3.0 Results

This section provides a summary of the results of the dredged material placement, SPI image analysis, and grain size distribution analysis. The information for the dredge material placement was provided by the Dredge Essayons via the USACE Portland District. The SPI images that were analyzed are presented in Appendix A. The coordinates for the SPI and sediment sampling locations are provided in Appendix B. A copy of the Parametrix bathymetric report is provided in Appendix C.

3.1 Dredged Material Placement

The placement of dredged material at the near shore site was conducted over a two day period (September 14th and 15th, 2005). The Essayons was commanded by Chief Mate Jeffrey S. McDonald during the pilot study. The weather and sea conditions were favorable during the study with light winds, temperatures between 55° and 60° F, with overcast skies and light drizzle on the 14th, and sunshine on the 15th. Wave conditions consisted of a modest swell between 2 to 3 feet with a long period. The tidal currents were moderated by a relatively small tidal exchange of -1 to +7.5 feet MLLW between lower low and higher high tides.

Data recorded during the disposal runs are presented in the Figures 6 through 11, which graphically displays the displacement and speed profiles of the dredge Essayons during each placement. Table 2 summarizes details of the enhanced disposal effort. The Essayons offloaded material in single continuous run along each disposal lane. The dredge displacement profiles show relatively constant disposal of material over the length of each run. Each disposal run took 8 to 10 minutes, with a ship speed ranging from 2 to 7.5 knots during the placement activities. The dredge turn-around-time was approximately 2.5 to 3.0 hours between dredging at Quadrant 4 in the navigational channel to disposal at the nearshore site. The length of each disposal ranged from 1183 to 1554.8 meter. The volume of dredged material per disposal run ranged from 5520 to 5810 cubic yards.

The average thickness of dredged material could be estimated using the dredged material volumes, the apparent footprint of dredged material using the recorded disposal lane lengths and average width of 180 feet. The estimate of average dredge material deposition ranged from 2.03 to 2.69 inches thick was based on volumetric calculations. The USACE, Portland District estimate a maximum simulated bottom accumulation of 4.8 inches using the MDFATE model of dredged material distribution at the South Jetty (Moritz 2005). The USACE model simulated ocean conditions during the pilot study using field data measured in September 2003 that matched the 2005 tide and wave conditions. These data were used for FATE model simulation of dredged material deposition on the seabed at the South Jetty Site. The parameters utilized in the model simulation included: wave height and direction, depth averaged current direction and velocity, and observed tides. Graphics depicting the model parameters and model simulation results are presented in Appendix D. These estimates are consistent with the goals of the enhanced disposal target depths of 2 to 4 inches identified in the research permit (USEPA 2005).

