



NMBAQC

NE Atlantic Marine Biological Analytical Quality Control Scheme

Particle Size Analysis Component Annual Report Scheme Operation 2024/2025 (Year 31)

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PARTICLE SIZE COMPONENT ANNUAL REPORT FROM APEM Ltd

CONTENTS

1. INTRODUCTION	4
1.1 ASSESSING PERFORMANCE.....	5
1.2 STATEMENT OF PERFORMANCE	5
2. SUMMARY OF PSA COMPONENT	5
2.1 INTRODUCTION	5
2.2 LOGISTICS	5
2.3 DATA RETURNS	6
2.4 CONFIDENTIALITY	6
3. PARTICLE SIZE ANALYSIS (PS) MODULE	6
3.1 DESCRIPTION	6
3.1.1 Asbestos testing.....	6
3.1.2 Preparation of the Samples.....	7
3.1.3 Analysis required	7
3.2 RESULTS	8
3.2.1 General comments	8
3.2.2 Analysis of sample replicates (Benchmark Data)	8
3.2.3 Results from participating laboratories.....	10
3.2.4 Discussion	19
3.2.5 Application of NMBAQC Scheme Standards and Laboratory Performance	23
4. PARTICLE SIZE OWN SAMPLE ANALYSIS (PS-OS) MODULE.....	23
4.1 DESCRIPTION	23
4.1.1 Analysis required	23
4.2 RESULTS	24
4.2.1 General comments	24
4.3 DISCUSSION	31
5. CONCLUSIONS AND RECOMMENDATIONS.....	32
6. REFERENCES	34

SCHEME OPERATION – 2024/25 (Year 31)

LINKED DOCUMENTS (HYPERLINKED IN THIS REPORT):

Particle Size Exercise Results –[PS92](#)

Particle Size Exercise Results –[PS93](#)

Particle Size Exercise Results –[PS94](#)

Particle Size Exercise Results –[PS95](#)

LIST OF FIGURES

Figure 1. Particle size distribution curves for sediment distributed as PS92.	11
Figure 2. Stacked column chart showing the percentage gravel, sand, silt, and clay for sediment distributed as PS92.	12
Figure 3. PS92 laser replicate data for participants PSA_3110, PSA_3112 and PSA_3115.	13
Figure 4. Particle size distribution curves for sediment distributed as PS93.	15
Figure 5. Stacked column chart showing the percentage gravel, sand, silt, and clay for sediment distributed as PS93.	15
Figure 6. Particle size distribution curves for sediment distributed as PS94.	16
Figure 7. Stacked column chart showing the percentage gravel, sand, silt, and clay for sediment distributed as PS94.	17
Figure 8. Particle size distribution curves for sediment distributed as PS95.	18
Figure 9. Stacked column chart showing the percentage gravel, sand, silt, and clay for sediment distributed as PS95.	19
Figure 10. Bar charts showing raw sieve data as percentages in each half-phi interval for P93 (top) and PS95 (bottom).	20
Figure 11. Differential final laser data provided by participants for exercises PS92 (top left), PS93 (top right), PS94 (bottom left) and PS95 (bottom right).	21
Figure 12. Bar charts showing percentage gravel, sand, silt, and clay in the PS-OS module from Batch 1 laboratories PSA_3101 (top), PSA_3102 (middle), PSA_3119 (bottom).	28
Figure 13. Bar charts showing percentage gravel, sand, silt, and clay in the PS-OS module from Batch 2 laboratories PSA_3103 (top left), PSA_3106 (top right), PSA_3110 (bottom left) and PSA_3113 (bottom right).	29
Figure 14. Bar charts showing percentage gravel, sand, silt, and clay in the PS-OS module from Batch 2 laboratories PSA_3118 (top), PSA_3107 (middle) and PSA_3104 (bottom).	30

LIST OF TABLES

Table 1. Summary data for original and re-submitted results for PSA_3105 for PS93..... 14

Table 2. Gradistat sediment descriptions from the primary data and the AQC re-analysis. ... 26

1. Introduction

The NE Atlantic Marine Biological Analytical Quality Control (NMBAQC) scheme is a quality assurance scheme developed on behalf of the UK competent monitoring authorities (CMAs). Its principal aim is to provide assessment of marine biological data contributing to UK national or European monitoring programmes.

The scheme also aims to develop and promote best practice in relation to sampling and analysis procedures through a range of training exercises, workshops, and literature guides.

The scheme includes seven biological components, each with its own set of training exercises and/or assessment modules.

APEM Ltd has been the administrative contractor for the Particle Size component since 2014 (Scheme year 21).

The Particle Size (PS) component of the scheme comprises two modules:

- ❖ The PS Ring Test (PS)
- ❖ The PS – Own Sample (PS-OS)

The PS module followed the same format as 2023/24; a series of exercises involved the distribution of test materials to participating laboratories and the centralised examination of returned data and samples.

The PS-OS module, introduced in the 2014/15 Scheme year, followed the same logistical format as the previous year. Selected participant samples are re-analysed by the NMBAQC Scheme PSA contractor, and the results are compared. The Particle Size Own Sample module is a training/audit module, and the purpose of this module is to examine the accuracy of particle size analysis for participants' in-house samples.

Seventeen laboratories signed up to participate in the 2024/25 PS module exercises (PS92, PS93, PS94 and PS95); seven were government laboratories and ten were private consultancies. Ten laboratories signed up to participate in the PS-OS module exercises (PS-OS31, PS-OS32 and PS-OS33); five were government laboratories and five were private consultancies.

To reduce potential errors and simplify administration, Lab Codes were assigned with a prefix to determine the Scheme component; all codes for the Particle Size component were prefixed with "PSA_".

As in previous years, some laboratories elected to be involved in limited aspects of the Scheme. Competent monitoring authorities (CMAs) completing PSA in support of biological analysis for monitoring programmes (including in assessment of MPA (Marine Protected Areas), as evidence under MSFD (Marine strategy framework directive) and WFD (Water Framework Directive), as well as the CSEMP (Clean Seas Environmental

Monitoring programme), must participate in this component of the Scheme. The Scheme is aware of other PSA methodologies (e.g. those used in the Regional Seabed Monitoring Plan) and encourages those involved in any relevant PSA monitoring programmes to participate in this Scheme, especially where pass/fail criteria can be used to assess overlapping aspects of different methodologies.

1.1 Assessing Performance

For 2024/25 (Scheme Year 31) both the PS and PS-OS reports followed a similar format, with each sample analysis section broken down for review, including sieve processing, laser processing and final data. Laboratories received a “Good” or “Review” flag based on their results; “Review” flags had accompanying comments as to where errors have been made and how to correct them. Review flags could be upgraded to “GOOD – following remedial action” provided the participant supplied evidence of completing required actions or re-submitted results within a month of the issue of the interim report.

1.2 Statement of Performance

Each participating laboratory received a copy of the interim results for each exercise; these included a summary of results provided by each laboratory and a basic discussion of any major outliers. Once any remedial actions, re-submissions and minor data changes were completed by participants a final version of each report was made available on the [Scheme website](#). Further details and analysis can be found in this report.

At the end of the Scheme year each laboratory received a ‘Statement of Performance’ document (SoP), which included a summary of results for each of the Scheme’s modules and details the resulting flags where appropriate. These statements were first circulated with the 1998/1999 annual report for the purpose of providing proof of Scheme participation and for ease of comparing year on year progress.

2. Summary of PSA Component

2.1 Introduction

The two 2024/25 year PSA modules, PS and PS-OS are described in more detail below. A brief outline of the information obtained from the module is given, together with a description of the preparation of the necessary materials and brief details of the processing instructions given to each of the participating laboratories.

2.2 Logistics

The labelling and distribution procedures employed previously have been maintained and specific details can be found in the Scheme’s annual reports for [1994/95](#) and [1995/96](#) (Unicomarine, 1995 & 1996). Email was the primary means of communication for all participating laboratories. This has considerably reduced the amount of paper required for the administration of the Scheme.

2.3 Data returns

Spreadsheet based workbooks for each circulation were distributed to participating laboratories via email and data returned to APEM Ltd via the [NMBAQC Scheme email address](#). In this and previous Scheme years slow or missing returns for exercises lead to delays in processing the data and resulted in difficulties with reporting and rapid feedback of results to laboratories. Reminders were distributed shortly before each exercise deadline.

2.4 Confidentiality

To preserve the confidentiality of participating laboratories, each was identified by a four-digit Laboratory Code prefixed with "PSA_", to identify the scheme component. In December 2024 each participant was given a confidential, randomly assigned 2024/25 (Scheme Year 31) Lab Code. Codes are prefixed with the Scheme year to reduce the possibility of obsolete codes being used inadvertently by laboratories, *e.g.* Laboratory number twelve in Scheme Year thirty-one (2024/25) was recorded as PSA_3112.

3. Particle Size Analysis (PS) Module

3.1 Description

This component examined the percentage of sediment found in each half-phi interval from the particle size analysis of replicate sediment samples. Four samples of sediment, two fine (PS92 & PS94), one mixed (PS93) and one coarse (PS95) were distributed in 2024/25. The samples were distributed in two stages; the first circulation (PS92 and PS93) was sent to participants on 6th January 2025 and the second circulation (PS94 and PS95) was sent on the 10th March 2025. For each circulation participants were given approximately 6 weeks to complete their analysis and send completed workbooks via email to APEM Ltd. PS92, PS93 and PS94 were derived from natural marine sediments; PS95 replicates were prepared from a mixture of natural sediment and artificially prepared commercial sand and aggregates; they were prepared at APEM's Letchworth laboratory as described below.

3.1.1 Asbestos testing

Following participant concerns raised during Scheme Year 25 (2018/2019) about the possible presence of asbestos in natural sediments used to create the PS exercises, all natural sediments were sent for asbestos testing prior to the creation of the samples. Sediments were only used when they had tested negative for asbestos; any that tested positive were disposed of either in a landfill that has a specific permit authorising it to accept asbestos or in a non-hazardous waste landfill, provided it is self-contained. Details and results of asbestos testing can be requested by emailing APEM's [NMBAQC](#) email address. Following the Particle Size workshop in 2022, guidance was provided to labs on how to mitigate against asbestos exposure in the possibility that it might be contained within the sediment. It is now assumed that participants have integrated asbestos risks into their internal SOP's and therefore natural sediments are no longer pre-screened.

3.1.2 Preparation of the Samples

The first PS circulation, PS92, was a Sand created using 300g of Sand from the Isle of Man, pre-sieved over a 1mm sieve to remove any larger particles.

The second exercise, PS93, was a mixed sediment created from 50g of mud from Swale, 250g sand from off Aberdeen and known amounts of gravel from 75km northeast off the Aberdeenshire coast (split into half-phi intervals by dry sieving using a mechanical sieve shaker). All fine material (mud and sand) were pre-sieved through a 1mm sieve to remove any larger particles or debris that may have been present.

The third exercise, PS94, was created from natural sediment from the Silvertown area of the River Thames, London. Approximately 10 litres of visually similar sediment were collected and returned to the laboratory where it was wet sieved at 1.0mm to remove any particles larger than 1.0mm. Sediment that passed through the 1.0mm sieve was retained in a large tray, mixed and left to settle; excess water was removed before it was cored into replicate samples of approximately 200 grams in weight.

The fourth replicate, PS95 was created using known quantities of artificial tropical reef gravel and coarse material from the West of Orkney (>1mm) (split into half-phi intervals by dry sieving using a mechanical sieve shaker).

Five replicate samples from each of these exercises were sent to Kenneth Pye Associates Ltd (KPAL) for particle size analysis to assess the degree of inter-sample variation and to produce benchmark data. Where laser diffraction analysis was required, these replicates were analysed using a Beckman Coulter LS13320 laser diffraction instrument. The remaining replicates were randomly assigned to participating laboratories and distributed according to the Scheme timetable. Spare replicates were kept at the APEM Ltd. Letchworth laboratory in case of problems such as damaged samples during delivery or significant processing errors.

3.1.3 Analysis required

The participating laboratories were required to conduct particle size analysis on the samples following the NMBAQC Scheme's best practice guidance for particle size analysis to support biological data ([NMBAQC Best Practice Guidelines \(Mason, 2022\)](#)), either in-house or using a subcontractor. A summary of the sample as a written description of the sediment characteristics was to be recorded, with a qualitative visual assessment made prior to processing, using the Folk (1954) textural classification. In addition, the percentages of gravel, sand and silt/clay and any use of peroxide treatment or chemical dispersant were to be noted. Also requested was a breakdown of the particle size distribution, expressed as a weight or volume percentage at half-phi (ϕ) intervals, for each of the raw sieve data (>1mm), the raw laser data (<1mm) and the final merged dataset.

The 2024/25 workbooks followed the format of the updated 2022/23 workbooks to help enable the continuity of data through the workbook. All sieve and laser data are now entered into a single worksheet, with conditional formatting to flag up red cells to indicate possible data entry errors. Data provided in the "Laser

Metadata” spreadsheet tab were for analytical purposes only and were not published in the Interim Results reports. Benchmark metadata were included in each sample report for participants to see how the Benchmark Lab analysed each sample.

Approximately six weeks were allowed for the analysis of the first pair of PS samples sent out (PS92 & PS93) and approximately six weeks for the second pair (PS94 & PS95).

3.2 Results

3.2.1 General comments

Seventeen laboratories subscribed to the exercises in 2024/25. For the first circulation (PS92 and PS93), twelve subscribing participants provided results on time. Three participants requested extensions; PSA_3103 submitted results 3 days after the deadline, PSA_3115 submitted results a week after the deadline and PSA_3110 submitted results two weeks after the deadline. Despite email reminders, participants PSA_3116 and PSA_3117 did not submit data and did not provide any further communication indicating non-participation. For the second circulation (PS94 and PS95) thirteen participants provided results on time. PSA_3010 and PSA_3015 requested an extension to the submission deadline. PSA_3112 communicated non-participation of PS95. PSA_3116 and PSA_3117 did not submit data and did not provide any further communication indicating non-participation.

