The National Marine Biological
Analytical Quality Control Scheme
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Particle Size Analysis
Results for PS51

2013/2014 (Year 20)

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Table 1. Summary of the replicate benchmark analysis and particle size information received from participating laboratories for exercise PS51.

Benchmark Data

Sample	Method	% Gravel	% Sand	% Mud	Median φ	Mean φ	Sediment Description (Post analysis)
PS51 TUM01	NMBAQC	99.67	0.33	0.00	-2.72	-2.80	Gravel
PS51 TUM02	NMBAQC	99.70	0.30	0.00	-2.73	-2.82	Gravel
PS51 TUM03	NMBAQC	99.80	0.20	0.00	-2.72	-2.80	Gravel
PS51 TUM04	NMBAQC	99.85	0.15	0.00	-2.73	-2.82	Gravel
PS51 TUM05	NMBAQC	99.77	0.23	0.00	-2.74	-2.82	Gravel
PS51 TUM06	NMBAQC	99.83	0.17	0.00	-2.73	-2.81	Gravel
PS51 TUM07	NMBAQC	99.85	0.15	0.00	-2.72	-2.81	Gravel
PS51 TUM08	NMBAQC	99.84	0.16	0.00	-2.73	-2.82	Gravel
PS51 TUM09	NMBAQC	99.81	0.19	0.00	-2.73	-2.81	Gravel
PS51 TUM10	NMBAQC	99.75	0.25	0.00	-2.73	-2.81	Gravel
TUM AVERAGE	NMBAQC	99.79	0.21	0.00	-2.73	-2.81	Gravel

Participant Data

Lab	Method	% Gravel	% Sand	% Mud	Sediment Description (Post analysis)
LB2003	NMBAQC	99.93	0.07	0.00	Gravel
LB2007	NMBAQC	99.91	0.09	0.00	Fine Gravel
LB2015	NMBAQC	99.88	0.12	0.00	Gravel
LB2020	NMBAQC	99.94	0.06	0.00	Gravel
LB2021	NMBAQC	99.96	0.04	0.00	Gravel
LB2022	NMBAQC	99.90	0.10	0.00	Gravel
LB2027	NMBAQC	99.95	0.05	0.00	Gravel
LB2029	NMBAQC	99.78	0.22	0.00	Gravel
LB2031	NMBAQC	99.88	0.12	0.00	Fine gravel
LB2032	NMBAQC	99.76	0.24	0.00	Gravel
LB2054	NMBAQC	99.95	0.05	0.00	Gravel
LB2056	OTHER	99.96	0.04	0.00	Gravel
LB2057	NMBAQC	99.92	0.08	0.00	Gravel
LB2060_A	NMBAQC & OTHER	99.95	0.05	0.00	Gravel
LB2060_B	NMBAQC & OTHER	99.96	0.04	0.00	Gravel
Key to methods					
NMBAQC - States following NMBAQC PSA SOP for supporting biological data					
OTHER - Following a different SOP.					

Figure 1. Particle size distribution curves resulting from analysis of ten replicate samples of sediment distributed as PS51 (Benchmark Data).
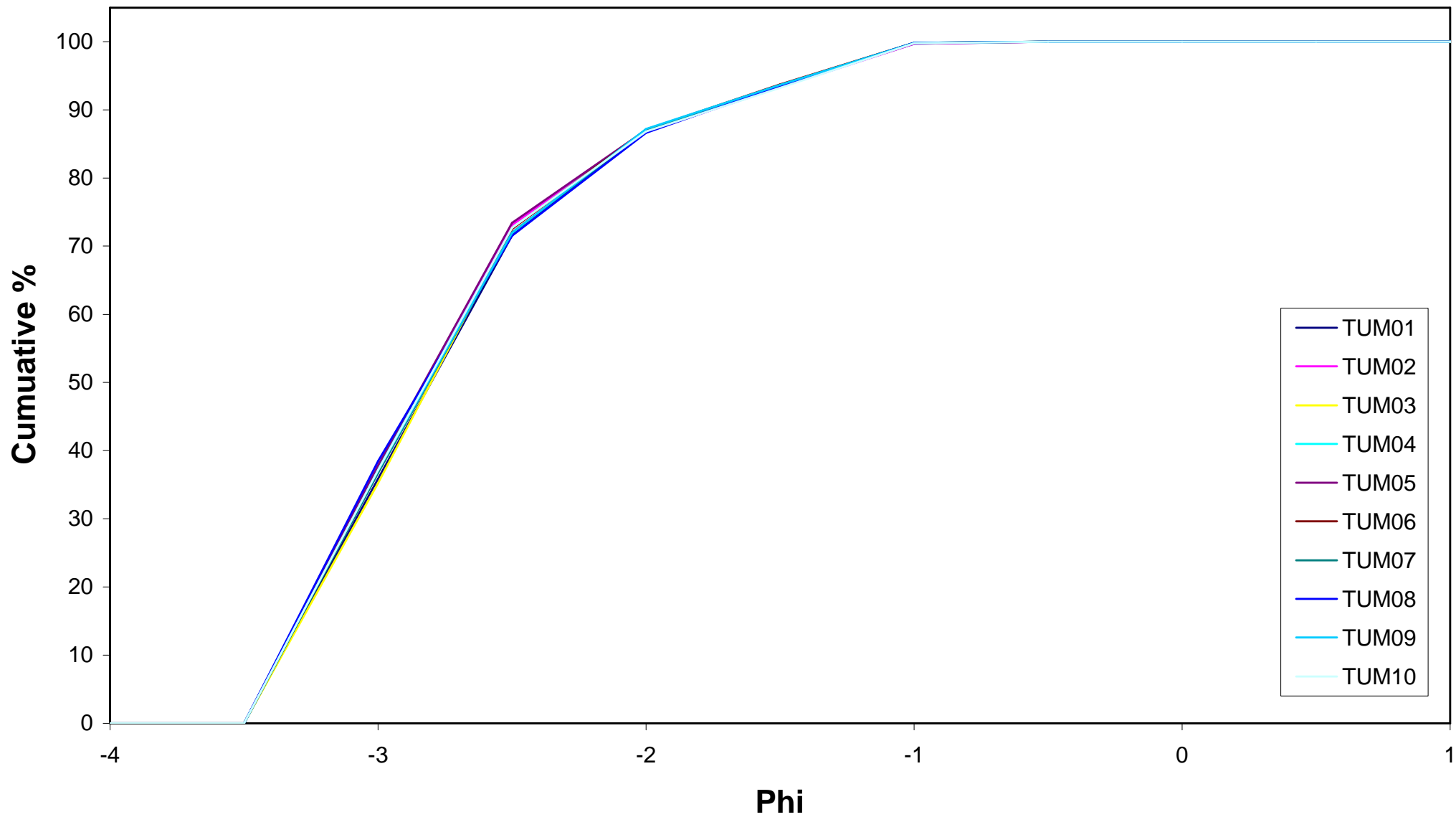
Figure 2. Particle size distribution curves from all participating laboratories for sediment samples from PS51.

Table 2. Summary of z-scores for each half-phi interval for PS51; data from all participating laboratories included in mean and standard deviation calculations.

