for OU1 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 four and seven 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 results to date have identified an area of sediment contamination 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. 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, although some component of the free-phase NAPL in the Hudson was discharged directly into the river.

Free-phase NAPL is found throughout the shallower sediments as well. This NAPL appears to come either from OU1 (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.

SCOPE AND ROLE OF ACTION

In order to better manage Superfund sites, work is often divided into operable units. This is the first of two planned operable units. OU1 addresses remediation of the source materials, which include contaminated soils and NAPL coal tar from industrial operations at the site. These source materials constitute principal threat wastes at the site. OU1 also addresses remediation of contaminated groundwater associated with the principal threat wastes. A second operable unit will address contaminated surface water, sediments, and organic silts associated with the Hudson River.

ENFORCEMENT

EPA has identified a group of potentially responsible parties (PRPs) for the site. The RI/FS work for OU1 has been performed under an administrative order on consent (AOC) with a group of PRPs. The OU2 RI/FS is being performed under a separate AOC with a single PRP.

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 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 below ground surface [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 will be addressed during future remedial actions, because direct contact with this material is expected to exceed acceptable risk levels (CH2M Hill, 2008). **Table 1** summarizes the exposure pathways and scenarios.

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 2** presents the COCs identified for surface soil, subsurface soil, and shallow groundwater.

WHAT IS RISK AND HOW IS IT CALCULATED?

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

Hazard Identification: In this step, the chemicals of potential concern (COPCs) at the site in various media (*i.e.*, soil, groundwater, surface water, and air) are identified based on such factors as toxicity, frequency of occurrence, and fate and transport of the contaminants in the environment, concentrations of the contaminants in specific media, mobility, persistence, and bioaccumulation.

Exposure Assessment: In this step, the different exposure pathways through which people might be exposed to the contaminants identified in the previous step are evaluated. Examples of exposure pathways include incidental ingestion of and dermal contact with contaminated soil and ingestion of and dermal contact with contaminated groundwater. Factors relating to the exposure assessment include, but are not limited to, the concentrations in specific media that people might be exposed to and the frequency and duration of that exposure. Using these factors, a "reasonable maximum exposure" scenario, which portrays the highest level of human exposure that could reasonably be expected to occur, is calculated.

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

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

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, dibenz(a,h)anthracene, benzo(b)fluoranthene, benzo(a)anthracene and naphthalene) as the primary risk drivers for most media and receptors evaluated. **Table 3** presents the relative risk contributions for each of these constituents. 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's 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

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.

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 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:

- 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 to the Hudson River or to areas that would result in direct contact exposure;
- Mitigate principal threats that pose a potential source of vapor intrusion and resulting inhalation exposure within existing or potential future structures, to the extent practicable; and
- Mitigate NAPL 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 reuse 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). 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 desired environmental benefit from satisfying the RAOs, and most of the mass, will be addressed through actions that target NZ-1 and NZ-2/NZ-5. As discussed below, applying the same remedial technologies to address all of NZ-3, NZ-4 or NZ-6 as evaluated for NZ-1 and NZ2/NZ-5 would be highly disruptive for the community, with a much lower likelihood of success and a much higher cost. Of the RAOs for source areas, the RAOs for direct contact and for free-phase migration of NAPL to sediments do not apply to these deep NAPL zones. 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.

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 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 their beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site.

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). 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 down-gradient receptors.

A stand-alone TI Report was prepared to document the need to waive ARARs. The TI 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 prevent further migration of the plume, prevent exposure to the contaminated groundwater, and evaluate further risk reduction, and 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 of potential aqueous releases will be a component of any remedy that is selected for the site.

Groundwater is not used as 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 the very shallow water table, which is as little as one foot below the ground surface.

These RAOs were developed for the shallow, unconfined groundwater; deeper groundwater, below the clay confining unit and in the bedrock, are unaffected by the site. Like the shallow unconfined groundwater that is contaminated by the site, these deeper groundwater units are also not currently used as a source of drinking water. The proposed 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 threats for the site, areas for which EPA has concluded treatment should be considered as part of the remedy.

Below is a summary of the remediation goals for source areas, soil and groundwater established for OU1.

Source Area 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.

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 sources, these other detections still constitute a significant volume of NAPL. These other NAPL detections are not included in the definition of source areas. Further delineation to refine the boundaries of the principal threat NAPL is expected prior to implementing any of the alternatives identified in this Proposed Plan.

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. Similar to NAPL, arsenic in soils is ubiquitous throughout this area. Levels below these remediation goals 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 these risk-based concentrations, and New Jersey Soil Remediation Standards for residential and nonresidential land use.

Soil remediation goals are presented in **Table 4**. Soils that exceed these values, but do not constitute 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 exceedences of these soil remediation goals, as would be expected for this type of formerly industrial property.

Groundwater Remediation Goals

Remediation goals were developed for groundwater based on the RAOs discussed earlier. The minimum concentration 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 5**. 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 containment of the aqueous plume, but not for achieving restoration of the groundwater.

SUMMARY OF REMEDIAL ALTERNATIVES

All of the remedial alternatives that were evaluated in the FS address principal threat source material and dissolved-phase COCs. Each active alternative employs a different combination of technologies to mitigate principal threats and COCs in groundwater.

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 restrictive covenant would 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 4** depicts areas to be capped as part of all active alternatives.

Please refer to **Table 6** for a summary of all the remedial alternatives.

Groundwater Remedial Alternatives

The groundwater alternatives provide for a containment barrier, using different remedial techniques, to contain, capture, or passively treat aqueous-phase coal tar constituents and metals, addressing potential release of groundwater contaminants to the Hudson River. These actions were developed to support an ARARs waiver for the on-site groundwater. 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 responses to the HCAA that are, in essence, targeted groundwater response actions.)

Alternative G1 - Hydraulic Containment with Passive Treatment Using Funnel-and-Gate/PRB System

Alternative G1 would be designed to capture and treat contaminated groundwater in place or "*in situ*" with either a funnel-and-gate system or a permeable reactive barrier (PRB). Either type of passive system would be placed along the shoreline, penetrating vertically from the ground surface down to the silty-clay confining unit to capture 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. 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. Institutional controls (groundwater use restrictions in the form of a classification exception area [CEA]) would be applied to prevent future exposure to groundwater.

Alternative G2 - Hydraulic Containment with a Groundwater Extraction and 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 (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)
- 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.

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. Institutional controls (groundwater use restrictions in the form of a CEA) would be applied to prevent future exposure to groundwater.

Alternative G3 - Subaqueous Reactive Barrier (SRB)
Groundwater Alternative G3 would treat contaminated groundwater as it flows through an 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.*, granular activated carbon or organoclay) between the permeable elements (the reactive core). Reactive core materials would be encapsulated between carrier textiles that adhere together to provide integrity. A ground-water 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 to predict when replacement may be required.

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 a sediment remedy; however, a concomitant 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 would 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.

Site groundwater conditions would be monitored to verify that site-related groundwater contamination is being captured prior to discharge to surface water, and that the footprint 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
Free-phase NAPL associated with NZ-1, NZ-2 and NZ-3 is located below the buildings on 115 River Road. The three active remedies meant to permanently address (rather than contain) the source areas evaluated ways to address these NAPL zones beneath the buildings. 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 as underpinning) 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 long-term 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 alternative approaches allowing for the preservation of the buildings.

As discussed previously, the remedial alternatives discussed below take different approaches for addressing the deep NAPL (NZ-3, NZ-4 or NZ-6) than for NZ-1 and NZ-2/5. Because they are at greater depths and are more diffuse, the deep NAPL areas are more difficult to remediate and, because they contain less mass, pose a low toxicity potential through direct exposure, and pose little potential for further NAPL migration beyond their current boundaries; remediating them does less to satisfy the RAOs, relative to the other source areas. Focusing more on passive technologies coupled with monitoring, response actions to address vapor intrusion potential and migration of contaminated groundwater to surface water were considered for addressing these deep NAPL zones.

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 may 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.

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; vapor mitigation/retrofitting of buildings at 115 River Road; and operation and maintenance (O&M). **Figure 5** depicts the areas to be contained as part of this alternative.

Groundwater Alternative G1 includes installation of a passive *in-situ* groundwater remedy to capture aqueous-phase NAPL and metals prior to release into the OU2 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 guidance for the remediation of contaminated soils.

Deed restrictions would be required to maintain protectiveness and functional integrity of the cap. Fill may be imported 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 slab-on-grade and other 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.

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. Long-term monitoring would continue for an assumed period of 30 years.

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)

A long-term monitoring and maintenance program would be implemented to ensure that the integrity and effectiveness of the engineered controls is maintained. Future maintenance activities at these buildings would require a remedial component and 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 repair of cover vegetation and soils that are 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, as shown on **Figure 6**, 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.

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.

NAPL Recovery Wells, Off-site Treatment and Disposal

Free-phase NAPL would be recovered, to the extent practicable, 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 still have a measurable quantity of NAPL, 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 (*e.g.*, heating and 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.

Off-site disposal options for collected NAPL may include oil recycling or stabilization. For cost-estimating purposes, off-site disposal of NAPL is assumed to be via oil recycling.

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.

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 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.

***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, this alternative protects the River from 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. **Figure 7** depicts the areas to be treated with solidification/stabilization as part of this alternative, in plan view and cross-section. Different sequestering mixes would be effective for treating free-phase NAPL, arsenic, and areas where these two wastes overlap; multiple solidification/stabilization 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 this material could interfere with the ISS process. These materials would be disposed of off site. It is assumed that the depth of debris emoval would be to about four feet, with deeper debris removed as necessary.

ISS of NAPL in NZ-2 and NZ-5 would entail solidification/stabilization behind the bulkhead, performed in sequenced or alternating patterns to protect bulkhead tie backs and prevent shoreline instability during cement setup. 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. 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. 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 process for most of the site, though other methods may also be effective[1]. Remediation goals for the method described above 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 constituents. Leachability testing would require site-specific development during remedial design, using either EPA's Synthetic Precipitation Leaching Process or the ANSI/ANS 16.1 method. 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 purpose 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 field criteria during implementation.

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

Of the deep NAPL zones, portions of NZ-3 are in close proximity to NZ-1, with little separation (less than 5 feet) 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 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.

Hydraulic Containment of the HCAA

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 well.

1 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

Treating HCAA soils with ISS would require a different approach from other places in 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. 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. Evaluation of HCAA stabilization, as an alternative to the hydraulic containment wall, would be further evaluated in remedial design.

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. Additional vapor intrusion mitigation systems at the other properties would be implemented as indicated by the monitoring data.

Groundwater Remedial Alternative G3- Subaqueous Reactive Barrier (SRB)
As discussed earlier, a SRB will provide additional safeguards to ensure that site-related groundwater contamination that is not attenuated on site will be captured prior to discharge to surface water.

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.

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 ground- water 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 8**, 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 under the footprint of the buildings.

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 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

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, and NZ-5 and tar boils would be remediated entirely; the deep NAPL would also be addressed, though less comprehensively, as discussed below. **Figure 9** depicts the areas to be treated with ISCO as part of this alternative. ISCO treats organic constituents and would be effective for treating NAPL, but not arsenic or other metals.

***In-Situ* Chemical Oxidation (ISCO)**
The reagent would be injected using a direct-push technology with locations placed on a grid throughout the targeted NAPL zones. Application of ISCO 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.

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 need to be performed to more accurately determine reagents and full-scale implementation requirements. Other reagents could be tested to determine their effectiveness at treating the NAPL.

Oxidation would be the primary mechanism for loss 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. 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.

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 a barrier wall, 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 also not attempt to treat the NAPL under 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 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 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.

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 4 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 4 feet would be managed through ISCO. Soil underneath the 115 River Road buildings would not be excavated because and potential exposure pathways would be addressed similar to Alternative 4a.

It is anticipated that the excavated soils would need to be disposed 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 NZ2/5, so while the NAPL concentrations are less, it would take a similar level of oxidant application, over a greater area, with a less 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 similar to Alternative 4a/b.

***In-Situ* Solidification/Stabilization 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 collocated 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 4 a/b, including the contingency for using stabilization in lieu of hydraulic containment.

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 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 the 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 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 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 10**, 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 under the footprint of the buildings.

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 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 would be coupled with Groundwater Alternative G3 (SRB), and costing for Alternative 6a incorporates G3. Alternative 6a/b combines excavation of principal threat NAPL waste, the HCAA and arsenic hotspots with 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. **Figure 11** depicts the areas to be excavated as part of this alternative.

Excavation

Soil, where tar boils have been observed, and areas of soft, plastic, or hard tars in the vadose zone on the Quanta property would be excavated to a depth of 4 feet. The remaining accessible portions of NAPL zones posing a principal threat would be excavated and disposed off site. NZ-1, NZ-2, and NZ-5 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, 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 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.

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[2].

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

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

under the 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-2/5) 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/b.

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.

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 future occupants from residuals left in place following excavation. The cap would be placed over the Quanta property and the remaining remedial areas on the 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 12**, 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 under the footprint of the buildings.

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 115 River Road buildings.

EVALUATION OF ALTERNATIVES

Nine criteria are used to evaluate the different remediation alternatives individually and against each other in order to select a remedy, (see table on following page, "Evaluation Criteria for Superfund Remedial Alternatives"). This section of the Proposed Plan profiles the relative performance of each alternative against the nine criteria, noting how each compares to the other options under consideration. A detailed analysis of alternatives can be found in the FS Report.

1. **Overall Protection of Human Health and the Environment**

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, but that condition 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, and containment to mitigate the potential for release of contaminated groundwater to surface water (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/or 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 mitigate 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.

On-going 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

EVALUATION CRITERIA FOR SUPERFUND REMEDIAL ALTERNATIVES
Overall Protectiveness of Human Health and the Environment evaluates whether and how an alternative eliminates, reduces, or controls threats to public health and the environment through institutional controls, engineering controls, or treatment.
Compliance with ARARs evaluates whether the alternative meets federal and state environmental statutes, regulations, and other requirements that are legally applicable, or relevant and appropriate to the site, or whether a waiver is justified.
Long-term Effectiveness and Permanence considers the ability of an alternative to maintain protection of human health and the environment over time.
Reduction of Toxicity, Mobility, or Volume of Contaminants through Treatment evaluates an alternative's use of treatment to reduce the harmful effects of principal contaminants, their ability to move in the environment, and the amount of contamination present.
Short-term Effectiveness considers the length of time needed to implement an alternative and the risks the alternative poses to workers, the community, and the environment during implementation.
Implementability considers the technical and administrative feasibility of implementing the alternative, including factors such as the relative availability of goods and services.
Cost includes estimated capital and annual operations and maintenance costs, as well as present worth cost. Present worth cost is the total cost of an alternative over time in terms of today's dollar value. Cost estimates are expected to be accurate within a range of +50 to -30 percent.
State/Support Agency Acceptance considers whether the State agrees with the EPA's analyses and recommendations, as described in the RI/FS and Proposed Plan.
Community Acceptance considers whether the local community agrees with EPA's analyses and preferred alternative. Comments received on the Proposed Plan are an important indicator of community acceptance.

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 reach the free-phase NAPL, eliminating this exposure consideration, though vapor intrusion would still be a future-use concern.)

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 ARARs**

While groundwater is not currently in use, applicable drinking water standards are exceeded throughout the study area and onto 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 will be required for the site. The widespread presence of NAPL and recalcitrant coal tar constituents, including the widespread presence of 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 Ground-water 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 violation of surface water criteria.

No other major ARARs considerations affect remedial decision-making. Alternatives 2 through 6 would be completed in compliance with chemical-, action- and location-specific ARARs.

3. **Long-term Effectiveness and Permanence**

The long-term effectiveness and permanence of the alternatives vary largely as a result of the adequacy and reliability of the remedial components implemented. 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 highly 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, therefore, could be more effectively flushed out and refitted. In Alternative G3, the SRB may also become blocked over time, but the source 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 some potential blockages, 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 protectiveness.

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 in the long term 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.

Alternative 6a/6b offers the highest degree of long-term effectiveness for the area, because principal threat waste would be physically removed from the site.

In-situ solidification/stabilization used in Alternative 4a/4b (and to a lesser degree in Alternative 5a/5b) is considered effective over the long term. Refinement of the appropriate treatment mixes to permanently sequester the site contaminants need to be ascertained through bench and pilot testing prior to remedy implementation. 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 this material to act as an ongoing source to groundwater and air.

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. During implementation, NAPL that currently has low mobility may be mobilized through the heat of reaction, and would require engineering controls to prevent the movement of NAPL on the site or into Hudson River 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.

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 (say, 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 reach 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 in several other factors: long-term maintenance of the buildings and the ability to seal off the communication 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 to ensure the long-term operation and maintenance of the building is implemented in a protective manner would be required.

In summary, for the buildings at 115 River Road, the long-term protectiveness of Alternatives 4a, 5a, and 6a, rely on a far more hands-on approach, and 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.

4. **Reduction of Toxicity, Mobility, or Volume of Contaminants Through Treatment**

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 from NZ-1, NZ-2 and NZ-5, 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, stabilization also shows the potential to convert arsenic to a less toxic form. If it can be shown 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 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.

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**

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 involved handling of contaminated material, resulting in relatively higher air emissions, in particular from arsenic in dust. Alternative 5 (a or b), while an *in-situ* process, would generate heat and vapors at the ground surface that would need to be managed. Alternative 4 (a or b) would also generate some fugitive emissions, but much smaller levels and easier to manage than for 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, personnel 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 Hudson River sediments. NAPL releases are occurring today; however, one consequence of some of the clean-up procedures discussed in this Proposed Plan can be the mobilization of NAPL that is currently not mobile. 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 transport 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.

