Australian Government
Department of Industry, Science and Resources
National Measurement Institute

Proficiency Test Final Report AQA 22-10A Trace Elements and Solids in Potable Water

February 2023

This report replaces AQA 22-10.

REVISION HISTORY

Date	Report Number	Reason for review
October 2022	AQA 22-10	Final Report – Original issue.
February 2023	AQA 22-10A	Acknowledgment Section

ACKNOWLEDGMENTS

This study was conducted by the National Measurement Institute (NMI). Support funding was provided by the Australian Government Department of Industry, Science and Resources.

I would like to thank the management and staff of the participating laboratories for supporting the study. It is only through widespread participation that we can provide an effective service to laboratories.

The assistance of the following NMI staff members in the planning, conducting and reporting of the study is acknowledged.

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Accredited for compliance with ISO/IEC 17043

TABLE OF CONTENTS

1 SUMMARY

This report presents the results of the proficiency test AQA 22-10, Trace Elements and Solids in Potable Water. The study focused on the measurement of total: Al, As, B, Ba, Be, Bi, Cd, Co, Cr, Cs, Cu, Fe, Hg, La, Li, Mn, Mo, Ni, P, Pb, Sb, Se, Sn, Sr, Th, Tl, U, V and Zn. Measurement of Total Dissolved Solids (TDS), Total Solids (TS), Total Suspended Solids (TSS) and Turbidity were also included in the program.

The sample set consisted of three water samples.

Twenty laboratories registered to participate and all submitted results.

The assigned values were the robust average of participants' results. The associated uncertainties were estimated from the robust standard deviation of the participants' results.

The outcomes of the study were assessed against the aims as follows, to:

i. compare the performance of participant laboratories and assess their accuracy;

Laboratory performance was assessed using both z-scores and E_n-scores.

Of 524 z-scores, 505 (96%) returned a satisfactory score of $|z| \leq 2.0$.

Of 524 E_n-scores, 477 (91%) returned a satisfactory score of $|E_n| \leq 1.0$.

Laboratory 19 received satisfactory z-scores for all analytes for which z-scores were calculated (40).

No laboratory returned satisfactory E_n scores for all 40 tests for which E_n-scores were calculated.

ii. evaluate the laboratories' methods used in determination of total elements in potable water;

Rounding of results and reporting results with an insufficient number of significant figures was one of the main causes for participants' poor performance.

iii. evaluate within laboratory precision-repeatability;

Sample S2 was the same fortified potable water used for Sample S1 preparation, further fortified for: Al, As, Ba, Bi, Cs, Fe, Hg, La, Mn, P, Sb, Sr, Th and U. The concentration of Cd, Sn and Zn in S2 was expected to remain unchanged from those in Sample S1. In some cases, the expanded measurement uncertainty in the two identical study samples were significantly different.

iv. compare the performance of participant laboratories with their past performance;

On average, participants' performance in potable water has remained consistent over time.

v. develop the practical application of traceability and measurement uncertainty and provide participants with information that will be useful in assessing their uncertainty estimates;

Of 524 numerical results, 522 (99.6%) were reported with an expanded measurement uncertainty. The magnitude of these expanded uncertainties was within the range 0.24% to 435% of the reported value. An example of estimating measurement uncertainty using only the proficiency testing data is given in Appendix 3.

vi. produce materials that can be used in method validation and as control samples.

The study samples were checked for homogeneity and are well characterised, both by in-house testing and from the results of the proficiency round. Surplus test samples are available for sale.

2 INTRODUCTION

2.1 NMI Proficiency Testing Program

The National Measurement Institute (NMI) is responsible for Australia's national measurement infrastructure providing a wide range of services, including a chemical proficiency testing program.

Proficiency testing (PT) "is evaluation of participant performance against pre-established criteria by means of inter-laboratory comparison."[1] NMI PT studies target chemical testing in areas of high public significance such as trade, environment and food safety. NMI offers studies in:

- inorganic analytes in soil, water, food and pharmaceuticals;
- pesticide residues in fruit and vegetables, soil and water;
- petroleum hydrocarbons in soil and water;
- PFAS in water, soil, biota and food;
- allergens in food;
- controlled drug assay; and
- folic acid in flour.

AQA 22-10 is the 30th NMI proficiency study of inorganic analytes in water.

2.2 Study Aims

The aims of the study were to:

- compare the performance of participant laboratories and assess their accuracy;
- evaluate the laboratories' methods used in determination of total elements in potable water;
- evaluate within laboratory precision repeatability;
- compare the performance of participant laboratories with their past performance;
- develop the practical application of traceability and measurement uncertainty; and
- produce materials that can be used in method validation and as control samples.

2.3 Study Conduct

The conduct of NMI proficiency tests is described in the NMI Chemical Proficiency Testing Study Protocol.[2] The statistical methods used are described in the NMI Chemical Proficiency Statistical Manual.[3] These documents have been prepared with reference to ISO Standard 17043[1] and The International Harmonized Protocol for Proficiency Testing of (Chemical) Analytical Laboratories.[4]

NMI is accredited by National Association of Testing Authorities, Australia (NATA) to ISO/IEC 17043 as a provider of proficiency testing schemes. This proficiency test is within the scope of NMI's accreditation.

The choice of the test method was left to the participating laboratories.

3 STUDY INFORMATION

3.1 Selection of Matrices and Inorganic Analytes

The 40 tests were selected from those for which an investigation level is published in the Australian Drinking Water Guidelines[5] and are commonly measured by water testing laboratories.

3.2 Participation

Twenty laboratories participated and all submitted results.

The timetable of the study was:

Invitation issued: 28 June 2022

Samples dispatched:	26 July 2022
Results due:	26 August 2022
Interim report issued:	31 August 2022

3.3 Test Material Specification

Three samples were provided for analysis:

Samples S1 was unfiltered potable water spiked for 18 elements and preserved by adding 2% (v/w) HNO_3 and 0.01% (v/w) HCl.

Sample S2 was Sample S1 further fortified for 14 elements.

Sample S3 was unfiltered water spiked for 3 analytes.

3.4 Laboratory Code

All participant laboratories were assigned a confidential code number.

3.5 Sample Preparation, Analysis and Homogeneity Testing

The same preparation procedure was followed as in previous studies. A partial homogeneity test was conducted for all tests except for Th in S2 and TS, TDS, TSS and Turbidity in S3.[1] The test samples from previous studies were demonstrated to be sufficiently homogeneous for the evaluation of participants' performance. Results from partial homogeneity testing are reported in this study as homogeneity values.

The preparation, analysis and homogeneity testing of the study samples are described in Appendix 1. In the present study, the test samples were demonstrated to be sufficiently homogeneous for all of the analytes assessed.

3.6 Stability of Analytes

No stability study was carried out for samples S1 and S2. Stability studies conducted for previous proficiency studies of metals in water found no significant changes in any of the analytes' concentration.

3.7 Sample Storage, Dispatch and Receipt

Samples S1 and S2 were refrigerated before dispatch. Sample S3 was stored at room temperature.

The samples were dispatched by courier on 26 July 2022.

A description of the test samples, instructions for participants, and a form for participants to confirm the receipt of the test samples were sent with the samples.

An Excel spreadsheet for the electronic reporting of results was e-mailed to participants.

3.8 Instructions to Participants

Participants were instructed as follows:

- Quantitatively analyse the samples using your normal test method.
- Participants are asked to report results in units of mg/L, except turbidity (NTU) for the following tests:

SAMPLE S1 unfiltered, acidified potable water		**SAMPLE S2** unfiltered, acidified potable water		**SAMPLE S3** unfiltered water	
Test TOTAL	**Estimated Value mg/L**	**Test TOTAL**	**Estimated Value mg/L**	**Test**	**Estimated Value mg/L**
As	<0.1	Al	<1.0	TDS (dried at 103-105 °C)	<500
Be	<0.1	As	<0.1	TSS (dried at 103-105 °C)	<500
Cd	<0.1	B	<5	TS (dried at 103-105 °C)	<500

Cr	<0.1	Ba	<1.0	Turbidity (NTU)	<250
Cu	<5.0	Bi	<0.1		
Co	<0.1	Cd	<0.1		
Fe	<5.0	Cs	<0.1		
Hg	<0.1	Fe	<5.0		
Li	<1.0	Hg	<0.1		
Mo	<0.1	La	<1.0		
Ni	<0.1	Mn	<5.0		
Pb	<0.1	P	<5.0		
Sb	<0.1	Sb	<0.1		
Se	<0.1	Sn	<0.1		
Sn	<0.1	Sr	<5.0		
Tl	<0.1	Th	<0.1		
V	<0.1	U	<0.1		
Zn	<5.0	Zn	<5.0		

- Report results using the electronic results sheet emailed to you.
- Report results as you would report to a client. For each analyte in each sample, report the expanded measurement uncertainty associated with your analytical result (e.g. 5.23 ± 0.51 mg/L).
- Please send us the requested details regarding the test method and the basis of your uncertainty estimate.

3.9 Interim Report

An interim report was emailed to participants on 31 August 2022.

4 PARTICIPANT LABORATORY INFORMATION

4.1 Test Method Summaries

Summaries of test methods for total elements are transcribed in Table 1. The instruments and settings reported by participants are presented in Appendix 5.

Table 1 Methodology for Total Elements

Lab. Code	Method Reference	Sample Volume (mL)	Temp. (°C)	Time (min)	Vol. HNO_3 (mL)	Vol. HCl (mL)
1	US EPA 200.7, US EPA 200.8 and APHA section 3125, US EPA 245.1	NA				
3	USEPA 200.8 & 6020	30	90-98	>90	0.5	0.25
4		100	96	240	1	
5*	3051A	20	170	15	1	1
6	APHA	5	95	90	3	1
7	Inhouse ICPMS method with reference to USEPA6020	14	95	90	0.28	0.42
8	In-house test method					
9		40	110	90	2	
11	USEPA 200.8	30	90-98	90	0.5	0.25
12*	APHA 3030F	50	95	30	2	1
14*	APHA Method 3030 E US EPA Method 245.7 (Hg)	10	100	60	0.5	
16	USEPA 200.8 & 6020	30	90-98	>90	0.5	0.25
18	W32 - Referencing APHA 3125					
19	Based on APHA 3030 E	40	100	480	2	
20	APHA 3030 E, APHA 3111 B	100	95	120	10	

*Additional Information in Table 3

Table 2 Method References for Solids and Turbidity

Lab. Code	Method Reference
1	APHA section 2540 C, 2540 B, 2540 D, and 2130
2	TSS - In-house method based on APHA 23rd Edition 2540 D TDS - In-house method based on APHA 23rd Edition 2540 C TS - In house method based on APHA 23rd Edition 2540B Turbidity - In-house method based on APHA 23rd Edition 2130 B
3	APHA2540 and Nephelometry
6	APHA
9	APHA
10	APHA 2130B, APHA 2540C, APHA 2540D
11	APHA2540 and Nephelometry
13	TSS-LTM-INO-4070 / TDS-LTM-INO-4170 / TS- LTM-INO-4140 / Tubidity-LTM-INO-4140
15	APHA Standard Methods for the Examination of Water and Waste Water, Methods 2540 C & E.
16	APHA2540 and Nephelometry
17	US EPA-2130B (Turbidity), 2540D (Total suspended solid)
18	In House W1 - Turbidity, W25 - TSS
19	SOLIDS by APHA 2540 B, C & D - Turb by APHA 2130 B
20	APHA 2340 D, APHA 2540 C, APHA 2540 B

4.2 Additional Information

Participants had the option to report additional information for each sample analysed. These are transcribed in Table 3.

Table 3 Additional Information

Lab Code	Additional Information
5	Microwave digestion
12	Samples concentrated for analysis
14	Digestion for Hg only: SampleVolume 2 mL, Regent 8 mL H2O, 1.5mL of 33% HCl and 0.2 mL 0.1N Potassium Bromide/potassium bromate solution

4.3 Basis of Participants' Measurement Uncertainty Estimates

Participants were requested to provide information about the basis of their uncertainty estimates (Table 4).

Table 4 Basis of Uncertainty Estimate

Lab. Code	Approach to Estimating MU	Information Sources for MU Estimation		Guide Document for Estimating MU
		Precision	Method Bias	
1	Top Down - precision and estimates of the method and laboratory bias	Control Samples – CRM Duplicate Analysis	CRM Recoveries of SS	John Eames
2	Top Down - precision and estimates of the method and laboratory bias	Control Samples – SS Duplicate Analysis	Recoveries of SS	NATA General Accreditation Guidance, Estimating and Reporting MU
3	Top Down - precision and estimates of the method and laboratory bias	Control Samples	Recoveries of SS	Eurachem/CITAC Guide
4	Top Down - precision and estimates of the method and laboratory bias	Control Samples Duplicate Analysis	Recoveries of SS	Eurachem/CITAC Guide
5	Top Down - precision and estimates of the method and laboratory bias	Control Samples – CRM Duplicate Analysis		NMI Uncertainty Course
6	Top Down - precision and estimates of the method and laboratory bias	Control Samples – CRM	CRM	Eurachem/CITAC Guide
7	Bottom Up (ISO/GUM, fish bone/ cause and effect diagram)	Duplicate Analysis	Recoveries of SS Instrument Calibration	Eurachem/CITAC Guide
8	Top Down - precision and estimates of the method and laboratory bias	Duplicate Analysis	CRM	Eurachem/CITAC Guide
9	Top Down - precision and estimates of the method and laboratory bias	Control Samples – CRM Duplicate Analysis	CRM Recoveries of SS	Nordtest Report TR537
10	Bottom Up (ISO/GUM, fish bone/ cause and effect diagram)	Control Samples – CRM	CRM	ISO/GUM
11	Top Down - precision and estimates of the method and laboratory bias	Control Samples	Recoveries of SS	Eurachem/CITAC Guide
12	Top Down Approach	Control Samples Instrument Calibration Duplicate Analysis	CRM Recoveries of SS Instrument Calibration	Eurochem Guide 2007
13		Control Samples – SS	Recoveries of SS	
14	Standard deviation of replicate analyses multiplied by 2 or 3	Control Samples – RM	CRM	Eurachem/CITAC Guide

15	Top Down - precision and estimates of the method and laboratory bias	Control Samples – SS Duplicate Analysis	Recoveries of SS	Internal SOP 08
16	Top Down - precision and estimates of the method and laboratory bias	Control Samples	Recoveries of SS	Eurachem/CITAC Guide
17	Standard deviation of replicate analyses multiplied by 2 or 3	Control Samples – CRM Duplicate Analysis	CRM	
18	Top Down - precision and estimates of the method and laboratory bias	Control Samples – CRM Duplicate Analysis	CRM Instrument Calibration Standard Purity	Nordtest Report TR537
19	Standard deviation of replicate analyses multiplied by 2 or 3	Control Samples Duplicate Analysis	CRM Recoveries of SS Instrument Calibration	ISO/GUM
20	Standard deviation of replicate analyses multiplied by 2 or 3	Control Samples – SS Instrument Calibration Duplicate Analysis	Recoveries of SS Instrument Calibration	NMI Uncertainty Course

[a]RM = Reference Material, CRM = Certified Reference Material, SS =Spiked samples.

4.4 Participant Comments on this PT Study or Suggestions for Future Studies

The study co-ordinator welcomes comments or suggestions from participants about this study or possible future studies. Such feedback may be useful in improving future studies.

Table 5 Participants' Comments

Participants' Comments	Study Co-ordinator's Response
Levels a bit low for ICP-OES for most analytes but we concentrated them down to achieve a detection level of 1ppb in most cases.	In this study we aim to support participants to assess their methods capabilities at measuring the analytes around Australian Drinking Water Guidelines levels[5]. Thank you for your feedback. It will help us in designing our next study in potable water.

5 PRESENTATION OF RESULTS AND STATISTICAL ANALYSIS

5.1 Results Summary

Participant results are listed in Tables 6 to 45 with resultant summary statistics: robust average, median, maximum, minimum, robust standard deviation (SD_{rob}) and robust coefficient of variation (CV_{rob}). Bar charts of results and performance scores are presented in Figures 2 to 41. An example chart with interpretation guide is shown in Figure 1.

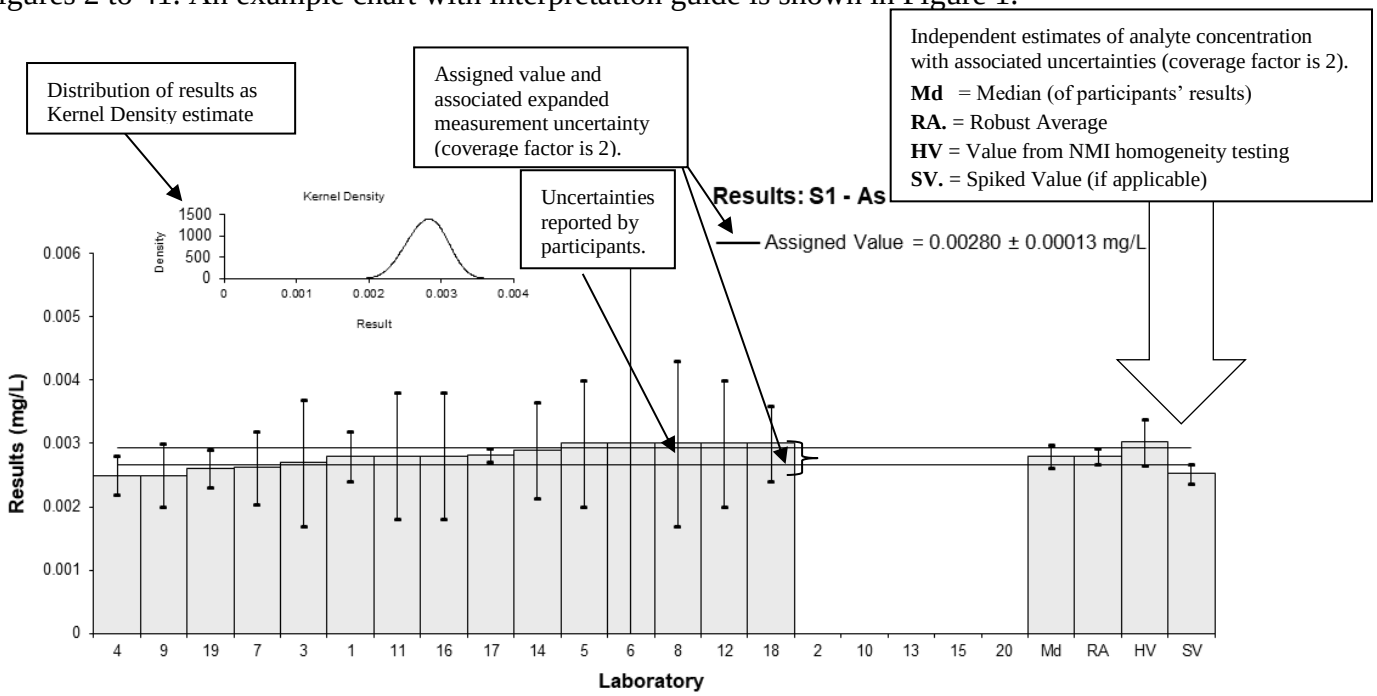


Figure 1 Guide to Presentation of Results

5.2 Outliers and Extreme Outliers

Outliers were results less than 50% and greater than 150% of the robust average and were removed before assigned value calculation. Extreme outliers were obvious blunders, such as those with incorrect units, decimal errors, or results from a different proficiency test item (gross errors) and were removed for calculation of summary statistics.[3, 4, 6]

5.3 Assigned Value

An example of the assigned value calculation using data from the present study is given in Appendix 2. The assigned value is defined as: 'the value attributed to a particular property of a proficiency test item.'[1] In this study the property is the mass fraction of analyte. Assigned values were the robust average of participants' results, outliers removed; the expanded uncertainties were estimated from the associated robust standard deviations.[4, 6]

5.4 Robust Average and Robust Between-Laboratory Coefficient of Variation

The robust averages and associated expanded measurement uncertainties were calculated using the procedure described in 'Statistical methods for use in proficiency testing by interlaboratory comparisons, ISO13528:2015(E)'.[6]

The robust between-laboratory coefficient of variation (robust CV) is a measure of the variability of participants' results and was calculated using the procedure described in ISO13528:2015(E).[6]

5.5 Target Standard Deviation for Proficiency Assessment

The target standard deviation for proficiency assessment (σ) is the product of the assigned value (X) and the performance coefficient of variation (PCV). This value is used for calculation of participant z-score and provides scaling for laboratory deviation from the assigned value.

$$\sigma = X * PCV \qquad \text{Equation 1}$$

It is important to note that the PCV is a fixed value and is not the standard deviation of participants' results. The fixed value set for PCV is based on the existing regulation, the acceptance criteria indicated by the methods, the matrix, the concentration level of analyte and on experience from previous studies. It is backed up by mathematical models such as the Thompson Horwitz equation.[7]

5.6 z-Score

An example of z-score calculation using data from the present study is given in Appendix 2. For each participants' result a z-score is calculated according to Equation 2 below:

$$z = \frac{(\chi - X)}{\sigma} \qquad \text{Equation 2}$$

Where:

z is z-score;

χ is participant's result;

X is the study assigned value;

σ is the target standard deviation.

A z-score with absolute value (|z|):

- $|z| \leq 2.0$ is satisfactory;
- $2.0 < |z| < 3.0$ is questionable;
- $|z| \geq 3.0$ is unsatisfactory.

5.7 E_n-Score

An example of E_n-score calculation using data from the present study is given in Appendix 2. The E_n-score is complementary to the z-score in assessment of laboratory performance. E_n-score includes measurement uncertainty and is calculated according to Equation 3 below:

$$E_n = \frac{(\chi - X)}{\sqrt{U_\chi^2 + U_X^2}} \qquad \text{Equation 3}$$

where:

E_n is E_n-score;

χ is a participant's result;

X is the study assigned value;

U_χ is the expanded uncertainty of the participant's result;

U_X is the expanded uncertainty of the assigned value.

An E_n-score with absolute value ($|E_n|$):

- $|E_n| \leq 1.0$ is satisfactory;
- $|E_n| > 1.0$ is unsatisfactory.

5.8 Traceability and Measurement Uncertainty

Laboratories accredited to ISO/IEC Standard 17025:2018[8] must establish and demonstrate the traceability and measurement uncertainty associated with their test results. Guidelines for quantifying uncertainty in analytical measurement are described in the Eurachem/CITAC Guide.[9]

6 TABLES AND FIGURES

Table 6

Sample Details

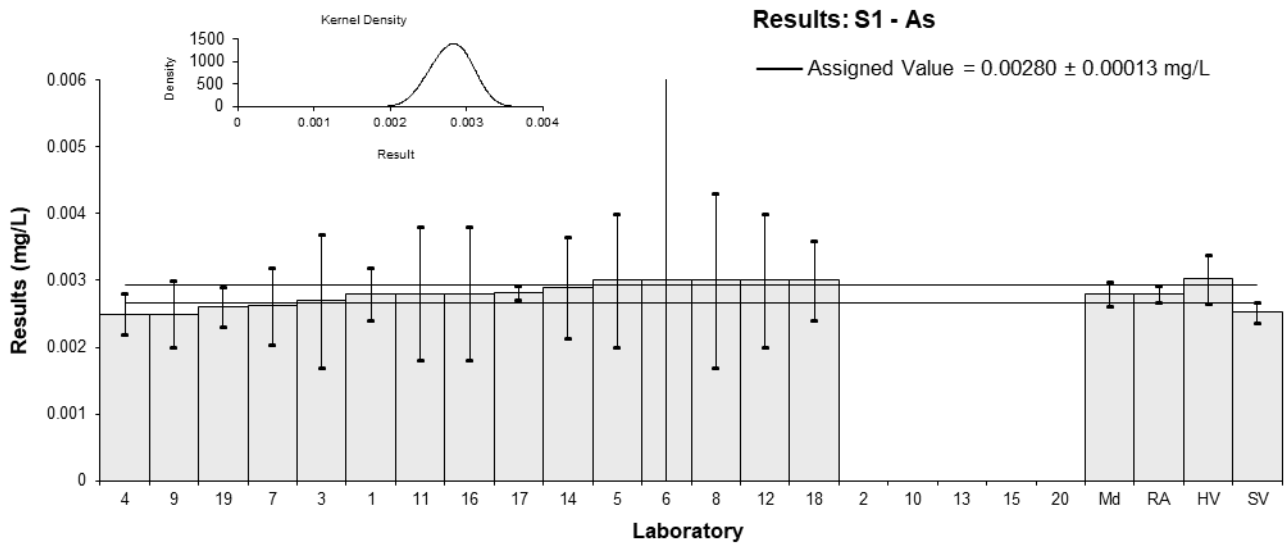
Sample	S1
Analyte	As
Matrix	Potable Water
Unit	mg/L

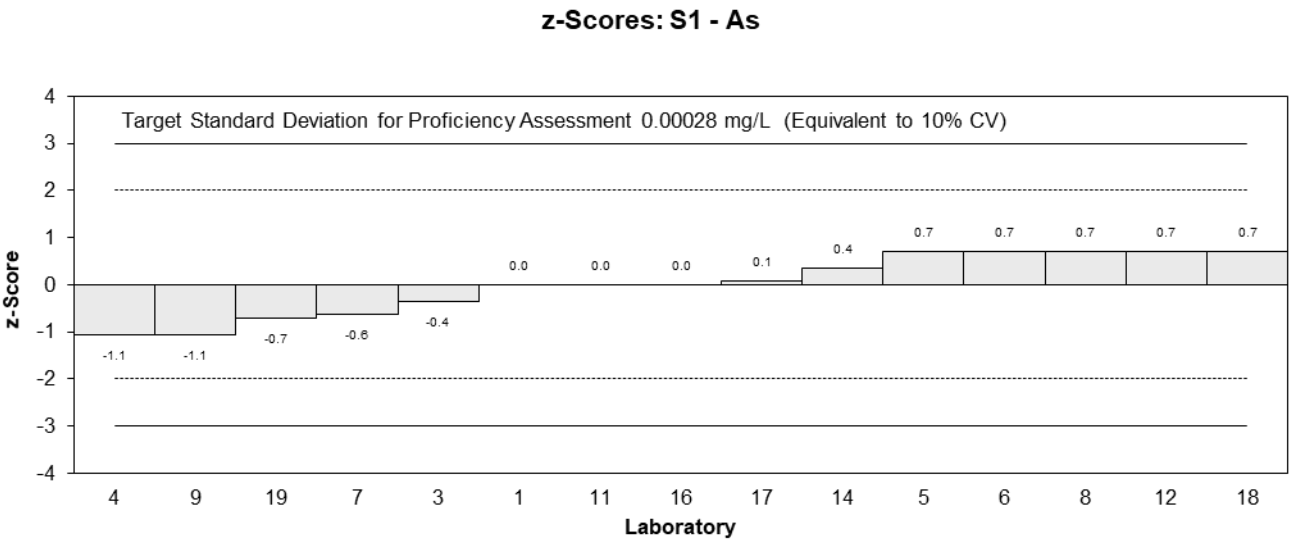
Participant Results

Lab. Code	Result	U	z	E_n
1	0.0028	0.0004	0.00	0.00
2	NT	NT		
3	0.0027	0.001	-0.36	-0.10
4	0.0025	0.0003	-1.07	-0.92
5	0.003	0.001	0.71	0.20
6	0.003	0.005	0.71	0.04
7	0.00262	0.00058	-0.64	-0.30
8	0.0030	0.0013	0.71	0.15
9	0.0025	0.0005	-1.07	-0.58
10	NT	NT		
11	0.0028	0.001	0.00	0.00
12	0.003	0.001	0.71	0.20
13	NT	NT		
14	0.00290	0.00076	0.36	0.13
15	NT	NT		
16	0.0028	0.001	0.00	0.00
17	0.00282	0.0001	0.07	0.12
18	0.003	0.0006	0.71	0.33
19	0.0026	0.0003	-0.71	-0.61
20	NT	NT		

Statistics

Assigned Value	0.00280	0.00013
Spike Value	0.00252	0.00015
Homogeneity Value	0.00302	0.00036
Robust Average	0.00280	0.00013
Median	0.00280	0.00019
Mean	0.00280	0.00009
N	15	
Max	0.003	
Min	0.0025	
Robust SD	0.00021	
Robust CV	7.4%	


Results: S1 - As
Assigned Value = 0.00280 ± 0.00013 mg/L
Kernel Density
Density
Result
Results (mg/L)
Laboratory
4 9 19 7 3 1 11 16 17 14 5 6 8 12 18 2 10 13 15 20 Md RA HV SV


z-Scores: S1 - As
Target Standard Deviation for Proficiency Assessment 0.00028 mg/L (Equivalent to 10% CV)
z-Score
-1.1 -1.1 -0.7 -0.6 -0.4 0.0 0.0 0.0 0.1 0.4 0.7 0.7 0.7 0.7 0.7
Laboratory
4 9 19 7 3 1 11 16 17 14 5 6 8 12 18

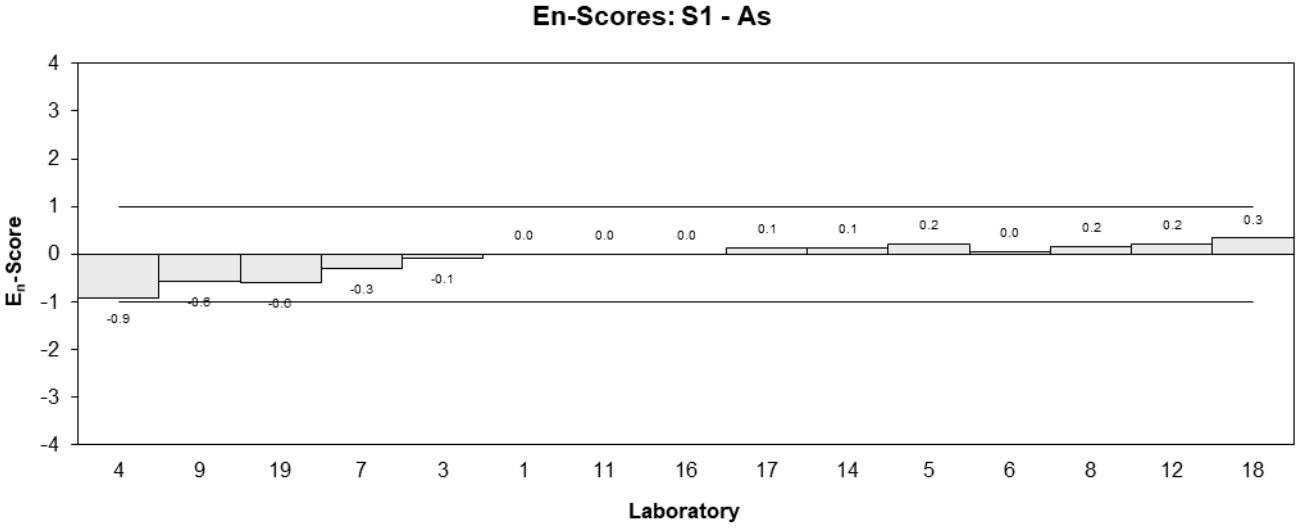

En-Scores: S1 - As
En-Score
-0.9 -0.6 -0.6 -0.3 -0.1 0.0 0.0 0.0 0.1 0.1 0.2 0.0 0.2 0.2 0.3
Laboratory
4 9 19 7 3 1 11 16 17 14 5 6 8 12 18

Figure 2

Table 7

Sample Details

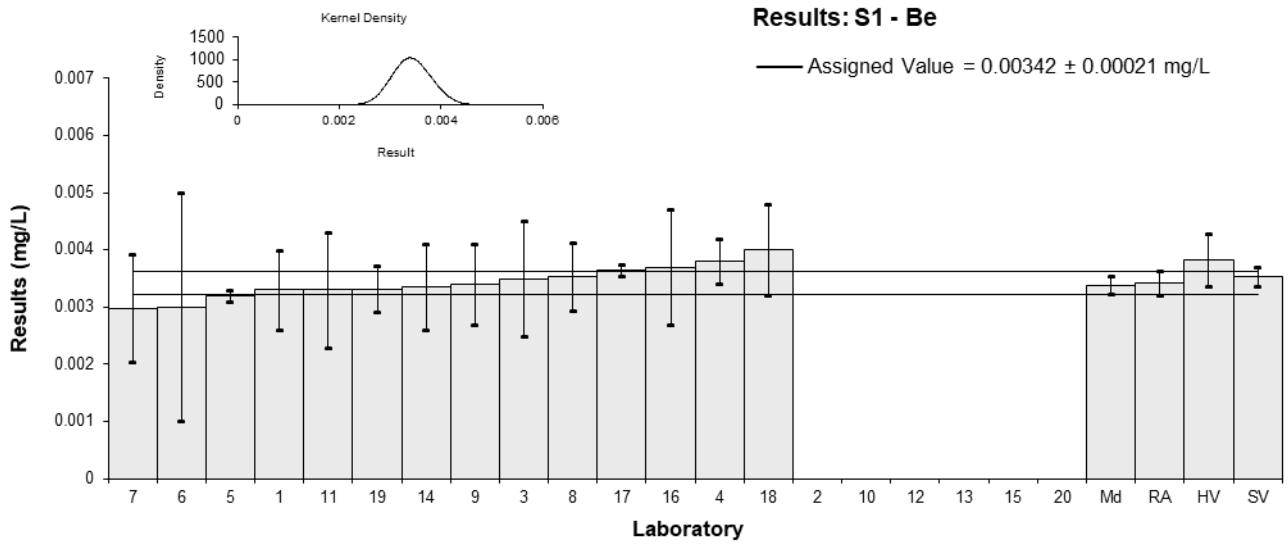
Sample	S1
Analyte	Be
Matrix	Potable Water
Unit	mg/L

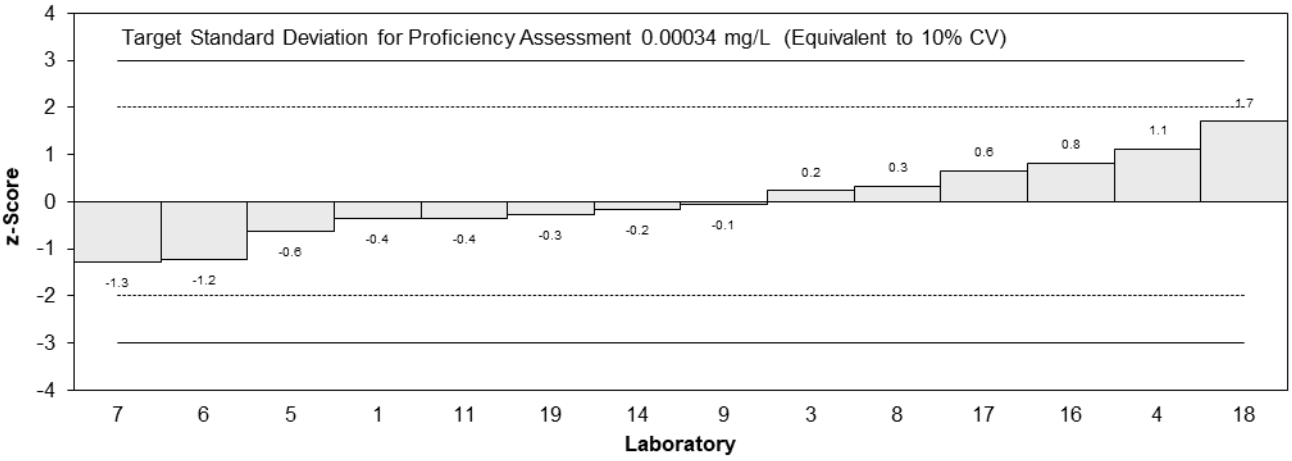
Participant Results

Lab. Code	Result	U	z	E_n
1	0.0033	0.0007	-0.35	-0.16
2	NT	NT		
3	0.0035	0.001	0.23	0.08
4	0.0038	0.0004	1.11	0.84
5	0.0032	0.0001	-0.64	-0.95
6	0.003	0.002	-1.23	-0.21
7	0.00298	0.00094	-1.29	-0.46
8	0.00353	0.0006	0.32	0.17
9	0.0034	0.0007	-0.06	-0.03
10	NT	NT		
11	0.0033	0.001	-0.35	-0.12
12	NT	NT		
13	NT	NT		
14	0.00336	0.00075	-0.18	-0.08
15	NT	NT		
16	0.0037	0.001	0.82	0.27
17	0.00364	0.0001	0.64	0.95
18	0.004	0.0008	1.70	0.70
19	0.00332	0.0004	-0.29	-0.22
20	NT	NT		

Statistics

Assigned Value	0.00342	0.00021
Spike Value	0.00353	0.00017
Homogeneity Value	0.00382	0.00046
Robust Average	0.00342	0.00021
Median	0.00338	0.00016
Mean	0.00343	0.00015
N	14	
Max	0.004	
Min	0.00298	
Robust SD	0.00031	
Robust CV	9%	


Kernel Density
Density
1500
1000
500
0
0
0.002
0.004
0.006
Result
Results: S1 - Be
Assigned Value = 0.00342 ± 0.00021 mg/L
Results (mg/L)
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
7 6 5 1 11 19 14 9 3 8 17 16 4 18 2 10 12 13 15 20 Md RA HV SV
Laboratory


z-Scores: S1 - Be
Target Standard Deviation for Proficiency Assessment 0.00034 mg/L (Equivalent to 10% CV)
z-Score
4
3
2
1
0
-1
-2
-3
-4
-1.3
-1.2
-0.6
-0.4
-0.4
-0.3
-0.2
-0.1
0.2
0.3
0.6
0.8
1.1
1.7
7 6 5 1 11 19 14 9 3 8 17 16 4 18
Laboratory

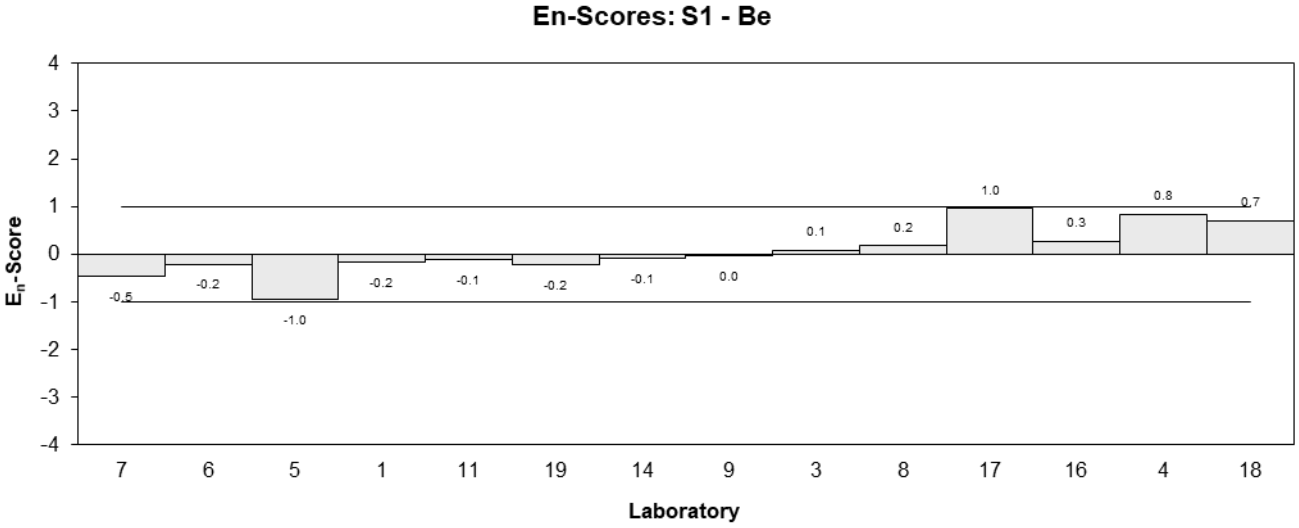

En-Scores: S1 - Be
En-Score
4
3
2
1
0
-1
-2
-3
-4
-0.5
-0.2
-1.0
-0.2
-0.1
-0.2
-0.1
0.0
0.1
0.2
1.0
0.3
0.8
0.7
7 6 5 1 11 19 14 9 3 8 17 16 4 18
Laboratory

Figure 3

Table 8

Sample Details

Sample	S1
Analyte	Cd
Matrix	Potable Water
Unit	mg/L

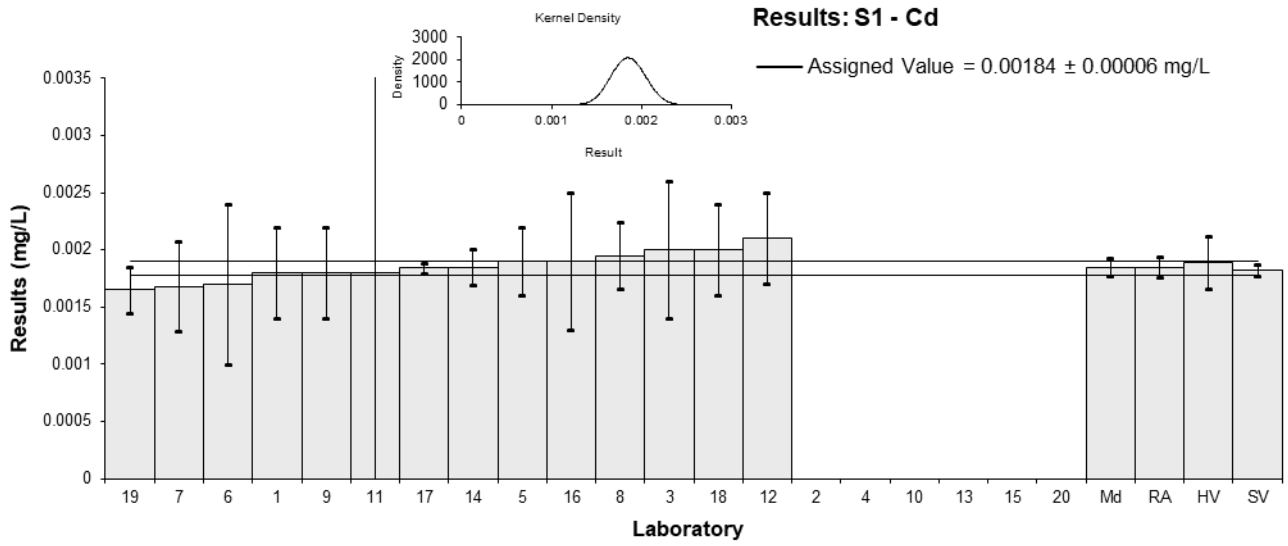
Participant Results

Lab. Code	Result	U	z	E_n
1	0.0018	0.0004	-0.22	-0.10
2	NT	NT		
3	0.0020	0.0006	0.87	0.27
4	<0.002	NR		
5	0.0019	0.0003	0.33	0.20
6	0.0017	0.0007	-0.76	-0.20
7	0.00168	0.00039	-0.87	-0.41
8	0.00195	0.00029	0.60	0.37
9	0.0018	0.0004	-0.22	-0.10
10	NT	NT		
11	0.0018	0.006	-0.22	-0.01
12	0.0021	0.0004	1.41	0.64
13	NT	NT		
14	0.00185	0.00016	0.05	0.06
15	NT	NT		
16	0.0019	0.0006	0.33	0.10
17	0.00184	0.00005	0.00	0.00
18	0.002	0.0004	0.87	0.40
19	0.00165	0.0002	-1.03	-0.91
20	NT	NT		

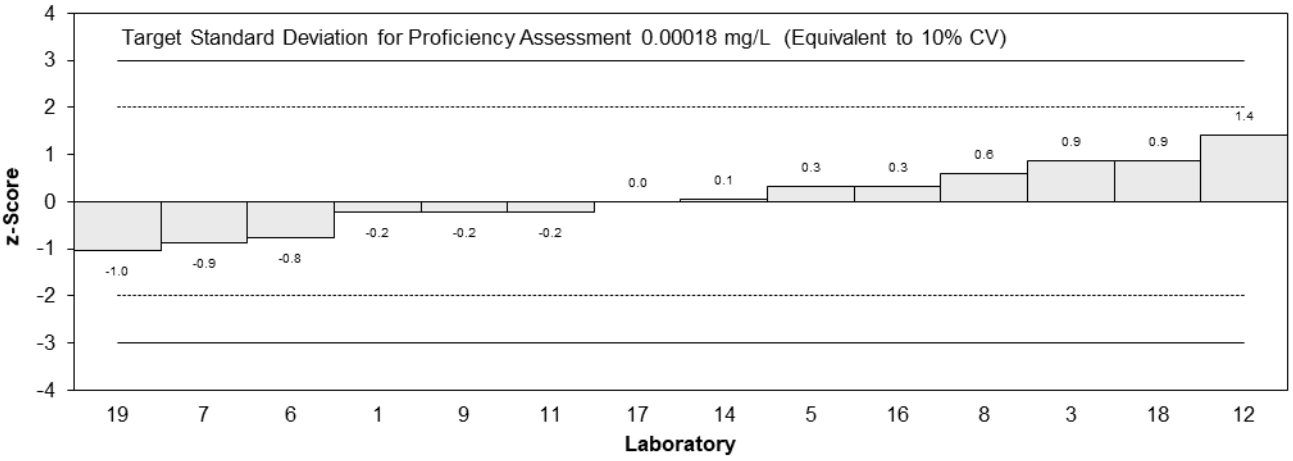
Statistics

Assigned Value*	0.00184	0.00006
Spike Value	0.00182	0.00005
Homogeneity Value	0.00189	0.00023
Robust Average	0.00185	0.00009
Median	0.00185	0.00008
Mean	0.00186	0.00007
N	14	
Max	0.0021	
Min	0.00165	
Robust SD	0.00014	
Robust CV	7.7%	

*The Assigned Value was calculated as the Robust Average of the combined results of Samples S1 and S2



z-Scores: S1 - Cd



En-Scores: S1 - Cd

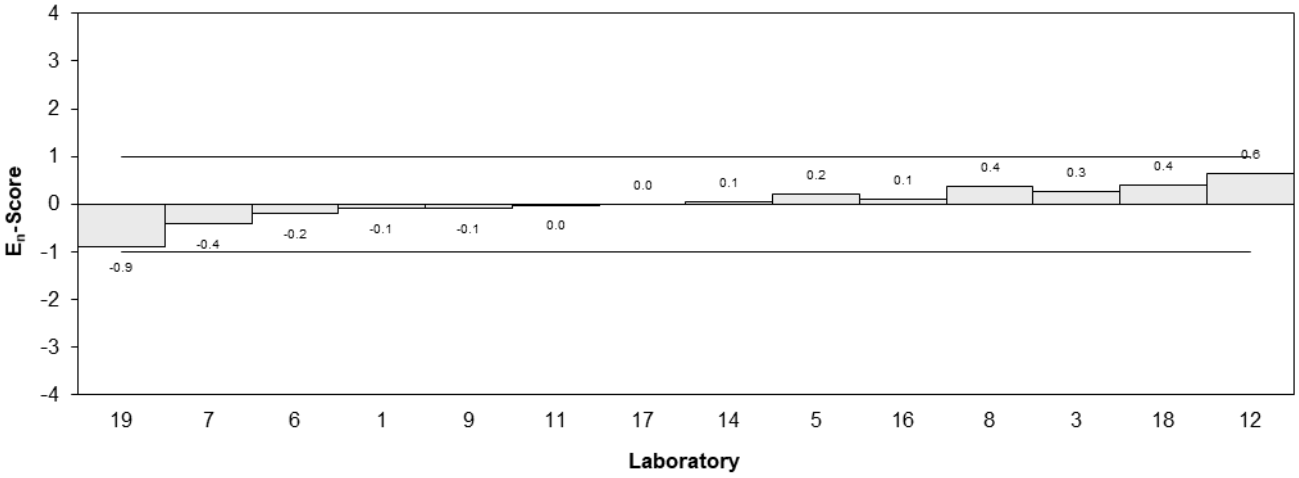


Figure 4

Table 9

Sample Details

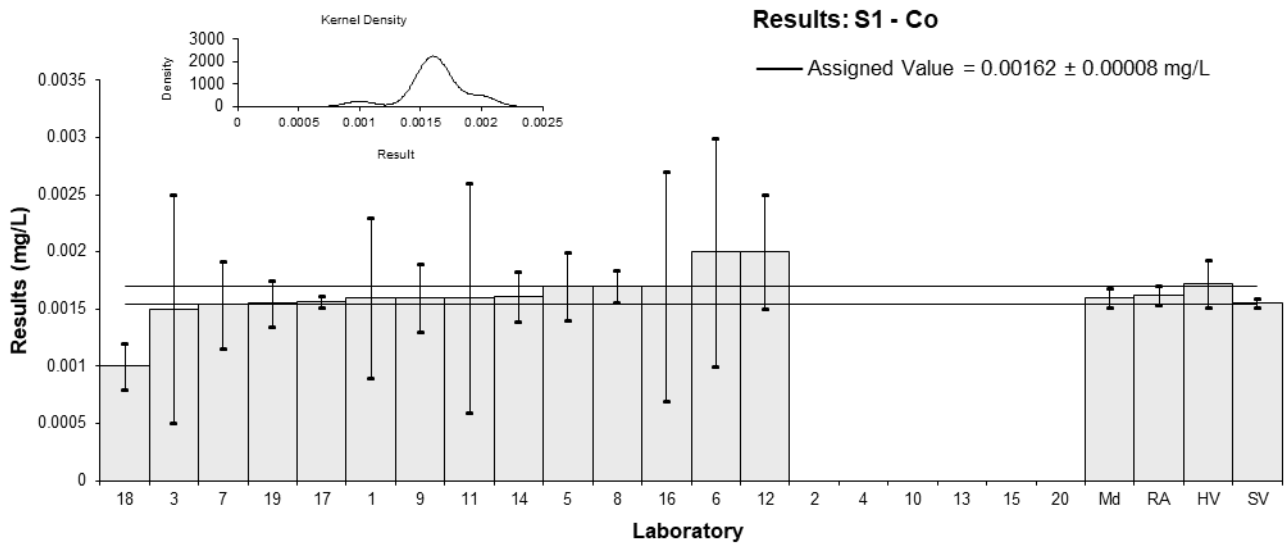
Sample	S1
Analyte	Co
Matrix	Potable Water
Unit	mg/L

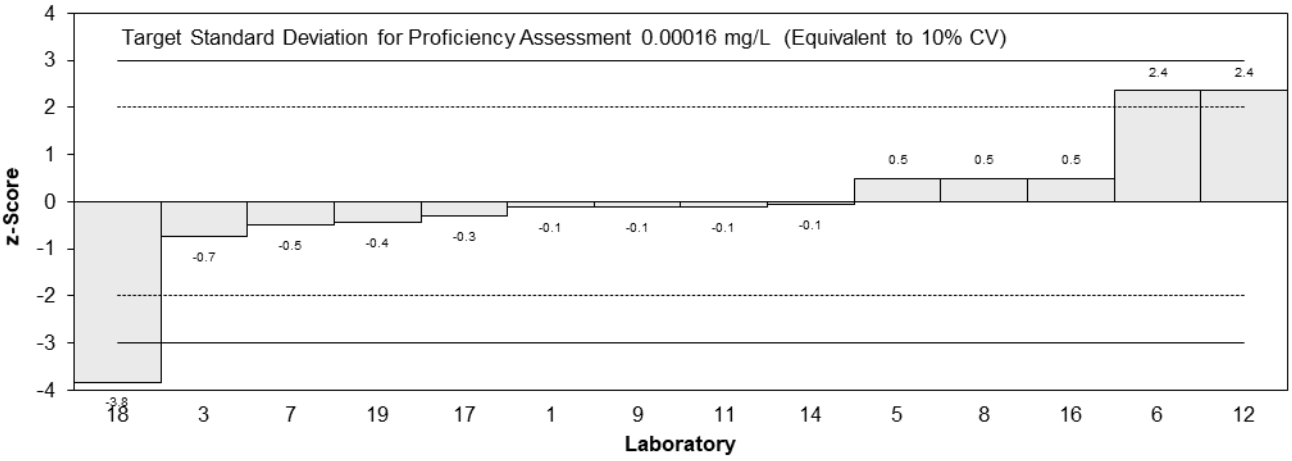
Participant Results

Lab. Code	Result	U	z	E_n
1	0.0016	0.0007	-0.12	-0.03
2	NT	NT		
3	0.0015	0.001	-0.74	-0.12
4	<0.002	NR		
5	0.0017	0.0003	0.49	0.26
6	0.002	0.001	2.35	0.38
7	0.00154	0.00038	-0.49	-0.21
8	0.00170	0.00014	0.49	0.50
9	0.0016	0.0003	-0.12	-0.06
10	NT	NT		
11	0.0016	0.001	-0.12	-0.02
12	0.002	0.0005	2.35	0.75
13	NT	NT		
14	0.00161	0.00022	-0.06	-0.04
15	NT	NT		
16	0.0017	0.001	0.49	0.08
17	0.00157	0.00005	-0.31	-0.53
18	0.001	0.0002	-3.83	-2.88
19	0.00155	0.0002	-0.43	-0.32
20	NT	NT		

Statistics

Assigned Value	0.00162	0.00008
Spike Value	0.00155	0.00004
Homogeneity Value	0.00172	0.00021
Robust Average	0.00162	0.00008
Median	0.00160	0.00008
Mean	0.00162	0.00013
N	14	
Max	0.002	
Min	0.001	
Robust SD	0.00012	
Robust CV	7.2%	


Results: S1 - Co
Assigned Value = 0.00162 ± 0.00008 mg/L
Kernel Density
Density
Result
Results (mg/L)
Laboratory
18 3 7 19 17 1 9 11 14 5 8 16 6 12 2 4 10 13 15 20 Md RA HV SV


z-Scores: S1 - Co
Target Standard Deviation for Proficiency Assessment 0.00016 mg/L (Equivalent to 10% CV)
z-Score
Laboratory
18 3 7 19 17 1 9 11 14 5 8 16 6 12

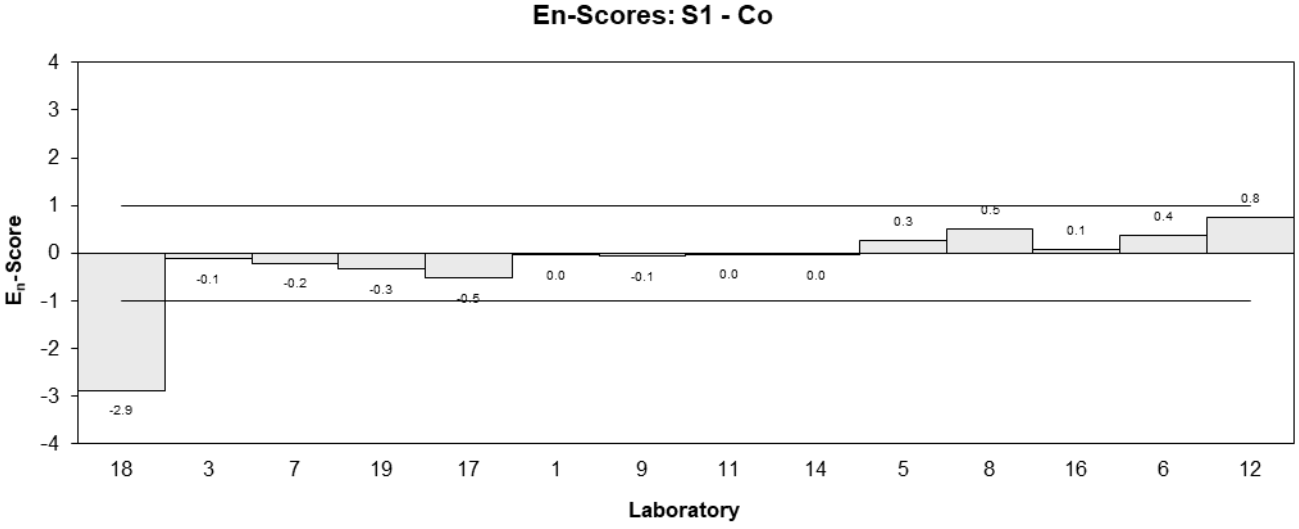

En-Scores: S1 - Co
En-Score
Laboratory
18 3 7 19 17 1 9 11 14 5 8 16 6 12

Figure 5

Table 10

Sample Details

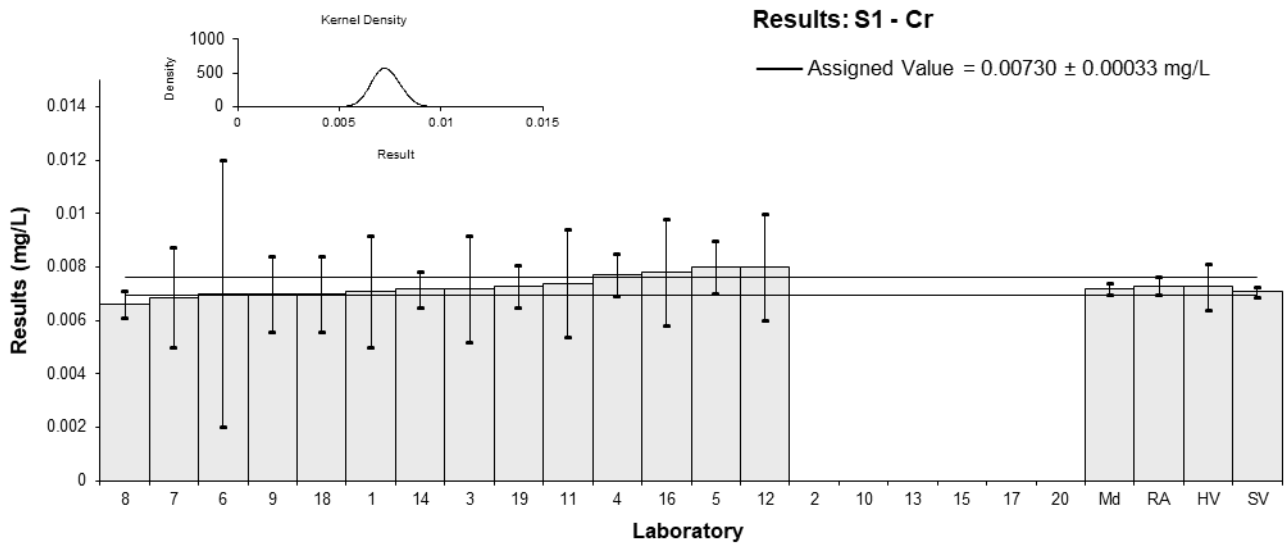
Sample	S1
Analyte	Cr
Matrix	Potable Water
Unit	mg/L

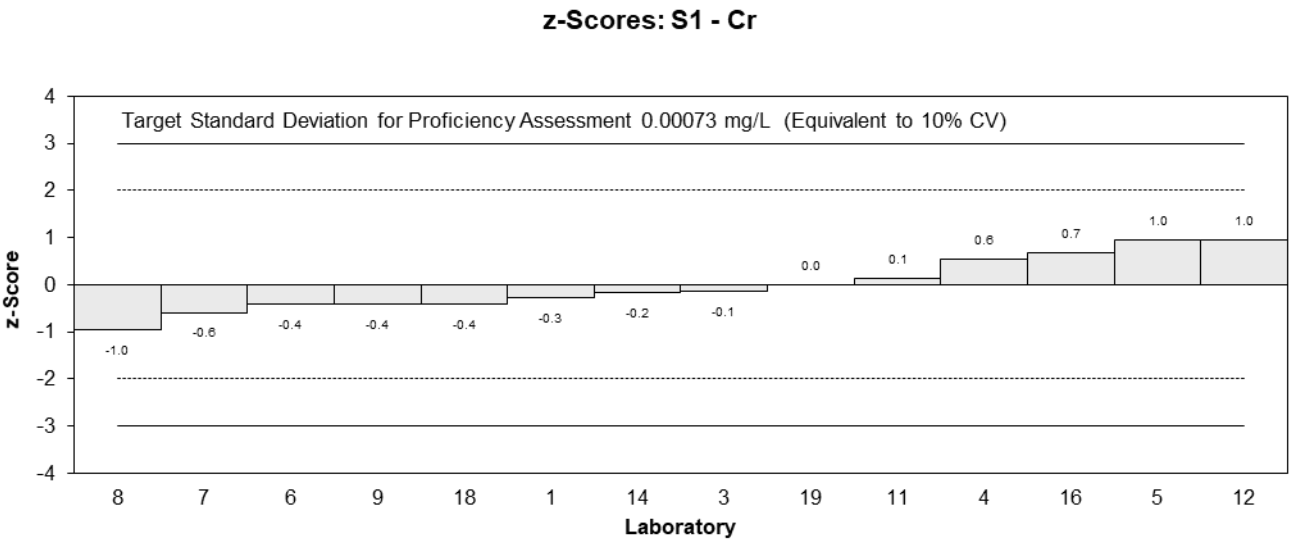
Participant Results

Lab. Code	Result	U	z	E_n
1	0.0071	0.0021	-0.27	-0.09
2	NT	NT		
3	0.0072	0.002	-0.14	-0.05
4	0.0077	0.0008	0.55	0.46
5	0.008	0.001	0.96	0.66
6	0.007	0.005	-0.41	-0.06
7	0.00687	0.00187	-0.59	-0.23
8	0.0066	0.0005	-0.96	-1.17
9	0.007	0.0014	-0.41	-0.21
10	NT	NT		
11	0.0074	0.002	0.14	0.05
12	0.008	0.002	0.96	0.35
13	NT	NT		
14	0.00717	0.00068	-0.18	-0.17
15	NT	NT		
16	0.0078	0.002	0.68	0.25
17	NR	NR		
18	0.007	0.0014	-0.41	-0.21
19	0.0073	0.0008	0.00	0.00
20	NT	NT		

