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US ARMY CORPS
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New England District

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January 2009

October 3, 2008
Field Survey Report

BOSTON HARBOR INNER HARBOR MAINTENANCE DREDGING PROJECT DISPOSAL PLUME MONITORING

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OCTOBER 3, 2008
FIELD SURVEY REPORT

BOSTON HARBOR INNER HARBOR MAINTENANCE DREDGING PROJECT
DISPOSAL PLUME MONITORING

Submitted to:

Department of the Army
U.S. Army Corps of Engineers
North Atlantic Division
New England District

Contract Number: DACW33-03-D-0004
Delivery Order Number: 44

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January 2009

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ACRONYMS AND ABBREVIATIONS

ADCP	Acoustic Doppler Current Profiler
CAD	Confined Aquatic Disposal
CTD	Conductivity Temperature Depth
CY	Cubic Yards
DB	Decibels
DO	Dissolved Oxygen
GF/F	Glass Fiber Filter
EPA	Environmental Protection Agency
HS	High Slack
LNG	Liquefied Natural Gas
LS	Low Slack
MBDS	Massachusetts Bay Disposal Site
ME	Maximum Ebb
MF	Maximum Flood
NAE	New England District
NTU	Nephelometric Turbidity Units
OBS	Optical Back-Scatter
SAP	Sampling and Analysis Plan
SRM	Standard Reference Materials
TSS	Total Suspended Solids
USACE	U.S. Army Corps of Engineers

1.0 INTRODUCTION

This report covers the field and laboratory activities conducted at the request of the U.S. Army Corps of Engineers (USACE), New England District (NAE) to support a maintenance dredging project for the Boston Harbor Inner Harbor in Boston, Massachusetts. This field report includes a description of work performed during water quality monitoring conducted during disposal of material dredged from the Reserved Channel into the Mystic River Confined Aquatic Deposal (CAD) cell (Figure 1 and Figure 2). This is the third Field Report generated for this delivery order; it describes field activities and preliminary results for the survey conducted on October 3, 2008.

1.1 Site Description

Boston Harbor is the largest port in New England and serves as a major hub for national and international shipping and commerce. Beginning in the spring of 2008, the USACE has conducted maintenance dredging of the inner portion of the Federal navigation channels in Boston Harbor. The maintenance dredging has been broken into base work and optional contract work. The base work involves dredging the Main Ship Channel from a location approximately half-way between Spectacle Island and Castle Island upstream to approximately the North Jetty, the upper Reserved Channel, and the approach channel to the Navy Dry Dock, all to their authorized depths. The base plan also involves the dredging of a CAD cell in the Mystic River and the removal of the silty layer over another potential CAD cell in the Main Ship Channel of the lower harbor. Approximately 1.3 million cubic yards (cy) of the 1.7 million cy to be dredged from the Federal channels are unsuitable for ocean placement and will be placed into CAD cells located beneath the Federal channels. The remaining 400,000 cy of dredged material, plus the parent material excavated in constructing the CAD cell(s), will be placed at the Massachusetts Bay Disposal Site (MBDS).

1.2 Project Objectives

The primary objective of this monitoring effort was to conduct shipboard field monitoring to gauge the extent of potential water quality impacts as per the conditions of the Water Quality Certification (WQC) issued for this project. The WQC requires that total suspended solids (TSS) and turbidity be monitored during a minimum of five disposal events. This field operation monitored the disposal plume for the last two required disposal monitoring events. That is, when the CAD cell is 90% full. The turbidity performance goal is $\leq$50 NTU's above background levels, 500 feet down current of the disposal cell, in the densest portion of the plume.

Another monitoring effort was conducted, which was not a requirement of the WQC, to determine if sediment resuspension, transport, and subsequent deposition on potential winter flounder spawning grounds is occurring. These spawning grounds have been identified by the resource agencies as an environmental concern (Figure 2). In order to identify any potential project related impacts relative to these resources, this monitoring effort used proven methods from similar past dredge monitoring projects to track in real-time migration of dredged material plumes resulting from disposal operations. This information was available to make operational

adjustments during disposal operations as may have been necessary to minimize impacts either to water quality or sediment transport to potential winter flounder spawning habitat.

