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June 12, 2020

REMEDIAL ACTION REPORT
Exterior Soil (AOC-1)
Final

Non-Residential Chromate Chemical Production Waste Site
Hudson County Chromate Site 16
45 Linden Avenue East
Jersey City, New Jersey
Program Interest Number: G000008644

NGA Document 16-013

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List of Acronyms

ACO	Administrative Consent Order
AECOM	AECOM Environmental, Inc.
AMP	Air Monitoring Plan
amsl	above mean sea level
ANS	ANS Consultants, Inc.
AOC	Areas of Concern
APTIM	Aptim Environmental & Infrastructure, LLC.
BAFs	bioaccumulation factors
bgs	below ground surface
CB&I	CB&I Environmental & Infrastructure, Inc.
CEC	Civil & Environmental Consultants, Inc.
CCPW	Chromate Chemical Production Waste
CMAA	Construction Manager as Agent
COC	contaminants of concern
COPEC	Contaminants of Potential Environmental Concern
Cr SCC	Chromium Soil Cleanup Criteria
DGA	dense graded aggregate
Entact	Entact Environmental Services
ESC	Ecological Screening Criteria
ES&E	Environmental Science and Engineering, Inc.
HASP	Health and Safety Plan
HCC	Hudson County Chromate
ICF Kaiser	ICF Kaiser Engineers, Inc.
IDW	Investigation Derived Waste
IGW SSL	Impact to Groundwater Soil Screening Level
IRAR	Interim Remedial Action Report
IRM	Interim Remedial Measures
JCO	Judicial Consent Order
mg/kg	milligram per kilogram

MDL	Method Detection Limit
MRCE	Mueser Rutledge Consulting Engineers
NJDEP	New Jersey Department of Environmental Protection
NJDOT	New Jersey Department of Transportation
PI	Program Interest
PID	photoionization detector
PM-10	Particulate Matter less than 10 micrometers in size
PPG	PPG Industries, Inc.
PVSC	Passaic Valley Sewage Commission
RA	Remedial Action
RAR	Remedial Action Report
RAWP	Remedial Action Work Plan
RDC SRS	Residential Direct Contact Soil Remediation Standard
RI	Remedial Investigation
RI/FS	Remedial Investigation/Feasibility Study
RIR	Remedial Investigation Report
RIWP	Remedial Investigation Work Plan
SPLP	Synthetic Precipitation Leaching Procedure
SRP	Site Remediation Program
Tetra Tech	Tetra Tech, Inc.
µg/L	Microgram per Liter
USEPA	United States Environmental Protection Agency
WCD	WCD Group, LLC
Weston Solutions	Weston Solutions, Inc.
WTS	Waste Technology Services, Inc.

1.0 Introduction

In 1990, PPG and the New Jersey Department of Environmental Protection (NJDEP) entered into an Administrative Consent Order (ACO) to investigate and remediate locations where chromate chemical production waste (CCPW) or CCPW-impacted materials related to former PPG operations may be present. On June 26, 2009, NJDEP, PPG, and the City of Jersey City entered into a Partial Consent Judgment Concerning the PPG Sites (JCO) with the purpose of remediating the soils and sources of contamination at the Hudson County Chromate sites as expeditiously as possible. The goal of the JCO was to complete the investigation and remediation of the PPG sites within five years, in accordance with a judicially enforceable master schedule. Priority for the remedial activities was given to residential locations where the CCPW and CCPW-impacted materials were present. The provisions of the original ACO remain in effect with the JCO taking precedence where there were conflicts between the two documents.

Aptim Environmental & Infrastructure, LLC. (APTIM), f/k/a CB&I Environmental & Infrastructure, Inc. (CB&I), has prepared this this *Remedial Action Report* (RAR) on behalf of PPG for the remediation of CCPW and chromium-impacted soils at Site 16 in Hudson County, Jersey City, New Jersey (the site).

1.1 Objectives

The objectives of this RAR are to present a summary of the findings and recommended Remedial Action (RA) for the exterior portion of the site; a description of the RA; a list of the remedial standards that apply; data that document that the RA is protective of public health, safety, and the environment; figures showing post-RA sample locations; a description of site restoration activities; the total RA costs; documentation of the off-site transport of wastes; documentation of the source, type, and quantities of fill; and a description of permits required during the RA. This RAR was prepared in accordance with the requirements set forth in the *Technical Requirements for Site Remediation* New Jersey Administrative Code, Title 7, Chapter 26E, Subchapter 5.5 (N.J.A.C. 7:26E-5.5), Appendix B of the 1990 NJDEP ACO, and the June 26, 2009 JCO.

The case inventory document summarizes the presence of four Areas of Concern (AOC) in connection with the site. This RAR addresses AOC-1 (Exterior Soil). Additional CCPW-related AOCs are being addressed under separate submittals.

1.2 Report Organization

This RAR is organized as follows:

- Section 1 provides the introduction and objectives of the RAR;
- Section 2 provides background information and the findings of historical investigations;
- Section 3 provides the environmental setting of the site and surrounding area;
- Section 4 identifies the applicable remediation standards/criteria and defines the AOCs associated with the exterior portion of the site;
- Section 5 provides a description of the remedial activities;
- Section 6 provides documentation supporting the protectiveness of the remedial action;

- Section 7 provides a description of the data validation process;
- Section 8 describes the results of a receptor evaluation;
- Section 9 provides conclusions and recommendations; and
- Section 10 provides a list of references cited in the preparation of the RAR.

Supplemental information is presented in the Attachments.

2.0 Background Information

2.1 Site Description

The site is located at 45 Linden Avenue East in Jersey City, New Jersey (Figure 1). The site was identified as a Non-Residential Hudson County Chromate (HCC) site by the NJDEP and is designated as HCC Site 16 in the July 19, 1990 ACO between the NJDEP and PPG. The NJDEP Site Remediation Program (SRP) Program Interest (PI) number for Site 16 is G000008644.

The site is identified by the New Jersey Department of the Treasury Division of Taxation as Block 27401; Lots 31, 33 (New Jersey Department of Transportation [NJDOT] property), and 35 (KIDS Realty property) and is approximately 12.9 acres in size. The site was formerly identified as Block 1507; Lots 10.E, 4.M, and 4L.

Current site usage is industrial and the area around the site is mainly industrial, commercial, and recreational (see Figures 1 and 2). The existing warehouse covers approximately 7.5 acres, a paved area (asphalt parking lot) covers approximately 2.0 acres, and the remaining 3.4 acres is unpaved area (AECOM Environmental, Inc [AECOM], 2011). Site 16 is bounded on the north by athletic fields and a drainage ditch, on the south by Linden Avenue, on the east by Site 112A and the Liberty National Golf Course, and on the west by Caven Point Road and the New Jersey Turnpike Extension (Figure 2).

2.2 Summary of Previous Soil Investigation Findings

CB&I (n/k/a/ APTIM) reviewed available historical reports prepared for the site, including a March 2011 *Remedial Investigation Work Plan* (RIWP) prepared by AECOM and a May 2013 *Remedial Investigation Report* (RIR) prepared by Tetra Tech, Inc. (Tetra Tech). AECOM's March 2011 RIWP indicated that three previous investigations were conducted at the site by various firms retained by responsible parties and/or state agencies:

- L. Robert Kimball and Associates (Kimball) were retained by the NJDOT to perform a soil investigation of the area within the Route 185 easement.
- Environmental Science and Engineering, Inc. (ES&E) performed a remedial investigation/feasibility study (RI/FS) at Site 16 – Linden Avenue East for NJDEP.
- ICF Kaiser Engineers, Inc. (ICF Kaiser) was retained by PPG to perform a RI on the HCC Group 4 sites, which include Site 16 – Linden Avenue East and Site 112A – Ultramar Petroleum.

The results of these three investigations are discussed below.

2.2.1 1987 NJDOT Investigation – L. Robert Kimball and Associates

In May 1987, a soil sampling program was initiated by NJDOT to determine the horizontal and vertical extent of chromium-impacted soils within the Route 185 easement area located within the boundaries of the HCC Group 4 sites. A surface water and sediment sampling program was also implemented to determine whether the drainage ditch along the northern property boundary had been impacted by CCPW where it crosses the Route 185 easement. This drainage ditch, sometimes referred to as "Claremont Creek" and/or "Claremont Ditch", is not a naturally occurring stream but a drainage channel dredged into the fill material that was used to reclaim the marshland (ICF Kaiser, 1993). The ditch was later remediated and lined during a RA. Kimball submitted the results of this RA work in September 1988.

The soil and waste investigation included a soil boring program as well as a test pit sampling program. Shallow soil samples and surface soil samples were collected on both sides of the drainage ditch at depths of 0 to 6 inches and in 6-inch intervals to 36 inches below ground surface (bgs). Nine test pits were located between previously sampled areas to provide additional data and information for depths greater than 36 inches bgs.

A total of 100 soil samples were analyzed for total chromium; however, only 11 of them were also analyzed for hexavalent chromium during this investigation. Total chromium concentrations ranged from 5 milligrams per kilogram (mg/kg) to 6,790 mg/kg with the higher concentrations encountered near the eastern side of the easement along the drainage ditch. Hexavalent chromium concentrations ranged from 0.01 mg/kg to 0.20 mg/kg.

Three test pit soil samples were analyzed for the eight Resource Conservation and Recovery Act metals with no results reported above the method detection limits (MDL). Three soil samples collected 6-inches above the water table in areas beneath visually identified CCPW were analyzed for Priority Pollutant Metals. The reported analytical results indicated that no compounds were detected above the MDL in these samples.

Investigation of the surface water and sediments along the banks of the drainage ditch were undertaken because of the potential for chromium to migrate to the ditch via groundwater and/or surface water run-off. One surface water sample was analyzed for total chromium. The concentration of total chromium reported from that sample was 2,029 mg/kg [sic], however it appears there was a quality control problem during sampling and/or analysis of that sample (AECOM, 2011). The Kimball report did not indicate whether the analytical results were fully validated.

Ten sediment samples were collected from seven locations along the drainage ditch bank. Five samples were analyzed for total chromium and one sample was analyzed for hexavalent chromium. Total chromium concentrations ranged from 237.6 mg/kg to 1,386 mg/kg. Hexavalent chromium was not detected above the MDL.

2.2.2 1989 NJDEP Investigation – Environmental Science and Engineering, Inc.

The results of RI/FS activities conducted by ES&E on behalf of NJDEP were submitted in a report dated March 1989 for Site 16. The purpose of this investigation was to survey the extent of chromium present in soils and examine potential impacts to surface water and sediments. The results of ES&E's work, as reported by ICF Kaiser (1993), are summarized below.

ES&E conducted a soil sampling program on behalf of NJDEP at Site 16 on January 19 and 20, 1987. Sixteen soil borings were advanced to a maximum depth of 6 feet bgs. The Hach screening methodology was used to analyze 47 soil samples for total chromium. Twenty-seven of these samples were also submitted for laboratory analysis for total chromium. Of the 47 samples analyzed by the Hach method, 13 had total chromium concentrations greater than 200 mg/kg, and of the 27 samples analyzed in the laboratory, 11 contained concentrations of total chromium greater than 500 mg/kg. Nine of these soil samples were submitted to the analytical laboratory for hexavalent chromium analysis. The concentration of hexavalent chromium in all but one of these samples was below 10 mg/kg. There was no indication in the ES&E report that these data had been formally validated.

Based on visual and analytical evidence, ES&E reported that CCPW and/or CCPW impacted material had been used as fill on portions of Site 16 and that chromium contamination extended to a depth of about 3 feet bgs.

Two surface water samples were collected at mid-depth and mid-stream in the drainage ditch. Surface water samples were analyzed for total chromium, hexavalent chromium, and total dissolved solids. Total chromium concentrations reported by the analytical laboratory for these samples were 48 micrograms per liter (µg/L) and 55 µg/L. Hexavalent chromium concentrations were less than the 10 µg/L MDL.

One sediment sample was collected from the drainage ditch at the same location as the downstream surface water sample. A total chromium concentration of 1,200 mg/kg was reported by the analytical laboratory for this sediment sample. Hexavalent chromium was reported at 0.1 mg/kg.

2.2.3 1992-1993 PPG Investigation – ICF Kaiser Engineers, Inc.

