

# PROFICIENCY TESTING

## Evaluation Report

### Scheduled Study

**WP19-3B**

Study Type

WPCHEM\_MICRO

Open Date

2019-07-10

Close Date

2019-08-23

Report Generated

2019-09-11

Laboratory

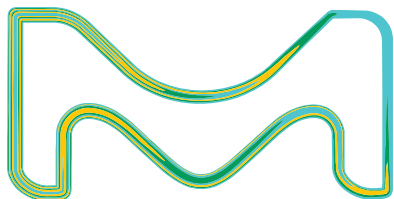
Energy Laboratories-Gillette  
Julie Weisz  
400 West Boxelder Rd.  
Gillette WY 82718 US

Account Number

49978849

US EPA Lab Code

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**Provider of the proficiency test**

Sigma-Aldrich RTC, Inc.  
2931 Soldier Springs Road  
Laramie, WY 82070 USA  
ptservice@milliporesigma.com

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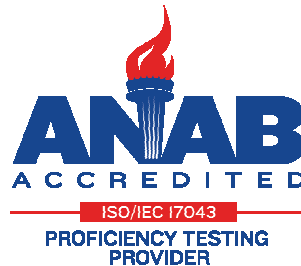
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## **Accreditors**

Evaluations of this study will be sent to the accreditor(s) listed below. If any of the information listed below is not correct, please contact Sigma-Aldrich RTC immediately.

No accreditors were selected to receive this report.

**Summary Results for WP19-3B**  
**PE1269-20ML Acidity - WP**  
**LRAC1205**

Analyte	Reported Value	Assigned Value	Acceptance Window	z-score*
<b>SM 2310 B-2011 (2011) 20044615</b>				
Miscellaneous Analytes				
Acidity, as CaCO <sub>3</sub> <sup>1,2</sup> 1500	1180 mg/L	1210 mg/L	1090 - 1330 mg/L	<b>-0.7</b> Acceptable
Analyst: JW Analysis Date: 2019-07-23	<i>Evaluation Criteria - 1*</i> <i>Parameters*: a:1, b:0, c:.03333334, d:0</i>			
<b>Group Analysis Summary</b>	Acceptable: 1/1		<b>Score: 100% - Acceptable</b>	

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**Summary Results for WP19-3B**  
**PE1060-20ML Anions - WP**  
**LRAC1178**

Analyte	Reported Value	Assigned Value	Acceptance Window	z-score*
<b>EPA 300.0 2.1 (1993) 10053200</b>				
<b>Minerals</b>				
Bromide <sup>1,2</sup> 1540 Analyst: BB Analysis Date: 2019-07-18	7.13 mg/L	7.03 mg/L	5.91 - 8.14 mg/L	<b>0.3</b> Acceptable
<i>Evaluation Criteria – 1*</i> <i>Parameters*: a:1.0098, b:-0.0533, c:0.0400, d:0.0912</i>				
Chloride <sup>1,2</sup> 1575 Analyst: BB Analysis Date: 2019-07-18	109 mg/L	106 mg/L	92.6 - 119 mg/L	<b>0.8</b> Acceptable
<i>Evaluation Criteria – 1*</i> <i>Parameters*: a:1.005, b:0.0490, c:0.0376, d:0.3716</i>				
Fluoride <sup>1,2</sup> 1730 Analyst: BB Analysis Date: 2019-07-18	1.68 mg/L	1.85 mg/L	1.49 - 2.21 mg/L	<b>-1.4</b> Acceptable
<i>Evaluation Criteria – 1*</i> <i>Parameters*: a:0.9748, b:0.0156, c:0.0487, d:0.0277</i>				
Sulfate <sup>1,2</sup> 2000 Analyst: BB Analysis Date: 2019-07-18	22.4 mg/L	21.0 mg/L	17.0 - 25.1 mg/L	<b>1.0</b> Acceptable
<i>Evaluation Criteria – 1*</i> <i>Parameters*: a:0.9880, b:-0.2130, c:0.0473, d:0.3309</i>				
<b>Group Analysis Summary</b>	Acceptable: 4/4		<b>Score: 100% - Acceptable</b>	
<b>Nutrients</b>				
Nitrate as N <sup>1,2</sup> 1810 Analyst: BB Analysis Date: 2019-07-18	15.7 mg/L	15.2 mg/L	12.7 - 17.7 mg/L	<b>0.6</b> Acceptable
<i>Evaluation Criteria – 1*</i> <i>Parameters*: a:0.9975, b:-0.0005, c:0.0506, d:0.0642</i>				
Nitrite as N <sup>1,2</sup> 1840 Analyst: BB Analysis Date: 2019-07-18	2.02 mg/L	2.01 mg/L	1.71 - 2.31 mg/L	<b>0.1</b> Acceptable
<i>Evaluation Criteria – 1*</i> <i>Parameters*: a:1.0017, b:-0.0030, c:0.0377, d:0.0250</i>				
<b>Group Analysis Summary</b>	Acceptable: 2/2		<b>Score: 100% - Acceptable</b>	

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**Summary Results for WP19-3B  
PE1130-20ML Demand - WP  
LRAB8996**

Analyte	Reported Value	Assigned Value	Acceptance Window	z-score*
<b>HACH 8000 (1979) 60003001</b>				
Demands				
Chemical oxygen demand (COD) <sup>1,2</sup> 1565	120 mg/L	124 mg/L	98.3 - 149 mg/L	<b>-0.4</b> Acceptable
Analyst: JW Analysis Date: 2019-07-25		Evaluation Criteria - 1* Parameters*: a:0.9843, b:-0.3171, c:0.0432, d:3.0191		
<b>Group Analysis Summary</b>		Acceptable: 1/1	<b>Score: 100% - Acceptable</b>	
<b>SM 5210 B-2011 (2011) 20135266</b>				
Demands				
5-day BOD <sup>1,2</sup> 1530	67.5 mg/L	77.4 mg/L	41.2 - 114 mg/L	<b>-0.8</b> Acceptable
Analyst: JW Analysis Date: 2019-07-25		Evaluation Criteria - 1* Parameters*: a:0.6237, b:0.7022, c:0.0928, d:0.6636		
Carbonaceous BOD (CBOD) <sup>1,2</sup> 1555	84.2 mg/L	70.1 mg/L	32.1 - 108 mg/L	<b>1.1</b> Acceptable
Analyst: JW Analysis Date: 2019-07-25		Evaluation Criteria - 1* Parameters*: a:0.5648, b:0.6665, c:0.0965, d:0.8253		
<b>Group Analysis Summary</b>		Acceptable: 2/2	<b>Score: 100% - Acceptable</b>	

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**Summary Results for WP19-3B**  
**MIC003-2EA E. coli in Water - Quantitative WP**  
**LRAC3154**

Analyte	Reported Value	Assigned Value	Acceptance Window	z-score*
<b>Colilert®-18 (Fecal Coliforms) (2010) 60002688</b>				
Microbiology				
Fecal coliform, MPN <sup>1,2</sup> 2530	59.8 MPN/100 mL	78.8 MPN/100 mL	7.57 - 822 MPN/100 mL	<b>-0.4</b> Acceptable
Analyst: JW Analysis Date: 2019-07-24		<i>Evaluation Criteria – 6*</i> <i>Parameters*: span:3</i>		
<b>Group Analysis Summary</b>	Acceptable: 1/1		<b>Score: 100% - Acceptable</b>	
<b>SM 9223 B (Colilert-18 Quanti-Tray)-2004 20213610</b>				
Microbiology				
Escherichia coli, MPN <sup>1,2</sup> 2525	166 MPN/100 mL	118 MPN/100 mL	19.7 - 703 MPN/100 mL	<b>0.6</b> Acceptable
Analyst: JW Analysis Date: 2019-07-24		<i>Evaluation Criteria – 6*</i> <i>Parameters*: span:3</i>		
<b>Group Analysis Summary</b>	Acceptable: 1/1		<b>Score: 100% - Acceptable</b>	
<b>SM 9223 B (Colilert®-18) 22nd ED 20214419</b>				
Microbiology				
Total Coliform, MPN <sup>1,2</sup> 2500	166 MPN/100 mL	117 MPN/100 mL	17.5 - 786 MPN/100 mL	<b>0.5</b> Acceptable
Analyst: JW Analysis Date: 2019-07-24		<i>Evaluation Criteria – 6*</i> <i>Parameters*: span:3</i>		
<b>Group Analysis Summary</b>	Acceptable: 1/1		<b>Score: 100% - Acceptable</b>	

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**Summary Results for WP19-3B  
PE1041-1KT Minerals - WP  
LRAC1170\***

Analyte	Reported Value	Assigned Value	Acceptance Window	z-score*
<b>SM 2320 B-2011 (2011) 20045618</b>				
Minerals				
Alkalinity as CaCO <sub>3</sub> <sup>1,2</sup> 1505 Analyst: JW Analysis Date: 2019-07-23	120 mg/L	117 mg/L	99.2 - 134 mg/L	<b>0.6</b> Acceptable
		<i>Evaluation Criteria – 4*</i> <i>Parameters*: break:40, highPercentage:0.15, lowPercentage:0.20</i>		
<b>Group Analysis Summary</b>	Acceptable: 1/1		<b>Score: 100% - Acceptable</b>	
<b>SM 2510 B-2011 (2011) 20048617</b>				
Minerals				
Specific conductance, Conductivity (25°C) <sup>1,2</sup> 1610 Analyst: MV Analysis Date: 2019-07-26	772 µmhos/cm	717 µmhos/cm	645 - 789 µmhos/cm	<b>2.3</b> Acceptable
		<i>Evaluation Criteria – 1*</i> <i>Parameters*: a:1, b:0, c:0.0333, d:0</i>		
<b>Group Analysis Summary</b>	Acceptable: 1/1		<b>Score: 100% - Acceptable</b>	

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**Summary Results for WP19-3B  
PE1083-2ML Oil & Grease - WP  
LRAC1177**

Analyte	Reported Value	Assigned Value	Acceptance Window	z-score*
<b>EPA 1664A (1999) 10127807</b>				
Miscellaneous Analytes				
Silica Gel Treated n-Hexane Extractable Material (Non-polar Material) <sup>2</sup> 6142 Analyst: BB Analysis Date: 2019-07-17	25.8 mg/L	27.8 mg/L	11.3 - 44.3 mg/L	<b>-0.4</b> Acceptable
		<i>Evaluation Criteria – 5*</i> <i>Parameters*: deviations:3</i>		
<b>Group Analysis Summary</b>	Acceptable: 1/1		<b>Score: 100% - Acceptable</b>	
Petroleum Hydrocarbons				
n-Hexane Extractable Material (O&G) <sup>1,2</sup> 1803 Analyst: BB Analysis Date: 2019-07-17	54.7 mg/L	57.1 mg/L	40.9 - 73.4 mg/L	<b>-0.4</b> Acceptable
		<i>Evaluation Criteria – 1*</i> <i>Parameters*: a:0.9400, b:-0.4166, c:0.0545, d:2.0789</i>		
<b>Group Analysis Summary</b>	Acceptable: 1/1		<b>Score: 100% - Acceptable</b>	

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**Summary Results for WP19-3B**  
**PE1210-100ML pH - WP - 100ML**  
**LRAC0859**

Analyte	Reported Value	Assigned Value	Acceptance Window	z-score*
<b>SM 4500-H+ B-2011 (2011) 20105220</b>				
Miscellaneous Analytes				
pH <sup>1,2</sup> 1900 Analyst: MV Analysis Date: 2019-07-26	7.83 Units	7.90 Units	7.11 - 8.69 Units	<b>-0.3</b> Acceptable
			<i>Evaluation Criteria - 1*</i> <i>Parameters*: a:1, b:0, c:0, d:0.06667</i>	
<b>Group Analysis Summary</b>	Acceptable: 1/1		<b>Score: 100% - Acceptable</b>	

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**Summary Results for WP19-3B  
PE3050-500ML Residue - WP  
LRAC1929**

Analyte	Reported Value	Assigned Value	Acceptance Window	z-score*
<b>SM 2540 C-2011 (2011) 20050413</b>				
Minerals				
Total Dissolved Solids at 180°C (TDS) <sup>1,2</sup> 1955	330 mg/L	340 mg/L	295 - 385 mg/L	<b>-0.7</b> Acceptable
Analyst: BB Analysis Date: 2019-07-19	<i>Evaluation Criteria – 1*</i> <i>Parameters*: a:1, b:0, c:0, d:15.0</i>			
<b>Group Analysis Summary</b>	Acceptable: 1/1		<b>Score: 100% - Acceptable</b>	
<b>SM 2540 D-2011 (2011) 20051212</b>				
Miscellaneous Analytes				
Total Suspended Solids, Non-Filterable Residue (TSS) <sup>1,2</sup> 1960	47 mg/L	49.1 mg/L	39.7 - 58.4 mg/L	<b>-0.7</b> Acceptable
Analyst: BB Analysis Date: 2019-07-16	<i>Evaluation Criteria – 1*</i> <i>Parameters*: a:0.9728, b:-0.6338, c:0.0300, d:1.5793</i>			
<b>Group Analysis Summary</b>	Acceptable: 1/1		<b>Score: 100% - Acceptable</b>	

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**Summary Results for WP19-3B  
PE1065-2ML Total Residual Chlorine - WP  
LRAC1172**

