APPENDIX C. DATA VALIDATION REPORT

LABORATORY DATA CONSULTANTS, INC.
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LDC #14172
November 04, 2005

Windward Environmental, LLC
200 West Mercer Street, Suite 401
Seattle, WA 98119
ATTN: Ms. Marina Mitchell

SUBJECT: Lower Duwamish Waterway Group Tissue and Sediment Sample Data Validation

Dear Ms. Mitchell,

Enclosed is the revised EPA Level IV data validation review of Analytical chemistry results generated in support of the Lower Duwamish Waterway Group project. The analyses were performed by BrooksRand Trace Metals Analysis & Products. Samples were analyzed for Inorganic Arsenic by EPA Method 1632 and Total Arsenic by modified EPA Method 1638. Samples are referenced under the following Sample Delivery Group: WIN002. See the Sample Analysis Table (Attachment 1) for the number of samples reviewed.

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

Sincerely,

Stella S. Cuenco
Project Manager/Senior Chemist

Attachment 1

LDC #14172 (Windward Environmental, LLC - Seattle WA / Lower Duwamish Waterway Group)

LDC	SDG#	DATE REC'D	(3) DATE DUE	Total As (1638)		Inorgnic As (1632)																													
Matrix: Tissue/Sediment				T	S	T	S	T	S	T	S	T	S	T	S	T	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S
A	WIN002	10/21/05	10/28/05	12	10	12	0																												
Total	B/SC			12	10	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34

Shaded cells indicate Level IV validation (all other cells are Level II validation). These sample counts do not include MS/MSD, and DUPs

CHEMICAL DATA QUALITY REVIEW FOR TISSUE AND SEDIMENT SAMPLES

Lower Duwamish Waterway Group
LDC# 14172

This report details the findings of an EPA Level IV data validation review of Analytical chemistry results generated in support of the Lower Duwamish Waterway Group project. All analyses were performed by BrooksRand Trace Metals Analysis & Products. Samples were analyzed for Inorganic Arsenic by EPA Method 1632 and Total Arsenic by modified EPA Method 1638. Samples are referenced under the following Sample Delivery Group: WIN002. See the Sample Analysis Table (Attachment 1) for the number of samples reviewed and the Sample Validation Table (Attachment 2) for the sample identifications and analyses.

*The QC guidelines used for data qualification are those specified in the National Functional Guidelines for Inorganic Data Review (July 2002). Specific QC criteria used follows the Final Benthic Invertebrate Sampling of the Lower Duwamish Waterway Quality Assurance Project Plan (July 30, 2004) and Additional Clam Sampling in Background Area Addendum (August 1, 2005). Where specific guidance is not available, the data has been evaluated in a conservative manner using professional experience.

The following items were evaluated during the review:

- Holding Times
- Sample Preservation
- Cooler Temperatures
- Instrument Calibration
- Blanks
- Matrix Spike/Matrix Spike Duplicates
- Internal Standards
- Laboratory Control Samples
- Target Compound Identifications
- Compound Quantitation and CRQLs
- System Performance
- Field Duplicates

Attachment 1

LDC #14172 (Windward Environmental, LLC - Seattle WA / Lower Duwamish Waterway Group)

LDC	SDG#	DATE REC'D	(3) DATE DUE	Total As (1638)		Inorgnic As (1632)																													
Matrix: Tissue/Sediment				T	S	T	S	T	S	T	S	T	S	T	S	T	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S	W	S
A	WIN002	10/21/05	10/28/05	12	10	12	0																												
Total	B/SC			12	10	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	34

Shaded cells indicate Level IV validation (all other cells are Level II validation). These sample counts do not include MS/MSD, and DUPs

Attachment 2

SDG#: WIN002 | VALIDATION SAMPLE TABLE | **LDC#:** 14172A

Project Name: Lower Duwamish Waterway Group | Parameters/Analytical Method | Project #04-08-06-22