In January 1992, ICF Kaiser initiated RI activities on behalf of PPG at the HCC Group 4 Sites, which included Sites 16 and 112A, as well as the portions of those sites within the NJDOT Route 185 easement. The main objectives of this sampling program were to verify the vertical and horizontal extent of total chromium and hexavalent chromium in soils and sediments, as well as provide data to characterize hydrogeologic properties and groundwater quality at the HCC Group 4 sites. The boring, sampling, and groundwater monitoring well locations were surveyed following sampling activities. Results of this work are summarized below.

During this investigation, soil samples were collected from 98 shallow soil borings, 25 deep soil borings, 9 shallow lysimeter borings, and from most of the soil borings advanced for the installation of permanent groundwater monitoring wells. Included in these totals are one deep and eight shallow borings installed within the warehouse on Site 16. Deep soil borings were typically advanced to the peat layer (meadow mat) or silt/clay confining layer and the total depth varied between 16 and 26 feet bgs. Shallow borings were advanced 12 and 14 feet bgs at the site. Several additional shallow borings were advanced 2 and 6 feet bgs within the Route 185 corridor for use in a Focused Feasibility Study.

In general, analytical samples were collected from split-spoon intervals 0 to2, 4 to6, 8 to10, and 12 to 14 feet bgs, and at selected intervals for depths greater than 16 feet bgs. Additional soil samples were collected from the split spoon sampling intervals between these analytical sample intervals and preserved for future analysis of total chromium and/or physical properties.

A summary ICF Kaiser's soil boring information, including coordinates and presence of CCPW, can be found in Attachment 1. Soil boring coordinate information was obtained from Figure 3 of AECOM's 2011 *Remedial Investigation Work Plan.* The ICF Kaiser boring logs presented in Attachment 5 present coordinate information in North American Datum (NAD 1927). AECOM converted the soil boring location coordinates to NAD 1983. Analytical results from ICF Kaiser's investigations that are incorporated as post-remedial soil samples to demonstrate compliance are included in Attachment 2. ICF Kaiser soil sample locations incorporated as post-remedial soil samples are depicted on figures included in Attachment 3. Analytical summary data for ICF Kaiser soil samples, including excavated soil samples, are included in Attachment 4. Soil boring logs are included in Attachment 5.

ICF Kaiser (1993) reported that 582 soil samples were analyzed for total chromium, with 462 of those samples also analyzed for hexavalent chromium. Surface water and sediment sampling was performed between May 5 and May 12, 1992 to evaluate the chromium concentrations in the drainage ditch. Sediment samples were collected at various depths beneath the streambed. Eight unfiltered surface water samples, including a field duplicate, were collected and analyzed for total chromium and hexavalent chromium during this period (ICF Kaiser, 1993). In addition, 28 sediment samples were collected from nine locations. Each of these sediment samples was analyzed for total chromium, hexavalent chromium, and total organic carbon.

Total chromium was not detected in surface water samples collected upstream of the Route 185 Easement Area. Total chromium was detected at a concentration of 12 µg/L in the surface water sample collected adjacent to and just downstream of the easement, and at a concentration of 39 µg/L in the farthest downstream location. Hexavalent chromium was not detected in any of the surface water samples, indicating that the drainage ditch was minimally impacted by CCPW and CCPW-related material within the HCC Group 4 sites (ICF Kaiser, 1993).

Total chromium concentrations in sediment samples ranged from 21 mg/kg to 2,620 mg/kg, with the highest concentrations being encountered in samples collected mid-stream immediately adjacent to the former tank berm area on Site 112A. Hexavalent chromium was detected in three sediment samples with the maximum concentration being 8.2 mg/kg.

2.3 Interim Remedial Actions

Interim remedial measures (IRMs) were implemented at Site 16 prior to the remediation of the exterior soil and included fencing and paving of the access road to the north of the site, the details of which are provided in the September 11, 1992 IT Corporation *IRM As-Built Report*. This IRM was conducted by PPG to reduce potential exposure to CCPW-impacted soils.

PPG began implementing additional IRMs at Site 16 in 2008 to achieve clean closure in an area converted to loading docks by the current occupant. These areas are labeled “loading dock” and are located along the eastern side of the warehouse building, as shown on Figure 3. CCPW-impacted soils were excavated in two areas along the east side of the warehouse building between December 19, 2008 and February 13, 2009. Approximately 3,140 cubic yards of material were reported as removed and disposed of off-site. The two areas were then backfilled with certified clean dense graded aggregate (DGA) and/or clean crushed stone (AECOM, 2009). This work was documented in AECOM’s 2009 *Interim Remedial Action Report* (IRAR).

None of the pre-excavation borings were advanced immediately adjacent to the building. The purpose of these borings was to screen and delineate soils for the development of the IRM excavation plan (AECOM, 2011). Pre-excavation borings were completed to depths ranging from 12 to 14 feet bgs and CCPW was encountered in nine borings ranging in depth from 0.5 to 5 feet bgs. CCPW was not continuous throughout this depth range.

AECOM reported that limited post-excavation concrete foundation sampling was completed and two samples were collected from the exposed concrete building foundation on the west end of the excavation after design depths were met. These samples were collected to evaluate whether the concrete was impacted. Sample 016-K01-001, collected from 0 to 6 inches into and at the base of the exposed foundation wall of the building in Area A near post-excavation sampling location PE9-001 had a hexavalent chromium concentration of 91.1 mg/kg. Sample 016-K01-001(0-1) was collected from 0 to 1 inch into and at the base of the exposed foundation wall of the building, also near post-excavation sampling location PE9-001. This sample had a hexavalent chromium concentration of 101 mg/kg, indicating that the building foundation was impacted in these areas. Visual CCPW was identified/observed as being embedded in the foundation wall. An attempt to remove the visible CCPW from the foundation was made but was unsuccessful. As such, the liner was installed along the building foundation (AECOM, 2009).

Site 112A and the drainage ditch were both remediated prior to the construction of the Liberty National Golf Course and received No Further Action determinations from the NJDEP on August 3, 2004. Therefore, additional investigation was not proposed in these two areas.

2.4 Remedial Investigation

Tetra Tech completed a RI at the site in accordance with a NJDEP-approved RIWP that was prepared by AECOM in March 2011. The objective of the RI was to determine the nature and extent of CCPW contamination at the site. Tetra Tech's RI included the installation of 71 soil borings and 14 groundwater monitoring wells, and the collection and analysis of 492 soil samples, 24 groundwater samples, 2 concrete core samples and 4 concrete slab samples. The results of the investigation concerning soil and building materials, which were documented in Tetra Tech's March 2013 RIR, are summarized below.

A summary Tetra Tech's soil boring information, including coordinates and presence of CCPW, can be found in Attachment 1. Analytical results from Tetra Tech's investigations that are incorporated as post-remedial soil samples to demonstrate compliance are included in Attachment 2. Tetra Tech soil sample locations incorporated as post-remedial soil samples are depicted on figures included in Attachment 3. Analytical summary data for Tetra Tech soil samples, including excavated soil samples, are included in Attachment 4. Soil boring logs are included in Attachment 5.

2.4.1 Soils Investigation

The RIR identified areas of the site where soils contained CCPW and where the concentrations of the CCPW-related metals were greater than the NJDEP's Residential Direct Contact Soil Remediation Standards (RDC SRS) or the Chromium Soil Cleanup Criteria (Cr SCC).

CCPW was identified in the surface and subsurface soils at the site. The RIR identified areas of surface and subsurface soils where concentrations of hexavalent chromium were above the Cr SCC, and where concentrations of antimony, nickel, and vanadium were above the RDC SRS or Impact to Groundwater Soil Screening Level (IGW SSL).

Hexavalent chromium was detected in 130 of the 490 soil samples with a range of detection from 0.55 to 276 mg/kg. Seventeen of the soil samples were above the Cr SCC.

Antimony was not detected above the RDC SRS. Antimony was detected in 12 of the 490 soil samples at a concentration above the IGW SSL with a range of 0.55 to 10.4 mg/kg.

Nickel was detected in one of the 490 soil samples at a concentration above the RDC SRS and the IGW SSL with a range of 0.36 to 3,220 mg/kg.

Vanadium was detected in 50 of the 490 soil samples at a concentration above the RDC SRS with a range of 0.38 to 1,060 mg/kg.

2.4.2 Concrete Slab and Foundation Investigation

The RIR evaluated the presence of hexavalent chromium in concrete core samples collected from the concrete floor of the building and from the sidewall foundation of the building at the loading dock area.

Hexavalent chromium was detected at a concentration above the Cr SCC in one of the two concrete slab samples. None of the samples of the sidewall foundation exhibited concentrations of hexavalent chromium above the Cr SCC.

2.5 Recommended Remedial Action

The recommended RA for soils at the site included the excavation and removal of visible CCPW and soils with concentrations of hexavalent chromium and total chromium above the Cr SCC and antimony, nickel, thallium, and vanadium above the SRS or default or site-specific IGW SSLs. Approval from the NJDEP to begin the remedial action, dated May 20, 2014, is included in Attachment 6.

3.0 Environmental Setting

Land use, soils, geology, topography, surface water, hydrogeology, and well search results for the site and surrounding area of Jersey City are summarized in the subsections below.

3.1 Topography

The topography at Site 16 is generally flat, gradually sloping towards the drainage ditch along the northern edge of the site (Figure 1). The facility buildings are at an approximate elevation of 10 feet above mean sea level (amsl) with the lowest elevations at the site nearing 5 feet amsl near the drainage ditch. Surface runoff on the site and surrounding area flows across the site to the north toward the Claremont Ditch. Surface water near the loading docks and the building is channeled into a storm sewer system that discharges into Claremont Ditch.

3.2 Regional Geology

The site lies within the glaciated section of the Piedmont Physiographic Province of the Appalachian Highlands, along the eastern edge of the Newark Basin (Killam, 1988, as cited in ICF Kaiser, 1993). The area is underlain by formations of Recent and Pleistocene sediments. The Triassic age bedrock throughout the region is comprised of non-marine sedimentary rocks, consisting mainly of sandstone, mudstone, and conglomerate. A diabase sill of regional extent is found west of the site.

The Triassic Newark Supergroup consists of non-marine sedimentary rocks with diabase intrusives. Generally, the Triassic Newark Supergroup exhibits a slight dip to the northwest with local warping and occasional faulting (Herpers and Barksdale, 1951). The formations generally strike northeast to southwest and dip between 10 to 20 degrees northwest. The Newark Supergroup is divided into three formations on the basis of lithology: (1) the lower unit - the Stockton Formation, (2) the middle unit – the Lockatong Formation, and (3) the upper unit - the Passaic Formation.

The Stockton Formation located beneath the site is a gray to reddish brown sandstone, interbedded with conglomerate, siltstone, and shale. The siltstone may be gray, green, or purple and fossiliferous. This formation is about 850 feet thick beneath the Project Area (Lyttle and Epstein, 1987).

The Lockatong Formation, located west of the site, consists of fossil-rich thinly laminated to thickly bedded gray to black siltstone and shale. A diabase sill of Lower Jurassic Age intrudes the Lockatong Formation west of the site within Jersey City.

The Passaic Formation (aka the Brunswick Formation) located west of the site is the thickest unit (about 10,000 feet) of the Triassic Newark Supergroup and is found west of the Project Area. The Passaic consists of reddish-brown mudstones, shale, siltstone, and sandstone with interbedded conglomeritic sandstones along the basin margins (Michalski, 1990).

The sediments overlying the Newark Supergroup include Pleistocene age glacial drift deposits consisting of stratified to unstratified sediments ranging from silty clay to sands and gravels, and recent alluvial deposits consisting of unconsolidated mud and silt, with peat, other organic material and, occasional sand and gravel lenses.

Preglacial Lakes Hackensack and Hudson, which existed north of the site, may have contributed outwash deposits to the site area as drainage of these lakes occurred. The terminal moraine stretches to south of Jersey City, across Perth Amboy, New Jersey, to Staten Island, New York, and to western Long Island, New York.

The Recent alluvial deposits were deposited by streams either directly on top of the Stockton Formation or on top of the Pleistocene age glacial outwash sediments. These deposits resulted in the creation of the Meadowlands tidal marshes. A "meadow mat" or peat layer is frequently associated with these tidal marshes. In many areas of Jersey City, these marsh areas have been dewatered and backfilled, resulting in a surface layer of fill material overlying the meadow mat (ICF Kaiser, 1993).

