# APPENDIX M

# PPG Sites 121 and 207 (Berry Lane Park), Compliance Averaging Analysis – CCPW Impacts in Site Soils

# Memorandum

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| Subject | PPG Sites 121 and 207 (Berry Lane Park), Compliance Averaging Analysis - CCPW Impacts in Site Soils | | |
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| Date | September 11, 2014 | | |

**Summary**

Hexavalent chromium contamination in soil at Sites 121 and 207 has been remediated by excavation and off-site disposal. Compliance with New Jersey Department of Environmental Protection ("NJDEP") Soil Remediation Standards ("SRS") for CCPW[1]-related metals that remain in site soils (nickel, thallium, and vanadium) has been attained via compliance averaging as detailed below.

**Background**

PPG is responsible for remediation of hexavalent chromium ("$Cr^{+6}$") and CCPW-related metals, including antimony, total chromium ("Cr"), nickel, thallium and vanadium, collectively referred to as CCPW-Metals, at a total of three areas of concern ("AOCs") at Berry Lane Park:

AOC 1 - Former Morris Canal;
AOC 2 - Site 121; and
AOC 3 – Site 207.

We understand that remediation of all other soil contaminants within these AOCs, which includes historic fill as defined by NJDEP that is known to include non-CCPW related metals (lead, arsenic, etc.), is the responsibility of the Jersey City Redevelopment Authority ("JCRA").

**Introduction**

On behalf of JCRA, Dresdner Robin conducted Site and Remedial Investigations at the subject properties between late 2010 through February 2012. Remedial Action activities were conducted in 2012 and 2013.

[1] Chromium Chemical Production Waste ("CCPW") is a by-product generated from the production of sodium bichromate, including Chromite Ore Processing Residue ("COPR"), Green-Gray Mud, and fill mixed with COPR or Green-Gray Mud.

Based on the findings presented by Dresdner Robin in their draft *March 2014 Remedial Action Report*, soils within AOC 1 have been completely remediated, and remaining soil concentrations are below NJDEP Residential Direct Contact Soil Remediation Standards ("RDCSRS") and November 2013 Default Impact to Groundwater Soil Screening Levels ("DIGWSSLs").

Soils within AOC 2 and AOC 3 have been remediated with regard to $Cr^{+6}$ (hot spot removal), and fully delineated with regard to CCPW-related metals. These areas have also been capped by JCRA in order to remediate non-CCPW related contaminants and historic fill present on Sites 121 and 207 (and the rest of the Park).

Although CCPW-related metals (specifically nickel, thallium and vanadium) remain in soils at Sites 121 and 207 at concentrations above the DIGWSSL or RDCSRS at specific locations, attainment of overall compliance with applicable SRS is achieved by compliance averaging; therefore, ***REMEDIATION OF THESE SPECIFIC CCPW-RELATED CONTAMINANTS IN SOIL IS NOT NECESSARY.***

This memo provides the approach used to arrive at this conclusion, and results of the compliance averaging calculations for nickel, thallium, and vanadium in soil at Site 121 and Site 207. The approach was conducted in accordance with the NJDEP *September 2012 Technical Guidance for the Attainment of Remediation Standards and Site-Specific Criteria, Version 1.0*. Compliance averaging is an acceptable approach at these sites since these contaminants have been fully delineated.

**Data Assessment versus NJDEP Standards**

The data used in this evaluation were presented in the Dresdner Robin *January 2012 Remedial Investigation Report and Remedial Action Workplan*, with additional soil delineation data for thallium and vanadium from the draft Dresdner Robin *March 2014 Remedial Action Report – Soil* for the Morris Canal. A summary of the soil exceedances is provided in **Table 1**. There are exceedances of the DIGWSSL for nickel at Site 207 (0-2 ft below ground surface ["bgs"]). There are two exceedances of the RDCSRS for thallium at Site 207. There is one soil sample at Site 121, and two soil samples at Site 207 with a concentration greater than the DIGWSSL for thallium, but these samples were collected below the groundwater interface ("GWI") where the DIGWSSL do not apply. There are two exceedances of the RDCSRS for vanadium in soil at Site 121 (0-2 ft bgs) and three exceedances of the RDCSRS for vanadium in soil at Site 207 (2-18 ft bgs).

**Approach**

In accordance with NJDEP guidance, functional areas were defined for compliance averaging. Details of the functional area selection and statistic calculations are provided in **Attachment 1**. For comparison to the DIGWSSL, samples collected from the ground surface to 2 ft were evaluated within two functional areas on Site 207. Groundwater is shallow beneath the Sites, with the groundwater interface approximately 2 ft bgs.

For comparison to the RDCSRS, functional areas were drawn within the Sites to capture the elevated concentrations. A surface zone of 0 to 2 ft bgs and one subsurface zone greater than 2 ft bgs were evaluated. Although the Sites are currently capped, the sample depths prior to capping are used to identify the data within the functional areas. Three functional areas were identified for compliance averaging in comparison to the RDCSRS:

- Site 207 thallium 2-18 ft bgs,
- Site 207 vanadium 0-2 ft bgs, and

- Site 121 vanadium 2-18 ft bgs.

Each functional area defined for exceedances of the RDCSRS are approximately 0.25 acres in size and nearly square. There are no exceedances of the RDCSRS outside of the functional areas defined.

The compliance averaging statistics are summarized in **Table 2**. A mean concentration (arithmetic mean or 95% upper confidence limit ["UCL"] on the mean) as well as a spatially weighted average concentration were calculated for each functional area.

**Findings**

***Nickel***

The arithmetic mean was selected as the averaging statistic, because there are less than ten sample results in each of the functional areas. The arithmetic means are 41.1 mg/kg and 34.7 mg/kg for the southernmost and northernmost functional areas in Site 207, respectively. The spatially weighted averages are 42.9 mg/kg and 33.1 mg/kg for the southernmost and northernmost functional areas, respectively. All average values are below the DIGWSSL of 48 mg/kg for nickel.

***Thallium***

For the 2 to 18 ft bgs soil interval within the functional area on Site 207, the 95% UCL was selected as the averaging statistic because there are more than nine sample results. The 95% UCL is 1.274 mg/kg and the spatially weighted average concentration is 3.9 mg/kg. Both values are less than the thallium RDCSRS of 5 mg/kg. Note that the DIGWSSL for thallium (3.0 mg/kg) is not applied in this case, since the soil results were detected in samples collected within the saturated zone, (i.e. below the groundwater interface). Thallium has not been detected in groundwater at concentrations exceeding its respective Groundwater Quality Standard ("GWQS").

***Vanadium***

For the 0 to 2 ft bgs soil interval within the functional area on Site 207, the arithmetic mean was selected as the averaging statistic because there are less than ten sample results. The arithmetic mean is 69.5 mg/kg and the spatially weighted average concentration is 59.6 mg/kg. Both values are less than the vanadium RDCSRS of 78 mg/kg. Note that NJDEP does not have a DIGWSSL for vanadium.

For the 2 to 18 ft bgs soil interval within the functional area on Site 121, the 95% UCL was selected as the averaging statistic because there are more than nine sample results. The 95% UCL is 32.18 mg/kg and the spatially weighted average concentration is 50.8 mg/kg. Both values are less than the vanadium RDCSRS of 78 mg/kg.

**Conclusion**

Although nickel was detected in soil on Site 207 above the DIGWSSL, on average, nickel concentrations are in compliance with the DIGWSSL. The lack of impact to groundwater is further supported by the groundwater sampling for the remedial investigation in 2011, which found no exceedance of the nickel GWQS. Nickel concentrations in groundwater were below the GWQS in samples collected from a well located on Site 207 in January 2014. Wells with exceedances of the nickel GWQS were located in the footprint of the remediated Morris Canal. The exceedances of the GWQS are attributed to a source (or former source) outside the bounds of Site 207, because the nickel concentrations from the well located within Site 207 are compliant with the GWQS. Recent groundwater sample results are provided in **Attachment 2**.

Thallium and vanadium were detected in soil at concentrations exceeding the RDCSRS. For both thallium and vanadium within the functional areas defined, on average, the concentrations are below RDCSRS.

Based on compliance averaging and supported by groundwater sampling results, nickel, thallium, and vanadium contamination in soil on Sites 121 and 207 is not at levels which require soil containment or other remedial action.

**Table 1. Exceedances of Standards**

| Units: mg/kg | Sample Depth (ft) | | | | RDCSRS | NRSDCSRS | DIGWSSL |
|---|---|---|---|---|---|---|---|
| Boring | Upper | Lower | DTW (ft) | Nickel | 1600 | 23000 | 48 |
| 207_B18 | 1 | 1.5 | 3.1 | 49.4 | Below | Below | Above |
| 207_B2 | 1 | 1.5 | 2.42 | 52.9 | Below | Below | Above |
| 207_B3 | 1 | 1.5 | 2.42 | 55.1 | Below | Below | Above |
| 207_B9 | 1 | 1.5 | 3.9 | 56.6 | Below | Below | Above |
| 207-B16 | 1.5 | 2 | 3.1 | 52.9 | Below | Below | Above |
| | | | | | | | |
| Boring | Upper | Lower | DTW (ft) | Thallium | 5 | 79 | 3 |
| 121_B2 | 8 | 8.5 | 3.9 | 4.15 | Below | Below | NA (1) |
| 207_B4 | 5.5 | 6 | 2.42 | 6.11 | Above | Below | NA (1) |
| 207_B5 | 9.5 | 10 | 3.1 | 8.23 | Above | Below | NA (1) |
| | | | | | | | |
| Boring | Upper | Lower | DTW (ft) | Vanadium | 78 | 1100 | NC |
| 121_B1 | 4.5 | 5 | 3.9 | 119 | Above | Below | -- |
| 121_B1-3 | 4.5 | 5 | 3.9 | 81.7 | Above | Below | -- |
| 207_B18 | 1 | 1.5 | 3.1 | 123 | Above | Below | -- |
| 207_B9 | 1 | 1.5 | 3.9 | 119 | Above | Below | -- |
| 207-B16 | 1.5 | 2 | 3.1 | 103 | Above | Below | -- |

NA = Not applicable
NC = No criterion

Note:

(1) The DIGWSSLs do not apply, because the exceedance occurs below the groundwater interface.

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**Table 2: Berry Lane Park Compliance Averaging Statistics**

| Units: mg/kg | Criteria | | Averaging Statistic | |
|---|---|---|---|---|
| Nickel 0-2 ft | | | | |
| Site 207 Southern-most Area | 48 | DIGWSSL | 41.1 | Arithmetic average |
| | 48 | DIGWSSL | 42.9 | Spatially weighted average |
| Site 207 Northern-most Area | 48 | DIGWSSL | 34.7 | Arithmetic average |
| | 48 | DIGWSSL | 33.1 | Spatially weighted average |
| Thallium 2-18 ft bgs | | | | |
| Site 207 - area with exceendances | 5 | RDCSRS | 1.3 | 95% UCL |
| | 5 | RDCSRS | 3.9 | Spatially weighted average |
| Vanadium 0-2 ft bgs | | | | |
| Site 207 - area with exceendances | 78 | RDCSRS | 69.5 | Arithmetic average |
| | 78 | RDCSRS | 59.6 | Spatially weighted average |
| Vanadium 2-18 ft bgs | | | | |
| Site 121 - area with exceendances | 78 | RDCSRS | 32.2 | 95% UCL |
| | 78 | RDCSRS | 50.8 | Spatially weighted average |

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# Attachment 1
# Functional Area Selection and Evaluation

The functional areas were selected and the compliance averaging statistics were calculated as described below. Text from the September 24, 2012 *Technical Guidance for the Attainment of Remediation Standards and Site-Specific Criteria, Version 1.0* is provided in italics followed by Site specific information.

# 1.0 Nickel – Impact to Groundwater Default Soil Screening Levels

*The use of functional areas facilitates the process of evaluating contaminated areas of the site. The purpose of the functional area is to help select the samples to be included in the compliance averaging process. Compliance averaging using the 95 percent UCL of the mean concentration employs a fixed area approach ("functional area").*

*For the impact to ground water exposure pathway, the functional area is based on the size of the AOC. The relevant dimension is the length of the AOC in the direction parallel to ground water flow. There is no constraint on the length of the AOC in the direction perpendicular to ground water flow.*

For the overall area of Berry Lane Park, the groundwater flow direction observed during both the May and June 2011 groundwater sampling events was to the South-Southeast according to the January 2012 Remedial Investigation ("RI") report prepared by Dresdner Robin. However, within the bounds of Sites 121 and 207, groundwater flow is observed to be generally to the northeast. This is more apparent in June 2011 sampling event. Groundwater contours for the May and June 2011 sampling events are provided on **Figure 1** and **Figure 2**, respectively which are from the RI. Note that the contours for May 2011 include MW-4-1, which appears to have an anomalous groundwater elevation.

