AECOM

Prepared for:
PPG
Monroeville, PA

Prepared by:
AECOM
Chelmsford, MA
Project #: 60545281
September 2019

Remedial Action Report
Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, AOC FS-2A, AOC FS-2B, and AOC FS-2C) Soil

Final

NJDEP Program Interest Number: 775706

PPG Garfield Avenue Group
Hudson County Chromate Sites
Jersey City, New Jersey

Document No. FS-002B

Contents

List of Tables

List of Figures

List of Appendices

List of Acronyms and Abbreviations

AAC	Acceptable Ambient Concentration
ACO	Administrative Consent Order
AMP	Air Monitoring Plan
AOC	Area of Concern
bgs	below ground surface
BOL	bill of lading
CCPW	Chromate Chemical Production Waste
CENJ	Clean Earth of North Jersey
CID	Case Inventory Document
CMAA	Construction Manager as Agent
COC	chain-of-custody
Cr^{+6}	hexavalent chromium
CrSCC	Chromium Soil Cleanup Criteria
DCP	Dust Control Plan
DGA	dense-graded aggregate
DIGWSSL	Default Impact to Groundwater Soil Screening Level
EDD	electronic data deliverable
El.	elevation
ENTACT	ENTACT Environmental Services of Latrobe, Pennsylvania
EQ	Environmental Quality Company
ERFS	Environmental Remediation and Financial Services, LLC
FSP	Forrest Street Properties
FSP-QAPP	Field Sampling Plan – Quality Assurance Project Plan
ft	foot or feet
GA Group	Garfield Avenue Group
GPS	global positioning system
HASP	Health and Safety Plan
HCC	Hudson County Chromate
HDPE	high-density polyethylene
IGW	Impact to Groundwater
IGWSRS-GAG	Impact to Groundwater Soil Remediation Standard - GA Group
JCO	Judicial Consent Order
LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LSRP	Licensed Site Remediation Professional
mg/kg	milligrams per kilogram
MGP	manufactured gas plant
MS	matrix spike
MSD	matrix spike duplicate
NAVD88	North American Vertical Datum of 1988
NJ	New Jersey

N.J.A.C.	New Jersey Administrative Code
NJDEP	New Jersey Department of Environmental Protection
NJGIN	New Jersey Geographic Information Network
NRDCSRS	Non-Residential Direct Contact Soil Remediation Standard
OGS	open grade stone
OM	oil-material
OSHA	Occupational Safety and Health Act
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PDI	pre-design investigation
PI	Program Interest
PPE	personal protective equipment
PSEG	Public Service Electric and Gas Company
PVSC	Passaic Valley Sewerage Commission
QA	quality assurance
QC	quality control
RA	remedial action
RAO	Response Action Outcome
RAP	Remedial Action Permit
RAR	Remedial Action Report
RAWP	Remedial Action Work Plan
RDCSRS	Residential Direct Contact Soil Remediation Standard
RDCSRS-GAG	Residential Direct Contact Soil Remediation Standard - GA Group
RE	receptor evaluation
RI	Remedial Investigation
RIR	Remedial Investigation Report
RIWP	Remedial Investigation Work Plan
RPD	relative percent difference
SESCP	Soil Erosion and Sediment Control Plan
SOP	standard operating procedure
SRP	Site Remediation Program
SRS	Soil Remediation Standard
SSRIR	Supplemental Soil Remedial Investigation Report
SVOC	semi-volatile organic compound
SW	Southwestern
TEE	terminal excavation elevation
TEP	Technical Execution Plan
TM	tar-material
TOC	total organic carbon
TRSR	Technical Requirements for Site Remediation
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VOC	volatile organic compound
Weston	Weston Solutions, Inc.

Regulatory Cross Reference Table

Regulatory Cross Reference Table
Remedial Action Report
Forrest Street, Garfield Avenue Group
PPG, Jersey City, New Jersey

N.J.A.C. 7:26C and 7:26E (last amended August 6, 2018) regulations are the primary source of Remedial Action Report (RAR) requirements. This document is not to be used as a replacement for the Technical Regulations.

Regulation	Description	Document Location	
N.J.A.C. 7:26E-5.7	**Remedial Action Report Requirements**	**Report**	**Location**
5.7(a)	The person responsible for conducting the remediation shall implement the remedial action and submit to the Department a remedial action report, along with a form found on the Department's website at www.nj.gov/dep/srp/srra/forms, pursuant to (b) below, and according to the applicable regulatory timeframe in N.J.A.C. 7:26E-5.8.	Remedial Action Report Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, FS-2A, AOC FS-2B, and AOC FS-2C) Soil	throughout
5.7(b)	The person responsible for conducting the remediation shall present and discuss in the remedial action report all of the information identified or collected pursuant to N.J.A.C. 7:26E-5.1 through 5.6, along with all of the following:	Remedial Action Report Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, FS-2A, AOC FS-2B, and AOC FS-2C) Soil	throughout
5.7(b) 1	The general reporting requirements in N.J.A.C. 7:26E-1.6;	Remedial Action Report Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, FS-2A, AOC FS-2B, and AOC FS-2C) Soil	see below
1.6(a) 1	Submit all documents, forms, spreadsheets and worksheets required in this chapter;	Remedial Action Report Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, FS-2A, AOC FS-2B, and AOC FS-2C) Soil	The Cover/Certification Form is included with the Regulatory Forms. The paper Remedial Action Report form is no longer accepted and is intended for work conducted under the Licensed Site Remediation Professional Program. As this work is being conducted under direct oversight and not being submitted online, no Remedial Action Report form is included.
1.6(a) 2	Certify and have the licensed site remediation professional certify, pursuant to N.J.A.C. 7:26C-1.5, all forms and documents prepared to pursuant to this chapter;	Remedial Action Report Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, FS-2A, AOC FS-2B, and AOC FS-2C) Soil	The Cover/Certification Form is included with the Regulatory Forms. The work is being conducted under direct oversight so it does not require certification by a Licensed Site Remediation Professional.
1.6(a) 3	Submit a completed case inventory document (CID) worksheet available on the Department's website at www.nj.gov/dep/srp/srra/forms at the front of each remedial phase workplan and report required by this chapter, except for a preliminary assessment report where no areas of concern were identified;	Remedial Action Report Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, FS-2A, AOC FS-2B, and AOC FS-2C) Soil	Regulatory Forms
1.6(a) 4	Submit a quality assurance project plan (QAPP) prepared pursuant to N.J.A.C. 7:26E-2.2 with each remedial phase workplan and report required by this chapter, except for a preliminary assessment report and remedial action report;	Remedial Action Report Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, FS-2A, AOC FS-2B, and AOC FS-2C) Soil	Not Applicable for this Remedial Action Report
1.6(a) 5	Except where a final remediation document for unrestricted use is filed with the Department within one year after the earliest applicable trigger to remediate listed in N.J.A.C. 7:26C-2.2, submit all sampling data electronically in a summary table using the format outlined in the Site Remediation Program's "Electronic Data Interchange Manual," available at www.nj.gov/dep/srp/hazsite/docs/, in effect as of the date the document is submitted and include items described in subsections 1.6(a) 5.i-iii of Tech Reg.	Remedial Action Report Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, FS-2A, AOC FS-2B, and AOC FS-2C) Soil	Electronic data deliverable provided to NJDEP for data used to document compliance with remedial action goals; receipts of submittal included in Appendix C - Laboratory Analytical Reports.
1.6(a) 6	Submit a geographic information system (GIS) compatible site plan that includes the site boundaries and the location of all areas of concern as polygons.	Remedial Action Report Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, FS-2A, AOC FS-2B, and AOC FS-2C) Soil	Figure 1-2 - Site Plan for Forrest Street

Regulatory Cross Reference Table
Remedial Action Report
Forrest Street, Garfield Avenue Group
PPG, Jersey City, New Jersey

N.J.A.C. 7:26C and 7:26E (last amended August 6, 2018) regulations are the primary source of Remedial Action Report (RAR) requirements. This document is not to be used as a replacement for the Technical Regulations.

Regulation	Description	Document Location	
N.J.A.C. 7:26E-5.7	Remedial Action Report Requirements	Report	Location
1.6(b) 1	The physical setting of the site that includes a general description of soils, geology, hydrology, hydrogeology, and topography of the site and surroundings;	Remedial Action Report Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, FS-2A, AOC FS-2B, and AOC FS-2C) Soil	Section 2.2 - Physical Setting of the Site
1.6(b) 2	A description of any significant events or seasonal variations that may have influenced sampling procedures or analytical results;	Remedial Action Report Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, FS-2A, AOC FS-2B, and AOC FS-2C) Soil	No significant events or seasonal variations influenced sampling procedures or analytical results. Soil sampling results are discussed in: Section 2.1 - Summary of Soil Remedial Investigation Findings Section 4.2.1 - Proposed Terminal Excavation Elevations and Pre-Design Investigation Section 5.3 - Post-Excavation Soil Sampling
1.6(b) 3	A description of the results and implications of field measurements or area-specific changes in sampling protocol due to field conditions;	Remedial Action Report Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, FS-2A, AOC FS-2B, and AOC FS-2C) Soil	Not Applicable for this Site
1.6(b) 4	A list of: i. All variances from the requirements of this chapter submitted pursuant to N.J.A.C. 7:26E-1.7; and ii. All rationales submitted for deviations from any technical guidance pursuant to N.J.A.C. 7:26C-1.2(a)3;	Remedial Action Report Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, FS-2A, AOC FS-2B, and AOC FS-2C) Soil	Not Applicable for this Site
1.6(b) 5	The applicable regulatory timeframe, including: i. Regulatory citation of the regulatory timeframe; and ii. Calendar date of the regulatory timeframe;	Remedial Action Report Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, FS-2A, AOC FS-2B, and AOC FS-2C) Soil	Master Schedule, referenced in Section 1.0
1.6(b) 6	A summary table(s), organized by area of concern, of all sampling results, including sample location, medium, sample depth, field and laboratory identification numbers, analytical results, and comparison to remediation standards, and the following: i. Identification of each contaminant concentration exceeding a remediation standard; ii. Identification of each sample with a method detection limit or a practical quantitation level that exceeds a remediation standard, along with an explanation in the table key; and iii. A report of all soils and solids sample results in milligrams per kilogram on a dry weight basis, aqueous sample results in micrograms per liter, and air results in micrograms per cubic meter;	Remedial Action Report Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, FS-2A, AOC FS-2B, and AOC FS-2C) Soil	Tables 5-1 through 5-7 - Analytical Results for In-Place Soil
1.6(b) 7	For soil borings, test pits and monitoring wells: i. Stratigraphic logs, which include soil/rock physical descriptions and field instrument readings detected during drilling for each soil boring, test pit and monitoring well; ii. State permit numbers and as-built specifications, if applicable; and iii. Monitoring well certification forms A (the well construction as built certification) and B (the well location certification) available on the Department's website at www.nj.gov/dep/srp/regs/guidance.htm;	Remedial Action Report Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, FS-2A, AOC FS-2B, and AOC FS-2C) Soil	i. Appendix G - Boring Logs ii and iii. Not Applicable

Regulatory Cross Reference Table
Remedial Action Report
Forrest Street, Garfield Avenue Group
PPG, Jersey City, New Jersey

N.J.A.C. 7:26C and 7:26E (last amended August 6, 2018) regulations are the primary source of Remedial Action Report (RAR) requirements. This document is not to be used as a replacement for the Technical Regulations.

Regulation	Description	Document Location	
N.J.A.C. 7:26E-5.7	Remedial Action Report Requirements	Report	Location
1.6(b) 8	Maps and figures, with map scale and orientation, including: i. Site location, land use, receptor evaluation, and area of concern maps; ii. Sample location map(s), that include the following: (1) Field identification numbers for all samples; (2) Sample locations, sample depths and contaminant concentrations plotted on the map; and (3) If data for more than 25 samples are presented for an area of concern, soil, ground water and sediment contaminant isopleth maps and cross section diagram(s), including the horizontal and vertical distribution of contaminants in each media, with sample point location numbers and contaminant concentrations; and iii. Ground water elevation contour maps showing the location of all monitoring wells, piezometers, or other ground water sampling points, for each set of static ground water level measurements for each aquifer;	Remedial Action Report Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, FS-2A, AOC FS-2B, and AOC FS-2C) Soil	i. Site Location - Figure 1-1 Areas of Concern - Figure 1-2 Land Use – Regulatory Forms – Receptor Evaluation ii. Sample Location Maps: Figures 5-1 through 5-7 iii. Groundwater maps - Not applicable
1.6(b) 9	A discussion of the usability of laboratory analytical data;	Remedial Action Report Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, FS-2A, AOC FS-2B, and AOC FS-2C) Soil	Section 6.0 - Reliability of Data: Data Validation and Usability
1.6(b) 10	A description of the significance of information generated in the library search of tentatively identified compounds and unknown compounds.	Remedial Action Report Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, FS-2A, AOC FS-2B, and AOC FS-2C) Soil	Not Applicable for this Site
5.7(b) 2	A presentation and discussion of all of the information identified or collected, pursuant to N.J.A.C. 7:26E-1.10 through 1.16 and an updated receptor evaluation on a form found on the Department's website at www.nj.gov/dep/srp/srra/forms;	Remedial Action Report Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, FS-2A, AOC FS-2B, and AOC FS-2C) Soil	Regulatory Forms - Receptor Evaluation and Section 8.0 - Receptor Evaluation Update
5.7(b) 3	A summary of the findings and recommendations for each area of concern from the remedial investigation report prepared pursuant to N.J.A.C. 7:26E-4.9;	Remedial Action Report Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, FS-2A, AOC FS-2B, and AOC FS-2C) Soil	Section 2.3 - Recommended Remedial Action
5.7(b) 4	A description, by area of concern, of each remedial action implemented;	Remedial Action Report Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, FS-2A, AOC FS-2B, and AOC FS-2C) Soil	Section 5.0 - Description of the Remedial Action
5.7(b) 5	A list, by remedial action, of the remediation standards that apply to each remedial action;	Remedial Action Report Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, FS-2A, AOC FS-2B, and AOC FS-2C) Soil	Section 3.0 - Identification of Applicable Remedial Standards/Criteria and Table 3-1 - Soil Remediation Standards/Criteria
5.7(b) 6	Documentation, by area of concern, that each remedial action is effective in protecting the public health and safety and the environment by: i. Providing an overview of the data to establish the remedial action is operating as designed; or ii. Demonstrating compliance with the applicable remediation standards;	Remedial Action Report Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, FS-2A, AOC FS-2B, and AOC FS-2C) Soil	Section 7.0 - Documentation of the Protectiveness of the Remedial Action
5.7(b) 7	A remedial action permit application prepared pursuant to N.J.A.C. 7:26C-7, if applicable;	Remedial Action Report Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, FS-2A, AOC FS-2B, and AOC FS-2C) Soil	Not Applicable for this Site

Regulatory Cross Reference Table
Remedial Action Report
Forrest Street, Garfield Avenue Group
PPG, Jersey City, New Jersey

N.J.A.C. 7:26C and 7:26E (last amended August 6, 2018) regulations are the primary source of Remedial Action Report (RAR) requirements. This document is not to be used as a replacement for the Technical Regulations.

Regulation	Description	Document Location	
N.J.A.C. 7:26E-5.7	**Remedial Action Report Requirements**	**Report**	**Location**
5.7(b) 8	"As-built" diagrams for any permanent structures associated with the remedial action including, without limitation, caps or other structures associated with the remedial action and engineering controls, if applicable;	Remedial Action Report Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, FS-2A, AOC FS-2B, and AOC FS-2C) Soil	Section 7.0 - Documentation of the Protectiveness of the Remedial Action Appendix E - As-Built Diagrams
5.7(b) 9	A detailed description of site restoration activities, if applicable;	Remedial Action Report Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, FS-2A, AOC FS-2B, and AOC FS-2C) Soil	Section 7.2 - Description of Restoration Activities
5.7(b) 10	The total remediation costs through the implementation of the remedial action;	Remedial Action Report Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, FS-2A, AOC FS-2B, and AOC FS-2C) Soil	Section 7.3 - Total Remedial Action Cost
5.7(b) 11	Documentation of all types and quantities of waste generated by the remedial action, including copies of fully executed manifests or bill(s) of lading documenting any off-site transport of waste;	Remedial Action Report Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, FS-2A, AOC FS-2B, and AOC FS-2C) Soil	Section 7.4 - Documentation of Waste Generation and Disposal Appendix H - Hazardous Waste Disposal Documentation Appendix I - Non-Hazardous Waste Disposal Documentation
5.7(b) 12	Documentation of the source, type, quantities, and location of each alternative fill and clean fill used as part of the remedial action at the site; and	Remedial Action Report Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, FS-2A, AOC FS-2B, and AOC FS-2C) Soil	Section 7.5 - Documentation of Source, Type, Quantities, and Location of Fill Appendix J - Clean Fill Documentation
5.7(b) 13	A description of each permit required and obtained to implement the remedial action.	Remedial Action Report Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, FS-2A, AOC FS-2B, and AOC FS-2C) Soil	Section 7.6 - Identification of Required Permits and Authorizations Appendix B - Permits and Approvals

Executive Summary

This Remedial Action Report (RAR) has been prepared by AECOM on behalf of PPG to document the remedial action (RA) for Forrest Street for the following:

- Chromate Chemical Production Waste (CCPW) and CCPW-impacted soil (Area of Concern [AOC] FS-1A, AOC FS-1B, and AOC FS-1C); and
- Soil impacted by manufactured gas plant (MGP)-related constituents associated with the former Halladay Street Gas Works MGP (AOC FS-2A, AOC FS-2B, and AOC FS-2C).

Forrest Street (the Site) is part of the Garfield Avenue Group (GA Group) Sites, which include Sites 114, 132, 133, 135, 137, 143, and 186, and adjacent roadways and properties (**Figure 1-1**). Site 114 is the former location of a chromite ore processing facility previously owned by PPG, and the former Halladay Street Gas Works MGP previously owned by Public Service Electric and Gas Company (PSEG). Forrest Street is tracked under the New Jersey Department of Environmental Protection (NJDEP) Site Remediation Program (SRP) Program Interest (PI) number 775706.

Forrest Street is located west of Halladay Street in Jersey City, New Jersey (NJ) (**Figure 1-2**). Forrest Street is bordered to the south and west by Site 114 (Block 21501, Lots 16 and Lot 17 as identified in the Jersey City Parcel Data from the New Jersey Geographic Information Network [NJGIN], last updated October 6, 2015 [available at: https://njgin.state.nj.us/OGIS_IW; last accessed in February 2019]). Forrest Street is bordered to the north by Forrest Street Properties (FSP) (Block 21501, Lots 11, 12, 14, and 15); FSP is part of the GA Group Sites and is tracked under the same PI number 775706. Forrest Street is bordered to the northeast by a Halladay Street residential property (Block 21501, Lot 10). The total area encompassed by Forrest Street is approximately 0.45 acres.

This RAR addresses only the soil impacts for which PPG is responsible under the *Administrative Consent Order* (ACO) (NJDEP, 1990) and the *Partial Consent Judgment Concerning the PPG Sites* (Judicial Consent Order [JCO]) (Superior Court of New Jersey Law Division – Hudson County, 2009). PPG is responsible for CCPW and CCPW-related impacts.

PPG and PSEG are jointly responsible for remediation of MGP-related parameters including those emanating from Site 114. PSEG is taking the lead on closing out MGP-related impacts in accordance with the Licensed Site Remediation Professional (LSRP) Program under PI number G000005480, activity number LSR120001, per the July 2019 agreement between PPG and PSEG (PPG and PSEG, 2019). MGP-related information has been included in this RAR for informational purposes only. For example, MGP-related information is provided in the Tables 5-4 through 5-7, Figures 5-4 through 5-7, and As-Built Diagrams in Appendix E. The MGP-related AOCs identified herein are superseded by MGP-related AOCs established by PSEG and are no longer relevant. Information required to document remediation of MGP-related impacts will be presented by PSEG in their forthcoming RAR.