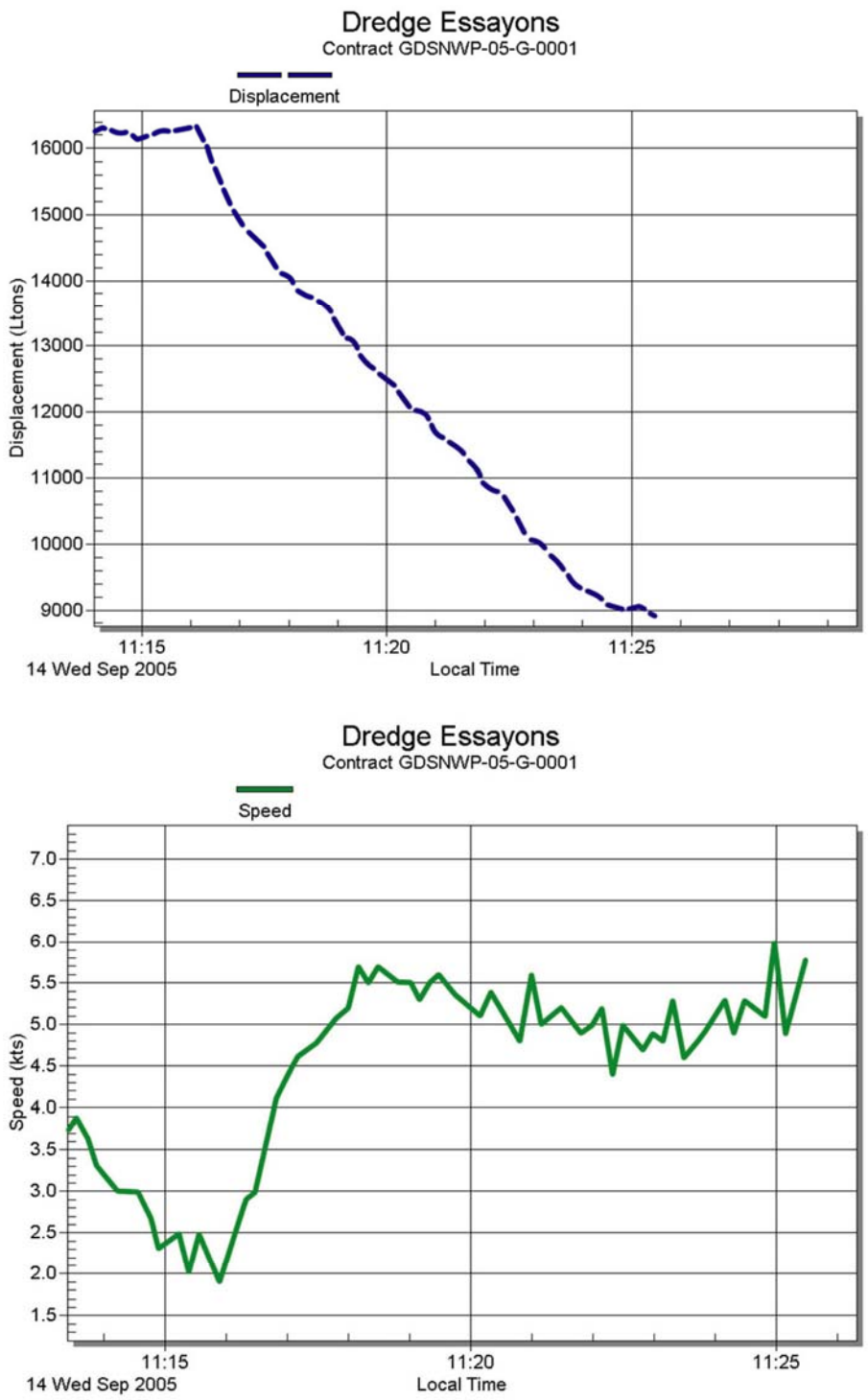

Figure 6. Dredge Displacement and Disposal Speed: Lane 1

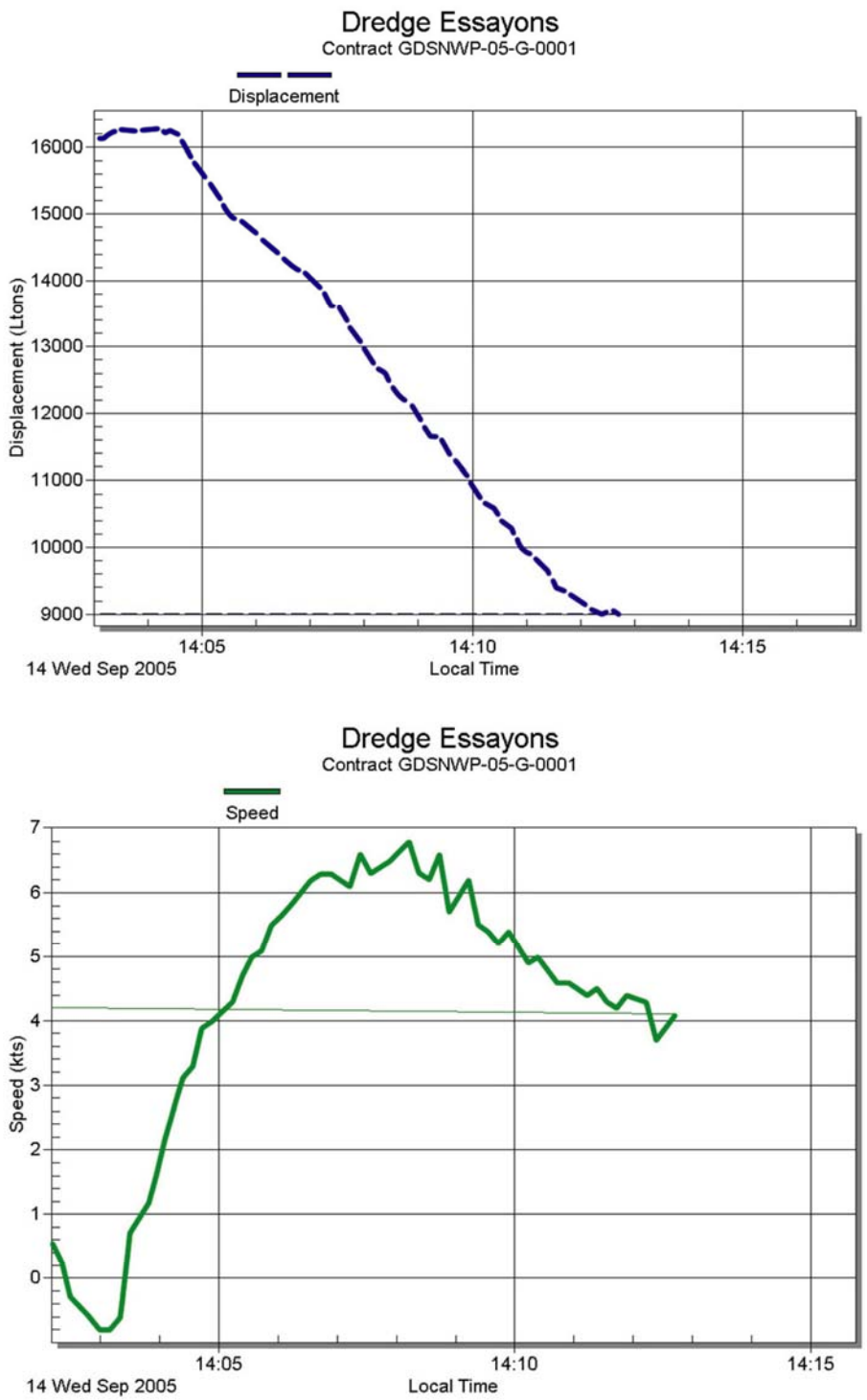

Figure 7. Dredge Displacement and Disposal Speed: Lane 2

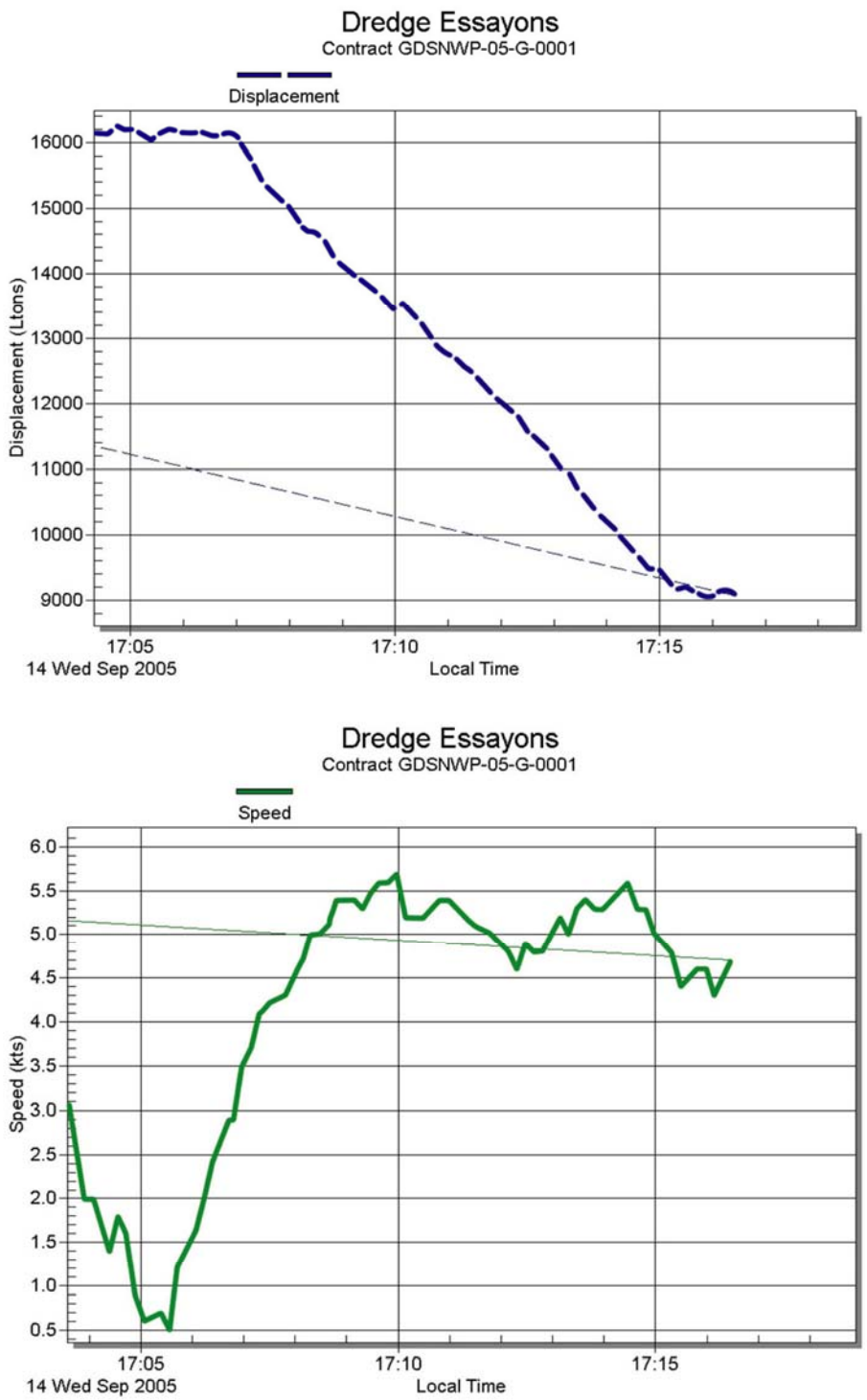

Figure 8. Dredge Displacement and Disposal Speed: Lane 3

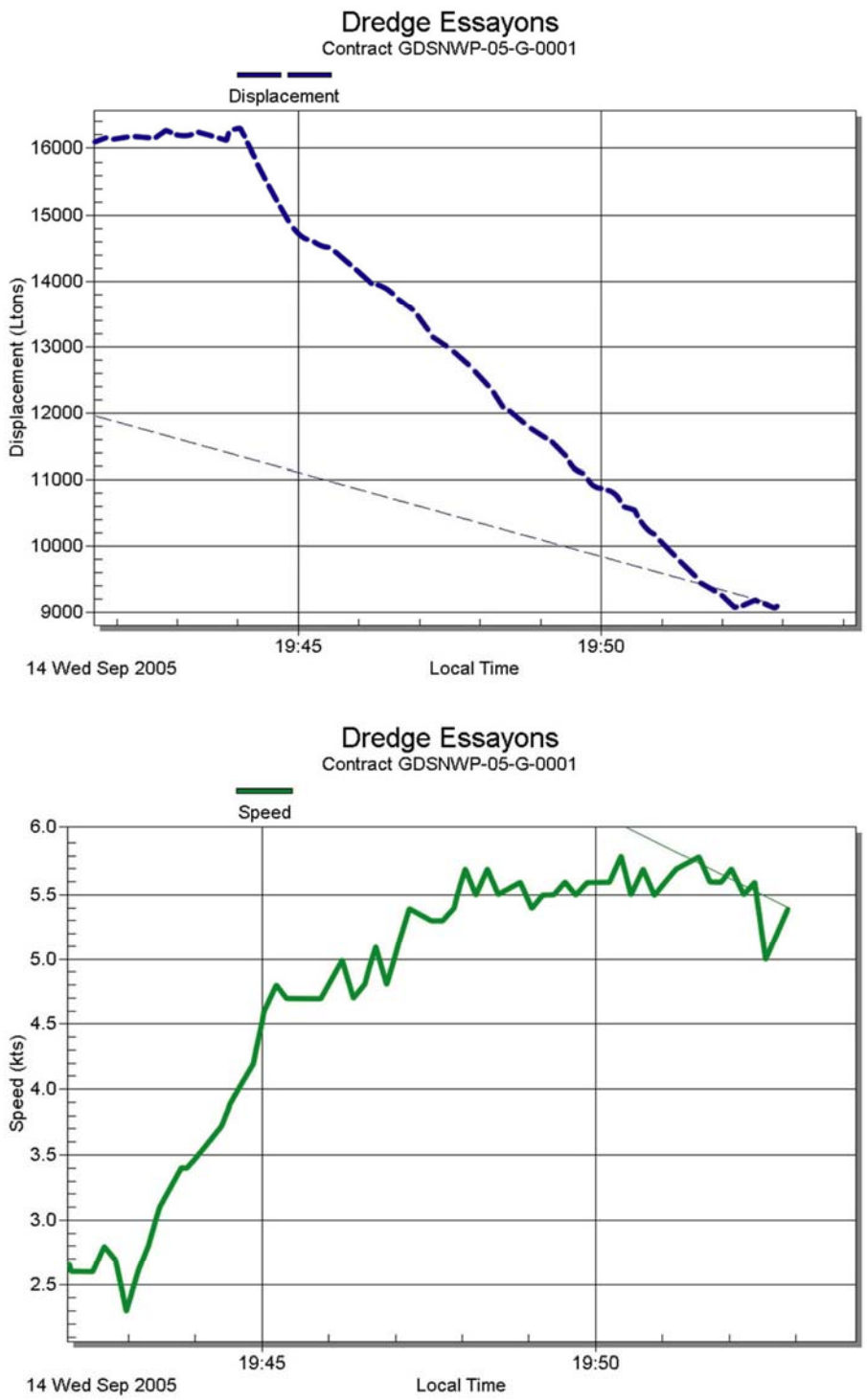

Figure 9. Dredge Displacement and Disposal Speed: Lane 4

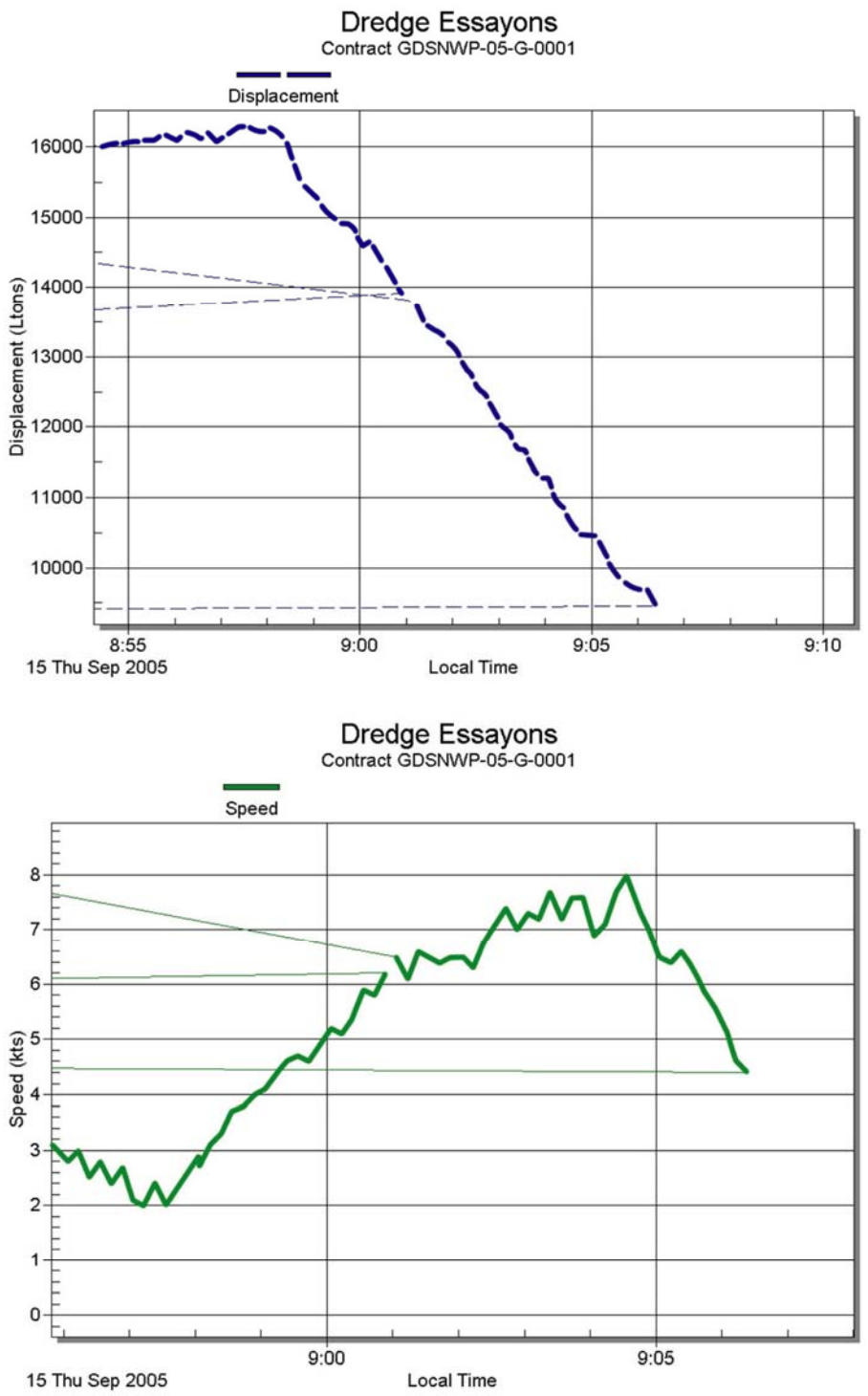

Figure 10. Dredge Displacement and Disposal Speed: Lane 5

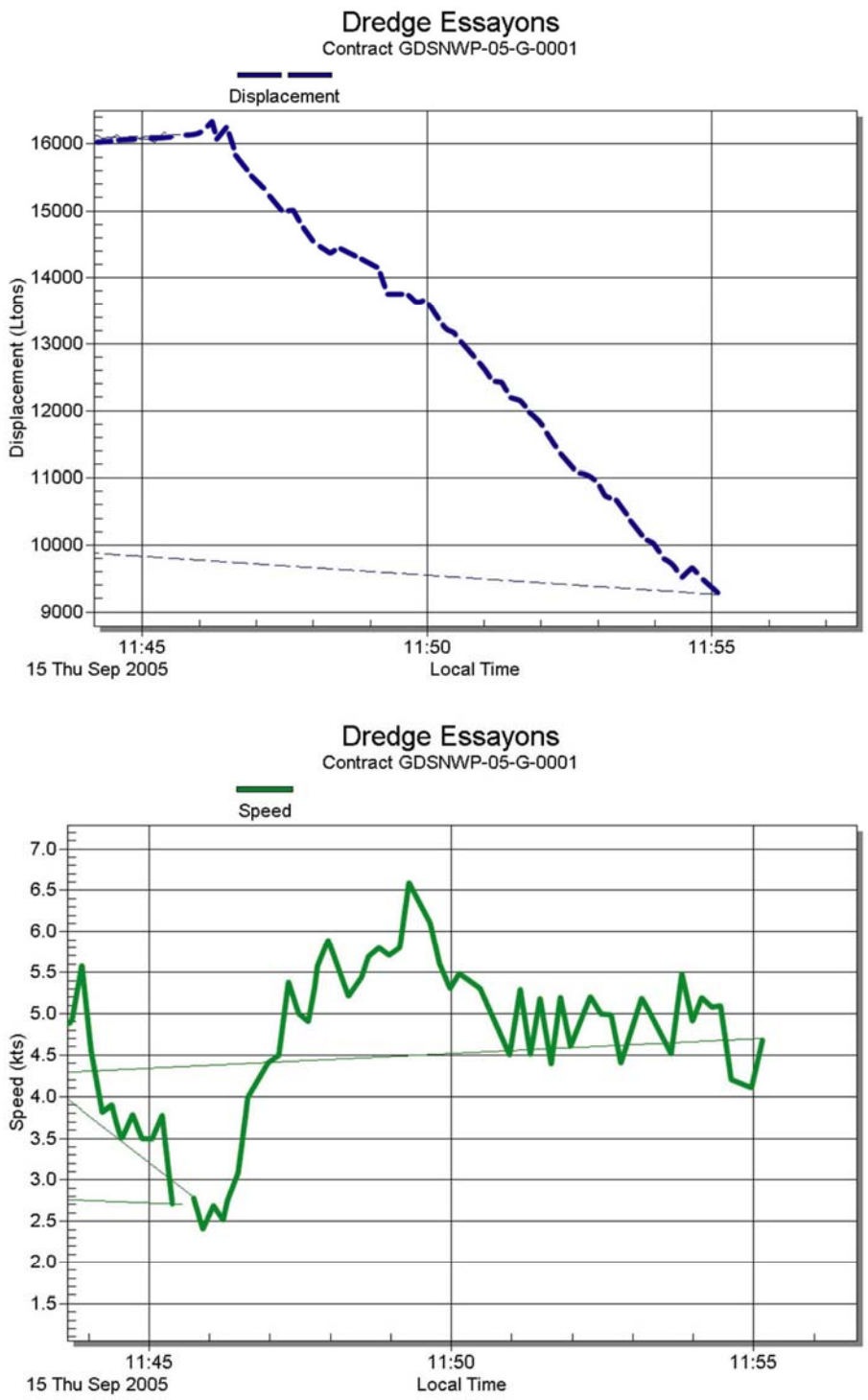

Figure 11. Dredge Displacement and Disposal Speed: Lane 6

Table 2. Dredged Material Placement for Pilot Study

Placement Run	Date	Start Time	End Time	Disposal Duration (min)	Average Dredge Speed (ft/sec)	Distance (feet)	Volume (yds3)	Estimated Average Depth (inches)
1	9/14/05	11:16	11:25	9	9.0	3881	5807	2.69
2	9/14/05	14:04	14:12	8	9.2	4433	5687	2.30
3	9/14/05	17:06	17:16	10	8.1	4849	5520	2.04
4	9/14/05	19:43	19:52	9	8.8	4753	5660	2.14
5	9/15/05	8:58	9:06	8	10.6	5101	5770	2.03
6	9/15/05	11:46	11:55	9	8.3	4648	5810	2.24

3.2 SPI Survey Results

A total of 77 out of 149 images collected were analyzed to represent the pre- and post- disposal conditions at the near shore study area. One representative image from each pre- and post-disposal station located along the disposal lanes, and each transect replicate was analyzed using the REMOTS system to determine several physical and biological parameters and identify the presence