Appendix F

Data Validation Reports

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DATA VALIDATION REPORT

Project: Jersey City PPG, Site 63/65/Burma Road; Report SDG JC22847/JC22847A
Sample Date: June 23, 2016
Analyses: Metals Analysis, EPA Method 6010C
Hexavalent Chromium Analysis, EPA Method 3060A/7196A
Redox Potential, ASTM D1498-76M
pH, EPA Method 9045C,D
Reviewer: Janis V. Giga, Ph.D., REP5554
Date: July 7, 2016

This data validation (DV) report presents the data review and result qualifications for four (4) groundwater (GW) samples collected at the Jersey City PPG Site 63/65/Burma Road in Jersey City, New Jersey on June 23, 2016 for sample delivery groups (SDGs) JC22847 and JC22847A. The groundwater samples were analyzed for the analytes listed above employing the identified analytical methods by Accutest Laboratories of Dayton, New Jersey.

Summary of Sample Results Qualifications

The groundwater sample analytical results for the samples of SDG JC22847A and JC22847 were found to be compliant with the analytical method (SW-846 Method 6010C) for the analysis of metals and hexavalent chromium (Cr+6) (Method 7196A) in the four collected groundwater samples.

Following the detailed DV review, the following sample results were qualified:

- pH (“J”) in Samples JC22847-1 through -4 (inclusive).

All quality control (QC) criteria were met for each of the ICP target analyte analyses. Consequently, none of the reported GW sample metals results in this SDG have been qualified and are usable as reported.

No hexavalent chromium results for the four groundwater samples of SDG JC22847 were qualified following the DV review, because all QC results were within method QC limits, except for the delayed pH measurements in the four groundwater samples. The sample results that were subject to qualification following the DV review are presented in Table 4 of this DV report. A data validation checklist is provided in Attachment A to summarize the observations during the DV review.

Sample Receipt

The four (4) groundwater samples collected June 23, 2016 were received at the Accutest laboratory the same day with an acceptable maximum corrected sampling cooler temperature of 3.3ºC. The GW sample identification numbers and corresponding laboratory identification numbers are as follows:

Table 1. Sample Receipt Summary

Client Sample Designation	Sample Lab ID Number	Date Collected	Matrix	Analyses
MW103	JC22847-1A	6/23/16	Aqueous	Metals
MW101	JC22847-2A	6/23/16	Aqueous	Metals
MSD	JC22847-2AD	6/23/16	Aqueous	Metals
MS	JC22847-2AS	6/23/16	Aqueous	Metals
MW102	JC22847-3A	6/23/16	Aqueous	Metals
DUP01	JC22847-4A	6/23/16	Aqueous	Metals
MW103	JC22847-1	6/23/16	Aqueous	Hex chrome, Redox, pH
MW101	JC22847-2	6/23/16	Aqueous	Hex chrome, Redox, pH
MSD	JC22847-2D	6/23/16	Aqueous	Hex chrome, Redox, pH
MS	JC22847-2S	6/23/16	Aqueous	Hex chrome, Redox, pH
MW102	JC22847-3	6/23/16	Aqueous	Hex chrome, Redox, pH
DUP01	JC22847-4	6/23/16	Aqueous	Hex chrome, Redox, pH
Metals – Antimony, chromium, nickel, thallium and vanadium analyzed by SW-846 Method 6010C. Hex chrome – Hexavalent chromium analyzed by SW-846 Method 7196A.				

The data package presenting the metals data is numbered JC22847A, while the data package for the hexavalent chromium analyses is numbered JC22847.

Data Review

Data, as presented in the analytical data packages SDG JC22847 and JC22847A, was primarily reviewed and validated using the following combination of method-specific criteria with professional judgement, as appropriate:

- New Jersey Department of Environmental Protection (NJDEP) *Standard Operating Procedure: Quality Assurance Data Validation of Analytical Deliverables Inorganics (Based on USEPA SW-846 Methods), SOP No. 5.A.16* (NJDEP, 2002);
- United States (US) Environmental Protection Agency (EPA) *"National Functional Guidelines for Inorganic Data Review"*, OSWER Publication 9240.1-51, EPA540-R-10-011, January 2010 (US EPA, 2010);
- US EPA *"ICP-AES Data Validation, SOP No. HW-2a, Revision 15"* (USEPA, 2012);
- NJDEP *Standard Operating Procedure (SOP) for Analytical Data Validation of Hexavalent Chromium* (NJDEP, 2009).
- NJDEP, *Data of Known Quality Protocols Technical Guidance*, Version 1.0, April 2014.
- NJDEP, *Data Quality Assessment and Data Usability Evaluation Technical Guidance*, Version 1.0, April 2014.
- NJDEP, *Analytical Laboratory Data Generation, Assessment and Usability Technical Guidance*, Version 1.0, April 2014.
- NJDEP, *Quality Assurance Project Plan Technical Guidance*, Version 1.0, April 2014.

Data associated with parameters that do not meet quality control (QC) specifications or compliance requirements, have been qualified in accordance with US EPA Region II/NJDEP specifications/guidelines, as appropriate.

The analysis of the identified samples was performed in compliance with the requirements specified in the respective analytical methods. The data is presented in a NJDEP "reduced" deliverables package and is considered complete, as defined by the NJDEP "Technical Regulations for Site Remediation" (NJDEP, 2012). However, it is emphasized that due to the absence of raw metals data and the associated preparation logs, the substantiation of the reported metals concentrations and the accuracy of the QC summary results is precluded. The data package was complete for the hexavalent chromium analysis and Cr+6 and associated QC results were substantiated during the DV review. The information presented in the data summary and quality control (QC) forms was reviewed and used to qualify the sample results. The quality of data collected in support of this sampling activity is considered acceptable with the noted results qualifications, considering the limitations attributable to a reduced deliverables data package.

The discussion below presents the findings of the data validation review organized according to the technical areas used to evaluate inorganic analytical data. For each of these analytical topics, the information on the summary forms, as well as the raw data and supporting information for the samples or standards analyzed were reviewed during the DV effort.

1.0 Metals Analysis Data Review

The discussion below presents the findings of the data validation review for the eleven technical areas used to evaluate inorganic analytical data. For each of these analytical topics, the information on the summary forms as well as the raw data printed on the quantitation report for each sample or standard analyzed was reviewed during the DV effort.

The data validation of the analytical data was reviewed for the following data quality items:

√ Holding times
√ Blank Analysis
√ Calibration standards
√ Calibration verification
√ Data package completeness
√ Data qualifiers
√ Matrix spike recoveries
√ Duplicate analysis
√ Laboratory control samples
√ Interference Check Samples
√ Field duplicate sample analysis

The groundwater (GW) samples were analyzed for five target EPA Method 6010C metals. No target analytes were detected above action levels in any of the groundwater samples.

Laboratory Case Narrative

The case narrative identified the RPD serial dilution result for thallium being outside QC limits, however, the percent difference (%D) result was acceptable due to a low initial sample concentration (< 50 times IDL). No other quality control or non-compliance issues were identified in the case narrative.

Holding times (QC Limit 6 months)

The six-month analytical holding time was met for all ICP samples.

Calibration Standards (QC Limits 90-110%)

All QC calibration requirements were met by the initial and continuing calibrations employed, with target analyte recoveries all within the respective required QC limits, thereby demonstrating linearity for the GW sample analyses and acceptable analyte quantitation (concentration determination).

Low Calibration Check Standard (QC Limit 70-130%)

The laboratory analyzed a “low calibration check standard” which is similar to and may also be referred to as a contract required detection limit (CRDL) standard. This standard is identified by the acronym CRI in the data. Although the analysis of a CRDL standard is not required under Method 6010C, the laboratory analyzed it and provided the data. There is no NJDEP DV guidance for qualifying inorganic sample results for CRDL standard analysis (NJDEP, 2002). The QC results provided were within QC limits of 70-130% that are applied to other metals analyses. All CRI recoveries were within QC limits and no sample results were subject to qualification.

Quality Control Blanks (QC Limit < CRDL or <RL)

There were no target metals concentrations detected in the procedure blank or continuing calibration blanks at the stated reporting limits, such that no groundwater sample results warranted qualification for any associated QC blank contamination issues in the four GW samples of SDG JC22847A.

ICP Interference Check Samples (QC Limits 80-120%)

All analyte recoveries in the interference check samples, both IND A and IND B, were within the specified QC limits.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) Analysis
(QC Limits 75-125% Recovery; ≤ 20%RPD)

The matrix spike and matrix spike duplicate recoveries were within QC limits for all target analytes, thereby demonstrating acceptable accuracy. Matrix spike recoveries in the PPG batch QC sample JC22847-2A ranged 95.4% - 99.0% for the groundwater sample analysis, thereby demonstrating acceptable analytical accuracy for this SDG.

No sample results required qualification for matrix spike recovery issues, thereby demonstrating acceptable analytical accuracy.

Duplicate analysis (QC Limit ≤ 20 %RPD)

The duplicate analysis was performed on one pair of spiked duplicate samples of PPG sample JC22847-2A. All %RPD values were below the laboratory QC limit of 20%RPD, with values ranging 0.5 – 2.3%RPD for the groundwater samples with no results requiring qualification. The duplicate analyses demonstrated excellent analytical precision.

Laboratory control samples (QC Limits 80-120% Recovery)

All analyte recoveries in the laboratory control samples were within the specified QC limits demonstrating acceptable analytical system performance, with blank spike recoveries ranging 95.0% - 99.5% for the GW sample metals analysis.

Field Duplicate Sample Analysis (QC Limit ≤ 20%RPD)

One set of field duplicate samples was collected for the GW samples as part of SDG JB22847A. Field duplicate sample collection and analysis can provide a determination of sampling representativeness and precision. Gross differences between field sample duplicates can be an indication of inconsistent sampling techniques or sample matrix complexities/non-homogeneity.

An advisory data validation guideline for field duplicate aqueous samples suggests QC limits of 20%RPD or the absolute difference value of the CRQL (reporting limit) for sample results less than five times the CRQL (USEPA Region 2, 2015).

The results for the analysis of the one pair of field duplicate GW samples are presented in Table 2, below. It is apparent that the results for the GW metals analytes in the field duplicate samples of MW102 were identical non-detected concentrations and, thus, are considered representative, as the concentrations between field duplicate samples were identical.

Table 2. Comparison of Field Duplicate GW Sample Metals Results – SDG JC22847A

Analyte	**MW102 (µg/L)**	**DUP01 (µg/L)**	**% RPD**	**DV Flag**
Antimony	< 6.0	< 6.0	0 %	-
Chromium	< 10	< 10	0 %	-
Nickel	< 10	< 10	0 %	-
Thallium	< 2.0	< 2.0	0 %	-
Vanadium	< 50	< 50	0 %	-

QC Limit is ≤ 20 %RPD for aqueous samples, or < CRQL (for concentrations < 5 × CRQL);
< – The analyte was not detected at the stated reporting limit;
CRQL – The value representing the US EPA CLP contract required quantitation limit, often represented by the reporting limit;
< CRQL – The difference between field duplicate results was less than the CRQL and meets QC requirements.

Thus, the field duplicate results for the field duplicate samples from MW102 demonstrated excellent sampling representativeness and precision, with field duplicate GW sample results differing by 0%RPD. No GW sample results were qualified for sampling representativeness issues.

Serial Dilution Analysis (QC Limit ≤ 10 %D)

The case narrative identified the RPD serial dilution result for thallium being outside QC limits. However, the percent difference (%D) result was acceptable due to the low initial sample concentration (< 50 times IDL). All other serial dilution results met QC limits for the analytes subject to data validation, with %D results ranging 0 – 1.8%D, such that no sample results were qualified for serial dilution issues.

Quantification Verification

Metals concentrations reported on the Form 1 sheets for the GW samples could not be verified because the data was provided in a NJDEP “Reduced deliverables” format (NJDEP, 2012), omitting the quantitation reports and preparation logs from the raw data.

Summary

The groundwater sample analytical results for the samples of SDG JC22847A were found to be compliant with the analytical methods for the analysis of metals in the four groundwater samples using SW-846 Method 6010C. All QC criteria were met for all ICP target metals analyses. Hence, no groundwater sample target metals results required any qualification for any associated QC issues.

2.0 Hexavalent Chromium Analysis Data Review

The analysis for hexavalent chromium (Cr^{+6}) was performed using US EPA Method 3060A for sample preparation and Method 7196A for aqueous groundwater sample analysis.

The data validation of the analytical data was reviewed for the following data quality items and a check mark (√) indicates successful achievement of meeting the relevant QC requirements.

Holding times (pH)
√ Blank Analysis
√ Calibration standards
√ Calibration verification
√ Data qualifiers
√ Data package completeness
√ Matrix spike recoveries
√ Duplicate analysis
√ Laboratory control samples
√ Quantitation checks
√ Field duplicate sample analysis

No hexavalent chromium concentrations were detected in the four groundwater samples at a reporting limit of 0.010 mg/L.

Case Narrative

The case narrative indicated that all QC requirements were met, except that the samples were received outside the analytical holding time for pH analysis. However, the analytical holding time for pH may range anywhere from "analyze immediately" or for up to 2 hours. The groundwater samples were analyzed within the remaining method holding times, all method blanks met method specific criteria, and sample (Lab sample ID: JC22847-2) was analyzed for the spike and duplicate analyses.

Matrix Spike (MS) Analysis
(QC Limits: 75-125% Recovery)

The matrix spike recovery was within QC limits for Cr+6 demonstrating acceptable accuracy. Matrix spike recovery in QC Batch GN48005 was an acceptable 97.3%, thereby demonstrating acceptable analytical accuracy for this SDG.

No sample results required qualification for matrix spike recovery issues.

Duplicate Analysis (QC Limit: ≤ 20 %RPD)

The duplicate analysis was performed on one set of duplicate groundwater samples. The %RPD value (0%RPD) for duplicate samples in QC Batch GN48005 was well within the QC limits of 20%RPD for aqueous samples (NJDEP, 2009). The %RPD values for redox potential was 8.5 %RPD, such that all analytical precision results were less than 20%RPD for all Cr^{+6} and redox potential analyses, thereby demonstrating excellent analytical precision. Hence, no sample Cr+6 results required qualification due to any differences in the duplicate analyses.

Results of Sample Analyses

All calibration criteria were met for the groundwater samples of this SDG. This included initial calibration linearity (r = 0.99993) and continuing calibration frequency and accuracy (102.7 to 103.8% CCV Recoveries). The method and calibration blanks were free of detectable Cr^{+6}

concentrations and the blank spike recovery (100.0%) demonstrated that the analytical system was performing accurately. The reported MS recovery (97.3%), duplicate precision result (0.0 %RPD) from a batch PPG QC sample, and the non-detect Cr+6 sample results were verified from the raw data with no observed discrepancies in the reported data. The QC results demonstrated that the analyses were conducted with acceptable accuracy and analytical precision.

Field Duplicate Analysis (QC Limit < 20%RPD)

The Cr+6 results for one set of field duplicate samples collected from sample location MW102 as part of the sampling representativeness evaluation for this SDG are presented in Table 3.

Table 3. Comparison of Field Duplicate GW Sample Results – JC22847

Analyte	MW102 (µg/L)	DUP01 (µg/L)	% RPD	DV Flag
Hexavalent Chromium	< 0.010	< 0.010	0 %	----
Key: < – The analyte was analyzed, but was not detected at the stated reporting limit.				

This set of field duplicate samples demonstrated excellent sampling representativeness and precision, as the Cr+6 results were identical non-detect concentrations of < 0.010 µg/L. No sample Cr+6 results need be qualified for field duplicate sample results disparities.

Summary for Hexavalent Chromium Analysis –SDG JC22847

Since the MS recovery for Cr+6 was within QC limits, as were all other QC results associated with the hexavalent chromium analysis, including the duplicate sample analysis, no Cr^{+6} results were qualified following the DV review and are usable as reported. However, since the pH measurements were performed four days after sample receipt following completion of the Cr+6 and Redox analyses, the pH results in the four groundwater samples were qualified as estimated values and are flagged with "J", as indicated below in Table 4.

Table 4. Summary of Qualified Sample pH Results in SDG JC22847

Sample ID	Lab ID	Analyte	Result (pH units)	DV Qualifier
MW103	JC22847-1	pH	7.62	J
MW101	JC22847-2	pH	9.27	J
MW102	JC22847-3	pH	7.60	J
DUP01	JC22847-4	pH	7.61	J
Key: J – The result is an estimated value.				

The pH measurements are considered usable for project assessment, but as estimated values.

3.0 DATA QUALIFIER DEFINITIONS

The absence of qualifiers indicates that the data are acceptable both qualitatively and quantitatively.

Qualifier	Definition
J	The reported result is an estimated value.
<	The analyte was analyzed, but was not detected at the stated reporting limit.

4.0 References

APHA, AWWA, and WEF, 1995, ***Standard Methods for the Examination of Water and Wastewater, 19th Edition,*** Washington, D.C., 1268 p.

New Jersey Department of Environmental Protection, 2014a, ***Data of Known Quality Protocols Technical Guidance*****,** Version 1.0, Trenton, New Jersey, April 2014.

New Jersey Department of Environmental Protection, 2014b, ***Data Quality Assessment and Data Usability Evaluation Technical Guidance,*** Version 1.0, Trenton, New Jersey, April 2014.

New Jersey Department of Environmental Protection, 2014c, ***Analytical Laboratory Data Generation, Assessment and Usability Technical Guidance,*** Version 1.0, Trenton, New Jersey, April 2014.

New Jersey Department of Environmental Protection, 2014d, ***Quality Assurance Project Plan Technical Guidance,*** Version 1.0, Trenton, New Jersey, April 2014.

New Jersey Department of Environmental Protection, 2002, ***Standard Operating Procedure: Quality Assurance Data Validation of Analytical Deliverables Inorganics (Based on USEPA SW-846 Methods), SOP No. 5.A.16***, Trenton, New Jersey.

New Jersey Department of Environmental Protection, 2001b, ***Standard Operating Procedure for the Analytical Data Validation of Target Analyte List - Inorganics BEMQA 5.A.2, Revision 4,*** Trenton, New Jersey.

US EPA, Region 2, 2015, ***"ICP-AES Data Validation SOP No. HW-3a Revision 0 ISM 02.2"***, July 2015.

US EPA, CLP, 2010, ***"National Functional Guidelines for Inorganic Superfund Data Review"***, OSWER Publication 9240.1-51, EPA540-R-10-011, January 2010.

US EPA, 2006, ***Validation of Metals for the Contract Laboratory Program (CLP) based on SOW ILMO5.3, SOP HW-2, Revision 13***, September 2006.

US EPA, 1997, ***Test Methods for Evaluating Solid Wastes, 3rd Edition including Final Update III***, Office of Solid Waste and Emergency Response, Washington, D.C., June 1997.

US EPA, 1992a, ***Guidance for Data Usability in Risk Assessment (Part A) Final***, Office of Solid Waste and Emergency Response (OSWER), April 1992.

ATTACHMENT A

DATA QUALITY ASSURANCE/QUALITY CONTROL CHECKLIST

Project: PPG SDGs: JC22847/JC22847A

1. Were the appropriate sample preservation requirements met?................ [✓ Yes] No

2. Were appropriate sample holding times

   (for both extraction/sample preparation and analysis) met? .... Yes [✓ No]

   If “No”, provide a brief explanation.

   The samples were received outside the analytical holding time for pH analysis. However, the analytical holding time for pH may range anywhere from “analyze immediately” or for up to 2 hours, which may be considered impractical for laboratory analysis. Because the pH measurements were made four days after sample receipt, the pH results for the four groundwater samples were qualified as estimated values (“J”) in Samples JC22847-1 through -4 (inclusive).

3. Were the samples diluted? .... Yes [✓ No]

   Indicate the identity of the samples and why.

4. If applicable, did sample dilutions result in elevated reporting limits that exceed applicable standards?... Yes [✓ No]

   If “Yes”, list the affected samples.

5. Were any applicable standards exceeded for any samples? .... Yes [✓ No]

   If “Yes”, include the number of samples and laboratory sample ID numbers.

6. Were the laboratory reporting limits below the applicable remediation standards/criteria required for the site?... [✓ Yes] No

   If “No”, provide a brief explanation of action taken.

7. Were qualifications noted in the non-conformance summary?................ Yes [✓ No]

   Provide a brief explanation.

   All QC requirements were met for both the metals and Cr+6 analyses. No problems with analytical procedures were noted.

8. Were qualified data used?.. Yes [✓ No]

9. Were rejections noted in the non-conformance summary?..................... Yes [✓ No]
Provide a brief explanation.

Not applicable

10. Were rejected data used?.. Yes [✓ No]
If “yes”, please indicate reasons rejected data were used:

○ For Hex Chrome, data were rejected because spike recovery was <50%.
○ Data were rejected due to missing deliverables.
○ Data were rejected but an applicable standard exceedance exists.
○ Data were rejected in an early phase of remediation; however, additional sampling and analysis are scheduled to be performed.
○ Other reasons not noted directly above. Explain:

11. Were the quality control criteria associated with the compounds of concern at the site met? .... [✓ Yes] No

12. Were the QC Summary Forms reviewed?.. [✓ Yes] No

13. Internal Standards acceptable.. [✓ Yes] No

14. MS/MSD acceptable.. [✓ Yes] No

15. Calibration summaries acceptable... [✓ Yes] No

16. Serial dilutions acceptable.. [✓ Yes] No

17. Inorganic duplicates acceptable... [✓ Yes] No

18. LCS recovery acceptable... [✓ Yes] No

19. Other QC acceptable?... [✓ Yes] No
Provide a brief explanation, if applicable.

All QC requirements were achieved in both the metals and Cr+6 analyses. No groundwater sample results were subject to qualification in this DV report, except for the pH measurements as part of the hexavalent chromium analyses. Qualified sample results are presented in Table 4 of this DV report.

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DATA VALIDATION REPORT

Project: **Jersey City PPG, Site 63/65/Burma Road; Report SDG JC24458/JC24458A**
Sample Date: **July 21, 2016**
Analyses: **Metals Analysis, EPA Method 6010C**
Hexavalent Chromium Analysis, EPA Method 3060A/7196A
Redox Potential, ASTM D1498-76M
pH, EPA Method 9045C,D
Reviewer: **Janis V. Giga, Ph.D., REP5554**
Date: **July 27, 2016**

This data validation (DV) report presents the data review and result qualifications for four (4) groundwater (GW) samples and one field blank (FB) collected at the Jersey City PPG Site 63/65/Burma Road in Jersey City, New Jersey on July 21, 2016 for sample delivery groups (SDGs) JC24458 and JC24458A. The groundwater samples were analyzed for the analytes listed above employing the identified analytical methods by Accutest Laboratories of Dayton, New Jersey.

Summary of Sample Results Qualifications

The groundwater sample analytical results for the samples of SDG JC24458A and JC24458 were found to be compliant with the analytical method (SW-846 Method 6010C) for the analysis of metals and hexavalent chromium (Cr+6) (Method 7196A) in the four collected groundwater samples and field blank.

All quality control (QC) criteria were met for each of the ICP target analyte analyses. Consequently, none of the reported GW sample results in this SDG have been qualified and are usable as reported.

No hexavalent chromium results for the four groundwater samples of SDG JC24458 were qualified following the DV review, because all QC results were within method QC limits. A data validation checklist is provided in Attachment A to summarize the observations during the DV review.

Sample Receipt

The four (4) groundwater samples and one field blank collected July 21, 2016 were received at the Accutest laboratory the same day with an acceptable maximum corrected sampling cooler temperature of 5.3ºC. The GW sample and field blank identification numbers and corresponding laboratory identification numbers are as follows:

Table 1. Sample Receipt Summary

Client Sample Designation	Sample Lab ID Number	Date Collected	Matrix	Analyses
MW103	JC24458-1A	7/21/16	Aqueous	Metals
MW103 MSD	JC24458-1DA	7/21/16	Aqueous	Metals
MW103 MS	JC24458-1SA	7/21/16	Aqueous	Metals
MW102	JC24458-2A	7/21/16	Aqueous	Metals
MW101	JC24458-3A	7/21/16	Aqueous	Metals
DUP	JC24458-4A	7/21/16	Aqueous	Metals
FB	JC24458-5A	7/21/16	Aqueous	Metals

Client Sample Designation	**Sample Lab ID Number**	**Date Collected**	**Matrix**	**Analyses**
MW103	JC24458-1	7/21/16	Aqueous	Hex chrome, Redox, pH
MW103 MSD	JC24458-1D	7/21/16	Aqueous	Hex chrome, Redox, pH
MW103 MS	JC24458-1S	7/21/16	Aqueous	Hex chrome, Redox, pH
MW102	JC24458-2	7/21/16	Aqueous	Hex chrome, Redox, pH
MW101	JC24458-3	7/21/16	Aqueous	Hex chrome, Redox, pH
DUP	JC24458-4	7/21/16	Aqueous	Hex chrome, Redox, pH
FB	JC24458-5	7/21/16	Aqueous	Hex chrome, Redox, pH
Metals – Antimony, chromium, nickel, thallium and vanadium analyzed by SW-846 Method 6010C. Hex chrome – Hexavalent chromium analyzed by SW-846 Method 7196A.				

The data package presenting the metals data is numbered JC24458A, while the data package for the hexavalent chromium analyses is numbered JC24458.

Data Review

Data, as presented in the analytical data packages SDG JC24458 and JC24458A, was primarily reviewed and validated using the following combination of method-specific criteria with professional judgement, as appropriate:

- New Jersey Department of Environmental Protection (NJDEP) *Standard Operating Procedure: Quality Assurance Data Validation of Analytical Deliverables Inorganics (Based on USEPA SW-846 Methods), SOP No. 5.A.16* (NJDEP, 2002);
- United States (US) Environmental Protection Agency (EPA) *"National Functional Guidelines for Inorganic Data Review"*, OSWER Publication 9240.1-51, EPA540-R-10-011, January 2010 (US EPA, 2010);
- US EPA *"ICP-AES Data Validation, SOP No. HW-2a, Revision 15"* (USEPA, 2012);
- NJDEP *Standard Operating Procedure (SOP) for Analytical Data Validation of Hexavalent Chromium* (NJDEP, 2009).
- NJDEP, *Data of Known Quality Protocols Technical Guidance*, Version 1.0, April 2014.
- NJDEP, *Data Quality Assessment and Data Usability Evaluation Technical Guidance*, Version 1.0, April 2014.
- NJDEP, *Analytical Laboratory Data Generation, Assessment and Usability Technical Guidance*, Version 1.0, April 2014.
- NJDEP, *Quality Assurance Project Plan Technical Guidance*, Version 1.0, April 2014.

Data associated with parameters that do not meet quality control (QC) specifications or compliance requirements, have been qualified in accordance with US EPA Region II/NJDEP specifications/guidelines, as appropriate.

The analysis of the identified samples was performed in compliance with the requirements specified in the respective analytical methods. The data is presented in a NJDEP "reduced" deliverables package and is considered complete, as defined by the NJDEP "Technical Requirements for Site Remediation" (NJDEP, 2012). However, it is emphasized that due to the absence of raw metals data and the associated preparation logs, the substantiation of the reported metals concentrations and the accuracy of the QC summary results is precluded. The data package was complete for the hexavalent chromium analysis and Cr+6 and associated QC results were substantiated during the DV review. The information presented in the data summary and quality control (QC) forms was reviewed and used to qualify the sample results. The quality of data collected in support of this sampling activity is considered acceptable with the noted results qualifications, considering the limitations attributable to a reduced deliverables data package.

The discussion below presents the findings of the data validation review organized according to the technical areas used to evaluate inorganic analytical data. For each of these analytical topics, the information on the summary forms, as well as the raw data and supporting information for the samples or standards analyzed were reviewed during the DV effort.

1.0 Metals Analysis Data Review

The discussion below presents the findings of the data validation review for the eleven technical areas used to evaluate inorganic analytical data. For each of these analytical topics, the information on the summary forms as well as the raw data printed on the quantitation report for each sample or standard analyzed was reviewed during the DV effort.

The data validation of the analytical data was reviewed for the following data quality items:

√ Holding times
√ Blank Analysis
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√ Calibration verification
√ Data package completeness
√ Data qualifiers
√ Matrix spike recoveries
√ Duplicate analysis
√ Laboratory control samples
√ Interference Check Samples
√ Field duplicate sample analysis

The groundwater (GW) samples and field blank were analyzed for five target EPA Method 6010C metals. No target analytes were detected in any of the groundwater samples above the associated action level.

Laboratory Case Narrative

The case narrative identified the RPD serial dilution results for antimony and chromium being outside QC limits, however, the percent difference (%D) results were acceptable due to a low initial sample concentrations (< 50 times IDL). No other quality control or non-compliance issues were identified in the case narrative.

Holding times (QC Limit 6 months)

The six-month analytical holding time was met for all ICP samples.

Calibration Standards (QC Limits 90-110%)

All QC calibration requirements were met by the initial and continuing calibrations employed, with target analyte recoveries all within the respective required QC limits, thereby demonstrating linearity for the GW sample analyses and acceptable analyte quantitation (concentration determination).

Low Calibration Check Standard (QC Limit 70-130%)

The laboratory analyzed a “low calibration check standard” which is similar to and may also be referred to as a contract required detection limit (CRDL) standard. This standard is identified by the acronym CRI in the data. A high calibration check standard was also run with acceptable recoveries. Although the analysis of a CRDL standard is not required under Method 6010C, the laboratory analyzed it and provided the data. There is no NJDEP DV guidance for qualifying inorganic sample results for CRDL standard analysis (NJDEP, 2002).

The QC results provided were within QC limits of 70-130% that are applied to other metals analyses, except for the elevated antimony recoveries in two low calibration check standards: CRID2 at 11:36 (173.3%) and CRID3 at 14:23 (143.3%) in analytical sequence MA39929 on 7/22/16.

The groundwater sample results were not affected by the elevated antimony recoveries in these two low-level calibration standards, because antimony was not detected in the associated samples and there is no potential positive bias in a non-detected result.

Consequently, no groundwater sample results were qualified for any calibration issues.

Quality Control Blanks (QC Limit < CRDL or <RL)

There were no target metals concentrations detected in the procedure blank, continuing calibration blanks, or field blank at the stated reporting limits, such that no groundwater sample results warranted qualification for any associated QC blank contamination issues in the four GW samples of SDG JC24458A.

ICP Interference Check Samples (QC Limits 80-120%)

All analyte recoveries in the interference check samples, both IND A and IND B, were within the specified QC limits.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) Analysis
(QC Limits 75-125% Recovery; ≤ 20%RPD)

The matrix spike and matrix spike duplicate recoveries were within QC limits for all target analytes demonstrating acceptable accuracy. Matrix spike recoveries in the batch QC samples ranged 93.0-100.4% for the groundwater sample analysis, thereby demonstrating acceptable analytical accuracy for this SDG.

No sample results required qualification for matrix spike recovery issues, thereby demonstrating acceptable analytical accuracy.

Duplicate analysis (QC Limit ≤ 20 %RPD)

The duplicate analysis was performed on one pair of spiked duplicate samples. All %RPD values were below the laboratory QC limit of 20%RPD, with values ranging 4.1 – 5.1%RPD for the groundwater samples with no results requiring qualification. The duplicate analyses demonstrated very good analytical precision.

Laboratory control samples (QC Limits 80-120% Recovery)

All analyte recoveries in the laboratory control samples were within the specified QC limits demonstrating acceptable analytical system performance, with blank spike recoveries ranging 95.0% - 100.0% for the GW sample metals analysis.

Field Duplicate Sample Analysis (QC Limit ≤ 20%RPD)

One set of field duplicate samples was collected for the GW samples as part of SDG JB24458A. Field duplicate sample collection and analysis can provide a determination of sampling representativeness and precision. Gross differences between field sample duplicates can be an indication of inconsistent sampling techniques or sample matrix complexities/non-homogeneity.

An advisory data validation guideline for field duplicate aqueous samples suggests QC limits of 20%RPD or the absolute difference value of the CRQL (reporting limit) for sample results less than five times the CRQL (USEPA Region 2, 2015).

The results for the analysis of the one pair of field duplicate GW samples are presented in Table 2, below. It is apparent that the results for the GW metals analytes in the field duplicate samples of MW101 were almost identical concentrations and, thus, are considered representative, as the concentrations between field duplicate samples differed by less than 8% RPD.

Table 2. Comparison of Field Duplicate GW Sample Metals Results – SDG JC24458A

Analyte	**MW101 (µg/L)**	**DUP (µg/L)**	**% RPD**	**DV Flag**
Antimony	< 6.0	< 6.0	0 %	-
Chromium	10.3	10.1	2.0 %	-
Nickel	17.2	18.6	7.8 %	-
Thallium	< 2.0	< 2.0	0 %	-
Vanadium	561	556	0.9 %	-
QC Limit is ≤ 20 %RPD for aqueous samples, or < CRQL (for concentrations < 5 × CRQL); < – The analyte was not detected at the stated reporting limit; CRQL – The value representing the US EPA CLP contract required quantitation limit, often represented by the reporting limit; < CRQL – The difference between field duplicate results was less than the CRQL and meets QC requirements.				

Thus, the field duplicate results for the field duplicate samples from MW101 demonstrated excellent sampling representativeness and precision, with field duplicate GW sample results differing by less than 8%RPD. No GW sample results were qualified for sampling representativeness issues.

Serial Dilution Analysis (QC Limit ≤ 10 %D)

The case narrative identified the RPD serial dilution result for antimony and chromium being outside QC limits. However, the percent difference (%D) results are acceptable due to the low initial sample concentrations (< 50 times IDL). All other serial dilution results met QC limits for the analytes subject to data validation, with %D results ranging 0 – 6.3%D, such that no sample results were qualified for serial dilution issues.

Quantification Verification

Metals concentrations reported on the Form 1 sheets for the GW samples could not be verified because the data was provided in a NJDEP “Reduced deliverables” format (NJDEP, 2012), omitting the quantitation reports and preparation logs from the raw data, in accordance with the requirements of the *Technical Requirements for Site Remediation* (NJDEP, 2012).

