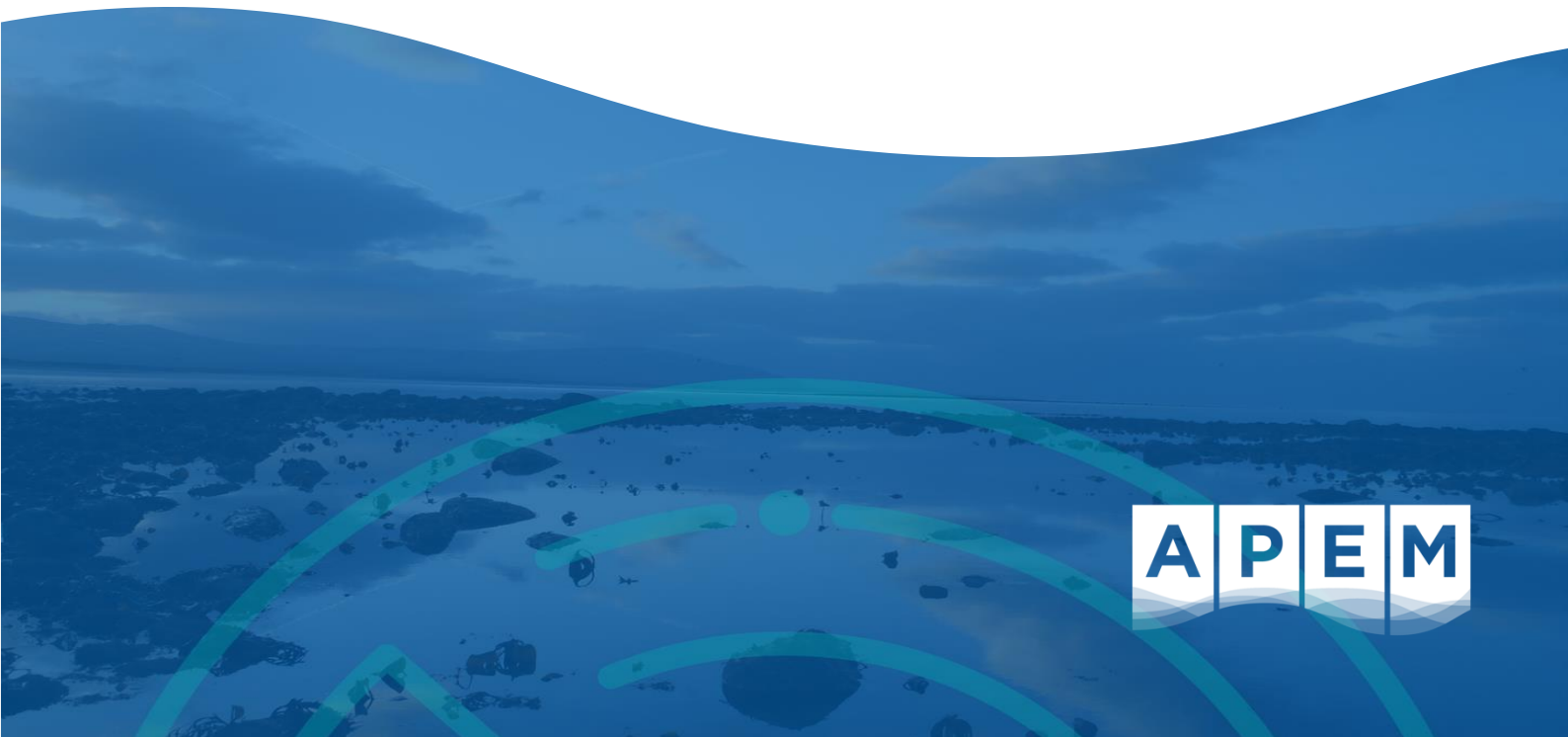
NMBAQC

NE Atlantic Marine Biological Analytical Quality Control Scheme

NMBAQC Scheme 2023/24

PS90 Report

Lydia McIntyre-Brown



Client: North East Atlantic Marine Biological Analytical Quality Control Scheme

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McIntyre-Brown, L. & Hall, D., 2024. National Marine Biological Analytical Quality Control Scheme. Particle Size Results: PS90 Report to the NMBAQC Scheme participants. Apem Report NMBAQCps90, 16pp, July 2024.

Revision and Amendment Register

Version Number	Date	Section(s)	Page(s)	Summary of Changes	Approved by
1.0	15/05/2024	All	All	Interim Report	LMB
1.1	17/05/2024	All	All	Review of Document	DH
1.2	06/06/2024	2 and appendices	8 - 16	Update PSA_3011 results	LMB
1.3	03/06/2024	2 and appendices	8 - 16	Update PSA_3008 results	LMB

At the time of issue no data had been received from participants PSA_3009, PSA_3013 and PSA_30014. PSA_3010 were yet to re-submit results following a “Review” flag.

Contents

List of Figures

List of Tables

Abbreviations

n/p – Not participating at the current time.

n/r – no response from participant/ no data submitted.

"-" – no data submitted.

1. BENCHMARK DATA

Table 1 Summary data for the Benchmark replicates distributed as PS90.

Sample	Method	% Gravel	% Sand	% Mud	Sediment Description
PSA_3036 BM REP 1	NMBAQC	0.00	49.05	50.95	Sandy Mud
PSA_3037 BM REP2	NMBAQC	0.00	47.79	52.21	Sandy Mud
PSA_3038 BM REP 3	NMBAQC	0.00	47.57	52.43	Sandy Mud
PSA_3039 BM REP 4	NMBAQC	0.00	48.44	51.56	Sandy Mud
PSA_3040 BM REP 5	NMBAQC	0.00	48.34	51.66	Sandy Mud
BM Rep Average	NMBAQC	0.00	48.24	51.76	Sandy Mud

Table 2 Summary of the sieve data the Benchmark replicates distributed as PS90*.

Phi Interval; microns	PSA_3036 BM REP 1	PSA_3037 BM REP2	PSA_3038 BM REP 3	PSA_3039 BM REP 4	PSA_3040 BM REP 5	BM Rep Average
-6.50 to -6.00; 63 mm						
-6.00 to -5.50; 45 mm						
-5.50 to -5.00; 31.5 mm						
-5.00 to -4.50; 22.4 mm						
-4.50 to -4.00; 16 mm						
-4.00 to -3.50; 11.2 mm						
-3.50 to -3.00; 8 mm						
-3.00 to -2.50; 5.6 mm						
-2.50 to -2.00; 4 mm						
-2.00 to -1.50; 2.8 mm						
-1.50 to -1.00; 2 mm						
-1.00 to -0.50; 1.4 mm						
-0.50 to 0.00; 1.0 mm						
>1.0mm						
<1.0mm – Base Pan						
<1.0mm – Oven dried						
Total Weight						

*one or two particles were retained on a 1mm sieve however these have been excluded from the final results. Three BM reps (PSA_3036, PSA_3037 and PSA_3040) retained 0.01g on the 1mm sieve.

Table 3 Summary of the final laser data for the Benchmark replicates distributed as PS90.

