

# REMEDIAL INVESTIGATION REPORT – GROUND WATER

## JULY 2018

FORMER MORRIS CANAL (AOC-1)  
CHROMIUM SITES 121 (AOC-2) AND  
CHROMIUM SITE 207 (AOC-3)

BERRY LANE PARK  
JERSEY CITY, NJ 07302

PREPARED FOR:

JERSEY CITY REDEVELOPMENT AGENCY  
66 YORK STREET  
JERSEY CITY, NJ 07302

PREPARED BY:

DRESDNER ROBIN  
ONE EVERTRUST PLAZA  
SUITE 901  
JERSEY CITY, NJ 07302  
(201) 217-9200  
PROJECT NO. B80-807

DRESDNER  
  
ROBIN

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## 1.0 INTRODUCTION

On behalf of the Jersey City Redevelopment Agency (JCRA), this Remedial Investigation Report (RIR) has been prepared by Dresdner Robin to present the ground water remedial investigations performed within and along the former Morris Canal portions which are located within Hudson County Chromium Site 121 and 207; which are located within the limits of the JCRA's Berry Lane Park in Jersey City, New Jersey ("the Site"). This RIR follows the format specified by the New Jersey Administrative Code (N.J.A.C.) 7:26E-4.9 of the NJDEP's *Technical Requirements for Site Remediation* (May 7, 2012) and applicable guidance documents.

Remedial investigations of Chromium Chemical Production Waste (CCPW) were conducted by Dresdner Robin between late 2010 through the NJDEP's approval of the Remedial Investigation Report and Remedial Action Workplan – Soil in February 2012. These investigations were overseen and approved by the NJDEP pursuant to a Memorandum of Agreement (MOA) executed between the NJDEP and the JCRA. The NJDEP Case Manager was Mr. Steve Kehayes of the Department of Brownfield Reuse. NJDEP approvals are included as **Appendix A**.

On July 20, 2012, a Licensed Site Remediation Professional (LSRP) was retained (Mr. John F. Tregidgo; LSRP ID No. 585012 [interim LSRP ID No. 535036]) by the JCRA to oversee the completion of the remedial actions for Program Interest No. 568229 as approved by the NJDEP. The LSRP Notification of Retention or Dismissal Form is included as **Appendix B**.

Please note that this report solely presents the ground water investigations related to Chromium Chemical Production Waste associated with AOC-1 Former Morris Canal. As presented within the Remedial Action Report for Soil dated June 2016, through the use of compliance averaging, and supported by ground water sampling results, concentrations of nickel, thallium, and vanadium in soil identified on Chromium Sites 121 and 207 was determined not to be at levels which warrant a ground water investigation. The memorandum prepared by PPG's technical consultant, AECOM, and entitled *PPG Sites 121 and 207 (Berry Lane Park), Compliance Averaging Analysis - CCPW Impacts in Site Soils* is discussed within Section 8.4 of this report. The reporting related to non-chromium related AOCs is provided separately.

It should also be noted that prior to the installation of the intermediate monitoring well network, the NJDEP was provided with the proposed well locations and screen intervals and guided by their technical consultant's recommendations, they concurred with the proposed well network.

As part of this submission, the following documentation is provided both unbound at the front of this report, as well as included within the respective attachments of this report: a Case Inventory Document (**Attachment A**); Cover/Certification Form (**Attachment B**); and Updated Receptor Evaluation Form (**Attachment C**).

## 2.0 BACKGROUND INFORMATION

Berry Lane Park includes a collection of eleven (11) former properties as presented in the below table. These properties were subdivided into Block 18901 Lot 1.01 with an address of 1 Berry Road.

Property No.	Name	Address	Block	Lot
1	65 Woodward Ave.	65 Woodward Ave.	19803	4, 5
2	948 Garfield Ave.	948 Garfield Ave.	19803	11
3	City of Jersey City	970, 972, 974, 976, 978, 980 and 984 Garfield Ave.	19803	16, 17, 18, 19, 20, 1
4	Garfield Junk Yard (also known as Chromium Site 121)	958, 960, 964 and 966 Garfield Ave.	19803	12, 13, 14
5	Hit or Miss (with a portion also known as Chromium Site 207)	942, 944 and 946 Garfield Ave.	19803	8, 9, 10, 21
6	MAOK	968 Garfield Ave.	19803	15
7	Purple Fish	990 Garfield Ave.	18901	1
8	1000 Garfield Ave.	1000 Garfield Ave.	18901	2
9	75 Woodward Ave.	75 Woodward Ave.	19803	3
10	Finch Oil	1 Berry Road	18901	Portion of 18
			17301	10 (northern side of Communipaw Ave.)
12	Woodward Metals	125 Woodward Street	18901	18

Properties listed were previously investigated on behalf of the JCRA with the NJDEP reviewing and approving site specific Remedial Action Workplans for each. Please note that chromium related investigations were not presented within these reports.

### 2.1 Environmental Setting

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

#### 2.1.1 Project Area Location and Description

Berry Lane Park is primarily located in a commercial/light industrial area of Jersey City, Hudson County, New Jersey and consists of an amalgamation of eleven (11) former properties. A USGS map presenting the regional location of the project is presented as **Figure 1**; an aerial photograph identifying each parcel is presented as **Figure 2**. The limits of Berry Lane Park are broadly defined by the Hudson Bergen Light Rail Train (HBLRT) tracks to the south, Communipaw Avenue to the north, Garfield Avenue to the west and Woodward Street to the east.

#### 2.1.2 Surrounding Land Use

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

#### 2.1.3 Topography

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

#### 2.1.4 Surface Water

There are no surface water bodies on or adjacent to the Site. The nearest water body is the Morris Bay,

which is located approximately 4,500 feet to the east. The Site is not designated as wetlands and none were identified on or adjacent to the Site. According to NJDEP's GeoWeb wetlands database, Disturbed Wetlands and Deciduous Wooded Wetlands exist approximately 3,500 feet south of the Site. Additionally, the Site is located within the 100-year floodplain boundary (Zone AH), which is defined as having flood depths ranging from one (1) to three (3) feet.

#### 2.1.5 Regional Geology

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

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

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

#### 2.1.6 Regional Soil

Generally, the subsurface conditions at the Site consist of the following strata listed in order of increasing depth:

- Engineering Control: A minimum of twenty-four (24) inches of certified clean fill was installed across the Site as part of the soil remediation of the park. The certified clean fill is underlain by a geotextile fabric which acts as a demarcation layer.
- Fill Material: The thickness and composition of the fill material is variable. The fill material generally rests on top of marine deposits, glacial deposits and bedrock. The fill material could be composed by a mixture of cinders, sand and gravel with a trace of silt and clay, construction demolition debris (concrete, brick, glass, metal, etc.), wood, slag and miscellaneous debris. The fill was often placed to raise surface elevations above the existing water level in an effort to reclaim wetlands and flood prone areas for development. Deeply occurring subsurface fill is common in Jersey City.
- Natural Marine and Estuarine Marsh Deposits: Generally, these deposits are composed of organic silt and clay (clayey silt), fine sand, traces of shells, traces of wood and peat (meadow mat). These deposits can range in thickness from 20 to 40 feet and thickness varies regionally.
- Glacial Deposits (undifferentiated): The glacial deposits generally consist of a thin layer of glacial till deposited on top of the bedrock. The glacial till comprises either brown or gray-brown coarse through fine sand and gravel with some silt and/or clayey silt with gravel and sand. The glacial deposits beneath the Project Area and its vicinity may not be continuous. According to the Glacial Map (Stanford, E.D. et al., New Jersey Geological Survey, 1990), the Project Area lies on lake-bottom sediment, which is composed of silty clay and fine sand that was deposited on the bottom of glacial lakes. The thickness of this geologic unit can be as much as 250 feet.

### 2.1.7 Regional Hydrogeology

Ground water at the Site occurs in three (3) general stratigraphic zones:

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

### 2.1.8 Regional Ground Water in Fill Deposits

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

### 2.1.9 Regional Ground Water in Native Unconsolidated Deposits

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

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

### 2.1.10 Regional Ground Water in the Stockton and Lockatong Formations (Bedrock)

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



### 3.0 APPLICABLE REGULATORY TIMEFRAMES

Provided below is a summary of the applicable regulatory timeframes and the date each was addressed.

#### APPLICABLE REGULATORY TIMEFRAMES

Citation	Requirement	Regulatory Timeframe	Completion Date
<b>LSRP Retention Requirements</b>			
7:26C-2.3(a)1	Hire LSRP when a discharge is discovered or initiation of remediation:	5/7/2012*	7/20/2012
7:26C-2.3(a)2	Submit LSRP retention form within 45 days after discharge or initiation of remediation:	5/7/2012*	7/20/2012
<b>Public Notification and Outreach Requirements</b>			
7:26C-1.7(h)2i	Distribute updated notification letters and submit documentation to local government entities:	5/7/2012*	8/29/2013; 6/6/2017
<b>Receptor Evaluation Requirements - General</b>			
7:26E1.12c	Submit initial receptor evaluation within 1 year after discharge is discovered or initiation of remediation:	5/7/2012*	11/16/2011
7:26C-3.3(a)2ii	Submit initial receptor evaluation within 2 years after discharge is discovered or initiation of remediation:	5/7/2013	11/16/2011
<b>Receptor Evaluation Requirements - Ground Water</b>			
7:26E-1.14(a)1	Conduct a well search as part of the ground water receptor evaluation within 90 days after ground water contamination is detected:	8/5/2012	5/5/2011
7:26E-1.14(a)3	Update the well search to identify any new wells every two years after the first trigger for a well search:	5/5/2013; 5/5/2015; 5/5/2017	5/5/2011; 5/1/2013; 9/8/2014; 5/12/2015; 5/19/2016
<b>Remedial Investigation Statutory Timeframe</b>			
7:26E-4.10	If remediation was required to be initiated on or after 5/7/2012, complete the RI and submit the RIR 5 years after the date remediation was required to be initiated:	3/1/2017	Soil - 2/1/2012; Ground Water - April 2018
<b>Remedial Action Workplan Statutory Timeframe</b>			
7:26E-5.5(a)	60 days prior to implementation of remedial action:	5/1/2012	Soil - 2/1/2012; Ground Water - Not Applicable
<b>Remedial Action Report for Soil and/or other Medium Statutory Timeframe</b>			
7:26E-5.8(b)2	Submit Remedial Action Report for Soil and/or medium 5 years after the regulatory timeframe to complete the RI and submit the RIR:	2/28/2022	Soil - May 2016; Ground Water - April 2018

Notes:

\* - indicates initial date of the Licensed Site Remediation Professional (LSRP) program.

#### **4.0 REGULATORY HISTORY**

A chronological summary of the various regulatory documents submitted and NJDEP responses associated with the remediation of the AOC-1: Former Morris Canal, AOC-2: Chromium Site 121 and AOC-3: Chromium Site 207 are as follows:

- Site Investigation Workplan, dated September 2010
- Site Investigation Report, dated February 2011
- NJDEP Site Investigation Report Approval, dated April 1, 2011
- Initial Receptor Evaluation Form, dated November 16, 2011
- Remedial Investigation Report and Remedial Action Workplan, dated February 2012
- NJDEP Remedial Investigation Report and Remedial Action Workplan Approval, dated February 10, 2012
- NJDEP Remedial Action Workplan Addendum Email, dated July 2012
- LSRP Notification of Retention or Dismissal, dated July 20, 2012
- Public Notification and Outreach, dated August 29, 2013
- Remedial Action Report for Soil, dated June 2016
- Unrestricted Use Soils Only Areas of Concern Response Action Outcome: AOC-1 Former Morris Canal; Chromium Site 121 and Chromium Site 207, dated June 22, 2016
- Public Notification and Outreach, dated June 6, 2017

## **5.0 SITE INVESTIGATION WORKPLAN, SEPTEMBER 2010**

A Site Investigation Workplan (SIW) was submitted to the NJDEP in September 2010. The report outlined the proposed site investigations of the former Morris Canal (**Appendix C**).

### **5.1 Ground Water Investigation**

Based on the historic map review, the estimated width and length of the former Morris Canal in the Berry Lane Park area was approximately 40 feet by 1,140 feet. For the soils investigation, eight (8) transects were proposed. Each transect was proposed to consist of either three (3) or five (5) borings; a single intermediate boring would be advanced between each transect. Transects would be spaced approximately 150 feet apart along the former Morris Canal.

A piezometer was proposed within each transect to characterize the ground water within the former Morris Canal. Piezometer locations within each transect were biased towards contamination; the screened interval of each piezometer was biased towards contamination and was not to exceed five (5) feet in length. If contamination was not observed within the transect, the piezometer was installed in the center boring.

Low-flow sampling techniques would be used to purge and sample piezometers. A pump with dedicated tubing would be used to draw the purge water from the well and discharge the water into a 55-gallon drum. The wells would be purged until the appropriate indicator parameter readings stabilize. Samples would be collected directly from the dedicated Teflon tubing and Teflon bailers (VOCs) into laboratory-supplied bottleware. Well purging information and indicator ground water parameter readings for pH, temperature, conductivity, ORP, DO, and turbidity would be recorded on field sampling logs. Observations of sheen and/or distinctive odors would also be recorded if encountered. Ground water samples would be analyzed for Target Compound List/Target Analyte List+30 (TCL/TAL+30), hexavalent chromium, total chromium, pH and Eh.

## 6.0 SITE INVESTIGATION REPORT, FEBRUARY 2011

### 6.1 Ground Water Investigation Procedures

As detailed in the February 2011 Site Investigation Report (**Appendix D**). A piezometer was installed within each of the three (3) and five (5) boring transects to characterize the ground water within the former Morris Canal. As the most significant chromium contamination was identified within the center (X) boring of each transect, piezometers constructed with a five (5) foot screen were installed across the upper five (5) feet of the saturated zone within these locations.

Low-flow sampling techniques were used to purge and sample the piezometers. Samples were then collected directly from the dedicated Teflon tubing and Teflon bailers (VOCs) into laboratory-supplied bottle ware. Well purging information and indicator ground water parameter readings for pH, temperature, conductivity, ORP, DO, and turbidity were recorded on field sampling logs. Observations of sheen and/or distinctive odors were recorded, if encountered. Ground water samples were analyzed for TCL/TAL+30, hexavalent chromium, pH and Eh.

### 6.2 Ground Water Investigation Results

The laboratory results were reviewed and compared with *Ground Water Quality Standards* (N.J.A.C. 7:9C) (last amended November 4, 2009) and as no standard existed for hexavalent chromium, results were compared to the GWQS for total chromium.

Review of the ground water analytical results for hexavalent chromium identified concentrations ranging from 6,530 ug/L (MC-011X) to 336,000 ug/L (MW-001X).

Concentration of total chromium in excess of the NJDEP's GWQC ranged in concentration from 6,820 ug/L (MC-011x) to 339,000 ug/L (MC-001X) consistent with hexavalent chromium results.

Select metals (antimony, nickel, thallium and vanadium) were traditionally attributed to impacts associated with CCPW. These metals were detected throughout the Site but not at concentrations which exceed the NJDEP's GWQC.

Excluding metals attributed to CCPW, select TAL metals (aluminum, arsenic, iron, lead, sodium) were identified within ground water samples at concentrations which exceed the NJDEP's GWQC. The concentration ranges for each analyte in relation to the NJDEP GWQC are presented in the below table:

<u>CONTAMINANT</u>	<u>NJDEP GWQC</u> <u>(ug/L)</u>	<u>MINIMUM</u> <u>CONCENTRATION</u> <u>(ug/L)</u>	<u>MAXIMUM</u> <u>CONCENTRATION</u> <u>(ug/L)</u>
Aluminum	200	25.9 J	686
Arsenic	3	1.54 J	78
Iron	300	158	160000
Lead	5	0.968 J	253
Sodium	50000	72200	756000

#### 6.2.1 Target Compound List Volatile Organics and Base Neutral Acid Extractables

Review of the ground water analytical results for Target Compound List Volatile Organics plus Ten (TCL VO+10) identified tetrachloroethene MC-01X and MC-03X at concentrations which marginally exceeded the NJDEP GWQC of 1 ug/L.

No concentrations of Target Compound List Base Neutral Analytes were identified above the NJDEP GWQC.

#### 6.2.2 Pesticides, Polychlorinated Biphenyls and Total Cyanide

Review of the ground water analytical results for Polychlorinated Biphenyls (PCBs) and total cyanide did not identify concentrations which exceed the NJDEP's GWQS.

Review of the ground water analytical results for pesticides identified an exceedance of dieldrin in ground water sample MC-015X and its replicate REP111610 at a concentration of 0.081 ug/L and 0.101 ug/L; respectively both exceed the NJDEP's GWQS of 0.03 ug/L.

### 6.3 Conclusions and Recommendations

#### 6.3.1 Ground Water

##### 6.3.1.1 Hexavalent Chromium and Total Chromium

Hexavalent chromium and total chromium were detected in the ground water throughout the former Morris Canal at elevated concentrations. Delineation of the hexavalent chromium and total chromium impacts, via the installation of permanent monitoring wells, was recommended. However, considering that the likely remedial scenario for soil contamination would include extensive removal of contaminated soils, it was recommended that the remedial investigation of ground water be postponed until after soil remedial actions were performed. To assess the extent of the impacts to Berry Lane Park properties that encompass the former Morris Canal, it was recommended that two (2) rounds of sampling be conducted from select monitoring wells in Berry Lane Park.

##### 6.3.1.2 Target Analyte List Metals

TAL metals were detected at elevated concentrations throughout the former Morris Canal. It should be noted that elevated concentrations of metals were also detected throughout the entirety of Berry Lane Park because of the widespread presence of Historic Fill. Considering the extent of the investigations that have been undertaken in Berry Lane Park, no further ground water investigations of TAL metals were recommended.

