

REMEDIAL INVESTIGATION REPORT AND REMEDIAL ACTION WORKPLAN JANUARY 2012

**MORRIS CANAL
CHROMIUM SITES 121 AND 207
BERRY LANE PARK
JERSEY CITY, NJ 07302**

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1.0 INTRODUCTION

On behalf of the Jersey City Redevelopment Agency (JCRA), this Remedial Investigation Report and Remedial Action Workplan (RIRRAW) has been prepared by Dresdner Robin to present the findings of the soil and groundwater remedial investigations conducted within and along the former Morris Canal within the limits of the JCRA's Berry Lane Park in Jersey City, New Jersey ("Project Area"). Investigations were also conducted on Chromium Site 121 (i.e. Property # 4) and Chromium Site 207 (i.e. a portion of Property # 5).

The primary objective of the investigations was to further delineate the extent of hexavalent chromium and Chromium Chemical Production Waste (CCPW) related impacts within the study area. The findings presented in this report supplement those presented in Dresdner Robin's February 2011 Site Investigation Report, which was approved by the New Jersey Department of Environmental Protection (NJDEP) in their correspondence letter dated April 1, 2011.

Investigation of Berry Lane Park is being conducted under the oversight of the NJDEP pursuant to a Memorandum of Agreement (MOA) executed between the NJDEP and the JCRA. The NJDEP Case Manager is Mr. Steve Kehayes of the Department of Brownfield Reuse.

Investigations presented within this report were conducted in accordance with the NJDEP *Technical Requirements for Site Remediation* ("TRSR"), N.J.A.C. 7:26E and the *NJDEP Field Sampling Procedures Manual*.

2.0 BACKGROUND INFORMATION

The proposed Berry Lane Park includes a collection of twelve (12) properties; a list of these properties addresses, block and lot and identification name is provided below:

<u>Address</u>	<u>Block</u>	<u>Lot</u>	<u>Property ID/Name</u>	<u>Property Owner</u>
65 Woodward Ave.	2040	D3 and S	Property # 1 (65 Woodward Ave.)	City of Jersey City
948 Garfield Ave.	1948	40	Property # 2 (948 Garfield Ave.)	City of Jersey City
970, 972, 974, 976, 978, 980 and 984 Garfield Ave.	1948	25B, 26, 28, 29, 31 and 32	Property # 3 (City of Jersey City)	City of Jersey City
958, 960, 964 and 966 Garfield Ave.	1948	34, 35 and 36A	Property # 4 (Garfield Junk Yard) also known as Chromium Site 121	City of Jersey City
942, 944 and 946 Garfield Ave.	1948	4B, 25C, 41A and 42A	Property # 5 (Hit or Miss) with a portion also known as Chromium Site 207	City of Jersey City
968 Garfield Ave.	1948	33	Property # 6 (MAOK)	City of Jersey City
990 Garfield Ave.	1948	24A	Property # 7 (Purple Fish)	City of Jersey City
1000 Garfield Ave.	1948	21D	Property # 8 (1000 Garfield Ave.)	City of Jersey City
75 Woodward Ave.	2040	D2	Property # 9 (75 Woodward Ave.)	City of Jersey City
1 Berry Road	2040 and 2057	EDUP, E1/G1, J1, B, K, H, APL and 16	Property # 10 (Finch Oil)	City of Jersey City
125 Woodward Street	2040	C16 and C18	Property # 12 (Woodward Metals)	City of Jersey City

All properties listed above are currently being investigated independently on behalf of the JCRA. At this time approvals have been issued by the NJDEP for properties #4, #6, #7, #8 and #9 (excluding hexavalent chromium).

2.1 Environmental Setting

A description of the project area, surrounding land use, topography, soils, surface water, geology and hydrogeology for the Project Area and surrounding area is summarized below.

2.1.1 Project Area Location and Description

Berry Lane Park is primarily located in a commercial/light industrial area of Jersey City, Hudson County, New Jersey and consists of an amalgamation of twelve (12) properties. A USGS map presenting the regional location of the project is presented as **Figure 1**; an aerial photograph identifying each parcel is presented as **Figure 2**. The limits of Berry Lane Park are broadly defined by the Hudson Bergen Light Rail Train (HBLRT) tracks to the south, Communipaw Avenue to the north, Garfield Avenue to the east and Woodward Street to the west.

2.1.2 Surrounding Land Use

This area of Jersey City is generally characterized as commercial and light industrial. Commercial properties and businesses, including warehousing and light manufacturing, are located to the north, east, and south of Berry Lane Park. Residences are located to the west, across Garfield Avenue, and to the east and north of the NJ Transit Light Rail.

2.1.3 Topography

The USGS Topographic Map (**Figure 1**) presents the regional topography in the area. Berry Lane Park has little topographic relief, with ground surface elevation generally ranging from 12 to 16 feet above mean sea level ("msl").

2.1.4 Surface Water

There are no surface water bodies on or adjacent to the Site. The nearest water body is the Morris Bay, which is located approximately 4,500 feet to the east. The Site is not designated as wetlands and none were identified on or adjacent to the Site. According to NJDEP's i-Map wetlands database, Disturbed Wetlands and Deciduous Wooded Wetlands exist approximately 3,500 feet south of the Site. Additionally, the Site is located within the 100-year floodplain boundary (Zone AH), which is defined as having flood depths ranging from one (1) to three (3) feet.

2.1.5 Regional Geology

The Project Area is located in the Piedmont Physiographic Province of New Jersey along the eastern edge of the Newark Basin. The Piedmont is described as a rolling plain which extends south and east from the southeastern edge of the New Jersey Highlands to the Hudson River, in the northern portion of New Jersey. The Newark Basin was formed during the Late Triassic and Early Jurassic periods and extends locally from the west of the first Watchung Mountain in northern central New Jersey to the Hudson River.

The Triassic Newark Supergroup consists of non-marine sedimentary rocks and diabase intrusions. The Newark Supergroup is divided into three (3) formations on the basis of distinctive lithology: (1) the lower unit - the Stockton Formation, (2) the middle unit - Lockatong Formation, and (3) the upper unit - the Passaic Formation.

The Bedrock Geology Map of Northern New Jersey, USGS 1996, indicates the bedrock at the Site is comprised of the Stockton and Lockatong Formations. The Stockton Formation is composed of light-gray, light-grayish-brown, yellowish-to-pinkish, or violet gray to reddish-purplish-brown sandstone, mudstone, silty mudstone, argillaceous siltstone and shale. The Lockatong Formation is composed of light to dark gray, greenish-gray and black dolomitic or silty argillite, mudstone, sandstone, siltstone and minor silty limestone.

2.1.6 Regional Soil

Generally the subsurface conditions at the Project Area consist of the following strata listed in order of increasing depth:

- Fill Material: The thickness and composition of the fill material is variable. The fill material generally rest on top of marine deposits, glacial deposits and bedrock. The fill material could be composed by a mixture of cinders, sand and gravel with a trace of silt and clay, construction demolition debris (concrete, brick, glass, metal, etc.), wood, slag and miscellaneous debris. The fill was often placed to raise surface elevations above the existing water level in an effort to reclaim wetlands and flood prone areas for development. Deeply occurring subsurface fill is common in Jersey City.
- Natural Marine and Estuarine Marsh Deposits: Generally, these deposits are composed of organic silt and clay (clayey silt), fine sand, traces of shells, traces of wood and peat (meadow mat). These deposits can range in thickness from 20 to 40 feet and thickness varies regionally.
- Glacial Deposits (undifferentiated): The glacial deposits generally consist of a thin layer of glacial till deposited on top of the bedrock. The glacial till comprises either brown or gray-brown coarse through fine sand and gravel with some silt and/or clayey silt with gravel and sand. The glacial deposits beneath the Project Area and its vicinity may not be continuous. According to the Glacial Map (Stanford, E.D. et al., New Jersey Geological Survey, 1990), the Project Area lies on lake-bottom sediment, which is composed of silty clay and fine sand that was deposited on the bottom of glacial lakes. The thickness of this geologic unit can be as much as 250 feet.