Phi Interval; microns	PSA_3036 BM REP 1	PSA_3037 BM REP2	PSA_3038 BM REP 3	PSA_3039 BM REP 4	PSA_3040 BM REP 5	BM Rep Average
0.00 to 0.50; (707 µm)	2.15	2.44	1.57	1.49	1.78	1.89
0.50 to 1.00; (500 µm)	4.43	4.42	3.49	4.16	4.21	4.14
1.00 to 1.50; (353.6 µm)	7.53	6.66	6.71	6.95	6.74	6.92
1.50 to 2.00; (250 µm)	8.77	8.48	8.53	8.72	8.48	8.60
2.00 to 2.50; (176.8 µm)	9.04	8.75	9.22	9.56	9.36	9.18
2.50 to 3.00; (125 µm)	7.28	7.09	7.60	7.60	7.52	7.42
3.00 to 3.50; (88.39 µm)	5.64	5.64	5.97	5.72	5.96	5.79
3.50 to 4.00; (62.5 µm)	4.23	4.32	4.47	4.22	4.29	4.31
4.00 to 4.50; (44.19 µm)	3.68	3.83	3.82	3.79	3.69	3.76
4.50 to 5.00; (31.25 µm)	3.79	3.70	3.98	3.84	3.73	3.81
5.00 to 5.50; (22.097 µm)	3.63	3.65	3.70	3.65	3.55	3.64
5.50 to 6.00; (15.625 µm)	3.93	4.11	4.02	4.06	3.97	4.02
6.00 to 6.50; (11.049 µm)	4.92	5.03	5.04	5.02	4.91	4.98
6.50 to 7.00; (7.813 µm)	5.07	5.22	5.22	5.27	5.10	5.18
7.00 to 7.50; (5.524 µm)	5.28	5.46	5.40	5.43	5.32	5.38
7.50 to 8.00; (3.906 µm)	5.06	5.22	5.16	5.10	5.11	5.13
8.00 to 8.50; (2.762 µm)	4.03	4.14	4.13	4.02	4.11	4.09
8.50 to 9.00; (1.953 µm)	2.89	2.95	2.97	2.83	2.96	2.92
9.00 to 9.50; (1.381 µm)	2.03	2.07	2.08	1.94	2.08	2.04
9.50 to 10.00; (0.977 µm)	1.37	1.42	1.41	1.32	1.42	1.39
10.00 to 10.50; (0.691 µm)	1.00	1.06	1.03	1.00	1.06	1.03
10.50 to 11.00; (0.488 µm)	0.93	0.97	0.96	0.92	0.99	0.95
11.00 to 11.50; (0.345 µm)	0.96	0.97	0.98	0.93	1.02	0.97
11.50 to 12.00; (0.244 µm)	0.90	0.89	0.92	0.87	0.96	0.91
12.00 to 12.50; (0.173 µm)	0.67	0.67	0.71	0.68	0.74	0.70
12.50 to 13.00; (0.122 µm)	0.45	0.46	0.50	0.48	0.52	0.48
13.00 to 13.50; (0.086 µm)	0.25	0.27	0.29	0.29	0.30	0.28
13.50 to 14.00; (0.061 µm)	0.09	0.10	0.11	0.11	0.11	0.10
14.00 to 14.50; (0.043 µm)	0.01	0.01	0.01	0.01	0.01	0.01
>14.50; (0.01 µm)	0.00	0.00	0.00	0.00	0.00	0.00
Total	100.00	100.00	100.00	100.00	100.00	100.00
Mean	42.22	39.98	38.66	40.83	39.81	40.29
Sorting	8.00	8.07	7.83	7.78	8.10	7.96
Skewness	-0.25	-0.21	-0.23	-0.24	-0.25	-0.24
Kurtosis	0.77	0.77	0.77	0.77	0.78	0.77
Mode	Trimodal	Bimodal	Trimodal	Trimodal	Trimodal	Trimodal
Primary Mode	213.4	213.4	213.4	213.4	213.4	213.4
Mode two:	6.7	6.7	6.7	6.7	6.7	6.7
Mode three:	37.7	0.0	37.7	37.7	37.7	37.7

Table 4 Summary of Coefficient of Variation for Benchmark laser replicates for PS90.

		PSA_3036 BM REP 1	PSA_3037 BM REP2	PSA_3038 BM REP 3	PSA_3039 BM REP 4	PSA_3040 BM REP 5
D_{10}	Sub-sample 1	4.59	2.52	1.04	1.95	0.98
	Sub-sample 2	2.56	2.64	2.26	1.01	1.87
	Sub-sample 3	1.29	0.94	1.05	2.95	3.00
D_{50}	Sub-sample 1	6.19	7.91	3.78	5.10	2.99
	Sub-sample 2	11.06	4.77	7.06	3.51	4.15
	Sub-sample 3	3.04	3.99	2.16	6.33	1.53
D_{90}	Sub-sample 1	2.85	2.48	0.92	2.33	2.28
	Sub-sample 2	5.32	2.76	3.75	1.80	1.83
	Sub-sample 3	2.90	1.24	1.57	2.69	1.87

$$COV = \left(\frac{StDev}{Mean}\right) * 100$$

ISO 133020 defines good reproducibility when: COV is <3% for D50

COV is <5% for D10 and D90

All limits double when the D50 is <10microns.

In reality 3% and 5% are low and greater variability is expected for natural sediment samples therefore a maximum of 20% (based on three replicates being measured) will be used as a guide.
The Benchmark replicates show good reproducibility.

Table 5 Laser Metadata for the Benchmark replicates for PS90.

	Benchmark Lab
Laser used:	Beckman Coulter LS 13320
Dispersion Unit:	Universal Liquid Module
Analysis model:	Mie
Dispersion Used	Water (RI – 1.33)
Particle Refractive Index	1.55
Particle Absorption Index:	0.1
Fines extension	PIDS system
Obscuration	10 - 12%
Pump Speed (% or rpm)	80%
Stirrer speed (% or rpm)	n/a
Ultrasonic duration	20
Ultrasonic level	2