Analyte	Reported Value	Assigned Value	Acceptance Window	z-score*
<b>SM 4500-Cl G-2011 (2011) 20081623</b>				
Miscellaneous Analytes				
Total residual chlorine <sup>1,2</sup> 1940 Analyst: JW Analysis Date: 2019-07-23	1.98 mg/L	2.01 mg/L	1.58 - 2.45 mg/L	<b>-0.2</b> Acceptable
<i>Evaluation Criteria - 2*</i> <i>Parameters*: c:0.0688, d:0.0073</i>				
Residual free chlorine <sup>2</sup> 1945 Analyst: JW Analysis Date: 2019-07-23	1.86 mg/L	1.95 mg/L	1.54 - 2.36 mg/L	<b>-0.7</b> Acceptable
<i>Evaluation Criteria - 5*</i> <i>Parameters*: deviations:3</i>				
<b>Group Analysis Summary</b>	Acceptable: 2/2		<b>Score: 100% - Acceptable</b>	

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**Summary Results for WP19-3B  
PE1081-20ML Turbidity - WP  
LRAC2740**

Analyte	Reported Value	Assigned Value	Acceptance Window	z-score*
<b>SM 2130 B-2011 (2011) 20048220</b>				
Miscellaneous Analytes				
Turbidity <sup>1,2</sup> 2055 Analyst: BB Analysis Date: 2019-07-19	14.5 NTU	14.2 NTU	11.7 - 16.7 NTU	<b>0.3</b> Acceptable
			<i>Evaluation Criteria - 1*</i> <i>Parameters*: a:1.0040, b:-0.0368, c:0.0475, d:0.1575</i>	
<b>Group Analysis Summary</b>	Acceptable: 1/1		<b>Score: 100% - Acceptable</b>	

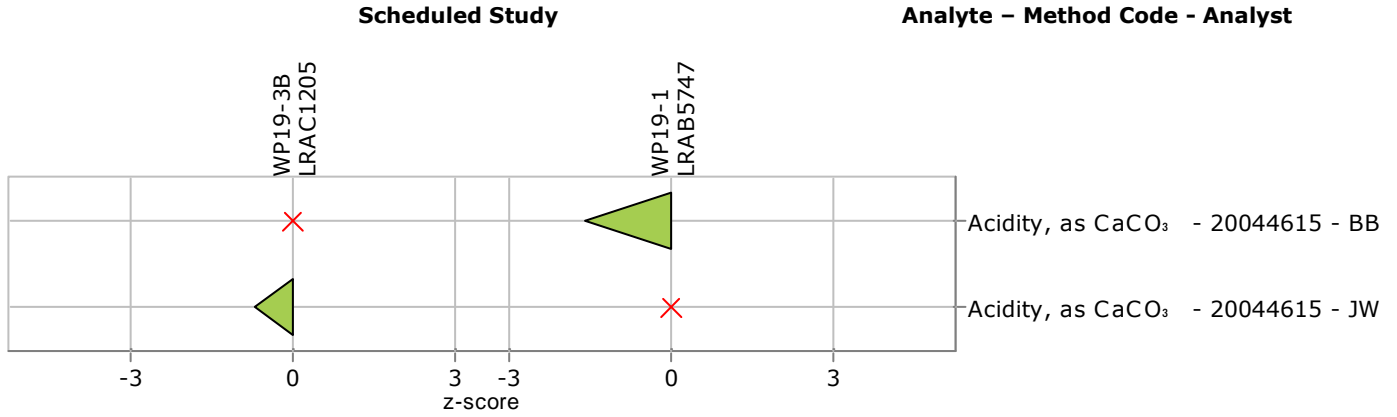
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**Graphical z-score Overview for WP19-3B  
PE1269-20ML Acidity - WP**

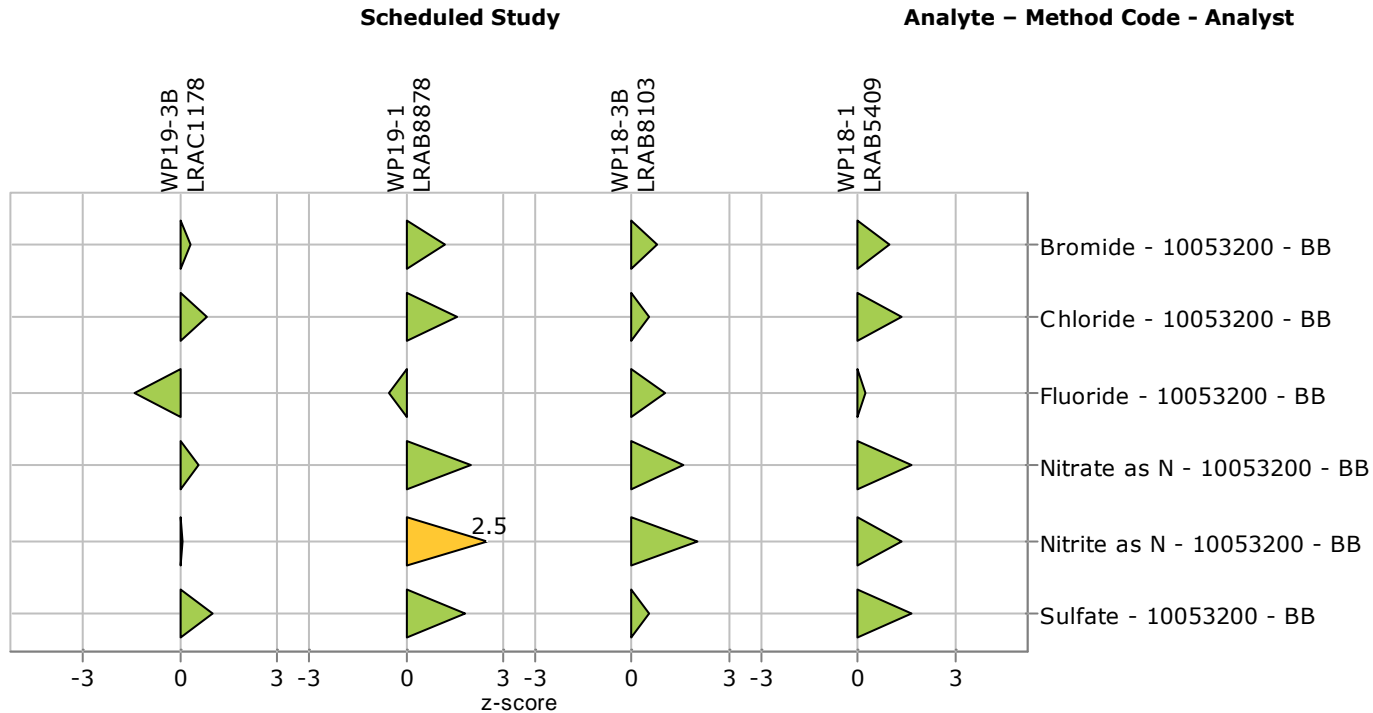
**z-score Overview\* for WP19-3B and the Previous three Scheduled Studies of this Study Type**



\* Evaluation parameters used for the statistical analysis; explanation at the end of report

**Graphical z-score Overview for WP19-3B  
PE1060-20ML Anions - WP**

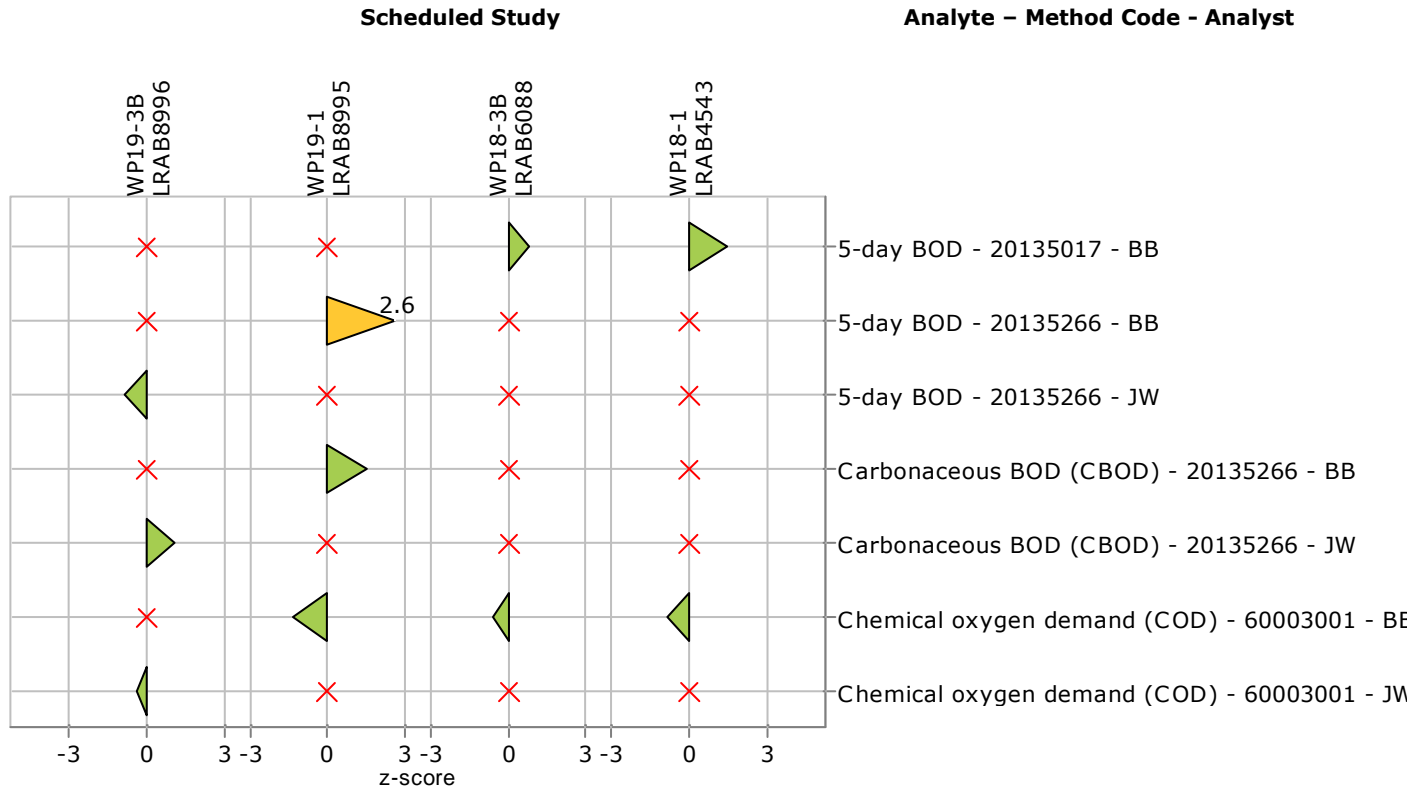
**z-score Overview\* for WP19-3B and the Previous three Scheduled Studies of this Study Type**



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**Graphical z-score Overview for WP19-3B  
PE1130-20ML Demand - WP**

**z-score Overview\* for WP19-3B and the Previous three Scheduled Studies of this Study Type**

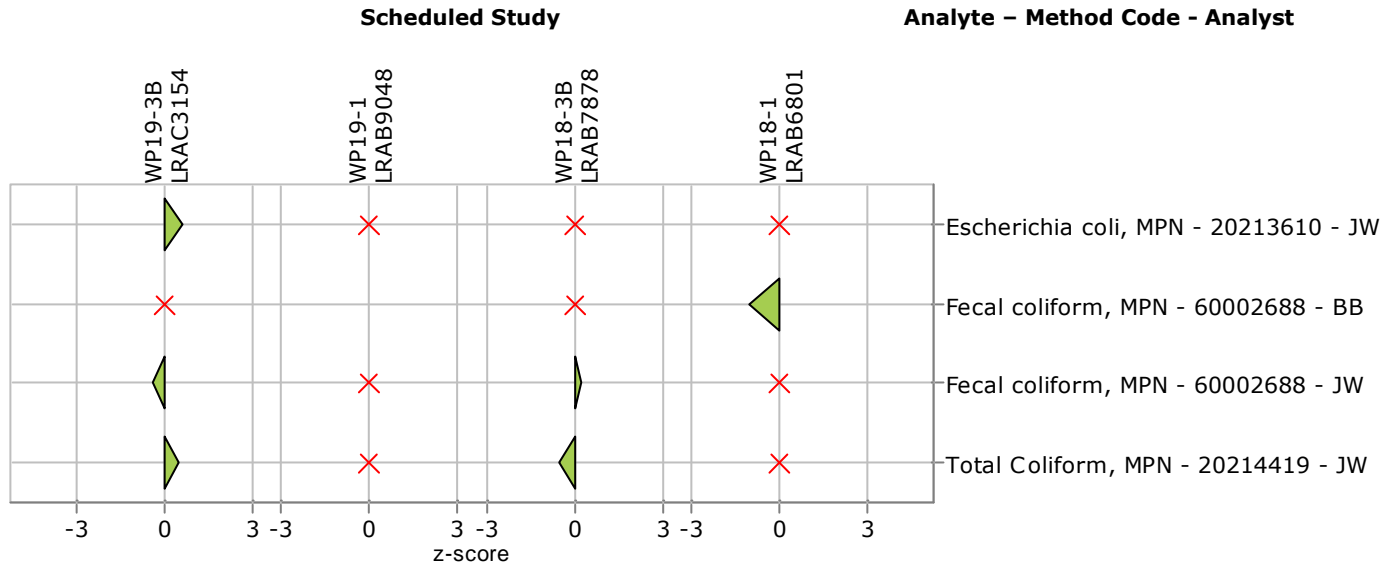


\* Evaluation parameters used for the statistical analysis; explanation at the end of report



