Data Validation Report
Remedial Investigation at RVAAP-66 Facility Wide Groundwater
Semi-Annual & Quarterly Sampling Event for June 2018

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

Contract Number: W9133L-14-D-0008

Task Order Number: 0003

Laboratory SDG 240-97364-1

Prepared For:

National Guard Bureau

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Prepared By:

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CONTRACTOR STATEMENT OF INDEPENDENT TECHNICAL REVIEW

TEC-WESTON Joint Venture has completed this Data Validation Report. Data validation was performed by the Validation Chemist and Secondary QC Review was performed by a Senior Chemist. Signatures indicate the report is approved for release.

Travis Withers, Validation Chemist, TEC-WESTON JV Date

Peter Chapman, Senior Chemist, TEC-WESTON JV 7/10/18
Date

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INTRODUCTION

This report summarizes the results of the **EPA Stage 2B** data validation performed on groundwater samples and quality control (QC) sample data for the Remedial Investigation for RVAAP-66, Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio. Results are reported in laboratory sample delivery group (SDG) **240-97364-1**.

TestAmerica, Inc., Canton, Ohio performed the analyses listed in the table below:

Parameters	Analytical Method	Laboratory Location
Hexavalent Chromium	7196A	Canton, OH

TestAmerica Canton does not hold DoD accreditation for hexavalent chromium analysis; therefore, method EPA SW-846 Method 7196A is reported.

The data were reviewed using guidance and quality control criteria documented in the *Draft Remedial Investigation Work Plan for Groundwater and Environmental Services for RVAAP-66 Facility-Wide Groundwater, Appendix A: Sampling Analysis Plan, A.2: Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio Attachment A Data Validation Evaluation Sheets (January 2016)* which are based on the *Department of Defense Quality Systems Manual (DoD QSM), Version 5.0*; *USEPA National Functional Guidelines for Organic Data Review* (*EPA 2014*); and *USEPA National Functional Guidelines for Inorganic Data Review* (*EPA 2014*), the analytical methods, and professional judgment.

During data validation, qualifiers are assigned to assist in proper data interpretation. If values are estimated, data may be used for site evaluation purposes but reasons for data qualification should be taken into consideration when interpreting sample concentrations. Data that have been rejected (R) should not be used for any purpose. Results with no qualifiers meet all data quality goals as outlined in the UFP-QAPP.

The following samples were validated:

Sample ID	Laboratory ID	Sample Date	Matrix	QC Sample	Hexavalent Chromium
CBLmw-001-062018-GW	240-97364-1	06/20/2018	Groundwater		✓
CBLmw-001-D-062018-GW	240-97364-2	06/20/2018	Groundwater	Field Duplicate	✓
CBLmw-002-062018-GW	240-97364-3	06/20/2018	Groundwater		✓

DATA VALIDATION REPORT

1.1 DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative. All requested target analytes were reported for each sample.

1.2 SAMPLE RECEIPT

The samples were received by the laboratory on June 21, 2018; the samples were received in good condition, under chain-of-custody, and custody seals intact. Samples were properly preserved and cooler temperatures were less than 6°C.

1.3 TECHNICAL DATA VALIDATION

1.3.1 Hexavalent Chromium by Method 7196A

The following parameters were evaluated and met the required criteria. No validation flags were assigned based on the following:

- Holding times
- LODs and LOQs
- LCS recoveries
- Method blank
- Initial calibration verification
- Continuing calibration verification
- Initial calibration blank
- Continuing calibration blank
- Field duplicate

No analytical or quality parameters requiring further discussion were identified for Method 7196A.

No qualifications were made in this SDG.

Data Validation Report
Remedial Investigation at RVAAP-66 Facility Wide Groundwater
Semi-Annual & Quarterly Sampling Event for June 2018

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

Contract Number: W9133L-14-D-0008

Task Order Number: 0003

Laboratory SDG 240-97441-1

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CONTRACTOR STATEMENT OF INDEPENDENT TECHNICAL REVIEW

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Travis Withers, Validation Chemist, TEC-WESTON JV Date

Peter Chapman, Senior Chemist, TEC-WESTON JV 7/10/18
Date

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INTRODUCTION

This report summarizes the results of the **EPA Stage 2B** data validation performed on groundwater samples and quality control (QC) sample data for the Remedial Investigation for RVAAP-66, Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio. Results are reported in laboratory sample delivery group (SDG) **240-97441-1**.

TestAmerica, Inc., Canton, Ohio performed the analyses listed in the table below:

Parameters	Analytical Method	Laboratory Location
Hexavalent Chromium	7196A	Canton, OH

TestAmerica Canton does not hold DoD accreditation for hexavalent chromium analysis; therefore, method EPA SW-846 Method 7196A is reported.

The data were reviewed using guidance and quality control criteria documented in the *Draft Remedial Investigation Work Plan for Groundwater and Environmental Services for RVAAP-66 Facility-Wide Groundwater, Appendix A: Sampling Analysis Plan, A.2: Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio Attachment A Data Validation Evaluation Sheets (January 2016)* which are based on the *Department of Defense Quality Systems Manual (DoD QSM), Version 5.0*; *USEPA National Functional Guidelines for Organic Data Review* (*EPA 2014*); and *USEPA National Functional Guidelines for Inorganic Data Review* (*EPA 2014*), the analytical methods, and professional judgment.

During data validation, qualifiers are assigned to assist in proper data interpretation. If values are estimated, data may be used for site evaluation purposes but reasons for data qualification should be taken into consideration when interpreting sample concentrations. Data that have been rejected (R) should not be used for any purpose. Results with no qualifiers meet all data quality goals as outlined in the UFP-QAPP.

The following samples were validated:

Sample ID	Laboratory ID	Sample Date	Matrix	QC Sample	Hexavalent Chromium
FWGmw-024-062118-GW	240-97441-1	06/21/2018	Groundwater		✓
FWGmw-017-062118-GW	240-97441-2	06/21/2018	Groundwater		✓
FWGmw-021-062118-GW	240-97441-3	06/21/2018	Groundwater		✓
FWGmw-020-062118-GW	240-97441-4	06/21/2018	Groundwater		✓
FWGmw-018-062118-GW	240-97441-5	06/21/2018	Groundwater		✓
CBLmw-003-062118-GW	240-97441-6	06/21/2018	Groundwater		✓
CBLmw-004-062118-GW	240-97441-7	06/21/2018	Groundwater		✓

DATA VALIDATION REPORT

1.1 DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative. All requested target analytes were reported for each sample.

1.2 SAMPLE RECEIPT

The samples were received by the laboratory on June 21, 2018; the samples were received in good condition, under chain-of-custody, and custody seals intact. Samples were properly preserved and cooler temperatures were less than 6°C.

1.3 TECHNICAL DATA VALIDATION

1.3.1 Hexavalent Chromium by Method 7196A

The following parameters were evaluated and met the required criteria. No validation flags were assigned based on the following:

- Holding times
- LODs and LOQs
- LCS recoveries
- Method blank
- Initial calibration verification
- Continuing calibration verification
- Initial calibration blank
- Continuing calibration blank

No analytical or quality parameters requiring further discussion were identified for Method 7196A.

No qualifications were made in this SDG.

Data Validation Report
Remedial Investigation at RVAAP-66 Facility Wide Groundwater
Semi-Annual & Quarterly Sampling Event for June 2018

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

Contract Number: W9133L-14-D-0008

Task Order Number: 0003

Laboratory SDG 240-97629-1

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CONTRACTOR STATEMENT OF INDEPENDENT TECHNICAL REVIEW

TEC-WESTON Joint Venture has completed this Data Validation Report. Data validation was performed by the Validation Chemist and Secondary QC Review was performed by a Senior Chemist. Signatures indicate the report is approved for release.

Travis Withers, Validation Chemist, TEC-WESTON JV Date

Peter Chapman, Senior Chemist, TEC-WESTON JV 7/10/18
Date

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INTRODUCTION

This report summarizes the results of the **EPA Stage 2B** data validation performed on groundwater samples and quality control (QC) sample data for the Remedial Investigation for RVAAP-66, Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio. Results are reported in laboratory sample delivery group (SDG) **240-97629-1**.

TestAmerica, Inc., Canton, Ohio performed the analyses listed in the table below:

Parameters	Analytical Method	Laboratory Location
Hexavalent Chromium	7196A	Canton, OH

TestAmerica Canton does not hold DoD accreditation for hexavalent chromium analysis; therefore, method EPA SW-846 Method 7196A is reported.

The data were reviewed using guidance and quality control criteria documented in the *Draft Remedial Investigation Work Plan for Groundwater and Environmental Services for RVAAP-66 Facility-Wide Groundwater, Appendix A: Sampling Analysis Plan, A.2: Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio Attachment A Data Validation Evaluation Sheets (January 2016)* which are based on the *Department of Defense Quality Systems Manual (DoD QSM), Version 5.0*; *USEPA National Functional Guidelines for Organic Data Review* (*EPA 2014*); and *USEPA National Functional Guidelines for Inorganic Data Review* (*EPA 2014*), the analytical methods, and professional judgment.

During data validation, qualifiers are assigned to assist in proper data interpretation. If values are estimated, data may be used for site evaluation purposes but reasons for data qualification should be taken into consideration when interpreting sample concentrations. Data that have been rejected (R) should not be used for any purpose. Results with no qualifiers meet all data quality goals as outlined in the UFP-QAPP.

The following samples were validated:

Sample ID	Laboratory ID	Sample Date	Matrix	QC Sample	Hexavalent Chromium
FBQmw-171-062518-GW	240-97629-1	06/25/2018	Groundwater		✓
FBQmw-171-D-062518-GW	240-97629-2	06/25/2018	Groundwater	Field Duplicate	✓

DATA VALIDATION REPORT

1.1 DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative. All requested target analytes were reported for each sample.

1.2 SAMPLE RECEIPT

The samples were received by the laboratory on June 25, 2018; the samples were received in good condition, under chain-of-custody, and custody seals intact. Samples were properly preserved and cooler temperatures were less than 6°C.

1.3 TECHNICAL DATA VALIDATION

1.3.1 Hexavalent Chromium by Method 7196A

The following parameters were evaluated and met the required criteria. No validation flags were assigned based on the following:

- Holding times
- LODs and LOQs
- LCS recoveries
- MS/MSD recoveries and RPDs
- Method blank
- Initial calibration verification
- Continuing calibration verification
- Initial calibration blank
- Continuing calibration blank
- Field duplicate

No analytical or quality parameters requiring further discussion were identified for Method 7196A.

No qualifications were made in this SDG.

Data Validation Report
Remedial Investigation at RVAAP-66 Facility Wide Groundwater
Semi-Annual & Quarterly Sampling Event for June 2018

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

Contract Number: W9133L-14-D-0008

Task Order Number: 0003

Laboratory SDG 240-97635-1

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CONTRACTOR STATEMENT OF INDEPENDENT TECHNICAL REVIEW

TEC-WESTON Joint Venture has completed this Data Validation Report. Data validation was performed by the Validation Chemist and Secondary QC Review was performed by a Senior Chemist. Signatures indicate the report is approved for release.

Travis Withers, Validation Chemist, TEC-WESTON JV Date

Peter Chapman, Senior Chemist, TEC-WESTON JV 7/10/18
Date

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INTRODUCTION

This report summarizes the results of the **EPA Stage 2B** data validation performed on groundwater samples and quality control (QC) sample data for the Remedial Investigation for RVAAP-66, Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio. Results are reported in laboratory sample delivery group (SDG) **240-97635-1**.

TestAmerica, Inc., Canton, Ohio performed the analyses listed in the table below:

Parameters	Analytical Method	Laboratory Location
Hexavalent Chromium	7196A	Canton, OH

TestAmerica Canton does not hold DoD accreditation for hexavalent chromium analysis; therefore, method EPA SW-846 Method 7196A is reported.

The data were reviewed using guidance and quality control criteria documented in the *Draft Remedial Investigation Work Plan for Groundwater and Environmental Services for RVAAP-66 Facility-Wide Groundwater, Appendix A: Sampling Analysis Plan, A.2: Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio Attachment A Data Validation Evaluation Sheets (January 2016)* which are based on the *Department of Defense Quality Systems Manual (DoD QSM), Version 5.0*; *USEPA National Functional Guidelines for Organic Data Review* (*EPA 2014*); and *USEPA National Functional Guidelines for Inorganic Data Review* (*EPA 2014*), the analytical methods, and professional judgment.

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The following samples were validated:

Sample ID	Laboratory ID	Sample Date	Matrix	QC Sample	Hexavalent Chromium
FBQmw-174-062518-GW	240-97635-1	06/25/2018	Groundwater		✓
FBQmw-175-062518-GW	240-97635-2	06/25/2018	Groundwater		✓

DATA VALIDATION REPORT

1.1 DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative. All requested target analytes were reported for each sample.

1.2 SAMPLE RECEIPT

The samples were received by the laboratory on June 26, 2018; the samples were received in good condition, under chain-of-custody, and custody seals intact. Samples were properly preserved and cooler temperatures were less than 6°C.

1.3 TECHNICAL DATA VALIDATION

1.3.1 Hexavalent Chromium by Method 7196A

The following parameters were evaluated and met the required criteria. No validation flags were assigned based on the following:

- Holding times
- LODs and LOQs
- LCS recoveries
- Method blank
- Initial calibration verification
- Continuing calibration verification
- Initial calibration blank
- Continuing calibration blank

No analytical or quality parameters requiring further discussion were identified for Method 7196A.

No qualifications were made in this SDG.

Data Validation Report
Remedial Investigation at RVAAP-66 Facility Wide Groundwater
Semi-Annual & Quarterly Sampling Event for June 2018

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

Contract Number: W9133L-14-D-0008

Task Order Number: 0003

Laboratory SDG 240-97682-1

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CONTRACTOR STATEMENT OF INDEPENDENT TECHNICAL REVIEW

TEC-WESTON Joint Venture has completed this Data Validation Report. Data validation was performed by the Validation Chemist and Secondary QC Review was performed by a Senior Chemist. Signatures indicate the report is approved for release.

Travis Withers, Validation Chemist, TEC-WESTON JV Date

Peter Chapman, Senior Chemist, TEC-WESTON JV 7/10/18
Date

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INTRODUCTION

This report summarizes the results of the **EPA Stage 2B** data validation performed on groundwater samples and quality control (QC) sample data for the Remedial Investigation for RVAAP-66, Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio. Results are reported in laboratory sample delivery group (SDG) **240-97682-1**.

TestAmerica, Inc., Canton, Ohio performed the analyses listed in the table below:

Parameters	Analytical Method	Laboratory Location
Hexavalent Chromium	7196A	Canton, OH

TestAmerica Canton does not hold DoD accreditation for hexavalent chromium analysis; therefore, method EPA SW-846 Method 7196A is reported.

The data were reviewed using guidance and quality control criteria documented in the *Draft Remedial Investigation Work Plan for Groundwater and Environmental Services for RVAAP-66 Facility-Wide Groundwater, Appendix A: Sampling Analysis Plan, A.2: Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio Attachment A Data Validation Evaluation Sheets (January 2016)* which are based on the *Department of Defense Quality Systems Manual (DoD QSM), Version 5.0*; *USEPA National Functional Guidelines for Organic Data Review* (*EPA 2014*); and *USEPA National Functional Guidelines for Inorganic Data Review* (*EPA 2014*), the analytical methods, and professional judgment.

During data validation, qualifiers are assigned to assist in proper data interpretation. If values are estimated, data may be used for site evaluation purposes but reasons for data qualification should be taken into consideration when interpreting sample concentrations. Data that have been rejected (R) should not be used for any purpose. Results with no qualifiers meet all data quality goals as outlined in the UFP-QAPP.

The following samples were validated:

Sample ID	Laboratory ID	Sample Date	Matrix	QC Sample	Hexavalent Chromium
LL12mw-247-062618-GW	240-97682-1	06/26/2018	Groundwater		✓
LL12mw-247-D-062618-GW	240-97682-2	06/26/2018	Groundwater	Field Duplicate	✓
NTAmw-120-062618-GW	240-97682-3	06/26/2018	Groundwater		✓
NTAmw-120-D-062618-GW	240-97682-4	06/26/2018	Groundwater	Field Duplicate	✓

DATA VALIDATION REPORT

1.1 DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative. All requested target analytes were reported for each sample.

1.2 SAMPLE RECEIPT

The samples were received by the laboratory on June 26, 2018; the samples were received in good condition, under chain-of-custody, and custody seals intact. Samples were properly preserved and cooler temperatures were less than 6°C.

1.3 TECHNICAL DATA VALIDATION

1.3.1 Hexavalent Chromium by Method 7196A

The following parameters were evaluated and met the required criteria. No validation flags were assigned based on the following:

- Holding times
- LODs and LOQs
- LCS recoveries
- MS/MSD recoveries and RPDs
- Method blank
- Initial calibration verification
- Continuing calibration verification
- Initial calibration blank
- Continuing calibration blank
- Field Duplicates

No analytical or quality parameters requiring further discussion were identified for Method 7196A.

No qualifications were made in this SDG.

Data Validation Report
Remedial Investigation at RVAAP-66 Facility Wide Groundwater
Semi-Annual & Quarterly Sampling Event for June 2018

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

Contract Number: W9133L-14-D-0008

Task Order Number: 0003

Laboratory SDG 240-97687-1

Prepared For:

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CONTRACTOR STATEMENT OF INDEPENDENT TECHNICAL REVIEW

TEC-WESTON Joint Venture has completed this Data Validation Report. Data validation was performed by the Validation Chemist and Secondary QC Review was performed by a Senior Chemist. Signatures indicate the report is approved for release.

Travis Withers, Validation Chemist, TEC-WESTON JV Date

Peter Chapman, Senior Chemist, TEC-WESTON JV 7/10/18
Date

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INTRODUCTION

This report summarizes the results of the **EPA Stage 2B** data validation performed on groundwater samples and quality control (QC) sample data for the Remedial Investigation for RVAAP-66, Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio. Results are reported in laboratory sample delivery group (SDG) **240-97687-1**.

TestAmerica, Inc., Canton, Ohio performed the analyses listed in the table below:

Parameters	Analytical Method	Laboratory Location
Hexavalent Chromium	7196A	Canton, OH

TestAmerica Canton does not hold DoD accreditation for hexavalent chromium analysis; therefore, method EPA SW-846 Method 7196A is reported.

The data were reviewed using guidance and quality control criteria documented in the *Draft Remedial Investigation Work Plan for Groundwater and Environmental Services for RVAAP-66 Facility-Wide Groundwater, Appendix A: Sampling Analysis Plan, A.2: Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio Attachment A Data Validation Evaluation Sheets (January 2016)* which are based on the *Department of Defense Quality Systems Manual (DoD QSM), Version 5.0*; *USEPA National Functional Guidelines for Organic Data Review* (*EPA 2014*); and *USEPA National Functional Guidelines for Inorganic Data Review* (*EPA 2014*), the analytical methods, and professional judgment.

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The following samples were validated:

Sample ID	Laboratory ID	Sample Date	Matrix	QC Sample	Hexavalent Chromium
LL3mw-244-062618-GW	240-97687-1	06/26/2018	Groundwater		✓
FWGmw-019-062618-GW	240-97687-2	06/26/2018	Groundwater		✓
FWGmw-022-062618-GW	240-97687-3	06/26/2018	Groundwater		✓
FWGmw-023-062618-GW	240-97687-4	06/26/2018	Groundwater		✓

DATA VALIDATION REPORT

1.1 DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative. All requested target analytes were reported for each sample.

1.2 SAMPLE RECEIPT

The samples were received by the laboratory on June 27, 2018; the samples were received in good condition, under chain-of-custody, and custody seals intact. Samples were properly preserved and cooler temperatures were less than 6°C.

1.3 TECHNICAL DATA VALIDATION

1.3.1 Hexavalent Chromium by Method 7196A

The following parameters were evaluated and met the required criteria. No validation flags were assigned based on the following:

- Holding times
- LODs and LOQs
- LCS recoveries
- Method blank
- Initial calibration verification
- Continuing calibration verification
- Initial calibration blank
- Continuing calibration blank

No analytical or quality parameters requiring further discussion were identified for Method 7196A.

No qualifications were made in this SDG.

Data Validation Report
Remedial Investigation at RVAAP-66 Facility Wide Groundwater
Semi-Annual & Quarterly Sampling Event for June 2018

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

Contract Number: W9133L-14-D-0008

Task Order Number: 0003

Laboratory SDG 240-97744-1

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CONTRACTOR STATEMENT OF INDEPENDENT TECHNICAL REVIEW

TEC-WESTON Joint Venture has completed this Data Validation Report. Data validation was performed by the Validation Chemist and Secondary QC Review was performed by a Senior Chemist. Signatures indicate the report is approved for release.

Travis Withers, Validation Chemist, TEC-WESTON JV Date

Peter Chapman, Senior Chemist, TEC-WESTON JV 7/10/18
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INTRODUCTION

This report summarizes the results of the **EPA Stage 2B** data validation performed on groundwater samples and quality control (QC) sample data for the Remedial Investigation for RVAAP-66, Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio. Results are reported in laboratory sample delivery group (SDG) **240-97744-1**.

TestAmerica, Inc., Canton, Ohio performed the analyses listed in the table below:

Parameters	Analytical Method	Laboratory Location
Hexavalent Chromium	7196A	Canton, OH

TestAmerica Canton does not hold DoD accreditation for hexavalent chromium analysis; therefore, method EPA SW-846 Method 7196A is reported.

The data were reviewed using guidance and quality control criteria documented in the *Draft Remedial Investigation Work Plan for Groundwater and Environmental Services for RVAAP-66 Facility-Wide Groundwater, Appendix A: Sampling Analysis Plan, A.2: Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio Attachment A Data Validation Evaluation Sheets (January 2016)* which are based on the *Department of Defense Quality Systems Manual (DoD QSM), Version 5.0*; *USEPA National Functional Guidelines for Organic Data Review* (*EPA 2014*); and *USEPA National Functional Guidelines for Inorganic Data Review* (*EPA 2014*), the analytical methods, and professional judgment.

During data validation, qualifiers are assigned to assist in proper data interpretation. If values are estimated, data may be used for site evaluation purposes but reasons for data qualification should be taken into consideration when interpreting sample concentrations. Data that have been rejected (R) should not be used for any purpose. Results with no qualifiers meet all data quality goals as outlined in the UFP-QAPP.

The following samples were validated:

Sample ID	Laboratory ID	Sample Date	Matrix	QC Sample	Hexavalent Chromium
LL1mw-089-062718-GW	240-97744-1	06/27/2018	Groundwater		✓
LL1mw-089-D-062718-GW	240-97744-2	06/27/2018	Groundwater	Field Duplicate	✓
LL1mw-084-062718-GW	240-97744-3	06/27/2018	Groundwater		✓

DATA VALIDATION REPORT

1.1 DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative. All requested target analytes were reported for each sample.

1.2 SAMPLE RECEIPT

The samples were received by the laboratory on June 27, 2018; the samples were received in good condition, under chain-of-custody, and custody seals intact. Samples were properly preserved and cooler temperatures were less than 6°C.

1.3 TECHNICAL DATA VALIDATION

1.3.1 Hexavalent Chromium by Method 7196A

The following parameters were evaluated and met the required criteria. No validation flags were assigned based on the following:

- Holding times
- LODs and LOQs
- LCS recoveries
- MS/MSD recoveries and RPDs
- Method blank
- Initial calibration verification
- Continuing calibration verification
- Initial calibration blank
- Continuing calibration blank
- Field duplicates

No analytical or quality parameters requiring further discussion were identified for Method 7196A.

No qualifications were made in this SDG.

Data Validation Report
Remedial Investigation at RVAAP-66 Facility Wide Groundwater
Semi-Annual & Quarterly Sampling Event for June 2018

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

Contract Number: W9133L-14-D-0008

Task Order Number: 0003

Laboratory SDG 240-97767-1

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CONTRACTOR STATEMENT OF INDEPENDENT TECHNICAL REVIEW

TEC-WESTON Joint Venture has completed this Data Validation Report. Data validation was performed by the Validation Chemist and Secondary QC Review was performed by a Senior Chemist. Signatures indicate the report is approved for release.

Travis Withers, Validation Chemist, TEC-WESTON JV Date

Peter Chapman, Senior Chemist, TEC-WESTON JV 7/10/18
Date

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INTRODUCTION

This report summarizes the results of the **EPA Stage 2B** data validation performed on groundwater samples and quality control (QC) sample data for the Remedial Investigation for RVAAP-66, Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio. Results are reported in laboratory sample delivery group (SDG) **240-97767-1**.

TestAmerica, Inc., Canton, Ohio performed the analyses listed in the table below:

Parameters	Analytical Method	Laboratory Location
Hexavalent Chromium	7196A	Canton, OH

TestAmerica Canton does not hold DoD accreditation for hexavalent chromium analysis; therefore, method EPA SW-846 Method 7196A is reported.

The data were reviewed using guidance and quality control criteria documented in the *Draft Remedial Investigation Work Plan for Groundwater and Environmental Services for RVAAP-66 Facility-Wide Groundwater, Appendix A: Sampling Analysis Plan, A.2: Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio Attachment A Data Validation Evaluation Sheets (January 2016)* which are based on the *Department of Defense Quality Systems Manual (DoD QSM), Version 5.0*; *USEPA National Functional Guidelines for Organic Data Review* (*EPA 2014*); and *USEPA National Functional Guidelines for Inorganic Data Review* (*EPA 2014*), the analytical methods, and professional judgment.

During data validation, qualifiers are assigned to assist in proper data interpretation. If values are estimated, data may be used for site evaluation purposes but reasons for data qualification should be taken into consideration when interpreting sample concentrations. Data that have been rejected (R) should not be used for any purpose. Results with no qualifiers meet all data quality goals as outlined in the UFP-QAPP.

The following samples were validated:

Sample ID	Laboratory ID	Sample Date	Matrix	QC Sample	Hexavalent Chromium
LL1mw-083-062718-GW	240-97767-1	06/27/2018	Groundwater		✓
LL2mw-272-062718-GW	240-97767-2	06/27/2018	Groundwater		✓

DATA VALIDATION REPORT

1.1 DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative. All requested target analytes were reported for each sample.

1.2 SAMPLE RECEIPT

The samples were received by the laboratory on June 27, 2018; the samples were received in good condition, under chain-of-custody, and custody seals intact. Samples were properly preserved and cooler temperatures were less than 6°C.

1.3 TECHNICAL DATA VALIDATION

1.3.1 Hexavalent Chromium by Method 7196A

The following parameters were evaluated and met the required criteria. No validation flags were assigned based on the following:

- Holding times
- LODs and LOQs
- LCS recoveries
- Method blank
- Initial calibration verification
- Continuing calibration verification
- Initial calibration blank
- Continuing calibration blank

No analytical or quality parameters requiring further discussion were identified for Method 7196A.

No qualifications were made in this SDG.

Data Validation Report
Remedial Investigation at RVAAP-66 Facility Wide Groundwater
Semi-Annual & Quarterly Sampling Event for June 2018

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

Contract Number: W9133L-14-D-0008

Task Order Number: 0003

Laboratory SDG 240-97858-1

Prepared For:

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Travis Withers, Validation Chemist, TEC-WESTON JV Date

Peter Chapman, Senior Chemist, TEC-WESTON JV 7/10/18
Date

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INTRODUCTION

This report summarizes the results of the **EPA Stage 2B** data validation performed on groundwater samples and quality control (QC) sample data for the Remedial Investigation for RVAAP-66, Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio. Results are reported in laboratory sample delivery group (SDG) **240-97858-1**.

TestAmerica, Inc., Canton, Ohio performed the analyses listed in the table below:

Parameters	Analytical Method	Laboratory Location
Hexavalent Chromium	7196A	Canton, OH

TestAmerica Canton does not hold DoD accreditation for hexavalent chromium analysis; therefore, method EPA SW-846 Method 7196A is reported.

The data were reviewed using guidance and quality control criteria documented in the *Draft Remedial Investigation Work Plan for Groundwater and Environmental Services for RVAAP-66 Facility-Wide Groundwater, Appendix A: Sampling Analysis Plan, A.2: Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio Attachment A Data Validation Evaluation Sheets (January 2016)* which are based on the *Department of Defense Quality Systems Manual (DoD QSM), Version 5.0*; *USEPA National Functional Guidelines for Organic Data Review* (*EPA 2014*); and *USEPA National Functional Guidelines for Inorganic Data Review* (*EPA 2014*), the analytical methods, and professional judgment.

During data validation, qualifiers are assigned to assist in proper data interpretation. If values are estimated, data may be used for site evaluation purposes but reasons for data qualification should be taken into consideration when interpreting sample concentrations. Data that have been rejected (R) should not be used for any purpose. Results with no qualifiers meet all data quality goals as outlined in the UFP-QAPP.

The following samples were validated:

Sample ID	Laboratory ID	Sample Date	Matrix	QC Sample	Hexavalent Chromium
RQLmw-011-062818-GW	240-97858-1	06/28/2018	Groundwater		✓

DATA VALIDATION REPORT

1.1 DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative. All requested target analytes were reported for each sample.

1.2 SAMPLE RECEIPT

The samples were received by the laboratory on June 28, 2018; the samples were received in good condition, under chain-of-custody, and custody seals intact. Samples were properly preserved and cooler temperatures were less than 6°C.

1.3 TECHNICAL DATA VALIDATION

1.3.1 Hexavalent Chromium by Method 7196A

The following parameters were evaluated and met the required criteria. No validation flags were assigned based on the following:

- Holding times
- LODs and LOQs
- LCS recoveries
- MS/MSD recoveries and RPDs
- Method blank
- Initial calibration verification
- Continuing calibration verification
- Initial calibration blank
- Continuing calibration blank

No analytical or quality parameters requiring further discussion were identified for Method 7196A.

No qualifications were made in this SDG.

Data Validation Report
Remedial Investigation at RVAAP-66 Facility Wide Groundwater
Semi-Annual & Quarterly Sampling Event for June 2018

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

Contract Number: W9133L-14-D-0008

Task Order Number: 0003

Laboratory SDG 240-97871-1

Prepared For:

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Travis Withers, Validation Chemist, TEC-WESTON JV Date

Peter Chapman, Senior Chemist, TEC-WESTON JV 7/10/18
Date

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INTRODUCTION

This report summarizes the results of the **EPA Stage 2B** data validation performed on groundwater samples and quality control (QC) sample data for the Remedial Investigation for RVAAP-66, Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio. Results are reported in laboratory sample delivery group (SDG) **240-97871-1**.

TestAmerica, Inc., Canton, Ohio performed the analyses listed in the table below:

Parameters	Analytical Method	Laboratory Location
Hexavalent Chromium	7196A	Canton, OH

TestAmerica Canton does not hold DoD accreditation for hexavalent chromium analysis; therefore, method EPA SW-846 Method 7196A is reported.

The data were reviewed using guidance and quality control criteria documented in the *Draft Remedial Investigation Work Plan for Groundwater and Environmental Services for RVAAP-66 Facility-Wide Groundwater, Appendix A: Sampling Analysis Plan, A.2: Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio Attachment A Data Validation Evaluation Sheets (January 2016)* which are based on the *Department of Defense Quality Systems Manual (DoD QSM), Version 5.0*; *USEPA National Functional Guidelines for Organic Data Review* (*EPA 2014*); and *USEPA National Functional Guidelines for Inorganic Data Review* (*EPA 2014*), the analytical methods, and professional judgment.

During data validation, qualifiers are assigned to assist in proper data interpretation. If values are estimated, data may be used for site evaluation purposes but reasons for data qualification should be taken into consideration when interpreting sample concentrations. Data that have been rejected (R) should not be used for any purpose. Results with no qualifiers meet all data quality goals as outlined in the UFP-QAPP.

The following samples were validated:

Sample ID	Laboratory ID	Sample Date	Matrix	QC Sample	Hexavalent Chromium
RQLmw-012-062818-GW	240-97871-1	06/28/2018	Groundwater		✓
RQLmw-013-062818-GW	240-97871-2	06/28/2018	Groundwater		✓
RQLmw-014-062818-GW	240-97871-3	06/28/2018	Groundwater		✓

DATA VALIDATION REPORT

1.1 DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative. All requested target analytes were reported for each sample.

1.2 SAMPLE RECEIPT

The samples were received by the laboratory on June 28, 2018; the samples were received in good condition, under chain-of-custody, and custody seals intact. Samples were properly preserved and cooler temperatures were less than 6°C.

1.3 TECHNICAL DATA VALIDATION

1.3.1 Hexavalent Chromium by Method 7196A

The following parameters were evaluated and met the required criteria. No validation flags were assigned based on the following:

- Holding times
- LODs and LOQs
- LCS recoveries
- MS/MSD recoveries and RPDs
- Method blank
- Initial calibration verification
- Continuing calibration verification
- Initial calibration blank
- Continuing calibration blank

No analytical or quality parameters requiring further discussion were identified for Method 7196A.

No qualifications were made in this SDG.

Data Validation Report
Remedial Investigation at RVAAP-66 Facility Wide Groundwater
Semi-Annual & Quarterly Sampling Event for June 2018

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

Contract Number: W9133L-14-D-0008

Task Order Number: 0003

Laboratory SDG 280-111344-1

Prepared For:

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CONTRACTOR STATEMENT OF INDEPENDENT TECHNICAL REVIEW

TEC-WESTON Joint Venture has completed this Data Validation Report. Data validation was performed by the Validation Chemist and Secondary QC Review was performed by a Senior Chemist. Signatures indicate the report is approved for release.

Travis Withers, Validator, TEC-WESTON JV — Date

Peter Chapman, Senior Chemist, TEC-WESTON JV — 9/12/18 Date

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INTRODUCTION

This report summarizes the results of the **EPA Stage 2B** data validation performed on groundwater samples and quality control (QC) sample data for the Remedial Investigation for RVAAP-66, Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio. Results are reported in laboratory sample delivery group (SDG) **280-111344-1**.

TestAmerica, Inc., Denver, Colorado or TestAmerica, Inc., Sacramento, CA performed the analyses listed in the table below:

Parameters	Analytical Method	Laboratory Location
Volatile Organic Compounds (VOCs)	8260B	Denver, CO
Semi-Volatile Organic Compounds (SVOCs)	8270D	Denver, CO
Organochlorine Pesticides	8081B	Denver, CO
Polychlorinated Biphenyls (PCBs)	8082A	Denver, CO
Nitroguanidine	8330 (Modified)	Sacramento, CA
Perchlorate	6860	Denver, CO
Explosives	8330B	Denver, CO
Metals	6010C/6020A/7470A	Denver, CO
Alkalinity	2320B	Denver, CO
Nitrocellulose	353.2	Sacramento, CA
Total Cyanide	9012B	Denver, CO
Sulfide	9034	Denver, CO
Corrosivity (pH)	9040C	Denver, CO
Nitrate	9056A	Denver, CO

The data were reviewed using guidance and quality control criteria documented in the *Draft Remedial Investigation Work Plan for Groundwater and Environmental Services for RVAAP-66 Facility-Wide Groundwater, Appendix A: Sampling Analysis Plan, A.2: Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio Attachment A Data Validation Evaluation Sheets (January 2016)* which are based on the *Department of Defense Quality Systems Manual (DoD QSM), Version 5.0*; *USEPA National Functional Guidelines for Organic Data Review* (*EPA 2014*); and *USEPA National Functional Guidelines for Inorganic Data Review* (*EPA 2014*), the analytical methods, and professional judgment.

During data validation, qualifiers are assigned to assist in proper data interpretation. If values are estimated, data may be used for site evaluation purposes but reasons for data qualification should be taken into consideration when interpreting sample concentrations. Data that have been rejected (R)

should not be used for any purpose. Results with no qualifiers meet all data quality goals as outlined in the UFP-QAPP.

The data was reviewed and validated by calculating Relative Percent Difference (RPD) between spiked sample values according to the *USEPA National Functional Guidelines for Organic Data Review* (*EPA 2014*) and *USEPA National Functional Guidelines for Inorganic Data Review* (*EPA 2014*). Therefore, the RPDs were calculated using the percent recovery values as stated in the above referenced USEPA documents. SW-846 Methods were utilized for this project and they recommend using the actual spiked sample values to calculate RPD values. However, the laboratory used varying spike amounts due to sample aliquot and percent moisture differences which lead to variations in the spike amounts making it very difficult to compare the spiked sample values. These differences would have created poor precision results for the spiked sample values that were not necessarily indicative of the data quality. The use of comparing spike recovery values in this case was a much better indicator of analytical precision.

The following samples were validated:

Sample ID	Laboratory ID	Sample Date	Matrix	QC Sample	VOCs	SVOCs	Pesticides	PCBs	Nitroguanidine	Perchlorate	Explosives	Metals	Alkalinity	Nitrocellulose	Total Cyanide	Sulfide	pH	Anions
FWGmw-020-062118-GW	280-111344-1	06/21/18	Groundwater		✓	✓		✓	✓	✓	✓	✓		✓	✓			✓
TB-062118-03	280-111344-2	06/21/18	Groundwater	Trip Blank	✓													
CBLmw-001-062018-GW	280-111344-3	06/20/18	Groundwater			✓		✓			✓	✓				✓	✓	
CBLmw-001-D-062018-GW	280-111344-4	06/20/18	Groundwater			✓		✓			✓	✓				✓	✓	
CBLmw-002-062018-GW	280-111344-5	06/20/18	Groundwater			✓		✓			✓	✓				✓	✓	
LL1mw-088-062118-GW	280-111344-6	06/21/18	Groundwater			✓	✓				✓	✓	✓					
FWGmw-021-062118-GW	280-111344-7	06/21/18	Groundwater		✓	✓	✓	✓	✓	✓	✓	✓		✓	✓			
TB-062118-01	280-111344-8	06/21/18	Groundwater	Trip Blank	✓													
CBLmw-003-062118-GW	280-111344-9	06/21/18	Groundwater			✓		✓			✓	✓			✓	✓	✓	✓
CBLmw-004-062118-GW	280-111344-10	06/21/18	Groundwater			✓		✓			✓	✓			✓	✓	✓	✓
LL3mw-246-D-062118-GW	280-111344-11	06/21/18	Groundwater	Field Duplicate		✓			✓	✓	✓	✓						
FWGmw-018-062118-GW	280-111344-12	06/21/18	Groundwater		✓	✓		✓	✓	✓	✓	✓		✓	✓			
TB-062118-02	280-111344-13	06/21/18	Groundwater	Trip Blank	✓													
FWGmw-024-062118-GW	280-111344-14	06/21/18	Groundwater		✓	✓			✓	✓	✓	✓		✓				
FWGmw-017-062118-GW	280-111344-15	06/21/18	Groundwater			✓				✓	✓	✓		✓				
TB-062118-04	280-111344-16	06/21/18	Groundwater	Trip Blank	✓													
LL3mw-246-062118-GW	280-111344-17	06/21/18	Groundwater			✓				✓	✓	✓						

Some samples were analyzed for natural attenuation parameters. Natural attenuation parameters are reported, but not validated in accordance with the QAPP.

DATA VALIDATION REPORT

1.1 DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative. All requested target analytes were reported for each sample.

1.2 SAMPLE RECEIPT

The samples were received by the laboratory on June 23, 2018; the samples were received in good condition, under chain-of-custody, properly preserved and cooler temperatures were less than 6°C.

All 11 coolers were received without a custody seal present. It was noted that the shipping tape was intact and there was no evidence of tampering during transit.

Nitroguanidine and nitrocellulose analyses were performed by TestAmerica, Sacramento.

Per request, the laboratory cancelled 2320B Alkalinity analysis and added 9040C pH analysis for the following samples: CBLmw-001-062018-GW, CBLmw-001-D-062018-GW, CBLmw-002-062018-GW, CBLmw-003-062118-GW, and CBLmw-004-062118-GW.

Sample volume for all requested 9056 nitrate analyses were received at the laboratory with less than 8 hours left of the holding time. The laboratory was not able to analyze these samples within the 48 hour sample hold time.

1.3 DEFINITIONS

Detection limit (DL): The smallest analyte concentration that can be demonstrated to be different from zero or a blank concentration with 99% confidence. At the DL, the false positive rate is 1%. A DL may be used as the lowest concentration for reliably reporting a detection of a specific matrix with a specific method with 99% confidence.

Limit of detection (LOD): The smallest concentration of a substance that must be present in a sample in order to be detected at the DL with 99% confidence. At the LOD, the false negative rate is 1%. An LOD may be used as the lowest concentration for reliably reporting a non-detect of a specific analyte in a specific matrix with a specific method with 99% confidence.

Limits of Quantitation (LOQ): The smallest concentration that produces a quantitative result with known and recorded precision and bias. For DoD/DOE projects, the LOQ shall be set at or above the concentration of the lowest initial calibration standard and within the calibration range.

The following validation flags and reason codes were applied:

Validation Flag	Reason Code	Description
U	B	Non-detection; blank criteria not met.
UJ	S	Estimated non-detection; surrogate recovery exceedance.
UJ	M	Estimated non-detection; MS/MSD recovery or RPD exceedance.
UJ	L	Estimated non-detection; LCS/LCSD recovery or RPD exceedance.
J	S	Estimated detection; surrogate recovery exceedance.
J	M	Estimated detection; MS/MSD recovery or RPD exceedance.
J	L	Estimated detection; LCS/LCSD recovery or RPD exceedance.
J	CC	Estimated detection; CCV recovery exceedance.
J	H	Estimated detection; holding time exceedance.
J	D	Estimated detection; laboratory duplicate RPD exceedance.
J	Q	Estimated detection; professional judgement.
R	L	Rejected result; extremely low (<10%) LCS recovery.

1.4 TECHNICAL DATA VALIDATION

1.4.1 Volatile Organic Compounds by Method 8260B

The following parameters were evaluated and met the required criteria. No validation flags were assigned based on the following:

- Holding times
- LODs and LOQs
- Method blank
- Instrument tuning
- Internal standard area counts
- Initial calibration
- Initial calibration verification
- Trip blank

All analytical or quality parameters requiring further discussion for Method 8260B are described in the sections below.

1.4.1.1 LCS/LCSD Recoveries and RPDs

1,1,2-Trichloroehtane (120%) recovered above the control limits (80-119%) in the LCSD. The LCS recovery (112%) and RPD (6%) were within the control limits; therefore, no qualification was necessary.

1.4.1.2 Continuing Calibration Verification

2-Hexananoe (+21.7%) recovered above the control limits (±20%) in the continuing calibration verification CCV 280-421119/2. All associated samples were non-detect for 2-hexanone; therefore, no qualification was necessary.

1.4.2 Semivolatile Organic Compounds by Method 8270D

The following parameters were evaluated and met the required criteria. No validation flags were assigned based on the following:

- Holding times
- Method blanks
- MS/MSD recoveries and RPDs
- LODs and LOQs
- Instrument tuning
- Internal standard area counts
- Initial calibration
- Initial calibration verification
- Continuing calibration verification
- Closing calibration verification
- Field duplicates

All analytical or quality parameters requiring further discussion for Method 8270D are described in the sections below.

1.4.2.1 Surrogate Recoveries

Surrogate terphenyl-d14 recovered below control limits (50-134%) in sample FWGmw-021-062118-GW. All associated sample results were qualified as estimated (UJ S).

1.4.2.2 LCS/LCSD Recoveries and RPDs

Hexachlorocyclopentadiene (4%) recovered below the control limits (10-120%) in the LCS associated with analytical batch 422564. All associated hexachlorocyclopentadiene sample results were rejected due to the extremely low (<10%) LCS recovery (R L). It is noted that hexachlorocyclopentadiene is a poor performer for this method.

