

# Memorandum

To Wayne Howitz, NJDEP  
David Doyle, NJDEP  
Prabal Amin, WESTON Solutions  
Laura Amend Babcock, WESTON Solutions  
James D. Ray, MDMC-Law  
Nancy Colson, MDMC-Law

Page 1

CC Jody Overmyer, PPG  
Mark Terril, PPG  
Rich Feinberg, PPG  
Joseph Lagrotteria, LeClairRyan  
Dorothy Laguzza, LeClairRyan  
William Spronz, AECOM  
Al LoPilato, AECOM

Subject PPG Site 156  
Final Compliance Averaging for Antimony in Soil

From Claire Hunt

Date July 23, 2018

This memorandum provides documentation of attainment of compliance for antimony (Sb) in soil with the New Jersey Department of Environmental Protection (NJDEP) Default Impact to Groundwater Soil Screening Level (DIGWSSL) for a site-specific soil sample set from Site 156 in accordance with the NJDEP *Technical Guidance for the Attainment of Remediation Standards and Site-Specific Criteria* (September 24, 2012, Version 1.0).

## Introduction

Based on investigation and remediation findings to date, the following Sb concentrations remain in place in excess of the DIGWSSL (6 milligrams per kilogram [mg/kg]) at Site 156 when using single point compliance, and for which compliance averaging has been applied for the attainment of compliance:

Grid ID	Location ID	Sample ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Antimony (mg/kg)
C-2	LA1-1	LA1-1 (3.0-3.5)	3.0 - 3.5	3.3 - 2.8	7.8 J
C9	PE-57N	156-PE-57N_C0-6	4.0 - 4.5	2.2 - 1.7	14.5
K1	PE-82	156-PE-82_B12-18	3.0 - 3.5	5.0 - 4.5	6.7
N/A	B73	156-B73B_1.5-2.0X	1.5 - 2.0	4.3 - 3.8	6.6 J
N/A	B76W	156-B76W_3-4b	3.0 - 4.0	2.9 - 1.9	22.2 J
N/A	B76W	156-B76W_3-4bd	3.0 - 4.0	2.9 - 1.9	23.9 J

Grid ID	Location ID	Sample ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Antimony (mg/kg)
N/A	B76W	156-B76W_4-5c	4.0 – 5.0	1.9 - 0.9	10.9 J
N/A	B97	156-B97_A2-3	2.0 – 3.0	4.9 - 3.9	6.3 J

bgs below ground surface  
ft foot or feet  
J The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.  
mg/kg milligrams per kilogram  
N/A The sample is located outside of the remediation grid.  
NAVD88 North American Vertical Datum of 1988

The DIGWSSL applies to samples above the 50<sup>th</sup> percentile groundwater interface elevation for the site (0.91 feet in the North American Vertical Datum of 1988 [ft NAVD88]). The calculation for the 50<sup>th</sup> percentile groundwater interface elevation is provided in the *PPG Site 156 (Metro Towers) Supplemental Remedial Investigation 2017 Groundwater Sampling Results* dated February 2018.

**Figure 1** shows data for borings with remaining Sb, the site boundary, and the location of the samples exceeding the Sb DIGWSSL. The remaining-in-place Sb results are provided in Table 2 of the *Final Site 156 Remedial Action Report (RAR)* dated July 2018.

### Delineation

Delineation was determined using the results for samples collected during the remedial investigation and pre-design sampling events and was further refined during remedial action using the results for samples listed on the following tables and shown on **Figure 1**. In the event that duplicate samples were collected at a single location, both results are shown below. Laboratory reports and data validation reports for these samples were included in Appendix L and Appendix M, respectively, of the *Final Site 156 Remedial Action Report (RAR)* dated July 2018.

### **Samples Delineating Antimony Exceedance at Sample LA1-1 (3.0-3.5) El. 3.3 - 2.8 ft NAVD88**

Grid ID	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Lab SDG	Sample Status	Date Collected	Antimony Result (mg/kg)	Direction
C-1	C(-1)-RW	NA	2.5 – 2.0	JB67489	Remaining	5/20/2014	0.36 J	East
C-2	LA1-1	4.0 – 4.5	2.3 – 1.8	JB21806	Remaining	11/20/2012	0.41 J	Vertical
C-2	1B-7	NA	2.5 – 2.0	AC71424	Remaining	3/25/2013	2.2 U	South
C-2	CS SS1B-SW2	2.6 – 3.1	3.5 – 3.0	JC18700	Remaining	4/20/2016	0.66 U	West
C-2	SW LA 2A-2	NA	3.3 – 2.8	JB67491	Remaining	5/21/2014	0.31 U	North

bgs below ground surface  
ft foot or feet  
J The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.  
mg/kg milligrams per kilogram  
NA (not applicable) is listed for post-excavation samples. Surface elevations do not apply for post-excavation samples where the sample start was a measured value.  
NAVD88 North American Vertical Datum of 1988  
SDG sample delivery group  
U The analyte was not detected above the sample reporting limit shown.

