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National Measurement Institute

Proficiency Test Report AQA 19-02 Metals, Nutrients and Exchangeable Bases in Soil

May 2019

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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.

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1 SUMMARY

This report presents the results of the proficiency test AQA 19-02, metals, nutrients and exchangeable bases in soil and agricultural soil. The study focused on the measurement of the following acid extractable elements: Ag, Al, As, B, Ba, Bi, Ca, Cd, Co, Cr, Cu, Cs, Fe, Hg, K, La, Li, Mg, Mn, Mo, Na, Ni, P, Pb, Rb, Se, Sn, Sr, Th, Tl, U, V and Zn.

Measurement of total P, P buffer index (with Colwell P)- PBI $_{+Col\ P}$, calcium chloride-extractable B, total carbon (TC), total organic carbon (TOC), total nitrogen (TN), Colwell P, Colwell K, EC, pH of 1:5 soil / 0.01 M $CaCl_2$ extract, exchangeable bases (Ca^{2+}, Mg^{2+}, Na^+, K^+) - 1M NH_4Cl extract and moisture content was also included in the program.

The sample set consisted of one moist soil sample, one dried soil sample and one agricultural soil sample.

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 935 results, 832 (89%) returned a satisfactory score of $|z| \leq 2$.

Of 935 E_n-scores, 736 (79%) were satisfactory with $|E_n| \leq 1$.

ii. evaluate the laboratories' methods used in determination of inorganic analytes in soil;

Low level Hg was the test that presented the most analytical difficulty to participating laboratories.

Some participants may need to check the procedure used for correcting results for moisture content.

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

Despite different matrices, analytes and analyte concentrations, on average participants' performance remained consistent.

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

Of 946 numerical results, 878 were reported with an expanded measurement uncertainty. While most participants are reporting an expanded measurement uncertainty the E_n-scores do still demonstrate that not everyone's estimation of uncertainty is realistic. An example of estimating measurement uncertainty using only proficiency testing data is given in Appendix 3.

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

The study samples were checked for homogeneity and stability and are well characterised, through in-house testing and from the results of the proficiency round.

Surplus test samples from this study 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 interlaboratory 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 19-02 is the 24th NMI proficiency study of inorganic analytes in soil.

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 the determination of inorganic analytes in soil;
- 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 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 fifty-five tests were selected from those for which an investigation level is published in the Guidelines on the Investigation Levels for Soil and Groundwater, promulgated by the National Environmental Protection Council (NEPC)[5] and from analytes commonly measured in soil.

3.2 Participation

Thirty-one laboratories participated and all submitted results.

The timetable of the study was:

Invitations issued:	28 January 2019
Samples dispatched:	25 February 2019
Results due:	29 March 2019
Interim report issued:	03 April 2019

3.3 Test Material Specification

Three samples were provided for analysis:

Sample S1 was 35 g of moist soil;

Sample S2 was 30 g of dried soil; and

Sample S3 was 75 g of dried agricultural soil.

3.4 Laboratory Code

All participant laboratories were assigned a confidential code number.

3.5 Sample Preparation, Analysis and Homogeneity Testing

Test samples from previous studies have been demonstrated to be sufficiently homogeneous for evaluation of participants' performance.[6, 7] Only a partial homogeneity test was conducted for all elements except calcium chloride-extractable B as the same preparation procedure was followed in previous studies.[1] The results from the partial homogeneity testing are reported in the present study as the homogeneity value.

The preparation, analysis and homogeneity testing of the study samples are described in Appendix 1.

3.6 Stability of Analytes

No stability study was carried out for the present study. Stability studies conducted for the previous proficiency tests of inorganic analytes in soil found no significant changes in any of the analytes' concentration.[6, 7]

3.7 Sample Storage, Dispatch and Receipt

The test samples were stored at ambient temperature prior to dispatch.

The samples were dispatched by courier on 25 February 2019.

The following items were packaged with the samples:

- a covering letter which included a description of the test samples and instructions for participants; and
- a form to confirm the receipt and condition of 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. Sample S1, the moist soil sample, should be thoroughly mixed before removing a test portion. To avoid loss of moisture, do not leave the sample uncovered.

- For Sample S3 for the determination of calcium chloride- extractable B, exchangeable bases (Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}) - 1M NH_4Cl extract and of P buffer index (with Colwell P)- $PBI_{+ColP,}$ participants are asked to use the methods defined by Rayment, G.E. and David, J. L in "Soil Chemical Methods-Australasia".
- For S1 report results for moisture content in % (g/100g). For acid extractable elements in S1 results are to be reported on dry weight bases (corrected for moisture content) and in units of mg/kg
- For S2 report results for acid extractable elements on as received basis in units of mg/kg.
- For S3 report results on as received basis in units of (cmol(+)/kg) for exchangeable bases (Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}) - 1M NH_4Cl extract. Except for EC, for all the other tests, report results on as received basis in units of mg/kg. EC results are to be reported in units of µS/cm.

SAMPLE S1		SAMPLE S2		SAMPLE S3	
Test acid extractable	Approximate Conc. Range mg/kg	Test acid extractable	Approximate Conc. Range mg/kg	Test	Approximate Conc. Range mg/kg
As	0.5-10	Ag	1-20	Ca (acid extractable)	250-5000
Ba	50-1000	Al	500-10000	Calcium chloride – extractable[1]	Not Available
Be	0.5-10	B	5-100	Colwell P	Not Available
Cd	0.5-10	Ba	50-1000	Colwell K	Not Available
Cr	25-500	Bi	0.5-10	EC	>200µS/cm
Cu	25-500	Co	1-20	Exchangeable Ca-1MNH_4Cl extract[2]	>5 cmol(+)/kg
Hg	0.2-4	Cs	1-20	Exchangeable Mg-1MNH_4Cl extract[2]	>0.25 cmol(+)/kg
Mn	50-1000	La	5-100	Exchangeable Na-1MNH_4Cl extract[2]	>0.25 cmol(+)/kg
Mo	10-100	Li	0.5-10	Exchangeable K-1MNH_4Cl extract[2]	>0.25cmol(+)/kg
Ni	5-100	Rb	1-20	Fe (acid extractable)	500-10000
Pb	5-100	Se	5-100	K (acid extractable)	250-5000
Sb	10-200	Sn	1-20	Mg (acid extractable)	250-5000
Se	0.5-10	Sr	1-20	Na (acid extractable)	25-500
Sn	1-20	Th	1-10	P (acid extractable)	50-1250
V	25-500	Tl	1-10	P (total)	50-1250
Zn	50-1000	U	5-100	P buffer index (with Colwell P)- PBI_{+ColP}[3]	Not Available
Moisture Content	5-40%	Zn	25-500	pH of 1:5soil/**0.01M$CaCl_2$** extract	>5
				S (acid extractable)	25-500
				Total Carbon	1250-25000
				Total Organic Carbon	1250-25000
				Total Nitrogen	1250-25000

[1]Method 12C, [2]Method 15A1, [4]3Method 9I2 as defined by Rayment, G.E. and David, J. L in "Soil Chemical Methods-Australasia".

- Report results as you would report to a client.
- Please send us all the requested details regarding the test method.
- Return the completed results sheet by 29 March 2019.

3.9 Interim Report

An interim report was emailed to participants on 03 April 2019.

4 PARTICIPANT LABORATORY INFORMATION

4.1 Test Method Summaries

Summaries of test methods are transcribed in Tables 1 to 10. The instruments and settings reported by participants are presented in Appendix 5.

Table 1 Methodology for Acid Extractable Elements

Lab. Code	Method Reference	Sample Mass (g)	Temp. (°C)	Time (min)	Vol. HNO_3 (mL)	Vol. HCl (mL)	Vol. HNO_3 (1:1) (mL)	Vol. HCl (1:1) (mL)	Vol. H_2O_2 (mL)	Other
1		2	95	120	2	6				
2	USEPA method 6020 – ICP-MS	1	95	120	7.5	2.5				
3	USEPA 3051A (Modification)	1	170	15			8	2		
4*	EPA3050B, 6020B	2	90-95	60	4	12				
5*	EPA3050B, 6020B	2	90-95	60	20mL AR used for Dilution (1 H20 : 1 HNO3 : 3 HCL) Sb : ICP-MS : Rh : ORS : He: 500 : 121					
6		1	112.5	120	7.5	2.5				
7	USEPA3050/6010/6020/200.7/200.8	2	90-98	120	3	3				
8	AS 4479.2-1997, AS4479.4-1999	0.5	95	120	1	3				
9	US EPA 6010	2	100	60	4	12				
10*	In House Method	6.9	105	90	4	6			2	
11	US EPA 200.8	0.5	95	30	2	2				10 mL (H_2O)
12	USEPA3050/6010/6020/200.7/200.8	2	90-98	120	3	3				
15	US EPA 3050B	0.5	95	120	7.5	5			1.5	
16	USEPA 200.8	1.2	95	30	2.5	2.5				
17		0.5	85	240	5	5				
18	USEPA3050/6010/6020/200.7/200.8	2	90-98	120	3	3				
19	inhouse- adapted from APHA	8.35	95	120	8	5				
20	In house method VL239	1	95	180	6	2				
21	In House S6 - referencing APHA 3125	0.4	120	60	2.5	7.5				
22		1	95 - 100	120	3	3				
23	Inhouse methods referenced to USEPA 6010 and 6020	1.2	95	120	2	3			2	
24	USEPA 3050B	2	95	120	3	3				
25	USEPA 200.2	1	95	60			2	10	2	
26	EPA Method 3050B Acid Digestion of Sediments, Sludges and Soils	0.5	85	240	5	5				

Table 1 Methodology for Acid Extractable Elements (continued)

Lab. Code	Method Reference	Sample Mass (g)	Temp. (°C)	Time (min)	Vol. HNO_3 (mL)	Vol. HCl (mL)	Vol. HNO_3 (1:1) (mL)	Vol. HCl (1:1) (mL)	Vol. H_2O_2 (mL)	Other
27	200.8	1	95	30	2.5	2.5				
28	EPA (Environmental Protection Agency) 1994 Method 200.8	2	109	60	800	400				1200
29	US EPA 200.2	1-1.1	95	50	2	2				10
30*	In-house Method	0.25	140	200	10					
31*	USEPA3050	3	85	120	10	5	10		6	

* See Additional Information for Methodology in Table 2

Table 2 Additional information for Acid Extractable Elements

Lab. Code	Additional Information
4	Sb - ICP-MS, Rh, ORS, He, 500, 123
5	20mL AR used for Dilution (1 H20 : 1 HNO3 : 3 HCL) Sb : ICP-MS : Rh : ORS : He: 500 : 121
10	Other instrument was a Graphite furnace AAS
30	This is a method adopted by our Lab for the soil type found in the Seychelles. The soil has very low nutrient status and low CEC and the use of are more aggressive method might cause overestimation of the extractable cation. For the detecton of Calcium, Potassium and sodium Flame Photmeter was used and Spectrophotometer was used for analysis of phophorous.
31	Instrument for Hg: Cetac Hg Analyser

Table 3 Methodology for Total Carbon

Lab. Code	Method Reference	Test Method	Measurement Technique	Additional Information
6	In house			normaly reported Organic Carbon % w/w DMB. Coverted for PT sample
7	Walkley-Black or Combustion	High Temperature Oxidation	Titration or NDIR	
9	In-house method LTM-INO-4060	High Temperature Oxidation	IR detection	
12	Walkley-Black or Combustion	High Temperature Oxidation	Titration or NDIR	
13	6B3	High Temperature Oxidation	LECO	
18	Walkley-Black or Combustion	High Temperature Oxidation	Titration or NDIR	
21	In house S4a	High Temperature Oxidation	LECO	
22		High Temperature Oxidation	Combustion then IR detector	

Table 3 Methodology for Total Carbon (continued)

Lab. Code	Method Reference	Test Method	Measurement Technique	Additional Information
25	EP004			
26		High Temperature Oxidation	IR detector	
29		High Temperature Oxidation	Catalytic combustion, separation, TCD detection	
30	In house Method			

Table 4 Methodology for Total Organic Carbon

Lab. Code	Method Reference	Test Method	Measurement Technique	Additional Information
6	In House	Chemical Oxidation (Ag2SO4 Added)	Spectrophotometer	Normally reported organic carbon % w/w DMB. Coverted for PT sample
7	Walkley-Black or Combustion	High Temperature Oxidation Chemical Oxidation (No Ag2SO4 Added)	Titration or NDIR	
9	In-house method LTM-INO-4060	High Temperature Oxidation	IR detection	
12	Walkley-Black or Combustion	High Temperature Oxidation Chemical Oxidation	Titration or NDIR	
13	6B3	High Temperature Oxidation	LECO	Sample didn't pass FIZZ test. Assumed no carbonate.
18	Walkley-Black or Combustion	High Temperature Oxidation	NDIR	
21	In House S4a	High Temperature Oxidation	LECO	TOC – Sample digested with sulfurous acid prior to analysis on LECO
22		High Temperature Oxidation	Removal or inorganic carbonates with dilute acid then combustion	
24		High Temperature Oxidation		
25	EP004	Chemical Oxidation (Ag2SO4 Added)	Titration	
26		High Temperature Oxidation (Ag2SO4 Added)	Titration	
29		High Temperature Oxidation	Catalytic combustion, separation, TCD detection	TOC – samples are pre-treated with acid to remove carbonates
30	In house Method	High Temperature Oxidation		

Table 5 Methodology for Colwell P and Colwell K

Lab. Code	Method Reference	Sample Mass (g)	Extraction Solution 0.5 M $NaHCO_3$ Volume (mL)	Shake time (hours)	Measurement Technique (Colwell K))	Measurement Technique (Colwell P)
7	Rayment and Lyons	1	100	16	ICP-OES-RV 766 nm	DA
12	Rayment and Lyons	1	100	16	ICP-OES-RV 766 nm	DA
13	9B2	1	100	16		FIA
21	Colwell P 9B2, Colwell K 18A1	0.4	40	16	ICPMS 31 nm	FIA
24	Rayment and Lyons 18A1	1	120	16		ICP-OES
31	Rayment and Lyons 9B1	1	100	16		DA 880 nm

Table 6 Methodology for P Buffer Index – PBI_{+ColP}

Lab. Code	Method Reference	Sample Mass (g)	Extraction Solution (P equilibrating Solution) Volume (mL)	Shake time (hours)	Instrument	Wavelength (nm) / Absorbance (nm)
7	Rayment and Lyons	7	70	17	DA	
12	Rayment and Lyons	7	70	17	DA	
21	9I2B	2	20	16	ICP-OES	213.617
24	Rayment and Lyons: 9I2B	2	20	17	ICP-OES	

Table 7 Methodology for Total P

Lab. Code	Method
2	Total P by Kjeldahl digestion and FIA
6	Total P by Kjeldahl digestion and DA
7	Acid extractable P
12	Acid extractable P
18	Acid extractable P ICP-OES analysis
25	Persulfate digestion followed by FIA
30	1:1 Nitric/Sulphuric Acid digest was done according to ICSPA (Egypt) February 1996, Method 11.4.1
31	Total P by Kjeldahl digestion and DA

Table 8 Methodology for Calcium Chloride Extractable B

Lab. Code	Method Reference	Sample Mass (g)	Extraction Solution (0.01 M $CaCl_2$) Volume (mL)	Reflux Time (min)	Instrument	Wavelength (nm) / Absorbance (nm)
7	Rayment and Lyons	10	20	30	ICP-OES-RV	
12	Rayment and Lyons	10	20	30	ICP-OES-RV	
18	Rayment and Lyons	10	20	30	ICP-OES-RV	
21	12C2	10	20	10	ICP-OES	208.889
24	Rayment and Lyons: 12C2, 12E1	2	25	10	ICP-OES	

Table 9 Methodology for Total Nitrogen

Lab. Code	Method Reference	Test Method	Measurement Method	Instrument	Additional Information
2	APHA 4500-Norg-D and Thermo Scientific Method D08727 and NEMI METHOD ID: 9171	Digestion $TN=TKN+NO_x$	Colorimetric – salicylate method	FIA	
6	In House	Digestion $TN=TKN+NO_x$	Colorimetric – Salicylate method	DA	
7	APHA 4500 Norg or TN by Furnace Chemiluminescence	combustion Digestion, $TN=TKN+NO_x$		Discrete Analyser or Furnace / Chemiluminescence	.
9	APHA 4500 Norg	Digestion, $TN=TKN+NO_x$	Colorimetric – Salicylate method	FIA	
12	APHA 4500 Norg or TN by Furnace Chemiluminescence	combustion Digestion, $TN+TKN+NO_x$		Discrete Analyser or Furnace / Chemiluminescence	
13	7A5	Dumas	Dumas -High temperature combustion	LECO	
18	APHA 4500 Norg TKN + NOX water extraction	Digestion, $TN=TKN+NO_x$	Colorimetric analysis	Discrete Analyser	
21	In house S4a – Dumas Combustion	Combustion	Dumas -High temperature combustion	LECO	

Table 9 Methodology for Total Nitrogen (continued)

Lab. Code	Method Reference	Test Method	Measurement Method	Instrument	Additional Information
22	APHA 4500 Norg B, C	Digestion, Distillation, TN=TKN+NO_x	Titrimetric Method	Manual analysis	TKN by digestion / distillation / titration. Nox by water extraction/ colorimetric on FIA
24		Combustion		LECO	
25	APHA, 4500-P J. & 4500-N C.	Digestion	Other	FIA	
26	AOAC 990.03	Combustion	Dumas -High temperature combustion	LECO	
30	AOAC 955.04-D (Method normally used for fertilizer N Analysis) but in our context this method has been adapted to soil and has been used since.	Digestion, Distillation, TN=TKN	Titrimetric Method	Methrom Automated titration system (Titrino Plus 877))	
31	ASTM D2216-98	Digestion, TN=TKN+NO_x	Colorimetric – Salicylate method	DA	

Table 10 Methodology for Exchangeable Bases

Lab. Code	Method Reference*	Sample Mass (g)	Shake time (hrs)	Extraction Solution	Extraction Solution Vol. (mL)
2	15A1	10	1	1M NH_4Cl	50
7	15A1	2.5	2	1M NH_4Cl	50
9	In-House method LTM-MET-3060	5	1	1M NH_4Cl	100
12	15A1	2.5	2	1M NH_4Cl	50
13	15A1	5	2	1M NH_4Cl	100
18	15A1	2.5	2	1M NH_4Cl	50
21	15A1	1	1	1M NH_4Cl	20
22	15A1	2	2	1M NH_4Cl	40
24	15A1	2	1	1M NH_4Cl	10
25	ED007	2.5	1	1M NH_4Cl	50
30	15A1	2.5	0.5	1M NH_4Cl	50
31	Rayment and Lyons 15D3 & 15N1	5		1M NH_4Cl	100

*15A1 as defined by Rayment, G.E. and David, J. L. in “Soil Chemical Methods-Australasia”

4.2 Basis of Participants' Measurement Uncertainty Estimates

Participants were requested to provide information about the basis of their uncertainty estimates (Tables 11 and 12).

Table 11 Basis of Uncertainty Estimate

Lab. Code	Approach to Estimating MU	Information Sources for MU Estimation		Guide Document for Estimating MU
		Precision[a]	Method Bias[a]	
1	Bottom Up (ISO/GUM, fish bone/ cause and effect diagram)	Control Samples-CRM Duplicate analysis Instrument calibration		ISO/GUM
2	Top Down - precision and estimates of the method and laboratory bias	Control Samples Duplicate analysis	Recoveries of SS	Eurachem/CITAC Guide
3	Top Down - precision and estimates of the method and laboratory bias	Control Samples-CRM Duplicate analysis	CRM	NMI Uncertainty Course
4*	Other – Refer to Table 12	Control Samples Duplicate analysis Instrument calibration	CRM Recoveries of SS	Refer to Table 12
5	Top Down - precision and estimates of the method and laboratory bias	Control Samples-SS Duplicate analysis	Recoveries of SS	ASTM E2554-13
6	SD of replicate analyses multiplied by 2 or 3	Control Samples-RM Duplicate analysis Instrument calibration	CRM Recoveries of SS Instrument Calibration	NATA Technical Note 33
7	Top Down - precision and estimates of the method and laboratory bias	Control Samples	Recoveries of SS	NATA Technical Note 33
8	Calculated from standard deviation and concentration of long term in house QC samples	Control Samples-RM Duplicate analysis Instrument calibration	Variation in sample moisture content	NATA Technical Note 33
9*	Top Down - precision and estimates of the method and laboratory bias	Control Samples-CRM	CRM Laboratory bias from PT studies Instrument Calibration	ASTM E2554-13
10	Top Down - precision and estimates of the method and laboratory bias	Control Sampless-RM Duplicate analysis Instrument calibration	CRM	NATA Technical Note 33
11	Top Down - precision and estimates of the method and laboratory bias	Control Samples-CRM Duplicate analysis	CRM Recoveries of SS	NATA Technical Note 33

Table 11 Basis of Uncertainty Estimate (continued)

Lab. Code	Approach to Estimating MU	Information Sources for MU Estimation		Guide Document for Estimating MU
		Precision[a]	Method Bias[a]	
12	Top Down - precision and estimates of the method and laboratory bias	Control Samples	Recoveries of SS	NATA Technical Note 33
13	Top Down - reproducibility (standard deviation) from PT studies used directly	Control Samples - CRM Duplicate analysis Instrument calibration		NATA Technical Note 33
15	Top Down - precision and estimates of the method and laboratory bias	Control Samples- CRM Duplicate analysis	CRM Recoveries of SS Instrument Calibration	NATA Technical Note 33
16	Top Down - precision and estimates of the method and laboratory bias			NATA Technical Note 33
17	SD of replicate analyses multiplied by 2 or 3	Control Samples- CRM Duplicate analysis Instrument calibration	CRM Instrument Calibration Laboratory Bias from PT Studies Standard Purity Recoveries of SS	NATA Technical Note 33
18	Top Down - precision and estimates of the method and laboratory bias	Control Samples	Recoveries of SS	NATA Technical Note 33
19	Top Down - precision and estimates of the method and laboratory bias	Duplicate analysis	CRM	NATA Technical Note 33
20	Bottom Up (ISO/GUM, fish bone/ cause and effect diagram)	Control Samples Duplicate analysis Instrument calibration	CRM Recoveries of SS	ISO/GUM
21	Top Down - precision and estimates of the method and laboratory bias	Control Samples – RM Duplicate analysis	Instrument calibration	Nordtest report TR537
22	Top Down - precision and estimates of the method and laboratory bias	Control Samples – RM Duplicate analysis	CRM Recoveries of SS Variation in sample moisture content	Nordtest report TR537
23	Bottom Up (ISO/GUM, fish bone/ cause and effect diagram)	Control Samples – CRM Duplicate analysis	Recoveries of SS	Eurachem/CITAC Guide
24		Control Samples Duplicate analysis	CRM Laboratory Bias from PT Studies	NATA Technical Note 33
25*	Top Down - precision and estimates of the method and laboratory bias	Control Samples – RM Duplicate analysis Instrument calibration	CRM Instrument calibration Laboratory Bias from PT Studies	NATA Technical Note 33

Table 11 Basis of Uncertainty Estimate (continued)

Lab. Code	Approach to Estimating MU	Information Sources for MU Estimation		Guide Document for Estimating MU
		Precision[a]	Method Bias[a]	
26	Top Down - precision and estimates of the method and laboratory bias	Control Samples – SS Duplicate analysis	Laboratory Bias from PT Studies	NATA Technical Note 33
27	Professional judgement	Duplicate analysis	CRM	
28	SD of replicate analyses multiplied by 2 or 3	Control Samples – RM Duplicate analysis	Recoveries of SS	
29	Top Down - precision and estimates of the method and laboratory bias	Duplicate analysis	CRM Laboratory Bias from PT Studies	Eurachem/CITAC Guide
30	SD of replicate analyses multiplied by 2 or 3	Control Samples-SS	Recoveries of SS Instrument calibration	
31	Top Down - precision and estimates of the method and laboratory bias	Control Samples Duplicate analysis Instrument calibration	CRM Instrument calibration	NATA Technical Note 33

[a] RM = Reference Material, CRM = Certified Reference Material, SS =Spiked samples. *Additional Information in Table 12.

Table 12 Additional Information for Measurement Uncertainty

Lab. Code	Additional Information
4	Estimation of MU from within-laboratory data on bias and precision has been calculated by using the procedures outlined in ASTM E2554-13 Standard Practice for Estimating and Monitoring the Uncertainty of Test Results of a Test Method Using Control Chart Techniques
9	Estimation of MU from within-laboratory data on bias and precision has been calculated by using the procedures outlined in ASTM E2554-13 Standard Practice for Estimating and Monitoring the Uncertainty of Test Results of a Test Method Using Control Chart Techniques.
25	Macro MU Calculation pack based on QC data

4.3 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. Participants' comments are reproduced in Table 13.

Table 13 Participants' Comments

Participants' Comments	Study Co-ordinator's Response
Our Lab at this stage is not fully equipped for Anion analysis. We are in the process of procuring our first Ion chromatograph, which will allow us to participate fully in the following PT studies. I have to say that the coordination and assistance from your Institute has been very good. In our first PT we encountered some challenges with our digestion process, some modifications have been made to improve the methods, however we still experienced some problems that we hope to address after we receive the results of this current PT.	Thank you for your feedback.

5 PRESENTATION OF RESULTS AND STATISTICAL ANALYSIS

5.1 Results Summary

Participant results are listed in Tables 14 to 68 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 56.

An example chart with interpretation guide is shown in Figure 1.

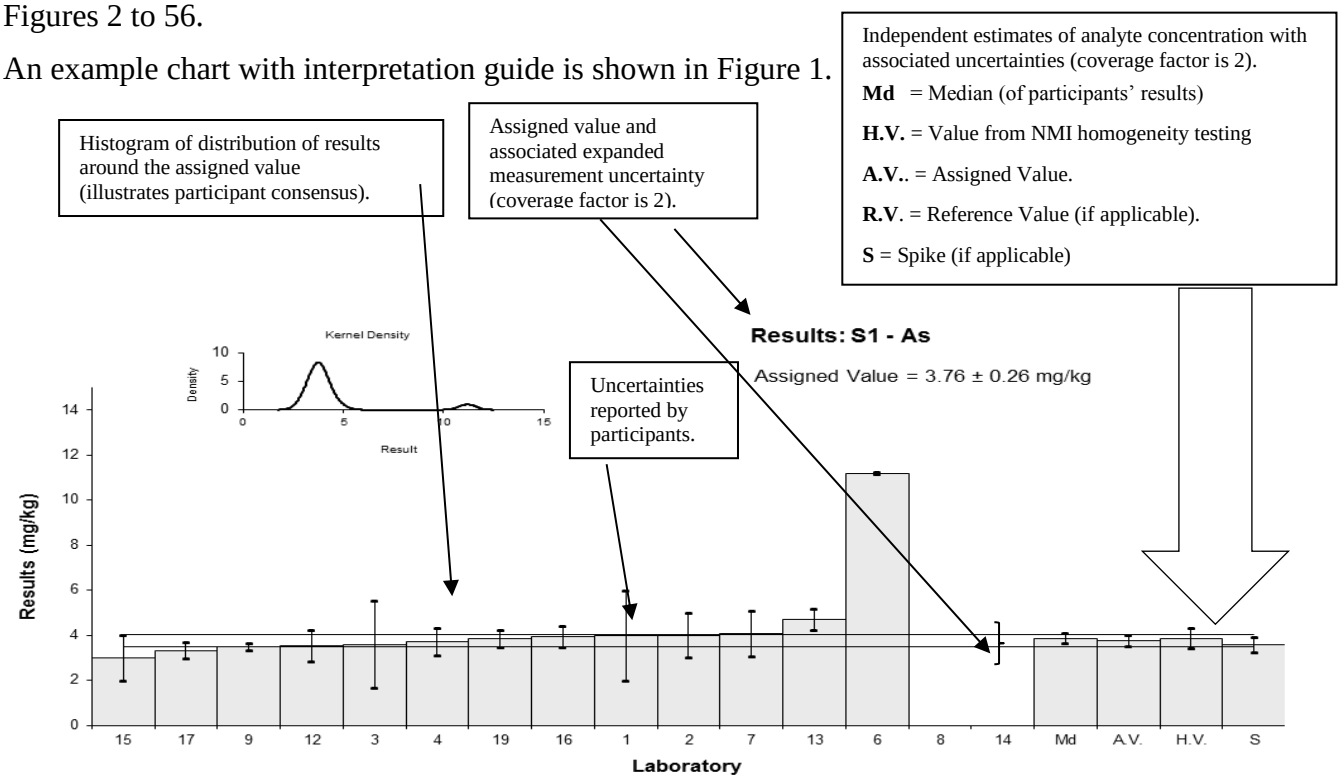


Figure 1 Guide to Presentation of Results

5.2 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 assigned values were the robust average of participants' results; the expanded uncertainties were estimated from the associated robust standard deviations.

5.3 Robust Average

The robust averages and associated expanded measurement uncertainties were calculated using the procedure described in 'Statistical methods for use in proficiency testing by inter-laboratory comparisons, ISO 13528:2015(E)'.[8]

5.4 Robust Between-Laboratory Coefficient of Variation

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).[8]

5.5 Target Standard Deviation

The target standard deviation (σ) is the product of the assigned value *(X)* and the performance coefficient of variation (PCV) as presented in Equation 1. 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 Thompson Horwitz equation.[9] By setting a fixed and realistic value for the PCV, the participants' performance does not depends on other participants' performance and can be compared from study to study and against achievable performance.

5.6 z-Score

An example of z-score calculation using data from the present study is given in Appendix 2. For each participant's 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 participants' result
X is the study assigned value
σ is the target standard deviation from Equation 1

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

- $|z| \leq 2$ is satisfactory;
- $2 < |z| < 3$ is questionable;
- $|z| \geq 3$ 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 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 ($|E_n|$):

- $|E_n| \leq 1$ is satisfactory;
- $|E_n| > 1$ is unsatisfactory.

5.8 Traceability and Measurement Uncertainty

Laboratories accredited to ISO/IEC Standard 17025:2017[10] 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.[11]

6 TABLES AND FIGURES

Table 14

Sample Details

Sample No.	S1
Matrix.	Soil
Analyte.	As
Units	mg/kg

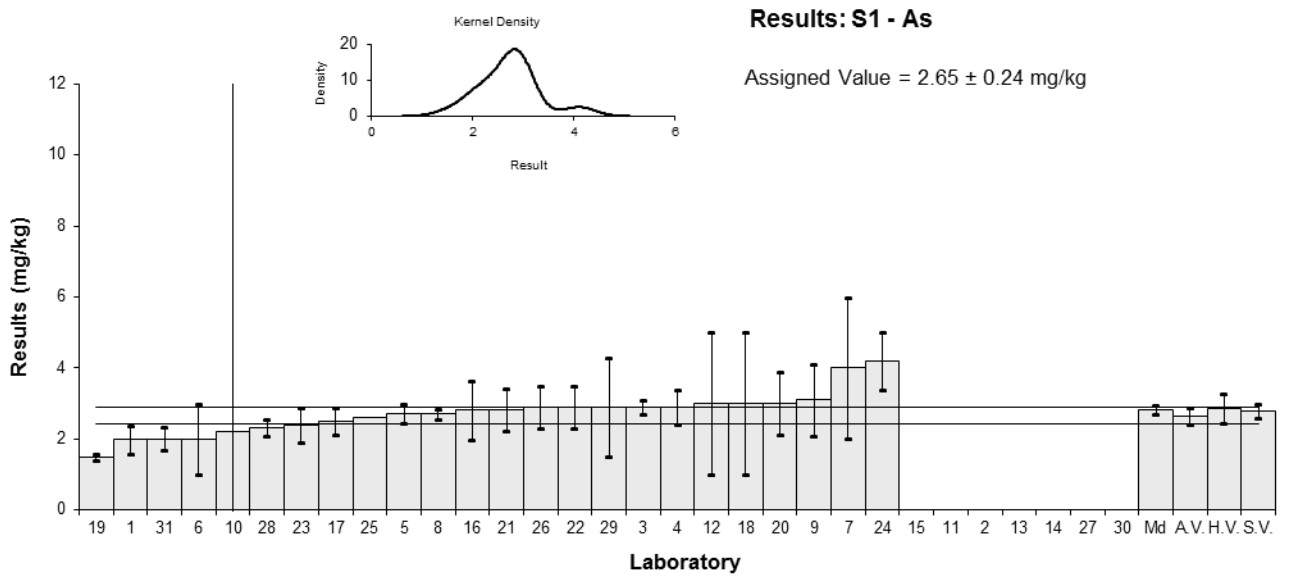
Participant Results

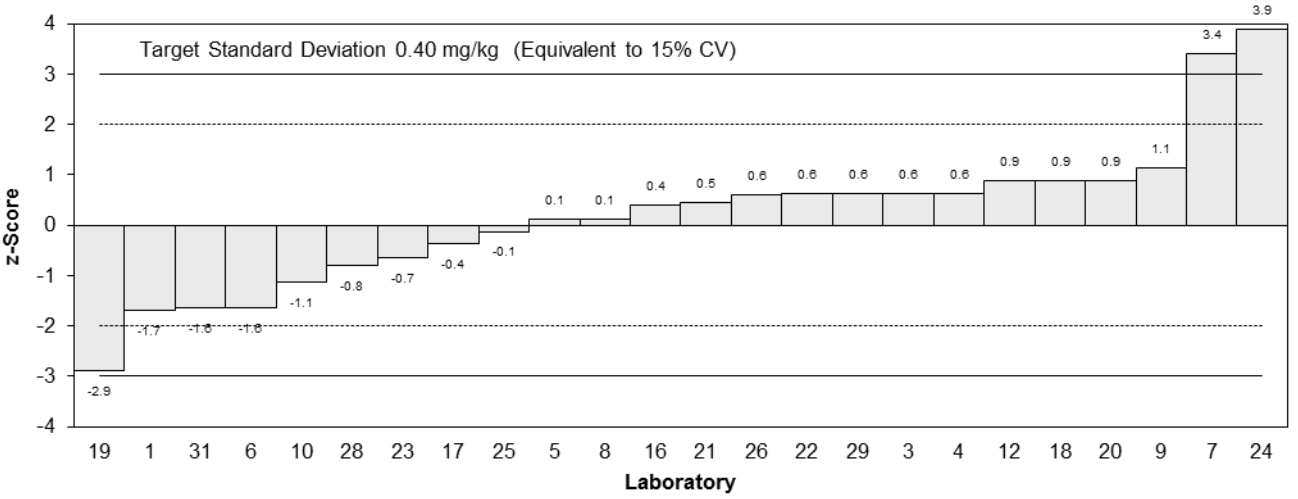
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	1.98	0.396	-1.69	-1.45
2	<5	NR		
3	2.9	0.2	0.63	0.80
4	2.9	0.5	0.63	0.45
5	2.7	0.27	0.13	0.14
6	2	1	-1.64	-0.63
7	4	2	3.40	0.67
8	2.7	0.13	0.13	0.18
9	3.1	1	1.13	0.44
10	2.2	22	-1.13	-0.02
11	<5	NR		
12	3	2	0.88	0.17
13	NT	NT		
14	NT	NT		
15	<4	NR		
16	2.81	0.84	0.40	0.18
17	2.5	0.38	-0.38	-0.33
18	3	2	0.88	0.17
19	1.50	0.09	-2.89	-4.49
20	3.00	0.88	0.88	0.38
21	2.83	0.6	0.45	0.28
22	2.9	0.6	0.63	0.39
23	2.39	0.47	-0.65	-0.49
24	4.2	0.8	3.90	1.86
25	2.6	NR	-0.13	-0.21
26	2.89	0.6	0.60	0.37
27	NT	NT		
28	2.331	0.233	-0.80	-0.95
29	2.9	1.4	0.63	0.18
30	NT	NT		
31	2	0.33	-1.64	-1.59

Statistics

Assigned Value*	2.65	0.24
Spike	2.80	0.20
Homogeneity Value	2.86	0.43
Robust Average	2.68	0.25
Median	2.82	0.13
Mean	2.72	
N	24	
Max.	4.2	
Min.	1.5	
Robust SD	0.46	
Robust CV	17%	

* Robust Average excluding Laboratory 24.


Results: S1 - As
Kernel Density
Density
Result
Assigned Value = 2.65 ± 0.24 mg/kg
Results (mg/kg)
Laboratory
19 1 31 6 10 28 23 17 25 5 8 16 21 26 22 29 3 4 12 18 20 9 7 24 15 11 2 13 14 27 30 Md A.V. H.V. S.V.


z-Scores: S1 - As
Target Standard Deviation 0.40 mg/kg (Equivalent to 15% CV)
z-Score
Laboratory
19 1 31 6 10 28 23 17 25 5 8 16 21 26 22 29 3 4 12 18 20 9 7 24

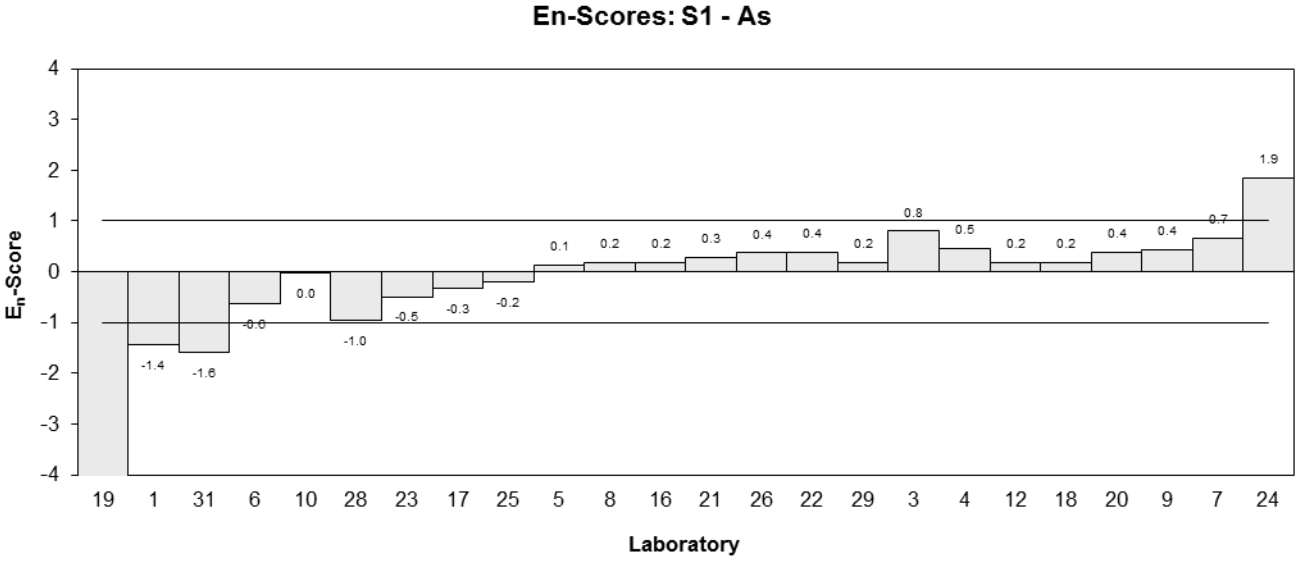

En-Scores: S1 - As
En-Score
Laboratory
19 1 31 6 10 28 23 17 25 5 8 16 21 26 22 29 3 4 12 18 20 9 7 24

Figure 2

Table 15

Sample Details

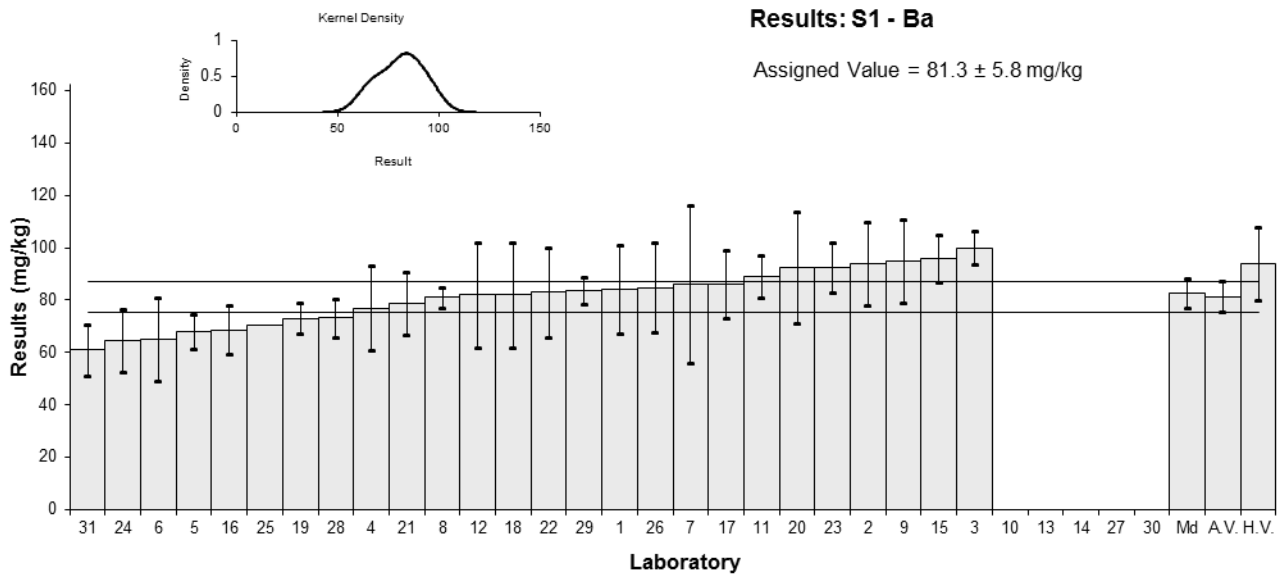
Sample No.	S1
Matrix.	Soil
Analyte.	Ba
Units	mg/kg

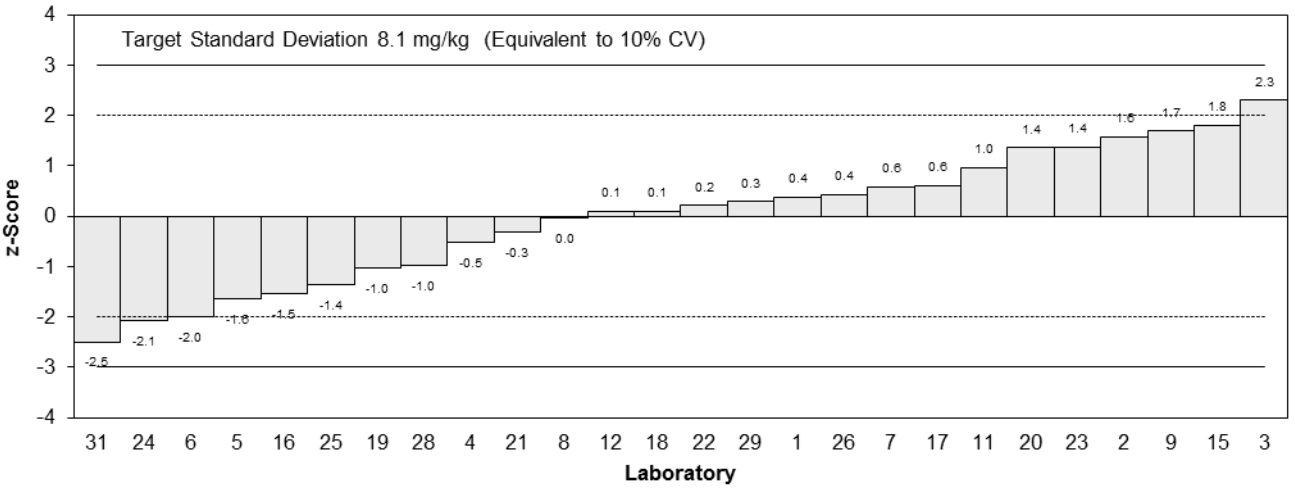
Participant Results

Lab Code	Result	Uncertainty	z-Score	En-Score
1	84.3	16.9	0.37	0.17
2	94	16	1.56	0.75
3	100	6.3	2.30	2.18
4	77	16	-0.53	-0.25
5	68	6.8	-1.64	-1.49
6	65	16	-2.00	-0.96
7	86	30	0.58	0.15
8	81	4.0	-0.04	-0.04
9	95	16	1.69	0.80
10	NT	NT		
11	89.1	8.0	0.96	0.79
12	82	20	0.09	0.03
13	NT	NT		
14	NT	NT		
15	96	9	1.81	1.37
16	68.7	9.3	-1.55	-1.15
17	86.12	13	0.59	0.34
18	82	20	0.09	0.03
19	73.0	5.84	-1.02	-1.01
20	92.3	21.2	1.35	0.50
21	78.7	12	-0.32	-0.20
22	83	17	0.21	0.09
23	92.5	9.7	1.38	0.99
24	64.4	12	-2.08	-1.27
25	70.3	NR	-1.35	-1.90
26	84.8	17	0.43	0.19
27	NT	NT		
28	73.335	7.333	-0.98	-0.85
29	83.6	5.1	0.28	0.30
30	NT	NT		
31	61	9.8	-2.50	-1.78

Statistics

Assigned Value	81.3	5.8
Spike	Not Spiked	
Homogeneity Value	94	14
Robust Average	81.3	5.8
Median	82.5	5.6
Mean	81.2	
N	26	
Max.	100	
Min.	61	
Robust SD	12	
Robust CV	14%	


Kernel Density
Density
Result
Results: S1 - Ba
Assigned Value = 81.3 ± 5.8 mg/kg
Results (mg/kg)
Laboratory
31 24 6 5 16 25 19 28 4 21 8 12 18 22 29 1 26 7 17 11 20 23 2 9 15 3 10 13 14 27 30 Md A.V. H.V.


z-Scores: S1 - Ba
Target Standard Deviation 8.1 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
31 24 6 5 16 25 19 28 4 21 8 12 18 22 29 1 26 7 17 11 20 23 2 9 15 3

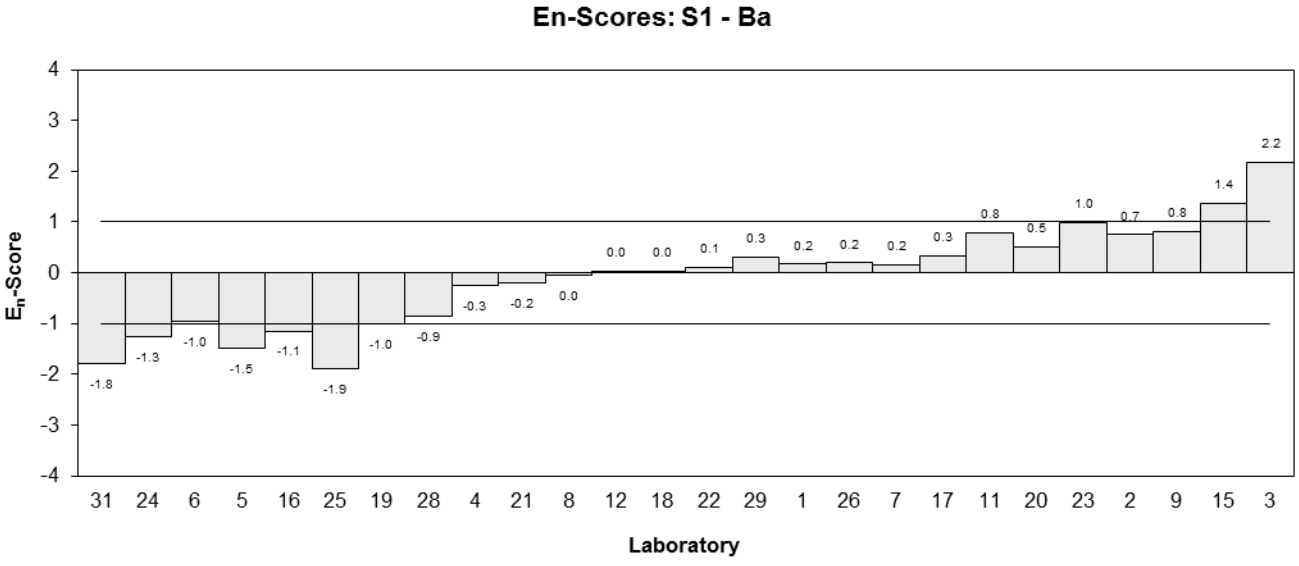

En-Scores: S1 - Ba
En-Score
Laboratory
31 24 6 5 16 25 19 28 4 21 8 12 18 22 29 1 26 7 17 11 20 23 2 9 15 3

Figure 3

Table 16

Sample Details

Sample No.	S1
Matrix.	Soil
Analyte.	Be
Units	mg/kg

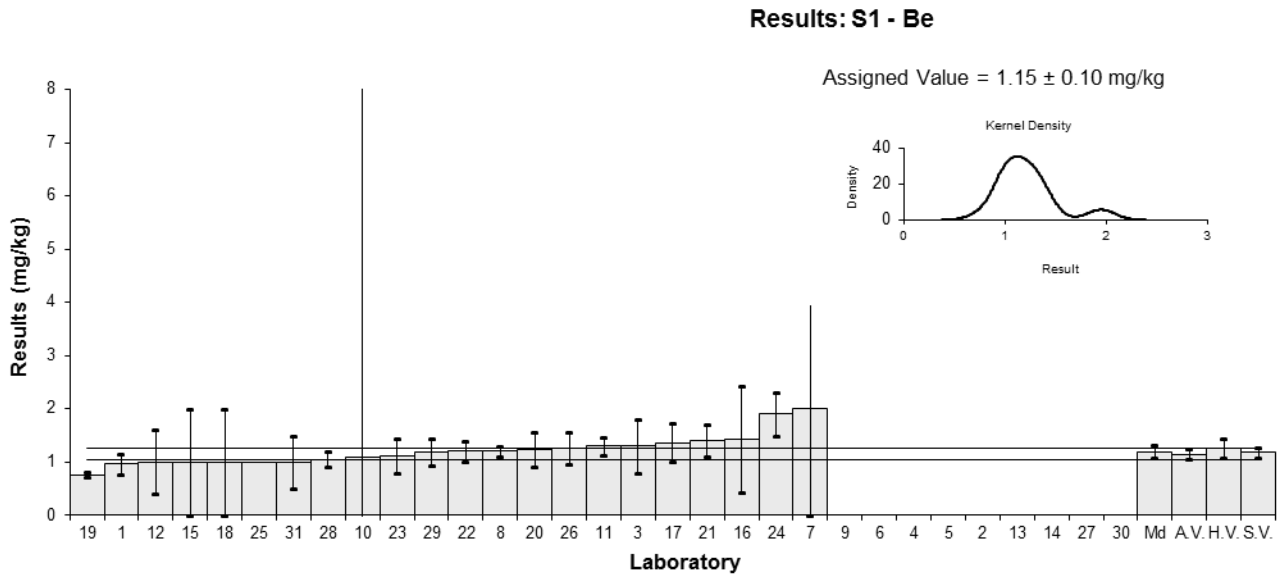
Participant Results

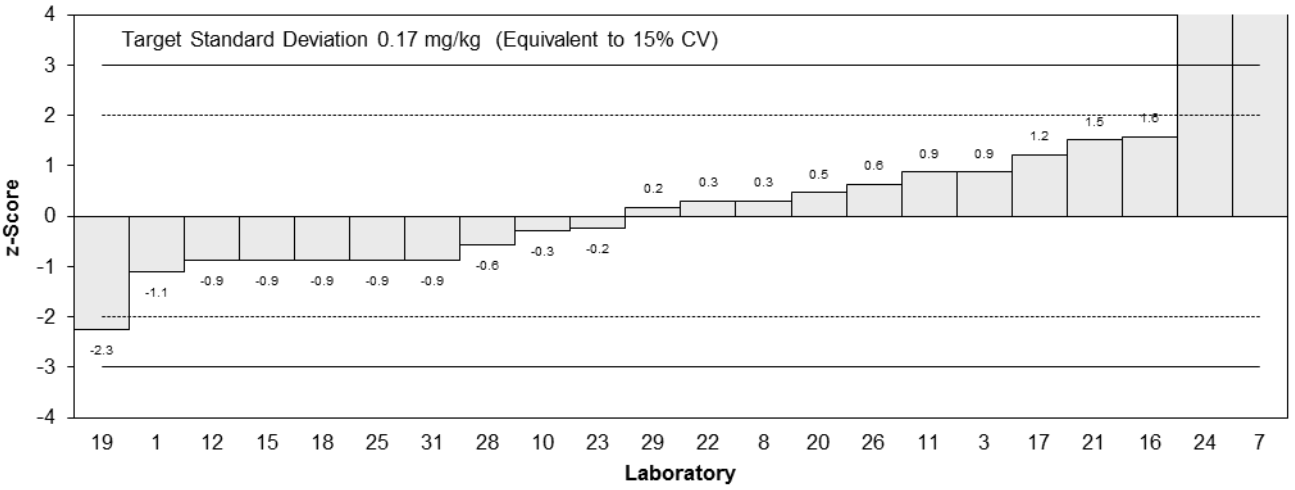
Lab Code	Result	Uncertainty	z-Score	En-Score
1	0.96	0.192	-1.10	-0.88
2	<5	NR		
3	1.3	0.5	0.87	0.29
4	<2	0.4		
5	<2	0.2		
6	<1	NR		
7	2	2	4.93	0.42
8	1.2	0.1	0.29	0.35
9	< 2	NR		
10	1.1	25	-0.29	0.00
11	1.30	0.17	0.87	0.76
12	1	0.6	-0.87	-0.25
13	NT	NT		
14	NT	NT		
15	1	1	-0.87	-0.15
16	1.42	1.0	1.57	0.27
17	1.3578	0.36	1.20	0.56
18	1	1	-0.87	-0.15
19	0.76	0.05	-2.26	-3.49
20	1.23	0.32	0.46	0.24
21	1.41	0.3	1.51	0.82
22	1.2	0.2	0.29	0.22
23	1.11	0.33	-0.23	-0.12
24	1.9	0.4	4.35	1.82
25	1.0	NR	-0.87	-1.50
26	1.26	0.3	0.64	0.35
27	NT	NT		
28	1.052	0.152	-0.57	-0.54
29	1.18	0.25	0.17	0.11
30	NT	NT		
31	1	0.5	-0.87	-0.29

Statistics

Assigned Value*	1.15	0.10
Spike	1.18	0.09
Homogeneity Value	1.26	0.19
Robust Average	1.18	0.11
Median	1.19	0.12
Mean	1.22	
N	22	
Max.	2	
Min.	0.76	
Robust SD	0.18	
Robust CV	15%	

* Robust Average excluding Laboratories 7 and 24.


Results: S1 - Be
Assigned Value = 1.15 ± 0.10 mg/kg
Kernel Density
Density
Result
Results (mg/kg)
19 1 12 15 18 25 31 28 10 23 29 22 8 20 26 11 3 17 21 16 24 7 9 6 4 5 2 13 14 27 30 Md A.V. H.V. S.V.
Laboratory


z-Scores: S1 - Be
Target Standard Deviation 0.17 mg/kg (Equivalent to 15% CV)
z-Score
19 1 12 15 18 25 31 28 10 23 29 22 8 20 26 11 3 17 21 16 24 7
Laboratory

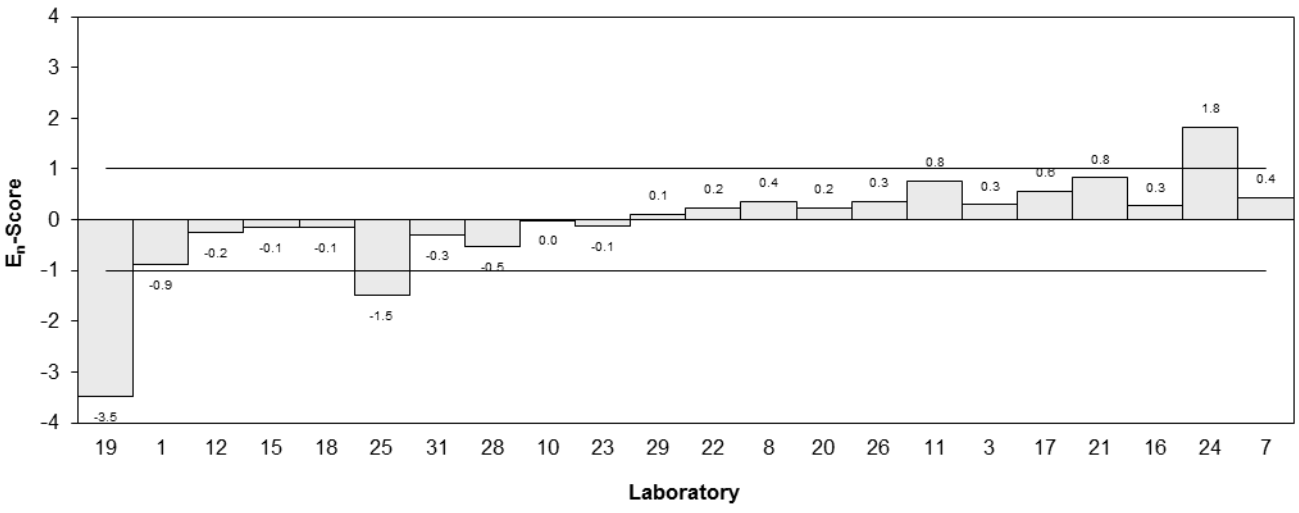

En-Scores: S1 - Be
En-Score
19 1 12 15 18 25 31 28 10 23 29 22 8 20 26 11 3 17 21 16 24 7
Laboratory

Figure 4

Table 17

Sample Details

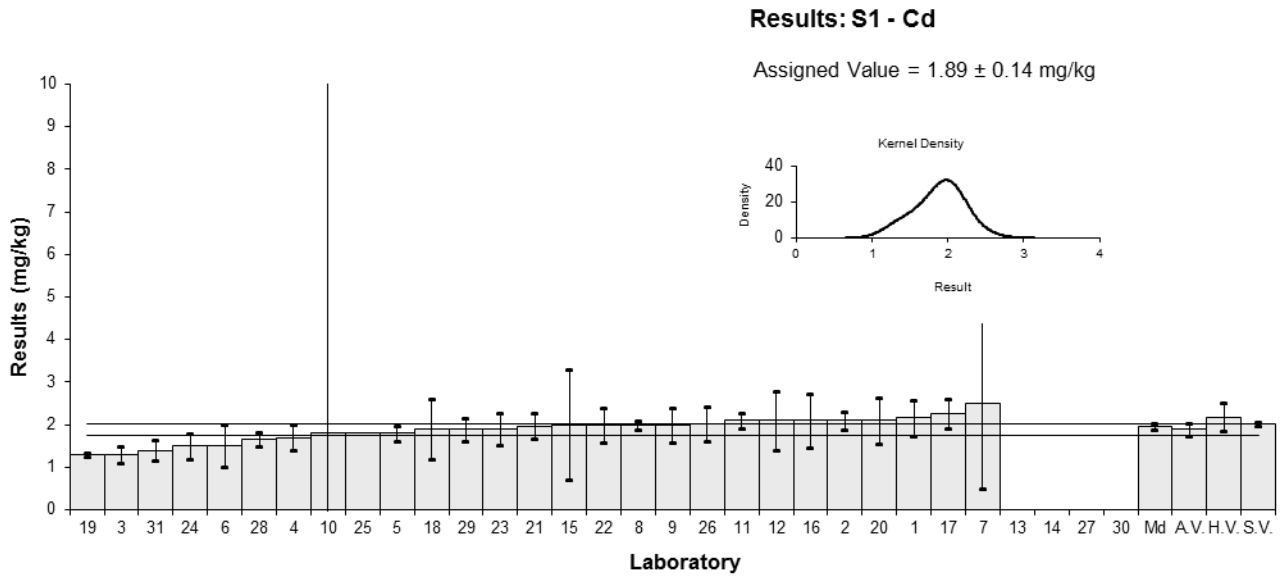
Sample No.	S1
Matrix.	Soil
Analyte.	Cd
Units	mg/kg

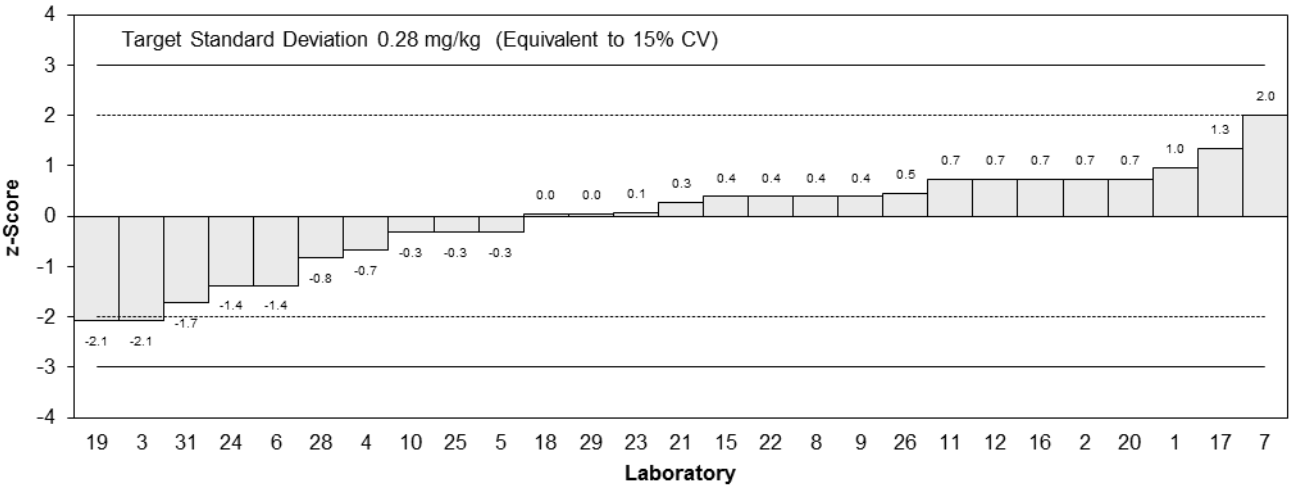
Participant Results

Lab Code	Result	Uncertainty	z-Score	En-Score
1	2.16	0.432	0.95	0.59
2	2.1	0.21	0.74	0.83
3	1.3	0.2	-2.08	-2.42
4	1.7	0.3	-0.67	-0.57
5	1.8	0.18	-0.32	-0.39
6	1.5	0.5	-1.38	-0.75
7	2.5	2	2.15	0.30
8	2.0	0.1	0.39	0.64
9	2	0.4	0.39	0.26
10	1.8	28	-0.32	0.00
11	2.10	0.18	0.74	0.92
12	2.1	0.7	0.74	0.29
13	NT	NT		
14	NT	NT		
15	2	1.3	0.39	0.08
16	2.10	0.63	0.74	0.33
17	2.2704	0.34	1.34	1.03
18	1.9	0.7	0.04	0.01
19	1.3	0.05	-2.08	-3.97
20	2.10	0.54	0.74	0.38
21	1.97	0.3	0.28	0.24
22	2.0	0.4	0.39	0.26
23	1.91	0.38	0.07	0.05
24	1.5	0.3	-1.38	-1.18
25	1.8	NR	-0.32	-0.64
26	2.02	0.4	0.46	0.31
27	NT	NT		
28	1.655	0.165	-0.83	-1.09
29	1.90	0.27	0.04	0.03
30	NT	NT		
31	1.4	0.24	-1.73	-1.76

Statistics

Assigned Value	1.89	0.14
Spike	2.02	0.04
Homogeneity Value	2.18	0.33
Robust Average	1.89	0.14
Median	1.97	0.08
Mean	1.89	
N	27	
Max.	2.5	
Min.	1.3	
Robust SD	0.29	
Robust CV	15%	


Results: S1 - Cd
Assigned Value = 1.89 ± 0.14 mg/kg
Kernel Density
Density
Result
Results (mg/kg)
19 3 31 24 6 28 4 10 25 5 18 29 23 21 15 22 8 9 26 11 12 16 2 20 1 17 7 13 14 27 30 Md A.V. H.V. S.V.
Laboratory


z-Scores: S1 - Cd
Target Standard Deviation 0.28 mg/kg (Equivalent to 15% CV)
z-Score
19 3 31 24 6 28 4 10 25 5 18 29 23 21 15 22 8 9 26 11 12 16 2 20 1 17 7
Laboratory

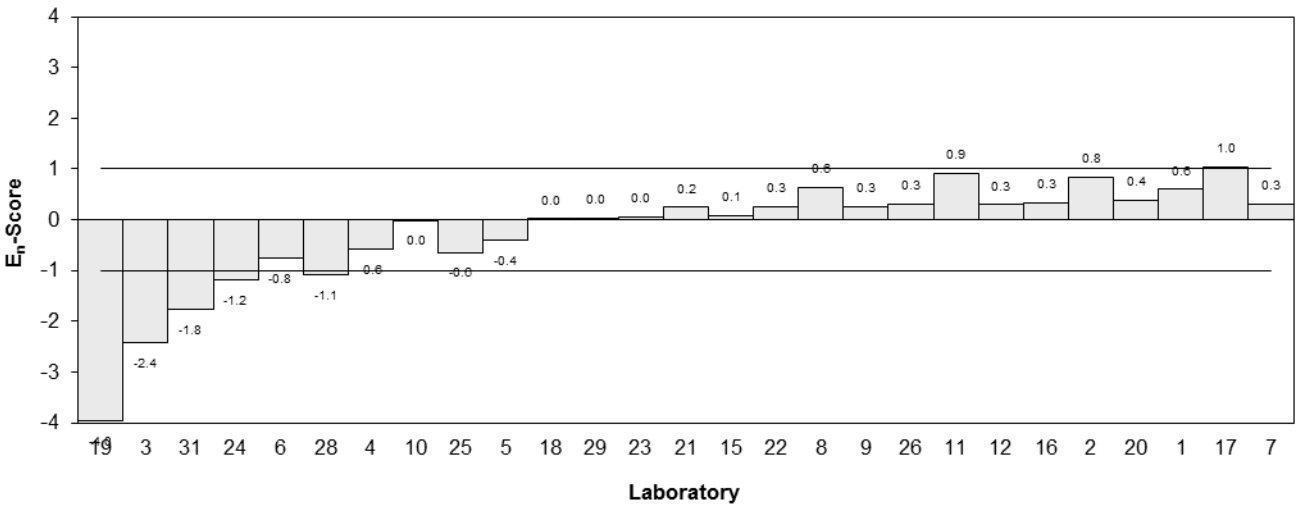

En-Scores: S1 - Cd
En-Score
19 3 31 24 6 28 4 10 25 5 18 29 23 21 15 22 8 9 26 11 12 16 2 20 1 17 7
Laboratory

Figure 5

Table 18

Sample Details

Sample No.	S1
Matrix.	Soil
Analyte.	Cr
Units	mg/kg

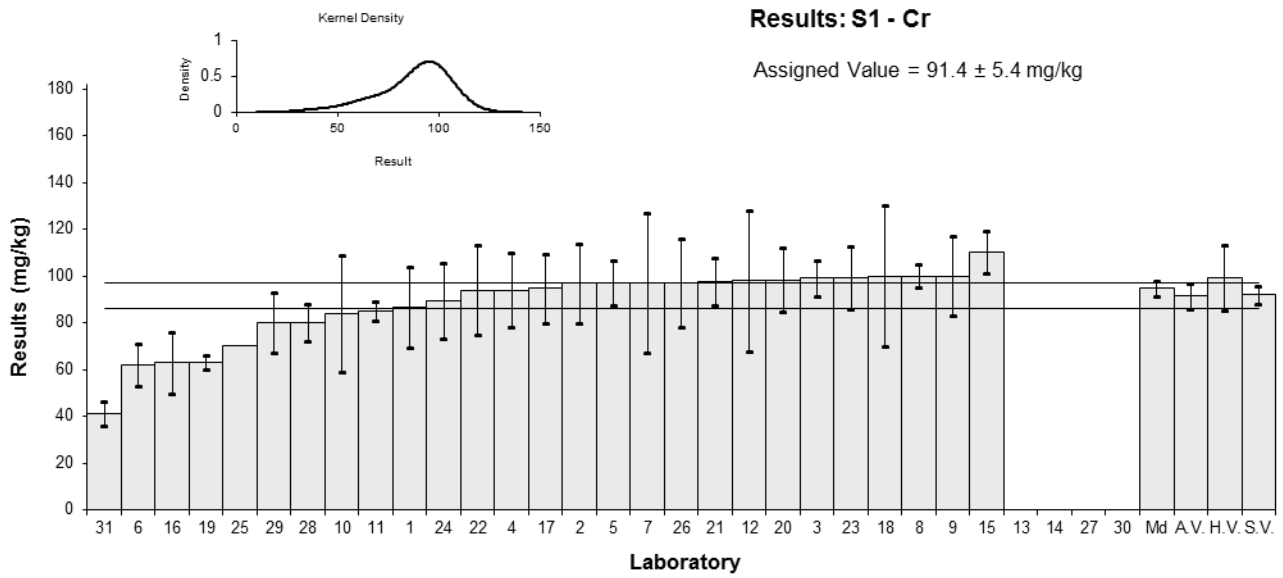
Participant Results

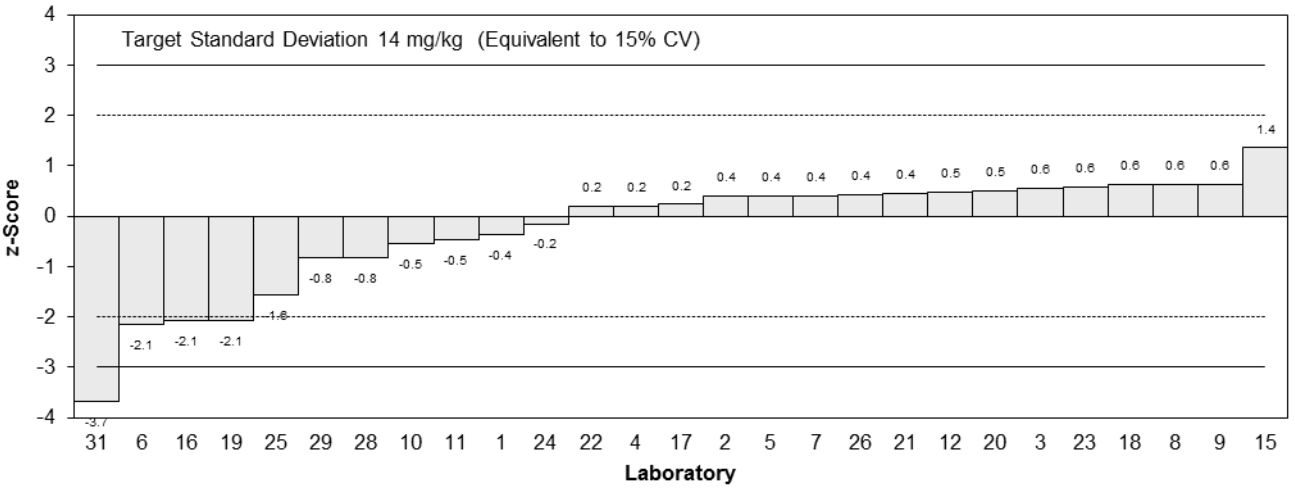
Lab Code	Result	Uncertainty	z-Score	En-Score
1	86.5	17.3	-0.36	-0.27
2	97	17	0.41	0.31
3	99	7.7	0.55	0.81
4	94	16	0.19	0.15
5	97	9.7	0.41	0.50
6	62	9	-2.14	-2.80
7	97	30	0.41	0.18
8	100	5.0	0.63	1.17
9	100	17	0.63	0.48
10	84	25	-0.54	-0.29
11	85.0	4.3	-0.47	-0.93
12	98	30	0.48	0.22
13	NT	NT		
14	NT	NT		
15	110	9	1.36	1.77
16	62.9	13	-2.08	-2.02
17	94.622	15	0.24	0.20
18	100	30	0.63	0.28
19	63	3.15	-2.07	-4.54
20	98.4	13.8	0.51	0.47
21	97.5	10	0.44	0.54
22	94	19	0.19	0.13
23	99.2	13.4	0.57	0.54
24	89.3	16	-0.15	-0.12
25	70.0	NR	-1.56	-3.96
26	97.1	19	0.42	0.29
27	NT	NT		
28	80.149	8.015	-0.82	-1.16
29	80	13	-0.83	-0.81
30	NT	NT		
31	41	5.3	-3.68	-6.66

Statistics

Assigned Value*	91.4	5.4
Spike	92.0	3.9
Homogeneity Value	99	14
Robust Average	90.0	6.3
Median	94.6	3.2
Mean	88.0	
N	27	
Max.	110	
Min.	41	
Robust SD	11	
Robust CV	12%	

* Robust Average excluding Laboratory 31.


Kernel Density
Density
Result
Results: S1 - Cr
Assigned Value = 91.4 ± 5.4 mg/kg
Results (mg/kg)
Laboratory
31 6 16 19 25 29 28 10 11 1 24 22 4 17 2 5 7 26 21 12 20 3 23 18 8 9 15 13 14 27 30 Md A.V. H.V. S.V.


z-Scores: S1 - Cr
Target Standard Deviation 14 mg/kg (Equivalent to 15% CV)
z-Score
Laboratory
31 6 16 19 25 29 28 10 11 1 24 22 4 17 2 5 7 26 21 12 20 3 23 18 8 9 15

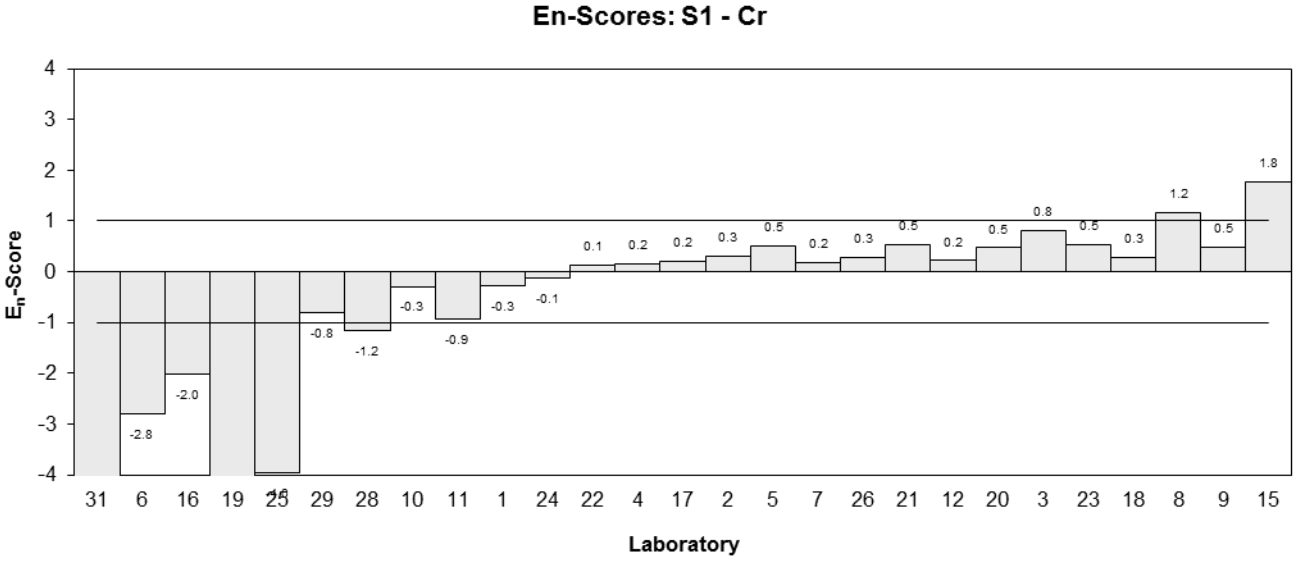

En-Scores: S1 - Cr
En-Score
Laboratory
31 6 16 19 25 29 28 10 11 1 24 22 4 17 2 5 7 26 21 12 20 3 23 18 8 9 15

Figure 6

Table 19

Sample Details

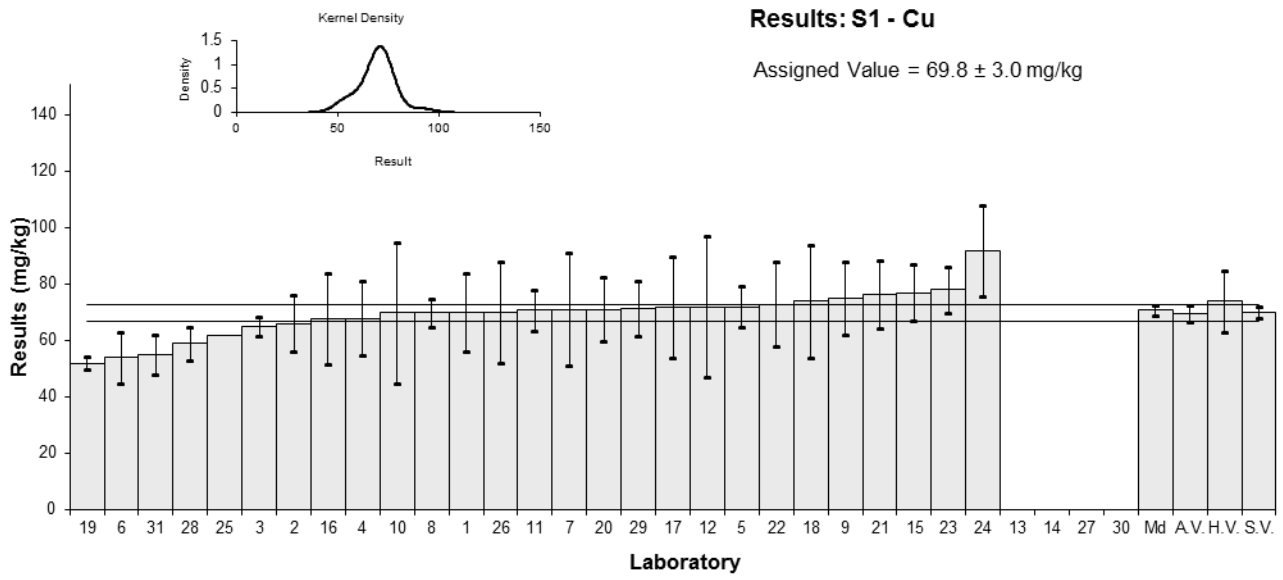
Sample No.	S1
Matrix.	Soil
Analyte.	Cu
Units	mg/kg

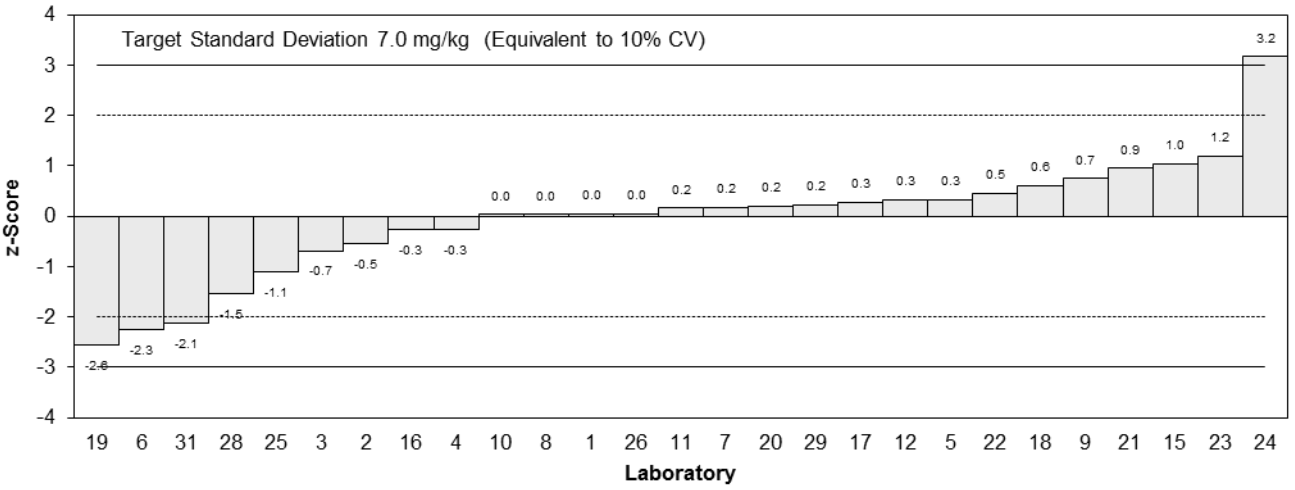
Participant Results

Lab Code	Result	Uncertainty	z-Score	En-Score
1	70.1	14	0.04	0.02
2	66	10	-0.54	-0.36
3	65	3.5	-0.69	-1.04
4	68	13	-0.26	-0.13
5	72	7.2	0.32	0.28
6	54	9	-2.26	-1.67
7	71	20	0.17	0.06
8	70	5.0	0.03	0.03
9	75	13	0.74	0.39
10	70	25	0.03	0.01
11	70.9	7.3	0.16	0.14
12	72	25	0.32	0.09
13	NT	NT		
14	NT	NT		
15	77	10	1.03	0.69
16	67.9	16	-0.27	-0.12
17	71.73	18	0.28	0.11
18	74	20	0.60	0.21
19	52	2.34	-2.55	-4.68
20	71.1	11.4	0.19	0.11
21	76.4	12	0.95	0.53
22	73	15	0.46	0.21
23	78.1	8.1	1.19	0.96
24	91.9	16	3.17	1.36
25	62.0	NR	-1.12	-2.60
26	70.1	18	0.04	0.02
27	NT	NT		
28	59.123	5.912	-1.53	-1.61
29	71.3	9.8	0.21	0.15
30	NT	NT		
31	55	7.04	-2.12	-1.93

Statistics

Assigned Value	69.8	3.0
Spike	70.0	2.0
Homogeneity Value	74	11
Robust Average	69.8	3.0
Median	70.9	1.8
Mean	69.4	
N	27	
Max.	91.9	
Min.	52	
Robust SD	6.2	
Robust CV	8.9%	


Kernel Density
Density
Result
Results: S1 - Cu
Assigned Value = 69.8 ± 3.0 mg/kg
Results (mg/kg)
Laboratory
19 6 31 28 25 3 2 16 4 10 8 1 26 11 7 20 29 17 12 5 22 18 9 21 15 23 24 13 14 27 30 Md A.V. H.V. S.V.


z-Scores: S1 - Cu
Target Standard Deviation 7.0 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
19 6 31 28 25 3 2 16 4 10 8 1 26 11 7 20 29 17 12 5 22 18 9 21 15 23 24

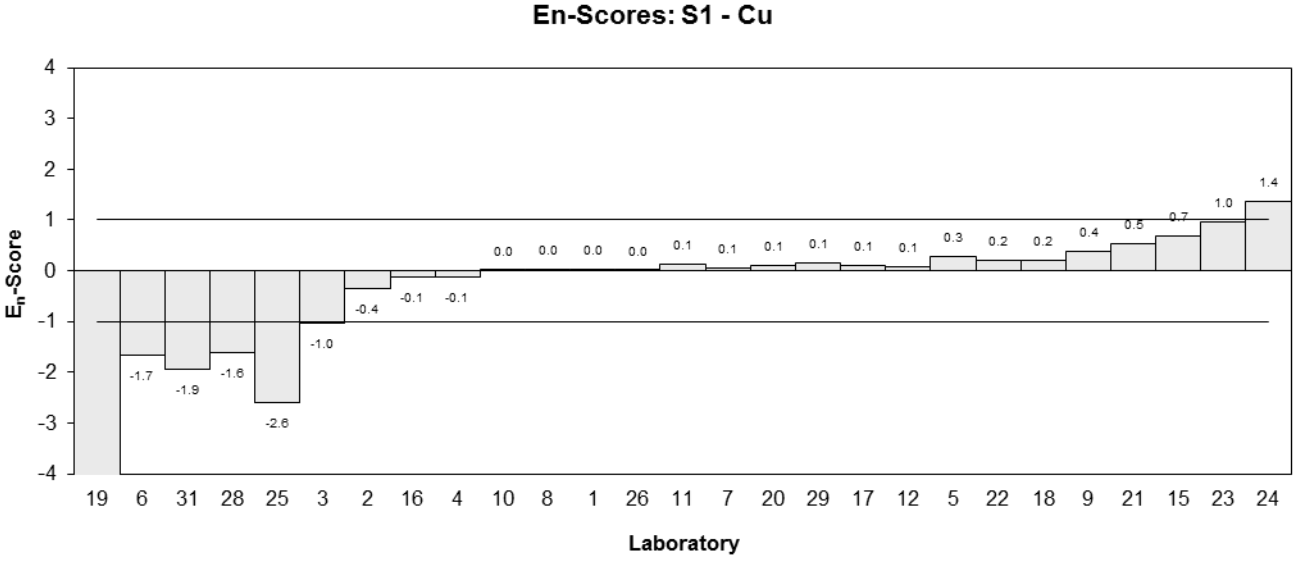

En-Scores: S1 - Cu
En-Score
Laboratory
19 6 31 28 25 3 2 16 4 10 8 1 26 11 7 20 29 17 12 5 22 18 9 21 15 23 24

Figure 7

Table 20

Sample Details

Sample No.	S1
Matrix.	Soil
Analyte.	Hg
Units	mg/kg

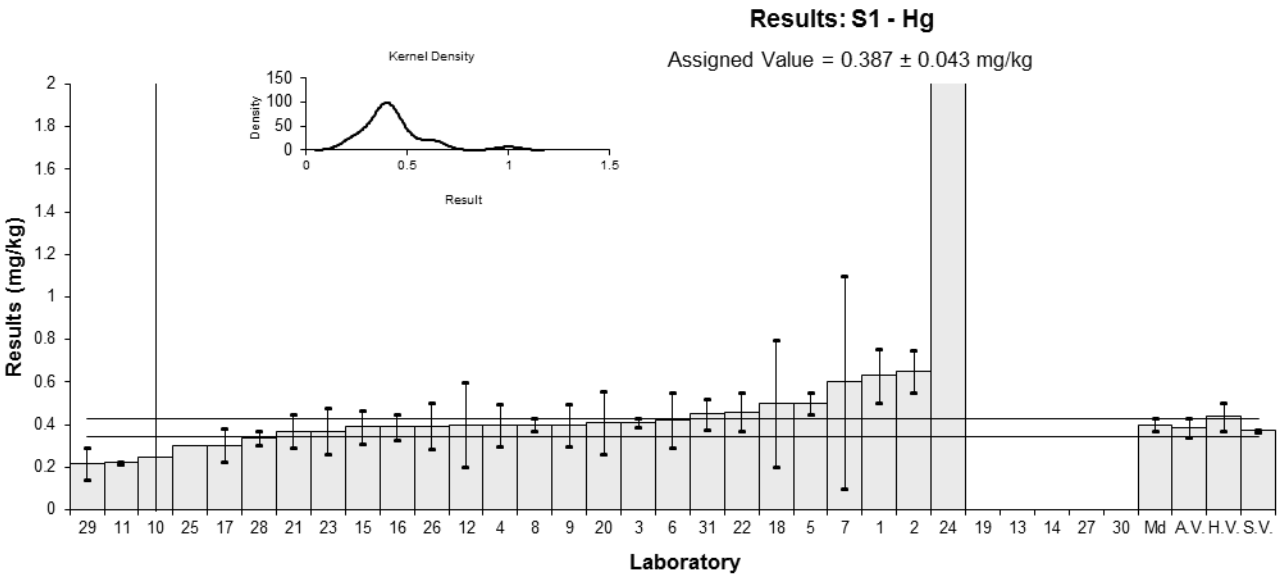
Participant Results

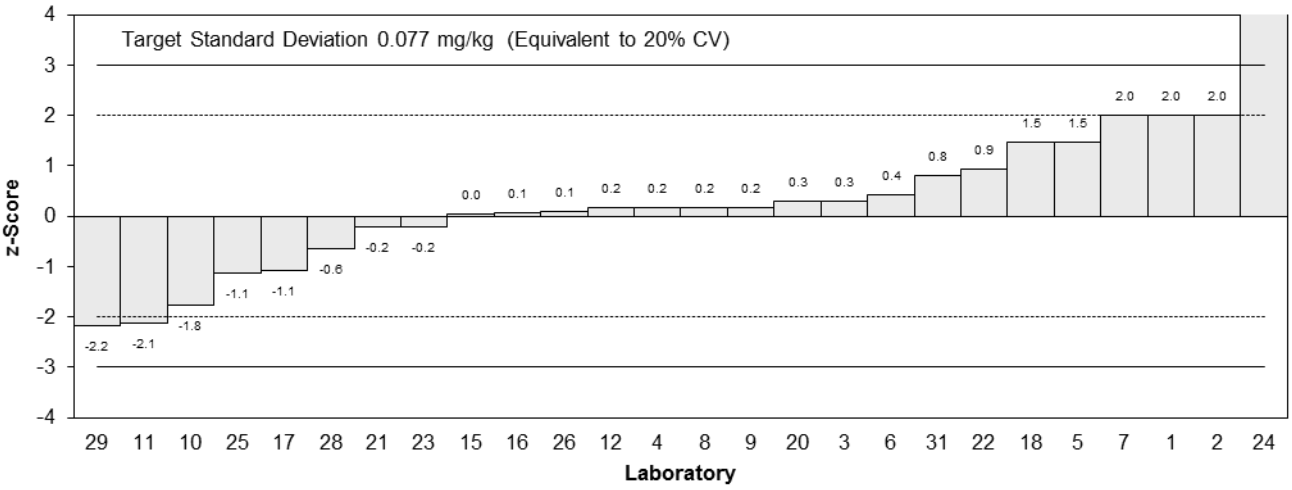
Lab Code	Result	Uncertainty	z-Score	En-Score
1	0.63	0.126	3.14	1.83
2	0.65	0.1	3.40	2.42
3	0.41	0.02	0.30	0.48
4	0.4	0.1	0.17	0.12
5	0.5	0.05	1.46	1.71
6	0.42	0.13	0.43	0.24
7	0.6	0.5	2.75	0.42
8	0.4	0.03	0.17	0.25
9	0.4	0.1	0.17	0.12
10	0.25	24	-1.77	-0.01
11	0.222	0.006	-2.13	-3.80
12	0.4	0.2	0.17	0.06
13	NT	NT		
14	NT	NT		
15	0.39	0.08	0.04	0.03
16	0.392	0.06	0.06	0.07
17	0.303	0.078	-1.09	-0.94
18	0.5	0.3	1.46	0.37
19	<1.0	NR		
20	0.410	0.15	0.30	0.15
21	0.37	0.08	-0.22	-0.19
22	0.46	0.09	0.94	0.73
23	0.37	0.11	-0.22	-0.14
24	19	4	240.48	4.65
25	0.3	NR	-1.12	-2.02
26	0.394	0.11	0.09	0.06
27	NT	NT		
28	0.337	0.034	-0.65	-0.91
29	0.219	0.074	-2.17	-1.96
30	NT	NT		
31	0.45	0.07	0.81	0.77

Statistics

Assigned Value*	0.387	0.043
Spike	0.372	0.008
Homogeneity Value	0.438	0.066
Robust Average	0.400	0.050
Median	0.400	0.031
Mean	1.122	
N	26	
Max.	19	
Min.	0.219	
Robust SD	0.083	
Robust CV	20%	

* Robust Average excluding Laboratories 1, 2 and 24.