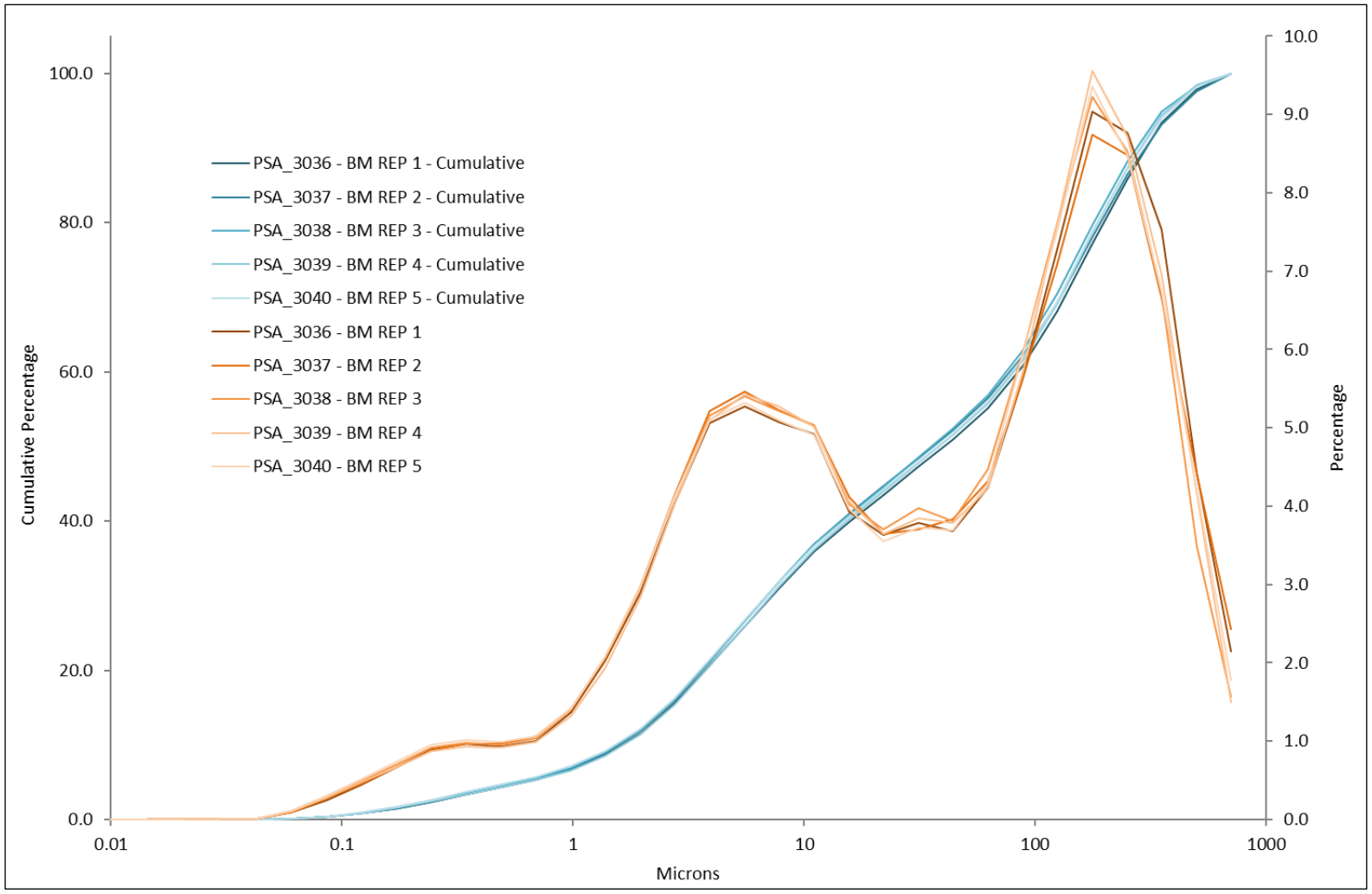

Figure 1 Particle size distribution curves resulting from final laser analysis of 5 replicate samples of sediment distributed as PS90 (Benchmark Data).

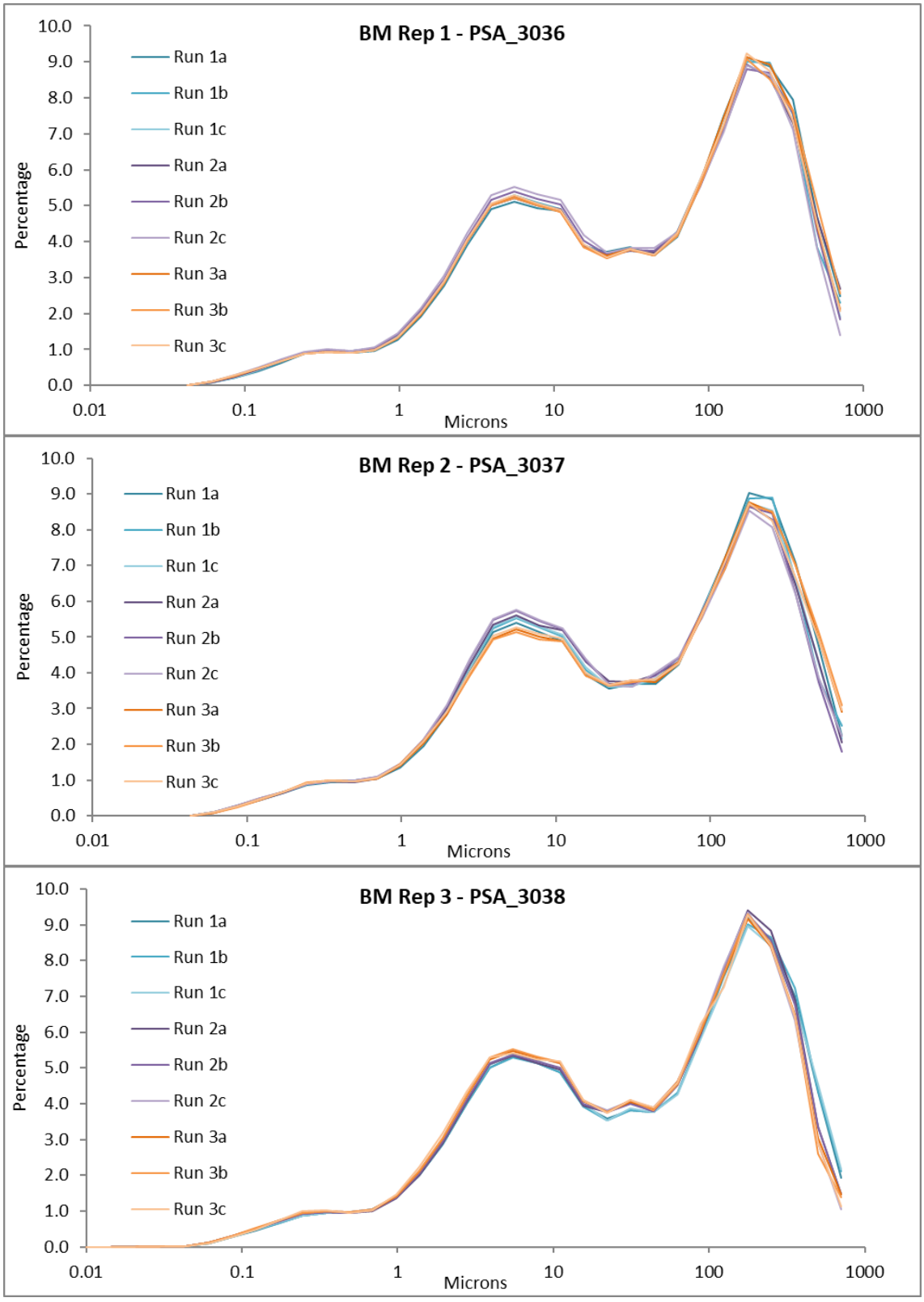

Figure 2 Particle size distribution curves resulting from laser analysis of five replicate samples of sediment distributed as PS90.