Summary

The groundwater sample analytical results for the samples of SDG JC24458A were found to be compliant with the analytical methods for the analysis of metals in the four groundwater samples and field blank using SW-846 Method 6010C. All QC criteria were met for all ICP target metals analyses. Hence, no groundwater sample target metals results required any qualification for any associated QC issues.

2.0 Hexavalent Chromium Analysis Data Review

The analysis for hexavalent chromium (Cr^{+6}) was performed using US EPA Method 3060A for sample preparation and Method 7196A for aqueous groundwater sample analysis.

The data validation of the analytical data was reviewed for the following data quality items and a check mark (√) indicates successful achievement of meeting the relevant QC requirements.

√ Holding times
√ Blank Analysis
√ Calibration standards
√ Calibration verification
√ Data qualifiers
√ Data package completeness
√ Matrix spike recoveries
√ Duplicate analysis
√ Laboratory control samples
√ Quantitation checks
√ Field duplicate sample analysis

No hexavalent chromium concentrations were detected in the four groundwater samples or the field blank at a reporting limit of 0.010 mg/L.

Case Narrative

The case narrative indicated that all QC requirements were met, except that the samples were received outside the analytical holding time for pH analysis. However, the analytical holding time for pH may range anywhere from “analyze immediately” or for up to 2 hours. The groundwater samples were analyzed within the remaining method holding times, all method blanks met method specific criteria, and sample (Lab sample ID: JC24458-1) was analyzed for the spike and duplicate analyses.

The case narrative for the hexavalent chromium analysis had incorrectly stated that there were 5 sample(s) and 1 Field Blank received, when there were only four GW samples and 1 FB received. The information in the metals case narrative was correct.

Matrix Spike (MS) Analysis

(QC Limits: 75-125% Recovery)

The matrix spike recovery was within QC limits for Cr+6 demonstrating acceptable accuracy. Matrix spike recovery in QC Batch GN49364 was an acceptable 93.3%, thereby demonstrating acceptable analytical accuracy for this SDG.

No sample results required qualification for matrix spike recovery issues.

Duplicate Analysis (QC Limit: ≤ 20 %RPD)

The duplicate analysis was performed on one set of duplicate groundwater samples. The %RPD value (0%RPD) for duplicate samples in QC Batch GN49364 was well within the QC limits of 20%RPD for aqueous samples (NJDEP, 2009). The %RPD values for redox potential and pH were 3.9 %RPD and 0.4 %RPD, such that all analytical precision results were less than 20%RPD for all $Cr^{+}6$, pH and redox potential analyses, thereby demonstrating excellent analytical precision. Hence, no sample Cr+6 results required qualification due to any differences in the duplicate analyses.

Results of Sample Analyses

All calibration criteria were met for the groundwater samples of this SDG. This included initial calibration linearity (r = 0.99994) and continuing calibration frequency and accuracy (102.4 to 102.6% CCV Recoveries). The method and calibration blanks were free of detectable Cr^{+6} concentrations and the blank spike recovery (100.0%) demonstrated that the analytical system was performing accurately. The reported MS recovery (93.3%), duplicate precision result (0.0 %RPD) from a PPG batch QC sample, and the non-detect field blank sample results were verified from the raw data with no observed discrepancies in the reported data. The QC results demonstrated that the analyses were conducted with acceptable accuracy and analytical precision.

Field Duplicate Sample Analysis (QC Limit < 20%RPD)

The Cr+6 results for one set of field duplicate samples collected from sample location MW101 as part of the sampling representativeness evaluation for this SDG are presented in Table 3.

Table 3. Comparison of Field Duplicate GW Sample Results – JC24458

Analyte	MW101 (µg/L)	DUP01 (µg/L)	% RPD	DV Flag
Hexavalent Chromium	< 0.010	< 0.010	0 %	----

Key:
< – The analyte was analyzed, but was not detected at the stated reporting limit..

This set of field duplicate samples demonstrated excellent sampling representativeness and precision, as the Cr+6 results were identical non-detect concentrations of < 0.010 µg/L. No sample Cr+6 results need be qualified for field duplicate sample results disparities.

Summary for Hexavalent Chromium Analysis –SDG JC24458

Since the MS recoveries were within QC limits, as were all other QC results associated with the hexavalent chromium analysis, including the duplicate sample analysis, no Cr^{+6} results were qualified following the DV review and are usable as reported without qualification.

The laboratory case narrative had stated that the holding times were met for all wet chemistry analyses, except for the pH analysis. The laboratory identified the pH as exceeding the holding time, because the analytical holding time, which is often listed as “analyze immediately”, had been exceeded. The GW samples were collected on 7/21 at approximately noon, relinquished at 4 p.m., received at the laboratory and subsequently analyzed the next day (7/22) along with the Redox potential analysis. However, professional judgement was applied in not qualifying the pH results since the laboratory performed the pH analysis in a practicable period of time following sample receipt. The absence of qualification of the pH results does not compromise the usefulness of the data presented in the data package, as the pH, in conjunction with the Redox potential data reflect the reducing nature of the samples. All four samples appear well below the Eh-pH phase diagram line, thereby supporting the non-detect Cr+6 concentrations observed in the four groundwater samples.

Furthermore, the pH results of this July 21 sampling event were compared to the pH results of these same GW sampling locations to those reported in SDG JC22847 for the June 23, 2016 sampling event and were observed to be quite similar, differing by less than 14%RPD. This difference is a value well within the laboratory variability considered acceptable by the industry. While the pH measurements were qualified as estimated in SDG JC22847 (flagged with “J”) because the pH measurements were made four days after collection, raises question as to whether the “analyze immediately” holding time is appropriate in assessing the need to qualify pH results, provided the measurement are performed within a reasonable, practicable period of time with proper “preservation” (stored at 4ºC).

Because of the acceptability of the QC data, no sample results warranted qualification following the review of the data and the reported results are considered fully usable without qualification.

3.0 DATA QUALIFIER DEFINITIONS

The absence of qualifiers indicates that the data are acceptable both qualitatively and quantitatively.

Qualifier	**Definition**
J	The reported result is an estimated value.
<	The analyte was analyzed, but was not detected at the stated reporting limit.
N	The matrix spike sample recovery in the associated QC sample is not within QC limits.
NJ+	The matrix spike sample recovery in the associated QC sample is above QC limits; the result may be biased high.
NJ-	The matrix spike sample recovery in the associated QC sample is below QC limits; the result may be biased low.
*****	Duplicate analysis not within control limits; indeterminate bias direction.

4.0 References

APHA, AWWA, and WEF, 1995, ***Standard Methods for the Examination of Water and Wastewater, 19th Edition,*** Washington, D.C., 1268 p.

New Jersey Department of Environmental Protection, 2014a, ***Data of Known Quality Protocols Technical Guidance*****,** Version 1.0, Trenton, New Jersey, April 2014.

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New Jersey Department of Environmental Protection, 2002, ***Standard Operating Procedure: Quality Assurance Data Validation of Analytical Deliverables Inorganics (Based on USEPA SW-846 Methods), SOP No. 5.A.16***, Trenton, New Jersey.

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US EPA, Region 2, 2015, ***"ICP-AES Data Validation SOP No. HW-3a Revision 0 ISM 02.2"***, July 2015.

US EPA, CLP, 2010, ***"National Functional Guidelines for Inorganic Superfund Data Review"***, OSWER Publication 9240.1-51, EPA540-R-10-011, January 2010.

US EPA, 2006, ***Validation of Metals for the Contract Laboratory Program (CLP) based on SOW ILMO5.3, SOP HW-2, Revision 13***, September 2006.

US EPA, 1997, ***Test Methods for Evaluating Solid Wastes, 3rd Edition including Final Update III***, Office of Solid Waste and Emergency Response, Washington, D.C., June 1997.

US EPA, 1992a, Guidance for Data Usability in Risk Assessment (Part A) Final, Office of Solid Waste and Emergency Response (OSWER), April 1992.

ATTACHMENT A

Data Validation Checklist

DATA QUALITY ASSURANCE/QUALITY CONTROL CHECKLIST

Project: PPG SDGs: JC24458/JC24458A

1. Were the appropriate sample preservation requirements met?................ [✓ Yes] No

2. Were appropriate sample holding times
   (for both extraction/sample preparation and analysis) met? .... Yes [✓ No]
   If "No", provide a brief explanation.

   The samples were received outside the analytical holding time for pH analysis. However, the analytical holding time for pH may range anywhere from "analyze immediately" or for up to 2 hours, which may be considered impractical for laboratory analysis. Because the pH measurements were performed the following day after sample receipt, professional judgement was applied in not qualifying the pH results.

3. Were the samples diluted? .... Yes [✓ No]
   Indicate the identity of the samples and why.

4. If applicable, did sample dilutions result in elevated reporting limits that exceed applicable standards?.. Yes [✓ No]
   If "Yes", list the affected samples.

5. Were any applicable standards exceeded for any samples? .... Yes [✓ No]
   If "Yes", include the number of samples and laboratory sample ID numbers.

6. Were the laboratory reporting limits below the applicable remediation standards/criteria required for the site?.. [✓ Yes] No
   If "No", provide a brief explanation of action taken.

7. Were qualifications noted in the non-conformance summary?................ Yes [✓ No]
   Provide a brief explanation.

All QC requirements were met for both the metals and Cr+6 analyses. No problems with analytical procedures were noted.

8. Were qualified data used?.. Yes [✓ No]

9. Were rejections noted in the non-conformance summary?..................... Yes [✓ No]
Provide a brief explanation.

Not applicable

10. Were rejected data used?.. Yes [✓ No]
If “yes”, please indicate reasons rejected data were used:
   - ○ For Hex Chrome, data were rejected because spike recovery was <50%.
   - ○ Data were rejected due to missing deliverables.
   - ○ Data were rejected but an applicable standard exceedance exists.
   - ○ Data were rejected in an early phase of remediation; however, additional sampling and analysis are scheduled to be performed.
   - ○ Other reasons not noted directly above. Explain:

11. Were the quality control criteria associated with the compounds of concern at the site met? .... [✓ Yes] No
12. Were the QC Summary Forms reviewed?... [✓ Yes] No
13. Internal Standards acceptable.. [✓ Yes] No
14. MS/MSD acceptable.. [✓ Yes] No
15. Calibration summaries acceptable... [✓ Yes] No
16. Serial dilutions acceptable... [✓ Yes] No
17. Inorganic duplicates acceptable... [✓ Yes] No
18. LCS recovery acceptable.. [✓ Yes] No
19. Other QC acceptable?.. [✓ Yes] No
Provide a brief explanation, if applicable.

All QC requirements were achieved in both the metals and Cr+6 analyses. No groundwater sample results were subject to qualification in this DV report

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DATA VALIDATION REPORT

Project: **Jersey City PPG, Site 63; Report SDG JC47790**
Sample Date: **July 26, 2017**
Analyses: **Metals Analysis, EPA Method 6010C**
Hexavalent Chromium Analysis, EPA Method 7196A
Redox Potential, ASTM D1498-76M
pH, EPA Method SM4500H+ B-11
Reviewer: **Janis V. Giga, Ph.D., REP5554**
Date: **August 7, 2017**

This data validation (DV) report presents the data review and result qualifications for ten (10) groundwater (GW) samples and one field blank (FB) collected at the Jersey City PPG Site 63 in Jersey City, New Jersey on July 26, 2017 for sample delivery group (SDG) JC47790. The groundwater samples and field blank were analyzed for the analytes listed above employing the identified analytical methods by SGS Accutest Laboratories of Dayton, New Jersey.

Summary of Sample Results Qualifications

The groundwater sample analytical results for the samples of SDG JC47790 were found to be compliant with the analytical method (SW-846 Method 6010C) for the analysis of metals in the ten collected groundwater samples and one field blank, and hexavalent chromium (^{Cr}+6) (Method 7196A) in the seven collected groundwater samples and one field blank.

All quality control (QC) criteria were met for each of the inductively coupled plasma (ICP) target analyte analyses. Consequently, none of the reported GW sample metals results in this SDG have been qualified and are usable as reported.

All QC criteria were met for each of the Cr+6 analyses, except for an exceedance of the 24-hour analytical holding time. Consequently, each of the seven reported GW sample and one field blank Cr+6 results in this SDG have been qualified as estimated values and are usable as reported with the applicable qualification.

Following the detailed DV review, the following sample results were qualified:

- Hexavalent chromium (“J”) in Samples JC47790-1 through JC47790-8 (inclusive)

A data validation checklist is provided in Attachment A to summarize the observations during the DV review.

Sample Receipt

The ten (10) groundwater samples and one field blank collected July 26, 2017 were received at the SGS Accutest laboratory the next day July 27, 2017, with an acceptable maximum corrected sampling cooler temperature of 3.6 degrees Celsius (ºC). The GW sample and field blank identification numbers and corresponding laboratory identification numbers are as follows:

Table 1. Sample Receipt Summary

Client Sample Designation	**Sample Lab ID Number**	**Date Collected**	**Matrix**	**Analyses**
MW-101	JC47790-1	7/26/17	Aqueous	Metals
MW-101	JC47790-1F	7/26/17	Aqueous (filtered)	Metals
MW-102	JC47790-2	7/26/17	Aqueous	Metals
DUP	JC47790-3	7/26/17	Aqueous	Metals
FB01	JC47790-4	7/26/17	Aqueous	Metals
MW-202	JC47790-5	7/26/17	Aqueous	Metals
MW-202	JC47790-5F	7/26/17	Aqueous (filtered)	Metals
MW-201	JC47790-6	7/26/17	Aqueous	Metals
MW-12	JC47790-7	7/26/17	Aqueous	Metals
MW-103	JC47790-8	7/26/17	Aqueous	Metals
MSD	JC47790-8D	7/26/17	Aqueous	Metals
MW-103	JC47790-8F	7/26/17	Aqueous (filtered)	Metals
MS	JC47790-8S	7/26/17	Aqueous	Metals
MW-101	JC47790-1	7/26/17	Aqueous	Cr+6
MW-102	JC47790-2	7/26/17	Aqueous	Cr+6
DUP	JC47790-3	7/26/17	Aqueous	Cr+6
FB01	JC47790-4	7/26/17	Aqueous	Cr+6
MW-202	JC47790-5	7/26/17	Aqueous	Cr+6
MW-201	JC47790-6	7/26/17	Aqueous	Cr+6
MW-12	JC47790-7	7/26/17	Aqueous	Cr+6
MW-103	JC47790-8	7/26/17	Aqueous	Cr+6
Metals – Antimony, chromium, nickel, thallium and vanadium analyzed by SW-846 Method 6010C. Cr+6 – Hexavalent chromium analyzed by SW-846 Method 7196A together with pH and redox potential.				

The data package presenting the metals analysis data is numbered JC47790, which also contained the hexavalent chromium and ancillary analysis data.

Data Review

Data, as presented in the analytical data package SDG JC47790, was primarily reviewed and validated using the following combination of method-specific criteria with professional judgement, as appropriate:

- New Jersey Department of Environmental Protection (NJDEP) *Standard Operating Procedure: Quality Assurance Data Validation of Analytical Deliverables Inorganics (Based on US EPA SW-846 Methods), SOP No. 5.A.16* (NJDEP, 2002).
- United States (US) Environmental Protection Agency (EPA) *"National Functional Guidelines for Inorganic Data Review"*, OSWER Publication 9355.0-131, EPA540-R-013-001, August 2014 (US EPA, 2014).
- US EPA *"ICP-AES Data Validation, SOP No. HW-3a, Revision 0 ISM 0.2.2"* (US EPA, 2015).
- NJDEP *Standard Operating Procedure (SOP) for Analytical Data Validation of Hexavalent Chromium* (NJDEP, 2009).
- NJDEP, *Data of Known Quality Protocols Technical Guidance*, Version 1.0, April 2014.
- NJDEP, *Data Quality Assessment and Data Usability Evaluation Technical Guidance*, Version 1.0, April 2014.

- NJDEP, *Analytical Laboratory Data Generation, Assessment and Usability Technical Guidance*, Version 1.0, April 2014.
- NJDEP, *Quality Assurance Project Plan Technical Guidance*, Version 1.0, April 2014.

Data associated with parameters that do not meet quality control specifications or compliance requirements, have been qualified in accordance with US EPA Region II/NJDEP specifications/guidelines, as appropriate.

The analysis of the identified samples was performed in compliance with the requirements specified in the respective analytical methods. The data is presented in a NJDEP full deliverables package and is considered complete, as defined by the NJDEP "Technical Requirements for Site Remediation" (NJDEP, 2012). The data package was complete for the metals and hexavalent chromium analysis, such that the metals and Cr+6 results with associated QC results were substantiated during the DV review. The information presented in the data summary and quality control (QC) forms was reviewed and used to qualify the sample results. The quality of data collected in support of this sampling activity is considered acceptable with the noted results qualifications, considering the limitations attributable to a reduced deliverables data package.

The discussion below presents the findings of the data validation review organized according to the technical areas used to evaluate inorganic analytical data. For each of these analytical topics, the information on the summary forms, as well as the raw data and supporting information for the samples or standards analyzed were reviewed during the DV effort.

1.0 Metals Analysis Data Review

The discussion below presents the findings of the data validation review for the eleven technical areas used to evaluate inorganic analytical data. For each of these analytical topics, the information on the summary forms as well as the raw data printed on the quantitation report for each sample or standard analyzed was reviewed during the DV effort.

The data validation of the analytical data was reviewed for the following data quality items:

√ Holding times
√ Blank Analysis
√ Calibration standards
√ Calibration verification
√ Data package completeness
√ Data qualifiers
√ Matrix spike recoveries
√ Duplicate analysis
√ Laboratory control samples
√ Interference Check Samples
√ Field duplicate sample analysis

The GW samples and field blank were analyzed for five target EPA Method 6010C metals. No target analytes were detected in any of the groundwater samples above the associated action level, except for antimony and chromium in MW-202, and vanadium in samples from MW-101, MW-202, and MW-103.

Laboratory Case Narrative

The case narrative identified the relative percent difference (RPD) serial dilution results for chromium and both nickel analyses in QC Batch MP2156, and the antimony in QC Batch MP2157, being outside QC limits. However, the percent difference (%D) results are acceptable due to the low initial sample concentrations (< 50 times the instrument detection limit [IDL]). The detection limit for thallium in JC47790-5F in QC Batch MP2156 and JC47790-5 in QC Batch MP2157 were elevated due to the dilution required for a high interfering element. The sample detection limits for antimony, chromium, nickel and vanadium in JC47790-5 in QC Batch MP2157 were elevated due to a difficult sample matrix.

No other quality control or non-compliance issues were identified in the case narrative.

Holding Times (QC Limit 6 months)

The six-month analytical holding time was met for all ICP samples.

Calibration Standards (QC Limits 90-110% Recovery)

All QC calibration requirements were met by the initial and continuing calibrations employed, with target analyte recoveries all within the respective required QC limits, thereby demonstrating linearity for the GW sample analyses and acceptable analyte quantitation (concentration determination).

Low Calibration Check Standard (QC Limit 70-130% Recovery)

The laboratory analyzed a “low calibration check standard”, the latter which is similar to and may also be referred to as a contract required detection limit (CRDL) standard. This standard is identified by the acronym CRI in the data. A high calibration check standard was also run with acceptable recoveries. Although the analysis of a CRDL standard is not required under Method 6010C, the laboratory analyzed it and provided the data. There is no NJDEP DV guidance for qualifying inorganic sample results for CRDL standard analysis (NJDEP, 2002).

The QC results provided were within QC limits of 70-130% that are applied to other metals analyses, except for the 0% antimony recoveries in various low calibration check standards: CRID1 at 10:18 and CRID2 at 16:01 in analytical sequence MA42511 on 7/31/17; CRID2 at 19:01, CRID3 at 23:52, and CRID4 at 4:24 in analytical sequence MA42514 on 7/31/17. The concentration of the CRID standard is 3 µg/L with an applicable affected range of 0-6 µg/L. The laboratory also analyzed a CRI standard at 6 µg/L, which is the reporting limit for the aqueous samples.

However, the recoveries of the 6 µg/L CRI standard, which served as a check on the ability to recover at the reporting limit were all within QC limits. Since antimony was not detected in any of the GW samples or the FB at the reporting limit of 6 µg/L and the laboratory demonstrated an acceptable ability to recover antimony at the reporting limit, it was judged appropriate to not qualify any of the antimony results, which were all non-detect values.

Hence, no groundwater sample or field blank results were qualified for any calibration issues.

Quality Control Blanks (QC Limit < CRDL or < Reporting Limit [RL])

There were no target metals concentrations detected in the procedure blanks or the field blank at the stated reporting limits in SDG JC47790, while thallium was detected in several continuing calibration blanks (CCBs) of a few analytical sequences. However, no sample results were subject to qualification, as discussed and explained below.

Thallium was detected in CCB1, CCB3, CCB7, and CCB9 at concentrations ranging from 2.0 to 2.4 µg/L in analytical sequence MA42511 that contained samples JC47790-1 through -4 (inclusive), JC47790-6, -7, -8, and JC47790-1F, -5F, and -8F; however, sample results were not affected because thallium was not detected in any of the samples, and some of the CCBs were not directly associated with the samples.

Thallium was detected in CCB12 at a concentration of 2.1 µg/L in analytical sequence MA42514 that contained thallium analysis for samples JC47790-1F, -5F, -8, and -8F; however, sample results were not affected because this CCB was not directly associated with any of the samples, which also displayed only non-detect thallium results.

Hence, no groundwater sample results warranted qualification for any associated QC blank contamination in SDG JC47790.

ICP Interference Check Samples (QC Limits 80-120% Recovery)

All analyte recoveries in the interference check samples, both IND A and IND B, were within the specified QC limits.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) Analysis

(QC Limits 75-125% Recovery; ≤ 20%RPD)

The matrix spike and matrix spike duplicate recoveries were within QC limits for all target analytes demonstrating acceptable accuracy. Matrix spike recoveries in the batch QC sample in Batch MP2156 associated with 9 GW samples and the FB ranged from 84.1% to 94.2% for the non-filtered QC sample and ranged from 92.6% to 99.4% for its filtered aliquot, while the MS recoveries in QC Batch MP2157 associated with only JC47790-5 ranged from 81.8% to 90.4%, thereby demonstrating acceptable analytical accuracy for this SDG.

No sample results required qualification for matrix spike recovery issues, thereby demonstrating acceptable analytical accuracy.

Duplicate Analysis (QC Limit ≤ 20 %RPD)

The duplicate analysis was performed on two pairs of spiked duplicate samples. All %RPD values were below the laboratory QC limit of 20%RPD, with values ranging from 4.9 – 5.4%RPD for the unfiltered QC sample associated with nine groundwater samples and the FB, and 0.5 to 1.1%RPD for the filtered QC sample aliquot, while the RPD values in QC Batch MP2157 associated with JC47790-5 ranged from 0 to 2.4%RPD. Hence, no metals results requiring qualification for the duplicate analysis issue, as the duplicate analyses demonstrated very good analytical precision.

Laboratory Control Samples (QC Limits 80-120% Recovery)

All analyte recoveries in the laboratory control samples (also referred to as the blank spike) were within the specified QC limits demonstrating acceptable analytical system performance, with blank spike recoveries ranging from 96.5% - 100.5% for the QC batch associated with the nine GW samples and FB, while the blank spike recoveries in QC Batch MP2157 associated with JC47790-5 ranged from 91.5% to 99.0% for the metals analysis. Thus, acceptable analytical system performance was demonstrated.

Field Duplicate Sample Analysis (QC Limit ≤ 20%RPD)

One set of field duplicate samples was collected for the GW samples as part of SDG JC47790. Field duplicate sample collection and analysis can provide a determination of sampling representativeness and precision. Gross differences between field sample duplicates can be an indication of inconsistent sampling techniques or sample matrix complexities/non-homogeneity.

An advisory data validation guideline for field duplicate aqueous samples suggests QC limits of 20%RPD or the absolute difference value of the CRQL (reporting limit) for sample results less than five times the CRQL (US EPA Region 2, 2015).

The results for the analysis of the one pair of field duplicate GW samples are presented in Table 2, below. It is apparent that the results for the GW metals analytes in the field duplicate samples of MW102 were identical non-detect concentrations and, thus, are considered representative, as the concentrations between field duplicate samples differed by essentially 0% RPD.

Table 2. Comparison of Field Duplicate GW Sample Metals Results – SDG JC47790

Analyte	MW102 (µg/L)	DUP (µg/L)	% RPD	DV Flag
Antimony	< 6.0	< 6.0	< CRQL	-
Chromium	< 10	< 10	< CRQL	-
Nickel	< 10	< 10	< CRQL	-
Thallium	< 2.0	< 2.0	< CRQL	-
Vanadium	< 50	< 50	< CRQL	-
QC Limit is ≤ 20 %RPD for aqueous samples, or < CRQL (for concentrations < 5 × CRQL); < – The analyte was not detected at the stated reporting limit; CRQL – The value representing the US EPA CLP contract required quantitation limit, often represented by the reporting limit; < CRQL – The difference between field duplicate results was less than the CRQL and meets QC requirements.				

Thus, the field duplicate results for the field duplicate samples from MW102 demonstrated excellent sampling representativeness and precision, with field duplicate GW sample results differing by 0%RPD. No GW sample results were qualified for sampling representativeness issues.

Serial Dilution Analysis (QC Limit ≤ 10 %D)

The case narrative identified the RPD serial dilution results for chromium and both nickel analyses in QC Batch MP2156, and the antimony in QC Batch MP2157 being outside QC limits. However, the percent difference (%D) results are acceptable due to the low initial sample concentrations (< 50 times IDL). All other serial dilution results met QC limits for the analytes subject to data validation, with %D results ranging 0 – 2.7%D, such that no sample results were qualified for serial dilution issues.

Quantification Verification

Sample concentrations reported on the Form 1 sheets for each sample were verified from the quantitation reports in the raw data during the validation activity.

Reporting Limits

Sample JC47790-5 required a five-fold (5×) dilution for thallium analysis and Sample JC47790-5f required a ten-fold (10×) dilution due to the presence of a high interfering element, such that the thallium reporting limits for these samples were raised to values of < 10 and < 20 µg/L, values above the respective New Jersey Groundwater Standard of 2 µg/L, as detailed below in Table 3.

Table 3. Sample Reporting Limits Affected by Sample Dilution

Sample ID	Lab ID	Analyte	Reporting Limit (µg/L)	Dilution Factor	Adjusted Result	NJ Groundwater Standard (µg/L)
MW-202	JC47790-5	Thallium	< 2	5	< 10	2
MW-202	JC47790-5f	Thallium	< 2	10	< 20	2
Units – µg/L < – The analyte was analyzed for, but was not detected above the stated reporting limit. f – Sample was filtered						

The interpretation of the reporting limits for thallium in JC47790-5 and its filtered aliquot JC47790-5f were not compromised because the antimony, chromium, and vanadium concentrations were above the respective NJ Groundwater Standard levels and the samples would need to be addressed in either additional review or some type of remedial action. Additionally, interpretation of the GW results were not compromised by these dilutions because thallium has not been detected in any of the samples during this phase of sampling at PPG.

Metals Analysis Summary

The groundwater sample analytical results for the samples of SDG JC47790 were found to be compliant with the analytical methods for the analysis of metals in the ten groundwater samples and one field blank using SW-846 Method 6010C. All QC criteria were met for all ICP target metals analyses. Hence, no groundwater sample target metals results required any qualification for any associated QC issues.

<u>2.0 Hexavalent Chromium Analysis Data Review</u>

The analysis for hexavalent chromium (Cr+6) was performed using Method 7196A for aqueous groundwater sample and field blank analysis.

The data validation of the analytical data was reviewed for the following data quality items and a check mark (√) indicates successful achievement of meeting the relevant QC requirements.

Holding times
√ Blank Analysis
√ Calibration standards
√ Calibration verification
√ Data qualifiers
√ Data package completeness
√ Matrix spike recoveries
√ Duplicate analysis
√ Laboratory control samples
√ Quantitation checks
√ Field duplicate sample analysis

No hexavalent chromium concentrations were detected in the seven groundwater samples or the field blank at a reporting limit of 0.010 mg/L.

<u>Laboratory Case Narrative</u>

The case narrative indicated that all QC requirements were met, except that the samples were analyzed outside the analytical [24-hour] holding time for Cr+6 analysis. Sample MW-103 (Lab sample ID: JC47790-8) was analyzed for the spike and duplicate analyses.

The case narrative stated that field analysis is required for pH analysis. The eight samples (7 GW and 1 FB) were received out of hold time and were analyzed by request. However, the analytical holding time for pH may range anywhere from “analyze immediately” or for up to 2 hours. The groundwater samples were analyzed within the remaining method holding times, all method blanks met method specific criteria.

While the case narrative for the SDG had stated that there were 10 sample(s) and 1 Field Blank received, only seven of the GW samples and 1 FB were analyzed for hexavalent chromium. The information in the metals case narrative was correct, as three of the samples had been filtered in the laboratory for metals analysis.

Matrix Spike (MS) Analysis
(QC Limits: 75-125% Recovery)

The matrix spike recovery was within QC limits for Cr+6 demonstrating acceptable accuracy. Matrix spike recovery in QC Batch GN67442 was an acceptable 106.7%, thereby demonstrating acceptable analytical accuracy for this SDG.

No sample results required qualification for matrix spike recovery issues.

Duplicate Analysis (QC Limit: ≤ 20 %RPD)

The duplicate analysis was performed on one set of duplicate groundwater samples. The %RPD value (0%RPD) for duplicate samples in QC Batch GN67442 was well within the QC limits of 20%RPD for aqueous samples (NJDEP, 2009). The %RPD values for redox potential and pH were 1.3 %RPD and 0.0 %RPD, such that all analytical precision results were less than 20%RPD for all Cr+6, pH and redox potential analyses, thereby demonstrating excellent analytical precision. Hence, no sample Cr+6 results required qualification due to any differences in the duplicate analyses.

Results of Sample Analyses

All calibration criteria were met for the groundwater samples of this SDG. This included initial calibration linearity (r = 0.99995), and continuing calibration frequency and accuracy (100.9% to 101.3% CCV Recoveries). The method and calibration blanks were free of detectable Cr+6 concentrations and the blank spike recovery (100.0%) demonstrated that the analytical system was performing accurately. The reported MS recovery (106.7%), duplicate precision result (0.0 %RPD) from a PPG batch QC sample, and the non-detect field blank sample results were verified from the raw data with no observed discrepancies in the reported data. The QC results demonstrated that the analyses were conducted with acceptable accuracy and analytical precision.

Field Duplicate Sample Analysis (QC Limit < 20%RPD)

The Cr+6 results for one set of field duplicate samples collected from sample location MW-102 as part of the sampling representativeness evaluation for this SDG are presented in Table 4.

Table 4. Comparison of Field Duplicate GW Sample Results – JC47790

Analyte	MW-102 (mg/L)	DUP (mg/L)	% RPD	DV Flag
Hexavalent Chromium	< 0.010	< 0.010	0 %	----

Key:
< – The analyte was analyzed, but was not detected at the stated reporting limit.

This set of field duplicate samples demonstrated excellent sampling representativeness and precision, as the Cr+6 results were identical non-detect concentrations of < 0.010 mg/L. No sample Cr+6 results need be qualified for field duplicate sample results disparities.

Summary for Hexavalent Chromium Analysis –SDG JC47790

Since the MS recoveries were within QC limits, as were all other QC results associated with the hexavalent chromium analysis, including the duplicate sample analysis, no Cr+6 results were subject to qualification for QC issues following the DV review. However, since the samples were received the day following collection and analyzed approximately 3 to 11 hours past the 24-hour analytical holding time, the Cr+6 results for the seven groundwater samples and one field blank are qualified as estimated values and flagged with "J" due to the exceeded holding times. However, the non-detect Cr+6 results in the seven GW samples and one field blank are usable as reported with the applied qualification.

Although the laboratory initially failed to analyze aqueous samples for pH and Eh, the collected pH and Eh field data were reviewed and plotted on an Eh-pH diagram during the DV evaluation following which it was observed that each of the groundwater samples fell below the phase diagram line depicting "reducing" conditions where conditions are not conducive to oxidize chromium to Cr+6. The use of field pH and Eh data collected by field personnel certified under NJAC 7:18 is likely more suitable than results obtained from the laboratory analyses performed several days after collection. Thus, the application of the field data was judged to be acceptable for assessing the suitability of the data in the data usability evaluation and subsequent qualification of the Cr+6 data. Because the laboratory pH results were not significantly different than the field-measured pH values, professional judgement was applied in not qualifying the pH results since the laboratory performed the pH analysis in response to a request for supplemental data. The absence of qualification of the pH results does not compromise the usefulness of the data presented in the data package, as the pH, in conjunction with the Redox potential data reflect the reducing nature of the samples. All seven GW samples appear well below the Eh-pH phase diagram line, thereby supporting the non-detect Cr+6 concentrations observed in the seven groundwater samples.

Table 5. Summary of Qualified Cr^{+6} Results in JC47790

Client ID	Laboratory Sample ID	Analyte	Cr+6 Result (mg/L)	DV Qualifier
MW-101	JC47790-1	Cr+6	< 0.010	J
MW-102	JC47790-2	Cr+6	< 0.010	J
DUP	JC47790-3	Cr+6	< 0.010	J
FB01	JC47790-4	Cr+6	< 0.010	J
MW-202	JC47790-5	Cr+6	< 0.010	J
MW-201	JC47790-6	Cr+6	< 0.010	J
MW-12	JC47790-7	Cr+6	< 0.010	J
MW-103	JC47790-8	Cr+6	< 0.010	J

Units – mg/kg.
< –The analyte was analyzed for, but was not detected above the stated reporting limit.
J – The result is an estimated value.
NJ- – The matrix spike sample recovery in the associated QC sample is below QC limits; the result is estimated and may be biased low.

Furthermore, the pH results of this July 26, 2017 sampling event were compared to the pH results of these same GW sampling locations to those reported in SDG JC22847 for the June 23, 2016 sampling event and JC24458 of the July 21, 2016 sampling event and were observed to be reasonably similar, differing by less than 11%RPD. This difference is a value well within the laboratory variability considered acceptable by the industry.