## 1.1 Size of functional area

*The functional area for the impact to ground water exposure pathway is defined by the area of concern (AOC). The length is defined as the part of the AOC parallel to ground water flow, and is not necessarily the longest dimension of the AOC. The 100 foot length is the AOC length value included in the dilution attenuation factor (DAF) equation utilized in the derivation of the impact to ground water soil remediation screening levels found in Table 1 of the technical guidance document "Development of Site-Specific Impact to Ground Water Soil Remediation Standards Using the Soil-Water Partition Equation" (www.nj.gov/dep/srp/guidance/rs/partition_equation.pdf).*

*For AOCs with a length up to and including 100 feet in the direction parallel to ground water flow, a length of 100 feet in the direction parallel to ground water flow can be used as the functional area if the investigator:*

- *Wants to use the impact to ground water soil screening levels found in Table 1 of the technical guidance document "Development of Site-Specific Impact to Ground Water Soil Remediation Standards Using the Soil-Water Partition Equation" (www.nj.gov/dep/srp/guidance/rs/partition_equation.pdf); or*
- *Has already calculated a site-specific standard using a length of 100 feet in the direction parallel to ground water flow.*
- *Delineated AOCs situated downgradient of each other whose total length (including "gaps" between AOCs) does not exceed 100 feet can be combined into a single functional area.*
- *If the size of the AOC is larger than 100 feet in the direction parallel to ground water flow, the investigator can evaluate the AOC using:*
- *If the default DAF is used, multiple functional areas of 100 feet length in the direction parallel to the direction of ground water flow as described above. To the degree practicable, the placement of the initially assessed functional area shall be biased to the worst case contaminant concentrations; or*

- *The entire delineated AOC as the functional area. If this option is chosen, then a site-specific DAF and impact to ground water standard are to be calculated using the length of the entire AOC as the functional area parallel to the direction of ground water flow.*

There are no exceedances of the default impact to groundwater soil screening level (DIGWSSL) for nickel on Site 121, but there were exceedances of the DIGWSSL on Site 207. Site 207 is approximately 170 ft across site in the direction of flow. Thus, the site was split into two functional areas where the distance across each area is approximately 100 ft in the direction of groundwater flow using the June 2011 contours from the RI. The functional areas are shown in shown in **Figure 3**.

### 1.2 Shape of functional area

*The shape of the functional area is based on the length of the AOC in the direction parallel to ground water flow (minimum length of 100 feet), and the delineated extent of contamination in all other directions.*

The functional areas are approximately 100 ft across in the direction of groundwater flow.

### 1.3 Vertical definition of functional area

*For the impact to ground water pathway there will be two vertical zones. The first zone is from the ground surface to two (2) feet above the water table, and the second zone is from two (2) feet above the water table to the water table (Figure 4).*

*Unlike the direct contact pathways, the receptor for impact to ground water is the ground water. The depth intervals for these zones are based on this receptor. To address fluctuations in the water table and the impact the soil contamination could have on the ground water, the two foot zone above the water table zone was established. The remainder of the vadose zone, whose height is obviously site-specific, is designated as the first zone.*

AECOM reviewed the topographic elevation survey contours provided by Dresdner Robin on August 19, 2014. The contours on the site are not labeled in the drawing. Since the site was observed to be flat, a single ground elevation of 12 ft was assigned to the surface based on the surrounding contours. The groundwater elevations are shown below for wells within the two Sites. Groundwater was found from 1.6 to 2.1 ft below ground surface ("bgs") on Site 207. The soil samples collected near the ground surface and above the groundwater interface were all collected between 1 to 2 ft bgs. For the vertical extent, a single groundwater interval of 0-2 ft bgs will be evaluated.

| Well Name | Northing | Easting | Well Elevation | Depth to Water May 2011 | Depth to Water June 2011 | Ground water Elevation May 2011 | Ground water Elevation June 2011 |
|---|---|---|---|---|---|---|---|
| MW-4-1 | 684203 | 611505 | 12.06 | 3.9 | -- | 8.2 | |
| MW-5-1 | 684031 | 611362 | 12.79 | 2.42 | 2.85 | *10.4* | *9.9* |
| MW-6-1 | 684346 | 611555 | 13.85 | 4.78 | 5.52 | 9.1 | 8.3 |

### 1.4 Evaluation of functional areas

*Compliance averaging using the arithmetic mean is only to be applied in those situations where there are two or fewer distinct sample values or nine or fewer total sample points.*

The data for the southernmost functional area are listed below.

| Boring | Nickel (mg/kg) |
|---|---|
| 207-B1 | 15.2 |
| 207-B2 | 52.9 |
| 207-B3 | 55.1 |

Because there are less than ten sample points, an arithmetic average is used to compliance average. The arithmetic average is 41.07 mg/kg. This value is below the DIGWSSL of 48 mg/kg.

The data for the northernmost functional area are listed below.

| Boring | Nickel (mg/kg) |
|---|---|
| 207-B4 | 35.8 |
| 207-B5 | 22.5 |
| 207-B6 | 14 |
| 207-B8 | 14.4 |
| 207-B9 | 56.6 |
| 207-B16 | 52.9 |
| 207-B17 | 36.2 |
| 207-B18 | 49.4 |
| 207-B19 | 30.8 |

The arithmetic average is 34.7 mg/kg. This value is below the DIGWSSL of 48 mg/kg.

### 1.5 Offsite compliance

*For the impact to ground water pathway, the functional area is defined by the associated AOC, which may extend across property boundaries.*

Only soil samples falling within or on the boundary of Site 207 were included in the functional areas.

### 1.6 Compliance Averaging using a Spatially Weighted Average

*As indicated in sections 6.7.4.1, 6.7.4.2, 6.7.5.1 and 6.7.5.2, compliance averaging using a weighted average can be conducted for the all exposure pathways in the remedial investigation and/or the remedial action phases. If this compliance option will be used, complete horizontal and vertical delineation using single point compliance, is required for completion of the remedial investigation.*

*To determine compliance with the applicable soil remediation standard, a spatially weighted average (area weighted mean) may be used whereby the sampling results are weighted according to the area they represent. The corresponding area may be defined using Thiessen Polygons (also known as Voronoi or Dirichlet tessellations). Polygons define individual areas of influence around each of a set of points. Thiessen polygons are polygons whose boundaries define the area that is closest to each point relative to all other points; they are mathematically defined by the perpendicular bisectors of the lines between all points. These calculations are typically performed using CAD or GIS software1, or can be performed manually. The results of each sample are adjusted for the percentage of the overall area the corresponding sample represents, and the adjusted values are averaged.*

*The methods for determining the size of the functional area and for the vertical subsurface zones to be used for the analyses are the same as defined for the 95 percent UCL of the mean in sections A2.1.1 (size) and A2.1.3 (vertical definition) above. As with the 95 percent UCL of the*

*mean, the size and vertical definition of the functional area will be determined by the appropriate exposure pathway (ingestion/dermal and inhalation, or impact to ground water).*

*The spatial analysis must be performed within each of the vertical zones within which contaminant concentrations exceed the applicable remediation standard. If multiple samples exist within a single vertical zone (e.g., 2 feet through 12 feet bgs), the greatest concentration within that zone should be used in the analysis. For sites greater in size than the functional area (0.25 acres for residential and 2 acres for commercial/industrial land uses), multiple functional areas may be defined. To the degree practicable, the placement of the initially assessed functional area shall be biased to the worst case contaminant concentrations.*

Spatially weighted nickel concentrations were calculated for the two functional areas in Site 207. Thiessen polygons were established for the sampling locations using ArcGIS (Voroni polygons from the Geospatial Analysis tool). The spatially weighted nickel concentrations are 42.9 mg/kg for the southernmost functional area and 33.1 mg/kg for the northernmost functional area. The calculations are provided below. These values are below the nickel DIGWSSL of 48 mg/kg.

Calculation for the southernmost functional area:

| Boring | Nickel (mg/kg) | Area (SF) | Area*Conc. |
|---|---|---|---|
| 207-B2 | 52.9 | 1700 | 89930 |
| 207-B3 | 55.1 | 7004 | 385920 |
| 207-B1 | 15.2 | 3698 | 56210 |
| | Sums: | 12402 | 532060 |
| | Spatially Weighted Average | | **42.9** |

Calculation for the northernmost functional area:

| Boring | Nickel (mg/kg) | Area (SF) | Area*Conc. |
|---|---|---|---|
| 207-B4 | 35.8 | 2530 | 90574 |
| 207-B6 | 14 | 1642 | 22988 |
| 207-B5 | 22.5 | 2796 | 62910 |
| 207-B19 | 30.8 | 1174 | 36159.2 |
| 207-B18 | 49.4 | 1538 | 75977.2 |
| 207-B16 | 52.9 | 277 | 14653.3 |
| 207-B17 | 36.2 | 94 | 3402.8 |
| 207-B8 | 14.4 | 938 | 13507.2 |
| 207-B9 | 56.6 | 1868 | 105728.8 |
| | Sums: | 12857 | 425900.5 |
| | Spatially Weighted Average | | **33.1** |

## 2.0 Thallium and Vanadium – Residential Direct Contact

*For the ingestion-dermal and inhalation pathways the "functional areas" correspond to the areas of typical residential and non-residential sites, as well as constraints placed on the models*

*involved. To the degree practicable, the placement of the initially assessed functional area shall be biased to the worst case contaminant concentrations for the ingestion-dermal and inhalation pathways.*

*For example, if the site is five acres in size, but contamination is limited to only two acres, only this two acre portion of the site requires evaluation. To determine whether to use the residential or non-residential functional area, land use should be taken into account. The investigator then assesses whether there is an exceedance of the remediation goal within each individual functional area.*

The individual Sites 121 and 207 are selected for the functional areas. The functional areas were defined to group areas with detections in soil samples exceeding the residential direct contact soil remediation standards ("RDCSRS").

### 2.1 Size of functional area

*The functional area for residential exposure scenarios will be 0.25 acres. In the case of the non-residential exposure scenarios, the functional area will be two (2) acres, the default non-residential site lot size. The residential exposure scenario of 0.25 acres represents one-half of the residential lot size, and assumes that ingestion of contamination is occurring in either the front yard or the back yard of the residence.*

*If more than one functional area is to be evaluated, and the contaminated areas of the site cannot be divided exactly, the size of the final functional area to be evaluated can be increased by up to 50 percent (note - functional areas are to be evaluated on a "worst case first" basis; see A2.1.4, Evaluation of Functional Areas below, for more details). Examples are as follows:*

*Residential site - functional area = 0.25 acres*

- *Site size is 0.33 acre, the entire site can be evaluated as one functional area.*
- *Site size is 1.1 acres, would require four functional areas, three being 0.25 acres, and the fourth 0.35 acres*

*Similarly, if the site size is less than 0.25 acres for a residential site or less than 2 acres for a non-residential site, the default functional area is applied, and the applicable residential or non-residential Ingestion-Dermal Soil Remediation Standard applied.*

Both Sites are approximately 0.52 acres. The Sites were split into one (approximately 0.25 acre) area with contaminated sample points, and another larger area with no exceedances of RDCSRS. The location of RDCSRS exceedances and the functional areas are shown in **Figure 4** (thallium 2-18 ft bgs), **Figure 5** (vanadium 0-2 ft bgs), and **Figure 6** (vanadium 2-18 ft bgs).

### 2.2 Shape of functional area

*Pursuant to the existing "Guidance Document - Inhalation Standards Compliance - Development of Alternative Remediation Standards for the Inhalation Pathway" (www.nj.gov/dep/srp/guidance/rs/compl_ars_inhalation.pdf), the preferred shape of the functional area is that of a square (Figure 1 below) but can vary somewhat based on site configuration and contamination distribution. However, it is preferred that the length of the functional area be kept to no more than four times the width (Figure 2 below). For consistency, the same shape restrictions apply to both the ingestion-dermal and inhalation exposure pathways.*

The ratio of length to width is less than 4 for each functional area (thallium 2-18 ft bgs and vanadium 0-2 ft bgs: 1.2 [121 ft / 97 ft] and vanadium 2-18 ft bgs: 1.1 [110 ft / 103 ft]).

### 2.3 Vertical definition of functional area

*In all cases, there is a surface zone of 0 to 2 feet below ground surface (bgs) and one subsurface zone (greater than 2 feet bgs) associated with the site being evaluated (Figure 3). The surface zone will encompass both surface samples (0.0 to 0.5 feet) as well as any other samples taken at 2 feet of depth or less. The final vertical depth for the subsurface zone shall be determined pursuant to the delineation requirements set forth in N.J.A.C. 7:26E. These depth intervals are*

*based on general assumptions on the potential and likelihood of soil disturbance. Based on the contaminant distribution pattern in both the surface and subsurface zones, the functional areas within the subsurface vertical zones may need to be placed and evaluated distinctly from the comparable functional areas within the surface vertical zone.*

Two vertical zones were identified: 0-2 ft bgs and 2-18 ft bgs. For thallium, there is one area on Site 207 with exceedances in the 2-18 ft bgs depth range. For vanadium, there is one area on Site 207 with exceedances in the 0-2 ft bgs depth range and one area on Site 121 with exceedances in the 2-18 ft bgs depth range.

### 2.4 Offsite compliance

*For the ingestion-dermal and inhalation pathways, if delineation indicates that contamination has migrated offsite at any depth, then delineation and compliance with the applicable soil remediation standard shall be determined by applying the most restrictive applicable standard to the offsite contaminated area. Pursuant to the Technical Requirements, contamination migrating offsite is to be delineated to the unrestricted use standard (N.J.A.C. 7:26E-4.2(a)2). Therefore, the contaminated offsite area shall be addressed separately and the 95 percent UCL of the mean of the offsite area compared to the most restrictive soil remediation standard, irrespective of its current land use.*

*If the functional area compliance evaluation for the offsite area indicates that there are no exceedances of the most stringent soil remediation standard in the worst case area, then no further remediation of the offsite contamination is required for either the ingestion-dermal or the inhalation exposure pathways. This does not preclude the need for additional remediation for the offsite area being evaluated based on the impact to ground water pathway. If the compliance evaluation for the offsite functional area indicates that there is an exceedance of the most restrictive soil remediation standard, a remedial action will be required; this may involve removal, treatment, or establishment of an institutional control, with or without an engineering control.*

Offsite migration of the thallium and vanadium contamination in soil is not suspected. Only soil samples falling within or on the boundary of the Sites were included in the functional areas.