of dredged material. A summary of the SPI parameters that were evaluated for this investigation, including grain size major mode, camera penetration, dredged material thickness, boundary roughness, benthic habitat type, and the highest benthic infaunal stage present are summarized in Tables 3, 4, and 5.

It should be noted that some of the post-disposal sampling locations were located outside the footprint of the dredged material placement. Every attempt was made to locate these stations along the center of the actual disposal track of the dredge Essayons. However, positioning information regarding the stop and start locations of the dredge Essayons in Lane 1 were not available at the time the images were collected. In addition, field conditions such as tidal currents and surface wind can affect boat positioning during SPI camera deployment and limit the ability to keep the sampling vessel in the same position for the collection of three consecutive replicates. Finally, while in the field, it was assumed that dredge material may create a depositional footprint up to 500 feet wide. This assumption was corrected to an average footprint width of 180 feet based on evaluation of the bathymetric survey (Moritz 2005). Therefore, during the evaluation of the image collection locations and visual assessments, 6 of the 24 post-disposal images were determined to be located outside the dredged material footprint. The intent of the transect stations was to collect images along a cross-section of the dredged material footprint for each disposal lane. Based on the evaluation of the transect image locations and visual assessments, it was determined that 17 of the 41 images were outside the dredged material footprint.

3.2.1 Grain Size Major Mode

The grain size distribution in SPI images as determined by REMOTS analysis was reported as the major mode in Φ size. The Φ size range for sediments is from –1 Φ (gravel), -1 to 4 Φ (sand), 4 to 8 Φ (silt), to greater than 8 Φ (clay). The pre-disposal survey indicated a grain size distribution that consisted predominately of medium-fine sand (3 to 2 Φ, 92%; 2 to 1 Φ 8%), n = 12). For locations identified within the dredged material footprint during the post-disposal survey, the major mode grain size was primarily coarse medium sand (2 to 1 Φ, 83%; 3 to 2 Φ 17%, n = 18). The six images collected during the post-disposal survey, but determined to be outside the dredged material footprint were split between coarse-medium and medium-fine sand (2 to 1 Φ, 50%; 3 to 2 Φ 50%, n = 6). For the transect survey coarse medium sand was found at all locations within the dredged material footprint (2 to 1 Φ, 100%, n = 24), and a combination of coarse-medium and medium-fine sand was found outside the footprint (2 to 1 Φ, 71%; 3 to 2 Φ29%, n = 17). Based on these findings, the dredged material was consistently coarse medium grained sand and native material was medium-fine grained sand.