Most participating laboratories now provide data in the requested format, although some variations remain. As reported previously, it should be remembered that the results presented may be from a more limited number of analytical laboratories than is immediately apparent since this component of the Scheme is often sub-contracted by participants to one of a limited number of specialist laboratories. Participant PSA_3108 submitted two sets of results for each sample. In scheme year 30 it was agreed with the contract manager that up to three submissions per replicate sample could be made before a second replicate sample would have to be paid for.

Detailed results for each exercise (PS92, PS93, PS94 and PS95) have been reported to the participating laboratories; additional comments are provided below.

3.2.2 Analysis of sample replicates (Benchmark Data)

Five replicate samples of the sediment used for the four PS distributions were analysed by KPAL to examine variability and establish benchmark data that participant results can be compared with. Replicate samples supplied by APEM were analysed, where required, using Endecotts British Standard 300mm and 200mm test sieves, Endecotts EFL 2000/2 and Retsch AS2001 Control ‘g’ sieve shakers and a Beckman Coulter LS13320 laser size analyser. In previous Scheme years replicates were analysed by both laser diffraction and sieve/pipette methods; however, as all participating laboratories are now conducting less than 1mm analysis by laser diffraction the testing of replicates for 2023/24 was undertaken only using a laser diffraction instrument.

The analysis results for the benchmark replicates were assessed by APEM to analyse the variability between the replicates and to establish the reproducibility of the samples. The analysis showed an overview of the sample including percentage Gravel, Sand and Mud along with a description of the sediment using the textural group from a Gradistat (Blott & Pye, 2001) output of the final data, e.g. Slightly Gravelly Muddy Sand. The processing of the sample was split into sieve and laser analysis.

Sieve analysis is displayed in a table with the raw weight recorded in each half phi interval from -6.5 to 0.0phi and the weight of the less than 1mm oven dried sample plus any sediment from the base pan of the sieve shaker. The percentage of sediment lost or gained during the sieving process was recorded. The percentage weight in each half-phi category is also displayed graphically in a bar chart for visual comparison.

Laser analysis included a table of the final laser data for each replicate with Gradistat outputs along with a graph showing the differential and cumulative percentage. The triplicate analysis undertaken to obtain the final laser data was presented in a table in Appendix 1. For each replicate sample the Coefficient of Variation (CV) was calculated for the D₁₀, D₅₀ and D₉₀ particle size in microns. The CV is most commonly expressed as the standard deviation as a percentage of the mean and describes the dispersion of a variable in a way that does not depend on the variables' measurement units. A low CV indicates a smaller amount of dispersion in the variable. BS ISO 13320 states that good laser reproducibility is shown for replicates when the %CV is <3% for the D₅₀ and <5% for the D₁₀ and D₉₀, all limits are doubled when the D₅₀ was less than 10µm. In reality 3% and 5% are low and greater variability is expected in natural sediment samples therefore a maximum of 20% will be used as guidance.

Benchmark analysis of the replicates for Sample PS92 indicated an average composition of 98.09% sand and 1.91% mud, classified as 'Sand' according to the Blott & Pye (2012) scheme. No material greater than 1mm was detected. The laser analysis produced a unimodal distribution with the primary mode at 213.4µm. Analysis of the triplicate laser analysis for each replicate sample showed that the %CVs for the D₁₀, D₅₀ and D₉₀ were well within the acceptable limits and therefore the replicates were deemed to have good reproducibility. Results for the individual replicates are provided in Tables 1, 2, 3, 4 and 5, and are displayed in Figures 1, 2 and 3 in the [PS92 Report](#).

Sample PS93 was a mixed sediment and contained an average of 53.60% gravel, 42.03% sand and 4.37% mud, classified as a 'Sandy gravel' according to the Blott & Pye (2012) scheme. The replicates were analysed by dry sieving and laser analysis. The sieve data shows a very low percentage (-0.3% – 0%) loss or gain during the sieving process. On average, 331.83g of sediment greater than 1mm was recorded and 262.56g of sediment less than 1mm was recorded. BM Rep 4 recorded higher weights (150.03g) in interval -5.0 to -4.5 phi compared to the other replicates (average of 66.52g) however this was compensated by lower weights (62.99g) recorded in -4.5 - -4.0 phi compared to other replicates (average of 129.14g). Laser data produced consistent results between the replicates with a unimodal distribution and the primary mode at 603.5µm. Triplicate laser analysis

showed low variation, with %CV well below acceptable levels for each statistic. Results for the individual replicates are provided in Tables 1, 2, 3, 4 and 5, and are displayed in Figures 1, 2 and 3 in the [PS93 Report](#).

Sample PS94 was a fine sample and contained an average of 44.34% sand and 55.66% mud, classified as a 'Sandy Mud' according to the Blott & Pye (2012) scheme. The replicates were analysed by laser analysis only. The triplicate laser analysis showed low percentage variation and was below the acceptable levels for all statistics. Results for the individual replicates are provided in Tables 1, 2, 3, 4 and 5, and are displayed in Figures 1, 2 and 3 in the [PS94 Report](#).

Sample PS95 was a coarse sediment sample containing an average of 94.66% gravel, 5.00% sand and 0.34% mud, classified as 'Gravel' according to the Blott & Pye (2012) scheme. The Benchmark lab opted to analyse the small less than 1mm fraction with the laser. Analysis of the triplicate laser analysis for each replicate sample showed that the percentage CVs for the D_{10} , D_{50} and D_{90} were well within the acceptable limits and therefore the replicates were deemed to have good reproducibility. Results for the individual replicates are provided in Tables 1, 2, 3, 4 and 5, and are displayed in Figures 1, 2 and 3 in the [PS95 Report](#).

3.2.3 Results from participating laboratories

In each of the PS92, PS93, PS94 and PS95 reports, data provided by the participants are displayed in a series of tables and figures for comparison with each other and with the Benchmark Data. The Participant section provides three tables of data, the first outlining an overview of summary data including equipment and methodology used, the use of any chemical dispersants or pre-treatments, the percentage gravel, sand, and silt/clay recorded as well as the participants' post-analysis sediment descriptions. The second table provides the raw sieve weights for each half-phi interval submitted by each participant including the less than 1mm weights for the sieve shaker base pan fraction and the wet-separated and oven dried fraction and in the third table the final laser data submitted by each participant is shown. Tables showing the results of the triplicate laser analysis supplied and the Coefficient of Variance of the D_{10} , D_{50} and D_{90} are available in Appendix 1. These tables are accompanied by a series of graphs and bar charts which allow the results to be visually compared. Appendix 2 shows the data used to create the percentage gravel, sand, silt, and clay bar-charts. The final merged data submitted by each participant and the benchmark laboratory are provided in Appendix 3. Where available a graphical comparison of individual sieve results are shown in Appendix 4.

3.2.3.1 Ninety-second distribution – PS92

Figures 1 and 2 show there was good agreement for PS92 between the results for the Benchmark replicates and those supplied by the participating laboratories. None of the participants re-submitted or adjusted their data after the issue of the Interim Report.

The summary data (Table 6 in the exercise report) showed that none of the participants used chemical dispersants or peroxide pre-treatments. All participant data recorded a Gradistat textural group of 'Sand'. Percentage sand ranged from 95.50% (PSA_3115) to 100.00% (multiple participants) with an average of

98.89% and the percentage of mud ranged from 0.00% (multiple participants) to 4.50% (PSA_3115) with an average of 1.10%.

All but three laboratories (PSA_3109, PSA_3111 and PSA_3112) followed the NMBAQC methodology. Those that followed differing methodologies did not provide any details on how their methodology differed from the NMBAQC method. Most participants analysed the sample using laser analysis only, however, PSA_3101, PSA_3104, PSA_3108 and PSA_3110 also undertook sieve analysis and recorded low (0.004g to 0.01g) weights of sediment greater than 1mm.

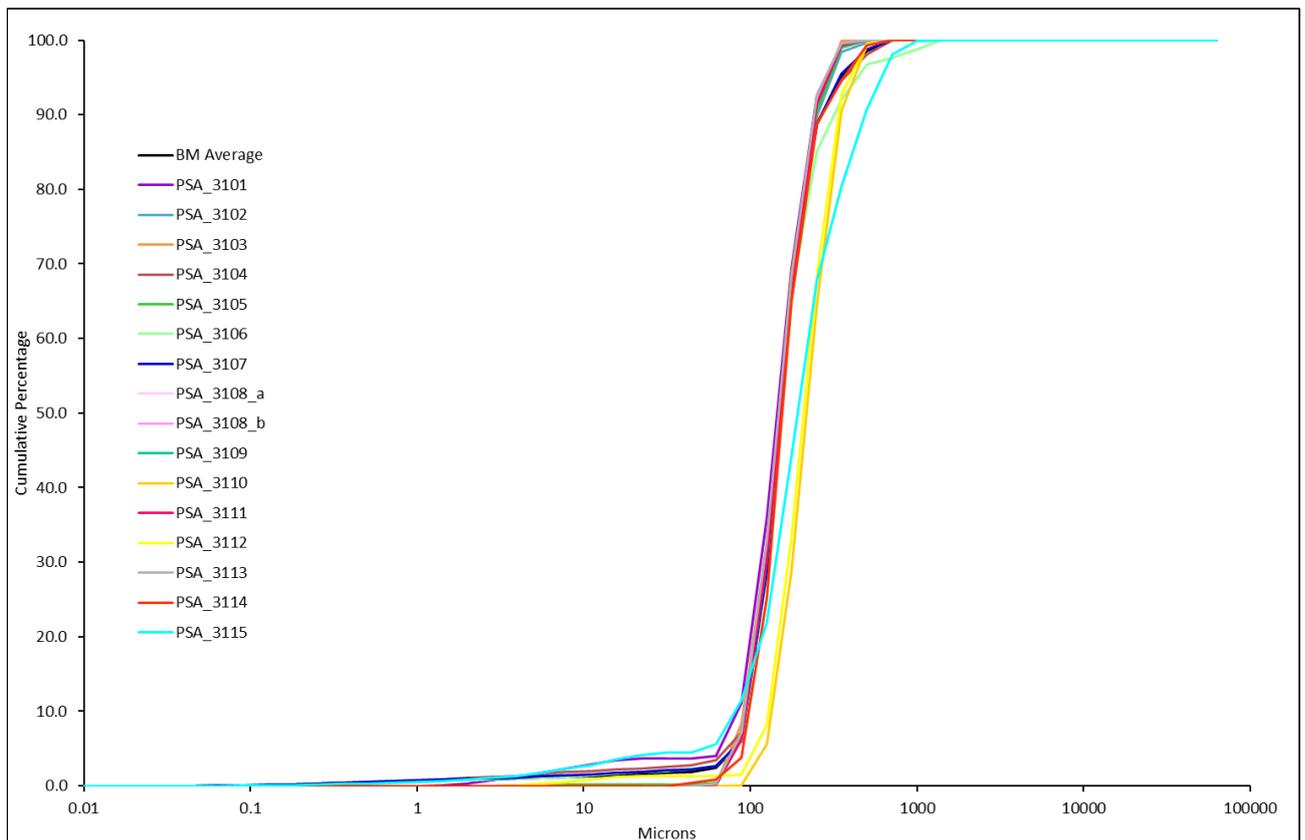


Figure 1. Particle size distribution curves for sediment distributed as PS92.

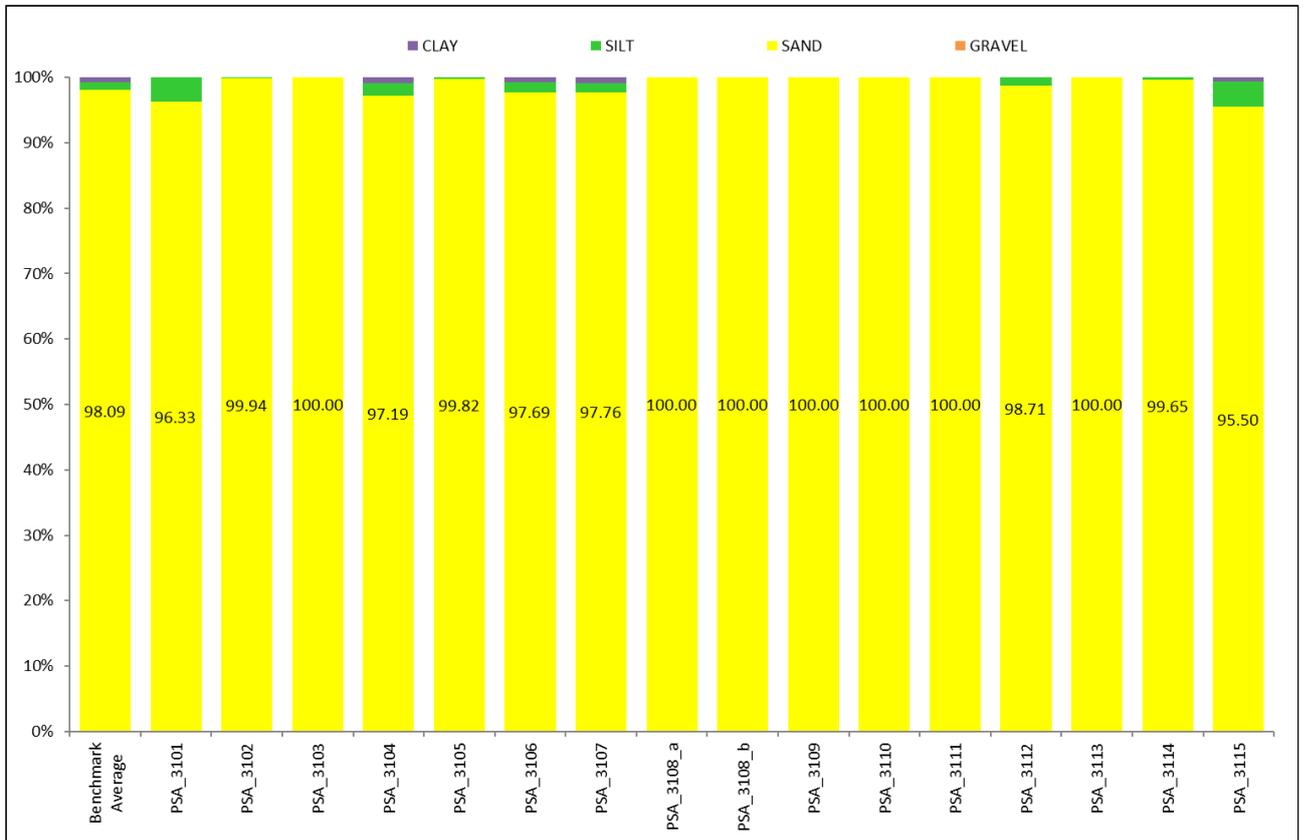


Figure 2. Stacked column chart showing the percentage gravel, sand, silt, and clay for sediment distributed as PS92.