Results: S1 - Hg
Assigned Value = 0.387 ± 0.043 mg/kg
Kernel Density
Density
Result
Results (mg/kg)
Laboratory
29 11 10 25 17 28 21 23 15 16 26 12 4 8 9 20 3 6 31 22 18 5 7 1 2 24 19 13 14 27 30 Md A.V. H.V. S.V.


z-Scores: S1 - Hg
Target Standard Deviation 0.077 mg/kg (Equivalent to 20% CV)
z-Score
Laboratory
29 11 10 25 17 28 21 23 15 16 26 12 4 8 9 20 3 6 31 22 18 5 7 1 2 24

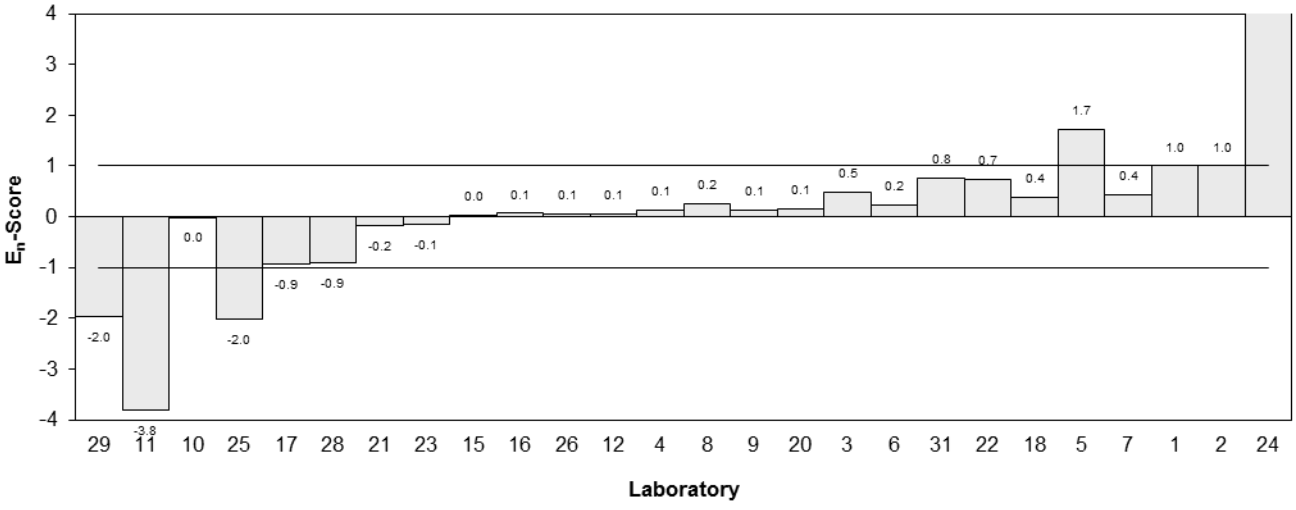

En-Scores: S1 - Hg
En-Score
Laboratory
29 11 10 25 17 28 21 23 15 16 26 12 4 8 9 20 3 6 31 22 18 5 7 1 2 24

Figure 8

Table 21

Sample Details

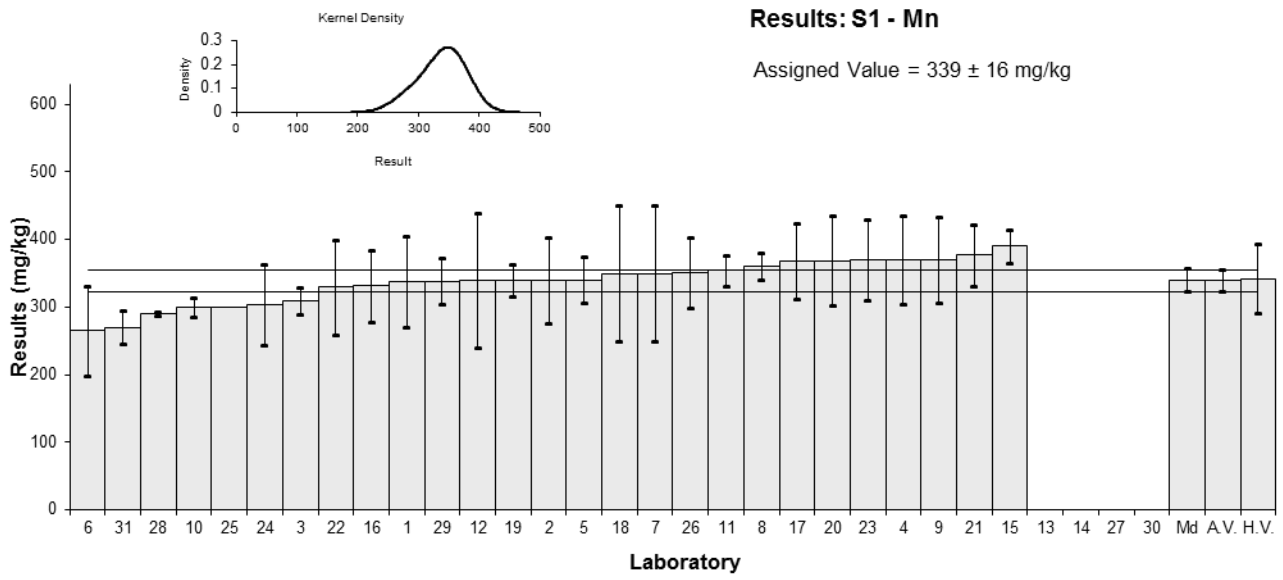
Sample No.	S1
Matrix.	Soil
Analyte.	Mn
Units	mg/kg

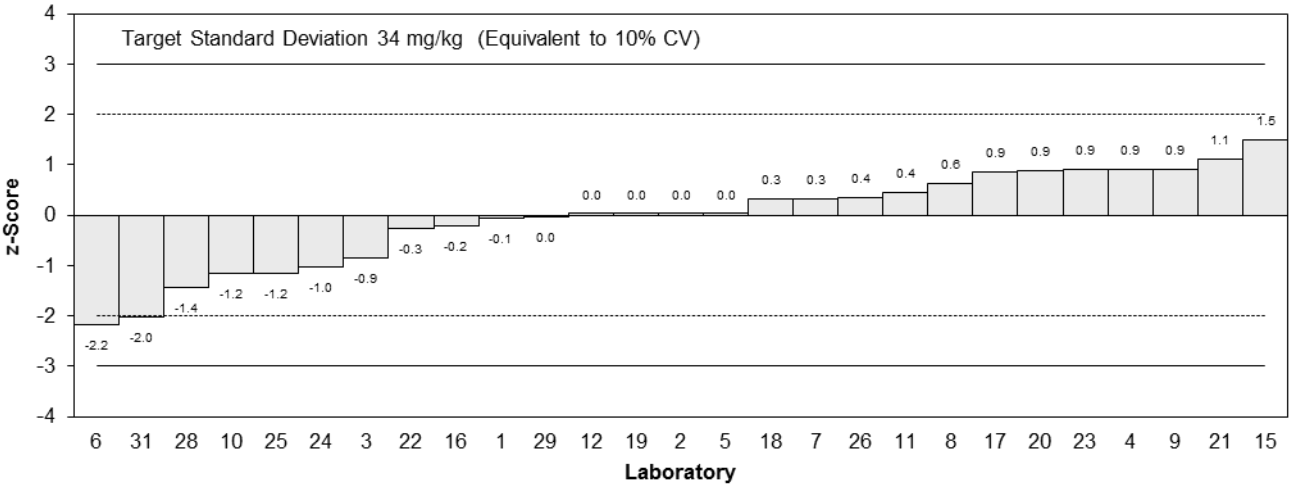
Participant Results

Lab Code	Result	Uncertainty	z-Score	En-Score
1	337	67.4	-0.06	-0.03
2	340	64	0.03	0.02
3	310	20	-0.86	-1.13
4	370	65	0.91	0.46
5	340	34	0.03	0.03
6	265	66	-2.18	-1.09
7	350	100	0.32	0.11
8	360	20	0.62	0.82
9	370	63	0.91	0.48
10	300	15	-1.15	-1.78
11	354	22	0.44	0.55
12	340	100	0.03	0.01
13	NT	NT		
14	NT	NT		
15	390	25	1.50	1.72
16	332	53	-0.21	-0.13
17	368.242	56	0.86	0.50
18	350	100	0.32	0.11
19	340	24	0.03	0.03
20	369	66	0.88	0.44
21	377	45	1.12	0.80
22	330	70	-0.27	-0.13
23	370	60	0.91	0.50
24	304	60	-1.03	-0.56
25	300	NR	-1.15	-2.44
26	351	53	0.35	0.22
27	NT	NT		
28	290.510	2.905	-1.43	-2.98
29	338	34	-0.03	-0.03
30	NT	NT		
31	270	25	-2.04	-2.32

Statistics

Assigned Value	339	16
Spike	Not Spiked	
Homogeneity Value	342	51
Robust Average	339	16
Median	340	17
Mean	338	
N	27	
Max.	390	
Min.	265	
Robust SD	33	
Robust CV	9.7%	


Kernel Density
Density
Result
Results: S1 - Mn
Assigned Value = 339 ± 16 mg/kg
Results (mg/kg)
Laboratory
6 31 28 10 25 24 3 22 16 1 29 12 19 2 5 18 7 26 11 8 17 20 23 4 9 21 15 13 14 27 30 Md A.V. H.V.


z-Scores: S1 - Mn
Target Standard Deviation 34 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
6 31 28 10 25 24 3 22 16 1 29 12 19 2 5 18 7 26 11 8 17 20 23 4 9 21 15

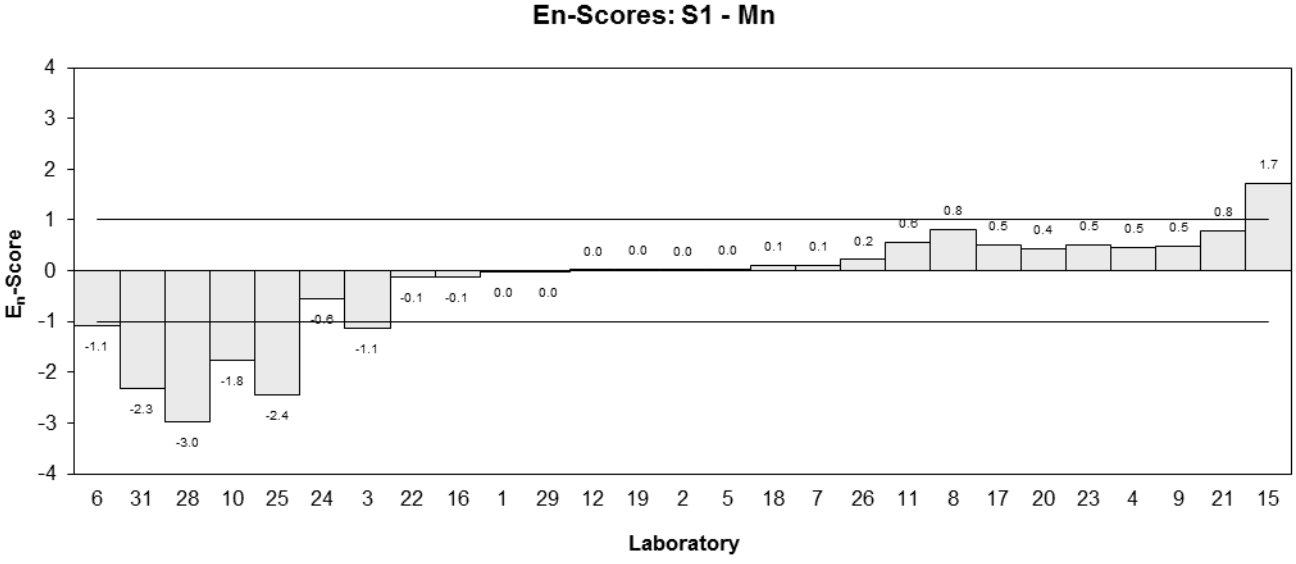

En-Scores: S1 - Mn
En-Score
Laboratory
6 31 28 10 25 24 3 22 16 1 29 12 19 2 5 18 7 26 11 8 17 20 23 4 9 21 15

Figure 9

Table 22

Sample Details

Sample No.	S1
Matrix.	Soil
Analyte.	Mo
Units	mg/kg

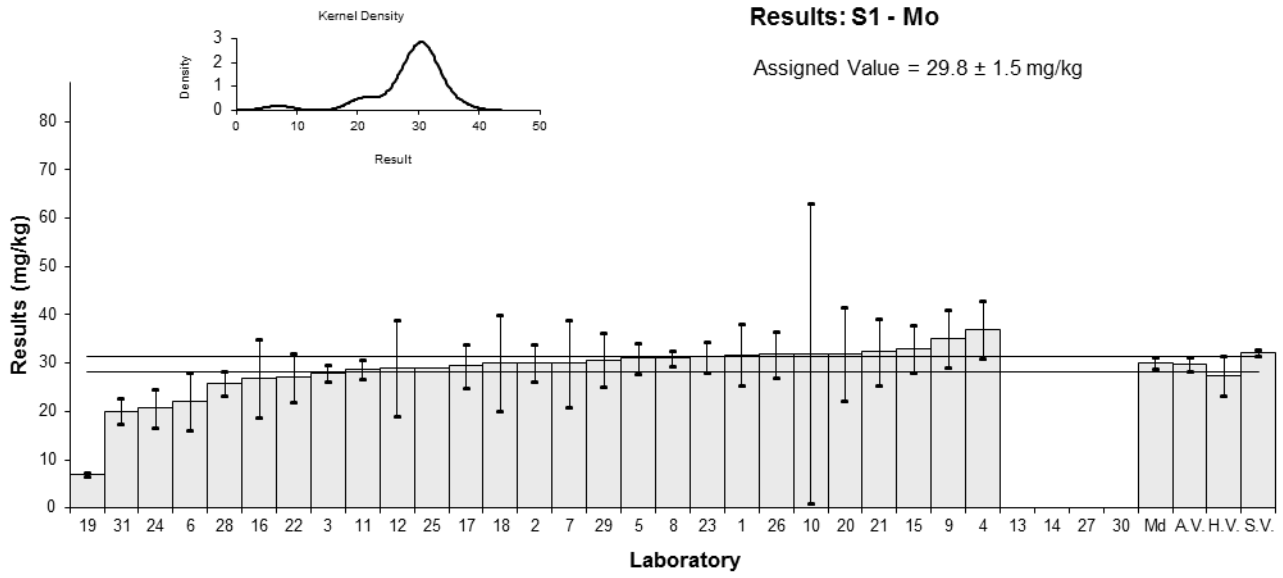
Participant Results

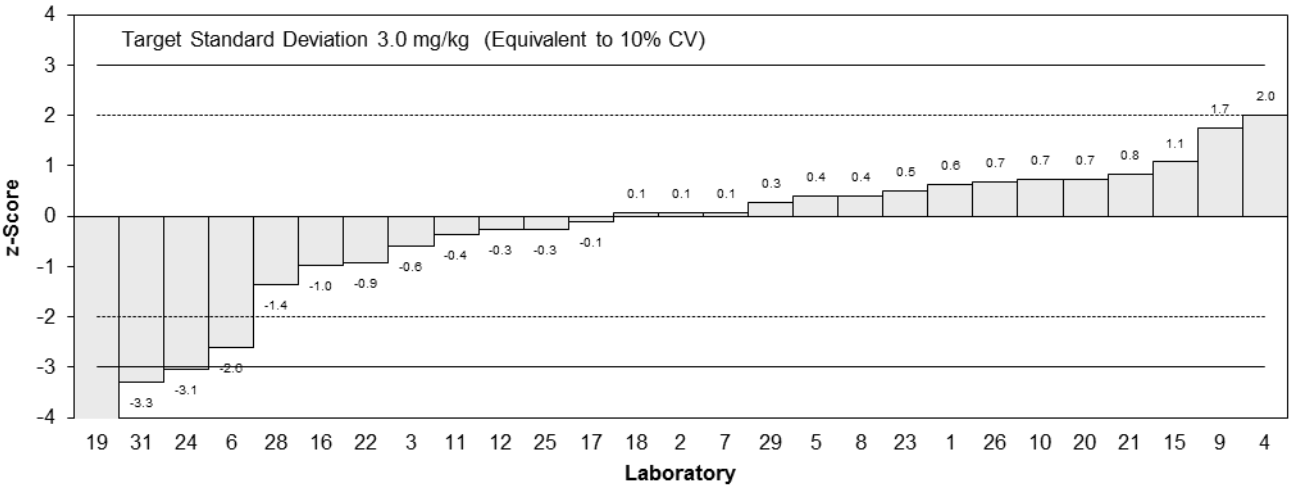
Lab Code	Result	Uncertainty	z-Score	En-Score
1	31.7	6.34	0.64	0.29
2	30	3.9	0.07	0.05
3	28	1.7	-0.60	-0.79
4	37	6	2.42	1.16
5	31	3.1	0.40	0.35
6	22	6	-2.62	-1.26
7	30	9	0.07	0.02
8	31	1.5	0.40	0.57
9	35	6	1.74	0.84
10	32	31	0.74	0.07
11	28.7	2.0	-0.37	-0.44
12	29	10	-0.27	-0.08
13	NT	NT		
14	NT	NT		
15	33	5	1.07	0.61
16	26.9	8.1	-0.97	-0.35
17	29.4878	4.5	-0.10	-0.07
18	30	10	0.07	0.02
19	6.9	0.34	-7.68	-14.89
20	32.0	9.7	0.74	0.22
21	32.3	7.0	0.84	0.35
22	27	5	-0.94	-0.54
23	31.3	3.2	0.50	0.42
24	20.7	4	-3.05	-2.13
25	29.0	NR	-0.27	-0.53
26	31.8	4.7	0.67	0.41
27	NT	NT		
28	25.771	2.577	-1.35	-1.35
29	30.6	5.6	0.27	0.14
30	NT	NT		
31	20	2.7	-3.29	-3.17

Statistics

Assigned Value*	29.8	1.5
Spike	32.3	0.7
Homogeneity Value	27.4	4.1
Robust Average	29.5	1.7
Median	30.0	1.2
Mean	28.6	
N	27	
Max.	37	
Min.	6.9	
Robust SD	3.1	
Robust CV	11%	

* Robust Average excluding Laboratory 19.


Kernel Density
Density
Result
Results: S1 - Mo
Assigned Value = 29.8 ± 1.5 mg/kg
Results (mg/kg)
Laboratory
19 31 24 6 28 16 22 3 11 12 25 17 18 2 7 29 5 8 23 1 26 10 20 21 15 9 4 13 14 27 30 Md A.V. H.V. S.V.


z-Scores: S1 - Mo
Target Standard Deviation 3.0 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
19 31 24 6 28 16 22 3 11 12 25 17 18 2 7 29 5 8 23 1 26 10 20 21 15 9 4

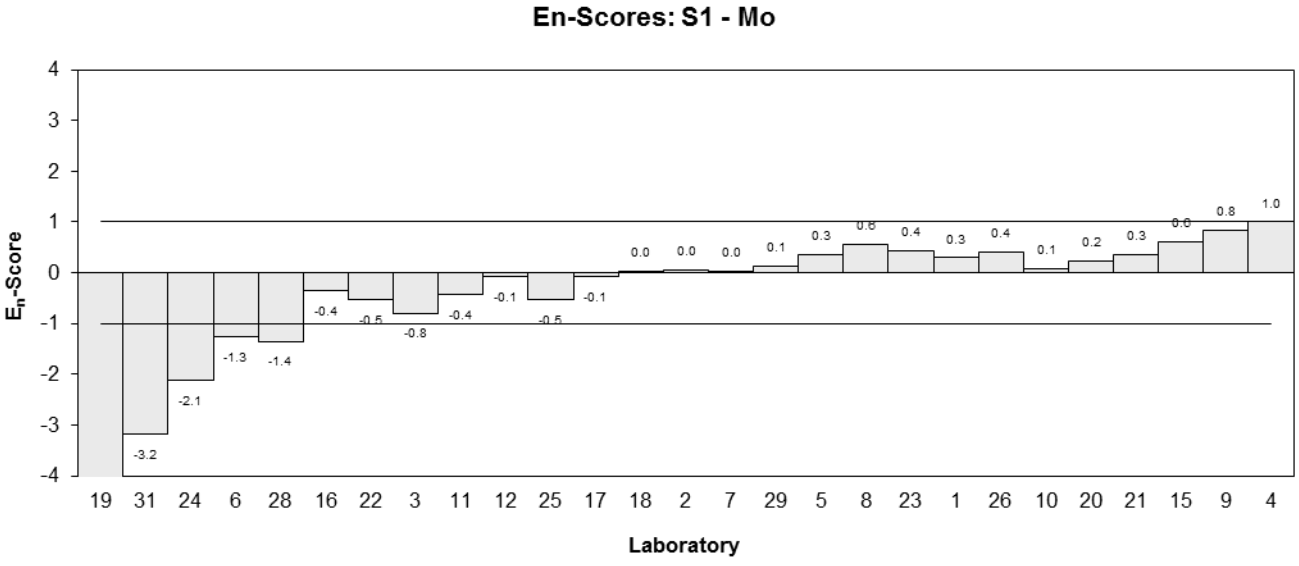

En-Scores: S1 - Mo
En-Score
Laboratory
19 31 24 6 28 16 22 3 11 12 25 17 18 2 7 29 5 8 23 1 26 10 20 21 15 9 4

Figure 10

Table 23

Sample Details

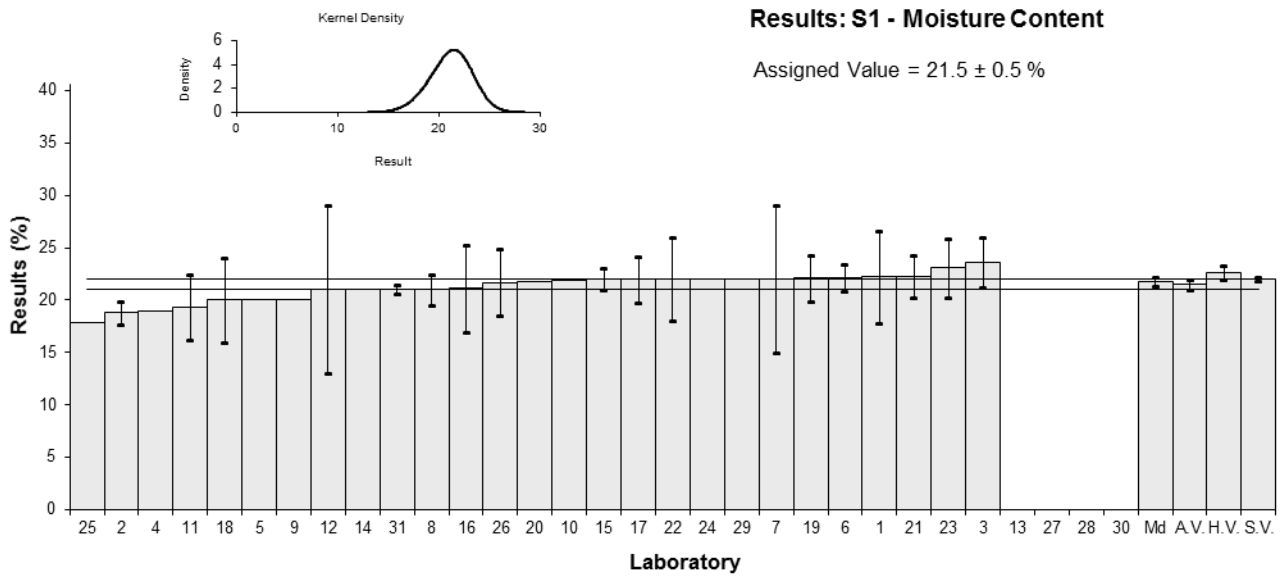
Sample No.	S1
Matrix.	Soil
Analyte.	Moisture Content
Units	%

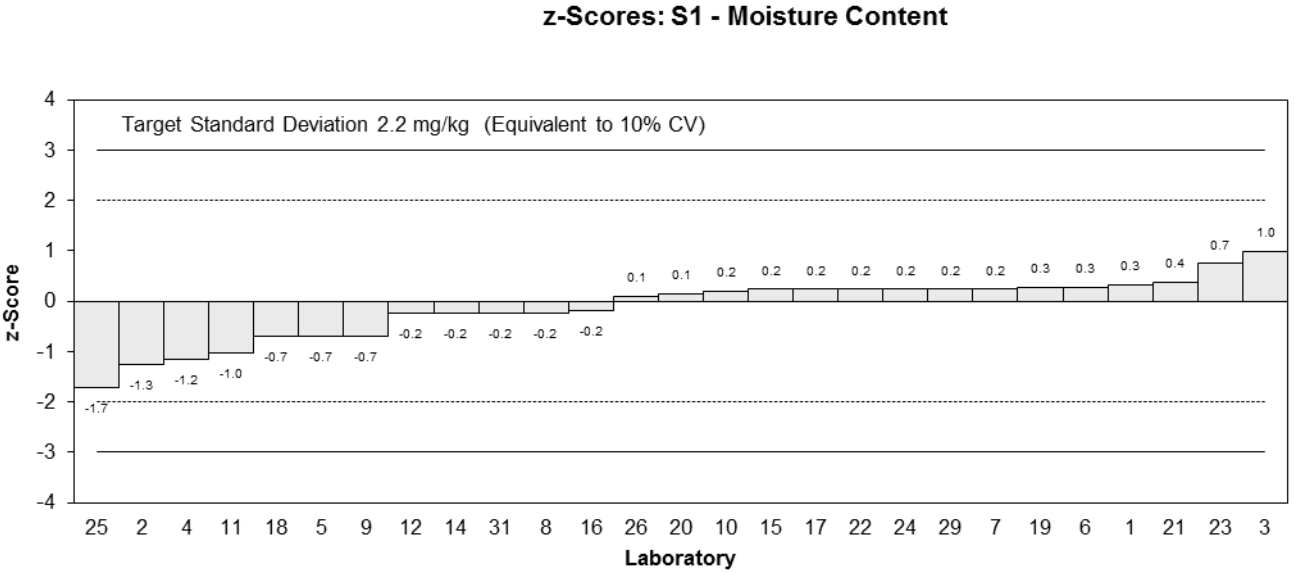
Participant Results

Lab Code	Result	Uncertainty	z-Score	En-Score
1	22.2	4.44	0.33	0.16
2	18.8	1.1	-1.26	-2.23
3	23.6	2.4	0.98	0.86
4	19	NR	-1.16	-5.00
5	20	NR	-0.70	-3.00
6	22.1	1.3	0.28	0.43
7	22	7	0.23	0.07
8	21	1.5	-0.23	-0.32
9	20	NR	-0.70	-3.00
10	21.9	NR	0.19	0.80
11	19.3	3.1	-1.02	-0.70
12	21	8	-0.23	-0.06
13	NT	NT		
14	21	NR	-0.23	-1.00
15	22	1	0.23	0.45
16	21.1	4.2	-0.19	-0.09
17	22	2.2	0.23	0.22
18	20	4	-0.70	-0.37
19	22.1	2.2	0.28	0.27
20	21.8	NR	0.14	0.60
21	22.3	2.0	0.37	0.39
22	22	4	0.23	0.12
23	23.1	2.8	0.74	0.56
24	22	NR	0.23	1.00
25	17.8	NR	-1.72	-7.40
26	21.7	3.2	0.09	0.06
27	NT	NT		
28	NT	NT		
29	22	NR	0.23	1.00
30	NT	NT		
31	21	0.42	-0.23	-0.77

Statistics

Assigned Value	21.5	0.5
Spike	22.0	0.2
Homogeneity Value	22.6	0.6
Robust Average	21.5	0.5
Median	21.8	0.4
Mean	21.2	
N	27	
Max.	23.6	
Min.	17.8	
Robust SD	1	
Robust CV	4.7%	


Kernel Density
Density
Result
Results: S1 - Moisture Content
Assigned Value = 21.5 ± 0.5 %
Results (%)
Laboratory
25 2 4 11 18 5 9 12 14 31 8 16 26 20 10 15 17 22 24 29 7 19 6 1 21 23 3 13 27 28 30 Md A.V. H.V. S.V.


z-Scores: S1 - Moisture Content
Target Standard Deviation 2.2 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
25 2 4 11 18 5 9 12 14 31 8 16 26 20 10 15 17 22 24 29 7 19 6 1 21 23 3

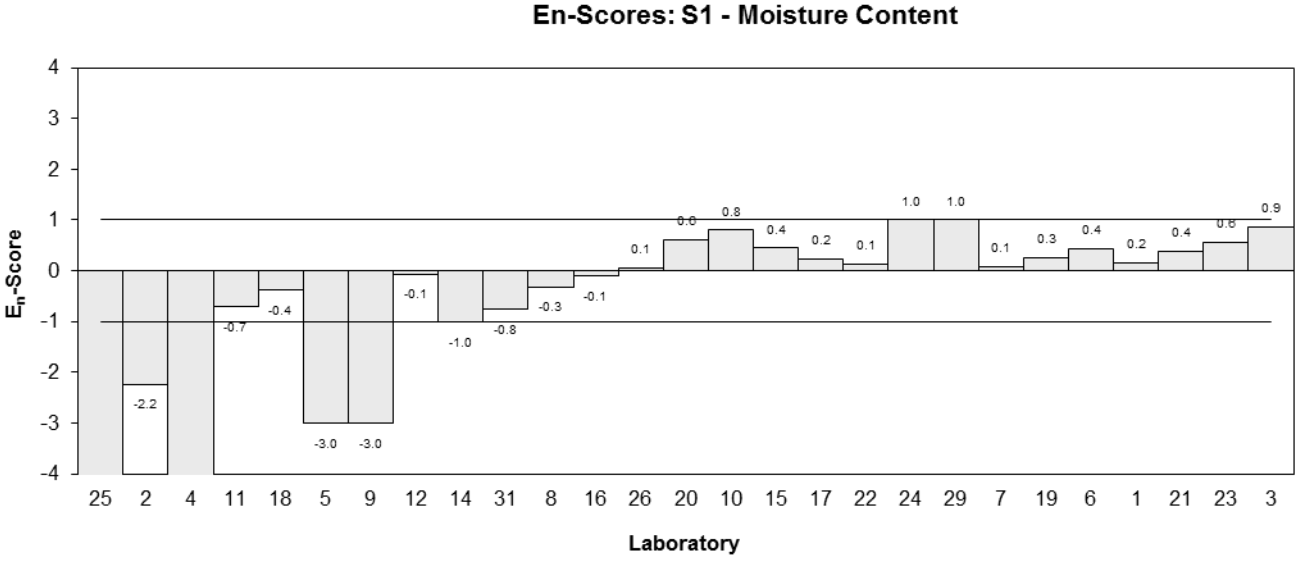

En-Scores: S1 - Moisture Content
En-Score
Laboratory
25 2 4 11 18 5 9 12 14 31 8 16 26 20 10 15 17 22 24 29 7 19 6 1 21 23 3

Figure 11

Table 24

Sample Details

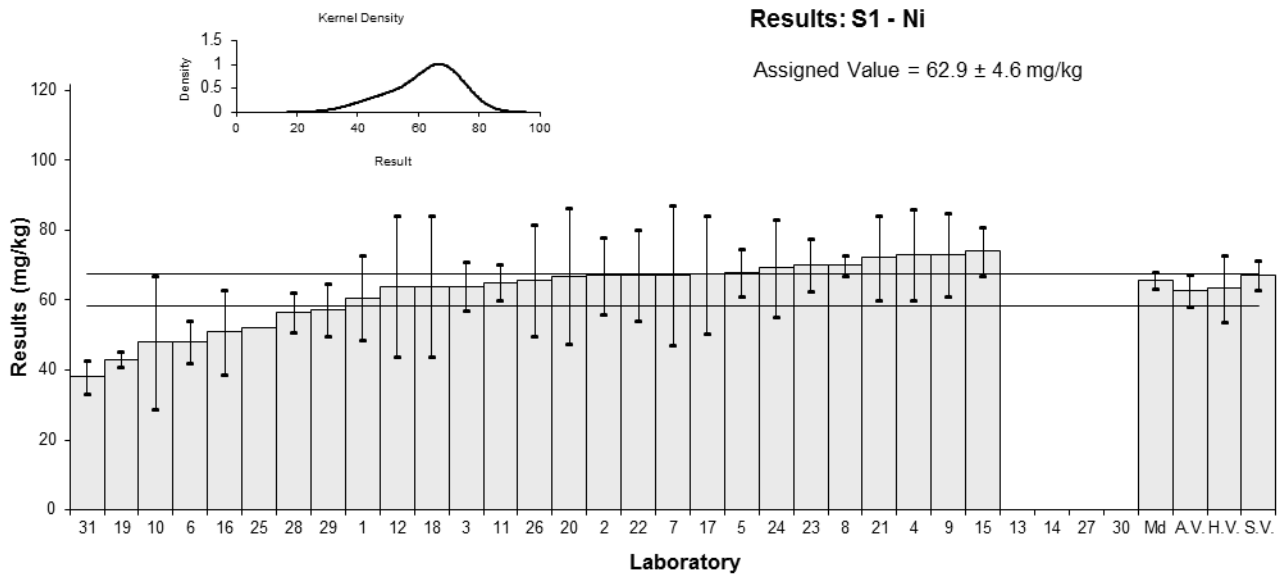
Sample No.	S1
Matrix.	Soil
Analyte.	Ni
Units	mg/kg

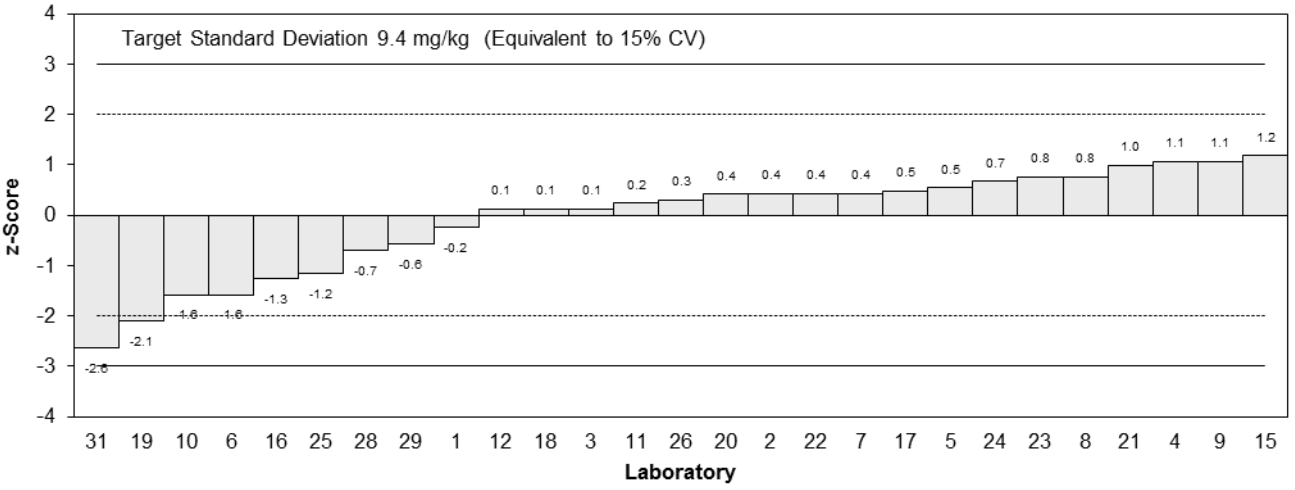
Participant Results

Lab Code	Result	Uncertainty	z-Score	En-Score
1	60.6	12.1	-0.24	-0.18
2	67	11	0.43	0.34
3	64	6.9	0.12	0.13
4	73	13	1.07	0.73
5	68	6.8	0.54	0.62
6	48	6	-1.58	-1.97
7	67	20	0.43	0.20
8	70	3.0	0.75	1.29
9	73	12	1.07	0.79
10	48	19	-1.58	-0.76
11	65.1	5.1	0.23	0.32
12	64	20	0.12	0.05
13	NT	NT		
14	NT	NT		
15	74	7	1.18	1.33
16	50.9	12	-1.27	-0.93
17	67.3453	17	0.47	0.25
18	64	20	0.12	0.05
19	43	2.15	-2.11	-3.92
20	66.8	19.4	0.41	0.20
21	72.1	12	0.98	0.72
22	67	13	0.43	0.30
23	70.0	7.6	0.75	0.80
24	69.2	14	0.67	0.43
25	52.0	NR	-1.16	-2.37
26	65.7	16	0.30	0.17
27	NT	NT		
28	56.371	5.637	-0.69	-0.90
29	57.4	7.5	-0.58	-0.63
30	NT	NT		
31	38	4.7	-2.64	-3.79

Statistics

Assigned Value	62.9	4.6
Spike	67.2	4.3
Homogeneity Value	63.4	9.5
Robust Average	62.9	4.6
Median	65.7	2.5
Mean	62.3	
N	27	
Max.	74	
Min.	38	
Robust SD	9.5	
Robust CV	15%	


Kernel Density
Density
Result
Results: S1 - Ni
Assigned Value = 62.9 ± 4.6 mg/kg
Results (mg/kg)
Laboratory
31 19 10 6 16 25 28 29 1 12 18 3 11 26 20 2 22 7 17 5 24 23 8 21 4 9 15 13 14 27 30 Md A.V. H.V. S.V.


z-Scores: S1 - Ni
Target Standard Deviation 9.4 mg/kg (Equivalent to 15% CV)
z-Score
Laboratory
31 19 10 6 16 25 28 29 1 12 18 3 11 26 20 2 22 7 17 5 24 23 8 21 4 9 15

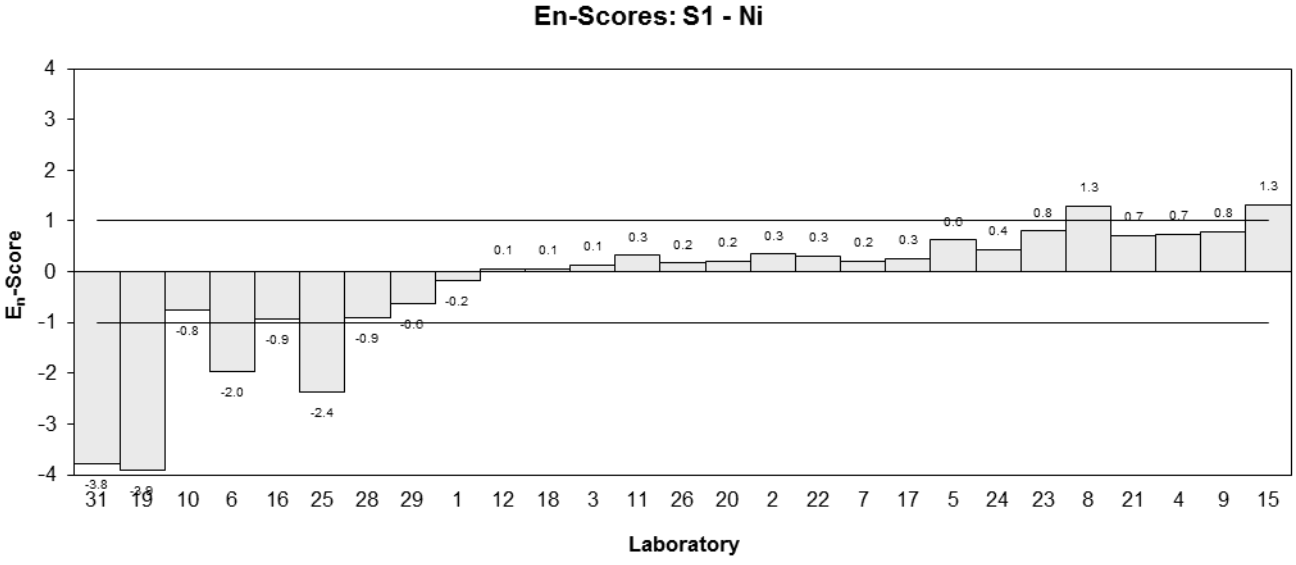

En-Scores: S1 - Ni
En-Score
Laboratory
31 19 10 6 16 25 28 29 1 12 18 3 11 26 20 2 22 7 17 5 24 23 8 21 4 9 15

Figure 12

Table 25

Sample Details

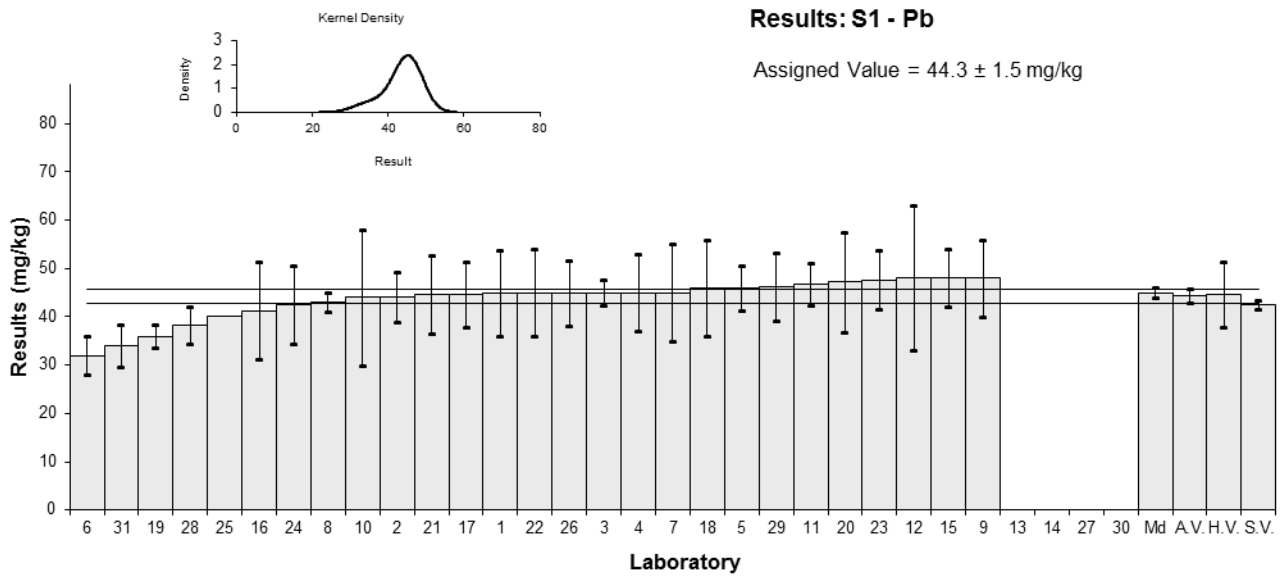
Sample No.	S1
Matrix.	Soil
Analyte.	Pb
Units	mg/kg

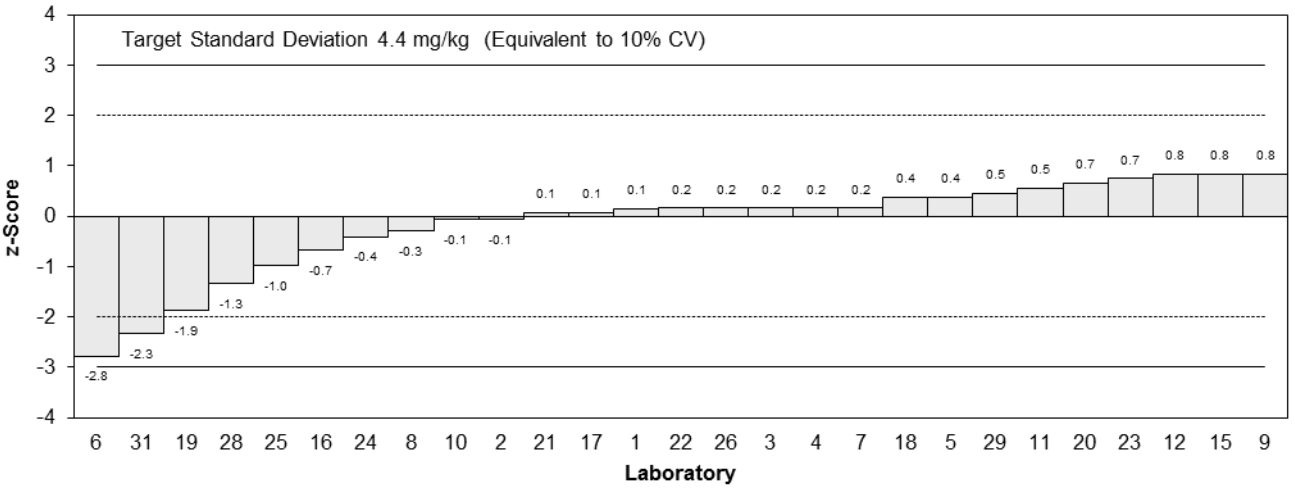
Participant Results

Lab Code	Result	Uncertainty	z-Score	En-Score
1	44.9	8.98	0.14	0.07
2	44	5.2	-0.07	-0.06
3	45	2.6	0.16	0.23
4	45	8	0.16	0.09
5	46	4.6	0.38	0.35
6	32	4	-2.78	-2.88
7	45	10	0.16	0.07
8	43	2.0	-0.29	-0.52
9	48	8	0.84	0.45
10	44	14	-0.07	-0.02
11	46.7	4.4	0.54	0.52
12	48	15	0.84	0.25
13	NT	NT		
14	NT	NT		
15	48	6	0.84	0.60
16	41.3	10	-0.68	-0.30
17	44.6162	6.7	0.07	0.05
18	46	10	0.38	0.17
19	36	2.5	-1.87	-2.85
20	47.2	10.3	0.65	0.28
21	44.6	8.0	0.07	0.04
22	45	9	0.16	0.08
23	47.6	6.1	0.74	0.53
24	42.5	8	-0.41	-0.22
25	40.0	NR	-0.97	-2.87
26	45.0	6.8	0.16	0.10
27	NT	NT		
28	38.356	3.836	-1.34	-1.44
29	46.3	7.0	0.45	0.28
30	NT	NT		
31	34	4.3	-2.33	-2.26

Statistics

Assigned Value	44.3	1.5
Spike	42.5	1.0
Homogeneity Value	44.6	6.7
Robust Average	44.3	1.5
Median	45.0	1.0
Mean	43.6	
N	27	
Max.	48	
Min.	32	
Robust SD	3.1	
Robust CV	7%	


Kernel Density
Density
Result
Results: S1 - Pb
Assigned Value = 44.3 ± 1.5 mg/kg
Results (mg/kg)
Laboratory
6 31 19 28 25 16 24 8 10 2 21 17 1 22 26 3 4 7 18 5 29 11 20 23 12 15 9 13 14 27 30 Md A.V. H.V. S.V.


z-Scores: S1 - Pb
Target Standard Deviation 4.4 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
6 31 19 28 25 16 24 8 10 2 21 17 1 22 26 3 4 7 18 5 29 11 20 23 12 15 9

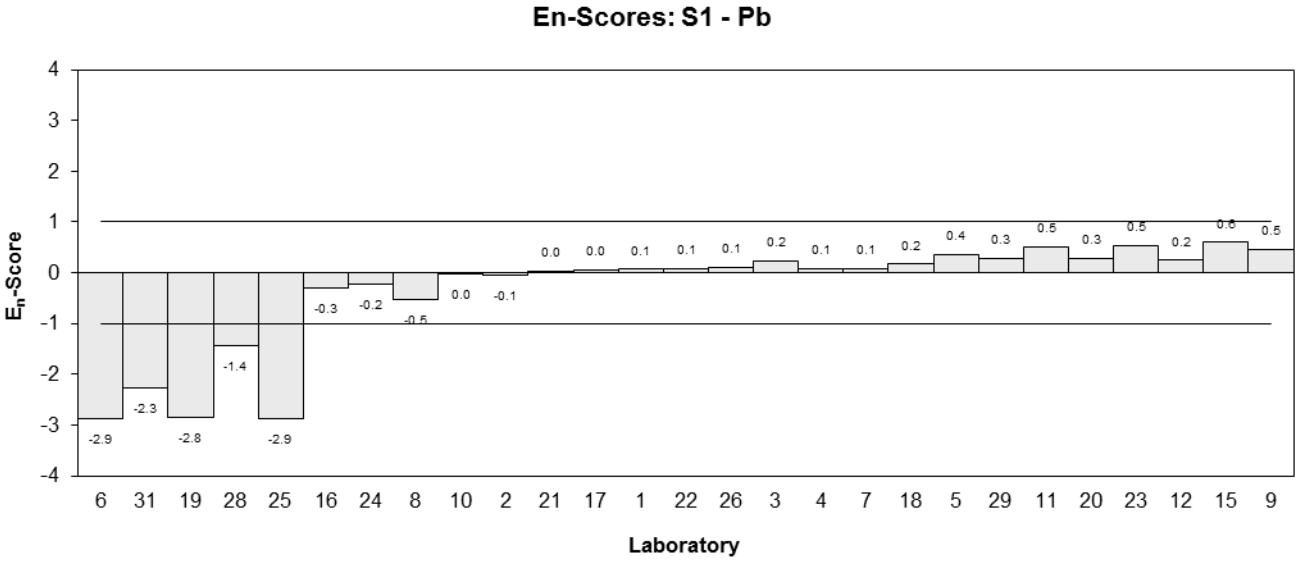

En-Scores: S1 - Pb
En-Score
Laboratory
6 31 19 28 25 16 24 8 10 2 21 17 1 22 26 3 4 7 18 5 29 11 20 23 12 15 9

Figure 13

Table 26

Sample Details

Sample No.	S1
Matrix.	Soil
Analyte.	Sb
Units	mg/kg

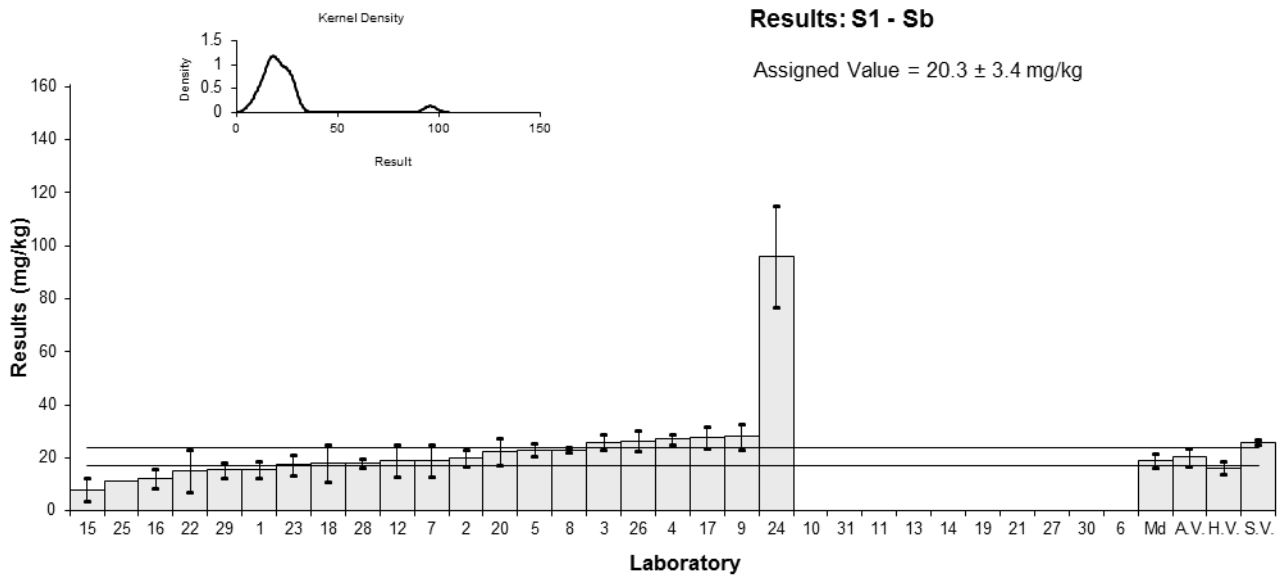
Participant Results

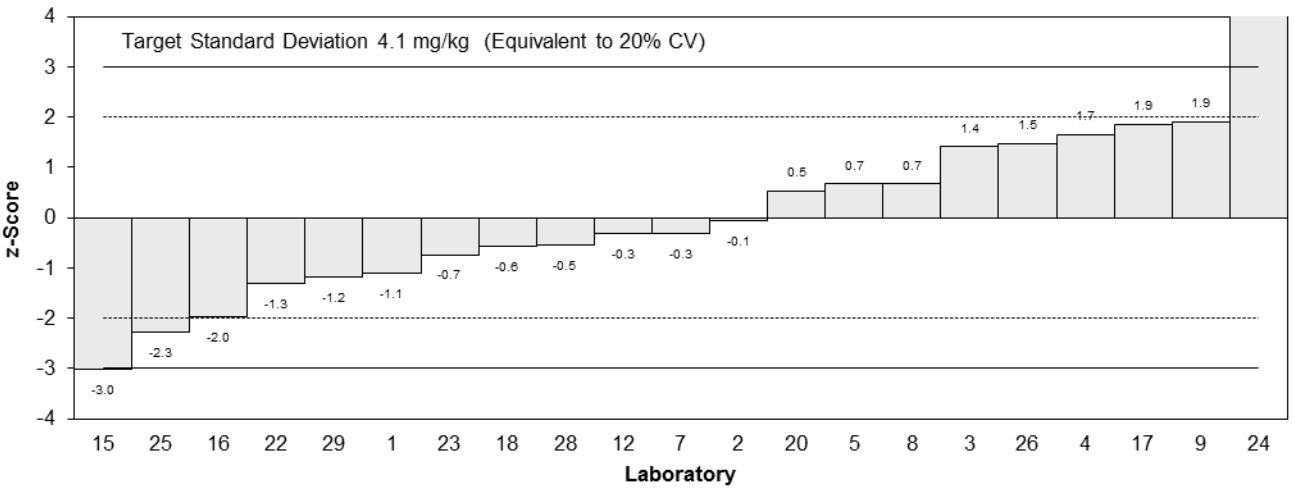
Lab Code	Result	Uncertainty	z-Score	En-Score
1	15.8	3.16	-1.11	-0.97
2	20	3.1	-0.07	-0.07
3	26	2.7	1.40	1.31
4	27	2	1.65	1.70
5	23	2.3	0.67	0.66
6	NT	NT		
7	19	6	-0.32	-0.19
8	23	1.0	0.67	0.76
9	28	5	1.90	1.27
10	<10	25		
11	NT	NT		
12	19	6	-0.32	-0.19
13	NT	NT		
14	NT	NT		
15	8	4.5	-3.03	-2.18
16	12.3	3.7	-1.97	-1.59
17	27.8571	4.2	1.86	1.40
18	18	7	-0.57	-0.30
19	NT	NT		
20	22.4	4.9	0.52	0.35
21	NT	NT		
22	15	8	-1.31	-0.61
23	17.3	3.7	-0.74	-0.60
24	96	19	18.65	3.92
25	11.0	NR	-2.29	-2.74
26	26.3	3.9	1.48	1.16
27	NT	NT		
28	18.075	1.808	-0.55	-0.58
29	15.5	2.9	-1.18	-1.07
30	NT	NT		
31	<3	NR		

Statistics

Assigned Value*	20.3	3.4
Spike	26.0	1.1
Homogeneity Value	16.2	2.4
Robust Average	20.2	3.6
Median	19.0	2.7
Mean	23.3	
N	21	
Max.	96	
Min.	8	
Robust SD	5.9	
Robust CV	29%	

* Robust Average excluding Laboratory 24


Kernel Density
Density
Result
Results: S1 - Sb
Assigned Value = 20.3 ± 3.4 mg/kg
Results (mg/kg)
Laboratory
15 25 16 22 29 1 23 18 28 12 7 2 20 5 8 3 26 4 17 9 24 10 31 11 13 14 19 21 27 30 6 Md A.V. H.V. S.V.


z-Scores: S1 - Sb
Target Standard Deviation 4.1 mg/kg (Equivalent to 20% CV)
z-Score
Laboratory
15 25 16 22 29 1 23 18 28 12 7 2 20 5 8 3 26 4 17 9 24

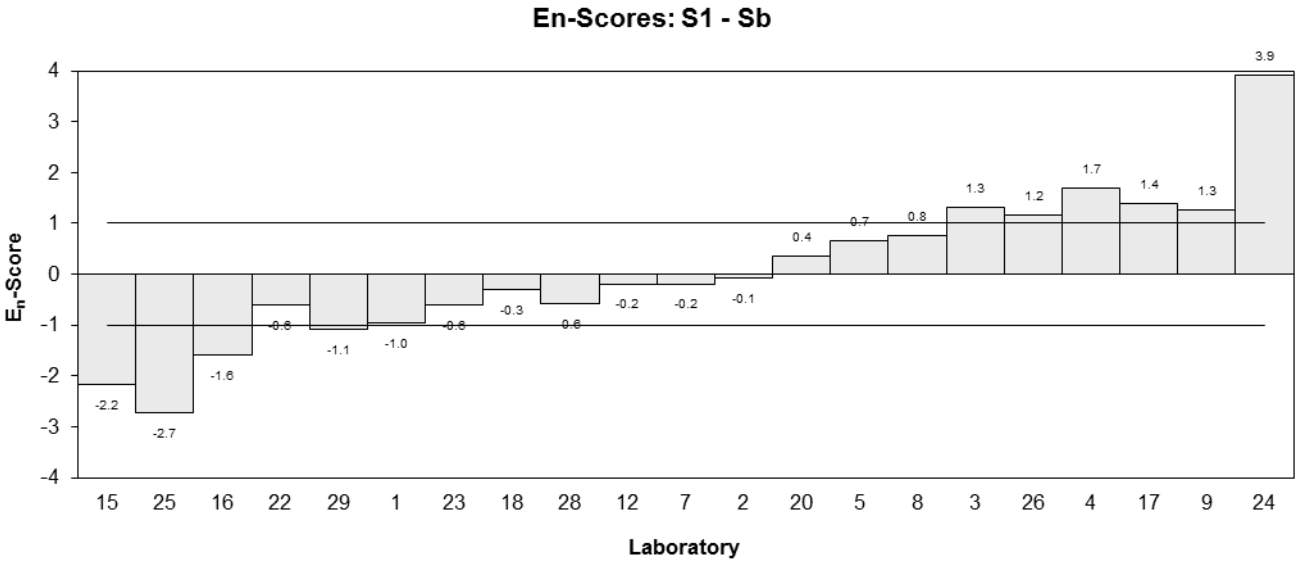

En-Scores: S1 - Sb
En-Score
Laboratory
15 25 16 22 29 1 23 18 28 12 7 2 20 5 8 3 26 4 17 9 24

Figure 14

Table 27

Sample Details

Sample No.	S1
Matrix.	Soil
Analyte.	Se
Units	mg/kg

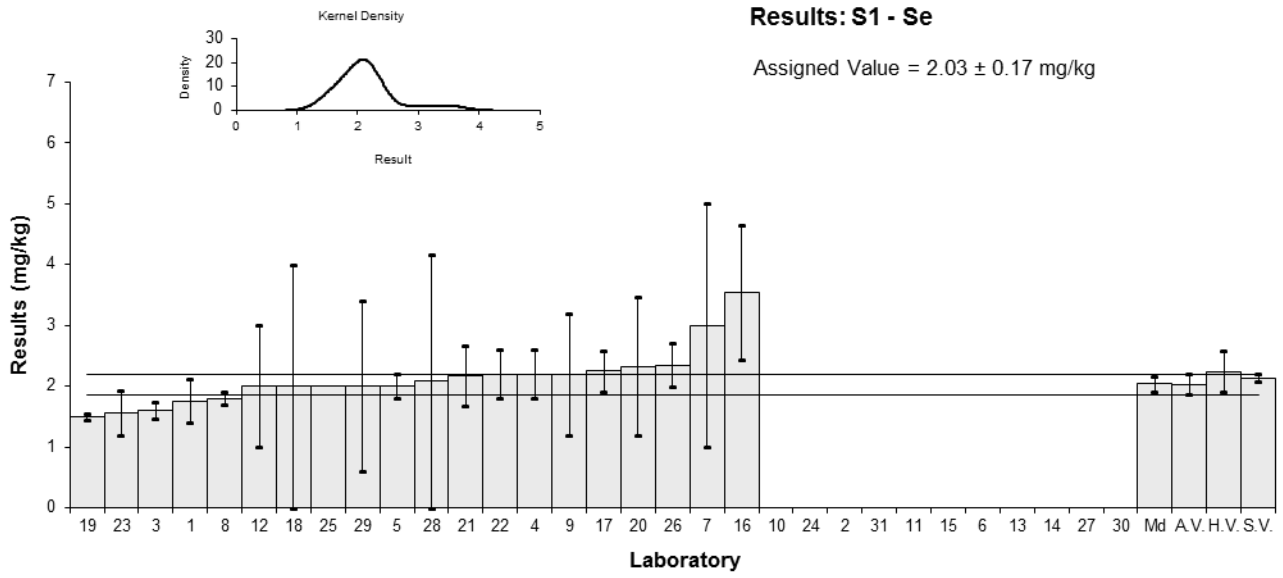
Participant Results

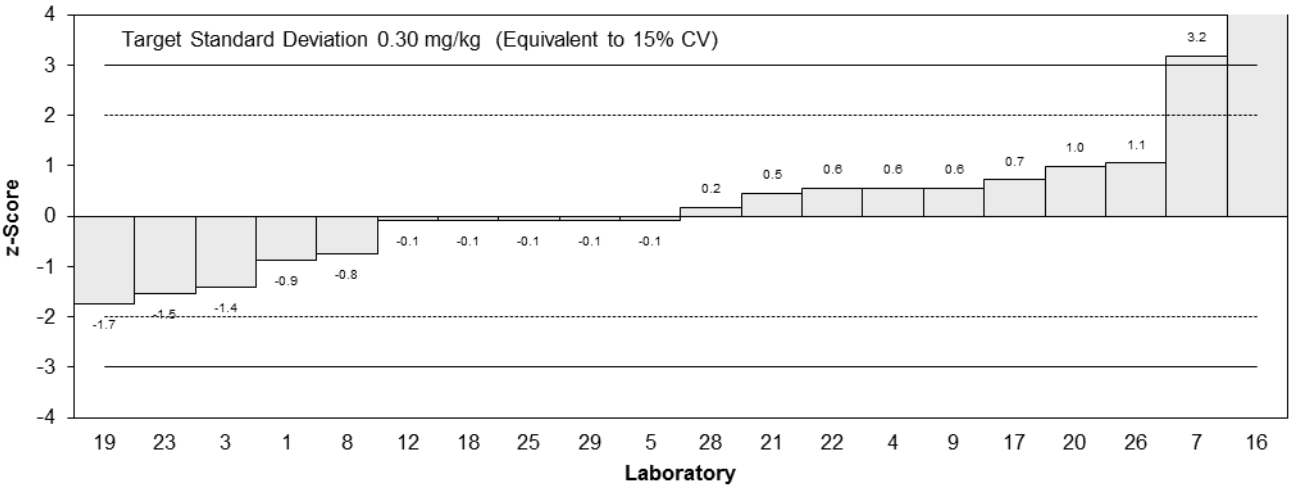
Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	1.76	0.352	-0.89	-0.69
2	<3	NR		
3	1.6	0.14	-1.41	-1.95
4	2.2	0.4	0.56	0.39
5	2	0.2	-0.10	-0.11
6	<5	NR		
7	3	2	3.19	0.48
8	1.8	0.1	-0.76	-1.17
9	2.2	1	0.56	0.17
10	<1	28		
11	<5	NR		
12	2	1	-0.10	-0.03
13	NT	NT		
14	NT	NT		
15	<5	NR		
16	3.54	1.1	4.96	1.36
17	2.2487	0.34	0.72	0.58
18	2	2	-0.10	-0.01
19	1.5	0.06	-1.74	-2.94
20	2.33	1.13	0.99	0.26
21	2.17	0.5	0.46	0.27
22	2.2	0.4	0.56	0.39
23	1.56	0.37	-1.54	-1.15
24	<2	NR		
25	2.0	NR	-0.10	-0.18
26	2.35	0.35	1.05	0.82
27	NT	NT		
28	2.081	2.081	0.17	0.02
29	2.0	1.4	-0.10	-0.02
30	NT	NT		
31	<3	NR		

Statistics

Assigned Value*	2.03	0.17
Spike	2.14	0.06
Homogeneity Value	2.24	0.34
Robust Average	2.06	0.19
Median	2.04	0.13
Mean	2.13	
N	20	
Max.	3.54	
Min.	1.5	
Robust SD	0.3	
Robust CV	15%	

* Robust Average excluding Laboratory 16.


