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# Remedial Action Report

## Final

**Hudson County Chromate Site 65**

**Burma Road and Morris Pesin Drive**

**Jersey City, Hudson County, New Jersey**

**Program Interest Number G000008693**

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## List of Acronyms

ACO	Administrative Consent Order
AECOM	AECOM Environmental, Inc.
amsl	above mean sea level
APTIM	Aptim Environmental & Infrastructure, Inc.
bgs	below ground surface
CB&I	CB&I Environmental and Infrastructure, Inc.
CCPW	Chromate Chemical Production Waste
COPEC	Contaminants of Potential Environmental Concern
COPR	Chromite Ore Processing Residue
CrSCC	Chromium Soil Cleanup Criteria
DPW	Department of Public Works
EDR	Environmental Data Resources, Inc.
EE	Ecological Evaluation
EPI	Environmental Probing Investigations, Inc.
GWQS	Ground Water Quality Standard
HCC	Hudson County Chrome
IGW SSL	Impact to Groundwater Soil Screening Level
JCMUA	Jersey City Municipal Utilities Authority
JCO	Judicial Consent Order
LSRP	Licensed Site Remediation Professional
MDL	method detection limit
mg/kg	milligrams per kilogram
MMP	Materials Management Plan
NAVD	North American Vertical Datum
NGA	Non-Garfield Avenue Group
NJDEP	New Jersey Department of Environmental Protection
RAR	Remedial Action Report
RDC SRS	Residential Direct Contact Soil Remediation Standard
RI	Remedial Investigation
RIR	Remedial Investigation Report
Sanborn Maps	Sanborn® Fire Insurance Maps

TAL	Target Analyte List
Tetra Tech	Tetra Tech, Inc.
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VI	Vapor Intrusion
VOCs	Volatile Organic Compounds

## Executive Summary

On behalf of PPG, Aptim Environmental & Infrastructure, Inc. (APTIM) has prepared this *Remedial Action Report* (RAR) to satisfy the requirements of the January 9, 2018 Settlement Agreement between the New Jersey Department of Environmental Protection (NJDEP), PPG, the City of Jersey City, and the Jersey City Municipal Utilities Authority (JCMUA) regarding the Site. The Settlement Agreement was executed to redefine the boundary of Hudson County Chrome (HCC) Site 65 (the Site) and memorialize PPG's responsibilities for the remediation of contamination encountered during subsurface utility work by the City of Jersey City and/or the JCMUA within the boundaries of the Site.

This RAR was prepared in accordance with the NJDEP's *Administrative Requirements for the Remediation of Contaminated Sites* (N.J.A.C. 7:26C), the NJDEP's *Technical Requirements for Site Remediation* (N.J.A.C. 7:26E), and applicable NJDEP guidance documents to present the remedial action selected for soil at the Site. The remedial action consists of the implementation of institutional and engineering controls that prevent exposure to contamination at the Site via the direct contact pathway. Additional information pertaining to the procedures required during the completion of subsurface work within the boundaries of the Site are also included.

Previous soil remedial actions relative to HCC Site 63, which is located adjacent to HCC Site 65, identified the presence of visible Chromate Chemical Production Waste (CCPW) waste in the subsurface in portions of HCC Site 65. Visible CCPW was observed under the western shoulder of Burma Road at multiple locations, which was subsequently removed during the remedial excavation of HCC Site 63 conducted by PPG. The HCC Site 63 soil remedial excavation progressed into Burma Road in February 2015. Visible CCPW was observed in the excavation sidewall at the boundary of HCC Site 63 along Morris Pesin Drive. The visible CCPW was observed in isolated areas and within approximately two feet of the ground surface. The observed CCPW along Morris Pesin Drive was not removed by PPG during the remedial excavation work due to the proximity of an existing 16-inch municipal water line owned by JCMUA. During the completion of delineation soil borings completed by PPG, non-CCPW metals were detected within the rights-of-way of Burma Road and/or Morris Pesin Drive. Evidence of additional potential contaminants, in the form of polycyclic aromatic hydrocarbons (PAHs), chlorinated organic compounds (CVOCs), and petroleum hydrocarbons, was observed within the rights-of-way of Burma Road and/or Morris Pesin Drive through visual and/or olfactory observation and/or field instrumentation measurements. Soil samples were not collected or analyzed from locations of suspected PAHs, CVOCs, and petroleum hydrocarbons to evaluate their presence in excess of applicable remediation standards.

A *Remedial Action Permit for Soil* application is being submitted concurrently to the NJDEP with this RAR to establish institutional and engineering controls at Site 65 as the selected restricted use remedy. PPG requests the administrative closure of the 65 by the NJDEP through the issuance of a Judicial Consent Compliance Letter upon issuance of a *Remedial Action Permit for Soil* for the Site.



## 1.0 Introduction

In 1990, PPG and the NJDEP entered into an *Administrative Consent Order* (ACO) (NJDEP, 1990) to investigate and remediate locations where 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*, also referred to as the Judicial Consent Order (JCO) (Superior Court of New Jersey Law Division – Hudson County, 2009), with the purpose of remediating soils and sources of contamination at these Hudson County Chromate (HCC) sites (Superior Court of New Jersey Law Division – Hudson County, 2009). 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 are conflicts between the two documents.

As part of the JCO, a judicially enforceable master schedule was created, establishing Remedial Action (RA) milestone dates for the New Jersey (NJ) Chrome Remediation Sites. Since its establishment in 2009, the master schedule has been revised several times. The most recent revision to the master schedule was finalized on July 31, 2018.

On January 9, 2018, the NJDEP, PPG, the City of Jersey City, and the Jersey City Municipal Utilities Authority (JCMUA) entered into a Settlement Agreement regarding HCC Site 65 (the Site). The Settlement Agreement was executed to redefine the boundaries of the Site and memorialize PPG's responsibilities for the remediation of contamination encountered during subsurface utility work involving the 16-inch municipal water line by the City of Jersey City and/or the JCMUA within the boundaries of the Site.