### 2.5 Evaluation of functional areas

*In all cases, each individual contaminant detected in the vertical zones (surface, subsurface) is evaluated by comparing the 95 percent UCL of the mean of the selected data against the applicable standard. The data to be selected are to include those required to delineate the AOC encompassed by the functional area. Data below regulatory concern other than those needed to delineate the AOC would not be included. Data from AOCs that are not of regulatory concern also would not be included.*

*The 95 percent UCL of the mean approach is used by the United States Environmental Protection Agency (U.S. EPA) for situations where, from a statistical perspective, there is a limited amount of data for a given AOC or site. All data necessary for delineation within a given functional area and vertical zone(s) are utilized in the evaluation.*

*An algorithm that properly addresses non-detect results should be used to evaluate the data. The program ProUCL is widely used and can be downloaded from the U.S. EPA website (go to www.epa.gov/osp/hstl/tsc/software.htm for the most up-to-date version of this software). The investigator can elect to utilize other software, but they must provide documentation on the algorithm used, and the underlying assumptions and techniques employed.*

*If more than one potential UCL is identified by the algorithm used, the lower value should be used in the evaluation.*

*If the calculated UCL is greater than all values in the data set, the maximum sample value in the data set should be used for evaluation.*

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*Compliance averaging using the arithmetic mean is only to be applied in those situations where there are two or fewer distinct sample values or nine or fewer total sample points.*

The data are listed below for each functional area.

Thallium 2-18 ft bgs on Site 207:

| Boring | Upper Depth (ft) | Lower Depth (ft) | Thallium | q |
|---|---|---|---|---|
| 207-B18 | 13 | 13.5 | 0.464 | J |
| 207-B18 | 16.5 | 17 | 0.294 | J |
| 207-B18 | 5.5 | 6 | 0.267 | J |
| 207-B18 | 9.5 | 10 | 1.88 | |
| 207-B19 | 13 | 13.5 | 0.434 | J |
| 207-B19 | 16.5 | 17 | 0.252 | J |
| 207-B19 | 5.5 | 6 | 0.486 | |
| 207-B19 | 9.5 | 10 | 1.24 | |
| 207-B4 | 13 | 13.5 | 0.272 | J |
| 207-B4 | 16.5 | 17 | 0.26 | J |
| 207-B4 | 5.5 | 6 | 6.11 | |
| 207-B4 | 9.5 | 10 | 0.37 | |
| 207-B5 | 13 | 13.5 | 0.304 | J |
| 207-B5 | 16.5 | 17 | 0.162 | U |
| 207-B5 | 5.5 | 6 | 1.45 | |
| 207-B5 | 9.5 | 10 | 8.23 | |
| 207-B6 | 10 | 10.5 | 0.16 | U |
| 207-B6 | 12 | 12.5 | 0.227 | U |
| 207-B6 | 6 | 6.5 | 0.204 | J |
| 207-B6 | 8 | 8.5 | 0.21 | J |
| 207-B8 | 12 | 12.5 | 0.146 | U |
| 207-B8 | 6 | 6.5 | 0.234 | J |
| 207-B8 | 9 | 9.5 | 0.649 | |
| 207-B9 | 12 | 12.5 | 0.146 | U |
| 207-B9 | 14.5 | 15 | 0.242 | U |
| 207-B9 | 4 | 4.5 | 0.268 | J |
| 207-B9 | 8 | 8.5 | 0.399 | |
| 207-B16 | 13.5 | 14 | 0.269 | U |
| 207-B16 | 17.5 | 18 | 0.17 | U |
| 207-B16 | 5.5 | 6 | 0.172 | J |
| 207-B16 | 9.5 | 10 | 0.395 | |
| 207-B5 | 9.5 | 10 | 0.165 | U |
| 207-B4 | 5.5 | 6 | 0.295 | J |
| 207-B17 | 13.5 | 14 | 0.279 | J |
| 207-B17 | 17.5 | 18 | 0.164 | U |
| 207-B17 | 5.5 | 6 | 0.16 | U |
| 207-B17 | 9.5 | 10 | 0.724 | |

Vanadium 0-2 ft bgs on Site 207:

| Boring | Upper Depth (ft) | Lower Depth (ft) | Vanadium |
|---|---|---|---|
| 207-B18 | 1 | 1.5 | 123 |
| 207-B19 | 1 | 1.5 | 44.1 |
| 207-B4 | 1 | 1.5 | 63.9 |
| 207-B5 | 1 | 1.5 | 27.1 |
| 207-B6 | 1 | 1.5 | 28.7 |
| 207-B8 | 1 | 1.5 | 34.9 |
| 207-B16 | 1.5 | 2 | 103 |
| 207-B17 | 1 | 1.5 | 59.6 |
| 207-B9 | 1 | 1.5 | 141 |

Vanadium 2-18 ft bgs on Site 121:

| Boring | Upper Depth (ft) | Lower Depth (ft) | Vanadium |
|---|---|---|---|
| 121-B1 | 12 | 12.5 | 20.3 |
| 121-B1 | 4.5 | 5 | 119 |
| 121-B1 | 8 | 8.5 | 21.7 |
| 121-B10 | 13.5 | 14 | 28 |
| 121-B10 | 17 | 17.5 | 35.4 |
| 121-B10 | 5.5 | 6 | 20.5 |
| 121-B10 | 9.5 | 10 | 30.9 |
| 121-B11 | 13.5 | 14 | 10.3 |
| 121-B11 | 17 | 17.5 | 20.6 |
| 121-B11 | 5.5 | 6 | 18.5 |
| 121-B11 | 9.5 | 10 | 27.3 |
| 121-B12 | 13 | 13.5 | 9.89 |
| 121-B12 | 17 | 17.5 | 25.5 |
| 121-B12 | 3.5 | 4 | 17.5 |
| 121-B12 | 5.5 | 6 | 22.3 |
| 121-B12 | 9.5 | 10 | 28 |
| 121-B13 | 12.5 | 13 | 16.6 |
| 121-B13 | 16 | 16.5 | 18.1 |
| 121-B13 | 5.5 | 6 | 20.9 |
| 121-B13 | 8.5 | 9 | 27.6 |
| 121-B2 | 12 | 12.5 | 36 |
| 121-B2 | 4.5 | 5 | 19.8 |
| 121-B2 | 8 | 8.5 | 21.2 |
| 121-B9 | 13.5 | 14 | 13.1 |
| 121-B9 | 17 | 17.5 | 18.5 |
| 121-B9 | 5.5 | 6 | 16 |
| 121-B9 | 9.5 | 10 | 28.7 |
| 121-B1 | 4.5 | 5 | 41 |

| Boring | Upper Depth (ft) | Lower Depth (ft) | Vanadium |
|---|---|---|---|
| 121-B1 | 4.5 | 5 | 81.7 |
| 121-B1 | 8 | 8.5 | 15.5 |
| 121-B1 | 4.5 | 5 | 21.7 |
| 121-B5 | 13.5 | 14 | 22.1 |
| 121-B5 | 17 | 17.5 | 14.9 |
| 121-B5 | 3.5 | 4 | 23.9 |
| 121-B5 | 5.5 | 6 | 21.1 |
| 121-B5 | 7.5 | 8 | 21.5 |
| 121-B5 | 9.5 | 10 | 33.4 |

ProUCL was used to calculate the UCLs. For thallium 2-18 ft bgs, the UCL suggested by ProUCL is 1.274 mg/kg. This value is below the RDCSRS of 5 mg/kg.

For vanadium 0-2 ft bgs, because there are less than ten sample points, an arithmetic average is used to compliance average. The arithmetic average is 69.5 mg/kg. This value is below the RDCSRS of 78 mg/kg.

For vanadium 2-18 ft bgs, the UCL suggested by ProUCL is 32.18 mg/kg. This value is below the RDCSRS of 78 mg/kg.

The calculated values from ProUCL are provided in **Table 1** for thallium 2-18 ft bgs and **Table 2** vanadium 2-18 ft bgs. (Note: to reproduce the UCL calculations, a copy of ProUCL should be downloaded from the USEPA website.)

### 2.6 Compliance Averaging using a Spatially Weighted Average

*As indicated in sections 6.7.4.1, 6.7.4.2, 6.7.5.1 and 6.7.5.2, compliance averaging using a weighted average can be conducted for the all exposure pathways in the remedial investigation and/or the remedial action phases. If this compliance option will be used, complete horizontal and vertical delineation using single point compliance, is required for completion of the remedial investigation.*

*To determine compliance with the applicable soil remediation standard, a spatially weighted average (area weighted mean) may be used whereby the sampling results are weighted according to the area they represent. The corresponding area may be defined using Thiessen Polygons (also known as Voronoi or Dirichlet tessellations). Polygons define individual areas of influence around each of a set of points. Thiessen polygons are polygons whose boundaries define the area that is closest to each point relative to all other points; they are mathematically defined by the perpendicular bisectors of the lines between all points. These calculations are typically performed using CAD or GIS software1, or can be performed manually. The results of each sample are adjusted for the percentage of the overall area the corresponding sample represents, and the adjusted values are averaged.*

*The methods for determining the size of the functional area and for the vertical subsurface zones to be used for the analyses are the same as defined for the 95 percent UCL of the mean in sections A2.1.1 (size) and A2.1.3 (vertical definition) above. As with the 95 percent UCL of the mean, the size and vertical definition of the functional area will be determined by the appropriate exposure pathway (ingestion/dermal and inhalation, or impact to ground water).*

Spatially weighted concentrations were calculated for the three functional areas. The Thiessen polygons were established for the sampling locations using ArcGIS (Voroni polygons from the Geospatial Analysis tool). The Thiessen polygons are shown on **Figure 4** (thallium 2-18 ft bgs), **Figure 5** (vanadium 0-2 ft bgs), and **Figure 6** (vanadium 2-18 ft bgs). The maximum

concentration detected within a boring and depth interval was selected for each Thiessen polygon to calculate the spatially weighted average.

For thallium 2-18 ft bgs, the spatially weighted average is 3.9 mg/kg. This value is below the RDCSRS of 5 mg/kg.

For vanadium 0-2 ft bgs, the spatially weighted average is 59.6 mg/kg. This value is below the RDCSRS of 78 mg/kg.

For vanadium 2-18 ft bgs, the spatially weighted average is 50.8 mg/kg. This value is below the RDCSRS of 78 mg/kg.

Spatially weighted average calculation for thallium 2-18 ft bgs:

| Boring | Thallium (mg/kg) | Area (SF) | Area*Conc. |
|---|---|---|---|
| 207-B4 | 6.11 | 2306 | 14090 |
| 207-B6 | 0.227 | 1165 | 264 |
| 207-B5 | 8.23 | 2771 | 22805 |
| 207-B19 | 1.24 | 1165 | 1445 |
| 207-B18 | 1.88 | 1113 | 2092 |
| 207-B16 | 0.395 | 277 | 109 |
| 207-B17 | 0.724 | 94 | 68 |
| 207-B8 | 0.649 | 938 | 609 |
| 207-B9 | 0.399 | 921 | 367 |
| | Sums: | 10750 | 41850 |
| | Spatially Weighted Average | | **3.9** |