##### 6.3.1.3 Target Compound List Volatile Organics

Tetrachloroethene (PCE) was detected at concentrations that marginally exceed the GWQC in piezometers MC01-1X and MC01-3X. Delineation of the PCE via the installation of permanent monitoring wells was recommended. However, considering that the likely remedial scenario for soil contamination would include extensive removal of contaminated soils, it was recommended that remedial investigations of ground water be postponed until after soil remedial actions are performed.

##### 6.3.1.4 Pesticides

Dieldrin was detected at concentrations that exceed the GWQC in piezometer MC-015X. Delineation of the Dieldrin via the installation of permanent monitoring wells was recommended. However, considering that the likely remedial scenario for soil contamination would include extensive removal of contaminated soils, it was recommended that remedial investigations of ground water be postponed until after soil remedial actions were performed.

## 7.0 REMEDIAL INVESTIGATION REPORT AND REMEDIAL ACTION WORKPLAN, FEBRUARY 2012

### 7.1 Remedial Investigation Report Summary

Soil and ground water investigations were conducted in May and June 2011. The goal being to: 1) further delineate the extent of hexavalent chromium, 2) further delineate the extent of the Chromate Chemical Production Waste (CCPW) related metals antimony, nickel, thallium and vanadium, 3) to assess ground water impacts, and 4) to further assess CCPW related contaminants at Chromium Site 121 (i.e. Property #4 and #6) and Chromium Site 207 (i.e. a portion of Property #5) as presented within AECOM's June 2010 Draft Remedial Investigation Report prepared on behalf of PPG Industries, Inc. (PPG). The scope of work was developed to satisfy requirements of the NJDEP TRSR and those specifically outlined by the NJDEP in their Site Investigation Report (SIR) approval letter dated April 1, 2011. Sampling was performed in accordance with the *NJDEP Field Sampling Procedures Manual revised April 30, 2009*.

#### 7.1.1 Ground Water Investigation Procedures

Two (2) rounds [May and June 2011] of low-flow sampling were conducted from monitoring wells MW-3-1, MW-3-2, MW-4-1, MW-5-1, MW-5-2, MW-6-1, MW-7-1, MW-7-2, MW-8-1, MW-9-1, MW-10-1, and MW-12-1 in Berry Lane Park.

Monitoring wells were selected based upon their location relative to the Morris Canal, Chromium Sites 121 and 207 (additionally, as part of the separate investigation of PCE and Dieldrin, referenced earlier; select piezometer locations were sampled and analyzed for PCE and dieldrin.) Ground water samples were analyzed for select TAL metals (total chromium, antimony, nickel, thallium, vanadium) and hexavalent chromium.

#### 7.1.2 Ground Water Investigation Results

The laboratory results for the May and June 2011 sampling events were reviewed and compared with *Ground Water Quality Standards* (N.J.A.C. 7:9C) (last amended November 4, 2009). As no standard existed for hexavalent chromium, results were compared to the GWQS for total chromium.

Review of the ground water analytical results for total and hexavalent chromium identified concentrations in excess of 70 ug/L in only MW-8-1 and MW-5-2. It should be noted that both of these wells were located within chromium source material placed within the former Morris Canal.

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

Overall ground water flow direction observed during both the May and June 2011 flowed to the South-Southeast. Ground water sample results for the May 2011 and June 2011 sampling events are presented on Table 4 and Table 5, respectively of the RIRRAW provided in **Appendix E**. The ground water analytical results exceeding the NJDEP's GWQS for the May and June 2011 sampling events are depicted on Figure 11 and Figure 12, respectively of the RIRRAW provided in **Appendix E**.

#### 7.1.3 Conclusions and Recommendations

##### 7.1.3.1 Ground Water

To assess the extent of the impacts to Berry Lane Park properties that encompass the former Morris Canal, two (2) rounds of sampling were conducted from select monitoring wells in Berry Lane Park. Hexavalent chromium and total chromium at elevated concentrations were detected in the ground water throughout the former Morris Canal. Further characterization of the ground water in the former Morris Canal was warranted. Considering that the likely remedial scenario for soil contamination would include extensive removal of

contaminated soils, it is recommended that further characterization of the ground water in the former Morris Canal (including the installation of monitoring wells) should be postponed until after soil remedial actions were performed.

## **7.2 Remedial Action Workplan Summary**

The RAW was submitted in February 2012 and was approved on February 10, 2012. It outlined five (5) principal components as follows:

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

A description of each of the ground water related components of the remedial action is provided below.

### **7.2.1 Pre-Remediation Activities**

#### **7.2.1.1 Monitoring Well Decommissioning**

Prior to soil remediation, existing ground water monitoring wells located within or closely adjacent to the proposed excavation area would be abandoned in accordance with NJDEP TRSR by a New Jersey licensed well driller.

### **7.2.2 Remediation Activities**

#### **7.2.2.1 Dewatering**

Dewatering would be required during the excavation of contaminated soils, as ground water may accumulate in the excavation during the course of work.

Water generated from dewatering was proposed to be: 1) treated by an onsite system to meet parameters established by the receiving authority and then discharged to the municipal combined sewer at a location agreed upon by the Jersey City Municipal Utility Authority (JCMUA), and/or 2) stored onsite in appropriate containers and transported offsite for disposal.

## **8.0 REMEDIAL ACTION REPORT – SOIL AND ISSUANCE OF A RESPONSE ACTION OUTCOME FOR SOIL**

### **8.1 Description of Remedial Actions**

As presented within the RAW summary in Section 7.2 the proposed remedial action for the Site was comprised of five (5) principal components as follows:

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

A detailed discussion of the ground water related components is provided below:

### **8.2 Pre-Remediation Activities**

#### **8.2.1 Monitoring Well Decommissioning**

Prior to soil remediation, ground water monitoring wells MW-3-1, MW-3-2, MW-4-1, MW-5-1, MW-5-2, MW-6-1, MW-7-1, and MW-8-1 were abandoned in accordance with NJDEP TRSR by Well Done of Budd Lake, New Jersey, a New Jersey licensed well driller.

### **8.3 Remediation Activities**

#### **8.3.1 Dewatering**

Water generated within the remedial excavation was pumped, using internal pumps, to one of two onsite 20,000-gallon holding tanks pending transport to 900 Garfield Avenue where it was treated with an onsite treatment system. Approximately 1,228,000 gallons of water was recovered and transported for treatment at 900 Garfield Avenue under the existing permits.

### **8.4 Deviation from the NJDEP Approved Remedial Action Workplan**

The concentrations of these contaminants within these two (2) sites were later evaluated in accordance with the NJDEP *September 2012 Technical Guidance for the Attainment of Remediation Standards and Site-Specific Criteria, Version 1.0*. Based on compliance averaging, and supported by ground water sampling results, nickel, thallium, and vanadium contamination in soil on Chromium Sites 121 and 207 was determined not to be at levels which require soil containment or other remedial action, subsequently implementation of an engineering and institutional control was judged not warranted. The memorandum prepared by PPG's technical consultant, AECOM, and entitled *PPG Sites 121 and 207 (Berry Lane Park), Compliance Averaging Analysis - CCPW Impacts in Site Soils* is provided as **Appendix F**.

It should be noted that an engineering control has been implemented at Chromium Sites 121 and 207 to address soil contamination associated with Historic Fill. Ongoing maintenance and monitoring associated with the engineering control is the responsibility of the property owner.

### **8.5 Issuance of an Unrestricted Use Area of Concern Specific Response Action Outcome for Soil**

On June 22, 2016, an Unrestricted Use Area of Concern Soils Only Response Action Outcome (RAO) was issued for AOC-1 – Former Morris Canal, AOC-2 Chromium Site 121 and AOC-3 Chromium Site 207.



## 9.0 REMEDIAL INVESTIGATION REPORT FOR GROUND WATER

Ground water samples discussed within the below sections were collected using techniques as outlined in the NJDEP's *Alternative Ground Water Sampling Techniques Guide* (July 1994) and in accordance to the provisions of the *NJDEP's Technical Requirements for Site Remediation, N.J.A.C. 7:26E et seq.* (last amended May 7, 2012) and the *NJDEP's Field Sampling Procedures Manual* (August 2005 updated April 11, 2011) for low-flow sampling.

As detailed in the Site Investigation Workplan (**Appendix D**) and summarized in Sections 6.3.1.3 and 6.3.1.4, PCE and Dieldrin had been observed at concentrations above NJDEP GWQC. However, as PCE and Dieldrin are not contaminants related to the placement of chromium waste on the sites as a fill material, further investigation of these contaminants will be addressed separately and is not within the scope of this remedial investigation.

### AOC-2 Chromium Site 121

After the soils remediation was completed on Chromium Site 121, post excavation sampling confirmed that Hexavalent Chromium had been remediated to the most stringent remedial criteria. However, there remained the potential for other CCPW-related metals, such as Nickel and Thallium to be present at levels that exceeded the NJDEP Default Impact to Ground Water Soil Screening Levels (DIGWSSL). Soil data was reviewed, and no CCPW-related metals were present in soils above the water table at concentrations that exceeded the NJDEP DIGWSSL. Additionally, previous ground water data from the Site (presented within the Remedial Investigation Report, dated February 2012) did not show CCPW-related metals present within ground water above the NJDEP GWQC.

Consequently, no further investigation of ground water at AOC-2 Chromium Site 121 was recommended. This is further detailed in a September 11, 2014 memorandum by AECOM (provided as **Appendix F**).

### AOC-3 Chromium Site 207

After the soils remediation was completed on Chromium Site 207, post excavation sampling confirmed that Hexavalent Chromium had been remediated to the most stringent remedial criteria. However, there remained the potential for other CCPW-related metals, such as Nickel and Vanadium to be present at levels that exceeded the NJDEP DIGWSSL. Soil data was reviewed, and Nickel and Vanadium were present in soils above the water table at concentrations that exceeded the DIGWSSL. AECOM, as detailed in their September 11, 2014 memorandum (provided as **Appendix F**), used Compliance Averaging to analyze the soil results. Both Nickel and Vanadium were, on average, in compliance with the DIGWSSL subsequently no further remediation was warranted.

This is supported by the previous ground water data from the Site (presented within the Remedial Investigation Report, dated February 2012) which did not show CCPW-related metals present within ground water above the NJDEP GWQC. Consequently, no further investigation of ground water at AOC-3 Chromium Site 207 was recommended.

A figure depicting the location of AOC-1 Former Morris Canal, AOC-2 Chromium Site 121 and Chromium Site 207 is provided as **Figure 3**.

## 9.1 Shallow Monitoring Well Installations – November 2013

During November 19 through 22, 2013, six (6) monitoring wells [MW-CR-1 through MW-CR-6] were installed. Two (2) additional wells [MW-CR-7 and MW-CR-8] were installed on December 7 and 8, 2013. Four (4) of these wells [MW-CR-1 through MW-CR-4] were installed alongside the southern property line adjacent to the sheeting (permanently left in place to minimize the migration of contaminated ground water from the adjacent Chromium Site 114 and NJDEP Orphan Site #2 [aka Sludge Line 2]). The remaining four wells [MW-CR-5 through MW-CR-8] were installed within the former Morris Canal to investigate whether there were CCPW

related impacts to ground water in excess of the NJDEP GWQS after completion of the soil remediation. The monitoring wells were installed by Environmental Management Consultants, Inc. (EMC), a New Jersey-licensed driller, under the supervision of Dresdner Robin. (See **Figure 4 – Monitoring Well Locations**).

Monitoring wells MW-CR-1 through MW-CR-4 were installed as follows: the screen, consisting of Schedule 40, 4-inch PVC with 0.01-inch slot size was set from approximately two (2) feet above ground water extending to the bottom of the borehole. The PVC screen and casing were inserted through the augers. The sand pack and seal were installed as the augers were removed from the ground. The sand pack for the well consisted of No.1 sand and was installed to a depth approximately one to two feet above the top of the screen. Bentonite pellets were installed above the sand pack in the well to prevent storm water or perched water from entering the sand pack. A steel protective flush mount casing was fit over the PVC riser and set in a concrete well collar. The surface of the well collar was sloped away from the center to prevent water from pooling above the well.

Monitoring wells MW-CR-5 through MW-CR-8 were installed as follows: As the wells were located within or proximal to a storm water detention basin; the wells were double cased to limit water infiltration from the surrounding storm water detention basin into the well. The screen, consisting of Schedule 40, 4-inch PVC with 0.01-inch slot size was set from approximately two (2) feet above ground water extending to the bottom of the borehole. The PVC screen and casing were inserted through the augers. The sand pack and seal were installed as the augers were removed from the ground. The sand pack for the well consisted of No.1 sand and was installed to a depth approximately one to two feet above the top of the screen. Bentonite pellets were installed above the sand pack in the well to prevent storm water or perched water from entering the sand pack. A steel protective flush mount casing was fit over the PVC riser and set in a concrete well collar. The surface of the well collar was sloped away from the center to prevent water from pooling above the well.

After installation, wells were developed using the pump and surge method. Specifically, water was evacuated from the well using a submersible pump and dedicated tubing. The development continued until the discharge water appeared clear and the monitoring well was allowed to equilibrate for at least two (2) weeks after development and prior to sample collection. Monitoring well information including well construction logs and Forms A and B are provided as **Appendix G**.

## **9.2 Ground Water Sampling and Investigation - January 2014, January 2015 and May 2015**

### **9.2.1 Ground Water Sampling – January 2014**

On January 14-16, 2014, ground water samples were collected from monitoring wells MW-CR-1 through MW-CR-8 using low-flow purging and sampling techniques. Samples were taken from each five feet of submerged well screen, so three samples were collected from each well.

Prior to purging, the presence/absence of product was recorded and the depth-to-water in the well was measured using an electronic oil-water interface meter.

Ground water was purged from the well using a submersible bladder pump with dedicated Teflon-lined water line. A water level indicator was used to monitor the amount of draw down in the water column; if necessary, the purging rate was adjusted to minimize draw down. A Horiba U-22 meter equipped with a flow cell was used to measure field parameters including temperature, specific conductivity, turbidity, pH, oxidation-reduction potential, and dissolved oxygen. Field parameters were recorded every five minutes throughout the purging period. The Horiba meter was calibrated at the beginning of the workday and checked at least once during the workday. Once all the field parameters had stabilized for three (3) consecutive measurements, the flow through cell was disconnected and the ground water sample was collected directly through the tubing into laboratory supplied sample containers. The sample was labeled and placed on ice in a cooler and transported to IAL under chain-of-custody documentation and analyzed for Chromate Chemical Production Waste (CCPW) metals, consisting of antimony, chromium (total), nickel, thallium, vanadium and chromium (hexavalent); and pH/Corrosivity. A sample summary table is provided as **Table 1** and the ground water sample locations are depicted in **Figure 4** and Low Flow Sampling Data Sheets are included as **Appendix H**.

### 9.2.2 Ground Water Sample Results (January 2014)

On January 14-16, 2014, three (3) ground water samples were collected via low-flow sampling procedures from the eight (8) monitoring wells. It should be noted that as acidified sampling containers were inadvertently utilized for ground water samples MW-CR-1A, MW-CR-1B, MW-CR-1C, MW-CR-2A, MW-CR-2B, MW-CR-2C, MW-CR-3A, MW-CR-3B and MW-CR-3C for the analysis of hexavalent chromium these locations were resampled for hexavalent chromium analysis on January 16, 2014.

Results for the 2014 sampling event identified concentrations of nickel in monitoring wells MW-CR-2 and MW-CR-5 slightly exceeding the NJDEP's Ground Water Quality Criteria (GWQC) - see Figure 4 – Ground Water Sample Results and **Table 2** – Ground Water Sample Analytical Results (January 2014). Both wells are located along the southern portion of the former canal. MW-CR-2 is installed immediately adjacent to the sheet line to screen ground water for infiltration from the green grey mud situated under the light rail (NJDEP Orphan Site #2 [aka Sludge Line 2]).

Ground water pH within the monitoring wells located in the former chromium excavation was alkaline (with a pH between 9.0 and 12.0). Ground water pH within monitoring wells installed immediately adjacent to the former excavation exhibited a pH between 7.2 and 7.7. Whether the concentrations were related to CCPW or historic fill interacting with elevated pH could not be determined with a single data set; subsequently an additional round of ground water samples was recommended from each of the chromium related wells from each of the previous sampling intervals.

The Laboratory Analytical Data Package is included in **Appendix I** and the Electronic Data Deliverables (EDDs) are provided in **Appendix J**.

## 9.3 Ground Water Sampling – January 2015

On January 13-14, 2015, ground water samples were collected from monitoring wells MW-CR-1 through MW-CR-8 using low-flow purging and sampling techniques consistent with the January 2014 event. Samples were taken from each five-foot screened interval, so three samples were collected from each well.

Prior to purging, the presence/absence of product was recorded and the depth-to-water in the well was measured using an electronic oil-water interface meter.

Ground water was purged from the well using a submersible bladder pump with dedicated Teflon-lined water line. A water level indicator was used to monitor the amount of draw down in the water column; if necessary, the purging rate was adjusted to minimize draw down. A Horiba U-22 meter equipped with a flow cell was used to measure field parameters including temperature, specific conductivity, turbidity, pH, oxidation-reduction potential, and dissolved oxygen. Field parameters were recorded every five minutes throughout the purging period. The Horiba meter was calibrated at the beginning of the workday and checked at least once during the workday. Once all the field parameters had stabilized for three (3) consecutive measurements, the flow through cell was disconnected and the ground water sample was collected directly through the tubing into laboratory supplied sample containers. The sample was labeled and placed on ice in a cooler and transported to IAL under chain-of-custody documentation and analyzed for Chromate Chemical Production Waste (CCPW) metals, consisting of antimony, chromium (total), nickel, thallium, vanadium and chromium (hexavalent); oxidation/reduction potential (Eh-mv) and pH/Corrosivity. A sample summary table is provided as **Table 1** and the ground water sample locations are depicted in **Figure 4** and Low Flow Sampling Data Sheets are included as **Appendix H**.