**Samples Delineating Antimony Exceedance at Sample 156-PE-57N\_C0-6 El. 2.2 - 1.7 ft NAVD88**

Grid ID	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Lab SDG	Sample Status	Date Collected	Antimony Result (mg/kg)	Direction
C9	PE-57	4.1 – 4.6	2.4 – 1.9	J28850	Removed	4/26/2006	2.3 UJ	South
D9	PE-57E	4.5 – 5.0	2.0 – 1.5	JA87496	Remaining	9/28/2011	1.2 J	East
C8	PE-56	4.0 – 4.5	2.5 – 2.0	J28850	Remaining	4/26/2006	2.2 UJ	North
C8	LA2-3	4.0 – 4.5	3.5 – 3.0	JB21536	Removed	11/16/2012	0.9 J	West
The sample is vertically delineated by the groundwater interface.								Vertical

bgs

below ground surface

ft

foot or feet

J

The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.

mg/kg

milligrams per kilogram

NAVD88

North American Vertical Datum of 1988

SDG

sample delivery group

UJ

The analyte was not detected above the sample reporting limit shown and the reporting limit was approximate.

**Samples Delineating Antimony Exceedance at Sample 156-PE-82\_B12-18 El. 5.0 - 4.5 ft NAVD88**

Grid ID	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Lab SDG	Sample Status	Date Collected	Antimony Result (mg/kg)	Direction
K-2	B52SW	2.0 – 3.0	5.3 – 4.3	B935	Removed	1/16/2007	1.2 UJ	West
K1	K1-S	NA	5.3 – 4.8	JB59349	Remaining	2/6/2014	0.27 U	North
K2	PE-13	1.0 – 1.5	6.1 – 5.6	J24695	Removed	3/10/2006	2.3 U 2.0 U (FD)	East
K1	PE-82	5.0 – 5.5	3.0 – 2.5	JA87496	Remaining	9/28/2011	1.6 J	Vertical
K1	K1-SW-B1	NA	6.1 – 5.6	JB58867	Removed	1/30/2014	1.8 J	South

bgs

below ground surface

FD

field duplicate

ft

foot or feet

J

The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.

mg/kg

milligrams per kilogram

NA

NA (not applicable) is listed for post-excavation samples. Surface elevations do not apply for post-excavation samples where the sample start was a measured value.

NAVD88

North American Vertical Datum of 1988

SDG

sample delivery group

U

The analyte was not detected above the sample reporting limit shown.

UJ

The analyte was not detected above the sample reporting limit shown and the reporting limit was approximate.

**Sample 156-B73B\_1.5-2.0X El. 4.3 - 3.8ft NAVD88**

For sample location B73, the sample exceeding the DIGWSSL is a field duplicate sample. The environmental sample at this location was compliant with the Sb DIGWSSL. NJDEP/Weston stated during a February 2, 2016 meeting that the compliant sample will be used to demonstrate delineation. The sample exceeding the Sb DIGWSSL will be used in compliance averaging (*PPG Site 156 [Metro Towers] Revised Scope of Work and Technical Rationale for Supplemental Remedial Investigation - Soil and Groundwater Sampling*, prepared for PPG, dated February 26, 2016). The results for samples delineating the antimony exceedance at sample 156-B73B\_1.5-2.0X are shown in the following table.

Grid ID	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Lab SDG	Sample Status	Date Collected	Antimony Result (mg/kg)	Direction
N/A	B73	1.5 – 2.0	4.3 - 3.8	W508	Remaining	8/31/2006	1.2 UJ (FD)	West
N/A	B73	4.1 – 4.6	1.7 – 1.2	W508	Remaining	8/31/2006	1.5 J	Vertical
N/A	B74W	3.0 – 4.0	3.2 – 2.2	B902	Remaining	1/15/2007	1.1 UJ	North
N/A	PE-58	1.5 – 2.0	4.4 – 3.9	W508	Remaining	8/31/2006	1.2 UJ	South
N/A	B94	2.0 – 3.0	4.2 – 3.2	JA88023	Removed	10/4/2011	4.0 J	East

bgs below ground surface  
 FD field duplicate  
 ft foot or feet  
 J The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.  
 mg/kg milligrams per kilogram  
 N/A The sample is located outside of the remediation grid.  
 NAVD88 North American Vertical Datum of 1988  
 SDG sample delivery group  
 UJ The analyte was not detected above the sample reporting limit shown and the reporting limit was approximate.

**Sample 156-B76W\_3-4b and 156-B76W\_3-4bd El. 2.9 - 1.9ft NAVD88**

There are no Sb sample results to the west of samples 156-B76W\_3-4b and 156-B76W\_3-4bd. During the February 2, 2016 meeting, NJDEP/Weston stated that samples from boring B76W are acceptable to NJDEP as sidewall samples. No additional sampling to the west of Layout Area 1 was required (*PPG Site 156 [Metro Towers] Revised Scope of Work and Technical Rationale for Supplemental Remedial Investigation - Soil and Groundwater Sampling*, prepared for PPG, dated February 26, 2016). The results for samples delineating the antimony exceedances at samples 156-B76W\_3-4b and 156-B76W\_3-4bd are shown in the following table.