Kernel Density
Density
Result
Results: S1 - Se
Assigned Value = 2.03 ± 0.17 mg/kg
Results (mg/kg)
Laboratory
19 23 3 1 8 12 18 25 29 5 28 21 22 4 9 17 20 26 7 16 10 24 2 31 11 15 6 13 14 27 30 Md A.V. H.V. S.V.


z-Scores: S1 - Se
Target Standard Deviation 0.30 mg/kg (Equivalent to 15% CV)
z-Score
Laboratory
19 23 3 1 8 12 18 25 29 5 28 21 22 4 9 17 20 26 7 16
-1.7 -1.5 -1.4 -0.9 -0.8 -0.1 -0.1 -0.1 -0.1 -0.1 0.2 0.5 0.6 0.6 0.6 0.7 1.0 1.1 3.2

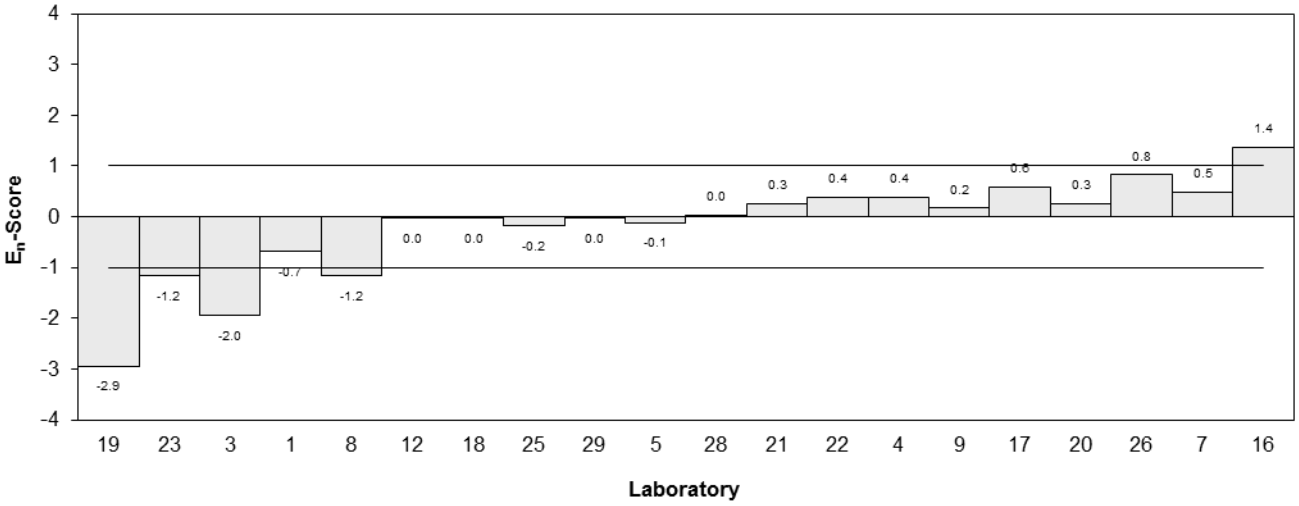

En-Scores: S1 - Se
En-Score
Laboratory
19 23 3 1 8 12 18 25 29 5 28 21 22 4 9 17 20 26 7 16
-2.9 -1.2 -2.0 -0.7 -1.2 0.0 0.0 -0.2 0.0 -0.1 0.0 0.3 0.4 0.4 0.2 0.6 0.3 0.8 0.5 1.4

Figure 15

Table 28

Sample Details

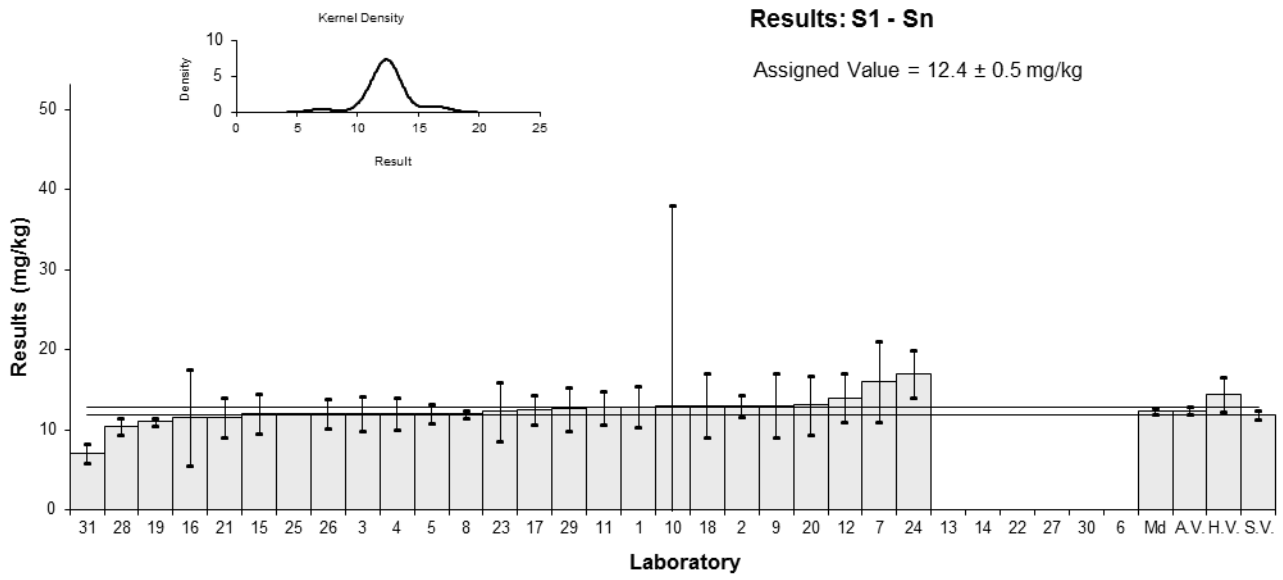
Sample No.	S1
Matrix.	Soil
Analyte.	Sn
Units	mg/kg

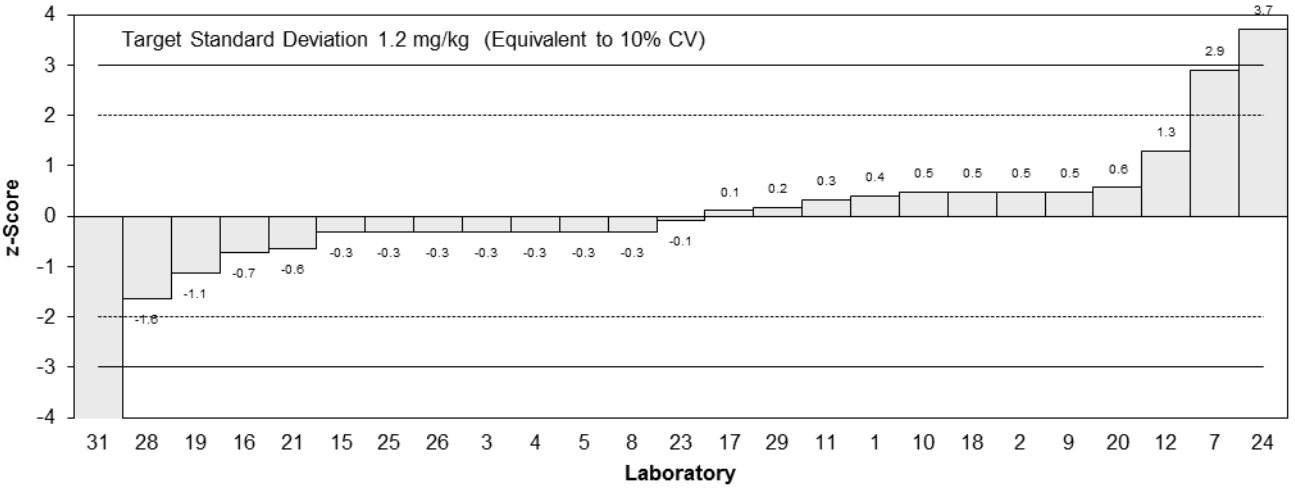
Participant Results

Lab Code	Result	Uncertainty	z-Score	En-Score
1	12.9	2.58	0.40	0.19
2	13	1.4	0.48	0.40
3	12	2.2	-0.32	-0.18
4	12	2	-0.32	-0.19
5	12	1.2	-0.32	-0.31
6	NT	NT		
7	16	5	2.90	0.72
8	12	0.5	-0.32	-0.57
9	13	4	0.48	0.15
10	13	25	0.48	0.02
11	12.8	2.1	0.32	0.19
12	14	3	1.29	0.53
13	NT	NT		
14	NT	NT		
15	12	2.5	-0.32	-0.16
16	11.5	6.0	-0.73	-0.15
17	12.53	1.9	0.10	0.07
18	13	4	0.48	0.15
19	11	0.44	-1.13	-2.10
20	13.1	3.64	0.56	0.19
21	11.6	2.5	-0.65	-0.31
22	NT	NT		
23	12.3	3.7	-0.08	-0.03
24	17.0	3	3.71	1.51
25	12.0	NR	-0.32	-0.80
26	12.0	1.8	-0.32	-0.21
27	NT	NT		
28	10.361	1.036	-1.64	-1.77
29	12.6	2.7	0.16	0.07
30	NT	NT		
31	7	1.2	-4.35	-4.15

Statistics

Assigned Value	12.4	0.5
Spike	11.9	0.6
Homogeneity Value	14.4	2.2
Robust Average	12.4	0.5
Median	12.3	0.4
Mean	12.4	
N	25	
Max.	17	
Min.	7	
Robust SD	1	
Robust CV	8.1%	


Kernel Density
Density
Result
Results: S1 - Sn
Assigned Value = 12.4 ± 0.5 mg/kg
Results (mg/kg)
Laboratory
31 28 19 16 21 15 25 26 3 4 5 8 23 17 29 11 1 10 18 2 9 20 12 7 24 13 14 22 27 30 6 Md A.V. H.V. S.V.


z-Scores: S1 - Sn
Target Standard Deviation 1.2 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
31 28 19 16 21 15 25 26 3 4 5 8 23 17 29 11 1 10 18 2 9 20 12 7 24

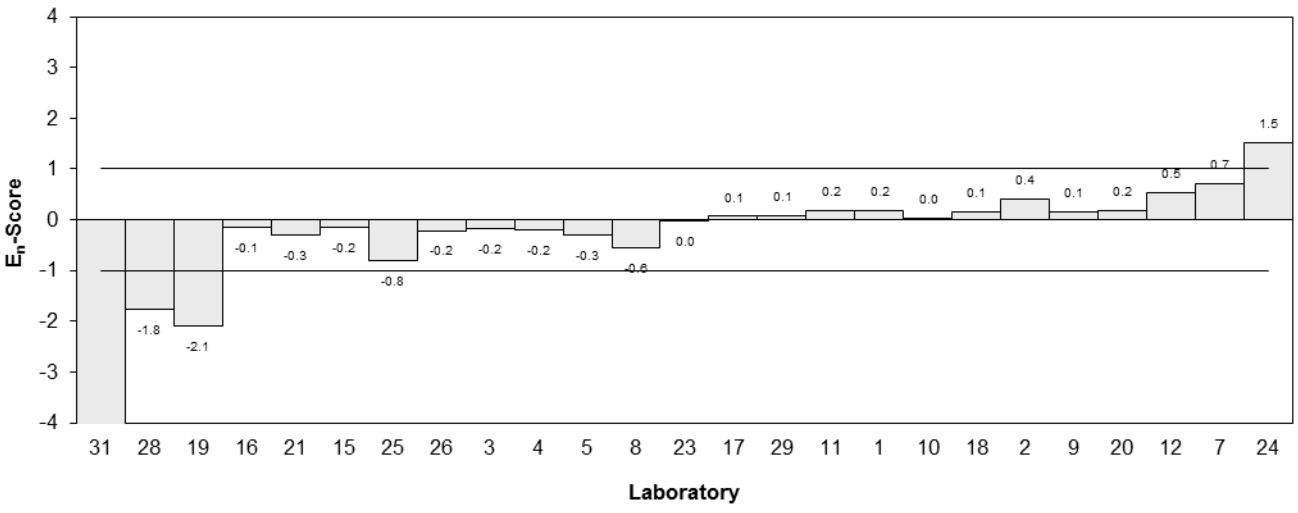

En-Scores: S1 - Sn
En-Score
Laboratory
31 28 19 16 21 15 25 26 3 4 5 8 23 17 29 11 1 10 18 2 9 20 12 7 24

Figure 16

Table 29

Sample Details

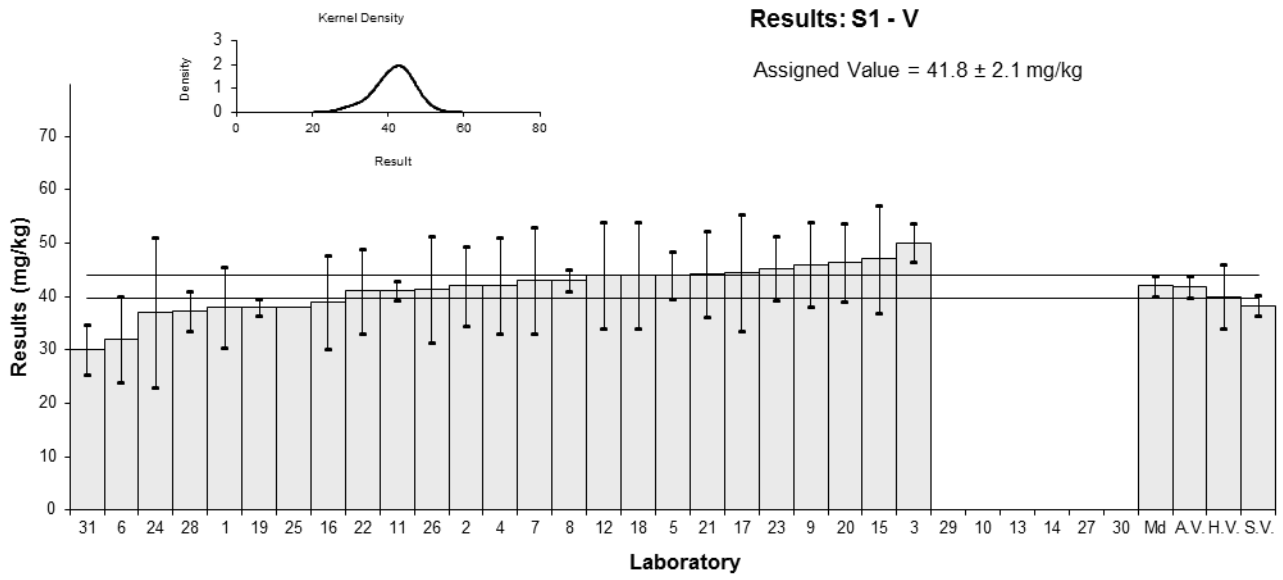
Sample No.	S1
Matrix.	Soil
Analyte.	V
Units	mg/kg

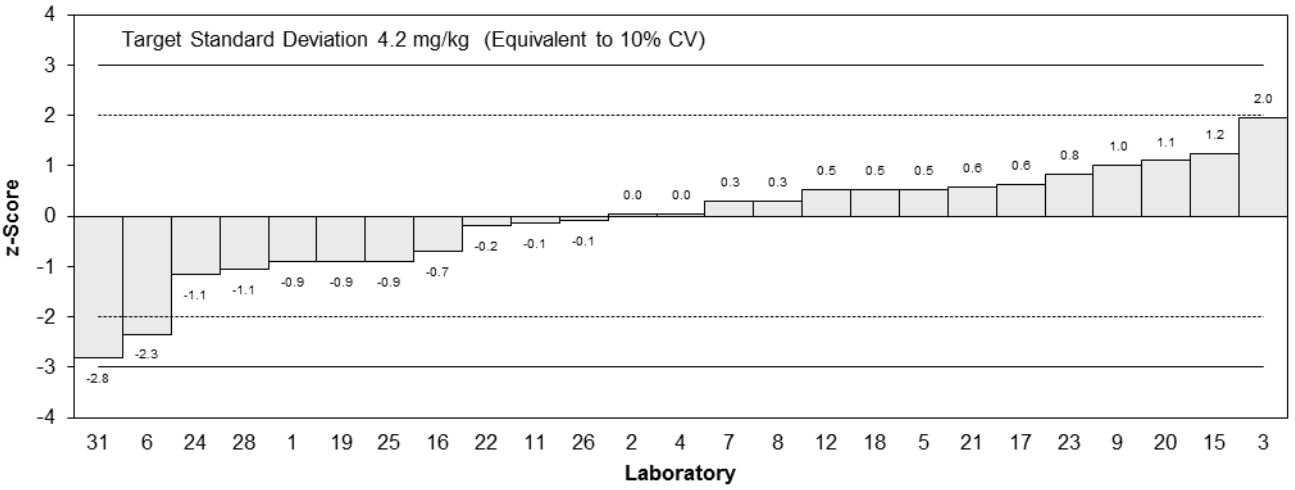
Participant Results

Lab Code	Result	Uncertainty	z-Score	En-Score
1	38.0	7.6	-0.91	-0.48
2	42	7.5	0.05	0.03
3	50	3.6	1.96	1.97
4	42	9	0.05	0.02
5	44	4.4	0.53	0.45
6	32	8	-2.34	-1.18
7	43	10	0.29	0.12
8	43	2.0	0.29	0.41
9	46	8	1.00	0.51
10	NT	NT		
11	41.2	1.8	-0.14	-0.22
12	44	10	0.53	0.22
13	NT	NT		
14	NT	NT		
15	47	10	1.24	0.51
16	38.9	8.8	-0.69	-0.32
17	44.44	11	0.63	0.24
18	44	10	0.53	0.22
19	38	1.5	-0.91	-1.47
20	46.4	7.3	1.10	0.61
21	44.2	8.0	0.57	0.29
22	41	8	-0.19	-0.10
23	45.3	6.1	0.84	0.54
24	37.0	14	-1.15	-0.34
25	38.0	NR	-0.91	-1.81
26	41.4	10	-0.10	-0.04
27	NT	NT		
28	37.335	3.734	-1.07	-1.04
29	<100	67		
30	NT	NT		
31	30	4.71	-2.82	-2.29

Statistics

Assigned Value	41.8	2.1
Spike	38.3	1.9
Homogeneity Value	40.0	6.0
Robust Average	41.8	2.1
Median	42.0	1.9
Mean	41.5	
N	25	
Max.	50	
Min.	30	
Robust SD	4.1	
Robust CV	9.8%	


Kernel Density
Density
Result
Results: S1 - V
Assigned Value = 41.8 ± 2.1 mg/kg
Results (mg/kg)
Laboratory
31 6 24 28 1 19 25 16 22 11 26 2 4 7 8 12 18 5 21 17 23 9 20 15 3 29 10 13 14 27 30 Md A.V. H.V. S.V.


z-Scores: S1 - V
Target Standard Deviation 4.2 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
31 6 24 28 1 19 25 16 22 11 26 2 4 7 8 12 18 5 21 17 23 9 20 15 3

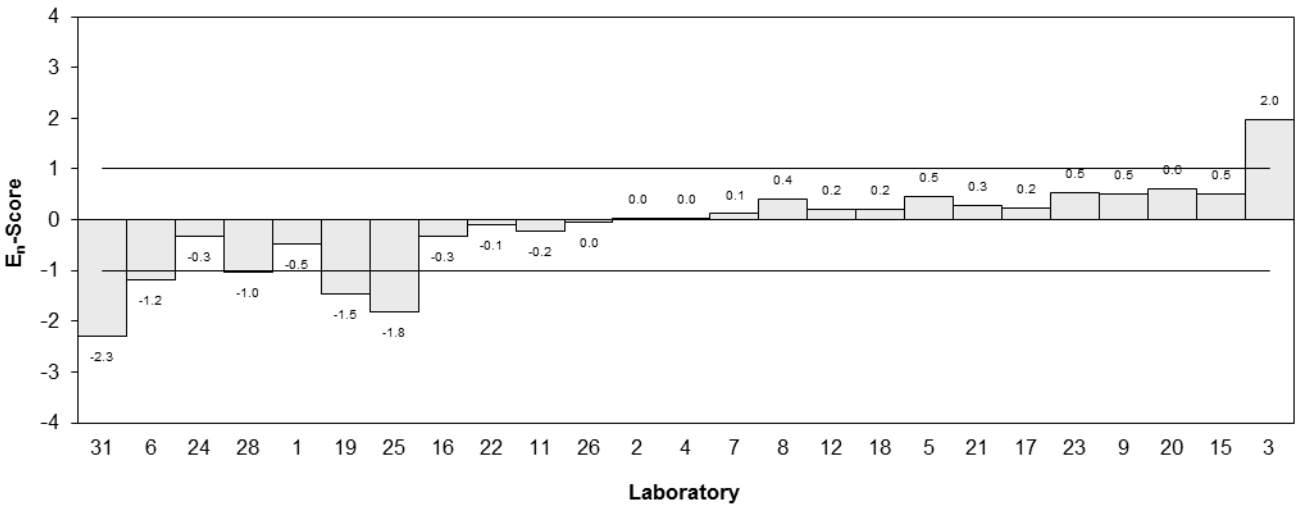

En-Scores: S1 - V
En-Score
Laboratory
31 6 24 28 1 19 25 16 22 11 26 2 4 7 8 12 18 5 21 17 23 9 20 15 3

Figure 17

Table 30

Sample Details

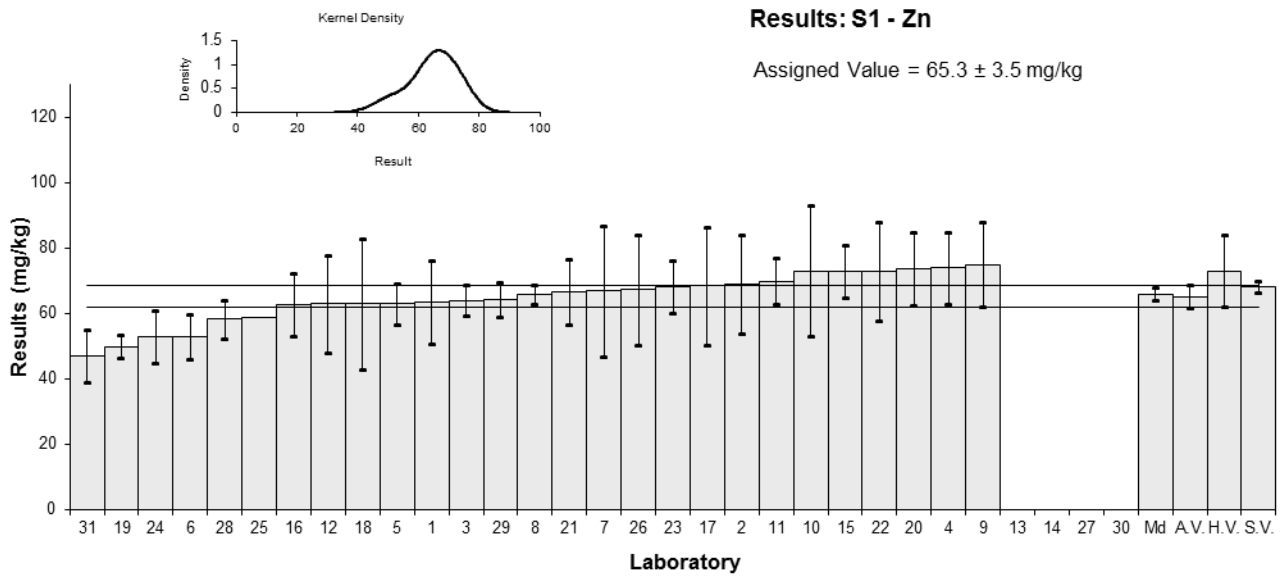
Sample No.	S1
Matrix.	Soil
Analyte.	Zn
Units	mg/kg

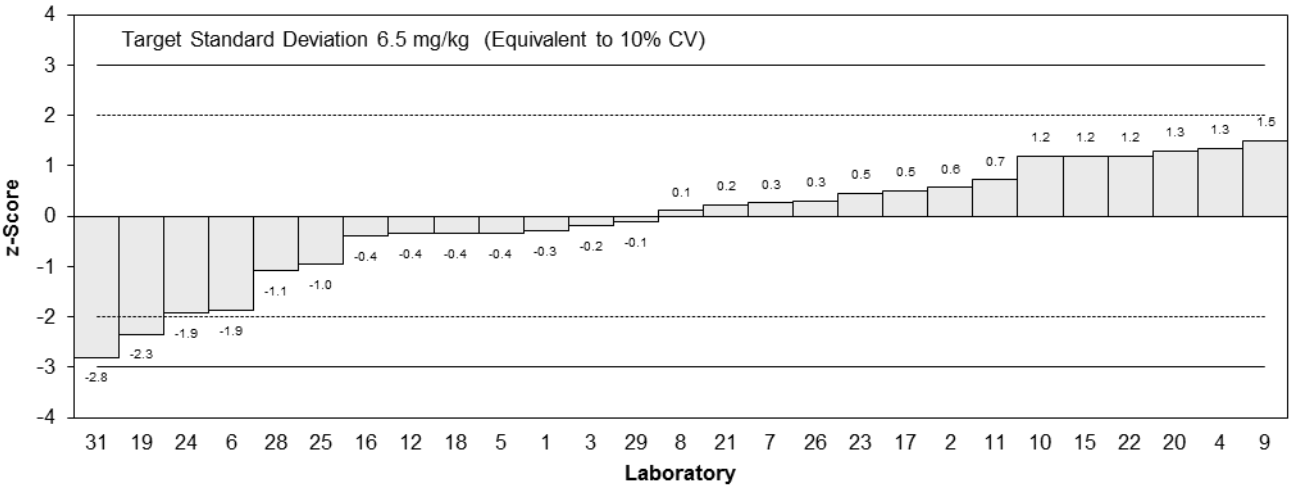
Participant Results

Lab Code	Result	Uncertainty	z-Score	En-Score
1	63.4	12.7	-0.29	-0.14
2	69	15	0.57	0.24
3	64	4.7	-0.20	-0.22
4	74	11	1.33	0.75
5	63	6.3	-0.35	-0.32
6	53	7	-1.88	-1.57
7	67	20	0.26	0.08
8	66	3.0	0.11	0.15
9	75	13	1.49	0.72
10	73	20	1.18	0.38
11	70.0	6.9	0.72	0.61
12	63	15	-0.35	-0.15
13	NT	NT		
14	NT	NT		
15	73	8	1.18	0.88
16	62.8	9.7	-0.38	-0.24
17	68.600	18	0.51	0.18
18	63	20	-0.35	-0.11
19	50	3.5	-2.34	-3.09
20	73.7	11.1	1.29	0.72
21	66.7	10	0.21	0.13
22	73	15	1.18	0.50
23	68.3	8.1	0.46	0.34
24	52.8	8	-1.91	-1.43
25	59.0	NR	-0.96	-1.80
26	67.3	17	0.31	0.12
27	NT	NT		
28	58.275	5.828	-1.08	-1.03
29	64.5	5.3	-0.12	-0.13
30	NT	NT		
31	47	8.1	-2.80	-2.07

Statistics

Assigned Value	65.3	3.5
Spike	68.2	1.7
Homogeneity Value	73	11
Robust Average	65.3	3.5
Median	66.0	1.9
Mean	64.8	
N	27	
Max.	75	
Min.	47	
Robust SD	7.3	
Robust CV	11%	


Kernel Density
Density
Result
Results: S1 - Zn
Assigned Value = 65.3 ± 3.5 mg/kg
Results (mg/kg)
Laboratory
31 19 24 6 28 25 16 12 18 5 1 3 29 8 21 7 26 23 17 2 11 10 15 22 20 4 9 13 14 27 30 Md A.V. H.V. S.V.


z-Scores: S1 - Zn
Target Standard Deviation 6.5 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
31 19 24 6 28 25 16 12 18 5 1 3 29 8 21 7 26 23 17 2 11 10 15 22 20 4 9

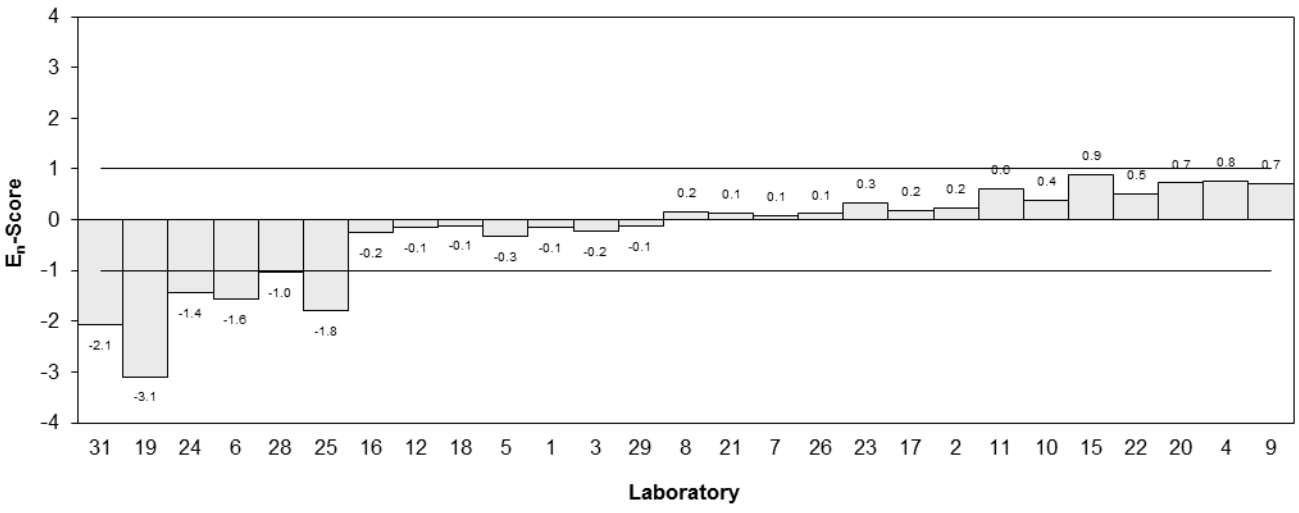

En-Scores: S1 - Zn
En-Score
Laboratory
31 19 24 6 28 25 16 12 18 5 1 3 29 8 21 7 26 23 17 2 11 10 15 22 20 4 9

Figure 18

Table 31

Sample Details

Sample No.	S2
Matrix.	Soil
Analyte.	Ag
Units	mg/kg

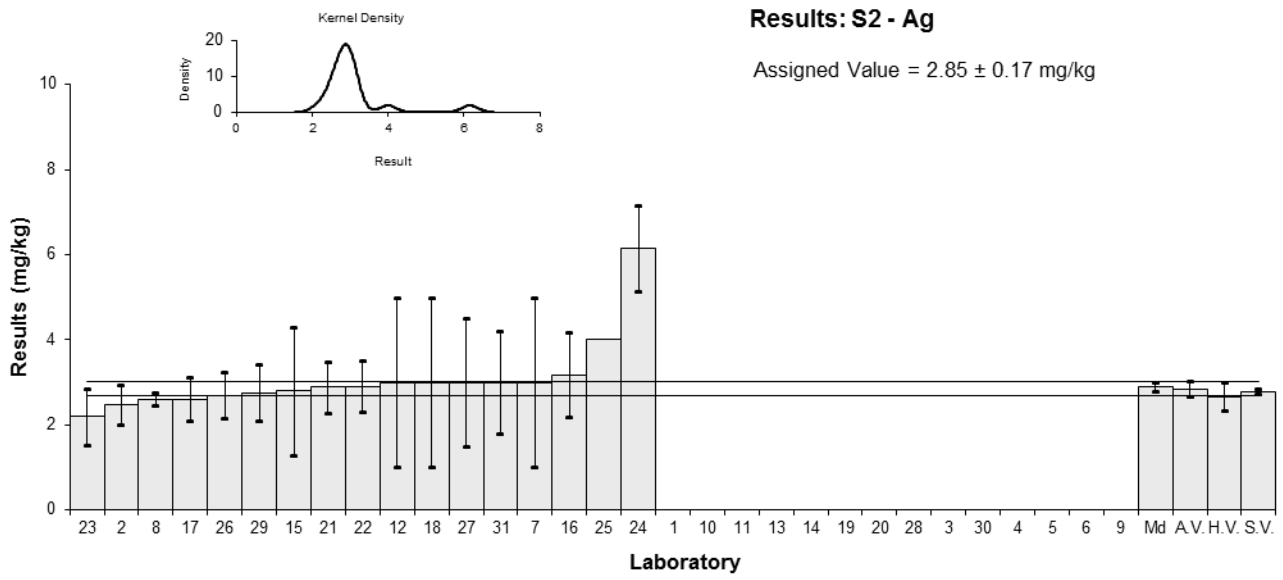
Participant Results

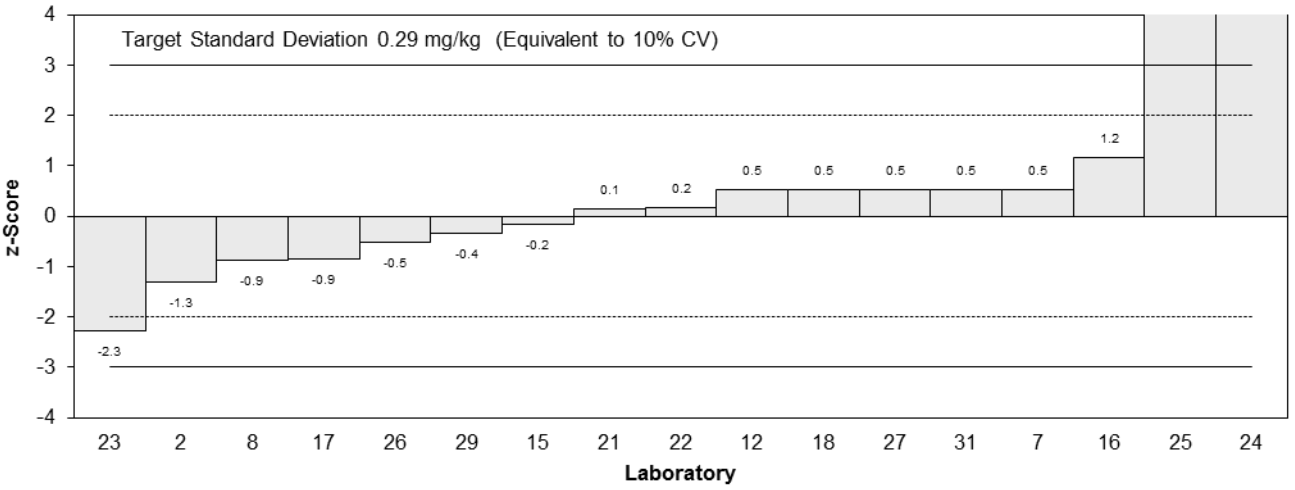
Lab Code	Result	Uncertainty	z-Score	En-Score
1	NT	NT		
2	2.479	0.47	-1.30	-0.74
3	NT	NT		
4	NT	NT		
5	NT	NT		
6	NT	NT		
7	3	2	0.53	0.07
8	2.6	0.15	-0.88	-1.10
9	NT	NT		
10	NT	NT		
11	NT	NT		
12	3	2	0.53	0.07
13	NT	NT		
14	NT	NT		
15	2.8	1.5	-0.18	-0.03
16	3.18	1.0	1.16	0.33
17	2.6067	0.52	-0.85	-0.44
18	3	2	0.53	0.07
19	NT	NT		
20	NT	NT		
21	2.89	0.6	0.14	0.06
22	2.9	0.6	0.18	0.08
23	2.20	0.66	-2.28	-0.95
24	6.15	1.0	11.58	3.25
25	4.0	NR	4.04	6.76
26	2.7	0.54	-0.53	-0.26
27	3	1.5	0.53	0.10
28	NT	NT		
29	2.75	0.66	-0.35	-0.15
30	NT	NT		
31	3.0	1.2	0.53	0.12

Statistics

Assigned Value*	2.85	0.17
Spike	2.78	0.06
Homogeneity Value	2.67	0.32
Robust Average	2.88	0.19
Median	2.90	0.11
Mean	3.07	
N	17	
Max.	6.15	
Min.	2.2	
Robust SD	0.27	
Robust CV	9.4%	

* Robust Average excluding Laboratory 24.


Kernel Density
Density
Result
Results: S2 - Ag
Assigned Value = 2.85 ± 0.17 mg/kg
Results (mg/kg)
Laboratory
23 2 8 17 26 29 15 21 22 12 18 27 31 7 16 25 24 1 10 11 13 14 19 20 28 3 30 4 5 6 9 Md A.V. H.V. S.V.


z-Scores: S2 - Ag
Target Standard Deviation 0.29 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
23 2 8 17 26 29 15 21 22 12 18 27 31 7 16 25 24
-2.3 -1.3 -0.9 -0.9 -0.5 -0.4 -0.2 0.1 0.2 0.5 0.5 0.5 0.5 0.5 1.2

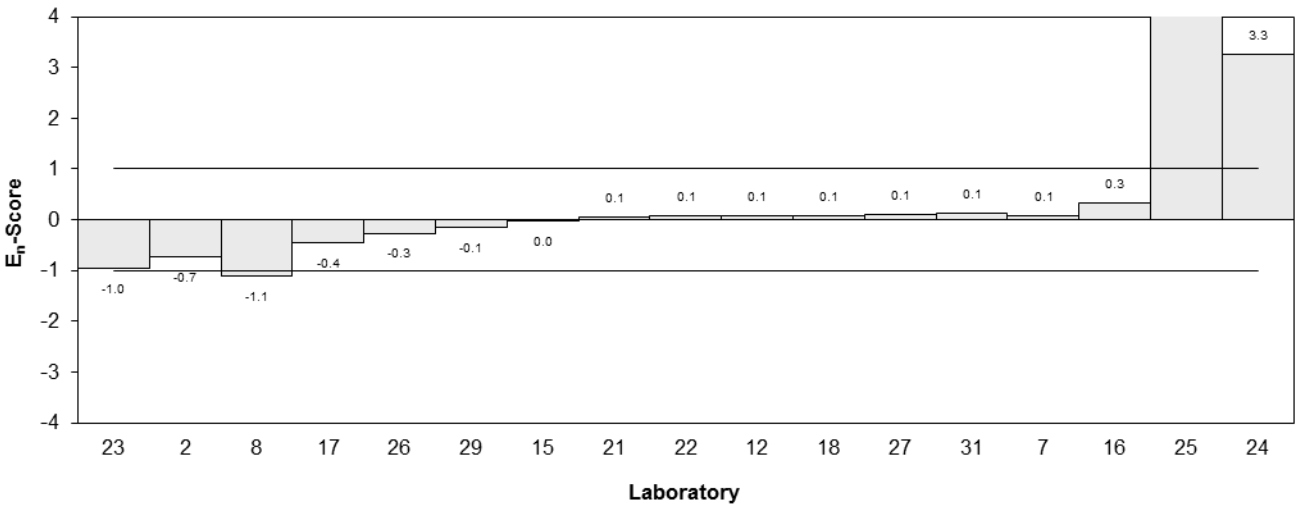

En-Scores: S2 - Ag
En-Score
Laboratory
23 2 8 17 26 29 15 21 22 12 18 27 31 7 16 25 24
-1.0 -0.7 -1.1 -0.4 -0.3 -0.1 0.0 0.1 0.1 0.1 0.1 0.1 0.1 0.1 0.3 3.3

Figure 19

Table 32

Sample Details

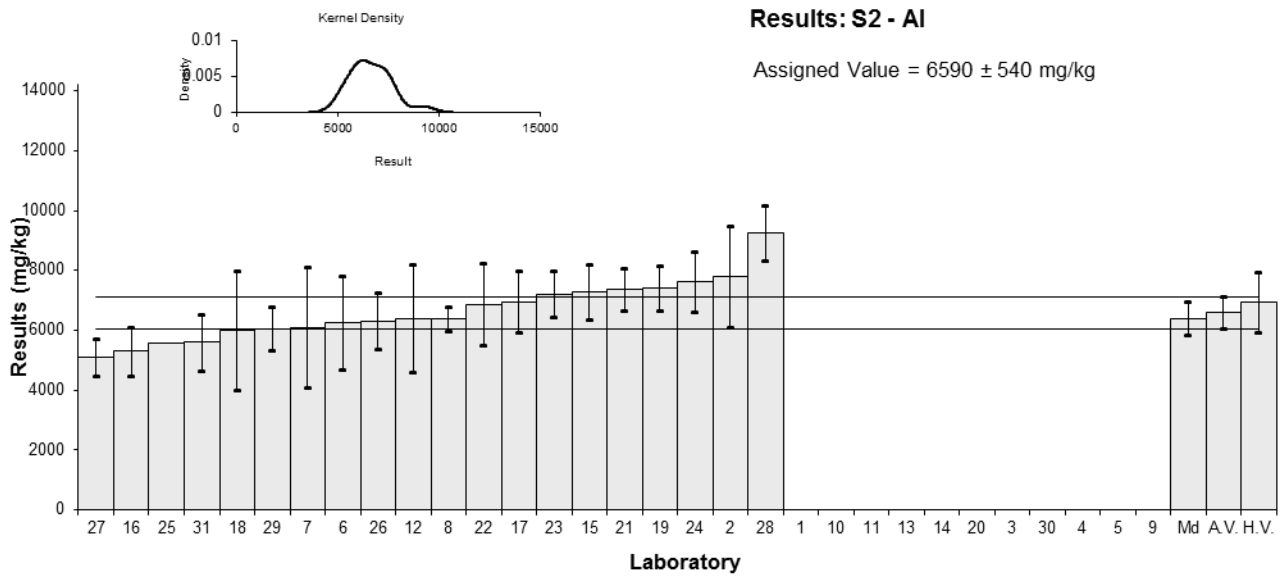
Sample No.	S2
Matrix.	Soil
Analyte.	Al
Units	mg/kg

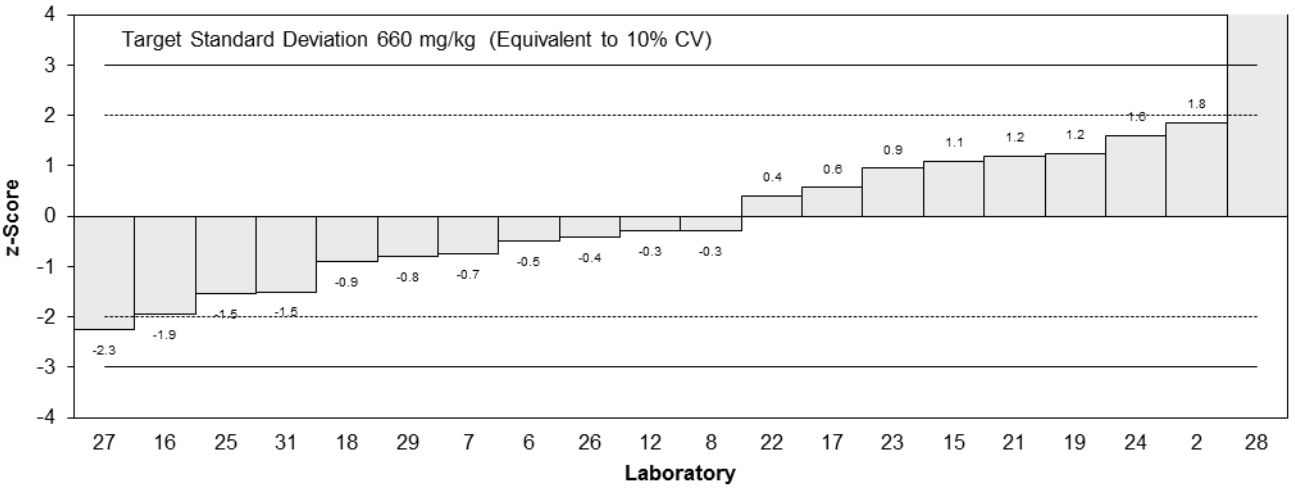
Participant Results

Lab Code	Result	Uncertainty	z-Score	En-Score
1	NT	NT		
2	7807	1700	1.85	0.68
3	NT	NT		
4	NT	NT		
5	NT	NT		
6	6270	1570	-0.49	-0.19
7	6100	2000	-0.74	-0.24
8	6400	400	-0.29	-0.28
9	NT	NT		
10	NT	NT		
11	NT	NT		
12	6400	1800	-0.29	-0.10
13	NT	NT		
14	NT	NT		
15	7300	920	1.08	0.67
16	5310	810	-1.94	-1.31
17	6961.91	1046	0.56	0.32
18	6000	2000	-0.90	-0.28
19	7410	740	1.24	0.90
20	NT	NT		
21	7380	700	1.20	0.89
22	6860	1370	0.41	0.18
23	7214	757	0.95	0.67
24	7640	1000	1.59	0.92
25	5580	NR	-1.53	-1.87
26	6320	950	-0.41	-0.25
27	5100	640	-2.26	-1.78
28	9236.578	923.658	4.02	2.47
29	6060	730	-0.80	-0.58
30	NT	NT		
31	5600	950	-1.50	-0.91

Statistics

Assigned Value	6590	540
Spike	Not Spiked	
Homogeneity Value	6950	1000
Robust Average	6590	540
Median	6400	560
Mean	6600	
N	20	
Max.	9236.578	
Min.	5100	
Robust SD	970	
Robust CV	15%	


Kernel Density
Density
Result
Results: S2 - Al
Assigned Value = 6590 ± 540 mg/kg
Results (mg/kg)
Laboratory
27 16 25 31 18 29 7 6 26 12 8 22 17 23 15 21 19 24 2 28 1 10 11 13 14 20 3 30 4 5 9 Md A.V. H.V.


z-Scores: S2 - Al
Target Standard Deviation 660 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
27 16 25 31 18 29 7 6 26 12 8 22 17 23 15 21 19 24 2 28

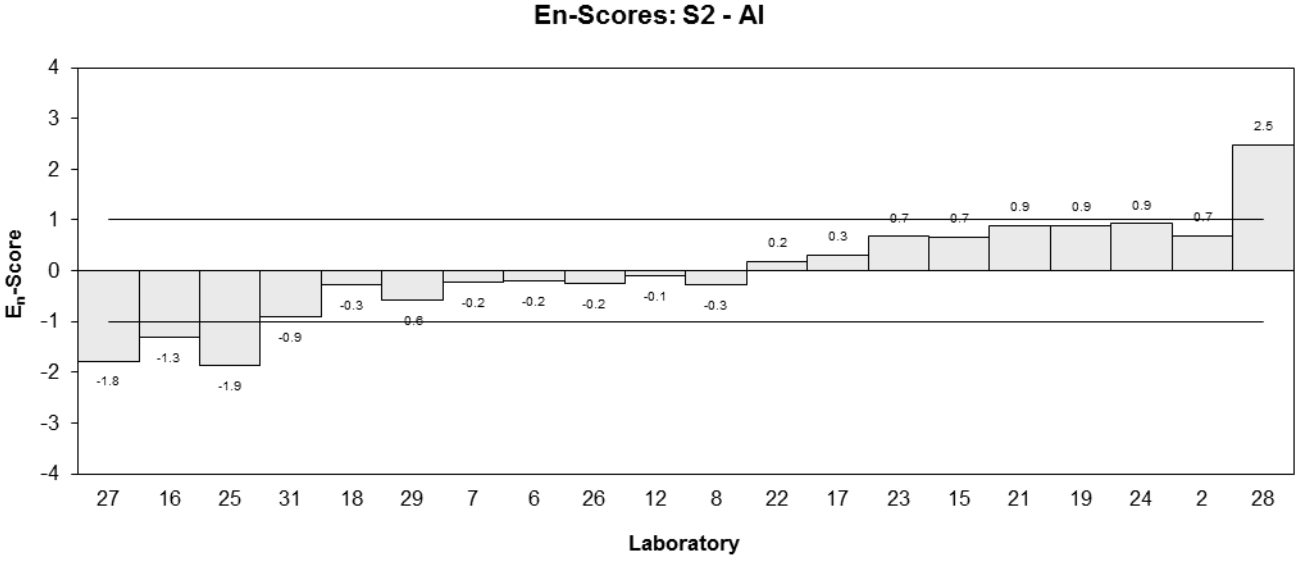

En-Scores: S2 - Al
En-Score
Laboratory
27 16 25 31 18 29 7 6 26 12 8 22 17 23 15 21 19 24 2 28

Figure 20

Table 33

Sample Details

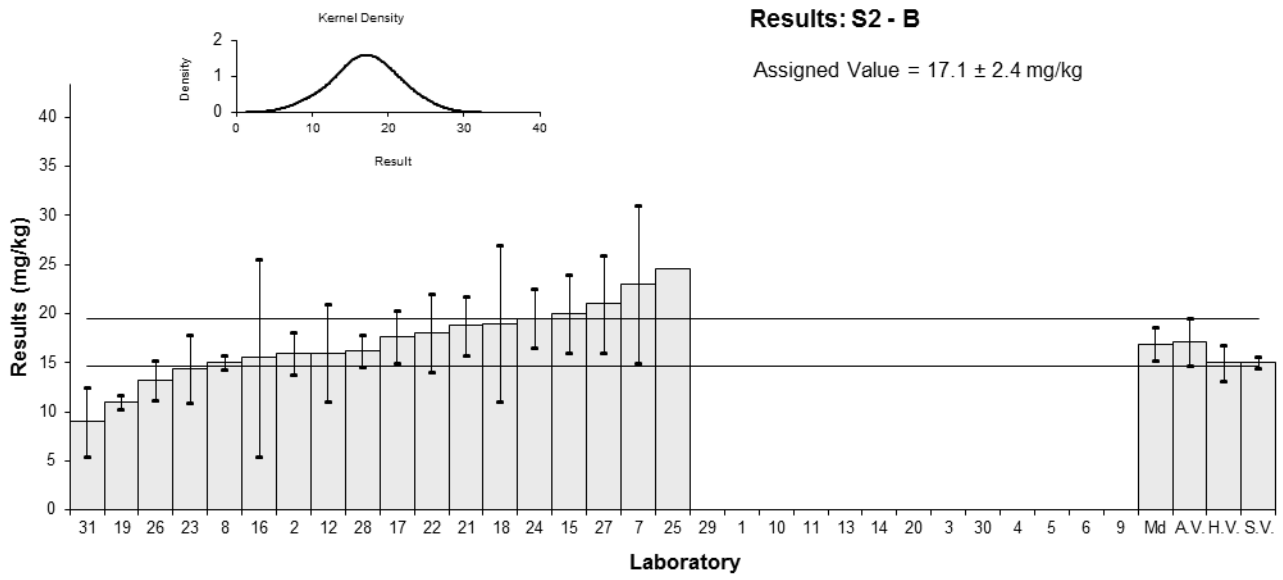
Sample No.	S2
Matrix.	Soil
Analyte.	B
Units	mg/kg

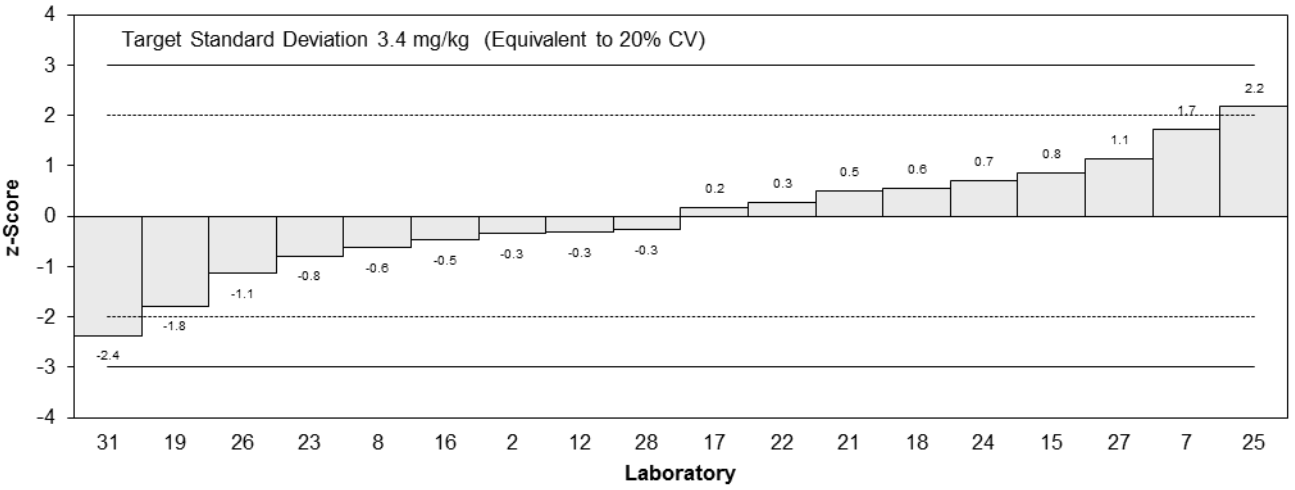
Participant Results

Lab Code	Result	Uncertainty	z-Score	En-Score
1	NT	NT		
2	15.95	2.2	-0.34	-0.35
3	NT	NT		
4	NT	NT		
5	NT	NT		
6	NT	NT		
7	23	8	1.73	0.71
8	15	0.7	-0.61	-0.84
9	NT	NT		
10	NT	NT		
11	NT	NT		
12	16	5	-0.32	-0.20
13	NT	NT		
14	NT	NT		
15	20	4	0.85	0.62
16	15.5	10	-0.47	-0.16
17	17.685	2.7	0.17	0.16
18	19	8	0.56	0.23
19	11	0.77	-1.78	-2.42
20	NT	NT		
21	18.8	3.0	0.50	0.44
22	18	4	0.26	0.19
23	14.4	3.5	-0.79	-0.64
24	19.5	3	0.70	0.62
25	24.53	NR	2.17	3.10
26	13.2	2.0	-1.14	-1.25
27	21	5	1.14	0.70
28	16.178	1.618	-0.27	-0.32
29	<20	3.6		
30	NT	NT		
31	9	3.5	-2.37	-1.91

Statistics

Assigned Value	17.1	2.4
Spike	15.0	0.6
Homogeneity Value	15.0	1.8
Robust Average	17.1	2.4
Median	16.9	1.7
Mean	17.1	
N	18	
Max.	24.53	
Min.	9	
Robust SD	4	
Robust CV	23%	


Kernel Density
Density
Result
Results: S2 - B
Assigned Value = 17.1 ± 2.4 mg/kg
Results (mg/kg)
Laboratory
31 19 26 23 8 16 2 12 28 17 22 21 18 24 15 27 7 25 29 1 10 11 13 14 20 3 30 4 5 6 9 Md A.V. H.V. S.V.


z-Scores: S2 - B
Target Standard Deviation 3.4 mg/kg (Equivalent to 20% CV)
z-Score
Laboratory
31 19 26 23 8 16 2 12 28 17 22 21 18 24 15 27 7 25
-2.4 -1.8 -1.1 -0.8 -0.6 -0.5 -0.3 -0.3 -0.3 0.2 0.3 0.5 0.6 0.7 0.8 1.1 1.7 2.2

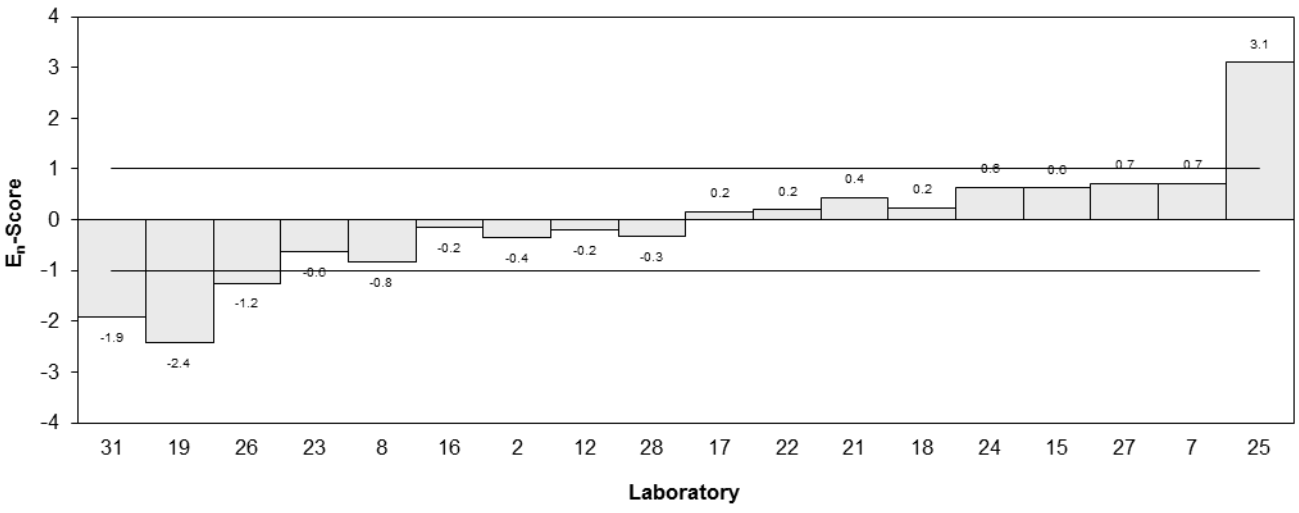

En-Scores: S2 - B
En-Score
Laboratory
31 19 26 23 8 16 2 12 28 17 22 21 18 24 15 27 7 25
-1.9 -2.4 -1.2 -0.6 -0.8 -0.2 -0.4 -0.2 -0.3 0.2 0.2 0.4 0.2 0.6 0.6 0.7 0.7 3.1

Figure 21

Table 34

Sample Details

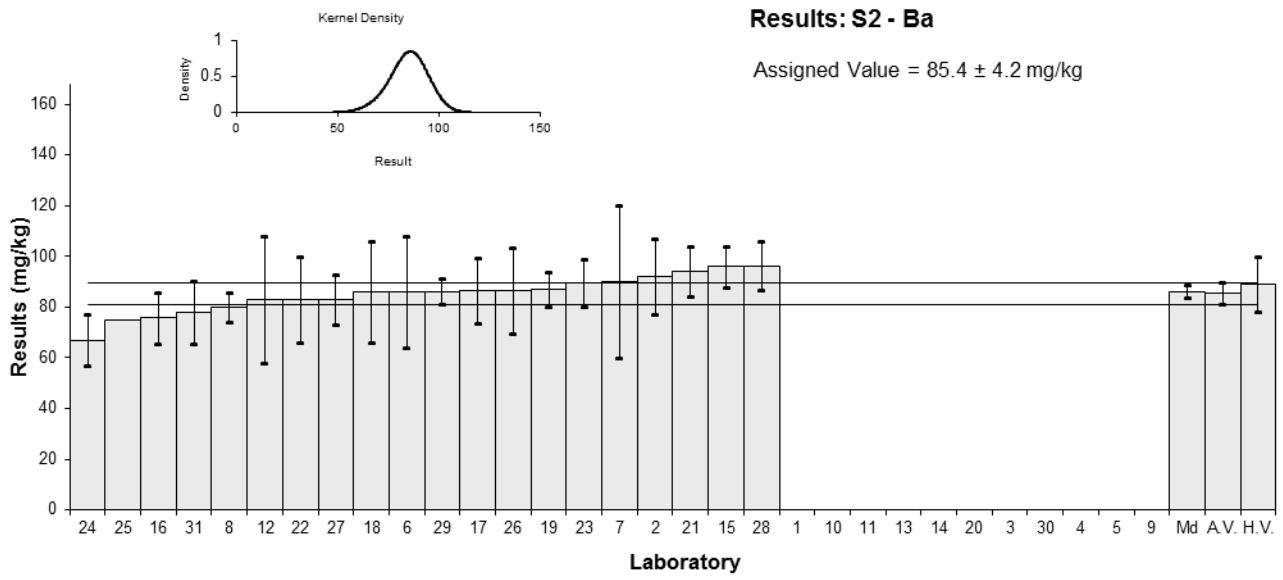
Sample No.	S2
Matrix.	Soil
Analyte.	Ba
Units	mg/kg

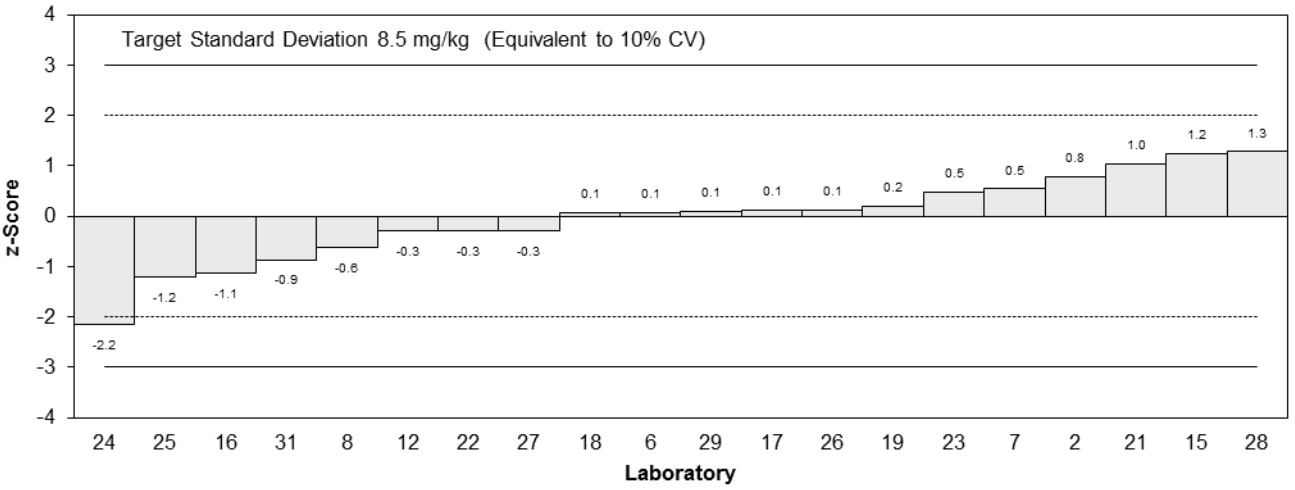
Participant Results

Lab Code	Result	Uncertainty	z-Score	En-Score
1	NT	NT		
2	92.01	15	0.77	0.42
3	NT	NT		
4	NT	NT		
5	NT	NT		
6	86	22	0.07	0.03
7	90	30	0.54	0.15
8	80	6.0	-0.63	-0.74
9	NT	NT		
10	NT	NT		
11	NT	NT		
12	83	25	-0.28	-0.09
13	NT	NT		
14	NT	NT		
15	96	8	1.24	1.17
16	75.8	10	-1.12	-0.89
17	86.43	13	0.12	0.08
18	86	20	0.07	0.03
19	87	6.96	0.19	0.20
20	NT	NT		
21	94.2	10	1.03	0.81
22	83	17	-0.28	-0.14
23	89.5	9.4	0.48	0.40
24	67	10	-2.15	-1.70
25	75.1	NR	-1.21	-2.45
26	86.5	17	0.13	0.06
27	83	10	-0.28	-0.22
28	96.334	9.634	1.28	1.04
29	86.2	5.2	0.09	0.12
30	NT	NT		
31	78	12.5	-0.87	-0.56

Statistics

Assigned Value	85.4	4.2
Spike	Not Spiked	
Homogeneity Value	89.0	11.0
Robust Average	85.4	4.2
Median	86.1	2.5
Mean	85.1	
N	20	
Max.	96.334	
Min.	67	
Robust SD	7.5	
Robust CV	8.8%	


Kernel Density
Density
Result
Results: S2 - Ba
Assigned Value = 85.4 ± 4.2 mg/kg
Results (mg/kg)
Laboratory
24 25 16 31 8 12 22 27 18 6 29 17 26 19 23 7 2 21 15 28 1 10 11 13 14 20 3 30 4 5 9 Md A.V. H.V.


z-Scores: S2 - Ba
Target Standard Deviation 8.5 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
24 25 16 31 8 12 22 27 18 6 29 17 26 19 23 7 2 21 15 28

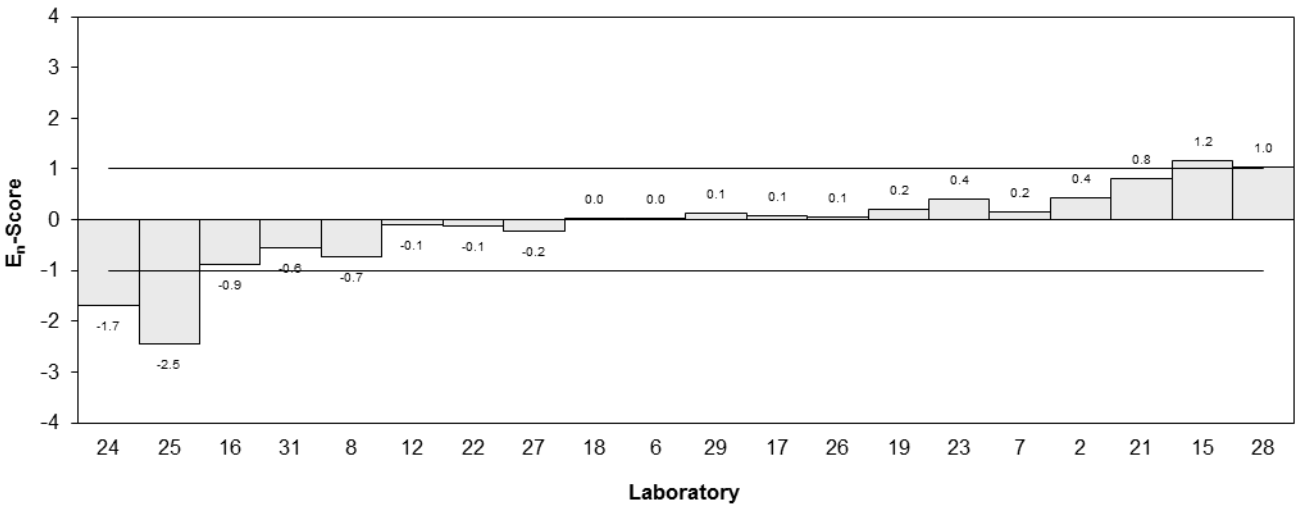

En-Scores: S2 - Ba
En-Score
Laboratory
24 25 16 31 8 12 22 27 18 6 29 17 26 19 23 7 2 21 15 28

Figure 22

Table 35

Sample Details

Sample No.	S2
Matrix.	Soil
Analyte.	Bi
Units	mg/kg

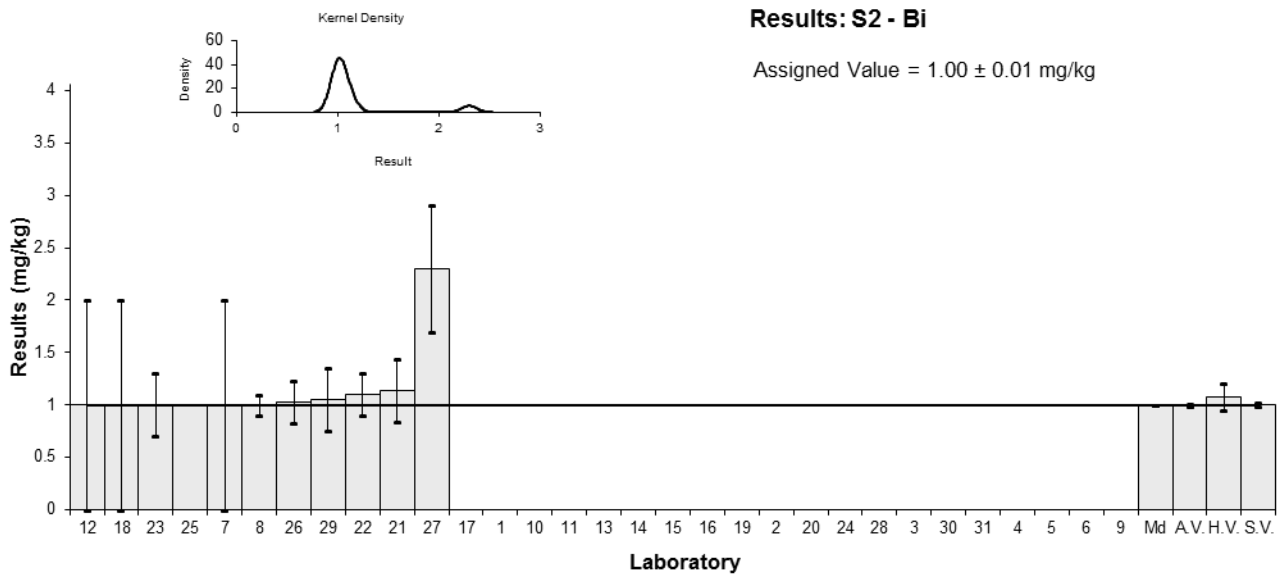
Participant Results

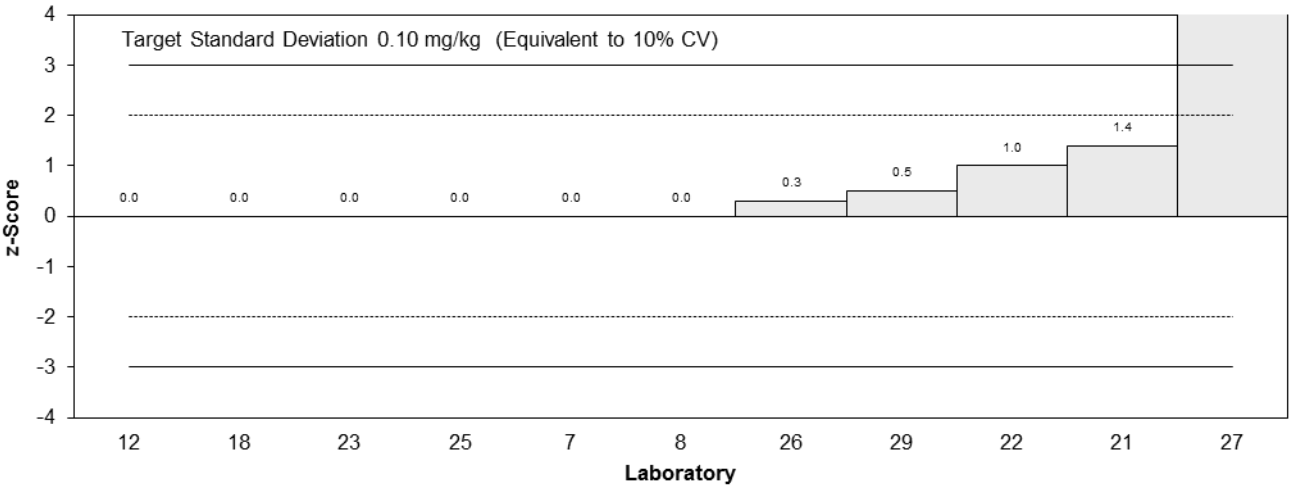
Lab Code	Result	Uncertainty	z-Score	En-Score
1	NT	NT		
2	NT	NT		
3	NT	NT		
4	NT	NT		
5	NT	NT		
6	NT	NT		
7	1	1	0.00	0.00
8	1.0	0.1	0.00	0.00
9	NT	NT		
10	NT	NT		
11	NT	NT		
12	1	1	0.00	0.00
13	NT	NT		
14	NT	NT		
15	NT	NT		
16	NR	NR		
17	<5	NR		
18	1	1	0.00	0.00
19	NT	NT		
20	NT	NT		
21	1.14	0.3	1.40	0.47
22	1.1	0.2	1.00	0.50
23	1.00	0.30	0.00	0.00
24	NR	NR		
25	1.0	NR	0.00	0.00
26	1.03	0.2	0.30	0.15
27	2.3	0.6	13.00	2.17
28	NT	NT		
29	1.05	0.30	0.50	0.17
30	NT	NT		
31	NT	NT		

Statistics

Assigned Value*	1.00	0.01
Spike	1.00	0.02
Homogeneity Value	1.08	0.13
Robust Average	1.00	0.01
Median	1.00	0.01
Mean	1.15	
N	11	
Max.	2.3	
Min.	1	
Robust SD	0	
Robust CV	0.01%	

* Robust Average excluding Laboratory 27.


Kernel Density
Density
Result
Results: S2 - Bi
Assigned Value = 1.00 ± 0.01 mg/kg
Results (mg/kg)
Laboratory
12 18 23 25 7 8 26 29 22 21 27 17 1 10 11 13 14 15 16 19 2 20 24 28 3 30 31 4 5 6 9 Md A.V. H.V. S.V.


z-Scores: S2 - Bi
Target Standard Deviation 0.10 mg/kg (Equivalent to 10% CV)
z-Score
0.0 0.0 0.0 0.0 0.0 0.0 0.3 0.5 1.0 1.4
Laboratory
12 18 23 25 7 8 26 29 22 21 27

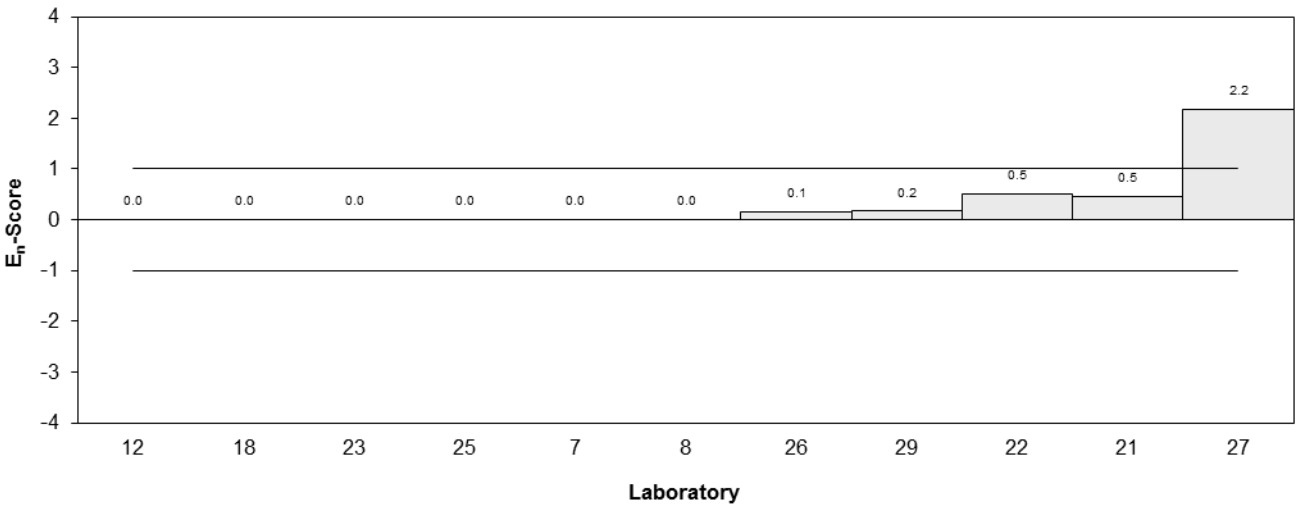

En-Scores: S2 - Bi
En-Score
0.0 0.0 0.0 0.0 0.0 0.0 0.1 0.2 0.5 0.5 2.2
Laboratory
12 18 23 25 7 8 26 29 22 21 27

Figure 23

Table 36

Sample Details

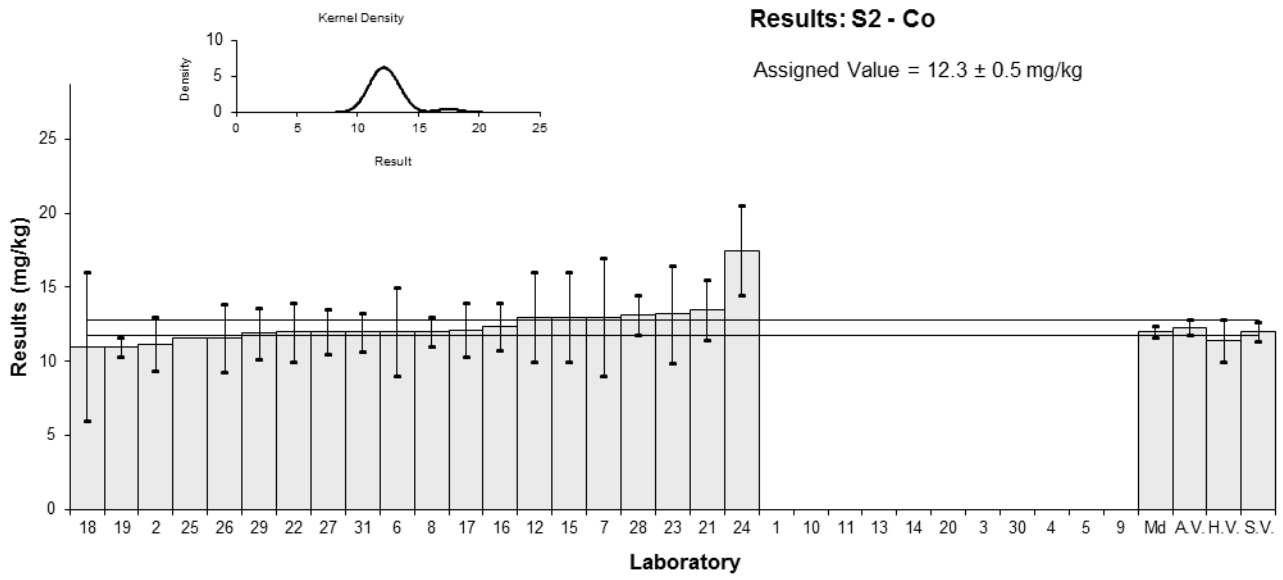
Sample No.	S2
Matrix.	Soil
Analyte.	Co
Units	mg/kg

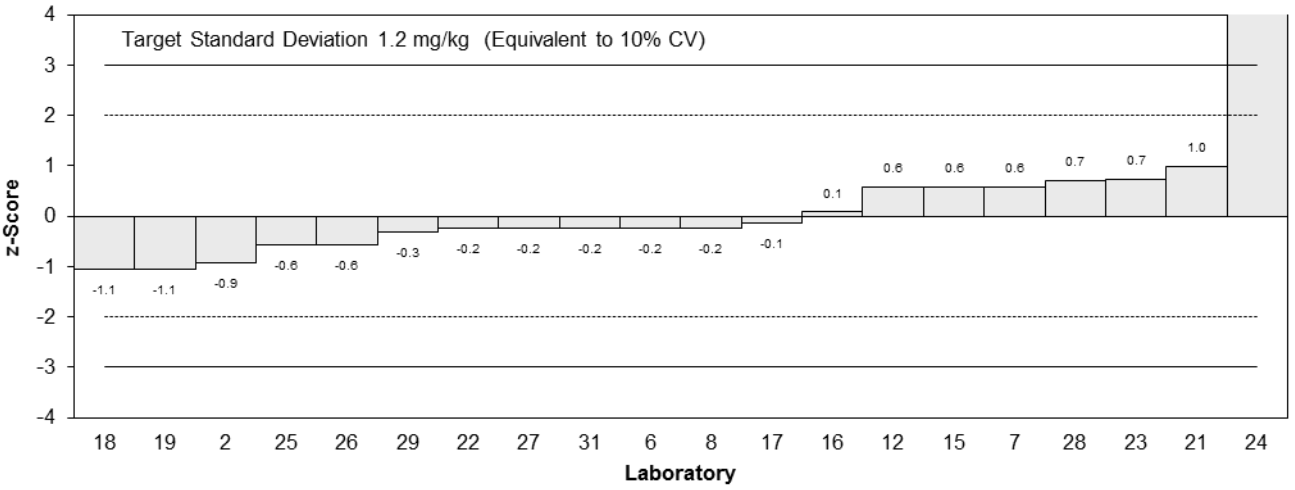
Participant Results

Lab Code	Result	Uncertainty	z-Score	En-Score
1	NT	NT		
2	11.17	1.8	-0.92	-0.60
3	NT	NT		
4	NT	NT		
5	NT	NT		
6	12	3	-0.24	-0.10
7	13	4	0.57	0.17
8	12	1.0	-0.24	-0.27
9	NT	NT		
10	NT	NT		
11	NT	NT		
12	13	3	0.57	0.23
13	NT	NT		
14	NT	NT		
15	13	3	0.57	0.23
16	12.4	1.6	0.08	0.06
17	12.1362	1.8	-0.13	-0.09
18	11	5	-1.06	-0.26
19	11	0.66	-1.06	-1.57
20	NT	NT		
21	13.5	2.0	0.98	0.58
22	12	2	-0.24	-0.15
23	13.2	3.3	0.73	0.27
24	17.5	3	4.23	1.71
25	11.6	NR	-0.57	-1.40
26	11.6	2.3	-0.57	-0.30
27	12	1.5	-0.24	-0.19
28	13.159	1.316	0.70	0.61
29	11.9	1.7	-0.33	-0.23
30	NT	NT		
31	12	1.3	-0.24	-0.22

Statistics

Assigned Value	12.3	0.5
Spike	12.0	0.7
Homogeneity Value	11.4	1.4
Robust Average	12.3	0.5
Median	12.0	0.4
Mean	12.5	
N	20	
Max.	17.5	
Min.	11	
Robust SD	0.9	
Robust CV	7.3%	


Kernel Density
Density
Result
Results: S2 - Co
Assigned Value = 12.3 ± 0.5 mg/kg
Results (mg/kg)
Laboratory
18 19 2 25 26 29 22 27 31 6 8 17 16 12 15 7 28 23 21 24 1 10 11 13 14 20 3 30 4 5 9 Md A.V. H.V. S.V.


z-Scores: S2 - Co
Target Standard Deviation 1.2 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
18 19 2 25 26 29 22 27 31 6 8 17 16 12 15 7 28 23 21 24
-1.1 -1.1 -0.9 -0.6 -0.6 -0.3 -0.2 -0.2 -0.2 -0.2 -0.2 -0.1 0.1 0.6 0.6 0.6 0.7 0.7 1.0

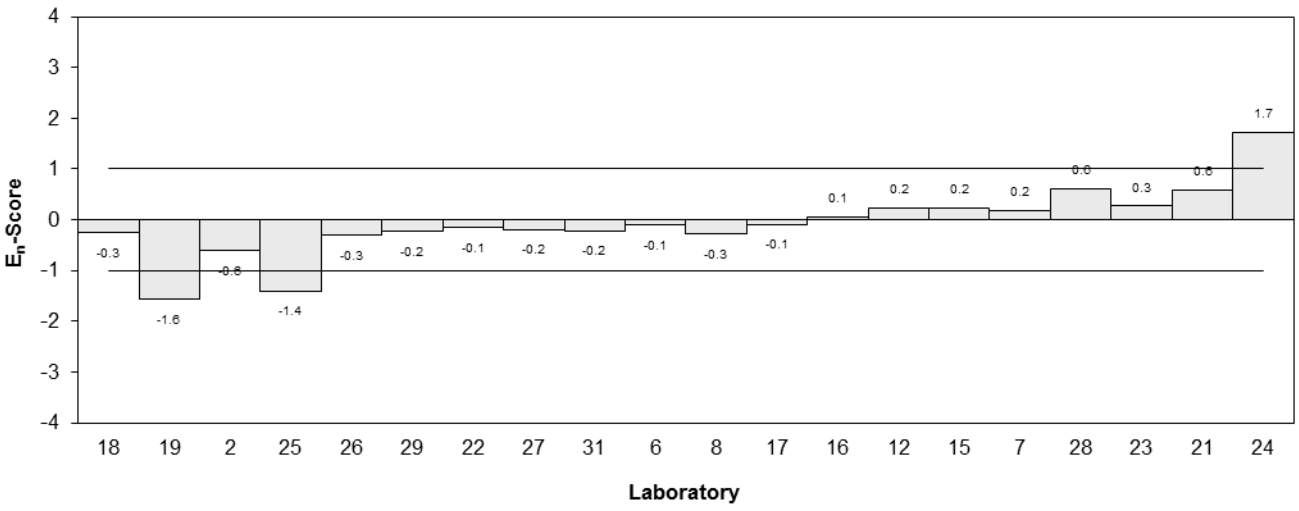

En-Scores: S2 - Co
En-Score
Laboratory
18 19 2 25 26 29 22 27 31 6 8 17 16 12 15 7 28 23 21 24
-0.3 -1.6 -0.6 -1.4 -0.3 -0.2 -0.1 -0.2 -0.2 -0.1 -0.3 -0.1 0.1 0.2 0.2 0.2 0.6 0.3 0.6 1.7

Figure 24

Table 37

Sample Details

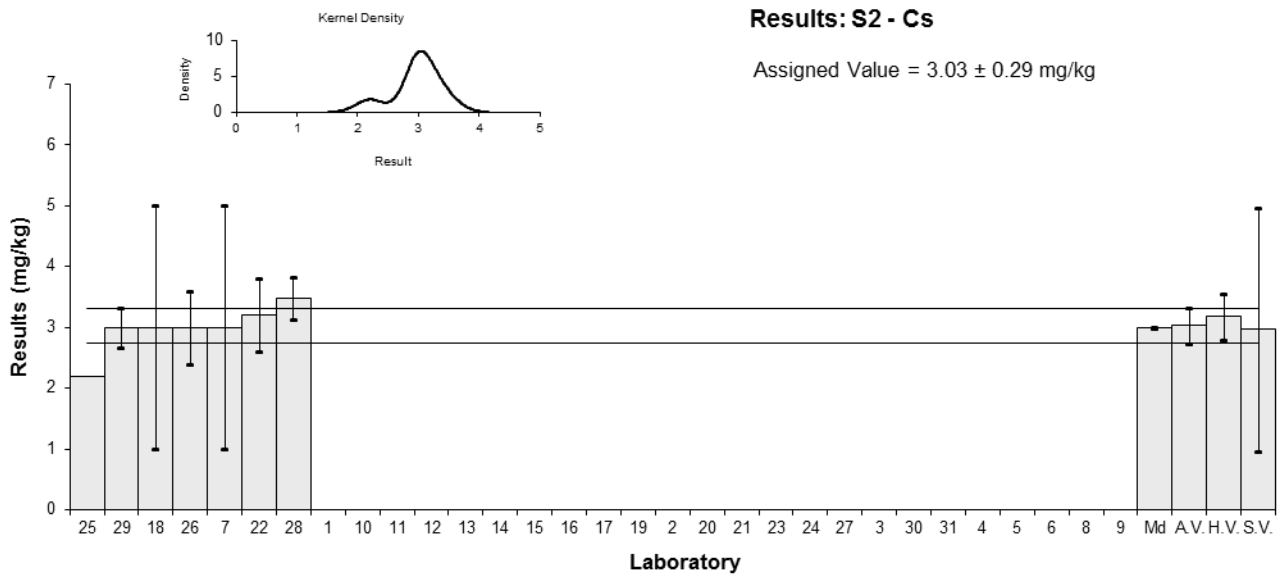
Sample No.	S2
Matrix.	Soil
Analyte.	Cs
Units	mg/kg

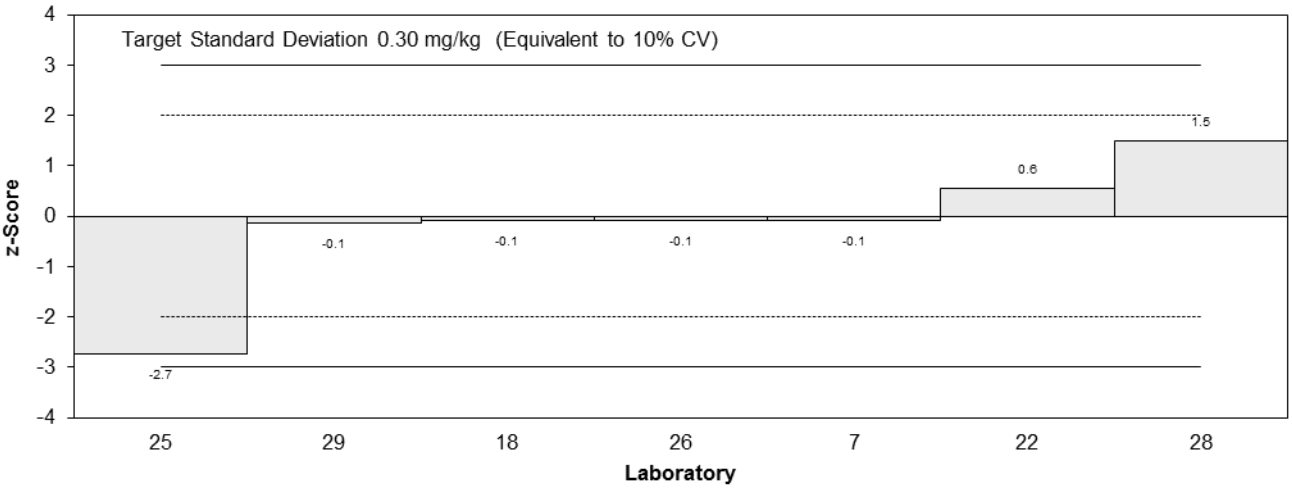
Participant Results

Lab Code	Result	Uncertainty	z-Score	En-Score
1	NT	NT		
2	NT	NT		
3	NT	NT		
4	NT	NT		
5	NT	NT		
6	NT	NT		
7	3	2	-0.10	-0.01
8	NT	NT		
9	NT	NT		
10	NT	NT		
11	NT	NT		
12	NR	NR		
13	NT	NT		
14	NT	NT		
15	NT	NT		
16	NR	NR		
17	NT	NT		
18	3	2	-0.10	-0.01
19	NT	NT		
20	NT	NT		
21	NT	NT		
22	3.2	0.6	0.56	0.26
23	NR	NR		
24	NR	NR		
25	2.2	NR	-2.74	-2.86
26	3.0	0.6	-0.10	-0.05
27	NT	NT		
28	3.483	0.348	1.50	1.00
29	2.99	0.33	-0.13	-0.09
30	NT	NT		
31	NT	NT		

Statistics

Assigned Value	3.03	0.29
Spike	3.0	2.0
Homogeneity Value	3.18	0.38
Robust Average	3.03	0.29
Median	3.00	0.01
Mean	2.98	
N	7	
Max.	3.48	
Min.	2.2	
Robust SD	0.31	
Robust CV	10%	


Kernel Density
Density
Result
Results: S2 - Cs
Assigned Value = 3.03 ± 0.29 mg/kg
Results (mg/kg)
25 29 18 26 7 22 28 1 10 11 12 13 14 15 16 17 19 2 20 21 23 24 27 3 30 31 4 5 6 8 9 Md A.V. H.V. S.V.
Laboratory


z-Scores: S2 - Cs
Target Standard Deviation 0.30 mg/kg (Equivalent to 10% CV)
z-Score
1.5
0.6
-0.1
-0.1
-0.1
-0.1
-2.7
25 29 18 26 7 22 28
Laboratory

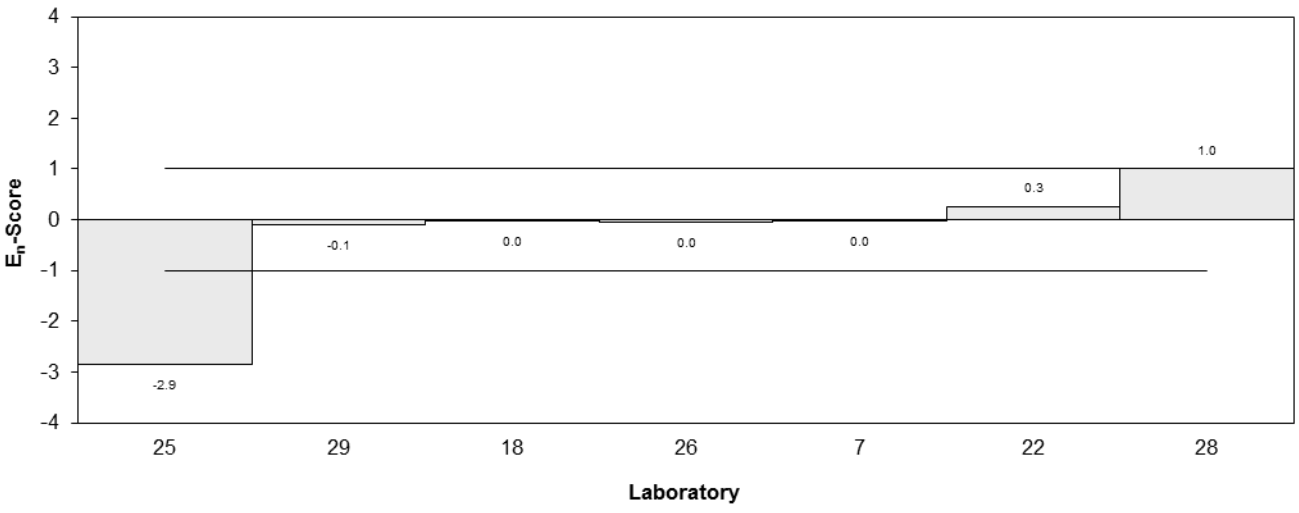

En-Scores: S2 - Cs
En-Score
1.0
0.3
-0.1
0.0
0.0
0.0
-2.9
25 29 18 26 7 22 28
Laboratory

Figure 25

Table 38

Sample Details

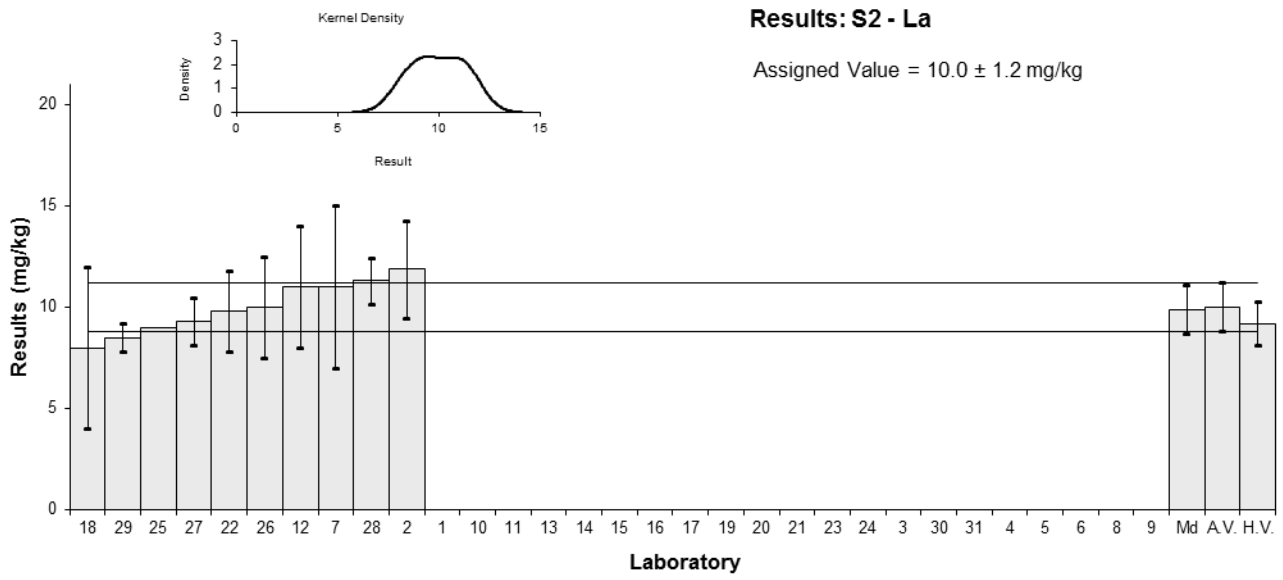
Sample No.	S2
Matrix.	Soil
Analyte.	La
Units	mg/kg