### 9.3.1 Ground Water Sample Results (January 2015)

On January 13-14, 2015, three (3) ground water samples were collected via low-flow sampling procedures from all eight (8) monitoring wells.

Results for the 2015 sampling event did not identify concentrations of nickel (or any other metal analyzed) above the NJDEP GWQC in any monitoring well, including MW-CR-2 and MW-CR-5 (which had slightly exceeded the NJDEP GWQC, in the previous sampling event in January 2014) - see **Figure 4** – Ground Water Sample Results and **Table 3** – Ground Water Sample Analytical Results (January 2015). Notably, the pH levels in nineteen of the twenty-six ground water samples had decreased (become less corrosive).

It was unclear whether the nickel exceedances in the January 2014 sampling event could be attributed to previous CCPW impacted ground water or to the relationship of the ground water's pH interacting with historic fill reused as backfill within the former Morris Canal excavation.

As ground water pH has moved towards neutral (pH 7.0) in the majority of the wells, it was recommended that one additional round of ground water samples be collected from each monitoring well at each of the previous sampling intervals and be analyzed for nickel only. Samples were proposed to be collected in May 2015 to account for seasonal variation in the ground water. If results of the May 2015 sampling were compliant of the NJDEP's GWQS, thus constituting two consecutive rounds of compliant samples, no further investigations related to ground water would be recommended.

The Laboratory Analytical Data Package is included in **Appendix I** and the Electronic Data Deliverables (EDDs) are provided in **Appendix J**.

#### **9.4 Ground Water Sampling – May 2015**

On April 30 and May 1, 2015, ground water samples were collected from monitoring wells MW-CR-1 through MW-CR-8 using low-flow purging and sampling techniques. Samples were taken from each five-foot screened interval, so three samples were collected from each well.

Prior to purging, the presence/absence of product was recorded and the depth-to-water in the well was measured using an electronic oil-water interface meter.

Ground water was purged from the well using a submersible bladder pump with dedicated Teflon-lined water line. A water level indicator was used to monitor the amount of draw down in the water column; if necessary, the purging rate was adjusted to minimize draw down. A Horiba U-22 meter equipped with a flow cell was used to measure field parameters including temperature, specific conductivity, turbidity, pH, oxidation-reduction potential, and dissolved oxygen. Field parameters were recorded every five minutes throughout the purging period. The Horiba meter was calibrated at the beginning of the workday and checked at least once during the workday. Once all the field parameters had stabilized for three (3) consecutive measurements, the flow through cell was disconnected and the ground water sample was collected directly through the tubing into laboratory supplied sample containers. The sample was labeled and placed on ice in a cooler and transported to IAL under chain-of-custody documentation and analyzed for Nickel only. A sample summary table is provided as **Table 1** and the ground water sample locations are depicted in **Figure 4** and Low Flow Sampling Data Sheets are included as **Appendix H**.

##### **9.4.1 Ground Water Sample Results (May 2015)**

On April 30 and May 1, 2015, three (3) ground water samples were collected via low-flow sampling procedures from all eight (8) monitoring wells (MW-CR-1 through MW-CR-8).

Results for the May 2015 sampling event did not identify concentrations of nickel above the NJDEP GWQC in any monitoring well, see **Figure 4** – Ground Water Sample Results and **Table 4** – Ground Water Sample Analytical Results (May 2015).

As the results of the May 2015 samples were compliant of the NJDEP's GWQS, thus constituting two consecutive rounds of compliant samples for CCPW related analytes, no further investigations related to ground water are recommended.

The Laboratory Analytical Data Package is included in **Appendix I** and the Electronic Data Deliverables (EDDs) are provided in **Appendix J**.

## **9.5 Intermediate Monitoring Well Installation - January 2018**

Between January 29 and February 5, 2018, three (3) intermediate monitoring wells [MW-CR-3i, MW-CR-7i, MW-CR-8i] were installed along the centerline of AOC-1 Former Morris Canal to determine whether there are CCPW related ground water impacts in excess of the NJDEP GWQS to the intermediate zone aquifer. It should be noted that the locations and depths of the intermediate monitoring wells were pre-approved by the NJDEP prior to the monitoring well installations.

Monitoring wells MW-CR-3i, MW-CR-7i, and MW-CR-8i were installed at slightly varying depths to account for variations in lithology and available tooling, however the overall method of construction was consistent throughout. The wells were double cased to limit water infiltration from the surrounding storm water detention basin and shallow bearing water zone into the well. The screen, consisting of Schedule 40, 2-inch PVC with 0.01-inch slot size was set based upon field observations and pre-determined depths. The screens extended to the bottom of the borehole. The PVC screen and casing were inserted through the augers. The sand pack and seal were installed as the augers were removed from the ground. The sand pack for the well consisted of No.1 sand and was installed to a depth approximately one to two feet above the top of the screen. Bentonite pellets were installed above the sand pack in the well to prevent storm water or perched water from entering the sand pack. A steel protective flush mount casing was fit over the PVC riser and set in a concrete well collar. The surface of the well collar was sloped away from the center to prevent water from pooling above the well.

After installation, monitoring wells were developed using the pump and surge method. Specifically, water was evacuated from the well using a submersible pump and dedicated tubing. The development continued until the discharge water appeared clear and the monitoring well were allowed to equilibrate for at least two (2) weeks after development and prior to sample collection. Monitoring well information including well construction logs and Forms A and B are provided as **Appendix G**.

## **9.6 Ground Water Sampling – February 2018**

On February 23, 2018, ground water samples were collected from monitoring wells MW-CR-3i, MW-CR-7i, and MW-CR-8i using low-flow purging and sampling techniques. Samples were collected every five feet of submerged well screen, subsequently two samples were collected from each monitoring well.

Prior to purging, the presence/absence of product was recorded and the depth-to-water in the well was measured using an electronic oil-water interface meter.

Ground water was purged from the monitoring well using a submersible bladder pump with dedicated Teflon-lined water line. A water level indicator was used to monitor the amount of draw down in the water column; if necessary, the purging rate was adjusted to minimize draw down. A Horiba U-22 meter equipped with a flow cell was used to measure field parameters including temperature, specific conductivity, turbidity, pH, oxidation-reduction potential, and dissolved oxygen. Field parameters were recorded every five minutes throughout the purging period. The Horiba meter was calibrated at the beginning of the workday and checked at least once during the workday. Once the field parameters had stabilized for three (3) consecutive measurements, the flow through cell was disconnected and the ground water sample was collected directly through the tubing into laboratory supplied sample containers. The sample was labeled and placed on ice in a cooler and transported to IAL under chain-of-custody documentation and analyzed for Chromate Chemical Production Waste (CCPW) metals, consisting of antimony, chromium (total), nickel, thallium, vanadium and chromium (hexavalent); oxidation/reduction potential (Eh-mv) and pH/Corrosivity. A sample summary table is provided as **Table 1** and the ground water sample locations are depicted on **Figure 4** and Low Flow Sampling Data Sheets are included as **Appendix H**.

#### 9.6.1 Ground Water Sample Results (February 2018)

On February 23, 2018, six (6) ground water samples were collected via low-flow sampling procedures from three (3) monitoring wells.

Results for the February 2018 sampling event did not identify concentrations of CCPW related constituents above the NJDEP GWQC in the three intermediate monitoring wells, see **Figure 9** – Ground Water Sample Results and **Table 5** – Ground Water Sample Analytical Results (February 2018).

#### 9.7 Investigative Derived Waste

During the remedial investigation of ground water several drums of soil / drill cuttings and development water were generated. Disposal Manifest records are provided in **Appendix K**.

#### 9.8 Significant Events or Seasonal Variations

No significant events or seasonal variations were noted which would have influenced sampling procedures and/or analytical results.

## **10.0 APPLICABLE REMEDIATION STANDARDS**

The ground water results were compared with the NJDEP's Ground Water Quality Criteria for Class IIA aquifers (N.J.A.C. 7:9C-1.7) dated May 2005 (amended January 16, 2018). As no standard exists for hexavalent chromium, results were compared to the GWQS for total chromium.

## **11.0 QUALITY ASSURANCE/QUALITY CONTROL**

Quality Assurance/Quality Control sampling was performed to provide control over the collection of samples and the validity of analytical data. The sample analyses were performed in accordance with full laboratory data deliverables as needed. Analytical methods and quality assurance conform to the NJDEP's *Field Sampling Procedures Manual revised April 11, 2011*.

### **11.1 Quality Assurance Protection Plan**

A Quality Assurance Protection Plan (QAPP) was generated prior to the site and remedial investigations. The QAPP is provided in **Appendix L** and includes the problem definition, the project team, sample collection methods, field equipment, analytical requirements, and data quality objectives.

### **11.1 Field Blanks**

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

### **11.2 Duplicate Samples**

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

### **11.3 Sampling Methods**

Soil samples were collected utilizing disposable plastic trowels.

### **11.4 Sample Storage, Handling and Preservation**

The sample containers were labeled with sample number, date, time of collection, analytical parameters, preservatives, site name and person or persons performing the sampling. The laboratory performing the analysis was responsible for preserving the sampling bottles prior to shipment into the field. Samples were kept cool at 4°C and transported in coolers to the laboratory. Proper chain-of-custody documentation was maintained, beginning with the laboratory's release of the bottles.

### **11.5 Decontamination Procedures**

Prior to and after collection of each ground water sample, the outside of the pump was washed with an Alconox solution and rinsed with distilled water, and a distilled water/wash solution cycled through the pump until the pump is thoroughly cleaned. Ground water samples would be collected utilizing a one-time use, disposable sampling device (i.e., teflon tubing,) and therefore no decontamination procedures would be necessary.

### **11.6 Containers and Chain-of-Custody Procedures**

Clean sample containers were supplied by the laboratory for the sampling event(s). The appropriate preservatives were added to the sample bottles by the laboratory prior to shipment. The chain-of-custody accompanies the bottles during transportation from the laboratory to the field, sample collection, transportation back to the laboratory, analysis and final disposal of the sample. The chain-of-custody listed each of the



individual sample containers and was signed by one of the sampling team members. Samples were stored on ice at 4°C in a secure area until they are relinquished to an IAL courier for delivery to the laboratory.

#### **11.7 Laboratory Data Deliverable Format**

Full laboratory data deliverables have been included for the hexavalent chromium analysis performed. Reduced laboratory data deliverables have been included for all other analyses. Laboratory data packages are included as **Appendix I** and Electronic Data Deliverables are included as **Appendix J**.

It should be noted that in accordance with 7:26E-2.1 15 the submittal of Full Laboratory Data Deliverables is not required for hexavalent chromium ground water samples.

#### **11.8 Data Validation**

The laboratory deliverables were reviewed by Environmental Quality Assurance, Inc. (EQA) of Middletown, New York in accordance with appropriate NJDEP and EPA protocols. EQA did not identify data quality issues in respect to the usability of the ground water sample results. Data validation packages are provided in **Appendix M**.

## 12.0 UPDATED RECEPTOR EVALUATION

Results of the Initial Receptor Evaluation did not identify sensitive receptors which warranted further investigation and/or mitigation.

Re-evaluation of the Updated Receptor Evaluation Form submitted as part of the June 2016 Remedial Action Report – Soil Former Morris Canal (AOC-1), Chromium Site 121 (AOC-2) and Chromium Site 207 (AOC-3) did not identify new or unknown sensitive receptors which warranted investigation. The Updated Receptor Evaluation Form is provided as **Attachment C** of this report.

## 13.0 TECHNICAL OVERVIEW

### 13.1 Data Quality Assessment

The field and laboratory data collected pursuant to the NJDEP-Approved RAW were reviewed for conformance with the NJDEP's Technical Requirements for Site Remediation, N.J.A.C. 7:26E and the NJDEP's Field Sampling Procedures Manual (August 2005). During the review process, field sampling documentation, Chain-of-Custody Forms, analytical methodology, detection limits, the results of field quality control samples, and laboratory QA documentation were reviewed to assess the overall reliability of the field and analytical data.

Integrated Analytical Laboratories provided a Sample Delivery Group Case Narrative for each event.

#### January 2014 – Sample Delivery Group Case Narrative

Samples were received in good condition with documentation in order. Cooler temperature was acceptable at  $4^{\circ} \pm 2^{\circ}\text{C}$ .

- The Calibration Curve Linearity met criteria
- Internal Standard Recovery met criteria
- LCS Percent Recovery met criteria
- MS Percent Recoveries met criteria
- Serial Dilution/Post Spike results met criteria
- Digestion Holding Time met requirement for each sample
- Analysis Holding Time met requirement for each sample
- Samples were analyzed as a straight run and no further dilutions were required

#### January 2015 – Sample Delivery Group Case Narrative

Samples were received in good condition with documentation in order. Cooler temperature was acceptable at  $4^{\circ} \pm 2^{\circ}\text{C}$ .

- The Calibration Curve Linearity met criteria
- Internal Standard Recovery met criteria
- LCS Percent Recovery met criteria
- MS Percent Recoveries met criteria
- Serial Dilution/Post Spike results met criteria
- Digestion Holding Time met requirement for each sample
- Analysis Holding Time met requirement for each sample
- Samples were analyzed as a straight run and no further dilutions were required

#### May 2015 – Sample Delivery Group Case Narrative

Samples were received in good condition with documentation in order. Cooler temperature was acceptable at  $4^{\circ} \pm 2^{\circ}\text{C}$ .

- The Calibration Curve Linearity met criteria
- Internal Standard Recovery met criteria
- LCS Percent Recovery met criteria
- MS Percent Recoveries met criteria
- Serial Dilution/Post Spike results met criteria
- Digestion Holding Time met requirement for each sample
- Analysis Holding Time met requirement for each sample
- Samples were analyzed as a straight run and no further dilutions were required

## February 2018 – Sample Delivery Group Case Narrative

Samples were received in good condition with documentation in order. Cooler temperature was acceptable at  $4^{\circ} \pm 2^{\circ}\text{C}$ .

- The Calibration Curve Linearity met criteria
- Internal Standard Recovery met criteria
- LCS Percent Recovery met criteria
- MS Percent Recoveries met criteria
- Serial Dilution/Post Spike results met criteria
- Digestion Holding Time met requirement for each sample
- Analysis Holding Time met requirement for each sample
- Samples were analyzed as a straight run and no further dilutions were required

As previously discussed validation of laboratory deliverables was performed by Environmental Quality Assurance, Inc. (EQA) of Middletown, New York in accordance with appropriate NJDEP and EPA protocols and are provided as **Appendix M**.

### **13.2 Usability of Laboratory Analytical Data**

Data validation did not identify any data that did not meet the usability criteria.

#### **14.0 DEVIATION AND VARIATIONS FROM THE TECHNICAL REGULATIONS/GUIDANCE**

No deviations or variations from the technical regulations were conducted.

## **15.0 CONCLUSIONS AND RECOMMENDATIONS**

### **AOC-1 Former Morris Canal**

Groundwater screening samples were collected from piezometers and monitoring wells prior to soil remediation at the Site. These pre-remediation samples showed evidence of ground water impacts for hexavalent chromium and CCPW metals. Additional ground water samples from shallow and intermediate monitoring wells were collected after soil remediation was completed and these samples show that the ground water meets NJDEP Ground Water Quality Standards. The ground water investigations are concluded through the performance of two rounds of compliant ground water samples within the shallow water bearing zone and one round of compliant ground water samples conducted within the intermediate water bearing zone. In both instances, no contaminants of concern were detected at concentrations exceeding NJDEP's GWQC. Therefore, no further investigation of ground water is recommended for this AOC.

### **AOC-2 Chromium Site 121**

As discussed, no further remedial actions within Chromium Site 121 was recommended, as there were no CCPW-related Metals within ground water at concentrations above the NJDEP GWQS; and the soils remaining, after the remedial excavation had been completed were compliant with the NJDEP DIGWSSL. Therefore, no further remedial actions are recommended for this AOC.

### **AOC-3 Chromium Site 207**

As discussed in Section 9.0, no further remedial investigation for ground water within Chromium Site 207 was recommended, as there were no CCPW-related Metals within ground water at concentrations above the NJDEP GWQS; and the soils remaining, after the remedial excavation had been completed were compliant with the NJDEP DIGWSSL when subjected to compliance averaging analysis. Therefore, no further remedial actions are recommended for this AOC.

Based upon the above it is recommended that an unrestricted Use Area of Concern Specific Response Action Outcome be issued for AOC-1 Former Morris Canal, AOC-2 Chromium Site 121 and AOC-3 Chromium Site 207.

It should be noted that monitoring wells MW-CR-1 through MW-CR-4 and MW-CR-3i should be incorporated into the ground water sampling program of the Responsible Party (RP) for Chromium Site 114 and/or NJDEP Orphan Site #2 [aka Sludge Line 2].

