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FINAL REPORT

AN ASSESSMENT OF NEARSHORE SEDIMENTS OF THE BREMERTON WATERFRONT: THEIR GRAIN-SIZE DISTRIBUTIONS, CHANGES OVER TIME AND TRANSPORT PATHWAYS

Prepared for:
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INTRODUCTION

The purpose of this report is to analyze various aspects of grain-size distributions that have been taken over the past 13 years from the Bremerton waterfront. The specific purposes are listed as follows:

1: Provide new grain-size analyses for 171 samples collected in 2010 and 2011.

2: Generate maps of grain-size data from all data sets extending from 1998 to the present.

3: Compare and assess sediment textural changes that have occurred between the sampling dates.

4: Generate and provide to the client all results in GIS format; shape files etc. (Note: This is provided as a geodata base in Appendix V).

5: Examine grain-size changes in samples taken from cores and assess possible causes.

6: Perform, using both Z-score and, if applicable, the more sensitive Monte Carlo Statistics, a Sediment Trend Analysis (STA®) on 48 samples collected in transects near Pier 7

7: In consultation with the client, prepare a report to contain all data and interpretations of the findings as determined in each of the above tasks.

THE DATA

This report considers grain-size data from sources summarized in Tables 1 and 2. All grain size data from these sources are contained as individual work sheets in an Excel spreadsheet file (Appendix I). Each of the sample data sets is mapped to show location and sediment type in Figures 1 through 9 (Appendix II).

DATA SET	DATE COLLECTED	NO. OF SAMPLES	FIGURE (Appendix II)	REFERENCE/NOTES
1	1998	349	AII-1	McLaren (1998)
2	2003	168	AII-2	McLaren (2004)
3	2007	108	AII-3	McLaren (2008)
4	2009 (Caisson Samples)	11	AII-4	Correspondence with Dr. R.K. Johnston, Aug. 2009
5	2010-2011	171	AII-5	Samples are comprised of a variety of types that are summarized in Table 2

Table 1: Summary of grain-size data used in this report.

DATA SET	NO. OF SAMPLES	SAMPLE TYPE	DATE COLLECTED	FIGURE
SQV01	3	Storm drain samples	4/20/11	AII-6, AII-8
SQV03	5	Dry Dock Samples	7/10	AII-7, AII-8
SQV04	5	Pier 7 Drum Samples	3/11	AII-9
SQV05	110	Includes sub-samples from 10 cores and surface grab samples	4/11	AII-6, AII-7, AII-8 (see Fig. AII-10 for the core locations only)
SQV06	48	Grab samples from around Pier 7	4/11	AII-9

Table 2: Summary of samples constituting Data Set 5 as listed in Table 1.

AN ASSESSMENT OF SEDIMENT TEXTURAL CHANGES THAT OCCURRED BETWEEN 1998 AND 2011

Utilizing the data sets listed in Table 1, all waterfront samples (i.e., only those samples found landward of the boom shown in Figure AII-5) were compared for textural changes through time. The changes in texture between successive data sets follow the same procedures described in the McLaren 2004 and 2008 reports. Data from each of the 5 sampling periods (Appendix I), including location and grain-size information, were transformed into ESRI shapefiles using ArcGIS 9.2. For each of the comparisons, the most recent data were defined to be the base data set, and the corresponding earlier data set was defined as the reference set for each of the respective comparisons. A geoprocessing tool was developed to first find the nearest sample from the reference set to each sample from the base set (using a cut off distance of 50 m between sample pairs). The distance between the samples was recorded, as well as the computed similarity of the grain-size distributions of each sample pair. Similarity is defined as the ratio between the intersection of the two grain-size distributions and the union of the two. It is expressed as a percentage, with 100% being the case where the two distributions are identical.

The principal findings from the comparison analysis (Tables 3 and 4) can be summarized as follows.

<u>(A) 1998 to 2003</u>

(1) During these 5 years, the surficial sediments associated with the waterfront became coarser, changing from a mean grain size of 6.01 phi to 5.09 phi. Despite the low number of sample pairs (5), the change was significant at the 99% level.

(2) All five sample pairs showed a progressive change becoming coarser, more poorly sorted and more negatively skewed.

(3) These changes in sediment texture were observed during the same time period encompassing all the samples throughout Dyes and Sinclair Inlets as reported in McLaren 2004. In that report it was shown that such a change can occur when a coarse fraction is added to the pre-existing sediment. The report offered several possible explanations for the coarsening of the sediment including: (i) abnormally high storm activity during the 5 years between samplings; (ii) the wake of a newly instigated high-speed ferry increasing coastal erosion; and (iii) the liberation of underlying glacial deposits caused by an increase in dredging operations

<u>(B) 2003 to 2007</u>

(1) The comparisons between these two data sets yielded the smallest distances between samples (on average 9 m apart) and, probably as a consequence, the greatest similarity for each of the sample pairs (an average of 83%).

(2) During the 4 year interval between samplings, the sediments changed significantly on average nearly ½ phi size finer, the largest percentage (48%; Table 4) of the pairs becoming finer, better sorted and more negatively skewed.

(3) The findings for the whole of Sinclair Inlet, as opposed to the waterfront samples only, showed the same change (reported in McLaren, 2008) and, as previously suggested, indicates that the sedimentological environment of Sinclair Inlet entered a recovery stage following the earlier effects of channel deepening and sediment remediation projects that were carried out between 1998 and 2003. As a result, the sediments sampled in 2007 had become, at least partially, more like their 1998 composition, the date when the first sampling took place.

<u>(C) 2007 to 2009</u>

The locations of Caisson samples collected in 2009 (Fig. AII-4) were too distant from the 2007 samples to provide comparisons. The Caisson samples could, however be compared with the 2011 samples which were sufficiently close to enable valid comparisons.

<u>(D) 2007 to 2011</u>

(1) In the 4 years encompassing the two sampling times, the waterfront sediments again changed significantly in the same manner as observed in the first comparison (1998 to 2003), becoming coarser, more poorly sorted and more negatively skewed.

(2) As in the first comparison, such a change suggests the addition of coarser sediment to the original distributions, possibly the result of an increase in dredging and ship maneuvering activities.

<u>(E) 2009 to 2011</u>

The changes observed when the Caisson samples are compared with the 2011 samples are not significant. Although the most number of pairs became finer, better sorted and more negatively skewed, the mean grain size actually coarsened on average. This happened because of the large standard deviation associated with the 2011 data set indicating that the amount of coarsening in a few of the pairs was much larger than the amount of fining contained in the majority of the pairs. No conclusions can be made from these data possibly because the Caisson samples are insufficient to represent the Waterfront samples as a whole and/or the two year interval between samplings is too short for a significant change to occur.

	COMPARISON BETWEEN 1998 AND 2003	COMPARISON BETWEEN 2003 AND 2007	COMPARISON BETWEEN 2007 AND 2011	COMPARISON BETWEEN 2009 AND 2011
Number of sample pairs compared	5	31	44	22
Mean distance between samples used for comparison	44.7 ±5.2 m Minimum: 37.1m Maximum: 49.5m	9.2 ± 12.1 m Minimum: 0.2m Maximum: 48.5m	30.9 ± 11.2 m Minimum: 7.8m Maximum: 49.7m	26.3 ±12.9 m Minimum: 2.9m Maximum: 48.9m
Average mean grain size of 1998-2009 data: Average mean grain size 2003-2011 data: Average mean grain-size change: (** change is 99% significant)	6.01 ± 0.12 phi (coarse silt) 5.09± 0.09 phi (coarse silt) -0.92 ± 0.12 phi**	4.91 ± 0.85 phi (coarse silt) 5.36 ± 0.32phi (coarse silt) 0.42 ± 0.71 phi**	5.07 ± 0.40 phi (coarse silt) 4.64 ± 0.86 phi (coarse silt) -0.43 ± 1.05 phi**	4.52 ± 0.25 phi (coarse silt) 4.45 ± 1.53 phi (coarse silt) -0.07 ± 1.59 phi
Mean % similarity between the two data sets	65.8 ± 4.3 % Minimum similarity: 59.8% Maximum similarity: 70.0%	82.6 ± 14.2 % Minimum similarity: 24.7% Maximum similarity: 93.5%	67.2 ± 16.8 % Minimum similarity: 15.8% Maximum similarity: 89.7%	61.7 ± 18.9 % Minimum similarity: 11.8% Maximum similarity: 90.0%
Number. of coarsening samples: Number of fining samples	5 (100%) 0 (0%)	2 (6%) 29 (94%)	24 (55%) 20 (45%)	7 (32%) 15 (68%)

Table 3: Statistics of grain-size changes from 1998 to 2010/2011. Comparisons between sample pairs are limited to samples located less than 50 meters apart from each other.

Nature of sediment changes (1998 to 2003) based on sample pairs		
Sediment becomes:	**Number of Pairs**	**Percentage**
1 Coarser More poorly sorted More negatively skewed	5	100

Nature of sediment changes (2003 to 2007) based on sample pairs		
Sediment becomes:	**Number of Pairs**	**Percentage**
1 Finer Better sorted More negatively skewed	15	48
2 Finer Better Sorted More positively skewed	9	29

3 Finer More poorly sorted More negatively skewed	4	13
4 Random, miscellaneous changes	3	10
Nature of sediment changes (2007 to 2011) based on sample pairs		
Sediment becomes:	**Number of Pairs**	**Percentage**
1 Coarser More Poorly Sorted More negatively skewed	20	45
2 Finer Better sorted More negatively skewed	16	36
3 Coarser More Poorly Sorted More positively skewed	3	7
4 Random, miscellaneous changes	5	12
Nature of sediment changes (2009 to 2011) based on sample pairs		
Sediment becomes:	**Number of Pairs**	**Percentage**
1 Finer Better sorted More negatively skewed	12	54
2 Coarser Better Sorted More positively skewed	4	38
3 Finer Better sorted More positively skewed	3	14
4 Random, miscellaneous changes	3	14

Table 4: Relative changes in grain-size distributions for each of the time intervals based on sample pairs within 50 m of each other.

SUMMARY

The surficial sediments of the Bremerton Waterfront follow a clear and significant trend in which they have become progressively coarser, more poorly sorted and more negatively skewed in the 13 years from 1998 to 2011. Figure 1 shows the regression for the change in mean grain size ranging from 6.01 phi to 4.45 phi. The trend is interrupted only in the 3 years from 2003 to 2007 during which there was a relatively minor but significant reversal in the coarsening sequence. Recognizing that the Bremerton Waterfront has had a complex history of dredging and shipping activities, the discovery of such a significant trend might be regarded as surprising. Both the coarsening and fining trends can be explained by depositional processes only. Erosion, although resulting in a coarsening trend will also improve the sorting of the trend. In this case, sorting has become poorer which, as described in McLaren (2008) can only happen when coarse sediment is added to pre-existing finer sediment. The short period of reversal where the sediments became slightly finer again can also only happen under depositional conditions.

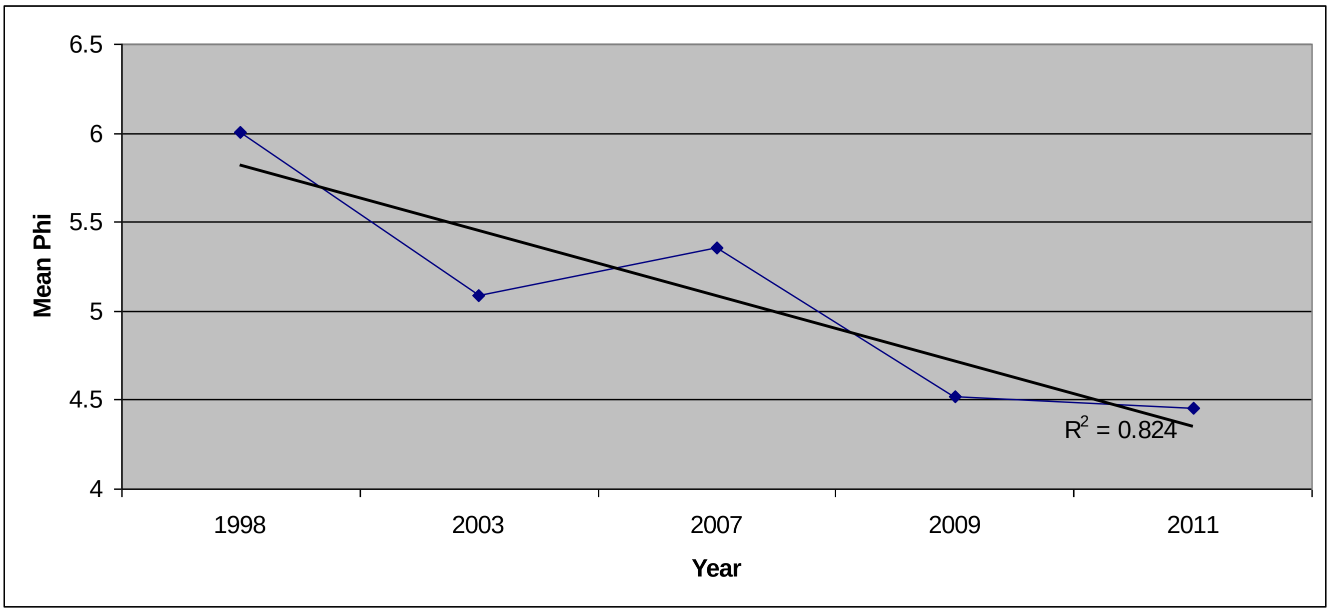

Figure 1: Change in mean grain size for Waterfront sediments from 1998 to 2011.

The trend line as shown in Figure 1 suggests that throughout the sampling period there has been an increase in the availability of coarser sediment into the transport regime. This could occur, for example, by dredging deeper into underlying glacial deposits in which a greater range of sediment sizes become available for transport and deposition than was available prior to their disturbance and exposure. At the same time, larger vessels and an increase in ship activities (propeller wash) would also increase the ability for the movement and deposition of coarser sediment. Only from 2003 to 2007 did the trend reverse suggesting that there was a hiatus in the dredging or a decline in vessel maneuverings enabling a return to the deposition of finer sediments.

SEDIMENT TEXTURAL CHANGES IN CORES

Each of 10 cores (Fig. AII-10) was sub-sampled at 6 regular intervals (0-3 cm; 3-6 cm; 6-9 cm; 9-13 cm; 13-19 cm; and 19-25 cm). To explore for the presence of systematic textural changes with depth, the entire grain-size distribution for each sub-sample was examined for each core, followed by a regression of the mean, sorting and skewness descriptors with depth down the core. These data are shown in Appendix III.

The most striking feature of the grain-size distributions is their lack of variability. An examination of the distributions with depth down each core reveals very similar distributions (the first graph for each core shown in

Appendix III). As seen in Table 5, only 5 of the 30 trends examined produced significant regression lines (see Cores 1, 2 and 3), not a sufficient number to produce a defensible generalized conclusion with respect to sediment change over time. Furthermore, there is little variability in the distributions among the cores themselves. The greatest variability is found in the tail of the coarse end of the distribution which is dependent on the sand content and which occasionally forms a separate mode. The silt fraction of the sediment tends to be similar throughout nearly all the samples with a mode at about 6.5 phi.

Core Number	MAP ID	CORE ID	MEAN	SORTING	SKEWNESS
1	SQV05-130	PS03 - Short/Clear core	Coarser*	Poorer*	More positive
2	SQV05-094	PS03 - Squeeze Core A	Coarser*	Poorer*	More positive
3	SQV05-1027	PS06 - Clear core	Coarser	Better	More positive*
4	SQV05-1051	PS07 - Clear core	Coarser	Better	More positive
5	SQV05-219	PS08 - Short/Clear core	No trend	Better	More positive
6	SQV05-147	PS09 - Short/Clear core	Coarser	Better	More positive
7	SQV05-112	PS09 - Squeeze Core B, 50 FT	Coarser	Better	More negative
8	SQV05-165	PS10 - Short/Clear core	Finer	Better*	More negative
9	SQV05-183	PS10.1 - Short/Clear core	Finer	Better	More negative
10	SQV05-201	PS11 - Short/Clear core	No trend	Better	More negative

Table 5: Summary of grain-size trends from depth to surface for each of the cores (as graphed in Appendix III). * = trend is significant at the 95% level.

It could be argued that, given the relatively consistent changes in the surficial sediments that were discussed above (namely that textures have become generally coarser since 1998) that the same observation of coarsening sediment should be seen from depth to the surface in the cores. However the data do not show enough consistent trends to support such a supposition. One explanation is that dredging and propeller wash are processes that continually (and randomly) disturb the sediments (at least in the top 25 cm) thereby destroying any regularity to the stratigraphic sequence that may have otherwise formed.

SEDIMENT TREND ANALYSIS (STA®) AT PIER 7

An STA was carried out on the 48 SQV06 samples at Pier 7 (Table 2; Fig. AII-9) using the same techniques described in McLaren (1998). A total of 14 lines of sample sequences were obtained that produced a consistent pattern of sediment transport accounting for all the samples. The transport pathways are shown in Figure 2 and the statistics for each line of samples are contained in Appendix IV.