Despite the acceptability of the QC data, the sample and field blank Cr+6 results were qualified following the review of the data due to the exceedance of the 24-hour analytical holding time. The reported results are considered usable in the context of the applied qualification.

3.0 DATA QUALIFIER DEFINITIONS

The absence of qualifiers indicates that the data are acceptable both qualitatively and quantitatively.

Qualifier	Definition
J	The reported result is an estimated value.
<	The analyte was analyzed, but was not detected at the stated reporting limit.

4.0 References

APHA, AWWA, and WEF, 1995, ***Standard Methods for the Examination of Water and Wastewater, 19th Edition,*** Washington, D.C., 1268 p.

New Jersey Department of Environmental Protection, 2014a, ***Data of Known Quality Protocols Technical Guidance*****,** Version 1.0, Trenton, New Jersey, April 2014.

New Jersey Department of Environmental Protection, 2014b, ***Data Quality Assessment and Data Usability Evaluation Technical Guidance,*** Version 1.0, Trenton, New Jersey, April 2014.

New Jersey Department of Environmental Protection, 2014c, ***Analytical Laboratory Data Generation, Assessment and Usability Technical Guidance,*** Version 1.0, Trenton, New Jersey, April 2014.

New Jersey Department of Environmental Protection, 2014d, ***Quality Assurance Project Plan Technical Guidance,*** Version 1.0, Trenton, New Jersey, April 2014.

New Jersey Department of Environmental Protection, 2012, ***Technical Requirements for Site Remediation, N.J.A.C. 7:26E***, Trenton, New Jersey, May 7, 2012.

New Jersey Department of Environmental Protection, 2002, ***Standard Operating Procedure: Quality Assurance Data Validation of Analytical Deliverables Inorganics (Based on US EPA SW-846 Methods), SOP No. 5.A.16***, Trenton, New Jersey.

New Jersey Department of Environmental Protection, 2001b, ***Standard Operating Procedure for the Analytical Data Validation of Target Analyte List - Inorganics BEMQA 5.A.2, Revision 4,*** Trenton, New Jersey.

US EPA, Region 2, 2015, ***"ICP-AES Data Validation SOP No. HW-3a Revision 0 ISM 02.2"***, July 2015.

US EPA, CLP, 2014, ***"National Functional Guidelines for Inorganic Superfund Data Review"***, OSWER Publication 9355.0-131, EPA540-R-013-001, August 2014.

US EPA, 2006, ***Validation of Metals for the Contract Laboratory Program (CLP) based on SOW ILMO5.3, SOP HW-2, Revision 13***, September 2006.

US EPA, 1997, ***Test Methods for Evaluating Solid Wastes, 3rd Edition including Final Update III***, Office of Solid Waste and Emergency Response, Washington, D.C., June 1997.

US EPA, 1992a, Guidance for Data Usability in Risk Assessment (Part A) Final, Office of Solid Waste and Emergency Response (OSWER), April 1992.

ATTACHMENT A

Data Validation Checklist

DATA QUALITY ASSURANCE/QUALITY CONTROL CHECKLIST

Project: ___PPG___ SDGs: ______JC47790______________________

1. Were the appropriate sample preservation requirements met?................ [✓ Yes] No

2. Were appropriate sample holding times
   (for both extraction/sample preparation and analysis) met? .... Yes [✓ No]
   If "No", provide a brief explanation.

   The 7 groundwater samples and field blank were analyzed a few hours past the 24-hour analytical holding time for Cr+6 analysis. The sample and FB Cr+6 results are qualified as estimated values and flagged with "J".

3. Were the samples diluted? .... [✓ Yes] No
   Indicate the identity of the samples and why.
   Samples JC47790-5 and JC47790-5f were diluted 5× and 10×, respectively, for the analysis of thallium due to the presence of a high interfering element.

4. If applicable, did sample dilutions result in elevated reporting limits that exceed applicable standards?.. Yes [✓ No]
   If "Yes", list the affected samples.
   Samples JC47790-5 and JC47790-5f were diluted 5× and 10×, respectively, for the analysis of thallium due to the presence of a high interfering element.

5. Were any applicable standards exceeded for any samples? .... [✓ Yes] No
   If "Yes", include the number of samples and laboratory sample ID numbers.
   Sample JC47790-5 exceeded the respective NJ Groundwater Standard for antimony, chromium and vanadium, while samples JC47790-1 and -8 exceeded the 60 µg/L NJ Groundwater Standard for vanadium.

6. Were the laboratory reporting limits below the applicable remediation standards/criteria required for the site?.. [✓ Yes] No
   If "No", provide a brief explanation of action taken.

7. Were qualifications noted in the non-conformance summary?................ Yes [✓ No]
   Provide a brief explanation.

All QC requirements were met for both the metals and Cr+6 analyses. No problems with analytical procedures were noted.

8. Were qualified data used?.. [✓ Yes] No

9. Were rejections noted in the non-conformance summary?..................... Yes [✓ No]
Provide a brief explanation.

Not applicable

10. Were rejected data used?.. Yes [✓ No]
If "yes", please indicate reasons rejected data were used:
○ For Hex Chrome, data were rejected because spike recovery was <50%.
○ Data were rejected due to missing deliverables.
○ Data were rejected but an applicable standard exceedance exists.
○ Data were rejected in an early phase of remediation; however, additional sampling and analysis are scheduled to be performed.
○ Other reasons not noted directly above. Explain:

11. Were the quality control criteria associated with the compounds of concern at the site met? .... [✓ Yes] No
12. Were the QC Summary Forms reviewed?.. [✓ Yes] No
13. Internal Standards acceptable.. [✓ Yes] No
14. MS/MSD acceptable.. [✓ Yes] No
15. Calibration summaries acceptable.. [✓ Yes] No
16. Serial dilutions acceptable... [✓ Yes] No
17. Inorganic duplicates acceptable.. [✓ Yes] No
18. LCS recovery acceptable.. [✓ Yes] No
19. Other QC acceptable?.. [✓ Yes] No
Provide a brief explanation, if applicable.

All QC requirements were achieved in both the metals and Cr+6 analyses. Refer to DV report tables 2, 3, and 4 for QC details. The groundwater and field blank sample results subject to qualification are presented in Table 5 of this DV report

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DATA VALIDATION REPORT

Project: **Jersey City PPG, Site 63/65; Report SDG JC60715A/JC60715**
Sample Date: **February 13, 2018**
Analyses: **Metals Analysis, EPA Method 6010C**
Hexavalent Chromium Analysis, EPA Method 7196A
Redox Potential, ASTM D1498-76
pH, EPA Method SM4500H+ B-11
Reviewer: **Janis V. Giga, Ph.D., REP5554**
Date: **April 24, 2019**

This data validation (DV) report presents the data review and result qualifications for four (4) groundwater (GW) samples and one field blank (FB) collected at the Jersey City PPG Site 63/65, 1 Burma Road, Jersey City, New Jersey on February 13, 2018 for sample delivery group (SDG) JC60715A and JC60715. The groundwater samples and field blank were analyzed for the analytes listed above employing the identified analytical methods by SGS North America Inc., Dayton, New Jersey.

Summary of Sample Results Qualifications

The groundwater sample analytical results for the samples of SDG JC60715A were found to be compliant with the analytical method (SW-846 Method 6010C) for the analysis of metals in the four collected groundwater samples and one field blank, and hexavalent chromium (Cr+6) (Method 7196A) in the four collected groundwater samples and one field blank in SDG JC60715.

The quality control (QC) criteria were met for each of the inductively coupled plasma (ICP) target metals analyte analyses in the QC batch, such that none of the four reported GW sample and one field blank results warranted qualification.

All QC criteria were also met for the Cr+6 analysis. Thus, none of the reported GW sample Cr+6 results in this SDG have been qualified and are usable as reported.

A data validation checklist is provided in Attachment A to summarize the observations during the DV review.

Sample Receipt

The four (4) groundwater samples and one field blank collected February 13, 2018 were received at the SGS North America Inc. laboratory the same day February 13, 2018, with an acceptable maximum corrected sampling cooler temperature of 3.8 degrees Celsius (ºC). The GW sample and field blank identification numbers and corresponding laboratory identification numbers are as follows:

Table 1. Sample Receipt Summary – SDG JC60715A and JC60715

Client Sample Designation	Sample Lab ID Number	Date Collected	Matrix	Analyses
MW-202	JC60715-1A	2/13/2018	Aqueous	Metals
DUP01	JC60715-2A	2/13/2018	Aqueous	Metals
ME-201 (MW-201)	JC60715-3A	2/13/2018	Aqueous	Metals
MSD	JC60715-3DA	2/13/2018	Aqueous	Metals
MS	JC60715-3SA	2/13/2018	Aqueous	Metals
MW-302	JC60715-4A	2/13/2018	Aqueous	Metals
FB-01	JC60715-5A	2/13/2018	Aqueous	Metals
PW-202 (MW-202)	JC60715-1	2/13/2018	Aqueous	Cr+6
DUP01	JC60715-2	2/13/2018	Aqueous	Cr+6
MW-201	JC60715-3	2/13/2018	Aqueous	Cr+6
MSD	JC60715-3D	2/13/2018	Aqueous	Cr+6
MS	JC60715-3S	2/13/2018	Aqueous	Cr+6
MW-302	JC60715-4	2/13/2018	Aqueous	Cr+6
FB-01	JC60715-5	2/13/2018	Aqueous	Cr+6
Metals – Antimony, chromium, nickel, thallium and vanadium analyzed by SW-846 Method 6010C. Cr+6 – Hexavalent chromium analyzed by SW-846 Method 7196A together with pH and redox potential.				

Note: The client ID for JC60715-3A is listed as ME-201 and the client ID for JC60715-1 is listed as PW-202. The correct client ID numbers should be MW-201 and MW-202, respectively. The samples are referred to in this DV report by their correct ID numbers.

The data package presenting the metals analysis data is numbered JC60715A, while the data package for JC60715 contained the hexavalent chromium and ancillary analysis data.

Data Review

Data, as presented in the analytical data packages SDG JC60715A and JC60715, was primarily reviewed and validated using the following combination of method-specific criteria with professional judgement, as appropriate:

- New Jersey Department of Environmental Protection (NJDEP) *Standard Operating Procedure: Quality Assurance Data Validation of Analytical Deliverables Inorganics (Based on US EPA SW-846 Methods), SOP No. 5.A.16* (NJDEP, 2002).
- United States (US) Environmental Protection Agency (EPA) *"National Functional Guidelines for Inorganic Data Review"*, OSWER Publication 9355.0-131, EPA540-R-013-001, August 2014 (US EPA, 2014).
- US EPA *"ICP-AES Data Validation, SOP No. HW-3a, Revision 0 ISM 0.2.2"* (US EPA, 2015).
- NJDEP *Standard Operating Procedure (SOP) for Analytical Data Validation of Hexavalent Chromium* (NJDEP, 2009).
- NJDEP, *Data of Known Quality Protocols Technical Guidance*, Version 1.0, April 2014.
- NJDEP, *Data Quality Assessment and Data Usability Evaluation Technical Guidance*, Version 1.0, April 2014.
- NJDEP, *Analytical Laboratory Data Generation, Assessment and Usability Technical Guidance*, Version 1.0, April 2014.
- NJDEP, *Quality Assurance Project Plan Technical Guidance*, Version 1.0, April 2014.

Data associated with parameters that do not meet quality control specifications or compliance requirements, have been qualified in accordance with US EPA Region II/NJDEP specifications/guidelines, as appropriate.

The analysis of the identified samples was performed in compliance with the requirements specified in the respective analytical methods. The data is presented in a NJDEP “reduced” deliverables package and is considered complete, as defined by the NJDEP “Technical Regulations for Site Remediation” (NJDEP, 2012). However, it is emphasized that due to the absence of raw metals data and the associated preparation logs, the substantiation of the reported metals concentrations and the accuracy of the QC summary results is precluded. The data package was complete for the hexavalent chromium analysis, such that the Cr+6 results with associated QC results were substantiated during the DV review. The information presented in the data summary and quality control (QC) forms was reviewed and used to qualify the sample results. The quality of data collected in support of this sampling activity is considered acceptable with the noted results qualifications, considering the limitations attributable to a reduced deliverables data package.

The discussion below presents the findings of the data validation review organized according to the technical areas used to evaluate inorganic analytical data. For each of these analytical topics, the information on the summary forms, as well as the raw data and supporting information for the samples or standards analyzed were reviewed during the DV effort.

1.0 Metals Analysis Data Review – SDG JC60715A

The discussion below presents the findings of the data validation review for the eleven technical areas used to evaluate inorganic analytical data. For each of these analytical topics, the information on the summary forms as well as the raw data printed on the quantitation report for each sample or standard analyzed was reviewed during the DV effort.

The data validation of the analytical data was reviewed for the following data quality items:

- √ Holding times
- √ Blank Analysis
- √ Calibration standards
- √ Laboratory control samples
- √ Calibration verification
- √ Data package completeness
- √ Matrix spike recoveries
- √ Duplicate analysis
- √ Serial dilution analysis
- √ Interference Check Samples
- √ Field duplicate sample analysis
- √ Data qualifiers

The GW samples and field blank were analyzed for five target EPA Method 6010C metals. Antimony and chromium exceeded the respective NJ Groundwater Criteria of 6 µg/L and 70 µg/L in two GW samples, JC60715-1A and JC60715-2A.

Laboratory Case Narrative

The case narrative identified the relative percent difference (RPD) serial dilution results for antimony, chromium and nickel analyses in QC Batch MP5748 as being outside QC limits. However, the percent difference (%D) results are acceptable for antimony, chromium and nickel due to the low initial sample concentrations (< 50 times the instrument detection limit [IDL]).

The detection limits for nickel and thallium in samples JC60715-1A and JC60715-2A in QC Batch MP5748 were elevated due to the dilution required for a high interfering element, while the antimony, chromium and vanadium reporting limits were elevated in these two samples due to difficult sample matrix.

No other quality control or non-compliance issues were identified in the case narrative.

Holding Times (QC Limit 6 months)
The six-month analytical holding time was met for all ICP samples.

Calibration Standards (QC Limits 90-110% Recovery)
All QC calibration requirements were met by the initial and continuing calibrations employed, with target analyte recoveries all within the respective required QC limits, thereby demonstrating linearity for the GW sample analyses and acceptable analyte quantitation (concentration determination).

Low Calibration Check Standard (QC Limit 70-130% Recovery)
The laboratory analyzed a “low calibration check standard”, the latter that is similar to and may also be referred to as a contract required detection limit (CRDL) standard. This standard is identified by the acronym CRI in the data. A high calibration check standard was also run with acceptable recoveries. There is no NJDEP DV guidance for qualifying inorganic sample results for CRDL standard analysis (NJDEP, 2002).

The QC results provided were within QC limits of 70-130% that are applied to other metals analyses.

Hence, no groundwater sample or field blank results were qualified for any calibration issues.

Quality Control Blanks (QC Limit < CRDL or < Reporting Limit [RL])
There were no target metals concentrations detected in the procedure blanks or the field blank at the stated reporting limits in SDG JC60715A.

Hence, no groundwater sample metals results warranted qualification for any associated QC blank contamination in SDG JC60715A.

ICP Interference Check Samples (QC Limits 80-120% Recovery)
All analyte recoveries in the interference check samples, both IND A and IND B, were within the specified QC limits.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) Analysis
(QC Limits 75-125% Recovery; ≤ 20%RPD)

The matrix spike and matrix spike duplicate recoveries were within QC limits for all target analytes demonstrating acceptable accuracy. Matrix spike recoveries in the batch QC sample in Batch MP5748 associated with 4 GW samples and the FB ranged from 97.0% to 106.8%, thereby demonstrating acceptable analytical accuracy for this SDG.

No sample results required qualification for matrix spike recovery issues, thereby demonstrating acceptable analytical accuracy.

Duplicate Analysis (QC Limit ≤ 20 %RPD)
The duplicate analysis was performed on one pair of spiked duplicate samples. All %RPD values were below the laboratory QC limit of 20%RPD, with values ranging from 0.0 – 1.0%RPD for the QC sample associated with four groundwater samples and the FB in QC Batch MP5748. Hence, no metals results requiring qualification for the duplicate analysis issue, as the duplicate analyses demonstrated very good analytical precision.

Laboratory Control Samples (QC Limits 80-120% Recovery)
All analyte recoveries in the laboratory control samples (also referred to as the blank spike) were within the specified QC limits demonstrating acceptable analytical system performance, with blank spike recoveries ranging from 104.5% - 109.0% for QC Batch MP5748 associated with the four GW samples and FB for the metals analysis. Thus, acceptable analytical system performance was demonstrated.

Field Duplicate Sample Analysis (QC Limit ≤ 20%RPD)
One set of field duplicate samples was collected for the GW samples as part of SDG JC60715A. Field duplicate sample collection and analysis can provide a determination of sampling representativeness and precision. Gross differences between field sample duplicates can be an indication of inconsistent sampling techniques or sample matrix complexities/non-homogeneity.

An advisory data validation guideline for field duplicate aqueous samples suggests QC limits of 20%RPD or the absolute difference value of the CRQL (reporting limit) for sample results less than five times the CRQL (US EPA Region 2, 2015).

The results for the analysis of the one pair of field duplicate GW samples are presented in Table 2, below. It is apparent that the results for the GW metals analytes in the field duplicate samples of MW-202 were quite similar concentrations and, thus, are considered representative, as the concentrations between field duplicate samples differed by less than 8% RPD.

Table 2. Comparison of Field Duplicate GW Sample Metals Results – SDG JC60715A

Analyte	**MW-202 (µg/L)**	**DUP01 (µg/L)**	**% RPD**	**DV Flag**
Antimony	45.4	43.0	5.4 %	-
Chromium	827	770	7.1 %	-
Nickel	< 100	< 100	< CRQL	-
Thallium	< 20	< 20	< CRQL	-
Vanadium	268	261	2.6 %	-

QC Limit is ≤ 20 %RPD for aqueous samples, or < CRQL (for concentrations < 5 × CRQL);
< – The analyte was not detected at the stated reporting limit;
CRQL – The value representing the US EPA CLP contract required quantitation limit, often represented by the reporting limit;
< CRQL – The difference between field duplicate results was less than the CRQL and meets QC requirements.

Thus, the field duplicate results for the field duplicate samples from MW-202 demonstrated excellent sampling representativeness and precision, with field duplicate GW sample results differing by less than 8%RPD. No GW sample results were qualified for sampling representativeness issues.

Serial Dilution Analysis (QC Limit ≤ 10 %D)

The case narrative identified the relative percent difference (RPD) serial dilution results for antimony, chromium and nickel analyses in QC Batch MP5748 as being outside QC limits. However, the percent difference (%D) results are acceptable for antimony, chromium and nickel due to the low initial sample concentrations (< 50 times the IDL). The other serial dilution results met QC limits for the analytes subject to data validation, with %D results ranging 0 – 5.4%D, such that no sample results were qualified for serial dilution issues.

Quantification Verification
Metals concentrations reported on the Form 1 sheets for the GW samples could not be verified because the data was provided in a NJDEP "Reduced deliverables" format (NJDEP, 2012), omitting the quantitation reports and preparation logs from the raw data.

Reporting Limits
Samples JC60715-1A and JC60715-2A required a five-fold (5×) dilution for the analysis of nickel and thallium due to the presence of a high interfering element, such that the nickel and thallium reporting limits for these samples were raised to values of < 100 µg/L and < 20 µg/L, purportedly additionally raised due to difficult sample matrix. These values appear at and above the respective New Jersey Groundwater Criteria of 100 µg/L and 2 µg/L, respectively, depicted below in Table 3.

Table 3. Sample Reporting Limits Affected by Sample Dilution

Sample ID	**Lab ID**	**Analyte**	**Reporting Limit (µg/L)**	**Dilution Factor**	**Adjusted Result**	**NJ Groundwater Standard (µg/L)**
MW-202	JC60715-1A	Nickel	< 10	5	< 100	100
MW-202	JC60715-1A	Thallium	< 2.0	5	< 20	2
DUP01	JC60715-2A	Nickel	< 10	5	< 100	100
DUP01	JC60715-2A	Thallium	< 2.0	5	< 20	2
Units – µg/L < – The analyte was analyzed for, but was not detected above the stated reporting limit.						

The interpretation of the reporting limits for nickel and thallium in samples JC60715-1A and JC60715-2A was not compromised, because the antimony and chromium concentrations were above the respective NJ Groundwater Criteria of 6 µg/L for antimony and 70 µg/L for chromium in both samples. Hence, these samples would need to be addressed in either additional review or some type of remedial action. Additionally, interpretation of the GW results were not compromised by these dilutions because thallium has not been detected in any of the samples during this phase of sampling at PPG.

Metals Analysis Summary

The groundwater sample analytical results for the samples of SDG JC60715A were found to be compliant with the analytical methods for the analysis of metals in the four groundwater samples and one field blank using SW-846 Method 6010C. All QC criteria were met for all ICP target metals analyses. Hence, no groundwater sample target metals results required any qualification for any associated QC issues.

2.0 Hexavalent Chromium Analysis Data Review – SDG JC60715

The analysis for hexavalent chromium (Cr+6) was performed using Method 7196A for aqueous groundwater sample and field blank analysis.

The data validation of the analytical data was reviewed for the following data quality items and a check mark (√) indicates successful achievement of meeting the relevant QC requirements.

√ Holding times
√ Blank Analysis
√ Calibration standards
√ Calibration verification
√ Data qualifiers
√ Data package completeness
√ Matrix spike recoveries
√ Duplicate analysis
√ Laboratory control samples
√ Quantitation checks
√ Field duplicate sample analysis

No hexavalent chromium concentrations were detected in the four groundwater samples or the field blank at a reporting limit of 0.010 mg/L.

Laboratory Case Narrative

The case narrative indicated that all QC requirements were met, except that the samples were received outside the analytical holding time for pH analysis. Though the samples were received outside of hold time, they were analyzed by request. All other QC requirements were met for the associated analyses.

Matrix Spike (MS) Analysis

(QC Limits: 75-125% Recovery)

The matrix spike recovery was within QC limits for Cr+6 demonstrating acceptable accuracy. Matrix spike recovery in QC Batch GN76168 was an acceptable 93.3%, thereby demonstrating acceptable analytical accuracy for this SDG.

No sample results required qualification for matrix spike recovery issues.

Duplicate Analysis (QC Limit: ≤ 20 %RPD)

The duplicate analysis was performed on one set of duplicate groundwater samples. The %RPD value (0%RPD) for duplicate samples in QC Batch GN76168 was well within the QC limits of 20%RPD for aqueous samples (NJDEP, 2009). The %RPD values for redox potential were 1.0 and 0.4%RPD for the pH analysis, such that all analytical precision results were less than 20%RPD for all Cr+6, pH and redox potential analyses, thereby demonstrating excellent analytical precision. Hence, no sample Cr+6 results required qualification due to any differences in the duplicate analyses.

Laboratory Control Samples (QC Limits 80-120% Recovery)

All analyte recoveries in the laboratory control samples (also referred to as the blank spike) were within the specified QC limits demonstrating acceptable analytical system performance, with a blank spike recovery of 100.0% for the QC batch associated with the four GW samples and field blank for the Cr+6 analysis. Thus, acceptable analytical system performance was demonstrated.

Results of Sample Analyses

All calibration criteria were met for the groundwater samples of this SDG. This included initial calibration linearity (r = 0.99995), and continuing calibration frequency and accuracy (101.1% to 102.06% CCV Recoveries). The method and calibration blanks were free of detectable Cr+6 concentrations and the blank spike recovery (100.0%) demonstrated that the analytical system was performing accurately. The reported MS recovery (93.3%), duplicate precision result (0.0 %RPD) from a PPG batch QC sample, and the non-detect field blank sample results were verified from the raw data with no observed discrepancies in the reported data. The QC results demonstrated that the analyses were conducted with acceptable accuracy and analytical precision.

The laboratory analyzed the aqueous samples for pH and Eh. The collected pH and Eh data were reviewed and plotted on an Eh-pH diagram during the DV review where it was observed that each of the groundwater samples and field blank fell below the phase diagram line depicting "reducing" conditions where conditions are not conducive to oxidize chromium to Cr+6. Each of the four GW samples and field blank appear below the Eh-pH phase diagram line, thereby supporting the non-detect Cr+6 concentrations observed in the four groundwater samples.

Field Duplicate Sample Analysis (QC Limit < 20%RPD)

The Cr+6 results for one set of field duplicate samples collected from sample location MW-202 as part of the sampling representativeness evaluation for this SDG are presented in Table 4.

Table 4. Comparison of Field Duplicate GW Sample Results – JC60715

Analyte	MW-202 (mg/L)	DUP01 (mg/L)	% RPD	DV Flag
Hexavalent Chromium	< 0.010	< 0.010	0 %	----
Key: < – The analyte was analyzed, but was not detected at the stated reporting limit.				

This set of field duplicate samples demonstrated excellent sampling representativeness and precision, as the Cr+6 results were identical non-detect concentrations of < 0.010 mg/L. No sample Cr+6 results need be qualified for field duplicate sample results disparities.

Summary for Hexavalent Chromium Analysis –SDG JC60715

Since the MS recoveries were within QC limits, as were all other QC results associated with the hexavalent chromium analysis, including the duplicate sample analysis, no Cr+6 results were subject to qualification for QC issues following the DV review.

The pH and Eh laboratory data were reviewed and plotted on an Eh-pH diagram during the DV evaluation following which it was observed that each of the groundwater samples fell below the phase diagram line depicting "reducing" conditions where conditions are not conducive to oxidize chromium to Cr+6.

Furthermore, the pH results of this February 13, 2018 sampling event were compared to the pH measurements of these GW sampling locations from other sampling events and were observed to be reasonably similar.

Since the MS recoveries were within QC limits, as were all other QC results associated with the hexavalent chromium analysis, including the duplicate sample analysis, no Cr+6 results were subject to qualification for QC issues following the DV review.

3.0 DATA QUALIFIER DEFINITIONS

The absence of qualifiers indicates that the data are acceptable both qualitatively and quantitatively.

Qualifier	**Definition**
<	The analyte was analyzed, but was not detected at the stated reporting limit.

4.0 References

APHA, AWWA, and WEF, 1995, ***Standard Methods for the Examination of Water and Wastewater, 19th Edition,*** Washington, D.C., 1268 p.

New Jersey Department of Environmental Protection, 2014a, ***Data of Known Quality Protocols Technical Guidance,*** Version 1.0, Trenton, New Jersey, April 2014.

New Jersey Department of Environmental Protection, 2014b, ***Data Quality Assessment and Data Usability Evaluation Technical Guidance,*** Version 1.0, Trenton, New Jersey, April 2014.

New Jersey Department of Environmental Protection, 2014c, ***Analytical Laboratory Data Generation, Assessment and Usability Technical Guidance,*** Version 1.0, Trenton, New Jersey, April 2014.

New Jersey Department of Environmental Protection, 2014d, ***Quality Assurance Project Plan Technical Guidance,*** Version 1.0, Trenton, New Jersey, April 2014.

New Jersey Department of Environmental Protection, 2012, ***Technical Requirements for Site Remediation, N.J.A.C. 7:26E***, Trenton, New Jersey, May 7, 2012.

New Jersey Department of Environmental Protection, 2009, ***Standard Operating Procedure (SOP) for Analytical Data Validation of Hexavalent Chromium, SOP No.: 5.A.10,*** Trenton, New Jersey, September 2009.

New Jersey Department of Environmental Protection, 2002, ***Standard Operating Procedure: Quality Assurance Data Validation of Analytical Deliverables Inorganics (Based on US EPA SW-846 Methods), SOP No. 5.A.16***, Trenton, New Jersey.

New Jersey Department of Environmental Protection, 2001, ***Standard Operating Procedure for the Analytical Data Validation of Target Analyte List - Inorganics BEMQA 5.A.2, Revision 4,*** Trenton, New Jersey.

US EPA, Region 2, 2015, ***“ICP-AES Data Validation SOP No. HW-3a Revision 0 ISM 02.2”***, July 2015.

US EPA, CLP, 2014, ***“National Functional Guidelines for Inorganic Superfund Data Review”***, OSWER Publication 9355.0-131, EPA540-R-013-001, August 2014.

US EPA, 2006, ***Validation of Metals for the Contract Laboratory Program (CLP) based on SOW ILMO5.3, SOP HW-2, Revision 13***, September 2006.

US EPA, 1997, ***Test Methods for Evaluating Solid Wastes, 3rd Edition including Final Update III***, Office of Solid Waste and Emergency Response, Washington, D.C., June 1997.

US EPA, 1992, Guidance for Data Usability in Risk Assessment (Part A) Final, Office of Solid Waste and Emergency Response (OSWER), April 1992.

ATTACHMENT A

Data Validation Checklist

DATA QUALITY ASSURANCE/QUALITY CONTROL CHECKLIST

Project: PPG SDGs: JC60715A/JC60715

1. Were the appropriate sample preservation requirements met?................ [✓ Yes] No

2. Were appropriate sample holding times
   (for both extraction/sample preparation and analysis) met? .... [✓ Yes] No
   If "No", provide a brief explanation.

3. Were the samples diluted? .... [✓ Yes] No
   Indicate the identity of the samples and why.

   Samples JC60715-1A and JC60715-2A were diluted 5× for nickel and thallium due to the presence of a high interfering element. The reporting limits were also raised in these two samples for antimony, chromium and vanadium "due to difficult sample matrix". However, there is no NJ GW criterion for vanadium, and the detected antimony and chromium concentrations in these two samples were above the respective criteria.

4. If applicable, did sample dilutions result in elevated reporting limits that exceed applicable standards?.. [✓ Yes] No
   If "Yes", list the affected samples.

   Samples JC60715-1A and JC60715-2A were diluted 5× for the analysis of nickel and thallium due to the presence of a high interfering element and the nickel reporting limit of < 100 µg/L was at the NJ GW criterion of 100 µg/L, while the reporting limit of <20 µg/L for thallium was above the criterion of 2 µg/L. However, detected antimony and chromium concentrations were above the respective NJ GW criteria.

5. Were any applicable standards exceeded for any samples? .... [✓ Yes] No
   If "Yes", include the number of samples and laboratory sample ID numbers.

   The detected antimony and chromium concentrations in samples JC60715-1A and JC60715-2A were above the respective NJ GW criteria of 6 µg/L and 70 µg/L.

6. Were the laboratory reporting limits below the applicable remediation standards/criteria required for the site?.. [✓ Yes] No
   If "No", provide a brief explanation of action taken.

7. Were qualifications noted in the non-conformance summary?................ Yes [✓ No]
   Provide a brief explanation.

Refer to DV report discussions of case narrative regarding QC limit exceedances. No problems with analytical procedures were noted.

8. Were qualified data used?.. [✓ Yes] No

9. Were rejections noted in the non-conformance summary?..................... Yes [✓ No]
   Provide a brief explanation.

Not applicable

10. Were rejected data used?.. Yes [✓ No]
    If “yes”, please indicate reasons rejected data were used:
    - ○ For Hex Chrome, data were rejected because spike recovery was <50%.
    - ○ Data were rejected due to missing deliverables.
    - ○ Data were rejected but an applicable standard exceedance exists.
    - ○ Data were rejected in an early phase of remediation; however, additional sampling and analysis are scheduled to be performed.
    - ○ Other reasons not noted directly above. Explain:

11. Were the quality control criteria associated with the compounds of concern at the site met? .... [✓ Yes] No
12. Were the QC Summary Forms reviewed?... [✓ Yes] No
13. Internal Standards acceptable.. [✓ Yes] No
14. MS/MSD acceptable.. [✓ Yes] No
15. Calibration summaries acceptable... [✓ Yes] No
16. Serial dilutions acceptable.. [✓ Yes] No
17. Inorganic duplicates acceptable... [✓ Yes] No
18. LCS recovery acceptable... [✓ Yes] No
19. Other QC acceptable?... [✓ Yes] No
    Provide a brief explanation, if applicable.

All QC requirements were achieved in both the metals and Cr+6 analyses. Refer to DV report tables 2, 3, and 4 for QC details. No groundwater or field blank sample results were subject to qualification following the DV review.

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DATA VALIDATION REPORT

Project: **Jersey City PPG, Site 63/65; Report SDG JC70668**
Sample Date: **July 26, 2018**
Analyses: **Metals Analysis, EPA Method 6020B**
Hexavalent Chromium Analysis, EPA Method 7196A
Redox Potential, ASTM D1498-76
pH, EPA Method SM4500H+ B-11
Reviewer: **Janis V. Giga, Ph.D., REP5554**
Date: **April 24, 2019**

This data validation (DV) report presents the data review and result qualifications for three (3) groundwater (GW) samples and one field blank (FB) collected at the Jersey City PPG Site 63/65, 1 Burma Road, Jersey City, New Jersey on July 26, 2018 for sample delivery group (SDG) JC70668. The groundwater samples and field blank were analyzed for the analytes listed above employing the identified analytical methods by SGS North America Inc., Dayton, New Jersey.

Summary of Sample Results Qualifications

The groundwater sample analytical results for the samples of SDG JC70668 were found to be compliant with the analytical method (SW-846 Method 6020B) for the analysis of metals in the three collected groundwater samples and one field blank, and hexavalent chromium (Cr+6) (Method 7196A) in the three collected groundwater samples and one field blank.

The quality control (QC) criteria were met for each of the inductively coupled plasma (ICP)/mass spectra (MS) target analyte analyses. Hence, none of the reported GW sample metals results in this SDG have been qualified, and are usable as reported.

All QC criteria were met for each of the Cr+6 analyses, except for the low matrix spike recovery. Thus, each of the three reported GW sample and field blank Cr+6 results in this SDG have been qualified and flagged with “NJ-”. The results are usable in the context of the applied qualifications.

Following the detailed DV review, the following sample results were qualified:

- Hexavalent chromium (“NJ-”) in Samples JC70668-1 through -4 (inclusive);

No other sample results in SDG JC70668 required qualification, based on the remaining acceptable associated QC results and analytical performance. Details are provided in the tables and text below.