Grid ID	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Lab SDG	Sample Status	Date Collected	Antimony Result (mg/kg)	Direction
N/A	B76	3.5 – 4.0	2.5 – 2.0	W423	Removed	8/30/2006	1.4 J	East
N/A	B76N	3.0 – 4.0	2.9 – 1.9	B902	Removed	1/15/2007	1.1 UJ	North
N/A	B88	4.0 – 5.0	2.3 – 1.3	D418	Remaining	2/28/2007	1.3 UJ	South
The sample is vertically delineated by the groundwater interface.								Vertical

bgs below ground surface  
 ft foot or feet  
 J The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.  
 mg/kg milligrams per kilogram  
 N/A The sample is located outside of the remediation grid.  
 NAVD88 North American Vertical Datum of 1988  
 SDG sample delivery group  
 UJ The analyte was not detected above the sample reporting limit shown and the reporting limit was approximate.

**Sample 156-B76W\_4-5c El. 1.9 - 0.9 ft NAVD88**

There are no Sb sample results to the west of sample 156-B76W\_4-5c. NJDEP/Weston stated in the February 2, 2016 meeting that samples from boring B76W are acceptable to NJDEP as sidewall samples. No additional sampling to the west of Layout Area 1 was required (*PPG Site 156 [Metro Towers] Revised Scope of Work and Technical Rationale for Supplemental Remedial Investigation - Soil and Groundwater Sampling*, prepared for

Final Compliance Averaging for Antimony in Soil  
PPG, Jersey City, New Jersey

PPG, dated February 26, 2016). The results for samples delineating the antimony exceedance at sample 156-B76W\_4-5c are shown in the following table.

Grid ID	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Lab SDG	Sample Status	Date Collected	Antimony Result (mg/kg)	Direction
N/A	B76N	4.0 – 5.0	1.9 – 0.9	B902	Remaining	1/15/2007	1.2 UJ	North
N/A	B88	5.0 – 6.0	1.3 – 0.3	D418	Remaining	2/28/2007	1.4 UJ 1.6 J (FD)	South
N/A	B76E	4.0 – 5.0	2.1 – 1.1	B902	Removed	1/15/2007	4.1 J	East
The sample is vertically delineated by the groundwater interface.								Vertical

bgs below ground surface  
FD field duplicate  
ft foot or feet  
J The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.  
mg/kg milligrams per kilogram  
N/A The sample is located outside of the remediation grid.  
NAVD88 North American Vertical Datum of 1988  
SDG sample delivery group  
UJ The analyte was not detected above the sample reporting limit shown and the reporting limit was approximate.

#### Sample 156-B97\_A2-3 El. 4.9 - 3.9 ft NAVD88

For sample location B97, NJDEP/Weston stated in the February 2, 2016 meeting that the results from proximate neighboring sample locations 1E-NESW and B96 were sufficient to demonstrate delineation of Sb (PPG Site 156 [Metro Towers] Revised Scope of Work and Technical Rationale for Supplemental Remedial Investigation - Soil and Groundwater Sampling, prepared for PPG, dated February 26, 2016). The results for samples delineating the antimony exceedance at sample 156-B97\_A2-3 are shown in the following table.

Grid ID	Location ID	Depth Interval (ft bgs)	Sample Elevation (ft NAVD88)	Lab SDG	Sample Status	Date Collected	Antimony Result (mg/kg)	Direction
H-2	B96	3.0 – 4.0	4.7 – 3.7	JA87933	Removed	10/3/2011	2 J	East
N/A	1E-NESW	NA	5.5 – 5.0	JB35856	Removed	5/1/2013	0.18 J	North
N/A	B97	5.0 - 6.0	1.9 – 0.9	JA88023	Remaining	10/4/2011	0.48 J	Vertical
N/A	1E-NB	NA	4.5 – 4.0	JB35856	Remaining	5/1/2013	0.54 J	West
N/A	B82	2.0 - 3.0	4.9 - 3.9	D363	Removed	2/27/2007	1.3 U	South

bgs below ground surface  
ft foot or feet  
J The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.  
mg/kg milligrams per kilogram  
N/A The sample is located outside of the remediation grid.  
NA NA (not applicable) is listed for post-excavation samples. Surface elevations and depth intervals do not apply for post-excavation samples where the sample start elevation was a measured value.  
NAVD88 North American Vertical Datum of 1988  
SDG sample delivery group  
U The analyte was not detected above the sample reporting limit shown.