The pattern of transport with sediments coming in from the offshore and tending to curve eastwards is very similar to the patterns previously derived in the 1998 STA (Fig. 3). The dynamic behaviour of the sediments, however, show different interpretations; the trends in the earlier study being in Net Erosion compared with Dynamic Equilibrium for the Pier 7 samples. This change in dynamic behaviour is likely due to the greater detail contained in the high sample density of the later study compared with the more regional, low density sampling that was carried out in 1998. Similar to the conclusions made in the earlier study, the dominance of the trends in Dynamic Equilibrium strongly suggests that ships' propeller wash inhibits the long-term stability of the deposits. Without this anthropogenic process occurring it would be expected that, given the high mud content of the sediments, their cohesive properties would limit further movement and Total Deposition would be expected. The derivation of the Dynamic Equilibrium trends supports the lack of stratigraphic trends found in the cores which would be unlikely in an environment where deposition is closely followed by random resuspension events caused by propeller-driven turbulence.

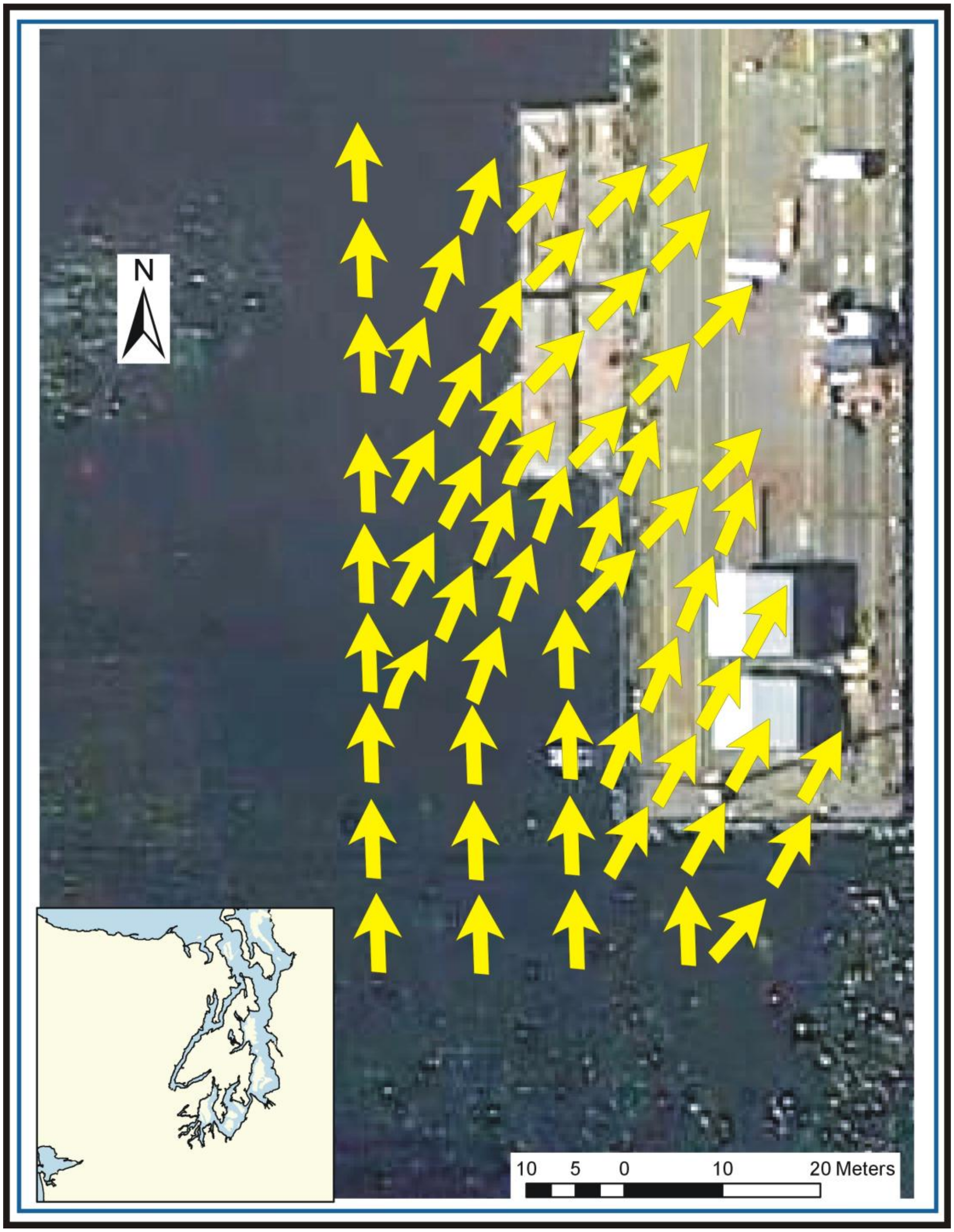

Figure 2: Sediment transport pathways derived from 48 samples (locations shown in Fig. AII-9). The yellow arrows denote that all trends are in Dynamic Equilibrium.

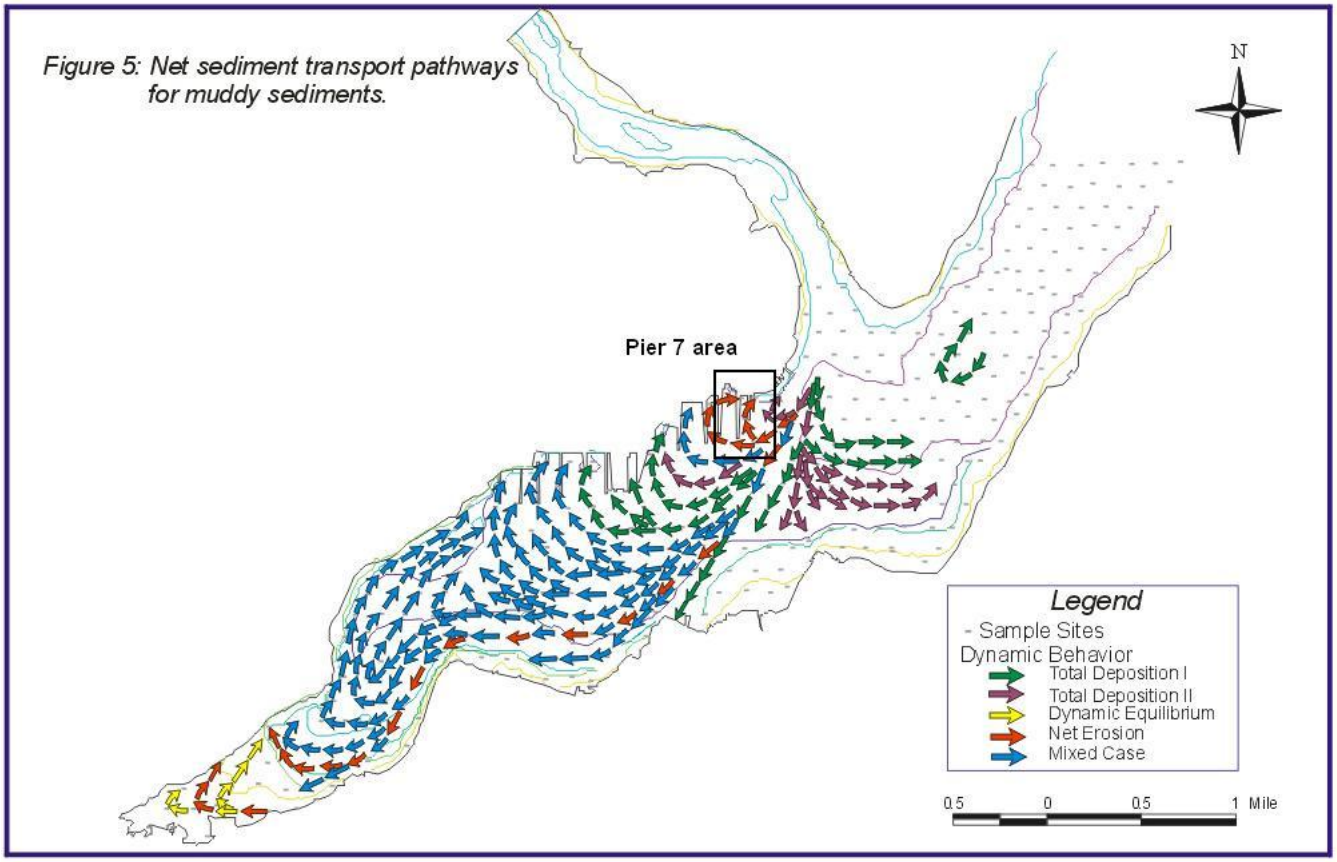

Figure 3: STA results from McLaren (1998).

REFERENCES

McLaren, P., 1998: A Sediment Trend Analysis (STA®) of Sinclair Inlet/Port Orchard. GeoSea Consulting Report to URS Greiner, Inc., on behalf of U.S. Navy, Environmental Group, Bremerton. Subcontract agreement No: SE-98-P; Navy Contract No. N62474-89-D-9295.

McLaren, P., 2004: The sediments of Dyes and Sinclair Inlets: an assessment of change between 1997-8 and 2003. GeoSea Consulting Report to the Puget Sound Naval Shipyard & Intermediate Maintenance Facility (PSNS); Purchase Order Number: N6600104MJ071.

McLaren, P., 2008: The sediments of Sinclair Inlet: an assessment of progressive change from 1998 to 2008. . GeoSea Consulting Report to the Puget Sound Naval Shipyard & Intermediate Maintenance Facility (PSNS); Purchase Order Number: N66001-08-M-1017.

APPENDIX II

Figures of sample locations and sediment types for all data sets listed in Table 1 of the main report.

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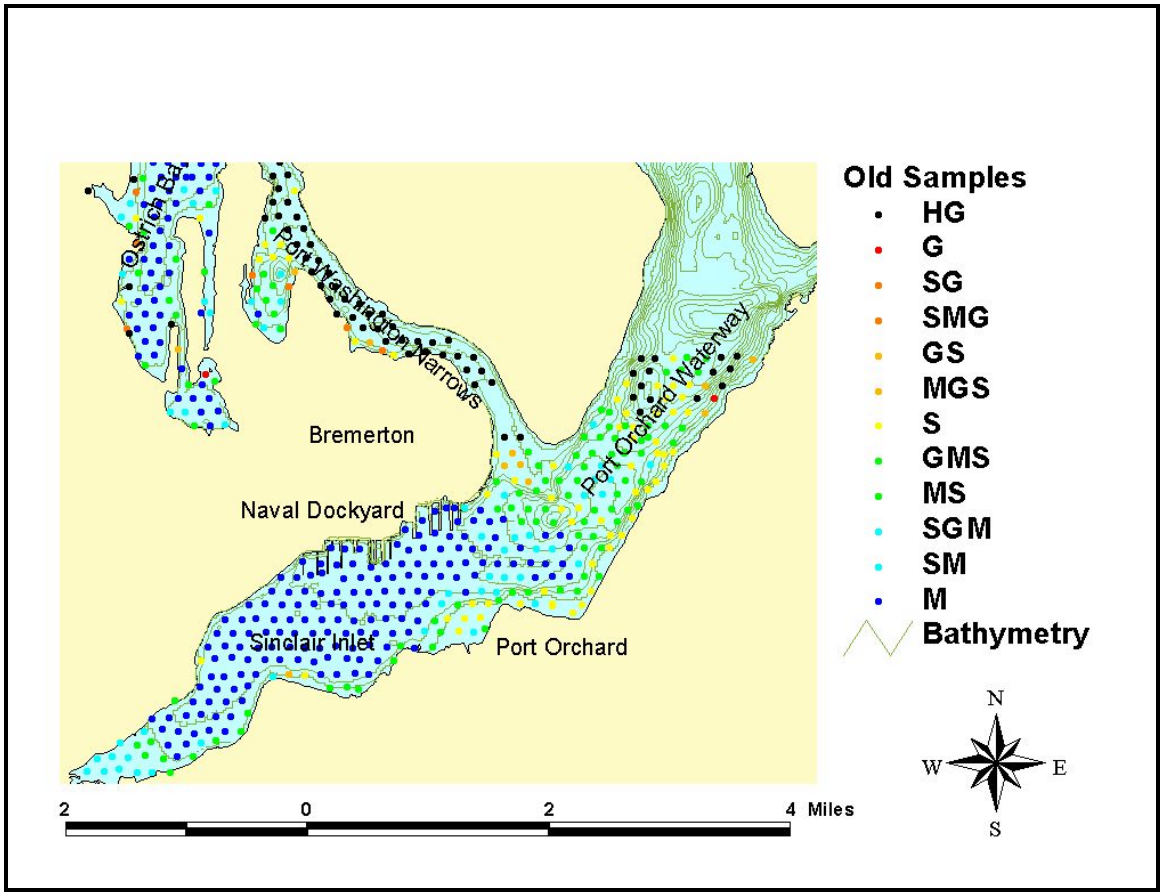

Figure AII-1: Locations and sediment types of 349 samples collected in 1998 (McLaren 1998)

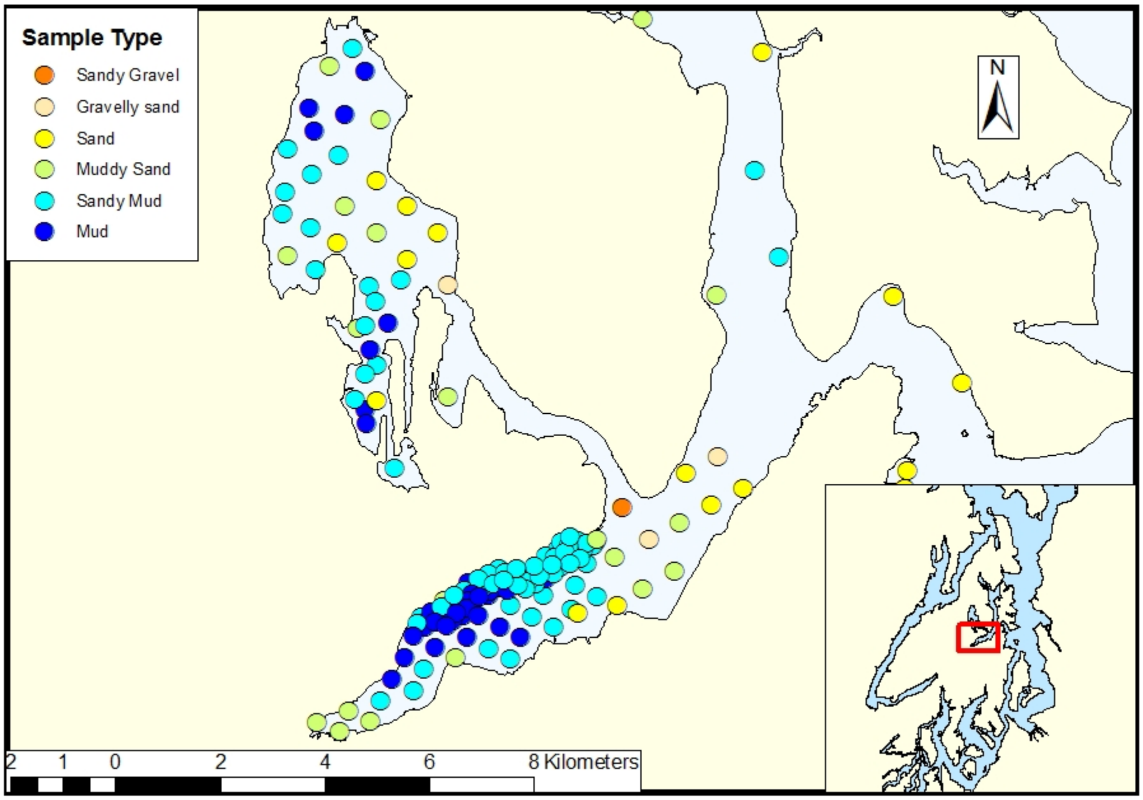

Figure AII-2: Locations and sediment types of 168 samples collected in 2003. (Note: Locations in front of the Naval Dock Yard Area represent the average position from a composite of three samples taken on a 50 foot grid).