2.1.7 Regional Hydrogeology

Groundwater in the Project Area occurs in three (3) general stratigraphic zones:

1. Non-native fill;
2. Unconsolidated native deposits including glacial silt, sand, gravel; and
3. Bedrock.

2.1.8 Regional Groundwater in Fill Deposits

Groundwater in the fill is typically encountered between 3 to 13.5 feet below ground surface (bgs). In general, shallow groundwater flow patterns represent a subdued version of land surface topography. Variations from this can be attributed to factors such as heterogeneities in the fill, subsurface structures, exfiltration from and infiltration to subsurface utilities, spatially variable recharge due to the presence of impervious surfaces, and the former Morris Canal.

2.1.9 Regional Groundwater in Native Unconsolidated Deposits

While there are some more permeable zones of sand and gravel in the intermediate zone, the aquifer below the meadow mat can be characterized as low to moderately permeable because of the high silt content. Observations of clay also support a lower permeability below the meadow mat.

Groundwater flow in the deep zone glacial deposits is controlled by primary permeability or flow through the interconnected pore spaces in the soil matrix. Groundwater moves most readily through the glacial deposits. Conceptually, in this stratum, groundwater flows horizontally but is influenced strongly by local recharge and discharge zones (i.e., drainage divides and surface water bodies, respectively). Regionally, glacial deposits can support water supply wells yielding up to 1,500 gpm (Geraghty, 1959).

2.1.10 Regional Groundwater in the Stockton and Lockatong Formations (Bedrock)

The unconsolidated native deposits and the bedrock are part of a regional aquifer serving most of the industrialized sections of northern New Jersey. Hydrogeologic properties of the Stockton and Lockatong Formations are not well-documented, but are expected to be similar to the Passaic Formation which is well documented. The hydraulic properties of the bedrock aquifer (i.e., storage capacity and transmissivity) are due to secondary permeability, characterized by flow within fractures. The thickness of water-bearing zones is small, with estimates ranging from a few inches to 20 feet. Groundwater occurrence and flow is controlled either by the numerous vertical or near-vertical fractures (Herpers and Barksdale, 1951), or by major bedding partings and/or intensely fractured seams (Michalski, 1990). These formations exhibit an anisotropic flow pattern with preferential flow along the strike of the beds. Well yields range from several gallons to several hundred gallons per minute ("gpm"), with yields generally decreasing with depth. Groundwater in these formations occurs under both unconfined and confined conditions.

3.0 REMEDIAL INVESTIGATION PROCEDURES

Soil and groundwater investigations were conducted in May and June 2011 the goal being to: 1) further delineate the extent of hexavalent chromium, 2) further delineate the extent of the Chromate Chemical Production Waste (CCPW) related metals antimony, nickel, thallium and vanadium, 3) to assess groundwater impacts, and 4) to further assess CCPW related contaminants at Chromium Site 121 (i.e. Property #4 and #6) and Chromium Site 207 (i.e. a portion of Property #5) as presented within AECOM's June 2010 Draft Remedial Investigation Report prepared on behalf of PPG Industries, Inc. (PPG). The scope of work was developed to satisfy requirements of the NJDEP TRSR and those specifically outlined by the NJDEP in their Site Investigation Report (SIR) approval letter dated April 1, 2011.

Please note that soil delineation south of Transect 001 was not conducted as: 1) a large diameter pressurized sewer line runs parallel to the northern side of the Conrail parcel, and 2) there are access issues with Conrail related to conducting investigations within twenty (25) feet of the centerline of their outermost rail.

3.1 Soil Investigation Procedures

Between May 9 and 18, 2011 drilling was performed by EMC, Inc. of Randolph, New Jersey using direct-push methods with a dual tube setup. The dual tube setup used two sets of probe rods to collect continuous soil cores. One set of drill rods was driven into the ground as an outer casing. These rods received the driving force from the hammer and provided a sealed hole from which soil samples could be recovered without the threat of cross contamination. The second, smaller set of rods was placed inside the outer casing. The smaller rods held a sample liner in place as the outer casing was driven the length of sampling interval. The small rods were then retracted to retrieve the filled liner. The macro-cores were collected continuously from the ground surface throughout the depth of the boring for visual inspection, geologic characterization, and the collection of samples. Rods were properly decontaminated between each boring with decontamination waste collected and stored within 55 gallon steel drums, pending offsite disposal.

3.1.1 *Morris Canal Investigation*

3.1.1.1 Hexavalent Chromium Delineation

Results of the previous site investigation, presented in the Site Investigation Report (SIR) dated February 2011, identified ten (10) exterior transect borings with concentrations of hexavalent chromium in excess of the NJDEP Non-Residential Chromium Soil Cleanup Criteria of 20 mg/kg. In order to delineate these exceedances, two (2) step out borings were advanced at each of these ten (10) locations (i.e. a total of twenty (20) soil borings). Step out distances from the original exceedances were approximately ten (10) feet. If chromium was visually identified within a boring, it was abandoned and advanced approximately 5 feet further away. Borings were extended vertically to predetermined sampling depth(s) consistent with the depths of the original exceedance(s). Soil samples were forwarded to Integrated Analytical Laboratories (IAL), a New Jersey Certified Environmental Testing Laboratory (Laboratory Certification ID No. 14751), and analyzed for hexavalent chromium, Eh and pH. Samples from the second step out boring were placed on hold pending the results of the first step out boring.

As discussed within the February 2011 SIR, soil boring MC-006X was not advanced during site investigations due to access constraints and therefore it was proposed to be completed during the remedial investigation. As constraints still existed during the remedial investigation, soil boring MC-006X was advanced as close as was logistically possible; which was approximately thirty-five (35) feet south of the proposed location. This soil boring was advanced a minimum of four (4) feet into native soil. If evidence of contamination existed within the native soils then the boring was extended further to facilitate vertical delineation of contamination. Soil was logged in two (2) foot intervals throughout the extent of the boring. Soil samples were collected from within a discrete six (6) inch interval from within each two (2) foot interval biased towards contamination. At a

minimum, one (1) sample per four (4) feet of boring depth were analyzed. The remaining samples were placed on hold for conditional analysis. Soil samples were transported to IAL for analysis of hexavalent chromium, TAL metals, Eh and pH. Boring locations are presented on **Figure 3**.

3.1.1.2 Chromate Chemical Production Waste (CCPW) Metals

Results of the previous site investigation identified eight (8) exterior transect borings (MC-001Z, MC-002Y, MC-004W, MC-004Y, MC-006Y, MC-007Y, MC-010Y and MC-013U) with concentrations of CCPW related metals (antimony, thallium and vanadium) in excess of the NJDEP RDCSRS. It should be noted that CCPW exceedances coincided with exceedances of hexavalent chromium in five (5) of the eight (8) locations (MC-001Z, MC-002Y, MC-004Y, MC-006Y and MC-007Y). Two (2) borings were advanced at each of these three (3) locations (i.e. an additional six (6) borings) to delineate the CCPW related metals. Step out distances were approximately ten (10) feet from the original exceedance with the boring extended vertically until predetermined sampling depth(s) were encountered. Sampling depths were consistent with depths of the original exceedance(s). If field observations identified chromium within the step out boring (indicating the likely presence of CCPW metals), the boring was abandoned and advanced approximately five (5) feet further away from the original exceedance. Soil samples were solely analyzed for the specific CCPW metal requiring delineation. Samples from the second step out boring were placed on hold pending the results of the first step out boring. Boring locations are presented on **Figure 3**.