## 16.0 REFERENCES

1. New Jersey Department of Environmental Protection (NJDEP), November 2009. Administrative Requirements for the Remediation of Contaminated Sites (ARRCS), N.J.A.C. 7:26C et. seq., adopted November 4, 2009, last amended May 7, 2012.
2. NJDEP, Ground Water Quality Standards, N.J.A.C. 7:9C, last amended January 16, 2018.
3. NJDEP, Remediation Standards, N.J.A.C. 7:26D et. seq., last amended September 18, 2017.
4. NJDEP, Chromium Soil Cleanup Criteria, September 2008 revised April 2010.
5. NJDEP, NJDEP Commissioner Jackson's February 8, 2007 Memorandum Regarding Chromium Moratorium, February 2007.
6. NJDEP, Field Sampling Procedures Manual, August 2005 revised April 20, 2009.
7. NJDEP, Technical Requirements for Site Remediation, N.J.A.C. 7:26E-2.2 et. seq., date last amended May 7, 2012.
8. NJDEP Soil Cleanup Criteria, last revised May 1999.
9. NJDEP SRP Alternative and Clean Fill Guidance for SRP Sites, Updated December 29, 2011, Version 2.0
10. NJDEP SRP Remedial Action Permits for Soils Guidance, dated February 24, 2010, Version 0.0
11. Stanford, E.D. et al., New Jersey Geological Survey Glacial Map, 1990
12. USGS Bedrock Geology Map of Northern New Jersey, 1996
13. USGS, dated 2002, Jersey City-NJ-NY Jersey City Quadrangle. 7.5 Minute Series. Topographic Map
14. AECOM, 2010, Field Sampling Plan-Quality Assurance Field Sampling Plan / Quality Assurance Project Plan Non-Residential Chromium Sites, Hudson County, New Jersey.
15. AECOM, June 2010 Draft Remedial Investigation Workplan, Non-Residential Chromate Chemical Production Waste Sites, Sites 114, 121, 132, 133, 135, 137, 143, 186, 207 and Berry Lane Park Area Jersey City, New Jersey
16. Dresdner Robin, September 2010. Site Investigation Workplan, Morris Canal - Berry Lane Park, Jersey City, NJ 07302
17. Dresdner Robin, February 2011. Site Investigation Report, Morris Canal - Berry Lane Park, Jersey City, NJ 07302
18. Dresdner Robin, January 2012. Remedial Investigation Report and Remedial Action Workplan, Morris Canal, Chromium Sites 121 and 207- Berry Lane Park, Jersey City, NJ 07302
19. NJDEP September 2012 Technical Guidance for the Attainment of Remediation Standards and Site-Specific Criteria, Version 1.0

# TABLES



**Table 1**  
**Ground Water Sample Summary**  
**Former Morris Canal**

MW ID	Water Sample ID	Sample Depth feet bgs	Sampling Method	Analytical Parameters
Jan-14				
MW-CR-1	MW-CR-1A	12.5	Grab	CCPW Metals
	MW-CR-1B	17.5	Grab	CCPW Metals
	MW-CR-1C	22.5	Grab	CCPW Metals
MW-CR-2	MW-CR-2A	13.0	Grab	CCPW Metals
	MW-CR-2B	18.0	Grab	CCPW Metals
	MW-CR-2C	23.0	Grab	CCPW Metals
MW-CR-3	MW-CR-3A	14.0	Grab	CCPW Metals
	MW-CR-3B	18.0	Grab	CCPW Metals
	MW-CR-3C	23.0	Grab	CCPW Metals
MW-CR-4	MW-CR-4A	11.0	Grab	CCPW Metals
	MW-CR-4B	16.0	Grab	CCPW Metals
	MW-CR-4C	21.0	Grab	CCPW Metals
MW-CR-5	MW-CR-5A	9.0	Grab	CCPW Metals
	MW-CR-5B	13.0	Grab	CCPW Metals
	MW-CR-5C	18.0	Grab	CCPW Metals
MW-CR-6	MW-CR-6A	11.0	Grab	CCPW Metals
	MW-CR-6B	15.5	Grab	CCPW Metals
	MW-CR-6C	20.5	Grab	CCPW Metals
MW-CR-7	MW-CR-7A	8.0	Grab	CCPW Metals
	MW-CR-7B	13.0	Grab	CCPW Metals
	MW-CR-7C	18.0	Grab	CCPW Metals
MW-CR-8	MW-CR-8A	10.0	Grab	CCPW Metals
	MW-CR-8B	15.0	Grab	CCPW Metals
	MW-CR-8C	20.0	Grab	CCPW Metals
Jan-15				
MW-CR-1	MW-CR-1A	12.5	Grab	CCPW Metals, pH, Eh-mv
	MW-CR-1B	17.5	Grab	CCPW Metals, pH, Eh-mv
	MW-CR-1C	22.5	Grab	CCPW Metals, pH, Eh-mv
MW-CR-2	MW-CR-2A	13.0	Grab	CCPW Metals, pH, Eh-mv
	MW-CR-2B	18.0	Grab	CCPW Metals, pH, Eh-mv
	MW-CR-2C	23.0	Grab	CCPW Metals, pH, Eh-mv
MW-CR-3	MW-CR-3A	14.0	Grab	CCPW Metals, pH, Eh-mv
	MW-CR-3B	18.0	Grab	CCPW Metals, pH, Eh-mv
	MW-CR-3C	23.0	Grab	CCPW Metals, pH, Eh-mv
MW-CR-4	MW-CR-4A	11.0	Grab	CCPW Metals, pH, Eh-mv
	MW-CR-4B	16.0	Grab	CCPW Metals, pH, Eh-mv
	MW-CR-4C	21.0	Grab	CCPW Metals, pH, Eh-mv
MW-CR-5	MW-CR-5A	9.0	Grab	CCPW Metals, pH, Eh-mv
	MW-CR-5B	13.0	Grab	CCPW Metals, pH, Eh-mv
	MW-CR-5C	18.0	Grab	CCPW Metals, pH, Eh-mv
MW-CR-6	MW-CR-6A	11.0	Grab	CCPW Metals, pH, Eh-mv
	MW-CR-6B	15.5	Grab	CCPW Metals, pH, Eh-mv
	MW-CR-6C	20.5	Grab	CCPW Metals, pH, Eh-mv
MW-CR-7	MW-CR-7A	8.0	Grab	CCPW Metals, pH, Eh-mv
	MW-CR-7B	13.0	Grab	CCPW Metals, pH, Eh-mv
	MW-CR-7C	18.0	Grab	CCPW Metals, pH, Eh-mv
MW-CR-8	MW-CR-8A	10.0	Grab	CCPW Metals, pH, Eh-mv
	MW-CR-8B	15.0	Grab	CCPW Metals, pH, Eh-mv
	MW-CR-8C	20.0	Grab	CCPW Metals, pH, Eh-mv

**Table 1**  
**Ground Water Sample Summary**  
**Former Morris Canal**

MW ID	Water Sample ID	Sample Depth feet bgs	Sampling Method	Analytical Parameters
May-15				
MW-CR-1	MW-CR-1A	12.5	Grab	Nickel only
	MW-CR-1B	17.5	Grab	Nickel only
	MW-CR-1C	22.5	Grab	Nickel only
MW-CR-2	MW-CR-2A	13.0	Grab	Nickel only
	MW-CR-2B	18.0	Grab	Nickel only
	MW-CR-2C	23.0	Grab	Nickel only
MW-CR-3	MW-CR-3A	14.0	Grab	Nickel only
	MW-CR-3B	18.0	Grab	Nickel only
	MW-CR-3C	23.0	Grab	Nickel only
MW-CR-4	MW-CR-4A	11.0	Grab	Nickel only
	MW-CR-4B	16.0	Grab	Nickel only
	MW-CR-4C	21.0	Grab	Nickel only
MW-CR-5	MW-CR-5A	9.0	Grab	Nickel only
	MW-CR-5B	13.0	Grab	Nickel only
	MW-CR-5C	18.0	Grab	Nickel only
MW-CR-6	MW-CR-6A	11.0	Grab	Nickel only
	MW-CR-6B	15.5	Grab	Nickel only
	MW-CR-6C	20.5	Grab	Nickel only
MW-CR-7	MW-CR-7A	8.0	Grab	Nickel only
	MW-CR-7B	13.0	Grab	Nickel only
	MW-CR-7C	18.0	Grab	Nickel only
MW-CR-8	MW-CR-8A	10.0	Grab	Nickel only
	MW-CR-8B	15.0	Grab	Nickel only
	MW-CR-8C	20.0	Grab	Nickel only
Feb-17				
MW-CR-3I	MW-CR-8IA	27.7	Grab	CCPW Metals, pH, Eh-mv
	MW-CR-8IB	33.7	Grab	CCPW Metals, pH, Eh-mv
MW-CR-7I	MW-CR-7IA	26.0	Grab	CCPW Metals, pH, Eh-mv
	MW-CR-7IB	32.0	Grab	CCPW Metals, pH, Eh-mv
MW-CR-8I	MW-CR-8IA	25.5	Grab	CCPW Metals, pH, Eh-mv
	MW-CR-8IB	35.5	Grab	CCPW Metals, pH, Eh-mv

Notes:

CCPW Metals - Chromate Chemical Production Waste Metals

bgs. - below ground surface

**Table 2**  
**Ground Water Sample Analytical Results**  
**January 2014**  
**Former Morris Canal**

Sample #:	Lab ID:	Date Sampled:	Depth(ft):																													
				GWQS				GWQS				GWQS				GWQS				GWQS				GWQS								
				Antimony	6			Chromium	70			Nickel	100			Thallium	2			Vanadium	NS			Hexavalent Chromium	NS							
				Conc	Q	RL	MDL	Conc	Q	RL	MDL	Conc	Q	RL	MDL	Conc	Q	RL	MDL	Conc	Q	RL	MDL	Conc	Q	RL	MDL					
MW-CR-1A*	00370-001	01/14/2014	12.5	1.03	J	2.00	1.00	11.6		2.00	2.00	13.9		2.00	1.00	ND		2.00	0.500	ND		2.00	2.00	ND		2.00	2.00	ND		10.0	4.00	
MW-CR-1B*	00370-002	01/14/2014	17.5	1.00	J	2.00	1.00	11.2		2.00	2.00	12.5		2.00	1.00	ND		2.00	0.500	2.10		2.00	2.00	ND		2.00	2.00	ND		10.0	4.00	
MW-CR-1C*	00370-003	01/14/2014	22.5	ND		2.00	1.00	6.84		2.00	2.00	9.73		2.00	1.00	ND		2.00	0.500	ND		2.00	2.00	ND		2.00	2.00	ND		10.0	4.00	
MW-CR-2A*	00370-004	01/14/2014	13.0	ND		2.00	1.00	3.13		2.00	2.00	104		2.00	1.00	ND		2.00	0.500	29.3		2.00	2.00	ND		2.00	2.00	ND		10.0	4.00	
MW-CR-2B*	00370-005	01/14/2014	18.0	ND		2.00	1.00	4.63		2.00	2.00	86.1		2.00	1.00	ND		2.00	0.500	29.5		2.00	2.00	ND		2.00	2.00	ND		10.0	4.00	
MW-CR-2C*	00370-006	01/14/2014	23.0	ND		2.00	1.00	6.23		2.00	2.00	88.0		2.00	1.00	ND		2.00	0.500	29.9		2.00	2.00	ND		2.00	2.00	ND		10.0	4.00	
MW-CR-3A*	00370-008	01/14/2014	14.0	ND		2.00	1.00	18.1		2.00	2.00	97.8		2.00	1.00	ND		2.00	0.500	27.8		2.00	2.00	ND		2.00	2.00	ND		10.0	4.00	
MW-CR-3B*	00370-009	01/14/2014	18.0	ND		2.00	1.00	22.5		2.00	2.00	94.2		2.00	1.00	ND		2.00	0.500	27.9		2.00	2.00	ND		2.00	2.00	ND		10.0	4.00	
MW-CR-3C*	00370-010	01/14/2014	23.0	ND		2.00	1.00	27.3		2.00	2.00	93.7		2.00	1.00	ND		2.00	0.500	36.8		2.00	2.00	ND		2.00	2.00	ND		10.0	4.00	
MW-CR-4A	00410-001	01/15/2014	11.0	2.63		2.00	1.00	11.5		2.00	2.00	20.2		2.00	1.00	ND		2.00	0.500	4.05		2.00	2.00	ND		2.00	2.00	ND		10.0	4.00	
MW-CR-4B	00410-002	01/15/2014	16.0	1.96	J	2.00	1.00	9.48		2.00	2.00	18.0		2.00	1.00	ND		2.00	0.500	3.45		2.00	2.00	ND		2.00	2.00	ND		10.0	4.00	
MW-CR-4C	00410-003	01/15/2014	21.0	ND		2.00	1.00	6.07		2.00	2.00	18.2		2.00	1.00	ND		2.00	0.500	ND		2.00	2.00	ND		2.00	2.00	ND		10.0	4.00	
MW-CR-5A	00410-004	01/15/2014	9.0	1.31	J	2.00	1.00	9.73		2.00	2.00	106		2.00	1.00	ND		2.00	0.500	51.8		2.00	2.00	ND		2.00	2.00	ND		10.0	4.00	
MW-CR-5B	00410-005	01/15/2014	13.0	1.16	J	2.00	1.00	3.37		2.00	2.00	99.1		2.00	1.00	ND		2.00	0.500	49.9		2.00	2.00	ND		2.00	2.00	ND		10.0	4.00	
MW-CR-5C	00410-006	01/15/2014	18.0	1.27	J	2.00	1.00	2.19		2.00	2.00	104		2.00	1.00	ND		2.00	0.500	52.7		2.00	2.00	ND		2.00	2.00	ND		10.0	4.00	
MW-CR-6A	00453-010	01/16/2014	11.0	ND		2.00	1.00	6.67		2.00	2.00	27.7		2.00	1.00	ND		2.00	0.500	13.6		2.00	2.00	ND		2.00	2.00	ND		10.0	4.00	
MW-CR-6B	00453-011	01/16/2014	15.5	ND		2.00	1.00	5.64		2.00	2.00	30.3		2.00	1.00	ND		2.00	0.500	13.9		2.00	2.00	ND		2.00	2.00	ND		10.0	4.00	
MW-CR-6C	00453-012	01/16/2014	20.5	ND		2.00	1.00	5.11		2.00	2.00	29.1		2.00	1.00	ND		2.00	0.500	13.6		2.00	2.00	ND		2.00	2.00	ND		10.0	4.00	
MW-CR-7A	00453-013	01/16/2014	8.0	ND		2.00	1.00	8.03		2.00	2.00	2.61		2.00	1.00	ND		2.00	0.500	6.96		2.00	2.00	ND		2.00	2.00	ND		10.0	4.00	
MW-CR-7B	00453-014	01/16/2014	13.0	ND		2.00	1.00	7.52		2.00	2.00	2.19		2.00	1.00	ND		2.00	0.500	6.50		2.00	2.00	ND		2.00	2.00	ND		10.0	4.00	
MW-CR-7C	00453-015	01/16/2014	18.0	ND		2.00	1.00	7.60		2.00	2.00	2.68		2.00	1.00	ND		2.00	0.500	6.32		2.00	2.00	ND		2.00	2.00	ND		10.0	4.00	
MW-CR-8A	00453-016	01/16/2014	10.0	1.40	J	2.00	1.00	6.55		2.00	2.00	23.2		2.00	1.00	ND		2.00	0.500	33.7		2.00	2.00	ND		2.00	2.00	ND		10.0	4.00	
MW-CR-8B	00453-017	01/16/2014	15.0	1.37	J	2.00	1.00	2.24		2.00	2.00	20.5		2.00	1.00	ND		2.00	0.500	33.2		2.00	2.00	ND		2.00	2.00	ND		10.0	4.00	
MW-CR-8C	00453-018	01/16/2014	20.0	1.57	J	2.00	1.00	2.26		2.00	2.00	23.5		2.00	1.00	ND		2.00	0.500	38.1		2.00	2.00	ND		2.00	2.00	ND		10.0	4.00	
REP-011614	00453-020	01/16/2014	-	1.61	J	2.00	1.00	ND		2.00	2.00	24.0		2.00	1.00	ND		2.00	0.500	38.5		2.00	2.00	ND		2.00	2.00	ND		10.0	4.00	
FB-01414	00453-020	01/14/2014	-	ND		2.00	1.00	ND		2.00	2.00	ND		2.00	1.00	ND		2.00	0.500	ND		2.00	2.00	~		2.00	2.00	~		~		~
FB-011514	00410-007	01/15/2014	-	ND		2.00	1.00	ND		2.00	2.00	ND		2.00	1.00	ND		2.00	0.500	ND		2.00	2.00	ND		2.00	2.00	ND		10.0	4.00	
FB-011614	00453-019	01/16/2014	-	ND		2.00	1.00	ND		2.00	2.00	ND		2.00	1.00	ND		2.00	0.500	ND		2.00	2.00	ND		2.00	2.00	ND		10.0	4.00	

**Notes:**

NJDEP Class II-A Specific Ground Water Quality Criteria : Ground Water Quality Standards N.J.A.C. 7:9C, Nov 2005

**BOLD** Indicates a concentration that exceeds the applicable criteria.

NS = No Standard Available

ND = Analyzed for but Not Detected at the MDL

J = Concentration detected at a value below the RL and above the MDL for target compounds.

~ = Sample not analyzed for

RL - Reporting Limit

MDL - Method Detection Limit

Conc - concentration in milligrams per Litre (ug/L)

\* Indicates that as acidified sampling containers were inadvertently utilized on 1/14/2014 for ground water samples MW-CR-1A, MW-CR-1B, MW-CR-1C, MW-CR-2A, MW-CR-2B, MW-CR-2C, MW-CR-3A, MW-CR-3B and MW-CR-3C for the analysis of hexavalent chromium these locations were resampled for hexavalent chromium analysis on 1/16/2014 (Lab ID: 00453-001 to 00453-009).