1.4.3 Organochlorine Pesticides by Method 8081B

The following parameters were evaluated and met the required criteria. No validation flags were assigned:

- Holding times
- Method blank
- Surrogate recoveries
- LCS/LCSD recoveries and RPDs

- Initial calibration
- Initial calibration verification
- LODs and LOQs

All analytical or quality parameters requiring further discussion for Method 8081B are described in the sections below.

1.4.3.1 Sample Preparation

Samples LL1mw-088-062118-GW and FWGmw-021-062118-GW required a mercury clean-up, via EPA Method 3660A, to reduce matrix interferences caused by sulfur.

Only a portion of the sample volume submitted for sample FWGmw-021-062118-GW was used for analysis due the sample container not being the appropriate size. As such, the required solvent rinse of the original container could not be performed. Based on professional judgement, no qualifications were made.

1.4.3.2 Continuing Calibration Verifications

4,4-DDD (+21%) recovered above the control limits (±20%) in the continuing calibration verification. All associated samples were non-detect for 4,4-DDD; therefore, no qualification was necessary.

1.4.4 Polychlorinated Biphenyls (PCBs) by Method 8082A

The following parameters were evaluated and met the required criteria. No validation flags were assigned:

- Holding times
- Method blank
- Surrogate recoveries
- LCS/LCSD recoveries and RPDs
- Initial calibration
- Initial calibration verification
- Continuing calibration verification
- LODs and LOQs

All analytical or quality parameters requiring further discussion for Method 8082A are described in the sections below.

1.4.4.1 Sample Preparation

Samples FWGmw-020-062118-GW, CBLmw-001-062018-GW, CBLmw-001-D-062018-GW, CBLmw-002-062018-GW, FWGmw-021-062118-GW, CBLmw-003-062118-GW, CBLmw-004-

062118, and FWGmw-018-062118-GW required a sulfuric acid clean-up, via EPA Method 3665A, to reduce matrix interferences.

1.4.5 Nitroguanidine by Method 8330 (Modified)

The following parameters were evaluated and met the required criteria. No validation flags were assigned:

- Holding times
- Method blanks
- LCS recoveries
- Initial calibration
- Initial calibration verification
- Initial calibration blank
- Continuing calibration verification
- Continuing calibration blank
- LODs and LOQs
- Initial calibration verification

No analytical or quality parameters required further discussion for Method 8330 (Modified).

1.4.6 Perchlorate by Method 6860

The following parameters were evaluated and met the required criteria. No validation flags were assigned based on the following:

- Holding times
- LODs and LOQs
- LCS recoveries
- Method blank
- Initial calibration verification
- Initial calibration blank
- Continuing calibration verification
- Continuing calibration blank
- Detection limit check
- Interference check standards

No analytical or quality parameters required further discussion for Method 6860.

1.4.7 Explosives by Method 8330B

The following parameters were evaluated and met the required criteria. No validation flags were assigned:

- Holding times
- Method blank
- Initial calibration
- Initial calibration verification
- Initial calibration blank
- Continuing calibration blank
- LODs and LOQs

All analytical or quality parameters requiring further discussion for Method 8330B are described in the sections below.

1.4.7.1 Surrogate Recoveries

Surrogate 1,2-dinitrobenzene recovered above the control limits (83-119%) in method blank MB 280-420406/1-A (122%). All associated method blank analytes were non-detect and the surrogate recoveries an all associated samples were within control; therefore, no qualification was necessary.

Surrogate 1,2-dinitrobenze recovered below the control limits (83-119%) in method blank MB 280-420242/1-A. All associated sample results were qualified as estimated (UJ/J S).

Surrogate 1,2-dinitrobenzene recovered below the control limits (83-119%) in laboratory control sample LCS 280-420242/2-A (60%). All associated sample results were qualified as estimated (UJ/J S).

1.4.7.2 LCS/LCSD Recoveries and RPDs

Several analytes recovered outside of the control limits in the LCS/LCSD associated with prep batch 420242. The following table outlines these exceedances:

Analyte	LCS %R	LCSD %R	%R Limits	RPD	RPD Limit
1,3,5-Trinitrobenzene	**70**	105	73-125	**40**	20
1,3-Dinitrobenzene	**56**	92	78-120	**49**	20
2,4,6-Trinitrotoluene	**58**	91	71-123	**45**	20
2,4-Dinitrotoluene	**48**	84	78-120	**54**	20
2,6-Dinitrotoleune	**46**	81	77-127	**55**	20
2-Amino-4,6-dinitrotoluene	**41**	**73**	79-120	**56**	20
2-Nitrotoluene	**33**	**66**	70-127	**67**	20
3-Nitrotoluene	**33**	**64**	73-125	**65**	20
4-Amino-2,6-dinitrotoluene	**42**	**70**	76-125	**51**	20
4-Nitrotoluene	**34**	**67**	71-127	**65**	20
HMX	83	103	65-135	**22**	20
Nitrobenzene	**47**	82	65-134	**55**	20
Nitroglycerin	79	113	74-127	**36**	20
PETN	73	103	73-127	**34**	20
RDX	76	104	68-130	**31**	20
Tertyl	65	99	64-128	**41**	20

%R = percent recovery
Bolded values are outside control limits.

The LCS recovery and RPD were outside of control limits for analytes 1,3,5-trinitrobenzene, 1,3-dinitrobenzene, 2,4,6-trinitrotoluene, 2,4-dinitrotoluene, 2,6-dinitrotoluene, and nitrobenzene. All associated sample results were qualified as estimated (UJ/J L).

The LCS recovery, LCSD recovery and RPD were outside of control limits for analytes 2-amino-4,6-dinitrotoluene, 2-nitrotoluene, 3-nitrotoluene, 4-amino-2,6-dinitrotoluene, and 4-nitrotoluene. All associated sample results were qualified as estimated (UJ/J L).

The RPD was outside of control limits for analytes HMX, nitroglycerin, PETN, RDX, and tertyl. The LCS and LCSD recoveries were within control limits for these analytes; therefore, no qualification was necessary.

m-Nitrotoluene (71%) recovered below the control limits (73-125%) in the LCS associated with prep batch 420406 on the secondary confirmation column. m-Nitrotoluene recovered within the control limits on the primary column; therefore, no qualification was necessary.

1.4.7.3 MS/MSD Recoveries and RPDs

An MS/MSD was performed on sample LL3mw-246-062118-GW. Several analytes exceeded the control limits for the MS/MSD. The following table outlines the exceedances:

Analyte	MS %R	MSD %R	%R Limits	RPD	RPD Limit
1,3-Dinitrobenzene	107	91	78-120	**23**	20
2,4-Dinitrotoluene	103	86	78-120	**25**	20
2,6-Dinitrotoleune	99	83	77-127	**24**	20
2-Amino-4,6-dinitrotoluene	99	**74**	79-120	**30**	20
2-Nitrotoluene	96	**67**	70-127	**42**	20
3-Nitrotoluene	95	**66**	73-125	**42**	20
4-Amino-2,6-dinitrotoluene	94	**71**	76-125	**29**	20
Nitrobenzene	100	73	65-134	**37**	20

%R = percent recovery
Bolded values are outside control limits.

The RPD for 1,3-dinitrobenzene, 2,4-dinitrotoluene, 2,6-ditnitrotoluene, and nitrobenzene were above the control limit. The MS and MSD recoveries are within the control limits for these analytes; therefore, no qualification was necessary.

The MSD recovery and RPD were above the control limits for 2-amino-4,6-dinitrotoluene, 2-nitrotoluene, 3-nitrotoluene, and 4-amino-2,6-dinitrotoluene. The associated parent sample results were qualified as estimated (UJ/J M).

1.4.7.4 Continuing Calibration Verification

m-Nitrotoluene recovered outside of the control limits in a continuing calibration verification on the secondary confirmation column. All of these analytes were within the control limits on the primary column; therefore, no qualification was necessary.

1.4.7.5 Sample Preparation

The laboratory analyst inadvertently used a 1L sample volume for analysis instead of the method required 500mL for samples CBLmw-001-062018-GW, CBLmw-001-D-062018-GW, and CBLmw-002-062018-GW, so only a portion of the sample was used in preparation. As such, the required solvent rinse of the original container could not be performed. Based on professional judgement, no qualification was necessary.

The incorrect sample volume was received by the laboratory for samples FWGmw-020-062118-GW, FWGmw-024-062118-GW, and FWGmw-017-062118-GW. A 1L sample volume for analysis instead of the method required 500mL. As such, the required solvent rinse of the original container could not be performed. Based on professional judgement, no qualification was necessary.

Samples LL1mw-088-062118-GW and FWGmw-021-062118-GW were filtered prior to analysis to reduce matrix interferences.

1.4.7.6 Confirmation Column

The RPD between the primary and confirmation column results for 2-amino-4,6-dinitrotoluene in samples FWGmw-021-062118-GW (85%), LL3mw-246-D-062118-GW (58%), and LL3mw-246-062118-GW (50%) exceeded 40%. The higher of the two results will be reported and qualified as estimated (J Q).

The RPD between the primary and confirmation column results for RDX in samples FWGmw-021-062118-GW (63%) and LL3mw-246-062118-GW (78%) exceeded 40%. The higher of the two results will be reported and qualified as estimated (J Q).

The RPD between the primary and confirmation column results for 4-amino-2,6-dinitrotoluene in samples FWGmw-021-062118-GW (77%) and LL3mw-246-D-062118-GW (42%) exceeded 40%. The higher of the two results will be reported and qualified as estimated (J Q).

1.4.8 Total Metals by Method 6010C/6020A/7470A

The following parameters were evaluated and met the required criteria. No validation flags were assigned based on the following:

- Holding times
- LODs and LOQs
- LCS/LCSD recoveries and RPDs
- Post digestion spike
- Serial dilution
- Initial and continuing calibration blanks
- Contract required detection limit standard
- Instrument tuning
- Interference check solutions
- Field duplicate

All analytical or quality issues requiring further discussion for Methods 6010C, 6020A, and/or 7470A are described in the sections below.

1.4.8.1 Sample Dilution

Sample LL3mw-246-062118-GW required a 5x dilution prior to mercury analysis. The reporting limits were adjusted accordingly.

1.4.8.2 Method Blank

Calcium (51.8 µg/L), magnesium (12.1 µg/L), and sodium (158 µg/L) were detected in the method blank at a concentration above their respective LOQs (1000 µg/L, 100 µg/L, & 5000 µg/L).

Calcium and magnesium were detected at concentrations above the LOQ in all associated samples; therefore, no qualification was necessary.

Sodium was detected at a concentration below the LOQ in samples CBLmw-001-06218-GW (1700 µg/L), CBLmw-001-D-062018-GW (1600 µg/L), CBLmw-002-062018-GW (2600 µg/L), FWGmw-021-062118-GW (3500 µg/L), CBLmw-003-062118-GW (1500 µg/L), CBLmw-004-062118-GW (2100 µg/L), LL3mw-246-D-062118-GW (3200 µg/L), LL3mw-246-062118-GW (3200 µg/L). These results were qualified as non-detect at the LOQ (U B). All other associated sample results were at concentrations above the LOQ; therefore, no qualification was necessary.

1.4.8.3 MS/MSD Recoveries and RPDs

An MS/MSD was performed on sample LL3mw-246-062118-GW. Mercury recovered below the control limits (82-119%) in the MS (77%) and MSD (78%). The associated parent sample result was qualified as estimated (J M).

1.4.8.4 Initial/Continuing Calibrations Verifications

Sodium recovered above control limits (80-120%) in the low-level continuing calibration verification CCVL 280-421256/74 (125%). All associated, detected sample results were qualified as estimated (J CC).

Barium recovered below control limits (80-120%) in the low-level continuing calibration verification CCVL 280-421258/134 (68%) and CCVL 280-421258/146 (79%). All associated sample results were qualified as estimated (J CC).

1.4.9 Alkalinity by Method 2320B

The following parameters were evaluated and met the required criteria. No validation flags were assigned based on the following:

- Holding times
- LODs and LOQs
- LCS recoveries
- Initial calibration verification
- Continuing calibration verification
- Initial calibration blank
- Continuing calibration blank
- Field duplicate

All analytical or quality issues requiring further discussion for Method 2320B are described in the sections below.

1.4.9.1 Method Blanks

Alkalinity was detected in the method blanks MB 280-421103/5 (2.86 mg/L) and MB 280-421103/31 (1.167mg/L) at a concentration below the LOQ (5.0 mg/L). All associated samples had alkalinity concentrations above the LOQ; therefore, no qualification was necessary.

1.4.10 Nitrocellulose by Method 353.2

The following parameters were evaluated and met the required criteria. No validation flags were assigned based on the following:

- Holding times
- LODs and LOQs
- LCS recoveries
- Initial calibration verification
- Continuing calibration verification
- Initial calibration blank
- Continuing calibration blank
- Field duplicate

No analytical or quality issues required further discussion for Method 353.2.

1.4.11 Total Cyanide by Method 9012B

The following parameters were evaluated and met the required criteria. No validation flags were assigned based on the following:

- Holding times
- LODs and LOQs
- Method blank
- LCS/LCSD recoveries and RPDs
- MS/MSD recoveries and RPDs
- Initial calibration verification
- Continuing calibration verification
- Initial calibration blank
- Continuing calibration blank
- Low and high level control sample recoveries
- Field duplicate

No analytical or quality issues required further discussion for Method 9012B.

1.4.12 Sulfide by Method 9034

The following parameters were evaluated and met the required criteria. No validation flags were assigned based on the following:

- Holding times
- LODs and LOQs
- Method blank
- LCS/LCSD recoveries and RPDs
- MS/MSD recoveries and RPDs

No analytical or quality issues required further discussion for Methods 9034.

1.4.13 Corrosivity (pH) by Method 9040C

The following parameters were evaluated and met the required criteria. No validation flags were assigned based on the following:

- Holding times
- LODs and LOQs
- LCS recoveries

No analytical or quality issues required further discussion for Methods 9040C.

1.4.14 Anions by Method 9056A

The following parameters were evaluated and met the required criteria. No validation flags were assigned based on the following:

- LODs and LOQs
- Method blank
- LCS/LCSD recoveries and RPDs
- MS/MSD recoveries and RPDs
- Initial calibration verification
- Continuing calibration verification
- Initial calibration blank
- Continuing calibration blank

All analytical or quality issues requiring further discussion for Method 9056A are described in the sections below.

1.4.14.1 Holding Time

Samples FWGmw-020-062118-GW, CBLmw-003-062118-GW and CBLmw-062118-GW were analyzed for nitrate as N outside of the sample holding time. All nitrate as N results for these samples were qualified as estimated (J H).

1.4.14.2 Laboratory Duplicate

A laboratory duplicate was performed on sample CBLmw-004-062118-GW. The RPD for nitrate as N (14%) exceeded the control limit (10%). The associated parent sample result was qualified as estimated (J D).

DATA VALIDATION TABLE

SDG	Field Sample ID	Lab Sample ID	Matrix	Parameter	CAS Number	Units	Result	Lab Flag	DV Flag	Detection	LOQ	LOD	MDL	AnalyticMethod	Reason Code
280-111344-1	FWGmw-020-062118-GW	280-111344-1	Ground Water	Sodium	7440-23-5	µg/L	16000	v	j	y	5000	350	120	6010C	CC
280-111344-1	FWGmw-020-062118-GW	280-111344-1	Ground Water	Barium	7440-39-3	µg/L	84	q	j	y	3	0.95	0.29	6020A	CC
280-111344-1	FWGmw-020-062118-GW	280-111344-1	Ground Water	Hexachlorocyclopentadiene	77-47-4	µg/L	28	u q	r	n	47	28	9.5	8270D	L
280-111344-1	FWGmw-020-062118-GW	280-111344-1	Ground Water	Nitrate as N	14797-55-8	mg/L	0.19	j h	j	y	0.5	0.1	0.042	9056A	H
280-111344-1	CBLmw-004-062118-GW	280-111344-10	Ground Water	Sodium	7440-23-5	µg/L	5000	j	u	n	5000	350	120	6010C	B
280-111344-1	CBLmw-004-062118-GW	280-111344-10	Ground Water	Barium	7440-39-3	µg/L	20	q	j	y	3	0.95	0.29	6020A	CC
280-111344-1	CBLmw-004-062118-GW	280-111344-10	Ground Water	Hexachlorocyclopentadiene	77-47-4	µg/L	30	u q	r	n	50	30	10	8270D	L
280-111344-1	CBLmw-004-062118-GW	280-111344-10	Ground Water	Nitrate as N	14797-55-8	mg/L	0.37	j h	j	y	0.5	0.1	0.042	9056A	H D
280-111344-1	LL3mw-246-D-062118-GW	280-111344-11	Ground Water	Sodium	7440-23-5	µg/L	5000	j	u	n	5000	350	120	6010C	B
280-111344-1	LL3mw-246-D-062118-GW	280-111344-11	Ground Water	Barium	7440-39-3	µg/L	14	q	j	y	3	0.95	0.29	6020A	CC
280-111344-1	LL3mw-246-D-062118-GW	280-111344-11	Ground Water	2-Amino-4,6-dinitrotoluene	35572-78-2	µg/L	0.47	j1 m	j	y	0.22	0.13	0.055	8330B	Q
280-111344-1	LL3mw-246-D-062118-GW	280-111344-11	Ground Water	4-Amino-2,6-dinitrotoluene	19406-51-0	µg/L	0.42	j1	j	y	0.22	0.13	0.063	8330B	Q
280-111344-1	FWGmw-018-062118-GW	280-111344-12	Ground Water	Sodium	7440-23-5	µg/L	18000	v	j	y	5000	350	120	6010C	CC
280-111344-1	FWGmw-018-062118-GW	280-111344-12	Ground Water	Barium	7440-39-3	µg/L	69	q	j	y	3	0.95	0.29	6020A	CC
280-111344-1	FWGmw-018-062118-GW	280-111344-12	Ground Water	Hexachlorocyclopentadiene	77-47-4	µg/L	28	u q	r	n	47	28	9.4	8270D	L
280-111344-1	FWGmw-024-062118-GW	280-111344-14	Ground Water	Sodium	7440-23-5	µg/L	5500	v	j	y	5000	350	120	6010C	CC
280-111344-1	FWGmw-024-062118-GW	280-111344-14	Ground Water	Barium	7440-39-3	µg/L	8.5	v	j	y	3	0.95	0.29	6020A	CC
280-111344-1	FWGmw-024-062118-GW	280-111344-14	Ground Water	Hexachlorocyclopentadiene	77-47-4	µg/L	29	u q	r	n	48	29	9.6	8270D	L
280-111344-1	FWGmw-017-062118-GW	280-111344-15	Ground Water	Sodium	7440-23-5	µg/L	14000	v	j	y	5000	350	120	6010C	CC
280-111344-1	FWGmw-017-062118-GW	280-111344-15	Ground Water	Barium	7440-39-3	µg/L	120	q	j	y	3	0.95	0.29	6020A	CC
280-111344-1	FWGmw-017-062118-GW	280-111344-15	Ground Water	Hexachlorocyclopentadiene	77-47-4	µg/L	28	u q	r	n	47	28	9.5	8270D	L
280-111344-1	LL3mw-246-062118-GW	280-111344-17	Ground Water	Sodium	7440-23-5	µg/L	5000	j	u	n	5000	350	120	6010C	B
280-111344-1	LL3mw-246-062118-GW	280-111344-17	Ground Water	Barium	7440-39-3	µg/L	13	q	j	y	3	0.95	0.29	6020A	CC
280-111344-1	LL3mw-246-062118-GW	280-111344-17	Ground Water	Mercury	7439-97-6	µg/L	0.93	j j1 d	j	y	1	0.4	0.14	7470A	M
280-111344-1	LL3mw-246-062118-GW	280-111344-17	Ground Water	2-Amino-4,6-dinitrotoluene	35572-78-2	µg/L	0.29	j1	j	y	0.22	0.13	0.056	8330B	M
280-111344-1	LL3mw-246-062118-GW	280-111344-17	Ground Water	2-Nitrotoluene	88-72-2	µg/L	0.22	u j1	uj	n	0.44	0.22	0.094	8330B	M
280-111344-1	LL3mw-246-062118-GW	280-111344-17	Ground Water	3-Nitrotoluene	99-08-1	µg/L	0.22	u j1	uj	n	0.44	0.22	0.092	8330B	M
280-111344-1	LL3mw-246-062118-GW	280-111344-17	Ground Water	4-Amino-2,6-dinitrotoluene	19406-51-0	µg/L	0.3	j1	j	y	0.22	0.13	0.063	8330B	M
280-111344-1	LL3mw-246-062118-GW	280-111344-17	Ground Water	2-Amino-4,6-dinitrotoluene	35572-78-2	µg/L	0.5	j1	j	y	0.22	0.13	0.056	8330B	Q
280-111344-1	LL3mw-246-062118-GW	280-111344-17	Ground Water	RDX	121-82-4	µg/L	0.25	j1	j	y	0.22	0.13	0.057	8330B	Q
280-111344-1	CBLmw-001-062018-GW	280-111344-3	Ground Water	Sodium	7440-23-5	µg/L	5000	j	u	n	5000	350	120	6010C	B
280-111344-1	CBLmw-001-062018-GW	280-111344-3	Ground Water	Barium	7440-39-3	µg/L	33	q	j	y	3	0.95	0.29	6020A	CC
280-111344-1	CBLmw-001-062018-GW	280-111344-3	Ground Water	1,3,5-Trinitrobenzene	99-35-4	µg/L	0.46	u q	uj	n	1.2	0.46	0.23	8330B	S L
280-111344-1	CBLmw-001-062018-GW	280-111344-3	Ground Water	1,3-Dinitrobenzene	99-65-0	µg/L	0.23	u q	uj	n	0.46	0.23	0.1	8330B	S L
280-111344-1	CBLmw-001-062018-GW	280-111344-3	Ground Water	2,4,6-Trinitrotoluene	118-96-7	µg/L	0.23	u q	uj	n	0.46	0.23	0.084	8330B	S L
280-111344-1	CBLmw-001-062018-GW	280-111344-3	Ground Water	2,4-Dinitrotoluene	121-14-2	µg/L	0.23	u q	uj	n	0.46	0.23	0.097	8330B	S L
280-111344-1	CBLmw-001-062018-GW	280-111344-3	Ground Water	2,6-Dinitrotoluene	606-20-2	µg/L	0.23	u q	uj	n	0.23	0.23	0.074	8330B	S L
280-111344-1	CBLmw-001-062018-GW	280-111344-3	Ground Water	2-Amino-4,6-dinitrotoluene	35572-78-2	µg/L	0.14	u q	uj	n	0.23	0.14	0.059	8330B	S L
280-111344-1	CBLmw-001-062018-GW	280-111344-3	Ground Water	2-Nitrotoluene	88-72-2	µg/L	0.23	u q	uj	n	0.46	0.23	0.099	8330B	S L
280-111344-1	CBLmw-001-062018-GW	280-111344-3	Ground Water	3-Nitrotoluene	99-08-1	µg/L	0.23	u q	uj	n	0.46	0.23	0.096	8330B	S L
280-111344-1	CBLmw-001-062018-GW	280-111344-3	Ground Water	4-Amino-2,6-dinitrotoluene	19406-51-0	µg/L	0.14	u q	uj	n	0.23	0.14	0.067	8330B	S L
280-111344-1	CBLmw-001-062018-GW	280-111344-3	Ground Water	4-Nitrotoluene	99-99-0	µg/L	0.46	u q	uj	n	1.2	0.46	0.23	8330B	S L
280-111344-1	CBLmw-001-062018-GW	280-111344-3	Ground Water	HMX	2691-41-0	µg/L	0.23	u m q	uj	n	0.46	0.23	0.1	8330B	S

280-111344-1	CBLmw-001-062018-GW	280-111344-3	Ground Water	Nitrobenzene	98-95-3	µg/L	0.23	u q	uj	n	0.46	0.23	0.11	8330B	S L
280-111344-1	CBLmw-001-062018-GW	280-111344-3	Ground Water	Nitroglycerin	55-63-0	µg/L	2.3	u q	uj	n	3.5	2.3	1.1	8330B	S
280-111344-1	CBLmw-001-062018-GW	280-111344-3	Ground Water	PETN	78-11-5	µg/L	1.4	u q	uj	n	2.3	1.4	0.48	8330B	S
280-111344-1	CBLmw-001-062018-GW	280-111344-3	Ground Water	RDX	121-82-4	µg/L	0.14	u q	uj	n	0.23	0.14	0.06	8330B	S
280-111344-1	CBLmw-001-062018-GW	280-111344-3	Ground Water	Tetryl	479-45-8	µg/L	0.23	u q	uj	n	0.28	0.23	0.092	8330B	S
280-111344-1	CBLmw-001-062018-GW	280-111344-3	Ground Water	2,4-Dinitrotoluene	121-14-2	µg/L	0.21	u h q	uj	n	0.41	0.21	0.086	8330B	S
280-111344-1	CBLmw-001-062018-GW	280-111344-3	Ground Water	2,6-Dinitrotoluene	606-20-2	µg/L	0.21	u h q	uj	n	0.21	0.21	0.066	8330B	S
280-111344-1	CBLmw-001-062018-GW	280-111344-3	Ground Water	2-Amino-4,6-dinitrotoluene	35572-78-2	µg/L	0.12	u h q	uj	n	0.21	0.12	0.052	8330B	S
280-111344-1	CBLmw-001-D-062018-GW	280-111344-4	Ground Water	Sodium	7440-23-5	µg/L	5000	j	u	n	5000	350	120	6010C	B
280-111344-1	CBLmw-001-D-062018-GW	280-111344-4	Ground Water	Barium	7440-39-3	µg/L	32	q	j	y	3	0.95	0.29	6020A	CC
280-111344-1	CBLmw-001-D-062018-GW	280-111344-4	Ground Water	1,3,5-Trinitrobenzene	99-35-4	µg/L	0.5	u q	uj	n	1.3	0.5	0.25	8330B	S L
280-111344-1	CBLmw-001-D-062018-GW	280-111344-4	Ground Water	1,3-Dinitrobenzene	99-65-0	µg/L	0.25	u q	uj	n	0.5	0.25	0.11	8330B	S L
280-111344-1	CBLmw-001-D-062018-GW	280-111344-4	Ground Water	2,4,6-Trinitrotoluene	118-96-7	µg/L	0.25	u q	uj	n	0.5	0.25	0.091	8330B	S L
280-111344-1	CBLmw-001-D-062018-GW	280-111344-4	Ground Water	2,4-Dinitrotoluene	121-14-2	µg/L	0.25	u q	uj	n	0.5	0.25	0.11	8330B	S L
280-111344-1	CBLmw-001-D-062018-GW	280-111344-4	Ground Water	2,6-Dinitrotoluene	606-20-2	µg/L	0.25	u q	uj	n	0.25	0.25	0.081	8330B	S L
280-111344-1	CBLmw-001-D-062018-GW	280-111344-4	Ground Water	2-Amino-4,6-dinitrotoluene	35572-78-2	µg/L	0.15	u q	uj	n	0.25	0.15	0.064	8330B	S L
280-111344-1	CBLmw-001-D-062018-GW	280-111344-4	Ground Water	2-Nitrotoluene	88-72-2	µg/L	0.25	u q	uj	n	0.5	0.25	0.11	8330B	S L
280-111344-1	CBLmw-001-D-062018-GW	280-111344-4	Ground Water	3-Nitrotoluene	99-08-1	µg/L	0.25	u q	uj	n	0.5	0.25	0.1	8330B	S L
280-111344-1	CBLmw-001-D-062018-GW	280-111344-4	Ground Water	4-Amino-2,6-dinitrotoluene	19406-51-0	µg/L	0.15	u q	uj	n	0.25	0.15	0.073	8330B	S L
280-111344-1	CBLmw-001-D-062018-GW	280-111344-4	Ground Water	4-Nitrotoluene	99-99-0	µg/L	0.5	u q	uj	n	1.3	0.5	0.25	8330B	S L
280-111344-1	CBLmw-001-D-062018-GW	280-111344-4	Ground Water	HMX	2691-41-0	µg/L	0.25	u m q	uj	n	0.5	0.25	0.11	8330B	S
280-111344-1	CBLmw-001-D-062018-GW	280-111344-4	Ground Water	Nitrobenzene	98-95-3	µg/L	0.25	u q	uj	n	0.5	0.25	0.11	8330B	S L
280-111344-1	CBLmw-001-D-062018-GW	280-111344-4	Ground Water	Nitroglycerin	55-63-0	µg/L	2.5	u q	uj	n	3.8	2.5	1.2	8330B	S
280-111344-1	CBLmw-001-D-062018-GW	280-111344-4	Ground Water	PETN	78-11-5	µg/L	1.5	u q	uj	n	2.5	1.5	0.52	8330B	S
280-111344-1	CBLmw-001-D-062018-GW	280-111344-4	Ground Water	RDX	121-82-4	µg/L	0.15	u q	uj	n	0.25	0.15	0.066	8330B	S
280-111344-1	CBLmw-001-D-062018-GW	280-111344-4	Ground Water	Tetryl	479-45-8	µg/L	0.25	u q	uj	n	0.3	0.25	0.1	8330B	S
280-111344-1	CBLmw-001-D-062018-GW	280-111344-4	Ground Water	2,4-Dinitrotoluene	121-14-2	µg/L	0.21	u h m q	uj	n	0.42	0.21	0.088	8330B	S
280-111344-1	CBLmw-001-D-062018-GW	280-111344-4	Ground Water	2,6-Dinitrotoluene	606-20-2	µg/L	0.21	u h q	uj	n	0.21	0.21	0.068	8330B	S
280-111344-1	CBLmw-001-D-062018-GW	280-111344-4	Ground Water	2-Amino-4,6-dinitrotoluene	35572-78-2	µg/L	0.13	u h q	uj	n	0.21	0.13	0.053	8330B	S
280-111344-1	CBLmw-002-062018-GW	280-111344-5	Ground Water	Sodium	7440-23-5	µg/L	5000	j	u	n	5000	350	120	6010C	B
280-111344-1	CBLmw-002-062018-GW	280-111344-5	Ground Water	Barium	7440-39-3	µg/L	51	q	j	y	3	0.95	0.29	6020A	CC
280-111344-1	CBLmw-002-062018-GW	280-111344-5	Ground Water	1,3,5-Trinitrobenzene	99-35-4	µg/L	0.49	u q	uj	n	1.2	0.49	0.25	8330B	S L
280-111344-1	CBLmw-002-062018-GW	280-111344-5	Ground Water	1,3-Dinitrobenzene	99-65-0	µg/L	0.25	u q	uj	n	0.49	0.25	0.11	8330B	S L
280-111344-1	CBLmw-002-062018-GW	280-111344-5	Ground Water	2,4,6-Trinitrotoluene	118-96-7	µg/L	0.25	u q	uj	n	0.49	0.25	0.089	8330B	S L
280-111344-1	CBLmw-002-062018-GW	280-111344-5	Ground Water	2,4-Dinitrotoluene	121-14-2	µg/L	0.25	u q	uj	n	0.49	0.25	0.1	8330B	S L
280-111344-1	CBLmw-002-062018-GW	280-111344-5	Ground Water	2,6-Dinitrotoluene	606-20-2	µg/L	0.25	u q	uj	n	0.25	0.25	0.08	8330B	S L
280-111344-1	CBLmw-002-062018-GW	280-111344-5	Ground Water	2-Amino-4,6-dinitrotoluene	35572-78-2	µg/L	0.15	u q	uj	n	0.25	0.15	0.063	8330B	S L
280-111344-1	CBLmw-002-062018-GW	280-111344-5	Ground Water	2-Nitrotoluene	88-72-2	µg/L	0.25	u q	uj	n	0.49	0.25	0.11	8330B	S L
280-111344-1	CBLmw-002-062018-GW	280-111344-5	Ground Water	3-Nitrotoluene	99-08-1	µg/L	0.25	u q	uj	n	0.49	0.25	0.1	8330B	S L
280-111344-1	CBLmw-002-062018-GW	280-111344-5	Ground Water	4-Amino-2,6-dinitrotoluene	19406-51-0	µg/L	0.15	u q	uj	n	0.25	0.15	0.071	8330B	S L
280-111344-1	CBLmw-002-062018-GW	280-111344-5	Ground Water	4-Nitrotoluene	99-99-0	µg/L	0.49	u q	uj	n	1.2	0.49	0.25	8330B	S L
280-111344-1	CBLmw-002-062018-GW	280-111344-5	Ground Water	HMX	2691-41-0	µg/L	0.25	u m q	uj	n	0.49	0.25	0.11	8330B	S
280-111344-1	CBLmw-002-062018-GW	280-111344-5	Ground Water	Nitrobenzene	98-95-3	µg/L	0.25	u q	uj	n	0.49	0.25	0.11	8330B	S L
280-111344-1	CBLmw-002-062018-GW	280-111344-5	Ground Water	Nitroglycerin	55-63-0	µg/L	2.5	u q	uj	n	3.7	2.5	1.1	8330B	S
280-111344-1	CBLmw-002-062018-GW	280-111344-5	Ground Water	PETN	78-11-5	µg/L	1.5	u q	uj	n	2.5	1.5	0.51	8330B	S
280-111344-1	CBLmw-002-062018-GW	280-111344-5	Ground Water	RDX	121-82-4	µg/L	0.15	u q	uj	n	0.25	0.15	0.064	8330B	S
280-111344-1	CBLmw-002-062018-GW	280-111344-5	Ground Water	Tetryl	479-45-8	µg/L	0.25	u q	uj	n	0.3	0.25	0.098	8330B	S

280-111344-1	CBLmw-002-062018-GW	280-111344-5	Ground Water	2,4-Dinitrotoluene	121-14-2	µg/L	0.13	j h q	j	y	0.43	0.21	0.089	8330B	S
280-111344-1	CBLmw-002-062018-GW	280-111344-5	Ground Water	2,6-Dinitrotoluene	606-20-2	µg/L	0.081	j h q	j	y	0.21	0.21	0.069	8330B	S
280-111344-1	CBLmw-002-062018-GW	280-111344-5	Ground Water	2-Amino-4,6-dinitrotoluene	35572-78-2	µg/L	0.13	u h q	uj	n	0.21	0.13	0.054	8330B	S
280-111344-1	LL1mw-088-062118-GW	280-111344-6	Ground Water	Sodium	7440-23-5	µg/L	27000	v	j	y	5000	350	120	6010C	CC
280-111344-1	LL1mw-088-062118-GW	280-111344-6	Ground Water	Barium	7440-39-3	µg/L	40	q	j	y	3	0.95	0.29	6020A	CC
280-111344-1	FWGmw-021-062118-GW	280-111344-7	Ground Water	Sodium	7440-23-5	µg/L	3500	j	j	y	5000	350	120	6010C	CC
280-111344-1	FWGmw-021-062118-GW	280-111344-7	Ground Water	Barium	7440-39-3	µg/L	14	q	j	y	3	0.95	0.29	6020A	CC
280-111344-1	FWGmw-021-062118-GW	280-111344-7	Ground Water	bis(2-Ethylhexyl)phthalate	117-81-7	µg/L	1.9	u	uj	n	9.5	1.9	0.53	8270D	S
280-111344-1	FWGmw-021-062118-GW	280-111344-7	Ground Water	Butyl benzyl phthalate	85-68-7	µg/L	1.9	u	uj	n	19	1.9	0.95	8270D	S
280-111344-1	FWGmw-021-062118-GW	280-111344-7	Ground Water	Diethylphthalate	84-66-2	µg/L	0.95	u	uj	n	19	0.95	0.36	8270D	S
280-111344-1	FWGmw-021-062118-GW	280-111344-7	Ground Water	Dimethyl phthalate	131-11-3	µg/L	0.47	u	uj	n	19	0.47	0.2	8270D	S
280-111344-1	FWGmw-021-062118-GW	280-111344-7	Ground Water	Di-N-Butyl phthalate	84-74-2	µg/L	4.2	u	uj	n	19	4.2	1.1	8270D	S
280-111344-1	FWGmw-021-062118-GW	280-111344-7	Ground Water	Di-N-Octyl phthalate	117-84-0	µg/L	0.95	u	uj	n	19	0.95	0.33	8270D	S
280-111344-1	FWGmw-021-062118-GW	280-111344-7	Ground Water	RDX	121-82-4	µg/L	0.11	j j1 m	j	y	0.2	0.12	0.053	8330B	Q
280-111344-1	FWGmw-021-062118-GW	280-111344-7	Ground Water	2-Amino-4,6-dinitrotoluene	35572-78-2	µg/L	0.42	j1	j	y	0.2	0.12	0.052	8330B	Q
280-111344-1	FWGmw-021-062118-GW	280-111344-7	Ground Water	4-Amino-2,6-dinitrotoluene	19406-51-0	µg/L	0.43	j1	j	y	0.2	0.12	0.059	8330B	Q
280-111344-1	CBLmw-003-062118-GW	280-111344-9	Ground Water	Sodium	7440-23-5	µg/L	5000	j	u	n	5000	350	120	6010C	B
280-111344-1	CBLmw-003-062118-GW	280-111344-9	Ground Water	Barium	7440-39-3	µg/L	38	q	j	y	3	0.95	0.29	6020A	CC
280-111344-1	CBLmw-003-062118-GW	280-111344-9	Ground Water	Hexachlorocyclopentadiene	77-47-4	µg/L	28	u q	r	n	47	28	9.5	8270D	L
280-111344-1	CBLmw-003-062118-GW	280-111344-9	Ground Water	Nitrate as N	14797-55-8	mg/L	0.91	h	j	y	0.5	0.1	0.042	9056A	H

Data Validation Report
Remedial Investigation at RVAAP-66 Facility Wide Groundwater
Semi-Annual & Quarterly Sampling Event for June 2018

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

Contract Number: W9133L-14-D-0008
Task Order Number: 0003

Laboratory SDG 280-111344-2

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CONTRACTOR STATEMENT OF INDEPENDENT TECHNICAL REVIEW

TEC-WESTON Joint Venture has completed this Data Validation Report. Data validation was performed by the Validation Chemist and Secondary QC Review was performed by a Senior Chemist. Signatures indicate the report is approved for release.

PC for Erica Fisher — 10/15/18

Erica Fisher, Validation Chemist, TEC-WESTON JV — Date

Peter Chapman — 10/15/18

Peter Chapman, Senior Chemist, TEC-WESTON JV — Date

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INTRODUCTION

This report summarizes the results of the **EPA Stage 2B** data validation performed on groundwater samples and quality control (QC) sample data for the Remedial Investigation for RVAAP-66, Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio. Results are reported in laboratory sample delivery group (SDG) **280-111344-2**.

TestAmerica, Inc., Canton, Ohio performed the analyses listed in the table below:

Parameters	Analytical Method	Laboratory Location
Sulfate/Nitrite	SW-846 Method 9056A	Arvada, CO

The data were reviewed using guidance and quality control criteria documented in the *Draft Remedial Investigation Work Plan for Groundwater and Environmental Services for RVAAP-66 Facility-Wide Groundwater, Appendix A: Sampling Analysis Plan, A.2: Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio Attachment A Data Validation Evaluation Sheets (January 2016)* which are based on the *Department of Defense Quality Systems Manual (DoD QSM), Version 5.0*; *USEPA National Functional Guidelines for Organic Data Review* (*EPA 2014*); and *USEPA National Functional Guidelines for Inorganic Data Review* (*EPA 2014*), the analytical methods, and professional judgment.

During data validation, qualifiers are assigned to assist in proper data interpretation. If values are estimated, data may be used for site evaluation purposes but reasons for data qualification should be taken into consideration when interpreting sample concentrations. Data that have been rejected (R) should not be used for any purpose. Results with no qualifiers meet all data quality goals as outlined in the UFP-QAPP.

The following samples were validated:

Sample ID	Laboratory ID	Sample Date	Matrix	QC Sample	SO4/NO2
CBLmw-003-062118-GW	280-111344-9	06/21/2018	Groundwater		✓
CBLmw-004-062118-GW	280-111344-10	06/21/2018	Groundwater		✓

DATA VALIDATION REPORT

1.1 DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative. All requested target analytes were reported for each sample.

1.2 SAMPLE RECEIPT

The samples were received by the laboratory on June 27, 2018; the samples were received in good condition, under chain-of-custody, and custody seals intact. Samples were properly preserved and cooler temperatures were less than 6°C.

1.3 TECHNICAL DATA VALIDATION

1.3.1 Sulfate/Nitrite by Method 9056A

The following parameters were evaluated and met the required criteria. No validation flags were assigned based on the following:

- LODs and LOQs
- LCS recoveries
- Method blank
- Initial calibration verification
- Continuing calibration verification
- Initial calibration blank
- Continuing calibration blank
- Field duplicate

The nitrate analyses were conducted past the 48 hour holding time as required by the method. Therefore, the non-detect and detected nitrate/nitrite results for these two samples were qualified as estimated values (UJ H).

No analytical or quality parameters requiring further discussion were identified for Method 9056A.

DATA VALIDATION TABLE

SDG	Field Sample ID	Lab Sample ID	Matrix	Parameter	Units	Result	Lab Flag	DV Flag	Detect	LOQ	LOD	MDL	Method	Reason Code
280-111344-2	CBLmw-003-062118-GW	280-111344-9	Ground Water	Nitrite	µg/L	100	u h	uj	n	500	100	49	9056A	H
280-111344-2	CBLmw-004-062118-GW	280-111421-10	Ground Water	Nitrite	µg/L	100	u h	uj	n	500	100	49	9056A	H

Data Validation Report
Remedial Investigation at RVAAP-66 Facility Wide Groundwater
Semi-Annual & Quarterly Sampling Event for June 2018

Former Ravenna Army Ammunition Plant
Portage and Trumbull Counties, Ohio

Contract Number: W9133L-14-D-0008

Task Order Number: 0003

Laboratory SDG 280-111377-1

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CONTRACTOR STATEMENT OF INDEPENDENT TECHNICAL REVIEW

TEC-WESTON Joint Venture has completed this Data Validation Report. Data validation was performed by the Validator and Secondary QC Review was performed by a Senior Chemist. Signatures indicate the report is approved for release.

Erica Fisher, Validator, TEC-WESTON JV — Date: 08/01/2018

Peter Chapman, Senior Chemist, TEC-WESTON JV — Date: 8/1/18

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INTRODUCTION

This report summarizes the results of the **EPA Stage 2B** data validation performed on groundwater samples and quality control (QC) sample data for the Remedial Investigation for RVAAP-66, Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio. Results are reported in laboratory sample delivery group (SDG) **280-111377-1**.

TestAmerica, Inc., Denver, Colorado performed the analyses listed in the table below:

Parameters	Analytical Method	Laboratory Location
Volatile Organic Compounds (VOCs)	8260B	Denver, CO
Semi-Volatile Organic Compounds (SVOCs)	8270D	Denver, CO
Explosives	8330B	Denver, CO
Metals	6010C/6020A/7470A	Denver, CO
Alkalinity	2320B	Denver, CO
Total Cyanide	9012B	Denver, CO
Sulfide	9034	Denver, CO

The data were reviewed using guidance and quality control criteria documented in the *Draft Remedial Investigation Work Plan for Groundwater and Environmental Services for RVAAP-66 Facility-Wide Groundwater, Appendix A: Sampling Analysis Plan, A.2: Uniform Federal Policy Quality Assurance Project Plan (UFP-QAPP) Former Ravenna Army Ammunition Plant, Portage and Trumbull Counties, Ohio Attachment A Data Validation Evaluation Sheets (January 2016)* which are based on the *Department of Defense Quality Systems Manual (DoD QSM), Version 5.0*; *USEPA National Functional Guidelines for Organic Data Review* (*EPA 2014*); and *USEPA National Functional Guidelines for Inorganic Data Review* (*EPA 2014*), the analytical methods, and professional judgment.