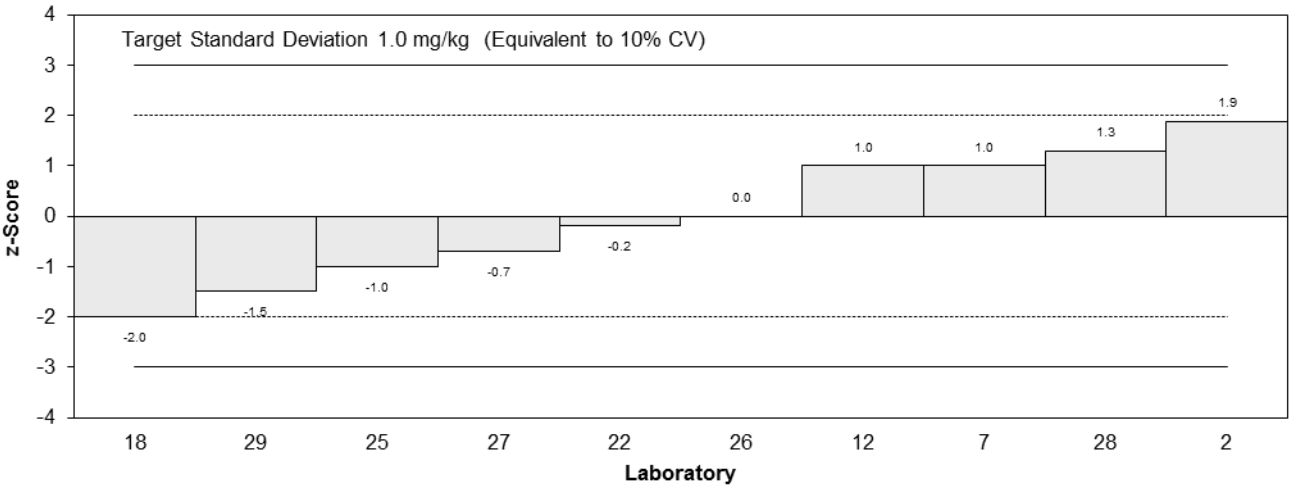
Participant Results

Lab Code	Result	Uncertainty	z-Score	En-Score
1	NT	NT		
2	11.88	2.4	1.88	0.70
3	NT	NT		
4	NT	NT		
5	NT	NT		
6	NT	NT		
7	11	4	1.00	0.24
8	NT	NT		
9	NT	NT		
10	NT	NT		
11	NT	NT		
12	11	3	1.00	0.31
13	NT	NT		
14	NT	NT		
15	NT	NT		
16	NR	NR		
17	NT	NT		
18	8	4	-2.00	-0.48
19	NT	NT		
20	NT	NT		
21	NT	NT		
22	9.8	2.0	-0.20	-0.09
23	NR	NR		
24	NR	NR		
25	9.0	NR	-1.00	-0.83
26	10	2.5	0.00	0.00
27	9.3	1.2	-0.70	-0.41
28	11.294	1.129	1.29	0.79
29	8.50	0.70	-1.50	-1.08
30	NT	NT		
31	NT	NT		

Statistics

Assigned Value	10.0	1.2
Spike	Not Spiked	
Homogeneity Value	9.2	1.1
Robust Average	10.0	1.2
Median	9.9	1.2
Mean	10.0	
N	10	
Max.	11.88	
Min.	8	
Robust SD	1.5	
Robust CV	15%	


Kernel Density
Density
Result
Results: S2 - La
Assigned Value = 10.0 ± 1.2 mg/kg
Results (mg/kg)
Laboratory
18 29 25 27 22 26 12 7 28 2 1 10 11 13 14 15 16 17 19 20 21 23 24 3 30 31 4 5 6 8 9 Md A.V. H.V.


z-Scores: S2 - La
Target Standard Deviation 1.0 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
18 29 25 27 22 26 12 7 28 2
-2.0
-1.5
-1.0
-0.7
-0.2
0.0
1.0
1.0
1.3
1.9

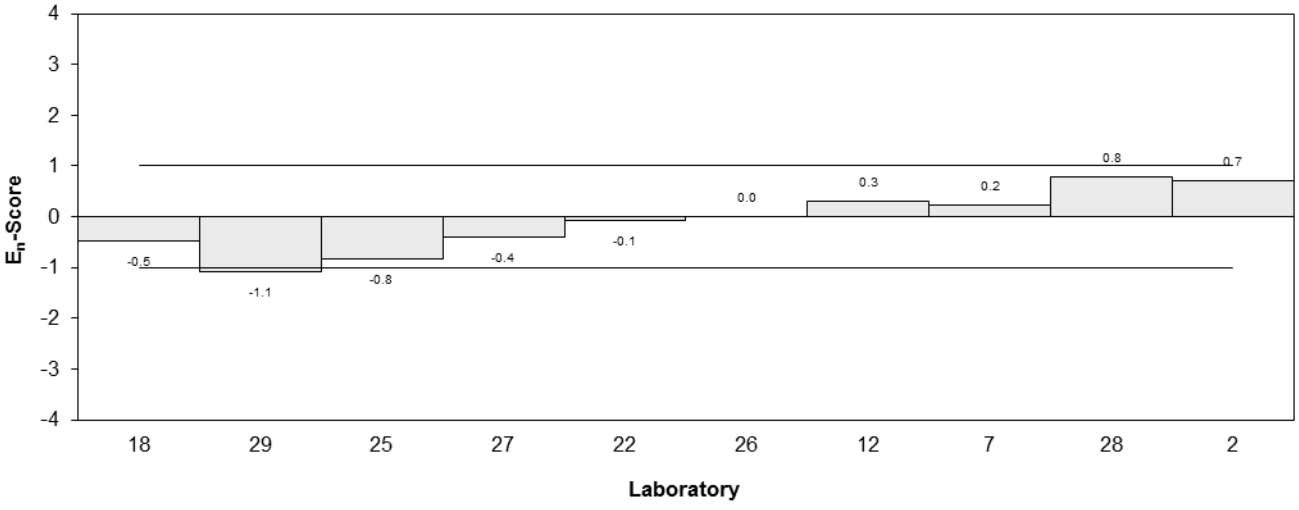

En-Scores: S2 - La
En-Score
Laboratory
18 29 25 27 22 26 12 7 28 2
-0.5
-1.1
-0.8
-0.4
-0.1
0.0
0.3
0.2
0.8
0.7

Figure 26

Table 39

Sample Details

Sample No.	S2
Matrix.	Soil
Analyte.	Li
Units	mg/kg

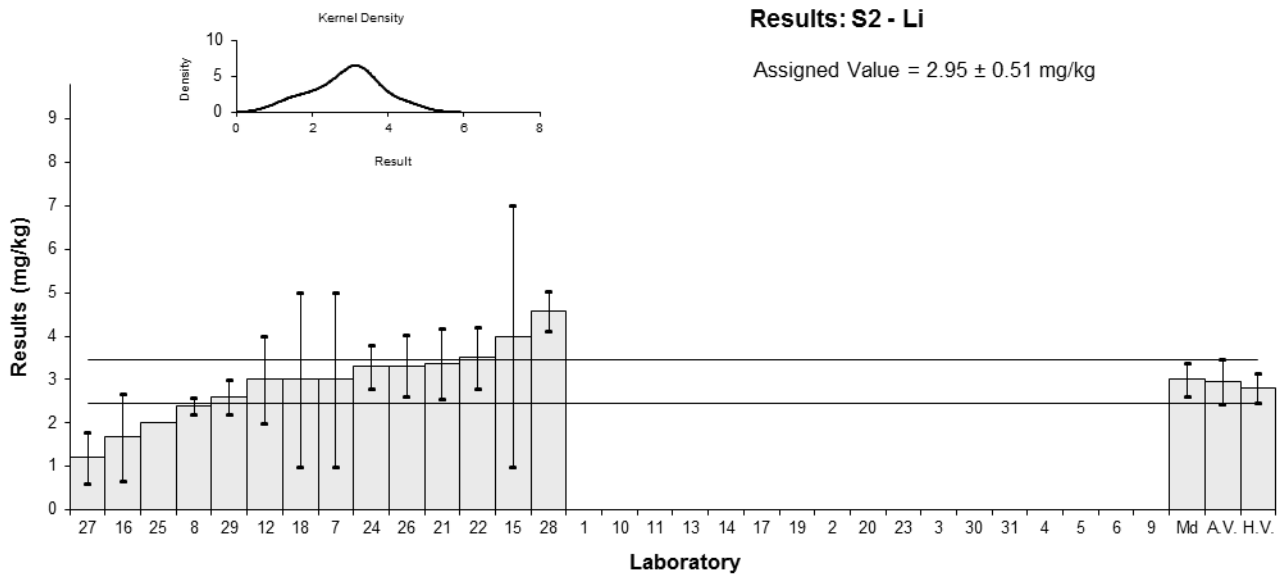
Participant Results

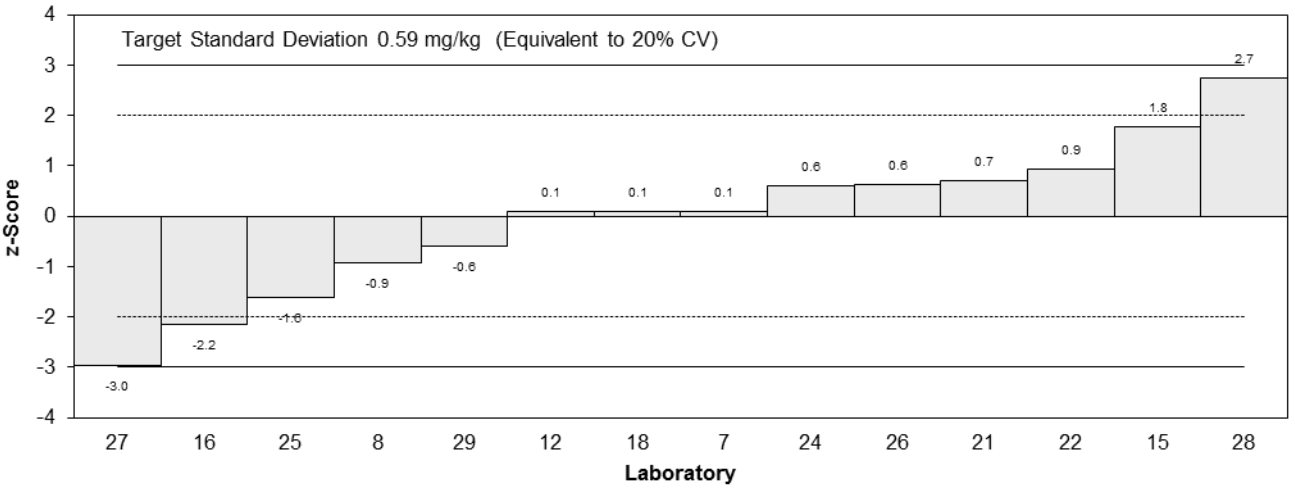
Lab Code	Result	Uncertainty	z-Score	En-Score
1	NT	NT		
2	NT	NT		
3	NT	NT		
4	NT	NT		
5	NT	NT		
6	NT	NT		
7	3	2	0.08	0.02
8	2.4	0.2	-0.93	-1.00
9	NT	NT		
10	NT	NT		
11	NT	NT		
12	3	1	0.08	0.04
13	NT	NT		
14	NT	NT		
15	4	3	1.78	0.35
16	1.68	1.0	-2.15	-1.13
17	NT	NT		
18	3	2	0.08	0.02
19	NT	NT		
20	NT	NT		
21	3.37	0.8	0.71	0.44
22	3.5	0.7	0.93	0.64
23	NR	NR		
24	3.3	0.5	0.59	0.49
25	2.0	NR	-1.61	-1.86
26	3.32	0.7	0.63	0.43
27	1.2	0.6	-2.97	-2.22
28	4.567	0.457	2.74	2.36
29	2.60	0.41	-0.59	-0.53
30	NT	NT		
31	NT	NT		

Statistics

Assigned Value*	2.95	0.51
Spike	Not Spiked	
Homogeneity Value	2.82	0.34
Robust Average*	2.93	0.62
Median	3.00	0.39
Mean	2.92	
N	14	
Max.	4.567	
Min.	1.2	
Robust SD	0.71	
Robust CV	24%	

* Robust Average excluding Laboratory 28


Kernel Density
Density
Result
Results: S2 - Li
Assigned Value = 2.95 ± 0.51 mg/kg
Results (mg/kg)
27 16 25 8 29 12 18 7 24 26 21 22 15 28 1 10 11 13 14 17 19 2 20 23 3 30 31 4 5 6 9 Md A.V. H.V.
Laboratory


z-Scores: S2 - Li
Target Standard Deviation 0.59 mg/kg (Equivalent to 20% CV)
z-Score
-3.0 -2.2 -1.6 -0.9 -0.6 0.1 0.1 0.1 0.6 0.6 0.7 0.9 1.8 2.7
27 16 25 8 29 12 18 7 24 26 21 22 15 28
Laboratory

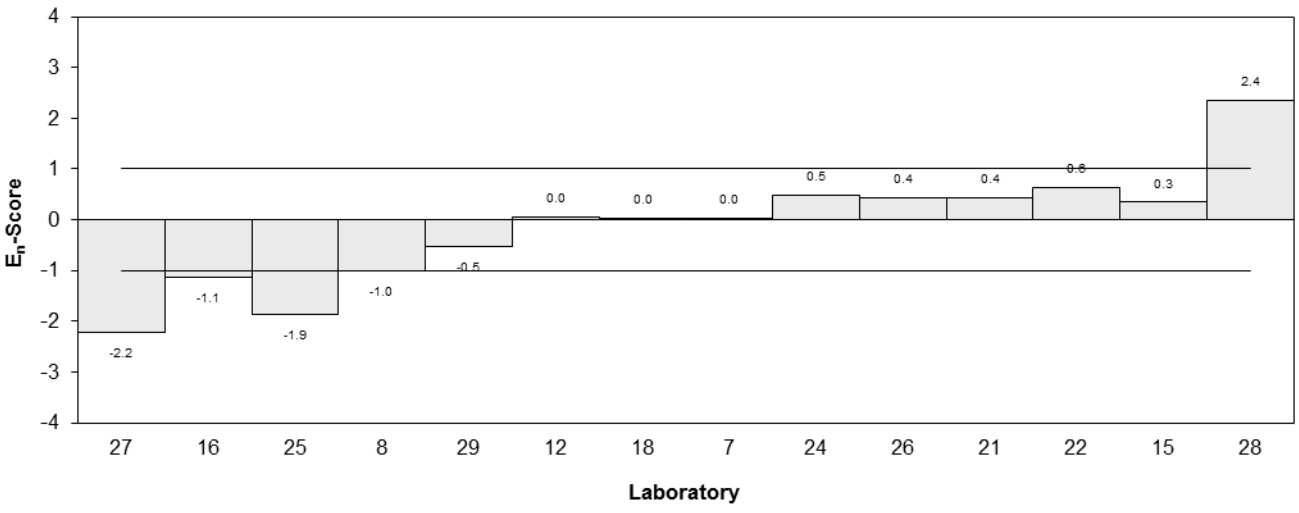

En-Scores: S2 - Li
En-Score
-2.2 -1.1 -1.9 -1.0 -0.5 0.0 0.0 0.0 0.5 0.4 0.4 0.6 0.3 2.4
27 16 25 8 29 12 18 7 24 26 21 22 15 28
Laboratory

Figure 27

Table 40

Sample Details

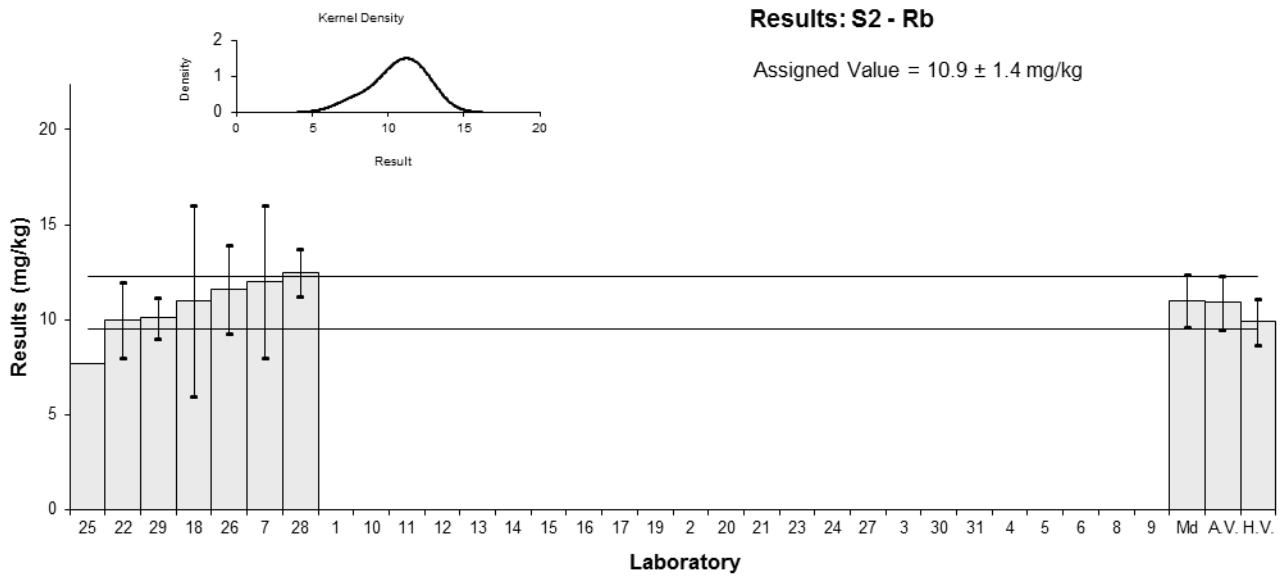
Sample No.	S2
Matrix.	Soil
Analyte.	Rb
Units	mg/kg

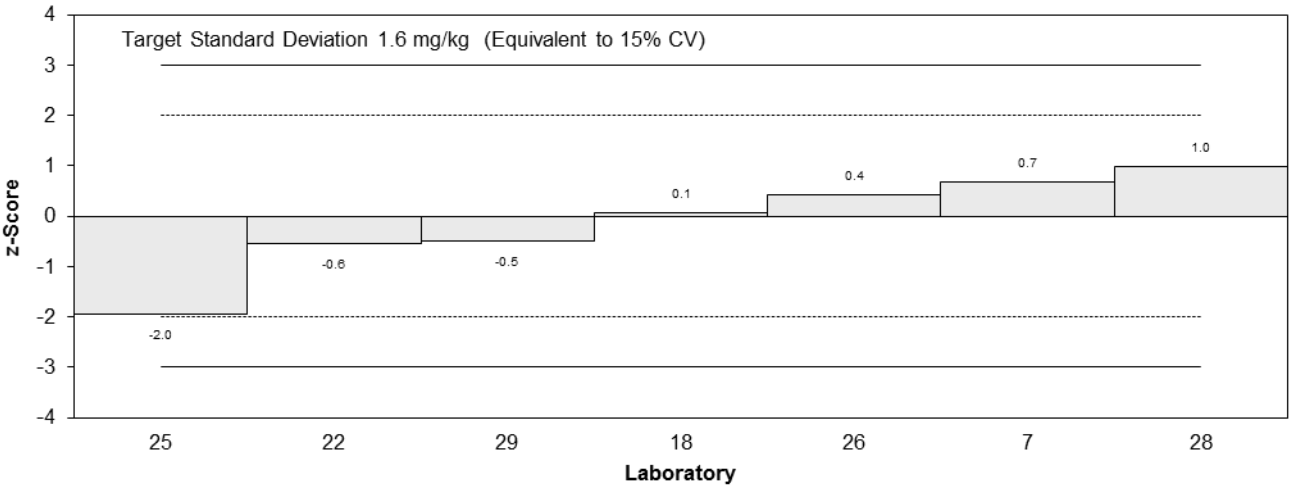
Participant Results

Lab Code	Result	Uncertainty	z-Score	En-Score
1	NT	NT		
2	NT	NT		
3	NT	NT		
4	NT	NT		
5	NT	NT		
6	NT	NT		
7	12	4	0.67	0.26
8	NT	NT		
9	NT	NT		
10	NT	NT		
11	NT	NT		
12	NR	NR		
13	NT	NT		
14	NT	NT		
15	NT	NT		
16	NR	NR		
17	NT	NT		
18	11	5	0.06	0.02
19	NT	NT		
20	NT	NT		
21	NT	NT		
22	10	2	-0.55	-0.37
23	NR	NR		
24	NR	NR		
25	7.7	NR	-1.96	-2.29
26	11.6	2.3	0.43	0.26
27	NT	NT		
28	12.503	1.25	0.98	0.85
29	10.1	1.1	-0.49	-0.45
30	NT	NT		
31	NT	NT		

Statistics

Assigned Value	10.9	1.4
Spike	Not Spiked	
Homogeneity Value	9.9	1.2
Robust Average	10.9	1.4
Median	11.0	1.4
Mean	10.7	
N	7	
Max.	12.503	
Min.	7.7	
Robust SD	1.5	
Robust CV	13%	


Kernel Density
Density
Result
Results: S2 - Rb
Assigned Value = 10.9 ± 1.4 mg/kg
Results (mg/kg)
Laboratory
25 22 29 18 26 7 28 1 10 11 12 13 14 15 16 17 19 2 20 21 23 24 27 3 30 31 4 5 6 8 9 Md A.V. H.V.


z-Scores: S2 - Rb
Target Standard Deviation 1.6 mg/kg (Equivalent to 15% CV)
z-Score
-2.0
-0.6
-0.5
0.1
0.4
0.7
1.0
Laboratory
25 22 29 18 26 7 28

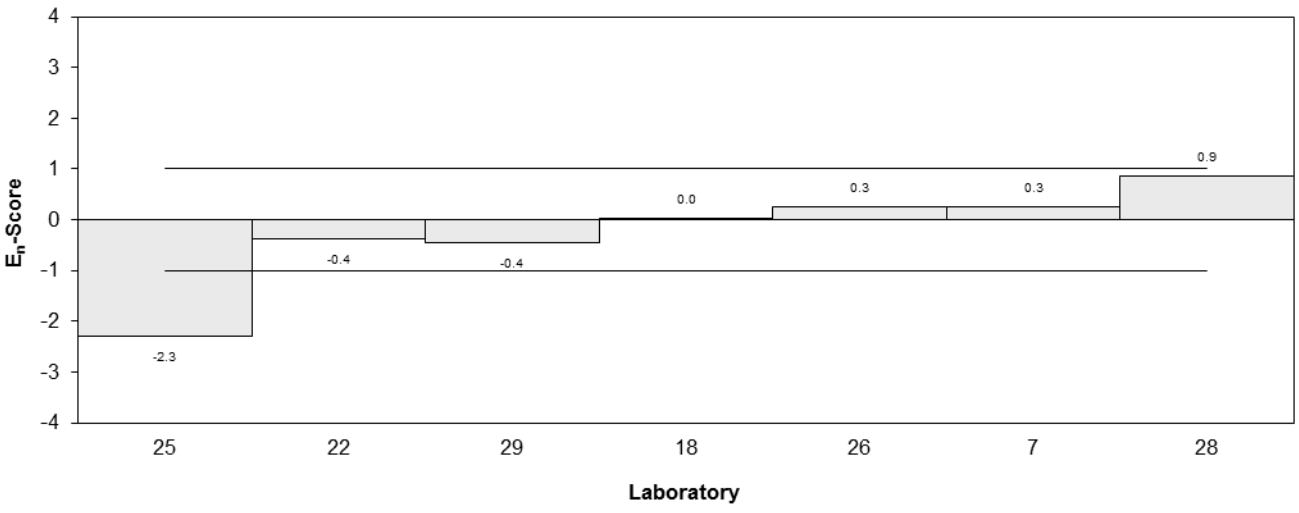

En-Scores: S2 - Rb
En-Score
-2.3
-0.4
-0.4
0.0
0.3
0.3
0.9
Laboratory
25 22 29 18 26 7 28

Figure 28

Table 41

Sample Details

Sample No.	S2
Matrix.	Soil
Analyte.	Se
Units	mg/kg

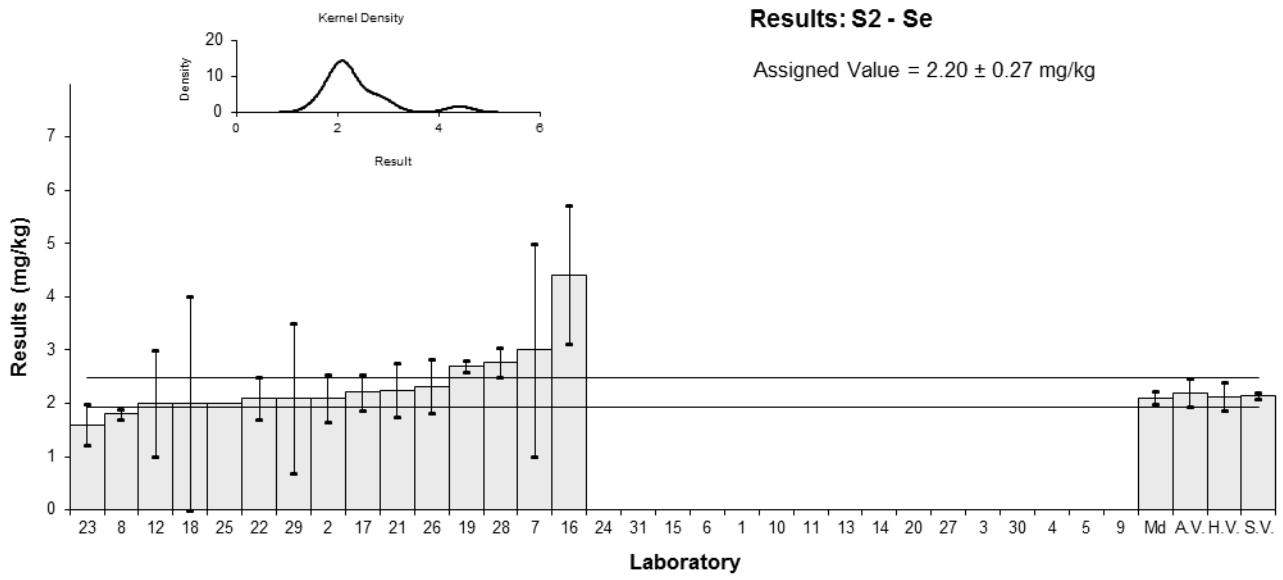
Participant Results

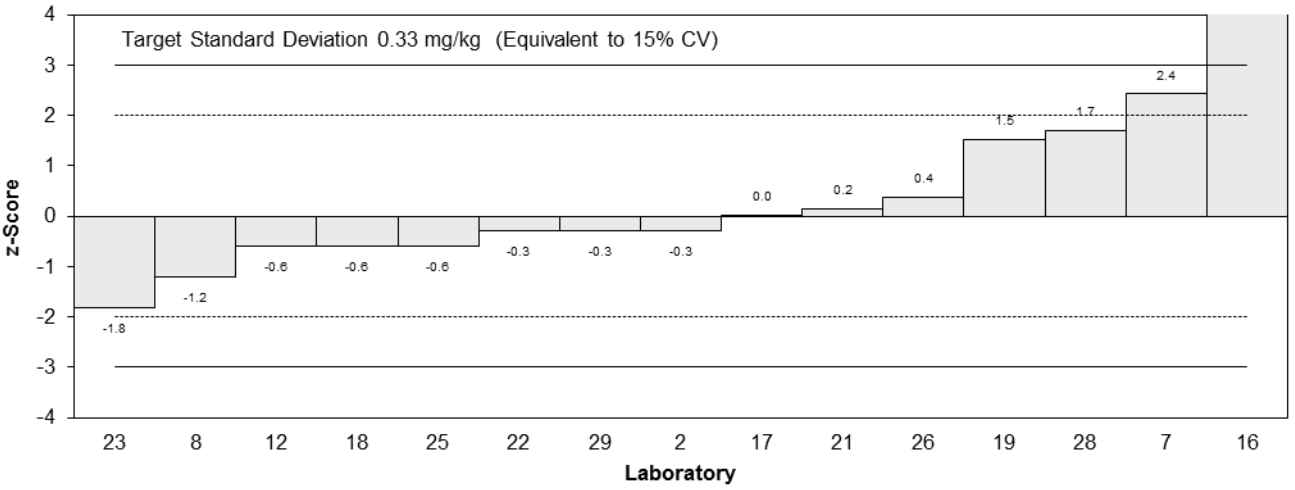
Lab Code	Result	Uncertainty	z-Score	En-Score
1	NT	NT		
2	2.104	0.45	-0.29	-0.18
3	NT	NT		
4	NT	NT		
5	NT	NT		
6	<5	NR		
7	3	2	2.42	0.40
8	1.8	0.1	-1.21	-1.39
9	NT	NT		
10	NT	NT		
11	NT	NT		
12	2	1	-0.61	-0.19
13	NT	NT		
14	NT	NT		
15	<4	NR		
16	4.41	1.3	6.70	1.66
17	2.206	0.34	0.02	0.01
18	2	2	-0.61	-0.10
19	2.7	0.11	1.52	1.71
20	NT	NT		
21	2.25	0.5	0.15	0.09
22	2.1	0.4	-0.30	-0.21
23	1.60	0.38	-1.82	-1.29
24	<2	NR		
25	2.0	NR	-0.61	-0.74
26	2.32	0.5	0.36	0.21
27	NT	NT		
28	2.761	0.276	1.70	1.45
29	2.1	1.4	-0.30	-0.07
30	NT	NT		
31	<3	NR		

Statistics

Assigned Value*	2.20	0.27
Spike	2.14	0.06
Homogeneity Value	2.13	0.26
Robust Average*	2.26	0.30
Median	2.10	0.12
Mean	2.36	
N	15	
Max.	4.41	
Min.	1.6	
Robust SD	0.4	
Robust CV	18%	

* Robust Average excluding Laboratory 16


Kernel Density
Density
Result
Results: S2 - Se
Assigned Value = 2.20 ± 0.27 mg/kg
Results (mg/kg)
Laboratory
23 8 12 18 25 22 29 2 17 21 26 19 28 7 16 24 31 15 6 1 10 11 13 14 20 27 3 30 4 5 9 Md A.V. H.V. S.V.


z-Scores: S2 - Se
Target Standard Deviation 0.33 mg/kg (Equivalent to 15% CV)
z-Score
Laboratory
23 8 12 18 25 22 29 2 17 21 26 19 28 7 16
-1.8 -1.2 -0.6 -0.6 -0.6 -0.3 -0.3 -0.3 0.0 0.2 0.4 1.5 1.7 2.4

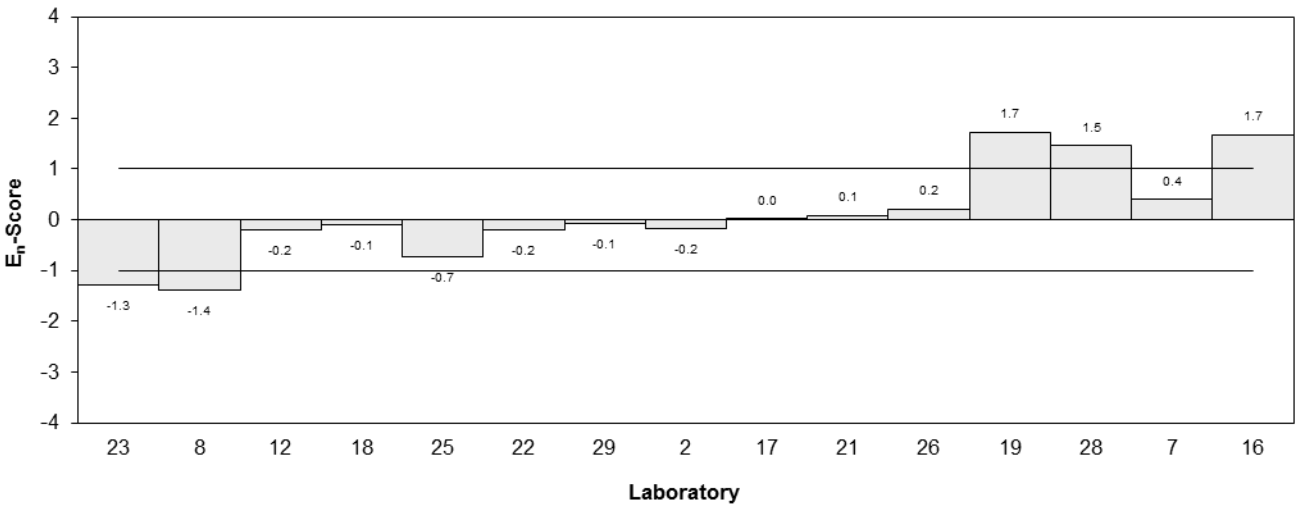

En-Scores: S2 - Se
En-Score
Laboratory
23 8 12 18 25 22 29 2 17 21 26 19 28 7 16
-1.3 -1.4 -0.2 -0.1 -0.7 -0.2 -0.1 -0.2 0.0 0.1 0.2 1.7 1.5 0.4 1.7

Figure 29

Table 42

Sample Details

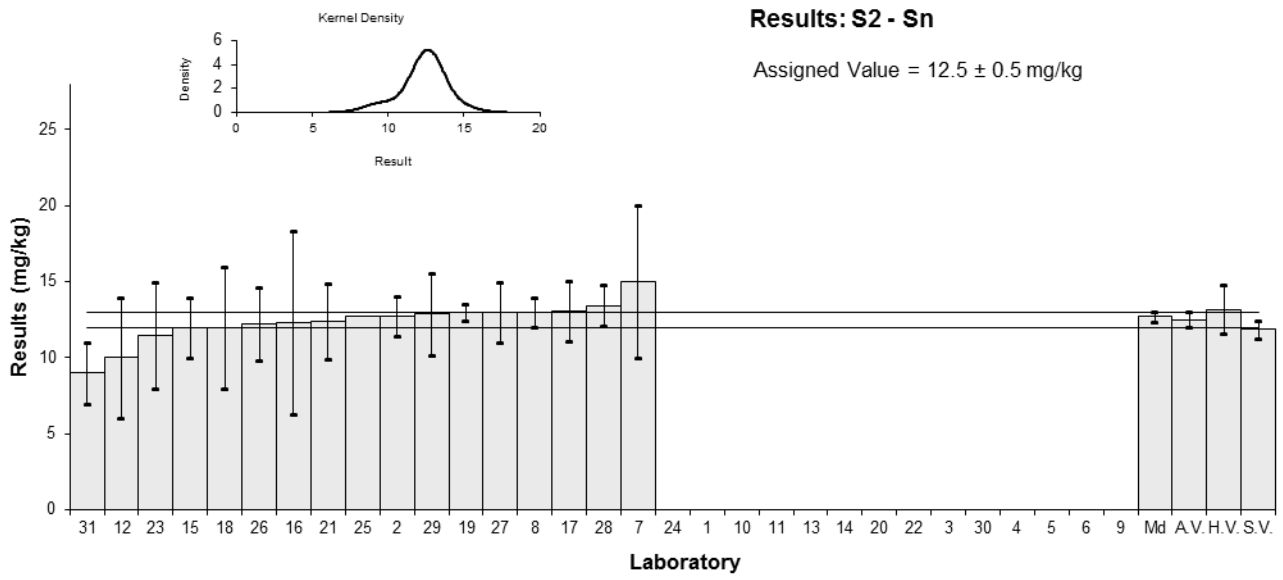
Sample No.	S2
Matrix.	Soil
Analyte.	Sn
Units	mg/kg

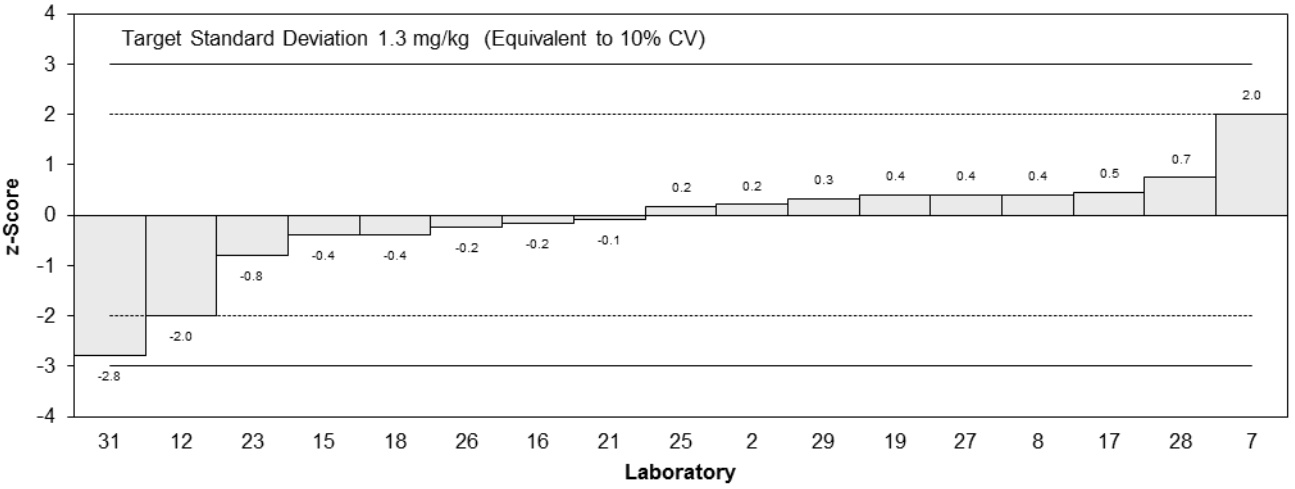
Participant Results

Lab Code	Result	Uncertainty	z-Score	En-Score
1	NT	NT		
2	12.76	1.3	0.21	0.19
3	NT	NT		
4	NT	NT		
5	NT	NT		
6	NT	NT		
7	15	5	2.00	0.50
8	13	1.0	0.40	0.45
9	NT	NT		
10	NT	NT		
11	NT	NT		
12	10	4	-2.00	-0.62
13	NT	NT		
14	NT	NT		
15	12	2	-0.40	-0.24
16	12.3	6.0	-0.16	-0.03
17	13.07	2.0	0.46	0.28
18	12	4	-0.40	-0.12
19	13	0.52	0.40	0.69
20	NT	NT		
21	12.4	2.5	-0.08	-0.04
22	NT	NT		
23	11.5	3.5	-0.80	-0.28
24	<1	NR		
25	12.7	NR	0.16	0.40
26	12.2	2.4	-0.24	-0.12
27	13	2	0.40	0.24
28	13.428	1.343	0.74	0.65
29	12.9	2.7	0.32	0.15
30	NT	NT		
31	9	2	-2.80	-1.70

Statistics

Assigned Value	12.5	0.5
Spike	11.9	0.6
Homogeneity Value	13.2	1.6
Robust Average	12.5	0.5
Median	12.7	0.3
Mean	12.4	
N	17	
Max.	15	
Min.	9	
Robust SD	0.8	
Robust CV	6.4%	


Kernel Density
Density
Result
Results: S2 - Sn
Assigned Value = 12.5 ± 0.5 mg/kg
Results (mg/kg)
Laboratory
31 12 23 15 18 26 16 21 25 2 29 19 27 8 17 28 7 24 1 10 11 13 14 20 22 3 30 4 5 6 9 Md A.V. H.V. S.V.


z-Scores: S2 - Sn
Target Standard Deviation 1.3 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
31 12 23 15 18 26 16 21 25 2 29 19 27 8 17 28 7
-2.8 -2.0 -0.8 -0.4 -0.4 -0.2 -0.2 -0.1 0.2 0.2 0.3 0.4 0.4 0.4 0.5 0.7 2.0

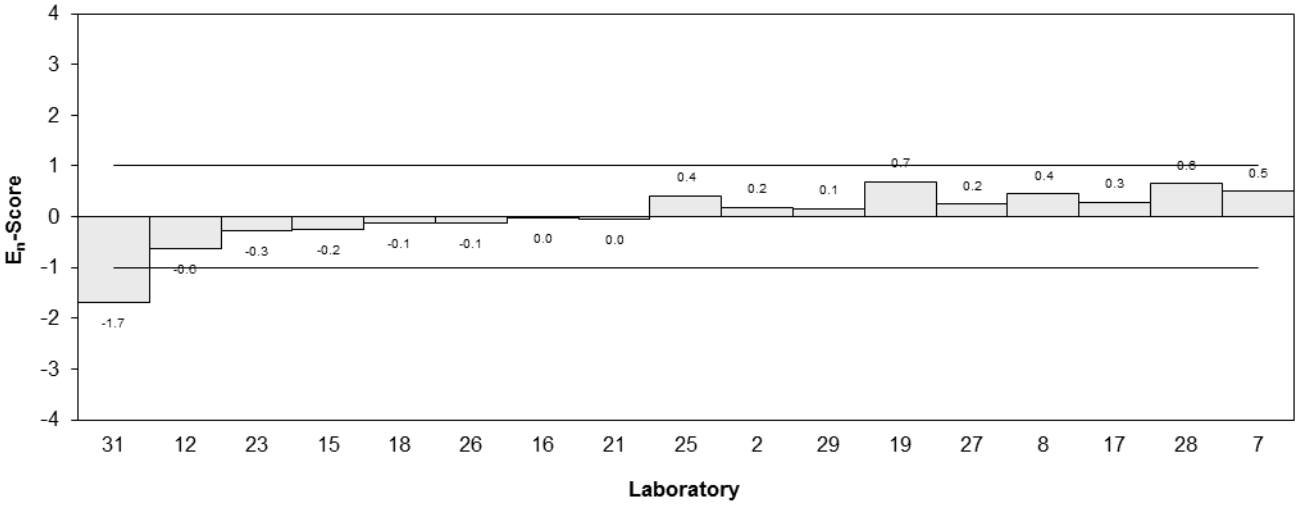

En-Scores: S2 - Sn
En-Score
Laboratory
31 12 23 15 18 26 16 21 25 2 29 19 27 8 17 28 7
-1.7 -0.6 -0.3 -0.2 -0.1 -0.1 0.0 0.0 0.4 0.2 0.1 0.7 0.2 0.4 0.3 0.6 0.5

Figure 30

Table 43

Sample Details

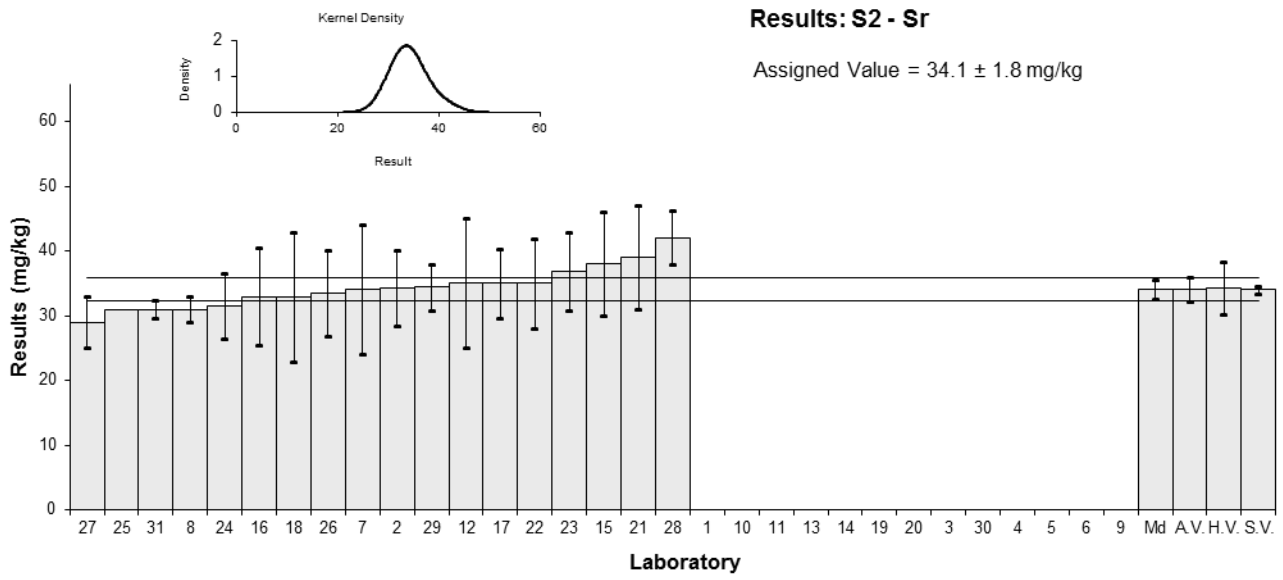
Sample No.	S2
Matrix.	Soil
Analyte.	Sr
Units	mg/kg

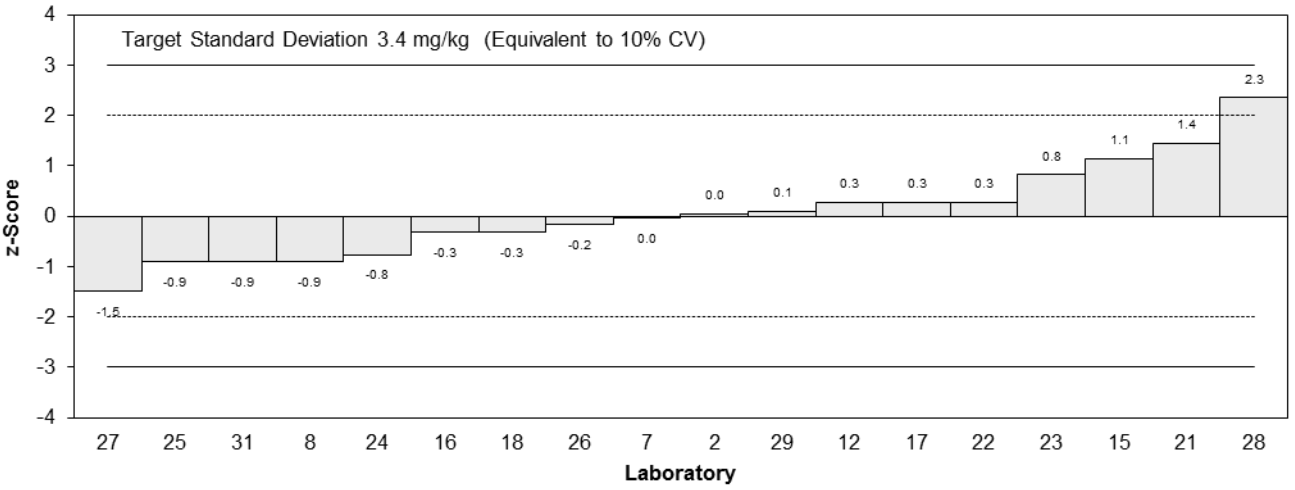
Participant Results

Lab Code	Result	Uncertainty	z-Score	En-Score
1	NT	NT		
2	34.26	5.9	0.05	0.03
3	NT	NT		
4	NT	NT		
5	NT	NT		
6	NT	NT		
7	34	10	-0.03	-0.01
8	31	2.0	-0.91	-1.15
9	NT	NT		
10	NT	NT		
11	NT	NT		
12	35	10	0.26	0.09
13	NT	NT		
14	NT	NT		
15	38	8	1.14	0.48
16	33	7.6	-0.32	-0.14
17	35	5.3	0.26	0.16
18	33	10	-0.32	-0.11
19	NT	NT		
20	NT	NT		
21	39.0	8.0	1.44	0.60
22	35	7	0.26	0.12
23	36.9	6.1	0.82	0.44
24	31.5	5	-0.76	-0.49
25	31.0	NR	-0.91	-1.72
26	33.5	6.7	-0.18	-0.09
27	29	4	-1.50	-1.16
28	42.106	4.211	2.35	1.75
29	34.4	3.6	0.09	0.07
30	NT	NT		
31	31	1.4	-0.91	-1.36

Statistics

Assigned Value	34.1	1.8
Spike	34.0	0.6
Homogeneity Value	34.3	4.1
Robust Average	34.1	1.8
Median	34.1	1.4
Mean	34.3	
N	18	
Max.	42.106	
Min.	29	
Robust SD	3.1	
Robust CV	9.1%	


Kernel Density
Density
Result
Results: S2 - Sr
Assigned Value = 34.1 ± 1.8 mg/kg
Results (mg/kg)
Laboratory
27 25 31 8 24 16 18 26 7 2 29 12 17 22 23 15 21 28 1 10 11 13 14 19 20 3 30 4 5 6 9 Md A.V. H.V. S.V.


z-Scores: S2 - Sr
Target Standard Deviation 3.4 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
27 25 31 8 24 16 18 26 7 2 29 12 17 22 23 15 21 28
-1.5 -0.9 -0.9 -0.9 -0.8 -0.3 -0.3 -0.2 0.0 0.0 0.1 0.3 0.3 0.3 0.8 1.1 1.4 2.3

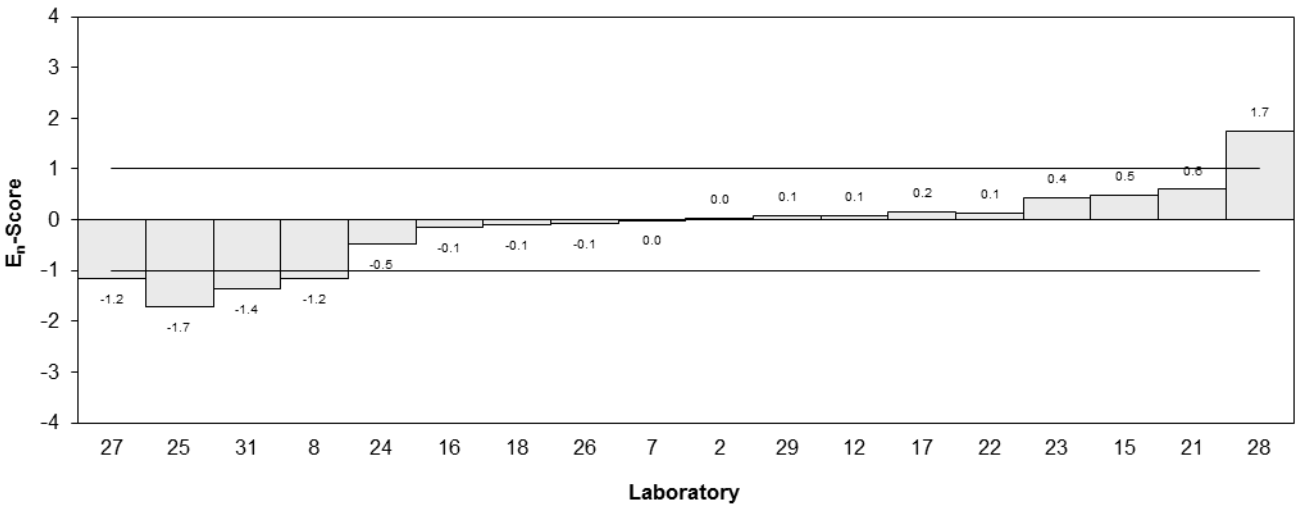

En-Scores: S2 - Sr
En-Score
Laboratory
27 25 31 8 24 16 18 26 7 2 29 12 17 22 23 15 21 28
-1.2 -1.7 -1.4 -1.2 -0.5 -0.1 -0.1 -0.1 0.0 0.0 0.1 0.1 0.2 0.1 0.4 0.5 0.6 1.7

Figure 31

Table 44

Sample Details

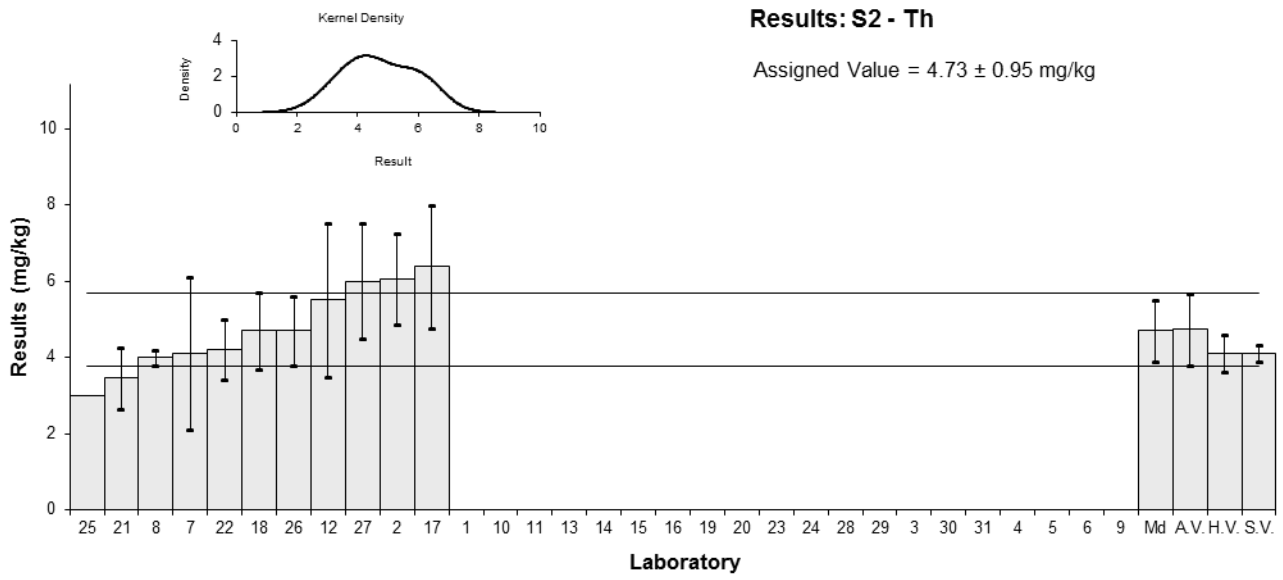
Sample No.	S2
Matrix.	Soil
Analyte.	Th
Units	mg/kg

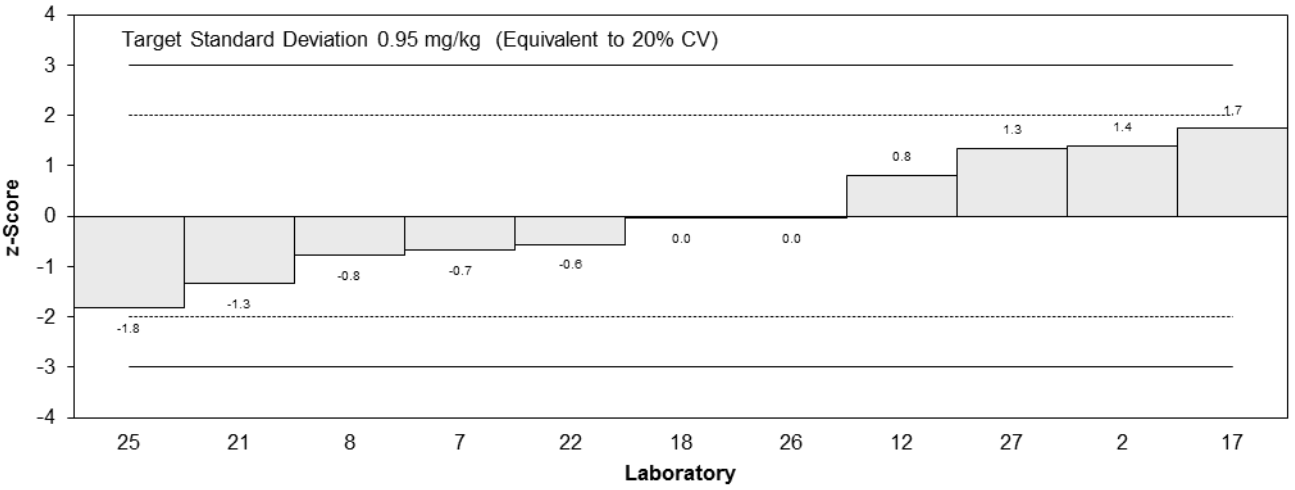
Participant Results

Lab Code	Result	Uncertainty	z-Score	En-Score
1	NT	NT		
2	6.046	1.2	1.39	0.86
3	NT	NT		
4	NT	NT		
5	NT	NT		
6	NT	NT		
7	4.1	2	-0.67	-0.28
8	4.0	0.2	-0.77	-0.75
9	NT	NT		
10	NT	NT		
11	NT	NT		
12	5.5	2	0.81	0.35
13	NT	NT		
14	NT	NT		
15	NT	NT		
16	NR	NR		
17	6.3753	1.6	1.74	0.88
18	4.7	1	-0.03	-0.02
19	NT	NT		
20	NT	NT		
21	3.46	0.8	-1.34	-1.02
22	4.2	0.8	-0.56	-0.43
23	NR	NR		
24	NR	NR		
25	3.0	NR	-1.83	-1.82
26	4.7	0.9	-0.03	-0.02
27	6.0	1.5	1.34	0.72
28	NT	NT		
29	NT	NT		
30	NT	NT		
31	NT	NT		

Statistics

Assigned Value	4.73	0.95
Spike	4.10	0.21
Homogeneity Value	4.10	0.49
Robust Average	4.73	0.95
Median	4.70	0.80
Mean	4.74	
N	11	
Max.	6.375	
Min.	3	
Robust SD	1.3	
Robust CV	28%	


Kernel Density
Density
Result
Results: S2 - Th
Assigned Value = 4.73 ± 0.95 mg/kg
Results (mg/kg)
Laboratory
25 21 8 7 22 18 26 12 27 2 17 1 10 11 13 14 15 16 19 20 23 24 28 29 3 30 31 4 5 6 9 Md A.V. H.V. S.V.


z-Scores: S2 - Th
Target Standard Deviation 0.95 mg/kg (Equivalent to 20% CV)
z-Score
Laboratory
25 21 8 7 22 18 26 12 27 2 17
-1.8 -1.3 -0.8 -0.7 -0.6 0.0 0.0 0.8 1.3 1.4 1.7

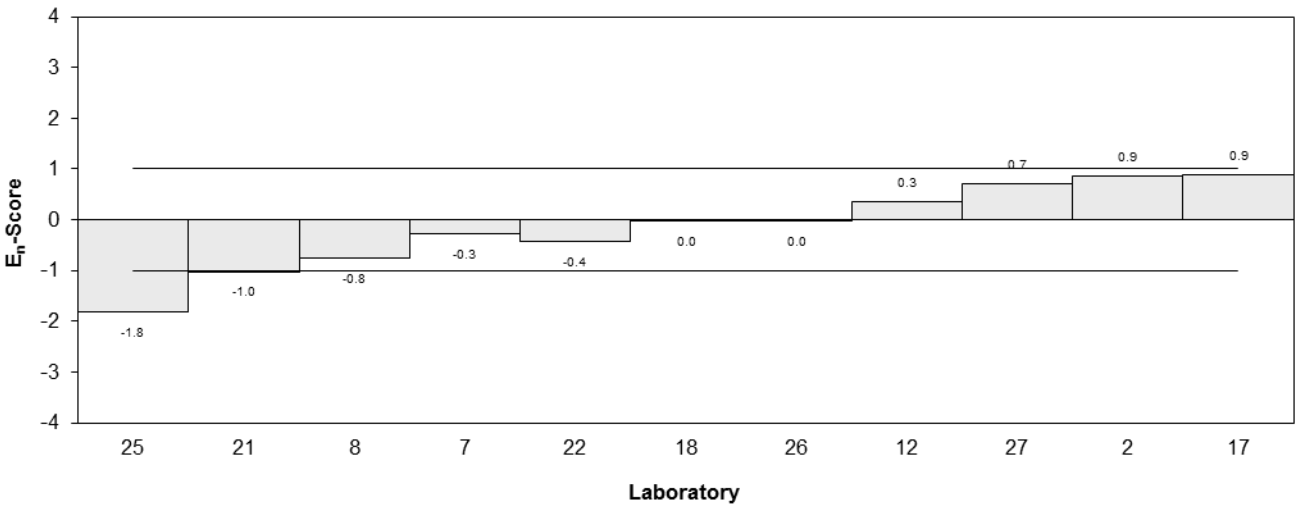

En-Scores: S2 - Th
En-Score
Laboratory
25 21 8 7 22 18 26 12 27 2 17
-1.8 -1.0 -0.8 -0.3 -0.4 0.0 0.0 0.3 0.7 0.9 0.9

Figure 32

Table 45

Sample Details

Sample No.	S2
Matrix.	Soil
Analyte.	Tl
Units	mg/kg

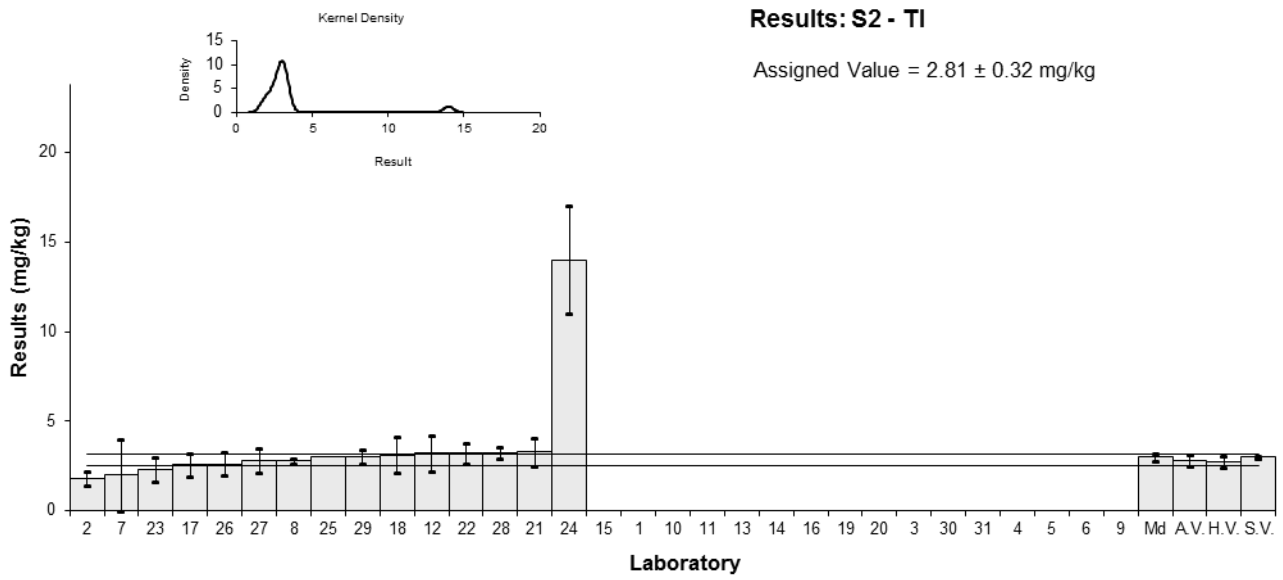
Participant Results

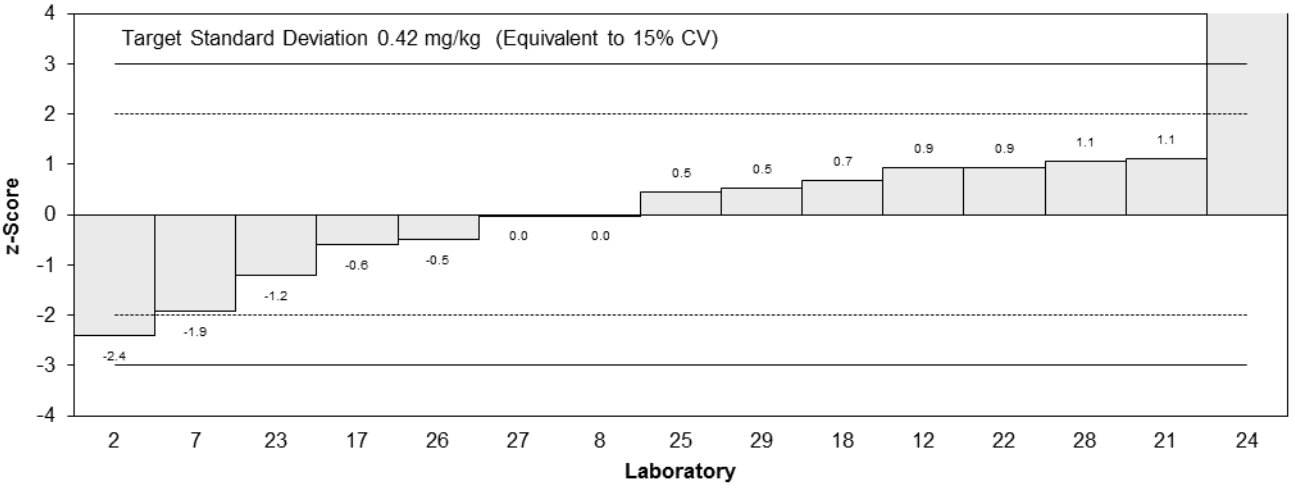
Lab Code	Result	Uncertainty	z-Score	En-Score
1	NT	NT		
2	1.800	0.39	-2.40	-2.00
3	NT	NT		
4	NT	NT		
5	NT	NT		
6	NT	NT		
7	2	2	-1.92	-0.40
8	2.8	0.14	-0.02	-0.03
9	NT	NT		
10	NT	NT		
11	NT	NT		
12	3.2	1	0.93	0.37
13	NT	NT		
14	NT	NT		
15	<4	NR		
16	NR	NR		
17	2.5599	0.64	-0.59	-0.35
18	3.1	1	0.69	0.28
19	NT	NT		
20	NT	NT		
21	3.28	0.8	1.12	0.55
22	3.2	0.6	0.93	0.57
23	2.30	0.69	-1.21	-0.67
24	14	3	26.55	3.71
25	3.0	NR	0.45	0.59
26	2.6	0.65	-0.50	-0.29
27	2.8	0.7	-0.02	-0.01
28	3.257	0.326	1.06	0.98
29	3.03	0.39	0.52	0.44
30	NT	NT		
31	NT	NT		

Statistics

Assigned Value	2.81	0.32
Spike	2.99	0.06
Homogeneity Value	2.72	0.33
Robust Average*	2.86	0.34
Median	3.00	0.21
Mean	3.53	
N	15	
Max.	14	
Min.	1.8	
Robust SD	0.47	
Robust CV	16%	

* Robust Average excluding Laboratory nr 24


Kernel Density
Density
Result
Results: S2 - Tl
Assigned Value = 2.81 ± 0.32 mg/kg
Results (mg/kg)
Laboratory
2 7 23 17 26 27 8 25 29 18 12 22 28 21 24 15 1 10 11 13 14 16 19 20 3 30 31 4 5 6 9 Md A.V. H.V. S.V.


z-Scores: S2 - Tl
Target Standard Deviation 0.42 mg/kg (Equivalent to 15% CV)
z-Score
Laboratory
2 7 23 17 26 27 8 25 29 18 12 22 28 21 24
-2.4 -1.9 -1.2 -0.6 -0.5 0.0 0.0 0.5 0.5 0.7 0.9 0.9 1.1 1.1

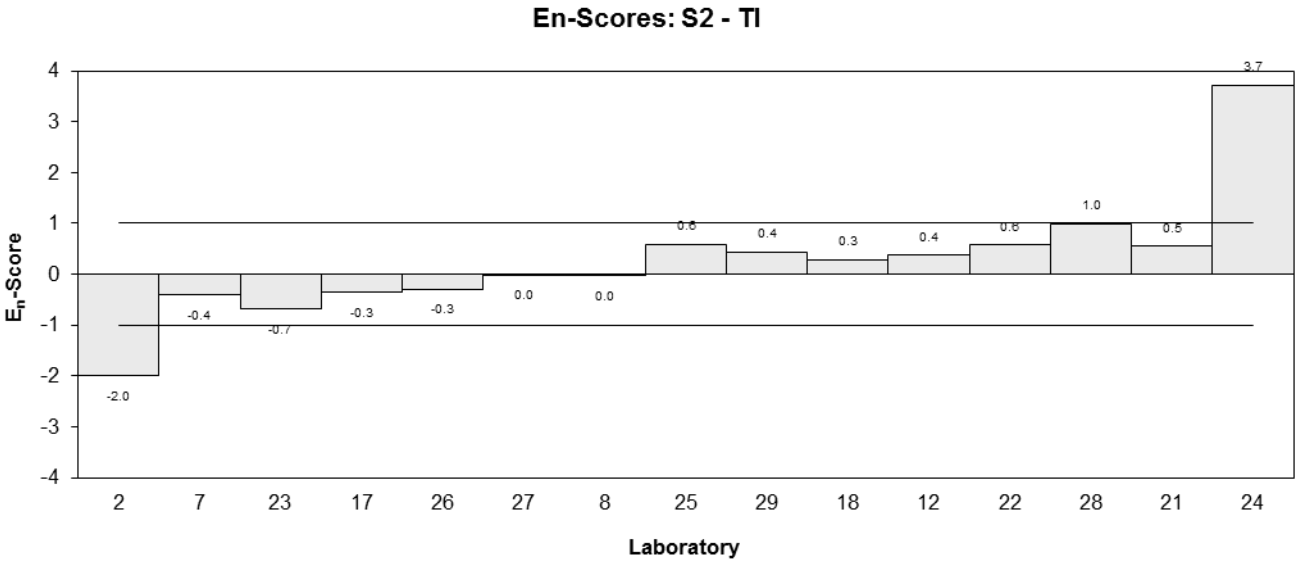

En-Scores: S2 - Tl
En-Score
Laboratory
2 7 23 17 26 27 8 25 29 18 12 22 28 21 24
-2.0 -0.4 -0.7 -0.3 -0.3 0.0 0.0 0.6 0.4 0.3 0.4 0.6 1.0 0.5 3.7

Figure 33

Table 46

Sample Details

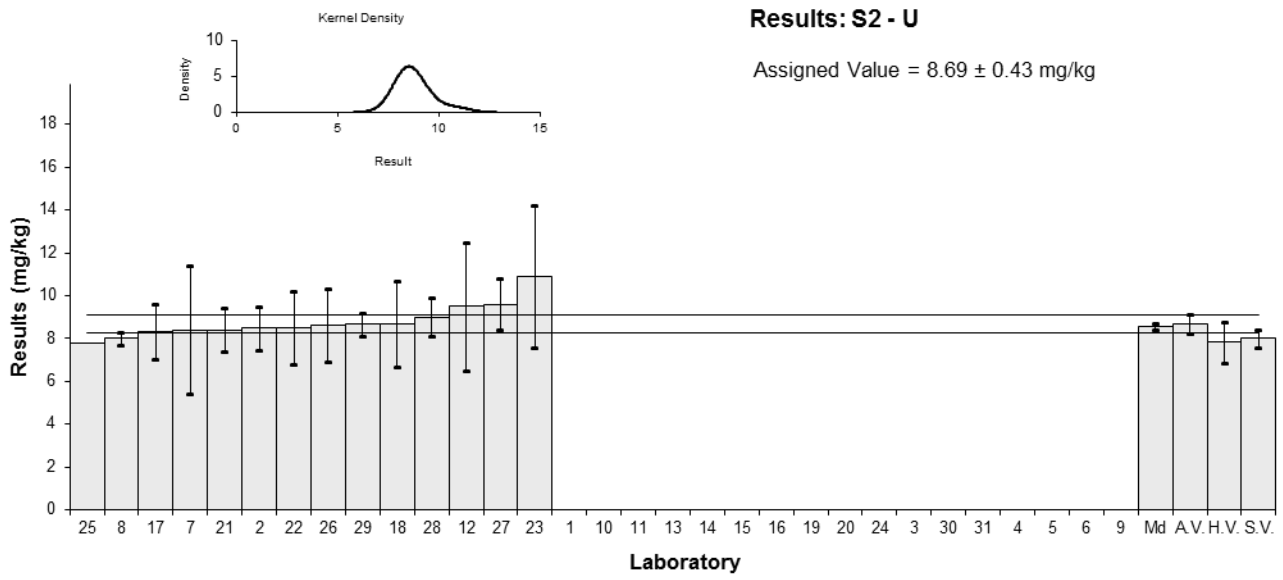
Sample No.	S2
Matrix.	Soil
Analyte.	U
Units	mg/kg

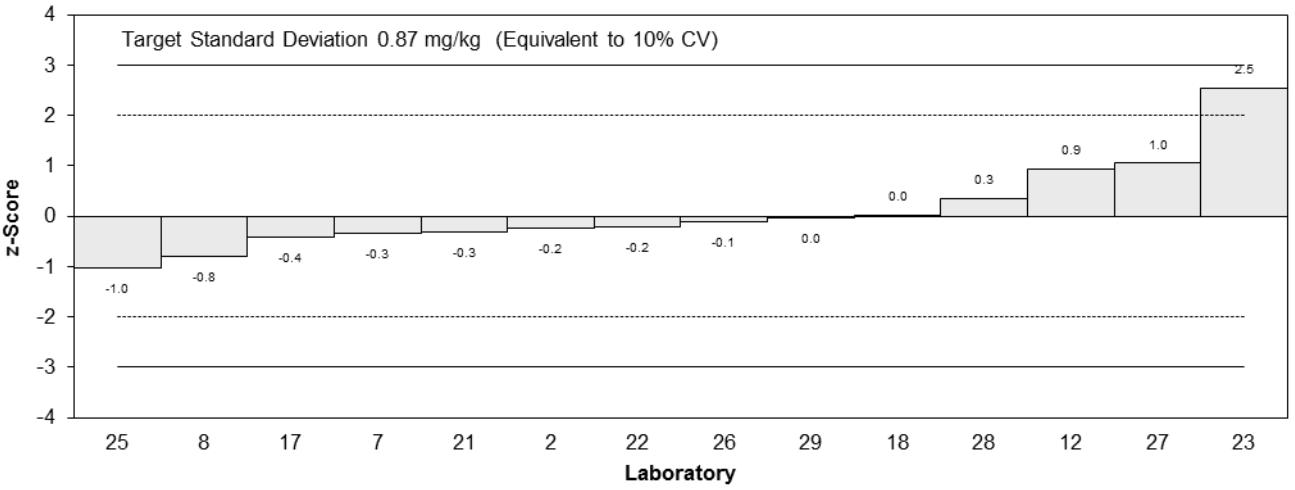
Participant Results

Lab Code	Result	Uncertainty	z-Score	En-Score
1	NT	NT		
2	8.480	1.0	-0.24	-0.19
3	NT	NT		
4	NT	NT		
5	NT	NT		
6	NT	NT		
7	8.4	3	-0.33	-0.10
8	8.0	0.3	-0.79	-1.32
9	NT	NT		
10	NT	NT		
11	NT	NT		
12	9.5	3	0.93	0.27
13	NT	NT		
14	NT	NT		
15	NT	NT		
16	NR	NR		
17	8.3228	1.3	-0.42	-0.27
18	8.7	2	0.01	0.00
19	NT	NT		
20	NT	NT		
21	8.41	1.0	-0.32	-0.26
22	8.5	1.7	-0.22	-0.11
23	10.9	3.3	2.54	0.66
24	NR	NR		
25	7.8	NR	-1.02	-2.07
26	8.6	1.7	-0.10	-0.05
27	9.6	1.2	1.05	0.71
28	8.994	0.899	0.35	0.31
29	8.66	0.53	-0.03	-0.04
30	NT	NT		
31	NT	NT		

Statistics

Assigned Value	8.69	0.43
Spike	8.01	0.42
Homogeneity Value	7.82	0.94
Robust Average	8.69	0.43
Median	8.55	0.16
Mean	8.78	
N	14	
Max.	10.9	
Min.	7.8	
Robust SD	0.64	
Robust CV	7.4%	


Kernel Density
Density
Result
Results: S2 - U
Assigned Value = 8.69 ± 0.43 mg/kg
Results (mg/kg)
Laboratory
25 8 17 7 21 2 22 26 29 18 28 12 27 23 1 10 11 13 14 15 16 19 20 24 3 30 31 4 5 6 9 Md A.V. H.V. S.V.


z-Scores: S2 - U
Target Standard Deviation 0.87 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
25 8 17 7 21 2 22 26 29 18 28 12 27 23
-1.0 -0.8 -0.4 -0.3 -0.3 -0.2 -0.2 -0.1 0.0 0.0 0.3 0.9 1.0 2.5

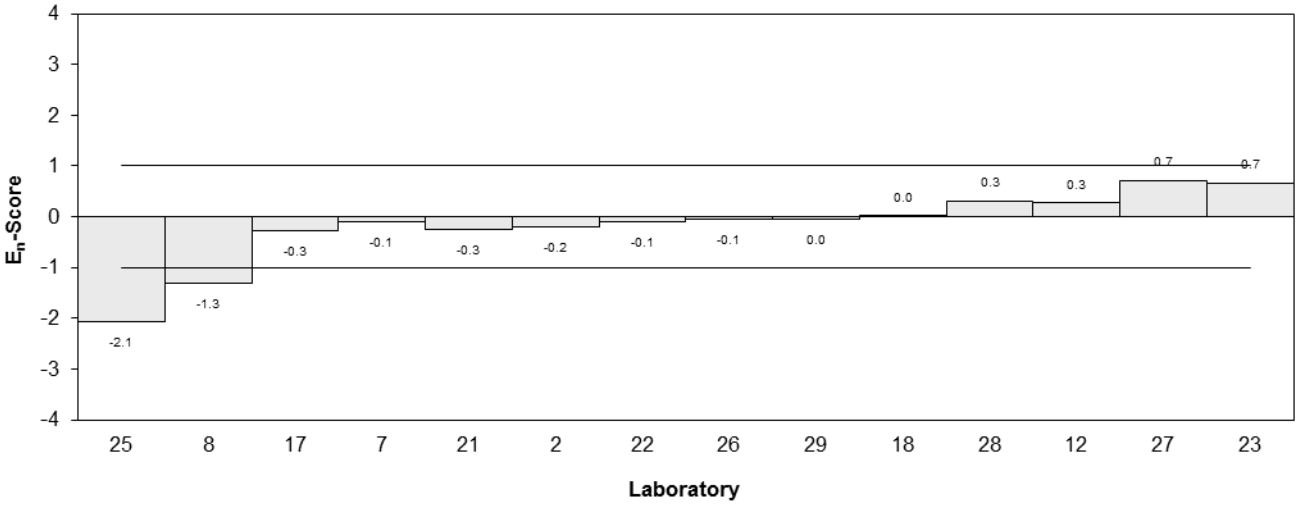

En-Scores: S2 - U
En-Score
Laboratory
25 8 17 7 21 2 22 26 29 18 28 12 27 23
-2.1 -1.3 -0.3 -0.1 -0.3 -0.2 -0.1 -0.1 0.0 0.0 0.3 0.3 0.7 0.7

Figure 34

Table 47

Sample Details

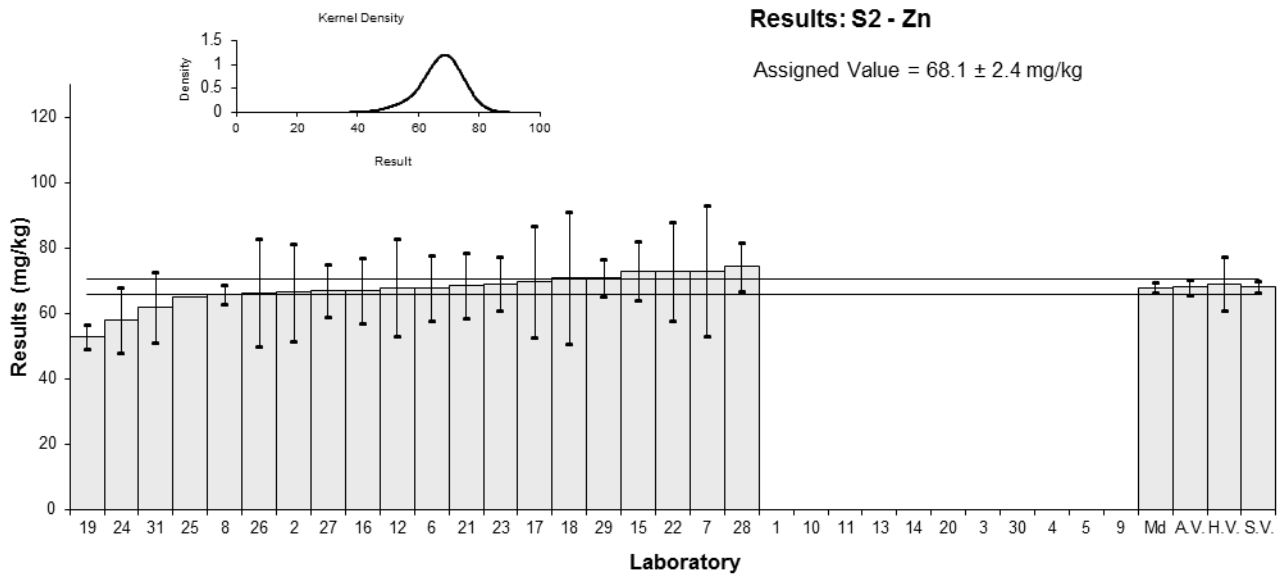
Sample No.	S2
Matrix.	Soil
Analyte.	Zn
Units	mg/kg

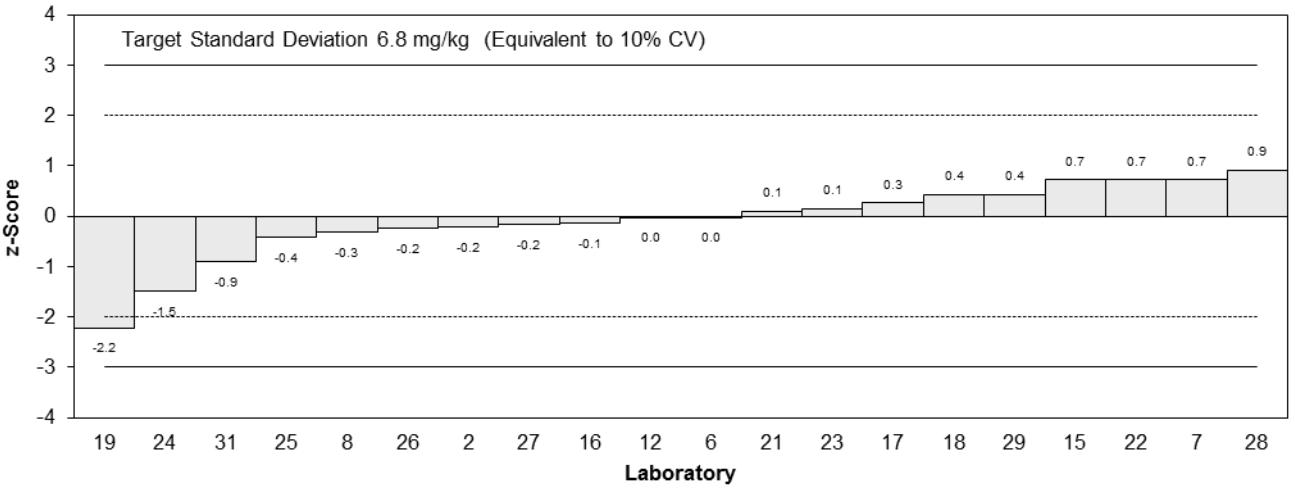
Participant Results

Lab Code	Result	Uncertainty	z-Score	En-Score
1	NT	NT		
2	66.56	15	-0.23	-0.10
3	NT	NT		
4	NT	NT		
5	NT	NT		
6	68	10	-0.01	-0.01
7	73	20	0.72	0.24
8	66	3.0	-0.31	-0.55
9	NT	NT		
10	NT	NT		
11	NT	NT		
12	68	15	-0.01	-0.01
13	NT	NT		
14	NT	NT		
15	73	9	0.72	0.53
16	67.1	10	-0.15	-0.10
17	69.8754	17	0.26	0.10
18	71	20	0.43	0.14
19	53	3.7	-2.22	-3.42
20	NT	NT		
21	68.7	10	0.09	0.06
22	73	15	0.72	0.32
23	69.1	8.2	0.15	0.12
24	58.0	10	-1.48	-0.98
25	65.2	NR	-0.43	-1.21
26	66.4	16.5	-0.25	-0.10
27	67	8	-0.16	-0.13
28	74.319	7.432	0.91	0.80
29	71.0	5.7	0.43	0.47
30	NT	NT		
31	62	10.7	-0.90	-0.56

Statistics

Assigned Value	68.1	2.4
Spike	68.2	1.7
Homogeneity Value	69.2	8.3
Robust Average	68.1	2.4
Median	68.0	1.7
Mean	67.5	
N	20	
Max.	74.319	
Min.	53	
Robust SD	4.3	
Robust CV	6.3%	


Kernel Density
Density
Result
Results: S2 - Zn
Assigned Value = 68.1 ± 2.4 mg/kg
Results (mg/kg)
Laboratory
19 24 31 25 8 26 2 27 16 12 6 21 23 17 18 29 15 22 7 28 1 10 11 13 14 20 3 30 4 5 9 Md A.V. H.V. S.V.


z-Scores: S2 - Zn
Target Standard Deviation 6.8 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
19 24 31 25 8 26 2 27 16 12 6 21 23 17 18 29 15 22 7 28
-2.2 -1.5 -0.9 -0.4 -0.3 -0.2 -0.2 -0.2 -0.1 0.0 0.0 0.1 0.1 0.3 0.4 0.4 0.7 0.7 0.7 0.9

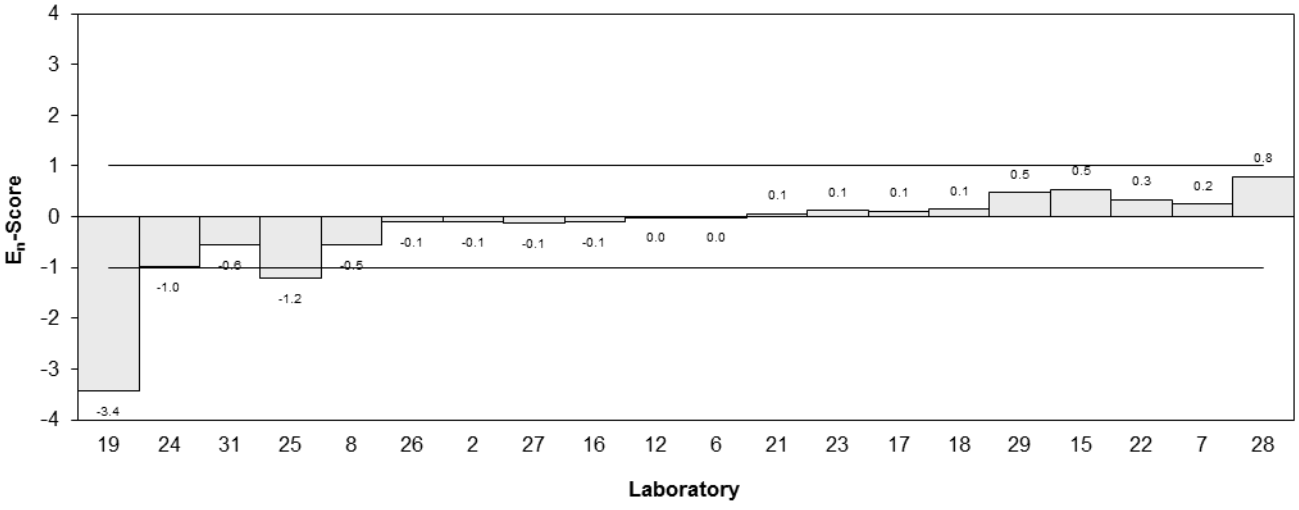

En-Scores: S2 - Zn
En-Score
Laboratory
19 24 31 25 8 26 2 27 16 12 6 21 23 17 18 29 15 22 7 28
-3.4 -1.0 -0.6 -1.2 -0.5 -0.1 -0.1 -0.1 -0.1 0.0 0.0 0.1 0.1 0.1 0.1 0.5 0.5 0.3 0.2 0.8

Figure 35

Table 48

Sample Details

Sample No.	S3
Matrix.	Soil
Analyte.	Ca
Units	mg/kg

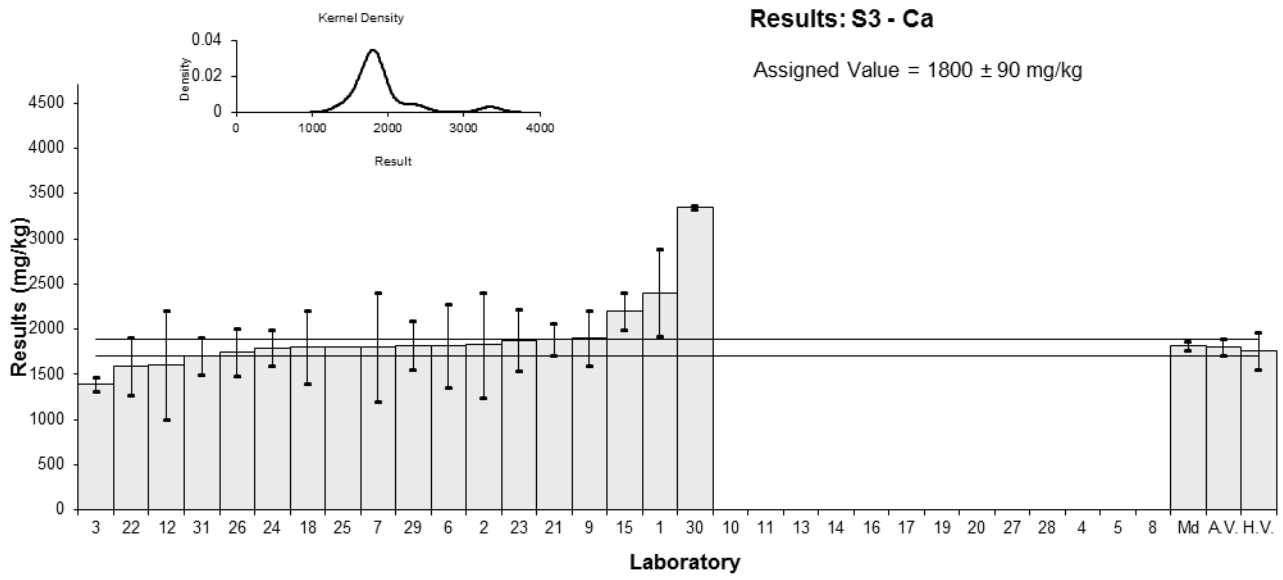
Participant Results

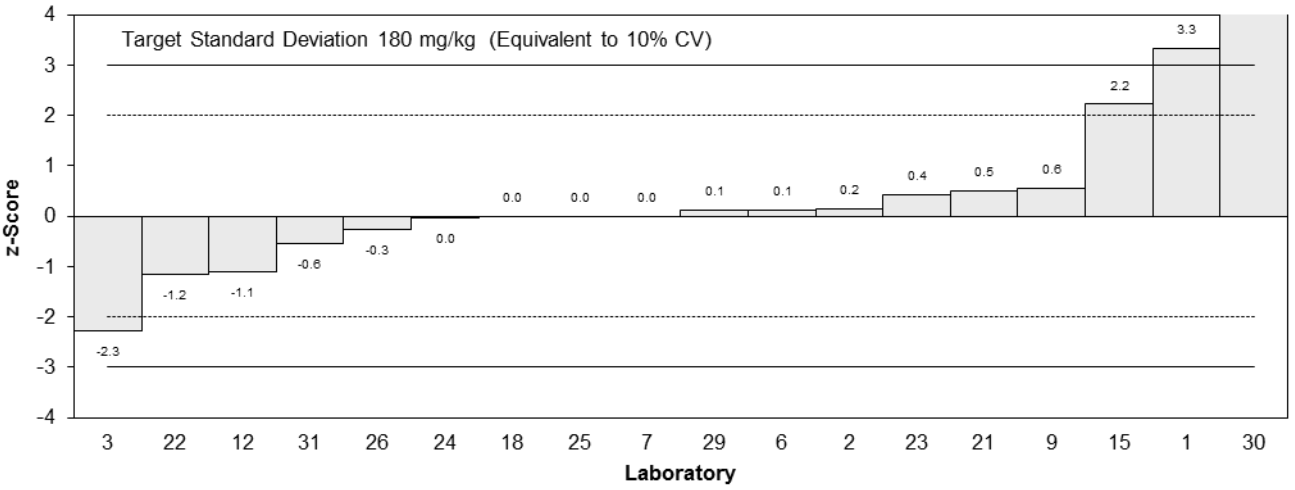
Lab Code	Result	Uncertainty	z-Score	En-Score
1	2400	480	3.33	1.23
2	1827	580	0.15	0.05
3	1390	83	-2.28	-3.35
4	NT	NT		
5	NT	NT		
6	1820	460	0.11	0.04
7	1800	600	0.00	0.00
8	NT	NT		
9	1900	304	0.56	0.32
10	NT	NT		
11	NT	NT		
12	1600	600	-1.11	-0.33
13	NR	NR		
14	NT	NT		
15	2200	200	2.22	1.82
16	NT	NT		
17	NT	NT		
18	1800	400	0.00	0.00
19	NT	NT		
20	NT	NT		
21	1890	180	0.50	0.45
22	1590	320	-1.17	-0.63
23	1877	338	0.43	0.22
24	1795	200	-0.03	-0.02
25	1800	NR	0.00	0.00
26	1750	263	-0.28	-0.18
27	NT	NT		
28	NT	NT		
29	1820	270	0.11	0.07
30	3347.4	16.91	8.60	16.90
31	1700	206	-0.56	-0.44

Statistics

Assigned Value*	1800	90
Spike	Not Spiked	
Homogeneity Value	1760	210
Robust Average	1820	110
Median	1810	50
Mean	1906	
N	18	
Max.	3347.4	
Min.	1390	
Robust SD	150	
Robust CV	8.2%	

* Robust Average excluding Laboratory 30.