Laser data showed some variation in the amount of fine material recorded in relation to the model of laser analyser used. Those participants using Beckman Coulter instruments (PSA_3104, PSA_3106, PSA_3107 and the Benchmark Lab) recorded an average percentage mud of 1.16% compared to an average of 0.23% for those using Malvern Mastersizer instruments. Participant PSA_3101 were an outlier to this trend and recorded 3.67% mud whilst using a Malvern Mastersizer. The Beckman Coulter LS13320 which uses a PIDS (Polarization Intensity Diffraction Scattering) system at the finer end, rather than diffraction, so provides better sensitivity than the Malvern system which employs diffraction of two different wavelengths of light (red and blue). Participant PSA_3115 is the only laboratory to use a Fritsch laser analyser, which recorded the highest percentage of mud (4.50%). The Benchmark lab and all participants recorded a unimodal laser distribution, the majority of participants recorded the mode at 213.4 μ m, participants PSA_3110, PSA_3112 and PSA_3115 recorded the mode at 301.8 μ m. Figure 3 below shows that PSA_3110 and PSA_3112 follow a similar distribution to the Benchmark data however the participant data appears to be displaced by half a phi towards the coarser end. Figure 1 (above) and Figure 4 (below) shows that PSA_3115 follows a different distribution to the Benchmark data and majority of other participants. With more fine material recorded as well as an increased coarse sand material. The Wentworth summary data in Appendix 2 shows that PSA_3115 recorded a combined percentage of 19.64% of Very Coarse Sand and Coarse Sand where the average of other participants was 3.09%.

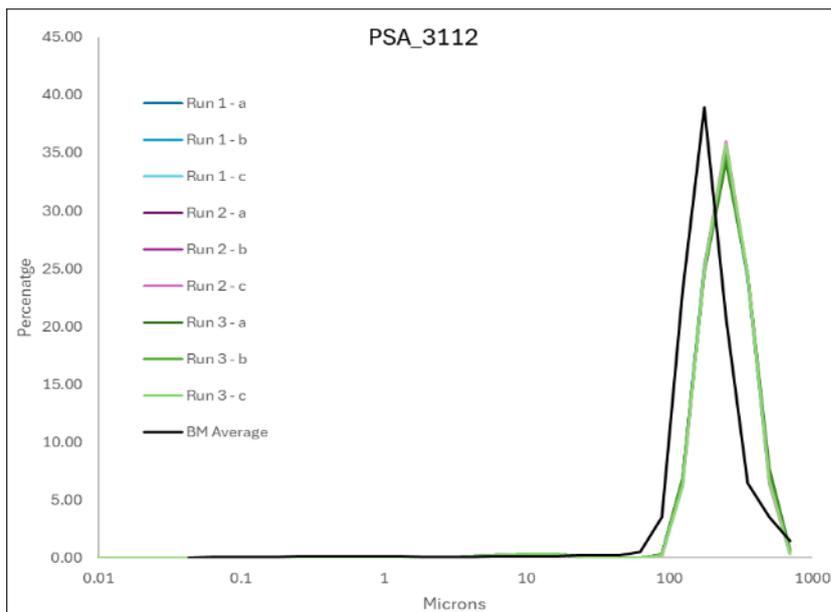
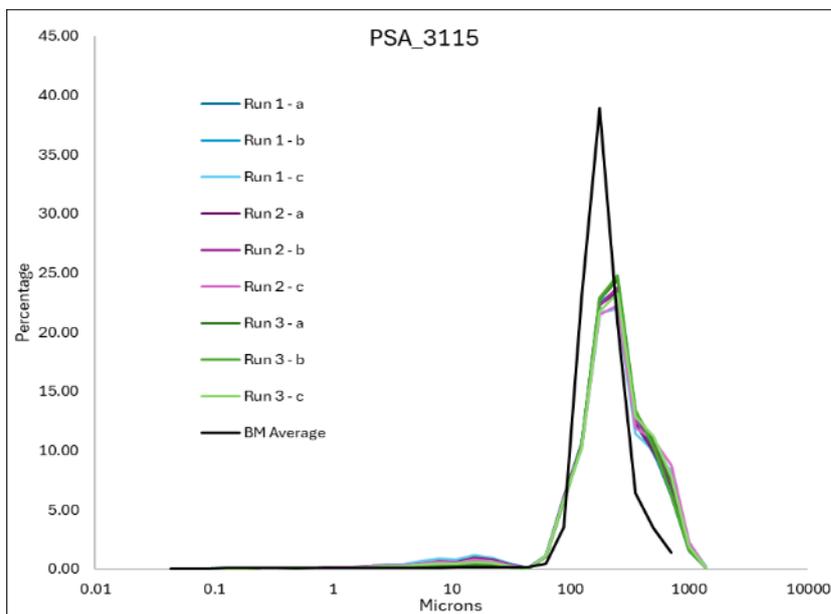
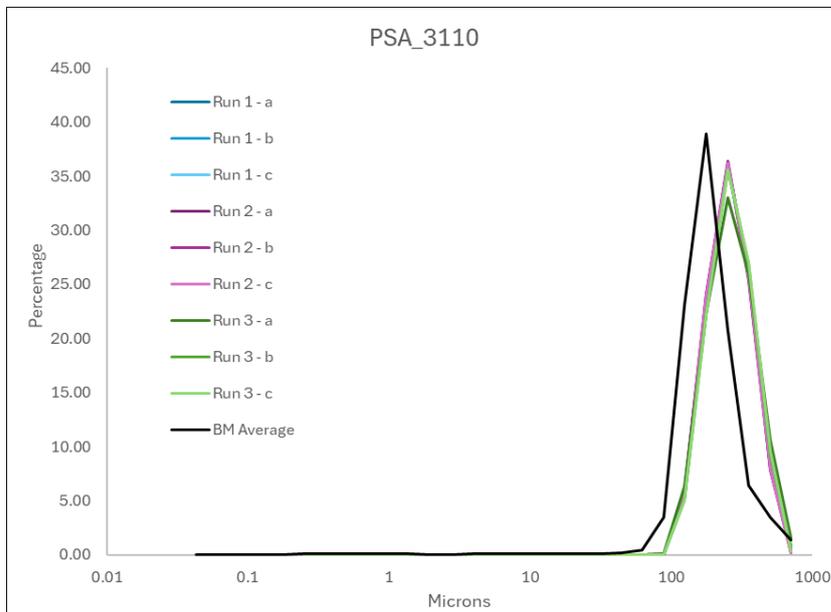


Figure 3. PS92 laser replicate data for participants PSA_3110, PSA_3112 and PSA_3115.

3.2.3.2 Ninety-third distribution – PS93

There was generally good agreement for PS93 between the results from the analysis of the benchmark replicates and those from the participating laboratories (see Figures 5 and 6). Participant PSA_3105 was asked to review their <1mm sieve result after the Interim Report due to a low weight of <1mm sediment recorded causing the sample to be recorded as Gravel rather than Sandy Gravel or Muddy Sandy Gravel as per other participants. There appeared to be an issue with the original replicate composition therefore a new replicate was dispatched for the participant to analyse. Participant PSA_3115 were asked to review their laser result due to following a different distribution to the Benchmark Data and the majority of other participants, however, at the time of writing no results have been re-submitted.

Table 1. Summary data for original and re-submitted results for PSA_3105 for PS93.

Participant	Percentage			Sediment Description
	Gravel	Sand	Mud	
Benchmark Average	53.60	42.03	4.37	Sandy Gravel
PSA_3105 Original	93.41	5.98	0.43	Gravel
PSA_3105 Re-submitted	58.13	36.58	5.29	Muddy Sandy Gravel

Following this re-submission all participants had a Gradistat textural group of either ‘Sandy Gravel’ or ‘Muddy Sandy Gravel’. Excluding the outlier of PSA_3115, percentage gravel ranged from 52.63% (PSA_3106) to 58.87% (PSA_3104) with an average of 55.01%, the percentage sand ranged from 36.58% (PSA_3105) to 45.05% (PSA_3114) with an average of 40.51% and the percentage of mud ranged from 2.02% (PSA_3102) to 7.88% (PSA_3108_a) with an average of 4.48%.

All but three laboratories (PSA_3109, PSA_3111 and PSA_3112) followed the NMBAQC methodology. Those that followed differing methodologies did not provide any details on how their methodology differed from the NMBAQC method. All participants analysed the sample using both sieve and laser analysis. PSA_3109 and PSA_3112 only sieve at 1-phi intervals above 1mm. Therefore, they are not assessed on the sieve aspect of the module. Participant PSA_3115 wet split the sample at 2mm therefore they have no sieve data for 1400mm and 2000mm. This data has been captured in the laser analysis.

The average weight of participant material greater than 1.0mm was 318.29g and the average weight of less than 1.0mm was 231.91g compared to Benchmark results of 331.84g (>1.0mm) and 263.61g (<1.0mm). All participants and the Benchmark lab produced a unimodal laser distribution. The majority of participants recorded the mode at 603.50µm; PSA_3108_b reported the primary mode slightly finer at 426.8 µm and PSA_3112 and PSA_3115 reported the primary mode slightly coarser at 853.5 µm.

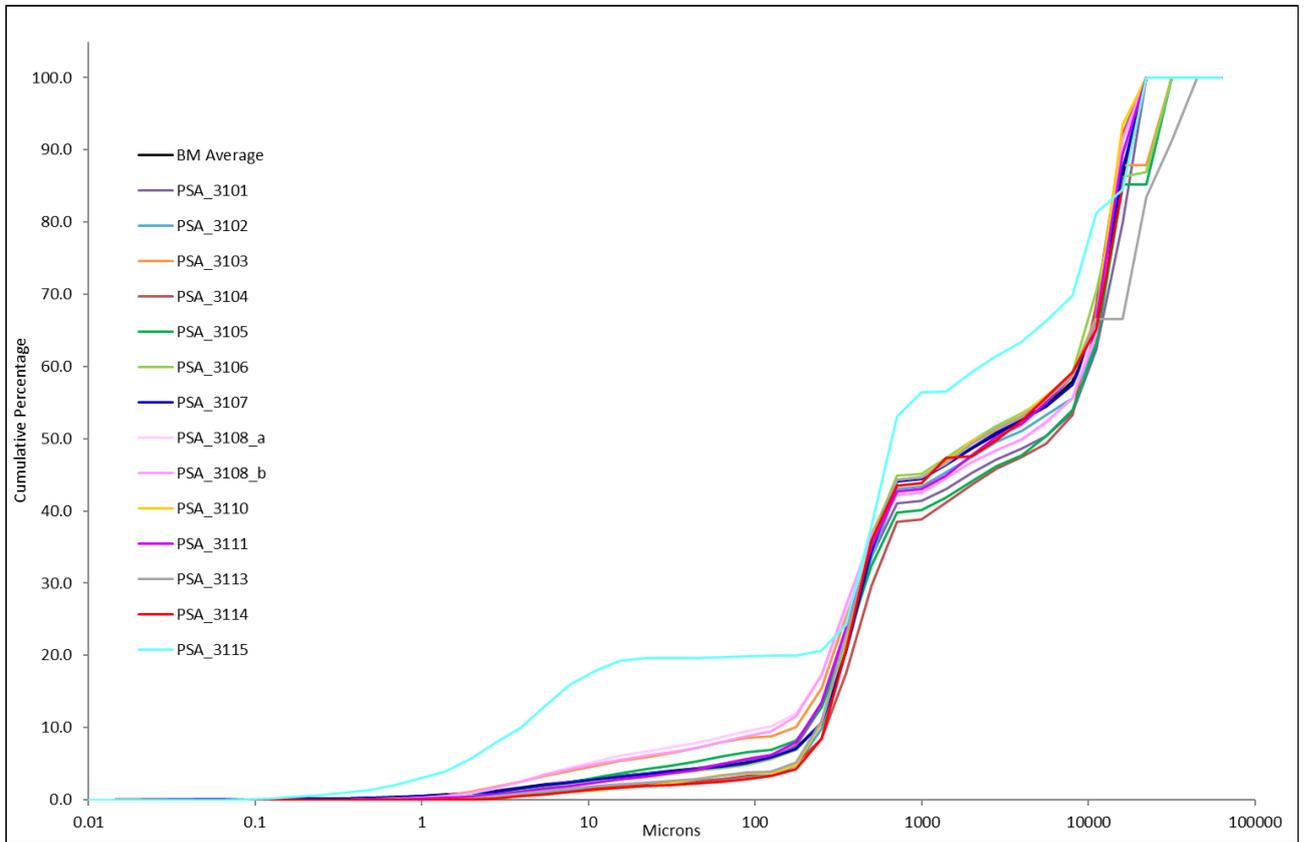


Figure 4. Particle size distribution curves for sediment distributed as PS93.