3.1.1.3 Hexavalent Chromium Refinement Delineation

Refinement of the hexavalent chromium delineation established during the previous site investigation was performed at seven (7) locations. A total of seven (7) borings were advanced, with boring placement determined based upon concentrations of hexavalent chromium, field observations and distance to nearest sample with concentrations below 20 mg/kg. Soil samples were collected at one (1) location, MC_004XW, as no visible green grey mud was observed within the six (6) remaining locations. Samples from MC_004XW were forwarded to IAL for analysis of hexavalent chromium, Eh and pH. Boring locations where samples were collected are presented on **Figure 3**.

3.1.2 Investigations outside of the Morris Canal

As presented in AECOM's June 2010 Draft Remedial Investigation Report, potential chromium containing material was observed in borings previously advanced by LANGAN, REACH Associates and Dresdner Robin on Property #4 (Site 121), Property #5 (Site 207), Property #6 (984 Garfield Avenue) and Property # 8 (1000 Garfield Avenue). AECOM recommended a total of forty-three (43) borings to investigate these locations.

Dresdner Robin advanced twenty-five (25) of the forty-three (43) recommended borings. The remaining borings were not necessary as these locations were located within the perceived extent of the Morris Canal and had been investigated during the site investigation of the Morris Canal.

Soil borings were advanced a minimum of four (4) feet into native soil. If evidence of contamination existed within the native soils then the boring was extended further to facilitate vertical delineation of contamination. Soil was logged in two (2) foot intervals throughout the extent of the borings. Soil samples were collected from within a discrete six (6) inch interval from within each two (2) foot interval biased towards contamination. At a minimum, one (1) sample per four (4) feet of boring depth were analyzed. The remaining samples were placed on hold for conditional analysis.

At a minimum, one (1) sample per four (4) feet of boring depth was forwarded to IAL for analysis of TAL metals, hexavalent chromium, Eh and/or pH. The remaining samples were placed on hold for conditional analysis. A soil sample summary table has been provided as **Table 1**. Soil boring locations are presented on **Figure 4** and Soil Boring Logs are included as **Attachment A**.

3.1.3 *Utility Protection*

Prior to conducting any intrusive investigations, existing drawings and geophysical surveys for Berry Lane Park previously conducted within the Project Area were reviewed to evaluate whether underground utilities exist. New Jersey One Call was notified by EMC at least three (3) and not more than ten (10) business days prior to the start of drilling.

No conflicts between proposed soil boring locations and underground utilities were identified subsequently none of the soil boring locations needed to be adjusted and/or soft-dig services (air-knife or vacuum boring) used.

3.1.4 *Visual Classification of Soil*

Visual classification of soil samples was performed using the Burmeister Soil Classification System (FSP-QAPP, Section 4.3). Sample descriptions included a geologic description of the soil and visual observations (e.g., staining, oily sheens, mottling, discoloration, etc.).

3.1.5 *Field Screening of Samples*

Each soil core was field-screened with a properly calibrated photo ionization detector (PID). Samples were field-screened within each acetate macro-core liner immediately upon opening the soil core. Field-screening results were recorded on the soil boring logs and in a dedicated field book.

3.1.6 *Sample Collection and Laboratory Analyses*

Sampling was performed in accordance with the *NJDEP Field Sampling Procedures Manual revised April 30, 2009*. Analytical samples were placed in pre-cleaned containers provided by IAL. The containers were clearly labeled with the sample identification, depth, date of collection, preservation, and analyses to be performed.

Soil samples collected were analyzed for hexavalent chromium, TAL Metals, pH and oxidation-reduction potential (Eh).

3.2 Groundwater Investigation Procedures

Two (2) rounds of groundwater samples were collected from existing monitoring wells (MW-3-1, MW-3-2, MW-4-1, MW-5-1, MW-5-2, MW-6-1, MW-7-1, MW-7-2, MW-8-1, MW-9-1, MW-10-1, and MW-12-1) in Berry Lane Park.

Monitoring wells were selected based upon their location relative to the Morris Canal, Chrome Sites 121 and 207 and/or the previous piezometer locations MC01-1X and MC01-3X where concentrations of tetrachloroethene (PCE) was identified in excess of the NJDEP's GWQS or piezometer location MC-015X where dieldrin was identified in excess of the NJDEP's GWQS.

It should be noted that MW-4-1 was not sampled during the second sampling event as the well was not accessible due to demolition activities taking place within the area.

3.2.1 *Low flow Sampling Procedures*

Low-flow sampling techniques were used to purge and sample the monitoring wells. A submersible bladder pump was used to draw the purge water from the well and discharge the water into a 55-gallon drum. The wells were purged until the appropriate indicator parameter readings stabilized. Samples were then collected

directly from the dedicated Teflon tubing into laboratory-supplied bottle ware. Well purging information and indicator groundwater parameter readings for pH, temperature, conductivity, ORP, DO, and turbidity were recorded on field sampling logs. Observations of sheen and/or distinctive odors were recorded, if encountered. A groundwater sample summary table has been provided as **Table 2**. Groundwater Sampling Logs are included as **Attachment B**.

Please note, the NJDEP Office of Quality Assurance requires laboratory certification for Low Flow Purge and Sampling (LFPS) field parameters (pH, turbidity, temperature and Dissolved Oxygen [D.O.]) but they have granted a grace period for laboratory certification pertaining to these low flow sampling parameters until May 2012 subsequently certification is not required at this time.

3.2.2 *Laboratory Analysis*

All groundwater samples were analyzed for select TAL metals (total chromium, antimony, nickel, thallium, vanadium) and hexavalent chromium; select locations were additionally analyzed for tetrachloroethene (PCE) [MW-3-2, MW-4-1, MW-5-1, MW-9-1] and/or dieldrin [MW-7-2, MW-8-1, MW-10-1].

3.3 Ambient Air Monitoring: Dust Control and Monitoring

As the potential for dust generation during the soil investigations was considered possible, three (3) Thermo MIE DR-4000's were utilized to measure particulate concentrations from 0.0001 mg per cubic meter up to 400 mg per cubic meter.

- One (1) instrument was located in an upwind location,
- One (1) instrument was located in a downwind location, and
- One (1) instrument was located local to the work in progress.

The primary activities which were judged to generate dust included movement of heavy equipment in areas that were not paved and subsurface drilling.

3.4 Investigation Derived Waste

Investigation-derived wastes ("IDW") generated during the field operations included drill cuttings, contaminated personal protective equipment ("PPE"), decontamination fluids, well purge water, and trash. IDW was placed into United States Department of Transportation ("USDOT") approved 55-gallon drums. A total of sixteen (16) drums were generated during the investigation. They were labeled as hazardous waste and temporarily staged on site within containment areas pending offsite disposal. The drums were subsequently picked up on June 10, 2011 and were transported to an appropriate offsite facility for disposal. PPG was listed as the generator; disposal manifests are available upon request.