REP011614 collected from MW-CR-8C

**Table 3**  
**Ground Water Sample Analytical Results**  
**January 2015**  
**Former Morris Canal**

Sample #:	Lab ID:	Date Sampled:	Depth(ft):																										
				GWQS				GWQS				GWQS				GWQS				GWQS				GWQS					
				Antimony		6		Chromium		70		Nickel		100		Thallium		2		Vanadium		NS		Hexavalent Chromium		NS	pH/Corrosivity	Eh-mV	
				Conc	Q	RL	MDL	Conc	Q	RL	MDL	Conc	Q	RL	MDL	Conc	Q	RL	MDL	Conc	Q	RL	MDL	Conc	Q	RL	MDL	Conc	Conc
MW-CR-1A	00325-001	01/13/2015	12.5	1.39	J	2.00	1.00	2.44		2.00	2.00	9.85		2.00	1.00	ND		2.00	0.500	ND		2.00	2.00	ND		10.0	4.00	7.17	236
MW-CR-1B	00325-002	01/13/2015	17.5	1.63	J	2.00	1.00	4.19		2.00	2.00	11.7		2.00	1.00	ND		2.00	0.500	ND		2.00	2.00	ND		10.0	4.00	7.05	281
MW-CR-1C	00325-003	01/13/2015	22.5	2.02		2.00	1.00	4.67		2.00	2.00	12.6		2.00	1.00	ND		2.00	0.500	ND		2.00	2.00	ND		10.0	4.00	6.97	296
MW-CR-2A	00325-004	01/13/2015	13.0	1.48	J	2.00	1.00	3.61		2.00	2.00	45.0		2.00	1.00	ND		2.00	0.500	19.9		2.00	2.00	ND		10.0	4.00	9.49	249
MW-CR-2B	00325-005	01/13/2015	18.0	2.02		2.00	1.00	5.66		2.00	2.00	18.5		2.00	1.00	ND		2.00	0.500	6.97		2.00	2.00	ND		10.0	4.00	8.32	266
MW-CR-2C	00325-006	01/13/2015	23.0	2.22		2.00	1.00	7.23		2.00	2.00	20.5		2.00	1.00	ND		2.00	0.500	7.59		2.00	2.00	ND		10.0	4.00	8.16	275
MW-CR-3A	00325-009	01/13/2015	14.0	ND		2.00	1.00	2.33		2.00	2.00	42.3		2.00	1.00	ND		2.00	0.500	15.8		2.00	2.00	ND		10.0	4.00	11.7	180
MW-CR-3B	00325-010	01/13/2015	18.0	ND		2.00	1.00	2.61		2.00	2.00	42.0		2.00	1.00	ND		2.00	0.500	15.9		2.00	2.00	ND		10.0	4.00	11.7	173
MW-CR-3C	00325-011	01/13/2015	23.0	ND		2.00	1.00	10.1		2.00	2.00	45.3		2.00	1.00	ND		2.00	0.500	20.2		2.00	2.00	ND		10.0	4.00	11.7	169
MW-CR-4A	00325-012	01/13/2015	11.0	ND		2.00	1.00	2.32		2.00	2.00	14.1		2.00	1.00	ND		2.00	0.500	ND		2.00	2.00	ND		10.0	4.00	7.48	350
MW-CR-4B	00325-013	01/13/2015	16.0	ND		2.00	1.00	2.36		2.00	2.00	12.0		2.00	1.00	ND		2.00	0.500	2.09		2.00	2.00	ND		10.0	4.00	7.33	361
MW-CR-4C	00325-014	01/13/2015	21.0	ND		2.00	1.00	ND		2.00	2.00	12.3		2.00	1.00	ND		2.00	0.500	ND		2.00	2.00	ND		10.0	4.00	7.23	365
MW-CR-5A	00366-001	01/14/2015	9.0	1.35	J	2.00	1.00	2.63		2.00	2.00	60.7		2.00	1.00	ND		2.00	0.500	5.58		2.00	2.00	ND		10.0	4.00	10.6	323
MW-CR-5B	00366-002	01/14/2015	13.0	1.39	J	2.00	1.00	ND		2.00	2.00	59.7		2.00	1.00	ND		2.00	0.500	5.37		2.00	2.00	ND		10.0	4.00	10.8	282
MW-CR-5C	00366-003	01/14/2015	18.0	1.41	J	2.00	1.00	ND		2.00	2.00	62.3		2.00	1.00	ND		2.00	0.500	5.93		2.00	2.00	ND		10.0	4.00	10.8	272
MW-CR-6A	00366-004	01/14/2015	11.0	2.17		2.00	1.00	ND		2.00	2.00	8.02		2.00	1.00	ND		2.00	0.500	ND		2.00	2.00	ND		10.0	4.00	10.9	282
MW-CR-6B	00366-005	01/14/2015	15.5	2.15		2.00	1.00	ND		2.00	2.00	8.31		2.00	1.00	ND		2.00	0.500	ND		2.00	2.00	ND		10.0	4.00	10.9	276
MW-CR-6C	00366-006	01/14/2015	20.5	2.02		2.00	1.00	ND		2.00	2.00	8.50		2.00	1.00	ND		2.00	0.500	ND		2.00	2.00	ND		10.0	4.00	10.9	266
MW-CR-7A	00366-009	01/14/2015	8.0	1.30	J	2.00	1.00	29.0		2.00	2.00	27.1		2.00	1.00	ND		2.00	0.500	11.7		2.00	2.00	ND		10.0	4.00	8.15	340
MW-CR-7B	00366-010	01/14/2015	13.0	1.02	J	2.00	1.00	20.2		2.00	2.00	15.4		2.00	1.00	ND		2.00	0.500	8.45		2.00	2.00	ND		10.0	4.00	7.86	347
MW-CR-7C	00366-011	01/14/2015	18.0	1.01	J	2.00	1.00	21.5		2.00	2.00	17.3		2.00	1.00	ND		2.00	0.500	8.67		2.00	2.00	ND		10.0	4.00	7.91	355
MW-CR-8A	00366-012	01/14/2015	10.0	1.08	J	2.00	1.00	ND		2.00	2.00	3.92		2.00	1.00	ND		2.00	0.500	2.19		2.00	2.00	ND		10.0	4.00	7.63	367
MW-CR-8B	00366-013	01/14/2015	15.0	1.14	J	2.00	1.00	ND		2.00	2.00	3.80		2.00	1.00	ND		2.00	0.500	2.31		2.00	2.00	ND		10.0	4.00	7.57	368
MW-CR-8C	00366-014	01/14/2015	20.0	1.31	J	2.00	1.00	3.42		2.00	2.00	4.81		2.00	1.00	ND		2.00	0.500	3.28		2.00	2.00	ND		10.0	4.00	7.53	371
FB-011315	00325-007	01/13/2015	-	ND		2.00	1.00	ND		2.00	2.00	ND		2.00	1.00	ND		2.00	0.500	ND		2.00	2.00	ND		10.0	4.00	7.40	410
DUP-011315	00325-008	01/13/2015	-	1.87	J	2.00	1.00	4.54		2.00	2.00	12.8		2.00	1.00	ND		2.00	0.500	ND		2.00	2.00	ND		10.0	4.00	6.80	377
FB-011415	00366-007	01/14/2015	-	ND		2.00	1.00	ND		2.00	2.00	ND		2.00	1.00	ND		2.00	0.500	ND		2.00	2.00	ND		10.0	4.00	5.54	432
DUP-011415	00366-008	01/14/2015	-	1.36	J	2.00	1.00	2.58		2.00	2.00	61.6		2.00	1.00	ND		2.00	0.500	6.04		2.00	2.00	ND		10.0	4.00	10.8	270

Notes:

NJDEP Class II-A Specific Ground Water Quality Criteria : Ground Water Quality Standards M

**BOLD** on that exceeds the applicable criteria.

NS = No Standard Available

ND = Analyzed for but Not Detected at the MDL

J = Concentration detected at a value below the RL and above the MDL for target compounds.

RL - Reporting Limit

MDL - Method Detection Limit

Conc - concentration in milligrams per Litre (ug/L)

DUP011315 collected from MW-CR-1C

DUP011415 collected from MW-CR-5C

**Table 4**  
**Ground Water Sample Analytical Results**  
**April and May 2015**  
**Former Morris Canal**

Sample #:	Lab ID:	Date Sampled:	Depth(ft):	GWQS			
				Nickel	100		
				Conc	Q	RL	MDL
MW-CR-1A	03569-001	04/30/2015	12.5	9.04		2.00	1.00
MW-CR-1B	03569-002	04/30/2015	17.5	10.6		2.00	1.00
MW-CR-1C	03569-003	04/30/2015	22.5	10.6		2.00	1.00
MW-CR-2A	03569-004	04/30/2015	13.0	28.6		2.00	1.00
MW-CR-2B	03569-005	04/30/2015	18.0	22.8		2.00	1.00
MW-CR-2C	03569-006	04/30/2015	23.0	22.6		2.00	1.00
MW-CR-3A	03569-007	04/30/2015	14.0	48.6		2.00	1.00
MW-CR-3B	03569-008	04/30/2015	18.0	43.0		2.00	1.00
MW-CR-3C	03569-009	04/30/2015	23.0	44.3		2.00	1.00
MW-CR-4A	03569-010	04/30/2015	11.0	20.2		2.00	1.00
MW-CR-4B	03569-011	04/30/2015	16.0	20.6		2.00	1.00
MW-CR-4C	03569-012	04/30/2015	21.0	20.8		2.00	1.00
MW-CR-5A	03569-013	05/01/2015	9.0	58.9		2.00	1.00
MW-CR-5B	03569-014	05/01/2015	13.0	62.8		2.00	1.00
MW-CR-5C	03569-015	05/01/2015	18.0	66.2		2.00	1.00
MW-CR-6A	03569-016	05/01/2015	11.0	5.58		2.00	1.00
MW-CR-6B	03569-017	05/01/2015	15.5	9.23		2.00	1.00
MW-CR-6C	03569-018	05/01/2015	20.5	6.12		2.00	1.00
MW-CR-7A	03569-019	04/30/2015	8.0	21.5		2.00	1.00
MW-CR-7B	03569-020	04/30/2015	13.0	12.4		2.00	1.00
MW-CR-7C	03569-021	04/30/2015	18.0	11.6		2.00	1.00
MW-CR-8A	03569-022	04/30/2015	10.0	6.41		2.00	1.00
MW-CR-8B	03569-023	04/30/2015	15.0	6.08		2.00	1.00
MW-CR-8C	03569-024	04/30/2015	20.0	7.61		2.00	1.00
REP043015	03569-025	04/30/2015	-	44.4		2.00	1.00
FB043015	03569-026	04/30/2015	-	ND		2.00	1.00
REP050115	03569-027	05/01/2015	-	4.66		2.00	1.00
FB050115	03569-028	05/01/2015	-	ND		2.00	1.00

Notes:

[NJDEP Class II-A Specific Ground Water Quality Criteria : Ground Water Quality Standards N.J.A.C. 7:9C, Nov 2005](#)

**BOLD** Indicates a concentration that exceeds the applicable criteria.

NS = No Standard Available

ND = Analyzed for but Not Detected at the MDL

J = Concentration detected at a value below the RL and above the MDL for target compounds.

RL - Reporting Limit

MDL - Method Detection Limit

Conc - concentration in milligrams per Litre (ug/L)

REP043015 collected from MW-CR-3A

REP050115 collected from MW-CR-6A

**Table 5**  
**Ground Water Sample Analytical Results**  
**February 2018**  
**Former Morris Canal**

Sample #:	Lab ID:	Date Sampled:	Depth(ft):																												
				GWQC				GWQC				GWQC				GWQC				GWQC				GWQC				pH/Corrosivity-SU		Eh-mV	
				Antimony		Chromium		Nickel		Thallium		Vanadium		Hexavalent Chromium		NS															
				Conc	Q	RL	MDL	Conc	Q	RL	MDL	Conc	Q	RL	MDL	Conc	Q	RL	MDL	Conc	Q	RL	MDL	Conc	Q	RL	MDL	Conc	Q		
MW-CR3IA	01373-001	02/23/2018	27.7	ND		2.00	0.600	16.2		2.00	1.00	40.5		2.00	1.00	ND		2.00	0.400	16.2		2.00	0.800	ND		25.0	6.00	9.11	380		
MW-CR3IB	01373-002	02/23/2018	33.7	ND		2.00	0.600	38.8		2.00	1.00	54.7		2.00	1.00	ND		2.00	0.400	10.1		2.00	0.800	ND		25.0	6.00	8.30	371		
MW-CR7IA	01373-003	02/23/2018	26.0	ND		2.00	0.600	4.50		2.00	1.00	5.22		2.00	1.00	ND		2.00	0.400	17.7		2.00	0.800	ND		25.0	6.00	11.6	366		
MW-CR7IB	01373-004	02/23/2018	32.0	ND		2.00	0.600	3.58		2.00	1.00	5.14		2.00	1.00	ND		2.00	0.400	15.4		2.00	0.800	ND		25.0	6.00	11.4	323		
MW-CR8IA	01373-005	02/23/2018	25.5	ND		2.00	0.600	5.32		2.00	1.00	8.89		2.00	1.00	ND		2.00	0.400	1.10	J	2.00	0.800	ND		25.0	6.00	6.88	366		
MW-CR8IB	01373-006	02/23/2018	35.5	ND		2.00	0.600	11.0		2.00	1.00	18.9		2.00	1.00	ND		2.00	0.400	6.15		2.00	0.800	ND		25.0	6.00	7.03	367		
DUP022318	01373-007	02/23/2018	~	ND		2.00	0.600	4.11		2.00	1.00	5.30		2.00	1.00	ND		2.00	0.400	16.4		2.00	0.800	ND		25.0	6.00	11.6	305		
FB022318	01373-008	02/23/2018	~	ND		2.00	0.600	ND		2.00	1.00	ND		2.00	1.00	ND		2.00	0.400	ND		2.00	0.800	ND		25.0	6.00	6.98	307		

## Notes

NJDEP Class II-A Specific Ground Water Quality Criteria : Ground Water Quality Standards N.J.A.C. 7:9C, Nov 2005

**BOLD** Indicates a concentration that exceeds the applicable criteria

NS = No Standard Available

ND = Analyzed for but Not Detected at the MDL

J = Concentration detected at a value below the RL and above the MDL for target compounds.

RL - Reporting Limit

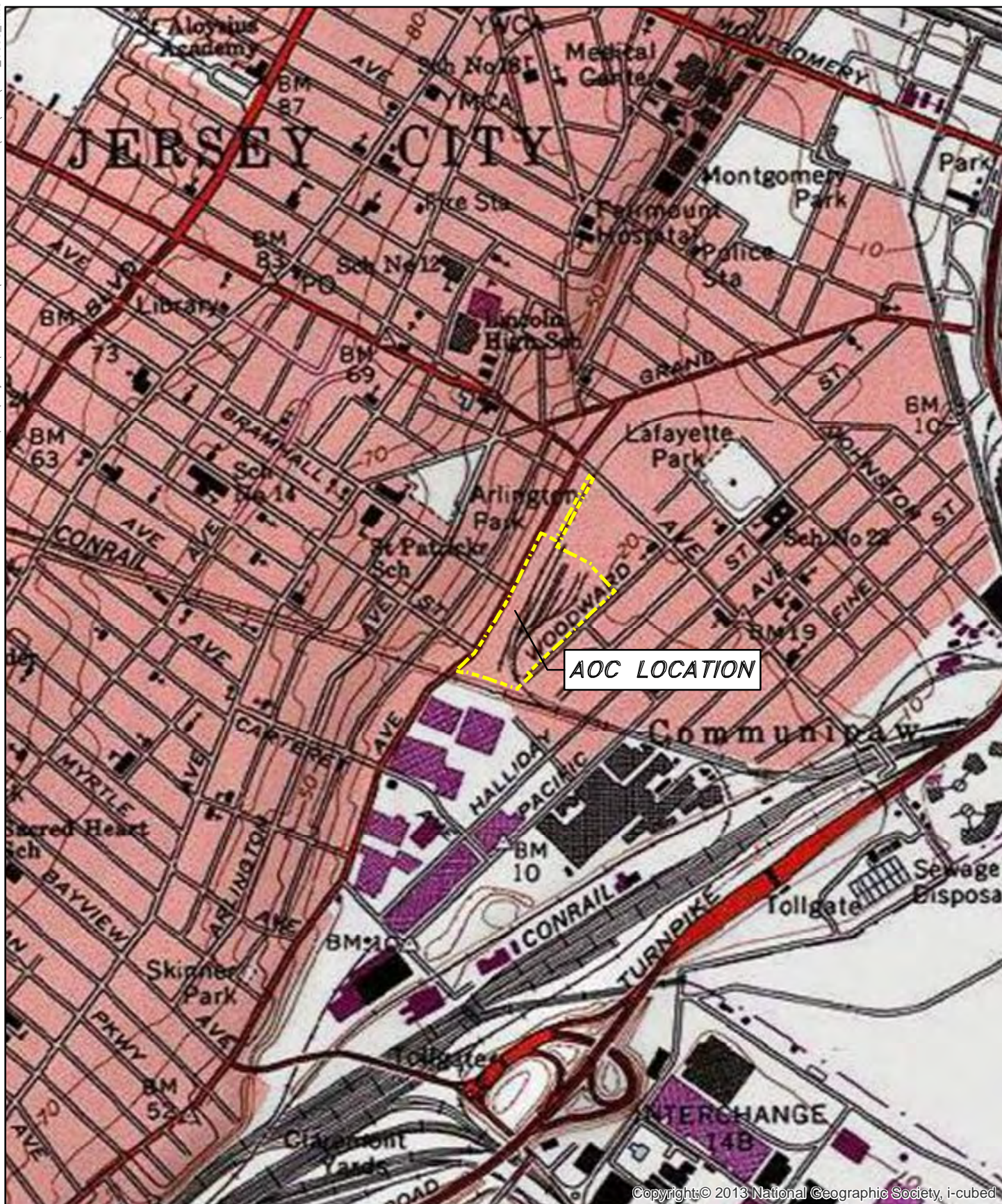
MDL - Method Detection Limit

Conc - concentration in milligrams per Litre (ug/L)