**Graphical z-score Overview for WP19-3B  
MIC003-2EA E. coli in Water - Quantitative WP**

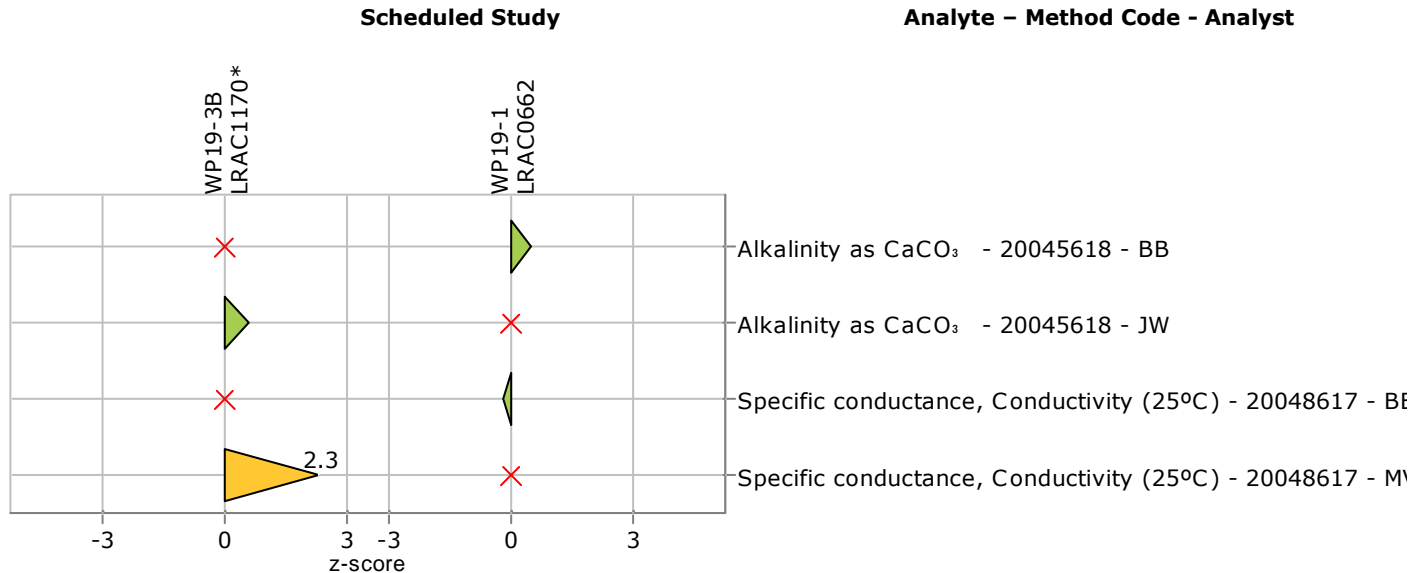
**z-score Overview\* for WP19-3B and the Previous three Scheduled Studies of this Study Type**



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**Graphical z-score Overview for WP19-3B  
PE1041-1KT Minerals - WP**

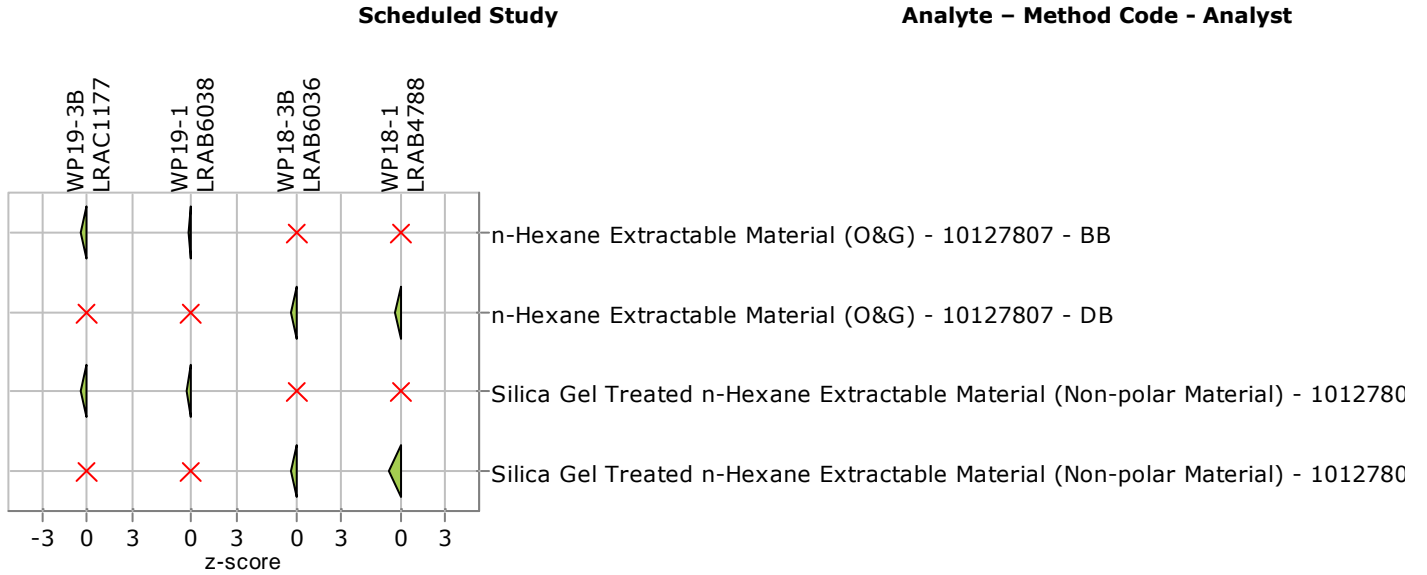
**z-score Overview\* for WP19-3B and the Previous three Scheduled Studies of this Study Type**



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**Graphical z-score Overview for WP19-3B  
PE1083-2ML Oil & Grease - WP**

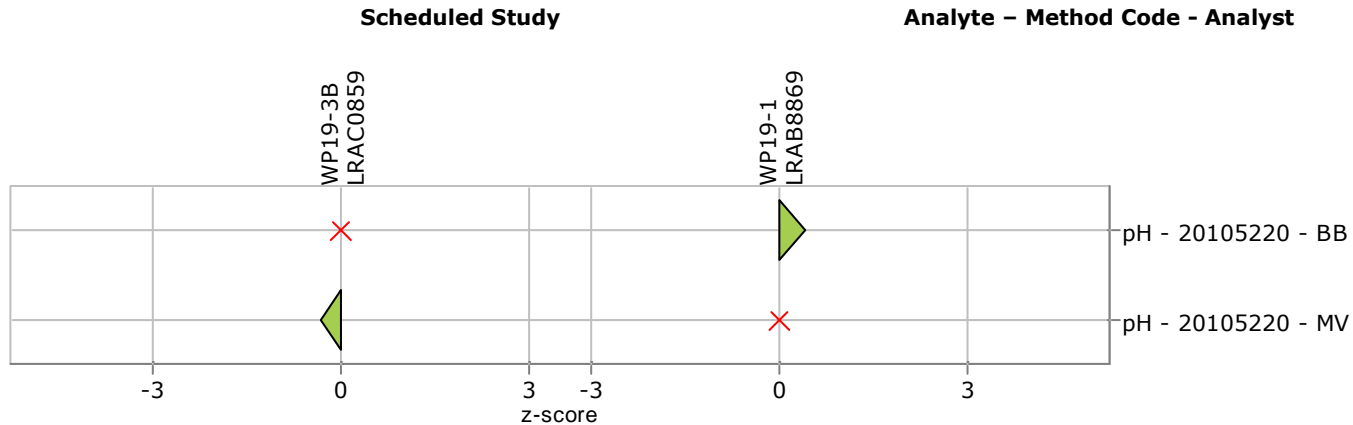
**z-score Overview\* for WP19-3B and the Previous three Scheduled Studies of this Study Type**



\* Evaluation parameters used for the statistical analysis; explanation at the end of report

**Graphical z-score Overview for WP19-3B  
PE1210-100ML pH - WP - 100ML**

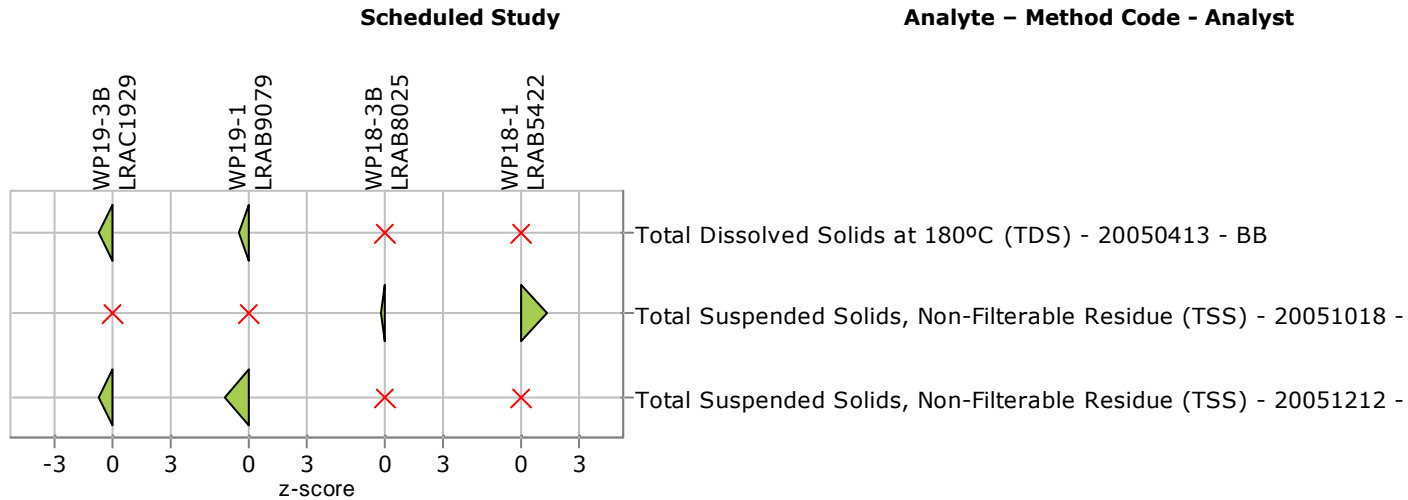
**z-score Overview\* for WP19-3B and the Previous three Scheduled Studies of this Study Type**



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**Graphical z-score Overview for WP19-3B  
PE3050-500ML Residue - WP**

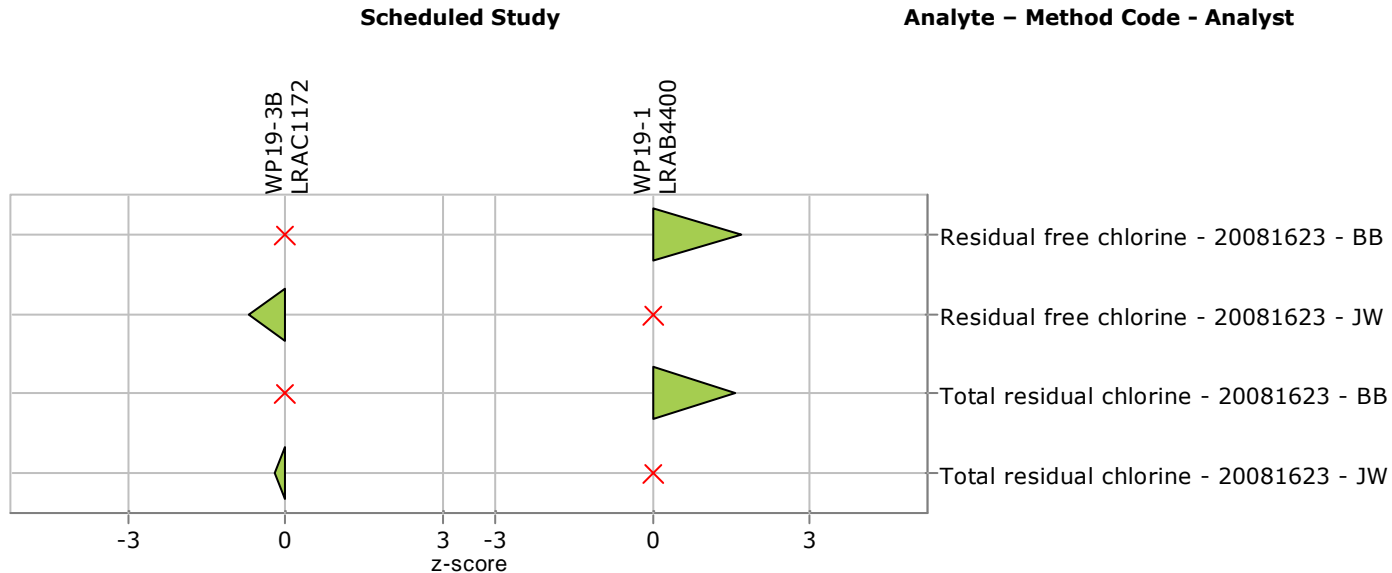
**z-score Overview\* for WP19-3B and the Previous three Scheduled Studies of this Study Type**



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**Graphical z-score Overview for WP19-3B  
PE1065-2ML Total Residual Chlorine - WP**

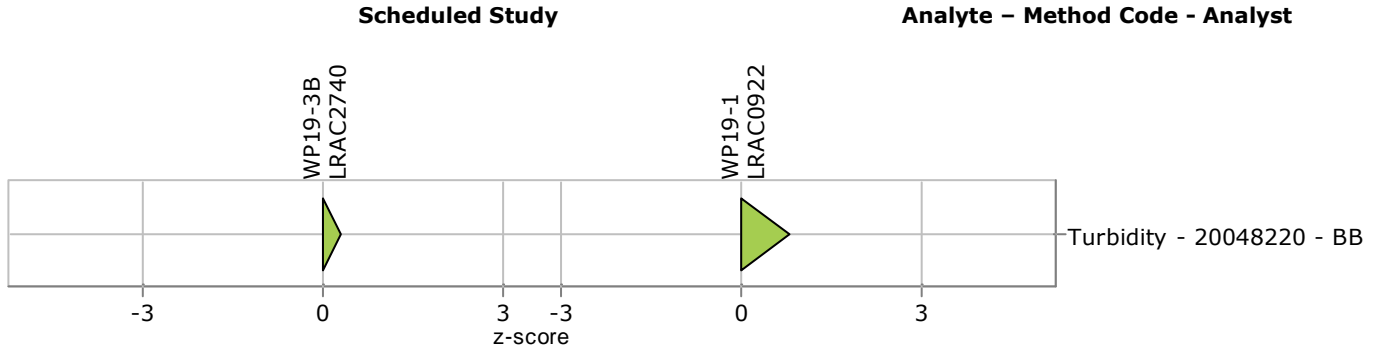
**z-score Overview\* for WP19-3B and the Previous three Scheduled Studies of this Study Type**



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**Graphical z-score Overview for WP19-3B  
PE1081-20ML Turbidity - WP**

**z-score Overview\* for WP19-3B and the Previous three Scheduled Studies of this Study Type**



\* Evaluation parameters used for the statistical analysis; explanation at the end of report

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## **1 Aim of the Proficiency Test**

This interlaboratory study is a proficiency test for the assessment of laboratory performance. It was conducted in the framework of external quality assurance and the report provides an external appraisal of the participant laboratories' competence in the particular testing field.