Statistics

Assigned Value	0.00730	0.00033
Spike Value	0.00708	0.00020
Homogeneity Value	0.00727	0.00087
Robust Average	0.00730	0.00033
Median	0.00719	0.00020
Mean	0.00730	0.00023
N	14	
Max	0.008	
Min	0.0066	
Robust SD	0.00049	
Robust CV	6.7%	


Results: S1 - Cr
Assigned Value = 0.00730 ± 0.00033 mg/L
Kernel Density
Density
Result
Results (mg/L)
Laboratory
8 7 6 9 18 1 14 3 19 11 4 16 5 12 2 10 13 15 17 20 Md RA HV SV


z-Scores: S1 - Cr
Target Standard Deviation for Proficiency Assessment 0.00073 mg/L (Equivalent to 10% CV)
z-Score
Laboratory
8 7 6 9 18 1 14 3 19 11 4 16 5 12
-1.0 -0.6 -0.4 -0.4 -0.4 -0.3 -0.2 -0.1 0.0 0.1 0.6 0.7 1.0 1.0

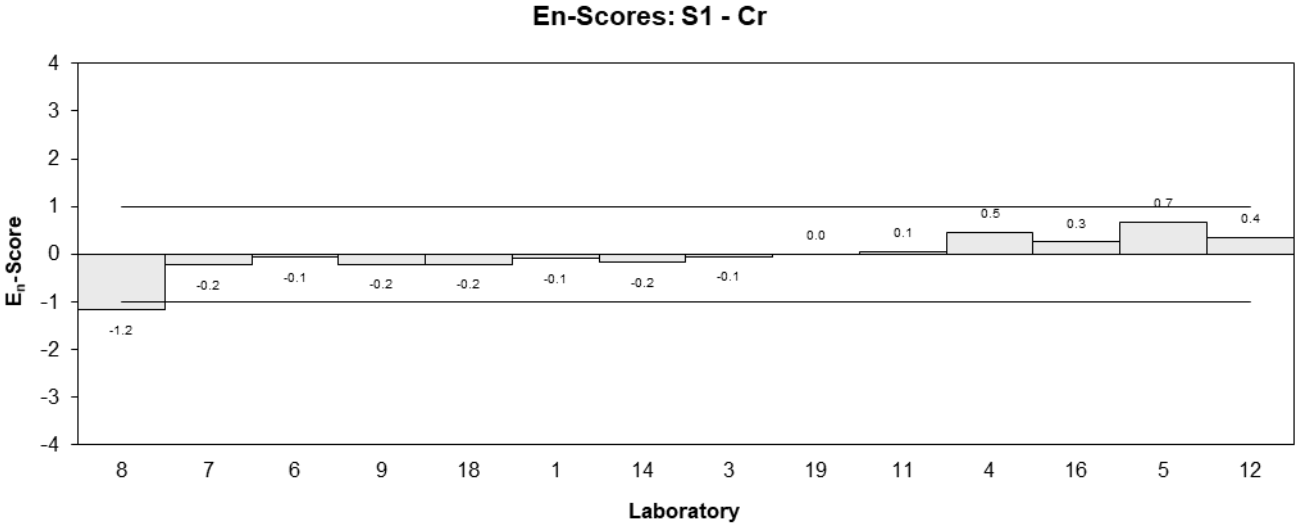

En-Scores: S1 - Cr
En-Score
Laboratory
8 7 6 9 18 1 14 3 19 11 4 16 5 12
-1.2 -0.2 -0.1 -0.2 -0.2 -0.1 -0.2 -0.1 0.0 0.1 0.5 0.3 0.7 0.4

Figure 6

Table 11

Sample Details

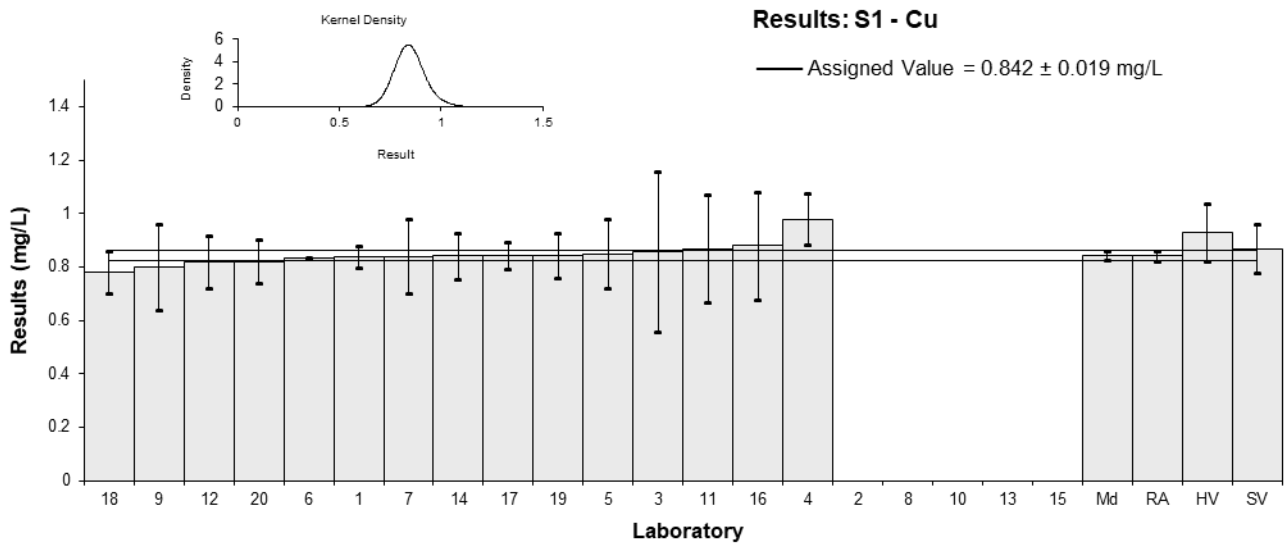
Sample	S1
Analyte	Cu
Matrix	Potable Water
Unit	mg/L

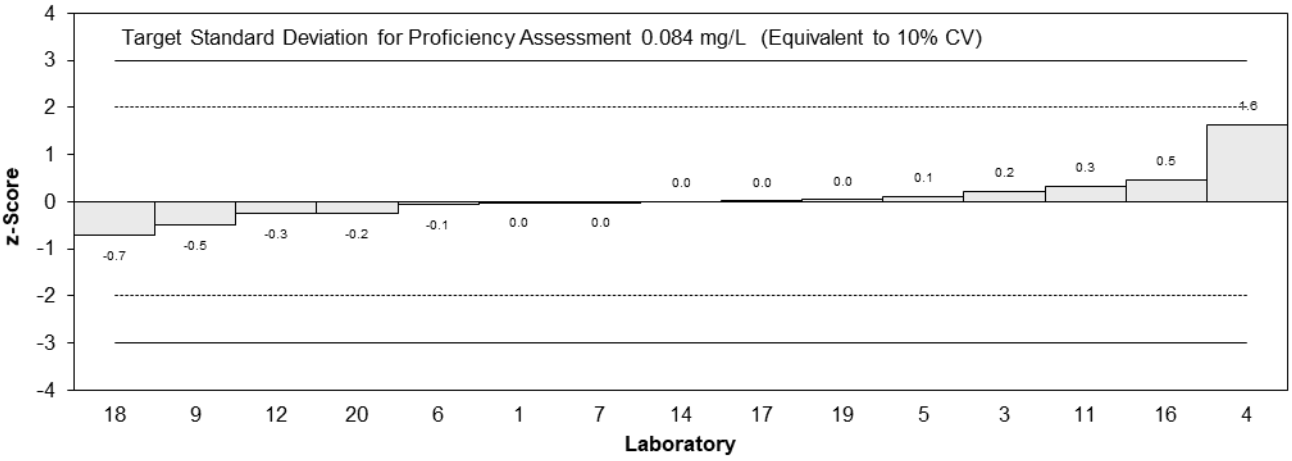
Participant Results

Lab. Code	Result	U	z	E_n
1	0.84	0.04	-0.02	-0.05
2	NT	NT		
3	0.86	0.3	0.21	0.06
4	0.9804	0.0980	1.64	1.39
5	0.85	0.13	0.10	0.06
6	0.836	0.002	-0.07	-0.31
7	0.84	0.14	-0.02	-0.01
8	NT	NT		
9	0.80	0.16	-0.50	-0.26
10	NT	NT		
11	0.87	0.2	0.33	0.14
12	0.82	0.10	-0.26	-0.22
13	NT	NT		
14	0.842	0.085	0.00	0.00
15	NT	NT		
16	0.88	0.2	0.45	0.19
17	0.843	0.05	0.01	0.02
18	0.782	0.08	-0.71	-0.73
19	0.845	0.085	0.04	0.03
20	0.822	0.082	-0.24	-0.24

Statistics

Assigned Value	0.842	0.019
Spike Value	0.870	0.090
Homogeneity Value	0.93	0.11
Robust Average	0.842	0.019
Median	0.842	0.017
Mean	0.847	0.023
N	15	
Max	0.9804	
Min	0.782	
Robust SD	0.029	
Robust CV	3.4%	


Kernel Density
Density
Result
Results: S1 - Cu
Assigned Value = 0.842 ± 0.019 mg/L
Results (mg/L)
Laboratory
18 9 12 20 6 1 7 14 17 19 5 3 11 16 4 2 8 10 13 15 Md RA HV SV


z-Scores: S1 - Cu
Target Standard Deviation for Proficiency Assessment 0.084 mg/L (Equivalent to 10% CV)
z-Score
Laboratory
18 9 12 20 6 1 7 14 17 19 5 3 11 16 4
-0.7 -0.5 -0.3 -0.2 -0.1 0.0 0.0 0.0 0.0 0.0 0.1 0.2 0.3 0.5 1.6

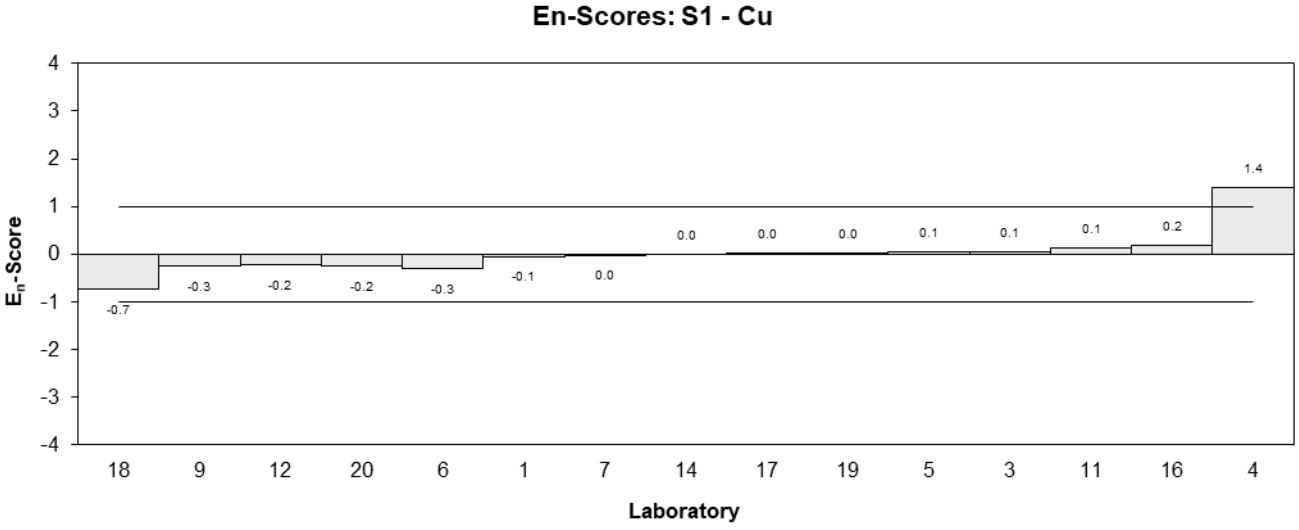

En-Scores: S1 - Cu
En-Score
Laboratory
18 9 12 20 6 1 7 14 17 19 5 3 11 16 4
-0.7 -0.3 -0.2 -0.2 -0.3 -0.1 0.0 0.0 0.0 0.0 0.1 0.1 0.1 0.2 1.4

Figure 7

Table 12

Sample Details

Sample	S1
Analyte	Fe
Matrix	Potable Water
Unit	mg/L

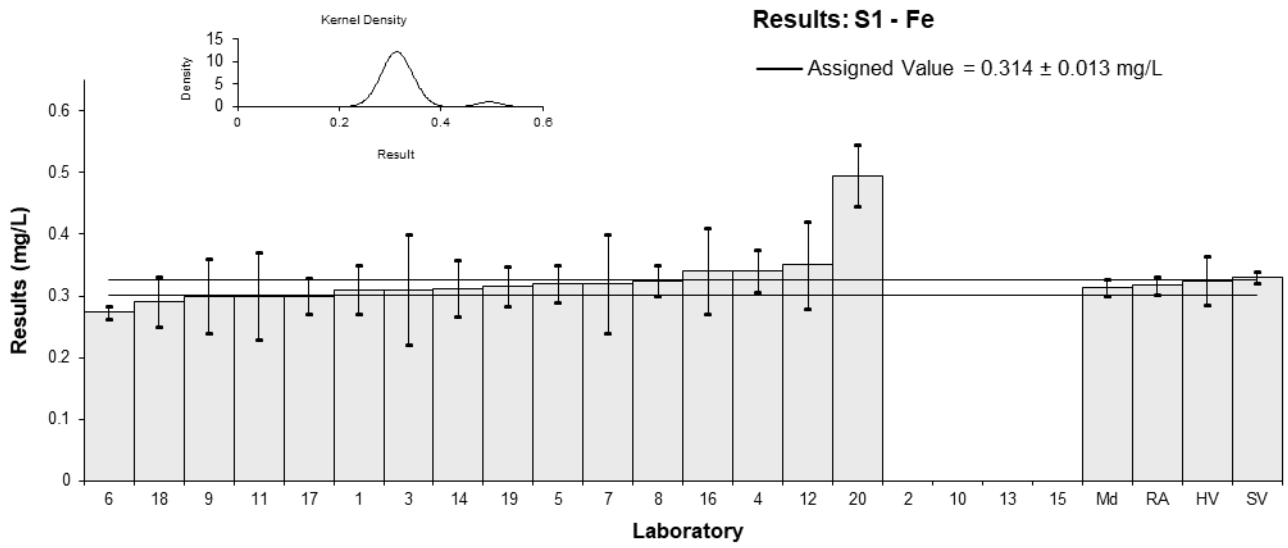
Participant Results

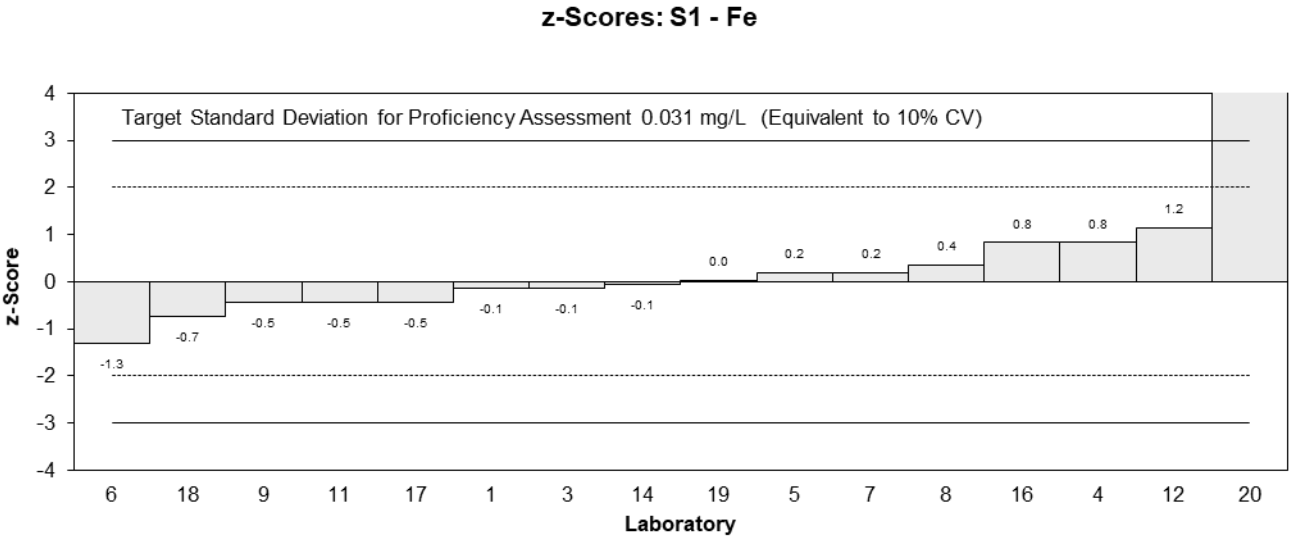
Lab. Code	Result	U	z	E_n
1	0.31	0.04	-0.13	-0.10
2	NT	NT		
3	0.31	0.09	-0.13	-0.04
4	0.3401	0.0340	0.83	0.72
5	0.32	0.03	0.19	0.18
6	0.273	0.01	-1.31	-2.50
7	0.32	0.08	0.19	0.07
8	0.325	0.024	0.35	0.40
9	0.30	0.060	-0.45	-0.23
10	NT	NT		
11	0.30	0.07	-0.45	-0.20
12	0.35	0.07	1.15	0.51
13	NT	NT		
14	0.312	0.046	-0.06	-0.04
15	NT	NT		
16	0.34	0.07	0.83	0.37
17	0.300	0.03	-0.45	-0.43
18	0.291	0.04	-0.73	-0.55
19	0.315	0.032	0.03	0.03
20*	0.495	0.050	5.76	3.50

* Outlier

Statistics

Assigned Value	0.314	0.013
Spike Value	0.330	0.010
Homogeneity Value	0.325	0.039
Robust Average	0.317	0.015
Median	0.314	0.013
Mean	0.325	0.025
N	16	
Max	0.495	
Min	0.273	
Robust SD	0.023	
Robust CV	7.4%	


Results: S1 - Fe
Assigned Value = 0.314 ± 0.013 mg/L
Kernel Density
Density
Result
Results (mg/L)
Laboratory
6 18 9 11 17 1 3 14 19 5 7 8 16 4 12 20 2 10 13 15 Md RA HV SV


z-Scores: S1 - Fe
Target Standard Deviation for Proficiency Assessment 0.031 mg/L (Equivalent to 10% CV)
z-Score
Laboratory
6 18 9 11 17 1 3 14 19 5 7 8 16 4 12 20
-1.3 -0.7 -0.5 -0.5 -0.5 -0.1 -0.1 -0.1 0.0 0.2 0.2 0.4 0.8 0.8 1.2

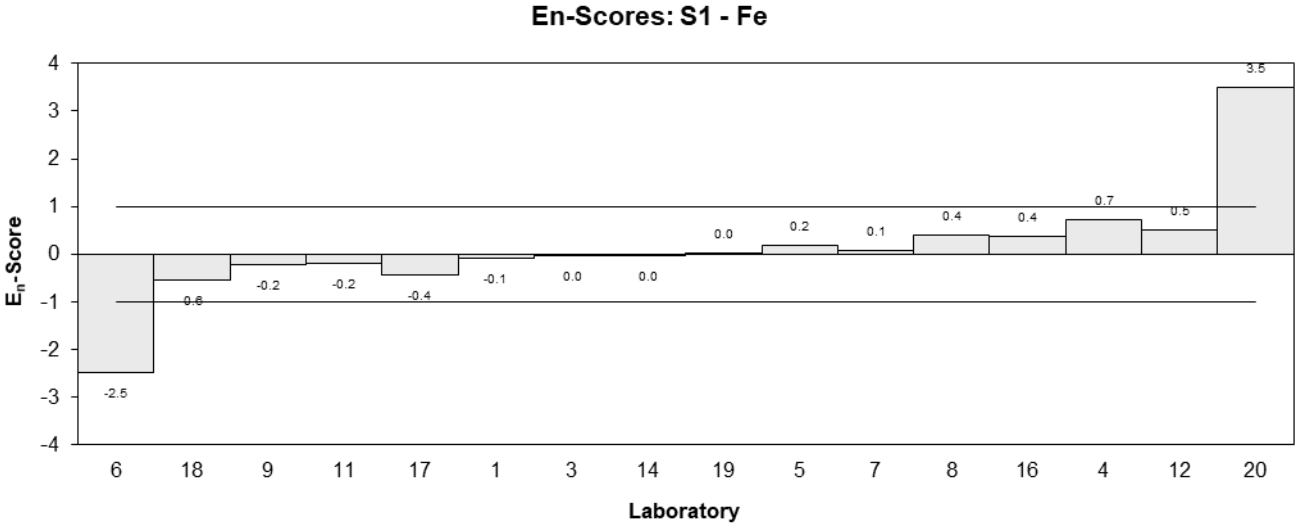

En-Scores: S1 - Fe
En-Score
Laboratory
6 18 9 11 17 1 3 14 19 5 7 8 16 4 12 20
-2.5 -0.6 -0.2 -0.2 -0.4 -0.1 0.0 0.0 0.0 0.2 0.1 0.4 0.4 0.7 0.5 3.5

Figure 8

Table 13

Sample Details

Sample	S1
Analyte	Hg
Matrix	Potable Water
Unit	mg/L

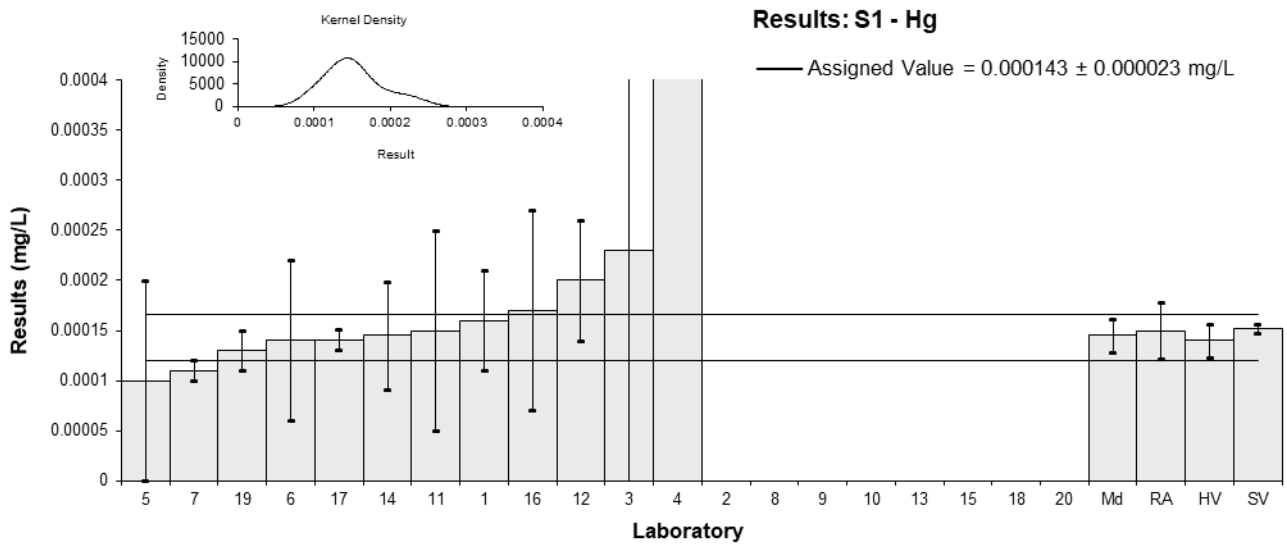
Participant Results

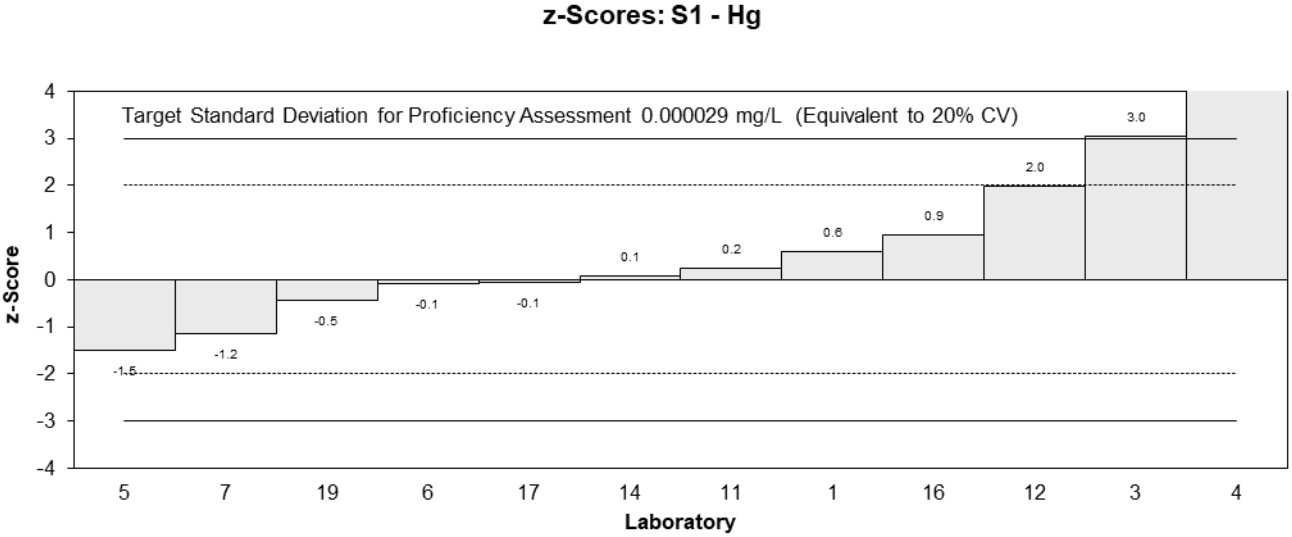
Lab. Code	Result	U	z	E_n
1	0.00016	0.00005	0.59	0.31
2	NT	NT		
3*	0.00023	0.001	3.04	0.09
4**	0.132	0.0132	4,610.38	9.99
5	0.0001	0.0001	-1.50	-0.42
6	0.00014	0.00008	-0.10	-0.04
7	0.00011	0.00001	-1.15	-1.32
8	NT	NT		
9	NR	NR		
10	NT	NT		
11	0.00015	0.0001	0.24	0.07
12	0.0002	0.00006	1.99	0.89
13	NT	NT		
14	0.000145	0.000054	0.07	0.03
15	NT	NT		
16	0.00017	0.0001	0.94	0.26
17	0.000141	0.00001	-0.07	-0.08
18	<0.0005	NR		
19	0.00013	0.00002	-0.45	-0.43
20	NT	NT		

* Outlier, ** Gross Error

Statistics

Assigned Value	0.000143	0.000023
Spike Value	0.000152	0.000004
Homogeneity Value	0.000140	0.000017
Robust Average	0.000150	0.000028
Median	0.000145	0.000017
Mean	0.000152	0.000023
N	11	
Max	0.00023	
Min	0.0001	
Robust SD	0.000037	
Robust CV	25%	


Results: S1 - Hg
Assigned Value = 0.000143 ± 0.000023 mg/L
Kernel Density
Density
Result
Results (mg/L)
Laboratory
5 7 19 6 17 14 11 1 16 12 3 4 2 8 9 10 13 15 18 20 Md RA HV SV


z-Scores: S1 - Hg
Target Standard Deviation for Proficiency Assessment 0.000029 mg/L (Equivalent to 20% CV)
z-Score
Laboratory
5 7 19 6 17 14 11 1 16 12 3 4
-1.5 -1.2 -0.5 -0.1 -0.1 0.1 0.2 0.6 0.9 2.0 3.0

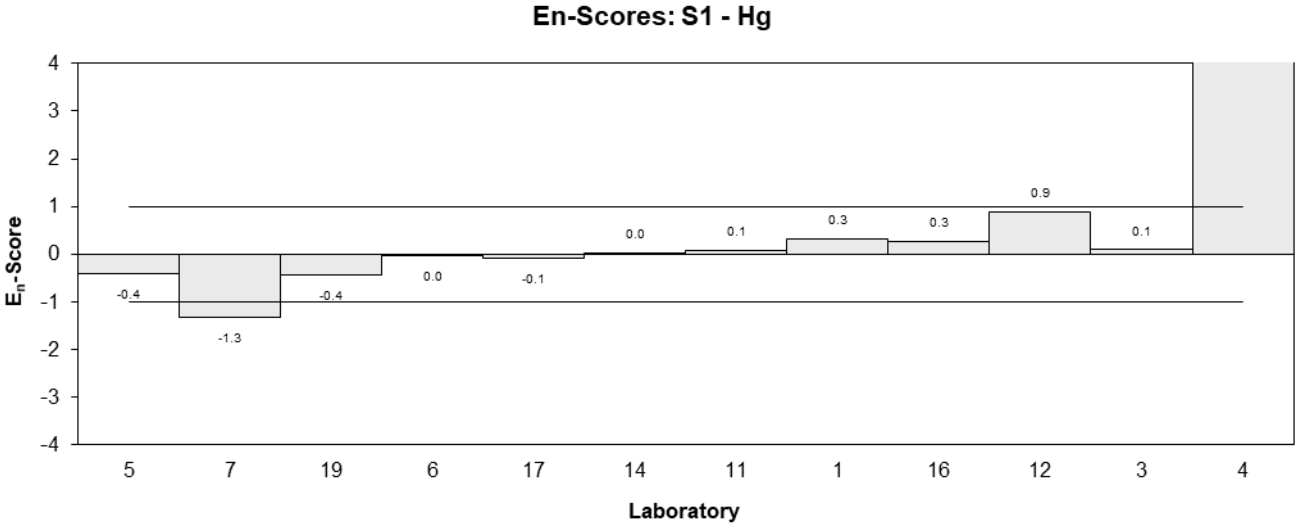

En-Scores: S1 - Hg
En-Score
Laboratory
5 7 19 6 17 14 11 1 16 12 3 4
-0.4 -1.3 -0.4 0.0 -0.1 0.0 0.1 0.3 0.3 0.9 0.1

Figure 9

Table 14

Sample Details

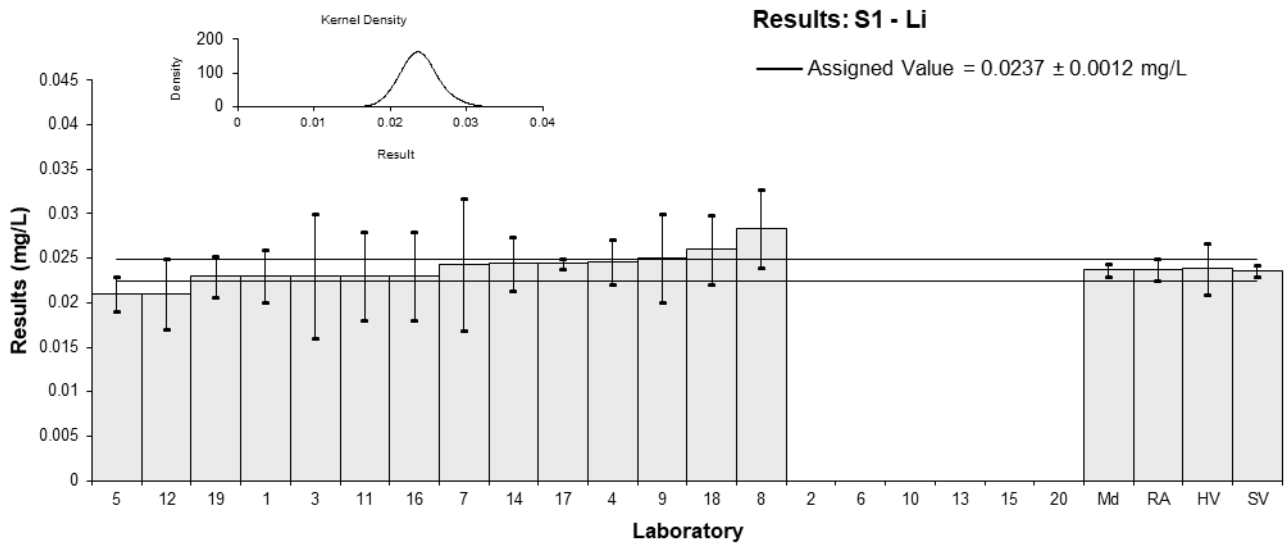
Sample	S1
Analyte	Li
Matrix	Potable Water
Unit	mg/L

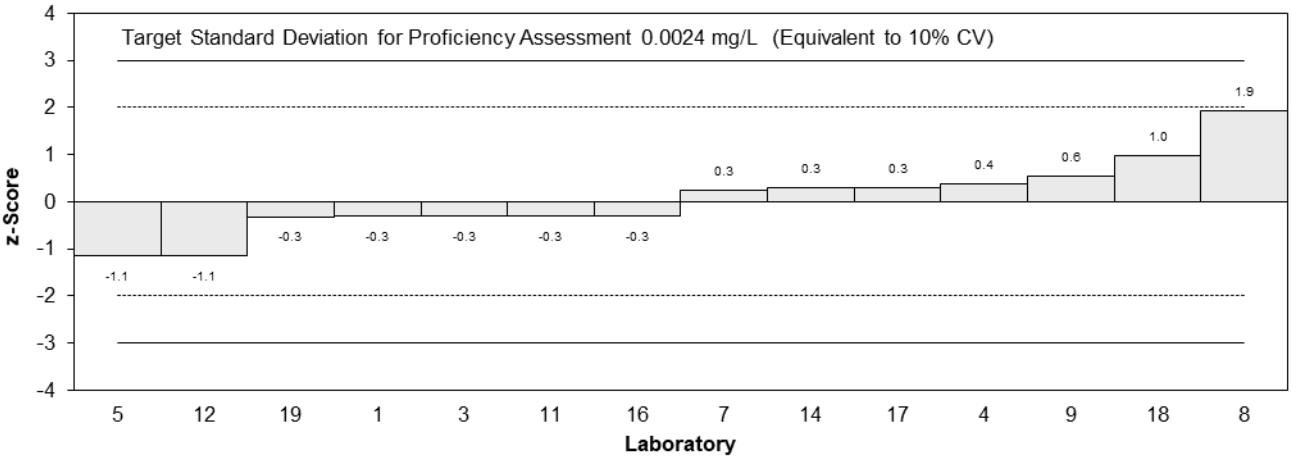
Participant Results

Lab. Code	Result	U	z	E_n
1	0.023	0.003	-0.30	-0.22
2	NT	NT		
3	0.023	0.007	-0.30	-0.10
4	0.0246	0.0025	0.38	0.32
5	0.021	0.002	-1.14	-1.16
6	NT	NT		
7	0.0243	0.0074	0.25	0.08
8	0.0283	0.0044	1.94	1.01
9	0.025	0.0050	0.55	0.25
10	NT	NT		
11	0.023	0.005	-0.30	-0.14
12	0.021	0.004	-1.14	-0.65
13	NT	NT		
14	0.0244	0.0030	0.30	0.22
15	NT	NT		
16	0.023	0.005	-0.30	-0.14
17	0.0244	0.00061	0.30	0.52
18	0.026	0.0039	0.97	0.56
19	0.02295	0.0023	-0.32	-0.29
20	NT	NT		

Statistics

Assigned Value	0.0237	0.0012
Spike Value	0.0236	0.0007
Homogeneity Value	0.0238	0.0029
Robust Average	0.0237	0.0012
Median	0.0237	0.0007
Mean	0.0239	0.0010
N	14	
Max	0.0283	
Min	0.021	
Robust SD	0.0018	
Robust CV	7.7%	


Kernel Density
Density
Result
Results: S1 - Li
Assigned Value = 0.0237 ± 0.0012 mg/L
Results (mg/L)
Laboratory
5 12 19 1 3 11 16 7 14 17 4 9 18 8 2 6 10 13 15 20 Md RA HV SV


z-Scores: S1 - Li
Target Standard Deviation for Proficiency Assessment 0.0024 mg/L (Equivalent to 10% CV)
z-Score
Laboratory
5 12 19 1 3 11 16 7 14 17 4 9 18 8

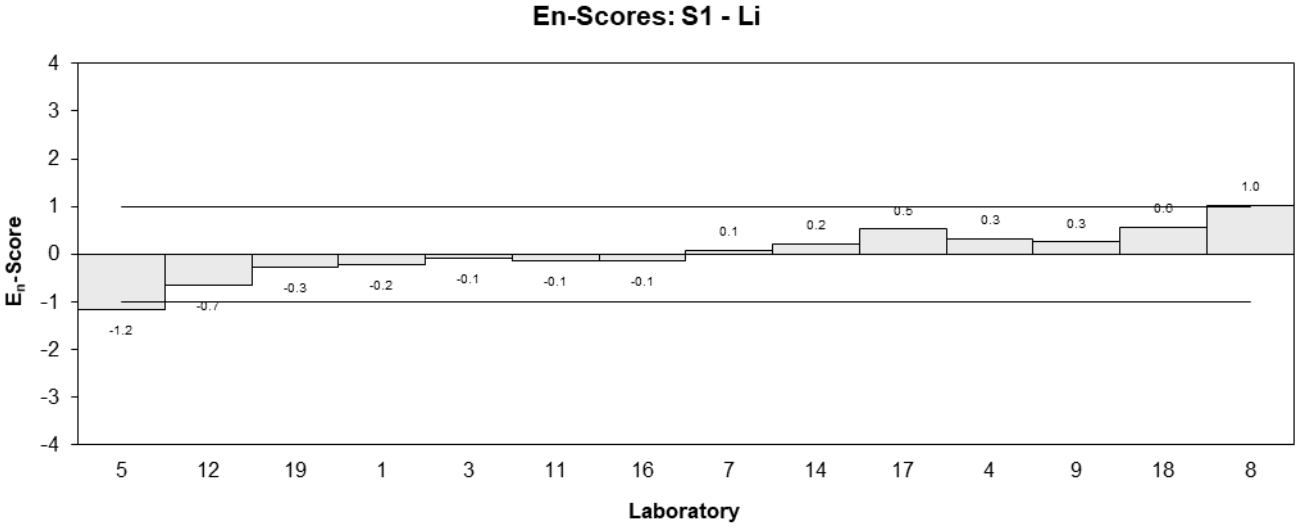

En-Scores: S1 - Li
En-Score
Laboratory
5 12 19 1 3 11 16 7 14 17 4 9 18 8

Figure 10

Table 15

Sample Details

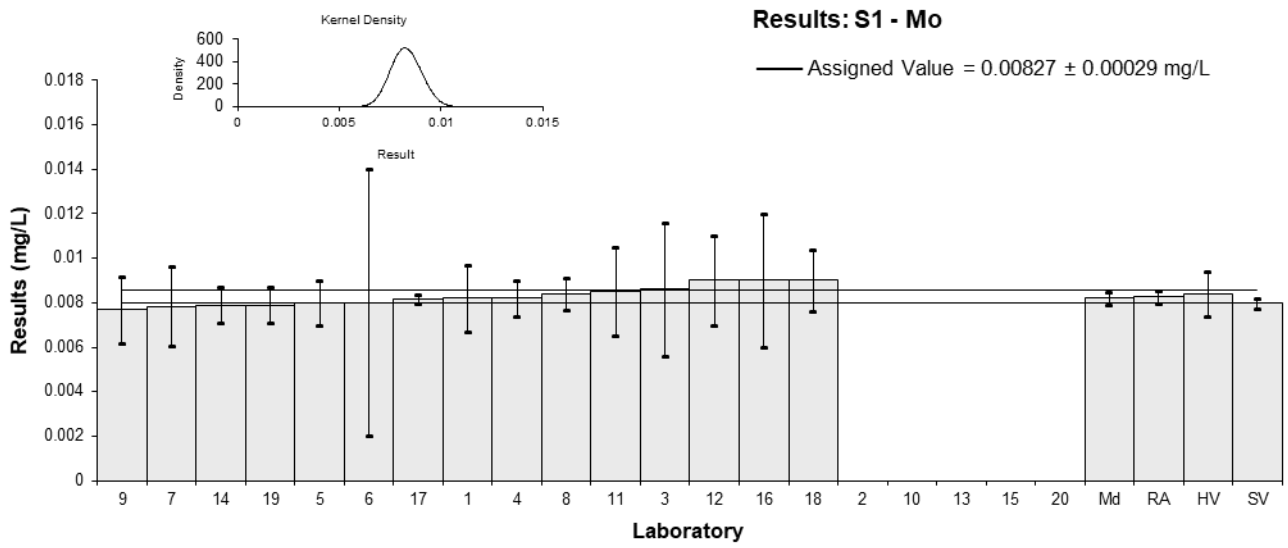
Sample	S1
Analyte	Mo
Matrix	Potable Water
Unit	mg/L

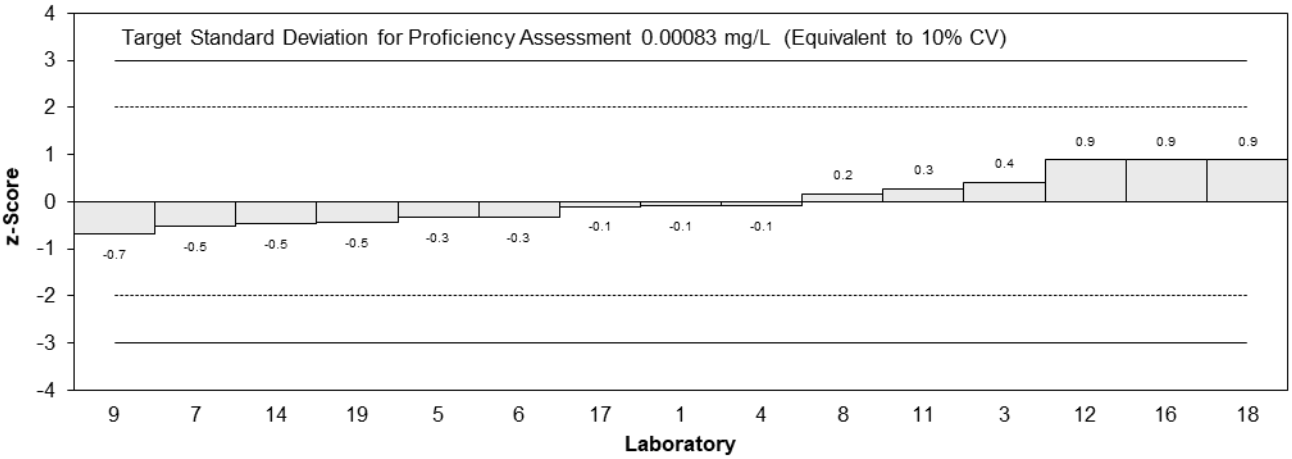
Participant Results

Lab. Code	Result	U	z	E_n
1	0.0082	0.0015	-0.08	-0.05
2	NT	NT		
3	0.0086	0.003	0.40	0.11
4	0.0082	0.0008	-0.08	-0.08
5	0.008	0.001	-0.33	-0.26
6	0.008	0.006	-0.33	-0.04
7	0.00784	0.00180	-0.52	-0.24
8	0.0084	0.0007	0.16	0.17
9	0.0077	0.0015	-0.69	-0.37
10	NT	NT		
11	0.0085	0.002	0.28	0.11
12	0.009	0.002	0.88	0.36
13	NT	NT		
14	0.00789	0.00081	-0.46	-0.44
15	NT	NT		
16	0.009	0.003	0.88	0.24
17	0.00819	0.0002	-0.10	-0.23
18	0.009	0.0014	0.88	0.51
19	0.0079	0.0008	-0.45	-0.43
20	NT	NT		

Statistics

Assigned Value	0.00827	0.00029
Spike Value	0.00799	0.00023
Homogeneity Value	0.0084	0.0010
Robust Average	0.00827	0.00029
Median	0.00820	0.00029
Mean	0.00829	0.00023
N	15	
Max	0.009	
Min	0.0077	
Robust SD	0.00045	
Robust CV	5.4%	


Results: S1 - Mo
Assigned Value = 0.00827 ± 0.00029 mg/L
Kernel Density
Density
Result
Results (mg/L)
Laboratory
9 7 14 19 5 6 17 1 4 8 11 3 12 16 18 2 10 13 15 20 Md RA HV SV


z-Scores: S1 - Mo
Target Standard Deviation for Proficiency Assessment 0.00083 mg/L (Equivalent to 10% CV)
z-Score
Laboratory
9 7 14 19 5 6 17 1 4 8 11 3 12 16 18
-0.7 -0.5 -0.5 -0.5 -0.3 -0.3 -0.1 -0.1 -0.1 0.2 0.3 0.4 0.9 0.9 0.9

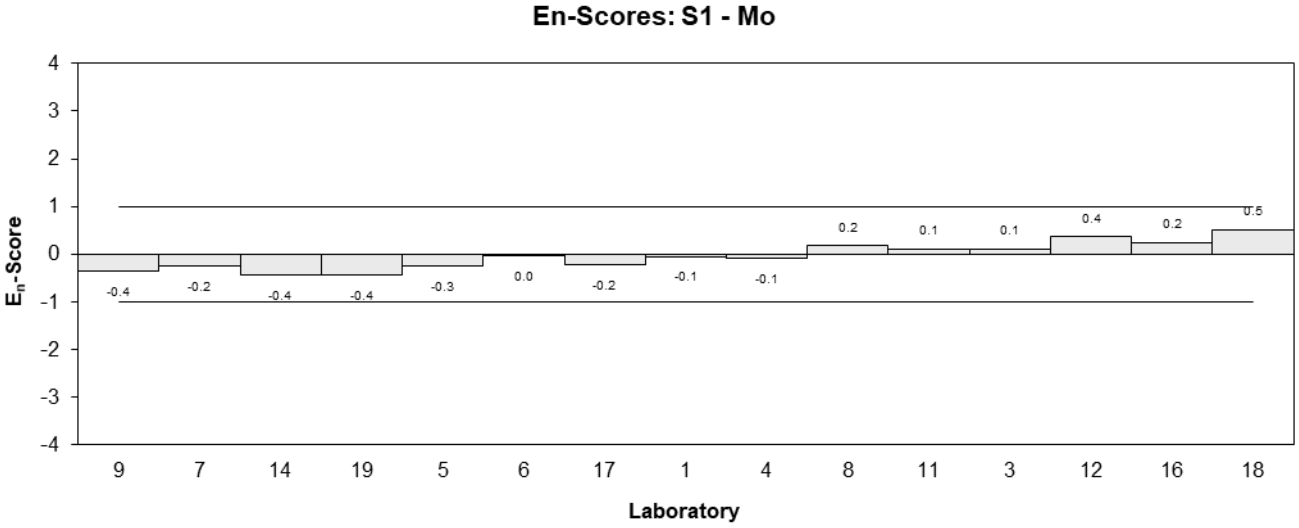

En-Scores: S1 - Mo
En-Score
Laboratory
9 7 14 19 5 6 17 1 4 8 11 3 12 16 18
-0.4 -0.2 -0.4 -0.4 -0.3 0.0 -0.2 -0.1 -0.1 0.2 0.1 0.1 0.4 0.2 0.5

Figure 11

Table 16

Sample Details

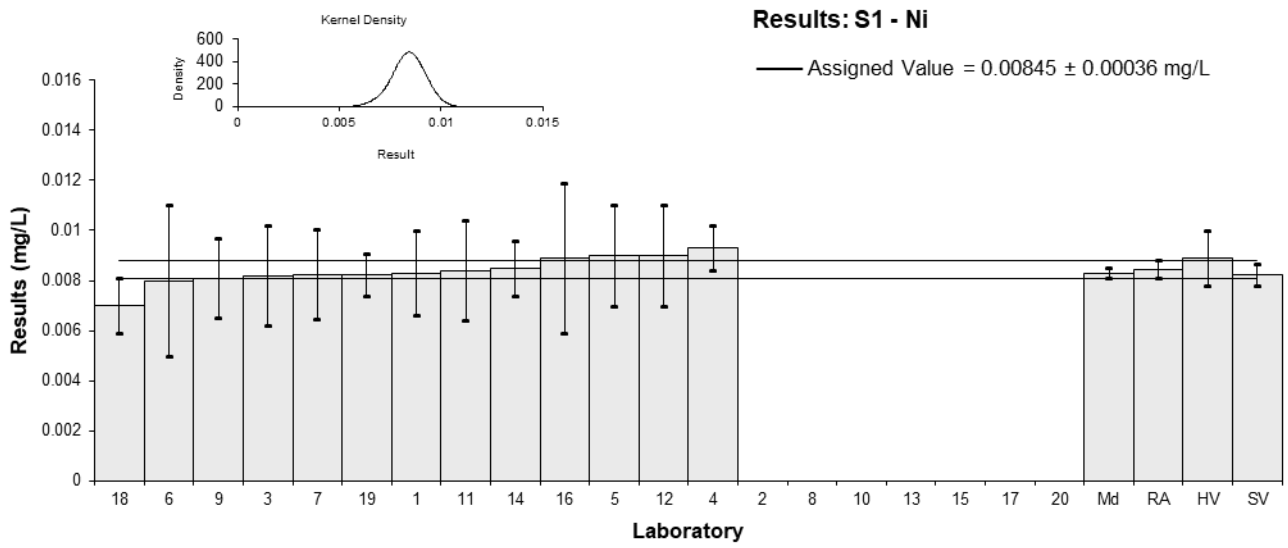
Sample	S1
Analyte	Ni
Matrix	Potable Water
Unit	mg/L

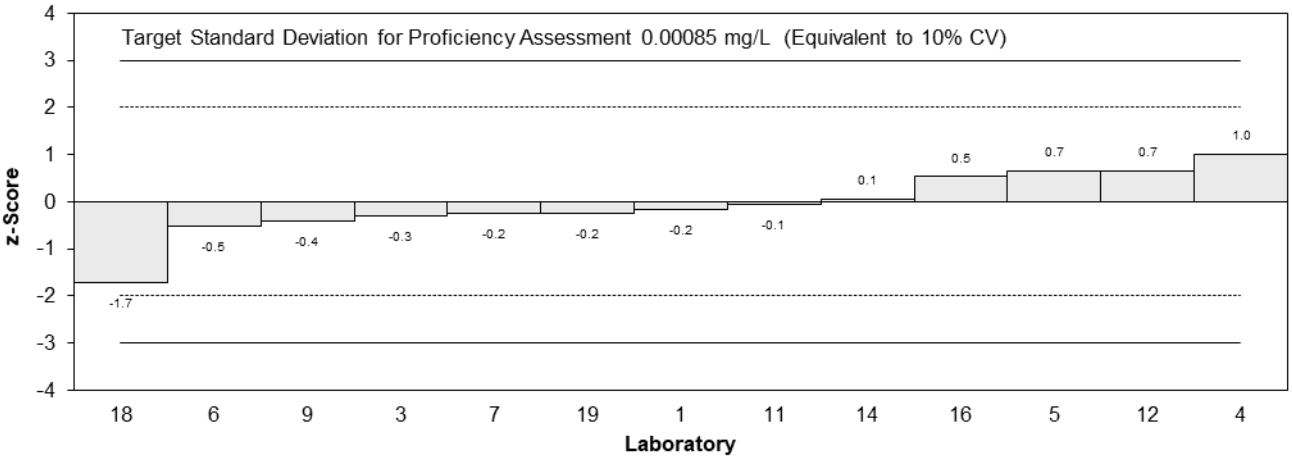
Participant Results

Lab. Code	Result	U	z	E_n
1	0.0083	0.0017	-0.18	-0.09
2	NT	NT		
3	0.0082	0.002	-0.30	-0.12
4	0.0093	0.0009	1.01	0.88
5	0.009	0.002	0.65	0.27
6	0.008	0.003	-0.53	-0.15
7	0.00825	0.00180	-0.24	-0.11
8	NT	NT		
9	0.0081	0.0016	-0.41	-0.21
10	NT	NT		
11	0.0084	0.002	-0.06	-0.02
12	0.009	0.002	0.65	0.27
13	NT	NT		
14	0.0085	0.0011	0.06	0.04
15	NT	NT		
16	0.0089	0.003	0.53	0.15
17	NR	NR		
18	0.007	0.0011	-1.72	-1.25
19	0.00825	0.00085	-0.24	-0.22
20	NT	NT		

Statistics

Assigned Value	0.00845	0.00036
Spike Value	0.00823	0.00044
Homogeneity Value	0.0089	0.0011
Robust Average	0.00845	0.00036
Median	0.00830	0.00021
Mean	0.00840	0.00032
N	13	
Max	0.0093	
Min	0.007	
Robust SD	0.00052	
Robust CV	6.1%	


Results: S1 - Ni
Assigned Value = 0.00845 ± 0.00036 mg/L
Kernel Density
Density
Result
Results (mg/L)
Laboratory
18 6 9 3 7 19 1 11 14 16 5 12 4 2 8 10 13 15 17 20 Md RA HV SV


z-Scores: S1 - Ni
Target Standard Deviation for Proficiency Assessment 0.00085 mg/L (Equivalent to 10% CV)
z-Score
Laboratory
18 6 9 3 7 19 1 11 14 16 5 12 4
-1.7 -0.5 -0.4 -0.3 -0.2 -0.2 -0.2 -0.1 0.1 0.5 0.7 0.7 1.0

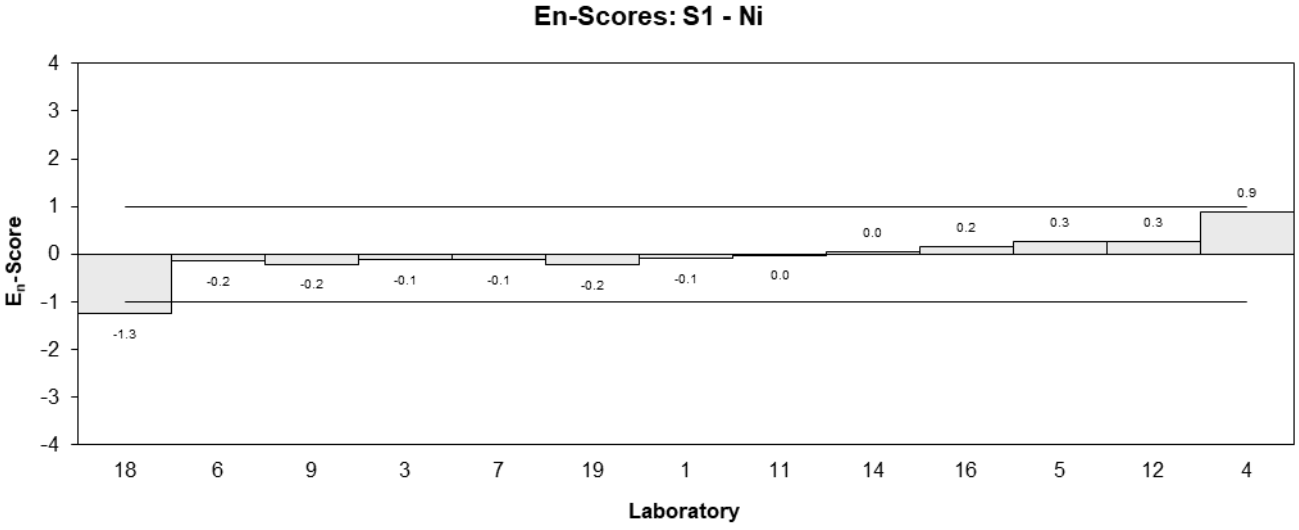

En-Scores: S1 - Ni
En-Score
Laboratory
18 6 9 3 7 19 1 11 14 16 5 12 4
-1.3 -0.2 -0.2 -0.1 -0.1 -0.2 -0.1 0.0 0.0 0.2 0.3 0.3 0.9

Figure 12

Table 17

Sample Details

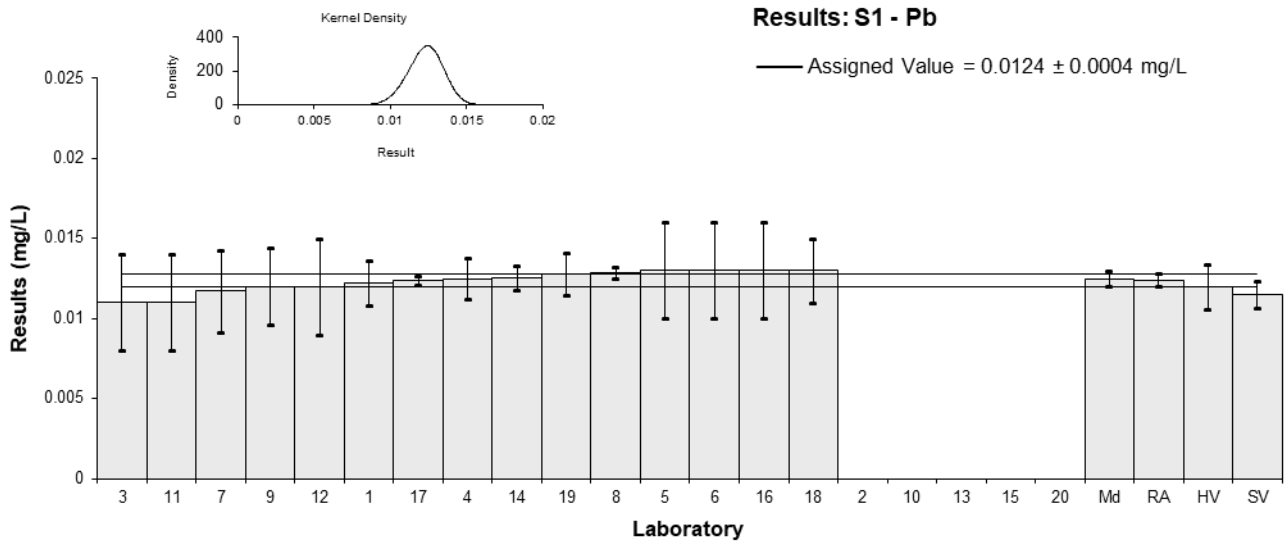
Sample	S1
Analyte	Pb
Matrix	Potable Water
Unit	mg/L

