

Reports of the Finnish Environment Institute 1 | 2024

Proficiency test 09/2023

Drinking water analyses

Päivi Grönroos, Riitta Koivikko, Mika Sarkkinen, Timo Sara-Aho,
Keijo Tervonen, Sari Lanteri, Ritva Väisänen and Markku Ilmakunnas

Suomen ympäristökeskus
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Abstract

Proficiency test 09/2023: Drinking water analyses

Proftest Syke carried out the proficiency test (PT) for laboratories conducting drinking water analyses in September 2023. Synthetic samples, as well as drinking water and raw water samples were provided for the participants. In total, there were 42 participants in the PT. Either the calculated concentration or the robust mean of the reported results was used as the assigned values for the measurands. The overall performance of the participants was evaluated by using z scores. In this PT 87 % of the results were satisfactory when total deviation of 0.2 pH units for pH values and 5–40 % for the other measurands was accepted from the assigned value. Warm thanks to all participants in this proficiency test!

Keywords: water analysis, alkalinity, Ca, Cl, conductivity, F, Fe, K, Mg, Mn, Na, NH_4, NO_2, NO_3, pH, SO_4, TOC, turbidity, water and environmental laboratories, proficiency test, interlaboratory comparison

Tiivistelmä

Pätevyyskoe 09/2023: Talousvesimääritykset

Proftest Syke järjesti syyskuussa 2023 pätevyyskokeen talousvesiä analysoiville laboratorioille synteettisistä vesinäytteistä sekä talous- ja raakavesinäytteistä. Pätevyyskokeeseen osallistui yhteensä 42 laboratoriota. Testisuureiden vertailuarvoina käytettiin joko laskennallista pitoisuutta tai osallistujien tulosten robustia keskiarvoa. Osallistujien pätevyyden arviointi tehtiin z-arvojen avulla. Koko tulosaineistossa oli 87 % hyväksyttäviä tuloksia, kun vertailuarvosta sallittiin pH-määrityksissä 0,2 pH-yksikön ja muissa määrityksissä 5–40 %:n poikkeama. Kiitos pätevyyskokeen osallistujille!

Asiasanat: vesianalyysi, alkaliniteetti, Ca, Cl, F, Fe, K, Mg, Mn, Na, NH_4, NO_2, NO_3, pH, SO_4, sähkönjohtavuus, TOC, sameus, vesi- ja ympäristölaboratoriot, pätevyyskoe, laboratorioiden välinen vertailumittaus

Sammandrag

Kompetensprövning 09/2023: Hushållvattenanalyser

Under september 2023 genomförde Proftest Syke en kompetensprövning för olika analyter i hushållsvatten och råvatten. Denna kompetensprövning hade totalt 42 deltagarna. Som referensvärde av analytens koncentration användes antingen det teoretiska värdet eller robust medelvärdet av deltagarnas resultat. Resultaten värderades med hjälp av z-värden. I denna kompetensprövning var 87 % av resultaten acceptabla. Resultatet var acceptabelt, om det devierade mindre än 0,2 pH enhet eller 5–40 % från referensvärdet. Ett varmt tack till alla deltagarna i testet!

Nyckelord: vattenanalyser, alkalinitet, Ca, Cl, F, Fe, K, ledningsförmåga, Mg, Mn, Na, NH_4, NO_2, NO_3, pH, SO_4, TOC, turbiditet, kompetensprovning, vatten- och miljölaboratorier, jämförelse mellan laboratorier

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1 Introduction

Proftest Syke carried out the proficiency test (PT) for analysis of alkalinity, Ca, K, Mg, Na, chloride, sulphate, fluoride, Fe, Mn, NH_4, NO_2, NO_3, pH, turbidity, conductivity, and TOC in synthetic samples and in drinking water as well as raw water samples in September 2023 (DW 09/2023).

Finnish Environment Institute (Syke) is appointed National Reference Laboratory in the environmental sector in Finland. The duties of the reference laboratory include providing interlaboratory proficiency tests and other comparisons for analytical laboratories and other producers of environmental information. This proficiency test has been carried out under the scope of the Syke reference laboratory and it provides an external quality evaluation between laboratory results, and mutual comparability of analytical reliability. The proficiency test was carried out in accordance with the international standard ISO/IEC 17043 [1] and applying ISO 13528 [2] and IUPAC Technical report [3]. Proftest Syke is accredited by the Finnish Accreditation Service as a proficiency testing provider (PT01, ISO/IEC 17043, finas.fi/sites/en). The organizing of this proficiency test is included in the accreditation scope of Proftest Syke.

2 Organizing the proficiency test

2.1 Responsibilities

Organizer

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The responsibilities in organizing the proficiency test

Päivi Grönroos	coordinator
Riitta Koivikko	substitute for coordinator
Keijo Tervonen	technical assistance
Markku Ilmakunnas	technical assistance
Sari Lanteri	technical assistance
Ritva Väisänen	technical assistance

Analytical experts

Mika Sarkkinen	Alkalinity, Cl, F, SO_4, pH, conductivity, NH_4, NO_2, NO_3, turbidity, TOC
Timo Sara-Aho	Fe, Mn, Ca, K, Mg, Na

Expert laboratory Syke, Helsinki and Oulu (T003, finas.fi/sites/en)

2.2 Participants

In total 42 laboratories participated in this PT (Appendix 1), 38 from Finland and 4 from abroad. 76 % of the participants have accredited quality management system based on ISO/IEC 17025 and 14 % have quality management system based on ISO 9000. Altogether 71 % of the participants used accredited analytical methods at least for a part of the measurements. For this PT, the expert laboratory has codes 13 (Syke, Helsinki) and 42 (Syke, Oulu) in the result tables.

2.3 Samples and delivery

Three types of samples were delivered to the participants: synthetic samples and drinking water as well as raw water samples for analysis of alkalinity, Ca, Cl, conductivity, F, Fe, K, Mg, Mn, Na, NH_4, NO_2, NO_3, pH, SO_4, TOC, and turbidity.

When preparing the samples, the cleanness of the used sample vessels was controlled. The randomly chosen sample vessels were filled with deionized water and the cleanness of the sample vessels was controlled after three days by analyzing TOC, Fe, NH_4, or conductivity. According to the test results all used vessels fulfilled the cleanness requirements.

The synthetic samples for alkalinity, NO_2, NO_3, NH_4, F, Fe, Mn, Na, K, Ca, Mg, Cl, SO_4, and TOC analysis were prepared by diluting from the traceable reference solutions produced by Supelco or by Merck. The drinking water sample was tap water from Kirkkonummi, Southern Finland and the raw water sample was well water collected from Tuusula, Southern Finland. Additions of single element standard solutions were done to the samples when needed. The sample preparation is described in more detail in Appendix 2.

The samples were delivered mainly on 11 September 2023 to the participants abroad and mainly on 12 September 2023 to the national participants. The samples arrived to the participants mainly on 13 September 2023, one participant received the samples on 14 September 2023 and one on 15 September 2023.

The samples were to be measured as follows:

Alkalinity, pH, conductivity, turbidity	14 September 2023
N compounds	at the latest on 15 September 2023
Ca, K, Mg, Na	at the latest on 22 September 2023
Cl, F, SO_4	at the latest on 22 September 2023
Fe, Mn	at the latest on 22 September 2023
TOC	at the latest on 22 September 2023

The results were requested to be reported at the latest on 25 September 2023. Participants delivered the results mainly accordingly, one participant delivered the results on 27 September 2023. The preliminary results report was delivered to the participants via ProftestWEB and email on 6 October 2023.

2.4 Homogeneity and stability studies

The homogeneity of the samples was tested by analyzing alkalinity, Cl, conductivity, N_{NH4}, N_{No3}, F, Fe, Na, pH, turbidity, and TOC. More detailed information of homogeneity test is shown in Appendix 3. According to the homogeneity test results, all samples were considered homogenous.

The temperature control sample was placed into the sample package and the temperature was requested to be measured immediately after opening the package. The temperature of the control sample was mainly ≤ 14 °C, and the highest reported temperature was 18.5 °C. It is crucial to measure the temperature of the control sample right after the sample package arrival.

The stability of the samples was tested by analysing alkalinity, pH, and N_{NH4} from the samples stored at the room temperature for one day. The measurement values were checked against the results of the samples stored at 4 °C. According to the test all samples were considered as stable (Appendix 4). Based on the stability test the possible increase of the sample temperature during the transportation did not affect the performance of the participants. Based on the literature and previous experience, other measurands are known to be stable over the given time period for the test.

2.5 Feedback from the proficiency test

The feedback from the proficiency test is shown in Appendix 5. The comments from the participants mainly dealt with delivered samples and their results reporting. The comment from the provider focused on the missing sample arrival documents and measurement uncertainty reporting. All the feedback from the proficiency test is valuable and is exploited when improving the activities.

2.6 **Processing the data**

2.6.1 Pretesting the data

To test the normality of the data the Kolmogorov-Smirnov test was applied. The outliers were rejected according to the Hampel or the Grubbs test before calculating the mean. The results which differed from the data more than $5 \times s_{rob}$ or 50 % from the robust mean, were rejected before the statistical results handling. If the result has been reported as below detection limit, it has not been included in the statistical calculations.

More information about the statistical handling of the data is available from the Guide for participant [4].

2.6.2 Assigned values

The calculated values were used as the assigned values for the synthetic samples prepared from the traceable reference solutions (alkalinity, Ca, Cl, F, Fe, K, Mg, Mn, Na, NH_4, SO_4, and TOC). For the other samples and measurands the robust mean of the results reported by the participants was used as the assigned value. Detailed information of the assigned values, their uncertainties and reliability is shown in Appendix 6.

The assigned values based on the robust mean are not metrologically traceable values. As it was not possible to have metrologically traceable assigned values, the best available values were selected to be used as the assigned values. The reliability of the assigned values was statistically tested [2, 3].

For the calculated assigned values, the expanded uncertainty (k=2) was evaluated by using standard uncertainties associated with individual operations involved in the preparation of the sample. The main individual source of the uncertainty was the purity of the stock compound. When the robust mean of the results reported by the participants was used as the assigned value, the uncertainty was calculated using the robust standard deviation or the standard deviation [2, 4].

The uncertainty of the calculated assigned values was 0.3–1.2 % (at the 95 % confidence level). When using the robust mean of the participant results as the assigned value, the uncertainties of the assigned values varied between 0.4 % and 14 % (Appendix 6). **After reporting the preliminary results report no changes have been made for the assigned values.**

2.6.3 Proficiency assessment procedure

The results of this proficiency test were evaluated with the z scores. The standard deviation for proficiency assessment was estimated based on the measurand concentration, the results of homogeneity and stability tests, the uncertainty of the assigned value, and the long-term variation in the former proficiency tests. The standard deviation for proficiency assessment ($2 \times s_{pt}$ at the 95 % confidence level) was set for pH measurements to 0.2 pH units and for the other measurements from 5 % to 40 % depending on the measurands. **After reporting the preliminary results report no changes have been made for the standard deviations of the proficiency assessment values.**

When using the robust mean as the assigned value, the reliability was tested according to the criterion $u_{pt} / s_{pt} \leq 0.3$, where u_{pt} is the standard uncertainty of the assigned value and s_{pt} is the standard deviation for proficiency assessment [2, 3]. When testing the reliability of the assigned value,

the criterion was fulfilled, except for the measurand turbidity of sample D2S, and the assigned values were considered reliable (Table 1).

The reliability of the standard deviation for proficiency assessment (s_{pt}) and the corresponding z score was estimated by comparing s_{pt} with the robust standard deviation (s_{rob}) of the reported results (the criterion) [3]. The uniformity criterion $s_{rob} / s_{pt} \leq 1.2$ was fulfilled (Table 1).

Table 1. Uncertainty of the performance evaluation: deviations from the criteria when evaluating the results.

Sample	Measurand	Reliability of the assigned value	Uniformity criterion
D2S	Turbidity	x	

3 Results and conclusions

3.1 Results

The summary of the results is presented in Table 2. The terms in the results table are explained in Appendix 7. The results and the performance of each participant are presented in Appendix 8 and the reported results with their expanded uncertainties (k=2) are presented in Appendix 9. The summary of the z scores is shown in Appendix 10 and z scores in the ascending order in Appendix 11.

The robust standard deviations of the results varied from 0.6 to 22 % (Table 2). The robust standard deviation was lower than 5 % for 65 % of the results. The robust standard deviations were approximately in the same range as in the previous similar proficiency test DW 08/2021, where the deviations varied from 0.5 % to 26 % [5].

Table 2. The summary of the results in the proficiency test DW 09/2023.

Measurand	Sample	Unit	Assigned value	Mean	Rob. mean	Median	s_{rob}	s_{rob} %	2 x s_{pt} %	n_{all}	Acc z %
Alkalinity	A1A	mmol/l	0.19	0.19	0.20	0.19	0.02	8.2	15	25	60
	D2A	mmol/l	0.91	0.91	0.91	0.92	0.03	3.6	10	25	88
	G3A	mmol/l	0.59	0.59	0.59	0.59	0.03	4.2	8	24	92
Ca	A1K	mg/l	2.04	2.03	2.03	2.03	0.06	2.9	10	19	89
	D2K	mg/l	23.0	23.0	23.0	23.0	1.0	4.5	10	18	94
	G3K	mg/l	10.3	10.3	10.3	10.3	0.5	4.8	10	18	89
Cl	A1CS	mg/l	15.1	15.1	15.1	15.0	0.5	3.1	10	29	90
	D2CS	mg/l	11.0	11.1	11.0	10.9	0.4	4.0	10	28	86
	G3CS	mg/l	23.9	23.8	23.9	23.8	0.8	3.5	10	25	96
Conductivity	A1J	µS/cm	393	394	393	395	4	1.1	5	35	89
	D2PJ	µS/cm	178	178	178	179	2	1.1	5	33	85
	G3PJ	µS/cm	158	158	158	158	2	1.5	5	33	82
F	A1F	mg/l	1.12	1.12	1.12	1.12	0.05	4.1	10	21	90
	D2F	mg/l	0.25	0.25	0.25	0.25	0.02	6.2	15	19	95
	G3F	mg/l	0.38	0.38	0.38	0.38	0.02	6.3	15	21	95
Fe	A1Fe	µg/l	52.3	51.1	51.1	51.1	2.9	5.6	15	23	83
	D2Fe	µg/l	19.6	19.6	19.6	19.1	2.5	12.6	25	22	77
	G3Fe	µg/l	32.1	32.2	32.1	32.0	2.1	6.7	15	21	81
K	A1K	mg/l	0.22	0.24	0.23	0.24	0.02	6.5	15	18	69
	D2K	mg/l	1.54	1.55	1.54	1.55	0.05	3.1	10	17	88
	G3K	mg/l	2.57	2.58	2.57	2.59	0.07	2.9	10	17	94
Mg	A1K	mg/l	3.14	3.13	3.12	3.14	0.09	2.9	10	19	95
	D2K	mg/l	1.80	1.80	1.80	1.80	0.07	4.2	10	18	89
	G3K	mg/l	2.13	2.14	2.13	2.15	0.08	3.7	10	18	89

Table 2. The summary of the results in the proficiency test DW 09/2023.

Measurand	Sample	Unit	Assigned value	Mean	Rob. mean	Median	s_{rob}	s_{rob} %	2 x s_{pt} %	n_{all}	Acc z %
Mn	A1Fe	µg/l	49.3	49.8	49.8	50.0	1.8	3.6	10	20	80
	D2Fe	µg/l	22.5	22.6	22.5	22.5	0.8	3.7	15	20	85
	G3Fe	µg/l	77.5	77.4	77.5	76.5	3.2	4.2	10	21	81
Na	A1K	mg/l	2.90	2.89	2.89	2.90	0.07	2.6	10	21	100
	D2K	mg/l	9.94	9.93	9.94	9.93	0.31	3.1	10	20	100
	G3K	mg/l	15.5	15.5	15.5	15.5	0.5	3.5	10	19	95
NH_4	A1N	mg/l	0.13	0.13	0.13	0.13	0.01	6.6	10	22	67
	D2N	mg/l	0.058	0.058	0.058	0.058	0.006	10.4	20	22	71
	G3N	mg/l	0.081	0.080	0.081	0.080	0.005	5.9	15	21	75
NO_2	A1N	mg/l	0.059	0.059	0.059	0.058	0.002	4.2	10	19	88
	D2N	mg/l	0.11	0.11	0.11	0.11	0.01	5.6	10	19	94
	G3N	mg/l	0.077	0.077	0.077	0.077	0.004	5.2	15	18	88
NO_3	A1N	mg/l	4.26	4.26	4.26	4.27	0.09	2.1	10	23	83
	D2N	mg/l	2.33	2.33	2.33	2.32	0.10	4.3	10	23	83
	G3N	mg/l	3.02	3.02	3.02	3.01	0.10	3.5	10	23	91
pH	A1P		7.26	7.27	7.26	7.28	0.04	0.6	2.8	34	91
	D2PJ		7.90	7.90	7.90	7.90	0.08	1.0	2.5	32	97
	G3PJ		7.33	7.33	7.33	7.33	0.11	1.5	2.7	32	91
SO_4	A1CS	mg/l	7.02	7.05	7.07	7.07	0.21	3.0	10	24	92
	D2CS	mg/l	19.8	19.8	19.8	19.9	0.6	2.9	10	24	92
	G3CS	mg/l	10.2	10.1	10.2	10.1	0.4	3.7	10	22	91
TOC	A1T	mg/l	2.32	2.39	2.39	2.39	0.12	5.0	10	17	88
	D2T	mg/l	1.63	1.64	1.63	1.64	0.16	9.8	20	17	76
	G3T	mg/l	2.68	2.68	2.68	2.67	0.18	6.7	15	17	88
Turbidity	A1S	FNU	0.24	0.24	0.24	0.23	0.03	13.8	25	25	84
	D2S	FNU	0.12	0.12	0.12	0.12	0.03	22.1	40	24	80
	G3S	FNU	0.24	0.24	0.24	0.23	0.04	16.9	35	24	88

Rob. mean: the robust mean, s_{rob}: the robust standard deviation, s_{rob} %: the robust standard deviation as percent, 2×s_{pt} %: the standard deviation for proficiency assessment at the 95 % confidence level, n_{all}: the number of the participants, Acc z %: the share of results (%), where $|z| \leq 2$, Acc.

3.2 Analytical methods

The participants could use different analytical methods for the measurements in the PT. The used analytical methods and results of the participants grouped by methods are shown in more detail in Appendix 12. The statistical comparison of the analytical methods was possible for the data where the number of the results was ≥ 5. The statistical comparison of the analytical methods was not performed for the results measured with 'Other method', as these results are statistically treated as a group, which

includes several methods. A case-specific visual method comparison was made for the 'Other method' results.

Alkalinity

Total alkalinity was measured using titration with two or more end points (based on standard ISO 9963-1 by 11–12 participants or Gran alkalinity by 1–2 participants, depending on the sample type) or using one end point titration (based on standard SFS 3005 by 5 participants or ISO 9963-1 by 4–5 participants, depending on the sample type, Appendix 12). One participant used titration according to standard method 2320 B.

Potentiometric titration with HCl to pH values 4.2 and 4.5 gave statistically significantly lower results for samples D2A (0.89 ± 0.02 mg/l, mean ± standard deviation) and G3A (0.58 ± 0.02 mg/l) when compared to the results of one point titration based on national standard SFS 3005 (D2A: 0.94 ± 0.01 mg/l and G3A: 0.62 ± 0.01 mg/l, Appendix 13). Based on the visual evaluation, similar difference was observed for sample A1A. For sample A1A similar statistically significant difference was observed in previous similar PT DW 08/2021 [5].

Ca, K, Mg, and Na

Most of the participants (9–12, depending on the sample) used ICP-OES techniques and 1–2 participants (depending on the sample) used FAAS techniques (Appendix 12) to determine Ca, K, Mg, and Na. The ICP-MS techniques were used by 3 participants. In addition, IC method was used by 1–3 participants (depending on the sample). Other used methods were the titrimetric method for the determination of calcium (1 participant), value calculated from hardness for the determination of magnesium (1 participant), and flame photometry for the determination of sodium (1 participant).

Chloride, Cl

19 participants determined chloride using the IC method based on standard EN ISO 10304 (Appendix 12). Depending on the sample, 3–4 participants used the potentiometric titration method. One participant used ion selective electrode. Other methods, such as photometric and ICP-OES techniques, were used by 1–4 participants (depending on the sample). Based on the visual evaluation, no clear differences between the used methods were noticed.

Conductivity

Most of the participants (31–34, depending on the sample) determined conductivity according to the standard method EN 27888 (Appendix 12). Depending on the sample 1–2 participants used other electrometric methods.

Fluoride, F

16 participants determined fluoride using the IC method based on standard EN ISO 10304 (Appendix 12). Depending on the sample, 3–4 participants used ion selective electrode. One participant used combustion IC. Based on the visual evaluation, no clear differences between the used methods were noticed.

Fe and Mn

Six participants used a spectrophotometric method according to national standard SFS 3028 for measurement of Fe and 4–5 participants (depending on the sample) used a spectrophotometric method according to the national standard SFS 3033 for measurement of Mn (Appendix 12). 8 participants used ICP-OES techniques for Fe measurement and ICP-OES or ICP-AES techniques for Mn measurements. Depending on the sample, 1–2 participants used FAAS and 6 participants used ICP-MS for both measurands. One participant used spectrophotometer Hach Lange DR3900 for measurement of Fe.

ICP-MS gave statistically significantly lower results for sample A1Fe (49.1 ± 2.4 mg/l, mean ± standard deviation) when compared to the results obtained with the national standard method SFS 3028 or similar spectrophotometric methods (53.1 ± 2.6 mg/l, Appendix 13). No other statistically significant differences were observed between the used methods. With ICP techniques the acid matrix of the calibration solutions should be matched to the samples to ensure reliable results.

Ammonium, NH_4

Six participants used manual indophenol blue spectrophotometric method according to the national standard SFS 3032 for measurement of ammonium in the samples (Appendix 12). Six participants used automatic indophenol blue method according to EN ISO 11732. Depending on the sample, 8–9 participants used other methods such as methods based on fluorescence (3 participants), Hach Lange tube method (2 participants), and ion selective electrodes (2 participants).

The results reported with other methods gave statistically significantly lower results for sample A1N when compared to the results obtained with automatic (CFA, FIA) indophenol blue method according to the standard EN ISO 11732 and for sample D2N when compared to the results obtained with manual indophenol blue method according to the national standard SFS 3032. The method specific results are not available from the group of other methods. For sample D2N similar difference was observed in previous similar PT DW 09/2022 [6]. Based on the visual evaluation, similar difference was observed. No other statistically significant or visual differences were observed between the used methods.

Nitrate, NO_3

Ten participants used the method based on standard ISO 13395 (Appendix 12) for nitrate measurements. Seven participants used method based on standard ISO 10304 or similar IC methods. One participant used tube method. Four participants used other methods such as HPLC or Hach Lange tube method. No statistically significant differences were observed between the used methods.

Nitrite, NO_2

Seven participants measured nitrite using the manual spectrophotometric sulfanilamide method based on standard SFS 3029 (Appendix 12). Six participants used the ISO13395 based automatic (CFA, FIA) sulfanilamide method. Depending on the sample 4–5 participants used other methods, for example IC methods (3 participants), tube method, or methods based on standard EN 26777. No statistically significant differences were observed between the used methods.

pH

Depending on the samples, 11–13 participants measured pH using universal electrode and 18–20 participants (depending on the sample) used electrode for low ionic waters. Two participants used method based on standard EN ISO 10523 (Appendix 12). The statistically significant difference between the results obtained with the electrode for low ionic waters and the universal electrode that has been observed in previous similar proficiency test DW 09/2022 was not observed in this PT [6].

Sulphate, SO_4

Most of the participants (19) determined sulphate according to the standard method EN ISO 10304 (Appendix 12). Two participants used turbidimetric determination method. Depending on the sample, 2–3 participants used other methods such as ICP-OES or photometric method.

TOC

Most of the participants (13) measured TOC using the NPOC method where inorganic carbon is removed prior total carbon measurement. Four participants quantified TOC as the calculated difference

of total and inorganic carbon. Based on the visual evaluation no clear differences between the methods were observed (Appendix 12).

Turbidity

Most of the participants (20–24, depending on the sample) used diffuse radiation measurement based on standard EN ISO 7027 for the measurement of turbidity (Appendix 12). One participant reported using Hach 2100AN IS turbidimeter.

3.3 Uncertainties of the reported results

Together with their results, the participants were to report the expanded uncertainties (k=2) as percentage. Altogether 86 % of the participants reported the measurement uncertainty with at least some of their results (Table 3, Appendix 14). The number was at the same level than in the previous similar proficiency test [5]. To promote the enhancement of environmental measurements' quality standards and traceability, the national quality recommendations for the data entered in the water quality registers have been published in Finland [7]. The recommendations for measurement uncertainties for the tested measurands in natural waters vary from 5 % to 20 % (for pH measurement 0.2 pH units, see Table 3). The requirements of the drinking water regulation 1352/2015 amending regulation 683/2017 regarding the highest allowed measurement uncertainties of the methods for the analysis of drinking water are also summarized in Table 3 [8].

Within the optimal measuring range, the expanded measurement uncertainty (k=2) should typically be 10 – 40 %. Close to the limit of quantification the relative measurement uncertainty is higher. The expanded uncertainties below 5 % could commonly be considered unrealistic uncertainty value for routine laboratories. It was evident, that for pH and turbidity some uncertainties had been reported erroneously, not as relative values (%) as the PT organizer had requested (Table 3). For many participants the reported measurement uncertainties were in the same scale with the recommendations. The share and scale of the reported measurement uncertainties were in the same scale than in the previous similar PT [5].

The most used approach to evaluate the measurement uncertainty was based on using the internal quality control data (synthetic sample and/or routine sample replicates, Appendix 14). Other approaches were using the internal quality control data and the results obtained from proficiency tests as well as evaluation using method validation data. Depending on the sample and measurand, up to twelve participants used MUkit measurement uncertainty software for the evaluation of their uncertainties, which is available on the webpage: syke.fi/envical/en [9, 10]. Generally, the used approach for evaluating the measurement uncertainty did not make definite impact on the uncertainty evaluations. Most of the participants reported the measurement uncertainty for all the results obtained with accredited methods.

Table 3. The ranges of the reported expanded uncertainties by participants as percent and recommendation for measurement uncertainties in natural waters and highest allowed measurement uncertainty of the methods for the analysis of domestic waters [7, 8].

Measurand	U_i %, Drinking water	U_i %, Raw water	Recommendation, U_i % [7]	Highest allowed, U_i % [8]
Alkalinity	3 – 15	3 – 21	± 10	-
Ca	5 – 25	6 – 25	± 10	-
Cl	5 – **50** [2)]	3 – 25	± 10	± 15
Conductivity	2 – 9.1	2 – 8	± 5	± 20
F	6 – 45	6 – 45	± 15	± 20
Fe	2 – **62**	2 – **50**	± 10	± 30
K	10 – **50**	10 – **50**	± 10	-
Mg	5 – **81**	5 – **62**	± 10	-
Mn	2 – **50**	2 – 40	± 10	± 30
Na	6 – 20	6 – 20	± 10	± 15
NH_4	6 – 32.3	6 – 32	± 15 [2)]	± 40
NO_2	4 – 30	4 – 30	± 15 [2)]	± 20
NO_3	6 – 35	6 – 35	± 15 [2)]	± 15
pH	**0.2** – 5	**0.2** – 5	± 0.2 pH-units (2-3 %)	± 0.2 pH-units (2-3 %)
SO_4^2	5 – 25	6 – 25	± 10	± 15
TOC	2 – **65**	2 – 38	± 15	± 30
Turbidity	**0.1** – ***100***	**0.1** – ***180***	± 20	± 30

[1)] In table with bold the values of expanded measurement uncertainty <1 % or ≥50 % and with bold and italic the values ≥ 100 %.

[2)] Recommendation given per nitrogen.

4 Evaluation of the results

The performance evaluation of the participants was based on the z scores, which were calculated using the assigned values and the standard deviation for proficiency assessment (Table 4 and Appendix 7).

Table 4. Interpretation of the z scores.

Criteria for z scores	Interpretation
$\lvert z \rvert \leq 2.0$	Satisfactory
$2.0 < \lvert z \rvert < 3.0$	Questionable
$\lvert z \rvert \geq 3.0$	Unsatisfactory

In total, 87 % of the results were satisfactory when total deviation of 0.2 pH units and for the other measurement 5–40 % from the assigned values were accepted. Altogether 71 % of participants used accredited analytical methods at least for a part of the measurands. The summary of the performance evaluation and comparison to the previous performance is presented in Table 5. In the previous similar PT, DW 08/2021, the performance was satisfactory for 89 % of the participant results [5]. Further, the measurands here were partly same than in PT DW 09/2022, and thus the performance is partly compared also against those results. In DW 09/2022, the performance was satisfactory for 86 % of the participant results when deviation of 5–20 % and 0.2 pH units from the assigned values were accepted [6].

Table 5. Summary of the performance evaluation in the proficiency test DW 09/2023.

Sample	Satisfactory results (%)	Accepted deviation from the assigned value (%)	Remarks
Alkalinity	80	8–15	Good performance for raw water sample G3A. In the PT DW 08/21 the performance was satisfactory for 89 % of the results [5].
Anions (Cl^-, F^-, SO_4^{2-})	92	10 – 15	Good overall performance. Excellent performance for Cl^- for raw water sample G3CS and for F^- for drinking water sample D2S and raw water sample G3S. In the PT DW 09/22 the performance was satisfactory for 92 % of the results when deviation of 10–20 % from the assigned value was accepted [6].
Ca, K, Mg, Na	91	10 – 15	Good overall performance. Excellent performance for Mg for synthetic sample A1K and for Na for all the samples. In the PT DW 09/22 the performance was satisfactory for 88 % of the results when deviation of 10 % from the assigned value was accepted [6].
pH	93	2.5 – 2.7 (0.2 pH units)	Good overall performance. Excellent performance for drinking water sample D2PJ. In the PT DW 09/22 the performance was satisfactory for 81 % of the results [6].
Conductivity	85	5	In the PT DW 09/22 the performance was satisfactory for 81 % of the results [6]
Fe, Mn	81	10 – 25	In the PT DW 09/22 the performance was satisfactory for 83 % of the results when deviation of 10–15 % from the assigned value was accepted [6].
NH_4, NO_2, NO_3	82	10 – 20	Good performance for NO_2 for drinking water sample D2N and for NO_3 for raw water sample G3N. In the PT DW 09/22 the performance was satisfactory for 79 % of the results [6].
TOC	84	10–20	In the PT DW 08/21 the performance was satisfactory for 78 % of the results [5].
Turbidity	84	25–40	The performance evaluation for the sample D2S is only approximate. In the PT DW 08/21 the performance was satisfactory for 88 % of the results [5].

5 Summary

Proftest Syke carried out the proficiency test (PT) for analysis of alkalinity, Ca, Cl, conductivity, F, Fe, K, Mg, Mn, Na, NH_4, NO_2, NO_3, pH, SO_4, TOC, and turbidity in synthetic samples and drinking water as well as raw water in September 2023 (DW 09/2023). In total, 42 laboratories participated in this proficiency test (Appendix 1).

The homogeneity and the stability of the samples were tested and the samples were regarded to be sufficiently homogenous and stable. Statistically significant differences between different methods of determination were observed in the determination of alkalinity in one- and two-point titrations with hydrochloric acid in the drinking water sample and ground water sample and in the determination of Fe with ICP-MS and spectrophotometric methods in the synthetic sample.

The calculated concentration or the robust mean of the results reported results by the participants was used as the assigned value for the measurands. The uncertainties of the assigned values were estimated at the 95 % confidence level (k=2) and they were ≤ 1.2 % for the calculated values and 0.4–14 % for the other assigned values (Appendix 6).

The performance evaluation was based on the z scores. In total, 87 % of the reported results were satisfactory when the total deviation of 0.2 pH units for pH values and 5–40 % for the other measurands was accepted from the assigned value at the 95 % confidence level. The performance was similar as in the previous similar proficiency tests. Altogether 71 % of the participants used accredited analytical methods at least for a part of the measurements and 90 % of those results were satisfactory.

6 Summary in Finnish

Proftest Syke järjesti pätevyyskokeen talousvesiä analysoiville laboratorioille syyskuussa 2023 (DW 09/2023). Pätevyyskokeessa testattiin alkaliniteetti, Ca, Cl, F, Fe, K, Mg, Mn, Na, NH_4, NO_2, NO_3, pH, SO_4, sähkönjohtavuus, TOC ja sameus raaka- ja talousvedestä sekä synteettisestä vesinäytteestä. Pätevyyskokeeseen osallistui yhteensä 42 laboratoriota (Liite 1).

Näytteiden valmistus on esitetty liitteessä 2. Näytteiden homogeenisuus ja stabiilisuus testattiin ja näytteiden todettiin täyttävän sekä homogeenisuudelle että säilyvyydelle asetetut kriteerit (Liitteet 3 ja 4). Pätevyyskokeesta saatu palaute koski muun muassa vuotaneita näytepulloja ja puuttuvia näytteitä sekä puutteellisesti raportoituja tuloksia (Liite 5).

Testisuureen vertailuarvona käytettiin laskennallista pitoisuutta tai osallistujien tulosten robustia keskiarvoa. Vertailuarvojen laajennettu epävarmuus oli 0.3–1.2 % laskennallisille vertailuarvoille ja 0.4–14 % kun vertailuarvon epävarmuus arvioitiin robustin keskihajonnan avulla (Liite 6).

Yhteenveto tuloksista on esitetty taulukossa 2. Raportin tulostaulukoissa esiintyviä lyhenteitä ja käsitteitä on selitetty liitteessä 7. Osallistujakohtaiset tulokset on esitetty liitteessä 8. Osallistujatulokset ja niiden mittausepävarmuudet on esitetty graafisesti liitteessä 9 ja yhteenvedot z-arvoista liitteessä 10. Liitteessä 11 z-arvot on esitetty suuruusjärjestyksessä. Asiantuntijalaboratorion (T003, finas.fi) tunnukset tässä pätevyyskokeessa olivat 42 (Syke, Oulu) ja 13 (Syke, Helsinki).

Määritysmenetelmien mukaan ryhmitellyt tulokset on esitetty liitteessä 12. Menetelmävertailuissa todettiin tilastollisesti merkitsevä ero alkaliniteetin määrityksessä yhden ja kahden pisteen titrauksissa suolahapolla juomavesinäytteestä ja raakavesinäytteestä sekä raudan määrityksessä ICP-MS ja spektrometrisen menetelmän välillä synteettisestä näytteestä (Liite 13).

Tuloksia arvioitiin z-arvojen avulla ja tavoitehajonnan arvoksi 95 % luottamusvälillä asetettiin pH-määrityksissä 0,2 pH-yksikköä ja muissa määrityksissä 5–40 %. Koko tulosaineistossa hyväksyttäviä tuloksia oli 87 %, mikä oli lähes samalla tasolla kuin edellisissä vastaavissa pätevyyskokeessa. Vuoden 2021 vastaavassa pätevyyskokeessa (DW 08/2021) hyväksyttäviä tuloksia oli 89 % ja vuoden 2022 pätevyyskokeessa (DW 09/2022), jossa testattiin osittain samoja testisuureita, hyväksyttäviä tuloksia oli 86 %, kun tulosten sallittiin vaihdella pH-määrityksissä 0,2 pH-yksikköä ja muissa määrityksissä 5–20 % vertailuarvosta [5, 6].

Osallistujista 86 % ilmoitti mittausepävarmuuden ainakin osalle tuloksistaan. Määrä samalla tasolla kuin edellisessä vastaavassa pätevyyskokeessa. Raportoitujen mittausepävarmuuksien välillä oli eroja, mutta visuaalisen arvioinnin perusteella käytetyllä mittausepävarmuuden arviointimenettelyllä ei ollut vaikutusta epävarmuuden suuruuteen (Taulukko 3, Liite 14).

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Appendix 1. **Participants in the proficiency test**

Country	Participant
Finland	Eurofins Ahma Oy Seinäjoki
	Eurofins Ahma Oy, Oulu
	Eurofins Ahma Oy, Rovaniemi
	Eurofins Environment Testing Finland Oy, Lahti
	Eurofins Scientific Finland Oy Helsingin laboratorioyksikkö
	Finnish Environment Institute (Syke), Helsinki
	Finnish Environment Institute (Syke), Oulu
	Finnish Institute of Occupational Health
	Finnsementti Oy
	Fortum Waste Solutions Oy, Riihimäki
	Hortilab Ab Oy
	HSY Käyttölaboratorio Pitkäkoski Helsinki
	KVVY Tutkimus Oy, Tampere
	Kymen Ympäristölaboratorio Oy
	Lounais-Suomen vesi- ja ympäristötutkimus Oy, Turku
	Luonnonvarakeskus, Viikki B2-laboratorio
	LUVYLab Oy Ab
	Neste Corporation, Technology Center, Kilpilahti
	Neste Oyj, Tutkimus ja kehitys/Vesilaboratorio, Kulloo
	Norilsk Nickel Harjavalta Oy
	Oulun Vesi Liikelaitos
	Saimaan Vesi- ja Ympäristötutkimus Oy, Lappeenranta
	Savo-Karjalan Ympäristötutkimus Oy, Joensuu
	Savo-Karjalan Ympäristötutkimus Oy, Kajaani
	Savo-Karjalan Ympäristötutkimus Oy, Kuopio
	ScanLab Oy
	SeiLab Oy Haapaveden toimipiste
	SeiLab Oy Seinäjoen toimipiste
	SGS Finland Oy, Karkkila
	SSAB Europe Oy, Analyysilaboratorio, Hämeenlinna
	SSAB Europe Raahe, Raahe
	Tampereen Vesi/Viemärilaitoksen laboratorio
	Teollisuuden Voima Oyj
	UPM Oyj, Kymi
	UPM Specialty Papers, Tervasaari
	UPM Tutkimuskeskus, Lappeenranta

Country	Participant
Finland	Yara Suomi Oy, Uusikaupunki
	ÅMHM laboratoriet, Jomala, Åland
Nepal	Zest Laboratories & Research Center
Norway	NIVA, Oslo, Norway
	ValdresLab AS
Sweden	Stockholm University, ACES

Appendix 2. **Sample preparation**

Measurand	Sample	Initial concentration	Addition	Assigned value
Alkanity [mmol/]	A1A	-	Na_2CO_3, 0.19	0.19
	D2A	1.02	-	0.91
	G3A	0.33	-	0.59
Ca [mg/l]	A1K		$Ca(NO_3)_2$, 2.04	2.04
	D2K	22.9	-	23.0
	G3K	10.0	-	10.3
Cl [mg/l]	A1CS	-	NaCl, 15.1	15.1
	D2CS	10.2	-	11.0
	G3CS	24.4	-	23.9
Conductivity [µS/cm]	A1J		KCl, 367	393
	D2PJ	181	-	178
	G3PJ	148	-	158
F [mg/l]	A1F		NaF, 1.12	1.12
	D2F	0.07	0.18	0.25
	G3F	0.06	0.33	0.38
Fe [µg/l]	A1Fe		$Fe(NO_3)_3$, 52.3	52.3
	D2Fe	19.8	8.3	19.6
	G3Fe	12.4	27.4	32.1
K [mg/l]	A1K		KNO_3, 0.22	0.22
	D2K	1.60	-	1.54
	G3K	2.12	-	2.57
Mg [mg/l]	A1K		$Mg(NO_3)_2$, 3.14	3.14
	D2K	1.78	-	1.80
	G3K	1.71	-	2.13
Mn [µg/l]	A1Fe		$Mn(NO_3)_2$, 49.3	49.3
	D2Fe	6.0	18.6	22.5
	G3Fe	10.4	70.0	77.5
Na[mg/l]	A1K		$NaNO_3$, 2.90	2.90
	D2K	9.40	-	9.94
	G3K	13.9	-	15.5

Measurand	Sample	Initial concentration	Addition	Target concentration
NH_4 [mg/l]	A1N	-	NH_4Cl 0.13	0.13
	D2N	0	0.07	0.058
	G3N	0	0.09	0.081
NO_2 [mg/l]	A1N	-	$NaNO_2$ 0.06	0.059
	D2N	0	0.10	0.11
	G3N	0	0.07	0.077
NO_3 [mg/l]	A1N		$NaNO_3$, 4.13	4.26
	D2N	1.98	0.12	2.33
	G3N	2.91	-	3.02
pH [pH unit]	A1P		KH_2PO_4+Na_2HPO_4, 7.25	7.26
	D2PJ	7.28	-	7.90
	G3PJ	6.14	-	7.33
SO_4 [mg/l]	A1CS	-	Na_2SO_4, 7.02	7.02
	D2CS	18.0	-	19.8
	G3CS	9.46	-	10.2
TOC [mg/l]	A1T	-	$C_8H_5KO_4$, 2.32	2.32
	D2T	1.89	-	1.63
	G3T	2.91	-	2.68
Turbidity [FNU]	A1S		Formazin (Hach), 0.21	0.24
	D2S	0.08	0.06	0.12
	G3S	0.07	0.32	0.24

First letter of the sample code indicates the sample matrix:
A = Synthetic sample
D = Drinking water
G = Raw water (ground water)

Appendix 3. **Homogeneity of the samples**

Criteria for homogeneity:

$s_{analytical} / s_{pt} < 0.5$ and $s_{sam}^2 < c$, where

$s_{analytical}$ = analytical deviation, standard deviation of the results in a sub sample
s_{pt} = standard deviation for proficiency assessment
s_{sam} = between-sample deviation, standard deviation of results between sub samples

$c = F1 \times s_{all}^2 + F2 \times s_{analytical}^2$, where

$s_{all}^2 = (0.3 \times s_{pt})^2$

F1 and F2 are constants of F distribution derived from the standard statistical tables for the tested number of samples [2, 3].

Table 1. Homogeneity test results of samples.

Measurand/ Sample	**Concentration** [mmol/l] [mg/l], [µg/l]	**n**	**s_{pt} %**	**s_{pt}**	**$s_{analytical}$**	**$s_{analytical} / s_{pt}$**	**$s_{analytical} / s_{pt}$ < 0.5?**	**s_{sam}^2**	**c**	**s_{sam}^2 < c?**
Alkanity / D2A	0.95	6	5.0	0.05	0.002	0.04	Yes	0	0.0005	Yes
Alkalinity / G3A	0.61	6	4	0.02	0.001	0.04	Yes	0	0.0001	Yes
Cl / D2CS	10.8	6	5	0.54	0.05	0.10	Yes	0.002	0.06	Yes
Cl / G3CS	23.2	6	5	1.16	0.07	0.06	Yes	0	0.28	Yes
F / D2F	0.22	4	7.5	0.02	0.001	0.07	Yes	0	0.0001	Yes
F / G3F	0.38	3	7.5	0.03	0.001	0.03	Yes	0.0004	0.0002	No
Fe /D2Fe	20.5	4	12.5	2.56	0.28	0.11	Yes	0.11	1.75	Yes
Fe /G3Fe	33.3	4	7.5	2.50	0.59	0.23	Yes	0	2.42	Yes
Na / D2K	10.1	6	5	0.51	0.07	0.13	Yes	0.003	0.06	Yes
Na / G3K	15.9	6	5	0.80	0.16	0.20	Yes	0	0.17	Yes
NH_4 / D2N	0.06	6	10	0.006	0.0006	0.11	Yes	0	0.00001	Yes
NH_4 / G3N	0.08	6	7.5	0.006	0.0008	0.13	Yes	0	0.00001	Yes
NO_3 /D2N	2.25	6	5	0.11	0.009	0.08	Yes	0	0.003	Yes
NO_3 / G3N	2.94	6	5	0.15	0.01	0.07	Yes	0.0001	0.005	Yes
pH /D2PJ	7.87	8	1.25	0.10	0.01	0.14	Yes	0.0009	0.002	Yes
pH / G3PJ	7.35	8	1.35	0.10	0.01	0.13	Yes	0.009	0.002	No
TOC / D2T	1.78	4	10	0.18	0.03	0.15	Yes	0.002	0.009	Yes
TOC / G3T	2.68	4	7.5	0.20	0.05	0.24	Yes	0.004	0.02	Yes
Turbidity / D2S	0.14	6	20	0.03	0.005	0.18	Yes	0.00002	0.0002	Yes
Turbidity / G3S	0.38	6	17.5	0.07	0.006	0.09	Yes	0.00005	0.0009	Yes

Conclusion: The samples could be considered as homogenous because most of the criteria of the homogenous test were met. In those two cases where the homogeneity criteria were not met, the results from the participants confirm the homogeneity compared to the standard deviation for the proficiency test.

Appendix 4. **Stability of the samples**

The samples were delivered mainly on 11 September 2023 to the participants abroad and mainly on 12 September 2023 to the national participants. The samples arrived to the participants mainly on 13 September 2023. The samples were requested to be measured as follows:

alkalinity, pH, conductivity, turbidity	14 September 2023
N compounds	at the latest on 15 September 2023
Ca, K, Mg, Na, Fe, Mn	at the latest on 22 September 2023
C l, F, SO_4, TOC	at the latest on 22 September 2023

Stability of alkalinity, pH, and N_{NH4} was tested by analyzing the samples stored at the temperatures 4 °C and 20 °C.

Criterion for stability: **$D < 0.3 \times s_{pt}$**, where

D = |the result at 20 °C – the result at 4 °C|

s_{pt} = standard deviation for proficiency assessment

Alkalinity

Sample	Result [mmol/l]		Sample	Result [mmol/l]		Sample	Result [mmol/l]	
Date	14.9. (20 °C)	14.9. (4 °C)	Date	14.9. (20 °C)	14.9. (4 °C)	Date	14.9. (20 °C)	14.9. (4 °C)
A1A	0.193	0.192	**D2A**	0.943	0.941	**G3A**	0.610	0.613
D	0.001		D	0.002		D	0.003	
0.3 × s_{pt}	0.004		0.3 × s_{pt}	0.014		0.3 × s_{pt}	0.007	
	$D < 0.3 \times s_{pt}$? Yes			**$D < 0.3 \times s_{pt}$? Yes**			**$D < 0.3 \times s_{pt}$? Yes**	

N_{NH4}

Sample	Result [mg/l]		Sample	Result [mg/l]		Sample	Result [mg/l]	
Date	14.9. (20 °C)	14.9. (4 °C)	Date	14.9. (20 °C)	14.9. (4 °C)	Date	14.9. (20 °C)	14.9. (4 °C)
A1N	0.134	0.135	**D2N**	0.059	0.060	**G3N**	0.077	0.078
D	0.001		D	0.001		D	0.0002	
0.3 × s_{pt}	0.002		0.3 × s_{pt}	0.002		0.3 × s_{pt}	0.002	
	$D < 0.3 \times s_{pt}$? Yes			**$D < 0.3 \times s_{pt}$? Yes**			**$D < 0.3 \times s_{pt}$? Yes**	

pH

Sample	Result [pH unit]		Sample	Result [pH unit]		Sample	Result [pH unit]	
Date	14.9. (20 °C)	14.9. (4 °C)	Date	14.9. (20 °C)	14.9. (4 °C)	Date	14.9. (20 °C)	14.9. (4 °C)
A1P	7.238	7.263	**D2PJ**	7.830	7.898	**G3PJ**	7.280	7.305
D	0.025		D	0.068		D	0.025	
0.3 × s_{pt}	0.030		0.3 × s_{pt}	0.030		0.3 × s_{pt}	0.030	
	$D < 0.3 \times s_{pt}$? Yes			**$D < 0.3 \times s_{pt}$? No**[1)]			**$D < 0.3 \times s_{pt}$? Yes**	

[1)] The difference is within the analytical error

Conclusion: According to the test results, the pH of the sample D2PJ could change slightly during transport and storage. The difference is within the analytical error. Thus, all the samples were considered stable.

Appendix 5. **Feedback from the proficiency test**

Feedback from the participants

Participant	Comments on technical excecution	Action / Proftest Syke
11	Thank you for this PT. The instructions were clear, the forms were easy to use, the preliminary results report came quickly and the contact via email worked well. Many of the PT sample bottles look very similar and when analyzing large number of samples at the same time, there is a chance that bottles could be mixed up due to human error. Especially if several samples have the same bottle number. Would it be possible to change the labels on the bottles so that it would be easier to identify the samples?	Thank you for your feedback! Participants should not get sample bottles with same bottle numbers, the organized apologized for that and thanked the participant for the development proposal. In future rounds more attention will be paid to the choice of sample bottles, so that a participant does not get several bottles with the same number.
16, 41	The link of the Sample arrival form was not available on ProftestWEB.	The organizer thanked the participants for the notice and the link was added promptly to ProftestWEB.
6	A1N sample had leaked.	The participant did not request a new sample.
10	D2N sample had leaked.	
41	G3N sample had leaked.	
22	The participant did not receive samples A1Fe, D2Fe, and G3Fe.	The organizer apologized for the incorrect delivery and the missing samples were delivered to the participant.
29	The participant did not receive D2N sample.	
25	The preliminary results report was delivered to a person who was no longer employed by the company.	The report is delivered to the person who has done the registration. Contact information was updated according to participants request and the report was re-delivered to the participant.
30	G3N sample had leaked.	New sample G3N was delivered to the participant.

Participant	Comments to the results	Action / Proftest Syke
19	The results for conductivity were misreported. The corrected results were: A1J 392 µS/cm D2PJ 178 µS/cm G3PJ 155 µS/cm.	The results were outliers in the statistical treatment, and thus did not affect the performance evaluation. If the results had been reported correctly, the evaluation of the results would have been, based on z scores: Satisfactory. The participant can re-calculate the z scores according to the Guide of participants [4].
28	The participant asked for advice on calculating the z scores.	The customer was advised how to calculate the value according to Appendix 3 of the Guide for participant [4].
30	The results for alkalinity were misreported. The corrected results were: A1A 0.196 mmol/l D2A 0.912 mmol/l.	The results were outliers in the statistical treatment, and thus did not affect the performance evaluation. If the results had been reported correctly, the evaluation of the results would have been, based on z scores: Satisfactory. The participant can re-calculate the z scores according to the Guide of participants [4].
35	The results for conductivity were misreported. The corrected results were: A1J 394 µS/cm G3PJ 182 µS/cm. The results for NO_3 were analysed as the sum of NO_2 and NO_3.	The results were outliers in the statistical treatment, and thus did not affect the performance evaluation. If the results had been reported correctly, the evaluation of the results would have been, based on z scores: A1J: Satisfactory G3PJ: Unsatisfactory The participant can re-calculate the z scores according to the Guide of participants [4].

Feedback to the participants

Participant	Comments
3, 12, 13, 15, 16, 20, 21, 28, 37, 40, 42	The participants did not return the sample arrival form to the organizer. Thus, the information of the sample arrival temperature was missing for them. The participants should follow the instructions of the organizer.
12, 20, 41, 42	The measurement uncertainty should be reported with the results obtained by accredited methods.

Appendix 6. **Evaluation of the assigned values and their uncertainties**

Measurand	Sample	Unit	Assigned value	U_{pt}	U_{pt}, %	Evaluation method of assigned value	u_{pt}/s_{pt}
Alkalinity	A1A	mmol/l	0.19	<0.01	0.5	Calculated value	0.03
	D2A	mmol/l	0.91	0.02	1.9	Robust mean	0.19
	G3A	mmol/l	0.59	0.01	2.3	Robust mean	0.29
Ca	A1K	mg/l	2.04	0.01	0.7	Calculated value	0.07
	D2K	mg/l	23.0	0.6	2.7	Robust mean	0.27
	G3K	mg/l	10.3	0.3	2.8	Robust mean	0.28
Cl	A1CS	mg/l	15.1	0.08	0.5	Calculated value	0.05
	D2CS	mg/l	11.0	0.2	2.0	Robust mean	0.20
	G3CS	mg/l	23.9	0.4	1.7	Robust mean	0.17
Conductivity	A1J	µS/cm	393	2	0.5	Robust mean	0.10
	D2PJ	µS/cm	178	1	0.5	Robust mean	0.10
	G3PJ	µS/cm	158	1	0.7	Robust mean	0.14
F	A1F	mg/l	1.12	<0.01	0.4	Calculated value	0.04
	D2F	mg/l	0.25	0.01	3.6	Robust mean	0.24
	G3F	mg/l	0.38	0.01	3.5	Robust mean	0.23
Fe	A1Fe	µg/l	52.3	0.4	0.7	Calculated value	0.05
	D2Fe	µg/l	19.6	1.5	7.6	Robust mean	0.30
	G3Fe	µg/l	32.1	1.3	3.9	Robust mean	0.26
K	A1K	mg/l	0.22	<0.01	0.7	Calculated value	0.05
	D2K	mg/l	1.54	0.03	2.0	Robust mean	0.20
	G3K	mg/l	2.57	0.05	1.8	Robust mean	0.18
Mg	A1K	mg/l	3.14	0.02	0.6	Calculated value	0.06
	D2K	mg/l	1.80	0.05	2.5	Robust mean	0.25
	G3K	mg/l	2.13	0.05	2.2	Robust mean	0.22
Mn	A1Fe	µg/l	49.3	0.3	0.7	Calculated value	0.07
	D2Fe	µg/l	22.5	0.5	2.2	Robust mean	0.15
	G3Fe	µg/l	77.5	1.9	2.5	Robust mean	0.25
Na	A1K	mg/l	2.90	0.01	0.3	Calculated value	0.03
	D2K	mg/l	9.94	0.17	1.7	Robust mean	0.17
	G3K	mg/l	15.5	0.3	2.0	Robust mean	0.20
NH_4	A1N	mg/l	0.13	<0.01	0.7	Calculated value	0.07
	D2N	mg/l	0.058	0.004	6.5	Robust mean	0.33
	G3N	mg/l	0.081	0.003	3.5	Robust mean	0.23

Measurand	Sample	Unit	Assigned value	U_{pt}	U_{pt}, %	Evaluation method of assigned value	u_{pt}/s_{pt}
NO_2	A1N	mg/l	0.059	0.002	2.7	Robust mean	0.27
	D2N	mg/l	0.11	<0.01	3.4	Robust mean	0.34
	G3N	mg/l	0.077	0.003	3.3	Robust mean	0.22
NO_3	A1N	mg/l	4.26	0.06	1.3	Robust mean	0.13
	D2N	mg/l	2.33	0.06	2.4	Robust mean	0.24
	G3N	mg/l	3.02	0.06	1.9	Robust mean	0.19
pH	A1P		7.26	0.02	0.3	Robust mean	0.11
	D2PJ		7.90	0.04	0.5	Robust mean	0.20
	G3PJ		7.33	0.05	0.7	Robust mean	0.26
SO_4	A1CS	mg/l	7.02	0.04	0.5	Calculated value	0.05
	D2CS	mg/l	19.8	0.3	1.6	Robust mean	0.16
	G3CS	mg/l	10.2	0.2	2.1	Robust mean	0.21
TOC	A1T	mg/l	2.32	0.03	1.2	Calculated value	0.12
	D2T	mg/l	1.63	0.11	6.5	Robust mean	0.33
	G3T	mg/l	2.68	0.11	4.2	Robust mean	0.28
Turbidity	A1S	FNU	0.24	0.02	7.3	Robust mean	0.29
	D2S	FNU	0.12	0.02	14.0	Robust mean	0.35
	G3S	FNU	0.24	0.02	9.2	Robust mean	0.26

U_{pt} = Expanded uncertainty of the assigned value

Criterion for reliability of the assigned value $u_{pt}/s_{pt} \leq 0.3$, where

s_{pt}= target value of the standard deviation for proficiency assessment

u_{pt}= standard uncertainty of the assigned value

If $u_{pt}/s_{pt} \leq 0.3$, the assigned value is reliable.

Appendix 7. **Terms in the results tables**

The information could be applied according to the PT.

Measurand The tested parameter

Sample The code of the sample

Assigned value The value attributed to a particular property of a proficiency test item

Participant's result The result reported by the participant (when replicate results are reported, the mean value)

2 × s_{pt} % The standard deviation for proficiency assessment (s_{pt}) at the 95 % confidence level

z score Used for the participant's performance evaluation in the PT.
Calculated with formula:

$z = (x_i - x_{pt})/s_{pt}$, where

x_i = the result of the individual participant
x_{pt} = the assigned value
s_{pt} = the standard deviation for proficiency assessment

Interpretation of the z scores

$\lvert z \rvert \leq 2.0$	Satisfactory
$2.0 < \lvert z \rvert < 3.0$	Questionable (warning signal), the result deviates more than $2 \times s_{pt}$ from the assigned value.
$\lvert z \rvert \geq 3.0$	Unsatisfactory (action signal), the result deviates more than $3 \times s_{pt}$ from the assigned value.

E_n score Error, normalized – Used to evaluate the difference between the assigned value and participant's result within their claimed expanded uncertainty. Calculated with formula:

$$(E_n)_i = \frac{x_i - x_{pt}}{\sqrt{U_i^2 + U_{pt}^2}}, \text{ where}$$

U_i = the expanded uncertainty of a participant's result
U_{pt} = the expanded uncertainty of the assigned value

Interpretation of the E_n scores

$\lvert E_n \rvert \leq 1.0$	Satisfactory, should be taken as an indicator of successful performance when the uncertainties are valid.
$\lvert E_n \rvert > 1.0$	Unsatisfactory (action signal), could indicate a need to review the uncertainty estimates, or to correct a measurement issue.

Md Median

s Standard deviation

s % Standard deviation, %

n_{stat} Number of results in statistical processing

More information of the statistical calculations in international standards ISO/IEC 17043 and ISO 13528 as well as in Proftest Syke Guide for participants [1, 2, 4].