Client ID #	Lab ID #	Matrix	Date Collected	Total As (1638)	Inorganic As (1632)											
VI-C1-T	05BR1325-1	tissue	08/23/05	X	X											
VI-C2-T	05BR1325-2	tissue	08/23/05	X	X											
VI-C3-T	05BR1325-3	tissue	08/23/05	X	X											
VI-C4-T	05BR1325-4	tissue	08/23/05	X	X											
VI-C5-T	05BR1325-5	tissue	08/23/05	X	X											
VI-C6-T	05BR1325-6	tissue	08/23/05	X	X											
VI-C1-TS	05BR1325-7	sediment	08/23/05	X												
VI-C2-TS	05BR1325-8	sediment	08/23/05	X												
VI-C3-TS	05BR1325-9	sediment	08/23/05	X												
VI-C4-TS	05BR1325-10	sediment	08/23/05	X												
VI-C5-TS	05BR1325-11	sediment	08/23/05	X												
VI-C6-TS	05BR1325-12	sediment	08/23/05	X												
Du-C1-T	05BR1325-13	tissue	08/19/05	X	X											
Du-C2-T	05BR1325-14	tissue	08/19/05	X	X											
Du-C3-T	05BR1325-15	tissue	08/19/05	X	X											
Du-C4-T	05BR1325-16	tissue	08/19/05	X	X											
Du-C123-T1	05BR1325-17	tissue	08/19/05	X	X											
Du-C123-T2	05BR1325-18	tissue	08/19/05	X	X											
Du-C1-S	05BR1325-19	sediment	08/19/05	X												
Du-C2-S	05BR1325-20	sediment	08/19/05	X												
Du-C3-S	05BR1325-21	sediment	08/19/05	X												
Du-C4-S	05BR1325-22	sediment	08/19/05	X												
VI-C2-TMS	05BR1325-2MS	tissue	08/23/05		X											
VI-C2-TMSD	05BR1325-2MSD	tissue	08/23/05		X											
VI-C2-TDUP	05BR1325-2DUP	tissue	08/23/05		X											

Note: X = Validation was performed.

SDG#: WIN002 | VALIDATION SAMPLE TABLE | **LDC#:** 14172A

Project Name: Lower Duwamish Waterway Group | Parameters/Analytical Method | Project #04-08-06-22

Client ID #	Lab ID #	Matrix	Date Collected	Total As (1638)	Inorganic As (1632)										
VI-C4-TMS	05BR1325-4MS	tissue	08/23/05	X											
VI-C4-TMSD	05BR1325-4MSD	tissue	08/23/05	X											
VI-C4-TDUP	05BR1325-4DUP	tissue	08/23/05	X											
VI-C5-TMS	05BR1325-5MS	tissue	08/23/05		X										
VI-C5-TMSD	05BR1325-5MSD	tissue	08/23/05		X										
VI-C5-TDUP	05BR1325-5DUP	tissue	08/23/05		X										
VI-C1-TSMS	05BR1325-7MS	tissue	08/23/05	X											
VI-C1-TSMSD	05BR1325-7MSD	tissue	08/23/05	X											
VI-C1-TSDUP	05BR1325-7DUP	tissue	08/23/05	X											
Du-C123-T2MS	05BR1325-18MS	tissue	08/19/05	X											
Du-C123-T2MSD	05BR1325-18MSD	tissue	08/19/05	X											
Du-C123-T2DUP	05BR1325-18DUP	tissue	08/19/05	X											

Note: X = Validation was performed.

Only issues which require comment or action are discussed in this report. Data deficiencies are arranged by method. Potential effects of data anomalies have been described where possible.

The following are definitions of the data qualifiers:

U Indicates the compound or analyte was analyzed for but not detected at or above the stated limit.

J Indicates an estimated value.

R Quality control indicates the data is not usable.

N Presumptive evidence of presence of the constituent.

UJ Indicates the compound or analyte was analyzed for but not detected. The sample detection limit is an estimated value.

A Indicates the finding is based upon technical validation criteria.

P Indicates the finding is related to a protocol/contractual deviation.

Overall Data Assessment

*I. Usability

Internal standard recovery problems have warranted the qualification of detected results as estimated (J) for arsenic in several samples.

Field duplicates were not collected for this sampling event.

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.

*deleted SRM statement

Total Arsenic by modified EPA Method 1638 & Inorganic Arsenic by EPA Method 1632

I. Technical Holding Times

All technical holding time requirements were met.

The chain-of-custodies were reviewed for documentation of cooler temperatures. All cooler temperatures met validation criteria.

II. Calibration

An initial calibration was performed.

The frequency and analysis criteria of the initial calibration verification (ICV) and continuing calibration verification (CCV) were met.

III. Blanks

Method blanks were reviewed for each matrix as applicable.