Aptim Environmental & Infrastructure, Inc. has prepared this *Remedial Action Report* (RAR) on behalf of PPG, to present the remedial action for Non-Garfield Avenue (NGA Group) HCC Site 65 in Jersey City, Hudson County, New Jersey.

### 1.1 Objectives

The objectives of this RAR are to:

- Memorialize the soils remedy for Site 65
- Present all data collected by PPG in Burma Road and Morris Pesin Drive to date
- Provide documentation that the soils remedy for Site 65 is protective of human health and the environment

### 1.2 Organization of Document

This RAR is organized as follows:

- Section 1 provides the introduction and objectives of the RAR
- Section 2 identifies background information relative to the Site and identifies the applicable remediation standards/criteria associated with the Site

- Section 3 provides information relative to the environmental setting of the Site;
- Section 4 provides a summary of historical soil investigations
- Section 5 describes the remedial action and remediation protocols
- Section 6 provides a description of the data validation process
- Section 7 describes the results of a receptor evaluation
- Section 8 provides conclusions and recommendations relative to the Site and
- Section 9 provides a list of references cited in the preparation of the RAR

Supplemental information is presented in the Appendices.

## 2.0 Background Information

### 2.1 Site Description

The Site consists of portions of Burma Road and Morris Pesin Drive (Figure 1) in Jersey City, Hudson County, New Jersey. The Site contains approximately 5,601 square feet or 0.129 acres. The boundaries of the Site were formalized with the execution of the January 9, 2018 Settlement Agreement between the NJDEP, PPG, the City of Jersey City, and the JCMUA. The Settlement Agreement was executed to redefine the boundaries of the Site and memorialize PPG's responsibilities for the remediation of contamination encountered during subsurface utility work involving the 16-inch municipal water line by the City of Jersey City and/or the JCMUA within the boundaries of the Site. PPG has an obligation to remediate CCPW-related contamination pursuant to the July 19, 1990 ACO and June 26, 2009 JCO, as amended.

### 2.2 Site History

Information on previous Site ownership and use was obtained from review of historical aerial photographs, historical topographic maps, and Sanborn® Fire Insurance Maps (Sanborn Maps) obtained from Environmental Data Resources, Inc. (EDR) of Shelton, Connecticut. Aerial photographs dated 1931, 1940, 1943, 1951, 1954, 1961, 1966, 1974, 1981, 1985, 1991, 1994, 1995, 2006, 2008, 2009, 2010, and 2011 were readily available for the Site. Sanborn Maps dated 1898, 1912, 1950, 1979, 1988, 1991, 1994, 1995, 1999, 2001, 2002, 2003, 2005, and 2006 were readily available for the Site. Topographic Maps dated 1891, 1900, 1905, 1925, 1947, 1955, 1967, and 1981 were also available from EDR for the area of the Site.

Historical aerial photographs were obtained from the Jersey City Library dated 1961, 1964, 1975, and 1984 and maps dated 1919 and 1928. Additional Topographic Maps dated 1958, 1964, 1969, and 1982 and aerial photographs dated 1979 and 1987 were available from [www.historicalaerials.com](http://www.historicalaerials.com). Additional maps for 1919 and 1928 were available from the Rutgers Historical New Jersey Maps website. In December 2015, a stereoscopic review of historical aerial photographs was performed at the NJDEP for the years 1940, 1951, 1953, 1961, and 1978.

In December 2015, a file review was completed at the Jersey City Department of Public Works (DPW) to determine if the DPW had information on the dates that Burma Road and Morris Pesin Drive were constructed and what materials were used as a road base. Mr. Chris Piersa of the DPW said that he had no information on the date of construction or materials used. Mr. Andrew Lim of the Jersey City Department of Architecture, Engineering, Traffic, and Transportation also was not able to identify a date when Burma Road or Pesin Drive were paved, but noted that a new sewer had been installed in Burma Road in 1962.

Based on a review of Sanborn Maps, the Site was developed as early as 1879 as the National Docks Railway (four to five rail lines) that serviced the National Storage Company's Oil Yards to the east, west, and south of present day Burma Road and Morris Pesin Drive. National Storage Company's Oil Yards consisted of several large aboveground petroleum storage tanks to the east and west of the Site with several buildings, including a Machine Shop and a Locomotive House, located to the east of the Site.

The present day location of Burma Road was formerly owned and operated by the National Docks Railroad from 1879 through 1898. From 1898 through 1957, Burma Road was owned and operated by the Lehigh Valley Railroad. From 1957 through 1960, Burma Road was owned and operated by Burma Realty. In 1960, Burma Realty dedicated Burma Road to the City of Jersey City, who has owned and operated Burma Road since.

The aboveground storage tanks had been removed from the property adjoining the Site to the east and west by 1912. By 1919, the property to the east of Burma Road was in use by the Cork Insulation Company (1919 Rutgers University Map collection). By 1922, the property to the east of Burma Road was in use by the Keystone Refractories Company for the manufacturing of firebrick and heat-resistant cement. This operation included a large coal bin for the storage of coal that fueled the kiln. Sanborn Maps depict two large horizontal steam boilers within the main building. A 25-foot chimney was identified on the Sanborn Maps. This facility was in operation from at least 1922 through at least 1964.

Burma Road remained occupied by railroad tracks through 1950. Morris Pesin Drive appears undeveloped. An unpaved roadway was observed on a 1928 map from the Rutgers University Map collection. This roadway appeared to provide access to the Keystone Refractories Facility. This unpaved roadway also appeared in the 1940 through 1954 aerials to the southeast of the present day location of Burma Road. This road appeared to provide access into Keystone Refractories and continued into the present day footprint of Morris Pesin Drive. Based on the review of historical Sanborn Maps, Topographic Maps, and aerial photographs, it appears that both Burma Road and Morris Pesin Drive may have been paved by 1961.