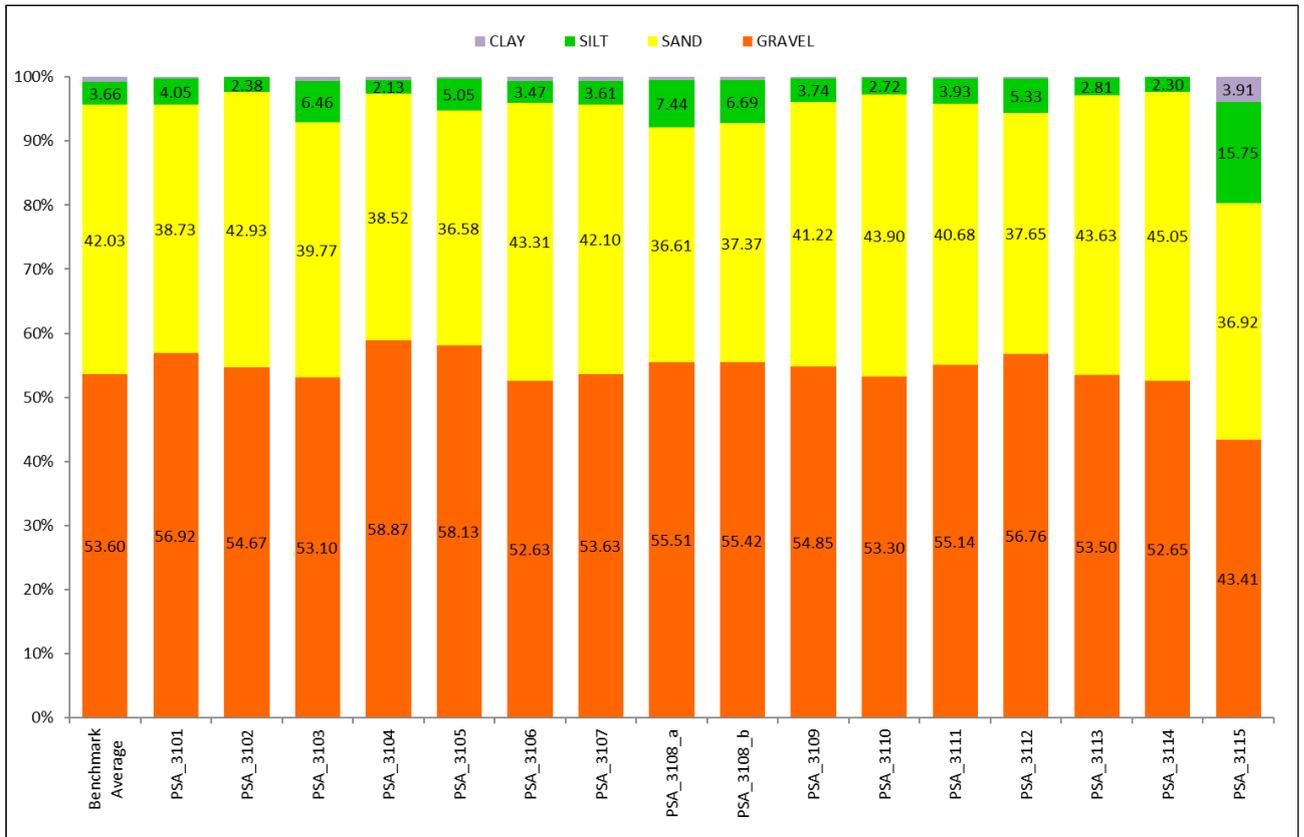


Figure 5. Stacked column chart showing the percentage gravel, sand, silt, and clay for sediment distributed as PS93.

3.2.3.3 Ninety-fourth distribution – PS94

As Figures 6 and 7 show there was some variation between the results reported by the participating laboratories and those obtained for the benchmark replicates for PS94. This sample was created using natural sediment and although there was a concerted effort to homogenise the bulk material it was expected that there would be more variation between participant results. No participants re-issued data following the circulation of the interim report. PSA_3110 asked for an extension as they were having issues with their laser analyser, at the time of writing their results were yet to be submitted.

Despite the variation all participants recorded a Gradistat textural group of ‘Sandy Mud’. One participant (PSA_3101) recorded a small amount (0.0098g) of sediment greater than 1mm, all other participants noted that there was no sediment greater than 1mm present. Sand composition ranged from 27.99% (PSA_3109) to 49.96% (PSA_3101) with an average of 43.48%. Mud composition ranged from a minimum of 50.04% (PSA_3101) to a maximum of 72.01% (PSA_3109) with an average of 56.53%.

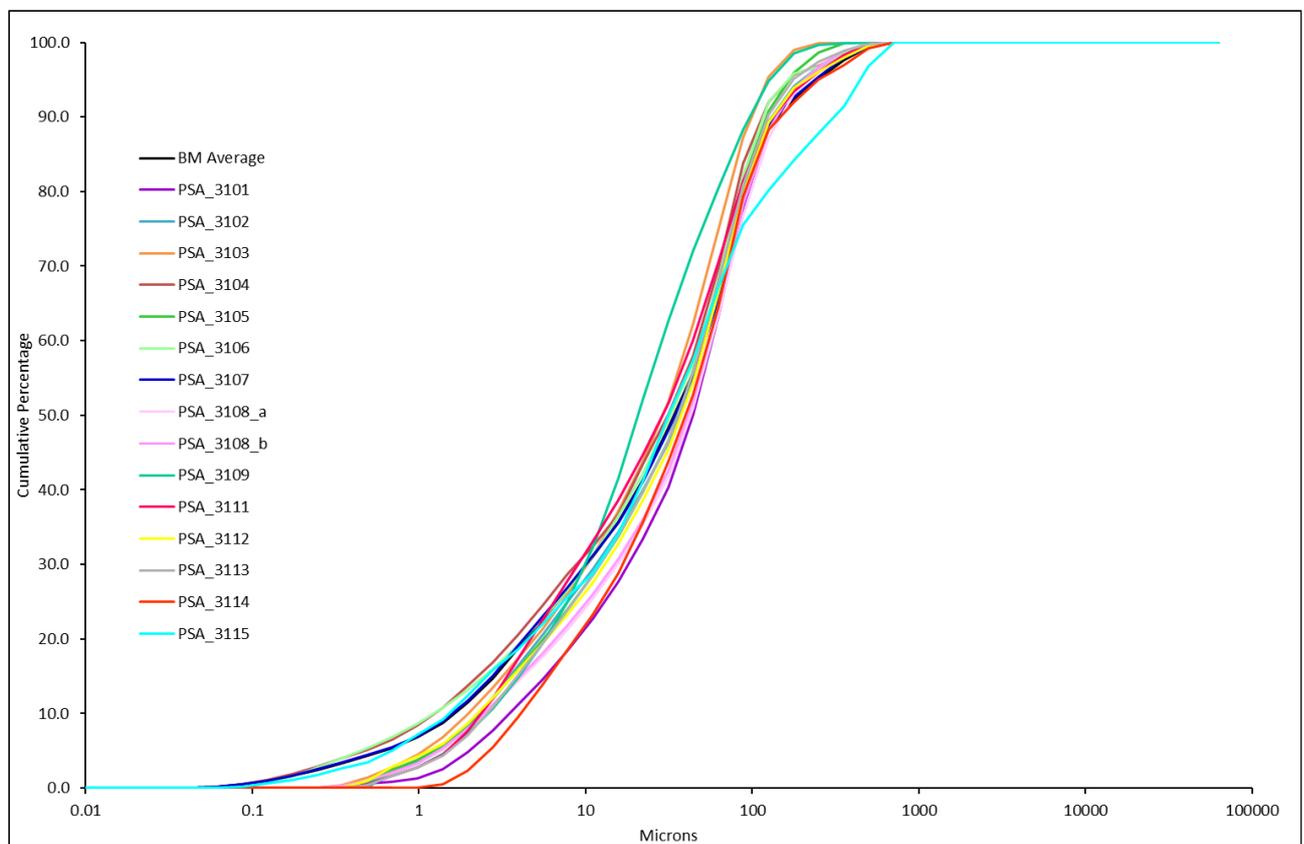


Figure 6. Particle size distribution curves for sediment distributed as PS94.

The majority of participants produced a unimodal laser distribution with the primary mode at 106.70 μ m; PSA_3103 and PSA_3115 recorded the primary mode at 75.45 μ m and PSA_3109 recorded the primary mode at 26.7 μ m.

The sample showed some variation in the amount of clay recorded in relation to the model of laser analyser used. Those participants using Beckman Coulter instruments (PSA_3104, PSA_3106, PSA_3107 and the

Benchmark Lab) recorded an average percentage clay of 9.82% which was higher than those using Malvern Mastersizer instruments which had an average of 4.60% clay. The Beckman Coulter LS13320 which uses a PIDS (Polarization Intensity Diffraction Scattering) system at the finer end, rather than diffraction, so provides better sensitivity than the Malvern system which employs diffraction of two different wavelengths of light (red and blue). Participant PSA_3115 are the only laboratory to use a Fritsch laser analyser, which recorded an amount of clay consistent with laboratories using the Beckman Coulter instruments.

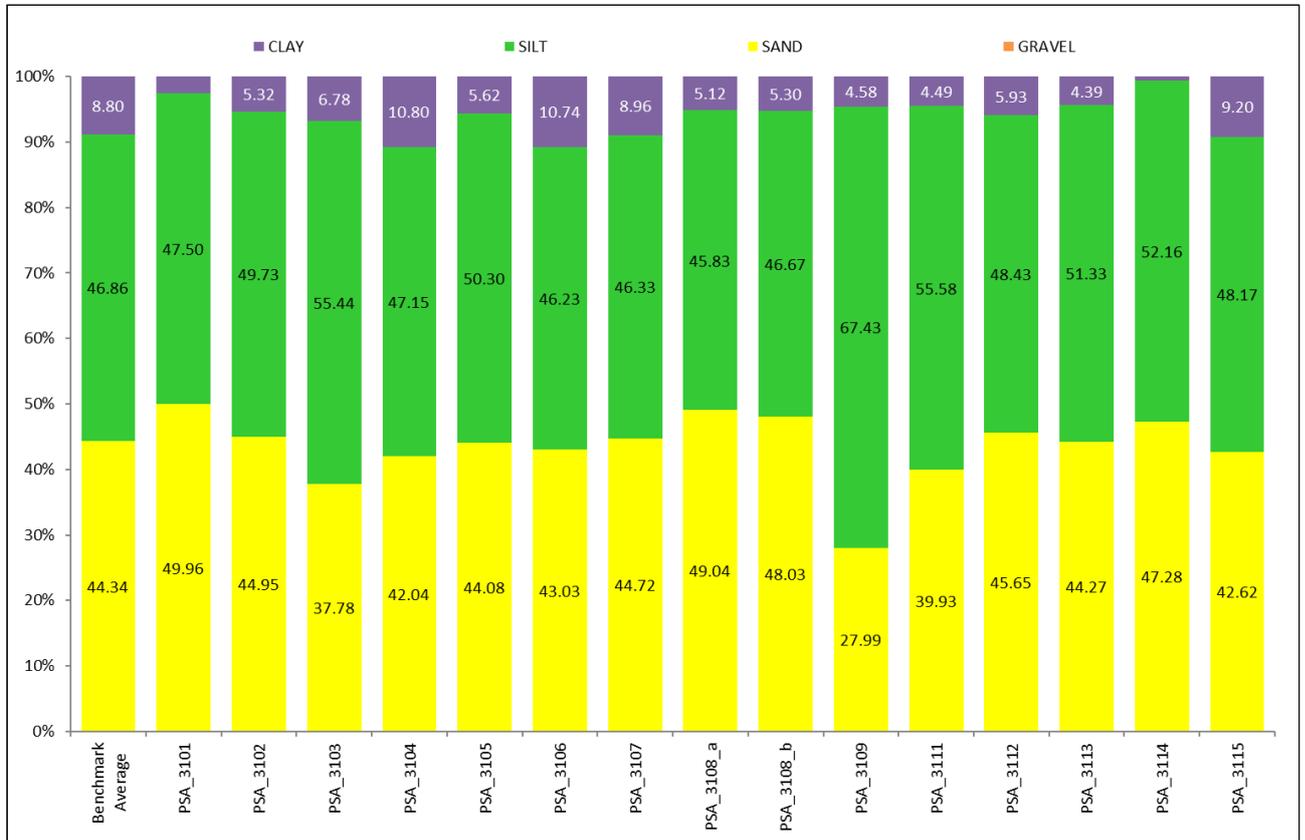


Figure 7. Stacked column chart showing the percentage gravel, sand, silt, and clay for sediment distributed as PS94.

3.2.3.4 Ninety-fifth distribution – PS95

There was good agreement in results between the laboratories and the benchmark data (see Figures 8 and 9). Participant PSA_3112 chose not to participate in this exercise and communicated non-participation. PSA_3109 follow a different method to the NMBAQC and only sieve at 1phi interval above 1mm therefore there data has been omitted from Figure 8 as it is not comparable with other participant data.

All participants had a Gradistat textural group of ‘Gravel’. Percentage Gravel ranged from 94.31% (PSA_3106) to 97.02% (PSA_3113) with an average of 95.16%. The percentage of sand ranged from 2.99% (PSA_3113) to 5.67% (PSA_3106) with an average of 4.74%. The percentage mud ranged from 0% to 0.40% (PSA_3108_a) and the average was 0.1%.