At Forrest Street, constituents covered by this RAR include:

- CCPW and hexavalent chromium (Cr^{+6});
- CCPW metals (antimony, total chromium, nickel, thallium, and vanadium);

- Select MGP-related semi-volatile organic compounds (SVOCs) (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-c,d)pyrene, and naphthalene); and
- Select MGP-related volatile organic compound (VOC) (benzene).

Under the ACO and JCO, PPG is not responsible for other constituents exceeding the NJDEP Soil Remediation Standards (SRS) or Default Impact to Groundwater Soil Screening Levels (DIGWSSLs) that may be present at the Site. Remediation of non-CCPW-related constituents and constituents not associated with operation of the former Halladay Street Gas Works MGP, including those associated with historic fill remaining at the Site, is the responsibility of the property owner under the LSRP program. This RAR addresses only the soil impacts for which PPG is responsible under the ACO and JCO.

Based on the findings of the Remedial Investigation (RI), the recommended RA for soil at the Site included the excavation and removal of visible CCPW and soil with concentrations of Cr^{+6} greater than the Chromium Soil Cleanup Criteria (CrSCC), as described in the GA Group Remedial Action Work Plan (RAWP) (see **Section 4.1.1** for the GA Group RAWP submittal history) and the technical memorandum entitled *Forrest Street and Forrest Street Properties – Proposed Terminal Elevation Excavation Elevations Submittal (Revision 1),* March 30, 2017 (Forrest TEE) (AECOM, 2017b). See **Section 4.2.1** for the Forrest TEE submittal history. Implementation of the full remedial excavation in the northern portion of Forrest Street was not possible at the time the remedial action was conducted due to the structural concerns associated with the adjacent buildings at 86/90 Forrest Street (Block 21501, Lots 11 and 12) and 98/100 Forrest Street (Block 21501, Lot 14) and existing nearby subsurface utilities. Therefore, for the northern portion of Forrest Street, the recommended RA, appropriate for the current commercial use of the adjacent FSP, included engineering controls (capping), institutional controls (notice in lieu of deed notice), and a corresponding Remedial Action Permit (RAP), as detailed in the Forrest RAWP (see **Section 4.1.2** for the Forrest RAWP submittal history). Forrest Street was subdivided into three areas based on these primary remedial approaches (**Figure 1-2**):

- Forrest Street Excavation Area (AOC FS-1A and AOC FS-2A): Excavation was conducted as the primary RA for the majority of Forrest Street, in accordance with the GA Group RAWP and the Forrest TEE. This area, on the southern portion of Forrest Street, encompasses Grid Rows DD through HH; Grids AA9B, BB9B, CC9B, V11B, V12B, W11B, X11B, Y10B, and Z10B; and a portion of Grids AA10B, BB10B, CC10B, W12B, Y11B, and Z11B;
- Forrest Street Utility Offset (AOC FS-1B and AOC FS-2B): Engineering controls appropriate for the current commercial use of the adjacent FSP were installed as the primary RA for the remaining portion of Forrest Street adjacent to the 86/90 and 98/100 Forrest Street buildings, in accordance with the Forrest RAWP for the Forrest Street Utility Offset. This area, on the northern portion of Forrest Street, encompasses the remainder of Grids AA10B, BB10B, CC10B, W12B, Y11B, and Z11B; a portion of Grid Y12B; and Grids AA11B, AA12B, BB11B, CC11B, X12B, and Z12B; and
- Southern Portion of 100 Forrest Street Loading Dock Driveway (AOC FS-1C and AOC FS-2C): Engineering controls appropriate for the current commercial use of the adjacent FSP serve as the primary RA for the portion of the 100 Forrest Street Loading Dock Driveway that is within the Forrest Street site boundary, in accordance with the Forrest RAWP. This area encompasses the remainder of Grid Y12B. Note that a majority of the 100 Forrest Street

Loading Dock Driveway is located on Block 21051, Lot 14; this RAR only addresses the southern portion of the driveway that is located within the Forrest Street right-of-way.

The overall objectives for Cr^{+6} and CCPW-impacted soil, as stated in the GA Group RAWP were:

- Elimination of potential exposure to Cr^{+6} in CCPW and CCPW-impacted soil (Cr^{+6} at concentrations greater than 20 milligrams per kilogram [mg/kg]) due to direct contact or windborne dust;
- Removal of accessible impacted soil at depths less than 20 feet (ft) below ground surface (bgs) and above the meadow mat;
- Removal of CCPW and certain impacted soil to depths greater than 20 ft bgs but to a maximum of 35 ft bgs where: a) the meadow mat is not present, and b) removal is technically prudent and beneficial to the future groundwater remediation; and
- Establishment of site conditions suitable for future uses of the Site.

As documented in the RI, it was determined that in Forrest Street, soil that exhibits analytical results exceeding the CrSCC for Cr^{+6} and which remains below the water table is attributed to historically contaminated groundwater that has migrated from Site 114. As such, the overall objectives for Cr^{+6} and CCPW-impacted soil in Forrest Street were further refined, as stated in the Forrest TEE:

- Remedial excavation to remove visually observed CCPW;
- Remedial excavation to remove soil that exhibits analytical results exceeding the CrSCC for Cr^{+6} above the water table;
- Where shallow soil that exhibits analytical results exceeding the CrSCC for Cr^{+6} extends into and through the water table, extend the remedial excavation to the shallowest clean sample or 20 ft bgs, whichever is shallower; and
- Remedial excavation to remove shallow soil that exhibits analytical results exceeding 1,000 mg/kg for Cr^{+6}, which would not be readily amenable to treatment in-situ via the groundwater remediation.

Where excavation was not possible due to structural concerns for the 86/90 and 98/100 Forrest Street buildings and existing nearby subsurface utilities (i.e., within the Forrest Street Utility Offset and the Southern Portion of 100 Forrest Street Loading Dock Driveway), the RA objectives, as stated in the Forrest RAWP, were the prevention of direct contact with, ingestion of, and inhalation of CCPW impacts and non-CCPW impacts emanating from Site 114 to Forrest Street and FSP with concentrations exceeding applicable criteria.

For the purposes of planning and implementing the RA, Forrest Street was identified as part of GA Group Phase 4, which included roadways within the GA Group area (**Figure 1-2**). Remedial excavation at the Forrest Street Excavation Area (AOC FS-1A) began on June 21, 2017 and was completed on August 4, 2017. Backfilling was completed on August 22, 2017. Installation of the engineering controls for the Forrest Street Utility Offset (AOC FS-1B) began on January 3, 2018. In accordance with the Forrest RAWP, in the Forrest Street Utility Offset (AOC FS-1B and AOC FS-2B), the engineering controls included a High-Density Polyethylene (HDPE) Liner; in the Southern Portion of 100 Forrest Street Loading Dock Driveway (AOC FS-1C and AOC FS-2C), the engineering controls included an Existing Asphalt Cap. Restoration activities across Forrest Street were completed on June 27, 2018.

In accordance with the GA Group RAWP, following excavation in the Forrest Street Excavation Area (AOC FS-2A), MGP-related constituents remaining in place at concentrations greater than the SRS are addressed through the placement of engineering controls (HDPE Liner or Clean Fill Soil Cap), institutional controls (notice in lieu of deed notice), and a corresponding RAP.

The Case Inventory Document (CID) for the Site summarizes the presence of 22 AOCs for soil associated with PI number 775706, located within Forrest Street and FSP. This RAR presents a summary of the implemented RA for the six remediated AOCs in Forrest Street, which includes AOC FS-1A (CCPW-impacted soil in the Forrest Street Excavation Area), AOC FS-1B (CCPW-impacted soil in the Forrest Street Utility Offset), AOC FS-1C (CCPW-impacted soil in the Southern Portion of the 100 Forrest Street Loading Dock Driveway), AOC FS-2A (MGP-impacted soil in the Forrest Street Excavation Area), AOC FS-2B (MGP-impacted soil in the Forrest Street Utility Offset), and AOC FS-2C (MGP-impacted soil in the Southern Portion of the 100 Forrest Street Loading Dock Driveway). Documentation of the RA for the AOCs in FSP, Block 21501, Lot 15 was included in the *Remedial Action Report, Forrest Street Properties (AOC FSP-1A, AOC FSP-1B, AOC FSP-2A, and AOC FSP-2B) Soil, Final* (FSP RAR) (AECOM, 2019c). Documentation of the RA for the additional AOCs in FSP (Block 21501, Lots 11, 12, and 14) will be provided in a separate document. Groundwater impacted by CCPW and/or MGP-related material throughout the GA Group Sites is being tracked under the Site 114 PI number G000005480 and is not included on the CID for the Site; documentation of the RA for groundwater for the GA Group Sites will be provided in a separate document.

Confirmation sampling results presented on figures and tables in this report indicate remedial objectives for Forrest Street have been achieved as follows:

AOC FS-1A: CCPW-impacted soil in the Forrest Street Excavation Area

- Excavation of soil containing Cr^{+6} met the requirements specified in the NJDEP memorandum entitled *Chromium Moratorium*, February 8, 2007 (the Chromium Policy) (NJDEP, 2007) in accordance with the *Updated Method to Determine Compliance with the Department's Chromium Policy, Garfield Avenue – Sites 114, 132, 133, 135, 137, and 143, Jersey City, NJ* (Method to Determine Compliance) (NJDEP, 2013) and/or the Forrest TEE (AECOM, 2017b).
- Soil concentrations for CCPW metals are in compliance with the CrSCC or SRS.
- Soil concentrations for CCPW metals in the unsaturated zone are in compliance with the DIGWSSLs and/or the site-specific Impact to Groundwater Soil Remediation Standards - GA Group (IGWSRS-GAGs).

AOC FS-1B: CCPW-impacted soil in the Forrest Street Utility Offset

- Cr^{+6} and visible CCPW remain in place at concentrations greater than the CrSCC and are addressed by an engineering control appropriate for the current commercial use of the adjacent FSP (HDPE Liner) and institutional controls (notice in lieu of deed notice).
- Soil concentrations of antimony, chromium, nickel, and thallium are in compliance with the CrSCC or SRS.
- Vanadium at one sample location remains in place at a concentration greater than the Residential Direct Contact Soil Remediation Standard - GA Group (RDCSRS-GAG), but less than the Non-Residential Direct Contact Soil Remediation Standard (NRDCSRS). Since

Forrest Street is a roadway and therefore a non-residential area, this sample is not out of compliance. The exceedance of the RDCSRS-GAG is documented via institutional controls (notice in lieu of deed notice). Soil concentrations for CCPW metals in the unsaturated zone are in compliance with the DIGWSSLs and/or the site-specific IGWSRS-GAGs.

AOC FS-1C: CCPW-impacted soil in the Southern Portion of 100 Forrest Street Loading Dock Driveway

- Cr^{+6} and visible CCPW remain in place at concentrations greater than the CrSCC and are addressed by an engineering control appropriate for the current commercial use of the adjacent FSP (Existing Asphalt Cap) and institutional controls (notice in lieu of deed notice).
- Soil concentrations for CCPW metals are in compliance with the CrSCC or SRS.
- Soil concentrations for CCPW metals in the unsaturated zone are in compliance with the DIGWSSLs and/or the site-specific IGWSRS-GAGs.

AOC FS-2A: MGP-impacted soil in the Forrest Street Excavation Area;
AOC FS-2B: MGP-impacted soil in the Forrest Street Utility Offset; and
AOC FS-2C: MGP-impacted soil in the Southern Portion of 100 Forrest Street Loading Dock Driveway

- Soil concentrations of MGP-related benzo(k)fluoranthene are in compliance with the SRS.
- Select MGP-related SVOCs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, and naphthalene) and MGP-related benzene remain in place at concentrations greater than the SRS and are addressed by engineering controls (HDPE Liner, Clean Fill Soil Cap, or Existing Asphalt Cap) and institutional controls (notice in lieu of deed notice).
- Soil concentrations of select MGP-related SVOCs (benzo(k)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, and naphthalene) and MGP-related benzene in the unsaturated zone are in compliance with the DIGWSSLs.
- Select MGP-related SVOCs (benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene) remain in place at concentrations greater than the DIGWSSLs and are addressed by engineering controls (HDPE Liner or Existing Asphalt Cap) and institutional controls (notice in lieu of deed notice).
- Benzo(a)anthracene, benzo(a)pyrene, and benzene remain in place at concentrations greater than the SRS and/or DIGWSSLs in Grid FF9B and HH8B. It has been determined that these exceedances are not associated with former MGP operations and, therefore, do not fall under the purview of the ACO and the JCO. Remediation of these impacts is the responsibility of the property owner.

The soil RAs for AOC FS-1A, AOC FS-1B (based on the current commercial use of the adjacent FSP), AOC FS-1C (based on the current commercial use of the adjacent FSP), AOC FS-2A, AOC FS-2B, and AOC FS-2C are effective in protecting public health and safety and the environment, and no further soil remediation is warranted for these AOCs. This RAR demonstrates compliance with the applicable remediation requirements for the soil at AOC FS-1A, AOC FS-1B (based on the current commercial use of the adjacent FSP), AOC FS-1C (based on the current commercial use of the adjacent FSP), AOC FS-2A, AOC FS-2B, and AOC FS-2C, and no further action with regard to these AOCs is needed (other than filing the notice in lieu of deed notice and implementing the

RAP). PPG requests the closure of AOC FS-1A, AOC FS-1B (based on the current commercial use of the adjacent FSP), AOC FS-1C (based on the current commercial use of the adjacent FSP), AOC FS-2A, AOC FS-2B, and AOC FS-2C by the NJDEP through the issuance of a Consent Judgment Compliance Letter. Once the Consent Judgment Compliance Letter is granted, PPG will implement the permit conditions under the LSRP program, rather than under the JCO program.

Prior to the future residential use of the adjacent FSP, PPG will conduct a remedial excavation within Forrest Street at AOC FS-1B and AOC FS-1C to address CCPW-impacted soil, which is currently inaccessible due to the current commercial use of the adjacent FSP. The future residential use remediation will be conducted under the existing site-wide GA Group RAWP (AECOM, 2018f) in accordance with the February 8, 2007 NJDEP memorandum entitled *Chromium Moratorium* (NJDEP, 2007), under the LSRP program. Following completion of the future residential use remediation, PPG will update the notice in lieu of deed notice, RAR, and RAP. PPG's LSRP will then issue a Response Action Outcome (RAO) appropriate for the residential use of the adjacent FSP.

1.0 Introduction

This Remedial Action Report (RAR) has been prepared by AECOM on behalf of PPG to document the Remedial Action (RA) for Forrest Street for the following:

- Chromate Chemical Production Waste (CCPW) and CCPW-impacted soil (Area of Concern [AOC] FS-1A, AOC FS-1B, and AOC FS-1C); and
- Soil impacted by manufactured gas plant (MGP)-related constituents associated with the former Halladay Street Gas Works MGP (AOC FS-2A, AOC FS-2B, and AOC FS-2C).

Forrest Street (the Site) is one of the Garfield Avenue Group (GA Group) Sites, which include Sites 114, 132, 133, 135, 137, 143, and 186, and adjacent roadways and properties (**Figure 1-1**). Site 114 is the former location of a chromite ore processing facility previously owned by PPG, and the former Halladay Street Gas Works MGP previously owned by Public Service Electric and Gas Company (PSEG). Forrest Street is tracked under the New Jersey Department of Environmental Protection (NJDEP) Site Remediation Program (SRP) Program Interest (PI) number 775706.

Forrest Street is located west of Halladay Street in Jersey City, New Jersey (NJ) (**Figure 1-2**). Forrest Street is bordered to the south and west by Site 114 (Block 21501, Lots 16 and Lot 17 as identified in the Jersey City Parcel Data from the New Jersey Geographic Information Network [NJGIN], last updated October 6, 2015 [available at: https://njgin.state.nj.us/OGIS_IW; last accessed in February 2019]). Forrest Street is bordered to the north by Forrest Street Properties (FSP) (Block 21501, Lots 11, 12, 14, and 15); FSP is part of the GA Group Sites and is tracked under the same PI number 775706. Forrest Street is bordered to the northeast by a Halladay Street residential property (Block 21501, Lot 10). The total area encompassed by Forrest Street is approximately 0.45 acres.

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 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 soil and sources of contamination at these Hudson County Chromate (HCC) sites. 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 RA milestone dates for the NJ Chrome Remediation Sites, including Forrest Street. 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, 2019 (Riccio, 2019).

PPG and PSEG are jointly responsible for remediation of MGP parameters related to the former Halladay Street Gas Works MGP. PSEG, as the former Halladay Street Gas Works MGP operator, is the lead party for addressing these impacts.

PSEG is taking the lead on closing out MGP-related impacts in accordance with the Licensed Site Remediation Professional (LSRP) Program under PI number G000005480, activity number LSR120001, per the July 2019 agreement between PPG and PSEG (PPG and PSEG, 2019). MGP-related information has been included in this RAR for informational purposes only. For example, MGP-related information is provided in the Tables 5-4 through 5-7, Figures 5-4 through 5-7, and As-Built Diagrams in Appendix E. The MGP-related AOCs identified herein are superseded by MGP-related AOCs established by PSEG and are no longer relevant. Information required to document remediation of MGP-related impacts will be presented by PSEG in their forthcoming RAR.

Forrest Street is an active, two-lane asphalt roadway underlain by underground water, combined sewer, and gas utility lines.

Forrest Street was subdivided into three areas based on the primary remedial approach (**Figure 1-2**):

- Forrest Street Excavation Area (AOC FS-1A and AOC FS-2A): Excavation was conducted as the primary RA for the majority of Forrest Street, in accordance with the GA Group Remedial Action Work Plan (RAWP) (see **Section 4.1.1** for the GA Group RAWP submittal history) and the technical memorandum entitled *Forrest Street and Forrest Street Properties – Proposed Terminal Elevation Excavation Elevations Submittal (Revision 1),* March 30, 2017 (Forrest TEE) (AECOM, 2017b). See **Section 4.2.1** for the Forrest TEE submittal history. This area, on the southern portion of Forrest Street, encompasses Grid Rows DD through HH; Grids AA9B, BB9B, CC9B, V11B, V12B, W11B, X11B, Y10B, and Z10B; and a portion of Grids AA10B, BB10B, CC10B, W12B, Y11B, and Z11B;
- Forrest Street Utility Offset (AOC FS-1B and AOC FS-2B): Engineering controls appropriate for the current commercial use of the adjacent FSP were installed as the primary RA for the remaining portion of Forrest Street adjacent to the 86/90 and 98/100 Forrest Street buildings, in accordance with the Forrest RAWP (see **Section 4.1.2** for the Forrest RAWP submittal history) for the Forrest Street Utility Offset. This area, on the northern portion of Forrest Street, encompasses the remainder of Grids AA10B, BB10B, CC10B, W12B, Y11B, and Z11B; a portion of Grid Y12B; and Grids AA11B, AA12B, BB11B, CC11B, X12B, and Z12B; and
- Southern Portion of the 100 Forrest Street Loading Dock Driveway (AOC FS-1C and AOC FS-2C): Engineering controls appropriate for the current commercial use of the adjacent FSP serve as the primary RA for the portion of the 100 Forrest Street Loading Dock Driveway that is within the Forrest Street site boundary, in accordance with the Forrest RAWP (see **Section 4.1.2** for the Forrest RAWP submittal history). This area encompasses the remainder of Grid Y12B. Note that a majority of the 100 Forrest Street Loading Dock Driveway is located on Block 21051, Lot 14; this RAR only addresses the southern portion of the driveway that is located within the Forrest Street right-of-way.