### **2.3 Surrounding Land Use**

The areas adjacent to and surrounding the Site are characterized as commercial, light industrial and recreational. A home furniture manufacturer/warehouse, storage facility, and a diner are located to the east of Site 65 across Burma Road. The Site is bordered to the north and east by HCC Site 63 with the New Jersey Turnpike Hudson County extension beyond. Liberty National Golf Course is located south of the site.

### **2.4 Physical Setting**

The Project Area is located in an urban area in Jersey City, Hudson County, New Jersey. The Project Area is located on the western shoulder of Burma Road and northern shoulder of Morris Pesin Drive. The Project Area consists of a former railroad and former industrial businesses.

There is little topographic relief within the Project Area, where the topography is an average of 8 feet relative to the North American Vertical Datum of 1988 (NAVD 88). The topography east of the Project Area is flat, extending to the Hudson River and Upper New York Bay. Due to highly compacted surface soils and other impervious features, storm water runoff within the Project Area is primarily channeled into the municipal storm sewer system (ENSR, 2006).

### **2.5 Historical Industrial and Regional Development**

The Project Area is located in a section of Jersey City that experienced significant industrial development in the early 1900s. To create more available land, developers filled the surrounding marshlands and estuarine areas. Research indicates that the fill included construction spoils consisting of silts and sands, garbage from New York City, and ship ballast. It is unknown what specific fill material

was used in which locations. The meadow mat associated with wetland areas was covered with fill materials and/or removed for building foundations or other improvement projects (ENSR, 2006).

## 2.6 Regulatory History

Investigation and remediation activities at the Site are regulated by the NJDEP, but are administered by the Superior Court of New Jersey under an ACO and a JCO. PPG and the NJDEP entered into an ACO in 1990, requiring the investigation and remediation of locations where CCPW or CCPW-impacted materials related to former PPG operations may have been present. On June 26, 2009, NJDEP, PPG and the City of Jersey City entered into a JCO with the purpose of assessing and remediating sources of contamination and impacted soil and groundwater at PPG's HCC sites.

On January 9, 2018, the NJDEP, PPG, the City of Jersey City, and the JCMUA entered into a Settlement Agreement regarding the Site. The Settlement Agreement was executed to redefine the boundaries of the Site and memorialize PPG's responsibilities for the remediation of contamination encountered during subsurface utility work involving the 16-inch municipal water line by the City of Jersey City and/or the JCMUA within the boundaries of the Site.

## 2.7 Contaminants of Concern

The remedial actions 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 as amended August 6, 2018.
- N.J.A.C. 7:26D – *Soil Remediation Standards*, dated September 2017.
- N.J.A.C. 7:26E – *Technical Requirements for Site Remediation*, as amended 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 *Development of Site-Specific Impact to Groundwater Soil Remediation Standards Using the Synthetic Precipitation Leaching Procedure (SPLP) Guidance*, dated November 2013.
- NJDEP Memorandum from Lisa P. Jackson to Irene Kropp, Subject: Chromium Moratorium, February 8, 2007.
- NJDEP Chromium Soil Cleanup Criteria (CrSCC), 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.
- Settlement Agreement between NJDEP, PPG, the City of Jersey City, and the JCMUA, January 9, 2018

## 2.8 Soil Remediation Standards/Criteria

Soil Remediation Standards for CCPW-related metals for the Site are based on the September 2017 NJDEP Residential Direct Contact Soil Remediation Standards (RDC SRS)<sup>1</sup>, the NJDEP's Letter of

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<sup>1</sup> N.J.A.C. 7:26D, Remediation Standards, last amended September 18, 2017.

February 8, 2007 related to the lifting of the Chromium Moratorium<sup>2</sup>, and the NJDEP's September 2008 CrSCC document<sup>3</sup>.

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 the CCPW-related metals Antimony, Nickel, Thallium, and Vanadium. Concentrations of Target Analyte List (TAL) Metals for samples discussed in this RAR were compared to the September 2017 NJDEP RDC SRS.

The NJDEP Default Impact to Groundwater Soil Screening Levels (IGW SSLs) are additional criteria for Antimony, Nickel, and Thallium and the remainder of the TAL Metals list, except for when SPLP data was used to establish a site-specific IGW SSL. The SPLP was used to determine a site-specific impact-to-groundwater concentration for nickel of 205 milligrams per kilogram (mg/kg) (see Alternative or New Remediation Standard and/or Screening Level Application). The groundwater elevation used for the evaluation of the Impact to Ground Water (IGW) exposure pathway is 5.2 feet NAVD. This elevation was calculated using historical and recent groundwater elevation measurement data from monitoring wells associated with HCC Site 63 that are nearest to Site 65.

The soil remediation standards/criteria for CCPW-related contamination include the following values:

**Table 2-8**  
**Soil Remediation Screening Levels/Standards/Criteria**  
**HCC Site 65**  
**Burma Road and Morris Pesin Drive**  
**Jersey City, Hudson County, New Jersey**  
**Program Interest G00008693**

<b>Metals</b>	<b>Default IGW SSL / (Site-Specific IGWSRS) (mg/kg)</b>	<b>RDC SRS / (ARS) (mg/kg)</b>	<b>CrSCC (mg/kg)</b>
Trivalent chromium	NA	NA	120,000
Hexavalent chromium	NA	NA	20
Antimony	6	31	NA
Nickel	48 / (205*)	1,600	NA
Thallium	3	NA	NA
Vanadium	NA	78 / (390**)	NA

**Notes:**

NA = Not Applicable

Default IGW SSL = Impact to Groundwater Soil Screening Level (November 2013)

IGWSRS = Impact to Groundwater Soil Remediation Standard

RDC SRS = Residential Direct Contact Soil Remediation Standards (September 2017)

ARS = Alternative Remediation Standard

CrSCC = Chromium Soil Cleanup Criteria

mg/kg = milligrams per kilogram

<sup>2</sup> NJDEP Memorandum from Lisa P. Jackson to Irene Kropp, Subject: Chromium Moratorium, February 8, 2007.