## 2 Sample Information

### PE1269-20ML Acidity - WP LRAC1205

Analyte	Unit	Gravimetric Value	PTRL	Study Mean*	Study Std. Dev.*
Acidity, as CaCO <sub>3</sub> 1500	mg/L	1210 ± 6.00	585	1200	24.4

### PE1060-20ML Anions - WP LRAC1178

Analyte	Unit	Gravimetric Value	PTRL	Study Mean*	Study Std. Dev.*
Bromide 1540	mg/L	7.01 ± 0.0400	0.560	7.04	0.505
Chloride 1575	mg/L	105 ± 1.00	29.0	110	6.06
Fluoride 1730	mg/L	1.88 ± 0.0100	0.130	1.75	0.154
Nitrate as N 1810	mg/L	15.2 ± 0.100	0.190	15.2	0.943
Nitrite as N 1840	mg/L	2.01 ± 0.0100	0.280	1.97	0.0912
Sulfate 2000	mg/L	21.5 ± 0.100	2.80	21.5	1.48

### PE1130-20ML Demand - WP LRAB8996

Analyte	Unit	Gravimetric Value	PTRL	Study Mean*	Study Std. Dev.*
5-day BOD 1530	mg/L	123 ± 1.00	4.50	75.5	14.3
Carbonaceous BOD (CBOD) 1555	mg/L	123 ± 1.00	3.70	70.6	16.0
Chemical oxygen demand (COD) 1565	mg/L	126 ± 1.00	17.0	126	8.43

### MIC003-2EA E. coli in Water - Quantitative WP LRAC3154

Analyte	Unit	Gravimetric Value	PTRL	Study Mean*	Study Std. Dev.*
Total Coliform, MPN 2500	MPN/100 mL	252 ± 37.1	2.00	117	74.3

\* If there are not enough data available to provide Study mean and Study Std. Dev, this is indicated by "---".

Analyte	Unit	Gravimetric Value	PTRL	Study Mean*	Study Std. Dev.*
Escherichia coli, MPN 2525	MPN/100 mL	252 ± 37.1	2.00	118	70.1
Fecal coliform, MPN 2530	MPN/100 mL	252 ± 37.1	2.00	78.8	61.6

**PE1041-1KT Minerals - WP  
LRAC1170\***

Analyte	Unit	Gravimetric Value	PTRL	Study Mean*	Study Std. Dev.*
Alkalinity as CaCO <sub>3</sub> 1505	mg/L	117 ± 0.600	20.0	119	4.66
Specific conductance, Conductivity (25°C) 1610	µmhos/cm	717 ± 2.10	180	715	17.0

**PE1083-2ML Oil & Grease - WP  
LRAC1177**

Analyte	Unit	Gravimetric Value	PTRL	Study Mean*	Study Std. Dev.*
n-Hexane Extractable Material (O&G) 1803	mg/L	61.2 ± 0.400	8.80	54.5	7.55
Silica Gel Treated n-Hexane Extractable Material (Non-polar Material) 6142	mg/L	30.7 ± 0.500	---	27.8	5.51

**PE1210-100ML pH - WP - 100ML  
LRAC0859**

Analyte	Unit	Gravimetric Value	PTRL	Study Mean*	Study Std. Dev.*
pH 1900	Units	7.90	---	7.78	0.0563

**PE3050-500ML Residue - WP  
LRAC1929**

Analyte	Unit	Gravimetric Value	PTRL	Study Mean*	Study Std. Dev.*
Total Dissolved Solids at 180°C (TDS) 1955	mg/L	340 ± 74.1	98.0	338	19.8

\* If there are not enough data available to provide Study mean and Study Std. Dev, this is indicated by "---".

Analyte	Unit	Gravimetric Value	PTRL	Study Mean*	Study Std. Dev.*
Total Suspended Solids, Non-Filterable Residue (TSS) 1960	mg/L	51.1 ± 0.261	14.0	46.1	3.21

**PE1065-2ML Total Residual Chlorine - WP LRAC1172**

Analyte	Unit	Gravimetric Value	PTRL	Study Mean*	Study Std. Dev.*
Total residual chlorine 1940	mg/L	1.93 ± 0.0300	0.360	2.01	0.195
Residual free chlorine 1945	mg/L	1.93 ± 0.0300	---	1.95	0.136

**PE1081-20ML Turbidity - WP LRAC2740**

Analyte	Unit	Gravimetric Value	PTRL	Study Mean*	Study Std. Dev.*
Turbidity 2055	NTU	14.2 ± 0.100	1.20	13.6	0.924

\* If there are not enough data available to provide Study mean and Study Std. Dev, this is indicated by "---".

### 3 Data Availability

#### PE1269-20ML Acidity - WP LRAC1205

Analyte	Number of participating laboratories		Number of data points	
	in total	with quantitative data points only*	in total	quantitative only*
Acidity, as CaCO <sub>3</sub> 1500	6	6	6	6

#### PE1060-20ML Anions - WP LRAC1178

Analyte	Number of participating laboratories		Number of data points	
	in total	with quantitative data points only*	in total	quantitative only*
Bromide 1540	13	13	18	18
Chloride 1575	49	49	62	62
Fluoride 1730	32	32	37	37
Nitrate as N 1810	34	34	47	47
Nitrite as N 1840	29	29	41	41
Sulfate 2000	45	45	59	59

#### PE1130-20ML Demand - WP LRAB8996

Analyte	Number of participating laboratories		Number of data points	
	in total	with quantitative data points only*	in total	quantitative only*
5-day BOD 1530	115	115	117	117
Carbonaceous BOD (CBOD) 1555	88	88	89	89
Chemical oxygen demand (COD) 1565	53	53	57	57

\* Only quantitative values are taken into account in the calculation of study mean and study std.dev. (i.e. without missing results, without less-than results, without larger-than results).

**MIC003-2EA E. coli in Water - Quantitative WP  
LRAC3154**

Analyte	Number of participating laboratories		Number of data points	
	in total	with quantitative data points only*	in total	quantitative only*
Total Coliform, MPN 2500	16	16	24	24
Escherichia coli, MPN 2525	18	18	21	21
Fecal coliform, MPN 2530	20	20	25	25

**PE1041-1KT Minerals - WP  
LRAC1170\***

Analyte	Number of participating laboratories		Number of data points	
	in total	with quantitative data points only*	in total	quantitative only*
Alkalinity as CaCO <sub>3</sub> 1505	45	45	49	49
Specific conductance, Conductivity (25°C) 1610	42	42	48	48

**PE1083-2ML Oil & Grease - WP  
LRAC1177**

Analyte	Number of participating laboratories		Number of data points	
	in total	with quantitative data points only*	in total	quantitative only*
n-Hexane Extractable Material (O&G) 1803	73	73	78	78
Silica Gel Treated n-Hexane Extractable Material (Non-polar Material) 6142	24	24	26	26

**PE1210-100ML pH - WP - 100ML  
LRAC0859**

Analyte	Number of participating laboratories		Number of data points	
	in total	with quantitative data points only*	in total	quantitative only*
pH 1900	37	37	41	41

\* Only quantitative values are taken into account in the calculation of study mean and study std.dev. (i.e. without missing results, without less-than results, without larger-than results).

**PE3050-500ML Residue - WP  
LRAC1929**

Analyte	Number of participating laboratories		Number of data points	
	in total	with quantitative data points only*	in total	quantitative only*
Total Dissolved Solids at 180°C (TDS) 1955	53	53	56	56
Total Suspended Solids, Non-Filterable Residue (TSS) 1960	204	204	206	206

**PE1065-2ML Total Residual Chlorine - WP  
LRAC1172**

Analyte	Number of participating laboratories		Number of data points	
	in total	with quantitative data points only*	in total	quantitative only*
Total residual chlorine 1940	140	140	143	143
Residual free chlorine 1945	20	20	22	22

**PE1081-20ML Turbidity - WP  
LRAC2740**

Analyte	Number of participating laboratories		Number of data points	
	in total	with quantitative data points only*	in total	quantitative only*
Turbidity 2055	12	12	13	13

\* Only quantitative values are taken into account in the calculation of study mean and study std.dev. (i.e. without missing results, without less-than results, without larger-than results).

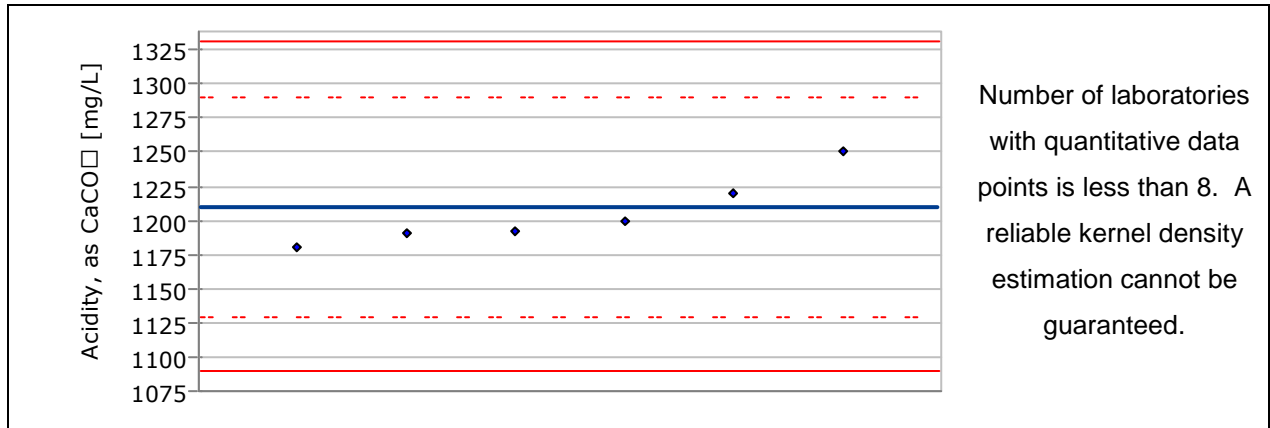


## 4 Results

### 4.1 PE1269-20ML Acidity - WP / LRAC1205

#### 4.1.1 Acidity, as CaCO<sub>3</sub>

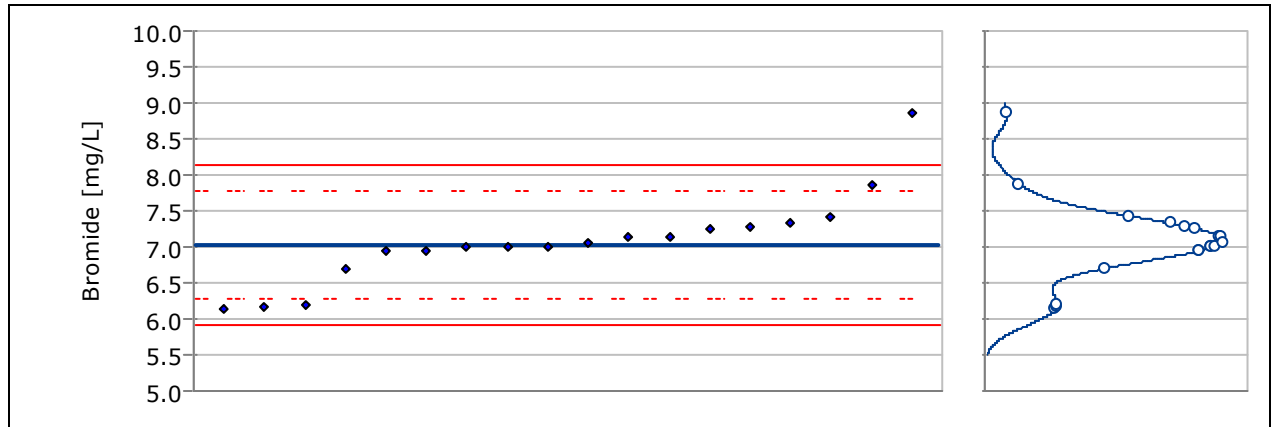
No. of participating laboratories (in total / with quant. data points only)	6 / 6
No. of data points (in total / quantitative)	6 / 6
Assigned value	1210 mg/L
Proficiency std. dev.	40.3 mg/L
Acceptance window	1090 - 1330 mg/L