Appendix 8. **Results of each participant**

Participant 1												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
Alkalinity	mmol/l	A1A		-0.28	0.19	15	0.19	0.19	0.19	0.01	3.5	15
	mmol/l	D2A		-0.70	0.91	10	0.88	0.92	0.91	0.03	3.2	22
	mmol/l	G3A		-1.02	0.59	8	0.57	0.59	0.59	0.02	3.8	22
Conductivity	µS/cm	A1J		0.20	393	5	395	395	394	4	1.0	31
	µS/cm	D2PJ		0.22	178	5	179	179	178	2	1.3	29
	µS/cm	G3PJ		0.25	158	5	159	158	158	2	1.4	29
NH_4	mg/l	A1N		-0.15	0.13	10	0.13	0.13	0.13	0.01	4.0	15
	mg/l	D2N		0.07	0.058	20	0.058	0.058	0.058	0.006	10.4	16
	mg/l	G3N		0.12	0.081	15	0.082	0.080	0.080	0.003	4.0	18
NO_2	mg/l	A1N		1.39	0.059	10	0.063	0.058	0.059	0.002	3.9	15
	mg/l	D2N		0.18	0.11	10	0.11	0.11	0.11	0.00	4.1	17
	mg/l	G3N		0.76	0.077	15	0.081	0.077	0.077	0.004	5.4	15
NO_3	mg/l	A1N		-0.47	4.26	10	4.16	4.27	4.26	0.12	2.8	17
	mg/l	D2N		-0.60	2.33	10	2.26	2.32	2.33	0.08	3.6	21
	mg/l	G3N		-0.46	3.02	10	2.95	3.01	3.02	0.12	3.8	21
pH		A1P		0.20	7.26	2.8	7.28	7.28	7.27	0.03	0.4	33
		D2PJ		-0.20	7.90	2.5	7.88	7.90	7.90	0.08	1.0	32
		G3PJ		0.71	7.33	2.7	7.40	7.33	7.33	0.11	1.4	32
Turbidity	FNU	A1S		0.70	0.24	25	0.26	0.23	0.24	0.03	11.6	22
	FNU	D2S			0.12	40	*<0.15*	0.12	0.12	0.02	19.5	16
	FNU	G3S		0.17	0.24	35	0.25	0.23	0.24	0.04	16.3	21

Participant 2												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
Ca	mg/l	A1K		0.10	2.04	10	2.05	2.03	2.03	0.06	2.7	17
	mg/l	D2K		0.00	23.0	10	23.0	23.0	23.0	0.9	4.0	17
	mg/l	G3K		0.00	10.3	10	10.3	10.3	10.3	0.6	5.6	18
Cl	mg/l	A1CS		3.31	15.1	10	17.60	15.03	15.12	0.48	3.1	26
	mg/l	D2CS		2.36	11.0	10	12.3	10.9	11.1	0.5	4.4	25
Conductivity	µS/cm	A1J		-1.22	393	5	381	395	394	4	1.0	31
	µS/cm	G3PJ		-2.28	158	5	149	158	158	2	1.4	29
F	mg/l	A1F		6.61	1.12	10	1.49	1.12	1.12	0.05	4.0	19
	mg/l	G3F		16.91	0.38	15	0.86	0.38	0.38	0.02	5.7	20
K	mg/l	A1K		-0.24	0.22	15	0.22	0.24	0.24	0.01	5.3	12
	mg/l	D2K		-0.26	1.54	10	1.52	1.55	1.55	0.04	2.3	16
	mg/l	G3K		-0.16	2.57	10	2.55	2.59	2.58	0.06	2.5	16
Mg	mg/l	A1K		-0.19	3.14	10	3.11	3.14	3.13	0.09	2.9	18
	mg/l	D2K		-0.33	1.80	10	1.77	1.80	1.80	0.06	3.4	17
	mg/l	G3K		0.00	2.13	10	2.13	2.15	2.14	0.06	3.0	17
Na	mg/l	A1K		-1.79	2.90	10	2.64	2.90	2.89	0.07	2.3	20
	mg/l	D2K		-1.35	9.94	10	9.27	9.93	9.93	0.31	3.1	20
	mg/l	G3K		-1.03	15.5	10	14.7	15.5	15.5	0.5	3.0	19
pH		A1P		-0.89	7.26	2.8	7.17	7.28	7.27	0.03	0.4	33
		G3PJ		-0.20	7.33	2.7	7.31	7.33	7.33	0.11	1.4	32
SO_4	mg/l	A1CS		-0.26	7.02	10	6.93	7.07	7.05	0.18	2.6	22
	mg/l	D2CS		-0.20	19.8	10	19.6	19.9	19.8	0.5	2.6	22

Participant 3													
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
Alkalinity	mmol/l	A1A		-0.21	0.19	15	0.19	0.19	0.19	0.01	3.5	15
	mmol/l	D2A		-0.44	0.91	10	0.89	0.92	0.91	0.03	3.2	22
	mmol/l	G3A		-0.51	0.59	8	0.58	0.59	0.59	0.02	3.8	22
Ca	mg/l	A1K		-0.39	2.04	10	2.00	2.03	2.03	0.06	2.7	17
	mg/l	D2K		-0.87	23.0	10	22.0	23.0	23.0	0.9	4.0	17
	mg/l	G3K		-0.97	10.3	10	9.8	10.3	10.3	0.6	5.6	18
Cl	mg/l	A1CS		-0.26	15.1	10	14.90	15.03	15.12	0.48	3.1	26
	mg/l	D2CS		-0.73	11.0	10	10.6	10.9	11.1	0.5	4.4	25
	mg/l	G3CS		-0.08	23.9	10	23.8	23.8	23.8	0.8	3.3	25
Conductivity	µS/cm	A1J		0.20	393	5	395	395	394	4	1.0	31
	µS/cm	D2PJ		0.00	178	5	178	179	178	2	1.3	29
	µS/cm	G3PJ		-0.51	158	5	156	158	158	2	1.4	29
F	mg/l	A1F		0.18	1.12	10	1.13	1.12	1.12	0.05	4.0	19
	mg/l	D2F		1.60	0.25	15	0.28	0.25	0.25	0.01	2.4	18
	mg/l	G3F		0.35	0.38	15	0.39	0.38	0.38	0.02	5.7	20
Fe	µg/l	A1Fe		-1.66	52.3	15	45.8	51.1	51.1	2.9	5.6	19
	µg/l	D2Fe		-1.27	19.6	25	16.5	19.1	19.6	2.3	11.8	17
	µg/l	G3Fe		-0.91	32.1	15	29.9	32.0	32.2	2.2	6.8	18
K	mg/l	A1K		2.42	0.22	15	0.26	0.24	0.24	0.01	5.3	12
	mg/l	D2K		0.78	1.54	10	1.60	1.55	1.55	0.04	2.3	16
	mg/l	G3K		0.23	2.57	10	2.60	2.59	2.58	0.06	2.5	16
Mg	mg/l	A1K		-0.25	3.14	10	3.10	3.14	3.13	0.09	2.9	18
	mg/l	D2K		-1.11	1.80	10	1.70	1.80	1.80	0.06	3.4	17
	mg/l	G3K		-0.28	2.13	10	2.10	2.15	2.14	0.06	3.0	17
Mn	µg/l	A1Fe		-0.16	49.3	10	48.9	50.0	49.8	1.6	3.2	16
	µg/l	D2Fe		0.06	22.5	15	22.6	22.5	22.6	0.5	2.4	17
	µg/l	G3Fe		0.03	77.5	10	77.6	76.5	77.4	3.1	4.0	18
Na	mg/l	A1K		0.00	2.90	10	2.90	2.90	2.89	0.07	2.3	20
	mg/l	D2K		0.12	9.94	10	10.00	9.93	9.93	0.31	3.1	20
	mg/l	G3K		0.65	15.5	10	16.0	15.5	15.5	0.5	3.0	19
NO_3	mg/l	A1N		0.28	4.26	10	4.32	4.27	4.26	0.12	2.8	17
	mg/l	D2N		-0.34	2.33	10	2.29	2.32	2.33	0.08	3.6	21
	mg/l	G3N		-0.13	3.02	10	3.00	3.01	3.02	0.12	3.8	21
pH		A1P		0.00	7.26	2.8	7.26	7.28	7.27	0.03	0.4	33
		D2PJ		0.10	7.90	2.5	7.91	7.90	7.90	0.08	1.0	32
		G3PJ		-0.51	7.33	2.7	7.28	7.33	7.33	0.11	1.4	32
SO_4	mg/l	A1CS		-0.77	7.02	10	6.75	7.07	7.05	0.18	2.6	22
	mg/l	D2CS		-0.61	19.8	10	19.2	19.9	19.8	0.5	2.6	22
	mg/l	G3CS		-0.67	10.2	10	9.9	10.1	10.1	0.4	3.6	20
TOC	mg/l	A1T		0.34	2.32	10	2.36	2.39	2.39	0.11	4.5	16
	mg/l	D2T		-0.49	1.63	20	1.55	1.64	1.64	0.18	10.7	14
	mg/l	G3T		-0.10	2.68	15	2.66	2.67	2.68	0.19	7.2	16
Turbidity	FNU	A1S		0.07	0.24	25	0.24	0.23	0.24	0.03	11.6	22
	FNU	D2S			0.12	40	< 0.2	0.12	0.12	0.02	19.5	16
	FNU	G3S		-0.40	0.24	35	0.22	0.23	0.24	0.04	16.3	21

Participant 4												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
Cl	mg/l	A1CS		1.19	15.1	10	16.00	15.03	15.12	0.48	3.1	26
	mg/l	D2CS		1.82	11.0	10	12.0	10.9	11.1	0.5	4.4	25
Conductivity	µS/cm	A1J		0.10	393	5	394	395	394	4	1.0	31
	µS/cm	D2PJ		0.00	178	5	178	179	178	2	1.3	29
Fe	µg/l	A1Fe		0.43	52.3	15	54.0	51.1	51.1	2.9	5.6	19
	µg/l	D2Fe		2.20	19.6	25	25.0	19.1	19.6	2.3	11.8	17
pH		A1P		0.39	7.26	2.8	7.30	7.28	7.27	0.03	0.4	33
		D2PJ		-1.01	7.90	2.5	7.80	7.90	7.90	0.08	1.0	32

Participant 5												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
Conductivity	µS/cm	A1J		0.10	393	5	394	395	394	4	1.0	31
	µS/cm	D2PJ		0.00	178	5	178	179	178	2	1.3	29
	µS/cm	G3PJ		0.00	158	5	158	158	158	2	1.4	29
pH		A1P		0.30	7.26	2.8	7.29	7.28	7.27	0.03	0.4	33
		D2PJ		0.20	7.90	2.5	7.92	7.90	7.90	0.08	1.0	32
		G3PJ		1.01	7.33	2.7	7.43	7.33	7.33	0.11	1.4	32
Turbidity	FNU	A1S		-1.47	0.24	25	0.20	0.23	0.24	0.03	11.6	22
	FNU	D2S		-0.96	0.12	40	0.10	0.12	0.12	0.02	19.5	16
	FNU	G3S		0.50	0.24	35	0.26	0.23	0.24	0.04	16.3	21

Participant 6												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
Alkalinity	mmol/l	A1A		2.18	0.19	15	0.22	0.19	0.19	0.01	3.5	15
	mmol/l	D2A		0.33	0.91	10	0.93	0.92	0.91	0.03	3.2	22
	mmol/l	G3A		1.57	0.59	8	0.63	0.59	0.59	0.02	3.8	22
Ca	mg/l	A1K		6.27	2.04	10	2.68	2.03	2.03	0.06	2.7	17
	mg/l	D2K		0.61	23.0	10	23.7	23.0	23.0	0.9	4.0	17
	mg/l	G3K		2.14	10.3	10	11.4	10.3	10.3	0.6	5.6	18
Cl	mg/l	A1CS		-1.19	15.1	10	14.20	15.03	15.12	0.48	3.1	26
	mg/l	D2CS		-0.55	11.0	10	10.7	10.9	11.1	0.5	4.4	25
	mg/l	G3CS		-0.92	23.9	10	22.8	23.8	23.8	0.8	3.3	25
Conductivity	µS/cm	A1J		0.31	393	5	396	395	394	4	1.0	31
	µS/cm	D2PJ		1.46	178	5	185	179	178	2	1.3	29
	µS/cm	G3PJ		0.86	158	5	161	158	158	2	1.4	29
F	mg/l	A1F		0.18	1.12	10	1.13	1.12	1.12	0.05	4.0	19
	mg/l	D2F		0.00	0.25	15	0.25	0.25	0.25	0.01	2.4	18
	mg/l	G3F		0.60	0.38	15	0.40	0.38	0.38	0.02	5.7	20
Fe	µg/l	A1Fe		0.31	52.3	15	53.5	51.1	51.1	2.9	5.6	19
	µg/l	D2Fe		0.20	19.6	25	20.1	19.1	19.6	2.3	11.8	17
	µg/l	G3Fe		3.66	32.1	15	40.9	32.0	32.2	2.2	6.8	18
Mg	mg/l	A1K		-0.19	3.14	10	3.11	3.14	3.13	0.09	2.9	18
	mg/l	D2K		-6.67	1.80	10	1.20	1.80	1.80	0.06	3.4	17
	mg/l	G3K		-5.26	2.13	10	1.57	2.15	2.14	0.06	3.0	17
Mn	µg/l	A1Fe		0.49	49.3	10	50.5	50.0	49.8	1.6	3.2	16
	µg/l	D2Fe		-0.12	22.5	15	22.3	22.5	22.6	0.5	2.4	17
	µg/l	G3Fe		0.18	77.5	10	78.2	76.5	77.4	3.1	4.0	18

Participant 6												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
NH_4	mg/l	A1N		-0.62	0.13	10	0.13	0.13	0.13	0.01	4.0	15
	mg/l	D2N		0.69	0.058	20	0.062	0.058	0.058	0.006	10.4	16
	mg/l	G3N		-0.05	0.081	15	0.081	0.080	0.080	0.003	4.0	18
NO_2	mg/l	A1N		0.71	0.059	10	0.061	0.058	0.059	0.002	3.9	15
	mg/l	D2N		-0.91	0.11	10	0.11	0.11	0.11	0.00	4.1	17
	mg/l	G3N		-0.14	0.077	15	0.076	0.077	0.077	0.004	5.4	15
NO_3	mg/l	A1N		0.05	4.26	10	4.27	4.27	4.26	0.12	2.8	17
	mg/l	D2N		-0.43	2.33	10	2.28	2.32	2.33	0.08	3.6	21
	mg/l	G3N		-0.40	3.02	10	2.96	3.01	3.02	0.12	3.8	21
pH		A1P		0.49	7.26	2.8	7.31	7.28	7.27	0.03	0.4	33
		D2PJ		2.03	7.90	2.5	8.10	7.90	7.90	0.08	1.0	32
		G3PJ		2.22	7.33	2.7	7.55	7.33	7.33	0.11	1.4	32
SO_4	mg/l	A1CS		-0.17	7.02	10	6.96	7.07	7.05	0.18	2.6	22
	mg/l	D2CS		-0.51	19.8	10	19.3	19.9	19.8	0.5	2.6	22
	mg/l	G3CS		-0.20	10.2	10	10.1	10.1	10.1	0.4	3.6	20
Turbidity	FNU	A1S		-1.33	0.24	25	0.20	0.23	0.24	0.03	11.6	22
	FNU	D2S		-3.38	0.12	40	0.04	0.12	0.12	0.02	19.5	16
	FNU	G3S		-2.71	0.24	35	0.13	0.23	0.24	0.04	16.3	21

Participant 7												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
Alkalinity	mmol/l	A1A		3.86	0.19	15	0.25	0.19	0.19	0.01	3.5	15
	mmol/l	D2A		0.97	0.91	10	0.95	0.92	0.91	0.03	3.2	22
	mmol/l	G3A		1.65	0.59	8	0.63	0.59	0.59	0.02	3.8	22
Ca	mg/l	A1K		0.88	2.04	10	2.13	2.03	2.03	0.06	2.7	17
	mg/l	D2K		0.96	23.0	10	24.1	23.0	23.0	0.9	4.0	17
	mg/l	G3K		0.78	10.3	10	10.7	10.3	10.3	0.6	5.6	18
Cl	mg/l	A1CS		-0.94	15.1	10	14.39	15.03	15.12	0.48	3.1	26
	mg/l	D2CS		-0.24	11.0	10	10.9	10.9	11.1	0.5	4.4	25
	mg/l	G3CS		-0.38	23.9	10	23.5	23.8	23.8	0.8	3.3	25
F	mg/l	A1F		-0.95	1.12	10	1.07	1.12	1.12	0.05	4.0	19
	mg/l	D2F		2.51	0.25	15	0.30	0.25	0.25	0.01	2.4	18
	mg/l	G3F		1.09	0.38	15	0.41	0.38	0.38	0.02	5.7	20
K	mg/l	A1K		1.03	0.22	15	0.24	0.24	0.24	0.01	5.3	12
	mg/l	D2K		2.60	1.54	10	1.74	1.55	1.55	0.04	2.3	16
	mg/l	G3K		3.04	2.57	10	2.96	2.59	2.58	0.06	2.5	16
Mg	mg/l	A1K		-0.38	3.14	10	3.08	3.14	3.13	0.09	2.9	18
	mg/l	D2K		-0.11	1.80	10	1.79	1.80	1.80	0.06	3.4	17
	mg/l	G3K		0.09	2.13	10	2.14	2.15	2.14	0.06	3.0	17
Na	mg/l	A1K		0.28	2.90	10	2.94	2.90	2.89	0.07	2.3	20
	mg/l	D2K		-0.20	9.94	10	9.84	9.93	9.93	0.31	3.1	20
	mg/l	G3K		-0.13	15.5	10	15.4	15.5	15.5	0.5	3.0	19
NO_2	mg/l	A1N		15.59	0.059	10	0.105	0.058	0.059	0.002	3.9	15
	mg/l	D2N		1.27	0.11	10	0.12	0.11	0.11	0.00	4.1	17
NO_3	mg/l	A1N		0.20	4.26	10	4.30	4.27	4.26	0.12	2.8	17
	mg/l	D2N		0.64	2.33	10	2.41	2.32	2.33	0.08	3.6	21
	mg/l	G3N		0.31	3.02	10	3.07	3.01	3.02	0.12	3.8	21

Participant 7												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2×s_{pt} %	Participant's result	Md	Mean	s	s %	n_{stat}
SO_4	mg/l	A1CS		0.36	7.02	10	7.15	7.07	7.05	0.18	2.6	22
	mg/l	D2CS		0.44	19.8	10	20.2	19.9	19.8	0.5	2.6	22
	mg/l	G3CS		-0.20	10.2	10	10.1	10.1	10.1	0.4	3.6	20

Participant 8												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2×s_{pt} %	Participant's result	Md	Mean	s	s %	n_{stat}
Alkalinity	mmol/l	A1A		3.02	0.19	15	0.23	0.19	0.19	0.01	3.5	15
	mmol/l	D2A		1.03	0.91	10	0.96	0.92	0.91	0.03	3.2	22
	mmol/l	G3A		1.91	0.59	8	0.64	0.59	0.59	0.02	3.8	22
Ca	mg/l	A1K		-0.59	2.04	10	1.98	2.03	2.03	0.06	2.7	17
	mg/l	D2K		1.13	23.0	10	24.3	23.0	23.0	0.9	4.0	17
	mg/l	G3K		0.78	10.3	10	10.7	10.3	10.3	0.6	5.6	18
Cl	mg/l	A1CS		-0.26	15.1	10	14.90	15.03	15.12	0.48	3.1	26
	mg/l	D2CS		-0.91	11.0	10	10.5	10.9	11.1	0.5	4.4	25
	mg/l	G3CS		-0.84	23.9	10	22.9	23.8	23.8	0.8	3.3	25
Conductivity	µS/cm	A1J		0.51	393	5	398	395	394	4	1.0	31
	µS/cm	D2PJ		-1.12	178	5	173	179	178	2	1.3	29
	µS/cm	G3PJ		-1.52	158	5	152	158	158	2	1.4	29
F	mg/l	A1F		6.43	1.12	10	1.48	1.12	1.12	0.05	4.0	19
	mg/l	D2F		0.11	0.25	15	0.25	0.25	0.25	0.01	2.4	18
	mg/l	G3F		-0.25	0.38	15	0.37	0.38	0.38	0.02	5.7	20
Fe	µg/l	A1Fe		0.38	52.3	15	53.8	51.1	51.1	2.9	5.6	19
	µg/l	D2Fe		-0.49	19.6	25	18.4	19.1	19.6	2.3	11.8	17
	µg/l	G3Fe		0.62	32.1	15	33.6	32.0	32.2	2.2	6.8	18
K	mg/l	A1K			0.22	15	*<1.0*	0.24	0.24	0.01	5.3	12
	mg/l	D2K		1.04	1.54	10	1.62	1.55	1.55	0.04	2.3	16
	mg/l	G3K		0.78	2.57	10	2.67	2.59	2.58	0.06	2.5	16
Mg	mg/l	A1K		1.27	3.14	10	3.34	3.14	3.13	0.09	2.9	18
	mg/l	D2K		1.00	1.80	10	1.89	1.80	1.80	0.06	3.4	17
	mg/l	G3K		1.13	2.13	10	2.25	2.15	2.14	0.06	3.0	17
Mn	µg/l	A1Fe		1.01	49.3	10	51.8	50.0	49.8	1.6	3.2	16
	µg/l	D2Fe		-0.06	22.5	15	22.4	22.5	22.6	0.5	2.4	17
	µg/l	G3Fe		0.28	77.5	10	78.6	76.5	77.4	3.1	4.0	18
Na	mg/l	A1K		0.62	2.90	10	2.99	2.90	2.89	0.07	2.3	20
	mg/l	D2K		0.72	9.94	10	10.30	9.93	9.93	0.31	3.1	20
	mg/l	G3K		0.77	15.5	10	16.1	15.5	15.5	0.5	3.0	19
NH_4	mg/l	A1N			0.13	10	*<0.50*	0.13	0.13	0.01	4.0	15
	mg/l	D2N			0.058	20	*<0.50*	0.058	0.058	0.006	10.4	16
	mg/l	G3N			0.081	15	*<0.50*	0.080	0.080	0.003	4.0	18
NO_2	mg/l	A1N			0.059	10	*<0.50*	0.058	0.059	0.002	3.9	15
	mg/l	D2N			0.11	10	*<0.50*	0.11	0.11	0.00	4.1	17
	mg/l	G3N			0.077	15	*<0.50*	0.077	0.077	0.004	5.4	15
NO_3	mg/l	A1N		2.16	4.26	10	4.72	4.27	4.26	0.12	2.8	17
	mg/l	D2N		0.60	2.33	10	2.40	2.32	2.33	0.08	3.6	21
	mg/l	G3N		0.79	3.02	10	3.14	3.01	3.02	0.12	3.8	21
pH		A1P		-0.20	7.26	2.8	7.24	7.28	7.27	0.03	0.4	33
		D2PJ		-0.61	7.90	2.5	7.84	7.90	7.90	0.08	1.0	32
		G3PJ		-1.41	7.33	2.7	7.19	7.33	7.33	0.11	1.4	32

Participant 8												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
SO_4	mg/l	A1CS		0.20	7.02	10	7.09	7.07	7.05	0.18	2.6	22
	mg/l	D2CS		0.40	19.8	10	20.2	19.9	19.8	0.5	2.6	22
	mg/l	G3CS		0.59	10.2	10	10.5	10.1	10.1	0.4	3.6	20
TOC	mg/l	A1T		0.17	2.32	10	2.34	2.39	2.39	0.11	4.5	16
	mg/l	D2T		0.00	1.63	20	1.63	1.64	1.64	0.18	10.7	14
	mg/l	G3T		-0.60	2.68	15	2.56	2.67	2.68	0.19	7.2	16

Participant 9												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
Alkalinity	mmol/l	A1A		0.49	0.19	15	0.20	0.19	0.19	0.01	3.5	15
	mmol/l	D2A		0.81	0.91	10	0.95	0.92	0.91	0.03	3.2	22
	mmol/l	G3A		0.17	0.59	8	0.59	0.59	0.59	0.02	3.8	22
Ca	mg/l	A1K		0.20	2.04	10	2.06	2.03	2.03	0.06	2.7	17
	mg/l	D2K		0.17	23.0	10	23.2	23.0	23.0	0.9	4.0	17
	mg/l	G3K		0.00	10.3	10	10.3	10.3	10.3	0.6	5.6	18
Cl	mg/l	A1CS		0.66	15.1	10	15.60	15.03	15.12	0.48	3.1	26
	mg/l	D2CS		1.27	11.0	10	11.7	10.9	11.1	0.5	4.4	25
	mg/l	G3CS		0.08	23.9	10	24.0	23.8	23.8	0.8	3.3	25
Conductivity	µS/cm	A1J		0.81	393	5	401	395	394	4	1.0	31
	µS/cm	D2PJ		1.12	178	5	183	179	178	2	1.3	29
	µS/cm	G3PJ		0.25	158	5	159	158	158	2	1.4	29
F	mg/l	A1F		0.18	1.12	10	1.13	1.12	1.12	0.05	4.0	19
	mg/l	D2F		0.48	0.25	15	0.26	0.25	0.25	0.01	2.4	18
	mg/l	G3F		0.70	0.38	15	0.40	0.38	0.38	0.02	5.7	20
Fe	µg/l	A1Fe		-0.15	52.3	15	51.7	51.1	51.1	2.9	5.6	19
	µg/l	D2Fe		1.96	19.6	25	24.4	19.1	19.6	2.3	11.8	17
	µg/l	G3Fe		0.33	32.1	15	32.9	32.0	32.2	2.2	6.8	18
K	mg/l	A1K		1.21	0.22	15	0.24	0.24	0.24	0.01	5.3	12
	mg/l	D2K		0.00	1.54	10	1.54	1.55	1.55	0.04	2.3	16
	mg/l	G3K		-1.09	2.57	10	2.43	2.59	2.58	0.06	2.5	16
Mg	mg/l	A1K		-0.06	3.14	10	3.13	3.14	3.13	0.09	2.9	18
	mg/l	D2K		0.56	1.80	10	1.85	1.80	1.80	0.06	3.4	17
	mg/l	G3K		0.47	2.13	10	2.18	2.15	2.14	0.06	3.0	17
Mn	µg/l	A1Fe		0.89	49.3	10	51.5	50.0	49.8	1.6	3.2	16
	µg/l	D2Fe		0.41	22.5	15	23.2	22.5	22.6	0.5	2.4	17
	µg/l	G3Fe		0.70	77.5	10	80.2	76.5	77.4	3.1	4.0	18
Na	mg/l	A1K		-0.97	2.90	10	2.76	2.90	2.89	0.07	2.3	20
	mg/l	D2K		-0.87	9.94	10	9.51	9.93	9.93	0.31	3.1	20
	mg/l	G3K		-0.90	15.5	10	14.8	15.5	15.5	0.5	3.0	19
NH_4	mg/l	A1N		1.54	0.13	10	0.14	0.13	0.13	0.01	4.0	15
	mg/l	D2N		-1.62	0.058	20	0.049	0.058	0.058	0.006	10.4	16
	mg/l	G3N		0.21	0.081	15	0.082	0.080	0.080	0.003	4.0	18
NO_2	mg/l	A1N		-0.34	0.059	10	0.058	0.058	0.059	0.002	3.9	15
	mg/l	D2N		0.18	0.11	10	0.11	0.11	0.11	0.00	4.1	17
	mg/l	G3N		0.43	0.077	15	0.080	0.077	0.077	0.004	5.4	15
NO_3	mg/l	A1N		0.28	4.26	10	4.32	4.27	4.26	0.12	2.8	17
	mg/l	D2N		-0.17	2.33	10	2.31	2.32	2.33	0.08	3.6	21
	mg/l	G3N		0.07	3.02	10	3.03	3.01	3.02	0.12	3.8	21

Participant 9												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
pH		A1P		0.20	7.26	2.8	7.28	7.28	7.27	0.03	0.4	33
		D2PJ		1.82	7.90	2.5	8.08	7.90	7.90	0.08	1.0	32
		G3PJ		2.02	7.33	2.7	7.53	7.33	7.33	0.11	1.4	32
SO_4	mg/l	A1CS		0.83	7.02	10	7.31	7.07	7.05	0.18	2.6	22
	mg/l	D2CS		0.30	19.8	10	20.1	19.9	19.8	0.5	2.6	22
	mg/l	G3CS		0.78	10.2	10	10.6	10.1	10.1	0.4	3.6	20
TOC	mg/l	A1T		4.22	2.32	10	2.81	2.39	2.39	0.11	4.5	16
	mg/l	D2T		0.86	1.63	20	1.77	1.64	1.64	0.18	10.7	14
	mg/l	G3T		1.04	2.68	15	2.89	2.67	2.68	0.19	7.2	16
Turbidity	FNU	A1S		1.13	0.24	25	0.27	0.23	0.24	0.03	11.6	22
	FNU	D2S		1.75	0.12	40	0.16	0.12	0.12	0.02	19.5	16
	FNU	G3S		1.88	0.24	35	0.32	0.23	0.24	0.04	16.3	21

Participant 10												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
Alkalinity	mmol/l	A1A		0.00	0.19	15	0.19	0.19	0.19	0.01	3.5	15
	mmol/l	D2A		0.44	0.91	10	0.93	0.92	0.91	0.03	3.2	22
	mmol/l	G3A		0.42	0.59	8	0.60	0.59	0.59	0.02	3.8	22
Ca	mg/l	A1K		0.20	2.04	10	2.06	2.03	2.03	0.06	2.7	17
	mg/l	D2K		-0.26	23.0	10	22.7	23.0	23.0	0.9	4.0	17
	mg/l	G3K		-0.39	10.3	10	10.1	10.3	10.3	0.6	5.6	18
Cl	mg/l	A1CS		1.06	15.1	10	15.90	15.03	15.12	0.48	3.1	26
	mg/l	D2CS		1.64	11.0	10	11.9	10.9	11.1	0.5	4.4	25
	mg/l	G3CS		1.34	23.9	10	25.5	23.8	23.8	0.8	3.3	25
Conductivity	µS/cm	A1J		-1.53	393	5	378	395	394	4	1.0	31
	µS/cm	D2PJ		-0.45	178	5	176	179	178	2	1.3	29
	µS/cm	G3PJ		-0.76	158	5	155	158	158	2	1.4	29
F	mg/l	A1F		0.54	1.12	10	1.15	1.12	1.12	0.05	4.0	19
	mg/l	D2F		1.60	0.25	15	0.28	0.25	0.25	0.01	2.4	18
	mg/l	G3F		0.70	0.38	15	0.40	0.38	0.38	0.02	5.7	20
Fe	µg/l	A1Fe		-0.56	52.3	15	50.1	51.1	51.1	2.9	5.6	19
	µg/l	D2Fe		-0.86	19.6	25	17.5	19.1	19.6	2.3	11.8	17
	µg/l	G3Fe		-0.29	32.1	15	31.4	32.0	32.2	2.2	6.8	18
K	mg/l	A1K		6.06	0.22	15	0.32	0.24	0.24	0.01	5.3	12
	mg/l	D2K		0.00	1.54	10	1.54	1.55	1.55	0.04	2.3	16
	mg/l	G3K		-0.23	2.57	10	2.54	2.59	2.58	0.06	2.5	16
Mg	mg/l	A1K		0.64	3.14	10	3.24	3.14	3.13	0.09	2.9	18
	mg/l	D2K		0.78	1.80	10	1.87	1.80	1.80	0.06	3.4	17
	mg/l	G3K		0.75	2.13	10	2.21	2.15	2.14	0.06	3.0	17
Mn	µg/l	A1Fe		0.20	49.3	10	49.8	50.0	49.8	1.6	3.2	16
	µg/l	D2Fe		0.30	22.5	15	23.0	22.5	22.6	0.5	2.4	17
	µg/l	G3Fe		0.21	77.5	10	78.3	76.5	77.4	3.1	4.0	18
Na	mg/l	A1K		0.00	2.90	10	2.90	2.90	2.89	0.07	2.3	20
	mg/l	D2K		-0.30	9.94	10	9.79	9.93	9.93	0.31	3.1	20
	mg/l	G3K		-0.26	15.5	10	15.3	15.5	15.5	0.5	3.0	19
NH_4	mg/l	A1N		0.46	0.13	10	0.13	0.13	0.13	0.01	4.0	15
	mg/l	D2N		0.86	0.058	20	0.063	0.058	0.058	0.006	10.4	16
	mg/l	G3N		0.16	0.081	15	0.082	0.080	0.080	0.003	4.0	18

Participant 10												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
NO_2	mg/l	A1N		-0.34	0.059	10	0.058	0.058	0.059	0.002	3.9	15
	mg/l	D2N		-0.55	0.11	10	0.11	0.11	0.11	0.00	4.1	17
	mg/l	G3N		0.00	0.077	15	0.077	0.077	0.077	0.004	5.4	15
NO_3	mg/l	A1N		0.94	4.26	10	4.46	4.27	4.26	0.12	2.8	17
	mg/l	D2N		-3.00	2.33	10	1.98	2.32	2.33	0.08	3.6	21
	mg/l	G3N		-1.79	3.02	10	2.75	3.01	3.02	0.12	3.8	21
pH		A1P		-0.98	7.26	2.8	7.16	7.28	7.27	0.03	0.4	33
		D2PJ		-0.81	7.90	2.5	7.82	7.90	7.90	0.08	1.0	32
		G3PJ		1.82	7.33	2.7	7.51	7.33	7.33	0.11	1.4	32
SO_4	mg/l	A1CS		-0.09	7.02	10	6.99	7.07	7.05	0.18	2.6	22
	mg/l	D2CS		-0.20	19.8	10	19.6	19.9	19.8	0.5	2.6	22
	mg/l	G3CS		-0.39	10.2	10	10.0	10.1	10.1	0.4	3.6	20
TOC	mg/l	A1T		0.52	2.32	10	2.38	2.39	2.39	0.11	4.5	16
	mg/l	D2T		-0.67	1.63	20	1.52	1.64	1.64	0.18	10.7	14
	mg/l	G3T		-0.05	2.68	15	2.67	2.67	2.68	0.19	7.2	16
Turbidity	FNU	A1S		-0.33	0.24	25	0.23	0.23	0.24	0.03	11.6	22
	FNU	D2S		0.00	0.12	40	0.12	0.12	0.12	0.02	19.5	16
	FNU	G3S		0.24	0.24	35	0.25	0.23	0.24	0.04	16.3	21

Participant 11												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
Cl	mg/l	A1CS		-0.05	15.1	10	15.06	15.03	15.12	0.48	3.1	26
	mg/l	D2CS		-0.38	11.0	10	10.8	10.9	11.1	0.5	4.4	25
	mg/l	G3CS		-0.17	23.9	10	23.7	23.8	23.8	0.8	3.3	25
Conductivity	µS/cm	A1J		0.23	393	5	395	395	394	4	1.0	31
	µS/cm	D2PJ		0.11	178	5	179	179	178	2	1.3	29
	µS/cm	G3PJ		0.05	158	5	158	158	158	2	1.4	29
Fe	µg/l	A1Fe		-0.03	52.3	15	52.2	51.1	51.1	2.9	5.6	19
	µg/l	D2Fe		1.47	19.6	25	23.2	19.1	19.6	2.3	11.8	17
	µg/l	G3Fe		1.30	32.1	15	35.2	32.0	32.2	2.2	6.8	18
Mn	µg/l	A1Fe		1.12	49.3	10	52.1	50.0	49.8	1.6	3.2	16
	µg/l	D2Fe		0.49	22.5	15	23.3	22.5	22.6	0.5	2.4	17
	µg/l	G3Fe		0.74	77.5	10	80.4	76.5	77.4	3.1	4.0	18
Na	mg/l	A1K		0.63	2.90	10	2.99	2.90	2.89	0.07	2.3	20
	mg/l	D2K		0.77	9.94	10	10.32	9.93	9.93	0.31	3.1	20
	mg/l	G3K		0.60	15.5	10	16.0	15.5	15.5	0.5	3.0	19
NO_3	mg/l	A1N		2.96	4.26	10	4.89	4.27	4.26	0.12	2.8	17
	mg/l	D2N		1.03	2.33	10	2.45	2.32	2.33	0.08	3.6	21
	mg/l	G3N		1.59	3.02	10	3.26	3.01	3.02	0.12	3.8	21
pH		A1P		2.66	7.26	2.8	7.53	7.28	7.27	0.03	0.4	33
		D2PJ		1.11	7.90	2.5	8.01	7.90	7.90	0.08	1.0	32
		G3PJ		1.62	7.33	2.7	7.49	7.33	7.33	0.11	1.4	32
SO_4	mg/l	A1CS		-0.09	7.02	10	6.99	7.07	7.05	0.18	2.6	22
	mg/l	D2CS		0.95	19.8	10	20.7	19.9	19.8	0.5	2.6	22

Participant 12												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2×s_{pt} %	Participant's result	Md	Mean	s	s %	n_{stat}
Alkalinity	mmol/l	A1A		0.56	0.19	15	0.20	0.19	0.19	0.01	3.5	15
	mmol/l	D2A		-1.01	0.91	10	0.86	0.92	0.91	0.03	3.2	22
	mmol/l	G3A		-0.72	0.59	8	0.57	0.59	0.59	0.02	3.8	22
Ca	mg/l	A1K		-0.98	2.04	10	1.94	2.03	2.03	0.06	2.7	17
	mg/l	D2K		0.87	23.0	10	24.0	23.0	23.0	0.9	4.0	17
	mg/l	G3K		0.78	10.3	10	10.7	10.3	10.3	0.6	5.6	18
Cl	mg/l	A1CS		0.00	15.1	10	15.10	15.03	15.12	0.48	3.1	26
	mg/l	D2CS		-0.36	11.0	10	10.8	10.9	11.1	0.5	4.4	25
	mg/l	G3CS		-0.25	23.9	10	23.6	23.8	23.8	0.8	3.3	25
Conductivity	µS/cm	A1J		-0.81	393	5	385	395	394	4	1.0	31
	µS/cm	D2PJ		-0.67	178	5	175	179	178	2	1.3	29
	µS/cm	G3PJ		-0.76	158	5	155	158	158	2	1.4	29
F	mg/l	A1F		0.00	1.12	10	1.12	1.12	1.12	0.05	4.0	19
	mg/l	D2F		0.00	0.25	15	0.25	0.25	0.25	0.01	2.4	18
	mg/l	G3F		0.00	0.38	15	0.38	0.38	0.38	0.02	5.7	20
K	mg/l	A1K		-1.21	0.22	15	0.20	0.24	0.24	0.01	5.3	12
	mg/l	D2K		0.52	1.54	10	1.58	1.55	1.55	0.04	2.3	16
	mg/l	G3K		0.16	2.57	10	2.59	2.59	2.58	0.06	2.5	16
Mg	mg/l	A1K		-0.70	3.14	10	3.03	3.14	3.13	0.09	2.9	18
	mg/l	D2K		-0.67	1.80	10	1.74	1.80	1.80	0.06	3.4	17
	mg/l	G3K		-0.28	2.13	10	2.10	2.15	2.14	0.06	3.0	17
Na	mg/l	A1K		0.14	2.90	10	2.92	2.90	2.89	0.07	2.3	20
	mg/l	D2K		0.52	9.94	10	10.20	9.93	9.93	0.31	3.1	20
	mg/l	G3K		0.65	15.5	10	16.0	15.5	15.5	0.5	3.0	19
NH_4	mg/l	A1N		4.00	0.13	10	0.16	0.13	0.13	0.01	4.0	15
	mg/l	D2N		3.10	0.058	20	0.076	0.058	0.058	0.006	10.4	16
	mg/l	G3N		2.80	0.081	15	0.098	0.080	0.080	0.003	4.0	18
NO_3	mg/l	A1N		-1.30	4.26	10	3.98	4.27	4.26	0.12	2.8	17
	mg/l	D2N		0.90	2.33	10	2.44	2.32	2.33	0.08	3.6	21
	mg/l	G3N		-0.07	3.02	10	3.01	3.01	3.02	0.12	3.8	21
pH		A1P		-0.30	7.26	2.8	7.23	7.28	7.27	0.03	0.4	33
		D2PJ		-0.91	7.90	2.5	7.81	7.90	7.90	0.08	1.0	32
		G3PJ		0.10	7.33	2.7	7.34	7.33	7.33	0.11	1.4	32
SO_4	mg/l	A1CS		-0.85	7.02	10	6.72	7.07	7.05	0.18	2.6	22
	mg/l	D2CS		-0.71	19.8	10	19.1	19.9	19.8	0.5	2.6	22
	mg/l	G3CS		-1.02	10.2	10	9.7	10.1	10.1	0.4	3.6	20
TOC	mg/l	A1T		0.69	2.32	10	2.40	2.39	2.39	0.11	4.5	16
	mg/l	D2T		-0.80	1.63	20	1.50	1.64	1.64	0.18	10.7	14
	mg/l	G3T		-0.40	2.68	15	2.60	2.67	2.68	0.19	7.2	16
Turbidity	FNU	A1S		3.33	0.24	25	0.34	0.23	0.24	0.03	11.6	22
	FNU	D2S			0.12	40	*<0.30*	0.12	0.12	0.02	19.5	16
	FNU	G3S		2.86	0.24	35	0.36	0.23	0.24	0.04	16.3	21

Participant 13												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
Ca	mg/l	A1K		-0.59	2.04	10	1.98	2.03	2.03	0.06	2.7	17
	mg/l	D2K		-0.78	23.0	10	22.1	23.0	23.0	0.9	4.0	17
	mg/l	G3K		-1.26	10.3	10	9.7	10.3	10.3	0.6	5.6	18
Fe	µg/l	A1Fe		0.03	52.3	15	52.4	51.1	51.1	2.9	5.6	19
	µg/l	D2Fe		0.16	19.6	25	20.0	19.1	19.6	2.3	11.8	17
	µg/l	G3Fe		-0.08	32.1	15	31.9	32.0	32.2	2.2	6.8	18
K	mg/l	A1K		0.55	0.22	15	0.23	0.24	0.24	0.01	5.3	12
	mg/l	D2K		-0.39	1.54	10	1.51	1.55	1.55	0.04	2.3	16
	mg/l	G3K		0.16	2.57	10	2.59	2.59	2.58	0.06	2.5	16
Mg	mg/l	A1K		-0.45	3.14	10	3.07	3.14	3.13	0.09	2.9	18
	mg/l	D2K		-0.56	1.80	10	1.75	1.80	1.80	0.06	3.4	17
	mg/l	G3K		-0.38	2.13	10	2.09	2.15	2.14	0.06	3.0	17
Mn	µg/l	A1Fe		1.18	49.3	10	52.2	50.0	49.8	1.6	3.2	16
	µg/l	D2Fe		0.06	22.5	15	22.6	22.5	22.6	0.5	2.4	17
	µg/l	G3Fe		-0.59	77.5	10	75.2	76.5	77.4	3.1	4.0	18
Na	mg/l	A1K		-0.62	2.90	10	2.81	2.90	2.89	0.07	2.3	20
	mg/l	D2K		-0.44	9.94	10	9.72	9.93	9.93	0.31	3.1	20
	mg/l	G3K		-0.26	15.5	10	15.3	15.5	15.5	0.5	3.0	19

Participant 14												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
Alkalinity	mmol/l	A1A		1.40	0.19	15	0.21	0.19	0.19	0.01	3.5	15
	mmol/l	D2A		0.66	0.91	10	0.94	0.92	0.91	0.03	3.2	22
	mmol/l	G3A		0.00	0.59	8	0.59	0.59	0.59	0.02	3.8	22
Cl	mg/l	A1CS		0.53	15.1	10	15.50	15.03	15.12	0.48	3.1	26
	mg/l	D2CS		0.18	11.0	10	11.1	10.9	11.1	0.5	4.4	25
	mg/l	G3CS		0.17	23.9	10	24.1	23.8	23.8	0.8	3.3	25
Conductivity	µS/cm	A1J		-0.10	393	5	392	395	394	4	1.0	31
	µS/cm	D2PJ		0.13	178	5	179	179	178	2	1.3	29
	µS/cm	G3PJ		0.05	158	5	158	158	158	2	1.4	29
F	mg/l	A1F		-0.18	1.12	10	1.11	1.12	1.12	0.05	4.0	19
	mg/l	D2F		0.00	0.25	15	0.25	0.25	0.25	0.01	2.4	18
	mg/l	G3F		-0.35	0.38	15	0.37	0.38	0.38	0.02	5.7	20
NH_4	mg/l	A1N		0.77	0.13	10	0.14	0.13	0.13	0.01	4.0	15
	mg/l	D2N		-0.69	0.058	20	0.054	0.058	0.058	0.006	10.4	16
	mg/l	G3N		-0.33	0.081	15	0.079	0.080	0.080	0.003	4.0	18
NO_2	mg/l	A1N		-0.68	0.059	10	0.057	0.058	0.059	0.002	3.9	15
	mg/l	D2N		-1.09	0.11	10	0.10	0.11	0.11	0.00	4.1	17
	mg/l	G3N		-0.52	0.077	15	0.074	0.077	0.077	0.004	5.4	15
NO_3	mg/l	A1N		1.46	4.26	10	4.57	4.27	4.26	0.12	2.8	17
	mg/l	D2N		0.34	2.33	10	2.37	2.32	2.33	0.08	3.6	21
	mg/l	G3N		0.40	3.02	10	3.08	3.01	3.02	0.12	3.8	21
pH		A1P		-0.10	7.26	2.8	7.25	7.28	7.27	0.03	0.4	33
		D2PJ		0.00	7.90	2.5	7.90	7.90	7.90	0.08	1.0	32
		G3PJ		0.00	7.33	2.7	7.33	7.33	7.33	0.11	1.4	32
Turbidity	FNU	A1S		-0.50	0.24	25	0.23	0.23	0.24	0.03	11.6	22
	FNU	D2S		-0.25	0.12	40	0.11	0.12	0.12	0.02	19.5	16
	FNU	G3S		-0.38	0.24	35	0.22	0.23	0.24	0.04	16.3	21

Participant 15												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
Ca	mg/l	A1K		-0.20	2.04	10	2.02	2.03	2.03	0.06	2.7	17
K	mg/l	A1K		2.18	0.22	15	0.26	0.24	0.24	0.01	5.3	12
Mg	mg/l	A1K		0.19	3.14	10	3.17	3.14	3.13	0.09	2.9	18
Na	mg/l	A1K		-0.48	2.90	10	2.83	2.90	2.89	0.07	2.3	20
NH_4	mg/l	A1N		-3.38	0.13	10	0.11	0.13	0.13	0.01	4.0	15

Participant 16												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
Cl	mg/l	A1CS		0.26	15.1	10	15.30	15.03	15.12	0.48	3.1	26
	mg/l	D2CS		0.36	11.0	10	11.2	10.9	11.1	0.5	4.4	25
	mg/l	G3CS		0.17	23.9	10	24.1	23.8	23.8	0.8	3.3	25
Conductivity	µS/cm	A1J		0.00	393	5	393	395	394	4	1.0	31
	µS/cm	D2PJ		0.45	178	5	180	179	178	2	1.3	29
	µS/cm	G3PJ		0.25	158	5	159	158	158	2	1.4	29
NH_4	mg/l	A1N		1.54	0.13	10	0.14	0.13	0.13	0.01	4.0	15
	mg/l	D2N		-1.38	0.058	20	0.050	0.058	0.058	0.006	10.4	16
	mg/l	G3N		-0.16	0.081	15	0.080	0.080	0.080	0.003	4.0	18
NO_2	mg/l	A1N			0.059	10	*<0.05*	0.058	0.059	0.002	3.9	15
	mg/l	D2N		-1.82	0.11	10	0.10	0.11	0.11	0.00	4.1	17
	mg/l	G3N		-1.21	0.077	15	0.070	0.077	0.077	0.004	5.4	15
NO_3	mg/l	A1N		3.71	4.26	10	5.05	4.27	4.26	0.12	2.8	17
	mg/l	D2N		5.49	2.33	10	2.97	2.32	2.33	0.08	3.6	21
	mg/l	G3N		6.69	3.02	10	4.03	3.01	3.02	0.12	3.8	21
SO_4	mg/l	A1CS		0.66	7.02	10	7.25	7.07	7.05	0.18	2.6	22
	mg/l	D2CS		0.10	19.8	10	19.9	19.9	19.8	0.5	2.6	22
	mg/l	G3CS		0.00	10.2	10	10.2	10.1	10.1	0.4	3.6	20

Participant 17												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
Alkalinity	mmol/l	A1A		0.07	0.19	15	0.19	0.19	0.19	0.01	3.5	15
	mmol/l	D2A		0.00	0.91	10	0.91	0.92	0.91	0.03	3.2	22
	mmol/l	G3A		-0.17	0.59	8	0.59	0.59	0.59	0.02	3.8	22
Cl	mg/l	A1CS		-0.53	15.1	10	14.70	15.03	15.12	0.48	3.1	26
	mg/l	D2CS		-0.73	11.0	10	10.6	10.9	11.1	0.5	4.4	25
	mg/l	G3CS		-0.75	23.9	10	23.0	23.8	23.8	0.8	3.3	25
Conductivity	µS/cm	A1J		-0.20	393	5	391	395	394	4	1.0	31
	µS/cm	D2PJ		-0.45	178	5	176	179	178	2	1.3	29
	µS/cm	G3PJ		-0.25	158	5	157	158	158	2	1.4	29
F	mg/l	A1F		-0.54	1.12	10	1.09	1.12	1.12	0.05	4.0	19
	mg/l	D2F		-0.21	0.25	15	0.25	0.25	0.25	0.01	2.4	18
	mg/l	G3F		-1.44	0.38	15	0.34	0.38	0.38	0.02	5.7	20
pH		A1P		0.20	7.26	2.8	7.28	7.28	7.27	0.03	0.4	33
		D2PJ		0.20	7.90	2.5	7.92	7.90	7.90	0.08	1.0	32
		G3PJ		0.00	7.33	2.7	7.33	7.33	7.33	0.11	1.4	32
SO_4	mg/l	A1CS		1.00	7.02	10	7.37	7.07	7.05	0.18	2.6	22
	mg/l	D2CS		-0.51	19.8	10	19.3	19.9	19.8	0.5	2.6	22
	mg/l	G3CS		-0.39	10.2	10	10.0	10.1	10.1	0.4	3.6	20

Participant 17												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
TOC	mg/l	A1T		0.09	2.32	10	2.33	2.39	2.39	0.11	4.5	16
	mg/l	D2T		-1.23	1.63	20	1.43	1.64	1.64	0.18	10.7	14
	mg/l	G3T		-0.95	2.68	15	2.49	2.67	2.68	0.19	7.2	16
Turbidity	FNU	A1S		-1.47	0.24	25	0.20	0.23	0.24	0.03	11.6	22
	FNU	D2S		-1.25	0.12	40	0.09	0.12	0.12	0.02	19.5	16
	FNU	G3S		0.52	0.24	35	0.26	0.23	0.24	0.04	16.3	21

Participant 18												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
Alkalinity	mmol/l	A1A		2.11	0.19	15	0.22	0.19	0.19	0.01	3.5	15
	mmol/l	D2A		0.66	0.91	10	0.94	0.92	0.91	0.03	3.2	22
	mmol/l	G3A		0.85	0.59	8	0.61	0.59	0.59	0.02	3.8	22
Ca	mg/l	A1K		5.39	2.04	10	2.59	2.03	2.03	0.06	2.7	17
	mg/l	D2K		3.22	23.0	10	26.7	23.0	23.0	0.9	4.0	17
	mg/l	G3K		2.72	10.3	10	11.7	10.3	10.3	0.6	5.6	18
Cl	mg/l	A1CS		-0.13	15.1	10	15.00	15.03	15.12	0.48	3.1	26
	mg/l	D2CS		0.00	11.0	10	11.0	10.9	11.1	0.5	4.4	25
	mg/l	G3CS		0.08	23.9	10	24.0	23.8	23.8	0.8	3.3	25
Conductivity	µS/cm	A1J		0.31	393	5	396	395	394	4	1.0	31
	µS/cm	D2PJ		0.45	178	5	180	179	178	2	1.3	29
	µS/cm	G3PJ		0.25	158	5	159	158	158	2	1.4	29
Fe	µg/l	A1Fe		-1.68	52.3	15	45.7	51.1	51.1	2.9	5.6	19
	µg/l	D2Fe		-3.14	19.6	25	11.9	19.1	19.6	2.3	11.8	17
	µg/l	G3Fe		-0.66	32.1	15	30.5	32.0	32.2	2.2	6.8	18
K	mg/l	A1K		-6.06	0.22	15	0.12	0.24	0.24	0.01	5.3	12
	mg/l	D2K		-1.69	1.54	10	1.41	1.55	1.55	0.04	2.3	16
	mg/l	G3K		0.47	2.57	10	2.63	2.59	2.58	0.06	2.5	16
Mg	mg/l	A1K		0.06	3.14	10	3.15	3.14	3.13	0.09	2.9	18
	mg/l	D2K		1.11	1.80	10	1.90	1.80	1.80	0.06	3.4	17
	mg/l	G3K		0.28	2.13	10	2.16	2.15	2.14	0.06	3.0	17
Mn	µg/l	A1Fe		3.08	49.3	10	56.9	50.0	49.8	1.6	3.2	16
	µg/l	D2Fe		1.36	22.5	15	24.8	22.5	22.6	0.5	2.4	17
	µg/l	G3Fe		1.96	77.5	10	85.1	76.5	77.4	3.1	4.0	18
Na	mg/l	A1K		0.00	2.90	10	2.90	2.90	2.89	0.07	2.3	20
	mg/l	D2K		0.32	9.94	10	10.10	9.93	9.93	0.31	3.1	20
	mg/l	G3K		0.39	15.5	10	15.8	15.5	15.5	0.5	3.0	19
NH_4	mg/l	A1N		38.46	0.13	10	0.38	0.13	0.13	0.01	4.0	15
	mg/l	D2N		21.03	0.058	20	0.180	0.058	0.058	0.006	10.4	16
	mg/l	G3N		14.65	0.081	15	0.170	0.080	0.080	0.003	4.0	18
NO_3	mg/l	A1N		0.19	4.26	10	4.30	4.27	4.26	0.12	2.8	17
	mg/l	D2N		-0.69	2.33	10	2.25	2.32	2.33	0.08	3.6	21
	mg/l	G3N		-0.33	3.02	10	2.97	3.01	3.02	0.12	3.8	21
pH		A1P		0.39	7.26	2.8	7.30	7.28	7.27	0.03	0.4	33
		D2PJ		0.61	7.90	2.5	7.96	7.90	7.90	0.08	1.0	32
		G3PJ		0.00	7.33	2.7	7.33	7.33	7.33	0.11	1.4	32
SO_4	mg/l	A1CS		-0.31	7.02	10	6.91	7.07	7.05	0.18	2.6	22
	mg/l	D2CS		0.20	19.8	10	20.0	19.9	19.8	0.5	2.6	22
	mg/l	G3CS		0.59	10.2	10	10.5	10.1	10.1	0.4	3.6	20

Participant 19												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2×s_{pt} %	Participant's result	Md	Mean	s	s %	n_{stat}
Alkalinity	mmol/l	A1A		2.32	0.19	15	0.22	0.19	0.19	0.01	3.5	15
	mmol/l	D2A		0.33	0.91	10	0.93	0.92	0.91	0.03	3.2	22
	mmol/l	G3A		0.85	0.59	8	0.61	0.59	0.59	0.02	3.8	22
Cl	mg/l	A1CS		1.39	15.1	10	16.15	15.03	15.12	0.48	3.1	26
	mg/l	D2CS		1.17	11.0	10	11.6	10.9	11.1	0.5	4.4	25
	mg/l	G3CS		1.06	23.9	10	25.2	23.8	23.8	0.8	3.3	25
Conductivity	µS/cm	A1J		-21.90	393	5	178	395	394	4	1.0	31
	µS/cm	D2PJ		-4.45	178	5	158	179	178	2	1.3	29
	µS/cm	G3PJ		59.24	158	5	392	158	158	2	1.4	29
F	mg/l	A1F		-1.18	1.12	10	1.05	1.12	1.12	0.05	4.0	19
	mg/l	D2F		0.21	0.25	15	0.25	0.25	0.25	0.01	2.4	18
	mg/l	G3F		-0.53	0.38	15	0.37	0.38	0.38	0.02	5.7	20
Fe	µg/l	A1Fe		-0.32	52.3	15	51.1	51.1	51.1	2.9	5.6	19
	µg/l	D2Fe		0.69	19.6	25	21.3	19.1	19.6	2.3	11.8	17
	µg/l	G3Fe		0.56	32.1	15	33.5	32.0	32.2	2.2	6.8	18
Mn	µg/l	A1Fe		-1.01	49.3	10	46.8	50.0	49.8	1.6	3.2	16
	µg/l	D2Fe		-1.24	22.5	15	20.4	22.5	22.6	0.5	2.4	17
	µg/l	G3Fe		-0.54	77.5	10	75.4	76.5	77.4	3.1	4.0	18
NH_4	mg/l	A1N		1.38	0.13	10	0.14	0.13	0.13	0.01	4.0	15
	mg/l	D2N		0.69	0.058	20	0.062	0.058	0.058	0.006	10.4	16
	mg/l	G3N		-0.16	0.081	15	0.080	0.080	0.080	0.003	4.0	18
NO_2	mg/l	A1N		-0.68	0.059	10	0.057	0.058	0.059	0.002	3.9	15
	mg/l	D2N		-1.27	0.11	10	0.10	0.11	0.11	0.00	4.1	17
	mg/l	G3N		-0.69	0.077	15	0.073	0.077	0.077	0.004	5.4	15
NO_3	mg/l	A1N		-0.42	4.26	10	4.17	4.27	4.26	0.12	2.8	17
	mg/l	D2N		-0.69	2.33	10	2.25	2.32	2.33	0.08	3.6	21
	mg/l	G3N		-0.73	3.02	10	2.91	3.01	3.02	0.12	3.8	21
pH		A1P		-0.89	7.26	2.8	7.17	7.28	7.27	0.03	0.4	33
		D2PJ		-0.51	7.90	2.5	7.85	7.90	7.90	0.08	1.0	32
		G3PJ		-1.21	7.33	2.7	7.21	7.33	7.33	0.11	1.4	32
SO_4	mg/l	A1CS		-0.95	7.02	10	6.69	7.07	7.05	0.18	2.6	22
	mg/l	D2CS		-0.66	19.8	10	19.1	19.9	19.8	0.5	2.6	22
	mg/l	G3CS		-0.76	10.2	10	9.8	10.1	10.1	0.4	3.6	20
TOC	mg/l	A1T		1.26	2.32	10	2.47	2.39	2.39	0.11	4.5	16
	mg/l	D2T		0.10	1.63	20	1.65	1.64	1.64	0.18	10.7	14
	mg/l	G3T		0.33	2.68	15	2.75	2.67	2.68	0.19	7.2	16
Turbidity	FNU	A1S		-0.73	0.24	25	0.22	0.23	0.24	0.03	11.6	22
	FNU	D2S		-0.25	0.12	40	0.11	0.12	0.12	0.02	19.5	16
	FNU	G3S		-0.83	0.24	35	0.21	0.23	0.24	0.04	16.3	21

Participant 20												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2×s_{pt} %	Participant's result	Md	Mean	s	s %	n_{stat}
Alkalinity	mmol/l	A1A		-3.02	0.19	15	0.15	0.19	0.19	0.01	3.5	15
	mmol/l	D2A		-9.10	0.91	10	0.50	0.92	0.91	0.03	3.2	22
	mmol/l	G3A		-10.47	0.59	8	0.34	0.59	0.59	0.02	3.8	22
Ca	mg/l	A1K		0.43	2.04	10	2.08	2.03	2.03	0.06	2.7	17
	mg/l	D2K		-1.14	23.0	10	21.7	23.0	23.0	0.9	4.0	17
	mg/l	G3K		-0.14	10.3	10	10.2	10.3	10.3	0.6	5.6	18

Participant 20												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
Cl	mg/l	A1CS		3.59	15.1	10	17.81	15.03	15.12	0.48	3.1	26
	mg/l	D2CS		3.97	11.0	10	13.2	10.9	11.1	0.5	4.4	25
	mg/l	G3CS		2.26	23.9	10	26.6	23.8	23.8	0.8	3.3	25
Conductivity	µS/cm	A1J		-25.90	393	5	139	395	394	4	1.0	31
	µS/cm	D2PJ		-9.08	178	5	138	179	178	2	1.3	29
	µS/cm	G3PJ		-22.04	158	5	71	158	158	2	1.4	29
Fe	µg/l	A1Fe		3.49	52.3	15	66.0	51.1	51.1	2.9	5.6	19
	µg/l	G3Fe		0.46	32.1	15	33.2	32.0	32.2	2.2	6.8	18
Mg	mg/l	A1K		-1.37	3.14	10	2.93	3.14	3.13	0.09	2.9	18
	mg/l	D2K		-0.10	1.80	10	1.79	1.80	1.80	0.06	3.4	17
	mg/l	G3K		-0.84	2.13	10	2.04	2.15	2.14	0.06	3.0	17
Mn	µg/l	A1Fe		0.28	49.3	10	50.0	50.0	49.8	1.6	3.2	16
	µg/l	D2Fe		-4.86	22.5	15	14.3	22.5	22.6	0.5	2.4	17
	µg/l	G3Fe		-13.81	77.5	10	24.0	76.5	77.4	3.1	4.0	18
Na	mg/l	A1K		0.65	2.90	10	2.99	2.90	2.89	0.07	2.3	20
	mg/l	D2K		0.05	9.94	10	9.97	9.93	9.93	0.31	3.1	20
	mg/l	G3K		2.30	15.5	10	17.3	15.5	15.5	0.5	3.0	19
NH_4	mg/l	A1N		16.00	0.13	10	0.23	0.13	0.13	0.01	4.0	15
	mg/l	D2N		15.52	0.058	20	0.148	0.058	0.058	0.006	10.4	16
	mg/l	G3N		14.81	0.081	15	0.171	0.080	0.080	0.003	4.0	18
NO_3	mg/l	A1N		0.09	4.26	10	4.28	4.27	4.26	0.12	2.8	17
	mg/l	D2N		-16.09	2.33	10	0.46	2.32	2.33	0.08	3.6	21
	mg/l	G3N		1.36	3.02	10	3.23	3.01	3.02	0.12	3.8	21
pH		A1P		-2.75	7.26	2.8	6.98	7.28	7.27	0.03	0.4	33
		D2PJ		-0.81	7.90	2.5	7.82	7.90	7.90	0.08	1.0	32
		G3PJ		-2.02	7.33	2.7	7.13	7.33	7.33	0.11	1.4	32
SO_4	mg/l	A1CS		-8.50	7.02	10	4.04	7.07	7.05	0.18	2.6	22
	mg/l	D2CS		-4.71	19.8	10	15.1	19.9	19.8	0.5	2.6	22
	mg/l	G3CS		-7.57	10.2	10	6.3	10.1	10.1	0.4	3.6	20
Turbidity	FNU	A1S		-8.00	0.24	25	0.00	0.23	0.24	0.03	11.6	22
	FNU	D2S		-5.00	0.12	40	0.00	0.12	0.12	0.02	19.5	16
	FNU	G3S		-5.71	0.24	35	0.00	0.23	0.24	0.04	16.3	21

Participant 21												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
Alkalinity	mmol/l	A1A		2.11	0.19	15	0.22	0.19	0.19	0.01	3.5	15
	mmol/l	D2A		0.04	0.91	10	0.91	0.92	0.91	0.03	3.2	22
	mmol/l	G3A		-0.85	0.59	8	0.57	0.59	0.59	0.02	3.8	22
Ca	mg/l	A1K		0.39	2.04	10	2.08	2.03	2.03	0.06	2.7	17
	mg/l	D2K		0.49	23.0	10	23.6	23.0	23.0	0.9	4.0	17
	mg/l	G3K		0.00	10.3	10	10.3	10.3	10.3	0.6	5.6	18
Cl	mg/l	A1CS		0.66	15.1	10	15.60	15.03	15.12	0.48	3.1	26
	mg/l	D2CS		0.36	11.0	10	11.2	10.9	11.1	0.5	4.4	25
	mg/l	G3CS		0.84	23.9	10	24.9	23.8	23.8	0.8	3.3	25
Conductivity	µS/cm	A1J		0.33	393	5	396	395	394	4	1.0	31
	µS/cm	D2PJ		0.45	178	5	180	179	178	2	1.3	29
	µS/cm	G3PJ		0.66	158	5	161	158	158	2	1.4	29

Participant 21												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2×s_{pt} %	Participant's result	Md	Mean	s	s %	n_{stat}
F	mg/l	A1F		0.54	1.12	10	1.15	1.12	1.12	0.05	4.0	19
	mg/l	D2F		0.16	0.25	15	0.25	0.25	0.25	0.01	2.4	18
	mg/l	G3F		-0.84	0.38	15	0.36	0.38	0.38	0.02	5.7	20
Fe	µg/l	A1Fe		2.47	52.3	15	62.0	51.1	51.1	2.9	5.6	19
	µg/l	D2Fe		1.27	19.6	25	22.7	19.1	19.6	2.3	11.8	17
	µg/l	G3Fe		2.16	32.1	15	37.3	32.0	32.2	2.2	6.8	18
K	mg/l	A1K		0.79	0.22	15	0.23	0.24	0.24	0.01	5.3	12
	mg/l	D2K		-0.61	1.54	10	1.49	1.55	1.55	0.04	2.3	16
	mg/l	G3K		0.54	2.57	10	2.64	2.59	2.58	0.06	2.5	16
Mg	mg/l	A1K		-0.76	3.14	10	3.02	3.14	3.13	0.09	2.9	18
	mg/l	D2K		-0.59	1.80	10	1.75	1.80	1.80	0.06	3.4	17
	mg/l	G3K		-0.56	2.13	10	2.07	2.15	2.14	0.06	3.0	17
Mn	µg/l	A1Fe		5.92	49.3	10	63.9	50.0	49.8	1.6	3.2	16
	µg/l	D2Fe		3.26	22.5	15	28.0	22.5	22.6	0.5	2.4	17
	µg/l	G3Fe		2.76	77.5	10	88.2	76.5	77.4	3.1	4.0	18
Na	mg/l	A1K		-0.14	2.90	10	2.88	2.90	2.89	0.07	2.3	20
	mg/l	D2K		-0.23	9.94	10	9.82	9.93	9.93	0.31	3.1	20
	mg/l	G3K		-0.39	15.5	10	15.2	15.5	15.5	0.5	3.0	19
NH_4	mg/l	A1N		-0.46	0.13	10	0.13	0.13	0.13	0.01	4.0	15
	mg/l	D2N		-0.17	0.058	20	0.057	0.058	0.058	0.006	10.4	16
	mg/l	G3N		-1.15	0.081	15	0.074	0.080	0.080	0.003	4.0	18
NO_2	mg/l	A1N		-0.34	0.059	10	0.058	0.058	0.059	0.002	3.9	15
	mg/l	D2N		-1.09	0.11	10	0.10	0.11	0.11	0.00	4.1	17
	mg/l	G3N		-0.35	0.077	15	0.075	0.077	0.077	0.004	5.4	15
NO_3	mg/l	A1N		1.17	4.26	10	4.51	4.27	4.26	0.12	2.8	17
	mg/l	D2N		1.03	2.33	10	2.45	2.32	2.33	0.08	3.6	21
	mg/l	G3N		0.73	3.02	10	3.13	3.01	3.02	0.12	3.8	21
pH		A1P		-0.07	7.26	2.8	7.25	7.28	7.27	0.03	0.4	33
		D2PJ		-0.02	7.90	2.5	7.90	7.90	7.90	0.08	1.0	32
		G3PJ		-1.08	7.33	2.7	7.22	7.33	7.33	0.11	1.4	32
SO_4	mg/l	A1CS		0.63	7.02	10	7.24	7.07	7.05	0.18	2.6	22
	mg/l	D2CS		0.81	19.8	10	20.6	19.9	19.8	0.5	2.6	22
	mg/l	G3CS		0.59	10.2	10	10.5	10.1	10.1	0.4	3.6	20
TOC	mg/l	A1T		-0.60	2.32	10	2.25	2.39	2.39	0.11	4.5	16
	mg/l	D2T		0.32	1.63	20	1.68	1.64	1.64	0.18	10.7	14
	mg/l	G3T		-0.70	2.68	15	2.54	2.67	2.68	0.19	7.2	16
Turbidity	FNU	A1S		1.03	0.24	25	0.27	0.23	0.24	0.03	11.6	22
	FNU	D2S		1.29	0.12	40	0.15	0.12	0.12	0.02	19.5	16
	FNU	G3S		0.24	0.24	35	0.25	0.23	0.24	0.04	16.3	21