During data validation, qualifiers are assigned to assist in proper data interpretation. If values are estimated, data may be used for site evaluation purposes but reasons for data qualification should be taken into consideration when interpreting sample concentrations. Data that have been rejected (R) should not be used for any purpose. Results with no qualifiers meet all data quality goals as outlined in the UFP-QAPP.

The data was reviewed and validated by calculating Relative Percent Difference (RPD) between spiked sample values according to the *USEPA National Functional Guidelines for Organic Data*

Review (*EPA 2014*) and *USEPA National Functional Guidelines for Inorganic Data Review* (*EPA 2014*). Therefore, the RPDs were calculated using the percent recovery values as stated in the above referenced USEPA documents. SW-846 Methods were utilized for this project and they recommend using the actual spiked sample values to calculate RPD values. However, the laboratory used varying spike amounts due to sample aliquot and percent moisture differences which lead to variations in the spike amounts making it very difficult to compare the spiked sample values. These differences would have created poor precision results for the spiked sample values that were not necessarily indicative of the data quality. The use of comparing spike recovery values in this case was a much better indicator of analytical precision.

The following samples were validated:

Sample ID	Laboratory ID	Sample Date	Matrix	QC Sample	VOCs	SVOCs	Explosives	Metals	Arsenic	Total Cyanide	Alkalinity
FWGmw-007-062518-GW	280-111377-1	06/25/18	Groundwater			✓	✓	✓			
FBQmw-171-062518-GW	280-111377-2	06/25/18	Groundwater						✓	✓	✓
FBQmw-171-D-062518-GW	280-111377-3	06/25/18	Groundwater	Field Duplicate					✓	✓	✓
FBQmw-172-062518-GW	280-111377-4	06/25/18	Groundwater							✓	
LL11mw-005-062518-GW	280-111377-5	06/25/18	Groundwater							✓	
LL7mw-001-062518-GW	280-111377-6	06/25/18	Groundwater		✓	✓	✓	✓		✓	
LL7mw-006-62518-GW	280-111377-7	06/25/18	Groundwater				✓				
TB-062518-01	280-111377-8	06/25/18	Groundwater	Trip Blank	✓						

Some samples were analyzed for natural attenuation parameters. Natural attenuation parameters are reported, but not validated in accordance with the QAPP.

DATA VALIDATION REPORT

1.1 DATA PACKAGE COMPLETENESS

The laboratory submitted all required deliverables. The laboratory followed adequate corrective action processes and all anomalies were discussed in the case narrative. All requested target analytes were reported for each sample.

1.2 SAMPLE RECEIPT

The samples were received by the laboratory on June 26, 2018; the samples were received in good condition, under chain-of-custody, properly preserved and cooler temperatures were less than 4°C. The laboratory noted that the coolers were received without a custody seal present; however, the shipping tape was intact and no evidence of sample volume tampering was evident.

1.3 DEFINITIONS

Detection limit (DL): The smallest analyte concentration that can be demonstrated to be different from zero or a blank concentration with 99% confidence. At the DL, the false positive rate is 1%. A DL may be used as the lowest concentration for reliably reporting a detection of a specific matrix with a specific method with 99% confidence.

Limit of detection (LOD): The smallest concentration of a substance that must be present in a sample in order to be detected at the DL with 99% confidence. At the LOD, the false negative rate is 1%. An LOD may be used as the lowest concentration for reliably reporting a non-detect of a specific analyte in a specific matrix with a specific method with 99% confidence.

Limits of Quantitation (LOQ): The smallest concentration that produces a quantitative result with known and recorded precision and bias. For DoD/DOE projects, the LOQ shall be set at or above the concentration of the lowest initial calibration standard and within the calibration range.

The following validation flags and reason codes were applied:

Validation Flag	Reason Code	Description
UJ	Q	Estimated non-detection; professional judgement.
J	L	Estimated detection; LCS/LCSD percent recovery or RPD exceedance.
J	IC	Estimated detection; initial calibration criteria not met.

Validation Flag	Reason Code	Description
J	CC	Estimated detection; continuing calibration criteria not met.
UJ	CC	Estimated non-detection; continuing calibration criteria not met.

1.4 TECHNICAL DATA VALIDATION

1.4.1 Volatile Organic Compounds by Method 8260B

The following parameters were evaluated and met the required criteria. No validation flags were assigned based on the following:

- Holding times
- Method blanks
- MS/MSD recoveries and RPDs
- LODs and LOQs
- Instrument tuning
- Internal standard area counts
- Initial calibration
- Initial calibration verification
- Closing calibration verification
- Trip blank

All analytical or quality parameters requiring further discussion for Method 8260B are described in the sections below.

1.4.1.1 LCS/LCSD Recoveries and RPDs

All LCS/LCSD recoveries and RPDs were within control limits with the exception of the exceedances presented in the following table:

Analyte	LCS %R	LCSD %R	%R QC Limits	RPD	RPD Limits
Bromoethane	**168**	**164**	53-141	2	20
Chloroethane	**156**	**160**	60-138	2	20
Chloromethane	**144**	**143**	50-139	1	20
Vinyl chloride	**138**	**128**	58-137	**7**	20

%R = percent recovery
Bolded values are outside control limits.

The LCS and LCSD recoveries for bromoethane, chloroethane, chloromethane and vinyl chloride are above the acceptable limits, although the RPD was within acceptable limits. However, the analytes were not detected in the associated samples, therefore no qualification is necessary.

1.4.2 Semivolatile Organic Compounds by Method 8270D

The following parameters were evaluated and met the required criteria. No validation flags were assigned based on the following:

- Holding times
- Method blanks
- Surrogate recoveries
- LCS/LCSD recoveries and RPDs
- LODs and LOQs
- Instrument tuning
- Internal standard area counts
- Initial calibration
- Initial calibration verification
- Continuing calibration verification
- Closing calibration verification
- Field duplicates

1.4.3 Explosives by Method 8330B

The following parameters were evaluated and met the required criteria. No validation flags were assigned:

- Holding times
- Method blank
- Surrogate recoveries
- LCS/LCSD recoveries and RPDs
- Initial calibration
- Initial calibration verification
- LODs and LOQs

All analytical or quality parameters requiring further discussion for Method 8330B are described in the sections below.

1.4.3.1 Sample Preparation

Samples FWGmw-007-062518-GW, LL7mw-001-062518-GW and LL7mw-006-62518-GW were filtered prior to analysis to reduce matrix interferences.

1.4.3.2 Continuing Calibration Verifications

The percent difference (%D) for 2-nitrotoluene (-32.9%), 2,4,6-trinitrotoluene (-33.8%) and PETN (-31.1%) exceeded the QC limit (±20%) on the secondary column for continuing calibration verification sample CCV 280-421027/7 bracketing the samples in the SDG. All associated sample results are therefore qualified estimated (UJ CC).

The percent difference (%D) for 2-nitrotoluene (-33.5%) 3-nitrotoluene (-21.5%), 2,6-dinitrotoluene (-23.5%), 2,4,6-trinitrotoluene (-37.3%) and PETN (-33.6%) exceeded the QC limit (±20%) on the second column for continuing calibration verification sample CCV 280-421027/18

bracketing the samples in this SDG. All associated sample results are therefore qualified estimated (UJ CC).

1.4.3.3 Second Column Confirmation

The RPD between the primary and secondary column (40.1%) marginally exceeded the acceptable limit (40%) for RDX in sample LL7mw-006-62518-GW and is therefore qualified estimated (J Q).

1.4.4 Total Metals by Method 6010C/6020A/7470A

The following parameters were evaluated and met the required criteria. No validation flags were assigned based on the following:

- Holding times
- Method blank
- LODs and LOQs
- LCS/LCSD recoveries and RPDs
- Post digestion spike
- Serial dilution
- Initial and continuing calibration blanks
- Contract required detection limit standard
- Instrument tuning
- Interference check solutions
- Field duplicate

All analytical or quality issues requiring further discussion for Methods 6010C, 6020A, and/or 7470A are described in the sections below.

1.4.4.1 Initial/Continuing Calibrations Verifications

Beryllium (126%) recovered above control limits (80-120%) in the low-level initial calibration verification ICVL 280-42124/11. Beryllium (125%) also recovered above control limits in the low-level continuing calibration verification 280-421124/206. All associated samples are qualified estimated (J/UJ IC/CC).

Manganese (126%) recovered above control limits (80-120%) in the low-level continuing calibration verification CCVL 280-421124/193. All associated sample results are qualified estimated (J/CC).

1.4.5 Total Cyanide by Method 9012B

The following parameters were evaluated and met the required criteria. No validation flags were assigned based on the following:

- Holding times
- LODs and LOQs
- Method blank
- MS/MSD sample recovery and RPD
- Initial calibration verification
- Continuing calibration verification
- Initial calibration blank
- Continuing calibration blank
- Low and high level control sample recoveries
- Field duplicate

All analytical or quality issues requiring further discussion for Methods 9012B are described in the sections below.

1.4.5.1 LCS/LCSD Recoveries and RPDs

Total cyanide recovered above the control limits (83-116%) in the LCS (133%) and LCSD (131%), though the RPD (1%) was within control limits (20%). Total cyanide was detected in all associated samples below the LOQ and are therefore qualified estimated (J L).

1.4.6 Alkalinity by Method 2320B

The following parameters were evaluated and met the required criteria. No validation flags were assigned based on the following:

- Holding times
- LODs and LOQs
- LCS recoveries
- Initial calibration verification
- Continuing calibration verification
- Initial calibration blank
- Field duplicate

All analytical or quality issues requiring further discussion for Methods 2320B are described in the sections below.

1.4.6.1 Method Blanks

Alkalinity (2.21 mg/L) was detected in the method blank at a concentration below the LOQ (5.0 mg/L). Alkalinity was detected at a concentration above the LOQ in all associated samples; therefore, no qualification was necessary.

1.4.6.2 Continuing Calibration Blanks

Alkalinity was detected in one continuing calibration blanks (1.64 mg/L) below the LOQ (5 mg/L). Alkalinity was detected at a concentration above the LOQ in all associated samples; therefore, no qualification was necessary.

DATA VALIDATION TABLE

SDG	Field Sample ID	Lab Sample ID	Matrix	Parameter	CAS Number	Units	Result	Lab Flag	DV Flag	Detection	LOQ	LOD	MDL	AnalyticMethod	Reason Code
280-111377-1	FWGmw-007-062518-GW	280-111377-1	Ground Water	2,4,6-Trinitrotoluene	118-96-7	µg/L	0.21	u	uj	n	0.43	0.21	0.077	Explosives	CC
280-111377-1	FWGmw-007-062518-GW	280-111377-1	Ground Water	2,6-Dinitrotoluene	606-20-2	µg/L	0.21	u	uj	n	0.43	0.21	0.077	Explosives	CC
280-111377-1	FWGmw-007-062518-GW	280-111377-1	Ground Water	2-Nitrotoluene	88-72-2	µg/L	0.21	u	uj	n	0.42	0.21	0.091	Explosives	CC
280-111377-1	FWGmw-007-062518-GW	280-111377-1	Ground Water	3-Nitrotoluene	99-08-1	µg/L	0.21	u	uj	n	0.42	0.21	0.089	Explosives	CC
280-111377-1	FWGmw-007-062518-GW	280-111377-1	Ground Water	PETN	78-11-5	µg/L	1.3	u	uj	n	2.1	1.3	0.44	Explosives	CC
280-111377-1	FWGmw-007-062518-GW	280-111377-1	Ground Water	Beryllium	7440-41-7	µg/L	0.12	j	j	y	1.0	0.30	0.080	Metals	IC CC
280-111377-1	FWGmw-007-062518-GW	280-111377-1	Ground Water	Manganese	7439-96-5	µg/L	170		j	y	3.5	0.95	0.31	Metals	CC
280-111377-1	FWGmw-007-062518-GW	280-111377-1	Ground Water	Total Cyanide	57-12-5	µg/L	3.5	jq	j	y	10	5.0	2.0	Total Cyanide	L
280-111377-1	FBQmw-171-D-062518-GW	280-111377-3	Ground Water	Total Cyanide	57-12-5	µg/L	3.2	jq	j	y	10	5.0	2.0	Total Cyanide	L
280-111377-1	FBQmw-172-062518-GW	280-111377-4	Ground Water	Total Cyanide	57-12-5	µg/L	2.3	jq	j	y	10	5.0	2.0	Total Cyanide	L
280-111377-1	LL11mw-005-062518-GW	280-111377-5	Ground Water	Total Cyanide	57-12-5	µg/L	2.1	jq	j	y	10	5.0	2.0	Total Cyanide	L
280-111377-1	LL7mw-001-062518-GW	280-111377-6	Ground Water	2,4,6-Trinitrotoluene	118-96-7	µg/L	0.41	u	uj	n	1.0	0.41	0.20	Explosives	CC
280-111377-1	LL7mw-001-062518-GW	280-111377-6	Ground Water	2,6-Dinitrotoluene	606-20-2	µg/L	0.21	u	uj	n	0.21	0.21	0.069	Explosives	CC
280-111377-1	LL7mw-001-062518-GW	280-111377-6	Ground Water	2-Nitrotoluene	88-72-2	µg/L	0.21	u	uj	n	0.43	0.21	0.091	Explosives	CC
280-111377-1	LL7mw-001-062518-GW	280-111377-6	Ground Water	3-Nitrotoluene	99-08-1	µg/L	0.21	u m	uj	n	0.43	0.21	0.089	Explosives	CC
280-111377-1	LL7mw-001-062518-GW	280-111377-6	Ground Water	PETN	78-11-5	µg/L	1.3	u	uj	n	2.1	1.3	0.43	Explosives	CC
280-111377-1	LL7mw-001-062518-GW	280-111377-6	Ground Water	Beryllium	7440-41-7	µg/L	0.32	j	j	y	1.0	0.30	0.080	Metals	IC CC
280-111377-1	LL7mw-001-062518-GW	280-111377-6	Ground Water	Manganese	7439-96-5	µg/L	430		j	y	3.5	0.95	0.31	Metals	CC
280-111377-1	LL7mw-001-062518-GW	280-111377-6	Ground Water	Total Cyanide	57-12-5	µg/L	3.8	jq	j	y	10	5.0	2.0	Total Cyanide	L
280-111377-1	LL7mw-006-062518-GW	280-111377-7	Ground Water	2,4,6-Trinitrotoluene	118-96-7	µg/L	0.21	u	uj	n	0.43	0.21	0.077	Explosives	CC
280-111377-1	LL7mw-006-062518-GW	280-111377-7	Ground Water	2,6-Dinitrotoluene	606-20-2	µg/L	0.21	u q	uj	n	0.43	0.21	0.091	Explosives	CC
280-111377-1	LL7mw-006-062518-GW	280-111377-7	Ground Water	2-Nitrotoluene	88-72-2	µg/L	0.21	u q	uj	n	0.43	0.21	0.089	Explosives	CC
280-111377-1	LL7mw-006-062518-GW	280-111377-7	Ground Water	3-Nitrotoluene	99-08-1	µg/L	0.13	u q	uj	n	0.21	0.13	0.061	Explosives	CC
280-111377-1	LL7mw-006-062518-GW	280-111377-7	Ground Water	2-Nitrotoluene	88-72-2	µg/L	0.21	u q	uj	n	0.43	0.21	0.089	Explosives	CC
280-111377-1	LL7mw-006-062518-GW	280-111377-7	Ground Water	3-Nitrotoluene	99-08-1	µg/L	0.13	u q	uj	n	0.21	0.13	0.061	Explosives	CC
280-111377-1	LL7mw-006-062518-GW	280-111377-7	Ground Water	PETN	78-11-5	µg/L	0.43	u q	uj	n	1.1	0.43	0.21	Explosives	CC
280-111377-1	LL7mw-006-062518-GW	280-111377-7	Ground Water	RDX	121-82-4	µg/L	0.43	m j1	uj	n	0.21	0.13	0.056	Explosives	Q

LABORATORY DATA CONSULTANTS, INC.
2701 Loker Ave. West, Suite 220, Carlsbad, CA 92010 Bus: 760-827-1100 Fax: 760-827-1099

Cardno
2496 Old Ivy Road, Suite 300
Charlottesville, VA 22903
ATTN: Peter Chapman

August 7, 2018

SUBJECT: Ravenna, Ohio, Data Validation

Dear Mr. Chapman,

Enclosed are the final validation reports for the fractions listed below. This SDG was received on July 31, 2018. Attachment 1 is a summary of the samples that were reviewed for each analysis.

LDC Project #42791:

SDG #	Fraction
280-111421-1	Volatiles, Semivolatiles, Polynuclear Aromatic Hydrocarbons, Chlorinated Pesticides, Polychlorinated Biphenyls, Metals, Wet Chemistry, Explosives, Nitroguanidine, Perchlorate

The data validation was performed under Stage 4 guidelines. The analyses were validated using the following documents, as applicable to each method:

- The Final Remedial Investigation Work Plan for Groundwater and Environmental Investigation Services for RVAAP-66 Facility-Wide Groundwater Former Ravenna Army Ammunition Plant Portage and Trumbull Counties, Ohio; December 20, 2016
- U.S. Department of Defense, Quality Systems Manual, for Environmental Laboratories, Version 5.0; July 2013
- USEPA National Functional Guidelines for Superfund Organic Methods Data Review; August 2014
- USEPA National Functional Guidelines for Inorganic Superfund Data Review; August 2014
- EPA SW 846, Third Edition, Test Methods for Evaluating Solid Waste, update 1, July 1992; update IIA, August 1993; update II, September 1994; update IIB, January 1995; update III, December 1996; update IIIA, April 1998; IIIB, November 2004; update IV, February 2007, update V, July 2014

Please feel free to contact us if you have any questions.

Sincerely,

Pei Geng
Project Manager/Senior Chemist

5,609 pages-DL 1 WEEK TAT Attachment 1

Stage 4 EDD — LDC #42791 (Cardno, GS, Inc-Charlottesville, VA / Ravenna, Ohio)

LDC	SDG#	DATE REC'D	(3) DATE DUE	VOA (8260B)		SVOA (8270D)		PAHs (8270D -SIM)		Pest. (8081B)		PCBs (8082A)		Metals (SW846)		Hg (7470A)		Expl. (8330B)		Nitroguanidine (8330)		CLO_4 (6860)		Alk. (2320B)		S= (9034)		Cl,SO4 NO3-N (9056A)		CN- (9012B)		Nitro celluose (353.2)			
Matrix:	Water/Soil			W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S
A	280-111421-1	07/31/18	08/07/18	7	0	14	0	4	0	3	0	2	0	11	0	11	0	11	0	2	0	2	0	2	0	2	0	4	0	10	0	2	0		
Total	J/PG			7	0	14	0	4	0	3	0	2	0	11	0	11	0	11	0	2	0	2	0	2	0	2	0	4	0	10	0	2	0	0	87

Shaded cells indicate Stage 4 validation (all other cells are Stage 2B validation). Sample counts do not include MS, MSD, or DUP's.

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Ravenna, Ohio

LDC Report Date: August 3, 2018

Parameters: Volatiles

Validation Level: Stage 4

Laboratory: TestAmerica, Inc.

Sample Delivery Group (SDG): 280-111421-1

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
NTAmw-119-062518-GW	280-111421-8	Water	06/25/18
NTAmw-119-D-062518-GW	280-111421-9	Water	06/25/18
TB-062518-02	280-111421-12	Water	06/25/18
DETmw-003-D-062618-GW	280-111421-16	Water	06/26/18
DETmw-003-062618-GW	280-111421-18	Water	06/26/18
LL10mw-003-062618-GW	280-111421-19	Water	06/26/18
TB-062618-01	280-111421-20	Water	06/26/18
LL10mw-003-062618-GWMS	280-111421-19MS	Water	06/26/18
LL10mw-003-062618-GWMSD	280-111421-19MSD	Water	06/26/18

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with The Final Remedial Investigation Work Plan for Groundwater and Environmental Investigation Services for RVAAP-66 Facility-Wide Groundwater Former Ravenna Army Ammunition Plant Portage and Trumbull Counties, Ohio (December 20, 2016), the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013), and a modified outline of the USEPA National Functional Guidelines (NFG) for Superfund Organic Methods Data Review (August 2014). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following method:

Volatile Organic Compounds (VOCs) by Environmental Protection Agency (EPA) SW 846 Method 8260B

All sample results were subjected to Stage 4 data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The compound or analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The compound or analyte was analyzed for and positively identified by the laboratory; however the compound or analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The compound or analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected compound or analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition and cooler temperatures upon receipt met validation criteria.

All technical holding time requirements were met.

II. GC/MS Instrument Performance Check

A bromofluorobenzene (BFB) tune was performed at 12 hour intervals.

All ion abundance requirements were met.

III. Initial Calibration and Initial Calibration Verification

An initial calibration was performed as required by the method.

For compounds where average relative response factors (RRFs) were utilized, the percent relative standard deviations (%RSD) were less than or equal to 15.0%.

In the case where the laboratory used a calibration curve to evaluate the compounds, all coefficients of determination (r^2) were greater than or equal to 0.990.

Average relative response factors (RRF) for all compounds were within validation criteria.

The percent differences (%D) of the initial calibration verification (ICV) standard were less than or equal to 20.0% for all compounds.

IV. Continuing Calibration

Continuing calibration was performed at the required frequencies.

The percent differences (%D) were less than or equal to 20.0% for all compounds.

The percent differences (%D) of the ending continuing calibration verifications (CCVs) were less than or equal to 50.0% for all compounds.

All of the continuing calibration relative response factors (RRF) were within validation criteria.

V. Laboratory Blanks

Laboratory blanks were analyzed as required by the method. No contaminants were found in the laboratory blanks.

VI. Field Blanks

Samples TB-062518-02 and TB-062618-01 were identified as trip blanks. No contaminants were found with the following exceptions:

Blank ID	Collection Date	Compound	Concentration	Associated Samples
TB-062618-01	06/26/18	Methylene chloride	0.78 ug/L	NTAmw-119-062518-GW NTAmw-119-D-062518-GW DETmw-003-D-062618-GW DETmw-003-062618-GW LL10mw-003-062618-GW

Sample concentrations were compared to concentrations detected in the field blanks. The sample concentrations were either not detected or were significantly greater than the concentrations found in the associated field blanks with the following exceptions:

Sample	Compound	Reported Concentration	Modified Final Concentration
DETmw-003-D-062618-GW	Methylene chloride	0.62 ug/L	5.0U ug/L
DETmw-003-062618-GW	Methylene chloride	0.43 ug/L	5.0U ug/L

VII. Surrogates

Surrogates were added to all samples as required by the method. All surrogate recoveries (%R) were within QC limits.

VIII. Matrix Spike/Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicate (MSD) sample analysis was performed on an associated project sample. Percent recoveries (%R) were within QC limits with the following exceptions:

Spike ID (Associated Samples)	Compound	MS (%R) (Limits)	MSD (%R) (Limits)	Flag	A or P
LL10mw-003-062618-GWMS/MSD (LL10mw-003-062618-GW)	Carbon tetrachloride	-	69 (72-136)	J (all detects)	A

Relative percent differences (RPD) were within QC limits.

IX. Laboratory Control Samples

Laboratory control samples (LCS) and laboratory control samples duplicates (LCSD) were analyzed as required by the method. Percent recoveries (%R) were within QC limits with the following exceptions:

LCS ID (Associated Samples)	Compound	LCS %R (Limits)	LCSD %R (Limits)	Flag	A or P
LCS/D 280-421459/8,9 (NTAmw-119-062518-GW NTAmw-119-D-062518-GW TB-062518-02)	Bromomethane Chloroethane Chloromethane Vinyl chloride	168 (53-141) 156 (60-138) 144 (50-139) 138 (58-137)	164 (53-141) 160 (60-138) 143 (50-139) -	NA	-

Relative percent differences (RPD) were within QC limits.

X. Field Duplicates

Samples NTAmw-119-062518-GW and NTAmw-119-D-062518-GW and samples DETmw-003-D-062618-GW and DETmw-003-062618-GW were identified as field duplicates. No results were detected in any of the samples with the following exceptions:

Compound	Concentration (ug/L)		RPD (Limits)	Difference (Limits)	Flag	A or P
	NTAmw-119-062518-GW	NTAmw-119-D-062518-GW				
Acetone	10	3.8	-	6.2 (≤10)	-	

Compound	Concentration (ug/L)		RPD (Limits)	Difference (Limits)	Flag	A or P
	DETmw-003-D-062618-GW	DETmw-003-062618-GW				
Acetone	5.2	6.5	-	1.3 (≤10)	-	-
Methylene chloride	0.62	0.43	-	0.19 (≤5.0)	-	-

XI. Internal Standards

All internal standard areas and retention times were within QC limits.

XII. Compound Quantitation

All compound quantitations met validation criteria.

XIII. Target Compound Identifications

All target compound identifications met validation criteria.

XIV. System Performance

The system performance was acceptable.

XV. Overall Assessment of Data

The analysis was conducted within all specifications of the method. No results were rejected in this SDG.

Due to MS/MSD %R, data were qualified as estimated in one sample.

Due to trip blank contamination, data were qualified as not detected in two samples.

The quality control criteria reviewed, other than those discussed above, were met and are considered acceptable. Sample results that were found to be estimated (J) are usable for limited purposes only. Based upon the data validation all other results are considered valid and usable for all purposes.

Ravenna, Ohio
Volatiles - Data Qualification Summary - SDG 280-111421-1

Sample	Compound	Flag	A or P	Reason
LL10mw-003-062618-GW	Carbon tetrachloride	J (all detects)	A	Matrix spike/Matrix spike duplicate (%R)

Ravenna, Ohio
Volatiles - Laboratory Blank Data Qualification Summary - SDG 280-111421-1

No Sample Data Qualified in this SDG

Ravenna, Ohio
Volatiles - Field Blank Data Qualification Summary - SDG 280-111421-1

Sample	Compound	Modified Final Concentration	A or P
DETmw-003-D-062618-GW	Methylene chloride	5.0U ug/L	A
DETmw-003-062618-GW	Methylene chloride	5.0U ug/L	A

LDC #: 42791A1 **VALIDATION COMPLETENESS WORKSHEET** Date: 08/02/18
SDG #: 280-111421-1 Stage 4 Page: 1 of 1
Laboratory: Test America, Inc. Reviewer: JV
2nd Reviewer:

METHOD: GC/MS Volatiles (EPA SW 846 Method 8260B)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A / A	
II.	GC/MS Instrument performance check	A	
III.	Initial calibration/ICV	A / A	ICAL ≤ 15%, r ICV ≤ 20%
IV.	Continuing calibration /ending	A	CCV ≤ 20/50%
V.	Laboratory Blanks	A	
VI.	Field blanks	SW	TB = *3, 7
VII.	Surrogate spikes	SW	
VIII.	Matrix spike/Matrix spike duplicates	SW	
IX.	Laboratory control samples	SW	LCS/D
X.	Field duplicates	SW	D = 1/2, 4/5
XI.	Internal standards	A	
XII.	Compound quantitation RL/LOQ/LODs	A	
XIII.	Target compound identification	A	
XIV.	System performance	A	
XV.	Overall assessment of data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; * ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID		Lab ID	Matrix	Date
+ 1 1	NTAmw-119-062518-GW	D1	280-111421-8	Water	06/25/18
+ 2 1	NTAmw-119-D-062518-GW	D1	280-111421-9	Water	06/25/18
- 3 1	TB-062518-02		280-111421-12	Water	06/25/18
+ 4 2	DETmw-003-D-062618-GW	D2	280-111421-16	Water	06/26/18
+ 5 2	DETmw-003-062618-GW	D2	280-111421-18	Water	06/26/18
+ 6 2	LL10mw-003-062618-GW		280-111421-19	Water	06/26/18
+ 7 2	TB-062618-01		280-111421-20	Water	06/26/18
8 2	LL10mw-003-062618-GWMS		280-111421-19MS	Water	06/26/18
9 2	LL10mw-003-062618-GWMSD		280-111421-19MSD	Water	06/26/18
10					

Notes:

1	MB 280-421459/11						
2	" -421566/6						

LDC #: 42791A1

VALIDATION FINDINGS CHECKLIST

Reviewer: JVG
2nd Reviewer:

Method: Volatiles (EPA SW 846 Method 8260B)

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
Were all technical holding times met?	✓			
Was cooler temperature criteria met?	✓			
II. GC/MS Instrument performance check				
Were the BFB performance results reviewed and found to be within the specified criteria?	✓			
Were all samples analyzed within the 12 hour clock criteria?	✓			
IIIa. Initial calibration				
Did the laboratory perform a 5 point calibration prior to sample analysis?	✓			
Were all percent relative standard deviations (%RSD) and relative response factors (RRF) within method criteria for all CCCs and SPCCs?	✓			
Was a curve fit used for evaluation? If yes, did the initial calibration meet the curve fit acceptance criteria of ≥ 0.990?	✓			
Were all percent relative standard deviations (%RSD) ≤ 30%/15% and relative response factors (RRF) ≥ 0.05?	✓			
IIIb. Initial Calibration Verification				
Was an initial calibration verification standard analyzed after each initial calibration for each instrument?	✓			
Were all percent differences (%D) ≤ 20% or percent recoveries (%R) 80-120%?	✓			
IV. Continuing calibration				
Was a continuing calibration standard analyzed at least once every 12 hours for each instrument?	✓			
Were all percent differences (%D) and relative response factors (RRF) within method criteria for all CCCs and SPCCs?	✓			
Were all percent differences (%D) ≤ 20% and relative response factors (RRF) ≥ 0.05?	✓			
V. Laboratory Blanks				
Was a laboratory blank associated with every sample in this SDG?	✓			
Was a laboratory blank analyzed at least once every 12 hours for each matrix and concentration?	✓			
Was there contamination in the laboratory blanks? If yes, please see the Blanks validation completeness worksheet.		✓		
VI. Field blanks				
Were field blanks were identified in this SDG?	✓			
Were target compounds detected in the field blanks?	✓			
VII. Surrogate spikes				
Were all surrogate percent recovery (%R) within QC limits?	*	✓		
If the percent recovery (%R) for one or more surrogates was out of QC limits, was a reanalysis performed to confirm samples with %R outside of criteria?		✓		

LDC #: 42791 A1

VALIDATION FINDINGS CHECKLIST

Reviewer: JWG
2nd Reviewer:

Validation Area	Yes	No	NA	Findings/Comments
VIII. Matrix spike/Matrix spike duplicates				
Were a matrix spike (MS) and matrix spike duplicate (MSD) analyzed for each matrix in this SDG? If no, indicate which matrix does not have an associated MS/MSD. Soil / Water.	✓			
Was a MS/MSD analyzed every 20 samples of each matrix?	✓			
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?		✓		
IX. Laboratory control samples				
Was an LCS analyzed for this SDG?	✓			
Was an LCS analyzed per analytical batch?	✓			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?		✓		
X. Field duplicates				
Were field duplicate pairs identified in this SDG?	✓			
Were target compounds detected in the field duplicates?	✓			
XI. Internal standards				
Were internal standard area counts within -50% to +100% of the associated calibration standard?	✓			
Were retention times within + 30 seconds of the associated calibration standard?	✓			
XII. Compound quantitation				
Were the correct internal standard (IS), quantitation ion and relative response factor (RRF) used to quantitate the compound?	✓			
Were compound quantitation and RLs adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	✓			
XIII. Target compound identification				
Were relative retention times (RRT's) within ± 0.06 RRT units of the standard?	✓			
Did compound spectra meet specified EPA "Functional Guidelines" criteria?	✓			
Were chromatogram peaks verified and accounted for?	✓			
XIV. System performance				
System performance was found to be acceptable.	✓			
XV. Overall assessment of data				
Overall assessment of data was found to be acceptable.	✓			

TARGET COMPOUND WORKSHEET

METHOD: VOA

A. Chloromethane	AA. Tetrachloroethene	AAA. 1,3,5-Trimethylbenzene	AAAA. Ethyl tert-butyl ether	A1. 1,3-Butadiene	A2.
B. Bromomethane	BB. 1,1,2,2-Tetrachloroethane	BBB. 4-Chlorotoluene	BBBB. tert-Amyl methyl ether	B1. Hexane	B2.
C. Vinyl choride	CC. Toluene	CCC. tert-Butylbenzene	CCCC. 1-Chlorohexane	C1. Heptane	C2.
D. Chloroethane	DD. Chlorobenzene	DDD. 1,2,4-Trimethylbenzene	DDDD. Isopropyl alcohol	D1. Propylene	D2.
E. Methylene chloride	EE. Ethylbenzene	EEE. sec-Butylbenzene	EEEE. Acetonitrile	E1. Freon 11	E2.
F. Acetone	FF. Styrene	FFF. 1,3-Dichlorobenzene	FFFF. Acrolein	F1. Freon 12	F2.
G. Carbon disulfide	GG. Xylenes, total	GGG. p-Isopropyltoluene	GGGG. Acrylonitrile	G1. Freon 113	G2.
H. 1,1-Dichloroethene	HH. Vinyl acetate	HHH. 1,4-Dichlorobenzene	HHHH. 1,4-Dioxane	H1. Freon 114	H2.
I. 1,1-Dichloroethane	II. 2-Chloroethylvinyl ether	III. n-Butylbenzene	IIII. Isobutyl alcohol	I1. 2-Nitropropane	I2.
J. 1,2-Dichloroethene, total	JJ. Dichlorodifluoromethane	JJJ. 1,2-Dichlorobenzene	JJJJ. Methacrylonitrile	J1. Dimethyl disulfide	J2.
K. Chloroform	KK. Trichlorofluoromethane	KKK. 1,2,4-Trichlorobenzene	KKKK. Propionitrile	K1. 2,3-Dimethyl pentane	K2.
L. 1,2-Dichloroethane	LL. Methyl-tert-butyl ether	LLL. Hexachlorobutadiene	LLLL. Ethyl ether	L1. 2,4-Dimethyl pentane	L2.
M. 2-Butanone	MM. 1,2-Dibromo-3-chloropropane	MMM. Naphthalene	MMMM. Benzyl chloride	M1. 3,3-Dimethyl pentane	M2.
N. 1,1,1-Trichloroethane	NN. Methyl ethyl ketone	NNN. 1,2,3-Trichlorobenzene	NNNN. Iodomethane	N1. 2-Methylpentane	N2.
O. Carbon tetrachloride	OO. 2,2-Dichloropropane	OOO. 1,3,5-Trichlorobenzene	OOOO.1,1-Difluoroethane	O1. 3-Methylpentane	O2.
P. Bromodichloromethane	PP. Bromochloromethane	PPP. trans-1,2-Dichloroethene	PPPP. Tetrahydrofuran	P1. 3-Ethylpentane	P2.
Q. 1,2-Dichloropropane	QQ. 1,1-Dichloropropene	QQQ. cis-1,2-Dichloroethene	QQQQ. Methyl acetate	Q1. 2,2-Dimethylpentane	Q2.
R. cis-1,3-Dichloropropene	RR. Dibromomethane	RRR. m,p-Xylenes	RRRR. Ethyl acetate	R1. 2,2,3- Trimethylbutane	R2.
S. Trichloroethene	SS. 1,3-Dichloropropane	SSS. o-Xylene	SSSS. Cyclohexane	S1. 2,2,4-Trimethylpentane	S2.
T. Dibromochloromethane	TT. 1,2-Dibromoethane	TTT. 1,1,2-Trichloro-1,2,2-trifluoroethane	TTTT. Methylcyclohexane	T1. 2-Methylhexane	T2.
U. 1,1,2-Trichloroethane	UU. 1,1,1,2-Tetrachloroethane	UUU. 1,2-Dichlorotetrafluoroethane	UUUU. Allyl chloride	U1. Nonanal	U2.
V. Benzene	VV. Isopropylbenzene	VVV. 4-Ethyltoluene	VVVV. Methyl methacrylate	V1. 2-Methylnaphthalene	V2.
W. trans-1,3-Dichloropropene	WW. Bromobenzene	WWW. Ethanol	WWWW. Ethyl methacrylate	W1. Methanol	W2.
X. Bromoform	XX. 1,2,3-Trichloropropane	XXX. Di-isopropyl ether	XXXX. cis-1,4-Dichloro-2-butene	X1. 1,2,3-Trimethylbenzene	X2.
Y. 4-Methyl-2-pentanone	YY. n-Propylbenzene	YYY. tert-Butanol	YYYY. trans-1,4-Dichloro-2-butene	Y1.	Y2.
Z. 2-Hexanone	ZZ. 2-Chlorotoluene	ZZZ. tert-Butyl alcohol	ZZZZ. Pentachloroethane	Z1.	Z2.

LDC #: 42791 A1

VALIDATION FINDINGS WORKSHEET
Field Blanks

Reviewer: JVG
2nd Reviewer:

METHOD: GC/MS VOA (EPA SW 846 Method 8260B)

(Y) N N/A Were field blanks identified in this SDG?
Y N N/A Were target compounds detected in the field blanks?

Blank units: ug/L **Associated sample units:** ug/L
Sampling date: 06/26/18
Field blank type: (circle one) Field Blank / Rinsate / (Trip Blank) / Other: Associated Samples: All except 3,7

Compound	Blank ID	Sample Identification									
	7		4	5							
E	0.78		0.62/5.0U	0.43/5.0U							

Blank units: **Associated sample units:**
Sampling date:
Field blank type: (circle one) Field Blank / Rinsate / Trip Blank / Other: Associated Samples:

Compound	Blank ID	Sample Identification									

CIRCLED RESULTS WERE NOT QUALIFIED. ALL RESULTS NOT CIRCLED WERE QUALIFIED BY THE FOLLOWING STATEMENT:
Common contaminants such as Methylene chloride, Acetone, 2-Butanone and Carbon disulfide that were detected in samples within ten times the associated field blank concentration were qualified as not detected, "U". Other contaminants within five times the field blank concentration were also qualified as not detected, "U".

LDC #: 42791 A1

VALIDATION FINDINGS WORKSHEET
Surrogate Spikes

Page: 1 of 1
Reviewer: JVG
2nd Reviewer:

METHOD: GC/MS VOA (EPA SW 846 Method 8260B)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

Y (N) N/A Were all surrogate %R within QC limits?

Y (N) N/A If the percent recovery (%R) for one or more surrogates was out of QC limits, was a reanalysis performed to confirm samples with %R out of outside of criteria?

#	Date	Sample ID	Surrogate	%Recovery (Limits)	Qualifications
		MB 280-421459/11	BFB	117 (85-114)	J dets/P
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	
				( )	

SMC1 (TOL) = Toluene-d8
SMC2 (BFB) = Bromofluorobenzene
SMC3 (DCE) = 1,2-Dichloroethane-d4
SMC4 (DFM) = Dibromofluoromethane

LDC #: 42791A1

VALIDATION FINDINGS WORKSHEET

Matrix Spike/Matrix Spike Duplicates

Page: 1 of 1
Reviewer: JVG
2nd Reviewer:

METHOD : GC/MS VOA (EPA SW 846 Method 8260B)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

[✓ Y] N N/A Were a matrix spike (MS) and matrix spike duplicate (MSD) analyzed for each matrix in this SDG? If no, indicate which matrix does not have an associated MS/MSD. Soil / Water.

[✓ Y] N N/A Was a MS/MSD analyzed every 20 samples of each matrix?

Y [✓ N] N/A Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?

#	MS/MSD ID	Compound	MS %R (Limits)	MSD %R (Limits)	RPD (Limits)	Associated Samples	Qualifications
	8/9	O	( )	69 (72-136)	( )	6 (Det)	J/UJ/A
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		

LDC #: 42791 A1

VALIDATION FINDINGS WORKSHEET

Laboratory Control Samples (LCS)

Page: 1 of 1
Reviewer: JVG
2nd Reviewer: Q

METHOD: GC/MS VOA (EPA SW 846 Method 8260B)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

[✓ Y] N N/A Was a LCS required?

Y [✓ N] N/A Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?

#	LCS/LCSD ID	Compound	LCS %R (Limits)	LCSD %R (Limits)	RPD (Limits)	Associated Samples	Qualifications
	LCS/D 280-421459/8,9	B	168 (53-141)	164 (53-141)	( )	1-3, MB1 (ND)	J dets/P
		D	156 (60-138)	160 (66-138)	( )	↓	↓
		A	144 (50-139)	143 (50-139)	( )		
		C	138 (58-137)	( )	( )	↓ ↓	↓
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		
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			( )	( )	( )		
			( )	( )	( )		
			( )	( )	( )		

LDC#: 42791A1

VALIDATION FINDINGS WORKSHEET
Field Duplicates

Page: 1 of 1
Reviewer: JVG
2nd Reviewer: ~~~

METHOD: GCMS VOA (EPA SW 846 Method 8260B)

(Y) N NA Were field duplicate pairs identified in this SDG?
Y N NA Were target analytes detected in the field duplicate pairs?