## 4.2 PE1060-20ML Anions - WP / LRAC1178

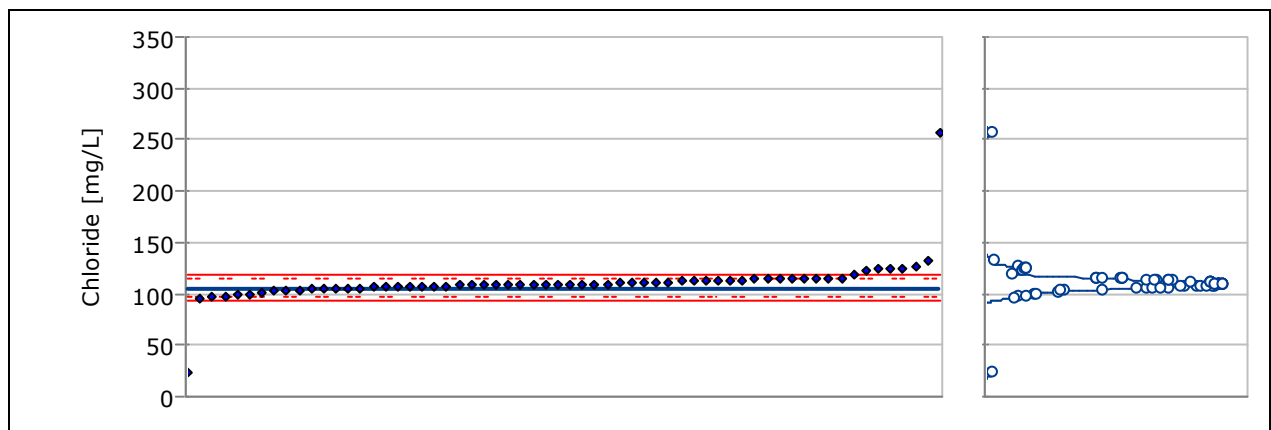
### 4.2.1 Bromide

No. of participating laboratories (in total / with quant. data points only)	13 / 13
No. of data points (in total / quantitative)	18 / 18
Assigned value	7.03 mg/L
Proficiency std. dev.	0.372 mg/L
Acceptance window	5.91 - 8.14 mg/L



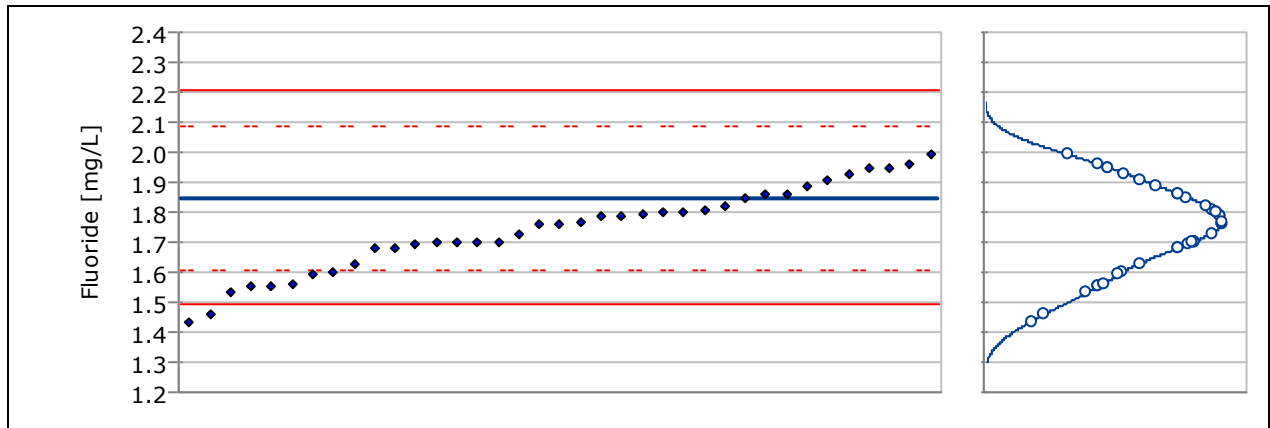
### 4.2.2 Chloride

No. of participating laboratories (in total / with quant. data points only)	49 / 49
No. of data points (in total / quantitative)	62 / 62
Assigned value	106 mg/L
Proficiency std. dev.	4.32 mg/L
Acceptance window	92.6 - 119 mg/L



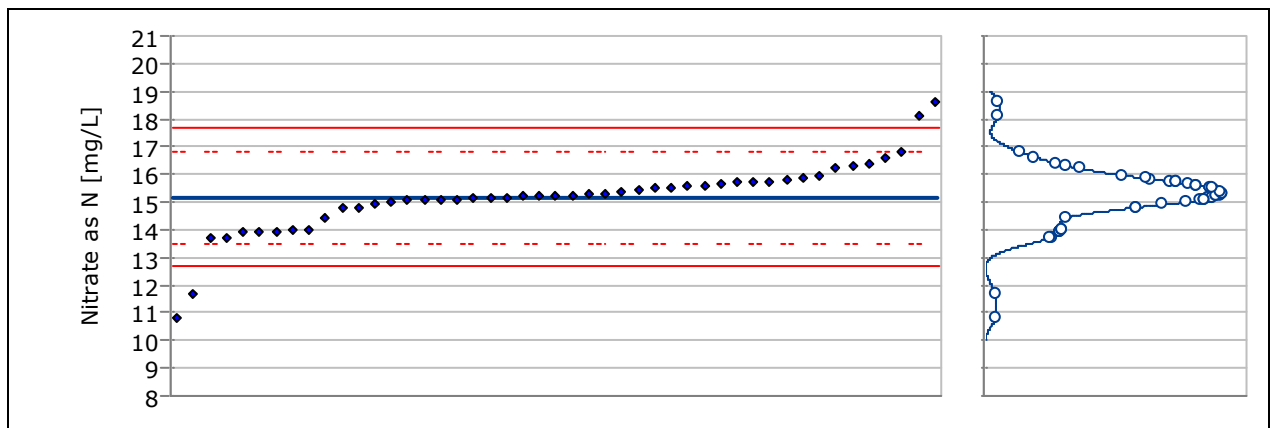
### 4.2.3 Fluoride

No. of participating laboratories (in total / with quant. data points only)	32 / 32
No. of data points (in total / quantitative)	37 / 37
Assigned value	1.85 mg/L
Proficiency std. dev.	0.119 mg/L
Acceptance window	1.49 - 2.21 mg/L



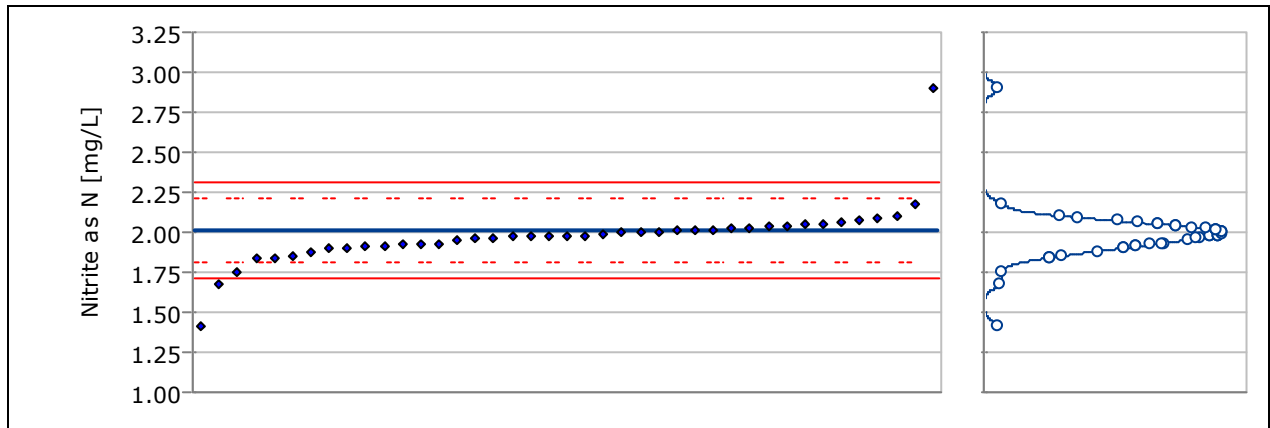
### 4.2.4 Nitrate as N

No. of participating laboratories (in total / with quant. data points only)	34 / 34
No. of data points (in total / quantitative)	47 / 47
Assigned value	15.2 mg/L
Proficiency std. dev.	0.833 mg/L
Acceptance window	12.7 - 17.7 mg/L



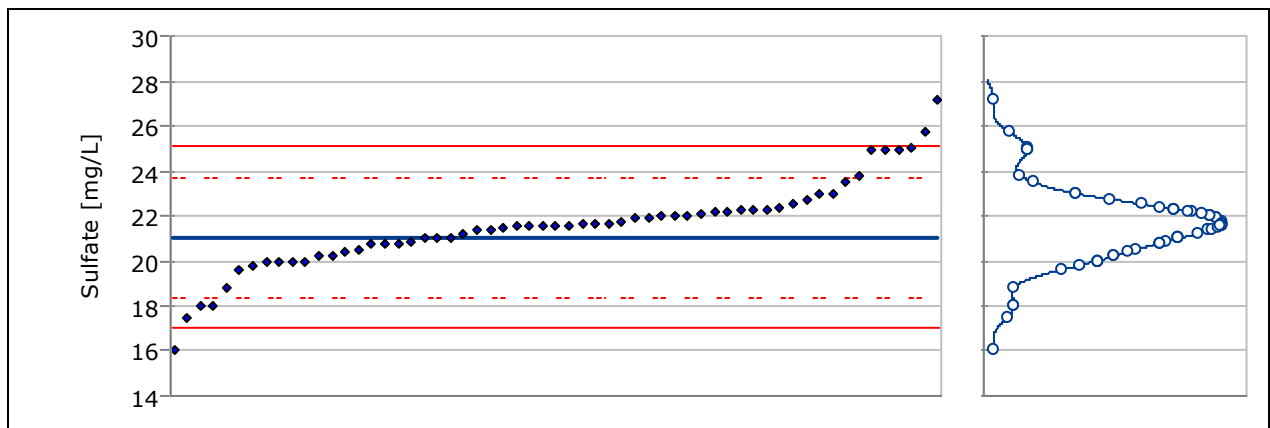
### 4.2.5 Nitrite as N

No. of participating laboratories (in total / with quant. data points only)	29 / 29
No. of data points (in total / quantitative)	41 / 41
Assigned value	2.01 mg/L
Proficiency std. dev.	0.101 mg/L
Acceptance window	1.71 - 2.31 mg/L



### 4.2.6 Sulfate

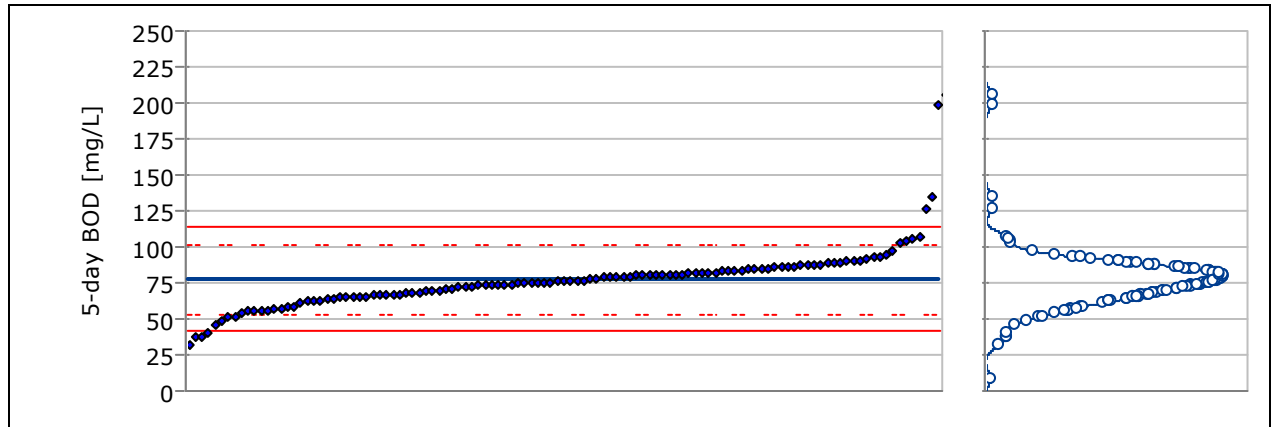
No. of participating laboratories (in total / with quant. data points only)	45 / 45
No. of data points (in total / quantitative)	59 / 59
Assigned value	21.0 mg/L
Proficiency std. dev.	1.35 mg/L
Acceptance window	17.0 - 25.1 mg/L



### 4.3 PE1130-20ML Demand - WP / LRAB8996

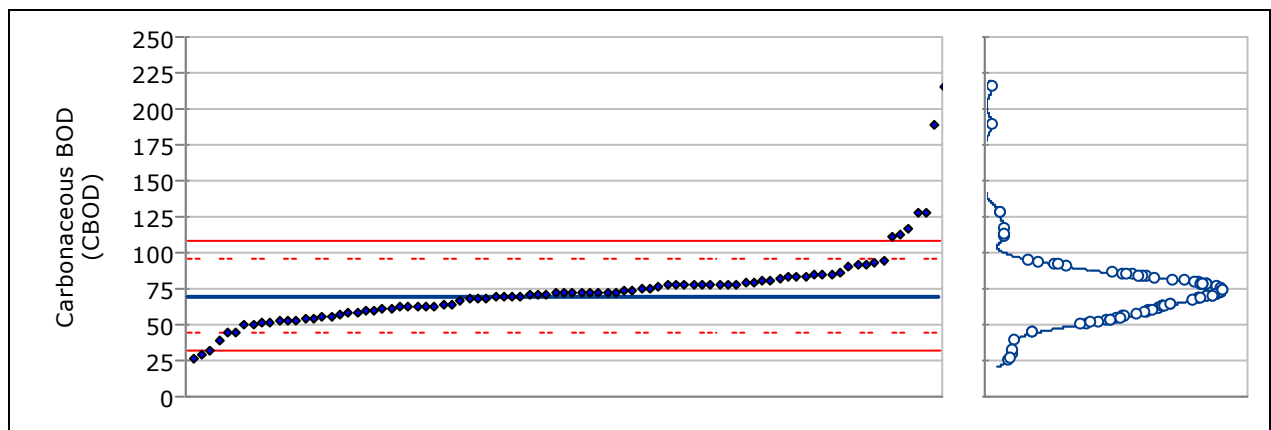
#### 4.3.1 5-day BOD

No. of participating laboratories (in total / with quant. data points only)	115 / 115
No. of data points (in total / quantitative)	117 / 117
Assigned value	77.4 mg/L
Proficiency std. dev.	12.1 mg/L
Acceptance window	41.2 - 114 mg/L