4.0 REMEDIAL INVESTIGATION FINDINGS

Laboratory results for soil samples collected as part of the remedial investigation were reviewed and compared with the NJDEP's June 2008 (last amended November 4, 2009) Soil Remediation Standards (SRS) consisting of the Residential Direct Contact Soil Remediation Standard (RDCSRS) and Non-Residential Direct Contact Soil Remediation Standard (NRDCSRS) and the default Impact to Groundwater Soil Screening Levels (IGWSSL). The most stringent (non-residential) chromium soil cleanup criteria of 20 mg/kg for hexavalent chromium, and the most stringent (residential) soil cleanup criteria of 120,000 mg/kg for trivalent chromium were utilized for soil delineation purposes pursuant to the *Chromium Soil Cleanup Criteria* (NJDEP, September 2008 revised April 2010). Laboratory results for groundwater samples collected as part of the remedial investigation were reviewed and compared with the NJDEP's Groundwater Quality Standards (GWQS).

The following sections report the findings based upon our comparison with these standards and are categorized by Morris Canal, Chromium Site 121 and 207. Soil sample results are presented on **Table 3**. Groundwater sample results for the May 2011 and June 2011 sampling events are presented on **Table 4** and **Table 5**, respectively.

4.1 Soil Investigation Results within the Morris Canal

4.1.1 Hexavalent Chromium

Review of the soil analytical results for hexavalent chromium identified detected concentrations ranging from 0.610 mg/kg to 5,400 mg/kg (for samples MC-004XW_3.0 and MC-006X_7.5 respectively). Results from both the site and remedial investigation are presented on **Figure 5**.

4.1.2 Total Chromium

Review of the soil analytical results for total chromium did not exceed the most stringent (residential) soil cleanup criteria of 120,000 mg/kg for trivalent chromium pursuant to the *Chromium Soil Cleanup Criteria* (NJDEP, September 2008 revised April 2010). Results from both the site and remedial investigation are presented on **Figure 5A**.

4.1.3 Metals attributed to Chromate Chemical Production Waste (CCPW) Metals

Antimony, nickel, thallium and vanadium are traditionally attributed to the presence of CCPW. Only samples MC-006X_3.5, MC-006X_7.5 and MC-006X_11.5, all collected from soil boring MC-006X located at the perceived centerline of the Morris Canal, had concentrations of vanadium in excess of the NJDEP SRS. Results for antimony, nickel, thallium and vanadium from both the site and remedial investigation are presented on **Figure 6**, **Figure 7**, **Figure 8** and **Figure 9**, respectively.

4.1.4 Target Analyte List Metals

Various TAL metals were identified at concentrations which exceed the NJDEP's IGWSSL but only arsenic was identified in soil samples MC-006X_3.5, MC-006X_7.5 and MC-006X_11.5 at concentrations which exceed its applicable NJDEP RDSCRS and/or NRDCSRS. The range of the concentrations detected for each analyte are presented in the below table:

<u>CONTAMINANT</u>	<u>NJDEP RDCSRS (mg/kg)</u>	<u>NJDEP NRDCSRS (mg/kg)</u>	<u>NJDEP IGWSSL (mg/kg)</u>	<u>MINIMUM CONCENTRATION (mg/kg)</u>	<u>MAXIMUM CONCENTRATION (mg/kg)</u>
Aluminum	78,000	NC	3,900	9,180	57,700
Arsenic	19	19	19	4.58	24.0
Barium	16,000	59,000	1,300	59.9	123
Beryllium	16	140	0.5	0.452	1.15
Cadmium	78	78	1	0.163U	2.77
Cobalt	1,600	590	59	5.03	170
Copper	3,100	4,5000	7300	12.6	110
Manganese	11,000	5,900	42	103	1,660
Lead	400	800	59	8.93	308
Mercury	23	65	0.1	0.011J	2.70
Selenium	390	5,700	7	1.94J	3.90
Silver	390	5,700	1	0.163U	0.346J
Zinc	23,000	110,000	600	58.4	1,330

Results exceeding NJDEP SRS are presented on **Figure 10**.

4.2 Soil Investigation Results outside of the Morris Canal

4.2.1 Hexavalent Chromium

Review of the soil analytical results for hexavalent chromium identified detected concentrations ranging from 0.829J mg/kg to 2.33 mg/kg (for samples 121-B6 and P6-B1_1.0 respectively). Results are presented on **Figure 5**.

4.2.2 Total Chromium

Detected concentration of total chromium ranged from 3.02 mg/kg to 26,100 mg/kg (for samples 207_B18_16.5 and 207_B19_1.0 respectively). It should be noted that concentrations of total chromium did not exceed the most stringent (residential) soil cleanup criteria of 120,000 mg/kg for trivalent chromium pursuant to the *Chromium Soil Cleanup Criteria* (NJDEP, September 2008 revised April 2010).

4.2.3 Metals attributed to Chromate Chemical Production Waste (CCPW) Metals

Antimony, nickel, thallium and vanadium are traditionally attributed to the presence of CCPW. Nickel, thallium and vanadium were identified at concentrations which exceed the NJDEP's RDCSRS, NRDCSRS and/or IGWSSL; but it should be noted nickel only exceeded the IGWSSL and thallium and vanadium the RDCSRS and/or IGWSSL. The range of the concentrations detected for each analyte are presented in the below table:

<u>CONTAMINANT</u>	<u>NJDEP RDCSRS (mg/kg)</u>	<u>NJDEP NRDCSRS (mg/kg)</u>	<u>NJDEP IGWSSL (mg/kg)</u>	<u>MINIMUM CONCENTRATION (mg/kg)</u>	<u>MAXIMUM CONCENTRATION (mg/kg)</u>
Antimony	31	450	6	0.359J	1.14J
Nickel	1,600	23,000	31	1.24J	56.6
Thallium	5	79	3	0.172J	8.23
Vanadium	78	1,100	NC	10.2	141

Results for antimony, nickel, thallium and vanadium from both the site and remedial investigation are presented on **Figure 6**, **Figure 7**, **Figure 8** and **Figure 9**, respectively.

4.2.3 Target Analyte List Metals

TAL metals, excluding metals attributed to CCPW, were identified throughout the Site at concentrations which exceed the NJDEP's RDCSRS, NRDCSRS and/or IGWSSL. The range of the concentrations detected for each analyte are presented in the below table:

<u>CONTAMINANT</u>	<u>NJDEP RDCSRS (mg/kg)</u>	<u>NJDEP NRDCSRS (mg/kg)</u>	<u>NJDEP IGWSSL (mg/kg)</u>	<u>MINIMUM CONCENTRATION (mg/kg)</u>	<u>MAXIMUM CONCENTRATION (mg/kg)</u>
Aluminum	78,000	NC	3,900	2400	30,700
Arsenic	19	19	19	0.676	120
Barium	16,000	59,000	1,300	15.4	1410
Beryllium	16	140	0.5	0.243J	71.3
Cadmium	78	78	1	0.178J	6.96
Cobalt	1,600	590	59	0.928	16.9
Copper	3,100	45,000	7,300	3.03	97.5
Manganese	11,000	5,900	42	21.3	2440
Lead	400	800	59	2.70	4750

Mercury	23	65	0.1	0.000637J	2.88
Selenium	390	5,700	7	0.813	11.2
Silver	390	5,700	1	0.151J	1.66
Zinc	23,000	110,000	600	8.56	13,800

Results exceeding NJDEP SRS are presented on **Figure 10**.