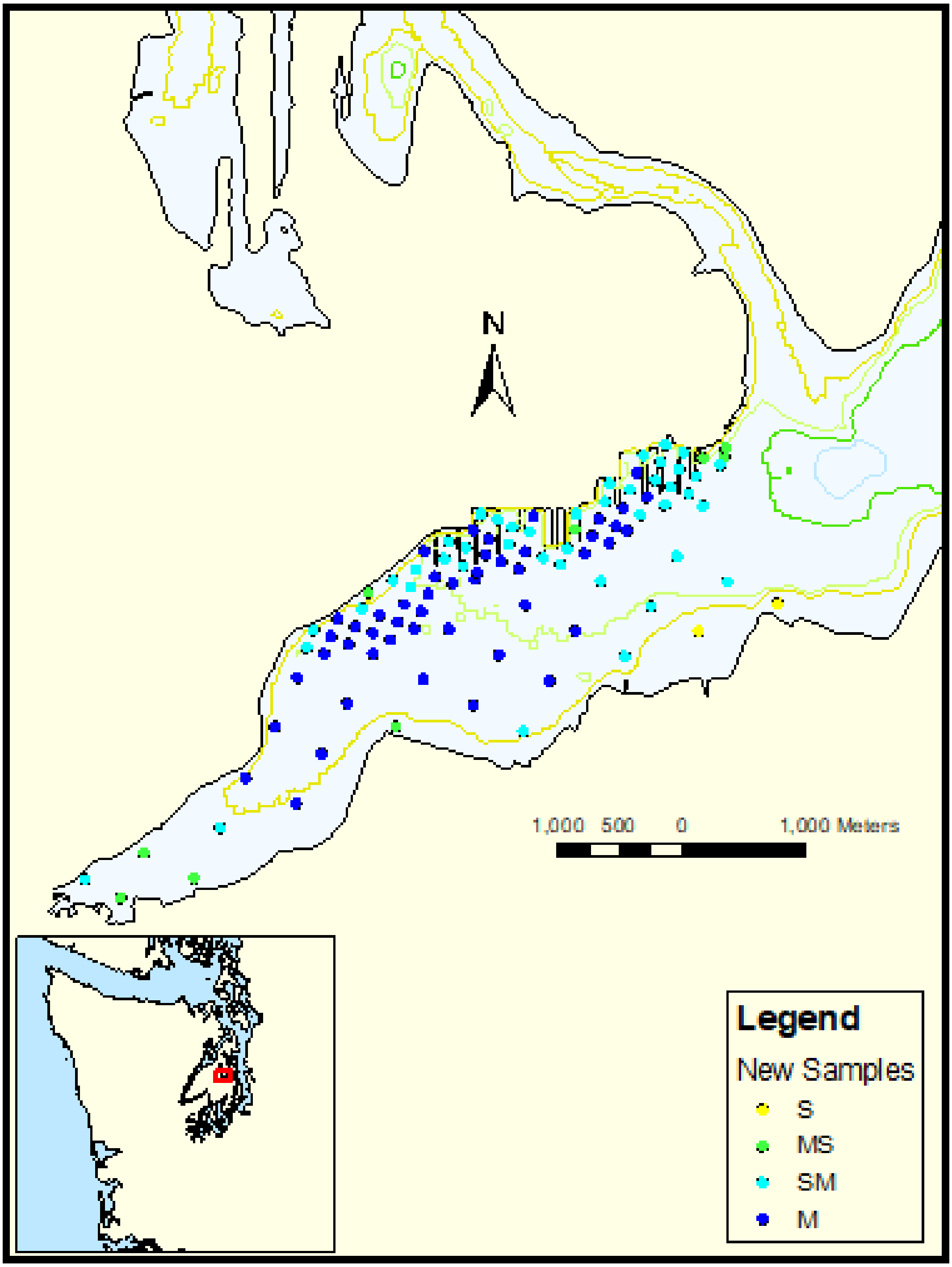

Figure AII-3: Locations and sediment types of 108 Sinclair Inlet samples collected in 2007 (McLaren, 2008).

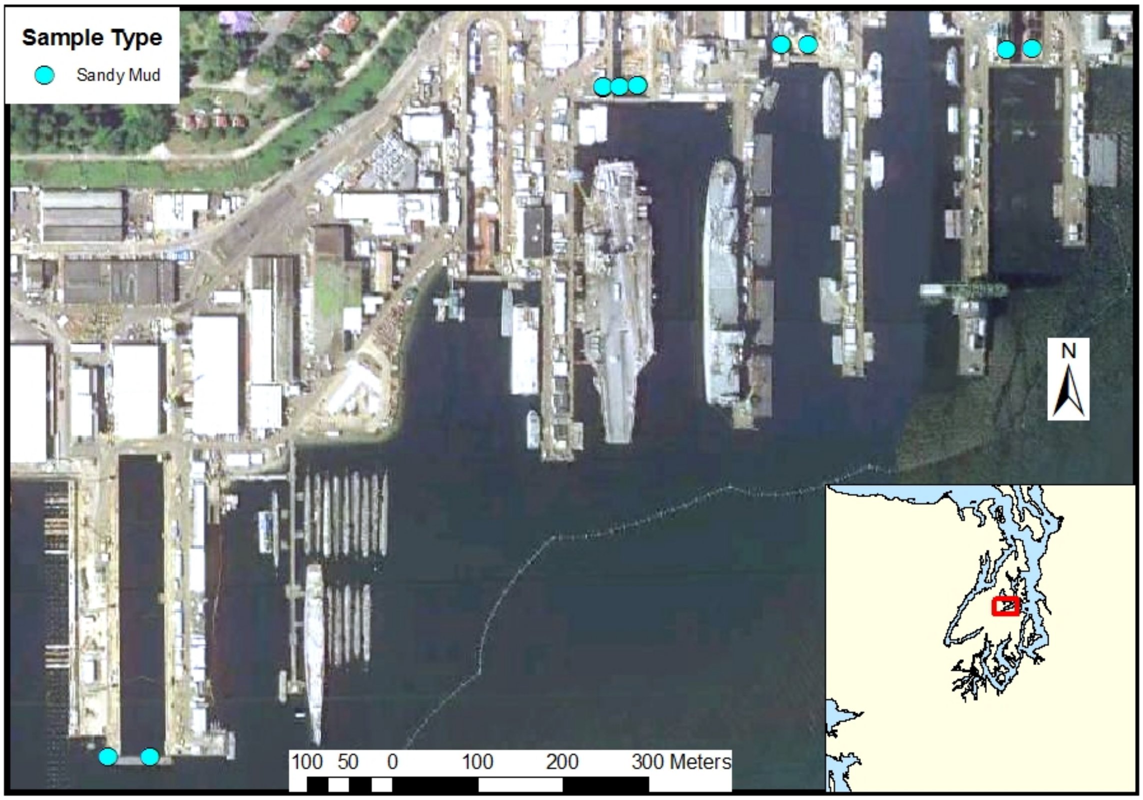

Figure AII-4: Locations and sediment types of 11 caisson samples collected in 1999 (McLaren 1998)

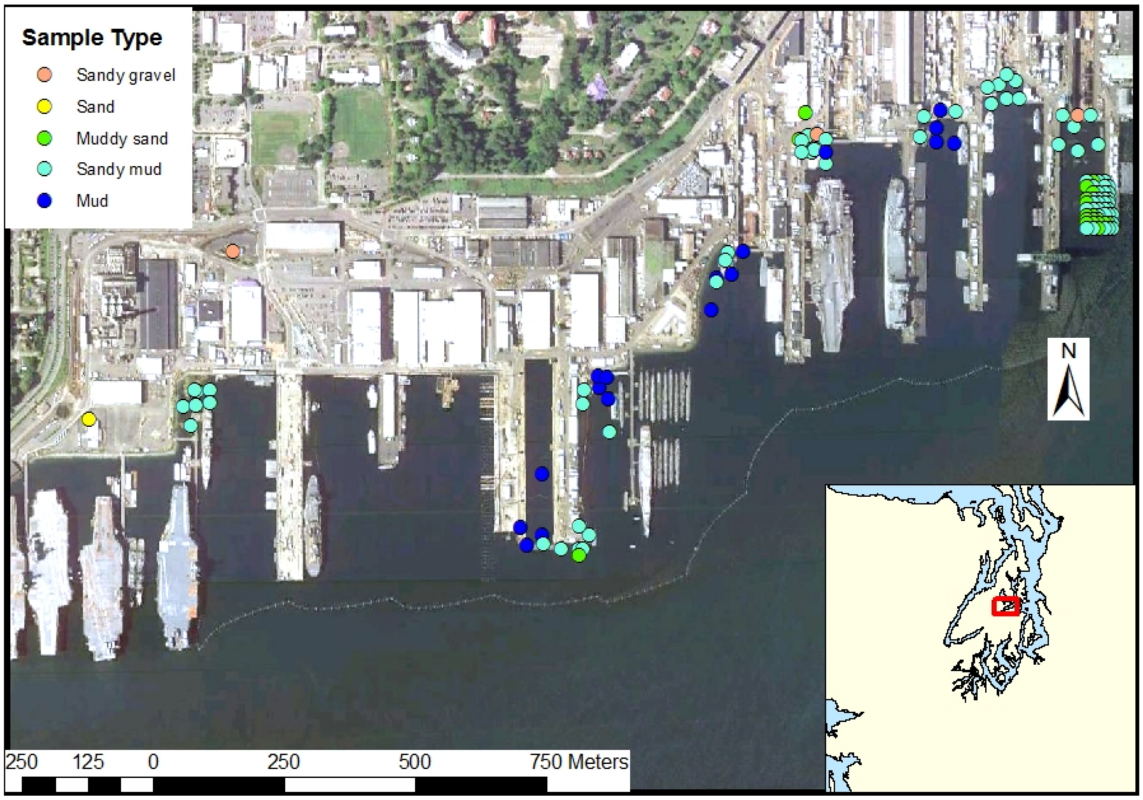

Figure AII-5: Locations and sediment types of 171 samples collected in 2010-2011 which were analyzed for their grain-sized distributions to be used in this study (See Table 2).

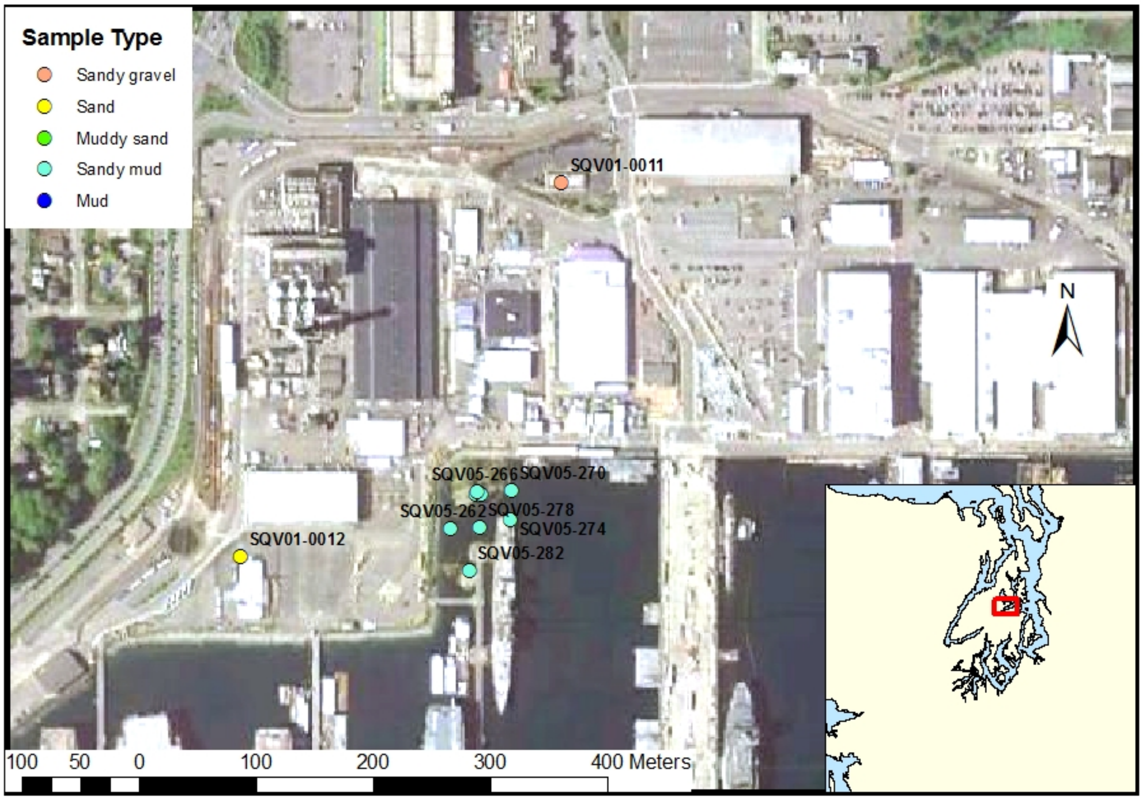

Figure AII-6: Western portion of study area. Locations and sediment types of SQV01 and SQV05 samples (Table 2)

Figure AII-7: <u>Central</u> portion of study area. Locations and sediment types of SQV03 and SQV05 samples (Table 2)

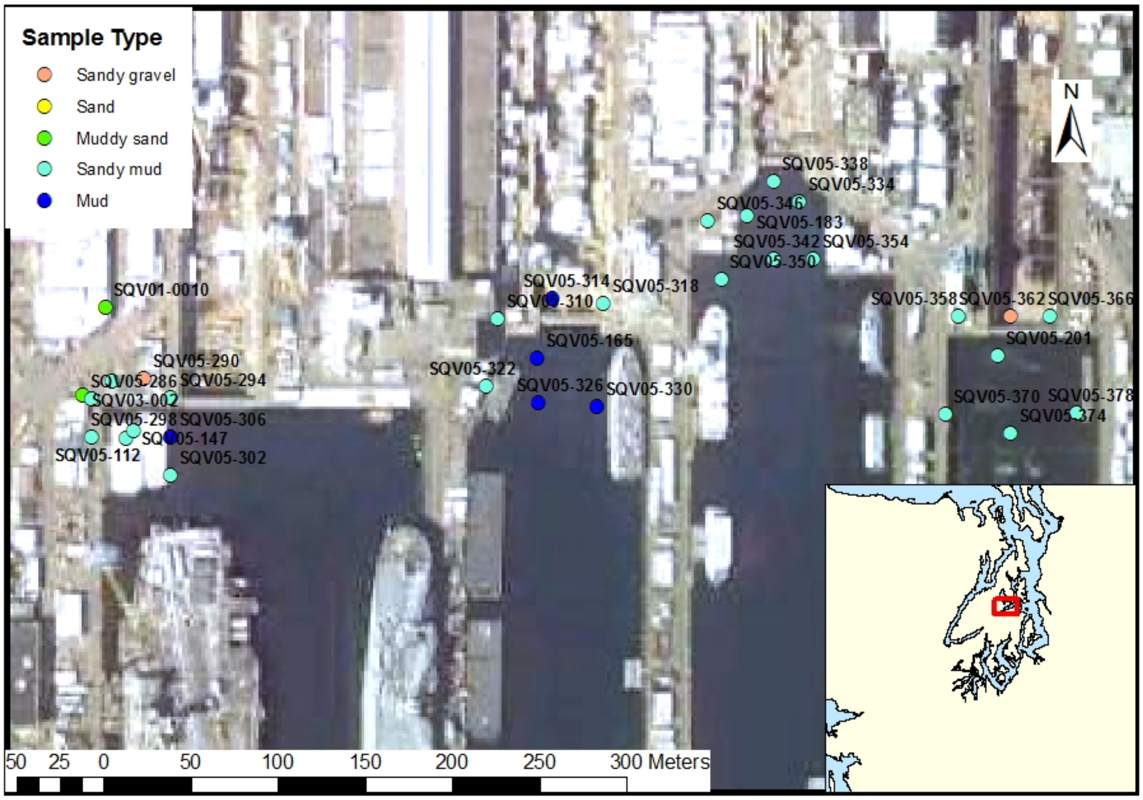

Figure AII-8: Eastern portion of study area. Locations of SQV01, SQV03 and SQV05 samples (Table 2).

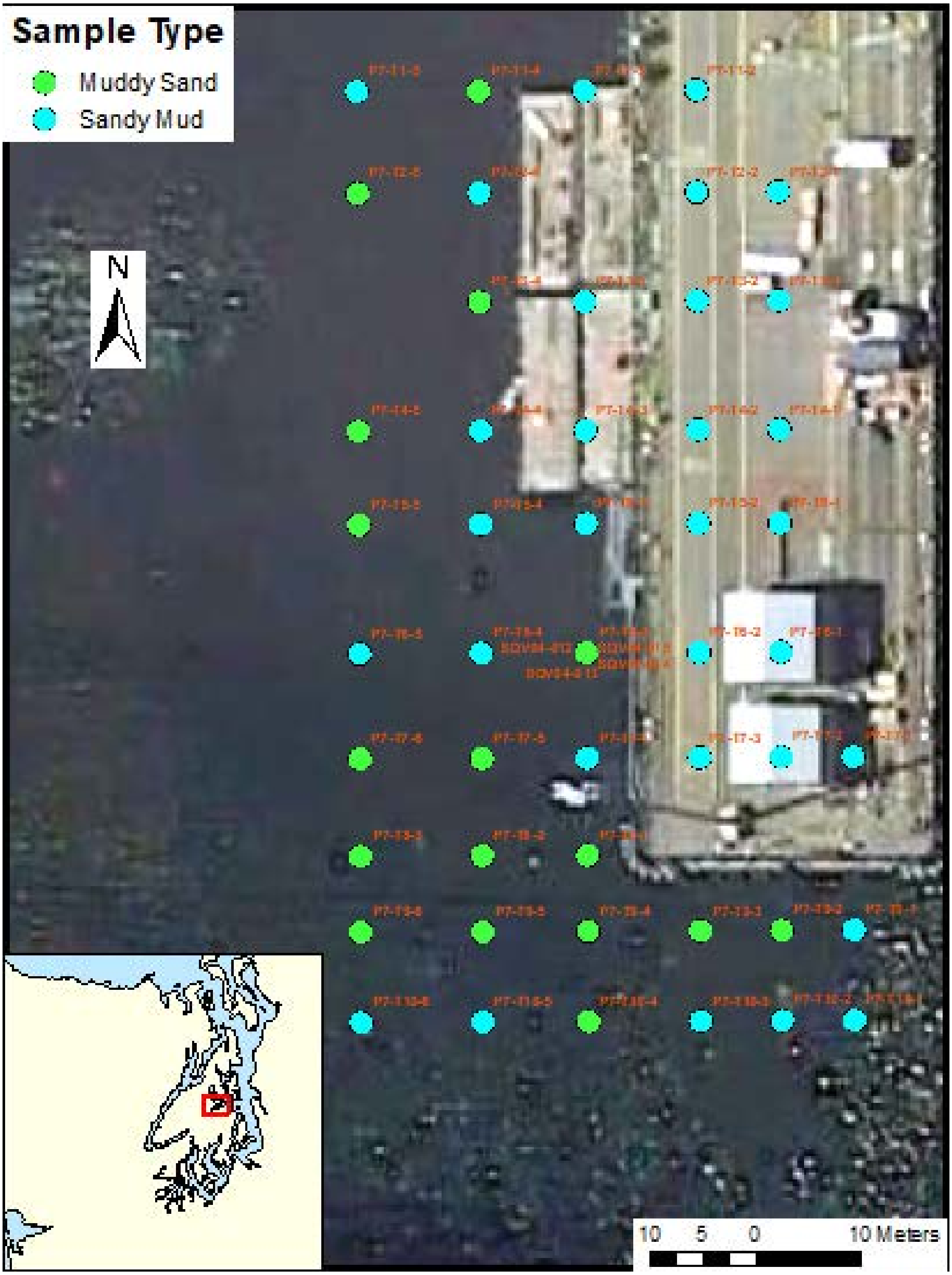

Figure AII-9: Locations of 48 samples (2010-2011) in the vicinity of Pier 7 used for a Sediment Trend Analysis.