Kernel Density
Density
Result
Results: S3 - Ca
Assigned Value = 1800 ± 90 mg/kg
Results (mg/kg)
Laboratory
3 22 12 31 26 24 18 25 7 29 6 2 23 21 9 15 1 30 10 11 13 14 16 17 19 20 27 28 4 5 8 Md A.V. H.V.


z-Scores: S3 - Ca
Target Standard Deviation 180 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
3 22 12 31 26 24 18 25 7 29 6 2 23 21 9 15 1 30

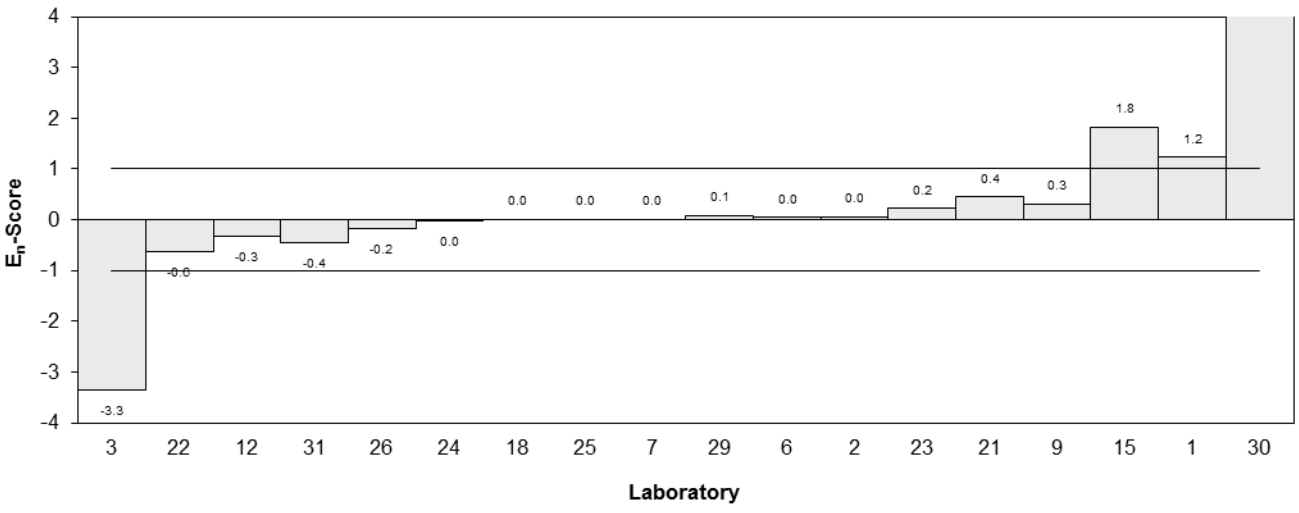

En-Scores: S3 - Ca
En-Score
Laboratory
3 22 12 31 26 24 18 25 7 29 6 2 23 21 9 15 1 30

Figure 36

Table 49

Sample Details

Sample No.	S3
Matrix.	Soil
Analyte.	Colwell K
Units	mg/kg

Participant Results

Lab Code	Result	Uncertainty
1	NT	NT
2	NT	NT
3	NT	NT
4	NT	NT
5	NT	NT
6	NT	NT
7	140	40
8	NT	NT
9	NT	NT
10	NT	NT
11	NT	NT
12	NR	NR
13	NR	NR
14	NT	NT
15	NT	NT
16	NT	NT
17	NT	NT
18	NT	NT
19	NT	NT
20	NT	NT
21	198	25
22	NR	NR
23	NR	NR
24	NR	NR
25	NR	NR
26	NT	NT
27	NT	NT
28	NT	NT
29	NT	NT
30	NT	NT
31	NT	NT

Statistics

Assigned Value	Not Set	
Spike	Not Spiked	
Homogeneity Value	158	19
Robust Average	169	82
Median	170	390
Mean	169	
N	2	
Max.	198	
Min.	140	
Robust SD	47	
Robust CV	28%	

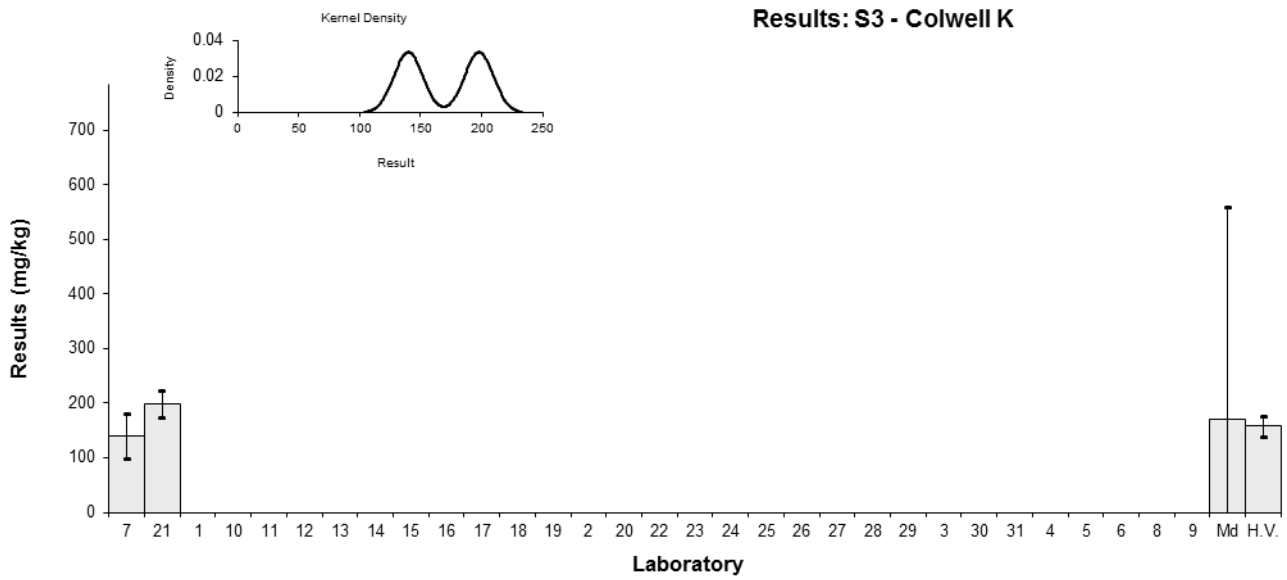

Results: S3 - Colwell K
Kernel Density
Density
0.04
0.02
0
0
50
100
150
200
250
Result
Results (mg/kg)
700
600
500
400
300
200
100
0
7
21
1
10
11
12
13
14
15
16
17
18
19
2
20
22
23
24
25
26
27
28
29
3
30
31
4
5
6
8
9
Md
H.V.
Laboratory

Figure 37

Table 50

Sample Details

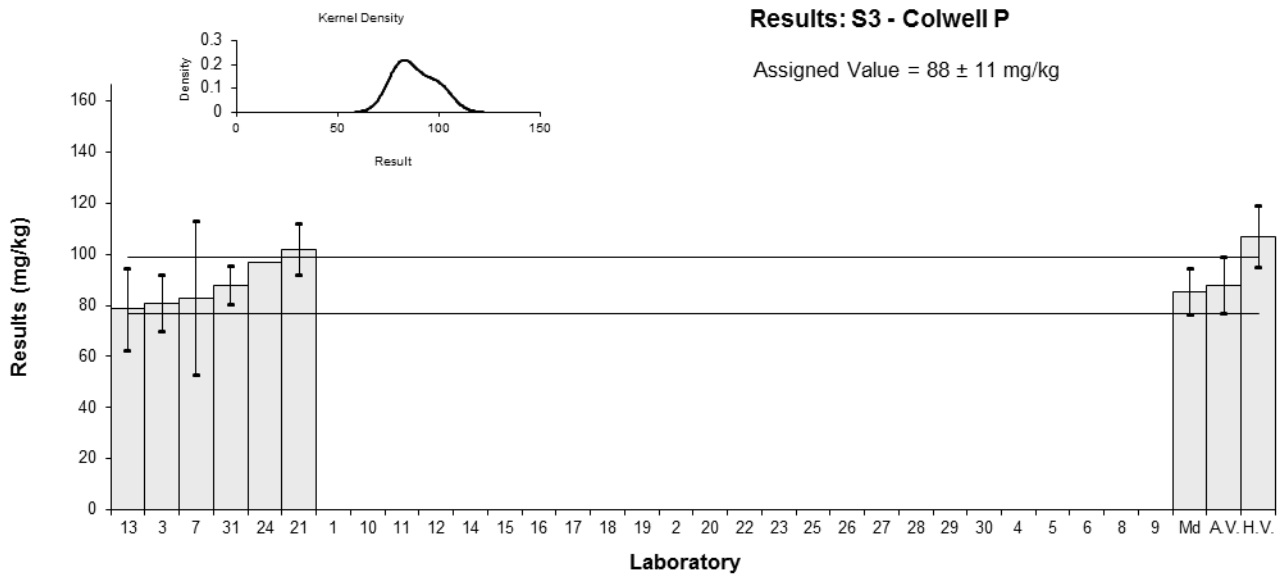
Sample No.	S3
Matrix.	Soil
Analyte.	Colwell P
Units	mg/kg

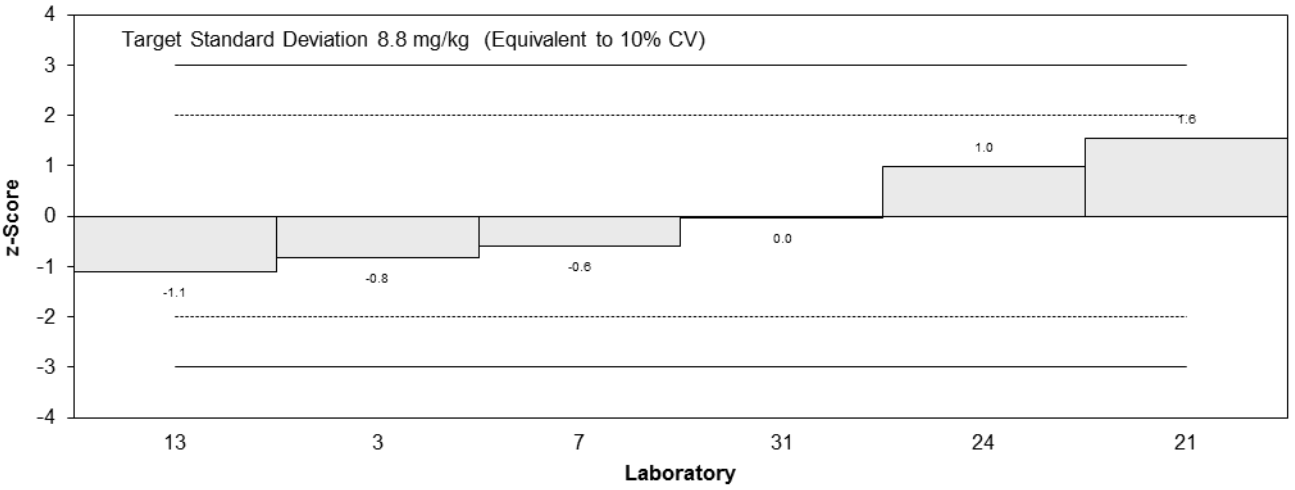
Participant Results

Lab Code	Result	Uncertainty	z-Score	En-Score
1	NT	NT		
2	NT	NT		
3	81	11	-0.80	-0.45
4	NT	NT		
5	NT	NT		
6	NT	NT		
7	83	30	-0.57	-0.16
8	NT	NT		
9	NT	NT		
10	NT	NT		
11	NT	NT		
12	NR	NR		
13	78.6	16	-1.07	-0.48
14	NT	NT		
15	NT	NT		
16	NT	NT		
17	NT	NT		
18	NT	NT		
19	NT	NT		
20	NT	NT		
21	102	10	1.59	0.94
22	NR	NR		
23	NR	NR		
24	97.0	NR	1.02	0.82
25	NR	NR		
26	NT	NT		
27	NT	NT		
28	NT	NT		
29	NT	NT		
30	NT	NT		
31	88	7.62	0	0

Statistics

Assigned Value	88	11
Spike	Not Spiked	
Homogeneity Value	107	12
Robust Average	88	11
Median	85.5	8.9
Mean	88.3	
N	6	
Max.	102	
Min.	78.6	
Robust SD	11	
Robust CV	13%	


Kernel Density
Density
Result
Results: S3 - Colwell P
Assigned Value = 88 ± 11 mg/kg
Results (mg/kg)
Laboratory
13 3 7 31 24 21 1 10 11 12 14 15 16 17 18 19 2 20 22 23 25 26 27 28 29 30 4 5 6 8 9 Md A.V. H.V.


z-Scores: S3 - Colwell P
Target Standard Deviation 8.8 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
13 3 7 31 24 21
-1.1
-0.8
-0.6
0.0
1.0
1.6

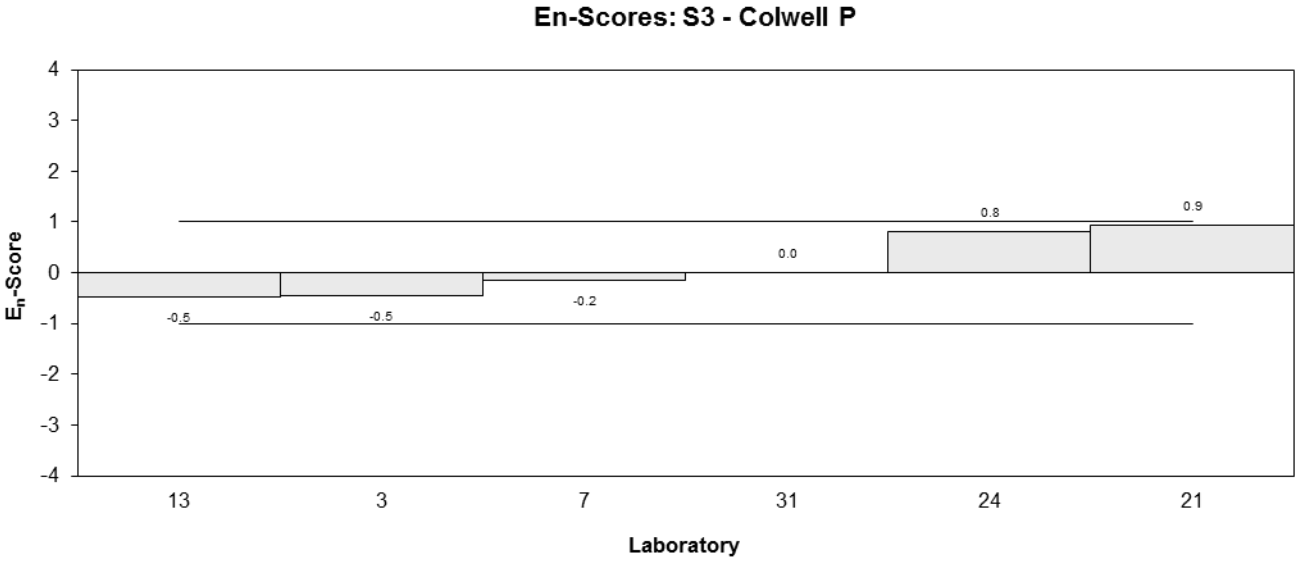

En-Scores: S3 - Colwell P
En-Score
Laboratory
13 3 7 31 24 21
-0.5
-0.5
-0.2
0.0
0.8
0.9

Figure 38

Table 51

Sample Details

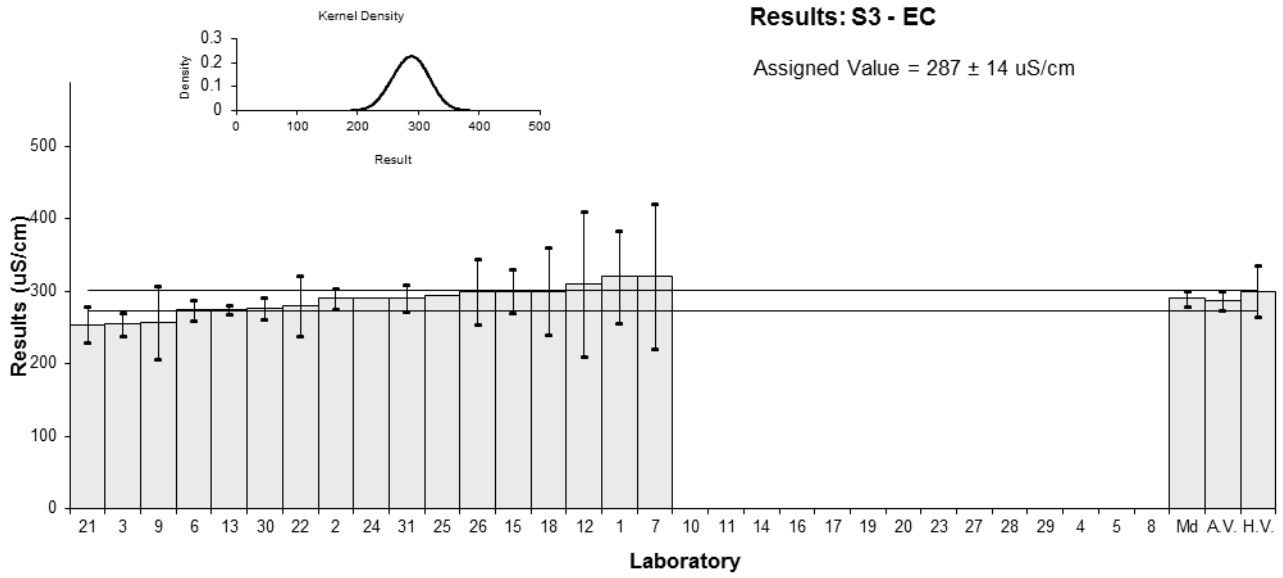
Sample No.	S3
Matrix.	Soil
Analyte.	EC
Units	uS/cm

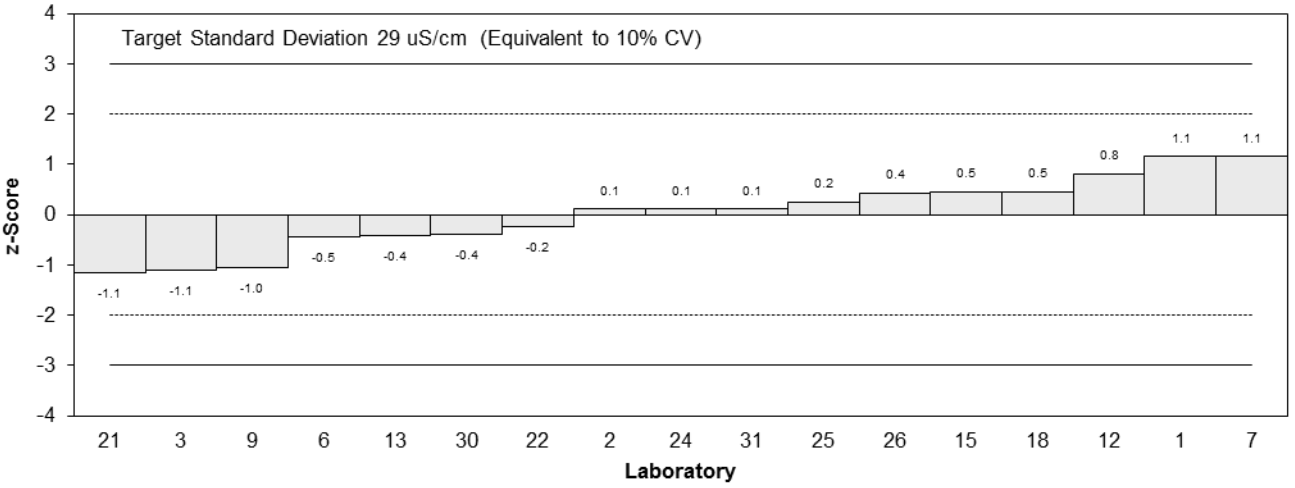
Participant Results

Lab Code	Result	Uncertainty	z-Score	En-Score
1	320	64	1.15	0.50
2	290	14	0.10	0.15
3	255	16	-1.11	-1.51
4	NT	NT		
5	NT	NT		
6	274	14	-0.45	-0.66
7	320	100	1.15	0.33
8	NT	NT		
9	257	51	-1.05	-0.57
10	NT	NT		
11	NT	NT		
12	310	100	0.80	0.23
13	275	6	-0.42	-0.79
14	NT	NT		
15	300	30	0.45	0.39
16	NT	NT		
17	NT	NT		
18	300	60	0.45	0.21
19	NT	NT		
20	NT	NT		
21	254	25	-1.15	-1.15
22	280	42	-0.24	-0.16
23	NR	NR		
24	290	NR	0.10	0.21
25	294	NR	0.24	0.50
26	299	45	0.42	0.25
27	NT	NT		
28	NT	NT		
29	NT	NT		
30	276	15	-0.38	-0.54
31	290	18.6	0.10	0.13

Statistics

Assigned Value	287	14
Spike	Not Spiked	
Homogeneity Value	300	36
Robust Average	287	14
Median	290	11
Mean	287	
N	17	
Max.	320	
Min.	254	
Robust SD	23	
Robust CV	8%	


Kernel Density
Density
Result
Results: S3 - EC
Assigned Value = 287 ± 14 uS/cm
Results (uS/cm)
Laboratory
21 3 9 6 13 30 22 2 24 31 25 26 15 18 12 1 7 10 11 14 16 17 19 20 23 27 28 29 4 5 8 Md A.V. H.V.


z-Scores: S3 - EC
Target Standard Deviation 29 uS/cm (Equivalent to 10% CV)
z-Score
Laboratory
21 3 9 6 13 30 22 2 24 31 25 26 15 18 12 1 7
-1.1 -1.1 -1.0 -0.5 -0.4 -0.4 -0.2 0.1 0.1 0.1 0.2 0.4 0.5 0.5 0.8 1.1 1.1

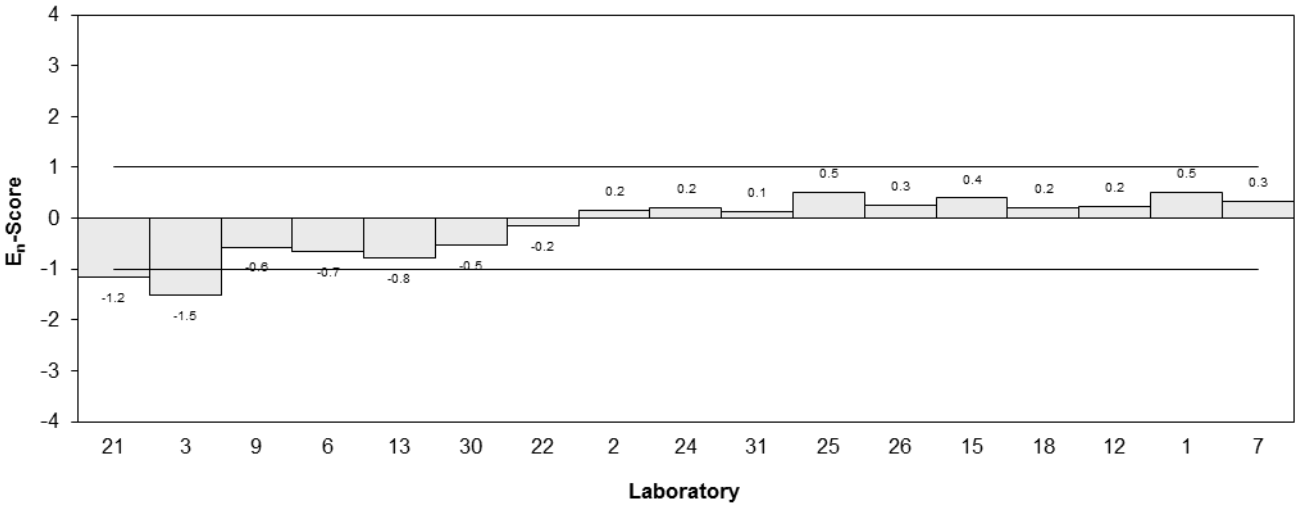

En-Scores: S3 - EC
En-Score
Laboratory
21 3 9 6 13 30 22 2 24 31 25 26 15 18 12 1 7
-1.2 -1.5 -0.6 -0.7 -0.8 -0.5 -0.2 0.2 0.2 0.1 0.5 0.3 0.4 0.2 0.2 0.5 0.3

Figure 39

Table 52

Sample Details

Sample No.	S3
Matrix.	Soil
Analyte.	Exchangeable Ca
Units	cmol(+)/kg

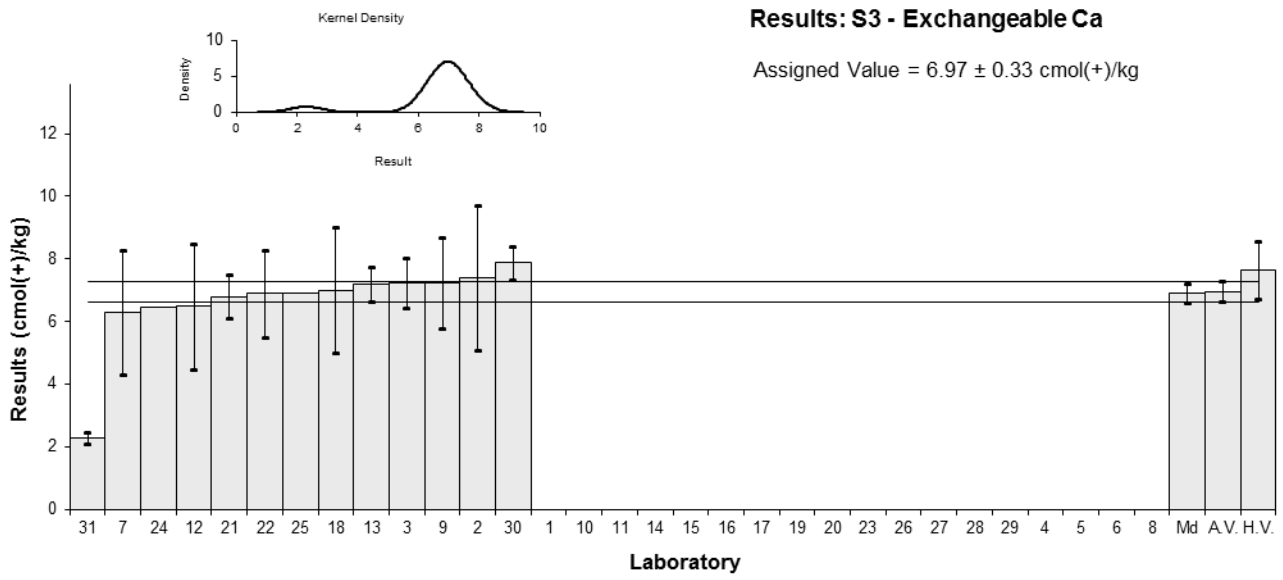
Participant Results

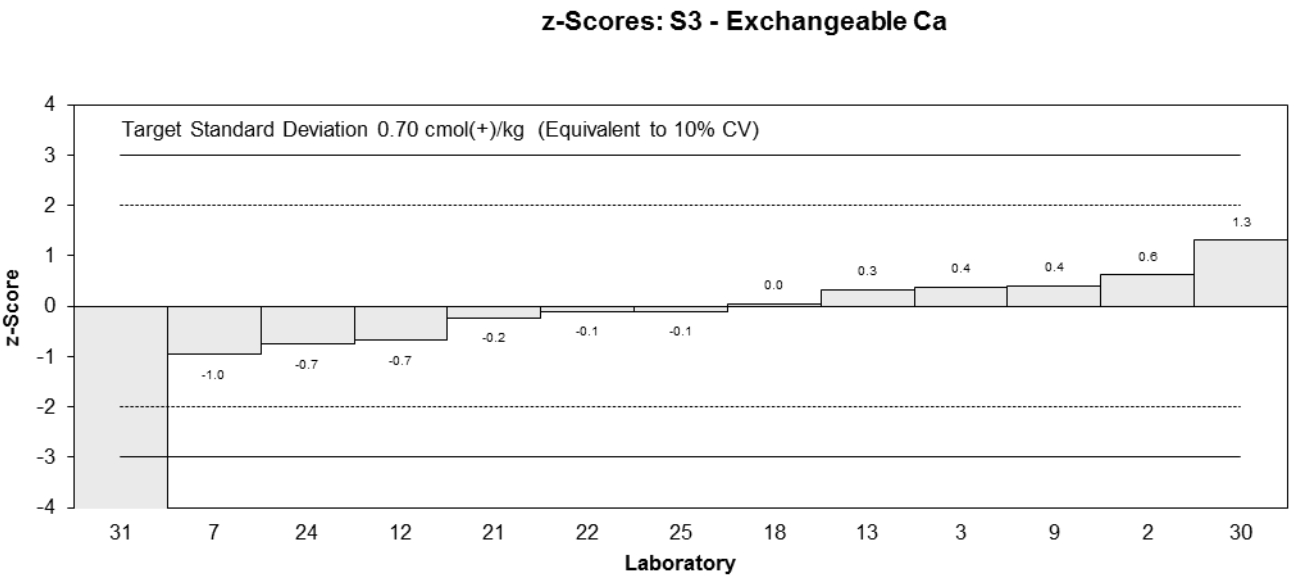
Lab Code	Result	Uncertainty	z-Score	En-Score
1	NT	NT		
2	7.4	2.3	0.62	0.19
3	7.23	0.80	0.37	0.30
4	NT	NT		
5	NT	NT		
6	NT	NT		
7	6.3	2	-0.96	-0.33
8	NT	NT		
9	7.25	1.45	0.40	0.19
10	NT	NT		
11	NT	NT		
12	6.5	2	-0.67	-0.23
13	7.2	0.56	0.33	0.35
14	NT	NT		
15	NT	NT		
16	NT	NT		
17	NT	NT		
18	7.0	2	0.04	0.01
19	NT	NT		
20	NT	NT		
21	6.81	0.7	-0.23	-0.21
22	6.9	1.4	-0.10	-0.05
23	NR	NR		
24	6.45	NR	-0.75	-1.58
25	6.9	NR	-0.10	-0.21
26	NT	NT		
27	NT	NT		
28	NT	NT		
29	NT	NT		
30	7.88	0.525	1.31	1.47
31	2.3	0.17	-6.70	-12.58

Statistics

Assigned Value*	6.97	0.33
Spike	Not Spiked	
Homogeneity Value	7.65	0.92
Robust Average	6.90	0.36
Median	6.90	0.31
Mean	6.63	
N	13	
Max.	7.88	
Min.	2.3	
Robust SD	0.46	
Robust CV	6.7%	

* Robust Average excluding Laboratory 31.


Kernel Density
Density
Result
Results: S3 - Exchangeable Ca
Assigned Value = 6.97 ± 0.33 cmol(+)/kg
Results (cmol(+)/kg)
31 7 24 12 21 22 25 18 13 3 9 2 30 1 10 11 14 15 16 17 19 20 23 26 27 28 29 4 5 6 8 Md A.V. H.V.
Laboratory


z-Scores: S3 - Exchangeable Ca
Target Standard Deviation 0.70 cmol(+)/kg (Equivalent to 10% CV)
z-Score
1.3 0.6 0.4 0.4 0.3 0.0 -0.1 -0.1 -0.2 -0.7 -0.7 -1.0
31 7 24 12 21 22 25 18 13 3 9 2 30
Laboratory

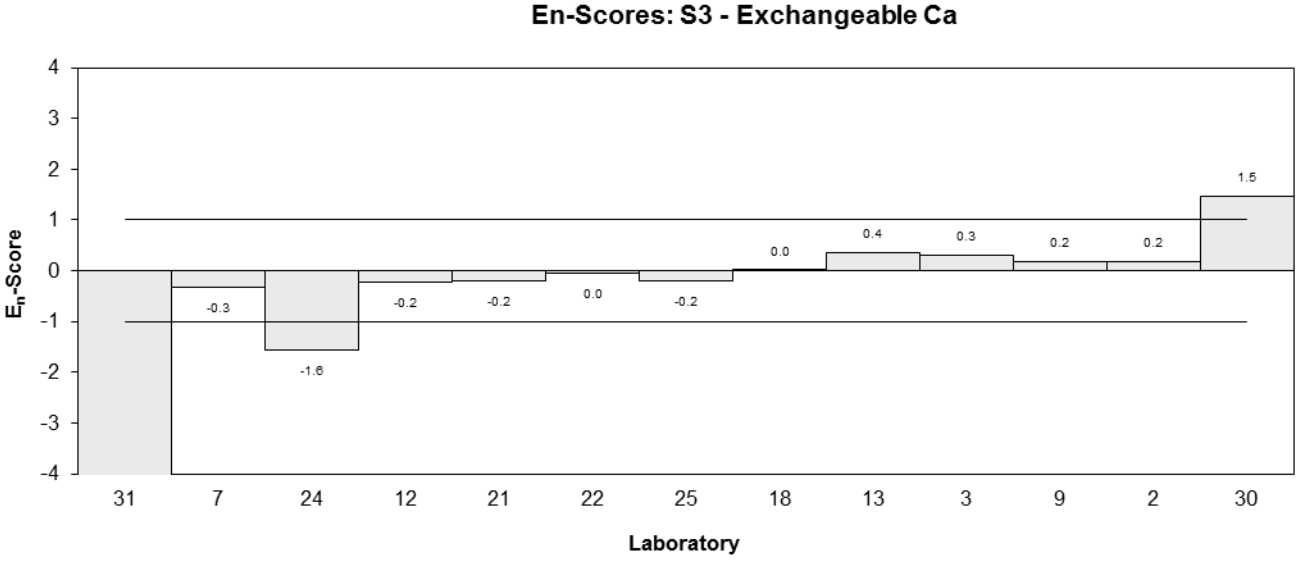

En-Scores: S3 - Exchangeable Ca
En-Score
1.5 0.4 0.3 0.2 0.2 0.0 0.0 -0.2 -0.2 -0.2 -0.3 -1.6
31 7 24 12 21 22 25 18 13 3 9 2 30
Laboratory

Figure 40

Table 53

Sample Details

Sample No.	S3
Matrix.	Soil
Analyte.	Exchangeable K
Units	cmol(+)/kg

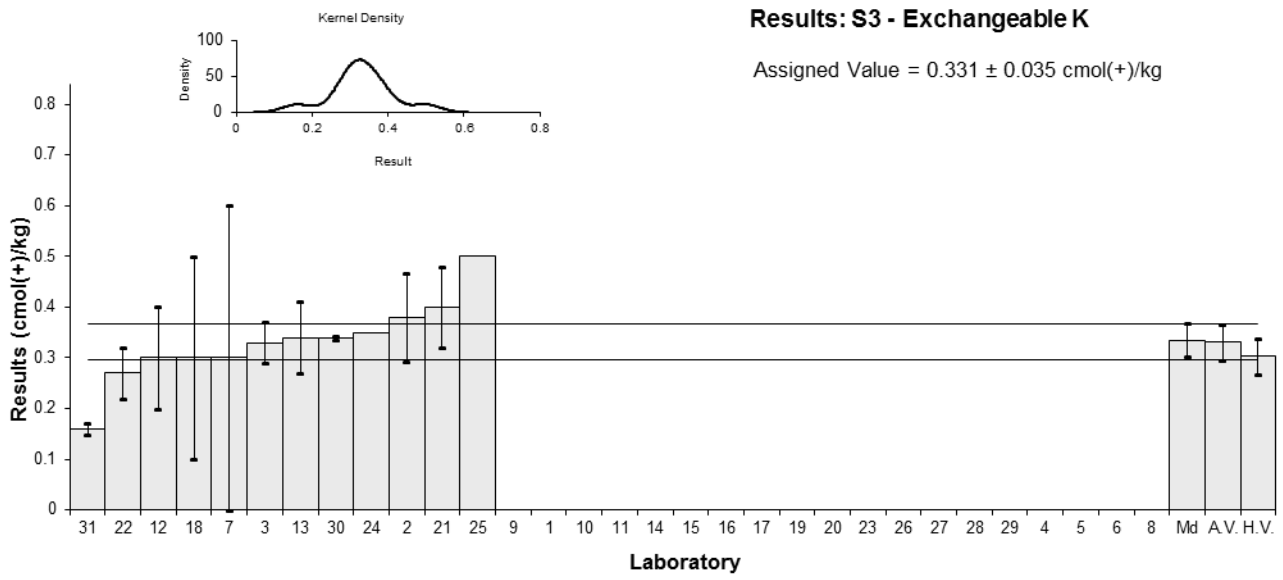
Participant Results

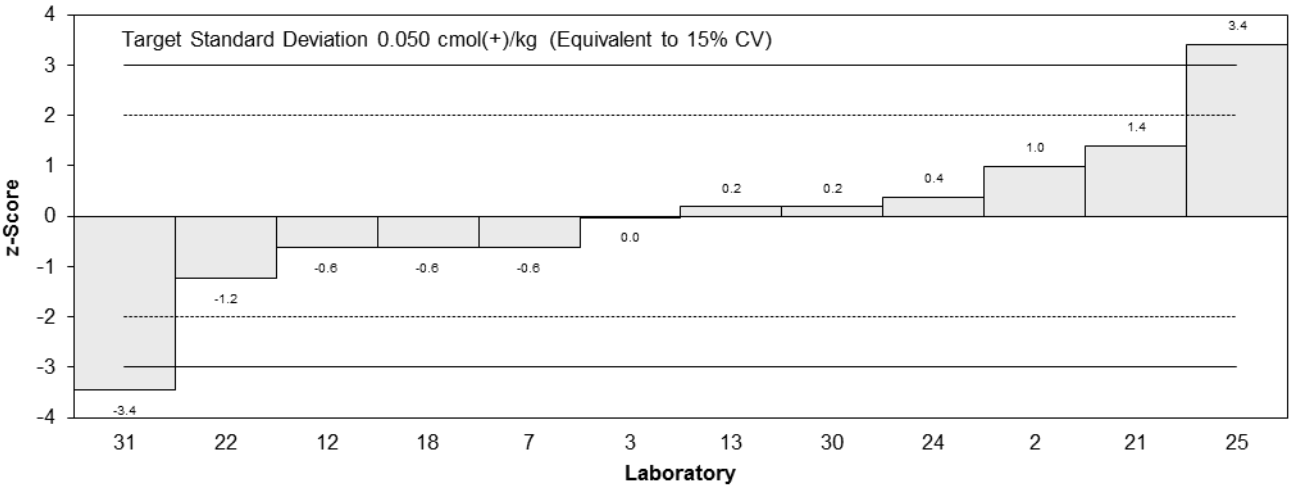
Lab Code	Result	Uncertainty	z-Score	En-Score
1	NT	NT		
2	0.38	0.087	0.99	0.52
3	0.33	0.04	-0.02	-0.02
4	NT	NT		
5	NT	NT		
6	NT	NT		
7	0.3	0.3	-0.62	-0.10
8	NT	NT		
9	< 0.5	NR		
10	NT	NT		
11	NT	NT		
12	0.3	0.1	-0.62	-0.29
13	0.34	0.07	0.18	0.11
14	NT	NT		
15	NT	NT		
16	NT	NT		
17	NT	NT		
18	0.3	0.2	-0.62	-0.15
19	NT	NT		
20	NT	NT		
21	0.40	0.08	1.39	0.79
22	0.27	0.05	-1.23	-1.00
23	NR	NR		
24	0.35	NR	0.38	0.54
25	0.5	NR	3.40	4.83
26	NT	NT		
27	NT	NT		
28	NT	NT		
29	NT	NT		
30	0.34	0.004	0.18	0.26
31	0.16	0.012	-3.44	-4.62

Statistics

Assigned Value*	0.331	0.035
Spike	Not Spiked	
Homogeneity Value	0.303	0.036
Robust Average	0.331	0.043
Median	0.335	0.033
Mean	0.331	
N	12	
Max.	0.5	
Min.	0.16	
Robust SD	0.045	
Robust CV	14%	

* Robust Average excluding Laboratories 25 and 31


Kernel Density
Density
Result
Results: S3 - Exchangeable K
Assigned Value = 0.331 ± 0.035 cmol(+)/kg
Results (cmol(+)/kg)
Laboratory
31 22 12 18 7 3 13 30 24 2 21 25 9 1 10 11 14 15 16 17 19 20 23 26 27 28 29 4 5 6 8 Md A.V. H.V.


z-Scores: S3 - Exchangeable K
Target Standard Deviation 0.050 cmol(+)/kg (Equivalent to 15% CV)
z-Score
Laboratory
31 22 12 18 7 3 13 30 24 2 21 25
-3.4 -1.2 -0.6 -0.6 -0.6 0.0 0.2 0.2 0.4 1.0 1.4 3.4

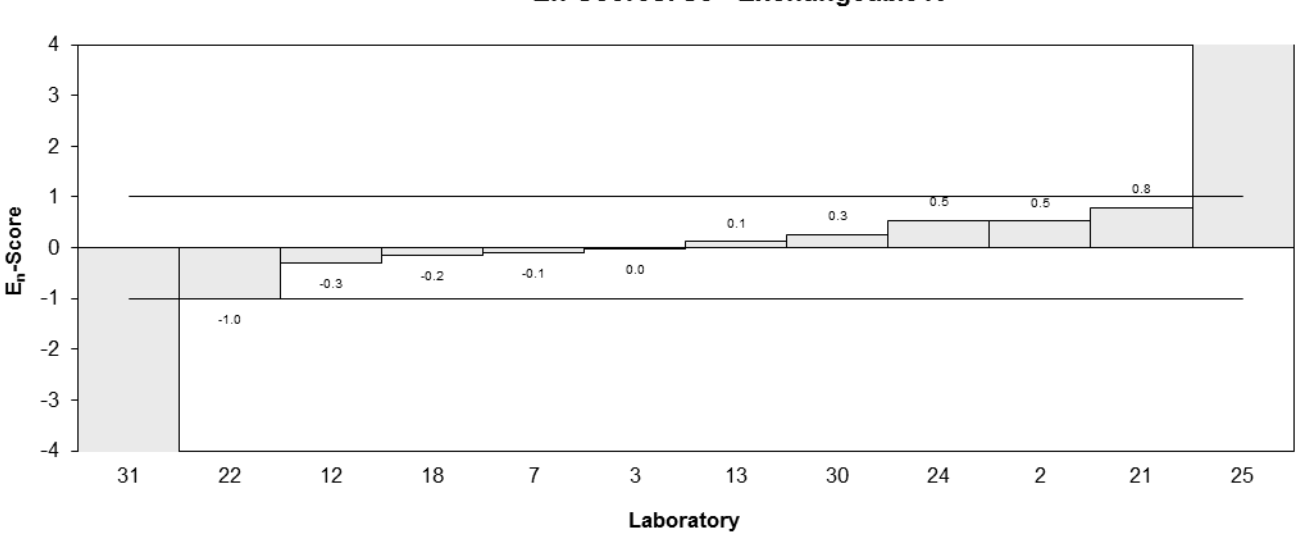

En-Scores: S3 - Exchangeable K
En-Score
Laboratory
31 22 12 18 7 3 13 30 24 2 21 25
-1.0 -0.3 -0.2 -0.1 0.0 0.1 0.3 0.5 0.5 0.8

Figure 41

Table 54

Sample Details

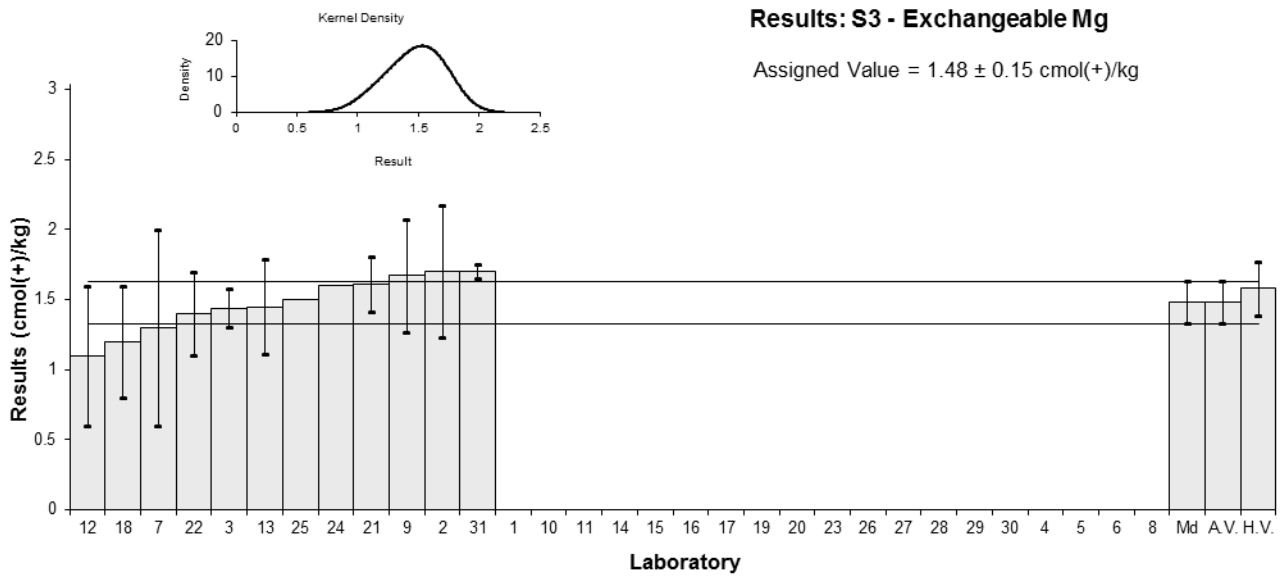
Sample No.	S3
Matrix.	Soil
Analyte.	Exchangeable Mg
Units	cmol(+)/kg

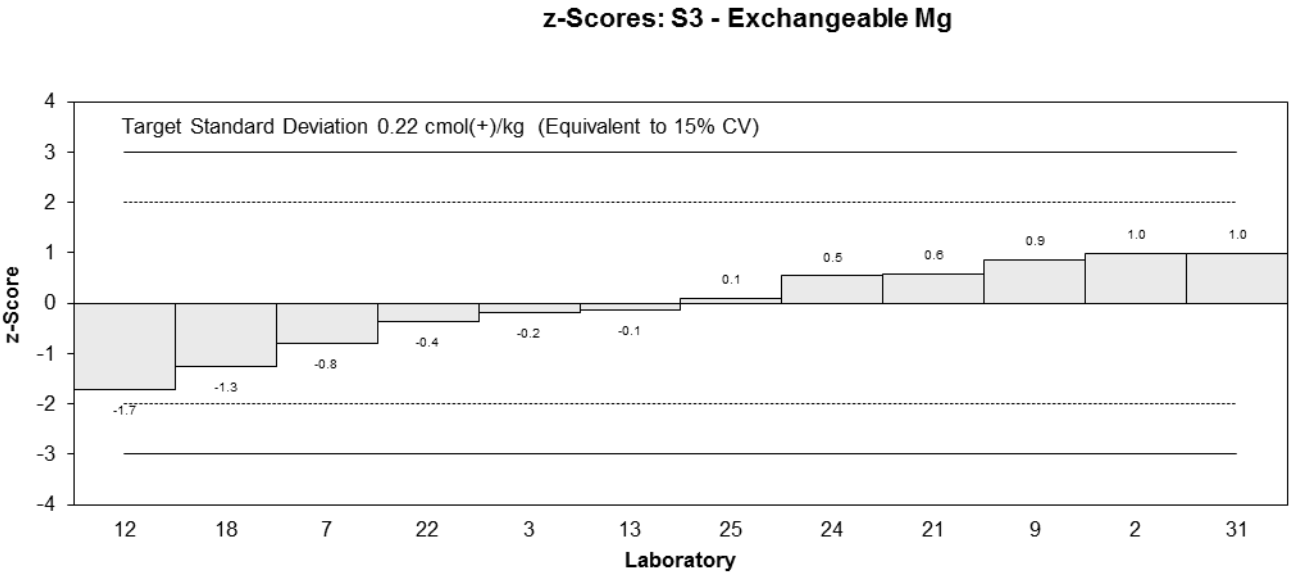
Participant Results

Lab Code	Result	Uncertainty	z-Score	En-Score
1	NT	NT		
2	1.7	0.47	0.99	0.45
3	1.44	0.14	-0.18	-0.19
4	NT	NT		
5	NT	NT		
6	NT	NT		
7	1.3	0.7	-0.81	-0.25
8	NT	NT		
9	1.67	0.4	0.86	0.44
10	NT	NT		
11	NT	NT		
12	1.1	0.5	-1.71	-0.73
13	1.45	0.34	-0.14	-0.08
14	NT	NT		
15	NT	NT		
16	NT	NT		
17	NT	NT		
18	1.2	0.4	-1.26	-0.66
19	NT	NT		
20	NT	NT		
21	1.61	0.2	0.59	0.52
22	1.4	0.3	-0.36	-0.24
23	NR	NR		
24	1.60	NR	0.54	0.80
25	1.5	NR	0.09	0.13
26	NT	NT		
27	NT	NT		
28	NT	NT		
29	NT	NT		
30	NT	NT		
31	1.7	0.05	0.99	1.39

Statistics

Assigned Value	1.48	0.15
Spike	Not Spiked	
Homogeneity Value	1.58	0.19
Robust Average	1.48	0.15
Median	1.48	0.15
Mean	1.47	
N	12	
Max.	1.7	
Min.	1.1	
Robust SD	0.21	
Robust CV	14%	


Kernel Density
Density
Result
Results: S3 - Exchangeable Mg
Assigned Value = 1.48 ± 0.15 cmol(+)/kg
Results (cmol(+)/kg)
12 18 7 22 3 13 25 24 21 9 2 31 1 10 11 14 15 16 17 19 20 23 26 27 28 29 30 4 5 6 8 Md A.V. H.V.
Laboratory


z-Scores: S3 - Exchangeable Mg
Target Standard Deviation 0.22 cmol(+)/kg (Equivalent to 15% CV)
z-Score
-1.7 -1.3 -0.8 -0.4 -0.2 -0.1 0.1 0.5 0.6 0.9 1.0 1.0
12 18 7 22 3 13 25 24 21 9 2 31
Laboratory

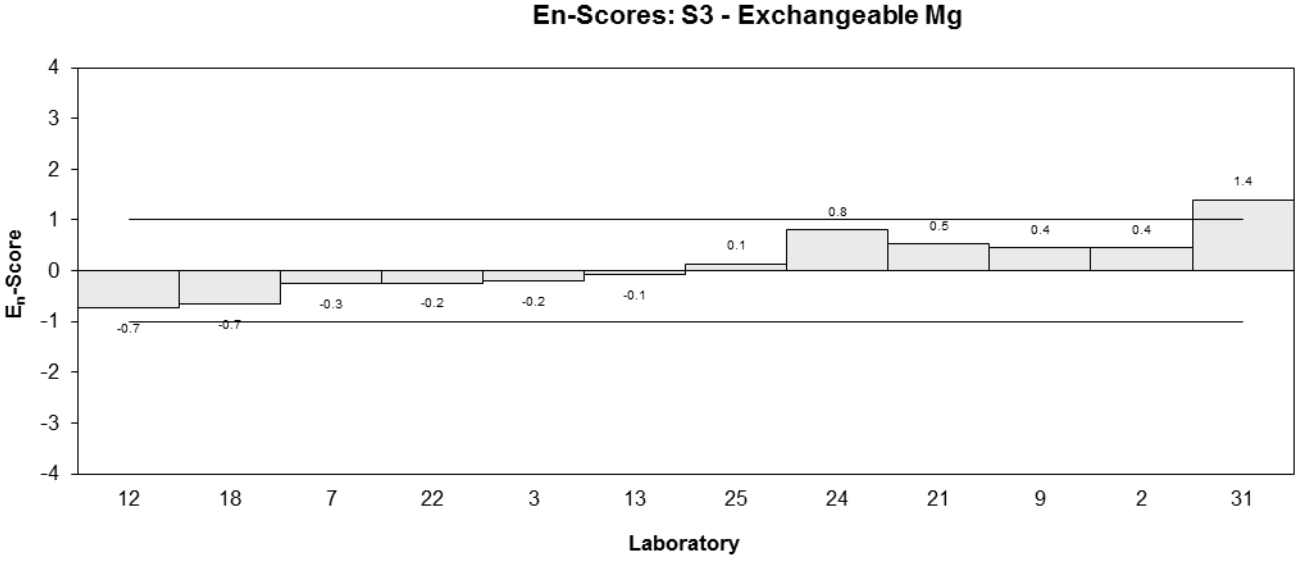

En-Scores: S3 - Exchangeable Mg
En-Score
-0.7 -0.7 -0.3 -0.2 -0.2 -0.1 0.1 0.8 0.5 0.4 0.4 1.4
12 18 7 22 3 13 25 24 21 9 2 31
Laboratory

Figure 42

Table 55

Sample Details

Sample No.	S3
Matrix.	Soil
Analyte.	Exchangeable Na
Units	cmol(+)/kg

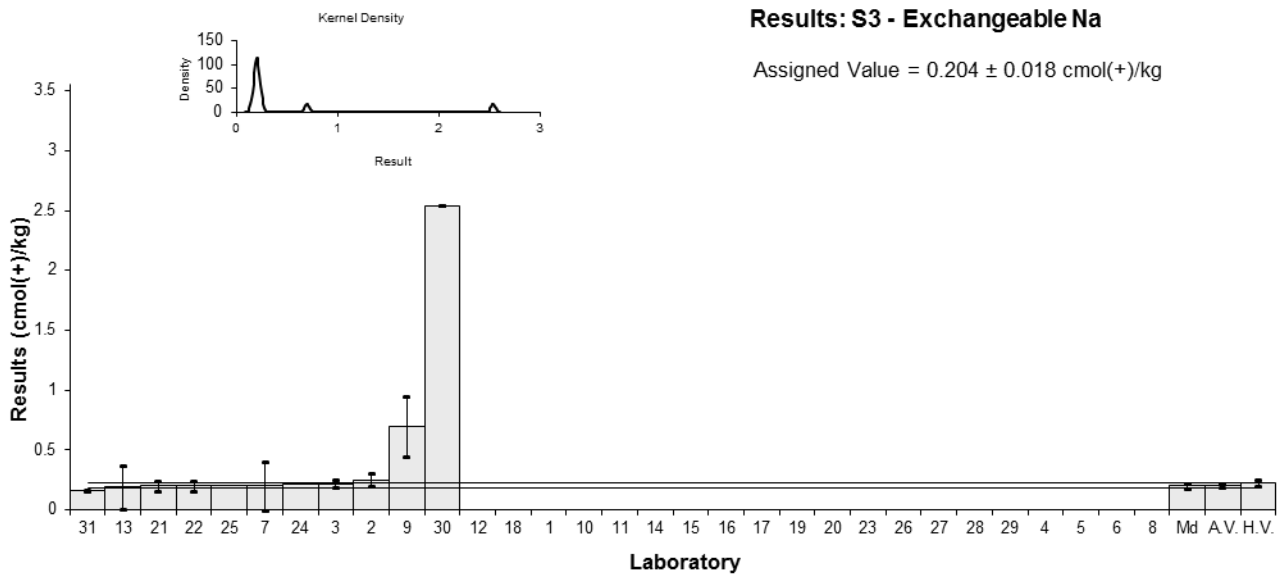
Participant Results

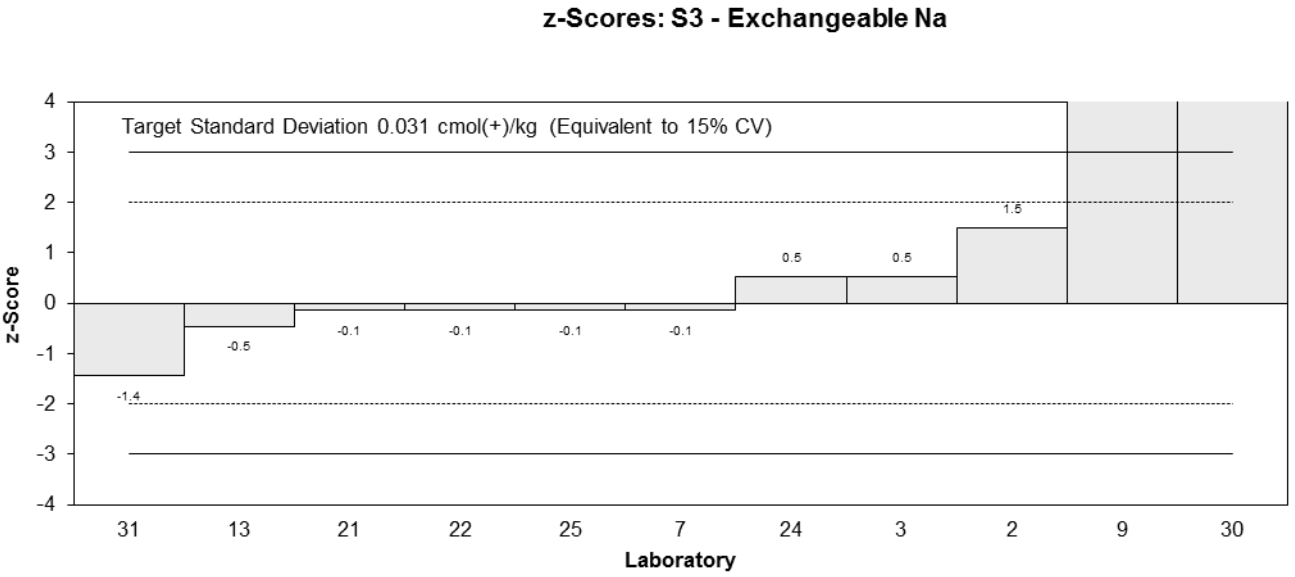
Lab Code	Result	Uncertainty	z-Score	En-Score
1	NT	NT		
2	0.25	0.055	1.50	0.79
3	0.22	0.03	0.52	0.46
4	NT	NT		
5	NT	NT		
6	NT	NT		
7	0.2	0.2	-0.13	-0.02
8	NT	NT		
9	0.7	0.25	16.21	1.98
10	NT	NT		
11	NT	NT		
12	<0.1	NR		
13	0.19	0.18	-0.46	-0.08
14	NT	NT		
15	NT	NT		
16	NT	NT		
17	NT	NT		
18	<0.1	NR		
19	NT	NT		
20	NT	NT		
21	0.20	0.04	-0.13	-0.09
22	0.20	0.04	-0.13	-0.09
23	NR	NR		
24	0.22	NR	0.52	0.89
25	0.2	NR	-0.13	-0.22
26	NT	NT		
27	NT	NT		
28	NT	NT		
29	NT	NT		
30	2.54	0	76.34	129.78
31	0.16	0.005	-1.44	-2.36

Statistics

Assigned Value*	0.204	0.018
Spike	Not Spiked	
Homogeneity Value	0.223	0.027
Robust Average	0.220	0.035
Median	0.200	0.020
Mean	0.462	
N	11	
Max.	2.54	
Min.	0.16	
Robust SD	0.021	
Robust CV	9.5%	

* Robust Average excluding Laboratories 9 and 30


Kernel Density
Density
Result
Results: S3 - Exchangeable Na
Assigned Value = 0.204 ± 0.018 cmol(+)/kg
Results (cmol(+)/kg)
Laboratory
31 13 21 22 25 7 24 3 2 9 30 12 18 1 10 11 14 15 16 17 19 20 23 26 27 28 29 4 5 6 8 Md A.V. H.V.


z-Scores: S3 - Exchangeable Na
Target Standard Deviation 0.031 cmol(+)/kg (Equivalent to 15% CV)
z-Score
Laboratory
31 13 21 22 25 7 24 3 2 9 30
-1.4
-0.5
-0.1
-0.1
-0.1
-0.1
0.5
0.5
1.5

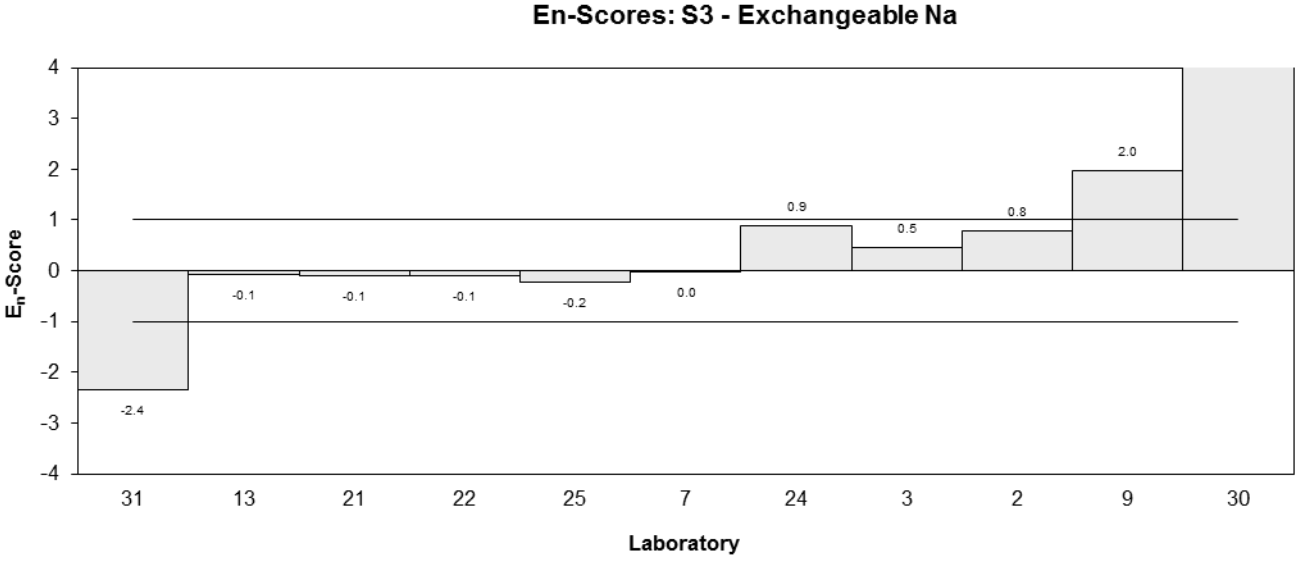

En-Scores: S3 - Exchangeable Na
En-Score
Laboratory
31 13 21 22 25 7 24 3 2 9 30
-2.4
-0.1
-0.1
-0.1
-0.2
0.0
0.9
0.5
0.8
2.0

Figure 43

Table 56

Sample Details

Sample No.	S3
Matrix.	Soil
Analyte.	Extractable B
Units	mg/kg

Participant Results

Lab Code	Result	Uncertainty
1	NT	NT
2	NT	NT
3	NT	NT
4	NT	NT
5	NT	NT
6	NT	NT
7	0.5	0.5
8	NT	NT
9	NT	NT
10	NT	NT
11	NT	NT
12	NR	NR
13	NR	NR
14	NT	NT
15	NT	NT
16	NT	NT
17	NT	NT
18	0.6	0.3
19	NT	NT
20	NT	NT
21	0.62	0.1
22	NR	NR
23	NR	NR
24	0.89	NR
25	0.3	NR
26	NT	NT
27	NT	NT
28	NT	NT
29	NT	NT
30	NT	NT
31	NT	NT

Statistics

Assigned Value	Not Set	
Spike	Not Spiked	
Robust Average	0.58	0.27
Median	0.60	0.18
Mean	0.58	
N	5	
Max.	0.89	
Min.	0.3	
Robust SD	0.17	
Robust CV	29%	

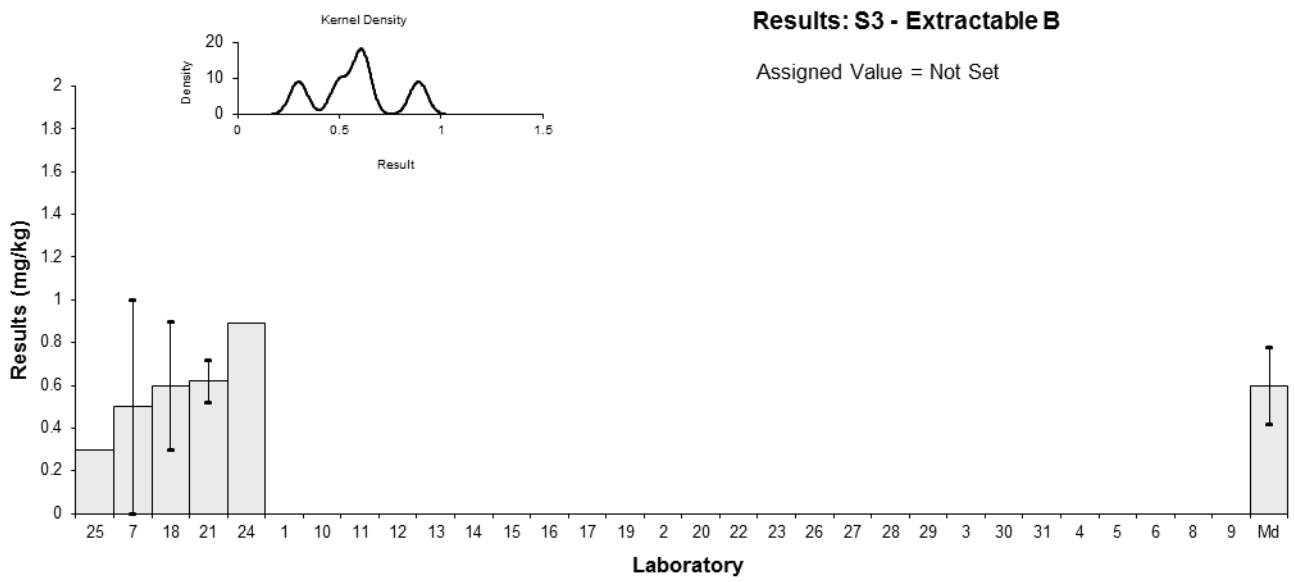

Kernel Density
Density
Result
Results: S3 - Extractable B
Assigned Value = Not Set
Results (mg/kg)
Laboratory
25 7 18 21 24 1 10 11 12 13 14 15 16 17 19 2 20 22 23 26 27 28 29 3 30 31 4 5 6 8 9 Md

Figure 44

Table 57

Sample Details

Sample No.	S3
Matrix.	Soil
Analyte.	Fe
Units	mg/kg

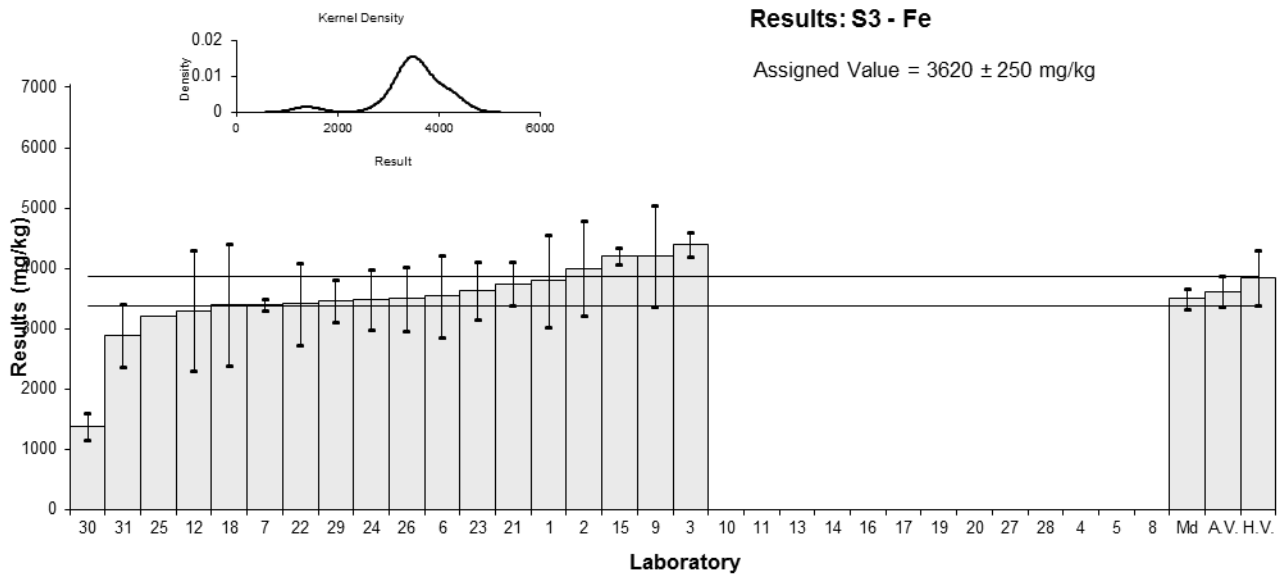
Participant Results

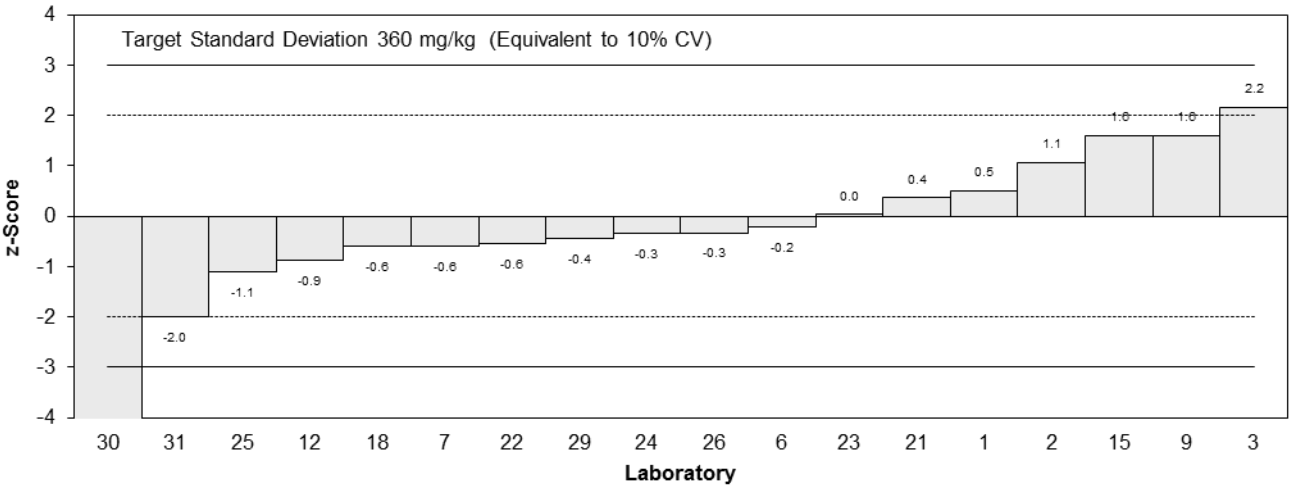
Lab Code	Result	Uncertainty	z-Score	En-Score
1	3800	760	0.50	0.22
2	4003	780	1.06	0.47
3	4400	210	2.15	2.39
4	NT	NT		
5	NT	NT		
6	3540	670	-0.22	-0.11
7	3400	100	-0.61	-0.82
8	NT	NT		
9	4200	840	1.60	0.66
10	NT	NT		
11	NT	NT		
12	3300	1000	-0.88	-0.31
13	NR	NR		
14	NT	NT		
15	4200	140	1.60	2.02
16	NT	NT		
17	NT	NT		
18	3400	1000	-0.61	-0.21
19	NT	NT		
20	NT	NT		
21	3750	370	0.36	0.29
22	3420	680	-0.55	-0.28
23	3630	483	0.03	0.02
24	3495	500	-0.35	-0.22
25	3220	NR	-1.10	-1.60
26	3500	525	-0.33	-0.21
27	NT	NT		
28	NT	NT		
29	3460	350	-0.44	-0.37
30	1390.3	225	-6.16	-6.63
31	2900	519.1	-1.99	-1.25

Statistics

Assigned Value*	3620	250
Spike	Not Spiked	
Homogeneity Value	3850	460
Robust Average	3580	270
Median	3500	170
Mean	3500	
N	18	
Max.	4400	
Min.	1390.3	
Robust SD	410	
Robust CV	12%	

* Robust Average excluding Laboratory 30.