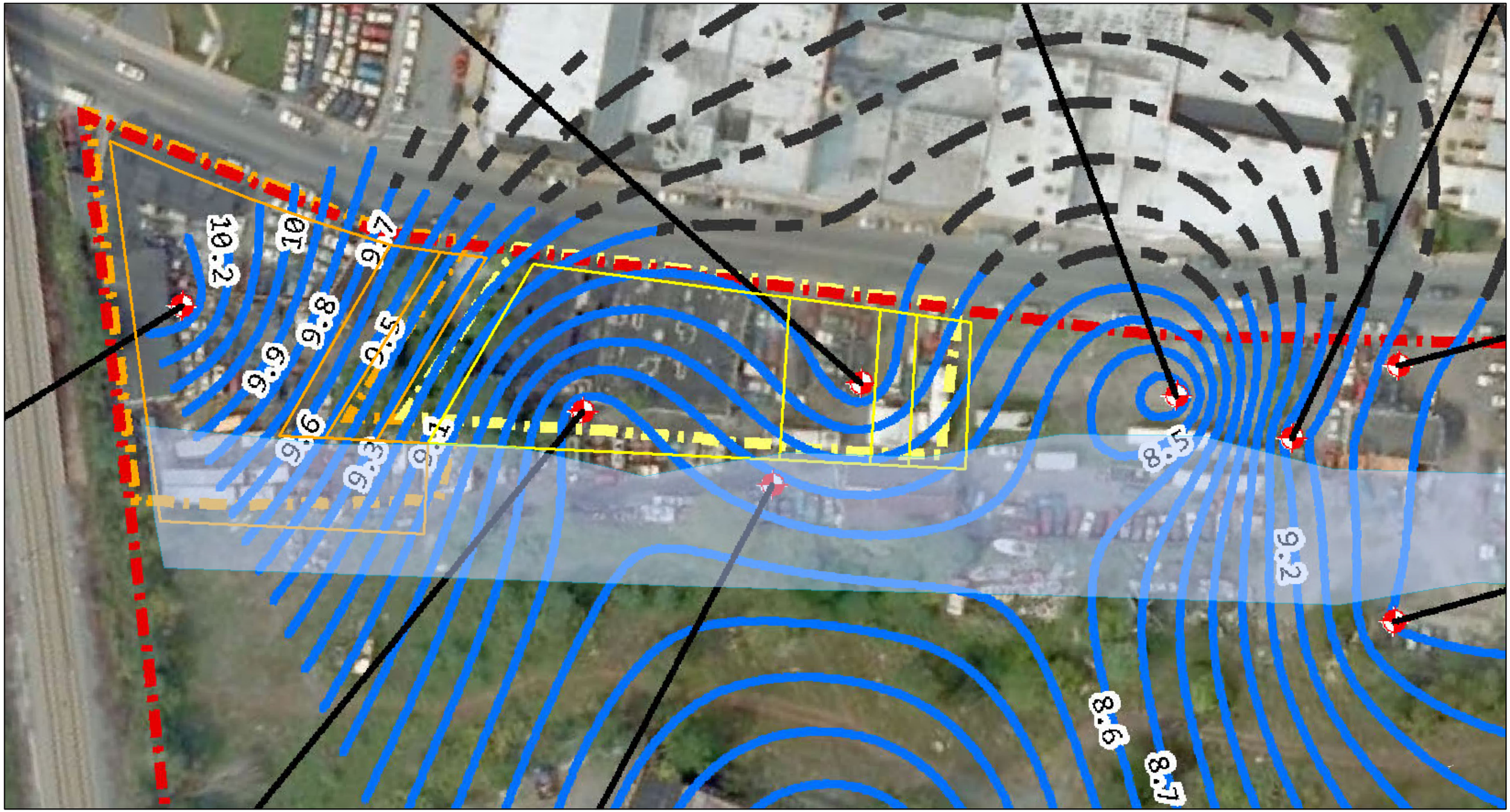
Spatially weighted average calculation for vanadium 0-2 ft bgs:

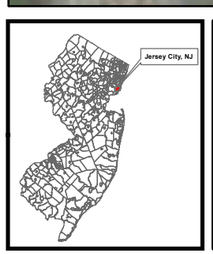
| Boring | Vanadium (mg/kg) | Area (SF) | Area*Conc. |
|---|---|---|---|
| 207-B4 | 63.9 | 2306 | 147353.4 |
| 207-B6 | 28.7 | 1167 | 33492.9 |
| 207-B5 | 27.1 | 2772 | 75121.2 |
| 207-B19 | 44.1 | 1165 | 51376.5 |
| 207-B18 | 123 | 1113 | 136899 |
| 207-B16 | 103 | 277 | 28531 |
| 207-B17 | 59.6 | 94 | 5602.4 |
| 207-B8 | 34.9 | 938 | 32736.2 |
| 207-B9 | 141 | 925 | 130425 |
| | Sums: | 10757 | 641538 |
| | Spatially Weighted Average | | **59.6** |

Spatially weighted average calculation for vanadium 2-18 ft bgs:

| Boring | Vanadium (mg/kg) | Area (SF) | Area*Conc. |
|---|---|---|---|
| 121-B1 | 119 | 2479 | 295001 |
| 121-B12 | 28 | 1512 | 42336 |
| 121-B11 | 27.3 | 1544 | 42151.2 |
| 121-B5 | 33.4 | 765 | 25551 |
| 121-B9 | 28.7 | 927 | 26604.9 |
| 121-B10 | 35.4 | 727 | 25735.8 |
| 121-B2 | 36 | 1633 | 58788 |
| 121-B13 | 27.6 | 1269 | 35024.4 |
| | Sums: | 10856 | 551192 |

Spatially Weighted Average **50.8**




0 25 50

Feet

MorrisCanal

**Contours.jpg**

**RGB**

Red: Band_1

Green: Band_2

Blue: Band_3

**Groundwater Contours May 2011**
**From Figure 11A of January 2012 RI/RAWP**

PPG Sites 112 and 207
Berrys Lane Park
Jersey City, New Jersey 07304

| SCALE: | DATE: | PROJECT NUMBER: | PATH AND FILE NAME: |
|---|---|---|---|
| 1:600 | 10/14/2013 | 60308927 | ECC14\GIS |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| FIGURE NUMBER: |
|---|
| 1 |
| **SHEET NUMBER:** |
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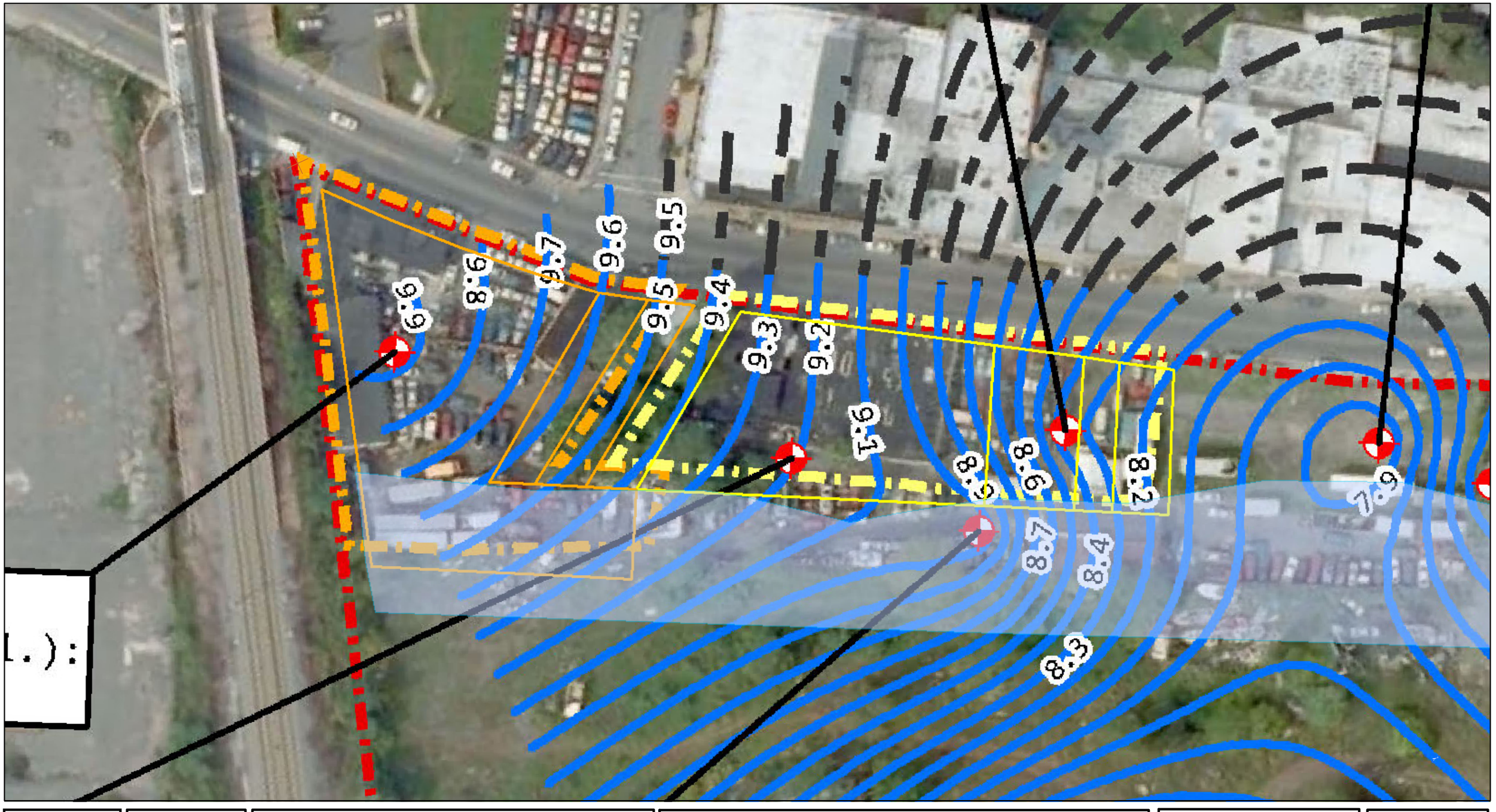



0 25 50
Feet

MorrisCanal

**Groundwater Contours June 2011**
**From Figure 12A of January 2012 RI/RAWP**

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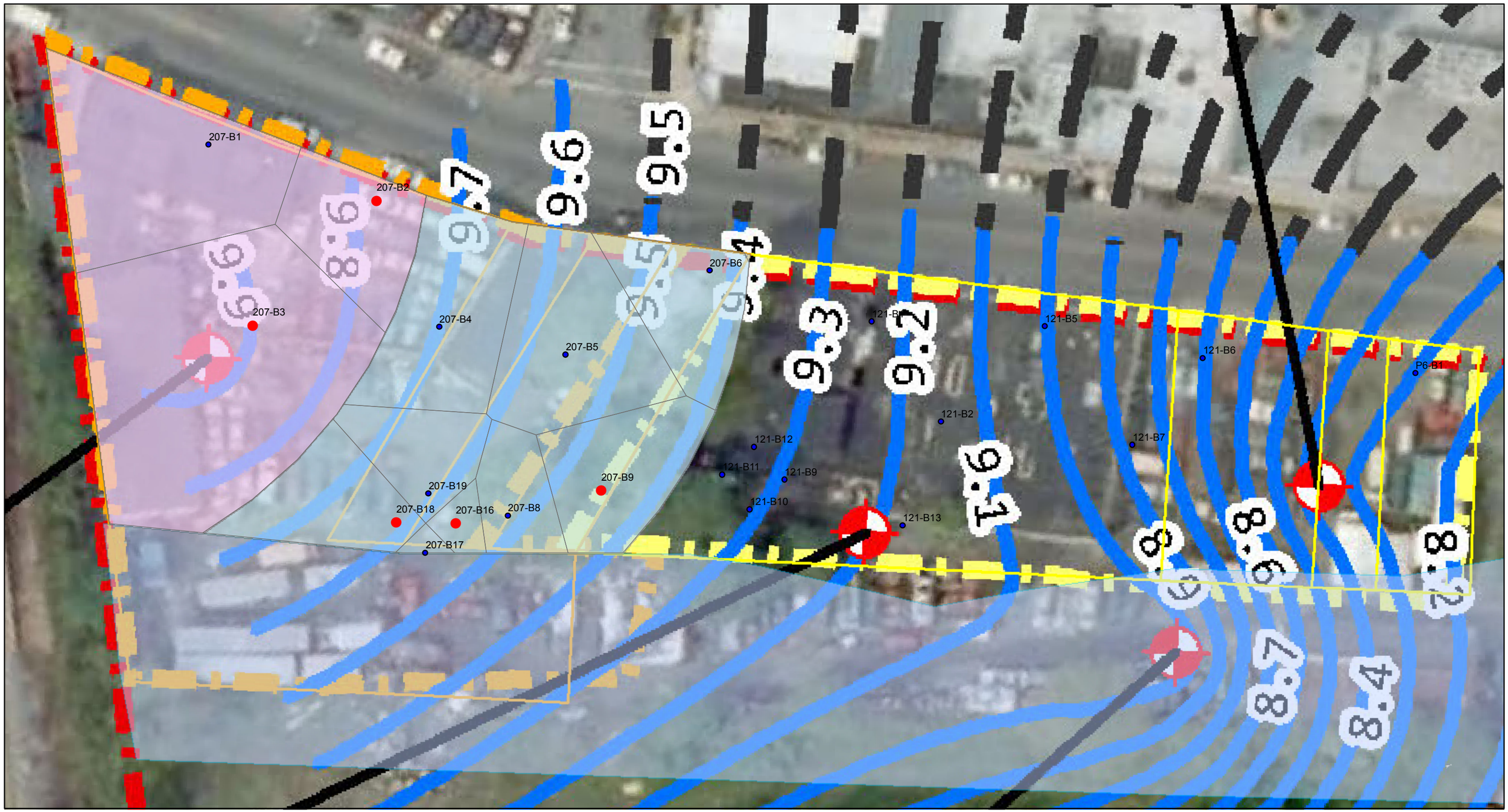
| FIGURE NUMBER: |
|---|
| 2 |
| SHEET NUMBER: |
| 1 of 1 |




**Nickel 0-2 ft**

- No
- Yes
- Thiessen Polygons
- MorrisCanal

June 2011 groundwater contours shown.