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 evident difference between Alternatives 4, 5 and 6 in short-term effects of work on 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**

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 on 115 River Road 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 complicated than their non-demolition counterparts. Under CERCLA, EPA would be able to acquire the property for purposes of demolition, though the legal condemnation process 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 on-going use of the 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.

Environmental Testing, Monitoring, and Controls
Alternatives 4 and 5 would require bench- and pilot-scale testing prior to implementation. Additionally all alternatives would require storm-water controls and fence line monitoring for dust and emissions.

Temporary controls to prevent mobilization of free-phase NAPL to OU2 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).

Businesses located in 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 most complicated for Alternatives 5 and 6, which could result in the generation of large amounts of vapor. Still, engineering practices to control dust, noise and other construction issues are readily available 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. PRPs may determine that temporary relocation of particular tenants in 115 River Road could possibly 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. The FS includes a construction sequencing plan to assess how to minimize the disruption to the 115 River Road tenants during a projected remediation.

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 115 River Road buildings will need to be retrofitted with vapor mitigation systems, and the building slabs will need to be regularly inspected for cracks or other openings, and sealed. 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.

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 the aqueous phase. 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**

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.

8. **State/Support Agency Acceptance**

The State of New Jersey is still evaluating EPA's preferred alternative as presented in this Proposed Plan.

9. **Community Acceptance**

Community acceptance of the preferred alternatives will be evaluated after the public comment period ends and will be described in the Record of Decision, the document that formalizes the selection of the remedy for the site.

PREFERRED ALTERNATIVE

Based upon an evaluation of the remedial alternatives, EPA recommends Alternative 4a as the Preferred Alternative. Alternative 4a has the following key components: *in-situ* solidification/stabilization of NAPL source areas and arsenic hotspots; hydraulic containment of the HCAA[3]; capping of both the treated source areas and other site areas where contaminated soils are present; and Groundwater Alternative G3 (SRB).

Alternative 4a also calls for preserving the buildings at 115 River Road at this time. EPA believes that the long-term management of NAPL under the buildings at 115 River Road is protective; however, EPA also feels that, as a long-term strategy, the NAPL source areas under those buildings should eventually be treated. Given the age of the buildings and the value of real estate in this area, EPA expects that the current structures would be replaced at some time in the future; thus, as a additional component to the preferred alternative, EPA would require the use of ISS to address the remaining free-phase NAPL at the time when this property would be slated for redevelopment in the future. In EPA's assessment, implementing that part of the cleanup in the future provides the right balance, allowing most of the area to be addressed now, but allowing this property to continue to function for the time being. Alternative 4a would require several modifications to the 115 River Road buildings, including installation of a vapor mitigation system throughout the building and actions to seal the basements of the buildings (some of this work has already been initiated voluntarily by the PRPs and the building owner).

A center that provides day care for children from infants to pre-kindergarten age is a tenant at 115 River Road. Regular monitoring, performed since 2002, including indoor air sampling conducted in classrooms of the day care facility, do not indicate that there is a health concern for the day care center from site-related chemicals. While it could be possible to implement the Preferred Alternative with the facility in its current space, this center poses a number of logistical challenges that can be avoided by relocation. Thus relocation of the day care center prior to implementation of the remedial action is an additional component of the Preferred Alternative.

Alternative 4a would also require ongoing operation, maintenance and monitoring of the implemented remedy to ensure that it continues to be effective, and institutional controls such as a deed notice or restrictive covenant on affected properties to aid in the long-term protectiveness of the remedy.

The Preferred Alternative would achieve the remediation goals for the principal threat source areas and for soils, but would require a waiver of the remediation goals for the groundwater, due to technical impracticability. The Preferred Alternative would address the groundwater by remediating continuing sources of groundwater contamination to the extent practicable and by establishing a contaminant barrier, an SRB in the Hudson River sediments, to mitigate future releases of groundwater contamination to the surface water.

The Preferred Alternative is believed to provide the best balance of tradeoffs among the alternatives based on the information available to EPA at this time. EPA believes that the Preferred Alternative would be protective of human health and the environment, would comply with ARARs, would be cost-effective, and would utilize permanent solutions and alternative treatment technologies to the maximum extent practicable. The selected alternative can change in response to public comment or new information.

It should also be noted that the site was reviewed by EPA's National Remedy Review Board. The Board, which includes senior representatives from EPA offices across the nation, was established to review proposed high-cost remedies and provide advisory recommendations relative to national consistency and cost effectiveness. The Board supported the need for action at the Quanta site, including the treatment of the arsenic and NAPL waste materials. Among its recommenda- tions, the Board did encourage a more comprehensive approach for addressing NAPL waste materials, particularly free-phase NAPL, to achieve a more effective and reliable

3 *In-situ* stabilization of the HCAA would replace hydraulic containment if it can be demonstrated to be effective during remedial design.

remedy. The Region adopted a number of the Board recommendations and incorporated them into the Proposed Alternative. Both the Board recommendations and the Region's response are available as part of the Administrative Record for the site.

COMMUNITY PARTICIPATION

EPA encourages the public to gain a more comprehensive understanding of the site and the Superfund activities that have been conducted there.

The dates for the public comment period, the date, location and time of the public meeting, and the locations of the Administrative Record files, are provided on the front page of this Proposed Plan. Written comments on the Proposed Plan should be addressed to the Remedial Project Manager Richard Ho at the address below.

EPA Region 2 has designated a public liaison as a point-of-contact for the community concerns and questions about the federal Superfund program in New York, New Jersey, Puerto Rico, and the U.S. Virgin Islands. To support this effort, the Agency has established a 24-hour, toll-free number that the public can call to request information, express their concerns, or register complaints about Superfund.

For further information on the Quanta Resources site, please contact:

Richard Ho Remedial Project Manager (212) 637-4372 ho.richard@epa.gov	Natalie Loney Community Relations Coordinator (212) 637-3639 loney.natalie@epa.gov

Written comments on this Proposed Plan should be addressed to Mr. Ho.

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The public liaison for U.S. EPA Region 2 is:

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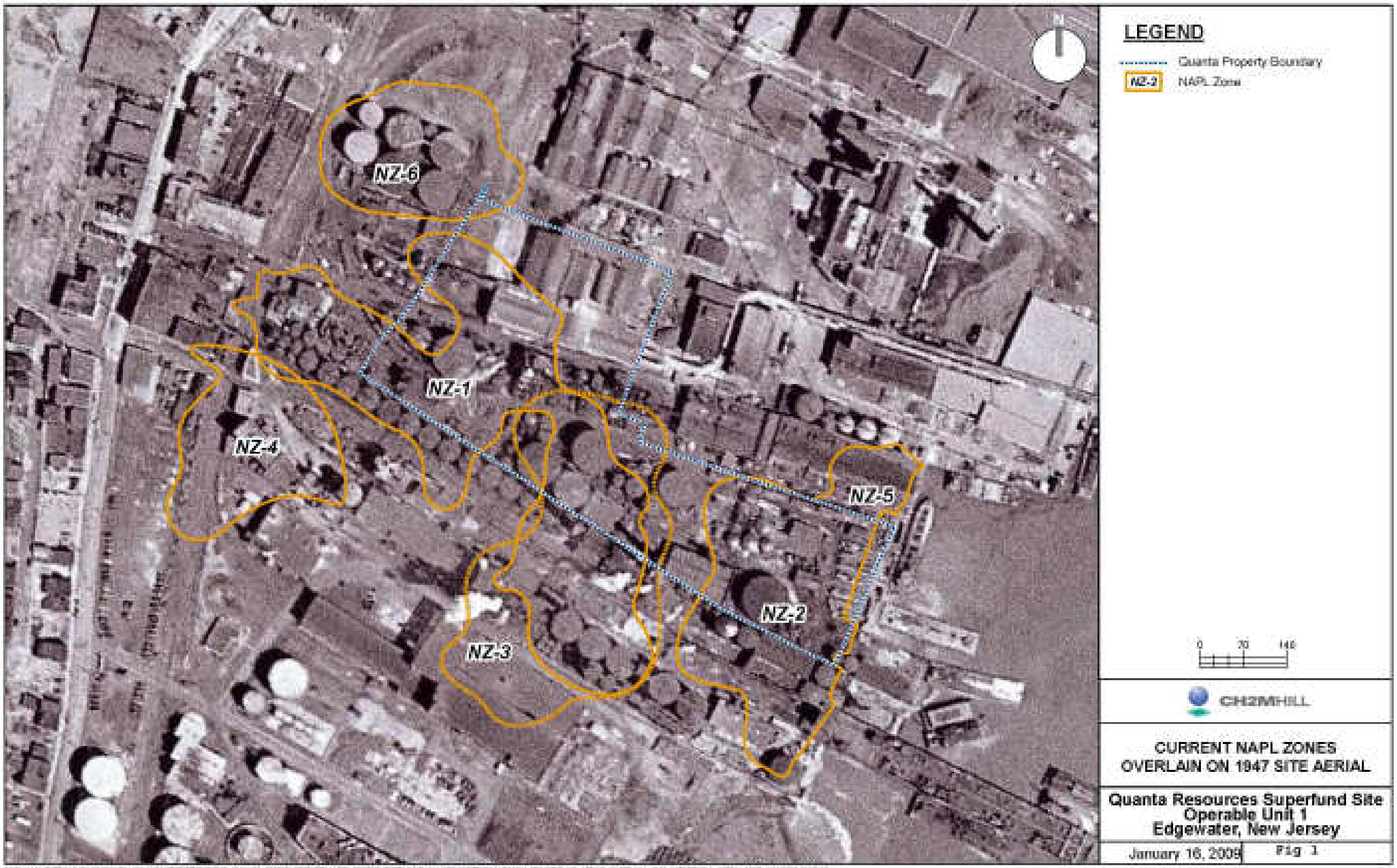
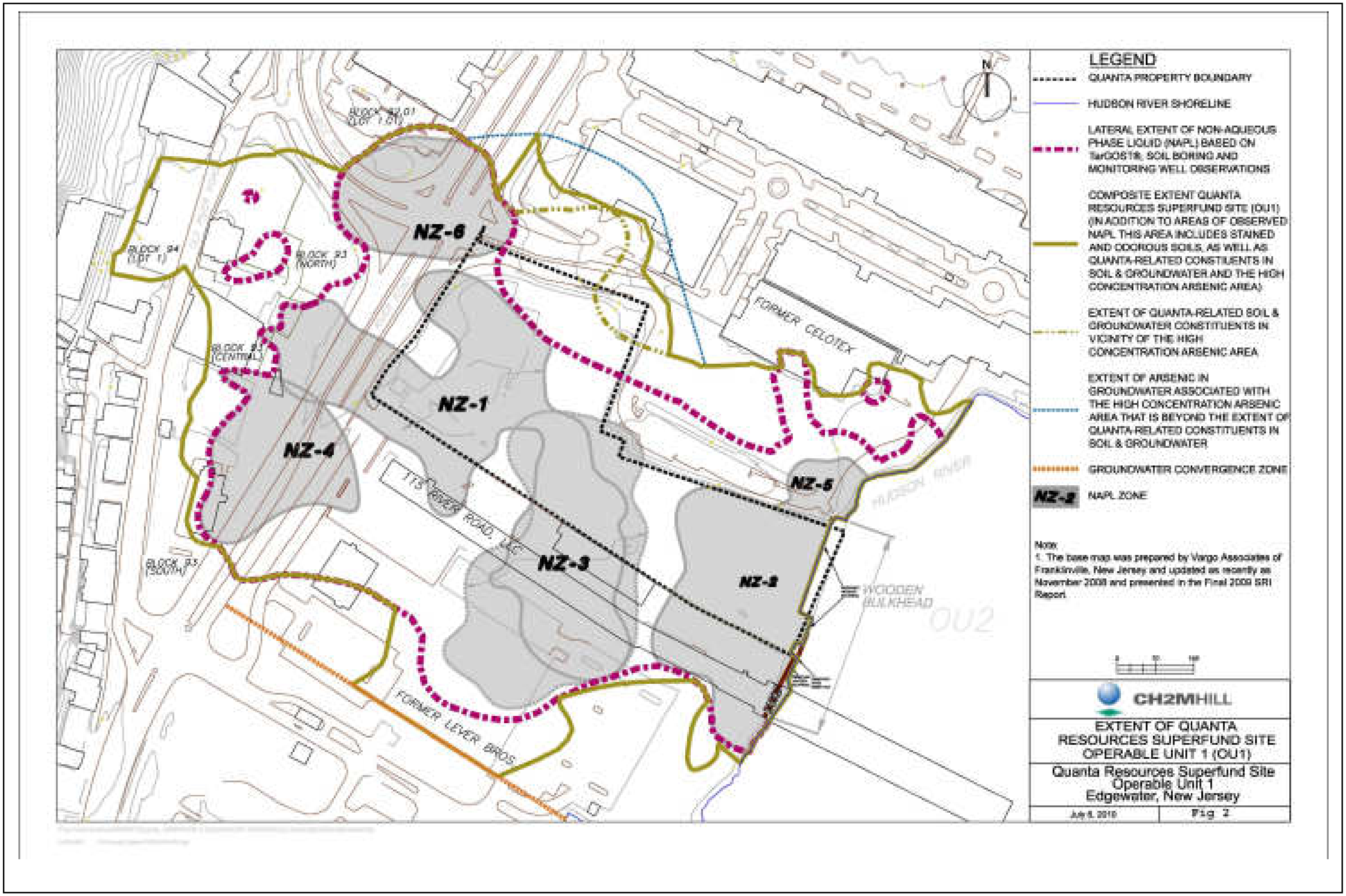
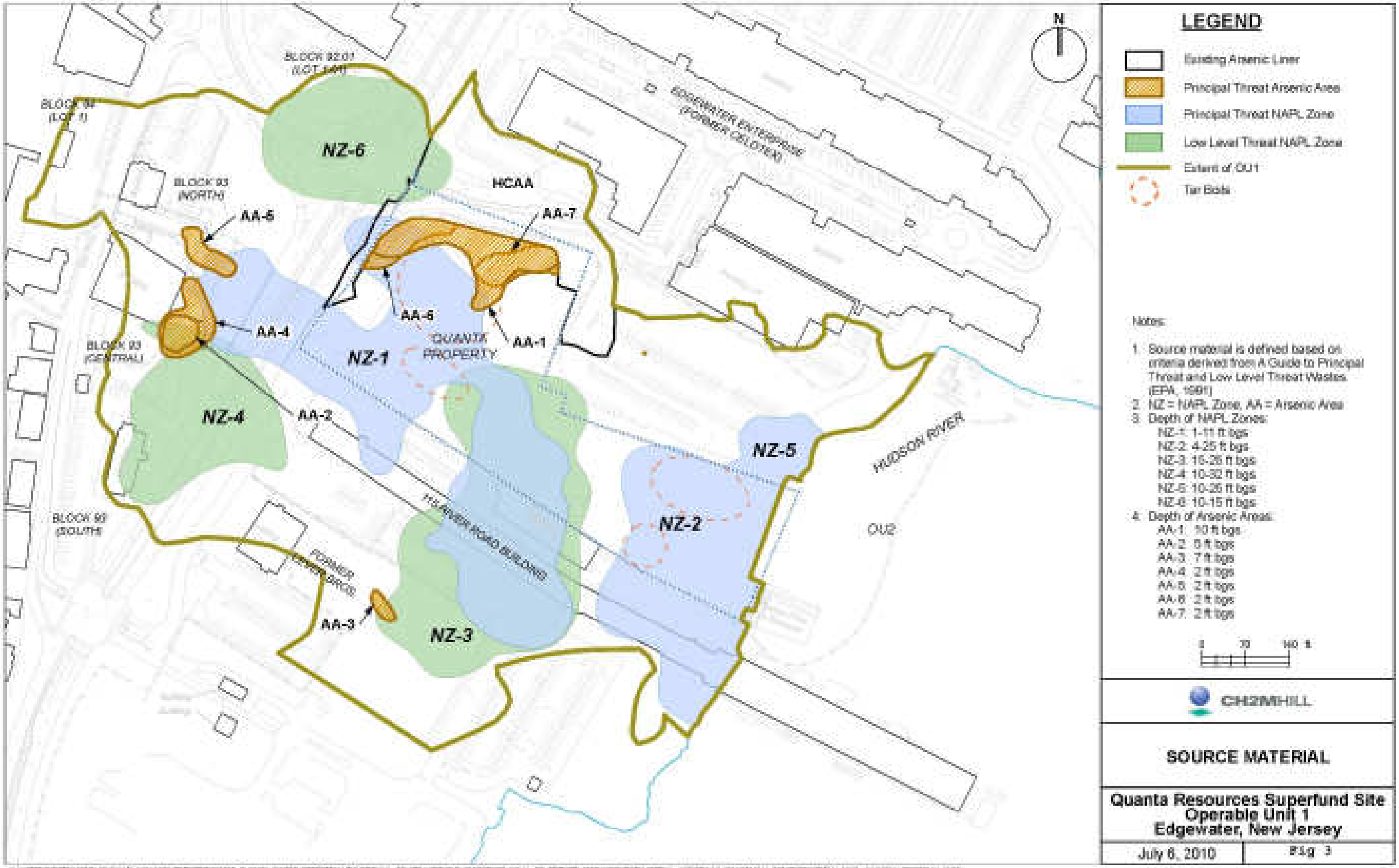
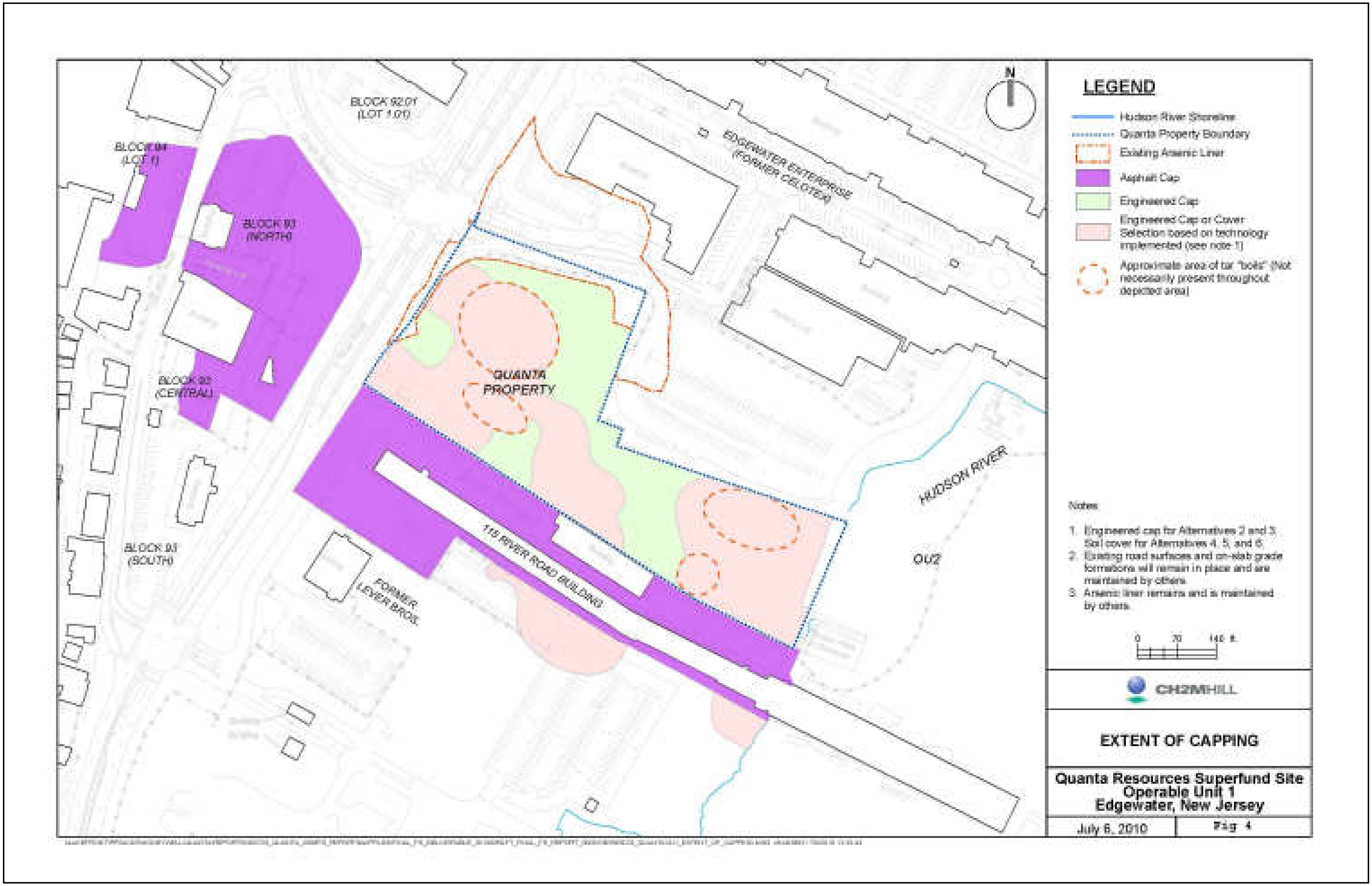
2890 Woodbridge Avenue, MS-211
Edison, New Jersey 08837-3679