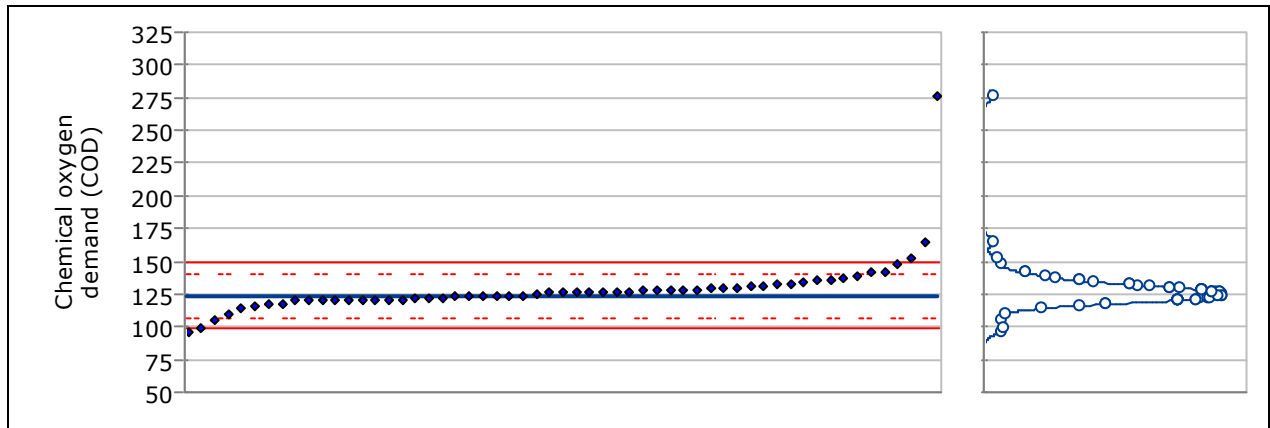
#### 4.3.2 Carbonaceous BOD (CBOD)

No. of participating laboratories (in total / with quant. data points only)	88 / 88
No. of data points (in total / quantitative)	89 / 89
Assigned value	70.1 mg/L
Proficiency std. dev.	12.7 mg/L
Acceptance window	32.1 - 108 mg/L



### 4.3.3 Chemical oxygen demand (COD)

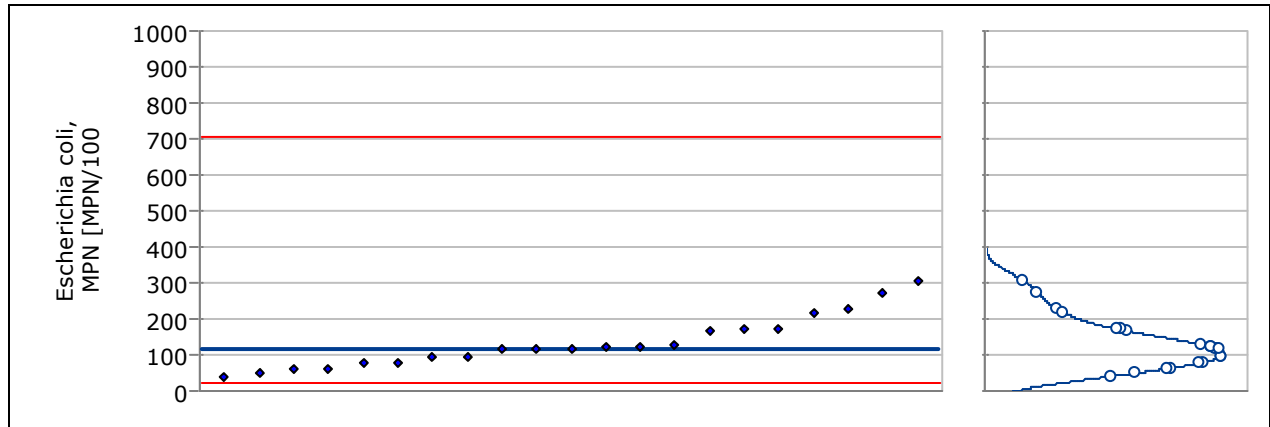
No. of participating laboratories (in total / with quant. data points only)	53 / 53
No. of data points (in total / quantitative)	57 / 57
Assigned value	124 mg/L
Proficiency std. dev.	8.46 mg/L
Acceptance window	98.3 - 149 mg/L



## 4.4 MIC003-2EA E. coli in Water - Quantitative WP / LRAC3154

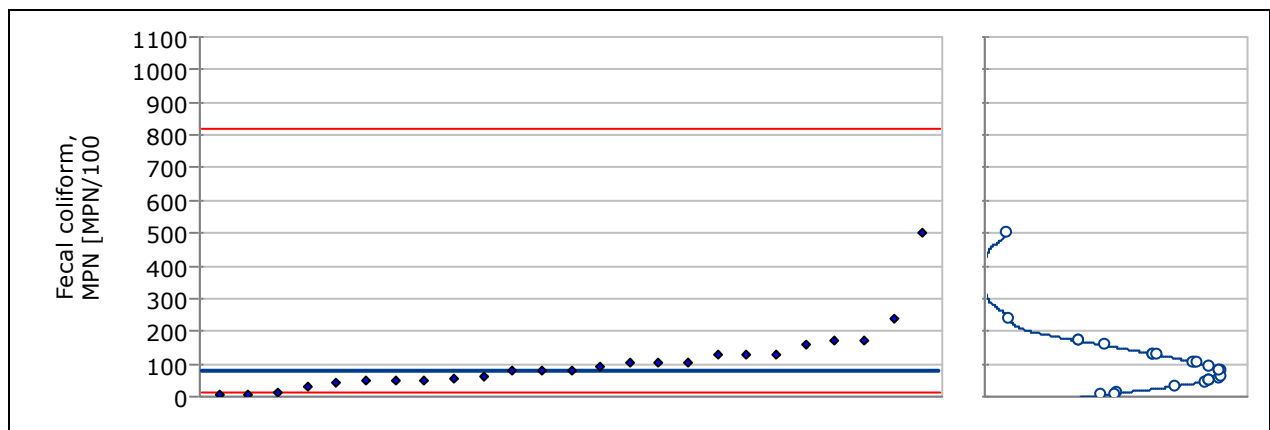
### 4.4.1 Escherichia coli, MPN

No. of participating laboratories (in total / with quant. data points only)	18 / 18
No. of data points (in total / quantitative)	21 / 21
Assigned value	118 MPN/100 mL
Proficiency std. dev.	70.1 MPN/100 mL
Acceptance window	19.7 - 703 MPN/100 mL



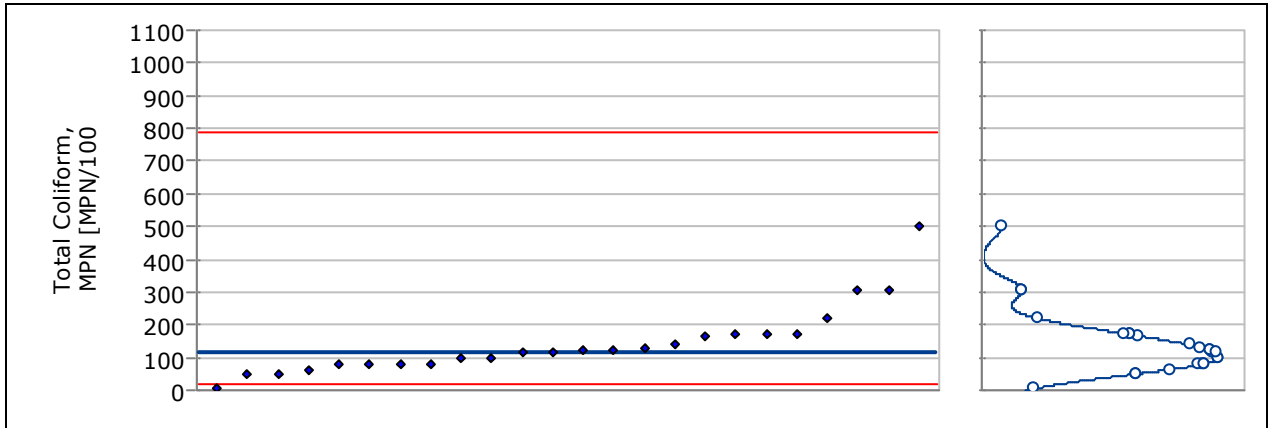
### 4.4.2 Fecal coliform, MPN

No. of participating laboratories (in total / with quant. data points only)	20 / 20
No. of data points (in total / quantitative)	25 / 25
Assigned value	78.8 MPN/100 mL
Proficiency std. dev.	61.6 MPN/100 mL
Acceptance window	7.57 - 822 MPN/100 mL



### 4.4.3 Total Coliform, MPN

No. of participating laboratories (in total / with quant. data points only)	16 / 16
No. of data points (in total / quantitative)	24 / 24
Assigned value	117 MPN/100 mL
Proficiency std. dev.	74.3 MPN/100 mL
Acceptance window	17.5 - 786 MPN/100 mL

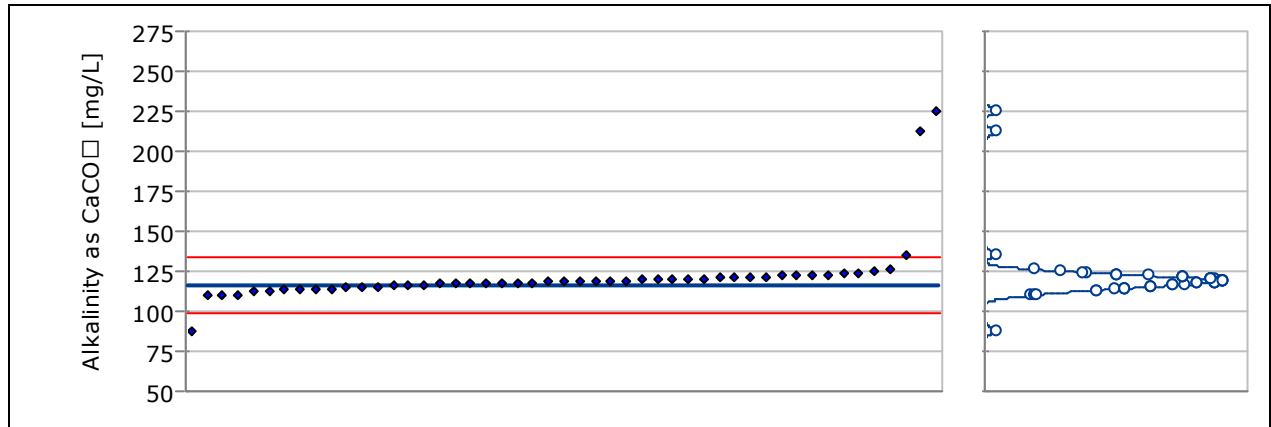




## 4.5 PE1041-1KT Minerals - WP / LRAC1170\*

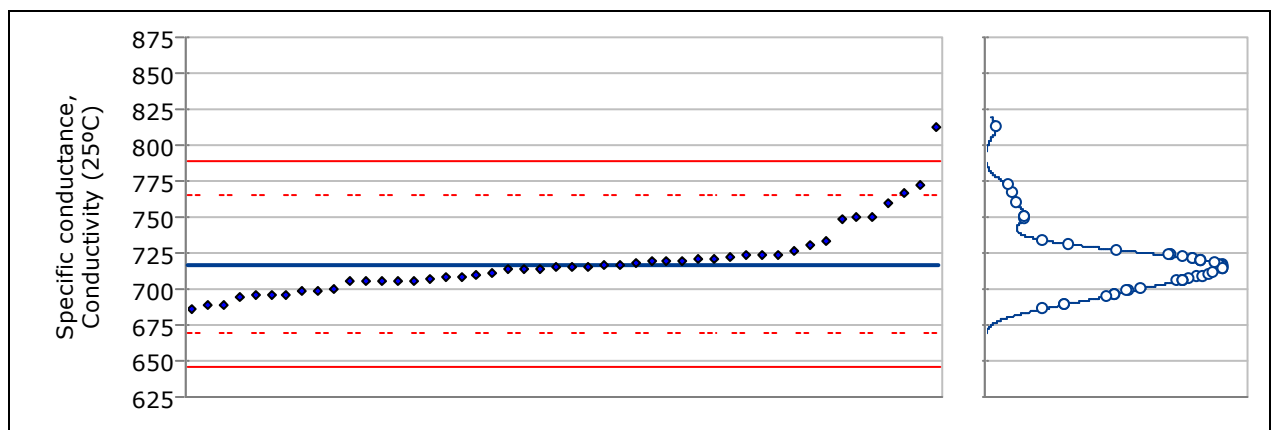
### 4.5.1 Alkalinity as CaCO<sub>3</sub>

No. of participating laboratories (in total / with quant. data points only)	45 / 45
No. of data points (in total / quantitative)	49 / 49
Assigned value	117 mg/L
Proficiency std. dev.	5.84 mg/L
Acceptance window	99.2 - 134 mg/L