4.3 Groundwater Investigation Results

The laboratory results were reviewed and compared with *Ground Water Quality Standards* (N.J.A.C. 7:9C) (last amended November 4, 2009) and as no standard currently exists for hexavalent chromium results were compared to the GWQS for total chromium. Groundwater sample results for the May 2011 and June 2011 sampling events are presented on **Table 4** and **Table 5**, respectively.

4.3.1 Hexavalent Chromium

Review of the groundwater analytical results for hexavalent chromium for samples collected during the May and June 2011 events identified concentrations in excess of 70 ug/L in only MW-8-1 and MW-5-2 as follows:

Location	May 2011	June 2011
MW-8-1	940 ug/L	1,180 ug/L
MW-5-2	2,380 ug/L	14,500 ug/L

It should be noted that the data collected during the two (2) sampling events was qualified as the aqueous concentration was at an incorrect level. This is a protocol deviation only, with in determinant bias direction or magnitude.

4.3.2 Total Chromium

Review of the groundwater analytical results for total chromium for samples collected during the May and June 2011 events identified concentrations in excess of 70 ug/L in only MW-8-1 and MW-5-2 as follows:

Location	May 2011	June 2011
MW-8-1	1,160 ug/L	1,560 ug/L
MW-5-2	2,470 ug/L	15,100 ug/L

It should be noted that only groundwater samples collected within the former Morris Canal contained concentrations of hexavalent chromium and/or total chromium in excess of the NJDEP GWQC for total chromium of 70 ug/L.

4.3.3 Metals attributed to Chromate Chemical Production Waste (CCPW) Metals

Select metals (antimony, nickel, thallium and vanadium) are traditionally attributed to impacts associated with CCPW; one or more of these metals were detected within each of the monitoring wells during each of the two (2) sampling events but not at concentrations which exceed the NJDEP's GWQC.

4.3.4 *Tetrachloroethene and Dieldrin*

Sample analyzed for tetrachloroethene did not exceed the NJDEP's GWQC of 1 ug/L and concentrations of dieldrin marginally exceeding the NJDEP's GWQC of 0.03 ug/L within MW-8-1 during the second sampling event.

Overall groundwater flow direction observed during both the May and June 2011 flows to the South-Southeast. The groundwater analytical results exceeding the NJDEP's GWQS for the May and June 2011 sampling events are depicted on **Figure 11** and **Figure 12**, respectively. Groundwater contours for the May and June 2011 sampling events are provided on **Figure 11A** and **Figure 12A**, respectively. The Groundwater Contour Reporting Forms for both the May and June 2011 sampling events are included as **Attachment C**. The laboratory data deliverables are provided in **Attachment D**. The electronic data deliverables are provided in **Attachment E**.

4.4 Ambient Air Monitoring: Dust Control and Monitoring Results

Continuous monitoring did not identify air borne dust at levels requiring action therefore no dust suppression was required during the duration of the investigation.

5.0 QUALITY ASSURANCE/QUALITY CONTROL

Quality Assurance/Quality Control sampling was performed to provide control over the collection of samples and the validity of analytical data. The sample analyses were performed in accordance with full and reduced laboratory data deliverables as needed. Analytical methods and quality assurance conform to the *NJDEP's Field Sampling Procedures Manual revised April 20, 2009*.

5.1 Field Blanks

Field blanks were collected by pouring demonstrated analyte free water through the sampling device (i.e., acetate sleeve for soil and teflon bailer for groundwater) so that the rinsate flowed directly into the empty sample containers. The demonstrated analyte free water originated from one common source and physical location within the laboratory and was the same as the method blank water used by the laboratory performing the analysis. The field blanks were analyzed for the same parameters as samples collected that particular day. The field blanks were maintained at 4°C while on-site and during shipment.

5.2 Trip Blank Samples

For groundwater sampling events, one (1) trip blank accompanied each days worth of samples and containers when tetrachloroethene was collected. For the groundwater sampling events, groundwater trip blanks accompanied each days worth of aqueous samples and containers. The trip blanks consisted of a set of sample bottles filled at the laboratory with laboratory demonstrated analyte free water. The trip blanks accompanied the bottles prepared at the laboratory into the field and back to the laboratory, along with the collected samples for analysis. The trip blanks were analyzed for tetrachloroethene.

5.3 Duplicate Samples

Duplicate samples were collected to evaluate the laboratory's performance by comparing analytical results of two (2) samples from the same location. The duplicate samples were analyzed for the same parameters as the samples analyzed that day.

5.4 Sampling Methods

Soil samples were collected utilizing disposable plastic trowels and groundwater samples were collected directly through the pump.

5.5 Sample Storage, Handling and Preservation

The sample containers were labeled with sample number, date, time of collection, analytical parameters, preservatives, site name and person or persons performing the sampling. The laboratory performing the analysis was responsible for preserving the sampling bottles prior to shipment into the field. Samples were kept cool at 4°C and transported in coolers to the laboratory. Proper chain-of-custody documentation was maintained, beginning with the laboratory's release of the bottles. A detailed soil sampling log has been prepared for each sampling location. The sample holding time began at the time of collection. Blanks and samples were not held on-site for longer than two (2) calendar days and arrived back in the lab within one (1) day of shipment from the field, constituting a four (4) day handling time.

5.6 Decontamination Procedures

Since samples were collected utilizing a disposable sampling device (i.e., plastic trowel/scoop, teflon tubing, and acetate liners), no decontamination procedures were required.

5.7 Field Instrumentation

A PID was utilized during field activities. The PID lamp was cleaned regularly and the battery fully charged prior to the start of field activities.

Dust was continuously monitored using three (3) Thermo MIE DR-4000's. Instruments were checked every morning in dust free air to confirm zero.

Groundwater field parameters (pH, dissolved oxygen (DO), oxygen reduction potential (ORP), specific conductivity, turbidity and temperature) were measure using a Horiba U-20. The instrument was checked for calibration prior to purging each temporary well location. Check standard readings were within $\pm 10\%$ of the known concentration.

5.8 Containers and Chain-of-Custody Procedures

Clean sample containers were supplied by the laboratory for the sampling event(s). The appropriate preservatives were added to the sample bottles by the laboratory prior to shipment. The chain-of-custody accompanies the bottles during transportation from the laboratory to the field, sample collection, transportation back to the laboratory, analysis and final disposal of the sample. The chain-of-custody listed each of the individual sample containers and was signed by one of the sampling team members. Samples were stored on ice at 4°C in a secure area until they are relinquished to an IAL courier for delivery to the laboratory.

5.9 Laboratory Data Deliverable Format

In accordance with Appendix A of the NJDEP Technical Requirements for Site Remediation dated November 2009 last amended April 19, 2010, full laboratory data deliverables have been included for hexavalent chromium, pH and Eh. Reduced laboratory data deliverables have been included for all other analyses. Laboratory data packages are included as **Attachment D**.

5.10 Data Validation

Validation of laboratory deliverables was performed by Environmental Quality Assurance, Inc. of Middletown, New York in accordance with appropriate NJDEP and EPA protocols. The data validation reports are included as **Attachment F**.

It should be noted that some of the hexavalent chromium soil data generated during the remedial investigation required the application of qualifiers due to low laboratory spike recoveries, the complete data set was cautiously used in the decision making process. Table 3 presents the samples which were qualified by the data validator.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 Soil

A total of ninety-seven (97) soil borings were advanced during the site and remedial investigations. Site and remedial investigation soil sample results for CCPW related constituents are provided as **Table 6**.