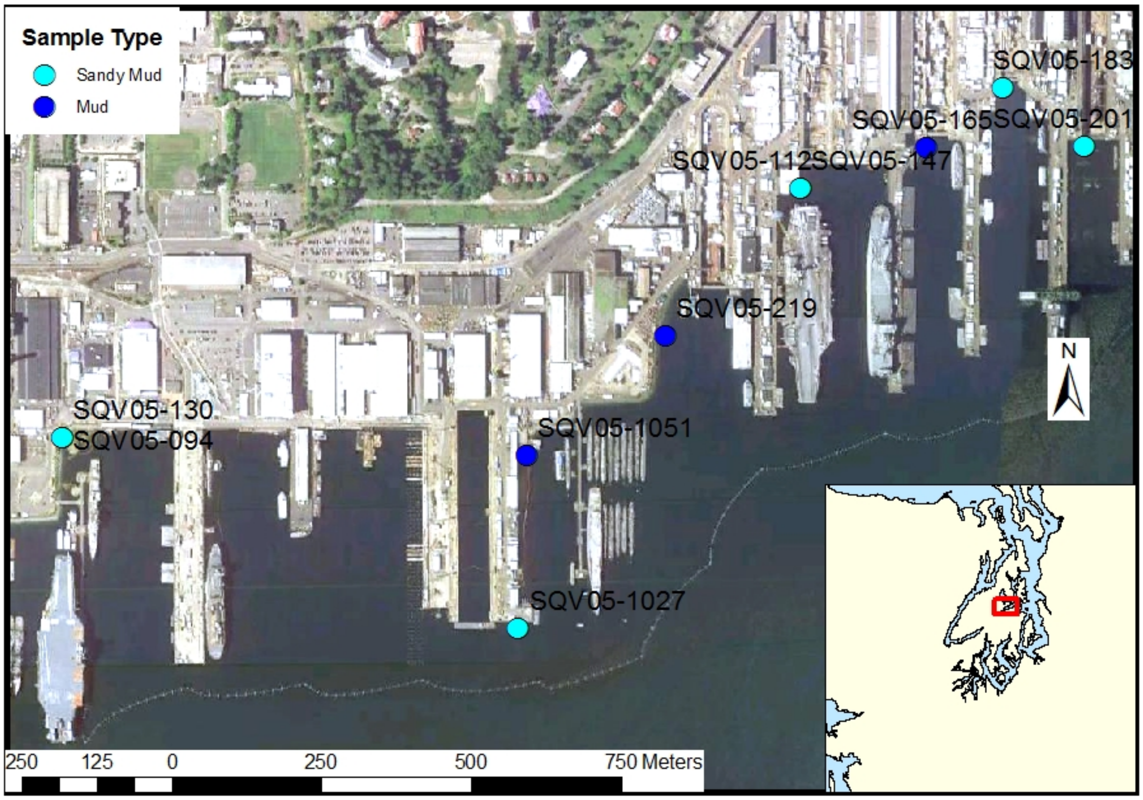

Figure AII-10: Locations of core samples (SQV05 Data Set; Table 2).

APPENDIX III

Core Analyses

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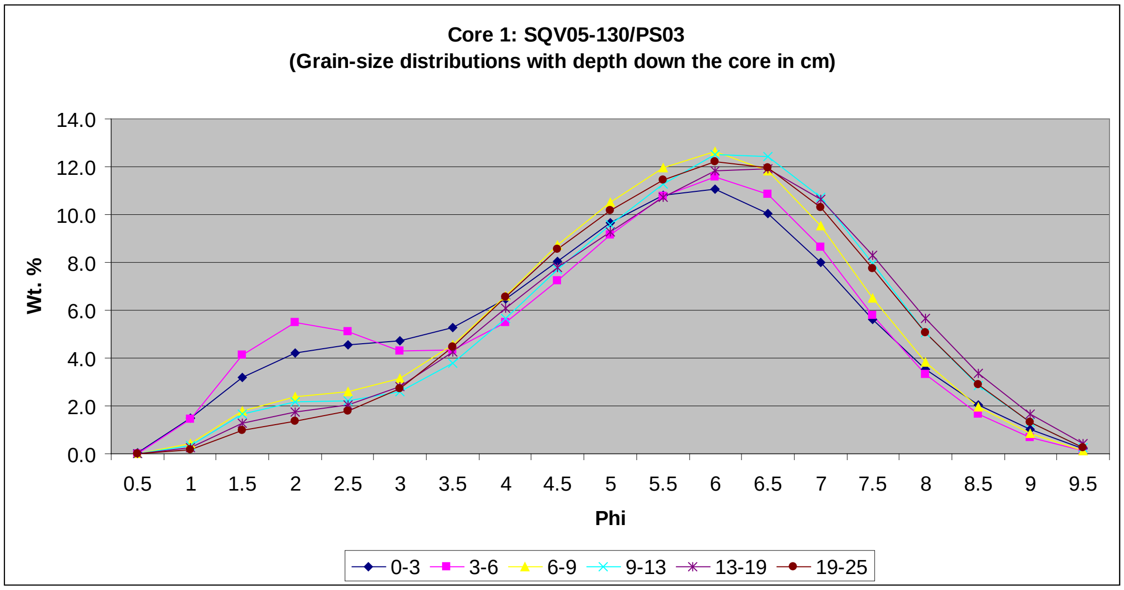
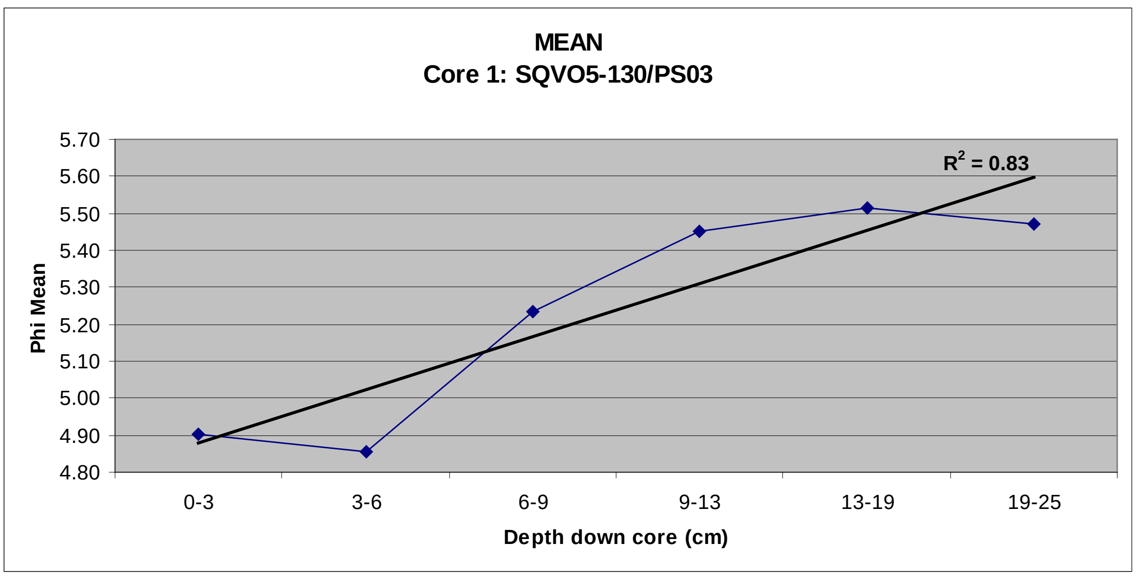
CORE NUMBER	ID (Figure AIII-1)	FIGURE NUMBER	CAPTION	PAGE NUMBER
4	SQV05-1051/PS07	AIII-4a	Grain-size distributions with depth Mean grain-size with depth (regression)	7
		AIII-4b	Sorting with depth (regression) Skewness with depth (regression)	8
5	SQV05-219/PS08	AIII-5a	Grain-size distributions with depth Mean grain-size with depth (regression)	9
		AIII-5b	Sorting with depth (regression) Skewness with depth (regression)	10
6	SQV05-147/PS09	AIII-6a	Grain-size distributions with depth Mean grain-size with depth (regression)	11
		AIII-6b	Sorting with depth (regression) Skewness with depth (regression)	12





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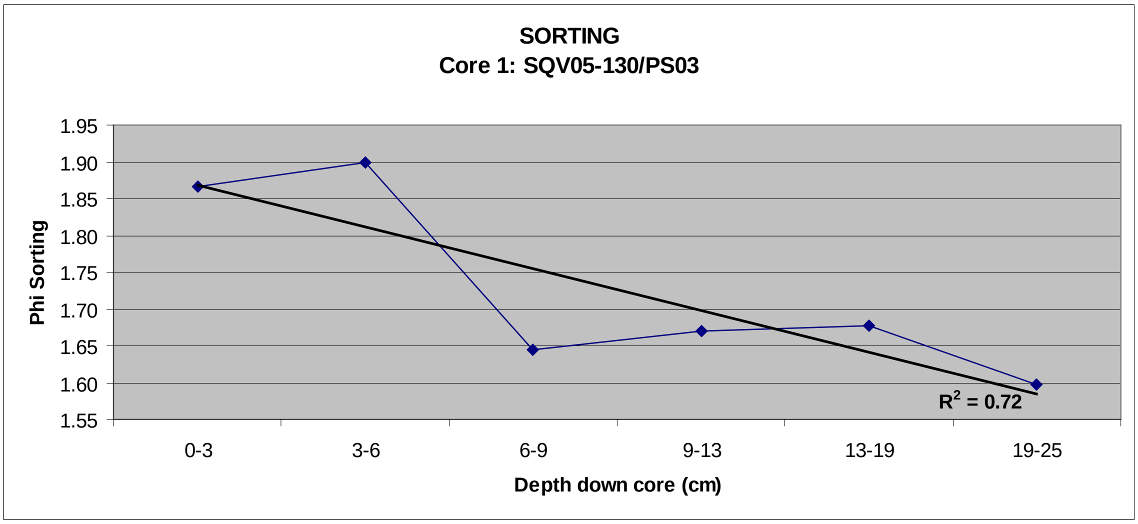


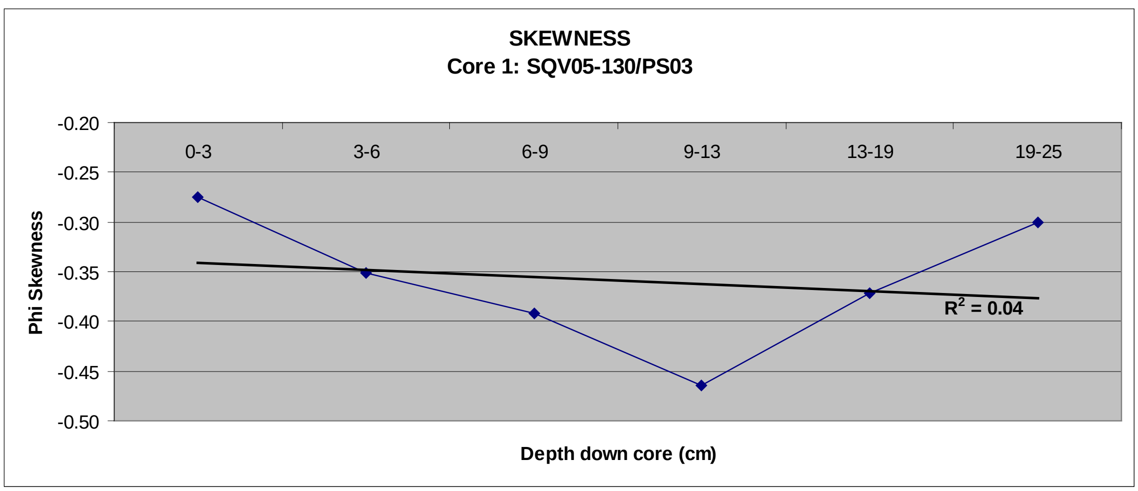
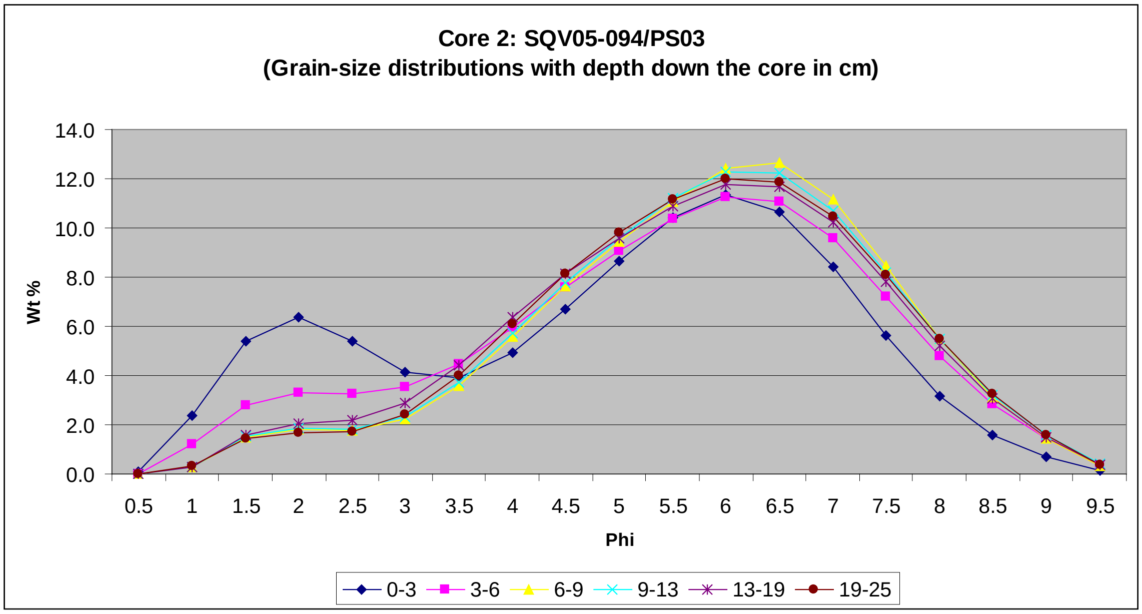
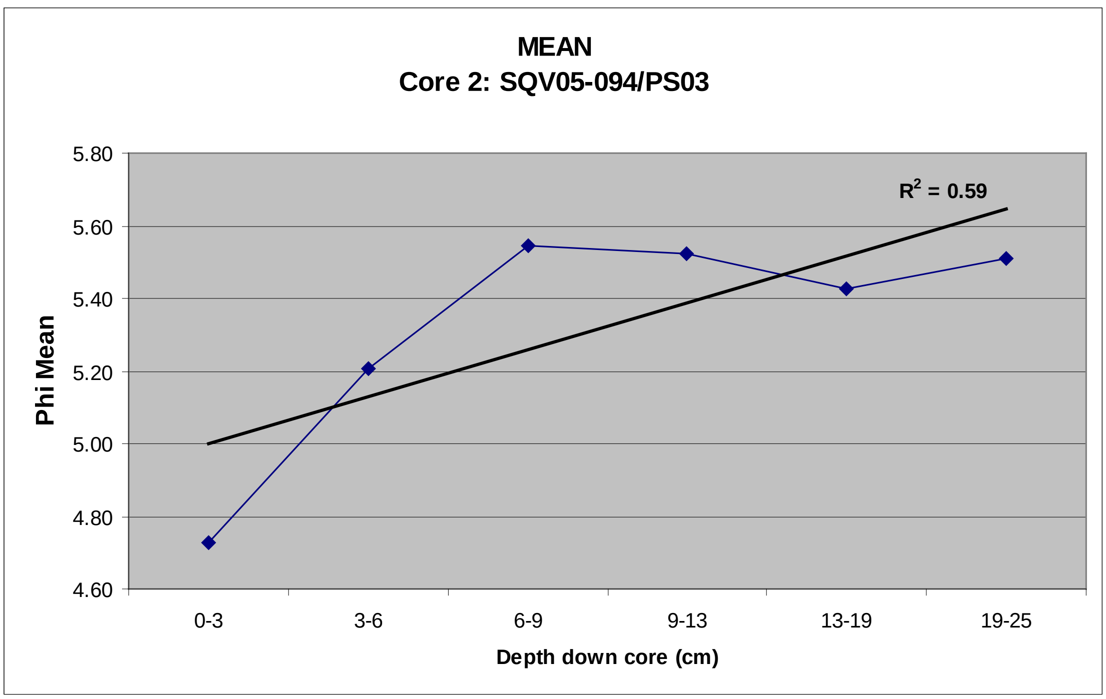