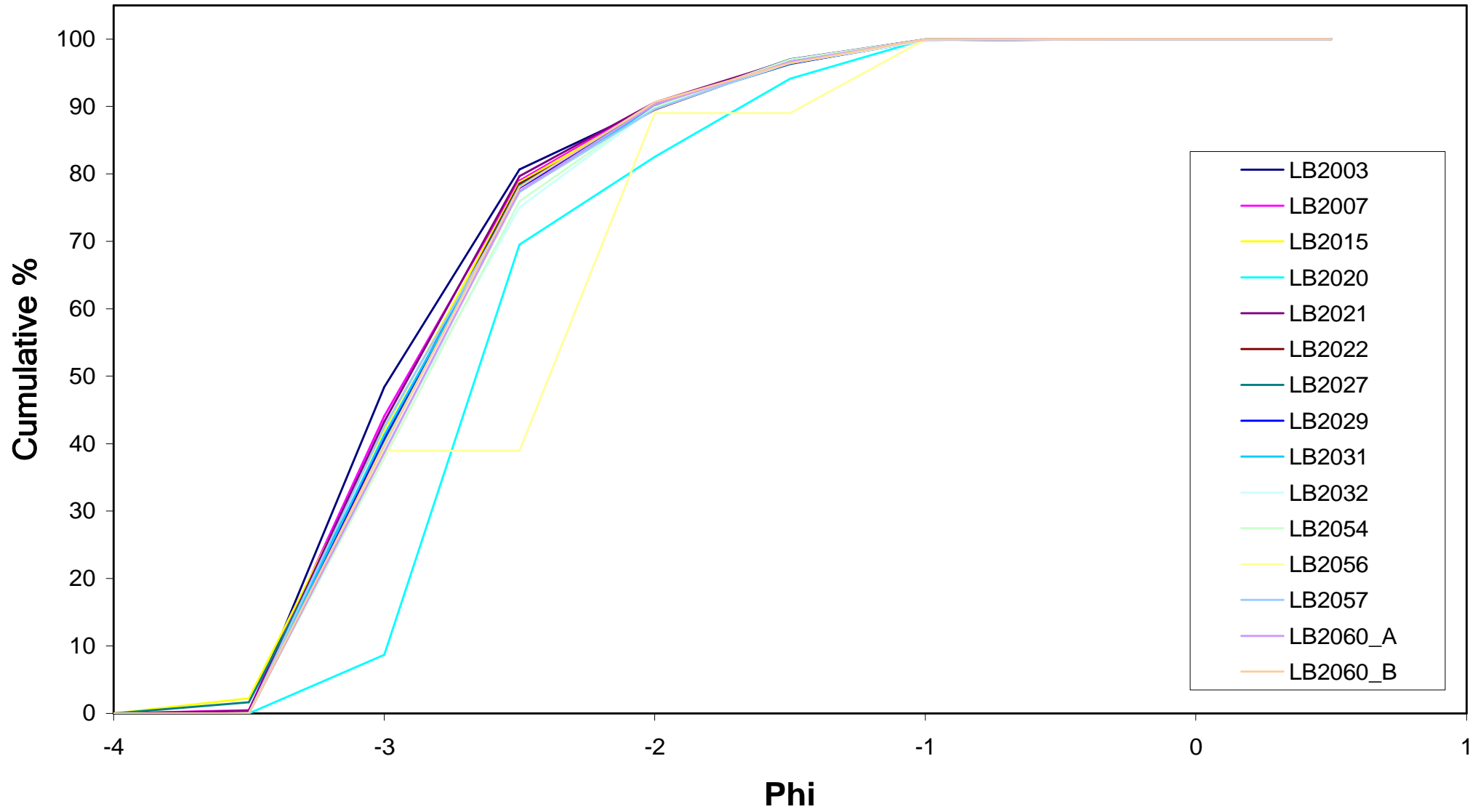|	-4.50 to -4.00	-4.00 to -3.50	-3.50 to -3.00	-3.00 to -2.50	-2.50 to -2.00	-2.00 to -1.50	-1.50 to -1.00	-1.00 to -0.50	-0.50 to 0.00	0.00 to 0.50	0.50 to 1.00
TUM AVERAGE	0	-0.472	-0.209	-0.031	-0.015	0.069	1.120	2.028	-0.519	0	0
LB2003	0	-0.472	1.139	-0.305	-0.554	0.235	-0.500	-0.355	-0.365	0	0
LB2007	0	0.246	0.566	-0.070	-0.328	-0.212	-0.275	0.193	-0.533	0	0
LB2015	0	2.846	0.121	0.091	-0.337	-0.016	-0.356	0.626	-0.397	0	0
LB2020	0	-0.472	-3.561	2.198	-0.173	2.395	0.893	-0.798	1.209	0	0
LB2021	0	0.054	0.486	0.057	-0.390	-0.083	-0.411	-0.763	-0.180	0	0
LB2022	0	-0.472	0.218	0.189	-0.385	0.348	-0.377	0.420	-0.644	0	0
LB2027	0	2.044	0.010	0.176	-0.302	-0.085	-0.171	-0.392	-0.459	0	0
LB2029	0	-0.472	0.244	0.119	-0.280	-0.018	-0.258	0.791	3.155	0	0
LB2031	0	-0.472	0.288	0.035	-0.223	0.104	-0.310	0.483	-0.367	0	0
LB2032	0	-0.472	0.048	0.009	0.012	0.079	-0.306	2.482	-0.551	0	0
LB2054	0	-0.472	-0.107	0.204	-0.073	0.283	-0.481	-0.354	-0.635	0	0
LB2056	0	-0.472	0.018	-3.131	3.710	-2.960	3.392	-1.135	0.885	0	0
LB2057	0	-0.472	0.436	-0.071	-0.259	0.279	-0.332	-0.104	-0.173	0	0
LB2060_A	0	-0.472	-0.015	0.270	-0.195	-0.060	-0.292	-0.532	-0.468	0	0
LB2060_B	0	-0.472	0.110	0.230	-0.222	-0.290	-0.217	-0.562	-0.478	0	0
Mean	0	0.313	38.788	35.731	14.694	6.413	3.970	0.076	0.016	0	0
St. Dev	0	0.664	8.454	11.411	9.543	2.167	2.052	0.067	0.024	0	0

z-score >1.96 or <-1.96
All values equal 0

Figure 3. Summary of z-scores for the benchmark data (TUM Average); data from all participating laboratories included in mean and standard deviation calculations.
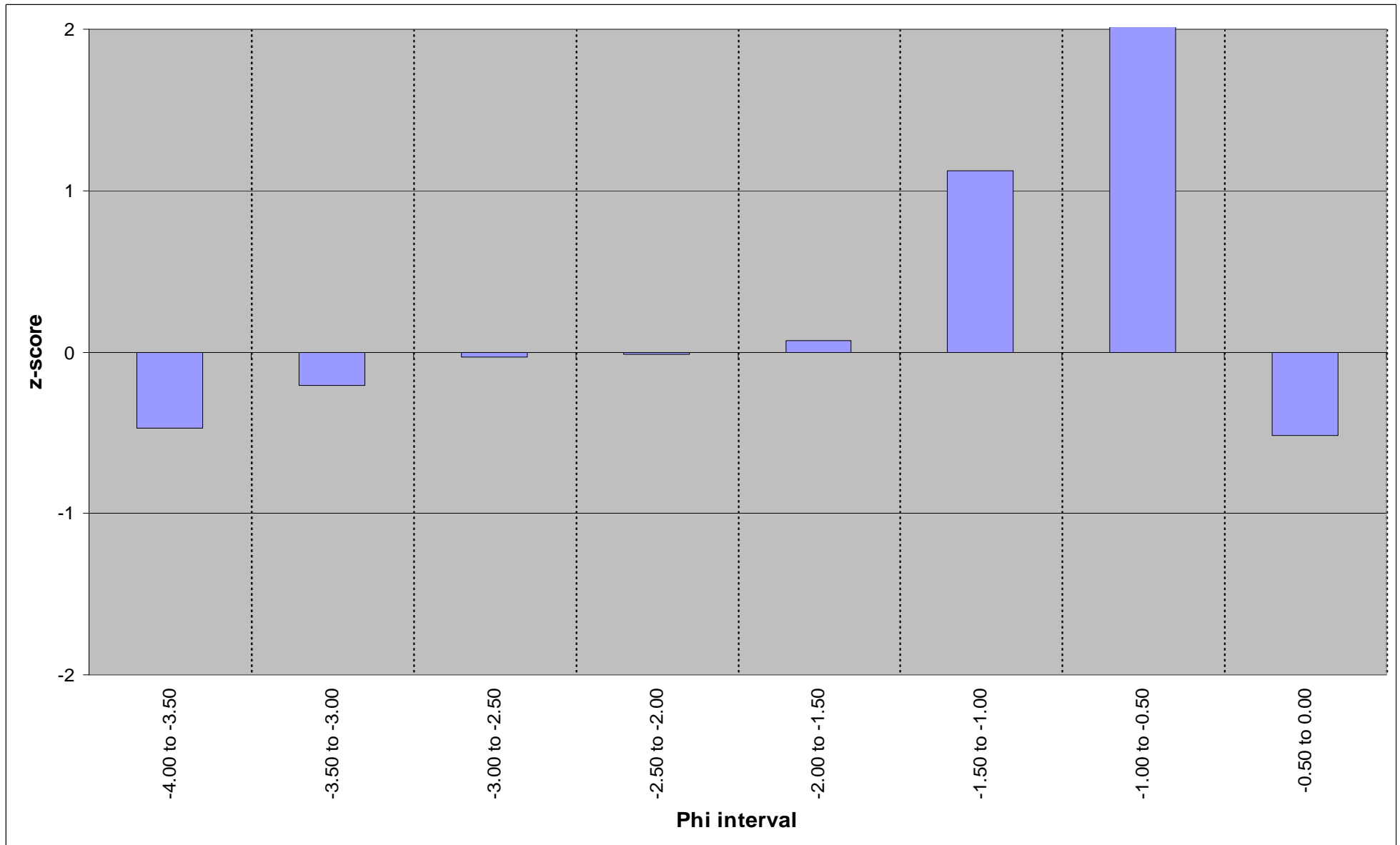
Results of SIMPROF testing on PSA Ring test PS51 data

Data was entered into PRIMER v. 6.1.13 in half-phi intervals; any missing data was entered as zero. The data did not need to be transformed as all data was on a similar percentage scale. A Euclidean distance matrix was created from the data; The Euclidean distance between two samples (labs) j and k, is defined algebraically as $d_{jk} = \sqrt{\sum_{i=1}^{p}(y_{ij} - y_{ik})^2}$. From this distance matrix cluster analysis was carried out including a SIMPROF test at a 5% significance level. The red SIMPROF lines on the dendrogram indicate labs that cannot be distinguished from each other at the 5% significance level; the black lines indicate labs that can be distinguished from each other. The results are presented as a cluster dendrogram (Figure 4) and non-metric Multi-Dimensional Scaling (MDS) diagrams (Figures 5) below. It is important to note that, although the MDS plot is bounded by a box, the box does not represent either axes or scale. Two samples with a high similarity index will appear close together while those less similar will appear further apart. The 'correct' configuration of sample points will be multidimensional and the plot represents the best 2-dimensional solution to the problem. The technique should be viewed as complementary to cluster analysis, offering a different perspective of the same information.