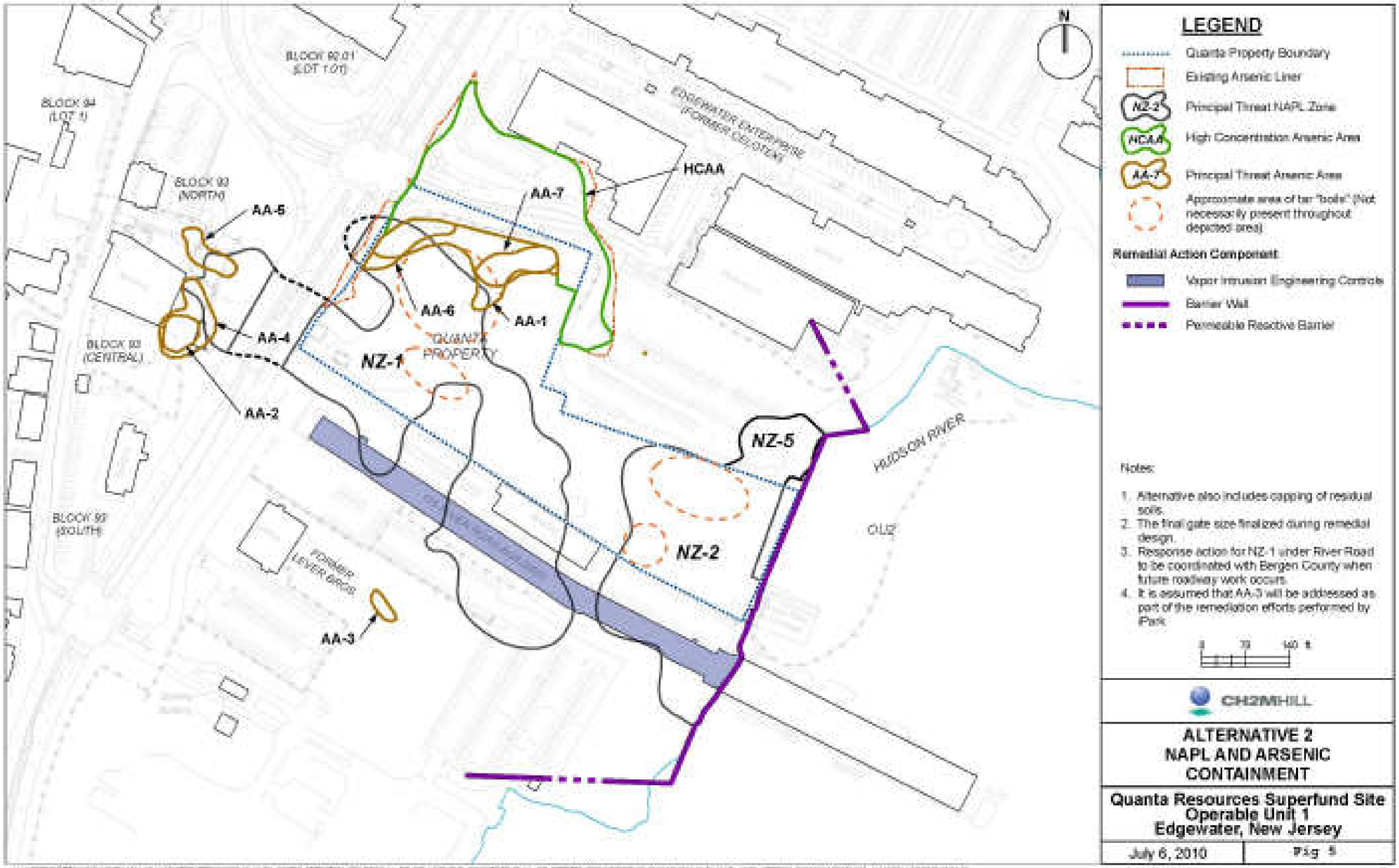

N
LEGEND
Quanta Property Boundary
NZ-2
NAPL Zone
NZ-6
NZ-1
NZ-4
NZ-5
NZ-2
NZ-3
0
70
140
CH2MHILL
CURRENT NAPL ZONES
OVERLAIN ON 1947 SITE AERIAL
Quanta Resources Superfund Site
Operable Unit 1
Edgewater, New Jersey
January 16, 2009
Fig 1



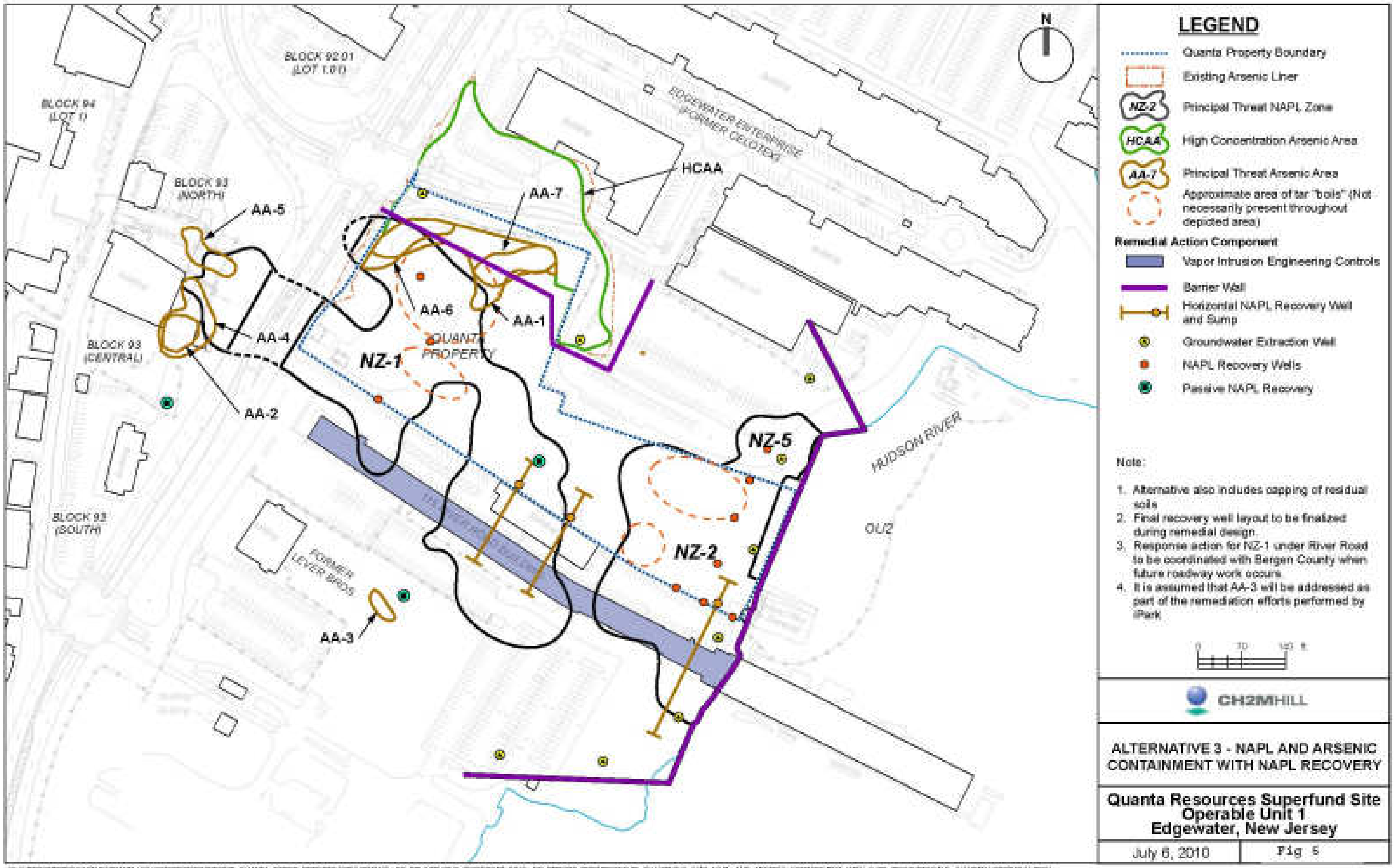
Note: EPA considers the extent of arsenic in the groundwater associated with the HCAA to be part of OU1.

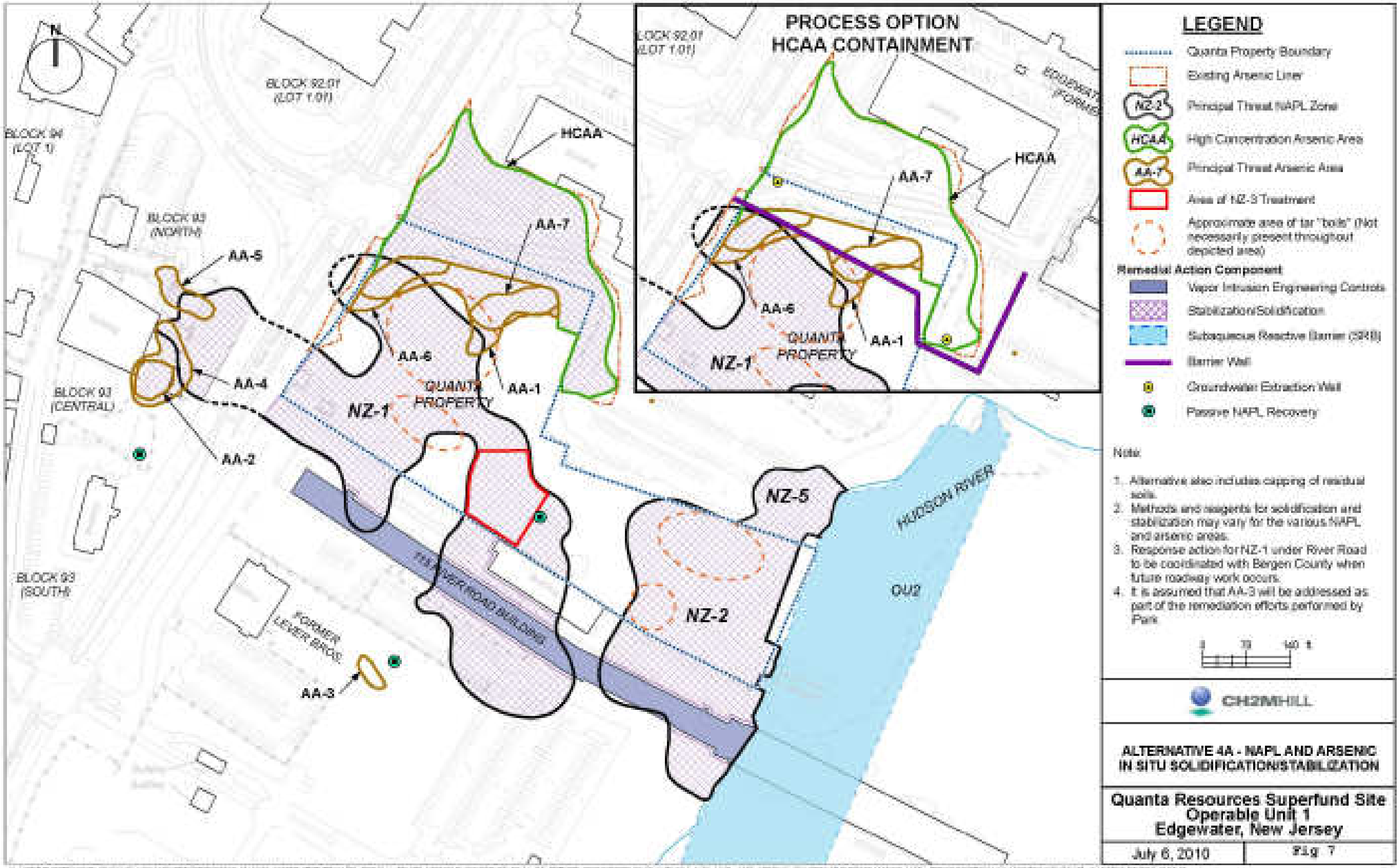

LEGEND
Existing Arsenic Liner
Principal Threat Arsenic Area
Principal Threat NAPL Zone
Low Level Threat NAPL Zone
Extent of OU1
Tar Boils
N
NZ-1
NZ-2
NZ-3
NZ-4
NZ-5
NZ-6
AA-1
AA-2
AA-3
AA-4
AA-5
AA-6
AA-7
HCAA
QUANTA PROPERTY
HUDSON RIVER
OU2
115 RIVER ROAD BUILDING
EDGEWATER ENTERPRISE (FORMER CELOTEX)
FORMER LEVER BROS
BLOCK 93 (NORTH)
BLOCK 93 (CENTRAL)
BLOCK 93 (SOUTH)
Notes:
1. Source material is defined based on criteria derived from A Guide to Principal Threat and Low Level Threat Wastes (EPA, 1991)
2. NZ = NAPL Zone, AA = Arsenic Area
3. Depth of NAPL Zones:
NZ-1: 1-11 ft bgs
NZ-2: 4-25 ft bgs
NZ-3: 15-25 ft bgs
NZ-4: 10-32 ft bgs
NZ-5: 10-25 ft bgs
NZ-6: 10-15 ft bgs
4. Depth of Arsenic Areas:
AA-1: 10 ft bgs
AA-2: 8 ft bgs
AA-3: 7 ft bgs
AA-4: 2 ft bgs
AA-5: 2 ft bgs
AA-6: 2 ft bgs
AA-7: 2 ft bgs
0
70
140
CH2MHILL
SOURCE MATERIAL
Quanta Resources Superfund Site
Operable Unit 1
Edgewater, New Jersey
July 6, 2010
Fig 3