The Case Inventory Document (CID) summarizes the presence of 22 AOCs for soil associated with PI number 775706, located within Forrest Street and FSP. As part of the Supplemental Soil Remedial Investigation Report (SSRIR) for the GA Group Sites, contaminated soil within FSP and Forrest Street was considered to be a single AOC (Forrest Street and Forrest Street Properties - Soil) (AECOM, 2018d). As part of this RAR and other RAR submittals for FSP and Forrest Street, the single AOC for soil has been subdivided into 22 AOCs in both Forrest Street and FSP based on the contaminants of concern, RA approach, and RA status, as presented in the CID. This RAR presents a summary of the implemented RA for the six remediated Forrest Street AOCs, which

includes AOC FS-1A (CCPW-impacted soil in the Forrest Street Excavation Area), AOC FS-1B (CCPW-impacted soil in the Forrest Street Utility Offset), AOC FS-1C (CCPW-impacted soil in the Southern Portion of the 100 Forrest Street Loading Dock Driveway), AOC FS-2A (MGP-impacted soil in the Forrest Street Excavation Area), AOC FS-2B (MGP-impacted soil in the Forrest Street Utility Offset), and AOC FS-2C (MGP-impacted soil in the Southern Portion of the 100 Forrest Street Loading Dock Driveway), as presented in **Table 1-1**. The survey limits of each AOC presented in this RAR are shown on **Figure 1-2**.

Documentation of the RA for the AOCs in FSP, Block 21501, Lot 15 was included in the previously submitted *Remedial Action Report – Forrest Street Properties (AOC FSP-1A, AOC FSP-1B, AOC FSP-2A, and AOC FSP-2B) Soil, Final* (FSP RAR) (AECOM, 2019c). Documentation of the RA for the additional AOCs in FSP (Block 21501, Lots 11, 12, and 14) will be provided in a separate document. Groundwater impacted by CCPW and/or MGP-related material throughout the GA Group Sites is being tracked under PI number G000005480 for Site 114 (the location of the former Chromate Chemical Production Facility and MGP). Remediation of non-CCPW-related constituents and constituents not associated with operation of the former Halladay Street Gas Works MGP is the responsibility of the property owner under the LSRP program. The CID included herein only reflects the remediated soil AOCs that PPG is responsible for associated with the ACO/JCO.

This RAR was prepared in accordance with the requirements set forth in the *Technical Requirements for Site Remediation* (TRSR), New Jersey Administrative Code (N.J.A.C.), Title 7, Chapter 26E, Subchapter 5.5 (N.J.A.C. 7:26E-5.5) (NJDEP, 1993b), Appendix A of the 1990 ACO (NJDEP, 1990), and the June 26, 2009 JCO (Superior Court of New Jersey Law Division – Hudson County, 2009).

The remainder of this RAR is organized as follows:

- **Section 2** provides the summary of soil remedial investigation (RI) findings and recommendations;
- **Section 3** identifies the applicable remedial standards/criteria;
- **Section 4** presents the summary of pre-remedial action design activities;
- **Section 5** provides the description of the RA implemented;
- **Section 6** discusses the reliability of the data including data validation and usability;
- **Section 7** includes documentation of the protectiveness of the remedy;
- **Section 8** provides the updated receptor evaluation information;
- **Section 9** presents the conclusions and recommendations; and
- **Section 10** lists the references cited in the report.

Supporting information is presented in the appendices.

2.0 Summary of Soil Remedial Investigation Findings and Recommendations

2.1 Summary of Soil Remedial Investigation Findings

RI activities performed at the GA Group Sites were detailed in the following documents, including Remedial Investigation Work Plans (RIWPs) and Remedial Investigation Reports (RIRs), previously submitted to the NJDEP:

- April 2003 *Remedial Investigation Work Plan – Site 114* (ENSR, 2003).
- March 2006 *Remedial Investigation Report – Site 114* (Site 114 RIR) (ENSR, 2006a).
- March 2006 *Remedial Investigation Work Plan – Site 114 (Off Site)* (ENSR, 2006b).
- September 2006 *Remedial Investigation Work Plan – Sites 132, 133, 135, 137 and 143* (ENSR, 2006c).
- December 2007 *Remedial Investigation Report, Former Halladay Street Gas Works, Jersey City, New Jersey* (Halladay Street Gas Works RIR) (CMX, 2007).
- July 2008 *Remedial Investigation Report Addendum, Supplemental Offsite Soil Sampling, Former Halladay Street Gas Works, Jersey City, New Jersey* (RIR Addendum) (CMX, 2008).
- December 2009 *Remedial Investigation Report – Non-Residential Chromate Chemical Production Waste Sites, Sites 114, 132, 133, 135, 137, and 143* (AECOM, 2009).
- March 2011 *Soil Remedial Investigation Work Plan – Sites 114, 132, 133, 135, 137, 143 and Site 186* (AECOM, 2011a).
- February 2012 *Remedial Investigation Report – Soil Garfield Avenue Group Non-Residential CCPW Sites 114, 132, 133, 135, 137, 143 and 186* (2012 RIR) (AECOM, 2012a).
- May 2014 *Remedial Investigation Report Former Halladay Street Gas Works Jersey City, New Jersey* (AMEC, 2014).
- August 2018 *Supplemental Soil Remedial Investigation Report, Final Revision 1, PPG Garfield Avenue Group, Hudson County Chromium Sites, Jersey City, New Jersey* (August 2018 SSRIR) (AECOM, 2018d), as approved by NJDEP on October 22, 2018 (NJDEP 2018a).

The 2012 RIR provides a detailed summary of the previous RI work throughout the GA Group Sites but includes limited data for Forrest Street. These initial, limited investigation results were documented in the 2012 RIR (AECOM, 2012a), and additional investigation results in Forrest Street that occurred after the 2012 RIR were documented in the August 2018 SSRIR (AECOM, 2018d).

Impact to Groundwater Soil Remediation Standards - GA Group (IGWSRS-GAGs) for antimony and nickel were developed and presented in the August 2018 SSRIR (AECOM, 2018d). The following paragraphs include a summary of the information provided in the August 2018 SSRIR with respect to Forrest Street.

RI activities were conducted at Site 114 and the southern GA Group Sites (Sites 132, 133, 135, 137, and 143) between 2005 and 2008. The results of these activities were included in the Site 114 RIR (ENSR, 2006a), the Halladay Street Gas Works RIR (CMX, 2007), and the RIR Addendum (CMX, 2008).

Forrest Street was initially targeted for RI activities by PPG because of its proximity to Site 114. RI activities were also conducted by PSEG for impacts related to the former Halladay Street Gas Works MGP located in the northeastern portion of Site 114. PPG and PSEG conducted several RI phases throughout the GA Group Sites. The 2018 SSRIR incorporated the results of RI work conducted on and adjacent to Forrest Street by both PPG and PSEG through 2017. The RI work was designed to delineate the compounds on or potentially emanating from Site 114 related to the former chromite ore processing operations and related to PPG's former ownership of Site 114. The compounds present on Site 114 included volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), polychlorinated biphenyls (PCBs), metals, and hexavalent chromium (Cr^{+6}), as well as CCPW.

The RI activities conducted at Forrest Street identified visible CCPW as well as the presence of Cr^{+6} in soil in the western portion of Forrest Street at concentrations greater than the NJDEP Chromium Soil Cleanup Criteria (CrSCC). Visible CCPW material observed in Forrest Street was found within the fill material that was placed on top of the meadow mat or on top of native materials where the meadow mat was not present. Concentrations of Cr^{+6} greater than the CrSCC within Forrest Street were found in the fill material and in the undisturbed native material beneath the fill, extending to a maximum depth of 35.5 feet below ground surface (ft bgs).

The Cr^{+6} exceedances detected in the shallow fill material were related to fill containing limited quantities of CCPW-impacted material and/or impacted groundwater that had migrated into the Forrest Street area prior to the remediation of Site 114. The Cr^{+6} exceedances detected in the undisturbed native material beneath the fill are primarily related to impacted groundwater that had migrated into the Forrest Street area prior to the remediation of Site 114, as documented in the *Additional Forrest Street Remedial Investigation – Soil & Groundwater* (AECOM, 2016a).

The RI activities identified the presence of CCPW metals (specifically vanadium and nickel) in soil in the western portion of Forrest Street at concentrations greater than the Residential Direct Contact Soil Remediation Standard - GA Group (RDCSRS-GAG) and IGWSRS-GAG, respectively.

The PSEG RI activities identified visible oil-material/tar-material (OM/TM) in the western portion of Forrest Street during the investigation of MGP waste (CMX, 2007); this OM/TM was delineated during the Halladay Street Gas Works RI. An emanating from Site 114 evaluation was conducted in 2016 and revised in 2018, as documented in the memoranda entitled *North of Forrest Street Area – Evaluation of Non-CCPW-Related Compounds Emanating from Site 114 (Revision 1)* (2016 Emanating-From Memorandum) (AECOM, 2016b) and *Forrest Street and Forrest Street Properties Emanating-From Parameters (Revision 1)* (2018 Emanating-From Memorandum) (AECOM, 2018e). It was determined that MGP-related polycyclic aromatic hydrocarbons (PAHs) (benzo(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene) (AECOM, 2016b) and benzene and naphthalene (AECOM, 2018e) were likely emanating from Site 114 onto the western portion of Forrest Street, primarily where OM/TM was observed (AECOM, 2016b). Benzene, benzo(a)anthracene, and benzo(a)pyrene were also detected in the eastern portion of Forrest Street at concentrations that exceed the Soil Remediation Standards (SRS) and/or Default Impact to Groundwater Soil Screening Levels (DIGWSSLs); however, the SVOCs

and benzene in this area were determined not to be emanating from Site 114, nor were they attributable to MGP impacts (AECOM, 2018e).

The 2018 SSRIR discusses that the SVOC concentrations of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and naphthalene at sample locations P4-FOR-Y12B and P4-FOR-Y12BR that are greater than the SRS and/or the DIGWSSLs require further delineation (AECOM, 2018d). Delineation of these compounds at these locations will be addressed as part of the forthcoming FSP RAR for Lots 11, 12, and 14, Block 21501.

2.2 Physical Setting of the Site

The GA Group Sites, including Forrest Street, are in an urban area in Jersey City, Hudson County, NJ, between Garfield Avenue, Caven Point Avenue, Pacific Avenue, and the NJ Transit Light Rail. The GA Group Sites consist of former industrial and commercial properties and businesses. The GA Group Sites, including Forrest Street, are located within the Canal Crossing Redevelopment Area, which encompasses 111 acres of planned redevelopment space in the southeastern section of Jersey City, NJ (City of Jersey City, 2009).

There is little topographic relief within and surrounding the GA Group Sites, where the topography typically ranges from elevation (El.) 9 feet (ft) to 16 ft relative to the North American Vertical Datum of 1988 (NAVD88). However, west of Garfield Avenue, the land surface slopes upward and reaches approximately El. 100 ft NAVD88 about one-half mile to the west. The topography east of the GA Group Sites is flat, extending to the Hudson River and Upper New York Bay. Due to highly compacted surface soil and other impervious features, storm water runoff within the GA Group Sites is primarily channeled into the municipal storm sewer system (ENSR, 2006a).

The GA Group Sites are 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, ship ballast, coal ash, and incinerator ash. 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, 2006a).

2.2.1 Topography

The United States Geological Survey (USGS) Jersey City, NJ topographic quadrangle map (**Figure 1-1**) presents the regional topography for the GA Group Sites and surrounding areas. Forrest Street has little topographic relief, with ground surface at approximately El. 11 ft NAVD88. Directly west of the 100 Forrest Street building, there is a drainage swale that collects surface water runoff from the Block 21501, Lot 15 property and the 100 Forrest Street building roof, and channels it towards Forrest Street, where storm water is collected by a combined sewer catch basin. Just to the west of Garfield Avenue, the topography rises approximately 30 to 40 ft in elevation within several hundred yards of the GA Group Sites, and to approximately El. 100 ft NAVD88 about a half-mile west of the GA Group Sites. As of September 2018, the surface elevation of the Site following soil remediation and restoration ranges from El. 9 to 12 ft NAVD88.

2.2.2 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 west of Garfield Avenue approximately 200 million years ago.

2.2.3 Forrest Street Geology

Most of the GA Group is located on miscellaneous fill material that was used to reclaim the salt marsh for the construction of this portion of Jersey City. Although Forrest Street includes fill material overlying native sands and silts, most of Forrest Street was not part of the salt marsh. Soil boring logs and the NJDEP Historic Fill Map of the Jersey City Quadrangle (NJDEP, 2004) establish that Forrest Street is located within an area of historic fill overlying native sand and silt (AECOM, 2012a). Meadow mat is generally absent in this area, which was higher topographically than the salt marsh prior to the introduction of the historic fill material. The major geologic units in the area of the Forrest Street, from top to bottom, include:

- A non-native fill layer (the shallow zone);
- Native soil consisting of sand, silty sand, and clays (the intermediate zone);
- 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 (bedrock zone).

The bedrock surface is relatively shallow west of Garfield Avenue, but fairly deep beneath Site 114. Bedrock was observed at depths less than 10 ft bgs west of the Site along Garfield Avenue, at depths exceeding 100 ft bgs below the center of Site 114, and at an approximate depth of 80 ft bgs at Halladay Street to the east of Forrest Street (AECOM, 2012a).

East of the GA Group Sites, 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).

Most of Forrest Street was not part of the salt marsh. Therefore, the meadow mat is not present and the historic fill is in direct contact with the underlying native soil. The historic fill in this location is thinner and less debris-laden than the fill material observed in other parts of the GA Group. Depths to the underlying native soils range from approximately 3 to 14 ft bgs (AECOM, 2017d).

Below the fill, soil is unconsolidated and is characterized by fine to medium sand and silt with clay and some gravel, typical of the current understanding of the geologic depositional history of the area. The native, unconsolidated soil ranges in thickness from approximately 56 to 77 ft, based on borings that extended to bedrock.

Excavation of CCPW-impacted historic fill at the Site took place between March 2017 and July 2017. A summary of the restoration activities, including backfilling, is provided in **Section 7.2** of this RAR.

2.2.4 Hydrogeology

This RAR only addresses the RA of soil at AOC FS-1A, AOC FS-1B, AOC FS-1C, AOC FS-2A, AOC FS-2B, and AOC FS-2C. Groundwater impacted by CCPW and/or MGP material throughout the GA Group Sites is being tracked under PI number G000005480 for Site 114 (the location of the former Chromate Chemical Production Facility and MGP). The status of the groundwater investigation throughout the GA Group Sites is documented in the *Groundwater Remedial Investigation Report, Draft* submitted to the NJDEP on October 1, 2018 (AECOM, 2018g). A separate RAR will be prepared and submitted to document the groundwater RA at the GA Group Sites. This description of hydrogeology is provided herein solely to meet the regulatory requirements of N.J.A.C. 7:26E-5.7(b)1 as specified by N.J.A.C. 7:26E-1.6(b)1.

2.2.4.1 Regional Groundwater Flow

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

- **Fill (Shallow Water-Bearing Zone):** Groundwater in the fill is typically encountered within 10 ft bgs. In general, shallow groundwater flow patterns represent a subdued version of the 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 this soil 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 soil; 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 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.

2.2.4.2 GA Group Sites Groundwater Flow

Like the regional hydrogeology, groundwater at the GA Group Sites occurs in several hydrogeologic zones:

- The shallow fill zone (shallow water-bearing zone);
- The intermediate sand and silty sand zone including the meadow mat (intermediate water-bearing zone);
- The deep sand, gravel lenses, silts, clays, and glacial till (deep water-bearing zone); and

- Bedrock of the Stockton and Lockatong Formations (bedrock water-bearing zone).

Shallow groundwater flow is complex and is affected by various on- and off-site activities and features, including excavations, placement of clean and/or amended fill, sheet pile, implementation of interim groundwater remedial measures, other subsurface infrastructure, and localized variability in recharge. The principal direction of groundwater flow in the intermediate and deep water-bearing zones is from northwest to southeast. This flow direction is consistent with the geologic setting where the GA Group area is recharged from groundwater coming off the topographic high to the west. Recharge to the intermediate water-bearing zone is also occurring due to downward gradients in the fill and upward gradients in the deep water-bearing zone.

During a May/June 2018 groundwater sampling round, groundwater elevations throughout the GA Group Sites in the shallow, intermediate, and deep overburden, and bedrock groundwater zones ranged from El. 3.25 to 12.78 ft NAVD88 (shallow), El. 6.16 to 9.67 ft NAVD88 (intermediate), El. 6.44 to 8.03 ft NAVD88 (deep), and El. 7.55 to 10.48 ft NAVD88 (bedrock).

The 50th percentile groundwater elevation for Forrest Street was estimated to be El. 6.3 ft NAVD88 based on seven monitoring wells located on or adjacent to Forrest Street gauged between December 2003 and December 2016. The monitoring well locations and data are included in **Appendix A**.

2.3 Recommended Remedial Action

Based on the findings of the RI, the recommended RA for soil at the Site included the excavation and removal of visible CCPW and soil with concentrations of Cr^{+6} greater than the CrSCC. It was anticipated that the presence of CCPW metals (antimony, total chromium, nickel, thallium, and vanadium) at concentrations greater than the CrSCC, SRS, DIGWSSLs, or the site-specific IGWSRS-GAGs would be resolved as a result of the excavation being driven by the presence of Cr^{+6} and visible CCPW impacts.

PPG is also responsible for remediation of select MGP-related SVOCs and select VOCs emanating from Site 114 at concentrations greater than the SRS or DIGWSSLs. The excavation extent was not driven by the presence of these other constituents; it was anticipated that the presence of such constituents in soil would be resolved as a result of the excavation being driven by the presence of Cr^{+6} and visible CCPW.

Following excavation, MGP-related constituents remaining in place at concentrations greater than the SRS were addressed through either the placement of engineering controls (High-Density Polyethylene [HDPE] Liner or Clean Fill Soil Cap), institutional controls (notice in lieu of deed notice), and a corresponding Remedial Action Permit (RAP).

Where implementation of full remedial excavation was not possible at the time the remedial action was conducted due to both structural concerns associated with the adjacent buildings at 86/90 Forrest Street (Block 21501, Lots 11 and 12) and 98/100 Forrest Street (Block 21501, Lot 14) and existing nearby subsurface utilities (i.e., within the Forrest Street Utility Offset and the Southern Portion of 100 Forrest Street Loading Dock Driveway), the recommended RA for soil, appropriate for the current commercial use of the adjacent FSP, included engineering controls (HDPE Liner or Existing Asphalt Cap), institutional controls (notice in lieu of deed notice), and a corresponding RAP. Prior to the future residential use of the adjacent FSP, the recommended RA for soil within

this area of Forrest Street included the excavation and removal of visible CCPW and soil with concentrations of Cr^{+6} greater than the CrSCC.

3.0 Identification of Applicable Remedial Standards/Criteria

3.1 Regulatory Requirements, Guidance and Alternative/Site-Specific Determinations

The RAs described in the RAWPs (see **Section 4.1** for the RAWP submittal history) were performed in accordance with the following regulatory requirements, NJDEP Guidance, and Site-specific determinations:

- N.J.A.C. 7:9D – *Well Construction and Maintenance; Sealing of Abandoned Wells*, last amended January 2, 2018 (NJDEP, 2001).
- N.J.A.C. 7:26C – *Administrative Requirements for the Remediation of Contaminated Sites*, last amended August 6, 2018 (NJDEP, 1993a).
- N.J.A.C. 7:26D – *Soil Remediation Standards*, last amended September 18, 2017 (NJDEP, 2008a).
- N.J.A.C. 7:26E – *Technical Requirements for Site Remediation*, last amended August 6, 2018 (NJDEP, 1993b).
- NJDEP *Field Sampling Procedures Manual*, dated August 2005, last updated April 2011 (NJDEP, 2005).
- NJDEP *Technical Guidance for the Attainment of Remediation Standards and Site-Specific Criteria*, dated September 2012 (NJDEP, 2012c).
- NJDEP Memorandum from Lisa P. Jackson to Irene Kropp, Subject: *Chromium Moratorium*, February 8, 2007 (the Chromium Policy) (NJDEP, 2007).
- NJDEP *Chromium Soil Cleanup Criteria*, September 2008, revised April 2010 (NJDEP, 2008b).
- NJDEP *Administrative Consent Order*, dated July 19, 1990 (NJDEP, 1990).
- *Partial Consent Judgment Concerning the PPG Sites* (JCO) between NJDEP, PPG, and the City of Jersey City, June 26, 2009 (Superior Court of New Jersey Law Division - Hudson County, 2009).
- Letter from Mr. Thomas Cozzi to W. Michael McCabe, Subject: *Updated Method to Determine Compliance with the Department's Chromium Policy, Garfield Avenue – Sites 114, 132, 133, 135, 137, and 143, Jersey City, NJ.* August 13, 2013 (Method to Determine Compliance) (NJDEP, 2013).
- NJDEP Memorandum from Diane Groth to David Doyle, Subject: *PPG Garfield Avenue Group Sites, Adjacent Streets and Nearby Properties, Jersey City, NJ: Alternative Remediation Standard for Vanadium*, December 28, 2016 (NJDEP, 2016).
- August 2018 *Supplemental Soil Remedial Investigation Report, Final Revision 1, PPG Garfield Avenue Group, Hudson County Chromium Sites, Jersey City, New Jersey* (August 2018 SSRIR) (AECOM, 2018d), which presents the IGWSRS-GAGs for antimony and nickel. The August 2018 SSRIR was approved by NJDEP on October 22, 2018 (NJDEP, 2018a).