Figure 4. Cluster dendrogram of PS51 including all laboratories, with the benchmark replicates (TUM average).
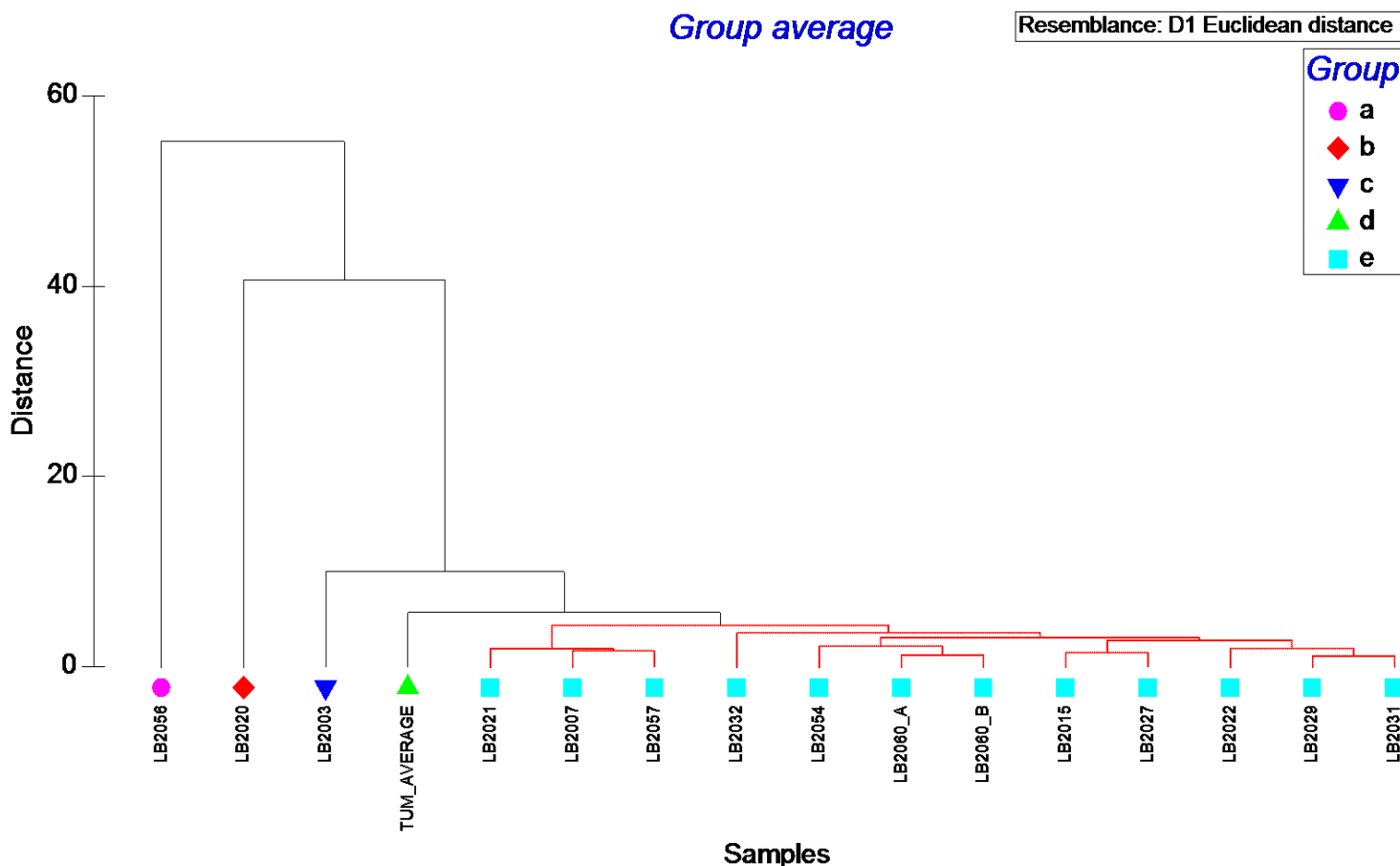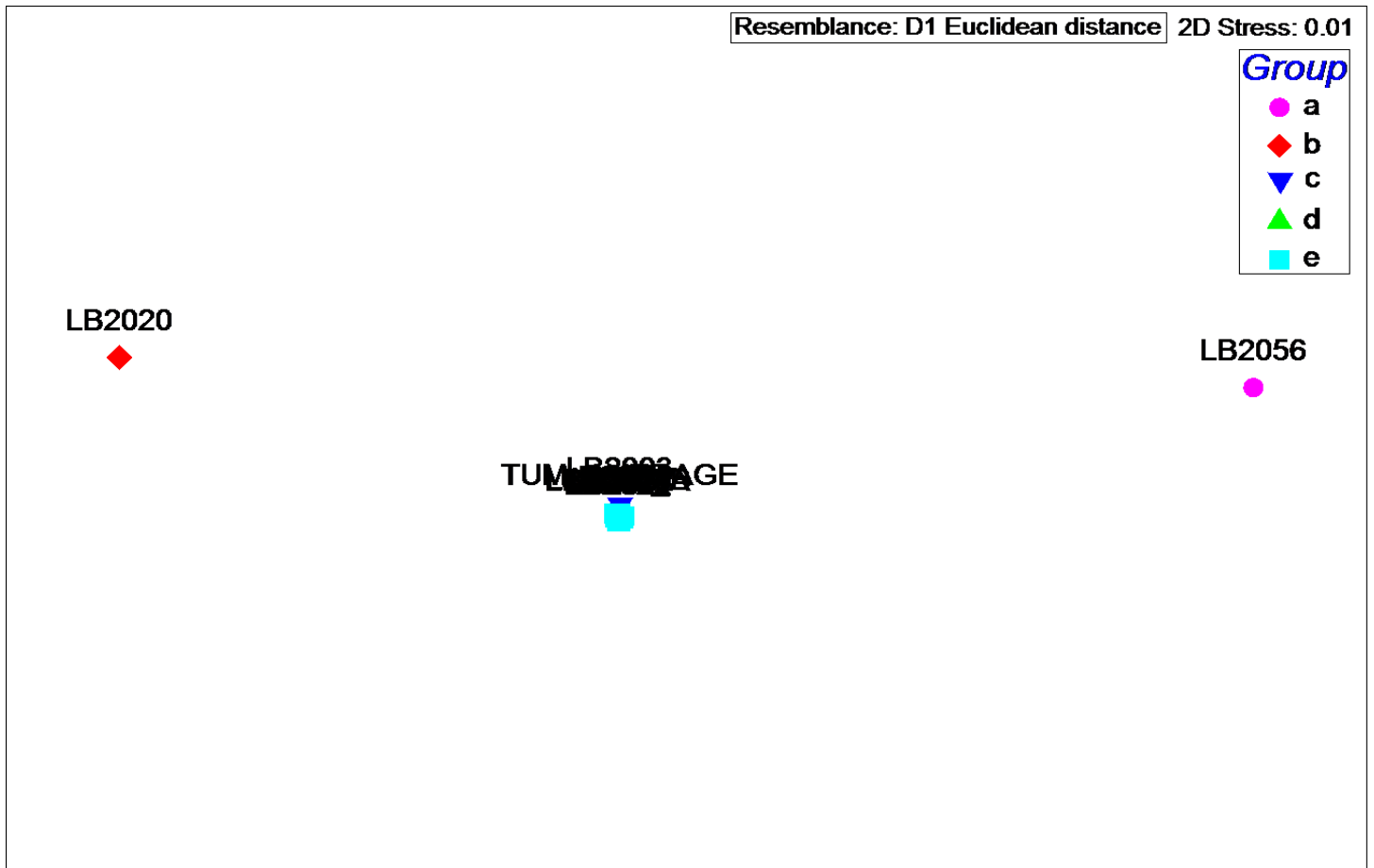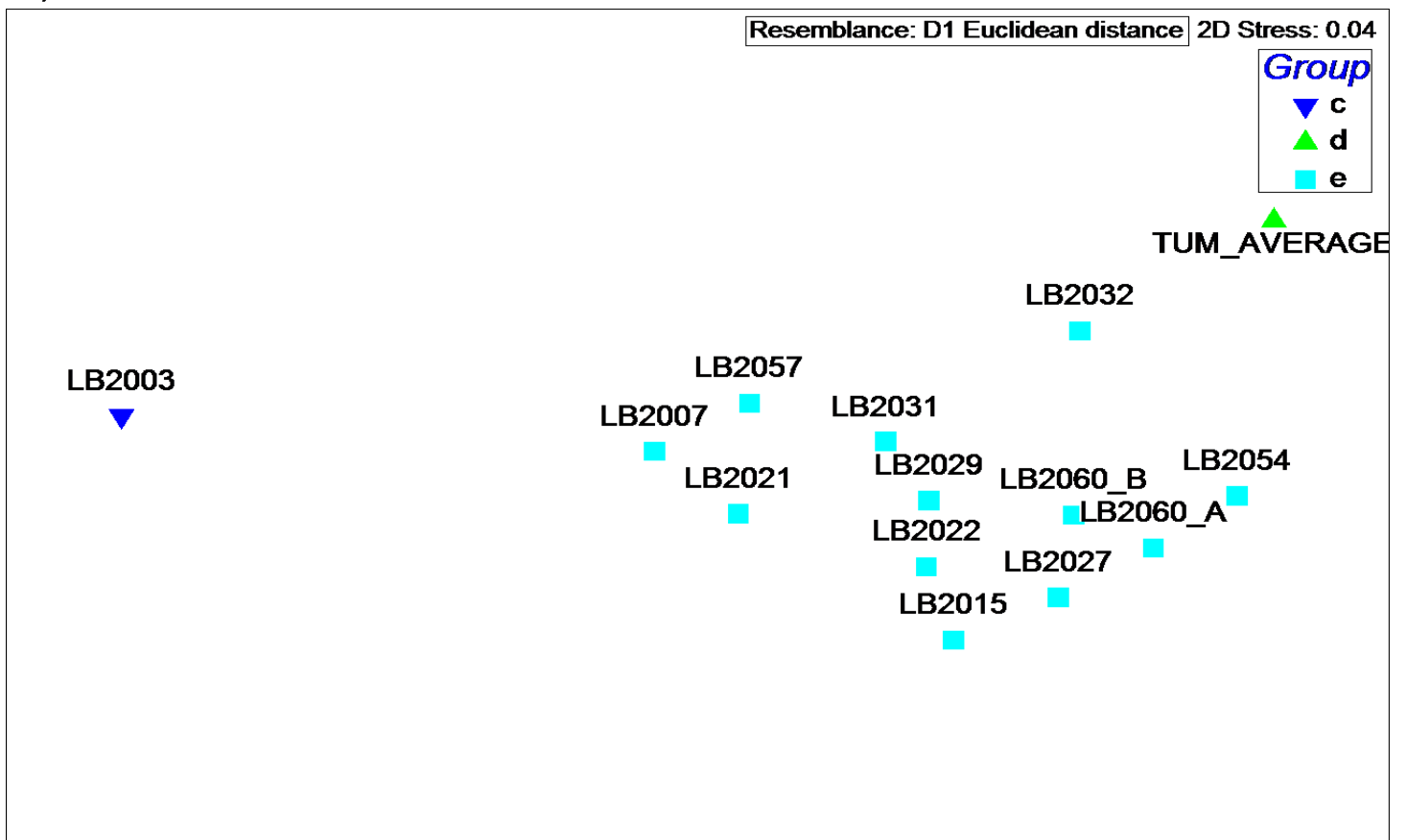
Figure 5. a) MDS plot of PS51 with the benchmark replicates (TUM AVERAGE) averaged; and b) a subset of cluster groups c through e.