Kernel Density
Density
Result
Results: S3 - Fe
Assigned Value = 3620 ± 250 mg/kg
Results (mg/kg)
Laboratory
30 31 25 12 18 7 22 29 24 26 6 23 21 1 2 15 9 3 10 11 13 14 16 17 19 20 27 28 4 5 8 Md A.V. H.V.


z-Scores: S3 - Fe
Target Standard Deviation 360 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
30 31 25 12 18 7 22 29 24 26 6 23 21 1 2 15 9 3
-2.0 -1.1 -0.9 -0.6 -0.6 -0.6 -0.4 -0.3 -0.3 -0.2 0.0 0.4 0.5 1.1 1.6 1.6 2.2

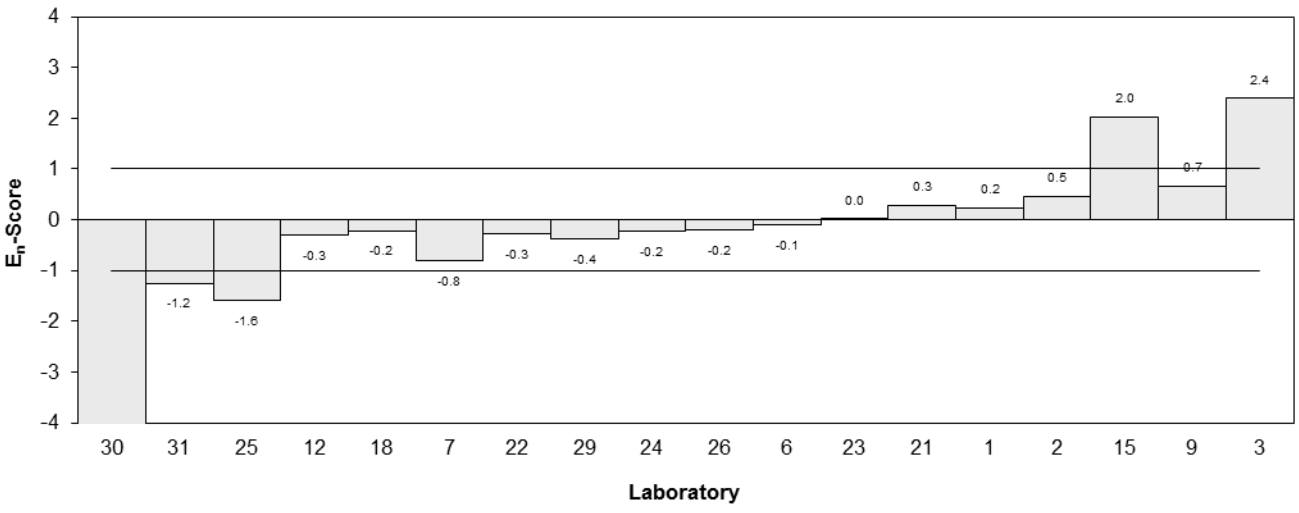

En-Scores: S3 - Fe
En-Score
Laboratory
30 31 25 12 18 7 22 29 24 26 6 23 21 1 2 15 9 3
-1.2 -1.6 -0.3 -0.2 -0.8 -0.3 -0.4 -0.2 -0.2 -0.1 0.0 0.3 0.2 0.5 2.0 0.7 2.4

Figure 45

Table 58

Sample Details

Sample No.	S3
Matrix.	Soil
Analyte.	K
Units	mg/kg

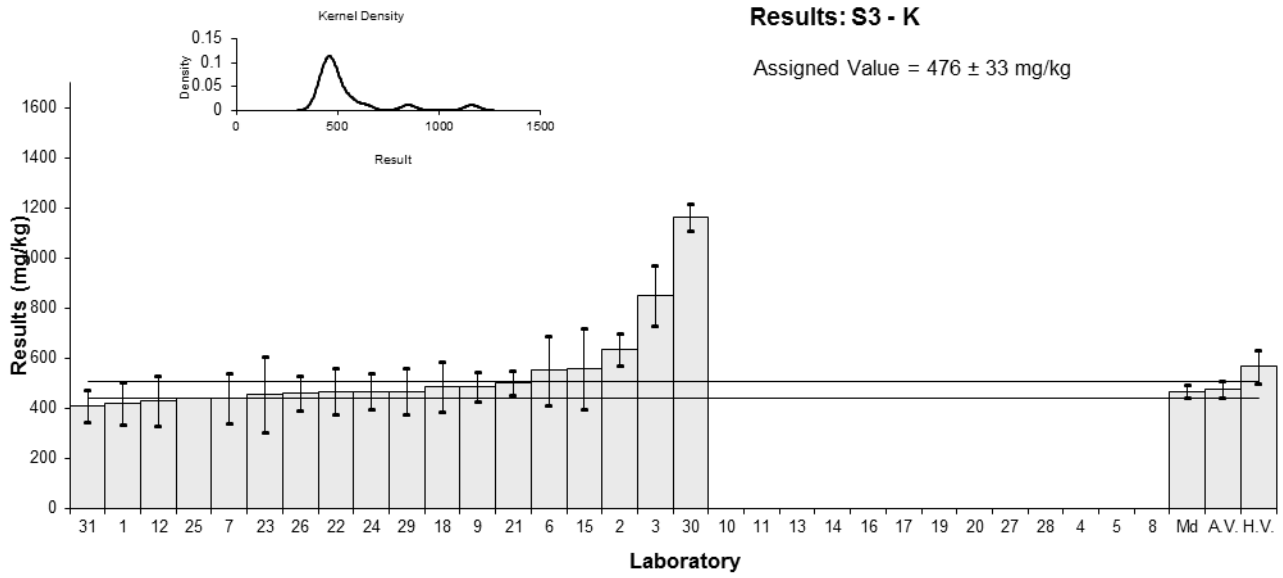
Participant Results

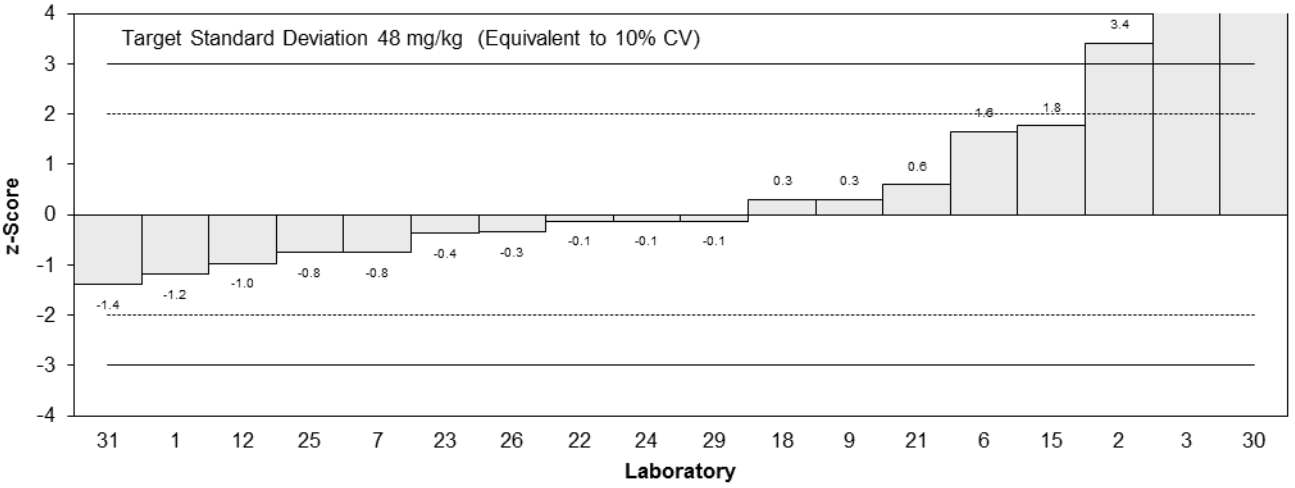
Lab Code	Result	Uncertainty	z-Score	En-Score
1	420	84	-1.18	-0.62
2	638.2	65	3.41	2.23
3	850	120	7.86	3.01
4	NT	NT		
5	NT	NT		
6	554	139	1.64	0.55
7	440	100	-0.76	-0.34
8	NT	NT		
9	490	59	0.29	0.21
10	NT	NT		
11	NT	NT		
12	430	100	-0.97	-0.44
13	NR	NR		
14	NT	NT		
15	560	160	1.76	0.51
16	NT	NT		
17	NT	NT		
18	490	100	0.29	0.13
19	NT	NT		
20	NT	NT		
21	504	50	0.59	0.47
22	470	90	-0.13	-0.06
23	458	153	-0.38	-0.12
24	470	70	-0.13	-0.08
25	440	NR	-0.76	-1.09
26	460	69	-0.34	-0.21
27	NT	NT		
28	NT	NT		
29	470	93	-0.13	-0.06
30	1163.6	53.4	14.45	10.95
31	410	65	-1.39	-0.91

Statistics

Assigned Value*	476	33
Spike	Not Spiked	
Homogeneity Value	568	68
Robust Average	493	43
Median	470	24
Mean	540	
N	18	
Max.	1163.6	
Min.	410	
Robust SD	53	
Robust CV	11%	

* Robust Average excluding Laboratories 3 and 30.


Kernel Density
Density
Result
Results: S3 - K
Assigned Value = 476 ± 33 mg/kg
Results (mg/kg)
Laboratory
31 1 12 25 7 23 26 22 24 29 18 9 21 6 15 2 3 30 10 11 13 14 16 17 19 20 27 28 4 5 8 Md A.V. H.V.


z-Scores: S3 - K
Target Standard Deviation 48 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
31 1 12 25 7 23 26 22 24 29 18 9 21 6 15 2 3 30

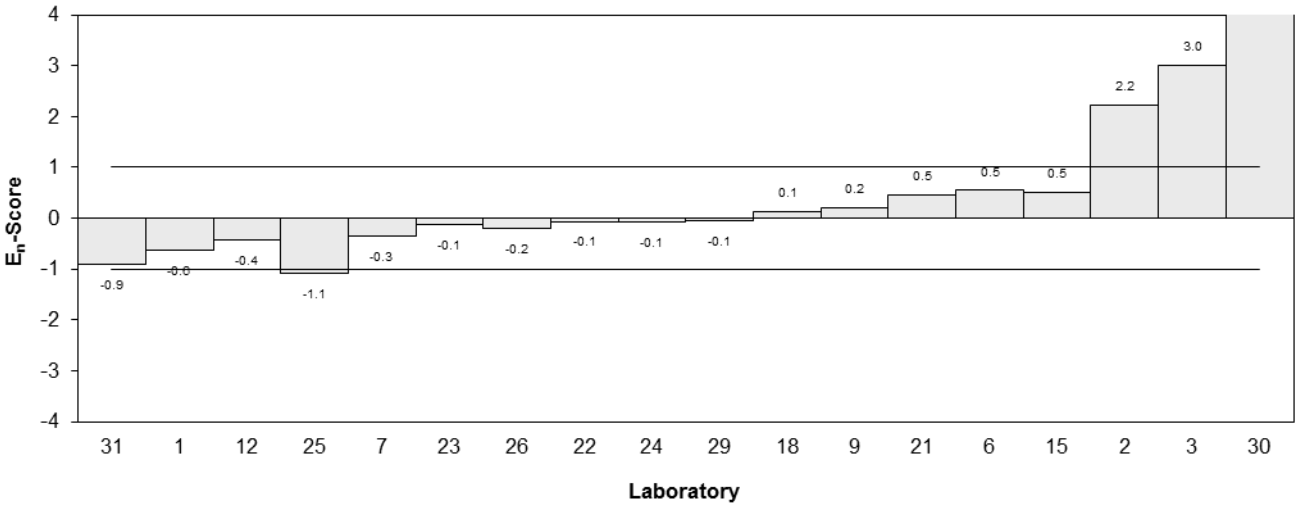

En-Scores: S3 - K
En-Score
Laboratory
31 1 12 25 7 23 26 22 24 29 18 9 21 6 15 2 3 30

Figure 46

Table 59

Sample Details

Sample No.	S3
Matrix.	Soil
Analyte.	Mg
Units	mg/kg

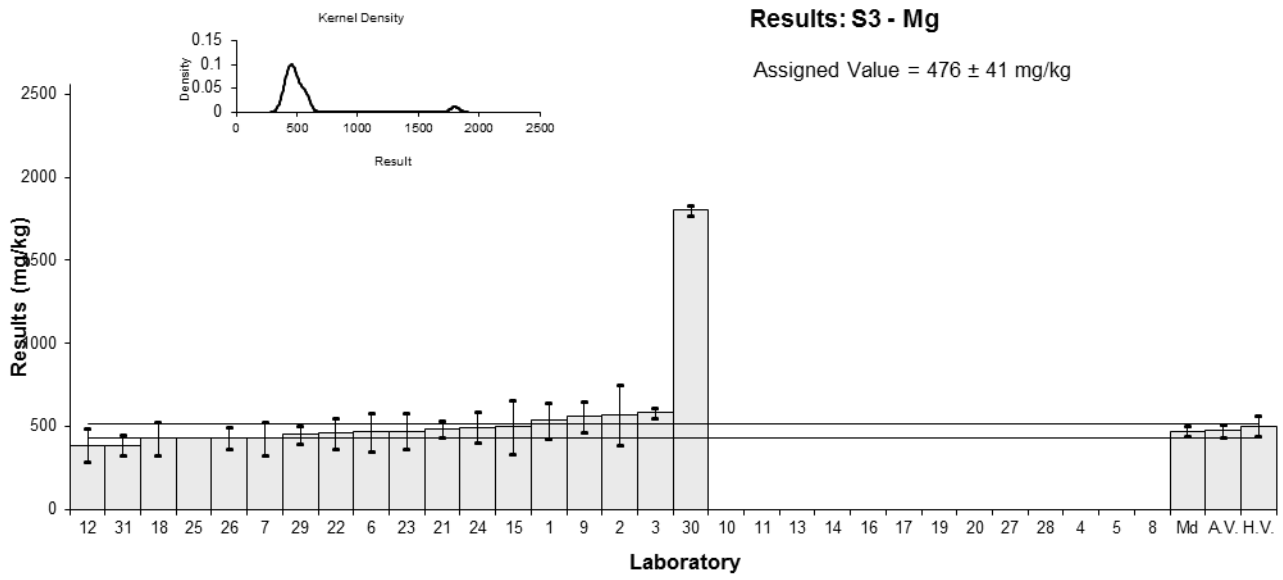
Participant Results

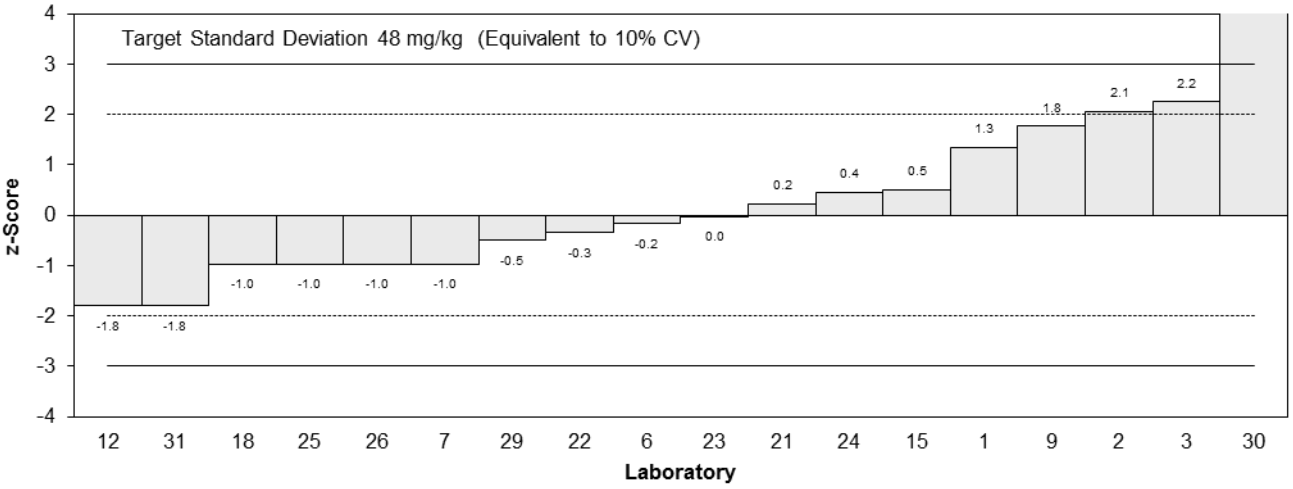
Lab Code	Result	Uncertainty	z-Score	En-Score
1	540	108	1.34	0.55
2	574.0	180	2.06	0.53
3	583	33	2.25	2.03
4	NT	NT		
5	NT	NT		
6	468	117	-0.17	-0.06
7	430	100	-0.97	-0.43
8	NT	NT		
9	560	96	1.76	0.80
10	NT	NT		
11	NT	NT		
12	390	100	-1.81	-0.80
13	NR	NR		
14	NT	NT		
15	500	160	0.50	0.15
16	NT	NT		
17	NT	NT		
18	430	100	-0.97	-0.43
19	NT	NT		
20	NT	NT		
21	487	48	0.23	0.17
22	460	90	-0.34	-0.16
23	475	105	-0.02	-0.01
24	497	90	0.44	0.21
25	430	NR	-0.97	-1.12
26	430	65	-0.97	-0.60
27	NT	NT		
28	NT	NT		
29	452	53	-0.50	-0.36
30	1800	28.3	27.82	26.58
31	390	59.28	-1.81	-1.19

Statistics

Assigned Value*	476	41
Spike	Not Spiked	
Homogeneity Value	505	61
Robust Average	483	43
Median	472	31
Mean	550	
N	18	
Max.	1800	
Min.	390	
Robust SD	67	
Robust CV	14%	

* Robust Average excluding Laboratory 30.


Kernel Density
Density
Result
Results: S3 - Mg
Assigned Value = 476 ± 41 mg/kg
Results (mg/kg)
Laboratory
12 31 18 25 26 7 29 22 6 23 21 24 15 1 9 2 3 30 10 11 13 14 16 17 19 20 27 28 4 5 8 Md A.V. H.V.


z-Scores: S3 - Mg
Target Standard Deviation 48 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
12 31 18 25 26 7 29 22 6 23 21 24 15 1 9 2 3 30

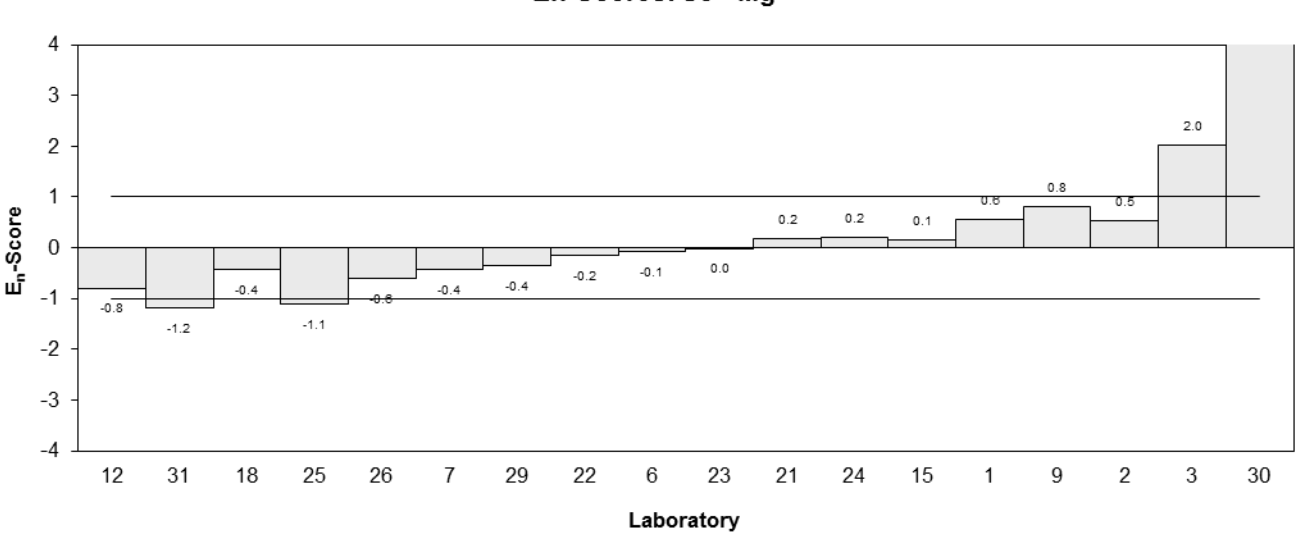

En-Scores: S3 - Mg
En-Score
Laboratory
12 31 18 25 26 7 29 22 6 23 21 24 15 1 9 2 3 30

Figure 47

Table 60

Sample Details

Sample No.	S3
Matrix.	Soil
Analyte.	Na
Units	mg/kg

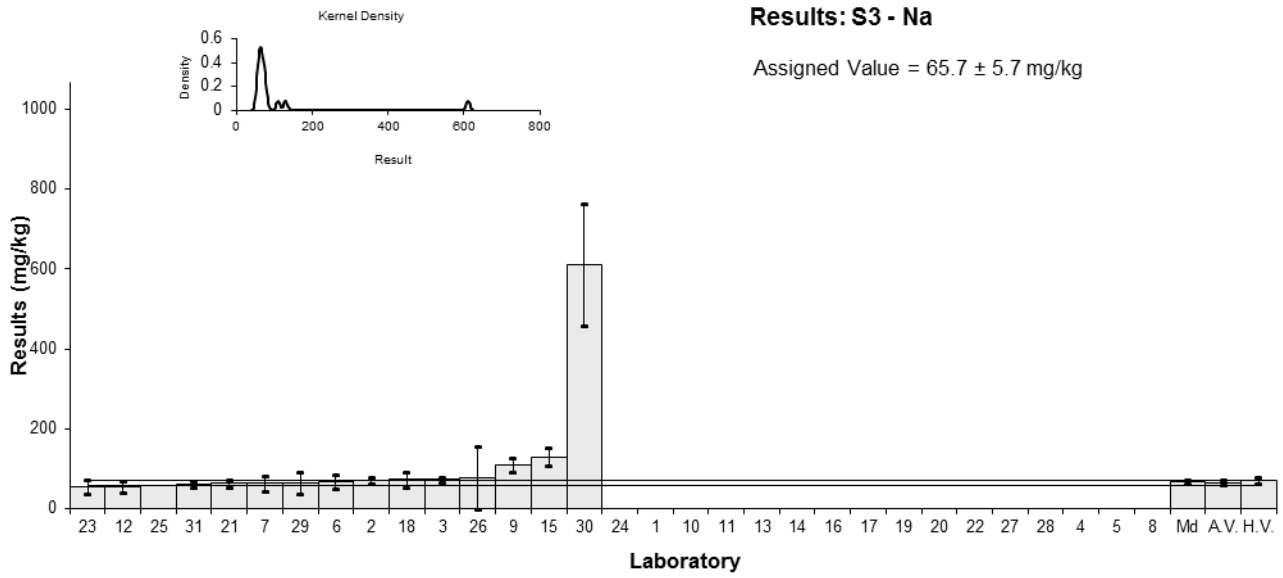
Participant Results

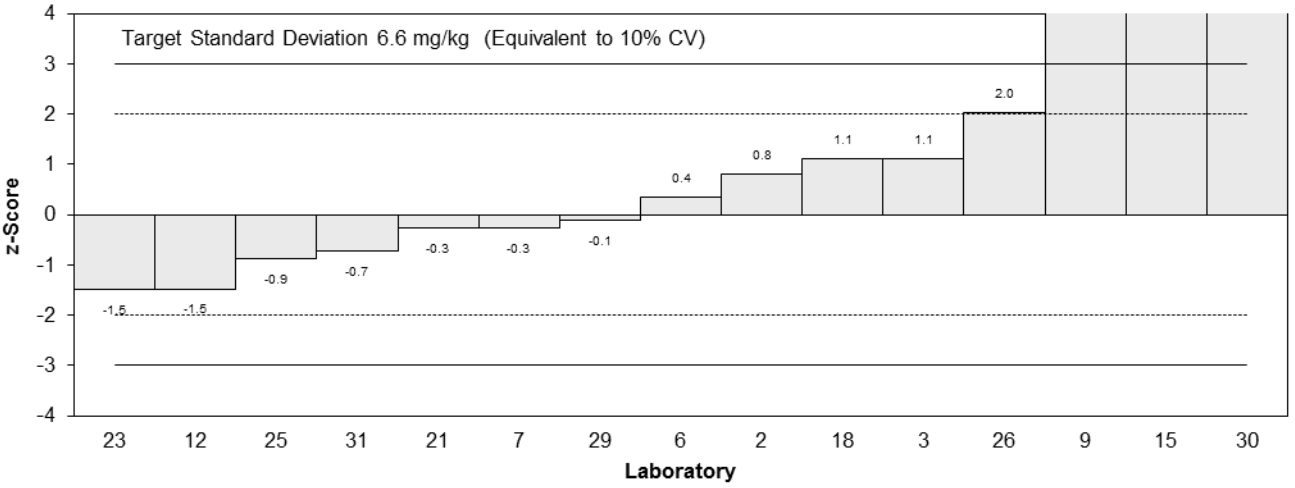
Lab Code	Result	Uncertainty	z-Score	En-Score
1	NT	NT		
2	70.97	8.7	0.80	0.51
3	73	7.3	1.11	0.79
4	NT	NT		
5	NT	NT		
6	68	17	0.35	0.13
7	64	20	-0.26	-0.08
8	NT	NT		
9	110	17	6.74	2.47
10	NT	NT		
11	NT	NT		
12	56	15	-1.48	-0.60
13	NR	NR		
14	NT	NT		
15	130	22	9.79	2.83
16	NT	NT		
17	NT	NT		
18	73	20	1.11	0.35
19	NT	NT		
20	NT	NT		
21	64	10	-0.26	-0.15
22	NR	NR		
23	55.9	16.8	-1.49	-0.55
24	<50	NR		
25	60	NR	-0.87	-1.00
26	79	79	2.02	0.17
27	NT	NT		
28	NT	NT		
29	65	28	-0.11	-0.02
30	610.9	152	82.98	3.58
31	61	8.9	-0.72	-0.44

Statistics

Assigned Value*	65.7	5.7
Spike	Not Spiked	
Homogeneity Value	70.5	8.5
Robust Average	71.4	9.7
Median	68.0	5.7
Mean	109	
N	15	
Max.	610.9	
Min.	55.9	
Robust SD	7.9	
Robust CV	11%	

* Robust Average excluding Laboratories 9, 15 and 30


Kernel Density
Density
Result
Results: S3 - Na
Assigned Value = 65.7 ± 5.7 mg/kg
Results (mg/kg)
Laboratory
23 12 25 31 21 7 29 6 2 18 3 26 9 15 30 24 1 10 11 13 14 16 17 19 20 22 27 28 4 5 8 Md A.V. H.V.


z-Scores: S3 - Na
Target Standard Deviation 6.6 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
23 12 25 31 21 7 29 6 2 18 3 26 9 15 30
-1.5 -1.5 -0.9 -0.7 -0.3 -0.3 -0.1 0.4 0.8 1.1 1.1 2.0

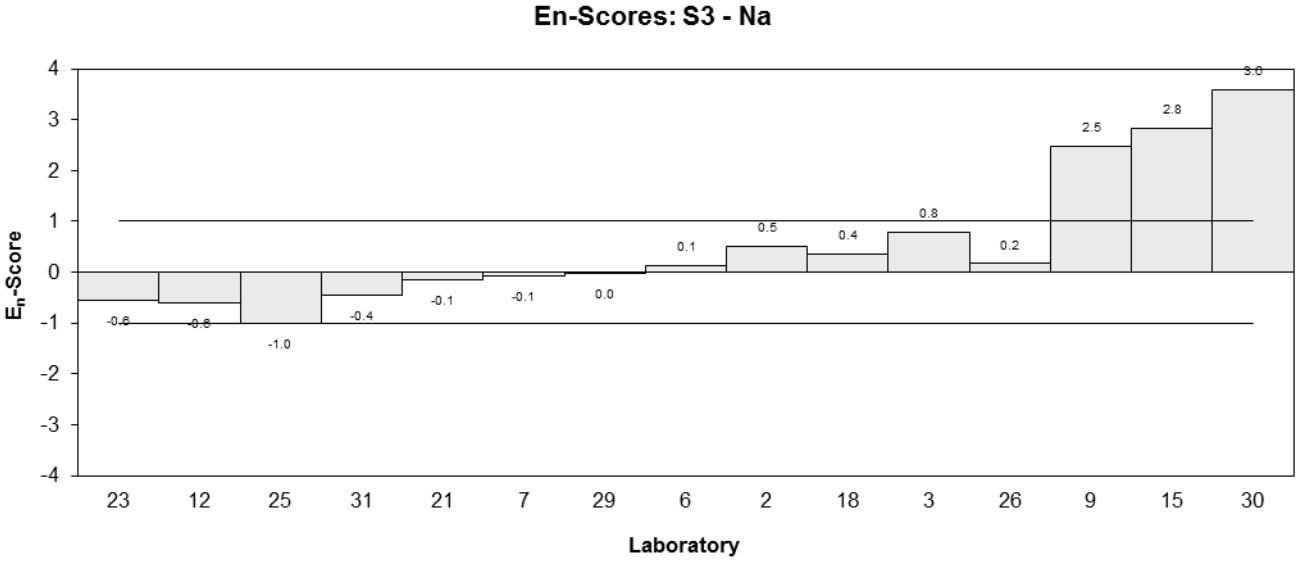

En-Scores: S3 - Na
En-Score
Laboratory
23 12 25 31 21 7 29 6 2 18 3 26 9 15 30
-0.6 -0.6 -1.0 -0.4 -0.1 -0.1 0.0 0.1 0.5 0.4 0.8 0.2 2.5 2.8 3.6

Figure 48

Table 61

Sample Details

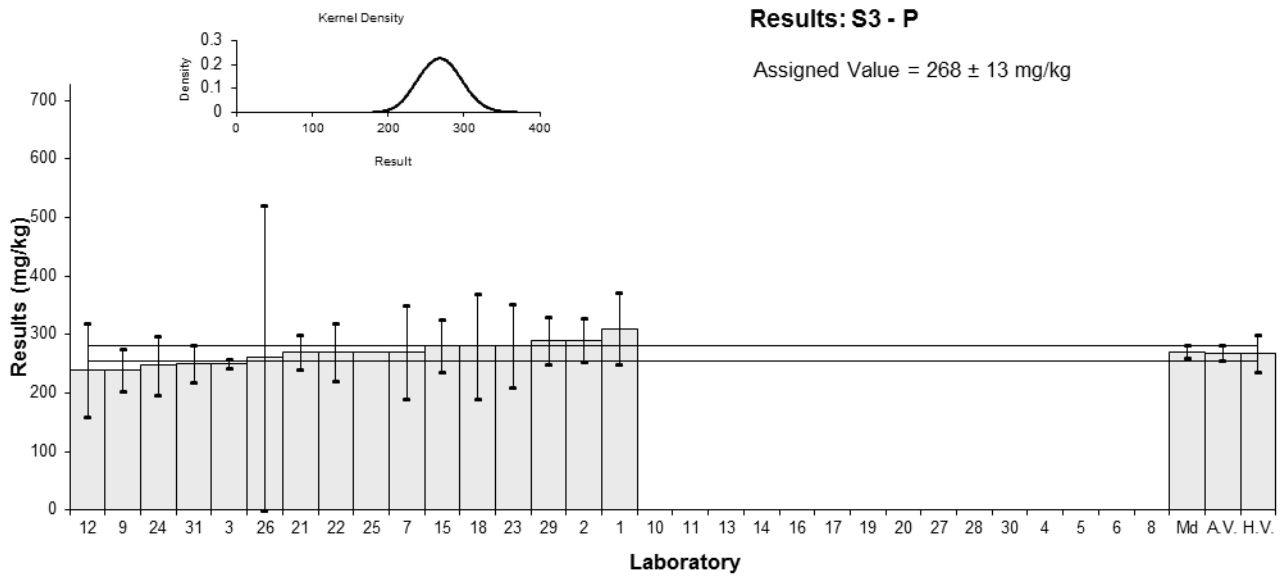
Sample No.	S3
Matrix.	Soil
Analyte.	P
Units	mg/kg

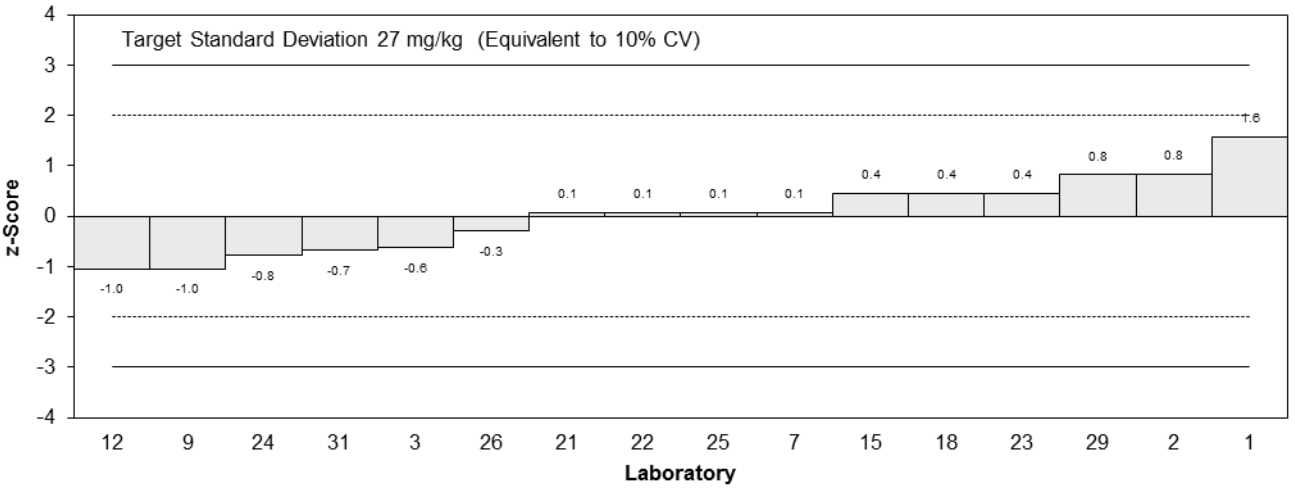
Participant Results

Lab Code	Result	Uncertainty	z-Score	En-Score
1	310	62	1.57	0.66
2	290.2	37	0.83	0.57
3	251	7.5	-0.63	-1.13
4	NT	NT		
5	NT	NT		
6	NT	NT		
7	270	80	0.07	0.02
8	NT	NT		
9	240	36	-1.04	-0.73
10	NT	NT		
11	NT	NT		
12	240	80	-1.04	-0.35
13	NR	NR		
14	NT	NT		
15	280	45	0.45	0.26
16	NT	NT		
17	NT	NT		
18	280	90	0.45	0.13
19	NT	NT		
20	NT	NT		
21	270	30	0.07	0.06
22	270	50	0.07	0.04
23	280	71	0.45	0.17
24	247	50	-0.78	-0.41
25	270	NR	0.07	0.15
26	260	260	-0.30	-0.03
27	NT	NT		
28	NT	NT		
29	290	40	0.82	0.52
30	NT	NT		
31	250	31.8	-0.67	-0.52

Statistics

Assigned Value	268	13
Spike	Not Spiked	
Homogeneity Value	268	32
Robust Average	268	13
Median	270	11
Mean	269	
N	16	
Max.	310	
Min.	240	
Robust SD	21	
Robust CV	7.8%	


Kernel Density
Density
Result
Results: S3 - P
Assigned Value = 268 ± 13 mg/kg
Results (mg/kg)
Laboratory
12 9 24 31 3 26 21 22 25 7 15 18 23 29 2 1 10 11 13 14 16 17 19 20 27 28 30 4 5 6 8 Md A.V. H.V.


z-Scores: S3 - P
Target Standard Deviation 27 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
12 9 24 31 3 26 21 22 25 7 15 18 23 29 2 1

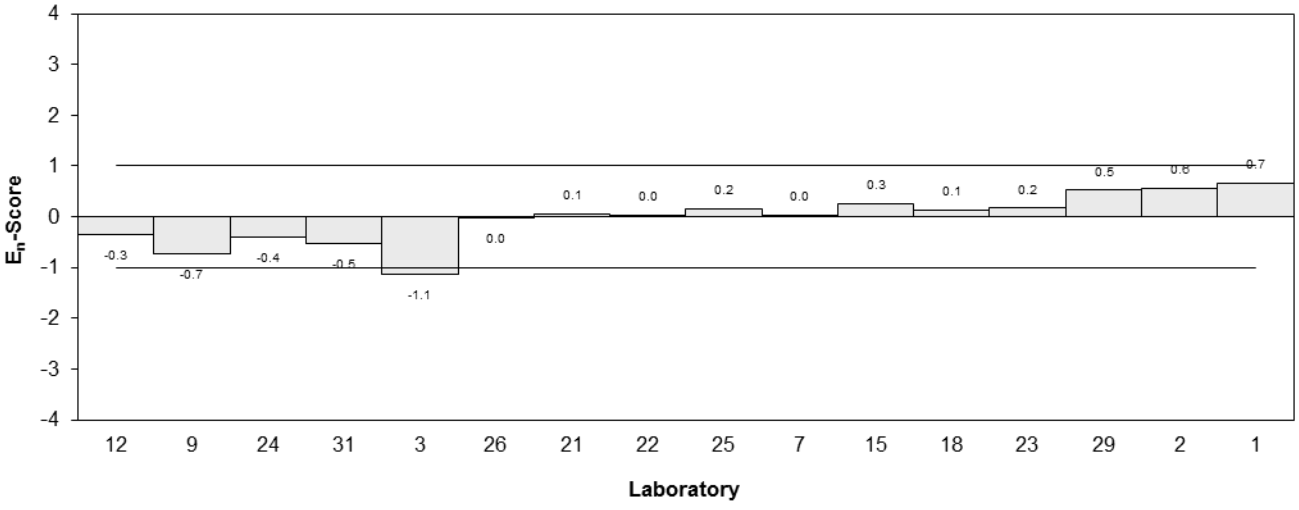

En-Scores: S3 - P
En-Score
Laboratory
12 9 24 31 3 26 21 22 25 7 15 18 23 29 2 1

Figure 49

Table 62

Sample Details

Sample No.	S3
Matrix.	Soil
Analyte.	PBI
Units	mg/kg

Participant Results

Lab Code	Result	Uncertainty
1	NT	NT
2	NT	NT
3	63.0	6
4	NT	NT
5	NT	NT
6	NT	NT
7	75	25
8	NT	NT
9	NT	NT
10	NT	NT
11	NT	NT
12	NR	NR
13	NR	NR
14	NT	NT
15	NT	NT
16	NT	NT
17	NT	NT
18	NT	NT
19	NT	NT
20	NT	NT
21	67	7.0
22	NR	NR
23	NR	NR
24	73	15
25	NR	NR
26	NT	NT
27	NT	NT
28	NT	NT
29	NT	NT
30	NT	NT
31	NT	NT

Statistics

Assigned Value	Not Set	
Spike	Not Spiked	
Homogeneity Value	107	13
Robust Average	69.5	7.8
Median	70.0	9.4
Mean	69.5	
N	4	
Max.	75	
Min.	63	
Robust SD	6.2	
Robust CV	8.9%	

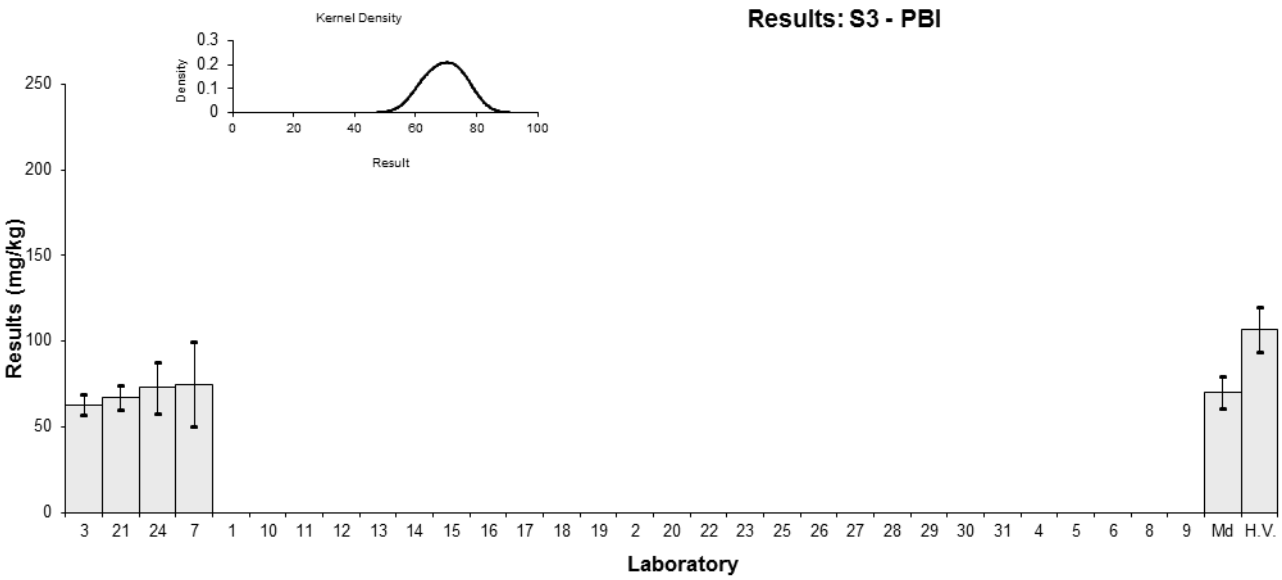

Results: S3 - PBI
Kernel Density
Density
0.3
0.2
0.1
0
0
20
40
60
80
100
Result
Results (mg/kg)
250
200
150
100
50
0
3
21
24
7
1
10
11
12
13
14
15
16
17
18
19
2
20
22
23
25
26
27
28
29
30
31
4
5
6
8
9
Md
H.V.
Laboratory

Figure 50

Table 63

Sample Details

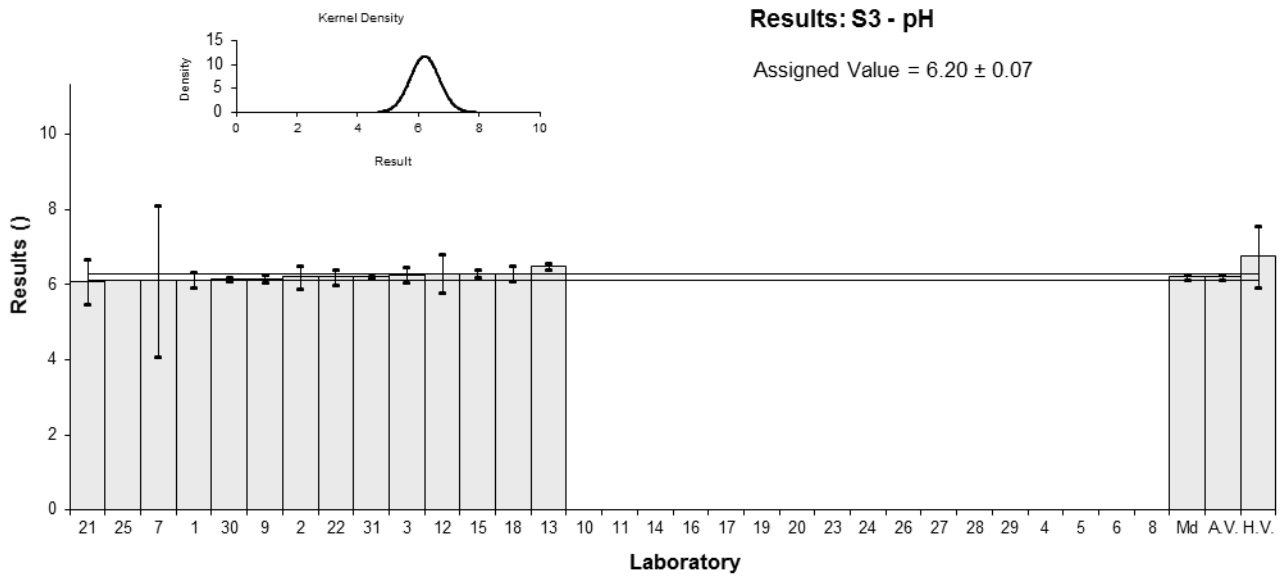
Sample No.	S3
Matrix.	Soil
Analyte.	pH

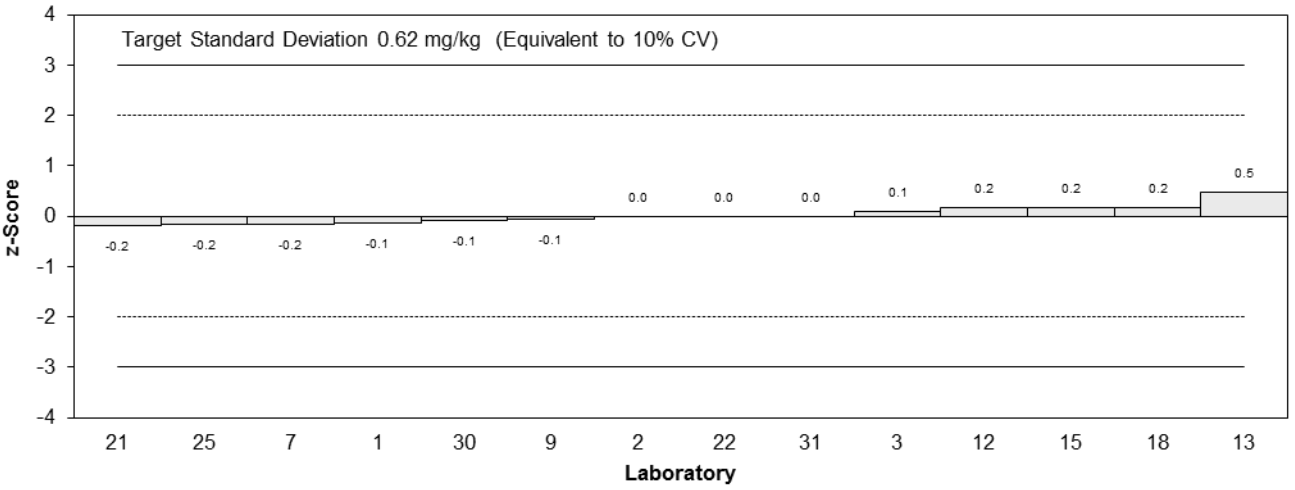
Participant Results

Lab Code	Result	Uncertainty	z-Score	E_n-Score
1	6.12	0.2	-0.13	-0.38
2	6.2	0.3	0.00	0.00
3	6.26	0.2	0.10	0.28
4	NT	NT		
5	NT	NT		
6	NT	NT		
7	6.1	2	-0.16	-0.05
8	NT	NT		
9	6.16	0.1	-0.06	-0.33
10	NT	NT		
11	NT	NT		
12	6.3	0.5	0.16	0.20
13	6.5	0.082	0.48	2.78
14	NT	NT		
15	6.3	0.1	0.16	0.82
16	NT	NT		
17	NT	NT		
18	6.3	0.2	0.16	0.47
19	NT	NT		
20	NT	NT		
21	6.08	0.6	-0.19	-0.20
22	6.2	0.2	0.00	0.00
23	NR	NR		
24	NR	NR		
25	6.1	NR	-0.16	-1.43
26	NT	NT		
27	NT	NT		
28	NT	NT		
29	NT	NT		
30	6.15	0.037	-0.08	-0.63
31	6.2	0.0434	0.00	0.00

Statistics

Assigned Value	6.20	0.07
Spike	Not Spiked	
Homogeneity Value	6.75	0.81
Robust Average	6.20	0.07
Median	6.20	0.08
Mean	6.21	
N	14	
Max.	6.5	
Min.	6.08	
Robust SD	0.1	
Robust CV	1.6%	


Kernel Density
Density
Result
Results: S3 - pH
Assigned Value = 6.20 ± 0.07
Results ()
21 25 7 1 30 9 2 22 31 3 12 15 18 13 10 11 14 16 17 19 20 23 24 26 27 28 29 4 5 6 8 Md A.V. H.V.
Laboratory


z-Scores: S3 - pH
Target Standard Deviation 0.62 mg/kg (Equivalent to 10% CV)
z-Score
-0.2 -0.2 -0.2 -0.1 -0.1 -0.1 0.0 0.0 0.0 0.1 0.2 0.2 0.2 0.5
21 25 7 1 30 9 2 22 31 3 12 15 18 13
Laboratory

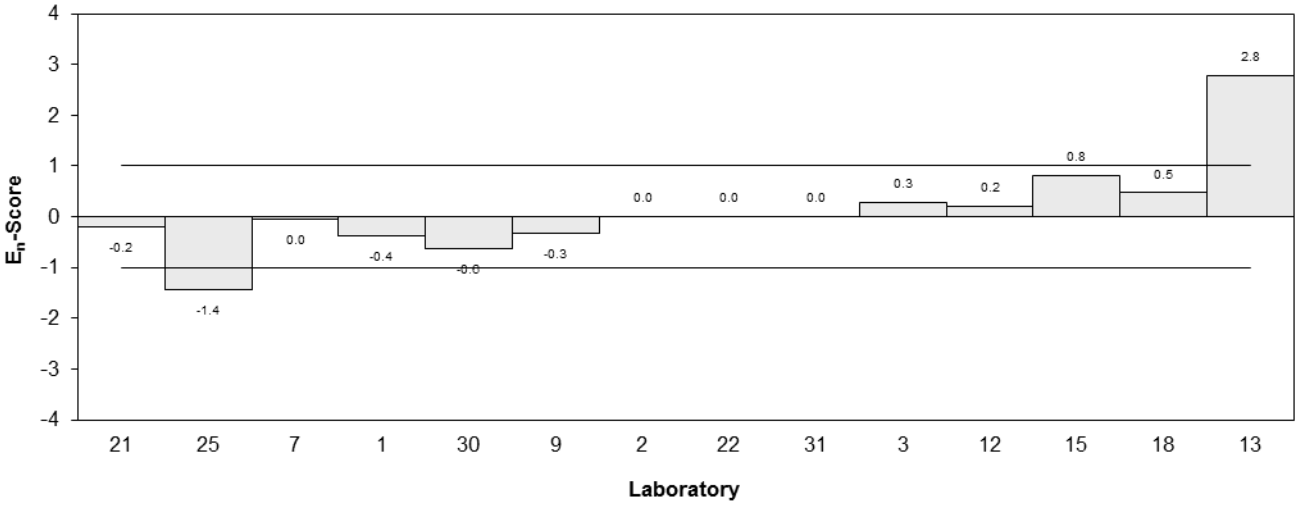

En-Scores: S3 - pH
En-Score
-0.2 -1.4 0.0 -0.4 -0.6 -0.3 0.0 0.0 0.0 0.3 0.2 0.8 0.5 2.8
21 25 7 1 30 9 2 22 31 3 12 15 18 13
Laboratory

Figure 51

Table 64

Sample Details

Sample No.	S3
Matrix.	Soil
Analyte.	S
Units	mg/kg

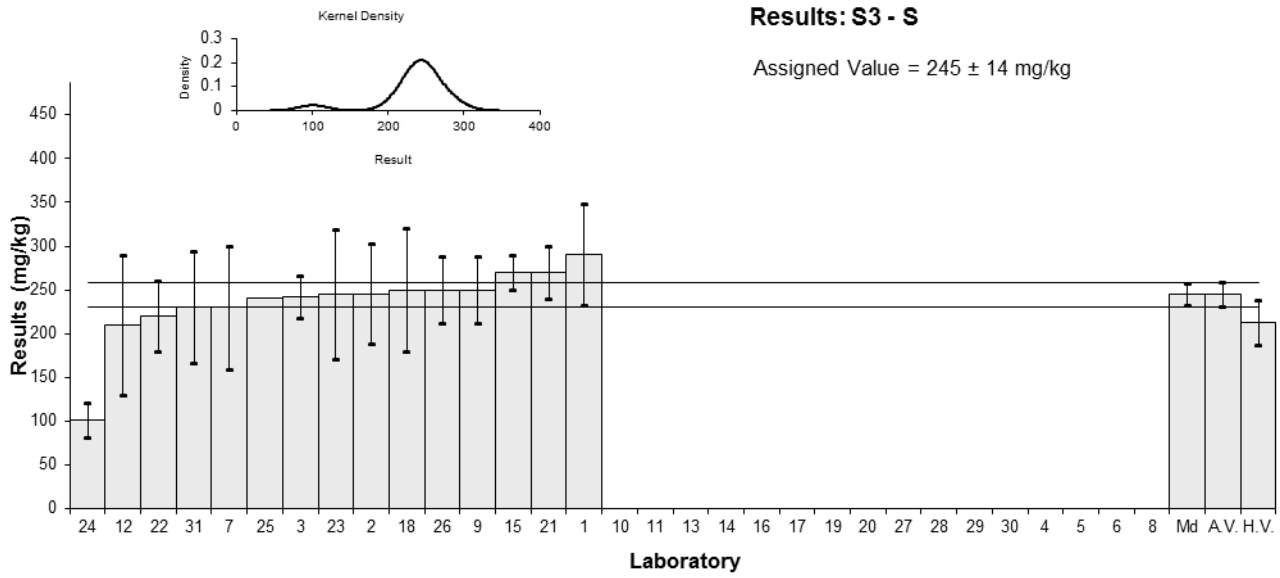
Participant Results

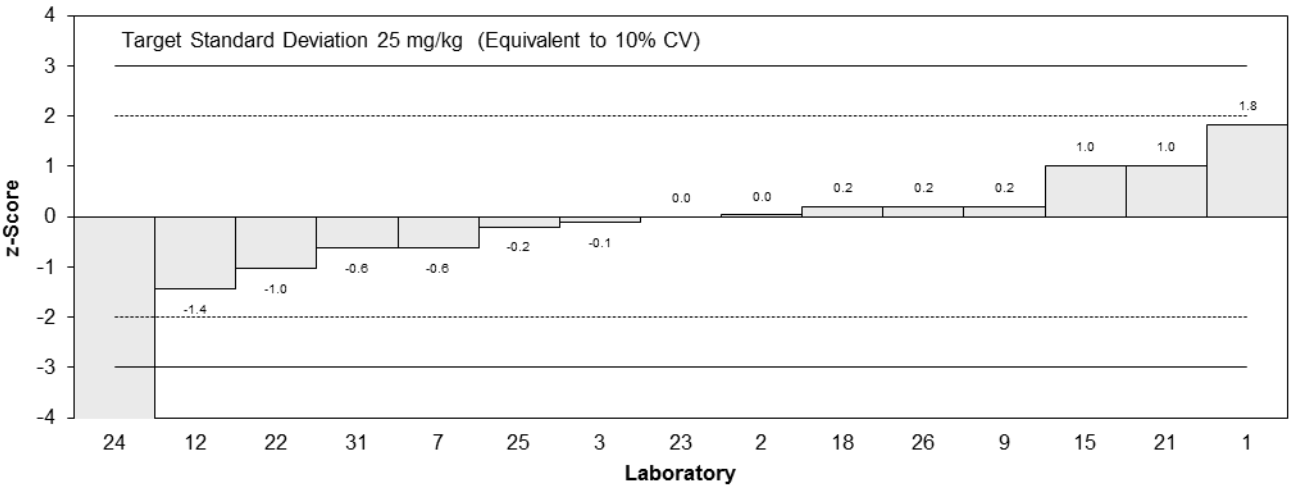
Lab Code	Result	Uncertainty	z-Score	En-Score
1	290	58	1.84	0.75
2	245.7	57	0.03	0.01
3	242	24	-0.12	-0.11
4	NT	NT		
5	NT	NT		
6	NT	NT		
7	230	70	-0.61	-0.21
8	NT	NT		
9	250	38	0.20	0.12
10	NT	NT		
11	NT	NT		
12	210	80	-1.43	-0.43
13	NR	NR		
14	NT	NT		
15	270	20	1.02	1.02
16	NT	NT		
17	NT	NT		
18	250	70	0.20	0.07
19	NT	NT		
20	NT	NT		
21	270	30	1.02	0.76
22	220	40	-1.02	-0.59
23	245	74	0.00	0.00
24	101	20	-5.88	-5.90
25	240	NR	-0.20	-0.36
26	250	38	0.20	0.12
27	NT	NT		
28	NT	NT		
29	NT	NT		
30	NT	NT		
31	230	64	-0.61	-0.23

Statistics

Assigned Value*	245	14
Spike	Not Spiked	
Homogeneity Value	213	26
Robust Average	243	15
Median	245	12
Mean	236	
N	15	
Max.	290	
Min.	101	
Robust SD	21	
Robust CV	8.6%	

* Robust Average excluding Laboratory 24.


Kernel Density
Density
Result
Results: S3 - S
Assigned Value = 245 ± 14 mg/kg
Results (mg/kg)
Laboratory
24 12 22 31 7 25 3 23 2 18 26 9 15 21 1 10 11 13 14 16 17 19 20 27 28 29 30 4 5 6 8 Md A.V. H.V.


z-Scores: S3 - S
Target Standard Deviation 25 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
24 12 22 31 7 25 3 23 2 18 26 9 15 21 1
-1.4 -1.0 -0.6 -0.6 -0.2 -0.1 0.0 0.0 0.2 0.2 0.2 1.0 1.0 1.8

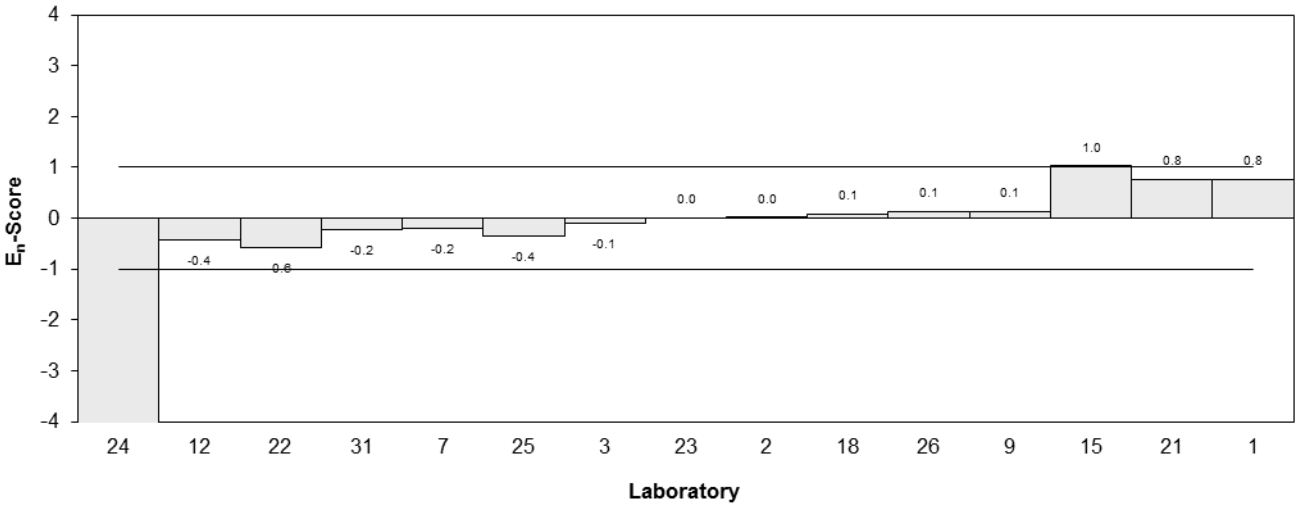

En-Scores: S3 - S
En-Score
Laboratory
24 12 22 31 7 25 3 23 2 18 26 9 15 21 1
-0.4 -0.6 -0.2 -0.2 -0.4 -0.1 0.0 0.0 0.1 0.1 0.1 1.0 0.8 0.8

Figure 52

Table 65

Sample Details

Sample No.	S3
Matrix.	Soil
Analyte.	TC
Units	mg/kg

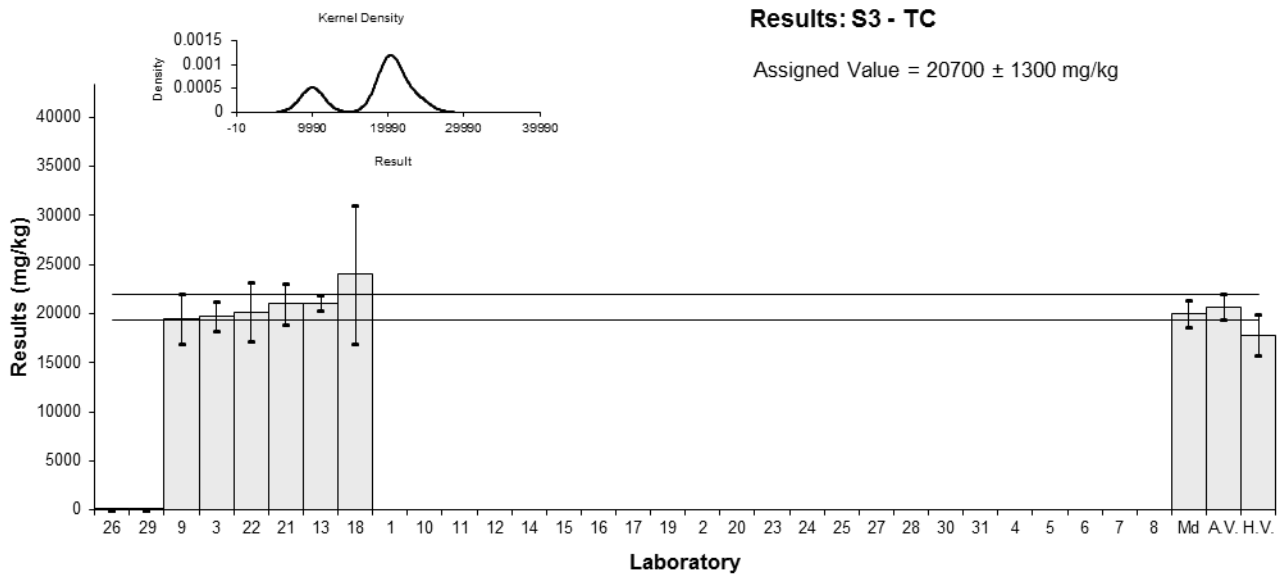
Participant Results

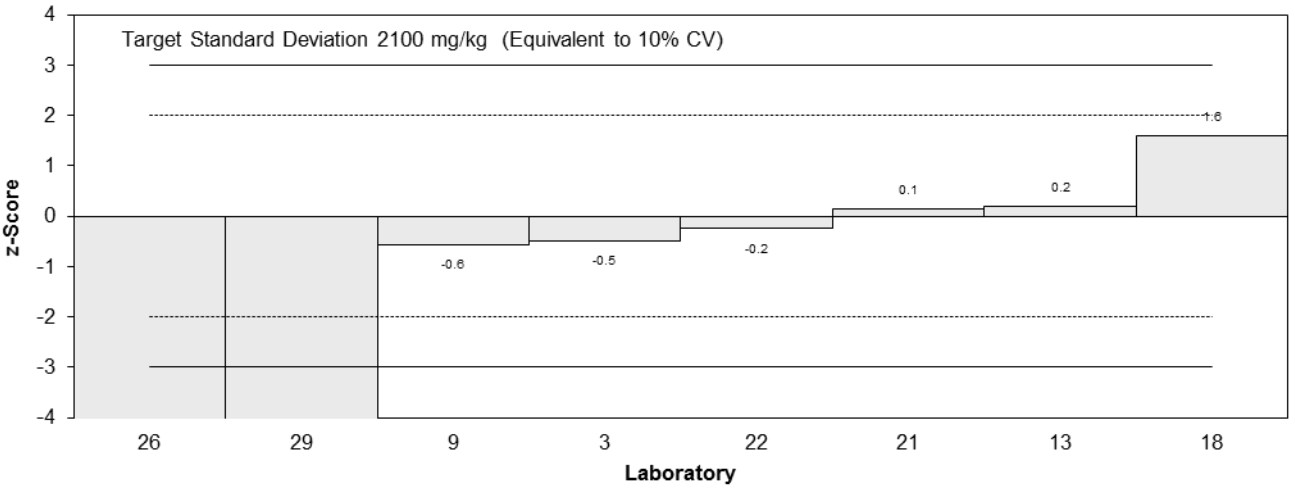
Lab Code	Result	Uncertainty	z-Score	En-Score
1	NT	NT		
2	NR	NR		
3	19700	1500	-0.48	-0.50
4	NT	NT		
5	NT	NT		
6	NT	NT		
7	NR	NR		
8	NT	NT		
9	19540	2540	-0.56	-0.41
10	NT	NT		
11	NT	NT		
12	NR	NR		
13	21100	800	0.19	0.26
14	NT	NT		
15	NT	NT		
16	NT	NT		
17	NT	NT		
18	24000	7000	1.59	0.46
19	NT	NT		
20	NT	NT		
21	21000	2100	0.14	0.12
22	20200	3000	-0.24	-0.15
23	NR	NR		
24	NR	NR		
25	NR	NR		
26	2.0	0.4	-10.00	-15.92
27	NT	NT		
28	NT	NT		
29	2.00	0.13	-10.00	-15.92
30	NT	NT		
31	NT	NT		

Statistics

Assigned Value*	20700	1300
Spike	Not Spiked	
Homogeneity Value	17800	2100
Robust Average	15700	9800
Median	20000	1400
Mean	15700	
N	8	
Max.	24000	
Min.	2	
Robust SD	820	
Robust CV	5.2%	

* Robust Average excluding Laboratories 26 and 29


Kernel Density
Density
Result
Results: S3 - TC
Assigned Value = 20700 ± 1300 mg/kg
Results (mg/kg)
Laboratory
26 29 9 3 22 21 13 18 1 10 11 12 14 15 16 17 19 2 20 23 24 25 27 28 30 31 4 5 6 7 8 Md A.V. H.V.


z-Scores: S3 - TC
Target Standard Deviation 2100 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
26 29 9 3 22 21 13 18
-0.6
-0.5
-0.2
0.1
0.2
1.6

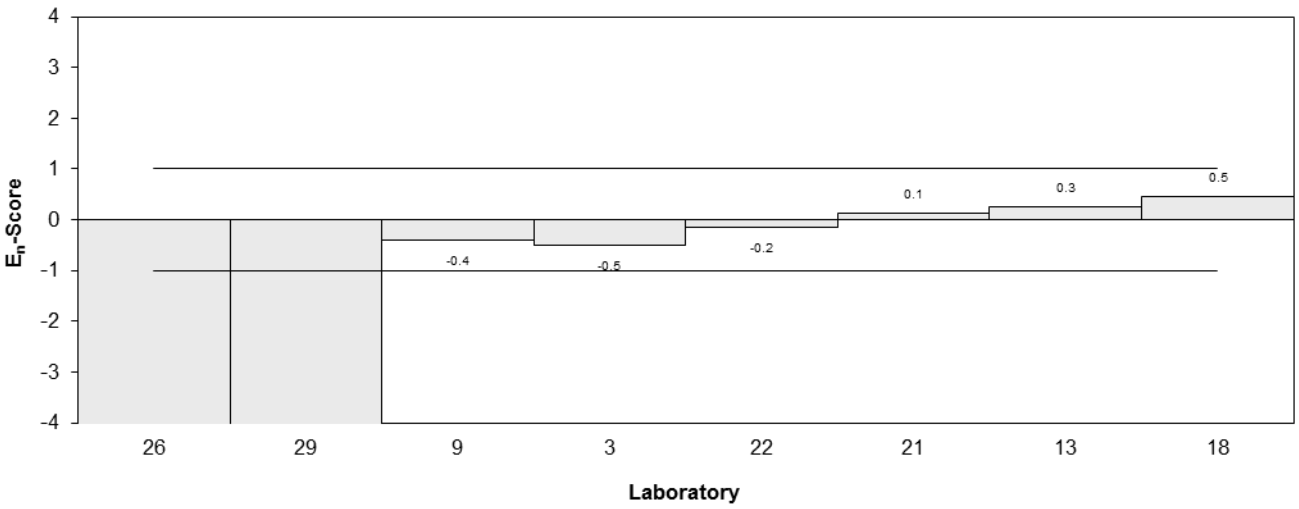

En-Scores: S3 - TC
En-Score
Laboratory
26 29 9 3 22 21 13 18
-0.4
-0.5
-0.2
0.1
0.3
0.5

Figure 53

Table 66

Sample Details

Sample No.	S3
Matrix.	Soil
Analyte.	TN
Units	mg/kg

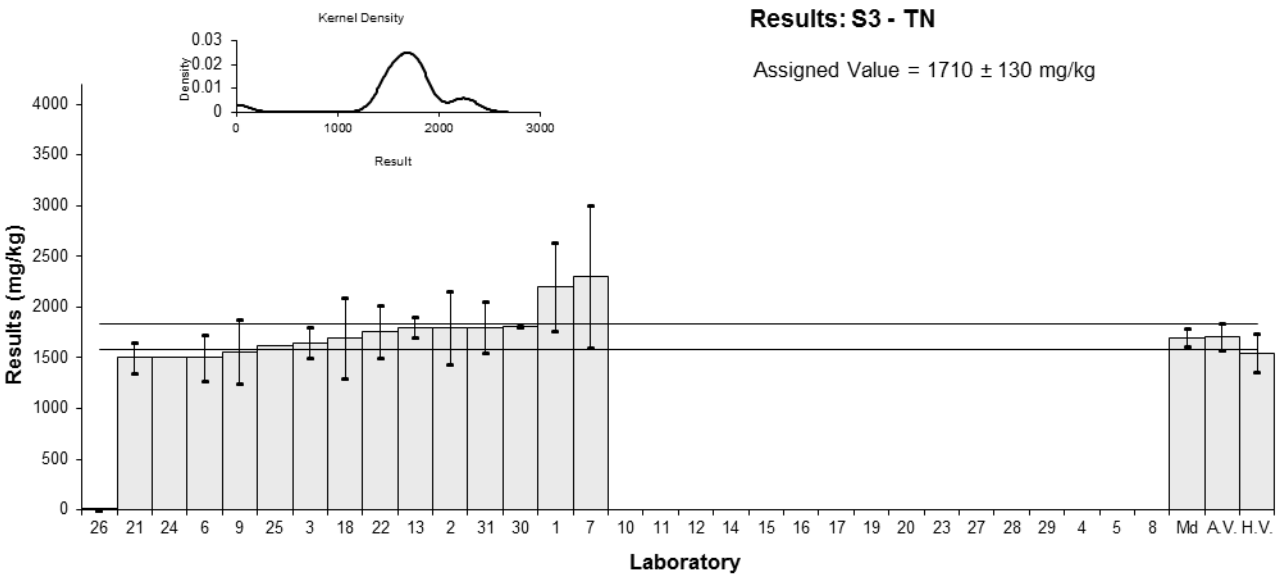
Participant Results

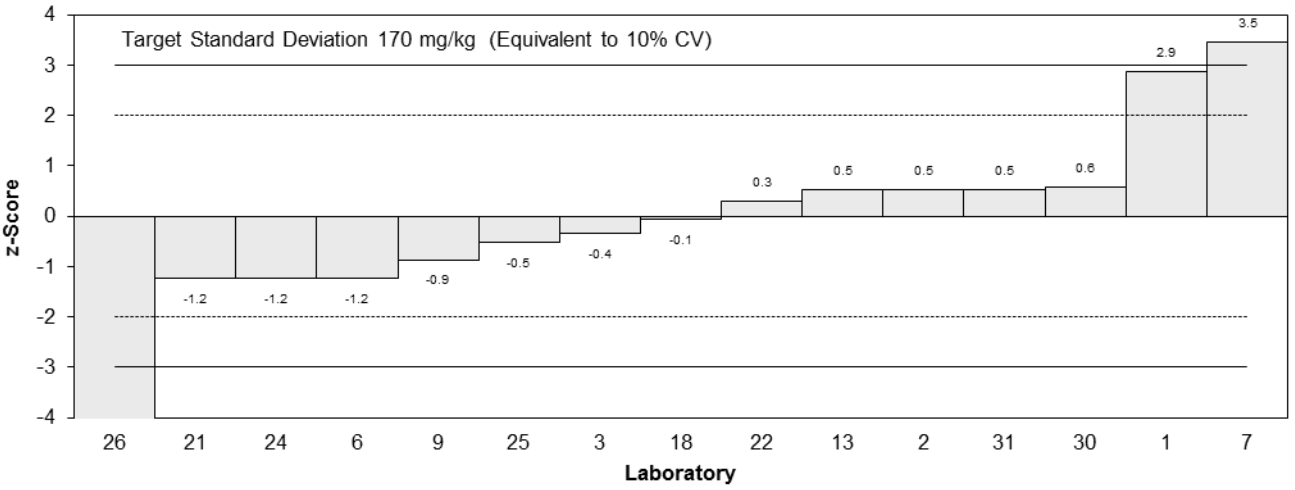
Lab Code	Result	Uncertainty	z-Score	En-Score
1	2200	440	2.87	1.07
2	1800	360	0.53	0.24
3	1650	150	-0.35	-0.30
4	NT	NT		
5	NT	NT		
6	1500	230	-1.23	-0.79
7	2300	700	3.45	0.83
8	NT	NT		
9	1562	312	-0.87	-0.44
10	NT	NT		
11	NT	NT		
12	NR	NR		
13	1800	100	0.53	0.55
14	NT	NT		
15	NT	NT		
16	NT	NT		
17	NT	NT		
18	1700	400	-0.06	-0.02
19	NT	NT		
20	NT	NT		
21	1500	150	-1.23	-1.06
22	1760	260	0.29	0.17
23	NR	NR		
24	1500	NR	-1.23	-1.62
25	1620	NR	-0.53	-0.69
26	0.15	0.02	-10.00	-13.15
27	NT	NT		
28	NT	NT		
29	NT	NT		
30	1808	5.34	0.57	0.75
31	1800	251	0.53	0.32

Statistics

Assigned Value*	1710	130
Spike	Not Spiked	
Homogeneity Value	1550	190
Robust Average	1690	140
Median	1700	90
Mean	1633	
N	15	
Max.	2300	
Min.	0.15	
Robust SD	190	
Robust CV	11%	

* Robust Average excluding Laboratory 26.


Kernel Density
Density
Result
Results: S3 - TN
Assigned Value = 1710 ± 130 mg/kg
Results (mg/kg)
Laboratory
26 21 24 6 9 25 3 18 22 13 2 31 30 1 7 10 11 12 14 15 16 17 19 20 23 27 28 29 4 5 8 Md A.V. H.V.


z-Scores: S3 - TN
Target Standard Deviation 170 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
26 21 24 6 9 25 3 18 22 13 2 31 30 1 7
-1.2 -1.2 -1.2 -0.9 -0.5 -0.4 -0.1 0.3 0.5 0.5 0.5 0.6 2.9 3.5

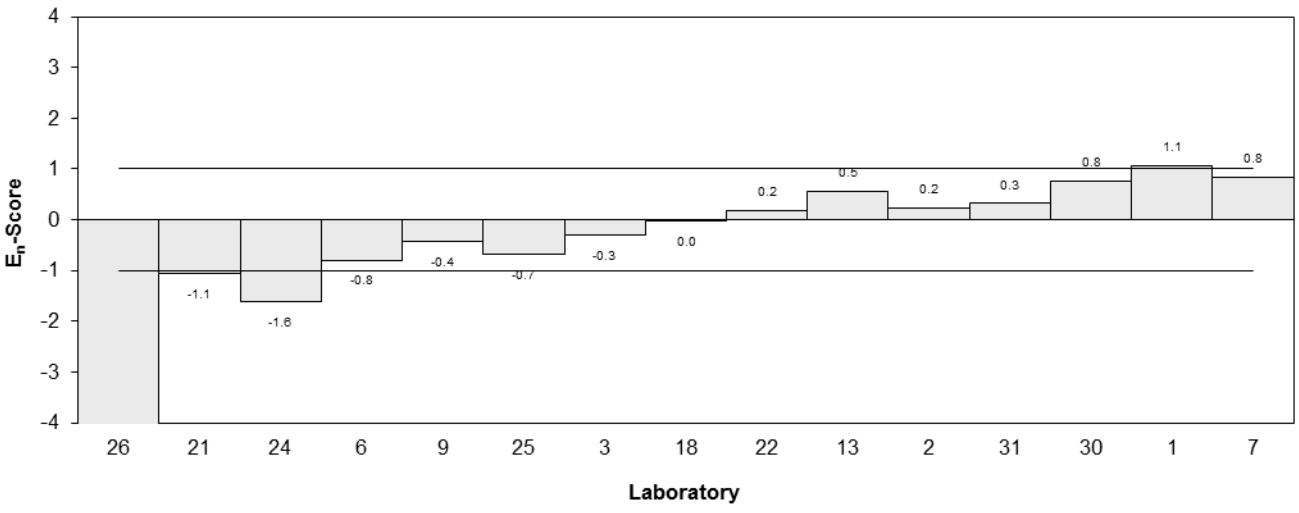

En-Scores: S3 - TN
En-Score
Laboratory
26 21 24 6 9 25 3 18 22 13 2 31 30 1 7
-1.1 -1.6 -0.8 -0.4 -0.7 -0.3 0.0 0.2 0.5 0.2 0.3 0.8 1.1 0.8

Figure 54

Table 67

Sample Details

Sample No.	S3
Matrix.	Soil
Analyte.	TOC
Units	mg/kg

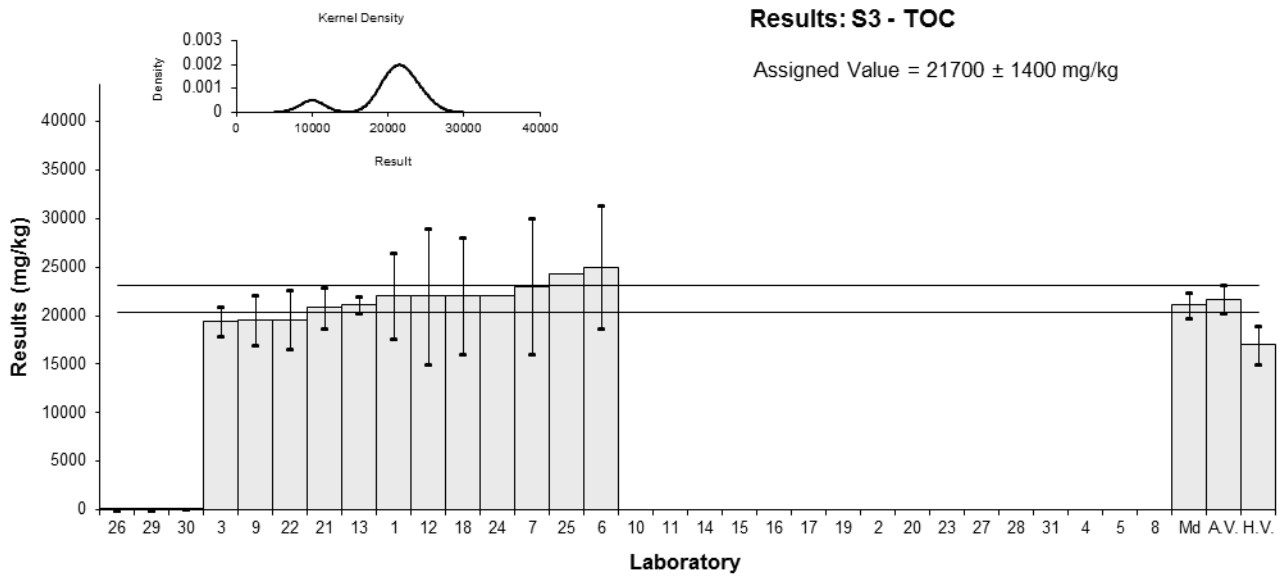
Participant Results

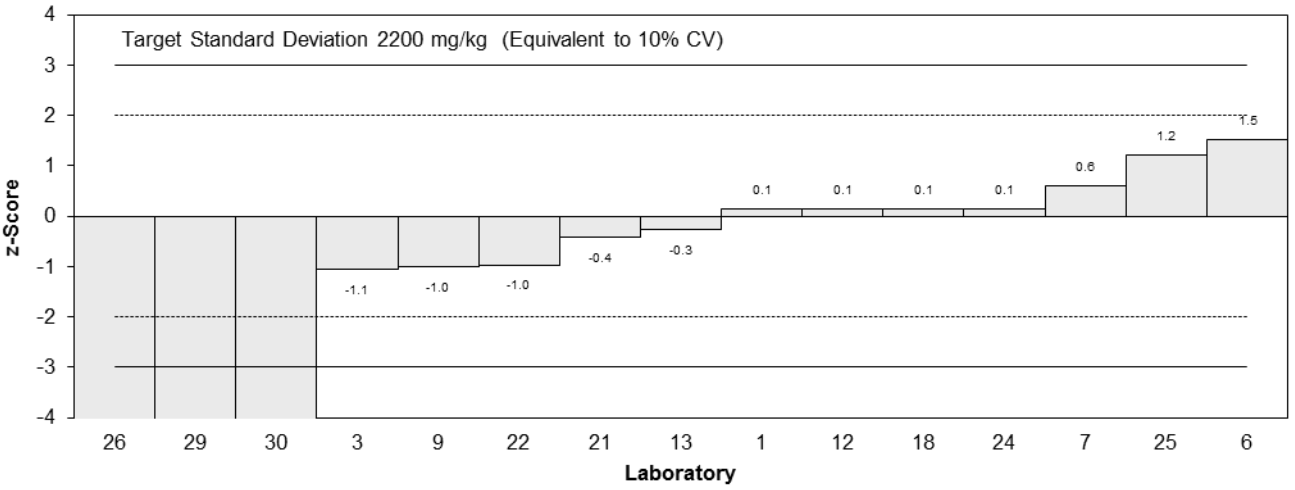
Lab Code	Result	Uncertainty	z-Score	En-Score
1	22000	4400	0.14	0.06
2	NR	NR		
3	19400	1500	-1.06	-1.12
4	NT	NT		
5	NT	NT		
6	25000	6300	1.52	0.51
7	23000	7000	0.60	0.18
8	NT	NT		
9	19510	2536	-1.01	-0.76
10	NT	NT		
11	NT	NT		
12	22000	7000	0.14	0.04
13	21100	853	-0.28	-0.37
14	NT	NT		
15	NT	NT		
16	NT	NT		
17	NT	NT		
18	22000	6000	0.14	0.05
19	NT	NT		
20	NT	NT		
21	20800	2080	-0.41	-0.36
22	19600	3000	-0.97	-0.63
23	NR	NR		
24	22000	NR	0.14	0.21
25	24330	NR	1.21	1.88
26	1.81	0.36	-10.00	-15.50
27	NT	NT		
28	NT	NT		
29	1.91	0.16	-10.00	-15.50
30	38	0	-9.98	-15.47
31	NT	NT		

Statistics

Assigned Value*	21700	1400
Spike	Not Spiked	
Homogeneity Value	17000	2000
Robust Average	20300	2500
Median	21100	1300
Mean	17385	
N	15	
Max.	25000	
Min.	1.81	
Robust SD	2000	
Robust CV	9.9%	

* Robust Average excluding Laboratories 26, 29 and 30


Kernel Density
Density
Result
Results: S3 - TOC
Assigned Value = 21700 ± 1400 mg/kg
Results (mg/kg)
Laboratory
26 29 30 3 9 22 21 13 1 12 18 24 7 25 6 10 11 14 15 16 17 19 2 20 23 27 28 31 4 5 8 Md A.V. H.V.


z-Scores: S3 - TOC
Target Standard Deviation 2200 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
26 29 30 3 9 22 21 13 1 12 18 24 7 25 6
-1.1 -1.0 -1.0 -0.4 -0.3 0.1 0.1 0.1 0.1 0.6 1.2 1.5

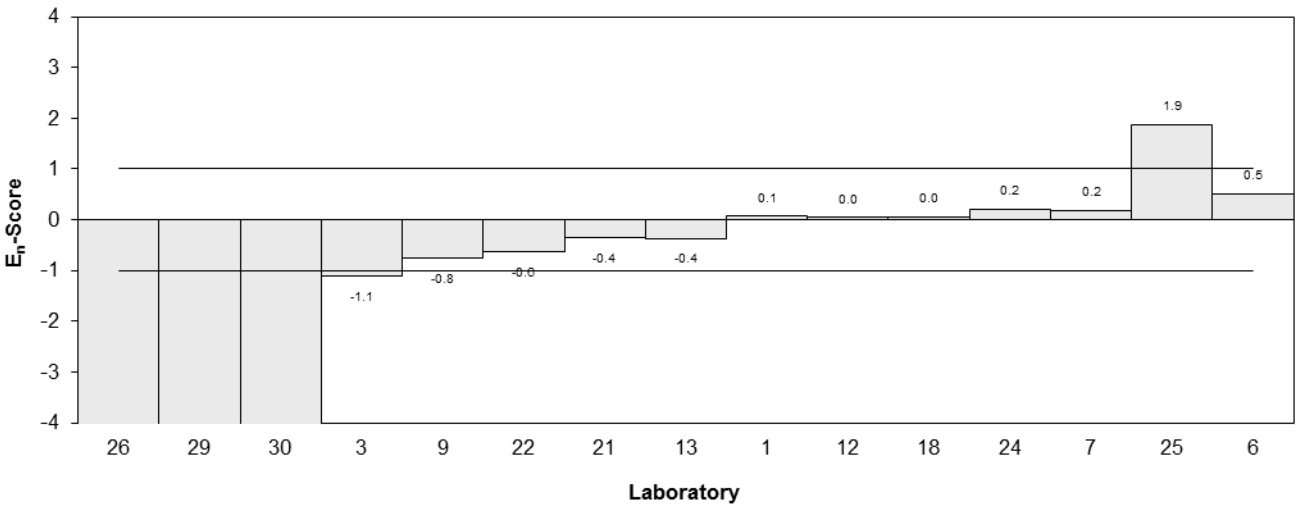

En-Scores: S3 - TOC
En-Score
Laboratory
26 29 30 3 9 22 21 13 1 12 18 24 7 25 6
-1.1 -0.8 -0.6 -0.4 -0.4 0.1 0.0 0.0 0.2 0.2 1.9 0.5

Figure 55

Table 68

Sample Details

Sample No.	S3
Matrix.	Soil
Analyte.	Total P
Units	mg/kg

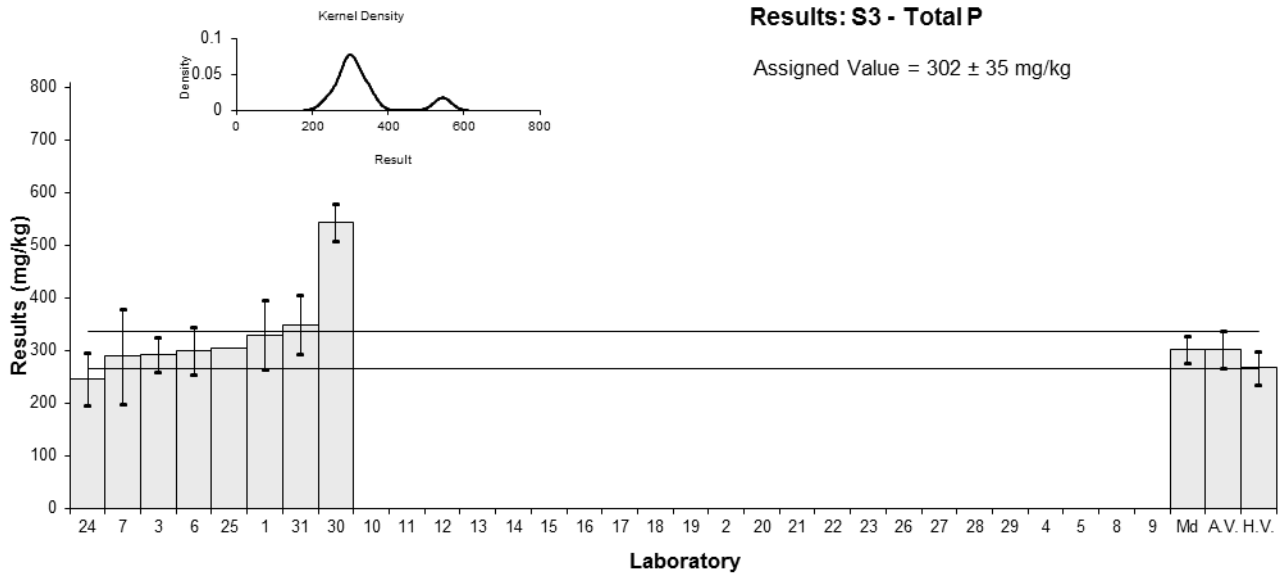
Participant Results

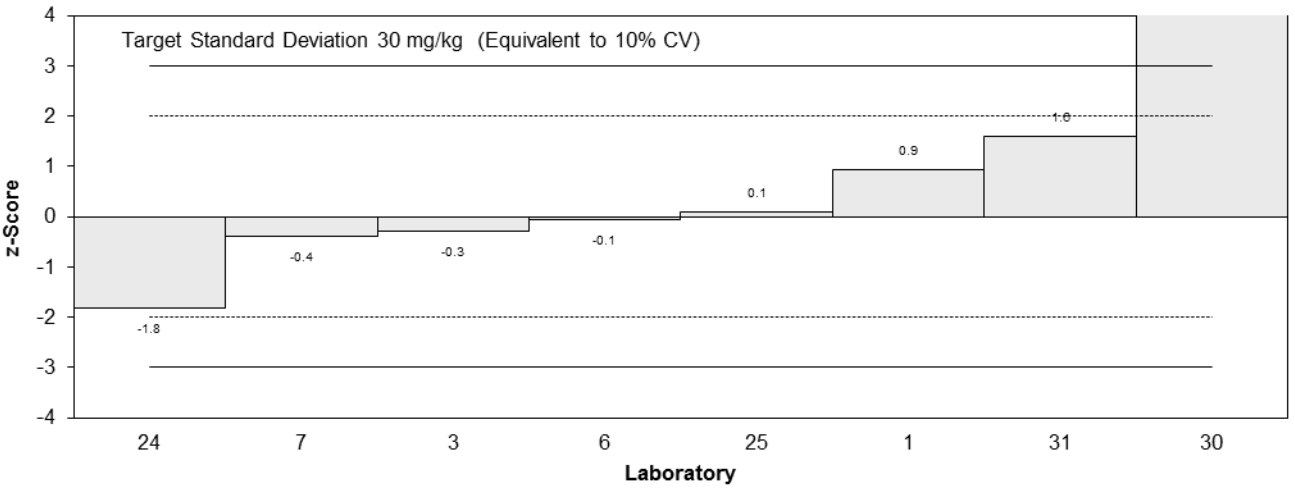
Lab Code	Result	Uncertainty	z-Score	En-Score
1	330	66	0.93	0.37
2	NR	NR		
3	293	32	-0.30	-0.19
4	NT	NT		
5	NT	NT		
6	300	45	-0.07	-0.04
7	290	90	-0.40	-0.12
8	NT	NT		
9	NT	NT		
10	NT	NT		
11	NT	NT		
12	NR	NR		
13	NR	NR		
14	NT	NT		
15	NT	NT		
16	NT	NT		
17	NT	NT		
18	NT	NT		
19	NT	NT		
20	NT	NT		
21	NR	NR		
22	NR	NR		
23	NR	NR		
24	247	50	-1.82	-0.90
25	305	NR	0.10	0.09
26	NT	NT		
27	NT	NT		
28	NT	NT		
29	NT	NT		
30	544.4	34.43	8.03	4.94
31	350	56.35	1.59	0.72

Statistics

Assigned Value*	302	35
Spike	Not Spiked	
Homogeneity Value	268	32
Robust Average	312	42
Median	303	25
Mean	332	
N	8	
Max.	544.4	
Min.	247	
Robust SD	37	
Robust CV	12%	

* Robust Average excluding Laboratory 30


Kernel Density
Density
Result
Results: S3 - Total P
Assigned Value = 302 ± 35 mg/kg
Results (mg/kg)
Laboratory
24 7 3 6 25 1 31 30 10 11 12 13 14 15 16 17 18 19 2 20 21 22 23 26 27 28 29 4 5 8 9 Md A.V. H.V.


z-Scores: S3 - Total P
Target Standard Deviation 30 mg/kg (Equivalent to 10% CV)
z-Score
Laboratory
24 7 3 6 25 1 31 30
-1.8
-0.4
-0.3
-0.1
0.1
0.9
1.6

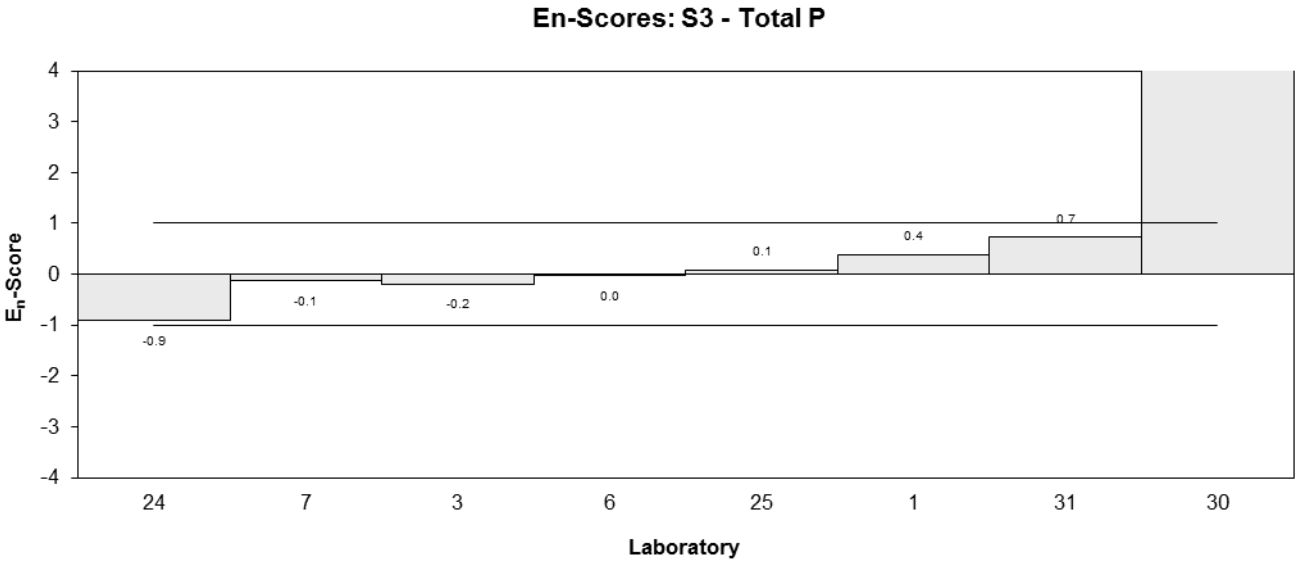

En-Scores: S3 - Total P
En-Score
Laboratory
24 7 3 6 25 1 31 30
-0.9
-0.1
-0.2
0.0
0.1
0.4
0.7

Figure 56

7 DISCUSSION OF RESULTS

7.1 Assigned Value

Sample S1 was moist soil and **Sample S2** was dried soil. Both samples were prepared from the same fortified and dried soil material. A known amount of ultrapure water was added to Sample S1. Participants were asked to report the results for Sample S1 corrected for moisture content.