**Functional Area**

The functional area for the impact to groundwater pathway is limited in the direction of groundwater flow to 100 feet. The length of each functional area is 100 feet in the direction of groundwater flow. Perpendicular to groundwater flow, the functional area is limited to the delineated extent of contamination. The functional area is oriented to be between the two delineation points that bound the functional area perpendicular to the groundwater flow direction. The extent of the functional area within the site boundary is shown in **Figure 1**. Historically, groundwater flow at the Site has been observed to be to the southwest with additional flow to the north and west. During the 2017 monitoring events, groundwater flow was observed to be to the southwest on the southwestern portion of the site; however, a groundwater elevation high was present in the center of the Site, resulting in northwesterly and northeasterly groundwater flow components on the northwestern and northeastern portions of the Site, respectively. Groundwater flow at the Site may be influenced by dewatering or other activities offsite. The groundwater contours and flow direction from the November 21, 2017 sampling event were used to orient the functional areas and are shown on **Figure 1**.

Vertically, the samples are grouped into one of two categories depending on the elevation of the sample exceedance: from the groundwater interface to two feet above the groundwater interface (elevation 0.91 to 2.91 ft NAVD88) or from two feet above the groundwater interface to the ground surface (elevation 2.91 feet NAVD88 to the ground surface).

**Compliance Averaging**

For samples 156-PE-82\_B12-18 (El. 5.0 - 4.5 ft NAVD88), 156-B76W\_4-5c (El. 1.9 - 0.9 ft NAVD88) and 156-B76W\_3-4b and 156-B76W\_3-4bd (El. 2.9 - 1.9 ft NAVD88), compliance with the Sb DIGWSSL is demonstrated through spatial averaging. Thiessen polygons were created within the functional area as shown in **Figure 1**.

The sample selection process is as follows:

1. The samples for Sb with a sample status of remaining that fall within the functional area horizontally and vertically are identified.
2. The maximum concentration is selected at each sample location for use in the weighted average. The maximum of the concentration for detections or the Method Detection Limit (MDL)/Reporting Limit (RL) for non-detects is selected.

Laboratory reports and data validation reports for the samples were included in Appendix L and Appendix M, respectively, of the *Final Site 156 Remedial Action Report (RAR)*, July 2018.

**Sample 156-PE-82\_B12-18 El. 5.0 - 4.5 ft NAVD88**

Grid ID	Location ID	Sample Depth (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	Maximum Antimony Result (mg/kg)	Area (sf)	Area x Maximum Antimony Result (sf*mg/kg)
I1	I1-SW	N/A	3.0 - 2.5	1/30/2014	1.2 J	264	317
I1	I1-UB	N/A	3.4 - 2.9	1/10/2014	0.33 J	537	177
I1	I1-WEDGE	N/A	3.4 - 2.9	2/11/2014	0.89 J	185	165
J1	J1-SW	N/A	5.3 - 4.8	1/30/2014	1.3 J	465	605

Final Compliance Averaging for Antimony in Soil  
PPG, Jersey City, New Jersey

Grid ID	Location ID	Sample Depth (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	Maximum Antimony Result (mg/kg)	Area (sf)	Area x Maximum Antimony Result (sf*mg/kg)
J1	J1-WEDGE	N/A	4.8 - 4.3	2/11/2014	1.1 J	513	564
J1	PE-81	5.0 - 5.5	3.2 - 2.7	9/29/2011	2.9	410	1,189
K0	K0-SW	N/A	5.5 - 5.0	1/16/2014	1 J	125	125
K0	K0-SW-B1	N/A	4.8 - 4.3	1/30/2014	1.2 J	409	491
K0	K0-UB	N/A	5.0 - 4.5	1/16/2014	< 0.25 UJ	29	7
K0	K0-WEDGE	N/A	5.0 - 4.5	2/6/2014	< 0.28 U	43	12
K0	LA3-1	4.0 - 4.5	3.2 - 2.7	11/15/2012	< 0.17 UJ	401	68
K0	PE-83	3.0 - 3.5	5.2 - 4.7	9/29/2011	4.7	319	1,499
K1	K1-E	N/A	5.3 - 4.8	2/11/2014	2.9	354	1,027
K1	K1-S	N/A	5.3 - 4.8	2/6/2014	< 0.27 U	92	25
K1	K1-SW-B1	N/A	3.5 - 3.0	1/30/2014	1.8 J	752	1,354
K1	PE-82	3.0 - 3.5	5.0 - 4.5	9/28/2011	6.7	83	556
K-1	IE-SBN	N/A	3.5 - 3.0	5/2/2013	0.56 J	443	248
K-1	IE-SNSW	N/A	6.5 - 6.0	5/2/2013	0.64 J	1,471	941
L-1	M-1-SW	N/A	5.9 - 5.4	1/17/2014	< 0.26 U	41	11
L-1	SW PPG1-B582	2.5 - 3.0	3.6 - 3.1	12/10/2013	< 0.39 U	455	177
Sum						7,391	9,558

bgs	below ground surface
ft	foot or feet
J	The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.
mg/kg	milligrams per kilogram
N/A	NA (not applicable) is listed for post-excavation samples. Surface elevations and sample depths do not apply for post-excavation samples where the sample start elevation was a measured value.
NAVD88	North American Vertical Datum of 1988
sf	square feet
U	The analyte was not detected above the sample reporting limit shown.
UJ	The analyte was not detected above the sample reporting limit shown and the reporting limit was approximate.