Compound	Concentration (ug/L)		RPD (≤_____ %)	Difference (ug/L)	Limits (<LOQ)	Qualifications (Parent Only)
	1	2				
F	10	3.8		6.2	(≤10)	

Compound	Concentration (ug/L)		RPD (≤_____ %)	Difference (ug/L)	Limits (<LOQ)	Qualifications (Parent Only)
	4	5				
F	5.2	6.5		1.3	(≤10)	
E	0.62	0.43		0.19	(≤5.0)	

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LDC #: 42791A1

VALIDATION FINDINGS WORKSHEET
Initial Calibration Calculation Verification

Reviewer: JVG
2nd Reviewer:

METHOD: GC/MS VOA (EPA SW 846 Method 8260B)

The Relative Response Factor (RRF), average RRF, and percent relative standard deviation (%RSD) were recalculated for the compounds identified below using the following calculations:

$RRF = (A_x)(C_{is})/(A_{is})(C_x)$
average RRF = sum of the RRFs/number of standards
%RSD = 100 * (S/X)

A_x = Area of Compound
C_x = Concentration of compound
S= Standard deviation of the RRFs

A_{is} = Area of associated internal standard
C_{is} = Concentration of internal standard
X = Mean of the RRFs

#	Standard ID	Calibration Date	Compound (IS)	Reported RRF (RRF 10 std)	Recalculated RRF (RRF 10 std)	Reported Average RRF (Initial)	Recalculated Average RRF (Initial)	Reported %RSD	Recalculated %RSD
1	ICAL VMS_Q	7/5/2018	Carbon tetrachloride (FB)	0.4734	0.4734	0.4035	0.4036	11.9	11.9
			Tetrachloroethene (CBZ)	1.2964	1.2964	1.1964	1.1964	8.4	8.4
			1,1,2,2-TCA (DCB)	0.4674	0.4674	0.4226	0.4226	6.4	6.4
3	ICAL VMS_Z	7/4/2018	Carbon tetrachloride (FB)	0.7305	0.7305	0.7606	0.7606	7.7	7.7
			Tetrachloroethene (CBZ)	1.8005	1.8005	1.8179	1.8179	7.0	7.0
			1,1,2,2-TCA (DCB)	0.8326	0.8326	0.8513	0.8514	3.1	3.1

LDC#: 42791A1

VALIDATION FINDINGS WORKSHEET
Continuing Calibration Calculation Verification

Reviewer: JVG
2nd Reviewer:

METHOD: GC/MS VOA (EPA SW 846 Method 8260B)

The percent difference (%D) of the initial calibration average Relative Response Factors (RRFs) and the continuing calibration RRFs were recalculated for the compounds identified below using the following calculation:

% Difference = 100 * (ave. RRF - RRF)/ave. RRF
RRF = (Ax)(Cis)/(Ais)(Cx)

Where:
ave. RRF = initial calibration average RRF
RRF = continuing calibration RRF
Ax = Area of compound
Cx = Concentration of compound,
Ais = Area of associated internal standard
Cis = Concentration of internal standard

#	Standard ID	Calibration Date	Compound (IS)	Average RRF (Initial)	Reported RRF (CCV)	Recalculated RRF (CCV)	Reported % D	Recalculated %D
1	Q5568	7/9/2018	Carbon tetrachloride (FB)	0.4035	0.4185	0.4185	3.7	3.7
			Tetrachloroethene (CBZ)	1.196	1.283	1.283	7.2	7.2
			1,1,2,2-TCA (DCB)	0.4226	0.4232	0.4232	0.1	0.1
2	Z8967	7/10/2018	Carbon tetrachloride (FB)	0.7606	0.7852	0.7852	3.2	3.2
			Tetrachloroethene (CBZ)	1.818	1.885	1.885	3.7	3.7
			1,1,2,2-TCA (DCB)	0.8513	0.818	0.818	3.9	3.9

LDC #: 42791A1

VALIDATION FINDINGS WORKSHEET
Surrogate Results Verification

Page: 1 of 1
Reviewer: JVG
2nd reviewer:

METHOD: GC/MS VOA (EPA SW 846 Method 8260B)

The percent recoveries (%R) of surrogates were recalculated for the compounds identified below using the following calculation:

% Recovery: SF/SS * 100

Where: SF = Surrogate Found
SS = Surrogate Spiked

Sample ID: # 1

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Dibromofluoromethane	10.5	11.3	107	108	1
1,2-Dichloroethane-d4		10.9	104	104	0
Toluene-d8		10.7	102	102	
Bromofluorobenzene		11.5	110	110	

Sample ID:

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Dibromofluoromethane					
1,2-Dichloroethane-d4					
Toluene-d8					
Bromofluorobenzene					

Sample ID:

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Dibromofluoromethane					
1,2-Dichloroethane-d4					
Toluene-d8					
Bromofluorobenzene					

Sample ID:

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Dibromofluoromethane					
1,2-Dichloroethane-d4					
Toluene-d8					
Bromofluorobenzene					

Sample ID:

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Dibromofluoromethane					
1,2-Dichloroethane-d4					
Toluene-d8					
Bromofluorobenzene					

LDC #: 42791 A1

VALIDATION FINDINGS WORKSHEET
Matrix Spike/Matrix Spike Duplicates Results Verification

Reviewer: JVG
2nd Reviewer: [illegible]

METHOD: GC/MS VOA (EPA SW 846 Method 8260B)

The percent recoveries (%R) and Relative Percent Difference (RPD) of the matrix spike and matrix spike duplicate were recalculated for the compounds identified below using the following calculation:

% Recovery = 100 * (SSC - SC)/SA Where: SSC = Spiked sample concentration; SA = Spike added; SC = Sample concentration

RPD = I MSC - MSC I * 2/(MSC + MSDC) MSC = Matrix spike concentration MSDC = Matrix spike duplicate concentration

MS/MSD sample: 8/9

Compound	Spike Added (ug/L)		Sample Concentration (ug/L)	Spiked Sample Concentration (ug/L)		Matrix Spike Percent Recovery		Matrix Spike Duplicate Percent Recovery		MS/MSD RPD	
	MS	MSD	------	MS	MSD	Reported	Recalc	Reported	Recalc	Reported	Recalculated
1,1-Dichloroethene	5.00	5.00	0	4.56	4.62	91	91	92	92	1	1
Trichloroethene				4.29	4.57	86	86	90	90	5	5
Benzene				4.41	4.54	88	88	91	91	3	3
Toluene				4.35	4.55	87	87	91	91	5	5
Chlorobenzene				4.11	4.46	82	82	89	89	8	8

Comments: Refer to Matrix Spike/Matrix Spike Duplicates findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 42791A1

VALIDATION FINDINGS WORKSHEET
Laboratory Control Sample Results Verification

Reviewer: JVG
2nd Reviewer:

METHOD: GC/MS VOA (EPA SW 846 Method 8260B)

The percent recoveries (%R) and Relative Percent Difference (RPD) of the laboratoy control sample and laboratory control sample duplicate (if applicable) were recalculated for the compounds identified below using the following calculation:

% Recovery = 100 * SSC/SA Where: SSC = Spiked sample concentration; SA = Spike added

RPD = I LCSC - LCSDC I * 2/(LCSC + LCSDC) LCSC = Laboraotry control sample concentration LCSDC = Laboratory control sample duplicate concentration

LCS ID: LCS ID 280-421459/8,9

Compound	Spike Added (ug/L)		Spiked Sample Concentration (ug/L)		LCS Percent Recovery		LCSD Percent Recovery		LCS/LCSD RPD	
	LCS	LCSD	LCS	LCSD	Reported	Recalc.	Reported	Recalc.	Reported	Recalculated
1,1-Dichloroethene	5.00	5.00	4.90	5.23	98	98	105	105	6	6
Trichloroethene			5.11	5.00	102	102	100	100	2	2
Benzene			5.35	5.25	107	107	105	105	2	2
Toluene			5.08	5.12	102	102	102	102	1	1
Chlorobenzene			5.15	5.08	103	103	102	102	1	1

Comments: Refer to Laboratory Control Sample findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 42791A1

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

Page: 1 of 1
Reviewer: JVG
2nd reviewer:

METHOD: GC/MS VOA (EPA SW 846 Method 8260B)

(Y) N N/A Were all reported results recalculated and verified for all level IV samples?

(Y) N N/A Were all recalculated results for detected target compounds agree within 10.0% of the reported results?

Concentration = $\frac{(A_x)(I_s)(DF)}{(A_{is})(RRF)(V_o)(\%S)}$

A_x = Area of the characteristic ion (EICP) for the compound to be measured

A_{is} = Area of the characteristic ion (EICP) for the specific internal standard

I_s = Amount of internal standard added in nanograms (ng)

RRF = Relative response factor of the calibration standard.

V_o = Volume or weight of sample pruged in milliliters (ml) or grams (g).

Df = Dilution factor.

%S = Percent solids, applicable to soils and solid matrices only.

Example:

Sample I.D. 6, Carbon Tetrachloride

Conc. = $\frac{(597066)(12.5)(\quad)}{(1301145)(0.7666)(\quad)(\quad)}$

= 7.54 ug/L

#	Sample ID	Compound	Reported Concentration (ug/L)	Calculated Concentration ( )	Qualification
			7.5		

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Ravenna, Ohio

LDC Report Date: August 3, 2018

Parameters: Semivolatiles

Validation Level: Stage 4

Laboratory: TestAmerica, Inc.

Sample Delivery Group (SDG): 280-111421-1

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
FBQmw-174-062518-GW	280-111421-1	Water	06/25/18
LL12mw-247-062618-GW	280-111421-4	Water	06/26/18
LL12mw-247-D-062618-GW	280-111421-5	Water	06/26/18
LL10mw-003-062618-GW	280-111421-7	Water	06/26/18
NTAmw-119-062518-GW	280-111421-8	Water	06/25/18
NTAmw-119-D-062518-GW	280-111421-9	Water	06/25/18
FWGmw-016-062518-GW	280-111421-13	Water	06/25/18
FWGmw-015-062518-GW	280-111421-14	Water	06/25/18
FWGmw-004-062518-GW	280-111421-15	Water	06/25/18
DETmw-003-D-062618-GW	280-111421-16	Water	06/26/18
DA2mw-115-062618-GW	280-111421-21	Water	06/26/18
DETmw-003-062618-GW	280-111421-22	Water	06/26/18
NTAmw-120-062618-GW	280-111421-23	Water	06/26/18
NTAmw-120-D-062618-GW	280-111421-24	Water	06/26/18
LL12mw-247-062618-GWMS	280-111421-4MS	Water	06/26/18
LL12mw-247-062618-GWMSD	280-111421-4MSD	Water	06/26/18
LL10mw-003-062618-GWMS	280-111421-7MS	Water	06/26/18
LL10mw-003-062618-GWMSD	280-111421-7MSD	Water	06/26/18

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with The Final Remedial Investigation Work Plan for Groundwater and Environmental Investigation Services for RVAAP-66 Facility-Wide Groundwater Former Ravenna Army Ammunition Plant Portage and Trumbull Counties, Ohio (December 20, 2016), the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013), and a modified outline of the USEPA National Functional Guidelines (NFG) for Superfund Organic Methods Data Review (August 2014). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following method:

Semivolatile Organic Compounds (SVOCs) by Environmental Protection Agency (EPA) SW 846 Method 8270D

All sample results were subjected to Stage 4 data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The compound or analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The compound or analyte was analyzed for and positively identified by the laboratory; however the compound or analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The compound or analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected compound or analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition and cooler temperatures upon receipt met validation criteria.

All technical holding time requirements were met.

II. GC/MS Instrument Performance Check

A decafluorotriphenylphosphine (DFTPP) tune was performed at 12 hour intervals.

All ion abundance requirements were met.

III. Initial Calibration and Initial Calibration Verification

An initial calibration was performed as required by the method.

For compounds where average relative response factors (RRFs) were utilized, percent relative standard deviations (%RSD) were less than or equal to 15.0%.

In the case where the laboratory used a calibration curve to evaluate the compounds, all coefficients of determination (r^2) were greater than or equal to 0.990.

Average relative response factors (RRF) for all compounds were within validation criteria.

The percent differences (%D) of the initial calibration verification (ICV) standard were less than or equal to 20.0% for all compounds.

IV. Continuing Calibration

Continuing calibration was performed at the required frequencies.

The percent differences (%D) were less than or equal to 20.0% for all compounds.

The percent differences (%D) of the ending continuing calibration verifications (CCVs) were less than or equal to 50.0% for all compounds.

All of the continuing calibration relative response factors (RRF) were within validation criteria.

V. Laboratory Blanks

Laboratory blanks were analyzed as required by the method. No contaminants were found in the laboratory blanks.

VI. Field Blanks

No field blanks were identified in this SDG.

VII. Surrogates

Surrogates were added to all samples as required by the method. All surrogate recoveries (%R) were within QC limits.

VIII. Matrix Spike/Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicate (MSD) sample analysis was performed on an associated project sample. Percent recoveries (%R) were within QC limits. Relative percent differences (RPD) were within QC limits.

IX. Laboratory Control Samples

Laboratory control samples (LCS) and laboratory control samples duplicates (LCSD) were analyzed as required by the method. Percent recoveries (%R) were within QC limits with the following exceptions:

LCS ID (Associated Samples)	Compound	LCS %R (Limits)	LCSD %R (Limits)	Flag	A or P
LCS/D 280-420810/2,3-A (DETmw-003-D-062618-GW DETmw-003-062618-GW NTAmw-120-062618-GW NTAmw-120-D-062618-GW)	Hexachlorocyclopentadiene	9 (10-120)	8 (10-120)	R (all non-detects)	P

Relative percent differences (RPD) were within QC limits with the following exceptions:

LCS ID (Associated Samples)	Compound	RPD (Limits)	Flag	A or P
LCS/D 280-420810/2,3-A (DETmw-003-D-062618-GW DETmw-003-062618-GW NTAmw-120-062618-GW NTAmw-120-D-062618-GW)	Hexachlorocyclopentadiene	21 (≤20)	NA	-

X. Field Duplicates

Samples LL12mw-247-062618-GW and LL12mw-247-D-062618-GW, samples NTAmw-119-062518-GW and NTAmw-119-D-062518-GW, samples DETmw-003-D-062618-GW and DETmw-003-062618-GW, and samples NTAmw-120-062618-GW and NTAmw-120-D-062618-GW were identified as field duplicates. No results were detected in any of the samples.

XI. Internal Standards

All internal standard areas and retention times were within QC limits.

XII. Compound Quantitation

All compound quantitations were within validation criteria.

XIII. Target Compound Identifications

All target compound identifications were within validation criteria.

XIV. System Performance

The system performance was acceptable.

XV. Overall Assessment of Data

The analysis was conducted within all specifications of the method.

Due to MS/MSD %R, data were rejected in four samples.

The quality control criteria reviewed, other than those discussed above, were met and are considered acceptable. Sample results that were found to be rejected (R) are unusable for all purposes. Based upon the data validation all other results are considered valid and usable for all purposes.

Ravenna, Ohio
Semivolatiles - Data Qualification Summary - SDG 280-111421-1

Sample	Compound	Flag	A or P	Reason
DETmw-003-D-062618-GW DETmw-003-062618-GW NTAmw-120-062618-GW NTAmw-120-D-062618-GW	Hexachlorocyclopentadiene	R (all non-detects)	P	Matrix spike/Matrix spike duplicate (%R)

Ravenna, Ohio
Semivolatiles - Laboratory Blank Data Qualification Summary - SDG 280-111421-1

No Sample Data Qualified in this SDG

Ravenna, Ohio
Semivolatiles - Field Blank Data Qualification Summary - SDG 280-111421-1

No Sample Data Qualified in this SDG

LDC #: 42791A2a
SDG #: 280-111421-1
Laboratory: Test America, Inc.

VALIDATION COMPLETENESS WORKSHEET
Stage 4

Date: 08/02/18
Page: 1 of 2
Reviewer: [illegible]
2nd Reviewer: [illegible]

METHOD: GC/MS Semivolatiles (EPA SW 846 Method 8270D)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A / A	
II.	GC/MS Instrument performance check	A	
III.	Initial calibration/ICV	A / A	ICAL ≤ 15% r² ICV ≤ 20%
IV.	Continuing calibration/ending	A	CCV ≤ 20/50%
V.	Laboratory Blanks	SW	
VI.	Field blanks	ND	FB = 1
VII.	Surrogate spikes	A	
VIII.	Matrix spike/Matrix spike duplicates	A	
IX.	Laboratory control samples	SW	LCS/D
X.	Field duplicates	ND	D = 2/3, 5/6, 10/12, 13/14
XI.	Internal standards	A	
XII.	Compound quantitation RL/LOQ/LODs	A	
XIII.	Target compound identification	A	
XIV.	System performance	A	
XV.	Overall assessment of data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID		Lab ID	Matrix	Date
1	FBQmw-174-062518-GW		280-111421-1	Water	06/25/18
2	LL12mw-247-062618-GW	D1	280-111421-4	Water	06/26/18
3	LL12mw-247-D-062618-GW	D1	280-111421-5	Water	06/26/18
4	LL10mw-003-062618-GW		280-111421-7	Water	06/26/18
5	NTAmw-119-062518-GW	D1	280-111421-8	Water	06/25/18
6	NTAmw-119-D-062518-GW	D1	280-111421-9	Water	06/25/18
7	FWGmw-016-062518-GW		280-111421-13	Water	06/25/18
8	FWGmw-015-062518-GW		280-111421-14	Water	06/25/18
9	FWGmw-004-062518-GW		280-111421-15	Water	06/25/18
10	DETmw-003-D-062618-GW	D3	280-111421-16	Water	06/26/18
11	DA2mw-115-062618-GW		280-111421-21	Water	06/26/18
12	DETmw-003-062618-GW	D3	280-111421-22	Water	06/26/18
13	NTAmw-120-062618-GW	D4	280-111421-23	Water	06/26/18

LDC #: 42791A2a
SDG #: 280-111421-1
Laboratory: Test America, Inc.

VALIDATION COMPLETENESS WORKSHEET
Stage 4

Date: 08/02/18
Page: 2 of 2
Reviewer: JG
2nd Reviewer:

METHOD: GC/MS Semivolatiles (EPA SW 846 Method 8270D)

	Client ID	Lab ID	Matrix	Date
1 14	NTAmw-120-D-062618-GW D4	280-111421-24	Water	06/26/18
2 15	LL12mw-247-062618-GWMS	280-111421-4MS	Water	06/26/18
2 16	LL12mw-247-062618-GWMSD	280-111421-4MSD	Water	06/26/18
2 17	LL10mw-003-062618-GWMS	280-111421-7MS	Water	06/26/18
2 18	LL10mw-003-062618-GWMSD	280-111421-7MSD	Water	06/26/18
19				
20				
21				

Notes:

1	MB 280-420810/1-A						
2	↓ -421012/1-A						

List 4 = 1-3, 7-9, 11
List 2 = 4, 5, 6
List 1 = 10, 12
Full list = 13, 14

LDC #: 42791A2a

VALIDATION FINDINGS CHECKLIST

Reviewer: JVG
2nd Reviewer: CF

Method: Semivolatiles (EPA SW 846 Method 8270D)

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
Were all technical holding times met?	✓			
Was cooler temperature criteria met?	✓			
II. GC/MS Instrument performance check				
Were the DFTPP performance results reviewed and found to be within the specified criteria?	✓			
Were all samples analyzed within the 12 hour clock criteria?	✓			
IIIa. Initial calibration				
Did the laboratory perform a 5 point calibration prior to sample analysis?	✓			
Were all percent relative standard deviations (%RSD) ≤ ~~20%~~ 15 and relative response factors (RRF) within method criteria?	✓			
Was a curve fit used for evaluation? If yes, did the initial calibration meet the curve fit acceptance criteria of ≥ 0.990?	✓			
IIIb. Initial Calibration Verification				
Was an initial calibration verification standard analyzed after each initial calibration for each instrument?	✓			
Were all percent differences (%D) ≤ ~~30%~~ 20 or ~~percent recoveries (%R) 70-130%~~?	✓			
IV. Continuing calibration				
Was a continuing calibration standard analyzed at least once every 12 hours for each instrument?	✓			
Were all percent differences (%D) ≤ 20% and relative response factors (RRF) within method criteria?	✓			
V. Laboratory Blanks				
Was a laboratory blank associated with every sample in this SDG?	✓			
Was a laboratory blank analyzed at least once every 12 hours for each matrix and concentration?	✓			
Was there contamination in the laboratory blanks? If yes, please see the Blanks validation completeness worksheet.	✓			
VI. Field blanks				
Were field blanks were identified in this SDG?	✓			
Were target compounds detected in the field blanks?		✓		
VII. Surrogate spikes				
Were all surrogate percent recovery (%R) within QC limits?	✓			
If 2 or more base neutral or acid surrogates were outside QC limits, was a reanalysis?			✓	
If 2 or more base neutral or acid surrogates were outside QC limits, was a reanalysis performed to confirm %R?			✓	

Validation Area	Yes	No	NA	Findings/Comments
VIII. Matrix spike/Matrix spike duplicates				
Were a matrix spike (MS) and matrix spike duplicate (MSD) analyzed for each matrix in this SDG? If no, indicate which matrix does not have an associated MS/MSD. Soil / Water.	✓			
Was a MS/MSD analyzed every 20 samples of each matrix?	✓			
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?	✓			
IX. Laboratory control samples				
Was an LCS analyzed for this SDG?	✓			
Was an LCS analyzed per analytical batch?	✓			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?		✓		
X. Field duplicates				
Were field duplicate pairs identified in this SDG?	✓			
Were target compounds detected in the field duplicates?		✓		
XI. Internal standards				
Were internal standard area counts within -50% to +100% of the associated calibration standard?	✓			
Were retention times within ± 30 seconds of the associated calibration standard?	✓			
XII. Compound quantitation				
Were the correct internal standard (IS), quantitation ion and relative response factor (RRF) used to quantitate the compound?	✓			
Were compound quantitation and RLs adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	✓			
XIII. Target compound identification				
Were relative retention times (RRT's) within ± 0.06 RRT units of the standard?	✓			
Did compound spectra meet specified EPA "Functional Guidelines" criteria?	✓			
Were chromatogram peaks verified and accounted for?	✓			
XIV. System performance				
System performance was found to be acceptable.	✓			
XV. Overall assessment of data				
Overall assessment of data was found to be acceptable.	✓			

VALIDATION FINDINGS WORKSHEET

METHOD: GC/MS SVOA

A. Phenol	AA. 2-Chloronaphthalene	AAA. Butylbenzylphthalate	AAAA. Dibenzothiophene	A1. N-Nitrosodiethylamine
B. Bis (2-chloroethyl) ether	BB. 2-Nitroaniline	BBB. 3,3'-Dichlorobenzidine	BBBB. Benzo(a)fluoranthene	B1. N-Nitrosodi-n-butylamine
C. 2-Chlorophenol	CC. Dimethylphthalate	CCC. Benzo(a)anthracene	CCCC. Benzo(b)fluorene	C1. N-Nitrosomethylethylamine
D. 1,3-Dichlorobenzene	DD. Acenaphthylene	DDD. Chrysene	DDDD. cis/trans-Decalin	D1. N-Nitrosomorpholine
E. 1,4-Dichlorobenzene	EE. 2,6-Dinitrotoluene	EEE. Bis(2-ethylhexyl)phthalate	EEEE. Biphenyl	E1. N-Nitrosopyrrolidine
F. 1,2-Dichlorobenzene	FF. 3-Nitroaniline	FFF. Di-n-octylphthalate	FFFF. Retene	F1. Phenacetin
G. 2-Methylphenol	GG. Acenaphthene	GGG. Benzo(b)fluoranthene	GGGG. C30-Hopane	G1. 2-Acetylaminofluorene
H. 2,2'-Oxybis(1-chloropropane)	HH. 2,4-Dinitrophenol	HHH. Benzo(k)fluoranthene	HHHH. 1-Methylphenanthrene	H1. Pronamide
I. 4-Methylphenol	II. 4-Nitrophenol	III. Benzo(a)pyrene	IIII. 1,4-Dioxane	I1. Methyl methanesulfonate
J. N-Nitroso-di-n-propylamine	JJ. Dibenzofuran	JJJ. Indeno(1,2,3-cd)pyrene	JJJJ. Acetophenone	J1. Ethyl methanesulfonate
K. Hexachloroethane	KK. 2,4-Dinitrotoluene	KKK. Dibenz(a,h)anthracene	KKKK. Atrazine	K1. o,o',o''-Triethylphosphorothioate
L. Nitrobenzene	LL. Diethylphthalate	LLL. Benzo(g,h,i)perylene	LLLL. Benzaldehyde	L1. n-Phenylene diamine
M. Isophorone	MM. 4-Chlorophenyl-phenyl ether	MMM. Bis(2-Chloroisopropyl)ether	MMMM. Caprolactam	M1. 1,4-Naphthoquinone
N. 2-Nitrophenol	NN. Fluorene	NNN. Aniline	NNNN. 2,6-Dichlorophenol	N1. N-Nitro-o-toluidine
O. 2,4-Dimethylphenol	OO. 4-Nitroaniline	OOO. N-Nitrosodimethylamine	OOOO. 1,2-Diphenylhydrazine	O1. 1,3,5-Trinitrobenzene
P. Bis(2-chloroethoxy)methane	PP. 4,6-Dinitro-2-methylphenol	PPP. Benzoic Acid	PPPP. 3-Methylphenol	P1. Pentachlorobenzene
Q. 2,4-Dichlorophenol	QQ. N-Nitrosodiphenylamine	QQQ. Benzyl alcohol	QQQQ. 3&4-Methylphenol	Q1. 4-Aminobiphenyl
R. 1,2,4-Trichlorobenzene	RR. 4-Bromophenyl-phenylether	RRR. Pyridine	RRRR. 4-Dimethyldibenzothiophene (4MDT)	R1. 2-Naphthylamine
S. Naphthalene	SS. Hexachlorobenzene	SSS. Benzidine	SSSS. 2/3-Dimethyldibenzothiophene (4MDT)	S1. Triphenylene
T. 4-Chloroaniline	TT. Pentachlorophenol	TTT. 1-Methylnaphthalene	TTTT. 1-Methyldibenzothiophene (1MDT)	T1. Octachlorostyrene
U. Hexachlorobutadiene	UU. Phenanthrene	UUU.Benzo(b)thiophene	UUUU.. 2,3,4,6-Tetrachlorophenol	U1. Famphur
V. 4-Chloro-3-methylphenol	VV. Anthracene	VVV.Benzonaphthothiophene	VVVV. 1,2,4,5-Tetrachlorobenzene	V1. 1,4-phenylenediamine
W. 2-Methylnaphthalene	WW. Carbazole	WWW.Benzo(e)pyrene	WWWW.. 2-Picoline	W1. Methapyrilene
X. Hexachlorocyclopentadiene	XX. Di-n-butylphthalate	XXX. 2,6-Dimethylnaphthalene	XXXX. 3-Methylcholanthrene	X1. Pentachloroethane
Y. 2,4,6-Trichlorophenol	YY. Fluoranthene	YYY. 2,3,5-Trimethylnaphthalene	YYYY. a,a-Dimethylphenethylamine	Y1. 3,3'-Dimethylbenzidine
Z. 2,4,5-Trichlorophenol	ZZ. Pyrene	ZZZ. Perylene	ZZZZ. Hexachloropropene	Z1. o-Toluidine

LDC #: 42791 A2a

VALIDATION FINDINGS WORKSHEET

Laboratory Control Samples (LCS)

Page: 1 of 1
Reviewer: JVG
2nd Reviewer: Q

METHOD: GC/MS BNA (EPA SW 846 Method 8270D)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

[✓ Y] N N/A Was a LCS required?

Y [✓ N] N/A Were the LCS/LCSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?

#	Date	LCS/LCSD ID	Compound	LCS %R (Limits)	LCSD %R (Limits)	RPD (Limits)	Associated Samples	Qualifications
		LCS/D 280-420810/23-A	X	9 (10-120)	8 (10-120)	( )	10, 12-14, MB 1 (ND)	J/R/P
			X	( )	( )	21 (20)	↓ ↓	J dets/P
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
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				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		

LDC #: 42791A2a

VALIDATION FINDINGS WORKSHEET
Initial Calibration Calculation Verification

Reviewer: JVG
2nd Reviewer:

METHOD: GC/MS SVOA (EPA SW 846 Method 8270D)

The Relative Response Factor (RRF), average RRF, and percent relative standard deviation (%RSD) were recalculated for the compounds identified below using the following calculations:

$RRF = (A_x)(C_{is})/(A_{is})(C_x)$ — A_x = Area of Compound — A_{is} = Area of associated internal standard

average RRF = sum of the RRFs/number of standards — C_x = Concentration of compound, — C_{is} = Concentration of internal standard

%RSD = 100 * (S/X) — S= Standard deviation of the RRFs, — X = Mean of the RRFs

#	Standard ID	Calibration Date	Compound (IS)	Reported RRF (50 std)	Recalculated RRF (50 std)	Reported Average RRF (Initial)	Recalculated Average RRF (Initial)	Reported %RSD	Recalculated %RSD
1	ICAL SMS G6	6/28/2018	Phenol (IS1)	1.8823	1.8823	1.8893	1.8893	2.8	2.8
			Naphthalene (IS2)	1.1038	1.1038	1.1002	1.1002	2.4	2.4
			Diethyl phthalate (IS3)	1.5222	1.5222	1.5150	1.5150	4.4	4.4
			Hexachlorobenzene (IS4)	0.2447	0.2447	0.2415	0.2415	3.0	3.0
			Butylbenzylphthalate (IS5)	0.7352	0.7352	0.7262	0.7262	2.4	2.4
			Benzo(a)pyrene (IS6)	1.2362	1.2362	1.2256	1.2256	3.4	3.4

LDC#: _42791A2a__

VALIDATION FINDINGS WORSHEET
Continuing Calibration Results Verification

Reviewer: JVG
2nd Reviewer:

METHOD: GC/MS SVOA (EPA SW 846 Method 8270D)

The percent difference (%D) of the initial calibration average Relative Response Factors (RRFs) and the continuing calibration RRFs were recalculated for the compounds identified below using the following calculation:

% Difference = 100 * (ave. RRF - RRF)/ave. RRF
RRF = (Ax)(Cis)/(Ais)(Cx)

ave. RRF = initial calibration average RRF
RRF = continuing calibration RRF
Ax = Area of compound

Cx = Concentration of compound
Ais = Area of associated internal standard
Cis = Concentration of internal standard

#	Standard ID	Calibration Date	Compound (IS)	Average RRF (Initial RRF)	Reported (CC RRF)	Recalculated (CC RRF)	Reported %D	Recalculated %D
1	G6_34594	07/13/18	Phenol (IS1)	1.8893	1.8841	1.8841	0.3	0.3
			Naphthalene (IS2)	1.1002	1.1080	1.1080	0.7	0.7
			Diethyl phthalate (IS3)	1.5150	1.5874	1.5874	4.8	4.8
			Hexachlorobenzene (IS4)	0.2415	0.2446	0.2446	1.3	1.3
			Butylbenzylphthalate (IS5)	0.7262	0.7415	0.7415	2.1	2.1
			Benzo(a)pyrene (IS6)	1.2256	1.2820	1.2820	4.6	4.6
2	G6_34628	7/14/2018	Diethyl phthalate (IS3)	1.5150	1.4966	1.4966	1.2	1.2
			Butylbenzylphthalate (IS5)	0.7262	0.7214	0.7214	0.7	0.7
3	G6_34662	07/16/18	Diethyl phthalate (IS3)	1.5150	1.4931	1.4931	1.4	1.4
			Butylbenzylphthalate (IS5)	0.7262	0.6986	0.6986	3.8	3.8
4	G6_34732	07/18/18	Phenol (IS1)	1.8893	1.9268	1.9268	2.0	2.0
			Naphthalene (IS2)	1.1002	1.1076	1.1076	0.7	0.7
			Diethyl phthalate (IS3)	1.5150	1.4962	1.4962	1.2	1.2
			Hexachlorobenzene (IS4)	0.2415	0.2314	0.2314	4.2	4.2
			Butylbenzylphthalate (IS5)	0.7262	0.7241	0.7241	0.3	0.3
			Benzo(a)pyrene (IS6)	1.2256	1.2960	1.2960	5.7	5.7

LDC #: 42791A2a

VALIDATION FINDINGS WORKSHEET
Surrogate Results Verification

Page: 1 of 1
Reviewer: JVG
2nd reviewer: ~~~

METHOD: GC/MS Semivolatiles (EPA SW 846 Method 8270D)

The percent recoveries (%R) of surrogates were recalculated for the compounds identified below using the following calculation:

% Recovery: SF/SS * 100

Where: SF = Surrogate Found
SS = Surrogate Spiked

Sample ID: #1

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Nitrobenzene-d5	100	71.5	71	71	0
2-Fluorobiphenyl		70.6	71	71	
Terphenyl-d14		78.6	79	79	
Phenol-d5		77.1	77	77	
2-Fluorophenol		79.2	79	79	
2,4,6-Tribromophenol	↓	74.8	74	74	↓
2-Chlorophenol-d4					
1,2-Dichlorobenzene-d4					

Sample ID: _____

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Nitrobenzene-d5					
2-Fluorobiphenyl					
Terphenyl-d14					
Phenol-d5					
2-Fluorophenol					
2,4,6-Tribromophenol					
2-Chlorophenol-d4					
1,2-Dichlorobenzene-d4					

Sample ID: _____

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Nitrobenzene-d5					
2-Fluorobiphenyl					
Terphenyl-d14					
Phenol-d5					
2-Fluorophenol					
2,4,6-Tribromophenol					
2-Chlorophenol-d4					
1,2-Dichlorobenzene-d4					

LDC #: 42791 A2a

VALIDATION FINDINGS WORKSHEET
Matrix Spike/Matrix Spike Duplicates Results Verification

Reviewer: JVG
2nd Reviewer: [illegible]

METHOD: GC/MS BNA (EPA SW 846 Method 8270D)

The percent recoveries (%R) and Relative Percent Difference (RPD) of the matrix spike and matrix spike duplicate were recalculated for the compounds identified below using the following calculation:

% Recovery = 100 * (SSC - SC)/SA Where: SSC = Spiked sample concentration; SA = Spike added; SC = Sample concentation

RPD = I MSC - MSC I * 2/(MSC + MSDC) MSC = Matrix spike concentration MSDC = Matrix spike duplicate concentration

MS/MSD samples: 15/16

Compound	Spike Added (ug/L)		Sample Concentration (ug/L)	Spiked Sample Concentration (ug/L)		Matrix Spike Percent Recovery		Matrix Spike Duplicate Percent Recovery		MS/MSD RPD	
	MS	MSD	------	MS	MSD	Reported	Recalc	Reported	Recalc	Reported	Recalc
Phenol											
N-Nitroso-di-n-propylamine											
4-Chloro-3-methylphenol											
Acenaphthene											
Pentachlorophenol											
Pyrene											
EEE	75.6	76.5	0	57.9	56.4	77	77	74	74	3	3

Comments: Refer to Matrix Spike/Matrix Spike Duplicates findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 42791A2a

VALIDATION FINDINGS WORKSHEET

Laboratory Control Sample/Laboratory Control Sample Duplicates Results Verification

Reviewer: JVG
2nd Reviewer: [illegible]

METHOD: GC/MS BNA (EPA SW 846 Method 8270D)

The percent recoveries (%R) and Relative Percent Difference (RPD) of the laboratory control sample and laboratory control sample duplicate were recalculated for the compounds identified below using the following calculation:

% Recovery = 100 * (SC/SA Where: SSC = Spike concentration
SA = Spike added

RPD = I LCSC - LCSDC I * 2/(LCSC + LCSDC) LCSC = Laboratory control sample concentration LCSDC = Laboratory control sample duplicate concentration

LCS/LCSD samples: LCS ID 280-420810/2, 3-4

Compound	Spike Added (ug/L)		Spike Concentration (ug/L)		LCS Percent Recovery		LCSD Percent Recovery		LCS/LCSD RPD	
	LCS	LCSD	LCS	LCSD	Reported	Recalc	Reported	Recalc	Reported	Recalculated
Phenol	80.0	80.0	57.1	66.0	71	71	82	82	14	14
N-Nitroso-di-n-propylamine			59.0	65.3	74	74	82	82	10	10
4-Chloro-3-methylphenol			62.9	68.4	79	79	86	86	8	8
Acenaphthene			61.9	65.6	77	77	82	82	6	6
Pentachlorophenol	160.0	160.0	120	129	75	75	81	81	7	7
Pyrene	80.0	80.0	64.8	68.6	81	81	86	86	6	6

Comments: Refer to Laboratory Control Sample/Laboratory Control Sample Duplicates findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 42791 42a

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

Page: 1 of 1
Reviewer: JVG
2nd reviewer:

METHOD: GC/MS BNA (EPA SW 846 Method 8270D)

(Y) N N/A Were all reported results recalculated and verified for all level IV samples?
(Y) N N/A Were all recalculated results for detected target compounds agree within 10.0% of the reported results?

Concentration = $\frac{(A_x)(I_s)(V_t)(DF)(2.0)}{(A_{is})(RRF)(V_o)(V_i)(\%S)}$

A_x = Area of the characteristic ion (EICP) for the compound to be measured

A_{is} = Area of the characteristic ion (EICP) for the specific internal standard

I_s = Amount of internal standard added in nanograms (ng)

V_o = Volume or weight of sample extract in milliliters (ml) or grams (g).

V_i = Volume of extract injected in microliters (ul)

V_t = Volume of the concentrated extract in microliters (ul)

Df = Dilution Factor.

%S = Percent solids, applicable to soil and solid matrices only.

2.0 = Factor of 2 to account for GPC cleanup

Example:

Sample I.D. MD, Phenol
LCS - 420810

Conc. = $\frac{(121168)(40.0)(1ml)(\quad)(\quad)(\quad)}{(44896)(1.8893)(1L)(\quad)(\quad)(\quad)}$

= 57.1 ug/L

#	Sample ID	Compound	Reported Concentration (ug/L)	Calculated Concentration ( )	Qualification
			57.1		

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Ravenna, Ohio

LDC Report Date: August 3, 2018

Parameters: Polynuclear Aromatic Hydrocarbons

Validation Level: Stage 4

Laboratory: TestAmerica, Inc.

Sample Delivery Group (SDG): 280-111421-1

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
NTAmw-119-062518-GW	280-111421-8	Water	06/25/18
NTAmw-119-D-062518-GW	280-111421-9	Water	06/25/18
DETmw-003-D-062618-GW	280-111421-16	Water	06/26/18
DETmw-003-062618-GW	280-111421-22	Water	06/26/18

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with The Final Remedial Investigation Work Plan for Groundwater and Environmental Investigation Services for RVAAP-66 Facility-Wide Groundwater Former Ravenna Army Ammunition Plant Portage and Trumbull Counties, Ohio (December 20, 2016), the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013), and a modified outline of the USEPA National Functional Guidelines (NFG) for Superfund Organic Methods Data Review (August 2014). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following method:

Polynuclear Aromatic Hydrocarbons (PAHs) by Environmental Protection Agency (EPA) SW 846 Method 8270D in Selected Ion Monitoring (SIM) mode

All sample results were subjected to Stage 4 data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The compound or analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The compound or analyte was analyzed for and positively identified by the laboratory; however the compound or analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The compound or analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected compound or analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition and cooler temperatures upon receipt met validation criteria.

All technical holding time requirements were met.

II. GC/MS Instrument Performance Check

A decafluorotriphenylphosphine (DFTPP) tune was performed at 12 hour intervals.

All ion abundance requirements were met.

III. Initial Calibration and Initial Calibration Verification

An initial calibration was performed as required by the method.

The percent relative standard deviations (%RSD) were less than or equal to 15.0% for all compounds.

Average relative response factors (RRF) for all compounds were within validation criteria.

The percent differences (%D) of the initial calibration verification (ICV) standard were less than or equal to 20.0% for all compounds.

IV. Continuing Calibration

Continuing calibration was performed at the required frequencies.

The percent differences (%D) were less than or equal to 20.0% for all compounds.

The percent differences (%D) of the ending continuing calibration verifications (CCVs) were less than or equal to 50.0% for all compounds.

All of the continuing calibration relative response factors (RRF) were within validation criteria.

V. Laboratory Blanks

Laboratory blanks were analyzed as required by the method. No contaminants were found in the laboratory blanks with the following exceptions:

Blank ID	Extraction Date	Compound	Concentration	Associated Samples
MB 280-420756/1-A	07/01/18	Acenaphthylene Benzo(a)anthracene Chrysene Fluoranthene Phenanthrene Pyrene	0.0135 ug/L 0.0131 ug/L 0.0124 ug/L 0.0323 ug/L 0.0729 ug/L 0.0209 ug/L	NTAmw-119-062518-GW NTAmw-119-D-062518-GW
MB 280-420946/1-A	07/03/18	Anthracene Benzo(a)anthracene Benzo(b)fluoranthene Benzo(k)fluoranthene Chrysene Fluoranthene Naphthalene Phenanthrene Pyrene	0.00951 ug/L 0.0250 ug/L 0.0282 ug/L 0.0285 ug/L 0.0320 ug/L 0.0166 ug/L 0.0170 ug/L 0.0246 ug/L 0.0122 ug/L	DETmw-003-D-062618-GW DETmw-003-062618-GW

Sample concentrations were compared to concentrations detected in the laboratory blanks. The sample concentrations were either not detected or were significantly greater than the concentrations found in the associated laboratory blanks with the following exceptions:

Sample	Compound	Reported Concentration	Modified Final Concentration
NTAmw-119-062518-GW	Fluoranthene Phenanthrene Pyrene	0.025 ug/L 0.038 ug/L 0.015 ug/L	0.10U ug/L 0.10U ug/L 0.10U ug/L
NTAmw-119-D-062518-GW	Acenaphthylene Fluoranthene Phenanthrene Pyrene	0.014 ug/L 0.027 ug/L 0.051 ug/L 0.021 ug/L	0.10U ug/L 0.10U ug/L 0.10U ug/L 0.10U ug/L
DETmw-003-D-062618-GW	Anthracene Benzo(a)anthracene Benzo(b)fluoranthene Benzo(k)fluoranthene Chrysene Fluoranthene Naphthalene Phenanthrene Pyrene	0.015 ug/L 0.037 ug/L 0.030 ug/L 0.029 ug/L 0.035 ug/L 0.045 ug/L 0.020 ug/L 0.045 ug/L 0.033 ug/L	0.11U ug/L 0.11U ug/L 0.11U ug/L 0.11U ug/L 0.11U ug/L 0.11U ug/L 0.11U ug/L 0.11U ug/L 0.11U ug/L
DETmw-003-062618-GW	Chrysene Fluoranthene Naphthalene Phenanthrene Pyrene	0.012 ug/L 0.012 ug/L 0.012 ug/L 0.022 ug/L 0.011 ug/L	0.099U ug/L 0.099U ug/L 0.099U ug/L 0.099U ug/L 0.099U ug/L

VI. Field Blanks

No field blanks were identified in this SDG.

VII. Surrogates

Surrogates were added to all samples as required by the method. All surrogate recoveries (%R) were within QC limits.

VIII. Matrix Spike/Matrix Spike Duplicates

The laboratory has indicated that there were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

IX. Laboratory Control Samples

Laboratory control samples (LCS) and laboratory control samples duplicates (LCSD) were analyzed as required by the method. Percent recoveries (%R) were within QC limits with the following exceptions:

LCS ID (Associated Samples)	Compound	LCS %R (Limits)	LCSD %R (Limits)	Flag	A or P
LCS/D 280-420756/2,3-A (NTAmw-119-062518-GW NTAmw-119-D-062518-GW)	Benzo(a)anthracene Benzo(b)fluoranthene Benzo(k)fluoranthene Benzo(g,h,i)perylene Chrysene Dibenzo(a,h)anthracene Indeno(1,2,3-cd)pyrene	- - - - - - 	136 (59-120) 148 (53-126) 148 (54-125) 148 (44-128) 171 (57-120) 134 (44-131) 140 (48-130)	NA	-
LCS/D 280-420756/2,3-A (NTAmw-119-062518-GW NTAmw-119-D-062518-GW)	Fluoranthene Pyrene	- -	121 (58-120) 124 (53-121)	J (all detects) J (all detects)	A

Relative percent differences (RPD) were within QC limits with the following exceptions:

LCS ID (Associated Samples)	Compound	RPD (Limits)	Flag	A or P
LCS/D 280-420756/2,3-A (NTAmw-119-062518-GW NTAmw-119-D-062518-GW)	Anthracene Benzo(a)anthracene Benzo(b)fluoranthene Benzo(k)fluoranthene Benzo(g,h,i)perylene Benzo(a)pyrene Chrysene Dibenzo(a,h)anthracene Indeno(1,2,3-cd)pyrene	38 (≤20) 62 (≤20) 65 (≤20) 69 (≤20) 61 (≤20) 51 (≤20) 67 (≤20) 66 (≤20) 66 (≤20)	NA	-
LCS/D 280-420756/2,3-A (NTAmw-119-062518-GW NTAmw-119-D-062518-GW)	Fluoranthene Phenanthrene Pyrene	53 (≤20) 32 (≤20) 53 (≤20)	J (all detects) J (all detects) J (all detects)	A
LCS/D 280-420946/2,3-A (DETmw-003-D-062618-GW)	Benzo(k)fluoranthene	21 (≤20)	J (all detects)	A

LCS ID (Associated Samples)	Compound	RPD (Limits)	Flag	A or P
LCS/D 280-420946/2,3-A (DETmw-003-062618-GW)	Benzo(k)fluoranthene	21 (≤20)	NA	-

X. Field Duplicates

Samples NTAmw-119-062518-GW and NTAmw-119-D-062518-GW and samples DETmw-003-D-062618-GW and DETmw-003-062618-GW were identified as field duplicates. No results were detected in any of the samples with the following exceptions:

Compound	Concentration (ug/L)		RPD (Limits)	Difference (Limits)	Flag	A or P
	NTAmw-119-062518-GW	NTAmw-119-D-062518-GW				
Acenaphthylene	0.042U	0.014	-	0.028 (≤0.10)	-	-
Fluoranthene	0.025	0.027	-	0.002 (≤0.10)	-	-
Naphthalene	0.022	0.025	-	0.003 (≤0.10)	-	-
Phenanthrene	0.038	0.051	-	0.013 (≤0.10)	-	-
Pyrene	0.015	0.021	-	0.006 (≤0.10)	-	-

Compound	Concentration (ug/L)		RPD (Limits)	Difference (Limits)	Flag	A or P
	DETmw-003-D-062618-GW	DETmw-003-062618-GW				
Anthracene	0.015	0.040U	-	0.025 (≤0.099)	-	-
Benzo(a)anthracene	0.037	0.012U	-	0.025 (≤0.099)	-	-
Benzo(b)fluoranthene	0.030	0.012U	-	0.018 (≤0.099)	-	-
Benzo(k)fluoranthene	0.029	0.012U	-	0.017 (≤0.099)	-	-
Benzo(a)pyrene	0.019	0.012U	-	0.007 (≤0.099)	-	-
Chrysene	0.035	0.012	-	0.023 (≤0.11)	-	-
Fluoranthene	0.045	0.012	-	0.033 (≤0.11)	-	-
Naphthalene	0.020	0.012	-	0.008 (≤0.11)	-	-

Compound	Concentration (ug/L)		RPD (Limits)	Difference (Limits)	Flag	A or P
	DETmw-003-D-062618-GW	DETmw-003-062618-GW				
Phenanthrene	0.045	0.022	-	0.023 (≤0.11)	-	-
Pyrene	0.033	0.011	-	0.022 (≤0.11)	-	-

XI. Internal Standards

All internal standard areas and retention times were within QC limits.