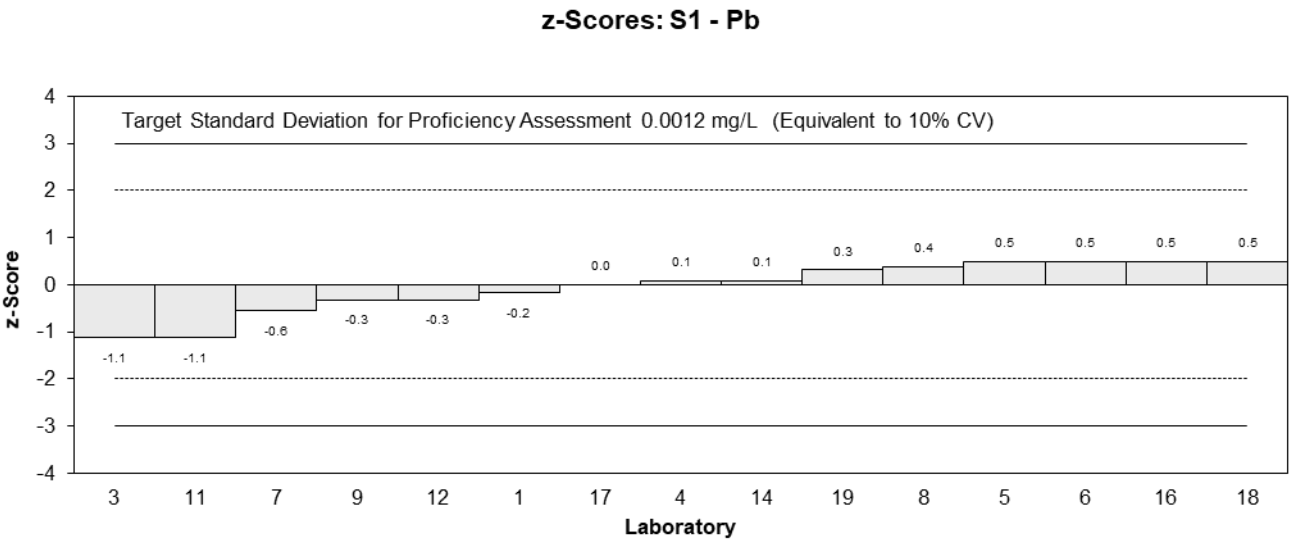
Participant Results

Lab. Code	Result	U	z	E_n
1	0.0122	0.0014	-0.16	-0.14
2	NT	NT		
3	0.011	0.003	-1.13	-0.46
4	0.0125	0.0013	0.08	0.07
5	0.013	0.003	0.48	0.20
6	0.013	0.003	0.48	0.20
7	0.0117	0.0026	-0.56	-0.27
8	0.01288	0.00038	0.39	0.87
9	0.012	0.0024	-0.32	-0.16
10	NT	NT		
11	0.011	0.003	-1.13	-0.46
12	0.012	0.003	-0.32	-0.13
13	NT	NT		
14	0.01251	0.00076	0.09	0.13
15	NT	NT		
16	0.013	0.003	0.48	0.20
17	0.0124	0.0003	0.00	0.00
18	0.013	0.0020	0.48	0.29
19	0.01278	0.0013	0.31	0.28
20	NT	NT		

Statistics

Assigned Value	0.0124	0.0004
Spike Value	0.0115	0.0008
Homogeneity Value	0.0120	0.0014
Robust Average	0.0124	0.0004
Median	0.0125	0.0005
Mean	0.0123	0.0004
N	15	
Max	0.013	
Min	0.011	
Robust SD	0.00066	
Robust CV	5.3%	


Kernel Density
Density
Result
Results: S1 - Pb
Assigned Value = 0.0124 ± 0.0004 mg/L
Results (mg/L)
Laboratory
3 11 7 9 12 1 17 4 14 19 8 5 6 16 18 2 10 13 15 20 Md RA HV SV


z-Scores: S1 - Pb
Target Standard Deviation for Proficiency Assessment 0.0012 mg/L (Equivalent to 10% CV)
z-Score
Laboratory
3 11 7 9 12 1 17 4 14 19 8 5 6 16 18
-1.1 -1.1 -0.6 -0.3 -0.3 -0.2 0.0 0.1 0.1 0.3 0.4 0.5 0.5 0.5 0.5

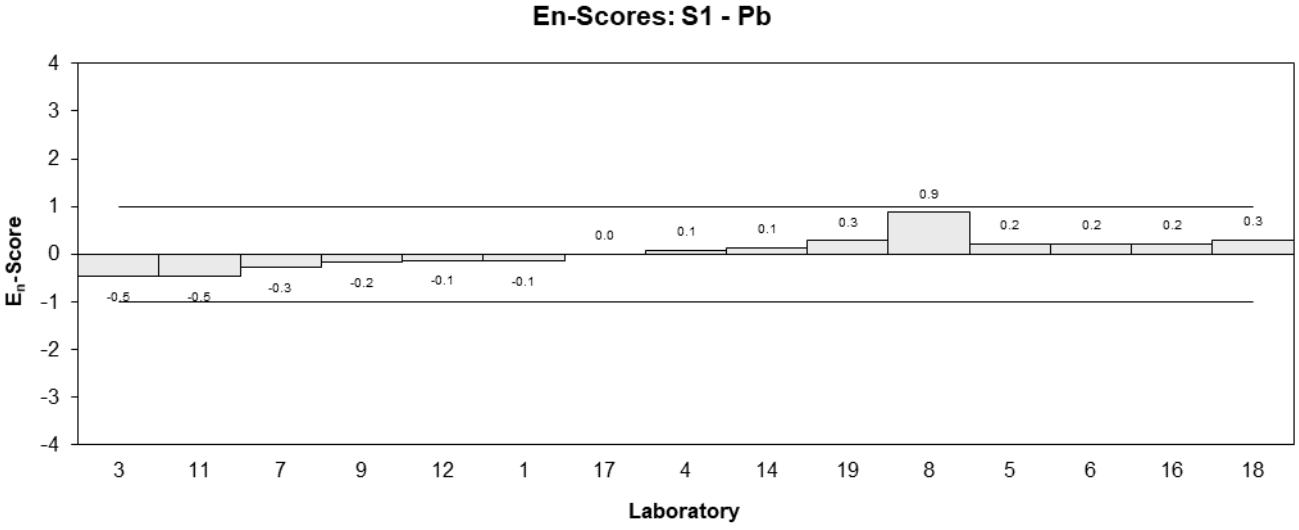

En-Scores: S1 - Pb
En-Score
Laboratory
3 11 7 9 12 1 17 4 14 19 8 5 6 16 18
-0.5 -0.5 -0.3 -0.2 -0.1 -0.1 0.0 0.1 0.1 0.3 0.9 0.2 0.2 0.2 0.3

Figure 13

Table 18

Sample Details

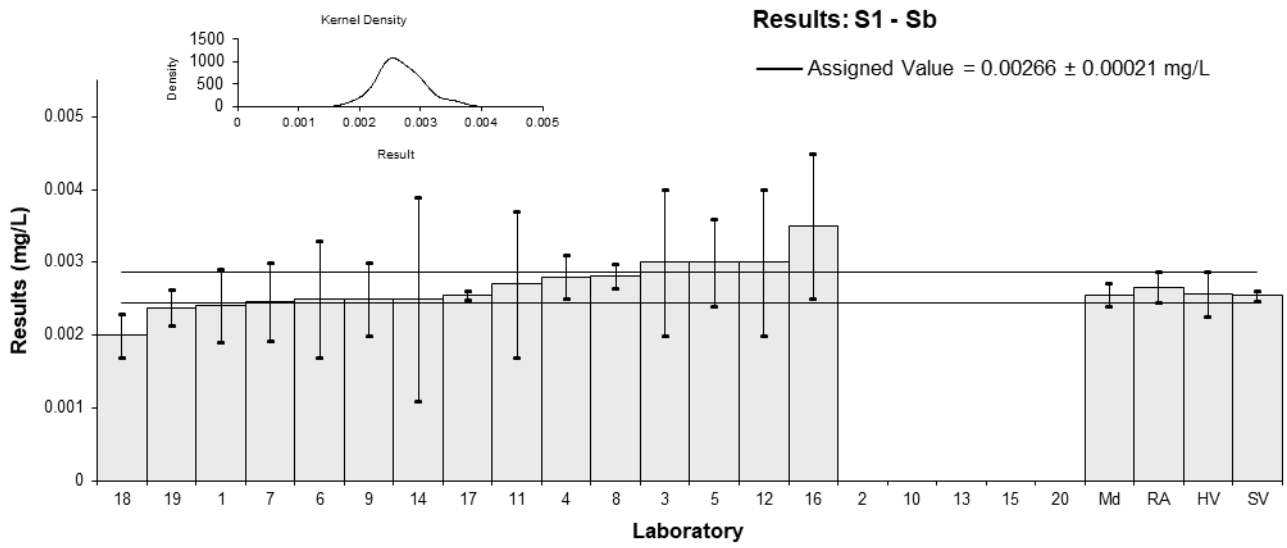
Sample	S1
Analyte	Sb
Matrix	Potable Water
Unit	mg/L

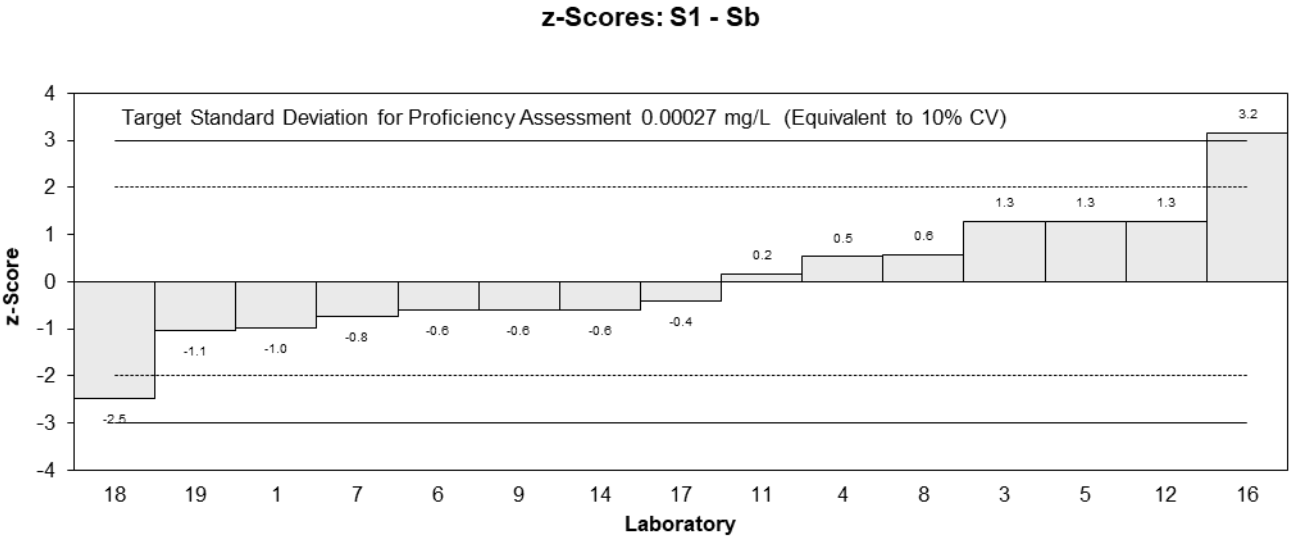
Participant Results

Lab. Code	Result	U	z	E_n
1	0.0024	0.0005	-0.98	-0.48
2	NT	NT		
3	0.0030	0.001	1.28	0.33
4	0.0028	0.0003	0.53	0.38
5	0.003	0.0006	1.28	0.53
6	0.0025	0.0008	-0.60	-0.19
7	0.00246	0.00054	-0.75	-0.35
8	0.00281	0.00017	0.56	0.56
9	0.0025	0.0005	-0.60	-0.30
10	NT	NT		
11	0.0027	0.001	0.15	0.04
12	0.003	0.001	1.28	0.33
13	NT	NT		
14	0.0025	0.0014	-0.60	-0.11
15	NT	NT		
16	0.0035	0.001	3.16	0.82
17	0.00255	0.00006	-0.41	-0.50
18	0.002	0.0003	-2.48	-1.80
19	0.00238	0.00024	-1.05	-0.88
20	NT	NT		

Statistics

Assigned Value	0.00266	0.00021
Spike Value	0.00254	0.00007
Homogeneity Value	0.00257	0.00031
Robust Average	0.00266	0.00021
Median	0.00255	0.00016
Mean	0.00267	0.00019
N	15	
Max	0.0035	
Min	0.002	
Robust SD	0.00032	
Robust CV	12%	


Kernel Density
Density
1500
1000
500
0
0
0.001
0.002
0.003
0.004
0.005
Result
Results: S1 - Sb
Assigned Value = 0.00266 ± 0.00021 mg/L
Results (mg/L)
0.005
0.004
0.003
0.002
0.001
0
18 19 1 7 6 9 14 17 11 4 8 3 5 12 16 2 10 13 15 20 Md RA HV SV
Laboratory


z-Scores: S1 - Sb
Target Standard Deviation for Proficiency Assessment 0.00027 mg/L (Equivalent to 10% CV)
z-Score
4
3
2
1
0
-1
-2
-3
-4
-2.5
-1.1
-1.0
-0.8
-0.6
-0.6
-0.6
-0.4
0.2
0.5
0.6
1.3
1.3
1.3
3.2
18 19 1 7 6 9 14 17 11 4 8 3 5 12 16
Laboratory

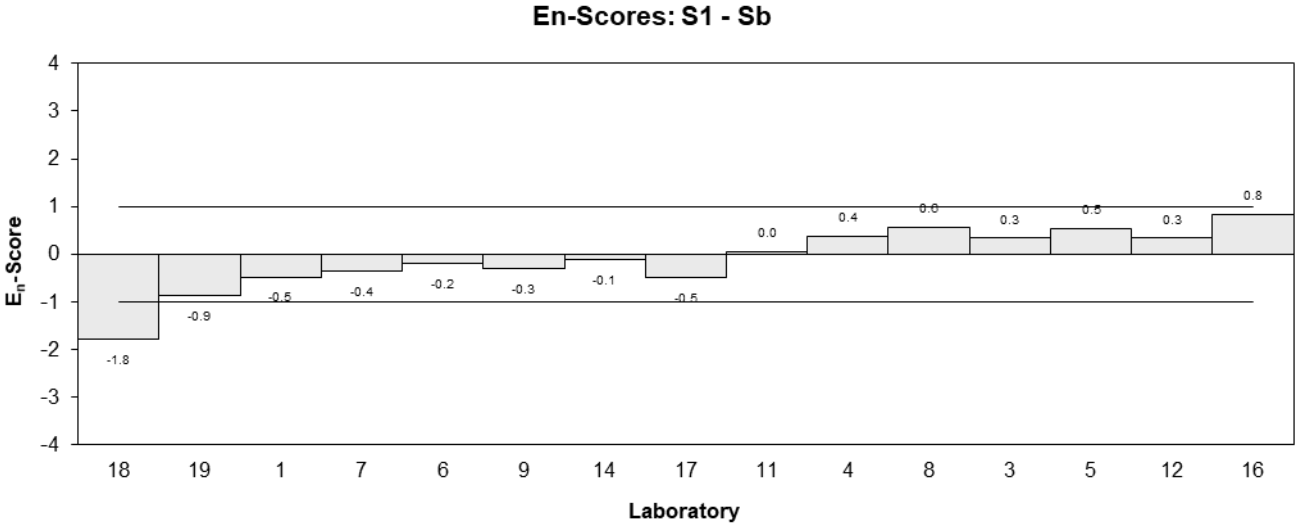

En-Scores: S1 - Sb
En-Score
4
3
2
1
0
-1
-2
-3
-4
-1.8
-0.9
-0.5
-0.4
-0.2
-0.3
-0.1
-0.5
0.0
0.4
0.6
0.3
0.5
0.3
0.8
18 19 1 7 6 9 14 17 11 4 8 3 5 12 16
Laboratory

Figure 14

Table 19

Sample Details

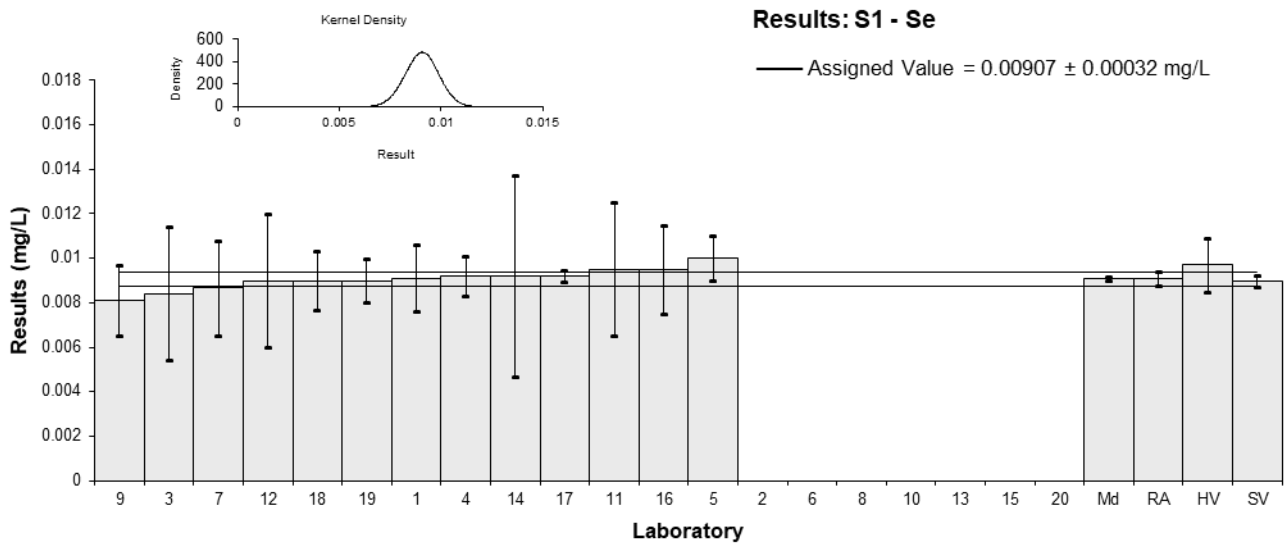
Sample	S1
Analyte	Se
Matrix	Potable Water
Unit	mg/L

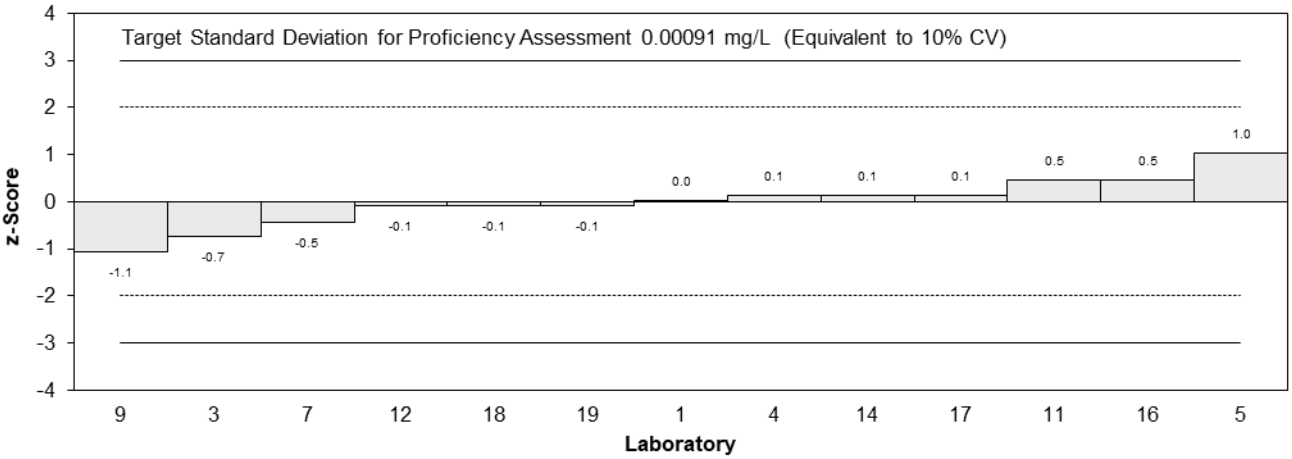
Participant Results

Lab. Code	Result	U	z	E_n
1	0.0091	0.0015	0.03	0.02
2	NT	NT		
3	0.0084	0.003	-0.74	-0.22
4	0.0092	0.0009	0.14	0.14
5	0.010	0.001	1.03	0.89
6	< 0.01	0.01		
7	0.00866	0.00214	-0.45	-0.19
8	NT	NT		
9	0.0081	0.0016	-1.07	-0.59
10	NT	NT		
11	0.0095	0.003	0.47	0.14
12	0.009	0.003	-0.08	-0.02
13	NT	NT		
14	0.0092	0.0045	0.14	0.03
15	NT	NT		
16	0.0095	0.002	0.47	0.21
17	0.00920	0.00025	0.14	0.32
18	0.009	0.0013	-0.08	-0.05
19	0.009	0.001	-0.08	-0.07
20	NT	NT		

Statistics

Assigned Value	0.00907	0.00032
Spike Value	0.00896	0.00025
Homogeneity Value	0.0097	0.0012
Robust Average	0.00907	0.00032
Median	0.00910	0.00010
Mean	0.00907	0.00027
N	13	
Max	0.01	
Min	0.0081	
Robust SD	0.00046	
Robust CV	5.1%	


Kernel Density
Density
Result
Results: S1 - Se
Assigned Value = 0.00907 ± 0.00032 mg/L
Results (mg/L)
Laboratory
9 3 7 12 18 19 1 4 14 17 11 16 5 2 6 8 10 13 15 20 Md RA HV SV


z-Scores: S1 - Se
Target Standard Deviation for Proficiency Assessment 0.00091 mg/L (Equivalent to 10% CV)
z-Score
Laboratory
9 3 7 12 18 19 1 4 14 17 11 16 5
-1.1 -0.7 -0.5 -0.1 -0.1 -0.1 0.0 0.1 0.1 0.1 0.5 0.5 1.0

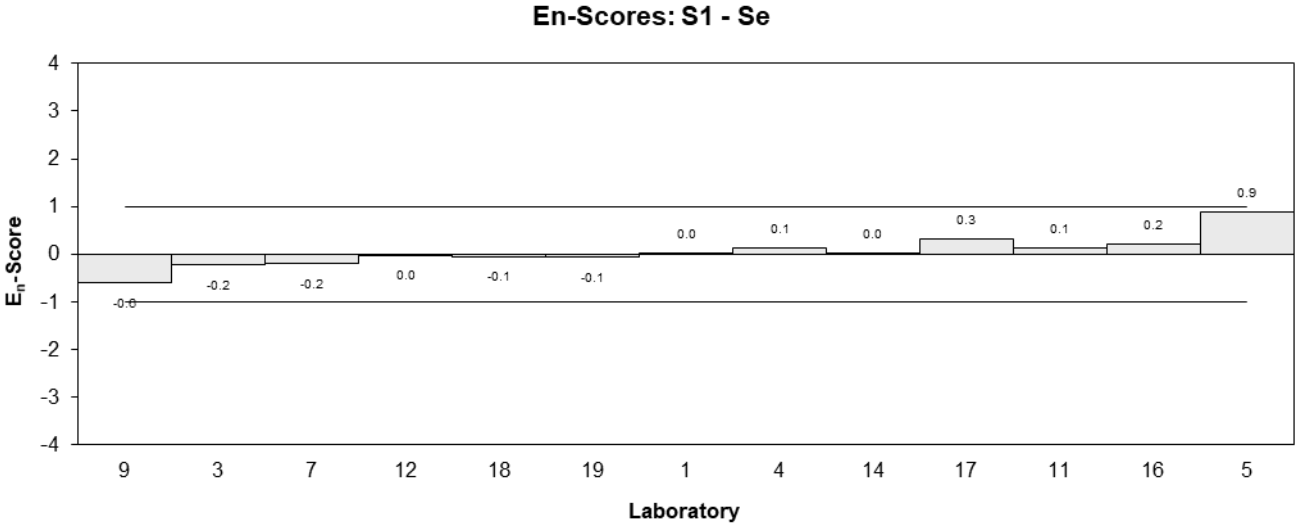

En-Scores: S1 - Se
En-Score
Laboratory
9 3 7 12 18 19 1 4 14 17 11 16 5
-0.6 -0.2 -0.2 0.0 -0.1 -0.1 0.0 0.1 0.0 0.3 0.1 0.2 0.9

Figure 15

Table 20

Sample Details

Sample	S1
Analyte	Sn
Matrix	Potable Water
Unit	mg/L

Participant Results

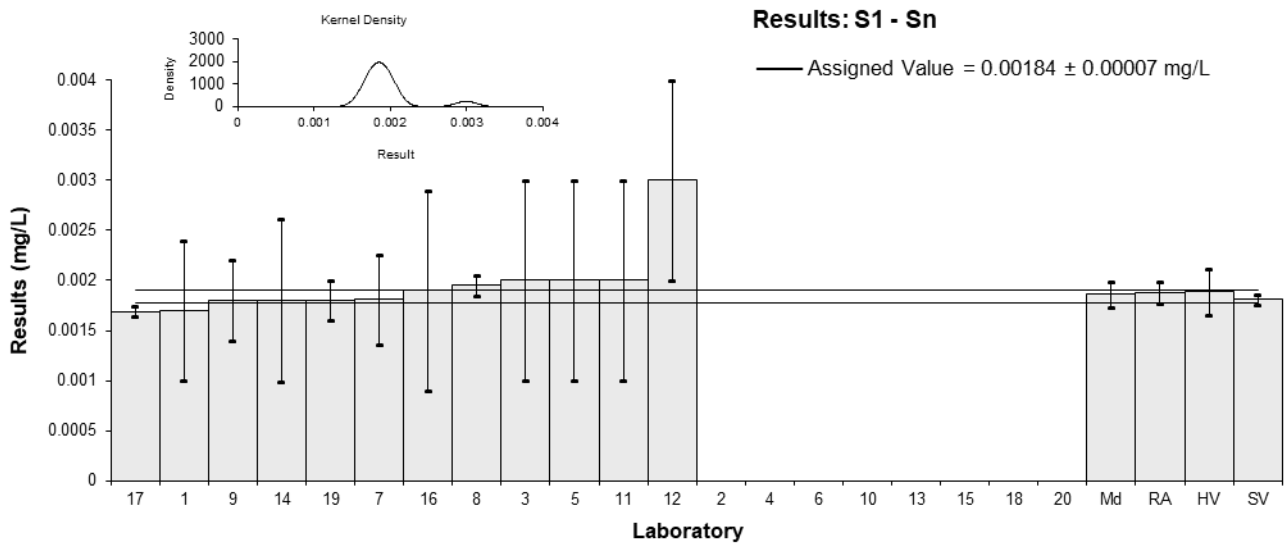
Lab. Code	Result	U	z	E_n
1	0.0017	0.0007	-0.76	-0.20
2	NT	NT		
3	0.0020	0.001	0.87	0.16
4	<0.002	NR		
5	0.002	0.001	0.87	0.16
6	NT	NT		
7	0.00181	0.00045	-0.16	-0.07
8	0.00195	0.00010	0.60	0.90
9	0.0018	0.0004	-0.22	-0.10
10	NT	NT		
11	0.002	0.001	0.87	0.16
12*	0.003	0.001	6.30	1.16
13	NT	NT		
14	0.00180	0.00081	-0.22	-0.05
15	NT	NT		
16	0.0019	0.001	0.33	0.06
17	0.00169	0.00005	-0.82	-1.74
18	NT	NT		
19	0.0018	0.0002	-0.22	-0.19
20	NT	NT		

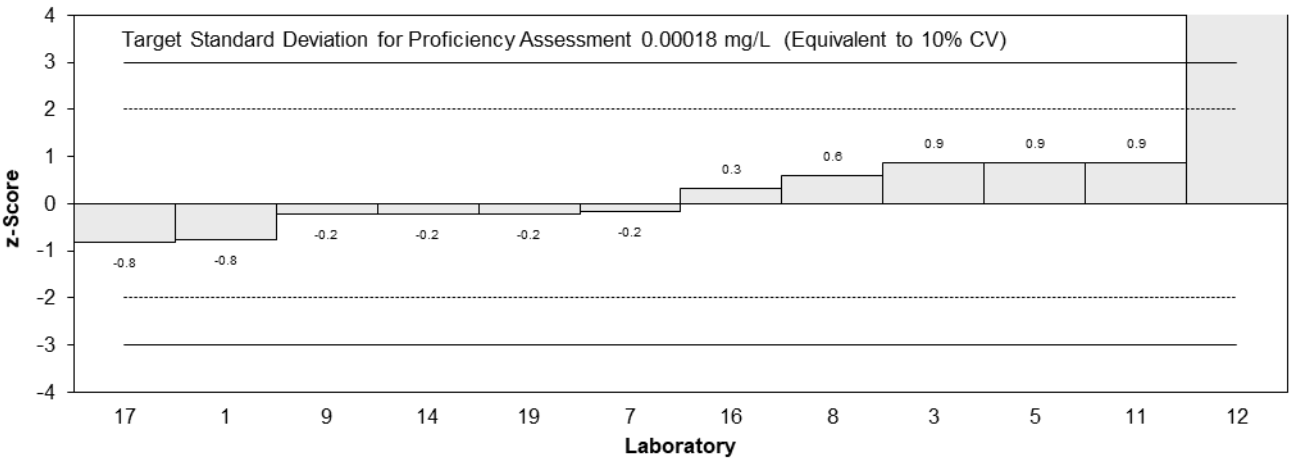
* Outlier

Statistics

Assigned Value*	0.00184	0.00007
Spike Value	0.00181	0.00005
Homogeneity Value	0.00189	0.00023
Robust Average	0.00188	0.00011
Median	0.00186	0.00013
Mean	0.00195	0.00020
N	12	
Max	0.003	
Min	0.00169	
Robust SD	0.00015	
Robust CV	8%	

*The Assigned Value was calculated as the Robust Average of the combined results of Samples S1 and S2


Results: S1 - Sn
Assigned Value = 0.00184 ± 0.00007 mg/L
Kernel Density
Density
Result
Results (mg/L)
Laboratory
17 1 9 14 19 7 16 8 3 5 11 12 2 4 6 10 13 15 18 20 Md RA HV SV


z-Scores: S1 - Sn
Target Standard Deviation for Proficiency Assessment 0.00018 mg/L (Equivalent to 10% CV)
z-Score
Laboratory
17 1 9 14 19 7 16 8 3 5 11 12

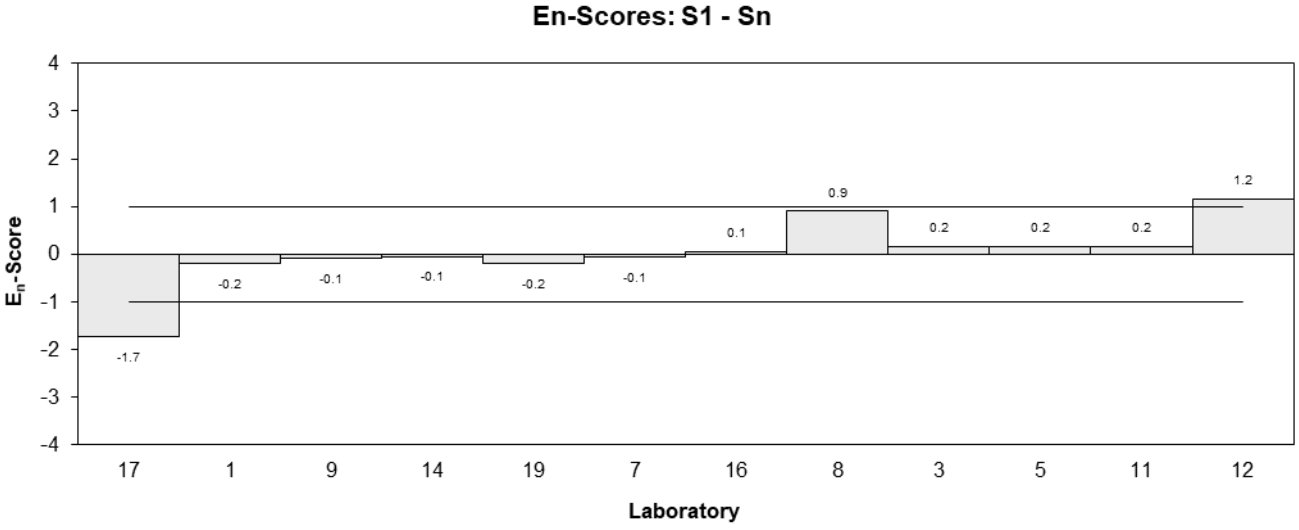

En-Scores: S1 - Sn
En-Score
Laboratory
17 1 9 14 19 7 16 8 3 5 11 12

Figure 16

Table 21

Sample Details

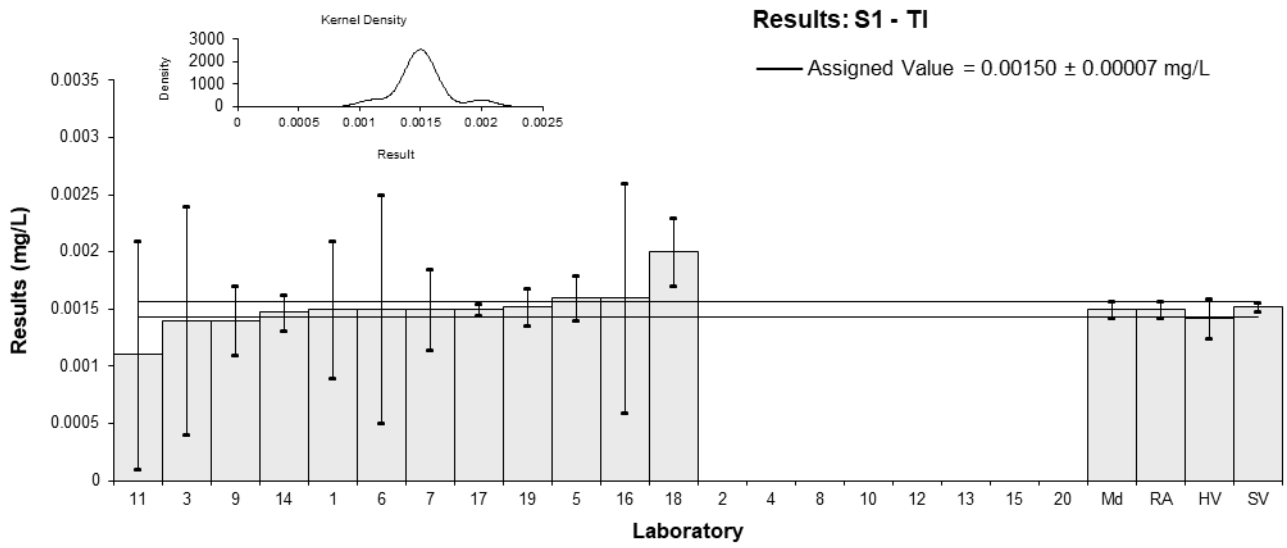
Sample	S1
Analyte	Tl
Matrix	Potable Water
Unit	mg/L

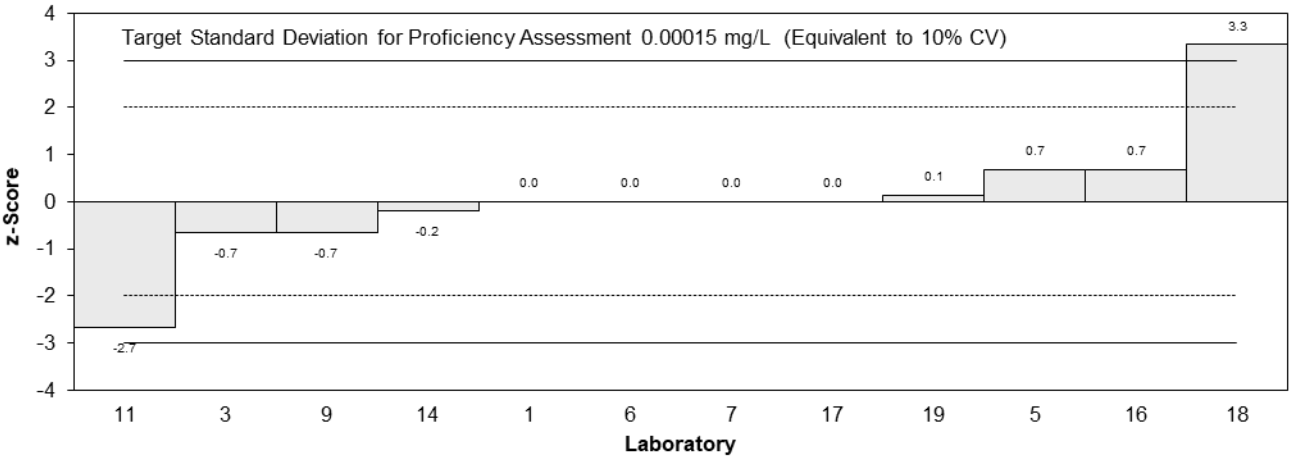
Participant Results

Lab. Code	Result	U	z	E_n
1	0.0015	0.0006	0.00	0.00
2	NT	NT		
3	0.0014	0.001	-0.67	-0.10
4	<0.002	NR		
5	0.0016	0.0002	0.67	0.47
6	0.0015	0.001	0.00	0.00
7	0.00150	0.00035	0.00	0.00
8	NT	NT		
9	0.0014	0.0003	-0.67	-0.32
10	NT	NT		
11	0.0011	0.001	-2.67	-0.40
12	NT	NT		
13	NT	NT		
14	0.00147	0.00016	-0.20	-0.17
15	NT	NT		
16	0.0016	0.001	0.67	0.10
17	0.00150	0.00005	0.00	0.00
18	0.002	0.0003	3.33	1.62
19	0.00152	0.00016	0.13	0.11
20	NT	NT		

Statistics

Assigned Value	0.00150	0.00007
Spike Value	0.00152	0.00004
Homogeneity Value	0.00142	0.00017
Robust Average	0.00150	0.00007
Median	0.00150	0.00007
Mean	0.00151	0.00012
N	12	
Max	0.002	
Min	0.0011	
Robust SD	0.00010	
Robust CV	6.7%	


Results: S1 - Tl
Assigned Value = 0.00150 ± 0.00007 mg/L
Kernel Density
Density
Result
Results (mg/L)
Laboratory
11 3 9 14 1 6 7 17 19 5 16 18 2 4 8 10 12 13 15 20 Md RA HV SV


z-Scores: S1 - Tl
Target Standard Deviation for Proficiency Assessment 0.00015 mg/L (Equivalent to 10% CV)
z-Score
Laboratory
11 3 9 14 1 6 7 17 19 5 16 18

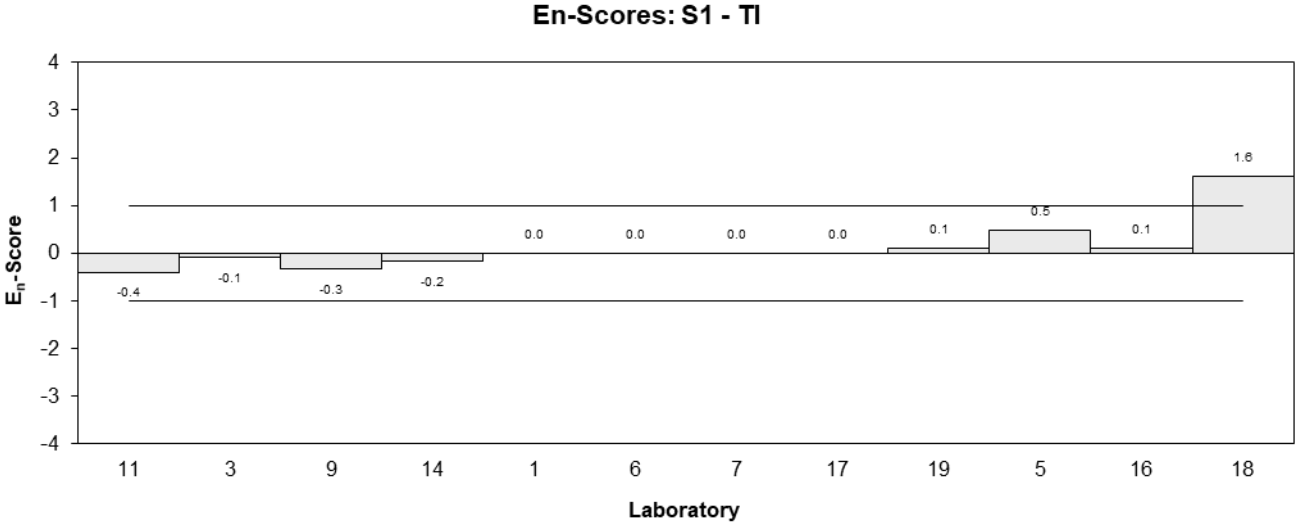

En-Scores: S1 - Tl
En-Score
Laboratory
11 3 9 14 1 6 7 17 19 5 16 18

Figure 17

Table 22

Sample Details

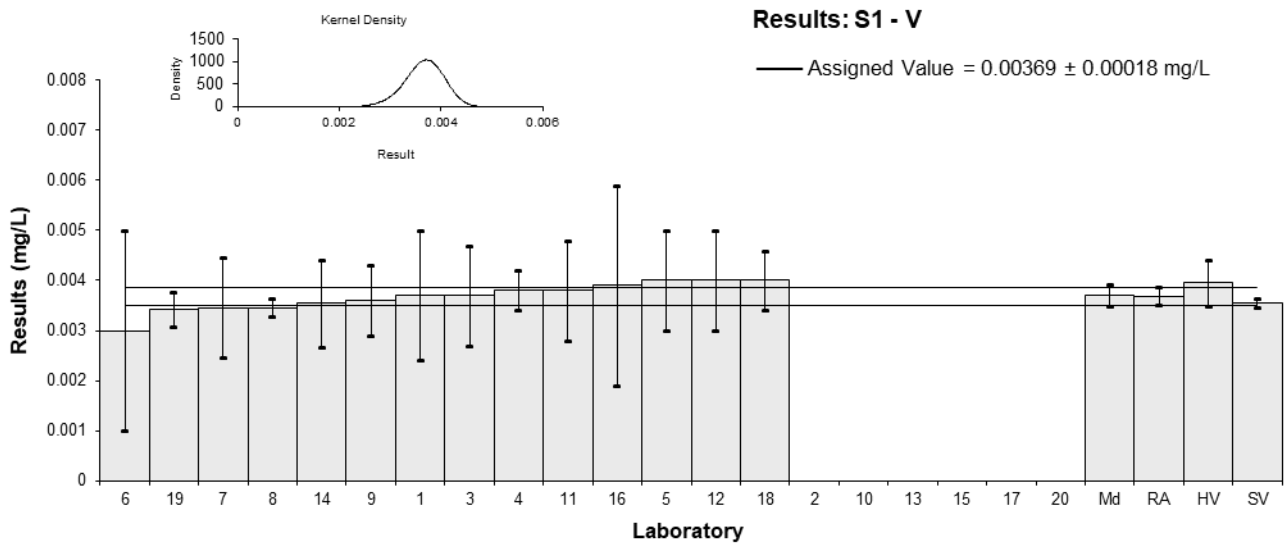
Sample	S1
Analyte	V
Matrix	Potable Water
Unit	mg/L

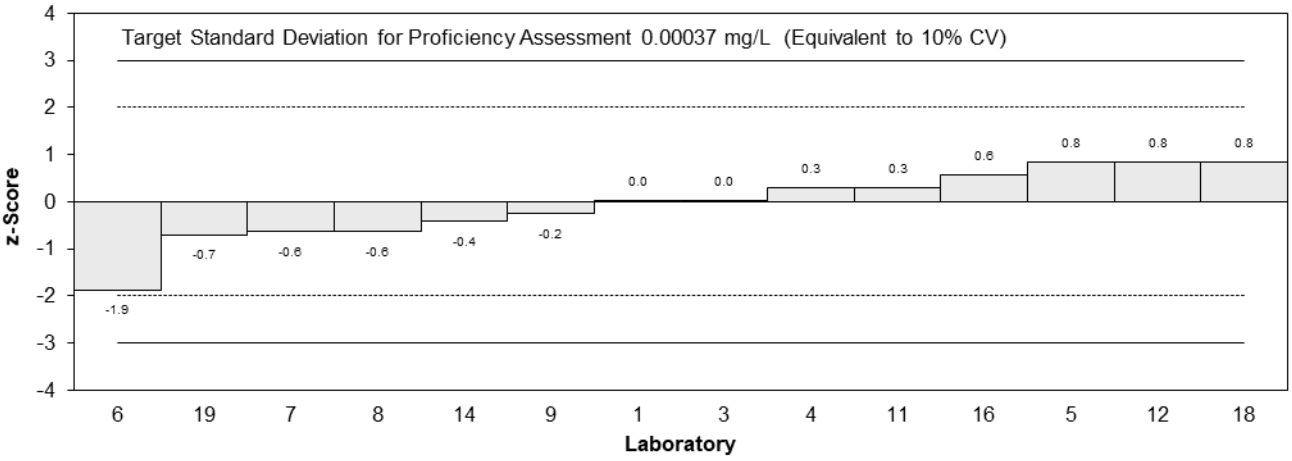
Participant Results

Lab. Code	Result	U	z	E_n
1	0.0037	0.0013	0.03	0.01
2	NT	NT		
3	0.0037	0.001	0.03	0.01
4	0.0038	0.0004	0.30	0.25
5	0.004	0.001	0.84	0.31
6	0.003	0.002	-1.87	-0.34
7	0.00346	0.00099	-0.62	-0.23
8	0.00346	0.00017	-0.62	-0.93
9	0.0036	0.0007	-0.24	-0.12
10	NT	NT		
11	0.0038	0.001	0.30	0.11
12	0.004	0.001	0.84	0.31
13	NT	NT		
14	0.00354	0.00088	-0.41	-0.17
15	NT	NT		
16	0.0039	0.002	0.57	0.10
17	NR	NR		
18	0.004	0.0006	0.84	0.49
19	0.00343	0.00035	-0.70	-0.66
20	NT	NT		

Statistics

Assigned Value	0.00369	0.00018
Spike Value	0.00355	0.00010
Homogeneity Value	0.00395	0.00047
Robust Average	0.00369	0.00018
Median	0.00370	0.00022
Mean	0.00367	0.00015
N	14	
Max	0.004	
Min	0.003	
Robust SD	0.00027	
Robust CV	7.3%	


Results: S1 - V
Kernel Density
Density
Result
Assigned Value = 0.00369 ± 0.00018 mg/L
Results (mg/L)
Laboratory
6 19 7 8 14 9 1 3 4 11 16 5 12 18 2 10 13 15 17 20 Md RA HV SV


z-Scores: S1 - V
Target Standard Deviation for Proficiency Assessment 0.00037 mg/L (Equivalent to 10% CV)
z-Score
Laboratory
6 19 7 8 14 9 1 3 4 11 16 5 12 18
-1.9 -0.7 -0.6 -0.6 -0.4 -0.2 0.0 0.0 0.3 0.3 0.6 0.8 0.8 0.8

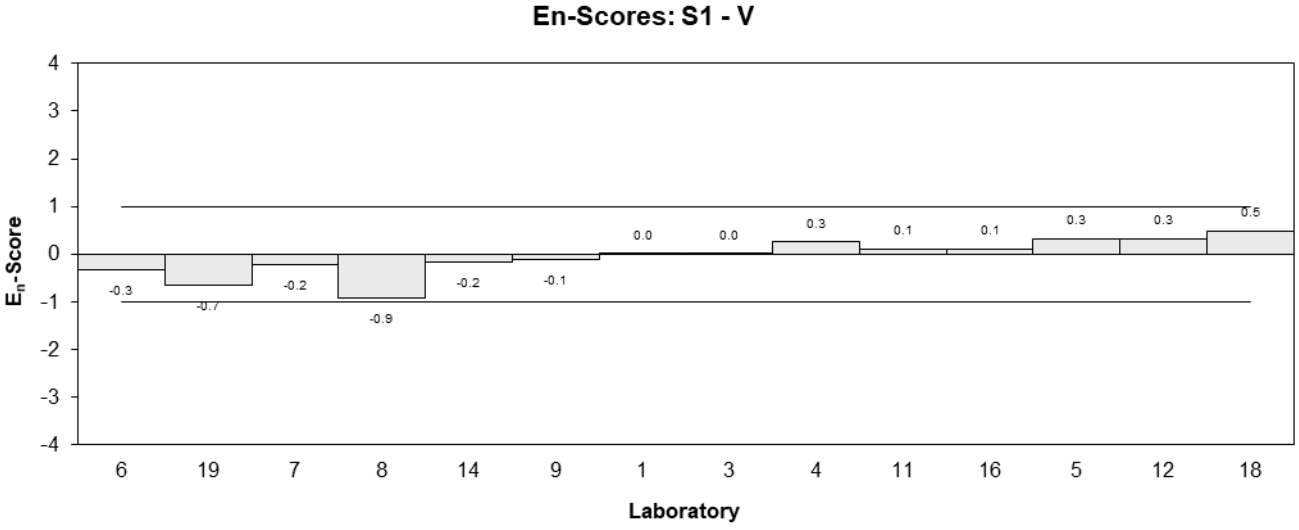

En-Scores: S1 - V
En-Score
Laboratory
6 19 7 8 14 9 1 3 4 11 16 5 12 18
-0.3 -0.7 -0.2 -0.9 -0.2 -0.1 0.0 0.0 0.3 0.1 0.1 0.3 0.3 0.5

Figure 18

Table 23

Sample Details

Sample	S1
Analyte	Zn
Matrix	Potable Water
Unit	mg/L

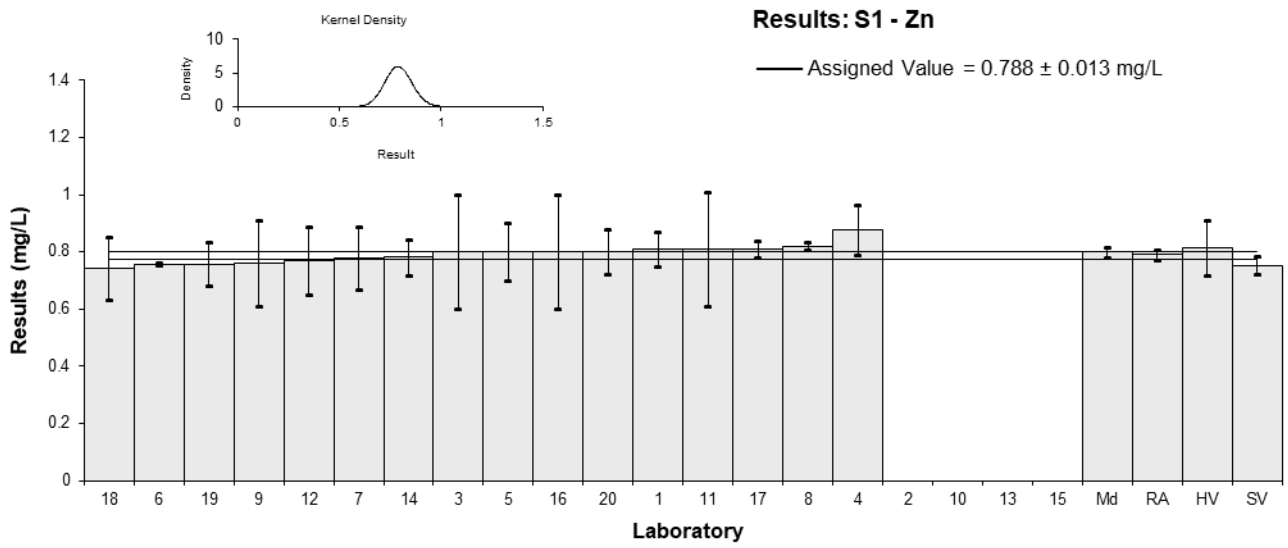
Participant Results

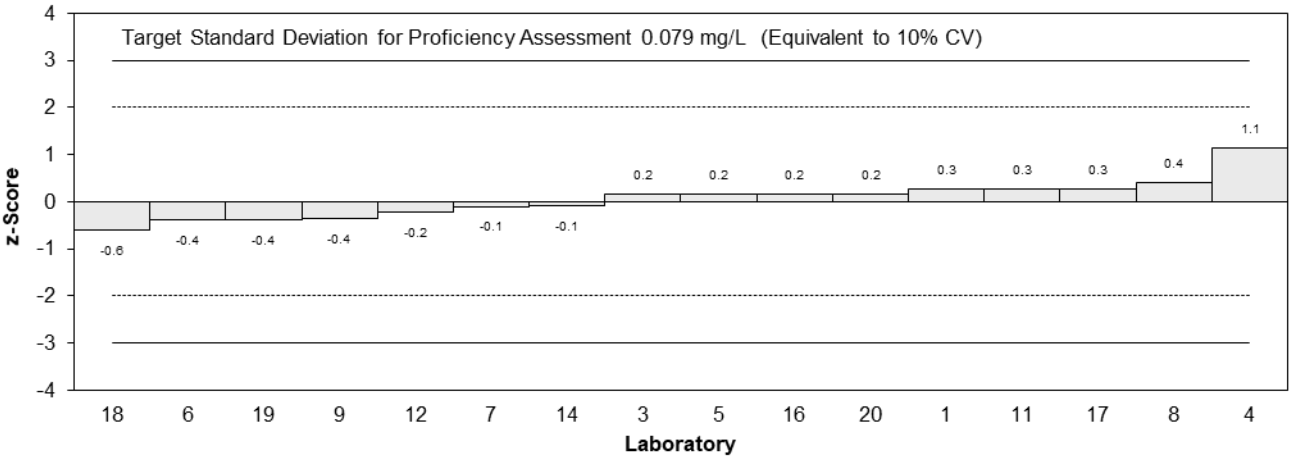
Lab. Code	Result	U	z	E_n
1	0.81	0.06	0.28	0.36
2	NT	NT		
3	0.8	0.2	0.15	0.06
4	0.8776	0.0878	1.14	1.01
5	0.80	0.10	0.15	0.12
6	0.757	0.005	-0.39	-2.23
7	0.78	0.11	-0.10	-0.07
8	0.820	0.014	0.41	1.67
9	0.76	0.15	-0.36	-0.19
10	NT	NT		
11	0.81	0.2	0.28	0.11
12	0.77	0.12	-0.23	-0.15
13	NT	NT		
14	0.781	0.063	-0.09	-0.11
15	NT	NT		
16	0.8	0.2	0.15	0.06
17	0.81	0.03	0.28	0.67
18	0.741	0.11	-0.60	-0.42
19	0.757	0.077	-0.39	-0.40
20	0.801	0.08	0.16	0.16

Statistics

Assigned Value*	0.788	0.013
Spike Value	0.753	0.031
Homogeneity Value	0.815	0.098
Robust Average	0.790	0.018
Median	0.800	0.018
Mean	0.792	0.016
N	16	
Max	0.8776	
Min	0.741	
Robust SD	0.029	
Robust CV	3.7%	

*The Assigned Value was calculated as the Robust Average of the combined results of Samples S1 and S2


Results: S1 - Zn
Assigned Value = 0.788 ± 0.013 mg/L
Kernel Density
Density
Result
Results (mg/L)
Laboratory
18 6 19 9 12 7 14 3 5 16 20 1 11 17 8 4 2 10 13 15 Md RA HV SV


z-Scores: S1 - Zn
Target Standard Deviation for Proficiency Assessment 0.079 mg/L (Equivalent to 10% CV)
z-Score
Laboratory
18 6 19 9 12 7 14 3 5 16 20 1 11 17 8 4
-0.6 -0.4 -0.4 -0.4 -0.2 -0.1 -0.1 0.2 0.2 0.2 0.2 0.3 0.3 0.3 0.4 1.1

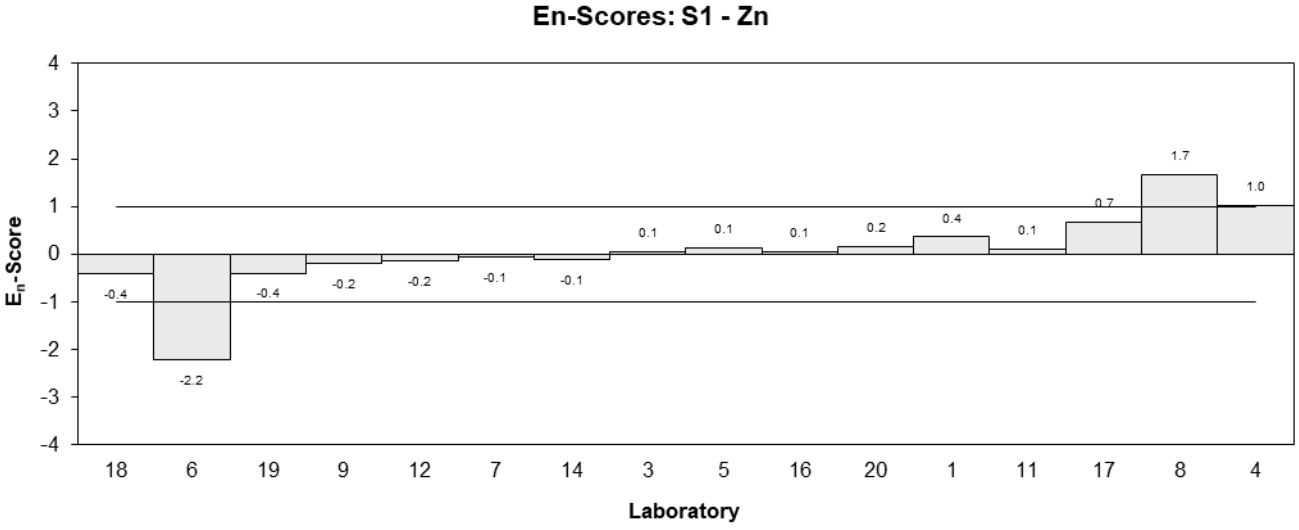

En-Scores: S1 - Zn
En-Score
Laboratory
18 6 19 9 12 7 14 3 5 16 20 1 11 17 8 4
-0.4 -2.2 -0.4 -0.2 -0.2 -0.1 -0.1 0.1 0.1 0.1 0.2 0.4 0.1 0.7 1.7 1.0

Figure 19

Table 24

Sample Details

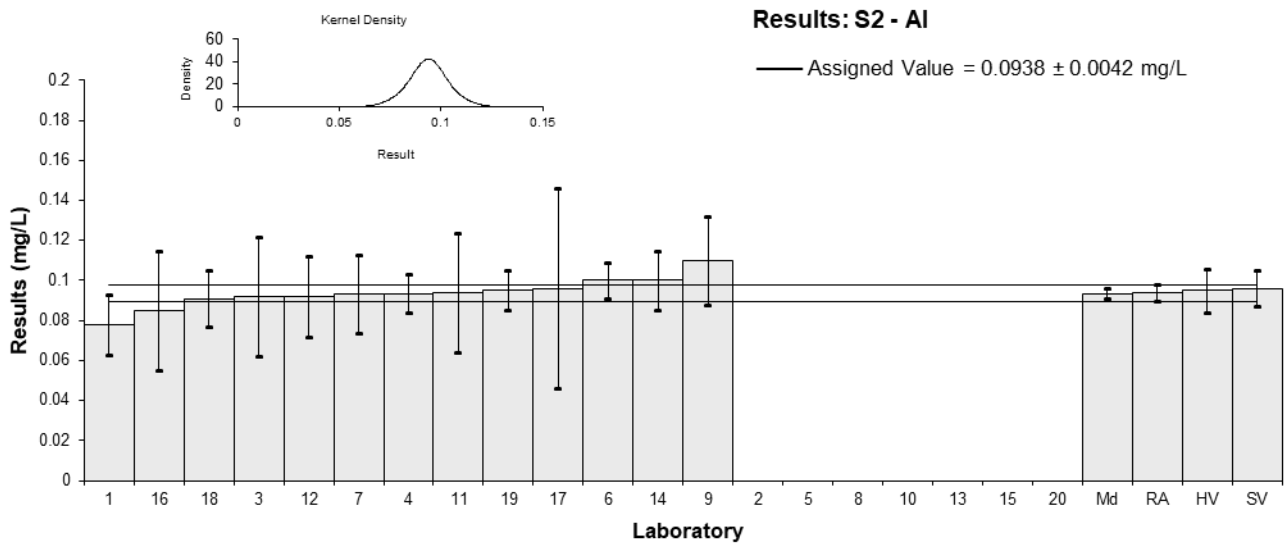
Sample	S2
Analyte	Al
Matrix	Potable Water
Unit	mg/L