Sample S3 was dried agricultural soil.

Assigned values for the 55 tests in the study samples were the robust averages of participants' results. The robust averages used as assigned values and their associated expanded uncertainties were calculated using the procedures described in 'ISO 13528:2015(E). Results less than 50% and more than 150% of the robust average were removed before calculation of each assigned value.[8] Appendix 2 sets out the calculation for the robust average of Al in Sample S2 and its associated uncertainty.

No assigned value was set for Colwell K, Extractable B and Phosphorus Buffer Index in S3 because too few results were reported for these tests.

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. 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 946 numerical results, 878 were reported with an expanded measurement uncertainty, indicating that all laboratories have addressed this requirement of ISO 17025.[10] The participants used a wide variety of procedures to estimate the expanded measurement uncertainty. These are presented in Tables 11 and 12.

Approaches to estimating measurement uncertainty include: standard deviation of replicate analysis, long term reproducibility, professional judgement, top down approach using precision and estimates of method and laboratory bias and top down approach using only the reproducibility from inter-laboratory comparisons studies.[11– 18]

Proficiency tests allow a check of participants' uncertainty estimates. Results and the expanded MU are presented in the bar charts for each analyte (Figure 2 to 56). In this study, the reported expanded measurement uncertainty has been over-estimated in some cases (e.g. Lab 10 for sample S1) or under-estimated (e.g. Lab 11 for Hg in S1). As a simple rule of thumb, when the uncertainty estimate is smaller than the 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.

Double counting the precision uncertainty components and overestimation of the laboratory or method bias are the most common errors seen when preparing uncertainty budgets. According to General Accreditation Guidance-Estimating and Reporting MU of Chemical Test Results[14] and to NORDTEST TR 537,[12] the most common experimental data used for estimating the precision component for the measurement uncertainty calculation in the top down approach are from:

- Stable control samples that cover the whole analytical process (including extraction) and **have a matrix similar** to the samples; **or**
- Stable control samples **and** duplicate analyses if control samples do not cover whole analytical process (e.g. the control sample is a synthetic sample- we have to take into consideration uncertainties arising from different matrices); **or**

- When control samples are not stable, from analysis of natural duplicates (gives within-day variation for sampling and measurement) and long-term uncertainty component from the variation in the instrument calibration; **or**
- Replicate analyses performed on the same sample at different times to obtain estimates of intermediate precision; within-batch replication provides estimates of repeatability only.

The most common sources for estimating the method bias component for the measurement uncertainty calculation are from:

- Certified reference material recoveries; **or**
- Participation in PT studies (laboratory bias from at least 6 successful PT studies); **or**
- From sample spike recoveries.

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.[12, 14] An example of estimating measurement uncertainty using proficiency testing data only is given in Appendix 3.

Laboratories 4 and 5 attached estimates of the expanded measurement uncertainty for results reported as less than their limit of detection. An estimate of uncertainty expressed as a value cannot be attached to a result expressed as a range.[11]

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 0.6 ± 0.06 mg/kg, it is better to report 0.60 ± 0.06 mg/kg or instead of 84 ± 16.1 mg/kg, it is better to report 84 ± 16 mg/kg.[11]

7.3 E_n-score

E_n-score should be interpreted only in conjunction with z-scores. The E_n-score indicates how closely a result agrees with the assigned value taking into account the respective uncertainties. An unsatisfactory E_n 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 57. 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 935 results for which E_n-scores were calculated, 736 (79%) returned a satisfactory score of $|E_n| \leq 1$ indicating agreement of the participants' results with the assigned values within their respective expanded measurement uncertainties.

7.4 z-Score

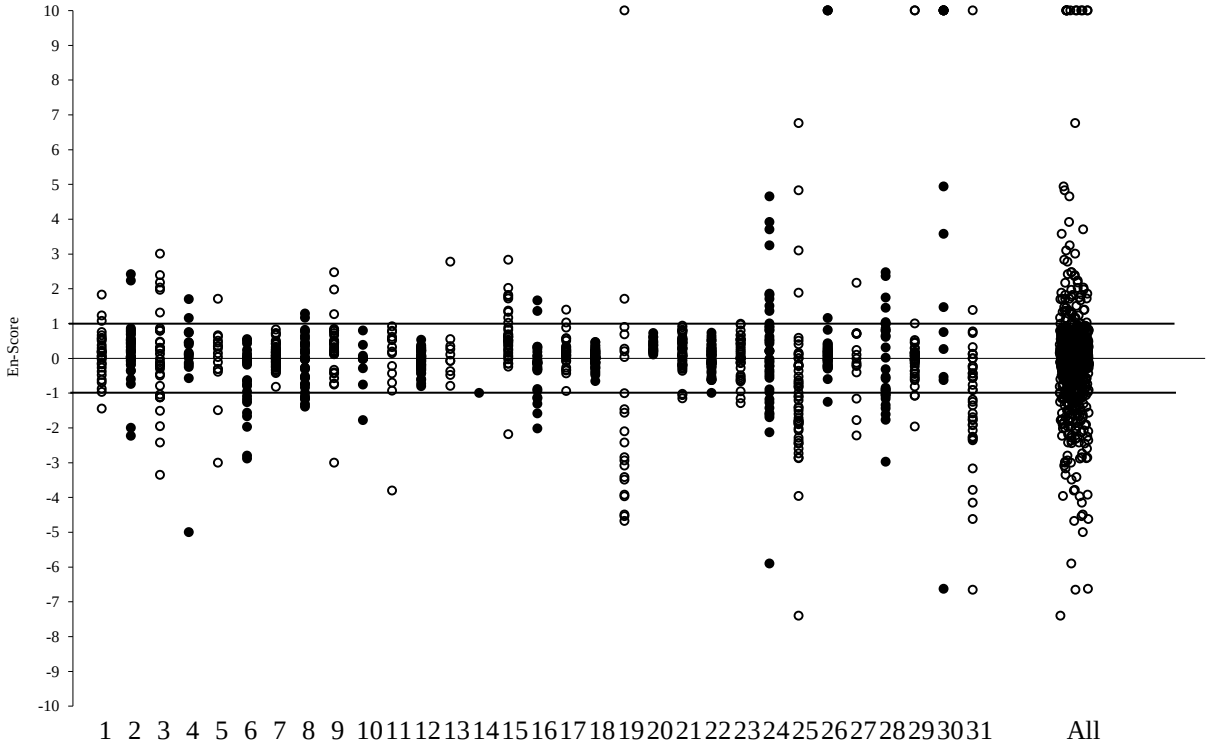
The z-score compares participant's deviation from the assigned value with the target standard deviation set for proficiency assessment.

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 a fixed reference value point for assessment of laboratory performance, independent of group performance.

The between laboratory coefficient of variation predicted by the Thompson equation[9] and the between laboratory coefficient of variation resulted in this study are presented for comparison in Table 69. The dispersal of participants' z-scores is presented in Figure 58 (by laboratory code) and in Figure 59 (by test). Of 935 results for which z-scores were calculated, 832 (89%)

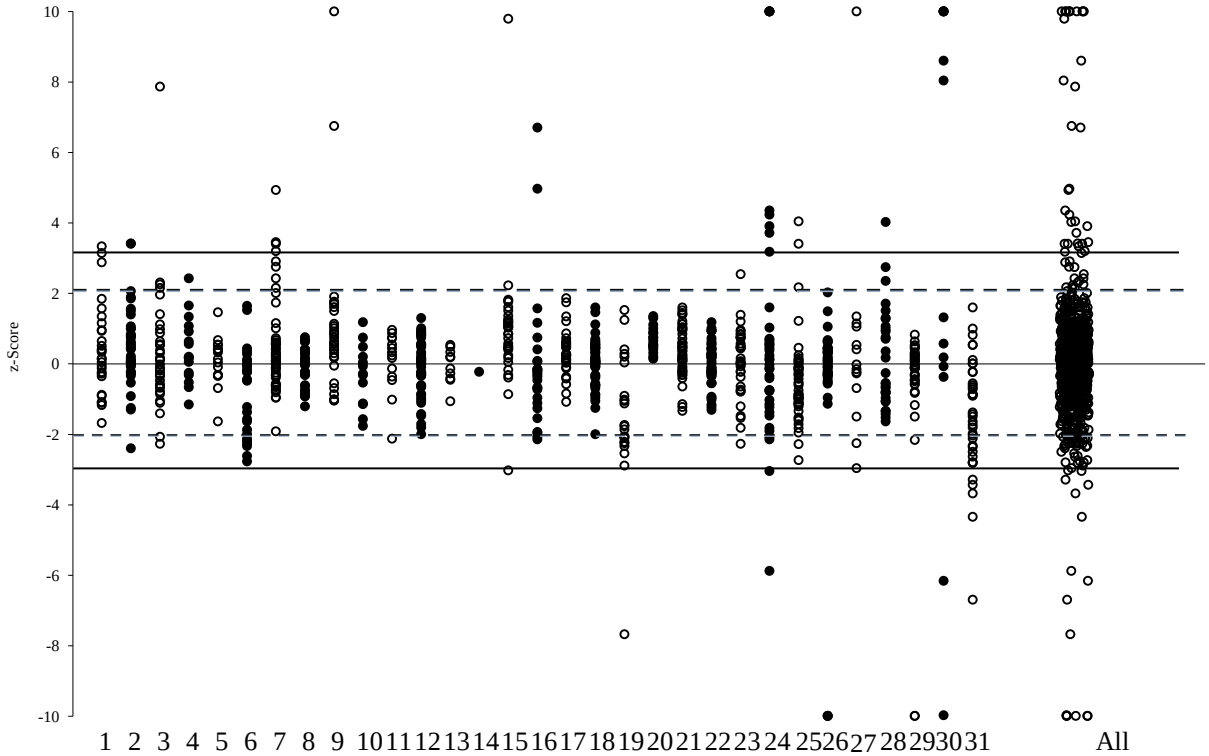
returned a satisfactory score of $|z| \leq 2$ and 54 (6%) were questionable of $2 < |z| < 3$. Participants with multiple z-scores larger than 2 or smaller than -2 should check for laboratory bias.

Laboratories 12, 18, 21 and **22** returned satisfactory z-scores for all analytes reported in all three study samples.



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

Figure 57 E_n-Score Dispersal by Laboratory



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

Figure 58 z-Score Dispersal by Laboratory

Table 69 Between-Laboratory CV of this Study, Thompson CV and Set Target CV

Sample	Test	Assigned value mg/kg	Between Laboratories CV	Thompson/ Horwitz CV	Target SD (as CV)
S1	As	2.65	17%	14%	15%
S1	Ba	81.3	14%	8%	10%
S1	Be	1.15	15%	16%	15%
S1	Cd	1.89	15%	15%	15%
S1	Cr	91.4	12%	8%	15%
S1	Cu	69.8	8.9%	8%	10%
S1	Hg	0.387	20%	18%	20%
S1	Mn	339	9.7%	7%	10%
S1	Mo	29.8	11%	10%	10%
S1	Ni	62.9	15%	9%	15%
S1	Pb	44.3	7%	9%	10%
S1	Sb	20.3	29%	10%	20%
S1	Se	2.03	15%	14%	15%
S1	Sn	12.4	8.1%	11%	10%
S1	V	41.8	9.8%	9%	10%
S1	Zn	65.3	11%	10%	10%
S2	Ag	2.85	9.4%	14%	10%
S2	Al	6590	15%	4%	10%
S2	B	17.1	23%	10%	20%
S2	Ba	85.4	8.8%	8%	10%
S2	Bi	1.00	0.01%	16%	10%
S2	Co	12.3	7.3%	11%	10%
S2	Cs	3.03	10%	14%	10%
S2	La	10.0	15%	11%	10%
S2	Li	2.95	24%	14%	20%
S2	Rb	10.9	13%	11%	15%
S2	Se	2.20	18%	14%	15%
S2	Sn	12.5	6.4%	11%	10%
S2	Sr	34.1	9.1%	9%	10%
S2	Th	4.73	28%	13%	20%
S2	Tl	2.81	16%	14%	15%
S2	U	8.69	7.4%	12%	10%
S2	Zn	68.1	6.3%	8%	10%
S3	Ca	1800	8.2%	5%	10%
S3	EC	287	8%	7%	10%
S3	Colwell P	88	13%	8%	10%
S3	Exchangeable Ca^{2+} (cmol(+)/kg)	6.97	6.7%	12%	10%
S3	Exchangeable Mg^{2+} (cmol(+)/kg)	1.48	14%	15%	15%
S3	Exchangeable Na^{+} (cmol(+)/kg)	0.204	9.5%	20%	15%
S3	Exchangeable K^{+} (cmol(+)/kg)	0.331	14%	19%	15%
S3	Fe	3620	12%	5%	10%
S3	K	476	11%	6%	10%
S3	Mg	476	14%	6%	10%
S3	Na	65.7	11%	9%	10%
S3	P	268	7.8%	7%	10%
S3	Total P	302	12%	7%	10%
S3	pH (No unit)	6.20	1.6%	12%	10%
S3	S	245	8.6%	7%	10%
S3	TC	20700	5.2%	4%	10%
S3	TOC	21700	9.9%	4%	10%
S3	TN	1710	11%	5%	10%

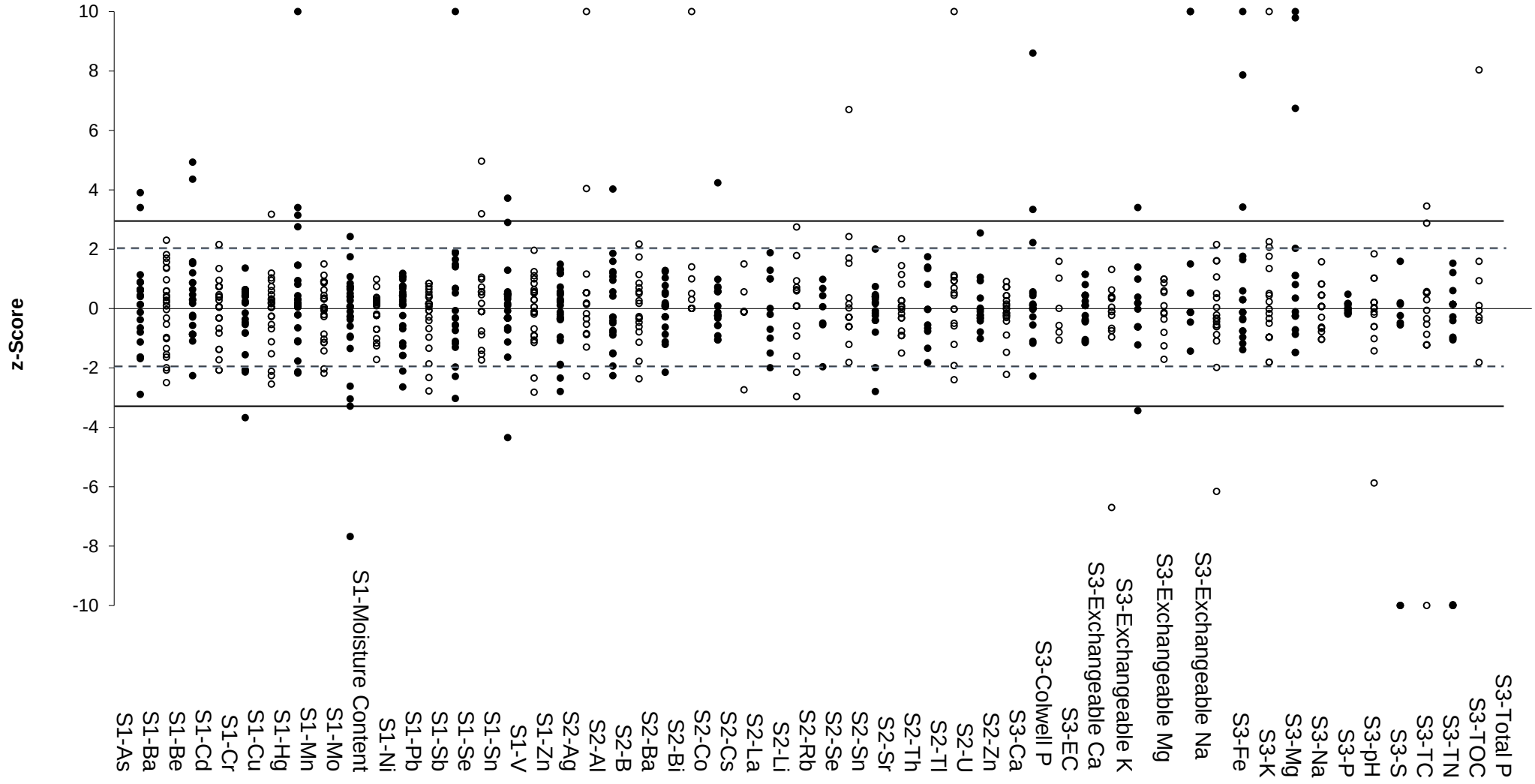


Figure 59 z-Score Dispersal by Element

Table 70 Summary of Participants' Results and Performance for Sample S1

Lab Code	S1-As (mg/kg)	S1-Ba (mg/kg)	S1-Be (mg/kg)	S1-Cd (mg/kg)	S1-Cr (mg/kg)	S1-Cu (mg/kg)	S1-Hg (mg/kg)	S1-Mn (mg/kg)	S1-Mo (mg/kg)	S1-Ni (mg/kg)	S1-Pb (mg/kg)	S1-Sb (mg/kg)	S1-Se (mg/kg)	S1-Sn (mg/kg)	S1-V (mg/kg)	S1-Zn (mg/kg)	S1-Moisture Content (%)
H.V.	2.86	94	1.26	2.18	99	74	0.438	342	27.4	63.4	44.6	16.2	2.24	14.4	40.0	73	22.6
A.V.	2.65	81.3	1.15	1.89	91.4	69.8	0.387	339	29.8	62.9	44.3	20.3	2.03	12.4	41.8	65.3	21.5
1	1.98	84.3	0.96	2.16	86.5	70.1	0.63	337	31.7	60.6	44.9	15.8	1.76	12.9	38.0	63.4	22.2
2	<5	94	<5	2.1	97	66	0.65	340	30	67	44	20	<3	13	42	69	18.8
3	2.9	100	1.3	1.3	99	65	0.41	310	28	64	45	26	1.6	12	50	64	23.6
4	2.9	77	<2	1.7	94	68	0.4	370	37	73	45	27	2.2	12	42	74	19
5	2.7	68	<2	1.8	97	72	0.5	340	31	68	46	23	2	12	44	63	20
6	2	65	<1	1.5	62	54	0.42	265	22	48	32	NT	<5	NT	32	53	22.1
7	4	86	2	2.5	97	71	0.6	350	30	67	45	19	3	16	43	67	22
8	2.7	81	1.2	2.0	100	70	0.4	360	31	70	43	23	1.8	12	43	66	21
9	3.1	95	< 2	2	100	75	0.4	370	35	73	48	28	2.2	13	46	75	20
10	2.2	NT	1.1	1.8	84	70	0.25	300	32	48	44	<10	<1	13	NT	73	21.9
11	<5	89.1	1.30	2.10	85.0	70.9	0.222	354	28.7	65.1	46.7	NT	<5	12.8	41.2	70.0	19.3
12	3	82	1	2.1	98	72	0.4	340	29	64	48	19	2	14	44	63	21
13	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
14	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	21
15	<4	96	1	2	110	77	0.39	390	33	74	48	8	<5	12	47	73	22
16	2.81	68.7	1.42	2.10	62.9	67.9	0.392	332	26.9	50.9	41.3	12.3	3.54	11.5	38.9	62.8	21.1
17	2.5	86.12	1.3578	2.2704	94.622	71.73	0.303	368.242	29.4878	67.3453	44.6162	27.8571	2.2487	12.53	44.44	68.600	22
18	3	82	1	1.9	100	74	0.5	350	30	64	46	18	2	13	44	63	20
19	1.5	73.0	0.76	1.3	63	52	<1.0	340	6.9	43	36	NT	1.5	11	38	50	22.1
20	3.00	92.3	1.23	2.10	98.4	71.1	0.410	369	32.0	66.8	47.2	22.4	2.33	13.1	46.4	73.7	21.8
21	2.83	78.7	1.41	1.97	97.5	76.4	0.37	377	32.3	72.1	44.6	NT	2.17	11.6	44.2	66.7	22.3
22	2.9	83	1.2	2.0	94	73	0.46	330	27	67	45	15	2.2	NT	41	73	22
23	2.39	92.5	1.11	1.91	99.2	78.1	0.37	370	31.3	70.0	47.6	17.3	1.56	12.3	45.3	68.3	23.1
24	4.2	64.4	1.9	1.5	89.3	91.9	19	304	20.7	69.2	42.5	96	<2	17.0	37.0	52.8	22
25	2.6	70.3	1.0	1.8	70.0	62.0	0.3	300	29.0	52.0	40.0	11.0	2.0	12.0	38.0	59.0	17.8
26	2.89	84.8	1.26	2.02	97.1	70.1	0.394	351	31.8	65.7	45.0	26.3	2.35	12.0	41.4	67.3	21.7
27	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
28	2.331	73.335	1.052	1.655	80.149	59.123	0.337	290.510	25.771	56.371	38.356	18.075	2.081	10.361	37.335	58.275	NT
29	2.9	83.6	1.18	1.90	80	71.3	0.219	338	30.6	57.4	46.3	15.5	2.0	12.6	<100	64.5	22
30	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
31	2	61	1	1.4	41	55	0.45	270	20	38	34	<3	<3	7	30	47	21

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

Table 71 Summary of Participants' Results and Performance for Sample S2

Lab Code	S2-Ag (mg/kg)	S2-Al (mg/kg)	S2-B (mg/kg)	S2-Ba (mg/kg)	S2-Bi (mg/kg)	S2-Co (mg/kg)	S2-Cs (mg/kg)	S2-La (mg/kg)	S2-Li (mg/kg)	S2-Rb (mg/kg)	S2-Se (mg/kg)	S2-Sn (mg/kg)	S2-Sr (mg/kg)	S2-Th (mg/kg)	S2-Tl (mg/kg)	S2-U (mg/kg)	S2-Zn (mg/kg)
H.V.	2.67	6950	15.0	89.0	1.08	11.4	3.18	9.2	2.82	9.9	2.13	13.2	34.3	4.10	2.72	7.82	69.2
A.V.	2.85	6590	17.1	85.4	1.00	12.3	3.03	10.0	2.95	10.9	2.20	12.5	34.1	4.73	2.81	8.69	68.1
1	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
2	2.479	7807	15.95	92.01	NT	11.17	NT	11.88	NT	NT	2.104	12.76	34.26	6.046	1.800	8.480	66.56
3	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
5	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
6	NT	6270	NT	86	NT	12	NT	NT	NT	NT	<5	NT	NT	NT	NT	NT	68
7	3	6100	23	90	1	13	3	11	3	12	3	15	34	4.1	2	8.4	73
8	2.6	6400	15	80	1.0	12	NT	NT	2.4	NT	1.8	13	31	4.0	2.8	8.0	66
9	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
10	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
11	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
12	3	6400	16	83	1	13	NR	11	3	NR	2	10	35	5.5	3.2	9.5	68
13	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
14	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
15	2.8	7300	20	96	NT	13	NT	NT	4	NT	<4	12	38	NT	<4	NT	73
16	3.18	5310	15.5	75.8	NR	12.4	NR	NR	1.68	NR	4.41	12.3	33	NR	NR	NR	67.1
17	2.6067	6961.91	17.685	86.43	<5	12.1362	NT	NT	NT	NT	2.206	13.07	35	6.3753	2.5599	8.3228	69.8754
18	3	6000	19	86	1	11	3	8	3	11	2	12	33	4.7	3.1	8.7	71
19	NT	7410	11	87	NT	11	NT	NT	NT	NT	2.7	13	NT	NT	NT	NT	53
20	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
21	2.89	7380	18.8	94.2	1.14	13.5	NT	NT	3.37	NT	2.25	12.4	39.0	3.46	3.28	8.41	68.7
22	2.9	6860	18	83	1.1	12	3.2	9.8	3.5	10	2.1	NT	35	4.2	3.2	8.5	73
23	2.20	7214	14.4	89.5	1.00	13.2	NR	NR	NR	NR	1.60	11.5	36.9	NR	2.30	10.9	69.1
24	6.15	7640	19.5	67	NR	17.5	NR	NR	3.3	NR	<2	<1	31.5	NR	14	NR	58.0
25	4.0	5580	24.53	75.1	1.0	11.6	2.2	9.0	2.0	7.7	2.0	12.7	31.0	3.0	3.0	7.8	65.2
26	2.7	6320	13.2	86.5	1.03	11.6	3.0	10	3.32	11.6	2.32	12.2	33.5	4.7	2.6	8.6	66.4
27	3	5100	21	83	2.3	12	NT	9.3	1.2	NT	NT	13	29	6.0	2.8	9.6	67
28	NT	9236.578	16.178	96.334	NT	13.159	3.483	11.294	4.567	12.503	2.761	13.428	42.106	NT	3.257	8.994	74.319
29	2.75	6060	<20	86.2	1.05	11.9	2.99	8.50	2.60	10.1	2.1	12.9	34.4	NT	3.03	8.66	71.0
30	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
31	3.0	5600	9	78	NT	12	NT	NT	NT	NT	<3	9	31	NT	NT	NT	62

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

Table 72 Summary of Participants' Results and Performance for Sample S3

Lab Code	S3-Ca (mg/kg)	S3- Extractable B (mg/kg)	S3-Colwell P (mg/kg)	S3-Colwell K (mg/kg)	S3-EC (uS/cm)	S3-Exchangeable Ca^{2+} (cmol(+)/kg)	S3-Exchangeable Mg^{2+} (cmol(+)/kg)	S3-Exchangeable Na- (cmol(+)/kg)	S3-Exchangeable K (cmol(+)/kg)	S3-Fe (mg/kg)
H.V.	1760	NA	107	158	300	7.65	1.58	0.223	0.303	3850
A.V.	1800	Not Set	88.3	Not Set	287	6.97	1.48	0.204	0.331	3620
1	2400	NT	NT	NT	320	NT	NT	NT	NT	3800
2	1827	NT	NT	NT	290	7.4	1.7	0.25	0.38	4003
3	1390	NT	81	NT	255	7.23	1.44	0.22	0.33	4400
4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
5	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
6	1820	NT	NT	NT	274	NT	NT	NT	NT	3540
7	1800	0.5	83	140	320	6.3	1.3	0.2	0.3	3400
8	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
9	1900	NT	NT	NT	257	7.25	1.67	0.7	< 0.5	4200
10	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
11	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
12	1600	NR	NR	NR	310	6.5	1.1	<0.1	0.3	3300
13	NR	NR	78.6	NR	275	7.2	1.45	0.19	0.34	NR
14	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
15	2200	NT	NT	NT	300	NT	NT	NT	NT	4200
16	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
17	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
18	1800	0.6	NT	NT	300	7.0	1.2	<0.1	0.3	3400
19	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
20	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
21	1890	0.62	102	198	254	6.81	1.61	0.20	0.40	3750
22	1590	NR	NR	NR	280	6.9	1.4	0.20	0.27	3420
23	1877	NR	NR	NR	NR	NR	NR	NR	NR	3630
24	1795	0.89	97.0	NR	290	6.45	1.60	0.22	0.35	3495
25	1800	0.3	NR	NR	294	6.9	1.5	0.2	0.5	3220
26	1750	NT	NT	NT	299	NT	NT	NT	NT	3500
27	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
28	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
29	1820	NT	NT	NT	NT	NT	NT	NT	NT	3460
30	3347.4	NT	NT	NT	276	7.88	NT	2.54	0.34	1390.3
31	1700	NT	88	NT	290	2.3	1.7	0.16	0.16	2900

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

Table 72 Summary of Participants' Results and Performance for Sample S3 (Continued)

Lab Code	S3-K (mg/kg)	S3-Mg (mg/kg)	S3-Na (mg/kg)	S3-P (mg/kg)	S3-Total P (mg/kg)	S3-PBI$_{+ColP}$ (mg/kg)	S3-pH	S3-S (mg/kg)	S3-TC (mg/kg)	S3-TOC (mg/kg)	S3-TN (mg/kg)
H.V.	568	505	70.5	268	268	107	6.75	213	17800	17000	1550
A.V.	476	476	65.7	268	302	Not Set	6.20	245	20700	21700	1710
1	420	540	NT	310	330	NT	6.12	290	NT	22000	2200
2	638.2	574.0	70.97	290.2	NR	NT	6.2	245.7	NR	NR	1800
3	850	583	73	251	293	63.0	6.26	242	19700	19400	1650
4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
5	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
6	554	468	68	NT	300	NT	NT	NT	NT	25000	1500
7	440	430	64	270	290	75	6.1	230	NR	23000	2300
8	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
9	490	560	110	240	NT	NT	6.16	250	19540	19510	1562
10	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
11	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
12	430	390	56	240	NR	NR	6.3	210	NR	22000	NR
13	NR	NR	NR	NR	NR	NR	6.5	NR	21100	21100	1800
14	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
15	560	500	130	280	NT	NT	6.3	270	NT	NT	NT
16	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
17	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
18	490	430	73	280	NT	NT	6.3	250	24000	22000	1700
19	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
20	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
21	504	487	64	270	NR	67	6.08	270	21000	20800	1500
22	470	460	NR	270	NR	NR	6.2	220	20200	19600	1760
23	458	475	55.9	280	NR	NR	NR	245	NR	NR	NR
24	470	497	<50	247	247	73	NR	101	NR	22000	1500
25	440	430	60	270	305	NR	6.1	240	NR	24330	1620
26	460	430	79	260	NT	NT	NT	250	2.0	1.81	0.15
27	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
28	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
29	470	452	65	290	NT	NT	NT	NT	2.00	1.91	NT
30	1163.6	1800	610.9	NT	544.4	NT	6.15	NT	NT	38	1808
31	410	390	61	250	350	NT	6.2	230	NT	NT	1800

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

7.5 Participants' Results and Analytical Methods for Acid Extractable Elements

A summary of participants' results and performance is presented in Tables 70 to 72 and in Figures 58 and 59.

Hg was the element with the most unsatisfactory z-scores.

Bi, moisture content and pH were the tests that presented the least analytical difficulty to participating laboratories (the between laboratory CV was < 5%).

While most of the reported results by laboratories 6, 7, 19 and 31 returned a satisfactory z-scores in Sample S2, all their results for Sample S1 were lower (lab 6, 19 and 31) or higher (lab 7) than the assigned value for this sample. These participants used the same extraction and instrumental techniques for analyses of both study samples and the discrepancy in their performances could be due to calculation error with moisture content or the special sampling/weighing step which had to be involved for moist soil analysis. The results from these laboratories were not included in the analyses of the extraction methods and instrumental techniques employed by participants.

The method descriptions provided by participants are presented in Tables 1 to 10 while the instrumental conditions are presented in Appendix 5.

Extraction Methods

The request was for acid extractable elements; NMI PT studies of metals in soil focus on 'pseudo-total' analyses of elements in soil rather than on true total metal content because when an assessment of the anthropogenic impact of the metal content in a soil sample is made, aggressive digestion regimes can lead to misleading conclusions – since metals can be extracted from the fraction naturally present in the soil matrix.[5, 19-21] While an aggressive digestion regime can produce high, misleading results, weak digestion regimes (low digestion temperature, reduced digestion time, diluted acids and/or a low ratio of acid to sample size) may extract just a fraction of the contaminants from the soil. The methods for acid extractable elements are not standardised. In general methods are conventionally defined by procedures involving extractions: with aqua regia or with various amounts of HNO_3, HCl, in combination or alone and most of these methods produce comparable results.[22-24]

Except one, all participants used both HNO_3 and HCl as extraction agents and most used a digestion temperature of 95-100°C.

One laboratory used dilute HNO_3 and HCl but digested the samples at 170°C for 15 minutes.

Two laboratories used a digestion temperature of 85°C for 240 min and a large ratio of acid to sample size of 10 mL to 0.5 g.

Three laboratories digested the samples at 95°C for only 30 minutes which might explain some of the low results reported for elements strongly dependent on digestion regime.

Laboratory 30 used a very small sample size of 0.25 g and only HNO_3 as extraction agent. Caution should be exercised when such a small sample size is taken for analyses as this might not be representative of the whole sample. Some acid extractable elements can be partially recovered from the soil when only HNO_3 is used for extraction.

Individual Element Commentary

Aluminium is an element strongly dependent on the digestion regime. The between laboratory coefficient of variation for Al in Sample S2 was high (15%), higher than predicted

by Thomson (4%). Short extraction time (30 min) may explain the low results reported by Laboratory 27.

Plots of Al results versus instrumental techniques used are presented in Figure 60.

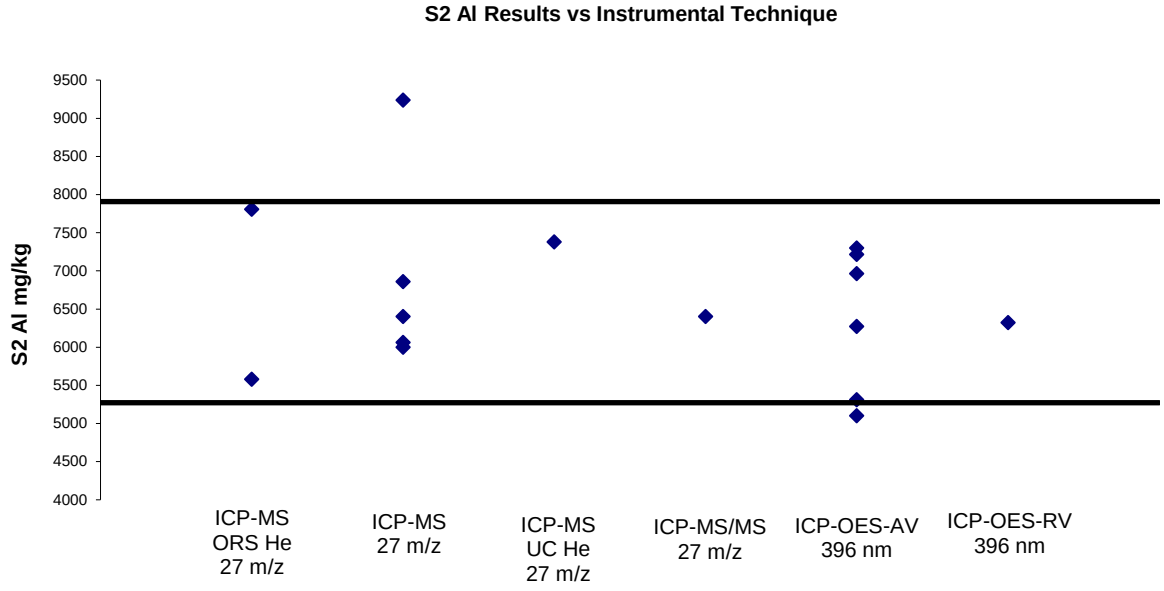


Figure 60 Al Results vs. Instrumental Technique

Arsenic Most participants used ICP-MS for As measurements with various collision/reaction cells and He as collision gas (Figure 61).

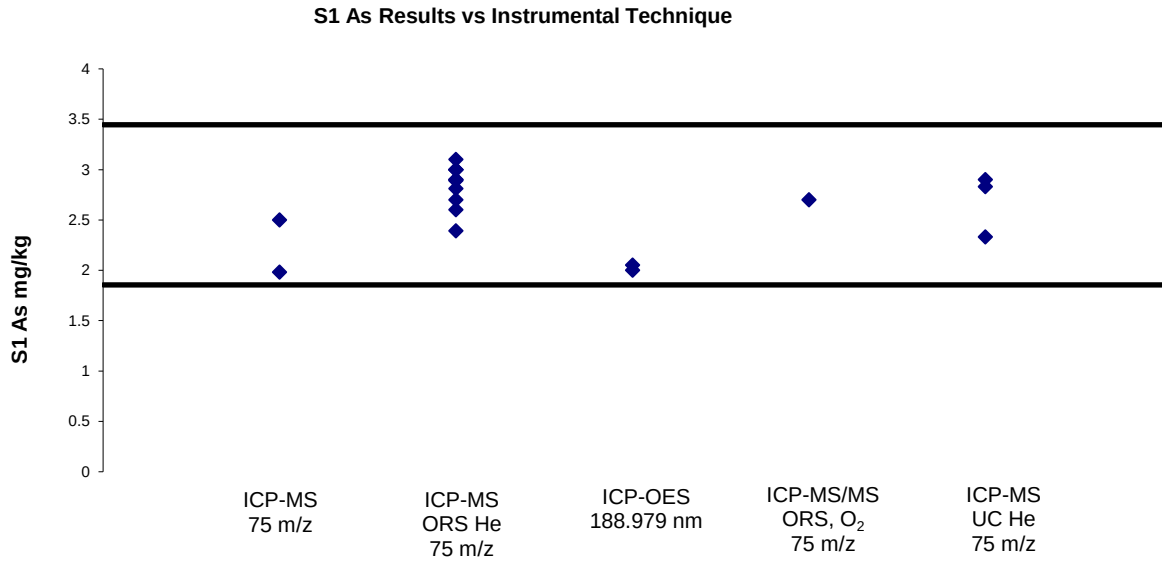


Figure 61 As Results vs. Instrumental Technique

Chromium and Nickel are two elements strongly dependent on the extraction regime. The between laboratories coefficient of variation for these elements was higher than predicted by Thomson value. Weak extraction conditions (small amounts of acids or dilute HNO_3 and dilute HCl) or short extraction time might explain the low results.

Plots of participants' results versus instrumental techniques used are presented in Figures 62 and 63.

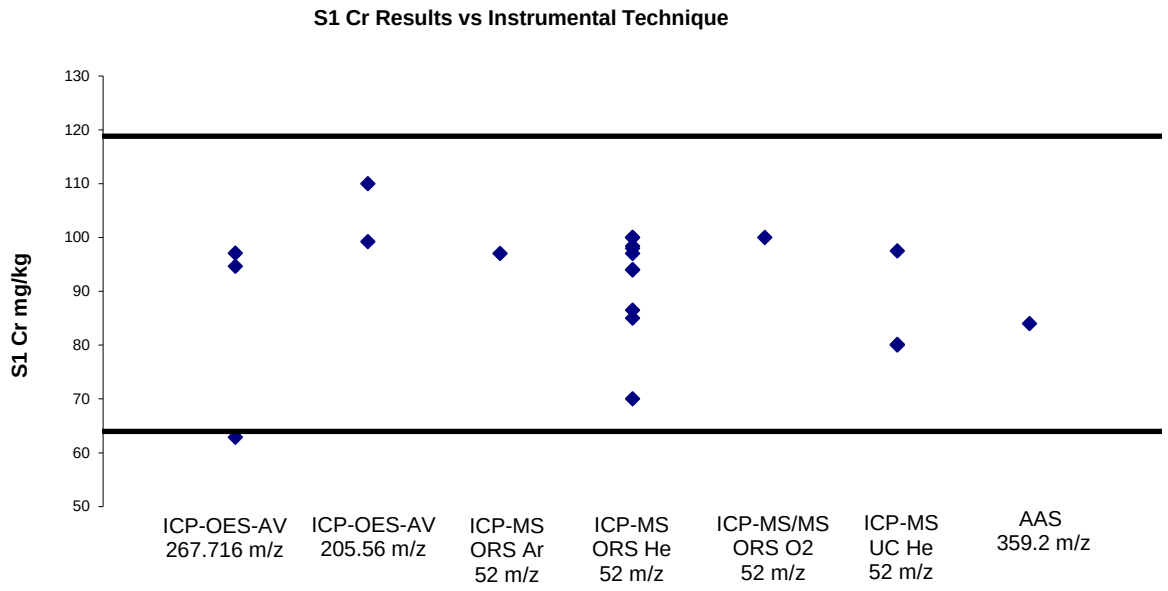


Figure 62 Cr Results vs. Instrumental Technique

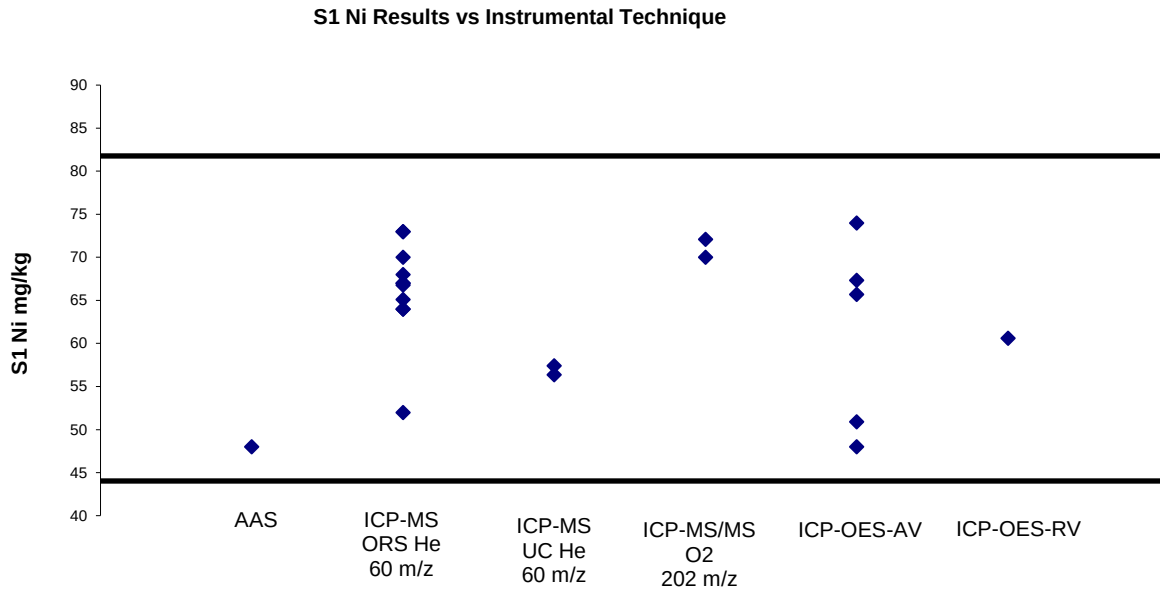


Figure 63 Ni Results vs. Instrumental Technique

Mercury level in S1 was low, 0.387 mg/kg. 26 participants reported results for Hg in S1 and 21 performed satisfactorily. Plots of participants' results versus instrumental technique used are presented in Figure 64.

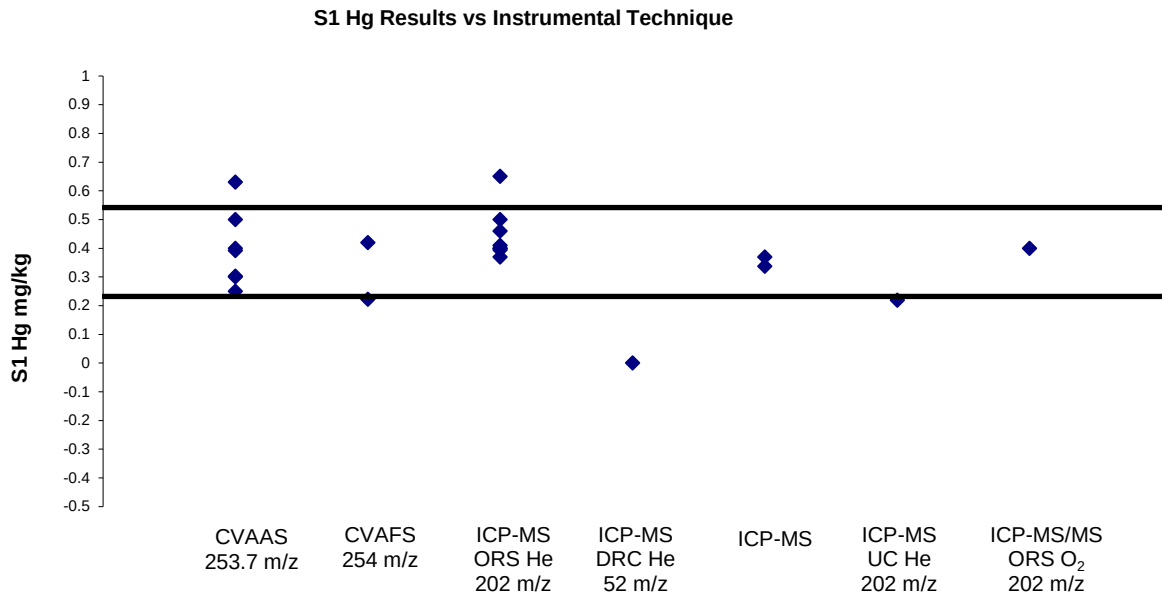


Figure 64 Hg Results vs. Instrumental Technique

Use of expired standards or those not prepared fresh from standard stock solutions before measurement, could be a cause of high Hg results.

Lithium The results reported for Li were variable (between laboratories CV was 24%). Short digestion time (30 min) may explain the low, unsatisfactory results reported for Li in S2.

Lanthanum, Rubidium and Thorium A small number of participants reported results for La, Rb and Th in S2 and all returned satisfactory z-scores.

Selenium Participants' results versus the instrumental techniques used for Se measurement in S1and S2 are presented in Figure 65.

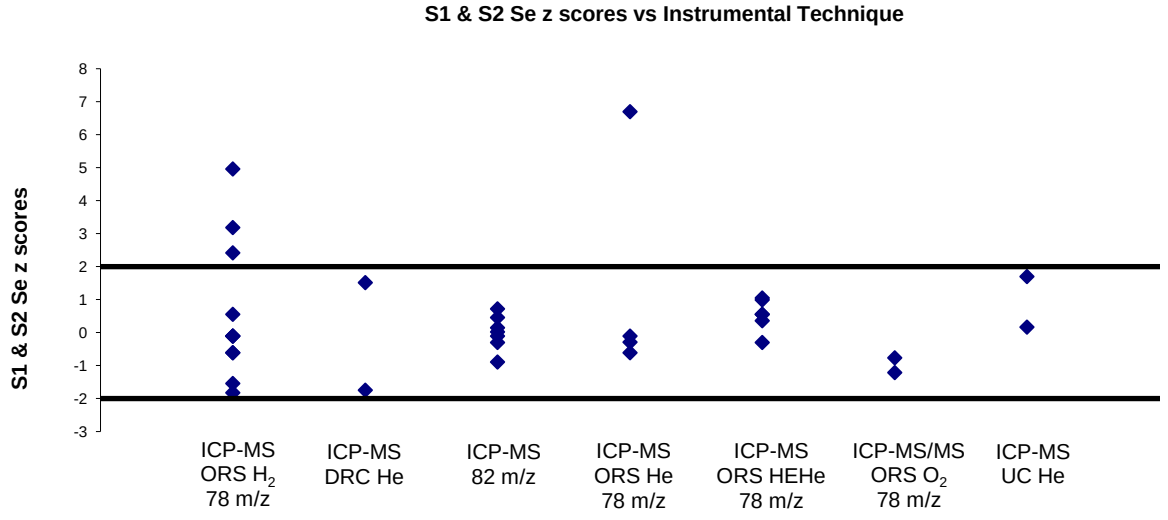


Figure 65 S1-Se and S2-Se Results vs. Instrumental Technique

All unsatisfactory results were higher than the assigned value, an indication that some participants might not have overcome the interference problems for Se.

Calcium, Potassium, Phosphorus and Sodium Plots of Ca, K, Na and P results versus instrumental technique are presented in Figures 66 to 69. ICP-OES with axial or radial view was the preferred measurement technique for these elements, although All ICP-MS results were satisfactory.

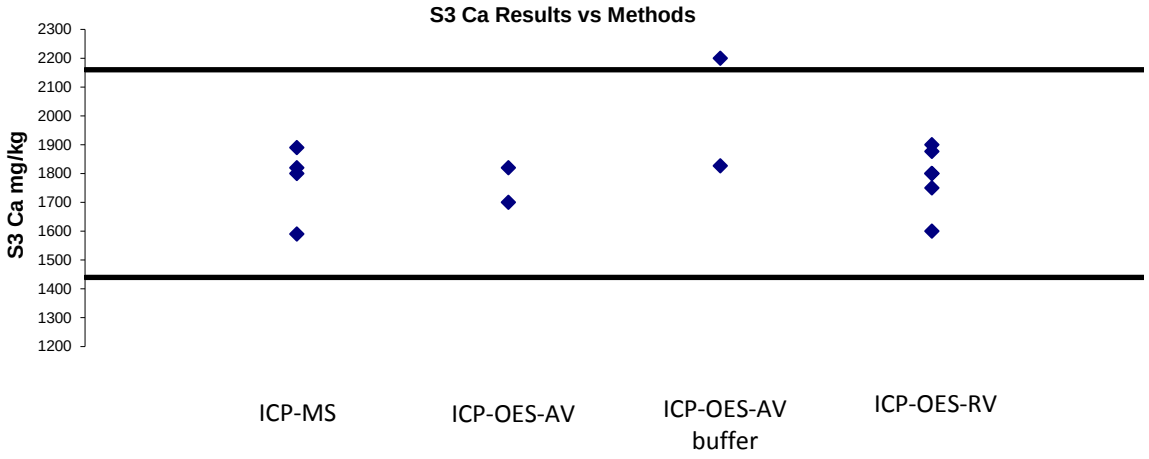


Figure 66 Ca Results vs. Instrumental Technique

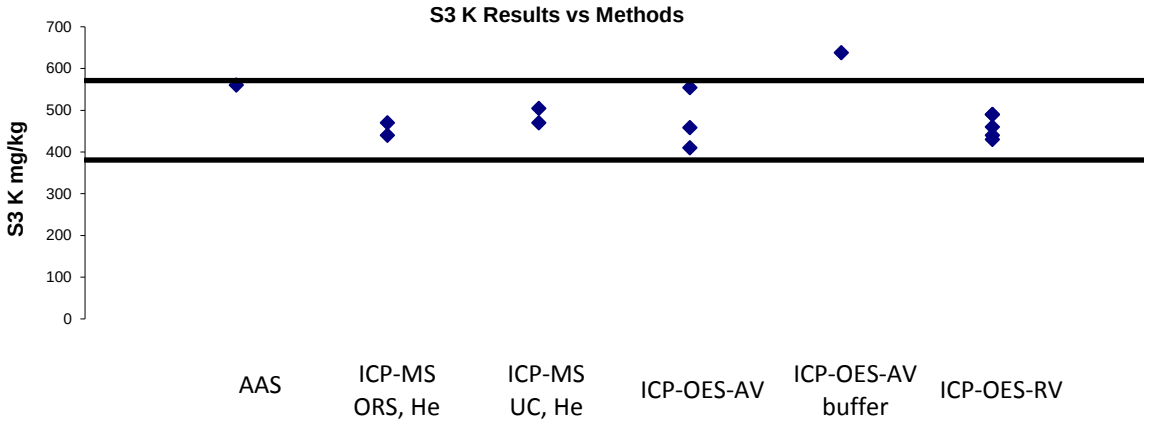


Figure 67 K Results vs. Instrumental Technique

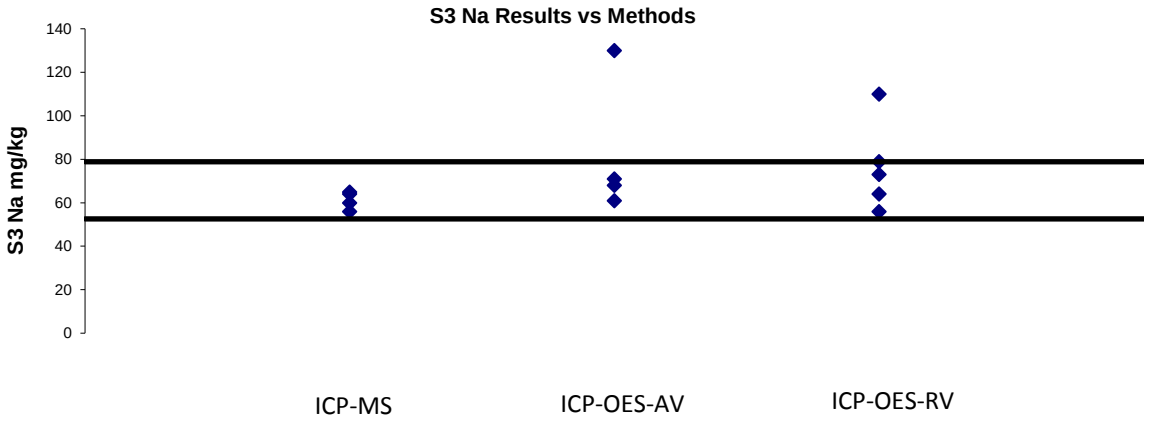


Figure 68 Na Results vs. Instrumental Technique

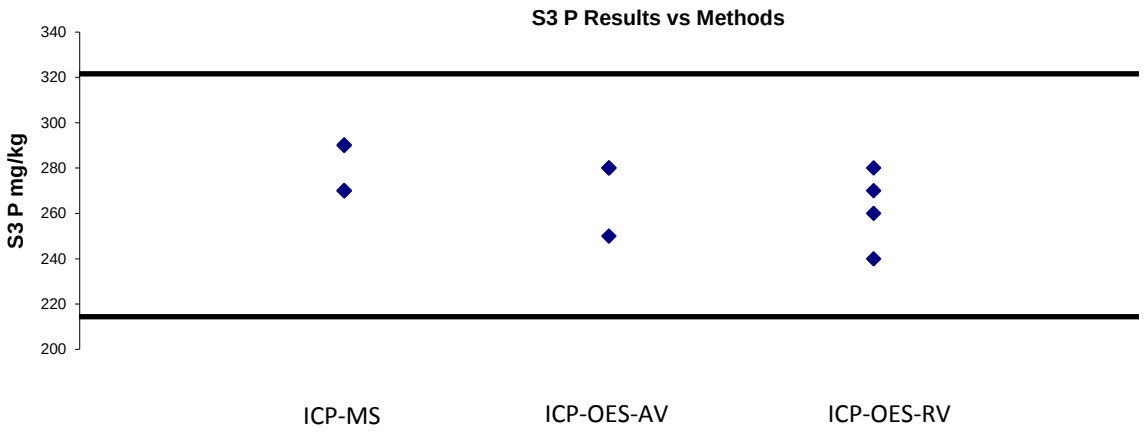


Figure 69 P Results vs. Instrumental Technique

Moisture content Measurement of moisture content in the test sample S1 did not present a difficulty to the participant laboratories. All results reported for moisture content returned satisfactory z-scores.

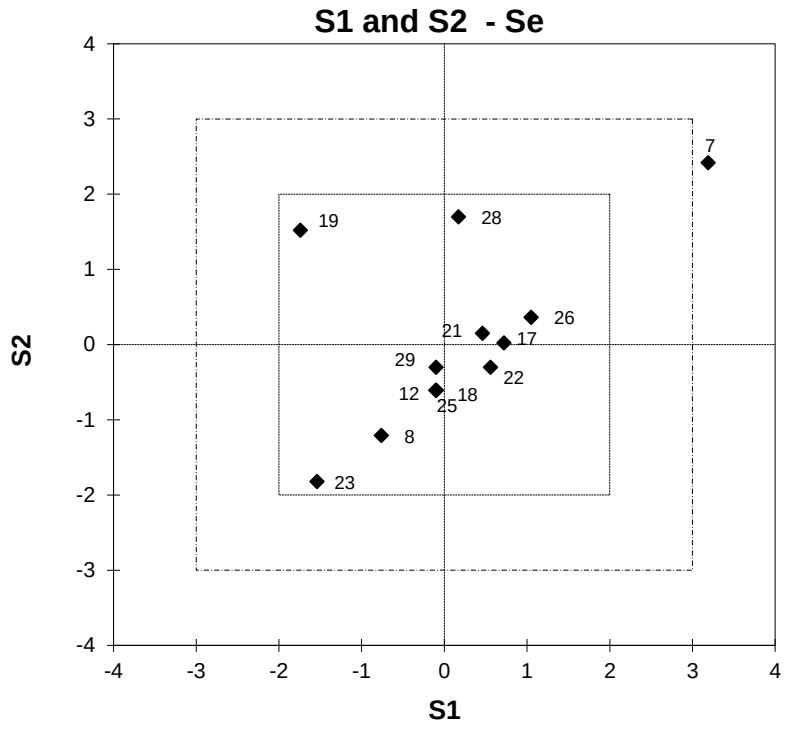
Participants were asked to report the results for Sample S1 corrected for moisture content. While most of the results reported by Laboratories 6, 19 and 31 in S2 returned satisfactory z-scores, the majority of the results produced by them in S1 were below the expected value by approximately the same factor of 0.78. These participants might have reported the S1 results on an as received basis, not corrected for moisture content, or they may have conducted the analysis on a dried sample and corrected the results back to wet basis.

All of the unsatisfactory results reported by Laboratory 17 in S1 were approximately 1.3 times higher than the assigned values. They may have either used the solid content value (78%) to correct these results for moisture content or conducted analyses on the dried sample and further corrected results for moisture content.

Sampling Methods

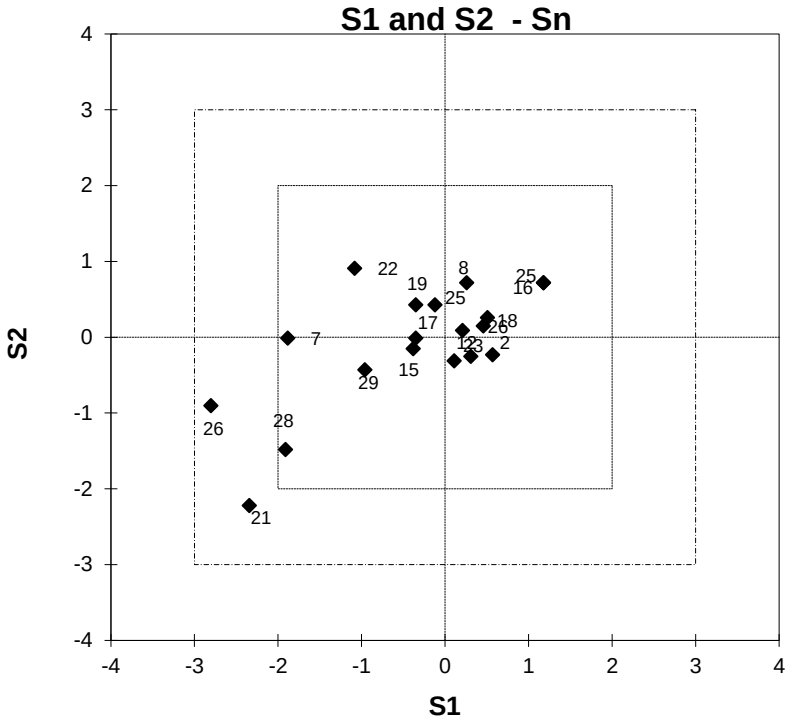
Sample S1 was prepared by addition of a known amount of ultrapure water to the same fortified dried soil used to prepare Sample S2. Participants were asked to report results for S1 corrected for moisture content and for S2 on an as received basis. The results for Se, Sn and Zn in the two study samples were expected to be comparable.

A good sample preparation procedure was required for the moist soil sample S1 as a representative aliquot of it had to be taken for analysis before extraction and instrumental measurement. The same targeted standard deviation was used to assess participants' reported results for these analytes in S1 and S2. This allowed participants to distinguish the effects of instrumental and extraction techniques from the effects of sampling method on their performances.



Laboratory 16 is off scale

Figure 70 z-Score Scatter Plots for Se in S1 and S2



Laboratory 16 is off scale

Figure 71 z-Score Scatter Plots for Sn in S1 and S2

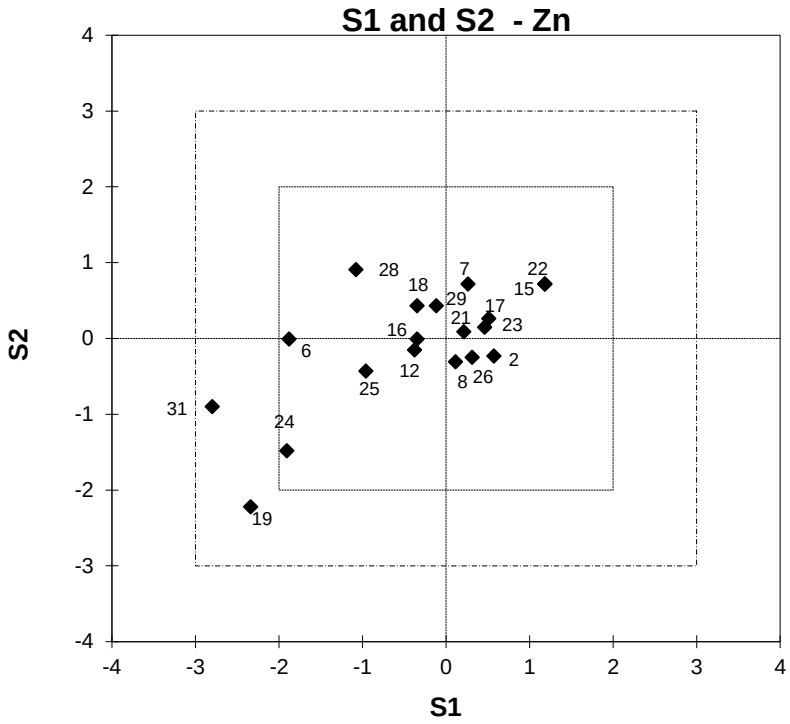


Figure 72 z-Score Scatter Plots for Zn in S1 and S2

Scatter plots of z-scores for Se, Sn and Zn inS1 and S2 are presented in Figures 70 to 72. Points close to the diagonal axis represent excellent sample preparation procedure while end points close to zero represent excellent accuracy.

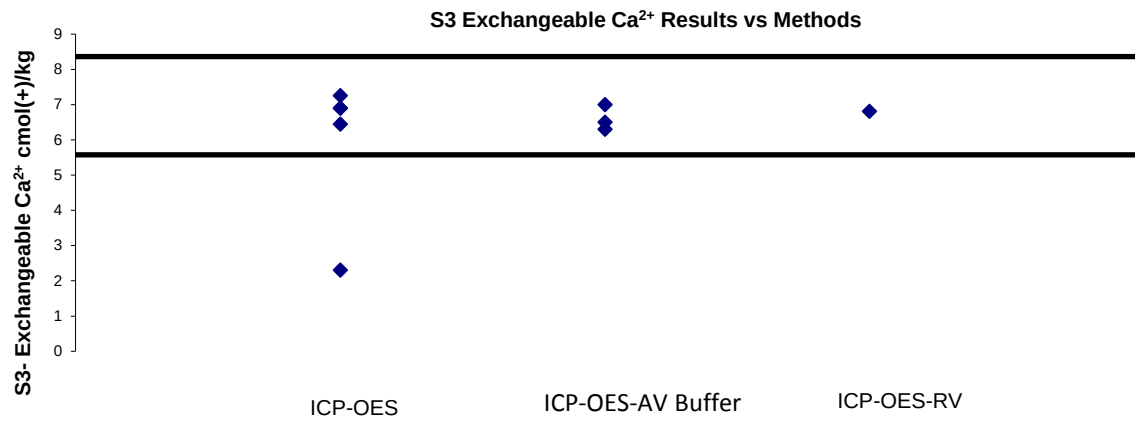
Most laboratories are plotted in the inner quadrant indicating that they have an excellent sampling preparation procedure.

7.6 Participants' Results and Analytical Methods for Exchangeable Cations

Measurement of exchangeable bases in soil is an empirical measurement – where the method of extraction defines the measurand. The participating laboratories were asked to analyse the sample using their normal measurement technique but to use the same preparation procedure the Method 15A1 as defined by Rayment, G.E. and David, J. L in "Soil Chemical Methods-Australasia".[25]

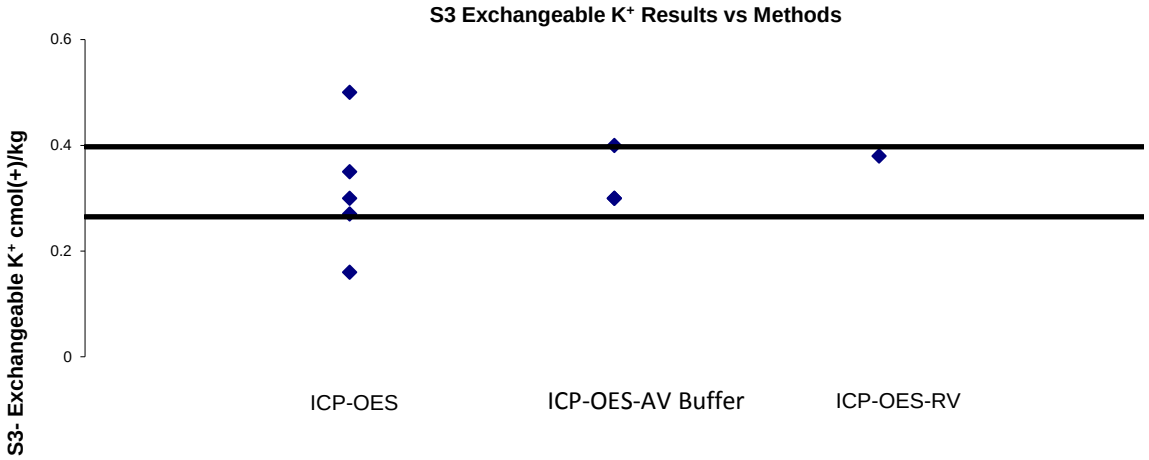
The method descriptions provided by participants are presented in Table 10.

Plots of participants' results versus the analytical methods used for the exchangeable bases measurement are presented in Figures 73 to 76.



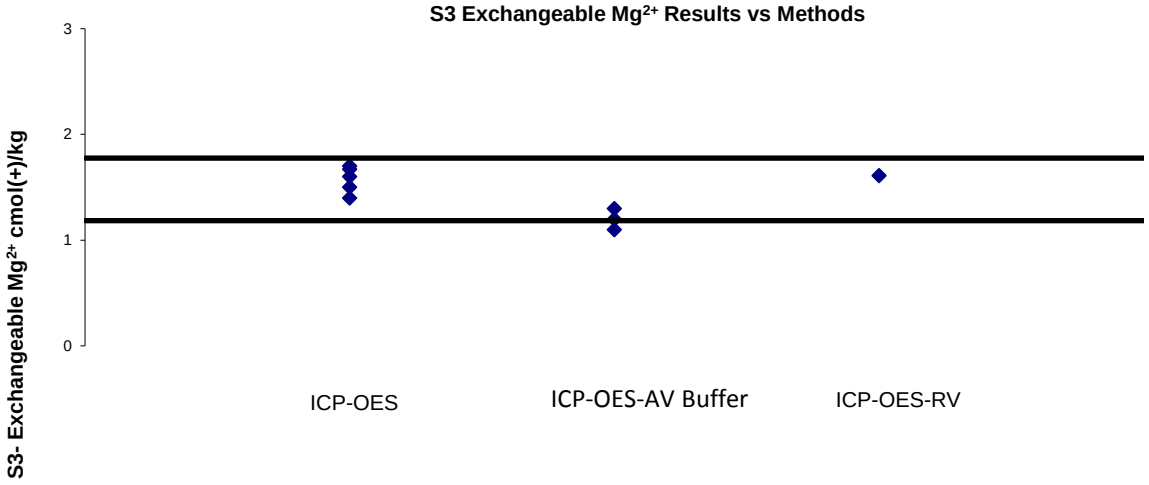
Horizontal lines on chart are the results corresponding to z-scores of 2 and -2; extr. sol. = extraction solution

Figure 73 Exchangeable Ca^{2+} Results vs. Analytical Methods



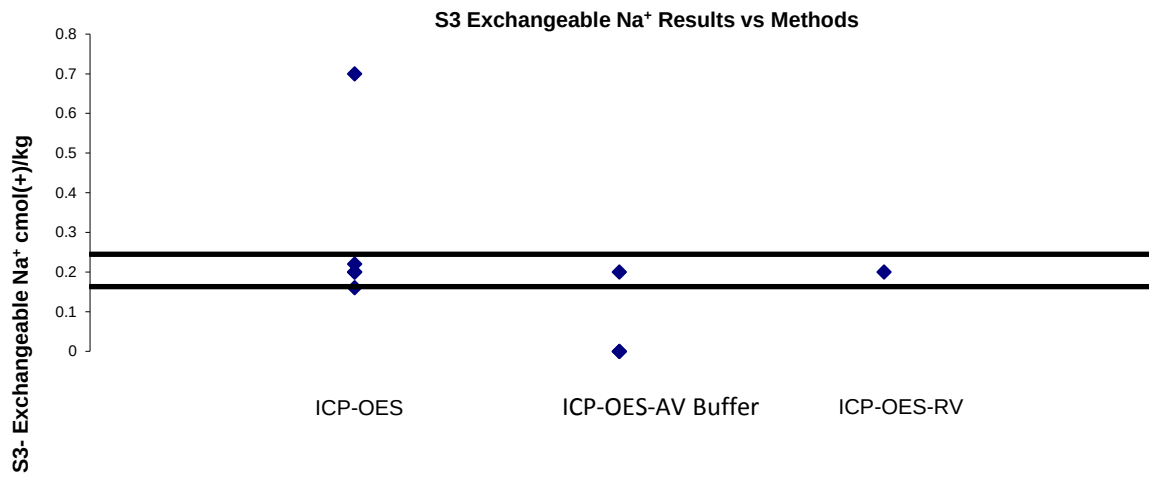
Horizontal lines on chart are the results corresponding to z-scores of 2 and -2; extr. sol. = extraction solution

Figure 74 Exchangeable K^{+} Results vs. Analytical Methods



Horizontal lines on chart are the results corresponding to z-scores of 2 and -2; extr. sol. = extraction solution

Figure 75 Exchangeable Mg^{2+} Results vs. Analytical Methods



Horizontal lines on chart are the results corresponding to z-scores of 2 and -2; extr. sol. = extraction solution

Figure 76 Exchangeable Na^+ Results vs. Analytical Methods

7.7 Participants' Results and Analytical Methods for Colwell P and Colwell K

Colwell K Two participants extracted K in S3 using 0.5 M $NaHCO_3$ and reported results for this test. One laboratory used ICP-OES with radial view for Colwell K measurements and one used ICP-MS. The two results were in a relative agreement with each other.

Colwell P Only 6 results were reported for Colwell P in S3 and all were in agreement with each other, centred on 92.5 mg/kg. All participants shook the sample for 16 hours and except for one, all used a ratio sample mass/extraction solution of 1 to 100 (Table 5). Plots of participants' results versus the instrumental technique used are presented in Figure 77.

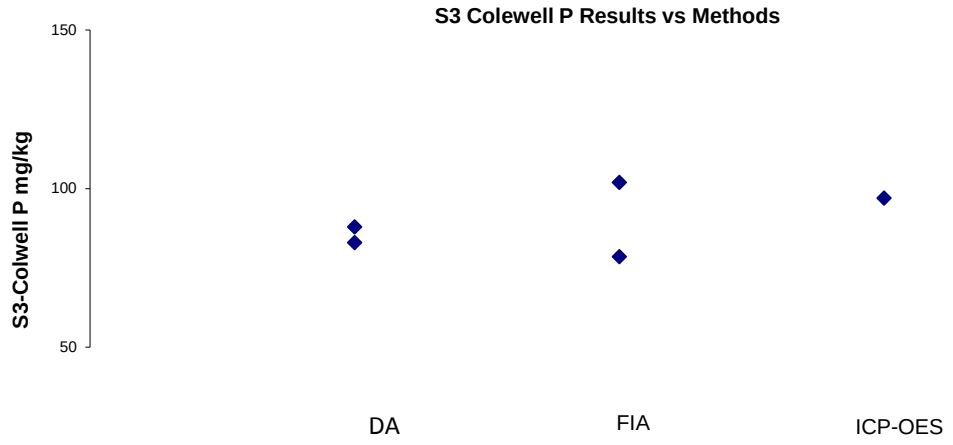


Figure 77 Colwell P Results vs. Instrumental Technique

7.8 Participants' Results and Analytical Methods for Phosphorus Buffer Index-PBI$_{+ColP}$

P Buffer Index-PBI$_{+ColP}$ gives an indication of soil ability to fix P and make it unavailable to plant uptake. Four laboratories reported results for this test. The results were in good agreement with each other centred on 71.7 mg/kg value (Figure 78).

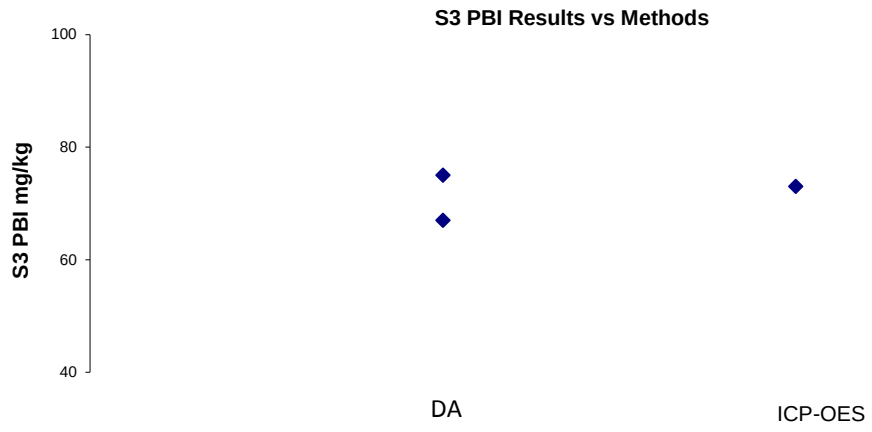


Figure 78 PBI Results vs. Instrumental Technique

7.9 Participants' Results and Analytical Methods for Total P

Total P assigned value was 302 mg/kg. Eight participants reported results for total P and all performed satisfactorily except for one. One participant reported acid extractable P, two used Kjeldahl digestion and one persulfate digestion (Figure 79).

Laboratory 30 should check their sample preparation/dilution procedure. Most of the results reported by them in S3 were approximately 2 times higher than the assigned value.

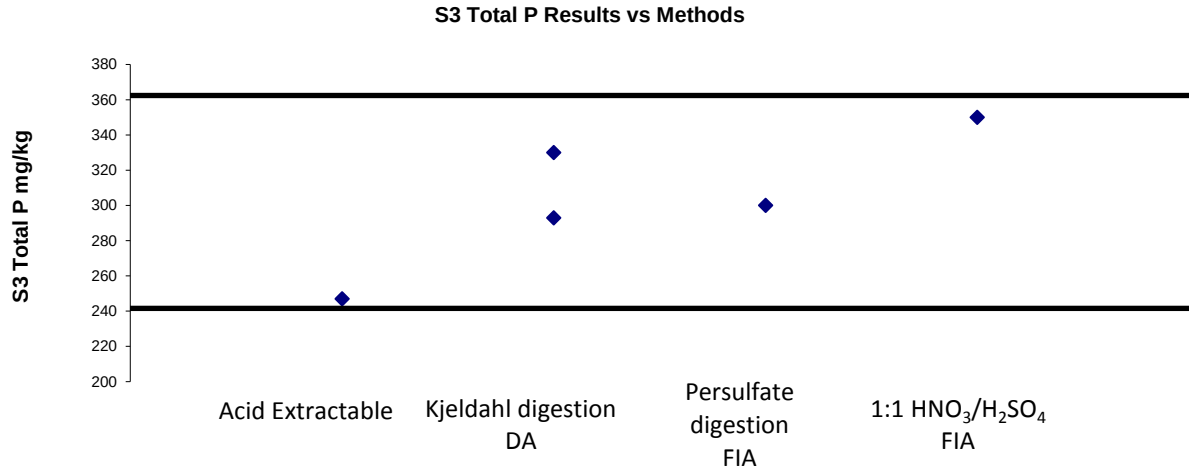


Figure 79 Total P Results vs. Methods

7.10 Participants' Results and Analytical Methods for Calcium Chloride Extractable B

The results reported for extractable B were centred on a value of 0.65 mg/kg value. Three participants used for B extraction a ratio of 1 to 20 sample mass to extraction solution and one used a ratio of 1 to 12.5 sample mass to extraction solution (Figure 80).