6.1.1 Hexavalent Chromium

Hexavalent chromium in excess of 20 mg/kg has been vertically and horizontally delineated and is present throughout the former canal. A single isolated hexavalent chromium hotspot is present on Chrome Site 121 (Property #4). **Figure 13** presents the aerial extent of the hexavalent chromium. Cross sections of the Morris Canal are provided in **Figure 14** which clearly present the horizontal and vertical delineation of hexavalent chromium.

No further investigation of hexavalent chromium in soil is warranted. Excavation and offsite disposal of all soil with hexavalent chromium exceeding 20 mg/kg is recommended.

6.1.2 Total Chromium

Total chromium was not identified in excess of 120,000 mg/kg at any location during the site and remedial investigation therefore no further investigations of total chromium in soil is warranted.

6.1.3 CCPW Metals

Metals related to CCPW were detected throughout the former Morris Canal during the site and remedial investigation.

Thallium - Concentrations of thallium were detected during the remedial investigation in excess of the NJDEP SRS in two (2) samples (207-B5_9.5 and 207-B4_5.5) both locations are delineated through the use of existing soil data.

Vanadium - Concentrations of vanadium were detected during the remedial investigation in excess of the NJDEP SRS as follows:

- Chrome Site 121 – one (1) sample (121-B1_4.5);
- Chrome Site 207 – four (4) samples (207-B9_1.0, REP050911-2 [collected with 207-B9_1.0], 207-B18_1.0); and
- Morris Canal – four (4) samples (MC-006X_3.5, MC-006X_7.5, MC-006X_11.5, REP051811-1 [collected with MC-006X_11.5]).

With the exception of the vanadium delineation to the west of soil sample 121_B1_4.5, these locations are delineated through the use of existing soil data.

Antimony – Concentrations of antimony were not detected during the remedial investigation in excess of the NJDEP SRS, with the exception of soil samples MC-006X_3.5, MC-006X_7.5 and MC-006X_11.5 which exceed as a result of elevated Minimum Detection Limits (MDLs) due to sample dilution.

Nickel - Concentrations of nickel were not detected during the remedial investigation in excess of the NJDEP SRS.

It is recommended that further delineation of vanadium at 121-B1_4.5 be conducted to the west. The typical remedial scenario to address contaminants at these concentrations is the installation and implementation of an engineering and institutional control (i.e. cap and deed notice).

6.1.4 *Target Analyte List Metals*

One or more TAL metals, unrelated to CCPW, were detected within each sample collected during the remedial investigation. In light of the extent of investigations that have been undertaken throughout the remainder of the Berry Lane Park properties no further investigations of TAL metals is recommended. It is recommended that these constituents be remediated via the installation and implementation of an engineering and institutional control (i.e.; cap and deed notice).

6.2 Groundwater

6.2.1 *Total and Hexavalent Chromium*

To assess the extent of the impacts to Berry Lane Park properties that encompass the former Morris Canal, two (2) rounds of sampling were conducted from select monitoring wells in Berry Lane Park. Hexavalent chromium and total chromium were detected in the groundwater throughout the former Morris Canal at elevated concentrations. Further characterization of the groundwater in the former Morris Canal canal is warranted, however the existing data suggests that concentrations fall below GWQS less than 50 feet of the canal.

Taking into account that the likely remedial scenario for soil contamination will include extensive removal of contaminated soils, it is recommended that further characterization of the groundwater in the former Morris Canal (including the installation of monitoring wells) be postponed until after soil remedial actions are performed.

6.2.3 *Target Compound List Volatile Organics*

During the site investigation tetrachloroethene (PCE) was detected at concentrations that marginally exceed the GWQS in piezometers MC01-1X and MC01-3X. Sample results collected in May and June 2011 from existing monitoring wells MW-5-1, MW-5-2 and MW-3-2 delineate the exceedance to the north and west. However, taking into account that the likely remedial scenario for soil contamination will include extensive removal of contaminated soils, it recommended that further groundwater delineation of PCE be postponed until completion of remedial action at which time permanent monitoring wells will be installed within the previous piezometer locations of MC-01-1X and MC-01-3X.

6.2.4 *Pesticides*

During the site investigation dieldrin was detected at a concentration that exceeds the GWQS in piezometer MC-015X. Sample collected during the May 2011 sampling event were compliant of GWQS but results from existing monitoring well MW-8-1 collected during the June 2011 sampling event marginally exceeded GWQS. Sample results collected in May and June 2011 from existing monitoring wells MW-7-2, MW-10-1 delineate this exceedance to the south and east. However, taking into account that the likely remedial scenario for soil contamination will include extensive removal of contaminated soils, it recommended that further groundwater delineation be postponed until completion of remedial action at which time permanent monitoring wells will be installed within the previous piezometer locations of MC-015X.

7.0 REMEDIAL ACTION WORKPLAN (RAW) – SOIL

7.1 Description of Proposed Remedial Actions

In accordance with N.J.A.C. 7:26E-6, a Remedial Action Selection Report has been prepared and is provided in **Attachment G**. The proposed remedial action for the Site comprises five (5) principal components as follows:

- Delineation of Vanadium on Chrome Site 121;
- Pre-Remediation Activities;
- Remediation Activities;
- Reuse of soil impacted with historic fill constituents, and
- Engineering Control and Implementation of a Site wide Deed Notice to address reused soils.

A detailed description of each component of the remedial action is provided below.

7.2 Delineation of Vanadium on Chrome Site 121

Concentrations of vanadium identified in soil sample 121_B1_4.5 located within Chrome Site 121 will be delineated to the west. These results will be submitted to the NJDEP within a Remedial Action Workplan Addendum prior to implementation of soil removal activities presented later within this RAW. It is anticipated that this exceedance will be remediated via the installation and implementation of an engineering and institutional control (i.e. cap and deed notice).

7.3 Pre-Remediation Activities

7.3.1 *Excavation Survey*

The horizontal limits of the proposed excavation area will be surveyed by a New Jersey licensed surveyor prior to the collection of in-situ waste classification samples and ultimately the excavation of contaminated soil.

7.3.2 *In-Situ Waste Classification*

In-situ waste classification samples will be collected in order to facilitate direct load out of contaminated soil for transportation to the offsite disposal facility. Composite and/or discrete samples will be collected at a frequency which satisfies the requirements of the offsite disposal facility.

Borings will be advanced by Hollow Stem Auger (HSA) or geoprobe by a subcontractor with a New Jersey well driller and/or boring license. Samples will be continuously collected using a 2 inch split spoon sampler or four (4) to five (5) foot macrocores. Samples will be immediately transferred to appropriately precleaned and preserved bottles supplied by a New Jersey certified environmental testing laboratory. The samples will be logged, placed on ice in a cooler and delivered under a chain-of-custody to the laboratory for analysis.

7.3.3 *Monitoring Well Decommissioning*

Prior to soil remediation, existing groundwater monitoring wells located within or closely adjacent to the proposed excavation area will be abandoned in accordance with NJDEP TRSR by a New Jersey licensed well driller. Well abandonment documentation will be furnished within the final Remedial Action Report submitted upon completion of the project.

7.3.4 Permit Requirements/Approvals

The JCRA and/or its subcontractors will obtain the required local, state and federal permits associated with the tasks described within this RAW. The following regional, state and municipal permits or notifications have been identified.