3.3 Site Geology

Site 16 is located in an area formerly part of the Upper New York Bay where water depths in the bay ranged from about 1 to 4 feet. The former bay area currently occupied by the site was filled to the present-day configuration by 1912 and the fill material lying on top of the former bay bottom includes unconsolidated coarse to fine sand, silt, and clay (ICF Kaiser, 1993). A thick sequence of unconsolidated natural material underlies the fill. The major geologic units at the site from top to bottom, as reported in the ICF Kaiser RI Report (1993) include:

- A discontinuous layer of CCPW and/or CCPW-impacted soils;
- A fill layer consisting of sand (ICF Kaiser's "Upper Sand Unit");
- A series of organic, fine grained natural soils and peat (ICF Kaiser's "Upper Confining Unit" or "meadow mat");
- A natural sand layer with varying thickness and continuity (ICF Kaiser's "Lower Sand Unit"); and
- A silt unit of unknown total thickness (ICF Kaiser's "Lower Confining Unit"). The bedrock beneath the overburden at the site is the Stockton Formation.

Overburden in the area is made up of four to five major geologic units with minor subunits, some of which may not be present throughout the site (Appendix E, ICF Kaiser Figures 4-1 and 4-2).

The fill material at Site 16 includes the upper two geologic units: 1) CCPW and/or CCPW-related soils, and 2) the Upper Sand Unit. The CCPW and/or CCPW-impacted soils are typically found between 0 and 2 feet bgs at Site 16 and are not continuous across the site. The CCPW fill is found above the groundwater table and consists of reddish brown, coarse to fine grained sand with some silt, traces of medium to fine grained gravel, with visible CCPW and occasional yellow staining.

The Upper Sand Unit fill is found between about 0 and 12 feet bgs beneath the site and consists of grayish brown, coarse to fine grained sand, trace silt, trace fine gravel, and shell fragments. The groundwater table is typically encountered within this unit. ICF Kaiser deemed the groundwater found within this unit as the "Shallow Groundwater Zone."

Naturally occurring geologic units are generally found at depths greater than 12 feet bgs beneath the site. ICF Kaiser defined the Upper Confining Unit as two or three subunits: (1) organic silt and clay, (2) peat (meadow mat) which may or may not be present in all areas across the site, and (3) silt. The organic silt and clay subunit was described as a dark gray organic, micaceous silt and clay with trace shell fragments and peat. Typically, this subunit was encountered between 12 and 19 feet bgs, above the meadow mat. The meadow mat was generally encountered from 19 to 21 feet bgs at the site. A subunit of gray silt with trace shell fragments was encountered below the meadow mat from 21 to 25 feet bgs. This Upper Confining Unit separated the Shallow Groundwater Zone found in the Upper Sand Unit from the Deep Groundwater Zone, which was identified within in the Lower Sand Unit.

The Lower Sand Unit was typically encountered from 25 to 31 feet bgs at the site but may not be continuous across the site (ICF Kaiser, 1993). This unit consists of reddish brown to gray medium to fine grained sand with trace silt and shell fragments and overlays the Silt unit that ICF Kaiser defined as the Lower Confining Unit.

The Lower Confining Unit was described as reddish brown to gray micaceous silt and was typically encountered below 31 feet bgs across the site. It is not known how thick this unit is as none of the borings advanced during previous investigations fully penetrated this unit.

The site is underlain by the Stockton Formation, although a gradational contact and/or interfingering with the Lockatong Formation may exist west of the site. The Stockton Formation, dips gently to the west and is described as gray to reddish-brown sandstone inter-bedded with conglomerate, siltstone, and shale. The siltstone may be gray, green, or purple and fossiliferous. This formation is found at depths of about 60 feet bgs on the west side of Site 16 to about 110 feet bgs on the east side of the site and has a thickness of approximately 850 feet beneath the site (i-Map NJ Geology, 2010; Lyttle and Epstein, 1987). No borings from previous investigations were advanced to the bedrock.

3.4 Regional Hydrology

Regionally, groundwater occurs in three overburden water-bearing zones and within bedrock fractures. The overburden water bearing zones include: (1) an unconfined water-bearing zone within the fill material, (2) an unconfined to semi-confined zone within the alluvial sediments beneath the fill, and (3) an unconfined to semi-confined zone within the glacial silt, sand, and gravel overlying the bedrock.

Salt-water intrusion has been an on-going groundwater problem in the region since at least 1959 (Geraghty, 1959; ICF Kaiser, 1993). The salt-water intrusion at the site has been attributed to past industrial use of the groundwater from both overburden and bedrock formations (Geraghty, 1959, as cited in ICF Kaiser, 1993). The source of the salinity has been attributed to the direct contact between the coarse sand and gravel of the glacial deposits and bedrock fractures with the saline waters of the nearby Hudson River and New York Bay (ICF Kaiser, 1993).

There is one natural surface water feature and several man-made surface water features within a half-mile radius of the site. The Upper New York Bay is located approximately 700 feet to the east of the site. A man-made drainage ditch (Claremont Ditch) borders the northern site boundary.

The drainage ditch was remediated and lined during the RA work completed by Liberty National Development Company in 2002. Several landscaped ponds and drainage features were constructed on the Liberty National Golf Course for aesthetic purposes and run-off control.

About 75 percent of the site is paved or covered by the existing warehouse. Surface runoff on the site and surrounding areas on paved (impervious) surfaces is generally channeled into a storm sewer system that discharges into the drainage ditch along the northern site border.

Groundwater is found in three water-bearing units within the overburden:

- fill material;
- alluvial deposits beneath the fill; and
- glacial sediments and till beneath the alluvium.

The shallow water-bearing unit can range from moderate to high hydraulic conductivity depending upon the materials making up the fill. The water bearing zones beneath the fill are generally characterized as low to moderately conductive because of the silt and clay content of the sediments.

Groundwater flow within the shallow water-bearing unit is influenced by infiltration through unpaved surface areas and the hydraulic characteristics of the fill material. Groundwater in the fill is typically encountered within 5 to 10 feet bgs. In general, shallow groundwater flow patterns represent a subdued version of land surface topography but can vary due to precipitation intensity and duration. Variations can be attributed to heterogeneities in the fill, subsurface structures, and variable recharge due to the presence of impervious surfaces.

Groundwater flow in the intermediate and deep water bearing zones is expected to be southeastward toward New York Bay. The intermediate zone described regionally corresponds to the zone that ICF Kaiser identified as the "deep groundwater zone" during previous site investigations. The deep water-bearing zoned identified regionally was not investigated during previous site investigations.

Flow velocity within the intermediate and deep zones is generally low due to the silt and clay content of the sediments. However, highly conductive discontinuous gravel layers are sometimes found within the deep glacial sediments. Regionally, the glacial deposits can support water supply wells yielding up to 1,500 gallons per minute (gpm) (Geraghty, 1959, as cited in ICF Kaiser, 1993).

The Stockton and Lockatong Formations are part of a major regional aquifer serving most of the industrialized sections of northern New Jersey. However, groundwater beneath the site is not considered potable and no public water supply wells draw water from either of these formations in the Jersey City area.

The hydrogeologic properties of the Stockton and Lockatong Formations in this area are not well-documented but are expected to be similar to the Passaic Formation, which was formerly referred to as the Brunswick Formation. Hydraulic conductivity within the rock matrix is virtually nonexistent.

Hydraulic conductivity is due to secondary features such as fractures and joints. The thickness of water-bearing zones is limited to fractures or fracture sets ranging from a few inches up to approximately 20 feet (ICF Kaiser, 1993). Groundwater occurrence and flow is controlled by major bedding plane partings and/or intensely fractured seams (Michalski, 1990). Near-vertical fractures are also present but are considered minor flow paths. Groundwater flow within the bedrock is generally anisotropic, with preferential flow northeast or southwest along the strike of the beds. Well yields range from several gallons to several hundred gpm with yields generally decreasing with depth. Groundwater in these formations can occur under both confined and unconfined conditions (ICF Kaiser, 1993).

3.5 Site Hydrogeology

Groundwater is found in three water-bearing units within the overburden beneath the site:

- Shallow water-bearing zone: This zone is defined as saturated sections of the Upper Sand Unit (fill) encountered south of the drainage ditch, and the portion of the Upper Sand Unit underlying small perched groundwater zone located off-site and north of the drainage ditch. This zone extends to about 12 to 20 feet bgs throughout the site area. The shallow water- bearing zone is separated from the underlying intermediate zone by a confining layer of fine- grained sediments including the organic silt, clay, and peat.
- Intermediate water-bearing zone: This zone was identified as the "Deep Groundwater Zone" in previous investigation reports. It is found within the Lower Sand Unit reported in the ICF Kaiser RIR and was encountered at about 25 to 31 feet bgs, primarily east of Site 16 and beneath Site 112A. This zone ranges up to approximately 15 feet thick on Site 112A but may either be missing or discontinuous beneath Site 16. The intermediate water-bearing zone is separated from the deep zone by a layer of low hydraulic conductivity silts and clays. Borings were not advanced through this layer during previous investigations.
- Deep water-bearing zone: Previous site investigations did not extend into the deep water-bearing zone. Based upon regional information, the deep water-bearing zone is expected to be about 40 feet bgs and extend to bedrock (approximately 60 to 110 feet bgs depending on the location within the Project Area). This zone appears to be made up of sand coarsening with depth and may include seams of gravel. A clay layer is usually found beneath the sand and gravel close to the bedrock surface.

Nineteen monitoring wells were used to evaluate the hydrogeology beneath Sites 16 and 112A during the 1992 RI activities. Seven of these wells are located on Site 16 property, including PPG4-MW1, PPG4-MW2, PPG4-MW13, PPG4-MW14, PPG4-MW15, and PPG4-MW16, which were screened in the shallow groundwater zone, and PPG4-MW1A, which was screened in the deep groundwater zone. In general, groundwater was encountered between 5 and 10 feet bgs across the site, and groundwater flows northeasterly towards the Claremont Ditch. Subsequent excavation lead to the abandonment of monitoring wells PPG4-MW1 and PPG4-MW1A.

A tidal study was conducted during the RI using 15 monitoring wells over a 14-hour period on February 5, 1992. The results of the tidal study indicate relatively small tidally influenced fluctuations in groundwater levels in three deep wells and one shallow well. No tidal influences were reported in any of the other wells (Table 4-3 from ICF Kaiser, 1993).

No borings or wells were advanced to bedrock during previous investigations at the site. However, bedrock beneath the site is expected to be similar to the regional bedrock. Hydraulic conductivity within the rock matrix is virtually nonexistent. Hydraulic conductivity is due to secondary features such as fractures and joints. The thickness of water-bearing zones within the bedrock is limited to fractures or fracture sets ranging from a few inches up to several feet. Groundwater occurrence and flow is controlled by major bedding plane partings and/or intensely fractured seams (Michalski, 1990). Near-vertical fractures are also present but are considered minor flow paths.

Groundwater flow within the bedrock is generally anisotropic, with preferential flow northeast or southwest along the strike of the beds. Well yields range from several gallons to several hundred gpm, with yields generally decreasing with depth. Groundwater within the bedrock occurs under both unconfined and confined conditions.

Groundwater sampling events completed at the site in December 2017, January 2018, January 2019, and February 2019 have not revealed the presence of CCPW-related metals at concentrations in excess of the NJDEP Groundwater Quality Standards exterior to the building. Groundwater contamination remains beneath the structure due to the presence of source material and a Classification Exception Area/Well Restriction Area is being proposed for the site under a separate submittal.

4.0 Identification of Applicable Remedial Standards/Criteria and AOCs

4.1 Remediation Standards/Criteria

The RA described in the RAR were performed in accordance with the following regulatory requirements and NJDEP Guidance.

- N.J.A.C. 7:26C – *Administrative Requirements for the Remediation of Contaminated Sites*, dated August 6, 2018.
- N.J.A.C. 7:26D – *Soil Remediation Standards*, last amended September 18, 2017.
- N.J.A.C. 7:26E – *Technical Requirements for Site Remediation*, dated August 6, 2018.
- NJDEP *Field Sampling Procedures Manual*, dated August 2005 (last updated April 2011).
- NJDEP *Technical Guidance for the Attainment of Remediation Standards and Site-Specific Criteria*, dated September 2012.
- NJDEP *Technical Guidance for the Site Investigation of Soil, Remedial Investigation of Soil, and Remedial Action Verification Sampling for Soil*, dated March 2015.
- NJDEP *Development of Site-Specific Impact to Groundwater Soil Remediation Standards Using the Synthetic Precipitation Leaching Procedure Guidance*, dated November 2013.
- NJDEP Memorandum from Lisa P. Jackson to Irene Kropp, Subject: Chromium Moratorium, February 8, 2007.
- NJDEP Chromium Soil Cleanup Criteria, September 2008, revised April 2010.
- NJDEP Administrative Consent Order, Dated July 19, 1990.
- JCO between NJDEP, PPG, and the City of Jersey City, June 26, 2009.
- NJDEP *Fill Material Guidance for SRP Sites,* dated April 2015.
- NJDEP *Guidance for Characterization of Concrete and Clean Material Certification for Recycling,* dated January 2010.