Figure AIII-1b





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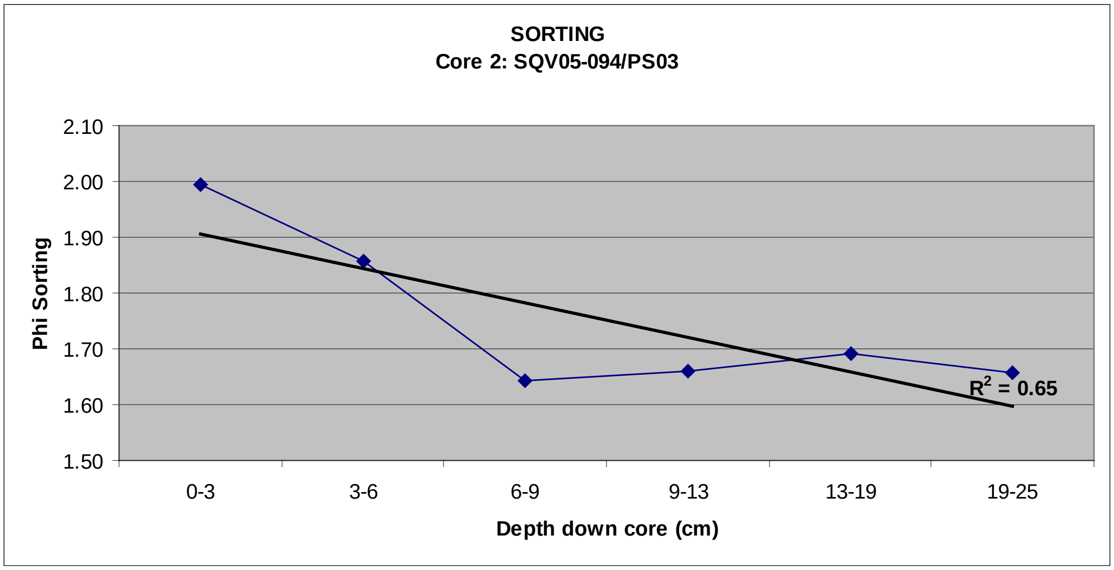

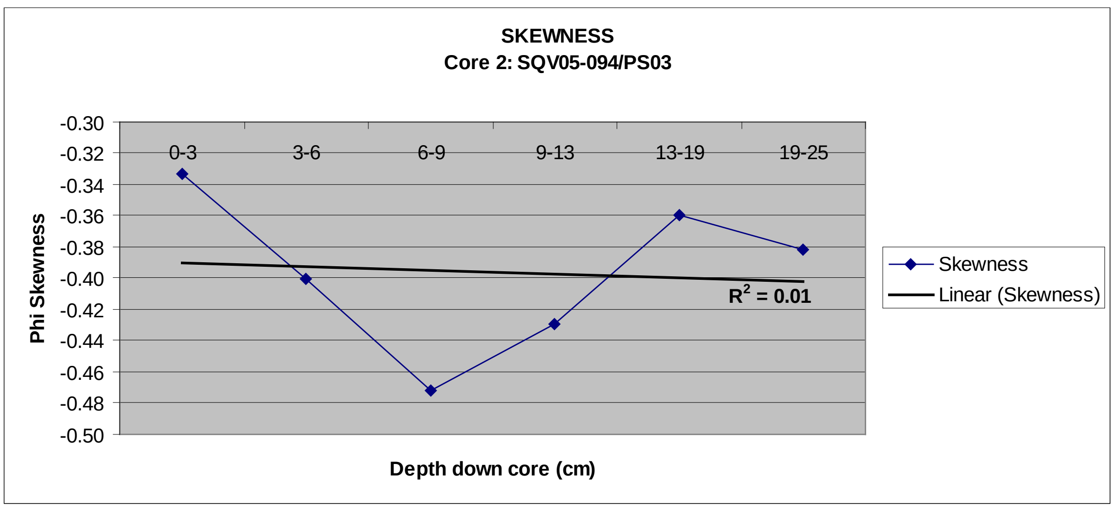

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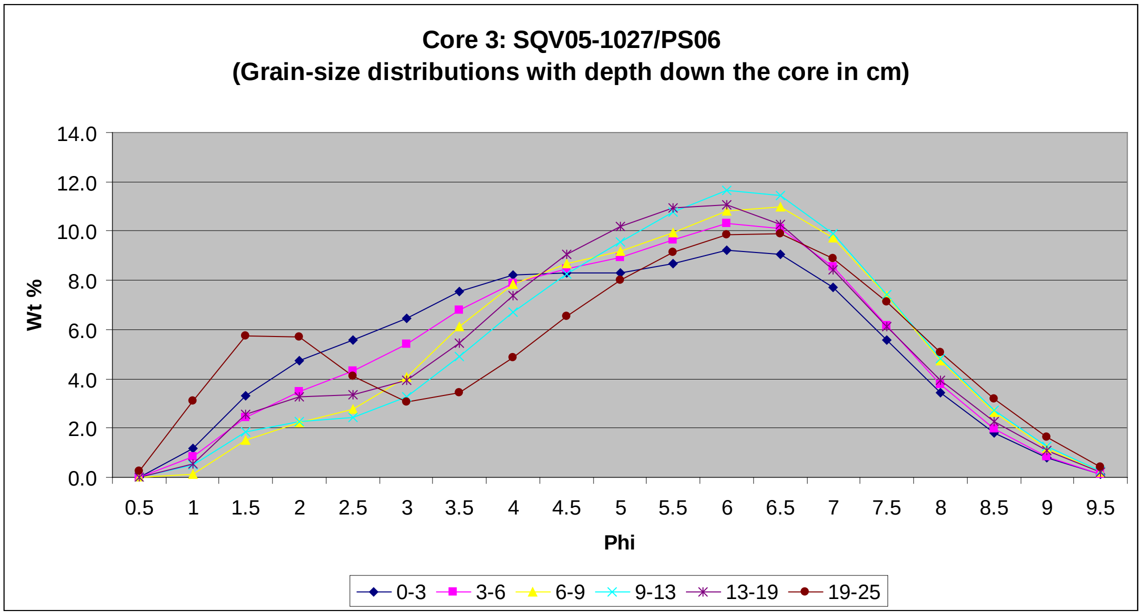

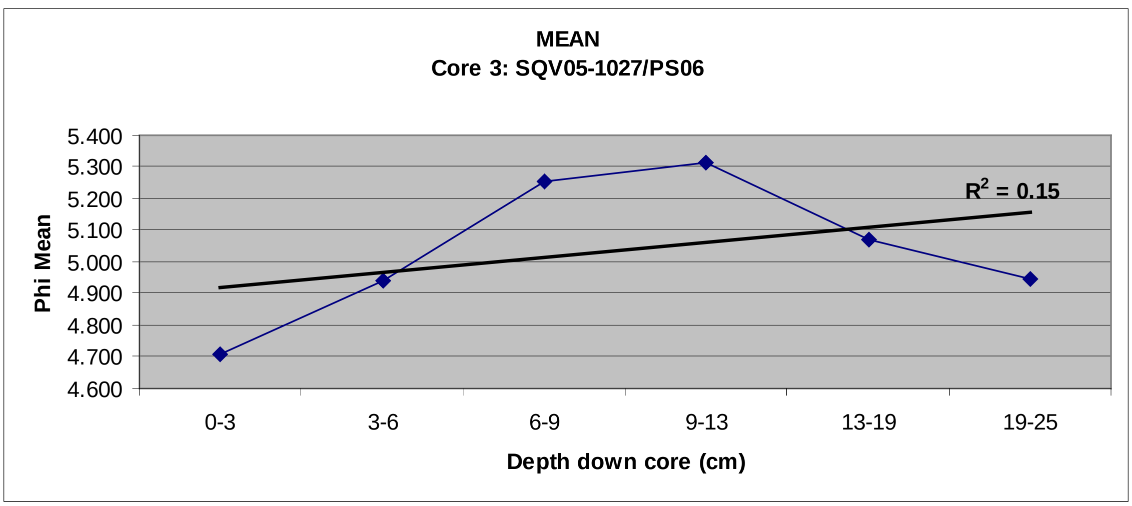

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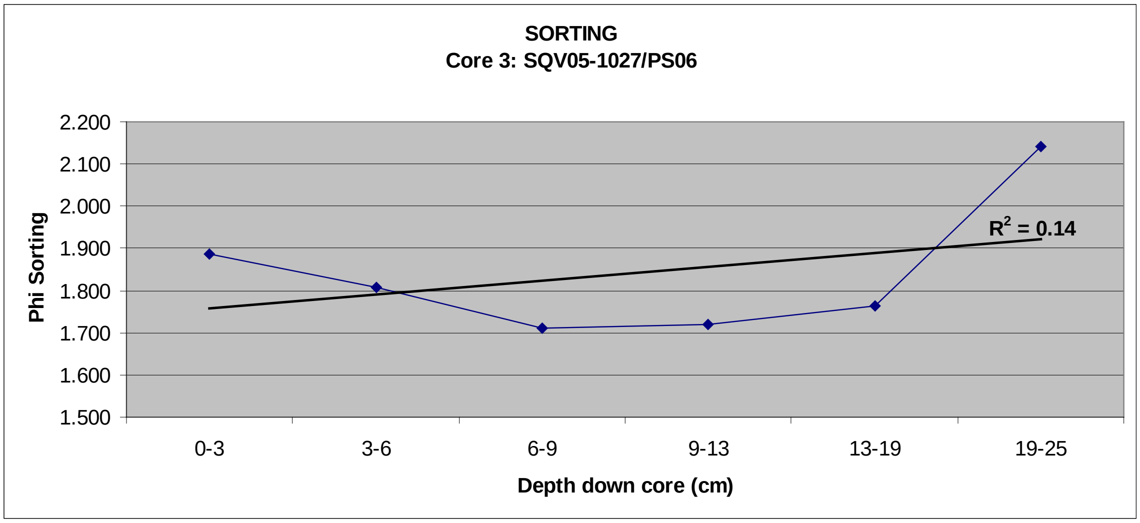

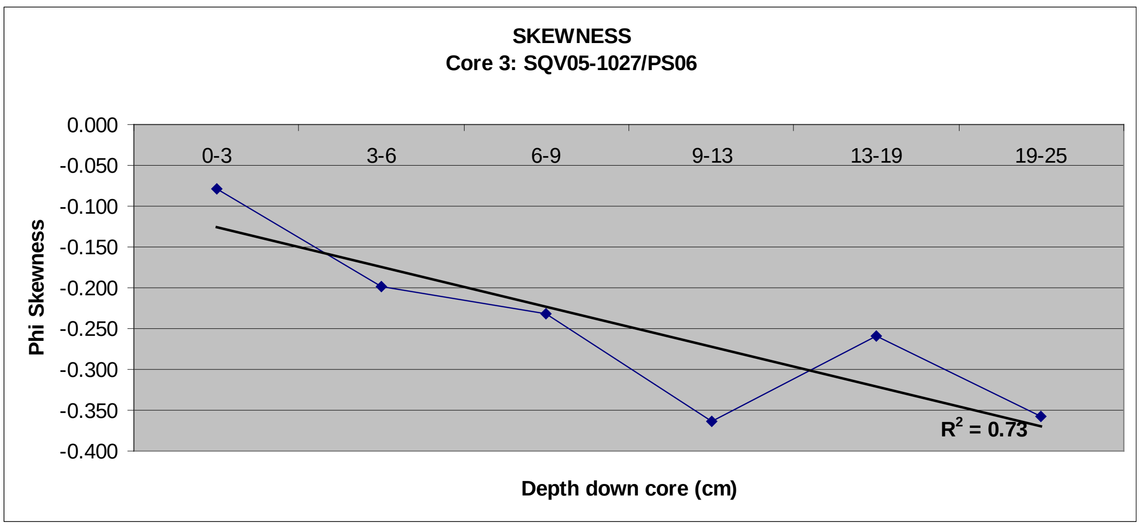

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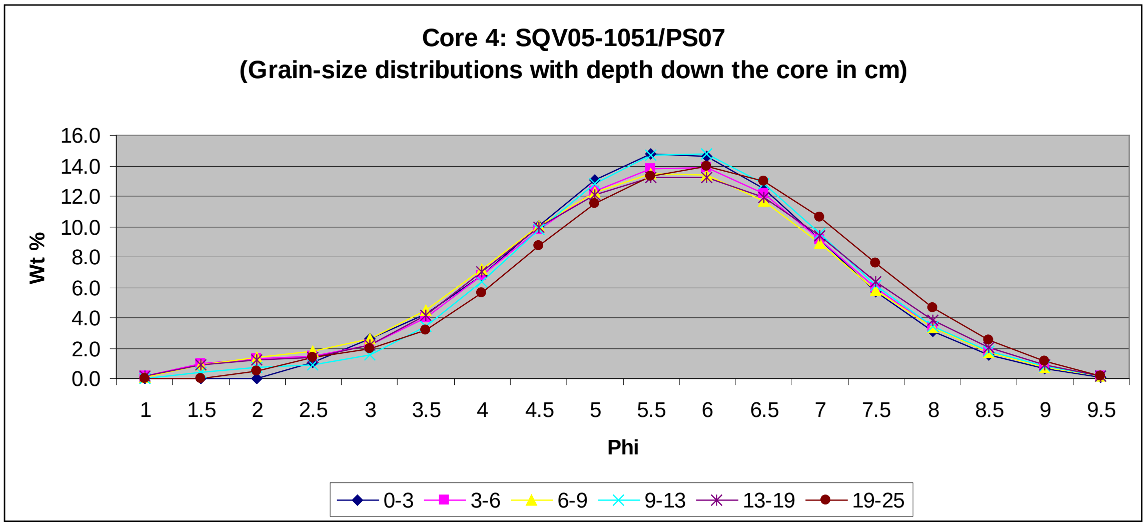

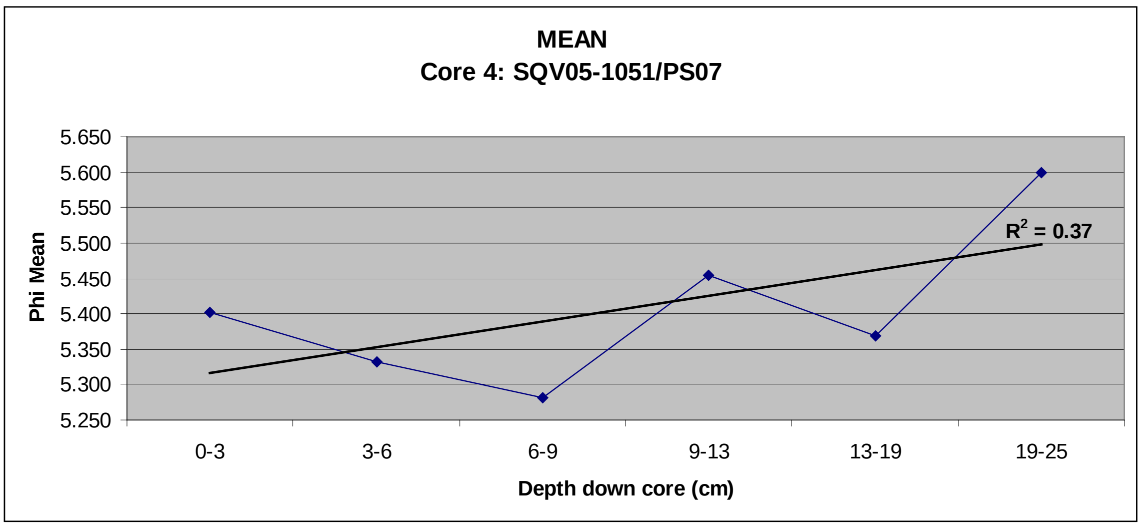

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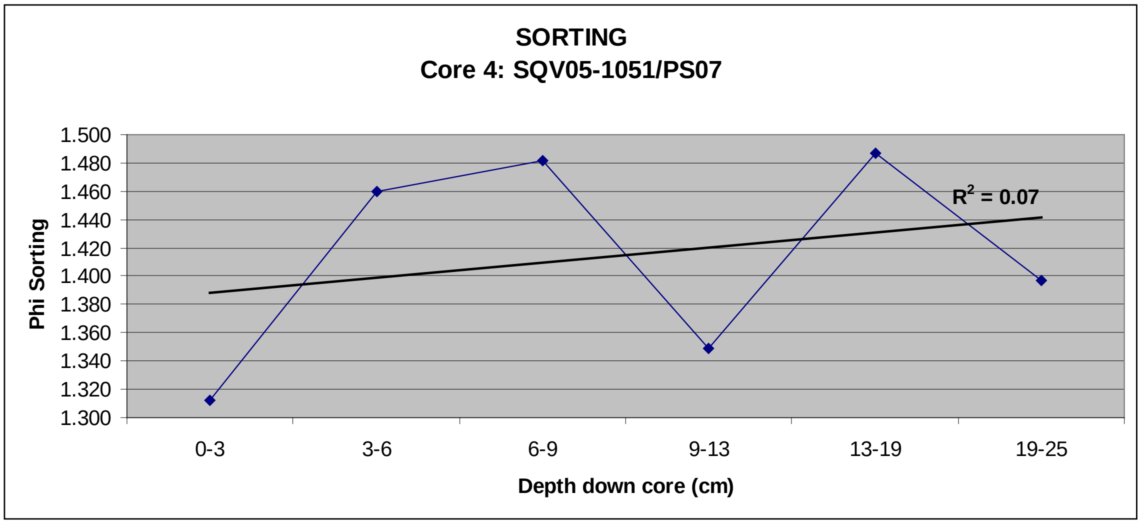