Regional

- Soil Erosion and Sediment Control (SESC) Plan Certification by Hudson-Essex-Passaic Soil Conservation District (HEPSCD) for land disturbance of greater than 5,000 square feet;
- Wastewater Discharge Approval and Sewer Use Permit by Jersey City Municipal Utility Authority;

State

- NJDEP approval of RAW;
- NJDEP Treatment Works Approval for water discharge to regional sewer authority in excess of 8,000 gallons per day (gpd); and

Municipal

- Municipal approvals by City of Jersey City including Road Opening Permit, Sidewalk Opening Permit, and Security Fence Permit;
- Authorization from the City of Jersey Construction Official for construction trailers and associated utility hookups, and temporary mobile structures to support excavation work; and
- Street Closing/Street Opening Permits from the City of Jersey City Environmental Services Department for street closures, no parking and traffic control requirements.

7.3.5 Utility Clearance

Prior to the start of any intrusive activities at the Site, a sub-surface utility clearance will be performed. Utilities present along the perimeter of the Site include telephone, cable and electric lines above ground services, and gas, water, and sewer below ground services that are present in the right-of-ways surrounding the Site.

Utility mark outs will be arranged by contacting the New Jersey One Call at least 72 hours prior to conducting any intrusive activities. Marking paint, flags and/or stakes will be used to clearly display the identified sub-surface utilities and structures.

If necessary, existing utilities, catch basins, and manholes, which require abandonment or relocation, will be addressed prior to any intrusive work. This may require permits from the appropriate utility companies/authorities.

7.4 Remediation Activities

7.4.1 Dewatering

Dewatering will be required during the excavation of contaminated soils which may accumulate in the excavation during the course of work. The estimated volume of water generated within the excavation(s) will be determined prior to remediation through performance of slug and pump tests. This data will be used to assure the ability to direct-load excavated materials.

Water generated from dewatering can be: 1) treated by an onsite system to meet parameters established by the receiving authority and then discharged to the municipal combined sewer at a location agreed upon by the

Jersey City Municipal Utility Authority (JCMUA), and/or 2) stored onsite in appropriate containers and transported offsite for disposal.

7.4.2 *Excavation of Contaminated Soil*

An estimated 25,000 cubic yards of soil with hexavalent chromium exceeding 20 mg/kg is proposed to be excavated for offsite disposal. It should be noted that the estimated volume does not include overburden which is estimated at 8,500 cubic yards. Excavated impacted soils will be direct loaded or transported to a designated area where it will be stockpiled pending load out into offsite transport trucks. The excavation will horizontally and vertically extend to compliant soil sample locations from previous investigations and from the northern property line of Block 1948 Lot 21D and the southern property line of Block 1948 Lot 4B. **Figure 15** presents cross sections of the proposed excavation based upon the results of the site and remedial investigation. Three dimensional graphic representations of the excavation area in relation to Berry Lane Park and the surrounding area are presented on **Figure 16**. If during remediation visible CCPW is encountered above, below, or extending laterally further than anticipated, this material will be excavated and disposed as part of the remediation.

Contaminated soil will be transported to an offsite disposal facility. Only licensed transporters will be sub-contracted and manifests will accompany each load which leaves the Site. Transportation and disposal activities will be conducted in accordance with applicable regulations. Documentation regarding the transporter and off-site disposal facilities used and their license and permit numbers will be included in a final Remedial Action Report submitted to the NJDEP upon completion.

Project records will be kept through the use of daily soil tracking logs documenting the source location, type, quantity, and characteristics of excavated soil. The remediation contractor shall submit a Daily Soil Tracking Log for each workday involving excavation, stockpiling, transport and disposal of Regulated Waste. The Daily Soil Tracking Log shall contain, at a minimum, the following information:

- A) Date,
- B) Location(s) of excavation and placement of stockpiled material,
- C) Volume of soil removed, and
- D) Name(s) and signature(s) of the remediation contractor representative(s) responsible for preparing and executing the Daily Soil Tracking Log.

It is anticipated that sheet piles will be necessary to provide a level of hydraulic control and stabilize the sidewalls of the excavation. Prior to entering public right-way, trucks and/or heavy equipment will be properly decontaminated and loads secured to minimize dust and liquids from leaving the vehicles.

7.4.3 *Soil Stockpiles*

If necessary, the excavated soil will be temporarily stockpiled on contaminated soil areas and covered to control dust and odors. Wet soils may be stabilized by combining contaminated dry soils. Soil will be stockpiled away from the edge of excavations in accordance with OSHA requirements. Stockpiles will be maintained at a manageable size in order to properly cover them during periods of inactivity. Polyethylene sheeting will be manually deployed and secured using sandbags or similar means.

7.4.4 *Post Excavation Sampling*

The primary form of CCPW waste identified during the Site and Remedial Investigations was "green grey mud", which is clearly visible in the field. As the extent of the hexavalent chromium is proposed to be excavated, the excavation will be visually inspected for signs of CCPW, subsequently a variance is requested relative to post excavation sample frequency. In lieu of post excavation samples, existing delineation samples will be used to demonstrate remediation has been completed.

If during excavation activities, no visible impacts are observed within the sidewalls or base of the excavation a soil sample may be collected and forwarded to a New Jersey certified environmental testing laboratory for analysis of total and hexavalent chromium and CCPW metals. If compliant this sample will serve as a post excavation sample.

7.4.5 Equipment Decontamination

Prior to leaving the Site, all equipment, tools and vehicles that have come in contact with contaminated soil will be decontaminated to ensure that it is free of excess soil or contaminated fluids.

Decontamination procedures shall include physical removal of packed soil and grit, pressure washer wash-down, scrubbing with water/mild soap solutions, and any other decontamination procedure necessary to prevent tracking or un-manifested conveyance of contaminated material from the Site. Vehicles and equipment shall be air or mechanically dried prior to leaving the site. For vehicles and heavy equipment particular attention will be paid to wheels and undercarriage areas.

Decontamination will be performed on a temporary containment pad(s) designed and constructed to collect all runoff from the decontamination procedure. The decontamination pad will be removed and disposed of at the completion of site activities which involve contaminated materials. Decontamination liquids will be collected and disposed of in accordance with state and local requirements and/or treated onsite and discharged into the municipal combined sewer.

7.4.6 Soil Erosion and Sediment Control

A soil erosion and sediment control plan will be prepared and submitted to the Soil Conservation District for approval. Measures that will be taken to minimize soil and sediment erosion during the remedial action at the Site will include installation of sediment barriers along the perimeter and dust control during soil excavation and load out.

7.4.7 Emissions Control

A program to manage odor, dust emissions will be maintained during the soil excavation program. Target contaminants for control will be determined by the Site Health and Safety Supervisor (SHSS) in accordance with the protocols established below.

Emissions will be monitored on a continuous basis until Site baseline conditions are determined and the effectiveness of control remedies established. If at any time during Site excavation activities the detected emission levels either on-site or in the surrounding off-site areas exceed any of the air standards identified in the Health and Safety Plan.

A detailed Perimeter Air Monitoring Plan, which will include a Dust Suppression Plan, will be submitted to the NJDEP for approval prior to the commencement of remedial activities. The Plans will include necessary measures to evaluate and control dust during working and non-working hours (i.e. 24 hours per day).

7.5 Proposed Reuse of Soil Impacted with Historic Fill Constituents

It is recommended that overburden associated with the hexavalent chromium excavation, historic fill and/or concrete generated elsewhere within Berry Lane Park during site development, be reused to backfill the excavation as well as to achieve project design elevations throughout the extent of Berry Lane Park. A Soil Reuse Plan will be submitted to the NJDEP for review and approval within one (1) month of RAW approval.

7.6 Health and Safety Plan

A site-specific Health and Safety Plan (HASP) will be prepared by the contractor under the direction of the SHSS prior to the commencement of any Site work. The HASP will set forth detailed health and safety requirements necessary to protect nearby residents and workers involved in the remedial activities at the Site.