Participant 22												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2×s_{pt} %	Participant's result	Md	Mean	s	s %	n_{stat}
Alkalinity	mmol/l	A1A		-0.63	0.19	15	0.18	0.19	0.19	0.01	3.5	15
	mmol/l	D2A		-0.79	0.91	10	0.87	0.92	0.91	0.03	3.2	22
	mmol/l	G3A		-1.19	0.59	8	0.56	0.59	0.59	0.02	3.8	22
Ca	mg/l	A1K		-0.20	2.04	10	2.02	2.03	2.03	0.06	2.7	17
	mg/l	D2K		-0.52	23.0	10	22.4	23.0	23.0	0.9	4.0	17
	mg/l	G3K		-0.91	10.3	10	9.8	10.3	10.3	0.6	5.6	18

Participant 22												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2×s_{pt} %	Participant's result	Md	Mean	s	s %	n_{stat}
Cl	mg/l	A1CS		0.53	15.1	10	15.50	15.03	15.12	0.48	3.1	26
	mg/l	D2CS		0.55	11.0	10	11.3	10.9	11.1	0.5	4.4	25
	mg/l	G3CS		0.75	23.9	10	24.8	23.8	23.8	0.8	3.3	25
Conductivity	µS/cm	A1J		-1.63	393	5	377	395	394	4	1.0	31
	µS/cm	D2PJ		-2.36	178	5	168	179	178	2	1.3	29
	µS/cm	G3PJ		-2.61	158	5	148	158	158	2	1.4	29
F	mg/l	A1F		-0.36	1.12	10	1.10	1.12	1.12	0.05	4.0	19
	mg/l	D2F		1.60	0.25	15	0.28	0.25	0.25	0.01	2.4	18
	mg/l	G3F		0.53	0.38	15	0.40	0.38	0.38	0.02	5.7	20
Fe	µg/l	A1Fe		-0.03	52.3	15	52.2	51.1	51.1	2.9	5.6	19
	µg/l	D2Fe		-0.24	19.6	25	19.0	19.1	19.6	2.3	11.8	17
	µg/l	G3Fe		0.17	32.1	15	32.5	32.0	32.2	2.2	6.8	18
K	mg/l	A1K		0.30	0.22	15	0.23	0.24	0.24	0.01	5.3	12
	mg/l	D2K		0.13	1.54	10	1.55	1.55	1.55	0.04	2.3	16
	mg/l	G3K		0.47	2.57	10	2.63	2.59	2.58	0.06	2.5	16
Mg	mg/l	A1K		0.25	3.14	10	3.18	3.14	3.13	0.09	2.9	18
	mg/l	D2K		0.11	1.80	10	1.81	1.80	1.80	0.06	3.4	17
	mg/l	G3K		0.47	2.13	10	2.18	2.15	2.14	0.06	3.0	17
Mn	µg/l	A1Fe		-0.77	49.3	10	47.4	50.0	49.8	1.6	3.2	16
	µg/l	D2Fe		-0.59	22.5	15	21.5	22.5	22.6	0.5	2.4	17
	µg/l	G3Fe		-1.29	77.5	10	72.5	76.5	77.4	3.1	4.0	18
Na	mg/l	A1K		0.07	2.90	10	2.91	2.90	2.89	0.07	2.3	20
	mg/l	D2K		0.52	9.94	10	10.20	9.93	9.93	0.31	3.1	20
	mg/l	G3K		0.39	15.5	10	15.8	15.5	15.5	0.5	3.0	19
NH_4	mg/l	A1N		0.15	0.13	10	0.13	0.13	0.13	0.01	4.0	15
	mg/l	D2N		-0.52	0.058	20	0.055	0.058	0.058	0.006	10.4	16
	mg/l	G3N		-0.82	0.081	15	0.076	0.080	0.080	0.003	4.0	18
NO_2	mg/l	A1N		-0.68	0.059	10	0.057	0.058	0.059	0.002	3.9	15
	mg/l	D2N		-0.73	0.11	10	0.11	0.11	0.11	0.00	4.1	17
	mg/l	G3N		0.00	0.077	15	0.077	0.077	0.077	0.004	5.4	15
NO_3	mg/l	A1N		0.00	4.26	10	4.26	4.27	4.26	0.12	2.8	17
	mg/l	D2N		-0.09	2.33	10	2.32	2.32	2.33	0.08	3.6	21
	mg/l	G3N		-0.07	3.02	10	3.01	3.01	3.02	0.12	3.8	21
pH		A1P		0.30	7.26	2.8	7.29	7.28	7.27	0.03	0.4	33
		D2PJ		0.71	7.90	2.5	7.97	7.90	7.90	0.08	1.0	32
		G3PJ		0.40	7.33	2.7	7.37	7.33	7.33	0.11	1.4	32
SO_4	mg/l	A1CS		0.68	7.02	10	7.26	7.07	7.05	0.18	2.6	22
	mg/l	D2CS		1.01	19.8	10	20.8	19.9	19.8	0.5	2.6	22
	mg/l	G3CS		0.98	10.2	10	10.7	10.1	10.1	0.4	3.6	20
TOC	mg/l	A1T		1.21	2.32	10	2.46	2.39	2.39	0.11	4.5	16
	mg/l	D2T		-1.10	1.63	20	1.45	1.64	1.64	0.18	10.7	14
	mg/l	G3T		-0.75	2.68	15	2.53	2.67	2.68	0.19	7.2	16
Turbidity	FNU	A1S		0.33	0.24	25	0.25	0.23	0.24	0.03	11.6	22

Participant 23												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2×s_{pt} %	Participant's result	Md	Mean	s	s %	n_{stat}
Ca	mg/l	A1K		0.00	2.04	10	2.04	2.03	2.03	0.06	2.7	17
	mg/l	D2K		-0.20	23.0	10	22.8	23.0	23.0	0.9	4.0	17
	mg/l	G3K		-0.29	10.3	10	10.2	10.3	10.3	0.6	5.6	18
Cl	mg/l	A1CS		-0.13	15.1	10	15.00	15.03	15.12	0.48	3.1	26
	mg/l	D2CS		-0.49	11.0	10	10.7	10.9	11.1	0.5	4.4	25
	mg/l	G3CS		-0.04	23.9	10	23.9	23.8	23.8	0.8	3.3	25
F	mg/l	A1F		-0.36	1.12	10	1.10	1.12	1.12	0.05	4.0	19
	mg/l	D2F		-0.59	0.25	15	0.24	0.25	0.25	0.01	2.4	18
	mg/l	G3F		-1.19	0.38	15	0.35	0.38	0.38	0.02	5.7	20
Fe	µg/l	A1Fe		-0.55	52.3	15	50.1	51.1	51.1	2.9	5.6	19
	µg/l	D2Fe		-0.37	19.6	25	18.7	19.1	19.6	2.3	11.8	17
	µg/l	G3Fe		-0.04	32.1	15	32.0	32.0	32.2	2.2	6.8	18
K	mg/l	A1K			0.22	15	*<0.5*	0.24	0.24	0.01	5.3	12
	mg/l	D2K		0.13	1.54	10	1.55	1.55	1.55	0.04	2.3	16
	mg/l	G3K		0.31	2.57	10	2.61	2.59	2.58	0.06	2.5	16
Mg	mg/l	A1K		0.00	3.14	10	3.14	3.14	3.13	0.09	2.9	18
	mg/l	D2K		0.22	1.80	10	1.82	1.80	1.80	0.06	3.4	17
	mg/l	G3K		0.56	2.13	10	2.19	2.15	2.14	0.06	3.0	17
Mn	µg/l	A1Fe		0.37	49.3	10	50.2	50.0	49.8	1.6	3.2	16
	µg/l	D2Fe		-0.01	22.5	15	22.5	22.5	22.6	0.5	2.4	17
	µg/l	G3Fe		-0.25	77.5	10	76.5	76.5	77.4	3.1	4.0	18
Na	mg/l	A1K		-0.28	2.90	10	2.86	2.90	2.89	0.07	2.3	20
	mg/l	D2K		0.30	9.94	10	10.09	9.93	9.93	0.31	3.1	20
	mg/l	G3K		0.57	15.5	10	15.9	15.5	15.5	0.5	3.0	19
SO_4	mg/l	A1CS		2.09	7.02	10	7.75	7.07	7.05	0.18	2.6	22
	mg/l	D2CS		0.04	19.8	10	19.8	19.9	19.8	0.5	2.6	22
	mg/l	G3CS		-0.16	10.2	10	10.1	10.1	10.1	0.4	3.6	20
TOC	mg/l	A1T		1.81	2.32	10	2.53	2.39	2.39	0.11	4.5	16
	mg/l	D2T		0.06	1.63	20	1.64	1.64	1.64	0.18	10.7	14
	mg/l	G3T		0.00	2.68	15	2.68	2.67	2.68	0.19	7.2	16

Participant 24												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2×s_{pt} %	Participant's result	Md	Mean	s	s %	n_{stat}
Alkalinity	mmol/l	A1A		-0.14	0.19	15	0.19	0.19	0.19	0.01	3.5	15
	mmol/l	D2A		0.18	0.91	10	0.92	0.92	0.91	0.03	3.2	22
	mmol/l	G3A		0.13	0.59	8	0.59	0.59	0.59	0.02	3.8	22
Ca	mg/l	A1K		-0.10	2.04	10	2.03	2.03	2.03	0.06	2.7	17
	mg/l	D2K		0.00	23.0	10	23.0	23.0	23.0	0.9	4.0	17
	mg/l	G3K		-0.19	10.3	10	10.2	10.3	10.3	0.6	5.6	18
Cl	mg/l	A1CS		0.00	15.1	10	15.10	15.03	15.12	0.48	3.1	26
	mg/l	D2CS		-0.18	11.0	10	10.9	10.9	11.1	0.5	4.4	25
	mg/l	G3CS		0.33	23.9	10	24.3	23.8	23.8	0.8	3.3	25
Conductivity	µS/cm	A1J		0.51	393	5	398	395	394	4	1.0	31
	µS/cm	D2PJ		0.45	178	5	180	179	178	2	1.3	29
	µS/cm	G3PJ		0.25	158	5	159	158	158	2	1.4	29
F	mg/l	A1F		-0.18	1.12	10	1.11	1.12	1.12	0.05	4.0	19
	mg/l	D2F		-0.37	0.25	15	0.24	0.25	0.25	0.01	2.4	18
	mg/l	G3F		-0.21	0.38	15	0.37	0.38	0.38	0.02	5.7	20

Participant 24												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2×s_{pt} %	Participant's result	Md	Mean	s	s %	n_{stat}
Fe	µg/l	A1Fe		-0.69	52.3	15	49.6	51.1	51.1	2.9	5.6	19
	µg/l	D2Fe		-0.20	19.6	25	19.1	19.1	19.6	2.3	11.8	17
	µg/l	G3Fe		-0.29	32.1	15	31.4	32.0	32.2	2.2	6.8	18
K	mg/l	A1K		1.39	0.22	15	0.24	0.24	0.24	0.01	5.3	12
	mg/l	D2K		0.13	1.54	10	1.55	1.55	1.55	0.04	2.3	16
	mg/l	G3K		0.08	2.57	10	2.58	2.59	2.58	0.06	2.5	16
Mg	mg/l	A1K		0.00	3.14	10	3.14	3.14	3.13	0.09	2.9	18
	mg/l	D2K		-0.78	1.80	10	1.73	1.80	1.80	0.06	3.4	17
	mg/l	G3K		-1.03	2.13	10	2.02	2.15	2.14	0.06	3.0	17
Mn	µg/l	A1Fe		0.37	49.3	10	50.2	50.0	49.8	1.6	3.2	16
	µg/l	D2Fe		0.12	22.5	15	22.7	22.5	22.6	0.5	2.4	17
	µg/l	G3Fe		-0.26	77.5	10	76.5	76.5	77.4	3.1	4.0	18
Na	mg/l	A1K		-0.28	2.90	10	2.86	2.90	2.89	0.07	2.3	20
	mg/l	D2K		-1.05	9.94	10	9.42	9.93	9.93	0.31	3.1	20
	mg/l	G3K		-1.16	15.5	10	14.6	15.5	15.5	0.5	3.0	19
NH_4	mg/l	A1N		0.46	0.13	10	0.13	0.13	0.13	0.01	4.0	15
	mg/l	D2N		0.02	0.058	20	0.058	0.058	0.058	0.006	10.4	16
	mg/l	G3N		-0.56	0.081	15	0.078	0.080	0.080	0.003	4.0	18
NO_2	mg/l	A1N		0.78	0.059	10	0.061	0.058	0.059	0.002	3.9	15
	mg/l	D2N		1.82	0.11	10	0.12	0.11	0.11	0.00	4.1	17
	mg/l	G3N		1.39	0.077	15	0.085	0.077	0.077	0.004	5.4	15
NO_3	mg/l	A1N		-0.14	4.26	10	4.23	4.27	4.26	0.12	2.8	17
	mg/l	D2N		0.00	2.33	10	2.33	2.32	2.33	0.08	3.6	21
	mg/l	G3N		-0.13	3.02	10	3.00	3.01	3.02	0.12	3.8	21
pH		A1P		-0.10	7.26	2.8	7.25	7.28	7.27	0.03	0.4	33
		D2PJ		-1.11	7.90	2.5	7.79	7.90	7.90	0.08	1.0	32
		G3PJ		-1.01	7.33	2.7	7.23	7.33	7.33	0.11	1.4	32
SO_4	mg/l	A1CS		0.37	7.02	10	7.15	7.07	7.05	0.18	2.6	22
	mg/l	D2CS		-0.81	19.8	10	19.0	19.9	19.8	0.5	2.6	22
	mg/l	G3CS		-1.22	10.2	10	9.6	10.1	10.1	0.4	3.6	20
Turbidity	FNU	A1S		-1.27	0.24	25	0.20	0.23	0.24	0.03	11.6	22
	FNU	D2S			0.12	40	*<0.1*	0.12	0.12	0.02	19.5	16
	FNU	G3S		0.52	0.24	35	0.26	0.23	0.24	0.04	16.3	21

Participant 25												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2×s_{pt} %	Participant's result	Md	Mean	s	s %	n_{stat}
Conductivity	µS/cm	A1J		0.10	393	5	394	395	394	4	1.0	31
	µS/cm	D2PJ		0.38	178	5	180	179	178	2	1.3	29
	µS/cm	G3PJ		-0.05	158	5	158	158	158	2	1.4	29
pH		A1P		0.39	7.26	2.8	7.30	7.28	7.27	0.03	0.4	33
		D2PJ		-0.71	7.90	2.5	7.83	7.90	7.90	0.08	1.0	32
		G3PJ		0.71	7.33	2.7	7.40	7.33	7.33	0.11	1.4	32
Turbidity	FNU	A1S		-0.07	0.24	25	0.24	0.23	0.24	0.03	11.6	22
	FNU	D2S		-0.42	0.12	40	0.11	0.12	0.12	0.02	19.5	16
	FNU	G3S		-0.21	0.24	35	0.23	0.23	0.24	0.04	16.3	21

Participant 26												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
Alkalinity	mmol/l	A1A		-0.14	0.19	15	0.19	0.19	0.19	0.01	3.5	15
	mmol/l	D2A		0.15	0.91	10	0.92	0.92	0.91	0.03	3.2	22
Cl	mg/l	A1CS		-0.26	15.1	10	14.90	15.03	15.12	0.48	3.1	26
	mg/l	D2CS		-0.36	11.0	10	10.8	10.9	11.1	0.5	4.4	25
Conductivity	µS/cm	A1J		-0.51	393	5	388	395	394	4	1.0	31
	µS/cm	D2PJ		-0.29	178	5	177	179	178	2	1.3	29
Na	mg/l	A1K		0.21	2.90	10	2.93	2.90	2.89	0.07	2.3	20
	mg/l	D2K		1.13	9.94	10	10.50	9.93	9.93	0.31	3.1	20
pH		A1P		-0.20	7.26	2.8	7.24	7.28	7.27	0.03	0.4	33
		D2PJ		-0.10	7.90	2.5	7.89	7.90	7.90	0.08	1.0	32
Turbidity	FNU	A1S		-5.33	0.24	25	0.08	0.23	0.24	0.03	11.6	22
	FNU	D2S		-4.17	0.12	40	0.02	0.12	0.12	0.02	19.5	16

Participant 27												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
Cl	mg/l	A1CS		-0.42	15.1	10	14.78	15.03	15.12	0.48	3.1	26
	mg/l	G3CS		-0.49	23.9	10	23.3	23.8	23.8	0.8	3.3	25
Conductivity	µS/cm	A1J		-0.20	393	5	391	395	394	4	1.0	31
	µS/cm	G3PJ		1.01	158	5	162	158	158	2	1.4	29
F	mg/l	A1F		1.25	1.12	10	1.19	1.12	1.12	0.05	4.0	19
	mg/l	G3F		1.26	0.38	15	0.42	0.38	0.38	0.02	5.7	20
pH		A1P		-0.89	7.26	2.8	7.17	7.28	7.27	0.03	0.4	33
		G3PJ		-1.11	7.33	2.7	7.22	7.33	7.33	0.11	1.4	32

Participant 28												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
Alkalinity	mmol/l	A1A		-0.14	0.19	15	0.19	0.19	0.19	0.01	3.5	15
	mmol/l	D2A		-0.73	0.91	10	0.88	0.92	0.91	0.03	3.2	22
	mmol/l	G3A		-0.55	0.59	8	0.58	0.59	0.59	0.02	3.8	22
Ca	mg/l	A1K		-1.18	2.04	10	1.92	2.03	2.03	0.06	2.7	17
	mg/l	D2K		-1.30	23.0	10	21.5	23.0	23.0	0.9	4.0	17
	mg/l	G3K		-1.98	10.3	10	9.3	10.3	10.3	0.6	5.6	18
Cl	mg/l	A1CS		0.40	15.1	10	15.40	15.03	15.12	0.48	3.1	26
	mg/l	D2CS		0.18	11.0	10	11.1	10.9	11.1	0.5	4.4	25
	mg/l	G3CS		0.42	23.9	10	24.4	23.8	23.8	0.8	3.3	25
Conductivity	µS/cm	A1J		0.10	393	5	394	395	394	4	1.0	31
	µS/cm	D2PJ		0.22	178	5	179	179	178	2	1.3	29
	µS/cm	G3PJ		0.25	158	5	159	158	158	2	1.4	29
F	mg/l	A1F		1.61	1.12	10	1.21	1.12	1.12	0.05	4.0	19
	mg/l	D2F		0.05	0.25	15	0.25	0.25	0.25	0.01	2.4	18
	mg/l	G3F		-0.18	0.38	15	0.38	0.38	0.38	0.02	5.7	20
Fe	µg/l	A1Fe		-1.43	52.3	15	46.7	51.1	51.1	2.9	5.6	19
	µg/l	D2Fe		-1.06	19.6	25	17.0	19.1	19.6	2.3	11.8	17
	µg/l	G3Fe		-0.91	32.1	15	29.9	32.0	32.2	2.2	6.8	18
K	mg/l	A1K		0.42	0.22	15	0.23	0.24	0.24	0.01	5.3	12
	mg/l	D2K		0.00	1.54	10	1.54	1.55	1.55	0.04	2.3	16
	mg/l	G3K		-0.08	2.57	10	2.56	2.59	2.58	0.06	2.5	16

Participant 28												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
Mg	mg/l	A1K		0.57	3.14	10	3.23	3.14	3.13	0.09	2.9	18
	mg/l	D2K		0.78	1.80	10	1.87	1.80	1.80	0.06	3.4	17
	mg/l	G3K		0.66	2.13	10	2.20	2.15	2.14	0.06	3.0	17
Mn	µg/l	A1Fe		-0.41	49.3	10	48.3	50.0	49.8	1.6	3.2	16
	µg/l	D2Fe		-0.18	22.5	15	22.2	22.5	22.6	0.5	2.4	17
	µg/l	G3Fe		-0.52	77.5	10	75.5	76.5	77.4	3.1	4.0	18
Na	mg/l	A1K		-0.07	2.90	10	2.89	2.90	2.89	0.07	2.3	20
	mg/l	D2K		-0.16	9.94	10	9.86	9.93	9.93	0.31	3.1	20
	mg/l	G3K		-0.13	15.5	10	15.4	15.5	15.5	0.5	3.0	19
NH_4	mg/l	A1N		0.15	0.13	10	0.13	0.13	0.13	0.01	4.0	15
	mg/l	D2N		0.03	0.058	20	0.058	0.058	0.058	0.006	10.4	16
	mg/l	G3N		0.59	0.081	15	0.085	0.080	0.080	0.003	4.0	18
NO_2	mg/l	A1N		-1.36	0.059	10	0.055	0.058	0.059	0.002	3.9	15
	mg/l	D2N		-1.09	0.11	10	0.10	0.11	0.11	0.00	4.1	17
	mg/l	G3N		-0.33	0.077	15	0.075	0.077	0.077	0.004	5.4	15
NO_3	mg/l	A1N		-0.47	4.26	10	4.16	4.27	4.26	0.12	2.8	17
	mg/l	D2N		-0.26	2.33	10	2.30	2.32	2.33	0.08	3.6	21
	mg/l	G3N		0.00	3.02	10	3.02	3.01	3.02	0.12	3.8	21
pH		A1P		0.20	7.26	2.8	7.28	7.28	7.27	0.03	0.4	33
		D2PJ		0.10	7.90	2.5	7.91	7.90	7.90	0.08	1.0	32
		G3PJ		-0.10	7.33	2.7	7.32	7.33	7.33	0.11	1.4	32
SO_4	mg/l	A1CS		0.23	7.02	10	7.10	7.07	7.05	0.18	2.6	22
	mg/l	D2CS		0.30	19.8	10	20.1	19.9	19.8	0.5	2.6	22
	mg/l	G3CS		0.39	10.2	10	10.4	10.1	10.1	0.4	3.6	20
TOC	mg/l	A1T		0.78	2.32	10	2.41	2.39	2.39	0.11	4.5	16
	mg/l	D2T		1.53	1.63	20	1.88	1.64	1.64	0.18	10.7	14
	mg/l	G3T		1.24	2.68	15	2.93	2.67	2.68	0.19	7.2	16
Turbidity	FNU	A1S		-0.30	0.24	25	0.23	0.23	0.24	0.03	11.6	22
	FNU	D2S		-0.75	0.12	40	0.10	0.12	0.12	0.02	19.5	16
	FNU	G3S		-1.26	0.24	35	0.19	0.23	0.24	0.04	16.3	21

Participant 29												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
Alkalinity	mmol/l	A1A		2.11	0.19	15	0.22	0.19	0.19	0.01	3.5	15
	mmol/l	D2A		0.66	0.91	10	0.94	0.92	0.91	0.03	3.2	22
	mmol/l	G3A		1.27	0.59	8	0.62	0.59	0.59	0.02	3.8	22
Conductivity	µS/cm	A1J		0.31	393	5	396	395	394	4	1.0	31
	µS/cm	D2PJ		0.45	178	5	180	179	178	2	1.3	29
	µS/cm	G3PJ		0.51	158	5	160	158	158	2	1.4	29
NH_4	mg/l	A1N		4.92	0.13	10	0.16	0.13	0.13	0.01	4.0	15
	mg/l	D2N		1.55	0.058	20	0.067	0.058	0.058	0.006	10.4	16
	mg/l	G3N		0.99	0.081	15	0.087	0.080	0.080	0.003	4.0	18
NO_2	mg/l	A1N		0.34	0.059	10	0.060	0.058	0.059	0.002	3.9	15
	mg/l	D2N		-0.91	0.11	10	0.11	0.11	0.11	0.00	4.1	17
	mg/l	G3N		0.17	0.077	15	0.078	0.077	0.077	0.004	5.4	15
pH		A1P		0.10	7.26	2.8	7.27	7.28	7.27	0.03	0.4	33
		D2PJ		0.00	7.90	2.5	7.90	7.90	7.90	0.08	1.0	32
		G3PJ		-0.51	7.33	2.7	7.28	7.33	7.33	0.11	1.4	32

Participant 29												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
Turbidity	FNU	A1S		1.33	0.24	25	0.28	0.23	0.24	0.03	11.6	22
	FNU	D2S		1.67	0.12	40	0.16	0.12	0.12	0.02	19.5	16
	FNU	G3S		1.19	0.24	35	0.29	0.23	0.24	0.04	16.3	21
Participant 30												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
Alkalinity	mmol/l	A1A		50.67	0.19	15	0.91	0.19	0.19	0.01	3.5	15
	mmol/l	D2A		-15.69	0.91	10	0.20	0.92	0.91	0.03	3.2	22
	mmol/l	G3A		-0.08	0.59	8	0.59	0.59	0.59	0.02	3.8	22
Cl	mg/l	A1CS		-0.40	15.1	10	14.80	15.03	15.12	0.48	3.1	26
	mg/l	D2CS		-0.36	11.0	10	10.8	10.9	11.1	0.5	4.4	25
	mg/l	G3CS		-0.42	23.9	10	23.4	23.8	23.8	0.8	3.3	25
Conductivity	µS/cm	A1J		-0.03	393	5	393	395	394	4	1.0	31
	µS/cm	D2PJ		0.25	178	5	179	179	178	2	1.3	29
	µS/cm	G3PJ		-0.46	158	5	156	158	158	2	1.4	29
Fe	µg/l	A1Fe		2.93	52.3	15	63.8	51.1	51.1	2.9	5.6	19
	µg/l	D2Fe		14.69	19.6	25	55.6	19.1	19.6	2.3	11.8	17
	µg/l	G3Fe		6.98	32.1	15	48.9	32.0	32.2	2.2	6.8	18
Mn	µg/l	A1Fe		-12.66	49.3	10	18.1	50.0	49.8	1.6	3.2	16
	µg/l	D2Fe		0.59	22.5	15	23.5	22.5	22.6	0.5	2.4	17
	µg/l	G3Fe		0.90	77.5	10	81.0	76.5	77.4	3.1	4.0	18
NH_4	mg/l	A1N		0.46	0.13	10	0.13	0.13	0.13	0.01	4.0	15
	mg/l	D2N		0.34	0.058	20	0.060	0.058	0.058	0.006	10.4	16
	mg/l	G3N		-0.33	0.081	15	0.079	0.080	0.080	0.003	4.0	18
NO_2	mg/l	A1N		0.68	0.059	10	0.061	0.058	0.059	0.002	3.9	15
	mg/l	D2N		0.91	0.11	10	0.12	0.11	0.11	0.00	4.1	17
	mg/l	G3N		2.42	0.077	15	0.091	0.077	0.077	0.004	5.4	15
NO_3	mg/l	A1N		1.55	4.26	10	4.59	4.27	4.26	0.12	2.8	17
	mg/l	D2N		0.77	2.33	10	2.42	2.32	2.33	0.08	3.6	21
	mg/l	G3N		0.79	3.02	10	3.14	3.01	3.02	0.12	3.8	21
pH		A1P		-0.20	7.26	2.8	7.24	7.28	7.27	0.03	0.4	33
		D2PJ		0.30	7.90	2.5	7.93	7.90	7.90	0.08	1.0	32
		G3PJ		-0.30	7.33	2.7	7.30	7.33	7.33	0.11	1.4	32
SO_4	mg/l	A1CS		0.14	7.02	10	7.07	7.07	7.05	0.18	2.6	22
	mg/l	D2CS		0.20	19.8	10	20.0	19.9	19.8	0.5	2.6	22
	mg/l	G3CS		0.20	10.2	10	10.3	10.1	10.1	0.4	3.6	20
TOC	mg/l	A1T		1.72	2.32	10	2.52	2.39	2.39	0.11	4.5	16
	mg/l	D2T		2.70	1.63	20	2.07	1.64	1.64	0.18	10.7	14
	mg/l	G3T		0.70	2.68	15	2.82	2.67	2.68	0.19	7.2	16
Turbidity	FNU	A1S		-0.47	0.24	25	0.23	0.23	0.24	0.03	11.6	22
	FNU	D2S		-0.83	0.12	40	0.10	0.12	0.12	0.02	19.5	16
	FNU	G3S		-0.76	0.24	35	0.21	0.23	0.24	0.04	16.3	21

Participant 31												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
Conductivity	µS/cm	G3PJ		-0.30	158	5	157	158	158	2	1.4	29
Mn	µg/l	G3Fe		8.65	77.5	10	111.0	76.5	77.4	3.1	4.0	18
pH		G3PJ		-0.91	7.33	2.7	7.24	7.33	7.33	0.11	1.4	32
Turbidity	FNU	G3S		-1.67	0.24	35	0.17	0.23	0.24	0.04	16.3	21

Participant 32												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
Conductivity	µS/cm	A1J		-0.92	393	5	384	395	394	4	1.0	31
	µS/cm	D2PJ		-0.22	178	5	177	179	178	2	1.3	29
	µS/cm	G3PJ		-0.76	158	5	155	158	158	2	1.4	29
NH_4	mg/l	A1N		2.15	0.13	10	0.14	0.13	0.13	0.01	4.0	15
	mg/l	D2N		3.10	0.058	20	0.076	0.058	0.058	0.006	10.4	16
	mg/l	G3N		2.14	0.081	15	0.094	0.080	0.080	0.003	4.0	18
NO_2	mg/l	A1N		-0.68	0.059	10	0.057	0.058	0.059	0.002	3.9	15
	mg/l	D2N		-0.55	0.11	10	0.11	0.11	0.11	0.00	4.1	17
	mg/l	G3N		0.17	0.077	15	0.078	0.077	0.077	0.004	5.4	15
pH		A1P		6.69	7.26	2.8	7.94	7.28	7.27	0.03	0.4	33
		D2PJ		1.22	7.90	2.5	8.02	7.90	7.90	0.08	1.0	32
		G3PJ		0.10	7.33	2.7	7.34	7.33	7.33	0.11	1.4	32
Turbidity	FNU	A1S		6.67	0.24	25	0.44	0.23	0.24	0.03	11.6	22
	FNU	D2S		7.08	0.12	40	0.29	0.12	0.12	0.02	19.5	16
	FNU	G3S		-1.67	0.24	35	0.17	0.23	0.24	0.04	16.3	21

Participant 33												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
Alkalinity	mmol/l	A1A		-2.67	0.19	15	0.15	0.19	0.19	0.01	3.5	15
	mmol/l	D2A		-3.91	0.91	10	0.73	0.92	0.91	0.03	3.2	22
	mmol/l	G3A		-4.75	0.59	8	0.48	0.59	0.59	0.02	3.8	22
Cl	mg/l	A1CS		-0.60	15.1	10	14.65	15.03	15.12	0.48	3.1	26
	mg/l	D2CS		-0.49	11.0	10	10.7	10.9	11.1	0.5	4.4	25
	mg/l	G3CS		-0.41	23.9	10	23.4	23.8	23.8	0.8	3.3	25
Conductivity	µS/cm	A1J		0.31	393	5	396	395	394	4	1.0	31
	µS/cm	D2PJ		0.27	178	5	179	179	178	2	1.3	29
	µS/cm	G3PJ		0.18	158	5	159	158	158	2	1.4	29
F	mg/l	A1F		0.36	1.12	10	1.14	1.12	1.12	0.05	4.0	19
	mg/l	D2F		0.59	0.25	15	0.26	0.25	0.25	0.01	2.4	18
	mg/l	G3F		0.18	0.38	15	0.39	0.38	0.38	0.02	5.7	20
pH		A1P		0.79	7.26	2.8	7.34	7.28	7.27	0.03	0.4	33
		D2PJ		0.20	7.90	2.5	7.92	7.90	7.90	0.08	1.0	32
		G3PJ		0.30	7.33	2.7	7.36	7.33	7.33	0.11	1.4	32
SO_4	mg/l	A1CS		-0.14	7.02	10	6.97	7.07	7.05	0.18	2.6	22
	mg/l	D2CS		-0.16	19.8	10	19.6	19.9	19.8	0.5	2.6	22
	mg/l	G3CS		0.27	10.2	10	10.3	10.1	10.1	0.4	3.6	20
TOC	mg/l	A1T		2.24	2.32	10	2.58	2.39	2.39	0.11	4.5	16
	mg/l	D2T		8.40	1.63	20	3.00	1.64	1.64	0.18	10.7	14
	mg/l	G3T		5.12	2.68	15	3.71	2.67	2.68	0.19	7.2	16
Turbidity	FNU	A1S		-0.20	0.24	25	0.23	0.23	0.24	0.03	11.6	22
	FNU	D2S		-0.17	0.12	40	0.12	0.12	0.12	0.02	19.5	16
	FNU	G3S		-0.48	0.24	35	0.22	0.23	0.24	0.04	16.3	21

Participant 34												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2×s_{pt} %	Participant's result	Md	Mean	s	s %	n_{stat}
Alkalinity	mmol/l	A1A		-0.14	0.19	15	0.19	0.19	0.19	0.01	3.5	15
	mmol/l	D2A		-1.01	0.91	10	0.86	0.92	0.91	0.03	3.2	22
	mmol/l	G3A		-1.53	0.59	8	0.55	0.59	0.59	0.02	3.8	22
Conductivity	µS/cm	A1J		0.81	393	5	401	395	394	4	1.0	31
	µS/cm	D2PJ		-0.45	178	5	176	179	178	2	1.3	29
	µS/cm	G3PJ		0.25	158	5	159	158	158	2	1.4	29
pH		A1P		0.20	7.26	2.8	7.28	7.28	7.27	0.03	0.4	33
		D2PJ		0.91	7.90	2.5	7.99	7.90	7.90	0.08	1.0	32
		G3PJ		0.81	7.33	2.7	7.41	7.33	7.33	0.11	1.4	32
Turbidity	FNU	A1S		1.57	0.24	25	0.29	0.23	0.24	0.03	11.6	22
	FNU	D2S		1.75	0.12	40	0.16	0.12	0.12	0.02	19.5	16
	FNU	G3S		1.29	0.24	35	0.29	0.23	0.24	0.04	16.3	21

Participant 35												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2×s_{pt} %	Participant's result	Md	Mean	s	s %	n_{stat}
Ca	mg/l	A1K		0.59	2.04	10	2.10	2.03	2.03	0.06	2.7	17
	mg/l	D2K		1.30	23.0	10	24.5	23.0	23.0	0.9	4.0	17
	mg/l	G3K		0.58	10.3	10	10.6	10.3	10.3	0.6	5.6	18
Conductivity	µS/cm	A1J		-21.48	393	5	182	395	394	4	1.0	31
	µS/cm	D2PJ		-4.04	178	5	160	179	178	2	1.3	29
	µS/cm	G3PJ		59.75	158	5	394	158	158	2	1.4	29
Fe	µg/l	A1Fe		-0.33	52.3	15	51.0	51.1	51.1	2.9	5.6	19
	µg/l	D2Fe		-0.65	19.6	25	18.0	19.1	19.6	2.3	11.8	17
	µg/l	G3Fe		-0.46	32.1	15	31.0	32.0	32.2	2.2	6.8	18
K	mg/l	A1K		1.21	0.22	15	0.24	0.24	0.24	0.01	5.3	12
	mg/l	D2K		-0.52	1.54	10	1.50	1.55	1.55	0.04	2.3	16
	mg/l	G3K		-0.86	2.57	10	2.46	2.59	2.58	0.06	2.5	16
Mg	mg/l	A1K		-2.29	3.14	10	2.78	3.14	3.13	0.09	2.9	18
	mg/l	D2K		-2.78	1.80	10	1.55	1.80	1.80	0.06	3.4	17
	mg/l	G3K		-3.00	2.13	10	1.81	2.15	2.14	0.06	3.0	17
Mn	µg/l	A1Fe		0.28	49.3	10	50.0	50.0	49.8	1.6	3.2	16
	µg/l	D2Fe		-0.30	22.5	15	22.0	22.5	22.6	0.5	2.4	17
	µg/l	G3Fe		-0.39	77.5	10	76.0	76.5	77.4	3.1	4.0	18
Na	mg/l	A1K		-0.69	2.90	10	2.80	2.90	2.89	0.07	2.3	20
	mg/l	D2K		-0.10	9.94	10	9.89	9.93	9.93	0.31	3.1	20
	mg/l	G3K		-0.39	15.5	10	15.2	15.5	15.5	0.5	3.0	19
NH_4	mg/l	A1N		-4.00	0.13	10	0.10	0.13	0.13	0.01	4.0	15
	mg/l	D2N		-2.59	0.058	20	0.043	0.058	0.058	0.006	10.4	16
	mg/l	G3N		-3.95	0.081	15	0.057	0.080	0.080	0.003	4.0	18
NO_3	mg/l	A1N		-15.59	4.26	10	0.94	4.27	4.26	0.12	2.8	17
	mg/l	D2N		-15.35	2.33	10	0.54	2.32	2.33	0.08	3.6	21
	mg/l	G3N		-15.42	3.02	10	0.69	3.01	3.02	0.12	3.8	21
pH		A1P		0.39	7.26	2.8	7.30	7.28	7.27	0.03	0.4	33
		D2PJ		-1.01	7.90	2.5	7.80	7.90	7.90	0.08	1.0	32
		G3PJ		1.72	7.33	2.7	7.50	7.33	7.33	0.11	1.4	32
TOC	mg/l	A1T		-1.03	2.32	10	2.20	2.39	2.39	0.11	4.5	16
	mg/l	D2T		-4.23	1.63	20	0.94	1.64	1.64	0.18	10.7	14
	mg/l	G3T		-1.89	2.68	15	2.30	2.67	2.68	0.19	7.2	16

Participant 36												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
Alkalinity	mmol/l	A1A		0.14	0.19	15	0.19	0.19	0.19	0.01	3.5	15
	mmol/l	D2A		-0.07	0.91	10	0.91	0.92	0.91	0.03	3.2	22
	mmol/l	G3A		-0.13	0.59	8	0.59	0.59	0.59	0.02	3.8	22
Conductivity	µS/cm	A1J		0.00	393	5	393	395	394	4	1.0	31
	µS/cm	D2PJ		0.09	178	5	178	179	178	2	1.3	29
	µS/cm	G3PJ		-0.08	158	5	158	158	158	2	1.4	29
Fe	µg/l	A1Fe		-0.56	52.3	15	50.1	51.1	51.1	2.9	5.6	19
	µg/l	D2Fe		-0.20	19.6	25	19.1	19.1	19.6	2.3	11.8	17
	µg/l	G3Fe		-0.91	32.1	15	29.9	32.0	32.2	2.2	6.8	18
NH_4	mg/l	D2N		0.69	0.058	20	0.062	0.058	0.058	0.006	10.4	16
pH		A1P		0.20	7.26	2.8	7.28	7.28	7.27	0.03	0.4	33
		D2PJ		0.81	7.90	2.5	7.98	7.90	7.90	0.08	1.0	32
		G3PJ		-0.81	7.33	2.7	7.25	7.33	7.33	0.11	1.4	32
TOC	mg/l	A1T		0.52	2.32	10	2.38	2.39	2.39	0.11	4.5	16
	mg/l	D2T		-0.61	1.63	20	1.53	1.64	1.64	0.18	10.7	14
	mg/l	G3T		-0.15	2.68	15	2.65	2.67	2.68	0.19	7.2	16
Turbidity	FNU	A1S		-0.37	0.24	25	0.23	0.23	0.24	0.03	11.6	22
	FNU	D2S		-0.46	0.12	40	0.11	0.12	0.12	0.02	19.5	16
	FNU	G3S		-0.52	0.24	35	0.22	0.23	0.24	0.04	16.3	21

Participant 37												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
Cl	mg/l	A1CS		8.08	15.1	10	21.20	15.03	15.12	0.48	3.1	26
	mg/l	D2CS		6.27	11.0	10	14.5	10.9	11.1	0.5	4.4	25
Conductivity	µS/cm	A1J		0.20	393	5	395	395	394	4	1.0	31
	µS/cm	D2PJ		0.00	178	5	178	179	178	2	1.3	29
Fe	µg/l	A1Fe		0.43	52.3	15	54.0	51.1	51.1	2.9	5.6	19
	µg/l	D2Fe		7.92	19.6	25	39.0	19.1	19.6	2.3	11.8	17
pH		A1P		0.20	7.26	2.8	7.28	7.28	7.27	0.03	0.4	33
		D2PJ		-1.01	7.90	2.5	7.80	7.90	7.90	0.08	1.0	32

Participant 38												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
Conductivity	µS/cm	A1J		-0.20	393	5	391	395	394	4	1.0	31
	µS/cm	D2PJ		0.22	178	5	179	179	178	2	1.3	29
	µS/cm	G3PJ		0.25	158	5	159	158	158	2	1.4	29
Fe	µg/l	A1Fe		-0.65	52.3	15	49.8	51.1	51.1	2.9	5.6	19
	µg/l	D2Fe		0.78	19.6	25	21.5	19.1	19.6	2.3	11.8	17
	µg/l	G3Fe		0.93	32.1	15	34.4	32.0	32.2	2.2	6.8	18
Mn	µg/l	A1Fe		-0.28	49.3	10	48.6	50.0	49.8	1.6	3.2	16
	µg/l	D2Fe		-1.53	22.5	15	19.9	22.5	22.6	0.5	2.4	17
	µg/l	G3Fe		-0.81	77.5	10	74.4	76.5	77.4	3.1	4.0	18
pH		A1P		-0.30	7.26	2.8	7.23	7.28	7.27	0.03	0.4	33
		D2PJ		-0.71	7.90	2.5	7.83	7.90	7.90	0.08	1.0	32
		G3PJ		-1.01	7.33	2.7	7.23	7.33	7.33	0.11	1.4	32
TOC	mg/l	A1T		-0.86	2.32	10	2.22	2.39	2.39	0.11	4.5	16
	mg/l	D2T		4.29	1.63	20	2.33	1.64	1.64	0.18	10.7	14
	mg/l	G3T		2.14	2.68	15	3.11	2.67	2.68	0.19	7.2	16

Participant 39												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2×s_{pt} %	Participant's result	Md	Mean	s	s %	n_{stat}
Ca	mg/l	A1K		-0.39	2.04	10	2.00	2.03	2.03	0.06	2.7	17
	mg/l	D2K		-0.09	23.0	10	22.9	23.0	23.0	0.9	4.0	17
	mg/l	G3K		-0.39	10.3	10	10.1	10.3	10.3	0.6	5.6	18
Fe	µg/l	A1Fe		-13.32	52.3	15	0.1	51.1	51.1	2.9	5.6	19
	µg/l	D2Fe		-7.99	19.6	25	0.0	19.1	19.6	2.3	11.8	17
	µg/l	G3Fe		-13.32	32.1	15	0.0	32.0	32.2	2.2	6.8	18
K	mg/l	A1K		0.97	0.22	15	0.24	0.24	0.24	0.01	5.3	12
	mg/l	D2K		0.26	1.54	10	1.56	1.55	1.55	0.04	2.3	16
	mg/l	G3K		-0.08	2.57	10	2.56	2.59	2.58	0.06	2.5	16
Mg	mg/l	A1K		0.19	3.14	10	3.17	3.14	3.13	0.09	2.9	18
	mg/l	D2K		0.33	1.80	10	1.83	1.80	1.80	0.06	3.4	17
	mg/l	G3K		0.38	2.13	10	2.17	2.15	2.14	0.06	3.0	17
Mn	µg/l	A1Fe		-19.98	49.3	10	0.1	50.0	49.8	1.6	3.2	16
	µg/l	D2Fe		-13.32	22.5	15	0.0	22.5	22.6	0.5	2.4	17
	µg/l	G3Fe		-19.98	77.5	10	0.1	76.5	77.4	3.1	4.0	18
Na	mg/l	A1K		-0.14	2.90	10	2.88	2.90	2.89	0.07	2.3	20
	mg/l	D2K		0.04	9.94	10	9.96	9.93	9.93	0.31	3.1	20
	mg/l	G3K		0.00	15.5	10	15.5	15.5	15.5	0.5	3.0	19

Participant 40												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2×s_{pt} %	Participant's result	Md	Mean	s	s %	n_{stat}
Cl	mg/l	A1CS		-0.05	15.1	10	15.06	15.03	15.12	0.48	3.1	26
	mg/l	D2CS		-0.10	11.0	10	10.9	10.9	11.1	0.5	4.4	25
	mg/l	G3CS		-1.52	23.9	10	22.1	23.8	23.8	0.8	3.3	25
F	mg/l	A1F		-0.32	1.12	10	1.10	1.12	1.12	0.05	4.0	19
	mg/l	D2F		-1.28	0.25	15	0.23	0.25	0.25	0.01	2.4	18
	mg/l	G3F		-0.70	0.38	15	0.36	0.38	0.38	0.02	5.7	20
NO_2	mg/l	A1N		9.49	0.059	10	0.087	0.058	0.059	0.002	3.9	15
	mg/l	D2N		5.09	0.11	10	0.14	0.11	0.11	0.00	4.1	17
	mg/l	G3N		5.02	0.077	15	0.106	0.077	0.077	0.004	5.4	15
NO_3	mg/l	A1N		-0.03	4.26	10	4.25	4.27	4.26	0.12	2.8	17
	mg/l	D2N		-1.57	2.33	10	2.15	2.32	2.33	0.08	3.6	21
	mg/l	G3N		-0.85	3.02	10	2.89	3.01	3.02	0.12	3.8	21
SO_4	mg/l	A1CS		0.14	7.02	10	7.07	7.07	7.05	0.18	2.6	22
	mg/l	D2CS		0.02	19.8	10	19.8	19.9	19.8	0.5	2.6	22
	mg/l	G3CS		-0.11	10.2	10	10.1	10.1	10.1	0.4	3.6	20

Participant 41												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2×s_{pt} %	Participant's result	Md	Mean	s	s %	n_{stat}
Alkalinity	mmol/l	A1A		-0.07	0.19	15	0.19	0.19	0.19	0.01	3.5	15
	mmol/l	D2A		-0.13	0.91	10	0.90	0.92	0.91	0.03	3.2	22
	mmol/l	G3A		0.47	0.59	8	0.60	0.59	0.59	0.02	3.8	22
Cl	mg/l	A1CS		-0.40	15.1	10	14.80	15.03	15.12	0.48	3.1	26
	mg/l	D2CS		-0.73	11.0	10	10.6	10.9	11.1	0.5	4.4	25
	mg/l	G3CS		-0.25	23.9	10	23.6	23.8	23.8	0.8	3.3	25
Conductivity	µS/cm	A1J		0.21	393	5	395	395	394	4	1.0	31
	µS/cm	D2PJ		-0.18	178	5	177	179	178	2	1.3	29
	µS/cm	G3PJ		0.05	158	5	158	158	158	2	1.4	29

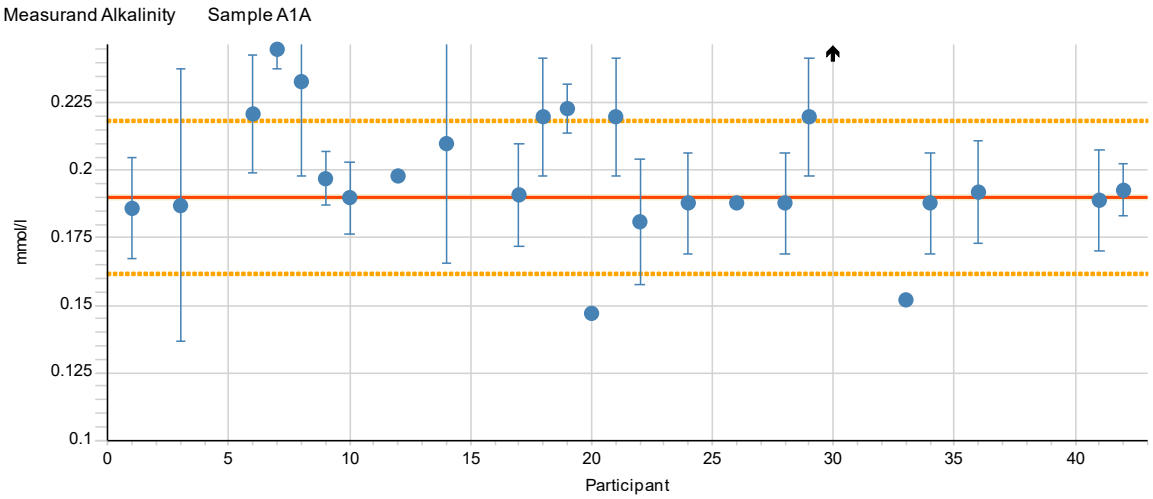
Participant 41												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2×s_{pt} %	Participant's result	Md	Mean	s	s %	n_{stat}
F	mg/l	A1F		-0.89	1.12	10	1.07	1.12	1.12	0.05	4.0	19
	mg/l	D2F		0.32	0.25	15	0.26	0.25	0.25	0.01	2.4	18
	mg/l	G3F		-0.07	0.38	15	0.38	0.38	0.38	0.02	5.7	20
Fe	µg/l	A1Fe		1.10	52.3	15	56.6	51.1	51.1	2.9	5.6	19
	µg/l	D2Fe		-1.02	19.6	25	17.1	19.1	19.6	2.3	11.8	17
	µg/l	G3Fe		-1.58	32.1	15	28.3	32.0	32.2	2.2	6.8	18
K	mg/l	A1K		-3.88	0.22	15	0.16	0.24	0.24	0.01	5.3	12
	mg/l	D2K		-2.08	1.54	10	1.38	1.55	1.55	0.04	2.3	16
	mg/l	G3K		-1.56	2.57	10	2.37	2.59	2.58	0.06	2.5	16
Mn	µg/l	A1Fe		-0.20	49.3	10	48.8	50.0	49.8	1.6	3.2	16
	µg/l	D2Fe		-0.12	22.5	15	22.3	22.5	22.6	0.5	2.4	17
	µg/l	G3Fe		-0.80	77.5	10	74.4	76.5	77.4	3.1	4.0	18
Na	mg/l	A1K		-0.83	2.90	10	2.78	2.90	2.89	0.07	2.3	20
	mg/l	D2K		-0.22	9.94	10	9.83	9.93	9.93	0.31	3.1	20
	mg/l	G3K		0.26	15.5	10	15.7	15.5	15.5	0.5	3.0	19
NH_4	mg/l	A1N		-0.31	0.13	10	0.13	0.13	0.13	0.01	4.0	15
	mg/l	D2N		-2.41	0.058	20	0.044	0.058	0.058	0.006	10.4	16
	mg/l	G3N		-0.16	0.081	15	0.080	0.080	0.080	0.003	4.0	18
NO_2	mg/l	A1N		-1.02	0.059	10	0.056	0.058	0.059	0.002	3.9	15
	mg/l	D2N		-0.91	0.11	10	0.11	0.11	0.11	0.00	4.1	17
	mg/l	G3N		-0.35	0.077	15	0.075	0.077	0.077	0.004	5.4	15
NO_3	mg/l	A1N		0.23	4.26	10	4.31	4.27	4.26	0.12	2.8	17
	mg/l	D2N		0.00	2.33	10	2.33	2.32	2.33	0.08	3.6	21
	mg/l	G3N		-0.15	3.02	10	3.00	3.01	3.02	0.12	3.8	21
pH		A1P		-0.30	7.26	2.8	7.23	7.28	7.27	0.03	0.4	33
		D2PJ		-0.51	7.90	2.5	7.85	7.90	7.90	0.08	1.0	32
		G3PJ		-0.10	7.33	2.7	7.32	7.33	7.33	0.11	1.4	32
SO_4	mg/l	A1CS		-0.11	7.02	10	6.98	7.07	7.05	0.18	2.6	22
	mg/l	D2CS		0.30	19.8	10	20.1	19.9	19.8	0.5	2.6	22
	mg/l	G3CS		-1.71	10.2	10	9.3	10.1	10.1	0.4	3.6	20
Turbidity	FNU	A1S		0.90	0.24	25	0.27	0.23	0.24	0.03	11.6	22
	FNU	D2S		0.17	0.12	40	0.12	0.12	0.12	0.02	19.5	16
	FNU	G3S		-0.29	0.24	35	0.23	0.23	0.24	0.04	16.3	21

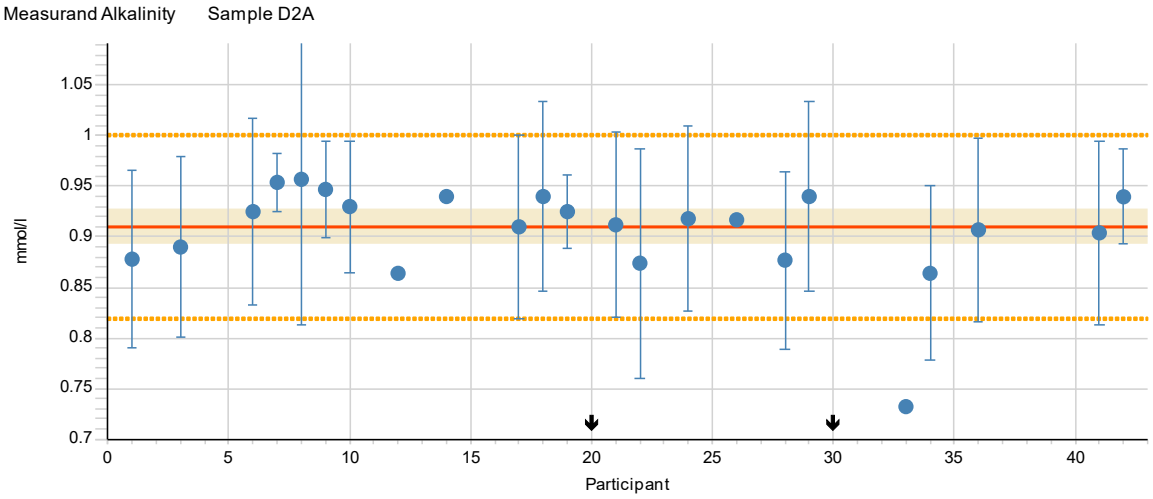
Participant 42												
Measurand	Unit	Sample	-3 0 3	z score	Assigned value	2×s_{pt} %	Participant's result	Md	Mean	s	s %	n_{stat}
Alkalinity	mmol/l	A1A		0.19	0.19	15	0.19	0.19	0.19	0.01	3.5	15
	mmol/l	D2A		0.65	0.91	10	0.94	0.92	0.91	0.03	3.2	22
	mmol/l	G3A		0.92	0.59	8	0.61	0.59	0.59	0.02	3.8	22
Cl	mg/l	A1CS		-0.35	15.1	10	14.84	15.03	15.12	0.48	3.1	26
	mg/l	D2CS		22.51	11.0	10	23.4	10.9	11.1	0.5	4.4	25
	mg/l	G3CS		-0.44	23.9	10	23.4	23.8	23.8	0.8	3.3	25
Conductivity	µS/cm	A1J		-36.03	393	5	39	395	394	4	1.0	31
	µS/cm	D2PJ		-35.99	178	5	18	179	178	2	1.3	29
	µS/cm	G3PJ		-36.15	158	5	15	158	158	2	1.4	29
F	mg/l	A1F		1.78	1.12	10	1.22	1.12	1.12	0.05	4.0	19
	mg/l	D2F		-1.16	0.25	15	0.23	0.25	0.25	0.01	2.4	18
	mg/l	G3F		-1.02	0.38	15	0.35	0.38	0.38	0.02	5.7	20

Participant 42												
Measurand	**Unit**	**Sample**	-3 0 3	**z score**	**Assigned value**	**2×s_{pt} %**	**Participant's result**	**Md**	**Mean**	**s**	**s %**	**n_{stat}**
NH_4	mg/l	A1N		0.52	0.13	10	0.13	0.13	0.13	0.01	4.0	15
	mg/l	D2N		0.47	0.058	20	0.061	0.058	0.058	0.006	10.4	16
	mg/l	G3N		-0.42	0.081	15	0.078	0.080	0.080	0.003	4.0	18
NO_2	mg/l	A1N		0.20	0.059	10	0.060	0.058	0.059	0.002	3.9	15
	mg/l	D2N		0.96	0.11	10	0.12	0.11	0.11	0.00	4.1	17
	mg/l	G3N		1.40	0.077	15	0.085	0.077	0.077	0.004	5.4	15
NO_3	mg/l	A1N		-0.29	4.26	10	4.20	4.27	4.26	0.12	2.8	17
	mg/l	D2N		-0.68	2.33	10	2.25	2.32	2.33	0.08	3.6	21
	mg/l	G3N		-0.57	3.02	10	2.93	3.01	3.02	0.12	3.8	21
pH		A1P		0.00	7.26	2.8	7.26	7.28	7.27	0.03	0.4	33
		D2PJ		-0.20	7.90	2.5	7.88	7.90	7.90	0.08	1.0	32
		G3PJ		0.10	7.33	2.7	7.34	7.33	7.33	0.11	1.4	32
SO_4	mg/l	A1CS		0.28	7.02	10	7.12	7.07	7.05	0.18	2.6	22
	mg/l	D2CS		-10.96	19.8	10	9.0	19.9	19.8	0.5	2.6	22
	mg/l	G3CS		6.37	10.2	10	13.5	10.1	10.1	0.4	3.6	20
TOC	mg/l	A1T		0.78	2.32	10	2.41	2.39	2.39	0.11	4.5	16
	mg/l	D2T		0.43	1.63	20	1.70	1.64	1.64	0.18	10.7	14
	mg/l	G3T		0.25	2.68	15	2.73	2.67	2.68	0.19	7.2	16
Turbidity	FNU	A1S		0.00	0.24	25	0.24	0.23	0.24	0.03	11.6	22
	FNU	D2S		0.42	0.12	40	0.13	0.12	0.12	0.02	19.5	16
	FNU	G3S		0.00	0.24	35	0.24	0.23	0.24	0.04	16.3	21

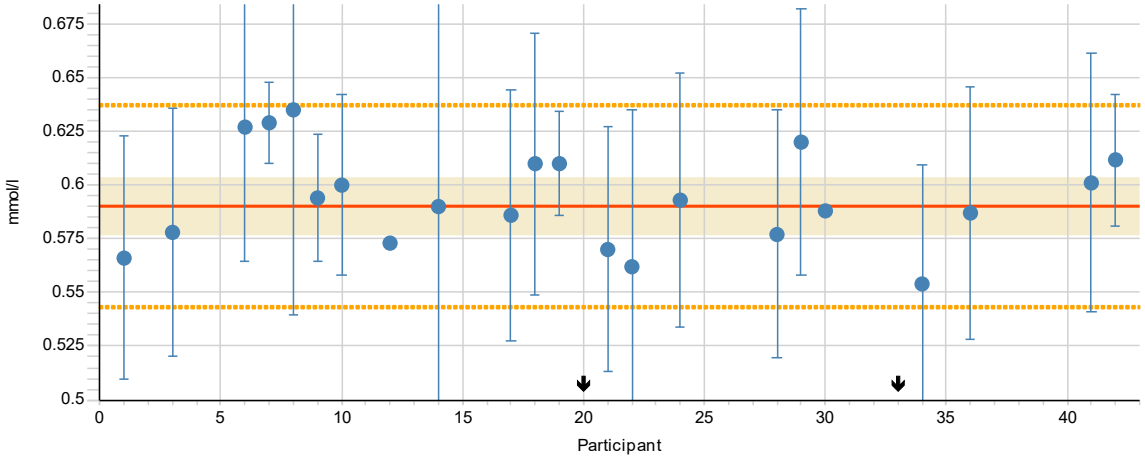
Appendix 9. **Results of participants and their uncertainties**

The dashed lines in figures describe the standard deviation for the proficiency assessment, red solid line shows the assigned value, shaded area describes the expanded uncertainty of the assigned value, and arrow describes the value outside the scale.