3.2 Soil Remediation Standards/Criteria

For soil at Forrest Street, under the ACO and JCO, PPG is responsible for CCPW, CCPW-related impacts, and MGP-related impacts associated with the former Halladay Street Gas Works MGP only. Under the ACO and JCO, PPG is not responsible for any other constituents at concentrations exceeding NJDEP SRS, CrSCC, DIGWSSLs, or IGWSRS-GAGs that may be present at Forrest Street. Remediation of non-CCPW-related constituents and constituents not associated with operation of the former Halladay Street Gas Works MGP, including those associated with historic fill remaining at the Site, is the responsibility of the property owner under the LSRP program. This RAR addresses only the soil impacts for which PPG is responsible under the ACO and JCO.

The NJDEP SRS and other criteria relevant to the remediation at Forrest Street are presented in **Table 3-1**.

4.0 Summary of Pre-Remedial Action Design Activities

Based on the findings of the RI (as summarized in **Section 2**), the recommended RA for soil at the Site included the excavation and removal of visible CCPW and soil with concentrations of Cr^{+6} greater than the CrSCC.

Where implementation of the full remedial excavation was not possible at the time the remedial action was conducted due to structural concerns associated with the adjacent buildings at 86/90 Forrest Street (Block 21501, Lots 11 and 12) and 98/100 Forrest Street (Block 21501, Lot 14) and existing nearby subsurface utilities (i.e., within the Forrest Street Utility Offset and the Southern Portion of 100 Forrest Street Loading Dock Driveway), the recommended RA for soil, appropriate for current commercial use of the adjacent FSP included engineering controls (capping), institutional controls (notice in lieu deed notice), and a corresponding RAP.

4.1 Summary of the Remedial Action Work Plan (Soil)

As described in this section, PPG developed a RAWP for the GA Group Sites, including Forrest Street, to address CCPW and Cr^{+6} soil impacts. In Forrest Street, the RA described in the GA Group RAWP (**Section 4.1.1**) applies to AOC FS-1A and AOC FS-2A.

Where implementation of the full remedial excavation was not possible at the time the remedial action was conducted due to both structural concerns associated with the adjacent buildings at 86/90 Forrest Street (Block 21501, Lots 11 and 12) and 98/100 Forrest Street (Block 21501, Lot 14) and existing nearby subsurface utilities (i.e., within the Forrest Street Utility Offset and the 100 Forrest Street Loading Dock portion of the 98/100 Forrest Street Building Footprint), the recommended RA for soil, appropriate for the current commercial use of the adjacent FSP, included engineering controls (capping), institutional controls (notice in lieu of deed notice), and a corresponding RAP, as described in the Forrest RAWP (**Section 4.1.2**). In Forrest Street, the RA described in the Forrest RAWP applies to AOC FS-1B, AOC FS-1C, AOC FS-2B, and AOC FS-2C. Prior to the future residential use of the adjacent FSP, the RA described in the GA Group RAWP will be implemented in this area of Forrest Street.

4.1.1 GA Group RAWP

Following the preparation and submittal of the RIR (AECOM, 2012a), AECOM (on behalf of PPG) prepared a RAWP for the GA Group Sites (GA Group RAWP). A summary of the GA Group RAWP submittal/approval history is as follows:

- On April 17, 2012, PPG/AECOM issued the *Draft Remedial Action Work Plan (Soil), Rev. 2, Garfield Avenue Group – Sites 114, 132, 133, 135, 137 and 143, Jersey City, New Jersey* (2012 RAWP) (AECOM, 2012d).
- On May 14, 2012, NJDEP found the 2012 RAWP to be administratively complete and issued a Conditional Approval in a letter from Thomas J. Cozzi to M. Michael McCabe, Subject: *Remedial Action Work Plan (Soil), Rev. 2, Garfield Avenue Group – Sites 114, 132, 133, 135, 137 and 143, Jersey City, New Jersey* (NJDEP, 2012b).

- On December 5, 2014, PPG/AECOM issued the *Draft Remedial Action Work Plan (Soil) Rev. 3, Garfield Avenue Group – Sites 114, 132, 133, 135, 137 and 143, Jersey City, New Jersey* (Draft 2014 RAWP) (AECOM, 2014), documenting compliance with the conditions of NJDEP's Conditional Approval.
- On February 28, 2018, Weston Solutions, Inc. (Weston), on behalf of NJDEP, issued an email that requested minor editorial changes to the Draft 2014 RAWP (Weston, 2018a).
- On May 15, 2018, PPG/AECOM issued the *Final Remedial Action Work Plan (Soil) Rev. 3, Garfield Avenue Group Sites, Jersey City, New Jersey* (Final RAWP Rev. 3) (AECOM, 2018c).
- On July 12, 2018, Weston, on behalf of NJDEP, issued an email that requested one additional minor editorial change to the Final RAWP Rev. 3 (Weston, 2018b).
- On August 21, 2018, on behalf of the City of Jersey City, Environmental Remediation and Financial Services, LLC (ERFS) provided comments on the Final RAWP Rev. 3 (ERFS, 2018a), which were distributed by the Site Administrator by email on August 21, 2018.
- On September 27, 2018, PPG/AECOM issued the *Final Remedial Action Work Plan (Soil) Rev. 4, Garfield Avenue Group Sites, Jersey City, New Jersey* (Final RAWP Rev. 4) (AECOM, 2018f).
- On October 10, 2018, on behalf of the City of Jersey City, ERFS provided concurrence on the Final RAWP Rev. 4 (ERFS, 2018b).
- On November 9, 2018, NJDEP approved the Final RAWP Rev. 4 (NJDEP, 2018b).

The overall objectives for Cr^{+6} and CCPW-impacted soil, as stated in the GA Group RAWP were:

- Elimination of potential exposure to Cr^{+6} in CCPW and CCPW- impacted soil (Cr^{+6} at concentrations greater than 20 milligrams per kilogram [mg/kg]) due to direct contact or windborne dust;
- Removal of accessible impacted soil at depths less than 20 ft bgs and above the meadow mat;
- Removal of CCPW and certain impacted soil to depths greater than 20 ft bgs but to a maximum of 35 ft bgs where: a) the meadow mat is not present, and b) removal is technically prudent and beneficial to the future groundwater remediation; and
- Establishment of site conditions suitable for future uses of the Site.

As documented in the RI, it was determined that in Forrest Street, soil that exhibits analytical results exceeding the CrSCC for Cr^{+6} and which remains below the water table is attributed to historically contaminated groundwater that has migrated from Site 114. As such, the overall objectives for Cr^{+6} and CCPW-impacted soil in Forrest Street were further refined, as presented in the Forrest TEE (described in **Section 4.2.1**).

The selected RA for Cr^{+6} and CCPW-impacted soil at AOC FS-1A was excavation (in areas where the impacted soil was present and accessible) and off-site disposal. Excavation and treatment of soil containing Cr^{+6} was to meet the Chromium Policy (NJDEP, 2007) by following the Method to Determine Compliance (NJDEP, 2013) and/or the objectives outlined in the Forrest TEE (AECOM, 2017b). Meadow mat, where present, was to be protected to the extent practical since it provides a natural barrier to chromium migration and can reduce Cr^{+6} to trivalent chromium.

Under the ACO and JCO, PPG was also responsible for remediation of select MGP-related SVOCs and VOCs emanating from Site 114 at concentrations greater than the SRS and DIGWSSLs (AOC FS-2A). However, the excavation extent was not driven by the presence of these other constituents; it was anticipated that the presence of these other constituents would be resolved as a result of the excavation being driven by the presence of Cr^{+6} and visible CCPW.

Following excavation, MGP-related constituents remaining in place at concentrations greater than the CrSCC or SRS were to be addressed through the placement of an engineering control (capping), institutional controls (notice in lieu of deed notice), and a corresponding RAP.

Excavation areas were to be backfilled with soil suitable for residential, commercial, or other potential uses. In areas where deemed necessary, a capillary break was to be installed between groundwater and the ground surface to eliminate the possibility of chromate crystallization from impacted groundwater wicking to the surface. As described in the *Capillary Break Design Final Report (Revision 2)* (AECOM, 2017k), it was determined that a capillary break was required within the Forrest Street Excavation Area (AOC FS-1A) because Cr^{+6} concentrations greater than the CrSCC exist in soil at this area, regardless of depth, where backfill amended with FerroBlack®-H is not present at similar elevations as the meadow mat found within the GA Group Sites to serve as an engineering control.

To improve the design of the RAWPs, several pre-design activities were planned. These activities were to include actions such as soil borings, test pits, utility surveys, geotechnical assessments and sampling, and obtaining permits, where required. The goals of these events were: to define the limits of excavation and the locations of underground utilities under adjacent road ways; to obtain geotechnical data to support the design of excavation; and to determine the depth of excavation in specific grids.

Sampling in soil borings prior to excavation (i.e., pre-excavation sampling) would be used to define the proposed terminal excavation elevation (TEE) for specific grids, subject to review and concurrence by NJDEP. Technical Execution Plans (TEPs) were to be prepared and submitted to NJDEP to define the sample collection and excavation methods to be used.

The excavation was to be implemented on a 30-ft by 30-ft grid pattern. To determine compliance with the remediation objectives, post-excavation sampling of pit bottoms and sidewalls or sampling in soil borings prior to excavation (i.e., pre-excavation sampling) was to be conducted in excavation areas, with analysis for Cr^{+6}. At the Forrest Street Excavation Area, where the TEE in adjacent grids varied by more than two ft, sidewall samples were to be collected every 30 linear ft and at two-ft depth intervals. Where excavation grids were enclosed by shoring, or where the TEEs in adjacent grids varied by less than two ft, sidewall sampling was not required. Samples were also to be collected at two-ft depth intervals along the northern sidewalls of the Forrest Street Excavation Area that abutted the adjacent Forrest Street Utility Offset. Samples to be analyzed for CCPW metals (total chromium, antimony, nickel, thallium, and vanadium) were to be collected at a frequency of 10% of the Cr^{+6} confirmation samples.

The final phase of remedial activities to be conducted at the Forrest Street Excavation Area was to include site restoration activities before demobilization from the area.

4.1.2 Forrest RAWP

On February 3, 2017, Weston, on behalf of NJDEP, issued an email that instructed PPG to develop a RAWP to address soil impacts that could not be remediated via excavation due to the proximity of

currently in-use commercial buildings on FSP per the Forrest TEE submittal (Weston, 2017a). After a meeting on May 17, 2017, NJDEP agreed that the Forrest RAWP would be submitted in three phases (NJDEP, 2017) that include:

- Phase 1: The 100 Forrest Street excavation offset and the 84 Forrest Street loading dock;
- Phase 2: The Forrest Street utility excavation offset and the 90 Forrest Street Alleyway, including the northwest corner of 86/90 Forrest Street; and
- Phase 3: The 90 Forrest Street boiler room basement and Forrest Street building footprints.

A summary of the Forrest RAWP submittal history is as follows:

- On June 30, 2017, PPG/AECOM issued the *Draft Remedial Action Work Plan, Forrest Street and Forrest Street Properties, Phase 1 – 100 Forrest Street Offset and 84 Forrest Street, Loading Dock, Jersey City, New Jersey* (AECOM, 2017e).
- On July 26, 2017, PPG/AECOM issued the *Draft Remedial Action Work Plan, Forrest Street and Forrest Street Properties, Phase 1 – 100 Forrest Street Offset and 84 Forrest Street Loading Dock, Phase 2 – Forrest Street Utility Offset and 90 Forrest Street Alleyway (Paved and Unpaved Areas), Jersey City, New Jersey* (AECOM, 2017f).
- On August 11, 2017, Weston, on behalf of NJDEP, provided comments on the July 26, 2017 submittal (Weston, 2017g).
- On November 21, 2017, PPG/AECOM presented the selected remedial action for the 100 Forrest Street Offset to the Stakeholders in the memorandum entitled *Summary of Proposed Forrest Street Restoration Activities – Skyways and Roadway* (Forrest Restoration Memo) (AECOM, 2017j).
- On March 29, 2018, PPG/AECOM issued the *Draft Interim Remedial Action Work Plan, Forrest Street and Forrest Street Properties, Deferred Remediation Areas, Jersey City, New Jersey* (AECOM, 2018a). This submittal revised the July 26, 2017 Phase 1 and Phase 2 RAWP submittal based on NJDEP/Weston's August 11, 2017 comments and consolidated the RAWP into a single document (Forrest RAWP) that incorporates Phases 1, 2, and 3.
- On March 29, 2018, PPG/AECOM issued the Technical Memorandum entitled *Response to Comments on the Forrest Street and Forrest Street Properties Remedial Action Workplan (Phases 1 & 2) and NJDEP Recommendations for the Forrest Remedial Action Workplan* (AECOM, 2018b) to provide responses to Weston's August 11, 2017 comments.
- On November 16, 2018, Weston, on behalf of NJDEP, provided comments on the Forrest RAWP (Weston, 2018c).
- On March 22, 2019, PPG/AECOM issued the *Remedial Action Work Plan for Current Use of Forrest Street and Forrest Street Properties (Soil), Final* (Forrest RAWP) (AECOM, 2019a). This submittal also included responses to NJDEP/Weston's November 16, 2018 comments.
- On May 4, 2019, the City of Jersey City transmitted by email comments dated April 26, 2019 on the April 19, 2019 Site Administrator's Tracking Log. In their comments on the Tracking Log, the City of Jersey City indicated that it had no further comments on the Forrest RAWP (City of Jersey City, 2019).
- On May 10, 2019, Weston, on behalf of NJDEP, provided comments on the Forrest RAWP (Weston, 2019a).

- On May 29, 2019, the FSP Owner's Representative submitted comments on the Forrest RAWP to Ron Riccio, Esq. and David Doyle (Scarinci Hollenbeck LLC., 2019).
- On May 31, 2019, Weston, on behalf of NJDEP, provided additional comments on the Forrest RAWP (Weston, 2019b).
- On July 19, 2019, PPG/AECOM issued the Technical Memorandum entitled *Response to Comments on the Final Forrest RAWP: Forrest Street Properties Owner's May 29, 2019 Comments* (AECOM, 2019b).

The objective of the remedial actions proposed by the Forrest RAWP is the prevention of direct contact with, ingestion of, and inhalation of, CCPW impacts and non-CCPW impacts emanating from Site 114 to Forrest Street and FSP with concentrations exceeding applicable criteria.

The selected RA for Cr^{+6} and CCPW-impacted soil for the current-use remediation areas was engineering controls, institutional controls, and a corresponding RAP and, in limited cases, source removal, until more extensive remediation can be conducted.

For the Forrest Street Utility Offset (AOC FS-1B, which is addressed by this RAR), the selected RA, as appropriate for the current commercial use of the adjacent FSP, consisted of the following:

- An HDPE liner placed on top of dense-graded aggregate (DGA), which extends horizontally to the north to the Forrest Street Property buildings and to the south to the sheet pile separating Forrest Street and Site 114.
- Implementation of institutional controls (notice in lieu of deed notice) and a corresponding RAP.

For the 100 Forrest Street Loading Dock Driveway (which includes the Southern Portion of the 100 Forrest Street Loading Dock Driveway located within the Forrest Street right-of-way, AOC FS-1C, which is addressed by this RAR), the selected RA consisted of the following:

- The existing asphalt and concrete driveway that provides access to the building's loading dock, which serves as a soil cap.
- Implementation of institutional controls (notice in lieu of deed notice) and a corresponding RAP.

Under the ACO and JCO, PPG was also responsible for remediation of select SVOCs and VOCs emanating from Site 114 at concentrations greater than the SRS and DIGWSSLs. The RA presented in the Forrest RAWP for addressing Cr^{+6} and CCPW-impacts in the Forrest Street Utility Offset and the 100 Forrest Street Loading Dock Driveway (which includes the Southern Portion of the 100 Forrest Street Loading Dock Driveway located within the Forrest Street right-of-way) was designed to also address these MGP-related parameters emanating from Site 114 onto Forrest Street (AOC FS-2B and AOC FS-2C).

Based on the site conditions within Forrest Street and FSP and on the criteria established as part of the *Capillary Break Design Final Report (Revision 2)* (AECOM, 2017l), and as documented in the Forrest RAWP (AECOM, 2019a), a capillary break is required in the Forrest Street Utility Offset and the Southern Portion of the 100 Forrest Street Loading Dock Driveway. Specifically, a capillary break is required in these areas because Cr^{+6} concentrations greater than the CrSCC exist in soil at these areas, regardless of depth, where backfill amended with FerroBlack®-H is not present at a

similar elevation as the meadow mat found within the GA Group Sites to serve as an engineering control.

4.2 Summary of the Technical Execution Plan and Related Activities

4.2.1 Proposed Terminal Excavation Elevations and Pre-Design Investigation

Proposed TEEs for both the Forrest Street and FSP excavation were provided in a series of memoranda from PPG/AECOM to NJDEP/Weston and responses to comments from PPG/AECOM. The memoranda typically included detailed information demonstrating how the final excavation depth in each grid would comply with the Cr^{+6} decision trees in the Method to Determine Compliance (NJDEP, 2013).

As part of the pre-RA activities, and to better define the TEEs and planned excavation, pre-design investigation (PDI) activities were implemented. Note that in February 2017, a supplemental PDI was conducted in accordance with the Technical Memorandum entitled *Forrest Street Properties Pre-Design Investigation Work Plan (Revision 2)* (AECOM, 2016c), with which NJDEP concurred (Weston, 2016). As a result, a supplemental TEE submittal was made.

As documented in the RI, it was determined that in Forrest Street, soil that exhibits analytical results exceeding the CrSCC for Cr^{+6} and which remains below the water table is attributed to historically contaminated groundwater that has migrated from Site 114. As such, the overall objectives for Cr^{+6} and CCPW-impacted soil in Forrest Street were further refined, as stated in the Forrest TEE:

- To remove visually-observed CCPW;
- To remove soil that exhibits analytical results exceeding the CrSCC for Cr^{+6} above the water table;
- Where shallow soil that exhibits analytical results exceeding the CrSCC for Cr^{+6} extends into and through the water table, extend the remedial excavation to the shallowest clean sample or 20 ft bgs, whichever is shallower; and
- To remove shallow soil that exhibits analytical results exceeding 1,000 mg/kg for Cr^{+6}, which would not be readily amenable to treatment in-situ via the groundwater remediation.

The proposed TEEs for Forrest Street were included in both the Forrest Street and Forrest Street Properties TEE submittal and the Forrest Street Properties Supplemental TEE submittal. The following is a listing of the deliverables and correspondence that detailed the proposed TEEs and PDI investigation activities in Forrest Street and FSP.