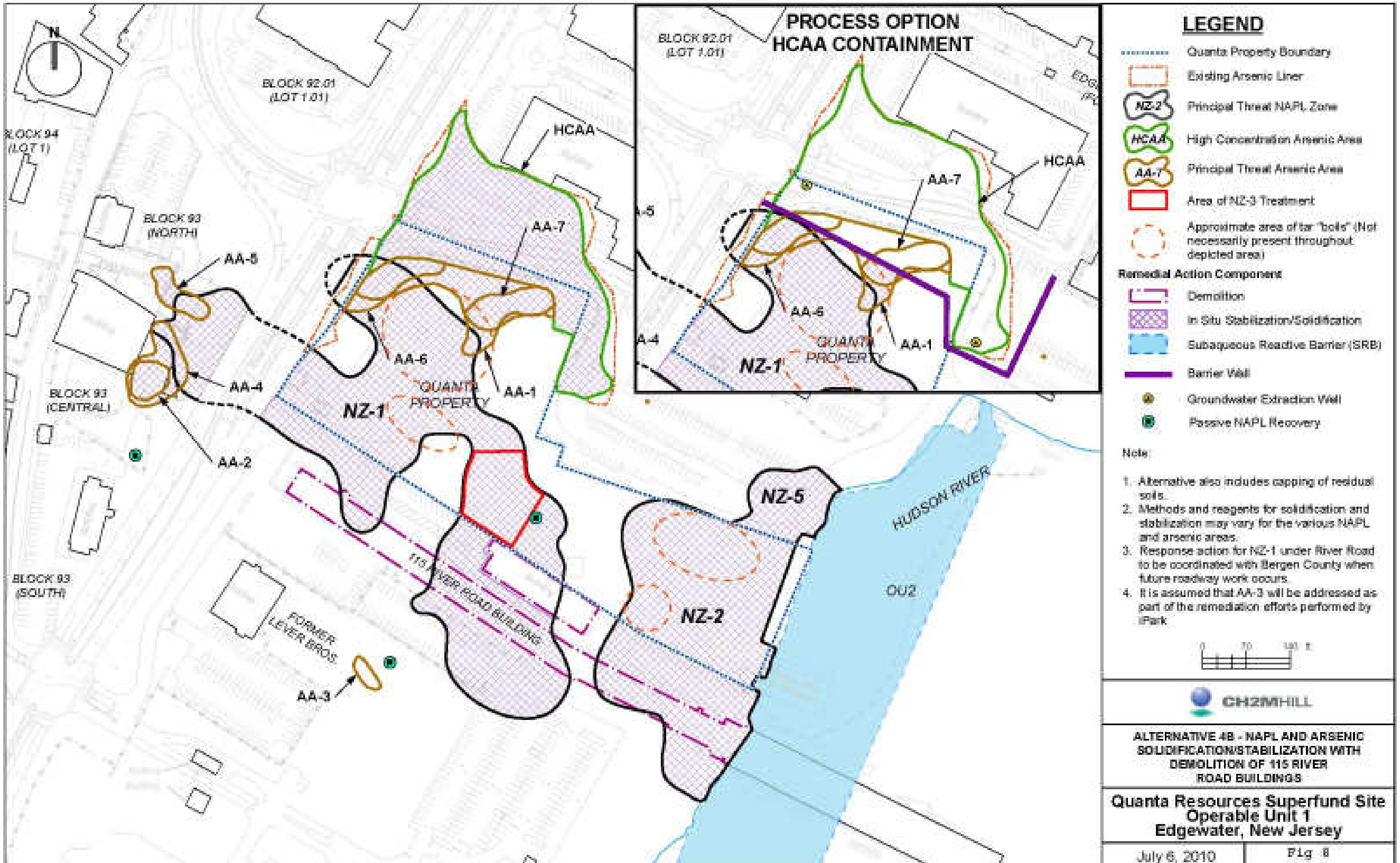

BLOCK 92.01
(LOT 1.01)
BLOCK 94
(LOT 1)
BLOCK 93
(NORTH)
BLOCK 93
(CENTRAL)
BLOCK 93
(SOUTH)
EDGEWATER ENTERPRISE
(FORMER CELOTEX)
QUANTA
PROPERTY
115 RIVER ROAD BUILDING
FORMER
LEVER BROS.
HUDSON RIVER
OU2
N
LEGEND
Hudson River Shoreline
Quanta Property Boundary
Existing Arsenic Liner
Asphalt Cap
Engineered Cap
Engineered Cap or Cover
Selection based on technology
implemented (see note 1)
Approximate area of tar "boils" (Not
necessarily present throughout
depicted area)
Notes:
1. Engineered cap for Alternatives 2 and 3.
Soil cover for Alternatives 4, 5, and 6.
2. Existing road surfaces and on-slab grade
formations will remain in place and are
maintained by others.
3. Arsenic liner remains and is maintained
by others.
0 70 140 ft.
CH2MHILL
EXTENT OF CAPPING
Quanta Resources Superfund Site
Operable Unit 1
Edgewater, New Jersey
July 6, 2010
Fig 4

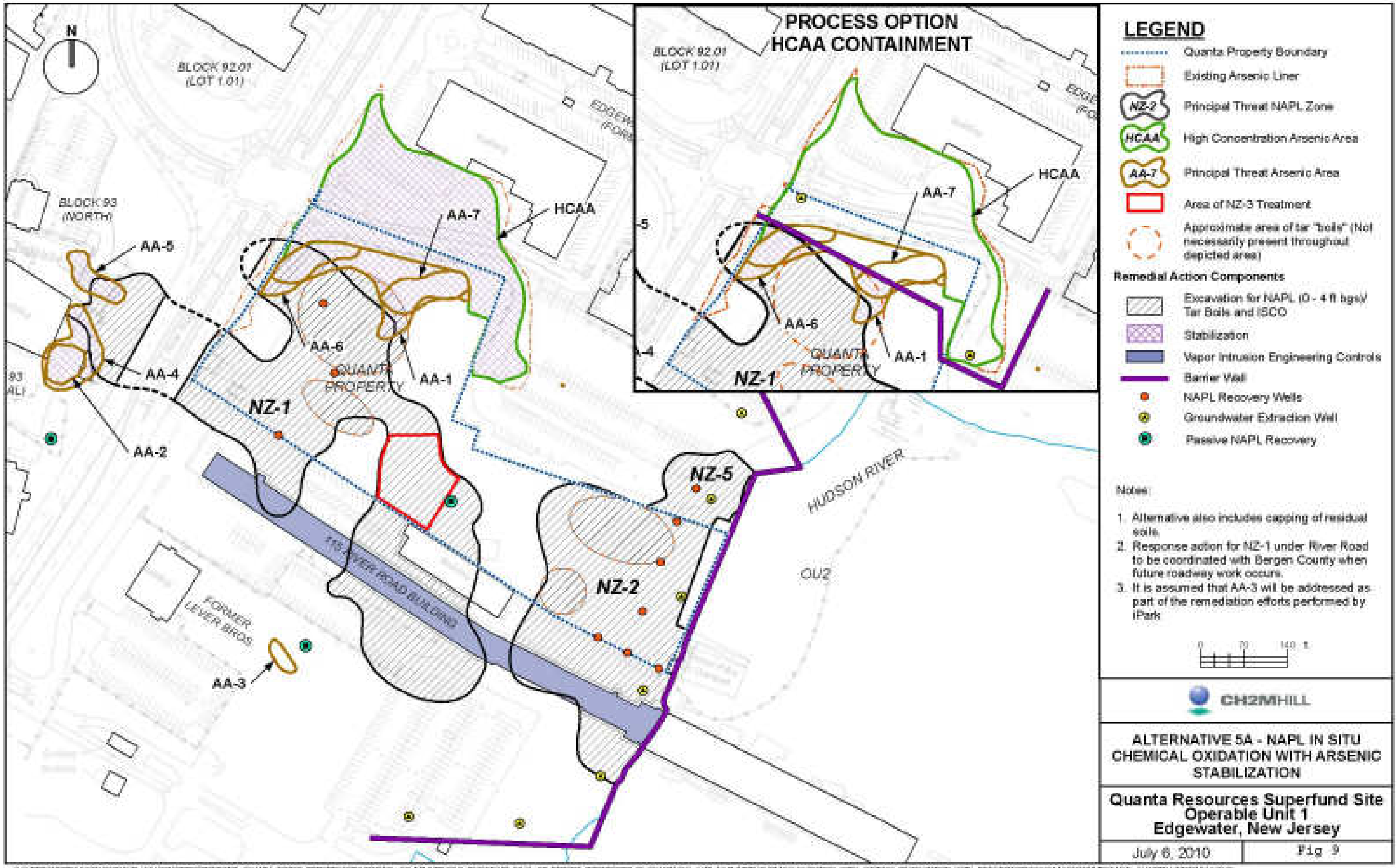


LEGEND
Quanta Property Boundary
Existing Arsenic Liner
Principal Threat NAPL Zone
High Concentration Arsenic Area
Principal Threat Arsenic Area
Approximate area of tar "boils" (Not necessarily present throughout depicted area)
Remedial Action Component
Vapor Intrusion Engineering Controls
Barrier Wall
Permeable Reactive Barrier
Notes:
1. Alternative also includes capping of residual soils.
2. The final gate size finalized during remedial design.
3. Response action for NZ-1 under River Road to be coordinated with Bergen County when future roadway work occurs.
4. It is assumed that AA-3 will be addressed as part of the remediation efforts performed by iPark.
CH2MHILL
ALTERNATIVE 2
NAPL AND ARSENIC
CONTAINMENT
Quanta Resources Superfund Site
Operable Unit 1
Edgewater, New Jersey
July 6, 2010
Fig 5
N
HCAA
AA-7
AA-5
AA-6
AA-1
AA-4
AA-2
AA-3
NZ-1
NZ-2
NZ-5
QUANTA PROPERTY
HUDSON RIVER
OU2
BLOCK 92.01 (LOT 1.01)
BLOCK 94 (LOT 1)
BLOCK 93 (NORTH)
BLOCK 93 (CENTRAL)
BLOCK 93 (SOUTH)
EDGEWATER ENTERPRISE (FORMER CELOTEX)
FORMER LEVER BROS

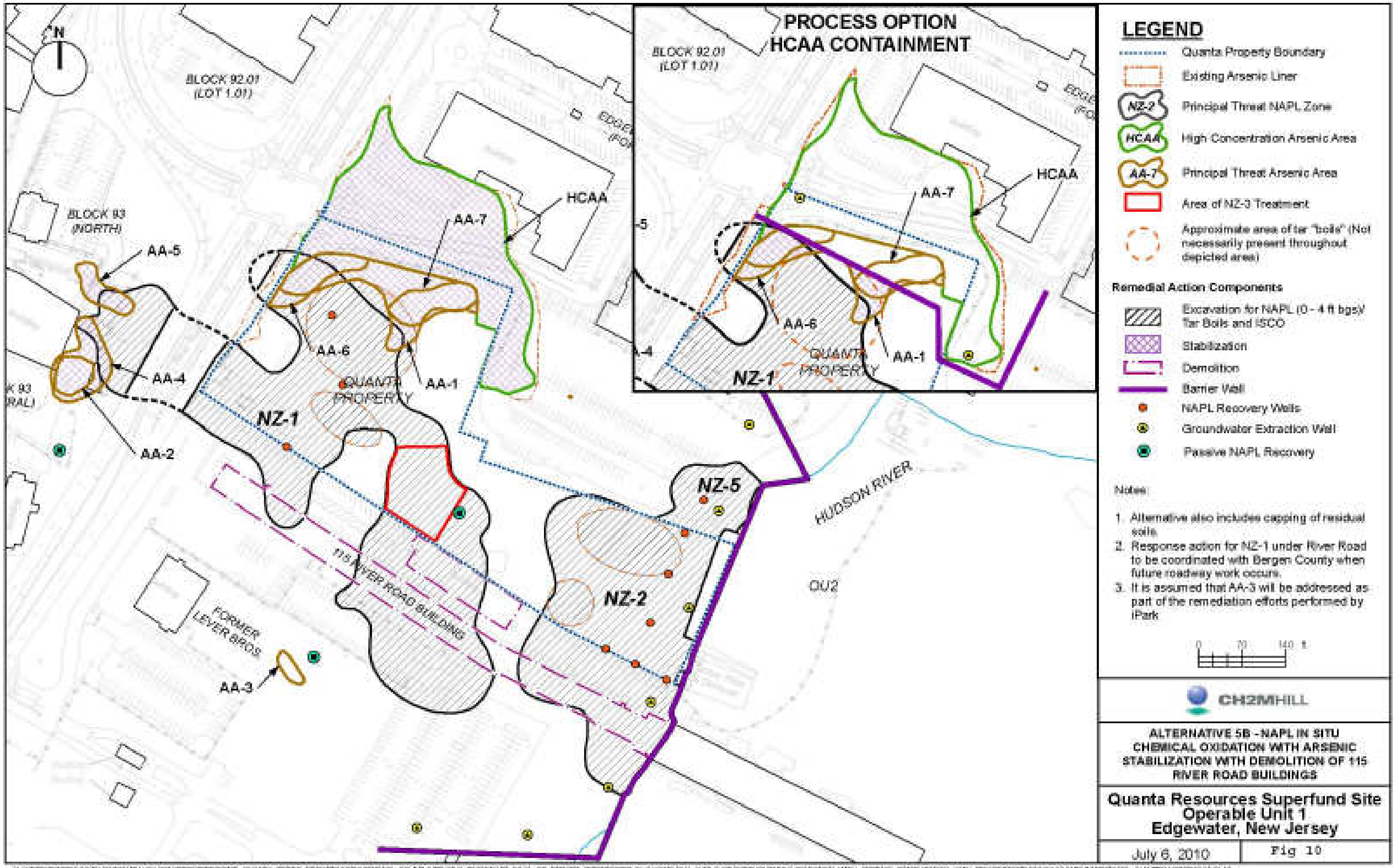

BLOCK 92.01
(LOT 1.01)
BLOCK 94
(LOT 1)
BLOCK 93
(NORTH)
BLOCK 93
(CENTRAL)
BLOCK 93
(SOUTH)
EDGEWATER ENTERPRISE
(FORMER CELOTEX)
FORMER
LEVER BROS
QUANTA
PROPERTY
HUDSON RIVER
OU2
HCAA
AA-1
AA-2
AA-3
AA-4
AA-5
AA-6
AA-7
NZ-1
NZ-2
NZ-5
N
LEGEND
Quanta Property Boundary
Existing Arsenic Liner
Principal Threat NAPL Zone
High Concentration Arsenic Area
Principal Threat Arsenic Area
Approximate area of tar "boils" (Not necessarily present throughout depicted area)
Remedial Action Component
Vapor Intrusion Engineering Controls
Barrier Wall
Horizontal NAPL Recovery Well and Sump
Groundwater Extraction Well
NAPL Recovery Wells
Passive NAPL Recovery
Note:
1. Alternative also includes capping of residual soils
2. Final recovery well layout to be finalized during remedial design.
3. Response action for NZ-1 under River Road to be coordinated with Bergen County when future roadway work occurs.
4. It is assumed that AA-3 will be addressed as part of the remediation efforts performed by iPark
CH2MHILL
ALTERNATIVE 3 - NAPL AND ARSENIC CONTAINMENT WITH NAPL RECOVERY
Quanta Resources Superfund Site
Operable Unit 1
Edgewater, New Jersey
July 6, 2010
Fig 5


PROCESS OPTION
HCAA CONTAINMENT
LEGEND
Quanta Property Boundary
Existing Arsenic Liner
Principal Threat NAPL Zone
High Concentration Arsenic Area
Principal Threat Arsenic Area
Area of NZ-3 Treatment
Approximate area of tar "boils" (Not necessarily present throughout depicted area)
Remedial Action Component
Vapor Intrusion Engineering Controls
Stabilization/Solidification
Subaqueous Reactive Barrier (SRB)
Barrier Wall
Groundwater Extraction Well
Passive NAPL Recovery
Note:
1. Alternative also includes capping of residual soils.
2. Methods and reagents for solidification and stabilization may vary for the various NAPL and arsenic areas.
3. Response action for NZ-1 under River Road to be coordinated with Bergen County when future roadway work occurs.
4. It is assumed that AA-3 will be addressed as part of the remediation efforts performed by Park.
CH2MHILL
ALTERNATIVE 4A - NAPL AND ARSENIC IN SITU SOLIDIFICATION/STABILIZATION
Quanta Resources Superfund Site
Operable Unit 1
Edgewater, New Jersey
July 6, 2010
Fig 7
HCAA
AA-7
AA-5
AA-6
AA-1
AA-4
AA-2
AA-3
NZ-1
NZ-2
NZ-5
QUANTA PROPERTY
HUDSON RIVER
OU2
BLOCK 92.01 (LOT 1.01)
BLOCK 94 (LOT 1)
BLOCK 93 (NORTH)
BLOCK 93 (CENTRAL)
BLOCK 93 (SOUTH)
FORMER LEVER BROS.