<sup>3</sup> NJDEP Chromium Soil Cleanup Criteria, September 2008, revised April 2010.

\*Nickel Site-Specific IGWSRS calculated using SPLP laboratory methods

\*\* The use of the USEPA Regional Soil Screening Level of 390 mg/kg for vanadium is proposed as an alternative remediation standard for the site. Based on: <https://www.epa.gov/risk/regional-screening-levels-rsls-users-guide-november-2015>

This RAR addresses only the soil impacts for which PPG is responsible for as defined in the ACO, JCO, as well as those contaminants it has agreed to address pursuant to the January 9, 2018 Settlement Agreement. The remediation standards for the non-CCPW related contaminants identified under the January 9, 2018 Settlement Agreement will be the RDC SRS, as amended.

## 3.0 Environmental Setting

### 3.1 Topography

The United States Geological Survey (USGS) Jersey City, NJ topographic quadrangle map presents the regional topography for the Project Area. Site 65 has little topographic relief, with ground surface along Burma Road ranging from El 6.4 to 8.2 feet NAVD 88. However, just to the west of abutting Site 63, the topography rises approximately 20 to 40 feet in elevation within several hundred yards of the Project Area. The elevation of the Project Area currently ranges from El 6.4 to 15.6 feet NAVD88.

### 3.2 Geology

A description of the regional and project area geology is presented below.

#### 3.2.1 Regional Geology

The regional geology includes unconsolidated sediments of Recent and Pleistocene age. According to the New Jersey Geologic Survey, these sediments include alluvial, estuarine, eolian (windblown), and glacial lacustrine deposits, as well as glacial till of late Wisconsin age. The Triassic age bedrock of the Newark Group (Lockatong and Stockton formations) throughout the region is comprised of non-marine sedimentary rocks, consisting mainly of sandstone, mudstone, and conglomerate. A diabase sill (i.e., the Palisades Sill) intruded into the Lockatong formation approximately 200 million years ago. (AECOM, 2016)

#### 3.2.2 Site Geology

The Site is underlain by fill that contains coal, coal ash, slag and metal impacted fill. Underlying these fill materials are native soils consisting of meadow mat, silts, clays, and sand at depths of approximately 8 to 10 feet below ground surface (bgs). Laboratory analytical results demonstrated that the materials beneath the roadway are also impacted by polycyclic aromatic hydrocarbons, non-CCPW metals, chlorinated organic compounds, and petroleum hydrocarbons from historic Site activities. (CB&I, 2017)

The Project Area is located on miscellaneous fill material that was used to reclaim the salt marsh in this area for the construction of this portion of Jersey City. The estuarine native soils beneath the fill material include an organic meadow mat layer and a thick sequence of unconsolidated natural material. The major geologic units at the Project Area from top to bottom include:

- A non-native fill layer (the shallow zone);
- Native soils consisting of sand, silty sand, and clays (the intermediate zone) generally separated from the fill by organic sediments or meadow mat;
- Till directly above the bedrock underlying sand with occasional gravel lenses generally separated from the intermediate zone by a layer of lower hydraulic conductivity silts and clayey silts (the deep zone); and,
- Bedrock of the Lockatong and Stockton Formations with a diabase sill intruding into the Lockatong formation along the western edge of the Project Area (bedrock zone).



East of the Site, the bedrock surface rises to a large bedrock plateau that extends to the shoreline of New York Bay. The bedrock slopes downward again east of Ellis Island (Stanford, 1995).

Site 65 lies within the glaciated section of the Piedmont Physiographic Province of the Appalachian Highlands, along the eastern edge of the Newark Basin; the area is underlain by formations of Recent and Pleistocene sediments. The Triassic age bedrock throughout the region is composed of non-marine sedimentary rocks, consisting mainly of sandstone, mudstone, and conglomerate. The Triassic Newark Supergroup consists of non-marine sedimentary rocks with diabase intrusives. It is common for the Triassic Newark Supergroup to exhibit a slight dip to the northwest with local warping and occasional faulting. The formations generally strike northeast to southwest and dip between 10 to 20 degrees northwest. The Newark Supergroup can be divided into three formations based on lithology: 1) the Stockton Formation, 2) the Lockatong Formation, and 3) the Passaic Formation (AECOM, 2011).

The Stockton Formation beneath Site 65 has a gray to reddish-brown sandstone, combined with conglomerate, siltstone, and shale. The siltstone may be gray, green, or purple and fossiliferous. The Stockton Formation is about 850 feet thick beneath Sites 63. 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 is located west of the Site, and it is the thickest formation (about 10,000 feet). The Passaic consists of reddish-brown mudstones, shale, siltstone, and sandstone with interbedded conglomeritic sandstones along the basin margins (AECOM, 2011).