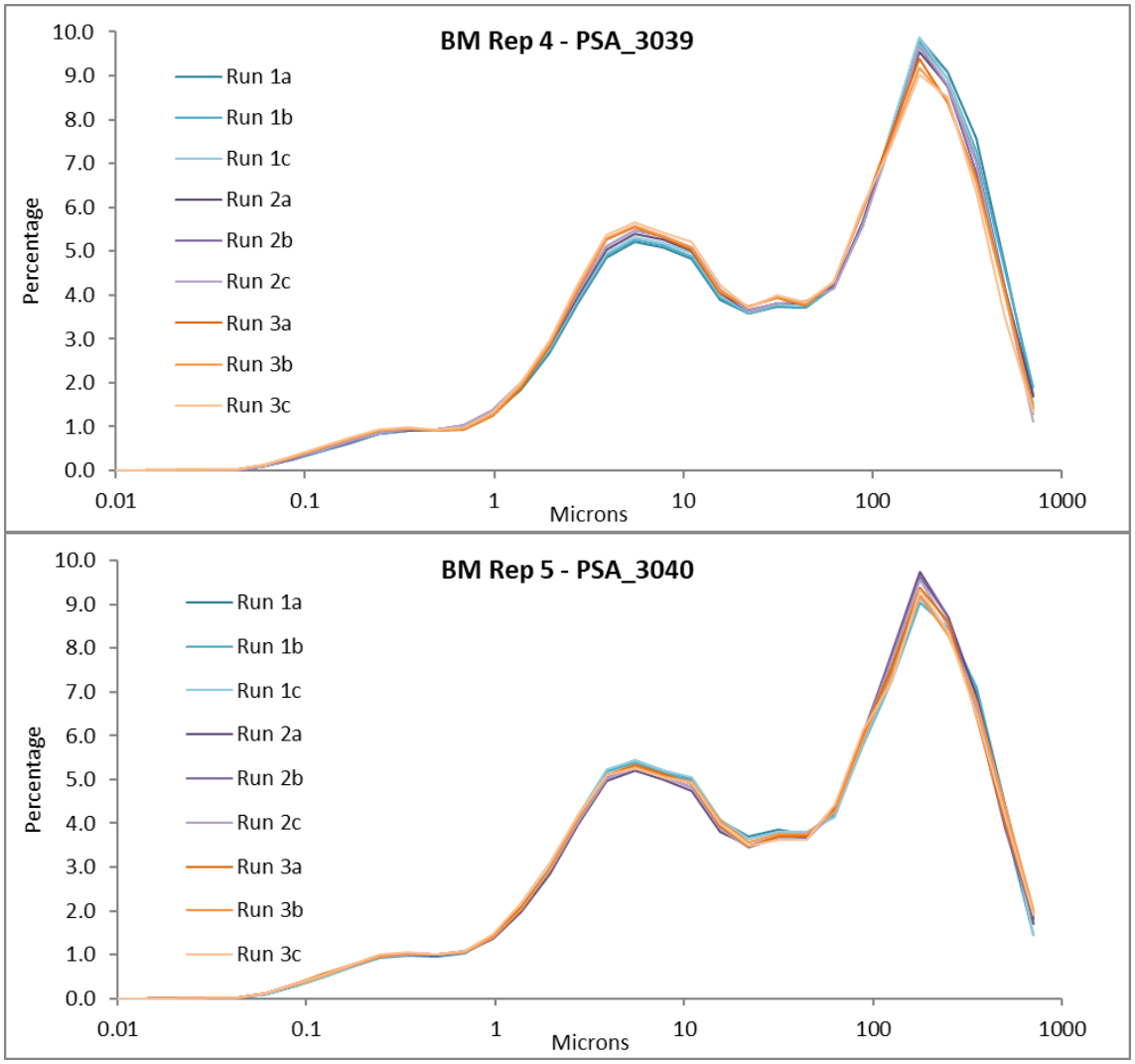

Figure 2 Particle size distribution curves resulting from laser analysis of five replicate samples of sediment distributed as PS90.

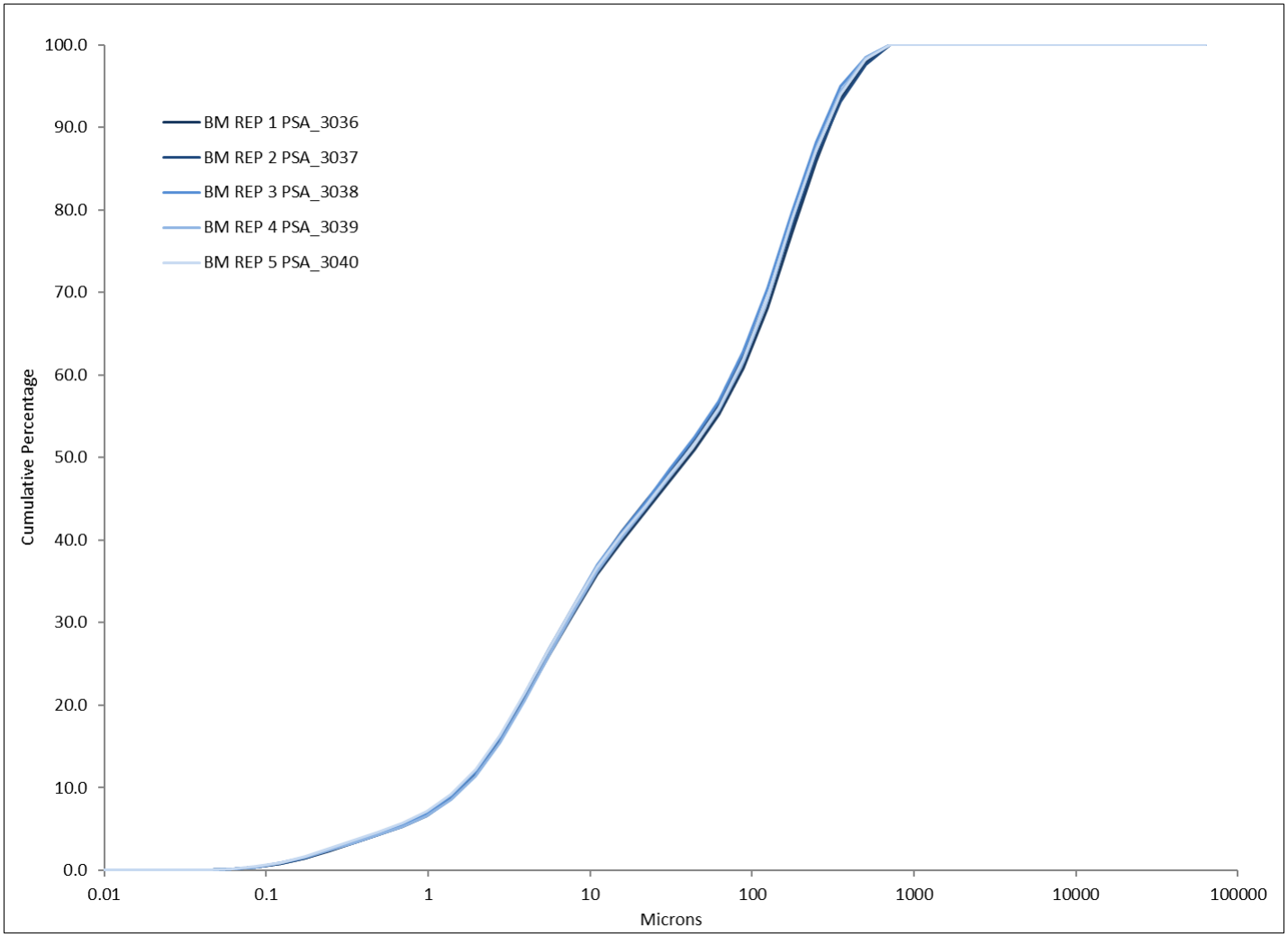

Figure 3 Particle size distribution curves resulting from analysis of 5 replicate samples of sediment distributed as PS90 (Benchmark Data).