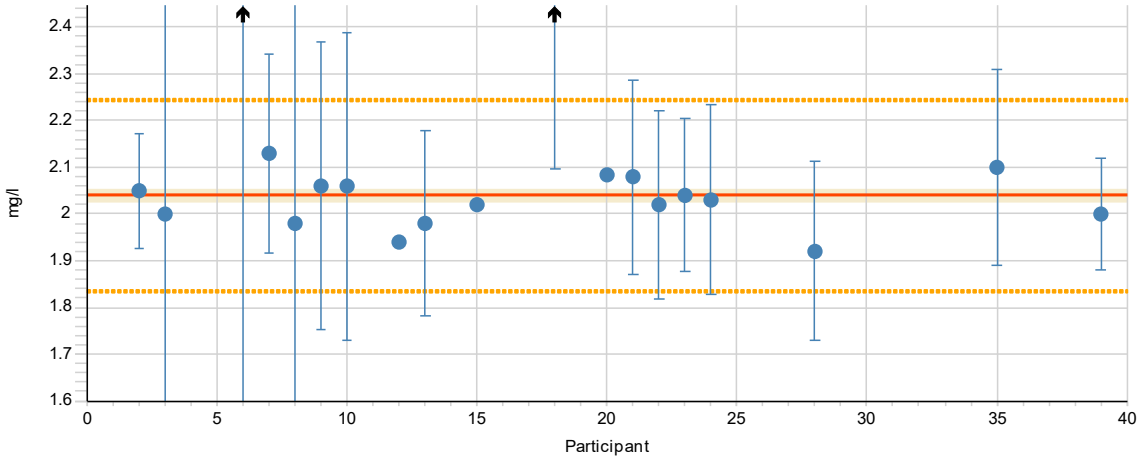




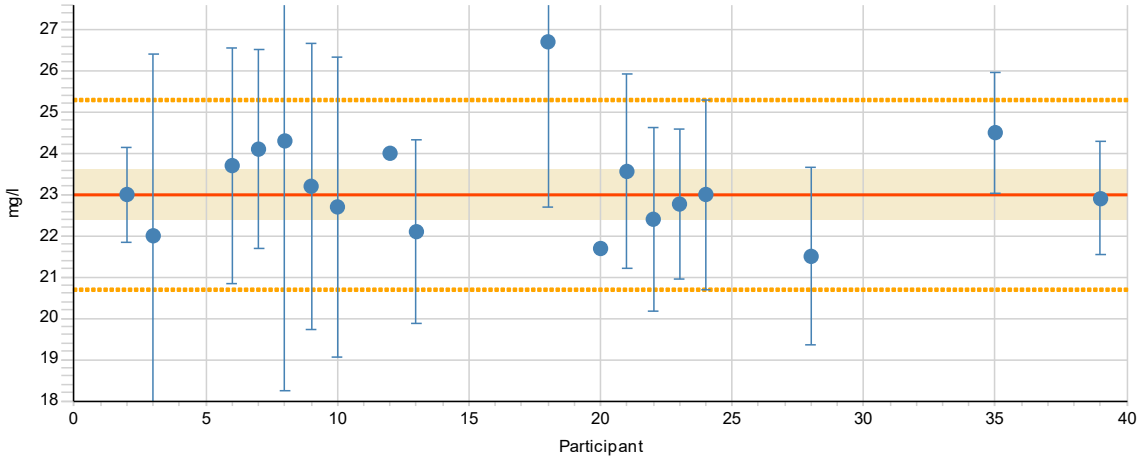
Measurand Alkalinity Sample G3A



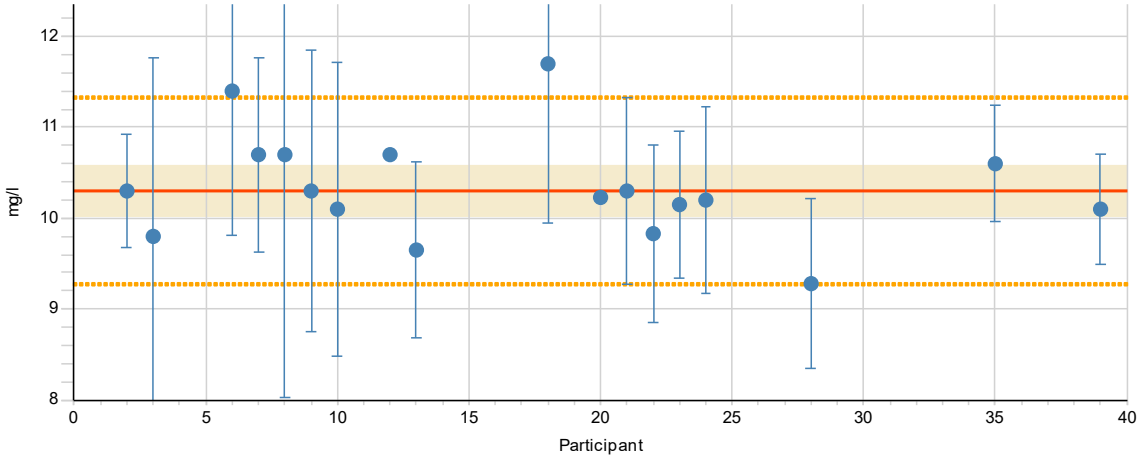
Measurand Ca Sample A1K



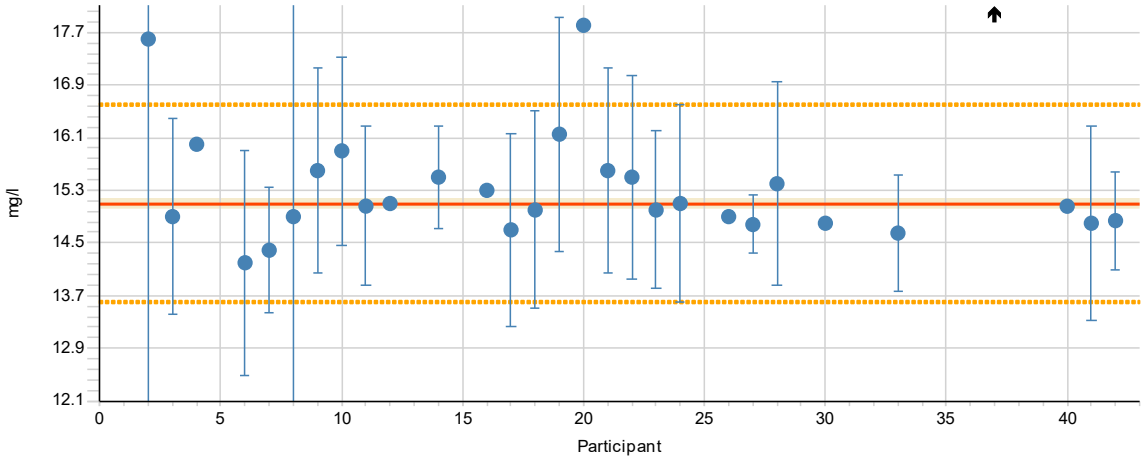
Measurand Ca Sample D2K



Measurand Ca Sample G3K



Measurand Cl Sample A1CS



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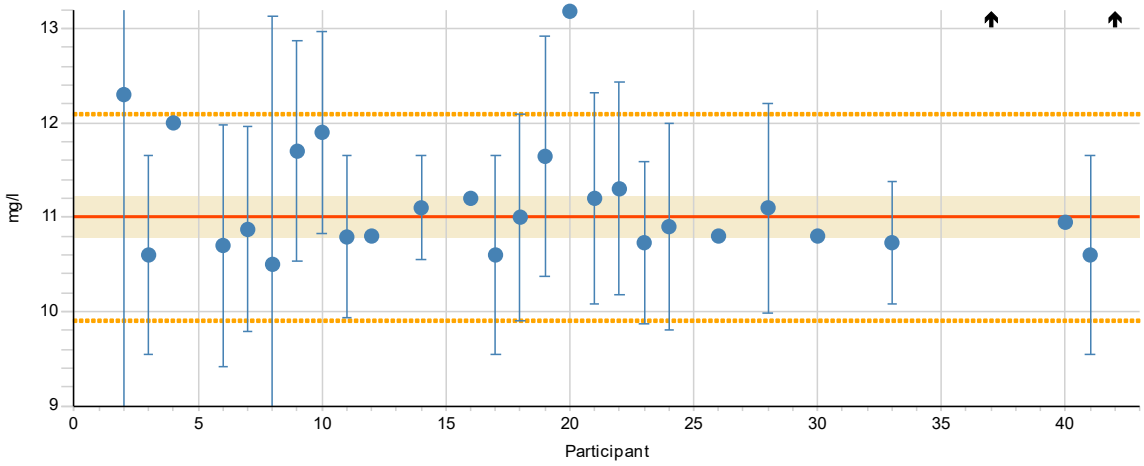

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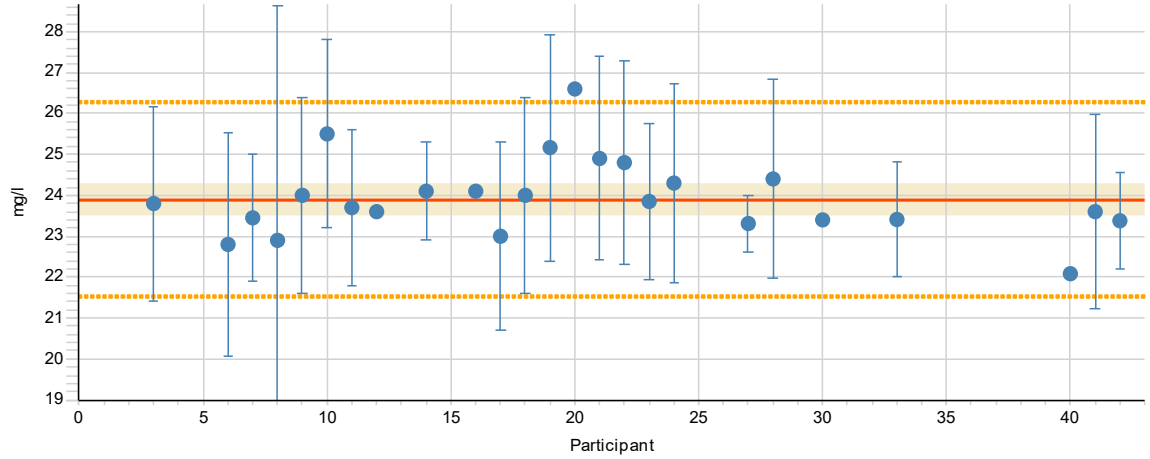
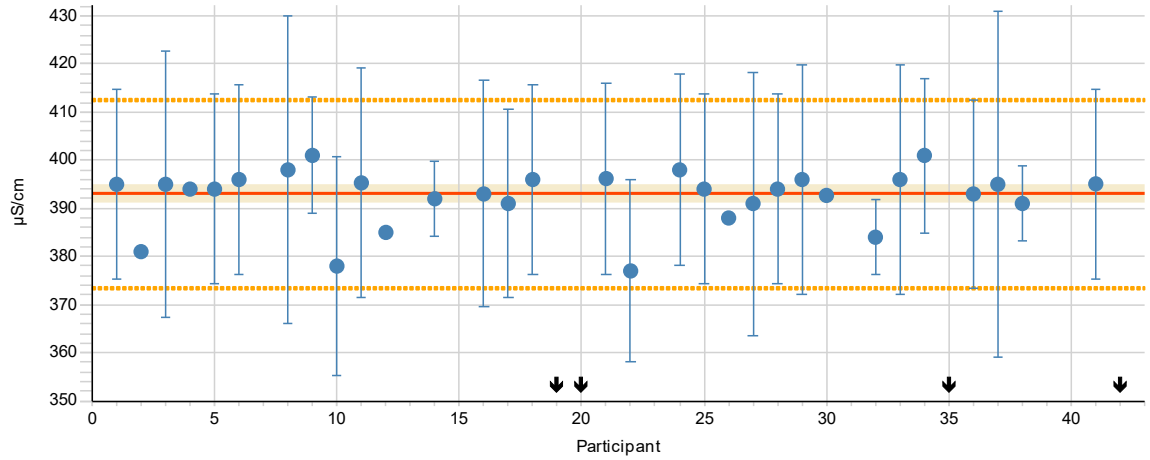
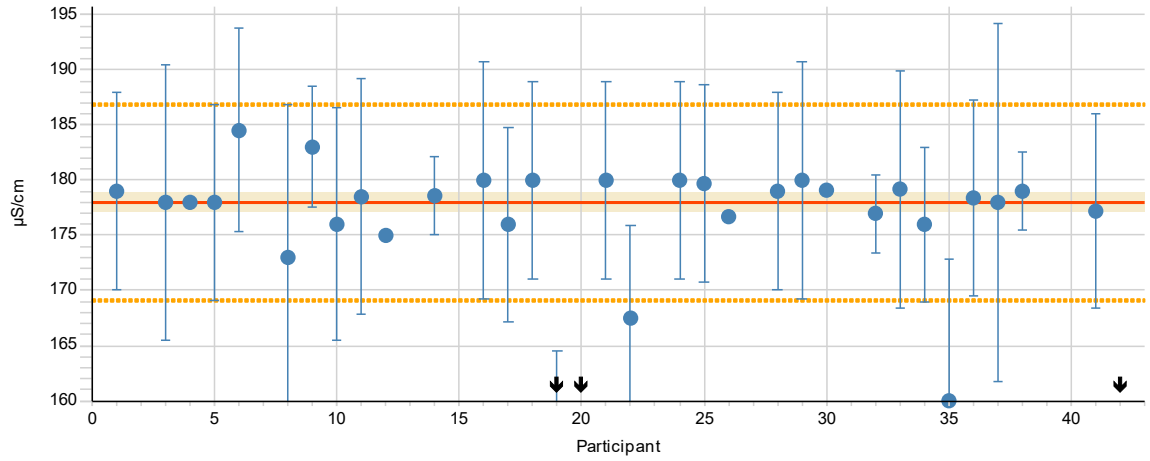


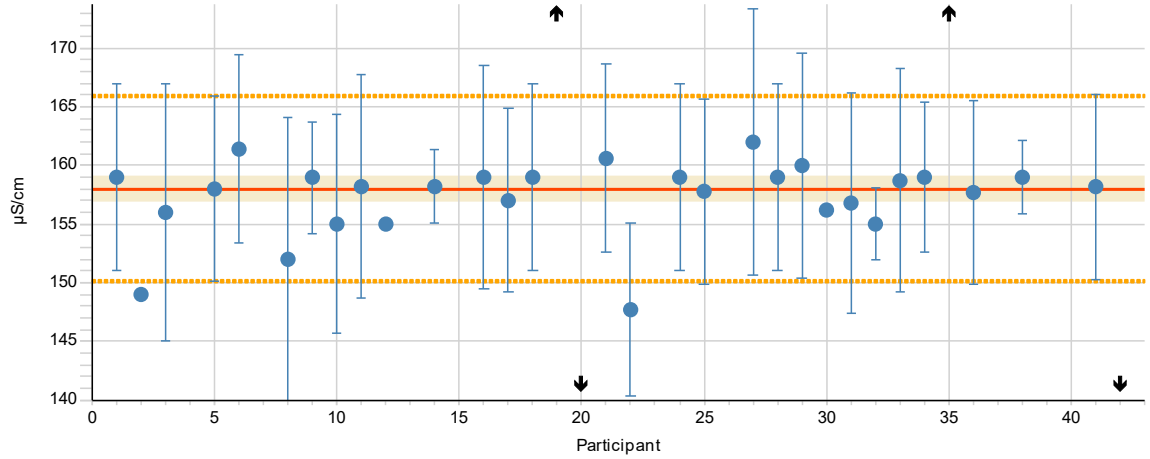
Measurand Conductivity Sample A1J



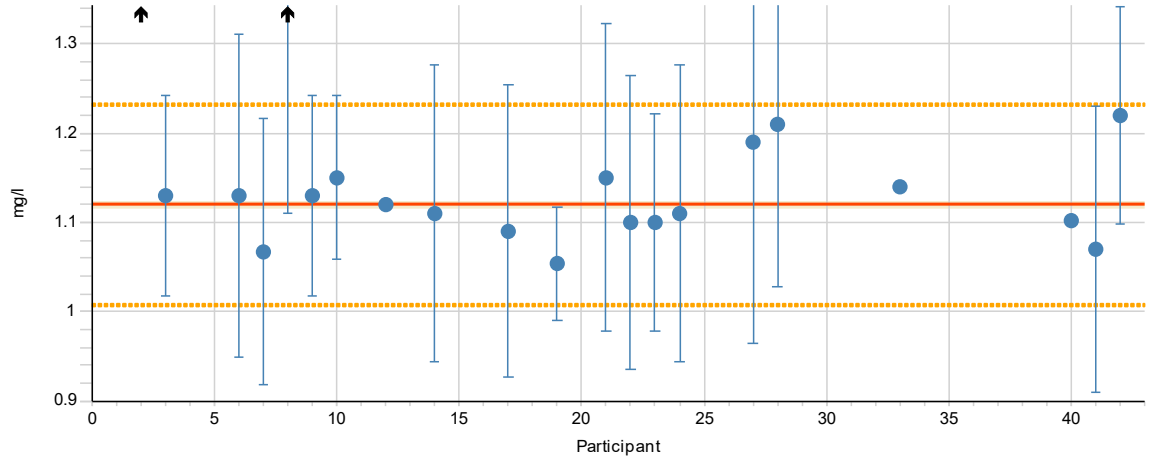
Measurand Conductivity Sample D2PJ



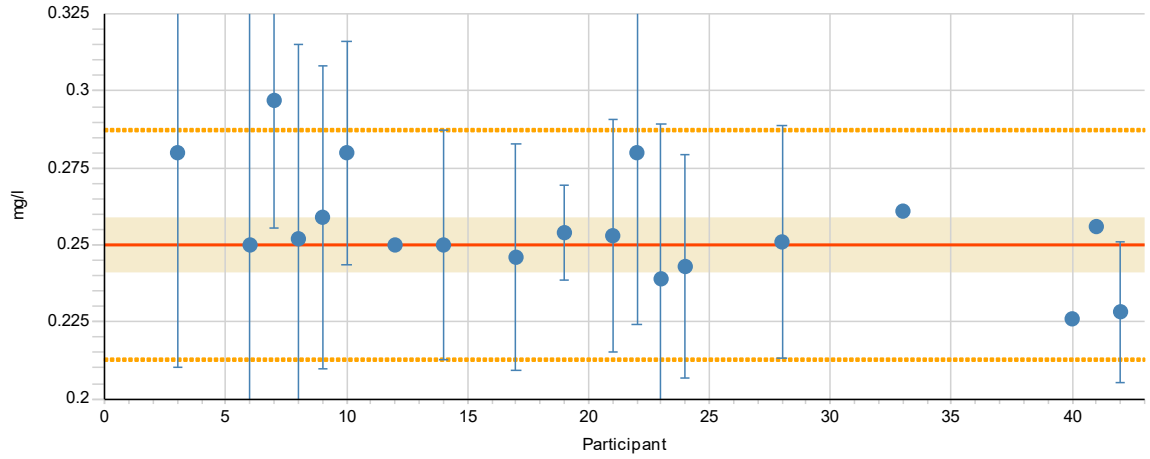
Measurand Conductivity Sample G3PJ



Measurand F Sample A1F



Measurand F Sample D2F



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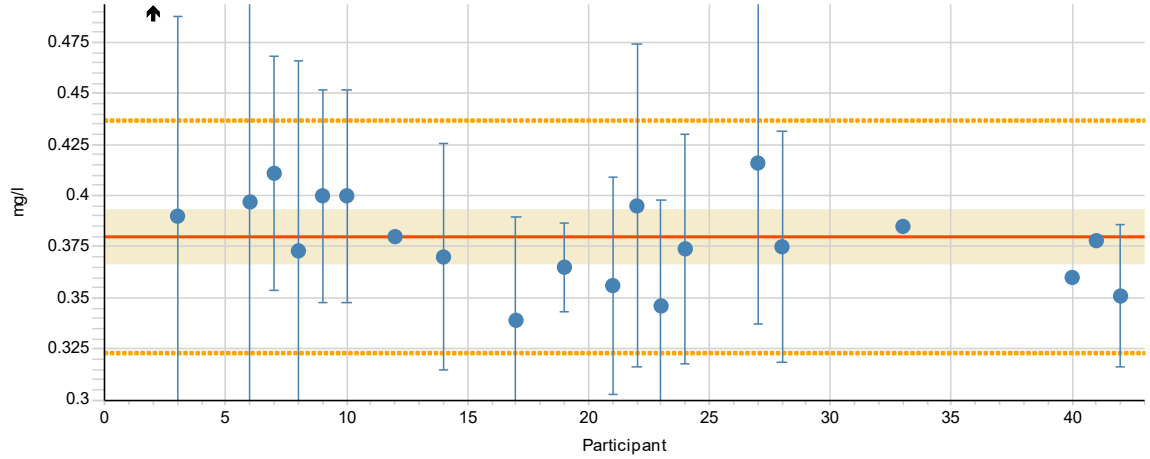
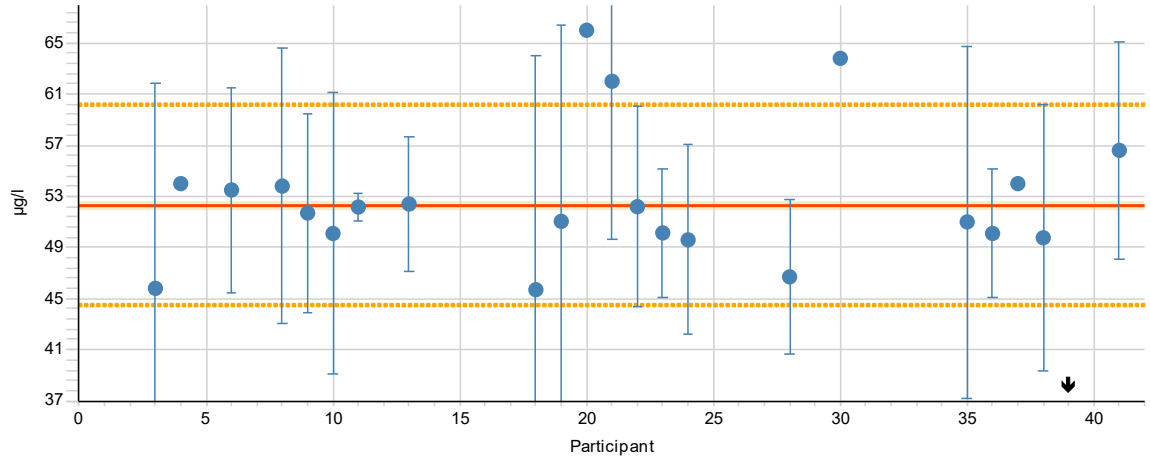
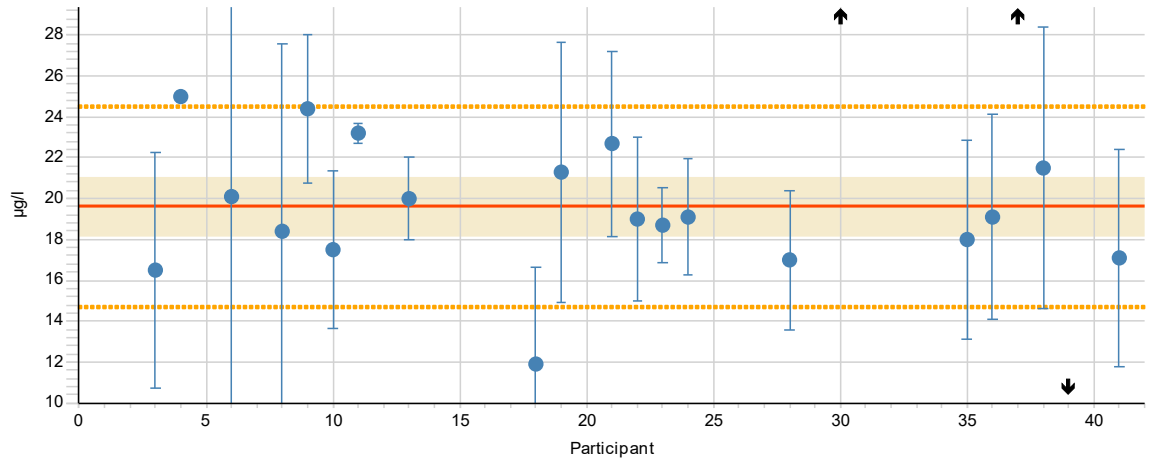


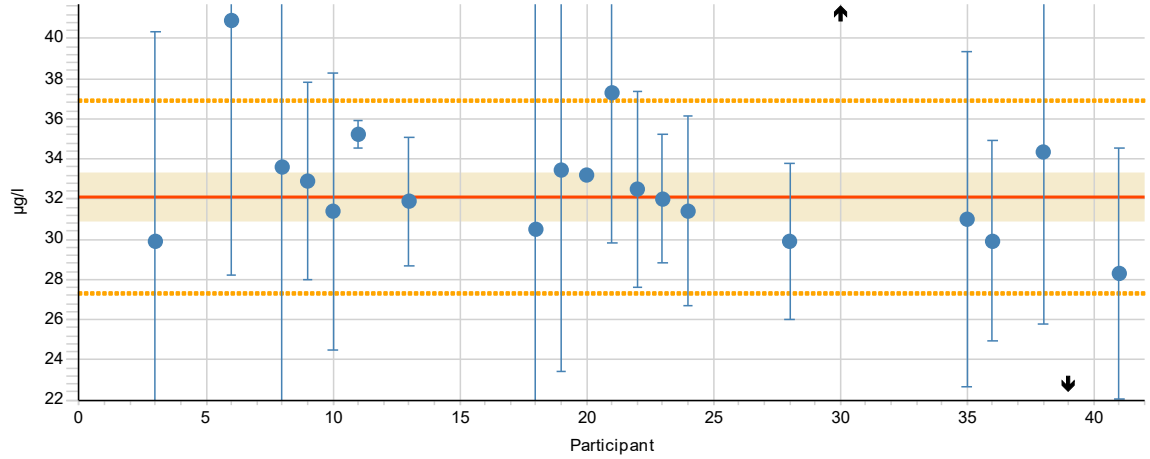
Measurand Fe Sample A1Fe



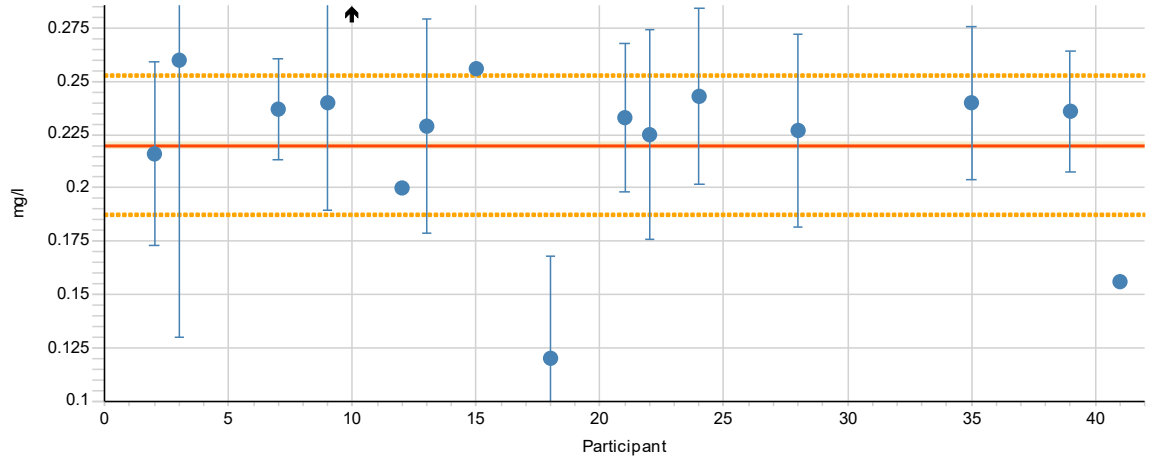
Measurand Fe Sample D2Fe



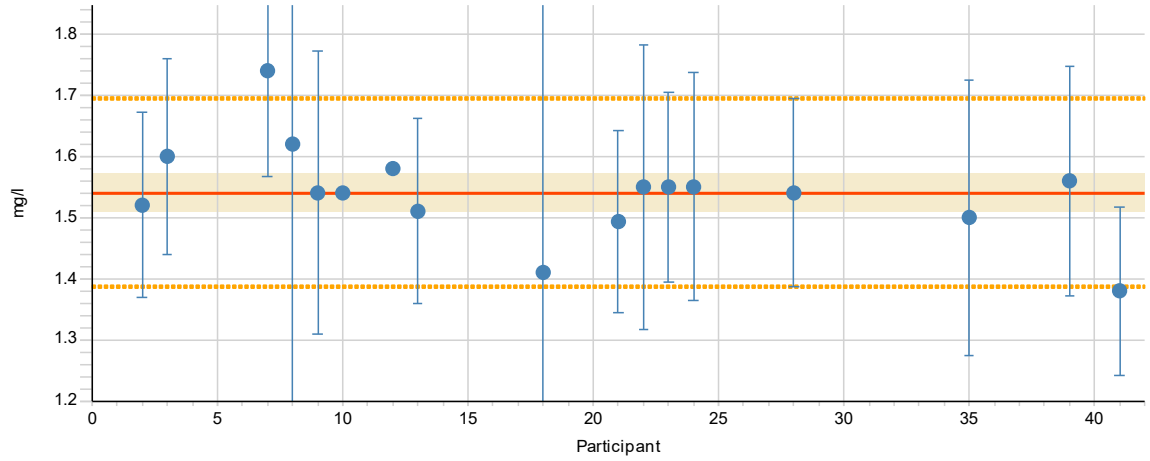
Measurand Fe Sample G3Fe



Measurand K Sample A1K



Measurand K Sample D2K



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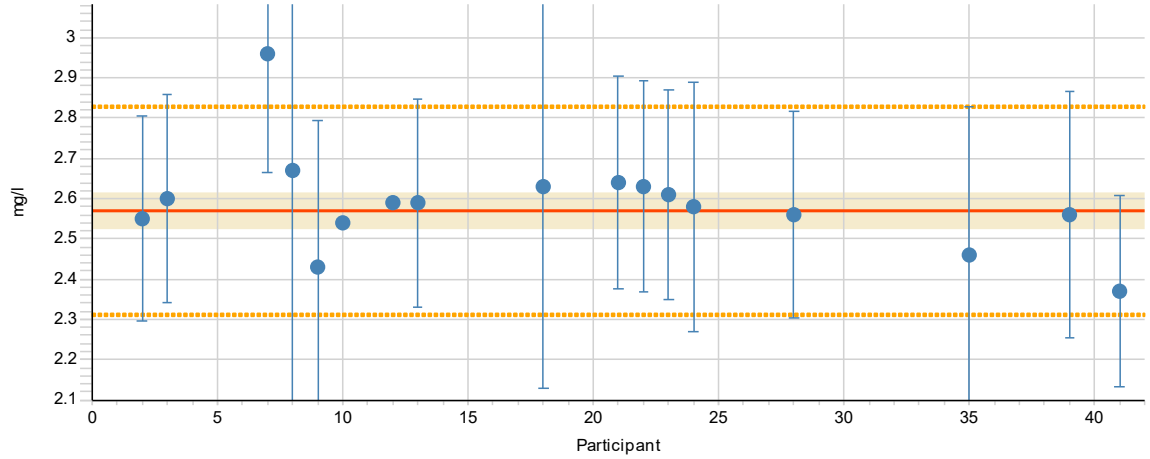

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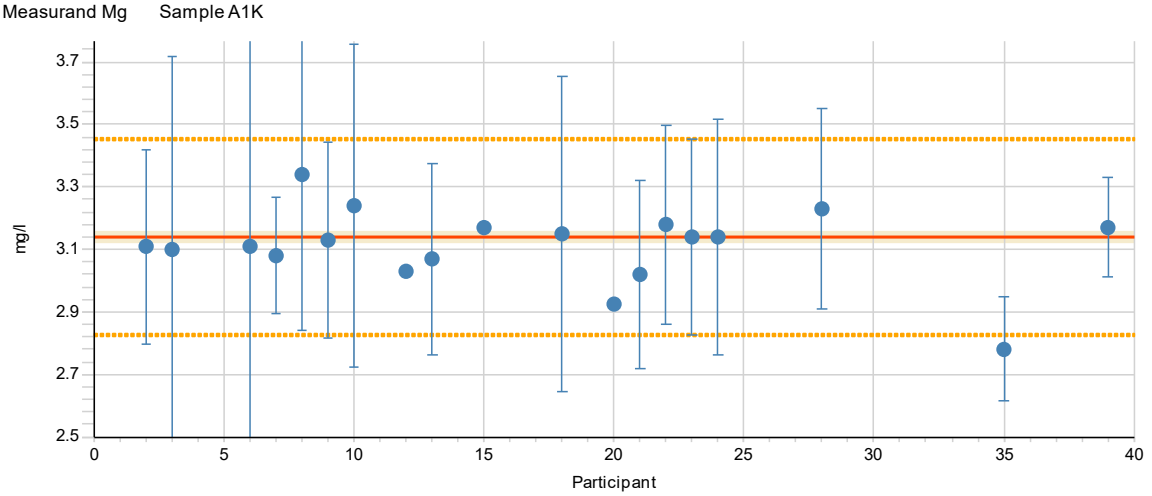

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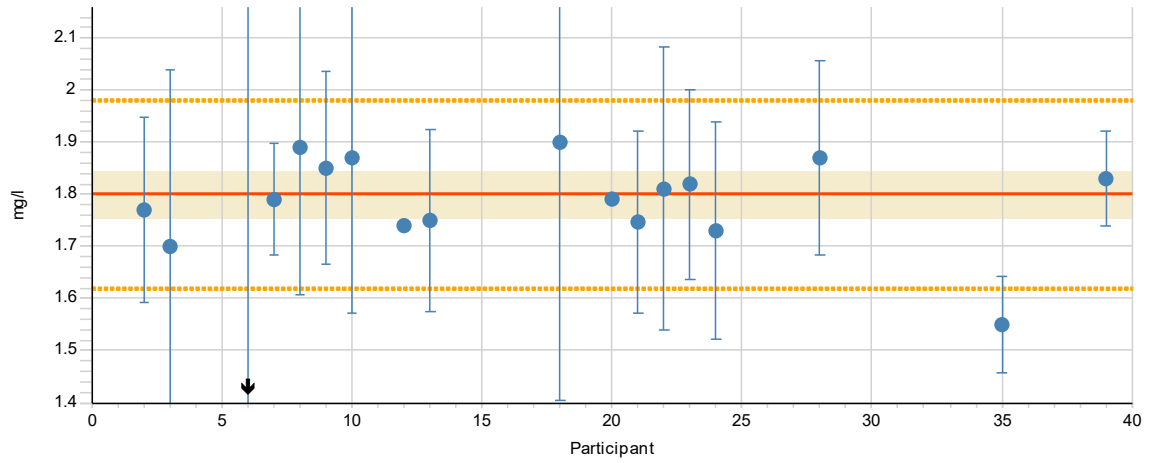
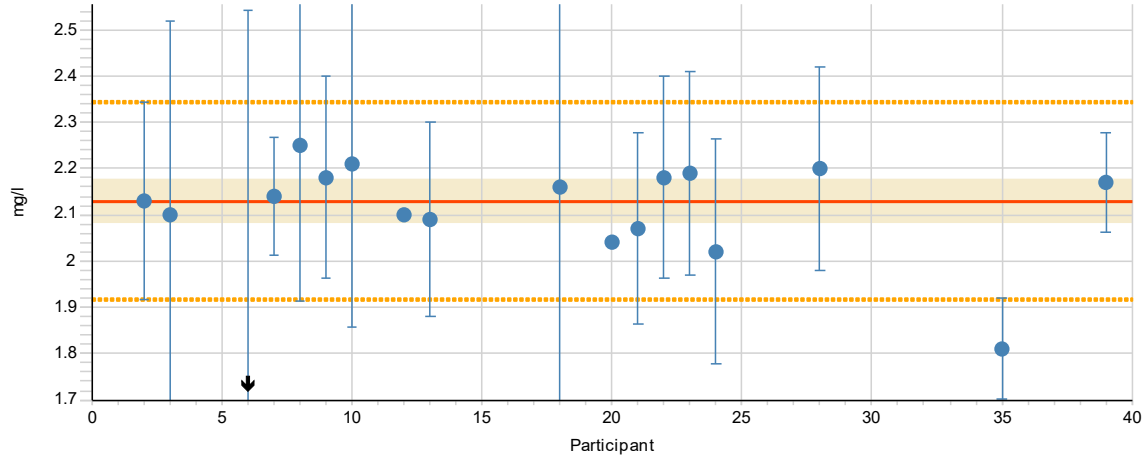
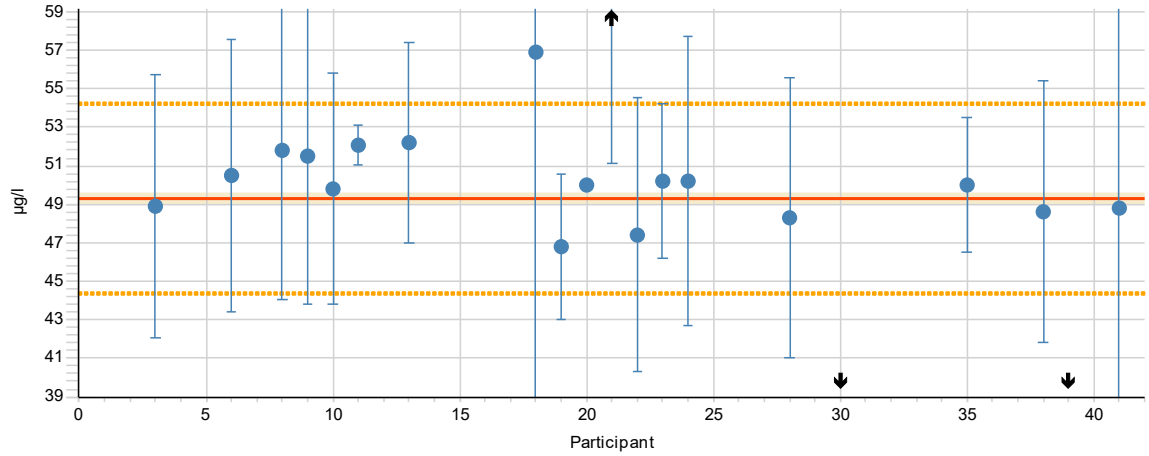


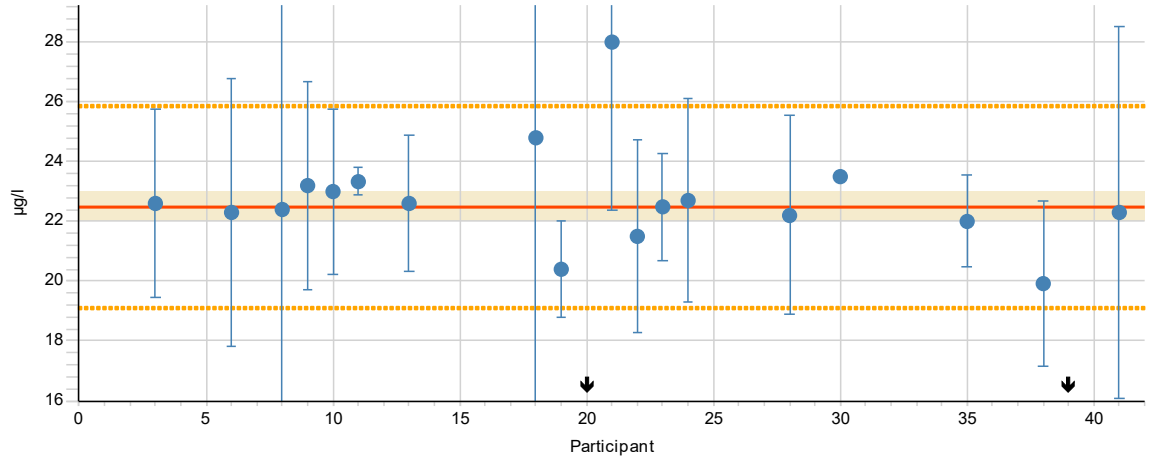
Measurand Mg Sample G3K



Measurand Mn Sample A1Fe



Measurand Mn Sample D2Fe



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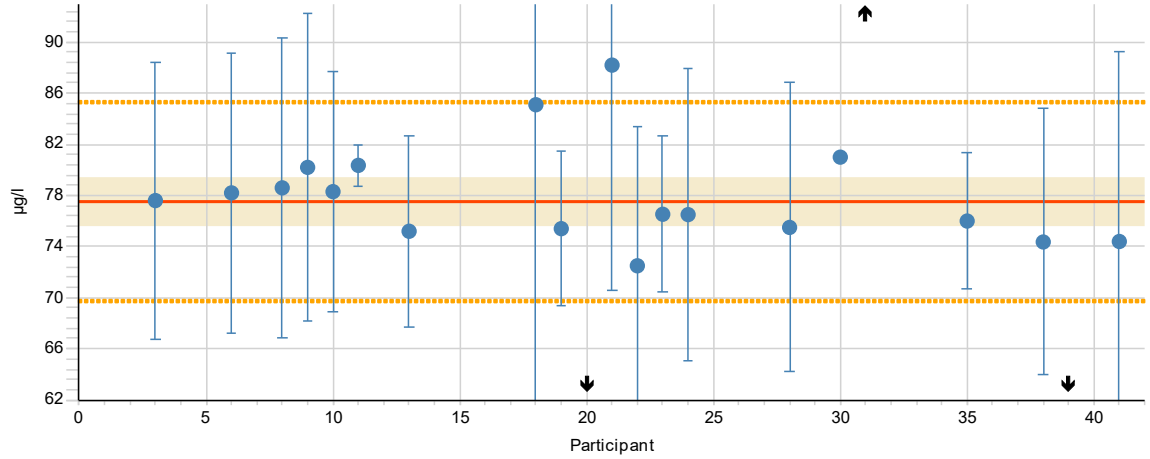
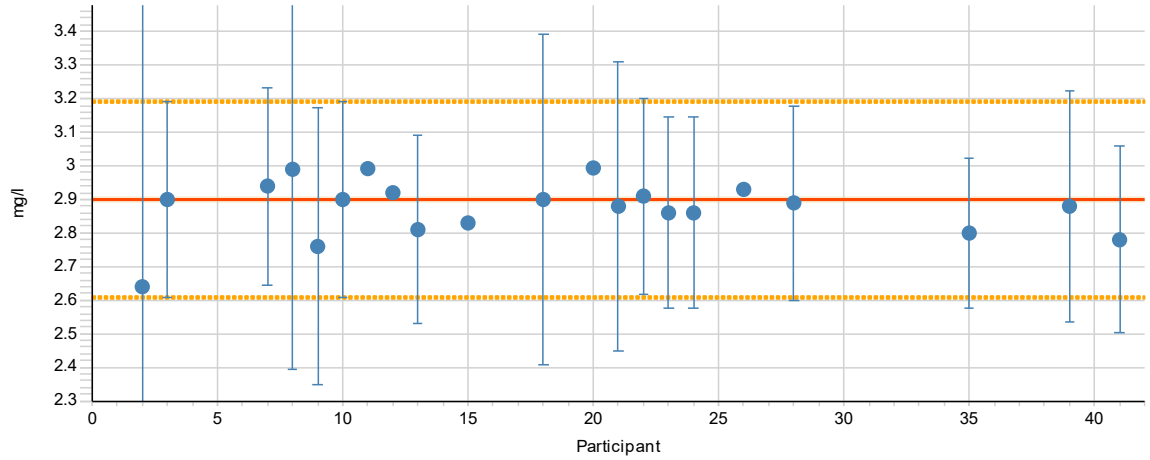


Measurand Na Sample A1K



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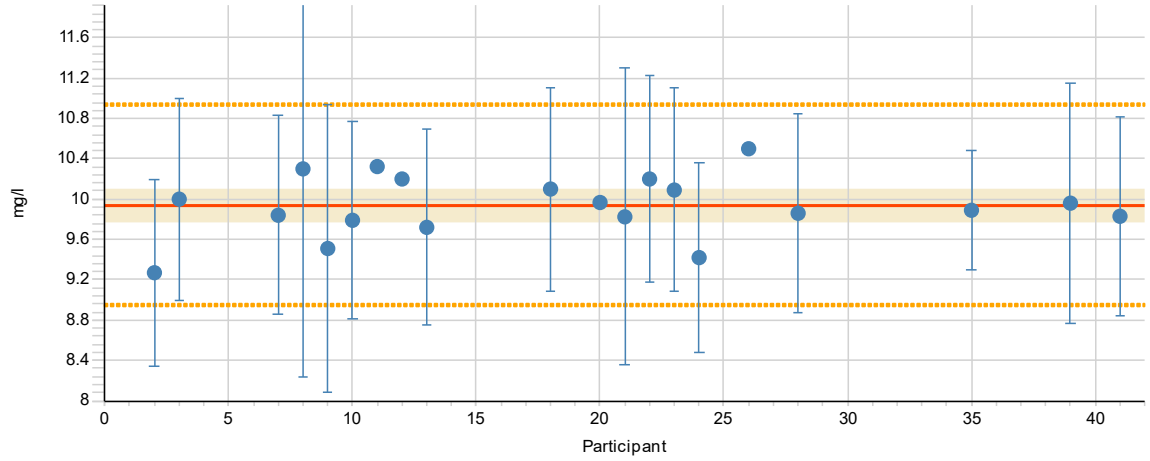
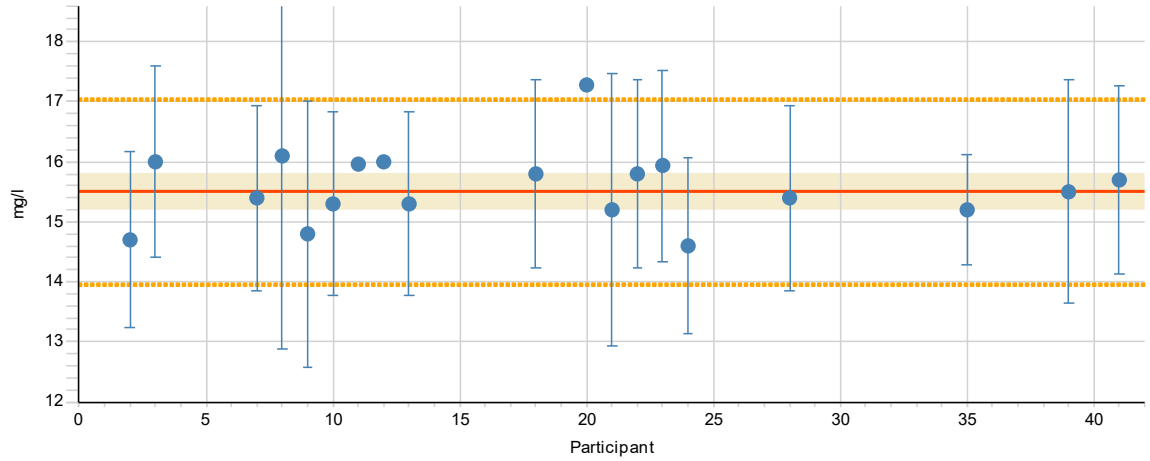
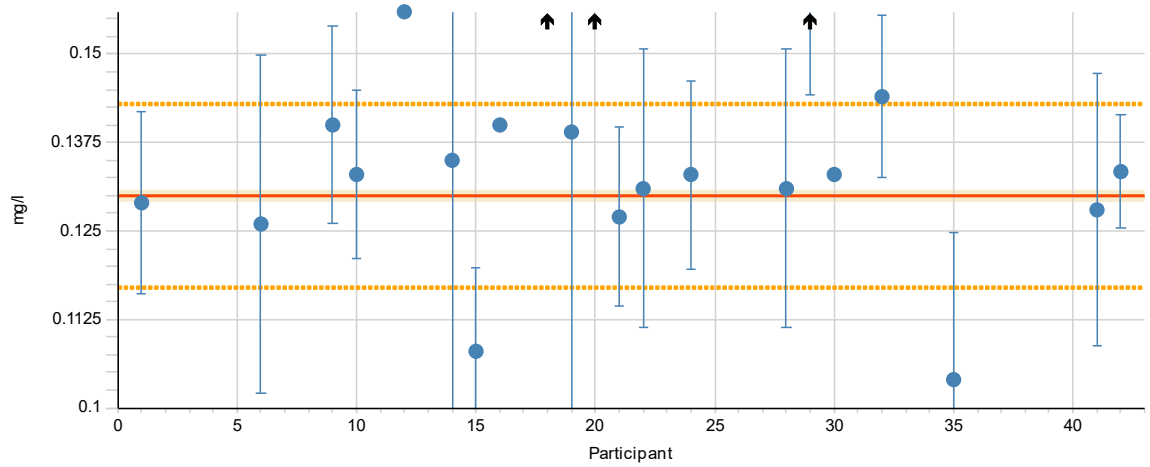


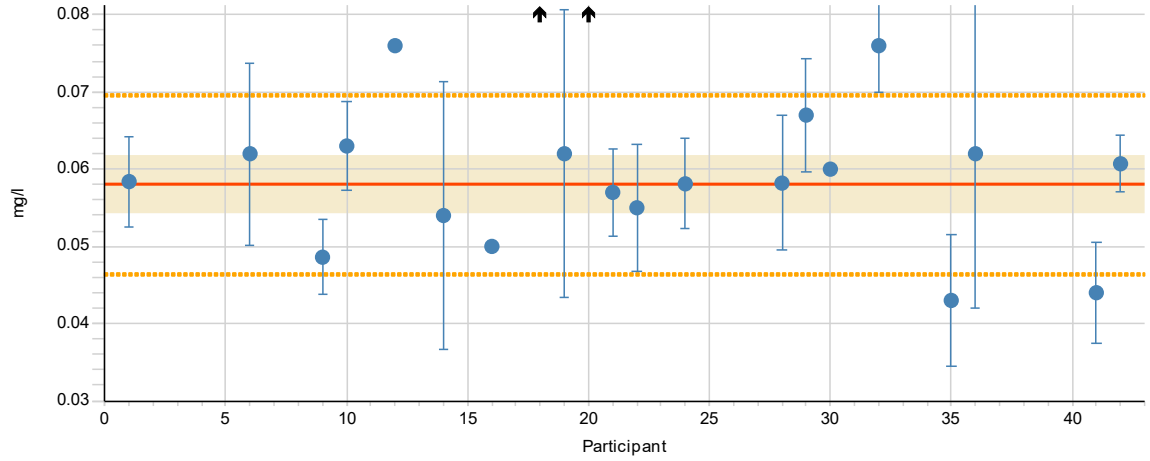
Measurand Na Sample G3K

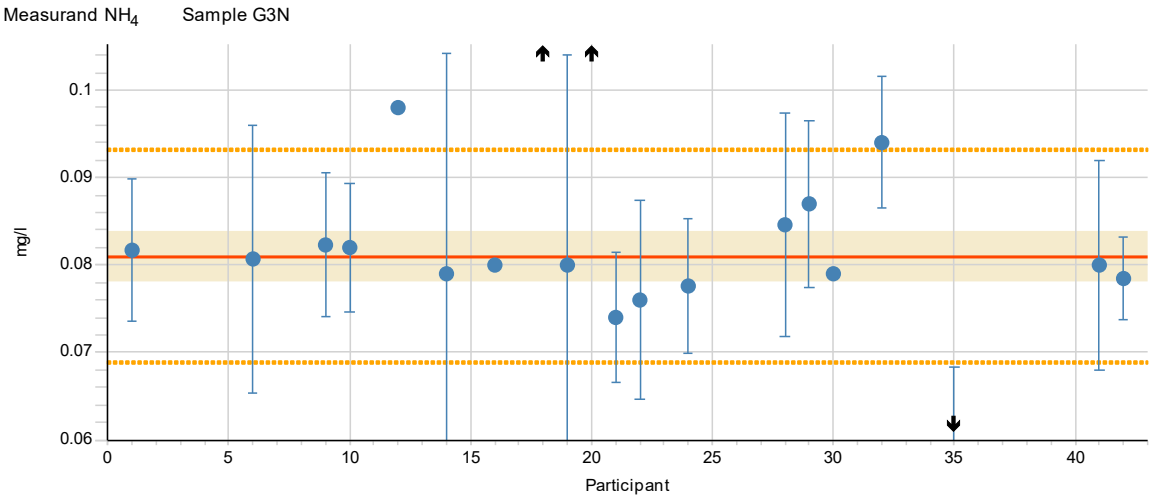


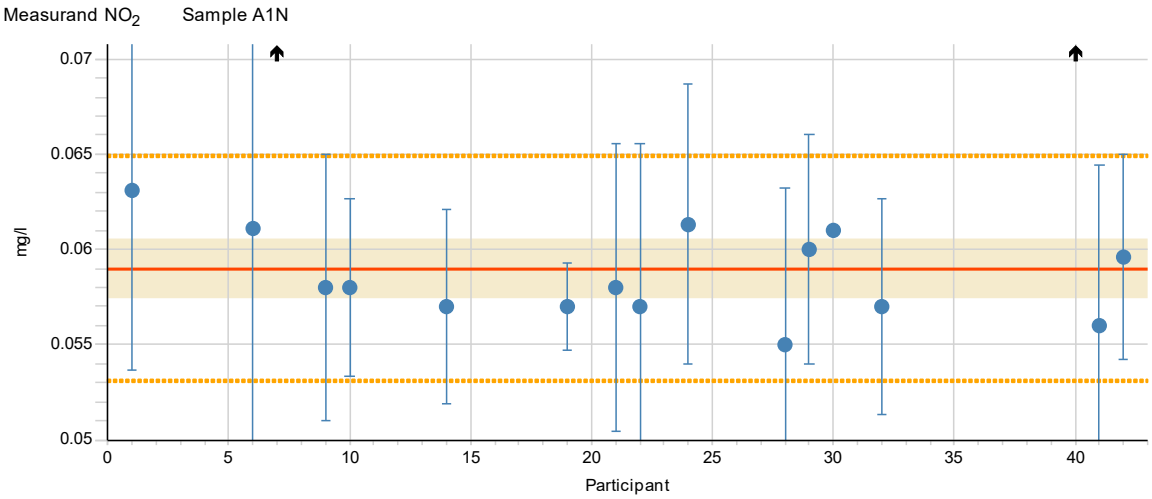
Measurand NH_4 Sample A1N

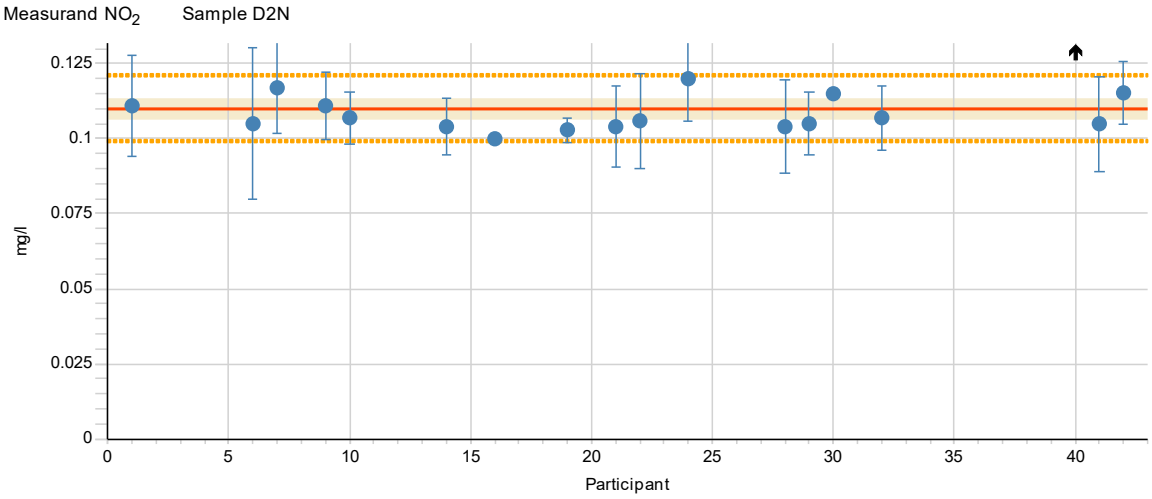


Measurand NH_4 Sample D2N

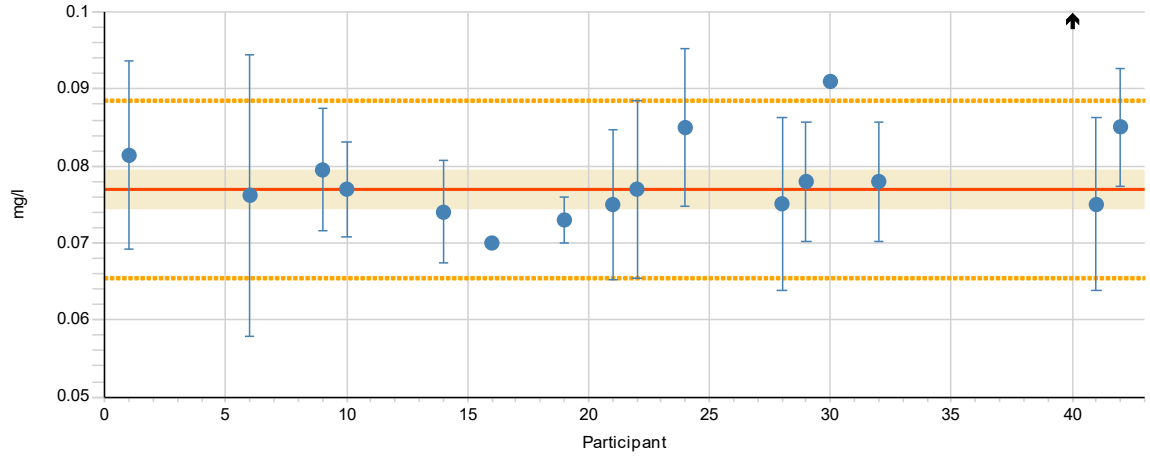



Measurand NH_4 Sample G3N
mg/l
0.1
0.09
0.08
0.07
0.06
0
5
10
15
20
25
30
35
40
Participant

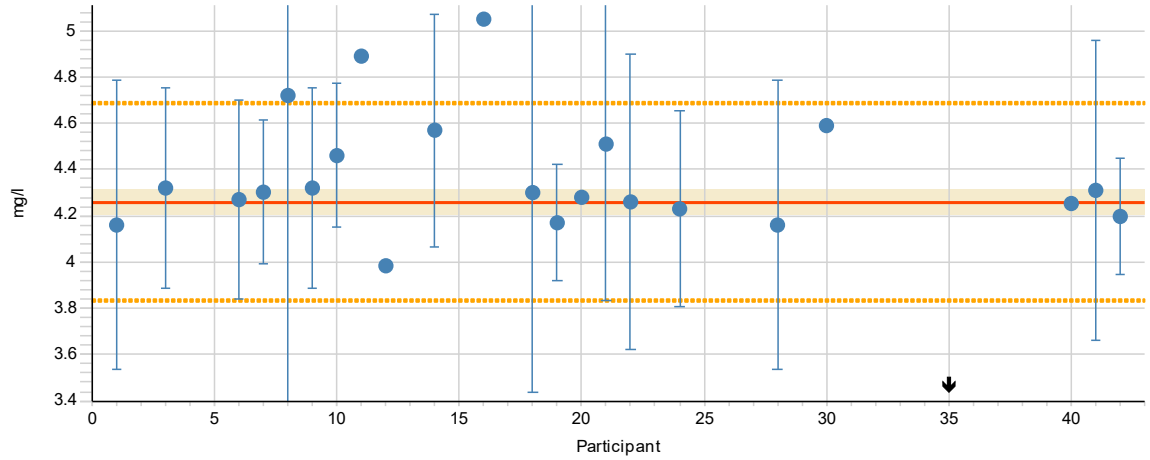

Measurand NO_2 Sample A1N
mg/l
0.07
0.065
0.06
0.055
0.05
0
5
10
15
20
25
30
35
40
Participant


Measurand NO_2 Sample D2N
mg/l
0.125
0.1
0.075
0.05
0.025
0
0
5
10
15
20
25
30
35
40
Participant

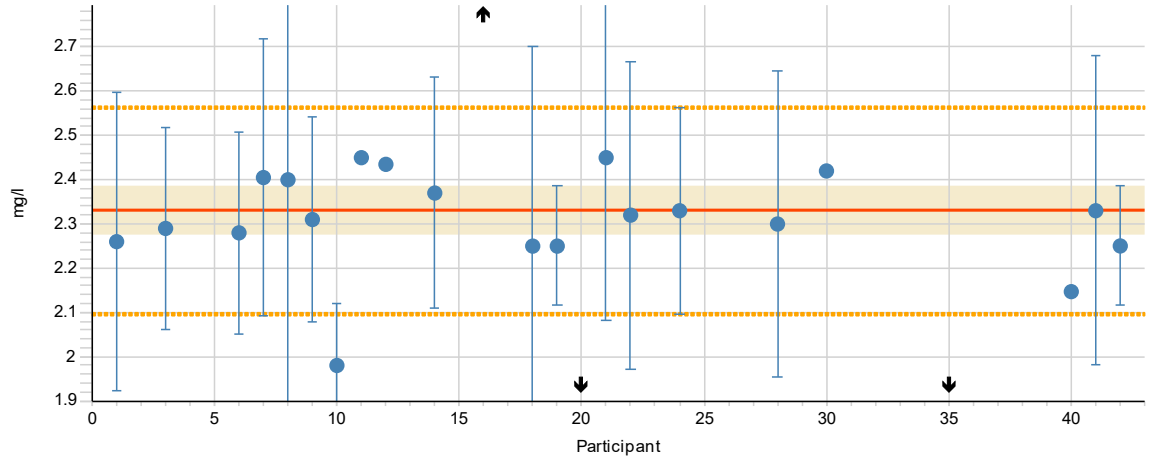
Measurand NO_2 Sample G3N

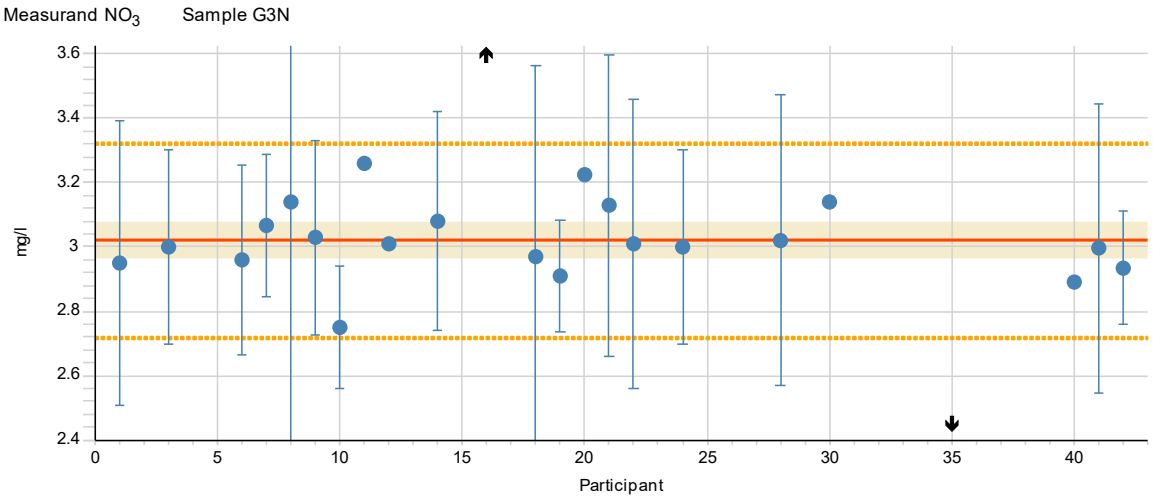


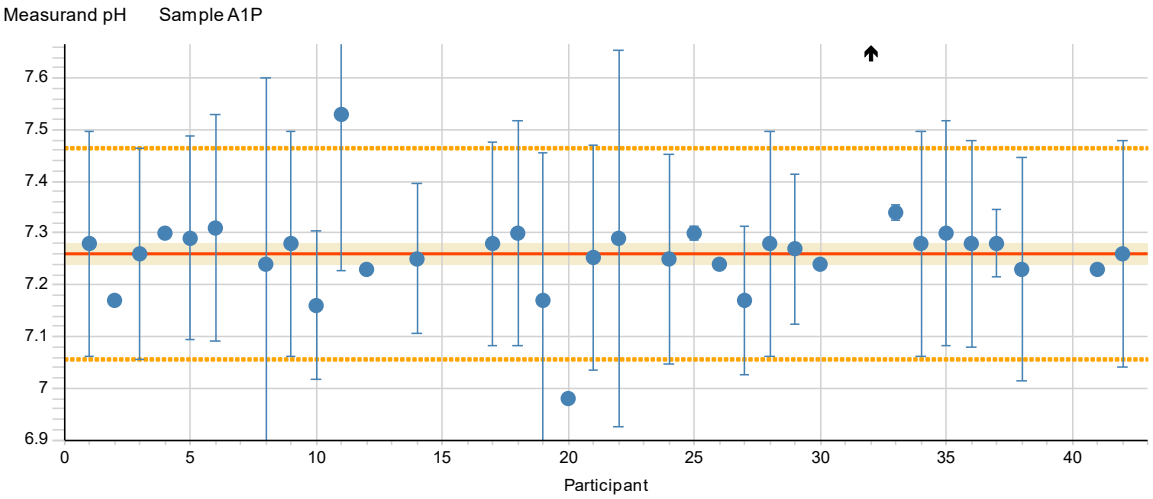
Measurand NO_3 Sample A1N

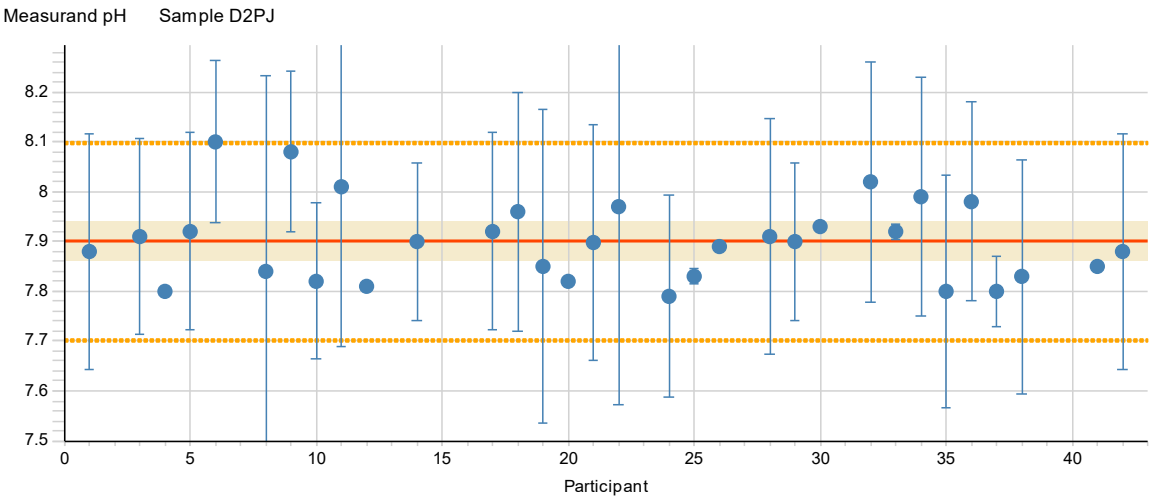


Measurand NO_3 Sample D2N

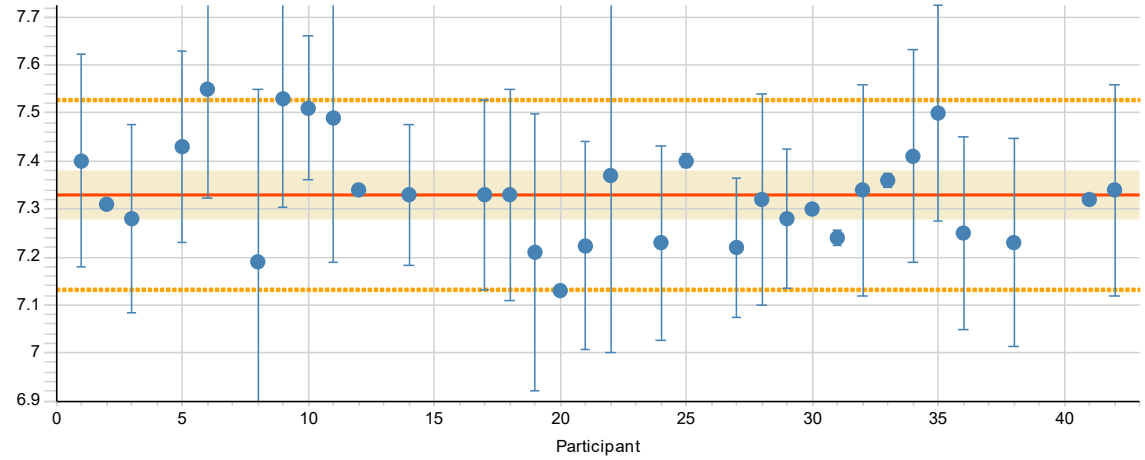



Measurand NO_3 Sample G3N
mg/l
3.6
3.4
3.2
3
2.8
2.6
2.4
0
5
10
15
20
25
30
35
40
Participant