Table 3. Summary of SPI Results for Pre-Disposal Survey

Station	Replicate Analyzed[1]	Grain Size Major Mode (Φ)	Prism Penetration Mean (cm)	Dredged Material Thickness Mean (cm)[2]	Boundary Roughness Mean	Benthic Habitat	Highest Stage Present[3]
1A00	2	2 to 1	1.86	NA	0.91	SA.M	ST I
1C00	3	3 to 2	1.67	NA	0.45	SA.F	ST I
2B00	2	3 to 2	5.05	NA	0.97	SA.F	ST I
2D00	1	3 to 2	6.79	NA	1.18	SA.F	ST I
3A00	1	3 to 2	3.83	NA	3.4	SA.F	ST I
3C00	1	3 to 2	5.74	NA	0.76	SA.F	INDET
4B00	1	3 to 2	2.66	NA	2.66	SA.F	INDET
4D00	1	3 to 2	4	NA	0.4	SA.F	INDET
5A00	1	3 to 2	5.99	NA	3.77	SA.F	INDET
5C00	2	3 to 2	5.27	NA	1.14	SA.F	INDET
6B00	2	3 to 2	4.32	NA	0.71	SA.F	INDET
6D00	1	3 to 2	4.53	NA	0.62	SA.F	INDET
Min	**-**	**3 to 2**	**1.67**	**-**	**0.40**	**-**	**-**
Max	**-**	**2 to 1**	**6.79**	**-**	**3.77**	**-**	**-**
Mean	**-**	**-**	**4.31**	**-**	**1.41**	**-**	**-**

Notes:

1: Three replicate images were collected at each sampling location, one replicate per location was selected for image analysis.

2: NA indicates that the substrate does not contain dredged material; thickness estimates are based on camera penetration depth because distinct dredged material layers overlying native material were not discernable.

3: INDET indicates the successional stage was indeterminate.

Table 4. Summary of SPI Results for Post-Disposal Survey

Station	Replicate Analyzed[1]	Grain Size Major Mode (Φ)	Prism Penetration Mean (cm)	Dredged Material Thickness Mean (cm)[2]	Boundary Roughness Mean	Benthic Habitat	Highest Stage Present[3]
1A01	1	2 to 1	3.81	NA	1.2	SA.M	ST I on III
1B01	3	2 to 1	2.22	NA	1.4	SA.M	INDET
1C01	2	2 to 1	4.47	4.47	1.31	SA.M	INDET
1DO1	3	3 to 2	3.86	NA	1.55	SA.F	INDET
2A01	2	2 to 1	4.9	4.9	0.92	SA.M	INDET
2B01	3	2 to 1	4.38	4.38	1.12	SA.M	INDET
2C01	2	2 to 1	4.14	4.14	1.07	SA.M	INDET
2D01	2	2 to 1	3.43	3.43	1.08	SA.M	INDET
3A01	2	2 to 1	4.83	4.83	1.16	SA.M	INDET
3B01	1	2 to 1	4.72	4.72	0.52	SA.M	INDET
3C01	1	2 to 1	5.32	5.32	0.75	SA.M	INDET
3D01	2	3 to 2	4.1	4.1	1.49	SA.F	INDET
4A01	3	2 to 1	4.71	4.71	2.02	SA.M	INDET
4B01	1	3 to 2	3.84	3.84	1.69	SA.F	INDET
4C01	2	2 to 1	5.31	5.31	3.69	SA.M	INDET
4DO1	1	2 to 1	5.06	5.06	0.76	SA.M	INDET
5A01	4	2 to 1	4.45	4.45	0.55	SA.M	INDET
5B01	2	2 to 1	3.24	3.24	1.68	SA.M	INDET
5C01	3	3 to 2	5.23	5.23	1.76	SA.F	INDET
5D01	1	3 to 2	4.67	NA	2.13	SA.F	INDET
6A01	1	2 to 1	5.25	5.25	1.14	SA.M	INDET
6B01	2	2 to 1	6.53	NA	0.91	SA.M	INDET
6C01	1	2 to 1	5.06	5.06	0.66	SA.M	INDET
6D01	3	3 to 2 phi	3.7	NA	1.9	SA.F	ST I
Min	**-**	**3 to 2**	**2.22**	**3.24**	**0.52**	**-**	**-**
Max	**-**	**2 to 1**	**6.53**	**5.32**	**3.69**	**-**	**-**
Mean	**-**	**-**	**4.47**	**4.58**	**1.35**	**-**	**-**

Notes:

1: Three replicate images were collected at each sampling location, one replicate per location was selected for image analysis.

2: NA indicates that the substrate does not contain dredged material; thickness estimates are based on camera penetration depth because distinct dredged material layers overlying native material were not discernable.

3: INDET indicates the successional stage was indeterminate.

Table 5. Summary of SPI Results for Disposal Lane Transect Survey

Station	Replicate Analyzed[1]	Disposal Run	Grain Size Major Mode (Φ)	Prism Penetration Mean (cm)	Dredged Material Thickness Mean (cm)[2]	Boundary Roughness Mean	Benthic Habitat	Highest Stage Present[3]
T1	A	1	3 to 2	3.44	NA	2.09	SA.F	ST I
T1	AB	1	2 to 1	2.8	NA	1.47	SA.M	INDET
T1	B	1	2 to 1	3.56	3.56	1.8	SA.M	INDET
T1	C	1	2 to 1	2.74	2.74	0.84	SA.M	INDET
T1	CD	1	2 to 1	2.98	2.98	1.82	SA.M	INDET
T1	D	1	2 to 1	5.23	5.23	1.01	SA.M	INDET
T1	E	2	2 to 1	1	NA	1.99	SA.M	INDET
T1	F	2	2 to 1	3.05	NA	1.3	SA.M	INDET
T1	G	2	2 to 1	4.03	4.03	1.19	SA.M	INDET
T1	H	2	2 to 1	3.98	3.98	0.78	SA.M	INDET
T1	I	2	2 to 1	4.06	4.06	0.62	SA.M	INDET
T1	J	2	2 to 1	3.46	3.46	1.15	SA.M	INDET
T1	K	2	2 to 1	3.95	NA	2.71	SA.M	INDET
T2	A	3	3 to 2	2.61	NA	1.80	SA.F	INDET
T2	B	3	2 to 1	5.94	5.94	0.35	SA.M	INDET
T2	C	3	2 to 1	3.38	3.38	1.09	SA.M	INDET
T2	D	3	2 to 1	4.82	4.82	0.95	SA.M	INDET
T2	E	3	2 to 1	5.78	5.78	2.40	SA.M	INDET
T2	F	3	2 to 1	5.74	NA	1.41	SA.M	INDET
T2	G	4	2 to 1	4.36	NA	1.41	SA.M	INDET
T2	H	4	2 to 1	5.01	5.01	2.33	SA.M	INDET
T2	I	4	2 to 1	4.25	4.25	1.76	SA.M	INDET
T2	J	4	3 to 2	3.76	NA	2.35	SA.F	ST I
T2	K	4	2 to 1	4.24	4.24	3.37	SA.M	INDET
T2	L	4	2 to 1	5.12	NA	2.64	SA.M	INDET
T2	M	5	2 to 1	6.45	NA	1.14	SA.M	INDET
T2	N	5	2 to 1	4.57	4.57	0.92	SA.M	INDET
T2	O	5	2 to 1	4.61	NA	1.28	SA.M	INDET
T2	P	5	2 to 1	5.22	5.22	2.18	SA.M	INDET
T2	Q	5	2 to 1	1.89	1.89	2.58	SA.M	INDET
T2	R	5	2 to 1	4.69	4.69	0.57	SA.M	INDET
T2	S	5	2 to 1	5.86	NA	1.11	SA.M	INDET
T2	T	5	2 to 1	5.39	NA	0.90	SA.M	INDET
T3	A	6	3 to 2	3.87	NA	1.38	SA.F	INDET
T3	B	6	3 to 2	3.49	NA	2.14	SA.F	INDET
T3	C	6	2 to 1	4.24	NA	1.47	SA.M	INDET