Spatially Weighted Average Concentration = 9,558 sf x mg/kg / 7,391 sf = 1 mg/kg

**Samples 156-B76W\_4-5c El. 1.9 - 0.9 ft NAVD88, 156-B76W\_3-4b and 156-B76W\_3-4bd El. 2.9 - 1.9 ft NAVD88**

Grid ID	Location ID	Sample Depth (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	Maximum Antimony Result (mg/kg)	Area (sf)	Area x Maximum Antimony Result (sf*mg/kg)
N/A	B76W	3.0 - 4.0	2.9 - 1.9	1/15/2007	23.9 J	1024	24,474
N/A	B88	3.0 - 4.0	3.3 - 2.3	2/28/2007	1.3 UJ	2224	2,891
N/A	B76N	4.0 - 5.0	1.9 - 0.9	1/15/2007	1.2 UJ	1856	2,227
Sum						5,104	29,592

bgs below ground surface  
 ft foot or feet  
 J The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.  
 mg/kg milligrams per kilogram  
 N/A The sample is located outside of the remediation grid.  
 NAVD88 North American Vertical Datum of 1988  
 sf square feet  
 UJ The analyte was not detected above the sample reporting limit shown and the reporting limit was approximate.

Spatially Weighted Average Concentration = 29,592 sf x mg/kg / 5,104 sf = 6 mg/kg<sup>1</sup>

For the remaining samples, compliance with the Sb DIGWSSL is demonstrated through the arithmetic average because there are nine or fewer samples remaining in the study areas. The sample selection process is as follows:

1. The samples for antimony with a sample status of remaining that fall within the study area horizontally and vertically are identified.
2. The remaining samples are used in the arithmetic average. Zero is substituted for the MDL/RL for non-detects.
3. For duplicate sample results, the higher value of the sample or duplicate result is selected.

Laboratory reports and data validation reports for the samples were included with Table 2 of the *Final Site 156 Remedial Action Report (RAR)*, July 2018.

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<sup>1</sup> The average concentration is 5.8 mg/kg and below the antimony DIGWSSL of 6 mg/kg, but is rounded to comply with NJDEP rounding procedures.



**Sample LA1-1 (3.0-3.5) El. 3.3 - 2.8 ft NAVD88**

Grid ID	Location ID	Sample Depth (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	Antimony Result (mg/kg)	Antimony Result Used in Average (mg/kg)
C-2	1B-1	NA	5.9 - 5.4	3/25/2013	2.2 U	0
C-2	1B-2	NA	5.0 - 4.5	3/25/2013	2.2 U	0
C-2	CS SS1B-SW2	2.6 - 3.1	3.5 - 3.0	4/20/2016	0.66 U	0
C-2	SW LA 2A-2	NA	3.3 - 2.8	5/21/2014	0.31 U	0
C-2	LA1-1	3.0 - 3.5	3.3 - 2.8	11/20/2012	7.8 J	7.8
					Sum	7.8

bgs below ground surface  
 ft foot or feet  
 J The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.  
 mg/kg milligrams per kilogram  
 NA NA (not applicable) is listed for post-excavation samples. Surface elevations and depth intervals do not apply for post-excavation samples where the sample elevation was a measured value.  
 NAVD88 North American Vertical Datum of 1988  
 U The analyte was not detected above the sample reporting limit shown.

Arithmetic Average Concentration = 7.8 mg/kg / 6 samples = 1 mg/kg

**Sample 156-PE-57N\_C0-6 El. 2.2 - 1.7 ft NAVD88**

Grid ID	Location ID	Sample Depth (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	Antimony Result (mg/kg)	Antimony Result Used in Average (mg/kg)
C8	PE-56	4.0 - 4.5	2.5 - 2.0	4/26/2006	2.2 UJ	0
C9	PE-57N	4.0 - 4.5	2.2 - 1.7	9/28/2011	14.5	14.5
D9	PE-57E	4.5 - 5.0	2.0 - 1.5	9/28/2011	1.2 J	1.2
C8	PE-56	5.0 - 5.5	1.5 - 1.0	4/26/2006	2.3 UJ	0
					Sum	15.7

bgs below ground surface  
 ft foot or feet  
 J The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.  
 mg/kg milligrams per kilogram  
 NAVD88 North American Vertical Datum of 1988  
 UJ The analyte was not detected above the sample reporting limit shown and the reporting limit was approximate.