### 4.5.2 Specific conductance, Conductivity (25°C)

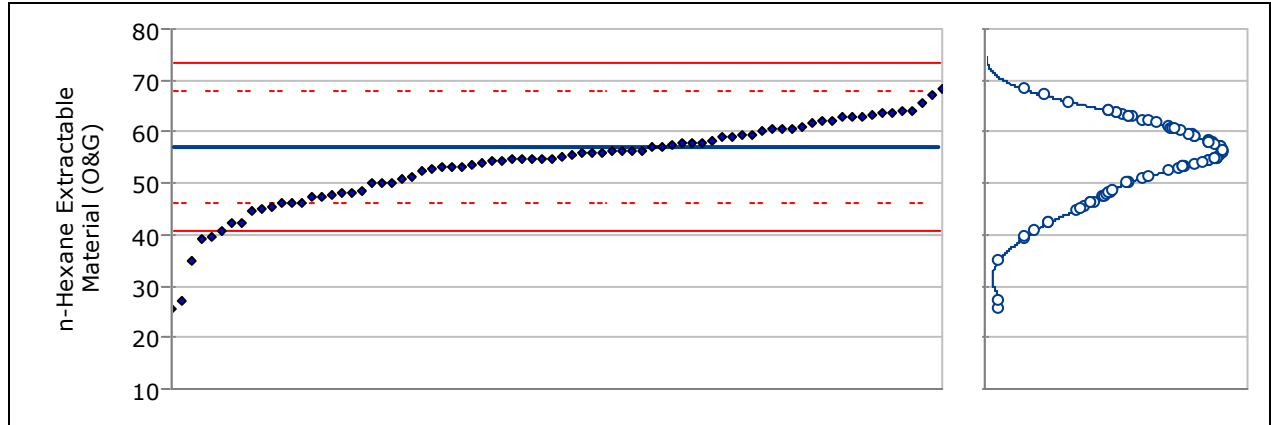
No. of participating laboratories (in total / with quant. data points only)	42 / 42
No. of data points (in total / quantitative)	48 / 48
Assigned value	717 µmhos/cm
Proficiency std. dev.	23.9 µmhos/cm
Acceptance window	645 - 789 µmhos/cm



## 4.6 PE1083-2ML Oil & Grease - WP / LRAC1177

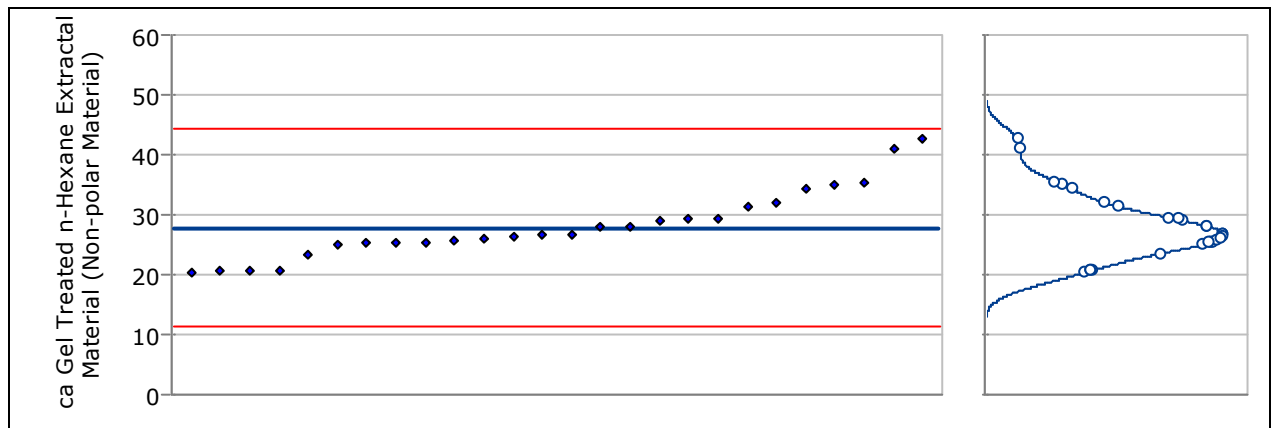
### 4.6.1 n-Hexane Extractable Material (O&G)

No. of participating laboratories (in total / with quant. data points only)	73 / 73
No. of data points (in total / quantitative)	78 / 78
Assigned value	57.1 mg/L
Proficiency std. dev.	5.41 mg/L
Acceptance window	40.9 - 73.4 mg/L



### 4.6.2 Silica Gel Treated n-Hexane Extractable Material (Non-polar Material)

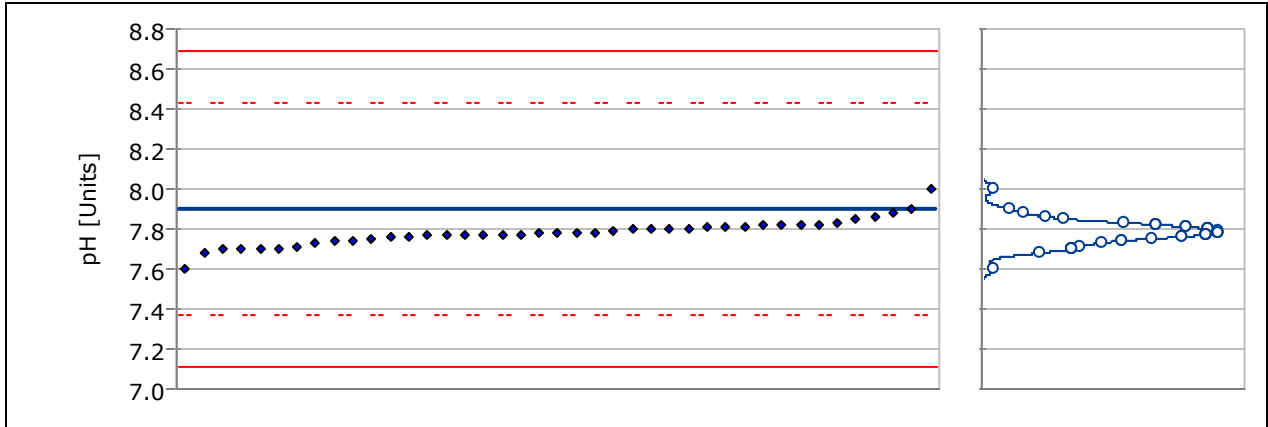
No. of participating laboratories (in total / with quant. data points only)	24 / 24
No. of data points (in total / quantitative)	26 / 26
Assigned value	27.8 mg/L
Proficiency std. dev.	5.51 mg/L
Acceptance window	11.3 - 44.3 mg/L



## 4.7 PE1210-100ML pH - WP - 100ML / LRAC0859

### 4.7.1 pH

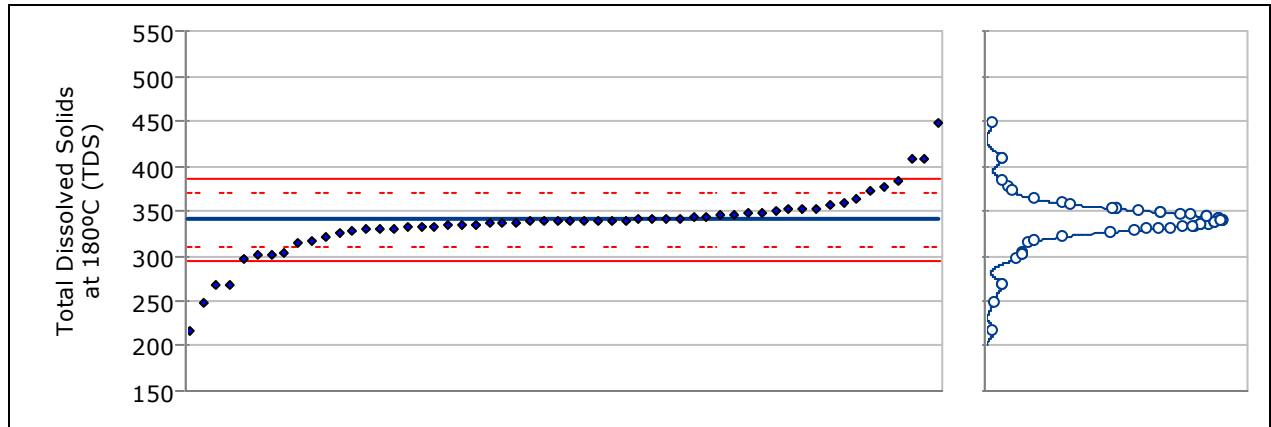
No. of participating laboratories (in total / with quant. data points only)	37 / 37
No. of data points (in total / quantitative)	41 / 41
Assigned value	7.90 Units
Proficiency std. dev.	0.0667 Units
Acceptance window	7.11 - 8.69 Units



## 4.8 PE3050-500ML Residue - WP / LRAC1929

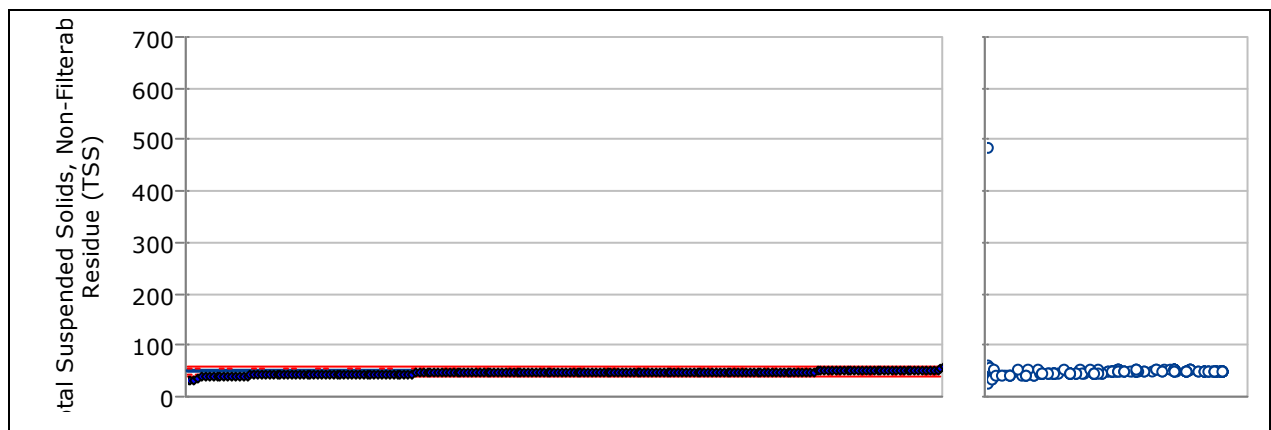
### 4.8.1 Total Dissolved Solids at 180°C (TDS)

No. of participating laboratories (in total / with quant. data points only)	53 / 53
No. of data points (in total / quantitative)	56 / 56
Assigned value	340 mg/L
Proficiency std. dev.	15.0 mg/L
Acceptance window	295 - 385 mg/L



### 4.8.2 Total Suspended Solids, Non-Filterable Residue (TSS)

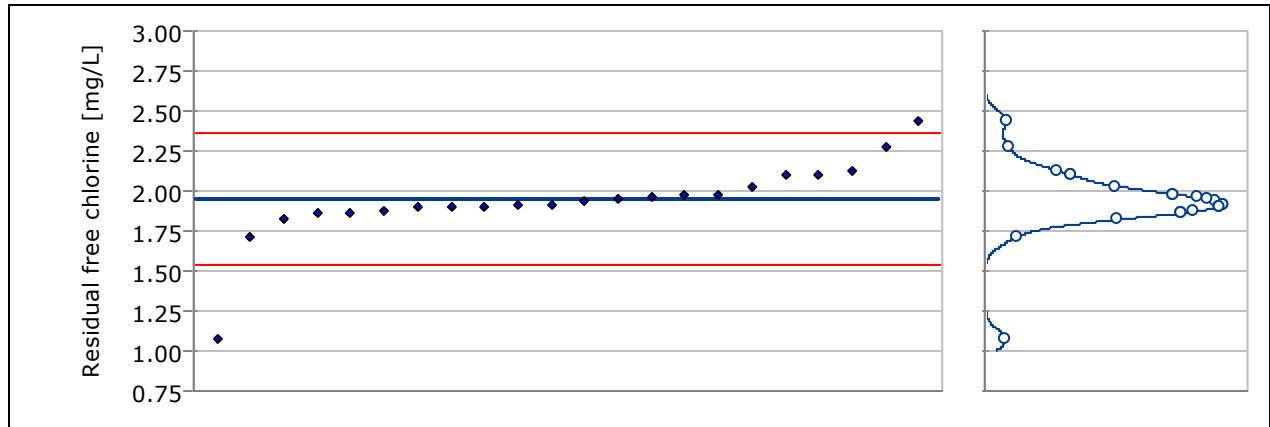
No. of participating laboratories (in total / with quant. data points only)	204 / 204
No. of data points (in total / quantitative)	206 / 206
Assigned value	49.1 mg/L
Proficiency std. dev.	3.11 mg/L
Acceptance window	39.7 - 58.4 mg/L