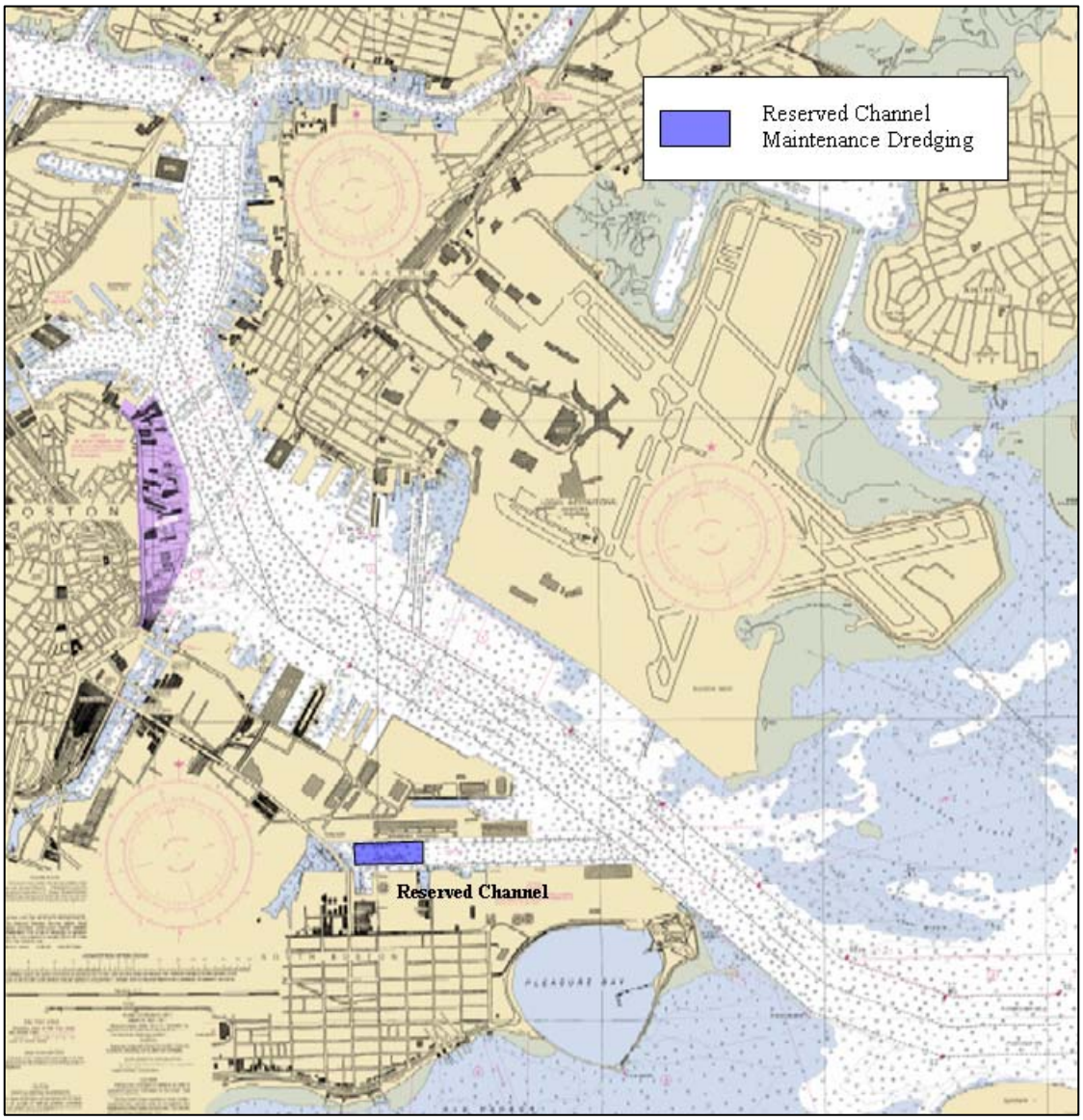

Figure 1. Site Map showing Boston Inner Harbor and the dredging location during the survey in the Reserved Channel.