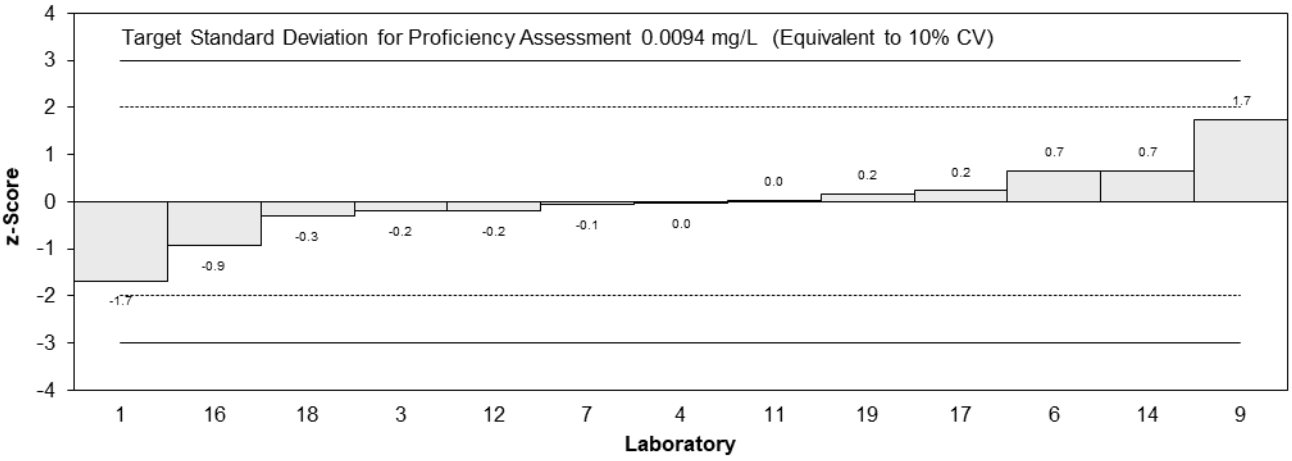
Participant Results

Lab. Code	Result	U	z	E_n
1	0.078	0.015	-1.68	-1.01
2	NT	NT		
3	0.092	0.03	-0.19	-0.06
4	0.0935	0.0094	-0.03	-0.03
5	NT	NT		
6	0.1	0.009	0.66	0.62
7	0.0932	0.0196	-0.06	-0.03
8	NT	NT		
9	0.11	0.022	1.73	0.72
10	NT	NT		
11	0.094	0.03	0.02	0.01
12	0.092	0.020	-0.19	-0.09
13	NT	NT		
14	0.100	0.015	0.66	0.40
15	NT	NT		
16	0.085	0.03	-0.94	-0.29
17	0.096	0.05	0.23	0.04
18	0.091	0.014	-0.30	-0.19
19	0.0954	0.01	0.17	0.15
20	NT	NT		

Statistics

Assigned Value	0.0938	0.0042
Spike Value	0.0961	0.0091
Homogeneity Value	0.095	0.011
Robust Average	0.0938	0.0042
Median	0.0935	0.0026
Mean	0.0939	0.0042
N	13	
Max	0.11	
Min	0.078	
Robust SD	0.0060	
Robust CV	6.4%	


Kernel Density
Density
Result
Results: S2 - Al
Assigned Value = 0.0938 ± 0.0042 mg/L
Results (mg/L)
Laboratory
1 16 18 3 12 7 4 11 19 17 6 14 9 2 5 8 10 13 15 20 Md RA HV SV


z-Scores: S2 - Al
Target Standard Deviation for Proficiency Assessment 0.0094 mg/L (Equivalent to 10% CV)
z-Score
Laboratory
1 16 18 3 12 7 4 11 19 17 6 14 9
-1.7 -0.9 -0.3 -0.2 -0.2 -0.1 0.0 0.0 0.2 0.2 0.7 0.7 1.7

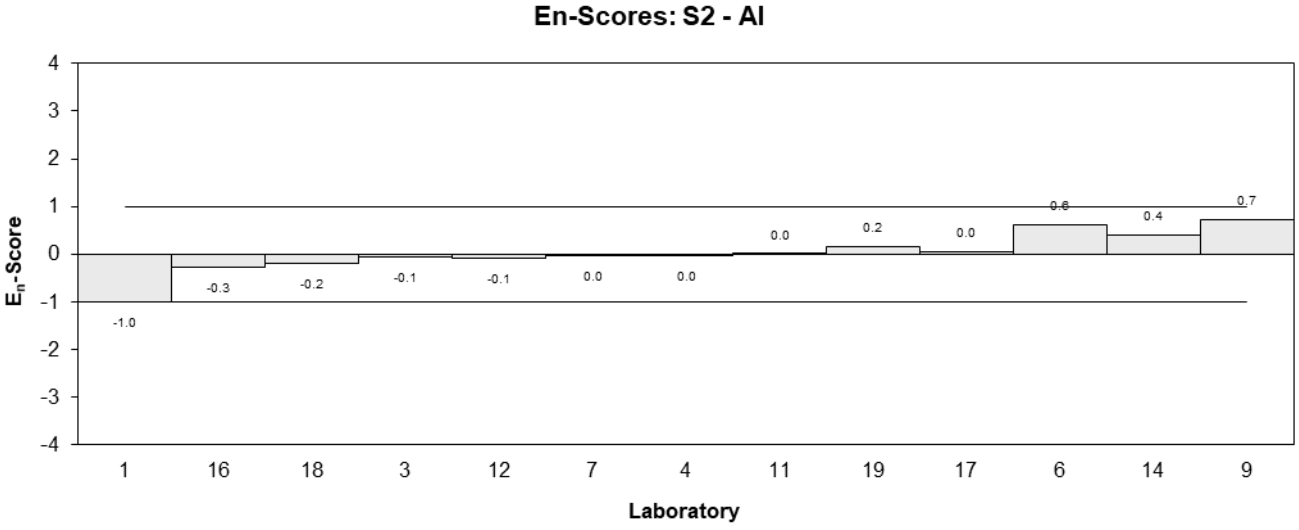

En-Scores: S2 - Al
En-Score
Laboratory
1 16 18 3 12 7 4 11 19 17 6 14 9
-1.0 -0.3 -0.2 -0.1 -0.1 0.0 0.0 0.0 0.2 0.0 0.6 0.4 0.7

Figure 20

Table 25

Sample Details

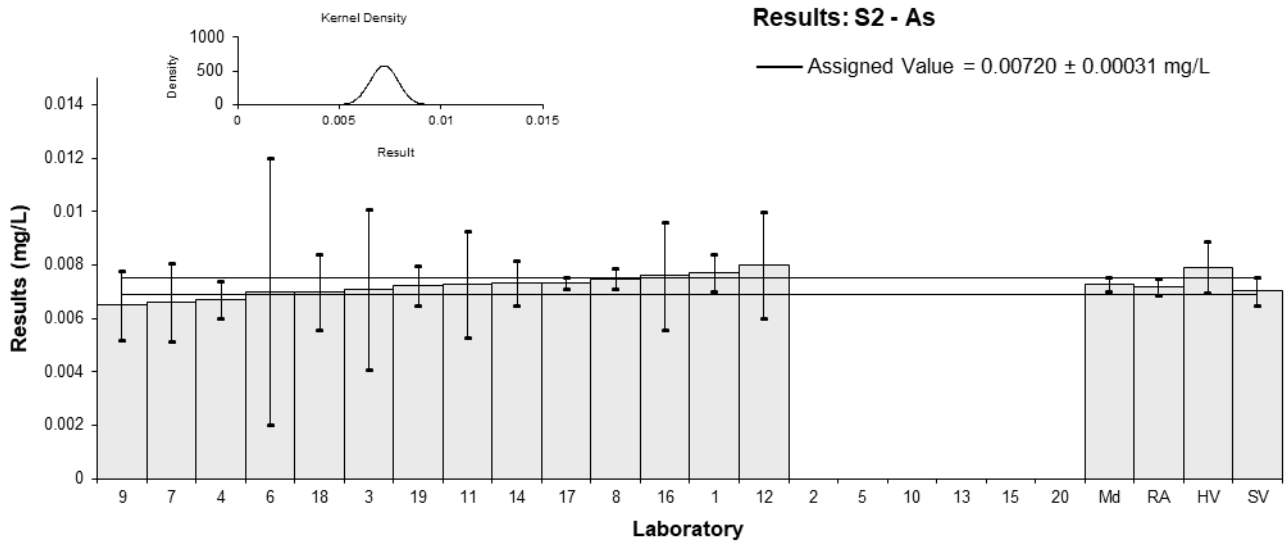
Sample	S2
Analyte	As
Matrix	Potable Water
Unit	mg/L

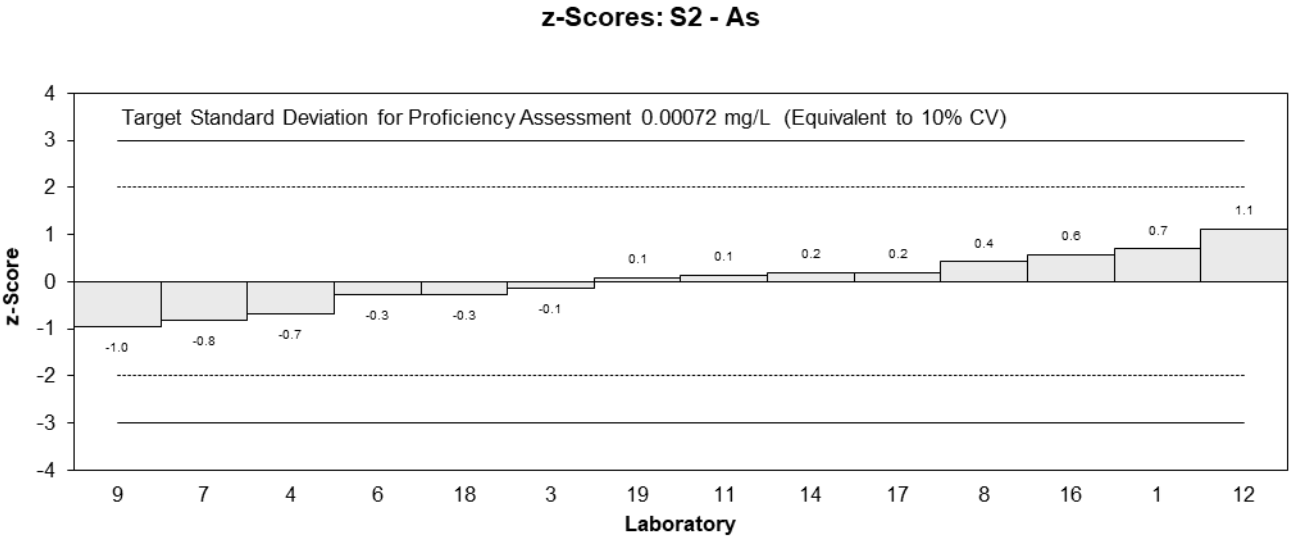
Participant Results

Lab. Code	Result	U	z	E_n
1	0.0077	0.0007	0.69	0.65
2	NT	NT		
3	0.0071	0.003	-0.14	-0.03
4	0.0067	0.0007	-0.69	-0.65
5	NT	NT		
6	0.007	0.005	-0.28	-0.04
7	0.00660	0.00147	-0.83	-0.40
8	0.00750	0.00037	0.42	0.62
9	0.0065	0.0013	-0.97	-0.52
10	NT	NT		
11	0.0073	0.002	0.14	0.05
12	0.008	0.002	1.11	0.40
13	NT	NT		
14	0.00733	0.00086	0.18	0.14
15	NT	NT		
16	0.0076	0.002	0.56	0.20
17	0.00733	0.0002	0.18	0.35
18	0.007	0.0014	-0.28	-0.14
19	0.00725	0.00075	0.07	0.06
20	NT	NT		

Statistics

Assigned Value	0.00720	0.00031
Spike Value	0.00703	0.00052
Homogeneity Value	0.00793	0.00095
Robust Average	0.00720	0.00031
Median	0.00728	0.00027
Mean	0.00721	0.00023
N	14	
Max	0.008	
Min	0.0065	
Robust SD	0.00047	
Robust CV	6.5%	


Results: S2 - As
Assigned Value = 0.00720 ± 0.00031 mg/L
Kernel Density
Density
Result
Results (mg/L)
Laboratory
9 7 4 6 18 3 19 11 14 17 8 16 1 12 2 5 10 13 15 20 Md RA HV SV


z-Scores: S2 - As
Target Standard Deviation for Proficiency Assessment 0.00072 mg/L (Equivalent to 10% CV)
z-Score
Laboratory
9 7 4 6 18 3 19 11 14 17 8 16 1 12
-1.0 -0.8 -0.7 -0.3 -0.3 -0.1 0.1 0.1 0.2 0.2 0.4 0.6 0.7 1.1

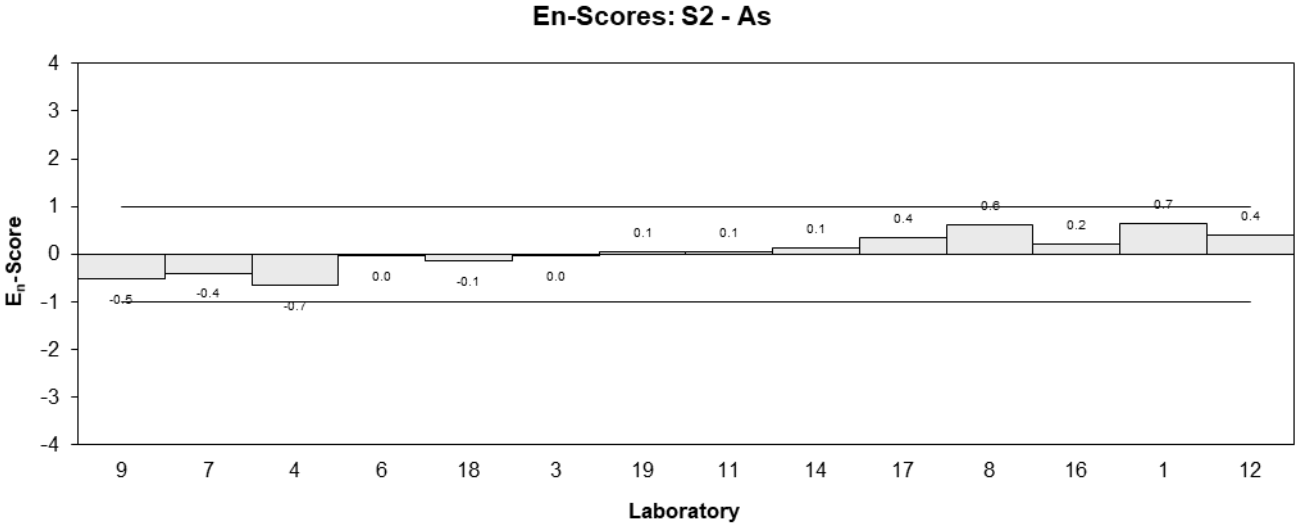

En-Scores: S2 - As
En-Score
Laboratory
9 7 4 6 18 3 19 11 14 17 8 16 1 12
-0.5 -0.4 -0.7 0.0 -0.1 0.0 0.1 0.1 0.1 0.4 0.6 0.2 0.7 0.4

Figure 21

Table 26

Sample Details

Sample	S2
Analyte	B
Matrix	Potable Water
Unit	mg/L

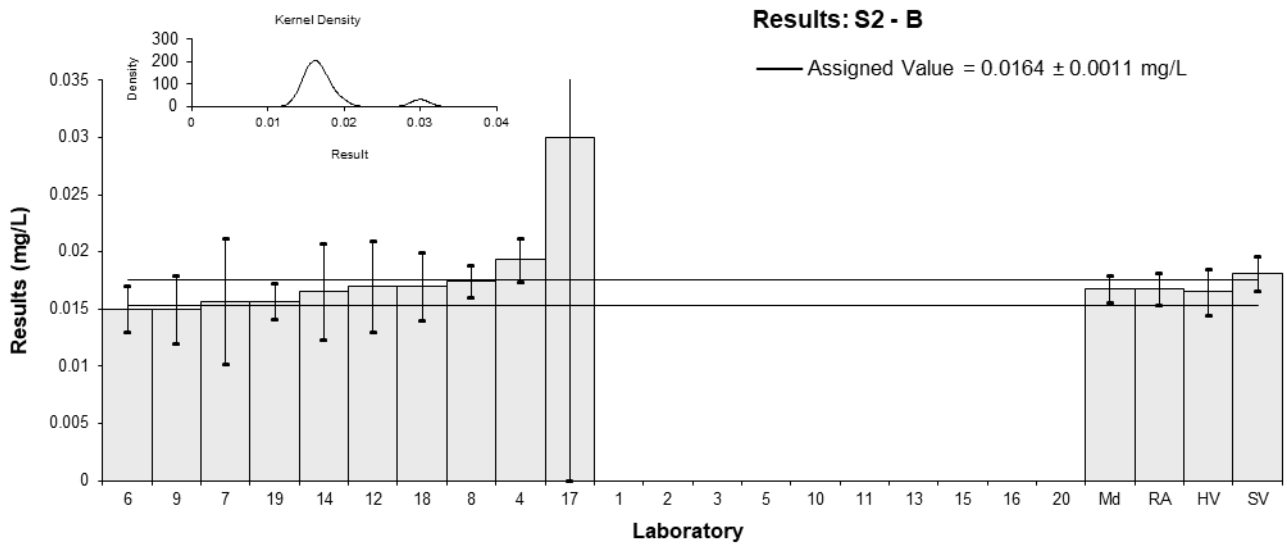
Participant Results

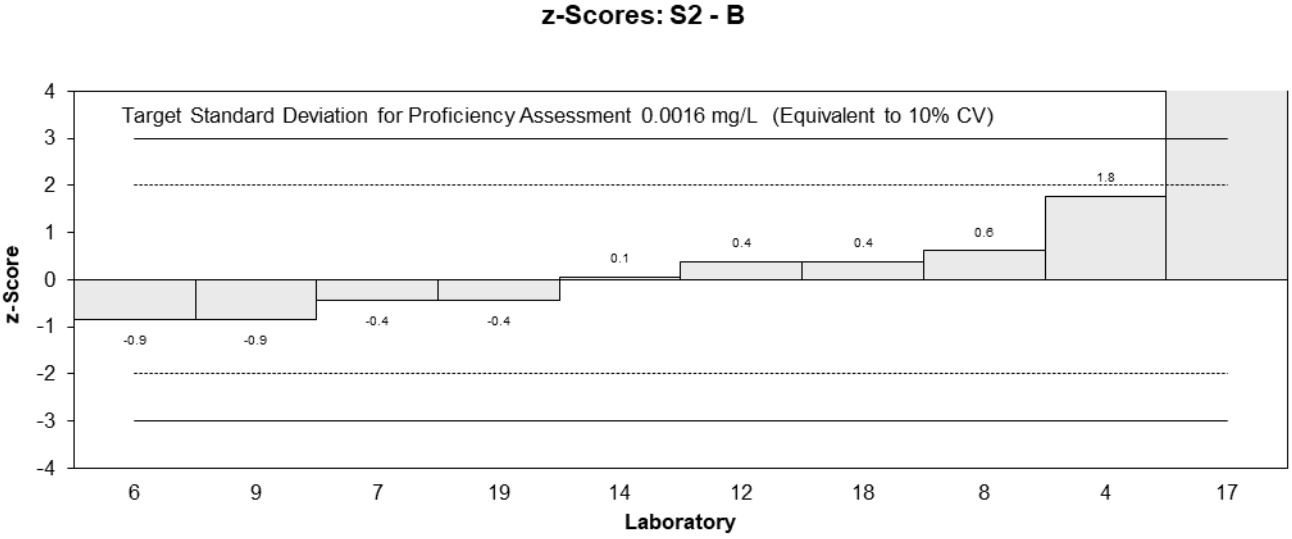
Lab. Code	Result	U	z	E_n
1	<0.1	NR		
2	NT	NT		
3	<0.02	NR		
4	0.0193	0.0019	1.77	1.32
5	NT	NT		
6	0.015	0.002	-0.85	-0.61
7	0.0157	0.0055	-0.43	-0.12
8	0.0174	0.0014	0.61	0.56
9	0.015	0.0030	-0.85	-0.44
10	NT	NT		
11	<0.02	NR		
12	0.017	0.004	0.37	0.14
13	NT	NT		
14	0.0165	0.0042	0.06	0.02
15	NT	NT		
16	<0.02	NR		
17*	0.030	0.03	8.29	0.45
18	0.017	0.0030	0.37	0.19
19	0.0157	0.0016	-0.43	-0.36
20	NT	NT		

* Outlier

Statistics

Assigned Value	0.0164	0.0011
Spike Value	0.0181	0.0015
Homogeneity Value	0.0165	0.0020
Robust Average	0.0168	0.0014
Median	0.0168	0.0012
Mean	0.0179	0.0028
N	10	
Max	0.03	
Min	0.015	
Robust SD	0.0018	
Robust CV	11%	


Results: S2 - B
Assigned Value = 0.0164 ± 0.0011 mg/L
Kernel Density
Density
Result
Results (mg/L)
Laboratory
6 9 7 19 14 12 18 8 4 17 1 2 3 5 10 11 13 15 16 20 Md RA HV SV


z-Scores: S2 - B
Target Standard Deviation for Proficiency Assessment 0.0016 mg/L (Equivalent to 10% CV)
z-Score
Laboratory
6 9 7 19 14 12 18 8 4 17
-0.9 -0.9 -0.4 -0.4 0.1 0.4 0.4 0.6 1.8

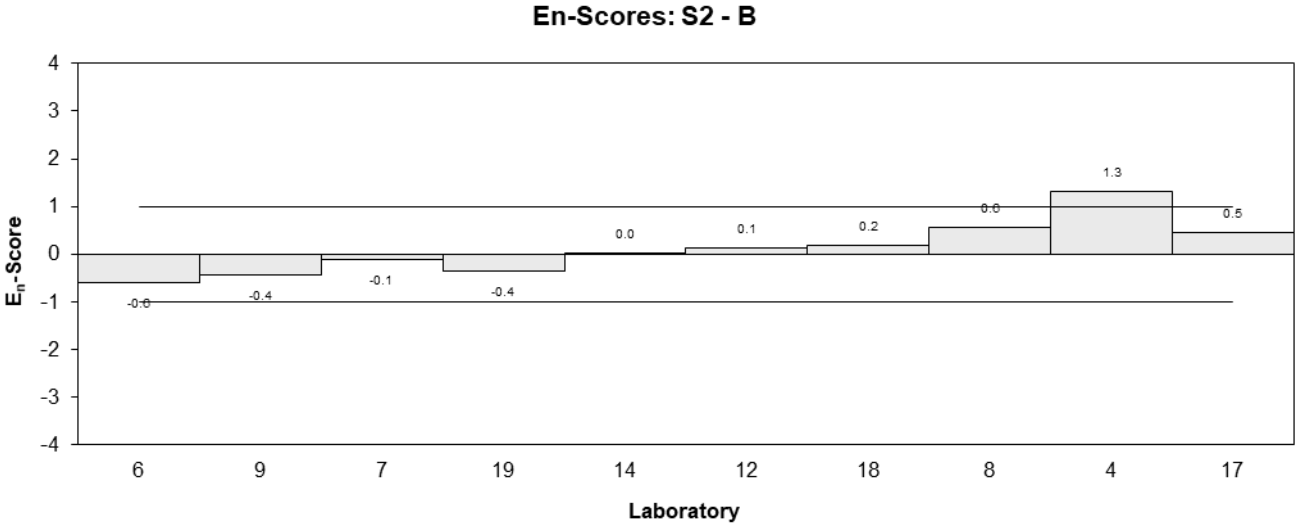

En-Scores: S2 - B
En-Score
Laboratory
6 9 7 19 14 12 18 8 4 17
-0.6 -0.4 -0.1 -0.4 0.0 0.1 0.2 0.6 1.3 0.5

Figure 22

Table 27

Sample Details

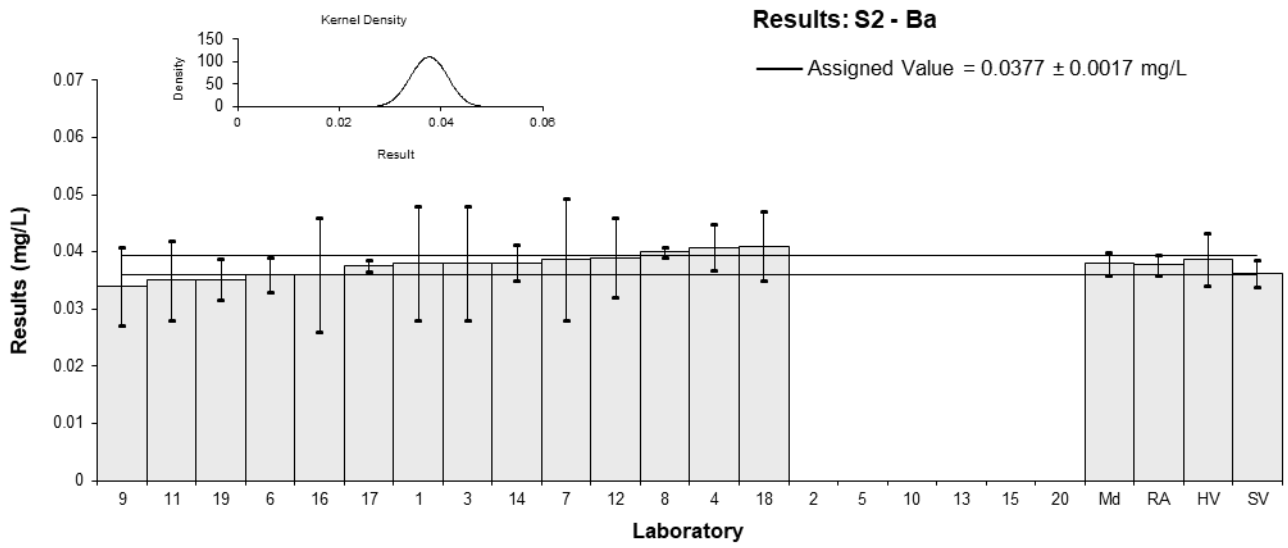
Sample	S2
Analyte	Ba
Matrix	Potable Water
Unit	mg/L

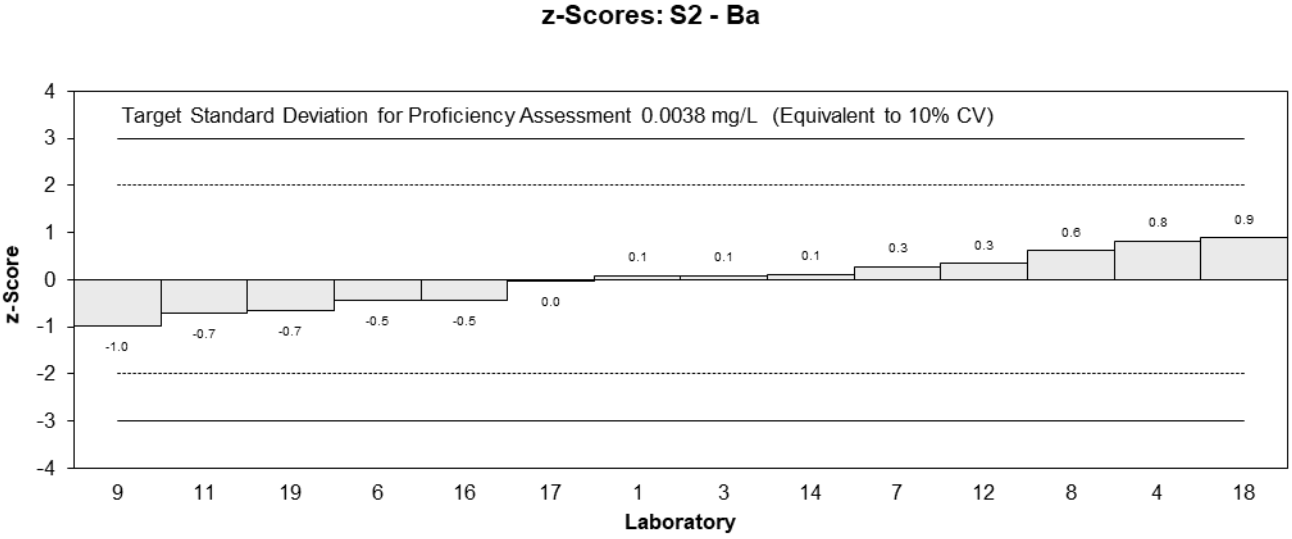
Participant Results

Lab. Code	Result	U	z	E_n
1	0.038	0.010	0.08	0.03
2	NT	NT		
3	0.038	0.01	0.08	0.03
4	0.0408	0.0041	0.82	0.70
5	NT	NT		
6	0.036	0.003	-0.45	-0.49
7	0.0387	0.0107	0.27	0.09
8	0.0400	0.0009	0.61	1.20
9	0.034	0.0068	-0.98	-0.53
10	NT	NT		
11	0.035	0.007	-0.72	-0.37
12	0.039	0.007	0.34	0.18
13	NT	NT		
14	0.0381	0.0031	0.11	0.11
15	NT	NT		
16	0.036	0.01	-0.45	-0.17
17	0.0376	0.001	-0.03	-0.05
18	0.041	0.006	0.88	0.53
19	0.03517	0.0036	-0.67	-0.64
20	NT	NT		

Statistics

Assigned Value	0.0377	0.0017
Spike Value	0.0362	0.0023
Homogeneity Value	0.0387	0.0046
Robust Average	0.0377	0.0017
Median	0.0380	0.0020
Mean	0.0377	0.0012
N	14	
Max	0.041	
Min	0.034	
Robust SD	0.0025	
Robust CV	6.6%	


Results: S2 - Ba
Assigned Value = 0.0377 ± 0.0017 mg/L
Kernel Density
Density
Result
Results (mg/L)
Laboratory
9 11 19 6 16 17 1 3 14 7 12 8 4 18 2 5 10 13 15 20 Md RA HV SV


z-Scores: S2 - Ba
Target Standard Deviation for Proficiency Assessment 0.0038 mg/L (Equivalent to 10% CV)
z-Score
Laboratory
9 11 19 6 16 17 1 3 14 7 12 8 4 18
-1.0 -0.7 -0.7 -0.5 -0.5 0.0 0.1 0.1 0.1 0.3 0.3 0.6 0.8 0.9

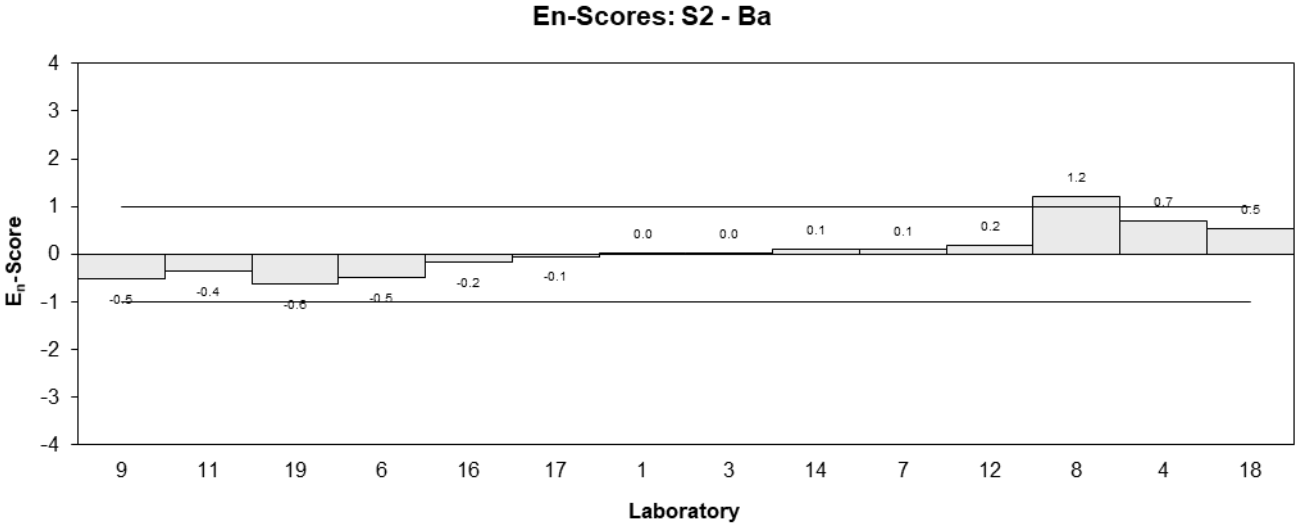

En-Scores: S2 - Ba
En-Score
Laboratory
9 11 19 6 16 17 1 3 14 7 12 8 4 18
-0.5 -0.4 -0.6 -0.5 -0.2 -0.1 0.0 0.0 0.1 0.1 0.2 1.2 0.7 0.5

Figure 23

Table 28

Sample Details

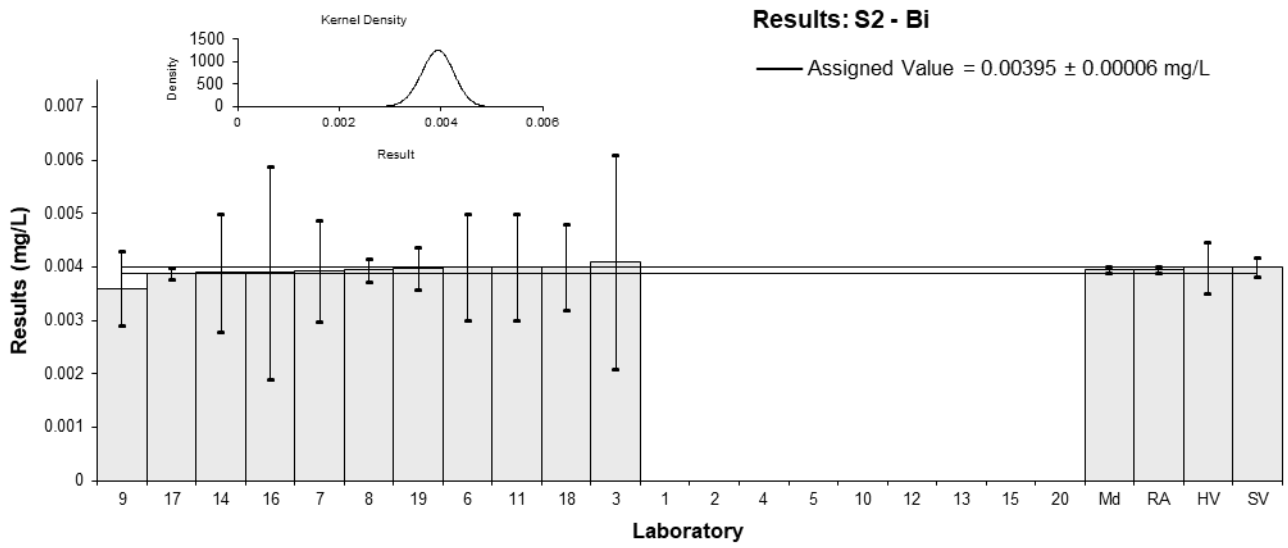
Sample	S2
Analyte	Bi
Matrix	Potable Water
Unit	mg/L

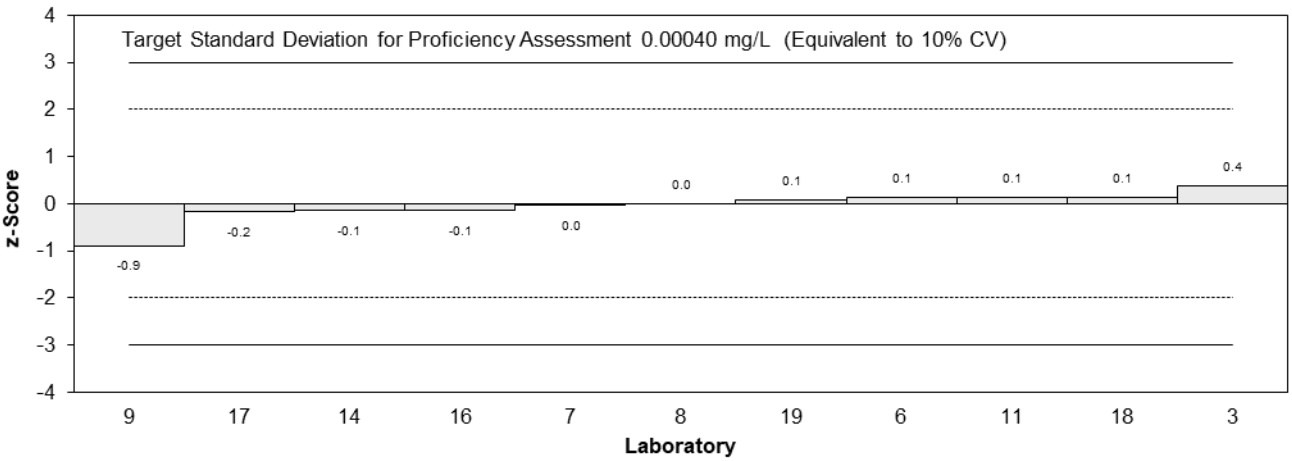
Participant Results

Lab. Code	Result	U	z	E_n
1	NT	NT		
2	NT	NT		
3	0.0041	0.002	0.38	0.07
4	NT	NT		
5	NT	NT		
6	0.004	0.001	0.13	0.05
7	0.00394	0.00095	-0.03	-0.01
8	0.00395	0.00022	0.00	0.00
9	0.0036	0.0007	-0.89	-0.50
10	NT	NT		
11	0.004	0.001	0.13	0.05
12	NT	NT		
13	NT	NT		
14	0.0039	0.0011	-0.13	-0.05
15	NT	NT		
16	0.0039	0.002	-0.13	-0.02
17	0.00388	0.0001	-0.18	-0.60
18	0.004	0.0008	0.13	0.06
19	0.00398	0.0004	0.08	0.07
20	NT	NT		

Statistics

Assigned Value	0.00395	0.00006
Spike Value	0.00400	0.00018
Homogeneity Value	0.00400	0.00048
Robust Average	0.00395	0.00006
Median	0.00395	0.00006
Mean	0.00393	0.00008
N	11	
Max	0.0041	
Min	0.0036	
Robust SD	0.000074	
Robust CV	1.9%	


Results: S2 - Bi
Assigned Value = 0.00395 ± 0.00006 mg/L
Kernel Density
Density
Result
Results (mg/L)
Laboratory
9 17 14 16 7 8 19 6 11 18 3 1 2 4 5 10 12 13 15 20 Md RA HV SV


z-Scores: S2 - Bi
Target Standard Deviation for Proficiency Assessment 0.00040 mg/L (Equivalent to 10% CV)
z-Score
-0.9 -0.2 -0.1 -0.1 0.0 0.0 0.1 0.1 0.1 0.1 0.4
Laboratory
9 17 14 16 7 8 19 6 11 18 3

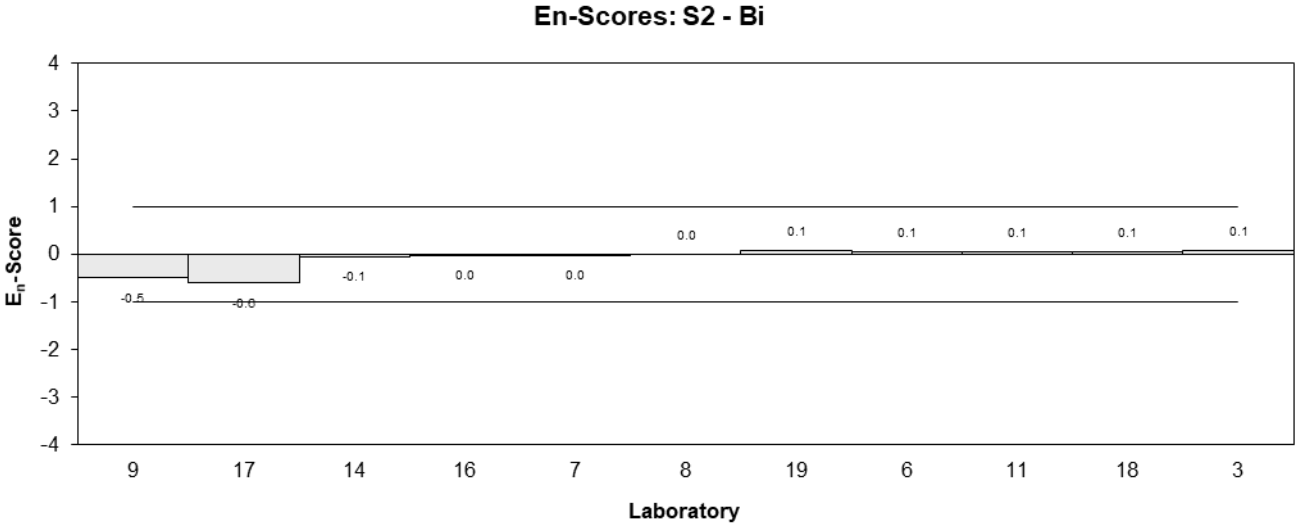

En-Scores: S2 - Bi
En-Score
-0.5 -0.6 -0.1 0.0 0.0 0.0 0.1 0.1 0.1 0.1 0.1
Laboratory
9 17 14 16 7 8 19 6 11 18 3

Figure 24

Table 29

Sample Details

Sample	S2
Analyte	Cd
Matrix	Potable Water
Unit	mg/L

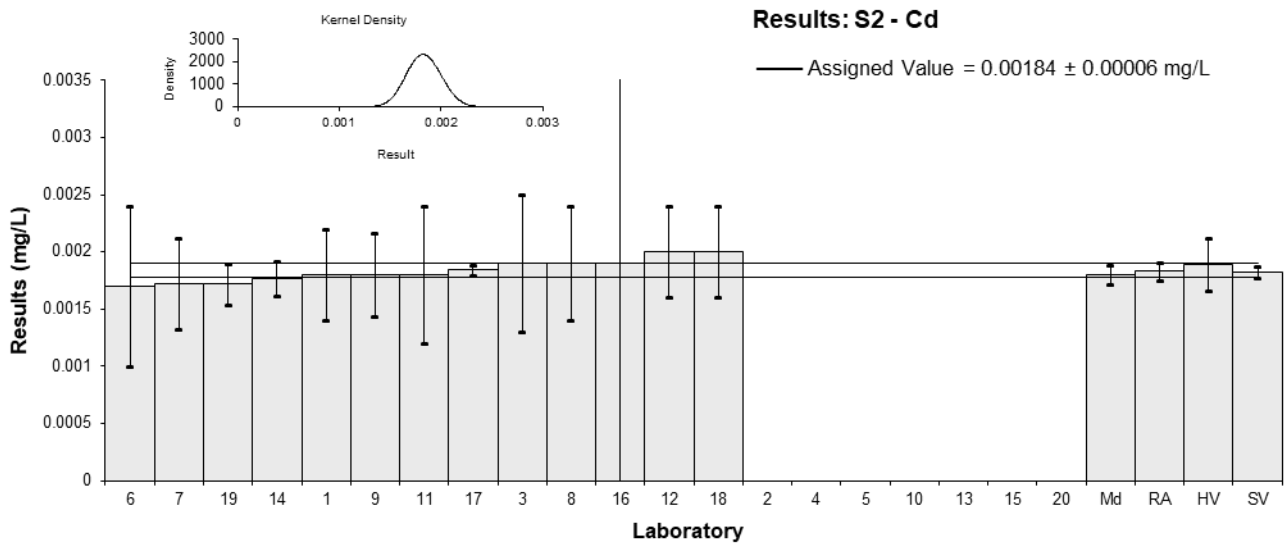
Participant Results

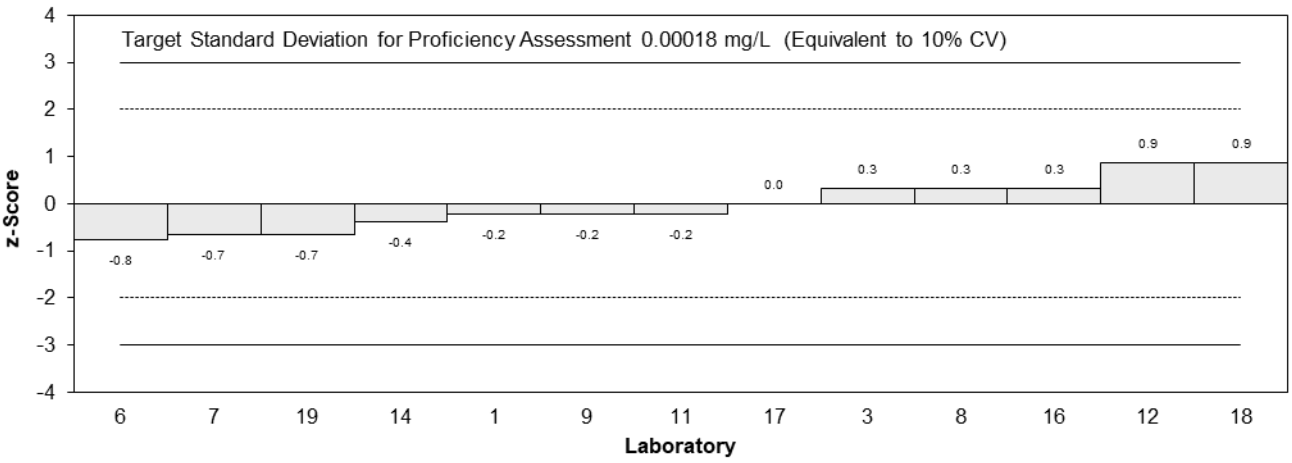
Lab. Code	Result	U	z	E_n
1	0.0018	0.0004	-0.22	-0.10
2	NT	NT		
3	0.0019	0.0006	0.33	0.10
4	<0.002	NR		
5	NT	NT		
6	0.0017	0.0007	-0.76	-0.20
7	0.00172	0.00040	-0.65	-0.30
8	0.0019	0.0005	0.33	0.12
9	0.0018	0.00036	-0.22	-0.11
10	NT	NT		
11	0.0018	0.0006	-0.22	-0.07
12	0.0020	0.0004	0.87	0.40
13	NT	NT		
14	0.00177	0.00015	-0.38	-0.43
15	NT	NT		
16	0.0019	0.006	0.33	0.01
17	0.00184	0.00005	0.00	0.00
18	0.002	0.0004	0.87	0.40
19	0.00172	0.00018	-0.65	-0.63
20	NT	NT		

Statistics

Assigned Value*	0.00184	0.00006
Spike Value	0.00182	0.00005
Homogeneity Value	0.00189	0.00023
Robust Average	0.00183	0.00008
Median	0.00180	0.00008
Mean	0.00183	0.00006
N	13	
Max	0.002	
Min	0.0017	
Robust SD	0.00011	
Robust CV	6%	

*The Assigned Value was calculated as the Robust Average of the combined results of Samples S1 and S2


Results: S2 - Cd
Assigned Value = 0.00184 ± 0.00006 mg/L
Kernel Density
Density
Result
Results (mg/L)
Laboratory
6 7 19 14 1 9 11 17 3 8 16 12 18 2 4 5 10 13 15 20 Md RA HV SV


z-Scores: S2 - Cd
Target Standard Deviation for Proficiency Assessment 0.00018 mg/L (Equivalent to 10% CV)
z-Score
Laboratory
6 7 19 14 1 9 11 17 3 8 16 12 18
-0.8 -0.7 -0.7 -0.4 -0.2 -0.2 -0.2 0.0 0.3 0.3 0.3 0.9 0.9

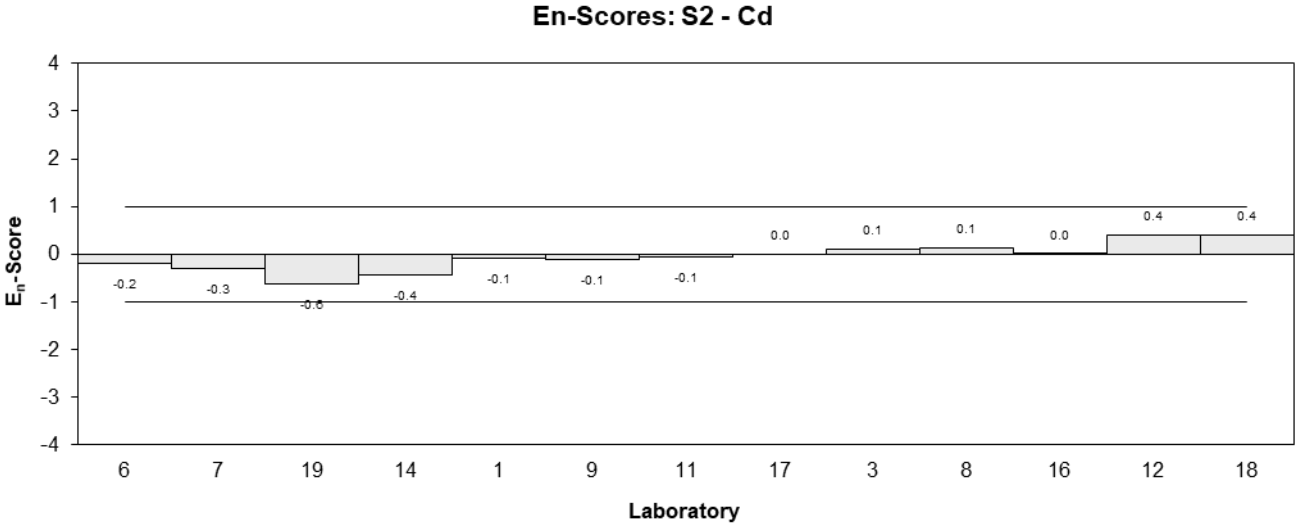

En-Scores: S2 - Cd
En-Score
Laboratory
6 7 19 14 1 9 11 17 3 8 16 12 18
-0.2 -0.3 -0.6 -0.4 -0.1 -0.1 -0.1 0.0 0.1 0.1 0.0 0.4 0.4

Figure 25

Table 30

Sample Details

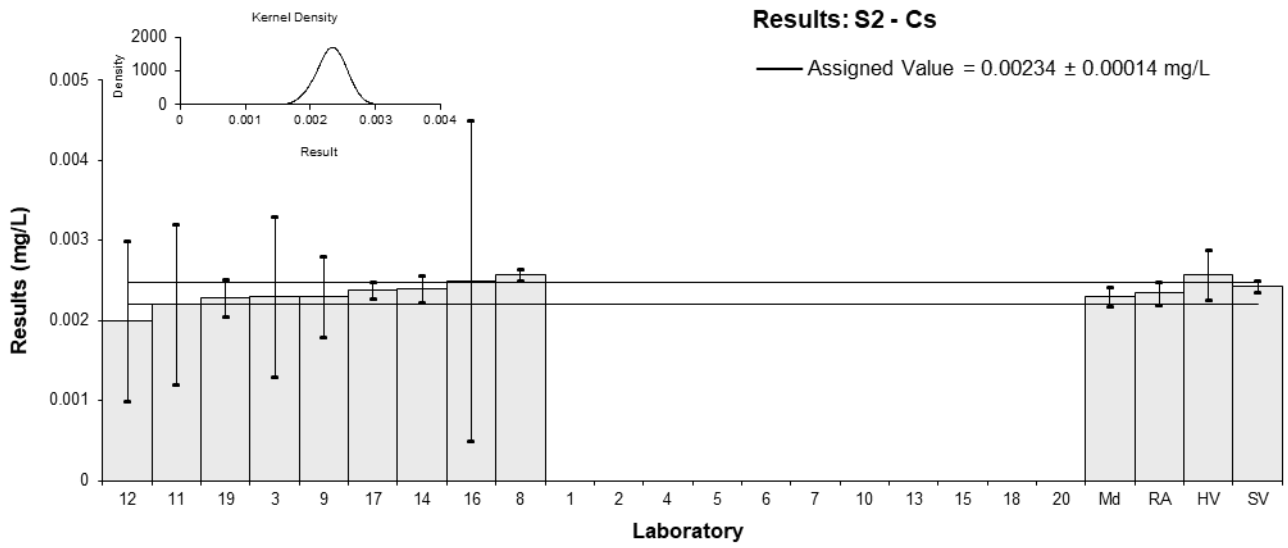
Sample	S2
Analyte	Cs
Matrix	Potable Water
Unit	mg/L

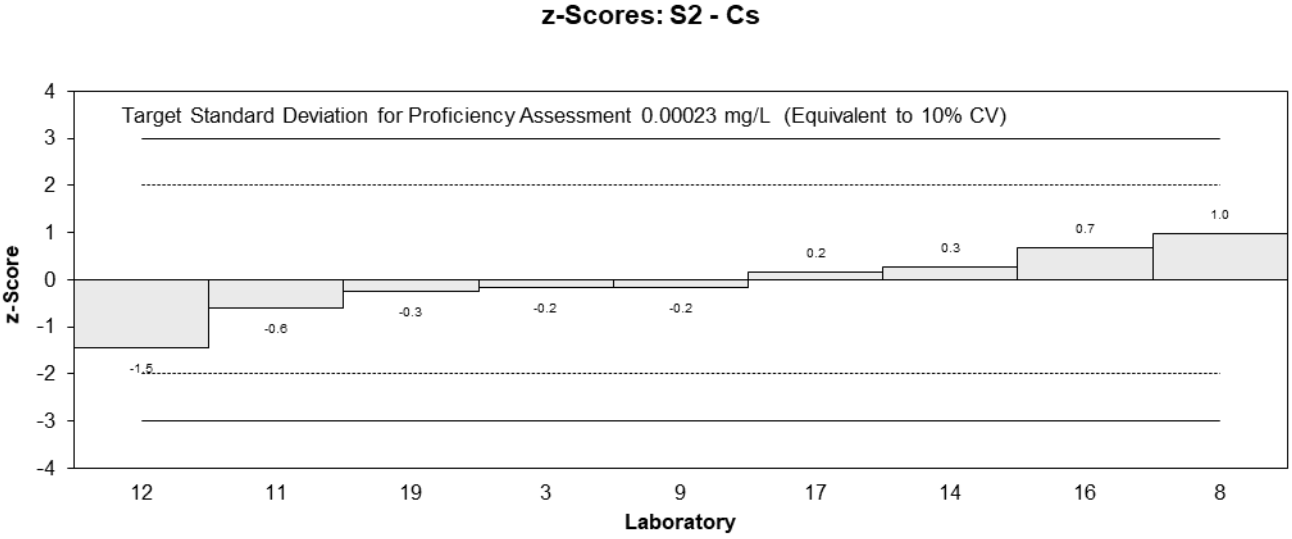
Participant Results

Lab. Code	Result	U	z	E_n
1	NT	NT		
2	NT	NT		
3	0.0023	0.001	-0.17	-0.04
4	NT	NT		
5	NT	NT		
6	NT	NT		
7	NR	NR		
8	0.00257	0.00007	0.98	1.47
9	0.0023	0.0005	-0.17	-0.08
10	NT	NT		
11	0.0022	0.001	-0.60	-0.14
12	0.002	0.001	-1.45	-0.34
13	NT	NT		
14	0.00240	0.00017	0.26	0.27
15	NT	NT		
16	0.0025	0.002	0.68	0.08
17	0.00238	0.0001	0.17	0.23
18	NT	NT		
19	0.00228	0.00023	-0.26	-0.22
20	NT	NT		

Statistics

Assigned Value	0.00234	0.00014
Spike Value	0.00243	0.00007
Homogeneity Value	0.00257	0.00031
Robust Average	0.00234	0.00014
Median	0.00230	0.00012
Mean	0.00233	0.00011
N	9	
Max	0.00257	
Min	0.002	
Robust SD	0.00017	
Robust CV	7.2%	


Results: S2 - Cs
Assigned Value = 0.00234 ± 0.00014 mg/L
Kernel Density
Density
Result
Results (mg/L)
Laboratory
12 11 19 3 9 17 14 16 8 1 2 4 5 6 7 10 13 15 18 20 Md RA HV SV


z-Scores: S2 - Cs
Target Standard Deviation for Proficiency Assessment 0.00023 mg/L (Equivalent to 10% CV)
z-Score
-1.5 -0.6 -0.3 -0.2 -0.2 0.2 0.3 0.7 1.0
Laboratory
12 11 19 3 9 17 14 16 8

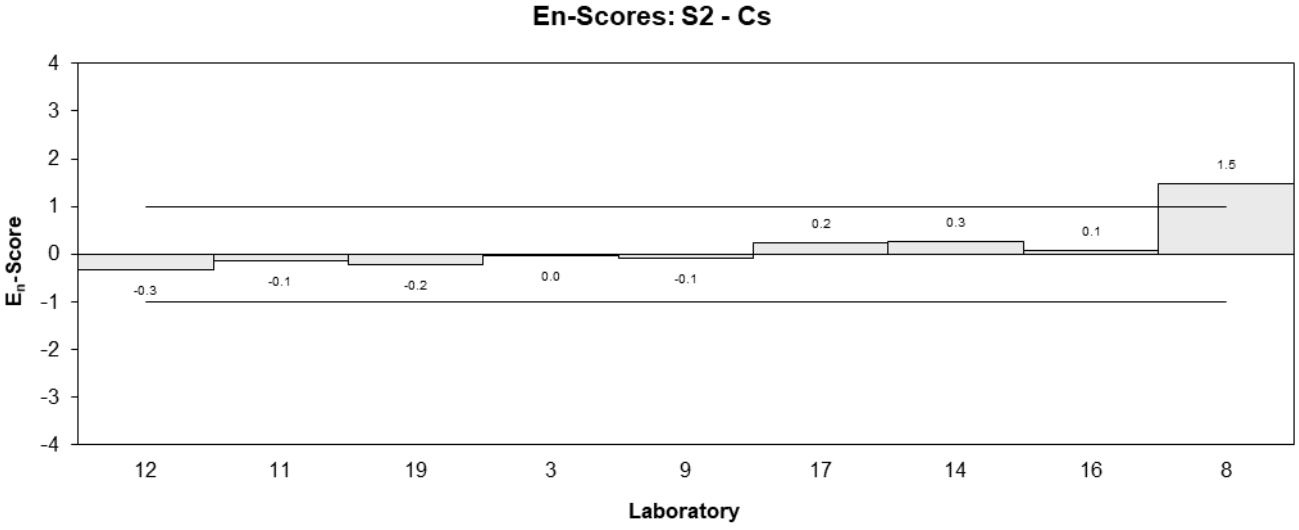

En-Scores: S2 - Cs
En-Score
-0.3 -0.1 -0.2 0.0 -0.1 0.2 0.3 0.1 1.5
Laboratory
12 11 19 3 9 17 14 16 8

Figure 26

Table 31

Sample Details

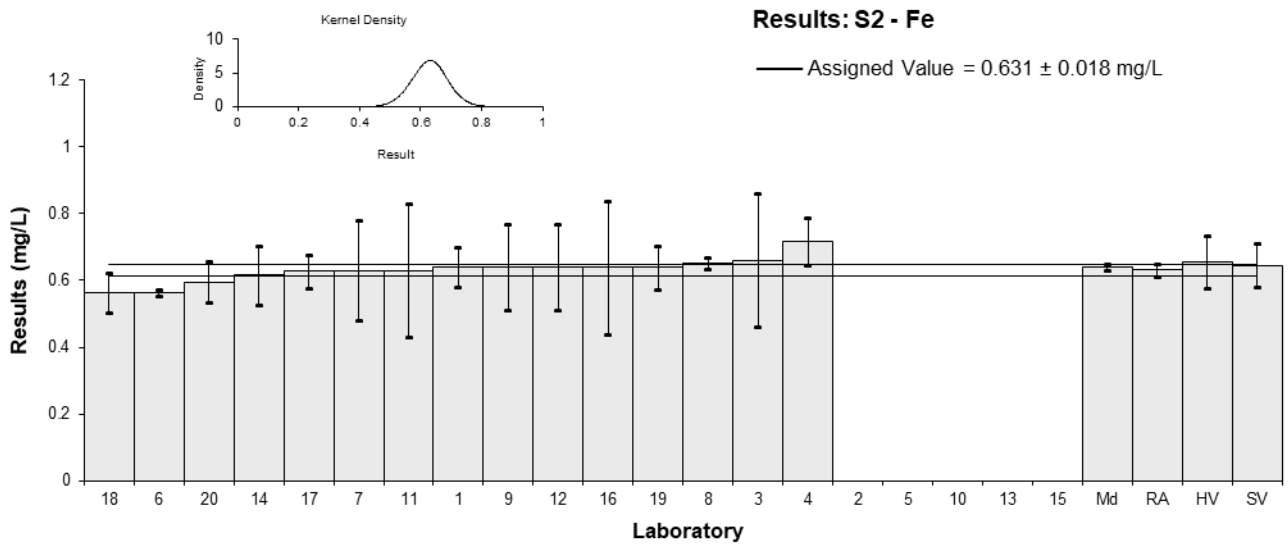
Sample	S2
Analyte	Fe
Matrix	Potable Water
Unit	mg/L