**Nickel Exceedances of DIGWSL**
**0-2 ft bgs**

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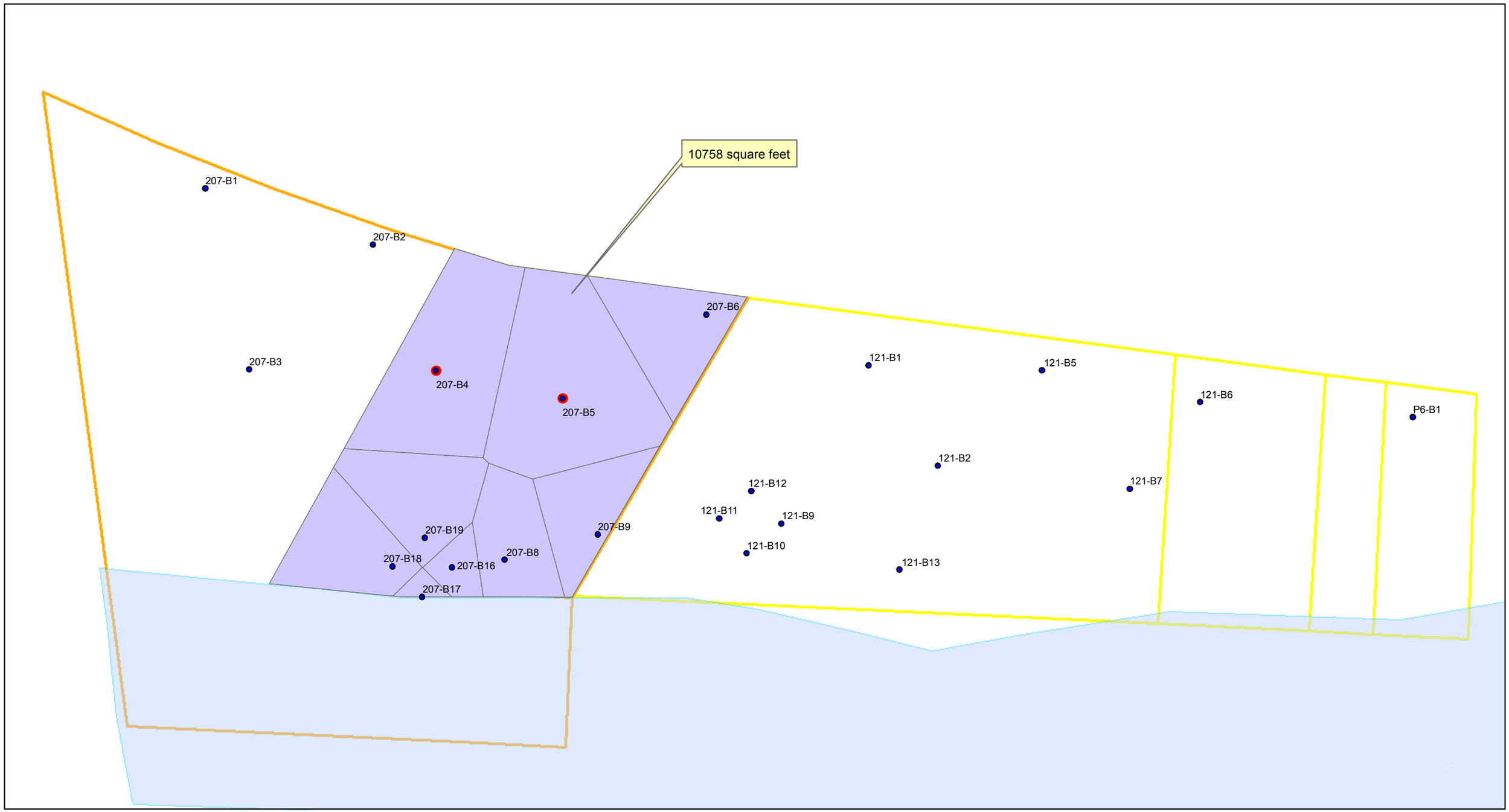
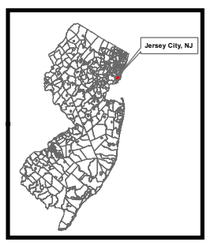
| FIGURE NUMBER: |
|---|
| 3 |
| **SHEET NUMBER:** |
| 1 of 1 |




0 15 30
Feet

**Thallium 2-18 ft**

- No Exceedances
- Exceedance
- Thiessen Polygons
- Thallium 2-18 ft Functional Area
- MorrisCanal

**Thallium Exceedances of RDC SRS**
**2-18 ft bgs**

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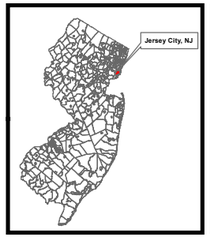
FIGURE NUMBER:
**4**
SHEET NUMBER:
1 of 1

207-B1
207-B2
10758 square feet
207-B6
207-B3
207-B4
207-B5
121-B1
121-B5
121-B6
P6-B1
121-B2
121-B12
121-B7
121-B11
121-B9
207-B9
121-B10
MC_004V
121-B13
207-B19
207-B18
207-B16
207-B8
207-B17




0 15 30
Feet

**Vanadium 0-2 ft**
- No Exceedances
- Exceedance
- Thiessen Polygons
- V0-2ft Functional Area
- Morris Canal

**Vanadium Exceedances of RDC SRS**
**0-2 ft bgs**

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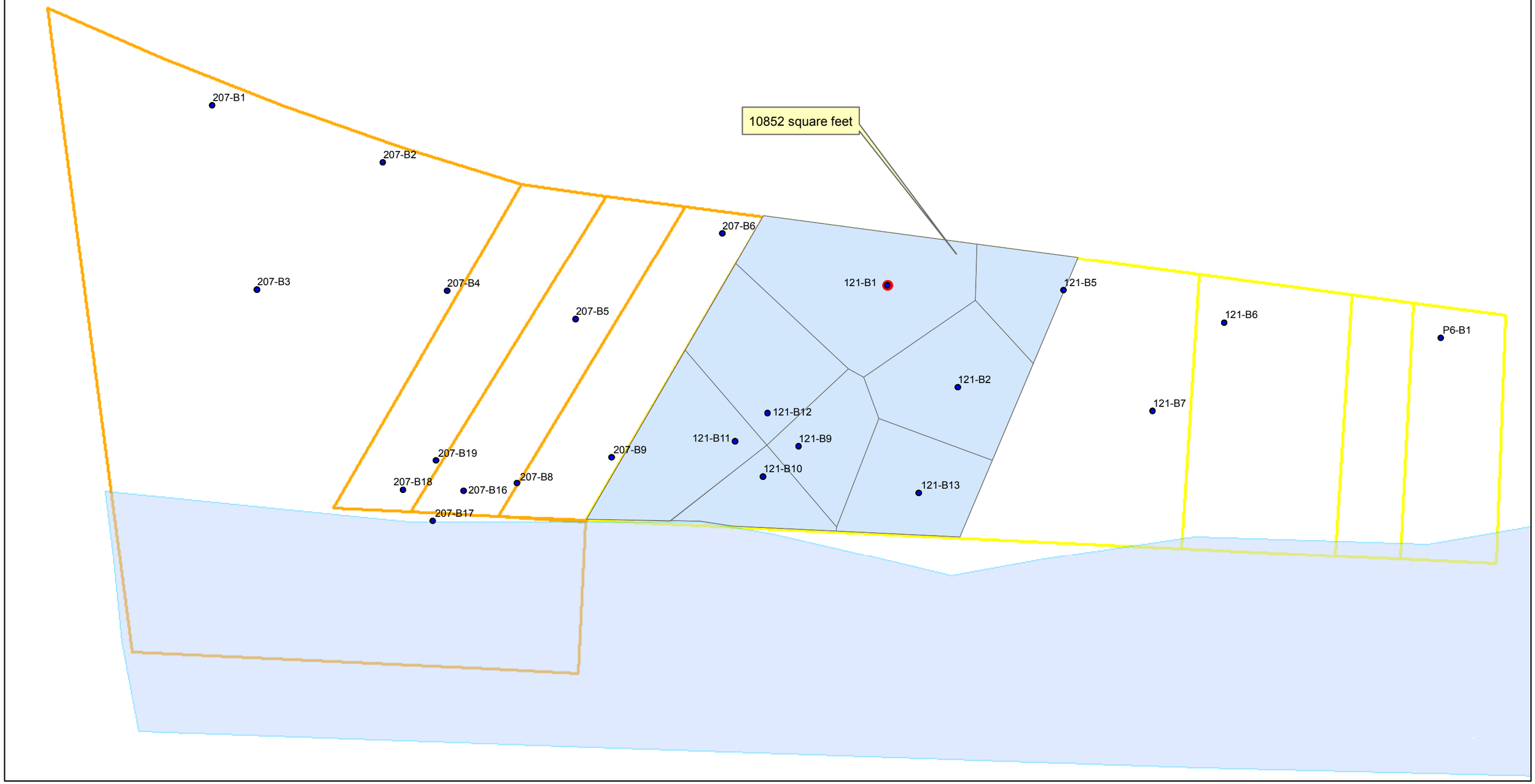
FIGURE NUMBER:
**5**
SHEET NUMBER:
1 of 1





0 15 30
Feet

**Vanadium 2-18 ft**

- No Exceedances
- Exceedance
- Thiessen Polygons
- V2-18ft Functional Area
- MorrisCanal

**Vanadium Exceedances of RDC SRS**
**2-18 ft bgs**

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|---|---|---|---|
| 1:360 | 10/14/2013 | 60308927 | ECC14\GIS |


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FIGURE NUMBER:

**6**

SHEET NUMBER:

1 of 1

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **Table 1: Thallium 2-18 ft - UCL Statistics for Data Sets with Non-Detects** | | | | | | | | | | | |
| 2 | | | | | | | | | | | | |
| 3 | User Selected Options | | | | | | | | | | | |
| 4 | Date/Time of Computation | 9/5/2014 2:16:36 PM | | | | | | | | | | |
| 5 | From File | for ProUCL_memo R2_c.xls | | | | | | | | | | |
| 6 | Full Precision | OFF | | | | | | | | | | |
| 7 | Confidence Coefficient | 95% | | | | | | | | | | |
| 8 | mber of Bootstrap Operations | 2000 | | | | | | | | | | |
| 9 | | | | | | | | | | | | |
| 10 | **Thallium** | | | | | | | | | | | |
| 11 | | | | | | | | | | | | |
| 12 | **General Statistics** | | | | | | | | | | | |
| 13 | Total Number of Observations | 37 | | | | | Number of Distinct Observations | 35 | | | | |
| 14 | Number of Detects | 26 | | | | | Number of Non-Detects | 11 | | | | |
| 15 | Number of Distinct Detects | 26 | | | | | Number of Distinct Non-Detects | 9 | | | | |
| 16 | Minimum Detect | 0.172 | | | | | Minimum Non-Detect | 0.146 | | | | |
| 17 | Maximum Detect | 8.23 | | | | | Maximum Non-Detect | 0.269 | | | | |
| 18 | Variance Detects | 3.554 | | | | | Percent Non-Detects | 29.73% | | | | |
| 19 | Mean Detects | 1.005 | | | | | SD Detects | 1.885 | | | | |
| 20 | Median Detects | 0.337 | | | | | CV Detects | 1.875 | | | | |
| 21 | Skewness Detects | 3.26 | | | | | Kurtosis Detects | 10.33 | | | | |
| 22 | Mean of Logged Detects | -0.72 | | | | | SD of Logged Detects | 0.994 | | | | |
| 23 | | | | | | | | | | | | |
| 24 | **Normal GOF Test on Detects Only** | | | | | | | | | | | |
| 25 | Shapiro Wilk Test Statistic | 0.46 | | | | | **Shapiro Wilk GOF Test** | | | | | |
| 26 | 5% Shapiro Wilk Critical Value | 0.92 | | | | | Detected Data Not Normal at 5% Significance Level | | | | | |
| 27 | Lilliefors Test Statistic | 0.367 | | | | | **Lilliefors GOF Test** | | | | | |
| 28 | 5% Lilliefors Critical Value | 0.174 | | | | | Detected Data Not Normal at 5% Significance Level | | | | | |
| 29 | **Detected Data Not Normal at 5% Significance Level** | | | | | | | | | | | |
| 30 | | | | | | | | | | | | |
| 31 | **Kaplan-Meier (KM) Statistics using Normal Critical Values and other Nonparametric UCLs** | | | | | | | | | | | |
| 32 | Mean | 0.752 | | | | | Standard Error of Mean | 0.268 | | | | |
| 33 | SD | 1.598 | | | | | 95% KM (BCA) UCL | 1.274 | | | | |
| 34 | 95% KM (t) UCL | 1.204 | | | | | 95% KM (Percentile Bootstrap) UCL | 1.238 | | | | |
| 35 | 95% KM (z) UCL | 1.193 | | | | | 95% KM Bootstrap t UCL | 2.561 | | | | |
| 36 | 90% KM Chebyshev UCL | 1.556 | | | | | 95% KM Chebyshev UCL | 1.92 | | | | |
| 37 | 97.5% KM Chebyshev UCL | 2.425 | | | | | 99% KM Chebyshev UCL | 3.418 | | | | |
| 38 | | | | | | | | | | | | |
| 39 | **Gamma GOF Tests on Detected Observations Only** | | | | | | | | | | | |
| 40 | A-D Test Statistic | 3.479 | | | | | **Anderson-Darling GOF Test** | | | | | |
| 41 | 5% A-D Critical Value | 0.781 | | | | | Detected Data Not Gamma Distributed at 5% Significance Level | | | | | |
| 42 | K-S Test Statistic | 0.309 | | | | | **Kolmogrov-Smirnoff GOF** | | | | | |
| 43 | 5% K-S Critical Value | 0.178 | | | | | Detected Data Not Gamma Distributed at 5% Significance Level | | | | | |
| 44 | **Detected Data Not Gamma Distributed at 5% Significance Level** | | | | | | | | | | | |
| 45 | | | | | | | | | | | | |
| 46 | **Gamma Statistics on Detected Data Only** | | | | | | | | | | | |
| 47 | k hat (MLE) | 0.816 | | | | | k star (bias corrected MLE) | 0.747 | | | | |
| 48 | Theta hat (MLE) | 1.233 | | | | | Theta star (bias corrected MLE) | 1.345 | | | | |
| 49 | nu hat (MLE) | 42.42 | | | | | nu star (bias corrected) | 38.86 | | | | |
| 50 | MLE Mean (bias corrected) | 1.005 | | | | | MLE Sd (bias corrected) | 1.163 | | | | |
| 51 | | | | | | | | | | | | |
| 52 | **Gamma Kaplan-Meier (KM) Statistics** | | | | | | | | | | | |
| 53 | k hat (KM) | 0.221 | | | | | nu hat (KM) | 16.38 | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 54 | Approximate Chi Square Value (16.38, α) | | | | | 8.234 | Adjusted Chi Square Value (16.38, β) | | | | | 7.983 |
| 55 | 5% Gamma Approximate KM-UCL (use when n>=50) | | | | | 1.496 | 95% Gamma Adjusted KM-UCL (use when n<50) | | | | | 1.543 |
| 56 | | | | | | | | | | | | |
| 57 | **Gamma ROS Statistics using Imputed Non-Detects** | | | | | | | | | | | |
| 58 | GROS may not be used when data set has > 50% NDs with many tied observations at multiple DLs | | | | | | | | | | | |
| 59 | GROS may not be used when kstar of detected data is small such as < 0.1 | | | | | | | | | | | |
| 60 | For such situations, GROS method tends to yield inflated values of UCLs and BTVs | | | | | | | | | | | |
| 61 | For gamma distributed detected data, BTVs and UCLs may be computed using gamma distribution on KM estimates | | | | | | | | | | | |
| 62 | Minimum | | | | | 0.01 | Mean | | | | | 0.71 |
| 63 | Maximum | | | | | 8.23 | Median | | | | | 0.268 |
| 64 | SD | | | | | 1.637 | CV | | | | | 2.308 |
| 65 | k hat (MLE) | | | | | 0.425 | k star (bias corrected MLE) | | | | | 0.409 |
| 66 | Theta hat (MLE) | | | | | 1.668 | Theta star (bias corrected MLE) | | | | | 1.735 |
| 67 | nu hat (MLE) | | | | | 31.47 | nu star (bias corrected) | | | | | 30.25 |
| 68 | MLE Mean (bias corrected) | | | | | 0.71 | MLE Sd (bias corrected) | | | | | 1.11 |
| 69 | | | | | | | Adjusted Level of Significance (β) | | | | | 0.0431 |
| 70 | Approximate Chi Square Value (30.25, α) | | | | | 18.69 | Adjusted Chi Square Value (30.25, β) | | | | | 18.3 |
| 71 | 95% Gamma Approximate UCL (use when n>=50) | | | | | 1.148 | 95% Gamma Adjusted UCL (use when n<50) | | | | | 1.173 |
| 72 | | | | | | | | | | | | |
| 73 | **Lognormal GOF Test on Detected Observations Only** | | | | | | | | | | | |
| 74 | Shapiro Wilk Test Statistic | | | | | 0.792 | **Shapiro Wilk GOF Test** | | | | | |
| 75 | 5% Shapiro Wilk Critical Value | | | | | 0.92 | Detected Data Not Lognormal at 5% Significance Level | | | | | |
| 76 | Lilliefors Test Statistic | | | | | 0.231 | **Lilliefors GOF Test** | | | | | |
| 77 | 5% Lilliefors Critical Value | | | | | 0.174 | Detected Data Not Lognormal at 5% Significance Level | | | | | |
| 78 | **Detected Data Not Lognormal at 5% Significance Level** | | | | | | | | | | | |
| 79 | | | | | | | | | | | | |
| 80 | **Lognormal ROS Statistics Using Imputed Non-Detects** | | | | | | | | | | | |
| 81 | Mean in Original Scale | | | | | 0.726 | Mean in Log Scale | | | | | -1.332 |
| 82 | SD in Original Scale | | | | | 1.63 | SD in Log Scale | | | | | 1.273 |
| 83 | 95% t UCL (assumes normality of ROS data) | | | | | 1.178 | 95% Percentile Bootstrap UCL | | | | | 1.216 |
| 84 | 95% BCA Bootstrap UCL | | | | | 1.397 | 95% Bootstrap t UCL | | | | | 2.526 |
| 85 | 95% H-UCL (Log ROS) | | | | | 1.056 | | | | | | |
| 86 | | | | | | | | | | | | |
| 87 | **DL/2 Statistics** | | | | | | | | | | | |
| 88 | **DL/2 Normal** | | | | | | **DL/2 Log-Transformed** | | | | | |
| 89 | Mean in Original Scale | | | | | 0.734 | Mean in Log Scale | | | | | -1.224 |
| 90 | SD in Original Scale | | | | | 1.627 | SD in Log Scale | | | | | 1.147 |
| 91 | 95% t UCL (Assumes normality) | | | | | 1.185 | 95% H-Stat UCL | | | | | 0.926 |
| 92 | **DL/2 is not a recommended method, provided for comparisons and historical reasons** | | | | | | | | | | | |
| 93 | | | | | | | | | | | | |
| 94 | **Nonparametric Distribution Free UCL Statistics** | | | | | | | | | | | |
| 95 | **Data do not follow a Discernible Distribution at 5% Significance Level** | | | | | | | | | | | |
| 96 | | | | | | | | | | | | |
| 97 | **Suggested UCL to Use** | | | | | | | | | | | |
| 98 | 95% KM (BCA) UCL | | | | | 1.274 | | | | | | |
| 99 | | | | | | | | | | | | |
| 100 | Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | | | | | | | | | |
| 101 | Recommendations are based upon data size, data distribution, and skewness. | | | | | | | | | | | |
| 102 | These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). | | | | | | | | | | | |
| 103 | However, simulations results will not cover all Real World data sets; for additional insight the user may want to consult a statisticia | | | | | | | | | | | |
| 104 | | | | | | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | **Table 2: Vanadium 2-18 ft - UCL Statistics for Data Sets with Non-Detects** | | | | | | | | | | | |
| 2 | | | | | | | | | | | | |
| 3 | User Selected Options | | | | | | | | | | | |
| 4 | Date/Time of Computation | 9/5/2014 2:14:44 PM | | | | | | | | | | |
| 5 | From File | for ProUCL_memo R2_e.xls | | | | | | | | | | |
| 6 | Full Precision | OFF | | | | | | | | | | |
| 7 | Confidence Coefficient | 95% | | | | | | | | | | |
| 8 | mber of Bootstrap Operations | 2000 | | | | | | | | | | |
| 9 | | | | | | | | | | | | |
| 10 | | | | | | | | | | | | |
| 11 | **Vanadium** | | | | | | | | | | | |
| 12 | | | | | | | | | | | | |
| 13 | **General Statistics** | | | | | | | | | | | |
| 14 | Total Number of Observations | 37 | | | Number of Distinct Observations | 34 | | | | | | |
| 15 | | | | | Number of Missing Observations | 0 | | | | | | |
| 16 | Minimum | 9.89 | | | Mean | 26.73 | | | | | | |
| 17 | Maximum | 119 | | | Median | 21.5 | | | | | | |
| 18 | SD | 19.63 | | | Std. Error of Mean | 3.228 | | | | | | |
| 19 | Coefficient of Variation | 0.735 | | | Skewness | 3.625 | | | | | | |
| 20 | | | | | | | | | | | | |
| 21 | **Normal GOF Test** | | | | | | | | | | | |
| 22 | Shapiro Wilk Test Statistic | 0.581 | | | **Shapiro Wilk GOF Test** | | | | | | | |
| 23 | 5% Shapiro Wilk Critical Value | 0.936 | | | Data Not Normal at 5% Significance Level | | | | | | | |
| 24 | Lilliefors Test Statistic | 0.271 | | | **Lilliefors GOF Test** | | | | | | | |
| 25 | 5% Lilliefors Critical Value | 0.146 | | | Data Not Normal at 5% Significance Level | | | | | | | |
| 26 | **Data Not Normal at 5% Significance Level** | | | | | | | | | | | |
| 27 | | | | | | | | | | | | |
| 28 | **Assuming Normal Distribution** | | | | | | | | | | | |
| 29 | **95% Normal UCL** | | | | **95% UCLs (Adjusted for Skewness)** | | | | | | | |
| 30 | 95% Student's-t UCL | 32.18 | | | 95% Adjusted-CLT UCL (Chen-1995) | 34.09 | | | | | | |
| 31 | | | | | 95% Modified-t UCL (Johnson-1978) | 32.5 | | | | | | |
| 32 | | | | | | | | | | | | |
| 33 | **Gamma GOF Test** | | | | | | | | | | | |
| 34 | A-D Test Statistic | 2.241 | | | **Anderson-Darling Gamma GOF Test** | | | | | | | |
| 35 | 5% A-D Critical Value | 0.753 | | | Data Not Gamma Distributed at 5% Significance Level | | | | | | | |
| 36 | K-S Test Statistic | 0.189 | | | **Kolmogrov-Smirnoff Gamma GOF Test** | | | | | | | |
| 37 | 5% K-S Critical Value | 0.146 | | | Data Not Gamma Distributed at 5% Significance Level | | | | | | | |
| 38 | **Data Not Gamma Distributed at 5% Significance Level** | | | | | | | | | | | |
| 39 | | | | | | | | | | | | |
| 40 | **Gamma Statistics** | | | | | | | | | | | |
| 41 | k hat (MLE) | 3.781 | | | k star (bias corrected MLE) | 3.492 | | | | | | |
| 42 | Theta hat (MLE) | 7.07 | | | Theta star (bias corrected MLE) | 7.654 | | | | | | |
| 43 | nu hat (MLE) | 279.8 | | | nu star (bias corrected) | 258.4 | | | | | | |
| 44 | MLE Mean (bias corrected) | 26.73 | | | MLE Sd (bias corrected) | 14.3 | | | | | | |
| 45 | | | | | Approximate Chi Square Value (0.05) | 222.2 | | | | | | |
| 46 | Adjusted Level of Significance | 0.0431 | | | Adjusted Chi Square Value | 220.7 | | | | | | |
| 47 | | | | | | | | | | | | |
| 48 | **Assuming Gamma Distribution** | | | | | | | | | | | |
| 49 | 95% Approximate Gamma UCL (use when n>=50)) | 31.09 | | | 95% Adjusted Gamma UCL (use when n<50) | 31.29 | | | | | | |
| 50 | | | | | | | | | | | | |
| 51 | **Lognormal GOF Test** | | | | | | | | | | | |
| 52 | Shapiro Wilk Test Statistic | 0.889 | | | **Shapiro Wilk Lognormal GOF Test** | | | | | | | |
| 53 | 5% Shapiro Wilk Critical Value | 0.936 | | | Data Not Lognormal at 5% Significance Level | | | | | | | |

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 54 | Lilliefors Test Statistic | | | | | 0.158 | **Lilliefors Lognormal GOF Test** | | | | | |
| 55 | 5% Lilliefors Critical Value | | | | | 0.146 | Data Not Lognormal at 5% Significance Level | | | | | |
| 56 | **Data Not Lognormal at 5% Significance Level** | | | | | | | | | | | |
| 57 | | | | | | | | | | | | |
| 58 | **Lognormal Statistics** | | | | | | | | | | | |
| 59 | Minimum of Logged Data | | | | | 2.292 | Mean of logged Data | | | | | 3.148 |
| 60 | Maximum of Logged Data | | | | | 4.779 | SD of logged Data | | | | | 0.472 |
| 61 | | | | | | | | | | | | |
| 62 | **Assuming Lognormal Distribution** | | | | | | | | | | | |
| 63 | 95% H-UCL | | | | | 30.22 | 90% Chebyshev (MVUE) UCL | | | | | 32.25 |
| 64 | 95% Chebyshev (MVUE) UCL | | | | | 35.1 | 97.5% Chebyshev (MVUE) UCL | | | | | 39.06 |
| 65 | 99% Chebyshev (MVUE) UCL | | | | | 46.84 | | | | | | |
| 66 | | | | | | | | | | | | |
| 67 | **Nonparametric Distribution Free UCL Statistics** | | | | | | | | | | | |
| 68 | **Data do not follow a Discernible Distribution (0.05)** | | | | | | | | | | | |
| 69 | | | | | | | | | | | | |
| 70 | **Nonparametric Distribution Free UCLs** | | | | | | | | | | | |
| 71 | 95% CLT UCL | | | | | 32.04 | 95% Jackknife UCL | | | | | 32.18 |
| 72 | 95% Standard Bootstrap UCL | | | | | 31.87 | 95% Bootstrap-t UCL | | | | | 40.07 |
| 73 | 95% Hall's Bootstrap UCL | | | | | 59.65 | 95% Percentile Bootstrap UCL | | | | | 32.76 |
| 74 | 95% BCA Bootstrap UCL | | | | | 34.51 | | | | | | |
| 75 | 90% Chebyshev(Mean, Sd) UCL | | | | | 36.41 | 95% Chebyshev(Mean, Sd) UCL | | | | | 40.8 |
| 76 | 97.5% Chebyshev(Mean, Sd) UCL | | | | | 46.89 | 99% Chebyshev(Mean, Sd) UCL | | | | | 58.85 |
| 77 | | | | | | | | | | | | |
| 78 | **Suggested UCL to Use** | | | | | | | | | | | |
| 79 | 95% Student's-t UCL | | | | | 32.18 | or 95% Modified-t UCL | | | | | 32.5 |
| 80 | | | | | | | | | | | | |
| 81 | Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. | | | | | | | | | | | |
| 82 | These recommendations are based upon the results of the simulation studies summarized in Singh, Singh, and Iaci (2002) | | | | | | | | | | | |
| 83 | and Singh and Singh (2003). However, simulations results will not cover all Real World data sets. | | | | | | | | | | | |
| 84 | For additional insight the user may want to consult a statistician. | | | | | | | | | | | |
| 85 | | | | | | | | | | | | |