Data qualification by the initial, continuing and preparation blanks (ICB/CCB/PBs) was based on the maximum contaminant concentration in the ICB/CCB/PBs in the analysis of each analyte. No contaminant concentrations were found in the initial, continuing and preparation blanks.

IV. ICP Interference Check Sample (ICS) Analysis

ICP Interference check data were not required by the method.

V. Matrix Spike Analysis

Matrix spike (MS) and matrix spike duplicate (MSD) samples were reviewed for each matrix as applicable. Percent recoveries (%R) and relative percent differences (RPD) were within QC limits.

VI. Duplicate Sample Analysis

Duplicate (DUP) sample analyses were reviewed for each matrix as applicable. Results were within QC limits.

***VII. Laboratory Control Samples (LCS)**

Laboratory control samples were reviewed for each matrix as applicable. Percent recoveries (%R) were within QC limits.

Standard reference material (SRM) were within QC limits for total arsenic.

*deleted SRM statement

VIII. Internal Standards (ICP-MS)

All internal standard percent recoveries (%R) were within QC limits with the following exceptions:

Sample	Internal Standard	%R (Limits)	Analyte	Flag	A or P
VI-C1-S VI-C2-S	Gallium^{71}	169	Arsenic	J (all detects) UJ (all non-detects)	P
VI-C3-S	Gallium^{71}	148	Arsenic	J (all detects) UJ (all non-detects)	P
VI-C4-S	Gallium^{71}	149	Arsenic	J (all detects) UJ (all non-detects)	P
VI-C5-S	Gallium^{71}	147	Arsenic	J (all detects) UJ (all non-detects)	P
VI-C6-S	Gallium^{71}	138	Arsenic	J (all detects) UJ (all non-detects)	P
Du-C1-S	Gallium^{71}	155	Arsenic	J (all detects) UJ (all non-detects)	P
Du-C2-S	Gallium^{71}	162	Arsenic	J (all detects) UJ (all non-detects)	P
Du-C3-S	Gallium^{71}	158	Arsenic	J (all detects) UJ (all non-detects)	P
Du-C4-S	Gallium^{71}	144	Arsenic	J (all detects) UJ (all non-detects)	P
VI-C1-SDUP	Gallium^{71}	157	Arsenic	J (all detects) UJ (all non-detects)	P

IX. Furnace Atomic Absorption QC

All graphite furnace atomic absorption QC were within validation criteria.

X. ICP Serial Dilution

ICP serial dilution was not required by the method.

XI. Sample Result Verification

All sample result verifications were acceptable.

XII. Overall Assessment of Data

The overall assessment of data was acceptable.

XIII. Field Duplicates

No field duplicates were identified in this SDG.

XIV. Field Blanks

No field blanks were identified in this SDG.

LDC #: 14172A4 **VALIDATION COMPLETENESS WORKSHEET** Date: 10/24/05
SDG #: WIN002 Level IV Page: 1 of 1
Laboratory: Brooks Rand LLC (Mod) Reviewer: km
2nd Reviewer: M

METHOD: Total Arsenic (EPA Method 1638), Inorganic Arsenic (EPA Method 1632)

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.	Technical holding times	A	Sampling dates: 8/19-22/05
II.	Calibration	A SW	
III.	Blanks	A	
IV.	ICP Interference Check Sample (ICS) Analysis	N	Not required
V.	Matrix Spike Analysis	A	
VI.	Duplicate Sample Analysis	D	Total Hg available re
VII.	Laboratory Control Samples (LCS)	A	us. SRM, ~~No SRM for Inorganic Arsenic Test~~.
VIII.	Internal Standard (ICP-MS)	SW	
IX.	Furnace Atomic Absorption QC	A	
X.	ICP Serial Dilution	N	Not required
XI.	Sample Result Verification	A	
XII.	Overall Assessment of Data	A	
XIII.	Field Duplicates	N	
XIV.	Field Blanks	N	

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

Validated Samples:

1	VI-C1-T Tissue	11	VI-C5-TS Sediment	21	Du-C3-S Sediment	31	VI-C5-TDUP
2	VI-C2-T	12	VI-C6-TS	22	Du-C4-S	32	~~Du-C123-T1MS~~
3	VI-C3-T	13	Du-C1-T Tissue	23	VI-C2-TMS	33	~~Du-C123-T1MSD~~
4	VI-C4-T	14	Du-C2-T	24	VI-C2-TMSD	34	~~Du-C123-T1DUP~~
5	VI-C5-T	15	Du-C3-T	25	VI-C2-TDUP	35	Du-C123-T2MS
6	VI-C6-T	16	Du-C4-T	26	VI-C4-TMS	36	Du-C123-T2MSD
7	VI-C1-TS Sediment	17	Du-C123-T1	27	VI-C4-TMSD	37	Du-C123-T2DUP
8	VI-C2-TS	18	Du-C123-T2	28	VI-C4-TDUP	38	VI-C1-TS MS
9	VI-C3-TS	19	Du-C1-S Sediment	29	VI-C5-TMS	39	MSD
10	VI-C4-TS	20	Du-C2-S	30	VI-C5-TMSD	40	Dup

Notes: 8

LDC #: 1472 A4
SDG #: W7N002

VALIDATION FINDINGS CHECKLIST

Page: 1 of 2
Reviewer: MM
2nd Reviewer: JC

Method: Metals (EPA SW 846 Method 6010/7000/6020)

Validation Area	Yes	No	NA	Findings/Comments
I. Technical holding times				
All technical holding times were met.	✓			
Cooler temperature criteria was met.	✓			
II. 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 and 85-115% for cyanide) QC limits?	✓			
Were all initial calibration correlation coefficients > 0.995? (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. ICP Interference Check Sample				
Were ICP interference check samples performed daily?			✓	
Were the AB solution percent recoveries (%R) with the 80-120% QC limits?			✓	
IV. 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.	✓			
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% QC limits for water samples and laboratory established QC limits for soils?	✓			
VI. Furnace Atomic Absorption QC				
If MSA was performed, was the correlation coefficients > 0.995?			✓	
Do all applicable analysies have duplicate injections? (Level IV only)			✓	
For sample concentrations > RL, are applicable duplicate injection RSD values < 20%? (Level IV only)			✓	
Were analytical spike recoveries within the 85-115% QC limits?			✓	

LDC #: 14172A4
SDG #: J7X102

VALIDATION FINDINGS CHECKLIST

Reviewer: MM
2nd Reviewer: [illegible]

Validation Area	Yes	No	NA	Findings/Comments
VII. ICP Serial Dilution				
Was an ICP serial dilution analyzed if analyte concentrations were > 50X the IDL?			✓	
Were all percent differences (%Ds) < 10%?			✓	
Was there evidence of negative interference? If yes, professional judgement will be used to qualify the data.			✓	
VIII. Internal Standards (EPA SW 846 Method 6020)				
Were all the percent recoveries (%R) within the ~~30-120%~~ 60-125 of the intensity of the internal standard in the associated initial calibration?		✓		163.8
If the %Rs were outside the criteria, was a reanalysis performed?		✓		
IX. Regional Quality Assurance and Quality Control				
Were performance evaluation (PE) samples performed?			✓	
Were the performance evaluation (PE) samples within the acceptance limits?			✓	
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 #: 1412A4
SDG #: W7K002

VALIDATION FINDINGS WORKSHEET
Sample Specific Element Reference

Reviewer: MH
2nd reviewer: h

All circled elements are applicable to each sample.

Sample ID	Matrix	Target Analyte List (TAL)	
1-6, 13-18	Tissue	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, Si, CN^-,	(Inorganic As)
7-12, 19-22	Sediment	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, Si, CN^-,	
23-25	Tissue	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, Si, CN^-,	(Inorganic As)
26-28	↓	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, Si, CN^-,	
29-31	↓	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, Si, CN^-,	(Inorganic As)
~~32-34~~	↓	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, Si, CN^-,	
35-37	↓	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, Si, CN^-,	
38-40	~~Tiss~~ Sediment	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, Si, CN^-,	
		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, Si, CN^-,	
		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, Si, CN^-,	
		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, Si, CN^-,	
		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, Si, CN^-,	
		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, Si, CN^-,	
		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, Si, CN^-,	
		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, Si, CN^-,	
		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, Si, CN^-,	
		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, Si, CN^-,	
		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, Si, CN^-,	
		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, Si, CN^-,	
		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, Si, CN^-,	
		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, Si, CN^-,	
		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, Si, CN^-,	
		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, Si, CN^-,	
		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, Si, CN^-,	
		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, Si, CN^-,	
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, Si, CN^-,	
ICP Trace		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, Si, CN^-,	
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, Si, CN^-,	
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, Si, CN^-,	

Comments: Mercury by CVAA if performed

LDC #: 14172A4
SDG #: W2N002

VALIDATION FINDINGS WORKSHEET
Internal Standards (ICP-MS)

Page: 1 of 1
Reviewer: MB
2nd Reviewer: [illegible]

1638

METHOD: Metals (EPA Method ~~200.8~~)

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

Y (N) N/A Were all internal standard percent recoveries within 60-125% of the intensity of the internal standard in the initial calibration standard ?