### 3.3 Hydrogeology

#### 3.3.1 Regional Groundwater Flow

Groundwater occurs regionally in the following hydrogeologic zones: the fill, meadow mat and the unconsolidated overburden soils; and the bedrock. A summary of the groundwater flow in these formations is included below (AECOM, 2016):

- **Fill (Shallow Water-Bearing Zone):** Groundwater in the fill is typically encountered within 10 feet bgs. In general, shallow groundwater flow patterns represent a subdued version of land surface topography. Variations from this can be attributed to heterogeneities in the fill. For instance, tightly compacted dredged sediments would be expected to restrict water flow much more than construction debris. Subsurface infrastructure (e.g., basements, drains, sheet pile, utility corridors, etc.) would also affect groundwater flow patterns. Groundwater elevations in the shallow fill can also be influenced by recharge events.
- **Overburden (Intermediate and Deep Water-Bearing Zones) and Meadow Mat:** Groundwater flow in the overburden is controlled by hydraulic conductivity, or flow through the connected porous spaces in the soil matrix. Groundwater flows horizontally in these soils, but may be influenced by local recharge and discharge zones (i.e., surface water bodies and drainage divides). Meadow mat is a dense matrix of organic material and fine-grained soils; the hydraulic conductivity of the meadow mat is expected to be three or more orders-of-magnitude less than the underlying overburden.
- **Bedrock (Bedrock Water-Bearing Zone):** Well yields from bedrock in the Project Area have been reported to range from several gallons to several hundred gallons per minute, with yields generally decreasing with depth. Groundwater in the bedrock formations occurs under both unconfined and confined conditions, primarily within secondary porosity due to fractures and joints. The Palisades Sill is understood to be a no flow boundary and has low permeability. In

general, groundwater flow in bedrock is a very small fraction of the total groundwater flux through the area.

### **3.3.2 Site Groundwater Flow**

Like the regional hydrogeology, groundwater at the Project Area occurs in several hydrogeologic zones; however, only the shallow fill zone has been impacted by CCPW-related contamination in the area of the Site. Groundwater contamination identified in monitoring wells surrounding the boundary of the Site is associated with and emanating from HCC Site 63. Monitoring wells associated with HCC Site 63 are shown on Figure 1.

Groundwater in the shallow water-bearing zone was encountered between 0.80 feet 12 feet bgs during groundwater sampling events completed for adjacent HCC Site 63. Groundwater elevations range from approximately 4.86 feet above mean sea level (amsl) to 7.38 feet amsl. Groundwater flow direction has been calculated to flow to the south-southwest in the area of the Site.

## 4.0 Summary of Historical Investigations

### 4.1 Remedial Investigation - Tetra Tech, Inc.

During the completion of remedial investigation (RI) activities for HCC Site 63, Tetra Tech Inc. (Tetra Tech) advanced fifteen soil borings within Burma Road. During the initial RI, 11 soil borings were advanced at the Site between July 2011 and August 2011. The soil borings are identified as 065\_A005, 065\_A006, 065\_A007, 065\_A008, 065\_A009, 065\_A010, 065\_A011, 065\_A012, 065\_A013, 065\_A014, and 065\_A015. Four additional soil borings, identified as 063\_Z005, 063\_Z009, 063\_Z011, and 063\_Z013, were advanced in December 2012.

Boring logs are provided in Appendix A. The locations of Tetra Tech's soil borings that are associated with Site 65 and/or Burma Road are depicted on Figure 2 in Appendix B which is excerpted from Tetra Tech's April 2013 *Remedial Investigation Report* (RIR). The results of the laboratory analysis for samples collected within the boundaries of the Site are summarized below. Relevant analytical summary tables excerpted from Tetra Tech's RIR are provided in Appendix C.

- **Chromium:** Total chromium was not reported in excess of the CrSCC in the samples collected by Tetra Tech at the soil boring locations identified above.
- **Hexavalent Chromium:** Hexavalent chromium was not reported in excess of the CrSCC in the samples collected by Tetra Tech at the soil boring locations identified above.
- **Antimony:** Antimony was not reported in excess of the RDC SRS and/or the Default Impact to Groundwater Soil Screening Level (IGW SSL) in the samples collected by Tetra Tech at the soil boring locations identified above, with the exception of soil samples 065\_A008\_0.0 and 065\_A013\_0.5. Soil sample 065\_A008\_0.0 exhibited an estimated antimony concentration of 6.1 mg/kg and 065\_A013\_0.5 exhibited an estimated antimony concentration of 7.3 mg/kg. Soil sample 065\_A006\_0.0, 065\_A007\_0.0, and 065\_A013\_0.0 exhibited elevated laboratory method detection limits (MDL) due to sample dilution due to interferences with other analytes. The MDL for these samples was in excess of the IGW SSL for antimony of 6 mg/kg. Antimony was not identified as a wide-spread contaminant of concern, due to the low percentage of Tetra Tech's RI data set exhibiting antimony concentrations in excess of the IGW SSL, including samples 065\_A008\_0.0 and 065\_A013\_0.5.
- **Nickel:** Nickel was reported at concentrations in excess of the IGW SSL in 10 soil samples at concentrations ranging from 33.4 mg/kg in soil sample 065\_A015\_0.0 to 96.6 mg/kg in soil sample 065\_A013\_0.0.
- **Thallium:** Thallium was not reported in excess of the IGW SSL and/or RDC SRS in the samples collected by Tetra Tech at the soil boring locations identified above.
- **Vanadium:** Vanadium was not reported in excess of the ARS of 390 mg/kg in the samples collected by Tetra Tech at the soil boring locations identified above.

### 4.2 Limited Soil Excavation – February 2015

Historically, visible CCPW was observed under the western shoulder of Burma Road at multiple locations. This material was removed during the remedial excavation of HCC Site 63, which was

conducted by PPG and progressed into Burma Road in February 2015. Visible CCPW impacts in the form of chromium “blooms” were observed in soils beneath Burma Road during this excavation work.

During the remedial excavation work conducted by PPG at HCC Site 63, visible CCPW, including Chromite Ore Processing Residue (COPR) nodules, was observed in the excavation sidewall at the boundary of HCC Site 63 along the northern shoulder of Morris Pesin Drive. The visible CCPW was observed in isolated areas and generally within two feet below the ground surface. The observed CCPW along Morris Pesin Drive was not removed by PPG during the remedial excavation work due to the proximity of the existing water line. The locations where visible COPR nodules were observed are depicted on Figure 2.