XII. Compound Quantitation

All compound quantitations were within validation criteria.

XIII. Target Compound Identifications

All target compound identifications were within validation criteria.

XIV. System Performance

The system performance was acceptable.

XV. Overall Assessment of Data

The analysis was conducted within all specifications of the method. No results were rejected in this SDG.

Due to LCS/LCSD %R and RPD, data were qualified as estimated in three samples.

Due to laboratory blank contamination, data were qualified as not detected in four samples.

The quality control criteria reviewed, other than those discussed above, were met and are considered acceptable. Sample results that were found to be estimated (J) are usable for limited purposes only. Based upon the data validation all other results are considered valid and usable for all purposes.

Ravenna, Ohio
Polynuclear Aromatic Hydrocarbons - Data Qualification Summary - SDG 280-111421-1

Sample	Compound	Flag	A or P	Reason
NTAmw-119-062518-GW NTAmw-119-D-062518-GW	Fluoranthene Pyrene	J (all detects) J (all detects)	A	Laboratory control samples (%R)
NTAmw-119-062518-GW NTAmw-119-D-062518-GW	Fluoranthene Phenanthrene Pyrene	J (all detects) J (all detects) J (all detects)	A	Laboratory control samples (RPD)
DETmw-003-D-062618-GW	Benzo(k)fluoranthene	J (all detects)	A	Laboratory control samples (RPD)

Ravenna, Ohio
Polynuclear Aromatic Hydrocarbons - Laboratory Blank Data Qualification Summary - SDG 280-111421-1

Sample	Compound	Modified Final Concentration	A or P
NTAmw-119-062518-GW	Fluoranthene Phenanthrene Pyrene	0.10U ug/L 0.10U ug/L 0.10U ug/L	A
NTAmw-119-D-062518-GW	Acenaphthylene Fluoranthene Phenanthrene Pyrene	0.10U ug/L 0.10U ug/L 0.10U ug/L 0.10U ug/L	A
DETmw-003-D-062618-GW	Anthracene Benzo(a)anthracene Benzo(b)fluoranthene Benzo(k)fluoranthene Chrysene Fluoranthene Naphthalene Phenanthrene Pyrene	0.11U ug/L 0.11U ug/L 0.11U ug/L 0.11U ug/L 0.11U ug/L 0.11U ug/L 0.11U ug/L 0.11U ug/L 0.11U ug/L	A
DETmw-003-062618-GW	Chrysene Fluoranthene Naphthalene Phenanthrene Pyrene	0.099U ug/L 0.099U ug/L 0.099U ug/L 0.099U ug/L 0.099U ug/L	A

Ravenna, Ohio
Polynuclear Aromatic Hydrocarbons - Field Blank Data Qualification Summary - SDG 280-111421-1

No Sample Data Qualified in this SDG

LDC #: 42791A2b
SDG #: 280-111421-1
Laboratory: Test America, Inc.

VALIDATION COMPLETENESS WORKSHEET
Stage 4

Date: 08/02/18
Page: 1 of 1
Reviewer: AG
2nd Reviewer:

METHOD: GC/MS Polynuclear Aromatic Hydrocarbons (EPA SW 846 Method 8270D-SIM)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A / A	
II.	GC/MS Instrument performance check	A	
III.	Initial calibration/ICV	A / A	ICAL ≤ 15%, ICV ≤ 20%
IV.	Continuing calibration / ending	A	CCV ≤ 20/50%
V.	Laboratory Blanks	SW	
VI.	Field blanks	N	
VII.	Surrogate spikes	A	
VIII.	Matrix spike/Matrix spike duplicates	N	CS
IX.	Laboratory control samples	SW	LCS/D
X.	Field duplicates	SW	D = 1/2, 3/4
XI.	Internal standards	A	
XII.	Compound quantitation RL/LOQ/LODs	A	
XIII.	Target compound identification	A	
XIV.	System performance	A	
XV.	Overall assessment of data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID		Lab ID	Matrix	Date
1	NTAmw-119-062518-GW	D1	280-111421-8	Water	06/25/18
2	NTAmw-119-D-062518-GW	D1	280-111421-9	Water	06/25/18
3	DETmw-003-D-062618-GW	D2	280-111421-16	Water	06/26/18
4	DETmw-003-062818-GW	D2	280-111421-22	Water	06/26/18
5					
6					
7					
8					

Notes:

1	MB 280-420756/1-A						
2	1 - 420946/1-A						

LDC #: 42791 A 26

VALIDATION FINDINGS CHECKLIST

Reviewer: JVG
2nd Reviewer: [signature]

Method: PAH (EPA SW 846 Method 8270D-SIM)

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
Were all technical holding times met?	✓			
Was cooler temperature criteria met?	✓			
II. GC/MS Instrument performance check (Not required)				
Were the DFTPP performance results reviewed and found to be within the specified criteria?	✓			
Were all samples analyzed within the 12 hour clock criteria?	✓			
IIIa. Initial calibration				
Did the laboratory perform a 5 point calibration prior to sample analysis?	✓			
Were all percent relative standard deviations (%RSD) ≤ ~~20%~~ 15 and relative response factors (RRF) ≥ 0.05?	✓			
Was a curve fit used for evaluation? If yes, did the initial calibration meet the curve fit acceptance criteria of ≥ 0.990?		✓		
IIIb. Initial Calibration Verification				
Was an initial calibration verification standard analyzed after each initial calibration for each instrument?	✓			
Were all percent differences (%D) ≤ ~~30%~~ 20 or ~~percent recoveries (%R) 70-130%~~?	✓			
IV. Continuing calibration				
Was a continuing calibration standard analyzed at least once every 12 hours for each instrument?	✓			
Were all percent differences (%D) ≤ 20% and relative response factors (RRF) ≥ 0.05?	✓			
V. Laboratory Blanks				
Was a laboratory blank associated with every sample in this SDG?	✓			
Was a laboratory blank analyzed for each matrix and concentration?	✓			
Was there contamination in the laboratory blanks? If yes, please see the Blanks validation completeness worksheet.	✓	✓		
VI. Field blanks				
Were field blanks identified in this SDG?	•	✓		
Were target compounds detected in the field blanks?			✓	
VII. Surrogate spikes				
Were all surrogate percent differences (%R) within QC limits?	✓			
If 2 or more base neutral or acid surrogates were outside QC limits, was a reanalysis performed to confirm %R?			✓	
If any percent recoveries (%R) was less than 10 percent, was a reanalysis performed to confirm %R?			✓	

LDC #: 42791A26

VALIDATION FINDINGS CHECKLIST

Reviewer: JVG
2nd Reviewer:

Validation Area	Yes	No	NA	Findings/Comments
VIII. Matrix spike/Matrix spike duplicates				
Were a matrix spike (MS) and matrix spike duplicate (MSD) analyzed for each matrix in this SDG? If no, indicate which matrix does not have an associated MS/MSD. Soil / Water.		✓		
Was a MS/MSD analyzed every 20 samples of each matrix?		✓		
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?			✓	
IX. Laboratory control samples				
Was an LCS analyzed for this SDG?	✓			
Was an LCS analyzed per analytical batch?	✓			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?	✓			
X. Field duplicates				
Were field duplicate pairs identified in this SDG?	✓			
Were target compounds detected in the field duplicates?	✓			
XI. Internal standards				
Were internal standard area counts within -50% or +100% of the associated calibration standard?	✓			
Were retention times within ± 30 seconds of the associated calibration standard?	✓			
XII. Compound quantitation				
Were the correct internal standard (IS), quantitation ion and relative response factor (RRF) used to quantitate the compound?	✓			
Were compound quantitation and RLs adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	✓			
XIII. Target compound identification				
Were relative retention times (RRT's) within ± 0.06 RRT units of the standard?	✓			
Did compound spectra meet specified EPA "Functional Guidelines" criteria?	✓			
Were chromatogram peaks verified and accounted for?	✓			
XIV. System performance				
System performance was found to be acceptable.	✓			
XV. Overall assessment of data				
Overall assessment of data was found to be acceptable.	✓			

VALIDATION FINDINGS WORKSHEET

METHOD: GC/MS SVOA

A. Phenol	AA. 2-Chloronaphthalene	AAA. Butylbenzylphthalate	AAAA. Dibenzothiophene	A1. N-Nitrosodiethylamine
B. Bis (2-chloroethyl) ether	BB. 2-Nitroaniline	BBB. 3,3'-Dichlorobenzidine	BBBB. Benzo(a)fluoranthene	B1. N-Nitrosodi-n-butylamine
C. 2-Chlorophenol	CC. Dimethylphthalate	CCC. Benzo(a)anthracene	CCCC. Benzo(b)fluorene	C1. N-Nitrosomethylethylamine
D. 1,3-Dichlorobenzene	DD. Acenaphthylene	DDD. Chrysene	DDDD. cis/trans-Decalin	D1. N-Nitrosomorpholine
E. 1,4-Dichlorobenzene	EE. 2,6-Dinitrotoluene	EEE. Bis(2-ethylhexyl)phthalate	EEEE. Biphenyl	E1. N-Nitrosopyrrolidine
F. 1,2-Dichlorobenzene	FF. 3-Nitroaniline	FFF. Di-n-octylphthalate	FFFF. Retene	F1. Phenacetin
G. 2-Methylphenol	GG. Acenaphthene	GGG. Benzo(b)fluoranthene	GGGG. C30-Hopane	G1. 2-Acetylaminofluorene
H. 2,2'-Oxybis(1-chloropropane)	HH. 2,4-Dinitrophenol	HHH. Benzo(k)fluoranthene	HHHH. 1-Methylphenanthrene	H1. Pronamide
I. 4-Methylphenol	II. 4-Nitrophenol	III. Benzo(a)pyrene	IIII. 1,4-Dioxane	I1. Methyl methanesulfonate
J. N-Nitroso-di-n-propylamine	JJ. Dibenzofuran	JJJ. Indeno(1,2,3-cd)pyrene	JJJJ. Acetophenone	J1. Ethyl methanesulfonate
K. Hexachloroethane	KK. 2,4-Dinitrotoluene	KKK. Dibenz(a,h)anthracene	KKKK. Atrazine	K1. o,o',o''-Triethylphosphorothioate
L. Nitrobenzene	LL. Diethylphthalate	LLL. Benzo(g,h,i)perylene	LLLL. Benzaldehyde	L1. n-Phenylene diamine
M. Isophorone	MM. 4-Chlorophenyl-phenyl ether	MMM. Bis(2-Chloroisopropyl)ether	MMMM. Caprolactam	M1. 1,4-Naphthoquinone
N. 2-Nitrophenol	NN. Fluorene	NNN. Aniline	NNNN. 2,6-Dichlorophenol	N1. N-Nitro-o-toluidine
O. 2,4-Dimethylphenol	OO. 4-Nitroaniline	OOO. N-Nitrosodimethylamine	OOOO. 1,2-Diphenylhydrazine	O1. 1,3,5-Trinitrobenzene
P. Bis(2-chloroethoxy)methane	PP. 4,6-Dinitro-2-methylphenol	PPP. Benzoic Acid	PPPP. 3-Methylphenol	P1. Pentachlorobenzene
Q. 2,4-Dichlorophenol	QQ. N-Nitrosodiphenylamine	QQQ. Benzyl alcohol	QQQQ. 3&4-Methylphenol	Q1. 4-Aminobiphenyl
R. 1,2,4-Trichlorobenzene	RR. 4-Bromophenyl-phenylether	RRR. Pyridine	RRRR. 4-Dimethyldibenzothiophene (4MDT)	R1. 2-Naphthylamine
S. Naphthalene	SS. Hexachlorobenzene	SSS. Benzidine	SSSS. 2/3-Dimethyldibenzothiophene (4MDT)	S1. Triphenylene
T. 4-Chloroaniline	TT. Pentachlorophenol	TTT. 1-Methylnaphthalene	TTTT. 1-Methyldibenzothiophene (1MDT)	T1. Octachlorostyrene
U. Hexachlorobutadiene	UU. Phenanthrene	UUU.Benzo(b)thiophene	UUUU.. 2,3,4,6-Tetrachlorophenol	U1. Famphur
V. 4-Chloro-3-methylphenol	VV. Anthracene	VVV.Benzonaphthothiophene	VVVV. 1,2,4,5-Tetrachlorobenzene	V1. 1,4-phenylenediamine
W. 2-Methylnaphthalene	WW. Carbazole	WWW.Benzo(e)pyrene	WWWW.. 2-Picoline	W1. Methapyrilene
X. Hexachlorocyclopentadiene	XX. Di-n-butylphthalate	XXX. 2,6-Dimethylnaphthalene	XXXX. 3-Methylcholanthrene	X1. Pentachloroethane
Y. 2,4,6-Trichlorophenol	YY. Fluoranthene	YYY. 2,3,5-Trimethylnaphthalene	YYYY. a,a-Dimethylphenethylamine	Y1. 3,3'-Dimethylbenzidine
Z. 2,4,5-Trichlorophenol	ZZ. Pyrene	ZZZ. Perylene	ZZZZ. Hexachloropropene	Z1. o-Toluidine

LDC #: 42791 A2b

VALIDATION FINDINGS WORKSHEET
Blanks

Reviewer: JVG
2nd Reviewer: [signature]

METHOD: GC/MS PAH (EPA SW 846 Method 8270D-SIM)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

Y N N/A Was a method blank analyzed for each matrix?
Y N N/A Was a method blank analyzed for each concentration preparation level?
Y N N/A Was a method blank associated with every sample?
Y N N/A Was the blank contaminated? If yes, please see qualification below.

Blank extraction date: 07/01/18 **Blank analysis date:** 07/19/18
Conc. units: ug/L Associated Samples: 1, 2

Compound	Blank ID								
	MB 280-420756/1-A		1	2					
DD	0.0135			0.014/0.10U					
CCC	0.0131								
DDD	0.0124								
YY	0.0323		0.025/0.10U	0.027/0.10U					
UU	0.0729		0.038/	0.051/					
ZZ	0.0209		0.015/	0.021/					

Blank extraction date: 07/03/18 **Blank analysis date:** 07/12/18
Conc. units: ug/L Associated Samples: 3, 4

Compound	Blank ID								
	MB 280-420946/1-A		3	4					
VV	0.00951		0.015/0.11U						
CCC	0.0250		0.037/						
GGG	0.0282		0.030/						
HHH	0.0285		0.029/						
DDD	0.0320		0.035/	0.012/0.099U					
YY	0.0166		0.045/	0.012/					
S	0.0170		0.020/	0.012/					
UU	0.0246		0.045/	0.022/					
ZZ	0.0122		0.033/	0.011/					

CIRCLED RESULTS WERE NOT QUALIFIED. ALL RESULTS NOT CIRCLED WERE QUALIFIED BY THE FOLLOWING STATEMENT:
Common contaminants such as the phthalates and TICs noted above that were detected in samples within ten times the associated method blank concentration were qualified as not detected, "U". Other contaminants within five times the method blank concentration were also qualified as not detected, "U".

LDC #: 42791A2b

VALIDATION FINDINGS WORKSHEET
Laboratory Control Samples (LCS)

Page: 1 of 1
Reviewer: JVG
2nd Reviewer:

METHOD: GC/MS PAH (EPA SW 846 Method 8270D-SIM)
Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".
[✓ Y] N N/A Was a LCS required?
Y [✓ N] N/A Were the LCS/LCSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?

#	Date	LCS/LCSD ID	Compound	LCS %R (Limits)	LCSD %R (Limits)	RPD (Limits)	Associated Samples	Qualifications
		LCS/D 280-420756/23-A		See (attached	( )	( )	1, 2, MB 1	J dets/P
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
		LCS/D 280-420946/23-A	HHH	( )	( )	21 (20)	3, 4, MB2	J dets/P
				( )	( )	( )	(Det = 3)	
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		
				( )	( )	( )		

FORM III
GC/MS SEMI VOA LAB CONTROL SAMPLE DUPLICATE RECOVERY

Lab Name: TestAmerica Denver Job No.: 280-111421-1

SDG No.:

Matrix: Water Level: Low Lab File ID: F2459.D

Lab ID: LCSD 280-420756/3-A Client ID:

COMPOUND	SPIKE ADDED (ug/L)	LCSD CONCENTRATION (ug/L)	LCSD % REC	% RPD	QC LIMITS RPD	QC LIMITS REC	#	
Acenaphthene	0.900	0.758	84	11	20	48-114		
Acenaphthylene	0.900	0.625	69	6	20	35-121		
Anthracene VV	0.900	0.939	104	38	20	53-119	Q	(ND)
Benzo[a]anthracene CCC	0.900	1.22	136	62	20	59-120	Q	
Benzo[b]fluoranthene GGG	0.900	1.33	148	65	20	53-126	Q	
Benzo[k]fluoranthene HHH	0.900	1.33	148	69	20	54-125	Q	
Benzo[g,h,i]perylene LLL	0.900	1.33	148	61	20	44-128	Q	
Benzo[a]pyrene III	0.900	0.973	108	51	20	53-120	Q	
Chrysene DDD	0.900	1.54	171	67	20	57-120	Q	
Dibenz(a,h)anthracene KKK	0.900	1.21	134	66	20	44-131	Q	
Fluoranthene YY	0.900	1.08	121	53	20	58-120	Q	(Det)
Fluorene	0.900	0.819	91	17	20	50-118		
Indeno[1,2,3-cd]pyrene JJJ	0.900	1.26	140	66	20	48-130	Q	(ND)
Naphthalene	0.900	0.713	79	4	20	43-114		
Phenanthrene UU	0.900	1.02	113	32	20	53-115	Q	(Det)
Pyrene ZZ	0.900	1.12	124	53	20	53-121	Q	

Column to be used to flag recovery and RPD values

FORM III 8270D SIM

LDC#: 42791A2b

VALIDATION FINDINGS WORKSHEET
Field Duplicates

Reviewer: JVG
2nd Reviewer: ~~~

METHOD: GCMS PAH (EPA SW 846 Method 8270D-SIM)

(Y)N NA Were field duplicate pairs identified in this SDG?
(Y)N NA Were target analytes detected in the field duplicate pairs?

Compound	Concentration (ug/L)		RPD (≤_____ %)	Difference (ug/L)	Limits (<LOQ)	Qualifications (Parent Only)
	1	2				
DD	0.042U	0.014		0.028	(≤0.10)	
YY	0.025	0.027		0.002	(≤0.10)	
S	0.022	0.025		0.003	(≤0.10)	
UU	0.038	0.051		0.013	(≤0.10)	
ZZ	0.015	0.021		0.006	(≤0.10)	

Compound	Concentration (ug/L)		RPD (≤_____ %)	Difference (ug/L)	Limits (<LOQ)	Qualifications (Parent Only)
	3	4				
VV	0.015	0.040U		0.025	(≤0.099)	
CCC	0.037	0.012U		0.025	(≤0.099)	
GGG	0.030	0.012U		0.018	(≤0.099)	
HHH	0.029	0.012U		0.017	(≤0.099)	
III	0.019	0.012U		0.007	(≤0.099)	
DDD	0.035	0.012		0.023	(≤0.11)	
YY	0.045	0.012		0.033	(≤0.11)	
S	0.020	0.012		0.008	(≤0.11)	
UU	0.045	0.022		0.023	(≤0.11)	
ZZ	0.033	0.011		0.022	(≤0.11)	

LDC#: 42791A2b

VALIDATION FINDINGS WORKSHEET
Initial Calibration Calculation Verification

Reviewer: JVG
2nd Reviewer:

METHOD: GC/MS PAH (EPA SW 846 Method 8270D-SIM)

The Relative Response Factor (RRF), average RRF, and percent relative standard deviation (%RSD) were recalculated for the compounds identified below using the following calculations:

$RRF = (A_x)(C_{is})/(A_{is})(C_x)$
average RRF = sum of the RRFs/number of standards
%RSD = 100 * (S/X)

A_x = Area of Compound
C_x = Concentration of compound,
S= Standard deviation of the RRFs,

A_{is} = Area of associated internal standard
C_{is} = Concentration of internal standard
X = Mean of the RRFs

#	Standard ID	Calibration Date	Compound (IS)	Reported RRF (600 std)	Recalculated RRF (600 std)	Reported Average RRF (Initial)	Recalculated Average RRF (Initial)	Reported %RSD	Recalculated %RSD
1	ICAL SMS F	7/10/18	Naphthalene (ANT)	2.0502	2.0502	2.1060	2.1060	4.4	4.4
			Phenanthrene (PHN)	1.3230	1.3230	1.3927	1.3927	8.5	8.5
			Benzo(a)pyrene (CRY)	1.2018	1.2018	1.2242	1.2242	10.5	10.5

LDC#: 42791A2b

VALIDATION FINDINGS WORKSHEET
Continuing Calibration Calculation Verification

Reviewer: JVG
2nd Reviewer:

METHOD: GC/MS PAH (EPA SW 846 Method 8270D-SIM)

The percent difference (%D) of the initial calibration average Relative Response Factors (RRFs) and the continuing calibration RRFs were recalculated for the compounds identified below using the following calculation:

% Difference = 100 * (ave. RRF - RRF)/ave. RRF
RRF = (Ax)(Cis)/(Ais)(Cx)

Where:
ave. RRF = initial calibration average RRF
RRF = continuing calibration RRF
Ax = Area of compound
Cx = Concentration of compound
Ais = Area of associated internal standard
Cis = Concentration of internal standard

#	Standard ID	Calibration Date	Compound	Ave RRF	Reported RRF	Recalculated RRF	Reported % D	Recalculated %D
1	F2272	7/11/2018	Naphthalene (ANT)	2.106	1.982	1.982	5.9	5.9
			Phenanthrene (PHN)	1.393	1.313	1.313	5.7	5.7
			Benzo(a)pyrene (CRY)	1.224	1.005	1.005	17.9	17.9
2	F2299	7/12/2018	Naphthalene (ANT)	2.106	2.161	2.161	2.6	2.6
			Phenanthrene (PHN)	1.393	1.282	1.282	7.9	7.9
			Benzo(a)pyrene (CRY)	1.224	0.979	0.979	20.0	20.0
3	F2354	7/16/2018	Naphthalene (ANT)	2.106	2.226	2.226	5.7	5.7
			Phenanthrene (PHN)	1.393	1.385	1.385	0.6	0.6
			Benzo(a)pyrene (CRY)	1.224	1.059	1.059	13.5	13.5
4	F2456	7/19/2018	Naphthalene (ANT)	2.106	2.218	2.218	5.3	5.3
			Phenanthrene (PHN)	1.393	1.412	1.412	1.4	1.4
			Benzo(a)pyrene (CRY)	1.224	1.100	1.100	10.1	10.2

LDC #: 42791A2b

VALIDATION FINDINGS WORKSHEET
Surrogate Results Verification

Page: 1 of 1
Reviewer: JVG
2nd reviewer:

METHOD: GC/MS PAH (EPA SW 846 Method 8270D-SIM)

The percent recoveries (%R) of surrogates were recalculated for the compounds identified below using the following calculation:

% Recovery: SF/SS * 100

Where: SF = Surrogate Found
SS = Surrogate Spiked

Sample ID: #1

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Nitrobenzene-d5	500	351.8	70	70	0
2-Fluorobiphenyl	↓	355.5	71	71	↓
Terphenyl-d14	↓	483.4	97	97	↓

Sample ID:

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Nitrobenzene-d5					
2-Fluorobiphenyl					
Terphenyl-d14					

Sample ID:

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Nitrobenzene-d5					
2-Fluorobiphenyl					
Terphenyl-d14					

Sample ID:

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Nitrobenzene-d5					
2-Fluorobiphenyl					
Terphenyl-d14					

Sample ID:

	Surrogate Spiked	Surrogate Found	Percent Recovery Reported	Percent Recovery Recalculated	Percent Difference
Nitrobenzene-d5					
2-Fluorobiphenyl					
Terphenyl-d14					

LDC #: 42791A26

VALIDATION FINDINGS WORKSHEET

Laboratory Control Sample/Laboratory Control Sample Duplicates Results Verification

Reviewer: JVG
2nd Reviewer: [signature]

METHOD: GC/MS PAH (EPA SW 846 Method 8270D-SIM)

The percent recoveries (%R) and Relative Percent Difference (RPD) of the laboratory control sample and laboratory control sample duplicate were recalculated for the compounds identified below using the following calculation:

% Recovery = 100 * (SC/SA Where: SSC = Spike concentration
SA = Spike added

RPD = | LCSC - LCSDC | * 2/(LCSC + LCSDC) LCSC = Laboratory control sample concentration LCSDC = Laboratory control sample duplicate concentration

LCS/LCSD samples: LCSD 280-420756/2,3-A

Compound	Spike Added (ug/L)		Spike Concentration (ug/L)		LCS Percent Recovery		LCSD Percent Recovery		LCS/LCSD RPD	
	LCS	LCSD	LCS	LCSD	Reported	Recalc	Reported	Recalc	Reported	Recalculated
Acenaphthene	0.900	0.900	0.681	0.758	76	76	84	84	11	11
Pyrene	↓	↓	0.649	1.12	72	72	124	124	53	53

Comments: Refer to Laboratory Control Sample/Laboratory Control Sample Duplicates findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 42791 A26

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

Page: 1 of 1
Reviewer: JVG
2nd reviewer: [redacted]

METHOD: GC/MS PAH (EPA SW 846 Method 8270D-SIM)

(Y) N N/A Were all reported results recalculated and verified for all level IV samples?
Y (N) N/A Were all recalculated results for detected target compounds agree within 10.0% of the reported results?

Concentration = $\frac{(A_x)(I_s)(V_t)(DF)(2.0)}{(A_{is})(RRF)(V_o)(V_i)(\%S)}$

A_x	=	Area of the characteristic ion (EICP) for the compound to be measured
A_{is}	=	Area of the characteristic ion (EICP) for the specific internal standard
I_s	=	Amount of internal standard added in nanograms (ng)
V_o	=	Volume or weight of sample extract in milliliters (ml) or grams (g).
V_i	=	Volume of extract injected in microliters (ul)
V_t	=	Volume of the concentrated extract in microliters (ul)
Df	=	Dilution Factor.
%S	=	Percent solids, applicable to soil and solid matrices only.
2.0	=	Factor of 2 to account for GPC cleanup

Example:

Sample I.D. 4 , Naphthalene

Conc. = $\frac{(598)(600)(1\text{ mL})(\quad)(\quad)}{(57971)(2.1061)(251.9\text{ mL})(\quad)}$

= 0.012 ug/L

#	Sample ID	Compound	Reported Concentration (ug/L)	Calculated Concentration ( )	Qualification
			0.012		

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Ravenna, Ohio

LDC Report Date: August 3, 2018

Parameters: Chlorinated Pesticides

Validation Level: Stage 4

Laboratory: TestAmerica, Inc.

Sample Delivery Group (SDG): 280-111421-1

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
FBQmw-174-062518-GW	280-111421-1	Water	06/25/18
DETmw-003-D-062618-GW	280-111421-16	Water	06/26/18
DETmw-003-062618-GW	280-111421-22	Water	06/26/18

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with The Final Remedial Investigation Work Plan for Groundwater and Environmental Investigation Services for RVAAP-66 Facility-Wide Groundwater Former Ravenna Army Ammunition Plant Portage and Trumbull Counties, Ohio (December 20, 2016), the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013), and a modified outline of the USEPA National Functional Guidelines (NFG) for Superfund Organic Methods Data Review (August 2014). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following method:

Chlorinated Pesticides by Environmental Protection Agency (EPA) SW 846 Method 8081A

All sample results were subjected to Stage 4 data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The compound or analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The compound or analyte was analyzed for and positively identified by the laboratory; however the compound or analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The compound or analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected compound or analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition and cooler temperatures upon receipt met validation criteria.

All technical holding time requirements were met.

II. GC Instrument Performance Check

Instrument performance was checked at 12 hour intervals.

The individual 4,4'-DDT and Endrin breakdowns (%BD) were less than or equal to 15.0%.

III. Initial Calibration and Initial Calibration Verification

An initial calibration was performed as required by the method.

For compounds where average calibration factors were utilized, percent relative standard deviations (%RSD) were less than or equal to 20.0%.

In the case where the laboratory used a calibration curve to evaluate the compounds, all coefficients of determination (r^2) were greater than or equal to 0.990.

Retention time windows were established as required by the method.

The percent differences (%D) of the initial calibration verification (ICV) standard were less than or equal to 20.0% for all compounds with the following exceptions:

Date	Standard	Column	Compound	%D	Associated Samples	Flag	A or P
07/20/18	07190034	CLP 1	Toxaphene	30.38	All samples in SDG 280-111421-1	UJ (all non-detects)	A

IV. Continuing Calibration

Continuing calibration was performed at required frequencies.

The percent differences (%D) were less than or equal to 20.0% for all compounds.

Retention times of all compounds in the calibration standards were within the established retention time windows.

V. Laboratory Blanks

Laboratory blanks were analyzed as required by the method. No contaminants were found in the laboratory blanks with the following exceptions:

Blank ID	Extraction Date	Compound	Concentration	Associated Samples
MB 280-421000/1-A	07/02/18	4,4'-DDT	0.0123 ug/L	DETmw-003-D-062618-GW DETmw-003-062618-GW

Sample concentrations were compared to concentrations detected in the laboratory blanks. The sample concentrations were either not detected or were significantly greater (>5X blank contaminants) than the concentrations found in the associated laboratory blanks.

VI. Field Blanks

Sample FBQmw-174-062518-GW was identified as a field blank. No contaminants were found.

VII. Surrogates/Internal Standards

Surrogates were added to all samples as required by the method. All surrogate recoveries (%R) were within QC limits.

All internal standard areas and retention times were within QC limits.

VIII. Matrix Spike/Matrix Spike Duplicates

The laboratory has indicated that there were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

IX. Laboratory Control Samples

Laboratory control samples (LCS) and laboratory control samples duplicates (LCSD) were analyzed as required by the method. Percent recoveries (%R) were within QC limits. Relative percent differences (RPD) were within QC limits.

X. Field Duplicates

Samples DETmw-003-D-062618-GW and DETmw-003-062618-GW were identified as field duplicates. No results were detected in any of the samples.

XI. Compound Quantitation

All compound quantitations met validation criteria.

XII. Target Compound Identification

All target compound identifications met validation criteria.

XIII. System Performance

The system performance was acceptable.

XIV. Overall Assessment of Data

The analysis was conducted within all specifications of the method. No results were rejected in this SDG.

Due to ICV %D, data were qualified as estimated in three samples.

The quality control criteria reviewed, other than those discussed above, were met and are considered acceptable. Sample results that were found to be estimated (J) are usable for limited purposes only. Based upon the data validation all other results are considered valid and usable for all purposes.

Ravenna, Ohio
Chlorinated Pesticides - Data Qualification Summary - SDG 280-111421-1

Sample	Compound	Flag	A or P	Reason
FBQmw-174-062518-GW DETmw-003-D-062618-GW DETmw-003-062618-GW	Toxaphene	UJ (all non-detects)	A	Initial calibration verification (%D)

Ravenna, Ohio
Chlorinated Pesticides - Laboratory Blank Data Qualification Summary - SDG 280-111421-1

No Sample Data Qualified in this SDG

Ravenna, Ohio
Chlorinated Pesticides - Field Blank Data Qualification Summary - SDG 280-111421-1

No Sample Data Qualified in this SDG

LDC #: 42791A3a
SDG #: 280-111421-1
Laboratory: Test America, Inc.

VALIDATION COMPLETENESS WORKSHEET
Stage 4

Date: 08/02/18
Page: 1 of 1
Reviewer: [illegible]
2nd Reviewer: [illegible]

METHOD: GC Chlorinated Pesticides (EPA SW846 Method 8081B)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A / A	
II.	GC Instrument Performance Check	A	
III.	Initial calibration/ICV	A / SW	ICAL ≤ 20% r² ICV ≤ 20%
IV.	Continuing calibration	A	CCV ≤ 20%
V.	Laboratory Blanks	SW	
VI.	Field blanks	ND	FB = 1
VII.	Surrogate spikes /IS	A/A	
VIII.	Matrix spike/Matrix spike duplicates	N	CS
IX.	Laboratory control samples	A	LCS/D
X.	Field duplicates	ND	b = 2/3
XI.	Compound quantitation/RL/LOQ/LODs	A	
XII.	Target compound identification	A	
XIII.	System Performance	A	
XIV.	Overall assessment of data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID		Lab ID	Matrix	Date
1	FBQmw-174-062518-GW		280-111421-1	Water	06/25/18
2	DETmw-003-D-062618-GW	b	280-111421-16	Water	06/26/18
3	DETmw-003-062618-GW	b	280-111421-22	Water	06/26/18
4					
5					
6					
7					
8					
9					
10					

Notes:

1	MB 280-420760/1-A						
2	1 - 421000/1						

LDC #: 42791 A3a

VALIDATION FINDINGS CHECKLIST

Reviewer: JVG
2nd Reviewer: Q

Method: Pesticides/PCBs (EPA SW 846 Method 8081/8082)

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
Were all technical holding times met?	✓			
Was cooler temperature criteria met?	✓			
II. GC/ECD Instrument performance check				
Was the instrument performance found to be acceptable?	✓			
Were Evaluation mix standards analyzed prior to the initial calibration and at beginning of each 12-hour shift?	✓			
Were endrin and 4,4'-DDT breakdowns ≤ 15% for individual breakdown in the Evaluation mix standards?	✓			
IIIa. Initial calibration				
Did the laboratory perform a 5 point calibration prior to sample analysis?	✓			
Were all percent relative standard deviations (%RSD) ≤ 20%?	✓			
Was a curve fit used for evaluation? If yes, did the initial calibration meet the curve fit acceptance criteria of ≥ 0.990?	✓			
Were the RT windows properly established?	✓			
IIIb. Initial calibration verification				
Was an initial calibration verification standard analyzed after each initial calibration for each instrument?	✓			
Were all percent differences (%D) ≤ 20% or percent recoveries (%R) 80-120%?	✓			
IV. Continuing calibration				
Was a continuing calibration analyzed daily?	✓			
Were all percent differences (%D) ≤ 20% or percent recoveries (%R) 80-120%?	✓			
Were all the retention times within the acceptance windows?	✓			
V. Laboratory Blanks				
Was a laboratory blank associated with every sample in this SDG?	✓			
Was a laboratory blank analyzed for each matrix and concentration?	✓			
Was there contamination in the laboratory blanks? If yes, please see the Blanks validation completeness worksheet.	✓			
VI. Field blanks				
Were field blanks identified in this SDG?	✓			
Were target compounds detected in the field blanks?		✓		
VII. Surrogate spikes/Internal Standards				
Were all surrogate percent recovery (%R) within the QC limits?	✓			

Validation Area	Yes	No	NA	Findings/Comments
If the percent recovery (%R) of one or more surrogates was outside QC limits, was a reanalysis performed to confirm %R?	.		✓	
If any percent recovery (%R) was less than 10 percent, was a reanalysis performed to confirm %R?			✓	
Were internal standard area counts within ± 50% of the average area calculated during calibration?	✓			
VII. Matrix spike/Matrix spike duplicates				
Were a matrix spike (MS) and matrix spike duplicate (MSD) analyzed for each matrix in this SDG? If no, indicate which matrix does not have an associated MS/MSD. Soil / Water.		✓		
Was a MS/MSD analyzed every 20 samples of each matrix?		✓		
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?			✓	
IX. Laboratory control samples				
Was an LCS analyzed for this SDG?	✓			
Was an LCS analyzed per extraction batch?	✓			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?	✓			
X. Field duplicates				
Were field duplicate pairs identified in this SDG?	✓			
Were target compounds detected in the field duplicates?		✓		
XI. Compound quantitation				
Were compound quantitation and RLs adjusted to reflect all sample dilutions, dry weight factors, and clean-up activities applicable to level IV validation?	✓			
Were relative percent difference (RPD) of the results between two columns ≤ 40%?	✓			
XII. Target compound identification				
Were the retention times of reported detects within the RT windows?	✓			
XIII. Overall assessment of data				
Overall assessment of data was found to be acceptable.	✓			

VALIDATION FINDINGS WORKSHEET

METHOD: Pesticide/PCBs (EPASW 846 Method 8081/8082)

A. alpha-BHC	K. Endrin	U. Toxaphene	EE. 2,4'-DDT	OO.
B. beta-BHC	L. Endosulfan II	V. Aroclor-1016	FF. Hexachlorobenzene	PP.
C. delta-BHC	M. 4,4'-DDD	W. Aroclor-1221	GG. Chlordane	QQ
D. gamma-BHC	N. Endosulfan sulfate	X. Aroclor-1232	HH. Chlordane (Technical)	RR.
E. Heptachlor	O. 4,4'-DDT	Y. Aroclor-1242	II. Aroclor 1262	SS.
F. Aldrin	P. Methoxychlor	Z. Aroclor-1248	JJ. Aroclor 1268	TT.
G. Heptachlor epoxide	Q. Endrin ketone	AA. Aroclor-1254	KK. Oxychlordane	UU.
H. Endosulfan I	R. Endrin aldehyde	BB. Aroclor-1260	LL. trans-Nonachlor	VV
I. Dieldrin	S. alpha-Chlordane	CC. 2,4'-DDD	MM. cis-Nonachlor	WW.
J. 4,4'-DDE	T. gamma-Chlordane	DD. 2,4'-DDE	NN.	XX.

Notes:_____

LDC #: 42791A3a

VALIDATION FINDINGS WORKSHEET
Initial Calibration Verification

Page: 1 of 1
Reviewer: JVG
2nd Reviewer: [signature]

METHOD: GC Pesticides/PCBs (EPA SW 846 Method 8081/8082)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".
What type of initial calibration verification calculation was performed? /%D or __%R
(Y) N N/A Was an initial calibration verification standard analyzed after each ICAL for each instrument?
Y (N) N/A Did the initial calibration verification standards meet the %D / %R validation criteria of ≤20.0% / 80-120%?

#	Date	Standard ID	Detector/ Column	Compound	%D (Limit ≤ 20.0)	Associated Samples	Qualifications
	07/20/18	07190034	CLP1	U	30.38	All (ND)	J / UJ / A

LDC #: 42791 A 3a

VALIDATION FINDINGS WORKSHEET
Blanks

Reviewer: JVG
2nd Reviewer: [signature]

METHOD: GC Pesticides/PCBs (EPA SW 846 Method 8081/8082)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

Y N N/A Were all samples associated with a method blank?
Y N N/A Was a method blank performed for each matrix and whenever a sample extraction was performed?
Y N N/A If extract clean-up was performed, were extract clean-up blanks analyzed at the proper frequencies?
Y N N/A Was there contamination in the method blanks? If yes, please see the qualifications below.

Blank extraction date: 07/02/18 Blank analysis date: 07/25/18 Associated samples: 2, 3 (ND)
Conc. units: ug/L

Compound	Blank ID	Sample Identification								
	MB 280-421000/1-A									
0	0.0123									

Blank extraction date: _____ Blank analysis date: _____ Associated samples: _____
Conc. units: _____

Compound	Blank ID	Sample Identification								

CIRCLED RESULTS WERE NOT QUALIFIED. ALL RESULTS NOT CIRCLED WERE QUALIFIED BY THE FOLLOWING STATEMENT:
All contaminants within five times the method blank concentration were qualified as not detected, "U".