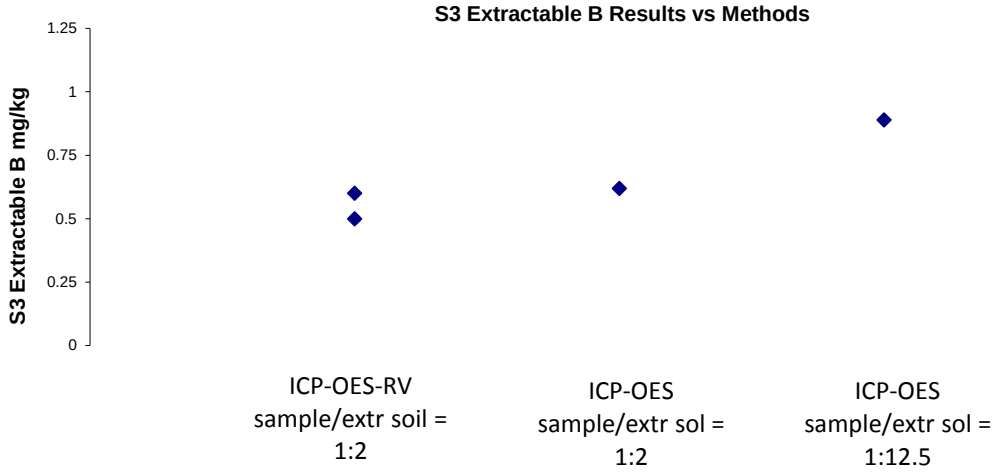
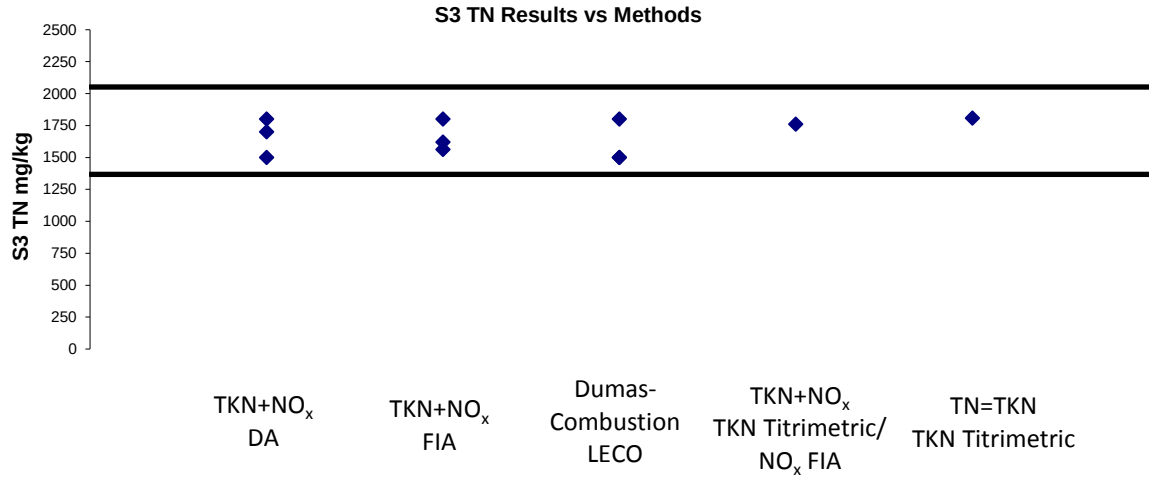


Figure 80 Extractable B Results vs. Methods

7.11 Participants' Results and Analytical Methods for Total Nitrogen

No significant difference was found between the TN results from combustion and TN results calculated from TKN and NO_x. The method descriptions provided by participants are presented in Table 9. A plot of participants' results versus analytical method and measurement technique used for TN analysis in S3 is presented in Figure 81.



Horizontal lines on chart are the results corresponding to z-scores of 2 and -2. Laboratory 26 result of 0.15 mg/kg has been plotted as 1500 mg/kg.

Figure 81 TN Results vs. Analytical Method

7.12 Participants' Results and Analytical Methods for Total Carbon and Total Organic Carbon

Participants were free to choose an appropriate method and were given no guidance apart from the instruction to: "Quantitatively analyse the samples using your normal test method."

The method descriptions provided by participants for TC and TOC analyses are presented in Tables 3 and 4.

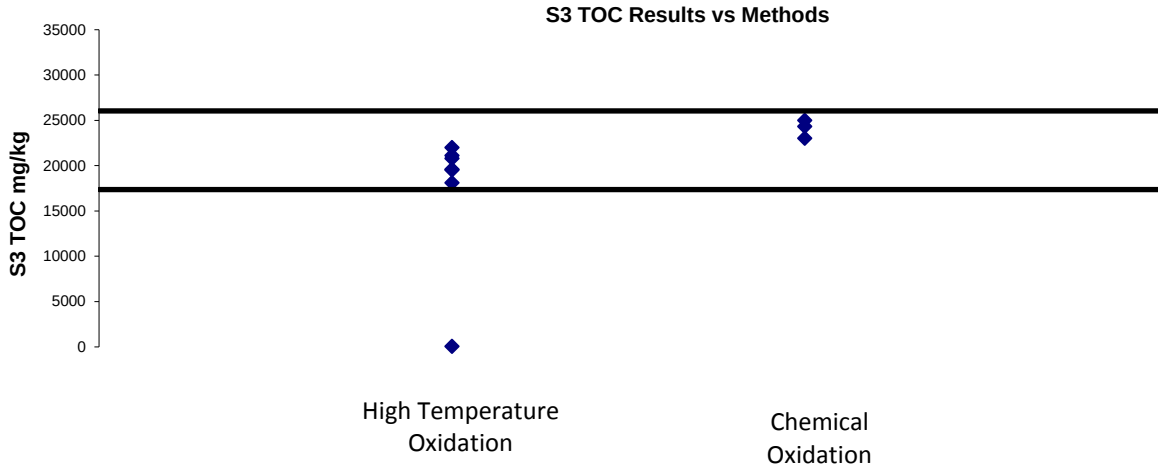
Laboratories 26 and 29 correctly measured TC and TOC in S3 but reported results in the wrong units.

Total Carbon assigned value was 20700 mg/kg. All reported results returned satisfactory z-scores except laboratories 26 and 29.

Total Organic Carbon assigned value was 21700 mg/kg.

Total organic carbon (TOC) measurements should involve measurement of both volatile organic carbon (VOC) and of non–purgeable organic carbon (NPOC). As the loss of VOC is considered negligible when compared to the content of NPOC in soil sample, all the NPOC reported results in sample S3 have been considered as TOC.[26, 27, 28]

Seven participants used a high temperature oxidation method and three a chemical oxidation method based on the "Walkley-Black" method.



Horizontal lines on chart are the results corresponding to z-scores of 2 and -2.

Figure 82 TOC Result vs. Analytical Method

Although still comparable the TOC results from the chemical oxidation method were higher than the ones produced by the high temperature oxidation method. Some problems which can be encountered with chemical oxidation include interferences caused by Cl^- and Fe^{2+} which can lead to positive errors in TOC determinations. Sample air –drying and addition of $AgSO_2$ or H_2SO_4 may help to avoid the interference problem.[26, 27]

The high temperature oxidation method for organic carbon determination can be rapid and reliable when inorganic carbon is removed prior to combustion. The separation of organic carbon from inorganic carbon can be achieved by ashing or acid treatment. When ashing is used, good knowledge of the nature of soil is required to choose the right ashing temperature. The major problem when acid treatment is used is uncertainty about the completeness of inorganic carbon removal. Introduction of a pretesting step to establish the right amount of sample to be taken for analyses and the right type and concentration of acid to be used for inorganic carbon removal can help avoid these problems.[28, 29]

Comparison studies on the efficiency of TOC methods recommended the automated dry combustion technique after pre-testing and pre-treatment for IC removal as the most appropriate method for soil TOC analyses.[29, 30]

7.13 Comparison with Previous NMI Proficiency Tests of Metals in Soil

AQA 19-02 is the twenty-fourth NMI proficiency test of metals in soil.

Participants' performance in measurement of metals in soil over time is presented in Figure 83. Despite different matrices, analytes and analytes' concentrations, on average participants' performance has remained consistent over the last 10 years, with the percentage of satisfactory z-scores ranging from 83% to 97% and satisfactory E_n scores from 72% to 89%.

7.14 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 73).

Table 73 Control Samples Used by Participants

Lab. Code	Description of Control Samples
1	CRM
3	CRM – PACS2 Marine Sediment and NIST SRM 2704 Buffalo River Sediment
4	CRM– AGAL 12 & AGAL 10
5	Spiked sample
6	Reference Material
8	AQA 16-14 Sample S3 and AQA17-11 Sample S1
9	ICV 1, ICV 3, AGAL 10
11	CRM – AGAL 10
13	CRM – ASPAC 7098-C-1, ASPAC 7118-C-1, ASPAC 7091-C-1
15	CRM 036
17	CRM – AGAL-10 Hawkesbury River Sediment
20	CRM – AGAL 10
21	RM – AGAL 12
22	RM – AGAL10 & AGAL 12
23	CRM – Novachem SQC001
26	Spiked Sample
27	CRM – AGAL 10
28	RM
29	CRM – AGAL-10 Hawkesbury River Sediment
30	Spiked Sample
31	CRM

Matrix matched control samples taken through all steps of the analytical process, are the most valuable quality control tools for assessing a methods' performance. 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 '*[31]

Surplus test samples from this study are available from NMI.

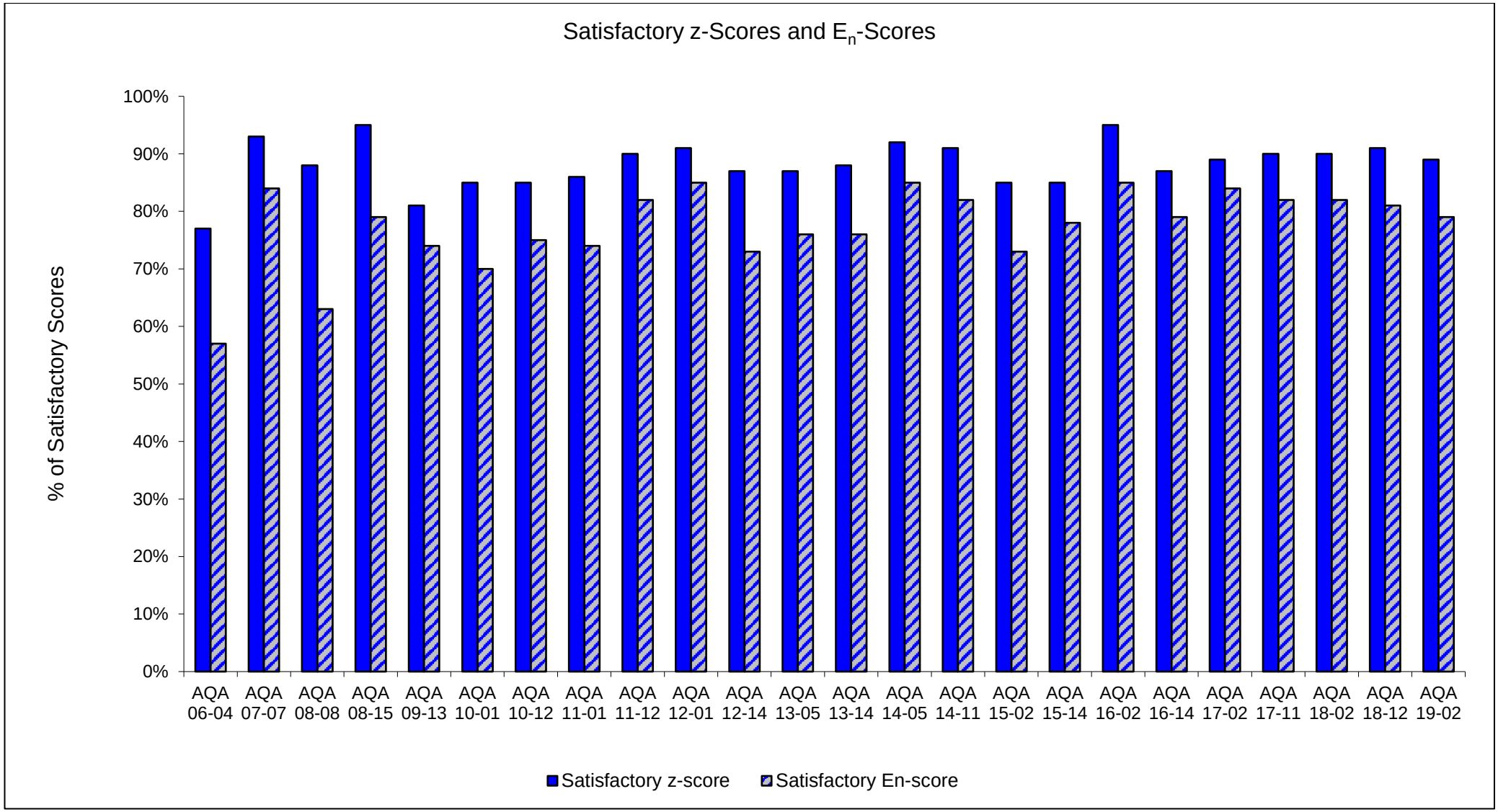


Figure 83 Participants' Performance over Time (2006-2019)

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APPENDIX 1 - SAMPLE PREPARATION, ANALYSIS AND HOMOGENEITY TESTING

Sample Preparation

Sample S1 was a moist soil sample prepared from a composite of soil samples submitted to NMI for metal analysis. The soil material was blended material, fortified for 14 elements, dried, ground and passed through a 212 µm sieve. A portion of the resulting soil was accurately weighed and wetted with a known amount of water. The moist soil was mixed and divided into portions of 35 g each.

Sample S2 was the same dried and fortified soil used for preparation of Sample S1, divided into portions of approximately 30 g each.

Sample S3 was an unfortified, dried, agricultural soil material. It was ground and sieved through 212 µm sieve, further mixed and divided in portions of approximately 75 g each.

Sample Analysis and Homogeneity Testing

A partial homogeneity test was conducted for all tests except calcium chloride-extractable B in S3. Three bottles were analysed in duplicate and the average of the results was reported as the homogeneity value.

Sample Analysis for Acid Extractable Elements

Measurements for acid extractable elements involved solubilisation of metals and metal complexes using a mixture of nitric acid and hydrochloric acid. Metals were then measured using ICP-MS and ICP-OES.

A test portion of approximately 1.4 g for the soil (moist) sample and 0.75 g for the dried soil sample was weighed into a 50 mL graduated polypropylene centrifuge tube. The samples were digested using 3 mL of concentrated nitric acid and 3 mL of concentrated hydrochloric acid on a hot block at 95°C ± 5°C. After digestion, each sample was diluted to 40 mL with Milli-Q water and then further diluted as necessary for ICP-MS or ICP-OES determination.

The measurement instrument was calibrated using external standards for targeted analytes. A set of quality control samples consisting of blanks, blank matrix spike, matrix matched reference materials, duplicates and sample matrix spikes, was carried through the same set of procedures and analysed at the same time as the samples. A summary of the instrument condition used and the ion/wavelength monitored for each analyte is given in Table 74.

Table 74 Instrumental Technique used for Acid Extractable Elements

Analyte	Instrument	Internal Standard	Reaction/ Collision Cell (if applicable)	Cell Mode/Gas (if applicable)	S1Final Dilution Factor	S2/S3Final Dilution Factor	Ion (m/z)/ Wavelength (nm)
Ag	ICP-MS	Rh	NA	NA	NA	800	107 m/z
Al	ICP-MS	Rh	NA	NA	NA	800	27 m/z
As	ICP-MS	Rh	ORS	He	800	NA	75 m/z
B	ICP-MS	Rh	NA	NA	NA	800	11 m/z
Ba	ICP-OES	Y	NA	NA	800	800	445.403 nm
Be	ICP-MS	Rh	NA	NA	800	NA	9 m/z
Bi	ICP-MS	Ir	NA	NA	NA	800	209 m/z
Ca	ICP-OES	Y	NA	NA	NA	800	422.673 nm
Cd	ICP-MS	Rh	NA	NA	800	NA	111 m/z
Co	ICP-MS	Rh	ORS	He	NA	800	59 m/z
Cr	ICP-MS	Rh	ORS	He	800	NA	52 m/z
Cu	ICP-MS	Rh	ORS	He	800	NA	65 m/z
Cs	ICP-MS	Rh	ORS	He	NA	800	113 m/z

Table 74 Instrumental Technique used for Acid Extractable Elements (continued)

Analyte	Instrument	Internal Standard	Reaction/ Collision Cell (if applicable)	Cell Mode/Gas (if applicable)	S1Final Dilution Factor	S2/S3 Final Dilution Factor	Ion (m/z)/ Wavelength (nm)
Fe	ICP-MS	Rh	NA	NA	NA	800	56 m/z
Hg	ICP-MS	Rh	NA	NA	800	NA	201 m/z
K	ICP-MS	Rh	ORS	He	NA	800	39 m/z
Li	ICP-MS	Rh	ORS	He	NA	800	7 m/z
Mg	ICP-OES	Y	NA	NA	NA	800	280.270 nm
Mn	ICP-MS	Rh	ORS	He	800	NA	55 m/z
Mo	ICP-MS	Rh	ORS	He	800	NA	95 m/z
Na	ICP-OES	Y	NA	NA	NA	800	588.995 nm
Ni	ICP-MS	Rh	ORS	He	800	NA	60
P	ICP-OES	Rh	NA	NA	NA	800	213.618
Pb	ICP-MS	Ir	NA	NA	800	NA	Average of 206, 207, 208 m/z
Rb	ICP-MS	Rh	ORS	He	NA	800	85 m/z
S	ICP-MS	Y	NA	NA	NA	800	191.972 nm
Se	ICP-MS	Rh	ORS	HEHe	800	800	78 m/z
Sn	ICP-MS	Rh	NA	NA	800	800	118 m/z
Sr	ICP-MS	Rh	ORS	He	NA	800	88 m/z
Th	ICP-MS	Ir	NA	NA	NA	800	205 m/z
U	ICP-MS	Ir	NA	NA	NA	800	238 m/z
V	ICP-MS	Rh	ORS	He	800	NA	51 m/z
Zn	ICP-MS	Rh	ORS	He	800	NA	66 m/z

Sample Analysis for Exchangeable Bases

A test portion of 5 g was weighed into a 100 mL polypropylene container. The container was then filled with 100 mL 1M NH_4Cl. The suspension was shaken, at room temperature for 1 h, centrifuged, and filtered through 0.45 µm filter. A summary of the measurement techniques used is presented in Table 75.

Table 75 Instrumental Technique used for Exchangeable Bases

Analyte	Instrument	Internal Standard	Final Dilution Factor	Wavelength nm
Exchangeable Ca^{2+}	ICP-OES	Y	40	315.887
Exchangeable Mg^{2+}	ICP-OES	Y	40	279.8
Exchangeable Na^{+}	ICP-OES	Y	40	588.995
Exchangeable K^{+}	ICP-OES	Y	40	766.491

Sample Analysis for Total Carbon and Total Organic Carbon

The measurements for TC and TOC were made using NMI Method NWS15.[32] For TOC measurements a portion of sample weighing 0.25 g was reacted for 12 hours with 20 mL diluted hydrochloric acid to remove inorganic carbon. The sample was further purged with nitrogen gas to remove the inorganic carbon in solution and further diluted with 20 mL Milli-Q water. The insoluble part was then filtered and collected on a filter, dried and analysed as total carbon (TC). The TOC was calculated as the sum of the TOC from the insoluble part and the dissolved organic carbon (DOC) from liquid solution.

Sample Analysis for Total Nitrogen

Total Nitrogen in Sample S3 was measured as the sum of TKN +NOx.
The measurements for TKN were made using NMI Method NWS9.[34] Organic nitrogen from a test portion of 1 g was converted to ammonia with 50 mL digestion reagent (potassium

sulfate, sulfuric acid and cupric sulfate) on a block digester at 400 ^{o}C ± 5 ^{o}C for 4 hours. The digested solution was then made alkaline with sodium hydroxide solution, distilled into a steam distillation analyser unit and automatically titrated with standard hydrochloric acid to the end point. The amount of ammonia nitrogen was then calculated.

Measurements for NOx in soil were made using NMI Method NW_B19.[35] A test portion of 10 g was weighed into a 100 mL polypropylene container. The container was then filled with 50 mL deionised water. The suspension was shaken, at room temperature for 1 h, centrifuged, and filtered through 0.45 µm filter. NO_3^--N was further measured by cadmium reduction to NO_2^--N followed by NO_x (the reduced NO_2^--N plus original NO_2^--N) measurements by FIA.

Sample Analysis for Colwell P

A test portion of approximately 1 g of dried soil were weighed into a 125 mL plastic container and shaken with 100 mL of extracting solution (0.5 M sodium bicarbonate at pH 8.5) for 16 hours. Colwell P was then measured in the extracting solution as P by ICP-OES.

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 'ISO 13258:2015(E)[8]; 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
$S_{rob\ mean}$ 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 76.

Table 76 Uncertainty of Assigned Value for Al in Sample S2

No. results (p)	20
Robust Average	6590 mg/kg
$S_{rob\ av}$	970 mg/kg
$u_{rob\ av}$	270 mg/kg
k	2
$U_{rob\ av}$	540 mg/kg

The assigned value for **Al** in Sample S2 is **6590 ± 540 mg/kg**

z-Score and E_n-score

For each participant's result z-score and E_n-score are calculated according to Equation 2 and Equation 3 respectively (see page 17).

A worked example is set out below in Table 77.

Table 77 z-Score and E_n-score for Al result reported by Laboratory 2 in S2

Al Result mg/kg	Assigned Value mg/kg	Set Target Standard Deviation	z-Score	E_n-Score
7807±1700	6590±540	10% as PCV or 0.10x6590 = =659 mg/kg	$z = \frac{(7807 - 6590)}{659}$ z = 1.847	$En = \frac{(7807 - 6590)}{\sqrt{540^2 + 1700^2}}$ E_n=0.682

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 also be used to estimate the uncertainty of their measurement results.[12, 14] An example is given.

Between 2009 and 2016 NMI carried out fourteen proficiency tests of metals in soil. These studies involved analyses of acid-extractable elements at low and high levels in dried soil, moist soil, biosoil, sediment and sludge. Laboratory X submitted results for As in thirteen of these PTs. All reported results returned satisfactory z-scores. This data can be separated into two ranges of results: 0.5 to 10 mg/kg and 10 to 100 mg/kg. Results are presented in Tables 78 and 79.

Table 78 Laboratory X Reported Results for As at 0.5 to 10 mg/kg Level.

Study No.	Sample	Laboratory result mg/kg	Assigned value* mg/kg	Robust CV of all results (%)	Number of Results
AQA 09-13	Biosoil	4.091 ± 0.41	3.64 ± 0.43	16	11
	Soil	4.29 ± 0.43	4.57 ± 0.50	15	12
AQA 11-01	Biosoil	3.54 ± 0.35	3.57 ± 0.26	20	18
AQA 13-05	Soil	9.22 ± 1.4	9.21 ± 0.68	14	22
AQA 14-11	Sediment	7.91 ± 1.2	7.37 ± 0.32	12	21
AQA 15-02	Sludge	8.29 ± 1.2	7.02 ± 0.29	13	22
	Sludge	7.42 ± 1.1	7.02 ± 0.29	11	17
AQA 15-14	Sediment	10 ± 1.5	9.95 ± 0.40	6.7	17
	Soil	4.53 ± 0.9	4.47 ± 0.19	6.4	14
AQA 16-02	Agricultural Soil	2.67 ± 0.4	2.11 ± 0.17	14	20
Average				13**	

* Expanded uncertainty at approximately 95% confidence.

** The mean value of Robust CV was used. The pooled standard deviation could also be used. In this case the pooled standard deviation is 13%. Using a coverage factor of 2 gives an estimate of 26%.

Table 79 Laboratory X Reported Results for As at 10 to 100 mg/kg Level.

Study No.	Sample	Laboratory result mg/kg	Assigned value* mg/kg	Robust CV of all results (%)	Number of Results
AQA 10-12	Soil	16.6 ± 1.66	14.4 ± 0.7	8.5	19
AQA 11-12	Moist Soil	25 ± 3.6	21.6 ± 2.2	15	13
AQA 12-01	Sediment	18.4 ± 2.7	17.3 ± 0.8	8.1	21
AQA 12-14	Soil	16.6 ± 2.4	14.8 ± 0.9	11	20
AQA 13-14	Sandy Soil	16.6 ± 2.4	15.1 ± 0.9	10	21
AQA 14-05	Soil	13.2 ± 1.9	12.3 ± 0.5	7.8	25
Average				10**	

* Expanded uncertainty at approximately 95% confidence.

** The mean value of Robust CV was used. The pooled standard deviation could also be used. In this case the pooled standard deviation is 10%. Using a coverage factor of 2 gives an estimate of 20%.

Taking the average of the robust CV over these PT samples for each concentration range gives estimates of the relative standard uncertainty of 13% and 10% respectively. Using a coverage factor of two gives relative expanded uncertainties of 26% and 20% respectively, at a level of confidence of approximately 95%. Tables 79 and 80 sets out the expanded uncertainty for results of the measurement of As in soil, biosoil, sediment, sludge, sandy soil, moist soil and agricultural soil over the ranges 0.5 to 10 mg/kg and 10 to 100 mg/kg.

Table 80 Uncertainty of As Results Estimated Using PT Data.

Results mg/kg	Uncertainty mg/kg
1.00	0.26
5.0	1.3
20	4
75	15

The estimates of 26% and 20% relative passes the test of being reasonable, and the analysis of the 16 different PT samples over seven years can be assumed to include all the relevant uncertainty components (different matrices, operators, reagents, calibrators etc.), and so complies with ISO 17025.[10]

APPENDIX 4 - ACRONYMS AND ABBREVIATIONS

APHA	American Public Health Association
A.V.	Assigned Value
CRI	Collision Reaction Interface
CRM	Certified Reference Material
CV	Coefficient of Variation
CV-AAS	Cold Vapour-Atomic Absorption Spectrometry
CV-AFS	Cold Vapour-Atomic Florescence Spectrometry
DA	Discreet Analyser
DRC	Dynamic Reaction Cell
FIA	Flow Injection Analyser
HEHe	High energy He mode
H.V.	Homogeneity Value
ICP-MS	Quadrupole - Inductively Coupled Plasma - 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
ICP-OES-AV-eq	Inductively Coupled Plasma - Optical Emission Spectrometry- axial view with correction equation
ICP-OES-RV	Inductively Coupled Plasma - Optical Emission Spectrometry- radial view
IC	Ion chromatograph
IR	Infrared Detector
ISE	Ion selective electrode
Max	Maximum value in a set of results
Md	Median
Min	Minimum value in a set of results
NEPC	National Environmental Protection Council
NMI	National Measurement Institute (of Australia)
NR	Not Reported
NT	Not Tested
ORS	Octopole Reaction System
PCV	Performance Coefficient of Variation
RM	Reference Material
Robust CV	Robust Coefficient of Variation
Robust SD	Robust Standard Deviation
S	Spiked or formulated concentration of a PT sample
SS	Spiked sample
SI	The International System of Units
s^2_{sam}	Sampling variance
s_a/σ	Analytical standard deviation divided by the target standard deviation
SFA	Segment Flow Analyser
SRM	Standard Reference Material (Trademark of NIST)
Target SD	Target standard deviation
σ	Target standard deviation
UC	Universal Cell
UV-Vis	Ultraviolet and Visible Spectroscopy

APPENDIX 5 - INSTRUMENT DETAILS

Table 81 Instrument Conditions Ag

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1					N/A	N/A	
2	ICP-MS	Rh	ORS	Ar	N/A	500	107
3					N/A	N/A	
4					N/A	N/A	
5					N/A	N/A	
6					N/A		
7	ICP-MS	Rh			N/A	25-250	
8	ICP-MS/MS	Rh103	ORS	O2	N/A	4000	Ag 108
9							
10					N/A	N/A	
11					N/A	N/A	
12	ICP-MS	Rh			N/A	25-250	
13					N/A	N/A	
14					N/A	N/A	
15	ICP-OES-AV-buffer	Y			N/A	100	328.068
16	ICP-MS	Rh	ORS	He	N/A		107
17	ICP-MS	Ge 72 and Rh 103			N/A	500	107
18	ICP-MS	Rh			N/A	25-250	107
19					N/A		
20					N/A	N/A	
21	ICP-MS	Rh	NA	NA	N/A	625	109
22	ICP-MS	Rh	ORS	He	N/A	800	107
23	ICP-MS	In	ORS	He	N/A	85	107
24	ICP-OES-AV	Y			N/A		
25	ICP-MS	103 Rh	ORS	He	N/A	50	107
26	ICP-MS	Ge 72	ORS		N/A		107 m/z
27	ICP-OES-RV	Yb			N/A		328.068
28					N/A	N/A	
29	ICP-MS	Rh	NA		N/A	2000	109
30					N/A	N/A	
31	ICP-OES-AV	Lu			N/A	83	328.068

Table 82 Instrument Conditions Al

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1					N/A	N/A	
2	ICP-MS	Sc	ORS	Ar	N/A	500	27
3					N/A	N/A	
4					N/A	N/A	
5					N/A	N/A	
6	ICP-OES-AV	Y 371.029			N/A	50	256.798
7	ICP-MS	Li6			N/A	25-250	396.152
8	ICP-MS/MS	Sc 45	NA	NA	N/A	4000	Al 27
9							
10					N/A	N/A	
11					N/A	N/A	
12	ICP-MS	Li6			N/A	25-250	396.152
13					N/A	N/A	
14					N/A	N/A	
15	ICP-OES-AV-buffer	Y			N/A	100	308.215
16	ICP-OES-AV	Y	NA		N/A		308.215
17	ICP-OES-AV	Y 371.029			N/A	5000	308.215
18	ICP-MS	Li6			N/A	25-250	396.152
19	ICP-MS	Sc	DRC	helium	N/A		
20					N/A	N/A	
21	ICP-MS	Sc	UC	He	N/A	625	27
22	ICP-MS	Sc			N/A	800	27
23	ICP-OES-AV	Lu	NA		N/A	85	237.312
24					N/A		
25	ICP-MS	45 Sc	ORS	He	N/A	50	27
26	ICP-OES-RV	Y377	NA		N/A		396.152 nm
27	ICP-OES-AV	Yb			N/A		396.152
28	ICP-MS	Sc	NA	NA	N/A	250	
29	ICP-MS	Sc	NA		N/A	2000	27
30					N/A	N/A	
31	ICP-OES-AV	Lu			N/A	83	396.152

Table 83 Instrument Conditions As

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1	ICP-MS					N/A	
2	ICP-MS	Ge	ORS	Ar	500	N/A	75
3						N/A	
4	ICP-MS	Rh	ORS	He	500	N/A	75
5	ICP-MS	Rh	ORS	He	500	N/A	72
6	ICP-OES-AV	Y 371.029			50	N/A	188.98
7	ICP-MS	Ge	ORS	He	25-250	N/A	75
8	ICP-MS/MS	Rh103	ORS	O2	4000	N/A	As 75/91
9	ICP-MS	Ge	ORS	He	20	N/A	75
10	if other please type				290	N/A	193.7
11	ICP-MS	Rh	ORS	He	100	N/A	75
12	ICP-MS	Ge	ORS	He	25-250	N/A	75
13					N/A	N/A	
14						N/A	
15	ICP-OES-AV-buffer	Y			100	N/A	189.042
16	ICP-MS	Rh	ORS	He		N/A	75
17	ICP-MS	Ge 72			500	N/A	75
18	ICP-MS	Ge	ORS	He	25-250	N/A	75
19	ICP-MS	Ge	DRC	helium		N/A	
20	ICP-MS	Germanium	ORS	He	200	N/A	75
21	ICP-MS	Ge	UC	He	625	N/A	75
22	ICP-MS	Rh	ORS	He	800	N/A	75
23	ICP-MS	Ge	ORS	He	70	N/A	75
24						N/A	
25	ICP-MS	103 Rh	ORS	He	50	N/A	75
26	ICP-MS	Ge 72	ORS			N/A	75m/z
27						N/A	
28	ICP-MS	Rh	UC	He	250	N/A	
29	ICP-MS	Rh	UC	He	1000	N/A	75
30					N/A	N/A	
31	ICP-OES-AV	Lu			83	N/A	188.98

Table 84 Instrument Conditions B

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1					N/A	N/A	
2	ICP-MS	Sc	ORS	Ar	N/A	500	11
3					N/A	N/A	
4					N/A	N/A	
5					N/A	N/A	
6					N/A		
7	ICP-MS	Li6			N/A	25-250	11
8	ICP-MS/MS	Sc 45	NA	NA	N/A	4000	B 11
9							
10					N/A	N/A	
11					N/A	N/A	
12	ICP-MS	Li6			N/A	25-250	11
13					N/A	N/A	
14					N/A	N/A	
15	ICP-OES-AV-buffer	Y			N/A	100	208.959
16	ICP-OES-AV	Y	NA		N/A		249.678
17	ICP-MS	Ge 72			N/A	500	11
18	ICP-MS	Li6			N/A	25-250	11
19	ICP-MS	Sc	DRC	helium	N/A		
20					N/A	N/A	
21	ICP-MS	Sc	NA	NA	N/A	625	10
22	ICP-MS	Sc			N/A	800	11
23	ICP-OES-AV	Lu	NA		N/A	85	208.956
24					N/A		
25	ICP-MS	45 Sc	NA		N/A	50	11
26	ICP-OES-RV	Te214	NA		N/A		249.678nm
27	ICP-OES-AV	Yb			N/A		249.772
28	ICP-MS	Sc	NA	NA	N/A	250	
29	ICP-MS	Sc	UC	He	N/A	1000	11
30					N/A	N/A	
31	ICP-OES-AV	Lu			N/A	83	182.577

Table 85 Instrument Conditions Ba

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1	ICP-MS					N/A	
2	ICP-MS	Ce	ORS	Ar	500	500	137
3						N/A	
4	ICP-MS	Rh	ORS	He	500	N/A	135
5	ICP-MS	Rh	ORS	He	500	N/A	135
6	ICP-OES-AV	Y 371.029			50	50	585.367
7	ICP-MS	Rh			25-250	25-250	138
8	ICP-MS/MS	Rh103	ORS	O2	4000	4000	Ba 137
9	ICP-MS	Rh	ORS	He	20	N/A	137
10						N/A	
11	ICP-MS	Ir	ORS	He	100	N/A	137
12	ICP-MS	Rh			25-250	25-250	138
13					N/A	N/A	
14						N/A	
15	ICP-OES-AV-buffer	Y			100	100	233.527
16	ICP-OES-AV	Y	NA				455.403
17	ICP-OES-AV	Y 371.029			500	500	413.064
18	ICP-MS	Rh			25-250	25-250	138
19	ICP-MS	In	DRC	helium			
20	ICP-MS	Rhodium			2000	N/A	136, 138
21	ICP-MS	Rh	NA	NA	625	625	138
22	ICP-MS	Rh	ORS	He	800	800	134
23	ICP-OES-AV	Lu	NA		70	85	455.403
24							
25	ICP-MS	103 Rh	ORS	He	50	50	137
26	ICP-OES-RV	Y371	NA				493.408 nm
27	ICP-OES-AV	Yb			N/A		455.403
28	ICP-MS	In	NA	NA	250	250	
29	ICP-MS	Tb	NA		2000	2000	137
30					N/A	N/A	
31	ICP-OES-AV	Lu			N/A	83	493.408

Table 86 Instrument Conditions Be

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1	ICP-MS					N/A	
2	ICP-MS	Sc	ORS	Ar	500	N/A	9
3						N/A	
4	ICP-MS	Sc	ORS	He	500	N/A	9
5	ICP-MS	Sc	ORS	No Gas	500	N/A	11
6	ICP-OES-AV	Y 371.029			50	N/A	313.107
7	ICP-MS	Li6			25-250	N/A	9
8	ICP-MS/MS	Sc 45	ORS	NA	4000	N/A	Be 9
9	ICP-MS	Sc			20	N/A	9
10	if other please type				290	N/A	234.9
11	ICP-MS	Sc	ORS	He	100	N/A	9
12	ICP-MS	Li6			25-250	N/A	9
13					N/A	N/A	
14						N/A	
15	ICP-OES-AV-buffer	Y			100	N/A	313.042
16	ICP-OES-AV	Y	NA			N/A	313.107
17	ICP-MS	Ge 72			500	N/A	9
18	ICP-MS	Li6			25-250	N/A	9
19	ICP-MS	Sc	DRC	helium		N/A	
20	ICP-MS	Rhodium			200	N/A	9
21	ICP-MS	Sc	NA	NA	625	N/A	9
22	ICP-MS	Sc			800	N/A	9
23	ICP-MS	Li6			70	N/A	9
24						N/A	
25	ICP-MS	45 Sc	NA		50	N/A	9
26	ICP-MS	Ge 72	ORS			N/A	9m/z
27						N/A	
28	ICP-MS	Sc	NA	NA	250	N/A	
29	ICP-MS	Sc	NA		2000	N/A	9
30					N/A	N/A	
31	ICP-OES-AV	Lu			83	N/A	313.042

Table 87 Instrument Conditions Bi

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1					N/A	N/A	
2					N/A		
3					N/A	N/A	
4					N/A	N/A	
5					N/A	N/A	
6					N/A		
7	ICP-MS	Lu			N/A	25-250	209
8	ICP-MS/MS	Ir 193	ORS	O2	N/A	4000	Bi 209
9							
10					N/A	N/A	
11					N/A	N/A	
12	ICP-MS	Lu			N/A	25-250	209
13					N/A	N/A	
14					N/A	N/A	
15					N/A		
16	ICP-OES-AV	Y	NA		N/A		
17	ICP-OES-AV	Te 214.282			N/A	50	190.171
18	ICP-MS	Lu			N/A	25-250	209
19					N/A		
20					N/A	N/A	
21	ICP-MS	Ir	NA	NA	N/A	625	209
22	ICP-MS	Ir	ORS	He	N/A	800	209
23	ICP-MS	Ir	ORS	He	N/A	85	209
24					N/A		
25	ICP-MS	193 Y	ORS	He	N/A	50	209
26	ICP-MS	Rh 103	ORS		N/A		209m/z
27	ICP-MS	Ir	ORS		N/A		193
28					N/A	N/A	
29	ICP-MS	Tb	NA		N/A	2000	209
30					N/A	N/A	
31	ICP-OES-AV	N/A			N/A	N/A	N/A

Table 88 Instrument Conditions Ca

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1					N/A		
2	ICP-OES-AV-buffer		NA	Ar	N/A	500	317.933
3					N/A		
4					N/A	N/A	
5					N/A	N/A	
6	ICP-OES-AV	Y 371.029			N/A	50	430.253
7	ICP-OES-RV	Lu			N/A	25-250	316
8	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9	ICP-OES-RV	Lu			N/A	20	317.932
10					N/A	N/A	
11					N/A	N/A	
12	ICP-OES-RV	Lu			N/A	25-250	316
13					N/A		
14					N/A	N/A	
15	ICP-OES-AV-buffer	Y			N/A	100	317.933
16	ICP-OES-AV	Y	NA		N/A	N/A	
17					N/A		
18	ICP-OES-RV	Lu			N/A	25-250	316
19					N/A	N/A	
20					N/A	N/A	
21	ICP-MS	Sc	UC	He	N/A	625	44
22	ICP-MS	Sc	ORS	He	N/A	800	43
23	ICP-OES-RV	Lu	NA		N/A	85	422.673
24					N/A		
25	ICP-MS	45 Sc	ORS	He	N/A	50	44
26	ICP-OES-RV	Y377	NA		N/A		317.933 nm
27					N/A	N/A	
28	ICP-MS	Sc	UC	He	N/A	N/A	
29	ICP-MS	Sc	NA		N/A	2000	43
30	if other please type	Spiked sample			N/A	200	
31	ICP-OES-AV	Lu			N/A	83	317.933

Table 89 Instrument Conditions Cd

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1						N/A	
2	ICP-MS	Rh	ORS	Ar	500	N/A	111
3						N/A	
4	ICP-MS	Rh	ORS	He	500	N/A	111
5	ICP-MS	Rh	ORS	He	500	N/A	111
6	ICP-OES-AV	Y 371.029			50	N/A	228.802
7	ICP-MS	Rh			25-250	N/A	111
8	ICP-MS/MS	Rh103	ORS	O2	4000	N/A	Cd 111
9	ICP-MS	Rh	ORS	He	20	N/A	111
10	AAS				7.2	N/A	228.8
11	ICP-MS	Rh	ORS	He	100	N/A	111
12	ICP-MS	Rh			25-250	N/A	111
13					N/A	N/A	
14						N/A	
15	ICP-OES-AV-buffer	Y			100	N/A	228.802
16	ICP-MS	Rh	ORS	He		N/A	111
17	ICP-MS	Rh 103 and Ir193			500	N/A	111
18	ICP-MS	Rh			25-250	N/A	111
19	ICP-MS	In	DRC	helium		N/A	
20	ICP-MS	Rhodium			200	N/A	114
21	ICP-MS	Rh	NA	NA	625	N/A	111
22	ICP-MS	Rh	ORS	He	800	N/A	111
23	ICP-MS	In	ORS	He	70	N/A	111
24						N/A	
25	ICP-MS	103 Rh	ORS	He	50	N/A	111
26	ICP-MS	Rh 103	ORS			N/A	111m/z
27						N/A	
28	ICP-MS	Rh	NA	NA	250	N/A	
29	ICP-MS	Rh	UC	He	1000	N/A	111
30					N/A	N/A	
31	ICP-OES-AV	Lu			83	N/A	214.439

Table 90 Instrument Conditions Co

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1					N/A	N/A	
2	ICP-MS	Sc	ORS	Ar	N/A	500	59
3					N/A	N/A	
4					N/A	N/A	
5					N/A	N/A	
6	ICP-OES-AV	Y 371.029			N/A	50	230.786
7	ICP-MS	Ge	ORS	He	N/A	25-250	59
8	ICP-MS/MS	Rh103	ORS	O2	N/A	4000	Co 59
9							
10					N/A	N/A	
11					N/A	N/A	
12	ICP-MS	Ge	ORS	He	N/A	25-250	59
13					N/A	N/A	
14					N/A	N/A	
15	ICP-OES-AV-buffer	Y			N/A	100	230.786
16	ICP-OES-AV	Y	NA		N/A		228.615
17	ICP-OES-AV	Y 371.029			N/A	50	228.615
18	ICP-MS	Ge	ORS	He	N/A	25-250	59
19	ICP-MS	Ge	DRC	helium	N/A		
20					N/A	N/A	
21	ICP-MS	Ge	UC	He	N/A	625	59
22	ICP-MS	Rh	ORS	He	N/A	800	59
23	ICP-OES-AV	Lu	NA		N/A	85	230.786
24					N/A		
25	ICP-MS	103 Rh	ORS	He	N/A	50	59
26	ICP-OES-AV	Te214	NA		N/A		228.615 nm
27	ICP-MS	Sc	ORS	He	N/A		59
28	ICP-MS	Rh	UC	He	N/A	250	
29	ICP-MS	Ga	UC	He	N/A	2000	59
30					N/A	N/A	
31	ICP-OES-AV	Lu			N/A	83	230.786

Table 91 Instrument Conditions Cr

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1	ICP-MS					N/A	
2	ICP-MS	Sc	ORS	Ar	500	N/A	52
3						N/A	
4	ICP-MS	Sc	ORS	He	500	N/A	52
5	ICP-MS	Sc	ORS	He	500	N/A	52
6	ICP-OES-AV	Y 371.029			50	N/A	267.716
7	ICP-MS	Ge	ORS	He	25-250	N/A	52
8	ICP-MS/MS	Sc 45	ORS	O2	4000	N/A	Cr 52
9	ICP-MS	Sc	ORS	He	20	N/A	52
10	AAS				7.2	N/A	359.4
11	ICP-MS	Ge	ORS	He	100	N/A	52
12	ICP-MS	Ge	ORS	He	25-250	N/A	52
13					N/A	N/A	
14						N/A	
15	ICP-OES-AV-buffer	Y			100	N/A	205.618
16	ICP-OES-AV	Y	NA			N/A	267.716
17	ICP-OES-AV	Y 371.029			50	N/A	267.716
18	ICP-MS	Ge	ORS	He	25-250	N/A	52
19	ICP-MS	Sc	DRC	helium		N/A	
20	ICP-MS	Germanium	ORS	He	2000	N/A	52
21	ICP-MS	Sc	UC	He	625	N/A	52
22	ICP-MS	Rh	ORS	He	800	N/A	52
23	ICP-OES-AV	Lu	NA		70	N/A	205.56
24						N/A	
25	ICP-MS	45 Sc	ORS	He	50	N/A	52
26	ICP-OES-AV	Te214	NA			N/A	267.716 nm
27						N/A	
28	ICP-MS	Sc	UC	He	250	N/A	
29	ICP-MS	Sc	UC	He	1000	N/A	52
30					N/A	N/A	
31	ICP-OES-AV	Lu			83	N/A	267.716

Table 92 Instrument Conditions Cu

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1	ICP-OES-RV					N/A	
2	ICP-MS	Sc	ORS	Ar	500	N/A	63
3						N/A	
4	ICP-MS	Sc	ORS	He	500	N/A	63
5	ICP-MS	Sc	ORS	He	500	N/A	63
6	ICP-OES-AV	Y 371.029			50	N/A	327.395
7	ICP-MS	Ge	ORS	He	25-250	N/A	63
8	ICP-MS/MS	Rh103	ORS	O2	4000	N/A	Cu 63
9	ICP-MS	Ge	ORS	He	20	N/A	63
10	AAS				7.2	N/A	324.8
11	ICP-MS	Ge	ORS	He	100	N/A	63
12	ICP-MS	Ge	ORS	He	25-250	N/A	63
13					N/A	N/A	
14						N/A	
15	ICP-OES-AV-buffer	Y			100	N/A	324.754
16	ICP-OES-AV	Y	NA			N/A	327.395
17	ICP-OES-AV	Te 214.282			50	N/A	217.895
18	ICP-MS	Ge	ORS	He	25-250	N/A	63
19	ICP-MS	Ge	DRC	helium		N/A	
20	ICP-MS	Germanium	ORS	He	2000	N/A	63
21	ICP-MS	Ge	UC	He	625	N/A	63
22	ICP-MS	Rh	ORS	He	800	N/A	63
23	ICP-OES-AV	Lu	NA		70	N/A	324.754
24						N/A	
25	ICP-MS	103 Rh	ORS	He	50	N/A	63
26	ICP-OES-RV	Y377	NA			N/A	327.395 nm
27						N/A	
28	ICP-MS	Rh	UC	He	250	N/A	
29	ICP-MS	Ga	UC	He	1000	N/A	63
30					N/A	N/A	
31	ICP-OES-AV	Lu			83	N/A	327.395

Table 93 Instrument Conditions Cs

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1					N/A	N/A	
2					N/A		
3					N/A	N/A	
4					N/A	N/A	
5					N/A	N/A	
6					N/A		
7					N/A		
8	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9							
10					N/A	N/A	
11					N/A	N/A	
12					N/A		
13					N/A	N/A	
14					N/A	N/A	
15					N/A		
16	ICP-OES-AV	Y	NA		N/A		
17					N/A		
18	ICP-MS	Rh			N/A		133
19					N/A		
20					N/A	N/A	
21					N/A		
22	ICP-MS	Rh	ORS	He	N/A	800	133
23							
24					N/A		
25	ICP-MS	103 Rh	ORS	He	N/A	50	133
26	ICP-MS	Rh 103	ORS		N/A		133 m/z
27					N/A		
28	ICP-MS	In	NA	NA	N/A	250	
29	ICP-MS	Tb	NA		N/A	2000	133
30					N/A	N/A	
31	ICP-OES-AV	N/A			N/A	N/A	N/A

Table 94 Instrument Conditions Fe

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1					N/A		
2	ICP-MS	Sc	ORS	Ar	N/A	500	56
3					N/A		
4					N/A	N/A	
5					N/A	N/A	
6	ICP-OES-AV	Y 371.029			N/A	50	370.792
7	ICP-OES-RV	Ge	ORS	He	N/A	25-250	259.94
8	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9	ICP-MS	Sc	ORS	He	20	N/A	56
10					N/A	N/A	
11					N/A	N/A	
12	ICP-OES-RV	Ge	ORS	He	N/A	25-250	259.94
13					N/A		
14					N/A	N/A	
15	ICP-OES-AV-buffer	Y			N/A	100	259.941
16	ICP-OES-AV	Y	NA		N/A	N/A	
17					N/A		
18	ICP-OES-RV	Ge	ORS	He	N/A	25-250	259.94
19	ICP-MS	Sc	DRC	helium	N/A	N/A	
20					N/A	N/A	
21	ICP-MS	Sc	UC	He	N/A	625	56
22	ICP-MS	Rh	ORS	He	N/A	800	56
23	ICP-OES-AV	Lu	NA		N/A	85	259.94
24					N/A		
25	ICP-OES-AV-equation	Eu	NA		N/A	50	258.3
26	ICP-OES-AV	Te214	NA		N/A		259.940nm
27					N/A	N/A	
28	ICP-MS	Sc	UC	He	N/A	N/A	
29	ICP-MS	Sc	NA		N/A	2000	54
30	AAS	Spiked sample			N/A	400	248.3
31	ICP-OES-AV	Lu			N/A	83	238.204

Table 95 Instrument Conditions Hg

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1	CVAAS					N/A	
2	ICP-MS	Rh	ORS	Ar	500	N/A	202
3						N/A	
4	ICP-MS	Lu	ORS	He	500	N/A	202
5	ICP-MS	Lu	ORS	He	500	N/A	202
6	CVAFS				500	N/A	254
7	CVAAS	--			25-250	N/A	253.7
8	ICP-MS/MS	Ir 193	ORS	O2	N/A	4000	Hg 202
9	ICP-MS	Lu	ORS	He	20	N/A	201
10	CVAAS				72	N/A	253.7
11	CVAFS				1000	N/A	253.652
12	CVAAS	--			25-250	N/A	253.7
13					N/A	N/A	
14						N/A	
15						N/A	
16	CVAAS	NA	NA			N/A	
17	CVAAS				250	N/A	
18	CVAAS	--			25-250	N/A	253.7
19	ICP-MS	Ir	DRC	helium		N/A	
20	ICP-MS	Rhodium			200	N/A	202
21	ICP-MS	Ir	NA	NA	625	N/A	201
22	ICP-MS	Ir	ORS	He	800	N/A	202
23	ICP-MS	Ir	ORS	He	70	N/A	202
24						N/A	
25	CVAAS	103 Rh	NA		50	N/A	253.7
26	ICP-MS	Ir 193	ORS			N/A	202m/z
27						N/A	
28	ICP-MS	Ir	NA	NA	250	N/A	
29	ICP-MS	Tb	UC	He	1000	N/A	201
30					N/A	N/A	
31	if other please type	N/A			83	N/A	253.7

Table 96 Instrument Conditions K

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1					N/A		
2	ICP-OES-AV-buffer		NA	Ar	N/A	500	766.491
3					N/A		
4					N/A	N/A	
5					N/A	N/A	
6	ICP-OES-AV	Y 371.029			N/A	50	769.897
7	ICP-OES-RV	Lu			N/A	25-250	766.491
8	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9	ICP-OES-RV	Lu			N/A	20	766.491
10					N/A	N/A	
11					N/A	N/A	
12	ICP-OES-RV	Lu			N/A	25-250	766.491
13					N/A		
14					N/A	N/A	
15	AAS				N/A		254.7
16	ICP-OES-AV	Y	NA		N/A	N/A	
17					N/A		
18	ICP-OES-RV	Lu			N/A	25-250	766.491
19					N/A	N/A	
20					N/A	N/A	
21	ICP-MS	Sc	UC	He	N/A	625	39
22	ICP-MS	Sc	ORS	He	N/A	800	39
23	ICP-OES-AV	Lu	NA		N/A	85	766.491
24					N/A		
25	ICP-MS	45 Sc	ORS	He	N/A	50	39
26	ICP-OES-RV	Y377	NA		N/A		766.491nm
27					N/A	N/A	
28	ICP-MS	Sc	NA	NA	N/A	N/A	
29	ICP-MS	Sc	UC	He	N/A	2000	39
30	if other please type	Spiked sample			N/A	400	
31	ICP-OES-AV	Lu			N/A	83	769.897

Table 97 Instrument Conditions La

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1					N/A	N/A	
2					N/A		
3					N/A	N/A	
4					N/A	N/A	
5					N/A	N/A	
6					N/A		
7					N/A		
8	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9					N/A	N/A	
10					N/A	N/A	
11					N/A	N/A	
12					N/A		
13					N/A	N/A	
14					N/A	N/A	
15					N/A		
16	ICP-OES-AV	Y	NA		N/A		
17					N/A		
18	ICP-MS	Rh			N/A		139
19					N/A		
20					N/A	N/A	
21					N/A		
22	ICP-MS	Rh	ORS	He	N/A	800	139
23							
24					N/A		
25	ICP-MS	103 Rh	ORS	He	N/A	50	139
26	ICP-MS	Rh 103	ORS		N/A		139 m/z
27	ICP-MS	In	ORS	He	N/A		139
28	ICP-MS	In	NA	NA	N/A	250	
29	ICP-MS	Tb	NA		N/A	2000	139
30					N/A	N/A	
31	ICP-OES-AV	N/A			N/A	N/A	N/A

Table 98 Instrument Conditions Li

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1					N/A	N/A	
2	ICP-OES-AV-buffer		NA	Ar	N/A	500	670.783
3					N/A	N/A	
4					N/A	N/A	
5					N/A	N/A	
6					N/A		
7	ICP-OES-RV	Li6			N/A	25-250	670.3
8	ICP-MS/MS	Sc45	ORS	N/A	N/A	4000	Li7
9					N/A	N/A	
10					N/A	N/A	
11					N/A	N/A	
12	ICP-OES-RV	Li6			N/A	25-250	670.3
13					N/A	N/A	
14					N/A	N/A	
15	ICP-OES-AV-buffer	Y			N/A	100	769.896
16	ICP-OES-AV	Y	NA		N/A		670.783
17					N/A		
18	ICP-OES-RV	Li6			N/A	25-250	670.3
19					N/A		
20					N/A	N/A	
21	ICP-MS	Sc	NA	NA	N/A	625	7
22	ICP-MS	Sc			N/A	800	7
23					N/A		
24					N/A		
25	ICP-MS	45 Sc	NA		N/A	50	7
26	ICP-MS	Ge 72	ORS		N/A		7 m/z
27	ICP-OES-AV	Yb			N/A		610.365
28	ICP-MS	Sc	NA	NA	N/A	250	
29	ICP-MS	Sc	NA		N/A	2000	7
30					N/A	N/A	
31	ICP-OES-AV	N/A			N/A	N/A	N/A

Table 99 Instrument Conditions Mg

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1					N/A		
2	ICP-OES-AV-buffer		NA	Ar	N/A	500	285.213
3					N/A		
4					N/A	N/A	
5					N/A	N/A	
6	ICP-OES-AV	Y 371.029			N/A	50	277.983
7	ICP-OES-RV	Lu			N/A	25-250	279.8
8	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9	ICP-OES-RV	Lu			N/A	20	285.213
10					N/A	N/A	
11					N/A	N/A	
12	ICP-OES-RV	Lu			N/A	25-250	279.8
13					N/A		
14					N/A	N/A	
15	ICP-OES-AV-buffer	Y			N/A	100	285.213
16	ICP-OES-AV	Y	NA		N/A	N/A	
17					N/A		
18	ICP-OES-RV	Lu			N/A	25-250	279.8
19					N/A	N/A	
20					N/A	N/A	
21	ICP-MS	Sc	UC	He	N/A	625	25
22	ICP-MS	Sc	ORS	He	N/A	800	24
23	ICP-OES-RV	Lu			N/A	85	285.213
24					N/A		
25	ICP-MS	45 Sc	ORS	He	N/A	50	24
26	ICP-OES-RV	Y377	NA		N/A		280.27 nm
27					N/A	N/A	
28					N/A	N/A	
29	ICP-MS	Sc	NA		N/A	2000	25
30	AAS	Spiked sample			N/A	800	285.2
31	ICP-OES-AV	Lu			N/A	83	383.829

Table 100 Instrument Conditions Mn

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1	ICP-OES-RV					N/A	
2	ICP-MS	Sc	ORS	Ar	500	N/A	55
3						N/A	
4	ICP-MS	Sc	ORS	He	500	N/A	55
5	ICP-MS	Sc	ORS	He	500	N/A	55
6	ICP-OES-AV	Y 371.029			50	N/A	293.931
7	ICP-MS	Ge	ORS	He	25-250	N/A	55
8	ICP-MS/MS	Rh103	NA	O2	4000	N/A	Mn 55
9	ICP-MS	Sc	ORS	He	20	N/A	55
10	AAS				7.2	N/A	403.1
11	ICP-MS	Rh	ORS	He	100	N/A	55
12	ICP-MS	Ge	ORS	He	25-250	N/A	55
13					N/A	N/A	
14						N/A	
15	ICP-OES-AV-buffer	Y			100	N/A	257.611
16	ICP-OES-AV	Y	NA			N/A	257.61
17	ICP-OES-AV	Te 214.282			50	N/A	293.931
18	ICP-MS	Ge	ORS	He	25-250	N/A	55
19	ICP-MS	Sc	DRC	helium		N/A	
20	ICP-OES-RV	Lutetium			20	N/A	257
21	ICP-MS	Sc	UC	He	625	N/A	55
22	ICP-MS	Rh	ORS	He	800	N/A	55
23	ICP-OES-AV	Lu			70	N/A	257.61
24						N/A	
25	ICP-MS	45 Sc	ORS	He	50	N/A	55
26	ICP-OES-AV	Te214	NA			N/A	191.446 nm
27						N/A	
28	ICP-MS	Rh	UC	He	250	N/A	
29	ICP-MS	Sc	UC	He	2000	N/A	55
30					N/A	N/A	
31	ICP-OES-AV	Lu			83	N/A	260.568

Table 101 Instrument Conditions Mo

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1	ICP-OES-RV					N/A	
2	ICP-MS	Y	ORS	Ar	500	N/A	95
3						N/A	
4	ICP-MS	Rh	ORS	He	500	N/A	95
5	ICP-MS	Sc	ORS	He	500	N/A	95
6	ICP-OES-AV	Y 371.029			50	N/A	202.032
7	ICP-MS	Rh			25-250	N/A	95
8	ICP-MS/MS	Rh103	NA	O2	4000	N/A	Mo 95
9	ICP-MS	Ge	ORS	He	20	NA	95
10	if other please type				290	N/A	313.3
11	ICP-MS	Rh	ORS	He	100	N/A	95
12	ICP-MS	Rh			25-250	N/A	95
13					N/A	N/A	
14						N/A	
15	ICP-OES-AV-buffer	Y			100	N/A	202.095
16	ICP-OES-AV	Y	NA			N/A	202.032
17	ICP-OES-AV	Y 371.029			50	N/A	202.032
18	ICP-MS	Rh			25-250	N/A	95
19	ICP-MS	Y	DRC	helium		N/A	
20	ICP-MS	Rhodium			2000	N/A	98
21	ICP-MS	Rh	NA	NA	625	N/A	95
22	ICP-MS	Rh	ORS	He	800	N/A	95
23	ICP-MS	In	ORS	He	70	N/A	95
24						N/A	
25	ICP-MS	103 Rh	ORS	He	50	N/A	95
26	ICP-OES-AV	Te214	NA			N/A	204.598 nm
27						N/A	
28	ICP-MS	Rh	NA	NA	250	N/A	
29	ICP-MS	Rh	NA		2000	N/A	98
30					N/A	N/A	
31	ICP-OES-AV	Lu			83	N/A	202.032

Table 102 Instrument Conditions Na

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1					N/A		
2	ICP-OES-AV-buffer		NA	Ar	N/A	500	588.995
3					N/A		
4					N/A	N/A	
5					N/A	N/A	
6	ICP-OES-AV	Y 371.029			N/A	50	588.995
7	ICP-OES-RV	Lu			N/A	25-250	588.995
8	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9	ICP-OES-RV				N/A	20	589.594
10					N/A	N/A	
11					N/A	N/A	
12	ICP-OES-RV	Lu			N/A	25-250	588.995
13					N/A		
14					N/A	N/A	
15	ICP-OES-AV-buffer	Y			N/A	100	589.592
16	ICP-OES-AV	Y	NA		N/A	N/A	
17					N/A		
18	ICP-OES-RV	Lu			N/A	25-250	588.995
19					N/A	N/A	
20					N/A	N/A	
21	ICP-MS	Sc	UC	He	N/A	625	23
22	ICP-MS	Sc	ORS	He	N/A	800	23
23	ICP-MS	Ge	ORS	He	N/A	85	23
24					N/A		
25	ICP-MS	45 Sc	ORS	He	N/A	50	23
26	ICP-OES-RV	Y377	NA		N/A		589.592 nm
27					N/A	N/A	
28					N/A	N/A	
29	ICP-MS	Sc	UC	He	N/A	2000	23
30	if other please type	Spiked sample			N/A	400	
31	ICP-OES-AV	Lu			N/A	83	589.592

Table 103 Instrument Conditions Ni

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1	ICP-OES-RV					N/A	
2	ICP-MS	Sc	ORS	Ar	500	N/A	60
3						N/A	
4	ICP-MS	Sc	ORS	He	500	N/A	60
5	ICP-MS	Sc	ORS	He	500	N/A	60
6	ICP-OES-AV	Y 371.029			50	N/A	231.604
7	ICP-MS	Ge	ORS	He	25-250	N/A	60
8	ICP-MS/MS	Rh103	NA	O2	4000	N/A	Ni 60
9	ICP-MS	Ge	ORS	He	20	NA	60
10	AAS				7.2	N/A	232
11	ICP-MS	Rh	ORS	He	100	N/A	60
12	ICP-MS	Ge	ORS	He	25-250	N/A	60
13					N/A	N/A	
14						N/A	
15	ICP-OES-AV-buffer	Y			100	N/A	231.604
16	ICP-OES-AV	Y	NA			N/A	
17	ICP-OES-AV	Te 214.282			50	N/A	67.3453
18	ICP-MS	Ge	ORS	He	25-250	N/A	60
19	ICP-MS	Ge	DRC	helium		N/A	
20	ICP-MS	Germanium	ORS	He	2000	N/A	60
21	ICP-MS	Ge	UC	He	625	N/A	60
22	ICP-MS	Rh	ORS	He	800	N/A	60
23	ICP-MS	Ge	ORS	He	70	N/A	60
24						N/A	
25	ICP-MS	103 Rh	ORS	He	50	N/A	60
26	ICP-OES-AV	Te214	NA			N/A	216.555 nm
27						N/A	
28	ICP-MS	Rh	UC	He	250	N/A	
29	ICP-MS	Ga	UC	He	1000	N/A	60
30					N/A	N/A	
31	ICP-OES-AV	Lu			83	N/A	231.604

Table 104 Instrument Conditions P

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1	ICP-OES-RV				N/A		
2	ICP-OES-AV-buffer		NA	Ar	N/A	500	213.618
3					N/A		
4					N/A	N/A	
5					N/A	N/A	
6					N/A		
7	ICP-OES-RV	Lu			N/A	25-250	213.618
8	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9	ICP-OES-RV	Lu			N/A	20	178.22
10					N/A	N/A	
11					N/A	N/A	
12	ICP-OES-RV	Lu			N/A	25-250	213.618
13					N/A		
14					N/A	N/A	
15	ICP-OES-AV-buffer	Y			N/A	100	177.495
16	ICP-OES-AV	Y	NA		N/A	N/A	
17					N/A		
18	ICP-OES-RV	Lu			N/A	25-250	213.618
19					N/A	N/A	
20					N/A	N/A	
21	ICP-MS	Sc	UC	He	N/A	625	31
22	ICP-MS	Sc	ORS	HEHe	N/A	800	31
23	ICP-OES-AV	Lu			N/A	85	177.434
24					N/A		
25	ICP-OES-AV-equation	Eu	NA		N/A	50	185.8
26	ICP-OES-AV	Te214	NA		N/A		177.434 nm
27					N/A	N/A	
28					N/A	N/A	
29	ICP-MS	Sc	NA		N/A	2000	31
30					N/A		
31	ICP-OES-AV	Lu			N/A	83	178.222

Table 105 Instrument Conditions Pb

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1	ICP-MS					N/A	
2	ICP-MS	Rh	ORS	Ar	500	N/A	
3						N/A	
4	ICP-MS	Lu	ORS	He	500	N/A	208
5	ICP-MS	Lu	ORS	He	500	N/A	208
6	ICP-OES-AV	Y 371.029			50	N/A	220.353
7	ICP-MS	Lu			25-250	N/A	206+207+208
8	ICP-MS/MS	Ir 193	NA	O2	4000	N/A	Pb 208
9	ICP-MS	Lu	ORS	He	20	NA	208
10	AAS				7.2	N/A	217
11	ICP-MS	Ir	ORS	He	100	N/A	208
12	ICP-MS	Lu			25-250	N/A	206+207+208
13					N/A	N/A	
14						N/A	
15	ICP-OES-AV-buffer	Y			100	N/A	220.353
16	ICP-OES-AV	Y	NA			N/A	220.353
17	ICP-OES-AV	Te 214.282			50	N/A	220.353
18	ICP-MS	Lu			25-250	N/A	206+207+208
19						N/A	
20	ICP-MS	Rhodium			2000	N/A	206207208
21	ICP-MS	Ir	NA	NA	625	N/A	206+207+208
22	ICP-MS	Ir	ORS	He	800	N/A	207
23	ICP-OES-AV	Lu			70	N/A	220.353
24						N/A	
25	ICP-MS	193 Y	ORS	He	50	N/A	208
26	ICP-OES-AV	Te214	NA			N/A	220.353 nm
27						N/A	
28	ICP-MS	Ir	NA	NA	250	N/A	
29	ICP-MS	Tb	UC	He	1000	N/A	206+207+208
30					N/A	N/A	
31	ICP-OES-AV	Lu			83	N/A	220.353

Table 106 Instrument Conditions Rb

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1					N/A	N/A	
2					N/A		
3					N/A	N/A	
4					N/A	N/A	
5					N/A	N/A	
6					N/A		
7					N/A	25-250	
8	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9							
10					N/A	N/A	
11					N/A	N/A	
12					N/A	25-250	
13					N/A	N/A	
14					N/A	N/A	
15					N/A		
16	ICP-OES-AV	Y	NA		N/A		
17					N/A		
18	ICP-MS	Ge			N/A	25-250	85
19					N/A		
20					N/A	N/A	
21					N/A		
22	ICP-MS	Rh	ORS	He	N/A	800	85
23							
24					N/A		
25	ICP-MS	103 Rh	ORS	He	N/A	50	85
26	ICP-MS	Rh 103	ORS		N/A		85 m/z
27					N/A		
28					N/A	N/A	
29	ICP-MS	Rh	NA		N/A	2000	85
30					N/A	N/A	
31	ICP-OES-AV	N/A			N/A	N/A	N/A

Table 107 Instrument Conditions S

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1	ICP-OES-RV				N/A		
2	ICP-OES-AV-buffer		NA	Ar	N/A	500	181.972
3					N/A		
4					N/A	N/A	
5					N/A	N/A	
6					N/A		
7	ICP-OES-RV	Lu			N/A	25-250	181.972
8	N/A	N/A	N/A	N/A	N/A	N/A	N/A
9	ICP-OES-AV	Lu			N/A	20	181.975
10					N/A	N/A	
11					N/A	N/A	
12	ICP-OES-RV	Lu			N/A	25-250	181.972
13					N/A		
14					N/A	N/A	
15	ICP-OES-AV-buffer	Y			N/A	100	180.731
16	ICP-OES-AV	Y	NA		N/A	N/A	
17					N/A		
18	ICP-OES-RV	Lu			N/A	25-250	181.972
19					N/A	N/A	
20					N/A	N/A	
21	ICP-OES-AV	Y	NA	NA	N/A	62.5	181.975
22	ICP-OES-AV	Y			N/A	800	
23	ICP-OES-AV	Lu			N/A	85	181.972
24					N/A		
25	ICP-OES-AV-equation	Eu	NA		N/A	50	178.2
26	ICP-OES-AV	Te214	NA		N/A		180.669 nm
27					N/A	N/A	
28					N/A	N/A	
29					N/A	NT	NT
30					N/A		
31	ICP-OES-AV	Lu			N/A	83	181.972

Table 108 Instrument Conditions Se

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1	ICP-MS					N/A	
2	ICP-MS	Ge	ORS	Ar	500	500	78
3						N/A	
4	ICP-MS	Rh	ORS	H2	500	N/A	78
5	ICP-MS	Sc	ORS	H2	500	N/A	78
6	ICP-OES-AV	Y 371.029			50	50	196.026
7	ICP-MS	Ge	ORS	H2	25-250	25-250	78
8	ICP-MS/MS	Rh103	ORS	O2	4000	4000	Se 78/94
9	ICP-MS	Ge	ORS	HEHe	20	N/A	78
10	if other please type				290	N/A	196
11	ICP-MS	Rh	ORS	H2	100	N/A	78
12	ICP-MS	Ge	ORS	H2	25-250	25-250	78
13					N/A	N/A	
14						N/A	
15	ICP-OES-AV-buffer	Y			100	100	196.09
16	ICP-MS	Rh	ORS	He			78
17	ICP-MS	Ge 72 and Rh 103			500	500	77
18	ICP-MS	Ge	ORS	H2	25-250	25-250	78
19	ICP-MS	Ge	DRC	helium			
20	ICP-MS	Germanium	ORS	HeHe	200	N/A	78
21	ICP-MS	Rh	NA	NA	625	625	82
22	ICP-MS	Rh	ORS	HEHe	800	800	78
23	ICP-MS	Ge	ORS	H2	70	85	78
24							
25	ICP-MS	103 Rh	ORS	He	50	50	78
26	ICP-MS	Rh 103	ORS	HEHe			78m/z
27	ICP-MS	Y	ORS	HEHe	N/A		80
28	ICP-MS	Rh	UC	He	250	250	
29	ICP-MS	Te	NA		2000	2000	82
30					N/A	N/A	
31	ICP-OES-AV	Lu			83	N/A	196.026

Table 109 Instrument Conditions Se

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1	ICP-OES-RV					N/A	
2	ICP-MS	Rh	ORS	Ar	500	500	118
3						N/A	
4	ICP-MS	Rh	ORS	He	500	N/A	118
5	ICP-MS	Rh	ORS	He	500	N/A	118
6					N/A		
7	ICP-MS	Rh			25-250	25-250	118
8	ICP-MS/MS	Rh103	NA	O2	4000	4000	Sn 118/134
9	ICP-MS	Rh	ORS	He	20	NA	118
10	if other please type				290	N/A	303.4
11	ICP-MS	Lu	ORS	He	100	N/A	118
12	ICP-MS	Rh			25-250	25-250	118
13					N/A	N/A	
14						N/A	
15	ICP-OES-AV-buffer	Y			100	100	189.991
16	ICP-OES-AV	Y	NA				189.925
17	ICP-OES-AV	Te 214.282			50	50	189.925
18	ICP-MS	Rh			25-250	25-250	118
19	ICP-MS	In	DRC	helium			
20	ICP-MS	Rhodium			2000	N/A	118120
21	ICP-MS	Rh	NA	NA	625	625	118
22	ICP-MS	Rh	ORS	He	800	800	118
23	ICP-OES-AV	Lu			70	85	189.925
24							
25	ICP-MS	103 Rh	ORS	He	50	50	118
26	ICP-MS	Rh 103	ORS				118m/z
27	ICP-MS	In	ORS	He	N/A		118
28	ICP-MS	Rh	NA	NA	250	250	
29	ICP-MS	Rh	NA		2000	2000	120
30					N/A	N/A	
31	ICP-OES-AV	Lu			83	N/A	189.925

Table 110 Instrument Conditions Sr

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1					N/A	N/A	
2	ICP-MS	Y	ORS	Ar	N/A	500	88
3					N/A	N/A	
4					N/A	N/A	
5					N/A	N/A	
6					N/A		
7	ICP-OES-RV	Ge			N/A	25-250	407.771
8	ICP-MS/MS	Rh103	NA	O2	N/A	4000	Sr 88
9					N/A	N/A	
10					N/A	N/A	
11					N/A	N/A	
12	ICP-OES-RV	Ge			N/A	25-250	407.771
13					N/A	N/A	
14					N/A	N/A	
15	ICP-OES-AV-buffer	Y			N/A	100	407.771
16	ICP-OES-AV	Y	NA		N/A		407.771
17	ICP-OES-AV	Y 371.029			N/A	50	421.552
18	ICP-OES-RV	Ge			N/A	25-250	407.771
19	ICP-MS	Y	DRC	helium	N/A		
20					N/A	N/A	
21	ICP-MS	Rh	NA	NA	N/A	625	88
22	ICP-MS	Rh	ORS	He	N/A	800	88
23	ICP-OES-AV	Lu			N/A	85	421.552
24					N/A		
25	ICP-MS	103 Rh	ORS	He	N/A	50	88
26	ICP-OES-RV	Y371	NA		N/A		407.771 nm
27	ICP-OES-AV	Yb			N/A		407.771
28	ICP-MS	Rh	NA	NA	N/A	250	
29	ICP-MS	Sr	NA		N/A	2000	88
30					N/A	N/A	
31	ICP-OES-AV	Lu			N/A	83	407.771

Table 111 Instrument Conditions Th

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1					N/A	N/A	
2	ICP-MS	Ir	ORS	Ar	N/A	500	205
3					N/A	N/A	
4					N/A	N/A	
5					N/A	N/A	
6					N/A		
7	ICP-MS	Lu			N/A	25-250	232
8	ICP-MS/MS	Ir 193	ORS	He	N/A	4000	Th 232
9					N/A	N/A	
10					N/A	N/A	
11					N/A	N/A	
12	ICP-MS	Lu			N/A	25-250	232
13					N/A	N/A	
14					N/A	N/A	
15					N/A		
16	ICP-OES-AV	Y	NA		N/A		
17	ICP-MS	Rh 103 and Ir193			N/A	500	232
18	ICP-MS	Lu			N/A	25-250	232
19					N/A		
20					N/A	N/A	
21	ICP-MS	Ir	NA	NA	N/A	625	232
22	ICP-MS	Ir	ORS	He	N/A	800	232
23							
24					N/A		
25	ICP-MS	193 Y	ORS	He	N/A	50	232
26	ICP-MS	Rh 103	ORS		N/A		232 m/z
27	ICP-MS	Ir	ORS	He	N/A		232
28					N/A	N/A	
29					N/A	NT	NT
30					N/A	N/A	
31	ICP-OES-AV	N/A			N/A	N/A	N/A

Table 112 Instrument Conditions Tl

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1					N/A	N/A	
2	ICP-MS	Ir	ORS	Ar	N/A	500	232
3					N/A	N/A	
4					N/A	N/A	
5					N/A	N/A	
6					N/A		
7	ICP-MS	Lu			N/A	25-250	205
8	ICP-MS/MS	Ir 193	ORS	O2	N/A	4000	Tl 205
9					N/A	N/A	
10					N/A	N/A	
11					N/A	N/A	
12	ICP-MS	Lu			N/A	25-250	205
13					N/A	N/A	
14					N/A	N/A	
15	ICP-OES-AV-buffer	Y			N/A	100	190.864
16	ICP-OES-AV	Y	NA		N/A		
17	ICP-MS	Rh 103 and Ir193			N/A	500	205
18	ICP-MS	Lu			N/A	25-250	205
19					N/A		
20					N/A	N/A	
21	ICP-MS	Ir	NA	NA	N/A	625	205
22	ICP-MS	Ir	ORS	He	N/A	800	205
23	ICP-MS	Ir	ORS	He	N/A	85	205
24					N/A		
25	ICP-MS	193 Y	ORS	He	N/A	50	205
26	ICP-MS	Rh 103	ORS		N/A		205 m/z
27	ICP-MS	Ir	ORS	He	N/A		205
28					N/A	N/A	
29	ICP-MS	Tb	NA		N/A	2000	205
30					N/A	N/A	
31	ICP-OES-AV	N/A			N/A	N/A	N/A

Table 113 Instrument Conditions U

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1					N/A	N/A	
2	ICP-MS	Ir	ORS	Ar	N/A	500	238
3					N/A	N/A	
4					N/A	N/A	
5					N/A	N/A	
6					N/A		
7	ICP-MS	Lu			N/A	25-250	238
8	ICP-MS/MS	Ir 193	ORS	He	N/A	4000	U 238
9					N/A	N/A	
10					N/A	N/A	
11					N/A	N/A	
12	ICP-MS	Lu			N/A	25-250	238
13					N/A	N/A	
14					N/A	N/A	
15					N/A		
16	ICP-OES-AV	Y	NA		N/A		
17	ICP-MS	Rh 103 and Ir193			N/A	500	238
18	ICP-MS	Lu			N/A	25-250	238
19					N/A		
20					N/A	N/A	
21	ICP-MS	Ir	NA	NA	N/A	625	238
22	ICP-MS	Ir	ORS	He	N/A	800	238
23	ICP-MS	Ir	ORS	He	N/A	85	238
24					N/A		
25	ICP-MS	193 Y	ORS	He	N/A	50	238
26	ICP-MS	Ir 193	ORS		N/A		238m/z
27	ICP-MS	Ir	ORS		N/A		238
28	ICP-MS	Ir	NA	NA	N/A	N/A	
29	ICP-MS	Tb	NA		N/A	2000	238
30					N/A	N/A	
31	ICP-OES-AV	N/A			N/A	N/A	N/A

Table 114 Instrument Conditions V

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1	ICP-MS					N/A	
2	ICP-MS	Sc	ORS	Ar	500	N/A	51
3						N/A	
4	ICP-MS	Sc	ORS	He	500	N/A	51
5	ICP-MS	Sc	ORS	He	500	N/A	51
6	ICP-OES-AV	Y 371.029			50	N/A	311.837
7	ICP-MS	Ge			25-250	N/A	51
8	ICP-MS/MS	Sc 45	NA	O2	4000	N/A	V 51
9	ICP-MS	Sc	ORS	He	20	N/A	51
10						N/A	
11	ICP-MS	Ge	ORS	He	100	N/A	51
12	ICP-MS	Ge			25-250	N/A	51
13					N/A	N/A	
14						N/A	
15	ICP-OES-AV-buffer	Y			100	N/A	292.402
16	ICP-OES-AV	Y	NA			N/A	292.401
17	ICP-OES-AV	Te 214.282			50	N/A	292.401
18	ICP-MS	Ge			25-250	N/A	51
19	ICP-MS	Sc	DRC	helium		N/A	
20	ICP-MS	Germanium		He	2000	N/A	51
21	ICP-MS	Sc	UC	He	625	N/A	51
22	ICP-MS	Rh	ORS	He	800	N/A	51
23	ICP-OES-AV	Lu	NA		70	N/A	292.401
24						N/A	
25	ICP-MS	45 Sc	ORS	He	50	N/A	51
26	ICP-OES-RV	Y371	NA			N/A	310.229 nm
27						N/A	
28	ICP-MS	Sc	UC	He	250	N/A	
29	ICP-MS	Sc	UC	He	2000	N/A	51
30					N/A	N/A	
31	ICP-OES-AV	Lu			83	N/A	292.401

Table 115 Instrument Conditions Zn

Laboratory Code	Instrument	Internal standard	Reaction Cell	Reaction Gas	S1 Final Dilution Factor	S2/S3 Final Dilution Factor	Wavelength (nm)/ Ion(m/z)/Absorbance(nm)
1	ICP-OES-RV					N/A	
2	ICP-MS	Sc	ORS	Ar	500	500	66
3						N/A	
4	ICP-MS	Sc	ORS	He	500	N/A	66
5	ICP-MS	Sc	ORS	He	500	N/A	66
6	ICP-OES-AV	Y 371.029			50	50	213.857
7	ICP-MS	Ge			25-250	25-250	66
8	ICP-MS/MS	Rh103	NA	O2	4000	N/A	Zn 66
9	ICP-MS	Ge	ORS	He	20	N/A	66
10	AAS				7.2	N/A	213.9
11	ICP-MS	Ge	ORS	He	100	N/A	66
12	ICP-MS	Ge			25-250	25-250	66
13					N/A	N/A	
14						N/A	
15	ICP-OES-AV-buffer	Y			100	100	213.856
16	ICP-OES-AV	Y	NA				213.857
17	ICP-OES-AV	Te 214.282			50	50	206.2
18	ICP-MS	Ge			25-250	25-250	66
19	ICP-MS	Ge					
20	ICP-MS	Germanium		He	2000	N/A	66
21	ICP-MS	Ge	UC	He	625	625	66
22	ICP-MS	Rh	ORS	He	800	800	64
23	ICP-OES-AV	Lu	NA		70	85	206.2
24							
25	ICP-MS	103 Rh	ORS	He	50	50	66
26	ICP-OES-AV	Te214	NA				202.548 nm
27	ICP-MS	Sc	ORS	He			66
28	ICP-MS	Rh	UC	He	250	250	
29	ICP-MS	Ga	UC	He	1000	1000	66
30					N/A	N/A	
31	ICP-OES-AV	Lu			83	N/A	213.857

Table 116 Instrument Conditions Exchangeable Ca^{2+}

Laboratory Code	Instrument	Internal standard	Reaction Collision Cell	Cell Gas	Final Dilution Factor	Wavelength (nm)/Ion(m/z) /Absorba
2	ICP-OES-AV-buffer	NA	NA	Ar		317.933
7	ICP-OES-AV-buffer				100	316
9	ICP-OES	Lu			200	317.932
12	ICP-OES-AV-buffer				100	316
18	ICP-OES-AV-buffer				100	316
21	ICP-OES-RV		NA		20	317.933
22	ICP-OES				40	315.887
24	ICP-OES					
25	ICP-OES	Eu	NA		1	315.9
30	if other please type				200	
31	ICP-OES					317.933

Table 117 Instrument Conditions Exchangeable Mg^{2+}

Laboratory Code	Instrument	Internal standard	Reaction Collision Cell	Cell Gas	Final Dilution Factor	Wavelength (nm)/Ion(m/z) /Absorba
2	ICP-OES-AV-buffer	NA	NA	Ar		285.213
7	ICP-OES-AV-buffer				100	279.8
9	ICP-OES	Lu			200	285.213
12	ICP-OES-AV-buffer				100	279.8
18	ICP-OES-AV-buffer				100	279.8
21	ICP-OES-RV		NA		20	285.213
22	ICP-OES				40	279.8
24	ICP-OES					
25	ICP-OES	Eu	NA		1	383.8
31	ICP-OES					383.829

Table 118 Instrument Conditions Exchangeable Na^+

Laboratory Code	Instrument	Internal standard	Reaction Collision Cell	Cell Gas	Final Dilution Factor	Wavelength (nm)/Ion(m/z) /Absorba
2	ICP-OES-AV-buffer	NA	NA	Ar		588.995
7	ICP-OES-AV-buffer				100	588.995
9	ICP-OES	Lu			200	589.594
12	ICP-OES-AV-buffer				100	588.995
18	ICP-OES-AV-buffer				100	588.995
21	ICP-OES-RV		NA		20	589.592
22	ICP-OES				40	588.995
24	ICP-OES					
25	ICP-OES	Eu	NA		1	766.5
30	if other please type				200	
31	ICP-OES					589.592

Table 119 Instrument Conditions Exchangeable K^+

Laboratory Code	Instrument	Internal standard	Reaction Collision Cell	Cell Gas	Final Dilution Factor	Wavelength (nm)/Ion(m/z) /Absorba
2	ICP-OES-AV-buffer	NA	NA	Ar		766.491
7	ICP-OES-AV-buffer				100	766.491
9	ICP-OES	Lu			200	766.491
12	ICP-OES-AV-buffer				100	766.491
18	ICP-OES-AV-buffer				100	766.491
21	ICP-OES-RV		NA		20	766.49
22	ICP-OES				40	766.491
24	ICP-OES					
25	ICP-OES	Eu	NA		1	589.6
30	if other please type				20	
31	ICP-OES					769.897

END OF REPORT