Post-excavation soil samples to demonstrate compliance with the IGW SSL, CrSCC, and/or RDC SRS were collected prior to backfill of the excavation associated with HCC Site 63 and were included in the CB&I Environmental & Infrastructure, Inc.(CB&I)<sup>4</sup> June 2017 *Remedial Action Report, Non-Residential CCPW Site, Former Baldwin Oil Facility, HCC Site 63, PI G00008691* (RAR). Bottom and sidewall samples located within the boundaries of Site 65 for which data was not reported in the June 2017 RAR are identified on Table 1. Several post-excavation soil samples (SW-04, SW-115, and SW-72R) were previously reported in the June 2017. The analytical results of the post-excavation soil samples are provided on Table 2 and Table 3. The locations of the post-excavation soil sample locations are depicted on Figure 2.

### 4.3 Soil Delineation - Roadway

In order to delineate the extent of Hexavalent Chromium in Burma Road, APTIM completed a soil boring investigation within the limits of Burma Road and Morris Pesin Drive. Field sampling activities were performed in accordance with the July 8, 2015 *Scope of Work – Additional Delineation of Burma Road and Morris Pesin Drive*, which was approved by NJDEP on October 2, 2016. The purpose of the investigation was to characterize fill materials under Burma Road and Morris Pesin Drive, due to the findings during remediation of Site 63.

APTIM subcontracted with Environmental Probing Investigations, Inc. (EPI) of Cream Ridge, New Jersey to advance soil borings under the direction of an APTIM geologist. Sixty-three soil borings were advanced to a depth of 10 feet below grade at the locations shown on Figure 3. The delineation investigation was performed over the course of three sampling events in June 2015, October 2015, and March 2016. The initial Burma Road delineation work began in June 2015 and included the installation of nine soil borings. Sixty-three soil borings were advanced in Burma Road and Morris Pesin Drive in October 2015 and March 2016 and are identified on Table 4. Soil borings were advanced using a 3-inch diameter Macro-core sampler and soils that were retrieved were logged (see Appendix A). APTIM collected 291 soil samples from Burma Road and Morris Pesin Drive for chemical analysis.

Evidence of petroleum impacts such as photoionization detector readings, odor, or a visible sheen was observed in 39 of the 63 soil borings. An apparent “bloom” was observed in some borings in Morris Pesin Drive and near the traffic circle; however, when blooming was observed, a step-out boring was advanced, with the exception of soil boring MPD-H. A step-out boring could not be completed in this location due to the close proximity of a large-diameter high pressure natural gas line beneath the roadway. Soil boring locations where visual observations of the presence of petroleum contamination and/or apparent “blooms” are depicted on Figure 4.

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<sup>4</sup> CB&I is now known as APTIM

Fifteen samples from 10 soil borings within Burma Road exhibited concentrations in excess of the CrSCC for hexavalent chromium, as indicated on Table 5 and depicted on Figure 2. The hexavalent chromium exceedances ranged from 20.6 milligrams per kilogram (mg/kg) to 160 mg/kg. Nine other borings exhibited concentrations in excess of the Soil Remediation Standard (SRS) of at least one of the CCPW-related metals. Soil samples collected from locations within Morris Pesin Drive and the traffic circle did not exhibit hexavalent chromium concentrations in excess of the CrSCC, as shown on Table 6 and depicted on Figure 2.

The soil samples were also analyzed for the Target Analyte List (TAL) metals, including lead and mercury. The analytical results indicate impacts from mercury and lead. Field observations of the soil cores identified petroleum impacts.

- Mercury Exceedances: 245 soil samples from Burma Road, Morris Pesin Drive, and the Traffic Circle were analyzed for mercury. Of these samples, 90 (36.7%) exhibited concentrations above the IGWSSL or RDC SRS for mercury of 0.1 mg/kg. The range of detections above the IGWS SSL or RDC SRS for Mercury was 0.11 mg/kg to 1,290 mg/kg.
- Lead Exceedances: 281 soil samples from Burma Road, Morris Pesin Drive, and the Traffic Circle were analyzed for lead. Of these samples, 108 (38.4%) exhibited concentrations above the RDC SRS or IGW SSL for lead (400 mg/kg and 59 mg/kg, respectively). The range of detections above the RDC SRS or IGW SSL for Lead was 92.4 mg/kg to 9,910 mg/kg.
- Petroleum Impacts: Evidence of petroleum impacts, such as elevated photo-ionization detector readings, petroleum odors, and/or a visible sheen, was observed in 36 of the 63 soil borings.

TAL Metals related impacts identified within Morris Pesin Drive, Burma Road, and/or the traffic circle are presented on Table 7 and are depicted on Figure 3.

## 5.0 Remedial Action Activities

Pursuant to the Settlement Agreement, the Parties involved agreed that the soils remedy to be implemented by PPG for the Site would be a restricted use remedy consisting of the following:

- The asphalt road surface covering Site 65 shall function as an engineering control to prevent direct contact exposure; the maintenance of which shall be borne by the City.
- A Notice in Lieu of Deed Notice will be filed because contaminants will be left in place in Site 65 soils that exceed NJDEP soil remediation criteria and/or standards.

Repairs, alterations and/or replacement to the 16-inch water line, in whole or part, within the boundaries of the Site will be managed by the JCMUA as a linear construction project governed by the NJDEP's Linear Construction guidance pursuant to the terms and conditions of the Settlement Agreement. Periodic monitoring, inspections, and reporting with respect to the integrity of the asphalt road surface will be conducted by PPG.

### 5.1 Site Boundary Identification

APTIM subcontracted Maser Consulting P.A. (Maser) to collect survey information, including distances and direction, in order to generate a written description of the boundary of the Site for incorporation into the Settlement Agreement and for use in the establishment of institutional and engineering controls associated with the Site. Maser's calculated boundary perimeters, Metes and Bounds descriptions and exhibit depicting HCC Site 65, the Supplemental Remediation Area, and the Released Area are included in the January 9, 2018 Settlement Agreement (Appendix D).