Y (N) N/A If the response to the above question is no, were the samples reanalyzed as required ?

#	Date	Internal Standard	Associated Metals	%R (Limits)	Associated Samples	Qualifications
1		Gallium 71	As	169	7	J/UJ/P
2				169	8	
3				148	9	
4				149	10	
5				147	11	
6				138	12	
7				155	19	
8				162	20	
9				158	21	
10		↓	↓	144	22	↓
11				155	~~36~~ 38	~~a~~ ~~UJ~~ ~~P~~ ~~J~~ ~~P~~ qual
12				159	~~41~~ 39	~~J~~ J
13		↓	↓	157	~~42~~ 40	~~J~~ J/UJ/P

INTST.4SW

LDC #: 14192A4
SDG #: MZN09

VALIDATION FINDINGS WORKSHEET
Initial and Continuing Calibration Calculation Verification

Page: 1 of 1
Reviewer: MY
2nd Reviewer: AC

METHOD: Trace Metals (EPA SW 846 Method 6010/7000)

An initial and continuing calibration verification percent recovery (%R) was recalculated for each type of analysis using the following formula:

%R = Found x 100 / True

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)
ICV	ICP (Initial calibration) MY	Ag	10.115	10	101.2	101.3	Y
↓	GFAA (Initial calibration)	Ag	5.43	5.0	108.6	108.7	↓
	CVAA (Initial calibration)						
CCV	ICP (Continuing calibration) MY	Ag-1	8.65	10	86.5	86.8	Y
↓	GFAA (Continuing calibration)	Ag	5.35	5.0	107	107.1	↓
	CVAA (Continuing calibration)						
	Cyanide (Initial calibration)						
	Cyanide (Continuing calibation)						

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 #: 14172A4
SDG #: W2N002

VALIDATION FINDINGS WORKSHEET
Level IV Recalculation Worksheet

Reviewer: MM
2nd Reviewer: K

METHOD: Trace Metals (EPA SW 846 Method 6010/7000)

Percent recoveries (%R) for an ICP interference check sample, a laboratory control sample and a matrix spike sample were recaluculated using the following formula:

$$\%R = \frac{Found}{True} \times 100$$

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:

$$RPD = \frac{|S-D|}{(S+D)/2} \times 100$$

Where, S = Original sample concentration
D = Duplicate sample concentration

An ICP serial dilution percent difference (%D) was recalculated using the following formula:

$$\%D = \frac{|I-SDR|}{I} \times 100$$

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)
MB	ICP interferance check						
LCS	Laboratory control sample	Ag	9.69	10	9.69	96.9	Y
MS	Matrix spike	Ag	(SSR-SR) 8.08	9.31	86.8	86.9	↓
DUP	Duplicate	Tungsten Ag	0.243	0.211	14.1	~~14.1~~ 14.1	
	ICP serial dilution						

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

LDC #: 14197A4
SDG #: V3N002

VALIDATION FINDINGS WORKSHEET
Sample Calculation Verification

Page: 1 of 1
Reviewer: MV
2nd reviewer: M

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 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 ~~14197A4~~ 1, 13, 21 were recalculated and verified using the following equation:

Concentration = $\frac{(RD)(FV)(Dil)}{(In.\ Vol.)(\%S)}$

RD = Raw data concentration
FV = Final volume (ml)
In. Vol. = Initial volume (ml) or weight (G)
Dil = Dilution factor
%S = Decimal percent solids

Recalculation:

#1 As = $\frac{13.76\ ug/L \times 0.047}{0.597\ g} = 0.92 \pm ug/g$

Sample ID	Analyte	Reported Concentration (ug/g)	Calculated Concentration (ug/g)	Acceptable (Y/N)
1	As	0.920	0.922	Y
	As (Inorganic)	0.148	0.148	Y
13	As	0.720	0.727	Y
	As (Inorganic)	0.047	0.047	Y
		~~3.3~~		
21	As	3.337	3.330	Y