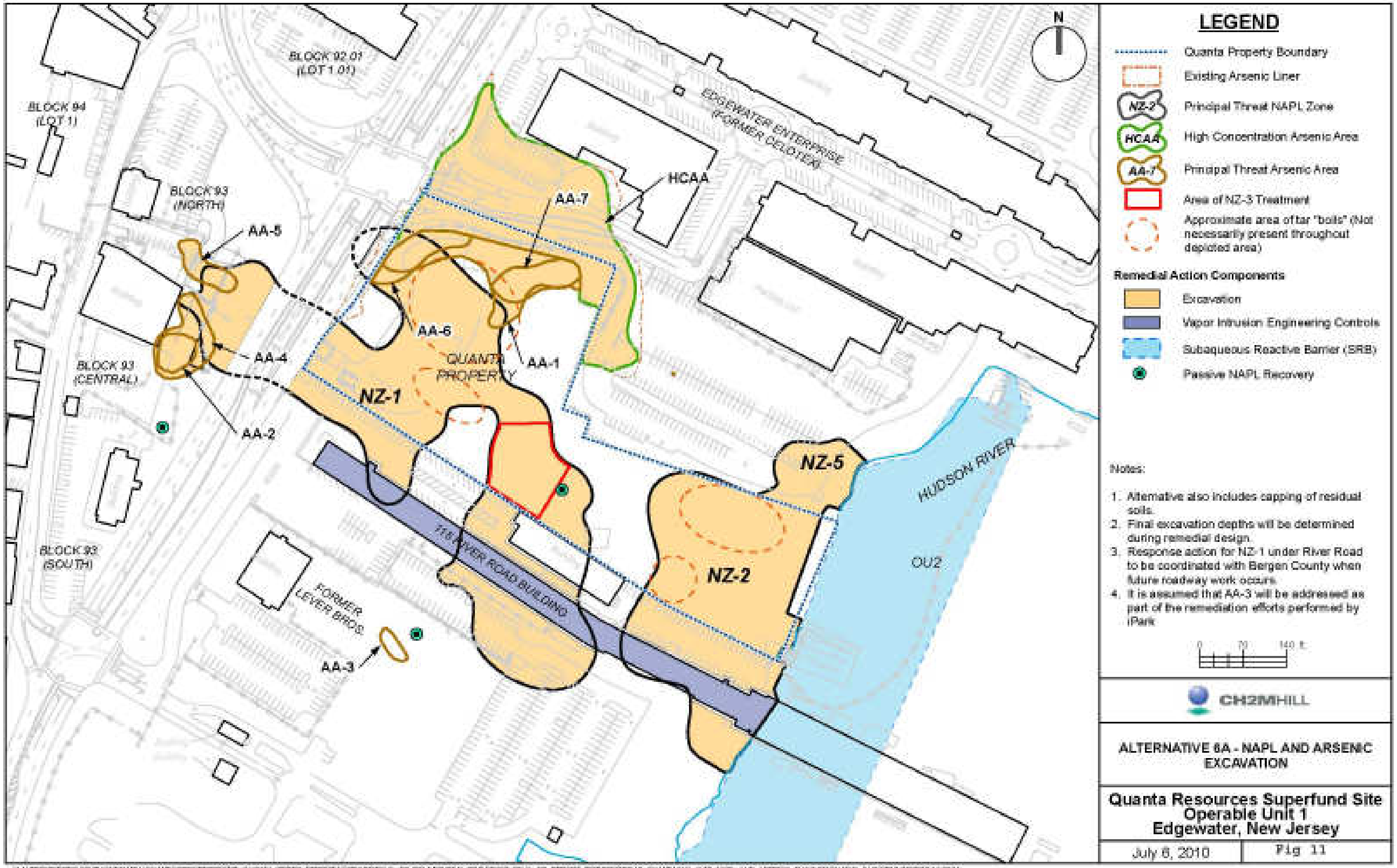

PROCESS OPTION
HCAA CONTAINMENT
LEGEND
Quanta Property Boundary
Existing Arsenic Liner
Principal Threat NAPL Zone
High Concentration Arsenic Area
Principal Threat Arsenic Area
Area of NZ-3 Treatment
Approximate area of tar "boils" (Not necessarily present throughout depicted area)
Remedial Action Component
Demolition
In Situ Stabilization/Solidification
Subaqueous Reactive Barrier (SRB)
Barrier Wall
Groundwater Extraction Well
Passive NAPL Recovery
Note:
1. Alternative also includes capping of residual soils.
2. Methods and reagents for solidification and stabilization may vary for the various NAPL and arsenic areas.
3. Response action for NZ-1 under River Road to be coordinated with Bergen County when future roadway work occurs.
4. It is assumed that AA-3 will be addressed as part of the remediation efforts performed by iPark.
CH2MHILL
ALTERNATIVE 4B - NAPL AND ARSENIC SOLIDIFICATION/STABILIZATION WITH DEMOLITION OF 115 RIVER ROAD BUILDINGS
Quanta Resources Superfund Site
Operable Unit 1
Edgewater, New Jersey
July 6, 2010
Fig 8
N
BLOCK 92.01 (LOT 1.01)
BLOCK 94 (LOT 1)
BLOCK 93 (NORTH)
BLOCK 93 (CENTRAL)
BLOCK 93 (SOUTH)
HCAA
AA-1
AA-2
AA-3
AA-4
AA-5
AA-6
AA-7
NZ-1
NZ-2
NZ-5
QUANTA PROPERTY
115 RIVER ROAD BUILDING
FORMER LEVER BROS
HUDSON RIVER
OU2



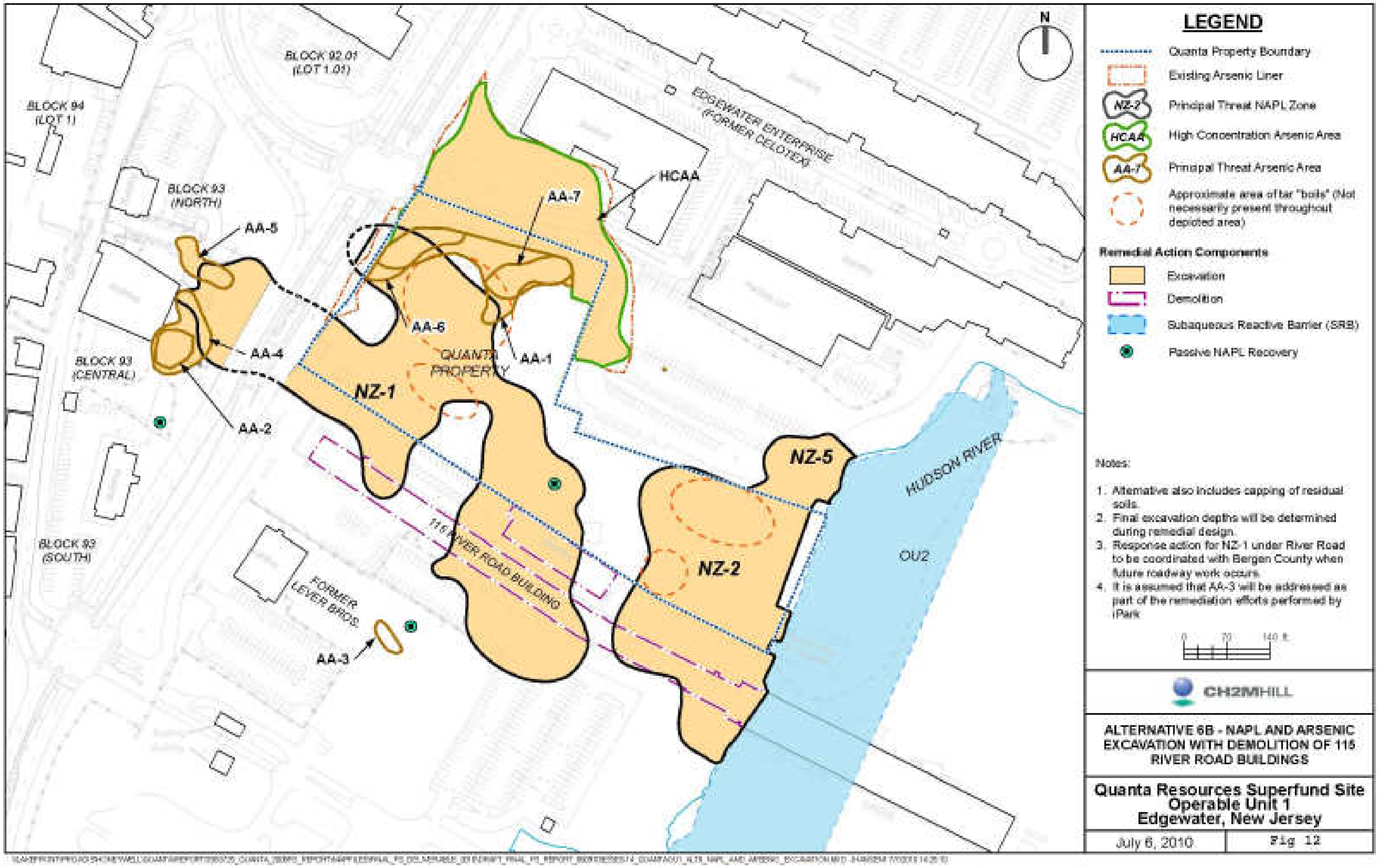
PROCESS OPTION
HCAA CONTAINMENT
LEGEND
Quanta Property Boundary
Existing Arsenic Liner
Principal Threat NAPL Zone
High Concentration Arsenic Area
Principal Threat Arsenic Area
Area of NZ-3 Treatment
Approximate area of tar "boils" (Not necessarily present throughout depicted area)
Remedial Action Components
Excavation for NAPL (0 - 4 ft bgs)/ Tar Boils and ISCO
Stabilization
Vapor Intrusion Engineering Controls
Barrier Wall
NAPL Recovery Wells
Groundwater Extraction Well
Passive NAPL Recovery
Notes:
1. Alternative also includes capping of residual soils.
2. Response action for NZ-1 under River Road to be coordinated with Bergen County when future roadway work occurs.
3. It is assumed that AA-3 will be addressed as part of the remediation efforts performed by iPark
0 70 140 ft
CH2MHILL
ALTERNATIVE 5A - NAPL IN SITU CHEMICAL OXIDATION WITH ARSENIC STABILIZATION
Quanta Resources Superfund Site
Operable Unit 1
Edgewater, New Jersey
July 6, 2010
Fig 9
N
BLOCK 92.01
(LOT 1.01)
BLOCK 93
(NORTH)
AA-1
AA-2
AA-3
AA-4
AA-5
AA-6
AA-7
HCAA
NZ-1
NZ-2
NZ-5
QUANTA PROPERTY
HUDSON RIVER
OU2
FORMER LEVER BROS.



PROCESS OPTION
HCAA CONTAINMENT
LEGEND
Quanta Property Boundary
Existing Arsenic Liner
Principal Threat NAPL Zone
High Concentration Arsenic Area
Principal Threat Arsenic Area
Area of NZ-3 Treatment
Approximate area of tar "boils" (Not necessarily present throughout depicted area)
Remedial Action Components
Excavation for NAPL (0 - 4 ft bgs)/ Tar Boils and ISCO
Stabilization
Demolition
Barrier Wall
NAPL Recovery Wells
Groundwater Extraction Well
Passive NAPL Recovery
Notes:
1. Alternative also includes capping of residual soils.
2. Response action for NZ-1 under River Road to be coordinated with Bergen County when future roadway work occurs.
3. It is assumed that AA-3 will be addressed as part of the remediation efforts performed by iPark
CH2MHILL
ALTERNATIVE 5B - NAPL IN SITU CHEMICAL OXIDATION WITH ARSENIC STABILIZATION WITH DEMOLITION OF 115 RIVER ROAD BUILDINGS
Quanta Resources Superfund Site
Operable Unit 1
Edgewater, New Jersey
July 6, 2010
Fig 10
BLOCK 92.01
(LOT 1.01)
BLOCK 93
(NORTH)
HCAA
AA-7
AA-5
AA-6
AA-4
AA-1
AA-2
AA-3
NZ-1
NZ-2
NZ-5
QUANTA PROPERTY
HUDSON RIVER
OU2
115 RIVER ROAD BUILDING
FORMER LEVER BROS



LEGEND
Quanta Property Boundary
Existing Arsenic Liner
Principal Threat NAPL Zone
High Concentration Arsenic Area
Principal Threat Arsenic Area
Area of NZ-3 Treatment
Approximate area of tar "boils" (Not necessarily present throughout depicted area)
Remedial Action Components
Excavation
Vapor Intrusion Engineering Controls
Subaqueous Reactive Barrier (SRB)
Passive NAPL Recovery
Notes:
1. Alternative also includes capping of residual soils.
2. Final excavation depths will be determined during remedial design.
3. Response action for NZ-1 under River Road to be coordinated with Bergen County when future roadway work occurs.
4. It is assumed that AA-3 will be addressed as part of the remediation efforts performed by iPark.
CH2MHILL
ALTERNATIVE 6A - NAPL AND ARSENIC EXCAVATION
Quanta Resources Superfund Site
Operable Unit 1
Edgewater, New Jersey
July 6, 2010
Fig 11
N
BLOCK 92.01 (LOT 1.01)
BLOCK 94 (LOT 1)
BLOCK 93 (NORTH)
BLOCK 93 (CENTRAL)
BLOCK 93 (SOUTH)
EDGEWATER ENTERPRISE (FORMER CELOTEX)
HCAA
AA-7
AA-5
AA-6
AA-4
AA-1
AA-2
AA-3
QUANTA PROPERTY
NZ-1
NZ-2
NZ-5
115 RIVER ROAD BUILDING
FORMER LEVER BROS.
HUDSON RIVER
OU2



LEGEND
Quanta Property Boundary
Existing Arsenic Liner
Principal Threat NAPL Zone
High Concentration Arsenic Area
Principal Threat Arsenic Area
Approximate area of tar "boils" (Not necessarily present throughout depicted area)
Remedial Action Components
Excavation
Demolition
Subaqueous Reactive Barrier (SRB)
Passive NAPL Recovery
Notes:
1. Alternative also includes capping of residual soils.
2. Final excavation depths will be determined during remedial design.
3. Response action for NZ-1 under River Road to be coordinated with Bergen County when future roadway work occurs.
4. It is assumed that AA-3 will be addressed as part of the remediation efforts performed by iPark
0 70 140 ft
CH2MHILL
ALTERNATIVE 6B - NAPL AND ARSENIC EXCAVATION WITH DEMOLITION OF 115 RIVER ROAD BUILDINGS
Quanta Resources Superfund Site
Operable Unit 1
Edgewater, New Jersey
July 6, 2010
Fig 12
N
BLOCK 92.01 (LOT 1.01)
BLOCK 94 (LOT 1)
BLOCK 93 (NORTH)
BLOCK 93 (CENTRAL)
BLOCK 93 (SOUTH)
EDGEWATER ENTERPRISE (FORMER CELOTEX)
HCAA
AA-7
AA-5
AA-6
AA-4
AA-1
AA-2
AA-3
QUANTA PROPERTY
NZ-1
NZ-2
NZ-5
115 RIVER ROAD BUILDING
FORMER LEVER BROS.
HUDSON RIVER
OU2

Table 1 – Summary of Exposure Pathways and Scenarios for Quanta Resources Site, Edgewater, NJ

	Resident, Adult	Resident, Child	Daycare Child	Commercial Worker	Construction /Utility Worker	Trespasser, Adult	Trespasser, Adolsecent (6 - 16)
Quanta Property	X	X	X	X	X	X	X
Unilever Property	X	X	X	X	X	X	X
Celotex Property	X	X	X	X	X		
115 River Road	X	X	X	X	X		
Block 93 North	X	X	X	X	X	X	X
Block 93 South	X	X		X	X	X	X
Block 93 Central	X	X			X	X	X
Site-wide Groundwater, Inhalation	X	X			X		
Site-wide Groundwater, Ingestion	X	X			X		

TABLE 2
Summary of Constituents of Concern
Quanta Resources Superfund Site, OU1, Edgewater, New Jersey

COC	Surface Soil (0–2 ft bgs)	Subsurface Soil (0–10 ft bgs)	Shallow Groundwater
1,2,4-Trimethylbenzene	—	—	X
1,3,5-Trimethylbenzene	—	—	X
2-Methylnaphthalene	X	X	X
2,4-Dinitrotoluene	X	—	—
4-Methylphenol	X	—	—
Antimony	X	X	X
Aroclor-1242	X	—	—
Aroclor-1254	X	—	—
Aroclor-1260	X	—	—
Arsenic	X	X	X
Benzene	X	X	X
Benzo(a)anthracene	X	X	X
Benzo(a)pyrene	X	X	X
Benzo(b)fluoranthene	X	X	X
Benzo(k)fluoranthene	X	—	X
Carbazole	X	—	—
Cadmium	—	—	X
Chromium	X	—	—
Chrysene	X	—	—
Copper	X	—	—
Dibenzo(a,h)anthracene	X	X	X
Fluorene	X	—	—
Heptachlor	X	—	—
Indeno(1,2,3-cd)pyrene	X	X	X
Iron	X	X	X
Lead	X	X	—
Manganese	—	—	X
Mercury	X	—	X
Naphthalene	X	X	X
Thallium	X	X	X
Vanadium	X	—	X
Xylenes, Total	X	—	X
Zinc	X	—	—

Note: As presented in the RI report (CH2M HILL, 2008) and final SRI report (CH2M HILL, 2010a). COCs are defined as contributing a chemical-specific Excess Lifetime Cancer Risk (ELCR) >1 × 10^{-6} or Hazard Index (HI) > 0.1 when receptor total ELCR (all soil pathways) >1 × 10^{-6} or HI > 1.0. COCs identified as primary risk drivers are underlined.