The reported concentrations were below the respective New Jersey Groundwater Criteria, except for chromium in sample JC70668-1, while hexavalent chromium (Cr+6) was not detected in any groundwater samples.

A data validation checklist is provided in Attachment A to summarize the observations during the DV review.

Sample Receipt

The three (3) groundwater samples and one field blank collected July 26, 2018 were received at the SGS North America, Inc. laboratory the same day July 26, 2018, with an acceptable maximum corrected sampling cooler temperature of 4.2 degrees Celsius (ºC). The GW sample and field blank identification numbers and corresponding laboratory identification numbers are as follows:

Table 1. Sample Receipt Summary – SDG JC70668

Client Sample Designation	Sample Lab ID Number	Date Collected	Matrix	Analyses
MW-301	JC70668-1	7/26/2018	Aqueous	Metals
MW-302	JC70668-2	7/26/2018	Aqueous	Metals
FIELD DUPE	JC70668-3	7/26/2018	Aqueous	Metals
FIELD BLANK	JC70668-4	7/26/2018	Aqueous	Metals
MW-301	JC70668-1	7/26/2018	Aqueous	Cr+6
MW-302	JC70668-2	7/26/2018	Aqueous	Cr+6
FIELD DUPE	JC70668-3	7/26/2018	Aqueous	Cr+6
FIELD BLANK	JC70668-4	7/26/2018	Aqueous	Cr+6
Metals – Antimony, chromium, nickel, thallium and vanadium analyzed by SW-846 Method 6020B. Cr+6 – Hexavalent chromium analyzed by SW-846 Method 7196A together with pH and redox potential.				

The data package presenting the metals analysis data is numbered JC70668, which also contained the hexavalent chromium and ancillary analysis data.

Data Review

Data, as presented in the analytical data package SDG JC70668, was primarily reviewed and validated using the following combination of method-specific criteria with professional judgement, as appropriate:

- New Jersey Department of Environmental Protection (NJDEP) *Standard Operating Procedure: Quality Assurance Data Validation of Analytical Deliverables Inorganics (Based on US EPA SW-846 Methods), SOP No. 5.A.16* (NJDEP, 2002).
- United States (US) Environmental Protection Agency (EPA) *"National Functional Guidelines for Inorganic Data Review"*, OSWER Publication 9355.0-131, EPA540-R-013-001, August 2014 (US EPA, 2014).
- US EPA *"ICP-AES Data Validation, SOP No. HW-3a, Revision 0 ISM 0.2.2"* (US EPA, 2015).
- NJDEP *Standard Operating Procedure (SOP) for Analytical Data Validation of Hexavalent Chromium* (NJDEP, 2009).
- NJDEP, *Data of Known Quality Protocols Technical Guidance*, Version 1.0, April 2014.
- NJDEP, *Data Quality Assessment and Data Usability Evaluation Technical Guidance*, Version 1.0, April 2014.
- NJDEP, *Analytical Laboratory Data Generation, Assessment and Usability Technical Guidance*, Version 1.0, April 2014.
- NJDEP, *Quality Assurance Project Plan Technical Guidance*, Version 1.0, April 2014.

Data associated with parameters that do not meet quality control specifications or compliance requirements, have been qualified in accordance with US EPA Region II/NJDEP specifications/guidelines, as appropriate.

The analysis of the identified samples was performed in compliance with the requirements specified in the respective analytical methods. The data is presented in a NJDEP full deliverables package and is considered complete, as defined by the NJDEP "Technical Requirements for Site Remediation" (NJDEP, 2012). The data package was complete for the metals and hexavalent chromium analysis, such that the metals and Cr+6 results with associated QC results were substantiated during the DV review. The information presented in the data summary and quality control (QC) forms was reviewed and used to qualify the sample results. The quality of data collected in support of this sampling activity is considered acceptable with the noted results qualifications.

The discussion below presents the findings of the data validation review organized according to the technical areas used to evaluate inorganic analytical data. For each of these analytical topics, the information on the summary forms, as well as the raw data and supporting information for the samples or standards analyzed were reviewed during the DV effort.

1.0 Metals Analysis Data Review

The discussion below presents the findings of the data validation review for the eleven technical areas used to evaluate inorganic analytical data. For each of these analytical topics, the information on the summary forms as well as the raw data printed on the quantitation report for each sample or standard analyzed was reviewed during the DV effort.

The data validation of the analytical data was reviewed for the following data quality items:

- √ Holding times
- √ Blank Analysis
- √ Calibration standards
- √ Laboratory control samples
- √ Calibration verification
- √ Data package completeness
- √ Matrix spike recoveries
- √ Duplicate analysis
- √ Serial dilution analysis
- √ Interference Check Samples
- √ Field duplicate sample analysis
- √ Data qualifiers

The GW samples and field blank were analyzed for five target EPA Method 6020B metals. Chromium exceeded the NJ Groundwater Criterion of 70 µg/L in sample JC70668-1; no other metals results exceeded the respective NJ Groundwater Criteria in the three GW samples.

Laboratory Case Narrative

The case narrative identified the relative percent difference (RPD) serial dilution results for antimony and vanadium analyses in QC Batch MP8334 as being outside QC limits. However, the percent difference (%D) results for antimony and vanadium are acceptable due to the low initial sample concentrations (< 50 times the instrument detection limit [IDL]).

The detection limits for antimony, nickel, thallium and vanadium in samples JC70668-2 and JC70668-3 in QC Batch MP8334 were elevated due to the difficult sample matrix.

No other quality control or non-compliance issues were identified in the case narrative.

Holding Times (QC Limit 6 months)
The six-month analytical holding time was met for all ICP samples.

Calibration Standards (QC Limits 90-110% Recovery)
All QC calibration requirements were met by the initial and continuing calibrations employed, with target analyte recoveries all within the respective required QC limits, thereby demonstrating linearity for the GW sample analyses and acceptable analyte quantitation (concentration determination).

Low Calibration Check Standard (QC Limit 70-130% Recovery)
The laboratory analyzed a "low calibration check standard", the latter that is similar to and may also be referred to as a contract required detection limit (CRDL) standard. This standard is identified by the acronym CRI in the data. There is no NJDEP DV guidance for qualifying inorganic sample results for CRDL standard analysis (NJDEP, 2002).

The QC results provided were within QC limits of 70-130% that are applied to other metals analyses.

Hence, no groundwater sample or field blank results were qualified for any calibration issues.

Quality Control Blanks (QC Limit < CRDL or < Reporting Limit [RL])
There were no target metals concentrations detected in the procedure blanks or the field blank at the stated reporting limits in SDG JC70668.

Hence, no groundwater sample results warranted qualification for any associated QC blank contamination in SDG JC70668.

ICP Interference Check Samples (QC Limits 80-120% Recovery)
All analyte recoveries in the interference check samples, both IND A and IND B, were within the specified QC limits.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) Analysis
(QC Limits 75-125% Recovery; ≤ 20%RPD)

The matrix spike and matrix spike duplicate recoveries were within QC limits for all target analytes demonstrating acceptable accuracy. Matrix spike recoveries in the batch QC sample in Batch MP8334 associated with 3 GW samples and the FB ranged from 94.5% to 107.5%, thereby demonstrating acceptable analytical accuracy for this SDG.

No sample results required qualification for matrix spike recovery issues, thereby demonstrating acceptable analytical accuracy.

Duplicate Analysis (QC Limit ≤ 20 %RPD)
The duplicate analysis was performed on one pair of spiked duplicate samples. All %RPD values were below the laboratory QC limit of 20%RPD, with values ranging from 1.5 – 2.9%RPD for the QC sample associated with three groundwater samples and the FB. Hence, no metals results requiring qualification for the duplicate analysis issue, as the duplicate analyses demonstrated very good analytical precision.

Laboratory Control Samples (QC Limits 80-120% Recovery)

All analyte recoveries in the laboratory control samples (also referred to as the blank spike) were within the specified QC limits demonstrating acceptable analytical system performance, with blank spike recoveries ranging from 101.4% - 106.3% for QC Batch MP8334 associated with the three GW samples and FB for the metals analysis. Thus, acceptable analytical system performance was demonstrated.

Field Duplicate Sample Analysis (QC Limit ≤ 20%RPD)

One set of field duplicate samples was collected for the GW samples as part of SDG JC70668. Field duplicate sample collection and analysis can provide a determination of sampling representativeness and precision. Gross differences between field sample duplicates can be an indication of inconsistent sampling techniques or sample matrix complexities/non-homogeneity.

An advisory data validation guideline for field duplicate aqueous samples suggests QC limits of 20%RPD or the absolute difference value of the CRQL (reporting limit) for sample results less than five times the CRQL (US EPA Region 2, 2015).

The results for the analysis of the one pair of field duplicate GW samples are presented in Table 2, below. It is apparent that the results for the GW metals analytes in the field duplicate samples of MW-302 were quite similar concentrations and, thus, are considered representative, as the concentrations between field duplicate samples differed by less than 13% RPD.

Table 2. Comparison of Field Duplicate GW Sample Metals Results – SDG JC70668

Analyte	**MW-302 (µg/L)**	**FIELD DUPE (µg/L)**	**% RPD**	**DV Flag**
Antimony	< 10	< 10	< CRQL	-
Chromium	7.7	8.5	9.9 %	-
Nickel	< 5.0	< 5.0	< CRQL	-
Thallium	< 2.5	< 2.5	< CRQL	-
Vanadium	6.1	6.9	12.3 %	-
QC Limit is ≤ 20 %RPD for aqueous samples, or < CRQL (for concentrations < 5 × CRQL); < – The analyte was not detected at the stated reporting limit; CRQL – The value representing the US EPA CLP contract required quantitation limit, often represented by the reporting limit; < CRQL – The difference between field duplicate results was less than the CRQL and meets QC requirements.				

Thus, the field duplicate results for the field duplicate samples from MW-302 demonstrated excellent sampling representativeness and precision, with field duplicate GW sample results differing by less than 13%RPD. No GW sample results were qualified for sampling representativeness issues.

Serial Dilution Analysis (QC Limit ≤ 10 %D)

The case narrative identified the RPD serial dilution results for antimony and vanadium analyses in the QC batch as being outside QC limits. However, the percent difference (%D) results are acceptable due to the low initial sample antimony and vanadium concentrations (< 50 times IDL). All other serial dilution results met QC limits for the analytes subject to data validation, with %D results ranging 0 – 2.6%D, such that no sample results were qualified for serial dilution issues.

Quantification Verification

Sample concentrations reported on the Form 1 sheets for each sample were verified from the quantitation reports in the raw data during the validation activity.

Reporting Limits

Samples JC70668-2 and JC70668-3 required a five-fold (5×) dilution for the analysis of antimony, nickel, thallium, and vanadium due to a difficult sample matrix, such that the antimony, nickel, thallium, and vanadium reporting limits for these samples were raised to values of 10, 5.0, 2.5, and 5.0 µg/L, respectively. The reporting limit values for antimony and thallium are above the respective New Jersey Groundwater Criteria of 6 µg/L and 2 µg/L, as depicted below in Table 3, while the non-detect results of < 5.0 for nickel in both samples was below the NJ GW Criterion of 100 µg/L. Vanadium was detected in both samples (6.1 and 6.9 µg/L) for which there is no defined NJ GW Criterion.

The reporting limits for antimony and thallium in sample JC70668-1 were raised to values of < 20 and < 5.0 µg/L, though not mentioned in the case narrative and no explanation for the elevated levels was provided. These reporting limits are also presented below in Table 3.

Table 3. Sample Reporting Limits Affected by Sample Dilution

Sample ID	Lab ID	Analyte	Reporting Limit (µg/L)	Dilution Factor	Adjusted Result	NJ Groundwater Standard (µg/L)
MW-301	JC70668-1	Antimony	2.0	2	< 20	6
MW-301	JC70668-1	Thallium	0.5	2	< 5.0	2
MW-302	JC70668-2	Antimony	2.0	5	< 10	6
MW-302	JC70668-2	Thallium	0.5	5	< 2.5	2
DUP01	JC70668-3	Antimony	2.0	5	< 10	6
DUP01	JC70668-3	Thallium	0.5	5	< 2.5	2
Units – µg/L < – The analyte was analyzed for, but was not detected above the stated reporting limit.						

The interpretation of the elevated reporting limits for antimony and thallium in sample JC70668-1 was not compromised, because the chromium concentration of 1120 µg/L was above the respective NJ Groundwater Criterion of 70 µg/L for chromium. Hence, this sample would need to be addressed in either additional review or some type of remedial action due to the elevated concentration of chromium.

The elevated reporting limits for antimony and thallium in samples JC70668-2 (MW-302) and JC70668-3 (DUP01) are not anticipated to create a problem in interpretation of the results, because the detected chromium concentrations (7.7 and 8.5 µg/L) are considerably below the NJ GW Criterion of 70 µg/L and the detected vanadium concentrations (6.1 and 6.9 µg/L) are also low, while nickel was not detected in either sample (< 5.0 µg/L). Hence, even though the reporting limits for antimony and thallium were raised above the respective NJ GW Criteria, the low concentrations of the remaining analytes suggest a rather “clean” sample.

Although the reporting limits for antimony and thallium were above the respective NJ GW Criteria, the concentration measurements for antimony and thallium in the raw data for samples JC70668-2 (2.162 µg/L and 0.034 µg/L) and JC70668-3 (2.368 µg/L and 0.029 µg/L) appear considerably below the respective NJ GW Criteria of 6 and 2 µg/L. This would thereby suggest that the interpretation of the data should not be compromised despite the apparent elevated reporting limits for antimony and thallium in these two field duplicate samples that demonstrate excellent sampling representativeness and precision with the RPD values less than 13%RPD where the QC limit is

20%RPD for aqueous samples. Additionally, interpretation of the GW results is not compromised by these dilutions, because thallium has not been detected in any of the samples during GW sampling at various PPG locations over the past few years.

The low chromium and vanadium concentrations of this July 26, 2018 sampling event were supported by the low chromium (13 µg/L) and low vanadium (9.9 µg/L) concentrations observed at MW-302 in a subsequent March 7, 2019 sampling event. Furthermore, the non-detect antimony (< 4.0 µg/L) and thallium (< 1.0 µg/L) results of the March 7, 2019 sampling event at MW-302 further support the concept that the elevated reporting limits for antimony and thallium for MW-302 and FIELD DUPE in the July 2018 sampling event do not elicit concern for the interpretation of the sample data.

Metals Analysis Summary

The groundwater sample analytical results for the samples of SDG JC70668 were found to be compliant with the analytical methods for the analysis of metals in the three groundwater samples and one field blank using SW-846 Method 6020B. All QC criteria were met for all ICP target metals analyses. Hence, no groundwater sample target metals results required any qualification for any associated QC issues.

2.0 Hexavalent Chromium Analysis Data Review

The analysis for hexavalent chromium (Cr+6) was performed using Method 7196A for aqueous groundwater sample and field blank analysis.

The data validation of the analytical data was reviewed for the following data quality items and a check mark (√) indicates successful achievement of meeting the relevant QC requirements.

√ Holding times
√ Blank Analysis
√ Calibration standards
√ Calibration verification
√ Data qualifiers
√ Data package completeness
Matrix spike recoveries
√ Duplicate analysis
√ Laboratory control samples
√ Quantitation checks
√ Field duplicate sample analysis

No hexavalent chromium concentrations were detected in the three groundwater samples or the field blank at a reporting limit of 0.010 mg/L.

Laboratory Case Narrative

The case narrative for the hexavalent chromium analyses indicated that the QC requirements were met for issues such as the holding time and method blanks. However, the [soluble] matrix spike recovery in QC Batch GN83375 for the initial analysis was outside control limits. The case narrative also stated that the samples were received outside the analytical holding time for pH analysis and were analyzed by request. All other QC requirements were met for the associated analyses.

Matrix Spike (MS) Analysis
(QC Limits: 75-125% Recovery)

The soluble matrix spike recovery was below the QC limits of 75-125% for QC Batch GN83375, as presented below in Table 4. Thus, the hexavalent chromium results in GW samples associated with QC Batch GN83375 required qualification based on the result of the soluble MS recovery due to a potential low bias in the ability to recover Cr^{+6} in the associated sample matrices.

Table 4. Hexavalent Chromium Analysis Matrix Spike Recovery Results – JC70668

QC Batch	QC Sample	Analyte	MS Recovery	DV Qualifier	Potential Bias
GN83375 ¥	JC70668-2	Cr^{+6}, soluble	60.7 %	NJ-	Low

QC Limits are 75-125% for MS recovery;
MS – Matrix spike
Cr^{+6} – Hexavalent chromium
NJ- – The matrix spike sample recovery in the associated QC sample is below QC limits; the result is estimated and may be biased low.
¥ – The samples associated with QC Batch GN83375 consist of JC70668-1 through -4 (inclusive).

The Cr^{+6} results qualified for low spike recoveries in the initial analysis are flagged with “NJ-”, as tabulated below in Table 6.

Duplicate Analysis (QC Limit: ≤ 20 %RPD)

The duplicate analysis was performed on one set of duplicate groundwater samples. The %RPD value (0%RPD) for duplicate samples in QC Batch GN83375 was well within the QC limits of 20%RPD for aqueous samples (NJDEP, 2009). The %RPD values for redox potential were 2.6%RPD, and 0.5 %RPD for the pH analysis, such that all analytical precision results were less than 20%RPD for all Cr+6, pH, and redox potential analyses, thereby demonstrating excellent analytical precision. Hence, no sample Cr+6 results required qualification due to any differences in the duplicate analyses.

Laboratory Control Samples (QC Limits 80-120% Recovery)
All analyte recoveries in the laboratory control samples (also referred to as the blank spike) were within the specified QC limits demonstrating acceptable analytical system performance, with a blank spike recovery of 106.7% for the QC batch associated with the five GW samples and field blank for the Cr+6 analysis. Thus, acceptable analytical system performance was demonstrated.

Results of Sample Analyses

All calibration criteria were met for the groundwater samples of this SDG. This included initial calibration linearity (r = 0.99978), and continuing calibration frequency and accuracy (105.5% to 106.3% CCV Recoveries). The method and calibration blanks were free of detectable Cr+6 concentrations and the blank spike recovery (106.7%) demonstrated that the analytical system was performing accurately. The reported duplicate precision result (0.0 %RPD) from a PPG batch QC sample, and the non-detect field blank sample results were verified from the raw data with no observed discrepancies in the reported data. The QC results demonstrated that the analyses were conducted with acceptable accuracy and analytical precision, except for the low MS recovery (60.7%).

The laboratory analyzed the aqueous samples for pH and Eh. The collected pH and Eh data were reviewed, however, the laboratory failed to plot the results on an Eh-pH diagram. During the DV review, the values were plotted on a graph where it was observed that each of the three GW samples and field blank all fell well below the Eh-pH phase diagram line depicting “reducing” conditions where conditions are not conducive to oxidize chromium to Cr+6. Hence, chromium is not expected to be oxidized to Cr+6, thereby supporting the non-detect Cr+6 concentrations observed in the three groundwater samples.

Field Duplicate Sample Analysis (QC Limit < 20%RPD)

The Cr+6 results for one set of field duplicate samples collected from sample location MW-302 as part of the sampling representativeness evaluation for this SDG are presented in Table 5.

Table 5. Comparison of Field Duplicate GW Sample Results – JC70668

Analyte	MW-302 (mg/L)	FIELD DUPE (mg/L)	% RPD	DV Flag
Hexavalent Chromium	< 0.010	< 0.010	0 %	----
Key: < – The analyte was analyzed, but was not detected at the stated reporting limit.				

This set of field duplicate samples demonstrated excellent sampling representativeness and precision, as the Cr+6 results were identical non-detect concentrations of < 0.010 mg/L. No sample Cr+6 results need be qualified for field duplicate sample results disparities.

Summary for Hexavalent Chromium Analysis –SDG JC70668

Since the MS recovery in the PPG QC sample in QC Batch GN83375 was observed to fall below QC limits, the Cr+6 results in the hexavalent chromium analysis were subject to qualification as estimated values flagged with “NJ-” following the DV review due to a potential low bias in the ability to recover Cr+6 in the GW sample matrix.

Table 6. Qualified Cr^{+6} Results in JC70668

Client ID	Lab Sample ID	Analyte	JC70668 Result (mg/L)	DV Flag
MW-301	JC70668-1	Cr+6	< 0.010	NJ-
MW-302	JC70668-2	Cr+6	< 0.010	NJ-
FIELD DUPE	JC70668-3	Cr+6	< 0.010	NJ-
FIELD BLANK	JC70668-4	Cr+6	< 0.010	NJ-
< –The analyte was analyzed for, but was not detected above the stated reporting limit. NJ- – The matrix spike sample recovery in the associated QC sample is below QC limits; the result is estimated and may be biased low.				

Furthermore, the pH results of this July 26, 2018 sampling event were compared to the pH measurements to those of the subsequent March 7, 2019 sampling event for sampling location MW-302 and were observed to be quite similar, differing by less than 1%RPD. This difference is a value well within the laboratory variability considered acceptable by the industry.

Although the MS recovery in the batch QC sample was below QC limits, the non-detect Cr+6 results in the three groundwater samples are supported by the Eh-pH results depicting “reducing” conditions, conditions where oxidation of chromium to Cr+6 is not conducive.

The reported sample results are usable within the context of the applied qualifications, based on data usability considerations.

3.0 DATA QUALIFIER DEFINITIONS

The absence of qualifiers indicates that the data are acceptable both qualitatively and quantitatively.

Qualifier	Definition
J	The reported result is an estimated value.
N	The matrix spike sample recovery in the associated QC sample is not within QC limits.
NJ-	The matrix spike sample recovery in the associated QC sample is below QC limits; the result is estimated and may be biased low.
<	The analyte was analyzed, but was not detected at the stated reporting limit.

4.0 References

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US EPA, 1997, ***Test Methods for Evaluating Solid Wastes, 3rd Edition including Final Update III***, Office of Solid Waste and Emergency Response, Washington, D.C., June 1997.

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ATTACHMENT A

Data Validation Checklist

DATA QUALITY ASSURANCE/QUALITY CONTROL CHECKLIST

Project: PPG SDGs: JC70668

1. Were the appropriate sample preservation requirements met?................ [✓ Yes] No

2. Were appropriate sample holding times
   (for both extraction/sample preparation and analysis) met? .... [✓ Yes] No
   If "No", provide a brief explanation.

3. Were the samples diluted? ……………………………………………………………… [✓ Yes] No
   Indicate the identity of the samples and why.
   Samples JC70668-1 through -4 (inclusive) were diluted 2×, except that samples JC70668-2 and -3 were further diluted 5×for antimony, nickel, thallium, and vanadium; while JC70668-1 was further diluted 5×for chromium, all due to difficult sample matrix.

4. If applicable, did sample dilutions result in elevated reporting limits that exceed applicable standards?.. [✓ Yes] No
   If "Yes", list the affected samples.
   Samples JC70668-2, and -3 were diluted 5× for the analysis of antimony and thallium due to difficult sample matrix and the respective reporting limits of < 10 µg/L and < 2.5 µg/L exceeded the NJ GW Criteria of 6 µg/L and 2 µg/L, respectively, while the antimony and thallium reporting limits in JC70668-1 were raised to < 20 and < 5 µg/L without explanation, presumably also due to a complex sample matrix.

5. Were any applicable standards exceeded for any samples? ………………… [✓ Yes] No
   If "Yes", include the number of samples and laboratory sample ID numbers.
   Samples JC70668-1 exceeded the NJ Groundwater Standard for chromium (70 µg/L).

6. Were the laboratory reporting limits below the applicable remediation standards/criteria required for the site?.. [✓ Yes] No
   If "No", provide a brief explanation of action taken.

7. Were qualifications noted in the non-conformance summary?................ Yes [✓ No]
   Provide a brief explanation.

Refer to DV report discussions of case narrative regarding QC limit exceedances. No problems with analytical procedures were noted.

8. Were qualified data used?.. [✓ Yes] No

9. Were rejections noted in the non-conformance summary?..................... Yes [✓ No]
Provide a brief explanation.

Not applicable

10. Were rejected data used?.. Yes [✓ No]
If “yes”, please indicate reasons rejected data were used:

O For Hex Chrome, data were rejected because spike recovery was <50%.

O Data were rejected due to missing deliverables.

O Data were rejected but an applicable standard exceedance exists.

O Data were rejected in an early phase of remediation; however, additional sampling and analysis are scheduled to be performed.

O Other reasons not noted directly above. Explain:

11. Were the quality control criteria associated with the compounds of concern at the site met? .... [✓ Yes] No

12. Were the QC Summary Forms reviewed?.. [✓ Yes] No

13. Internal Standards acceptable.. [✓ Yes] No

14. MS/MSD acceptable.. Yes [✓ No]

15. Calibration summaries acceptable... [✓ Yes] No

16. Serial dilutions acceptable... [✓ Yes] No

17. Inorganic duplicates acceptable... [✓ Yes] No

18. LCS recovery acceptable.. [✓ Yes] No

19. Other QC acceptable?.. [✓ Yes] No
Provide a brief explanation, if applicable.

The QC requirements were achieved in the metals analysis, while the MS recovery in the batch QC sample was below QC limits in the Cr+6 analysis. Refer to DV report tables 2, 3, 4, and 5 for QC details. The groundwater and field blank sample results subject to qualification are presented in Table 6 of this DV report

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DATA VALIDATION REPORT

Project: **Jersey City PPG, Site 63/65; Report SDG JC83999**
Sample Date: **March 7, 2019**
Analyses: **Metals Analysis, EPA Method 6020B**
Hexavalent Chromium Analysis, EPA Method 7196A
Redox Potential, ASTM D1498-76
pH, EPA Method SM4500H+ B-11
Reviewer: **Janis V. Giga, Ph.D., REP5554**
Date: **April 24, 2019**

This data validation (DV) report presents the data review and result qualifications for five (5) groundwater (GW) samples and one field blank (FB) collected at the Jersey City PPG Site 63/65, 1 Burma Road, Jersey City, New Jersey on March 7, 2019 for sample delivery group (SDG) JC83999. The groundwater samples and field blank were analyzed for the analytes listed above employing the identified analytical methods by SGS North America Inc., Dayton, New Jersey.

Summary of Sample Results Qualifications

The groundwater sample analytical results for the samples of SDG JC83999 were found to be compliant with the analytical method (SW-846 Method 6020B) for the analysis of metals in the five collected groundwater samples and one field blank, and hexavalent chromium (Cr+6) (Method 7196A) in the five collected groundwater samples and one field blank.

The quality control (QC) criteria were met for each of the inductively coupled plasma (ICP)/mass spectra (MS) target analyte analyses, except for the serial dilution results for nickel in both QC batches and chromium in one QC batch. Consequently, each of the five reported GW sample and one field blank nickel results and one chromium result in this SDG have been qualified as estimated values flagged with “EJ” and are usable as reported with the applicable qualification.

All QC criteria were met for each of the Cr+6 analyses. Thus, none of the reported GW sample Cr+6 results in this SDG have been qualified and are usable as reported.

Following a detailed DV review, the following sample results were qualified:

- Nickel (“EJ”) in Samples JC83999-1, -2, -4, and JC83999-6,
- Nickel (“UEJ”) in Sample JC83999-3,
- Nickel (“EJ”) in field blank JC83999-5, and
- Chromium (“EJ”) in Sample JC83999-4.

A data validation checklist is provided in Attachment A to summarize the observations during the DV review.

Sample Receipt

The five (5) groundwater samples and one field blank collected March 7, 2019 were received at the SGS North America Inc. laboratory the same day March 7, 2019, with an acceptable maximum corrected sampling cooler temperature of 2.3 degrees Celsius (ºC). The GW sample and field blank identification numbers and corresponding laboratory identification numbers are as follows:

Table 1. Sample Receipt Summary – SDG JC83999

Client Sample Designation	Sample Lab ID Number	Date Collected	Matrix	Analyses
MW-202	JC83999-1	3/7/2019	Aqueous	Metals
MW-DUP	JC83999-2	3/7/2019	Aqueous	Metals
MW-302	JC83999-3	3/7/2019	Aqueous	Metals
MSD	JC83999-3D	3/7/2019	Aqueous	Metals
MS	JC83999-3S	3/7/2019	Aqueous	Metals
MW-301	JC83999-4	3/7/2019	Aqueous	Metals
FB	JC83999-5	3/7/2019	Aqueous	Metals
MW-303	JC83999-6	3/7/2019	Aqueous	Metals
MW-202	JC83999-1	3/7/2019	Aqueous	Cr+6
MW-DUP	JC83999-2	3/7/2019	Aqueous	Cr+6
MW-302	JC83999-3	3/7/2019	Aqueous	Cr+6
MSD	JC83999-3D	3/7/2019	Aqueous	Cr+6
MS	JC83999-3S	3/7/2019	Aqueous	Cr+6
MW-301	JC83999-4	3/7/2019	Aqueous	Cr+6
FB	JC83999-5	3/7/2019	Aqueous	Cr+6
MW-303	JC83999-6	3/7/2019	Aqueous	Cr+6
Metals – Antimony, chromium, nickel, thallium and vanadium analyzed by SW-846 Method 6020B. Cr+6 – Hexavalent chromium analyzed by SW-846 Method 7196A together with pH and redox potential.				

The data package presenting the metals analysis data is numbered JC83999, which also contained the hexavalent chromium and ancillary analysis data.

Data Review

Data, as presented in the analytical data package SDG JC83999, was primarily reviewed and validated using the following combination of method-specific criteria with professional judgement, as appropriate:

- New Jersey Department of Environmental Protection (NJDEP) *Standard Operating Procedure: Quality Assurance Data Validation of Analytical Deliverables Inorganics (Based on US EPA SW-846 Methods), SOP No. 5.A.16* (NJDEP, 2002).
- United States (US) Environmental Protection Agency (EPA) *"National Functional Guidelines for Inorganic Data Review"*, OSWER Publication 9355.0-131, EPA540-R-013-001, August 2014 (US EPA, 2014).
- US EPA *"ICP-AES Data Validation, SOP No. HW-3a, Revision 0 ISM 0.2.2"* (US EPA, 2015).
- NJDEP *Standard Operating Procedure (SOP) for Analytical Data Validation of Hexavalent Chromium* (NJDEP, 2009).
- NJDEP, *Data of Known Quality Protocols Technical Guidance*, Version 1.0, April 2014.
- NJDEP, *Data Quality Assessment and Data Usability Evaluation Technical Guidance*, Version 1.0, April 2014.

- NJDEP, *Analytical Laboratory Data Generation, Assessment and Usability Technical Guidance*, Version 1.0, April 2014.
- NJDEP, *Quality Assurance Project Plan Technical Guidance*, Version 1.0, April 2014.

Data associated with parameters that do not meet quality control specifications or compliance requirements, have been qualified in accordance with US EPA Region II/NJDEP specifications/guidelines, as appropriate.

The analysis of the identified samples was performed in compliance with the requirements specified in the respective analytical methods. The data is presented in a NJDEP full deliverables package and is considered complete, as defined by the NJDEP "Technical Requirements for Site Remediation" (NJDEP, 2012). The data package was complete for the metals and hexavalent chromium analysis, such that the metals and Cr+6 results with associated QC results were substantiated during the DV review. The information presented in the data summary and quality control (QC) forms was reviewed and used to qualify the sample results. The quality of data collected in support of this sampling activity is considered acceptable with the noted results qualifications.

The discussion below presents the findings of the data validation review organized according to the technical areas used to evaluate inorganic analytical data. For each of these analytical topics, the information on the summary forms, as well as the raw data and supporting information for the samples or standards analyzed were reviewed during the DV effort.

1.0 Metals Analysis Data Review

The discussion below presents the findings of the data validation review for the eleven technical areas used to evaluate inorganic analytical data. For each of these analytical topics, the information on the summary forms as well as the raw data printed on the quantitation report for each sample or standard analyzed was reviewed during the DV effort.

The data validation of the analytical data was reviewed for the following data quality items:

√ Holding times
√ Blank Analysis
√ Calibration standards
√ Laboratory control samples
√ Calibration verification
√ Data package completeness
√ Matrix spike recoveries
√ Duplicate analysis
Serial dilution analysis
√ Interference Check Samples
√ Field duplicate sample analysis
√ Data qualifiers

The GW samples and field blank were analyzed for five target EPA Method 6020B metals. Antimony exceeded the NJ Groundwater Criterion of 5 µg/L in three of the five GW samples, while chromium exceeded the NJ Groundwater Criterion of 70 µg/L in three GW samples.

<u>Laboratory Case Narrative</u>

The case narrative identified the relative percent difference (RPD) serial dilution results for nickel and thallium analyses in QC Batch MP12987, and the chromium, nickel, and thallium in QC Batch MP13005, being outside QC limits. However, the percent difference (%D) results are acceptable for thallium due to the low initial sample concentrations (< 50 times the instrument detection limit

[IDL]). The nickel and chromium results in the respective QC batches indicate possible matrix interference.

The detection limit for thallium in JC83999-6 in QC Batch MP12987 and JC83999-4 in QC Batch MP13005 were elevated due to the dilution required for observed matrix interference.

No other quality control or non-compliance issues were identified in the case narrative.

Holding Times (QC Limit 6 months)
The six-month analytical holding time was met for all ICP samples.

Calibration Standards (QC Limits 90-110% Recovery)
All QC calibration requirements were met by the initial and continuing calibrations employed, with target analyte recoveries all within the respective required QC limits, thereby demonstrating linearity for the GW sample analyses and acceptable analyte quantitation (concentration determination).

Low Calibration Check Standard (QC Limit 70-130% Recovery)
The laboratory analyzed a “low calibration check standard”, the latter that is similar to and may also be referred to as a contract required detection limit (CRDL) standard. This standard is identified by the acronym CRI in the data. There is no NJDEP DV guidance for qualifying inorganic sample results for CRDL standard analysis (NJDEP, 2002).

The QC results provided were within QC limits of 70-130% that are applied to other metals analyses.

Hence, no groundwater sample or field blank results were qualified for any calibration issues.