No participants re-submitted data for PS95 following the circulation of the interim report.

This sample was predominantly material greater than 1mm however there was a small portion of sediment less than 1mm. Participants chose to capture this portion using different techniques. The Benchmark lab and four participants (PSA_3103, PSA_3107, PSA_3108 and PSA_3109) chose to laser the <1mm fraction. With the majority of participants undertaking laser analysis producing a unimodal laser distribution with the primary mode at 853.5µm. One participant (PSA_3109) produced a trimodal laser distribution, with the primary mode at 1200.0µm, the secondary mode at 26.7µm and a third mode at 150.9µm.

PSA_3114 and PSA_3115 chose not to include the less than 1mm portion of the sample and divided greater than 1mm weights by the total weight greater than 1mm to produce the final data in percentages. These participants were reminded that this portion of the sample needed to be included in the final data.

The remaining participants chose to include the <1mm portion of the sample in the 707µm interval in the final data. This <1mm portion of the sample equated to less than 1% of the total sample and therefore the method used had little impact on the final distribution of the sample.

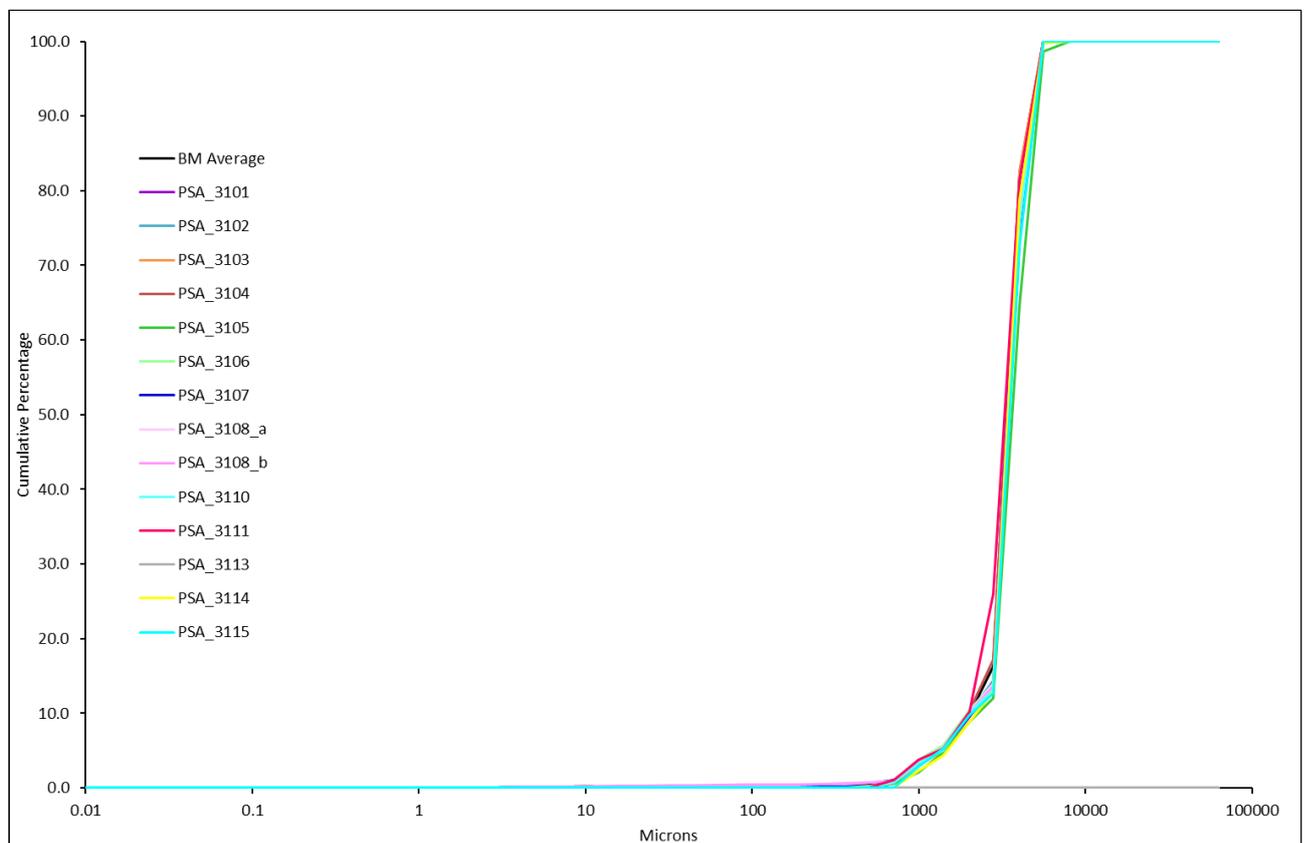


Figure 8. Particle size distribution curves for sediment distributed as PS95.

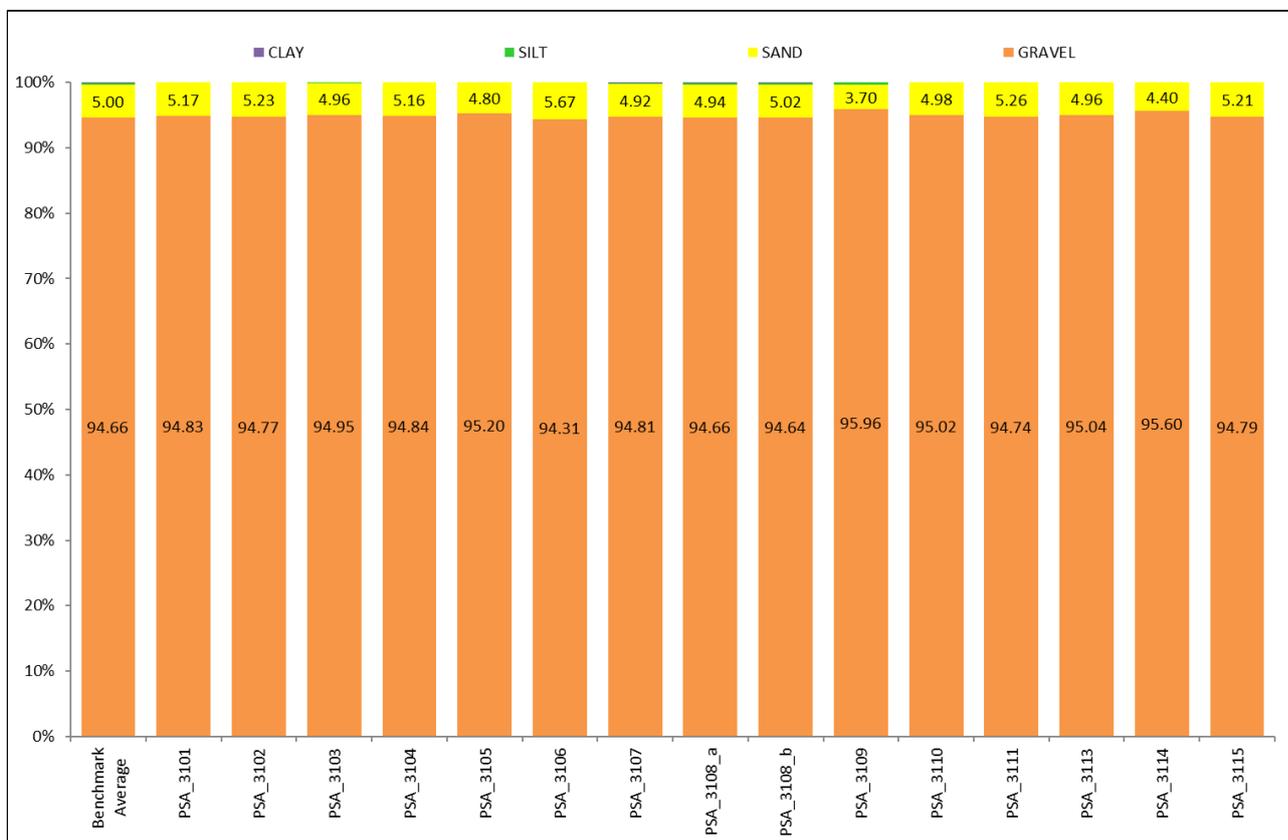


Figure 9. Stacked column chart showing the percentage gravel, sand, silt, and clay for sediment distributed as PS95.

3.2.4 Discussion

The exercise reports show that most participants follow the NMBAQC methodology for these exercises, those that followed a different methodology (PSA_3109, PSA_3111 and PSA_3112) did not provide details on how their methodology differed from that of the NMBAQC. PSA_3109 and PSA_3112 only process sediment greater than 1.0mm at one-phi intervals and therefore are not directly comparable with other participants or the Benchmark lab.

3.2.4.1 Sieve Analysis (>1mm)

Two exercises contained larger quantities of sediment greater than 1mm (PS93 and PS95). PS95 results show that the dry sieve analysis (>1mm) undertaken by participants was generally in agreement with each other and the benchmark data (see Figure 10) however there was more variation within PS93 particularly in the coarser fractions. Sediment type may be a contributing factor to these differences as PS93 consisted of natural sediment which is more prone to breaking up during analysis whereas PS95 was made up of aggregate material which is less likely to break down during the mechanical sieving process. There are less stringent guidelines on sieving times and amplitude and there are varying sieve times and amplitudes used among participants. The benchmark lab recorded a sieve time of 10mins and amplitude of 1.5mm/g'. Of the sieve metadata provided by participants, sieve time varies from 5 to 25 minutes; sieve amplitude units of measurement vary due to differing brands of sieve shaker with results provided from 1mm/g' to 2.1mm/g', 40Hz and Level 5 or Level 6. All these differences will affect the breakdown of particles particularly in natural, shelly sediment.

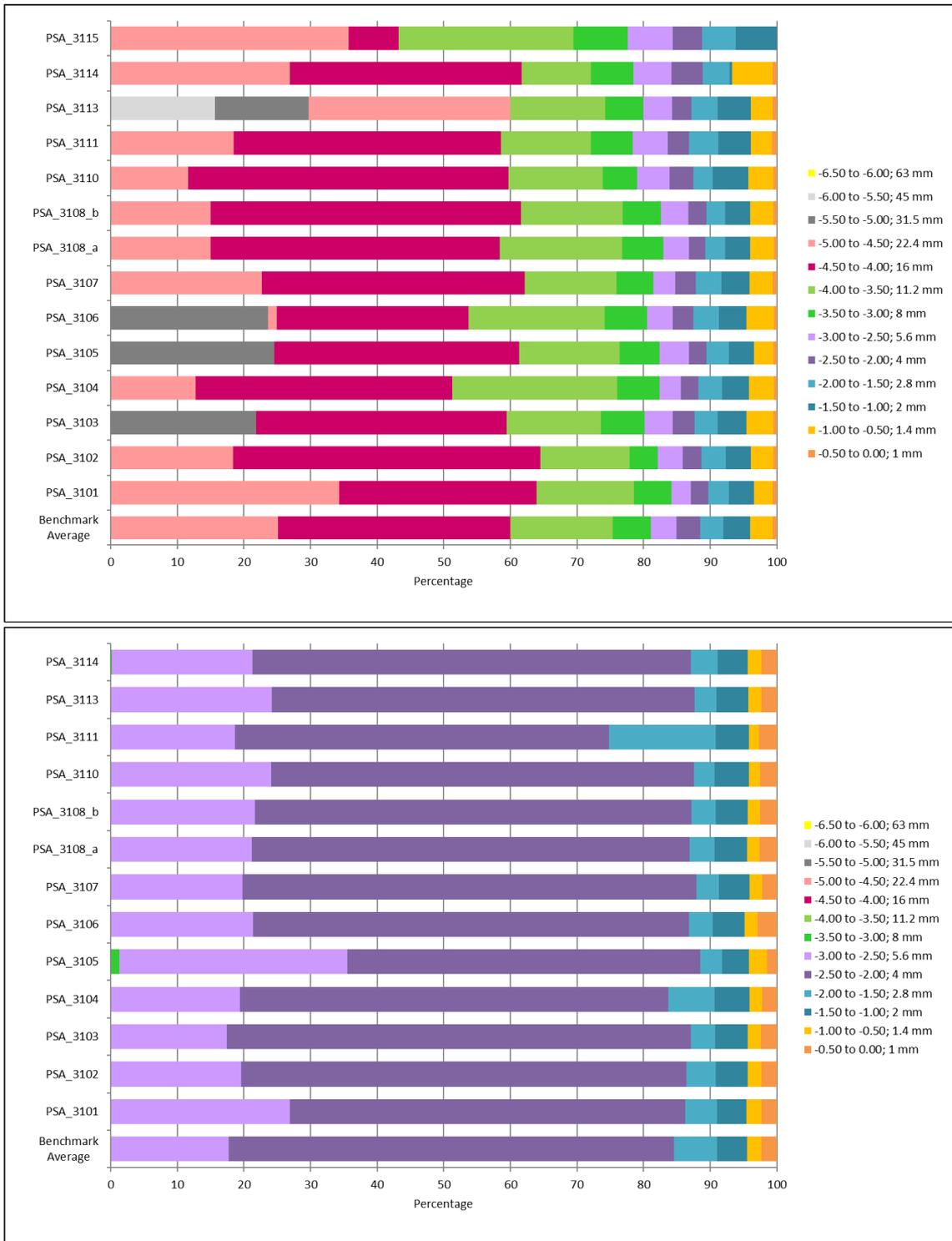


Figure 10. Bar charts showing raw sieve data as percentages in each half-phi interval for P93 (top) and PS95 (bottom).