TABLE 3
Percent Contribution of Risk Relative to a Medium's Cumulative Risk/Hazard for Constituents of Concern
Reasonable Maximum Exposure Scenario
Quanta Resources Superfund Site, OU1, Edgewater, New Jersey

Site: Quanta Resources

Surface Soil

	Percent Cancer Risk	Percent Non-cancer Hazard
Adult Trespasser		
Arsenic	33.8	
Benzo(a)anthracene	4.9	
Benzo(a)pyrene	44.2	
Benzo(b)fluoranthene	5.2	
Dibenz(a,h)anthracene	8.9	
Indeno(1,2,3-c,d)pyrene	2.5	
Adolescent Trespasser		
Arsenic	11.1	
Benzo(a)anthracene	6.5	
Benzo(a)pyrene	59.5	
Benzo(b)fluoranthene	7.0	
Dibenz(a,h)anthracene	11.9	
Indeno(1,2,3-c,d)pyrene	3.3	
Commercial Worker		
Arsenic	26.0	30.7
Aroclor-1242	0.1	
Aroclor-1260	0.1	
Benzo(a)anthracene	5.3	

Subsurface Soil

	Percent Cancer Risk	Percent Non-cancer Hazard
Construction Worker		
Antimony		1.2
Arsenic	55.6	49.1
Iron		0.7
Thallium		0.5
2-Methylnaphthalene		0.8
Benzo(a)anthracene	3.2	
Benzo(a)pyrene	30.6	
Benzo(b)fluoranthene	3.5	
Dibenz(a,h)anthracene	5.0	
Indeno(1,2,3-c,d)pyrene	1.6	
Naphthalene		46.0
Benzene	0.1	0.2

Groundwater (Above Confining Unit)

	Percent Cancer Risk	Percent Non-cancer Hazard
Construction Worker		
2-Methylnaphthalene		3.6
Benzo(a)anthracene	5.7	
Benzo(a)pyrene	70.7	
Benzo(b)fluoranthene	8.2	
Benzo(k)fluoranthene	0.4	
Dibenz(a,h)anthracene	11.1	
Indeno(1,2,3-c,d)pyrene	3.7	
Naphthalene		93.1
Benzene		1.7

TABLE 3
Percent Contribution of Risk Relative to a Medium's Cumulative Risk/Hazard for Constituents of Concern
Reasonable Maximum Exposure Scenario
Quanta Resources Superfund Site, OU1, Edgewater, New Jersey

Surface Soil			Subsurface Soil			Groundwater (Above Confining Unit)		
	Percent			Percent			Percent	
	Cancer Risk	Non-cancer Hazard		Cancer Risk	Non-cancer Hazard		Cancer Risk	Non-cancer Hazard
Benzo(a)pyrene	48.7							
Benzo(b)fluoranthene	5.7							
Benzo(k)fluoranthene	0.3							
Dibenz(a,h)anthracene	9.8							
Indeno(1,2,3-c,d)pyrene	2.7							
Naphthalene		53.3						
Benzene	0.8							
Trichloroethene	0.3							
Adult Resident								
Antimony		3.1						
Arsenic		38.8						
Iron		5.9						
Thallium		0.9						
2-Methylnaphthalene		0.5						
Naphthalene		41.9						
Benzene		1.4						
Child Resident								
Antimony		4.7						
Arsenic		57.5						
Copper		1.6						
Iron		9.1						
Thallium		1.3						
Vanadium		1.0						

TABLE 3
Percent Contribution of Risk Relative to a Medium's Cumulative Risk/Hazard for Constituents of Concern
Reasonable Maximum Exposure Scenario
Quanta Resources Superfund Site, OU1, Edgewater, New Jersey

Surface Soil			Subsurface Soil			Groundwater (Above Confining Unit)		
	Percent			Percent			Percent	
	Cancer Risk	Non-cancer Hazard		Cancer Risk	Non-cancer Hazard		Cancer Risk	Non-cancer Hazard
Zinc		0.1						
Mercury		1.1						
Aroclor-1242		2.4						
Aroclor-1260		1.2						
2-Methylnaphthalene		0.8						
4-Methylphenol		0.3						
Fluorene		0.1						
Naphthalene		16.7						
Benzene		0.6						
<u>Adult/Child Aggregate Resident</u>			-	-	-	-	-	-
Arsenic	8.6							
Heptachlor	0.01							
Aroclor-1242	0.03							
Aroclor-1260	0.02							
Benzo(a)anthracene	6.7							
Benzo(a)pyrene	61.2							
Benzo(b)fluoranthene	7.2							
Benzo(k)fluoranthene	0.3							
Carbazole	0.01							
Chrysene	0.1							
Dibenz(a,h)anthracene	12.3							
Indeno(1,2,3-c,d)pyrene	3.4							
Benzene	0.1							

TABLE 3
Percent Contribution of Risk Relative to a Medium's Cumulative Risk/Hazard for Constituents of Concern
Reasonable Maximum Exposure Scenario
Quanta Resources Superfund Site, OU1, Edgewater, New Jersey

Surface Soil			Subsurface Soil			Groundwater (Above Confining Unit)		
	Percent			Percent			Percent	
	Cancer Risk	Non-cancer Hazard		Cancer Risk	Non-cancer Hazard		Cancer Risk	Non-cancer Hazard
Trichloroethene	0.03							
Site: Edgewater								
Adult/Child Aggregate Resident			***Construction Worker***			***Construction Worker***		
Arsenic	10.4		Arsenic		47.6	Arsenic		79.45
Benzo(a)anthracene	6.4		2-Methylnaphthalene		1.6	Naphthalene		19.81
Benzo(a)pyrene	60.1		Naphthalene		30.9			
Benzo(b)fluoranthene	5.8							
Dibenz(a,h)anthracene	13.9							
Indeno(1,2,3-c,d)pyrene	3.4							
Site: 115 River Road								
Daycare Child			***Construction Worker***			***Construction Worker***		
Arsenic	0.7		Arsenic	2.0		Naphthalene		96.4
Benzo(a)anthracene	7.5		2-Methylnaphthalene		8.8			
Benzo(a)pyrene	66.7		Benzo(a)anthracene	10.1				
Benzo(b)fluoranthene	8.3		Benzo(a)pyrene	65.1				
Benzo(k)fluoranthene	0.4		Benzo(b)fluoranthene	6.9				
Dibenz(a,h)anthracene	12.3		Dibenz(a,h)anthracene	11.0				
Indeno(1,2,3-c,d)pyrene	4.0		Indeno(1,2,3-c,d)pyrene	2.9				
Chromium	0.2		Naphthalene		81.5			
Naphthalene		83.2						
Site: Former Lever Brothers								
Adolescent Trespasser			***Construction Worker***			***Construction Worker***		
Arsenic	5.4		Arsenic		55.9	Arsenic		7.7

TABLE 3

Percent Contribution of Risk Relative to a Medium's Cumulative Risk/Hazard for Constituents of Concern

Reasonable Maximum Exposure Scenario

Quanta Resources Superfund Site, OU1, Edgewater, New Jersey

Surface Soil			**Subsurface Soil**			**Groundwater (Above Confining Unit)**		
	Percent			**Percent**			**Percent**	
	Cancer Risk	**Non-cancer Hazard**		**Cancer Risk**	**Non-cancer Hazard**		**Cancer Risk**	**Non-cancer Hazard**
Benzo(a)anthracene	6.5		Naphthalene		12.1	2-Methylnaphthalene		6.4
Benzo(a)pyrene	64.7					Naphthalene		80.9
Benzo(b)fluoranthene	8.4							
Dibenz(a,h)anthracene	10.7							
Indeno(1,2,3-c,d)pyrene	3.9							
Site: Block 93 North								
Adult Trespasser			***Construction Worker***			***Construction Worker***		
Arsenic	15.9		Arsenic		3.3	Arsenic		91.7
Benzo(a)anthracene	8.9		2-Methylnaphthalene		2.6	Naphthalene		0.5
Benzo(a)pyrene	55.2		Naphthalene		86.6			
Benzo(b)fluoranthene	5.8							
Benzo(k)fluoranthene	0.5							
Dibenz(a,h)anthracene	10.2							
Indeno(1,2,3-c,d)pyrene	3.0							
Adolescent Trespasser							-	-
Arsenic	4.5							
Benzo(a)anthracene	10.1							
Benzo(a)pyrene	63.0							
Benzo(b)fluoranthene	6.6							
Benzo(k)fluoranthene	0.5							
Dibenz(a,h)anthracene	11.6							
Indeno(1,2,3-c,d)pyrene	3.5							

TABLE 3

Percent Contribution of Risk Relative to a Medium's Cumulative Risk/Hazard for Constituents of Concern

Reasonable Maximum Exposure Scenario

Quanta Resources Superfund Site, OU1, Edgewater, New Jersey

Surface Soil	Percent Cancer Risk	Percent Non-cancer Hazard
Commercial Worker		
Arsenic	11.6	
Aroclor-1260	0.2	
Benzo(a)anthracene	9.2	
Benzo(a)pyrene	57.4	
Benzo(b)fluoranthene	6.0	
Benzo(k)fluoranthene	0.5	
Dibenz(a,h)anthracene	10.6	
Indeno(1,2,3-c,d)pyrene	3.2	
Naphthalene		84.2
Benzene	1.1	
Site: Block 93 Central		
Adult Trespasser		
Arsenic	93.0	97.8
Benzo(a)anthracene	0.4	
Benzo(a)pyrene	4.8	
Benzo(b)fluoranthene	0.4	
Dibenz(a,h)anthracene	1.1	
Indeno(1,2,3-c,d)pyrene	0.3	
Adolescent Trespasser		
Arsenic	82.6	97.8
Benzo(a)anthracene	0.9	

Subsurface Soil	Percent Cancer Risk	Percent Non-cancer Hazard
Site: Block 93 Central		
Construction Worker		
Arsenic	58.8	60.9
Benzo(a)anthracene	3.1	
Benzo(a)pyrene	25.0	
Benzo(b)fluoranthene	1.9	
Dibenzo(a,h)anthracene	4.2	
Indeno(1,2,3-cd)pyrene	1.1	
Naphthalene	5.5	25.4

Groundwater (Above Confining Unit)	Percent Cancer Risk	Percent Non-cancer Hazard
Site: Block 93 Central		
Construction Worker		
Benzo(a)pyrene	98.7	
Naphthalene	1.0	95.0

TABLE 3
Percent Contribution of Risk Relative to a Medium's Cumulative Risk/Hazard for Constituents of Concern
Reasonable Maximum Exposure Scenario
Quanta Resources Superfund Site, OU1, Edgewater, New Jersey

Surface Soil			Subsurface Soil			Groundwater (Above Confining Unit)		
	Percent			Percent			Percent	
	Cancer Risk	Non-cancer Hazard		Cancer Risk	Non-cancer Hazard		Cancer Risk	Non-cancer Hazard
Benzo(a)pyrene	11.9							
Benzo(b)fluoranthene	1.1							
Dibenz(a,h)anthracene	2.7							
Indeno(1,2,3-c,d)pyrene	0.8							
Commercial Worker								
Arsenic	90.3	97.5						
Benzo(a)anthracene	0.5							
Benzo(a)pyrene	6.6							
Benzo(b)fluoranthene	0.6							
Dibenz(a,h)anthracene	1.5							
Indeno(1,2,3-c,d)pyrene	0.4							
Adult Resident								
Arsenic		96.6						
Child Resident								
Arsenic		97.7						
Adult/Child Aggregate Resident								
Arsenic	71.0							
Benzo(a)anthracene	1.5							
Benzo(a)pyrene	19.8							
Benzo(b)fluoranthene	1.8							
Benzo(k)fluoranthene	0.1							
Dibenzo(a,h)anthracene	4.5							
Indeno(1,2,3-cd)pyrene	1.3							

TABLE 3
Percent Contribution of Risk Relative to a Medium's Cumulative Risk/Hazard for Constituents of Concern
Reasonable Maximum Exposure Scenario
Quanta Resources Superfund Site, OU1, Edgewater, New Jersey

Surface Soil	Percent Cancer Risk	Percent Non-cancer Hazard	Subsurface Soil	Percent Cancer Risk	Percent Non-cancer Hazard	Groundwater (Above Confining Unit)	Percent Cancer Risk	Percent Non-cancer Hazard
Site: Block 93 South								
Adult Trespasser			***Construction Worker***			***Construction Worker***		
Arsenic	7.8		Arsenic	3.4		Naphthalene	93.72	95.91
Benzo(a)anthracene	5.3		Benzo(a)anthracene	5.5				
Benzo(a)pyrene	65.7		Benzo(a)pyrene	68.6				
Benzo(b)fluoranthene	5.2		Benzo(b)fluoranthene	5.4				
Benzo(k)fluoranthene	0.4		Dibenzo(a,h)anthracene	12.6				
Dibenzo(a,h)anthracene	11.9		Indeno(1,2,3-cd)pyrene	3.6				
Indeno(1,2,3-cd)pyrene	3.5							
Adolescent Trespasser								
Arsenic	3.0							
Benzo(a)anthracene	5.6							
Benzo(a)pyrene	69.3							
Benzo(b)fluoranthene	5.4							
Benzo(k)fluoranthene	0.4							
Dibenzo(a,h)anthracene	12.5							
Indeno(1,2,3-cd)pyrene	3.7							
Commercial Worker								
Arsenic	5.6							
Benzo(a)anthracene	5.4							
Benzo(a)pyrene	67.2							
Benzo(b)fluoranthene	5.3							
Benzo(k)fluoranthene	0.4							

TABLE 3
Percent Contribution of Risk Relative to a Medium's Cumulative Risk/Hazard for Constituents of Concern
Reasonable Maximum Exposure Scenario
Quanta Resources Superfund Site, OU1, Edgewater, New Jersey

Surface Soil			Subsurface Soil			Groundwater (Above Confining Unit)		
	Percent			Percent			Percent	
	Cancer Risk	Non-cancer Hazard		Cancer Risk	Non-cancer Hazard		Cancer Risk	Non-cancer Hazard
Dibenzo(a,h)anthracene	12.2							
Indeno(1,2,3-cd)pyrene	3.6							
Child Resident								
Arsenic		67.7						
Aroclor 1254		7.1						
Aroclor 1260		4.3						
Adult/Child Aggregate Resident								
Arsenic	1.5							
Aroclor 1254	0.01							
Aroclor 1260	0.009							
Benzo(a)anthracene	5.7							
Benzo(a)pyrene	70.3							
Benzo(b)fluoranthene	5.5							
Benzo(k)fluoranthene	0.5							
Chrysene	0.1							
Dibenzo(a,h)anthracene	12.7							
Indeno(1,2,3-cd)pyrene	3.7							
Naphthalene	0.02							
Site-Wide Groundwater (above the Confining Unit)								
Adult Resident			***Child Resident***			***Adult/Child Aggregate Resident***		
Arsenic		94.0	Arsenic		99.3	Arsenic	50.8	
Iron		0.2	Iron		0.2	alpha-BHC	0.0002	
Benzene		0.2	Benzene		0.1	delta-BHC	0.0002	

TABLE 3

Percent Contribution of Risk Relative to a Medium's Cumulative Risk/Hazard for Constituents of Concern

Reasonable Maximum Exposure Scenario

Quanta Resources Superfund Site, OU1, Edgewater, New Jersey

Surface Soil			Subsurface Soil			Groundwater (Above Confining Unit)		
	Percent			Percent			Percent	
	Cancer Risk	Non-cancer Hazard		Cancer Risk	Non-cancer Hazard		Cancer Risk	Non-cancer Hazard
Ethylbenzene		0.003	Ethylbenzene		0.002	Heptachlor	0.0001	
Toluene		0.005	Toluene		0.004	Benzene	0.2	
Trichloroethene		0.004	Trichloroethene		0.004	Trichloroethene	0.004	
m,p-Xylene		0.01	m,p-Xylene		0.001	Benzo(a)anthracene	2.0	
o-Xylene		0.01	o-Xylene		0.001	Benzo(a)pyrene	42.7	
Xylene (Total)		0.02	Xylene (Total)		0.002	Benzo(b)fluoranthene	2.8	
2,4-Dimethylphenol		0.02	2,4-Dimethylphenol		0.02	Benzo(k)fluoranthene	0.1	
2-Methylnaphthalene		0.1	2-Methylnaphthalene		0.1	Carbazole	0.003	
2-Methylphenol		0.002	2-Methylphenol		0.002	Chrysene	0.02	
3&4-Methylphenol		0.002	3&4-Methylphenol		0.002	Indeno(1,2,3-c,d)pyrene	1.3	
4-Methylphenol		0.1	4-Methylphenol		0.1			
Acenaphthene		0.004	Acenaphthene		0.004			
Benzo(g,h,i)perylene		0.01	Acenaphthylene		0.001			
1,1'-Biphenyl		0.001	Benzo(g,h,i)perylene		0.01			
Fluoranthene		0.01	1,1'-Biphenyl		0.001			
Naphthalene		5.2	Fluoranthene		0.01			
Pyrene		0.01	Fluorene		0.002			
			Naphthalene		0.2			
			Pyrene		0.01			
Site-Wide Groundwater (below the Confining Unit)								
Adult Resident			***Child Resident***			***Adult/Child Aggregate Resident***		
Trichloroethene		75.3	Arsenic		1.2	Arsenic	1.9	
2-Methylnaphthalene		0.2	Trichloroethene		97.2	Benzene	0.2	

TABLE 3
Percent Contribution of Risk Relative to a Medium's Cumulative Risk/Hazard for Constituents of Concern
Reasonable Maximum Exposure Scenario
Quanta Resources Superfund Site, OU1, Edgewater, New Jersey

Surface Soil			Subsurface Soil			Groundwater (Above Confining Unit)		
	Percent			Percent			Percent	
	Cancer Risk	Non-cancer Hazard		Cancer Risk	Non-cancer Hazard		Cancer Risk	Non-cancer Hazard
Naphthalene		23.0				Tetrachloroethene	2.0	
						Trichloroethene	93.7	
						Vinyl chloride	0.04	
						Benzo(a)anthracene	2.1	
						Carbazole	0.02	

Note: The percent risk/hazard for each constituent represents the percent individual risk relative to the total risk by all COPCs evaluated in a medium. If a cumulative ELCR of 1 × 10-4 is exceeded for a given medium, the COPCs that pose an individual ELCR greater than 1x10-6 for a potential receptor/property combination were identified as COCs. If a target organ-specific HI exceeds 1.0, the COPCs that pose an individual HQ greater than 0.10 were identified as COCs. An adult/child aggregate resident represents a resident exposed first as a child and then as an adult. The total percentages for each medium and receptor do not equal 100% because only chemicals identified as COCs are included in the table. The percent risk/hazard included in this table is based on the results of baseline HHRAs in the RI except for the Block 93 Central and South properties (Appendix P of the RI report). The percent risk/hazard for Block 93 Central and South properties is based on the results of HHRA conducted as part of SRI (Appendix HH of the SRI report).