Arithmetic Average Concentration = 15.7 mg/kg / 4 samples = 4 mg/kg

**Sample 156-B73B\_1.5-2.0X EI. 4.3 - 3.8 ft NAVD88**

Grid ID	Location ID	Sample Depth (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	Antimony Result (mg/kg)	Antimony Result Used in Average (mg/kg)
N/A	PE-58	0.5 - 1.0	5.4 - 4.9	8/31/2006	1.2 UJ	0
N/A	B73	0.5 - 1.0	5.3 - 4.8	8/31/2006	1.2 UJ	0
N/A	PE-58	1.5 - 2.0	4.4 - 3.9	8/31/2006	1.2 UJ	0
N/A	B73	1.5 - 2.0	4.3 - 3.8	8/31/2006	6.6 J	6.6
N/A	B74W	3.0 - 4.0	3.2 - 2.2	1/15/2007	1.1 UJ	0
					Sum	6.6

bgs below ground surface  
 ft foot or feet  
 J The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.  
 mg/kg milligrams per kilogram  
 N/A The sample is located outside of the remediation grid.  
 NAVD88 North American Vertical Datum of 1988  
 UJ The analyte was not detected above the sample reporting limit shown and the reporting limit was approximate.

Arithmetic Average Concentration = 6.6 mg/kg / 5 samples = 1 mg/kg

**Sample 156-B97\_A2-3 EI. 4.9 - 3.9 ft NAVD88**

Grid ID	Location ID	Sample Depth (ft bgs)	Sample Elevation (ft NAVD88)	Date Collected	Antimony Result (mg/kg)	Antimony Result Used in Average (mg/kg)
N/A	B98	1.0 - 2.0	5.9 - 4.9	10/4/2011	0.14 UJ	0
G-2	1E-NESW	NA	5.0 - 4.5	5/1/2013	0.29 J (FD)	0.29
N/A	B97	2.0 - 3.0	4.9 - 3.9	10/4/2011	6.3 J	6.3
N/A	1E-NB	NA	4.5 - 4.0	5/1/2013	0.54 J	0.54
N/A	B74N	3.0 - 4.0	3.9 - 2.9	1/16/2007	1 UJ	0
					Sum	7.13

bgs below ground surface  
 FD field duplicate  
 ft foot or feet  
 J The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.  
 mg/kg milligrams per kilogram  
 N/A The sample is located outside of the remediation grid.  
 NA (not applicable) is listed for post-excavation samples. Surface elevations do not apply for post-excavation samples where the sample start was a measured value.  
 NAVD88 North American Vertical Datum of 1988  
 UJ The analyte was not detected above the sample reporting limit shown and the reporting limit was approximate.

Arithmetic Average Concentration = 7.13 mg/kg / 5 samples = 1 mg/kg

### **Conclusions**

The spatially weighted average Sb concentration within the study area at sample 156-PE-82\_B12-18 is 1 mg/kg, which is compliant with the 6 mg/kg DIGWSSL.

The spatially weighted average Sb concentration within the study area at samples 156-B76W\_3-4b, 156-B76W\_3-4bd, and 156-B76W\_4-5c is 6 mg/kg (5.8 mg/kg to two significant figures), which is compliant with the 6 mg/kg DIGWSSL.

The arithmetic average Sb concentration within the study area at sample LA1-1 (3.0-3.5) is 1 mg/kg, which is compliant with the 6 mg/kg DIGWSSL.

The arithmetic average Sb concentration within the study area at sample 156-PE-57N\_C0-6 is 4 mg/kg, which is compliant with the 6 mg/kg DIGWSSL.

The arithmetic average Sb concentration within the study area at sample 156-B73B\_1.5-2.0X is 1 mg/kg, which is compliant with the 6 mg/kg DIGWSSL.

The arithmetic average Sb concentration within the study area at sample 156-B97\_A2-3 is 1 mg/kg, which is compliant with the 6 mg/kg DIGWSSL.