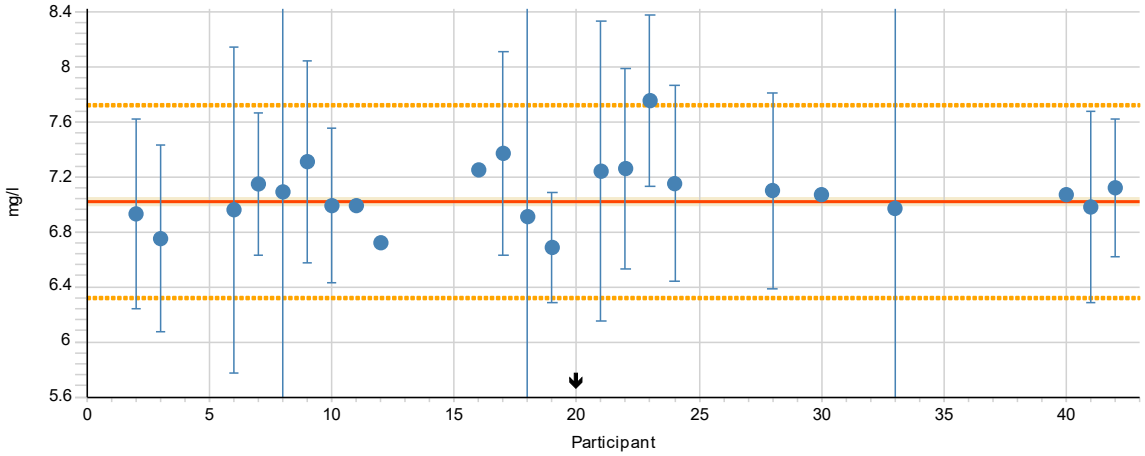

Measurand pH Sample A1P
7.6
7.5
7.4
7.3
7.2
7.1
7
6.9
0
5
10
15
20
25
30
35
40
Participant


Measurand pH Sample D2PJ
8.2
8.1
8
7.9
7.8
7.7
7.6
7.5
0
5
10
15
20
25
30
35
40
Participant

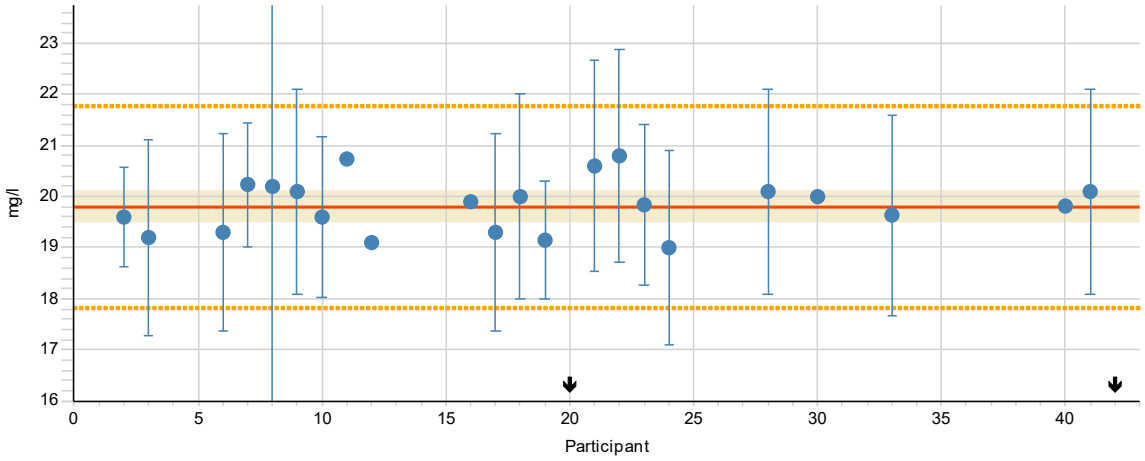
Measurand pH Sample G3PJ



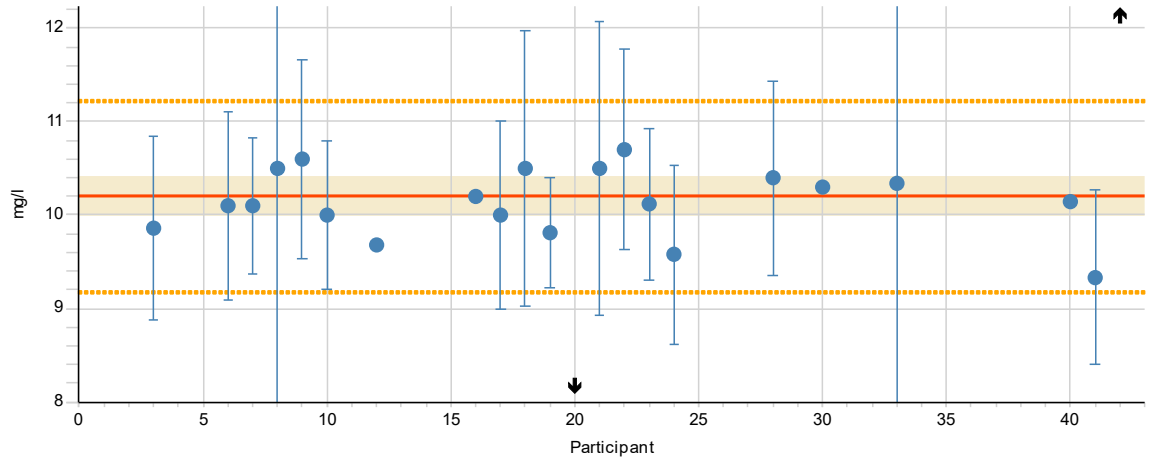
Measurand SO_4 Sample A1CS



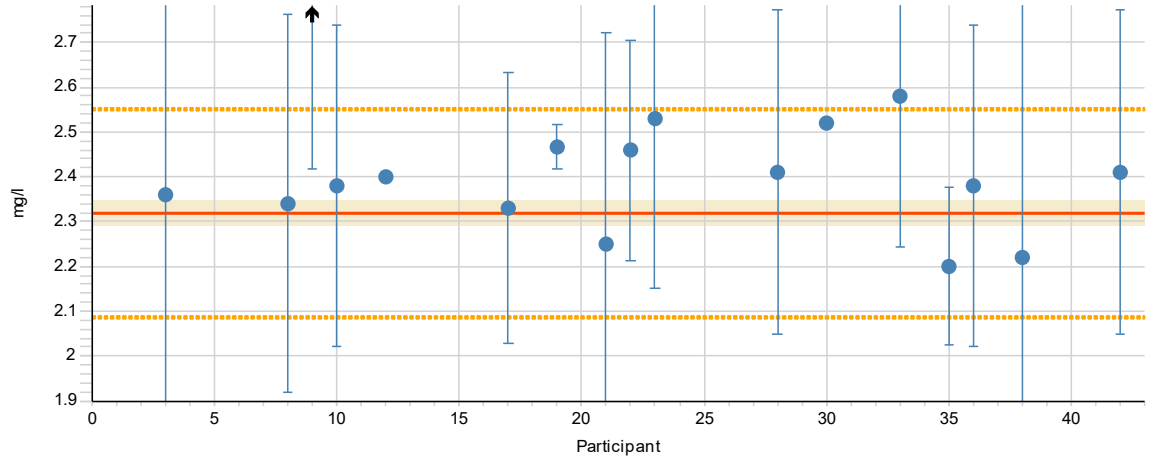
Measurand SO_4 Sample D2CS



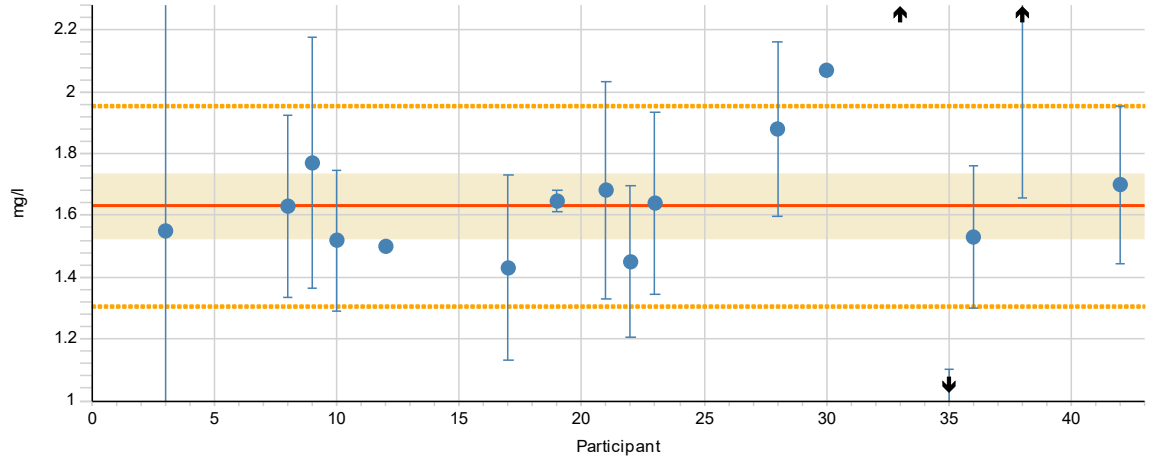
Measurand SO_4 Sample G3CS



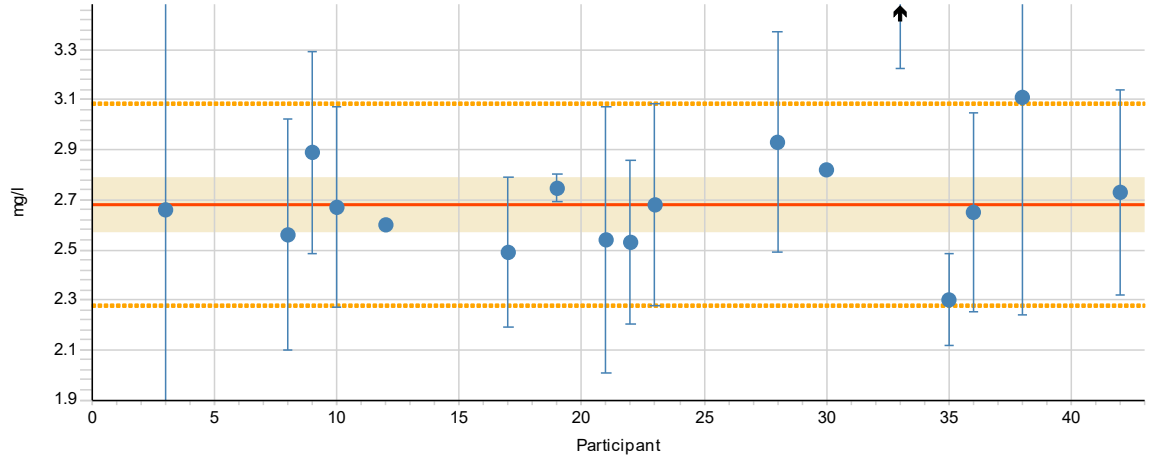
Measurand TOC Sample A1T



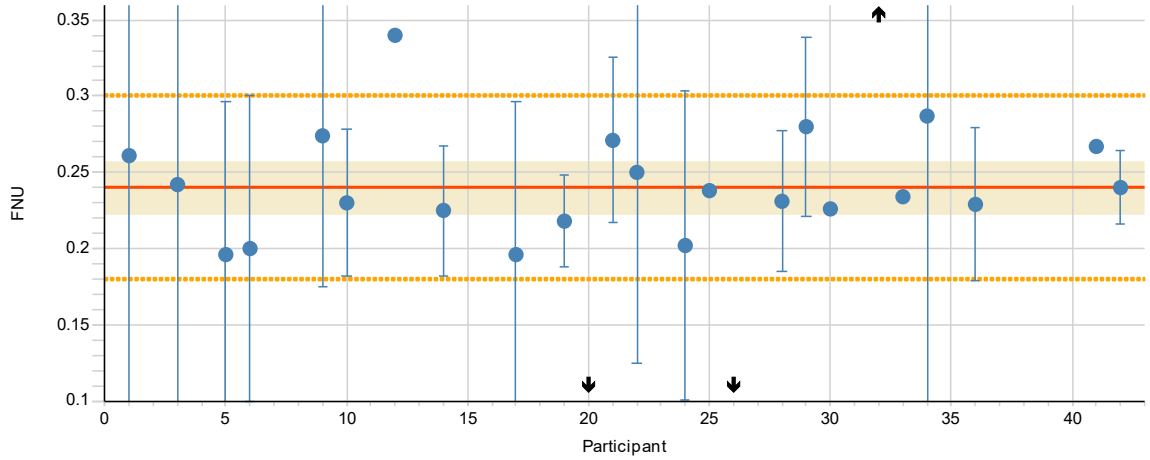
Measurand TOC Sample D2T



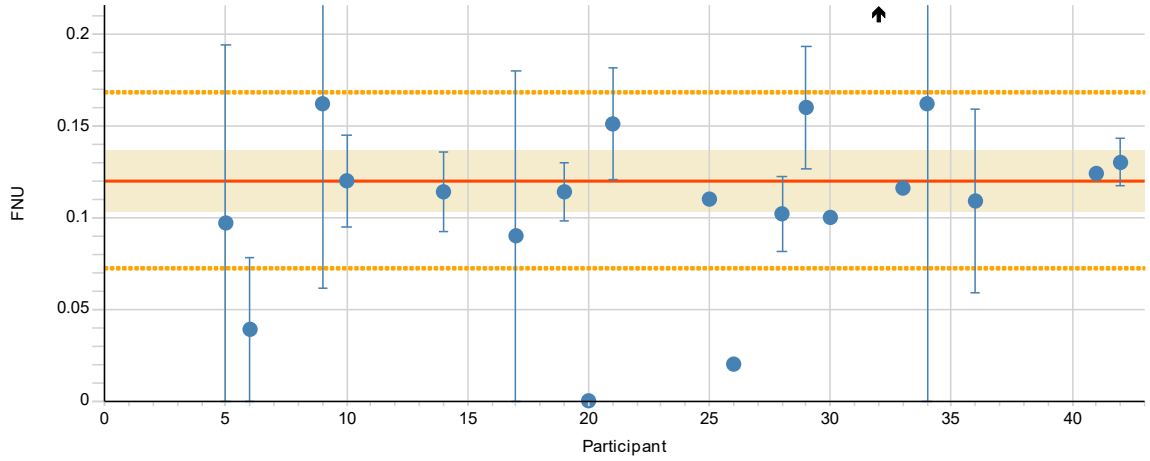
Measurand TOC Sample G3T

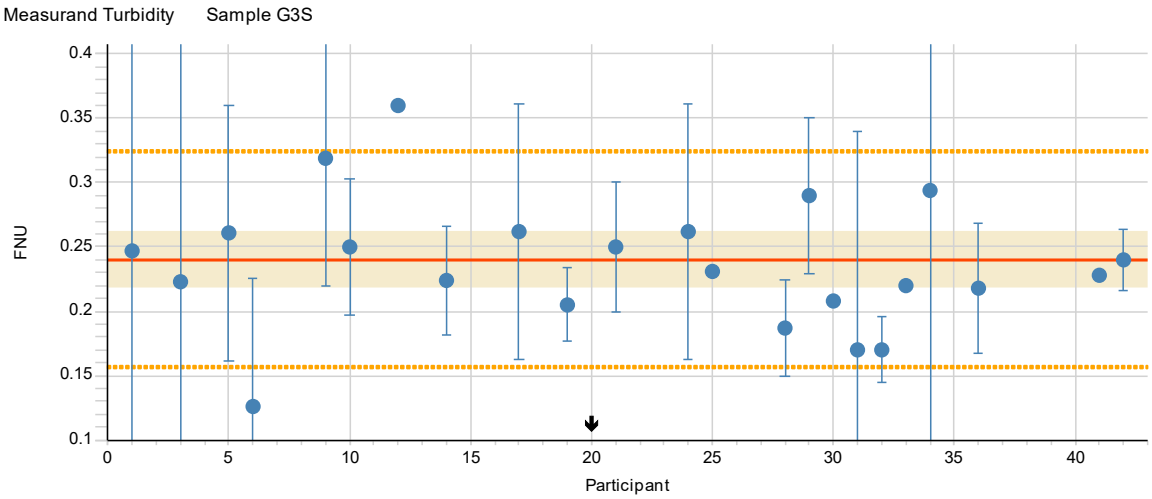


Measurand Turbidity Sample A1S



Measurand Turbidity Sample D2S




Measurand Turbidity
Sample G3S
FNU
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0
5
10
15
20
25
30
35
40
Participant

Appendix 10. **Summary of the z scores**

Measurand	Sample	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	%
Alkalinity	A1A	S	.	S	.	.	Q	U	U	S	S	.	S	.	S	.	.	S	Q	Q	u	Q	60.0
	D2A	S	.	S	.	.	S	S	S	S	S	.	S	.	S	.	.	S	S	S	u	S	88.0
	G3A	S	.	S	.	.	S	S	S	S	S	.	S	.	S	.	.	S	S	S	u	S	91.7
Ca	A1K	.	S	S	.	.	U	S	S	S	S	.	S	S	.	S	.	.	U	.	S	S	89.5
	D2K	.	S	S	.	.	S	S	S	S	S	.	S	S	.	.	.	.	U	.	S	S	94.4
	G3K	.	S	S	.	.	Q	S	S	S	S	.	S	S	.	.	.	.	Q	.	S	S	88.9
Cl	A1CS	.	U	S	S	.	S	S	S	S	S	S	S	.	S	.	S	S	S	S	U	S	89.7
	D2CS	.	Q	S	S	.	S	S	S	S	S	S	S	.	S	.	S	S	S	S	U	S	85.7
	G3CS	.	.	S	.	.	S	S	S	S	S	S	S	.	S	.	S	S	S	S	Q	S	96.0
Conductivity	A1J	S	S	S	S	S	S	.	S	S	S	S	S	.	S	.	S	S	S	u	u	S	88.6
	D2PJ	S	.	S	S	S	S	.	S	S	S	S	S	.	S	.	S	S	S	u	u	S	84.8
	G3PJ	S	q	S	.	S	S	.	S	S	S	S	S	.	S	.	S	S	S	U	u	S	81.8
F	A1F	.	U	S	.	.	S	S	U	S	S	.	S	.	S	.	.	S	.	S	.	S	90.5
	D2F	.	.	S	.	.	S	Q	S	S	S	.	S	.	S	.	.	S	.	S	.	S	94.7
	G3F	.	U	S	.	.	S	S	S	S	S	.	S	.	S	.	.	S	.	S	.	S	95.2
Fe	A1Fe	.	.	S	S	.	S	.	S	S	S	S	.	S	.	.	.	.	S	S	U	Q	82.6
	D2Fe	.	.	S	Q	.	S	.	S	S	S	S	.	S	.	.	.	.	u	S	.	S	77.3
	G3Fe	.	.	S	.	.	U	.	S	S	S	S	.	S	.	.	.	.	S	S	S	Q	81.0
K	A1K	.	S	Q	.	.	.	S	.	S	U	.	S	S	.	Q	.	.	u	.	.	S	68.8
	D2K	.	S	S	.	.	.	Q	S	S	S	.	S	S	.	.	.	.	S	.	.	S	88.2
	G3K	.	S	S	.	.	.	U	S	S	S	.	S	S	.	.	.	.	S	.	.	S	94.1
Mg	A1K	.	S	S	.	.	S	S	S	S	S	.	S	S	.	S	.	.	S	.	S	S	94.7
	D2K	.	S	S	.	.	u	S	S	S	S	.	S	S	.	.	.	.	S	.	S	S	88.9
	G3K	.	S	S	.	.	u	S	S	S	S	.	S	S	.	.	.	.	S	.	S	S	88.9
Mn	A1Fe	.	.	S	.	.	S	.	S	S	S	S	.	S	.	.	.	.	U	S	S	U	80.0
	D2Fe	.	.	S	.	.	S	.	S	S	S	S	.	S	.	.	.	.	S	S	u	U	85.0
	G3Fe	.	.	S	.	.	S	.	S	S	S	S	.	S	.	.	.	.	S	S	u	Q	81.0
Na	A1K	.	S	S	.	.	.	S	S	S	S	S	S	S	.	S	.	.	S	.	S	S	100
	D2K	.	S	S	.	.	.	S	S	S	S	S	S	S	.	.	.	.	S	.	S	S	100
	G3K	.	S	S	.	.	.	S	S	S	S	S	S	S	.	.	.	.	S	.	Q	S	94.7
NH_4	A1N	S	.	.	.	.	S	.	.	S	S	.	U	.	S	u	S	.	U	S	U	S	66.7
	D2N	S	.	.	.	.	S	.	.	S	S	.	U	.	S	.	S	.	U	S	U	S	71.4
	G3N	S	.	.	.	.	S	.	.	S	S	.	Q	.	S	.	S	.	U	S	U	S	75.0
NO_2	A1N	S	.	.	.	.	S	U	.	S	S	.	.	.	S	.	.	.	.	S	.	S	88.2
	D2N	S	.	.	.	.	S	S	.	S	S	.	.	.	S	.	S	.	.	S	.	S	94.4
	G3N	S	.	.	.	.	S	.	.	S	S	.	.	.	S	.	S	.	.	S	.	S	88.2

Measurand	Sample	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	%
NO_3	A1N	S	.	S	.	.	S	S	Q	S	S	Q	S	.	S	.	U	.	S	S	S	S	82.6
	D2N	S	.	S	.	.	S	S	S	S	u	S	S	.	S	.	U	.	S	S	u	S	82.6
	G3N	S	.	S	.	.	S	S	S	S	S	S	S	.	S	.	U	.	S	S	S	S	91.3
pH	A1P	S	S	S	S	S	S	.	S	S	S	Q	S	.	S	.	.	S	S	S	q	S	91.2
	D2PJ	S	.	S	S	S	Q	.	S	S	S	S	S	.	S	.	.	S	S	S	S	S	96.9
	G3PJ	S	S	S	.	S	Q	.	S	Q	S	S	S	.	S	.	.	S	S	S	q	S	90.6
SO_4	A1CS	.	S	S	.	.	S	S	S	S	S	S	S	.	.	.	S	S	S	S	u	S	91.7
	D2CS	.	S	S	.	.	S	S	S	S	S	S	S	.	.	.	S	S	S	S	u	S	91.7
	G3CS	.	.	S	.	.	S	S	S	S	S	.	S	.	.	.	S	S	S	S	u	S	90.9
TOC	A1T	.	.	S	.	.	.	.	S	U	S	.	S	.	.	.	.	S	.	S	.	S	88.2
	D2T	.	.	S	.	.	.	.	S	S	S	.	S	.	.	.	.	S	.	S	.	S	76.5
	G3T	.	.	S	.	.	.	.	S	S	S	.	S	.	.	.	.	S	.	S	.	S	88.2
Turbidity	A1S	S	.	S	.	S	S	.	.	S	S	.	U	.	S	.	.	S	.	S	u	S	84.0
	D2S	.	.	.	.	S	u	.	.	S	S	.	.	.	S	.	.	S	.	S	u	S	80.0
	G3S	S	.	S	.	S	q	.	.	S	S	.	Q	.	S	.	.	S	.	S	u	S	87.5
%		100	77	98	88	100	76	83	93	96	96	91	88	100	100	60	82	100	74	90	34	88	
accredited		20		42		9	36		35	51	46		41	18	26	1		24	16		35	51	

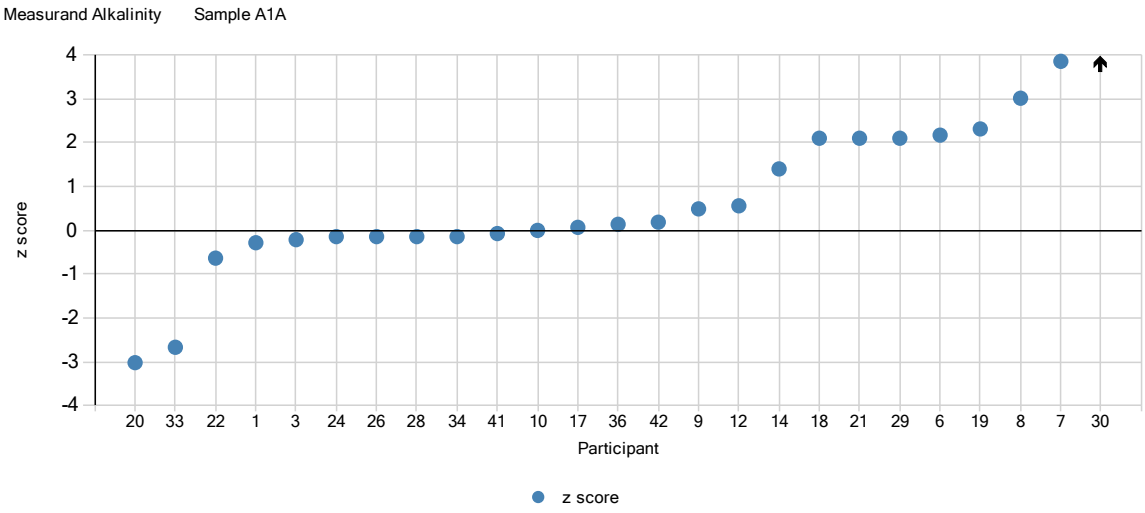
Measurand	Sample	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	%
Alkalinity	A1A	S	.	S	.	S	.	S	Q	U	.	.	q	S	.	S	.	.	.	.	S	S	60.0
	D2A	S	.	S	.	S	.	S	S	u	.	.	u	S	.	S	.	.	.	.	S	S	88.0
	G3A	S	.	S	.	.	.	S	S	S	.	.	u	S	.	S	.	.	.	.	S	S	91.7
Ca	A1K	S	S	S	.	.	.	S	.	.	.	.	.	.	S	.	.	.	S	.	.	.	89.5
	D2K	S	S	S	.	.	.	S	.	.	.	.	.	.	S	.	.	.	S	.	.	.	94.4
	G3K	S	S	S	.	.	.	S	.	.	.	.	.	.	S	.	.	.	S	.	.	.	88.9
Cl	A1CS	S	S	S	.	S	S	S	.	S	.	.	S	.	.	.	U	.	.	S	S	S	89.7
	D2CS	S	S	S	.	S	.	S	.	S	.	.	S	.	.	.	U	.	.	S	S	U	85.7
	G3CS	S	S	S	.	.	S	S	.	S	.	.	S	.	.	.	.	.	.	S	S	S	96.0
Conductivity	A1J	S	.	S	S	S	S	S	S	S	.	S	S	S	u	S	S	S	.	.	S	u	88.6
	D2PJ	q	.	S	S	S	.	S	S	S	.	S	S	S	u	S	S	S	.	.	S	u	84.8
	G3PJ	q	.	S	S	.	S	S	S	S	S	S	S	S	U	S	.	S	.	.	S	u	81.8
F	A1F	S	S	S	.	.	S	S	.	.	.	.	S	.	.	.	.	.	.	S	S	S	90.5
	D2F	S	S	S	.	.	.	S	.	.	.	.	S	.	.	.	.	.	.	S	S	S	94.7
	G3F	S	S	S	.	.	S	S	.	.	.	.	S	.	.	.	.	.	.	S	S	S	95.2
Fe	A1Fe	S	S	S	.	.	.	S	.	Q	.	.	.	.	S	S	S	S	u	.	S	.	82.6
	D2Fe	S	S	S	.	.	.	S	.	U	.	.	.	.	S	S	U	S	u	.	S	.	77.3
	G3Fe	S	S	S	.	.	.	S	.	U	.	.	.	.	S	S	.	S	u	.	S	.	81.0

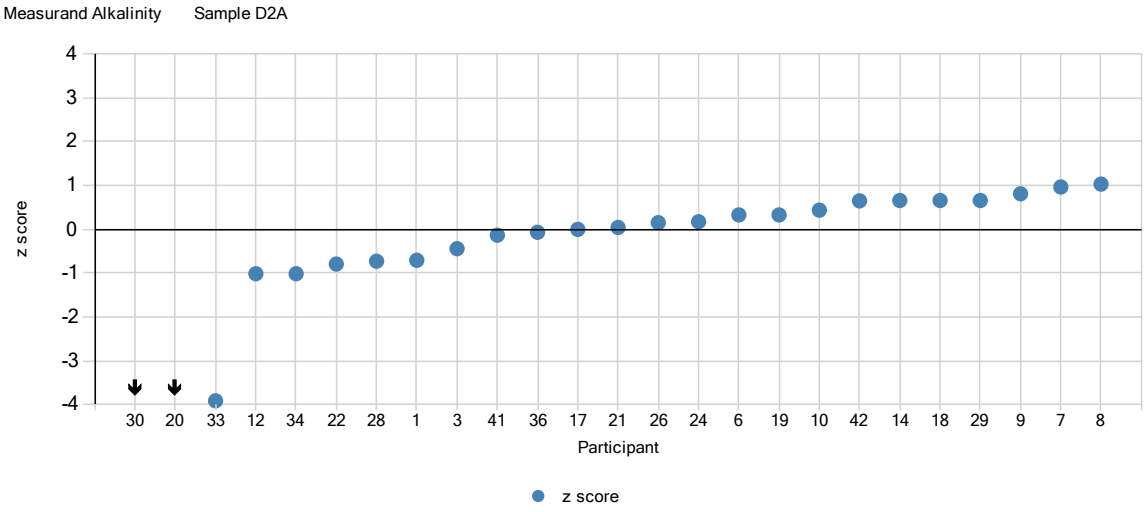
Measurand	Sample	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	%
K	A1K	**S**	.	**S**	.	.	.	**S**	.	.	.	.	.	.	**S**	.	.	.	*S*	.	**u**	.	68.8
	D2K	**S**	**S**	**S**	.	.	.	**S**	.	.	.	.	.	.	**S**	.	.	.	*S*	.	**q**	.	88.2
	G3K	**S**	**S**	**S**	.	.	.	**S**	.	.	.	.	.	.	**S**	.	.	.	*S*	.	**S**	.	94.1
Mg	A1K	**S**	**S**	**S**	.	.	.	**S**	.	.	.	.	.	.	**q**	.	.	.	*S*	.	.	.	94.7
	D2K	**S**	**S**	**S**	.	.	.	**S**	.	.	.	.	.	.	**q**	.	.	.	*S*	.	.	.	88.9
	G3K	**S**	**S**	**S**	.	.	.	**S**	.	.	.	.	.	.	**u**	.	.	.	*S*	.	.	.	88.9
Mn	A1Fe	**S**	**S**	**S**	.	.	.	**S**	.	*u*	.	.	.	.	**S**	.	.	*S*	*u*	.	**S**	.	80.0
	D2Fe	**S**	**S**	**S**	.	.	.	**S**	.	*S*	.	.	.	.	**S**	.	.	*S*	*u*	.	**S**	.	85.0
	G3Fe	**S**	**S**	**S**	.	.	.	**S**	.	*S*	*U*	.	.	.	**S**	.	.	*S*	*u*	.	**S**	.	81.0
Na	A1K	**S**	**S**	**S**	.	*S*	.	**S**	.	.	.	.	.	.	**S**	.	.	.	*S*	.	**S**	.	100
	D2K	**S**	**S**	**S**	.	*S*	.	**S**	.	.	.	.	.	.	**S**	.	.	.	*S*	.	**S**	.	100
	G3K	**S**	**S**	**S**	.	.	.	**S**	.	.	.	.	.	.	**S**	.	.	.	*S*	.	**S**	.	94.7
NH_4	A1N	**S**	.	**S**	.	.	.	**S**	**U**	*S*	.	**Q**	.	.	**u**	.	.	.	.	.	**S**	**S**	66.7
	D2N	**S**	.	**S**	.	.	.	**S**	**S**	*S*	.	**U**	.	.	**q**	**S**	.	.	.	.	**q**	**S**	71.4
	G3N	**S**	.	**S**	.	.	.	**S**	**S**	*S*	.	**Q**	.	.	**u**	.	.	.	.	.	**S**	**S**	75.0
NO_2	A1N	**S**	.	**S**	.	.	.	**S**	**S**	*S*	.	**S**	.	.	.	.	.	.	.	*U*	**S**	**S**	88.2
	D2N	**S**	.	**S**	.	.	.	**S**	**S**	*S*	.	**S**	.	.	.	.	.	.	.	*U*	**S**	**S**	94.4
	G3N	**S**	.	**S**	.	.	.	**S**	**S**	*Q*	.	**S**	.	.	.	.	.	.	.	*U*	**S**	**S**	88.2
NO_3	A1N	**S**	.	**S**	.	.	.	**S**	.	*S*	.	.	.	.	**u**	.	.	.	.	*S*	**S**	**S**	82.6
	D2N	**S**	.	**S**	.	.	.	**S**	.	*S*	.	.	.	.	**u**	.	.	.	.	*S*	**S**	**S**	82.6
	G3N	**S**	.	**S**	.	.	.	**S**	.	*S*	.	.	.	.	**u**	.	.	.	.	*S*	**S**	**S**	91.3
pH	A1P	**S**	.	**S**	**S**	*S*	**S**	**S**	**S**	*S*	.	**U**	*S*	**S**	**S**	**S**	*S*	*S*	.	.	**S**	**S**	91.2
	D2PJ	**S**	.	**S**	**S**	*S*	.	**S**	**S**	*S*	.	**S**	*S*	**S**	**S**	**S**	*S*	**S**	.	.	**S**	**S**	96.9
	G3PJ	**S**	.	**S**	**S**	.	**S**	**S**	**S**	*S*	**S**	**S**	*S*	**S**	**S**	**S**	.	**S**	.	.	**S**	**S**	90.6
SO_4	A1CS	**S**	**Q**	**S**	.	.	.	**S**	.	*S*	.	.	*S*	.	.	.	.	.	.	*S*	**S**	**S**	91.7
	D2CS	**S**	**S**	**S**	.	.	.	**S**	.	*S*	.	.	*S*	.	.	.	.	.	.	*S*	**S**	**u**	91.7
	G3CS	**S**	**S**	**S**	.	.	.	**S**	.	*S*	.	.	*S*	.	.	.	.	.	.	*S*	**S**	**U**	90.9
TOC	A1T	**S**	**S**	.	.	.	.	**S**	.	*S*	.	.	*Q*	.	**S**	**S**	.	*S*	.	.	.	**S**	88.2
	D2T	**S**	**S**	.	.	.	.	**S**	.	*Q*	.	.	*U*	.	**u**	**S**	.	**U**	.	.	.	**S**	76.5
	G3T	**S**	**S**	.	.	.	.	**S**	.	*S*	.	.	*U*	.	**S**	**S**	.	**Q**	.	.	.	**S**	88.2
Turbidity	A1S	**S**	.	**S**	**S**	*u*	.	**S**	**S**	*S*	.	**U**	*S*	**S**	.	**S**	.	.	.	.	**S**	**S**	84.0
	D2S	.	.	.	**S**	*u*	.	**S**	**S**	*S*	.	**U**	*S*	**S**	.	**S**	.	.	.	.	**S**	**S**	80.0
	G3S	.	.	**S**	**S**	.	.	**S**	**S**	*S*	**S**	**S**	*S*	**S**	.	S	.	.	.	.	**S**	**S**	87.5
%		96	97	100	100	83	100	100	89	78	75	60	75	100	61	100	63	87	67	80	93	82	
accredited		49	29	47	9		8	51	18		3	15		12	33	18		6			42	33	

S - satisfactory ($-2 \leq z \leq 2$), Q - questionable ($2 < z < 3$), q - questionable ($-3 < z < -2$), U - unsatisfactory ($z \geq 3$), and u - unsatisfactory ($z \leq -3$), respectively. Bold - accredited, italics - non-accredited % - percentage of satisfactory results.

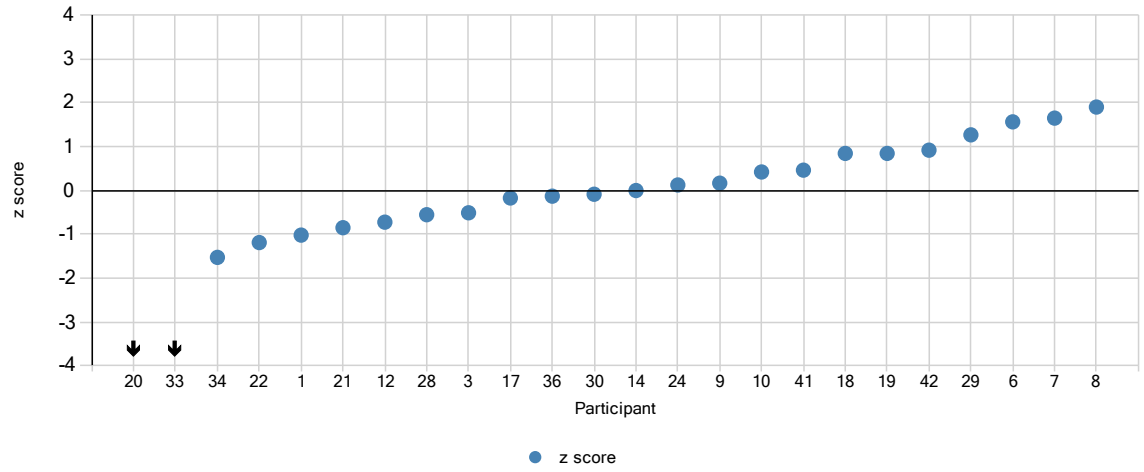
Satisfactory results, in total %: 87 in accredited %: 90 in non-accredited %: 80

Appendix 11. z scores in ascending order

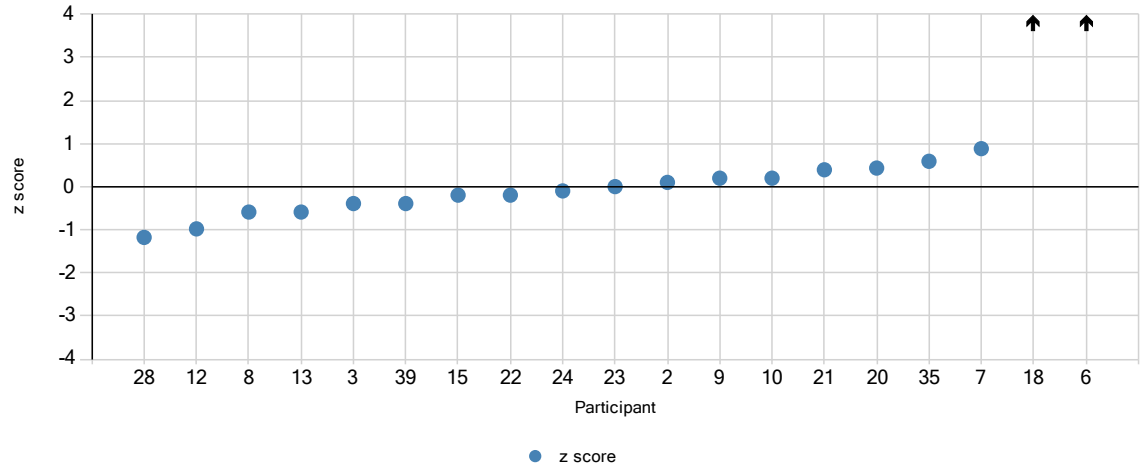




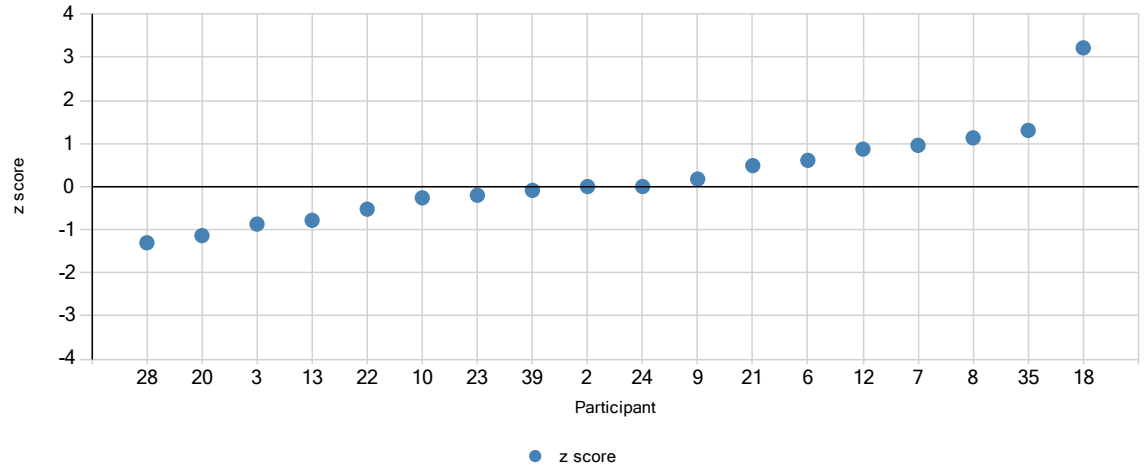
Measurand Alkalinity Sample G3A



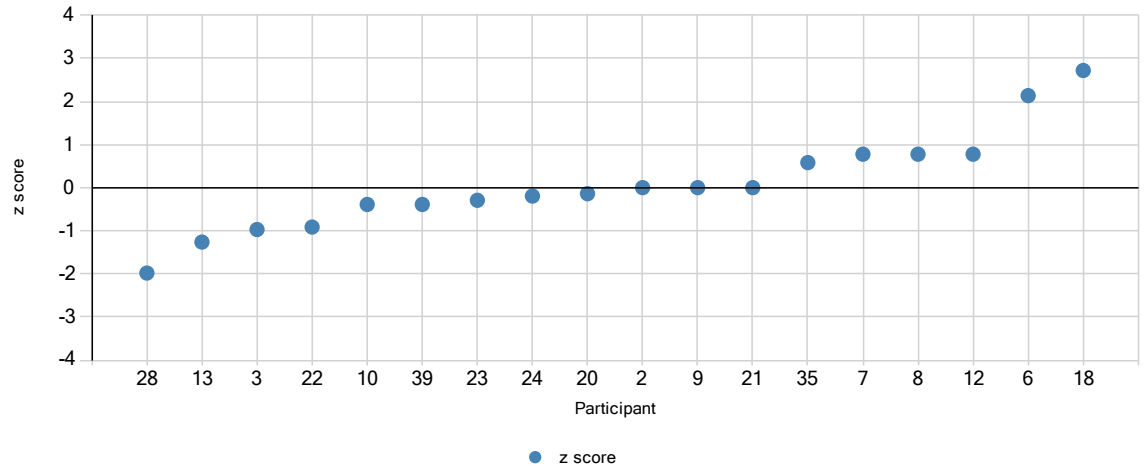
Measurand Ca Sample A1K



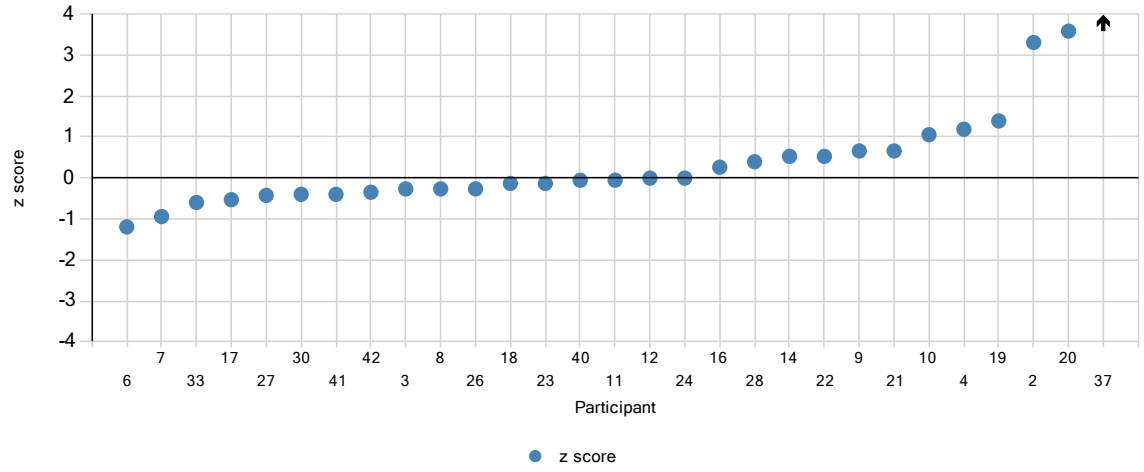
Measurand Ca Sample D2K



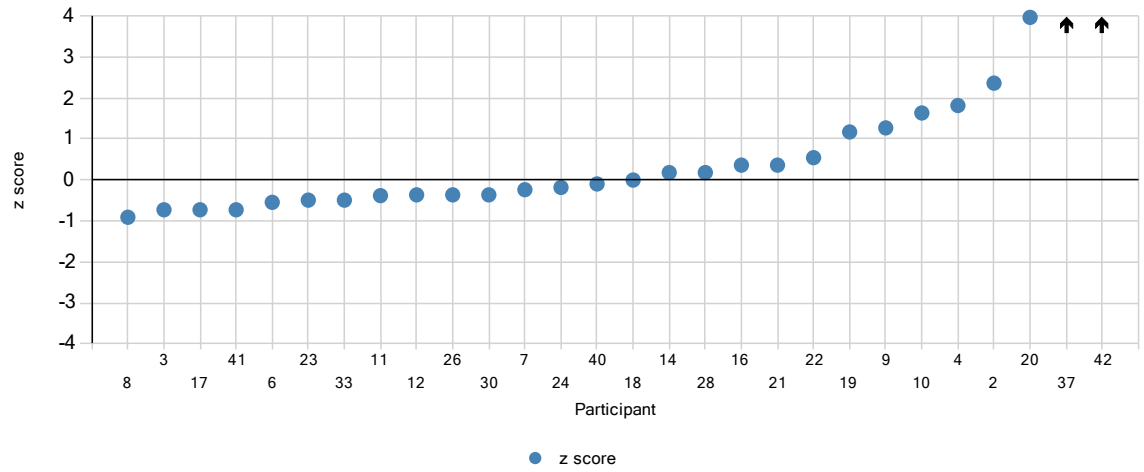
Measurand Ca Sample G3K



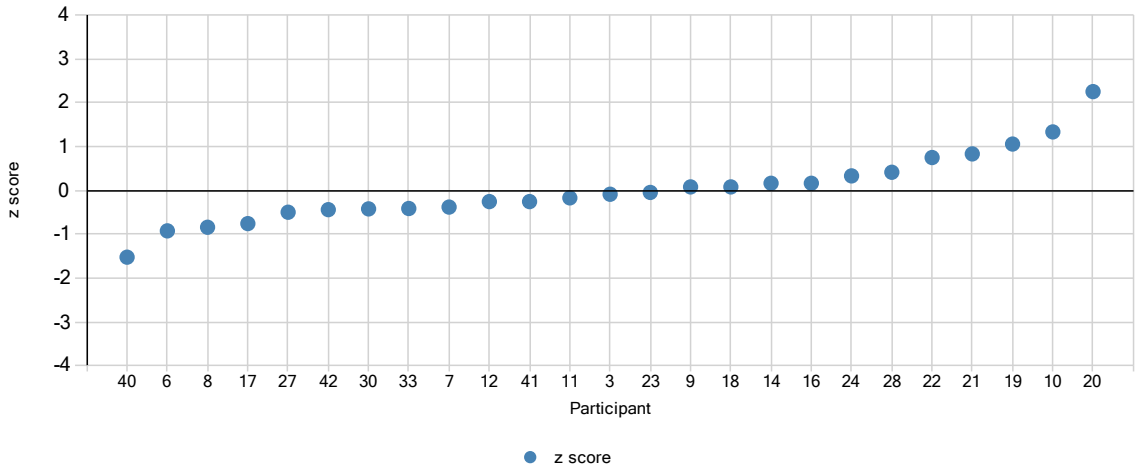
Measurand Cl Sample A1CS



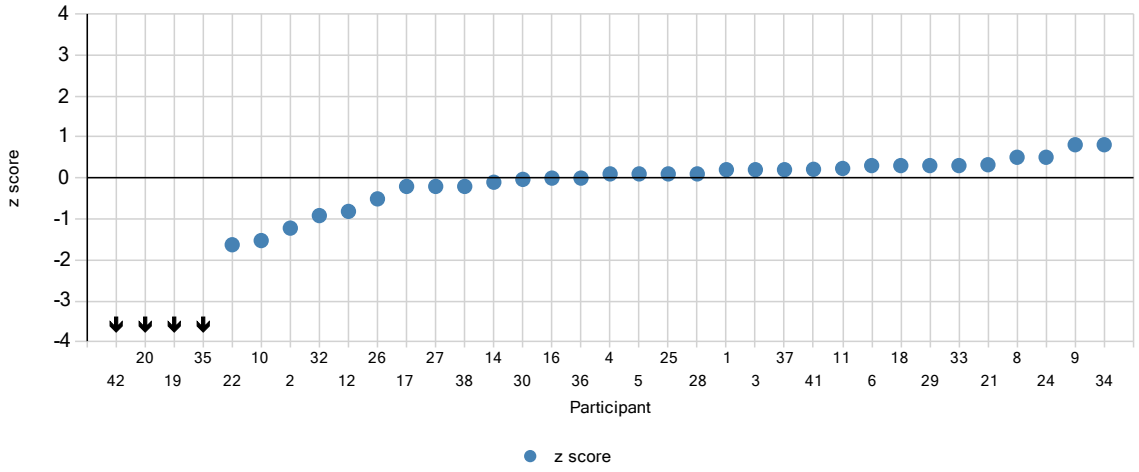
Measurand Cl Sample D2CS



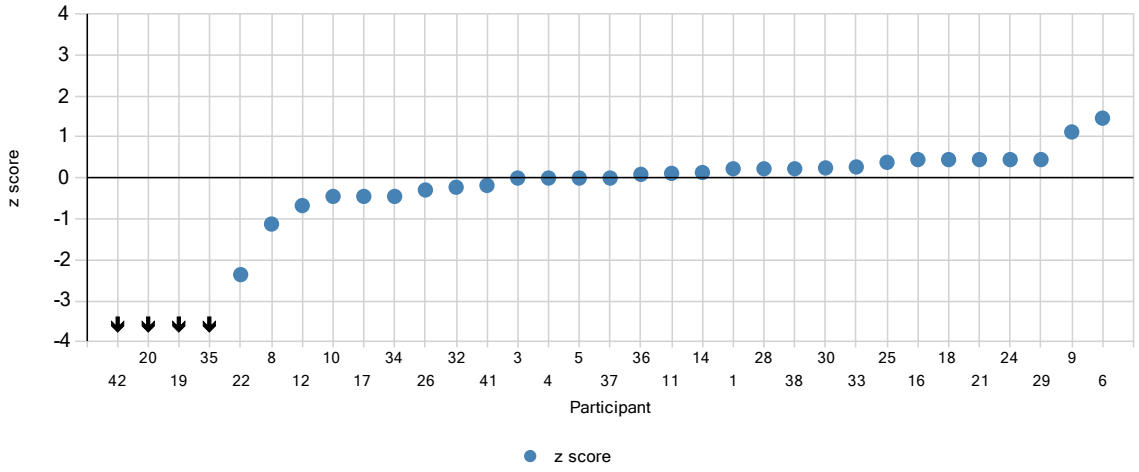
Measurand Cl Sample G3CS



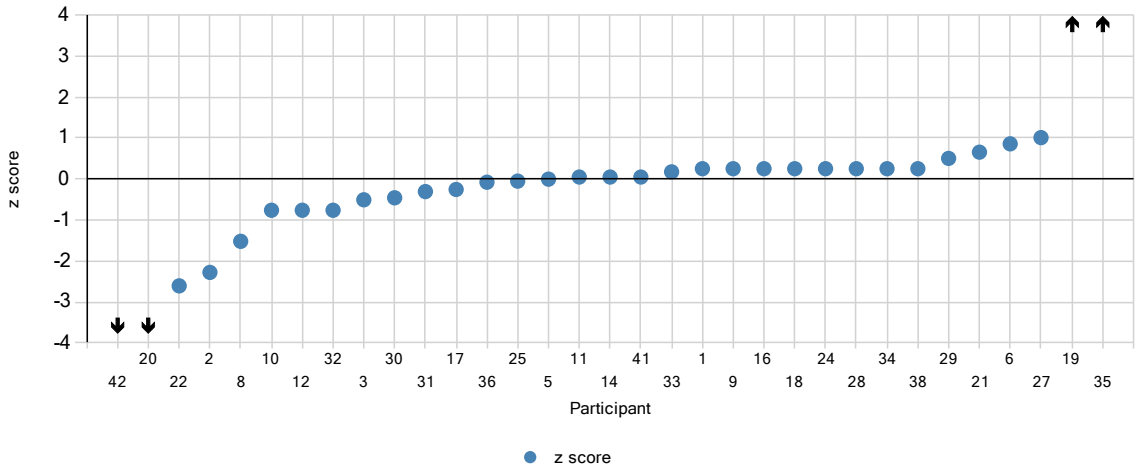
Measurand Conductivity Sample A1J



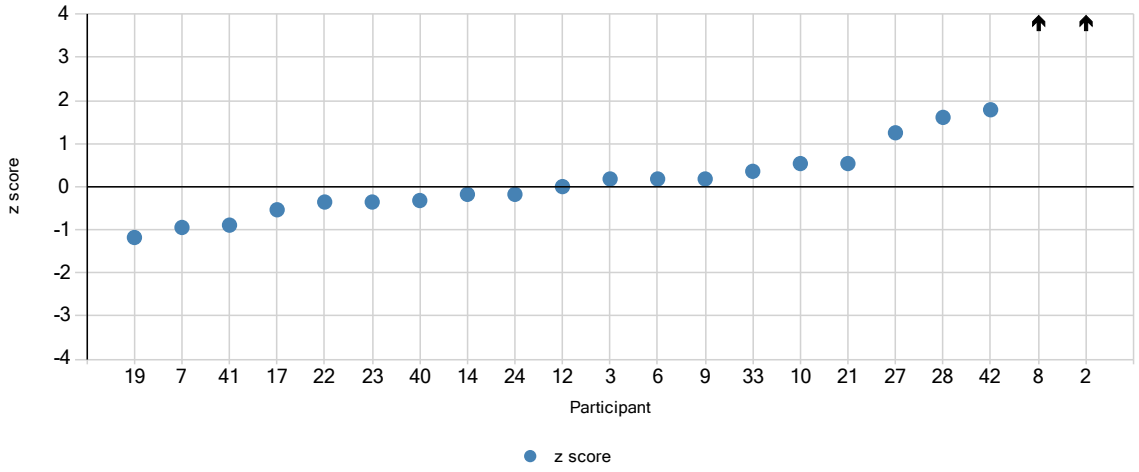
Measurand Conductivity Sample D2PJ



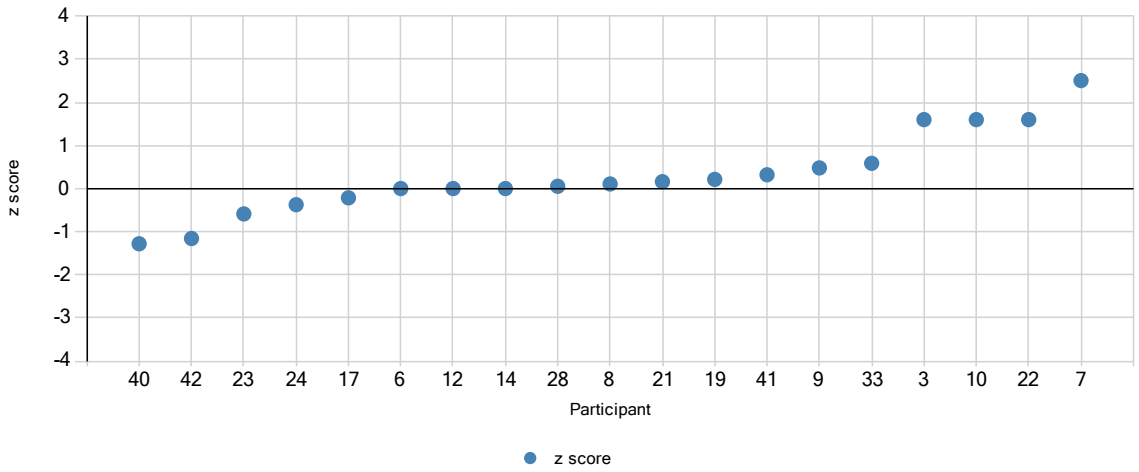
Measurand Conductivity Sample G3PJ



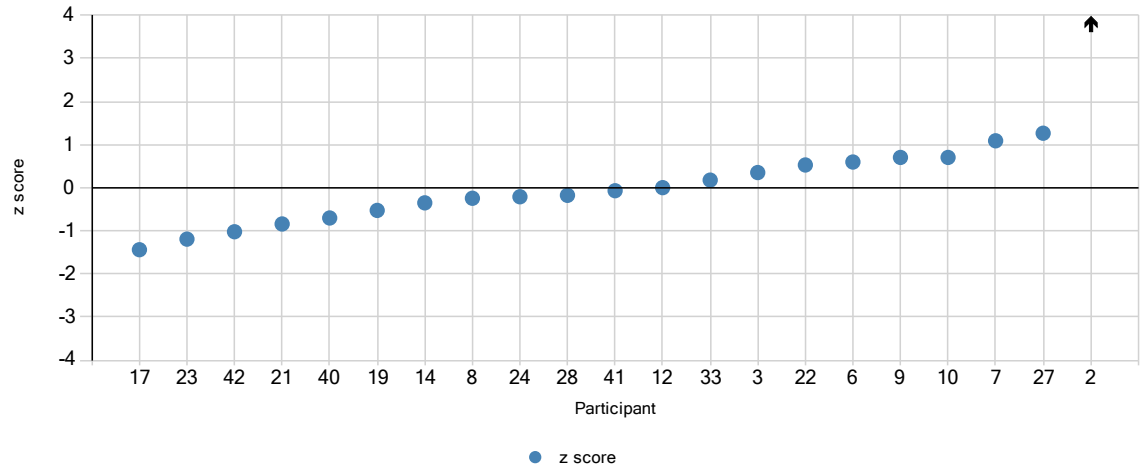
Measurand F Sample A1F



Measurand F Sample D2F



Measurand F Sample G3F



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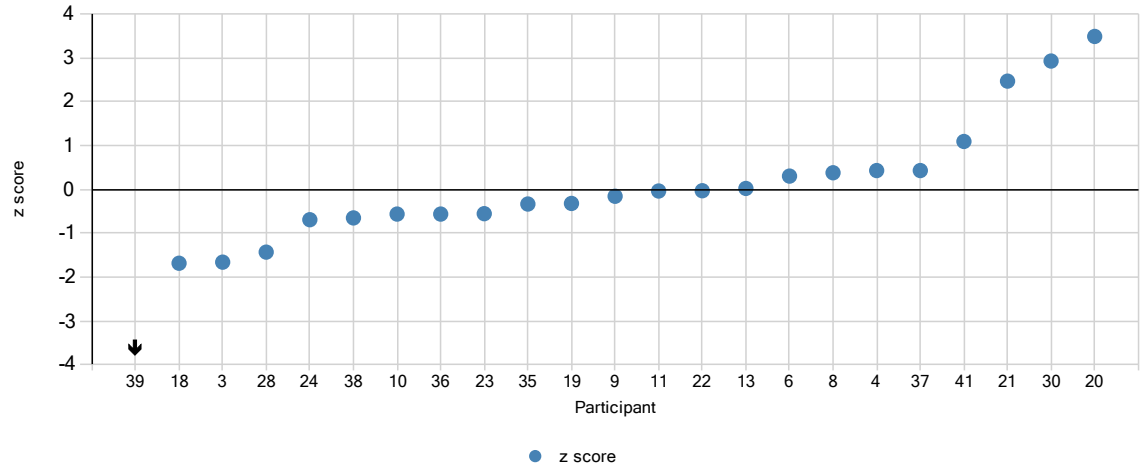