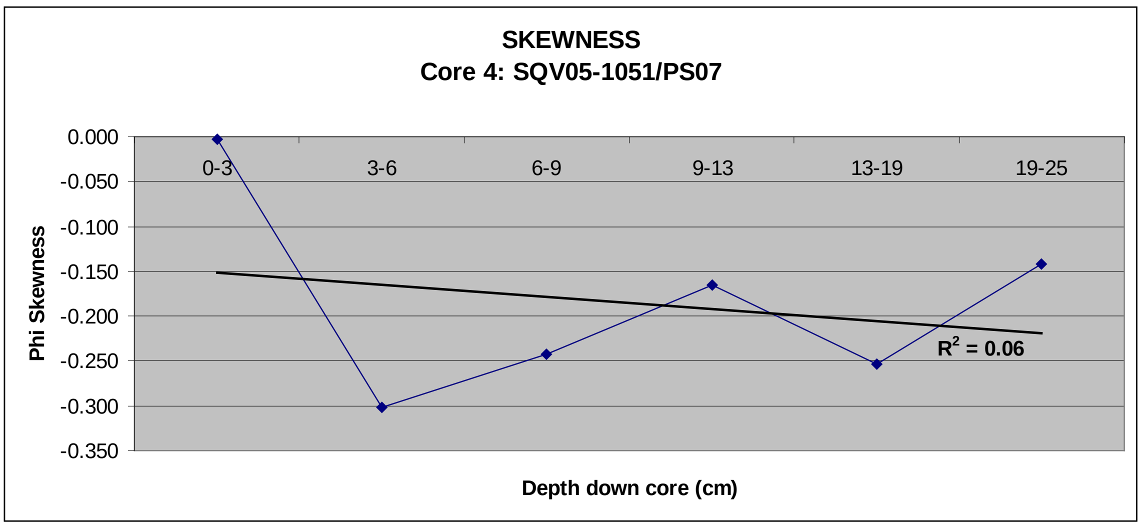

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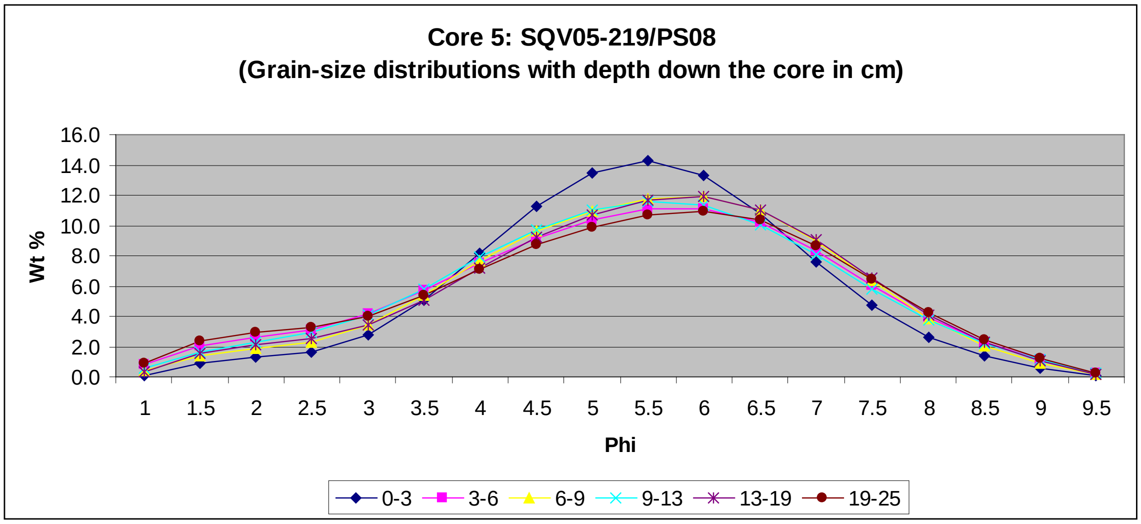

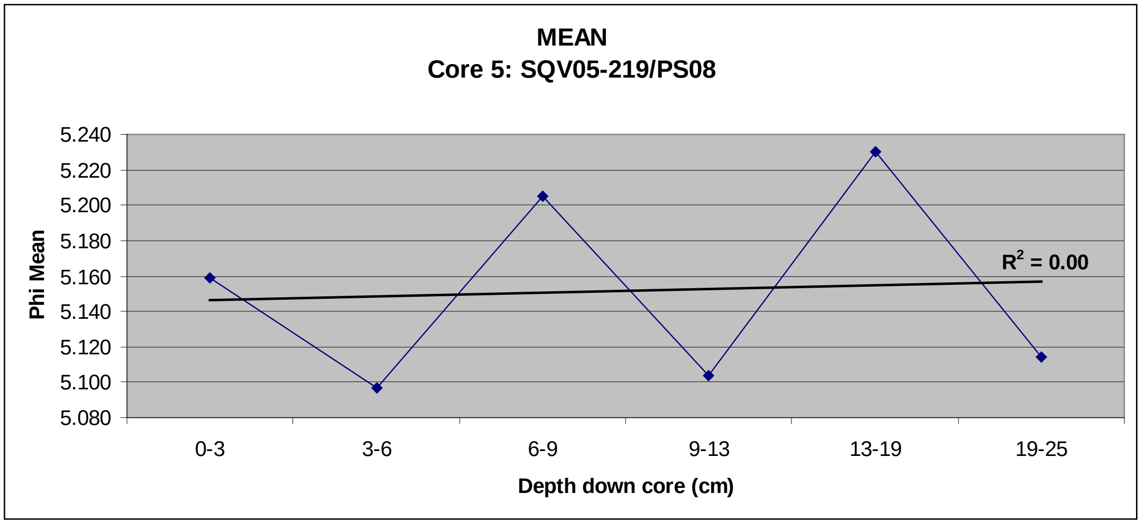

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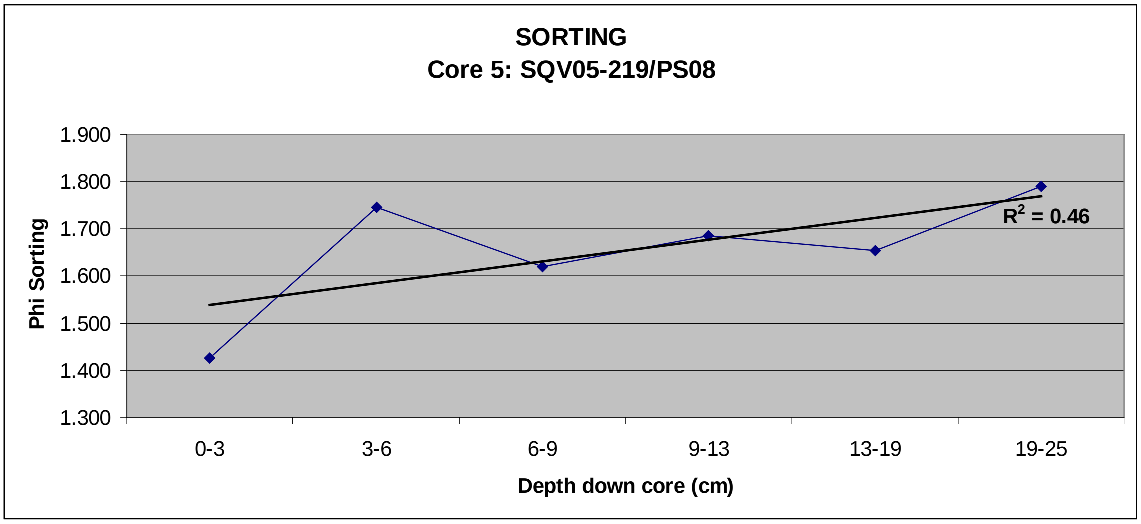

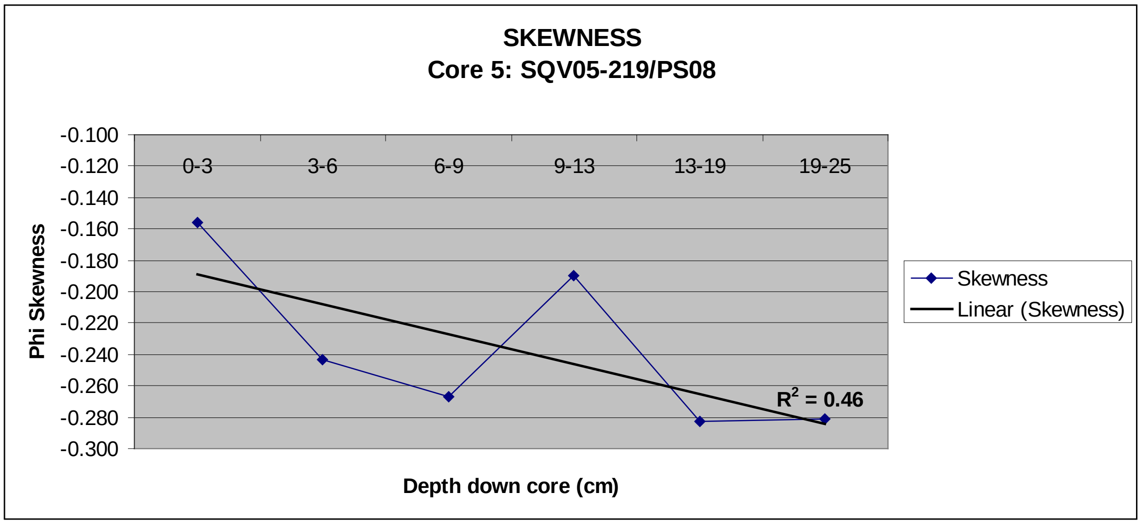

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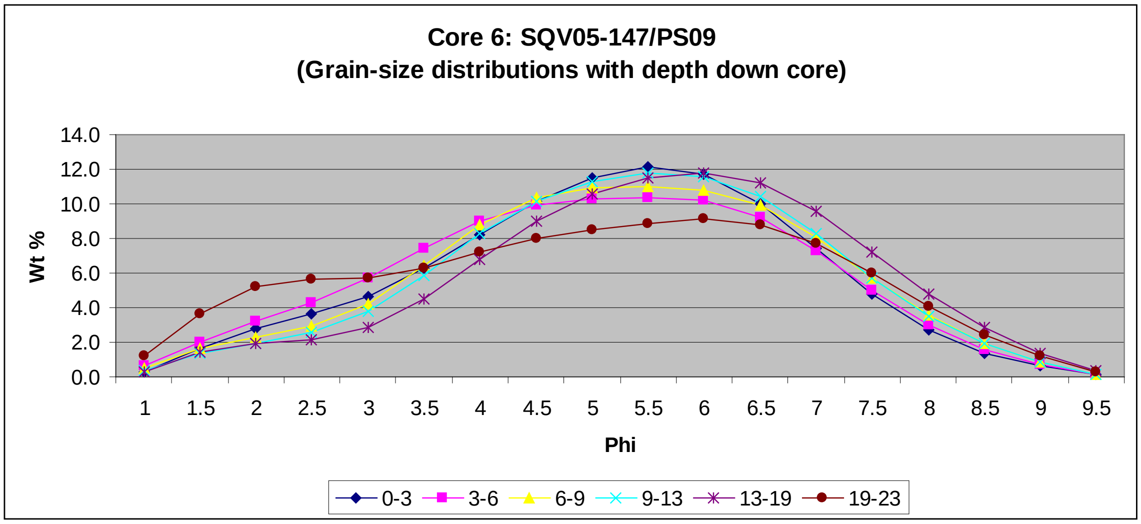

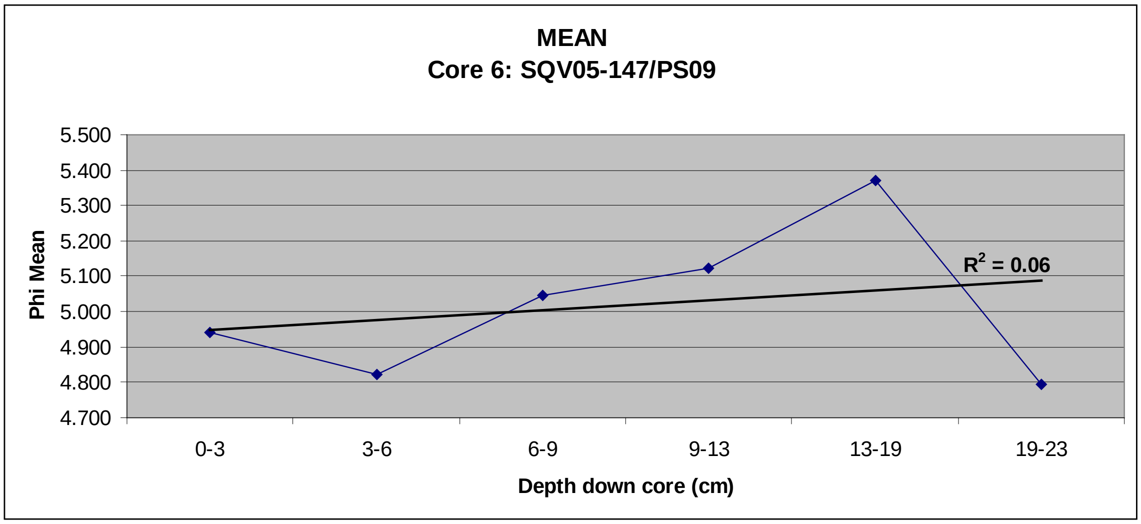

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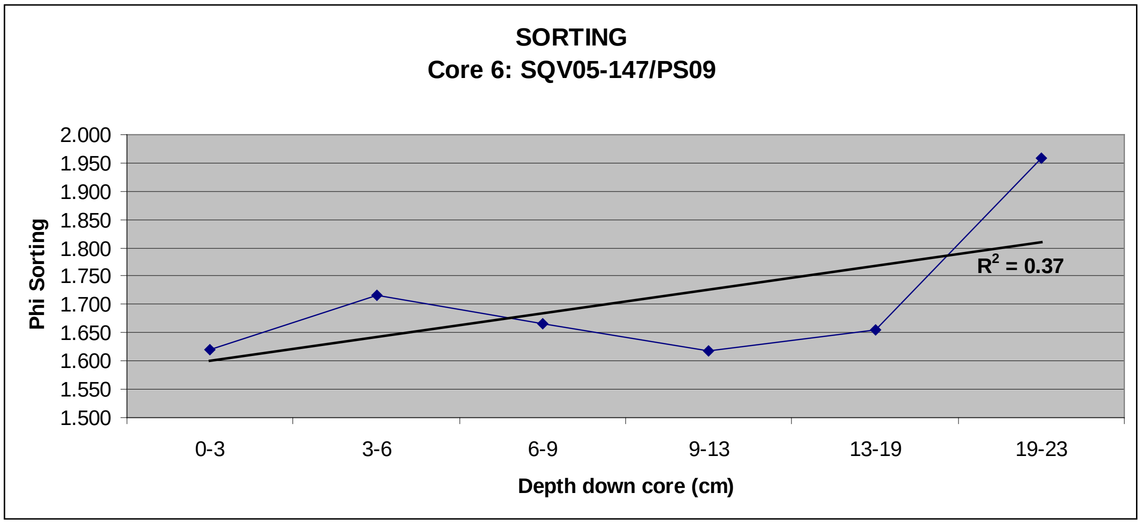