Station	Replicate Analyzed[1]	Disposal Run	Grain Size Major Mode (Φ)	Prism Penetration Mean (cm)	Dredged Material Thickness Mean (cm)[2]	Boundary Roughness Mean	Benthic Habitat	Highest Stage Present[3]
T3	D	6	2 to 1	5.57	5.57	1.93	SA.M	INDET
T3	E	6	2 to 1	2.48	2.48	1.08	SA.M	INDET
T3	F	6	2 to 1	3.68	3.68	1.52	SA.M	INDET
T3	G	6	2 to 1	4.47	4.47	1.49	SA.M	INDET
T3	H	6	2 to 1	4.46	4.46	2.18	SA.M	INDET
Min	**-**	**-**	**3 to 2**	**1.00**	**1.98**	**0.35**	**-**	**-**
Max	**-**	**-**	**2 to 1**	**6.45**	**5.94**	**3.37**	**-**	**-**
Mean	**-**	**-**	**-**	**4.17**	**4.37**	**1.56**	**-**	**-**

Notes:

1: One replicate image was collected at each sampling location and used for image analysis.

2: NA indicates that the substrate does not contain dredged material; thickness estimates are based on camera penetration depth because distinct dredged material layers overlying native material were not discernable.

3: INDET indicates the successional stage was indeterminate.

3.2.2 Prism Penetration Depth

The SPI prism penetration depths were similar for the entire survey ranging from 1.00 to 6.79 cm, with a mean penetration depths of 4.31 cm for the pre-disposal locations, 4.47 cm for the post-disposal locations, and 4.17 cm for the transect locations. Similarly, the mean penetration depth for native material was 4.17 cm (n = 35) compared to 4.35 cm (n = 42) of penetration in locations with dredged material. In general, the relatively shallow prism penetrations were due to the similar sandy substrate of both the native and dredged materials. Since the camera weight was constant throughout each survey, the penetration depths indicate that the consolidation of the sediments in the dredged material footprint is similar to the native substrate.

3.2.3 Dredged Material Thickness

Dredged material thickness was assessed in the 42 images located within the depositional footprint following disposal (Tables 4 & 5). Due to the visual similarities (i.e., color and particle size) and comparable consolidation of the dredged material relative to the native substrate it was not possible to discern a boundary between them. As discussed in Section 3.2.2, the mean prism penetration within the dredged material footprint was 4.35 cm or 1.71 inches, which is less than the average estimated depth (5.16 to 6.83 cm; or 2.03 to 2.69 inches) of dredged material based on volume placed in each disposal lane (Table 2). Therefore, the dredged material thickness could not be determined from the SPI images, and was recorded as equivalent to the prism penetration depth for images showing dredged material.

3.2.4 Mean Small-Scale Boundary Roughness

Small-scale boundary roughness features at the sediment surface are the result of depositional, erosional, and biogenic processes. Scouring of surface sediments by waves and currents, slope failure, or turbidite formation can also create physically induced boundary roughness. For the nearshore SPI survey, the source of boundary roughness was determined to be mainly due to physical processes. Biogenic activity that contributes to boundary roughness includes the formation of fecal mounds, burrow excavation mounds, megafaunal foraging, or feeding pits which were largely absent in the sandy substrate of the nearshore area. The boundary roughness for the native material (n = 35) ranged from 0.40 to 3.77 cm (mean = 1.57 cm), and ranged from 1.00 to 6.79 cm (mean = 1.48 cm) for the areas of dredged material deposition (n = 42). These results indicate that the placement of dredged material in the nearshore did not modify the small-scale substrate topography by introducing an increased surface relief on the existing sandy bottom.

3.2.5 Benthic Habitat Type

The benthic habitat consisted of hard sand bottom and two sub-types were identified in the images collected during the survey: 1) hard sand bottom: fine sand (SA.F) and 2) hard sand bottom: medium sand (SA.M). The native benthic habitat type (n = 35) consisted of both habitat type (SA.F: 52%; SA.M: 49%), whereas the dredged material habitat (n= 42) shifted towards the coarser grained substrate (SA.M: 90%; SA.F: 10%). The slight differences in habitat type are directly correlated to the marginal change in grain size major mode. Homogenous hard sandy

bottoms like the nearshore area are typically not bioturbated and are dominated by physical processes.

3.2.6 Infaunal Successional Stage

The infaunal successional stages observed in the images (n = 77) were Stage I (9%) and one instance of Stage I on III (1%), but for most images the infaunal successional stage was indeterminate (90%). The reasons for the indeterminate qualification are due in part to the native sandy substrate located at the site and the recent placement of dredged material. However, these data also indicate that the nearshore site does not have an established, complex infaunal community. Rather, the sandy substrate and high energy system result in a continuous Stage I community, with a sediment-water interface composed of small, colonizing benthic organisms. The Stage I on III successional stage indicates that the infaunal community has been physically disturbed and is in the process of re-colonization. The overall benthic habitat type is not modified because of similarities between the native sediment and dredged material.

3.3 Grain Size Results

A total of 10 surface sediment samples (0-10 cm) were collected and submitted for grain size distribution analysis. A total of six samples (1C, 2C, 3C, 4C, 5C, and 6C), one from each disposal lane was collected to characterize the dredged material placed at the nearshore study area. Four of the sediment sampling locations (1CN, 2/3C, 4/5C, and 6CS) were collected outside the dredged material footprint. Field observations were relatively consistent between the two substrate types, tan/gray, fine/medium to medium coarse sand, with benthic and epibenthic organisms (amphipods, polychaetes, sand dollars, and hermit crabs) were observed in both native and dredged material samples. A summary of field observations are presented in Table 6.

The quantitative results of the grain size distribution analysis (Table 7 and Figure 12) exemplify the similarities between the native substrate and the dredged material. The mean grain size distribution for the native substrate consisted of 99.3% sand, while the dredged material was 99.47%. The subtle difference between the two sample types was the distribution within the sand fraction. The native material had a slightly higher content of fine sand fraction (50.9%) relative to a medium sand fraction (43.9%). The dredged material was slightly coarser in content between the fine sand fraction (38.4%) and medium sand fraction (55.63%).

The most likely reason for the differences in distribution is the source of the dredged material. Since the dredged material was collected from the MCR navigational channel, the strong river currents combined with an ebb tide create a high energy environment that affects the relative sediment deposition and transport.

Table 6. Grain Size Descriptions

Sediment Sampling Station	Native or Dredged Material	Field Description/Observations
1CN	Native	Tan/gray fine/medium sand, scattered tubes on surface, amphipods and sand dollar observed in sample.
1C	Dredged Material	Medium sand, trace of wood debris, hermit crab on surface, traces of shell pieces, sand dollar, amphipods, and polychaetes observed in sample.
2C	Dredged Material	Homogenous, medium/fine sand, tubes below surface (buried?), scattered woody debris and shell pieces on surface.
2/3C	Native	Tan/gray fine/medium sand, scattered tubes & trace of fine shell debris on surface.
3C	Dredged Material	Tan/gray medium sand, no visible benthic/epibenthic organisms, trace of shell debris.
4C	Dredged Material	Tan/gray coarse/medium sand, traces of shell debris, small sand dollar (1/2 inch), a few tubes.
4/5C	Native	Fine/medium sand, gastropod & hermit crab, black fine-grained material present on surface.
5C	Dredged Material	Relatively homogenous, medium coarse sand, no odor, small tubes and a trace of small scattered shell pieces on surface.
6C	Dredged Material	Homogenous, gray medium coarse sand.
6CS	Native	Fine/medium sand, olive gray w/ some dark patches, small tubes on surface, organic (i.e. fresh fish) odor.