### **Attachments:**

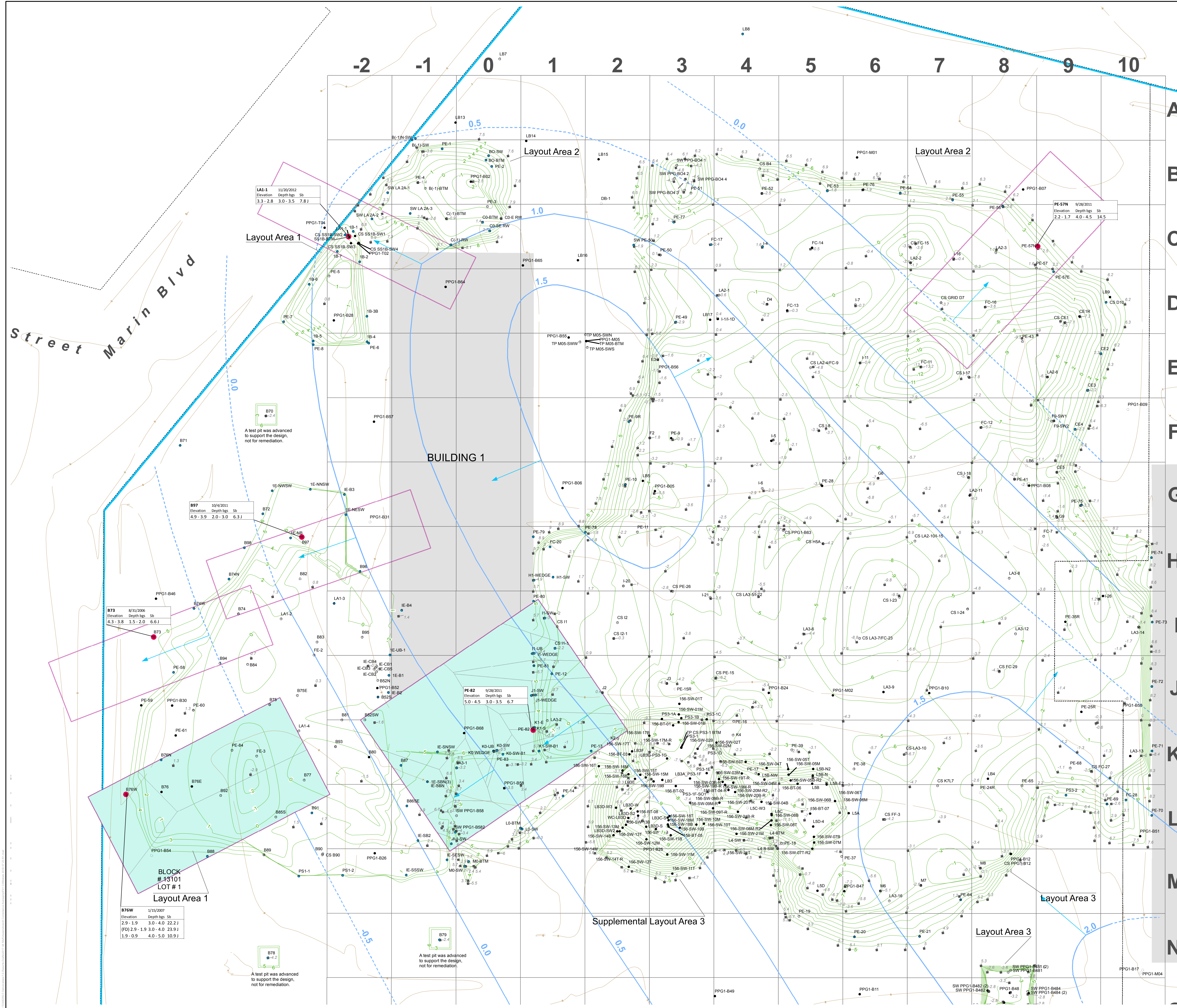
Figure 1      Sample Map for Antimony in the Unsaturated Soil Zone Compared to Impact to Groundwater Soil Screening Levels and Functional Areas - Remediated Area

PPG Site 156  
Final Compliance Averaging for Antimony in Soil  
PPG, Jersey City, New Jersey

**FIGURE 1**

**Sample Map for Antimony in the Unsaturated Soil Zone  
Compared to Impact to Groundwater Soil Screening Levels  
and Functional Areas - Remediated Area**





**ABBREVIATIONS:**  
 bgs - below ground surface  
 DIGWSSL - New Jersey Department of Environmental Protection Default Impact to Groundwater Soil Screening Level  
 E1 - Elevation (in ft NAVD88)  
 FD - field duplicate sample  
 ft - feet  
 mg/kg - milligrams per kilogram  
 NAVD88 - North American Vertical Datum of 1988  
 RAR - Final Site 156 Remedial Action Report, July 2018  
 SA - Antimony

**QUALIFIERS:**  
 J - The result was an estimated value; the associated numerical value was an approximate concentration of the analyte in the sample.

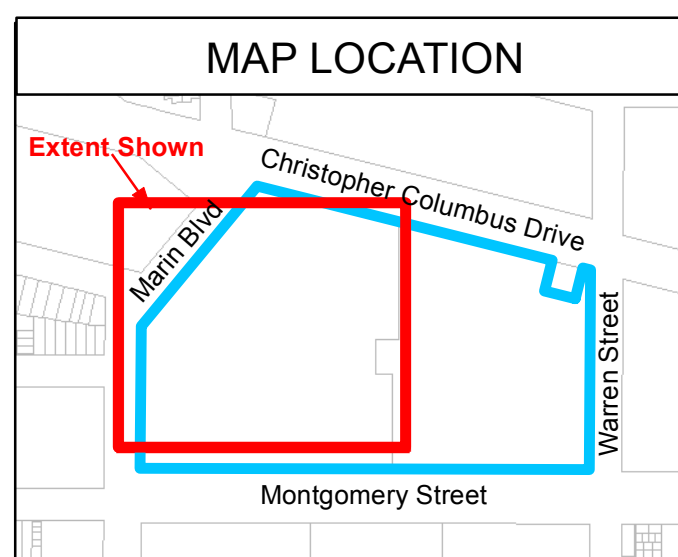
**GENERAL NOTES:**  
 G1. The antimony data associated with the sample locations shown on this figure are provided in the Technical Memorandum PPG Site 156 Compliance Averaging for Antimony in Soil-Final AECOM, July 2018 and Table 2 of the RAR. Additional sample locations are shown in Figure 58 of the RAR. Data presented in call out boxes on this figure are outliers (i.e., data points that require further explanation). Specific notes on how the New Jersey Department of Environmental Protection's remedial standards are being met and/or how remediation is being achieved/completed for each outlier sample are provided in the Specific Notes in Table 2 of the RAR.  
 G2. 'Elevation' refers to the sample elevation based on the pre-remediation surface elevation for samples collected from the pit bottom, and the surface elevation of the sample location when the sample was collected via boring or test pit.  
 G3. Elevation vertical datum is NAVD88, in U.S. survey ft.  
 G4. Results are reported in mg/kg.  
 G5. Source of block/lot information is Jersey City Parcel Data from New Jersey Geographic Information Network (NJ GIN), last updated 10/06/2015 (available at: <http://data.nj.gov/datasets/arcgis-city-parcel-polygon>).  
 G6. The Site 156 groundwater elevation was estimated as the 50th percentile of water gauging readings from 2016 and 2017 sampling events (using wells from the shallow aquifer and excluding the well in the basement of Building No. 2 which exhibited unusual readings compared to the remainder of the wells). The estimated groundwater elevation is EL 0.91 ft NAVD88.