4.2 Soil Remediation Standards/Criteria

Soil Remediation Standards for acceptance of post-excavation results for CCPW-related metals for the site were based on the September 2017 NJDEP Residential Direct Contact Soil Remediation Standards

(RDC SRS)[1], the NJDEP's Letter of February 8, 2007 related to the lifting of the Chromium Moratorium[2], and the NJDEP's September 2008 Cr SCC document[3].

The 2007 and 2008 Soil Cleanup Criteria were used only for trivalent chromium and hexavalent chromium. The September 2017 NJDEP RDC SRS were used for antimony, nickel, thallium, and vanadium. The Default NJDEP IGW SSLs are additional criteria for antimony, nickel, and thallium except for when Synthetic Precipitation Leaching Procedure (SPLP) data are used to establish a site-specific soil screening level. The SPLP was used to determine a site-specific IGW SSL for nickel of 654 mg/kg (Attachment 7) and was approved by the NJDEP on May 29, 2020.

The soil remediation standards/criteria include the following values:

Table 4-2
Applicable Soil Remediation Standards and/or Criteria
HCC Site 16
45 Linden Avenue East
Jersey City, Hudson County, New Jersey
Program Interest G000008644

Metals	Default IGW SSL / (Site-Specific IGW SRS) (mg/kg)	RDC SRS / (ARS) (mg/kg)	CrSCC (mg/kg)
Trivalent chromium	NA	NA	120,000
Hexavalent chromium	NA	NA	20
Antimony	6	31	NA
Nickel	48 / (654*)	1,600	NA
Thallium	3	NA	NA
Vanadium	NA	78 / (390**)	NA

Notes:
mg/kg = milligrams per kilogram
NA = Not Applicable.
*Nickel Site-Specific IGWSRS calculated using SPLP laboratory methods was approved by NJDEP on May 29, 2020.
** The use of the USEPA Regional Soil Screening Level of 390 mg/kg for vanadium was approved by NJDEP as an alternative remediation standard for the site on May 29, 2020. Based on: https://www.epa.gov/risk/regional-screening-levels-rsls-users-guide-november-2015

[1] N.J.A.C. 7:26D, Remediation Standards, last amended September 18, 2017.
[2] NJDEP Memorandum from Lisa P. Jackson to Irene Kropp, Subject: Chromium Moratorium, February 8, 2007.
[3] NJDEP Chromium Soil Cleanup Criteria, September 2008, revised April 2010.

PPG is not legally responsible for any other chemicals exceeding NJDEP Soil Remediation Standards that may be present at the site. This RAR addresses only chromium and CCPW-related constituents. PPG is responsible for CCPW and CCPW related impacts only and not for any other chemicals exceeding NJDEP Soil Remediation Standards that may be present at the site.

4.3 AOCs

Four AOCs (Figure 3) were identified at the site for the investigation of CCPW and CCPW-related materials:

- **AOC-1: Exterior Soil**

  Visible CCPW and CCPW-impacted materials were identified on the site at concentrations in excess of the Cr SCC and/or RDCSRS. RA relative to soils outside of the site building footprint were completed in the spring of 2015. Approximately 23,204 tons of CCPW-impacted non-hazardous material and approximately 22,705 tons of CCPW-impacted hazardous material were removed and transported offsite for disposal.

- **AOC-2: Groundwater**

  Historical groundwater investigations at the site identified the presence of CCPW-related metals in excess of the NJDEP Groundwater Quality Standards in shallow groundwater beneath the site. PPG completed the RI of CCPW-related metals in shallow groundwater via the installation of an offsite groundwater monitoring well. The completion of the RI related to groundwater will be documented in a *Remedial Investigation Report Addendum for Groundwater (AOC-2) and Linden Avenue East (AOC-4)*.

- **AOC-3: Interior Soil and Building Footer**

  Visible CCPW and CCPW-impacted materials were identified on the site at concentrations in excess of the Cr SCC and/or RDCSRS beneath the site building and within building foundation materials following RA in AOC-1. The presence of CCPW-impacted materials within the footprint of the building requires remediation. Proposed RA, which consists of institutional and engineering controls, were presented in a *Remedial Action Work Plan, AOC-3: Interior Soil, AOC-4: Linden Avenue East*, which was submitted to the NJDEP in October 2018.

- **AOC-4: Portion of Linden Avenue E**

  Visible CCPW was observed at the southern end of the property line at the boundary with Linden Avenue East during the completion of RA in connection with AOC-1. Impacts have been observed within the limits of Linden Avenue E. Additional soil borings to delineate the hexavalent chromium exceedance identified in soil borings were completed and the results will be documented in a *Remedial Investigation Report Addendum for Groundwater (AOC-2) and Linden Avenue East (AOC-4)*. Proposed RA for this AOC, which consist of institutional and engineering controls, were presented in a *Remedial Action Work Plan, AOC-3: Interior Soil, AOC-4: Linden Avenue East*, which was submitted to the NJDEP in October 2018.

5.0 Description of the Remedial Action

The RA selected by PPG for contaminated soils exterior to the site building was excavation and off-site disposal of the excavated materials at landfills permitted to accept the excavated materials. The following landfills were used for the disposal of CCPW, contaminated soils, contaminated concrete, wood, soils contaminated with polychlorinated biphenyls and CCPW-related metals, and soils contaminated with petroleum, solvents and CCPW-related metals. Waste manifests and quantities for materials disposed during the remedial action are included in Attachment 8.

All materials removed were sent to one of the following treatment facilities:

Non-Hazardous

- Cumberland County Improvements Authority Landfill, Deerfield Township, New Jersey

Hazardous

- Stablex, Blainville, Québec, Canada
- EQ Detroit Inc., Detroit, Michigan
- EQ- Michigan Disposal Waste Treatment Plant, Belleville, Michigan
- EQ- Wayne Disposal Inc. Site #2 Landfill, Belleville, Michigan
- EQ Envirite, York, Pennsylvania

Transite Pipe (Hazardous)

- EQ - Wayne Disposal Inc. Site #2 Landfill, Belleville, Michigan

Metal

- Cinelli Iron & Metal Company, Hackensack, New Jersey, for recycling

5.1 Exterior Soil Remediation

The RA at the site included the excavation of CCPW and soil impacted by CCPW, which included chromium, hexavalent chromium, antimony, nickel, thallium and vanadium soil contamination, offsite transport and disposal of affected soil, backfilling of the excavations, and restoration of the affected areas. The RA was performed in accordance with the NJDEP-approved Remedial Action Work Plan (RAWP).

Access agreements were obtained and state and local permitting requirements were met as required by site conditions.

During Remediation efforts, CB&I served as the design engineer. WCD Group, LLC (WCD) served as "Construction Manager as Agent" (CMAA) to manage and coordinate the work of multiple contractors hired by PPG to perform the required remedial construction and support work. On May 20, 2015, CB&I assumed responsibilities as CMAA while continuing as design engineer for the remainder of the project.

Emilcott Associates, Inc. of Morristown, New Jersey performed the air monitoring at the site to assess site conditions; evaluate whether the measures used to control potential fugitive emissions were effective; and document ambient air quality/conditions in the immediate vicinity of the site. Copies of their monthly reports are included as Attachment 9. During the course of the remediation, fugitive dust was controlled and measurable exceedances of the community air monitoring plan criteria were not observed. Air samples collected for laboratory analysis reported contaminant concentrations below criteria.

Entact Environmental Services (Entact) of Latrobe, Pennsylvania performed the remediation construction activities at the site. These services consisted of excavation, backfilling and compaction, decontamination, demolition, dewatering, and site restoration.

Waste Technology Services, Inc. (WTS) of Lewiston, New York coordinated transportation and disposal for the following waste streams:

- Non-Hazardous Soil
- Low Chrome Ore Process Residue
- High Chrome Ore Process Residue
- Chrome Contaminated Concrete
- Surface Water Runoff, Decontamination Waste Water and Groundwater
- Transite Pipe

In general, soil excavation activities proceeded from the north to the south in the three main phases, including the southern loading dock, which was completed in the spring of 2015. Soils were excavated in a grid system that was pre-characterized for waste classification and acceptance at an appropriate disposal facility. The site was divided into 30-foot by 30-foot grids (432 total) (Figure 4). Soil analytical results from the design soil-boring program and the analytical results from the RI soil boring program were used to determine the depths of the excavation. Remaining soil impacts associated with AOC-3 and AOC-4 are depicted on Figure 3. Proposed RA for AOC-3 and AOC-4, which consists of institutional and engineering controls, were presented in a *Remedial Action Work Plan, AOC-3: Interior Soil, AOC-4: Linden Avenue East*, which was submitted to the NJDEP in October 2018.

5.2 Pre-Construction Activities

The following activities were conducted prior to starting excavation of chromium-impacted soils:

- Approval of all permit applications and plans submitted to the state and local agencies
- Implementation of a Soil Erosion and Sedimentation Control Plan / Storm Water Pollution Prevention Plan
- Obtaining access agreements from affected property owners
- Implementation of an Air Monitoring Plan (AMP)
- Development of a Site-Specific health and safety plan (HASP)

- Site utility clearance activities
- Equipment mobilization and set up of temporary facilities
- Removal of guardrails and set up site perimeter fencing
- Establish work zones
- Abandonment of monitoring wells located within extent of excavation

All necessary permits (Attachment 10) were obtained from and approved by the state and local and county agencies prior to initiation of activities covered by the permits as detailed below.

Pre-construction field activities started with the implementation of the Erosion and Sedimentation Control Plan, which was included in the August 2013 RAWP submittal to the NJDEP. The sediment and erosion controls consisted primarily of hay bales to contain any soil potentially displaced during RA. The hay bales were installed along the down-gradient perimeter of the site. Sediment filters were installed in the storm water catch basins located along Linden Avenue East.

Access agreements were obtained from the site property owner K.I.D.S Realty (Site 16), the NJDOT and Anheuser Busch. In addition to the access agreements, a Jersey City traffic permit (lane occupancy) was obtained from the City of Jersey City.

The AMP was developed to provide specific procedures for measuring, documenting, and responding to potential airborne impacts during RA at the site. The AMP assessed site conditions, evaluated whether the measures used to control potential fugitive dust emissions were effective and document ambient air quality/conditions in the immediate vicinity of the site. The Project AMP was approved by Weston Solutions, Inc. (Weston Solutions) prior to initiation of work.

A site-specific HASP was developed for the RA at the site in accordance with Occupational Safety and Health Administration 1910.120. The HASP documents policies and procedures to be followed to protect workers and the public from potential hazards posed at this site. The HASP includes training program protocols, medical surveillance program, equipment maintenance programs, personal hygiene practices, project air monitoring plan, dust control plan and other information.

In addition to contacting the New Jersey One-Call system, a utility survey was conducted prior to intrusive site activities. A private utility locator, TPI Environmental Inc. of Easton Pennsylvania, performed a geophysical survey to mark underground utilities (gas, sewer, water, phone, cable, electrical, etc.) that exist within the proposed excavation area. No utilities were identified during the geophysical survey of proposed excavation areas within Site 16; however, during excavation several underground pipes were encountered and are discussed below.

Equipment was delivered to the site during the initial mobilization phase and on an as-needed basis as work progressed. Temporary facilities including field office trailers, sanitary facilities, and equipment storage Conex/intermodal boxes were mobilized and set up for use during RA.

Guardrails located along Linden Avenue East were removed and replaced with jersey barriers. A security fence was erected on top of the jersey barriers and around the site perimeter to secure the site.