a)

b)

Due to a problem with the distributed workbook formulas, the data received was merged independently before further analyses were performed. Statistical analysis is based on the results presented in Appendix 2.

The cluster analysis separates the laboratories in to 5 SIMPROF cluster groups; 4 of these groups each comprise a single laboratory.

Cluster group a comprises a single laboratory (LB2056). Figure 2 shows that LB2056 records intermittent sharp rises in the cumulative percentage curve. This is due to this laboratory recording at each whole phi rather than each half phi level. This discrepancy is also shown in Table 2 with the differences in z-score values between phi levels -3 and -1. However, it does show that this laboratory meets the majority of other laboratories on the cumulative percentage curve where it has recorded values.

Cluster group b is formed of a single laboratory (LB2020). Figure 2 shows that LB2020 did not start recording phi values until -3. It also shows a sharp rise in cumulative percentage between -3 and -2.5. This is due to LB2020 recording a lower percentage proportion of -3 and a higher percentage proportion of -2.5 than any other laboratory. This explains the differences shown in Table 2 regarding these values. The discrepancy shown in table 2 regarding phi level -1.5 is due to this laboratory recording a higher proportion of sediment than any other laboratory an this interval. The cause of these differences could be attributed to this laboratory using alternate apparatus to measure their >1mm sediment.

Cluster group c is formed of a single laboratory (LB2003). Figure 2 shows that LB2003 records higher cumulative proportions of sediment between phi intervals -3 and -2.5. However, the difference is not significant enough to be flagged in Table 2.

Cluster group d (TUM AVERAGE) and e (LB2021, LB2007, LB2057, LB2032, LB2054, LB2060 A&B, LB2015, LB2027, LB2022, LB2029 and LB2031) form the remaining laboratories. Table 2 shows that five laboratories from group d (TUM AVERAGE at -0.5) and e (LB2015 at -3.5; LB2027 at -3.5; LB2029 at 0; and LB2032 at -0.5) had z-scores that differed significantly from other laboratories at one particular phi interval. However, differentiation between these two groups is almost indistinguishable due to the euclidean distance between the remaining laboratories being so low. This is corroborated in figure 5c which presents the correlation between the data of the laboratories in cluster groups c, d and e. The closer the data points are positioned the more analogous the results; hence LB2032 is most related to TUM_AVERAGE as its data point is arranged closest to the TUM data point.

Appendices

Appendix 1. Final Summary Data sheets as supplied by participating laboratories (arranged by Lab Code).

<table>
<tr><td colspan="2">NMBAQCS - PS Exercise Data Workbook
(Page 2 - Final Merged Data Submission)</td><td>Return to Thomson Unicomarine Ltd. by 04-04-14</td></tr>
</table>

Exercise Code:	**PS51**
LabCode:	**LB2003**
Sample Code:	**PS512003**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Total volume percentage (should equal 100) (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	0.0000
-6.00 to -5.50; 45 mm	0.0000
-5.50 to -5.00; 31.5 mm	0.0000
-5.00 to -4.50; 22.4 mm	0.0000
-4.50 to -4.00; 16 mm	0.0000
-4.00 to -3.50; 11.2 mm	0.0000
-3.50 to -3.00; 8 mm	48.3462
-3.00 to -2.50; 5.6 mm	32.2008
-2.50 to -2.00; 4 mm	9.3928
-2.00 to -1.50; 2.8 mm	6.9127
-1.50 to -1.00; 2 mm	2.9400
-1.00 to -0.50; 1.4 mm	0.0519
-0.50 to 0.00; 1 mm	0.0068
0.00 to 0.50; (707 µm)	0.0000
0.50 to 1.00; (500 µm)	0.0000
1.00 to 1.50; (353.6 µm)	0.0000
1.50 to 2.00; (250 µm)	0.0000
2.00 to 2.50; (176.8 µm)	0.0000
2.50 to 3.00; (125 µm)	0.0000
3.00 to 3.50; (88.39 µm)	0.0000
3.50 to 4.00; (62.5 µm)	0.0000
4.00 to 4.50; (44.19 µm)	0.0000
4.50 to 5.00; (31.25 µm)	0.0000
5.00 to 5.50; (22.097 µm)	0.0000
5.50 to 6.00; (15.625 µm)	0.0000
6.00 to 6.50; (11.049 µm)	0.0000
6.50 to 7.00; (7.813 µm)	0.0000
7.00 to 7.50; (5.524 µm)	0.0000
7.50 to 8.00; (3.906 µm)	0.0000
8.00 to 8.50; (2.762 µm)	0.0000
8.50 to 9.00; (1.953 µm)	0.0000
9.00 to 9.50; (1.381 µm)	0.0000
9.50 to 10.00; (0.977 µm)	0.0000
10.00 to 10.50; (0.691 µm)	0.0000
10.50 to 11.00; (0.488 µm)	0.0000
11.00 to 11.50; (0.345 µm)	0.0000
11.50 to 12.00; (0.244 µm)	0.0000
12.00 to 12.50; (0.173 µm)	0.0000
12.50 to 13.00; (0.122 µm)	0.0000
13.00 to 13.50; (0.086 µm)	0.0000

NMBAQCS - PS Exercise Data Workbook
(Page 2 - Final Merged Data Submission)

Exercise Code:	**PS51**
LabCode:	**LB2007**
Sample Code:	**PS512007**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Total volume percentage (should equal 100) (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	**0.0000**
-6.00 to -5.50; 45 mm	**0.0000**
-5.50 to -5.00; 31.5 mm	**0.0000**
-5.00 to -4.50; 22.4 mm	**0.0000**
-4.50 to -4.00; 16 mm	**0.0000**
-4.00 to -3.50; 11.2 mm	**2.1180**
-3.50 to -3.00; 8 mm	**193.6320**
-3.00 to -2.50; 5.6 mm	**155.2450**
-2.50 to -2.00; 4 mm	**51.3680**
-2.00 to -1.50; 2.8 mm	**26.4570**
-1.50 to -1.00; 2 mm	**15.1340**
-1.00 to -0.50; 1.4 mm	**0.3930**
-0.50 to 0.00; 1 mm	**0.0120**
0.00 to 0.50; (707 µm)	**0.0320**
0.50 to 1.00; (500 µm)	**0.0300**
1.00 to 1.50; (353.6 µm)	**0.0530**
1.50 to 2.00; (250 µm)	**0.0730**
2.00 to 2.50; (176.8 µm)	**0.0800**
2.50 to 3.00; (125 µm)	**0.0610**
3.00 to 3.50; (88.39 µm)	**0.1220**
3.50 to 4.00; (62.5 µm)	**0.0200**
4.00 to 4.50; (44.19 µm)	**0.0180**
4.50 to 5.00; (31.25 µm)	**0.0000**
5.00 to 5.50; (22.097 µm)	**0.0000**
5.50 to 6.00; (15.625 µm)	**0.0000**
6.00 to 6.50; (11.049 µm)	**0.0000**
6.50 to 7.00; (7.813 µm)	**0.0000**
7.00 to 7.50; (5.524 µm)	**0.0000**
7.50 to 8.00; (3.906 µm)	**0.0000**
8.00 to 8.50; (2.762 µm)	**0.0000**
8.50 to 9.00; (1.953 µm)	**0.0000**
9.00 to 9.50; (1.381 µm)	**0.0000**
9.50 to 10.00; (0.977 µm)	**0.0000**
10.00 to 10.50; (0.691 µm)	**0.0000**
10.50 to 11.00; (0.488 µm)	**0.0000**
11.00 to 11.50; (0.345 µm)	**0.0000**
11.50 to 12.00; (0.244 µm)	**0.0000**
12.00 to 12.50; (0.173 µm)	**0.0000**
12.50 to 13.00; (0.122 µm)	**0.0000**
13.00 to 13.50; (0.086 µm)	**0.0000**