3.2.4.2 Laser Analysis (<1mm)

Figure 11 shows the differential curves for the laser data for each exercise. Although the results continue to show improvement from previous years, laser analysis remains the main source of variability between participants. All participants re-scaled their laser data to 100% before merging with the sieve data; where the laser replicate data provided included sediment >1mm, data were re-scaled to include only the <1mm fractions for comparisons with benchmark and other participant data.

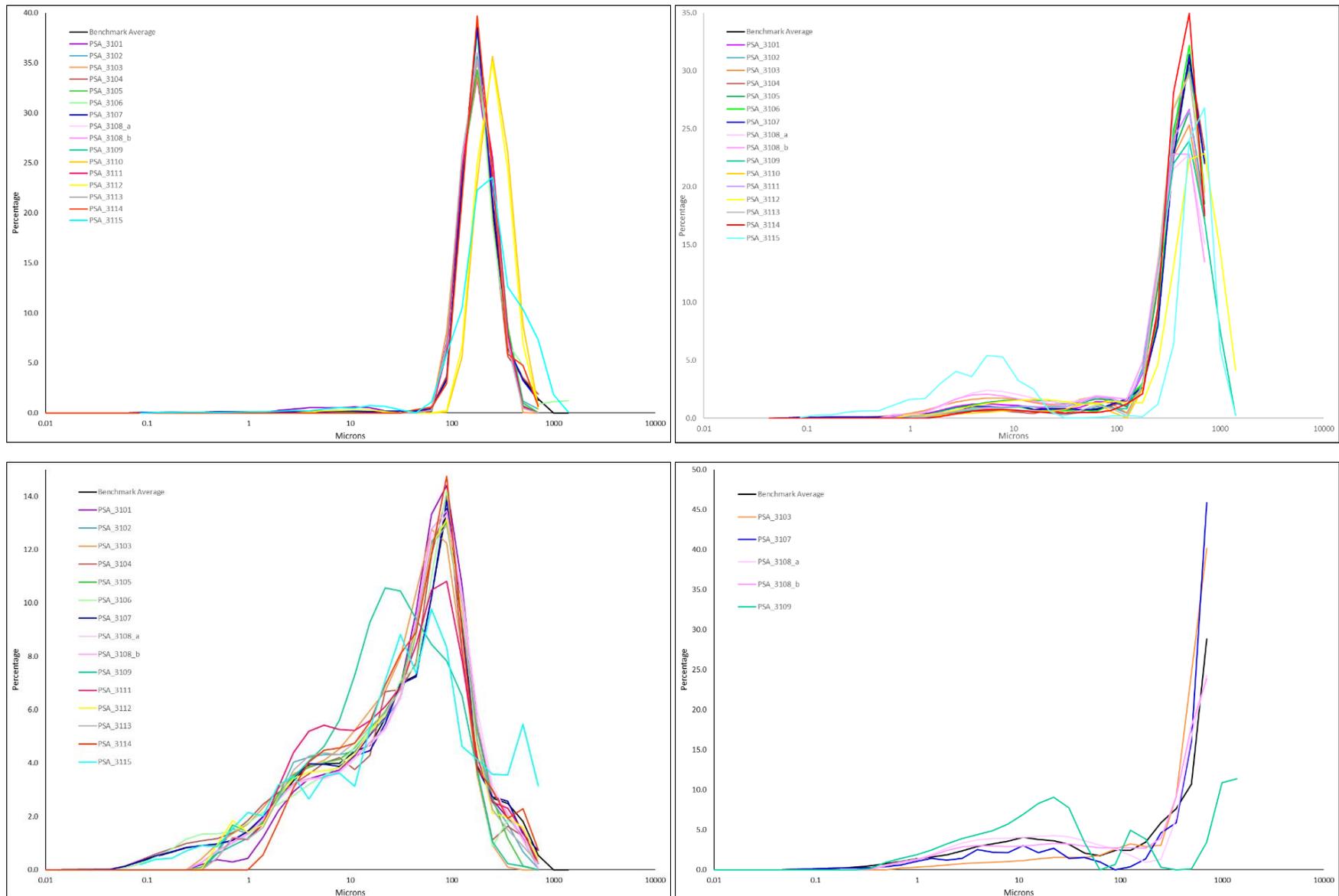


Figure 11. Differential final laser data provided by participants for exercises PS92 (top left), PS93 (top right), PS94 (bottom left) and PS95 (bottom right).

As in previous years it was apparent in the exercises that required laser analysis and had a significant mud fraction (PS94) that there were some differences in results depending on which laser instrument was being used. The participants using the Beckman Coulter and Fritsch instruments recorded on average approximately 5% more clay than those using Malvern instruments. The Beckman Coulter instruments have greater measurement sensitivity and along with the Fritsch analyser were the only instruments capable of detecting particles below 0.345µm. The results obtained using the Beckman Coulter instruments also showed a much greater degree of similarity to each other than those using generated using the Malvern instruments. However, there were still slight differences detected between the participants using Coulter instruments, which could be due to differences in the samples supplied to each lab, different sub-sampling, sample dispersion and/or sample presentation procedures being used.

These differences between laser manufacturers were taken into consideration when comparing participant data with the Benchmark data especially where participants used the Malvern analysers as the Benchmark data is created using a Beckman Coulter.

Laser metadata are very important in helping to identify where possible mistakes are made and whether it is an issue with the laser or a sample preparation problem. For this reason, provision of metadata is a compulsory requirement. The majority of participants supplied laser metadata in the current year, PSA_3110 provided no metadata and PSA_3111 only provided laser model and dispersion unit.

The NMBAQC recommends using the Mie Theory model, a Particle Refractive Index of 1.55 and a Particle Absorption Index of 0.1, the dispersant used is water which has a Refractive Index of 1.33. Based on the information supplied, most participants are now using the NMBAQC Guidance recommendations. Participants that were not following the recommendations were reminded to do so in their results.

For Exercises PS92, PS93, PS94 and PS95 all the participants that submitted metadata are now using the Mie Theory analysis model. All of the participants that provided metadata information used a Particle Absorption Index of 0.1. Most participants used a Particle Refractive Index of 1.55 while two participants used a Particle Refractive Index of 1.52 (PSA_3105 and PSA_3112). All participants using Beckman Coulter laser analysers used the PIDS (Polarized Intensity Differential Scattering) system as the fines extension; all participants using Malvern Mastersizer instruments used both the red and blue light wavelengths.

There remains a degree of variation in the pump and stirrer speeds and the use of ultrasonics. These factors are probably mostly responsible for the variation in the laser size distributions seen in Figure 11. It is not always obvious why a result appears to be different without detailed laser metadata. In addition to laser instrument set-up conditions and performance there are other factors that could be affecting the results, including sample preparation, sample dispersion methods and sample presentation to the laser instrument, about which little or no information has been provided.

3.2.5 Application of NMBAQC Scheme Standards and Laboratory Performance

One of the key roles of the Particle Size Analysis component of the NMBAQC Scheme is to assess the reliability of data collected as part of the Clean Seas Environment Monitoring Programme (CSEMP; formerly UK NMMP) and Water Framework Directive (WFD) monitoring programmes. With this aim, performance target standards were defined for certain Scheme modules and applied in 1996/97 (Scheme year three). These standards were the subject of a review in 2001 ([Unicomarine, 2001](#)) and were altered in Scheme year eight; each performance standard is described in detail in the [Description of the Scheme Standards for the Particle Size Analysis Component](#) document. An overall summary of the data reported by each participant is presented in each of the PS exercise reports, and along with this each participant receives a results table outlining their individual performance. In previous years laboratories meeting or exceeding the required standard for a given exercise would be considered to have performed satisfactorily for that particular exercise; a flag indicating a “Pass” or “Fail” would be assigned to each laboratory for each of the exercises concerned. As the Pass/Fail criteria are still under review for the PS exercises, in 2024/25 (Scheme year 31) a “Good” or “Review” flag has been issued for Sieve analysis (>1mm), Laser Analysis (<1mm) and Final Data. This aims to highlight any potential errors but will not be used to assess the performance of a laboratory. As this is a training exercise rather than a proficiency test, participants are encouraged to review their results especially where “Review” flags have been issued and can re-submit improved data after the issue of the interim report. Each laboratory was issued with a Statement of Performance certificate outlining their results and participation in the Scheme.

4. Particle Size Own Sample Analysis (PS-OS) module

4.1 Description

The Particle Size Own Sample (PS-OS) module was first introduced in Scheme year 21 (2014/15) as a training/audit module and now is in its ninth year of operation. Participants’ “own” samples are re-analysed by the NMBAQC Scheme PSA contractor and the results are compared. The purpose of this exercise is to examine the accuracy of particle size analysis for participants’ in-house samples. In its first year (2014/15) the PS-OS exercises carried a trial Pass/Fail criterion based on the correlation between the participant data and the AQC data. After discussions between KPAL, APEM and the Scheme’s PSA Contract Manager (Claire Mason, Cefas), it was decided that a more simplistic approach to analysing the results would be more appropriate in identifying errors in participants’ results. The results now follow a similar format to the PS exercises and were split into sieve processing, laser processing and final data. Participants received a “Good” or “Review” flag based on their results. Where a “Review” flag was issued comments were supplied detailing problems that had arisen and where to find information to help address them.

4.1.1 Analysis required

Laboratories were requested to submit details of a survey with at least 12 samples from their previous year’s Clean Seas Environment Monitoring Programme (formerly NMMP) samples, or similar alternative sampling programmes (if not responsible for CSEMP samples), along with the associated PSA data. Once these data were

provided, three samples were randomly chosen by APEM Ltd to be re-analysed by the NMBAQC Scheme's PSA contractor.

Spreadsheet based workbooks were distributed to each participating laboratory via email for each PS-OS exercise. These were to be returned to APEM Ltd via the NMBAQC Scheme email address (nmbaqc@apemltd.co.uk).

In each workbook a written description of the sediment classification was to be recorded, a visual estimate was made prior to analysis and a post analysis classification based on the percentages of gravel, sand and silt/clay and the Folk (1954) terminology. Any use of hydrogen peroxide treatment or chemical dispersant was also to be recorded. Also requested was a breakdown of the particle size distribution of the sediment, expressed as a weight or weight percentage of sediment in half-phi (ϕ) intervals, as well as sieve and laser metadata to provide insight into laboratory procedures, especially for the laser analysis.

The different components of each PS-OS sample (< 1mm, > 1mm and laser sub-sample) were to be sent to APEM's Letchworth laboratory to be passed on to the NMBAQC Scheme PSA contractors. The two sets of results were then compared by APEM Ltd.

Following on from delays resulting from the Covid-19 pandemic the timetable for the PS-OS module was altered to allow participants more time to submit data and to speed up reporting of results to participants. Participants who took part in Batch 1 submitted data by 17th January 2024, had samples selected by the 2nd February 2025 and reports were issued at the end of April 2025; Batch 2 submitted data by 21st March 2025, had samples selected by the 25th April 2025 and reports were issued by the end of July 2025.

4.2 Results

4.2.1 General comments

Ten laboratories subscribed to the PS-OS module in 2024/25. All laboratories that subscribed to the module provided data and samples for re-analysis. Three participants submitted data in Batch 1 and seven participants submitted data in Batch 2.

Each laboratory received detailed comparisons of their data with the re-analysis results obtained by the NMBAQC Scheme's contractor. Where the original analysis was performed by the Scheme's contractor an external auditor was used to re-analyse the samples. Results were split into sieve processing, laser processing and final data. At the end of each report participants received a "Good" or "Review" flag based on their results; where "Review" flags were issued, comments were made on errors that had arisen and where possible information was provided to help resolve problems.

Most of the laboratories that provided samples provided all necessary fractions of their sample for re-analysis; participant PSA_3110 provided a dried laser sub-samples and therefore this required re-wetting and mixing

into a soft but stiff paste consistency in order to extract representative laser subsamples. Participant PSA_3103 bagged the sediment retained on each sieve in the original analysis separately. The AQC laboratory noted that this makes it difficult to empty 100% of the sample from the bags, potentially leading to slight underestimation of the sample weight, although every effort was made to extract as much sediment as possible. There is no need to bag each individual sieve fraction, particularly as this only serves to hamper rather than hinder any reanalysis. PSA_3103 also provided three laser subsample pots per sample, the AQC lab noted that for this AQC it defeats the purpose of being able to assess how representative the subsampling process has been from a single pot.

There was generally good agreement between the participants and the AQC results, particularly in terms of basic sediment textural classification (see Table 2 - differences are highlighted in blue).

Table 2. Gradistat sediment descriptions from the primary data and the AQC re-analysis.