Table 7. Grain Size Distribution (% retention)

Station	Gravel			Sand					Silt				Clay		
				very coarse	coarse	medium	fine	very fine							
phi size (Φ):	< -2	-2	-1	0	+1	+2	+3	+4	+5	+6	+7	+8	+9	+10	> +10
mm:	4.75	4	2	1	0.5	0.25	0.125	0.063	0.032	0.016	0.008	0.004	0.002	0.001	<0.001
1CN	< 0.1	0.10	0.30	0.10	1.3	42.1	53.0	2.90	0.30	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
1C	< 0.1	< 0.1	< 0.1	0.30	1.00	57.6	38.4	2.80	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
2C	< 0.1	< 0.1	0.10	0.30	1.90	56.8	38.8	1.90	0.30	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
2/3C	< 0.1	< 0.1	< 0.1	0.30	0.40	42.9	52.2	4.10	0.30	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
3C	< 0.1	< 0.1	0.30	0.40	1.20	49.0	44.1	5.00	0.10	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
4C	< 0.1	< 0.1	< 0.1	0.10	4.60	73.7	19.8	1.30	0.50	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
4/5C	< 0.1	0.30	0.10	0.50	0.60	52.0	41.7	3.70	0.40	< 0.1	0.40	0.20	< 0.1	< 0.1	< 0.1
5C	< 0.1	< 0.1	0.10	0.40	0.50	44.3	47.1	6.80	< 0.1	< 0.1	0.40	0.20	< 0.1	< 0.1	< 0.1
6C	< 0.1	< 0.1	0.40	0.10	0.90	52.4	42.0	3.30	0.30	< 0.1	0.60	< 0.1	< 0.1	< 0.1	< 0.1
6CS	< 0.1	< 0.1	< 0.1	0.10	0.80	38.8	56.7	2.90	0.60	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1

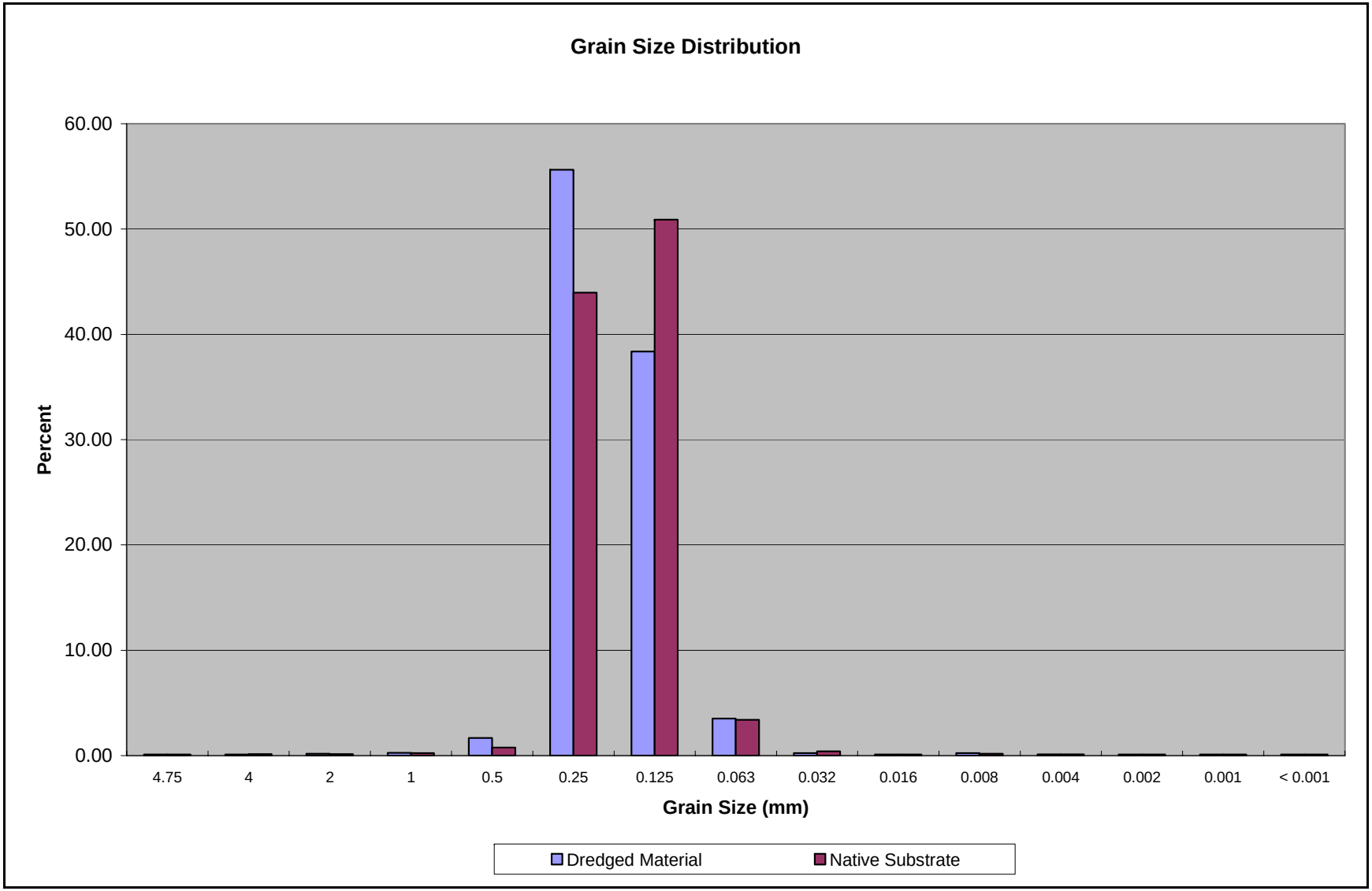

Figure 12. Grain Size Distribution

3.4 Bathymetric Survey

The bathymetric survey of the pilot study site was conducted over three days covering an area of 4.7 km^2 in water depths ranging from 30 to 60 feet deep. Based on the backscatter imagery, the general overview of geomorphic conditions following the placement of dredged material at the site concluded that topography was very flat. The six East-West disposal lanes are visible in the image, but there was no measurable bathymetric relief (Appendix C, Figure: *Area 2D MBES Backscatter Imagery*).

4.0 Discussion

The various data types collected to monitor the enhanced placement of dredged material at the nearshore site were consistent in their findings. The native substrate and the dredged material placed at the nearshore site are very similar in visual and physical characteristics. Subtle differences in the grain size distribution, with the dredge material consisting of slightly more medium grained sand, were evident in the SPI images, grain size analysis, and backscatter imagery. However, these differences in grain size were too subtle to result in notable changes in the seafloor topography or benthic habitat within the nearshore site following the placement of dredged material.

Figures 13 through 16 provide a set of examples that demonstrate seafloor conditions at Stations 2B and 5A, respectively, both before and after the placement of dredged material. These two sets of images reflect both the similarities and contrasts between the native substrate and dredged material. In the pre-disposal images both locations demonstrate a relatively heterogeneous mix of fine-grained sand, with streaks of darker colored particles throughout the sediment horizon. The post-disposal images demonstrate the presence of a more homogenous substrate consisting primarily of medium grained sand. Both pre- and post-disposal substrates demonstrate a similar sediment type (consolidated sand), benthic habitat type, and indeterminate benthic stage, which is typical for higher energy sandy substrates.