### 5.2 Water Line Identification

APTIM subcontracted Maser to perform utility location services to locate and mark the ground surface corresponding to the location of the water line at depth. The ground surface indicating the location of the water line at depth was marked in the field using blue marking paint and/or pin flags.

Under the direction of experienced APTIM field personnel, the horizontal and vertical location of the water line was visually verified through soft-dig methods by APTIM's subcontractor, EPI. APTIM field personnel collected depth measurements from the top of the asphalt surface to the top of the water line at each soft-dig location. The soft-dig locations are depicted on Figure 5.

Maser then returned to the site to collect survey information along the length of the water line. Maser generated cross-sections of the water line using the data collected during the utility location and soft-dig activities, including ground surface and top of water line elevations. Utilities other than the water line were not located and/or surveyed. Maser's *Cross Section Plan Locations* and *Water Line Cross Sections* are provided in Appendix E.

### 5.3 Engineering Control

The engineering control within the boundary of the Site consists of the existing asphalt pavement that is intended to prevent direct contact to contamination in excess of the RDC SRS and/or Cr SCC that

has been identified at the Site. Based on field observations, the existing asphalt pavement is approximately 4-inches and consists of two, 2-inch thick paving courses. At the time field activities were completed for visual verification of the water line (November 2017), the pavement was observed to be in fair condition, with no areas in need of immediate repair to eliminate an exposure risk.

## 5.4 Institutional Control

Institutional controls will be placed on the Site in the form of a Notice in Lieu of Deed Notice that provides information regarding the contaminants present, the engineering control(s) in place, and the frequency of monitoring, maintenance, and reporting of the protectiveness of the remedy. A draft Notice in Lieu of Deed Notice has been prepared in accordance with the requirements of N.J.A.C. 7:26C-7.2 (Appendix F). As the Site consists of a portion of a roadway, PPG will provide a copy of the Notice in Lieu of Deed Notice documents, including all maps, prepared pursuant to 7:26C-7.2(a) in both paper and electronic format to the following:

- The City of Jersey City Road Department;
- The JCMUA (water and sewer)
- Spectra Energy (natural gas)

A copy of the Notice in Lieu of Deed Notice will be filed with the Hudson County Clerk.

## 5.5 Memorialization of Remediation Protocols

Pursuant to the Settlement Agreement, in the event the JCMUA initiates repairs, alterations, and/or replacement to the water line within the boundaries of the Site, the work will be completed via trench excavation. The extent of the trench will be dependent on the extent of the work to be completed by the JCMUA within the Site boundaries. The Settlement Agreement dictates that the trench excavation will extend three feet laterally from every point along the outside diameter of the water line, as measured on the center axis perpendicular to the direction of the water line. The maximum vertical depth of the trench will be six feet below grade, regardless of the actual depth required by the JCMUA to conduct the work. Following completion of the work, the disturbed areas will be repaved with new asphalt at the surface to serve as the engineering control.

### 5.5.1 Prevailing Documents

All work on the water line to be undertaken by the JCMUA will be performed in accordance with the following documents:

- *Procedure for Coordinating Utility Work Within Chromium Soil Areas, Honeywell Sites, Jersey City, New Jersey*, prepared by Amec Foster Wheeler Environment and Infrastructure, Inc., and dated December 2014, updated January 2017 (included in Appendix F)
- *Worker Training Manual for Managing Contaminated Soils and Groundwater*, prepared by Amec Foster Wheeler Environment and Infrastructure, Inc., and dated December 2014, updated January 2017 (included in Appendix F)
- NJDEP's *Linear Construction Technical Guidance*, dated January 2012, as amended (the LC Guidance)

In the event of any conflict, the terms of the Settlement Agreement will prevail.

The JCMUA will be required to retain a Licensed Site Remediation Professional (LSRP) to oversee water line work within the boundaries of the Site following the LC Guidance and develop a Materials Management Plan (MMP) that identifies the actions required to manage visible CCPW, contaminated dewatering fluids, and contaminated soils resulting from JCMUA water line work in the excavation trench.

### **5.5.2 Remediation of Visible CCPW**

During trench excavation activities and prior to backfilling of the area, the JCMUA LSRP and an LSRP designated by PPG (PPG LSRP) will conduct inspections of the excavation trench to determine if visible CCPW is present following the procedures outlined in the Notice in Lieu of Deed Notice (Appendix F). If there is agreement between LSRPs that there is no visible CCPW within the excavation trench, the area may be backfilled.

If the presence of visible CCPW within the excavation trench is agreed upon by the LSRPs, visible CCPW within the seven-foot area beyond the Site boundaries, identified as the Supplemental Remediation Area, and visible CCPW between the water line and the boundary of HCC Site 63 will be excavated, transported offsite, and properly disposed. Maser's Metes and Bounds Description for the Supplemental Remediation Area and an Exhibit depicting the same are included in Appendix D. The collection of post-excavation soil samples for analysis will not be required following the removal of visible CCPW, pursuant to the Settlement Agreement.

### **5.6 Management of Excavation Spoils**

Materials removed from the subsurface during the course of water line work initiated by the JCMUA within the boundaries of the Site will be evaluated by the JCMUA's LSRP to determine if reuse as backfill within the trench excavation is appropriate in accordance with the LC Guidance and associated NJDEP Guidance Documents referenced therein.

If the JCMUA determines that the excavated material must otherwise be disposed offsite, due to the presence of any contaminant, substance or characteristic, and based upon the JCMUA LSRP's application of the LC Guidance and/or presence of visible CCPW, excavated material must be disposed of offsite at an appropriately licensed disposal facility.