TABLE 4
Summary of Soil Preliminary Remediation Goals
Quanta Resources Superfund Site, OU1, Edgewater, New Jersey

Constituent	Risk-Based PRGs (mg/kg): ELCR = 10^{-6}	ELCR = 10^{-4}	HQ = 1	NJ Soil Standard (Residential) (mg/kg)	NJ Soil Standard (Non-Residential) (mg/kg)	PRG (mg/kg)	Basis for PRG	Comments
Surface Soil (0–2 ft)								
2-Methyl-naphthalene	—	—	310	230	2,400	**230**	RSS	NJ Residential Soil Standard is more conservative than the risk-based concentration.
2,4-Dinitrotoluene	1.6	160	120	0.7	3	**0.7**	RSS	NJ Residential Soil Standard is more conservative than the risk-based concentration.

TABLE 4
Summary of Soil Preliminary Remediation Goals
Quanta Resources Superfund Site, OU1, Edgewater, New Jersey

Constituent	Risk-Based PRGs (mg/kg) ELCR = 10^{-6}	ELCR = 10^{-4}	HQ = 1	NJ Soil Standard (Residential) (mg/kg)	NJ Soil Standard (Non-Residential) (mg/kg)	PRG (mg/kg)	Basis for PRG	Comments
4-Methylphenol	—	—	310	31	340	**31**	RSS	NJ Residential Soil Standard is more conservative than the risk-based concentration.
Antimony	—	—	31	31	450	**31**	RSS/HQ	NJ Residential Soil Standard equals the HQ=1 concentration
Aroclor-1242	0.22	22	—	0.2	1.0	**0.2**	RSS	NJ Residential Soil Standard is more conservative than the risk-based concentration.
Aroclor-1254	0.22	22	1.1	0.2	1.0	**0.2**	RSS	NJ Residential Soil Standard is more conservative than the risk-based concentration.
Aroclor-1260	0.22	22	—	0.2	1.0	**0.2**	RSS	NJ Residential Soil Standard is more conservative than the risk-based concentration.
Arsenic	0.39	39	22	19	19	**0.39**	ELCR	Risk-based concentration is lower than the NJ Soil Standards
Benzene	1.1	110	90	2	5	**1.1**	ELCR	Risk-based concentration is lower than the NJ Soil Standards
Benzo(a)anthracene	0.15	15	—	0.6	2	**0.15**	ELCR	Risk-based concentration is lower than the NJ Soil Standards
Benzo(a)pyrene	0.015	1.5	—	0.2	0.2	**0.015**	ELCR	Risk-based concentration is lower than the NJ Soil Standards
Benzo(b)fluoranthene	0.15	15	—	0.6	2	**0.15**	ELCR	Risk-based concentration is lower than the NJ Soil Standards
Benzo(k)fluoranthene	1.5	150	—	6	23	**1.5**	ELCR	Risk-based concentration is lower than the NJ Soil Standards
Carbazole	24	2,400	—	24	96	**24**	RSS/ ELCR	NJ Residential Soil Standard equals the risk-based concentration for and ELCR value of 10^{-6}
Chromium	39	3,900	230	NA	NA	**39**	ELCR	NJ Soil Standards for chromium are not available
Chrysene	15	1,500	—	62	230	**15**	ELCR	Risk-based concentration is lower than the NJ Soil Standards

TABLE 4
Summary of Soil Preliminary Remediation Goals
Quanta Resources Superfund Site, OU1, Edgewater, New Jersey

Constituent	Risk-Based PRGs (mg/kg)			NJ Soil Standard (Residential) (mg/kg)	NJ Soil Standard (Non-Residential) (mg/kg)	PRG (mg/kg)	Basis for PRG	Comments
	ELCR = 10^{-6}	ELCR = 10^{-4}	HQ = 1					
Copper	—	—	3,100	3,100	45,000	**3,100**	RSS/HQ	NJ Residential Soil Standard equals the HQ=1 concentration
Dibenzo(a,h)an-thracene	0.015	1.5	—	0.2	0.2	**0.015**	ELCR	Risk-based concentration is lower than the NJ Soil Standards.
Fluoranthene	—	—	2,300	2,300	24,000	**2,300**	RSS/HQ	NJ Residential Soil Standard equals the HQ=1 concentration
Fluorene	—	—	2,300	2,300	24,000	**2,300**	RSS/HQ	NJ Residential Soil Standard equals the HQ=1 concentration
Heptachlor	0.11	11	31	0.1	0.7	**0.1**	RSS	NJ Residential Soil Standard is more conservative than risk-based concentration.
Indeno(1,2,3-cd) pyrene	0.15	15	—	0.6	2	**0.15**	ELCR	Risk-based concentration is lower than the NJ Soil Standards.
Iron	—	—	55,000	NA	NA	**55,000**	HQ	NJ Soil Standards for iron are not available
Lead	—	—	400[a,b]	400	800	**400**	RSS/HQ	NJ Residential Soil Standard equals the risk-based concentration.
Mercury	—	—	23	23	65	**23**	RSS/HQ	NJ Residential Soil Standard equals the HQ=1 concentration.
Naphthalene	3.9	390	150	6	17	**3.9**	ELCR	Risk-based concentration is lower than the NJ Soil Standards.
Thallium	—	—	5.1	5	79	**5**	RSS	NJ Residential Soil Standard is more conservative than risk-based concentration.
Trichloroethene	2.8	280	—	7	20	**2.8**	ELCR	Risk-based concentration is lower than the NJ Soil Standards.
Vanadium	—	—	390	78	1100	**78**	RSS	NJ Residential Soil Standard is more conservative than risk-based concentration.
Xylenes, Total	—	—	600	12,000	170,000	**600**	HQ	Risk-based concentration is lower than the NJ Soil Standards

TABLE 4
Summary of Soil Preliminary Remediation Goals
Quanta Resources Superfund Site, OU1, Edgewater, New Jersey

Constituent	Risk-Based PRGs (mg/kg) ELCR = 10^{-6}	ELCR = 10^{-4}	HQ = 1	NJ Soil Standard (Residential) (mg/kg)	NJ Soil Standard (Non-Residential) (mg/kg)	PRG (mg/kg)	Basis for PRG	Comments
Zinc	—	—	23,000	23,000	110,000	**23,000**	RSS	NJ Residential Soil Standard equals the HQ=1 concentration.
Subsurface Soil (0–10 ft)								
2-Methyl-naphthalene	—	—	1,200	230	2,400	**230**	RSS	NJ Residential Soil Standard is more conservative than the risk-based concentration.
2,4-Dinitrotoluene	—	—	—	0.7	3	**0.7**	RSS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
2,6-Dinitrotoluene	—	—	—	0.7	3	**0.7**	RSS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Antimony	—	—	120	31	450	**31**	RSS	NJ Residential Soil Standard is more conservative than the risk-based concentration.
Aroclor-1242	—	—	—	0.2	1.0	**0.2**	RSS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Aroclor-1248	—	—	—	0.2	1.0	**0.2**	RSS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Aroclor-1254	—	—	—	0.2	1.0	**0.2**	RSS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Aroclor-1260	—	—	—	0.2	1.0	**0.2**	RSS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Arsenic	13	1,300	80	19	19	**13**	ELCR	Risk-based concentration is lower than the NJ Soil Standards
Beryllium	—	—	—	16	140	**16**	RSS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Benzene	98	9,800	320	2	5	**2**	RSS	NJ Residential Soil Standard is more conservative than the risk-based concentration.
Benzo(a)anthracene	21	2,100	—	0.6	2	**0.6**	RSS	NJ Residential Soil Standard is more conservative than the risk-based concentration.

TABLE 4
Summary of Soil Preliminary Remediation Goals
Quanta Resources Superfund Site, OU1, Edgewater, New Jersey

Constituent	Risk-Based PRGs (mg/kg) ELCR = 10^{-6}	ELCR = 10^{-4}	HQ = 1	NJ Soil Standard (Residential) (mg/kg)	NJ Soil Standard (Non-Residential) (mg/kg)	PRG (mg/kg)	Basis for PRG	Comments
Benzo(a)pyrene	2.1	210	—	0.2	0.2	**0.2**	RSS	NJ Residential Soil Standard is more conservative than the risk-based concentration.
Benzo(b)fluoranthene	21	2,100	—	0.6	2	**0.6**	RSS	NJ Residential Soil Standard is more conservative than the risk-based concentration.
Benzo(k)fluoranthene	—	—	—	6	23	**6**	RSS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Carbazole	—	—	—	24	96	**24**	RSS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Chrysene	—	—	—	62	230	**62**	RSS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Copper	—	—	—	3,100	45,000	**3,100**	RSS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Dibenzo(a,h)anthracene	2.1	210	—	0.2	0.2	**0.2**	RSS	NJ Residential Soil Standard is more conservative than the risk-based concentration.
Fluoranthene	—	—	—	2,300	24,000	**2,300**	RSS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Fluorene	—	—	—	2,300	24,000	**2,300**	RSS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Indeno(1,2,3-cd) pyrene	21	2,100	—	0.6	2	**0.6**	RSS	NJ Residential Soil Standard is more conservative than the risk-based concentration.
Iron	—	—	220,000	NA	NA	**220,000**	HQ	NJ Soil Standards for iron are not available.
Lead	—	—	618 [b]	400	800	**400**	RSS	NJ Residential Soil Standard is more conservative than the risk-based concentration.
Mercury	—	—	—	23	65	**23**	RSS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Naphthalene	410	41,000	530	6	17	**6**	RSS	NJ Residential Soil Standard is more conservative than the risk-based concentration.

TABLE 4
Summary of Soil Preliminary Remediation Goals
Quanta Resources Superfund Site, OU1, Edgewater, New Jersey

Constituent	Risk-Based PRGs (mg/kg) ELCR = 10^{-6}	ELCR = 10^{-4}	HQ = 1	NJ Soil Standard (Residential) (mg/kg)	NJ Soil Standard (Non-Residential) (mg/kg)	PRG (mg/kg)	Basis for PRG	Comments
Nickel	—	—	—	1,600	23,000	**1,600**	RSS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Pyrene	—	—	—	1,700	18,000	**1,700**	RSS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Tetrachloro-ethene	—	—	—	2	5	**2**	RSS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Thallium	—	—	20	5	79	**5**	RSS	NJ Residential Soil Standard is more conservative than the risk-based concentration.
Vanadium	—	—	—	78	1100	**78**	RSS	PRG selected to meet an ARAR; constituent is not a COC for this medium.

NA, not available; RSS, N.J. Residential Soil Standard; HQ, hazard quotient; ELCR, excess lifetime cancer risk. Surface soil risk-based remedial goals are based on the EPA Regional Screening Level (RSL) Table for Residential Soil (April 2009). RSL for “chromium VI (particulates)” used for chromium. RSL for “mercury, inorganic salts” used for mercury. RSL for “thallium (soluble salts)” used for thallium. RSL for “vanadium and compounds” used for vanadium. RSL for “zinc (metallic)” used for zinc. The risk-based PRG for carbazole was calculated using the EPA Health Effects Assessment Summary Tables (HEAST) at http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm.

[a] Based on the EPA Lead Working Group.
[b] Calculated using the adult lead methodology.

TABLE 5
Summary of Groundwater Preliminary Remediation Goals
Quanta Resources Superfund Site, OU1, Edgewater, New Jersey

	Federal and State Promulgated Standards			Site-Specific Risk-Based PRGs						
Constituent	NJ GWQS (Class IIA)[a] (µg/L)	NJ GWQS (Interim)[b] (µg/L)	State MCL[c] (µg/L)	Federal MCL[d] (µg/L)	ELCR = 10^{-6} (µg/L)	ELCR = 10^{-4} (µg/L)	HQ = 1 (µg/L)	PRG[e] (µg/L)	Basis for PRG	Comments
Metals										
Aluminum	200	NA	NA	NA	NA	NA	NA	200	NJ GWQS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Antimony	6	NA	6	6	NA	NA	5,600	6	NJ GWQS/NJ MCL	—
Arsenic	3	NA	5	10	4,300	430,000	28,000	3	NJ GWQS	—
Beryllium	1	NA	4	4	NA	NA	NA	1	NJ GWQS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Cadmium	4	NA	5	5	NA	NA	2,300	4	NJ GWQS	—
Cobalt	NA	100	NA	NA	NA	NA	NA	100	NJ GWQS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Iron	300	NA	NA	NA	NA	NA	65,000,000	300	NJ GWQS	—
Lead	5	NA	15	15	NA	NA	NA	5	NJ GWQS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Manganese*	50	NA	NA	NA	NA	NA	520,000	50	NJ GWQS	—
Mercury	2	NA	2	2	NA	NA	19,000	2	NJ GWQS/NJ MCL	—
Nickel	100	NA	NA	NA	NA	NA	NA	100	NJ GWQS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Selenium	40	NA	50	50	NA	NA	NA	40	NJ GWQS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Sodium*	50,000	NA	NA	NA	NA	NA	NA	50,000	NJ GWQS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Thallium	2	NA	2	2	NA	NA	6,000	2	NJ GWQS/NJ MCL	—
Zinc	2,000	NA	NA	NA	NA	NA	NA	2,000	NJ GWQS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
VOCs										

TABLE 5
Summary of Groundwater Preliminary Remediation Goals
Quanta Resources Superfund Site, OU1, Edgewater, New Jersey

Constituent	Federal and State Promulgated Standards			Site-Specific Risk-Based PRGs						
	NJ GWQS (Class IIA)[a] (µg/L)	NJ GWQS (Interim)[b] (µg/L)	State MCL[c] (µg/L)	Federal MCL[d] (µg/L)	ELCR = 10^{-6} (µg/L)	ELCR = 10^{-4} (µg/L)	HQ = 1 (µg/L)	PRG[e] (µg/L)	Basis for PRG	Comments
1,1-Dichloroethane*	50	NA	50	NA	NA	NA	NA	50	NJ GWQS/NJ MCL	PRG selected to meet an ARAR; constituent is not a COC for this medium.
1,2,4-Trichlorobenzene	9	NA	9	70	NA	NA	NA	9	NJ GWQS/NJ MCL	PRG selected to meet an ARAR; constituent is not a COC for this medium.
1,2-Dichloroethane*	2	NA	2	5	NA	NA	NA	2	NJ GWQS/NJ MCL	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Benzene	1	NA	1	5	810	81,000	2,700	1	NJ GWQS/NJ MCL	—
Chloroethane	NA	5	NA	NA	NA	NA	NA	5	NJ GWQS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Ethylbenzene	700	NA	700	700	NA	NA	NA	700	NJ GWQS/NJ MCL/Federal MCL	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Styrene	100	NA	100	100	NA	NA	NA	100	NJ GWQS/NJ MCL/Federal MCL	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Tetrachloroethene*	1	NA	1	5	NA	NA	NA	1	NJ GWQS/NJ MCL	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Toluene	600	NA	1,000	1,000	NA	NA	NA	600	NJ GWQS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Trichloroethene*	1	NA	1	5	NA	NA	NA	1	NJ GWQS/NJ MCL	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Vinyl Chloride*	1	NA	2	2	NA	NA	NA	1	NJ GWQS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Xylenes, m/p-	1,000	NA	1,000	1,000	NA	NA	NA	1,000	NJ GWQS/NJ MCL/Federal MCL	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Xylenes, Total	1,000	NA	1,000	1,000	NA	NA	10,000	1,000	NJ GWQS/NJ MCL/Federal MCL	—
PAHs										

TABLE 5
Summary of Groundwater Preliminary Remediation Goals
Quanta Resources Superfund Site, OU1, Edgewater, New Jersey

	Federal and State Promulgated Standards			Site-Specific Risk-Based PRGs						
Constituent	NJ GWQS (Class IIA)[a] (µg/L)	NJ GWQS (Interim)[b] (µg/L)	State MCL[c] (µg/L)	Federal MCL[d] (µg/L)	ELCR = 10^{-6} (µg/L)	ELCR = 10^{-4} (µg/L)	HQ = 1 (µg/L)	PRG[e] (µg/L)	Basis for PRG	Comments
2-Methylnaphthalene	NA	30	NA	NA	NA	NA	4,300	30	NJ GWQS	—
Acenaphthene	400	NA	NA	NA	NA	NA	NA	400	NJ GWQS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Acenaphthylene	NA	100	NA	NA	NA	NA	NA	100	NJ GWQS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Benzo(a)anthracene	0.1	NA	NA	NA	9.5	950	NA	0.1	NJ GWQS	—
Benzo(a)pyrene	0.1	NA	0.2	0.2	0.56	56	NA	0.1	NJ GWQS	—
Benzo(b)fluoranthene	0.2	NA	NA	NA	5.5	550	NA	0.2	NJ GWQS	—
Benzo(g,h,i)perylene	NA	100	NA	NA	NA	NA	NA	100	NJ GWQS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Benzo(k)fluoranthene	0.5	NA	NA	NA	59	5,900	NA	0.5	NJ GWQS	—
Chrysene	5	NA	NA	NA	NA	NA	NA	5	NJ GWQS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Dibenzo(a,h)anthracene	0.3	NA	NA	NA	0.36	36	NA	0.3	NJ GWQS	—
Fluoranthene	300	NA	NA	NA	NA	NA	NA	300	NJ GWQS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Fluorene	300	NA	NA	NA	NA	NA	NA	300	NJ GWQS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Indeno(1,2,3-cd)pyrene	0.2	NA	NA	NA	5.3	530	NA	0.2	NJ GWQS	—
Naphthalene	300	NA	300	NA	250	25,000	370	250	ELCR 10^{-6}	—
Phenanthrene	NA	100	NA	NA	NA	NA	NA	100	NJ GWQS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Pyrene	200	NA	NA	NA	NA	NA	NA	200	NJ GWQS	PRG selected to meet an ARAR; constituent is not a COC for this medium.