**SPECIFIC NOTES:**  
 S1. Post-excavation elevation survey points were taken from the 'As-Built Excavation Volume' produced by Layout Inc., dated 06/03/2013 for Layout 1, the 'Post-Excavation Survey Overall for ENTACT, LLC Layout Areas 2 & 3 Remediation Metropolitan Towers - Site 156' produced by Maser Consulting P.A., dated 10/08/2015 for Layout Areas 2 and 3, and 'Post-Excavation Plan' produced by Maser Consulting P.A., dated 11/05/2017 for Supplemental Layout Area 3.  
 S2. The pre-excavation surface contours were taken from the 'Topographic Survey' produced by Langan Engineering, dated 04/05/2001, last revised 02/16/2006.  
 S3. Some discrepancies between the field notes and surveyed elevations are noted in Table 2 of the RAR.  
 S4. Some sample locations are co-located; therefore, the sampling location symbols overlap on the figure.  
 S5. The groundwater contours and flow direction are based on the 11/21/2017 gauging event.

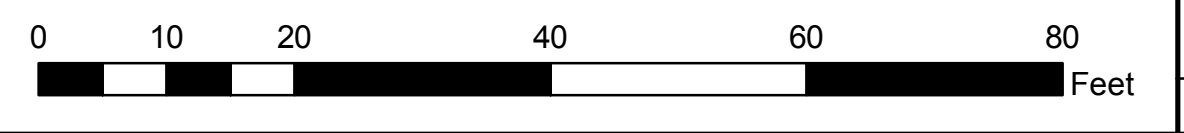
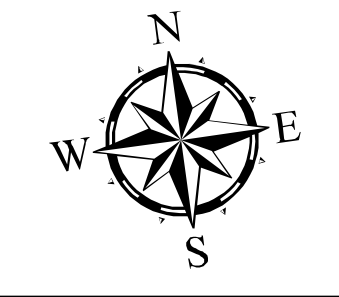
- Legend**
- SAMPLES NOT ANALYZED FOR ANTIMONY
  - SAMPLING LOCATION (REMAINING SAMPLES)
  - SAMPLING LOCATION (REMOVED SAMPLES)
  - ANTIMONY RESULT EXCEEDS THE MOST STRINGENT STANDARD (DIGWSSL), BUT IS IN COMPLIANCE WITH REMEDIATION OBJECTIVES
  - ANTIMONY RESULT IS BELOW THE MOST STRINGENT STANDARD (DIGWSSL)
  - ▲ POST-EXCAVATION ELEVATION SURVEY POINT REPRESENTING AS-BUILT TERMINAL EXCAVATION ELEVATION (FT NAVD88)
  - ▲ POST-EXCAVATION ELEVATION CONTOUR (1-FOOT INTERVAL IN FT NAVD88)
  - ▲ PRE-REMEDIATION ELEVATION CONTOUR (1-FOOT INTERVAL IN FT NAVD88)
  - FUNCTIONAL
  - THIENESS POLYGON
  - PROPERTY BOUNDARY
  - GROUNDWATER FLOW DIRECTION
  - GROUNDWATER CONTOUR, 0.5-FT INTERVAL IN FT NAVD88
  - GROUNDWATER CONTOUR, ESTIMATED
  - SITE BOUNDARY
  - GRID LAYOUT

**Soil Remediation Standards (mg/kg)**

Analyte	DIGWSSL
ANTIMONY	6



**AECOM**



PPG  
 SITE 156  
 METROPOLIS TOWERS  
 JERSEY CITY, NEW JERSEY

SAMPLE MAP FOR ANTIMONY IN THE UNSATURATED SOIL ZONE COMPARED TO IMPACT TO GROUNDWATER SOIL SCREENING LEVELS AND FUNCTIONAL AREAS - REMEDIATED AREA

DATE: 07/23/2018

FIGURE 1