4.2.1.1 Forrest Street and Forrest Street Properties – Proposed TEE Submittal

- On December 23, 2016, PPG/AECOM submitted the technical memorandum entitled *Forrest Street and Forrest Street Properties – Proposed Terminal Excavation Elevations Submittal* (AECOM, 2016d).
- On February 3, 2017, Weston, on behalf of NJDEP, provided comments on PPG/AECOM's December 23, 2016 memorandum (Weston, 2017a).
- On March 30, 2017, PPG/AECOM submitted the technical memorandum entitled *Forrest Street and Forrest Street Properties – Proposed Terminal Excavation Elevations Submittal (Revision 1)* (AECOM, 2017b), which also included responses to NJDEP/Weston's February 3, 2017 comments.

- On April 20, 2017, Weston, on behalf of NJDEP, provided comments on AECOM's March 30, 2017 memorandum (Weston, 2017d).
- On May 12, 2017, PPG/AECOM submitted the technical memorandum entitled *Response to NJDEP/Weston's 02/03/2017 and 04/20/2017 Comments on the Forrest Street and Forrest Street Properties – Proposed Terminal Excavation Elevations Submittal (Revisions 0 and 1)* (AECOM, 2017d).
- On May 25, 2017, Weston, on behalf of NJDEP, determined that PPG/AECOM's responses in the May 12, 2017 submittal were adequate (Weston, 2017f).

4.2.2 Technical Execution Plan

The TEPs for Forrest Street and FSP provided more detailed information on the planned RA including descriptions of the remediation activities and goals as well as depictions of the anticipated horizontal extent of excavation and the post-excavation sampling approach. The TEP submittal history for Forrest Street and FSP is provided below.

4.2.2.1 Southwestern (SW) Area TEP

- On December 12, 2011, PPG/AECOM issued the *DRAFT Technical Execution Plan, Southwestern Area Soil Excavation, PPG Site 114 - Garfield Avenue, Jersey City, New Jersey* (AECOM, 2011b).
- On March 9, 2012, PPG/AECOM issued the *Technical Execution Plan, Southwestern Area Soil Excavation, PPG Site114 – Garfield Avenue, Jersey City, New Jersey* (SW Area TEP) (AECOM, 2012b) and the Response to Comments reference table.
- On March 27, 2012, the NJDEP conditionally approved the SW Area TEP (NJDEP, 2012a).
- On April 23, 2012, PPG/AECOM submitted the *Final Technical Execution Plan, Southwestern Area Soil Excavation, PPG Site 114 – Garfield Avenue, Jersey City, New Jersey* (AECOM, 2012e).

4.2.2.2 Forrest Street and Forrest Street Properties TEP

- On December 23, 2016, PPG/AECOM issued the *Technical Execution Plan, Forrest Street and Forrest Street Properties Soil Excavation, Jersey City, New Jersey* (Forrest TEP) (AECOM, 2016e).
- On February 3, 2017, Weston, on behalf of NJDEP, provided comments on the Forrest TEP (Weston, 2017b).
- On March 23, 2017, PPG/AECOM submitted the *Technical Execution Plan (Revision 1), Forrest Street and Forrest Street Properties Soil Excavation, Jersey City, New Jersey* (Forrest TEP – Revision 1) (AECOM, 2017a), which included responses to NJDEP/Weston's February 3, 2017 comments (Weston, 2017b).
- On April 7, 2017, Weston, on behalf of NJDEP, provided comments on the Forrest TEP – Revision 1 and associated response to comments (Weston, 2017c).
- On April 21, 2017, PPG/AECOM submitted the technical memorandum entitled *Response to Comments on the Forrest Street and Forrest Street Properties Technical Execution Plan (Revision 1)* (AECOM, 2017c), which included responses to NJDEP/Weston's April 7, 2017 comments.

- On May 8, 2017, Weston, on behalf of NJDEP, determined that PPG/AECOM's responses in the April 21, 2017 submittal were adequate (Weston, 2017e).

5.0 Description of the Remedial Action

The RA at AOC FS-1A (CCPW-impacted soil in the Forrest Street Excavation Area) included the excavation of CCPW and visible CCPW-impacted soil, off-site transport and disposal of affected soil, backfilling of the excavations, and restoration of the affected areas. It was anticipated that the presence of CCPW metals (antimony, total chromium, nickel, thallium, and vanadium) at concentrations greater than the CrSCC, SRS, DIGWSSLs, or IGWSRS-GAGs would be resolved as a result of the excavation being driven by the presence of Cr^{+6} and visible CCPW.

The RA at AOC FS-2A (MGP-impacted soil in Forrest Street Excavation Area) included two parts. The first portion consisted of the excavation of CCPW and CCPW-impacted soil, which also resulted in the removal of some MGP-impacted soil. MGP-related SVOCs (including benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, and naphthalene) and a select MGP-related VOC (benzene) were evaluated to determine if these compounds were remaining in place at concentrations greater than the NJDEP SRS or DIGWSSLs. The second portion of the RA consisted of the placement of engineering controls (an HDPE Liner and a Clean Fill Soil Cap), a notice in lieu of deed notice, and a corresponding RAP to mitigate exposure to benzo(a)anthracene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, and naphthalene emanating from Site 114, remaining in place at concentrations greater than the SRS.

Benzo(a)anthracene and benzo(a)pyrene remain in place at the eastern end of Forrest Street (refer to **Figures 5-4** and **5-5**) at concentrations greater than the SRS and/or DIGWSSLs. These exceedances are associated with historic fill and not MGP operations because: 1) the soil boring logs and NJDEP Historic Fill Map for the Jersey City Quadrangle (NJDEP, 2004) establish that Forrest Street is within an area of historic fill; 2) the samples were collected within historic fill; 3) the concentrations of these samples fall within the range of concentrations presented in the NJDEP historic fill database (NJDEP, 2011); 4) no visible MGP-related materials were encountered during sample collection; 5) the exceedances of benzo(a)anthracene and benzo(a)pyrene are not co-located with elevated concentrations of naphthalene; and 6) concentrations of benzo(a)anthracene and benzo(a)pyrene at sample locations on the northern side of Site 114, Phase 2A (the location of the former Halladay Street Gas Works Plant) are less than the benzo(a)anthracene and benzo(a)pyrene exceedance concentrations located in Grid FF9B. Since these exceedances are associated with historic fill and not MGP operations, they do not fall under the purview of the ACO (NJDEP, 1990) and JCO (Superior Court of New Jersey Law Division – Hudson County, 2009). Therefore, PPG is not responsible for the remedy for these historic fill impacts, which are the responsibility of the City of Jersey City since the impacts are within the public right-of-way and are not emanating from Site 114.

Benzene remains in place at the eastern end of Forrest Street (refer to **Figure 5-7**) at concentrations greater than the DIGWSSL. These exceedances for benzene are not associated with MGP operations and do not fall under the purview of the ACO (NJDEP, 1990) and JCO (Superior Court of New Jersey Law Division – Hudson County, 2009) as per the 2018 Emanating-From Memorandum (AECOM, 2018e) as accepted by NJDEP on October 5, 2018. Therefore, PPG is not responsible for the remedy of these non-MGP-related impacts, which are the responsibility of the City of Jersey City since the impacts are within the public right-of-way and are not emanating from Site 114.

The RAs at AOC FS-1B (CCPW-impacted soil in the Forrest Street Utility Offset) and AOC FS-2B (MGP-impacted soil in the Forrest Street Utility Offset) included the placement of engineering controls (an HDPE Liner), a notice in lieu of deed notice, and a corresponding RAP to mitigate exposure to the CCPW impacts and MGP-related compounds emanating from Site 114 that are remaining in place in these AOCs at concentrations greater than the SRS. The HDPE liner is also intended to function as a low-permeability barrier that prevents potential future leaching of SVOCs that may be present in soil at concentrations greater than the DIGWSSLs.

The RAs at AOC FS-1C (CCPW-impacted soil in the Southern Portion of the 100 Forrest Street Loading Dock Driveway) and AOC FS-2C (MGP-impacted soil in the Southern Portion of the 100 Forrest Street Loading Dock Driveway) included the use of an existing cap as an engineering control (Existing Asphalt Cap), a notice in lieu of deed notice, and a corresponding RAP to mitigate exposure to the CCPW impacts and MGP-related compounds emanating from Site 114 that are remaining in place in these AOCs at concentrations greater than the SRS. The Existing Asphalt Cap is also intended to function as a low-permeability barrier that prevents potential future leaching of SVOCs that may be present in soil at concentrations greater than the DIGWSSLs.

The RA was performed in accordance with the NJDEP-conditionally-approved GA Group RAWP (AECOM, 2012d) in the Forrest Street Excavation Area (AOC FS-1A and AOC FS-2A) and the Forrest RAWP (AECOM, 2018a) in the Forrest Street Utility Offset (AOC FS-1B and AOC FS-2B) and the Southern Portion of 100 Forrest Street Loading Dock Driveway (AOC FS-1C and AOC FS-2C) as described in **Section 4.1**. The RA was performed in accordance with the TEPs and TEE submittals, as described in **Section 4.2**.

Preparatory activities for the remediation of the GA Group Sites, overall, began in 2010 with obtaining regulatory permits and/or approvals to facilitate implementation of the RA. Mobilization and preparation for the RA of the GA Group Sites began in June 2010.

AECOM served as the remediation engineer. Mueser-Rutledge Consulting Engineers served as the geotechnical/structural engineer.

ENTACT Environmental Services of Latrobe, Pennsylvania (ENTACT) 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.

AECOM performed the air monitoring at the Site during excavation and restoration activities, in accordance with the December 2010 *Revision of the Air Monitoring Workplan for Ground Intrusive Activities at the Garfield Avenue Site in Jersey City, New Jersey* (AMP) and applicable AMP Amendments (29 and 31) (AECOM, 2010b).

ENTACT performed the remedial construction activities at the Site. These services consisted of coordination and disconnection of utilities, excavation and backfilling, decontamination, demolition, dewatering, and Site restoration.

ENTACT coordinated transportation and disposal of the waste streams generated from the RA activities.

The following sections summarize the RA activities as implemented.

5.1 Pre-Construction Activities

The following activities were conducted prior to starting excavation of CCPW and CCPW-impacted soil:

- Obtaining access agreement from the property owner.
- Submitting approvals of permit applications and plans to the state and local agencies.
- Implementing a Soil Erosion and Sediment Control Plan (SESCP).
- Implementing the AMP.
- Developing a site-specific Health and Safety Plan (HASP).
- Implementing Site utility clearance activities.
- Mobilizing equipment and setting up temporary facilities.
- Establishing work zones.
- Re-directing local traffic onto Site 114.

The necessary permits were obtained from and approved by the state, local, and county agencies prior to initiation of activities covered by the permits as detailed in **Section 7.6**. Necessary permits and approvals are documented in **Appendix B**.

A road closure permit was obtained from the City of Jersey City, and an access agreement was established with the property owner of the adjacent Forrest Street Properties.

Pre-construction activities including mobilization and placement of Jersey barriers and temporary fencing, implementation of the SESCP, and establishment of work zones were performed in June 2017. The erosion and sediment controls consisted primarily of the placement of hay bales to contain soil that was potentially displaced during remedial activities. Hay bales were placed in areas where contractors were actively working at the Site and were relocated throughout the areas of remediation activities, as needed, in accordance with the SESCP. Hay bales were installed along the downgradient perimeter of the Site. To maintain access to the Forrest Street Properties during remediation of Forrest Street, local traffic was temporarily re-directed onto Site 114 as proposed in the sequencing plan drawings as part of the Forrest TEP – Revision 1.

The AMP was developed to provide specific procedures for measuring, documenting, and responding to potential airborne impacts during remedial activities at the Site. The AMP was approved by NJDEP prior to the initiation of work.

A HASP was developed for the RA at the GA Group Sites (including Forrest Street) in accordance with the Occupational Safety and Health Act (OSHA) 1910.120. The HASP documents policies and procedures to be followed to protect workers and the public from potential hazards posed at the GA Group Sites. The HASP includes training program protocols, a medical surveillance program, equipment maintenance programs, personal hygiene practices, a project air monitoring plan, a dust control plan, and other information.

In addition to contacting the New Jersey One-Call system, a utility survey was conducted prior to undertaking intrusive Site activities. A private utility locator, Enviroscan, Inc. of Lancaster, Pennsylvania, performed a geophysical survey to mark underground utilities (gas, sewer, water, phone, cable, electrical, etc.) within Forrest Street. In accordance with the Forrest RAWP, the

Forrest Street Utility Offset was designated to protect a majority of the utilities located in the street during remediation.

Equipment was delivered during the initial mobilization phase for the RA activities at the GA Group Sites and on an as-needed basis as work progressed. Temporary facilities including field office trailers, sanitary facilities, and Conex/intermodal boxes for equipment storage were mobilized onto Site 114 and set up for use during the RAs.

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, and Conex/intermodal storage boxes, and provide for vehicle parking.
- An Exclusion Zone encompassed areas associated with impacted material and/or heavy equipment hazards. Temporary fencing was installed to isolate the exclusion zones and modified Level D personal protective equipment (PPE), including Tyvek, was required when working in the exclusion zone.
- A Contamination Reduction Zone and a 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 onto sidewalks from vehicles and personnel exiting the Site.

Excavation shoring was installed in December 2013 as part of the Site 114 RA at the southern limits of Forrest Street to facilitate excavation on Site 114 (see **Figures 5-1** through **5-7**). Shoring consisted of steel sheet piling.

5.2 Excavation

In accordance with the Forrest TEP – Revision 1 (AECOM, 2017a), the soil at the Forrest Street Excavation Area (AOC FS-1A and AOC FS-2A) was excavated in 30-ft by 30-ft grid cells.

Each grid in the Forrest Street Excavation Area was excavated to a target depth. Soil analytical results from the RI soil boring program and the PDI soil boring program were used to determine the planned depths of the excavation. However, at the Forrest Street Excavation Area, some grids were not planned to be excavated based on the RI and PDI results. See **Section 2** for further information regarding the RI and **Section 4** for further information regarding the PDI activities, planned TEEs, and TEPs.

Excavation of the Forrest Street Properties Lot 15 Excavation Area and Forrest Street Excavation Area was conducted as a single excavation, which was conducted in stages, beginning on March 27, 2017. Excavation of the Forrest Street Excavation Area began on June 21, 2017 and was completed on August 4, 2017. Some coincidental excavation occurred in the Forrest Street Utility Offset to accommodate sloping for excavation of the Forrest Street Excavation Area. Some additional excavation of the subgrade occurred in the Forrest Street Utility Offset to install the HDPE

Liner engineering control in February and March 2018. Excavation was performed by ENTACT utilizing an excavator.

Prohibiting full excavation within the Forrest Street Utility Offset in accordance with the Forrest RAWP protected a majority of the existing subsurface utilities within Forrest Street. However, some utilities within Forrest Street were required to be removed and replaced to facilitate the excavation in accordance with the Forrest TEP, including a catch basin and the associated section of the sewer utility line, and two storm drain lines (one from the trench drain at the southern end of the 100 Forrest Street Loading Dock Driveway, and the other from the 98/100 Forrest Street Building roof drain).

AECOM implemented dust control measures at the Site, in accordance with the March 2011 Revision of the Dust Control Plan (DCP) and applicable DCP Amendments, during excavation, stockpiling, transportation, backfilling, and associated activities during the RA. Results of the air monitoring and sampling during the Forrest Street activities were documented as part of the activities associated with the larger scale GA Group Sites, available on the Chromium Cleanup Website (http://www.chromiumcleanup.com, last accessed in February 2019) in the form of Monthly Reports and Event Documentation Reports. The concentrations and the short-duration metrics demonstrate that the dust control measures were effective at maintaining Cr^{+6} in dust at concentrations less than the Acceptable Ambient Concentration (AAC).

ENTACT verified vertical excavation extents using global positioning system (GPS) survey equipment to document that proposed excavation depths were achieved. Once the excavation limits met the targeted depths within each grid cell in the Forrest Street Excavation Area, a representative from Weston and/or an AECOM geologist inspected the completed excavation for visible CCPW. If visible CCPW was noted within the Forrest Street Excavation Area, excavation would continue in half-foot increments until inspection revealed that there was no visible CCPW present. Post-excavation samples were collected, if required, to document compliance in accordance with the Method to Determine Compliance (NJDEP, 2013). **Figures 5-1** through **5-7** depict the grid layout of Forrest Street and the final as-built TEEs.

Excavated materials were live-loaded into lined dump trucks where possible. Soil stockpiles were not used during this excavation; therefore, the Soil and Stockpile Management Plan for the GA Group Sites included in the 2012 RAWP (AECOM, 2012d) was not implemented for this excavation. During times when excavation was progressing, but trucks were not on site, day piles were created in areas that had not yet been remediated, adjacent to or within the excavation. The ground surface was pitched so that liquid that may have drained out of the soil returned into the excavation prior to its transport for off-site disposal (**Section 7.4** includes information regarding waste generation and disposal).

During the excavation at the Site, MRCE monitored the structural integrity of the Forrest Street buildings located adjacent to the ongoing excavation. MRCE performed vibration and crack monitoring of the Forrest Street Properties buildings.

Surface water runoff, storm water, groundwater entering the excavation, and decontamination wastewater were transferred by pump to the GA Group Sites groundwater treatment plant located on Site 114.

5.3 Post-Excavation Soil Sampling

During the RA activities in the Forrest Street Excavation Area, post-excavation pit bottom samples were collected, if required, to document compliance with the Chromium Policy (NJDEP, 2007) in accordance with the Method to Determine Compliance (NJDEP, 2013) and the Forrest TEE (AECOM, 2017b). Where the TEE in adjacent grids varied by more than two ft, sidewall samples were collected every 30 linear ft and at two-ft depth intervals. Where excavation grids were enclosed by shoring, or where the TEE in adjacent grids varied by less than two ft, sidewall sampling was not conducted. Samples were collected at two-ft depth intervals along the northern sidewalls in the Forrest Street Excavation Area that abutted the adjacent Forrest Street Utility Offset. In some cases, excavation was designed so that PDI or historical boring locations served as sidewall samples. The Specific Notes on **Table 5-1** explain how the Chromium Policy was met in these specific instances.

In the event that the excavation was expanded to remove visible CCPW beyond the original proposed excavation extents, either post-excavation pit bottom and sidewall samples or samples from soil borings prior to excavation (i.e., pre-excavation sampling) were used as confirmation samples. In addition, the areas were visually inspected by the Site Administrator's independent technical consultant, Weston, and/or an AECOM geologist to confirm that the excavation bottom and sidewalls were free of visible CCPW.

The post-excavation/confirmation samples were analyzed for:

- Cr^{+6} using United States Environmental Protection Agency (USEPA) SW-846 Method 3060A digestion and USEPA SW-846 Method 7196A, as modified by NJDEP;
- pH using USEPA SW-846 Method 9045C, D;
- Redox Potential using method ASTM International Method D1498-76M; and
- Total chromium, antimony, nickel, thallium, and vanadium using USEPA SW-846 Method 6010C (in 10% of selected samples only, per the GA Group RAWP [see **Section 4.1.1** for the GA Group RAWP submittal history] and Field Change Notification SWTEP 1 discussed in **Section 5.5**).

In Forrest Street, under the ACO and JCO, the other constituents for which PPG was responsible (select SVOCs and VOCs identified as parameters emanating from Site 114) were analyzed for in the post-excavation/confirmation samples as follows:

- VOCs using USEPA SW-846 Method SW8260 (in 10% of selected samples only per the GA Group RAWP); and
- SVOCs using USEPA SW-846 Method SW8270 (in 10% of selected samples only per the GA Group RAWP).