Work zones were established to exclude unauthorized personnel from entering the site and to prevent contamination from being tracked off site or into clean work zones. The following work zones were established:

- A Secure Zone was established to exclude unauthorized personnel from entering the site. The Secure Zone consisted of a steel chain link fence and locking gates. Warning signs were placed on the fence to prevent unauthorized entry into work areas.
- A Support Zone was established to stage office trailers, sanitary facilities, storage Conex/intermodal boxes, and vehicle parking.
- An Exclusion Zone encompassed areas associated with impacted material and/or heavy equipment hazards. Temporary fence was installed to isolate the exclusion zones and modified Level D personal protective equipment including Tyvek was required when working in the exclusion zone.
- A Contamination Reduction Zone and truck decontamination pad were constructed for transition from the Exclusion Zone. The Contamination Reduction Zone prevented the track-out of sediment onto off-site streets, other paved areas, and sidewalks from vehicles exiting the site.

5.3 Well Abandonment

Accessible monitoring wells within the limits of excavation were properly abandoned prior to the start of work, as shown in Table 5-3. Decommissioning records and well abandonment information are located in Attachment 10. In some cases, the May 2013 RIR (Tetra Tech, 2013) and/or the alternative well decommissioning request included in Attachment 10 referred to monitoring wells by a different name than what is presented on NJDEP records. For completeness, references to monitoring well names used in the May 2013 RIR and/or the alternative well decommissioning request included in Attachment 10 have been incorporated into Table 5-3.

Historical monitoring well MW-2 (Permit 2600028184) was decommissioned on 2/11/1993 due to damage from a large vehicle. This monitoring well was subsequently replaced by monitoring well MW-2R (2600032562).

Table 5-3
Monitoring Well Abandonment Information
HCC Site 16
45 Linden Avenue East
Jersey City, Hudson County, New Jersey
Program Interest G000008644

Well ID (Local ID)	Permit Number	Well Completion Date	Easting (X)	Northing (Y)	Date Decommissioned	Driller Initials
* (PPG4-MW1)	2600028185	1/10/1992	607807	676422	Unknown**	-
* (PPG4-MW1A)	2600028186	1/10/1992	607822	676425	Unknown**	-
MW-2 (PPG4-MW2, PPG4_MW02)	2600028184	1/10/1992	607778	676844	2/11/1993	SCG
016-MW-07 (016_MW07)	E201110447	8/3/2011	607769	676500	7/30/2014	DWM
016-MW-08 (016_MW08)	E201110448	8/3/2011	607587	676282	7/30/2014	DWM
016-MW-9 (016_MW09)	E201300344	1/15/2013	607685	676206	7/30/2014	DWM
016-MW-10 (016_MW10)	E201300252	1/14/2013	607654	676275	7/30/2014	DWM
016-MW-11 (016_MW11)	E201300345	1/14/2013	607722	676308	7/30/2014	DWM
016-MW-06 (016_MW06)	E201110446	8/3/2011	607863	676554	1/23/2018	+
MW-09 (016_MW09)	E201303833	3/26/2013	607673	676201	1/23/2018	+
MW-2R / MW2-R (PPG4-MW-2R)	2600032562	2/11/1993	607778	676844	1/23/2018	+
PPG4-13 (PPG4-MW-13)	2600030577	8/27/1992	607560	676308	1/23/2018	+
PPG4-14 (PPG4-MW-14)	2600030578	8/26/1992	607804	676754	1/23/2018	+
MW-15-PPG4-15 (PPG4-MW-15)	2600030579	8/31/1992	607576	676972	1/23/2018	+

Well ID (Local ID)	Permit Number	Well Completion Date	Easting (X)	Northing (Y)	Date Decommissioned	Driller Initials
MW-16 (PPG4-MW-16)	2600030580	9/14/1992	607211	676553	1/23/2018	+

Table 5-3 Notes:
+ Alternative decommissioning technique approved by NJDEP in September 2018.
* Monitoring Well name not listed or listed as “0” on DataMiner records; local name obtained from figures excerpted from the 1993 ICF Kaiser Draft RIR (Appendix A-1)
** Decommissioning report not identified on NJDEP DataMiner records. A request for additional information has been submitted to the NJDEP and the results are pending. Decommissioning information will be submitted to the NJDEP with a future Remedial Action Report for Groundwater (AOC-2).

Seven monitoring wells (Permit numbers E201110446, E201303833, 2600032562, 2600030577, 2600030578, 2600030579, and 2600030580) located exterior to the Site structure could not be located during the exterior excavation activities.

On behalf of PPG, APTIM submitted a letter notification to the NJDEP Bureau of Water Allocation and Well Permitting (Bureau) detailing efforts made to locate the monitoring wells in order to properly abandon them. APTIM requested that the Bureau concur with the assessment that the wells have been lost and/or destroyed and provide documentation that additional efforts are not warranted to locate the seven monitoring wells and that they are considered abandoned. On September 19, 2018 the Bureau replied to the January 23, 2018 letter. The Bureau concurred that the wells have been destroyed and can longer be properly decommissioned and no further action is required for the referenced wells. A copy of the letter submitted to the Bureau and a copy of the Bureau response letter are provided in Attachment 10.

Historical monitoring wells PPG4-MW1 and PPG4-MW1A (local ID obtained from 1993 ICF Kaiser Draft RIR) were reported in the March 2011 RIWP (AECOM, 2011) to have been abandoned prior to historical excavation work within AOC-1 but the AECOM report did not provide decommissioning reports within the document. A search of NJDEP DataMiner revealed that the monitoring well names associated with Monitoring Well Permit numbers 2600028185 and 2600028186 is not listed on the well permits and is listed as “0” on the well record. A request for additional information regarding these monitoring wells was submitted to the NJDEP and the results are pending. Decommissioning information will be submitted to the NJDEP with a future Remedial Action Report for Groundwater (AOC-2).

5.4 Excavation and Off-Site Disposal

Excavation activities began on June 9, 2014 in the northern portion of the site and were completed to the south on August 4, 2015. The excavation proceeded in 3 phases due to active businesses using the warehouse. Each phase considered and accommodated the swing radius of delivery trucks.

Prior to the start of the remediation, the initial vertical and horizontal limits of excavation were surveyed and marked. As excavation was performed by Entact utilizing a Komatsu PC 350 excavator and Hitachi mini excavator, a WCD geologist or construction manager oversaw the work.

Entact verified vertical excavation extents using GPS survey equipment to document that proposed excavation depths were achieved. Once the excavation limits were met to the targeted depths within each waste class grid cell, a representative from Weston Solutions or a WCD geologist with the permission of a Weston Solutions representative inspected the completed excavation for visible CCPW. If visible CCPW was noted, excavation would continue in half-foot increments until inspection revealed no presence of CCPW. Post-excavation samples were collected if the excavation depth extended more than 12 inches beyond the original targeted cutline limits.

The confirmation samples were analyzed for:

- Hexavalent chromium was performed using 3060A SW 846 digestion and 7196A SW 846 analysis as modified by NJDEP;
- pH was performed using SW 846 9045C,D;
- Redox Potential was performed using ASTM D1498-76M;
- Total chromium, antimony, nickel, thallium, and vanadium were performed using USEPA Methods 6010C, 3050B.

Surface water runoff, storm water, groundwater entering the excavation and decontamination water were transferred utilizing pumps into closed-top fixed-axle storage (frac) tanks. After receiving analytical results indicating the water in the frac tanks was non-hazardous, WTS coordinated the transportation and disposal of the water from the frac tanks to the Passaic Valley Sewage Commission (PVSC) wastewater treatment plant facility located in Newark, New Jersey.

5.5 Post-Excavation Soil Sampling

Post-excavation soil samples were routinely collected during the course of the RA. Post-excavation base samples were collected whenever excavation within a cell grid progressed greater than 1-foot deeper than originally designed. Post-excavation sidewall samples were collected along the perimeter of the excavation every 30-feet to define the lateral extents of the excavation. Summaries of laboratory analytical results are provided as Attachments 2 and 4. Attachment 3 presents figures that show the location of the post-remediation base of excavation samples and post-remediation excavation sidewall samples, as well as the topographic extents of the bottom of the excavation. Validation reports for the results are included in Attachment 11. Analytical data were qualified but were generally found to be usable, as discussed in Section 7.0.

5.6 Summary of Activities

Activities including mobilization and set up of temporary facilities, removal of guard rails, placement of jersey barriers and temporary fencing, implementation of the erosion and sedimentation control plan, establishment of work zones, utility clearance, clearing vegetation, and removal of site debris (garbage) were performed Pre-Construction. On June 9, 2014, remedial excavation activities began.

Post-excavation samples were collected from areas outside the original proposed excavation extents where visible CCPW was removed; the samples were sent for laboratory analysis. Prior to sample collection, the areas were visually inspected and cleared of CCPW by Weston Solutions and/or a WCD or a CB&I geologist with permission of a Weston Solutions representative.

Prior to backfilling, an orange demarcation liner was placed in the excavation. Excavation grid areas that were excavated with vertical extents verified and visually cleared were backfilled with certified clean stone fines/screenings, quarry process, ¾ stone, (NJDOT) recycled concrete aggregate (RCA)/DGA, and DGA/Type 5A from Weldon Material Inc.'s Fanwood Crushed Stone Company Quarry located in Watchung, New Jersey. ANS Consultants, Inc. of South Clinton, New Jersey verified backfill compaction using a nuclear density gauge.

Additional excavation (re-dig) was completed for failed samples. An area of approximately 30 feet by 30 feet was excavated for each failed sample. If the sample location was backfilled, the backfill material was removed to a depth of 1 foot above the failed sample and segregated for reuse. Backfill material immediately above the failed sample and additional soil associated with the re-dig was segregated and classified as hazardous or non-hazardous and was transported offsite for disposal at an appropriate facility.

The following summarizes the different complications that occurred during the completion of the excavation:

5.7 Tar-Like Soil Area

During excavation along the northern side of the warehouse and south of the Claremont Ditch, a tar-like substance was encountered. On October 3, 2014, WCD collected waste characterization samples of suspect petroleum impacted soils in grid cells 2P, 2Q, 2R, and 3S. The samples were identified as 2P-WCS-01-PETROLEUM, 2Q-WCS-02-PETROLEUM, 2R-WCS-03-CCPW-PETROLEUM, 3S-WCS-04-SW-NORTH-PETROLEUM. One truck load of the suspect soil was excavated and transported offsite for disposal.

5.8 Warehouse Footer Underpinning

During excavation efforts at the site, CCPW impacts were observed on the footer that spans the eastern length of the warehouse. Removal of CCPW impacts observed on the footer was attempted in October 2014 under the oversight of Mueser Rutledge Consulting Engineers (MRCE), PPG's structural engineering consultant. A memorandum summarizing MRCE's observations is provided as Attachment 12.

Four post-excavation soil samples (UP-1C-BOTTOM, UP-1E-BOTTOM, UP-2A-BOTTOM, and UP-4F-BOTTOM) and one concrete sample (UP-4B-LOW FOOTER CONC) were collected during underpinning activities. The samples collected did not exhibit concentrations of targeted contaminants in excess of the applicable RDC SRS and/or Cr SCC. The results of the soil sample analyses are presented on Table 2B in Attachment 2 and Table 4B in Attachment 4. The results of the concrete sample analyses are presented on Table 2G in Attachment 2. The laboratory data deliverables are included in Attachment 11. Removal of all visible CCPW impacted material was not completed along the length of the building footing. The remaining CCPW-impacted material will be addressed during the remediation of AOC-3.

5.9 Slurry Wall and Cap Disturbance

On December 30, 2014, Entact inadvertently breeched the slurry wall and cap associated with Hudson County Chromate Site 112A (NJDEP Program Interest #015203 - Ultramar) with an excavator. The event occurred while Entact was expanding the excavation area to remove visible CCPW that was located on Site 16 at the direction of WCD.

An area of approximately ±1,300-square feet was disturbed in the northwestern corner of the CCPW containment cell located on Site 112A as shown on Figure 1 of Attachment 13. The disturbance area was located on Block 27401, Lot 33, which is owned by the NJDOT. The disturbance included the removal of approximately 2 feet of clean cap backfill, the high density polyethylene (HDPE) liner, 3 to 4 feet of CCPW-impacted fill, and the top 3 to 4 feet of the slurry containment wall on Site 112A, as shown in the photographs included in Attachment 13. To document the incident, NJDEP Spill Hotline was called and incident number 15-01-05-1746-31 was assigned. NJDEP's DataMiner indicates that the incident number was referred and is associated with Program Interest 015203 (Site 112A).