TABLE 5
Summary of Groundwater Preliminary Remediation Goals
Quanta Resources Superfund Site, OU1, Edgewater, New Jersey

	Federal and State Promulgated Standards			Site-Specific Risk-Based PRGs						
Constituent	NJ GWQS (Class IIA)[a] (µg/L)	NJ GWQS (Interim)[b] (µg/L)	State MCL[c] (µg/L)	Federal MCL[d] (µg/L)	ELCR = 10^{-6} (µg/L)	ELCR = 10^{-4} (µg/L)	HQ = 1 (µg/L)	PRG[e] (µg/L)	Basis for PRG	Comments
SVOCs										
2,4-Dimethylphenol	100	NA	NA	NA	NA	NA	NA	100	NJ GWQS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Biphenyl	400	NA	NA	NA	NA	NA	NA	400	NJ GWQS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
bis(2-Ethylhexyl) phthalate*	3	NA	6	6	NA	NA	NA	3	NJ GWQS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Dibenzofuran	NA	NA	NA	NA	NA	NA	860	860	HQ = 1	—
Nitrobenzene	6	NA	NA	NA	NA	NA	NA	6	NJ GWQS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Pentachlorophenol	0.3	NA	1	1	NA	NA	NA	0.3	NJ GWQS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Phenol	2,000	NA	NA	NA	NA	NA	NA	2,000	NJ GWQS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Pesticides										
4,4'-DDD	0.1	NA	NA	NA	NA	NA	NA	0.1	NJ GWQS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
4,4'-DDE	0.1	NA	NA	NA	NA	NA	NA	0.1	NJ GWQS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
alpha-BHC	0.02	NA	NA	NA	NA	NA	NA	0.02	NJ GWQS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Wet Chemistry										
Ammonia	3,000	NA	NA	NA	NA	NA	NA	3,000	NJ GWQS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Chloride*	250,000	NA	NA	NA	NA	NA	NA	250,000	NJ GWQS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Hardness, total as $CaCO_3$	250,000	NA	NA	NA	NA	NA	NA	250,000	NJ GWQS	PRG selected to meet an ARAR; constituent is not a COC for this medium.
Sulfate	250,000	NA	NA	NA	NA	NA	NA	250,000	NJ GWQS	PRG selected to meet an ARAR; constituent is not a COC for this medium.

TABLE 5
Summary of Groundwater Preliminary Remediation Goals
Quanta Resources Superfund Site, OU1, Edgewater, New Jersey

	Federal and State Promulgated Standards			Site-Specific Risk-Based PRGs						
Constituent	NJ GWQS (Class IIA)[a] (µg/L)	NJ GWQS (Interim)[b] (µg/L)	State MCL[c] (µg/L)	Federal MCL[d] (µg/L)	ELCR = 10^{-6} (µg/L)	ELCR = 10^{-4} (µg/L)	HQ = 1 (µg/L)	PRG[e] (µg/L)	Basis for PRG	Comments

GWQS, groundwater quality standard; MCL, maximum contaminant level; HQ, hazard quotient. Values in grey are not exceeded within OU1 during sampling conducted by CH2M HILL during RI-related groundwater sampling events from 2005 to 2009. Monitoring wells outside the lateral extent of OU1 or screened within the deep sand or bedrock are excluded. Risk-based PRGs are applicable to monitoring wells screened at 10 ft bgs or less.
*Constituent is not Site related.
[a]New Jersey Groundwater Quality Standard; http://www.state.nj.us/dep/wms/bwqsa/gwqs_table1.html; accessed December 29, 2009.
[b]New Jersey Interim Groundwater Quality Criteria; http://www.state.nj.us/dep/wms/bwqsa/gwqs_interim_criteria_table.htm; accessed December 29, 2009.
[c]NJDEP (2005).
[d]EPA Maximum Contaminant Levels; http://www.epa.gov/safewater/contaminants/index.html#mcls; accessed December 29, 2009. NA, not applicable or not available.
[e]PRGs are selected as the lowest of federal, state or site-specific risk-based PRG values.

TABLE 6 REMEDIAL ALTERNATIVES SUMMARY QUANTA RESOURCES SUPERFUND SITE, OU1, EDGEWATER, NEW JERSEY

		Alternative							
				4—NAPL and Arsenic In Situ Solidification/Stabilization		5— NAPL In Situ Chemical Oxidation with Arsenic Stabilization		6—NAPL and Arsenic Excavation	
		2—NAPL and Arsenic Containment	3—NAPL and Arsenic Containment with NAPL Recovery	4a—Preservation of 115 River Rd. Buildings	4b—Demolition of 115 River Rd. Buildings	5a—Preservation of 115 River Rd. Buildings	5b—Demolition of 115 River Rd. Buildings	6a—Preservation of 115 River Rd. Buildings	6b—Demolition of 115 River Rd. Buildings
Evaluation Criteria									
Principal Threat NAPL	Alternative Description	Tar boils at the ground surface throughout the site, NAPL present in NZ-1, NZ-2 and NZ-5 would be capped. Institutional controls would be established to document and limit use of areas with COCs remaining in place. A funnel-and-gate system (barrier cutoff wall with a permeable reactive barrier) would be installed to prevent potential NAPL migration to the Hudson River.	NAPL would be collected via standard recovery wells located in NZ-1, NZ-2 and NZ-5 and via directionally drilled recovery wells under the 115 River Rd. Building. Capping and institutional controls would be established to document and limit use of areas with COCs remaining in place. A barrier cutoff wall with groundwater extraction and treatment would be installed to prevent potential NAPL migration to the Hudson River..	In situ solidification/stabilization of tar boils, accessible NAPL present in NZ-1, NZ-2, and NZ-5 with capping. Subsurface debris would be excavated for offsite disposal. Institutional controls would be established and maintained to document and limit use of areas with COCs remaining in place. NAPL under 115 River Rd. is left in place.	115 River Rd. tenants are relocated, building is demolished to access NAPL areas below building footprint, and then the building is reconstructed.	Tar boils at the ground surface throughout the site, NZ-1, and NZ-2 soils would be excavated to a depth of 4 ft bgs for offsite disposal. NAPL would be collected via standard recovery wells located in NZ-1, NZ-2, and NZ-5. NAPL collection would be followed by in situ chemical oxidation in NAPL zones NZ-1, NZ-2, and NZ-5. A barrier cutoff wall would be installed along NZ-2 and NZ-5 shoreline NAPL under 115 River Rd. is left in place.	115 River Rd. tenants are relocated, building is demolished to access NAPL areas below building footprint, and then the building is reconstructed.	NAPL present in NZ-1, NZ-2, NZ-5, tar boils would be excavated from accessible areas and disposed of offsite. Water generated from dewatering activities would be treated onsite prior to discharge to the Hudson River. Following excavation the site would be backfilled and compacted with clean material to grade. A barrier cutoff wall would be installed along NZ-2 and NZ-5 shoreline. NAPL under 115 River Rd. is left in place.	115 River Rd. tenants are relocated, building is demolished to access NAPL areas below building footprint, and then the building is reconstructed.
	NAPL Mobility Addressed	Barrier cutoff wall with PRB to prevent migration of NAPL to the River	NAPL recovery and barrier cutoff wall to prevent migration of NAPL to the River	In situ solidification/stabilization mitigates potential migration of NAPL to the Hudson River.		NAPL recovery and ISCO mitigates potential migration to the Hudson River		Excavation mitigates potential migration of NAPL to the Hudson River.	
	NAPL Toxicity Addressed	Capping and ICs, including maintenance of existing surfaces, eliminates direct contact pathway. Funnel-and-gate protects ecological receptors.	Capping and ICs, including maintenance of existing surfaces, and NAPL recovery eliminates direct contact pathway. Barrier cutoff wall protects ecological receptors.	In situ solidification/stabilization of NAPL reduces accessibility and leachability (and therefore toxicity). Capping and ICs are also provided.		ISCO and NAPL recovery reduces accessibility and leachability (and therefore toxicity). Capping and ICs are also provided		Excavation eliminates direct contact exposure pathway. Capping and ICs are also provided.	

TABLE 6 REMEDIAL ALTERNATIVES SUMMARY QUANTA RESOURCES SUPERFUND SITE, OU1, EDGEWATER, NEW JERSEY

Evaluation Criteria		Alternative							
		2—NAPL and Arsenic Containment	3—NAPL and Arsenic Containment with NAPL Recovery	4—NAPL and Arsenic In Situ Solidification/Stabilization		5— NAPL In Situ Chemical Oxidation with Arsenic Stabilization		6—NAPL and Arsenic Excavation	
				4a—Preservation of 115 River Rd. Buildings	4b—Demolition of 115 River Rd. Buildings	5a—Preservation of 115 River Rd. Buildings	5b—Demolition of 115 River Rd. Buildings	6a—Preservation of 115 River Rd. Buildings	6b—Demolition of 115 River Rd. Buildings
Arsenic-Contaminated Soil	Alternative Description	Arsenic-contaminated soils >390 ppm from 0-2 ft bgs and soils >1,000 ppm from 2-10 ft bgs would be capped, or existing surfaces maintained. Institutional controls would be established to document and limit use of areas with COCs remaining in place.	Arsenic-contaminated soils >390 ppm from 0-2 ft bgs and soils >1,000 ppm from 2-10 ft bgs would be capped, or existing surfaces maintained. Institutional controls would be established to document and limit use of areas with COCs remaining in place. A cutoff wall would be installed downgradient of the HCAA with groundwater extraction and treatment.	Principal threat arsenic on Block 93 and the Quanta property, and arsenic within the HCAA would be solidified/stabilized. **HCAA Process option:** Principal threat arsenic on Block 93 and the Quanta property would be solidified/ stabilized and cutoff wall would be installed downgradient of the HCAA with groundwater extraction and treatment.		Principal threat arsenic on Block 93 and the Quanta property, and arsenic within the HCAA would be solidified/stabilized. **HCAA Process option:** Principal threat arsenic on Block 93 and the Quanta property would be solidified/stabilized in situ. A cutoff wall would be installed downgradient of the HCAA with groundwater extraction and treatment.		Principal threat arsenic on Block 93 and the Quanta property, and arsenic within the HCAA would be excavated, and then backfilled and compacted with clean material to grade.	
	Arsenic Enabler	Despite the presence of NAPL, attenuation of arsenic through adsorption is occurring at the site	NAPL recovery would provide a potential change in redox conditions that would promote reduced arsenic solubility and increased attenuation of dissolved phase arsenic.	In situ solidification/stabilization of NAPL would reduce potential for PAHs to leach to groundwater and provides a potential change in redox conditions that would promote reduced arsenic solubility and increased attenuation of dissolved phase arsenic. Stabilization/solidification of arsenic reduces potential of arsenic to leach to groundwater. **HCAA Process Option:** Installation of cutoff wall with groundwater extraction and treatment to reduce arsenic concentrations in groundwater downgradient of HCAA.		NAPL recovery and ISCO would reduce potential for PAHs to leach to groundwater and provides a potential change in redox conditions that would promote reduced arsenic solubility and increased attenuation of dissolved phase arsenic. Stabilization/solidification of arsenic reduces potential of arsenic to leach to groundwater **HCAA Process Option:** Installation of cutoff wall with groundwater extraction and treatment to reduce arsenic concentrations in groundwater downgradient of HCAA.		Excavation would reduce potential for PAHs to leach to groundwater and provides a potential change in redox conditions that would promote reduced arsenic solubility and increased attenuation of dissolved phase arsenic. Excavation of arsenic reduces potential of arsenic to leach to groundwater.	

TABLE 6 REMEDIAL ALTERNATIVES SUMMARY QUANTA RESOURCES SUPERFUND SITE, OU1, EDGEWATER, NEW JERSEY

		Alternative							
				4—NAPL and Arsenic In Situ Solidification/Stabilization		5— NAPL In Situ Chemical Oxidation with Arsenic Stabilization		6—NAPL and Arsenic Excavation	
Evaluation Criteria		2—NAPL and Arsenic Containment	3—NAPL and Arsenic Containment with NAPL Recovery	4a—Preservation of 115 River Rd. Buildings	4b—Demolition of 115 River Rd. Buildings	5a—Preservation of 115 River Rd. Buildings	5b—Demolition of 115 River Rd. Buildings	6a—Preservation of 115 River Rd. Buildings	6b—Demolition of 115 River Rd. Buildings
Arsenic-Contaminated Soil	Residual Soil	Existing River/Gorge Rd. surfaces would be maintained and institutional controls would remain in place. Residual soils would be capped. The cap would be either a single-layer engineered cap or a vegetative cap, depending on redevelopment. Institutional controls would be established to place restrictions on future land use and control future construction and redevelopment activities.	Same as Alternative 2	Same as Alternative 2		Same as Alternative 2		Same as Alternative 2	
	Vapor	A vapor intrusion mitigation system would be installed in the basements of Buildings 7 and 8 of 115 River Rd. building. Institutional controls would be established and maintained to prevent vapor intrusion in other buildings and to inspect/maintain controls at 115 River Rd. Vapor intrusion mitigation would be installed in the other occupied buildings, if warranted.	Same as Alternative 2	Institutional controls would be established and maintained to prevent vapor intrusion in other buildings and to inspect/maintain controls at 115 River Rd. Vapor intrusion mitigation would be installed in the other occupied buildings, if warranted.		Institutional controls would be established and maintained to prevent vapor intrusion in other buildings and to inspect/maintain controls at 115 River Rd. Vapor intrusion mitigation would be installed in the other occupied buildings, if warranted.		Institutional controls would be established and maintained to prevent vapor intrusion in other buildings and to inspect/maintain controls at 115 River Rd. Vapor intrusion mitigation would be installed in the other occupied buildings, if warranted.	
				A vapor intrusion mitigation system would be installed in the basements of the 115 River Rd. building.	Materials under 115 River Rd. would be treated.	A vapor intrusion mitigation system would be installed in the basements of the 115 River Rd. building.	Materials under 115 River Rd. would be treated.	A vapor intrusion mitigation system would be installed in the basements of the 115 River Rd. building.	Materials under 115 River Rd. would be treated.

TABLE 6 **REMEDIAL ALTERNATIVES SUMMARY QUANTA RESOURCES SUPERFUND SITE, OU1, EDGEWATER, NEW JERSEY**

Evaluation Criteria		Alternative							
		2—NAPL and Arsenic Containment	3—NAPL and Arsenic Containment with NAPL Recovery	4—NAPL and Arsenic In Situ Solidification/Stabilization		5— NAPL In Situ Chemical Oxidation with Arsenic Stabilization		6—NAPL and Arsenic Excavation	
				4a—Preservation of 115 River Rd. Buildings	4b—Demolition of 115 River Rd. Buildings	5a—Preservation of 115 River Rd. Buildings	5b—Demolition of 115 River Rd. Buildings	6a—Preservation of 115 River Rd. Buildings	6b—Demolition of 115 River Rd. Buildings
Groundwater/ Surface Water	Alternative Description	Site groundwater would be contained and treated with a funnel-and-gate system (barrier cutoff wall with a permeable reactive barrier) before discharging to the Hudson River. Institutional controls restricting groundwater use would be established.	Site groundwater would be contained with a barrier cutoff wall and groundwater extraction and treatment prior to discharging to the Hudson River. Institutional controls restricting groundwater use would be established.	A subaqueous reactive barrier, which consists of a reactive material encapsulated between carrier textiles, would be placed over the sediments in OU2 to treat groundwater discharging to the river. Institutional controls restricting groundwater use would be established. **HCAA Process Option:** Site groundwater would be contained around the HCAA with a barrier cutoff wall and groundwater extraction and treatment.		Site groundwater would be contained with a barrier cutoff wall and groundwater extraction and treatment prior discharging to the Hudson River. Institutional controls restricting groundwater use would be established. **HCAA Process Option:** Site groundwater would be contained around the HCAA with a barrier cutoff wall and groundwater extraction and treatment.		A subaqueous reactive barrier, which consists of a reactive material encapsulated between carrier textiles, would be placed over the sediments in OU2 to treat groundwater discharging to the river. Institutional controls restricting groundwater use would be established.	
	Groundwater Source	NAPL and arsenic continue to serve as a source to groundwater.	NAPL recovery reduces sources of PAHs to groundwater, thereby promoting attenuation. Residuals in soils, especially outside of treatment areas, and historic fill material continue to serve as sources to groundwater.	In situ solidification/stabilization of NAPL reduces sources of PAHs to groundwater, thereby promoting attenuation. Stabilization of arsenic or installation of barrier cutoff wall and groundwater extraction and treatment reduces sources of arsenic to groundwater, thereby promoting attenuation. Residuals in soils, especially, outside of treatment areas, and historic fill material continue to serve as sources to groundwater.		Excavation and ISCO reduces sources of PAHs to groundwater, thereby promoting attenuation. Stabilization of arsenic or installation of barrier cutoff wall and groundwater extraction and treatment reduces sources of arsenic to groundwater, thereby promoting attenuation. Residuals in soils, especially, outside of treatment areas, and historic fill material continue to serve as sources to groundwater.		Excavation reduces sources of PAHs and arsenic to groundwater, thereby promoting attenuation. Residuals in soils, especially outside of treatment areas, and historic fill material continue to serve as sources to groundwater	