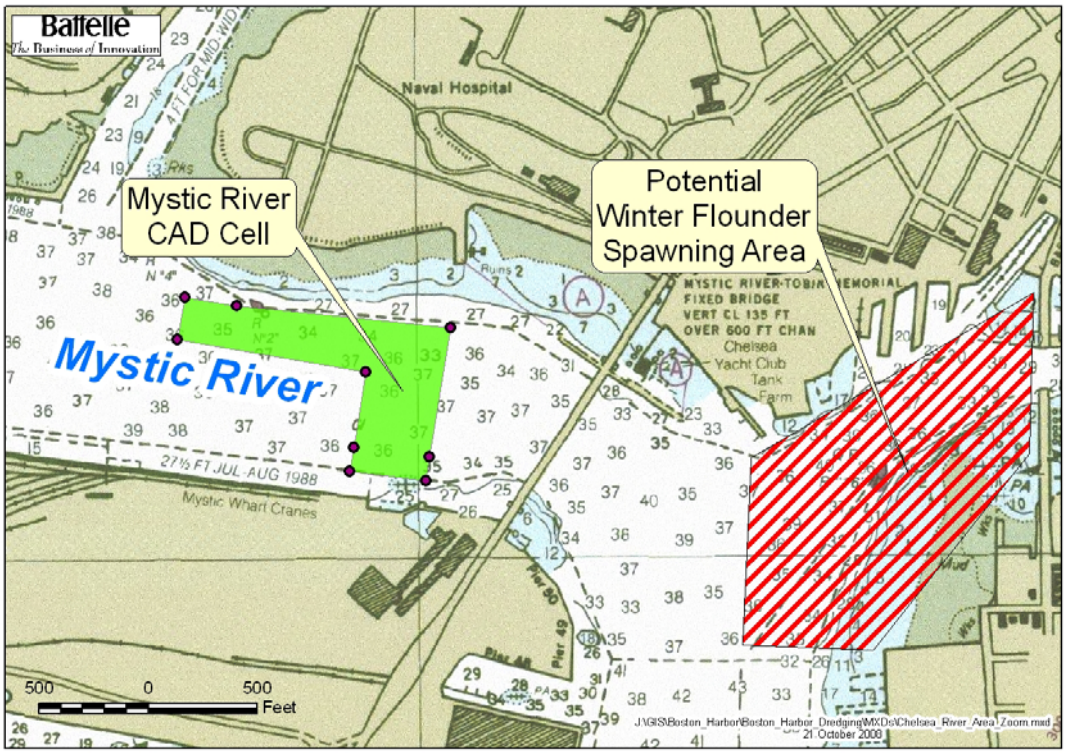

Figure 2. Map of Inner Harbor Confluence Area Showing the Mystic River CAD Cell and Potential Winter Flounder Spawning Area.

1.3 Field Activity Summary

Water quality monitoring was conducted in Boston Harbor's Inner Harbor in the vicinity of the CAD cell located in the Mystic River near the confluence of the Mystic and Chelsea Rivers (Figure 1). All planned field monitoring activities were completed during the placement of dredged material into the CAD cell at slack tide (Figure 3). This included plume tracking and turbidity monitoring during two disposal events. Dredged material plumes were observed during each monitoring event. Turbidity values never exceeded the established threshold criteria[1] and consequently no monitoring exceedance protocols were initiated. All planned samples were collected for laboratory TSS analysis.

Monitoring was performed during two scow releases on October 3, 2008. The first release occurred shortly after morning low slack (LS) and the second shortly after afternoon high slack (HS). The releases occurred, as required, during the period from 1 hour before to 2 hours after slack tide. Table 1 presents a list of on-site field personnel during the survey. This field report describes field sampling activities and provides a synopsis of some preliminary observations from the survey. A description of survey methods is provided in Section 2. A chronological summary of survey activities is provided in Section 3. Preliminary survey results are provided in Section 4. A description of survey problems, corrective actions, and recommendations for future

[1] Dredged material plume turbidity greater than 50 NTU above background 500 ft up or down channel from the CAD cell or migration of the plume to areas outside the navigation channel (>25 NTU above background in less than 25 feet depth).

surveys, can be found in Section 5. Supporting information such as field logs and TSS data are provided in Appendices 1-5 of this document.

Table 1. Survey Personnel for Disposal Plume Monitoring at the Mystic River CAD cell, October 3, 2008.

Responsibility	Personnel
Chief Scientist	Paul Dragos
Lead Technician	Patrick Curran
NAVSAM Operator	Bob Mandeville
Vessel Captain	Bob Carr

Figure 3. Split Hull Scow Placing Dredged Material into the Mystic River CAD Cell.

2.0 METHODS

Details on the survey/sampling methods can be found in the final project Sampling and Analysis Plan (Battelle, 2008).

The study design incorporated a broad scale monitoring of sediment plumes using a ship-mounted Acoustic Doppler Current Profiler (ADCP) combined with discrete location water

column profiling for *in situ* turbidity using a CTD/Turbidity/rosette sampler and whole water sample collection for TSS analysis.