Exercise Code:	PS51
LabCode:	LB2015
Sample Code:	PS512015

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Total volume percentage (should equal 100) (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	0.0000
-6.00 to -5.50; 45 mm	0.0000
-5.50 to -5.00; 31.5 mm	0.0000
-5.00 to -4.50; 22.4 mm	0.0000
-4.50 to -4.00; 16 mm	0.0000
-4.00 to -3.50; 11.2 mm	2.2000
-3.50 to -3.00; 8 mm	39.8100
-3.00 to -2.50; 5.6 mm	36.7700
-2.50 to -2.00; 4 mm	11.4800
-2.00 to -1.50; 2.8 mm	6.3800
-1.50 to -1.00; 2 mm	3.2400
-1.00 to -0.50; 1.4 mm	0.1200
-0.50 to 0.00; 1 mm	0.0100
0.00 to 0.50; (707 µm)	0.0200
0.50 to 1.00; (500 µm)	0.0000
1.00 to 1.50; (353.6 µm)	0.0000
1.50 to 2.00; (250 µm)	0.0000
2.00 to 2.50; (176.8 µm)	0.0000
2.50 to 3.00; (125 µm)	0.0000
3.00 to 3.50; (88.39 µm)	0.0000
3.50 to 4.00; (62.5 µm)	0.0000
4.00 to 4.50; (44.19 µm)	0.0000
4.50 to 5.00; (31.25 µm)	0.0000
5.00 to 5.50; (22.097 µm)	0.0000
5.50 to 6.00; (15.625 µm)	0.0000
6.00 to 6.50; (11.049 µm)	0.0000
6.50 to 7.00; (7.813 µm)	0.0000
7.00 to 7.50; (5.524 µm)	0.0000
7.50 to 8.00; (3.906 µm)	0.0000
8.00 to 8.50; (2.762 µm)	0.0000
8.50 to 9.00; (1.953 µm)	0.0000
9.00 to 9.50; (1.381 µm)	0.0000
9.50 to 10.00; (0.977 µm)	0.0000
10.00 to 10.50; (0.691 µm)	0.0000
10.50 to 11.00; (0.488 µm)	0.0000
11.00 to 11.50; (0.345 µm)	0.0000
11.50 to 12.00; (0.244 µm)	0.0000
12.00 to 12.50; (0.173 µm)	0.0000
12.50 to 13.00; (0.122 µm)	0.0000
13.00 to 13.50; (0.086 µm)	0.0000

Exercise Code:	**PS51**
LabCode:	**LB2020**
Sample Code:	**PS512020**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Total volume percentage (should equal 100) (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	0.0000
-6.00 to -5.50; 45 mm	0.0000
-5.50 to -5.00; 31.5 mm	0.0000
-5.00 to -4.50; 22.4 mm	0.0000
-4.50 to -4.00; 16 mm	0.0000
-4.00 to -3.50; 11.2 mm	0.0000
-3.50 to -3.00; 8 mm	8.6800
-3.00 to -2.50; 5.6 mm	60.8118
-2.50 to -2.00; 4 mm	13.0425
-2.00 to -1.50; 2.8 mm	11.6033
-1.50 to -1.00; 2 mm	5.8017
-1.00 to -0.50; 1.4 mm	0.0225
-0.50 to 0.00; 1 mm	0.0450
0.00 to 0.50; (707 μm)	0.0000
0.50 to 1.00; (500 μm)	0.0000
1.00 to 1.50; (353.6 μm)	0.0000
1.50 to 2.00; (250 μm)	0.0000
2.00 to 2.50; (176.8 μm)	0.0000
2.50 to 3.00; (125 μm)	0.0000
3.00 to 3.50; (88.39 μm)	0.0000
3.50 to 4.00; (62.5 μm)	0.0000
4.00 to 4.50; (44.19 μm)	0.0000
4.50 to 5.00; (31.25 μm)	0.0000
5.00 to 5.50; (22.097 μm)	0.0000
5.50 to 6.00; (15.625 μm)	0.0000
6.00 to 6.50; (11.049 μm)	0.0000
6.50 to 7.00; (7.813 μm)	0.0000
7.00 to 7.50; (5.524 μm)	0.0000
7.50 to 8.00; (3.906 μm)	0.0000
8.00 to 8.50; (2.762 μm)	0.0000
8.50 to 9.00; (1.953 μm)	0.0000
9.00 to 9.50; (1.381 μm)	0.0000
9.50 to 10.00; (0.977 μm)	0.0000
10.00 to 10.50; (0.691 μm)	0.0000
10.50 to 11.00; (0.488 μm)	0.0000
11.00 to 11.50; (0.345 μm)	0.0000
11.50 to 12.00; (0.244 μm)	0.0000
12.00 to 12.50; (0.173 μm)	0.0000
12.50 to 13.00; (0.122 μm)	0.0000
13.00 to 13.50; (0.086 μm)	0.0000

Exercise Code:	**PS51**
LabCode:	**LB2021**
Sample Code:	**PS512021**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Total volume percentage (should equal 100) (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	0.0000
-6.00 to -5.50; 45 mm	0.0000
-5.50 to -5.00; 31.5 mm	0.0000
-5.00 to -4.50; 22.4 mm	0.0000
-4.50 to -4.00; 16 mm	0.0000
-4.00 to -3.50; 11.2 mm	0.3486
-3.50 to -3.00; 8 mm	42.8334
-3.00 to -2.50; 5.6 mm	36.3291
-2.50 to -2.00; 4 mm	10.9529
-2.00 to -1.50; 2.8 mm	6.2232
-1.50 to -1.00; 2 mm	3.1217
-1.00 to -0.50; 1.4 mm	0.0247
-0.50 to 0.00; 1 mm	0.0112
0.00 to 0.50; (707 μm)	0.0000
0.50 to 1.00; (500 μm)	0.0000
1.00 to 1.50; (353.6 μm)	0.0000
1.50 to 2.00; (250 μm)	0.0000
2.00 to 2.50; (176.8 μm)	0.0000
2.50 to 3.00; (125 μm)	0.0000
3.00 to 3.50; (88.39 μm)	0.0000
3.50 to 4.00; (62.5 μm)	0.0000
4.00 to 4.50; (44.19 μm)	0.0000
4.50 to 5.00; (31.25 μm)	0.0000
5.00 to 5.50; (22.097 μm)	0.0000
5.50 to 6.00; (15.625 μm)	0.0000
6.00 to 6.50; (11.049 μm)	0.0000
6.50 to 7.00; (7.813 μm)	0.0000
7.00 to 7.50; (5.524 μm)	0.0000
7.50 to 8.00; (3.906 μm)	0.0000
8.00 to 8.50; (2.762 μm)	0.0000
8.50 to 9.00; (1.953 μm)	0.0000
9.00 to 9.50; (1.381 μm)	0.0000
9.50 to 10.00; (0.977 μm)	0.0000
10.00 to 10.50; (0.691 μm)	0.0000
10.50 to 11.00; (0.488 μm)	0.0000
11.00 to 11.50; (0.345 μm)	0.0000
11.50 to 12.00; (0.244 μm)	0.0000
12.00 to 12.50; (0.173 μm)	0.0000
12.50 to 13.00; (0.122 μm)	0.0000
13.00 to 13.50; (0.086 μm)	0.0000

Exercise Code:	**PS51**
LabCode:	**LB2022**
Sample Code:	**PS512022**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Total volume percentage (should equal 100) (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	0.0000
-6.00 to -5.50; 45 mm	0.0000
-5.50 to -5.00; 31.5 mm	0.0000
-5.00 to -4.50; 22.4 mm	0.0000
-4.50 to -4.00; 16 mm	0.0000
-4.00 to -3.50; 11.2 mm	0.0000
-3.50 to -3.00; 8 mm	40.6219
-3.00 to -2.50; 5.6 mm	37.8724
-2.50 to -2.00; 4 mm	11.0139
-2.00 to -1.50; 2.8 mm	7.1663
-1.50 to -1.00; 2 mm	3.1950
-1.00 to -0.50; 1.4 mm	0.1035
-0.50 to 0.00; 1 mm	0.0000
0.00 to 0.50; (707 µm)	0.0000
0.50 to 1.00; (500 µm)	0.0000
1.00 to 1.50; (353.6 µm)	0.0000
1.50 to 2.00; (250 µm)	0.0000
2.00 to 2.50; (176.8 µm)	0.0000
2.50 to 3.00; (125 µm)	0.0000
3.00 to 3.50; (88.39 µm)	0.0000
3.50 to 4.00; (62.5 µm)	0.0000
4.00 to 4.50; (44.19 µm)	0.0000
4.50 to 5.00; (31.25 µm)	0.0000
5.00 to 5.50; (22.097 µm)	0.0000
5.50 to 6.00; (15.625 µm)	0.0000
6.00 to 6.50; (11.049 µm)	0.0000
6.50 to 7.00; (7.813 µm)	0.0000
7.00 to 7.50; (5.524 µm)	0.0000
7.50 to 8.00; (3.906 µm)	0.0000
8.00 to 8.50; (2.762 µm)	0.0000
8.50 to 9.00; (1.953 µm)	0.0000
9.00 to 9.50; (1.381 µm)	0.0000
9.50 to 10.00; (0.977 µm)	0.0000
10.00 to 10.50; (0.691 µm)	0.0000
10.50 to 11.00; (0.488 µm)	0.0000
11.00 to 11.50; (0.345 µm)	0.0000
11.50 to 12.00; (0.244 µm)	0.0000
12.00 to 12.50; (0.173 µm)	0.0000
12.50 to 13.00; (0.122 µm)	0.0000
13.00 to 13.50; (0.086 µm)	0.0000