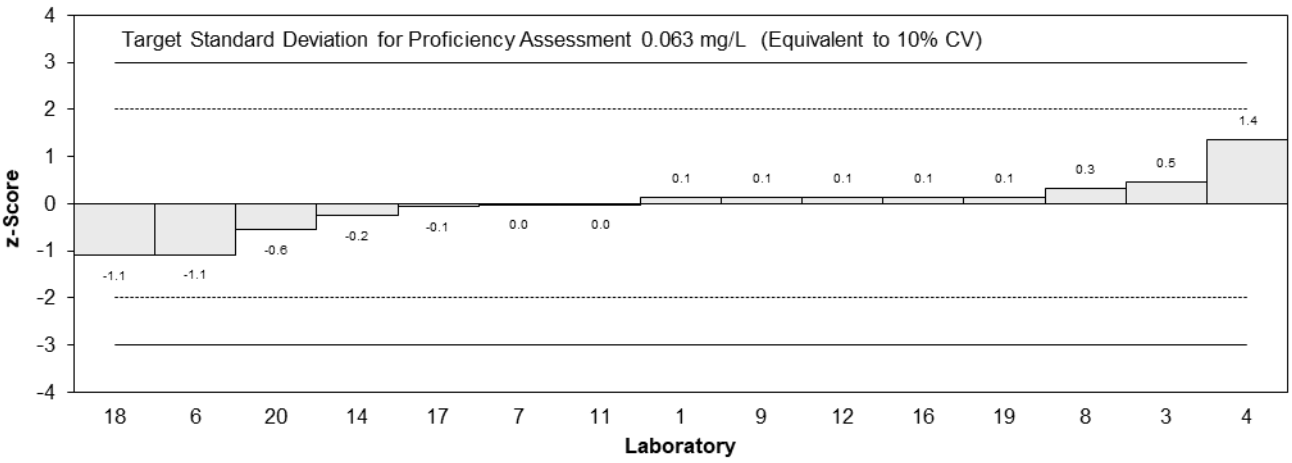
Participant Results

Lab. Code	Result	U	z	E_n
1	0.64	0.06	0.14	0.14
2	NT	NT		
3	0.66	0.2	0.46	0.14
4	0.716	0.0716	1.35	1.15
5	NT	NT		
6	0.563	0.01	-1.08	-3.30
7	0.63	0.15	-0.02	-0.01
8	0.651	0.018	0.32	0.79
9	0.64	0.13	0.14	0.07
10	NT	NT		
11	0.63	0.2	-0.02	0.00
12	0.64	0.13	0.14	0.07
13	NT	NT		
14	0.616	0.088	-0.24	-0.17
15	NT	NT		
16	0.64	0.2	0.14	0.04
17	0.627	0.05	-0.06	-0.08
18	0.562	0.06	-1.09	-1.10
19	0.64	0.065	0.14	0.13
20	0.596	0.06	-0.55	-0.56

Statistics

Assigned Value	0.631	0.018
Spike Value	0.646	0.067
Homogeneity Value	0.657	0.079
Robust Average	0.631	0.018
Median	0.640	0.011
Mean	0.630	0.019
N	15	
Max	0.716	
Min	0.562	
Robust SD	0.027	
Robust CV	4.4%	


Results: S2 - Fe
Assigned Value = 0.631 ± 0.018 mg/L
Kernel Density
Density
Result
Results (mg/L)
Laboratory
18 6 20 14 17 7 11 1 9 12 16 19 8 3 4 2 5 10 13 15 Md RA HV SV


z-Scores: S2 - Fe
Target Standard Deviation for Proficiency Assessment 0.063 mg/L (Equivalent to 10% CV)
z-Score
Laboratory
18 6 20 14 17 7 11 1 9 12 16 19 8 3 4
-1.1 -1.1 -0.6 -0.2 -0.1 0.0 0.0 0.1 0.1 0.1 0.1 0.1 0.3 0.5 1.4

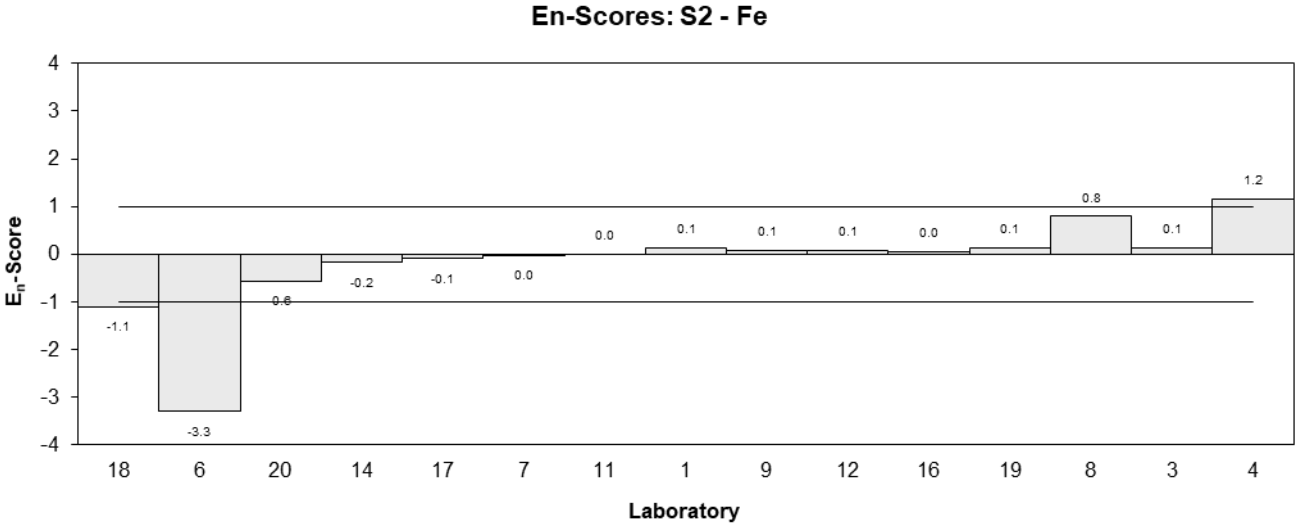

En-Scores: S2 - Fe
En-Score
Laboratory
18 6 20 14 17 7 11 1 9 12 16 19 8 3 4
-1.1 -3.3 -0.6 -0.2 -0.1 0.0 0.0 0.1 0.1 0.1 0.0 0.1 0.8 0.1 1.2

Figure 27

Table 32

Sample Details

Sample	S2
Analyte	Hg
Matrix	Potable Water
Unit	mg/L

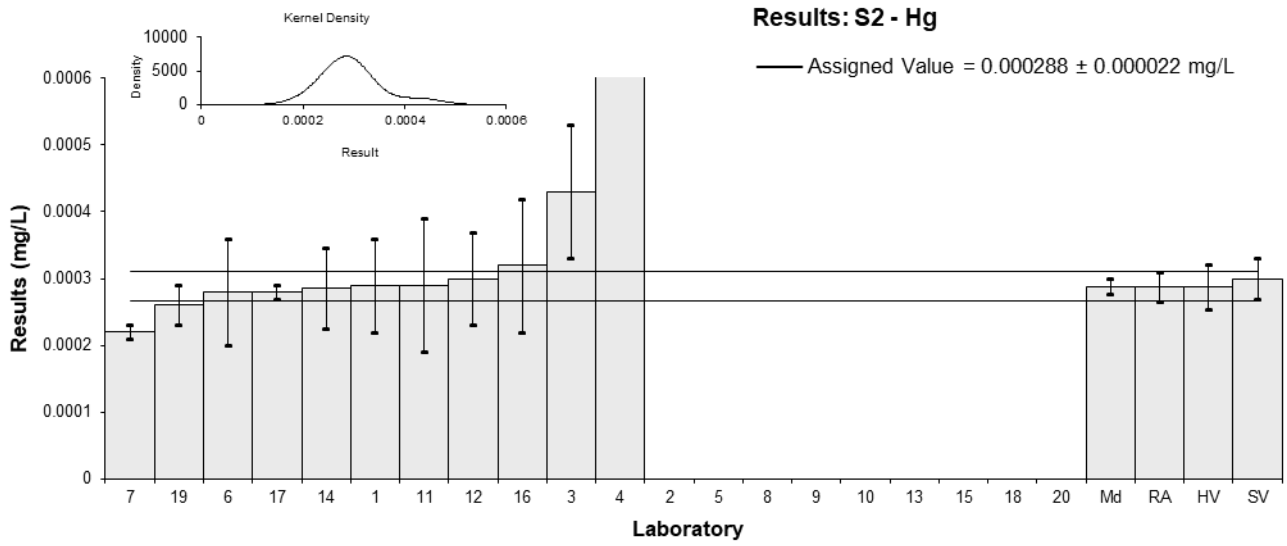
Participant Results

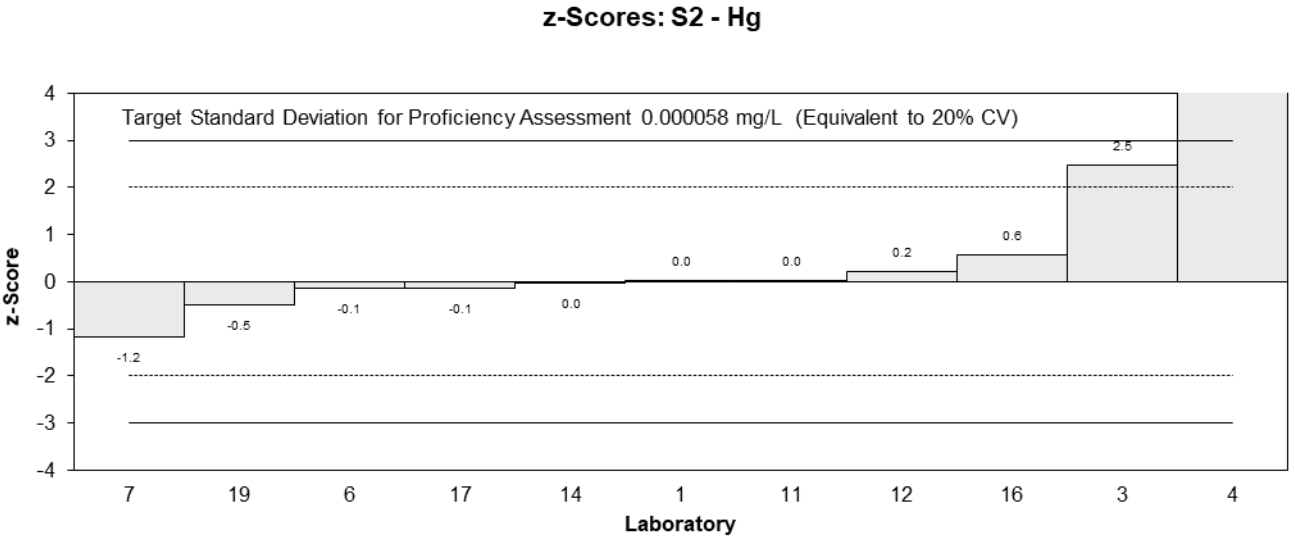
Lab. Code	Result	U	z	E_n
1	0.00029	0.00007	0.03	0.03
2	NT	NT		
3	0.00043	0.0001	2.47	1.39
4**	0.2755	0.0276	4,777.99	9.97
5	NT	NT		
6	0.00028	0.00008	-0.14	-0.10
7	0.00022	0.00001	-1.18	-2.81
8	NT	NT		
9	NR	NR		
10	NT	NT		
11	0.00029	0.0001	0.03	0.02
12	0.0003	0.00007	0.21	0.16
13	NT	NT		
14	0.000286	0.000060	-0.03	-0.03
15	NT	NT		
16	0.00032	0.0001	0.56	0.31
17	0.00028	0.00001	-0.14	-0.33
18	<0.0005	NR		
19	0.00026	0.00003	-0.49	-0.75
20	NT	NT		

** Gross Error

Statistics

Assigned Value	0.000288	0.000022
Spike Value	0.000300	0.000031
Homogeneity Value	0.000287	0.000034
Robust Average	0.000288	0.000022
Median	0.000288	0.000012
Mean	0.000296	0.000034
N	10	
Max	0.00043	
Min	0.00022	
Robust SD	0.000028	
Robust CV	9.8%	


Results: S2 - Hg
Assigned Value = 0.000288 ± 0.000022 mg/L
Kernel Density
Density
Result
Results (mg/L)
Laboratory
7 19 6 17 14 1 11 12 16 3 4 2 5 8 9 10 13 15 18 20 Md RA HV SV


z-Scores: S2 - Hg
Target Standard Deviation for Proficiency Assessment 0.000058 mg/L (Equivalent to 20% CV)
z-Score
Laboratory
7 19 6 17 14 1 11 12 16 3 4
-1.2 -0.5 -0.1 -0.1 0.0 0.0 0.0 0.2 0.6 2.5

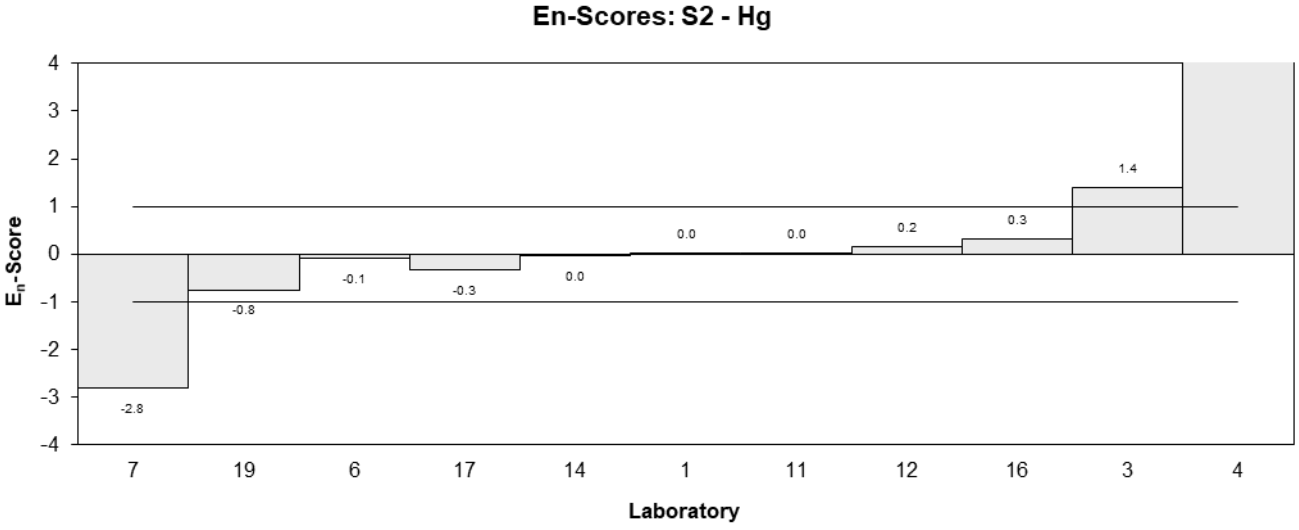

En-Scores: S2 - Hg
En-Score
Laboratory
7 19 6 17 14 1 11 12 16 3 4
-2.8 -0.8 -0.1 -0.3 0.0 0.0 0.0 0.2 0.3 1.4

Figure 28

Table 33

Sample Details

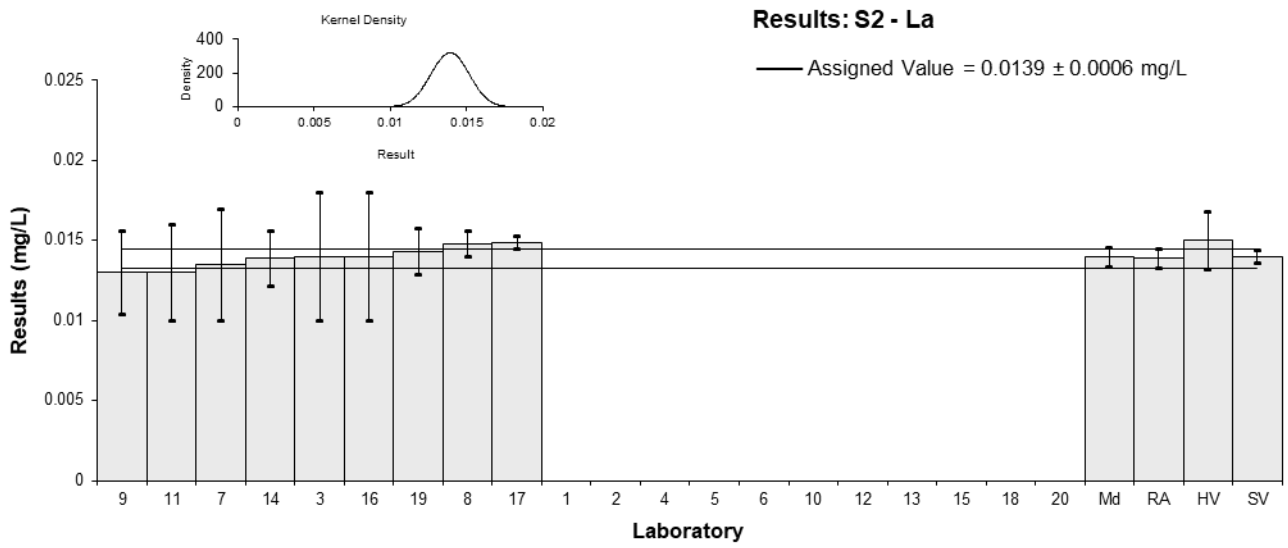
Sample	S2
Analyte	La
Matrix	Potable Water
Unit	mg/L

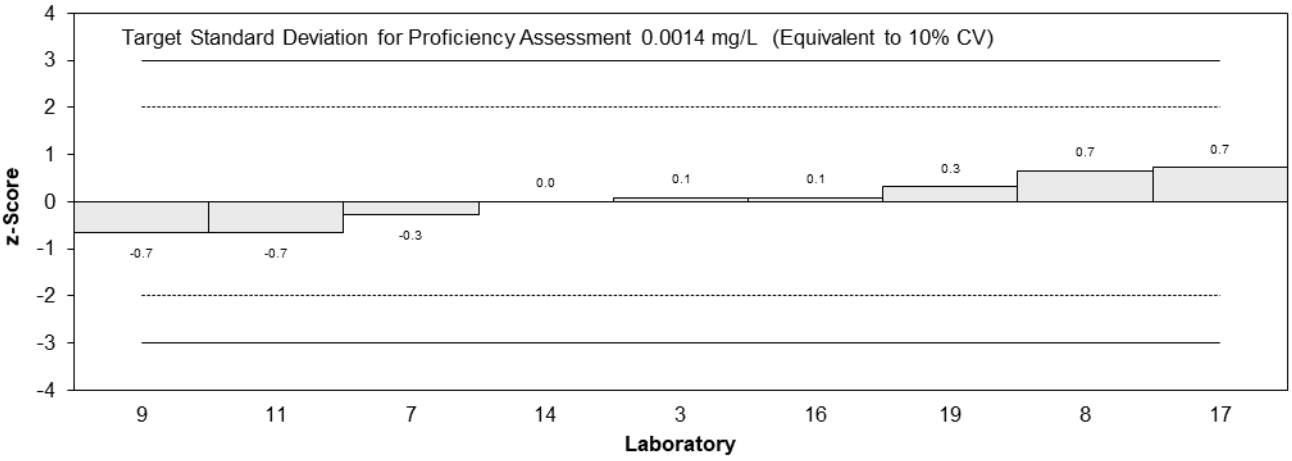
Participant Results

Lab. Code	Result	U	z	E_n
1	NT	NT		
2	NT	NT		
3	0.014	0.004	0.07	0.02
4	NT	NT		
5	NT	NT		
6	NT	NT		
7	0.0135	0.0035	-0.29	-0.11
8	0.0148	0.0008	0.65	0.90
9	0.013	0.0026	-0.65	-0.34
10	NT	NT		
11	0.013	0.003	-0.65	-0.29
12	NT	NT		
13	NT	NT		
14	0.0139	0.0017	0.00	0.00
15	NT	NT		
16	0.014	0.004	0.07	0.02
17	0.0149	0.00038	0.72	1.41
18	NT	NT		
19	0.01433	0.00144	0.31	0.28
20	NT	NT		

Statistics

Assigned Value	0.0139	0.0006
Spike Value	0.0140	0.0004
Homogeneity Value	0.0150	0.0018
Robust Average	0.0139	0.0006
Median	0.0140	0.0006
Mean	0.0139	0.0005
N	9	
Max	0.0149	
Min	0.013	
Robust SD	0.00078	
Robust CV	5.6%	


Kernel Density
Density
Result
Results: S2 - La
Assigned Value = 0.0139 ± 0.0006 mg/L
Results (mg/L)
Laboratory
9 11 7 14 3 16 19 8 17 1 2 4 5 6 10 12 13 15 18 20 Md RA HV SV


z-Scores: S2 - La
Target Standard Deviation for Proficiency Assessment 0.0014 mg/L (Equivalent to 10% CV)
z-Score
-0.7 -0.7 -0.3 0.0 0.1 0.1 0.3 0.7 0.7
Laboratory
9 11 7 14 3 16 19 8 17

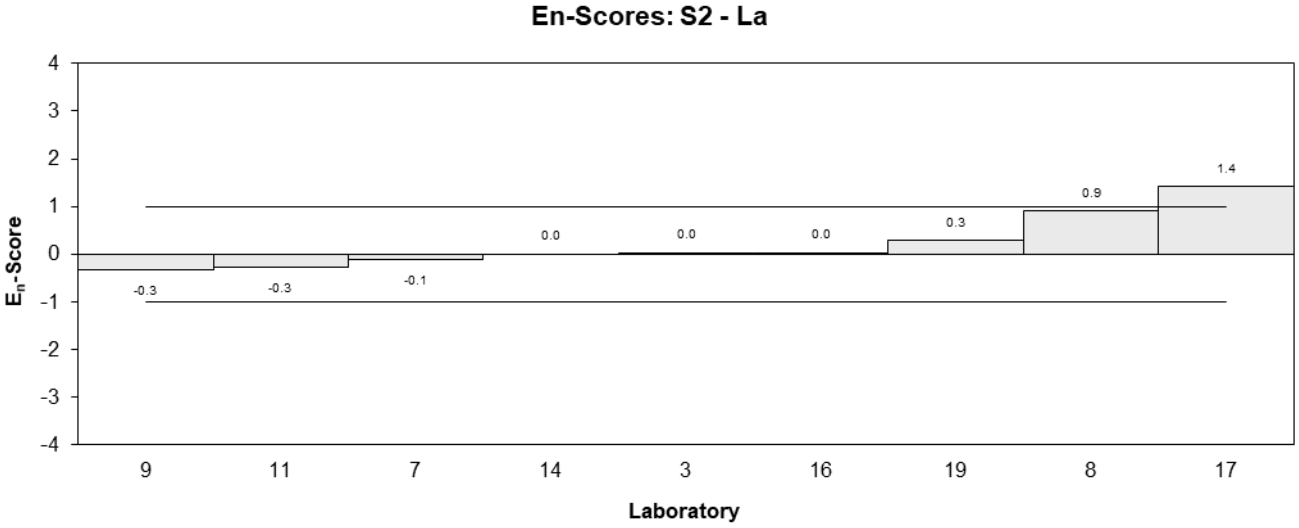

En-Scores: S2 - La
En-Score
-0.3 -0.3 -0.1 0.0 0.0 0.0 0.3 0.9 1.4
Laboratory
9 11 7 14 3 16 19 8 17

Figure 29

Table 34

Sample Details

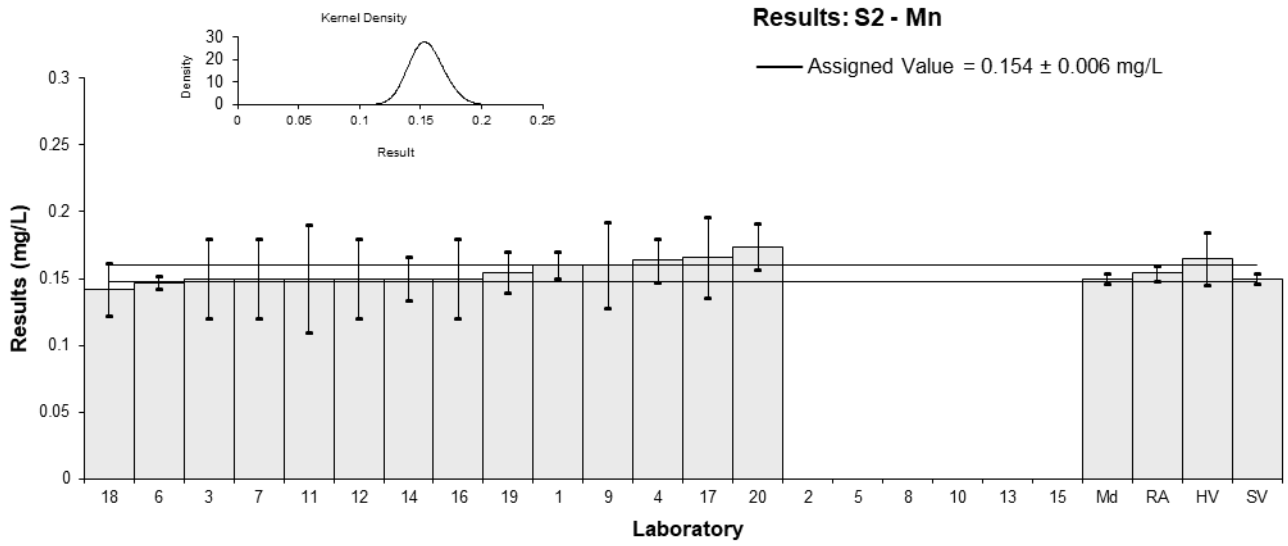
Sample	S2
Analyte	Mn
Matrix	Potable Water
Unit	mg/L

Participant Results

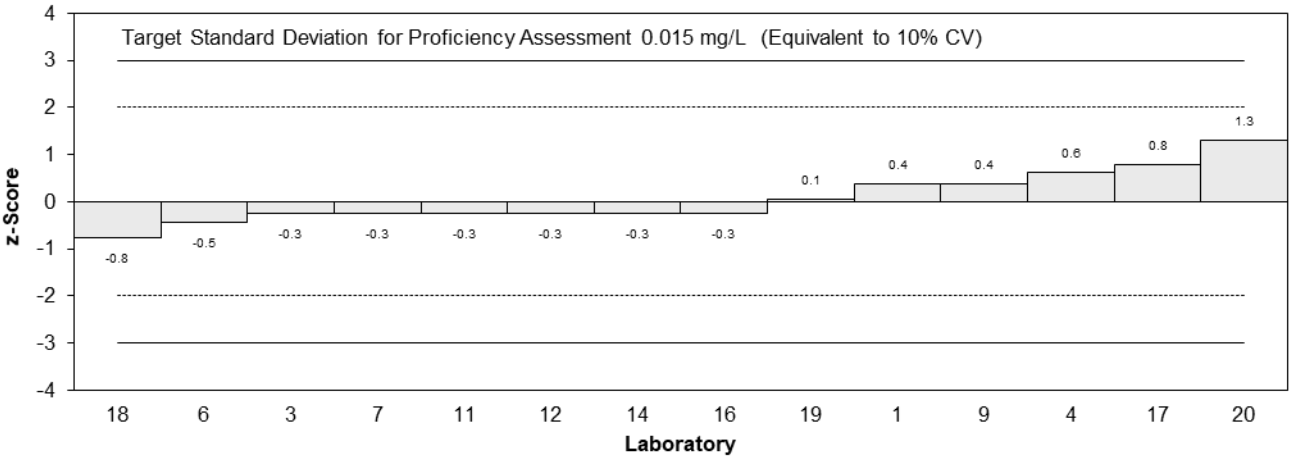
Lab. Code	Result	U	z	E_n
1	0.16	0.01	0.39	0.51
2	NT	NT		
3	0.15	0.03	-0.26	-0.13
4	0.1635	0.0164	0.62	0.54
5	NT	NT		
6	0.147	0.005	-0.45	-0.90
7	0.15	0.03	-0.26	-0.13
8	NT	NT		
9	0.16	0.0320	0.39	0.18
10	NT	NT		
11	0.15	0.04	-0.26	-0.10
12	0.15	0.03	-0.26	-0.13
13	NT	NT		
14	0.150	0.016	-0.26	-0.23
15	NT	NT		
16	0.15	0.03	-0.26	-0.13
17	0.166	0.03	0.78	0.39
18	0.142	0.02	-0.78	-0.57
19	0.15473	0.0155	0.05	0.04
20	0.174	0.017	1.30	1.11

Statistics

Assigned Value	0.154	0.006
Spike Value	0.150	0.004
Homogeneity Value	0.165	0.020
Robust Average	0.154	0.006
Median	0.150	0.004
Mean	0.155	0.005
N	14	
Max	0.174	
Min	0.142	
Robust SD	0.0088	
Robust CV	5.7%	



z-Scores: S2 - Mn



En-Scores: S2 - Mn

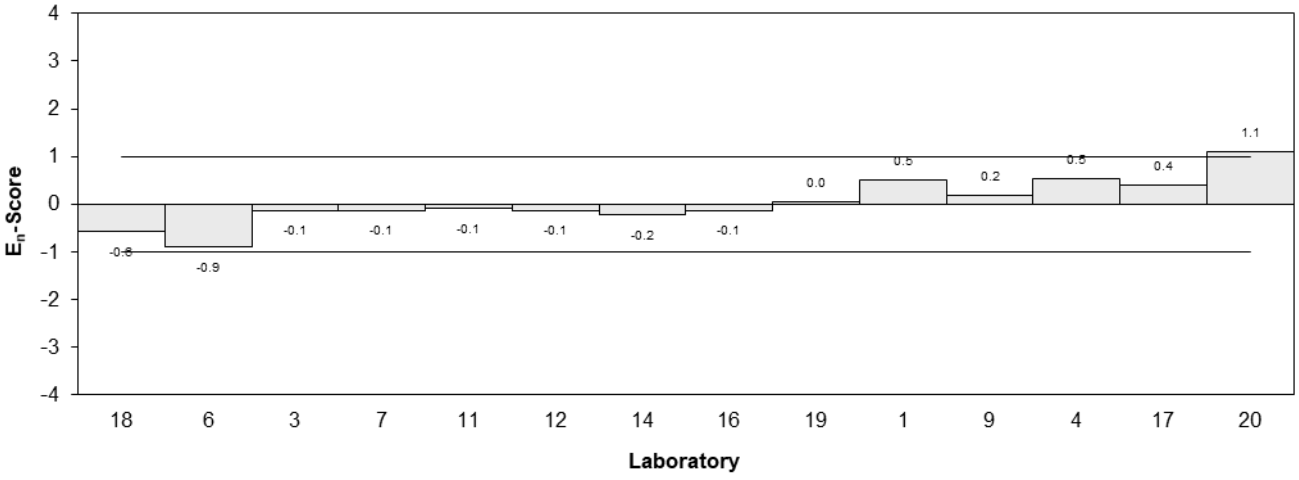


Figure 30

Table 35

Sample Details

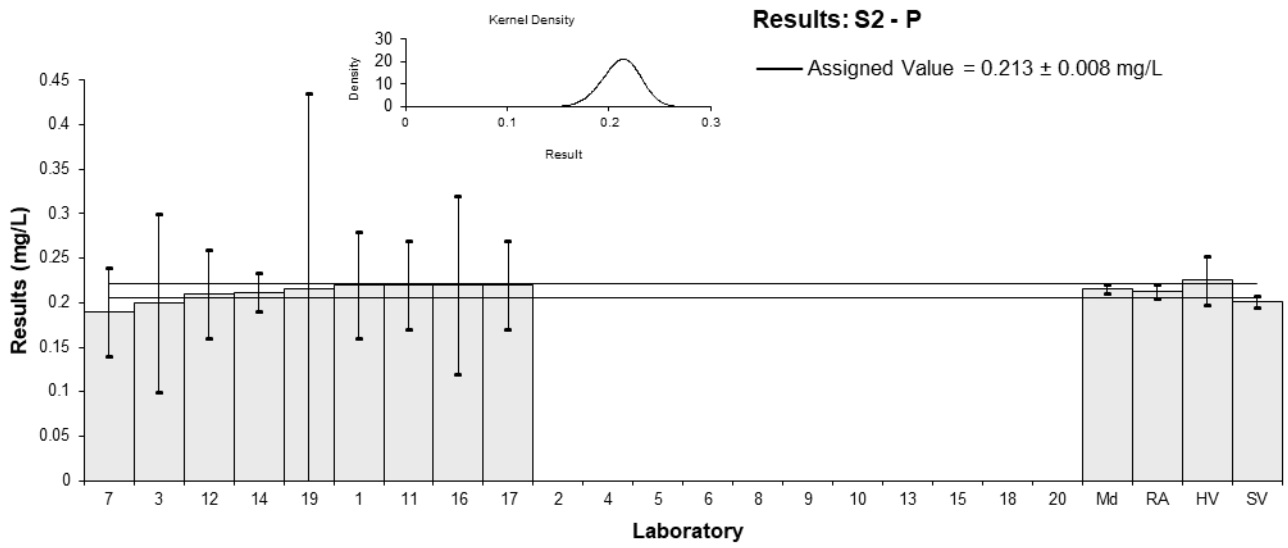
Sample	S2
Analyte	P
Matrix	Potable Water
Unit	mg/L

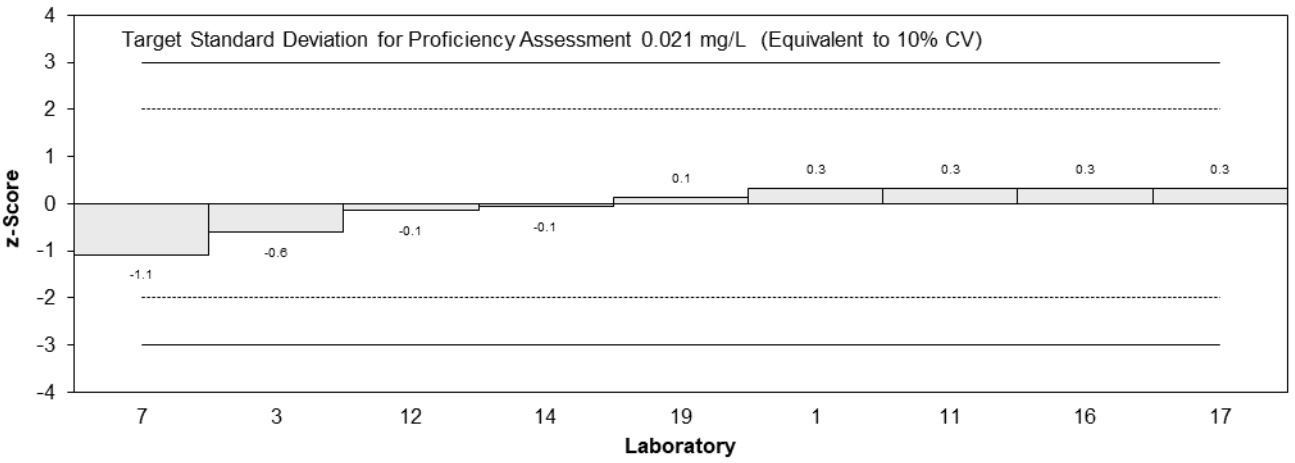
Participant Results

Lab. Code	Result	U	z	E_n
1	0.22	0.06	0.33	0.12
2	NT	NT		
3	0.20	0.1	-0.61	-0.13
4	NT	NT		
5	NT	NT		
6	NT	NT		
7	0.19	0.05	-1.08	-0.45
8	NT	NT		
9	NR	NR		
10	NT	NT		
11	0.22	0.05	0.33	0.14
12	0.21	0.05	-0.14	-0.06
13	NT	NT		
14	0.212	0.022	-0.05	-0.04
15	NT	NT		
16	0.22	0.1	0.33	0.07
17	0.22	0.05	0.33	0.14
18	<0.5	NR		
19	0.216	0.22	0.14	0.01
20	NT	NT		

Statistics

Assigned Value	0.213	0.008
Spike Value	0.201	0.006
Homogeneity Value	0.225	0.027
Robust Average	0.213	0.008
Median	0.216	0.005
Mean	0.212	0.007
N	9	
Max	0.22	
Min	0.19	
Robust SD	0.0099	
Robust CV	4.6%	


Results: S2 - P
Assigned Value = 0.213 ± 0.008 mg/L
Kernel Density
Density
Result
Results (mg/L)
Laboratory
7 3 12 14 19 1 11 16 17 2 4 5 6 8 9 10 13 15 18 20 Md RA HV SV


z-Scores: S2 - P
Target Standard Deviation for Proficiency Assessment 0.021 mg/L (Equivalent to 10% CV)
z-Score
-1.1 -0.6 -0.1 -0.1 0.1 0.3 0.3 0.3 0.3
Laboratory
7 3 12 14 19 1 11 16 17

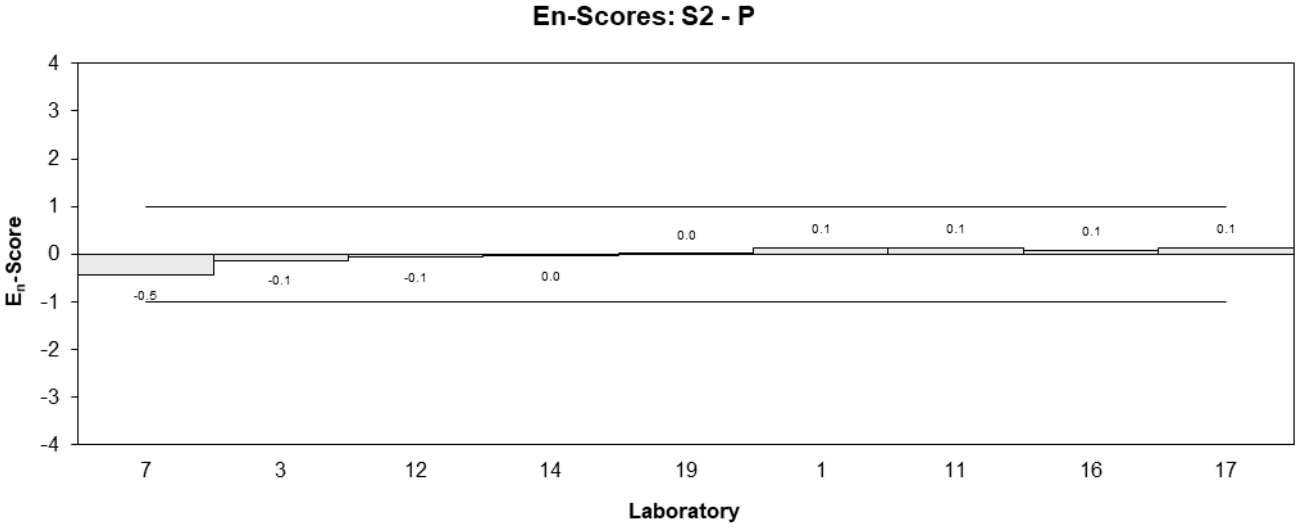

En-Scores: S2 - P
En-Score
-0.5 -0.1 -0.1 0.0 0.0 0.1 0.1 0.1 0.1
Laboratory
7 3 12 14 19 1 11 16 17

Figure 31

Table 36

Sample Details

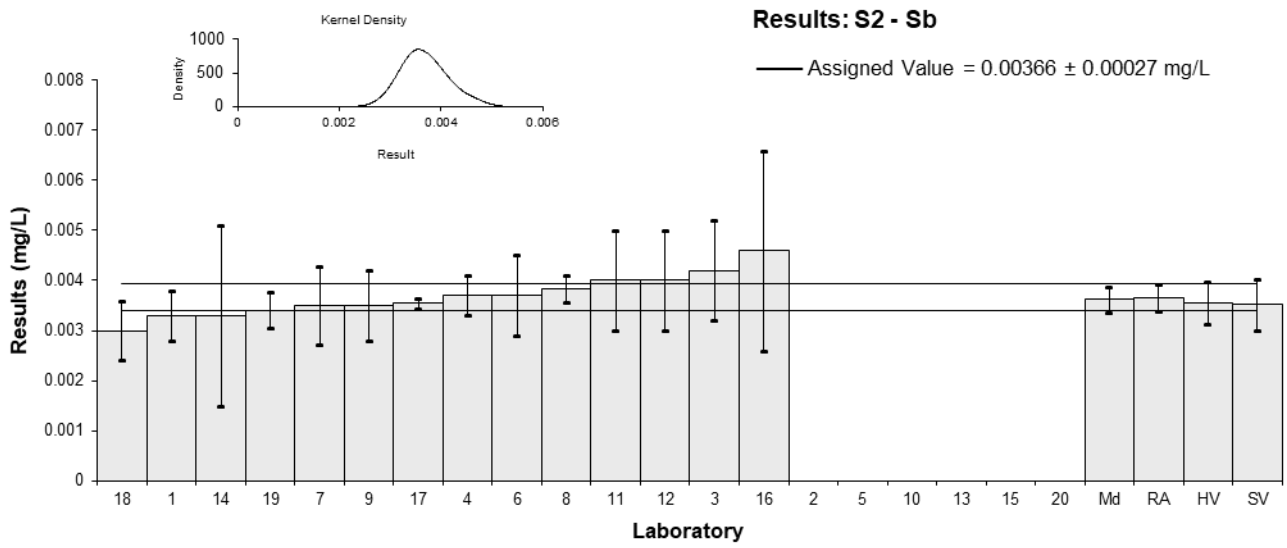
Sample	S2
Analyte	Sb
Matrix	Potable Water
Unit	mg/L

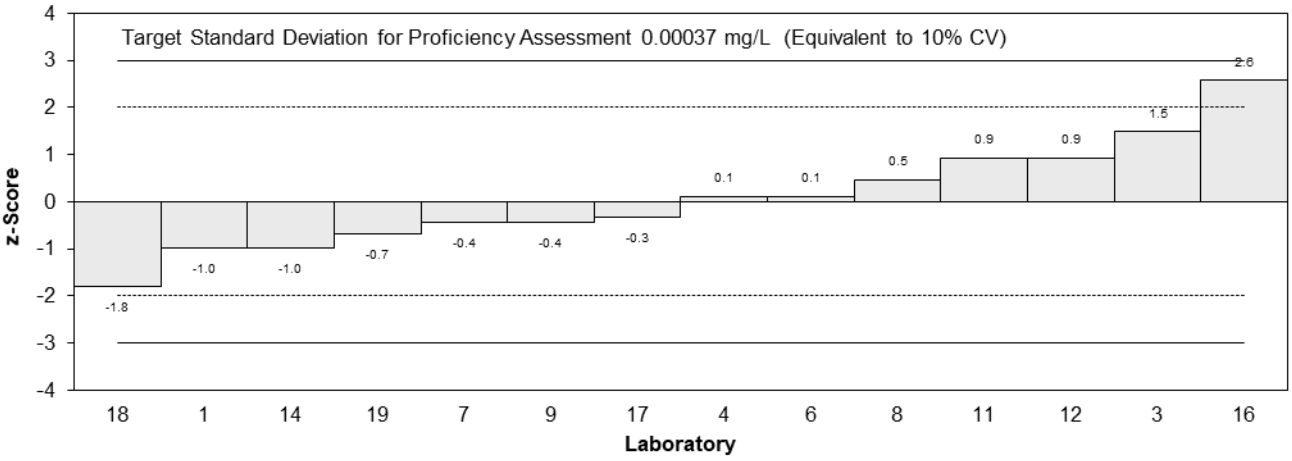
Participant Results

Lab. Code	Result	U	z	E_n
1	0.0033	0.0005	-0.98	-0.63
2	NT	NT		
3	0.0042	0.001	1.48	0.52
4	0.0037	0.0004	0.11	0.08
5	NT	NT		
6	0.0037	0.0008	0.11	0.05
7	0.00350	0.00077	-0.44	-0.20
8	0.00383	0.00026	0.46	0.45
9	0.0035	0.0007	-0.44	-0.21
10	NT	NT		
11	0.004	0.001	0.93	0.33
12	0.004	0.001	0.93	0.33
13	NT	NT		
14	0.0033	0.0018	-0.98	-0.20
15	NT	NT		
16	0.0046	0.002	2.57	0.47
17	0.00354	0.0001	-0.33	-0.42
18	0.003	0.0006	-1.80	-1.00
19	0.00341	0.00035	-0.68	-0.57
20	NT	NT		

Statistics

Assigned Value	0.00366	0.00027
Spike Value	0.00352	0.00051
Homogeneity Value	0.00355	0.00043
Robust Average	0.00366	0.00027
Median	0.00362	0.00026
Mean	0.00368	0.00022
N	14	
Max	0.0046	
Min	0.003	
Robust SD	0.00041	
Robust CV	11%	


Kernel Density
Density
1000
500
0
0
0.002
0.004
0.006
Result
Results: S2 - Sb
Assigned Value = 0.00366 ± 0.00027 mg/L
Results (mg/L)
0.008
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0
18 1 14 19 7 9 17 4 6 8 11 12 3 16 2 5 10 13 15 20 Md RA HV SV
Laboratory


z-Scores: S2 - Sb
Target Standard Deviation for Proficiency Assessment 0.00037 mg/L (Equivalent to 10% CV)
z-Score
4
3
2
1
0
-1
-2
-3
-4
-1.8
-1.0
-1.0
-0.7
-0.4
-0.4
-0.3
0.1
0.1
0.5
0.9
0.9
1.5
2.6
18 1 14 19 7 9 17 4 6 8 11 12 3 16
Laboratory

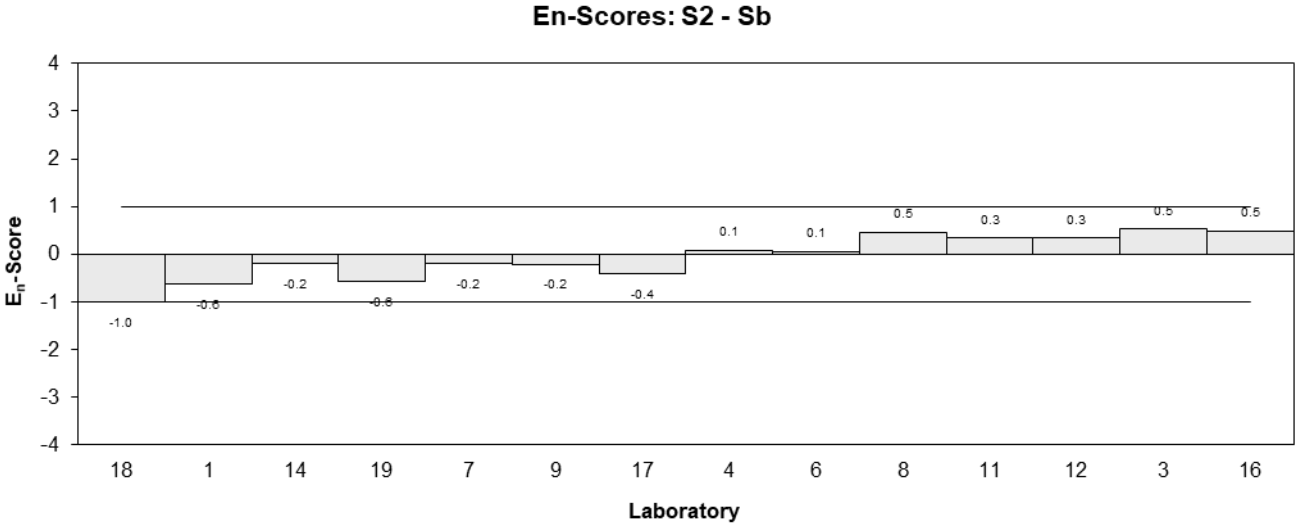

En-Scores: S2 - Sb
En-Score
4
3
2
1
0
-1
-2
-3
-4
-1.0
-0.6
-0.2
-0.6
-0.2
-0.2
-0.4
0.1
0.1
0.5
0.3
0.3
0.5
0.5
18 1 14 19 7 9 17 4 6 8 11 12 3 16
Laboratory

Figure 32

Table 37

Sample Details

Sample	S2
Analyte	Sn
Matrix	Potable Water
Unit	mg/L

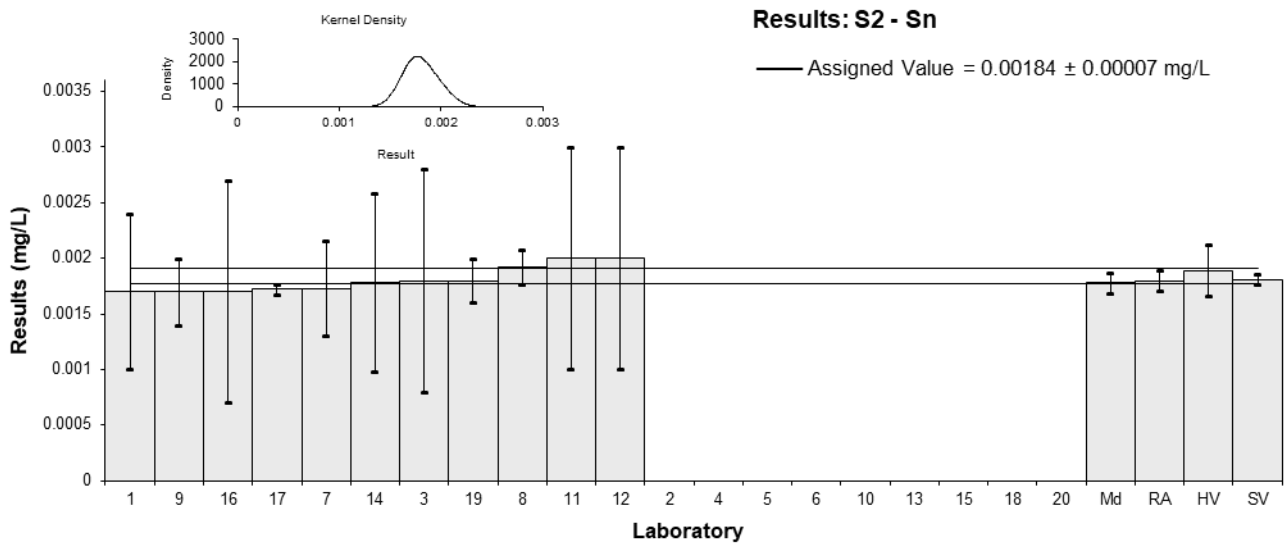
Participant Results

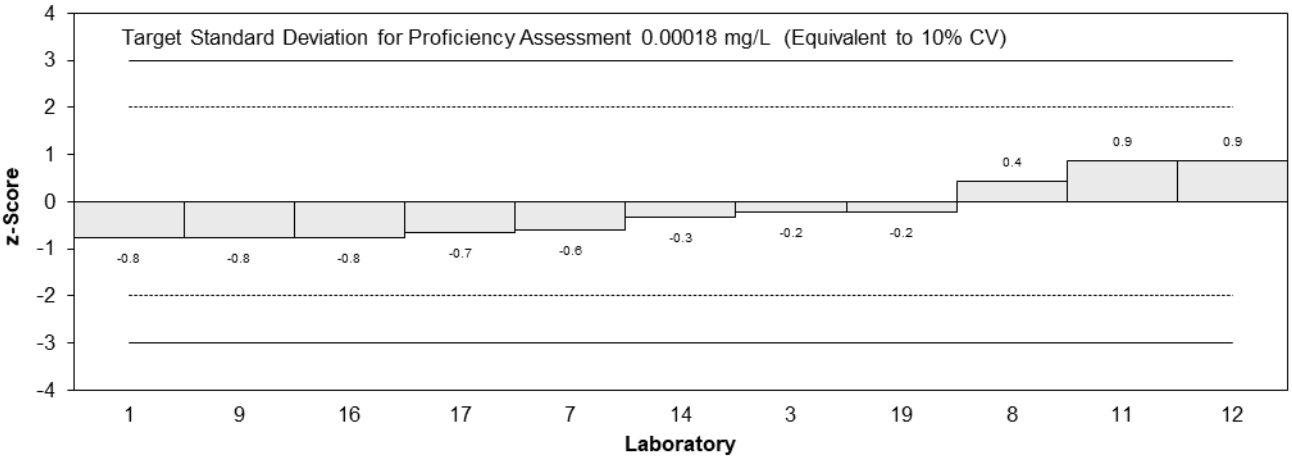
Lab. Code	Result	U	z	E_n
1	0.0017	0.0007	-0.76	-0.20
2	NT	NT		
3	0.0018	0.001	-0.22	-0.04
4	<0.002	NR		
5	NT	NT		
6	NT	NT		
7	0.00173	0.00043	-0.60	-0.25
8	0.00192	0.00016	0.43	0.46
9	0.0017	0.0003	-0.76	-0.45
10	NT	NT		
11	0.002	0.001	0.87	0.16
12	0.002	0.001	0.87	0.16
13	NT	NT		
14	0.00178	0.00080	-0.33	-0.07
15	NT	NT		
16	0.0017	0.001	-0.76	-0.14
17	0.00172	0.00005	-0.65	-1.39
18	NT	NT		
19	0.0018	0.0002	-0.22	-0.19
20	NT	NT		

Statistics

Assigned Value*	0.00184	0.00007
Spike Value	0.00181	0.00005
Homogeneity Value	0.00189	0.00023
Robust Average	0.00180	0.00009
Median	0.00178	0.00009
Mean	0.00180	0.00007
N	11	
Max	0.002	
Min	0.0017	
Robust SD	0.00012	
Robust CV	6.5%	

*The Assigned Value was calculated as the Robust Average of the combined results of Samples S1 and S2


Results: S2 - Sn
Assigned Value = 0.00184 ± 0.00007 mg/L
Kernel Density
Density
Result
Results (mg/L)
Laboratory
1 9 16 17 7 14 3 19 8 11 12 2 4 5 6 10 13 15 18 20 Md RA HV SV


z-Scores: S2 - Sn
Target Standard Deviation for Proficiency Assessment 0.00018 mg/L (Equivalent to 10% CV)
z-Score
Laboratory
1 9 16 17 7 14 3 19 8 11 12

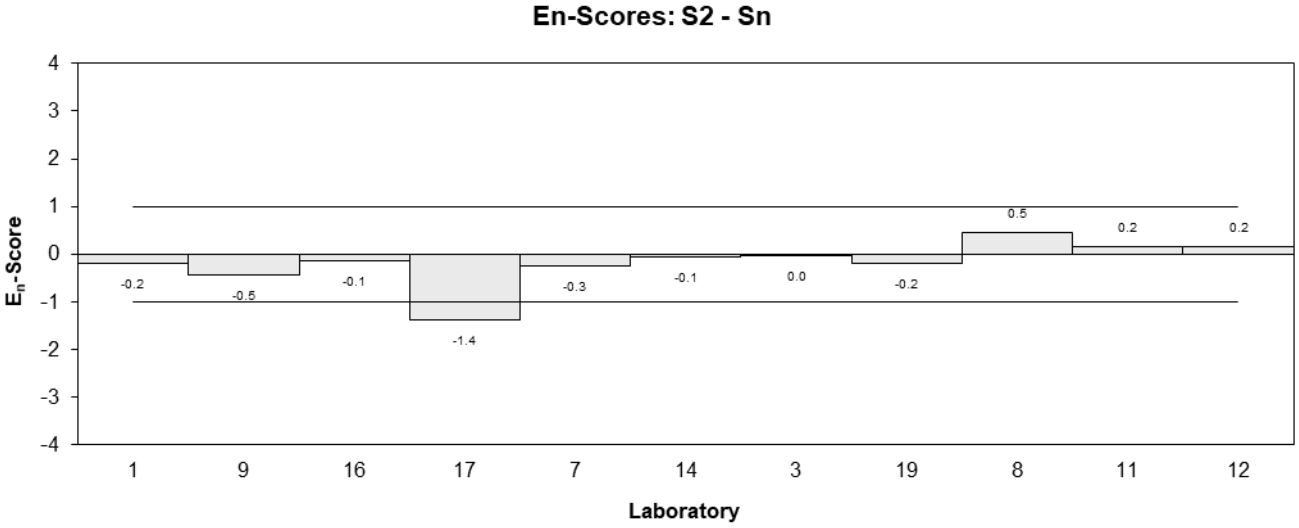

En-Scores: S2 - Sn
En-Score
Laboratory
1 9 16 17 7 14 3 19 8 11 12

Figure 33

Table 38

Sample Details

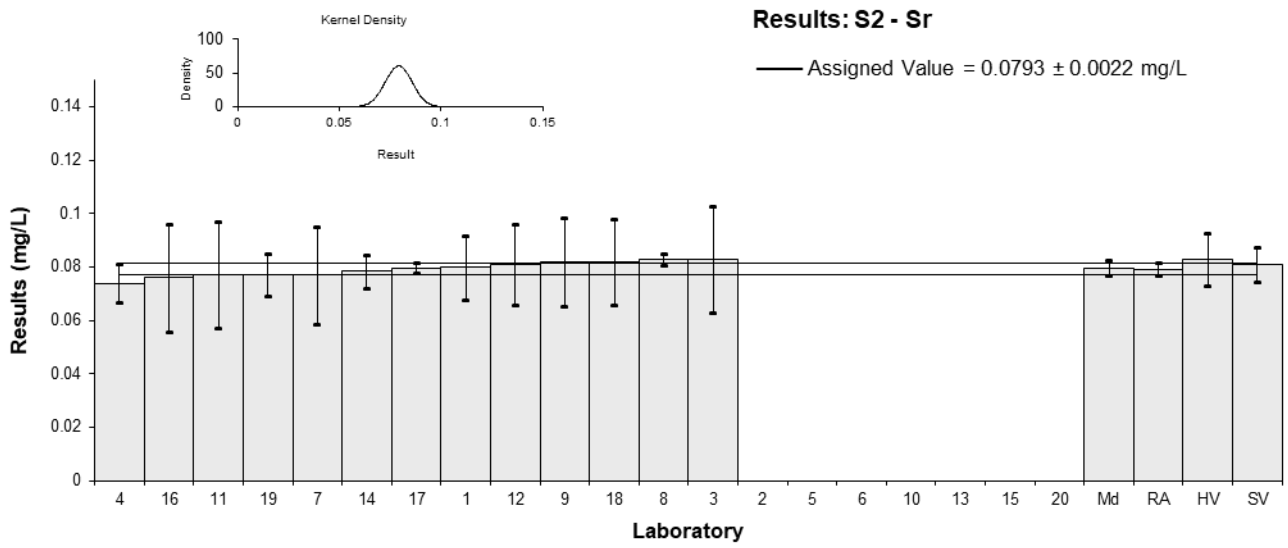
Sample	S2
Analyte	Sr
Matrix	Potable Water
Unit	mg/L

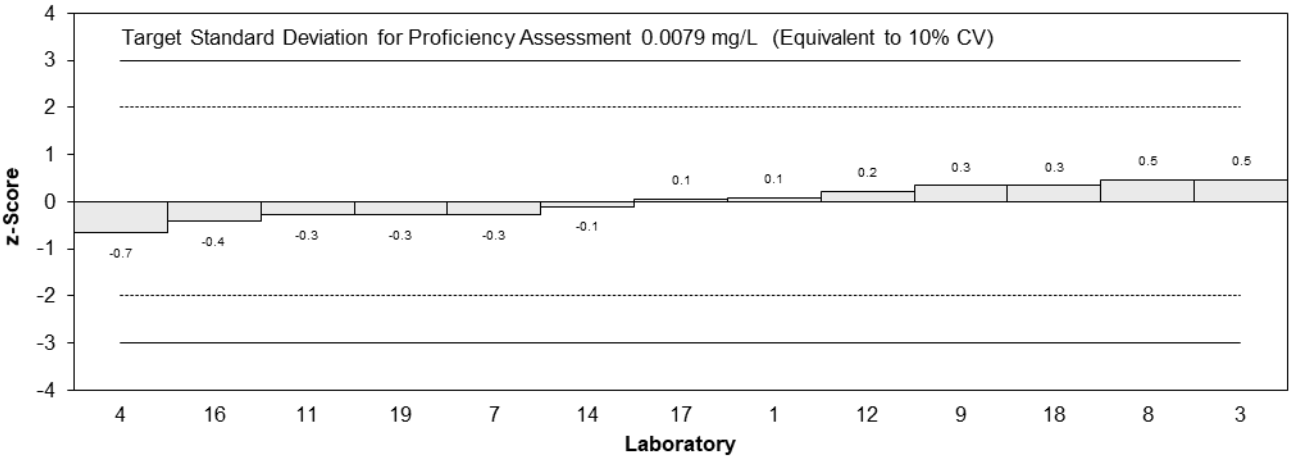
Participant Results

Lab. Code	Result	U	z	E_n
1	0.080	0.012	0.09	0.06
2	NT	NT		
3	0.083	0.02	0.47	0.18
4	0.074	0.0074	-0.67	-0.69
5	NT	NT		
6	NT	NT		
7	0.0771	0.0183	-0.28	-0.12
8	0.0829	0.0020	0.45	1.21
9	0.082	0.0164	0.34	0.16
10	NT	NT		
11	0.077	0.02	-0.29	-0.11
12	0.081	0.015	0.21	0.11
13	NT	NT		
14	0.0785	0.0063	-0.10	-0.12
15	NT	NT		
16	0.076	0.02	-0.42	-0.16
17	0.0798	0.002	0.06	0.17
18	0.082	0.016	0.34	0.17
19	0.07708	0.0078	-0.28	-0.27
20	NT	NT		