DUP022318 collected from MW-CR-71A

# FIGURES





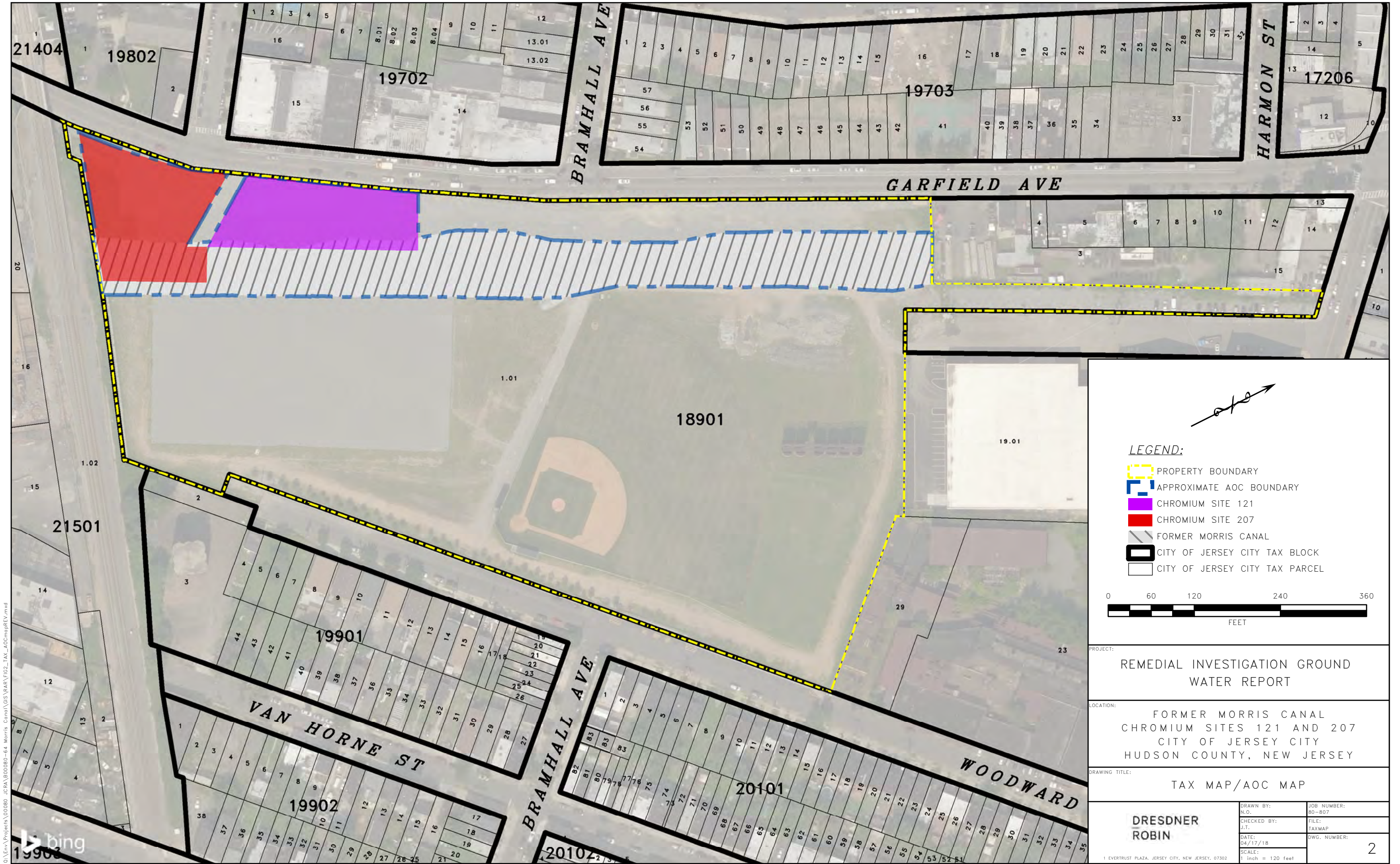
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REMEDIAL INVESTIGATION GROUND WATER REPORT  
FORMER MORRIS CANAL  
CHROMIUM SITES 121 AND 207  
CITY OF JERSEY CITY  
HUDSON COUNTY, NEW JERSEY

DRESDNER  
ROBIN

JOB NUMBER: 80-807  
FIGURE: 1





LEGEND:

- PROPERTY BOUNDARY
- APPROXIMATE AOC BOUNDARY
- CHROMIUM SITE 121
- CHROMIUM SITE 207
- FORMER MORRIS CANAL
- CITY OF JERSEY CITY TAX BLOCK
- CITY OF JERSEY CITY TAX PARCEL



PROJECT:  
REMEDIAL INVESTIGATION GROUND  
WATER REPORT

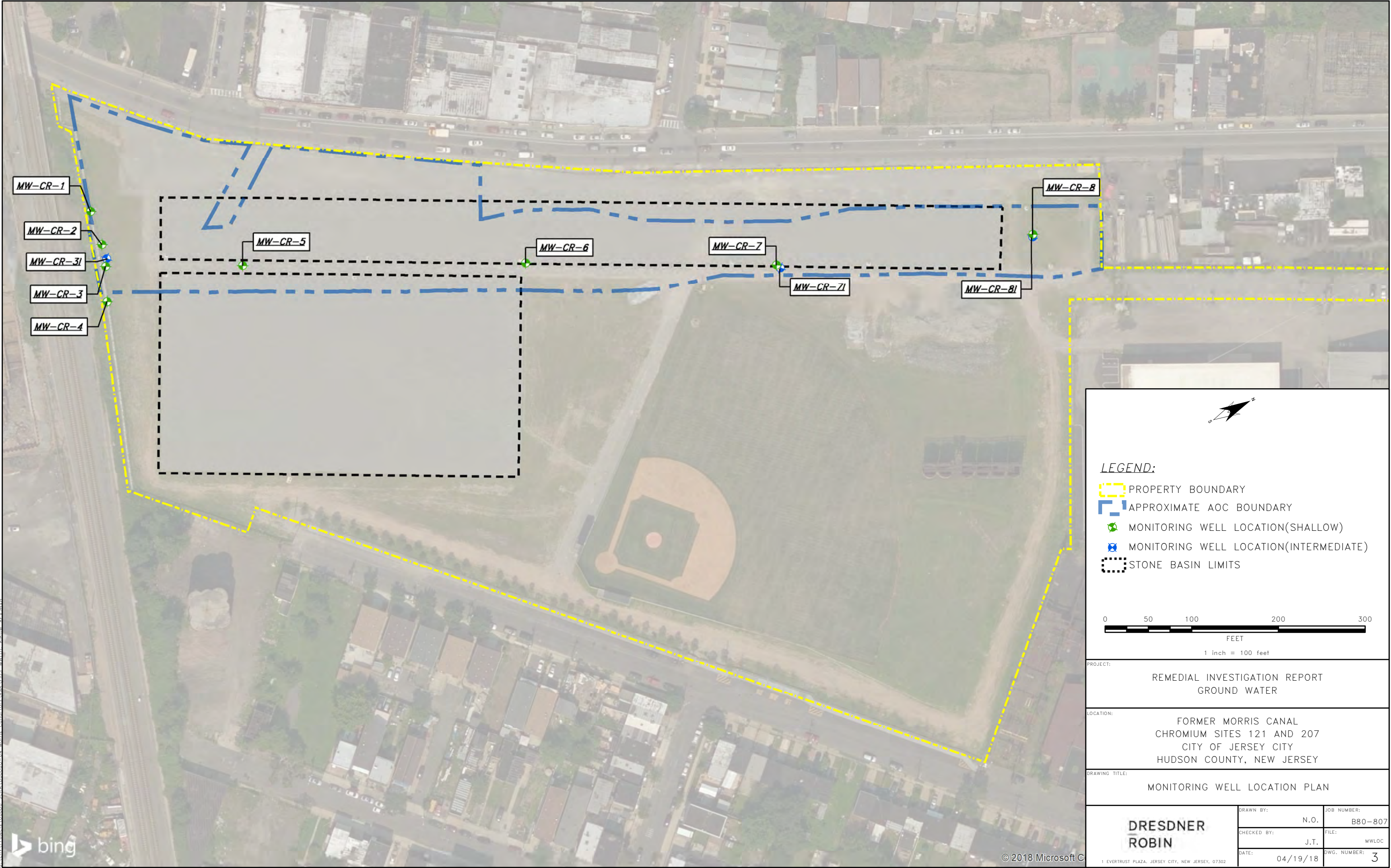
LOCATION:  
FORMER MORRIS CANAL  
CHROMIUM SITES 121 AND 207  
CITY OF JERSEY CITY  
HUDSON COUNTY, NEW JERSEY

DRAWING TITLE:  
TAX MAP/AOC MAP

DRESDNER  
ROBIN

DRAWN BY: N.O.	JOB NUMBER: 80-807
CHECKED BY: J.T.	FILE: TAXMAP
DATE: 04/17/18	DWG. NUMBER: 2
SCALE: 1 inch = 120 feet	





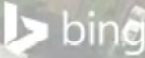
LEGEND:

- PROPERTY BOUNDARY
- APPROXIMATE AOC BOUNDARY
- MONITORING WELL LOCATION(SHALLOW)
- MONITORING WELL LOCATION(INTERMEDIATE)
- STONE BASIN LIMITS



PROJECT: REMEDIAL INVESTIGATION REPORT GROUND WATER		
LOCATION: FORMER MORRIS CANAL CHROMIUM SITES 121 AND 207 CITY OF JERSEY CITY HUDSON COUNTY, NEW JERSEY		
DRAWING TITLE: MONITORING WELL LOCATION PLAN		
<b>DRESDNER ROBIN</b>	DRAWN BY: N.O.	JOB NUMBER: B80-807
	CHECKED BY: J.T.	FILE: MWLOC
	DATE: 04/19/18	DWG. NUMBER: 3

\\na\Projects\00080 - CRA\B00080-64 Morris Canal\GIS\BAP\FIG3.MXD - R100 - REV.mxd



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REFERENCES: NEW JERSEY STATE OFFICE OF GIS, 2016; MICROSOFT VIRTUAL EARTH AERIAL 2017; NEW JERSEY DEPARTMENT OF TRANSPORTATION 2016.



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REFERENCES: NEW JERSEY STATE OFFICE OF GIS, 2016; MICROSOFT VIRTUAL EARTH AERIAL 2017; NEW JERSEY DEPARTMENT OF TRANSPORTATION 2016.

Monitoring Well ID	Date Sampled:	Field Sample ID	Pump Depth (ft)	pH/Corrosivity	Eh-mV	Antimony	Chromium	Nickel	Thallium	Vanadium	Hexavalent Chromium
						GWQS (6)	GWQS (70)	GWQS (100)	GWQS (2)	GWQS (NS)	GWQS (70)
						Conc. (ppb)	Conc. (ppb)	Conc. (ppb)	Conc. (ppb)	Conc. (ppb)	Conc. (ppb)
MW-CR-1	01/14/2014	MW-CR-1A	12.5	NA	NA	1.03 J	11.6	13.9	ND	ND	ND
	01/14/2014	MW-CR-1B	17.5	NA	NA	1.00 J	11.2	12.5	ND	2.10	ND
	01/14/2014	MW-CR-1C	22.5	NA	NA	ND	6.84	9.73	ND	ND	ND
	01/13/2015	MW-CR-1A	12.5	7.17	236	1.39 J	2.44	9.85	ND	ND	ND
	01/13/2015	MW-CR-1B	17.5	7.05	281	1.63 J	4.19	11.7	ND	ND	ND
	01/13/2015	MW-CR-1C	22.5	6.97	296	2.02	4.67	12.6	ND	ND	ND
	01/13/2015	DUP-011315	22.5	6.80	377	1.87 J	4.54	12.8	ND	ND	ND
	04/30/2015	MW-CR-1A	12.5	NA	NA	NA	NA	9.04	NA	NA	NA
	04/30/2015	MW-CR-1B	17.5	NA	NA	NA	NA	10.6	NA	NA	NA
	04/30/2015	MW-CR-1C	22.5	NA	NA	NA	NA	10.6	NA	NA	NA

Monitoring Well ID	Date Sampled:	Field Sample ID	Pump Depth (ft)	pH/Corrosivity	Eh-mV	Antimony	Chromium	Nickel	Thallium	Vanadium	Hexavalent Chromium
						GWQS (6)	GWQS (70)	GWQS (100)	GWQS (2)	GWQS (NS)	GWQS (70)
						Conc. (ppb)	Conc. (ppb)	Conc. (ppb)	Conc. (ppb)	Conc. (ppb)	Conc. (ppb)
MW-CR-5	01/15/2014	MW-CR-5A	9.0	NA	NA	1.31 J	9.73	106	ND	51.8	ND
	01/15/2014	MW-CR-5B	13.0	NA	NA	1.16 J	3.37	99.1	ND	49.9	ND
	01/15/2014	MW-CR-5C	18.0	NA	NA	1.27 J	2.19	104	ND	52.7	ND
	01/14/2015	MW-CR-5A	9.0	10.6	323	1.35 J	2.63	60.7	ND	5.58	ND
	01/14/2015	MW-CR-5B	13.0	10.8	282	1.39 J	ND	59.7	ND	5.37	ND
	01/14/2015	MW-CR-5C	18.0	10.8	272	1.41 J	ND	62.3	ND	5.93	ND
	01/14/2015	DUP-011415	18.0	10.8	270	1.36 J	2.58	61.6	ND	6.04	ND
	05/01/2015	MW-CR-5A	9.0	NA	NA	NA	NA	58.9	NA	NA	NA
	05/01/2015	MW-CR-5B	13.0	NA	NA	NA	NA	62.8	NA	NA	NA
	05/01/2015	MW-CR-5C	18.0	NA	NA	NA	NA	66.2	NA	NA	NA

Monitoring Well ID	Date Sampled:	Field Sample ID	Pump Depth (ft)	pH/Corrosivity	Eh-mV	Antimony	Chromium	Nickel	Thallium	Vanadium	Hexavalent Chromium
						GWQS (6)	GWQS (70)	GWQS (100)	GWQS (2)	GWQS (NS)	GWQS (70)
						Conc. (ppb)	Conc. (ppb)	Conc. (ppb)	Conc. (ppb)	Conc. (ppb)	Conc. (ppb)
MW-CR-8	01/16/2014	MW-CR-8A	10.0	NA	NA	1.40 J	6.55	23.2	ND	33.7	ND
	01/16/2014	MW-CR-8B	15.0	NA	NA	1.37 J	2.24	26.5	ND	33.2	ND
	01/16/2014	MW-CR-8C	20.0	NA	NA	1.57 J	2.26	23.5	ND	38.1	ND
	01/16/2014	REP-011614	20.0	NA	NA	1.61 J	ND	24.0	ND	38.5	ND
	01/14/2015	MW-CR-8A	10.0	7.63	367	1.08 J	ND	3.92	ND	2.19	ND
	01/14/2015	MW-CR-8B	15.0	7.57	368	1.14 J	ND	3.80	ND	2.31	ND
	01/14/2015	MW-CR-8C	20.0	7.53	371	1.31 J	3.42	4.81	ND	3.28	ND
	04/30/2015	MW-CR-8A	10.0	NA	NA	NA	NA	6.41	NA	NA	NA
	04/30/2015	MW-CR-8B	15.0	NA	NA	NA	NA	6.08	NA	NA	NA
	04/30/2015	MW-CR-8C	20.0	NA	NA	NA	NA	7.61	NA	NA	NA

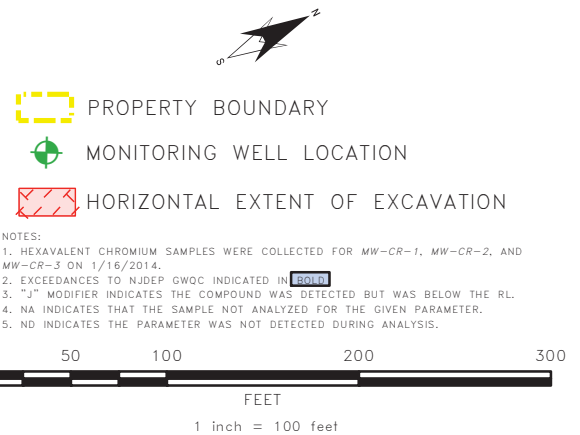
Monitoring Well ID	Date Sampled:	Field Sample ID	Pump Depth (ft)	pH/Corrosivity	Eh-mV	Antimony	Chromium	Nickel	Thallium	Vanadium	Hexavalent Chromium
						GWQS (6)	GWQS (70)	GWQS (100)	GWQS (2)	GWQS (NS)	GWQS (70)
						Conc. (ppb)	Conc. (ppb)	Conc. (ppb)	Conc. (ppb)	Conc. (ppb)	Conc. (ppb)
MW-CR-4	01/15/2014	MW-CR-4A	11.0	NA	NA	2.63	11.5	20.2	ND	4.05	ND
	01/15/2014	MW-CR-4B	16.0	NA	NA	1.96 J	9.48	18.0	ND	3.45	ND
	01/15/2014	MW-CR-4C	21.0	NA	NA	ND	6.07	18.2	ND	ND	ND
	01/13/2015	MW-CR-4A	11.0	7.48	350	ND	2.32	14.1	ND	ND	ND
	01/13/2015	MW-CR-4B	16.0	7.33	361	ND	2.36	12.0	ND	2.09	ND
	01/13/2015	MW-CR-4C	21.0	7.23	365	ND	ND	12.3	ND	ND	ND
	04/30/2015	MW-CR-4A	11.0	NA	NA	NA	NA	20.2	NA	NA	NA
	04/30/2015	MW-CR-4B	16.0	NA	NA	NA	NA	20.6	NA	NA	NA
	04/30/2015	MW-CR-4C	21.0	NA	NA	NA	NA	20.8	NA	NA	NA