Quality Control Blanks (QC Limit < CRDL or < Reporting Limit [RL])
There were no target metals concentrations detected in the procedure blanks or the field blank at the stated reporting limits in SDG JC83999, except for the 2.4 µg/L nickel detected in the field blank.

According to DV guidance (NJDEP, 2002), if the concentration of any analyte in a sample is greater than three (3) times, but less than or equal to ten (10) times, the concentration of that analyte in the associated field blank, the presence of that analyte in the sample is considered "real". The result is to be qualified as an estimated value flagged with the "J" qualifier and is quantitatively qualified due to field blank contamination. If the sample result is less than three times the FB value, the sample result is to be negated due to field blank contamination.

Nickel was detected in samples JC83999-4 and JC83999-6 at concentrations between three and ten times the FB value. Hence, these results are to be qualified as estimated and flagged with “J”. However, these two results, as are all nickel results in this SDG, are qualified as estimated values flagged with “EJ” due to the variability observed in the serial dilution analysis. Consequently, these two results were not further flagged with an additional “J” to avoid a redundancy in qualifiers that do not add value in the project data evaluation. Since the nickel concentration in sample JC83999-3 was less than three times the FB result (threshold value of 7.2 µg/L), the 2.8 µg/L result was negated and changed to a non-detect result of 2.8 UEJ µg/L.

No groundwater sample results, other than the negated nickel result in sample JC83999-3, warranted qualification for any associated QC blank contamination in SDG JC83999.

ICP Interference Check Samples (QC Limits 80-120% Recovery)
All analyte recoveries in the interference check samples, both IND A and IND B, were within the specified QC limits.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) Analysis
(QC Limits 75-125% Recovery; ≤ 20%RPD)

The matrix spike and matrix spike duplicate recoveries were within QC limits for all target analytes demonstrating acceptable accuracy. Matrix spike recoveries in the batch QC sample in Batch MP12987 associated with 4 GW samples and the FB ranged from 81.4% to 100.1%, while the MS/MSD recoveries in QC Batch MP13005 associated with sample JC83999-4 ranged 92.6% to 109.1%, thereby demonstrating acceptable analytical accuracy for this SDG.

No sample results required qualification for matrix spike recovery issues, thereby demonstrating acceptable analytical accuracy.

Duplicate Analysis (QC Limit ≤ 20 %RPD)
The duplicate analysis was performed on two pairs of spiked duplicate samples. All %RPD values were below the laboratory QC limit of 20%RPD, with values ranging from 2.2 – 6.6%RPD for the QC sample associated with four groundwater samples and the FB, and 0.1 to 0.7%RPD for the QC sample aliquot in QC Batch 13005 associated with JC83999-4. Hence, no metals results requiring qualification for the duplicate analysis issue, as the duplicate analyses demonstrated very good analytical precision.

Laboratory Control Samples (QC Limits 80-120% Recovery)
All analyte recoveries in the laboratory control samples (also referred to as the blank spike) were within the specified QC limits demonstrating acceptable analytical system performance, with blank spike recoveries ranging from 102.1% - 105.0% for QC Batch MP12987 associated with the four GW samples and FB. The blank spike recoveries in QC Batch MP13005 associated with JC83999-4 ranged from 100.5% to 114.0% for the metals analysis. Thus, acceptable analytical system performance was demonstrated.

Field Duplicate Sample Analysis (QC Limit ≤ 20%RPD)
One set of field duplicate samples was collected for the GW samples as part of SDG JC83999. Field duplicate sample collection and analysis can provide a determination of sampling representativeness and precision. Gross differences between field sample duplicates can be an indication of inconsistent sampling techniques or sample matrix complexities/non-homogeneity.

An advisory data validation guideline for field duplicate aqueous samples suggests QC limits of 20%RPD or the absolute difference value of the CRQL (reporting limit) for sample results less than five times the CRQL (US EPA Region 2, 2015).

The results for the analysis of the one pair of field duplicate GW samples are presented in Table 2, below. It is apparent that the results for the GW metals analytes in the field duplicate samples of MW-202 were quite similar concentrations and, thus, are considered representative, as the concentrations between field duplicate samples differed by less than 15% RPD.

Table 2. Comparison of Field Duplicate GW Sample Metals Results – SDG JC83999

Analyte	**MW-202 (µg/L)**	**MW-DUP (µg/L)**	**% RPD**	**DV Flag**
Antimony	28.1	28.4	1.1 %	-

Chromium	778	848	8.6 %	-
Nickel	27.7 EJ	26.1 EJ	6.0 %	-
Thallium	< 1.0	< 1.0	< CRQL	-
Vanadium	191	166	14.0 %	-

QC Limit is ≤ 20 %RPD for aqueous samples, or < CRQL (for concentrations < 5 × CRQL);
< – The analyte was not detected at the stated reporting limit;
CRQL – The value representing the US EPA CLP contract required quantitation limit, often represented by the reporting limit;
< CRQL – The difference between field duplicate results was less than the CRQL and meets QC requirements.

Thus, the field duplicate results for the field duplicate samples from MW-202 demonstrated excellent sampling representativeness and precision, with field duplicate GW sample results differing by less than 15%RPD. No GW sample results were qualified for sampling representativeness issues.

<u>Serial Dilution Analysis (QC Limit ≤ 10 %D)</u>
The case narrative identified the RPD serial dilution results for thallium analyses in both QC batches as being outside QC limits. However, the percent difference (%D) results are acceptable due to the low initial sample thallium concentrations (< 50 times IDL).

The case narrative also identified the serial dilution results being outside QC limits for nickel as the RPD serial dilution results for nickel were outside QC limits in both QC Batch MP12987 and QC Batch 13005, as well as chromium in QC Batch 13005, indicating possible matrix interference. Thus, the affected nickel and chromium results in the samples associated with the elevated %D exceedances are subject to qualification following the DV review, as discussed below. These QC results are detailed in Table 3 below.

Table 3. Serial Dilution Results above QC Limits

QC Batch	QC Sample	Analyte	% Difference	DV Qualifier
MP12987 Ω	JC83999-3	Nickel	11.9 %D	EJ
MP13005 ₡	JC84148-1	Chromium	26.2 %D	EJ
MP13005 ₡	JC84148-1	Nickel	156.8%D	EJ

<u>Note</u>:
EJ – The reported value is estimated because of the presence of interference; indeterminate bias direction.
Ω – The samples associated with QC Batch MP12987 consist of JC83999-1, -2, -3, -5, and -6.
₡ – The sample associated with QC Batch MP13005 consists of JC83999-4.

The associated nickel results in the six identified samples and chromium in sample JC83999-4 are qualified as estimated values and flagged with "EJ" to indicate that the result is an estimated value possibly experiencing variability in the reported value due to the presence of an interference in the sample matrix. The individual qualified nickel and chromium results are presented in the summary table, Table 5.

<u>Quantification Verification</u>
Sample concentrations reported on the Form 1 sheets for each sample were verified from the quantitation reports in the raw data during the validation activity.

Reporting Limits

Samples JC83999-4 and JC83999-6 required a five-fold (5×) dilution for thallium analysis due to matrix interference, such that the thallium reporting limits for these two samples were raised to a value of < 2.5 µg/L, a value above the respective New Jersey Groundwater Standard of 2 µg/L, as detailed below in Table 4.

Table 4. Sample Reporting Limits Affected by Sample Dilution

Sample ID	Lab ID	Analyte	Reporting Limit (µg/L)	Dilution Factor	Adjusted Result	NJ Groundwater Standard (µg/L)
MW-301	JC83999-4	Thallium	< 0.5	5	< 2.5	2
MW-303	JC83999-6	Thallium	< 0.5	5	< 2.5	2
Units – µg/L < – The analyte was analyzed for, but was not detected above the stated reporting limit.						

The interpretation of the reporting limit for thallium in samples JC83999-4 and JC83999-6 was not compromised because the chromium concentration was above the respective NJ Groundwater Criterion of 70 µg/L in JC83999-4, while the antimony concentration was above the respective NJ Groundwater Criterion of 6 µg/L in JC83999-6. Hence, these samples would need to be addressed in either additional review or some type of remedial action. Additionally, interpretation of the GW results was not compromised by these dilutions because thallium has not been detected in any of the samples during this phase of sampling at PPG.

Metals Analysis Summary

The groundwater sample analytical results for the samples of SDG JC83999 were found to be compliant with the analytical methods for the analysis of metals in the five groundwater samples and one field blank using SW-846 Method 6020B. All QC criteria were met for all ICP/MS target metals analyses, except for the serial dilution analyses of nickel and one chromium analysis. Hence, no groundwater sample target metals results required any qualification for any associated for all samples, except for the six nickel results and the chromium result for one sample, which are qualified as estimated values and flagged with "EJ", as identified below in Table 5, due to the presence of interference in the sample matrix.

Table 5. Summary of Qualified Cr^{+6} Results in JC83999

Client ID	Laboratory Sample ID	Analyte	Result (µg/L)	DV Qualifier
MW-201	JC83999-1	Nickel	27.7	EJ
MW-DUP	JC83999-2	Nickel	26.1	EJ
MW-302	JC83999-3	Nickel	2.8	UEJ
MW-301	JC83999-4	Chromium	267	EJ
MW-301	JC83999-4	Nickel	14.2	EJ
FB	JC83999-5	Nickel	2.4	EJ
MW-303	JC83999-6	Nickel	10.9	EJ
Units – mg/kg. EJ – The reported value is estimated because of the presence of interference; indeterminate bias direction. J – The result is an estimated value.				

The nickel result in sample JC83999-3 was negated and changed to a non-detect result of 2.8 UEJ µg/L because the sample concentration is less than three times the field blank value and is likely due to associated field bank contamination (NJDEP, 2002). No other metals results were subject to qualification following the metals analysis. The reported metals results are considered usable in the context of the applied qualification.

2.0 Hexavalent Chromium Analysis Data Review

The analysis for hexavalent chromium (Cr+6) was performed using Method 7196A for aqueous groundwater sample and field blank analysis.

The data validation of the analytical data was reviewed for the following data quality items and a check mark (√) indicates successful achievement of meeting the relevant QC requirements.

- √ Holding times
- √ Blank Analysis
- √ Calibration standards
- √ Calibration verification
- √ Data qualifiers
- √ Data package completeness
- √ Matrix spike recoveries
- √ Duplicate analysis
- √ Laboratory control samples
- √ Quantitation checks
- √ Field duplicate sample analysis

No hexavalent chromium concentrations were detected in the five groundwater samples or the field blank at a reporting limit of 0.010 mg/L.

Laboratory Case Narrative

The case narrative indicated that all QC requirements were met, except that the samples were received outside the analytical holding time for pH analysis and were analyzed by request. However, the analytical holding time for pH may range anywhere from “analyze immediately” or for up to 2 hours. The groundwater samples were analyzed within the remaining method holding times, all method blanks met method specific criteria, and sample (Lab sample ID: JC83999-3) was analyzed for the spike and duplicate analyses.

Matrix Spike (MS) Analysis
(QC Limits: 75-125% Recovery)

The matrix spike recovery was within QC limits for Cr+6 demonstrating acceptable accuracy. Matrix spike recovery in QC Batch GN92603 was an acceptable 93.3%, thereby demonstrating acceptable analytical accuracy for this SDG.

No sample results required qualification for matrix spike recovery issues.

Duplicate Analysis (QC Limit: ≤ 20 %RPD)

The duplicate analysis was performed on one set of duplicate groundwater samples. The %RPD value (0%RPD) for duplicate samples in QC Batch GN92603 was well within the QC limits of 20%RPD for aqueous samples (NJDEP, 2009). The %RPD values for redox potential were 0.0 and 0.7%RPD, and 0.1 %RPD for the pH analysis, such that all analytical precision results were less than 20%RPD for all Cr+6, pH and redox potential analyses, thereby demonstrating excellent analytical precision. Hence, no sample Cr+6 results required qualification due to any differences in the duplicate analyses.

Laboratory Control Samples (QC Limits 80-120% Recovery)

All analyte recoveries in the laboratory control samples (also referred to as the blank spike) were within the specified QC limits demonstrating acceptable analytical system performance, with a blank spike recovery of 100.0% for the QC batch associated with the five GW samples and field blank for the Cr+6 analysis. Thus, acceptable analytical system performance was demonstrated.

Results of Sample Analyses

All calibration criteria were met for the groundwater samples of this SDG. This included initial calibration linearity (r = 0.99945), and continuing calibration frequency and accuracy (102.9% to 105.5% CCV Recoveries). The method and calibration blanks were free of detectable Cr+6 concentrations and the blank spike recovery (100.0%) demonstrated that the analytical system was performing accurately. The reported MS recovery (93.3%), duplicate precision result (0.0 %RPD) from a PPG batch QC sample, and the non-detect field blank sample results were verified from the raw data with no observed discrepancies in the reported data. The QC results demonstrated that the analyses were conducted with acceptable accuracy and analytical precision.

The laboratory analyzed the aqueous samples for pH and Eh, the collected pH and Eh data were reviewed and plotted on an Eh-pH diagram and it was observed that each of the reported groundwater samples and field blank fell well below the phase diagram line depicting “reducing” conditions where conditions are not conducive to oxidize chromium to Cr+6. The result for JC83999-4 was not plotted on the Eh-pH diagram. The four reported GW samples and field blank appear well below the Eh-pH phase diagram line, thereby supporting the non-detect Cr+6 concentrations observed in the groundwater samples.

Field Duplicate Sample Analysis (QC Limit < 20%RPD)

The Cr+6 results for one set of field duplicate samples collected from sample location MW-202 as part of the sampling representativeness evaluation for this SDG are presented in Table 6.

Table 6. Comparison of Field Duplicate GW Sample Results – JC83999

Analyte	MW-202 (mg/L)	MW-DUP (mg/L)	% RPD	DV Flag
Hexavalent Chromium	< 0.010	< 0.010	0 %	----
Key: < – The analyte was analyzed, but was not detected at the stated reporting limit.				

This set of field duplicate samples demonstrated excellent sampling representativeness and precision, as the Cr+6 results were identical non-detect concentrations of < 0.010 mg/L. No sample Cr+6 results need be qualified for field duplicate sample results disparities.

Summary for Hexavalent Chromium Analysis –SDG JC83999

Since the MS recoveries were within QC limits, as were all other QC results associated with the hexavalent chromium analysis, including the duplicate sample analysis, no Cr+6 results were subject to qualification for QC issues following the DV review.

Furthermore, the pH results of this March 7, 2019 sampling event were compared to the field pH measurements of these same GW sampling locations and were observed to be reasonably similar, differing by less than 10%RPD. This difference is a value well within the laboratory variability considered acceptable by the industry.

Since the MS recoveries were within QC limits, as were all other QC results associated with the hexavalent chromium analysis, including the duplicate sample analysis, no Cr+6 results were subject to qualification for QC issues following the DV review.

3.0 DATA QUALIFIER DEFINITIONS

The absence of qualifiers indicates that the data are acceptable both qualitatively and quantitatively.

Qualifier	Definition
EJ	The reported value is estimated because of the presence of interference; indeterminate bias direction.
J	The reported result is an estimated value.
<	The analyte was analyzed, but was not detected at the stated reporting limit.

4.0 References

APHA, AWWA, and WEF, 1995, ***Standard Methods for the Examination of Water and Wastewater, 19th Edition,*** Washington, D.C., 1268 p.

New Jersey Department of Environmental Protection, 2014a, ***Data of Known Quality Protocols Technical Guidance,*** Version 1.0, Trenton, New Jersey, April 2014.

New Jersey Department of Environmental Protection, 2014b, ***Data Quality Assessment and Data Usability Evaluation Technical Guidance,*** Version 1.0, Trenton, New Jersey, April 2014.

New Jersey Department of Environmental Protection, 2014c, ***Analytical Laboratory Data Generation, Assessment and Usability Technical Guidance,*** Version 1.0, Trenton, New Jersey, April 2014.

New Jersey Department of Environmental Protection, 2014d, ***Quality Assurance Project Plan Technical Guidance,*** Version 1.0, Trenton, New Jersey, April 2014.

New Jersey Department of Environmental Protection, 2012, ***Technical Requirements for Site Remediation, N.J.A.C. 7:26E***, Trenton, New Jersey, May 7, 2012.

New Jersey Department of Environmental Protection, 2009, ***Standard Operating Procedure (SOP) for Analytical Data Validation of Hexavalent Chromium, SOP No.: 5.A.10,*** Trenton, New Jersey, September 2009.

New Jersey Department of Environmental Protection, 2002, ***Standard Operating Procedure: Quality Assurance Data Validation of Analytical Deliverables Inorganics (Based on US EPA SW-846 Methods), SOP No. 5.A.16***, Trenton, New Jersey.

New Jersey Department of Environmental Protection, 2001, ***Standard Operating Procedure for the Analytical Data Validation of Target Analyte List - Inorganics BEMQA 5.A.2, Revision 4,*** Trenton, New Jersey.

US EPA, Region 2, 2015, ***"ICP-AES Data Validation SOP No. HW-3a Revision 0 ISM 02.2"***, July 2015.

US EPA, CLP, 2014, ***"National Functional Guidelines for Inorganic Superfund Data Review"***, OSWER Publication 9355.0-131, EPA540-R-013-001, August 2014.

US EPA, 2006, ***Validation of Metals for the Contract Laboratory Program (CLP) based on SOW ILMO5.3, SOP HW-2, Revision 13***, September 2006.

US EPA, 1997, ***Test Methods for Evaluating Solid Wastes, 3rd Edition including Final Update III***, Office of Solid Waste and Emergency Response, Washington, D.C., June 1997.

US EPA, 1992, Guidance for Data Usability in Risk Assessment (Part A) Final, Office of Solid Waste and Emergency Response (OSWER), April 1992.

ATTACHMENT A

Data Validation Checklist

DATA QUALITY ASSURANCE/QUALITY CONTROL CHECKLIST

Project: PPG SDGs: JC83999

1. Were the appropriate sample preservation requirements met?................ [✓ Yes] No

2. Were appropriate sample holding times
   (for both extraction/sample preparation and analysis) met? .... [✓ Yes] No
   If "No", provide a brief explanation.

3. Were the samples diluted? .... [✓ Yes] No
   Indicate the identity of the samples and why.
   Samples JC83999-1 through -6 (inclusive) were diluted 2×, except that samples JC83999-1 and -2 were diluted 10×for chromium, JC83999-4 and -6 were further diluted 5×for thallium, while JC83999-6 was also further diluted 5× for vanadium, all due to the presence of matrix interference.

4. If applicable, did sample dilutions result in elevated reporting limits that exceed applicable standards?... [✓ Yes] No
   If "Yes", list the affected samples.
   Samples JC83999-4 and JC83999-6 were diluted 5× for the analysis of thallium due to the presence of matrix interference and the reporting limit of < 2.5 µg/L exceeded the NJ GW Criterion of 2 µg/L.

5. Were any applicable standards exceeded for any samples? .... [✓ Yes] No
   If "Yes", include the number of samples and laboratory sample ID numbers.
   Samples JC83999-1 and -2 exceeded the respective NJ Groundwater Criteria for antimony (6 µg/L) and chromium (70 µg/L), while sample JC83999-6 exceeded the antimony criterion and JC83999-4 exceeded the chromium criterion.

6. Were the laboratory reporting limits below the applicable remediation standards/criteria required for the site?.. [✓ Yes] No
   If "No", provide a brief explanation of action taken.

7. Were qualifications noted in the non-conformance summary?................ Yes [✓ No]
   Provide a brief explanation.

Refer to DV report discussions of case narrative regarding QC limit exceedances. No problems with analytical procedures were noted.

8. Were qualified data used?.. [✓ Yes] No

9. Were rejections noted in the non-conformance summary?..................... Yes [✓ No]
Provide a brief explanation.

Not applicable

10. Were rejected data used?... Yes [✓ No]
If "yes", please indicate reasons rejected data were used:
O For Hex Chrome, data were rejected because spike recovery was <50%.
O Data were rejected due to missing deliverables.
O Data were rejected but an applicable standard exceedance exists.
O Data were rejected in an early phase of remediation; however, additional sampling and analysis are scheduled to be performed.
O Other reasons not noted directly above. Explain:

11. Were the quality control criteria associated with the compounds of concern at the site met? .... [✓ Yes] No
12. Were the QC Summary Forms reviewed?... [✓ Yes] No
13. Internal Standards acceptable.. [✓ Yes] No
14. MS/MSD acceptable.. [✓ Yes] No
15. Calibration summaries acceptable.. [✓ Yes] No
16. Serial dilutions acceptable... Yes [✓ No]
17. Inorganic duplicates acceptable... [✓ Yes] No
18. LCS recovery acceptable... [✓ Yes] No
19. Other QC acceptable?... [✓ Yes] No
Provide a brief explanation, if applicable.

All QC requirements were achieved in both the metals and Cr+6 analyses, except for the serial dilution results for nickel and chromium. Refer to DV report tables 2, 3, 4, and 6 for QC details. The groundwater and field blank sample results subject to qualification are presented in Table 5 of this DV report

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DATA VALIDATION REPORT

Project: **Jersey City PPG, Site 63/65; Report SDG JC85832/JC85832A**
Sample Date: **April 5, 2019**
Analyses: **Metals Analysis, EPA Method 6020B**
Hexavalent Chromium Analysis, EPA Method 7196A
Redox Potential, ASTM D1498-76
pH, EPA Method SM4500H+ B-11
Reviewer: **Janis V. Giga, Ph.D., REP5554**
Date: **April 29, 2019**

This data validation (DV) report presents the data review and result qualifications for two (2) groundwater (GW) samples and one field blank (FB) collected at the Jersey City PPG Site 63/65, 1 Burma Road, Jersey City, New Jersey on April 5, 2019 for sample delivery group (SDG) JC85832 and JC85832A. The groundwater samples and field blank were analyzed for the analytes listed above employing the identified analytical methods by SGS North America Inc., Dayton, New Jersey.

Summary of Sample Results Qualifications

The groundwater sample analytical results for the samples of SDG JC85832 were found to be compliant with the analytical method (SW-846 Method 6020B) for the analysis of metals in the two collected groundwater samples and one field blank, and hexavalent chromium (Cr+6) (Method 7196A) in the two collected groundwater samples and one field blank in SDG JC85832A.

The quality control (QC) criteria were met for each of the inductively coupled plasma (ICP)/mass spectra (MS) target analyte analyses, except for the serial dilution results for vanadium in QC Batch MP14023. Consequently, the two reported GW samples and one field blank vanadium result in this SDG have been qualified as estimated values flagged with “EJ” and are usable as reported with the applicable qualification.

All QC criteria were met for each of the Cr+6 analysis. Thus, none of the reported GW sample non-detect Cr+6 results in this SDG have been qualified and are usable as reported.

Following the detailed DV review, the following sample results were qualified:

- Vanadium (“EJ”) in Samples JC85832-1 and JC85832-2,
- Vanadium (“EJ”) in field blank JC85823-3.

A data validation checklist is provided in Attachment A to summarize the observations during the DV review.

Sample Receipt

The two (2) groundwater samples and one field blank collected April 5, 2019 were received at the

SGS North America Inc. laboratory the same day April 5, 2019, with an acceptable maximum corrected sampling cooler temperature of 2.1 degrees Celsius (ºC). The GW sample and field blank identification numbers and corresponding laboratory identification numbers are as follows:

Table 1. Sample Receipt Summary – SDG JC85832 and JC85832A

Client Sample Designation	**Sample Lab ID Number**	**Date Collected**	**Matrix**	**Analyses**
MW-303	JC85832-1	4/5/2019	Aqueous	Metals
MSD	JC85832-1D	4/5/2019	Aqueous	Metals
MS	JC85832-1S	4/5/2019	Aqueous	Metals
DUP	JC85832-2	4/5/2019	Aqueous	Metals
FB	JC85832-3	4/5/2019	Aqueous	Metals
MW-303	JC85832-1A	4/5/2019	Aqueous	Cr+6
MSD	JC85832-1DA	4/5/2019	Aqueous	Cr+6
MS	JC85832-1SA	4/5/2019	Aqueous	Cr+6
DUP	JC85832-2A	4/5/2019	Aqueous	Cr+6
FB	JC85832-3A	4/5/2019	Aqueous	Cr+6
Metals – Antimony, chromium, nickel, thallium and vanadium analyzed by SW-846 Method 6020B. Cr+6 – Hexavalent chromium analyzed by SW-846 Method 7196A together with pH and redox potential.				

The data package presenting the metals analysis data is numbered JC85832, while the raw data for the hexavalent chromium and ancillary analysis data are presented in SDG JC85832A.

Data Review

Data, as presented in the analytical data packages SDG JC85832 and JC85832A, was primarily reviewed and validated using the following combination of method-specific criteria with professional judgement, as appropriate:

- New Jersey Department of Environmental Protection (NJDEP) *Standard Operating Procedure: Quality Assurance Data Validation of Analytical Deliverables Inorganics (Based on US EPA SW-846 Methods), SOP No. 5.A.16* (NJDEP, 2002).
- United States (US) Environmental Protection Agency (EPA) *"National Functional Guidelines for Inorganic Data Review"*, OSWER Publication 9355.0-131, EPA540-R-013-001, August 2014 (US EPA, 2014).
- US EPA *"ICP-AES Data Validation, SOP No. HW-3a, Revision 0 ISM 0.2.2"* (US EPA, 2015).
- NJDEP *Standard Operating Procedure (SOP) for Analytical Data Validation of Hexavalent Chromium* (NJDEP, 2009).
- NJDEP, *Data of Known Quality Protocols Technical Guidance*, Version 1.0, April 2014.
- NJDEP, *Data Quality Assessment and Data Usability Evaluation Technical Guidance*, Version 1.0, April 2014.
- NJDEP, *Analytical Laboratory Data Generation, Assessment and Usability Technical Guidance*, Version 1.0, April 2014.
- NJDEP, *Quality Assurance Project Plan Technical Guidance*, Version 1.0, April 2014.

Data associated with parameters that do not meet quality control specifications or compliance requirements, have been qualified in accordance with US EPA Region II/NJDEP specifications/guidelines, as appropriate.

The analysis of the identified samples was performed in compliance with the requirements specified in the respective analytical methods. The data is presented in a NJDEP "reduced deliverables" package and is considered complete, as defined by the NJDEP "Technical Requirements for Site Remediation" (NJDEP, 2012). The data package was complete for the hexavalent chromium analysis, such that the Cr+6 results with associated QC results were substantiated during the DV review. However, it is emphasized that due to the absence of raw metals data and the associated preparation logs, the substantiation of the reported metals concentrations and the accuracy of the QC summary results is precluded. The information presented in the data summary and quality control (QC) forms was reviewed and used to qualify the sample results. The quality of data collected in support of this sampling activity is considered acceptable with the noted results qualifications, considering the limitations attributable to a reduced deliverables data package.

The discussion below presents the findings of the data validation review organized according to the technical areas used to evaluate inorganic analytical data. For each of these analytical topics, the information on the summary forms, as well as the raw data and supporting information for the samples or standards analyzed were reviewed during the DV effort.

1.0 Metals Analysis Data Review – SDG JC85832

The discussion below presents the findings of the data validation review for the eleven technical areas used to evaluate inorganic analytical data. For each of these analytical topics, the information on the summary forms as well as the raw data printed on the quantitation report for each sample or standard analyzed was reviewed during the DV effort.

The data validation of the analytical data was reviewed for the following data quality items:

√ Holding times
√ Blank Analysis
√ Calibration standards
√ Laboratory control samples
√ Calibration verification
√ Data package completeness
√ Matrix spike recoveries
√ Duplicate analysis
Serial dilution analysis
√ Interference Check Samples
√ Field duplicate sample analysis
√ Data qualifiers

The GW samples and field blank were analyzed for five target EPA Method 6020B metals. No metals were detected in the two samples and, hence, no metals analytes exceeded the respective NJ Groundwater Criteria in two GW samples.

Laboratory Case Narrative
The case narrative identified the relative percent difference (RPD) serial dilution results for chromium, nickel, thallium and vanadium analyses in QC Batch MP14023 as being outside QC limits. However, the percent difference (%D) results are acceptable for chromium, nickel and thallium due to the low initial sample concentrations (< 50 times the instrument detection limit [IDL]). The vanadium results in the QC batch indicates possible matrix interference.

No other quality control or non-compliance issues were identified in the case narrative.

Holding Times (QC Limit 6 months)
The six-month analytical holding time was met for all ICP samples.

Calibration Standards (QC Limits 90-110% Recovery)
All QC calibration requirements were met by the initial and continuing calibrations employed, with target analyte recoveries all within the respective required QC limits, thereby demonstrating linearity for the GW sample analyses and acceptable analyte quantitation (concentration determination).

Low Calibration Check Standard (QC Limit 70-130% Recovery)
The laboratory analyzed a "low calibration check standard", the latter that is similar to and may also be referred to as a contract required detection limit (CRDL) standard. This standard is identified by the acronym CRI in the data. There is no NJDEP DV guidance for qualifying inorganic sample results for CRDL standard analysis (NJDEP, 2002).

The QC results provided were within QC limits of 70-130% that are applied to other metals analyses.

Hence, no groundwater sample or field blank results were qualified for any calibration issues.

Quality Control Blanks (QC Limit < CRDL or < Reporting Limit [RL])
There were no target metals concentrations detected in the procedure blanks or the field blank at the stated reporting limits in SDG JC85832.

Hence, no groundwater sample results warranted qualification for any associated QC blank contamination in SDG JC85832.

ICP Interference Check Samples (QC Limits 80-120% Recovery)
All analyte recoveries in the interference check samples, both IND A and IND B, were within the specified QC limits.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) Analysis
(QC Limits 75-125% Recovery; ≤ 20%RPD)

The matrix spike and matrix spike duplicate recoveries were within QC limits for all target analytes demonstrating acceptable accuracy. Matrix spike recoveries in the batch QC sample in Batch MP14023 associated with 2 GW samples and the FB ranged from 90.3% to 112.4%, thereby demonstrating acceptable analytical accuracy for this SDG.

No sample results required qualification for matrix spike recovery issues, thereby demonstrating acceptable analytical accuracy.

Duplicate Analysis (QC Limit ≤ 20 %RPD)
The duplicate analysis was performed on one pair of spiked duplicate samples. All %RPD values were below the laboratory QC limit of 20%RPD, with values ranging from 0.5 – 1.4%RPD for the QC sample associated with the two groundwater samples and the FB. Hence, no metals results requiring qualification for the duplicate analysis issue, as the duplicate analyses demonstrated very good analytical precision.

Laboratory Control Samples (QC Limits 80-120% Recovery)
All analyte recoveries in the laboratory control samples (also referred to as the blank spike) were within the specified QC limits demonstrating acceptable analytical system performance, with blank

spike recoveries ranging from 98.1% - 105.4% for QC Batch MP14023 associated with the two GW samples and FB. Thus, acceptable analytical system performance was demonstrated.

Field Duplicate Sample Analysis (QC Limit ≤ 20%RPD)
One set of field duplicate samples was collected for the GW samples as part of SDG JC85832. Field duplicate sample collection and analysis can provide a determination of sampling representativeness and precision. Gross differences between field sample duplicates can be an indication of inconsistent sampling techniques or sample matrix complexities/non-homogeneity.

An advisory data validation guideline for field duplicate aqueous samples suggests QC limits of 20%RPD or the absolute difference value of the CRQL (reporting limit) for sample results less than five times the CRQL (US EPA Region 2, 2015).

The results for the analysis of the one pair of field duplicate GW samples are presented in Table 2, below. It is apparent that the results for the GW metals analytes in the field duplicate samples of MW-303 were identical non-detect results and, thus, are considered representative, as the concentrations between field duplicate samples differed by 0% RPD.

Table 2. Comparison of Field Duplicate GW Sample Metals Results – SDG JC85832

Analyte	**MW-303 (µg/L)**	**DUP (µg/L)**	**% RPD**	**DV Flag**
Antimony	< 4.0	< 4.0	< CRQL	-
Chromium	< 2.0	< 2.0	< CRQL	-
Nickel	< 2.0	< 2.0	< CRQL	-
Thallium	< 1.0	< 1.0	< CRQL	-
Vanadium	< 2.0 EJ	< 2.0 EJ	< CRQL	-

QC Limit is ≤ 20 %RPD for aqueous samples, or < CRQL (for concentrations < 5 × CRQL);
< – The analyte was not detected at the stated reporting limit;
CRQL – The value representing the US EPA CLP contract required quantitation limit, often represented by the reporting limit;
< CRQL – The difference between field duplicate results was less than the CRQL and meets QC requirements.

Thus, the field duplicate results for the field duplicate samples from MW-303 demonstrated excellent sampling representativeness and precision, with field duplicate GW sample results differing by 0%RPD. No GW sample results were qualified for sampling representativeness issues.

Serial Dilution Analysis (QC Limit ≤ 10 %D)
The case narrative identified the RPD serial dilution results for chromium, nickel, thallium, and vanadium analyses in QC Batch MP14023 as being outside QC limits. However, the percent difference (%D) results for chromium, nickel, and thallium are acceptable due to the low initial sample thallium concentrations (< 50 times IDL).

The case narrative also identified the serial dilution results being outside QC limits for vanadium as the RPD serial dilution result was outside QC limits in QC Batch MP14023, indicating possible matrix interference. Thus, the affected vanadium results in the samples associated with the elevated %D exceedance are subject to qualification following the DV review, as discussed below. These QC results are detailed in Table 3 below.

Table 3. Serial Dilution Results above QC Limits

QC Batch	**QC Sample**	**Analyte**	**% Difference**	**DV Qualifier**

MP14923 Ω	JC85832-1	Vanadium	19.4 %D	EJ
Note: EJ – The reported value is estimated because of the presence of interference; indeterminate bias direction. Ω – The samples associated with QC Batch MP14023 consist of JC85832-1, -2, and -3.				

The associated vanadium results in the identified samples are qualified as estimated values and flagged with “EJ” to indicate that the result is an estimated value possibly experiencing variability in the reported value due to the presence of an interference in the sample matrix. The individual qualified vanadium results are presented in the summary table, Table 4.