To repair the breach in the slurry wall, a clay patch was installed. Approximately 3 to 4 feet of clay was placed within the breach such that it overlapped the existing slurry wall by at least 1 foot on either side of the breach and compacted with a roller. New HDPE liner was then welded to the edge of the existing HDPE liner to cover the breached area with several feet of overlap. On either face of the new HDPE liner, geotextile was placed as a protective layer. The disturbance area was then covered with a 2 to 3 foot thick clean fill cap to bring the area back up to grade. The clean fill consisted of stone fines. Copies of the clean fill certifications are included in Attachment 16.

5.10 Generator Area

In the spring of 2015, the Generator Area excavation, located in the southwest corner of the site (cell 23M) was conducted. Entact removed the generator and excavated within its former location from a depth of three to five feet bgs. Thirteen samples remain on site in the Generator Area and include seven soil samples and six concrete samples. Soil sample GA-Curb-SVL2 (1.5'BSG) exhibited a vanadium concentration 81.7 mg/kg, which was in excess of the target RDC SRS of 78 mg/kg for vanadium at the time of the excavation[4]. Soil sample GA-Curb-SVL2 (1.5'BSG) is below the proposed standard for vanadium of 390 mg/kg.

No additional samples collected in connection with the Generator Area exhibited concentrations of targeted contaminants in excess of the applicable IGW SSL, RDC SRS and/or Cr SCC. The results of the soil sample analyses are presented on Table 2C of Attachment 2 and Table 4C of Attachment 4. Sample locations are presented on Figure 3K of Attachment 3. Laboratory data deliverable packages are provided in Attachment 11.

Prior to backfilling the excavation with certified clean backfill, plastic sheeting was placed along the foundation of the warehouse. The retaining wall and concrete pad associated with the generator area

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[4] The NJDEP issued information allowing the use of the USEPA Regional Soil Screening Level of 390 mg/kg for vanadium in July 2016, which was following the completion of the excavation work in this location.

were reconstructed and brought to grade with backfill. Concrete was poured for the reinstallation of the generator and generator steel stand and the generator stand was bolted directly to the new concrete pad. The service lines were then reconnected to the generator. A paint finish was applied to the block retaining wall to complete the restoration in this area.

5.11 Former Piping Encountered

During excavation activities, several former piping structures were encountered. The majority of the subsurface pipes encountered were silted and clogged with debris. These included the following:

- Two drainage pipes were encountered running southwest to northeast from the storm sewer in the southern part of the site to the Claremont Ditch. The two pipes were removed and replaced in-kind following the completion of the CCPW excavation activities. Two 24-inch perforated high-density polyethylene (HDPE) pipes surrounded by No. 3 stone were used in the replacement. The majority of the storm sewer piping is covered with asphalt; however, areas that are not overlain by asphalt are covered with 4 to 6-inches of ¾-inch stone.
- An additional drainage pipe was encountered running west to east in WC-11 and WC-10. The pipe was cut, capped, and removed at the border of Site 112A. HDPE perforated pipe was then used to replace the previously remediated pipe after the visual CCPW was excavated.
- An 18-inch concrete drainpipe section was uncovered and removed from the southern area of the site. The outlet was located at the edge of the 18M/N border and the inlet was located at the corner of 16O and 16P cells. CCPW was identified in this area at four feet bgs and was identified beneath the pipe. The pipe was roughly 40 feet long running west to east in grid 17N. The area was remediated and the pipe removed and properly disposed of offsite. The pipe run was replaced with an HDPE pipe.

Other areas where piping was encountered:

- Entact completed three test pits in grids 6Q, 7Q and 11Q to investigate the path of the underground pipe that was identified. The test pit in 11Q required Entact to dig through backfill. The pipe was observed to be made of brittle concrete and filled with sediment. The pipe began to break and slump into the hole when Entact excavated below the pipe. A fourth test pit was completed in grid 9S to investigate the conditions around the existing manhole and drainage pipe. A trace amount of visible CCPW around the manhole was observed and removed.
- Entact also completed test pits through backfill in grids 12Q, 12R, 11Q, 10Q, 9Q and 8Q to investigate the path of an underground pipe. No CCPW was observed around the pipe. Entact excavated to the top of the pipe, crushed it in place and backfilled the excavation. While excavating down to the underground pipe, Entact worked in 10-15 foot sections. Excavation took place under Weston Solutions & WCD surveillance. Once the pipe was found and crushed, Weston Solutions & WCD halted excavation and inspected the material around the pipe. No CCPW was identified, so the pipe was crushed and then backfilled over. Only after each visual inspection would Entact move to the next 10-15 foot section of piping.

- On August 5, 2014, Entact removed underground concrete pipes during excavation in 15P due to the visible presence of CCPW around the pipes. A large catch basin was also removed due to visible CCPW around the concrete.
- Entact encountered an underground pipe in 5Q and 6Q. Based on lack of visual CCPW, the pipe was crushed and left in place.
- Entact removed an out of service pipe from Grid 2M and identified another pipe in Grid 2N that was left in place. No visible CCPW was observed in the vicinity of the pipe located in Grid 2N.
- Entact removed a concrete pipe from grid 5V. The pipe was not functional.

5.12 Southern Loading Dock

The southernmost loading dock area located in grids 20M/N, 21M/N and 22M/N was excavated in the spring of 2015. The Southern Loading Dock is depicted on figures included in Attachment 3. Three test pits were excavated in the area to determine the extents of the excavation. The test pits confirmed that there was CCPW impacted material approximately six inches beneath the asphalt. During excavation activities, CCPW lenses were observed in a sandy layer beneath the concrete slabs of the southern loading dock. As excavation progressed, the majority of the concrete loading dock and drain were removed and the soil beneath it was excavated to two feet below ground surface. The concrete was broken into 3-inch minus pieces and the rebar within the concrete was trimmed for disposal. The metal drain was sent to Cinelli Iron & Metal Company, Hackensack, New Jersey, for recycling. Once all visible CCPW was removed, post-excavation soil samples were collected for analysis, as depicted on Figure 3F, 3G, and 3I in Attachment 3. The southwest corner of the loading dock was visually inspected by a Weston Solutions representative or a CB&I geologist with permission of Weston Solutions and was deemed not impacted by CCPW. The area was backfilled to grade with certified clean backfill and restored.

5.13 Concrete Vault

During excavation activities along Linden Avenue East, where visible CCPW was identified beneath the roadway, a concrete box/vault, approximately 8-feet wide by 10-feet long, was discovered at approximately 6-feet bgs in cell 23N. The vault location is depicted on figures included in Attachment 3. Within the vault, wires and conduit were observed along with what appeared to be a black ash-like material that exhibited a faint petroleum odor and green staining. Field instrument readings (i.e., a photoionization detector) peaked at 1.5 parts per million above ambient background conditions. The concrete vault and the material were removed and broken up into 6-inch minus pieces to be loaded and transported off site for disposal. The material within the vault was loaded out as hazardous waste and transported offsite for disposal at one of the above identified facilities. The area was backfilled to grade with certified clean backfill and restored.

5.14 Concrete Samples Remaining on Site

During remediation efforts, two concrete chip samples were collected from the warehouse footer that exhibited hexavalent chromium concentrations in excess of the Cr SCC. Concrete chip sample 2H-Concrete (2'BSG) exhibited a hexavalent chromium concentration of 25.2 mg/kg and concrete chip sample 3K-SW-South2 (4'BSG) exhibited a hexavalent chromium concentration of 25.5 mg/kg. Concrete chip sample 3K-SW-South2 (4'BSG) was reanalyzed due to low MS recovery. The laboratory reported a hexavalent chromium concentration of 11.6 mg/kg. Concrete chip sample 3K-SW-South2 (4'BSG) also exhibited a vanadium concentration of 424 mg/kg, which exceeds the applicable SRS for vanadium. The final post-remediation analytical data is presented in Table 2G in Attachment 2 and depicted on Figure 3J of Attachment 3. Due to these samples being located on the footer of the building, they will be addressed as part of the remedial action associated with AOC-3 (Interior Soil and Building Footer).

5.15 Supplemental Investigation

During excavation of the site, base and perimeter sidewall samples were collected from the excavation. In addition, several base and perimeter sidewall samples had been collected during the design boring investigations completed prior to the excavation. The NJDEP *Technical Guidance for Site Investigation of Soil, Remedial Investigation of Soil, and Remedial Action Verification Sampling for Soil* (Version 1.2, March 2015) requires confirmation sampling at a frequency of one base sample per 900 square feet of excavation area and one sidewall sample for every 30 linear feet of sidewall. The existing number of base samples for Sample Grids 2B, 3B, 4W, 8P, and 8Q and the sidewall samples for grids 2U, 3W, 15O, and 17/18U was insufficient to meet the spatial coverage requirements. In addition, APTIM identified that a historical soil boring, 016_L005 (Grid 3S) exhibited a hexavalent chromium concentration in excess of the Cr SCC at a depth of 20 feet below original grade. In order to complete the post-remediation confirmation sampling, APTIM developed a Supplemental Investigation scope of work to collect the required samples.

Soil borings were advanced at the locations depicted on Figure 3L in Attachment 3 and were located immediately adjacent to samples that had been excavated or in the center of each sampling grid that had not been previously sampled. Each boring in Sample Grids 2B, 3B, 4W, 8P, and 8Q extended to depths ranging from 5 to 10 feet below grade in order to reach the base of the excavation. Soil boring logs are provided in Attachment 5. The base of the excavation was identified by the observation of a change in fill type and by the orange plastic demarcation layer that was placed at the base of the excavation. Each boring in Sample Grids 2U, 3W, 15O, and 17/18U was extended to a depth of approximately five feet in depth. An additional bottom sample, KD008, was collected on April 12, 2019 in Grid 8Q to confirm the hexavalent chromium exceedance identified in August 2013 had been removed during remedial excavation. Soil borings were advanced to the required depth using 3-inch-diameter macro-core samplers.

To confirm whether a hexavalent chromium exceedance was present at historical boring location 016_L005, the boring was over-drilled using an 8-inch diameter hollow stem auger to a target depth of 25 ft bgs as determined by the previous borings at these locations. Cuttings were characterized and logged as the auger advanced. Once the target depth was achieved, soil samples were collected from the target depth using a 3-inch diameter acetate-lined Geoprobe macro-core.

Soil encountered during the completion of the borings was logged in the field by an APTIM geologist. At each boring location, an evaluation for visible CCPW was performed by an APTIM geologist. Visible CCPW was not observed in the boring locations. The samples are reported in Attachments 1, 2 and 4. Sample locations are shown in Attachment 3 on Figure 3L. It should be noted that soil samples PPG016_2B-BOTTOM-4-4.5 and PPG016_3B-BOTTOM-4.8-5.3 were misidentified during field collection. PPG016_2B-BOTTOM-4-4.5 original surface elevation is 5.8 amsl. The sample was collected at a depth of 3.3-3.8 feet bgs at an elevation of 2.0-2.5 amsl. The surface elevation for PPG016_3B-BOTTOM-4.8-5.3 is 5.5 feet amsl. The sample was collected from a depth of 3.0-3.5 feet bgs at an elevation of 2.0-2.5 amsl. The correct depths and elevations are shown on Table 1A in Attachment 1, Table 2H in Attachment 2, and Figure 3L in Attachment 3.

5.15.1 Grid 3W

Upon arrival at the site and advancement of the soil boring, the location was determined to consist of backfill from the area of overlap of the excavations from HCC Site 112A and HCC Site 16 (see Attachment 3). A sample was collected from soil boring location 3W-BOTTOM but was not analyzed. An analysis of investigation, post-excavation, Claremont Ditch, and HCC Site 112A soil borings and samples was conducted to determine if any soil borings were completed or soil samples collected in “HCC Site 16 Grid 3W” that could be used as a base sample. However, during this review it was determined the “HCC Site 16 Grid 3W” is located off-site between the slurry wall of Site 112A and the limits of excavation of Site 112A. Based on the information contained in Hudson County Deed Book 07330, Page 00067, which is one of multiple Deed Notices in place for HCC Site 112A, this grid location is located within the restricted area for Site 112A and is being monitored under a Remedial Action Permit for Soil associated with HCC Site 112A.