Statistics

Assigned Value	0.0793	0.0022
Spike Value	0.0810	0.0064
Homogeneity Value	0.083	0.010
Robust Average	0.0793	0.0022
Median	0.0798	0.0028
Mean	0.0793	0.0016
N	13	
Max	0.083	
Min	0.074	
Robust SD	0.0032	
Robust CV	4%	


Kernel Density
Density
Result
Results: S2 - Sr
Assigned Value = 0.0793 ± 0.0022 mg/L
Results (mg/L)
Laboratory
4 16 11 19 7 14 17 1 12 9 18 8 3 2 5 6 10 13 15 20 Md RA HV SV


z-Scores: S2 - Sr
Target Standard Deviation for Proficiency Assessment 0.0079 mg/L (Equivalent to 10% CV)
z-Score
Laboratory
4 16 11 19 7 14 17 1 12 9 18 8 3
-0.7 -0.4 -0.3 -0.3 -0.3 -0.1 0.1 0.1 0.2 0.3 0.3 0.5 0.5

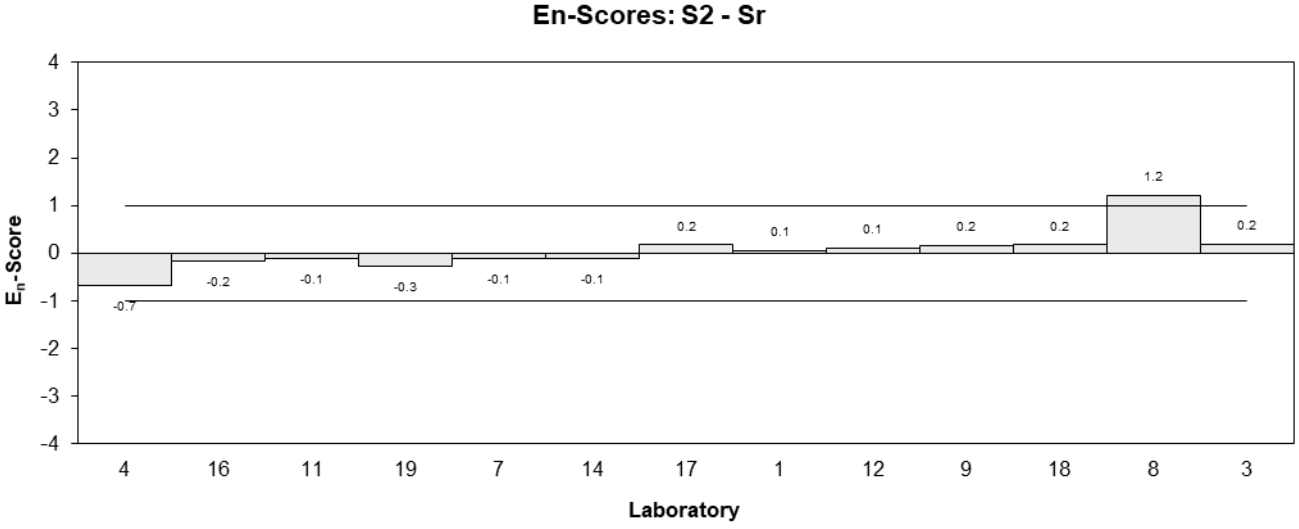

En-Scores: S2 - Sr
En-Score
Laboratory
4 16 11 19 7 14 17 1 12 9 18 8 3
-0.7 -0.2 -0.1 -0.3 -0.1 -0.1 0.2 0.1 0.1 0.2 0.2 1.2 0.2

Figure 34

Table 39

Sample Details

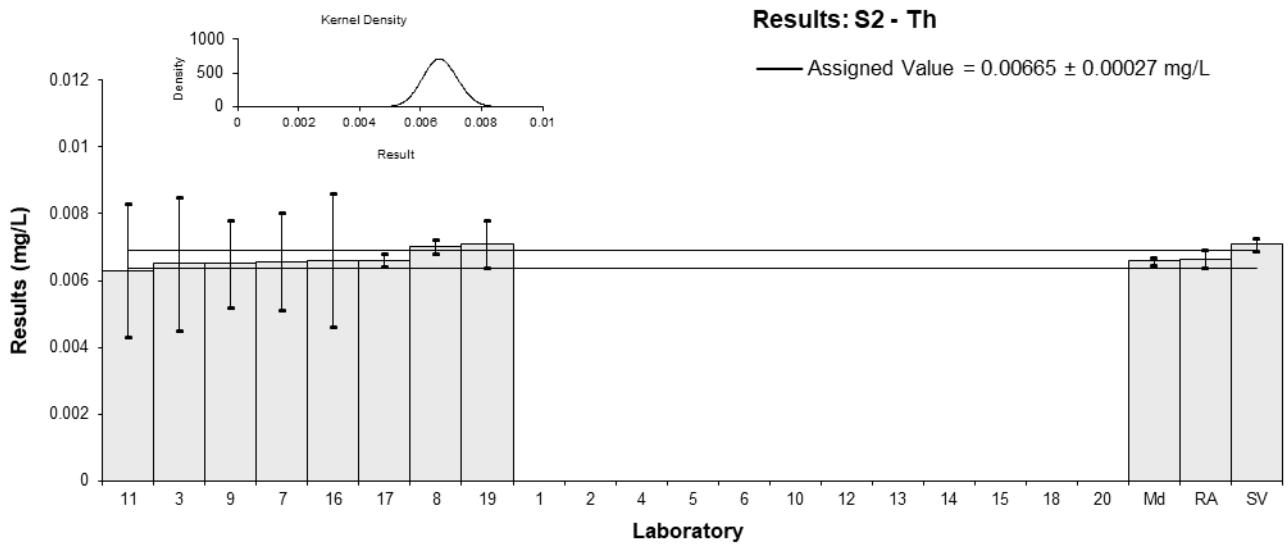
Sample	S2
Analyte	Th
Matrix	Potable Water
Unit	mg/L

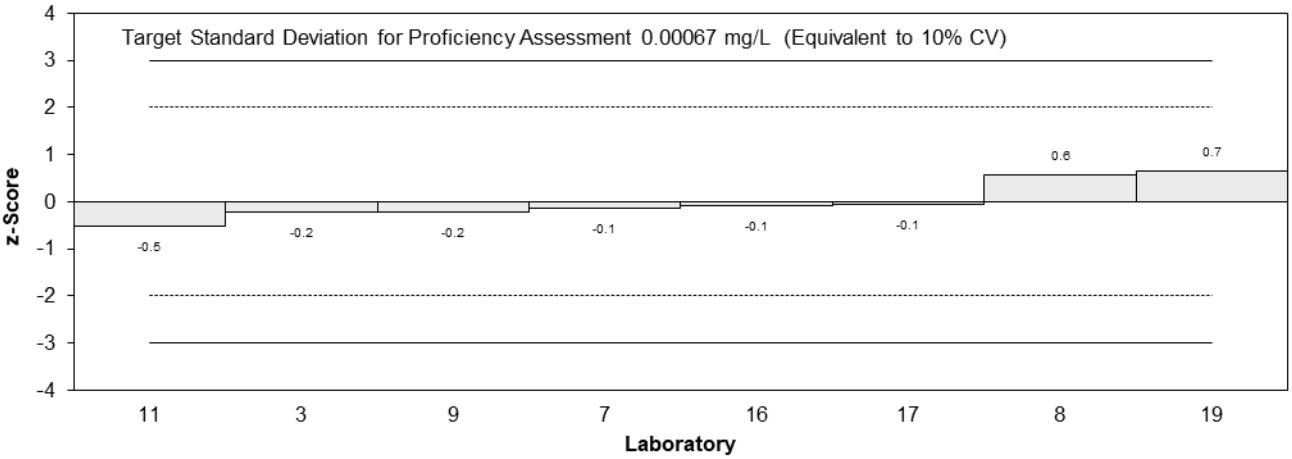
Participant Results

Lab. Code	Result	U	z	E_n
1	NT	NT		
2	NT	NT		
3	0.0065	0.002	-0.23	-0.07
4	NT	NT		
5	NT	NT		
6	NT	NT		
7	0.00656	0.00146	-0.14	-0.06
8	0.00702	0.00020	0.56	1.10
9	0.0065	0.0013	-0.23	-0.11
10	NT	NT		
11	0.0063	0.002	-0.53	-0.17
12	NT	NT		
13	NT	NT		
14	NT	NT		
15	NT	NT		
16	0.0066	0.002	-0.08	-0.02
17	0.00661	0.0002	-0.06	-0.12
18	<0.010	NR		
19	0.00709	0.00071	0.66	0.58
20	NT	NT		

Statistics

Assigned Value	0.00665	0.00027
Spike Value	0.00708	0.00020
Robust Average	0.00665	0.00027
Median	0.00658	0.00010
Mean	0.00665	0.00019
N	8	
Max	0.00709	
Min	0.0063	
Robust SD	0.00031	
Robust CV	4.6%	


Kernel Density
Density
1000
500
0
0
0.002
0.004
0.006
0.008
0.01
Result
Results: S2 - Th
Assigned Value = 0.00665 ± 0.00027 mg/L
Results (mg/L)
0.012
0.01
0.008
0.006
0.004
0.002
0
11 3 9 7 16 17 8 19 1 2 4 5 6 10 12 13 14 15 18 20 Md RA SV
Laboratory


z-Scores: S2 - Th
Target Standard Deviation for Proficiency Assessment 0.00067 mg/L (Equivalent to 10% CV)
z-Score
4
3
2
1
0
-1
-2
-3
-4
-0.5
-0.2
-0.2
-0.1
-0.1
-0.1
0.6
0.7
11 3 9 7 16 17 8 19
Laboratory

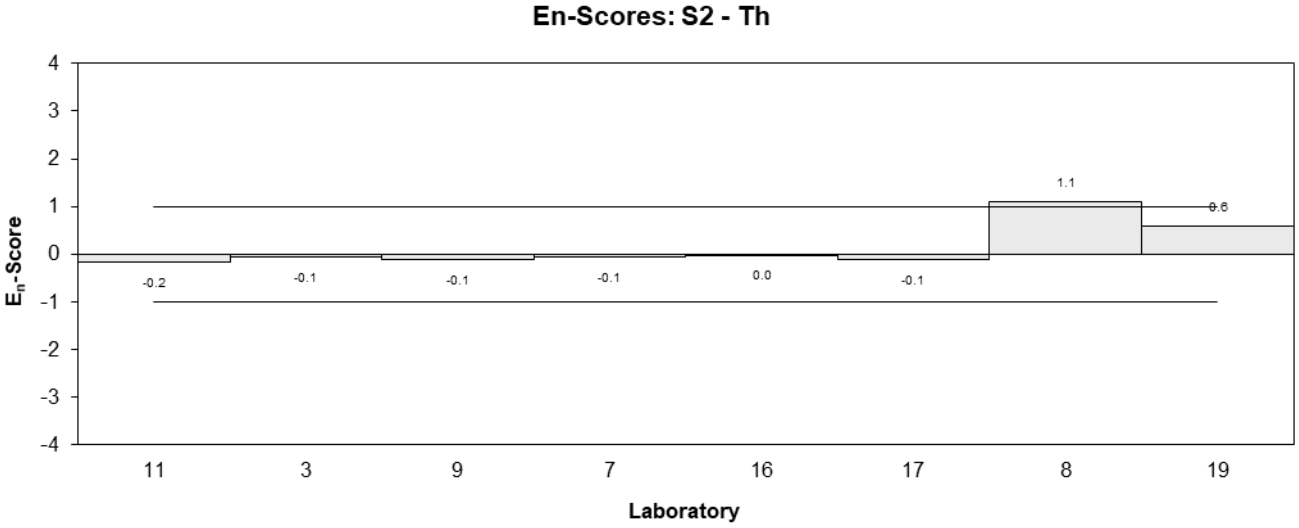

En-Scores: S2 - Th
En-Score
4
3
2
1
0
-1
-2
-3
-4
-0.2
-0.1
-0.1
-0.1
0.0
-0.1
1.1
0.6
11 3 9 7 16 17 8 19
Laboratory

Figure 35

Table 40

Sample Details

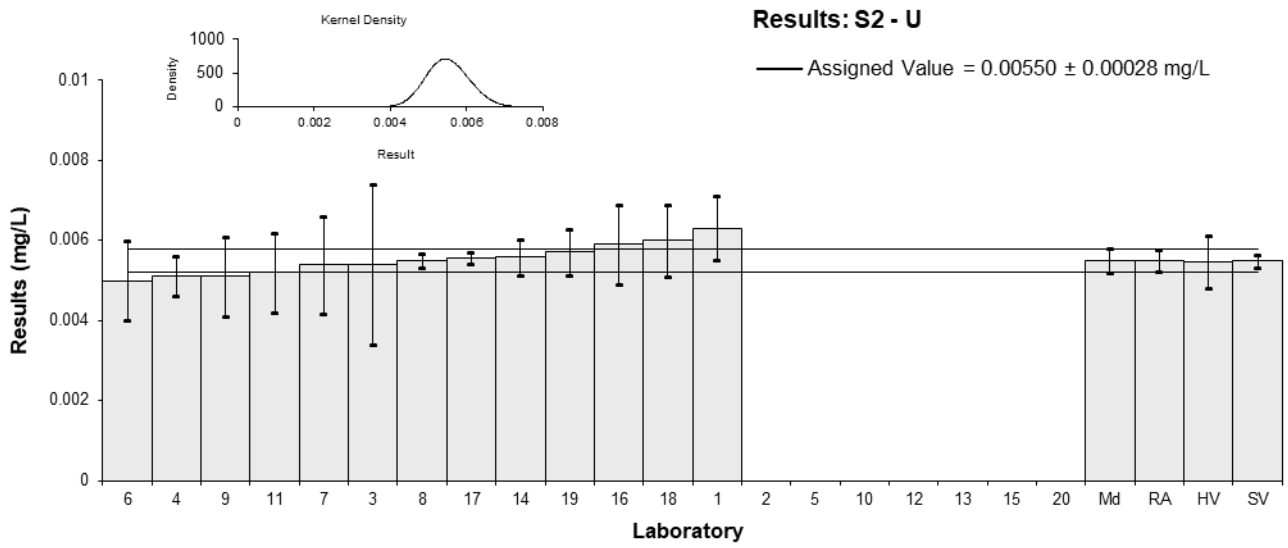
Sample	S2
Analyte	U
Matrix	Potable Water
Unit	mg/L

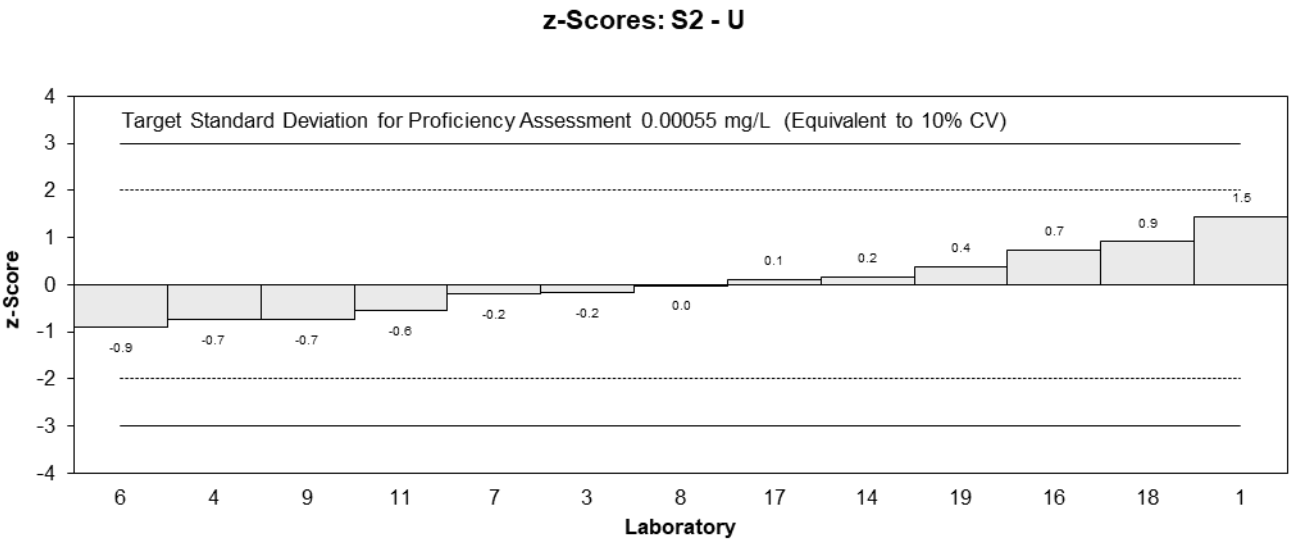
Participant Results

Lab. Code	Result	U	z	E_n
1	0.0063	0.0008	1.45	0.94
2	NT	NT		
3	0.0054	0.002	-0.18	-0.05
4	0.0051	0.0005	-0.73	-0.70
5	NT	NT		
6	0.005	0.001	-0.91	-0.48
7	0.00539	0.00121	-0.20	-0.09
8	0.00549	0.00017	-0.02	-0.03
9	0.0051	0.0010	-0.73	-0.39
10	NT	NT		
11	0.0052	0.001	-0.55	-0.29
12	NT	NT		
13	NT	NT		
14	0.00558	0.00045	0.15	0.15
15	NT	NT		
16	0.0059	0.001	0.73	0.39
17	0.00556	0.00015	0.11	0.19
18	0.006	0.0009	0.91	0.53
19	0.005717	0.00058	0.39	0.34
20	NT	NT		

Statistics

Assigned Value	0.00550	0.00028
Spike Value	0.00549	0.00016
Homogeneity Value	0.00547	0.00066
Robust Average	0.00550	0.00028
Median	0.00549	0.00030
Mean	0.00552	0.00021
N	13	
Max	0.0063	
Min	0.005	
Robust SD	0.00040	
Robust CV	7.4%	


Results: S2 - U
Assigned Value = 0.00550 ± 0.00028 mg/L
Kernel Density
Density
Result
Results (mg/L)
Laboratory
6 4 9 11 7 3 8 17 14 19 16 18 1 2 5 10 12 13 15 20 Md RA HV SV


z-Scores: S2 - U
Target Standard Deviation for Proficiency Assessment 0.00055 mg/L (Equivalent to 10% CV)
z-Score
Laboratory
6 4 9 11 7 3 8 17 14 19 16 18 1
-0.9 -0.7 -0.7 -0.6 -0.2 -0.2 0.0 0.1 0.2 0.4 0.7 0.9 1.5

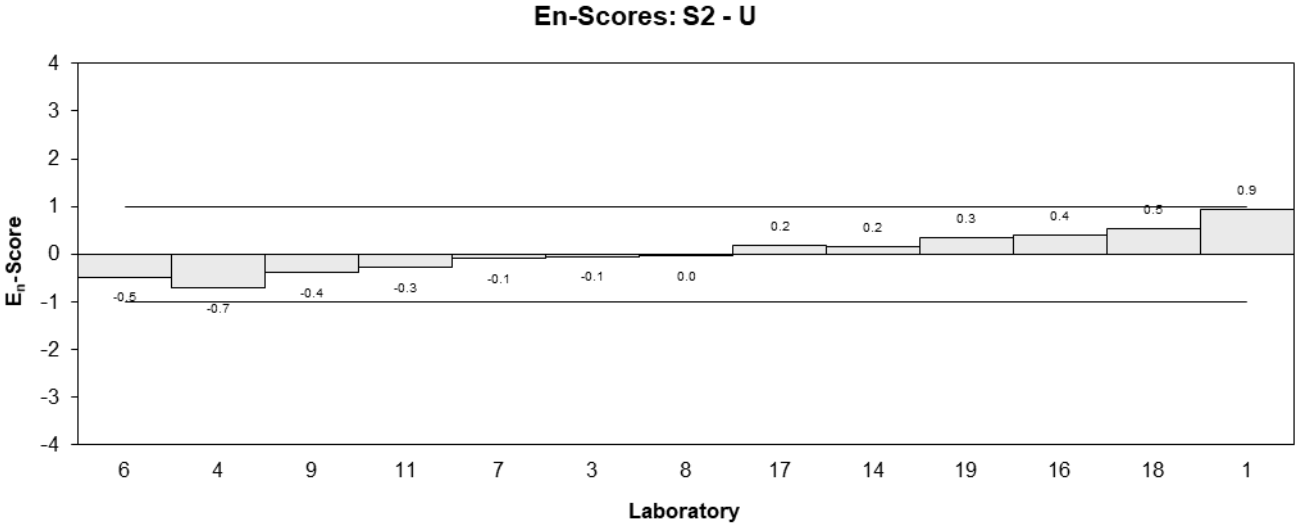

En-Scores: S2 - U
En-Score
Laboratory
6 4 9 11 7 3 8 17 14 19 16 18 1
-0.5 -0.7 -0.4 -0.3 -0.1 -0.1 0.0 0.2 0.2 0.3 0.4 0.5 0.9

Figure 36

Table 41

Sample Details

Sample	S2
Analyte	Zn
Matrix	Potable Water
Unit	mg/L

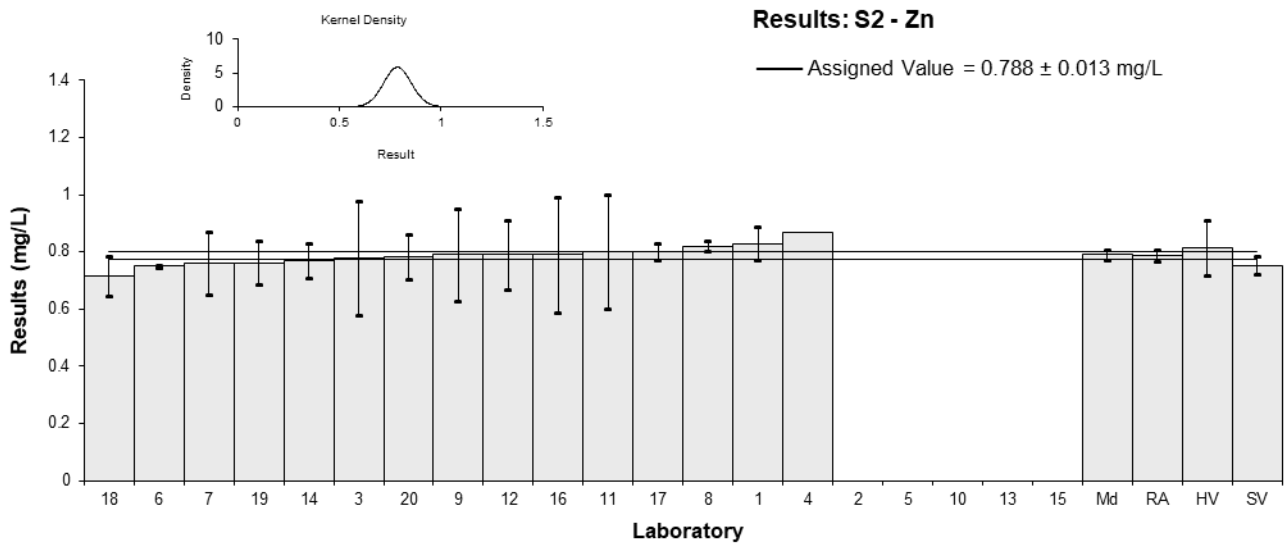
Participant Results

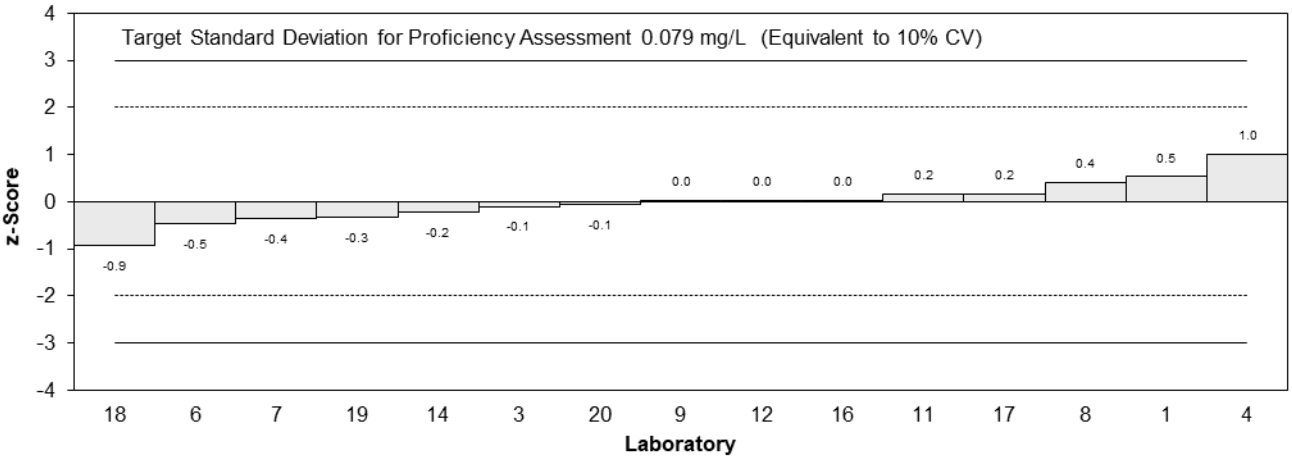
Lab. Code	Result	U	z	E_n
1	0.83	0.06	0.53	0.68
2	NT	NT		
3	0.78	0.2	-0.10	-0.04
4	0.8669	NR	1.00	6.07
5	NT	NT		
6	0.751	0.005	-0.47	-2.66
7	0.76	0.11	-0.36	-0.25
8	0.820	0.019	0.41	1.39
9	0.79	0.16	0.03	0.01
10	NT	NT		
11	0.8	0.2	0.15	0.06
12	0.79	0.12	0.03	0.02
13	NT	NT		
14	0.770	0.062	-0.23	-0.28
15	NT	NT		
16	0.79	0.2	0.03	0.01
17	0.80	0.03	0.15	0.37
18	0.715	0.07	-0.93	-1.03
19	0.7623	0.077	-0.33	-0.33
20	0.784	0.078	-0.05	-0.05

Statistics

Assigned Value*	0.788	0.013
Spike Value	0.753	0.031
Homogeneity Value	0.815	0.098
Robust Average	0.787	0.020
Median	0.790	0.019
Mean	0.787	0.018
N	15	
Max	0.8669	
Min	0.715	
Robust SD	0.031	
Robust CV	4%	

*The Assigned Value was calculated as the Robust Average of the combined results of Samples S1 and S2


Kernel Density
Density
Result
Results: S2 - Zn
Assigned Value = 0.788 ± 0.013 mg/L
Results (mg/L)
Laboratory
18 6 7 19 14 3 20 9 12 16 11 17 8 1 4 2 5 10 13 15 Md RA HV SV


z-Scores: S2 - Zn
Target Standard Deviation for Proficiency Assessment 0.079 mg/L (Equivalent to 10% CV)
z-Score
Laboratory
18 6 7 19 14 3 20 9 12 16 11 17 8 1 4
-0.9 -0.5 -0.4 -0.3 -0.2 -0.1 -0.1 0.0 0.0 0.0 0.2 0.2 0.4 0.5 1.0

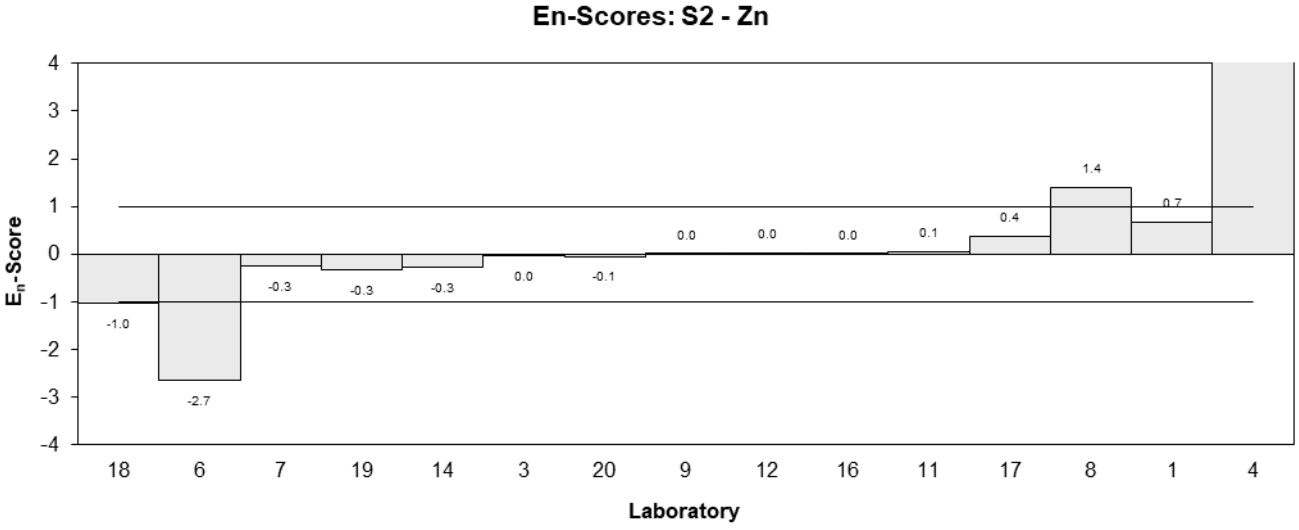

En-Scores: S2 - Zn
En-Score
Laboratory
18 6 7 19 14 3 20 9 12 16 11 17 8 1 4
-1.0 -2.7 -0.3 -0.3 -0.3 0.0 -0.1 0.0 0.0 0.0 0.1 0.4 1.4 0.7

Figure 37

Table 42

Sample Details

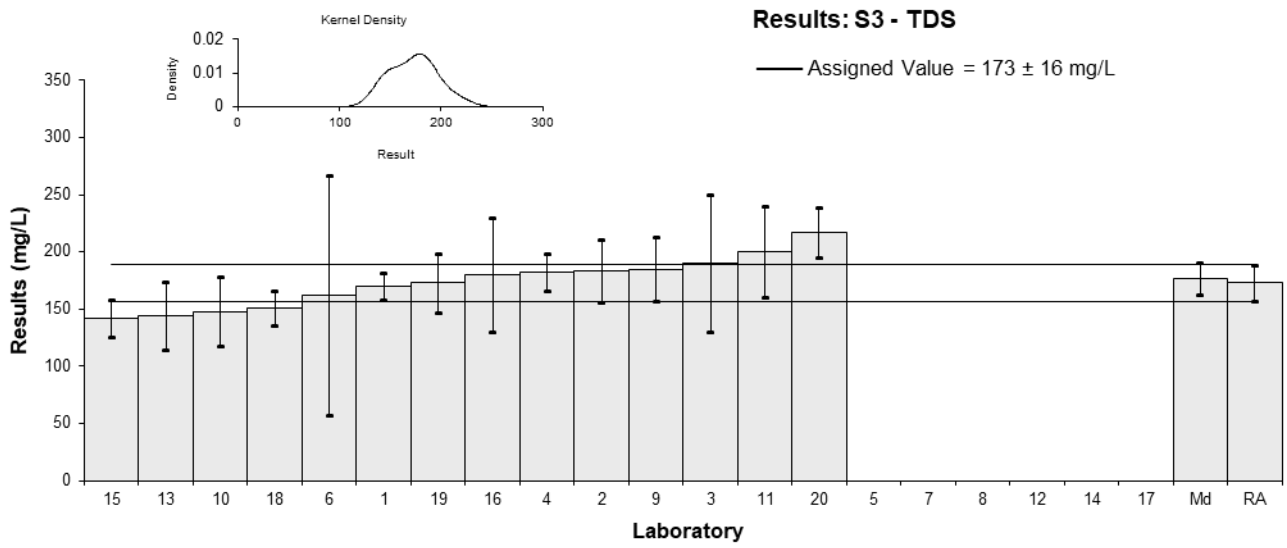
Sample	S3
Analyte	TDS
Matrix	Potable Water
Unit	mg/L

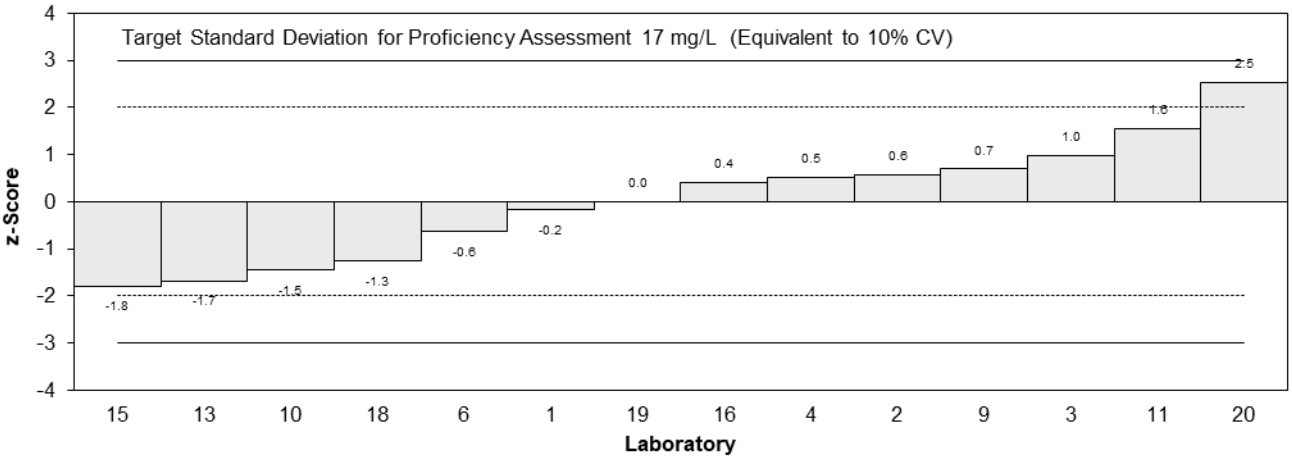
Participant Results

Lab. Code	Result	U	z	E_n
1	170	12	-0.17	-0.15
2	183	27.45	0.58	0.31
3	190	60	0.98	0.27
4	182	16.38	0.52	0.39
5	NT	NT		
6	162	105	-0.64	-0.10
7	NT	NT		
8	NT	NT		
9	185	28	0.69	0.37
10	148	30	-1.45	-0.74
11	200	40	1.56	0.63
12	NT	NT		
13	144.0	29.7	-1.68	-0.86
14	NT	NT		
15	142	16.2	-1.79	-1.36
16	180	50	0.40	0.13
17	NT	NT		
18	151	15	-1.27	-1.00
19	173	26	0.00	0.00
20	217	22	2.54	1.62

Statistics

Assigned Value	173	16
Spike Value	Not Spiked	
Robust Average	173	16
Median	177	14
Mean	173	12
N	14	
Max	217	
Min	142	
Robust SD	24	
Robust CV	14%	


Kernel Density
Density
0.02
0.01
0
0
100
200
300
Result
Results: S3 - TDS
Assigned Value = 173 ± 16 mg/L
Results (mg/L)
350
300
250
200
150
100
50
0
15 13 10 18 6 1 19 16 4 2 9 3 11 20 5 7 8 12 14 17 Md RA
Laboratory


z-Scores: S3 - TDS
Target Standard Deviation for Proficiency Assessment 17 mg/L (Equivalent to 10% CV)
z-Score
4
3
2
1
0
-1
-2
-3
-4
-1.8
-1.7
-1.5
-1.3
-0.6
-0.2
0.0
0.4
0.5
0.6
0.7
1.0
1.6
2.5
15 13 10 18 6 1 19 16 4 2 9 3 11 20
Laboratory

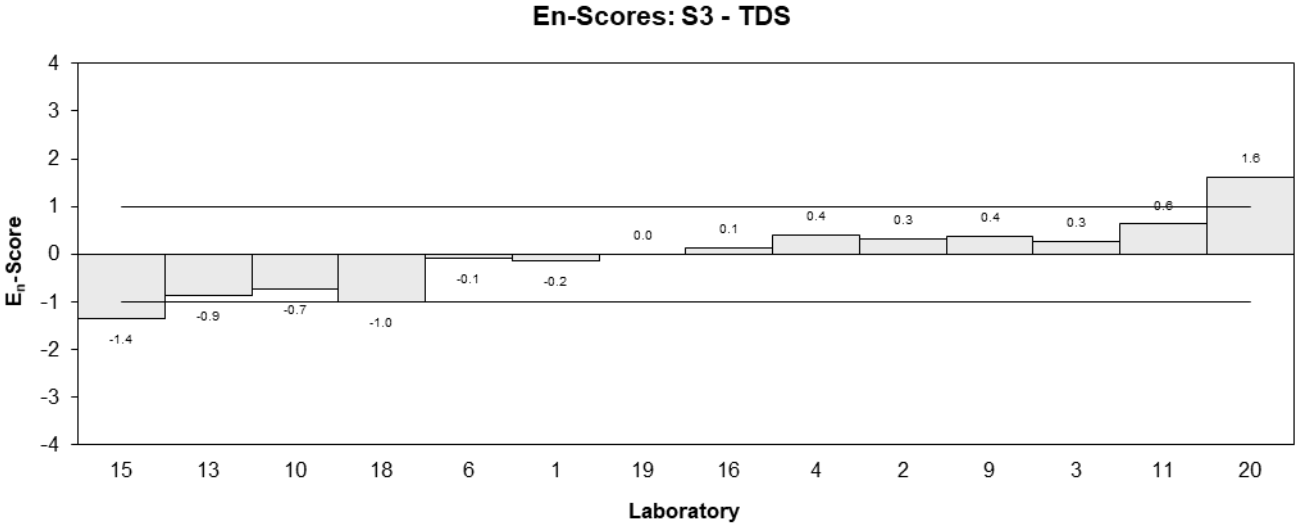

En-Scores: S3 - TDS
En-Score
4
3
2
1
0
-1
-2
-3
-4
-1.4
-0.9
-0.7
-1.0
-0.1
-0.2
0.0
0.1
0.4
0.3
0.4
0.3
0.6
1.6
15 13 10 18 6 1 19 16 4 2 9 3 11 20
Laboratory

Figure 38

Table 43

Sample Details

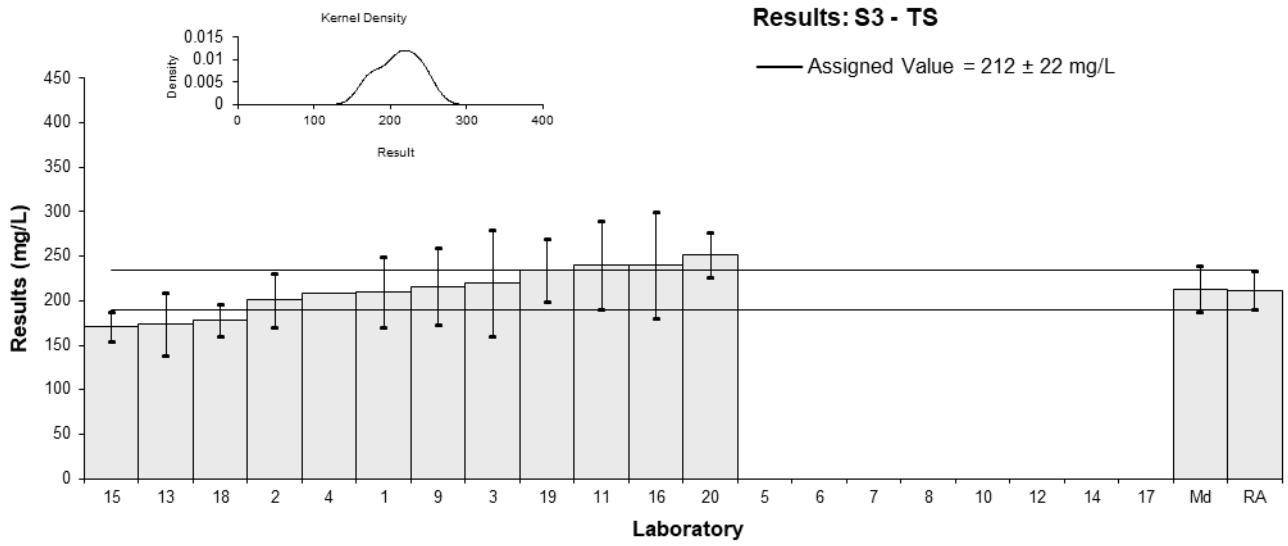
Sample	S3
Analyte	TS
Matrix	Potable Water
Unit	mg/L

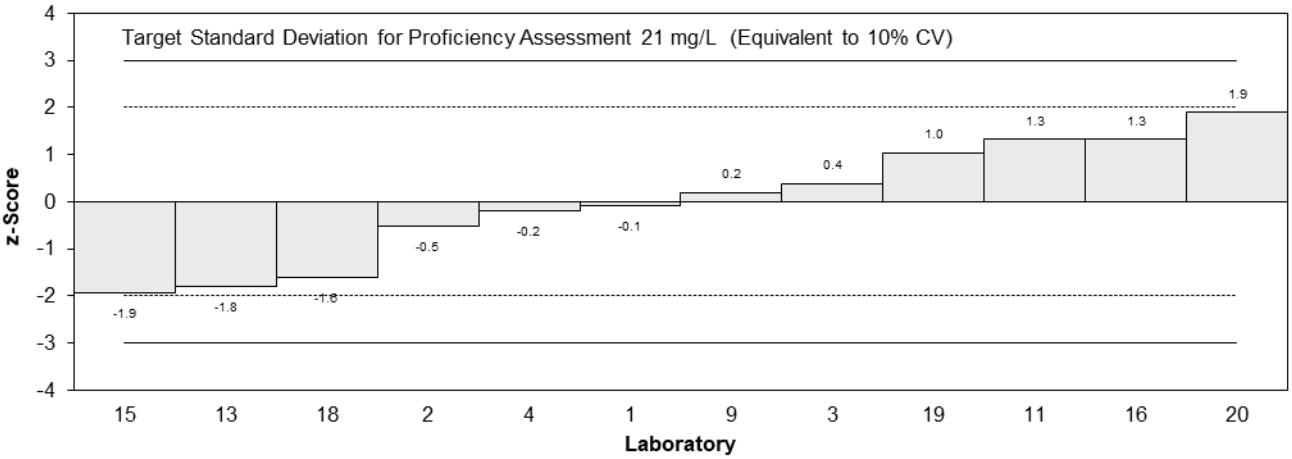
Participant Results

Lab. Code	Result	U	z	E_n
1	210	40	-0.09	-0.04
2	201	30.15	-0.52	-0.29
3	220	60	0.38	0.13
4	208	NR	-0.19	-0.18
5	NT	NT		
6	NT	NT		
7	NT	NT		
8	NT	NT		
9	216	43	0.19	0.08
10	NT	NT		
11	240	50	1.32	0.51
12	NT	NT		
13	173.9	35.8	-1.80	-0.91
14	NT	NT		
15	171	17.1	-1.93	-1.47
16	240	60	1.32	0.44
17	NT	NT		
18	178	18	-1.60	-1.20
19	234	35	1.04	0.53
20	252	25	1.89	1.20

Statistics

Assigned Value	212	22
Spike Value	Not Spiked	
Robust Average	212	22
Median	213	26
Mean	212	16
N	12	
Max	252	
Min	171	
Robust SD	31	
Robust CV	15%	


Kernel Density
Density
Result
Results: S3 - TS
Assigned Value = 212 ± 22 mg/L
Results (mg/L)
Laboratory
15 13 18 2 4 1 9 3 19 11 16 20 5 6 7 8 10 12 14 17 Md RA


z-Scores: S3 - TS
Target Standard Deviation for Proficiency Assessment 21 mg/L (Equivalent to 10% CV)
z-Score
Laboratory
15 13 18 2 4 1 9 3 19 11 16 20
-1.9 -1.8 -1.6 -0.5 -0.2 -0.1 0.2 0.4 1.0 1.3 1.3 1.9

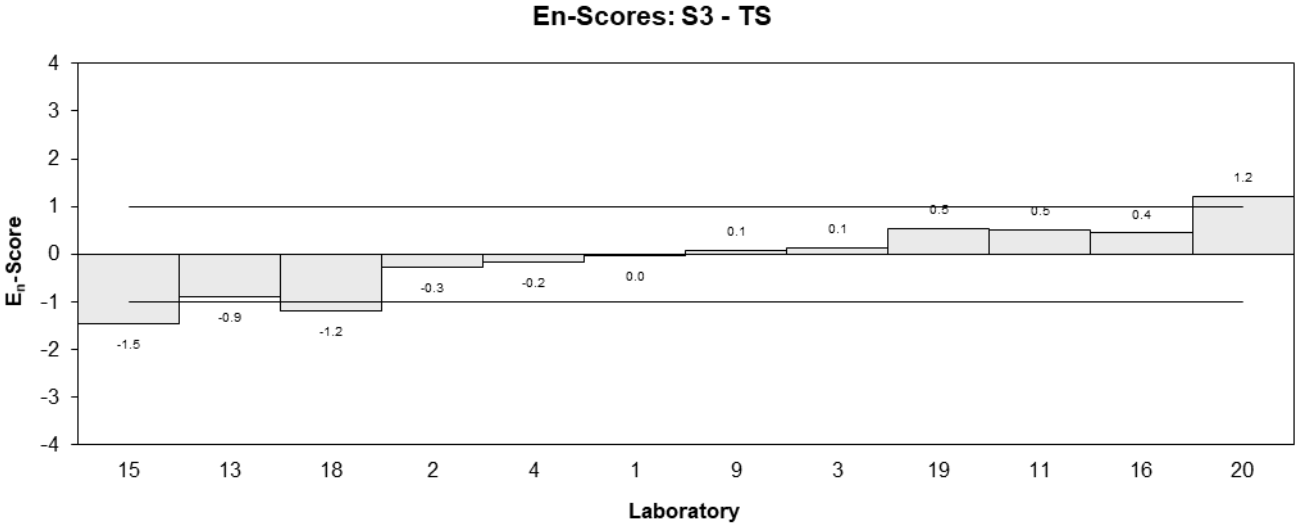

En-Scores: S3 - TS
En-Score
Laboratory
15 13 18 2 4 1 9 3 19 11 16 20
-1.5 -0.9 -1.2 -0.3 -0.2 0.0 0.1 0.1 0.5 0.5 0.4 1.2

Figure 39

Table 44

Sample Details

Sample	S3
Analyte	TSS
Matrix	Potable Water
Unit	mg/L

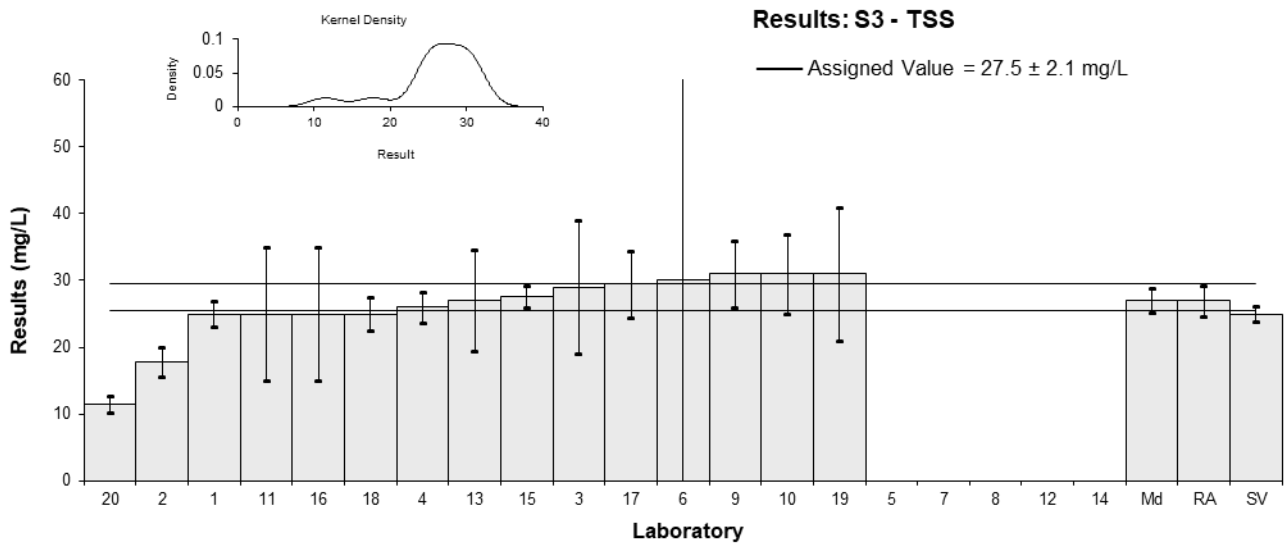
Participant Results

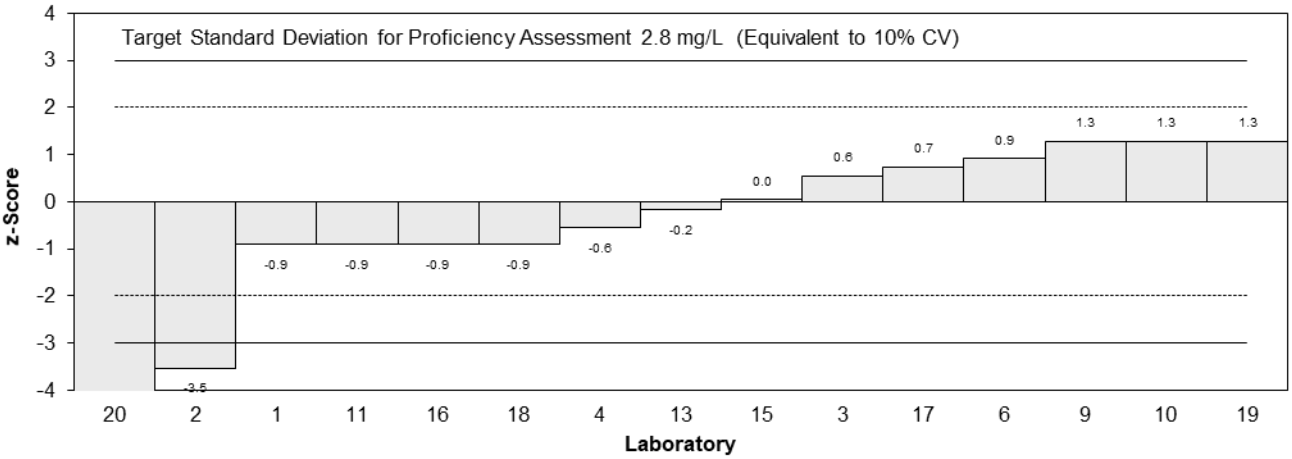
Lab. Code	Result	U	z	E_n
1	25	2	-0.91	-0.86
2	17.8	2.24	-3.53	-3.16
3	29	10	0.55	0.15
4	26	2.34	-0.55	-0.48
5	NT	NT		
6	30	88	0.91	0.03
7	NT	NT		
8	NT	NT		
9	31	5	1.27	0.65
10	31	6	1.27	0.55
11	25	10	-0.91	-0.24
12	NT	NT		
13	27	7.54	-0.18	-0.06
14	NT	NT		
15	27.6	1.7	0.04	0.04
16	25	10	-0.91	-0.24
17	29.5	5	0.73	0.37
18	25	2.5	-0.91	-0.77
19	31	10	1.27	0.34
20*	11.5	1.2	-5.82	-6.62

* Outlier

Statistics

Assigned Value	27.5	2.1
Spike Value	25.0	1.1
Robust Average	27.0	2.3
Median	27.0	1.9
Mean	26.1	2.8
N	15	
Max	31	
Min	11.5	
Robust SD	3.6	
Robust CV	13%	


Results: S3 - TSS
Kernel Density
Density
Result
Assigned Value = 27.5 ± 2.1 mg/L
Results (mg/L)
Laboratory
20 2 1 11 16 18 4 13 15 3 17 6 9 10 19 5 7 8 12 14 Md RA SV


z-Scores: S3 - TSS
Target Standard Deviation for Proficiency Assessment 2.8 mg/L (Equivalent to 10% CV)
z-Score
Laboratory
20 2 1 11 16 18 4 13 15 3 17 6 9 10 19

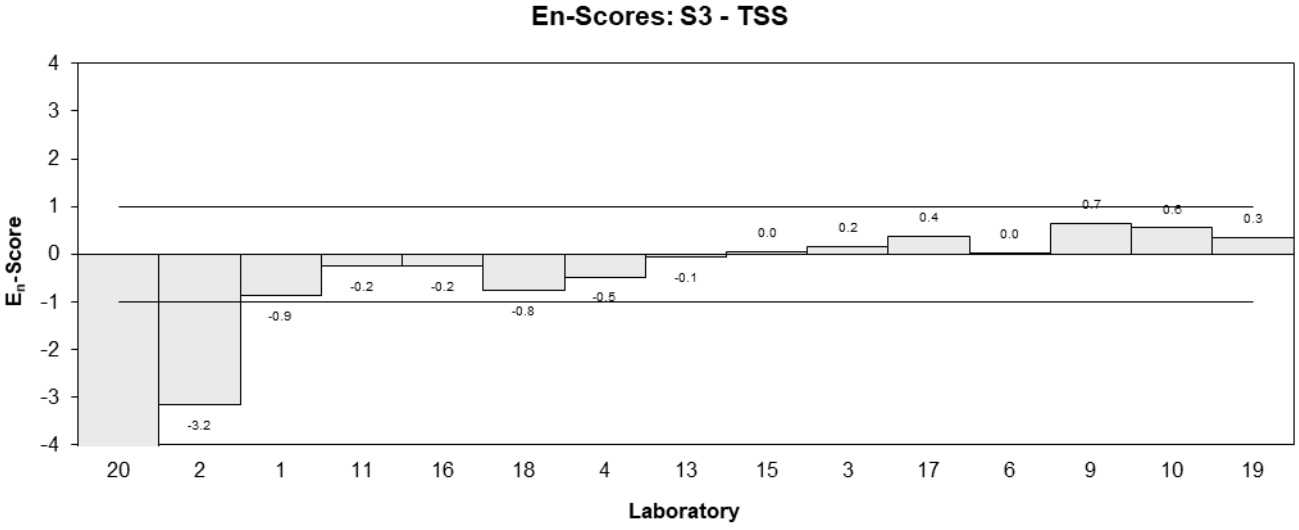

En-Scores: S3 - TSS
En-Score
Laboratory
20 2 1 11 16 18 4 13 15 3 17 6 9 10 19

Figure 40

Table 45

Sample Details

Sample	S3
Analyte	Turbidity
Matrix	Potable Water
Unit	NTU

Participant Results

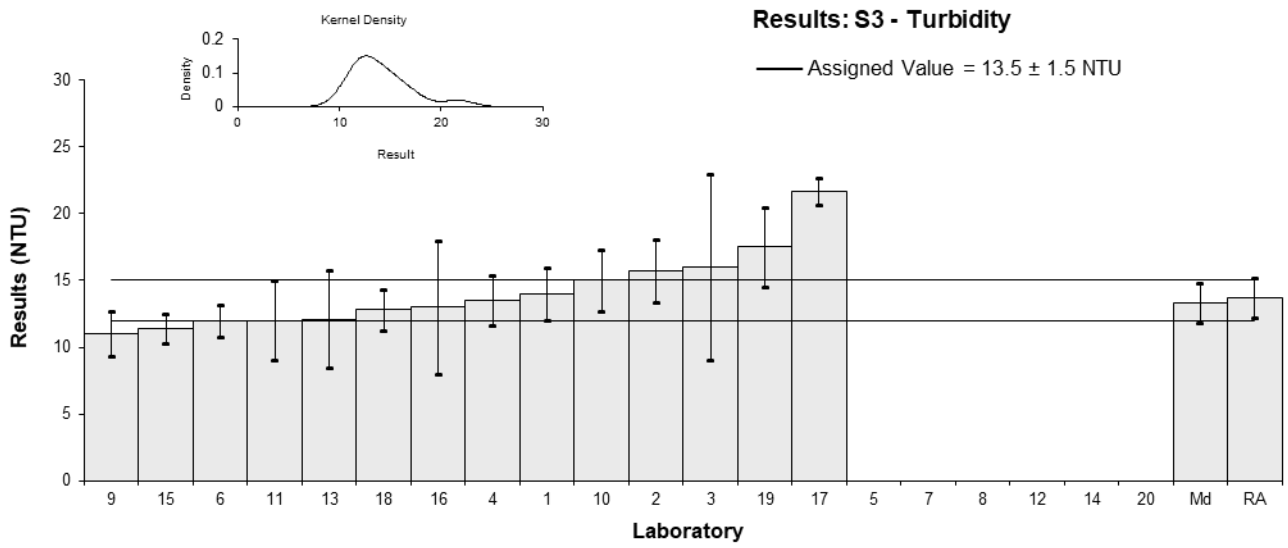
Lab. Code	Result	U	z	E_n
1	14	2	0.25	0.20
2	15.7	2.36	1.09	0.79
3	16	7	1.23	0.35
4	13.5	1.89	0.00	0.00
5	NT	NT		
6	12	1.2	-0.74	-0.78
7	NT	NT		
8	NT	NT		
9	11	1.7	-1.23	-1.10
10	15.0	2.3	0.74	0.55
11	12	3	-0.74	-0.45
12	NT	NT		
13	12.1	3.63	-0.69	-0.36
14	NT	NT		
15	11.4	1.1	-1.04	-1.13
16	13	5	-0.25	-0.10
17*	21.7	1.0	4.05	4.55
18	12.8	1.5	-0.35	-0.33
19	17.5	3	1.98	1.19
20	NT	NT		

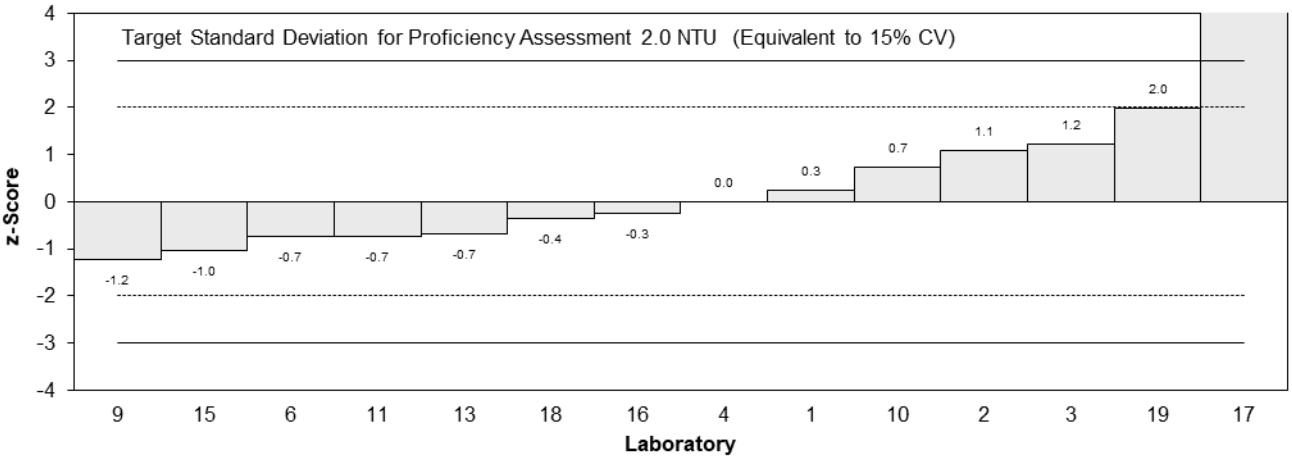
* Outlier

Statistics

Assigned Value	13.5	1.5
Spike Value*	4.99	0.22
Robust Average	13.7	1.5
Median	13.3	1.5
Mean	14.1	1.5
N	14	
Max	21.7	
Min	11	
Robust SD	2.2	
Robust CV	16%	

*Incurred value not included


Kernel Density
Density
Result
Results: S3 - Turbidity
Assigned Value = 13.5 ± 1.5 NTU
Results (NTU)
Laboratory
9 15 6 11 13 18 16 4 1 10 2 3 19 17 5 7 8 12 14 20 Md RA


z-Scores: S3 - Turbidity
Target Standard Deviation for Proficiency Assessment 2.0 NTU (Equivalent to 15% CV)
z-Score
-1.2 -1.0 -0.7 -0.7 -0.7 -0.4 -0.3 0.0 0.3 0.7 1.1 1.2 2.0
Laboratory
9 15 6 11 13 18 16 4 1 10 2 3 19 17

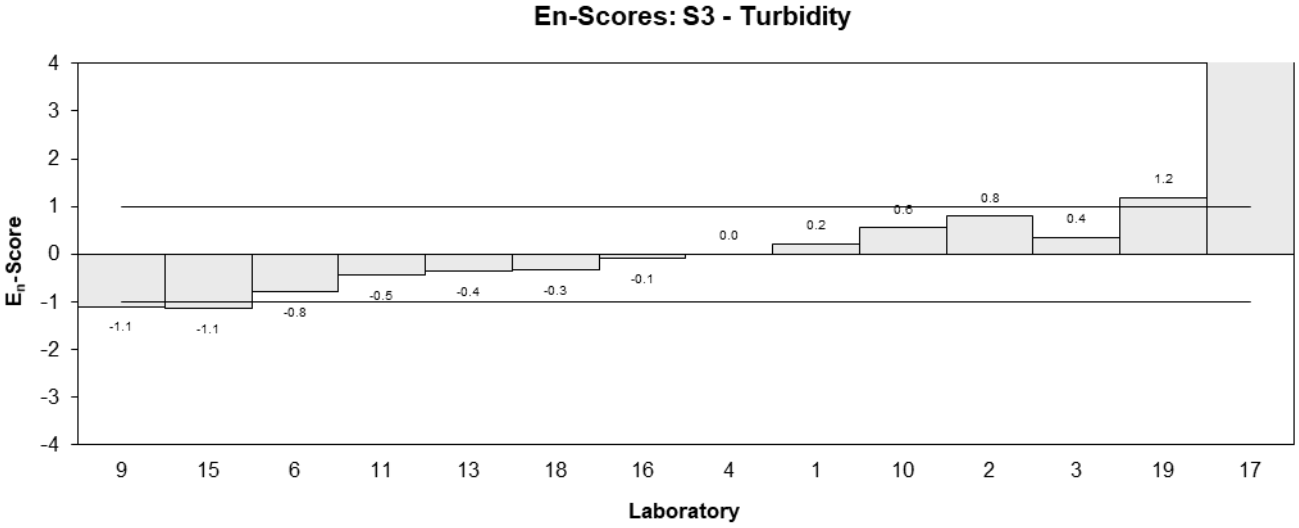

En-Scores: S3 - Turbidity
En-Score
-1.1 -1.1 -0.8 -0.5 -0.4 -0.3 -0.1 0.0 0.2 0.6 0.8 0.4 1.2
Laboratory
9 15 6 11 13 18 16 4 1 10 2 3 19 17

Figure 41

7 DISCUSSION OF RESULTS

7.1 Assigned Value

Sample S1 was unfiltered and acidified potable water to which a known amount of the elemental standard solutions were added.