Lab	Sample	Primary Sediment Description	AQC Sediment Description
PSA_3101	PS-OS 31	Slightly Gravelly Sandy Mud	Slightly Gravelly Sandy Mud
	PS-OS 32	Slightly Gravelly Muddy Sand	Slightly Gravelly Muddy Sand
	PS-OS 33	Gravelly Muddy Sand	Gravelly Muddy Sand
PSA_3102	PS-OS 31	Slightly Gravelly Sand	Slightly Gravelly Sand
	PS-OS 32	Gravelly Sand	Gravelly Sand
	PS-OS 33	Gravelly Sand	Gravelly Sand
PSA_3103	PS-OS 31	Muddy Sandy Gravel	Muddy Sandy Gravel
	PS-OS 32	Sandy Mud	Sandy Mud
	PS-OS 33	Slightly Gravelly Sand	Slightly Gravelly Sand
PSA_3104	PS-OS 31	Gravelly Sand	Gravelly Sand
	PS-OS 32	Slightly Gravelly Muddy Sand	Slightly Gravelly Muddy Sand
	PS-OS 33	Slightly Gravelly Muddy Sand	Slightly Gravelly Muddy Sand
PSA_3106	PS-OS 31	Muddy Sandy Gravel	Sandy Gravel
	PS-OS 32	Slightly Gravelly Sandy Mud	Slightly Gravelly Sandy Mud
	PS-OS 33	Gravelly Muddy Sand	Gravelly Muddy Sand
PSA_3107	PS-OS 31	Slightly Gravelly Muddy Sand	Slightly Gravelly Muddy Sand
	PS-OS 32	Slightly Gravelly Muddy Sand	Slightly Gravelly Muddy Sand
	PS-OS 33	Slightly Gravelly Muddy Sand	Slightly Gravelly Muddy Sand
PSA_3110	PS-OS 31	Muddy Sandy Gravel	Muddy Sandy Gravel
	PS-OS 32	Sandy Mud	Sandy Mud
	PS-OS 33	Slightly Gravelly Sand	Slightly Gravelly Sand
PSA_3113	PS-OS 31	Slightly Gravelly Muddy Sand	Slightly Gravelly Muddy Sand
	PS-OS 32	Muddy Sandy Gravel	Muddy Sandy Gravel
	PS-OS 33	Slightly Gravelly Sand	Slightly Gravelly Muddy Sand
PSA_3118	PS-OS 31	Muddy Sand	Muddy Sand
	PS-OS 32	Sand	Sand
	PS-OS 33	Sandy Mud	Muddy Sand
PSA_3119	PS-OS 31	Slightly Gravelly Sand	Slightly Gravelly Muddy Sand
	PS-OS 32	Slightly Gravelly Sand	Slightly Gravelly Muddy Sand
	PS-OS 33	Slightly Gravelly Sand	Slightly Gravelly Muddy Sand

Participant PSA_3119 follow a different methodology as they do not have a laser analyser, samples are sieved to 63µm which explains the difference in textural group. The AQC analysis followed the NMBAQC methodology and therefore recorded a higher percentage of fine material. Due to this participant PSA_3119 is only assessed on the >1.0mm fraction which is directly comparable with the AQC data.

The differences in sediment description for PSA_3106 PS-OS 31 and PSA_3113 PS-OS 33 are due to slight differences in the ratio of sand and mud, the percentage differences between the primary and AQC are actually relatively small (4.03% and 5.93% respectively)

The greater than 1mm data created by dry sieving was in general very good, there were a few discrepancies, but these are to be expected due to factors such as breakage of particles during repeat analysis and variations in sieving time and vibration amplitude.

Small amounts of variability particularly in percentage clay shown in Figures 11, 12 and 13 can be explained by differing laser instruments used by the AQC lab and participants. As discussed earlier in this report, the Malvern Mastersizer 2000 and 3000 instruments do not have the same resolution as the Coulter LS13320, especially at the finer end; the Coulter uses a PIDS (Polarization Intensity Differential Scattering) system at the bottom end, rather than diffraction, so provides better sensitivity than the Malvern system which employs diffraction of two different wavelengths of light (red and blue). Often the Coulter system reports higher mud content than the Malvern machines and the distributions produced by the Malvern tend to be more smoothed, and less able to identify discrete size modes. The output size distribution from the Malvern instruments machines is very dependent on the diffraction pattern interpretation model used; this can be selected by the operator as "General Purpose, Unimodal, and Multimodal etc." and can give rise to uncertainty. There is no such specification requirement with the Coulter instruments.

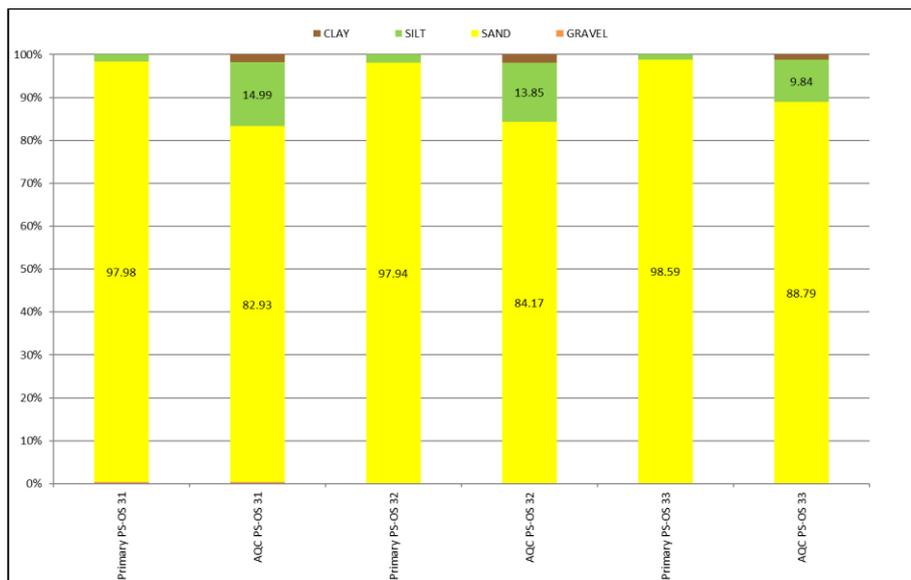
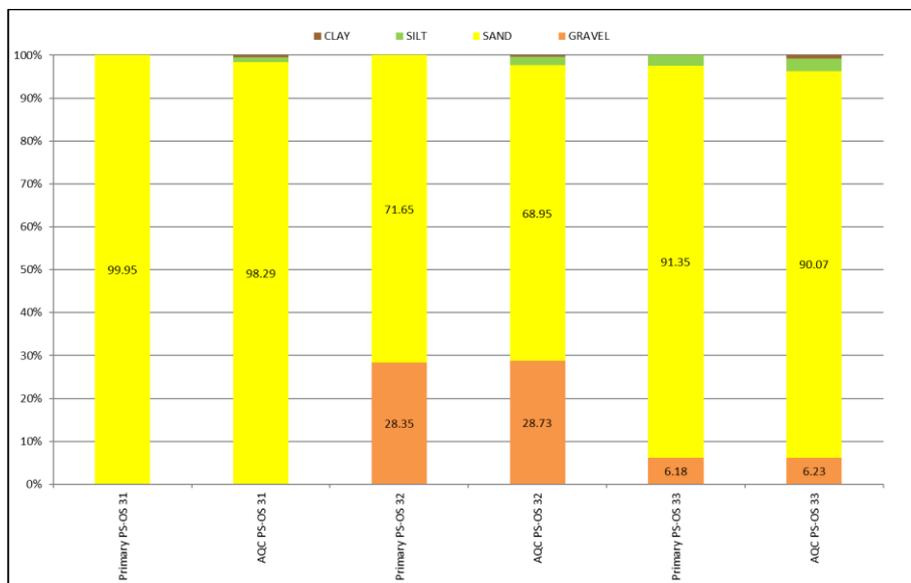
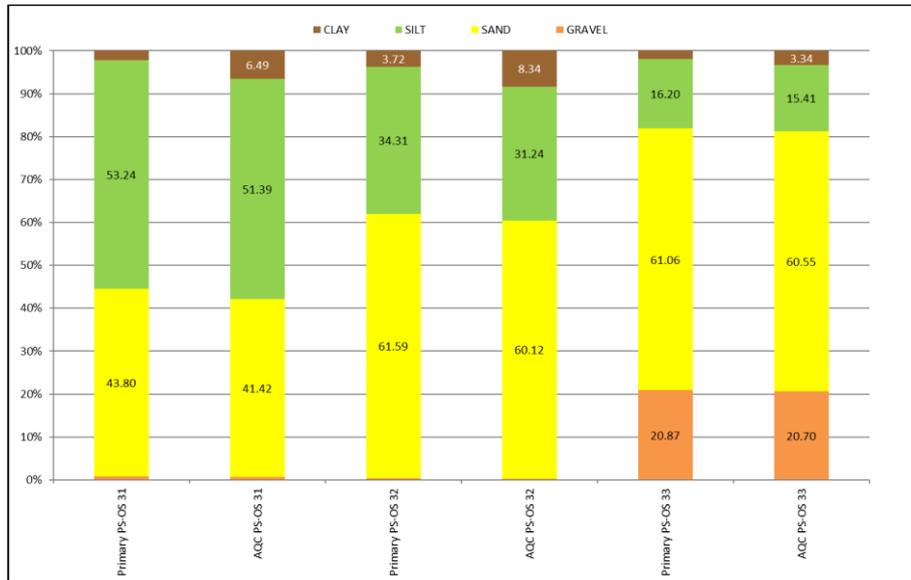


Figure 12. Bar charts showing percentage gravel, sand, silt, and clay in the PS-OS module from Batch 1 laboratories PSA_3101 (top), PSA_3102 (middle), PSA_3119 (bottom).

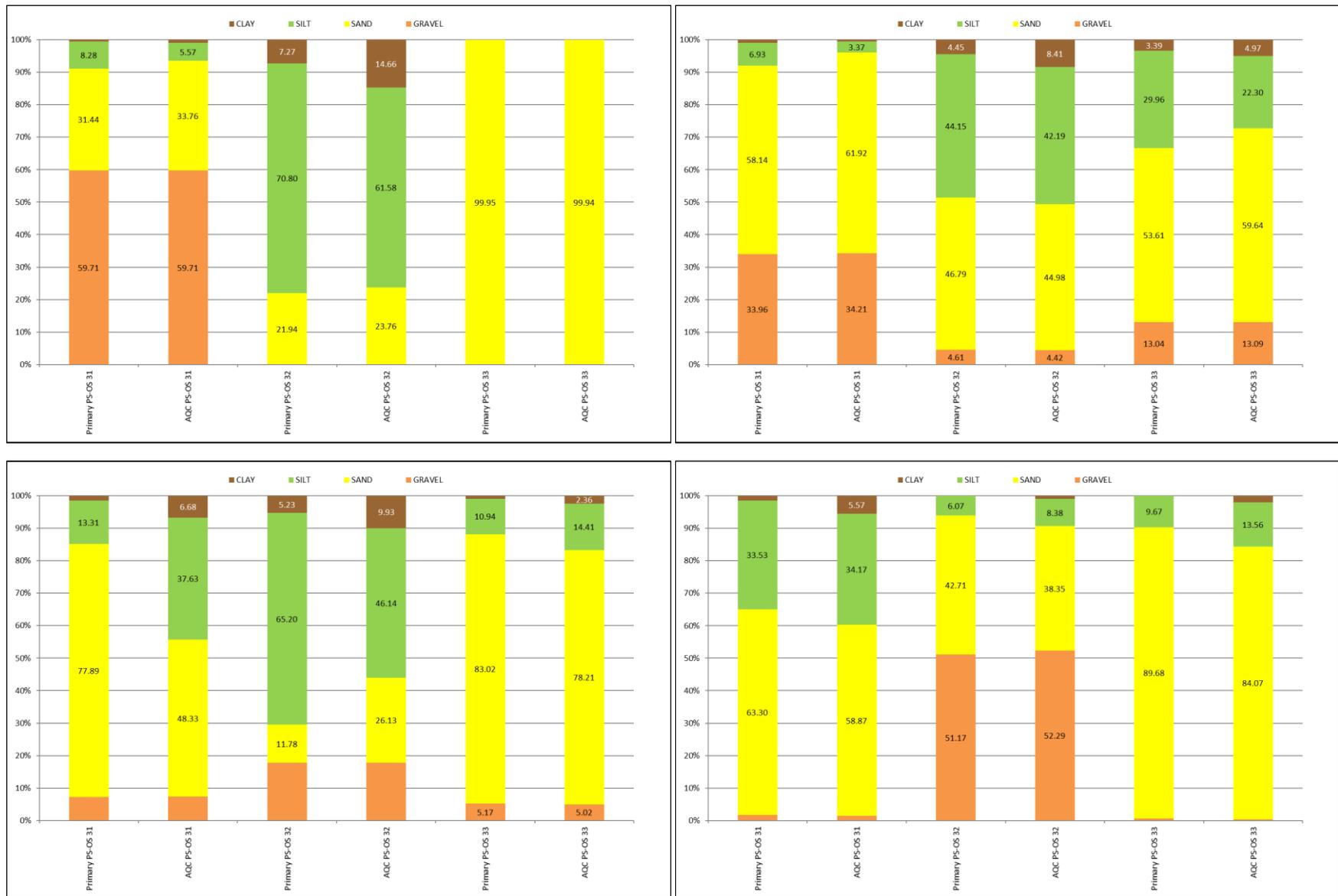


Figure 13. Bar charts showing percentage gravel, sand, silt, and clay in the PS-OS module from Batch 2 laboratories PSA_3103 (top left), PSA_3106 (top right), PSA_3110 (bottom left) and PSA_3113 (bottom right).