Quantification Verification
Metals concentrations reported on the Form 1 sheets for the GW samples could not be verified because the data was provided in a NJDEP “Reduced deliverables” format (NJDEP, 2012), omitting the quantitation reports and preparation logs from the raw data.

Reporting Limits
No samples required dilution, and no metals concentrations were detected in the two GW samples or field blank, such that all reporting limits were below the respective NJ Groundwater Criteria limit values.

Metals Analysis Summary
The groundwater sample analytical results for the samples of SDG JC85832 were found to be compliant with the analytical methods for the analysis of metals in the two groundwater samples and one field blank using SW-846 Method 6020B. All QC criteria were met for all ICP/MS target metals analyses, except for the serial dilution analyses of vanadium. Hence, no groundwater sample target metals results required any qualification for any associated for all samples, except for the vanadium results in the two groundwater samples and filed blank which are qualified as estimated values and flagged with “EJ”, as identified below in Table 4.

Table 4. Summary of Qualified Cr^{+6} Results in JC85832

Client ID	Laboratory Sample ID	Analyte	Result (µg/L)	DV Qualifier
MW-303	JC85832-1	Vanadium	< 2.0	EJ
DUP	JC85832-2	Vanadium	< 2.0	EJ
FB	JC85832-3	Vanadium	< 2.0	EJ
Units – µg/L. < – The analyte was not detected at the stated reporting limit; EJ – The reported value is estimated because of the presence of interference; indeterminate bias direction. J – The result is an estimated value.				

No other metals results were subject to qualification following the metals analysis. The reported metals results are considered usable in the context of the applied qualification.

2.0 Hexavalent Chromium Analysis Data Review – SDG JC85832A

The analysis for hexavalent chromium (Cr+6) was performed using Method 7196A for the aqueous groundwater sample and field blank analysis.

The data validation of the analytical data was reviewed for the following data quality items and a check mark (√) indicates successful achievement of meeting the relevant QC requirements.

- √ Holding times
- √ Blank Analysis
- √ Calibration standards
- √ Calibration verification
- √ Data qualifiers
- √ Data package completeness
- √ Matrix spike recoveries
- √ Duplicate analysis
- √ Laboratory control samples
- √ Quantitation checks
- √ Field duplicate sample analysis

No hexavalent chromium concentrations were detected in the two groundwater samples or the field blank at a reporting limit of 0.010 mg/L.

Laboratory Case Narrative

The case narrative indicated that all QC requirements were met, except that the samples were received outside the analytical holding time for pH analysis. These samples were subsequently analyzed for pH by request. All other QC requirements were met for the associated analyses.

Matrix Spike (MS) Analysis

(QC Limits: 75-125% Recovery)

The matrix spike recovery was within QC limits for Cr+6 demonstrating acceptable accuracy. Matrix spike recovery in QC Batch GN93768 was an acceptable 106.7%, thereby demonstrating acceptable analytical accuracy for this SDG.

No sample results required qualification for matrix spike recovery issues.

Duplicate Analysis (QC Limit: ≤ 20 %RPD)

The duplicate analysis was performed on one set of duplicate groundwater samples. The %RPD value (0%RPD) for duplicate samples in QC Batch GN93768 was well within the QC limits of 20%RPD for aqueous samples (NJDEP, 2009). The %RPD values for redox potential was 1.8%RPD, such that the analytical precision results were less than 20%RPD for all Cr+6, pH and redox potential analyses, thereby demonstrating excellent analytical precision. Hence, no sample Cr+6 results required qualification due to any differences in the duplicate analyses.

Laboratory Control Samples (QC Limits 80-120% Recovery)

All analyte recoveries in the laboratory control samples (also referred to as the blank spike) were within the specified QC limits demonstrating acceptable analytical system performance, with a blank spike recovery of 106.7% for the QC batch associated with the two GW samples and field blank for the Cr+6 analysis. Thus, acceptable analytical system performance was demonstrated.

Results of Sample Analyses

All calibration criteria were met for the groundwater samples of this SDG. This included initial calibration linearity (r = 0.99991), and continuing calibration frequency and accuracy (103.3% to 105.5% CCV Recoveries). The method and calibration blanks were free of detectable Cr+6 concentrations and the blank spike recovery (106.7%) demonstrated that the analytical system was performing accurately. The reported MS recovery (106.7%), duplicate precision result (0.0 %RPD) from a PPG batch QC sample, and the non-detect field blank sample results were verified from the raw data with no observed discrepancies in the reported data. The QC results demonstrated that the analyses were conducted with acceptable accuracy and analytical precision.

The laboratory analyzed the aqueous samples for pH and Eh. The collected pH and Eh data were reviewed and plotted on an Eh-pH diagram and it was observed that each of the groundwater samples and field blank fell well below the phase diagram line depicting “reducing” conditions where conditions are not conducive to oxidize chromium to Cr+6. Each of the two GW samples and field blank appear well below the Eh-pH phase diagram line, thereby supporting the non-detect Cr+6 concentrations observed in the two groundwater samples.

Field Duplicate Sample Analysis (QC Limit < 20%RPD)

The Cr+6 results for one set of field duplicate samples collected from sample location MW-303 as part of the sampling representativeness evaluation for this SDG are presented in Table 5.

Table 5. Comparison of Field Duplicate GW Sample Results – JC85832A

Analyte	MW-303 (mg/L)	DUP (mg/L)	% RPD	DV Flag
Hexavalent Chromium	< 0.010	< 0.010	0 %	----
Key: < – The analyte was analyzed, but was not detected at the stated reporting limit.				

This set of field duplicate samples demonstrated excellent sampling representativeness and precision, as the Cr+6 results were identical non-detect concentrations of < 0.010 mg/L. No sample Cr+6 results need be qualified for field duplicate sample results disparities.

Summary for Hexavalent Chromium Analysis –SDG JC85832A

Since the MS recoveries were within QC limits, as were all other QC results associated with the hexavalent chromium analysis, including the duplicate sample analysis, no Cr+6 results were subject to qualification for QC issues following the DV review.

Furthermore, the pH results of this April 5, 2019 sampling event were compared to the field pH measurements of this same GW sampling location and were observed to be reasonably similar, differing by less than 4%RPD. This difference is a value well within the laboratory variability considered acceptable by the industry.

Hence, no Cr+6 results were subject to qualification for QC issues following the DV review.

3.0 DATA QUALIFIER DEFINITIONS

The absence of qualifiers indicates that the data are acceptable both qualitatively and quantitatively.

Qualifier	Definition
EJ	The reported value is estimated because of the presence of interference; indeterminate bias direction.
J	The reported result is an estimated value.
<	The analyte was analyzed, but was not detected at the stated reporting limit.

4.0 References

APHA, AWWA, and WEF, 1995, ***Standard Methods for the Examination of Water and Wastewater, 19th Edition,*** Washington, D.C., 1268 p.

New Jersey Department of Environmental Protection, 2014a, ***Data of Known Quality Protocols Technical Guidance,*** Version 1.0, Trenton, New Jersey, April 2014.

New Jersey Department of Environmental Protection, 2014b, ***Data Quality Assessment and Data Usability Evaluation Technical Guidance,*** Version 1.0, Trenton, New Jersey, April 2014.

New Jersey Department of Environmental Protection, 2014c, ***Analytical Laboratory Data Generation, Assessment and Usability Technical Guidance,*** Version 1.0, Trenton, New Jersey, April 2014.

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ATTACHMENT A

Data Validation Checklist

DATA QUALITY ASSURANCE/QUALITY CONTROL CHECKLIST

Project: PPG SDGs: JC85832/JC85832A

1. Were the appropriate sample preservation requirements met?................ [✓ Yes] No

2. Were appropriate sample holding times
   (for both extraction/sample preparation and analysis) met? .... [✓ Yes] No
   If "No", provide a brief explanation.

3. Were the samples diluted? .... [✓ Yes] No
   Indicate the identity of the samples and why.

   Samples JC85832-1, -2, and -3 were diluted 2× according to the Report of Analysis sheets, though no mention is made in the case narrative as to why. Typically samples are further diluted due to the presence of a high interfering element.

4. If applicable, did sample dilutions result in elevated reporting limits that exceed applicable standards?... Yes [✓ No]
   If "Yes", list the affected samples.

5. Were any applicable standards exceeded for any samples? .... Yes [✓ No]
   If "Yes", include the number of samples and laboratory sample ID numbers.

   All analyte results were non-detect concentrations for the five metals and Cr+6.

6. Were the laboratory reporting limits below the applicable remediation standards/criteria required for the site?... [✓ Yes] No
   If "No", provide a brief explanation of action taken.

7. Were qualifications noted in the non-conformance summary?................ Yes [✓ No]
   Provide a brief explanation.

   Refer to DV report discussions of case narrative regarding QC limit exceedances. No problems with analytical procedures were noted.

8. Were qualified data used?.. [✓ Yes] No

9. Were rejections noted in the non-conformance summary?..................... Yes [✓ No]
Provide a brief explanation.

Not applicable

10. Were rejected data used?.. Yes [✓ No]
If "yes", please indicate reasons rejected data were used:
O For Hex Chrome, data were rejected because spike recovery was <50%.
O Data were rejected due to missing deliverables.
O Data were rejected but an applicable standard exceedance exists.
O Data were rejected in an early phase of remediation; however, additional sampling and analysis are scheduled to be performed.
O Other reasons not noted directly above. Explain:

11. Were the quality control criteria associated with the compounds of concern at the site met? .... [✓ Yes] No
12. Were the QC Summary Forms reviewed?... [✓ Yes] No
13. Internal Standards acceptable.. [✓ Yes] No
14. MS/MSD acceptable.. [✓ Yes] No
15. Calibration summaries acceptable... [✓ Yes] No
16. Serial dilutions acceptable.. Yes [✓ No]
17. Inorganic duplicates acceptable.. [✓ Yes] No
18. LCS recovery acceptable... [✓ Yes] No
19. Other QC acceptable?.. [✓ Yes] No
Provide a brief explanation, if applicable.

All QC requirements were achieved in both the metals and Cr+6 analyses, except for the serial dilution result for vanadium. Refer to DV report tables 2, 3, and 5 for QC details. The groundwater and field blank sample results subject to qualification are presented in Table 4 of this DV report

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DATA VALIDATION REPORT

Project: **Jersey City PPG, Site 63/65; Report SDG JD25615/JD25615A and JD25646/JD25646A**
Sample Date: **May 26, 2021**
Analyses: **Metals Analysis, EPA Method 6010D**
Metals Analysis, EPA Method 6020B
Hexavalent Chromium Analysis, EPA Method 7196A
Redox Potential, ASTM D1498-76
pH, EPA Method SM4500H+ B-11
Reviewer: **Janis V. Giga, Ph.D., REP5554**
Date: **October 19, 2021**

This data validation (DV) report presents the data review and result qualifications for three (3) groundwater (GW) samples and one field blank (FB) collected at the Jersey City PPG Site 63/65 at 1 Burma Road, Jersey City, New Jersey on May 26. 2021 for sample delivery groups (SDG) JD25615A, JD25615, as well as JD25646A and JD25646. The groundwater samples and field blank were analyzed for the analytes listed above employing the identified analytical methods by SGS North America Inc. laboratory of Dayton, New Jersey. The data in SDGs JD25646A and JD25646 represent the analysis of the filtered aliquots of these samples, except for the field blank which was not subsequently filtered.

Summary of Sample Results Qualifications

The groundwater samples and FB analytical results for the samples of SDG JD25615A were found to be compliant with the analytical method (SW-846 Method 6020B and Method 6010D) for the analysis of metals and hexavalent chromium (Cr+6) (Method 7196A) in the three collected groundwater samples and one field blank.

All routine quality control (QC) criteria were met for each of the inductively coupled plasma/mass spectrometer (ICP/MS) target analyte analyses, except for the field duplicate metals analysis. Upon review of the filtered data in SDG JD25646A, several results were rejected due to disparities in the chromium results for samples from location MW-301.

Following the detailed DV review, the following sample results were qualified:

- Chromium (“J”) in Sample JD25615-1A.
- Vanadium (“J”) in Sample JD25615-1A.
- Chromium (“J”) in Sample JD25615-2A.
- Vanadium (“J”) in Sample JD25615-2A.
- Chromium (“R”) in Sample JD25615-3A.
- Chromium (“R”) in Sample JD25646-2FAR

No hexavalent chromium results for the three reported GW samples and one field blank in this SDG have been qualified, and are usable as reported, because all QC results were within method QC limits for both the total and filtered analyses.

The chromium and vanadium results in samples JD25615-1A and JD25615-2A, as well as chromium in filtered samples JD25646-1FAR and JD25646-2FAR were detected above the New Jersey Groundwater Quality Standards (NJGWQS). No other target analytes were detected in any of the groundwater samples above the associated action levels.

A data validation checklist is provided in Attachment A to summarize the observations during the DV review.

Sample Receipt

The three (3) groundwater samples and one field blank collected May 26, 2021 were received at the SGS North America Inc. laboratory the same day, May 26, 2021, with an acceptable maximum corrected sampling cooler temperature of 3.5 degrees Celsius (ºC). Samples JD25615-1A, JD25615-2A and JD25615-3A were subsequently filtered June 15 and analyzed June 16, 2021 as part of SDG JD25646A. Please note the altered sequence of ID numbers for DUP and MW302 in SDG JD25646A and JD25646. The GW samples and field blank identification numbers and corresponding laboratory identification numbers are as follows:

Table 1. Sample Receipt Summary

Client Sample Designation	Sample Lab ID Number	Date Collected	Matrix	Analyses
MW-301	JD25615-1A	5/26/2021	Aqueous	Metals
MSD	JD25615-1DA	5/26/2021	Aqueous	Metals
MS	JD25615-1SA	5/26/2021	Aqueous	Metals
DUP	JD25615-2A	5/26/2021	Aqueous	Metals
MW-302	JD25615-3A	5/26/2021	Aqueous	Metals
FB	JD25615-4A	5/26/2021	Aqueous	Metals
MW-301	JD25615-1	5/26/2021	Aqueous	Cr+6
MSD	JD25615-1D	5/26/2021	Aqueous	Cr+6
MS	JD25615-1S	5/26/2021	Aqueous	Cr+6
DUP	JD25615-2	5/26/2021	Aqueous	Cr+6
MW-302	JD25615-3	5/26/2021	Aqueous	Cr+6
FB	JD25615-4	5/26/2021	Aqueous	Cr+6
MW-301F	JD25646-1FA	5/26/2021	Aqueous	Metals
MW-301F MSD	JD25646-1FAD	5/26/2021	Aqueous	Metals
MW-301F	JD25646-1FAR	5/26/2021	Aqueous	Metals
MW-301F MS	JD25646-1FAS	5/26/2021	Aqueous	Metals
MW-302F	JD25646-2FA	5/26/2021	Aqueous	Metals
MW-302F	JD25646-2FAR	5/26/2021	Aqueous	Metals
DUP-F	JD25646-3FA	5/26/2021	Aqueous	Metals
DUP-F	JD25646-3FAR	5/26/2021	Aqueous	Metals
MW-301F	JD25646-1F	5/26/2021	Aqueous	Cr+6
MW-302-F	JD25646-2F	5/26/2021	Aqueous	Cr+6
DUP-F	JD25646-3F	5/26/2021	Aqueous	Cr+6
Metals – Antimony, chromium, nickel, thallium and vanadium analyzed by SW-846 Method 6020B. Cr+6 – Hexavalent chromium analyzed by SW-846 Method 7196A together with pH and redox potential.				

The data package presenting the metals analysis data using EPA Method 6020B is numbered JD25615A, while the hexavalent chromium, and ancillary pH and redox potential analysis data are contained in SDG JD25615. The data for the filtered aliquots analyzed for metals using EPA Method 6010D are found in SDG JD25646A, while the Cr+6 analysis of the filtered samples are located in SDG JD25646.

Data Review

Data, as presented in the analytical data package SDG JD25615A, JD25615, JD25646A and JD25646 were primarily reviewed and validated using the following combination of method-specific criteria with professional judgement, as appropriate:

- New Jersey Department of Environmental Protection (NJDEP) *Standard Operating Procedure: Quality Assurance Data Validation of Analytical Deliverables Inorganics (Based on US EPA SW-846 Methods), SOP No. 5.A.16* (NJDEP, 2002).
- United States (US) Environmental Protection Agency (EPA) *"National Functional Guidelines for Inorganic Superfund Methods Data Review"*, OLEM Publication 9355.0-135, EPA540-R-2017-001, January 2017 (US EPA, 2017).
- US EPA *"ICP-AES Data Validation, SOP No. HW-3a, Revision 0, ISM 0.2.2"* (US EPA, 2015).
- NJDEP, 2014a, *Standard Operating Procedure (SOP) for Analytical Data Validation of Hexavalent Chromium* (NJDEP, 2009).
- NJDEP, 2014b, *Data of Known Quality Protocols Technical Guidance*, Version 1.0, April 2014.
- NJDEP, 2014c, *Data Quality Assessment and Data Usability Evaluation Technical Guidance*, Version 1.0, April 2014.
- NJDEP, 2014d, *Analytical Laboratory Data Generation, Assessment and Usability Technical Guidance*, Version 1.0, April 2014.
- NJDEP, 2014e, *Quality Assurance Project Plan Technical Guidance*, Version 1.0, April 2014.

Data associated with parameters that do not meet quality control specifications or compliance requirements, have been qualified in accordance with US EPA Region II/NJDEP specifications/guidelines, as appropriate.

The analysis of the identified samples was performed in compliance with the requirements specified in the respective analytical methods. The data is presented in a NJDEP "reduced deliverables" package and is considered complete, as defined by the NJDEP "Technical Regulations for Site Remediation" (NJDEP, 2012). However, it is emphasized that due to the absence of raw metals data and the associated preparation logs, the substantiation of the reported metals concentrations and the accuracy of the QC summary results is precluded. The information presented in the data summary and quality control (QC) forms was reviewed and used to qualify the sample results. The quality of data collected in support of this sampling activity is considered acceptable with the noted results qualifications, considering the limitations attributable to a reduced deliverables data package. The quality of data collected in support of this sampling activity is considered acceptable within the context of the affixed qualifications.

The discussion below presents the findings of the data validation review organized according to the technical areas used to evaluate inorganic analytical data. For each of these analytical topics, the information on the summary forms, as well as the raw data available and supporting information for the samples or standards analyzed were reviewed during the DV effort.

1.0 Metals Analysis Data Review

The discussion below presents the findings of the data validation review for the eleven technical areas used to evaluate inorganic analytical data. For each of these analytical topics, the information on the summary forms and available data for each sample or standard analyzed was reviewed during the DV effort.

The data validation of the analytical data was reviewed for the following data quality items and a check mark (√) indicates successful achievement of meeting the relevant QC requirements.

√ Holding times
√ Blank Analysis
√ Calibration standards
√ Calibration verification
√ Data package completeness
√ Data qualifiers
√ Matrix spike recoveries
√ Duplicate analysis
√ Laboratory control samples
√ Interference Check Samples
Field duplicate sample analysis

The three GW samples and field blank were analyzed for five target EPA Method 6020B metals June 2, 2021. Chromium and vanadium were detected in groundwater samples JD25615-1A and JD25615-2A above the New Jersey Groundwater Quality Standards. The three groundwater samples were subsequently filtered 6/15/2021 and analyzed using EPA Method 6010D on June 16, 2021. The field blank was not filtered for analysis.

Laboratory Case Narrative

The case narrative identified the relative percent difference (RPD) serial dilution results for antimony and thallium analyses in QC Batch MP26728 as being outside QC limits. However, the percent difference (%D) results for antimony are acceptable due to the low initial sample concentration (< 50 times the instrument detection limit [IDL]). The serial dilution result for thallium indicates possible matrix interference.

The RPD serial dilution results for antimony and thallium analyses in QC Batch MP26754 are outside QC limits. However, the percent difference (%D) results for antimony and thallium are acceptable due to the low initial sample concentrations (< 50 times the IDL).

The sample detection limits for antimony in samples JD25615-1A and JD25615-2A, and the detection limit for nickel in JD25615-1A, are elevated due to difficult sample matrix.

The case narrative of SDG JD25646A identified the RPD serial dilution results for chromium, nickel and vanadium analyses in QC Batch MP26960 as being outside QC limits. However, the percent difference (%D) results for these three analytes are acceptable due to the low initial sample concentration (< 50 times the IDL).

The sample detection limits for antimony, chromium, nickel, thallium, and vanadium in samples JD25646-1FAR and JD25646-2FAR are elevated due to difficult sample matrix.

No other quality control or non-compliance issues for the metals analysis were identified in the case narrative.

Holding Times (QC Limit 6 months)

The six-month analytical holding time was met for all ICP samples.

Calibration Standards (QC Limits 90-110% Recovery)

The QC calibration requirements were met by the initial and continuing calibration verification (CCV) standards employed, with target analyte recoveries all within the respective required QC limits, thereby demonstrating linearity for the groundwater sample and field blank analyses and acceptable analyte quantitation (concentration determination).

Hence, no sample results required qualifications for initial or continuing calibration issues.

Low Calibration Check Standard (QC Limit 70-130% Recovery)

The laboratory analyzed a high check standard and a "low calibration check standard", the latter which is similar to and may also be referred to as a contract required detection limit (CRDL) standard. This standard is identified by the acronym CRI in the data. The high calibration check standard was run with acceptable recoveries. Although the analysis of a CRDL standard is not required under Method 6020B, the laboratory analyzed it and provided the data. There is no NJDEP DV guidance for qualifying inorganic sample results for CRDL standard analysis (NJDEP, 2002).

The QC results provided for the high check standard and low calibration check standards, were within QC limits of 70-130% that are applied to other metals analyses.

Thus, no groundwater sample or field blank results were qualified for any calibration issues.

Quality Control Blanks (QC Limit < CRDL or < Reporting Limit [RL])

There were no target metals concentrations detected in the procedure blanks, continuing calibration blanks, or the field blank at the stated reporting limits in SDG JD25615A, as well as JD25646A, except that the field blank was not filtered or analyzed in the latter.

Hence, no groundwater sample results warranted qualification for any associated QC blank contamination in SDG JD25615A and JD25646A.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) Analysis

(QC Limits 75-125% Recovery; ≤ 20%RPD)

The matrix spike and matrix spike duplicate recoveries were within QC limits for all target analytes demonstrating acceptable accuracy. Matrix spike recoveries in the batch QC sample in Batch MP26728 associated with GW samples JD25615-3A and JD25615-4A (field blank) ranged from 93.3 – 111.4% and the MS recoveries for QC Batch MP26754 associated with samples JD125615-1A and JD25615-2A (DUP) ranged from 96.8% to 104.5%, thereby demonstrating acceptable analytical accuracy for this SDG. Furthermore, the matrix spike (MS/MSD) recoveries ranged from 98.4% to 106.5% associated with the three filtered GW samples in JD25646A

No sample results required qualification for matrix spike recovery issues, thereby demonstrating acceptable analytical accuracy.

Duplicate Analysis (QC Limit ≤ 20 %RPD)

The duplicate analysis was performed on two pairs of spiked duplicate samples in JD25615A. All %RPD values were below the laboratory QC limit of 20%RPD, with values ranging from 0.5 – 2.8%RPD for the QC sample associated with groundwater sample JD25615-3A and the FB in QC Batch MP26728 and 0.2 – 3.5%RPD for associated samples JD25615-1A and JD25615-2A.

The duplicate analysis was performed on one pair of spiked duplicate samples in JD25646A. All %RPD values were below the laboratory QC limit of 20%RPD, with values ranging from 0.0 – 1.9% RPD for the QC sample associated with the filtered groundwater samples JD25646-1A, JD25646-2A, and JD25646-3A.

Hence, no metals results requiring qualification for the duplicate analysis issue, as the duplicate analyses demonstrated excellent analytical precision.

Laboratory Control Samples (QC Limits 80-120% Recovery)

All analyte recoveries in the laboratory control samples (also referred to as the blank spike) were within the specified QC limits demonstrating acceptable analytical system performance, with blank spike recoveries ranging from 96.6% - 108.3% for the two QC batches associated with the three GW samples and FB for the metals analysis. The blank spike recoveries in JD25646A ranged from 99.0% to 106.5%.

Thus, acceptable analytical system performance was demonstrated.

Field Duplicate Sample Analysis (QC Limit ≤ 20%RPD)

One set of field duplicate samples was collected for the GW samples as part of SDG JD25615A. Field duplicate sample collection and analysis can provide a determination of sampling representativeness and precision. Gross differences between field sample duplicates can be an indication of inconsistent sampling techniques or sample matrix complexities/non-homogeneity.

An advisory data validation guideline for field duplicate aqueous samples suggests QC limits of 20%RPD or the absolute difference value of the CRQL (reporting limit) for sample results less than five times the CRQL (US EPA Region 2, 2015).

The results for the analysis of the one pair of field duplicate GW samples are presented in Table 2, below. It is apparent that the results for the GW metals analytes in the field duplicate samples of MW-301 were somewhat disparate, along with antimony and thallium results as non-detect concentrations. The chromium concentrations differed by approximately 90%RPD, with nickel and vanadium differing by about 30%RPD. However, the difference between the two nickel results was less than the stated reporting limit of 10 µg/L, thereby meeting the data quality criterion for sampling representativeness. Hence, the chromium and vanadium results for the field duplicate samples JD25615-1A and JD25615-2A are to be qualified as estimated concentrations and flagged with J in Table 2 and summarized in Table 8.

Table 2. Comparison of Field Duplicate GW Sample Metals Results – SDG JD25615A

Analyte	**MW-301 (µg/L)**	**DUP (µg/L)**	**% RPD**	**DV Flag**
Antimony	< 20.0	< 20.0	< CRQL	-
Chromium	533	1440	92.9 %	J
Nickel	18.1	24.2	< CRQL	-
Thallium	< 5.0	< 5.0	< CRQL	-
Vanadium	278	377	30.0%	J

QC Limit is ≤ 20 %RPD for aqueous samples, or < CRQL (for concentrations < 5 × CRQL);
< – The analyte was not detected at the stated reporting limit;
CRQL – The value representing the US EPA CLP contract required quantitation limit, often represented by the reporting limit;
< CRQL – The difference between field duplicate results was less than the CRQL and meets QC requirements.

Thus, the metals results for the field duplicate samples from MW-301 demonstrated some variability in the sampling representativeness and precision, with field duplicate GW sample results differing by more than 20%RPD for chromium and vanadium. No other GW sample results were qualified for sampling representativeness issues.

Following the analysis of the above samples, the three groundwater samples were filtered with the following results observed for the filtered field duplicate samples from MW-301:

Table 3. Comparison of Field Duplicate GW Sample Metals Results – SDG JD25646A

Analyte	**MW-301-F (µg/L)**	**DUP-F (µg/L)**	**% RPD**	**DV Flag**
Antimony	< 60	< 6	> CRQL	-
Chromium	292	< 10	187 %	-
Nickel	< 100	< 10	> CRQL	-
Thallium	< 100	< 10	> CRQL	-
Vanadium	< 500	< 50	> CRQL	-
QC Limit is ≤ 20 %RPD for aqueous samples, or < CRQL (for concentrations < 5 × CRQL); < – The analyte was not detected at the stated reporting limit; CRQL – The value representing the US EPA CLP contract required quantitation limit, often represented by the reporting limit; < CRQL – The difference between field duplicate results was less than the CRQL and meets QC requirements.				

The filtered field duplicate sample results appear quite disparate in terms of detected concentrations and the corresponding reporting limits. When the results of the two filtered samples identified as field duplicates in Table 3 are compared to the results of sample JD25646-2FAR (MW-302-F) in Table 4, the 292 µg/L chromium result of MW-301-F is quite similar to the 320 µg/L chromium concentration in MW-302-F, differing by an RPD value of only 11% with identical reporting limits for the remaining four analytes. Since the chromium results between the field duplicates in Table 3 differ by an RPD of more than 187% and the reporting limits differ by 164%, it suggests that the field duplicate results either warrant rejection or perhaps the samples were incorrectly identified, where the filtered sample aliquot identified as DUP-F is more likely to be MW-302-F, such that the comparison suggests that the sample identified as DUP-F may actually be MW-302-F.

Data validation guidelines recommend rejection of duplicate sample results that differ by more than 100% (USEPA, 2017; USEPA, 2015). These guidelines, although recommending qualification of results whose RPD values differ by more than 20% and rejection when > 100%, no such guideline for rejecting field duplicate sample results can be found among these guidelines.

Table 4. Comparison of Filtered Field Duplicate Sample Metals Results – SDG JD25646A

Analyte	**MW-301-F (µg/L)**	**DUP-F (µg/L)**	MW-302-F (µg/L)
Antimony	< 60	< 6	< 60
Chromium	292	< 10	320
Nickel	< 100	< 10	< 100
Thallium	< 100	< 10	< 100
Vanadium	< 500	< 50	< 500
QC Limit is ≤ 20 %RPD for aqueous samples, or < CRQL (for concentrations < 5 × CRQL); < – The analyte was not detected at the stated reporting limit; contract required quantitation limit, often represented by the reporting limit;			

< CRQL – The difference between field duplicate results was less than the CRQL and meets QC requirements.
CRQL – The value representing the US EPA CLP

Regardless of the potential sample ID errors, based strictly on the presented data, the large disparity between MW-301-F and DUP-F, though not subject to rejection for the observed difference, should be considered highly suspect, particularly the chromium results.

Serial Dilution Analysis (QC Limit ≤ 10 %D)

The case narrative of SDG JD25615A identified the RPD serial dilution results for antimony and thallium analyses in QC Batch MP26728 and QC Batch MP26754 being outside QC limits. However, the percent difference (%D) results are acceptable due to the low initial sample concentrations (< 50 times IDL) for all except thallium in MP26728. The serial dilution result for thallium in MP26728 indicates possible matrix interference for samples JD25615-3A and JD25615-4A. However, since sample JD25615-4A is a field blank and thallium was not detected at the reporting limit of 1.0 μg/L in either sample, it was judged appropriate that qualification of the two thallium results is unwarranted. All other serial dilution results met QC limits for the analytes subject to data validation, with %D results ranging 0.8 – 8.9%D, such that no sample results were qualified for serial dilution issues.

The case narrative of SDG JD25646A identified the RPD serial dilution results for chromium, nickel, and vanadium analyses in QC Batch MP26960 being outside QC limits. However, the percent difference (%D) results are acceptable due to the low initial sample concentrations (< 50 times IDL).

Hence, no sample results were qualified for serial dilution issues.

Quantification Verification

Metals concentrations reported on the Report of Analysis (Form 1) sheets for the GW samples could not be verified because the data was provided in a NJDEP "Reduced deliverables" format (NJDEP, 2012), omitting the quantitation reports and preparation logs from the raw data.

Reporting Limits

The samples in SDG JD25615A were each diluted by a factor of 2. However, the reporting limits for antimony and thallium in Samples JD25615-1A and JD25615-2A were raised to values of < 20 and < 5.0 μg/L, respectively, values above the respective NJ Groundwater Quality Standards of 6 and 2 μg/L, as detailed below in Table 5, due to a difficult sample matrix.

Table 5. Sample Reporting Limits Affected by Sample Dilution or Sample Matrix – JD25615A

Sample ID	Lab ID	Analyte	Reporting Limit (μg/L)	Dilution Factor	Adjusted Result	NJ GWQS (μg/L)
MW-301	JD25615-1A	Antimony	4	2	< 20	6
MW-301	JD25615-1A	Thallium	1	2	< 5	2
DUP	JD25615-2A	Antimony	4	2	< 20	6
DUP	JD25615-2A	Thallium	1	2	< 5	2

Units – μg/L
< – The analyte was analyzed for, but was not detected above the stated reporting limit.

The interpretation of the reporting limits for antimony and thallium in samples JD25615-1A (MW-301) and JD25615-2A (DUP) were not compromised by the elevated reporting limits, because the respective detected chromium concentrations of 533 µg/L and 1,440 µg/L in the samples had exceeded the NJGWQS of 70 µg/L. Consequently, this groundwater sampling location would be, thus, potentially subject to some sort of response action or further evaluation.

The filtered groundwater samples had not been diluted. However, the reporting limits had been raised, according to the case narrative, due to difficult sample matrix for all five metals in samples JD25646-1FAR (MW-301-F) and JD25646-2FAR (MW-302-F). Consequently, the reporting limits of non-detect results for antimony, thallium and vanadium exceeded the respective New Jersey Groundwater Quality Standards, while the non-detect results of < 100 µg/L for nickel matched the standard of 100 µg/L in these two samples. Note that reporting limits for the five non-detect metal results in the field duplicate sample (JD25646-3FAR; DUP-F) were not raised. The reporting limit for antimony was at the NJGWQS of 6 µg/L, but the reporting limit for the non-detect thallium result in the field duplicate sample exceeded the 2 µg/L standard, as identified in Table 6.

Table 6. Sample Reporting Limits Affected by Sample Dilution or Sample Matrix – JD25646A

Sample ID	**Lab ID**	**Analyte**	**Reporting Limit (µg/L)**	**Dilution Factor**	**Adjusted Result**	**NJ GWQS (µg/L)**
MW-301-F	JD25646-1FAR	Antimony	60	1	< 60	6
MW-301-F	JD25646-1FAR	Thallium	100	1	< 100	2
MW-301-F	JD25646-1FAR	Vanadium	500	1	< 500	60
MW-302-F	JD25646-2FAR	Antimony	60	1	< 60	6
MW-302-F	JD25646-2FAR	Thallium	100	1	< 100	2
MW-302-F	JD25646-2FAR	Vanadium	500	1	< 500	60
DUP-F	JD25646-3FAR	Thallium	10	1	< 10	2
Units – µg/L < – The analyte was analyzed for, but was not detected above the stated reporting limit.						

The results of the field duplicate analysis appear anomalous in that samples JD25646-1FAR (MW-301-F) and JD25646-2FAR (MW-302-F) required an elevation of reporting limits for all five metals, but the field duplicate sample (DUP-F) from location MW-301 did not. Additionally, the elevated reporting limits in the filtered samples did not compromise the results evaluation because the total chromium results reported for MW-301-F and MW-302-F exceeded the NJGWQS of 70 µg/L such that these sampling locations warrant further review and subsequent action or resampling.