5.15.2 Remedial Action Verification Sampling Adequacy

5.15.2.1 Grid 13S

A post-excavation bottom soil sample was not collected from Grid 13S during the remedial action at HCC Site 16. Soil boring 016_L010, which was advanced and sampled by Tetra Tech in 2011, exhibited an antimony concentration in excess of the RDC SRS and a hexavalent chromium concentration in excess of the Cr SCC from elevation 6.7 to 6.2 feet amsl. Concentrations of antimony and hexavalent chromium were not present in soil boring 016-L010 at concentrations in excess of the RDC SRC or Cr SCC, respectively from elevations below 6.2 feet amsl. The excavation of HCC Site 16 Grid 13S was completed to a bottom depth ranging from approximately 4 to 5 feet amsl. The sample collected from 5.7 to 6.2 feet amsl in soil boring location 016_L010 was compliant with the applicable remedial standards. The soil sample collected at this location from 5.7 to 6.2 feet amsl serves as the confirmation sample for Grid 13S, even though the sample interval was removed during soil excavation activities (for constructability reasons, not for the removal of CCPW-impacted material).

5.15.2.2 Grid 14S

The excavation limits of HCC Site 112A, which is adjacent to HCC Site 16 to the east, extended into the following HCC Site 16 Grids, as shown on the Figures in Attachment 3:

Row	Column	Row	Column
2	W, X	11	T
3	U, V, W, X	12	S, T
4	V, W, X	13	S
5	V, W, X	14	S
6	U, V, W, X	15	R, S
7	U, V, W, X	16	R, S
8	U, V, W, X	17	S, T
9	T, U, V, W, X	18	T, U

Row	Column	Row	Column
10	T, U		

Post-excavation soil samples collected in 2003 by Civil & Environmental Consultants, Inc. (CEC) during the excavation of HCC Site 112A are being incorporated to demonstrate compliance with post-excavation soil sampling requirements in HCC Site 16 Grid 14S, as depicted on Figure 3L in Attachment 3. Excerpts from CEC's July 2004 *Final Remedial Action Report, Liberty National Development Project* are provided in Attachment 3-1.

Historical soil sample PPG4-B86, which is located in Grid 14S, exhibited an estimated hexavalent chromium concentration of 63 mg/kg from elevation 9.22-8.72 feet amsl. This soil sample was excavated during the remediation of HCC Site 112A, as evidenced by the results of CEC post-excavation soil sample BE0214. CEC's Drawing M5.5-7 indicates soil sample BE0214 was collected beginning at an elevation of 7.67 feet amsl. Hexavalent chromium was reported at a concentration of 0.28 UJ mg/kg in BE0214. The results of CEC soil sample BE0214 indicate that the hexavalent chromium exceedance at historical soil boring location PPG4-B86 has been removed.

6.0 Documentation of the Protectiveness of the RA

Soil analytical results from the remedial design soil boring program and the analytical results from the RI soil boring program were used to pre-determine the depths of the excavation. These sampling results served as the post-excavation samples used to document the effectiveness and completeness of the soil remediation.

Once the excavation limits were met to the targeted depths, the NJDEP's independent technical consultant, Weston Solutions, and/or a CB&I geologist (with permission from a Weston Solutions representative) inspected the completed excavation for visible CCPW. If visible CCPW was noted, excavation would continue in half-foot increments until inspection revealed no presence of CCPW. Post-excavation samples were collected if the excavation depth extended more than 12 inches beyond the original targeted excavation limits.

The majority of the confirmation samples did not exceed the applicable soil remediation standards and/or criteria for CCPW-related contaminants. Compliance averaging techniques were employed with respect to several antimony exceedances identified in the soil samples collected for analysis. Compliance averaging documentation is presented in Attachment 14.

Because all confirmation soil samples were below their respective soil remediation standards (antimony, vanadium, thallium, and nickel) and soil cleanup criteria (trivalent and hexavalent chromium) or were compliance averaged, all CCPW impacted soil in AOC-1 has been remediated.

6.1 As-Built Diagrams

As-built drawings depicting the final extents of the excavation are provided in Attachment 15. In addition, an as-built diagram of the final site is presented in Attachment 15.

6.1.1 Excavation Grids 17N, 16O, and 17O

The July 21, 2015 *Post-Excavation As-Built Survey* included in Attachment 15, which was prepared by Maser Consulting, P.A. for Entact, LLC to present the bottom elevation of the excavation area, depicts a triangular shaped area of soil in excavation grids 17N, 16O, and 17O that appears to have not been excavated as part of the RA completed in 2014 and 2015.

AECOM prepared an IRAR, dated August 2009, to document excavation activities that were completed between December 2008 and February 2009 in two areas adjacent to the eastern side of the warehouse building. This action was completed as an interim remedial measure to allow for the construction of loading docks along the building by the property owner.

Figure 4 of AECOM's August 2009 IRAR depicts the excavation bottom elevations and post-excavation soil sample locations (Attachment 15-1). APTIM created an overlay of the excavation extent from Figure 4 of AECOM's August 2009 IRAR and the July 21, 2015 *Post-Excavation As-Built Survey* (Attachment 15-1). The excavation area defined by AECOM as "Area A" encompasses the following site excavation grids: 14L (portion); 14M-14O; 15M – 15O; 16M-16O; 17M-17O; and portions of 18M through 18O. AECOM's excavation depths within site excavation grids 17N, 16O, and 17O ranged from elevation 5 feet amsl in 17O (PE5-001) to 3.7 feet amsl in grid 16O (PEB2AS-001).

As noted in Section 5.11, an 18-inch concrete drainpipe section was uncovered and removed from this area during the 2014-2015 excavation activities. The outlet was located at the edge of the 18M/N border and the inlet was located at the corner of 16O and 16P cells. CCPW was identified in this area at four feet bgs and was identified beneath the pipe. The pipe was roughly 40 feet long running west to east in grid 17N. The area was remediated and the piping was replaced.

6.2 Description of Site Restoration Activities

Upon completion of the remedial action (excavation of the CCPW impacted soil) at the site, restoration activities were implemented. Copies of weight tickets for the clean backfill imported to the site are provided in Attachment 16.

The contractor cleared the entire site of all generated trash. All equipment and temporary facilities were removed from the site including temporary electric service, phone and internet hookups.

Asphalt and approximately four inches of ¾-inch gravel was placed as a final grade and spread on top of the compacted backfill used to fill the excavation. Certified fill materials used during the restoration activities included clean stone fines/screenings, quarry process, ¾ stone, NJDOT RCA/DGA, and DGA/Type 5A. The southern loading dock to the Warehouse was replaced in kind.

The generator pad and retaining walls in the southwestern part of the site were restored to original form pre-remediation. Two other retaining walls were replaced and painted in kind.

Guardrail at the southern site entrance along Linden Avenue was replaced in kind and painted yellow. Temporary fencing around the site perimeter to the east of the site entrance (Linden Avenue East) was replaced with eight-foot high chain link fence.

6.3 Total Remedial Action Cost

The total cost of the Remedial Action at Site 16 was approximately $13,334,050. The number includes the costs for consultants, site investigation, remedial design, contractors, excavation equipment, transportation and disposal of impacted soil, clean backfill, dewatering, water disposal, site restoration, construction oversight and engineering.

6.4 Documentation of Waste Generation and Disposal

During the excavation, 894 truckloads (approximately 23,204 tons) of CCPW impacted non-hazardous material were removed from the site for disposal. An additional 925 truckloads and roll-off containers (approximately 22,705 tons) of CCPW-impacted hazardous fill material were removed from the site for disposal. Some manifest weights were illegible and weights were estimated by averaging truck weights from the prior load out day. As tonnages were approximated not all numbers are precise. Soil waste manifests and summary tables for the hazardous and non-hazardous soil disposal are provided in Attachment 8.

Surface water runoff, storm water, and groundwater entering the excavation and decontamination water were transferred utilizing pumps into closed-top fixed-axle storage (frac) tanks. After receiving analytical resulting indicating the water in the frac tanks was non-hazardous, WTS coordinated the transportation and disposal of the water from the frac tanks to the PVSC wastewater treatment plant facility located in Newark, New Jersey. A total of 422 tanker loads (approximately 2,668,600 gallons) of impacted storm water, groundwater, and decontamination water were removed from the site. Disposal tickets for all impacted water disposed offsite are included in Attachment 8.

Non-Hazardous

- Cumberland County Improvements Authority Landfill, Deerfield Township, New Jersey

Hazardous

- Stablex, Blainville, Québec, Canada
- EQ Detroit Inc., Detroit, Michigan
- EQ- Michigan Disposal Waste Treatment Plant, Belleville, Michigan
- EQ- Wayne Disposal Inc. Site #2 Landfill, Belleville, Michigan
- EQ Envirite, York, Pennsylvania

Transite Pipe (Hazardous)

- EQ - Wayne Disposal Inc. Site #2 Landfill, Belleville, Michigan

Metal

- Cinelli Iron & Metal Company, Hackensack, New Jersey, for recycling

6.5 Documentation of Source, Type, Quantities, and Location of Fill

A total of 1,799 truckloads (approximately 44,937, tons) of clean fill material were imported to the site from Weldon Material Inc.'s Fanwood Crushed Stone Company Quarry of Watchung, New Jersey. The material consisted of stone fines and screenings from their stone crushing operations. Copies of weight tickets for the clean fill imported to the site and a clean material certification for this material from Weldon Materials, Inc. are provided in Attachment 16.

Approximately 225 tons of clean clay material was imported to the site from the Raritan Center site located at 1180 King George Road in Edison, New Jersey. Documentation for this material from the Raritan Center is provided in Attachment 16.

Approximately 100 tons of clean NJDOT DGA Type 5A and 340 tons of stone screenings and fines were imported from Weldon Material Inc.'s Lake Hopatcong, New Jersey quarry. Copies of the weight tickets are included in Attachment 16.

Approximately 47 tons of ASTM #3 stone was imported from Tilcon New York, Inc.'s Mount Hope Quarry. Copies of the weight tickets are included in Attachment 16.

Approximately 26 tons of ASTM #4 1-1/2 inch stone was imported from Tilcon New York, Inc.'s Pompton Lakes, New Jersey Quarry. Copies of the weight tickets are included in Attachment 16.

6.6 Identification of Required Permits and Authorizations

The permits and approvals needed for the remedial action are listed below.

- A Soil Erosion and Sediment Control Permit from Hudson-Essex-Passaic County Soil Conservation District (Attachment 10)
- Jersey City Temporary Construction Trailer Permit, City of Jersey City
- Jersey City Traffic Control Permit, City of Jersey City (Attachment 10)
- Plan Review for potential impact to city storm water infrastructure on site, Jersey City Municipal Utility Authority
- Electrical Service Permit – Field Trailer, City of Jersey City
- Review of RAWP for potential impact to utility poles, Public Service Electric and Gas Company
- Well Abandonment, NJDEP (Attachment 10)
- Construction dewatering permit, PVSC (Attachment 10)
- NJPDES Discharge to Surface Water General Permit for Construction Activity - Storm water (Attachment 10)
- Coastal Permit #15 & Freshwater Wetland General Permit #4 (Attachment 10)
- Jersey City Street Opening/Occupancy Permit (Attachment 10)
- NJDOT Highway Occupancy Permit (Attachment 10)

All necessary permits were obtained prior to initiation of activities covered by the permits.

7.0 Reliability of Data: Validation and Usability

The purpose of this section is to ensure that analytical data produced by the laboratory are presented in a clear and useable format. In addition, data quality and technical usability was evaluated prior to data use. The samples collected at the site were analyzed according to USEPA SW-846 analytical methodologies, in which data reduction and reporting schemes are well developed and clearly defined. The employment of this method ensures comparability with other similarly analyzed environmental samples. Reduction, validation and reporting specifications for these analyses are detailed below. Validation Reports for all post-remedial data packages are included in Attachment 11A.

Data, as presented in the analytical data packages included as Attachment 11B, was primarily reviewed and validated using the following combination of method-specific criteria with professional judgement, as appropriate:

- New Jersey Department of Environmental Protection (NJDEP) Standard Operating Procedure: Quality Assurance Data Validation of Analytical Deliverables Inorganics (Based on USEPA SW-846 Methods), SOP No. 5.A.16 (NJDEP, 2002);
- United States (US) Environmental Protection Agency (EPA) "National Functional Guidelines for Inorganic Data Review", OSWER Publication 9240.1-51, EPA540-R-10-011, January 2010 (US EPA, 2010);
- US EPA "ICP-AES Data Validation, SOP No. HW-2a, Revision 15" (USEPA, 2012);
- NJDEP Standard Operating Procedure (SOP) for Analytical Data Validation of Hexavalent Chromium (NJDEP, 2009).
- NJDEP, Data of Known Quality Protocols Technical Guidance, Version 1.0, April 2014.
- NJDEP, Data Quality Assessment and Data Usability Evaluation Technical Guidance, Version 1.0, April 2014.
- NJDEP, Analytical Laboratory Data Generation, Assessment and Usability Technical Guidance, Version 1.0, April 2014.
- NJDEP, Quality Assurance Project Plan Technical Guidance, Version 1.0, April 2014.