LDC #: 42791A3a

VALIDATION FINDINGS WORKSHEET
Initial Calibration Calculation Verification

Reviewer: JVG
2nd Reviewer:

METHOD: GC Pesticides (EPA SW 846 Method 8081B)

The Relative Response Factor (RRF), average RRF, and percent relative standard deviation (%RSD) were recalculated for the compounds identified below using the following calculations:

$RRF = (A_x)(C_{is})/(A_{is})(C_x)$

average RRF = sum of the RRFs/number of standards

%RSD = 100 * (S/X)

Where

A_x = Area of Compound

C_x = Concentration of compound,

S= Standard deviation of the RRFs,

A_{is} = Area of associated internal standard

C_{is} = Concentration of internal standard

X = Mean of the RRFs

#	Standard ID	Calibration Date	Compound	Reported RRF (25 std)	Recalculated RRF (25 std)	Reported Average RRF (Initial)	Recalculated Average RRF (Initial)	Reported %RSD	Recalculated %RSD
1	ICAL SGC_P2	7/20/2018	Dieldrin (CLP1)	1.3270	1.3270	1.3747	1.3747	4.2	4.2
			Endrin ketone (CLP1)	1.3581	1.3581	1.4296	1.4296	4.7	4.7
			Dieldrin (CLP2)	1.2900	1.2900	1.3142	1.3142	2.8	2.8
			Endrin ketone (CLP2)	1.4065	1.4065	1.4936	1.4936	8.0	8.0

IS= 1-Bromo-2-nitrobenzene - 75 ug/L

LDC # 42791A3a

VALIDATION FINDINGS WORKSHEET
Continuing Calibration Results Verification

Reviewer: JVG
2nd Reviewer:

METHOD: GC Pesticides (EPA SW 846 Method 8081B)

The percent difference (%D) of the initial calibration average Relative Response Factors (RRFs) and the continuing calibration RRFs were recalculated for the compounds identified below using the following calculation:

% Difference = 100 * (ave. RRF - RRF)/ave. RRF
RRF = (Ax)(Cis)/(Ais)(Cx)

Where:
ave. RRF = initial calibration average RRF
RRF = continuing calibration RRF
Ax = Area of compound,
Cx = Concentration of compound,
Ais = Area of associated internal standard
Cis = Concentration of internal standard

#	Standard ID	Calibration Date	Compound	Average RRF Conc	Reported RRF (CC)	Recalculated RRF (CC)	Reported % D	Recalculated % D
1	07250011	7/25/2018	Dieldrin (CLP1)	25.0	21.2	21.2	15.4	15.4
			Endrin ketone (CLP1)	25.0	21.8	21.8	12.8	12.8
			Dieldrin (CLP2)	25.0	21.5	21.5	14.0	14.0
			Endrin ketone (CLP2)	25.0	20.8	20.8	16.7	16.7
2	07250023	7/25/2018	Dieldrin (CLP1)	25.0	24.0	24.0	3.8	3.8
			Endrin ketone (CLP1)	25.0	23.0	23.0	7.9	7.9
			Dieldrin (CLP2)	25.0	24.4	24.4	2.3	2.3
			Endrin ketone (CLP2)	25.0	22.1	22.1	11.6	11.6

LDC #: 42791A3a

VALIDATION FINDINGS WORKSHEET

Surrogate Results Verification

Page: 1 of 1
Reviewer: JVG
2nd reviewer:

METHOD: GC Pesticides/PCBs (EPA SW 846 Method 8081/8082)

The percent recoveries (%R) of surrogates were recalculated for the compounds identified below using the following calculation:

% Recovery: SF/SS * 100

Where: SF = Surrogate Found
SS = Surrogate Spiked

Sample ID: # 2

Surrogate	Column	Surrogate Spiked	Surrogate Found	Percent Recovery	Percent Recovery	Percent Difference
				Reported	Recalculated	
Tetrachloro-m-xylene	ap 1	10.0	5.11	51	51	0
Tetrachloro-m-xylene	2		4.77	48	48	
Decachlorobiphenyl	1		6.80	68		
Decachlorobiphenyl	2		6.35	63		

Sample ID:

Surrogate	Column	Surrogate Spiked	Surrogate Found	Percent Recovery	Percent Recovery	Percent Difference
				Reported	Recalculated	
Tetrachloro-m-xylene						
Tetrachloro-m-xylene						
Decachlorobiphenyl						
Decachlorobiphenyl						

Sample ID:

Surrogate	Column	Surrogate Spiked	Surrogate Found	Percent Recovery	Percent Recovery	Percent Difference
				Reported	Recalculated	
Tetrachloro-m-xylene						
Tetrachloro-m-xylene						
Decachlorobiphenyl						
Decachlorobiphenyl						

Sample ID:

Surrogate	Column	Surrogate Spiked	Surrogate Found	Percent Recovery	Percent Recovery	Percent Difference
				Reported	Recalculated	
Tetrachloro-m-xylene						
Tetrachloro-m-xylene						
Decachlorobiphenyl						
Decachlorobiphenyl						

Notes:

LDC #: 42791A3a

VALIDATION FINDINGS WORKSHEET

Laboratory Control Sample/Laboratory Control Sample Duplicate Results Verification

Reviewer: JVG
2nd Reviewer: [illegible]

METHOD: GC Pesticides/PCBs (EPA SW 846 Method 8081/8082)

The percent recoveries (%R) and Relative Percent difference (RPD) of the laboratory control sample and laboratory control sample duplicate were recalculated for the compounds identified below using the following calculation:

% Recovery = 100* (SSC-SC)/SA

Where: SSC = Spiked sample concentration
SA = Spike added
SC = Concentration

RPD = I LCS - LCSD I * 2/(LCS + LCSD)

LCS = Laboratory control sample percent recovery

LCSD = Laboratory control sample duplicate percent recovery

LCS/LCSD samples: LCS/D 280-421060/2,3-A

Compound	Spike Added (ug/L)		Spiked Sample Concentration (ug/L)		LCS Percent Recovery		LCSD Percent Recovery		LCS/LCSD RPD	
	LCS	LCSD	LCS	LCSD	Reported	Recalc.	Reported	Recalc.	Reported	Recalc.
gamma-BHC	2.00	2.00	1.75	1.54	88	88	77	77	13	13
4,4'-DDT	↓	↓	2.59	2.15	129	129	167	167	18	18
Aroclor 1260										

Comments: Refer to Laboratory Control Sample/Laboratory Control Sample Duplicate findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 42791 A3L

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

Reviewer: JVG
2nd reviewer:

METHOD: GC Pesticides/PCBs (EPA SW 846 Method 8081/8082)

(Y) N N/A Were all reported results recalculated and verified for all level IV samples?
(Y) N N/A Were all recalculated results for detected target compounds agree within 10.0% of the reported results?

Example:

Sample I.D. LCS-42[illegible]000 ND Dieldrin

Conc. = $\frac{(1078476603)(75\text{ml})(5\text{ml})}{(64425317\text{4})(1.3747)(250\text{ml})}$

= 1.827

≈ 1.83

#	Sample ID	Compound	Reported Concentration (ug/L)	Calculated Concentration ( )	Qualification
			1.83		

Note:

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Ravenna, Ohio

LDC Report Date: August 3, 2018

Parameters: Polychlorinated Biphenyls

Validation Level: Stage 4

Laboratory: TestAmerica, Inc.

Sample Delivery Group (SDG): 280-111421-1

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
DETmw-003-D-062618-GW	280-111421-16	Water	06/26/18
DETmw-003-062618-GW	280-111421-22	Water	06/26/18

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with The Final Remedial Investigation Work Plan for Groundwater and Environmental Investigation Services for RVAAP-66 Facility-Wide Groundwater Former Ravenna Army Ammunition Plant Portage and Trumbull Counties, Ohio (December 20, 2016), the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013), and a modified outline of the USEPA National Functional Guidelines (NFG) for Superfund Organic Methods Data Review (August 2014). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following method:

Polychlorinated Biphenyls (PCBs) by Environmental Protection Agency (EPA) SW 846 Method 8082A

All sample results were subjected to Stage 4 data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The compound or analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The compound or analyte was analyzed for and positively identified by the laboratory; however the compound or analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The compound or analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected compound or analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition and cooler temperatures upon receipt met validation criteria.

All technical holding time requirements were met.

II. Initial Calibration and Initial Calibration Verification

An initial calibration was performed as required by the method.

A curve fit, based on the initial calibration, was established for quantitation. The coefficient of determination (r^2) was greater than or equal to 0.990.

Retention time windows were established as required by the method.

The percent differences (%D) of the initial calibration verification (ICV) standard were less than or equal to 20.0% for all compounds.

III. Continuing Calibration

Continuing calibration was performed at required frequencies.

The percent differences (%D) were less than or equal to 20.0% for all compounds.

Retention times of all compounds in the calibration standards were within the established retention time windows.

IV. Laboratory Blanks

Laboratory blanks were analyzed as required by the method. No contaminants were found in the laboratory blanks.

V. Field Blanks

No field blanks were identified in this SDG.

VI. Surrogates/Internal Standards

Surrogates were added to all samples as required by the method. All surrogate recoveries (%R) were within QC limits.

All internal standard areas and retention times were within QC limits.

VII. Matrix Spike/Matrix Spike Duplicates

The laboratory has indicated that there were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

VIII. Laboratory Control Samples

Laboratory control samples (LCS) were analyzed as required by the method. Percent recoveries (%R) were within QC limits.

IX. Field Duplicates

Samples DETmw-003-D-062618-GW and DETmw-003-062618-GW were identified as field duplicates. No results were detected in any of the samples.

X. Compound Quantitation

All compound quantitations met validation criteria.

XI. Target Compound Identification

All target compound identifications met validation criteria.

XII. Overall Assessment of Data

The analysis was conducted within all specifications of the method. No results were rejected in this SDG.

The quality control criteria reviewed were met and are considered acceptable. Based upon the data validation all results are considered valid and usable for all purposes.

Ravenna, Ohio
Polychlorinated Biphenyls - Data Qualification Summary - SDG 280-111421-1

No Sample Data Qualified in this SDG

Ravenna, Ohio
Polychlorinated Biphenyls - Laboratory Blank Data Qualification Summary - SDG 280-111421-1

No Sample Data Qualified in this SDG

Ravenna, Ohio
Polychlorinated Biphenyls - Field Blank Data Qualification Summary - SDG 280-111421-1

No Sample Data Qualified in this SDG

LDC #: 42791A3b
SDG #: 280-111421-1
Laboratory: Test America, Inc.

VALIDATION COMPLETENESS WORKSHEET
Stage 4

Date: 08/02/18
Page: 1 of 1
Reviewer: DVG
2nd Reviewer:

METHOD: GC Polychlorinated Biphenyls (EPA SW846 Method 8082A)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A / A	
II.	Initial calibration/ICV	A / A	r² ICV ≤ 20 %
III.	Continuing calibration	A	CCV ≤ 20 %
IV.	Laboratory Blanks	A	
V.	Field blanks	N	
VI.	Surrogate spikes /IS	A/A	
VII.	Matrix spike/Matrix spike duplicates	N	CS
VIII.	Laboratory control samples	A	LCS
IX.	Field duplicates	ND	b = 1/2
X.	Compound quantitation/RL/LOQ/LODs	A	
XI.	Target compound identification	A	
XII	Overall assessment of data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID		Lab ID	Matrix	Date
1	DETmw-003-D-062618-GW	D	280-111421-16	Water	06/26/18
2	DETmw-003-062618-GW	b	280-111421-22	Water	06/26/18
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					

Notes:

-	MB 280-421495/1-	A					

LDC #: 42791 A3b

VALIDATION FINDINGS CHECKLIST

Reviewer: JVG
2nd Reviewer: CP

Method: Pesticides/PCBs (EPA SW 846 Method 8081/8082)

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
Were all technical holding times met?	✓			
Was cooler temperature criteria met?	✓			
II. GC/ECD Instrument performance check				
Was the instrument performance found to be acceptable?	•		✓	
Were Evaluation mix standards analyzed prior to the initial calibration and at beginning of each 12-hour shift?			✓	
Were endrin and 4,4'-DDT breakdowns ≤ 15% for individual breakdown in the Evaluation mix standards?			✓	
IIIa. Initial calibration				
Did the laboratory perform a 5 point calibration prior to sample analysis?	✓			
Were all percent relative standard deviations (%RSD) ≤ 20%?			✓	
Was a curve fit used for evaluation? If yes, did the initial calibration meet the curve fit acceptance criteria of ≥ 0.990?	✓			
Were the RT windows properly established?	✓			
IIIb. Initial calibration verification				
Was an initial calibration verification standard analyzed after each initial calibration for each instrument?	✓			
Were all percent differences (%D) ≤ 20% or percent recoveries (%R) 80-120%?	✓			
IV. Continuing calibration				
Was a continuing calibration analyzed daily?	✓			
Were all percent differences (%D) ≤ 20% or percent recoveries (%R) 80-120%?	✓			
Were all the retention times within the acceptance windows?	✓			
V. Laboratory Blanks				
Was a laboratory blank associated with every sample in this SDG?	✓			
Was a laboratory blank analyzed for each matrix and concentration?	✓			
Was there contamination in the laboratory blanks? If yes, please see the Blanks validation completeness worksheet.		✓		
VI. Field blanks				
Were field blanks identified in this SDG?		✓		
Were target compounds detected in the field blanks?			✓	
VII. Surrogate spikes/Internal Standards				
Were all surrogate percent recovery (%R) within the QC limits?	✓			

Validation Area	Yes	No	NA	Findings/Comments
If the percent recovery (%R) of one or more surrogates was outside QC limits, was a reanalysis performed to confirm %R?	✓		✓	
If any percent recovery (%R) was less than 10 percent, was a reanalysis performed to confirm %R?			✓	
Were internal standard area counts within ± 50% of the average area calculated during calibration?	✓			
VII. Matrix spike/Matrix spike duplicates				
Were a matrix spike (MS) and matrix spike duplicate (MSD) analyzed for each matrix in this SDG? If no, indicate which matrix does not have an associated MS/MSD. Soil / Water.		✓		
Was a MS/MSD analyzed every 20 samples of each matrix?		✓		
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?			✓	
IX. Laboratory control samples				
Was an LCS analyzed for this SDG?	✓			
Was an LCS analyzed per extraction batch?	✓			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?	✓			
X. Field duplicates				
Were field duplicate pairs identified in this SDG?	✓			
Were target compounds detected in the field duplicates?		✓		
XI. Compound quantitation				
Were compound quantitation and RLs adjusted to reflect all sample dilutions, dry weight factors, and clean-up activities applicable to level IV validation?	✓			
Were relative percent difference (RPD) of the results between two columns ≤ 40%?	✓			
XII. Target compound identification				
Were the retention times of reported detects within the RT windows?	✓			
XIII. Overall assessment of data				
Overall assessment of data was found to be acceptable.	✓			

LDC#: 42791A3b

VALIDATION FINDINGS WORKSHEET
Initial Calibration Calculation Verification

Reviewer: JVG
2nd Reviewer:

METHOD: PCBs (EPA SW 846 Method 8082A)

Parameter: 1260-1

Order of regression: Linear

Date	Instrument	Compound	Points	x Response ratio	y Conc ratio
5/20/2018	SGC P3 CLP1	1260-1	Point 1	0.01571	0.025
			Point 2	0.02859	0.050
			Point 3	0.05090	0.100
			Point 4	0.11745	0.250
			Point 5	0.22784	0.500
			Point 6	0.34479	0.750
			Point 7	0.44910	1.000

Regression Output:			Reported WLR	
Constant	b =	0.00591	b =	5.2247
Std Err of Y Est		0.04		
R Squared	r^2 =	0.99982	r^2 =	1.00000
No. of Observations		6.00		
Degrees of Freedom		4.00		
X Coefficient(s)	m =	0.44598	m =	0.4478
Std Err of Coef.	0.01			

VALIDATION FINDINGS WORKSHEET
Initial Calibration Calculation Verification

METHOD: PCBs (EPA SW 846 Method 8082A)

Parameter: 1260-1

Order of regression: Linear

Date	Instrument	Compound	Points	x Response ratio	y Conc ratio
5/20/2018	SGC P3 CLP2	1260-1	Point 1	0.01796	0.025
			Point 2	0.03408	0.050
			Point 3	0.06217	0.100
			Point 4	0.14558	0.250
			Point 5	0.29219	0.500
			Point 6	0.43002	0.750
			Point 7	0.57516	1.000

Regression Output:			Reported WLR	
Constant	b =	0.00467	b =	4.36800
Std Err of Y Est		0.04		
R Squared	r^2 =	0.99994	r^2 =	1.00000
No. of Observations		6.00		
Degrees of Freedom		4.00		
X Coefficient(s)	m =	0.56991	m =	0.57070
Std Err of Coef.	0.01			

LDC#: 42791A3b

VALIDATION FINDINGS WORKSHEET
Continuing Calibration Calculation Verification

Reviewer: JVG
2nd Reviewer:

METHOD: GC ✓ HPLC____

The percent difference (%D) of the initial calibration average Calibration Factors (CF) and the continuing calibration percent difference (%D) values were recalculated for the compounds identified below using the following calculation:

Percent difference (%D) = 100 * (N - C)/N

Where:

N = Initial Calibration Factor or Nominal Amount

C = Calibration Factor from Continuing Calibration Standard or Calculated Amount

#	Standard ID	Calibration Date	Compound	CCV Conc	Reported Conc	Recalculated Conc	Reported % D	Recalculated %D
1	07111803	7/11/2018	1260-1 CLP1	500	481.2	481.2	3.7	3.8
			1260-2 CLP2	500	491.4	491.4	1.7	1.7

LDC #: 42791A3b

VALIDATION FINDINGS WORKSHEET
Surrogate Results Verification

Page: 1 of 1
Reviewer: JVG
2nd reviewer: ✓

METHOD: GC Pesticides/PCBs (EPA SW 846 Method 8081/8082)

The percent recoveries (%R) of surrogates were recalculated for the compounds identified below using the following calculation:

% Recovery: SF/SS * 100

Where: SF = Surrogate Found
SS = Surrogate Spiked

Sample ID: #1

Surrogate	Column	Surrogate Spiked	Surrogate Found	Percent Recovery	Percent Recovery	Percent Difference
				Reported	Recalculated	
Tetrachloro-m-xylene						
Tetrachloro-m-xylene	CLP 2	20.0	16.3	82	82	0
Decachlorobiphenyl	↓	↓	18.3	92	92	↓
Decachlorobiphenyl						

Sample ID:

Surrogate	Column	Surrogate Spiked	Surrogate Found	Percent Recovery	Percent Recovery	Percent Difference
				Reported	Recalculated	
Tetrachloro-m-xylene						
Tetrachloro-m-xylene						
Decachlorobiphenyl						
Decachlorobiphenyl						

Sample ID:

Surrogate	Column	Surrogate Spiked	Surrogate Found	Percent Recovery	Percent Recovery	Percent Difference
				Reported	Recalculated	
Tetrachloro-m-xylene						
Tetrachloro-m-xylene						
Decachlorobiphenyl						
Decachlorobiphenyl						

Sample ID:

Surrogate	Column	Surrogate Spiked	Surrogate Found	Percent Recovery	Percent Recovery	Percent Difference
				Reported	Recalculated	
Tetrachloro-m-xylene						
Tetrachloro-m-xylene						
Decachlorobiphenyl						
Decachlorobiphenyl						

Notes:

LDC #: 42791A3b

VALIDATION FINDINGS WORKSHEET

Laboratory Control Sample/Laboratory Control Sample Duplicate Results Verification

Reviewer: JVG
2nd Reviewer:

METHOD: GC Pesticides/PCBs (EPA SW 846 Method 8081/8082)

The percent recoveries (%R) and Relative Percent difference (RPD) of the laboratory control sample and laboratory control sample duplicate were recalculated for the compounds identified below using the following calculation:

% Recovery = 100* (SSC-SC)/SA

Where: SSC = Spiked sample concentration
SA = Spike added
SC = Concentration

RPD = I LCS - LCSD I * 2/(LCS + LCSD)

LCS = Laboratory control sample percent recovery

LCSD = Laboratory control sample duplicate percent recovery

LCS/LCSD samples: LCS 280-421495/2-A

Compound	Spike Added (ug/L)		Spiked Sample Concentration (ug/L)		LCS Percent Recovery		LCSD Percent Recovery		LCS/LCSD RPD	
	LCS	LCSD	LCS	LCSD	Reported	Recalc.	Reported	Recalc.	Reported	Recalc.
gamma-BHC										
4,4'-DDT										
Aroclor 1260	0.200	NA	0.186	NA	93	93				

Comments: Refer to Laboratory Control Sample/Laboratory Control Sample Duplicate findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 42791 A3b

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

Page: 1 of 1
Reviewer: JVG
2nd reviewer:

METHOD: GC Pesticides/PCBs (EPA SW 846 Method 8081/8082)

Y N N/A Were all reported results recalculated and verified for all level IV samples?
Y N N/A Were all recalculated results for detected target compounds agree within 10.0% of the reported results?

Example:

Sample I.D. ND LCS 1260 CLPX

1260-1 Conc. $= \dfrac{\left[\dfrac{(106922507)(1000)}{(10141503747)}\right] - (4.368)}{(6.5767)}$ #

$= 177.08$

1260 Total $= \dfrac{177.08 + 169.4 + 199.7 + 1924 + 191.3}{5}$

$= 186.0$

final conc. $= \dfrac{(186.0)(1\text{ml})}{(1000\text{ml})}$

$= 0.186$ ug/L

#	Sample ID	Compound	Reported Concentration (ug/L)	Calculated Concentration ( )	Qualification
			0.186		

Note:

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Ravenna, Ohio

LDC Report Date: August 3, 2018

Parameters: Metals

Validation Level: Stage 4

Laboratory: TestAmerica, Inc.

Sample Delivery Group (SDG): 280-111421-1

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
LL12mw-247-062618-GW	280-111421-4	Water	06/26/18
LL12mw-247-D-062618-GW	280-111421-5	Water	06/26/18
LL10mw-003-062618-GW	280-111421-7	Water	06/26/18
NTAmw-119-062518-GW	280-111421-8	Water	06/25/18
NTAmw-119-D-062518-GW	280-111421-9	Water	06/25/18
FWGmw-016-062518-GW	280-111421-13	Water	06/25/18
FWGmw-015-062518-GW	280-111421-14	Water	06/25/18
FWGmw-004-062518-GW	280-111421-15	Water	06/25/18
DETmw-003-D-062618-GW	280-111421-16	Water	06/26/18
DA2mw-115-062618-GW	280-111421-21	Water	06/26/18
DETmw-003-062618-GW	280-111421-22	Water	06/26/18
LL12mw-247-062618-GWMS	280-111421-4MS	Water	06/26/18
LL12mw-247-062618-GWMSD	280-111421-4MSD	Water	06/26/18
LL10mw-003-062618-GWMS	280-111421-7MS	Water	06/26/18
LL10mw-003-062618-GWMSD	280-111421-7MSD	Water	06/26/18

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with The Final Remedial Investigation Work Plan for Groundwater and Environmental Investigation Services for RVAAP-66 Facility-Wide Groundwater Former Ravenna Army Ammunition Plant Portage and Trumbull Counties, Ohio (December 20, 2016), the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013), and a modified outline of the USEPA National Functional Guidelines (NFG) for Inorganic Superfund Data Review (August 2014). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following methods:

Aluminum, Antimony, Arsenic, Barium, Beryllium, Cadmium, Calcium, Chromium, Cobalt, Copper, Iron, Lead, Magnesium, Manganese, Nickel, Potassium, Selenium, Silver, Sodium, Thallium, Vanadium, and Zinc by Environmental Protection Agency (EPA) SW 846 Methods 6010C/6020A
Mercury by EPA SW 846 Method 7470A

All sample results were subjected to Stage 4 evaluation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The compound or analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The compound or analyte was analyzed for and positively identified by the laboratory; however the compound or analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The compound or analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected compound or analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition.

All technical holding time requirements were met.

II. ICPMS Tune

The mass calibration was within 0.1 AMU and the percent relative standard deviation (%RSD) was less than or equal to 5%.

III. Instrument Calibration

Initial and continuing calibrations were performed as required by the methods.

The initial calibration verification (ICV) and continuing calibration verification (CCV) standards were within QC limits.

IV. ICP Interference Check Sample Analysis

The frequency of interference check sample (ICS) analysis was met. All criteria were within QC limits.

V. Laboratory Blanks

Laboratory blanks were analyzed as required by the methods. No contaminants were found in the laboratory blanks with the following exceptions:

Blank ID	Analyte	Maximum Concentration	Associated Samples
ICB/CCB	Silver Vanadium	0.0380 ug/L 0.610 ug/L	All samples in SDG 280-11421-1
ICB/CCB	Antimony	0.617 ug/L	LL12mw-247-062618-GW LL12mw-247-D-062618-GW LL10mw-003-062618-GW NTAmw-119-062518-GW
ICB/CCB	Antimony	0.464 ug/L	NTAmw-119-D-062518-GW FWGmw-016-062518-GW FWGmw-015-062518-GW FWGmw-004-062518-GW DETmw-003-D-062618-GW DA2mw-115-062618-GW DETmw-003-062818-GW

Data qualification by the laboratory blanks was based on the maximum contaminant concentration in the laboratory blanks in the analysis of each analyte. The sample concentrations were either not detected or were significantly greater than the concentrations found in the associated laboratory blanks with the following exceptions:

Sample	Analyte	Reported Concentration	Modified Final Concentration
LL12mw-247-D-062618-GW	Vanadium	1.8 ug/L	6.0U ug/L

VI. Field Blanks

No field blanks were identified in this SDG.

VII. Matrix Spike/Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicate (MSD) sample analysis was performed on an associated project sample. Percent recoveries (%R) were within QC limits with the following exceptions:

Spike ID (Associated Samples)	Analyte	MS (%R) (Limits)	MSD (%R) (Limits)	Flag	A or P
LL10mw-003-062618-GWMS/MSD (LL10mw-003-062618-GW)	Sodium Iron	43 (87-115) -	36 (87-115) (75-87-115)	J (all detects) J (all detects)	A

For LL12mw-247-062618-GWMS/MSD, no data were qualified for Manganese percent recoveries (%R) outside the QC limits since the parent sample results were greater than 4X the spike concentration.

For LL10mw-003-062618-GWMS/MSD, no data were qualified for Calcium percent recoveries (%R) outside the QC limits since the parent sample results were greater than 4X the spike concentration.

Relative percent differences (RPD) were within QC limits.

VIII. Duplicate Sample Analysis

The laboratory has indicated that there were no duplicate (DUP) analyses specified for the samples in this SDG, and therefore duplicate analyses were not performed for this SDG.

IX. Serial Dilution

Serial dilution analysis was performed on an associated project sample. Percent differences (%D) were within QC limits with the following exceptions:

Diluted Sample	Analyte	%D (Limits)	Associated Samples	Flag	A or P
LL12mw-247-062618-GW	Manganese	11 (≤10)	LL12mw-247-062618-GW	J (all detects)	A

X. Laboratory Control Samples

Laboratory control samples (LCS) and laboratory control samples duplicates (LCSD) were analyzed as required by the method. Percent recoveries (%R) were within QC limits. Relative percent differences (RPD) were within QC limits.

XI. Field Duplicates

Samples LL12mw-247-062618-GW and LL12mw-247-D-062618-GW, samples NTAmw-119-062518-GW and NTAmw-119-D-062518-GW, and samples DETmw-003-D-062618-GW and DETmw-003-062818-GW were identified as field duplicates. No results were detected in any of the samples with the following exceptions:

Analyte	Concentration (ug/L)		RPD (Limits)	Difference (Limits)	Flag	A or P
	LL12mw-247-062618-GW	LL12mw-247-D-062618-GW				
Aluminum	480	1100	-	620 (≤300)	-	-
Calcium	92000	96000	4 (≤20)	-	-	-
Iron	1700	2600	42 (≤20)	-	-	-
Magnesium	50000	51000	2 (≤20)	-	-	-
Potassium	2500	2700	-	200 (≤3000)	-	-
Sodium	22000	22000	-	0 (≤5000)	-	-
Arsenic	8.3	8.8	-	0.5 (≤5.0)	-	-
Barium	24	30	22 (≤20)	-	-	-
Beryllium	0.30U	0.11	-	0.19 (≤1.0)	-	-
Chromium	0.72	2.0	-	1.28 (≤10)	-	-
Cobalt	0.80	1.5	-	0.7 (≤1.0)	-	-
Copper	1.8U	1.0	-	0.8 (≤2.0)	-	-
Lead	0.35	0.84	-	0.49 (≤3.0)	-	-
Manganese	220	250	13 (≤20)	-	-	-
Nickel	0.97	2.4	-	1.43 (≤3.0)	-	-
Vanadium	2.0U	1.8	-	0.2 (≤6.0)	-	-

Analyte	Concentration (ug/L)		RPD (Limits)	Difference (Limits)	Flag	A or P
	LL12mw-247-062618-GW	LL12mw-247-D-062618-GW				
Zinc	3.0	7.0	-	4 (≤20)	-	-

Analyte	Concentration (ug/L)		RPD (Limits)	Difference (Limits)	Flag	A or P
	NTAmw-119-062518-GW	NTAmw-119-D-062518-GW				
Aluminum	100	50	-	50 (≤300)	-	-
Calcium	83000	83000	0 (≤20)	-	-	-
Iron	1100	1000	10 (≤20)	-	-	-
Magnesium	21000	21000	0 (≤20)	-	-	-
Potassium	1300	1400	-	100 (≤3000)	-	-
Sodium	6700	6600	-	100 (≤5000)	-	-
Arsenic	6.7	6.1	-	0.6 (≤5.0)	-	-
Barium	89	84	6 (≤20)	-	-	-
Cobalt	0.16	0.081	-	0.079 (≤1.0)	-	-
Manganese	360	340	6 (≤20)	-	-	-

Analyte	Concentration (ug/L)		RPD (Limits)	Difference (Limits)	Flag	A or P
	DETmw-003-D-062618-GW	DETmw-003-062818-GW				
Calcium	88000	88000	0 (≤20)	-	-	-
Iron	1800	1800	0 (≤20)	-	-	-
Magnesium	33000	32000	3 (≤20)	-	-	-
Potassium	2000	2000	-	0 (≤3000)	-	-
Sodium	12000	12000	-	0 (≤5000)	-	-
Arsenic	12	11	-	1 (≤5.0)	-	-
Barium	49	50	2 (≤20)	-	-	-

Analyte	Concentration (ug/L)		RPD (Limits)	Difference (Limits)	Flag	A or P
	DETmw-003-D-062618-GW	DETmw-003-062818-GW				
Cobalt	0.33	0.35	-	0.02 (≤1.0)	-	-
Manganese	270	260	4 (≤20)	-	-	-

XII. Internal Standards (ICP-MS)

All internal standard percent recoveries (%R) were within QC limits.

XIII. Sample Result Verification

All sample result verifications were acceptable.

XIV. Overall Assessment of Data

The analysis was conducted within all specifications of the methods. No results were rejected in this SDG.

Due to MS/MSD %R and serial dilution, data were qualified as estimated in two samples.

Due to laboratory blank contamination, data were qualified as not detected in one sample.

The quality control criteria reviewed, other than those discussed above, were met and are considered acceptable. Sample results that were found to be estimated (J) are usable for limited purposes only. Based upon the data validation all other results are considered valid and usable for all purposes.

Ravenna, Ohio
Metals - Data Qualification Summary - SDG 280-111421-1

Sample	Analyte	Flag	A or P	Reason
LL10mw-003-062618-GW	Sodium Iron	J (all detects) J (all detects)	A	Matrix spike/Matrix spike duplicate (%R)
LL12mw-247-062618-GW	Manganese	J (all detects)	A	Serial dilution (%D)

Ravenna, Ohio
Metals - Laboratory Blank Data Qualification Summary - SDG 280-111421-1

Sample	Analyte	Modified Final Concentration	A or P
LL12mw-247-D-062618-GW	Vanadium	6.0U ug/L	A

Ravenna, Ohio
Metals - Field Blank Data Qualification Summary - SDG 280-111421-1

No Sample Data Qualified in this SDG

LDC #: 42791A4a

SDG #: 280-111421-1

Laboratory: Test America, Inc.

VALIDATION COMPLETENESS WORKSHEET

Stage 4

Date: 8/2/18

Page: 1 of 2

Reviewer: JB

2nd Reviewer: [signature]

METHOD: Metals (EPA SW 846 Method 6010C/6020A/7470A)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A / A	
II.	ICP/MS Tune	A	
III.	Instrument Calibration	A	
IV.	ICP Interference Check Sample (ICS) Analysis	A	
V.	Laboratory Blanks	SW	
VI.	Field Blanks	N	
VII.	Matrix Spike/Matrix Spike Duplicates	SW	
VIII.	Duplicate sample analysis	N	
IX.	Serial Dilution	SW	
X.	Laboratory control samples	A	LCS
XI.	Field Duplicates	SW	(1,2) (4,5) (9,11)
XII.	Internal Standard (ICP-MS)	A	
XIII.	Sample Result Verification	A	
XIV.	Overall Assessment of Data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID	Lab ID	Matrix	Date
1	LL12mw-247-062618-GW	280-111421-4	Water	06/26/18
2	LL12mw-247-D-062618-GW	280-111421-5	Water	06/26/18
3	LL10mw-003-062618-GW	280-111421-7	Water	06/26/18
4	NTAmw-119-062518-GW	280-111421-8	Water	06/25/18
5	NTAmw-119-D-062518-GW	280-111421-9	Water	06/25/18
6	FWGmw-016-062518-GW	280-111421-13	Water	06/25/18
7	FWGmw-015-062518-GW	280-111421-14	Water	06/25/18
8	FWGmw-004-062518-GW	280-111421-15	Water	06/25/18
9	DETmw-003-D-062618-GW	280-111421-16	Water	06/26/18
10	DA2mw-115-062618-GW	280-111421-21	Water	06/26/18
11	DETmw-003-062818-GW	280-111421-22	Water	06/26/18
12	LL12mw-247-062618-GWMS	280-111421-4MS	Water	06/26/18
13	LL12mw-247-062618-GWMSD	280-111421-4MSD	Water	06/26/18
14	LL10mw-003-062618-GWMS	280-111421-7MS	Water	06/26/18
15	LL10mw-003-062618-GWMSD	280-111421-7MSD	Water	06/26/18

LDC #: 42791A4a

SDG #: 280-111421-1

Laboratory: Test America, Inc.

VALIDATION COMPLETENESS WORKSHEET

Stage 4

Date: 8/21/18

Reviewer: [illegible]

2nd Reviewer: [illegible]

METHOD: Metals (EPA SW 846 Method 6010C/6020A/7470A)

	Client ID	Lab ID	Matrix	Date
16				
17				
18				

Notes:

LDC #: 42791A4a

VALIDATION FINDINGS CHECKLIST

Reviewer: JB
2nd Reviewer: CV

Method: Metals (EPA SW 846 Method 6010/6020/7000)

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
All technical holding times were met.	✓			
Cooler temperature criteria was met.	✓			
II. ICP/MS Tune				
Were all isotopes in the tuning solution mass resolution within 0.1 amu?	✓			
Were %RSD of isotopes in the tuning solution ≤5%?	✓			
III. Calibration				
Were all instruments calibrated daily, each set-up time?	✓			
Were the proper number of standards used?	✓			
Were all initial and continuing calibration verification %Rs within the 90-110% (80-120% for mercury) QC limits?	✓			
Were the low standard checks within 70-130%	✓			
Were all initial calibration correlation coefficients within limits as specified by the method?	✓			
IV. Blanks				
Was a method blank associated with every sample in this SDG?	✓			
Was there contamination in the method blanks? If yes, please see the Blanks validation completeness worksheet.	✓			
V. ICP Interference Check Sample				
Were ICP interference check samples performed daily?	✓			
Were the AB solution percent recoveries (%R) with the 80-120% QC limits?	✓			
VI. Matrix spike/Matrix spike duplicates				
Were a matrix spike (MS) and duplicate (DUP) analyzed for each matrix in this SDG? If no, indicate which matrix does not have an associated MS/MSD or MS/DUP. Soil / Water.	✓			
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the 75-125 QC limits? If the sample concentration exceeded the spike concentration by a factor of 4 or more, no action was taken.		✓		
Were the MS/MSD or duplicate relative percent differences (RPD) ≤ 20% for waters and ≤ 35% for soil samples? A control limit of +/- RL(+/-2X RL for soil) was used for samples that were ≤ 5X the RL, including when only one of the duplicate sample values were ≤ 5X the RL.	✓			
VII. Laboratory control samples				
Was an LCS anaylzed for this SDG?	✓			
Was an LCS analyzed per extraction batch?	✓			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the 80-120% QC limits for water samples and laboratory established QC limits for soils?	✓			

Validation Area	Yes	No	NA	Findings/Comments
VIII. Internal Standards (EPA SW 846 Method 6020/EPA 200.8)				
Were all the percent recoveries (%R) within the 30-120% (6020)/60-125% (200.8) of the intensity of the internal standard in the associated initial calibration?	✓			
If the %Rs were outside the criteria, was a reanalysis performed?			✓	
IX. ICP Serial Dilution				
Was an ICP serial dilution analyzed if analyte concentrations were > 50X the MDL (ICP)/>100X the MDL(ICP/MS)?	✓			
Were all percent differences (%Ds) < 10%?		✓		
Was there evidence of negative interference? If yes, professional judgement will be used to qualify the data.		✓		
X. Sample Result Verification				
Were RLs adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	✓			
XI. Overall assessment of data				
Overall assessment of data was found to be acceptable.	✓			
XII. Field duplicates				
Field duplicate pairs were identified in this SDG.	✓			
Target analytes were detected in the field duplicates.	✓			
XIII. Field blanks				
Field blanks were identified in this SDG.		✓		
Target analytes were detected in the field blanks.			✓	

LDC #: 42791A4c

VALIDATION FINDINGS WORKSHEET
Sample Specific Element Reference

Page: 1 of 1
Reviewer: JB
2nd reviewer: [illegible]

All circled elements are applicable to each sample.

Sample ID	Matrix	Target Analyte List (TAL)
1-11	W	Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn, Mo, B, Sn, Ti, U,
		Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn, Mo, B, Sn, Ti, U,
		Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn, Mo, B, Sn, Ti, U,
QC		Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn, Mo, B, Sn, Ti, U,
12-15	W	Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn, Mo, B, Sn, Ti, U,
		Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn, Mo, B, Sn, Ti, U,
		Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn, Mo, B, Sn, Ti, U,
		Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn, Mo, B, Sn, Ti, U,
		Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn, Mo, B, Sn, Ti, U,
		Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn, Mo, B, Sn, Ti, U,
		Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn, Mo, B, Sn, Ti, U,
		Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn, Mo, B, Sn, Ti, U,
		Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn, Mo, B, Sn, Ti, U,
		Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn, Mo, B, Sn, Ti, U,
		Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn, Mo, B, Sn, Ti, U,
		Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn, Mo, B, Sn, Ti, U,
		Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn, Mo, B, Sn, Ti, U,
		Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn, Mo, B, Sn, Ti, U,
		Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn, Mo, B, Sn, Ti, U,
		Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn, Mo, B, Sn, Ti, U,
		Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn, Mo, B, Sn, Ti, U,
		Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn, Mo, B, Sn, Ti, U,
		Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn, Mo, B, Sn, Ti, U,
		Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn, Mo, B, Sn, Ti, U,
		Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn, Mo, B, Sn, Ti, U,
Analysis Method		
ICP		Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn, Mo, B, Sn, Ti, U,
ICP-MS		Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn, Mo, B, Sn, Ti, U,
GFAA		Al, Sb, As, Ba, Be, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Hg, Ni, K, Se, Ag, Na, Tl, V, Zn, Mo, B, Sn, Ti, U

Comments: ~~Mercury~~ by CVAA if performed

ELEMENTS.4

LDC #: 42791A4a

VALIDATION FINDINGS WORKSHEET
PB/ICB/CCB QUALIFIED SAMPLES

Reviewer: JB
2nd Reviewer:

METHOD: Trace metals (EPA SW 864 Method 6010B/6020/7000)
Soil preparation factor applied: NA
Sample Concentration units, unless otherwise noted: ug/L
Associated Samples: All

Analyte	Maximum PB[a] (mg/Kg)	Maximum PB[a] (ug/L)	Maximum ICB/CCB[a] (ug/L)	Action Level	2								
Ag			0.0380 J										
V			0.610 J		1.8 / 6.0								

Sample Concentration units, unless otherwise noted: ug/L
Associated Samples: 1 - 4

Analyte	Maximum PB[a] (mg/Kg)	Maximum PB[a] (ug/L)	Maximum ICB/CCB[a] (ug/L)	Action Level									
Sb			0.617 J										

Sample Concentration units, unless otherwise noted: ug/L
Associated Samples: 5 - 11

Analyte	Maximum PB[a] (mg/Kg)	Maximum PB[a] (ug/L)	Maximum ICB/CCB[a] (ug/L)	Action Level									
Sb			0.464 J										

Samples with analyte concentrations within five times the associated ICB, CCB or PB concentration are listed above with the identifications from the Validation Completeness Worksheet. These sample results were qualified as not detected, "U".
Note : a - The listed analyte concentration is the highest ICB, CCB, or PB detected in the analysis of each element.

LDC #: 42791A4a

VALIDATION FINDINGS WORKSHEET
Matrix Spike/Matrix Spike Duplicates

Reviewer: JB
2nd Reviewer:

METHOD: Trace metals (EPA SW 846 Method 6010/7000)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

(Y) N N/A Was a matrix spike analyzed for each matrix in this SDG?

Y (N) N/A Were matrix spike percent recoveries (%R) within the control limits of 75-125? If the sample concentration exceeded the spike concentration by a factor of 4 or more, no action was taken.

(Y) N N/A Were all duplicate sample relative percent differences (RPD) ≤ 20% for samples?

LEVEL IV ONLY:

(Y) N N/A Were recalculated results acceptable? See Level IV Recalculation Worksheet for recalculations.

#	MS/MSD ID	Matrix	Analyte	MS %Recovery	MSD %Recovery	RPD (Limits)	Associated Samples	Qualifications
	(14,15)	W	Na	43 (87-115)	36 (87-115)		3	J (LV) A (Det)
			Fe		75 (87-115)		3	↓

Comments: (12,13); Mn > 4x (14,15); Ca > 4x

LDC #: 42791A4a

VALIDATION FINDINGS WORKSHEET
ICP Serial Dilution

Reviewer: 3
2nd Reviewer:

METHOD: Trace Metals (EPA SW 846 Method 6010/6020/7000)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

(Y) N N/A If analyte concentrations were > 50X the MDL (ICP) ,or >100X the MDL (ICP/MS), was a serial dilution analyzed?
Y (N) N/A Were ICP serial dilution percent differences (%D) ≤10%?
Y (N) N/A Is there evidence of negative interference? If yes, professional judgement will be used to qualify the data.

LEVEL IV ONLY:

(Y) N N/A Were recalculated results acceptable? See Level IV Recalculation Worksheet for recalculations.

#	Diluted Sample ID	Matrix	Analyte	~~RPD~~ 7.D (Limits)	Associated Samples	Qualifications
	1	W	Mn	11 (10)	1	J/UJ/A (Det)

Comments:

LDC#: 42791A4a

VALIDATION FINDINGS WORKSHEET
Field Duplicates

Reviewer: VB
2nd Reviewer: [illegible]

METHOD: Metals (EPA Method 6010C/6020A/7470A)

Analyte	Concentration (ug/L)		RPD (≤30)	Difference	Limits	Qualifiers
	1	2				
Aluminum	480	1100		620	(≤300)	Jdet/A
Calcium	92000	96000	4			
Iron	1700	2600	42			Jdet/A
Magnesium	50000	51000	2			
Potassium	2500	2700		200	(≤3000)	
Sodium	22000	22000		0	(≤5000)	
Arsenic	8.3	8.8		0.5	(≤5.0)	
Barium	24	30	22			
Beryllium	0.30U	0.11		0.19	(≤1.0)	
Chromium	0.72	2.0		1.28	(≤10)	
Cobalt	0.80	1.5		0.7	(≤1.0)	
Copper	1.8U	1.0		0.8	(≤2.0)	
Lead	0.35	0.84		0.49	(≤3.0)	
Manganese	220	250	13			
Nickel	0.97	2.4		1.43	(≤3.0)	
Vanadium	2.0U	1.8		0.2	(≤6.0)	
Zinc	3.0	7.0		4	(≤20)	

Analyte	Concentration (ug/L)		RPD (≤20)	Difference	Limits	Qualifiers
	4	5				
Aluminum	100	50		50	(≤300)	
Calcium	83000	83000	0			

METHOD: Metals (EPA Method 6010/6020/7000)

Analyte	Concentration (ug/L)		RPD (≤20)	Difference	Limits	Qualifiers
	4	5				
Iron	1100	1000	10			
Magnesium	21000	21000	0			
Potassium	1300	1400		100	(≤3000)	
Sodium	6700	6600		100	(≤5000)	
Arsenic	6.7	6.1		0.6	(≤5.0)	
Barium	89	84	6			
Cobalt	0.16	0.081		0.079	(≤1.0)	
Manganese	360	340	6			

Analyte	Concentration (ug/L)		RPD (≤20)	Difference	Limits	Qualifiers
	9	11				
Calcium	88000	88000	0			
Iron	1800	1800	0			
Magnesium	33000	32000	3			
Potassium	2000	2000		0	(≤3000)	
Sodium	12000	12000		0	(≤5000)	
Arsenic	12	11		1	(≤5.0)	
Barium	49	50	2			
Cobalt	0.33	0.35		0.02	(≤1.0)	
Manganese	270	260	4			

LDC #: 42791A4a

VALIDATION FINDINGS WORKSHEET
Initial and Continuing Calibration Calculation Verification

Reviewer: JB
2nd Reviewer:

METHOD: Trace metals (EPA SW 846 Method 6010/6020/7000)

An initial and continuing calibration verification percent recovery (%R) was recalculated for each type of analysis using the following formula:

%R = Found / True x 100

Where, Found = concentration (in ug/L) of each analyte measured in the analysis of the ICV or CCV solution
True = concentration (in ug/L) of each analyte in the ICV or CCV source

Standard ID	Type of Analysis	Element	Found (ug/L)	True (ug/L)	Recalculated %R	Reported %R	Acceptable (Y/N)
ICVL	ICP (Low Level calibration) 7/6 13:30	K	2.773320 mg/L	3000 ug/L	92%	92%	Y
CRI	ICP/MS (Low Level calibration) 7/6 09:51	Sb	1.058 ug/L	1.00 ug/L	106%	106%	Y
ICV	ICP (Initial calibration) 7/9 13:34	Mg	10.016700 mg/L	10000 ug/L	100%	100%	Y
ICV	ICP/MS (Initial calibration) 7/6 9:41	Se	40.450 ug/L	40.0 ug/L	101%	101%	Y
ICV	CVAA (Initial calibration) 7/11 17:05	Hg	3.943 ug/L	4.00 ug/L	99%	99%	Y
CCV	ICP (Continuing calibration) 7/7 02:45	Ca	5.011288 mg/L	5000 ug/L	100%	100%	Y
CCV	ICP/MS (Continuing calibration) 7/6 23:51	Pb	52.641 ug/L	50.0 ug/L	105%	105%	Y
CCV	CVAA (Continuing calibration) 20:19	Hg	5.038 ug/L	5.00 ug/L	101%	101%	Y

ICP-MS TUNE	Calculation	Mass	Actual (Mean Counts / Axis)	Required (Counts / Axis)	Recalculated /Found %RSD / X%	Acceptable (Y/N)
	Mass Axis	208	208.000	± 0.1 AMU	NA	Y
	%RSD	59	14765	≤ 5% RSD	1.21%	Y

Comments:

LDC #: 42791A4a

VALIDATION FINDINGS WORKSHEET
Level IV Recalculation Worksheet

Reviewer: JB
2nd Reviewer:

METHOD: Trace Metals (EPA SW 846 Method 6010/6020/7000)

Percent recoveries (%R) for an ICP interference check sample, a laboratory control sample and a matrix spike sample were recalculated using the following formula:

%R = Found x 100 / True

Where, Found = Concentration of each analyte measured in the analysis of the sample. For the matrix spike calculation, Found = SSR (spiked sample result) - SR (sample result).
True = Concentration of each analyte in the source.