Total Metals vs. Filtered Metals

Following the analysis of total metals in SDG JD25615A, the samples were filtered June 15, 2021 and analyzed June 16, 2021. Below is a comparison of the total metals versus the filtered sample results. According to DV guidance, instances where the filtered result exceeds the concentration result for total metals, both results are to be qualified as estimated (J), but both are subject to rejection (R) when the result of the filtered sample exceeds the total result by more than 50% (USEPA, 1988; Westchester Community College, 1995).

Table 7. Comparison of Total vs. Filtered GW Sample Metals Results

Analyte	**MW-301(µg/L)**	**MW-301-F (µg/L)**	**% RPD**	**DV Flag**
Antimony	< 20	< 60	> CRQL	-
Chromium	533	292	58.4 %	-
Nickel	18.1	< 100	> CRQL	-

Thallium	< 5.0	< 100	> CRQL	-
Vanadium	278	< 500	> CRQL	-
	DUP	DUP-F		
Antimony	< 20	< 6.0		-
Chromium	1,440	< 10	197 %	-
Nickel	24.2	< 10	83.0 %	-
Thallium	< 5.0	< 10		-
Vanadium	377	< 10	190 %	-
	MW-302	MW-302-F		
Antimony	< 4.0	< 60		-
Chromium	24.7	326	172 %	R
Nickel	5.5	< 100		-
Thallium	<1.0	< 100		-
Vanadium	15.9	< 500		-
QC Limit is ≤ 20 %RPD for aqueous samples, or < CRQL (for concentrations < 5 × CRQL); < – The analyte was not detected at the stated reporting limit; CRQL – The value representing the US EPA CLP contract required quantitation limit, often represented by the reporting limit; < CRQL – The difference between field duplicate results was less than the CRQL and meets QC requirements.				

From the results presented in Table 7, the chromium results in the samples from MW-302 are to be rejected because the filtered chromium result exceeded the total chromium concentration by 172%. The chromium results in the field duplicate sample (DUP), though not subject to rejection since the filtered result did not exceed the total, appear highly suspect compared to the results of MW-301 where the filtered result was approximately half of 533 µg/L, but the entire 1,440 µg/L chromium result appears to have been removed through the filtration step.

Based on the results of the filtration data, the reported results for chromium appear highly suspect and possible candidates for rejection.

Metals Analysis Summary

The groundwater sample analytical results for the samples of SDG JD25615A were found to be compliant with the analytical methods for the analysis of metals in the three groundwater samples and one field blank using SW-846 Method 6020B. All QC criteria were met for all ICP target metals analyses, except for the observed differences between the field duplicate samples from monitoring well location MW-301.

In the initial review of the total metals results in SDG JD25615A, no groundwater sample target metals results required any qualification for any associated results, except for the chromium and vanadium results for the two field duplicate samples JD25615-1A and JD25615-2A, which are qualified as estimated values and flagged with “J”, as identified below in Table 8, due to the potential variability in sampling representativeness and precision.

Table 8. Summary of Qualified Total Metals Results in JD25615A

Client ID	Laboratory Sample ID	Analyte	Result (µg/L)	DV Qualifier

Client ID	Laboratory Sample ID	Analyte	Result (µg/L)	DV Qualifier
MW-301	JD25615-1A	Chromium	533	J
MW-301	JD25615-1A	Vanadium	278	J
DUP	JD25615-2A	Chromium	1440	J
DUP	JD25615-2A	Vanadium	377	J
Units – µg/L; J – The result is an estimated value.				

However, upon review of the filtered metals results in SDG JD25646A, several of the results, as reported, appeared candidates for qualification as well as creating suspicion as to the validity of the results as reported in the data due to the observed disparities among the various results. The chromium results in samples JD25615-3A and JD25646-2FAR in Table 9 were, however, appropriately rejected due to the greater filtered chromium concentration than the corresponding total chromium result.

Table 9. Summary of Qualified Filtered Metals Results in JD25646A

Client ID	Laboratory Sample ID	Analyte	Result (µg/L)	DV Qualifier
MW-302	JD25615-3A	Chromium	24.7	R
MW-302-F	JD25646-2FAR	Chromium	326	R
Units – µg/L; R – The result is rejected following DV review.				

The reported results, except for the identified rejected chromium results, are considered usable in the context of the applied qualification.

No other groundwater sample target metals results required any qualification for any associated QC issues.

2.0 Hexavalent Chromium Analysis Data Review

The analysis for hexavalent chromium (Cr+6) was performed using Method 7196A for aqueous groundwater samples and field blank analysis.

The data validation of the analytical data was reviewed for the following data quality items and a check mark (√) indicates successful achievement of meeting the relevant QC requirements.

√ Holding times
√ Blank Analysis
√ Calibration standards
√ Calibration verification
√ Data qualifiers
√ Data package completeness
√ Matrix spike recoveries
√ Duplicate analysis
√ Laboratory control samples
√ Quantitation checks
√ Field duplicate sample analysis

No hexavalent chromium concentrations were detected in the three groundwater samples of SDG JD25615 at a reporting limit of 0.050 mg/L, or the field blank at a reporting limit of 0.010 mg/L. The three groundwater samples were also filtered and analyzed in the same analytical sequence of May 26, 2021.

Laboratory Case Narrative

The case narrative of SDG JD25615 indicated that all QC requirements were met, except that the samples were received outside the analytical holding time for pH analysis. However, the analytical holding time for pH may range anywhere from "analyze immediately" or for up to 2 hours. The groundwater samples were analyzed within the remaining method holding times, all method blanks met method specific criteria, and sample MW-301 (Lab sample ID: JD25615-1) was analyzed for the spike and duplicate analyses. According to the case narrative, the reporting limits for Cr+6 were elevated in samples JD25615-2 and JD25615-3 due to dilution required for matrix interference.

Similarly, the case narrative of SDG JD25646 indicated that all QC requirements were met, except that the samples were received outside the analytical holding time for pH analysis. The groundwater samples were analyzed within the remaining method holding times, all method blanks met method specific criteria, and sample JD25646-1FMS and JD25646-1FDUP (MW-301-1F) was analyzed for the spike and duplicate analyses. According to the case narrative, the reporting limits for Cr+6 were elevated in samples JD25646-1F and JD25646-2F due to dilution required for matrix interference.

Professional judgement was applied in not qualifying the pH results, since this is an ancillary analysis to support the Cr+6 analysis, which, otherwise, met all QC requirements.

Matrix Spike (MS) Analysis
(QC Limits: 75-125% Recovery)

The matrix spike recoveries were within QC limits for Cr+6 demonstrating acceptable accuracy. Matrix spike recovery in QC Batch GN18540 for sample JD25615-1 was an acceptable 94.7%, while the MS recovery in the filtered sample JD25646-1F was an acceptable recovery of 90.7%, thereby demonstrating acceptable analytical accuracy for both the unfiltered and filtered groundwater samples in SDGs JD25615 and JD25646, respectively.

No sample results required qualification for matrix spike recovery issues.

Duplicate Analysis (QC Limit: ≤ 20 %RPD)

The duplicate analysis was performed on one set of duplicate groundwater samples in SDG JD25615 for sample JD25615-1. The %RPD value (0.0%RPD) for duplicate samples in QC Batch GN18540 was within the QC limits of 20%RPD for aqueous samples (NJDEP, 2009). The %RPD value for the redox potential was 11.6 %RPD for sample JD25615-1 in QC Batch GN18590.

The duplicate analysis for the filtered samples was performed on one set of duplicate groundwater samples in SDG JD25646. The reported %RPD value for the filtered duplicate sample in QC Batch GN18540 was also an acceptable 0.0%RPD. The %RPD value for the redox potential was reported as 11.6 %RPD from QC Batch 18590, such that all analytical precision results were less than 20%RPD for all Cr+6 and redox potential analyses, thereby demonstrating excellent analytical precision. Thus, no sample Cr+6 results required qualification due to any differences in the duplicate analyses for either the unfiltered or filtered Cr+6 results.

Field Duplicate Sample Analysis (QC Limit ≤ 20%RPD)
The Cr+6 results for one set of field duplicate samples collected from sample location MW-301 as part of the sampling representativeness evaluation for this SDG are presented in Table 10.

Table 10. Comparison of Field Duplicate GW Sample Results – JD25615

Analyte	MW-301 (mg/L)	DUP (mg/L)	% RPD	DV Flag
Hexavalent Chromium	< 0.050	< 0.050	0 %	----
Key: < – The analyte was analyzed, but was not detected at the stated reporting limit.				

This set of field duplicate samples demonstrated excellent sampling representativeness and precision, as the Cr+6 results were identical non-detect concentrations of < 0.050 mg/L. No sample Cr+6 results in SDG JD25615 need be qualified for field duplicate sample results disparities.

The three groundwater samples were filtered in SDG JD25646 and hexavalent chromium was not detected in any of the three samples. The results of the field duplicate analysis are presented in Table 11. Although Cr+6 was not detected in either aliquot, the reporting limits differ by a factor of five because the reporting limit in JD25646-1F was elevated due to the 5x dilution required to offset matrix interference.

Table 5. Comparison of Field Duplicate GW Sample Results – JD25646

Analyte	MW-301-F (mg/L)	DUP-F (mg/L)	% RPD	DV Flag
Hexavalent Chromium	< 0.050	< 0.010	< CRQL	---
Key: < – The analyte was analyzed, but was not detected at the stated reporting limit.				

As discussed above in the metals sections above, it is suspected that the sample ID numbers were erroneously assigned to samples JD25646-2F and JD25646-3F. Because the Cr+6 results were non-detect results for all three samples, the reporting limit of < 0.50 µg/L for JD25646-2F was suspected to be more apt to represent the field duplicate DUP-F (identified as JD25646-3F) result rather than MW-302-F.

This set of field duplicate samples demonstrated excellent sampling representativeness and precision in the initial analysis of unfiltered samples, as the Cr+6 results were identical non-detect concentrations of < 0.050 mg/L. However, the reported non-detect results for the filtered samples differed in the reporting limit values by a factor of five. No sample Cr+6 results need be qualified for field duplicate sample results disparities.

Results of Sample Hexavalent Chromium Analyses

All calibration criteria were met for the groundwater samples of SDG JD25615 and JD25646 for the analytical sequence of 5/26/2021 encompassing the samples of both SDGs. This included initial calibration linearity (r = 0.99987), and continuing calibration frequency and accuracy (93.5% to 95.5% CCV Recoveries). The method blank, calibration blanks, and the FB were free of detectable Cr+6 concentrations. The blank spike recovery (100.0%) demonstrated that the analytical system was performing accurately. The reported MS recovery (94.7%), duplicate precision result (0.0 %RPD) from PPG batch QC sample JD25615-1, and the non-detect field blank sample results were verified from the raw data with no observed discrepancies in the reported data. The reported MS recovery (90.7%) and duplicate precision result (0.0 %RPD) from filtered PPG sample JD25615-1F in QC Batch 18540 demonstrated that the analyses were conducted with acceptable accuracy and analytical precision.

The laboratory analyzed the aqueous samples for pH and Eh, the collected pH and Eh data were reviewed and plotted on an Eh-pH diagram and it was observed that one of the groundwater samples and field blank fell below the phase diagram line depicting “reducing” conditions where conditions are not conducive to oxidize chromium to Cr+6. The Eh-pH Phase Diagram indicated that sample MW-301 and DUP fell slightly above the phase line in SDG JD25615 suggesting a potential oxidizing sample character, perhaps related to sample matrix issues. However, the Eh-pH diagram in SDG JD25646 presented data where samples JD25646-1F (MW-301-F) and JD25646-2F (MW-302-F) were above the line with JD25646-3F (DUP-F) falling below it, thereby adding further suspicion regarding the correct identification of the filtered samples.

Review of the pH and Eh reported results on the respective Eh pH Phase Diagrams in JD25615 and JD25646 showed very similar placement of the symbols representing the respective samples on the two diagrams, except that the field blank was not filtered in JD25646 and not on the diagram. The Eh values are similar for samples JD25615-1 through -3 and JD25646-1F through -3F (inclusive), in the order listed, and the pH values are also similar. The Eh values on the diagrams matched the results on the respective Redox data sheets. However, the laboratory did not provide the sheets for the pH results, although the pH results for the sample numbers JD25615-1 through -3 and JD25646-1F through -3F were similar. Thus, due to the sample ID order of listing on the diagram for JD25615-2 (DUP) and JD25615-3 (MW-302) in SDG JD25615 compared to the listing order of JD25646-2F (MW-302-F) and JD25646-3F (DUP-F) in SDG JD25646, it is believed that a similarity exists between the plots of the Eh-pH phase diagrams in the two SDGs based on the results values, but a change/error in the locations of DUP and MW-302 on the two plots is suspected to be attributable to a potential sample identification errors in SDG JD25646. Consequently, the inconsistencies in the reported results for the various samples elicits concern regarding the validity of the various reported results.

Total vs. Filtered Hexavalent Chromium Results

The samples for hexavalent chromium were analyzed for total and filtered concentrations in the same analytical sequence of 5/26/2021. Below is a comparison of the total Cr+6 versus the filtered sample results. The results for hexavalent chromium analysis presented in Table 12 were identical non-detect results for the three samples for both the total and filtered analyses, except that the reporting limit in JD25646-3F was < 0.10 µg/L, rather than < 0.50 µg/L for all other samples.

Table 12. Comparison of Total vs. Filtered GW Sample Cr+6 Results

Analyte	**MW-301(µg/L)**	**MW301-F (µg/L)**	**% RPD**	**DV Flag**
Hex. Chromium	< 0.50	< 0.50	0 %	---
	DUP	**DUP-F**		
Hex. Chromium	< 0.50	< 0.10	< CRQL	---
	MW302	**MW302-F**		
Hex. Chromium	< 0.50	< 0.50	0 %	---
QC Limit is ≤ 20 %RPD for aqueous samples, or < CRQL (for concentrations < 5 × CRQL); < – The analyte was not detected at the stated reporting limit; CRQL – The value representing the US EPA CLP contract required quantitation limit, often represented by				

the reporting limit;
< CRQL – The difference between field duplicate results was less than the CRQL and meets QC requirements.

Since Cr+6 was not detected in any of the samples and the filtered value is not greater than the total Cr+6 result, no Cr+6 results are subject to qualification for total vs. filtered issues.

Summary for Hexavalent Chromium Analysis

Since the MS recoveries were within QC limits, as were all other QC results associated with the hexavalent chromium analysis, including the field duplicate sample analysis, no Cr+6 results were subject to qualification for QC issues following the DV review.

Data Review Summary Statements

Due to the observed variability between the field duplicate samples, the uncertainty regarding the sample identities and the seeming inconsistencies among the unfiltered versus filtered results for various samples, the data is considered suspect and potentially subject to rejection. Consequently, it is suggested that minimal credence be given to the current set of data as currently presented when evaluating site conditions and resampling is, therefore, highly recommended.

3.0 DATA QUALIFIER DEFINITIONS

The absence of qualifiers indicates that the data are acceptable both qualitatively and quantitatively.

Qualifier	Definition
<	The analyte was analyzed, but was not detected at the stated reporting limit.
J	The reported result is an estimated value.
R	The reported result is rejected and considered not usable.

4.0 References

APHA, AWWA, and WEF, 1995, ***Standard Methods for the Examination of Water and Wastewater, 19th Edition,*** Washington, D.C., 1268 p.

New Jersey Department of Environmental Protection, 2014a, ***Data of Known Quality Protocols Technical Guidance*,** Version 1.0, Trenton, New Jersey, April 2014.

New Jersey Department of Environmental Protection, 2014b, ***Data Quality Assessment and Data Usability Evaluation Technical Guidance,*** Version 1.0, Trenton, New Jersey, April 2014.

New Jersey Department of Environmental Protection, 2014c, ***Analytical Laboratory Data Generation, Assessment and Usability Technical Guidance,*** Version 1.0, Trenton, New Jersey, April 2014.

New Jersey Department of Environmental Protection, 2014d, ***Quality Assurance Project Plan Technical Guidance,*** Version 1.0, Trenton, New Jersey, April 2014.

New Jersey Department of Environmental Protection, 2012, ***Technical Requirements for Site Remediation, N.J.A.C. 7:26E***, Trenton, New Jersey, May 7, 2012.

New Jersey Department of Environmental Protection, 2009, ***Standard Operating Procedure (SOP) for Analytical Data Validation of Hexavalent Chromium, SOP No.: 5.A.10,*** Trenton, New Jersey, September 2009.

New Jersey Department of Environmental Protection, 2002, ***Standard Operating Procedure: Quality Assurance Data Validation of Analytical Deliverables Inorganics (Based on US EPA SW-846 Methods), SOP No. 5.A.16***, Trenton, New Jersey.

New Jersey Department of Environmental Protection, 2001, ***Standard Operating Procedure for the Analytical Data Validation of Target Analyte List - Inorganics BEMQA 5.A.2, Revision 4,*** Trenton, New Jersey.

US EPA, CLP, 2017, ***"National Functional Guidelines for Inorganic Superfund Methods Data Review"***, OLEM Publication 9355.0-135, EPA540-R-2017-001, January 2017.

US EPA, 2015, ***"ICP-AES Data Validation SOP No. HW-3a Revision 0 ISM 02.2"***, July 2015.

US EPA, 1997, ***Test Methods for Evaluating Solid Wastes, 3rd Edition including Final Update III***, Office of Solid Waste and Emergency Response, Washington, D.C., June 1997.

US EPA, 1988, ***"Evaluation of Metals Data Contract Laboratory Program, Appendix A.1, Data Validation SOP No. HW-2 Revision 8"***, December 1988.

Westchester Community College, 1995, ***CLP Inorganics Data Validation Course,*** March, 1995.

ATTACHMENT A

Data Validation Checklist

DATA QUALITY ASSURANCE/QUALITY CONTROL CHECKLIST

Project: PPG SDGs:
JD25615/JD25615A/JD25646/JD25646A

1. Were the appropriate sample preservation requirements met?................ [✓ Yes] No

2. Were appropriate sample holding times
   (for both extraction/sample preparation and analysis) met? ……………. [✓ Yes] No
   If "No", provide a brief explanation.

3. Were the samples diluted? …………………………………………………………… [✓ Yes] No
   Indicate the identity of the samples and why.

Samples JD25615-1A, -2A, -3A, and Field Blank JD25615-4A were diluted by 2x in the metals analysis, with the chromium result in JD25615-2A diluted 5x. These three samples and FB were diluted 2x in the Cr+6 analysis.
Filtered samples JD25646-1F and -2F were diluted 2x in the Cr+6 analysis.

4. If applicable, did sample dilutions result in elevated reporting limits that exceed applicable standards?.. [✓ Yes] No
   If "Yes", list the affected samples.

The reporting limits for antimony and thallium in Samples JD25615-1A and -2A were above the respective NJ Groundwater Quality Standards of 6 µg/L and 2 µg/L.
The reporting limits for antimony, thallium, and vanadium in filtered samples JD25646-1FAR and -2FAR were above the respective NJ Groundwater Quality Standards of 6 µg/L, 2 µg/L, and 60 µg/L, as was the thallium reporting limit in -3FAR.

5. Were any applicable standards exceeded for any samples? …………………. [✓ Yes] No
   If "Yes", include the number of samples and laboratory sample ID numbers.

The chromium and vanadium results in Samples JD25615-1A and -2A were above the respective NJ Groundwater Quality Standards of 70 µg/L and 60 µg/L, as were the filtered chromium results in samples JD25646-1FAR and -2FAR.

6. Were the laboratory reporting limits below the applicable remediation standards/criteria required for the site?.. [✓ Yes] No
   If "No", provide a brief explanation of action taken.

7. Were qualifications noted in the non-conformance summary?................ Yes [✓ No]
   Provide a brief explanation.

   All routine QC requirements were met for both the metals and Cr+6 analyses. No problems with analytical procedures were noted.

8. Were qualified data used?.. [✓ Yes] No

9. Were rejections noted in the non-conformance summary?..................... Yes [✓ No]
   Provide a brief explanation.

   Not applicable

10. Were rejected data used?... Yes [✓ No]
    If "yes", please indicate reasons rejected data were used:
    O For Hex Chrome, data were rejected because spike recovery was <50%.
    O Data were rejected due to missing deliverables.
    O Data were rejected but an applicable standard exceedance exists.
    X Data were rejected in an early phase of remediation; however, additional sampling and analysis are scheduled to be performed.
    O Other reasons not noted directly above. Explain:

11. Were the quality control criteria associated with the compounds of concern at the site met? ………………………………………………………. Yes [✓ No]
12. Were the QC Summary Forms reviewed?... [✓ Yes] No
13. Internal Standards acceptable…………………………………………………………. [✓ Yes] No
14. MS/MSD acceptable………………………………………………………………………. [✓ Yes] No
15. Calibration summaries acceptable………………………………………………… [✓ Yes] No
16. Serial dilutions acceptable……………………………………………………………… [✓ Yes] No
17. Inorganic duplicates acceptable……………………………………………………. [✓ Yes] No
18. LCS recovery acceptable……………………………………………………………….. [✓ Yes] No
19. Other QC acceptable?... Yes [✓ No]
    Provide a brief explanation, if applicable.

The total and filtered chromium results in samples JD25615-1 and JD25646-1FAR, respectively, were rejected because the filtered result exceeded the total chromium concentration by more than 50%.

All QC requirements were achieved in both the metals and Cr+6 analyses, except for the field duplicate results in the metals analysis and filtered analysis for chromium. Refer to DV report tables 2, 3, and 5 for QC details. The chromium and vanadium results were qualified as estimated values flagged with J in field duplicate samples JD25615-1A and -2A presented in Table 8 and the chromium results in samples JD25615-3A and JD25646-2FAR were rejected and presented in Table 12. No other sample results were qualified, though due to disparities and inconsistencies, the reported results in this data set are suspect.

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DATA VALIDATION REPORT

Project: **Jersey City PPG, Site 63/65; Report SDG L2142416/L2142417**
Sample Date: **August 6, 2021**
Analyses: **Metals Analysis, EPA Method 6020B**
Hexavalent Chromium Analysis, EPA Method 7196A
pH, EPA Method SM4500H+ B-11
Reviewer: **Janis V. Giga, Ph.D., REP5554**
Date: **August 26, 2021**

This data validation (DV) report presents the data review and result qualifications for two (2) groundwater (GW) samples and field blank (FB) collected at the Jersey City PPG Site 63/65 at 1 Burma Road, Jersey City, New Jersey on August 6, 2021 for sample delivery group (SDG) L2142416, as well as L2142417. The groundwater samples and field blank were analyzed for the analytes listed above employing the identified analytical methods by Alpha Analytical laboratory of Westborough, Massachusetts.

Summary of Sample Results Qualifications

The groundwater sample and FB results for the samples of SDG L2142417 were found to be compliant with the analytical method (SW-846 Method 6020B) for the analysis of metals and L2142416 for the analysis of hexavalent chromium (Cr+6) (Method 7196A) in the two collected groundwater samples and one field blank.

All routine quality control (QC) criteria were met for each of the inductively coupled plasma/mass spectrometer (ICP/MS) target analyte analyses.

Following the detailed DV review, the following sample metals result was qualified:

- Thallium (“1 UB”) in Sample L2142417-03.

No hexavalent chromium results for the two reported GW samples and one field blank in this SDG have been qualified, and are usable as reported, because all QC results were within method QC limits.

The antimony and chromium results in sample L2142417-01 were detected above the respective New Jersey Groundwater Quality Standard (NJGWQS). No other target analytes were detected in any of the groundwater samples above the associated action levels.

A data validation checklist is provided in Attachment A to summarize the observations during the DV review.

Sample Receipt

The two (2) groundwater samples and one field blank collected August 6, 2021 were received at the Alpha Analytical laboratory August 7, 2021, with an acceptable maximum corrected sampling cooler temperature of 4.1 degrees Celsius (ºC). The GW sample and field blank identification numbers and corresponding laboratory identification numbers are as follows:

Table 1. Sample Receipt Summary

Client Sample Designation	**Sample Lab ID Number**	**Date Collected**	**Matrix**	**Analyses**
MW-202	L2142417-01	8/6/2021	Aqueous	Metals
FB-01	L2142417-02	8/6/2021	Aqueous	Metals
MW-302	L2142417-03	8/6/2021	Aqueous	Metals
MW-202	L2142416-01	8/6/2021	Aqueous	Cr+6
DUP	L2142416-02	8/6/2021	Aqueous	Cr+6
MW-302	L2142416-03	8/6/2021	Aqueous	Cr+6
Metals – Antimony, chromium, nickel, thallium and vanadium analyzed by SW-846 Method 6020B. Cr+6 – Hexavalent chromium analyzed by SW-846 Method 7196A together with pH.				

The data package presenting the metals analysis data is numbered L2142417, while the hexavalent chromium and ancillary pH analysis data are contained in SDG L2142416.

Data Review

Data, as presented in the analytical data package SDG L2142416 and L2142417, were primarily reviewed and validated using the following combination of method-specific criteria with professional judgement, as appropriate:

- New Jersey Department of Environmental Protection (NJDEP) *Standard Operating Procedure: Quality Assurance Data Validation of Analytical Deliverables Inorganics (Based on US EPA SW-846 Methods), SOP No. 5.A.16* (NJDEP, 2002).
- United States (US) Environmental Protection Agency (EPA) *"National Functional Guidelines for Inorganic Superfund Methods Data Review"*, OLEM Publication 9355.0-135, EPA540-R-2017-001, January 2017 (US EPA, 2017).
- US EPA *"ICP-AES Data Validation, SOP No. HW-3a, Revision 0, ISM 0.2.2"* (US EPA, 2015).
- NJDEP, 2009, *Standard Operating Procedure (SOP) for Analytical Data Validation of Hexavalent Chromium* (NJDEP, 2009).
- NJDEP, 2014a, *Data of Known Quality Protocols Technical Guidance*, Version 1.0, April 2014.
- NJDEP, 2014b, *Data Quality Assessment and Data Usability Evaluation Technical Guidance*, Version 1.0, April 2014.
- NJDEP, 2014c, *Analytical Laboratory Data Generation, Assessment and Usability Technical Guidance*, Version 1.0, April 2014.
- NJDEP, 2014d, *Quality Assurance Project Plan Technical Guidance*, Version 1.0, April 2014.

Data associated with parameters that do not meet quality control specifications or compliance requirements, have been qualified in accordance with US EPA Region II/NJDEP specifications/guidelines, as appropriate.

The analysis of the identified samples was performed in compliance with the requirements specified in the respective analytical methods. The data is presented in a NJDEP "reduced deliverables" package and is considered complete, as defined by the NJDEP "Technical Regulations for Site Remediation" (NJDEP, 2012). However, it is emphasized that due to the absence of raw metals data and the associated preparation logs, the substantiation of the reported metals concentrations and the accuracy of the QC summary results is precluded. The data package was complete for the hexavalent chromium analysis and the Cr+6 and associated QC results were substantiated during the DV review. The information presented in the data summary and quality control (QC) forms was reviewed and used to qualify the sample results. The quality of data collected in support of this sampling activity is considered acceptable with the noted results qualifications, considering the limitations attributable to a reduced deliverables data package. The information presented in the data summary and quality control (QC) forms was reviewed and used to qualify sample results. The quality of data collected in support of this sampling activity is considered acceptable within the context of the affixed qualifications.

The discussion below presents the findings of the data validation review organized according to the technical areas used to evaluate inorganic analytical data. For each of these analytical topics, the information on the summary forms, as well as the raw data available and supporting information for the samples or standards analyzed were reviewed during the DV effort.

1.0 Metals Analysis Data Review

The discussion below presents the findings of the data validation review for the eleven technical areas used to evaluate inorganic analytical data. For each of these analytical topics, the information on the summary forms and available data for each sample or standard analyzed was reviewed during the DV effort.

The data validation of the analytical data was reviewed for the following data quality items and a check mark (√) indicates successful achievement of meeting the relevant QC requirements.

√ Holding times
√ Blank Analysis
√ Calibration standards
√ Calibration verification
√ Data package completeness
√ Data qualifiers
√ Matrix spike recoveries
√ Duplicate analysis
√ Serial dilution analysis
√ Laboratory control samples
√ Interference Check Samples

The two GW samples and one field blank were analyzed for five target EPA Method 6020B metals. Antimony and chromium were detected in groundwater sample L2142417-01 above the respective New Jersey Groundwater Quality Standard.

Laboratory Case Narrative
The case narrative stated that all non-detect (ND) or estimated concentrations (J-qualified) have been quantitated to the limit noted in the MDL column. All DKQP required questions were answered with affirmative responses; therefore, there are no relevant data issues to discuss.

Hence, no quality control or non-compliance issues for the metals analysis were identified in the case narrative.

Holding Times (QC Limit 6 months)
The six-month analytical holding time was met for all ICP samples.

Calibration Standards (QC Limits 90-110% Recovery)
The QC calibration requirements were met by the initial and continuing calibration verification (CCV) standards employed, with target analyte recoveries all within the respective required QC

limits, thereby demonstrating linearity for the groundwater sample analyses and acceptable analyte quantitation (concentration determination).

Hence, no sample results required qualifications for initial or continuing calibration issues.

Low Calibration Check Standard (QC Limit 70-130% Recovery)
A "low calibration check standard", which is similar to and may also be referred to as a contract required detection limit (CRDL) standard was not reported. The analysis of a CRDL standard is not required under Method 6020B. Additionally, there is no NJDEP DV guidance for qualifying inorganic sample results for CRDL standard analysis (NJDEP, 2002).

Thus, no groundwater sample results were qualified for any calibration check issues.

Quality Control Blanks (QC Limit < CRDL or < Reporting Limit [RL])
Target metals concentrations were not detected in the method blank or continuing calibration blanks at the stated reporting limits in SDG L2142417, except for thallium detected in the method blank with a result of 0.1654 J µg/L and most of the calibration blanks with detected concentrations ranging from 0.404 J to 0.486 J µg/L for the samples analyzed 8/13/2021, including the initial calibration blank, as well as ranging 0.269 J µg/L to 0.593 J µg/L for supplemental QC analyses on 8/17/2021. In sample L2142417-03 (MW-302), a detected thallium result of 0.1698 J µg/L was reported. However, thallium was also detected in the associated MB at a concentration of 0.1654 J µg/L.

Based on interpretation of the NJDEP 2002 DV guidelines for SW-846 inorganics and the USEPA 2015 DV guidelines for ICP-MS (6020B), the thallium result in MW-302 was negated and changed to a non-detect result of 1 UB µg/L, as indicated in Table 2. According to EPA DV guidelines, if the absolute value of the Prep blank (method blank) is ≤ RL, report results that are ≥ MDL but ≤ RL as RL-U. The NJDEP DV guidelines state that if the concentration of any analyte in a sample is less than or equal to three times the concentration in the method blank, the presence of that analyte in the sample is negated due to method blank contamination and the 'B' flag must be reported with the analytical result to indicate the result was associated with blank contamination.

Thus, the thallium result in MW-302 was changed from a detected result of 0.1698 J ug/L to a non-detect result of 1 UB ug/L.

Table 2. Sample Groundwater Metals Results Qualified for Method Blank Contamination

Lab Sample #	Client ID	Analyte	Result (µg/L)	DV Qualifier
L2142417-03	MW-302	Thallium	0.1698 J	1 UB
WG1532669-1	Method Blank	Thallium	0.1654 J	---

Qualifiers:

J – (Lab qualifier) The reported value is less than the RL (reporting limit).

B – (Lab qualifier) The analyte was detected in the associated method blank;

U – (DV qualifier) The reported value is negated and changed to a non-detect result at the reporting limit.

Although chromium was detected in the field blank with a result of 0.4377 J µg/L, no sample results were subject to qualification, since the detected sample chromium concentrations were considerably greater than ten times the field blank result and the results are considered "real" (NJDEP, 2002).

ICP Interference Check Samples (QC Limits 80-120% Recovery)
Detected concentrations for antimony, chromium, nickel, thallium and vanadium were reported for ICSA, but without percent recovery values, although results for ICSA typically are evaluated for only aluminum, calcium, iron, and magnesium. No results were qualified for the interference check sample results.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) Analysis
(QC Limits 75-125% Recovery; ≤ 20%RPD)
The matrix spike (MS) and matrix spike duplicate (MS/MSD) recoveries were within the QC limits of 75 - 125% for the five target analytes in the PPG QC sample L2142417-03 (MW-302) in QC batch samples WG1532669-3 and WG1532669-4 with matrix spike recoveries ranging from 90% to 101%. Hence no sample results were subject to qualification for any matrix spike recovery issues, thereby demonstrating acceptable analytical accuracy.

No groundwater sample or FB results were qualified for matrix spike recovery issues.

Duplicate Analysis (QC Limit ≤ 20 %RPD)

The duplicate analysis was performed on one set of matrix spike duplicate GW sample aliquots from the PPG QC sample L2142417-03 (MW-302) in QC batch samples WG1532669-3 and WG1532669-4. The RPD values ranging from 0 to 5% were below the RPD limit of 20%. Thus, no sample results were subject to qualification for any matrix spike duplicate analysis issues, thereby demonstrating acceptable analytical precision.

No groundwater sample or FB results were qualified for any duplicate analysis issues.

Laboratory Control Samples (QC Limits 80-120% Recovery)
All analyte recoveries in the laboratory control samples (also referred to as the blank spike) were within the specified QC limits demonstrating acceptable analytical system performance, with blank spike recoveries ranging from 90% - 103% for the QC batch associated with the two GW samples for the metals analysis. Thus, acceptable analytical system performance was demonstrated.

Serial Dilution Analysis (QC Limit ≤ 20 %D for Method 6020B)
The serial dilution analysis reported results for chromium in QC batch sample WG1532669-6. The 2%D result in sample 2142417-03 (MW-302) was within the QC limit of 20%RPD for chromium. Thus, no sample results were subject to qualification for any serial dilution issues, thereby demonstrating an absence of interference within the sample matrix.