2. PARTICIPANT DATA

Table 6 Summary of equipment and methods used by participants and sample summary data provided by participants for sediment distributed as PS90.

Lab	Equipment Used		Method Used	Chemical Dispersant	Peroxide pre-treatment	Summary Data			Sediment Description	
	Sieves	Laser				% Gravel	% Sand	% Mud	(post analysis)	Gradistat Textural Group
BM Average	No	Yes	NMBAQC	No	No	0.00	48.24	51.76	Sandy Mud	Sandy Mud
PSA_3001_a	Yes	Yes	NMBAQC	No	No	0.00	56.82	43.18	Muddy Sand	Muddy Sand
PSA_3001_b	Yes	Yes	NMBAQC	No	No	0.00	52.20	47.80	Muddy Sand	Muddy Sand
PSA_3002	No	Yes	OTHER	No	No	0.00	41.11	58.89	Sandy Mud	Sandy Mud
PSA_3003	Yes	Yes	NMBAQC	No	No	0.00	51.51	48.49	Mud and sandy mud	Muddy Sand
PSA_3004	Yes	Yes	NMBAQC	No	No	0	51.20	48.80	Muddy Sand	Muddy Sand
PSA_3005	No	Yes	NMBAQC	No	No	0.00	42.90	57.10	Sandy Mud	Sandy Mud
PSA_3006	No	Yes	NMBAQC	No	No	0.00	46.90	53.10	Sandy Mud	Sandy Mud
PSA_3007	No	Yes	OTHER	No	No	0.00	44.44	55.56	Sandy Mud	Sandy Mud
PSA_3008	No	Yes	NMBAQC	No	No	0.00	51.56	48.44	Muddy Sand	Muddy Sand
PSA_3009	n/p	n/p	n/p	n/p	n/p	n/p	n/p	n/p	n/p	n/p
PSA_3010	Yes	Yes	NMBAQC	No	No	0.03	64.51	35.46	-	Slightly Gravelly
PSA_3011	No	Yes	NMBAQC	No	No	0.00	48.90	51.10	Sandy Mud	Sandy Mud
PSA_3012	Yes	Yes	NMBAQC	No	No	0.00	49.87	50.13	Sandy Mud	Sandy Mud
PSA_3013	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r	n/r
PSA_3014	n/p	n/p	n/p	n/p	n/p	n/p	n/p	n/p	n/p	n/p
PSA_3015	No	Yes	NMBAQC	No	No	0.00	52.20	47.80	Muddy Sand	Muddy Sand

Table 7 Summary of the sieve data* provided by participants for sediment distributed as PS90.

Phi interval (explicit); Sieve mesh (mm)		Benchmark Average	PSA_3001_a	PSA_3003	PSA_3004	PSA_3010	PSA_3012
Sieves Used		No	Yes	Yes	Yes	Yes	Yes
-6.50 to -6.00; 63 mm		-				0.00	
-6.00 to -5.50; 45 mm		-				0.00	
-5.50 to -5.00; 31.5 mm		-				0.00	
-5.00 to -4.50; 22.4 mm		-				0.00	
-4.50 to -4.00; 16 mm		-				0.00	
-4.00 to -3.50; 11.2 mm		-				0.00	
-3.50 to -3.00; 8 mm		-				0.00	
-3.00 to -2.50; 5.6 mm		-				0.00	
-2.50 to -2.00; 4 mm		-				0.00	
-2.00 to -1.50; 2.8 mm		-				0.00	
-1.50 to -1.00; 2 mm		-				0.04	0.0030
-1.00 to -0.50; 1.4 mm		-	0.001			0.04	0.0050
-0.50 to 0.00; 1 mm		-	0.005	0.01	0.02	0.09	0.0049
Total		-	0.01	0.01	0.02	0.17	0.0129
Summary Data							
>1 mm		-	0.01	0.01	0.02	0.17	0.01
<1 mm	Base pan	-	0.02	0.01	0.00	0.00	0.03
	Oven dried	-	96.88	76.48	94.81	111.40	72.05
Total Sample Weight		-	96.91	76.50	94.83	111.57	72.10

*Data is only shown for participants who undertook sieve analysis.