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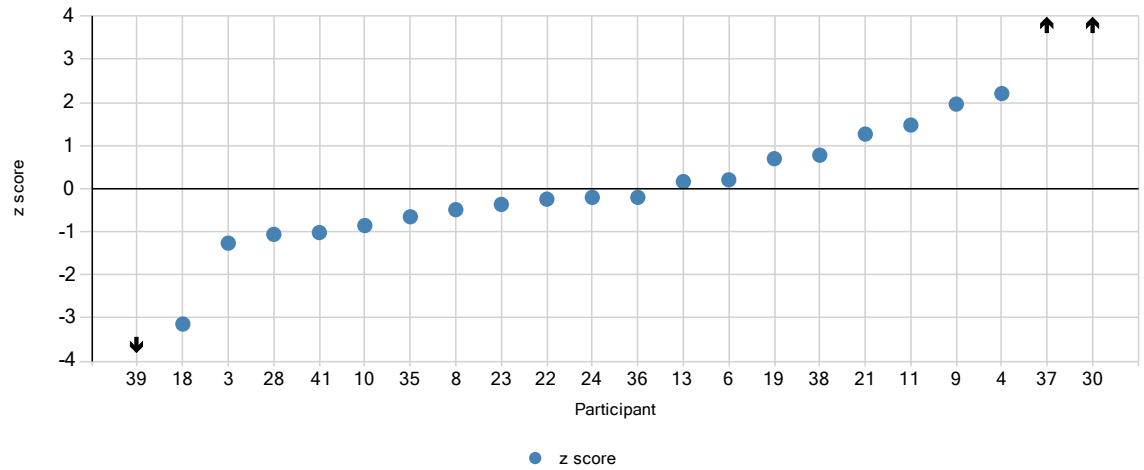

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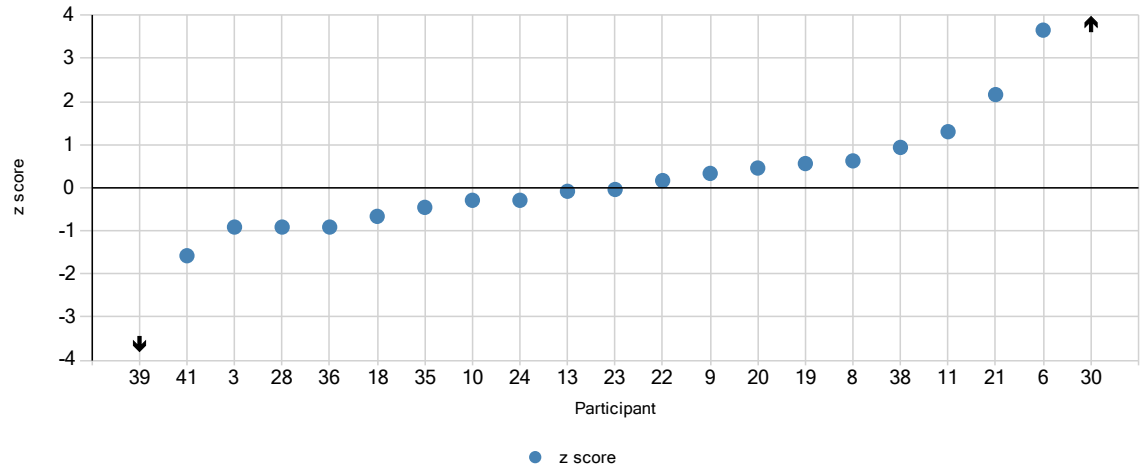

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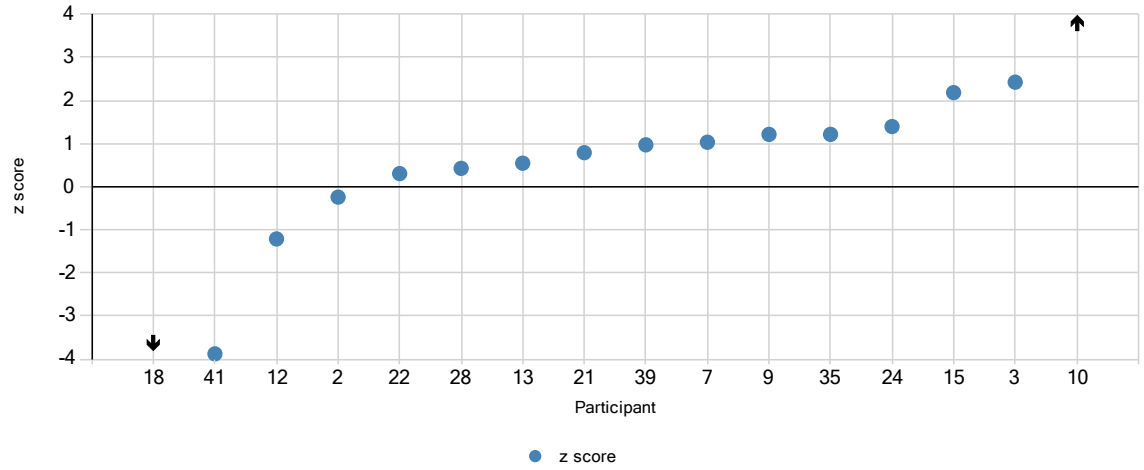

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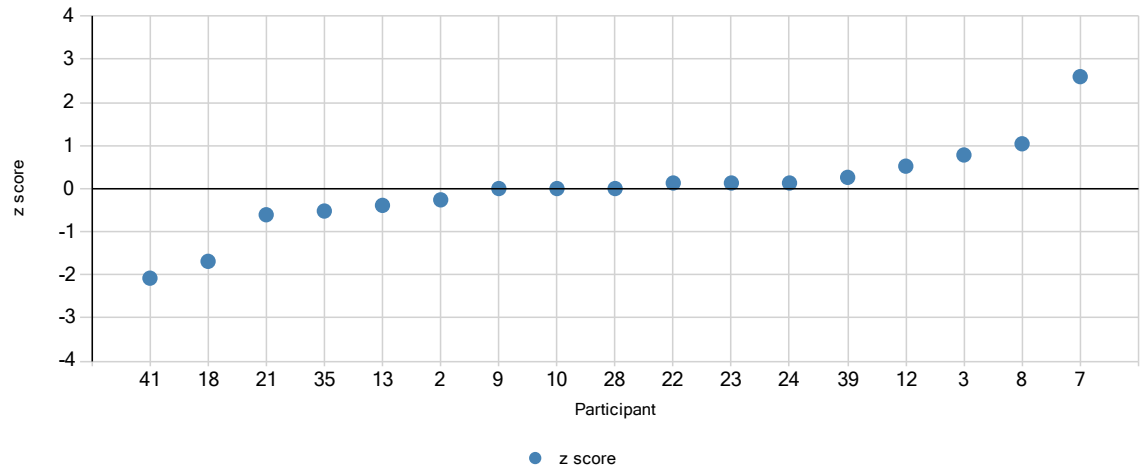

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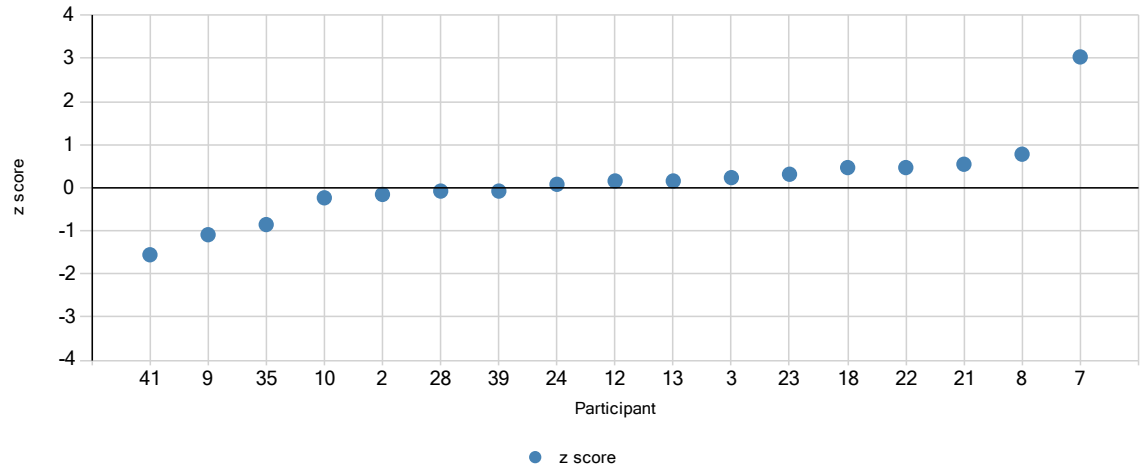

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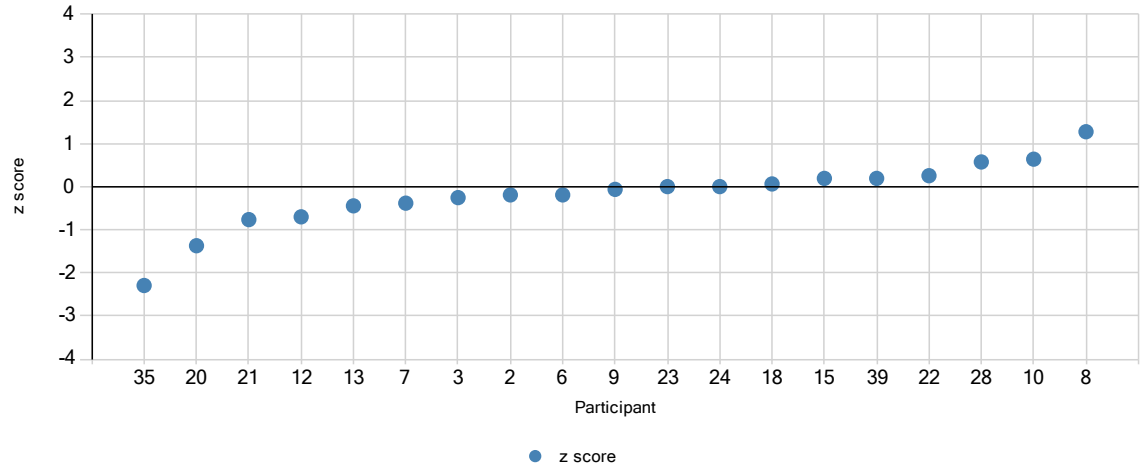

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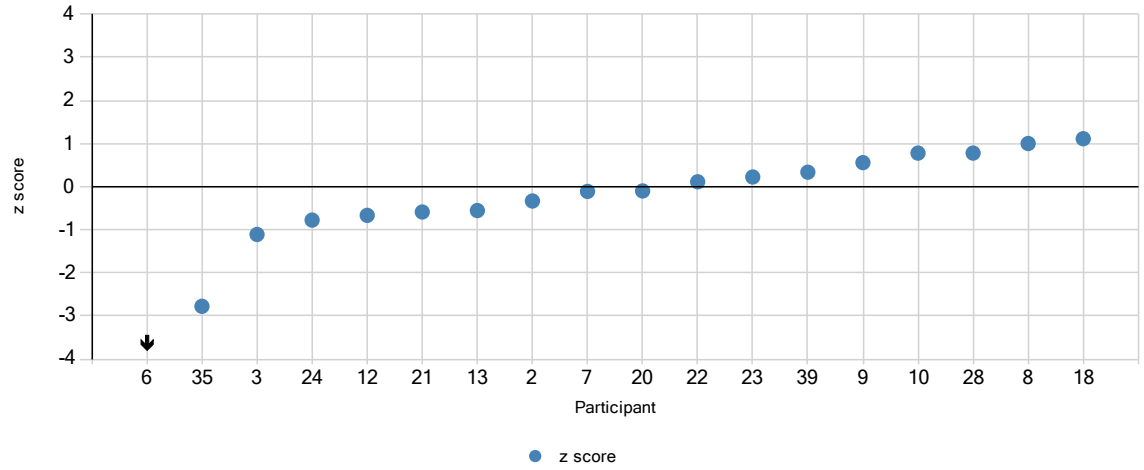

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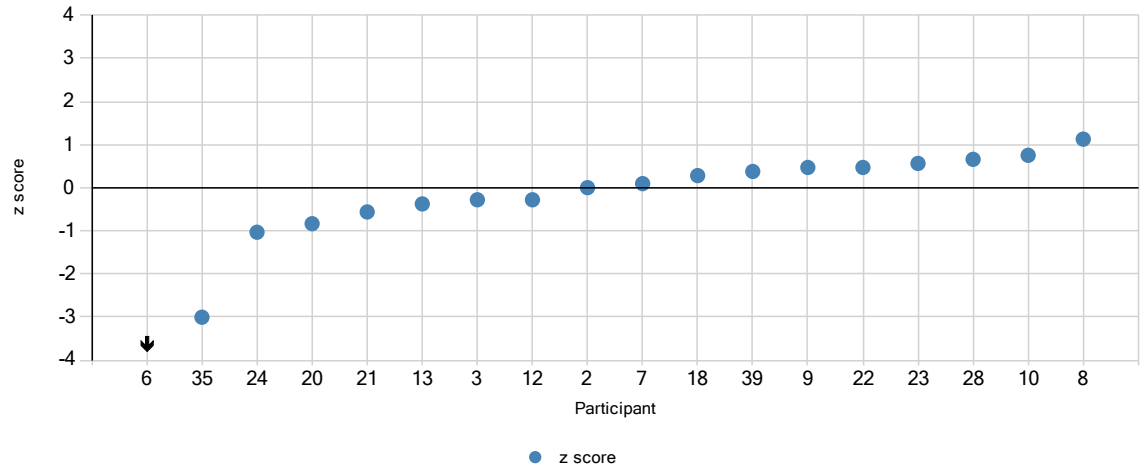

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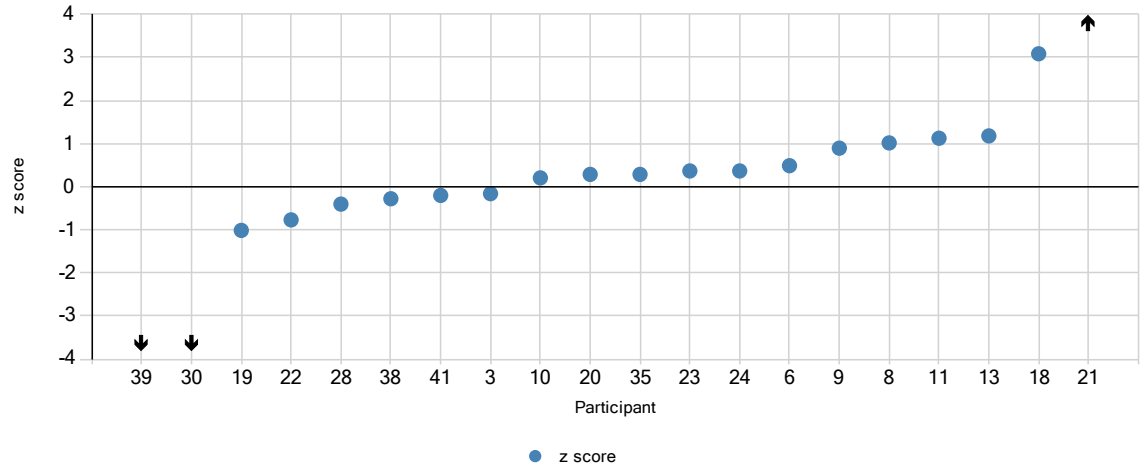

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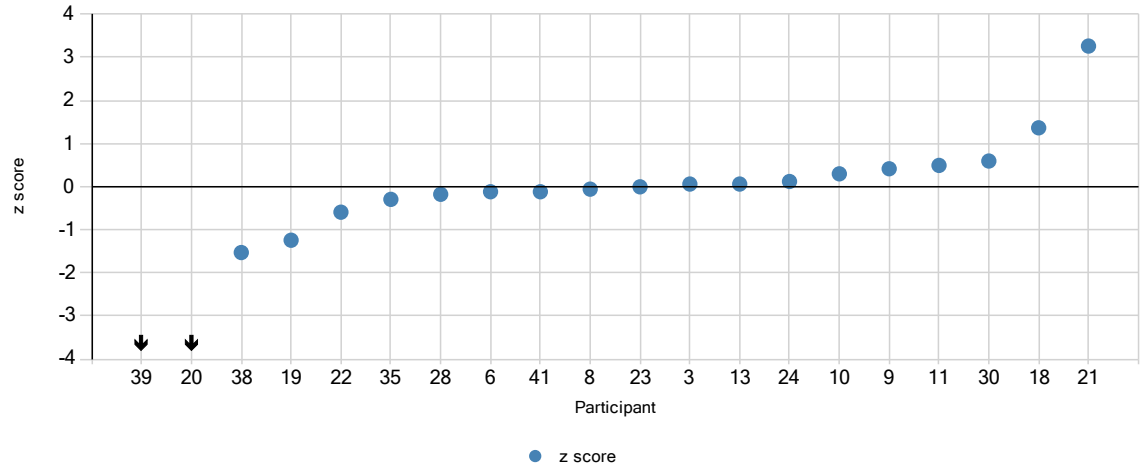

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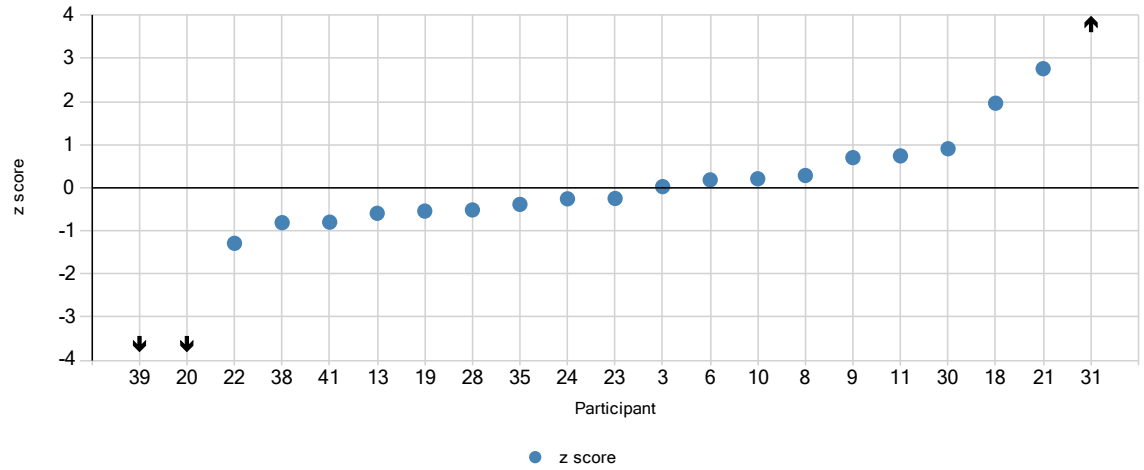

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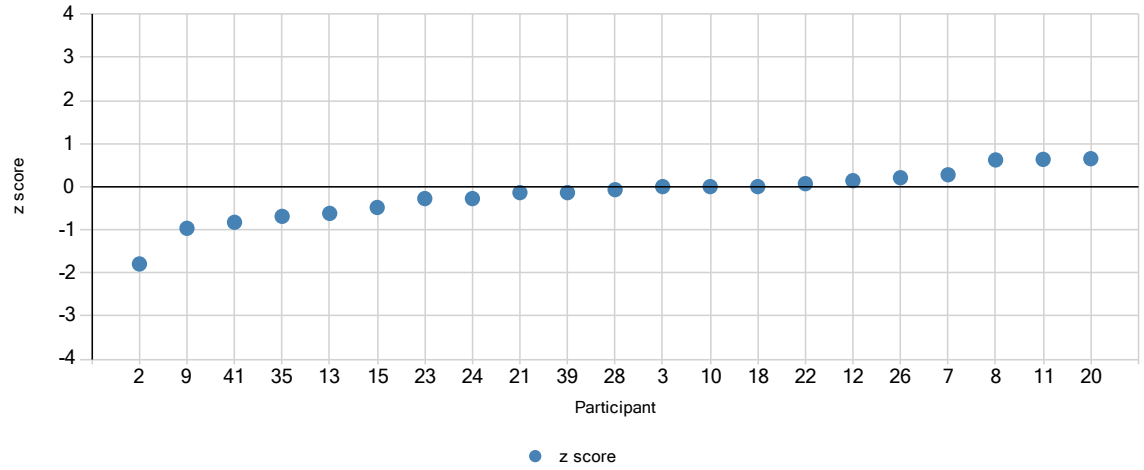

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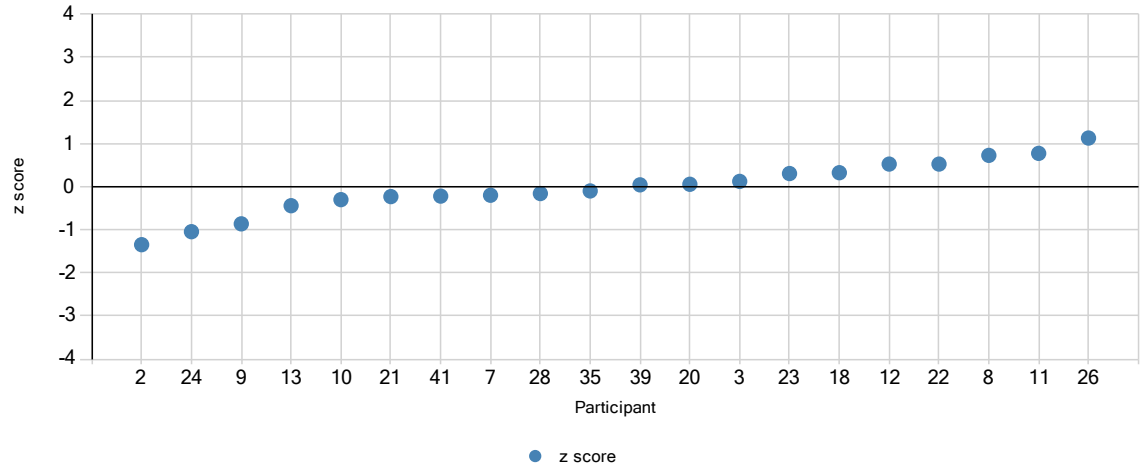

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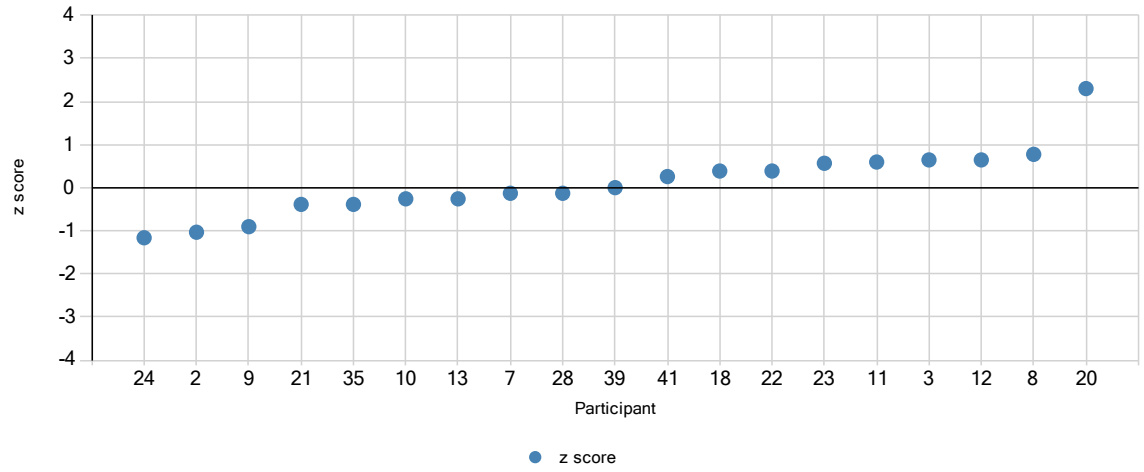

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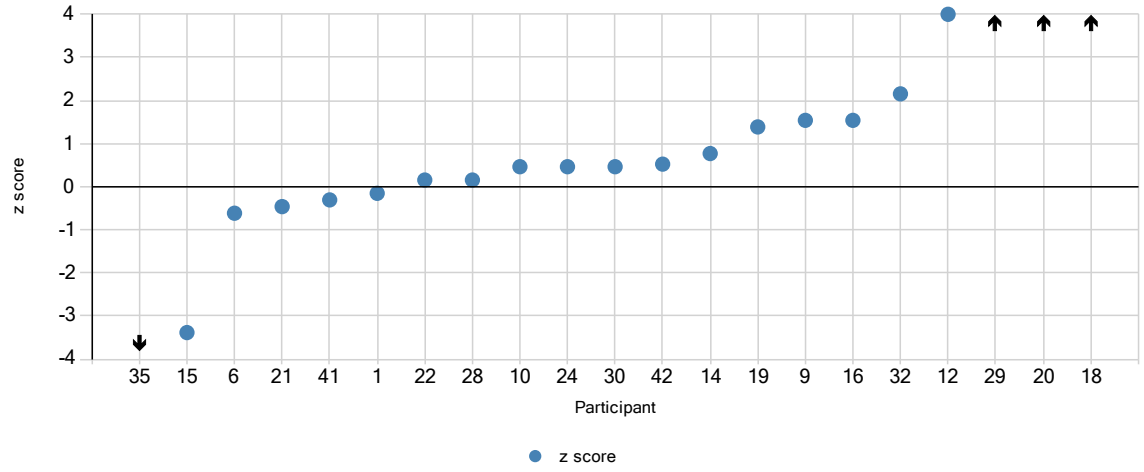

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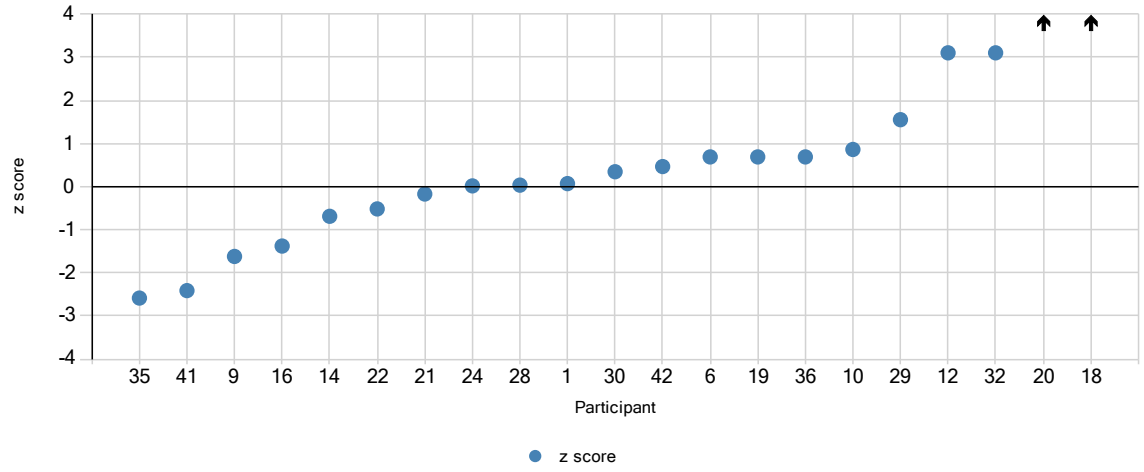

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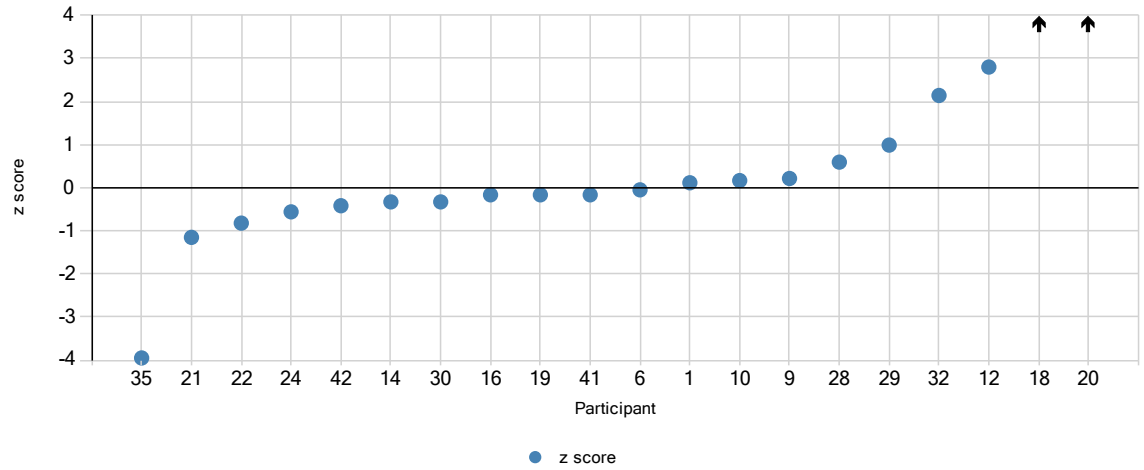

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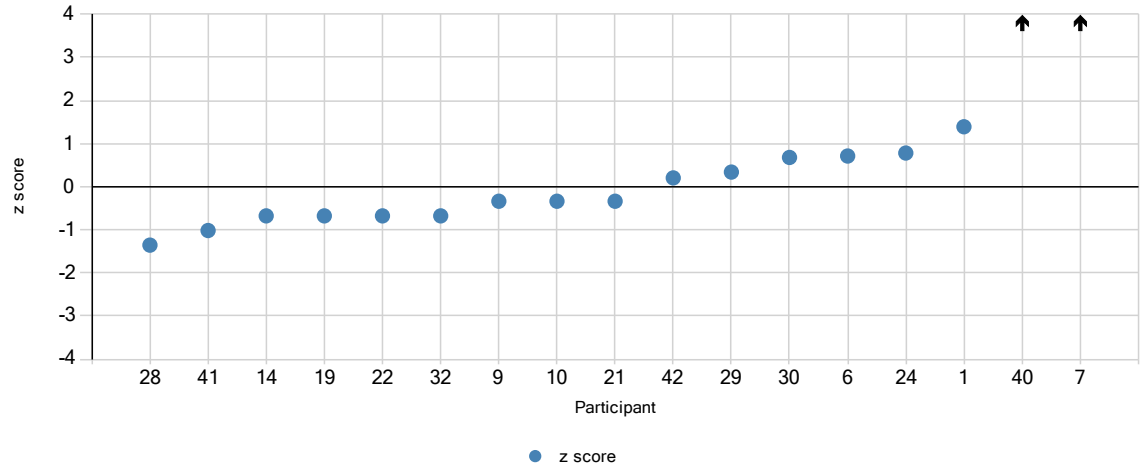

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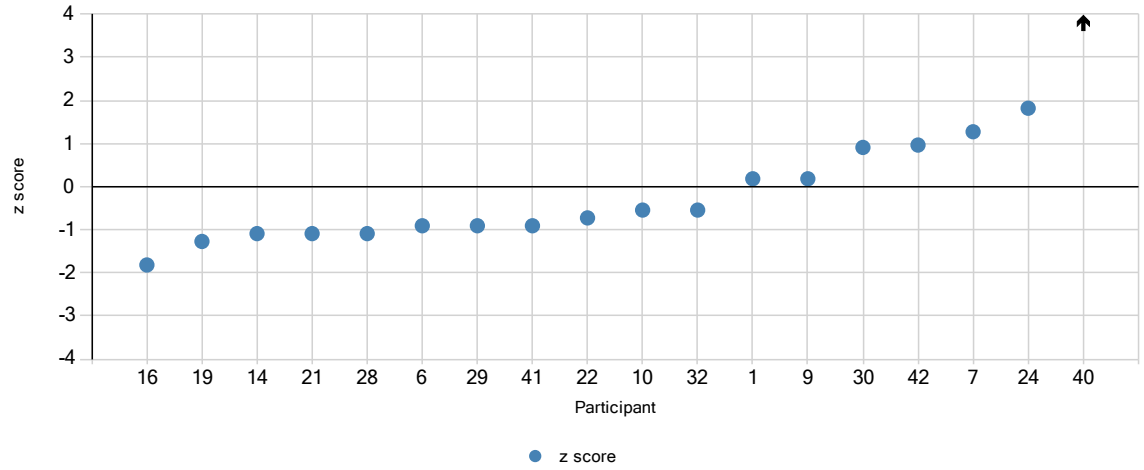

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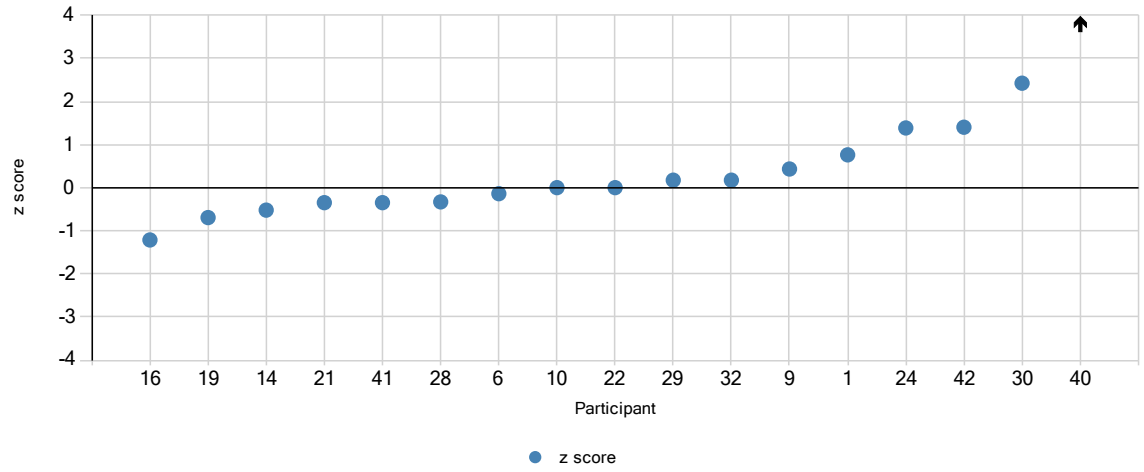

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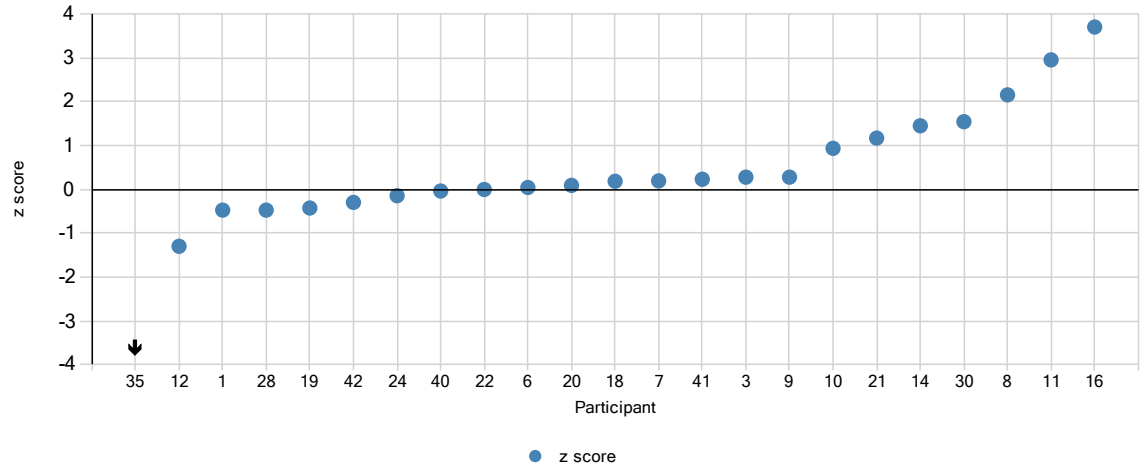

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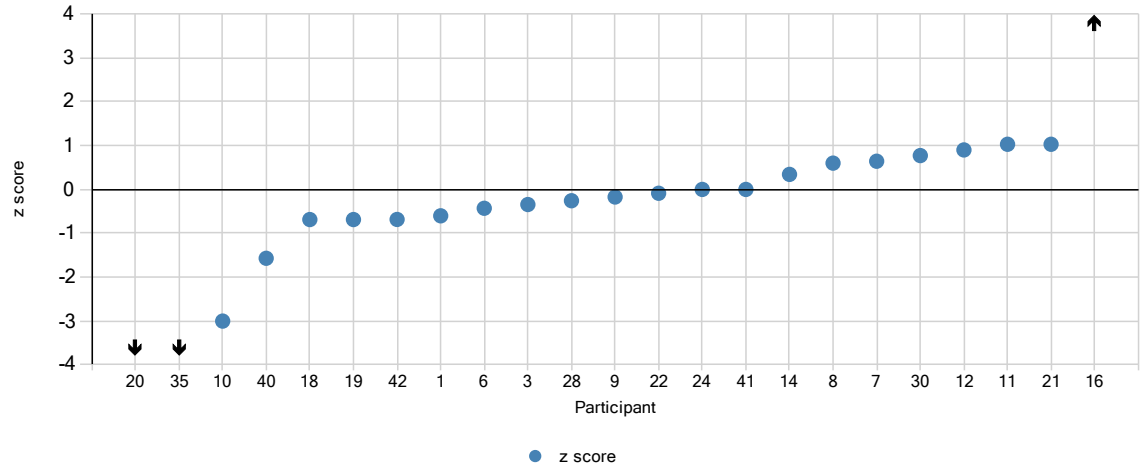

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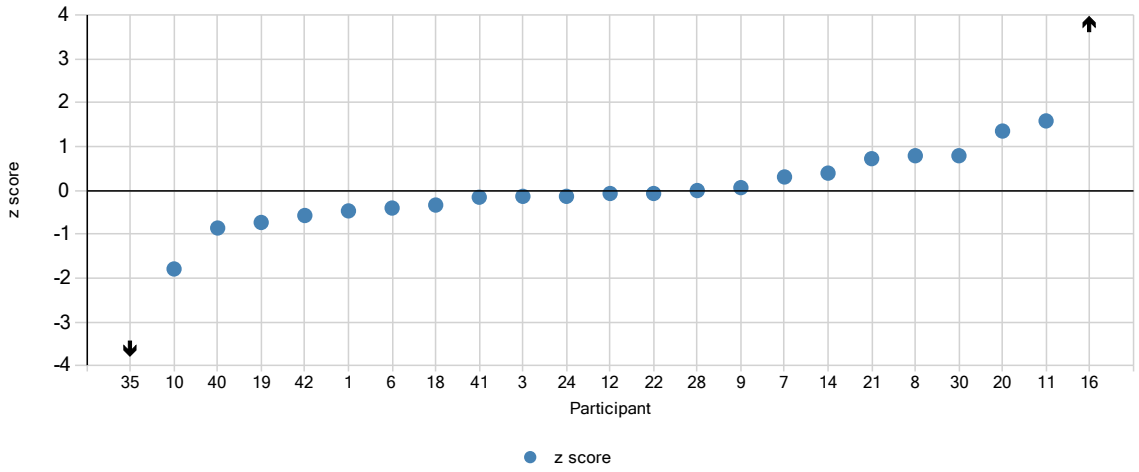
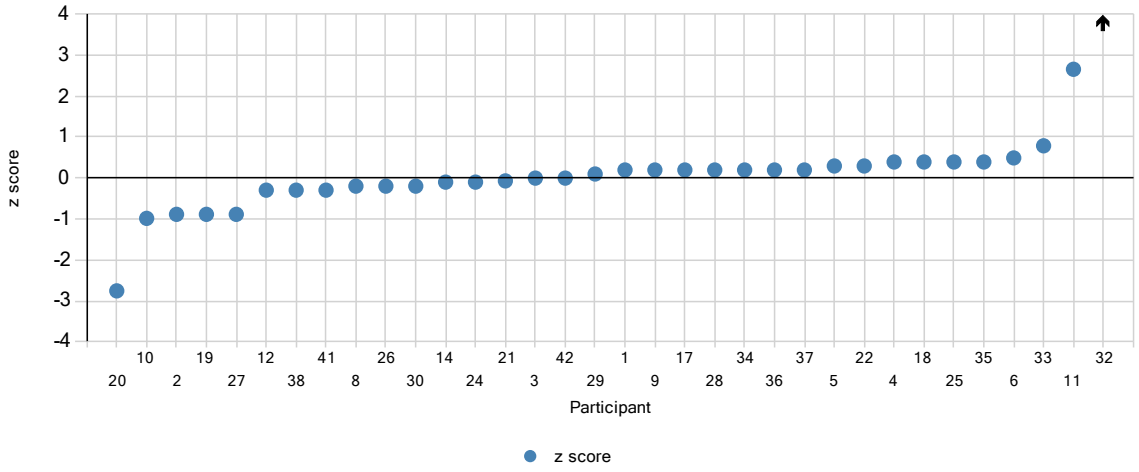


Measurand pH Sample A1P



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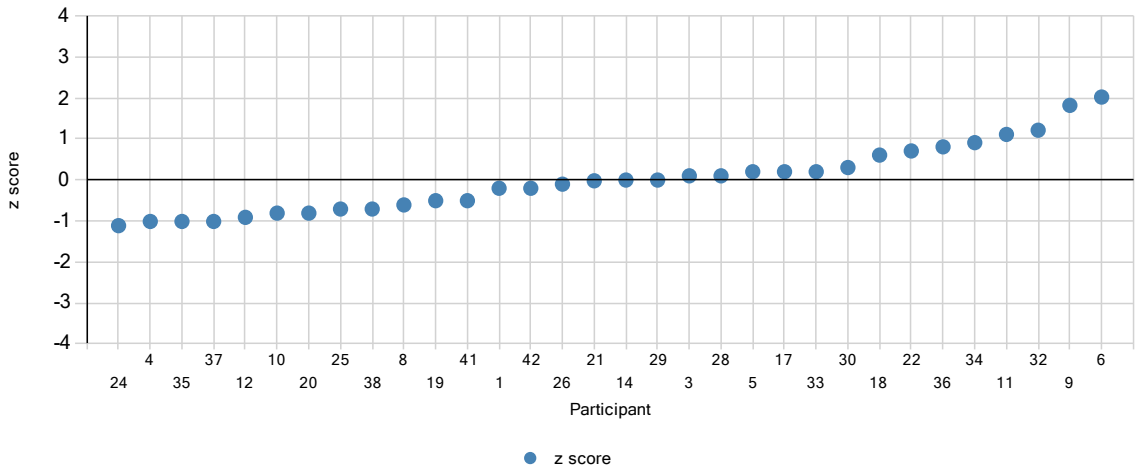
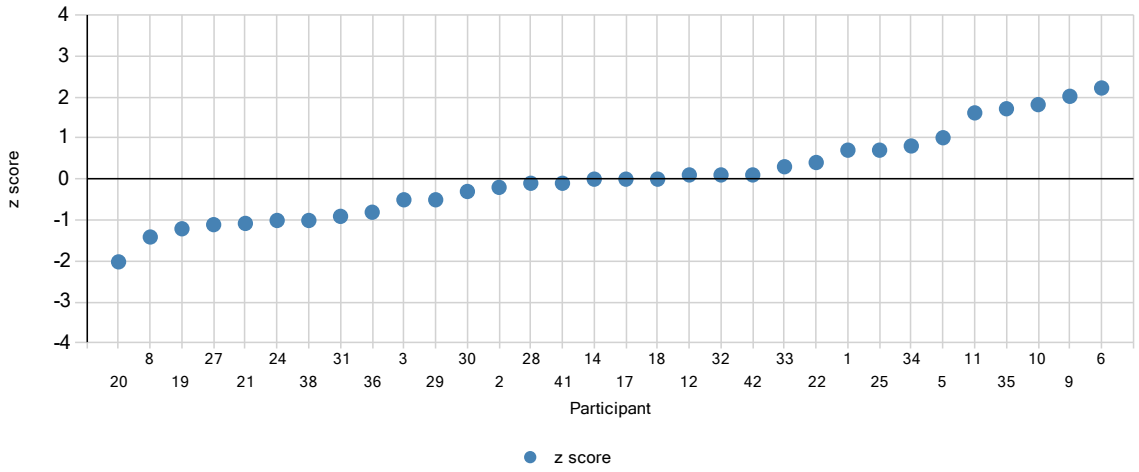


Measurand pH Sample G3PJ



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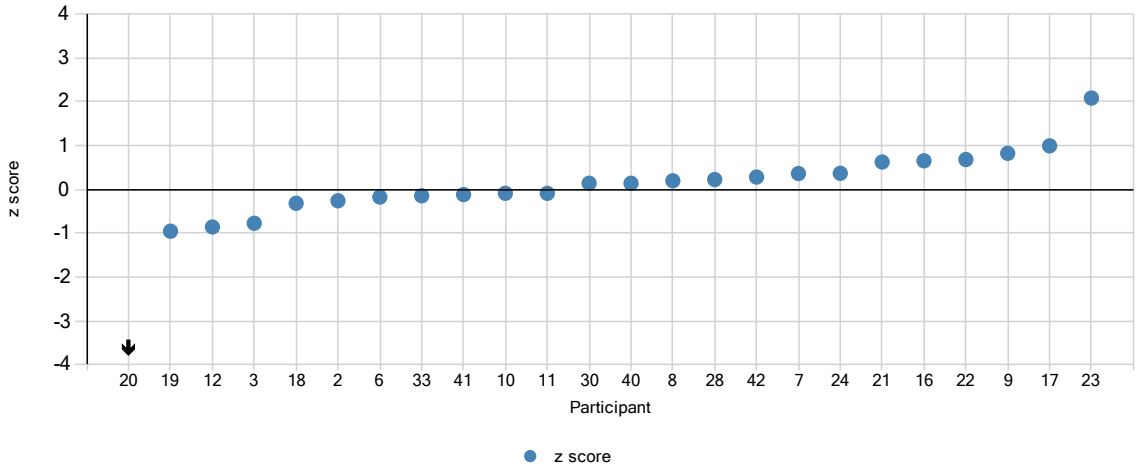

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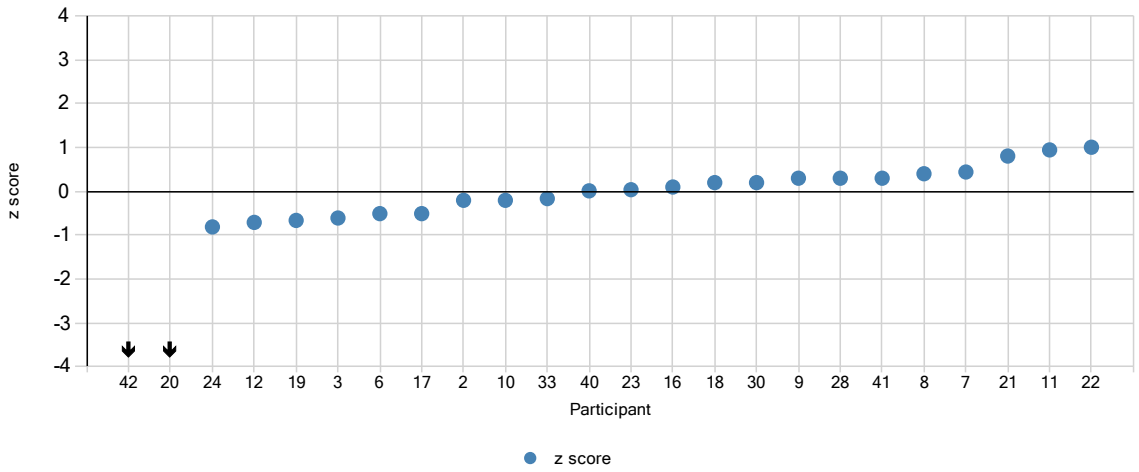

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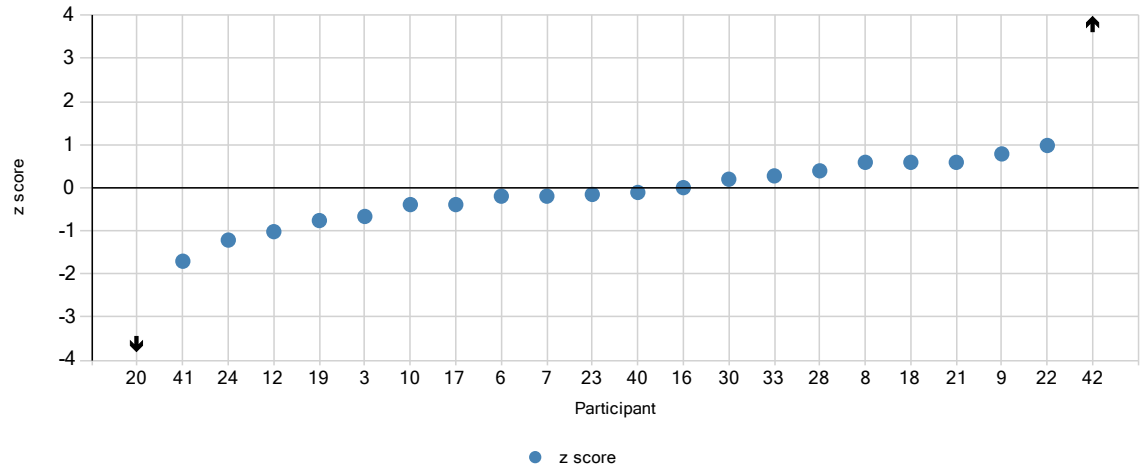

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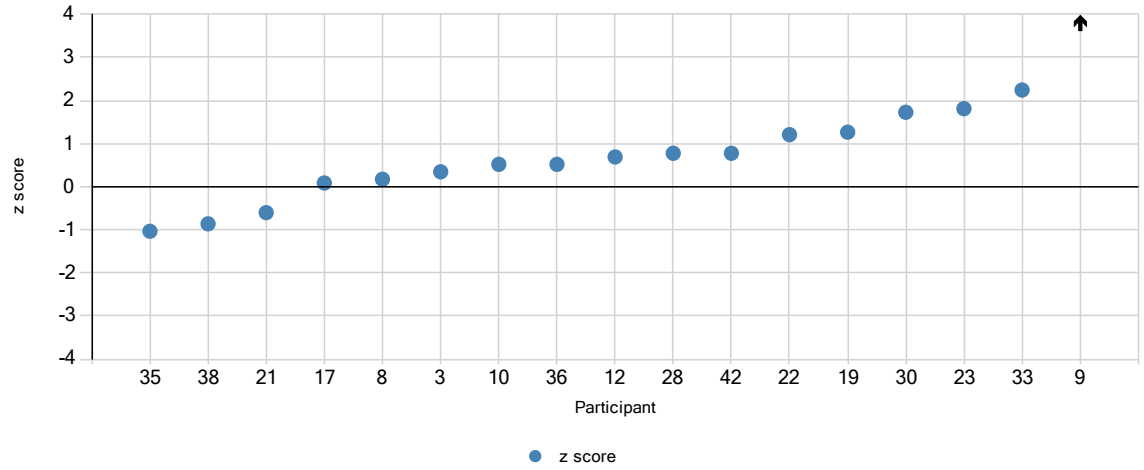

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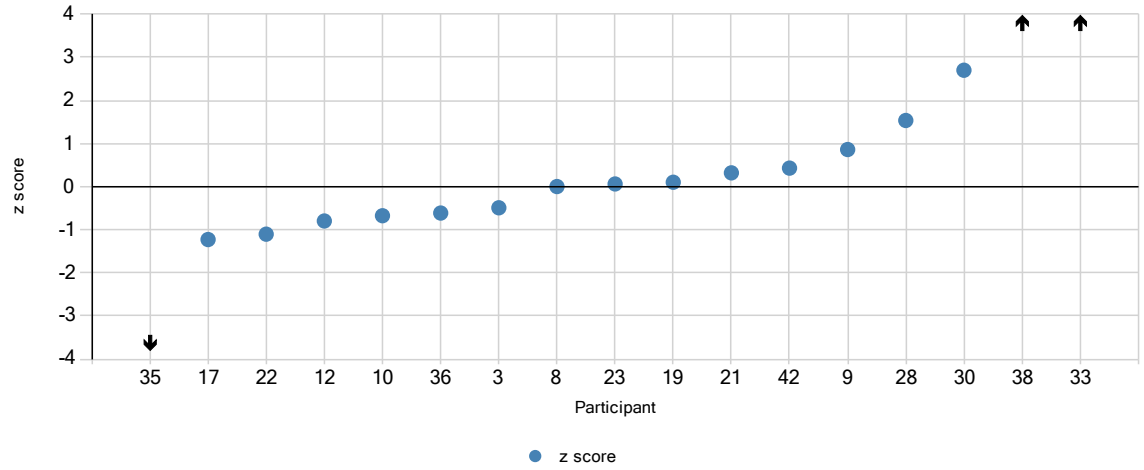

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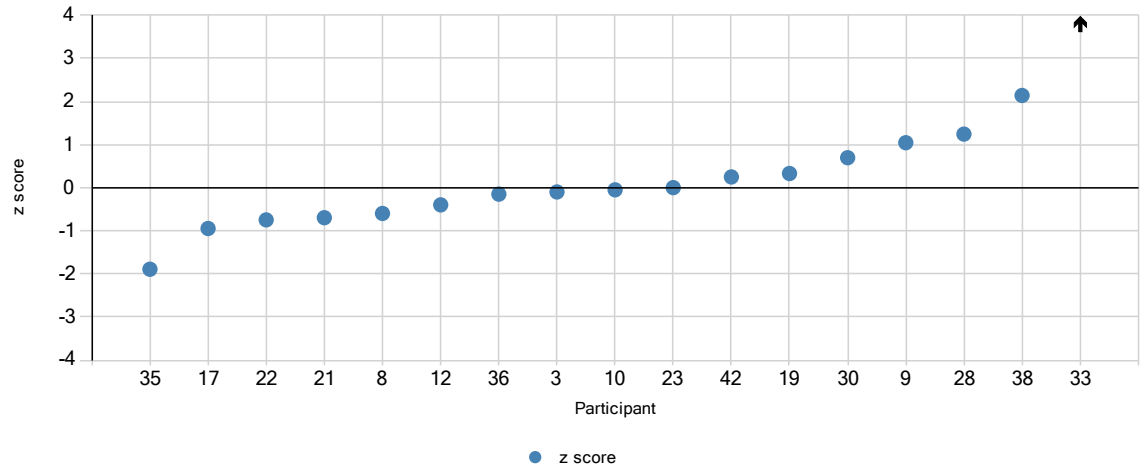
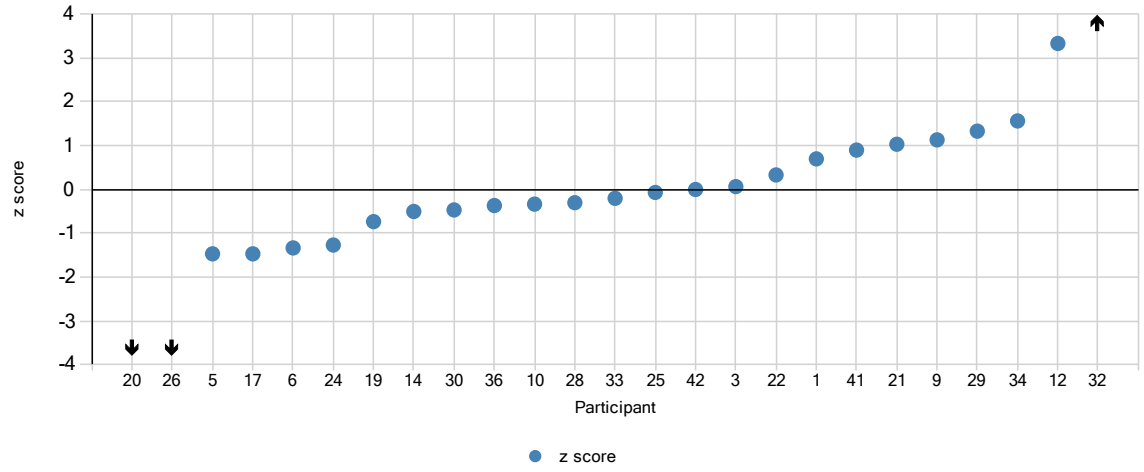
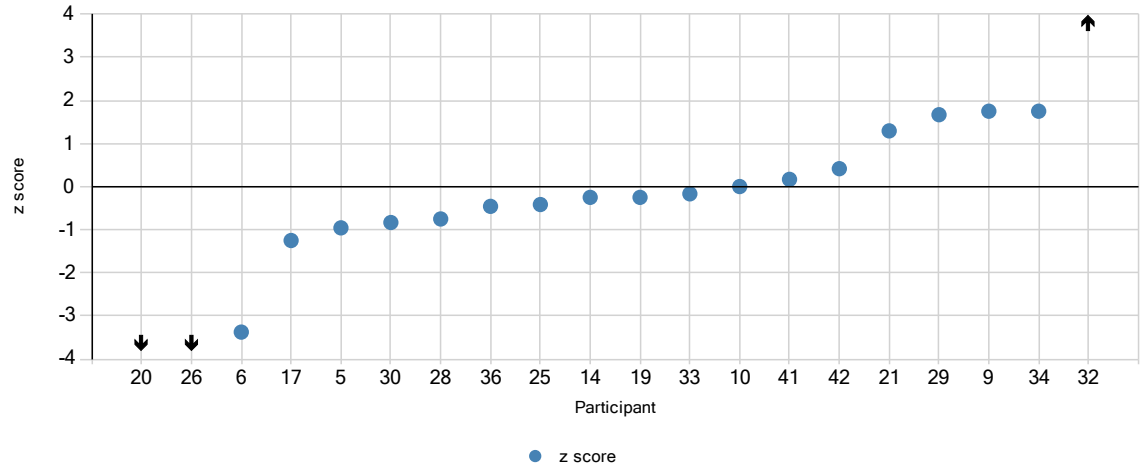
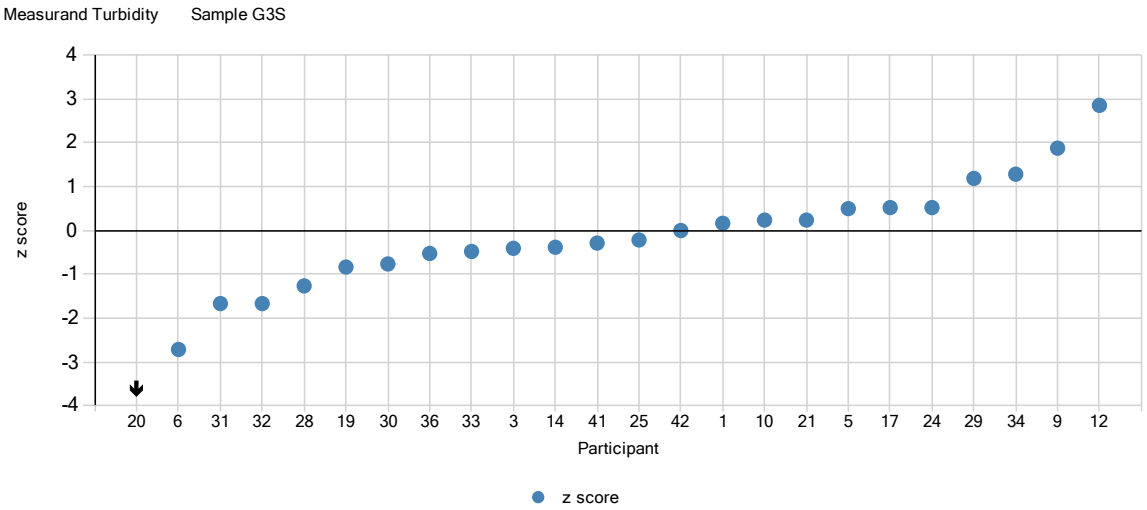


Measurand Turbidity Sample A1S



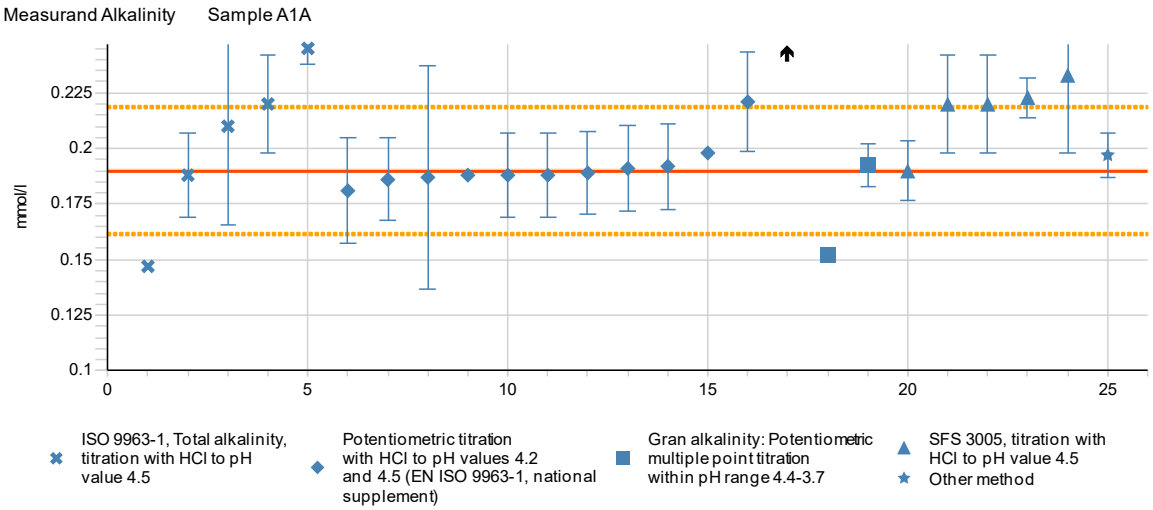
Measurand Turbidity Sample D2S

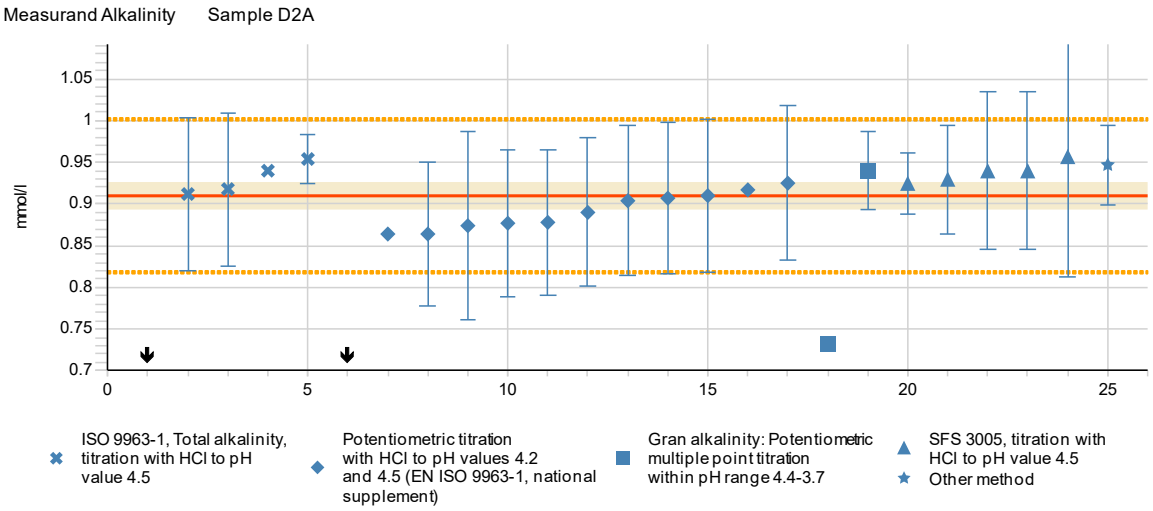



Measurand Turbidity
Sample G3S
z score
4
3
2
1
0
-1
-2
-3
-4
20 6 31 32 28 19 30 36 33 3 14 41 25 42 1 10 21 5 17 24 29 34 9 12
Participant
z score

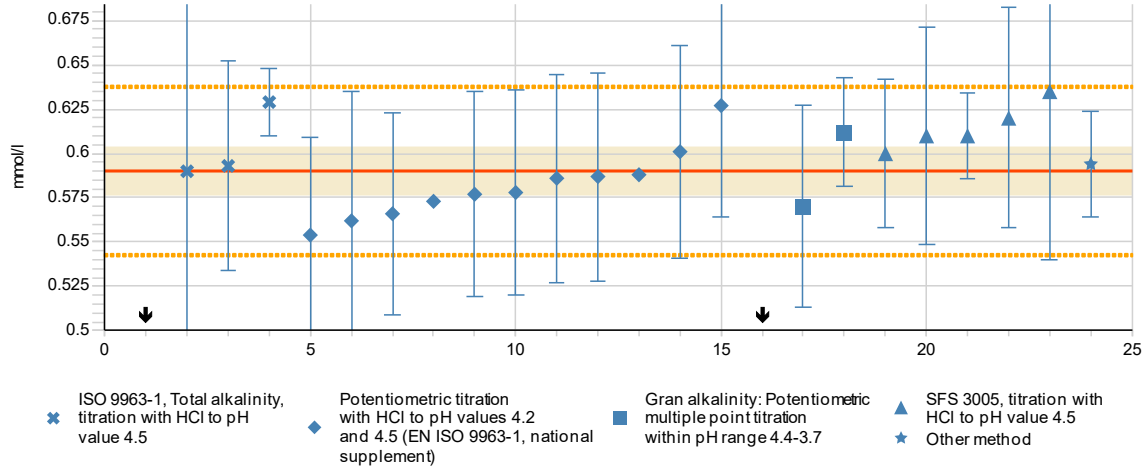
Appendix 12. **Results grouped according to the methods**

The explanations for the figures are described in the Appendix 9. The results are shown in ascending order.