Additional excavation (re-dig) was completed where post-excavation soil samples exceeded the CrSCC (see **Section 3**). Typically, the full 30-ft by 30-ft grid was excavated to remove the CrSCC exceedance(s). In the event that a sidewall sample exceeded the CrSCC, the sidewall was normally further excavated to remove the CrSCC exceedance. In the event that a sidewall sample exceeded the CrSCC along the excavation sidewall that abutted the Forrest Street Utility Offset, the sidewall remains in place and is addressed by the HDPE Liner engineering control.

Figures 5-1 through **5-7** and **Tables 5-1** through **5-7** present data for locations within the Site that have samples remaining in place. In addition, locations from outside the Site boundary and/or removed samples may be shown to demonstrate compliance with the RA objectives. Laboratory analytical reports and data validation reports for the data presented in **Tables 5-1** through **5-7** are included in **Appendix C** and **Appendix D**, respectively. The laboratory electronic data deliverables (EDDs) passed submission and have been logged into the NJDEP database, as documented in **Appendix C-2**.

5.4 Institutional and Engineering Controls

5.4.1 Clean Fill Soil Cap Engineering Control

In the westernmost portion of Forrest Street, the engineering control for SVOCs remaining in place at concentrations greater than the unrestricted use standards consists of a two-ft Clean Fill Soil Cap for a restricted area consisting of Forrest Street Grids V11B and V12B and a portion of Grids W11B and W12B.

Within these grids, following remediation of soil in the Forrest Street Excavation Area, DGA backfill material was placed at the bottom of the excavation and compacted to final backfill subgrades. A visible change in soil type between the DGA and the native materials serves as the visible demarcation between the Clean Fill Soil Cap and the impacted material beneath it. DGA is present throughout the restricted area at a thickness greater than two feet. The Clean Fill Soil Cap Engineering Control only includes the first two feet of material placed above the bottom of the excavation.

The horizontal extent and the approximate elevation of the Clean Fill Soil Cap throughout the restricted area are depicted on the as-built diagrams in **Appendix E**. The northern and southern extent of the restricted area is the property boundary. The Block 21501, Lot 15 portion of the Clean Fill Soil Cap Engineering Control is documented in the FSP RAR (AECOM, 2019c). The eastern extent of the Clean Fill Soil Cap is the edge of the HDPE Liner engineering control restricted area (discussed below).

The Clean Fill Soil Cap serves as an engineering control for a portion AOC FS-2A to restrict access to soil with SVOCs at concentrations greater than the unrestricted use standards.

5.4.2 HDPE Liner Engineering Control

In the central portion of Forrest Street, the engineering control for visible CCPW and/or constituents at concentrations greater than the CrSCC, unrestricted use standards and/or DIGWSSLs consists of an HDPE Liner for a restricted area consisting of Forrest Street Rows X through BB plus portions of Grids CC9B, CC10B, CC11B, W11B, and W12B. As noted on **Figure 5-1**, the seam of visible CCPW material observed during excavation was removed during restoration activities.

Following excavation within the Forrest Street Excavation Area, DGA was placed and graded to approximately El. 9 ft NAVD88. In the Forrest Street Utility Offset Area, the existing asphalt was removed, and underlying soil was excavated to approximately 16 inches bgs to approximately El. 9 ft NAVD88. A 40-mil HDPE Liner was placed on top of the prepared surface in both the Forrest Street Excavation Area and the Forrest Street Utility Offset. Along the southern boundary of Forrest Street, the liner was draped over the top of the sheet pile boundary between Site 114 and Forrest Street. Along the northern boundary of Forrest Street, the liner was placed to abut the FSP buildings. The HDPE Liner engineering control extends into a portion of Block 21501, Lot 14, which

will be documented in a separate document. This HDPE liner also serves as a capillary break, as described in **Section 7.2**.

The horizontal extent and the approximate elevation of the HDPE Liner engineering control is depicted on the as-built diagrams in **Appendix E**. The northern and southern extent of the restricted area is the property boundary. The Block 21501, Lot 14 portion of the HDPE Liner engineering control will be documented in a separate submittal; the Lot 15 portion was documented in the FSP RAR (AECOM, 2019c). The western extent of the restricted area is the edge of the Clean Fill Soil Cap (discussed in **Section 5.4.1**). The HDPE Liner does not extend into the westernmost portion of Forrest Street because excavation in this portion of the street terminated in meadow mat with a thickness greater than one foot. The eastern extent of the restricted area is based on the delineation of Cr^{+6} that meets the Chromium Policy (NJDEP, 2007) in accordance with the Method to Determine Compliance (NJDEP, 2013) and/or the Forrest TEE (AECOM, 2017b) (as shown on **Figure 5-1**). The HDPE Liner extends further east beyond the extent of the restricted area but does not serve as an engineering control beyond the delineated region.

Within the restricted area, the HDPE Liner serves as an engineering control for AOC FS-1B to restrict access to soil with Cr^{+6} at concentrations greater than the CrSCC and visible CCPW, and as an engineering control for AOC FS-2A and AOC FS-2B, to restrict access to soil with SVOCs, and VOCs at concentrations greater than the unrestricted-use standards. The liner also acts to prevent leaching of SVOCs that may be present in underlying soil at concentrations greater than the DIGWSSLs.

5.4.3 Existing Asphalt Cap Engineering Control

In a portion of Grid Y12B, the engineering control for Cr^{+6} and SVOCs remaining in place at concentrations greater than the CrSCC and/or unrestricted-use standards consists of the Existing Asphalt Cap of the 100 Forrest Street Loading Dock Driveway.

The existing driveway is present north of Forrest Street, providing access to a loading dock at 100 Forrest Street. The eastern bay is paved with asphalt (minimum observed thickness of 6 inches). The horizontal extent and the approximate thickness of the Existing Asphalt Cap and the extent of the restricted area are depicted on the as-built diagrams in **Appendix E.** The Existing Asphalt Cap Engineering Control extends into Block 21501, Lot 14. The Block 21501, Lot 14 portion of the Existing Asphalt Cap Engineering Control will be documented in a separate submittal. The horizontal extent of the engineering control is limited by the dimensions of the existing asphalt driveway. This existing asphalt cap also serves as a capillary break, as described in **Section 7.2**.

The Existing Asphalt Cap serves as an engineering control for AOC FS-1C to restrict access to underlying soil that may contain Cr^{+6} at concentrations greater than the CrSCC and as an engineering control for AOC FS-2C to restrict access to soil with SVOCs at concentrations greater than the unrestricted-use standards. The Existing Asphalt Cap also acts, in combination with the HDPE Liner, to prevent potential future leaching of SVOCs that may be present in underlying soil at concentrations greater than the DIGWSSLs.

5.4.4 Institutional Controls

PPG is leading the RA of CCPW-related impacts. The notice in lieu of deed notice for CCPW-related impacts on Forrest Street is provided in **Appendix F**. Once NJDEP approves the RAR, the final notice in lieu of deed notice will be filed with the following entities: 1) each road department of each municipality in which the property is located; 2) each road department of each county in which

the property is located; 3) the New Jersey Department of Transportation; and 4) each utility company with an easement on the roadway, pursuant to N.J.A.C. 7:26C-7.2. Once the notice in lieu of deed notice is filed, a RAP application will be submitted for the remaining soil impacts, along with the final RAR, to NJDEP for approval.

PSEG, as the former MGP operator, is leading the RA of impacts related to the operation of the former MGP. PSEG is responsible for preparing and filing the notice in lieu of deed notice and RAP associated with MGP impacts and, therefore, that notice in lieu of deed notice is not included in this submittal.

5.5 Field Change Notifications

Field changes made during implementation of the TEPs were documented in Field Change Notification forms. Field Change Notifications, relevant to the RA activities at the Site, are listed in **Table 5-8**.

6.0 Reliability of Data: Data Validation and Usability

6.1 Data Validation

Data validation was performed by AECOM to evaluate whether the analytical data collected to demonstrate compliance with the RA objectives were scientifically defensible, properly documented, of known quality, and met RA objectives. Data validation included the review of analytical procedures, quality control (QC) results, calibration procedures, data reduction, and completeness of the laboratory data packages as specified in the soil RIWP (AECOM, 2011a) and the *Field Sampling Plan – Quality Assurance Project Plan PPG Non-Residential and Residential Chromium Sites, Hudson County, New Jersey* (FSP-QAPP) (AECOM, 2010a). Deficiencies noted were communicated to the laboratory and resolutions were documented in the data validation reports. If appropriate, data were qualified for use as described later in this section.

The laboratory data analytical packages (**Appendix C**) were reviewed in accordance with the FSP-QAPP (AECOM, 2010a), the NJDEP validation Standard Operating Procedures (SOPs) for Cr^{+6} and inorganic data, and USEPA Region 2 metals, VOC, and SVOC validation guidelines. The following NJDEP validation guidelines served as the basis for the actions taken during validation:

- NJDEP Office of Data Quality *SOP 5.A.10, Rev 3* (September 2009), *SOP for Analytical Data Validation of Hexavalent Chromium – for USEPA SW-846 Method 3060A, USEPA SW-846 Method 7196A and USEPA SW-846 Method 7199* (NJDEP, 2009); and
- NJDEP Office of Data Quality *SOP 5.A.16, Rev 1* (May 2002), *Quality Assurance Data Validation of Analytical Deliverables for Inorganics* (based on USEPA SW-846 Methods) (NJDEP, 2002).

Where USEPA Region 2 inorganic and organic validation guidelines were also used in assessing metals, benzene, and SVOCs, the most current guidance in effect at the time of validation was used; the specific revision used is listed in each data validation memorandum provided in **Appendix D**. The link to USEPA Region 2 validation guidance on the USEPA website is shown below:

- https://www.epa.gov/quality/region-2-quality-assurance-guidance-and-standard-operating-procedures (last accessed in February 2019).

The level of validation ranged from a comprehensive validation according to the NJDEP guidelines to a limited validation based on QC summary information or completeness reviews, depending on the analyte and matrix. The validation procedures for the Cr^{+6} data included full validation, which involved a comprehensive review of both summary forms and raw data, whereas the metals, benzene, and SVOC data received limited validation. Limited validation for metals, benzene, and SVOC data was based on information provided by the laboratory on its QC summary forms and did not include raw data review. At a minimum, limited validation included validation of the following data elements:

- Agreement of analyses conducted with chain-of-custody (COC) requests;
- Holding times and sample preservation;

- Method blanks/field equipment blanks/trip blanks;
- Surrogate spike recoveries;
- Laboratory control samples (LCS) or equivalent results;
- Matrix spike (MS)/matrix spike duplicate (MSD) results;
- Laboratory duplicate results;
- Field duplicate results; and,
- Quantitation limits and sample results (limited to evaluating dilutions and re-analyses).

Full validation was conducted on the Cr^{+6} data. Full validation included each of the data elements listed for limited validation along with review of calibration data and raw data, and spot checks for verification of calculations.

Validation reports were prepared for each data package that was validated. The validation reports are provided in **Appendix D**. The reports summarize the samples reviewed, parameters reviewed, non-conformance with the established criteria, and validation actions (including application of data qualifiers) presented in accordance with the NJDEP "hit list" format. Validation data qualifiers were based on the USEPA Region 2 validation guidelines for organic data and the NJDEP validation SOPs for the Cr^{+6} and inorganic data. The following qualifiers are used in data validation:

J Indicates the result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample. J+ or J- is used when the direction of bias can be determined.

U Indicates the analyte was not detected in the sample above the sample reporting limit.

UJ Indicates the analyte was not detected above the reporting limit and the reporting limit was approximate.

UB The analyte concentration is less than or equal to three (3) times the concentration in the associated method/preparation blank. The presence of the analyte in the sample is negated due to laboratory blank contamination

JB The analyte concentration is greater than three (3) times, but less than or equal to ten (10) times the concentration in the associated method/preparation blank. The presence of that analyte in the sample is considered "real" but the concentration is quantitatively qualified due to method blank contamination.

R The sample result was rejected due to serious deficiencies; the presence or absence of the analyte could not be confirmed.

RA The sample result was rejected due to NJ-specific data validation QC requirements; however, the result is usable for project objectives. Refer to the Data Quality and Usability section of the data validation report for further information.

It was noted that certain nickel and vanadium results reported from analyses conducted in 2005-2006 for Schoor-DePalma were reported with the "B" qualifier added by the laboratory. This qualifier indicates that the value reported is less than the practical quantitation limit but greater than or equal

to the instrument detection limit; this qualifier would typically be changed to "J" during validation to indicate an estimated value as defined above.

6.2 Data Usability Assessment

Soil samples collected to demonstrate compliance with the RA objectives were sent to Test America Laboratories (formerly Severn Trent Laboratories) in Edison, NJ (NJ certification 12028) or SGS-Accutest Laboratories in Dayton, NJ (NJ Certification 12129). The analyses were performed in accordance with USEPA- and NJDEP-approved analytical protocols in place at the time the analyses were performed. Quality assurance analytical measures were implemented in accordance with the NJDEP TRSR (N.J.A.C. 7:26E) (NJDEP, 1993b) and complied with the requirements for a NJDEP-certified laboratory specified in *Regulations Governing the Certification of Laboratories and Environmental Measurements* (NJDEP, 1981). Specific quality control issues identified during validation are documented in the individual data validation reports provided in **Appendix D**. Results of the data validation indicated that, in general, the analytical data were of adequate quality to meet the project objectives. However, there were some quality assurance (QA)/QC issues identified during data validation that resulted in rejection of data or qualification of data as estimated.

Data usability was evaluated using the data quality indicators of precision, accuracy, representativeness, comparability, completeness, and sensitivity. Data that were not rejected during validation are regarded as usable.

Certain Cr^{+6} results that were rejected due to failure of the matrix spikes to meet the NJDEP-specified control limits of 50-150% were qualified "RA" to indicate that the result may have value for information purposes. This qualifier is typically used for Cr^{+6} where the spiked sample matrix appears to be reducing and would not be expected to support the presence of Cr^{+6}. The presence of other indicators of a reducing environment such as total organic carbon (TOC), sulfide, or ferrous iron is a factor in the decision to utilize the "RA" qualifier.

6.2.1 Precision

Precision is the measure of agreement among repeated measurements of the same property under identical or substantially similar conditions and includes both field and analytical components. The information used to evaluate precision included results for field duplicates, matrix duplicates, and laboratory duplicates. For the Forrest Street RAR data set (the data used to demonstrate compliance with the RA objectives), relative percent difference (RPD) non-conformances were observed for field and/or laboratory duplicates associated with CCPW metals, Cr^{+6}, and SVOCs.

Field precision was assessed through the collection and analysis of field duplicates and was expressed as the RPD of the sample and field duplicate pair results. For the Site RAR data set, field duplicate precision resulted in qualification of 2.4% of the CCPW metals data, 30.7% of the Cr^{+6} data, and 1.5% of the SVOC data; none of the benzene results were qualified based on field precision.

Laboratory precision was assessed through the RPD results for MS/MSDs, LCS/laboratory control sample duplicate (LCSD) pairs, and duplicate sample analyses. MS/MSDs and duplicate sample analyses do not reflect laboratory precision as purely as LCS/LCSDs since sample homogeneity, which can be a significant issue for soil samples, can impact the precision of sample and matrix spike duplicates. However, no differentiation of the applied reason code is made between LCS/LCSDs and MS/MSDs or sample duplicates. Lab precision resulted in qualification of 15.4% of

the Cr^{+6} data; none of the benzene, CCPW metals, or SVOC results in the Site RAR data set were qualified based on laboratory precision.

6.2.2 Accuracy

Accuracy is the degree of agreement between an observed value and an accepted reference or true value. The results of LCS data, surrogate recoveries, method blanks, and MS/MSDs were used as the primary indicators of accuracy; information such as sample container type, preservation, holding time, and moisture content was also considered as impacting to analytical accuracy. Some of this information was assessed by the laboratory at the time of receipt (container type and preservation); other parameters were evaluated during the validation process.

Seventeen (17) of the Cr^{+6} results (3.1% of the Site Cr^{+6} results) in the Site data set were qualified "RA" to indicate that the results were rejected since both the initial and reanalysis spike recoveries fell outside of the control limits of 50-150%, but the sample matrix appeared to be reducing and, therefore, unable to support the presence of Cr^{+6}. None of the benzene, CCPW metals, or SVOC results associated with the RAR sampling were rejected or qualified "RA".

Qualification of data as estimated (J/UJ) for accuracy was related to issues such as field or laboratory blank contamination, MS results, and percent solids. A summary of the validation findings is presented by QC parameter type below.

The presence of negative blanks, or target analytes in blanks related to field activities (i.e., field blanks) was cited as a reason for qualification of 0.08% of the CCPW metals results and 1.8% of the Cr^{+6} results; no qualification based on blanks was reported for benzene or SVOC data. For those blanks in which contaminants were detected, action levels were established in accordance with the NJDEP or USEPA Region 2 validation guidance documents. Associated sample results were qualified accordingly.

MS and/or MSD recoveries resulted in qualification of 17.5% of the CCPW metals data, 34.2% of the Cr^{+6} data, and 0.37% of the SVOC data; none of the benzene data was qualified based on matrix spike recoveries.

Other QC issues resulted in qualification of selected data points. Moisture content greater than 50% resulted in selected data points being qualified as estimated (flagged as J or UJ). Approximately 1.9% of the Site results were qualified based on low percent solids.

6.2.3 Representativeness

The representativeness of any field program is a function of the planning and procedures used to collect the samples and the locations and density of samples collected. Sampling and preservation methods were based on established methods and SOPs outlined in the soil RIWP (AECOM, 2011a) and FSP-QAPP (AECOM, 2010a), which are known to minimize error associated with the disturbance of environmental samples from their natural setting.

Factors to be considered in evaluating representativeness are the use of standard analytical procedures, sample preservation, and the use of the appropriate sample container. The analytical methods, preservation procedures, and containers used in this program were as specified in the FSP-QAPP.

The moisture content of samples is also a factor in the representativeness of the data. In accordance with USEPA Region 2 validation guidance, samples containing more than 50% moisture were qualified as estimated. This requirement resulted in the qualification of 6.9% of the benzene results, 1.1% of the CCPW metals results, 0.55% of the Cr^{+6} results, and 7.8% of the SVOC results.

6.2.4 Comparability

Comparability of the data in the RAR data set was maximized by using standard methods for sampling, analysis, and data validation.

6.2.5 Completeness

Completeness is the measure of the amount of valid data obtained from a measurement system; valid data are defined as those data judged to be usable (i.e., not rejected as a result of the validation process). For the Site RAR data set, 2,166 individual data points were generated. Of those data points, 17 Cr^{+6} results (0.78% of the total results generated) were qualified as "RA" to indicate that, although QC exceedances were identified, the results still had value for understanding site conditions. Overall, 99.2% of the reported Site values generated for benzene, CCPW metals, Cr^{+6}, and SVOCs are considered usable for project decisions with an understanding of the quality issues identified during validation.

The values qualified as "RA" do not meet the required 50-150% soluble and insoluble matrix spike recovery limits due to sample matrices which do not appear capable of supporting Cr^{+6}. However, these results can be used for information purposes with a full understanding of the limitations as described in the data validation report.

6.2.6 Sensitivity

Analytical dilutions can be necessary due to the sample matrix or elevated concentrations of target or non-target analytes. The detection limits reported by the laboratory were adjusted to reflect dilution factors. Limitations in analytical methodologies and/or low percent solids content for some soil samples can result in detection limits that exceed either the Residential Direct Contact Soil Remediation Standard (RDCSRS), DIGWSSL, or CrSCC. One thallium result (sample P4-FOR-FF9B-1.0-1.5) was reported as a non-detect value greater than the DIGWSSL due to the presence of elevated levels of an interfering element.

6.2.7 Data Quality/Data Usability Conclusions

The findings of this Data Quality Assessment and Data Usability Evaluation indicate that the data used to demonstrate compliance with the RA objectives are sufficiently representative of actual conditions and may be used to support decisions with the exceptions identified below:

- Cr^{+6} results qualified "RA" due to matrix spike recoveries outside of the range of 50-150% may provide useful information for site decisions based on the apparent reducing nature of the matrix but should be used with an understanding of the data limitations.