Exercise Code:	**PS51**
LabCode:	**LB2027**
Sample Code:	**PS512027**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Total volume % (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	0.0000
-6.00 to -5.50; 45 mm	0.0000
-5.50 to -5.00; 31.5 mm	0.0000
-5.00 to -4.50; 22.4 mm	0.0000
-4.50 to -4.00; 16 mm	0.0000
-4.00 to -3.50; 11.2 mm	7.4300
-3.50 to -3.00; 8 mm	172.8300
-3.00 to -2.50; 5.6 mm	167.7700
-2.50 to -2.00; 4 mm	52.5100
-2.00 to -1.50; 2.8 mm	27.6900
-1.50 to -1.00; 2 mm	16.0900
-1.00 to -0.50; 1.4 mm	0.2200
-0.50 to 0.00; 1 mm	0.0200
0.00 to 0.50; (707 µm)	0.0000
0.50 to 1.00; (500 µm)	0.0000
1.00 to 1.50; (353.6 µm)	0.0000
1.50 to 2.00; (250 µm)	0.0000
2.00 to 2.50; (176.8 µm)	0.0000
2.50 to 3.00; (125 µm)	0.0000
3.00 to 3.50; (88.39 µm)	0.0000
3.50 to 4.00; (62.5 µm)	0.0000
4.00 to 4.50; (44.19 µm)	0.0000
4.50 to 5.00; (31.25 µm)	0.0000
5.00 to 5.50; (22.097 µm)	0.0000
5.50 to 6.00; (15.625 µm)	0.0000
6.00 to 6.50; (11.049 µm)	0.0000
6.50 to 7.00; (7.813 µm)	0.0000
7.00 to 7.50; (5.524 µm)	0.0000
7.50 to 8.00; (3.906 µm)	0.0000
8.00 to 8.50; (2.762 µm)	0.0000
8.50 to 9.00; (1.953 µm)	0.0000
9.00 to 9.50; (1.381 µm)	0.0000
9.50 to 10.00; (0.977 µm)	0.0000
10.00 to 10.50; (0.691 µm)	0.0000
10.50 to 11.00; (0.488 µm)	0.0000
11.00 to 11.50; (0.345 µm)	0.0000
11.50 to 12.00; (0.244 µm)	0.0000
12.00 to 12.50; (0.173 µm)	0.0000
12.50 to 13.00; (0.122 µm)	0.0000
13.00 to 13.50; (0.086 µm)	0.0000

Exercise Code:	**PS51**
LabCode:	**LB2029**
Sample Code:	**PS512029**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Total volume percentage (should equal 100) (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	0.0000
-6.00 to -5.50; 45 mm	0.0000
-5.50 to -5.00; 31.5 mm	0.0000
-5.00 to -4.50; 22.4 mm	0.0000
-4.50 to -4.00; 16 mm	0.0000
-4.00 to -3.50; 11.2 mm	0.0000
-3.50 to -3.00; 8 mm	40.8319
-3.00 to -2.50; 5.6 mm	37.0770
-2.50 to -2.00; 4 mm	12.0157
-2.00 to -1.50; 2.8 mm	6.3721
-1.50 to -1.00; 2 mm	3.4379
-1.00 to -0.50; 1.4 mm	0.1282
-0.50 to 0.00; 1 mm	0.0922
0.00 to 0.50; (707 µm)	0.0000
0.50 to 1.00; (500 µm)	0.0000
1.00 to 1.50; (353.6 µm)	0.0000
1.50 to 2.00; (250 µm)	0.0000
2.00 to 2.50; (176.8 µm)	0.0000
2.50 to 3.00; (125 µm)	0.0001
3.00 to 3.50; (88.39 µm)	0.0003
3.50 to 4.00; (62.5 µm)	0.0004
4.00 to 4.50; (44.19 µm)	0.0006
4.50 to 5.00; (31.25 µm)	0.0009
5.00 to 5.50; (22.097 µm)	0.0011
5.50 to 6.00; (15.625 µm)	0.0012
6.00 to 6.50; (11.049 µm)	0.0013
6.50 to 7.00; (7.813 µm)	0.0013
7.00 to 7.50; (5.524 µm)	0.0013
7.50 to 8.00; (3.906 µm)	0.0066
8.00 to 8.50; (2.762 µm)	0.0000
8.50 to 9.00; (1.953 µm)	0.0000
9.00 to 9.50; (1.381 µm)	0.0000
9.50 to 10.00; (0.977 µm)	0.0000
10.00 to 10.50; (0.691 µm)	0.0000
10.50 to 11.00; (0.488 µm)	0.0000
11.00 to 11.50; (0.345 µm)	0.0000
11.50 to 12.00; (0.244 µm)	0.0000
12.00 to 12.50; (0.173 µm)	0.0000
12.50 to 13.00; (0.122 µm)	0.0000
13.00 to 13.50; (0.086 µm)	0.0000

Exercise Code:	**PS51**
LabCode:	**LB2031**
Sample Code:	**PS512031**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Total volume percentage (should equal 100) (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	0.0000
-6.00 to -5.50; 45 mm	0.0000
-5.50 to -5.00; 31.5 mm	0.0000
-5.00 to -4.50; 22.4 mm	0.0000
-4.50 to -4.00; 16 mm	0.0000
-4.00 to -3.50; 11.2 mm	0.0000
-3.50 to -3.00; 8 mm	41.2220
-3.00 to -2.50; 5.6 mm	36.1265
-2.50 to -2.00; 4 mm	12.5659
-2.00 to -1.50; 2.8 mm	6.6376
-1.50 to -1.00; 2 mm	3.3334
-1.00 to -0.50; 1.4 mm	0.1077
-0.50 to 0.00; 1 mm	0.0067
0.00 to 0.50; (707 μm)	0.0000
0.50 to 1.00; (500 μm)	0.0000
1.00 to 1.50; (353.6 μm)	0.0000
1.50 to 2.00; (250 μm)	0.0000
2.00 to 2.50; (176.8 μm)	0.0000
2.50 to 3.00; (125 μm)	0.0000
3.00 to 3.50; (88.39 μm)	0.0000
3.50 to 4.00; (62.5 μm)	0.0000
4.00 to 4.50; (44.19 μm)	0.0000
4.50 to 5.00; (31.25 μm)	0.0000
5.00 to 5.50; (22.097 μm)	0.0000
5.50 to 6.00; (15.625 μm)	0.0000
6.00 to 6.50; (11.049 μm)	0.0000
6.50 to 7.00; (7.813 μm)	0.0000
7.00 to 7.50; (5.524 μm)	0.0000
7.50 to 8.00; (3.906 μm)	0.0000
8.00 to 8.50; (2.762 μm)	0.0000
8.50 to 9.00; (1.953 μm)	0.0000
9.00 to 9.50; (1.381 μm)	0.0000
9.50 to 10.00; (0.977 μm)	0.0000
10.00 to 10.50; (0.691 μm)	0.0000
10.50 to 11.00; (0.488 μm)	0.0000
11.00 to 11.50; (0.345 μm)	0.0000
11.50 to 12.00; (0.244 μm)	0.0000
12.00 to 12.50; (0.173 μm)	0.0000
12.50 to 13.00; (0.122 μm)	0.0000
13.00 to 13.50; (0.086 μm)	0.0000

Exercise Code:	PS51
LabCode:	LB2032
Sample Code:	PS512032

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Total volume percentage (should equal 100) (mark as "0" for not analysed or no material)
-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	39.17
-3.00 to -2.50; 5.6 mm	35.81
-2.50 to -2.00; 4 mm	14.80
-2.00 to -1.50; 2.8 mm	6.58
-1.50 to -1.00; 2 mm	3.34
-1.00 to -0.50; 1.4 mm	0.24
-0.50 to 0.00; 1 mm	0.00
<1mm	0.06
	0.00
	0.00
	0.00
	0.00
	0.00
	0.00
	0.00
	0.00
	0.00
	0.00
	0.00
	0.00
	0.00
	0.00
	0.00
	0.00
	0.00
	0.00
	0.00
	0.00
	0.00
	0.00
	0.00
	0.00
	0.00
	0.00