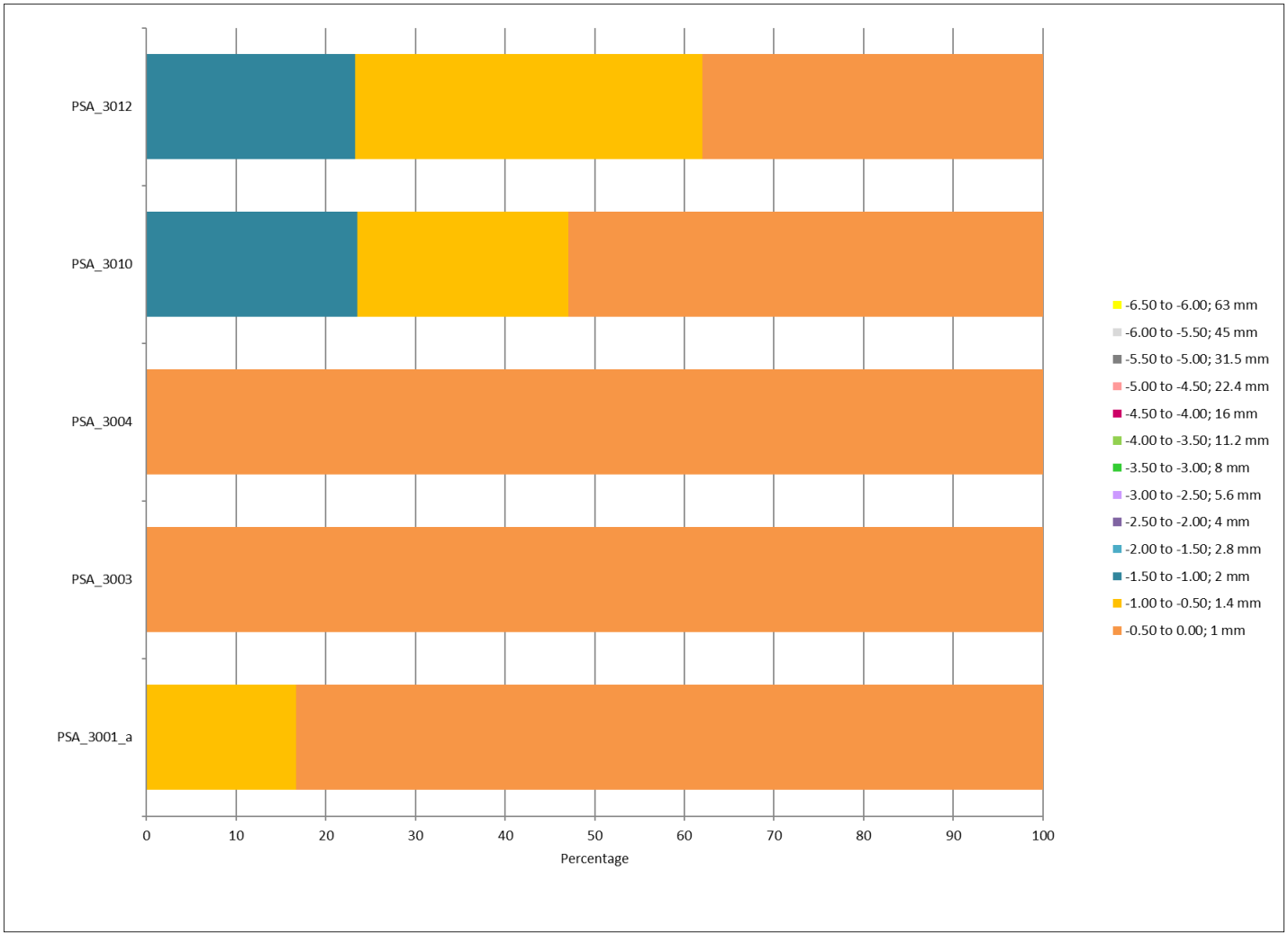

Figure 4 Final sieve data (in percentages) provided by each participant for sediment distributed as PS90.

Table 8 Summary of final laser data for the participants for sediment distributed as PS90 with Gradistat output.

Microns	BM Average	PSA_3001_a	PSA_3001_b	PSA_3002	PSA_3003	PSA_3004	PSA_3005	PSA_3006
707	1.89	1.39	1.37	0.00	2.82	0.68	0.00	1.60
500	4.14	5.47	3.78	0.14	5.10	3.83	2.13	3.60
353.6	6.92	9.59	7.16	2.95	7.31	7.55	6.23	6.58
250	8.60	11.60	9.82	8.21	9.34	9.79	8.06	8.37
176.8	9.18	10.75	10.24	9.81	10.07	9.77	8.03	9.32
125	7.42	8.18	8.71	8.35	7.61	8.49	7.14	7.44
88.39	5.79	5.69	6.43	6.40	5.41	6.51	6.10	5.75
62.5	4.31	4.15	4.68	5.25	3.85	4.81	5.21	4.24
44.19	3.76	3.46	3.84	4.75	3.69	3.79	4.65	3.76
31.25	3.81	3.28	3.65	4.61	2.71	3.51	4.46	4.00
22.097	3.64	3.37	3.74	4.70	4.26	3.81	4.60	3.72
15.625	4.02	3.67	3.98	5.02	3.05	4.23	4.97	4.19
11.049	4.98	4.12	4.42	5.64	3.14	4.63	5.49	5.12
7.813	5.18	4.57	5.07	6.37	5.00	5.41	5.98	5.36
5.524	5.38	4.80	5.55	6.74	5.51	5.64	6.15	5.49
3.906	5.13	4.64	5.39	6.39	5.04	5.25	5.81	5.15
2.762	4.09	3.98	4.59	5.34	4.08	4.61	4.98	4.10
1.953	2.92	2.93	3.16	3.74	3.11	2.91	3.79	2.93
1.381	2.04	1.86	1.74	2.14	2.21	1.76	2.53	2.04
0.977	1.39	1.12	1.14	1.40	1.46	1.25	1.61	1.41
0.691	1.03	0.76	1.15	1.42	1.08	1.32	1.13	1.07
0.488	0.95	0.51	0.38	0.62	1.03	0.47	0.75	1.00
0.345	0.97	0.13	0.00	0.01	1.04	0.00	0.20	1.02
0.244	0.91	0.00	0.00	0.00	0.91	0.00	0.00	0.96
0.173	0.70	0.00	0.00	0.00	0.61	0.00	0.00	0.75
0.122	0.48	0.00	0.00	0.00	0.35	0.00	0.00	0.54
0.086	0.28	0.00	0.00	0.00	0.16	0.00	0.00	0.32
0.061	0.10	0.00	0.00	0.00	0.05	0.00	0.00	0.12
0.043	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.02
0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gradistat Outputs								
MEAN:	40.29	59.21	48.52	30.64	45.68	47.35	33.78	37.60
SORTING:	7.96	6.62	6.45	5.87	8.22	6.45	6.49	7.98
SKEWNESS:	-0.24	-0.40	-0.30	-0.08	-0.32	-0.28	-0.09	-0.21
KURTOSIS:	0.77	0.71	0.70	0.69	0.75	0.70	0.71	0.78
MODE:	Trimodal	Bimodal	Bimodal	Bimodal	Trimodal	Bimodal	Bimodal	Trimodal
Mode 1	213.40	301.80	213.40	213.40	213.40	301.80	301.80	213.40
Mode 2	6.67	6.67	6.67	6.67	6.67	6.67	6.67	6.67
Mode 3	37.72	-	-	-	26.67	-	-	37.72

Table 8 Summary of final laser data for the participants for sediment distributed as PS90 with Gradistat output.