Sample S2 was the same fortified potable water used for Sample S1 preparation, further fortified for: Al, As, Ba, Bi, Cs, Fe, Hg, La, Mn, P, Sb, Sr, Th and U. The concentration of Cd, Sn and Zn in S2 was expected to remain unchanged from those in Sample S1

For Sample S1, participants were asked to report results for total As, Be, Cd, Co, Cr, Cu, Fe, Hg, Li, Mo, Ni, Pb, Sb, Se, Sn, Tl, V and Zn, and for Sample S2 to report results for total Al, As, B, Ba, Bi, Cd, Cs, Fe, Hg, La, Mn, P, Sb, Sn, Sr, Th, U and Zn. The samples were chilled prior to dispatch.

Sample S3 was potable water fortified with a known amount of glass fibre filter, potassium chloride and formazin turbidity standard. Participants were asked to report: TS, TDS, TSS and turbidity.

Assigned Values for the 40 tests were the robust average of participants' results. The robust averages used as assigned values and their associated expanded uncertainties were calculated using the procedure described in 'ISO13528:2015(E), Statistical methods for use in proficiency testing by interlaboratory comparisons'. Results less than 50% and more than 150% of the robust average were removed before calculation of each assigned value.[6] Appendix 2 sets out the calculation of the robust average and assigned value for Be in Sample S1 and its associated uncertainty.

Assigned values for Cd, Sn and Zn in S1 and S2 were calculated as the robust average of the combined results of both samples

Spike Value where applicable, includes both the incurred value and the fortified value.

Assigned values, spike values and homogeneity values were in agreement with each other within their estimates of uncertainty for all elements of interest.

Traceability The assigned values are not traceable to any external reference; they are traceable to the consensus of participants' results derived from a variety of measurement methods and (presumably) a variety of calibrators, for which the traceability to SI has not been confirmed. So although expressed in SI units, the metrological traceability of the assigned values has not been established.

7.2 Measurement Uncertainty Reported by Participants

Participants were asked to report an estimate of the expanded measurement uncertainty associated with their results. Of 524 numerical results, 522 (99.6%) were reported with an expanded measurement uncertainty, indicating that the majority of laboratories have addressed this requirement of AS ISO 17025.[8] The magnitude of these expanded uncertainties was within the range 0.24% to 435% of the reported value. The participants used a wide variety of procedures to estimate the expanded measurement uncertainty. These are presented in Table 4.

Approaches to estimating measurement uncertainty include: standard deviation of replicate analysis, Horwitz formula, long term reproducibility, professional judgement, bottom up approach, top down approach using precision and estimates of method and laboratory bias, and top down approach using only the reproducibility from inter-laboratory comparison studies.[10 – 14]

Participation in proficiency testing programs allows participants to check how reasonable their estimates of uncertainty are. Results and the expanded MU are presented in the bar charts for each analyte (Figure 2 to 41). As a simple rule of thumb, when the uncertainty estimate is smaller than uncertainty of the assigned value, or larger than the uncertainty of the

assigned value plus twice the target standard deviation, then this should be reviewed as suspect. For example, 16 laboratories reported results for Fe in S1. The uncertainty of the assigned value estimated from the robust standard deviation of the 16 laboratories' results is 0.013 mg/L (see equation 4, Appendix 2). Laboratory 6 might have under-estimated its expanded measurement uncertainties reported for Fe in S1 (0.01 mg/L) as an uncertainty estimated from one measurement should not be smaller than the uncertainty estimated from 16 measurements. Alternatively, estimates of uncertainties for Co in S1 (for example) larger than 0.0004 mg/L (the uncertainty of the assigned value, 0.00008 µg/L plus the allowable variation from the assigned value, the target standard deviation of 0.00016 mg/kg, multiplied by 2, the coverage factor for a confidence interval of 95%), should also be viewed as suspect. For example, the expanded measurement uncertainties reported by laboratory 3 for Co in S1 (0.001 mg/L) might have been over-estimated.

Laboratory 6 should review their procedure for estimating measurement uncertainty as most of their estimated uncertainties were either under or over-estimated.

Laboratories 16 and 17 should also review their procedure for estimating measurement uncertainty as most of the uncertainties estimated by Laboratory 16 were over-estimated while most of the uncertainties estimated by Laboratory 17 were under-estimated.

When a laboratory has successfully participated in at least 6 proficiency testing studies, the standard deviation from proficiency testing studies only, can also be used to estimate the uncertainty of their measurement results.[10] An example of estimating measurement uncertainty using proficiency testing data only is given in Appendix 3.

Laboratory 6 attached an estimate of the expanded measurement uncertainty to Se result in S1 which was reported as "less than". An estimate of uncertainty expressed as a value cannot be attached to a result expressed as a range.[9]

Laboratories 3, 5, 6, 11, 16, 17 and 19 reported an estimate of expanded uncertainty for some measurement results equal or larger than the results themselves.

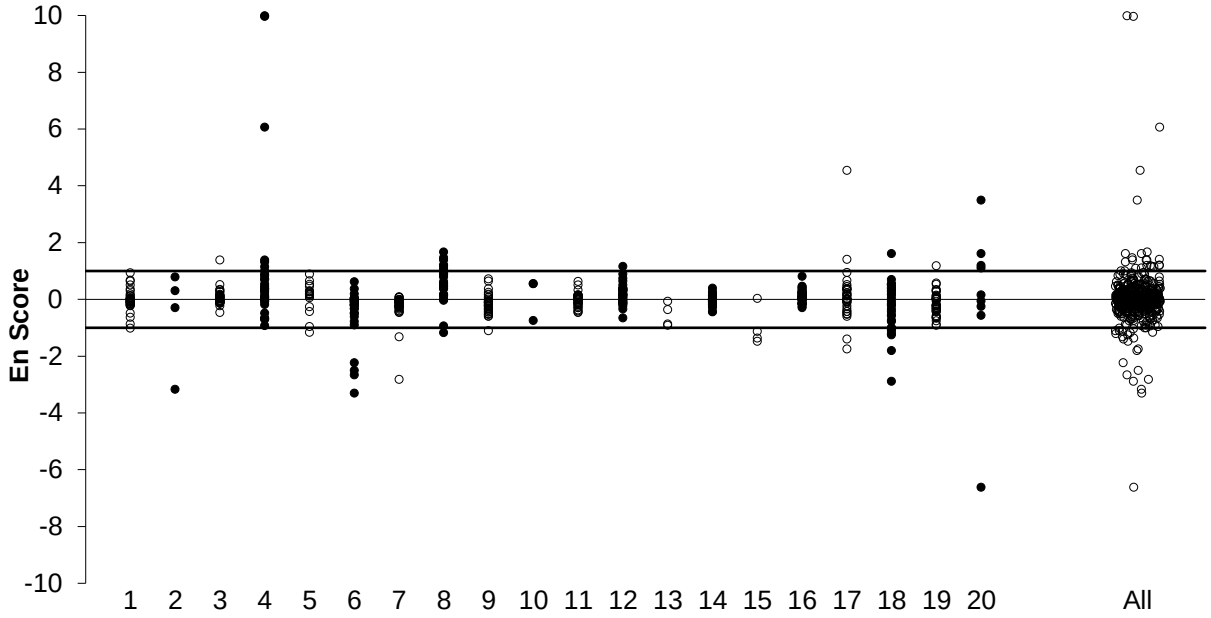
In some cases the results were reported with an inappropriate number of significant figures. The recommended format is to write uncertainty to no more than two significant figures and then to write the result with the corresponding number of decimal places. For example, instead of 18.44 ± 3.4 mg/L, it is better to report 18.4 ± 3.4 mg/L or instead of 0.0023 ± 0.00048 mg/L, it is better to report 0.0023 ± 0.0005 mg/L.[9]

7.3 E_n-score

En-score should be interpreted only in conjunction with z-scores. The En-score indicates how closely a result agrees with the assigned value taking into account the respective uncertainties. An unsatisfactory En score for an analyte can either be caused by an inappropriate measurement, an inappropriate estimation of measurement uncertainty, or both.

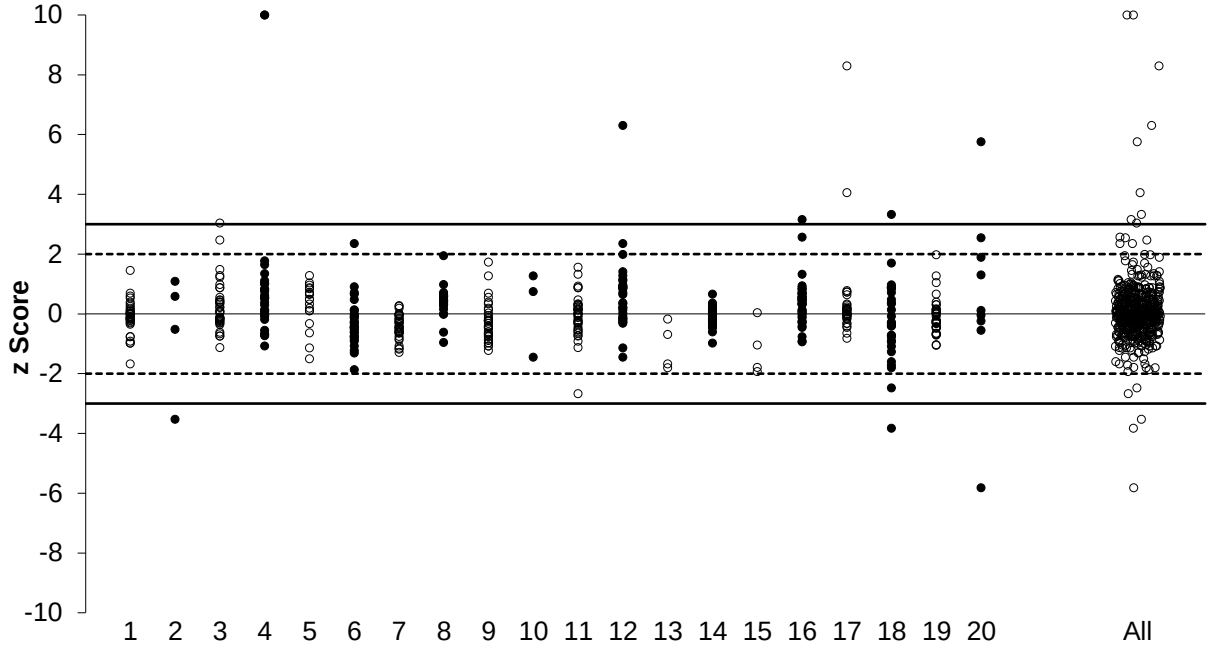
The dispersal of participants' E_n-scores is graphically presented in Figure 42. Where a laboratory did not report an expanded uncertainty with a result, an expanded uncertainty of zero (0) was used to calculate the E_n-score.

Of 524 results for which E_n-scores were calculated, 477 (91%) returned a satisfactory score of $|E_n| \leq 1.0$ indicating agreement of the participants' results with the assigned values within their respective expanded measurement uncertainties.



Scores of >10 or < -10 have been plotted as 10 or -10.

Figure 42 E_n-Score Dispersal by Laboratory



Scores of >10 or <-10 have been plotted as 10 or -10.

Figure 43 z-Score Dispersal by Laboratory

7.4 z-Score

The z-score compares the participant's deviation from the assigned value with the target standard deviation set for proficiency assessment. The target standard deviation defines satisfactory performance in a proficiency test. Target standard deviations equivalent to 10%, 15% and 20% CV were used to calculate z-scores. Unlike the standard deviation based on between laboratories CV, setting the target standard deviation as a realistic, set value enables z-scores to be used as fixed reference value points for assessment of laboratory performance, independent of group performance.

The between laboratories coefficient of variation predicted by the Thompson equation[7] and the between laboratories coefficient of variation resulted in this study are presented for comparison in Table 46. The dispersal of participants' z-scores is presented in Figure 43 (by laboratory code) and in Figure 44 (by test). Of 524 results for which z-scores were calculated, 505 (96%) returned a satisfactory score of $|z| \leq 2.0$ and 7 (1%) were questionable with a score

of 2.0 < |z| < 3.0. Participants with multiple z-scores larger than 2.0 or smaller than -2.0 should check for laboratory bias. Summary of participants' performance is presented in Figure 45**.**

Laboratory 19 reported results for all 40 tests and all returned satisfactory z-scores. Laboratory **11** returned satisfactory results for 38 results out of a total of 39 reported and laboratories **16 and 3** for 37.

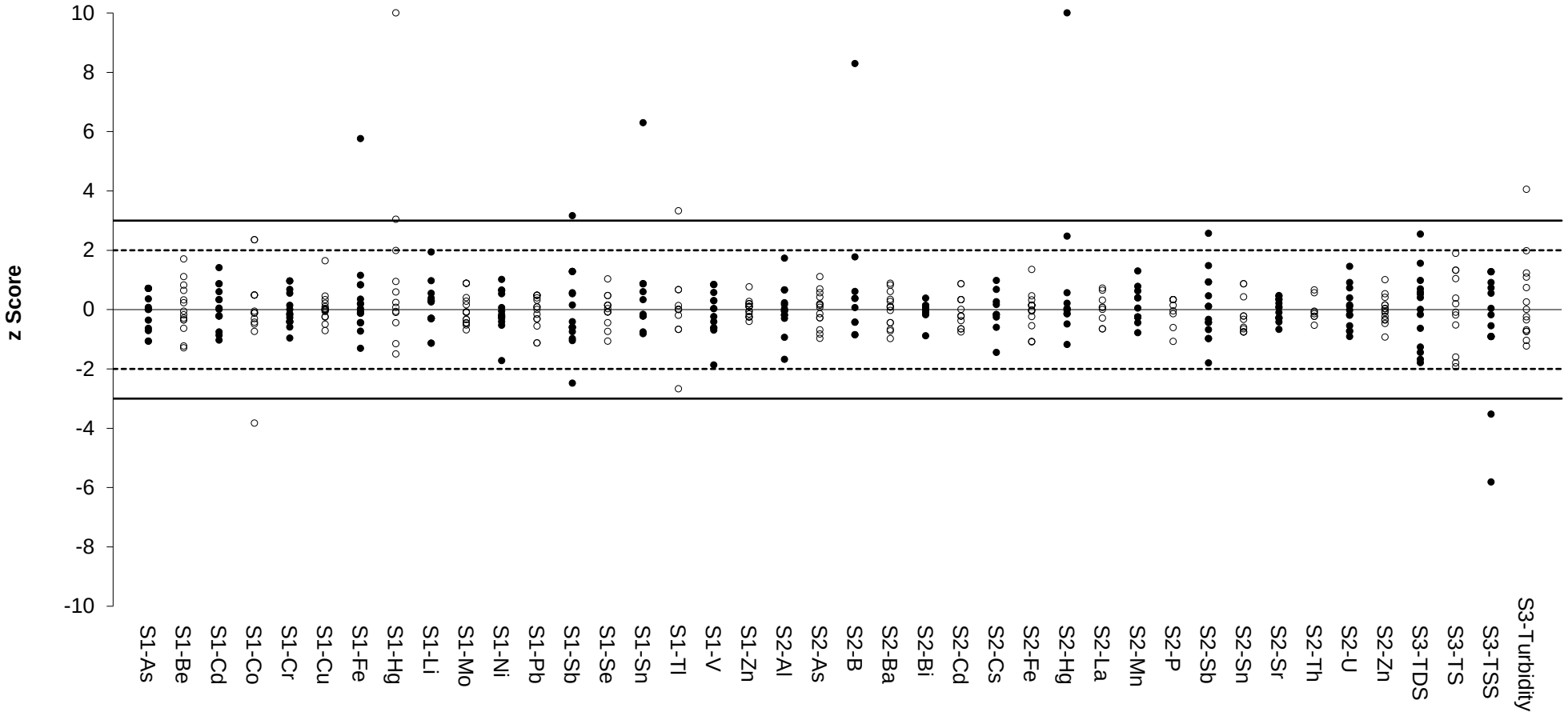
All results reported by **laboratories 9** (37), **14** (35), **1** (35), **7** (35), **8** (27), **5** (18), **13** (4), **15** (4) and **10** (3) returned satisfactory z scores.

All results reported by **laboratories 14** (35) and **13** (4) returned satisfactory E_n scores.

Table 46 Between Laboratories CV of this study, Thompson CV and Set Target CV

Sample	Test	Assigned value (mg/L)	Between Laboratories CV*	Thompson/ Horwitz CV	Target SD (as CV)
S1	As	0.00280	7.4%	22%	10%
S1	Be	0.00342	9%	22%	10%
S1	Cd	0.00184	7.7%	22%	10%
S1	Co	0.00162	7.2%	22%	10%
S1	Cr	0.00730	6.7%	22%	10%
S1	Cu	0.842	3.4%	16%	10%
S1	Fe	0.314	6.5%	19%	10%
S1	Hg	0.000143	21%	22%	20%
S1	Li	0.0237	7.7%	22%	10%
S1	Mo	0.00827	5.4%	22%	10%
S1	Ni	0.00845	6.1%	22%	10%
S1	Pb	0.0124	5.3%	22%	10%
S1	Sb	0.00266	12%	22%	10%
S1	Se	0.00907	5.1%	22%	10%
S1	Sn	0.00184	7.1%	22%	10%
S1	Tl	0.00150	6.7%	22%	10%
S1	V	0.00369	7.3%	22%	10%
S1	Zn	0.788	3.1%	17%	10%
S2	Al	0.0938	6.4%	22%	10%
S2	As	0.00720	6.5%	22%	10%
S2	B	0.0164	7.9%	22%	10%
S2	Ba	0.0377	6.6%	22%	10%
S2	Bi	0.00395	1.9%	22%	10%
S2	Cd	0.00184	6.0%	22%	10%
S2	Cs	0.00234	7.2%	22%	10%
S2	Fe	0.631	4.4%	17%	10%
S2	Hg	0.000288	9.8%	22%	20%
S2	La	0.0139	5.6%	22%	10%
S2	Mn	0.154	5.7%	21%	10%
S2	P	0.213	4.6%	20%	10%
S2	Sb	0.00366	11%	22%	10%
S2	Sn	0.00184	6.5%	22%	10%
S2	Sr	0.0793	4.0%	22%	10%
S2	Th	0.00665	4.6%	22%	10%
S2	U	0.00550	7.4%	22%	10%
S2	Zn	0.788	4.0%	17%	10%
S3	TDS	173	14%	7.4%	10%
S3	TS	212	15%	7.1%	10%
S3	TSS	27.5	11%	9.7%	10%
S3	Turbidity	13.5 NTU	16%	11%	15%

*Robust between -laboratory CV outliers removed



Scores of >10 and <-10 have been plotted as 10 or -10.

Figure 44 z-Score Dispersal by Test

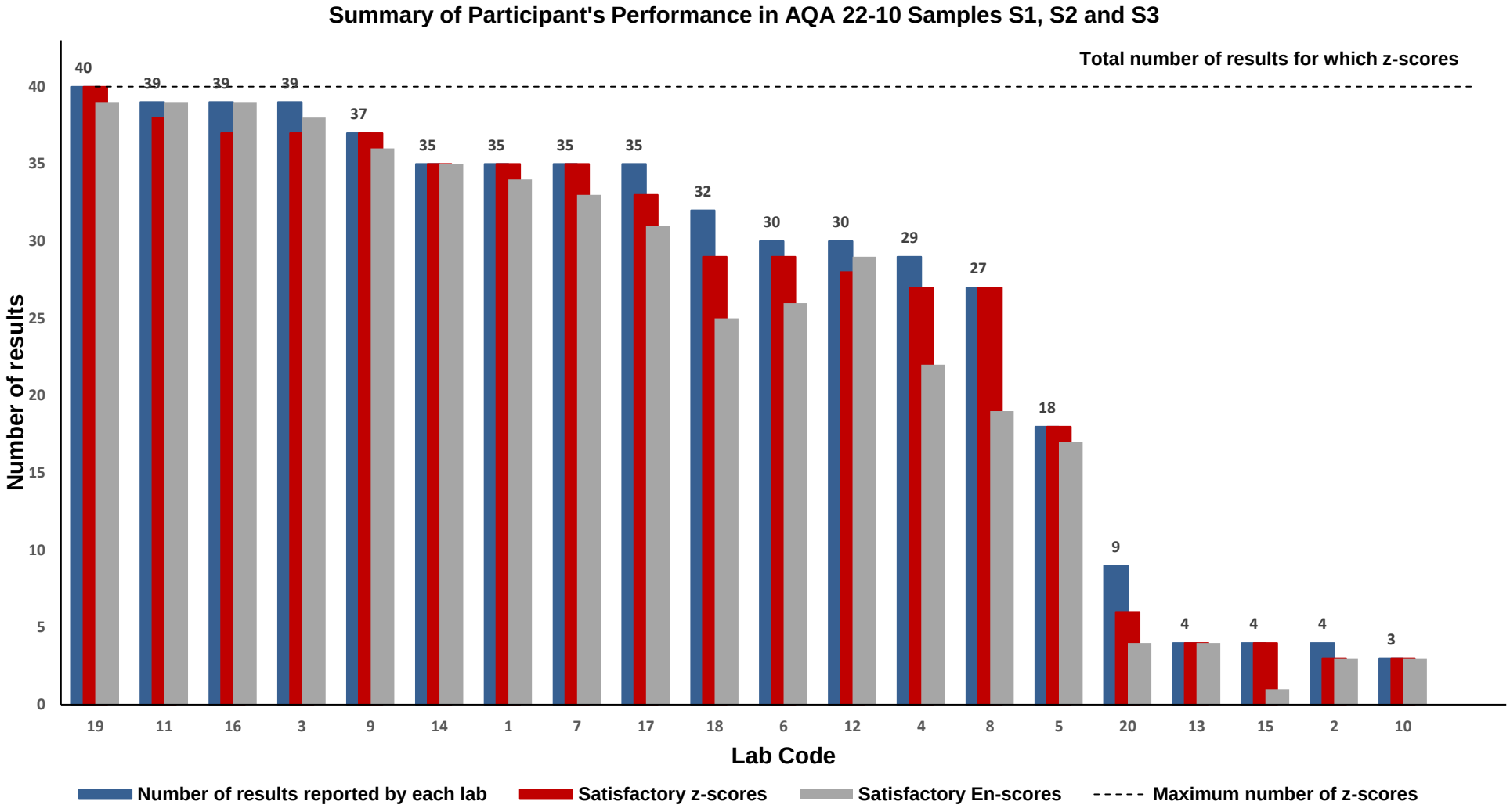


Figure 45: Summary of Participants Performance in AQA 22-10

Table 47 Summary of Participants' Results and Performance for S1.

Lab Code	As (mg/L)	Be (mg/L)	Cd (mg/L)	Co (mg/L)	Cr (mg/L)	Cu (mg/L)	Fe (mg/L)	Hg (mg/L)	Li (mg/L)	Mo (mg/L)	Ni (mg/L)	Pb (mg/L)	Sb (mg/L)	Se (mg/L)	Sn (mg/L)	Tl (mg/L)	V (mg/L)	Zn (mg/L)
A.V.	0.00280	0.00342	0.00184	0.00162	0.00730	0.842	0.314	0.000143	0.0237	0.00827	0.00845	0.0124	0.00266	0.00907	0.00184	0.00150	0.00369	0.788
H.V.	0.00302	0.00382	0.00189	0.00172	0.00727	0.93	0.325	0.000140	0.0238	0.0084	0.0089	0.0120	0.00257	0.0097	0.00189	0.00142	0.00395	0.815
1	0.0028	0.0033	0.0018	0.0016	0.0071	0.84	0.31	0.00016	0.023	0.0082	0.0083	0.0122	0.0024	0.0091	0.0017	0.0015	0.0037	0.81
2	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
3	0.0027	0.0035	0.0020	0.0015	0.0072	0.86	0.31	0.00023	0.023	0.0086	0.0082	0.011	0.0030	0.0084	0.0020	0.0014	0.0037	0.8
4	0.0025	0.0038	<0.002	<0.002	0.0077	0.9804	0.3401	0.132	0.0246	0.0082	0.0093	0.0125	0.0028	0.0092	<0.002	<0.002	0.0038	0.8776
5	0.003	0.0032	0.0019	0.0017	0.008	0.85	0.32	0.0001	0.021	0.008	0.009	0.013	0.003	0.010	0.002	0.0016	0.004	0.80
6	0.003	0.003	0.0017	0.002	0.007	0.836	0.273	0.00014	NT	0.008	0.008	0.013	0.0025	< 0.01	NT	0.0015	0.003	0.757
7	0.00262	0.00298	0.00168	0.00154	0.00687	0.84	0.32	0.00011	0.0243	0.00784	0.00825	0.0117	0.00246	0.00866	0.00181	0.00150	0.00346	0.78
8	0.0030	0.00353	0.00195	0.00170	0.0066	NT	0.325	NT	0.0283	0.0084	NT	0.01288	0.00281	NT	0.00195	NT	0.00346	0.820
9	0.0025	0.0034	0.0018	0.0016	0.007	0.80	0.30	NR	0.025	0.0077	0.0081	0.012	0.0025	0.0081	0.0018	0.0014	0.0036	0.76
10	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
11	0.0028	0.0033	0.0018	0.0016	0.0074	0.87	0.30	0.00015	0.023	0.0085	0.0084	0.011	0.0027	0.0095	0.002	0.0011	0.0038	0.81
12	0.003	NT	0.0021	0.002	0.008	0.82	0.35	0.0002	0.021	0.009	0.009	0.012	0.003	0.009	0.003	NT	0.004	0.77
13	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
14	0.00290	0.00336	0.00185	0.00161	0.00717	0.842	0.312	0.000145	0.0244	0.00789	0.0085	0.01251	0.0025	0.0092	0.00180	0.00147	0.00354	0.781
15	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
16	0.0028	0.0037	0.0019	0.0017	0.0078	0.88	0.34	0.00017	0.023	0.009	0.0089	0.013	0.0035	0.0095	0.0019	0.0016	0.0039	0.8
17	0.00282	0.00364	0.00184	0.00157	NR	0.843	0.300	0.000141	0.0244	0.00819	NR	0.0124	0.00255	0.00920	0.00169	0.00150	NR	0.81
18	0.003	0.004	0.002	0.001	0.007	0.782	0.291	<0.0005	0.026	0.009	0.007	0.013	0.002	0.009	NT	0.002	0.004	0.741
19	0.0026	0.00332	0.00165	0.00155	0.0073	0.845	0.315	0.00013	0.02295	0.0079	0.00825	0.01278	0.00238	0.009	0.0018	0.00152	0.00343	0.757
20	NT	NT	NT	NT	NT	0.822	0.495	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	0.801

Shaded cells are results which returned a questionable or unsatisfactory z-score. A.V. = Assigned Value, H.V. = Homogeneity Value

Table 48 Summary of Participants' Results and Performance for S2 and S3

Lab Code	S2-Al (mg/L)	S2-As (mg/L)	S2-B (mg/L)	S2-Ba (mg/L)	S2-Bi (mg/L)	S2-Cd (mg/L)	S2-Cs (mg/L)	S2-Fe (mg/L)	S2-Hg (mg/L)	S2-La (mg/L)	S2-Mn (mg/L)
A.V.	0.0938	0.00720	0.0164	0.0377	0.00395	0.00184	0.00234	0.631	0.000288	0.0139	0.154
H.V.	0.095	0.00793	0.0165	0.0387	0.00400	0.00189	0.00257	0.657	0.000287	0.0150	0.165
1	0.078	0.0077	<0.1	0.038	NT	0.0018	NT	0.64	0.00029	NT	0.16
2	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
3	0.092	0.0071	<0.02	0.038	0.0041	0.0019	0.0023	0.66	0.00043	0.014	0.15
4	0.0935	0.0067	0.0193	0.0408	NT	<0.002	NT	0.716	0.2755	NT	0.1635
5	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
6	0.1	0.007	0.015	0.036	0.004	0.0017	NT	0.563	0.00028	NT	0.147
7	0.0932	0.00660	0.0157	0.0387	0.00394	0.00172	NR	0.63	0.00022	0.0135	0.15
8	NT	0.00750	0.0174	0.0400	0.00395	0.0019	0.00257	0.651	NT	0.0148	NT
9	0.11	0.0065	0.015	0.034	0.0036	0.0018	0.0023	0.64	NR	0.013	0.16
10	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
11	0.094	0.0073	<0.02	0.035	0.004	0.0018	0.0022	0.63	0.00029	0.013	0.15
12	0.092	0.008	0.017	0.039	NT	0.0020	0.002	0.64	0.0003	NT	0.15
13	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
14	0.100	0.00733	0.0165	0.0381	0.0039	0.00177	0.00240	0.616	0.000286	0.0139	0.150
15	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
16	0.085	0.0076	<0.02	0.036	0.0039	0.0019	0.0025	0.64	0.00032	0.014	0.15
17	0.096	0.00733	0.030	0.0376	0.00388	0.00184	0.00238	0.627	0.00028	0.0149	0.166
18	0.091	0.007	0.017	0.041	0.004	0.002	NT	0.562	<0.0005	NT	0.142
19	0.0954	0.00725	0.0157	0.03517	0.00398	0.00172	0.00228	0.64	0.00026	0.01433	0.15473
20	NT	NT	NT	NT	NT	NT	NT	0.596	NT	NT	0.174

Shaded cells are results which returned a questionable or unsatisfactory z-score. A.V. = Assigned Value, H.V. = Homogeneity Value; NA = Not Available

Table 48 Summary of Participants' Results and Performance for S2 and S3 (Continued)

Lab Code	S2-P (mg/L)	S2-Sb (mg/L)	S2-Sn (mg/L)	S2-Sr (mg/L)	S2-Th (mg/L)	S2-U (mg/L)	S2-Zn (mg/L)	S3-TDS (mg/L)	S3-TS (mg/L)	S3-TSS (mg/L)	S3-Turbidity (NTU)
A.V.	0.213	0.00366	0.00184	0.0793	0.00665	0.00550	0.788	173	212	27.5	13.5
H.V.	0.225	0.00355	0.00189	0.083	NA	0.00547	0.815	NA	NA	NA	NA
1	0.22	0.0033	0.0017	0.080	NT	0.0063	0.83	170	210	25	14
2	NT	NT	NT	NT	NT	NT	NT	183	201	17.8	15.7
3	0.20	0.0042	0.0018	0.083	0.0065	0.0054	0.78	190	220	29	16
4	NT	0.0037	<0.002	0.074	NT	0.0051	0.8669	182	208	26	13.5
5	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
6	NT	0.0037	NT	NT	NT	0.005	0.751	162	NT	30	12
7	0.19	0.00350	0.00173	0.0771	0.00656	0.00539	0.76	NT	NT	NT	NT
8	NT	0.00383	0.00192	0.0829	0.00702	0.00549	0.820	NT	NT	NT	NT
9	NR	0.0035	0.0017	0.082	0.0065	0.0051	0.79	185	216	31	11
10	NT	NT	NT	NT	NT	NT	NT	148	NT	31	15.0
11	0.22	0.004	0.002	0.077	0.0063	0.0052	0.8	200	240	25	12
12	0.21	0.004	0.002	0.081	NT	NT	0.79	NT	NT	NT	NT
13	NT	NT	NT	NT	NT	NT	NT	144.0	173.9	27	12.1
14	0.212	0.0033	0.00178	0.0785	NT	0.00558	0.770	NT	NT	NT	NT
15	NT	NT	NT	NT	NT	NT	NT	142	171	27.6	11.4
16	0.22	0.0046	0.0017	0.076	0.0066	0.0059	0.79	180	240	25	13
17	0.22	0.00354	0.00172	0.0798	0.00661	0.00556	0.80	NT	NT	29.5	21.7
18	<0.5	0.003	NT	0.082	<0.010	0.006	0.715	151	178	25	12.8
19	0.216	0.00341	0.0018	0.07708	0.00709	0.005717	0.7623	173	234	31	17.5
20	NT	NT	NT	NT	NT	NT	0.784	217	252	11.5	NT

Shaded cells are results which returned a questionable or unsatisfactory z-score. A.V. = Assigned Value, H.V. = Homogeneity Value; NA = Not Available

7.5 Participants' Results and Analytical Methods

The Australian Drinking Water Guidelines for parameters in water are expressed in units of mg/L.[5] Hence, in the present study, participants were requested to analyse samples using their normal test method and to report a single result in units of mg/L. A summary of participants' results and performance is presented in Tables 47 and 48 and in Figures 42 to 45.

Rounding of results and reporting results with an insufficient number of significant figures was still the main cause of unsatisfactory results.

Analytical test results are rounded to avoid presenting a misleading impression of precision. However, most of the instrumental techniques used by participants in the present study should be capable of producing results with a reasonable degree of certainty to up to two significant figures at ppb level for most tests. Potable water is a less challenging matrix than sea water; while participants reported test results with 2 - 3 significant figures in the previous PT study in seawater, the same participants reported some results with only one significant figure in the present study. The level of analytes in the two studies were comparable. This suggests that change of unit is a source of confusion and/or that results could have been transferred from calculation spreadsheets that automatically apply the rounding rule. Laboratories 5, 12 and 18 should consider revising their calculation/reporting procedure.

Caution should be exercised when a rounding protocol is designed by a laboratory in order to avoid inadvertent loss of important information. According to Eurachem/CITAC Guide, "The reported result has to provide enough information in case a decision has to be made (e.g. when the result is close to the accepted guideline)."

Co in S1 was the analyte with the largest number of unsatisfactory results. All these results were reported with only one significant figure.

Participants were requested to analyse the drinking water samples for total elements. The method descriptions provided by participants are presented in Tables 1 and 3 and instrumental conditions are presented in Appendix 5.

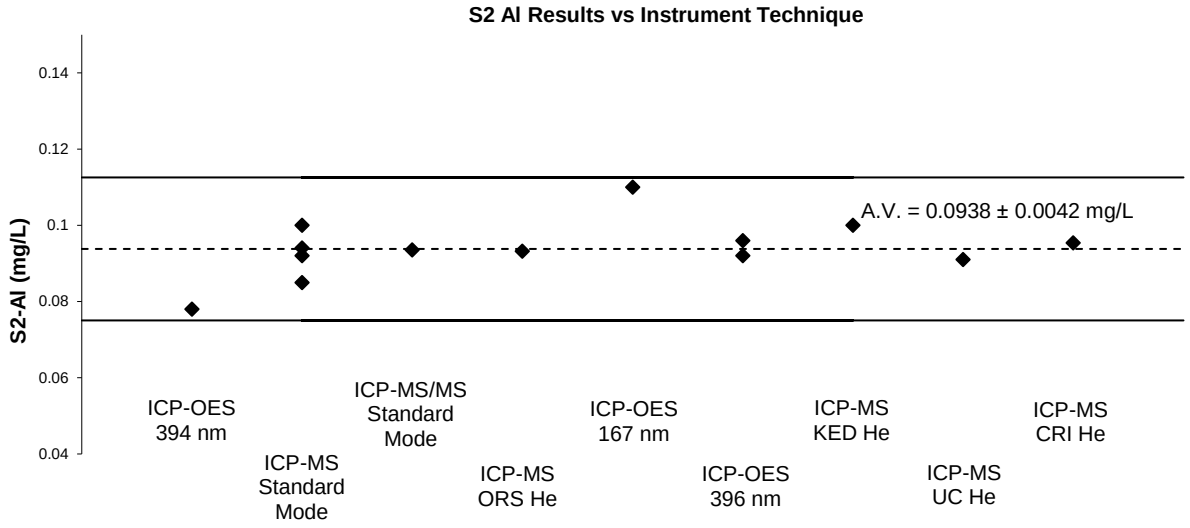
No significant difference was observed between the performances of participants who performed digestion and the ones who did not conduct a digestion procedure on the test samples. Instrumental measurement was one of the main factors that influenced results. However, participants' performance does not only reflect instrument performance, but also the performance of the analyst and of the analytical method used by the testing laboratory. Thus, these results should not be construed as an evaluation of a particular instrument.

Individual Element Commentary

Aluminium level in S2 was 0.0938 mg/L. Four participants used ICP-OES with wavelengths of 396 nm (2), 167 nm (1) or 394 nm (1). Eight laboratories reported using ICP-MS in standard or collision mode and one ICP-MS/MS in standard mode. All instrumental techniques produced satisfactory results (Figure 46).

Arsenic level in the potable water sample S1 was 0.00280 mg/L, whereas in S2 it was 2.5 times higher at 0.00720 mg/L. Three laboratories reported As results in both samples with only one significant figure. The instrumental techniques used by participants are presented in Figure 47. One laboratory used ICP-OES with vapour generator accessory and a wavelength of 193 nm.

Cobalt in S1 was the analyte with the largest number of unsatisfactory z-scores. All results reported for Co with only one significant figure were unsatisfactory. There was no evident relationship between participants' performance and instrumental technique used (Figure 48).



Horizontal lines on charts correspond to z-scores of 2 and -2.

Figure 46 S2-Al Participants' Results vs Instrumental Technique

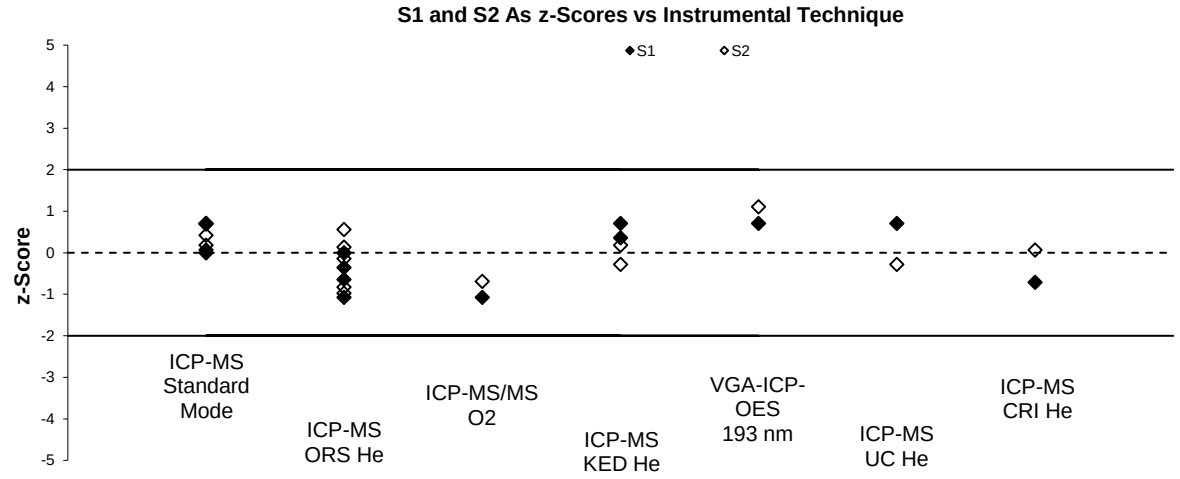
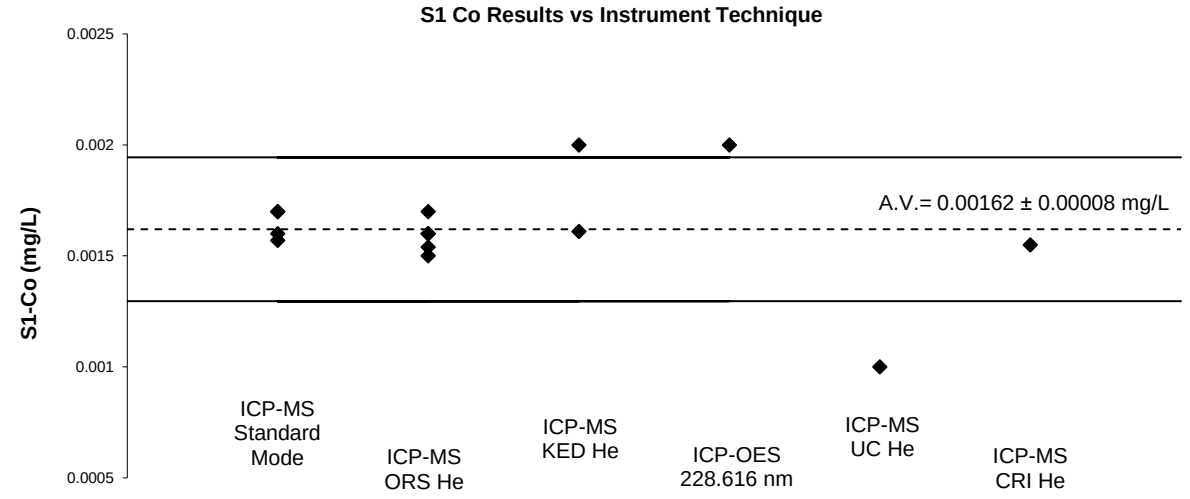


Figure 47 S1 and S2-As Participants' Performance vs Instrumental Technique



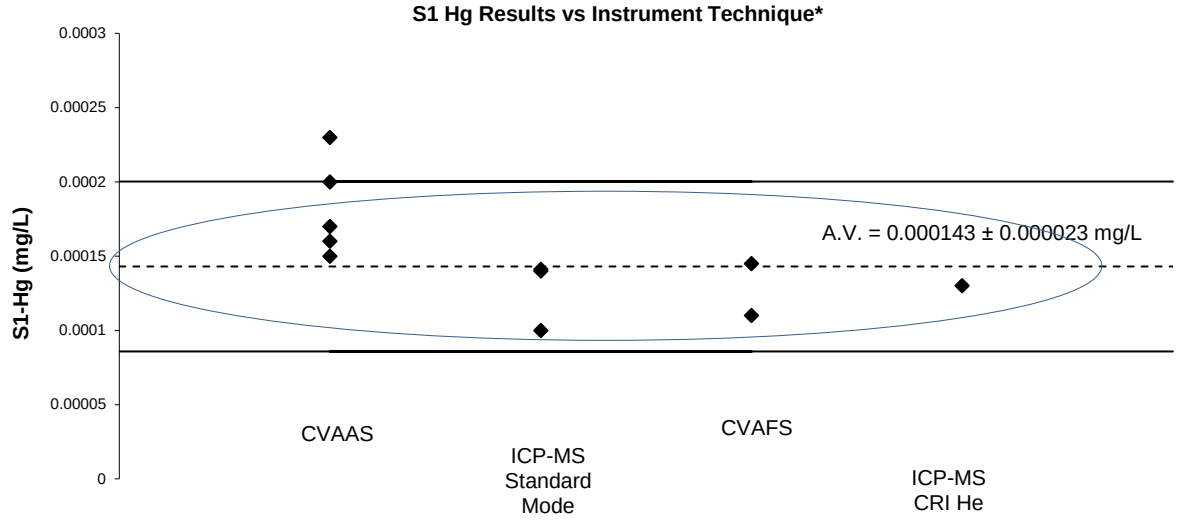
Horizontal lines on charts correspond to z-scores of 2 and -2.

Figure 48 S1-Co Participants' Results vs Instrumental Technique

Mercury Although Hg level in S1 and S2 was low 0.000143 mg/L and 0.000288 mg/L respectively, the between-laboratory CVs (21% and 9.8% respectively) were smaller than that predicted by Thomson and Horwitz (22%). There was excellent agreement between the results reported for Hg, regardless of instrumental technique used (Figure 49) with the exception of results which were rounded up and/or reported with an inappropriate number of significant figures.

Laboratory 3 might need to check the standard preparation procedure used for Hg analysis. The results they reported in S1 and S2 were higher than the assigned value by approximately the same factor of 1.5. Expired calibration standards, when not prepared fresh from stock solutions before measurement, are the most common cause of high Hg results.

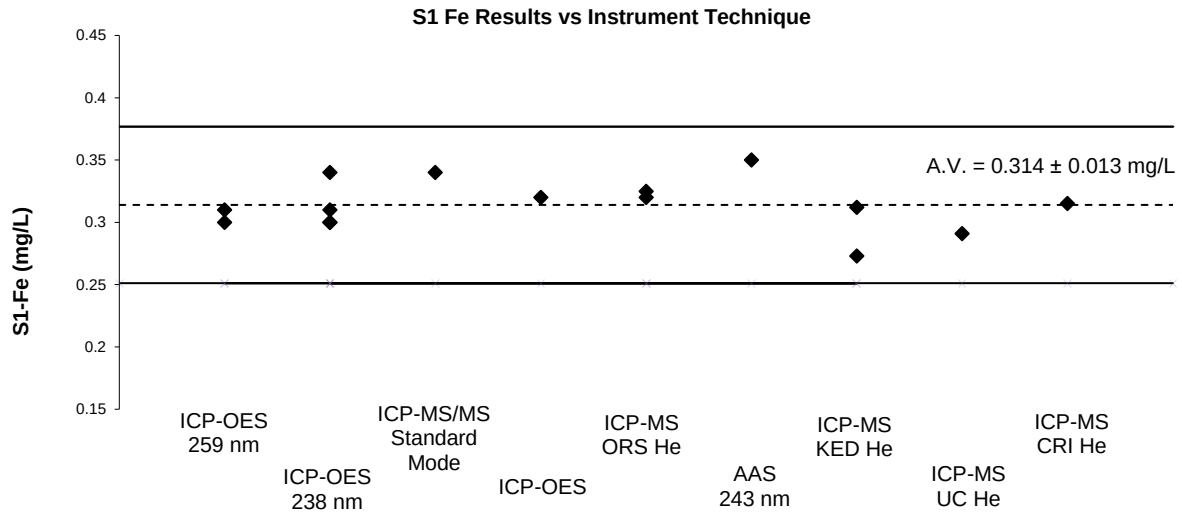
Laboratory 4 might have reported Hg results in the wrong units (µg/L).



*The reported by laboratory 4 was excluded. Horizontal lines on charts correspond to z-scores of 2 and -2.

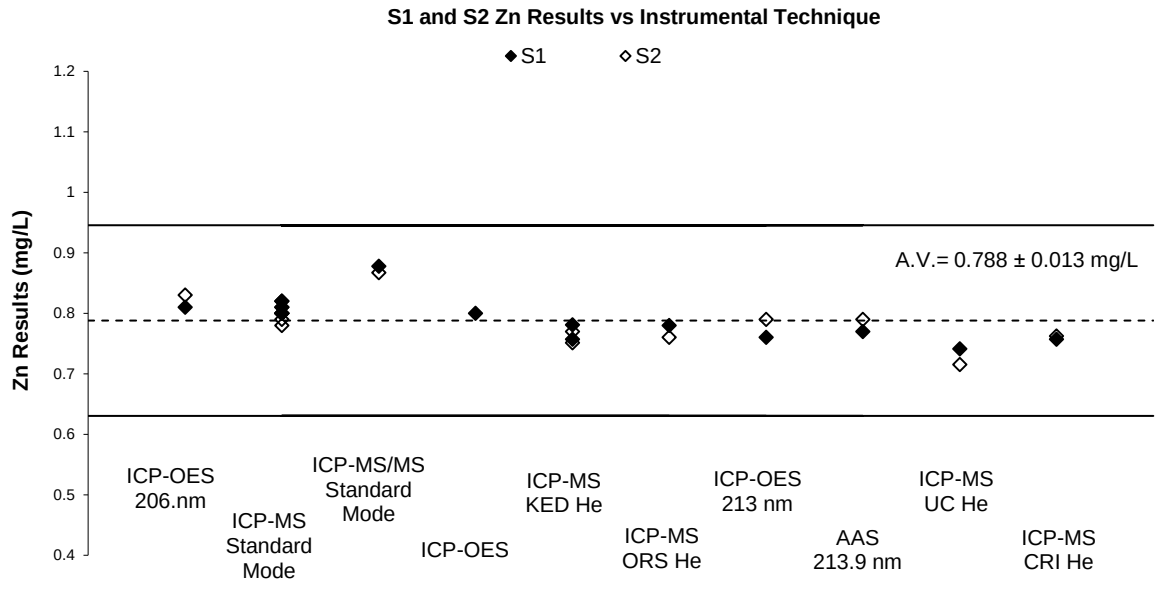
Figure 49 S1-Hg Participants' Results vs Instrumental Technique

Iron and zinc are known to be ubiquitous in the environment; hence, special precautions (e.g. special gloves) are necessary in order to avoid contamination. Plots of participants' results reported for Fe and Zn versus measurement technique used are presented in Figures 50 and 51.



Horizontal lines on charts correspond to z-scores of 2 and -2.

Figure 50 S1-Fe Participants' Results vs Instrumental Technique



Horizontal lines on charts correspond to z-scores of 2 and -2.

Figure 51 S1 and S2-Zn Participants' Results vs Instrumental Technique

Antimony Most participants used for Sb measurements in the two potable water samples ICP-MS in standard mode (Figure 52).

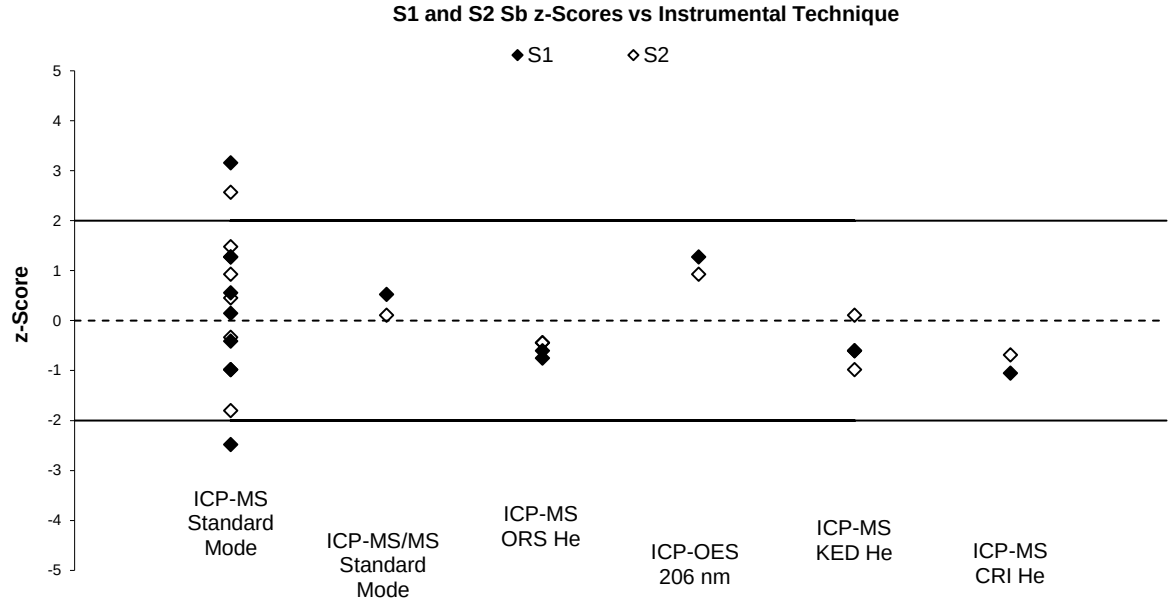
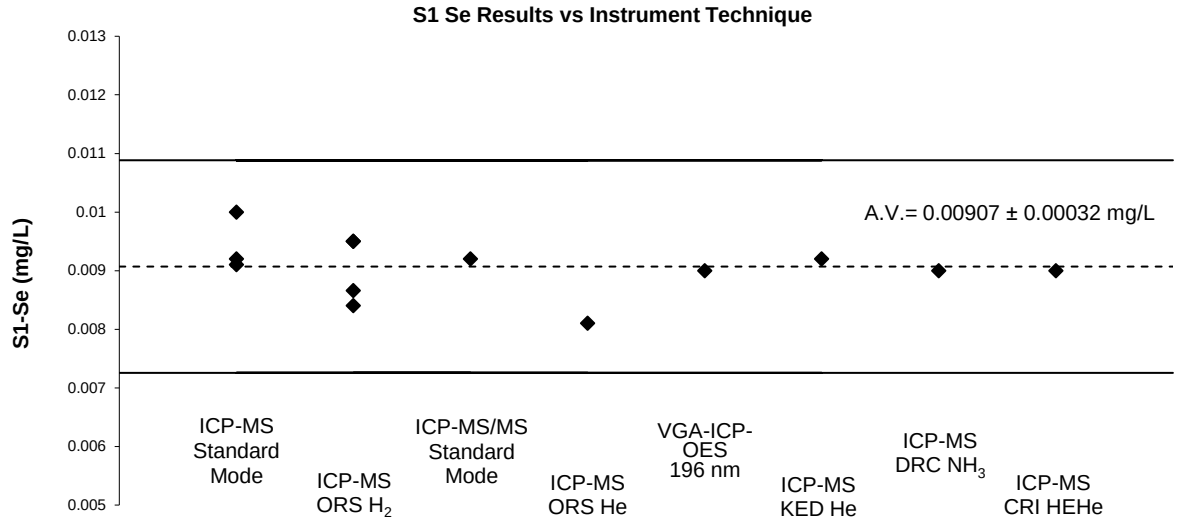


Figure 52 S1 and S2-Sb Participants' Performance vs Instrumental Technique

Selenium All participants reported satisfactory results for Se in S1. Participants used 8 different instrumental techniques: ICP-MS in standard, collision, reaction or MS/MS mode and with various collision/reaction gases: He, HEHe, NH_3 and H_2, (see Figure 53).



Horizontal lines on charts correspond to z-scores of 2 and -2.

Figure 53 S1 Se Participants' Results vs Instrumental Technique

Solids and Turbidity The method description provided by participants is presented in Table 2. Most participants used APHA Method 2540 for solids and APHA Method 2530 for Turbidity.

7.6 Participants' Within – Laboratory Repeatability

Sample S2 was the same fortified potable water used for Sample S1 preparation, further fortified for: Al, As, B, Ba, Bi, Cs, Fe, Hg, La, Mn, P, Sb, Sr, Th and U. The concentration of Cd, Sn and Zn in S2 was expected to remain unchanged from those in Sample S1

Scatter plots of z-scores in Samples S1 and S2 for Cd, Sn and Zn are presented in Figures 54 to 56. Points close to the diagonal axis represent excellent repeatability, and points close to zero represent excellent repeatability and accuracy.