A sample and duplicate relative percent difference (RPD) was recalculated using the following formula:

RPD = |S-D| x 100 / (S+D)/2

Where, S = Original sample concentration
D = Duplicate sample concentration

An ICP serial dilution percent difference (%D) was recalculated using the following formula:

%D = |I-SDR| x 100 / I

Where, I = Initial Sample Result (mg/L)
SDR = Serial Dilution Result (mg/L) (Instrument Reading x 5)

Sample ID	Type of Analysis	Element	Found / S / I (units)	True / D / SDR (units)	Recalculated %R / RPD / %D	Reported %R / RPD / %D	Acceptable (Y/N)
ICSAB	ICP interference check 420/16 10:09	V	104.245 ug/L	100ug/L	104.	104.	Y
LCS	Laboratory control sample 02:11	Fe	1.026895 mg/L	1000 ug/L	103.	103.	Y
MS	Matrix spike -4 19:54	Hg	ND (SSR-SR) 5.10 ug/L	5.00ug/L	102.	102.	Y
MSD	Duplicate -4 53	Hg	5.447 ug/L	FOUND: 5.10 ug/L	7 RPD	7 RPD	Y
PDS	Post digestion spike -4	Ag	53.007ug/L	SR= ND SA = 50.0 ug/L	106.	106.	Y
SD	ICP serial dilution -4 02:18	Ca	92004 ug/L	SR = 92000 ug/L	07.7	0.107.7	Y

Comments: _____

LDC #: 42791A4a
SDG #: 280-111421-1

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

Reviewer: JB
2nd reviewer: [illegible]

METHOD: Trace metals (EPA CLP SOW ILM02.1)

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

Y N N/A Have results been reported and calculated correctly?
Y N N/A Are results within the calibrated range of the instruments and within the linear range of the ICP?
Y N N/A Are all detection limits below the CRDL?

Detected analyte results for Mg #10 were recalculated and verified using the following equation:

Concentration = (RD)(FV)(Dil) / (In. Vol.)

RD = Raw data concentration
FV = Final volume (ml)
In. Vol. = Initial volume (ml) or weight (G)
Dil = Dilution factor

Recalculation:

Mg #10 From Raw Data = 29.456300 mg/L
= 29456.300 ug/L

#	Sample ID	Analyte	Reported Concentration (ug/L)	Calculated Concentration (ug/L)	Acceptable (Y/N)
23:04	1	Zn	3.0	3.0	Y
2:31	2	Fe	2600	2600	Y
23:37	3	Ba	1.3	1.3	Y
2:58	4	Al	100	100	Y
00:01	5	Mn	340	340	Y
3:05	6	K	2300	2300	Y
03	7	Co	0.25	0.25	Y
3:12	8	Na	4400	4400	Y
15	9	As	12	12	Y
7/10 1:13	10	Mg	29000	29000	Y
3:27	11	Ca	88000	88000	Y

Note: _____

LDC Report# 42791A6

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Ravenna, Ohio

LDC Report Date: August 3, 2018

Parameters: Wet Chemistry

Validation Level: Stage 4

Laboratory: TestAmerica, Inc.

Sample Delivery Group (SDG): 280-111421-1

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
FBQmw-174-062518-GW	280-111421-1	Water	06/25/18
FBQmw-175-062518-GW	280-111421-2	Water	06/25/18
FBQmw-176-062518-GW	280-111421-3	Water	06/25/18
LL12mw-247-062618-GW	280-111421-4	Water	06/26/18
LL12mw-247-D-062618-GW	280-111421-5	Water	06/26/18
LL4mw-193-062618-GW	280-111421-6	Water	06/26/18
NTAmw-117-062518-GW	280-111421-10	Water	06/25/18
NTAmw-118-062518-GW	280-111421-11	Water	06/25/18
DETmw-003-D-062618-GW	280-111421-16	Water	06/26/18
FWGmw-010-062618-GW	280-111421-17	Water	06/26/18
DA2mw-115-062618-GW	280-111421-21	Water	06/26/18
DETmw-003-062818-GW	280-111421-22	Water	06/26/18
NTAmw-120-062618-GW	280-111421-23	Water	06/26/18
NTAmw-120-D-062618-GW	280-111421-24	Water	06/26/18
LL12mw-247-062618-GWMS	280-111421-4MS	Water	06/26/18
LL12mw-247-062618-GWMSD	280-111421-4MSD	Water	06/26/18
LL12mw-247-062618-GWDUP	280-111421-4DUP	Water	06/26/18

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with The Final Remedial Investigation Work Plan for Groundwater and Environmental Investigation Services for RVAAP-66 Facility-Wide Groundwater Former Ravenna Army Ammunition Plant Portage and Trumbull Counties, Ohio (December 20, 2016), the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013), and a modified outline of the USEPA National Functional Guidelines (NFG) for Inorganic Superfund Data Review (August 2014). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following methods:

Alkalinity by Standard Method 2320B
Sulfide by Environmental Protection Agency (EPA) SW 846 Method 9034
Chloride, Sulfate, and Nitrate as Nitrogen by EPA SW 846 method 9056A
Total Cyanide by EPA SW 846 Method 9012B
Nitrocellulose by EPA Method 353.2

All sample results were subjected to Stage 4 data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The compound or analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The compound or analyte was analyzed for and positively identified by the laboratory; however the compound or analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The compound or analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected compound or analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition.

All technical holding time requirements were met.

II. Initial Calibration

All criteria for the initial calibration of each method were met.

III. Continuing Calibration

Continuing calibration frequency and analysis criteria were met for each method when applicable.

IV. Laboratory Blanks

Laboratory blanks were analyzed as required by the methods. No contaminants were found in the laboratory blanks with the following exceptions:

Blank ID	Analyte	Maximum Concentration	Associated Samples
PB (prep blank)	Chloride Sulfate Alkalinity	627 ug/L 520 ug/L 2.21 mg/L	FBQmw-174-062518-GW FBQmw-175-062518-GW
ICB/CCB	Sulfate Alkalinity	0.493 ug/L 1.69 ug/L	FBQmw-174-062518-GW FBQmw-175-062518-GW
PB (prep blank)	Cyanide	2.77 ug/L	FBQmw-176-062518-GW LL12mw-247-062618-GW LL12mw-247-D-062618-GW LL4mw-193-062618-GW NTAmw-117-062518-GW NTAmw-118-062518-GW DETmw-003-D-062618-GW FWGmw-010-062618-GW DA2mw-115-062618-GW DETmw-003-062818-GW
ICB/CCB	Chloride	0.619 ug/L	FBQmw-174-062518-GW
ICB/CCB	Chloride	0.669 ug/L	FBQmw-175-062518-GW

Data qualification by the laboratory blanks was based on the maximum contaminant concentration in the laboratory blanks in the analysis of each analyte. The sample concentrations were either not detected or were significantly greater than the concentrations found in the associated laboratory blanks with the following exceptions:

Sample	Analyte	Reported Concentration	Modified Final Concentration
FBQmw-174-062518-GW	Chloride	1400 ug/L	3000U ug/L
FBQmw-175-062518-GW	Chloride Alkalinity	2000 ug/L 4.9 mg/L	3000U ug/L 5.0U mg/L
FBQmw-176-062518-GW	Cyanide	6.1 ug/L	20U ug/L
LL12mw-247-062618-GW	Cyanide	2.1 ug/L	10U ug/L
LL12mw-247-D-062618-GW	Cyanide	3.0 ug/L	10U ug/L
LL4mw-193-062618-GW	Cyanide	2.8 ug/L	10U ug/L
NTAmw-117-062518-GW	Cyanide	2.7 ug/L	10U ug/L
NTAmw-118-062518-GW	Cyanide	3.9 ug/L	10U ug/L
FWGmw-010-062618-GW	Cyanide	2.6 ug/L	10U ug/L

V. Field Blanks

Samples FBQmw-174-062518-GW, FBQmw-175-062518-GW, and FBQmw-176-062518-GW were identified as field blanks. No contaminants were found with the following exceptions:

Blank ID	Collection Date	Analyte	Concentration	Associated Samples
FBQmw-174-062518-GW	06/25/18	Chloride Sulfate Alkalinity	1400 ug/L 12000 ug/L 5.5 mg/L	No associated samples in this SDG
FBQmw-175-062518-GW	06/25/18	Sulfide Chloride Sulfate Alkalinity	800 ug/L 2000 ug/L 17000 ug/L 4.9 mg/L	No associated samples in this SDG
FBQmw-176-062518-GW	06/25/18	Cyanide	6.1 ug/L	LL12mw-247-062618-GW LL12mw-247-D-062618-GW LL4mw-193-062618-GW NTAmw-117-062518-GW NTAmw-118-062518-GW DETmw-003-D-062618-GW FWGmw-010-062618-GW DA2mw-115-062618-GW DETmw-003-062818-GW

Sample concentrations were compared to concentrations detected in the field blanks. The sample concentrations were either not detected or were significantly greater than the concentrations found in the associated field blanks with the following exceptions:

Sample	Analyte	Reported Concentration	Modified Final Concentration
LL12mw-247-062618-GW	Cyanide	2.1 ug/L	10U ug/L
LL12mw-247-D-062618-GW	Cyanide	3.0 ug/L	10U ug/L
LL4mw-193-062618-GW	Cyanide	2.8 ug/L	10U ug/L
NTAmw-117-062518-GW	Cyanide	2.7 ug/L	10U ug/L
NTAmw-118-062518-GW	Cyanide	3.9 ug/L	10U ug/L
FWGmw-010-062618-GW	Cyanide	2.6 ug/L	10U ug/L

VI. Matrix Spike/Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicate (MSD) sample analysis was performed on an associated project sample. Percent recoveries (%R) were within QC limits. Relative percent differences (RPD) were within QC limits.

VII. Duplicate Sample Analysis

Duplicate (DUP) sample analysis was performed on an associated project sample. Results were within QC limits.

VIII. Laboratory Control Samples

Laboratory control samples (LCS) and laboratory control samples duplicates (LCSD) were analyzed as required by the methods. Percent recoveries (%R) were within QC limits. Relative percent differences (RPD) were within QC limits.

IX. Field Duplicates

Samples LL12mw-247-062618-GW and LL12mw-247-D-062618-GW, samples DETmw-003-D-062618-GW and DETmw-003-062818-GW, and samples NTAmw-120-062618-GW and NTAmw-120-D-062618-GW were identified as field duplicates. No results were detected in any of the samples with the following exceptions:

Analyte	Concentration (ug/L)		RPD (Limits)	Difference (Limits)	Flag	A or P
	LL12mw-247-062618-GW	LL12mw-247-D-062618-GW				
Cyanide	2.1	3.0	-	0.9 (≤10)	-	-

X. Sample Result Verification

All sample result verifications were acceptable.

XI. Overall Assessment of Data

The analysis was conducted within all specifications of the methods. No results were rejected in this SDG.

Due to laboratory blank contamination, data were qualified as not detected in nine samples.

Due to field blank contamination, data were qualified as not detected in six samples.

The quality control criteria reviewed, other than those discussed above, were met and are considered acceptable. Based upon the data validation all other results are considered valid and usable for all purposes.

Ravenna, Ohio
Wet Chemistry - Data Qualification Summary - SDG 280-111421-1

No Sample Data Qualified in this SDG

Ravenna, Ohio
Wet Chemistry - Laboratory Blank Data Qualification Summary - SDG 280-111421-1

Sample	Analyte	Modified Final Concentration	A or P
FBQmw-174-062518-GW	Chloride	3000U ug/L	A
FBQmw-175-062518-GW	Chloride Alkalinity	3000U ug/L 5.0U mg/L	A
FBQmw-176-062518-GW	Cyanide	20U ug/L	A
LL12mw-247-062618-GW	Cyanide	10U ug/L	A
LL12mw-247-D-062618-GW	Cyanide	10U ug/L	A
LL4mw-193-062618-GW	Cyanide	10U ug/L	A
NTAmw-117-062518-GW	Cyanide	10U ug/L	A
NTAmw-118-062518-GW	Cyanide	10U ug/L	A
FWGmw-010-062618-GW	Cyanide	10U ug/L	A

Ravenna, Ohio
Wet Chemistry - Field Blank Data Qualification Summary - SDG 280-111421-1

Sample	Analyte	Modified Final Concentration	A or P
LL12mw-247-062618-GW	Cyanide	10U ug/L	A
LL12mw-247-D-062618-GW	Cyanide	10U ug/L	A
LL4mw-193-062618-GW	Cyanide	10U ug/L	A
NTAmw-117-062518-GW	Cyanide	10U ug/L	A
NTAmw-118-062518-GW	Cyanide	10U ug/L	A

Sample	Analyte	Modified Final Concentration	A or P
FWGmw-010-062618-GW	Cyanide	10U ug/L	A

LDC #: 42791A6
SDG #: 280-111421-1
Laboratory: Test America, Inc.

VALIDATION COMPLETENESS WORKSHEET
Stage 4

Date: 8/2/19
Page: 1 of 2
Reviewer: VB
2nd Reviewer: [signature]

METHOD: (Analyte) Alkalinity (SM 2320B), Sulfide (EPA SW846 Method 9034), Chloride, Sulfate, Nitrate as N (EPA SW846 Method 9056A)Total Cyanide (EPA SW846 Method 9012B), Nitrocellulose (EPA Method 353.2)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A / A	
II	Initial calibration	A	
III.	Calibration verification	A	
IV	Laboratory Blanks	SW	
V	Field blanks	SW	FB = 1-3
VI.	Matrix Spike/Matrix Spike Duplicates	A	(15,16)
VII.	Duplicate sample analysis	A	17
VIII.	Laboratory control samples	A	LCS ID
IX.	Field duplicates	SW	(4,5) (9,12)* (13,14)*
X.	Sample result verification	A	
XI	Overall assessment of data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; *ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID	Lab ID	Matrix	Date
1	FBQmw-174-062518-GW	280-111421-1	Water	06/25/18
2	FBQmw-175-062518-GW	280-111421-2	Water	06/25/18
3	FBQmw-176-062518-GW	280-111421-3	Water	06/25/18
4	LL12mw-247-062618-GW	280-111421-4	Water	06/26/18
5	LL12mw-247-D-062618-GW	280-111421-5	Water	06/26/18
6	LL4mw-193-062618-GW	280-111421-6	Water	06/26/18
7	NTAmw-117-062518-GW	280-111421-10	Water	06/25/18
8	NTAmw-118-062518-GW	280-111421-11	Water	06/25/18
9	DETmw-003-D-062618-GW	280-111421-16	Water	06/26/18
10	FWGmw-010-062618-GW	280-111421-17	Water	06/26/18
11	DA2mw-115-062618-GW	280-111421-21	Water	06/26/18
12	DETmw-003-062818-GW	280-111421-22	Water	06/26/18
13	NTAmw-120-062618-GW	280-111421-23	Water	06/26/18
14	NTAmw-120-D-062618-GW	280-111421-24	Water	06/26/18
15	LL12mw-247-062618-GWMS	280-111421-4MS	Water	06/26/18
16	LL12mw-247-062618-GWMSD	280-111421-4MSD	Water	06/26/18
17	LL12mw-247-062618-GWDUP	280-111421-4DUP	Water	06/26/18

LDC #: 42791A6

SDG #: 280-111421-1

Laboratory: Test America, Inc.

VALIDATION COMPLETENESS WORKSHEET

Stage 4

Date: 8/2/18

Reviewer:

2nd Reviewer:

METHOD: (Analyte) Alkalinity (SM 2320B), Sulfide (EPA SW846 Method 9034), Chloride, Sulfate, Nitrate as N (EPA SW846 Method 9056A)Total Cyanide (EPA SW846 Method 9012B), Nitrocellulose (EPA Method 353.2)

	Client ID	Lab ID	Matrix	Date
18				
19				
20				

Notes:

LDC #: 42791A6

VALIDATION FINDINGS CHECKLIST

Reviewer: JB
2nd Reviewer:

Method: Inorganics (EPA Method See Cover)

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
All technical holding times were met.	✓			
II. Calibration				
Were all instruments calibrated daily, each set-up time?	✓			
Were the proper number of standards used?	✓			
Were all initial calibration correlation coefficients ≥ 0.995?	✓			
Were all initial and continuing calibration verification %Rs within the 90-110% QC limits?	✓			
Were titrant checks performed as required? (Level IV only)	✓			
Were balance checks performed as required? (Level IV only)			✓	
III. Blanks				
Was a method blank associated with every sample in this SDG?	✓			
Was there contamination in the method blanks? If yes, please see the Blanks validation completeness worksheet.	✓			
IV. Matrix spike/Matrix spike duplicates and Duplicates				
Were a matrix spike (MS) and duplicate (DUP) analyzed for each matrix in this SDG? If no, indicate which matrix does not have an associated MS/MSD or MS/DUP. Soil / Water.	✓			
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the 75-125 QC limits? If the sample concentration exceeded the spike concentration by a factor of 4 or more, no action was taken.	✓			
Were the MS/MSD or duplicate relative percent differences (RPD) ≤ 20% for waters and ≤ 35% for soil samples? A control limit of ≤ CRDL(≤ 2X CRDL for soil) was used for samples that were ≤ 5X the CRDL, including when only one of the duplicate sample values were ≤ 5X the CRDL.	✓			
V. Laboratory control samples				
Was an LCS anaylzed for this SDG?	✓			
Was an LCS analyzed per extraction batch?	✓			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the 80-120% (85-115% for Method 300.0) QC limits?	✓			
VI. Regional Quality Assurance and Quality Control				
Were performance evaluation (PE) samples performed?			✓	
Were the performance evaluation (PE) samples within the acceptance limits?			✓	

LDC #: 42791A6

VALIDATION FINDINGS CHECKLIST

Reviewer: JB
2nd Reviewer:

Validation Area	Yes	No	NA	Findings/Comments
VII. Sample Result Verification				
Were RLs adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	✓			
Were detection limits < RL?	✓			
VIII. Overall assessment of data				
Overall assessment of data was found to be acceptable.	✓			
IX. Field duplicates				
Field duplicate pairs were identified in this SDG.	✓			
Target analytes were detected in the field duplicates.	✓			
X. Field blanks				
Field blanks were identified in this SDG.	✓			
Target analytes were detected in the field blanks.	✓			

LDC #: 42791A6

VALIDATION FINDINGS WORKSHEET
Sample Specific Analysis Reference

Page: 1 of 1
Reviewer: JB
2nd reviewer:

All circled methods are applicable to each sample.

Sample ID	Parameter
1,2	pH TDS [✓ Cl] F NO_3 NO_2 [✓ SO_4] O-PO_4 [✓ Alk] CN NH_3 TKN TOC Cr6+ ClO_4 [✓ S^{2-}]
3,6-12	pH TDS Cl F NO_3 NO_2 SO_4 O-PO_4 Alk [✓ CN] NH_3 TKN TOC Cr6+ ClO_4
4,5	pH TDS Cl F [✓ NO_3] NO_2 SO_4 O-PO_4 Alk [✓ CN] NH_3 TKN TOC Cr6+ ClO_4
13,14	pH TDS Cl F NO_3 NO_2 SO_4 O-PO_4 Alk CN NH_3 TKN TOC Cr6+ ClO_4 [✓ Nitrocellulose]
	pH TDS Cl F NO_3 NO_2 SO_4 O-PO_4 Alk CN NH_3 TKN TOC Cr6+ ClO_4
QC	pH TDS Cl F NO_3 NO_2 SO_4 O-PO_4 Alk CN NH_3 TKN TOC Cr6+ ClO_4
15,16	pH TDS Cl F [✓ NO_3] NO_2 SO_4 O-PO_4 Alk [✓ CN] NH_3 TKN TOC Cr6+ ClO_4
17	pH TDS Cl F [✓ NO_3] NO_2 SO_4 O-PO_4 Alk CN NH_3 TKN TOC Cr6+ ClO_4
	pH TDS Cl F NO_3 NO_2 SO_4 O-PO_4 Alk CN NH_3 TKN TOC Cr6+ ClO_4
	pH TDS Cl F NO_3 NO_2 SO_4 O-PO_4 Alk CN NH_3 TKN TOC Cr6+ ClO_4
	pH TDS Cl F NO_3 NO_2 SO_4 O-PO_4 Alk CN NH_3 TKN TOC Cr6+ ClO_4
	pH TDS Cl F NO_3 NO_2 SO_4 O-PO_4 Alk CN NH_3 TKN TOC Cr6+ ClO_4
	pH TDS Cl F NO_3 NO_2 SO_4 O-PO_4 Alk CN NH_3 TKN TOC Cr6+ ClO_4
	pH TDS Cl F NO_3 NO_2 SO_4 O-PO_4 Alk CN NH_3 TKN TOC Cr6+ ClO_4
	pH TDS Cl F NO_3 NO_2 SO_4 O-PO_4 Alk CN NH_3 TKN TOC Cr6+ ClO_4
	pH TDS Cl F NO_3 NO_2 SO_4 O-PO_4 Alk CN NH_3 TKN TOC Cr6+ ClO_4
	pH TDS Cl F NO_3 NO_2 SO_4 O-PO_4 Alk CN NH_3 TKN TOC Cr6+ ClO_4
	pH TDS Cl F NO_3 NO_2 SO_4 O-PO_4 Alk CN NH_3 TKN TOC Cr6+ ClO_4
	pH TDS Cl F NO_3 NO_2 SO_4 O-PO_4 Alk CN NH_3 TKN TOC Cr6+ ClO_4
	pH TDS Cl F NO_3 NO_2 SO_4 O-PO_4 Alk CN NH_3 TKN TOC Cr6+ ClO_4
	pH TDS Cl F NO_3 NO_2 SO_4 O-PO_4 Alk CN NH_3 TKN TOC Cr6+ ClO_4
	pH TDS Cl F NO_3 NO_2 SO_4 O-PO_4 Alk CN NH_3 TKN TOC Cr6+ ClO_4
	pH TDS Cl F NO_3 NO_2 SO_4 O-PO_4 Alk CN NH_3 TKN TOC Cr6+ ClO_4
	pH TDS Cl F NO_3 NO_2 SO_4 O-PO_4 Alk CN NH_3 TKN TOC Cr6+ ClO_4
	pH TDS Cl F NO_3 NO_2 SO_4 O-PO_4 Alk CN NH_3 TKN TOC Cr6+ ClO_4
	pH TDS Cl F NO_3 NO_2 SO_4 O-PO_4 Alk CN NH_3 TKN TOC Cr6+ ClO_4
	pH TDS Cl F NO_3 NO_2 SO_4 O-PO_4 Alk CN NH_3 TKN TOC Cr6+ ClO_4
	pH TDS Cl F NO_3 NO_2 SO_4 O-PO_4 Alk CN NH_3 TKN TOC Cr6+ ClO_4
	pH TDS Cl F NO_3 NO_2 SO_4 O-PO_4 Alk CN NH_3 TKN TOC Cr6+ ClO_4

Comments:

LDC #: 42791A6

VALIDATION FINDINGS WORKSHEET
Blanks

Reviewer: JB
2nd Reviewer:

METHOD: Inorganics, Method See Cover

Conc. units: ug/L **Associated Samples** 1, 2

Analyte	Blank ID	Blank ID	Blank Action Limit										
	PB	ICB/CCB (mg/L)		1	2								
Chloride	627 J			1400 / 3000	2000 / 3000								
Sulfate	520 J	0.493 J											
Alkalinity (mg/L)	2.21 J	1.69 J			4.9 / 5.0								

Conc. units: ug/L **Associated Samples:** 3 - 12

Analyte	Blank ID	Blank ID	Blank Action Limit										
	PB	ICB/CCB (mg/L)		3	4	5	6	7	8	10			
Cyanide	2.77 J			6.1 / 20	2.1 / 10	3.0 / 10	2.8 / 10	2.7 / 10	3.9 / 10	2.6 / 10			

Conc. units: ug/L **Associated Samples:** 1

Analyte	Blank ID	Blank ID	Blank Action Limit										
	PB	ICB/CCB (mg/L)		1									
Chloride		0.619 J		1400 / 3000									

Conc. units: ug/L **Associated Samples:** 2

Analyte	Blank ID	Blank ID	Blank Action Limit										
	PB	ICB/CCB (mg/L)		2									
Chloride		0.669 J		2000 / 3000									

CIRCLED RESULTS WERE NOT QUALIFIED. ALL RESULTS NOT CIRCLED WERE QUALIFIED BY THE FOLLOWING STATEMENT:
All contaminants within five times the method blank concentration were qualified as not detected, "U".

LDC #: 42791A6

VALIDATION FINDINGS WORKSHEET
Field Blanks

Reviewer: AG
2nd Reviewer:

METHOD: Inorganics, EPA Method See Cover
Blank units: ug/L **Associated sample units: ug/L**
Sampling date: 6/25/18 Soil factor applied NA
Field blank type: (circle one) Field Blank / Rinsate / Other: FB Associated Samples: NONE

Analyte	Blank ID	Action Limit	Sample Identification							
	1									
Chloride	1400 J									
Sulfate	12000									
Alkalinity (mg/L)	5.5									

Blank units: ug/L **Associated sample units: ug/L**
Sampling date: 6/25/18 Soil factor applied NA
Field blank type: (circle one) Field Blank / Rinsate / Other: FB Associated Samples: NONE

Analyte	Blank ID	Action Limit	Sample Identification							
	2									
Sulfide	800 J									
Chloride	2000 J									
Sulfate	17000									
Alkalinity (mg/L)	4.9 J									

Blank units: ug/L **Associated sample units: ug/L**
Sampling date: 6/25/18 Soil factor applied NA
Field blank type: (circle one) Field Blank / Rinsate / Other: FB Associated Samples: 4 - 12

Analyte	Blank ID	Action Limit	Sample Identification							
	3		4	5	6	7	8	10		
Cyanide	6.1 J		2.1 / 10	3.0 / 10	2.8 / 10	2.7 / 10	3.9 / 10	2.6 / 10		

CIRCLED RESULTS WERE NOT QUALIFIED. ALL RESULTS NOT CIRCLED WERE QUALIFIED BY THE FOLLOWING STATEMENT:
Samples with analyte concentrations within five times the associated field blank concentration are listed above, these sample results were qualified as not detected, "U".

LDC#: 42791A6

VALIDATION FINDINGS WORKSHEET

Field Duplicates

Reviewer: [illegible]

2nd Reviewer: [illegible]

Inorganics, Method See Cover

Analyte	Concentration (ug/L)		RPD (≤30)	Difference	Limits	Qualification (Parent only)
	4	5				
Cyanide	2.1	3.0		0.9	(≤ 10)	

V:\FIELD DUPLICATES\Field Duplicates\FD_inorganic\2018\42791A6.wpd

LDC #: 42791A6

Validation Findings Worksheet
Initial and Continuing Calibration Calculation Verification

Page: 1 of 1
Reviewer: VB
2nd Reviewer:

Method: Inorganics, Method See Cover

The correlation coefficient (r) for the calibration of CN^- was recalculated. Calibration date: 6/29/18

An initial or continuing calibration verification percent recovery (%R) was recalculated for each type of analysis using the following formula:

$$\%R = \frac{\text{Found} \times 100}{\text{True}}$$

Where, Found = concentration of each analyte measured in the analysis of the ICV or CCV solution
True = concentration of each analyte in the ICV or CCV source

Type of analysis	Analyte	Standard	Conc. (ug/L)	Response	Recalculated r or r^2	Reported r or r^2	Acceptable (Y/N)
Initial calibration	CN^-	s1	0	315.564972	*0.999956*	0.999956	Y
		s2	10	7565.687012			
		s3	20	14719.72949			
		s4	50	36849.75			
		s5	100	72742.10938			
		s6	200	143567.4219			
		s7	400	282311.3438			
6/20 Calibration verification	NO_3	ICV	FOUND: 3.8452 mg/L	TRUE: 4.00 mg/L	96.	96.	Y
Calibration verification	AlK^-	CCV	FOUND: 201 mg/L	TRUE: 200 mg/L	101.	101.	Y
Calibration verification							

Comments: Refer to Calibration Verification findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 42791A4

VALIDATION FINDINGS WORKSHEET
Level IV Recalculation Worksheet

Reviewer: JB
2nd Reviewer:

METHOD: Inorganics, Method See Cover

Percent recoveries (%R) for a laboratory control sample and a matrix spike sample were recalculated using the following formula:

%R = Found x 100 / True Where, Found = concentration of each analyte measured in the analysis of the sample. For the matrix spike calculation, Found = SSR (spiked sample result) - SR (sample result).
True = concentration of each analyte in the source.

A sample and duplicate relative percent difference (RPD) was recalculated using the following formula:

RPD = |S-D| x 100 / (S+D)/2 Where, S = Original sample concentration
D = Duplicate sample concentration

Sample ID	Type of Analysis	Element	Found / S (units)	True / D (units)	Recalculated %R / RPD	Reported %R / RPD	Acceptable (Y/N)
LCS	Laboratory control sample 6127	NO_3	5.0599 mg/L	5.00 mg/L	101%	101%	Y
MS	Matrix spike sample	CN	2.1 (SSR-SR) 100.9607 ug/L -SR = 98.8607 ug/L	100 ug/L	99% ~~100 ug/L~~ JB	99%	Y
MSD	Duplicate sample	CN	100.680 ug/L	FOUND: 100.9607 ug/L	ORPD	ORPD	Y

Comments: _____

LDC #: 42791A6

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

Page: 1 of 1
Reviewer: JB
2nd reviewer: [illegible]

METHOD: Inorganics, Method See Cover

Please see qualifications below for all questions answered "N". Not applicable questions are identified as "N/A".

Y N N/A Have results been reported and calculated correctly?
Y N N/A Are results within the calibrated range of the instruments?
Y N N/A Are all detection limits below the CRQL?

Compound (analyte) results for SO_4 #1 reported with a positive detect were recalculated and verified using the following equation:

Concentration =

Recalculation:

SO_4 - $y = mx + b$

$y = 4794781B$

$m = 4117419.242$

$b = -1700646.886$

$SO_4 = \frac{4117419.242 + 1700646.886}{4117419.242}$

$= 12.057\ mg/L = 12057\ ug/L$

#	Sample ID	Analyte	Reported Concentration (ug/L)	Calculated Concentration (ug/L)	Acceptable (Y/N)
	1	SO_4	12000	12000	Y
	2	S^{2-}	800	800	Y
		Alk	4.9 mg/L	4.9 mg/L	Y
	3	CN	6.1	6.1	Y
	4	CN^-	2.1	2.1	Y
	5	CN^-	3.0	3.0	Y
	6	CN^-	2.8	2.8	Y
	7	CN^-	2.7	2.7	Y
	8	CN^-	3.9	3.9	Y
	10	CN^-	2.6	2.6	Y

Note:

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Ravenna, Ohio

LDC Report Date: August 3, 2018

Parameters: Explosives

Validation Level: Stage 4

Laboratory: TestAmerica, Inc.

Sample Delivery Group (SDG): 280-111421-1

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
FBQmw-174-062518-GW	280-111421-1	Water	06/25/18
LL12mw-247-062618-GW	280-111421-4	Water	06/26/18
LL12mw-247-D-062618-GW	280-111421-5	Water	06/26/18
NTAmw-119-062518-GW	280-111421-8	Water	06/25/18
NTAmw-119-D-062518-GW	280-111421-9	Water	06/25/18
FWGmw-016-062518-GW	280-111421-13	Water	06/25/18
FWGmw-015-062518-GW	280-111421-14	Water	06/25/18
FWGmw-004-062518-GW	280-111421-15	Water	06/25/18
DETmw-003-D-062618-GW	280-111421-16	Water	06/26/18
DA2mw-115-062618-GW	280-111421-21	Water	06/26/18
DETmw-003-062618-GW	280-111421-22	Water	06/26/18
NTAmw-120-062618-GW	280-111421-23	Water	06/26/18
NTAmw-120-D-062618-GW	280-111421-24	Water	06/26/18
LL12mw-247-062618-GWMS	280-111421-4MS	Water	06/26/18
LL12mw-247-062618-GWMSD	280-111421-4MSD	Water	06/26/18

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with The Final Remedial Investigation Work Plan for Groundwater and Environmental Investigation Services for RVAAP-66 Facility-Wide Groundwater Former Ravenna Army Ammunition Plant Portage and Trumbull Counties, Ohio (December 20, 2016), the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013), and a modified outline of the USEPA National Functional Guidelines (NFG) for Superfund Organic Methods Data Review (August 2014). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following method:

Explosives by Environmental Protection Agency (EPA) SW 846 Method 8330B

All sample results were subjected to Stage 4 data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The compound or analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The compound or analyte was analyzed for and positively identified by the laboratory; however the compound or analyte should be considered not detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The compound or analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected compound or analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition and cooler temperatures upon receipt met validation criteria.

All technical holding time requirements were met.

II. Initial Calibration and Initial Calibration Verification

An initial calibration was performed as required by the method.

For compounds where average calibration factors were utilized, percent relative standard deviations (%RSD) were less than or equal to 15.0% with the following exceptions:

In the case where the laboratory used a calibration curve to evaluate the compounds, all coefficients of determination (r^2) were greater than or equal to 0.990.

The percent differences (%D) of the initial calibration verification (ICV) standard were less than or equal to 20.0% for all compounds.

Retention time windows were established as required by the method.

III. Continuing Calibration

Continuing calibration was performed at required frequencies.

The percent differences (%D) were less than or equal to 20.0% for all compounds.

Retention times of all compounds in the calibration standards were within the established retention time windows.

IV. Laboratory Blanks

Laboratory blanks were analyzed as required by the method. No contaminants were found in the laboratory blanks.

V. Field Blanks

Sample FBQmw-174-062518-GW was identified as a field blank. No contaminants were found with the following exceptions:

Blank ID	Collection Date	Compound	Concentration	Associated Samples
FBQmw-174-062518-GW	06/26/18	2,4-Dinitrotoluene 2-Amino-4,6-dinitrotoluene 4-Amino-2,6-dinitrotoluene 2,4,6-Trinitrotoluene	0.29 ug/L 9.1 ug/L 26 ug/L 28 ug/L	LL12mw-247-062618-GW LL12mw-247-D-062618-GW NTAmw-119-062518-GW NTAmw-119-D-062518-GW FWGmw-016-062518-GW FWGmw-015-062518-GW FWGmw-004-062518-GW DETmw-003-D-062618-GW DA2mw-115-062618-GW DETmw-003-062618-GW

Sample concentrations were compared to concentrations detected in the field blanks. The sample concentrations were either not detected or were significantly greater than the concentrations found in the associated field blanks.

VI. Surrogates

Surrogates were added to all samples as required by the method. All surrogate recoveries (%R) were within QC limits.

VII. Matrix Spike/Matrix Spike Duplicates

Matrix spike (MS) and matrix spike duplicate (MSD) sample analysis was performed on an associated project sample. Percent recoveries (%R) were within QC limits. Relative percent differences (RPD) were within QC limits.

VIII. Laboratory Control Samples

Laboratory control samples (LCS) were analyzed as required by the method. Percent recoveries (%R) were within QC limits.

IX. Field Duplicates

Samples LL12mw-247-062618-GW and LL12mw-247-D-062618-GW, samples NTAmw-119-062518-GW and NTAmw-119-D-062518-GW, samples DETmw-003-D-062618-GW and DETmw-003-062618-GW, and samples NTAmw-120-062618-GW and NTAmw-120-D-062618-GW were identified as field duplicates. No results were detected in any of the samples with the following exceptions:

Compound	Concentration (ug/L)		RPD (Limits)	Difference (Limits)	Flag	A or P
	NTAmw-119-062518-GW	NTAmw-119-D-062518-GW				
4-Nitrotoluene	0.58	0.41U	-	0.17 (≤1.0)	-	-

Compound	Concentration (ug/L)		RPD (Limits)	Difference (Limits)	Flag	A or P
	NTAmw-120-062618-GW	NTAmw-120-D-062618-GW				
4-Nitrotoluene	0.40	0.60	-	0.2 (≤1.0)	-	-

X. Compound Quantitation

All compound quantitations met validation criteria.

XI. Target Compound Identifications

All target compound identifications met validation criteria.

XII. Overall Assessment of Data

The analysis was conducted within all specifications of the method. No results were rejected in this SDG.

The quality control criteria reviewed were met and are considered acceptable. Based upon the data validation all results are considered valid and usable for all purposes.

Ravenna, Ohio
Explosives - Data Qualification Summary - SDG 280-111421-1

No Sample Data Qualified in this SDG

Ravenna, Ohio
Explosives - Laboratory Blank Data Qualification Summary - SDG 280-111421-1

No Sample Data Qualified in this SDG

Ravenna, Ohio
Explosives - Field Blank Data Qualification Summary - SDG 280-111421-1

No Sample Data Qualified in this SDG

LDC #: 42791A40a
SDG #: 280-111421-1
Laboratory: Test America, Inc.

VALIDATION COMPLETENESS WORKSHEET
Stage 4

Date: 08/02/18
Page: 1 of 1
Reviewer:
2nd Reviewer:

METHOD: HPLC Explosives (EPA SW 846 Method 8330B)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A / A	
II.	Initial calibration/ICV	A / A	ICAL ≤ 15% r² ICV ≤ 20%
III.	Continuing calibration	A	CCV ≤ 20%
IV.	Laboratory Blanks	A	
V.	Field blanks	SW	FB = 1
VI.	Surrogate spikes	A	
VII.	Matrix spike/Matrix spike duplicates	A	
VIII.	Laboratory control samples	A	LCS
IX.	Field duplicates	SW	D = 2/3*, 4/5, 9/11*, 14/15
X.	Compound quantitation RL/LOQ/LODs	A	
XI.	Target compound identification	A	
XII.	Overall assessment of data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; * ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID		Lab ID	Matrix	Date
+ 1	FBQmw-174-062518-GW		280-111421-1	Water	06/25/18
- 2	LL12mw-247-062618-GW	D1	280-111421-4	Water	06/26/18
- 3	LL12mw-247-D-062618-GW	D1	280-111421-5	Water	06/26/18
+ 4	NTAmw-119-062518-GW	D2	280-111421-8	Water	06/25/18
- 5	NTAmw-119-D-062518-GW	D2	280-111421-9	Water	06/25/18
- 6	FWGmw-016-062518-GW		280-111421-13	Water	06/25/18
- 7	FWGmw-015-062518-GW		280-111421-14	Water	06/25/18
- 8	FWGmw-004-062518-GW		280-111421-15	Water	06/25/18
- 9	DETmw-003-D-062618-GW	D3	280-111421-16	Water	06/26/18
- 10	DA2mw-115-062618-GW		280-111421-21	Water	06/26/18
+- 11	DETmw-003-062618-GW	D3	280-111421-22	Water	06/26/18
12	LL12mw-247-062618-GWMS		280-111421-4MS	Water	06/26/18
13	LL12mw-247-062618-GWMSD		280-111421-4MSD	Water	06/26/18
14	NTAmw-120-062618-GW	D4	-23		
	Notes: NTAmw-120-D-062618-GW	D4	-24		
F	MB 280-420700/1-A				

X/10X

IS

LDC #: 42791 A40a

VALIDATION FINDINGS CHECKLIST

Reviewer: JVG
2nd Reviewer:

Method: GC ✓ HPLC

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
Were all technical holding times met?	✓			
Was cooler temperature criteria met?	✓			
IIa. Initial calibration				
Did the laboratory perform a 5 point calibration prior to sample analysis?	✓			
Were all percent relative standard deviations (%RSD) ≤ 20%?	✓			
Was a curve fit used for evaluation? If yes, did the initial calibration meet the curve fit acceptance criteria of ≥ 0.990?	✓			
Were the RT windows properly established?	✓			
IIb. Initial calibration verification				
Was an initial calibration verification standard analyzed after each initial calibration for each instrument?	✓			
Were all percent differences (%D) ≤ 20% or percent recoveries (%R) 80-120%?	✓			
III. Continuing calibration				
Was a continuing calibration analyzed daily?	✓			
Were all percent differences (%D) ≤ 20% or percent recoveries (%R) 80-120%?	✓			
Were all the retention times within the acceptance windows?	✓			
IV. Laboratory Blanks				
Was a laboratory blank associated with every sample in this SDG?	✓			
Was a laboratory blank analyzed for each matrix and concentration?	✓			
Was there contamination in the laboratory blanks? If yes, please see the Blanks validation completeness worksheet.		✓		
V. Field Blanks				
Were field blanks identified in this SDG?	✓			
Were target compounds detected in the field blanks?	✓			
VI. Surrogate spikes				
Were all surrogate percent recovery (%R) within the QC limits?	✓			
If the percent recovery (%R) of one or more surrogates was outside QC limits, was a reanalysis performed to confirm %R?			✓	
If any %R was less than 10 percent, was a reanalysis performed to confirm %R?			✓	
VII. Matrix spike/Matrix spike duplicates				
Were a matrix spike (MS) and matrix spike duplicate (MSD) analyzed for each matrix in this SDG? If no, indicate which matrix does not have an associated MS/MSD. Soil / Water.	✓			
Was a MS/MSD analyzed every 20 samples of each matrix?	✓			
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?	✓			

Validation Area	Yes	No	NA	Findings/Comments
VIII. Laboratory control samples				
Was an LCS analyzed for this SDG?	✓			
Was an LCS analyzed per extraction batch?	✓			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?	✓			
IX. Field duplicates				
Were field duplicate pairs identified in this SDG?	✓			
Were target compounds detected in the field duplicates?	✓			
X. Compound quantitation				
Were compound quantitation and RLs adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	✓			
XI. Target compound identification				
Were the retention times of reported detects within the RT windows?	✓			
XIII. Overall assessment of data				
Overall assessment of data was found to be acceptable.	✓			

VALIDATION FINDINGS WORKSHEET

METHOD: ____GC __/__HPLC

8310	8330	8151	8141	8141(Con't)	8021B
A. Acenaphthene	A. HMX	A. 2,4-D	A. Dichlorvos	X. EPN	V. Benzene
B. Acenaphthylene	B. RDX	B. 2,4-DB	B. Mevinphos	Y. Azinphos-methyl	CC. Toluene
C. Anthracene	C. 1,3,5-Trinitrobenzene	C. 2,4,5-T	C. Demeton-O	Z. Coumaphos	EE. Ethyl Benzene
D. Benzo(a)anthracene	D. 1,3-Dinitrobenzene	D. 2,4,5-TP	D. Demeton-S	AA. Parathion	SSS. O-Xylene
E. Benzo(a)pyrene	E. Tetryl	E. Dinoseb	E. Ethoprop	BB. Trichloronate	RRR. MP-Xylene
F. Benzo(b)fluoranthene	F. Nitrobenzene	F. Dichlorprop	F. Naled	CC. Trichlorinate	GG. Total Xylene
G. Benzo(g,h,i)perylene	G. 2.4.6-Trinitrotoluene	G. Dicamba	G. Sulfotep	DD. Trifluralin	
H. Benzo(k)fluoranthene	H. 4-Amino-2,6-dinitrotoluene	H. Dalapon	H. Phorate	EE. Def	**8315A**
I. Chrysene	I. 2-Amino-4,6-dinitrotoluene	I. MCPP	I. Dimethoate	FF. Prowl	A. Formaldehyde
J. Dibenz(a,h)anthracene	J. 2,4-Dinitrotoluene	J. MCPA	J. Diazinon	GG. Ethion	B. Acetaldehyde
K. Fluoranthene	K. 2,6-Dinitrotoluene	K. Pentachlorophenol	K. Disulfoton	HH. Famphur	C. Benzaldehyde
L. Fluorene	L. 2-Nitrotoluene	L. 2,4,5-TP (silvex)	L. Parathion-methyl	II. Phosmet	D. Butyraldehyde
M. Indeno(1,2,3-cd)pyrene	M. 3-Nitrotoluene	M. Silvex	M. Ronnel	JJ. Tetrachlorvinphos	
N. Naphthalene	N. 4-Nitrotoluene	N.	N. Malathion	KK. Demeton (total)	
O. Phenanthrene	O. Nitroglycerin	O.	O. Chlorpyrifos		
P. Pyrene	P. Picric acid	P.	P. Fenthion		
Q.	Q. 2,4-Dinitrophenol	Q.	Q. Parathion-ethyl		
R.	R. 3,5-Dinitroaniline		R. Trichlornate		
S.	S. 2-Nitrophenol		S. Merphos		
	T. 4-Nitrophenol		T. Stirofos		
	U. Picramic acid		U. Tokuthion		
	V. PETN		V. Fensulfothion		
			W. Bolstar		

Notes:_____

LDC #: 42791A40a

VALIDATION FINDINGS WORKSHEET
Field Blanks

Reviewer: JMG
2nd Reviewer:

METHOD: __ GC __HPLC

Y N N/A Were field blanks identified in this SDG?