# Attachment 2
# Recent Groundwater Data

G:\Env\Projects\00080 JCRA\B00080-64 Morris Canal\GIS\REMEDIATION\BLPGW_JAN2014XCD.mxd

RANDOLPH AVE

HUDSON COUNTY 610

HARMON ST

GARFIELD AVE

| MW-7-2A | (DEPTH: 8.5) |
|---|---|
| ANALYTE | CONC. (µg/kg) |
| Benzene | 9.78 |

| MW-7-2B | (DEPTH: 12.5) |
|---|---|
| ANALYTE | CONC. (µg/kg) |
| Benzene | 12.9 |

| MW-CR-2A | (DEPTH: 13.0) |
|---|---|
| ANALYTE | CONC. (µg/kg) |
| Nickel | 104 |

| MW-10-1A | (DEPTH: 11.0) |
|---|---|
| ANALYTE | CONC. (µg/kg) |
| 2-Methylnaphthalene | 70.3 |
| Benzo(A)Anthracene | 3.03 |
| Benzo(A)Pyrene | 2.07 |
| Benzo(B)Fluoranthene | 1.75 |
| Benzo(K)Fluoranthene | 1.96 |
| Dibenzo(A,H)Anthracene | 0.569 |
| Indeno(1,2,3-Cd)Pyrene | 0.955 |

MW-4-UST6-1
MW-3-UST5-1
MW-7-UST1-1
MW-CR1
MW-CR2
MW-CR3
MW-CR4
MW-CR5
MW-CR6
MW-CR7
MW-CR8
MW-10-1
MW-9-1
MW-9-3
MW-9-4
MW-12-2
MW-SS-1

| MW-CR-5A | (DEPTH: 9.0) |
|---|---|
| ANALYTE | CONC. (µg/kg) |
| Nickel | 106 |

| MW-CR-5C | (DEPTH: 18.0) |
|---|---|
| ANALYTE | CONC. (µg/kg) |
| Nickel | 104 |

| REP-011314 | (DEPTH: 10.3) |
|---|---|
| ANALYTE | CONC. (µg/kg) |
| Total Xylenes | 1010 |

| MW-SS-1A | (DEPTH: 11.5) |
|---|---|
| ANALYTE | CONC. (µg/kg) |
| Aluminum | 640 |
| Iron | 896 |
| Manganese | 987 |
| Sodium | 247000 |

| REP-011314 | (DEPTH: 11.5) |
|---|---|
| ANALYTE | CONC. (µg/kg) |
| Aluminum | 710 |
| Iron | 824 |
| Manganese | 1020 |
| Sodium | 258000 |

| MW-SS-1B | (DEPTH: 14.0) |
|---|---|
| ANALYTE | CONC. (µg/kg) |
| Aluminum | 390 |
| Iron | 570 |
| Manganese | 1270 |
| Sodium | 342000 |

VAN HORNE ST

HALLADAY ST

bing™

Legend

- MONITORING WELL LOCATION WITH GWQC EXCEEDANCE
- MONITORING WELL LOCATION
- BERRY LANE PARK BOUNDARY
- HORIZONTAL EXTENT OF EXCAVATION

| Analyte | Higher of PQLs and GWQC (µg/L) | Vapor Intrusion GW Screening Levels (µg/L) |
|---|---|---|
| 2-Methylnaphthalene | 30 | NS |
| Aluminum | 200 | NS |
| Benzene | 1 | 20 |
| Benzo(A)Anthracene | 0.1 | NS |
| Benzo(A)Pyrene | 0.1 | NS |
| Benzo(B)Fluoranthene | 0.2 | NS |
| Benzo(K)Fluoranthene | 0.5 | NS |
| Dibenzo(A,H)Anthracene | 0.3 | NS |
| Indeno(1,2,3-Cd)Pyrene | 0.2 | NS |
| Iron | 300 | NS |
| Manganese | 50 | NS |
| Nickel | 100 | NS |
| Sodium | 50000 | NS |
| Total Xylenes | 1000 | 8600 |

GWQC = GROUNDWATER QUALITY CRITERIA NS = NO STANDARD

0 30 60 90 120 240 360

FEET
1 inch = 120 feet

PROJECT:
REMEDIAL INVESTIGATION

LOCATION:
FOOT OF BERRY LANE ROAD
CITY OF JERSEY CITY
HUDSON COUNTY, NEW JERSEY

DRAWING TITLE:
GROUNDWATER SAMPLING EVENT JANUARY 14-16 2014
NJDEP GROUNDWATER QUALITY CRITERIA EXCEEDANCES

DRESDNER ROBIN

| DRAWN BY: | JOB NUMBER: |
|---|---|
| N.K. | B80-806 |
| CHECKED BY: | FILE: |
| J.T. | BLPGW_JAN2014XCD |
| DATE: 02/04/14 | FIGURE 1 |

REFERENCES: MICROSOFT VIRTUAL EARTH AERIAL 2013; NEW JERSEY DEPARTMENT OF TRANSPORTATION 2013.

# Table 1
# Ground Water Analytical Results Summary
# Berry Lane Park
# Chromate Investigation
# January 14-16, 2014

| Sample #: | HIGHER OF | MW-CR-1A | | | | MW-CR-1B | | | | MW-CR-1C | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PQLs | | | | | | | | | | | | |
| Lab ID: | and | 00370-001 | | | | 00370-002 | | | | 00370-003 | | | |
| Date Sampled: | GWQC | 01/14/2014 | | | | 01/14/2014 | | | | 01/14/2014 | | | |
| Depth(ft): | (ug/L) | 12.5 | | | | 17.5 | | | | 22.5 | | | |
| | | | | | | | | | | | | | |
| **Pesticides (ug/L)** | | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** |
| Dieldrin | **0.03** | ~ | | ~ | ~ | ~ | | ~ | ~ | ~ | | ~ | ~ |
| **Metals (ug/L)** | | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** |
| Antimony | **6** | 1.03 | J | 2.00 | 1.00 | 1.00 | J | 2.00 | 1.00 | ND | | 2.00 | 1.00 |
| Chromium | **70** | 11.6 | | 2.00 | 2.00 | 11.2 | | 2.00 | 2.00 | 6.84 | | 2.00 | 2.00 |
| Nickel | **100** | 13.9 | | 2.00 | 1.00 | 12.5 | | 2.00 | 1.00 | 9.73 | | 2.00 | 1.00 |
| Thallium | **2** | ND | | 2.00 | 0.500 | ND | | 2.00 | 0.500 | ND | | 2.00 | 0.500 |
| Vanadium | **NS** | ND | | 2.00 | 2.00 | 2.10 | | 2.00 | 2.00 | ND | | 2.00 | 2.00 |
| **General Analytical** | | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** |
| Hexavalent Chromium-ug/L | **NS** | ND | | 10.0 | 4.00 | ND | | 10.0 | 4.00 | 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 Conc** Indicates a concentration that exceeds the applicable criteria.

**BOLD RL** Indicates RL that exceeds applicable criteria.

**BOLD MDL** Indicates MDL that exceeds 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. For non-target compounds (i.e. TICs), qualifier indicates estimated concentrations

# Table 1
# Ground Water Analytical Results Summary
# Berry Lane Park
# Chromate Investigation
# January 14-16, 2014

| Sample #: | HIGHER OF | MW-CR-2A | | | | MW-CR-2B | | | | MW-CR-2C | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PQLs | | | | | | | | | | | | |
| Lab ID: | and | 00370-004 | | | | 00370-005 | | | | 00370-006 | | | |
| Date Sampled: | GWQC | 01/14/2014 | | | | 01/14/2014 | | | | 01/14/2014 | | | |
| Depth(ft): | (ug/L) | 13.0 | | | | 18.0 | | | | 23.0 | | | |
| | | | | | | | | | | | | | |
| **Pesticides (ug/L)** | | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** |
| Dieldrin | **0.03** | ~ | | ~ | ~ | ~ | | ~ | ~ | ~ | | ~ | ~ |
| **Metals (ug/L)** | | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** |
| Antimony | **6** | ND | | 2.00 | 1.00 | ND | | 2.00 | 1.00 | ND | | 2.00 | 1.00 |
| Chromium | **70** | 3.13 | | 2.00 | 2.00 | 4.63 | | 2.00 | 2.00 | 6.23 | | 2.00 | 2.00 |
| Nickel | **100** | **104** | | 2.00 | 1.00 | 86.1 | | 2.00 | 1.00 | 88.0 | | 2.00 | 1.00 |
| Thallium | **2** | ND | | 2.00 | 0.500 | ND | | 2.00 | 0.500 | ND | | 2.00 | 0.500 |
| Vanadium | **NS** | 29.3 | | 2.00 | 2.00 | 29.5 | | 2.00 | 2.00 | 29.9 | | 2.00 | 2.00 |
| **General Analytical** | | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** |
| Hexavalent Chromium-ug/L | **NS** | ND | | 10.0 | 4.00 | ND | | 10.0 | 4.00 | ND | | 10.0 | 4.00 |

Notes:

NJDEP Class II-A Specific Ground Water Quality Criteria : (

**BOLD Conc** Indicates a cor

**BOLD RL** Indicates RL th

**BOLD MDL** Indicates MDL

NS = No Standard Available

ND = Analyzed for but Not Detected at the MDL

J = Concentration detected at a value below the RL and abo

# Table 1
# Ground Water Analytical Results Summary
# Berry Lane Park
# Chromate Investigation
# January 14-16, 2014

| Sample #: | HIGHER OF | MW-CR-3A | | | | MW-CR-3B | | | | MW-CR-3C | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PQLs | | | | | | | | | | | | |
| Lab ID: | and | 00370-008 | | | | 00370-009 | | | | 00370-010 | | | |
| Date Sampled: | GWQC | 01/14/2014 | | | | 01/14/2014 | | | | 01/14/2014 | | | |
| Depth(ft): | (ug/L) | 14.0 | | | | 18.0 | | | | 23.0 | | | |
| | | | | | | | | | | | | | |
| **Pesticides (ug/L)** | | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** |
| Dieldrin | **0.03** | ~ | ~ | ~ | | ~ | | ~ | ~ | ~ | | ~ | ~ |
| **Metals (ug/L)** | | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** |
| Antimony | **6** | ND | | 2.00 | 1.00 | ND | | 2.00 | 1.00 | ND | | 2.00 | 1.00 |
| Chromium | **70** | 18.1 | | 2.00 | 2.00 | 22.5 | | 2.00 | 2.00 | 27.3 | | 2.00 | 2.00 |
| Nickel | **100** | 97.8 | | 2.00 | 1.00 | 94.2 | | 2.00 | 1.00 | 93.7 | | 2.00 | 1.00 |
| Thallium | **2** | ND | | 2.00 | 0.500 | ND | | 2.00 | 0.500 | ND | | 2.00 | 0.500 |
| Vanadium | **NS** | 27.8 | | 2.00 | 2.00 | 27.9 | | 2.00 | 2.00 | 36.8 | | 2.00 | 2.00 |
| **General Analytical** | | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** |
| Hexavalent Chromium-ug/L | **NS** | ND | | 10.0 | 4.00 | ND | | 10.0 | 4.00 | ND | | 10.0 | 4.00 |

Notes:

NJDEP Class II-A Specific Ground Water Quality Criteria : (

**BOLD Conc** Indicates a cor

**BOLD RL** Indicates RL th

**BOLD MDL** Indicates MDL

NS = No Standard Available

ND = Analyzed for but Not Detected at the MDL

J = Concentration detected at a value below the RL and ab

# Table 1
# Ground Water Analytical Results Summary
# Berry Lane Park
# Chromate Investigation
# January 14-16, 2014

| Sample #: | HIGHER OF | MW-CR-4A | | | | MW-CR-4B | | | | MW-CR-4C | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PQLs | | | | | | | | | | | | |
| Lab ID: | and | 00410-001 | | | | 00410-002 | | | | 00410-003 | | | |
| Date Sampled: | GWQC | 01/15/2014 | | | | 01/15/2014 | | | | 01/15/2014 | | | |
| Depth(ft): | (ug/L) | 11.0 | | | | 16.0 | | | | 21.0 | | | |
| | | | | | | | | | | | | | |
| **Pesticides (ug/L)** | | **Conc** | **Q** | | | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **Conc** | **Q** |
| Dieldrin | **0.03** | ~ | | | | ~ | | ~ | ~ | ~ | | ~ | ~ |
| **Metals (ug/L)** | | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** |
| Antimony | **6** | 2.63 | | 2.00 | 1.00 | 1.96 | J | 2.00 | 1.00 | ND | | 2.00 | 1.00 |
| Chromium | **70** | 11.5 | | 2.00 | 2.00 | 9.48 | | 2.00 | 2.00 | 6.07 | | 2.00 | 2.00 |
| Nickel | **100** | 20.2 | | 2.00 | 1.00 | 18.0 | | 2.00 | 1.00 | 18.2 | | 2.00 | 1.00 |
| Thallium | **2** | ND | | 2.00 | 0.500 | ND | | 2.00 | 0.500 | ND | | 2.00 | 0.500 |
| Vanadium | **NS** | 4.05 | | 2.00 | 2.00 | 3.45 | | 2.00 | 2.00 | ND | | 2.00 | 2.00 |
| **General Analytical** | | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** |
| Hexavalent Chromium-ug/L | **NS** | ND | | 10.0 | 4.00 | ND | | 10.0 | 4.00 | ND | | 10.0 | 4.00 |