Data qualifiers and reason codes were applied by the data validator to identify data limitations found in the validation process. Specific details regarding analytes and samples can be found in the individual data validation reports in **Appendix D.**

7.0 Documentation of the Protectiveness of the Remedial Action

Soil analytical results from the RI and PDI soil boring programs were used to pre-determine the depths of the excavation. These sampling results, in combination with the post-excavation sampling results, were used to document the effectiveness and completeness of the soil remediation.

Once the excavation limits met the final as-built TEEs, the Site Administrator's independent technical consultant, Weston, and/or an AECOM geologist inspected the completed excavation to confirm the absence of visible CCPW.

As summarized in **Section 5.3**, the locations of samples used to demonstrate compliance with the remediation goals for the Site are depicted on **Figures 5-1** through **5-7**, and **Tables 5-1** through **5-7** present the analytical results for samples used to demonstrate compliance with the remediation goals. Laboratory analytical reports and data validation reports for the data presented in these tables are included in **Appendices C** and **D**, respectively. As discussed in **Section 6**, the laboratory analytical data for the collected samples was found to be usable for the purposes of defining the extents of the remedial excavation. **Appendix G** presents the available boring logs from the locations of samples that were used to demonstrate compliance with the remediation goals.

Excavation in Forrest Street AOC FS-1A and AOC FS-2A was not designed to remove all soil from the unsaturated zone, as detailed in the TEPs and TEE submittals (see **Section 4.2**). Therefore, the elevations of samples remaining in place were compared to the groundwater elevation, above which is the unsaturated zone. The groundwater elevation was estimated as the 50th percentile groundwater elevation from seven monitoring wells located on or adjacent to Forrest Street gauged between December 2003 and December 2016. The monitoring well locations and data are included in **Appendix A**. The estimated groundwater elevation which defines the unsaturated zone for this Site is El. 6.3 ft NAVD88.

At Forrest Street, AOC FS-1A, AOC FS-1B, AOC FS-1C, AOC FS-2A, AOC FS-2B, and AOC FS-2C have been remediated as follows:

- AOC FS-1A: CCPW-impacted soil in the Forrest Street Excavation Area
  - Excavation of soil containing Cr^{+6} met the requirements specified in the Chromium Policy (NJDEP, 2007) in accordance with the Method to Determine Compliance (NJDEP, 2013) and/or the Forrest TEE (AECOM, 2017b).
  - Soil concentrations for CCPW metals are in compliance with the CrSCC or SRS.
  - Soil concentrations for CCPW metals in the unsaturated zone are in compliance with the DIGWSSLs and/or the site-specific IGWSRS-GAGs.
- AOC FS-1B: CCPW-impacted soil in the Forrest Street Utility Offset
  - Cr^{+6} and visible CCPW remain in place at concentrations greater than the CrSCC and are addressed by an engineering control appropriate for the current commercial use of the adjacent FSP (HDPE Liner) and institutional controls (notice in lieu of deed notice).

  - Soil concentrations of antimony, chromium, nickel, and thallium are in compliance with the CrSCC or SRS.
  - Vanadium at one sample location remains in place at a concentration greater than the RDCSRS-GAG, but less than the Non-Residential Direct Contact Soil Remediation Standard (NRDCSRS). Since Forrest Street is a roadway and therefore a non-residential area, this sample is not out of compliance. The exceedance of the RDCSRS-GAG is documented via institutional controls (notice in lieu of deed notice). Soil concentrations for CCPW metals in the unsaturated zone are in compliance with the DIGWSSLs and/or the site-specific IGWSRS-GAGs.

- AOC FS-1C: CCPW-impacted soil in the Southern Portion of 100 Forrest Street Loading Dock Driveway
  - Cr^{+6} and visible CCPW remain in place at concentrations greater than the CrSCC and are addressed by an engineering control appropriate for the current commercial use of the adjacent FSP (Existing Asphalt Cap) and institutional controls (notice in lieu of deed notice).
  - Soil concentrations for CCPW metals are in compliance with the CrSCC or SRS.
  - Soil concentrations for CCPW metals in the unsaturated zone are in compliance with the DIGWSSLs and/or the site-specific IGWSRS-GAGs.
- AOC FS-2A: MGP-impacted soil in the Forrest Street Excavation Area;
  AOC FS-2B: MGP-impacted soil in the Forrest Street Utility Offset; and
  AOC FS-2C: MGP-impacted soil in the Southern Portion of 100 Forrest Street Loading Dock Driveway
  - Soil concentrations of MGP-related benzo(k)fluoranthene are in compliance with the SRS.
  - Select MGP-related SVOCs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, and naphthalene) and MGP-related benzene remain in place at concentrations greater than the SRS and are addressed by engineering controls (HDPE Liner, Clean Fill Soil Cap, or Existing Asphalt Cap) and institutional controls (notice in lieu of deed notice).
  - Soil concentrations of select MGP-related SVOCs (benzo(k)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, and naphthalene) and MGP-related benzene in the unsaturated zone are in compliance with the DIGWSSLs.
  - Select MGP-related SVOCs (benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene) remain in place at concentrations greater than the DIGWSSLs and are addressed by engineering controls (HDPE Liner or Existing Asphalt Cap) and institutional controls (notice in lieu of deed notice).
  - Benzo(a)anthracene, benzo(a)pyrene, and benzene remain in place at concentrations greater than the SRS and/or DIGWSSLs in Grid FF9B and HH8B. It has been determined that these exceedances are not associated with the former MGP operations and, therefore, do not fall under the purview of the ACO and the JCO. Remediation of these impacts is the responsibility of the property owner.

Waste manifests and bills of lading (BOLs) for soil and other materials that were loaded for off-site disposal are presented in **Appendices H** and **I**.

Clean fill documentation is provided in **Appendix J**.

7.1 As-Built Diagrams

The following as-built diagrams are included in **Appendix E**:

- As-built diagram depicting the final extents of the excavation for Forrest Street, as well as FSP;
- As-built diagrams depicting the horizontal extent and typical section of the HDPE Liner, Existing Asphalt Cap, and Clean Fill Soil Cap Engineering Controls to address the CCPW-related impacts and MGP-related impacts remaining in place Forrest Street; and
- As-built diagram of the final Site grades following restoration in Forrest Street, as well as FSP.

7.2 Description of Site Restoration Activities

After completion of the excavation activities at each grid cell in the Forrest Street Excavation Area, the backfill was amended with FerroBlack®-H by ENTACT in accordance with the plans and specifications. The placement of FerroBlack®-H serves as a phase of groundwater remediation, which will be documented in a future FerroBlack®-H Permit-By-Rule Close-Out Report, and as has been documented in the *Progress Report No. 22 (3rd Quarter 2017), Garfield Avenue Group - Sites 114, 132, 133, 135, 137, and 143, Jersey City, Hudson County, New Jersey* (AECOM, 2017i). Backfilling of the Forrest Street Excavation Area was completed in stages, keeping pace with the excavation. Backfilling following excavation in the Forrest Street Excavation Area was completed on August 22, 2017. Additional backfill was imported in January and February 2018 for the installation of the engineering controls in the Forrest Street Excavation Area and the Forrest Street Utility Offset. Restoration activities were completed at the Site between January 3, 2018 and June 27, 2018.

In the Forrest Street Excavation Area, backfill was placed for restoration. In the westernmost portion of the area, where the HDPE Liner is not present, backfill is at least two-ft thick and also serves as a Clean Fill Soil Cap engineering control (further discussed in **Section 5.4.1**). In the Forrest Street Excavation Area, the backfill was placed and compacted to approximately El. 9 ft NAVD88.

Clean fill for site restoration consisted of ¾-inch stone and DGA backfill material supplied by Tilcon. Information regarding the source and quality of the backfill material is provided in **Section 7.5**. Based on the compaction goal of 95% standard proctor, specified in the Forrest TEP - Revision 1 (AECOM, 2017a), ENTACT satisfactorily completed compaction of the backfill placed within the limits of the Site. Final compaction results ranged from 96.5% to 100%, exceeding the 95% compaction goal.

The catch basin and associated sewer utility line within Forrest Street and two storm-drain lines adjacent to the 100 Forrest Street Loading Dock Driveway, that were removed during excavation, were replaced as part of the restoration activities (see **Figure 7-1**).

In the Forrest Street Utility Offset, the existing asphalt and underlying soil was removed to approximately 16 inches bgs, to facilitate installation of the HDPE Liner engineering control (further discussed in **Section 5.4.2**) and HDPE liner capillary break (further discussed below) and final roadway restoration. The HDPE Liner was placed at approximately El. 9 ft NAVD88 throughout the Forrest Street Excavation Area and Forrest Street Utility Offset (see **Figure 7-2**).

Based on the site conditions within Forrest Street and FSP and on the criteria established as part of the *Capillary Break Design Final Report (Revision 2)* (AECOM, 2017m), and as documented in the Forrest RAWP (AECOM, 2019), a capillary break was required within Forrest Street. Two types of capillary breaks were installed in Forrest Street: an HDPE liner capillary break and an asphalt capillary break. The horizontal extent of the capillary breaks and cross-section details are shown on **Figure 7-2**. The HDPE liner capillary break, which consists of a 40-mil HDPE liner placed between two layers of non-woven geotextile (10 ounces per square yard), was installed throughout the majority of Forrest Street at approximately El. 9 ft NAVD88, as shown on **Figure 7-2**. (A portion of the HDPE liner also serves as an engineering control described in **Section 5.4.2**; however, the capillary break extends further east beyond the engineering control area). The HDPE liner capillary break extends horizontally onto Block 21501, Lot 14 and Block 21501, Lot 15 as shown on **Figure 7-2**. The asphalt capillary break consists of an existing asphalt layer (observed minimum thickness of 6 inches) within the Southern Portion of the 100 Forrest Street Loading Dock Driveway. (The existing asphalt layer also serves as an engineering control as described in **Section 5.4.3**). The asphalt capillary break extends horizontally onto Block 21501, Lot 14 as shown on **Figure 7-2**. The capillary breaks will be managed through a future groundwater RAP.

To complete restoration, the HDPE Liner was covered with additional DGA backfill, and overlain with asphalt pavement. A concrete sidewalk was installed along the north side of the roadway, and an asphalt sidewalk was installed along the south side of the roadway (see **Figure 7-1**). An overhead utility pole was repaired to facilitate the sidewalk installation.

The Site was backfilled and restored in accordance with the *Restoration Technical Execution Plan, Garfield Avenue Group (Revision 1)*, dated August 2017 (AECOM, 2017g), the PPG/AECOM memorandum entitled *Response to NJDEP/Weston's 08/31/17 Comments and the City of Jersey City/ERFS's 09/12/17 Comments on the Restoration Technical Execution Plan, Garfield Avenue Group (Revision 1)*, dated October 16, 2017 (AECOM, 2017h), and the PPG/AECOM memorandum entitled *Summary of Proposed Forrest Street Restoration Activities – Skyways and Roadway* (Forrest Restoration Memo), dated November 21, 2017 (AECOM, 2017j). The Forrest Restoration Memo included a restoration design for Forrest Street that was developed in conjunction with Jersey City Engineering and complied with Jersey City roadway specifications. Verbal concurrence on the Forrest Restoration Memo was received from the NJDEP and the property owner on November 9, 2017.

7.3 Total Remedial Action Cost

PPG's total remediation cost for implementation of the RA at the Site was estimated at approximately $3,000,000. This includes costs for: RI; engineering; excavation and backfilling; air monitoring; construction management; groundwater management and treatment; installation of engineering controls; waste transportation and disposal; and overall project management and reporting.

7.4 Documentation of Waste Generation and Disposal

The approximate in-place volume of soil excavated from the Site and disposed of off site is estimated at 2,000 cubic yards (approximately 3,000 tons assuming a soil density of 1.5 tons per cubic yard), based on the limits of excavation.

Waste manifests and BOLs for the Site excavation are included in **Appendix H** (Hazardous Waste Disposal Documentation) and **Appendix I** (Non-Hazardous Waste Disposal Documentation), respectively.

During this phase of work, waste manifests and BOLs were tracked by sets of one to four grids. Loads that were from grids or sets of grids located only on FSP were included in the FSP RAR (AECOM, 2019c). Loads that were removed from grids or sets of grids that straddle the Forrest Street and FSP boundary are included in this RAR and the FSP RAR; as such, the total weight of the excavated soil according to the waste manifests and BOLs (4,500 tons) exceeds the weight estimated from the limits of excavation from Forrest Street. Groundwater treatment plant sludge material was also generated because of the RA activities at the Site.

The following facilities were used for the off-site disposal of waste materials generated during RA activities at the Site:

7.4.1 Hazardous Waste Materials

- Clean Earth of North Jersey (CENJ) treatment, storage, and disposal facility, Kearny, NJ;
- Environmental Quality Company (EQ) Detroit, Inc., Detroit, Michigan;
- EQ Michigan Disposal Waste Treatment Plant, Belleville, Michigan;
- EQ Envirite of Pennsylvania, Inc., York, Pennsylvania; and/or
- Stablex, Canada Inc., Blainville, Québec, Canada.

7.4.2 Non Hazardous Waste Materials

- Bayshore Recycling Corporation, Keasbey, NJ;
- CENJ treatment, storage, and disposal facility, Kearney, NJ; and/or
- Cumberland County Improvements Authority Landfill, Deerfield Township, NJ.

Copies of fully executed manifests, BOLs, and certificates of disposal documenting the off-site transport of waste material are presented in the following appendices:

- **Appendix H** – Hazardous Waste Disposal Documentation. This appendix includes fully executed manifests and certificates of disposal (if provided) documenting the off-site transport of hazardous soil and groundwater treatment system sludge.
- **Appendix I** – Non-Hazardous Waste Disposal Documentation. This appendix includes BOLs documenting the off-site transport of non-hazardous asphalt and soil and groundwater treatment system sludge.

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

Licensed quarry material was utilized for backfill and restoration and consisted of ¾-inch open grade stone (OGS) and DGA supplied by Tilcon (from their licensed mine facilities at 625 Mt. Hope Road, Wharton, NJ and Broad Street, Pompton Lakes, NJ), a licensed quarry facility permitted to operate as a commercial quarry by NJDEP.

To meet the minimum requirements of the NJDEP TRSR (NJDEP, 1993b) at the time of the Site activities, the sources of imported fill were certified by the supplier as clean from a virgin source, based on their knowledge of the place of origin and history. In accordance with Field Change Notification #16A dated July 24, 2015, each quarry, on an annual basis, was required to provide its License (Mining Certificate) and Annual Certification that the material was from a clean, virgin

source with analytical results provided by the quarry/mine in accordance with NJDEP's *Fill Material Guidance for SRP Sites Version 3.0* (NJDEP, 2015).

The concentrations of the analytes in samples collected from the quarry material were less than the corresponding NJDEP RDCSRS and the quarry material did not pose a potential impact to groundwater (per NJDEP's *Fill Material Guidance for SRP Sites Version 3.0* [NJDEP, 2015]), indicating that the material was acceptable for on-site use.

In addition, AECOM implemented a stringent visual inspection process, by on-site AECOM personnel, to verify the quality of the backfill. Visual inspection criteria included the size of the individual stones, the presence of foreign debris, the ratio of fines in the material, and significant differences in color.

A list of the quarry material load reports is provided in **Appendix J-1** and the analytical reports, mine certificates, and annual certifications are provided in **Appendix J-2**.

7.6 Identification of Required Permits and Authorizations

The permits and approvals needed for the RA at the Site are listed below:

- SESCP approvals from Hudson-Essex-Passaic County Soil Conservation District.
- Notice of Non-Applicability, Discharge to Surface Water General Permit for Construction Activity – Stormwater (5G3), NJDEP, Division of Water Quality.
- Water Use Registration, NJDEP, Division of Water Supply.
- Permit-By-Rule Discharge Authorization for Site-wide FerroBlack®-H Backfill Amendment, NJDEP, Site Remediation Program.
- Community Right-to-Know Survey for 2017, NJDEP.
- Passaic Valley Sewerage Commission (PVSC) Sewer Use Permit #31630010 (Site 114 groundwater treatment plant).

The necessary permits were obtained from and approved by the state, local, and county agencies prior to initiation of the activities covered by the permits. Necessary permits and approvals are documented in **Appendix B**.

Local permits that are not included in **Appendix B** include local road closure and street opening permits (which were renewed approximately every 6 months).

8.0 Receptor Evaluation Update

The purpose of a receptor evaluation (RE) is to document the existence of human or ecological receptors, and the actions taken to protect those receptors, at contaminated sites. Pursuant to N.J.A.C. 7:25E-1.12, REs must include general site information, an evaluation of surrounding land use, a description of contamination, a discussion of groundwater use in the area, an evaluation of vapor intrusion potential, and an ecological evaluation.

The *Receptor Evaluation Report, Rev. 3, Non-Residential Chromate Chemical Production Waste Sites 114, 132, 133, 135, 137, 143 and 186 Jersey City, New Jersey,* dated March 20, 2012 (AECOM, 2012c), was submitted to the NJDEP on March 23, 2012. The Final Garfield Avenue Group RE/Ground Water RE/Baseline Ecological Evaluation Reports were submitted to the NJDEP on July 22, 2013. The updated RE form and required attachments are provided with this RAR.

9.0 Conclusions and Recommendations

9.1 Soil

This RAR documents that the soil RA for Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, AOC FS-2A, AOC FS-2B, and AOC FS-2C) is effective in protecting public health and safety and the environment and remedial objectives have been achieved, as follows:

AOC FS-1A: CCPW-impacted soil in the Forrest Street Excavation Area

- Excavation of soil containing Cr^{+6} met the requirements specified in the Chromium Policy (NJDEP, 2007) in accordance with the Method to Determine Compliance (NJDEP, 2013) and/or the Forrest TEE (AECOM, 2017b).
- Soil concentrations for CCPW metals are in compliance with the CrSCC or SRS.
- Soil concentrations for CCPW metals in the unsaturated zone are in compliance with the DIGWSSLs and/or the site-specific IGWSRS-GAGs.

AOC FS-1B: CCPW-impacted soil in the Forrest Street Utility Offset

- Cr^{+6} and visible CCPW remain in place at concentrations greater than the CrSCC and are addressed by an engineering control appropriate for the current commercial use of the adjacent FSP (HDPE Liner) and institutional controls (notice in lieu of deed notice).
- Soil concentrations of antimony, chromium, nickel, and thallium are in compliance with the CrSCC or SRS.
- Vanadium at one sample location remains in place at a concentration greater than the RDCSRS-GAG, but less than the NRDCSRS. Since Forrest Street is a roadway and therefore a non-residential area, this sample is not out of compliance. The exceedance of the RDCSRS-GAG is documented via institutional controls (notice in lieu of deed notice). Soil concentrations for CCPW metals in the unsaturated zone are in compliance with the DIGWSSLs and/or the site-specific IGWSRS-GAGs.

AOC FS-1C: CCPW-impacted soil in the Southern Portion of 100 Forrest Street Loading Dock Driveway

- Cr^{+6} and visible CCPW remain in place at concentrations greater than the CrSCC and are addressed by an engineering control appropriate for the current commercial use of the adjacent FSP (Existing Asphalt Cap) and institutional controls (notice in lieu of deed notice).
- Soil concentrations for CCPW metals are in compliance with the CrSCC or SRS.
- Soil concentrations for CCPW metals in the unsaturated zone are in compliance with the DIGWSSLs and/or the site-specific IGWSRS-GAGs.