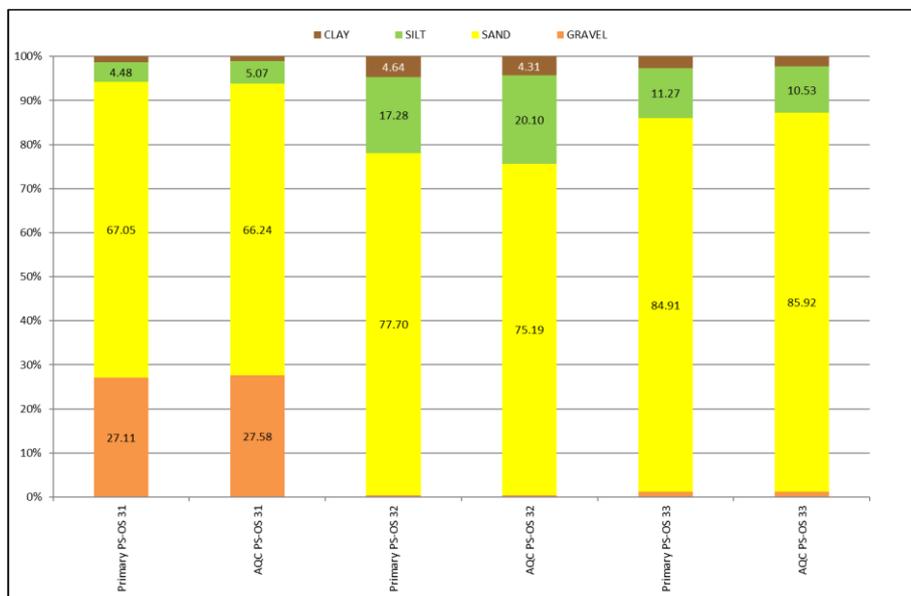
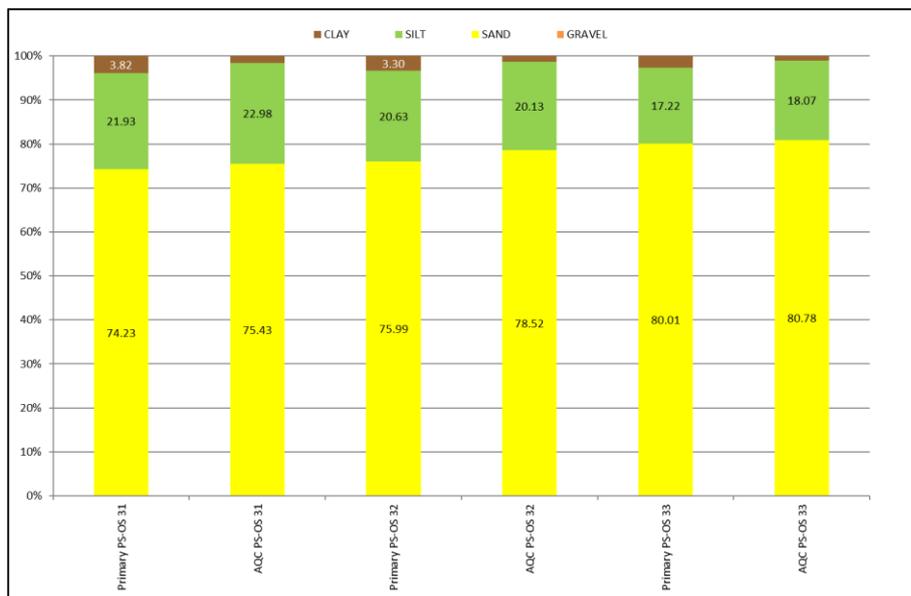
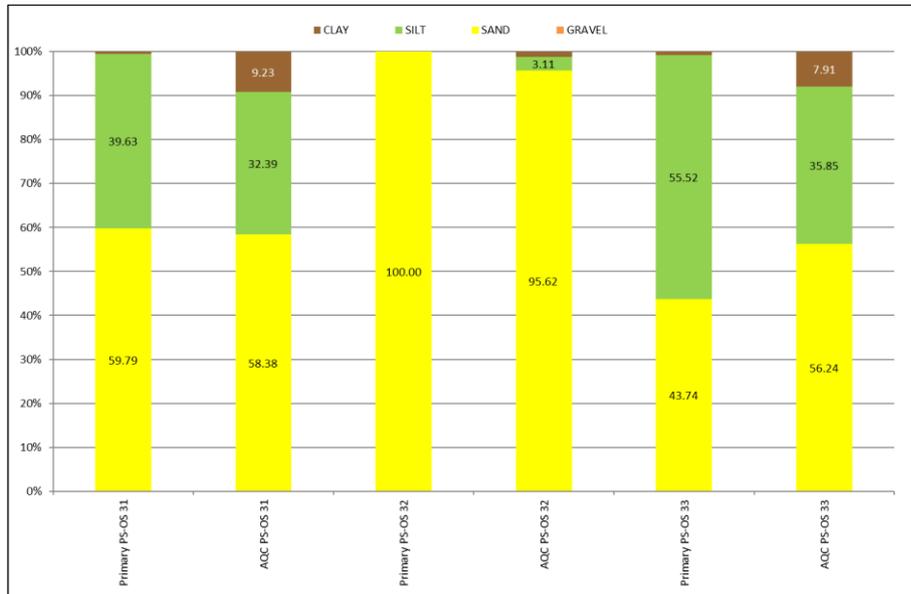


Figure 14. Bar charts showing percentage gravel, sand, silt, and clay in the PS-OS module from Batch 2 laboratories PSA_3118 (top), PSA_3107 (middle) and PSA_3104 (bottom).

4.3 Discussion

As in previous years, differences in laser analysis are still the main area of concern in the PS-OS samples. The interpretation of the methodology set out in the [NMBAQC Best Practice Guidelines \(Mason, 2022\)](#), in particular how the laser analysis is undertaken still appears to be a possible issue in some cases. These guidelines, originally written in 2011, were based on the widespread use at that time amongst participants of Malvern Instruments laser diffraction instruments that have 15 – 25 second standard run times and generally are restricted to the analysis of material < 1mm in size. The original methodology suggested that:

1. A homogenised sub-sample of approximately 100ml is taken from the bulk sample for laser analysis (Laser Pot).
2. A small representative sub-sample is taken from the Laser Pot and passed through a 1mm sieve using as little water as possible (Replicate 1).
3. All of Replicate 1 is then run through the laser at the desired obscuration, producing three run results.

Steps 2 and 3 are then repeated to create Replicates 2 and 3, giving a final result of 9 runs to create the final laser data, the average of these 9 runs.

The completion of nine analyses, and subsequent merging of results is necessarily a time-consuming process, especially if standard run times longer than 15 to 25 seconds are used (e.g. 60 seconds is standard with Beckman Coulter instruments (if the PIDS system is activated)). It has been demonstrated by KPAL that, for most samples, there is little practical benefit in routinely carrying out analysis of three replicate sub-samples if samples are homogenised properly both before the laser sub-sample is taken from the bulk sample and when the test sample is taken from the laser sub-sample, and the sample is adequately dispersed prior to presentation to the instrument. In relatively rare instances where samples consist very largely of > 1mm size material and it is impractical to obtain a representative laser sub-sample from the bulk sample, more consistent laser results can be obtained by taking a laser sub-sample from the wet separated < 1mm fraction of the sediment, rather than from the bulk sample.

Where samples display, or are suspected of, unstable behaviour, such as time-dependent agglomeration, one or more repeat runs of the same test sample should be carried out, and

additional replicate test samples analysed. Sometimes this may require repeat runs of more than three replicates to fully characterise agglomerative behaviour, and to establish the best dispersal procedures required to obtain repeatable results (e.g. ultrasonic treatment before as well as during the analysis run, and/or use of chemical dispersants). If the laser sub-sample is visually heterogeneous, and/or during the preparation of the test sample it is observed that small amounts of sand are present within a mainly muddy matrix, two or more test samples should be analysed. Additionally, for QA purposes, it is good practice to carry out at least duplicate analysis on 1 in 10 samples. The guidance has been updated to incorporate most of these findings and recommendations, with some further follow up expected at future NMBAQC PSA workshops. The most recent version of the guidance can be viewed in [Mason \(2022\)](#).

The returns for the 2024/25 PS-OS module showed that most laboratories in routine case work only run one laser test sample, with, for QA demonstration purposes, replicates run every 10th, 20th or 50th sample, dependent on sediment type (less frequently for well sorted uniform sand samples than for poorly sorted muddy sand and muddy sandy gravel mixtures). The results obtained by KPAL, for the NMBAQC replicates samples prepared by APEM since 2014/15, demonstrate that the high degree of repeatability which can be obtained when strict analysis protocols are followed, and that a high degree of confidence can be placed in the results obtained for any individual analysis.

The PS-OS module also revealed that a few participants do not follow the NMBAQC methodology for routine samples. This generally occurs when a participant does not have access to a laser analyser, in this case only the sieve and final data can be compared. Participants are encouraged to participate even when samples have been analysed following a different methodology as long as details of the methodology used are presented clearly. Although re-analysis will be undertaken following the NMBAQC methodology this gives a chance to compare how results differ when using alternate methodologies. Using a different methodology will always be taken into consideration when comparing the primary and AQC analysis.

5. Conclusions and Recommendations

A number of observations may be made based on the results of the exercises described above. The following is a summary of the major points of importance.

1. **Laboratories should ensure that they follow the NMBAQC methodology when participating in the Particle Size (PS) Ring Test.** The PS Ring Test is designed to test whether all participants are getting comparable results when they follow the same methodology. It is therefore important that only the NMBAQC methodology ([Mason, 2022](#)) is used where possible and that results for 3 x 3 laser analyses are provided. If an alternate methodology has been used it is imperative that the differences to the NMBAQC methodology are shared so that results can be fairly assessed. Participants who do not have access to a laser analyser will be permitted to use alternate methods for samples that contain sediment less than 1mm as long as the method used is detailed in the summary section of the workbook. Participants can choose to opt out of either the sieve or laser aspects if they do not routinely undertake that type of analysis. The participant must let the administrator know at the start of the scheme year if they wish to opt out of any analysis. Results will only be provided for the analysis that was undertaken and a note will be put on the Statement of Performance that the participant has opted out of certain points.

Samples for the PS-OS module can be analysed following alternative in-house methods however these must be thoroughly described and the participant should be aware that re-analysis will be undertaken following the NMBAQC methodology. Samples provided for PS-OS which have been routinely analysed do not necessarily have to provide 3 x 3 laser analysis data but should show that appropriate QC checks have been carried out, including on the final data set.

2. **The current NMBAQC Scheme Pass/Fail criteria for the PS modules are under review.** Currently results are broken down for review, including sieve processing, laser processing and final data. Laboratories then received a “Good” or “Review” flag based on their results; “Review” flags came with accompanying comments as to where mistakes have been made and how to correct them. This approach was thought to be more informative and would help participants to identify errors and correct any issues for future exercises. Following the publication of ‘Statistical comparisons of sediment particle size distributions’ (Barry *et al.*, 2021) in Continental Shelf Research, data from previous and future reports will trial this new statistical method of comparing the benchmark and participant data to understand if we can achieve a pass/ fail criteria for the particle size component, with the possibility of a report detailing the outcomes available in the next couple of scheme years.

3. **A Review is not a failure.** Although every attempt is made to ensure that all replicates are as similar as is humanly possible there will naturally be some variation, particularly in natural mud samples. A review flag is just to point out that your analysis differs from that of the Benchmark Lab and other participants. We encourage participants to review their data and if required request a new replicate or ask for their replicate to be re-analysed by the Benchmark Lab for a comparison.
4. **A comparison study for different laser manufacturers and models is currently underway.** This study is being run by Cefas alongside the NMBAQC Scheme and will help to assess the variation between different laser models for different sediment types including muds, sandy muds and muddy sands. Once complete, data and outcomes obtained will be discussed at a NMBAQC workshop and published in the NMBAQC PSA guidance document.
5. **A PSA workshop is being planned for Summer 2026** and will present the data and outcomes of the laser comparison study as well as a potential “training” session on the NMBAQC methodology to participants who are new to particle size or require a refresher.

6. References

Blott, S.J. and Pye, K. 2001 GRADISTAT: a grain size distribution and statistics package for the analysis of unconsolidated sediments. *Earth Surface Processes and Landforms* 26, 1237-1248.

Blott, S.J. & Pye, K. 2012 Particle size scales and classification of sediment types based on size distributions: review and recommended procedures. *Sedimentology* 59, 2071-2096.

Folk, R.L., 1954. The distinction between grain size and mineral composition in sedimentary-rock nomenclature. *Journal of Geology* 62, 344-359.

[Hall, D.J. 2010 National Marine Biological Analytical Quality Control Scheme. Description of Scheme Standards for the Particle Size Analysis Component from Scheme Year 8 \(2001/02\) to Year 16 \(2009/10\). Report to the NMBAQC Scheme participants. Unicmarine report NMBAQCpsa_stds, February 2010.](#)

[Mason, C. 2022. NMBAQC's Best Practice Guidance. Particle Size Analysis \(PSA\) for Supporting Biological Analysis. National Marine Biological AQC Coordinating Committee, 84pp, First published 2011, updated March 2022.](#)

[McIntyre-Brown, L. & Hall, D., 2025. National Marine Biological Analytical Quality Control Scheme. Particle Size Results: PS92 Report to the NMBAQC Scheme participants. Apem Report NMBAQCps92, 17pp, May 2025.](#)

[McIntyre-Brown, L. & Hall, D., 2025. National Marine Biological Analytical Quality Control Scheme. Particle Size Results: PS93 Report to the NMBAQC Scheme participants. Apem Report NMBAQCps93, 20pp, May 2025.](#)

[McIntyre-Brown, L. & Hall, D., 2025. National Marine Biological Analytical Quality Control Scheme. Particle Size Results: PS94 Report to the NMBAQC Scheme participants. Apem Report NMBAQCps94, 17pp, May 2025.](#)

[McIntyre-Brown, L. & Hall, D., 2025. National Marine Biological Analytical Quality Control Scheme. Particle Size Results: PS95 Report to the NMBAQC Scheme participants. Apem Report NMBAQCps95, 18pp, May 2025.](#)

[Unicomarine. 1995 National Marine Biological Quality Control Scheme. Annual Report \(Year one\). Report to the NMBAQC Committee and Scheme participants. September 1995.](#)

[Unicomarine. 1996 National Marine Biological Quality Control Scheme. Annual Report \(Year two\). Report to the NMBAQC Committee and Scheme participants. September 1996.](#)

[Unicomarine. 2001 National Marine Biological Analytical Quality Control Scheme. Own Sample Format and Standards Review: Current Problems and Proposed Solutions. Report to the NMBAQC Committee. April 2001.](#)