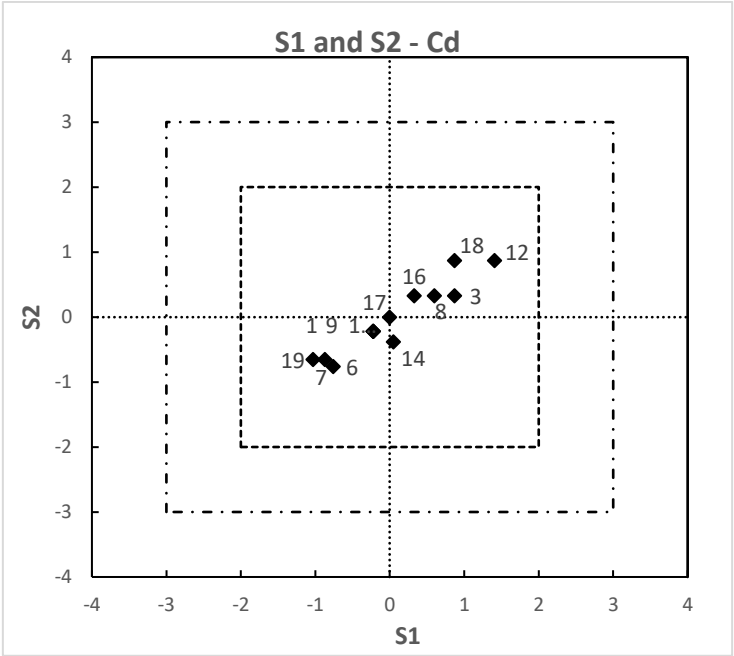


Figure 54 Scatter Plots of z-Scores for Cd in S1 and S2

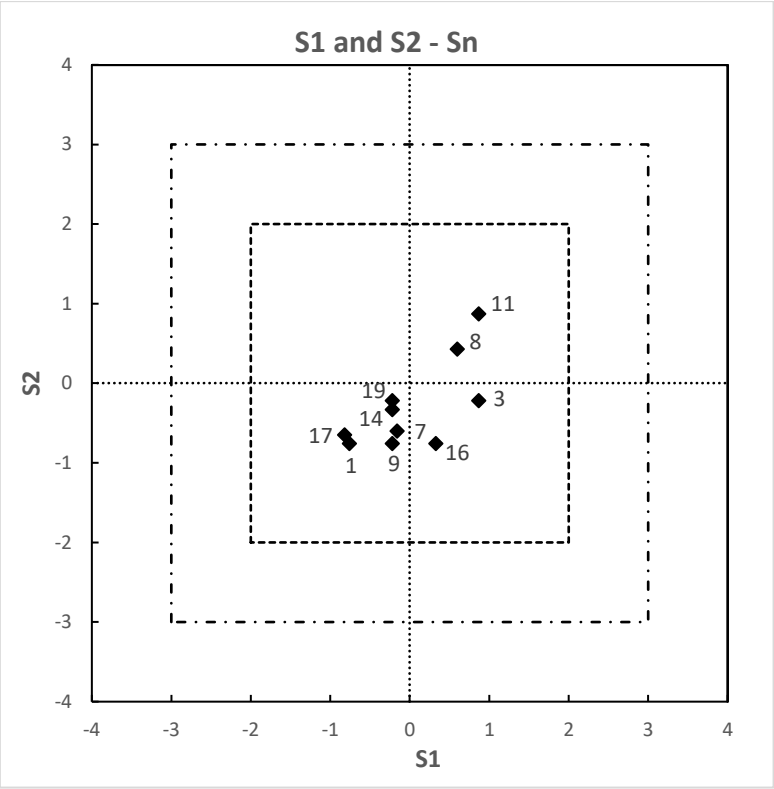


Figure 55 Scatter Plots of z-Scores for Sn in S1 and S2

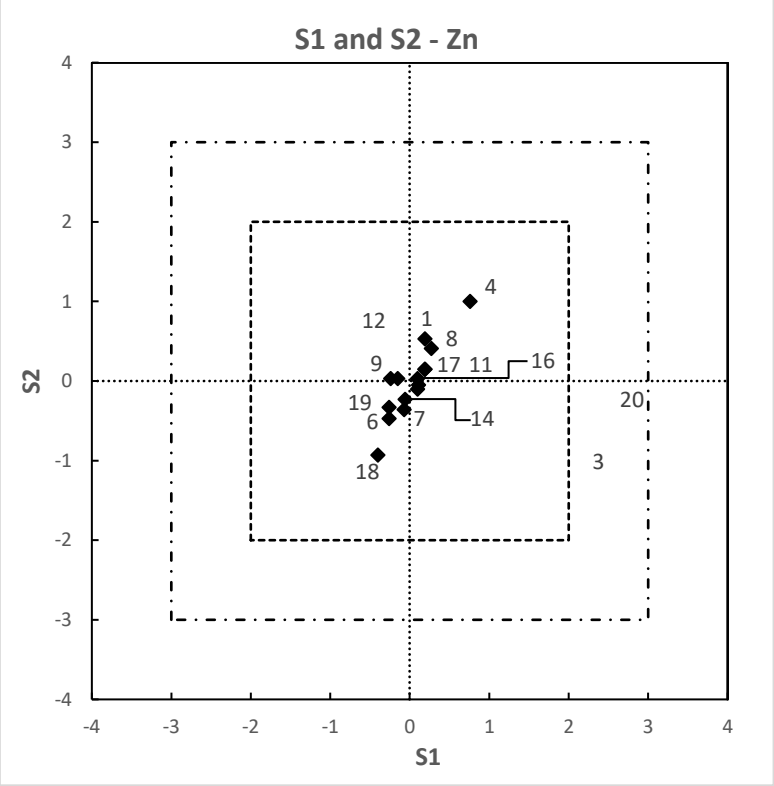


Figure 56 Scatter Plots of z-Scores for Zn in S1 and S2

Results reported for the above elements and the expanded MU are presented in the bar charts for each of these analyte in both study samples (Figure 57 to 59). In some cases, the expanded

measurement uncertainty in the two identical study samples are significantly different (e.g. uncertainties reported by laboratories 11 and 16 for Cd and uncertainty reported by laboratory 8 for Sn).

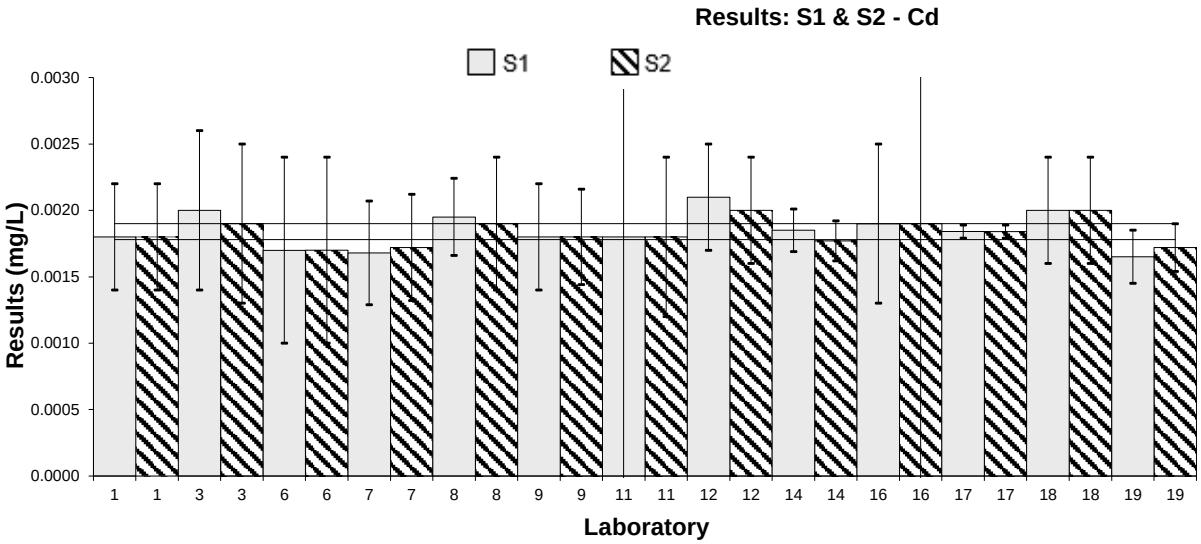


Figure 57 Bar Charts of Results for S1 and S2 – Cd

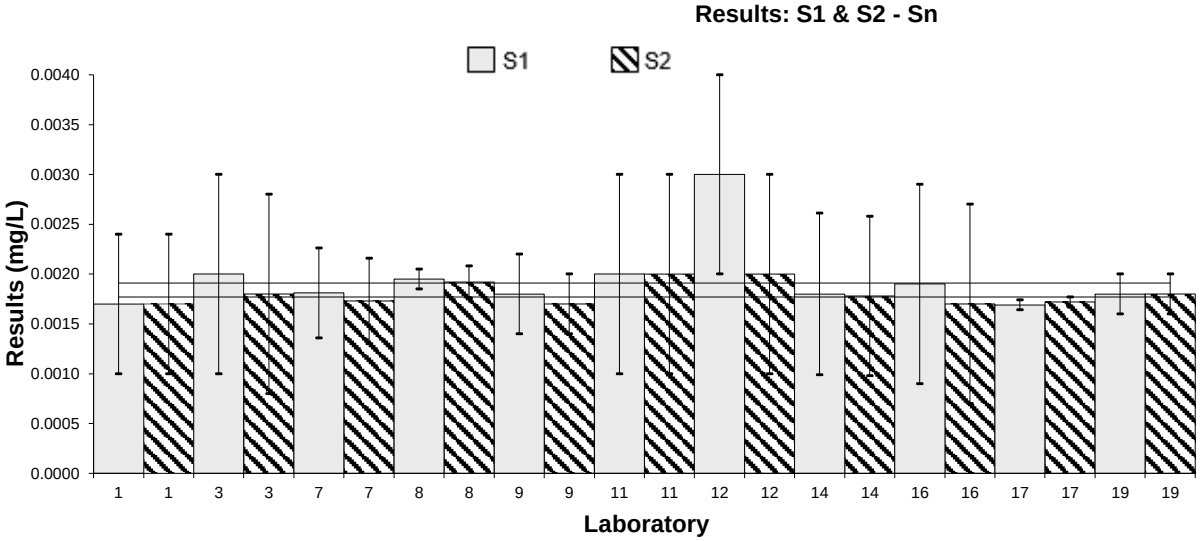


Figure 58 Bar Charts of Results for S1 and S2 – Sn

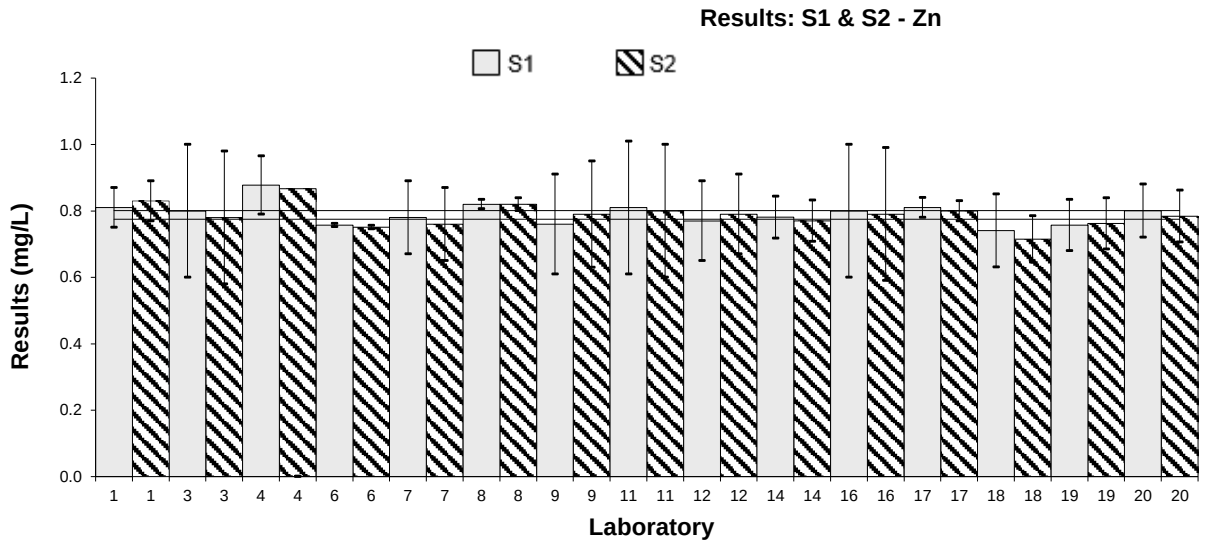


Figure 59 Bar Charts of Results for S1 and S2 – Zn

7.7 Comparison with Previous NMI Proficiency Tests of Metals in Water

AQA 22-10 is the sixth NMI proficiency test of metals in potable water. For most analytes, the same fixed target standard deviation was used in the present study as in previous studies of metals in water. This allowed for a comparison of participants' performance (z-score) over time and provided a benchmark for progressive improvement.

Despite different analytes concentrations, on average participants' performance has remained consistent with a percentage of satisfactory z-scores ranging from 88% to 96% and satisfactory E_n -scores from 80% to 91% (Figure 60).

Individual performance history reports are emailed to each participant at the end of the study; the consideration of z-scores for an analyte over time provides much more useful information than a single z-score.

Over time, laboratories should expect at least 95% of their scores to lie within the range $|z| \leq 2.0$. Scores in the range $2.0 < |z| < 3.0$ occasionally occur, however these should be interpreted in conjunction with the other scores obtained by that laboratory. For example, a trend of z-scores on one side of the zero line is an indication of method or laboratory bias.

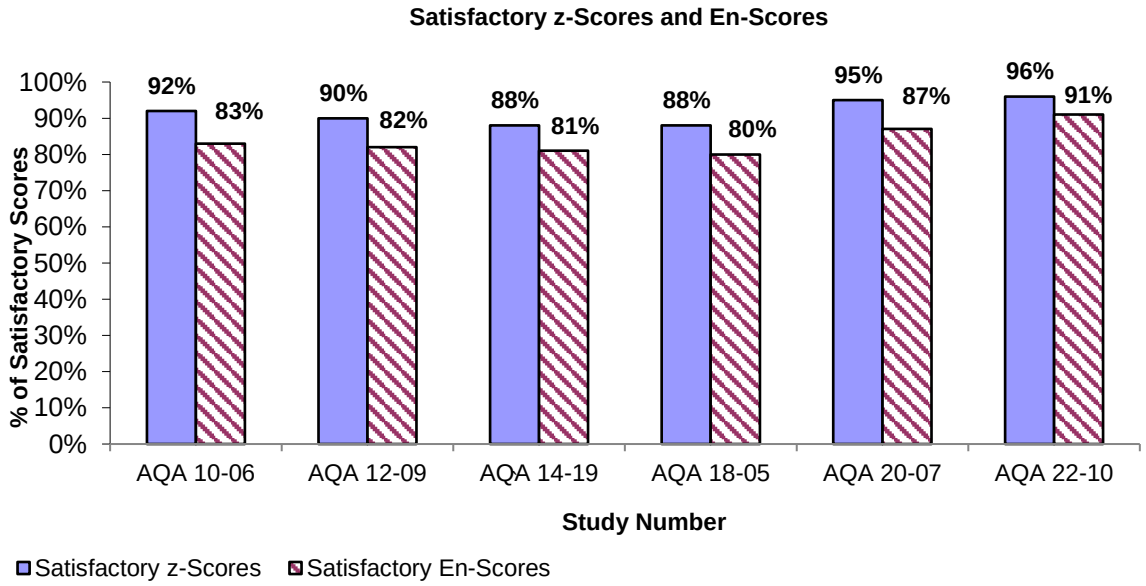


Figure 60 Participants' Performance in Metals in Potable Water over Time

7.8 Reference Materials and Certified Reference Materials

Participants reported whether control samples (spiked samples, certified reference materials-CRMs or matrix specific reference materials-RMs) had been used (Table 49).

Table 49 Control Samples Used by Participants

Lab. Code	Description of Control Samples
1	CRM - CWWTMA, CWWTMC
2	Spiked Sample
5	CRM
6	CRM - TMDW Trace metals in Drinking Water #2126004
8	Elemental check standards sourced from LGC Standards (ISO 17034:2016 accredited Reference Materials Producer, A2LA Certificate No. 2848.02)
9	CRM
10	CRM - ERA Turbidity Lot No P283-777, nsilab solutions High Level Solids Standard Lot 200109
12	HPS - Metals QCS-26
13	Spiked Sample - S/WAT/P21/0523 - Turbidity
14	Spiked Sample
15	RM
17	CRM - QCI-084 (TDS), QCI-057 (TSS), QCI-092 (Turbid), TMDW, ICP-AM-17
18	CRM - CWW-TM-A, B and C
20	Spiked Sample - Inorganic Ventures WW-LFS-1 Multi Analyte Custom Grade Solution - AAS QC Check Inorganic Ventures IV-STOCK-4 Multi Analyte Custom Grade Solution - AAS Calibration Std

Some laboratories reported using certified reference materials. These materials may not meet the internationally recognised definition of a Certified Reference Material:

> *'a reference material, accompanied by documentation issued by an authoritative body and providing one or more specified property values with associated uncertainties and traceabilities, using valid procedures'*[15]

8 REFERENCES

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APPENDIX 1 - SAMPLE PREPARATION, ANALYSIS AND HOMOGENEITY TESTING

Sample Preparation

Sample S1 was prepared from potable water. Approximately 9.8 L of tap water was stabilised by adding 2% (v/w) nitric acid and 0.01% (v/w) HCl. It was then fortified for 18 elements.

Sample S2 was prepared from 4.9 L of Sample S1, further fortified for 14 elements.

Sample S3 was prepared by adding 2.5 L of composite spike solution containing glass fibre filter paper and potassium chloride to 17.5 L of potable water. The solution was further spiked with 25 mL formazin turbidity standard.

Sample Analysis and Homogeneity Testing

A partial homogeneity test was conducted for all analytes of interest in samples S1 and S2, with the exception of Th in S2. Three bottles were analysed in duplicate for both samples and the average of the results was reported as the homogeneity value.

Methodology for Total Elements

For analysis of both samples, a test portion of 10 mL was transferred to a 14 mL graduated polypropylene centrifuge tube and sent for instrumental analysis.
Testing involved measurements using ICP-MS. The measurement instrument was calibrated using external standards for targeted analytes. A set of quality control samples consisting of blanks, blank matrix spike, duplicates and sample matrix spikes was carried out through the same set of procedures and analysed at the same time as the samples. A summary of the ion/s used for each analyte is given in Table 50.

Table 50 Instrumental Technique used for Total Elements

Analyte	Instrument	Internal Standard	Reaction/ Collision Cell (if applicable)	Cell Mode/Gas (if applicable)	S1 Final Dilution Factor	S2 Final Dilution Factor	Ion (m/z)
Al	ICP-MS	Rh	NA	NA	NA	1	27
As	ICP-MS	Rh	ORS	He	1	1	75
B	ICP-MS	Rh	NA	NA	NA	1	11
Ba	ICP-MS	Rh	ORS	He	NA	1	138
Be	ICP-MS	Rh	NA	NA	1	NA	9
Bi	ICP-MS	Ir	ORS	He	NA	1	209
Cd	ICP-MS	Rh	NA	NA	1	1	111
Co	ICP-MS	Rh	ORS	He	1	NA	59
Cr	ICP-MS	Rh	ORS	He	1	NA	52
Cs	ICP-MS	Rh	ORS	He	NA	1	133
Cu	ICP-MS	Rh	ORS	He	1	NA	63
Fe	ICP-MS	Rh	NA	NA	1	1	56
Hg	ICP-MS	Rh	NA	NA	1	1	202
La	ICP-MS	Rh	ORS	He	NA	1	139
Li	ICP-MS	Rh	ORS	He	1	NA	7
Mn	ICP-MS	Rh	ORS	He	NA	1	55
Mo	ICP-MS	Rh	ORS	He	1	NA	95
Ni	ICP-MS	Rh	ORS	He	1	NA	60
P	ICP-MS	Ir	ORS	HEHe	NA	1	31
Pb	ICP-MS	Ir	NA	NA	1	NA	Average of 206, 207, 208
Sb	ICP-MS	Ir	ORS	He	1	1	121
Se	ICP-MS	Rh	ORS	HEHe	1	NA	78
Sn	ICP-MS	Rh	NA	NA	1	1	118
Sr	ICP-MS	Rh	ORS	He	NA	1	88

Tl	ICP-MS	Rh	ORS	He	1	NA	205
U	ICP-MS	Ir	NA	NA	NA	1	238
V	ICP-MS	Rh	ORS	He	1	NA	51
Zn	ICP-MS	Rh	ORS	He	1	1	64

APPENDIX 2 - ASSIGNED VALUE, Z-SCORE AND E_N SCORE CALCULATION

The assigned value was calculated as the robust average using the procedure described in 'ISO13528:2015(E), Statistical methods for use in proficiency testing by inter-laboratory comparisons – Annex C'.[6] The uncertainty was estimated as:

$$u_{rob\ av} = 1.25 * S_{rob\ av} / \sqrt{p} \qquad \text{Equation 4}$$

where:

$u_{rob\ av}$ robust average standard uncertainty
$S_{rob\ av}$ robust average standard deviation
p number of results

The expanded uncertainty ($U_{rob\ av}$) is the standard uncertainty multiplied by a coverage factor of 2 at approximately 95% confidence level.

A worked example is set out below in Table 51.

Table 51 Uncertainty of Assigned Value for Be in Sample S1

No. results (p)	14
Robust Average	0.00342 mg/L
$S_{rob\ av}$	0.00031 mg/L
$u_{rob\ av}$	0.00010 mg/L
k	2
$U_{rob\ av}$	0.00021 mg/L

The assigned value for Be in Sample S1 is **0.00342 ± 0.00021 mg/L.**

z-Score and E_n-score

For each participant's result a z-score and E_n-score are calculated according to Equation 2 and Equation 3 respectively (see page 9).

A worked example is set out below in Table 52.

Table 52 z-Score and E_n-score for Be result reported by Laboratory 16 in S1

Be Result mg/L	Assigned Value mg/L	Set Target Standard Deviation	z-Score	E_n-Score
0.0037±0.001	0.00342±0.00021	10% as CV or 0.10x0.00342= =0.000342mg/L	$z = \frac{(0.0037 - 0.00342)}{0.000342}$ z = 0.82	$En = \frac{(0.0037 - 0.00342)}{\sqrt{0.001^2 + 0.00021^2}}$ E_n= 0.27

APPENDIX 3 - USING PT DATA FOR UNCERTAINTY ESTIMATION

When a laboratory has successfully participated in at least 6 proficiency testing studies, the standard deviation from proficiency testing studies can be used to estimate the uncertainty of their measurement results.[10, 12] Between 2007 and 2022, NMI carried out 30 proficiency tests of metals in water. These studies involved analyses of dissolved or total elements at low and high levels in potable, fresh (river), saline water, ground water and waste water. Laboratory X participated and submitted satisfactory results in 22 of these PTs. This data can be separated into two ranges of results: 0.0005 to 0.01 mg/L and 0.01 to 0.10 mg/L. Results are presented in Tables 53 and 54.

Table 53 Laboratory X Reported Results for Ni at 0.0005 to 0.01 mg/L Level.

Study No.	Sample	Laboratory result* mg/L	Assigned value mg/L	Robust CV of all results (%)	Number of Results
AQA 11-07	Fresh	0.0015 ± 0.0003	0.00100 ± 0.00001	24	15
	Fresh	0.0039 ± 0.00078	0.00306 ± 0.00016	18	19
	Fresh	0.0039 ± 0.00078	0.00306 ± 0.00016	9.6	19
AQA 12-20	Saline	0.0039 ± 0.0008	0.00370 ± 0.00028	13	19
AQA 13-09	Fresh	0.0044 ± 0.0009	0.00409 ± 0.00017	7.9	15
AQA 13-22	Saline	0.00170 ± 0.00034	0.00165 ± 0.00014	13	14
	Saline	0.00384 ± 0.00077	0.00378 ± 0.00012	13	14
AQA 15-06	Sea	0.00180 ±0.0004	0.00177 ± 0.00021	28	12
	Sea	0.00172 ± 0.0004	0.00177 ± 0.00021	28	11
AQA 15-18	Surface	0.002 ± 0.0003	0.00196 ± 0.00013	7.8	10
AQA 16-03	Waste	0.0041 ± 0.0008	0.00398 ± 0.00031	8.6	9
AQA 16-15	Sea	0.0070 ± 0.0010	0.00652 ± 0.00038	9.4	16
AQA 17-16	Sea	0.0015 ± 0.0003	0.00143 ± 0.00029	22	10
AQA 18-16	Sea	0.0022 ± 0.0005	0.00206 ± 0.00015	11	14
AQA 19-07	Fresh	0.0018 ± 0.0004	0.00187 ± 0.00009	5.3	10
AQA 19-16	Sea	0.0021 ± 0.0004	0.00168 ± 0.00037	25	8
AQA 20-16	Sea	0.0013 ± 0.0003	0.00178 ± 0.00034	24	10
AQA 21-09	River	0.0007 ± 0.0002	0.000756 ± 0.000059	8.9	8
AQA 21-18	Saline Water	0.0029 ± 0.0006	0.00298 ± 0.00031	13	6
AQA 22-10	Potable	0.007 ± 0.0011	0.00845 ± 0.00036	6.1	13
Average				15**	

* Expanded uncertainty at 95% confidence level. ** The mean value of Robust CV was used.

Table 54 Laboratory X Reported Results for Ni at 0.01 to 0.10 mg/L Level.

Study No.	Sample	Laboratory result* mg/L	Assigned value mg/L	Robust CV of all results (%)	Number of Results
AQA 11-17	Waste	0.10 ± 0.009	0.099 ± 0.001	2	15
	Waste	0.10 ± 0.009	0.098 ± 0.001	2	15
AQA 12-09	Potable	0.047 ± 0.007	0.045 ± 0.002	6.7	19
	Potable	0.055 ± 0.008	0.053 ± 0.002	7.4	19
AQA 12-20	Saline	0.0415 ± 0.0083	0.0384 ± 0.0021	11	22
AQA 13-09	Fresh	0.0393 ± 0.0040	0.0361 ± 0.0010	4.8	16

Table 54 Laboratory X Reported Results for Ni at 0.01 to 0.10 mg/L Level (continued)

Study No.	Sample	Laboratory result* mg/L	Assigned value mg/L	Robust CV of all results (%)	Number of Results
AQA 13-09	Fresh	0.0258 ± 0.0030	0.0272 ± 0.0025	15	15
AQA 14-08	Ground	0.019 ± 0.004	0.0191 ± 0.0007	7.9	13
AQA 14-19	Potable	0.019 ± 0.004	0.0183 ± 0.0013	11	14
AQA 15-18	Surface	0.036 ± 0.0035	0.0336 ± 0.0013	5.1	13
AQA 16-03	Waste	0.042 ± 0.0045	0.0352 ± 0.0050	19	11
AQA 16-15	Sea	0.0456 ± 0.0060	0.0409 ± 0.0029	12	17
AQA 17-16	Sea	0.0116 ± 0.0012	0.0101 ± 0.0023	27	9
AQA 18-05	Potable	0.017 ± 0.002	0.0172 ± 0.0010	8.7	16
AQA 18-16	Sea	0.015 ± 0.0030	0.0138 ± 0.0014	15	15
AQA 19-07	Fresh	0.029 ± 0.0035	0.0283 ± 0.0009	4.3	11
AQA 20-07	Potable	0.010 ± 0.002	0.0106 ± 0.0004	6	16
AQA 21-09	Waste	0.014 ± 0.0021	0.0143 ± 0.0006	8.1	21
Average				9.6**	

*Expanded uncertainty at 95% confidence level. **The mean value of Robust CV was used

Taking the average of the robust CVs over these PT samples for each concentration range gives estimates of the relative standard uncertainty of 15% and 9.6% respectively. Using a coverage factor of two gives relative expanded uncertainties of 30% and 20% respectively, at a level of confidence of 95% level.

Table 55 sets out the expanded uncertainty for results of the measurement of Ni in fresh, saline, waste or potable water over the ranges 0.0005 – 0.01 mg/L and 0.01 – 0.10 mg/L.

Table 55 Uncertainty of Ni results estimated using PT data.

Results mg/L	Uncertainty mg/L
0.00050	0.00015
0.00100	0.00030
0.0100	0.0020
0.100	0.020
0.150	0.030

The estimates of 30% and 20% relative passes the test of being reasonable, and the analysis of the thirty-eight different PT samples over ten years can be assumed to include all the relevant uncertainty components (different matrices, operators, reagents, calibrators etc.), and so complies with ISO 17025.[8]

APPENDIX 4 - ACRONYMS AND ABBREVIATIONS

APHA	American Public Health Association
ASNZS	Standards Australia and Standards New Zealand
CITAC	Cooperation on International Traceability in Analytical Chemistry
CRI	Collision Reaction Interface
CRM	Certified Reference Material
CV	Coefficient of Variation
CVAAS	Cold Vapour-Atomic Absorption Spectrometry
CVAFS	Cold Vapour-Atomic Fluorescence Spectroscopy
DRC	Dynamic Reaction Cell
GUM	Guide to the Expression of Uncertainty in Measurement
HEHe	High Energy He Mode
ICP-MS	Inductively Coupled Plasma - Mass Spectrometry
ICP-MS/MS	Inductively Coupled Plasma - Tandem Mass Spectrometry
ICP-OES-AV	Inductively Coupled Plasma - Optical Emission Spectrometry- axial view
ICP-OES-AV-buffer	Inductively Coupled Plasma - Optical Emission Spectrometry- axial view with buffer
ISO	International Organisation for Standardisation
Max	Maximum Value in a Set of Results
Md	Median
Min	Minimum Value in a Set of Results
MU	Measurement Uncertainty
NATA	National Association of Testing Authorities
NIST	National Institute of Standards and Technology
NMI	National Measurement Institute (of Australia)
NR	Not Reported
NT	Not Tested
ORS	Octopole Reaction System
PCV	Performance Coefficient of Variation
PT	Proficiency Test
RM	Reference Material
Robust CV	Robust Coefficient of Variation
Robust SD	Robust Standard Deviation
S.V.	Spiked or Formulated Concentration of a PT Sample
SI	The International System of Units
s^2_{sam}	Sampling Variance
s_a/σ	Analytical Standard Deviation Divided by the Target Standard Deviation
SRM	Standard Reference Material (Trademark of NIST)
Target SD	Target Standard Deviation
σ	Target Standard Deviation
UC	Universal Cell
USEPA	United States Environmental Protection Agency

APPENDIX 5 - INSTRUMENT DETAILS FOR TOTAL ELEMENTS

Table 56 Instrument Conditions Al

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-AV-buffer	Y	NA		NA	1	394.401
2	NA	NA	NA	NA	NA	NA	NA
3	ICP-MS	6Li	NA		1	1	27
4	ICP-MS/MS				NA		27
5	NA	NA	NA	NA	NA	NA	NA
6	ICP-MS	Ir, Rh			NA		
7	ICP-MS	Ge	ORS	He	NA	1.05	27
8	ICP-MS	Virtual Internal Standard (Sc, Y, In, Tb)	NA	NA	NA		
9	ICP-OES-AV	Y	NA	NA	NA	2	167.019
10	NA	NA	NA	NA	NA	NA	NA
11	ICP-MS	6Li	NA		1	1	27
12	ICP-OES-AV	None	NA	NA	10:01	NA	396.153
13	NA	NA	NA	NA	NA	NA	NA
14	ICP-MS	Sc	KED	He	NA	1	27
15	NA	NA	NA	NA	NA	NA	NA
16	ICP-MS	6Li	NA		1	1	27
17	ICP-OES	Lu			NA	1	396
18	ICP-MS	Sc	UC	He	NA	1	27
19	ICP-MS		CRI	He	NA		27
20					NA		

Table 57 Instrument Conditions As

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	Ge			1	1	75
2	NA	NA	NA	NA	NA	NA	NA
3	ICP-MS	Ge	ORS	He	1	1	75
4	ICP-MS/MS						75/91
5	ICP-MS					NA	
6	ICP-MS	Ir, Rh	KED				
7	ICP-MS	Ge	ORS	He	1.05	1.05	75
8	ICP-MS	Virtual Internal Standard (Sc, Y, In, Tb)	NA	NA	10	10	75
9	ICP-MS	Rh	ORS	He	1.25	1.25	75
10	NA	NA	NA	NA	NA	NA	NA
11	ICP-MS	Ge	ORS	He	1	1	75
12	VGA-ICP-OES	None	NA	NA	1	NA	193.7
13	NA	NA	NA	NA	NA	NA	NA
14	ICP-MS	Te	KED	He	1	1	75
15	NA	NA	NA	NA	NA	NA	NA
16	ICP-MS	Ge	ORS	He	1	1	75
17	ICP-MS	Rh			1	1	75
18	ICP-MS	Ge	UC	He	1	1	75
19	ICP-MS		CRI	He			75
20							

Table 48 Instrument Conditions B

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-AV-buffer	Y	NA		NA	1	208.957
2	NA	NA	NA	NA	NA	NA	NA
3	ICP-MS	6Li	NA		1	1	11
4	ICP-MS/MS				NA		11
5	NA	NA	NA	NA	NA	NA	NA
6	ICP-MS	Ir, Rh			NA		
7	ICP-MS	Ge		standard mode	NA	1.05	11
8	ICP-MS	Virtual Internal Standard (Sc, Y, In, Tb)	NA	NA	NA	10	11
9	ICP-OES-AV	Y	NA	NA	NA	2	249.678
10	NA	NA	NA	NA	NA	NA	NA
11	ICP-MS	6Li	NA		1	1	11
12	ICP-OES-AV	None	NA	NA	10:01	NA	249.772
13	NA	NA	NA	NA	NA	NA	NA
14	ICP-MS	Sc	KED	He	NA	1	10
15	NA	NA	NA	NA	NA	NA	NA
16	ICP-MS	6Li	NA		1	1	11
17	ICP-OES	Lu			NA	1	208
18	ICP-MS	Sc	NA	NA	NA	1	10
19	ICP-MS				NA		11
20					NA		

Table 49 Instrument Conditions Ba

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-AV-buffer	Y	NA		NA	1	233.527
2	NA	NA	NA	NA	NA	NA	NA
3	ICP-MS	Rh	NA		1	1	138
4	ICP-MS/MS				NA		137
5	NA	NA	NA	NA	NA	NA	NA
6	ICP-MS	Ir, Rh	KED		NA		
7	ICP-MS	Ir		He	NA	1.05	137
8	ICP-MS	Virtual Internal Standard (Sc, Y, In, Tb)	NA	NA	NA	10	137
9	ICP-MS	Rh	ORS	He	NA	1.25	134
10	NA	NA	NA	NA	NA	NA	NA
11	ICP-MS	Rh	NA		1	1	138
12	ICP-OES-AV	None	NA	NA	10:01	NA	455.403
13	NA	NA	NA	NA	NA	NA	NA
14	ICP-MS	Tb	KED	He	NA	1	137
15	NA	NA	NA	NA	NA	NA	NA
16	ICP-MS	Rh	NA		1	1	138
17	ICP-MS	Ir			NA	1	137
18	ICP-MS	Rh	NA	NA	NA	1	138
19	ICP-MS		CRI	He	NA		137
20					NA		

Table 50 Instrument Conditions Be

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	Sc			1	NA	9
2	NA	NA	NA	NA	NA	NA	NA
3	ICP-MS	6Li	NA		1	1	9
4	ICP-MS/MS					NA	9
5	ICP-MS					NA	
6	ICP-MS	Ir, Rh				NA	
7	ICP-MS	Ge		standard mode	1.05	NA	9
8	ICP-MS	Virtual Internal Standard (Sc, Y, In, Tb)	NA	NA	10	NA	9
9	ICP-MS	Rh	ORS	He	1.25	NA	9
10	NA	NA	NA	NA	NA	NA	NA
11	ICP-MS	6Li	NA		1	1	9
12	NA	NA	NA	NA	NA	NA	NA
13	NA	NA	NA	NA	NA	NA	NA
14	ICP-MS	Sc	KED	He	1	NA	9
15	NA	NA	NA	NA	NA	NA	NA
16	ICP-MS	6Li	NA		1	1	9
17	ICP-MS	Rh			1	NA	9
18	ICP-MS	Sc	NA	NA	1	NA	9
19	ICP-MS					NA	9
20						NA	

Table 51 Instrument Conditions Bi

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	NT				NA	NT	
2	NA	NA	NA	NA	NA	NA	NA
3	ICP-MS	Lu	NA		1	1	209
4	ICP-MS/MS				NA		
5	NA	NA	NA	NA	NA	NA	NA
6	ICP-MS	Ir, Rh			NA		
7	ICP-MS	Ir		He	NA	1.05	209
8	ICP-MS	Virtual Internal Standard (Sc, Y, In, Tb)	NA	NA	NA	10	209
9	ICP-MS	Rh	ORS	He	NA	1.25	209
10	NA	NA	NA	NA	NA	NA	NA
11	ICP-MS	Lu	NA		1	1	209
12	NA	NA	NA	NA	NA	NA	NA
13	NA	NA	NA	NA	NA	NA	NA
14	ICP-MS	Tb	KED	He	NA	1	209
15	NA	NA	NA	NA	NA	NA	NA
16	ICP-MS	Lu	NA		1	1	209
17	ICP-MS	Ir			NA	1	209
18	ICP-MS	Ir	NA	NA	NA	1	209
19	ICP-MS		CRI	He	NA		209
20					NA		

Table 52 Instrument Conditions Cd

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	In			1	1	111
2	NA	NA	NA	NA	NA	NA	NA
3	ICP-MS	Rh	NA		1	1	111
4	ICP-MS/MS						111
5	ICP-MS					NA	
6	ICP-MS	Ir, Rh					
7	ICP-MS	In		He	1.05	1.05	111
8	ICP-MS	Virtual Internal Standard (Sc, Y, In, Tb)	NA	NA	10	10	111
9	ICP-MS	Rh	ORS	He	1.25	1.25	111
10	NA	NA	NA	NA	NA	NA	NA
11	ICP-MS	Rh	NA		1	1	111
12	ICP-OES-AV	None	NA	NA	10:01	NA	214.44
13	NA	NA	NA	NA	NA	NA	NA
14	ICP-MS	Rh	KED	He	1	1	111
15	NA	NA	NA	NA	NA	NA	NA
16	ICP-MS	Rh	NA		1	1	111
17	ICP-MS	Rh			1	1	114
18	ICP-MS	Rh	NA	NA	1		111
19	ICP-MS		CRI	He			111
20							

Table 53 Instrument Conditions Co

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	Ga			1	NA	59
2	NA	NA	NA	NA	NA	NA	NA
3	ICP-MS	Ge	ORS	He	1	1	59
4	ICP-MS/MS					NA	59
5	ICP-MS					NA	
6	ICP-MS	Ir, Rh	KED			NA	
7	ICP-MS	Ge		He	1.05	NA	59
8	ICP-MS	Virtual Internal Standard (Sc, Y, In, Tb)	NA	NA	10	NA	59
9	ICP-MS	Rh	ORS	He	1.25	NA	59
10	NA	NA	NA	NA	NA	NA	NA
11	ICP-MS	Ge	ORS	He	1	1	59
12	ICP-OES-AV	None	NA	NA	10:01	NA	228.616
13	NA	NA	NA	NA	NA	NA	NA
14	ICP-MS	Ga	KED	He	1	NA	59
15	NA	NA	NA	NA	NA	NA	NA
16	ICP-MS	Ge	ORS	He	1	1	59
17	ICP-MS	Rh			1	NA	59
18	ICP-MS	Ge	UC	He	1	NA	59
19	ICP-MS		CRI	He		NA	59
20						NA	

Table 54 Instrument Conditions Cr

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	Ga	DRC	NH3	1	NA	52
2	NA	NA	NA	NA	NA	NA	NA
3	ICP-MS	Ge	ORS	He	1	1	52
4	ICP-MS/MS					NA	52
5	ICP-MS					NA	
6	ICP-MS	Ir, Rh	KED			NA	
7	ICP-MS	Ge		He	1.05	NA	52
8	ICP-MS	Virtual Internal Standard (Sc, Y, In, Tb)	NA	NA	10	NA	52
9	ICP-MS	Rh	ORS	He	1.25	NA	52
10	NA	NA	NA	NA	NA	NA	NA
11	ICP-MS	Ge	ORS	He	1	1	52
12	ICP-OES-AV	None	NA	NA	10:01	NA	267.716
13	NA	NA	NA	NA	NA	NA	NA
14	ICP-MS	Sc	KED	He	1	NA	52
15	NA	NA	NA	NA	NA	NA	NA
16	ICP-MS	Ge	ORS	He	1	1	52
17	ICP-OES	Lu			1	NA	205
18	ICP-MS	Sc	UC	He	1	NA	52
19	ICP-MS		CRI	He		NA	52
20						NA	

Table 55 Instrument Conditions Cs

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	NT				NA	NT	
2	NA	NA	NA	NA	NA	NA	NA
3	ICP-MS	Rh	NA		1	1	133
4	ICP-MS/MS				NA		
5	NA	NA	NA	NA	NA	NA	NA
6	NA	NA			NA		
7	ICP-MS				NA		
8	ICP-MS	Virtual Internal Standard (Sc, Y, In, Tb)	NA	NA	NA	10	133
9	ICP-MS	Rh	ORS	He	NA	1.25	133
10	NA	NA	NA	NA	NA	NA	NA
11	ICP-MS	Rh	NA		1	1	133
12	ICP-OES-AV	None	NA	NA	10:01	NA	852.1
13	NA	NA	NA	NA	NA	NA	NA
14	ICP-MS	Tb	KED	He	NA	1	133
15	NA	NA	NA	NA	NA	NA	NA
16	ICP-MS	Rh	NA		1	1	133
17	ICP-MS	Rh			NA	1	133
18					NA		
19	ICP-MS		CRI	He	NA		133
20					NA		

Table 56 Instrument Conditions Cu

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-AV-buffer	Y	NA		1	NA	324.752
2	NA	NA	NA	NA	NA	NA	NA
3	ICP-MS	Ge	ORS	He	1	1	63
4	ICP-MS/MS					NA	63
5	ICP-MS					NA	
6	ICP-MS	Ir, Rh	KED			NA	
7	ICP-MS	Ge		He	1.05	NA	63
8	ICP-MS	Virtual Internal Standard (Sc, Y, In, Tb)	NA	NA		NA	
9	ICP-OES-AV	y	NA	NA	2	NA	267.716
10	NA	NA	NA	NA	NA	NA	NA
11	ICP-MS	Ge	ORS	He	1	1	63
12	AAS	None	NA	NA	1	NA	324.7
13	NA	NA	NA	NA	NA	NA	NA
14	ICP-MS	Ga	KED	He	1	NA	63
15	NA	NA	NA	NA	NA	NA	NA
16	ICP-MS	Ge	ORS	He	1	1	63
17	ICP-OES	Lu			1	NA	324
18	ICP-MS	Ge	UC	He	1	NA	63
19	ICP-MS		CRI	He		NA	63
20						NA	

Table 57 Instrument Conditions Fe

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-AV-buffer	Y	NA		1	1	259.939
2	NA	NA	NA	NA	NA	NA	NA
3	ICP-OES-AV	--	NA		1	1	238.2
4	ICP-MS/MS						56
5	ICP-OES-AV					NA	
6	ICP-MS	Ir, Rh	KED				
7	ICP-MS	Ge		He	1.05	1.05	56
8	ICP-MS	Virtual Internal Standard (Sc, Y, In, Tb)	ORS	He	10	10	56
9	ICP-OES-AV	Y	NA	NA	2	2	238.204
10	NA	NA	NA	NA	NA	NA	NA
11	ICP-OES-AV	--	NA		1	1	238.2
12	AAS	None	NA	NA	1	NA	243.8
13	NA	NA	NA	NA	NA	NA	NA
14	ICP-MS	Sc	KED	He	1	1	56
15	NA	NA	NA	NA	NA	NA	NA
16	ICP-OES-AV	--	NA		1	1	238.2
17	ICP-OES	Lu			1	1	259
18	ICP-MS	Sc	UC	He	1	1	56
19	ICP-MS		CRI	He			56
20							

Table 58 Instrument Conditions Hg

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	CVAAS				2	2	253.7nm
2	NA	NA	NA	NA	NA	NA	NA
3	CVAAS	--	NA		1	1	253.7
4	ICP-MS/MS						
5	ICP-MS					NA	
6	ICP-MS	Ir, Rh					
7	CVAFS		NA		1.5	1.5	253.7
8	ICP-MS	Virtual Internal Standard (Sc, Y, In, Tb)	NA	NA	10	10	
9							
10	NA	NA	NA	NA	NA	NA	NA
11	CVAAS	--	NA		1	1	253.7
12	CVAAS	None	NA	NA	1	NA	253.6
13	NA	NA	NA	NA	NA	NA	NA
14	CVAFS	NA	NA	NA	5	5	253.7
15	NA	NA	NA	NA	NA	NA	NA
16	CVAAS	--	NA		1	1	253.7
17	ICP-MS	Ir			1	1	201
18	ICP-MS	Ir	NA	NA	1	1	201
19	ICP-MS		CRI	He			202
20							

Table 59 Instrument Conditions La

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	NT				NA	NT	
2	NA	NA	NA	NA	NA	NA	NA
3	ICP-MS	Rh	NA		1	1	139
4	ICP-MS/MS				NA		
5	NA	NA	NA	NA	NA	NA	NA
6	NA	NA			NA		
7	ICP-MS	In		He	NA	1.05	139
8	ICP-MS	Virtual Internal Standard (Sc, Y, In, Tb)	NA	NA	NA	10	139
9	ICP-MS	Rh	ORS	He	NA	1.25	139
10	NA	NA	NA	NA	NA	NA	NA
11	ICP-MS	Rh	NA		1	1	139
12	NA	NA	NA	NA	NA	NA	NA
13	NA	NA	NA	NA	NA	NA	NA
14	ICP-MS	Tb	KED	He	NA	1	139
15	NA	NA	NA	NA	NA	NA	NA
16	ICP-MS	Rh	NA		1	1	139
17	ICP-MS	Ir			NA	1	139
18					NA		
19	ICP-MS		CRI	He	NA		139
20					NA		

Table 60 Instrument Conditions Li

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	Sc			1	NA	7
2	NA	NA	NA	NA	NA	NA	NA
3	ICP-MS	6Li	NA		1	1	7
4	ICP-MS/MS					NA	7
5	ICP-MS					NA	
6	NA	NA				NA	
7	ICP-MS	Ge		He	1.05	NA	7
8	ICP-MS	Virtual Internal Standard (Sc, Y, In, Tb)	NA	NA	10	NA	7
9	ICP-MS	Rh	ORS	He	1.25	NA	7
10	NA	NA	NA	NA	NA	NA	NA
11	ICP-MS	6Li	NA		1	1	7
12	ICP-OES-AV	None	NA	NA	10:01	NA	670.784
13	NA	NA	NA	NA	NA	NA	NA
14	ICP-MS	Sc	KED	He	1	NA	7
15	NA	NA	NA	NA	NA	NA	NA
16	ICP-MS	6Li	NA		1	1	7
17	ICP-MS	Rh			1	NA	7
18	ICP-MS	Sc	NA	NA	1	NA	7
19	ICP-MS					NA	7
20						NA	

Table 61 Instrument Conditions Mn

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-AV-buffer	Y	NA		NA	1	257.61
2	NA	NA	NA	NA	NA	NA	NA
3	ICP-MS	Ge	ORS	He	1	1	55
4	ICP-MS/MS				NA		55
5	NA	NA	NA	NA	NA	NA	NA
6	ICP-MS	Ir, Rh	KED		NA		
7	ICP-MS	Ge		He	NA	1.05	55
8	ICP-MS	Virtual Internal Standard (Sc, Y, In, Tb)	NA	NA	NA		
9	ICP-OES-AV	Y	NA	NA	NA	2	257.61
10	NA	NA	NA	NA	NA	NA	NA
11	ICP-MS	Ge	ORS	He	1	1	55
12	AAS	None	NA	NA	1	NA	279.5
13	NA	NA	NA	NA	NA	NA	NA
14	ICP-MS	Sc	KED	He	NA	1	55
15	NA	NA	NA	NA	NA	NA	NA
16	ICP-MS	Ge	ORS	He	1	1	55
17	ICP-OES	Lu			NA	1	257
18	ICP-MS	Sc	UC	He	NA	1	55
19	ICP-MS		CRI	He	NA		55
20					NA		

Table 62 Instrument Conditions Mo

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	In			1	NA	95
2	NA	NA	NA	NA	NA	NA	NA
3	ICP-MS	Rh	NA		1	1	98
4	ICP-MS/MS					NA	95
5	ICP-MS					NA	
6	ICP-MS	Ir, Rh	KED			NA	
7	ICP-MS	Rh		He	1.05	NA	95
8	ICP-MS	Virtual Internal Standard (Sc, Y, In, Tb)	NA	NA	10	NA	95
9	ICP-MS	Rh	ORS	He	1.25	NA	95
10	NA	NA	NA	NA	NA	NA	NA
11	ICP-MS	Rh	NA		1	1	98
12	ICP-OES-AV	None	NA	NA	10:01	NA	202.031
13	NA	NA	NA	NA	NA	NA	NA
14	ICP-MS	Rh	KED	He	1	NA	98
15	NA	NA	NA	NA	NA	NA	NA
16	ICP-MS	Rh	NA		1	1	98
17	ICP-MS	Rh			1	NA	95
18	ICP-MS	Rh	NA	NA	1	NA	95
19	ICP-MS		CRI	He		NA	95
20						NA	

Table 63 Instrument Conditions Ni

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	Ga			1	NA	60
2	NA	NA	NA	NA	NA	NA	NA
3	ICP-MS	Ge	ORS	He	1	1	60
4	ICP-MS/MS					NA	60
5	ICP-MS					NA	
6	ICP-MS	Ir, Rh	KED			NA	
7	ICP-MS	Ge		He	1.05	NA	60
8	ICP-MS	Virtual Internal Standard (Sc, Y, In, Tb)	NA	NA		NA	
9	ICP-MS	Rh	ORS	He	1.25	NA	60
10	NA	NA	NA	NA	NA	NA	NA
11	ICP-MS	Ge	ORS	He	1	1	60
12	ICP-OES-AV	None	NA	NA	10:01	NA	231.604
13	NA	NA	NA	NA	NA	NA	NA
14	ICP-MS	Ga	KED	He	1	NA	60
15	NA	NA	NA	NA	NA	NA	NA
16	ICP-MS	Ge	ORS	He	1	1	60
17	ICP-OES	Lu			1	NA	231
18	ICP-MS	Ge	UC	He	1	NA	60
19	ICP-MS		CRI	He		NA	60
20						NA	

Table 64 Instrument Conditions P

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-AV-buffer	Y	NA		NA	1	178.221
2	NA	NA	NA	NA	NA	NA	NA
3	ICP-OES-AV	--	NA		1	1	213.618
4	ICP-MS/MS				NA		
5	NA	NA	NA	NA	NA	NA	NA
6	NA	NA			NA		
7	ICP-MS	Ge		He	NA	1.05	31
8	ICP-MS	Virtual Internal Standard (Sc, Y, In, Tb)	NA	NA	NA		
9					NA		
10	NA	NA	NA	NA	NA	NA	NA
11	ICP-OES-AV	--	NA		1	1	213.618
12	ICP-OES-AV	None	NA	NA	10:01	NA	213.617
13	NA	NA	NA	NA	NA	NA	NA
14	ICP-MS	Sc	KED	He	NA	1	31
15	NA	NA	NA	NA	NA	NA	NA
16	ICP-OES-AV	--	NA		1	1	213.618
17	ICP-OES	Lu			NA	1	178
18	ICP-MS	Sc	UC	He	NA	1	31
19	ICP-OES-RV				NA		177.4
20					NA		

Table 65 Instrument Conditions Pb

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	Ir			1	NA	208
2	NA	NA	NA	NA	NA	NA	NA
3	ICP-MS	Lu	NA		1	1	206+207+208
4	ICP-MS/MS					NA	208
5	ICP-MS					NA	
6	ICP-MS	Ir, Rh				NA	
7	ICP-MS	Ir		He	1.05	NA	208
8	ICP-MS	Virtual Internal Standard (Sc, Y, In, Tb)	NA	NA	10	NA	206
9	ICP-MS	Rh	ORS	He	1.25	NA	208
10	NA	NA	NA	NA	NA	NA	NA
11	ICP-MS	Lu	NA		1	1	206+207+208
12	ICP-OES-AV	None	NA	NA	10:01	NA	220.353
13	NA	NA	NA	NA	NA	NA	NA
14	ICP-MS	Tb	KED	He	1	NA	206+207+208
15	NA	NA	NA	NA	NA	NA	NA
16	ICP-MS	Lu	NA		1	1	206+207+208
17	ICP-MS	Ir			1	NA	209
18	ICP-MS	Ir	NA	NA	1	NA	206+207+208
19	ICP-MS		CRI	He		NA	sum of isotopes
20						NA	

Table 66 Instrument Conditions Sb

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	In			1	1	121
2	NA	NA	NA	NA	NA	NA	NA
3	ICP-MS	Rh	NA		1	1	121
4	ICP-MS/MS						121
5	ICP-MS					NA	
6	ICP-MS	Ir, Rh	KED				
7	ICP-MS	In		He	1.05	1.05	121
8	ICP-MS	Virtual Internal Standard (Sc, Y, In, Tb)	NA	NA	10	10	121
9	ICP-MS	Rh	ORS	He	1.25	1.25	121
10	NA	NA	NA	NA	NA	NA	NA
11	ICP-MS	Rh	NA		1	1	121
12	ICP-OES-AV	None	NA	NA	10:01	NA	206.836
13	NA	NA	NA	NA	NA	NA	NA
14	ICP-MS	Rh	KED	He	1	1	121
15	NA	NA	NA	NA	NA	NA	NA
16	ICP-MS	Rh	NA		1	1	121
17	ICP-MS	Rh			1	1	121
18	ICP-MS	Rh	NA	NA	1	1	121
19	ICP-MS		CRI	He			121
20							

Table 67 Instrument Conditions Se

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	Ge			1	NA	78
2	NA	NA	NA	NA	NA	NA	NA
3	ICP-MS	Ge	ORS	H2	1	1	78
4	ICP-MS/MS					NA	78/94
5	ICP-MS					NA	
6	ICP-MS	Ir, Rh				NA	
7	ICP-MS	Ge		H2	1.05	NA	78
8	ICP-MS	Virtual Internal Standard (Sc, Y, In, Tb)	NA	NA		NA	
9	ICP-MS	Rh	ORS	He	1.25	NA	77
10	NA	NA	NA	NA	NA	NA	NA
11	ICP-MS	Ge	ORS	H2	1	1	78
12	VGA-ICP-OES	None	NA	NA	1	NA	196
13	NA	NA	NA	NA	NA	NA	NA
14	ICP-MS	Te	KED	He	1	NA	82
15	NA	NA	NA	NA	NA	NA	NA
16	ICP-MS	Ge	ORS	H2	1	1	78
17	ICP-MS	Rh			1	NA	78
18	ICP-MS	Rh	DRC	NH3	1	NA	82
19	ICP-MS		CRI	HEHe		NA	82
20						NA	

Table 68 Instrument Conditions Sn

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	In			1	1	118
2	NA	NA	NA	NA	NA	NA	NA
3	ICP-MS	Rh	NA		1	1	118
4	ICP-MS/MS						118
5	ICP-MS					NA	
6	NA	NA					
7	ICP-MS	In		He	1.05	1.05	118
8	ICP-MS	Virtual Internal Standard (Sc, Y, In, Tb)	NA	NA	10	10	118
9	ICP-MS	Rh	ORS	He	1.25	1.25	118
10	NA	NA	NA	NA	NA	NA	NA
11	ICP-MS	Rh	NA		1	1	118
12	ICP-OES-AV	None	NA	NA	10:01	NA	235.485
13	NA	NA	NA	NA	NA	NA	NA
14	ICP-MS	Rh	KED	He	1	1	120
15	NA	NA	NA	NA	NA	NA	NA
16	ICP-MS	Rh	NA		1	1	118
17	ICP-MS	Rh			1	1	118
18							
19	ICP-MS		CRI	He			118
20							

Table 69 Instrument Conditions Sr

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-AV-buffer	Y			NA	1	407.771
2	NA	NA	NA	NA	NA	NA	NA
3	ICP-MS	Rh	NA		1	1	88
4	ICP-MS/MS				NA		88
5	NA	NA	NA	NA	NA	NA	NA
6	NA	NA			NA		
7	ICP-MS	Ge		He	NA	1.05	88
8	ICP-MS	Virtual Internal Standard (Sc, Y, In, Tb)	NA	NA	NA	10	88
9	ICP-OES-AV	Y	NA	NA	NA	2	421.552
10	NA	NA	NA	NA	NA	NA	NA
11	ICP-MS	Rh	NA		1	1	88
12	ICP-OES-AV	None	NA	NA	10:01	NA	407.771
13	NA	NA	NA	NA	NA	NA	NA
14	ICP-MS	Rh	KED	He	NA	1	88
15	NA	NA	NA	NA	NA	NA	NA
16	ICP-MS	Rh	NA		1	1	88
17	ICP-MS	Rh			NA	1	88
18	ICP-MS	Rh	NA	NA	NA	1	88
19	ICP-MS		CRI	He	NA		88
20					NA		

Table 70 Instrument Conditions Th

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	NT				NA	NT	
2	NA	NA	NA	NA	NA	NA	NA
3	ICP-MS	Lu	NA		1	1	232
4	ICP-MS/MS				NA		
5	NA	NA	NA	NA	NA	NA	NA
6	NA	NA			NA		
7	ICP-MS	Ir		He	NA	1.05	232
8	ICP-MS	Virtual Internal Standard (Sc, Y, In, Tb)	NA	NA	NA	10	232
9	ICP-MS	Rh	ORS	He	NA	1.25	232
10	NA	NA	NA	NA	NA	NA	NA
11	ICP-MS	Lu	NA		1	1	232
12	NA	NA	NA	NA	NA	NA	NA
13	NA	NA	NA	NA	NA	NA	NA
14	NA	NA	NA	NA	NA	NA	NA
15	NA	NA	NA	NA	NA	NA	NA
16	ICP-MS	Lu	NA		1	1	232
17	ICP-MS	Ir			NA	1	232
18	ICP-MS	Ir	NA	NA	NA	1	232
19	ICP-MS		CRI	He	NA		232
20					NA		

Table 71 Instrument Conditions Tl

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	Ir				NA	203
2	NA	NA	NA	NA	NA	NA	NA
3	ICP-MS	Lu	NA		1	1	205
4	ICP-MS/MS					NA	
5	ICP-MS					NA	
6	ICP-MS	Ir, Rh				NA	
7	ICP-MS	Ir		He	1.05	NA	205
8	ICP-MS	Virtual Internal Standard (Sc, Y, In, Tb)	NA	NA		NA	
9	ICP-MS	Rh	ORS	He	1.25	NA	205
10	NA	NA	NA	NA	NA	NA	NA
11	ICP-MS	Lu	NA		1	1	205
12	NA	NA	NA	NA	NA	NA	NA
13	NA	NA	NA	NA	NA	NA	NA
14	ICP-MS	Tb	KED	He	1	NA	205
15	NA	NA	NA	NA	NA	NA	NA
16	ICP-MS	Lu	NA		1	1	205
17	ICP-MS	Ir			1	NA	205
18	ICP-MS	Ir	NA	NA	1	NA	205
19	ICP-MS		CRI	He		NA	205
20						NA	

Table 72 Instrument Conditions U

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	Ir			NA	1	238
2	NA	NA	NA	NA	NA	NA	NA
3	ICP-MS	Lu	NA		1	1	238
4	ICP-MS/MS				NA		238
5	NA	NA	NA	NA	NA	NA	NA
6	ICP-MS	Ir, Rh			NA		
7	ICP-MS	Ir		He	NA	1.05	238
8	ICP-MS	Virtual Internal Standard (Sc, Y, In, Tb)	NA	NA	NA	10	238
9	ICP-MS	Rh	ORS	He	NA	1.25	238
10	NA	NA	NA	NA	NA	NA	NA
11	ICP-MS	Lu	NA		1	1	238
12	NA	NA	NA	NA	NA	NA	NA
13	NA	NA	NA	NA	NA	NA	NA
14	ICP-MS	Tb	KED	He	NA	1	238
15	NA	NA	NA	NA	NA	NA	NA
16	ICP-MS	Lu	NA		1	1	238
17	ICP-MS	Ir			NA	1	238
18	ICP-MS	Ir	NA	NA	NA	1	238
19	ICP-MS		CRI	He	NA		238
20					NA		

Table 73 Instrument Conditions V

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-MS	Ga			1	NA	51
2	NA	NA	NA	NA	NA	NA	NA
3	ICP-MS	Ge	ORS	He	1	1	51
4	ICP-MS/MS					NA	51
5	ICP-MS					NA	
6	ICP-MS	Ir, Rh	KED			NA	
7	ICP-MS	Ge		He	1.05	NA	51
8	ICP-MS	Virtual Internal Standard (Sc, Y, In, Tb)	NA	NA	10	NA	51
9	ICP-MS	Rh	ORS	He	1.25	NA	51
10	NA	NA	NA	NA	NA	NA	NA
11	ICP-MS	Ge	ORS	He	1	1	51
12	ICP-OES-AV	None	NA	NA	10:01	NA	310.23
13	NA	NA	NA	NA	NA	NA	NA
14	ICP-MS	Sc	KED	He	1	NA	51
15	NA	NA	NA	NA	NA	NA	NA
16	ICP-MS	Ge	ORS	He	1	1	51
17	ICP-OES	Lu			1	NA	290
18	ICP-MS	Sc	UC	He	1	NA	51
19	ICP-MS		CRI	He		NA	51
20						NA	

Table 74 Instrument Conditions Zn

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/ Absorbance(nm)
1	ICP-OES-AV-buffer	Y			1	1	206.2
2	NA	NA	NA	NA	NA	NA	NA
3	ICP-MS	Ge	NA		1	1	66
4	ICP-MS/MS						66
5	ICP-OES-AV					NA	
6	ICP-MS	Ir, Rh	KED				
7	ICP-MS	Ge		He	1.05	1.05	66
8	ICP-MS	Virtual Internal Standard (Sc, Y, In, Tb)	NA	NA	10	10	66
9	ICP-OES-AV	Y	NA	NA	2	2	213.857
10	NA	NA	NA	NA	NA	NA	NA
11	ICP-MS	Ge	NA		1	1	66
12	AAS	None	NA	NA	1	NA	213.9
13	NA	NA	NA	NA	NA	NA	NA
14	ICP-MS	Te	KED	He	1	1	66
15	NA	NA	NA	NA	NA	NA	NA
16	ICP-MS	Ge	NA		1	1	66
17	ICP-MS	Lu			1	1	206
18	ICP-MS	Ge	UC	He	1	1	66
19	ICP-MS		CRI	He			66
20							

END OF REPORT