Monitoring Well ID	Date Sampled:	Field Sample ID	Pump Depth (ft)	pH/Corrosivity	Eh-mV	Antimony	Chromium	Nickel	Thallium	Vanadium	Hexavalent Chromium
						GWQS (6)	GWQS (70)	GWQS (100)	GWQS (2)	GWQS (NS)	GWQS (70)
						Conc. (ppb)	Conc. (ppb)	Conc. (ppb)	Conc. (ppb)	Conc. (ppb)	Conc. (ppb)
MW-CR-6	01/16/2014	MW-CR-6A	11.0	NA	NA	ND	6.67	27.7	ND	13.6	ND
	01/16/2014	MW-CR-6B	15.5	NA	NA	ND	5.64	30.3	ND	13.9	ND
	01/16/2014	MW-CR-6C	20.5	NA	NA	ND	5.11	29.1	ND	13.6	ND
	01/14/2015	MW-CR-6A	11.0	10.9	282	2.17	ND	8.02	ND	ND	ND
	01/14/2015	MW-CR-6B	15.5	10.9	278	2.15	ND	8.31	ND	ND	ND
	01/14/2015	MW-CR-6C	20.5	10.9	289	2.02	ND	6.50	ND	ND	ND
	05/01/2015	MW-CR-6A	11.0	NA	NA	NA	NA	6.58	NA	NA	NA
	05/01/2015	REP050115	11.0	NA	NA	NA	NA	4.86	NA	NA	NA
	05/01/2015	MW-CR-6B	15.5	NA	NA	NA	NA	9.23	NA	NA	NA
	05/01/2015	MW-CR-6C	20.5	NA	NA	NA	NA	6.12	NA	NA	NA

Monitoring Well ID	Date Sampled:	Field Sample ID	Pump Depth (ft)	pH/Corrosivity	Eh-mV	Antimony	Chromium	Nickel	Thallium	Vanadium	Hexavalent Chromium
						GWQS (6)	GWQS (70)	GWQS (100)	GWQS (2)	GWQS (NS)	GWQS (70)
						Conc. (ppb)	Conc. (ppb)	Conc. (ppb)	Conc. (ppb)	Conc. (ppb)	Conc. (ppb)
MW-CR-7	01/16/2014	MW-CR-7A	8.0	NA	NA	ND	8.03	2.61	ND	6.96	ND
	01/16/2014	MW-CR-7B	13.0	NA	NA	ND	7.52	2.19	ND	6.50	ND
	01/16/2014	MW-CR-7C	18.0	NA	NA	ND	7.60	2.68	ND	6.32	ND
	01/14/2015	MW-CR-7A	8.0	8.15	340	1.30 J	29.0	27.1	ND	11.7	ND
	01/14/2015	MW-CR-7B	13.0	7.86	347	1.02 J	20.2	15.4	ND	8.46	ND
	01/14/2015	MW-CR-7C	18.0	7.91	355	1.01 J	21.5	17.3	ND	8.67	ND
	04/30/2015	MW-CR-7A	8.0	NA	NA	NA	NA	21.5	NA	NA	NA
	04/30/2015	MW-CR-7B	13.0	NA	NA	NA	NA	12.4	NA	NA	NA
	04/30/2015	MW-CR-7C	18.0	NA	NA	NA	NA	11.6	NA	NA	NA

Monitoring Well ID	Date Sampled:	Field Sample ID	Pump Depth (ft)	pH/Corrosivity	Eh-mV	Antimony	Chromium	Nickel	Thallium	Vanadium	Hexavalent Chromium
						GWQS (6)	GWQS (70)	GWQS (100)	GWQS (2)	GWQS (NS)	GWQS (70)
						Conc. (ppb)	Conc. (ppb)	Conc. (ppb)	Conc. (ppb)	Conc. (ppb)	Conc. (ppb)
MW-CR-3	01/14/2014	MW-CR-3A	14.0	NA	NA	ND	18.1	97.8	ND	27.8	ND
	01/14/2014	MW-CR-3B	18.0	NA	NA	ND	22.5	94.2	ND	27.9	ND
	01/14/2014	MW-CR-3C	23.0	NA	NA	ND	27.3	93.7	ND	36.8	ND
	01/13/2015	MW-CR-3A	14.0	11.7	180	ND	2.33	42.3	ND	15.8	ND
	01/13/2015	MW-CR-3B	18.0	11.7	173	ND	2.61	42.0	ND	15.9	ND
	01/13/2015	MW-CR-3C	23.0	11.7	169	ND	10.1	45.3	ND	20.2	ND
	04/30/2015	MW-CR-3A	14.0	NA	NA	NA	NA	48.6	NA	NA	NA
	04/30/2015	REP043015	14.0	NA	NA	NA	NA	44.4	NA	NA	NA
	04/30/2015	MW-CR-3B	18.0	NA	NA	NA	NA	43.0	NA	NA	NA
	04/30/2015	MW-CR-3C	23.0	NA	NA	NA	NA	44.3	NA	NA	NA

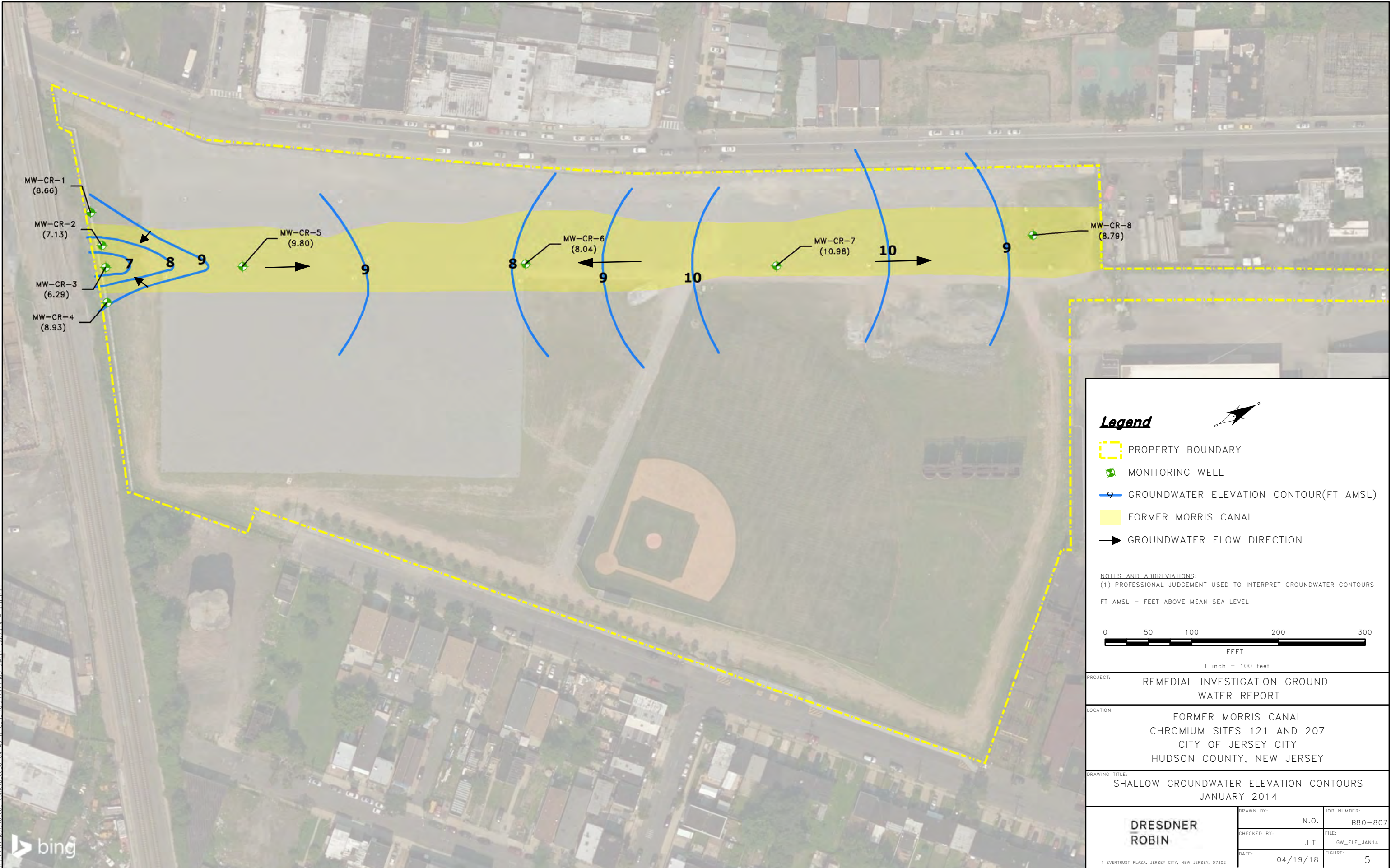
Monitoring Well ID	Date Sampled:	Field Sample ID	Pump Depth (ft)	pH/Corrosivity	Eh-mV	Antimony	Chromium	Nickel	Thallium	Vanadium	Hexavalent Chromium
						GWQS (6)	GWQS (70)	GWQS (100)	GWQS (2)	GWQS (NS)	GWQS (70)
						Conc. (ppb)	Conc. (ppb)	Conc. (ppb)	Conc. (ppb)	Conc. (ppb)	Conc. (ppb)
MW-CR-2	01/14/2014	MW-CR-2A	13.0	NA	NA	ND	3.13	104	ND	29.3	ND
	01/14/2014	MW-CR-2B	18.0	NA	NA	ND	4.63	86.1	ND	29.5	ND
	01/14/2014	MW-CR-2C	23.0	NA	NA	ND	6.23	88.0	ND	29.9	ND
	01/13/2015	MW-CR-2A	13.0	9.49	249	1.48 J	3.61	45.0	ND	19.9	ND
	01/13/2015	MW-CR-2B	18.0	8.32	266	2.02	5.66	18.5	ND	6.97	ND
	01/13/2015	MW-CR-2C	23.0	8.16	275	2.22	7.23	20.5	ND	7.59	ND
	04/30/2015	MW-CR-2A	13.0	NA	NA	NA	NA	28.6	NA	NA	NA
	04/30/2015	MW-CR-2B	18.0	NA	NA	NA	NA	22.8	NA	NA	NA
	04/30/2015	MW-CR-2C	23.0	NA	NA	NA	NA	22.6	NA	NA	NA



- NOTES:
1. HEXAVALENT CHROMIUM SAMPLES WERE COLLECTED FOR MW-CR-1, MW-CR-2, AND MW-CR-3 ON 1/16/2014.
  2. EXCEEDANCES TO NJDEP GWQC INDICATED IN **Blue**.
  3. "J" MODIFIER INDICATES THE COMPOUND WAS DETECTED BUT WAS BELOW THE RL.
  4. NA INDICATES THAT THE SAMPLE NOT ANALYZED FOR THE GIVEN PARAMETER.
  5. ND INDICATES THE PARAMETER WAS NOT DETECTED DURING ANALYSIS.

PROJECT:		REMEDIAL INVESTIGATION REPORT GROUND WATER	
LOCATION:		FORMER MORRIS CANAL CHROMIUM SITES 121 AND 207 CITY OF JERSEY CITY HUDSON COUNTY, NEW JERSEY	
DRAWING TITLE:		SHALLOW GROUND WATER SAMPLE RESULTS	
DRAWN BY:		N.O.	
CHECKED BY:		J.T.	
DATE:		7/18/2018	
JOB NUMBER:		B80-807	
FILE:		mw_result_060515	
DWG. NUMBER:		4	





**Legend**



- PROPERTY BOUNDARY
- MONITORING WELL
- GROUNDWATER ELEVATION CONTOUR(FT AMSL)
- FORMER MORRIS CANAL
- GROUNDWATER FLOW DIRECTION

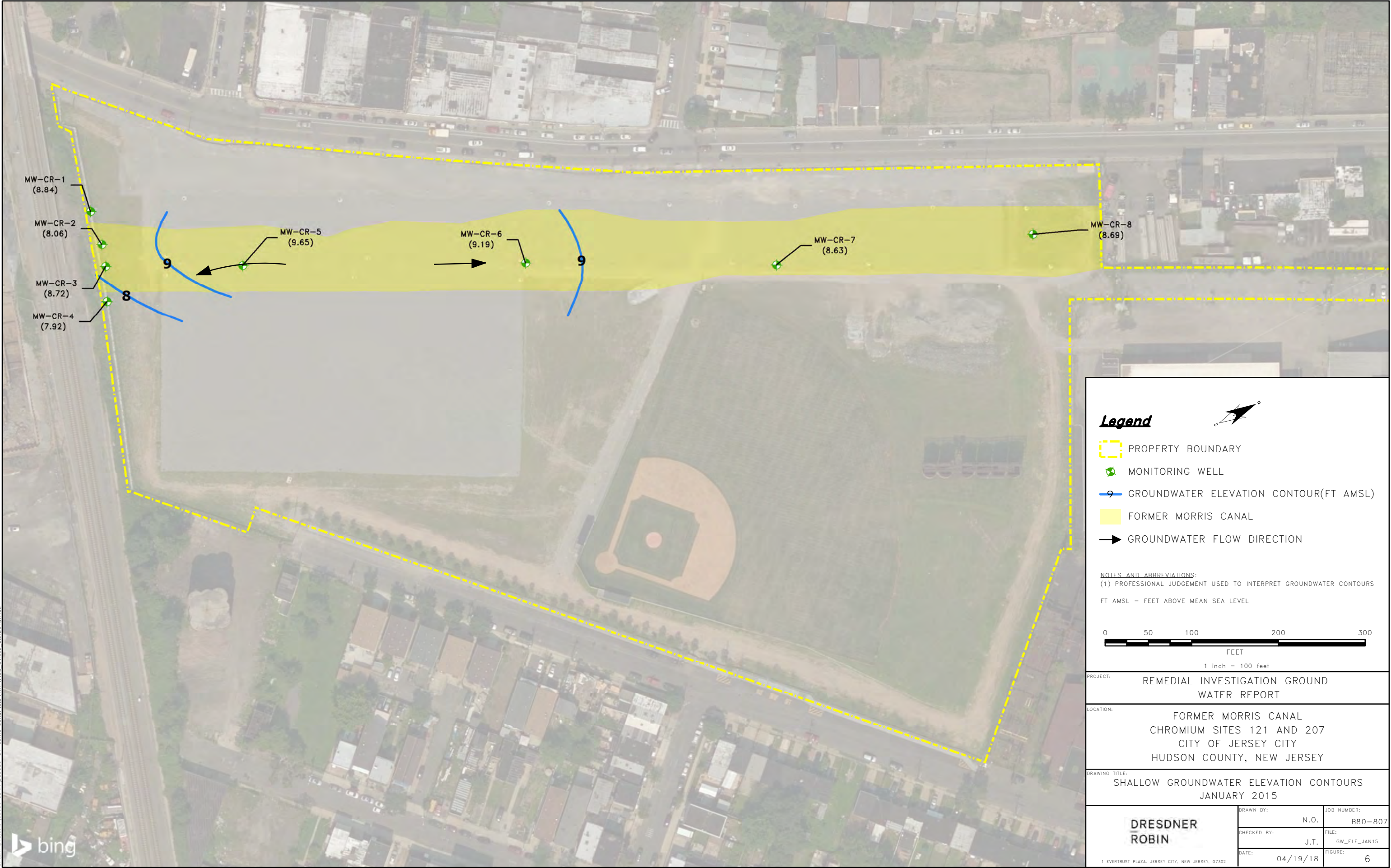
NOTES AND ABBREVIATIONS:  
(1) PROFESSIONAL JUDGEMENT USED TO INTERPRET GROUNDWATER CONTOURS  
FT AMSL = FEET ABOVE MEAN SEA LEVEL



PROJECT:	REMEDIAL INVESTIGATION GROUND WATER REPORT		
LOCATION:	FORMER MORRIS CANAL CHROMIUM SITES 121 AND 207 CITY OF JERSEY CITY HUDSON COUNTY, NEW JERSEY		
DRAWING TITLE:	SHALLOW GROUNDWATER ELEVATION CONTOURS JANUARY 2014		
	DRAWN BY:	N.O.	JOB NUMBER: B80-807
	CHECKED BY:	J.T.	FILE: GW_ELE_JAN14
	DATE:	04/19/18	FIGURE: 5

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MW-CR-1  
(8.84)  
MW-CR-2  
(8.06)  
MW-CR-3  
(8.72)  
MW-CR-4  
(7.92)

MW-CR-5  
(9.65)

MW-CR-6  
(9.19)

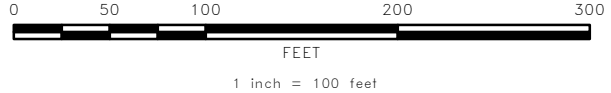
MW-CR-7  
(8.63)

MW-CR-8  
(8.69)