Measurand Alkalinity Sample G3A



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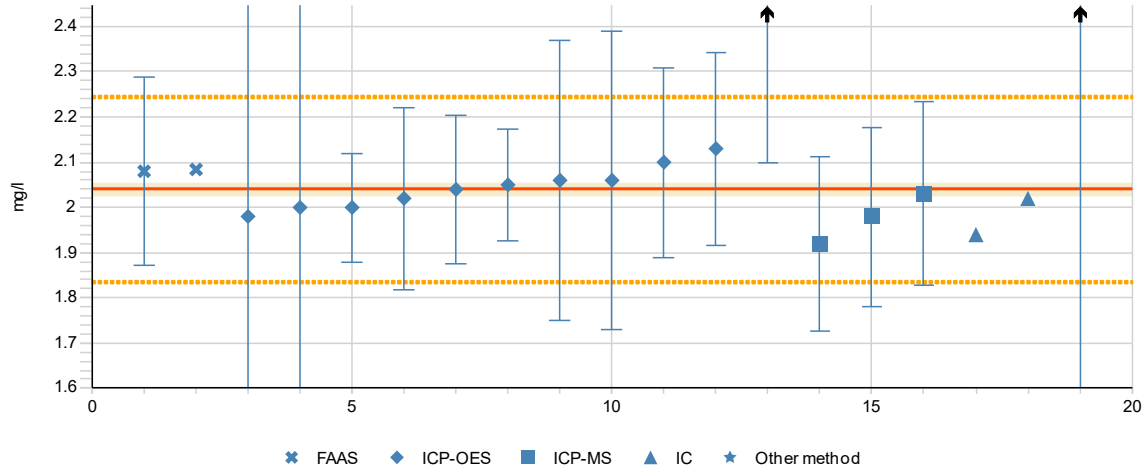

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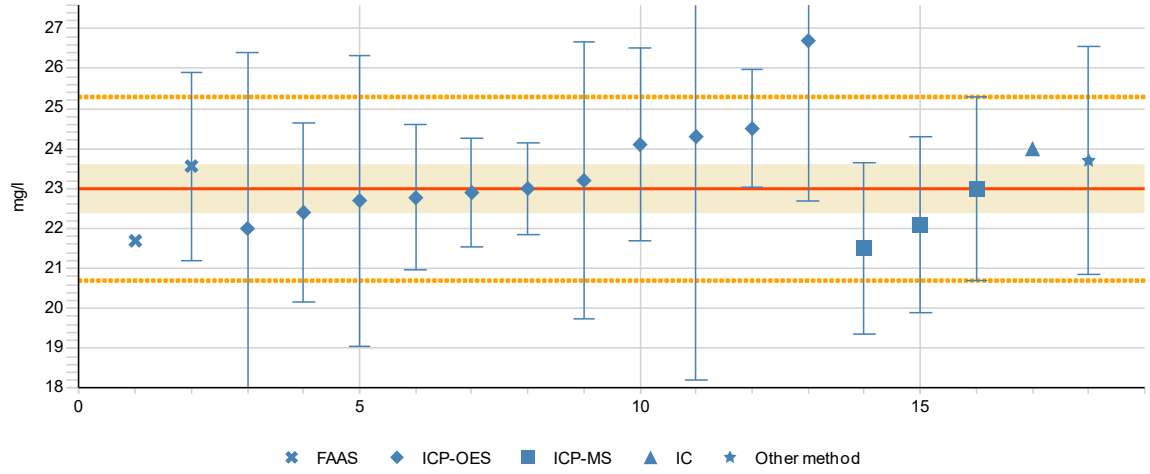

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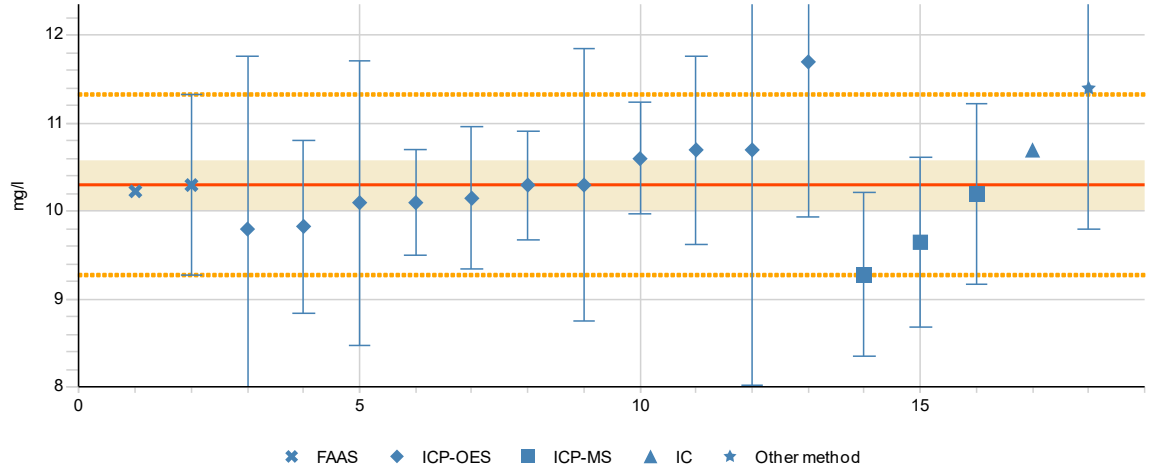
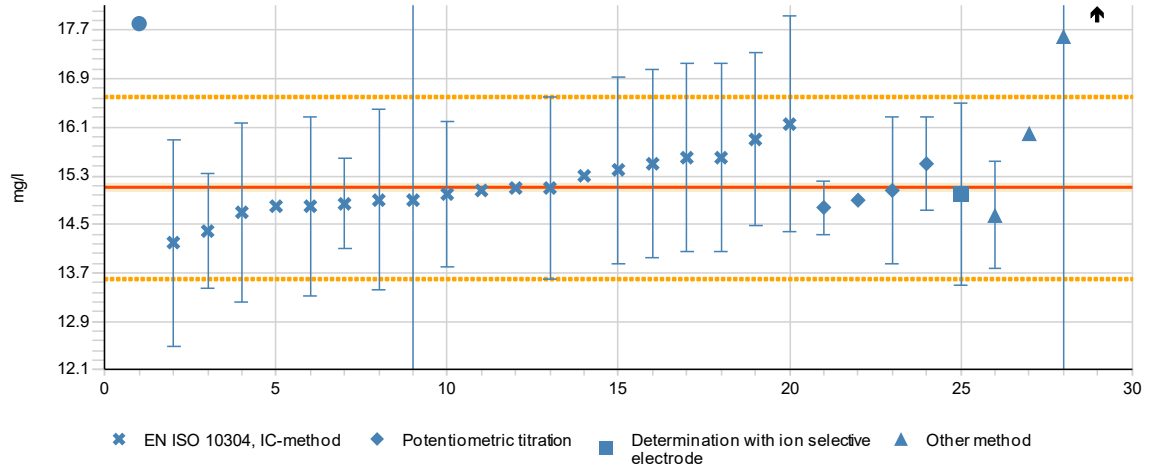


Measurand Cl Sample A1CS



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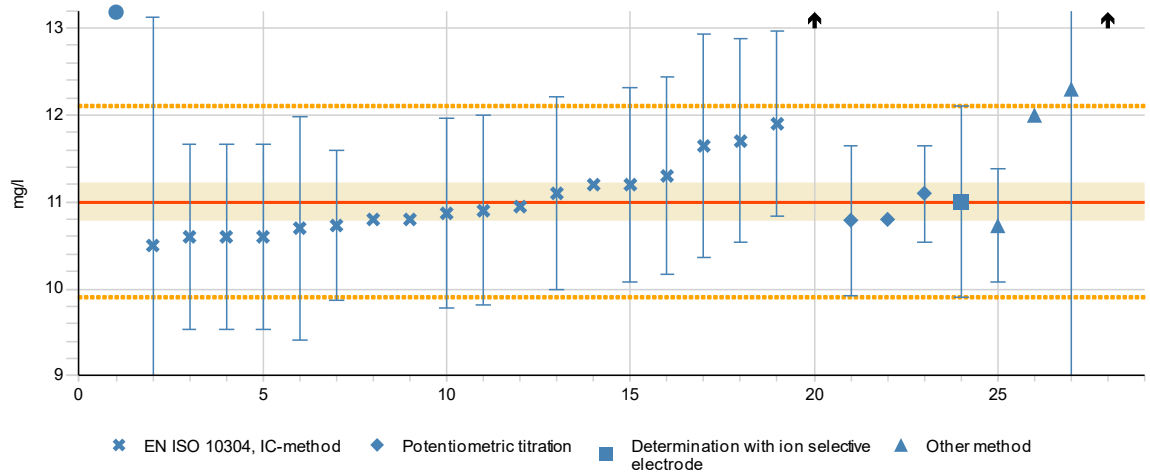

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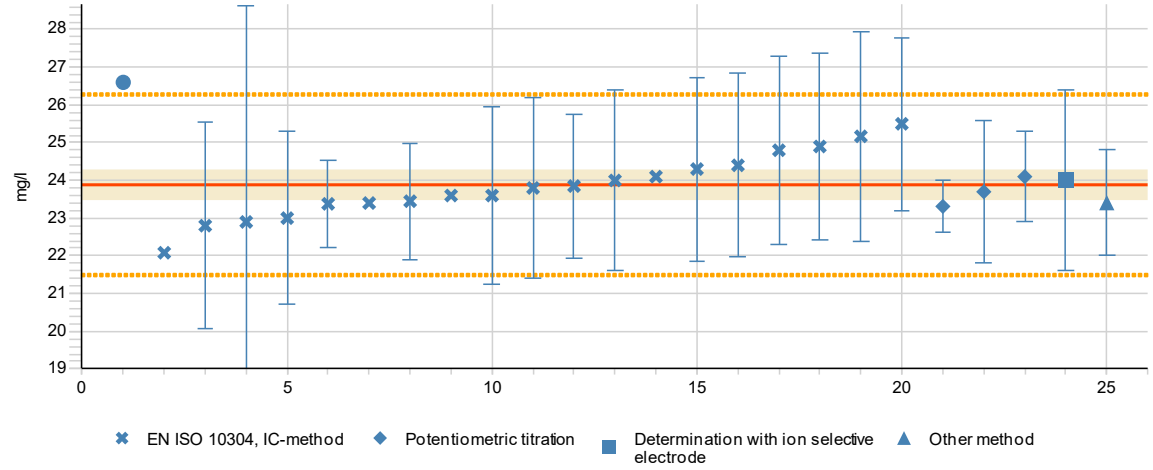
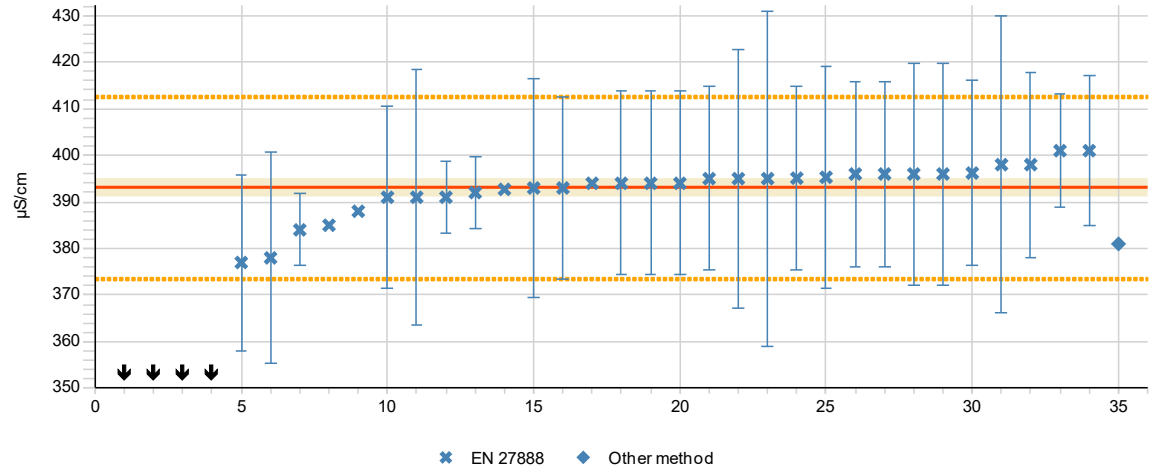


Measurand Conductivity Sample A1J



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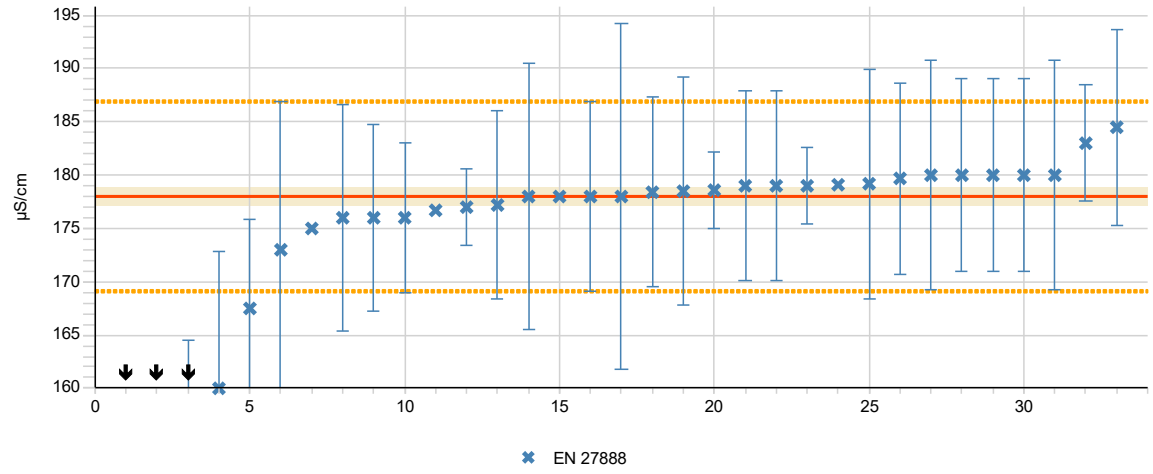

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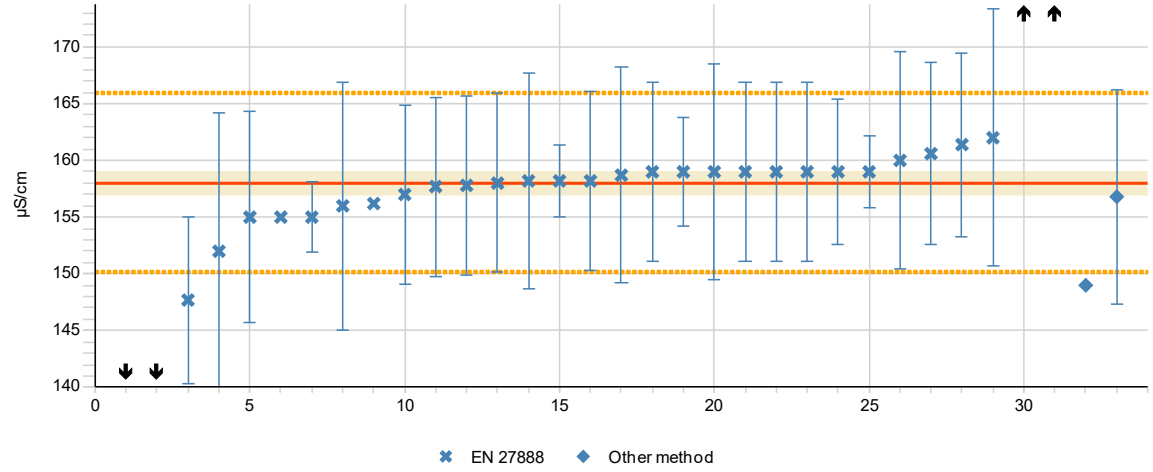

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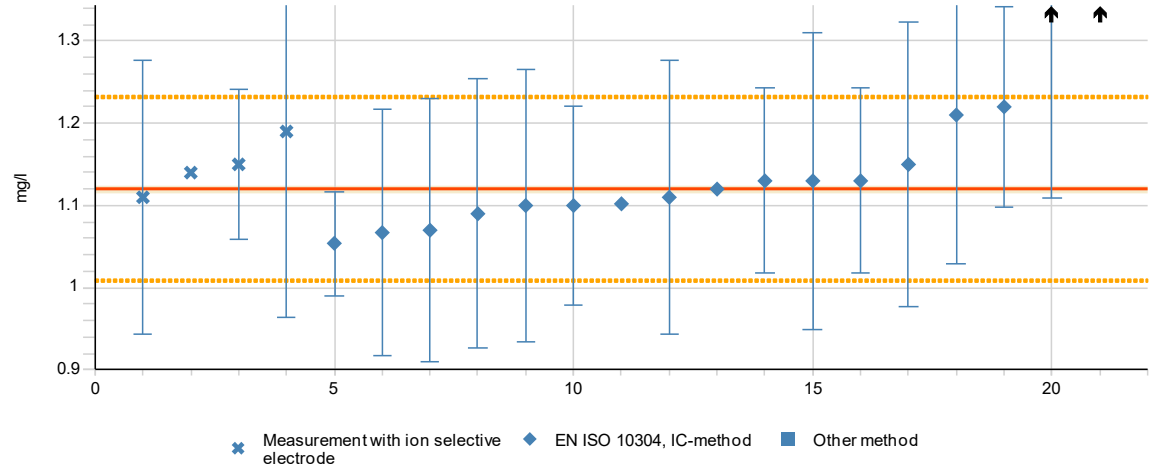
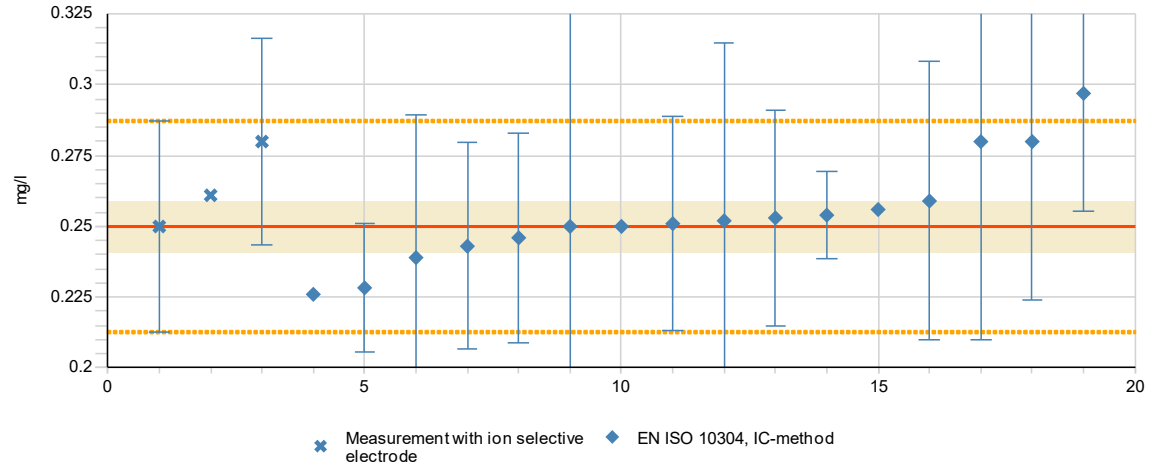


Measurand F Sample D2F



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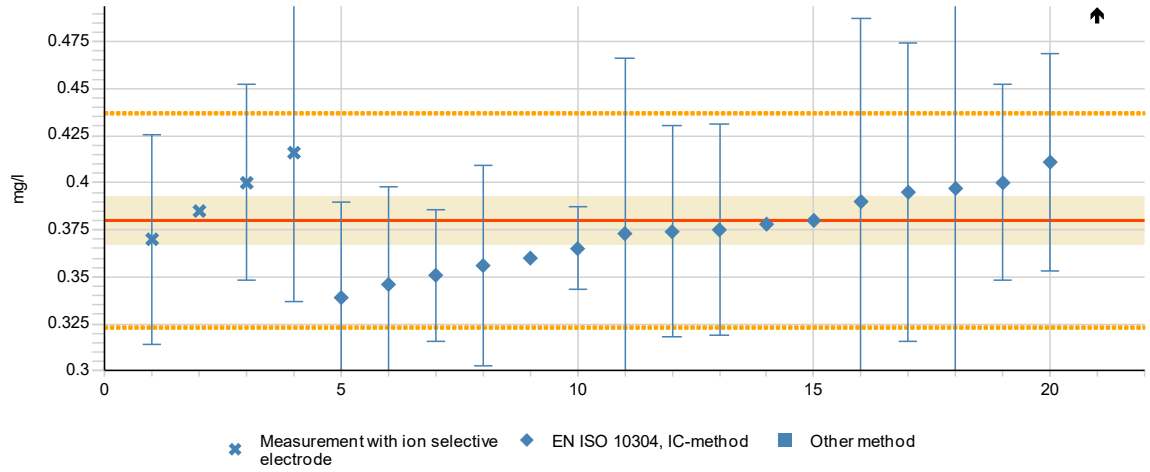
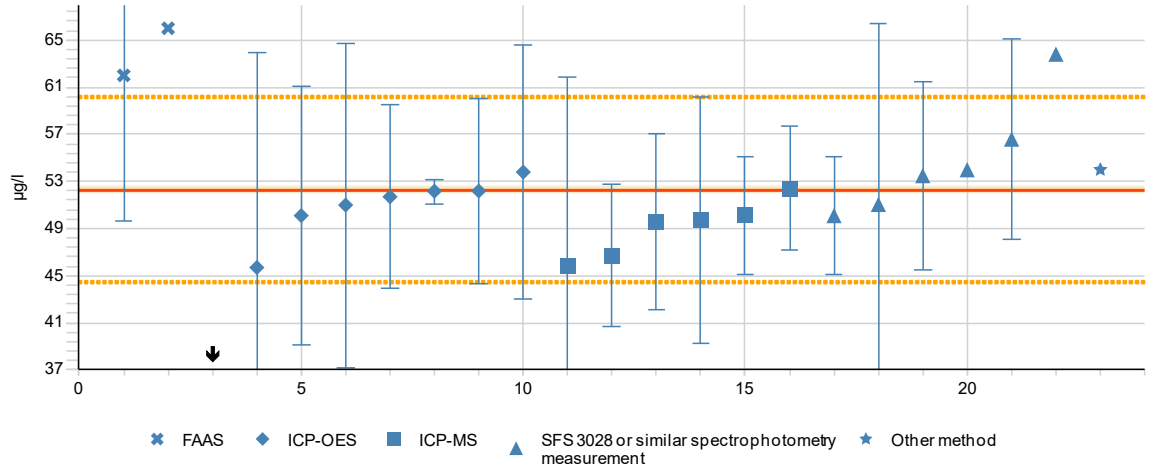


Measurand Fe Sample A1Fe



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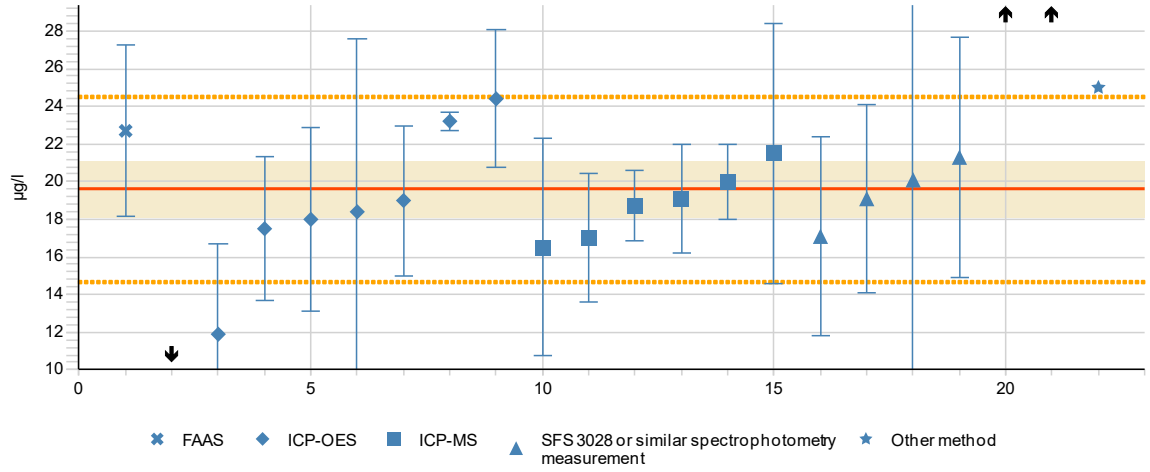
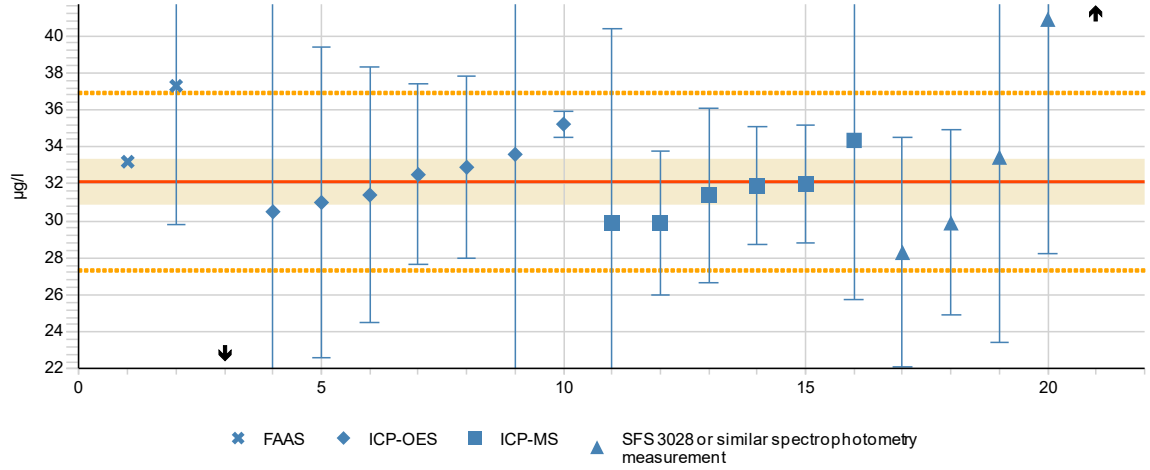
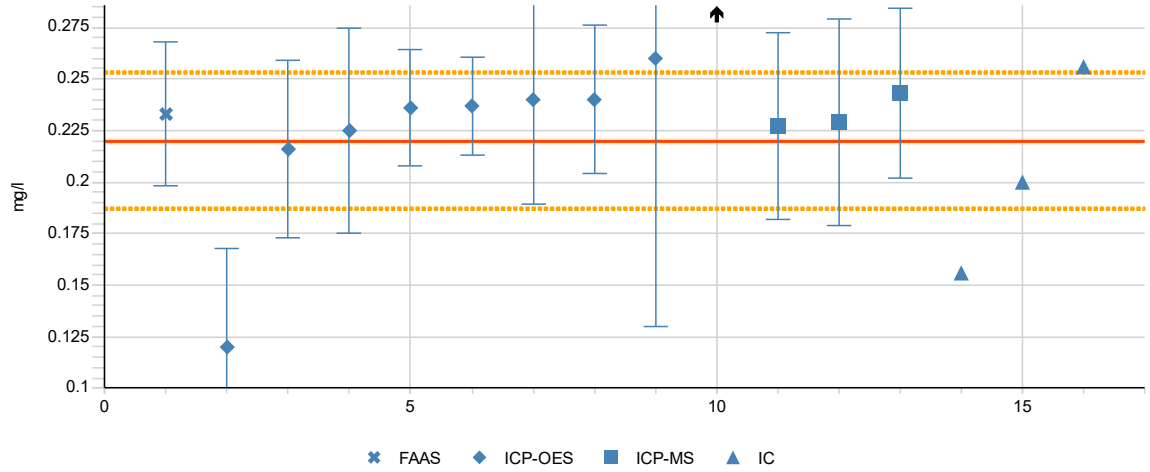


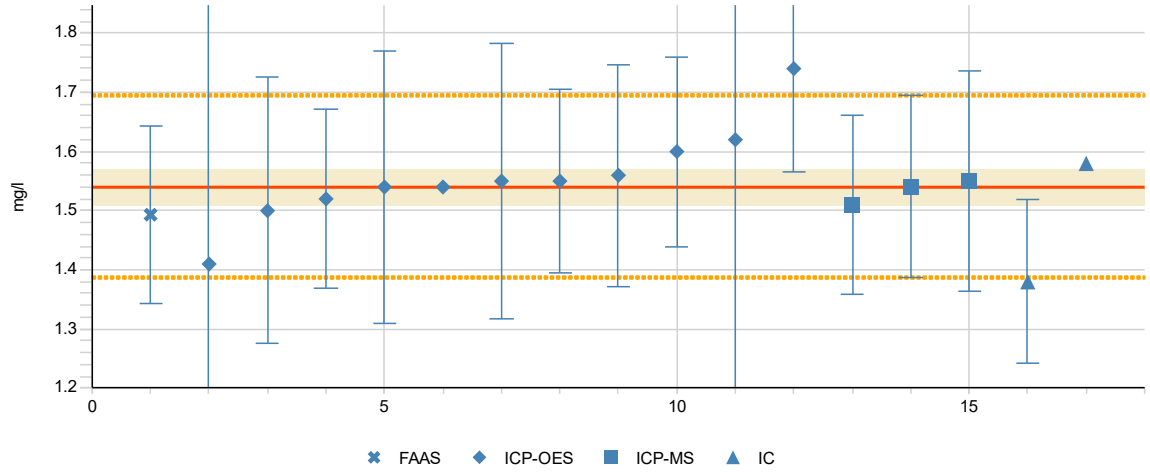
Measurand Fe Sample G3Fe



Measurand K Sample A1K



Measurand K Sample D2K



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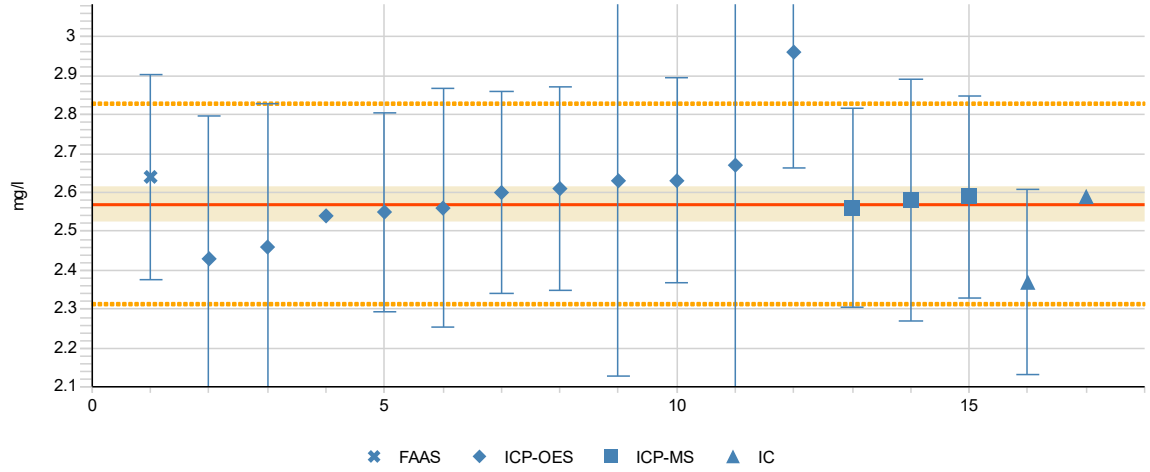

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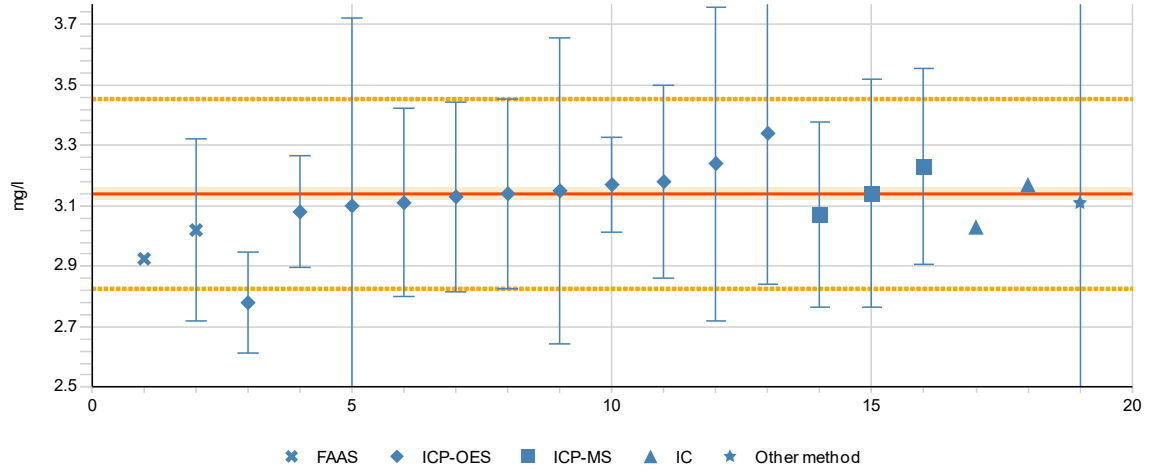

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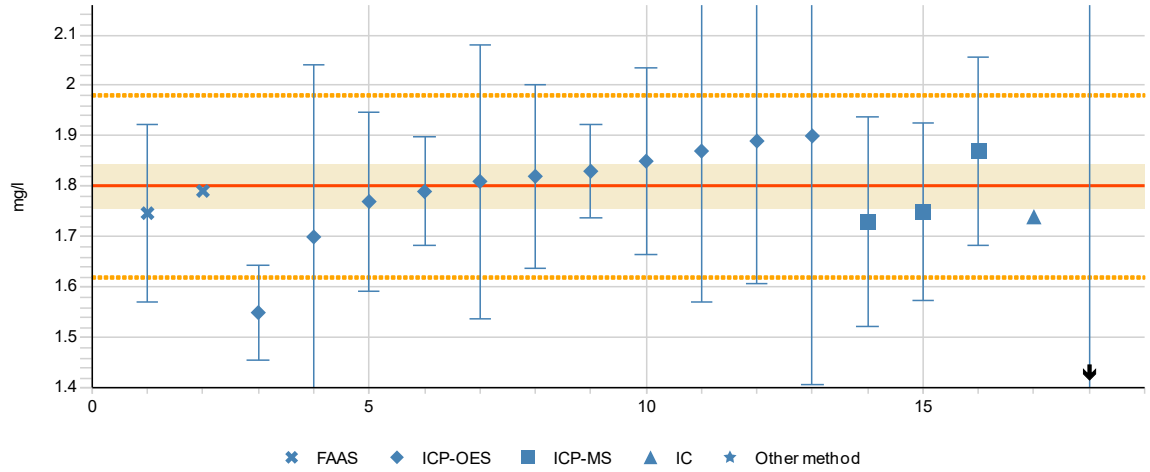

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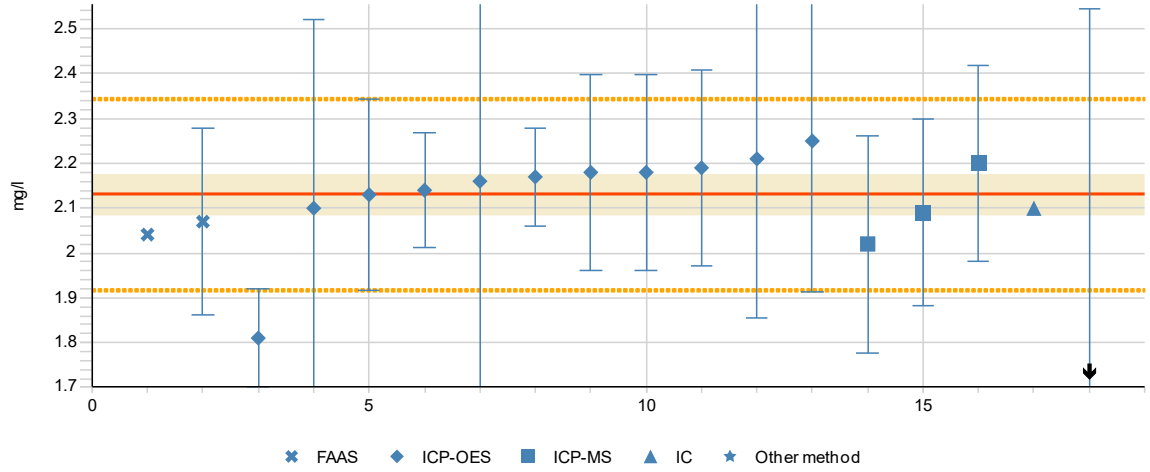
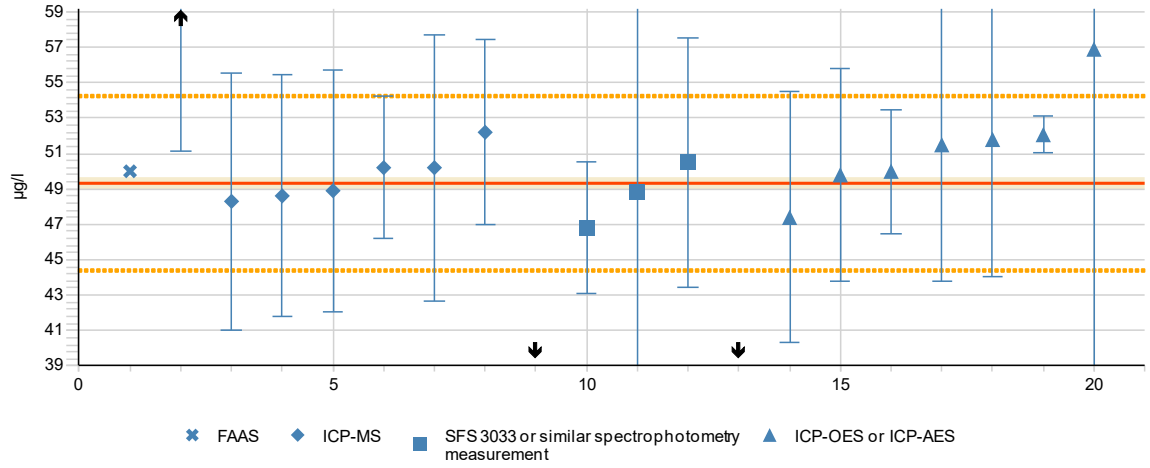
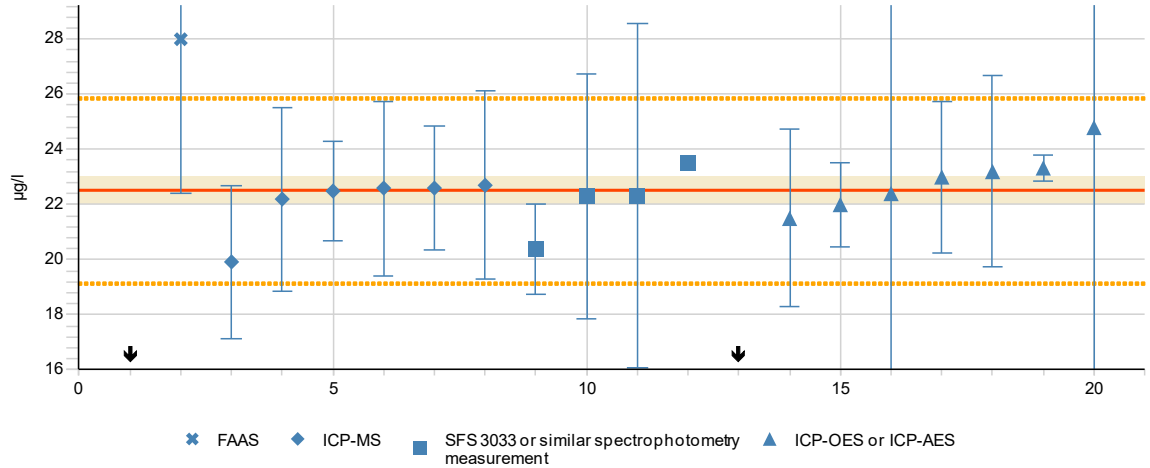


Measurand Mn Sample A1Fe



Measurand Mn Sample D2Fe



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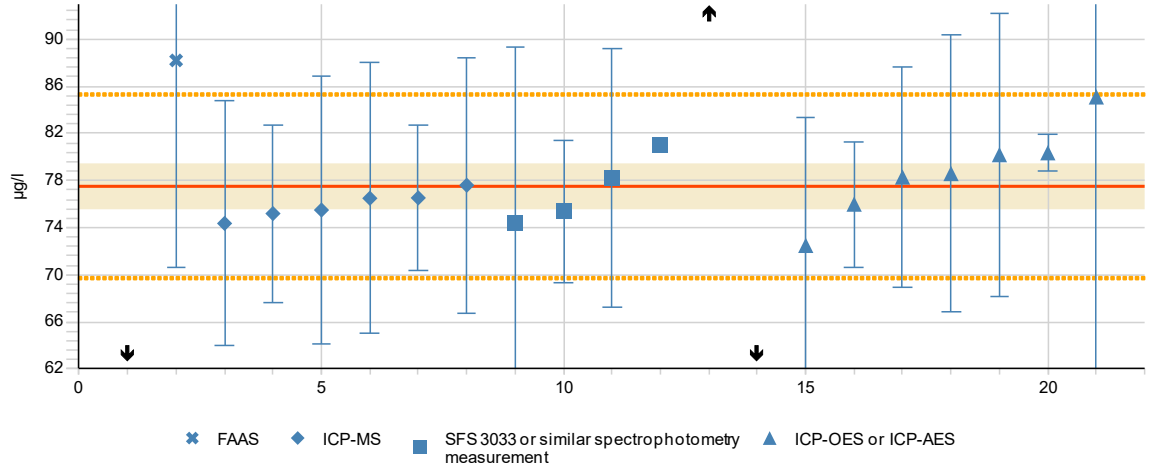

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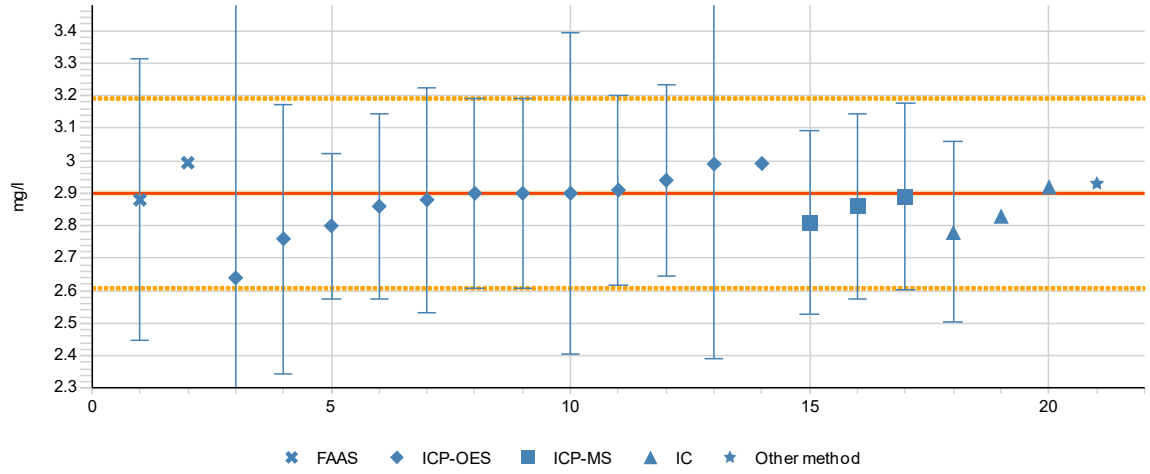

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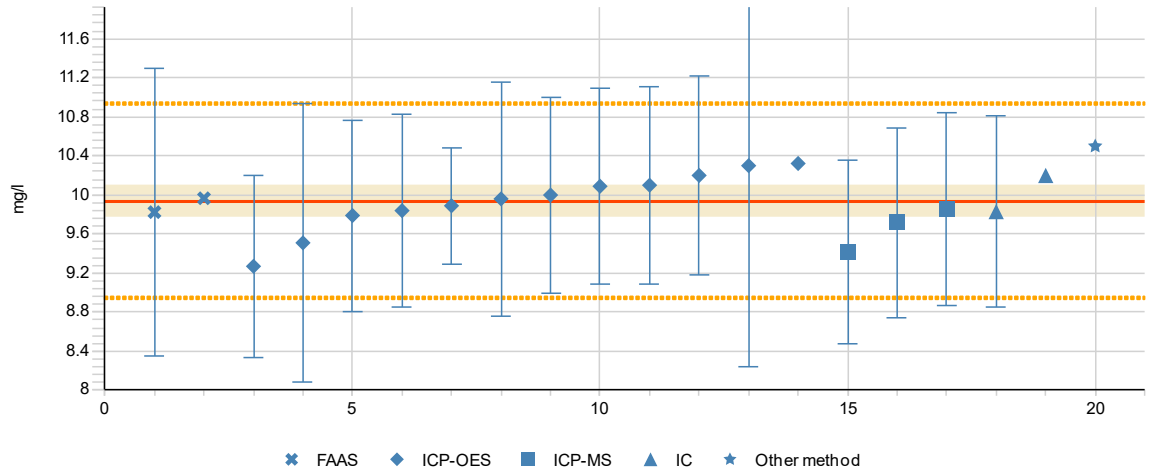

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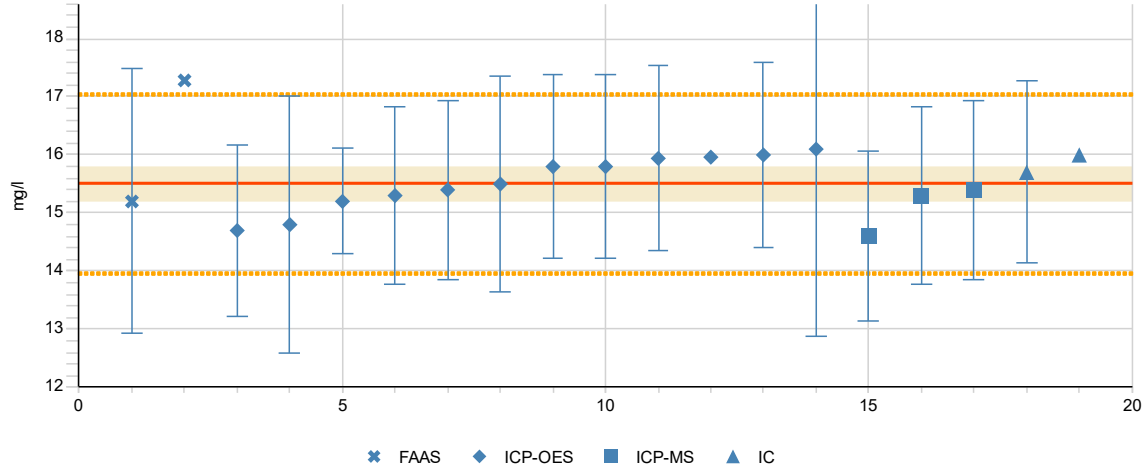
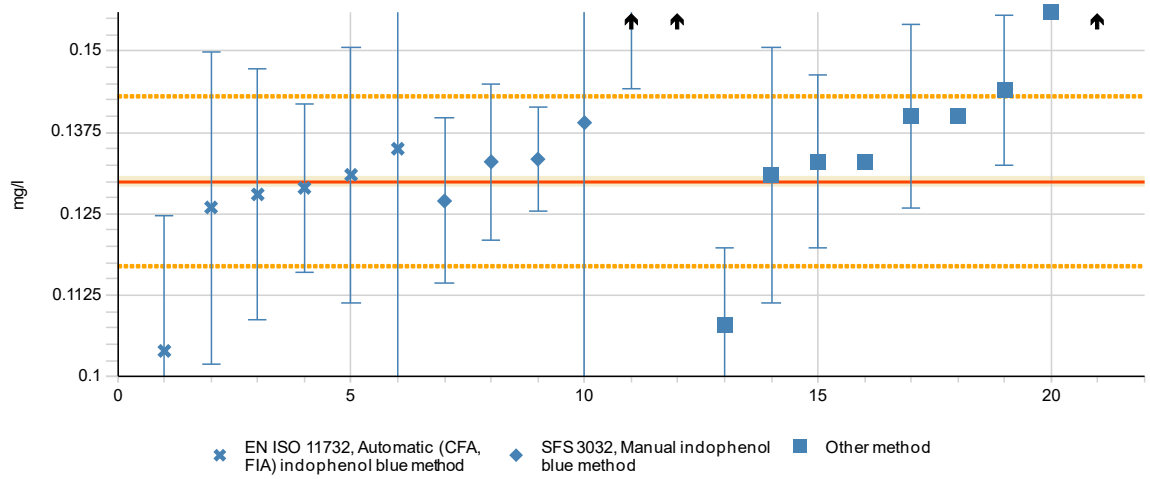


Measurand NH_4 Sample A1N



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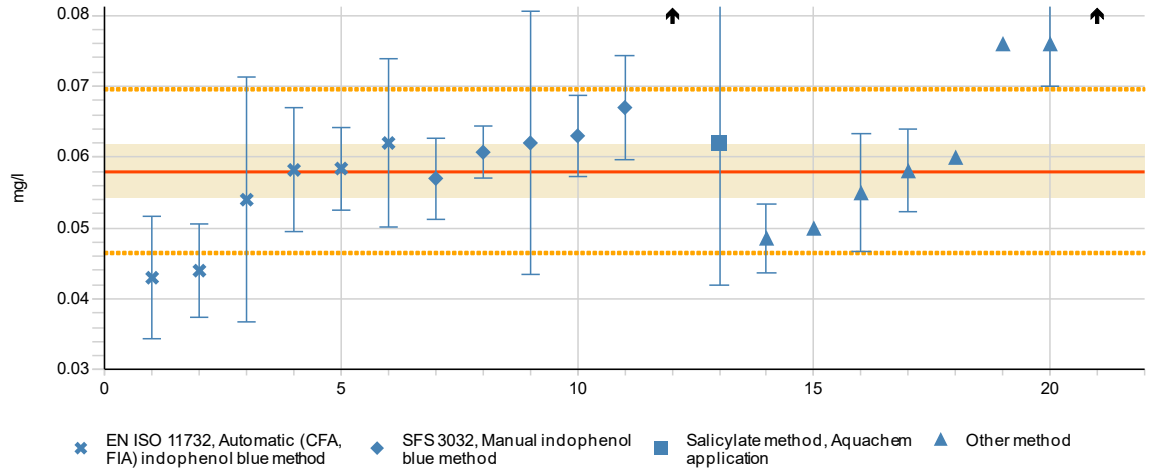
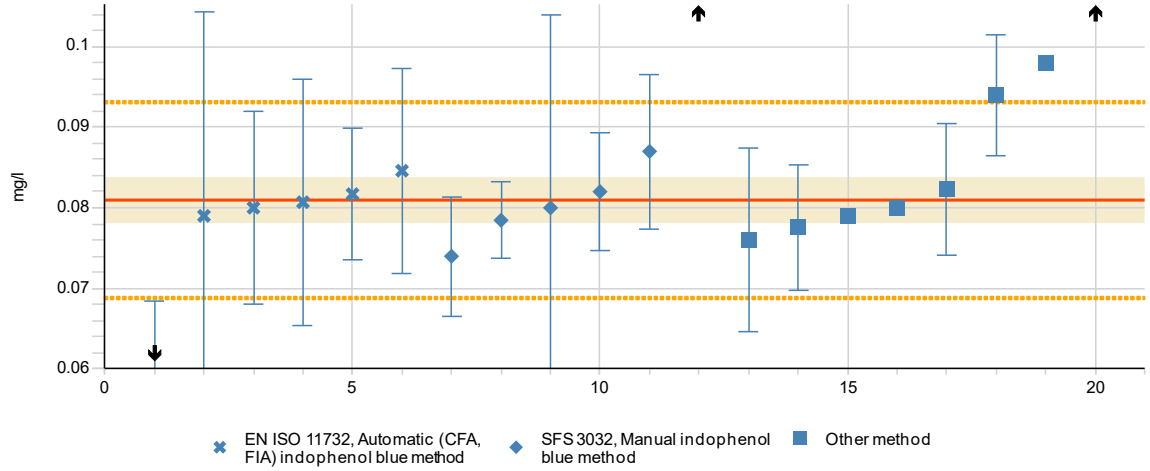
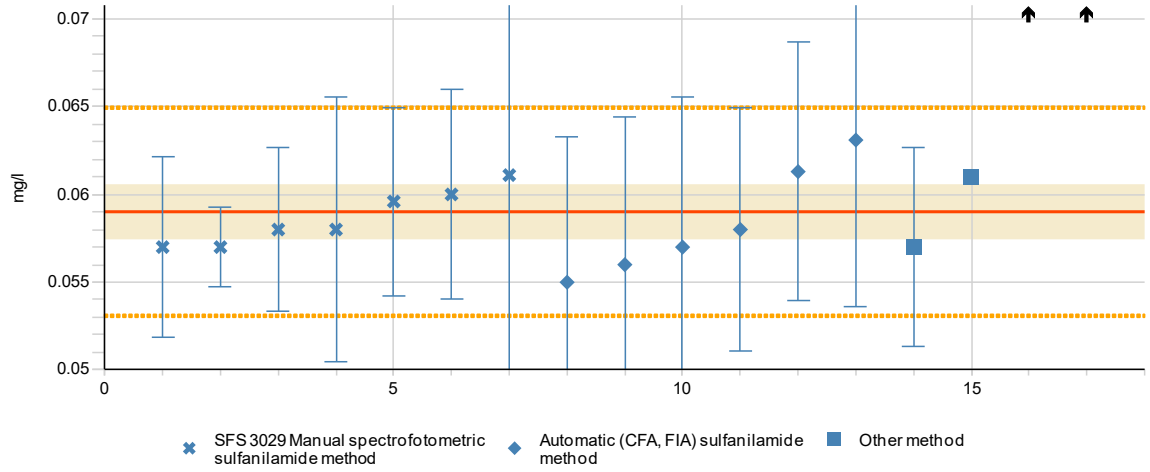


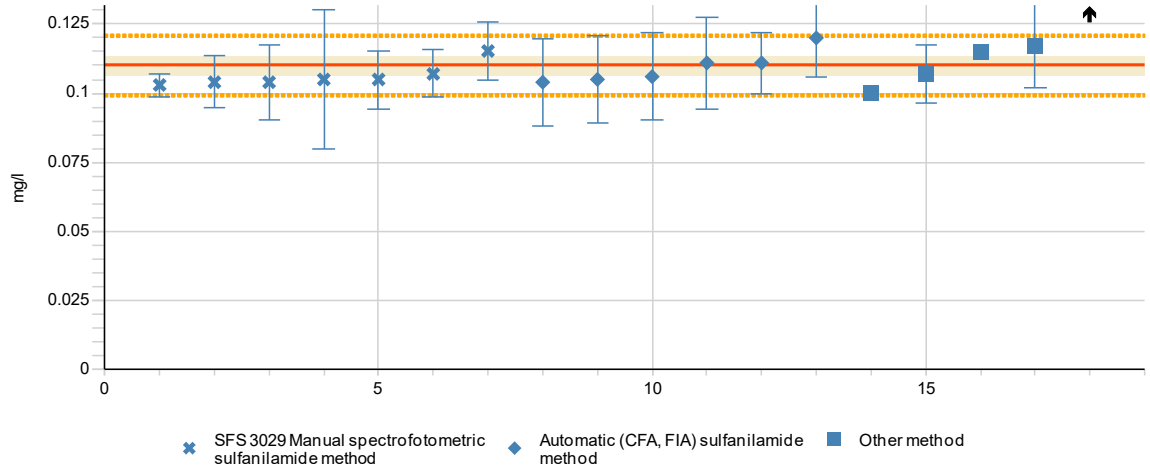
Measurand NH_4 Sample G3N



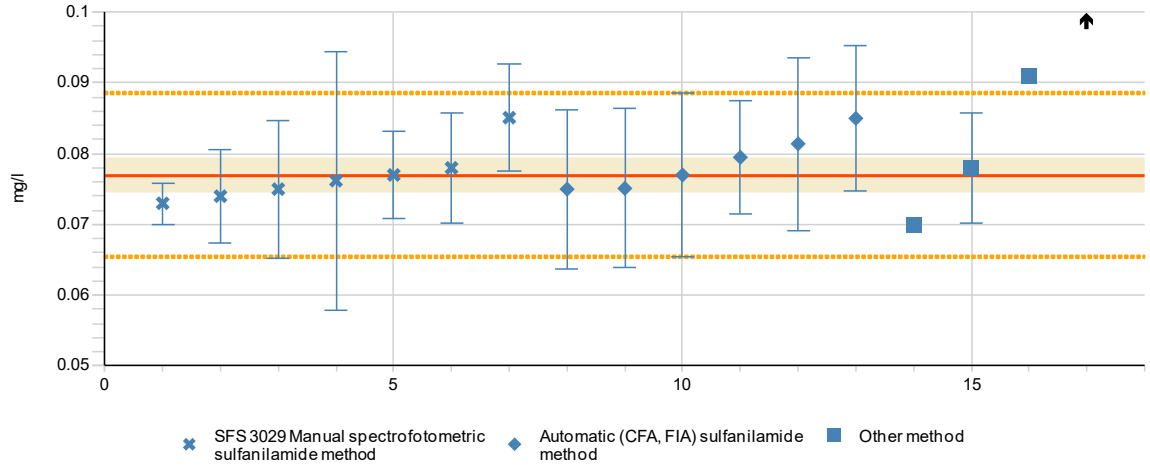
Measurand NO_2 Sample A1N



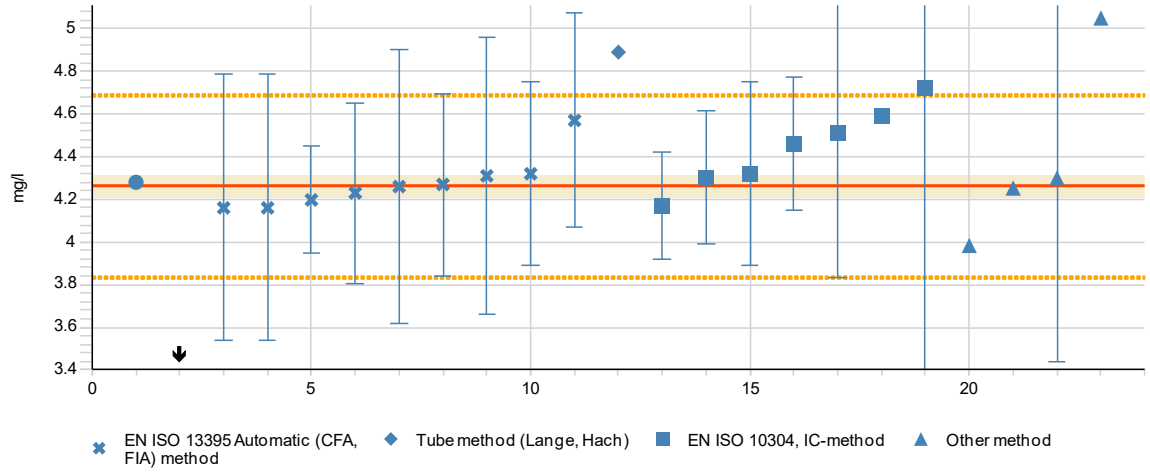
Measurand NO_2 Sample D2N



Measurand NO_2 Sample G3N



Measurand NO_3 Sample A1N



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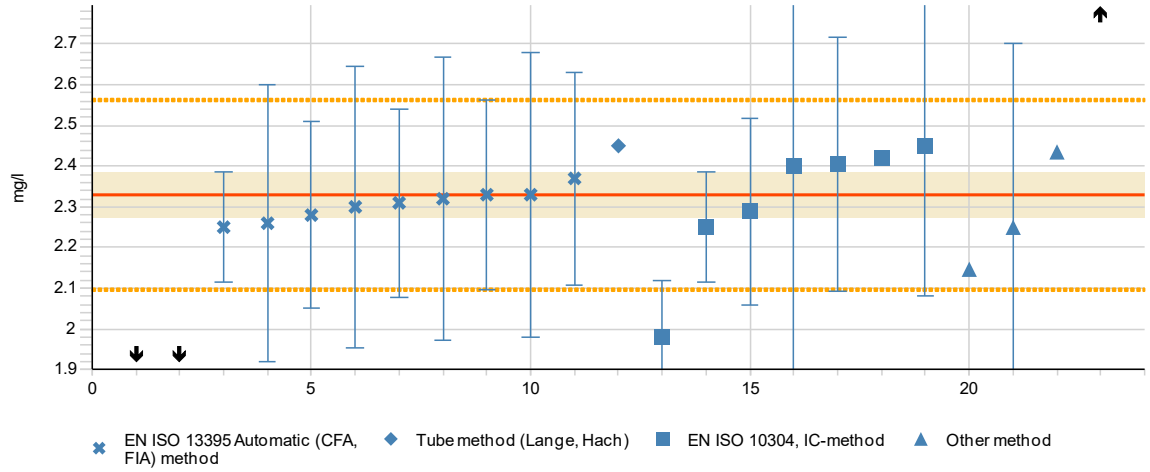