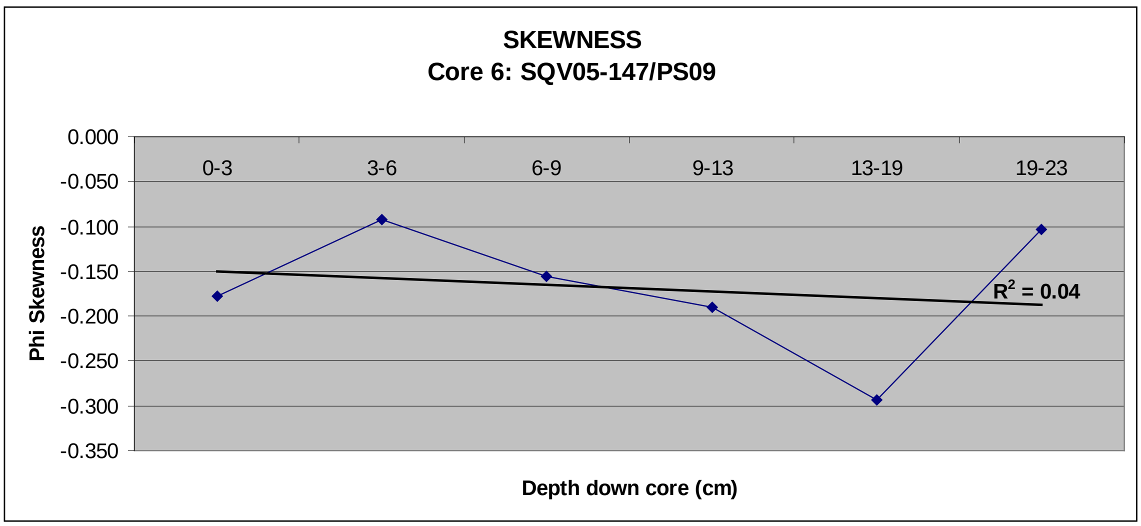

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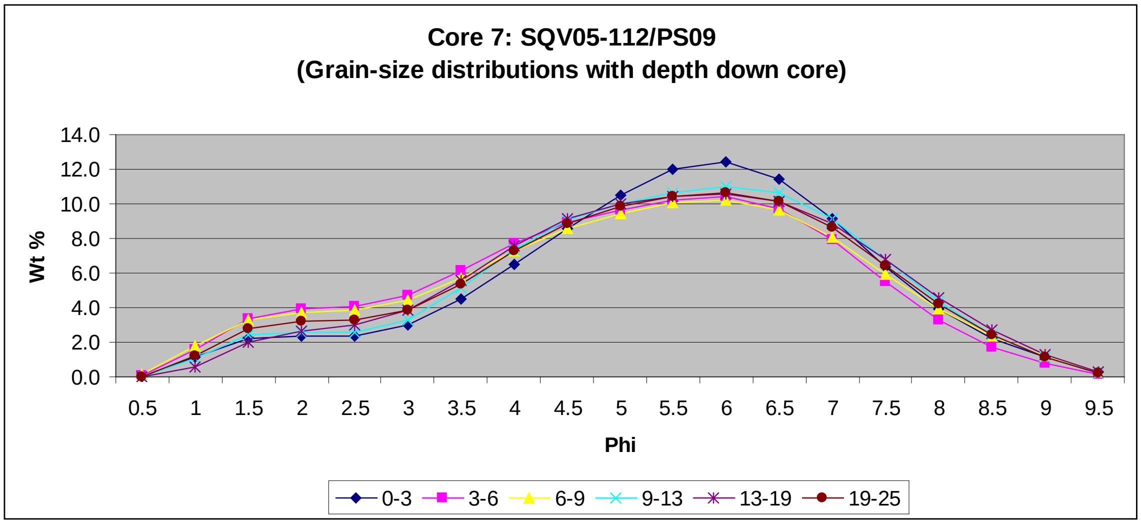

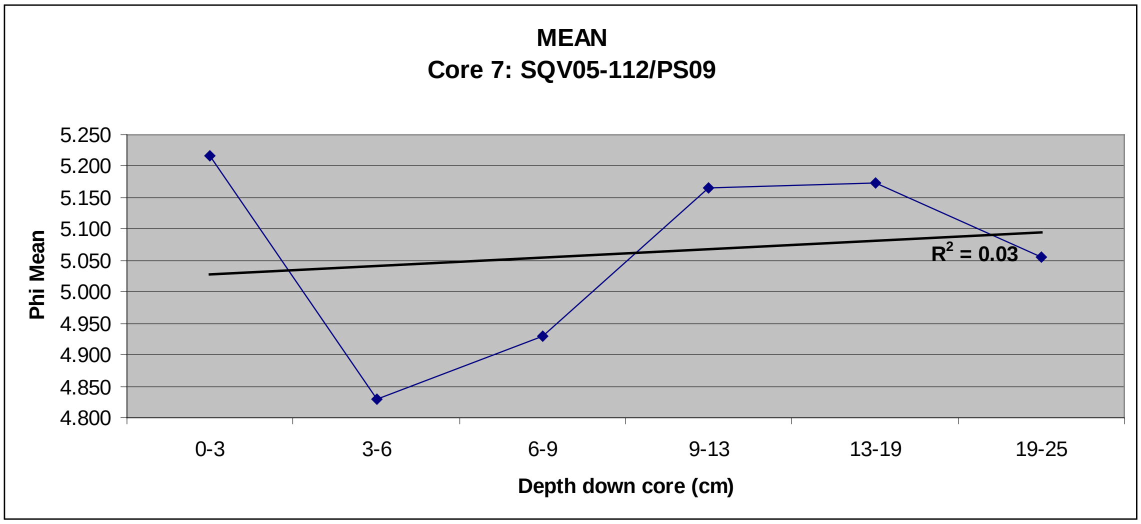

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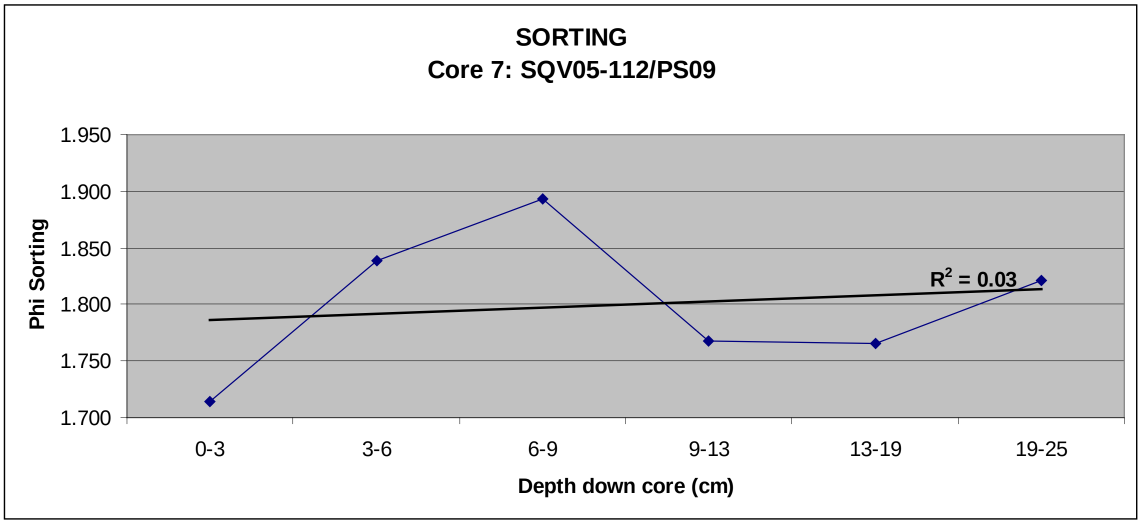

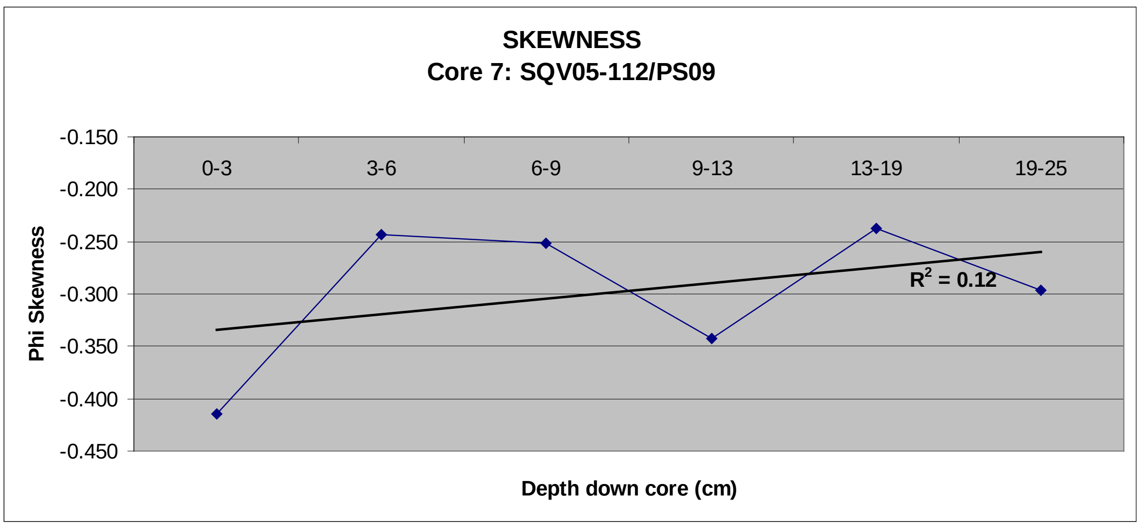

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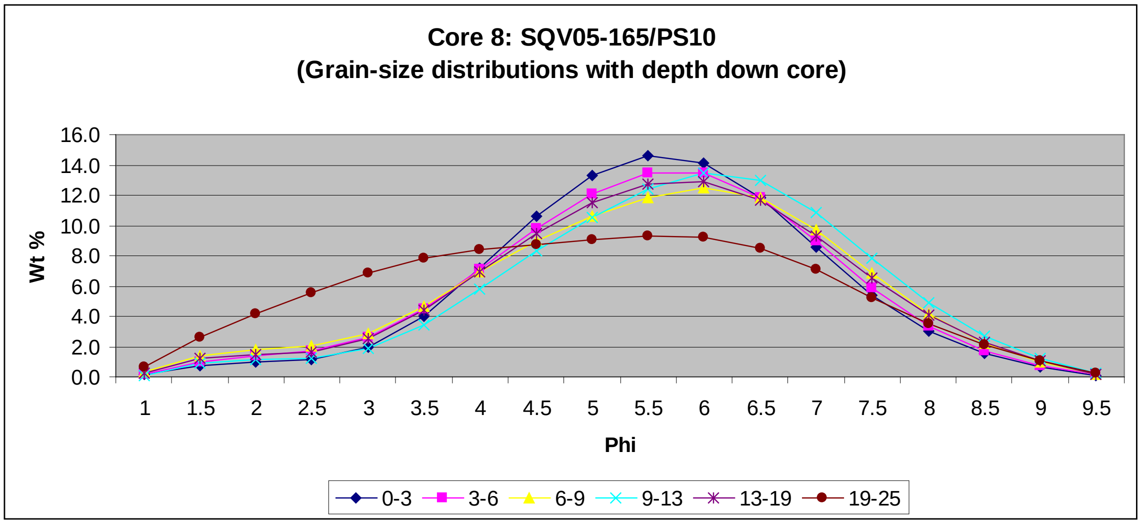

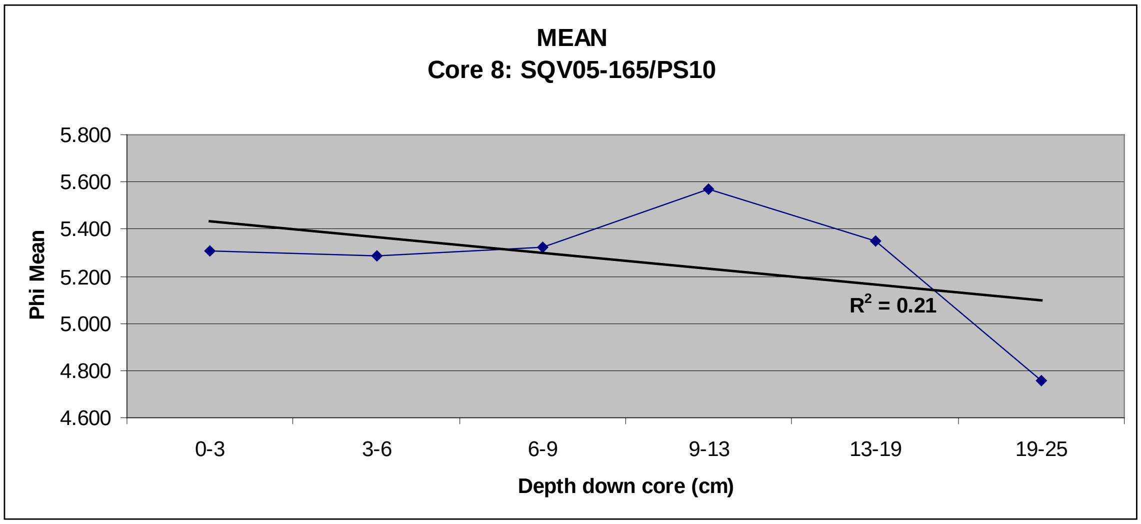

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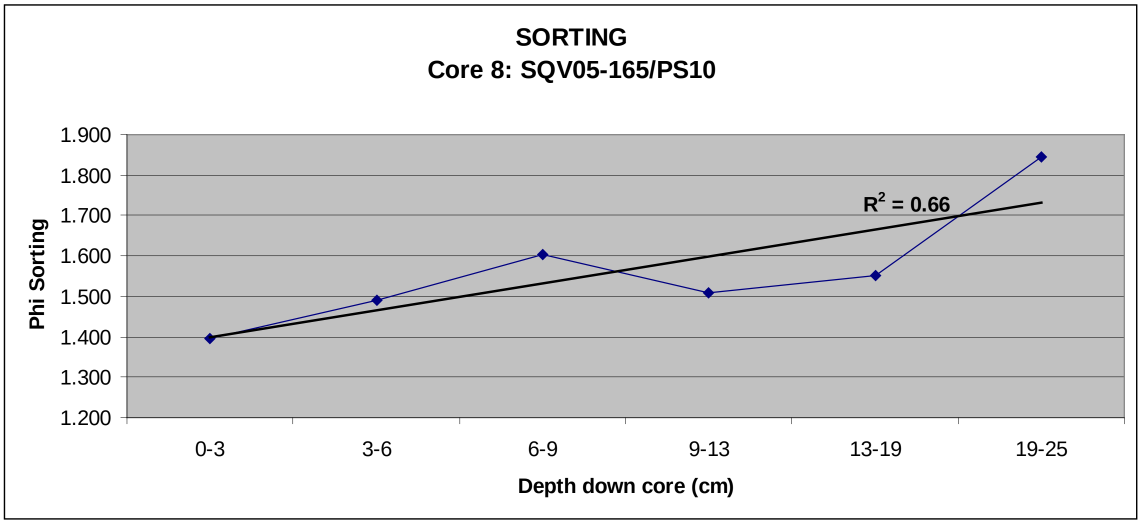

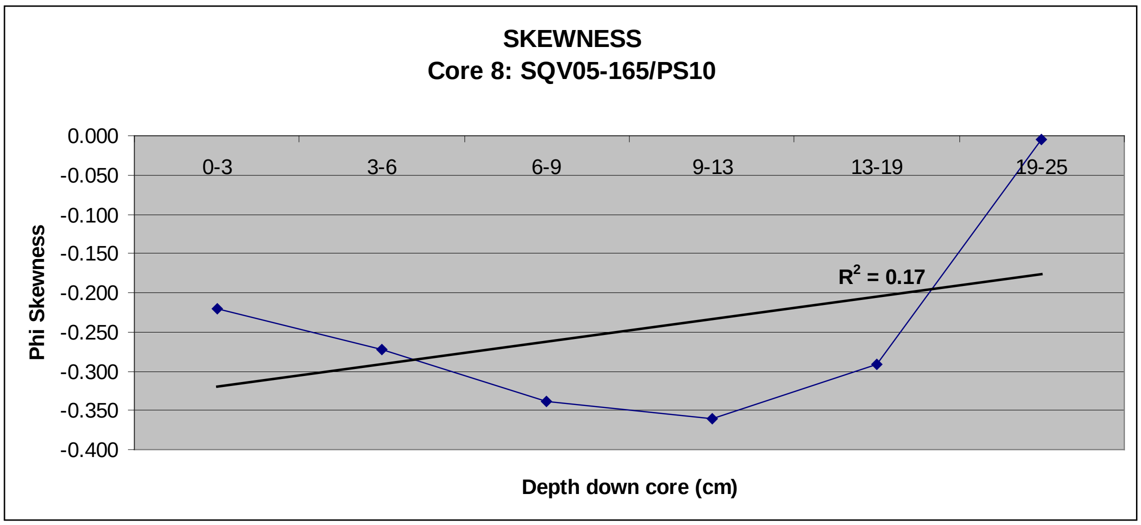

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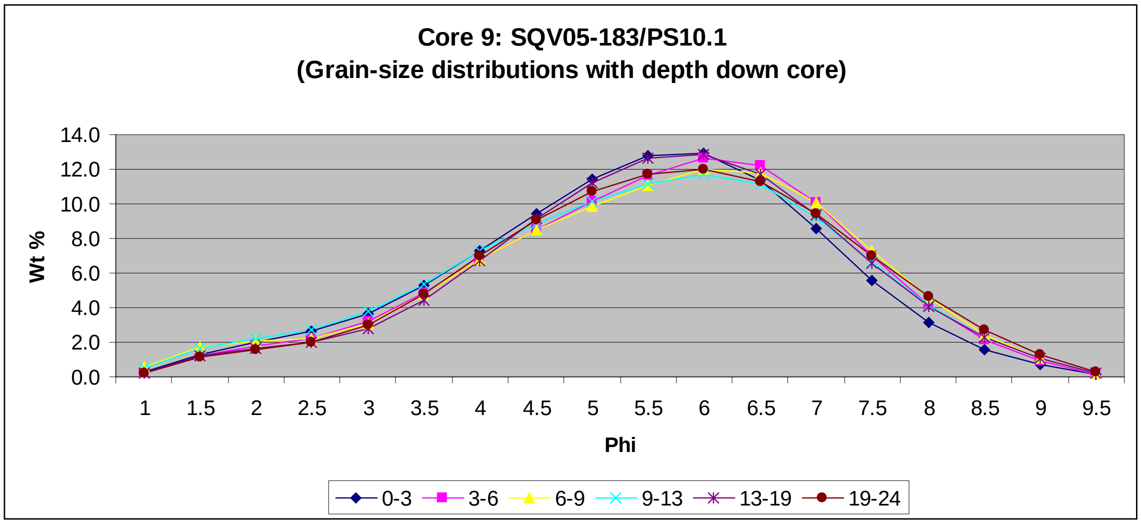