## 4.9 PE1065-2ML Total Residual Chlorine - WP / LRAC1172

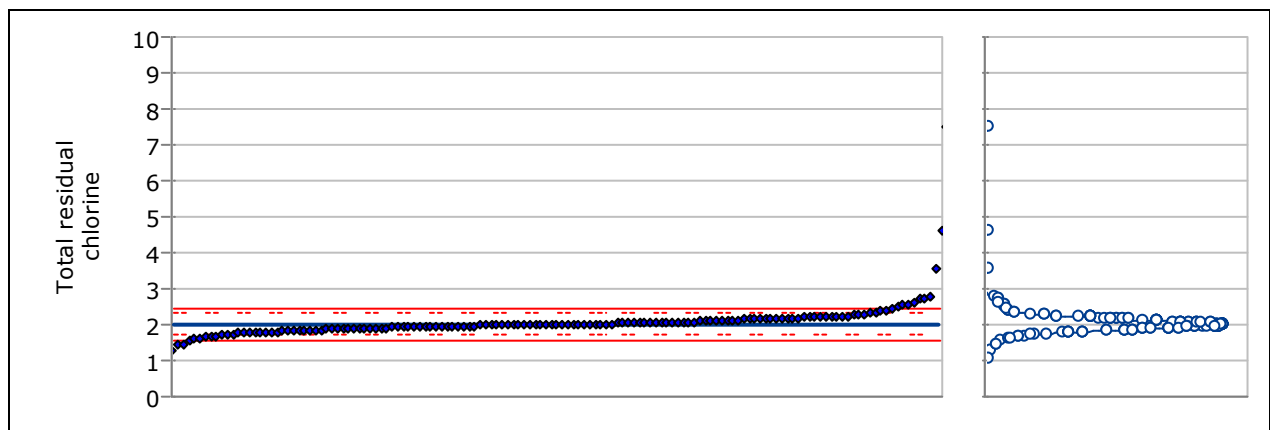
### 4.9.1 Residual free chlorine

No. of participating laboratories (in total / with quant. data points only)	20 / 20
No. of data points (in total / quantitative)	22 / 22
Assigned value	1.95 mg/L
Proficiency std. dev.	0.136 mg/L
Acceptance window	1.54 - 2.36 mg/L



### 4.9.2 Total residual chlorine

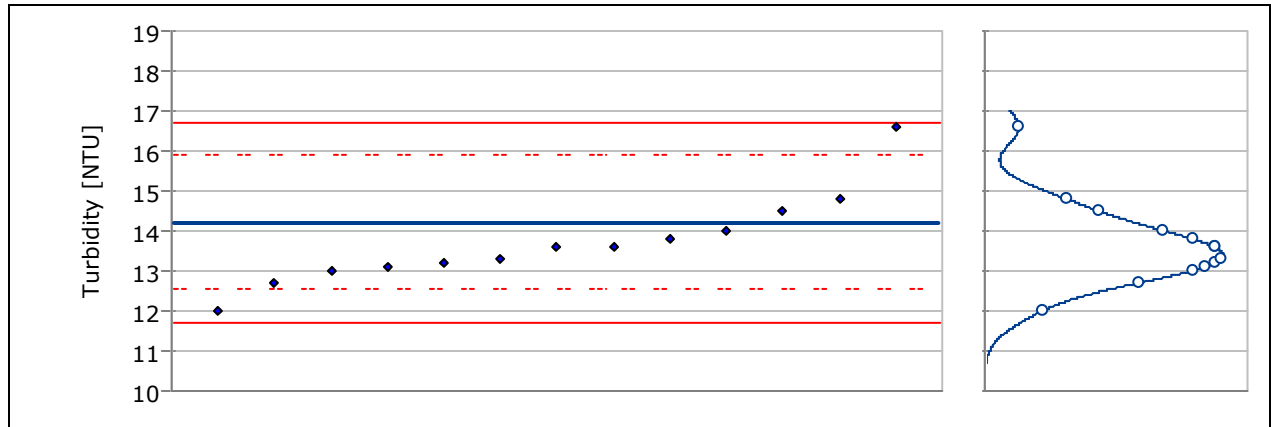
No. of participating laboratories (in total / with quant. data points only)	140 / 140
No. of data points (in total / quantitative)	143 / 143
Assigned value	2.01 mg/L
Proficiency std. dev.	0.146 mg/L
Acceptance window	1.58 - 2.45 mg/L



## 4.10 PE1081-20ML Turbidity - WP / LRAC2740

### 4.10.1 Turbidity

No. of participating laboratories (in total / with quant. data points only)	12 / 12
No. of data points (in total / quantitative)	13 / 13
Assigned value	14.2 NTU
Proficiency std. dev.	0.832 NTU
Acceptance window	11.7 - 16.7 NTU



## 5 Statistical Analysis

### 5.1 Definitions and Interpretation

#### Reported Value

The participant's result.

#### Assigned Value

Value attributed to a particular quantity and accepted, sometimes by convention, as having an uncertainty appropriate for a given purpose. See ISO/IEC 17043 for additional information. In general, the assigned value is the value used to assess proficiency and may or may not be the made to value (gravimetric value).

#### Acceptance Window

The range of values that constitute acceptable performance for a laboratory participating in this PT study.

#### z-score

A z-score shows how a single data point compares to normal data. A z-score says not only whether a point was above or below average, but how unusual the measurement is. Generally, a method result with a z-score less than |2| is considered to be in control and 'Acceptable'; a z-score between |2| and |3| is considered 'Questionable', but still within control and 'Acceptable' and a z-score greater than |3| is considered 'Not Acceptable' and the method is out of control. For WS studies, a z-score greater than |2| is not acceptable.

Calculated as  $z = (\text{Reported Value} - \text{Assigned Value}) / \text{Proficiency Std. Dev.}$

A z-score cannot be provided

- (1) for presence/absence data,
- (2) for identification data and other categorial data,
- (3) where the analyte is not present in the sample,
- (4) for "less than" and "greater than" values,
- (5) NOEC analytes (in the framework of WETT analysis).

In cases (1) to (3) the participant's result is only evaluated by "acceptable" if it matches with the assigned value. Otherwise the result is indicated as "not acceptable". In case the analyte is not present in the sample and a PTRL is available, the participant's result is indicated as "acceptable" as long the result is less than the PTRL.

In case (4) the following evaluation rules will be applied:

- “less than” values:
  - When the analyte is not present in the sample the result is always “acceptable”.
  - When the analyte is truly present in the sample, the result is only “acceptable” if the “less than” value is greater than the lower limit of the acceptance window.
- “greater than” values:
  - When the analyte is not present in the sample the result is always “not acceptable”.
  - When the analyte is truly present in the sample, the result is only “acceptable” if the “greater than” value is less than the upper limit of the acceptance window.

In case (5) the result is indicated as “acceptable” if it lies within the acceptance window, otherwise the result is indicated as “not acceptable”.

#### **Proficiency Std. Dev.**

Standard deviation calculated based on Evaluation Criteria.

#### **PTRL**

Proficiency Testing Reporting Limit

#### **Study Mean**

Statistical study mean calculated using a robust statistical model. Robust statistical techniques are used to minimize the influence extreme results can have on estimates of the mean and standard deviation. NOTE - These techniques assign less weight to extreme results, rather than eliminate them from a data set.

Choice of statistical technique: In case of quantitative data points from at least 8 laboratories, Algorithm A (ISO 13528, Section C.3.1), and in case of quantitative data points of 4 to 7 laboratories, the Hampel estimator (ISO 13528, Section C.5.3) is applied. A study mean cannot be calculated in case there are quantitative data points from less than 4 laboratories available.



### **Study Std. Dev.**

Standard deviation calculated from study data using robust statistics.

In case of quantitative data points from at least 8 laboratories, Algorithm A (ISO 13528, Section C.3.1), and in case of quantitative data points of 4 to 7 laboratories, the Q method (ISO 13528, Section C.5.2) is applied. A study standard deviation cannot be calculated in case there are quantitative data points from less than 4 laboratories available.

### **Gravimetric Value**

The 'prepared to' value, determined by gravimetric means. The uncertainty associated with this value is the standard uncertainty and based on Sigma-Aldrich RTC's gravimetric tolerances.

### **Analytical Value**

The measured value, determined after preparation. The uncertainty associated to this value is the standard uncertainty and based on the measurement process.

## 5.2 Evaluation Criteria

### 1 - Regression Equation

Acceptance windows based on TNI adopted equation of proficiency value  $\pm 3$  proficiency standard deviations and check limits of proficiency value  $\pm 2$  proficiency standard deviations. Proficiency value and proficiency standard deviation are calculated from gravimetric variables a, b, c & d as proficiency value =  $a * \text{gravimetric} + b$  and proficiency standard deviation =  $c * \text{gravimetric} + d$ .

### 2 - Study Robust Mean and c, d regression

Acceptance windows based on TNI adopted equation of proficiency value  $\pm 3$  proficiency standard deviations and check limits of proficiency value  $\pm 2$  proficiency standard deviations. Proficiency value and proficiency standard deviation calculated from robust study mean and variables c & d as proficiency value = robust mean and proficiency standard deviation =  $c * \text{proficiency value} + d$ .

### 3 - Fixed Limits

Acceptance windows based on span of gravimetric percentage from gravimetric as  $\text{gravimetric} \pm \text{gravimetric} * \text{percentage}$ .

### 4 - Adjustable Fixed Limits

Acceptance windows based on a span of gravimetric percentage from gravimetric as  $\text{gravimetric} \pm \text{gravimetric} * \text{lowPercentage}$  where  $\text{gravimetric} < \text{break}$  and  $\text{gravimetric} \pm \text{gravimetric} * \text{highPercentage}$  where  $\text{gravimetric} \geq \text{break}$ .

### 5 - Study Statistics

Acceptance windows based on a number of standard deviations span from the study mean as  $\text{study mean} \pm (\text{deviations} * \text{standard deviation})$ .

### 6 - Log Transform Statistics

Acceptance windows based on lognormal distributed data. Acceptance windows =  $\text{mean}(\text{lognormal}) \pm \text{span} * \text{standard deviation}(\text{lognormal})$ .

### 7 - Regression Equation 2SD

Acceptance windows based on EPA equation of proficiency value  $\pm 2$  proficiency standard deviations. Proficiency value and proficiency standard deviation are calculated from gravimetric variables a, b, c & d as proficiency value =  $a * \text{gravimetric} + b$  and proficiency standard deviation =  $c * \text{gravimetric} + d$ . Generally reserved for drinking water studies.

### 8 - Study Median and Dilution Levels

Acceptance windows based on study median  $\pm 1$  dilution. If the median falls between two test dilutions, then the assigned value is set at the higher value, and the lower acceptance limit is the second test dilution below the median, and the upper acceptance limit is the second test dilution above the median. Generally reserved for NOEC analytes (in the framework of WETT analysis).

### 9 - Fixed Limits based on Analytical Value

Acceptance windows based on span of analytical value from measurements.

## 6 Notes on the Interpretation of the Results

### z score Overview

The z-scores are presented as colored triangles. For each item, the z-scores of all analytes of the current and the previous (up to three) scheduled studies of this study type. The z-scores depend on the lot, analytical method used, and analyst (if given). A red cross is shown if no z-score is available.

For the assessment of participants by means of z-scores according to ISO/IEC 17043:2010 [2], the triangles were colored as follows:

$ z  \leq 2$	green
$2 <  z  < 3$	yellow (WS studies, WETT samples: red)
$ z  \geq 3$	red.

For  $|z| \geq 3$ , the corresponding triangles are displayed as -3 or 3. For  $|z| > 2$ , the value of the z score is displayed next to the triangle (yellow or red). A z-score = 0 is shown as a light blue vertical bar.

#### Interpretation of the z-scores' overview:

A z-score  $< 0$ , i.e. the triangle points to the left, means that the measurement result is lower than the assigned value.

A z-score  $> 0$ , i.e. the triangle points to the right, means that the measurement result is higher than the assigned value.

A z-score = 0, i.e. a light blue vertical bar is shown, means that the measurement result coincides with the assigned value.

### Figures per Combination of Item, Lot and Analyte

The *diagram on the left* shows the participant results by means of blue diamonds.

The horizontal blue line indicates the assigned value.

Both the acceptance and the check limits for the participant results are calculated based on z-scores.

The acceptance limits are displayed as solid lines and correspond to z-scores of  $\pm 3$ . For WS studies and non-NOEC analytes (in the framework of WETT analysis), the acceptance limits correspond to a z-score  $\pm 2$ . For NOEC analytes (in the framework of WETT analysis), the acceptance limits correspond to  $\pm 1$  dilution.

The check limits are displayed as dashed lines and correspond to z-scores of  $\pm 2$ . They are only calculated if a rule is given by the evaluation criterion.

In case there are at least 8 laboratories with quantitative data points are available: The *diagram on the right* is a kernel density estimation of the distribution of the participant results. The measurement values are indicated as small circles. The kernel width is determined by the ISO 13528 formula from section 10.3.2 i) a).

## 7 Proficiency Test Item Preparation, Homogeneity and Stability Assessment

Sigma-Aldrich RTC uses proprietary and published methods for the manufacture, homogeneity and stability testing of proficiency test items. Sigma-Aldrich RTC's proficiency test materials meet the requirements of ISO 17034. For more information contact Sigma-Aldrich RTC. Additionally, Sigma-Aldrich RTC complies with the TNI Volume 3 'General Requirements for Environmental Proficiency Test Providers', EL-V3-2009, 2009 for all TNI Fields of Proficiency Testing analytes.

## 8 Metrological Traceability

All preparations are made using balances calibrated annually traceable to NIST standards. Where appropriate analytical measurements are traceable through an unbroken chain to NIST standards, or a Certified Reference Material manufactured under ISO 17034 in conjunction with ISO/IEC 17025.

## 9 Additional Information

Go to [merck-pt.com](http://merck-pt.com) for additional information on summary statistics for specific methods, advice on the interpretation of the statistical analysis and additional comments/recommendations. Sigma-Aldrich RTC recommends that you contact your accreditation body for specific instruction.

## 10 References

- [1] ISO 13528: Statistical methods for use in proficiency testing by interlaboratory comparison, August 2015
- [2] ISO/IEC 17025:2017: General requirements for the competence of testing and calibration laboratories
- [3] ISO/IEC 17043:2010: Conformity assessment - General requirements for proficiency testing, May 2010
- [4] S. Uhlig und P. Henschel (1997): Limits of tolerance and z-scores in ring tests. Fresenius' J. Anal. Chem., Vol. 358, pp. 761-766.
- [5] ISO 17034:2016: General requirements for the competence of reference material producers.

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