The depositional depth of the dredged material footprint was estimated to average from 2.03 to 2.69 inches based on the volume of material placed at each disposal lane. This depositional estimate is within the targeted depth identified in the permit letter. The visual and physical similarities of the dredged material and native substrate, in conjunction with the prism penetration depth, inhibited the identification of an interface between the deposition and original surface in the SPI images. The bathymetric survey was unable to discern any measurable bathymetric relief following placement, which would indicate that significant mounding of dredged material did not occur. The slightly coarser-grained sand provided the only identifiable physical attribute in each of the data types collected to indicate the presence of dredged material.

The physical characteristics of the native substrate and dredged material are similar enough, as demonstrated in the SPI images, that changes to the seafloor that would adversely affect the benthic habitat are not anticipated. The dredged material provides the same habitat-type for benthic organisms that existed prior to disposal. The native substrate benthic community stage was identified as either indeterminate or as Stage 1 for all the pre-disposal images. This is typical for a sandy substrate in a high energy environment. The benthic community is in a

continual state of flux as a pioneering community due to changes from natural physical processes. The dredged material does not alter the topographic relief in a manner that would affect physical processes along the seafloor, and should be readily adapted to and utilized by the pioneering benthic community that is predominate at the site.

Based on the data collected for the pilot study, enhanced disposal in a nearshore environment appears to be a feasible alternative for the beneficial use of dredged materials from the MCR navigational channel. Further investigations would be warranted to determine the extent of desired benefits from placing the additional material in the littoral zone.

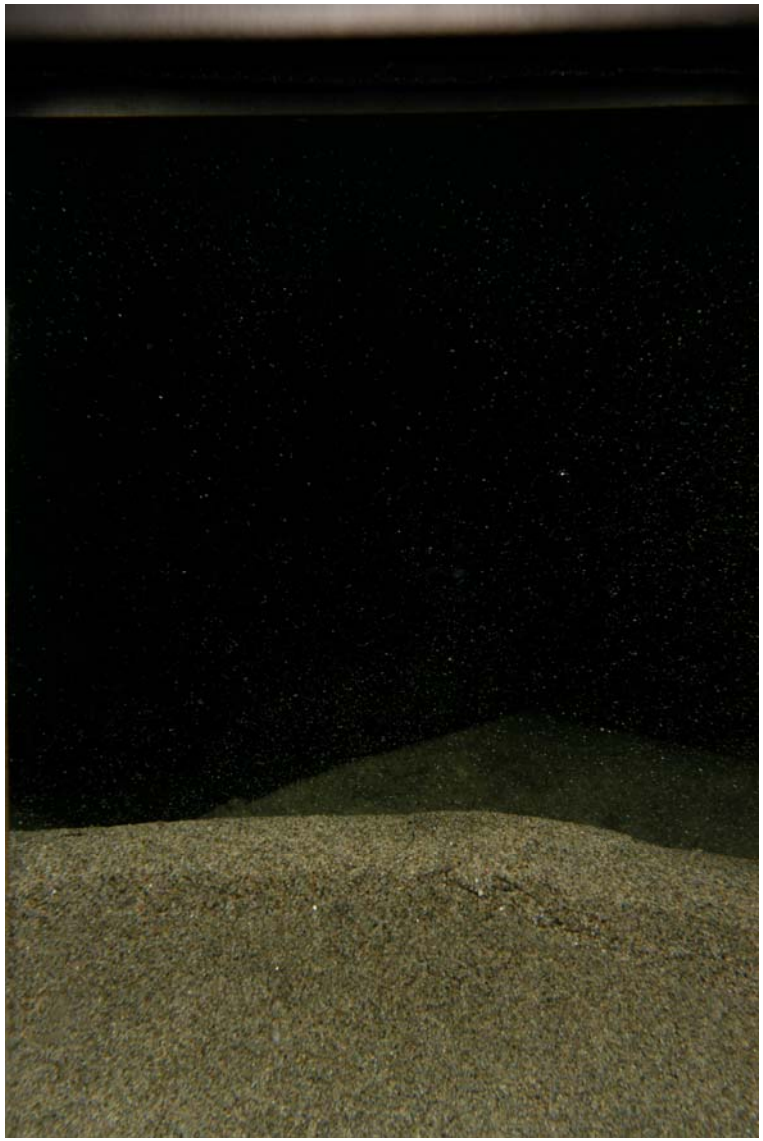

Figure 13. Station 2B Pre-Disposal

Figure 14. Station 2B Post-Disposal

Figure 15. Station 5A Pre-Disposal

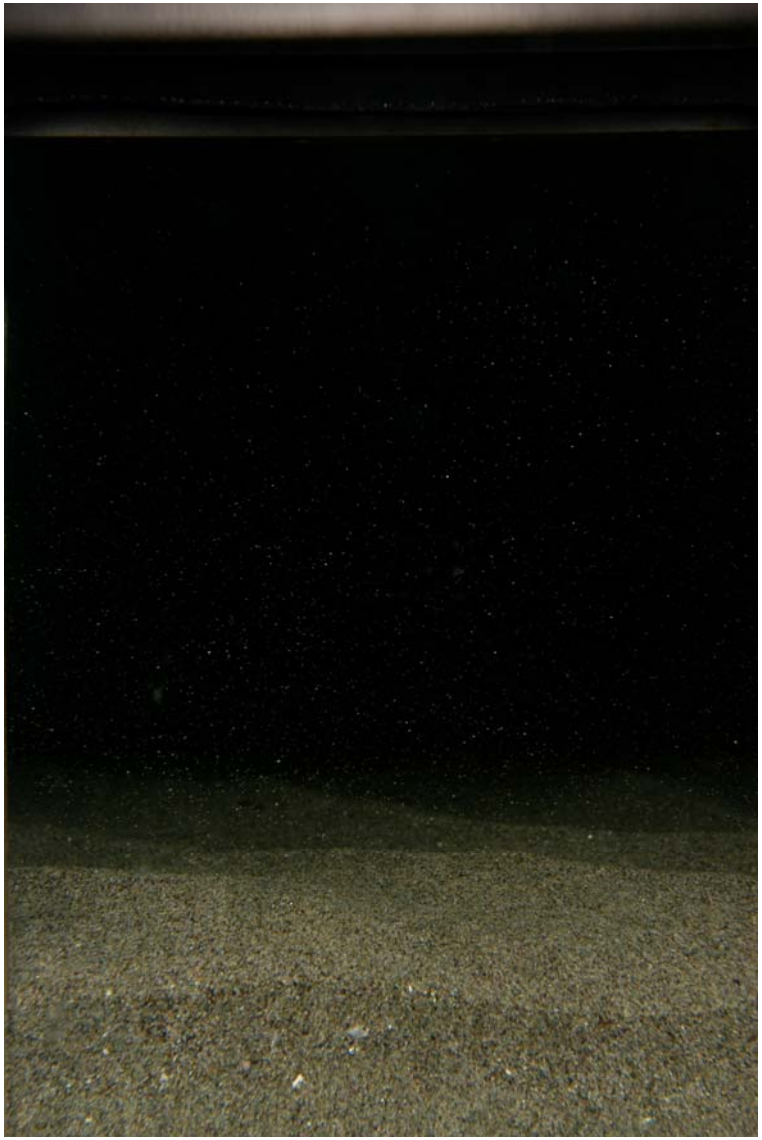

Figure 16. Station 5A Post-Disposal