Microns	BM Average	PSA_3007	PSA_3008	PSA_3010	PSA_3011	PSA_3012	PSA_3015
1000	-	-	-	-	0.05	-	-
707	1.89	0.43	2.49	2.27	2.42	0.28	4.06
500	4.14	3.58	5.83	8.72	4.02	3.02	11.48
353.6	6.92	6.91	8.14	12.98	6.02	6.74	10.23
250	8.60	9.09	10.29	13.17	9.03	9.40	10.54
176.8	9.18	9.09	8.79	10.37	9.37	9.80	6.14
125	7.42	6.86	6.33	7.12	8.18	8.72	2.87
88.39	5.79	4.43	5.48	5.21	6.32	6.76	3.30
62.5	4.31	4.05	4.21	4.65	3.48	5.13	3.57
44.19	3.76	5.61	4.56	4.57	2.75	4.26	2.91
31.25	3.81	7.19	5.21	4.32	4.44	4.02	4.02
22.097	3.64	7.41	5.89	3.92	4.49	4.18	4.21
15.625	4.02	6.49	6.12	3.59	4.17	4.48	4.44
11.049	4.98	5.45	5.99	3.42	4.59	4.92	3.54
7.813	5.18	4.82	5.90	3.27	5.09	5.25	4.90
5.524	5.38	4.48	5.47	3.01	5.29	5.50	4.91
3.906	5.13	4.05	4.34	2.60	4.87	5.18	3.46
2.762	4.09	3.37	2.94	2.15	3.70	4.42	4.15
1.953	2.92	2.50	1.54	1.61	2.55	3.14	3.25
1.381	2.04	1.66	0.48	1.10	1.88	1.82	1.86
0.977	1.39	1.10	0.00	0.76	1.50	1.21	1.79
0.691	1.03	0.82	0.00	0.63	1.26	1.24	1.24
0.488	0.95	0.52	0.00	0.45	1.15	0.53	0.72
0.345	0.97	0.09	0.00	0.11	1.06	0.00	0.81
0.244	0.91	0.00	0.00	0.00	0.90	0.00	0.69
0.173	0.70	0.00	0.00	0.00	0.64	0.00	0.41
0.122	0.48	0.00	0.00	0.00	0.43	0.00	0.37
0.086	0.28	0.00	0.00	0.00	0.25	0.00	0.12
0.061	0.10	0.00	0.00	0.00	0.09	0.00	0.00
0.043	0.01	0.00	0.00	0.00	0.01	0.00	0.00
0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Gradistat Outputs							
MEAN:	40.29	43.55	59.92	92.08	40.91	44.40	54.05
SORTING:	7.96	5.87	5.50	5.63	8.00	6.26	8.75
SKEWNESS:	-0.24	-0.07	-0.14	-0.46	-0.24	-0.25	-0.27
KURTOSIS:	0.77	0.78	0.71	0.87	0.80	0.71	0.70
MODE:	Trimodal	Bimodal	Bimodal	Unimodal	Trimodal	Bimodal	Polymodal
Mode 1	213.40	213.40	301.80	301.80	213.40	213.40	301.80
Mode 2	6.67	26.67	18.86	-	6.67	6.67	6.67
Mode 3	37.72	-	-	-	26.67	-	18.86

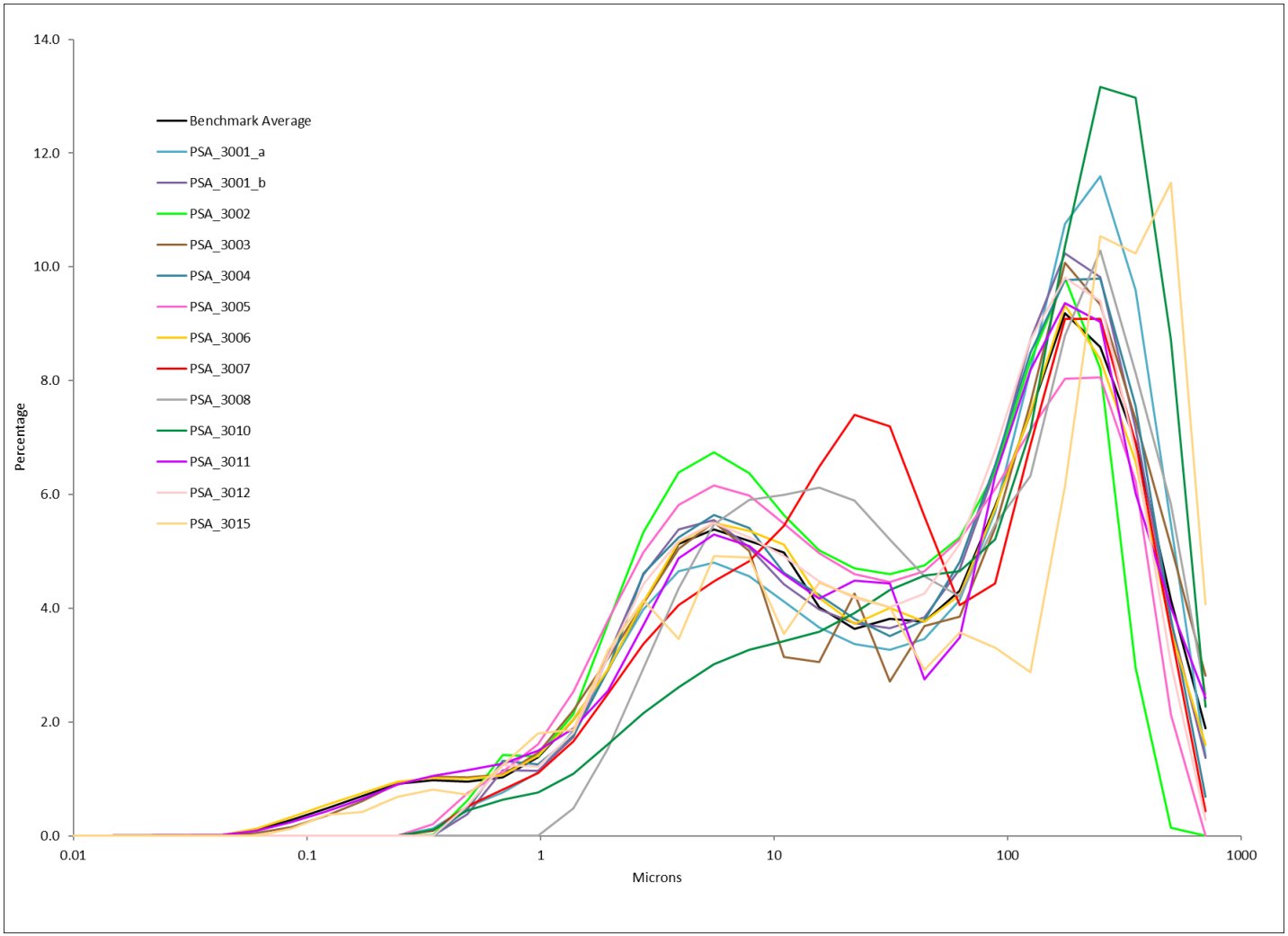

Figure 5 Final laser data (in percentages) provided by each participant and the Benchmark average for sediment distributed as PS90.