No groundwater sample or field blank results were qualified for serial dilution issues.

Quantification Verification
Metals concentrations reported on the Report of Analysis (Form 1) sheets for the GW samples could not be verified because the data was provided in a NJDEP "Reduced deliverables" format (NJDEP, 2012), omitting the quantitation reports and preparation logs from the raw data.

Reporting Limits

No samples required dilution, such that all reporting limits were below the respective New Jersey Groundwater Quality Standards limit values.

Metals Analysis Summary – L2142417

The groundwater sample and field blank analytical results for the samples of SDG L2142417 were found to be compliant with the analytical methods for the analysis of metals in the two groundwater samples and one field blank using SW-846 Method 6020B. All QC criteria provided were met for the ICP target metals analyses.

No groundwater sample target metals results required qualification for any associated results, except for the thallium result in Sample L2142417-03 (MW-302), which is negated and changed to non-detect result reported as 1 UB µg/L, as identified below in Table 3, due to the associated method blank contamination.

Table 3. Summary of Qualified Metals Results in L2142417

Client ID	Laboratory Sample ID	Analyte	Result (µg/L)	DV Qualifier
MW-302	L2142417-03	Thallium	0.1698 J	1 UB
Units – µg/L; *J – (Lab qualifier) The reported value is less than the RL (reporting limit).* *B – (Lab qualifier) The analyte was detected in the associated method blank;* *U – (DV qualifier) The reported value is negated and changed to a non-detect result at the reporting limit.*				

The reported revised non-detect thallium result for sample MW-302 result is considered usable in the context of the applied qualification.

No other groundwater sample or field blank target metals results were qualified for any associated QC issues.

2.0 Hexavalent Chromium Analysis Data Review

The analysis for hexavalent chromium (Cr+6) was performed using Method 7196A for aqueous groundwater samples and field blank analysis.

The data validation of the analytical data was reviewed for the following data quality items and a check mark (√) indicates successful achievement of meeting the relevant QC requirements.

√ Holding times
√ Blank Analysis
√ Calibration standards
√ Calibration verification
√ Data package completeness
√ Matrix spike recoveries
√ Duplicate analysis
√ Laboratory control samples
√ Quantitation checks
√ Data qualifiers

No hexavalent chromium concentrations were detected in either of the two groundwater samples or field blank.

Laboratory Case Narrative

The case narrative stated that all non-detect (ND) or estimated concentrations (J-qualified) have been quantitated to the limit noted in the MDL column. All DKQP required questions were answered with affirmative responses; therefore, there are no relevant data issues to discuss.

Hence, no quality control or non-compliance issues for the Cr+6 analysis were identified in the case narrative.

Matrix Spike (MS) Analysis

(QC Limits: 75-125% Recovery)

The matrix spike/matrix spike duplicate recoveries in QC batch samples WG1532581-4 and WG1532581-5 for sample L2142416-03 (MW-302) were within the 75-125% DV QC limits for Cr+6 specified in the DV guidelines (NJDEP, 2009). The MS.MSD recoveries of 88% and 85% registered an RPD result of 2%, a value within the QC limit of 20%, thereby demonstrating acceptable analytical accuracy and precision.

No groundwater sample or field blank results required qualification for matrix spike recovery issues.

Duplicate Analysis (QC Limit: ≤ 20 %RPD)

The laboratory duplicate analysis was performed on batch QC sample WG1532581-3 with duplicate aliquots taken from PPG QC sample L2142417-03 (MW-302). The RPD value for the duplicate analysis was reported as NC (Not calculated) for the two non-detect results. The term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit. Thus, no sample results were subject to qualification for any duplicate analysis issues, thereby demonstrating acceptable analytical precision.

Hence, no sample Cr+6 results required qualification due to any differences in the duplicate analyses.

Laboratory Control Samples (QC Limits 80-120% Recovery)

The Cr+6 analyte recovery in the laboratory control sample WG1532581-2 (also referred to as the blank spike) was within the specified QC limits demonstrating acceptable analytical system performance, with a blank spike recovery of 99% for the QC batch associated with the two GW samples and one field blank for the Cr+6 analysis. Thus, acceptable analytical system performance was demonstrated.

No sample Cr+6 results required qualification due to any LCS recovery issues.

Results of Sample Analyses

All calibration criteria were met for the groundwater samples of this SDG and the samples were analyzed within the specified holding time of 24 hours from aqueous sample collection. This included initial calibration linearity (r = 0.999711), with initial and continuing calibration frequency and accuracy (99% ICV and CCV Recoveries). The method blank and calibration blank were free of detectable Cr+6 concentrations. The blank spike recovery (99%) demonstrated that the analytical system was performing accurately. The reported MS recoveries (88% and 85%) and duplicate precision result (< ± RL) from a PPG batch QC sample results were verified from the raw data with no observed discrepancies in the reported data. The QC results demonstrated that the analyses were conducted with acceptable accuracy and analytical precision.

Summary for Hexavalent Chromium Analysis – L2142416

Since the MS/MSD recoveries were within QC limits specified in DV guidelines, as were all other QC results associated with the hexavalent chromium analysis, including the field blank sample analysis, no Cr+6 results were subject to qualification for QC issues following the DV review.

3.0 DATA QUALIFIER DEFINITIONS

The absence of qualifiers indicates that the data are acceptable both qualitatively and quantitatively.

Qualifier	Definition
U	The analyte was analyzed, but was not detected at the stated reporting limit.

4.0 References

APHA, AWWA, and WEF, 1995, ***Standard Methods for the Examination of Water and Wastewater, 19th Edition,*** Washington, D.C., 1268 p.

New Jersey Department of Environmental Protection, 2014a, ***Data of Known Quality Protocols Technical Guidance***, Version 1.0, Trenton, New Jersey, April 2014.

New Jersey Department of Environmental Protection, 2014b, ***Data Quality Assessment and Data Usability Evaluation Technical Guidance,*** Version 1.0, Trenton, New Jersey, April 2014.

New Jersey Department of Environmental Protection, 2014c, ***Analytical Laboratory Data Generation, Assessment and Usability Technical Guidance,*** Version 1.0, Trenton, New Jersey, April 2014.

New Jersey Department of Environmental Protection, 2014d, ***Quality Assurance Project Plan Technical Guidance,*** Version 1.0, Trenton, New Jersey, April 2014.

New Jersey Department of Environmental Protection, 2012, ***Technical Requirements for Site Remediation, N.J.A.C. 7:26E***, Trenton, New Jersey, May 7, 2012.

New Jersey Department of Environmental Protection, 2009, ***Standard Operating Procedure (SOP) for Analytical Data Validation of Hexavalent Chromium, SOP No.: 5.A.10,*** Trenton, New Jersey, September 2009.

New Jersey Department of Environmental Protection, 2002, ***Standard Operating Procedure: Quality Assurance Data Validation of Analytical Deliverables Inorganics (Based on US EPA SW-846 Methods), SOP No. 5.A.16***, Trenton, New Jersey.

New Jersey Department of Environmental Protection, 2001, ***Standard Operating Procedure for the Analytical Data Validation of Target Analyte List - Inorganics BEMQA 5.A.2, Revision 4,*** Trenton, New Jersey.

US EPA, CLP, 2017, ***"National Functional Guidelines for Inorganic Superfund Methods Data Review"***, OLEM Publication 9355.0-135, EPA540-R-2017-001, January 2017.

US EPA, Region 2, 2015, ***"ICP-MS Data Validation SOP No. HW-3b Revision 0 ISM 02.2"***, July 2015.

US EPA, 1997, ***Test Methods for Evaluating Solid Wastes, 3rd Edition including Final Update III***, Office of Solid Waste and Emergency Response, Washington, D.C., June 1997.

ATTACHMENT A

Data Validation Checklist

DATA QUALITY ASSURANCE/QUALITY CONTROL CHECKLIST

Project: PPG **SDGs:** L2142416/L2142417

1. Were the appropriate sample preservation requirements met?................ [✓ Yes] No

2. Were appropriate sample holding times
(for both extraction/sample preparation and analysis) met? .... [✓ Yes] No
If "No", provide a brief explanation.

3. Were the samples diluted? .... Yes [✓ No]
Indicate the identity of the samples and why.

4. If applicable, did sample dilutions result in elevated reporting limits that exceed applicable
standards?... Yes [✓ No]
If "Yes", list the affected samples.

5. Were any applicable standards exceeded for any samples? .... [✓ Yes] No
If "Yes", include the number of samples and laboratory sample ID numbers.

The antimony and chromium results in Sample L2142417-01 were above the respective NJ Groundwater Quality Standards of 6 µg/L and 70 µg/L.

6. Were the laboratory reporting limits below the applicable remediation standards/criteria required for
the site?... [✓ Yes] No
If "No", provide a brief explanation of action taken.

7. Were qualifications noted in the non-conformance summary?................ Yes [✓ No]
Provide a brief explanation.

All routine QC requirements were met for both the metals and Cr+6 analyses. No problems with analytical procedures were noted.

8. Were qualified data used?.. [✓ Yes] No

9. Were rejections noted in the non-conformance summary?..................... Yes [✓ No]
Provide a brief explanation.

Not applicable

10. Were rejected data used?.. Yes [✓ No]
If "yes", please indicate reasons rejected data were used:
○ For Hex Chrome, data were rejected because spike recovery was <50%.
○ Data were rejected due to missing deliverables.
○ Data were rejected but an applicable standard exceedance exists.
○ Data were rejected in an early phase of remediation; however, additional sampling and analysis are scheduled to be performed.
○ Other reasons not noted directly above. Explain:

11. Were the quality control criteria associated with the compounds of concern at the site met? .... [✓ Yes] No
12. Were the QC Summary Forms reviewed?.. [✓ Yes] No
13. Internal Standards acceptable.. [✓ Yes] No
14. MS/MSD acceptable.. [✓ Yes] No
15. Calibration summaries acceptable.. [✓ Yes] No
16. Serial dilutions acceptable.. [✓ Yes] No
17. Inorganic duplicates acceptable.. [✓ Yes] No
18. LCS recovery acceptable... [✓ Yes] No
19. Other QC acceptable?... [✓ Yes] No
Provide a brief explanation, if applicable.

All QC requirements were achieved in both the metals and Cr+6 analyses. Refer to DV report table 2 for QC details. The negated result for thallium in sample L2142417-03 is reported in Table 2 and Table 3. No other sample results were qualified.

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DATA VALIDATION REPORT

Project: **Jersey City PPG, Site 63/65; Report SDG L2142529/L2142530**
Sample Date: **August 9, 2021**
Analyses: **Metals Analysis, EPA Method 6020B**
Hexavalent Chromium Analysis, EPA Method 7196A
pH, EPA Method SM4500H+ B-11
Reviewer: **Janis V. Giga, Ph.D., REP5554**
Date: **August 23, 2021**

This data validation (DV) report presents the data review and result qualifications for two (2) groundwater (GW) samples collected at the Jersey City PPG Site 63/65 at 1 Burma Road, Jersey City, New Jersey on August 9, 2021 for sample delivery group (SDG) L2142529, as well as L2142530. The groundwater samples were analyzed for the analytes listed above employing the identified analytical methods by Alpha Analytical laboratory of Westborough, Massachusetts.

Summary of Sample Results Qualifications

The groundwater sample results for the samples of SDG L2142529 were found to be compliant with the analytical method (SW-846 Method 6020B) for the analysis of metals and L2142530 for the analysis of hexavalent chromium (Cr+6) (Method 7196A) in the two collected groundwater samples.

All routine quality control (QC) criteria were met for each of the inductively coupled plasma/mass spectrometer (ICP/MS) target analyte analyses.

Following the detailed DV review, no sample metals results were qualified:

No hexavalent chromium results for the two reported GW samples in this SDG have been qualified, and are usable as reported, because all QC results were within method QC limits.

The chromium results in samples L2142529-01 and L2142529-02 were detected above the New Jersey Groundwater Quality Standards (NJGWQS). No other target analytes were detected in any of the groundwater samples above the associated action levels.

A data validation checklist is provided in Attachment A to summarize the observations during the DV review.

Sample Receipt

The two (2) groundwater samples collected August 9, 2021 were received at the Alpha Analytical laboratory August 10, 2021, with an acceptable maximum corrected sampling cooler temperature of 5.8 degrees Celsius (ºC). The GW samples identification numbers and corresponding laboratory identification numbers are as follows:

Table 1. Sample Receipt Summary

Client Sample Designation	Sample Lab ID Number	Date Collected	Matrix	Analyses
MW-301	L2142529-01	8/9/2021	Aqueous	Metals
DUP	L2142529-02	8/9/2021	Aqueous	Metals
MW-301	L2142530-01	8/9/2021	Aqueous	Cr+6
DUP	L2142530-02	8/9/2021	Aqueous	Cr+6
Metals – Antimony, chromium, nickel, thallium and vanadium analyzed by SW-846 Method 6020B. Cr+6 – Hexavalent chromium analyzed by SW-846 Method 7196A together with pH.				

The data package presenting the metals analysis data is numbered L2142529, while the hexavalent chromium and ancillary pH analysis data are contained in SDG L2142530.

Data Review

Data, as presented in the analytical data package SDG L2142529 and L2142530, were primarily reviewed and validated using the following combination of method-specific criteria with professional judgement, as appropriate:

- New Jersey Department of Environmental Protection (NJDEP) *Standard Operating Procedure: Quality Assurance Data Validation of Analytical Deliverables Inorganics (Based on US EPA SW-846 Methods), SOP No. 5.A.16* (NJDEP, 2002).
- United States (US) Environmental Protection Agency (EPA) *"National Functional Guidelines for Inorganic Superfund Methods Data Review"*, OLEM Publication 9355.0-135, EPA540-R-2017-001, January 2017 (US EPA, 2017).
- US EPA *"ICP-AES Data Validation, SOP No. HW-3a, Revision 0, ISM 0.2.2"* (US EPA, 2015).
- NJDEP, 2009, *Standard Operating Procedure (SOP) for Analytical Data Validation of Hexavalent Chromium* (NJDEP, 2009).
- NJDEP, 2014a, *Data of Known Quality Protocols Technical Guidance*, Version 1.0, April 2014.
- NJDEP, 2014b, *Data Quality Assessment and Data Usability Evaluation Technical Guidance*, Version 1.0, April 2014.
- NJDEP, 2014c, *Analytical Laboratory Data Generation, Assessment and Usability Technical Guidance*, Version 1.0, April 2014.
- NJDEP, 2014d, *Quality Assurance Project Plan Technical Guidance*, Version 1.0, April 2014.

Data associated with parameters that do not meet quality control specifications or compliance requirements are subject to qualification in accordance with US EPA Region II/NJDEP specifications/guidelines, as appropriate. No sample results were qualified following the DV review.

The analysis of the identified samples was performed in compliance with the requirements specified in the respective analytical methods. The data is presented in a NJDEP "reduced deliverables" package and is considered complete, as defined by the NJDEP "Technical Regulations for Site Remediation" (NJDEP, 2012). However, it is emphasized that due to the absence of raw metals data and the associated preparation logs, the substantiation of the reported metals concentrations and the accuracy of the QC summary results is precluded. The data package was complete for the hexavalent chromium analysis and the Cr+6 and associated QC results were substantiated during the DV review. The information presented in the data summary and quality control (QC) forms was reviewed and used to assess whether the sample results required qualification. The quality of data collected in support of this sampling activity is considered acceptable with the noted results qualifications, considering the limitations attributable to a reduced deliverables data package. The information presented in the data summary and quality control (QC) forms was reviewed and used to qualify sample results. The quality of data collected in support of this sampling activity is considered acceptable and are fully usable unqualified.

The discussion below presents the findings of the data validation review organized according to the technical areas used to evaluate inorganic analytical data. For each of these analytical topics, the information on the summary forms, as well as the raw data available and supporting information for the samples or standards analyzed were reviewed during the DV effort.

1.0 Metals Analysis Data Review

The discussion below presents the findings of the data validation review for the eleven technical areas used to evaluate inorganic analytical data. For each of these analytical topics, the information on the summary forms and available data for each sample or standard analyzed was reviewed during the DV effort.

The data validation of the analytical data was reviewed for the following data quality items and a check mark (√) indicates successful achievement of meeting the relevant QC requirements.

√ Holding times
√ Blank Analysis
√ Calibration standards
√ Calibration verification
√ Data package completeness
√ Data qualifiers
NA Matrix spike recoveries
NA Duplicate analysis
√ Laboratory control samples
√ Interference Check Samples
√ Field duplicate sample analysis

The two GW samples were analyzed for five target EPA Method 6020B metals. Chromium was detected in groundwater samples L2142529-01 and L2142529-02 above the New Jersey Groundwater Quality Standard. Data for a matrix spike or duplicate analysis were not provided in the data package (NA – not available).

Laboratory Case Narrative

The case narrative stated that all non-detect (ND) or estimated concentrations (J-qualified) have been quantitated to the limit noted in the MDL column. Samples L2142529-01 and 2142529-02 were received above the appropriate pH for the Total metals analysis [pH = 4]. The laboratory added additional HNO_3 to a pH < 2. The samples had elevated detection limits due to the dilution required by the sample matrix.

No other quality control or non-compliance issues for the metals analysis were identified in the case narrative.

Holding Times (QC Limit 6 months)

The six-month analytical holding time was met for all ICP samples.

Calibration Standards (QC Limits 90-110% Recovery)

The QC calibration requirements were met by the initial and continuing calibration verification (CCV) standards employed, with target analyte recoveries all within the respective required QC limits, thereby demonstrating linearity for the groundwater sample analyses and acceptable analyte quantitation (concentration determination).

Hence, no sample results required qualifications for initial or continuing calibration issues.

Low Calibration Check Standard (QC Limit 70-130% Recovery)
A "low calibration check standard", which is similar to and may also be referred to as a contract required detection limit (CRDL) standard was not reported. The analysis of a CRDL standard is not required under Method 6020B. Additionally, there is no NJDEP DV guidance for qualifying inorganic sample results for CRDL standard analysis (NJDEP, 2002).

Thus, no groundwater sample results were qualified for any calibration check issues.

Quality Control Blanks (QC Limit < CRDL or < Reporting Limit [RL])
There were no target metals concentrations detected in the preparation blank or continuing calibration blanks at the stated reporting limits in SDG L2142529, except for thallium detected in each calibration blank with concentrations ranging from 0.269 J to 0.593 J µg/L, including the initial calibration blank.

Since thallium was not detected in either groundwater sample, no groundwater sample results warranted qualification for any associated QC blank contamination in SDG L2142529.

ICP Interference Check Samples (QC Limits 80-120% Recovery)
Detected concentrations for antimony, chromium, nickel, thallium and vanadium were reported for the ICSA standard, but without percent recovery values, although results for ICSA typically are evaluated for only aluminum, calcium, iron, and magnesium. No results were qualified for the interference check sample results.

Matrix Spike/Matrix Spike Duplicate (MS/MSD) Analysis
(QC Limits 75-125% Recovery; ≤ 20%RPD)

No matrix spike or matrix spike duplicate recoveries were reported for this SDG, apparently because neither PPG sample was spiked as the batch QC sample.

No groundwater sample results could be qualified for matrix spike recovery issues.

Duplicate Analysis (QC Limit ≤ 20 %RPD)
Data for a duplicate analysis was not provided in the data package, presumably because a PPG sample had not been used as the batch QC sample.

No groundwater sample results could be qualified for duplicate analysis issues.

Laboratory Control Samples (QC Limits 80-120% Recovery)
All analyte recoveries in the laboratory control samples (also referred to as the blank spike) were within the specified QC limits demonstrating acceptable analytical system performance, with blank spike recoveries ranging from 85% - 102% for the QC batch associated with the two GW samples for the metals analysis. Thus, acceptable analytical system performance was demonstrated.

Field Duplicate Sample Analysis (QC Limit ≤ 20%RPD)
One set of field duplicate samples was collected for the GW samples as part of SDG L2142529. Field duplicate sample collection and analysis can provide a determination of sampling representativeness and precision. Gross differences between field sample duplicates can be an indication of inconsistent sampling techniques or sample matrix complexities/non-homogeneity.

An advisory data validation guideline for field duplicate aqueous samples suggests QC limits of 20%RPD or the absolute difference value of the CRQL (reporting limit) for sample results less than five times the CRQL (US EPA Region 2, 2015).

The results for the analysis of the one pair of field duplicate GW samples are presented in Table 2, below. It is apparent that the results for the GW metals analytes in the field duplicate samples of MW-301 were quite similar, with RPD values less than 5%, along with antimony and thallium results as non-detect concentrations. Hence, the results for the field duplicate samples MW-301 and DUP are acceptable and do not warrant qualification, as indicated in Table 2.

Table 2. Comparison of Field Duplicate GW Sample Metals Results – SDG L2142529

Analyte	**MW-301 (µg/L)**	**DUP (µg/L)**	**% RPD**	**DV Flag**
Antimony	< 20.0	< 20.0	< CRQL	-
Chromium	264.4	257.2	2.8 %	-
Nickel	15.43	15.72	1.9 %	-
Thallium	< 5.0	< 5.0	< CRQL	-
Vanadium	299	285.7	4.5%	-

QC Limit is ≤ 20 %RPD for aqueous samples, or < CRQL (for concentrations < 5 × CRQL);
< – The analyte was not detected at the stated reporting limit;
CRQL – The value representing the US EPA CLP contract required quantitation limit, often represented by the reporting limit;
< CRQL – The difference between field duplicate results was less than the CRQL and meets QC requirements.

Thus, the metals results for the field duplicate samples from MW-301 demonstrated very good sampling representativeness and precision, with field duplicate GW sample results differing by less than 5%RPD. No GW sample results were qualified for sampling representativeness issues.

Serial Dilution Analysis (QC Limit ≤ 20 %D for Method 6020B)

Data for a serial dilution analysis was not provided in the data package, presumably because a PPG sample had not been used as the batch QC sample.

No groundwater sample results could be qualified for serial dilution issues.

Quantification Verification

Metals concentrations reported on the Report of Analysis (Form 1) sheets for the GW samples could not be verified because the data was provided in a NJDEP “Reduced deliverables” format (NJDEP, 2012), omitting the quantitation reports and preparation logs from the raw data.

Reporting Limits

The two groundwater samples in SDG L2142529 were each diluted by a factor of 5. However, the reporting limits for antimony and thallium in Samples L2142529-01 and L2142529-02 were raised to values of < 20 and < 5.0 µg/L, respectively, values above the respective NJ Groundwater Quality Standards of 6 and 2 µg/L, as detailed below in Table 3, due to a difficult sample matrix.

Table 3. Sample Reporting Limits Affected by Sample Dilution or Sample Matrix

Sample ID	**Lab ID**	**Analyte**	**Reporting Limit (µg/L)**	**Dilution Factor**	**Adjusted Result**	**NJ GWQS (µg/L)**
MW-301	L2142529-01	Antimony	4	5	< 20	6
MW-301	L2142529-01	Thallium	1	5	< 5	2
DUP	L2142529-02	Antimony	4	5	< 20	6

DUP	L2142529-02	Thallium	1	2	< 5	2
Units – µg/L < – The analyte was analyzed for, but was not detected above the stated reporting limit.						

The interpretation of the reporting limits for antimony and thallium in samples L2142529-01 (MW-301) and L2142529-02 (DUP) were not compromised by the elevated reporting limits, because the respective detected chromium concentrations of 264.4 µg/L and 257.2 µg/L in the samples had exceeded the NJGWQS of 70 µg/L. Consequently, this groundwater sampling location would be, thus, potentially subject to some sort of response action or further evaluation.

Metals Analysis Summary – L2142529

The groundwater sample analytical results for the samples of SDG L2142529 were found to be compliant with the analytical methods for the analysis of metals in the two groundwater samples using SW-846 Method 6020B. All QC criteria provided were met for the ICP target metals analyses.

No groundwater sample target metals results were qualified for any associated QC issues.

2.0 Hexavalent Chromium Analysis Data Review

The analysis for hexavalent chromium (Cr+6) was performed using Method 7196A for aqueous groundwater sample analysis.

The data validation of the analytical data was reviewed for the following data quality items and a check mark (√) indicates successful achievement of meeting the relevant QC requirements.

- √ Holding times
- √ Blank Analysis
- √ Calibration standards
- √ Calibration verification
- √ Data qualifiers
- √ Data package completeness
- √ Matrix spike recoveries
- √ Duplicate analysis
- √ Laboratory control samples
- √ Quantitation checks
- √ Field duplicate sample analysis

A hexavalent chromium concentration was detected in one of the two groundwater samples with a result of 5.0 J µg/L.

Laboratory Case Narrative

The case narrative stated that all non-detect (ND) or estimated concentrations (J-qualified) have been quantitated to the limit noted in the MDL column. Sample 2142530-02 had an elevated detection limit due to the dilution required by the sample matrix. The MS recovery for WG1533299-4, performed on L2142530-02 (DUP) is outside the acceptance criteria for chromium, hexavalent (84%); however, the associated LCS is within criteria. No further action was taken.

No other quality control or non-compliance issues for the Cr+6 analysis were identified in the case narrative.

Matrix Spike (MS) Analysis
(QC Limits: 75-125% Recovery)

Although the case narrative identified the MS recovery of 84% as being outside the acceptance criteria (identified in the data package as 85-115%), the matrix spike recovery was within the 75-125% DV QC limits for Cr+6 specified in the DV guidelines (NJDEP, 2009), thereby demonstrating acceptable analytical accuracy. Hence, the matrix spike recovery in QC batch sample WG1533299-4 for sample L2142530-02 (DUP) was an acceptable 84%.

No sample results required qualification for matrix spike recovery issues.

Duplicate Analysis (QC Limit: ≤ 20 %RPD)
The duplicate analysis was performed on one set of duplicate groundwater samples. The %RPD value for duplicate samples in the QC batch was reported as ‘NC’. The term NC indicates “Not calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter’s reporting unit”.

In the evaluation of the raw data, it was observed that the difference between the 5 J µg/L result for Cr+6 in Sample L2142530-01 (MW-301) and the Cr+6 result reported as ND for WG1533299-3 (MW-301 DUP) was not calculated (reported as NC) as indicated in Table 4. However, the actual value for the ND result in WG1533299-3 was a non-detect result of 10 U µg/L.

Table 4. Comparison of GW Sample Duplicate Results – L2142530

Analyte	MW-301 (µg/L)	MW-301 DUP (µg/L)	% RPD	DV Flag
Hexavalent Chromium	5 J	ND	NC	----

Key:
J – The result is an estimated value;
NC – Not calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter’s reporting unit;
ND – The analyte was analyzed, but was not detected at the stated reporting limit.

Hence, since the measured difference between MW-301 and it’s analytical duplicate WG1533299-3 was, by definition, less than the reporting limit of 10 µg/L, the associated Cr+6 sample results are not subject to qualification because the analytical duplicate results meet the alternate QC limit of ± RL when either of the sample results are less than four times the reporting limit (NJDEP, 2009).

Hence, no sample Cr+6 results required qualification due to any differences in the duplicate analyses.

Laboratory Control Samples (QC Limits 80-120% Recovery)
The Cr+6 analyte recovery in the laboratory control sample (also referred to as the blank spike) was within the specified QC limits demonstrating acceptable analytical system performance, with a blank spike recovery of 98% for the QC batch associated with the two GW samples for the Cr+6 analysis. Thus, acceptable analytical system performance was demonstrated.

Field Duplicate Sample Analysis (QC Limit ≤ 20%RPD)
The Cr+6 results for one set of field duplicate samples collected from sample location MW-301 as part of the sampling representativeness evaluation for this SDG are presented in Table 5.

Table 5. Comparison of Field Duplicate GW Sample Results – L2142530

Analyte	MW-301 (µg/L)	DUP (µg/L)	% RPD	DV Flag
Hexavalent Chromium	5 J	ND	NC	----
Key: J – The result is an estimated value; NC – Not calculated: Term is utilized when one or more of the results utilized in the calculation are non-detect at the parameter's reporting unit; ND – The analyte was analyzed, but was not detected at the stated reporting limit.				

The difference between the 5 J µg/L result for Cr+6 in Sample L2142530-01 (MW-301) and the field duplicate sample result reported as ND for L2142530-02 (DUP) was not calculated (reported as NC) as indicated in Table 5. However, the value for the ND result in L2142530-02 (DUP) was listed as a non-detect result of 50 U µg/L for a 5-fold dilution due to matrix effects.

In the inspection of the raw data, it was observed that the raw measurement for MW-301 following adjustment for background absorbance was 0.005 mg/L and the field duplicate (DUP) value was 0.001 mg/L. Thus, after adjusting for the dilution factor of five, the Cr+6 value for the non-detect result reported as 50 U µg/L was 0.005 mg/L, a value equal to the Cr+6 result for MW-301 reported as 5 J µg/L. Hence, professional judgement was applied in justifying the decision to not qualify the field duplicate sample results despite the apparent disparity in reported results.

No sample Cr+6 results need be qualified for field duplicate sample results disparities, thereby suggesting acceptable sampling representativeness and precision, as the Cr+6 results were similar adjusted measurements below the reporting limit of 10 U µg/L.

Results of Sample Analyses

All calibration criteria were met for the groundwater samples of this SDG and the samples were analyzed within the specified holding time of 24 hours from aqueous sample collection. This included initial calibration linearity (r = 0.999990), with initial and continuing calibration frequency and accuracy (98% ICV and CCV Recoveries). The method blank and calibration blank were free of detectable Cr+6 concentrations. The blank spike recovery (98%) demonstrated that the analytical system was performing accurately. The reported MS recovery (84%) and duplicate precision result (< ± RL) from a PPG batch QC sample results were verified from the raw data with no observed discrepancies in the reported data. The QC results demonstrated that the analyses were conducted with acceptable accuracy and analytical precision.

Summary for Hexavalent Chromium Analysis – L2142530

Since the MS recovery was within QC limits specified in DV guidelines, as were all other QC results associated with the hexavalent chromium analysis, including the field duplicate sample analysis, no Cr+6 results were subject to qualification for QC issues following the DV review.

3.0 DATA QUALIFIER DEFINITIONS

The absence of qualifiers indicates that the data are acceptable both qualitatively and quantitatively.

Qualifier	**Definition**
J	The reported result is an estimated value.
<	The analyte was analyzed, but was not detected at the stated reporting limit.

4.0 References

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New Jersey Department of Environmental Protection, 2002, ***Standard Operating Procedure: Quality Assurance Data Validation of Analytical Deliverables Inorganics (Based on US EPA SW-846 Methods), SOP No. 5.A.16***, Trenton, New Jersey.

New Jersey Department of Environmental Protection, 2001, ***Standard Operating Procedure for the Analytical Data Validation of Target Analyte List - Inorganics BEMQA 5.A.2, Revision 4,*** Trenton, New Jersey.

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US EPA, Region 2, 2015, ***"ICP-MS Data Validation SOP No. HW-3b Revision 0 ISM 02.2"***, July 2015.

US EPA, 1997, ***Test Methods for Evaluating Solid Wastes, 3rd Edition including Final Update III***, Office of Solid Waste and Emergency Response, Washington, D.C., June 1997.

ATTACHMENT A

Data Validation Checklist

DATA QUALITY ASSURANCE/QUALITY CONTROL CHECKLIST

Project: PPG SDGs: L2142529/L2142530

1. Were the appropriate sample preservation requirements met?................ [✓ Yes] No

2. Were appropriate sample holding times
   (for both extraction/sample preparation and analysis) met? .... [✓ Yes] No
   If "No", provide a brief explanation.

3. Were the samples diluted? .... [✓ Yes] No
   Indicate the identity of the samples and why.

   Samples L2142529-01 and -02 were diluted by 5x in the metals analysis. Sample L2142530-02 was diluted 5x in the Cr+6 analysis.

4. If applicable, did sample dilutions result in elevated reporting limits that exceed applicable standards?.. [✓ Yes] No
   If "Yes", list the affected samples.

   The reporting limits for antimony and thallium in Samples L2142529-01 and -02 were above the respective NJ Groundwater Quality Standards of 6 µg/L and 2 µg/L.

5. Were any applicable standards exceeded for any samples? .... [✓ Yes] No
   If "Yes", include the number of samples and laboratory sample ID numbers.

   The chromium results in Samples L2142529-01 and -02 were above the respective NJ Groundwater Quality Standard of 70 µg/L.

6. Were the laboratory reporting limits below the applicable remediation standards/criteria required for the site?.. [✓ Yes] No
   If "No", provide a brief explanation of action taken.

7. Were qualifications noted in the non-conformance summary?................ Yes [✓ No]
   Provide a brief explanation.

All routine QC requirements were met for both the metals and Cr+6 analyses. No problems with analytical procedures were noted.

8. Were qualified data used?.. Yes [✓ No]

9. Were rejections noted in the non-conformance summary?..................... Yes [✓ No]
   Provide a brief explanation.

Not applicable

10. Were rejected data used?.. Yes [✓ No]
    If "yes", please indicate reasons rejected data were used:
    O For Hex Chrome, data were rejected because spike recovery was <50%.
    O Data were rejected due to missing deliverables.
    O Data were rejected but an applicable standard exceedance exists.
    O Data were rejected in an early phase of remediation; however, additional sampling and analysis are scheduled to be performed.
    O Other reasons not noted directly above. Explain:

11. Were the quality control criteria associated with the compounds of concern at the site met? .... [✓ Yes] No
12. Were the QC Summary Forms reviewed?.. [✓ Yes] No
13. Internal Standards acceptable.. [✓ Yes] No
14. MS/MSD acceptable.. [✓ Yes] No
15. Calibration summaries acceptable... [✓ Yes] No
16. Serial dilutions acceptable... [✓ Yes] No
17. Inorganic duplicates acceptable.. [✓ Yes] No
18. LCS recovery acceptable.. [✓ Yes] No
19. Other QC acceptable?.. [✓ Yes] No
    Provide a brief explanation, if applicable.

All QC requirements were achieved in both the metals and Cr+6 analyses. Refer to DV report tables 2, 4, and 5 for QC details. No sample results were qualified.