Notes:

NJDEP Class II-A Specific Ground Water Quality Criteria : (

**BOLD Conc** Indicates a cor

**BOLD RL** Indicates RL th

**BOLD MDL** Indicates MDL

NS = No Standard Available

ND = Analyzed for but Not Detected at the MDL

J = Concentration detected at a value below the RL and ab

# Table 1
# Ground Water Analytical Results Summary
# Berry Lane Park
# Chromate Investigation
# January 14-16, 2014

| Sample #: | HIGHER OF | MW-CR-5A | | | | MW-CR-5B | | | | MW-CR-5C | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PQLs | | | | | | | | | | | | |
| Lab ID: | and | 00410-004 | | | | 00410-005 | | | | 00410-006 | | | |
| Date Sampled: | GWQC | 01/15/2014 | | | | 01/15/2014 | | | | 01/15/2014 | | | |
| Depth(ft): | (ug/L) | 9.0 | | | | 13.0 | | | | 18.0 | | | |
| | | | | | | | | | | | | | |
| **Pesticides (ug/L)** | | **Conc** | **Q** | | | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **Conc** | **Q** |
| Dieldrin | **0.03** | ~ | | | | ~ | | ~ | ~ | ~ | | ~ | ~ |
| **Metals (ug/L)** | | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** |
| Antimony | **6** | 1.31 | J | 2.00 | 1.00 | 1.16 | J | 2.00 | 1.00 | 1.27 | J | 2.00 | 1.00 |
| Chromium | **70** | 9.73 | | 2.00 | 2.00 | 3.37 | | 2.00 | 2.00 | 2.19 | | 2.00 | 2.00 |
| Nickel | **100** | **106** | | 2.00 | 1.00 | 99.1 | | 2.00 | 1.00 | **104** | | 2.00 | 1.00 |
| Thallium | **2** | ND | | 2.00 | 0.500 | ND | | 2.00 | 0.500 | ND | | 2.00 | 0.500 |
| Vanadium | **NS** | 51.8 | | 2.00 | 2.00 | 49.9 | | 2.00 | 2.00 | 52.7 | | 2.00 | 2.00 |
| **General Analytical** | | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** |
| Hexavalent Chromium-ug/L | **NS** | ND | | 10.0 | 4.00 | ND | | 10.0 | 4.00 | ND | | 10.0 | 4.00 |

Notes:

NJDEP Class II-A Specific Ground Water Quality Criteria : (

**BOLD Conc** Indicates a cor

**BOLD RL** Indicates RL th

**BOLD MDL** Indicates MDL

NS = No Standard Available

ND = Analyzed for but Not Detected at the MDL

J = Concentration detected at a value below the RL and ab

# Table 1
# Ground Water Analytical Results Summary
# Berry Lane Park
# Chromate Investigation
# January 14-16, 2014

| Sample #: | HIGHER OF | MW-CR-6A | | | | MW-CR-6B | | | | MW-CR-6C | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PQLs | | | | | | | | | | | | |
| Lab ID: | and | 00453-010 | | | | 00453-011 | | | | 00453-012 | | | |
| Date Sampled: | GWQC | 01/16/2014 | | | | 01/16/2014 | | | | 01/16/2014 | | | |
| Depth(ft): | (ug/L) | 11.0 | | | | 15.5 | | | | 20.5 | | | |
| | | | | | | | | | | | | | |
| **Pesticides (ug/L)** | | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** |
| Dieldrin | **0.03** | ~ | | ~ | ~ | ~ | | ~ | ~ | ~ | | ~ | ~ |
| **Metals (ug/L)** | | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** |
| Antimony | **6** | ND | | 2.00 | 1.00 | ND | | 2.00 | 1.00 | ND | | 2.00 | 1.00 |
| Chromium | **70** | 6.67 | | 2.00 | 2.00 | 5.64 | | 2.00 | 2.00 | 5.11 | | 2.00 | 2.00 |
| Nickel | **100** | 27.7 | | 2.00 | 1.00 | 30.3 | | 2.00 | 1.00 | 29.1 | | 2.00 | 1.00 |
| Thallium | **2** | ND | | 2.00 | 0.500 | ND | | 2.00 | 0.500 | ND | | 2.00 | 0.500 |
| Vanadium | **NS** | 13.6 | | 2.00 | 2.00 | 13.9 | | 2.00 | 2.00 | 13.6 | | 2.00 | 2.00 |
| **General Analytical** | | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** |
| Hexavalent Chromium-ug/L | **NS** | ND | | 10.0 | 4.00 | ND | | 10.0 | 4.00 | ND | | 10.0 | 4.00 |
| | | | | | | | | | | | | | |
| Notes: | | | | | | | | | | | | | |
| NJDEP Class II-A Specific Ground Water Quality Criteria : ( | | | | | | | | | | | | | |
| **BOLD Conc** | Indicates a cor | | | | | | | | | | | | |
| **BOLD RL** | Indicates RL th | | | | | | | | | | | | |
| **BOLD MDL** | Indicates MDL | | | | | | | | | | | | |
| NS = No Standard Available | | | | | | | | | | | | | |
| ND = Analyzed for but Not Detected at the MDL | | | | | | | | | | | | | |
| J = Concentration detected at a value below the RL and ab | | | | | | | | | | | | | |

# Table 1
# Ground Water Analytical Results Summary
# Berry Lane Park
# Chromate Investigation
# January 14-16, 2014

| Sample #: | HIGHER OF | MW-CR-7A | | | | MW-CR-7B | | | | MW-CR-7C | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PQLs | | | | | | | | | | | | |
| Lab ID: | and | 00453-013 | | | | 00453-014 | | | | 00453-015 | | | |
| Date Sampled: | GWQC | 01/16/2014 | | | | 01/16/2014 | | | | 01/16/2014 | | | |
| Depth(ft): | (ug/L) | 8.0 | | | | 13.0 | | | | 18.0 | | | |
| | | | | | | | | | | | | | |
| **Pesticides (ug/L)** | | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** |
| Dieldrin | **0.03** | ~ | | ~ | ~ | ~ | | ~ | ~ | ~ | | ~ | ~ |
| **Metals (ug/L)** | | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** |
| Antimony | **6** | ND | | 2.00 | 1.00 | ND | | 2.00 | 1.00 | ND | | 2.00 | 1.00 |
| Chromium | **70** | 8.03 | | 2.00 | 2.00 | 7.52 | | 2.00 | 2.00 | 7.60 | | 2.00 | 2.00 |
| Nickel | **100** | 2.61 | | 2.00 | 1.00 | 2.19 | | 2.00 | 1.00 | 2.68 | | 2.00 | 1.00 |
| Thallium | **2** | ND | | 2.00 | 0.500 | ND | | 2.00 | 0.500 | ND | | 2.00 | 0.500 |
| Vanadium | **NS** | 6.96 | | 2.00 | 2.00 | 6.50 | | 2.00 | 2.00 | 6.32 | | 2.00 | 2.00 |
| **General Analytical** | | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** |
| Hexavalent Chromium-ug/L | **NS** | ND | | 10.0 | 4.00 | ND | | 10.0 | 4.00 | ND | | 10.0 | 4.00 |

Notes:

NJDEP Class II-A Specific Ground Water Quality Criteria : (

**BOLD Conc** Indicates a cor

**BOLD RL** Indicates RL th

**BOLD MDL** Indicates MDL

NS = No Standard Available

ND = Analyzed for but Not Detected at the MDL

J = Concentration detected at a value below the RL and ab

# Table 1
# Ground Water Analytical Results Summary
# Berry Lane Park
# Chromate Investigation
# January 14-16, 2014

| Sample #: | HIGHER OF | MW-CR-8A | | | | MW-CR-8B | | | | MW-CR-8C | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PQLs | | | | | | | | | | | | |
| Lab ID: | and | 00453-016 | | | | 00453-017 | | | | 00453-018 | | | |
| Date Sampled: | GWQC | 01/16/2014 | | | | 01/16/2014 | | | | 01/16/2014 | | | |
| Depth(ft): | (ug/L) | 10.0 | | | | 15.0 | | | | 20.0 | | | |
| | | | | | | | | | | | | | |
| **Pesticides (ug/L)** | | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** |
| Dieldrin | **0.03** | 0.0085 | | 0.010 | 0.0025 | 0.0079 | | 0.010 | 0.0025 | 0.00795 | | 0.010 | 0.0025 |
| **Metals (ug/L)** | | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** |
| Antimony | **6** | 1.40 | J | 2.00 | 1.00 | 1.37 | J | 2.00 | 1.00 | 1.57 | J | 2.00 | 1.00 |
| Chromium | **70** | 6.55 | | 2.00 | 2.00 | 2.24 | | 2.00 | 2.00 | 2.26 | | 2.00 | 2.00 |
| Nickel | **100** | 23.2 | | 2.00 | 1.00 | 20.5 | | 2.00 | 1.00 | 23.5 | | 2.00 | 1.00 |
| Thallium | **2** | ND | | 2.00 | 0.500 | ND | | 2.00 | 0.500 | ND | | 2.00 | 0.500 |
| Vanadium | **NS** | 33.7 | | 2.00 | 2.00 | 33.2 | | 2.00 | 2.00 | 38.1 | | 2.00 | 2.00 |
| **General Analytical** | | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** |
| Hexavalent Chromium-ug/L | **NS** | ND | | 10.0 | 4.00 | ND | | 10.0 | 4.00 | ND | | 10.0 | 4.00 |

Notes:

NJDEP Class II-A Specific Ground Water Quality Criteria : (

**BOLD Conc** Indicates a cor

**BOLD RL** Indicates RL th

**BOLD MDL** Indicates MDL

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ND = Analyzed for but Not Detected at the MDL

J = Concentration detected at a value below the RL and ab

# Table 1
# Ground Water Analytical Results Summary
# Berry Lane Park
# Chromate Investigation
# January 14-16, 2014

| Sample #: | HIGHER OF | REP-011614 | | | | FB01414 | | | | FB-011514 | | | | FB-011614 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | PQLs | | | | | | | | | | | | | | | | |
| Lab ID: | and | 00453-020 | | | | 00370-007 | | | | 00410-007 | | | | 00453-019 | | | |
| Date Sampled: | GWQC | 01/16/2014 | | | | 01/14/2014 | | | | 01/15/2014 | | | | 01/16/2014 | | | |
| Depth(ft): | (ug/L) | - | | | | - | | | | - | | | | - | | | |
| | | | | | | | | | | | | | | | | | |
| **Pesticides (ug/L)** | | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** |
| Dieldrin | **0.03** | 0.0082 | | 0.010 | 0.0025 | ~ | | ~ | ~ | ~ | | ~ | ~ | ND | | 0.010 | 0.0025 |
| **Metals (ug/L)** | | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** |
| Antimony | **6** | 1.61 | J | 2.00 | 1.00 | ND | | 2.00 | 1.00 | ND | | 2.00 | 1.00 | ND | | 2.00 | 1.00 |
| Chromium | **70** | ND | | 2.00 | 2.00 | ND | | 2.00 | 2.00 | ND | | 2.00 | 2.00 | ND | | 2.00 | 2.00 |
| Nickel | **100** | 24.0 | | 2.00 | 1.00 | ND | | 2.00 | 1.00 | ND | | 2.00 | 1.00 | ND | | 2.00 | 1.00 |
| Thallium | **2** | ND | | 2.00 | 0.500 | ND | | 2.00 | 0.500 | ND | | 2.00 | 0.500 | ND | | 2.00 | 0.500 |
| Vanadium | **NS** | 38.5 | | 2.00 | 2.00 | ND | | 2.00 | 2.00 | ND | | 2.00 | 2.00 | ND | | 2.00 | 2.00 |
| **General Analytical** | | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** | **Conc** | **Q** | **RL** | **MDL** |
| Hexavalent Chromium-ug/L | **NS** | ND | | 10.0 | 4.00 | ND | | 10.0 | 4.00 | ND | | 10.0 | 4.00 | ND | | 10.0 | 4.00 |

Notes:

NJDEP Class II-A Specific Ground Water Quality Criteria : (

**BOLD Conc** Indicates a cor

**BOLD RL** Indicates RL th

**BOLD MDL** Indicates MDL

NS = No Standard Available

ND = Analyzed for but Not Detected at the MDL

J = Concentration detected at a value below the RL and ab