2.1 Plume Tracking using ADCP

Plume tracking was conducted using RD Instruments 1200kHz Workhorse Sentinel ADCP mounted on the Battelle R/V *Aquamonitor* (Figure 4). The ADCP measured acoustic backscatter intensity in decibels (db), as an approximation of suspended sediment concentration, at 0.5 meter vertical intervals throughout the water column. ADCP measurements are made while the vessel is underway. As the vessel ran transects across the channel and the adjacent shallow areas or longitudinally along the ship channel, the ADCP mapped out vertical slices of suspended sediment concentration along those transects. These cross sections provided a real-time map of plume location, movement, and dispersion which was used to select CTD/Turbidity vertical profile locations. The disposal plumes dissipated quickly. Accordingly, vessel track was determined on-the-fly to maximize the plume coverage and not all planned transects were occupied. **Error! Reference source not found.** presents a summary of ADCP transects performed.

The ADCP is designed (and is more typically used) to measure current speed and direction and so the ADCP was also used to provide estimates of the current velocity at the same locations throughout the water column in real-time. The resulting tidal current speed and direction information was used during the survey to plan the plume survey ship tracks and reference locations.

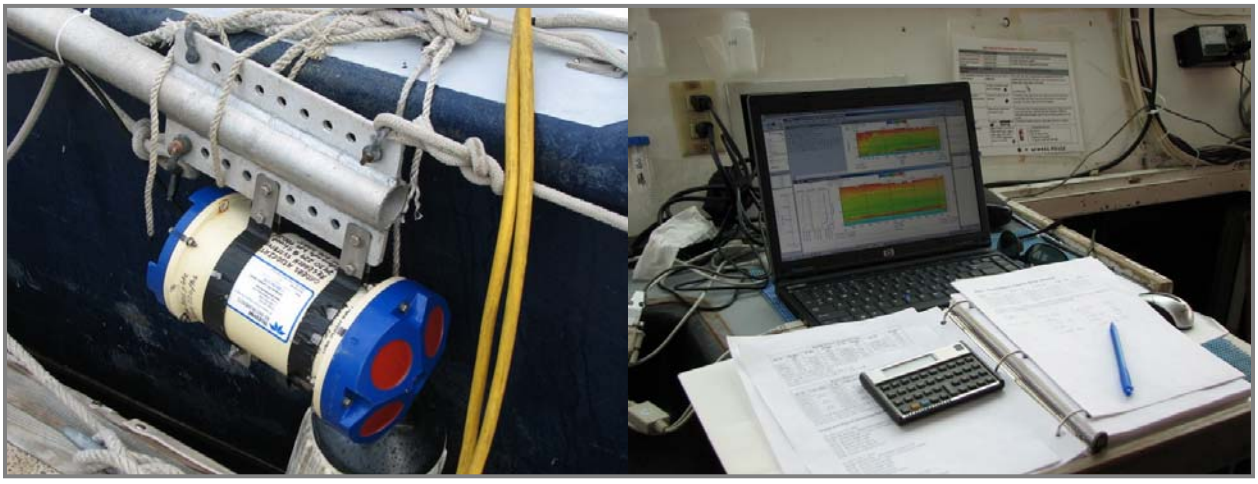

Figure 4. RD Instruments 1200khz Workhorse Sentinel ADCP Mounted on the Battelle R/V *Aquamonitor* and ADCP Real-Time Display / Data Collection Laptop.

2.2 Vertical CTD/Turbidity/Dissolved Oxygen Profiling and TSS Sampling

A CTD/Turbidity sensor and rosette water sampler was lowered over the stern of the R/V *Aquamonitor* (Figure 4) to perform vertical profiles at discrete locations (summarized in Table 3). The profiler was equipped with an underwater instrument package consisting of the CTD, a Dissolved Oxygen (DO) sensor, optical backscatter turbidity sensors (OBS) and a water-

sampling system including 9L Rosette sampling bottles. Three OBS's were included in the sensor suite, each configured for a different turbidity range (0– 25, 0–125, and 0–500 NTU).

Table 2. Type and Approximate Locations of ADCP Transects.