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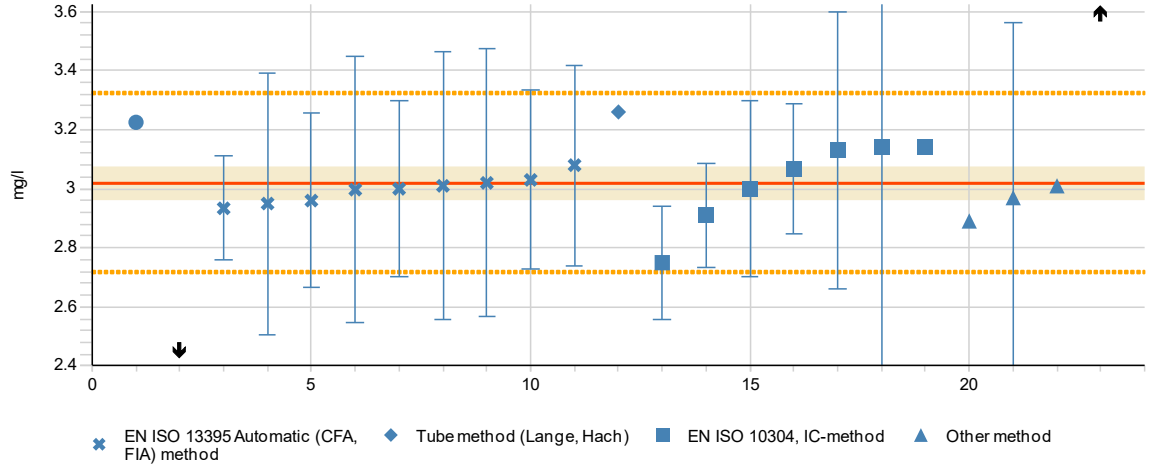
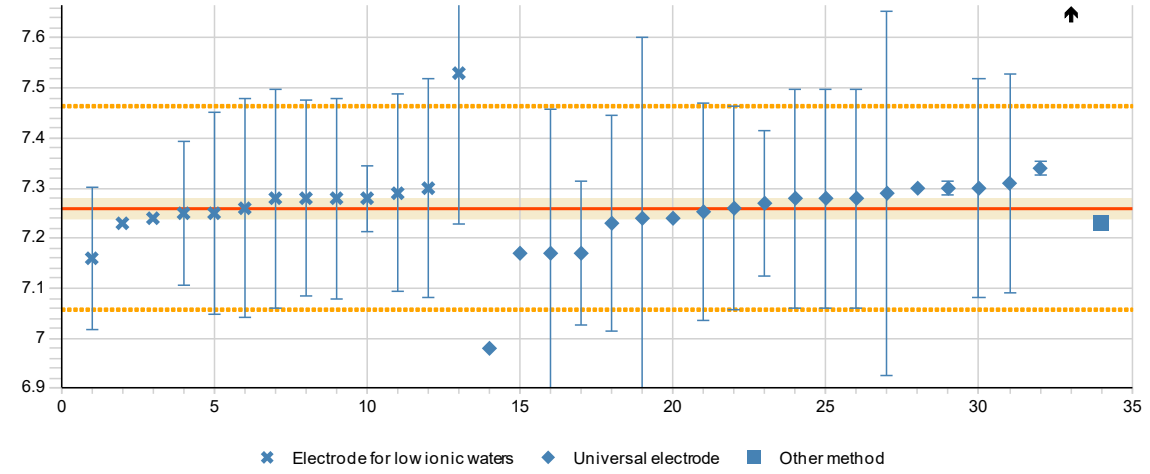
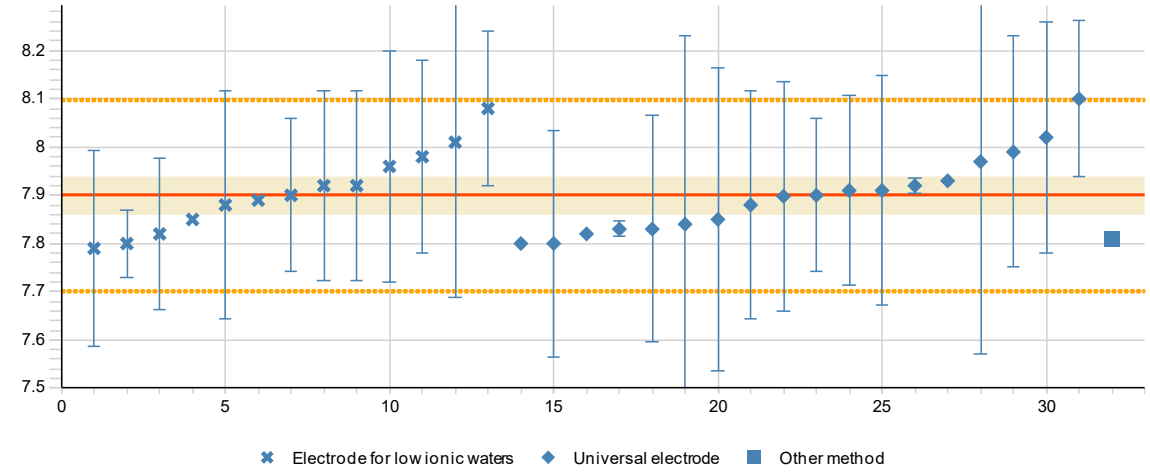


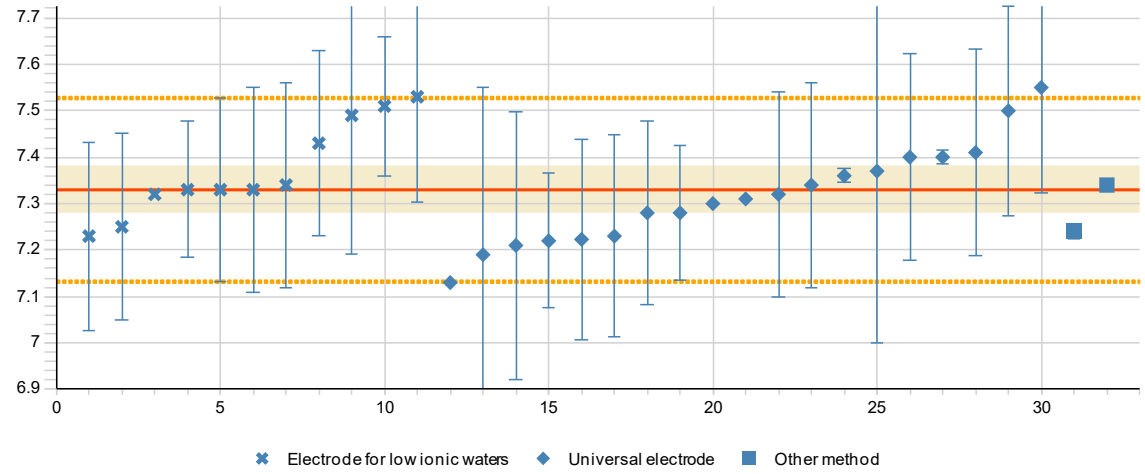
Measurand pH Sample A1P



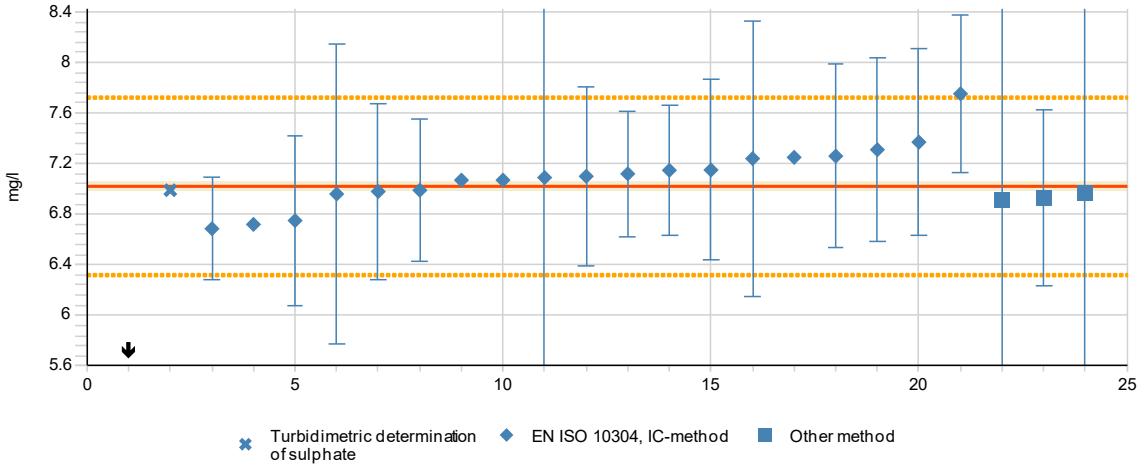
Measurand pH Sample D2PJ



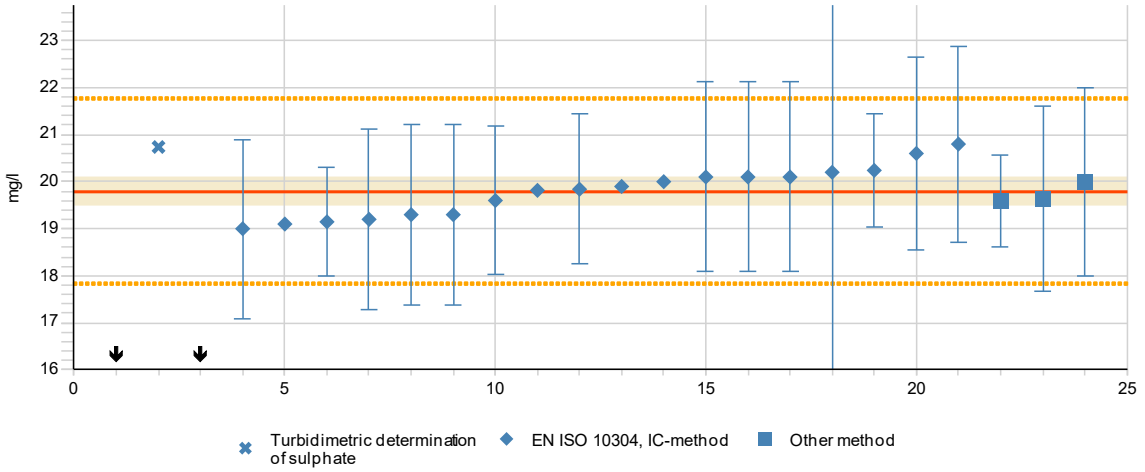
Measurand pH Sample G3PJ



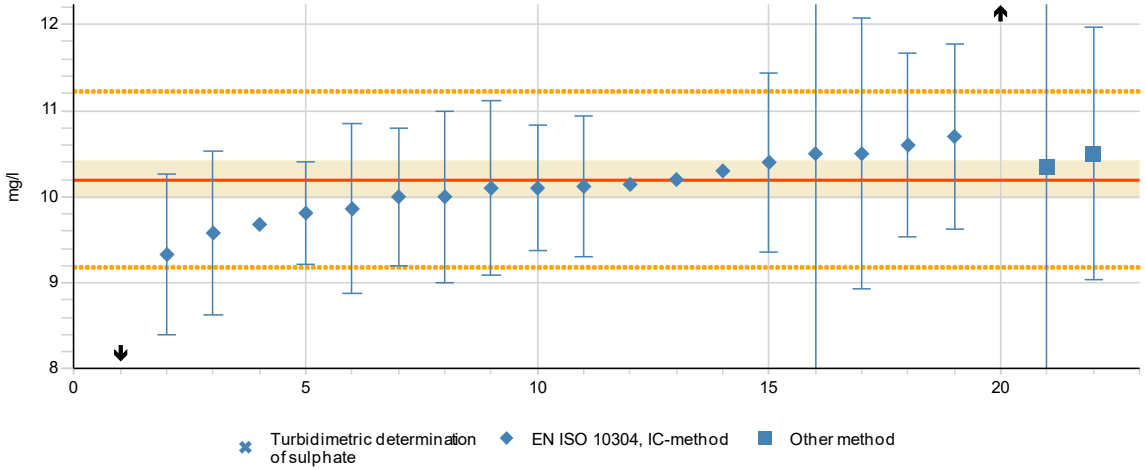
Measurand SO_4 Sample A1CS



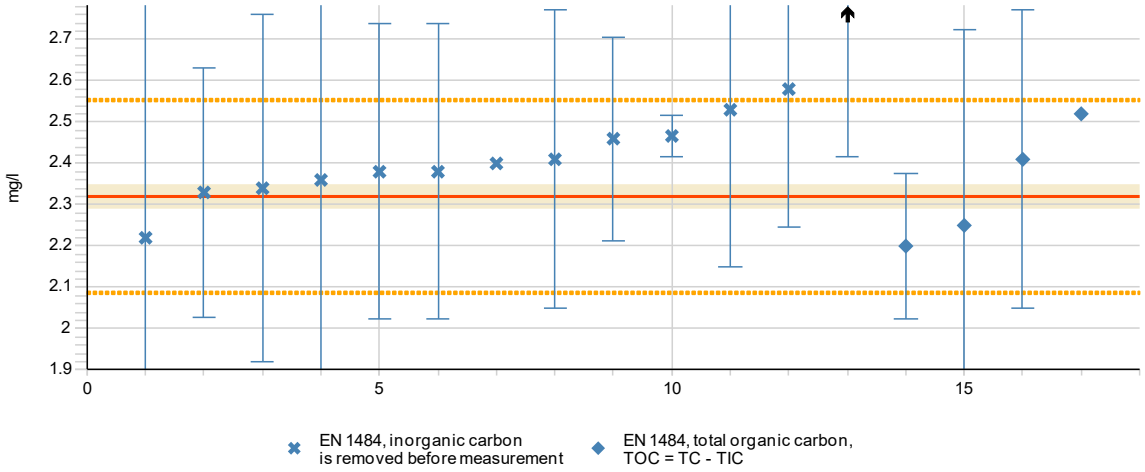
Measurand SO_4 Sample D2CS



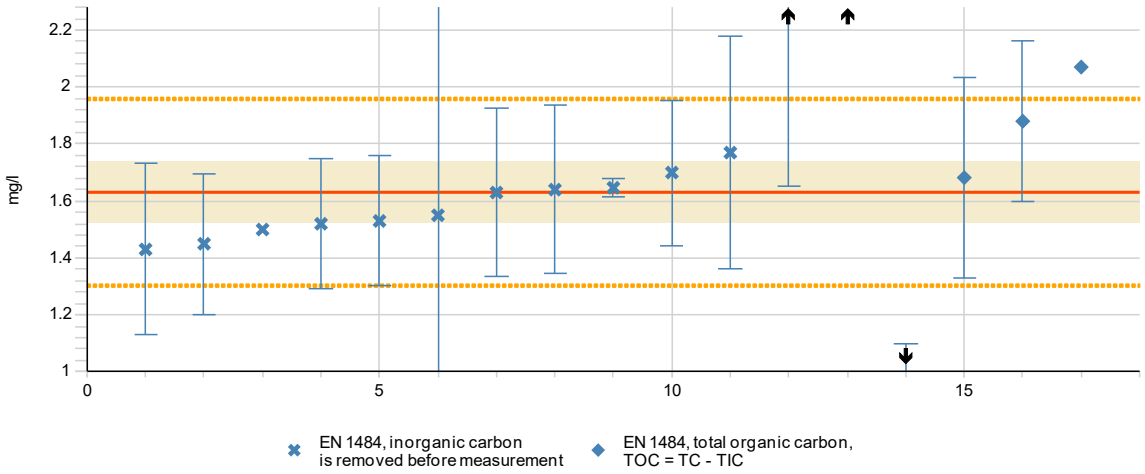
Measurand SO_4 Sample G3CS



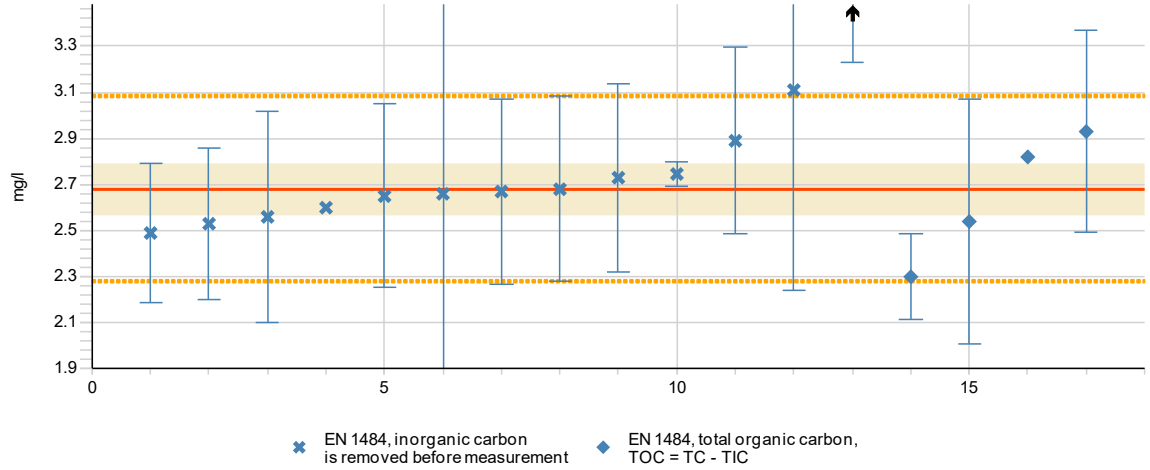
Measurand TOC Sample A1T



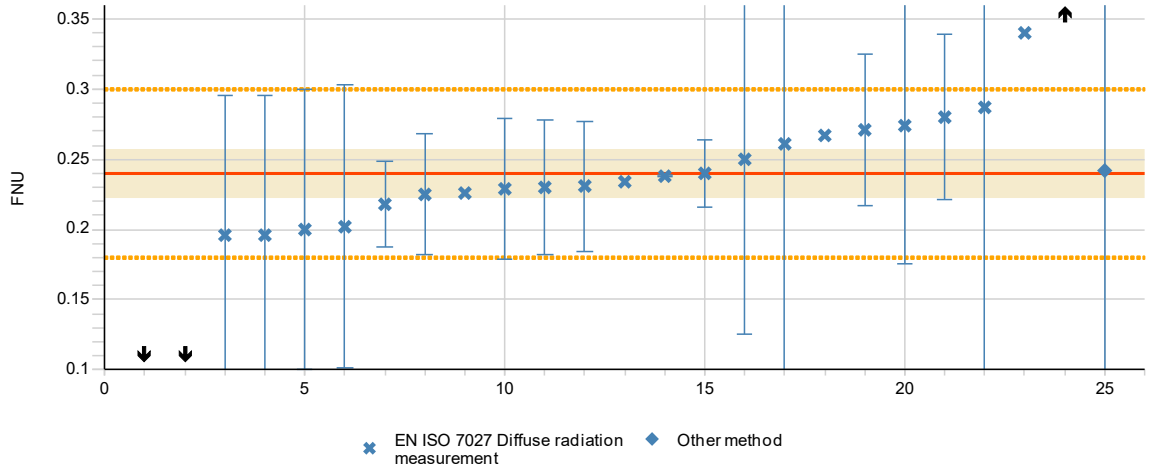
Measurand TOC Sample D2T



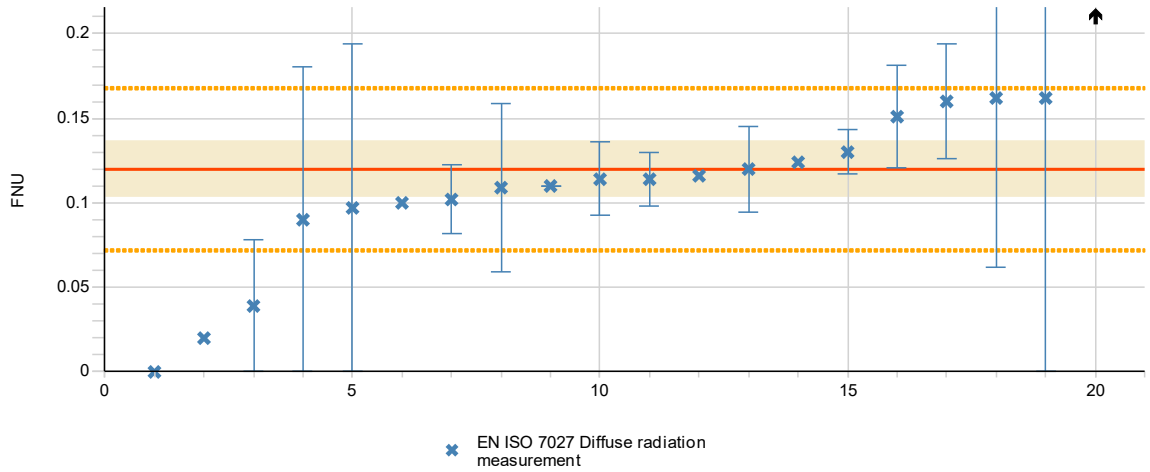
Measurand TOC Sample G3T

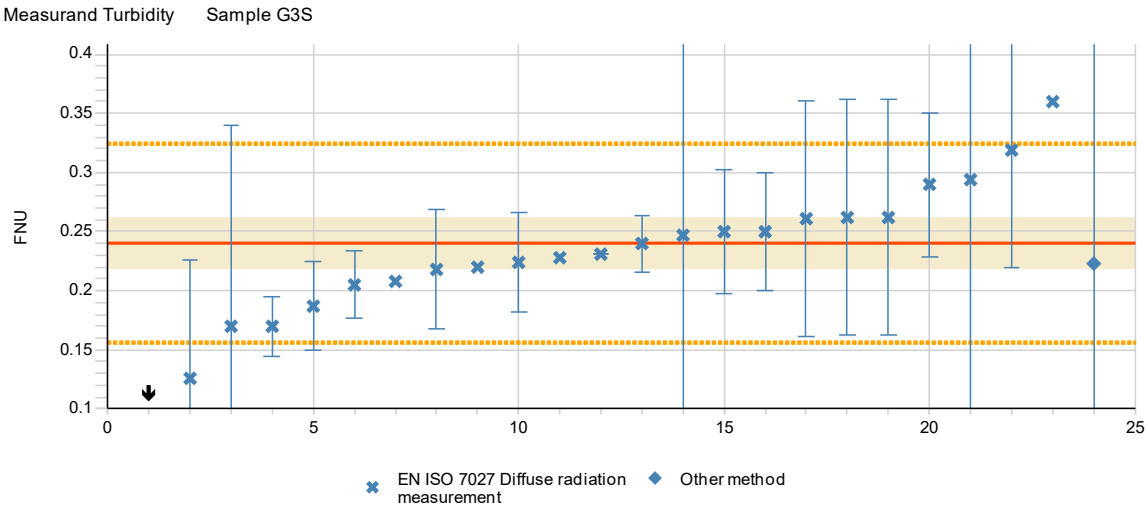


Measurand Turbidity Sample A1S



Measurand Turbidity Sample D2S

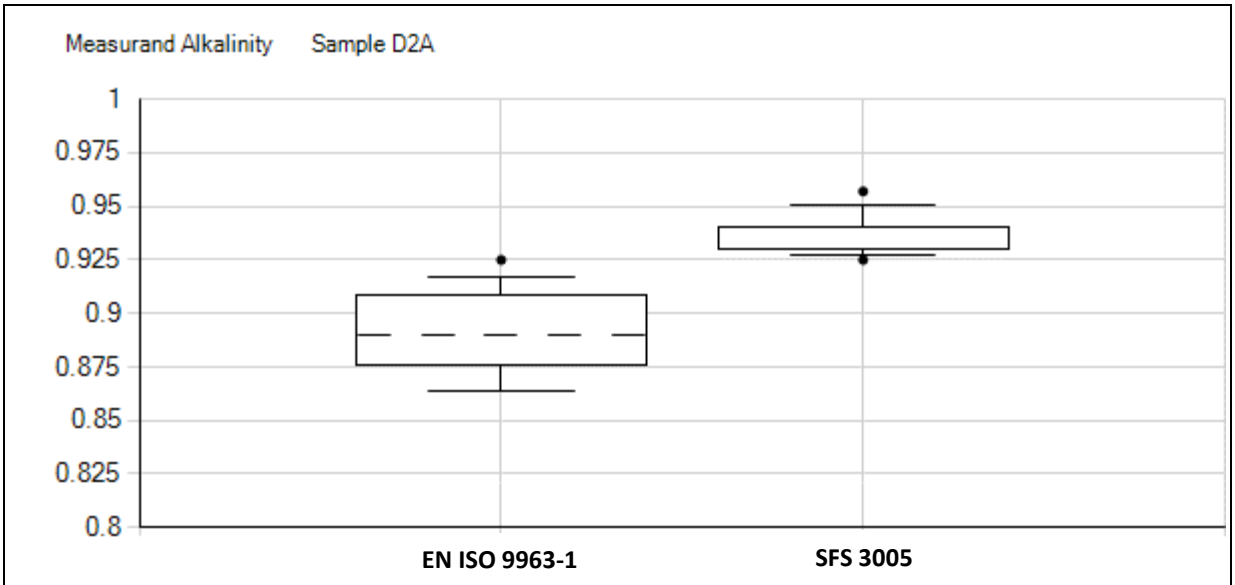



Measurand Turbidity
Sample G3S
FNU
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0
5
10
15
20
25
EN ISO 7027 Diffuse radiation measurement
Other method

Appendix 13. Significant differences in the results reported using different methods

Boxplot figures: In the box the upper and lower limit included 50 % of the results. The dashed vertical line in the middle of the box is the median of the results. The vertical lines above and under the box describe the limits of 80 % of the results. The black dots describe the highest and smallest results within the center 90 % of the results. The blue horizontal bar spans over results which are in the same data population with 95 % confidence level.

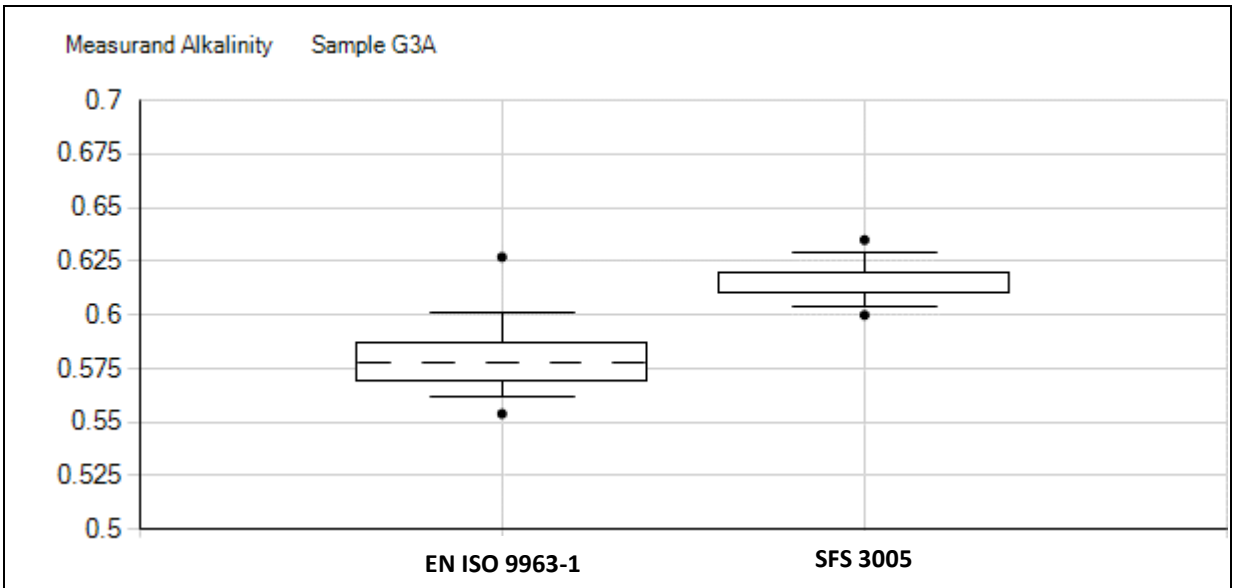
D2A: Alkalinity



Method	n	Mean (mg/l)	s (mg/l)
Potentiometric titration with HCl to pH values 4.2 and 4.5 (EN ISO 9963-1 national supplement)	11	0.89	0.02
SFS 3005, titration with HCl to pH value 4.5	5	0.94	0.01

n = number of results; s = standard deviation

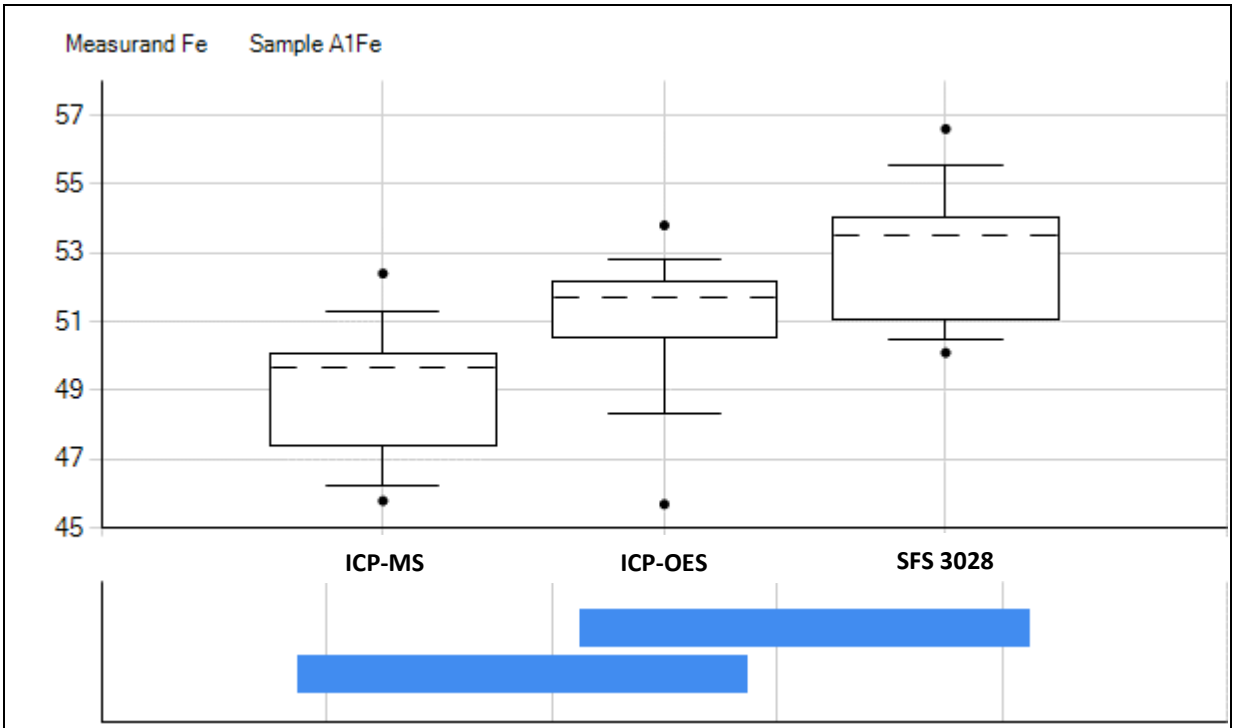
G3A: Alkalinity



Method	n	Mean (mg/l)	s (mg/l)
Potentiometric titration with HCl to pH values 4.2 and 4.5 (EN ISO 9963-1 national supplement)	11	0.58	0.02
SFS 3005, titration with HCl to pH value 4.5	5	0.62	0.01

n = number of results; s = standard deviation

A1Fe: Fe

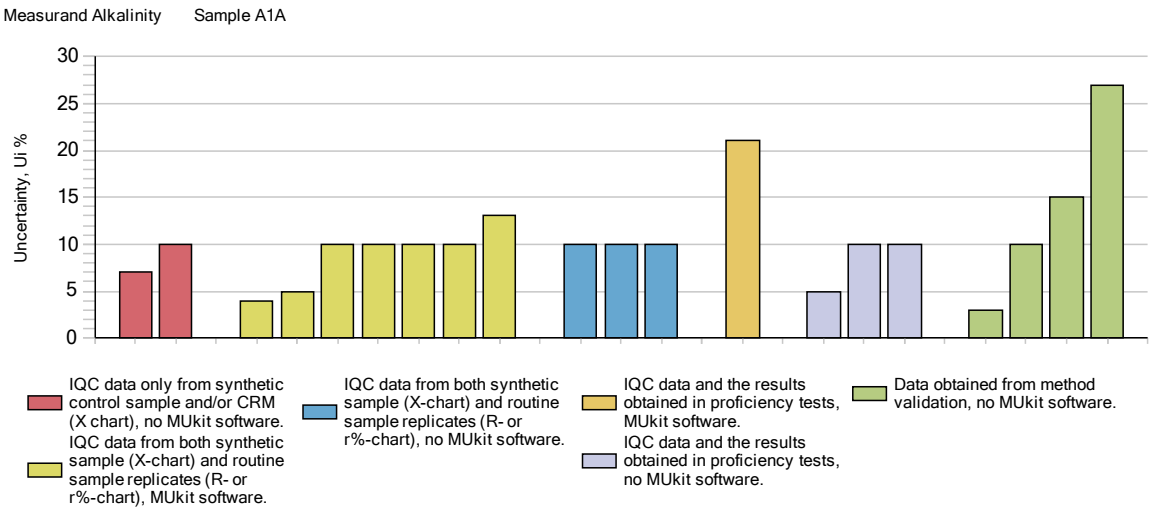


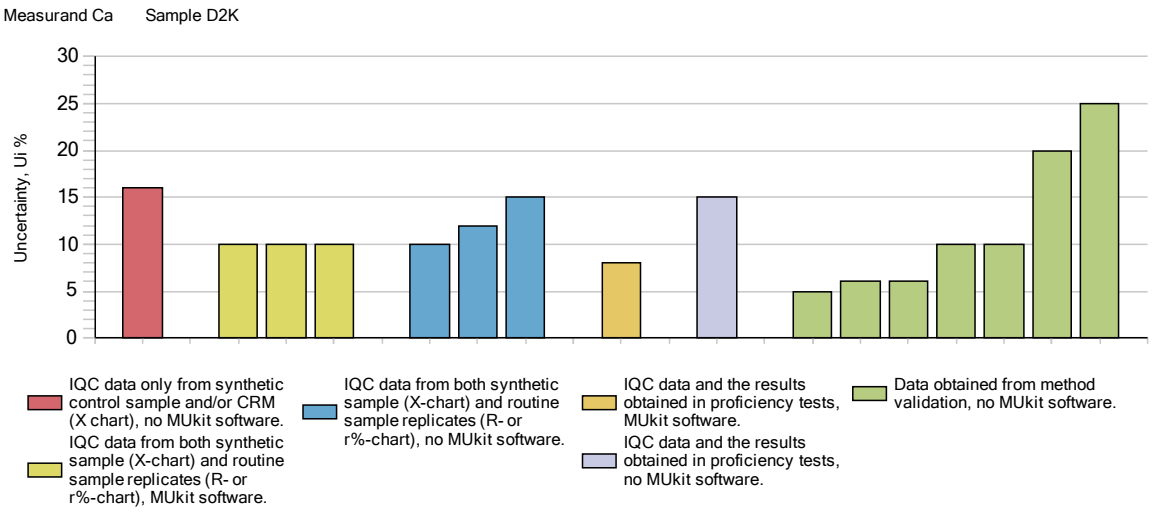
Method	n	Mean (mg/l)	s (mg/l)
ICP-MS	6	49.1	2.4
ICP-OES	7	51.0	2.6
SFS 3028 or similar spectrophotometry	5	53.1	2.6

n = number of results; s = standard deviation

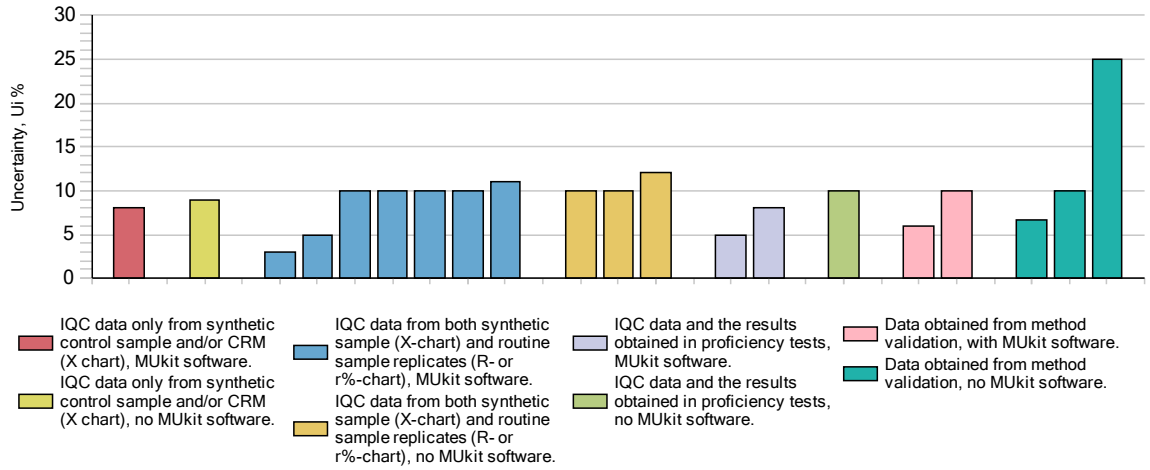
Appendix 14. **Examples of measurement uncertainties reported by the participants**

In figures, the presented expanded measurement uncertainties are grouped according to the method of evaluation at 95 % confidence level (k=2). The expanded uncertainties were evaluated mainly by using the internal quality control (IQC) data. The used procedures in figures below are distinguished e.g. between using or not using the MUkit software for uncertainty evaluation [8, 9].

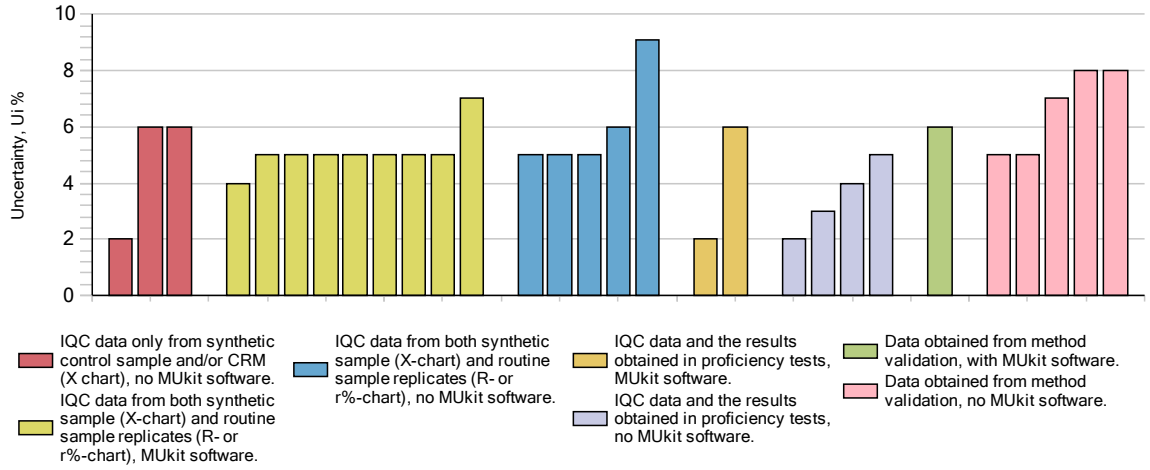




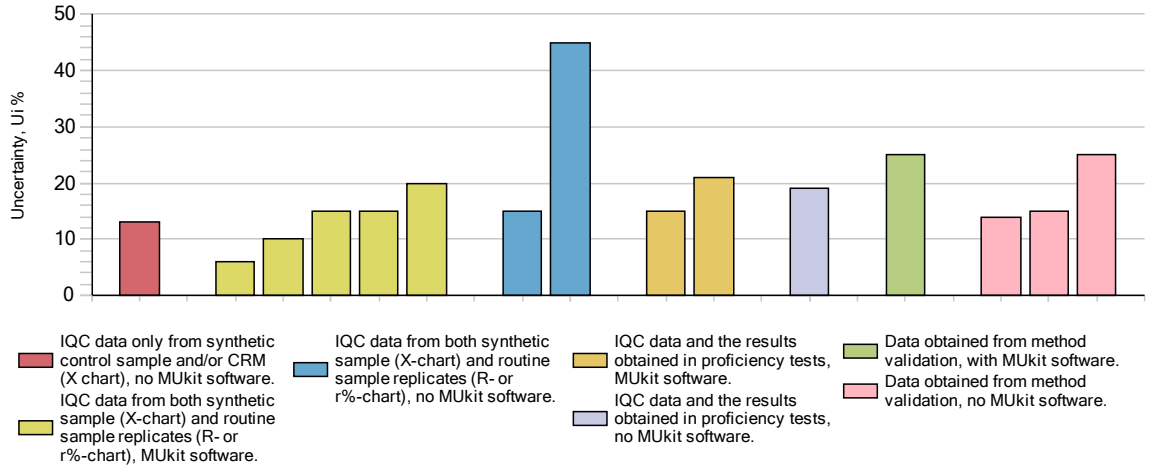
Measurand Cl Sample G3CS



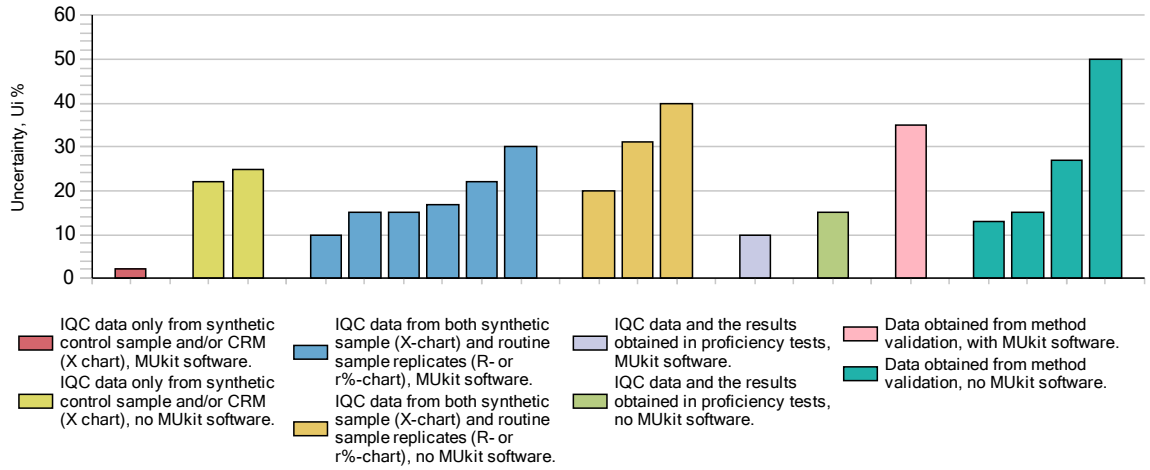
Measurand Conductivity Sample A1J



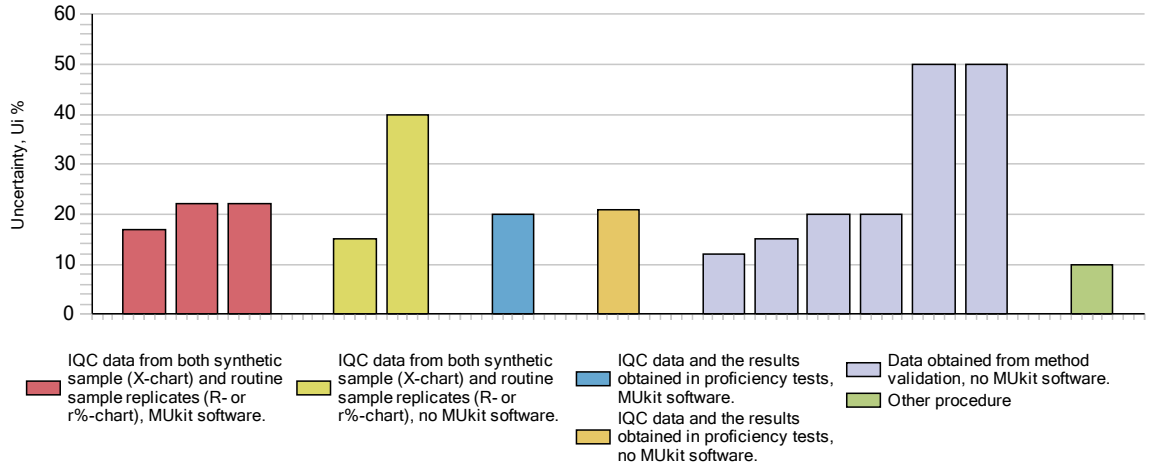
Measurand F Sample D2F



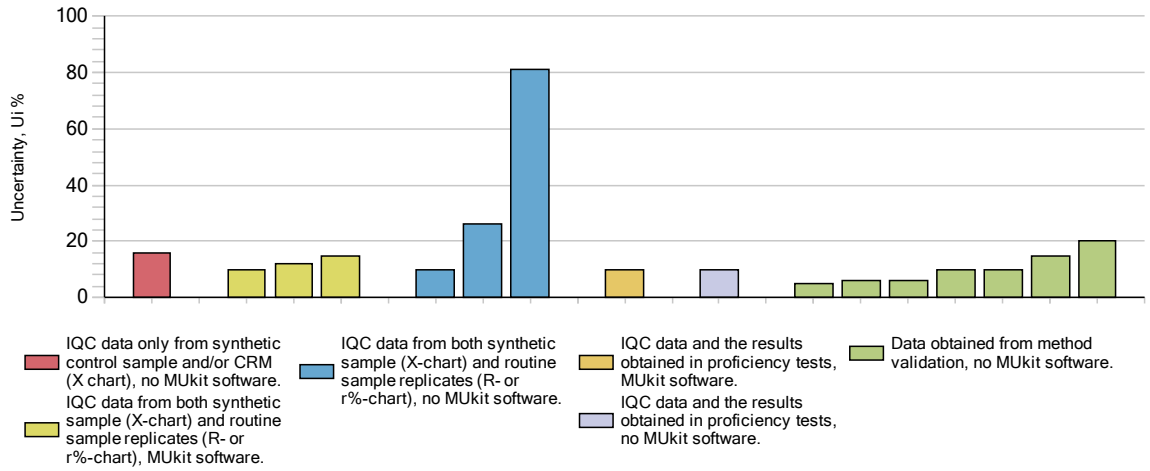
Measurand Fe Sample G3Fe



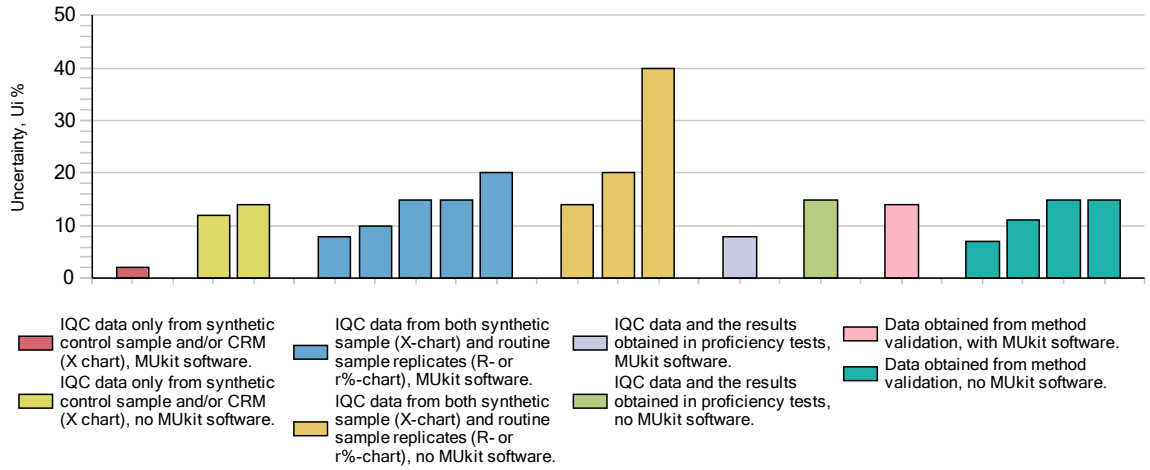
Measurand K Sample A1K



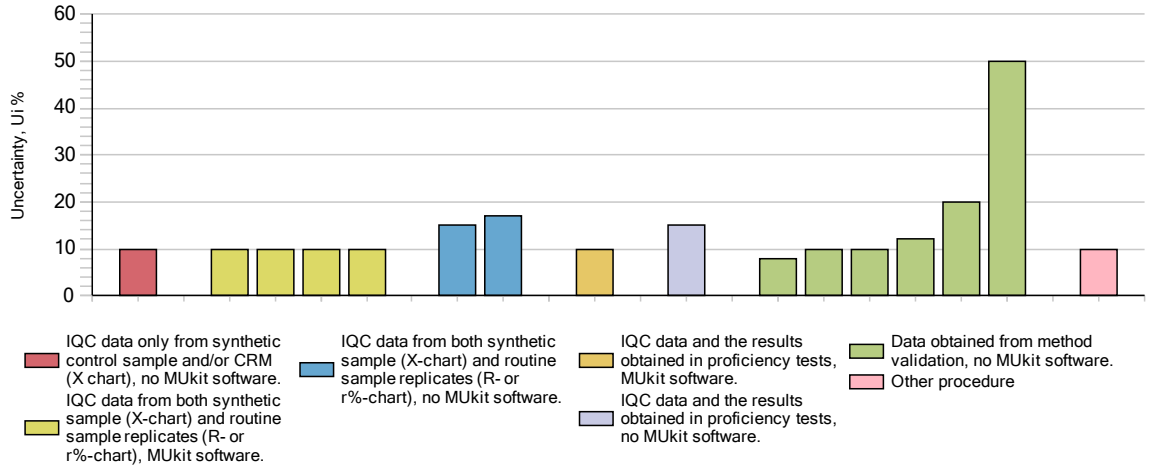
Measurand Mg Sample D2K



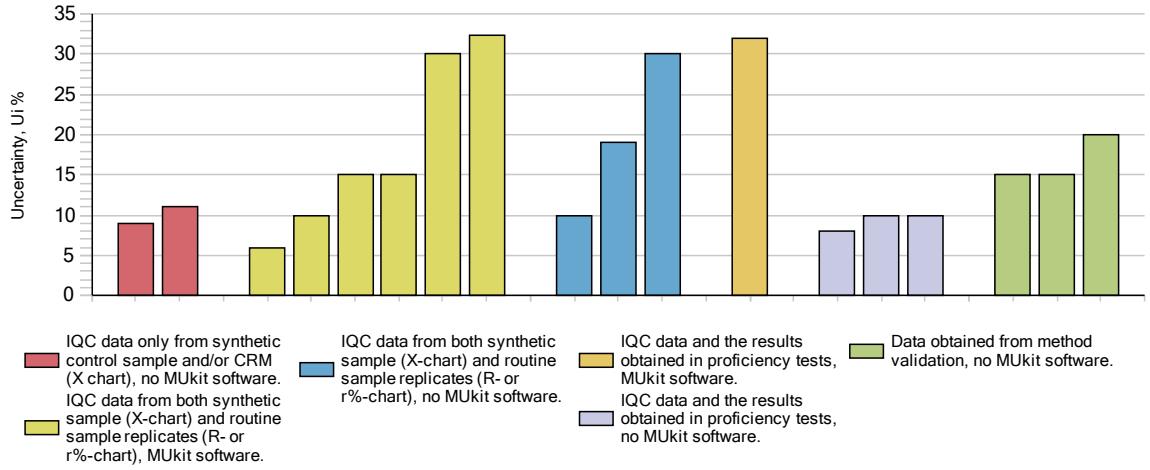
Measurand Mn Sample G3Fe



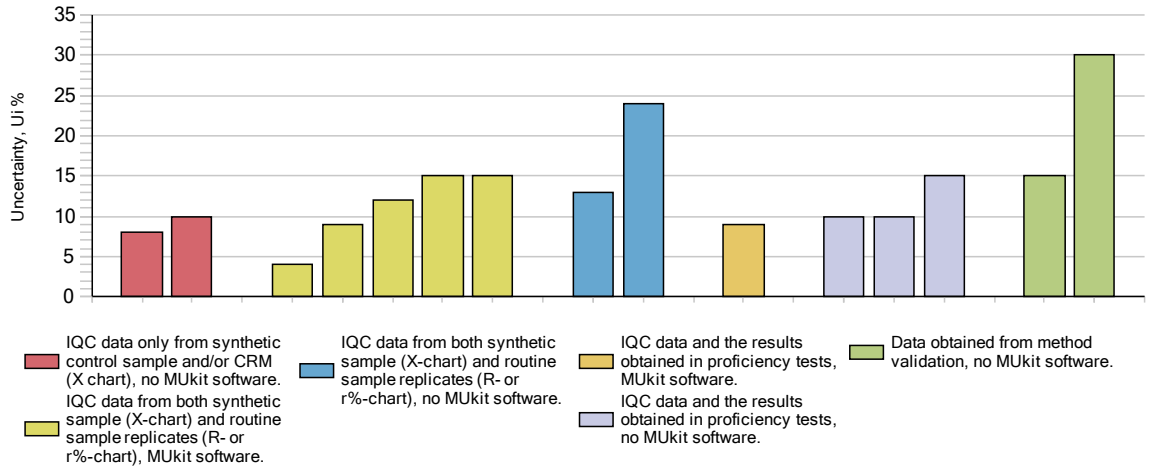
Measurand Na Sample A1K



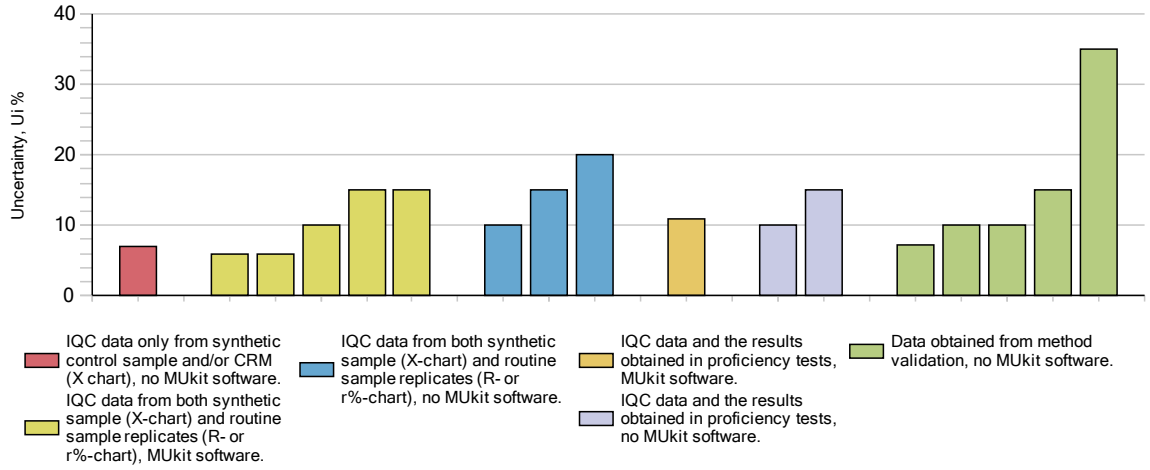
Measurand NH_4 Sample D2N



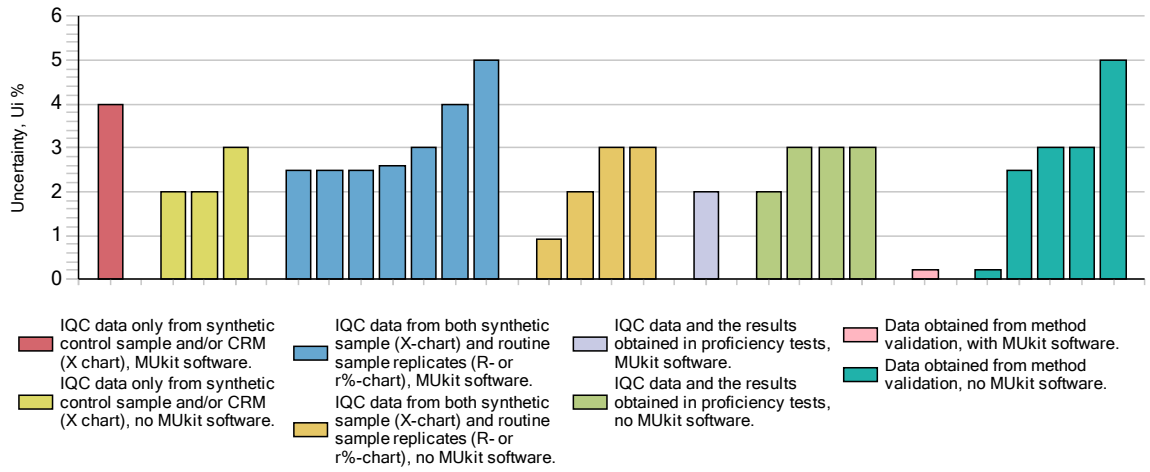
Measurand NO_2 Sample G3N



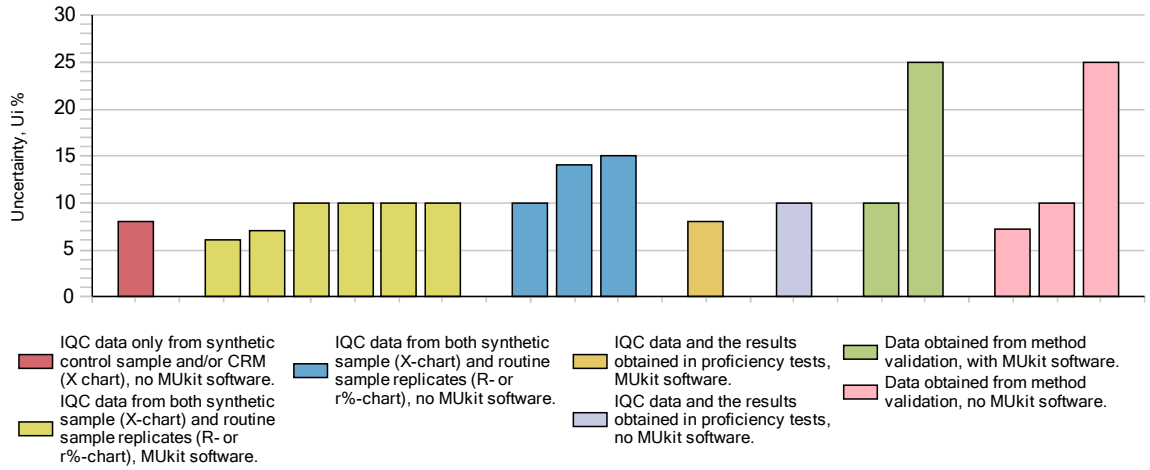
Measurand NO_3 Sample A1N



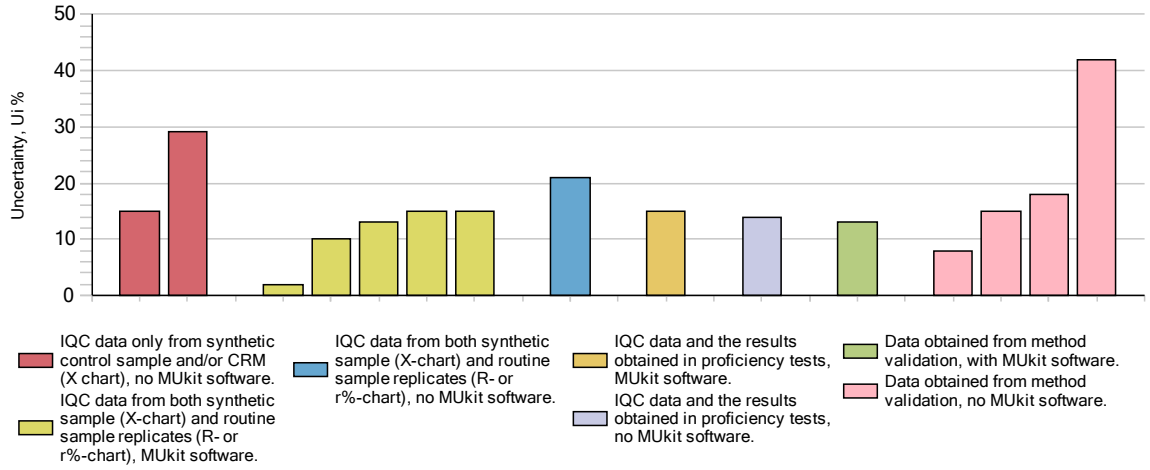
Measurand pH Sample D2PJ



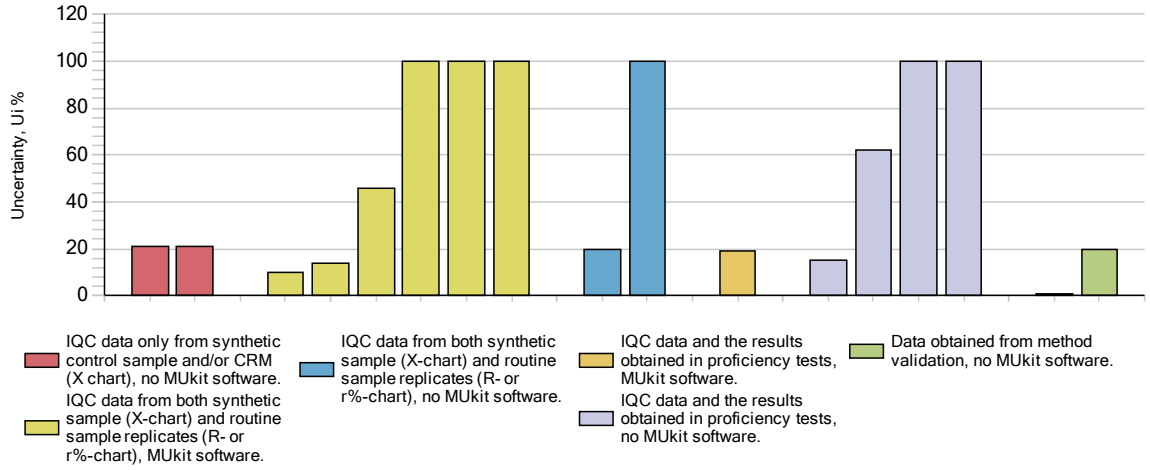
Measurand SO_4 Sample G3CS



Measurand TOC Sample A1T



Measurand Turbidity Sample D2S



Proficiency test 09/2023

Drinking water analyses

PROF TEST SYKE

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