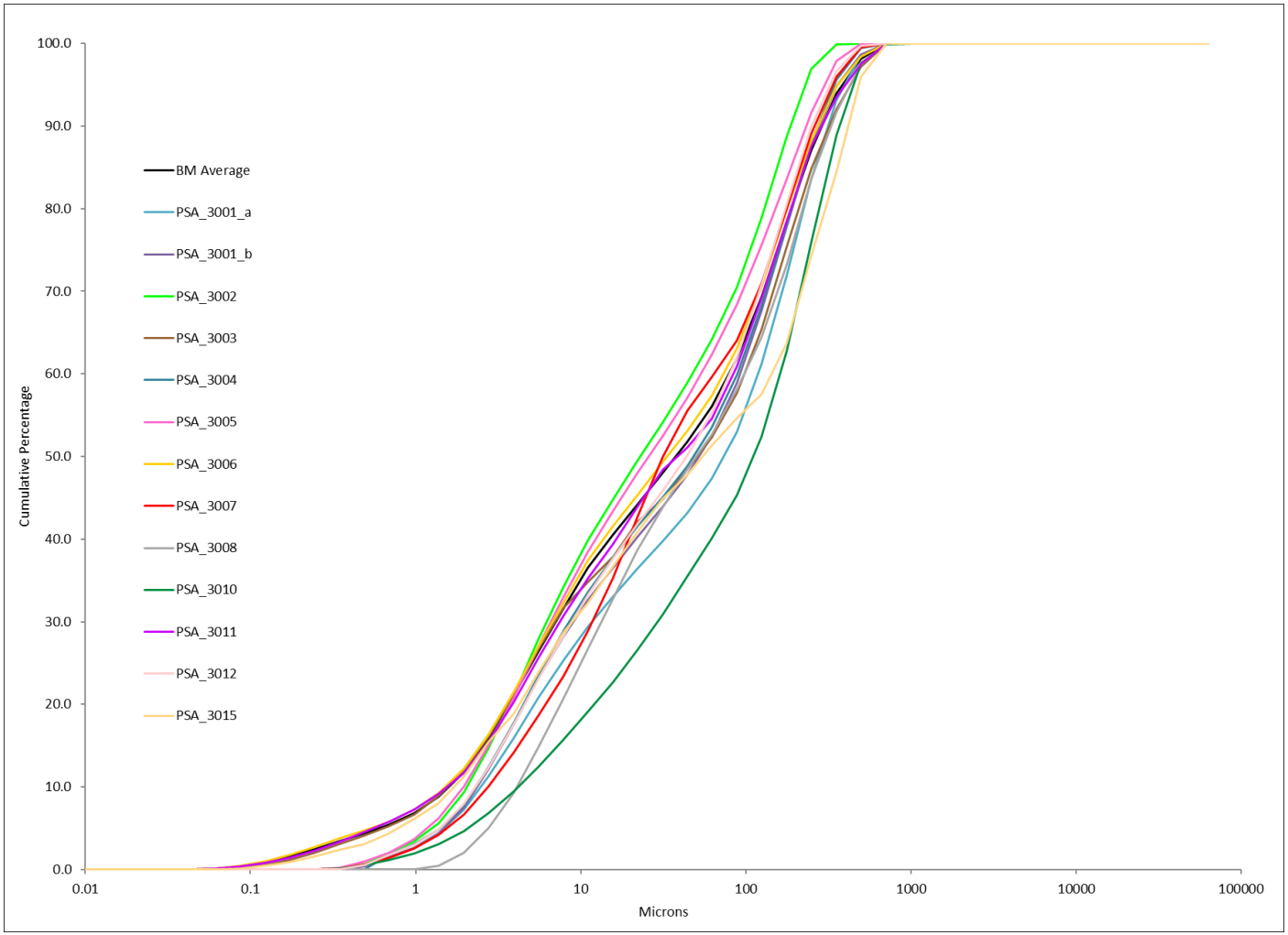

Figure 6 Particle size distribution curves from all participating laboratories and the Benchmark average for sediment distributed as PS90.

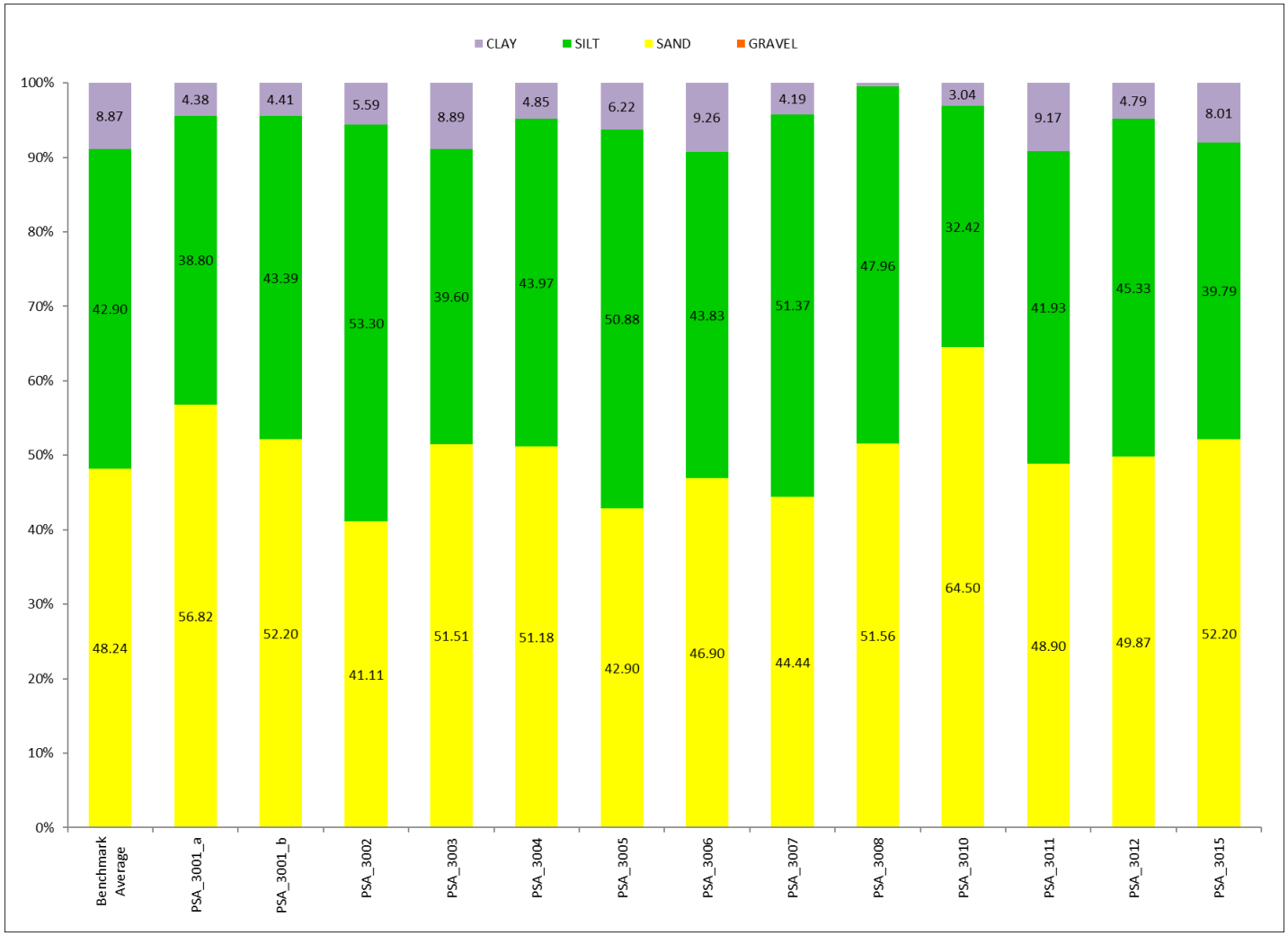

Figure 7 Bar charts showing the percentage gravel, sand, silt and clay recorded by each participating laboratory and the Benchmark average for PS90**.**

All appendices are MS Excel files embedded within this PDF Report.

Appendix 1 – Benchmark and Participant laser replicate data for sediment distributed as PS90.

Appendix 2 - Gradistat output of size categories based on final merged data provided by each participant and the Benchmark Average for sediment distributed as PS90.

Appendix 3 – Benchmark Lab and Participant Final Merged Data for sediment distributed as PS90.