Exercise Code:	**PS51**
LabCode:	**LB2054**
Sample Code:	**PS512054**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Total volume percentage (should equal 100) (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	0.0000
-6.00 to -5.50; 45 mm	0.0000
-5.50 to -5.00; 31.5 mm	0.0000
-5.00 to -4.50; 22.4 mm	0.0000
-4.50 to -4.00; 16 mm	0.0000
-4.00 to -3.50; 11.2 mm	0.0000
-3.50 to -3.00; 8 mm	37.8835
-3.00 to -2.50; 5.6 mm	38.0622
-2.50 to -2.00; 4 mm	13.9923
-2.00 to -1.50; 2.8 mm	7.0267
-1.50 to -1.00; 2 mm	2.9830
-1.00 to -0.50; 1.4 mm	0.0520
-0.50 to 0.00; 1 mm	0.0002
0.00 to 0.50; (707 µm)	0.0000
0.50 to 1.00; (500 µm)	0.0000
1.00 to 1.50; (353.6 µm)	0.0000
1.50 to 2.00; (250 µm)	0.0000
2.00 to 2.50; (176.8 µm)	0.0000
2.50 to 3.00; (125 µm)	0.0000
3.00 to 3.50; (88.39 µm)	0.0000
3.50 to 4.00; (62.5 µm)	0.0000
4.00 to 4.50; (44.19 µm)	0.0000
4.50 to 5.00; (31.25 µm)	0.0000
5.00 to 5.50; (22.097 µm)	0.0000
5.50 to 6.00; (15.625 µm)	0.0000
6.00 to 6.50; (11.049 µm)	0.0000
6.50 to 7.00; (7.813 µm)	0.0000
7.00 to 7.50; (5.524 µm)	0.0000
7.50 to 8.00; (3.906 µm)	0.0000
8.00 to 8.50; (2.762 µm)	0.0000
8.50 to 9.00; (1.953 µm)	0.0000
9.00 to 9.50; (1.381 µm)	0.0000
9.50 to 10.00; (0.977 µm)	0.0000
10.00 to 10.50; (0.691 µm)	0.0000
10.50 to 11.00; (0.488 µm)	0.0000
11.00 to 11.50; (0.345 µm)	0.0000
11.50 to 12.00; (0.244 µm)	0.0000
12.00 to 12.50; (0.173 µm)	0.0000
12.50 to 13.00; (0.122 µm)	0.0000
13.00 to 13.50; (0.086 µm)	0.0000

Exercise Code:	**PS51**
LabCode:	**LB2056**
Sample Code:	**PS512056**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Total volume percentage (should equal 100) (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	0.0000
-6.00 to -5.50; 45 mm	0.0000
-5.50 to -5.00; 31.5 mm	0.0000
-5.00 to -4.50; 22.4 mm	0.0000
-4.50 to -4.00; 16 mm	0.0000
-4.00 to -3.50; 11.2 mm	0.0000
-3.50 to -3.00; 8 mm	38.8726
-3.00 to -2.50; 5.6 mm	0.0000
-2.50 to -2.00; 4 mm	50.0113
-2.00 to -1.50; 2.8 mm	0.0000
-1.50 to -1.00; 2 mm	10.9132
-1.00 to -0.50; 1.4 mm	0.0000
-0.50 to 0.00; 1 mm	0.0371
0.00 to 0.50; (707 µm)	0.0212
0.50 to 1.00; (500 µm)	0.0163
1.00 to 1.50; (353.6 µm)	0.0102
1.50 to 2.00; (250 µm)	0.0078
2.00 to 2.50; (176.8 µm)	0.0073
2.50 to 3.00; (125 µm)	0.0085
3.00 to 3.50; (88.39 µm)	0.0075
3.50 to 4.00; (62.5 µm)	0.0077
4.00 to 4.50; (44.19 µm)	0.0076
4.50 to 5.00; (31.25 µm)	0.0069
5.00 to 5.50; (22.097 µm)	0.0066
5.50 to 6.00; (15.625 µm)	0.0051
6.00 to 6.50; (11.049 µm)	0.0040
6.50 to 7.00; (7.813 µm)	0.0031
7.00 to 7.50; (5.524 µm)	0.0027
7.50 to 8.00; (3.906 µm)	0.0024
8.00 to 8.50; (2.762 µm)	0.0000
8.50 to 9.00; (1.953 µm)	0.0039
9.00 to 9.50; (1.381 µm)	0.0000
9.50 to 10.00; (0.977 µm)	0.0032
10.00 to 10.50; (0.691 µm)	0.0036
10.50 to 11.00; (0.488 µm)	0.0000
11.00 to 11.50; (0.345 µm)	0.0000
11.50 to 12.00; (0.244 µm)	0.0000
12.00 to 12.50; (0.173 µm)	0.0000
12.50 to 13.00; (0.122 µm)	0.0000
13.00 to 13.50; (0.086 µm)	0.0000

Exercise Code:	PS51
LabCode:	LB2057
Sample Code:	PS512057

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Total volume percentage (should equal 100) (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	0.0000
-6.00 to -5.50; 45 mm	0.0000
-5.50 to -5.00; 31.5 mm	0.0000
-5.00 to -4.50; 22.4 mm	0.0000
-4.50 to -4.00; 16 mm	0.0000
-4.00 to -3.50; 11.2 mm	0.0000
-3.50 to -3.00; 8 mm	42.4773
-3.00 to -2.50; 5.6 mm	34.9158
-2.50 to -2.00; 4 mm	12.2220
-2.00 to -1.50; 2.8 mm	7.0170
-1.50 to -1.00; 2 mm	3.2877
-1.00 to -0.50; 1.4 mm	0.0686
-0.50 to 0.00; 1 mm	0.0114
0.00 to 0.50; (707 µm)	0.0000
0.50 to 1.00; (500 µm)	0.0000
1.00 to 1.50; (353.6 µm)	0.0000
1.50 to 2.00; (250 µm)	0.0000
2.00 to 2.50; (176.8 µm)	0.0000
2.50 to 3.00; (125 µm)	0.0000
3.00 to 3.50; (88.39 µm)	0.0000
3.50 to 4.00; (62.5 µm)	0.0000
4.00 to 4.50; (44.19 µm)	0.0000
4.50 to 5.00; (31.25 µm)	0.0000
5.00 to 5.50; (22.097 µm)	0.0000
5.50 to 6.00; (15.625 µm)	0.0000
6.00 to 6.50; (11.049 µm)	0.0000
6.50 to 7.00; (7.813 µm)	0.0000
7.00 to 7.50; (5.524 µm)	0.0000
7.50 to 8.00; (3.906 µm)	0.0000
8.00 to 8.50; (2.762 µm)	0.0000
8.50 to 9.00; (1.953 µm)	0.0000
9.00 to 9.50; (1.381 µm)	0.0000
9.50 to 10.00; (0.977 µm)	0.0000
10.00 to 10.50; (0.691 µm)	0.0000
10.50 to 11.00; (0.488 µm)	0.0000
11.00 to 11.50; (0.345 µm)	0.0000
11.50 to 12.00; (0.244 µm)	0.0000
12.00 to 12.50; (0.173 µm)	0.0000
12.50 to 13.00; (0.122 µm)	0.0000
13.00 to 13.50; (0.086 µm)	0.0000

Exercise Code:	**PS51_A**
LabCode:	**LB2060**
Sample Code:	**PS51_A2060**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Total volume percentage (should equal 100) (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	0.0000
-6.00 to -5.50; 45 mm	0.0000
-5.50 to -5.00; 31.5 mm	0.0000
-5.00 to -4.50; 22.4 mm	0.0000
-4.50 to -4.00; 16 mm	0.0000
-4.00 to -3.50; 11.2 mm	0.0000
-3.50 to -3.00; 8 mm	38.6434
-3.00 to -2.50; 5.6 mm	38.7960
-2.50 to -2.00; 4 mm	12.8286
-2.00 to -1.50; 2.8 mm	6.2809
-1.50 to -1.00; 2 mm	3.3700
-1.00 to -0.50; 1.4 mm	0.0402
-0.50 to 0.00; 1 mm	0.0043
0.00 to 0.50; (707 µm)	0.0000
0.50 to 1.00; (500 µm)	0.0000
1.00 to 1.50; (353.6 µm)	0.0000
1.50 to 2.00; (250 µm)	0.0000
2.00 to 2.50; (176.8 µm)	0.0000
2.50 to 3.00; (125 µm)	0.0000
3.00 to 3.50; (88.39 µm)	0.0000
3.50 to 4.00; (62.5 µm)	0.0000
4.00 to 4.50; (44.19 µm)	0.0000
4.50 to 5.00; (31.25 µm)	0.0000
5.00 to 5.50; (22.097 µm)	0.0000
5.50 to 6.00; (15.625 µm)	0.0000
6.00 to 6.50; (11.049 µm)	0.0000
6.50 to 7.00; (7.813 µm)	0.0000
7.00 to 7.50; (5.524 µm)	0.0000
7.50 to 8.00; (3.906 µm)	0.0000
8.00 to 8.50; (2.762 µm)	0.0000
8.50 to 9.00; (1.953 µm)	0.0000
9.00 to 9.50; (1.381 µm)	0.0000
9.50 to 10.00; (0.977 µm)	0.0000
10.00 to 10.50; (0.691 µm)	0.0000
10.50 to 11.00; (0.488 µm)	0.0000
11.00 to 11.50; (0.345 µm)	0.0000
11.50 to 12.00; (0.244 µm)	0.0000
12.00 to 12.50; (0.173 µm)	0.0000
12.50 to 13.00; (0.122 µm)	0.0000
13.00 to 13.50; (0.086 µm)	0.0000