With regard to historical laboratory analytical soil data (ICF Kaiser), the laboratory analytical data reports produced to detail the historical soil data collected during past RIs of the site were not available for review. Boring logs documented the visual identification of CCPW nodules and the reported summary soil analytical results confirmed that site soils were impacted by hexavalent and trivalent chromium and required remediation and were thus incorporated into the Remedial Action Work Plan and Cut Sheets for the site. As the remedial action progressed, virtually the entire exterior extent of the site was excavated horizontally lot line to lot line and beyond, as well as to vertical depth and re-assessed by collecting post-excavation samples to document compliance with the soil remediation standards. Therefore, the data quality of the historical ICF Kaiser soil laboratory analytical data is not critical to meeting the project data quality objectives of determining whether remedial action was warranted, nor was it critical for documenting or determining non-CCPW-impacted vertical or horizontal extents. The presence and extent of contamination has been acknowledged, accepted, documented, and addressed.

Historical laboratory analytical soil data generated during Tetra Tech's RI that was relied upon to evaluate completion of remedial excavation activities was validated by Tetra Tech, as documented in Tetra Tech's 2013 RIR, and accepted by the NJDEP.

The investigator has confidence that the historical summary laboratory analytical soil data is usable for its intended purpose as part of a remedial action to demonstrate non-compliance with applicable standards and criteria that warrants remedial action. As the DQO has been met, this laboratory analytical data has been relied on and used to support defensible conclusions regarding the site.

The post-excavation analytical data have been found to be of adequate quality and of sufficient precision, accuracy, representativeness, comparability, completeness, and sensitivity for the intended purpose. Data associated with parameters that did not meet quality control specifications or compliance requirements, were qualified in accordance with US EPA Region II/NJDEP specifications/guidelines, as appropriate. No gross QC failures were noted and no data were rejected except as noted below. The investigator has confidence that the laboratory data are usable for their intended purpose as part of a remedial action to demonstrate compliance with applicable standards and criteria and close out AOCs. As the data quality objectives have been met, these analytical data may be relied on with confidence and used to support defensible conclusions regarding the site. Although some analytical data may have been qualified, the data generated during the course of the work detailed here were generally found to be usable.

8.0 Receptor Evaluation

In order to assess potential impacts to human and environmental receptors associated with the site, a receptor evaluation was conducted. As outlined in the NJDEP *Technical Requirements for Site Remediation* (N.J.A.C. 7:26E), sensitive receptors are divided into four primary categories. The four receptor evaluation categories are summarized below:

- **Land Use**: Sensitive populations such as schools, playgrounds, daycare facilities, etc. within 200 feet of the subject property must be identified and evaluated.
- **Groundwater**: Groundwater use near an impacted property must be evaluated by conducting a well search. Further, any potable/domestic supply wells identified within 250 feet upgradient, 500 feet side gradient, or 500 downgradient feet of a known point of groundwater contamination must be sampled.
- **Vapor Intrusion**: If volatile organic compounds are present in groundwater above the NJDEP Groundwater Screening Levels and/or free phase petroleum product is identified on a property and structures are located near the impacted media, vapor intrusion must be evaluated.
- **Ecological**: An ecological evaluation consists of identifying contaminants of concern (COCs) on an impacted property, identifying sensitive ecological receptors on or adjacent to an impacted property, and identifying potential migratory pathways between the COCs and any identified sensitive ecological receptors.

Each of the above referenced receptor categories are evaluated in the following subsections. A stand-alone copy of the *Receptor Evaluation Form* will be provided to the NJDEP separately for administrative purposes.

8.1 Land Use

The site is located in an industrialized area of Jersey City, New Jersey. No sensitive land use populations were identified on the site or within 200 feet of the subject property, with the exception of the Jersey City Recreation facility located to the northeast.

8.2 Groundwater

PPG's responsibilities for groundwater contamination associated with the site will be limited to CCPW-related contaminants. A well search was completed in January 2018 to identify potentially potable wells location within the distances specified in N.J.A.C. 7:26E-1.14. Eight potentially potable wells were identified within a ½-mile radius of the Site. In order to evaluate groundwater usage pursuant to NJDEP (N.J.A.C. 7:26e-1.14(a)2 et seq.), APTIM conducted a door-to-door survey. On January 24, 2017, letters with a questionnaire were delivered to properties located within 250-feet upgradient, 500-feet side gradient, and 500-feet downgradient of the Site. The results of the well survey did not result in the identification of additional monitoring wells.

8.3 Vapor Intrusion

PPG's responsibilities for groundwater contamination associated with the site are limited to CCPW-related contaminants, which do not pose a vapor intrusion risk.

8.4 Ecological

In accordance with the requirements set forth in N.J.A.C. 7.26E-1.16, an Ecological Evaluation was completed at the site in May 2014. The ecological evaluation consists of identifying sensitive ecological receptors on or adjacent to an impacted property, COCs on an impacted property, and identifying potential migratory pathways between the identified sensitive ecological receptors and COCs. An Ecological Evaluation Report was submitted to the NJDEP in September 2014. The NJDEP approved the Ecological Evaluation Report in a letter dated October 3, 2014.

The sensitive ecological receptors identified are the man-made Claremont Ditch along the northern border of the site and a wetland which was inadvertently created during a previous remediation. The NJDEP Landscape Project Critical Wildlife Habitat database also identifies Claremont Ditch, the off-site created wetland, plus a 2.5-acre man-made pond approximately 700 feet to the east within the golf course. The remainder of the site is surrounded on two sides by roads, asphalt paved driveways, a layer of 3/4 inch stone parking area and a golf course. As no Contaminants of Potential Ecological Concern (COPECs) are present, there are no contaminant migration pathways present at or off site other than the areas associated with and near the Claremont Ditch.

Antimony, chromium, nickel, and vanadium are considered COPECs in sediment since one or more detected concentrations exceed the Ecological Screening Criteria (ESC). Hexavalent chromium was also detected in a sediment sample and is considered a potential COPEC, even though there is no available ESC. The unfiltered surface water samples obtained from the Claremont Ditch were all below reporting detection.

Based upon the analytical findings of sediment and surface water samples, benthic invertebrate communities in Claremont Ditch may be exposed to concentrations of contaminants that may result in adverse effects. However, due to the construction of the golf course there is no surface water flow off site from Claremont Ditch to the other environmentally sensitive areas under normal conditions. Additionally, the lack of detected concentrations in the unfiltered surface water samples indicates little suspension of sediments in surface water. Thus, the potential migration of contaminants from sediment in Claremont Ditch to the golf course pond unlikely.

Wildlife may be exposed through dietary consumption of contaminants present in sediment or wetland soils at concentrations greater than background. In order to assess the potential risks to various feeding guilds from sediment or sediment-related constituents, a food web model was constructed for the following target species: the Great Blue Heron (*Ardes herodeus*) and the Mallard Duck (*Anas platyrhynchos*). These food web models were used to evaluate wildlife exposure to COPECs present at concentrations above ESCs.

These two species are aquatic-based species and were selected as representative species for other avian wildlife within the same feeding guilds. These two species may be exposed to constituents present in the sediment through bioaccumulation in dietary items: aquatic plants, small fish, and aquatic vertebrates and invertebrates.

Ingestion rates, exposure factors, and other natural history parameters are from the Wildlife Exposure Factors Handbook (USEPA, 1993). Literature-derived bioconcentration factors (or bioaccumulation factors or bio transfer factors) were used to estimate COPEC concentrations in food items (e.g., aquatic plants and invertebrates). The bioaccumulation factors (BAFs) for aquatic plants and aquatic invertebrates for the COPECs. The sediment-to-aquatic plant bioaccumulation factors were obtained from the USEPA's Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities (1999). In accordance with USEPA (1999), inorganic COPECs without BAFs used the geometric mean of the available inorganic BAFs. The sediment-to-aquatic invertebrate bioaccumulation factors were obtained from the USEPA's Screening Level Ecological Risk Assessment Protocol for Hazardous Waste Combustion Facilities (1999). The soil/sediment ingestion rate for the receptor species is most often represented as a percentage of a receptor species' diet expressed as a ratio of dry weights.

The mallard, or other herbivorous wildlife, may be exposed to contaminants in Claremont Ditch through ingestion of aquatic plans that may have accumulated contaminants from the sediment as well as through incidental ingestion of sediments themselves during feeding behavior.

The Great Blue Heron, or other piscivorous or invertivorous wildlife, may be exposed to contaminants in Claremont Ditch through ingestion of fish or invertebrates that may have accumulated contaminants from the sediment as well as through incidental ingestion of sediments themselves during feeding behavior. As discussed previously, the exposure model for the Great Blue Heron conservatively assumed that the diet was 100% benthic invertebrates and not fish; benthic invertebrates would be expected to accumulate these contaminants at higher concentrations from the sediment due to the greater degree of exposure to the sediment and the lack of biomagnification for these contaminants.

The Ecological Evaluation concluded the potential risk to wildlife foraging in Claremont Ditch is considered minimal. Though the conservative wildlife exposure models indicated a potential risk for wildlife that are only feeding on benthic invertebrates only from the point of maximum sediment concentrations in Claremont Ditch, no significant risk was modeled when the small size of Claremont Ditch relative to the foraging area of wildlife was considered.

Based on the considerations and the information provided in the ecological evaluation report, it is concluded that site constituents are unlikely to have a significant adverse effect on sensitive ecological receptors or habitats, and further ecological assessments at Claremont Ditch are not warranted or recommended.

8.5 Riparian Restoration Monitoring

Portions of the site restoration activities occurred within the riparian zone (50') of the Claremont Ditch and in a man-made inadvertently created wetland. The removal activities and subsequent restoration was performed in accordance with the approved NJDEP Land Use Permits (Coastal Permit #15 & Freshwater Wetland General Permit #4 (Attachment 10)). As specified, all of these areas were restored to uplands. The remediation and restoration activities were completed in March 2015. The restored areas are being monitored for three years (2016 - 2018) to ensure mature growth and re-establishment of native vegetation within the impacted riparian zone as specified in the conditions of NJDEP permits.

After the second year of monitoring the restoration, areas are performing well. The results of the second annual vegetation monitoring event indicate that the site is progressing toward the third-year target of 85 percent coverage of native species within the restoration area. The current conditions have the native species coverage between 75 to 80 percent. It is expected that the number of native species within the restoration area will increase as desirable species volunteer into the site.

The NJDEP Division of Land Use and Regulation's Mitigation Unit is requiring PPG to undertake additional corrective actions regarding plantings, seed mixes, and invasive species management with regard to the riparian restoration monitoring. Upon implementation of the agreed upon corrective actions the final monitoring report will be completed and submitted to the NJDEP.

9.0 Conclusions and Recommendations

9.1 AOC-1: Exterior Soil

Based on the results of the soil sampling conducted at the site including the post-excavation sampling completed, as well as the documentation of the final grades of the excavation, and the supplemental investigations in 2017 and 2019, this remedial action is found to be complete for AOC-1. The remedial action has removed CCPW-impacted soil and fill materials from AOC-1 in a manner that is protective of public health, safety, and environment. Impacted materials have been replaced with clean fill from a New Jersey licensed quarry. Based on the results of the remedial action detailed herein, PPG requests that the NJDEP acknowledge that the soil remediation associated with AOC-1 is complete.

Proposed RA for AOC-3 and AOC-4, which consist of institutional and engineering controls, were presented in a *Remedial Action Work Plan, AOC-3: Interior Soil, AOC-4: Linden Avenue East*, which was submitted to the NJDEP in October 2018.

9.2 AOC-2: Groundwater

Prior to the remedial action, groundwater was found to be impacted by CCPW-related metals. PPG completed the RI of CCPW-related metals in shallow groundwater via the installation of an offsite groundwater monitoring well. The completion of the RI and proposed RA related to groundwater are being addressed under separate submittals.

10.0 References

The following documents, publications, maps, etc. were used as source materials for this RAR:

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