Tide Stage[a]	Predicted Slack tide[b]	ADCP File ID	Route Start Time	Transect Type and Approximate Locations
LS (weak flood)	08:18	BH083-018	09:59	multiple cross-channel 0, 250, 500, 750 ft up- and down-current
		BH083-023	10:59	multiple cross-channel 0, 250, 500, 750 ft up- and down-current
HS (weak ebb)	14:27	BH083-033	16:07	multiple cross-channel 0, 250, 500 ft up- and down-current
		BH083-035	16:32	cross-channel 1000 ft down-current
		BH083-036	16:38	cross-channel 0 ft down-current
		BH083-037	16:42	cross-channel 500 ft up-current

[a] HS = High Slack. LS = Low Slack.
[b] Predicted tides are for Charlestown, Charles River Ma.

Figure 5. CTD/Turbidity/Dissolved Oxygen Profiler and Water Sample Rosette System Being Deployed from the R/V Aquamonitor.

Figure 6. LaMotte Model 2020e Bench Top Turbidimeter.

Whole water samples were collected at reference stations and during plume sampling using the Rosette sample bottles for laboratory TSS analysis and for shipboard measurement of turbidity using a bench top LaMotte Model 2020e Turbidimeter. Reference samples were collected prior to dumping activities at locations 1500' east and west of the dump site to ensure the samples were not impacted by the plume. Plume and reference samples were collected using the same procedure. Samples were collected by triggering the Rosette bottles at two depths: the designated depths were near-bottom and at the turbidity maximum. If the turbidity maximum was near-bottom then the sample was collected at mid-depth. After the Rosette was recovered and on deck, samples were transferred to 1-L opaque bottles and stored on ice (~4°C) in the dark until they were delivered to Alpha Analytical for processing and TSS analysis. Water from the Rosette bottles was also transferred to 10mL glass vials for immediate onboard turbidity analysis (Figure 6). The outside of the vials were cleaned and dried prior to insertion into the Turbidimeter to prevent particles and condensation on the outside of the vial from interfering with the measurements. The instrument was set up to collect two separate readings from each sample and average the results. The averaged result was transcribed onto the field data sheet.

Table 3. Summary of CTD/Turbidity Profiles and TSS Samples

Date	Type of Monitoring	Location	Monitoring Period	Number of Profile Stations	Number of TSS Samples	Total Number of Samples Per Day
10/3/2008	Disposal	Mystic CAD Cell	Low Slack	5	10	20
			High Slack	5	10	

2.3 Laboratory TSS Processing

The whole water samples collected during the survey were analyzed by Alpha Analytical Laboratory for TSS using EPA method 160.2. A well-mixed sample was filtered through a standard glass fiber filter (GF/F) and the residual retained on the filter was dried and weighed. For each batch of 20 or fewer samples, a laboratory method blank, duplicate, and SRM was processed and analyzed with the field samples. Results are reported on a dry-weight basis.

2.4 Deviations

One planned field duplicate samples was inadvertently not collected during the survey due to a procedural error. The calibrations of TSS to the optical backscatter and TSS to the benchtop turbidity for this survey are comparable to the calibrations for the previous surveys. The missing duplicate sample does not appear to have an impact on the validity of the data for this survey.

The flexible ADCP protective cover was left in place over the transducer head during the LS survey. RD Instruments field service engineers confirmed what the real-time data suggested, that it would have no serious consequences for the data collected. The maximum range of the instrument might have been reduced but since water depth was less than half the maximum range this was not an issue. A bias may have been introduced into the velocity data but velocity measurements are secondary to this study and the RD Instruments field service engineers indicate that experience shows that any bias would be small (<5%).

Other deviations from planned activities are described in Section 5.

3.0 SURVEY CHRONOLOGY

Note: All times are recorded as Eastern Daylight Time

Mystic CAD Cell Disposal Monitoring: Friday, October 3, 2008

0600 Crew arrives at Hewitt's Cove Marina, begins setup, system checks, navigation check.
0635 Depart Hewitt's Cove Marina.
0740 Arrive Mystic River CAD cell. Determine current direction and landmarks for preliminary grid. Begin dry run.
0855 Begin Low Slack reference (background) sample collection.