Exercise Code:	**PS51_B**
LabCode:	**LB2060**
Sample Code:	**PS51_B2060**

Phi interval (explicit) + sieve mesh (theoretical sieves shown in brackets)	Total volume percentage (should equal 100) (mark as "0" for not analysed or no material)
-6.50 to -6.00; 63 mm	0.0000
-6.00 to -5.50; 45 mm	0.0000
-5.50 to -5.00; 31.5 mm	0.0000
-5.00 to -4.50; 22.4 mm	0.0000
-4.50 to -4.00; 16 mm	0.0000
-4.00 to -3.50; 11.2 mm	0.0000
-3.50 to -3.00; 8 mm	39.7015
-3.00 to -2.50; 5.6 mm	38.3410
-2.50 to -2.00; 4 mm	12.5712
-2.00 to -1.50; 2.8 mm	5.7836
-1.50 to -1.00; 2 mm	3.5238
-1.00 to -0.50; 1.4 mm	0.0381
-0.50 to 0.00; 1 mm	0.0040
0.00 to 0.50; (707 μm)	0.0000
0.50 to 1.00; (500 μm)	0.0000
1.00 to 1.50; (353.6 μm)	0.0000
1.50 to 2.00; (250 μm)	0.0000
2.00 to 2.50; (176.8 μm)	0.0000
2.50 to 3.00; (125 μm)	0.0000
3.00 to 3.50; (88.39 μm)	0.0000
3.50 to 4.00; (62.5 μm)	0.0000
4.00 to 4.50; (44.19 μm)	0.0000
4.50 to 5.00; (31.25 μm)	0.0000
5.00 to 5.50; (22.097 μm)	0.0000
5.50 to 6.00; (15.625 μm)	0.0000
6.00 to 6.50; (11.049 μm)	0.0000
6.50 to 7.00; (7.813 μm)	0.0000
7.00 to 7.50; (5.524 μm)	0.0000
7.50 to 8.00; (3.906 μm)	0.0000
8.00 to 8.50; (2.762 μm)	0.0000
8.50 to 9.00; (1.953 μm)	0.0000
9.00 to 9.50; (1.381 μm)	0.0000
9.50 to 10.00; (0.977 μm)	0.0000
10.00 to 10.50; (0.691 μm)	0.0000
10.50 to 11.00; (0.488 μm)	0.0000
11.00 to 11.50; (0.345 μm)	0.0000
11.50 to 12.00; (0.244 μm)	0.0000
12.00 to 12.50; (0.173 μm)	0.0000
12.50 to 13.00; (0.122 μm)	0.0000
13.00 to 13.50; (0.086 μm)	0.0000

Appendix 2. Percentage proportion of participant phi-intervals using independently merged data.

sample	LB2003	LB2007	LB2015	LB2020	LB2021	LB2022	LB2027	LB2029	LB2031	LB2032	LB2054	LB2056	LB2057	LB2060_A	LB2060_B
Phi-interval															
-6.50 to -6.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-6.00 to -5.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-5.50 to -5.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-5.00 to -4.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-4.50 to -4.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-4.00 to -3.50	0	0.476642	2.204523	0	0.349146	0	1.671315	0	0	0	0	0	0	0	0
-3.50 to -3.00	48.41499	43.57558	39.80752	8.680009	42.89994	40.63288	38.87664	40.8503	41.22203	39.19363	37.88353	38.93719	42.47735	38.657565	39.716119
-3.00 to -2.50	32.24656	34.93684	36.76532	60.81178	36.38555	37.88261	37.73844	37.09369	36.12651	35.82775	38.0622	0	34.9158	38.810201	38.355064
-2.50 to -2.00	9.406186	11.56002	11.48198	13.0425	10.96995	11.01683	11.81168	12.02114	12.56594	14.81123	13.99232	50.09437	12.22202	12.83333	12.575795
-2.00 to -1.50	6.922556	5.95397	6.379381	11.60333	6.232824	7.168257	6.228631	6.374986	6.637635	6.58327	7.026693	0	7.017022	6.2832208	5.7857768
-1.50 to -1.00	2.944231	3.405805	3.238104	5.801664	3.126549	3.195895	3.619309	3.439433	3.333408	3.341133	2.983009	10.93132	3.287728	3.371238	3.5250555
-1.00 to -0.50	0.05193	0.088442	0.117207	0.022487	0.024778	0.103529	0.049487	0.12822	0.107747	0.240742	0.052016	0	0.068637	0.0401792	0.03815
-0.50 to 0.00	0.006774	0.002701	0.00599	0.044974	0.011263	0	0.004499	0.092228	0.006734	0.00225	0.000226	0.037122	0.01144	0.0042648	0.0040394
0.00 to 0.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0.50 to 1.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.00 to 1.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1.50 to 2.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.00 to 2.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2.50 to 3.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.00 to 3.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3.50 to 4.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.00 to 4.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4.50 to 5.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.00 to 5.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
5.50 to 6.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.00 to 6.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
6.50 to 7.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.00 to 7.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7.50 to 8.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.00 to 8.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8.50 to 9.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9.00 to 9.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9.50 to 10.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.00 to 10.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10.50 to 11.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11.00 to 11.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11.50 to 12.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12.00 to 12.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12.50 to 13.00	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
13.00 to 13.50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix 3. Z-score calculations when data from all participating laboratories are included in mean and standard deviation calculations.

	-4.00 to -3.50	z-score	-3.50 to -3.00	z-score	-3.00 to -2.50	z-score	-2.50 to -2.00	z-score
TUM AVERAGE	0.000	-0.472	37.022	-0.209	35.379	-0.031	14.553	-0.015
LB2003	0.000	-0.472	48.415	1.139	32.247	-0.305	9.406	-0.554
LB2007	0.477	0.246	43.576	0.566	34.937	-0.070	11.560	-0.328
LB2015	2.205	2.846	39.808	0.121	36.765	0.091	11.482	-0.337
LB2020	0.000	-0.472	8.680	-3.561	60.812	2.198	13.043	-0.173
LB2021	0.349	0.054	42.900	0.486	36.386	0.057	10.970	-0.390
LB2022	0.000	-0.472	40.633	0.218	37.883	0.189	11.017	-0.385
LB2027	1.671	2.044	38.877	0.010	37.738	0.176	11.812	-0.302
LB2029	0.000	-0.472	40.850	0.244	37.094	0.119	12.021	-0.280
LB2031	0.000	-0.472	41.222	0.288	36.127	0.035	12.566	-0.223
LB2032	0.000	-0.472	39.194	0.048	35.828	0.009	14.811	0.012
LB2054	0.000	-0.472	37.884	-0.107	38.062	0.204	13.992	-0.073
LB2056	0.000	-0.472	38.937	0.018	0.000	-3.131	50.094	3.710
LB2057	0.000	-0.472	42.477	0.436	34.916	-0.071	12.222	-0.259
LB2060_A	0.000	-0.472	38.658	-0.015	38.810	0.270	12.833	-0.195
LB2060_B	0.000	-0.472	39.716	0.110	38.355	0.230	12.576	-0.222
Mean	0.313		38.7883509		35.731		14.6936872	
St. Dev	0.664		8.45397797		11.411		9.54277451	

	-2.00 to -1.50	z-score	-1.50 to -1.00	z-score	-1.00 to -0.50	z-score	-0.50 to 0.00	z-score
TUM AVERAGE	6.564	0.069	6.26916005	1.12037982	0.21051695	2.02756706	0.00304354	-0.5185819
LB2003	6.923	0.235	2.9442312	-0.4995694	0.05193046	-0.3551831	0.00677354	-0.3649434
LB2007	5.954	-0.212	3.40580477	-0.2746847	0.088442	0.19340013	0.00270052	-0.5327108
LB2015	6.379	-0.016	3.23810425	-0.3563906	0.11720676	0.62558849	0.00598982	-0.3972248
LB2020	11.603	2.395	5.80166404	0.89260959	0.02248707	-0.7975678	0.04497414	1.20853664
LB2021	6.233	-0.083	3.12654863	-0.410742	0.02477812	-0.7631449	0.01126278	-0.1800317
LB2022	7.168	0.348	3.19589485	-0.3769556	0.10352899	0.42008094	0	-0.643945
LB2027	6.229	-0.085	3.61930898	-0.1706626	0.04948713	-0.3918939	0.00449883	-0.4586385
LB2029	6.375	-0.018	3.43943313	-0.2583005	0.12821955	0.79105475	0.0922281	3.1549237
LB2031	6.638	0.104	3.33340816	-0.3099573	0.10774653	0.48344914	0.00673416	-0.3665655
LB2032	6.583	0.079	3.34113306	-0.3061936	0.24074157	2.48168972	0.00224992	-0.5512709
LB2054	7.027	0.283	2.98300884	-0.4806765	0.05201608	-0.3538967	0.00022616	-0.6346296
LB2056	0.000	-2.960	10.9313225	3.39184693	0	-1.1354343	0.03712155	0.88508909
LB2057	7.017	0.279	3.28772765	-0.3322134	0.06863732	-0.1041637	0.01143955	-0.1727506
LB2060_A	6.283	-0.060	3.37123797	-0.2915261	0.04017921	-0.5317447	0.00426483	-0.4682768
LB2060_B	5.786	-0.290	3.52505554	-0.2165841	0.03814995	-0.5622342	0.00403941	-0.4775621
Mean	6.413		3.96959223		0.076		0.01563355	
St. Dev	2.167		2.0524895		0.067		0.02427778	

Appendix 4. Summary of z-scores for each half-phi interval for PS51; when data from all participating laboratories included in the mean and standard deviation calculations.

LB2057

LB2060_A

LB2060_B