AOC FS-2A: MGP-impacted soil in the Forrest Street Excavation Area;
AOC FS-2B: MGP-impacted soil in the Forrest Street Utility Offset; and
AOC FS-2C: MGP-impacted soil in the Southern Portion of 100 Forrest Street Loading Dock Driveway

- Soil concentrations of MGP-related benzo(k)fluoranthene are in compliance with the SRS.
- Select MGP-related SVOCs (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, and naphthalene) and MGP-related benzene remain in place at concentrations greater than the SRS and are addressed by engineering controls (HDPE Liner, Clean Fill Soil Cap, or Existing Asphalt Cap) and institutional controls (notice in lieu of deed notice).
- Soil concentrations of select MGP-related SVOCs (benzo(k)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, and naphthalene) and MGP-related benzene in the unsaturated zone are in compliance with the DIGWSSLs.
- Select MGP-related SVOCs (benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene) remain in place at concentrations greater than the DIGWSSLs and are addressed by engineering controls (HDPE Liner or Existing Asphalt Cap) and institutional controls (notice in lieu of deed notice).
- Benzo(a)anthracene, benzo(a)pyrene, and benzene remain in place at concentrations greater than the SRS and/or DIGWSSLs in Grids FF9B and HH8B. It has been determined that these exceedances are not associated with the former MGP operations and, therefore, do not fall under the purview of the ACO and the JCO. Remediation of these impacts is the responsibility of the property owner.

On this basis, PPG, the responsible party, has demonstrated compliance with the applicable remediation requirements for the soil in AOC FS-1A, AOC FS-1B (based on the current commercial use of the adjacent FSP), AOC FS-1C (based on the current commercial use of the adjacent FSP), AOC FS-2A, AOC FS-2B, and AOC FS-2C and no further action with regard to these AOCs is needed (other than filing the notice in lieu of deed notice and implementing the RAP). PPG requests the closure of AOC FS-1A, AOC FS-1B (based on the current commercial use of the adjacent FSP), AOC FS-1C (based on the current commercial use of the adjacent FSP), AOC FS-2A, AOC FS-2B, and AOC FS-2C by the NJDEP through the issuance of a Consent Judgment Compliance Letter. Once the Consent Judgment Compliance Letter is granted, PPG will implement the permit conditions under the LSRP program, rather than under the JCO program.

Prior to the future residential use of the adjacent FSP, PPG will conduct a remedial excavation within Forrest Street at AOC FS-1B and AOC FS-1C to address CCPW-impacted soil, which is currently inaccessible due to the current commercial use of the adjacent FSP. The future residential use remediation will be conducted under the existing site-wide GA Group RAWP (AECOM, 2018f) in accordance with the February 8, 2007 NJDEP memorandum entitled *Chromium Moratorium* (NJDEP, 2007) under the LSRP program. Following completion of the future residential use remediation, PPG will update the notice in lieu of deed notice, RAR, and RAP. PPG's LSRP will then issue a Response Action Outcome (RAO) appropriate for the residential use of the adjacent FSP.

9.2 Groundwater

This RAR only addresses the RA of soil at Forrest Street (AOC FS-1A, AOC FS-1B, AOC FS-1C, AOC FS-2A, AOC FS-2B, and AOC FS-2C). CCPW and MGP-impacted groundwater within the GA Group Sites is being tracked under the Site 114 PI number G000005480. The status of the GA Group Sites groundwater contamination and plans for groundwater RA are documented in the *Groundwater Remedial Investigation Report, Draft*, submitted on October 1, 2018 (AECOM, 2018g). A separate RAR will be prepared and submitted to document the groundwater RA at the GA Group Sites.

10.0 References

AECOM, 2009. *Remedial Investigation Report – Non-Residential Chromate Chemical Production Waste Sites, Sites 114, 132, 133, 135, 137, and 143*. December 2009.

AECOM, 2010a. *Field Sampling Plan – Quality Assurance Project Plan PPG Non-Residential and Residential Chromium Sites, Hudson County, New Jersey*. June 2010.

AECOM, 2010b. *Revision of the Air Monitoring Workplan for Ground Intrusive Activities at the Garfield Avenue Site in Jersey City, New Jersey* (AMP) and applicable AMP Amendments (29 and 31). December 2010.

AECOM, 2011a. *Soil Remedial Investigation Work Plan – Sites 114, 132, 133, 135, 137, 143 and Site 186*. March 2011.

AECOM, 2011b. *DRAFT Technical Execution Plan, Southwestern Area Soil Excavation, PPG Site 114 - Garfield Avenue, Jersey City, New Jersey*. December 2011.

AECOM, 2012a. *Remedial Investigation Report – Soil Garfield Avenue Group Non-Residential CCPW Sites 114, 132, 133, 135, 137, 143 and 186*. February 2012.

AECOM, 2012b. *Technical Execution Plan, Southwestern Area Soil Excavation, PPG Site114 – Garfield Avenue, Jersey City, New Jersey*. March 9, 2012.

AECOM, 2012c. *Receptor Evaluation Report, Rev. 3, Non-Residential Chromate Chemical Production Waste Sites 114, 132, 133, 135, 137, 143 and 186 Jersey City, New Jersey*. March 20, 2012.

AECOM, 2012d. *Draft Remedial Action Work Plan (Soil), Rev. 2, Garfield Avenue Group – Sites 114, 132, 133, 135, 137 and 143, Jersey City, New Jersey*. April 17, 2012.

AECOM, 2012e. *Final Technical Execution Plan, Southwestern Area Soil Excavation, PPG Site 114 – Garfield Avenue, Jersey City, New Jersey*. April 23, 2012.

AECOM, 2014. *Draft Remedial Action Work Plan (Soil) Rev. 3, Garfield Avenue Group – Sites 114, 132, 133, 135, 137 and 143, Jersey City, New Jersey*. December 5, 2014.

AECOM, 2016a. Memorandum entitled *Additional Forrest Street Remedial Investigation – Soil & Groundwater.* March 17, 2016.

AECOM, 2016b. Memorandum entitled *North of Forrest Street Area – Evaluation of Non-CCPW-Related Compounds Emanating from Site 114 (Revision 1)*. August 26, 2016.

AECOM, 2016c. Memorandum entitled *Forrest Street Properties Pre-Design Investigation Work Plan (Revision 2)*. September 20, 2016.

AECOM, 2016d. Memorandum entitled *Forrest Street and Forrest Street Properties – Proposed Terminal Excavation Elevations Submittal*. December 23, 2016.

AECOM, 2016e. *Technical Execution Plan, Forrest Street and Forrest Street Properties Soil Excavation, Jersey City, New Jersey.* December 23, 2016.

AECOM, 2017a. *Technical Execution Plan (Revision 1), Forrest Street and Forrest Street Properties Soil Excavation, Jersey City, New Jersey.* March 23, 2017.

AECOM, 2017b. Memorandum entitled *Forrest Street and Forrest Street Properties – Proposed Terminal Excavation Elevations Submittal (Revision 1).* March 30, 2017.

AECOM, 2017c. Memorandum entitled *Response to Comments on the Forrest Street and Forrest Street Properties Technical Execution Plan (Revision 1).* April 21, 2017.

AECOM, 2017d. Memorandum entitled *Response to NJDEP/Weston's 02/03/2017 and 04/20/2017 Comments on the Forrest Street and Forrest Street Properties – Proposed Terminal Excavation Elevations Submittal (Revisions 0 and 1).* May 12, 2017.

AECOM, 2017e. *Draft Remedial Action Work Plan, Forrest Street and Forrest Street Properties, Phase 1 – 100 Forrest Street Offset and 84 Forrest Street, Loading Dock, Jersey City, New Jersey*. June 30, 2017.

AECOM, 2017f. *Draft Remedial Action Work Plan, Forrest Street and Forrest Street Properties, Phase 1 – 100 Forrest Street Offset and 84 Forrest Street Loading Dock, Phase 2 – Forrest Street Utility Offset and 90 Forrest Street Alleyway (Paved and Unpaved Areas), Jersey City, New Jersey*. July 26, 2017.

AECOM, 2017g. *Restoration Technical Execution Plan, Garfield Avenue Group (Revision 1)*. August 2017.

AECOM, 2017h. Memorandum entitled *Response to NJDEP/Weston's 08/31/17 Comments and the City of Jersey City/ERFS's 09/12/17 Comments on the Restoration Technical Execution Plan, Garfield Avenue Group (Revision 1)*. October 16, 2017.

AECOM, 2017i. *Progress Report No. 22 (3rd Quarter 2017), Garfield Avenue Group - Sites 114, 132, 133, 135, 137, and 143, Jersey City, Hudson County, New Jersey.* November 13, 2017.

AECOM, 2017j. Memorandum entitled *Summary of Proposed Forrest Street Restoration Activities – Skyways and Roadway.* November 21, 2017.

AECOM, 2017k. *Capillary Break Design Final Report (Revision 2)*. December 2017.

AECOM, 2018a. *Draft Interim Remedial Action Work Plan, Forrest Street and Forrest Street Properties, Deferred Remediation Areas, Jersey City, New Jersey.* March 29, 2018.

AECOM, 2018b. Memorandum entitled *Response to Comments on the Forrest Street and Forrest Street Properties Remedial Action Workplan (Phases 1 & 2) and NJDEP Recommendations for the Forrest Remedial Action Workplan.* March 29, 2018.

AECOM, 2018c. *Final Remedial Action Work Plan (Soil) Rev. 3, Garfield Avenue Group Sites, Jersey City, New Jersey*. May 15, 2018.

AECOM, 2018d. *Supplemental Soil Remedial Investigation Report, Final Revision 1, PPG Garfield Avenue Group, Hudson County Chromium Sites, Jersey City, New Jersey*. August 30, 2018.

AECOM, 2018e. Memorandum entitled *Forrest Street and Forrest Street Properties Emanating-From Parameters (Revision 1)*. September 20, 2018.

AECOM, 2018f. *Final Remedial Action Work Plan (Soil) Rev.4, Garfield Avenue Group Sites, Jersey City, New Jersey*. September 27, 2018.

AECOM, 2018g. *Groundwater Remedial Investigation Report, Draft*. October 1, 2018.

AECOM, 2019a. *Remedial Action Work Plan for Current Use of Forrest Street and Forrest Street Properties (Soil), Final*. March 22, 2019.

AECOM, 2019b. Memorandum entitled *Response to Comments on the Final Forrest RAWP: Forrest Street Properties Owner's May 29, 2019 Comments.* July 19, 2019.

AECOM, 2019c. *Remedial Action Report – Forrest Street Properties (AOC FSP-1A, AOC FSP-1B, AOC FSP-2A, and AOC FSP-2B) Soil, Final.* August 15, 2019.

AMEC, 2014. *Remedial Investigation Report Former Halladay Street Gas Works Jersey City, New Jersey*. May 2014.

City of Jersey City, 2009. *Canal Crossing Redevelopment Plan*. Division of City Planning. January 28, 2009.

City of Jersey City, 2019. Email RE: *May 6, 2019 Project Manager Conference Call.* May 4, 2019.

CMX, 2007. *Remedial Investigation Report, Former Halladay Street Gas Works, Jersey City, New Jersey*. December 2007.

CMX, 2008. *Remedial Investigation Report Addendum, Supplemental Offsite Soil Sampling, Former Halladay Street Gas Works, Jersey City, New Jersey*. July 2008.

ENSR, 2003. *Remedial Investigation Work Plan - Site 114*. April 2003.

ENSR, 2006a. *Remedial Investigation Report - Site 114*. March 2006.

ENSR, 2006b. *Remedial Investigation Work Plan – Site 114 (Off Site)*. March 2006.

ENSR, 2006c. *Remedial Investigation Work Plan – Sites 132, 133, 135, 137 and 143*. September 2006.

ERFS, 2018a. Email RE: *City Comments to GAG-002: FINAL Remedial Action Work Plan (Soil) Rev. 3, Garfield Avenue Group Sites*. August 21, 2018.

ERFS, 2018b. Email RE: *GAG-002: Final Remedial Action Work Plan (Soil) Rev. 4, Garfield Avenue Group Sites*. October 10, 2018.

NJDEP, 1981. N.J.A.C. 7:18 - *Regulations Governing the Certification of Laboratories and Environmental Measurements*. Adopted effective August 6, 1981. Readopted effective October 23, 2013. Last amended September 4, 2018.

NJDEP, 1990. *Administrative Consent Order*. July 19, 1990.

NJDEP, 1993a. N.J.A.C. 7:26C – *Administrative Requirements for the Remediation of Contaminated Sites*. Adopted effective May 17, 1993. Readopted July 11, 2018. Last amended August 6, 2018.

NJDEP, 1993b. N.J.A.C. 7:26E – *Technical Requirements for Site Remediation*. Adopted effective June 7, 1993. Most recently readopted May 7, 2012. Last amended August 6, 2018.

NJDEP, 2001. N.J.A.C. 7:9D – *Well Construction and Maintenance; Sealing of Abandoned Wells*. Adopted effective September 4, 2001. Readopted effective January 31, 2014. Last amended January 2, 2018.

NJDEP, 2002. NJDEP Office of Data Quality *SOP 5.A.16, Rev 1 Quality Assurance Data Validation of Analytical Deliverables for Inorganics* (based on USEPA SW-846 Methods). May 2002.

NJDEP, 2004. *Historic Fill of the Jersey City Quadrangle – Historic Fill Map HFM-53.* 2004.

NJDEP, 2005. NJDEP *Field Sampling Procedures Manual*. August 2005. Last updated April 2011.

NJDEP, 2007. NJDEP Memorandum from Lisa P. Jackson to Irene Kropp, Subject: *Chromium Moratorium*. February 8, 2007.

NJDEP, 2008a. N.J.A.C. 7:26D – *Soil Remediation Standards*. Adopted effective June 2, 2008. Readopted effective April 27, 2015. Last amended September 18, 2017.

NJDEP, 2008b. NJDEP *Chromium Soil Cleanup Criteria*. September 2008, revised April 2010.

NJDEP, 2009. NJDEP Office of Data Quality *SOP 5.A.10, Rev 3 SOP for Analytical Data Validation of Hexavalent Chromium – for USEPA SW-846 Method 3060A, USEPA SW-846 Method 7196A and USEPA SW-846 Method 7199*. September 2009.

NJDEP, 2011. N.J.A.C. 7:26E – *Technical Requirements for Site Remediation*. February 22, 2011 amendments.

NJDEP, 2012a. Letter from Thomas J. Cozzi to M. Michael McCabe, Subject: *Technical Execution Plan – Southwestern Soil Excavation PPG Site 114 - Garfield Avenue, Jersey City, New Jersey*. March 27, 2012.

NJDEP, 2012b. Letter from Thomas J. Cozzi to M. Michael McCabe, Subject: *Remedial Action Work Plan (Soil), Rev. 2, Garfield Avenue Group – Sites 114, 132, 133, 135, 137 and 143, Jersey City, New Jersey*. May 14, 2012.

NJDEP, 2012c. *Technical Guidance for the Attainment of Remediation Standards and Site-Specific Criteria*. September 2012.

NJDEP, 2013. Letter from Thomas Cozzi to M. Michael McCabe, Subject: Re: *Updated Method to Determine Compliance with the Department's Chromium Policy, Garfield Avenue – Sites 114, 132, 133, 135, 137, and 143, Jersey City, NJ*. August 13, 2013.

NJDEP, 2015. *Fill Material Guidance for SRP Sites Version 3.0.* April 2015.

NJDEP, 2016. Memorandum from Diane Groth to David Doyle, Subject: *PPG Garfield Avenue Group Sites, Adjacent Streets and Nearby Properties, Jersey City, NJ: Alternative Soil Remediation Standard for Vanadium*. December 28, 2016.

NJDEP, 2017. Email RE: *Meeting Summary, Wednesday, May 17*. May 23, 2017.

NJDEP, 2018a. Letter from Wayne C. Howitz to Ronald J. Riccio Esq., Subject: *Supplemental Soil Remedial Investigation Report – Soil, Garfield Avenue Group Non-Residential Chromate Chemical Production Waste Sites - 114, 132, 133, 135, 137, 143, and Adjacent Properties and Roadways, Final Revision 1, PPG Garfield Avenue Group, Hudson County Chromium Sites, Jersey City, New Jersey*. October 22, 2018.

NJDEP, 2018b. Letter from Wayne C. Howitz to Ronald J. Riccio Esq., Subject: *Remedial Action Work Plan (Soil) Rev. 4, Garfield Avenue Group Sites, Jersey City, Hudson County, New Jersey*. November 9, 2018.

PPG and PSEG, 2019. Letter from Louis H. Hahn and Mark Terril to Wayne Howitz, Subject: *Closeout of Garfield Avenue Group Sites and Former Halladay Street Gas Works; PI No. G000005480; City of Jersey City, Hudson County, New Jersey.* July 9, 2019.

Riccio, 2019. Letter from Ronald J. Riccio to The Honorable Jeffrey R. Jablonski, P.J. Ch., Subject: *PROGRESS REPORT (January 25, 2019 through the date of this Report): New Jersey Department of Environmental Protection, et al. v. Honeywell International, Inc., et al. v. City of Jersey City, et al., Superior Court of New Jersey, Chancery Division, Hudson County, Civil Action No. HUD-C-77-05; Partial Consent Judgment Concerning the PPG Sites (the "JCO").* July 31, 2019.

Scarinci Hollenbeck LLC., 2019. Letter from John M. Scagnelli to Ron Riccio, Esq. and David Doyle, Case Manager, Subject: Caragliano - 84-100 Forrest Street, Jersey City, New Jersey Property-Draft PPG March 2019 Remedial Action Work Plan for Current Use of Forrest Street and Forrest Street Properties (Soil), NJDEP P.I. No.: 775706 Our File No. 13547.1000. May 29, 2019.

Stanford, S.D., 1995. *Surficial Geology of the Jersey City Quadrangle, Hudson and Essex Counties, New Jersey*. Department of Environmental Protection, Division of Science and Research, New Jersey Geological Survey. 1995.

Superior Court of New Jersey Law Division – Hudson County, 2009. *Partial Consent Judgment Concerning the PPG Sites*. New Jersey Department of Environmental Protection and the Administrator of the New Jersey Spill Compensation Fund, Plaintiffs, v. Honeywell International, Inc., Occidental Chemical Corporation and PPG Industries, Inc., Defendants, v. City of Jersey City, Jersey City Municipal Utilities Authority, Jersey City Incinerator Authority, and New Jersey Turnpike Authority, Third Party Defendants. Filed June 26, 2009.

Weston, 2016. Email RE: *RE: FOR-012: Forrest Street Properties PDI Work Plan*. November 9, 2016.

Weston, 2017a. Email RE: *FOR-010: Forrest Street and Forrest Street Properties Terminal Excavation Elevation Submittal*. February 3, 2017.

Weston, 2017b. Email RE: *FOR-011: Forrest Street and Forrest Street Properties Terminal Excavation Elevation Submittal*. February 3, 2017.

Weston, 2017c. Email RE: *FOR-011: Forrest Street and Forrest Street Properties Technical Execution Plan*. April 7, 2017.

Weston, 2017d. Email RE: *FOR-010: Forrest Street and Forrest Street Properties Terminal Excavation Elevation Submittal*. April 20, 2017.

Weston, 2017e. Email RE: *FOR-011: Forrest Street and Forrest Street Properties Technical Execution Plan*. May 8, 2017.

Weston, 2017f. Email RE: *FOR-010: Forrest Street and Forrest Street Properties Terminal Excavation Elevation Submittal*. May 25, 2017.

Weston, 2017g. Email RE: *FOR-022: Forrest RAWP (Phase 1 and 2)*. August 11, 2017.

Weston, 2018a. Email RE: G*AG RAWP finalization*. February 28, 2018.

Weston, 2018b. Email RE: *RE: GAG-002: FINAL Remedial Action Work Plan (Soil) Rev. 3, Garfield Avenue Group Sites*. July 12, 2018.

Weston, 2018c. Email RE: *FOR-022C: Interim Forrest RAWP: Forrest St and Forrest St Properties - Deferred Remediation Areas*. November 16, 2018.

Weston, 2019a. Email RE: *FOR-022C: Final Forrest RAWP*. May 10, 2019.

Weston, 2019b. Email RE: *FOR-022C: Final Forrest RAWP.* May 31, 2019.