If soils are determined to be hazardous, PPG will be responsible for:

- Executing a *Uniform Hazardous Waste Manifest* as required by the Federal Resource Conservation and Recovery Act (40 CFR Subpart B Parts 262.20 to 262.23) and N.J.A.C 7:26G;
- Obtaining an EPA Identification Number and complying with all applicable requirements, including recordkeeping requirements, with respect to the transportation and disposal of hazardous waste materials.

If dewatering of the excavation trench is required during JCMUA water line work, the fluids will be evaluated by the JCMUA's LSRP to determine if they are contaminated and the appropriate method of disposal will be identified. If dewatering fluids are determined to be hazardous, PPG will be responsible for:



- Executing a *Uniform Hazardous Waste Manifest* as required by the Federal Resource Conservation and Recovery Act (40 CFR Subpart B Parts 262.20 to 262.23) and N.J.A.C. 7:26G;
- Obtaining an EPA Identification Number and complying with all applicable requirements, including recordkeeping requirements, with respect to the transportation and disposal of hazardous waste materials.

### **5.6.1 Backfilling of Excavated Areas**

Upon the completion of water line work within the boundaries of the Site, the excavation trench will be backfilled using certified clean backfill material provided by a licensed quarry/mine. If backfill material is obtained from a source other than a licensed quarry/mine, it must be sampled and analyzed in accordance with the procedures for determining the suitability for clean fill outlined in the NJDEP's *Fill Material Guidance for Site Remediation Program Sites* dated April 2015, as amended.

### **5.6.2 Groundwater**

Groundwater that exceeds the NJDEP Groundwater Quality Standards (GWQS, N.J.A.C. 7:9C), for total chromium within the Site boundaries, the Supplemental Remediation Area, the Released Area (as defined in the Settlement Agreement) or another location adjacent to HCC Site 63, will be addressed by PPG under the JCO as emanating from HCC Site 63.

## 6.0 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 data packages are included in Appendix G.

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

- 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 Environmental Protection Agency (USEPA) "National Functional Guidelines for Inorganic Data Review", OSWER Publication 9240.1-51, EPA540-R-10-011, January 2010 (US EPA, 2010);
- USEPA "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.

The 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 QC 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. 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 APTIM's investigational work detailed here were found to be usable.

## 7.0 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:

- 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 (VI): If volatile organic compounds (VOCs) are present in groundwater above the NJDEP GWSL and/or free phase petroleum product is identified on a property and structures are located near the impacted media, VI 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.

### 7.1 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.

### 7.2 Groundwater

Groundwater that exceeds the NJDEP Groundwater Quality Standards, N.J.A.C. 7:9C for total chromium within the Site boundaries, the Supplemental Remediation Area, the Released Area (as defined Attachment B) or another location adjacent to HCC Site 63, will be addressed by PPG under the JCO as emanating from HCC Site 63.

### 7.3 Vapor Intrusion

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

## **7.4 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 March 2016. As the entire Site consists of fill, no ecological sensitive natural resource (ESNR) receptors have been identified on the Site.

## **8.0 Conclusions and Recommendations**

### **8.1 Soil**

Based on the results of the soil sampling conducted at the Site, including the post-excavation sampling completed in connection with remedial actions at HCC Site 63, and the presence of an engineered asphalt cap, the restricted use remedial action is found to be complete for the Site. The remedial action will be administratively monitored under a Remedial Action Permit for Soil, which is being applied for separately. PPG requests the administrative closure of the Site by the NJDEP through the issuance of a Judicial Consent Compliance Letter.

### **8.2 Groundwater**

Groundwater that exceeds the NJDEP Groundwater Quality Standards (GWQS, N.J.A.C. 7:9C), for total chromium within the Site boundaries, the Supplemental Remediation Area, the Released Area (as defined Attachment B) or another location adjacent to HCC Site 63, will be addressed by PPG under the JCO as emanating from HCC Site 63. No further action regarding groundwater associated with Site 65 is required and thus requests the administrative closure of the Site by the NJDEP through the issuance of a Judicial Consent Compliance Letter for Groundwater.

## 9.0 References

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

- N.J.A.C. 7:26C – Administrative Requirements for the Remediation of Contaminated Sites, as amended August 6, 2018.
- N.J.A.C. 7:26D – Soil Remediation Standards, September 2017.
- N.J.A.C. 7:26E – Technical Requirements for Site Remediation, as amended August 6, 2018.
- NJDEP Field Sampling Procedures Manual, dated August 2005 (last revised April 2011).
- NJDEP Technical Guidance for the Attainment of Remediation Standards and Site-Specific Criteria, dated September 2012.
- 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.
- Settlement Agreement between NJDEP, PPG, the City of Jersey City, and the JCMUA, January 9, 2018.
- Remedial Investigation Report, Tetra Tech, April 2013
- State of NJ - Tax List Search, [http://njgin.state.nj.us/oit/gis/NJ\\_TaxListSearch/](http://njgin.state.nj.us/oit/gis/NJ_TaxListSearch/)
- Preliminary Assessment Burma Road and Morris Pesin Drive, CB&I, April 2017
- Standard Language Guide PPG New Jersey Chrome Program, AECOM 2016
- ENSR, 2006. Remedial Investigation Report – PPG Site 114 – Garfield Avenue, Jersey City, New Jersey. March.
- AECOM, 2016. Site-Wide Groundwater Summary Report, April 2015 through March 2016. Garfield Avenue Group, Hudson County Chromium Sites. June.
- Stanford, S.D., 1995, Surficial Geology of the Jersey City Quadrangle, Hudson and Essex Counties, New Jersey: N.J. Geological Survey Open File Map 20, 1 sheet, scale 1:24000
- CB&I, 2017, Remedial Action Report Non-Residential Chromate Chemical Production Waste Site Former Baldwin Oil Facility, Hudson County Chrome Site 63
- Hudson County Chromate Site 65 Technical Memorandum, Weston Solutions, Inc., December 2017