Y N N/A Were target compounds detected in the field blanks?

Blank units: ug/L **Associated sample units:** ug/L

Sampling date: 06/26/18

Field blank type: (circle one) Field Blank / Trip Blank / Atmospheric Blank / Ambient Blank Rinsate / Equipment Rinsate / Equipment Blank / Source Blank / Other:_____

Associated Samples: All except 1 (ND)

Compound	Blank ID	Blank ID	Sample Identification							
	1									
J	0.29									
I	9.1									
H	26									
G	28									
CRQL										

Blank units:_____ **Associated sample units:**_____

Sampling date:_____

Field blank type: (circle one) Field Blank / Trip Blank/ Atmospheric Blank/ Ambient Blank Rinsate / Equipment Rinsate / Equipment Blank / Source Blank / Other:_____

Associated Samples:_____

Compound	Blank ID	Blank ID	Sample Identification							
CRQL										

CIRCLED RESULTS WERE NOT QUALIFIED. ALL RESULTS NOT CIRCLED WERE QUALIFIED BY THE FOLLOWING STATEMENT:

Samples with compound concentrations within five times the associated field blank concentration are listed above, these sample results were qualified as not detected, "U".

LDC#: 42791A40a

VALIDATION FINDINGS WORKSHEET
Field Duplicates

Page: 1 of 1
Reviewer: JVG
2nd Reviewer: ~~X~~

METHOD: HPLC Explosives (EPA SW 846 Method 8330B)

(Y) N NA Were field duplicate pairs identified in this SDG?
Y (N) NA Were target analytes detected in the field duplicate pairs?

Compound	Concentration (ug/L)		RPD (≤_____ %)	Difference (ug/L)	Limits (<LOQ)	Qualifications (Parent Only)
	4	5				
N	0.58	0.41U		0.17	(≤1.0)	

Compound	Concentration (ug/L)		RPD (≤_____ %)	Difference (ug/L)	Limits (<LOQ)	Qualifications (Parent Only)
	14	15				
N	0.40	0.60		0.2	(≤1.0)	

V:\Josephine\FIELD DUPLICATES\42791A40a cardno ravenna.wpd

LDC #: 42791A40

VALIDATION FINDINGS WORKSHEET
Initial Calibration Calculation Verification

Reviewer: JVG
2nd Reviewer:

METHOD: GC _____ HPLC /

The calibration factors (CF), average CF, and relative standard deviation (%RSD) were recalculated for compounds identified below using the following calculations:

CF = A/C
average CF = sum of the CF/number of standards
%RSD = 100 * (S/X)

Where:
A = Area of compound
C = Concentration of compound
S = Standard deviation of calibration factors
X = Mean of calibration factors

#	Standard ID	Calibration Date	Compound	Reported CF (0.10 std)	Recalculated CF (0.10 std)	Reported Average RRF (Initial)	Recalculated Average RRF (Initial)	Reported %RSD	Recalculated %RSD
1	ICAL HPLC X3	5/18/2018	HMX (Ultracarb5u)	81370	81370	84945.63	84945.63	3.5	3.5
			2-4,6-TNT (Ultracarb5u)	210707	210707	214477.88	214477.88	2.8	2.8
2	ICAL G2_Luna	7/10/2018	HMX (Luna-phenyl)	182750	182750	179938.11	179938.11	1.6	1.6
			2-4,6-TNT (Luna-phenyl)	420857	420857	416300.99	416300.99	9.9	9.9

LDC # 42791A40

VALIDATION FINDINGS WORKSHEET
Continuing Calibration Results Verification

Reviewer: JVG
2nd Reviewer:

METHOD: GC____HPLC✓

The percent difference (%D) of the initial calibration average Calibration Factors (CF) and the continuing calibration percent difference (%D) values were recalculated for the compounds identified below using the following calculation:

Percent difference (%D) = 100 * (N - C)/N

Where:
N = Initial Calibration Factor or Nominal Amount
C = Calibration Factor from Continuing Calibration Standard or Calculated Amount

#	Standard ID	Calibration Date	Compound	CCV Conc	Reported Conc	Recalculated Conc	Reported % D	Recalculated %D
1	07030007 X3	7/3/2018	HMX (Ultracarb5u)	0.2500	0.2577	0.2577	3.1	3.1
			2-4,6-TNT (Ultracarb5u)	0.2500	0.2603	0.2603	4.1	4.1
2	07030007 X3	7/3/2018	HMX (Ultracarb5u)	0.2500	0.2578	0.2578	3.1	3.1
			2-4,6-TNT (Ultracarb5u)	0.2510	0.2602	0.2602	3.7	3.7
3	07110026 G2	7/12/2018	HMX (Luna-phenyl)	0.2500	0.2526	0.2526	1.0	1.0
			2-4,6-TNT (Luna-phenyl)	0.2510	0.2621	0.2621	4.4	4.4

LDC #: 42791A4a

VALIDATION FINDINGS WORKSHEET
Surrogate Results Verification

Reviewer: JVG
2nd reviewer:

METHOD: __ GC / HPLC

The percent recoveries (%R) of surrogates were recalculated for the compounds identified below using the following calculation:

% Recovery: SF/SS * 100

Where: SF = Surrogate Found
SS = Surrogate Spiked

Sample ID: 1

Surrogate	Column/Detector	Surrogate Spiked	Surrogate Found	Percent Recovery	Percent Recovery	Percent Difference
				Reported	Recalculated	
FF	Ultracarb	0.200	0.1934	97	97	0

Sample ID: _____

Surrogate	Column/Detector	Surrogate Spiked	Surrogate Found	Percent Recovery	Percent Recovery	Percent Difference
				Reported	Recalculated	

	Surrogate Compound		Surrogate Compound		Surrogate Compound		Surrogate Compound		Surrogate Compound
A	Chlorobenzene (CBZ)	H	Ortho-Terphenyl	O	Decachlorobiphenyl (DCB)	V	Tri-n-propyltin	CC	2,5-Dibromotoluene
B	4-Bromofluorobenzene (BFB)	I	Fluorobenzene (FBZ)	P	1-methylnaphthalene	W	Tributyl Phosphate	DD	n-Nonatriacontane
C	a,a,a-Trifluorotoluene	J	n-Triacontane	Q	Dichlorophenyl Acetic Acid (DCAA)	X	Triphenyl Phosphate	EE	1,2-Dibromopropane
D	Bromochlorobenene	K	Hexacosane	R	4-Nitrophenol	Y	Tetrachloro-m- xylene	FF	1,2-Dinitrobenzene
E	1,4-Dichlorobutane	L	Bromobenzene	S	1-Chloro-3-Nitrobenzene	Z	2-Bromonaphthalene	GG	2-Nitro-m-xylene
F	1,4-Difluorobenzene (DFB)	M	Benzo(e)Pyrene	T	3,4-Dinitrotoluene	AA	1-Chlorooctadecane	HH	p-Terphenyl
G	Octacosane	N	Terphenyl-D14	U	Tripentyltin	BB	2,4-Dichlorophenylacetic acid	II	

LDC #: 42791 A40a

VALIDATION FINDINGS WORKSHEET
Matrix Spike/Matrix Spike Duplicates Results Verification

Reviewer: JVG
2nd Reviewer:

METHOD: ___ GC ✓ HPLC

The percent recoveries (%R) and relative percent differences (RPD) of the matrix spike and matrix spike duplicate were recalculated for the compounds identified below using the following calculation:

%Recovery = 100 * (SSC - SC)/SA

RPD =({{SSCMS - SSCMSD} * 2) / (SSCMS + SSCMSD))*100

Where SSC = Spiked sample concentration; SC = Sample concentration; SA = Spike added

MS = Matrix spike; MSD = Matrix spike duplicate

MS/MSD samples: 12/13

Compound	Spike Added (mg/L)		Sample Conc. (mg/L)	Spike Sample Concentration (mg/L)		Matrix spike Percent Recovery		Matrix Spike Duplicate Percent Recovery		MS/MSD RPD	
	MS	MSD	---	MS	MSD	Reported	Recalc.	Reported	Recalc.	Reported	Recalc.
Gasoline (8015)											
Diesel (8015)											
Benzene (8021B)											
Methane (RSK-175)											
2,4-D (8151)											
Dinoseb (8151)											
Naphthalene (8310)											
Anthracene (8310)											
HMX (8330)	2.09	2.14	0	2.01	1.99	96	96	93	93	1	1
2,4,6-Trinitrotoluene (8330)	↓	↓	↓	2.03	1.99	97	97	93	93	2	2
Phorate (8141A)											
Malathion (8141A)											
Formaldehyde (8315A)											

Comments: Refer to Matrix Spike/Matrix Spike Duplicates findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 42791 A40a

VALIDATION FINDINGS WORKSHEET

Laboratory Control Sample/Laboratory Control Sample Duplicates Results Verification

Reviewer: JVG
2nd Reviewer:

METHOD: __ GC /HPLC

The percent recoveries (%R) and relative percent differences (RPD) of the laboratory control sample and laboratory control sample duplicate were recalculated for the compounds identified below using the following calculation:

%Recovery = 100 * (SSC/SA)
RPD =(({SSCLCS - SSCLCSD} * 2) / (SSCLCS + SSCLCSD))*100

Where SSC = Spiked sample concentration; SA = Spike added
LCS = Laboratory Control Sample; LCSD = Laboratory Control Sample duplicate

LCS/LCSD samples: LCS 280-420700/2-A

Compound	Spike Added (ug/L)		Spike Sample Concentration (ug/L)		LCS Percent Recovery		LCSD Percent Recovery		LCS/LCSD RPD	
	LCS	LCSD	LCS	LCSD	Reported	Recalc.	Reported	Recalc.	Reported	Recalc.
Gasoline (8015)										
Diesel (8015)										
Benzene (8021B)										
Methane (RSK-175)										
2,4-D (8151)										
Dinoseb (8151)										
Naphthalene (8310)										
Anthracene (8310)										
HMX (8330)	2.00	NA	1.91	NA	96	96				
2,4,6-Trinitrotoluene (8330)	↓	↓	1.94	↓	97	97				
Phorate (8141A)										
Malathion (8141A)										
Formaldehyde (8315A)										

Comments: Refer to Laboratory Control Sample/Laboratory Control Sample Duplicate findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 42791 A40a

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

Reviewer: JVG
2nd Reviewer:

METHOD: __ GC _/ HPLC

(Y) N N/A Were all reported results recalculated and verified for all level IV samples?
Y N N/A Were all recalculated results for detected target compounds within 10% of the reported results?

Concentration= (A)(Fv)(Df) / (RF)(Vs or Ws)(%S/100)

A= Area or height of the compound to be measured
Fv= Final Volume of extract
Df= Dilution Factor
RF= Average response factor of the compound In the initial calibration
Vs= Initial volume of the sample
Ws= Initial weight of the sample
%S= Percent Solid

Example:

Sample ID. 1 Compound Name 2,4,6-TNT

Concentration = $\frac{(59673)(5\,ml)(10)(1000)}{(214477.88)(493.7\,mL)}$ = 28 ug/L

#	Sample ID	Compound	Reported Concentrations (ug/L)	Recalculated Results Concentrations ( )	Qualifications
			28		

Comments:

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Ravenna, Ohio

LDC Report Date: August 3, 2018

Parameters: Nitroguanidine

Validation Level: Stage 4

Laboratory: TestAmerica, Inc.

Sample Delivery Group (SDG): 280-111421-1

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
NTAmw-120-062618-GW	280-111421-23	Water	06/26/18
NTAmw-120-D-062618-GW	280-111421-24	Water	06/26/18

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with The Final Remedial Investigation Work Plan for Groundwater and Environmental Investigation Services for RVAAP-66 Facility-Wide Groundwater Former Ravenna Army Ammunition Plant Portage and Trumbull Counties, Ohio (December 20, 2016), the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013), and a modified outline of the USEPA National Functional Guidelines (NFG) for Superfund Organic Methods Data Review (August 2014). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following method:

Nitroguanidine by Environmental Protection Agency (EPA) SW 846 Method 8330

All sample results were subjected to Stage 4 data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The compound or analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The compound or analyte was analyzed for and positively identified by the laboratory; however the compound or analyte should be considered not detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The compound or analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected compound or analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition and cooler temperatures upon receipt met validation criteria.

All technical holding time requirements were met with the following exceptions:

Sample	Compound	Total Days From Sample Collection Until Extraction	Required Holding Time (in Days) From Sample Collection Until Extraction	Flag	A or P
NTAmw-120-062618-GW NTAmw-120-D-062618-GW	Nitroguanidine	16	7	UJ (all non-detects)	P

II. Initial Calibration and Initial Calibration Verification

An initial calibration was performed as required by the method.

The percent relative standard deviations (%RSD) were less than or equal to 15.0%.

The percent differences (%D) of the initial calibration verification (ICV) standard were less than or equal to 20.0%.

Retention time windows were established as required by the method.

III. Continuing Calibration

Continuing calibration was performed at required frequencies.

The percent differences (%D) were less than or equal to 20.0%.

Retention times of all compounds in the calibration standards were within the established retention time windows.

IV. Laboratory Blanks

Laboratory blanks were analyzed as required by the method. No contaminants were found in the laboratory blanks.

V. Field Blanks

No field blanks were identified in this SDG.

VI. Surrogates

Surrogates were added to all samples as required by the method. All surrogate recoveries (%R) were within QC limits.

VII. Matrix Spike/Matrix Spike Duplicates

The laboratory has indicated that there were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

VIII. Laboratory Control Samples

Laboratory control samples (LCS) were analyzed as required by the method. Percent recoveries (%R) were within QC limits.

IX. Field Duplicates

Samples NTAmw-120-062618-GW and NTAmw-120-D-062618-GW were identified as field duplicates. No results were detected in any of the samples.

X. Compound Quantitation

All compound quantitations met validation criteria.

XI. Target Compound Identifications

All target compound identifications met validation criteria.

XII. Overall Assessment of Data

The analysis was conducted within all specifications of the method. No results were rejected in this SDG.

Due to technical holding time, data were qualified as estimated in two samples.

The quality control criteria reviewed, other than those discussed above, were met and are considered acceptable. Sample results that were found to be estimated (J) are usable for limited purposes only. Based upon the data validation all other results are considered valid and usable for all purposes.

Ravenna, Ohio
Nitroguanidine - Data Qualification Summary - SDG 280-111421-1

Sample	Compound	Flag	A or P	Reason
NTAmw-120-062618-GW NTAmw-120-D-062618-GW	Nitroguanidine	UJ (all non-detects)	P	Technical holding times

Ravenna, Ohio
Nitroguanidine - Laboratory Blank Data Qualification Summary - SDG 280-111421-1

No Sample Data Qualified in this SDG

Ravenna, Ohio
Nitroguanidine - Field Blank Data Qualification Summary - SDG 280-111421-1

No Sample Data Qualified in this SDG

LDC #: 42791A40b
SDG #: 280-111421-1
Laboratory: Test America, Inc.

VALIDATION COMPLETENESS WORKSHEET
Stage 4

Date: 08/02/18
Page: 1 of 1
Reviewer: DM
2nd Reviewer: [signature]

METHOD: HPLC Nitroguanidine (EPA SW 846 Method 8330)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A / SW	
II.	Initial calibration/ICV	A / A	ICAL ≤ 15% ICV ≤ 20%
III.	Continuing calibration	A	CCV ≤ 20%.
IV.	Laboratory Blanks	A	
V.	Field blanks	N	
VI.	Surrogate spikes	N	
VII.	Matrix spike/Matrix spike duplicates	N	CS
VIII.	Laboratory control samples	A	LCS
IX.	Field duplicates	ND	D = 1/2
X.	Compound quantitation RL/LOQ/LODs	A	
XI.	Target compound identification	A	
XII.	Overall assessment of data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID		Lab ID	Matrix	Date
1	NTAmw-120-062618-GW	D	280-111421-23	Water	06/26/18
2	NTAmw-120-D-062618-GW	D	280-111421-24	Water	06/26/18
3					
4					
5					
6					
7					
8					
9					
10					
11					

Notes:

-	MB 320-233710/1-A						

LDC #: 42791 A40 b

VALIDATION FINDINGS CHECKLIST

Reviewer: JVG
2nd Reviewer:

Method: GC ✓ HPLC

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
Were all technical holding times met?	~~W~~	✓		
Was cooler temperature criteria met?	✓			
IIa. Initial calibration				
Did the laboratory perform a 5 point calibration prior to sample analysis?	✓			
Were all percent relative standard deviations (%RSD) ≤ ~~20%?~~ 15%	✓			
Was a curve fit used for evaluation? If yes, did the initial calibration meet the curve fit acceptance criteria of ≥0.990?			✓	
Were the RT windows properly established?	✓			
IIb. Initial calibration verification				
Was an initial calibration verification standard analyzed after each initial calibration for each instrument?	✓			
Were all percent differences (%D) ≤ 20% or percent recoveries (%R) 80-120%?	✓			
III. Continuing calibration				
Was a continuing calibration analyzed daily?	✓			
Were all percent differences (%D) ≤ 20% or percent recoveries (%R) 80-120%?	✓			
Were all the retention times within the acceptance windows?	✓			
IV. Laboratory Blanks				
Was a laboratory blank associated with every sample in this SDG?	✓			
Was a laboratory blank analyzed for each matrix and concentration?	✓			
Was there contamination in the laboratory blanks? If yes, please see the Blanks validation completeness worksheet.		✓		
V. Field Blanks				
Were field blanks identified in this SDG?		✓		
Were target compounds detected in the field blanks?			✓	
VI. Surrogate spikes				
Were all surrogate percent recovery (%R) within the QC limits?		✓		
If the percent recovery (%R) of one or more surrogates was outside QC limits, was a reanalysis performed to confirm %R?			✓	
If any %R was less than 10 percent, was a reanalysis performed to confirm %R?			✓	
VII. Matrix spike/Matrix spike duplicates				
Were a matrix spike (MS) and matrix spike duplicate (MSD) analyzed for each matrix in this SDG? If no, indicate which matrix does not have an associated MS/MSD. Soil / Water.		✓		
Was a MS/MSD analyzed every 20 samples of each matrix?		✓		
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?			✓	

Validation Area	Yes	No	NA	Findings/Comments
VIII. Laboratory control samples				
Was an LCS analyzed for this SDG?	✓			
Was an LCS analyzed per extraction batch?	✓			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?	✓			
IX. Field duplicates				
Were field duplicate pairs identified in this SDG?	✓			
Were target compounds detected in the field duplicates?		✓		
X. Compound quantitation				
Were compound quantitation and RLs adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	✓			
XI. Target compound identification				
Were the retention times of reported detects within the RT windows?	✓			
XIII. Overall assessment of data				
Overall assessment of data was found to be acceptable.	✓			

LDC #: 42791A406

VALIDATION FINDINGS WORKSHEET
Technical Holding Times

Page: 1 of 1
Reviewer: JVG
2nd Reviewer:

All circled dates have exceeded the technical holding times.
(Y) N N/A Were all cooler temperatures within validation criteria?

METHOD : ___ GC ✓ ___ HPLC

Sample ID	Matrix	Preserved	Sampling Date	Extraction date	Analysis date	Total # of Days	Qualifier
All (ND)	W	N	06/26/18	07/12/18	07/13/18	16	J/UJ/P

TECHNICAL HOLDING TIME CRITERIA

VOLATILES:	Water unpreserved:	Aromatic within 7 days, non-aromatic within 14 days of sample collection.
	Water preserved:	Both within 14 days of sample collection.
	Soils:	Both within 14 days of sample collection.
EXTRACTABLES:		
	Water:	Extracted within 7 days, analyzed within 40 days.
	Soil:	Extracted within 14 days, analyzed within 40 days.

LDC #: 42791A40b

VALIDATION FINDINGS WORKSHEET
Initial Calibration Calculation Verification

Reviewer: JVG
2nd Reviewer:

METHOD: HPLC Nitroguanidine (EPA SW 846 Method 8330

The calibration factors (CF), average CF, and relative standard deviation (%RSD) were recalculated for compounds identified below using the following calculations:

CF = A/C
average CF = sum of the CF/number of standards
%RSD = 100 * (S/X)

Where:
A = Area of compound
C = Concentration of compound
S = Standard deviation of calibration factors
X = Mean of calibration factors

#	Standard ID	Calibration Date	Compound	Reported CF (100 std)	Recalculated CF (100 std)	Reported Average CF (Initial)	Recalculated Average CF (Initial)	Reported %RSD	Recalculated %RSD
1	ICAL LC12	6/5/2018	Nitroguanidine	65.650	65.650	63.754	63.754	3.8	3.8

LDC # 42791A40b

VALIDATION FINDINGS WORKSHEET
Continuing Calibration Results Verification

Reviewer: JVG
2nd Reviewer:

METHOD: HPLC Nitroguanidine (EPA SW 846 Method 8330)

The percent difference (%D) of the initial calibration average Calibration Factors (CF) and the continuing calibration percent difference (%D) values were recalculated for the compounds identified below using the following calculation:

Percent difference (%D) = 100 * (N - C)/N

Where:
N = Initial Calibration Factor or Nominal Amount
C = Calibration Factor from Continuing Calibration Standard or Calculated Amount

#	Standard ID	Calibration Date	Compound	Ave CF	Reported (CCV)	Recalculated (CCV)	Reported % D	Recalculated %D
1	M00003	7/13/2018	Nitroguanidine	63.754	66.255	66.255	3.9	3.9
2	M00009	7/13/2018	Nitroguanidine	63.754	66.790	66.790	4.8	4.8

LDC #: 42791 A40b

VALIDATION FINDINGS WORKSHEET

Laboratory Control Sample/Laboratory Control Sample Duplicates Results Verification

Reviewer: JVG
2nd Reviewer: CA

METHOD: ___ GC _/_ HPLC

The percent recoveries (%R) and relative percent differences (RPD) of the laboratory control sample and laboratory control sample duplicate were recalculated for the compounds identified below using the following calculation:

%Recovery = 100 * (SSC/SA)
RPD =(({SSCLCS - SSCLCSD} * 2) / (SSCLCS + SSCLCSD))*100

Where SSC = Spiked sample concentration; SA = Spike added
LCS = Laboratory Control Sample; LCSD = Laboratory Control Sample duplicate

LCS/LCSD samples: LCS 320-233710/2-A

Compound	Spike Added (ug/L)		Spike Sample Concentration (ug/L)		LCS Percent Recovery		LCSD Percent Recovery		LCS/LCSD RPD	
	LCS	LCSD	LCS	LCSD	Reported	Recalc.	Reported	Recalc.	Reported	Recalc.
Gasoline (8015)										
Diesel (8015)										
Benzene (8021B)										
Methane (RSK-175)										
2,4-D (8151)										
Dinoseb (8151)										
Naphthalene (8310)										
Anthracene (8310)										
HMX (8330)										
2,4,6-Trinitrotoluene (8330)										
Phorate (8141A)										
Malathion (8141A)										
Formaldehyde (8315A)										
Nitroguanidine (8330)	200	NA	195	NA	97	97				

Comments: Refer to Laboratory Control Sample/Laboratory Control Sample Duplicate findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 42791A406

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

Reviewer: JVG
2nd Reviewer: [signature]

METHOD: __ GC / HPLC

Y N N/A Were all reported results recalculated and verified for all level IV samples?
Y N N/A Were all recalculated results for detected target compounds within 10% of the reported results?

Concentration= $\frac{(A)(Fv)(Df)}{(RF)(Vs \text{ or } Ws)(\%S/100)}$

A= Area or height of the compound to be measured
Fv= Final Volume of extract
Df= Dilution Factor
RF= Average response factor of the compound In the initial calibration
Vs= Initial volume of the sample
Ws= Initial weight of the sample
%S= Percent Solid

Example:

Sample ID: MB LCS Compound Name Nitroguanidine

Concentration = $\frac{(124.28)(10\text{ml})}{(63.754)(10\text{ml})} = 194.9$

≈ 195 ug/L

#	Sample ID	Compound	Reported Concentrations (ug/L)	Recalculated Results Concentrations ( )	Qualifications
			195		

Comments: _____

Laboratory Data Consultants, Inc.
Data Validation Report

Project/Site Name: Ravenna, Ohio

LDC Report Date: August 3, 2018

Parameters: Perchlorate

Validation Level: Stage 4

Laboratory: TestAmerica, Inc.

Sample Delivery Group (SDG): 280-111421-1

Sample Identification	Laboratory Sample Identification	Matrix	Collection Date
NTAmw-120-062618-GW	280-111421-23	Water	06/26/18
NTAmw-120-D-062618-GW	280-111421-24	Water	06/26/18

Introduction

This Data Validation Report (DVR) presents data validation findings and results for the associated samples listed on the cover page. Data validation was performed in accordance with The Final Remedial Investigation Work Plan for Groundwater and Environmental Investigation Services for RVAAP-66 Facility-Wide Groundwater Former Ravenna Army Ammunition Plant Portage and Trumbull Counties, Ohio (December 20, 2016), the U.S. Department of Defense (DoD) Quality Systems Manual (QSM) for Environmental Laboratories, Version 5.0 (July 2013), and a modified outline of the USEPA National Functional Guidelines (NFG) for Superfund Organic Methods Data Review (August 2014). Where specific guidance was not available, the data has been evaluated in a conservative manner consistent with industry standards using professional experience.

The analyses were performed by the following method:

Perchlorate by Environmental Protection Agency (EPA) SW 846 Method 6860

All sample results were subjected to Stage 4 data validation, which is comprised of the quality control (QC) summary forms as well as the raw data, to confirm sample quantitation and identification.

The following are definitions of the data qualifiers utilized during data validation:

J (Estimated): The compound or analyte was analyzed for and positively identified by the laboratory; however the reported concentration is estimated due to non-conformances discovered during data validation.

U (Non-detected): The compound or analyte was analyzed for and positively identified by the laboratory; however the compound or analyte should be considered non-detected at the reported concentration due to the presence of contaminants detected in the associated blank(s).

UJ (Non-detected estimated): The compound or analyte was reported as not detected by the laboratory; however the reported quantitation/detection limit is estimated due to non-conformances discovered during data validation.

R (Rejected): The sample results were rejected due to gross non-conformances discovered during data validation. Data qualified as rejected is not usable.

NA (Not Applicable): The non-conformance discovered during data validation demonstrates a high bias, while the affected compound or analyte in the associated sample(s) was reported as not detected by the laboratory and did not warrant the qualification of the data.

A qualification summary table is provided at the end of this report if data has been qualified. Flags are classified as P (protocol) or A (advisory) to indicate whether the flag is due to a laboratory deviation from a specified protocol or is of technical advisory nature.

I. Sample Receipt and Technical Holding Times

All samples were received in good condition and cooler temperatures upon receipt met validation criteria.

All technical holding time requirements were met.

II. LC/MS Instrument Performance Check

Instrument performance check was performed at the required frequency.

III. Initial Calibration and Initial Calibration Verification

An initial calibration was performed as required by the method.

A curve fit, based on the initial calibration, was established for quantitation. The coefficient of determination (r^2) was greater than or equal to 0.990.

The isotope ratios were within QC limits.

The percent differences (%D) of the initial calibration verification (ICV) standard were less than or equal to 15.0%.

IV. Continuing Calibration

Continuing calibration was performed at the required frequencies.

The percent differences (%D) were less than or equal to 15.0%.

The percent differences (%D) of the limit of detection verification (LODV) standard were less than or equal to 30.0%.

The isotope ratios were within QC limits.

V. Laboratory Blanks

Laboratory blanks were analyzed as required by the method. No contaminants were found in the laboratory blanks.

VI. Field Blanks

No field blanks were identified in this SDG.

VII. Matrix Spike/Matrix Spike Duplicates

The laboratory has indicated that there were no matrix spike (MS) and matrix spike duplicate (MSD) analyses specified for the samples in this SDG, and therefore matrix spike and matrix spike duplicate analyses were not performed for this SDG.

VIII. Laboratory Control Samples

Laboratory control samples (LCS) and laboratory control samples duplicates (LCSD) were analyzed as required by the methods. Percent recoveries (%R) were within QC limits. Relative percent differences (RPD) were within QC limits.

IX. Interference Check Samples

Interference check samples (ICS) were analyzed as required by the method. Percent recoveries (%R) were within QC limits.

X. Field Duplicates

Samples NTAmw-120-062618-GW and NTAmw-120-D-062618-GW were identified as field duplicates. No results were detected in any of the samples.

XI. Internal Standards

All internal standard recoveries (%R) were within QC limits.

XII. Compound Quantitation

All compound quantitations were within validation criteria.

XIII. Target Compound Identifications

All target compound identifications were within validation criteria.

XIV. System Performance

The system performance was acceptable.

XV. Overall Assessment of Data

The analysis was conducted within all specifications of the method. No results were rejected in this SDG.

The quality control criteria reviewed were met and are considered acceptable. Based upon the data validation all results are considered valid and usable for all purposes.

Ravenna, Ohio
Perchlorate - Data Qualification Summary - SDG 280-111421-1

No Sample Data Qualified in this SDG

Ravenna, Ohio
Perchlorate - Laboratory Blank Data Qualification Summary - SDG 280-111421-1

No Sample Data Qualified in this SDG

Ravenna, Ohio
Perchlorate - Field Blank Data Qualification Summary - SDG 280-111421-1

No Sample Data Qualified in this SDG

LDC #: 42791A87
SDG #: 280-111421-1
Laboratory: Test America, Inc.

VALIDATION COMPLETENESS WORKSHEET
Stage 4

Date: 8/6/18
Page: 1 of 1
Reviewer: JVG
2nd Reviewer:

METHOD: LC/MS Perchlorate (EPA SW846 Method 6860)

The samples listed below were reviewed for each of the following validation areas. Validation findings are noted in attached validation findings worksheets.

	Validation Area		Comments
I.	Sample receipt/Technical holding times	A / A	
II.	LC/MS Instrument performance check	~~A~~	~~rr~~
III.	Initial calibration/ICV	A / A	rr ICV ≤ 15%
IV.	Continuing calibration	A	CCV ≤ 15%.
V.	Laboratory Blanks	A	
VI.	Field blanks	N	
VII.	Surrogate spikes	N	
VIII.	Matrix spike/Matrix spike duplicates	N	CS
IX.	Laboratory control samples	A	LCS/D
X.	Interference check sample	A	
XI.	Field duplicates	ND	D = 1/2
XII.	Internal standards	A	
XIII.	Compound quantitation RL/LOQ/LODs	A	
XIV.	Target compound identification	A	
XV.	System performance	A	
XVI.	Overall assessment of data	A	

Note: A = Acceptable; N = Not provided/applicable; SW = See worksheet; ND = No compounds detected; R = Rinsate; FB = Field blank; D = Duplicate; TB = Trip blank; EB = Equipment blank; SB=Source blank; OTHER:

	Client ID		Lab ID	Matrix	Date
1	NTAmw-120-062618-GW	b	280-111421-23	Water	06/26/18
2	NTAmw-120-D-062618-GW	b	280-111421-24	Water	06/26/18
3					
4					
5					
6					
7					

Notes:

MB 280-420424/13						

LDC #: 42791A87

VALIDATION FINDINGS CHECKLIST

Reviewer: JVC
2nd Reviewer:

Method: Perchlorate (EPA SW 846 Method 6850)

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
Were all technical holding times met?	✓			
Was cooler temperature criteria met?	✓			
II. LC/MS Instrument performance check				
Were the instrument performance reviewed and found to be within the specified criteria?	✓		✓	
Were the Perchlorate ions within ±0.3 m/z of mass 99,101 and 107?			✓	
IIIa. Initial calibration				
Did the laboratory perform a 5 point calibration prior to sample analysis?	✓			
Were all percent relative standard deviations (%RSD) ≤ 20%?			✓	
Was a curve fit used for evaluation? If yes, did the initial calibration meet the curve fit criteria of ≥ 0.990?	✓			
Was the isotope ratio of $^{35}Cl/^{37}Cl$ or m/z 99/101 within 2.3 to 3.8?	✓			
IIIb. Initial Calibration Verification				
Was an initial calibration verification standard analyzed after each initial calibration for each instrument?	✓			
Were all percent differences (%D) ≤ 15%?	✓			
IV. Continuing calibration				
Was a continuing calibration analyzed daily?	✓			
Were all percent differences (%D) of the mid-range continuing calibration ≤ 15%?	✓			
Were all percent differences (%D) of the low-range continuing calibration ≤ 50%?	✓			
Was the isotope ratio of $^{35}Cl/^{37}Cl$ or m/z 99/101 within 2.3 to 3.8?	✓			
V. Laboratory Blanks				
Was a laboratory blank associated with every sample in this SDG?	✓			
Was a laboratory blank analyzed for each matrix and concentration?	✓			
Was there contamination in the laboratory blanks? If yes, please see the Blanks validation completeness worksheet.		✓		
VI. Field blanks				
Were field blanks identified in this SDG?		✓		
Were target compounds detected in the field blanks?			✓	
VIII. Matrix spike/Matrix spike duplicates				
Were a matrix spike (MS) and matrix spike duplicate (MSD) analyzed for each matrix in this SDG? If no, indicate which matrix does not have an associated MS/MSD. Soil / Water.		✓		
Was a MS/MSD analyzed every 20 samples of each matrix?		✓		
Were the MS/MSD percent recoveries (%R) and the relative percent differences (RPD) within the QC limits?			✓	

Validation Area	Yes	No	NA	Findings/Comments
IX. Laboratory control samples				
Was an LCS analyzed for this SDG?	✓			
Was an LCS analyzed per extraction batch?	✓			
Were the LCS percent recoveries (%R) and relative percent difference (RPD) within the QC limits?	✓			
X. Field duplicates				
Were field duplicate pairs identified in this SDG?	✓			
Were target compounds detected in the field duplicates?.		✓		
XI. Internal standards				
Were internal standard area counts within ± 50% of the associated calibration standard?	✓			
Were retention times of m/z 89 ($Cl^{18}O_3^-$) within 0.2 minutes of m/z 83 (ClO_3^-)?	✓			
XII. Compound quantitation				
Were the correct internal standard (IS), quantitation ion and relative response factor (RRF) used to quantitate the compound?	✓			
Were compound quantitation and RLs adjusted to reflect all sample dilutions and dry weight factors applicable to level IV validation?	✓			
XIII. Target compound identification	✓			
Were relative retention times (RRT's) within 0.98 to 1.02?				
Was the isotope ratio of $^{35}Cl/^{37}Cl$ or m/z 99/101 within 2.3 to 3.8?	✓			
XIV. System performance				
System performance was found to be acceptable.	✓			
XIII. Overall assessment of data				
Overall assessment of data was found to be acceptable.	✓			

LDC#: 42791A87

VALIDATION FINDINGS WORKSHEET
Initial Calibration Calculation Verification

Reviewer: JVG
2nd Reviewer:

Method: LCMS Perchlorate (EPASW 846 Method 6860)

Calibration Date	System	Compound	Standard	(Y) Area ratio	(X) Conc ratio
6/28/2018	LCMS8	Perchlorate	1	0.13830	0.10
			2	0.32451	0.25
			3	0.62099	0.49
			4	1.22267	0.98
			5	3.13559	2.45
			6	6.25560	4.90

Regression Output		*Calculated*	*Reported WLR*
Constant	*b* =	*0.000513*	*2.144400*
R Squared	*r2* =	*0.999957*	*1.000000*
X Coefficient(s)	*m* =	*1.275773*	*1.26920*
Correlation Coefficient		*0.999979*	
Coefficient of Determination (r^2)		*0.999957*	*1.000000*

LDC#: 42791A87

VALIDATION FINDINGS WORKSHEET
Continuing Calibration Calculation Verification

Reviewer: JVG
2nd Reviewer:

Method: LCMS Perchlorate (EPASW 846 Method 6860)

The percent difference (%D) of the initial calibration average Calibration Factors (CF) and the continuing calibration percent difference (%D) values were recalculated for the compounds identified below using the following calculation:

Percent difference (%D) = 100 * (N - C)/N

Where:
N = Initial Calibration Factor or Nominal Amount
C = Calibration Factor from Continuing Calibration Standard or Calculated Amount

#	Standard ID	Calibration Date	Compound	CCV Conc	Reported Conc	Recalculated Conc	Reported % D	Recalculated %D
1	IC818F28032	6/28/2018	Perchlorate	0.200	0.180	0.180	9.9	9.9

LDC #: 42791A87

VALIDATION FINDINGS WORKSHEET

Laboratory Control Sample/Laboratory Control Sample Duplicates Results Verification

Reviewer: JVG
2nd Reviewer:

METHOD: LC/MS Perchlorate (EPA SW 846 Method 6850/6860)

The percent recoveries (%R) and Relative Percent Difference (RPD) of the laboratory control sample and laboratory control sample duplicate were recalculated for the compounds identified below using the following calculation:

% Recovery = 100 * (SC/SA Where: SSC = Spike concentration
SA = Spike added

RPD = I LCS - LCSD I * 2/(LCS + LCSD) LCS = Laboratory control sample percent recovery LCSD = Laboratory control sample duplicate percent recovery

LCS/LCSD samples: LCS/D 280-420424/14,15

Compound	Spike Added (ug/L)		Spike Concentration (ug/L)		LCS Percent Recovery		LCSD Percent Recovery		LCS/LCSD RPD	
	LCS	LCSD	LCS	LCSD	Reported	Recalc	Reported	Recalc	Reported	Recalc
Perchlorate	0.0500	0.0500	0.0451	0.0457	90	90	90	90	0	0

Comments: Refer to Laboratory Control Sample/Laboratory Control Sample Duplicates findings worksheet for list of qualifications and associated samples when reported results do not agree within 10.0% of the recalculated results.

LDC #: 42791A87

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

Page: 1 of 1
Reviewer: JVG
2nd reviewer: 4

METHOD: LCMS Perchlorate (EPA SW 846 Method 6850/6860)

(Y) N N/A Were all reported results recalculated and verified for all level IV samples?
(Y) N N/A Were all recalculated results for detected target compounds agree within 10.0% of the reported results?

Concentration = $\frac{(A_x)(I_s)(V_t)(DF)(2.0)}{(A_{is})(RRF)(V_o)(V_i)(\%S)}$

A_x	=	Area of the characteristic ion (EICP) for the compound to be measured
A_{is}	=	Area of the characteristic ion (EICP) for the specific internal standard
I_s	=	Amount of internal standard added in nanograms (ng)
V_o	=	Volume or weight of sample extract in milliliters (ml) or grams (g).
V_i	=	Volume of extract injected in microliters (ul)
V_t	=	Volume of the concentrated extract in microliters (ul)
Df	=	Dilution Factor.
%S	=	Percent solids, applicable to soil and solid matrices only.
2.0	=	Factor of 2 to account for GPC cleanup

Example:

Sample I.D. ND (LCS), Perchlorate:

Conc. $\frac{\left[\frac{(610004)(204)}{(2094795)}\right] - (2.1449)}{(1.2692)}$

= 45.115

final conc. = $\frac{(45.115)\,\text{ng}}{(1000)}$ = 0.045115 ug/L

#	Sample ID	Compound	Reported Concentration (ug/L)	Calculated Concentration ( )	Qualification
			0.0451		

LDC #: 42791

EDD POPULATION COMPLETENESS WORKSHEET

Date: 08/06/18

2nd Reviewer: JE

The LDC job number listed above was entered by CJ.

Entered from Body or Summary

	EDD Process		Comments/Action
I.	EDD Completeness	-	
Ia.	- All methods present?	y	
Ib.	- All samples present/match report?	y	
Ic.	- All reported analytes present?	y	
Id.	- 10% or 100% verification of EDD?	y	
II.	EDD Preparation/Entry	-	
IIa.	- Carryover U/J?	N	
IIb.	- Reason Codes used? If so, note which codes.	y	LDC
IIc.	- Additional Information (QC Level, Validator, Validated Y/N, etc.)	N	
III.	Reasonableness Checks	-	
IIIa.	- Do all qualified ND results have ND qualifier (e.g. UJ)?	y	
IIIb.	- Do all qualified detect results have detect qualifier (e.g. J)?	y	
IIIc.	- If reason codes are used, do all qualified results have reason code field populated, and vice versa?	y	
IIId.	-Does the detect flag require changing for blank qualifier? If so, are all U results marked ND?	-/-	
IIIe.	- Do blank concentrations in report match EDD where data was qualified due to blank contamination?	y	
IIIf.	- Were multiple results reported due to dilutions/reanalysis? If so, were results qualified appropriately?	N/A	
IIIg.	-Are there any discrepancies between the data packet and the EDD?	N	

Notes: *see discrepancy sheet