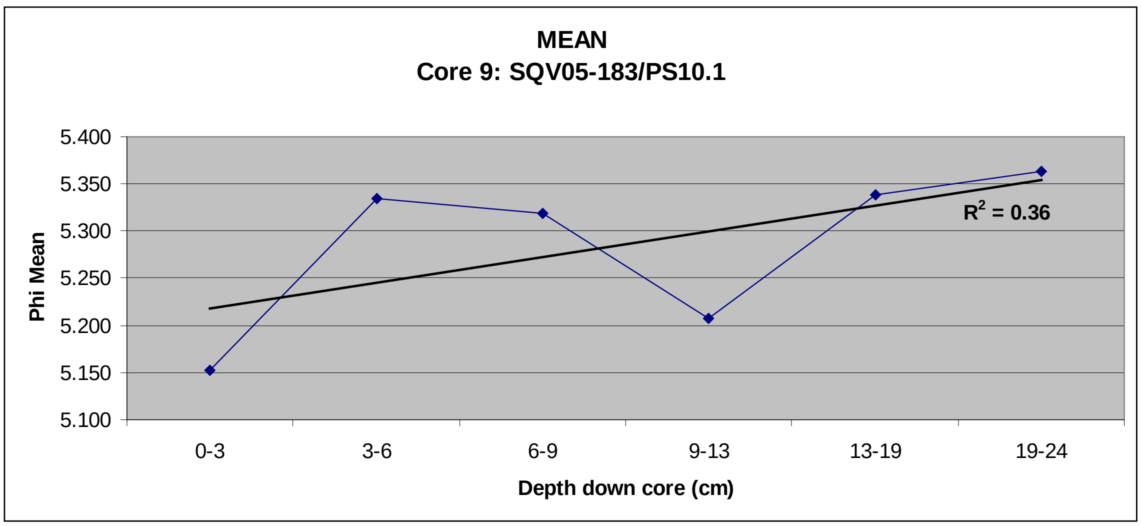

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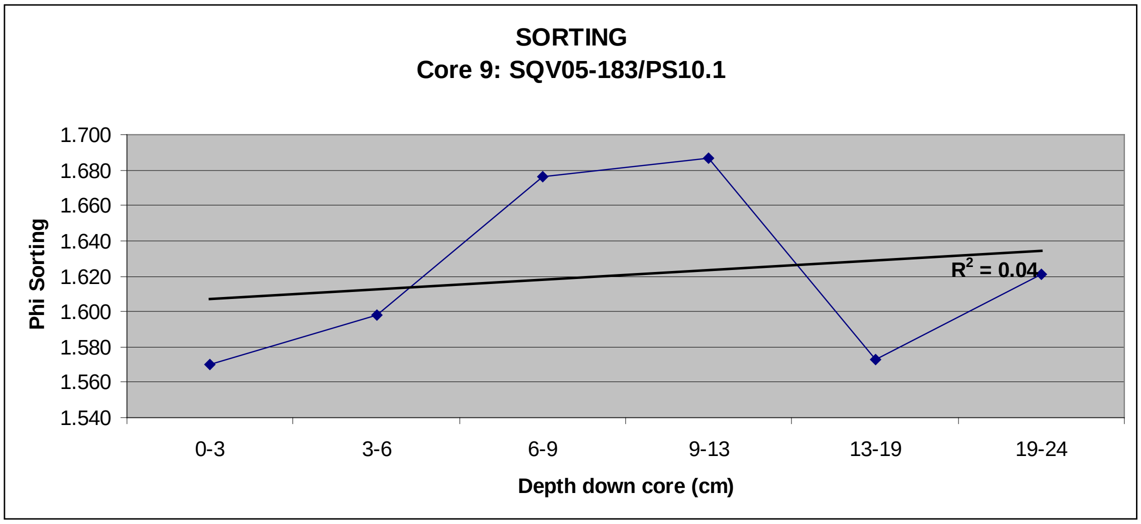

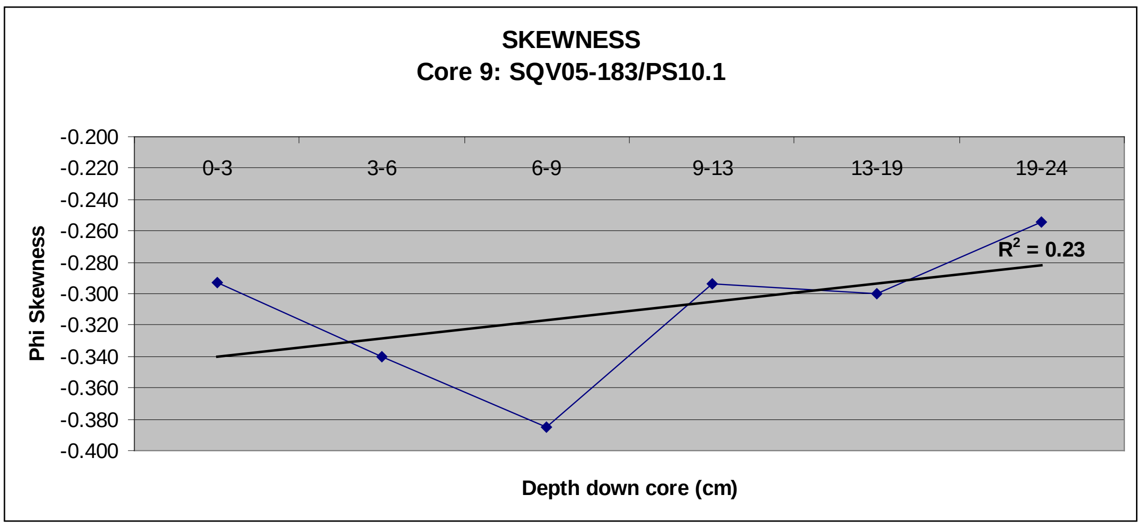

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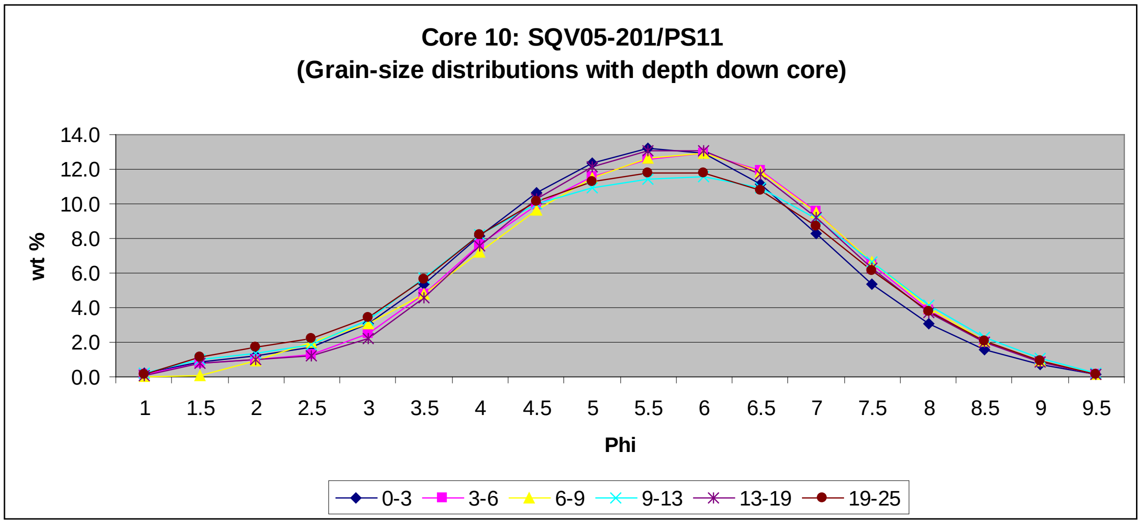

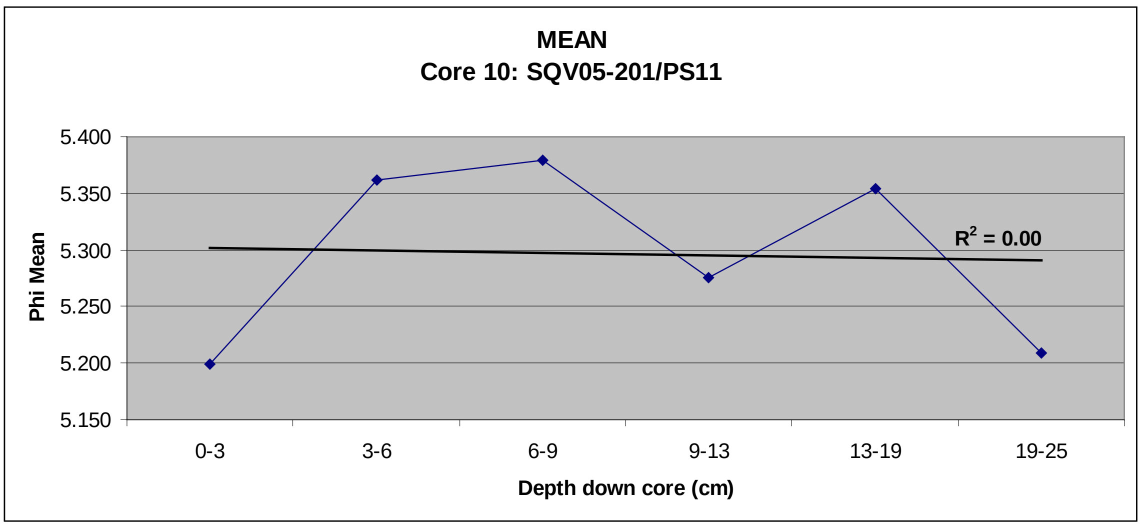

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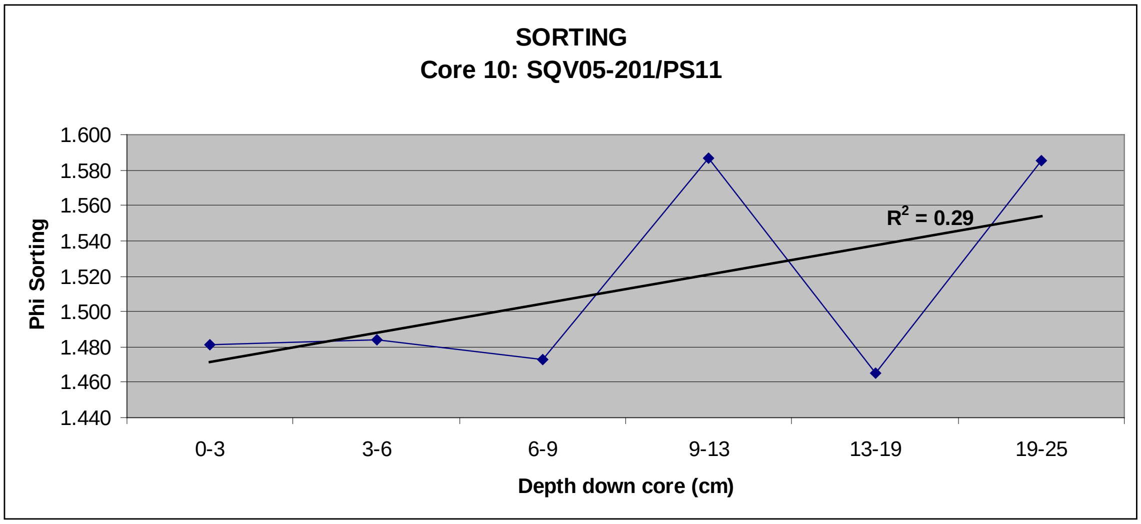

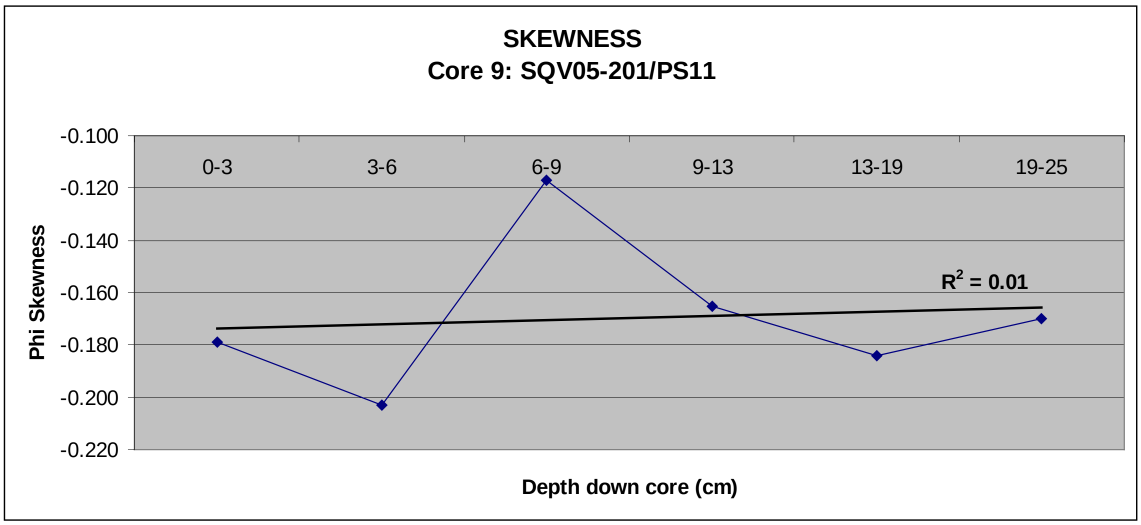

Figure AIII-10b

APPENDIX IV

SEDIMENT TREND STATISTICS FOR ALL SAMPLE LINES

Definitions:

(i) R^2 = multiple correlation coefficient derived from the mean, sorting and skewness of each sample pair making up a significant trend. This is a relative indication of how well the samples are related by transport.

(ii) Case B: Sediments becoming finer, better sorted and more negatively skewed in the direction of transport.

(iii) Case C: Sediments becoming coarser, better sorted and more positively skewed in the direction of transport.

(iv) N = number of possible pairs in the line of samples.

(v) X = number of pairs making a particular trend in a specific direction.

(vi) Z= Z-score statistic: ** are those trends significant at the 99% level. * are those trends significant at the 95% level. (Only trends at the 99% level are accepted.)

(vii) Down = transport in the "down-line" direction.

Up = transport in the "up-line" direction.

(viii) Status defines the dynamic behaviour of the sediments making up the line of samples (i.e., Net Erosion, Net Accretion, Dynamic Equilibrium etc.)

Line		R2	N	X	Z	Interpretation
L1	B Down:	0.98	28	11	4.29	** Dynamic Equilibrium
	Up:		28	6	1.43	
	C Down:		28	6	1.43	
	Up:		28	4	0.29	
L2	B Down:	0.97	21	8	3.55	** Dynamic Equilibrium
	Up:		21	6	2.23	*
	C Down:		21	0	-1.73	
	Up:		21	5	1.57	
L3	B Down:	0.96	28	16	7.14	** Dynamic Equilibrium
	Up:		28	6	1.43	
	C Down:		28	1	-1.43	
	Up:		28	4	0.29	
L4	B Down:	0.98	21	10	4.87	** Dynamic Equilibrium
	Up:		21	5	1.57	
	C Down:		21	3	0.25	
	Up:		21	2	-0.41	
L5	B Down:	0.96	28	15	6.57	** Dynamic Equilibrium
	Up:		28	6	1.43	
	C Down:		28	0	-2.00	
	Up:		28	0	-2.00	
L6	B Down:	0.96	6	4	4.01	** Dynamic Equilibrium
	Up:		6	1	0.31	
	C Down:		6	0	-0.93	
	Up:		6	0	-0.93	
L7	B Down:	0.94	28	12	4.86	** Dynamic Equilibrium
	Up:		28	4	0.29	
	C Down:		28	1	-1.43	
	Up:		28	7	2.00	*
L8	B Down:	1.00	15	9	5.56	** Dynamic Equilibrium
	Up:		15	0	-1.46	
	C Down:		15	1	-0.68	
	Up:		15	4	1.66	*
L9	B Down:	1.00	15	10	6.34	** Dynamic Equilibrium
	Up:		15	2	0.10	
	C Down:		15	1	-0.68	
	Up:		15	1	-0.68	
L10	B Down:	0.99	21	15	8.17	** Dynamic Equilibrium
	Up:		21	3	0.25	
	C Down:		21	1	-1.07	
	Up:		21	1	-1.07	
L11	B Down:	0.99	10	6	4.54	** Dynamic Equilibrium
	Up:		10	2	0.72	
	C Down:		10	1	-0.24	
	Up:		10	1	-0.24	

Line		R2	N	X	Z		Interpretation
12	B Down:	0.99	6	3	2.78	**	Dynamic Equilibrium
	Up:		6	0	-0.93		
	C Down:		6	1	0.31		
	Up:		6	1	0.31		
L13	B Down:	1.00	3	2	2.84	**	Dynamic Equilibrium
	Up:		3	1	1.09		
	C Down:		3	0	-0.65		
	Up:		3	0	-0.65		
L14	B Down:	1.00	3	2	2.84	**	Dynamic Equilibrium
	Up:		3	1	1.09		
	C Down:		3	0	-0.65		
	Up:		3	0	-0.65		