Total and hexavalent chromium and CCPW metals have been selected as the primary target analytes based upon concentrations present at the site and the general toxicity of these compound classes but it should be noted that PAH compounds and metals associated with Historic fill are also present throughout the extent of the site. Potential additional parameters of interest could be particulates (i.e., for fugitive dust and/or as surrogates for PAHs) and/or metals. Action levels for the targeted parameters will be developed for both onsite and offsite exposures. These action levels will be risk-based, calculated consistent with EPA guidelines (USEPA, 1989) and based on protection of human health and the environment. The public health action levels are developed consistent with EPA guidelines (USEPA, 1989) to protect off-site receptors from adverse health impacts from VOCs and PAHs for both short-term acute exposures and long-term chronic exposures. The action levels will be derived using human health based criteria for different averaging times, by relating peak concentrations observed over one averaging time to the peak concentrations expected for a different averaging time. This method is based on empirical observations of concentrations observed in the vicinity of an emission source subjected to normal variations in atmospheric dispersion.

The HASP shall address at minimum the following monitoring program objectives:

- Protection of human health and the environment,
- Enhancement of worker health and safety monitoring programs,
- Development of remedial action levels that are protective of public health,
- Establishment of target compound background levels prior to remedial activities,
- Evaluation of alternative vapor and/or dust control strategies
- Documentation of air quality during remedial activities,
- Monitoring and documentation of air quality during remedial activities at locations near sensitive receptors,
- Provision of risk management and public confidence, and
- Reduction of potential owner liabilities due to remedial activities.

A Health and Safety Plan setting forth minimum standards has been prepared in accordance with the requirements of 7:26E-1.9 and is attached as **Attachment H**.

7.7 Implementation of Engineering and Institutional Controls

As CCPW related metals (identified within Chrome Sites 121 and 207) and Historic Fill contaminants will remain at concentrations above the RDCSRS and NRDCRS, implementation of engineering and institutional controls (i.e.; cap and deed notice) is required to document the extent of contamination and the engineering controls. The property owner, the City of Jersey City, has agreed to implementation of this conditional remedy.

A Model Deed Notice is provided in **Attachment I**. It sets forth a schedule for the maintenance and evaluation of the institutional and engineering controls pursuant to N.J.A.C 7:26E-6.1(B). The responsibility for inspection and maintenance of the cap will be provided in the Deed Notice.

Please note that Chromium Site 121 consists of Property No. 4 and 6 and Chromium Site 207 is contained within a portion of Property No. 5. RAWs outlining the implementation of an engineering and institutional control to remediate Historic Fill contaminants have been approved by the NJDEP for Properties 4 and 6 and Property No. 5 is pending review and approval.

7.8 Site Restoration Plan

The remedial excavation will be compacted and backfilled with a combination of either crushed stone, certified clean fill or re-used soil/concrete pre-approved by the NJDEP. Imported materials must be compliant of the NJDEP's 2008 Soil Remediation Standards.

7.9 Applicable Remediation Standards

The soil remediation standards that will be applicable for this Site are the NJDEP's June 2008 (last amended November 4, 2009) Soil Remediation Standards (SRS) consisting of the Residential Direct Contact Soil Remediation Standard (RDCSR) and Non-Residential Direct Contact Soil Remediation Standard (NRDCSR) and the default Impact to Groundwater Soil Screening Levels (IGWSSL). The most stringent (non-residential) chromium soil cleanup criteria of 20 mg/kg for hexavalent chromium, and the most stringent (residential) soil cleanup criteria of 120,000 mg/kg for trivalent chromium were utilized for soil delineation purposes pursuant to the *Chromium Soil Cleanup Criteria* (NJDEP, September 2008 revised April 2010).

8.0 STATEMENT OF COMPLETION OF REMEDIAL ACTION REQUIREMENTS

All applicable requirements of N.J.A.C. 7:26E-6 will be completed. The NJDEP and City of Jersey will be notified of the intended remedial action. The remedial action will also meet the following criteria:

- Approval by the NJDEP prior to implementation,
- Compliance with all applicable remediation standards in effect at the time of RAW approval,
- Compliance with all applicable Federal, State, and local laws,
- Not in itself cause an uncontrolled or un-permitted discharge or transfer of contaminants from one media to another,
- Be re-evaluated every five years,
- Institutional and engineering controls will be utilized.

Following completion of activities described in the RAW, a Remedial Action Report will be prepared and submitted to the NJDEP.

9.0 REMEDIAL ACTION COST ESTIMATE

The cost of the proposed remedial action as outlined in this RAW is estimated to be between \$16,000,000 and \$18,000,000.

10.0 SCHEDULE

Dates below represent the target dates of the completion of the specified task:

1. Remedial Action Workplan Submission to NJDEP
2. Approval of Remedial Action Workplan – Month 1
3. Submission of Soil Reuse Plan – Month 2
4. Submission of a Soil Erosion and Sediment Control Plan to the Soil Conservation District – Month 2
5. Submission of Perimeter Air Monitoring Plan – Month 2
6. Submission of Dust Suppression Plan – Month 2
7. Approval of Soil Reuse Plan, Soil Erosion and Sediment Control Plan, Perimeter Air Monitoring Plan, and Dust Suppression Plan – Month 3
8. Implementation of Remedial Action Workplan – Month 4
9. Submission of Remedial Action Report – Month 8
10. Receipt of No Further Action Letter for Soils from the NJDEP – Month 9

11.0 REFERENCES

- AECOM, 2010, *Field Sampling Plan-Quality Assurance Field Sampling Plan / Quality Assurance Project Plan Non-Residential Chromium Sites, Hudson County, New Jersey*.
- New Jersey Department of Environmental Protection (NJDEP), November 2009. *Administrative Requirements for the Remediation of Contaminated Sites* (ARRCS), N.J.A.C. 7:26C et. seq., adopted November 4, 2009.
- NJDEP, November 2009. *Groundwater Quality Standards* (N.J.A.C. 7:9C), last amended November 4, 2009.
- NJDEP, November 2009. *Remediation Standards*, N.J.A.C. 7:26D et. seq., last amended November 4, 2009.
- NJDEP, September 2008 revised April 2010. *Chromium Soil Cleanup Criteria*.
- NJDEP, February 2007. NJDEP *Commissioner Jackson's February 8, 2007 Memorandum Regarding Chromium Moratorium*.
- NJDEP, August 2005 revised April 20, 2009. *Field Sampling Procedures Manual*.
- NJDEP, July 5, 2005. *Technical Requirements for Site Remediation*, N.J.A.C. 7:26E-2.2 et. seq., date last amended February 22, 2011.
- NJDEP, *Soil Cleanup Criteria*, last revised May 1999.
- Stanford, E.D. et al., *New Jersey Geological Survey Glacial Map*, 1990
- USGS *Bedrock Geology Map of Northern New Jersey*, 1996
- USGS, 1967, Photo revised 1981, *Jersey City-NJ-NY Jersey City Quadrangle. 7.5 Minute Series. Topographic Map (Northeastern Quadrant-Latitude: 4037.5N Longitude: 7400 W)*.
- Dresdner Robin, September 2010. Site Investigation Workplan, Morris Canal - Berry Lane Park, Jersey City, NJ 07302
- AECOM, June 2010 Draft Remedial Investigation Workplan, Non-Residential Chromate Chemical Production Waste Sites, Sites 114, 121, 132, 133, 135, 137, 143, 186, 207 and Berry Lane Park Area Jersey City, New Jersey