**Legend**

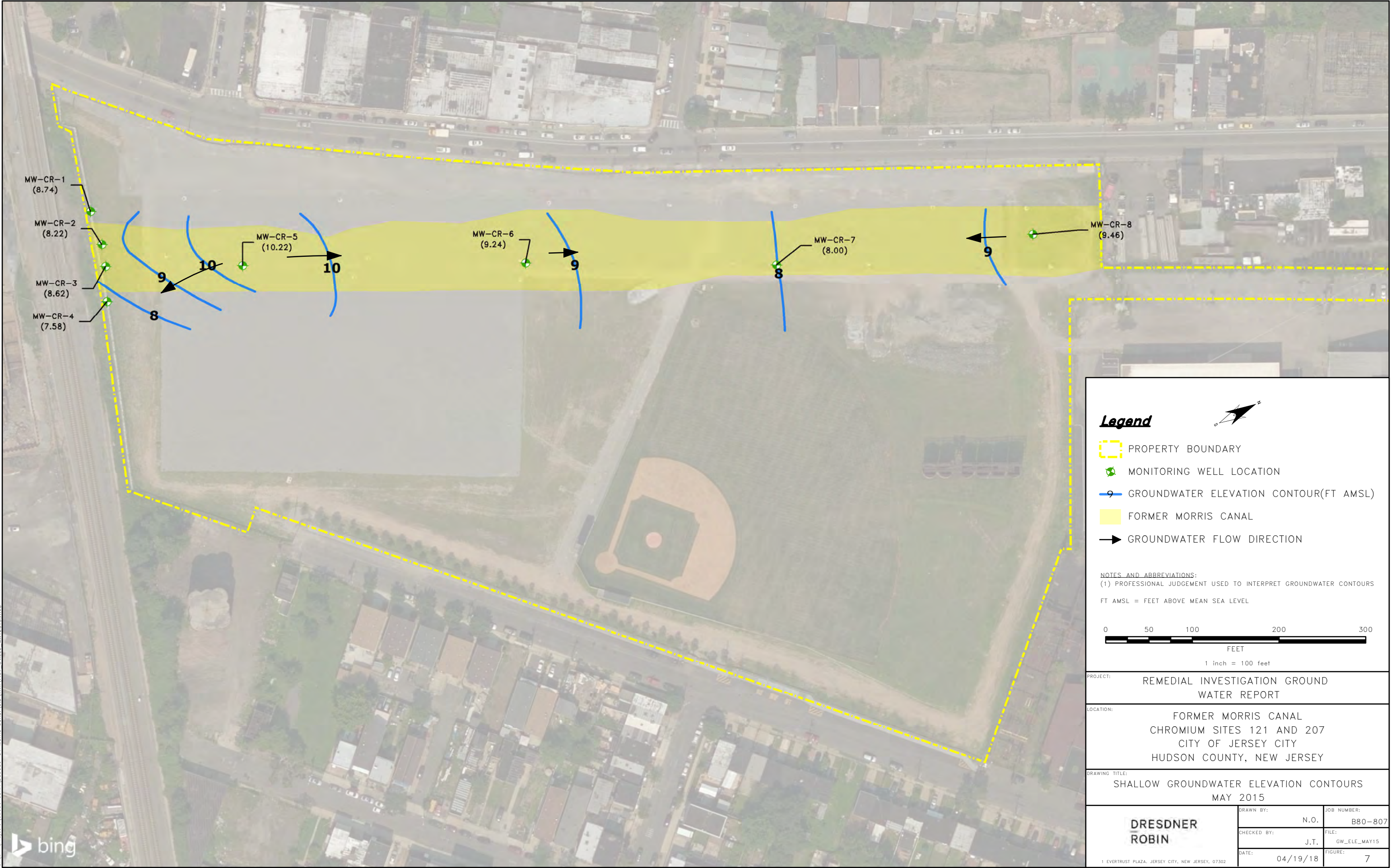
- PROPERTY BOUNDARY
- MONITORING WELL
- GROUNDWATER ELEVATION CONTOUR(FT AMSL)
- FORMER MORRIS CANAL
- GROUNDWATER FLOW DIRECTION

NOTES AND ABBREVIATIONS:  
(1) PROFESSIONAL JUDGEMENT USED TO INTERPRET GROUNDWATER CONTOURS  
FT AMSL = FEET ABOVE MEAN SEA LEVEL



PROJECT:	REMEDIAL INVESTIGATION GROUND WATER REPORT		
LOCATION:	FORMER MORRIS CANAL CHROMIUM SITES 121 AND 207 CITY OF JERSEY CITY HUDSON COUNTY, NEW JERSEY		
DRAWING TITLE:	SHALLOW GROUNDWATER ELEVATION CONTOURS JANUARY 2015		
<b>DRESDNER ROBIN</b>	DRAWN BY:	N.O.	JOB NUMBER: B80-807
	CHECKED BY:	J.T.	FILE: GW_ELE_JAN15
	DATE:	04/19/18	FIGURE: 6

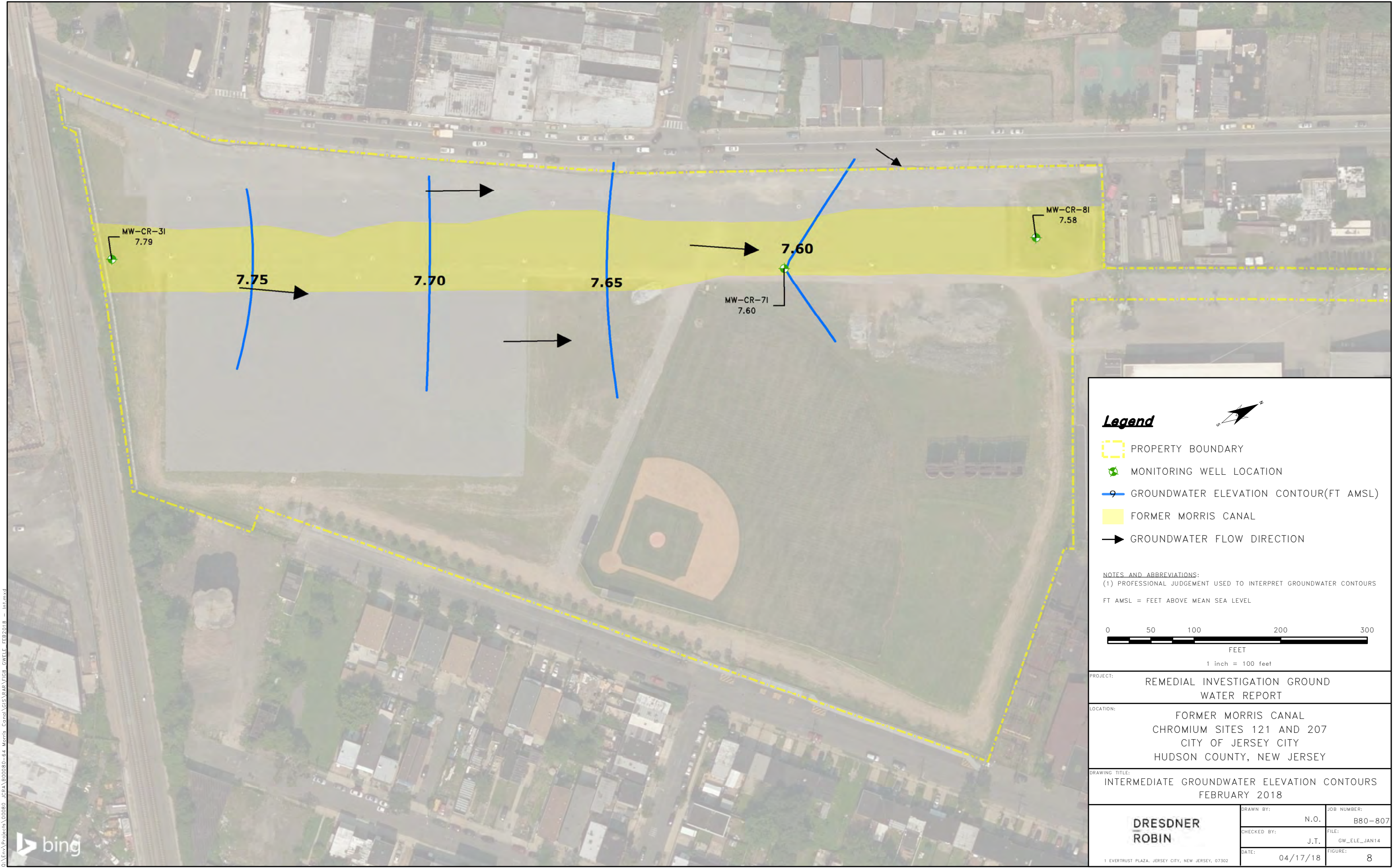




G:\Envi\Projects\00080\_JCDA\B00080-64\_Morris\_Canal\GIS\PAR\FIG7\_GW\_ELE\_MAY2015.mxd

REFERENCES: NEW JERSEY STATE OFFICE OF GIS, 2016; MICROSOFT VIRTUAL EARTH AERIAL 2016; NEW JERSEY DEPARTMENT OF TRANSPORTATION 2016; "MAJOR SUBDIVISION" DRAWING PREPARED BY DRESDNER ROBIN, 2015.





**Legend**



- PROPERTY BOUNDARY
- MONITORING WELL LOCATION
- GROUNDWATER ELEVATION CONTOUR(FT AMSL)
- FORMER MORRIS CANAL
- GROUNDWATER FLOW DIRECTION

NOTES AND ABBREVIATIONS:  
(1) PROFESSIONAL JUDGEMENT USED TO INTERPRET GROUNDWATER CONTOURS  
FT AMSL = FEET ABOVE MEAN SEA LEVEL



PROJECT: REMEDIAL INVESTIGATION GROUND WATER REPORT

LOCATION: FORMER MORRIS CANAL  
CHROMIUM SITES 121 AND 207  
CITY OF JERSEY CITY  
HUDSON COUNTY, NEW JERSEY

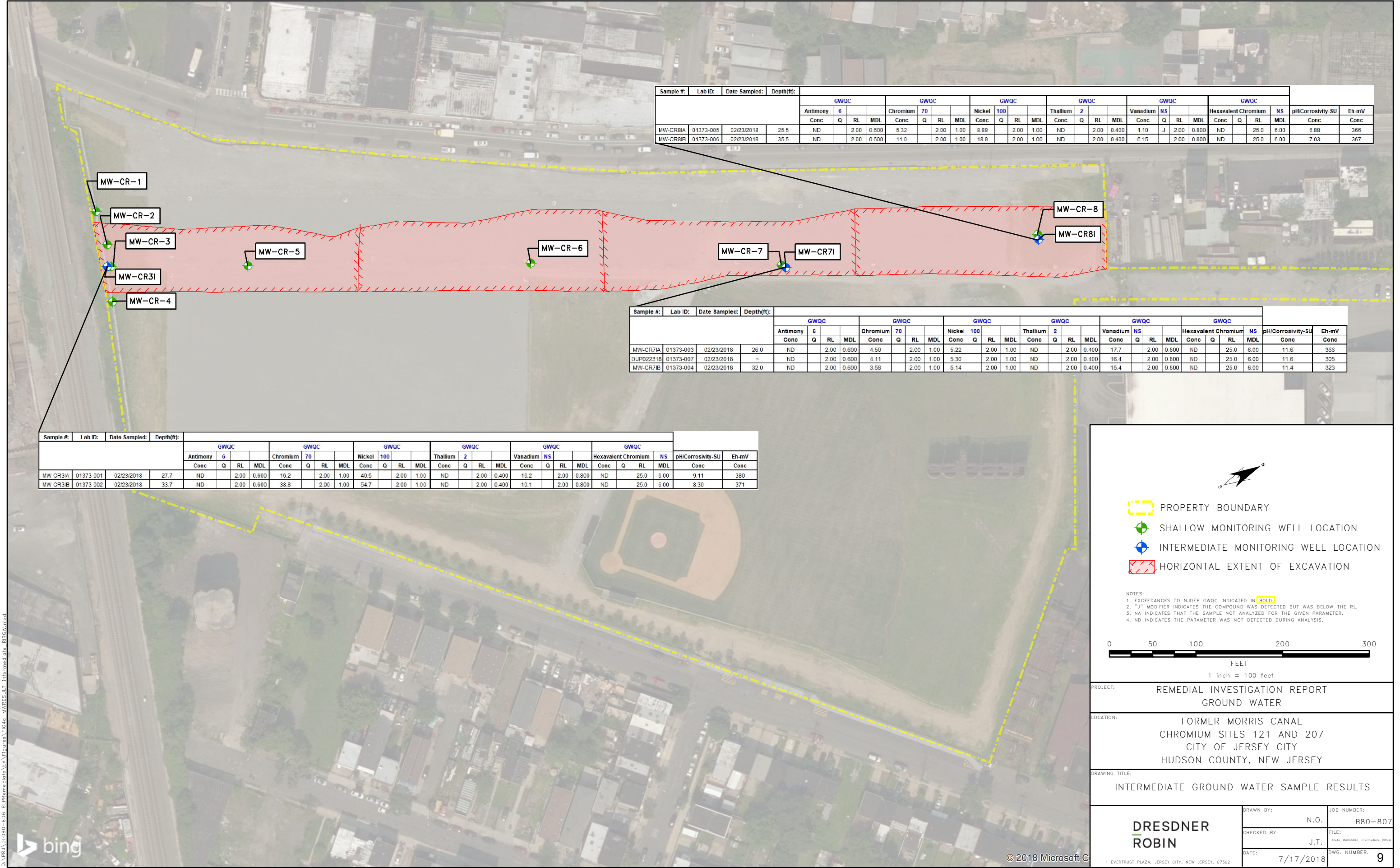
DRAWING TITLE: INTERMEDIATE GROUNDWATER ELEVATION CONTOURS  
FEBRUARY 2018

<b>DRESDNER ROBIN</b> <small>1 EVERTRUST PLAZA, JERSEY CITY, NEW JERSEY, 07302</small>	DRAWN BY: N.O.	JOB NUMBER: B80-807
	CHECKED BY: J.T.	FILE: GW_ELE_JAN14
	DATE: 04/17/18	FIGURE: 8

G:\Enviroment\00080\_LCRA\B00080-62 Morris Canal\GIS\RAW\FIG8\_GW.ELE\_FEB2018 - Int.mxd

REFERENCES: NEW JERSEY STATE OFFICE OF GIS, 2016; MICROSOFT VIRTUAL EARTH AERIAL 2016; NEW JERSEY DEPARTMENT OF TRANSPORTATION 2016; "MAJOR SUBDIVISION" DRAWING PREPARED BY DRESDNER ROBIN, 2015.





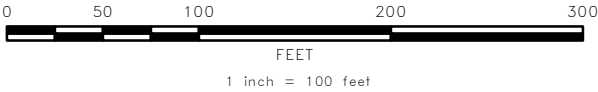
Sample #:	Lab ID:	Date Sampled:	Depth(ft):																										
				GWQC				GWQC				GWQC				GWQC				GWQC									
				Antimony	6			Chromium	70			Nickel	100			Thallium	2			Vanadium	NS			Hexavalent Chromium	NS	pH/Corrosivity-SU	Eh-mV		
				Conc	Q	RL	MDL	Conc	Q	RL	MDL	Conc	Q	RL	MDL	Conc	Q	RL	MDL	Conc	Q	RL	MDL	Conc	Q	RL	MDL	Conc	Conc
MW-CR8IA	01373-005	02/23/2018	25.5	ND		2.00	0.600	5.32		2.00	1.00	8.89		2.00	1.00	ND		2.00	0.400	1.10	J	2.00	0.800	ND		25.0	6.00	6.88	366
MW-CR8IB	01373-006	02/23/2018	35.5	ND		2.00	0.600	11.0		2.00	1.00	18.9		2.00	1.00	ND		2.00	0.400	6.15		2.00	0.800	ND		25.0	6.00	7.03	367

Sample #:	Lab ID:	Date Sampled:	Depth(ft):																										
				GWQC				GWQC				GWQC				GWQC				GWQC				GWQC					
				Antimony	6	RL	MDL	Chromium	70	RL	MDL	Nickel	100	RL	MDL	Thallium	2	RL	MDL	Vanadium	NS	RL	MDL	Hexavalent Chromium	NS	pH/Corrosivity-SU	Eh-mV		
Conc	Q			Conc	Q			Conc	Q			Conc	Q			Conc	Q			Conc	Q			Conc	Conc				
MW-CR7IA	01373-003	02/23/2018	26.0	ND		2.00	0.600	4.50		2.00	1.00	5.22		2.00	1.00	ND		2.00	0.400	17.7		2.00	0.800	ND		25.0	6.00	11.6	366
DUP022318	01373-007	02/23/2018	~	ND		2.00	0.600	4.11		2.00	1.00	5.30		2.00	1.00	ND		2.00	0.400	16.4		2.00	0.800	ND		25.0	6.00	11.6	305
MW-CR7IB	01373-004	02/23/2018	32.0	ND		2.00	0.600	3.58		2.00	1.00	5.14		2.00	1.00	ND		2.00	0.400	15.4		2.00	0.800	ND		25.0	6.00	11.4	323

Sample #:	Lab ID:	Date Sampled:	Depth(ft):																										
				GWQC				GWQC				GWQC				GWQC				GWQC				GWQC					
				Antimony	6			Chromium	70			Nickel	100			Thallium	2			Vanadium	NS			Hexavalent Chromium	NS	pH/Corrosivity-SU	Eh-mV		
				Conc	Q	RL	MDL	Conc	Q	RL	MDL	Conc	Q	RL	MDL	Conc	Q	RL	MDL	Conc	Q	RL	MDL	Conc	Q	RL	MDL	Conc	Conc
MW-CR3IA	01373-001	02/23/2018	27.7	ND		2.00	0.600	16.2		2.00	1.00	40.5		2.00	1.00	ND		2.00	0.400	16.2		2.00	0.800	ND		25.0	6.00	9.11	380
MW-CR3IB	01373-002	02/23/2018	33.7	ND		2.00	0.600	38.8		2.00	1.00	54.7		2.00	1.00	ND		2.00	0.400	10.1		2.00	0.800	ND		25.0	6.00	8.30	371

- PROPERTY BOUNDARY
- SHALLOW MONITORING WELL LOCATION
- INTERMEDIATE MONITORING WELL LOCATION
- HORIZONTAL EXTENT OF EXCAVATION

NOTES:  
1. EXCEEDANCES TO NJDEP GWQC INDICATED IN **BOLD**.  
2. "J" MODIFIER INDICATES THE COMPOUND WAS DETECTED BUT WAS BELOW THE RL.  
3. NA INDICATES THAT THE SAMPLE NOT ANALYZED FOR THE GIVEN PARAMETER.  
4. ND INDICATES THE PARAMETER WAS NOT DETECTED DURING ANALYSIS.



PROJECT:	REMEDIAL INVESTIGATION REPORT GROUND WATER	
LOCATION:	FORMER MORRIS CANAL CHROMIUM SITES 121 AND 207 CITY OF JERSEY CITY HUDSON COUNTY, NEW JERSEY	
DRAWING TITLE:	INTERMEDIATE GROUND WATER SAMPLE RESULTS	
<b>DRESDNER ROBIN</b>	DRAWN BY:	N.O. JOB NUMBER: B80-807
	CHECKED BY:	J.T. FILE: RIS4a_MWRESULT_Intermediate_BBOW
	DATE:	7/17/2018 DWG. NUMBER: 9

C:\PRJ\00080-808-BLUPRemediate\EA\Figures\FIG4a-MWRESULT-Intermediate-REGW.mxd