0959 Scow releases dredged material and ADCP transects begin immediately. Current flooding weakly.
1017 Begin CTD profiles and TSS/turbidity sample collection along the 500 ft transect.
1050 CTD profiles and TSS/turbidity sample collection completed.
1059 Begin additional transects at the 500 ft down-current line.
1105 Low Slack monitoring complete. [See 2.4 Deviations.]
1110 Standing by for next release during afternoon high slack.
1409 Begin High Slack reference (background) sample collection.
1607 Scow releases dredged material and ADCP transects immediately begin. Current ebbing to the east near-surface but flows to the west deeper in the water column.
1625 Perform first CTD profile and TSS/turbidity sample collection on 500 ft transect.
1638 Begin additional ADCP transects. Shear in water column results in plume that is not coherent and difficult to track.
1646 Perform 2nd and 3rd CTD profile and TSS/turbidity sample collection on 500 ft transect.
1657 CTD profiles and TSS/turbidity sample collection completed.
1700 High Slack monitoring complete. Depart for Hewitt's Cove Marina.
1805 Arrive Hewitt's Cove Marina, navigation check completed, demobilize.

4.0 SURVEY RESULTS

4.1 Field Observations

On October 3, 2008, one dredged material release occurred during morning LS at the Mystic River CAD cell and one release occurred during afternoon HS. Surveys were performed and disposal plumes were tracked using ADCP in the immediate vicinity of the release. A distinct signal was observed using the ADCP but the plume dissipated so quickly that measurements of turbidity and TSS in vertical profiles at the 500 ft line did not show comparably high turbidity values. Plume tracking was complicated by shear in the water column. The plumes were observed using ADCP out to a distance of approximately 500 ft down-current of the release point. The LS plume was also observed in the lower half of the water column along the edges of the channel north and south of the release point. The HS plume was observed in the lower half of the water column along the edge of the channel south of the release point. Turbidity values measured by OBS at the 500 ft line were 39 NTU above background near-bottom during the LS release and 10 NTU above background near-bottom during the HS release. No exceedances were observed during the release. No large vessels passed during the survey.

4.2 Results

CTD/Turbidity profiles and whole water samples were collected at each planned location during disposal plume monitoring. A summary of the profiles taken and the samples collected is presented in Table 4. All the *in situ* CTD, OBS turbidity, and DO profile data are presented in Appendix 3. Turbidity data presented in Appendix 3 have been calibrated using the bench top turbidimeter measurements made in the field but have not been corrected for background.

All field bench top turbidimeter measurements are presented in Appendix 4. These include measurements taken at each profile at the turbidity profile peak depth and near-bottom.

Results of the laboratory analysis of TSS are provided in Appendix 5.

Table 4. CTD/Turbidity Vertical Profile Locations and Samples Collected

Station	Station Type	NAVSAM File ID	Longitude	Latitude	Sample Time (EDT)	Station Bathymetric Depth (ft)	Number of TSS Samples Collected
DS21	Reference	BH083024	-71.05537	42.38623	8:55	50.9	2
DS22	Reference	BH083027	-71.04490	42.38308	9:13	42.3	2
DS23	Plume Centroid at 500ft	BH083032	-71.05175	42.38585	10:19	48.9	2
DS24	S Lateral Extent at 500ft	BH083035	-71.05185	42.38565	10:30	44.3	2
DS25	N Lateral Extent at 500ft	BH083038	-71.05296	42.38575	10:42	47.6	2
DS31	Reference	BH083048	-71.05535	42.38653	14:11	60.0	2
DS32	Reference	BH083051	-71.04455	42.38342	14:22	51.8	2
DS33	S Lateral Extent at 500ft	BH083055	-71.04837	42.38457	16:29	49.5	2
DS34	N Lateral Extent at 500ft	BH083059	-71.04792	42.38598	16:48	46.9	2
DS35	Plume Centroid	BH083062	-71.04807	42.38531	16:54	49.9	2

5.0 PROBLEMS EXPERIENCED, ACTIONS TAKEN, AND RECOMMENDATIONS

5.1 Logistical

None.

5.2 Technical

At the reference locations, the OBS profiles showed a background turbidity level of 2-4 NTU with occasional elevated turbidity peaks at certain depth, usually near bottom. The elevated turbidity peaks superimposed on the background level were likely residual dredged material turbidity and did not represent an accurate measure of the ambient turbidity. A background value of 2 NTU was chosen as the most realistic (and conservative) representation of the ambient turbidity.

6.0 REFERENCES

Sampling and Analysis Plan for Boston Harbor Inner Harbor Maintenance Dredging Plume Monitoring. (Battelle, 2008)

Appendix 1

Sampling Logs

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DREDGE PLUME WATER QUALITY MONIORING FIELD LOG

BATTELLE **Survey ID**: BH083

Duxbury Project Number: G606444 **Project Title**: Boston Harbor Dredge Plume Monitoring

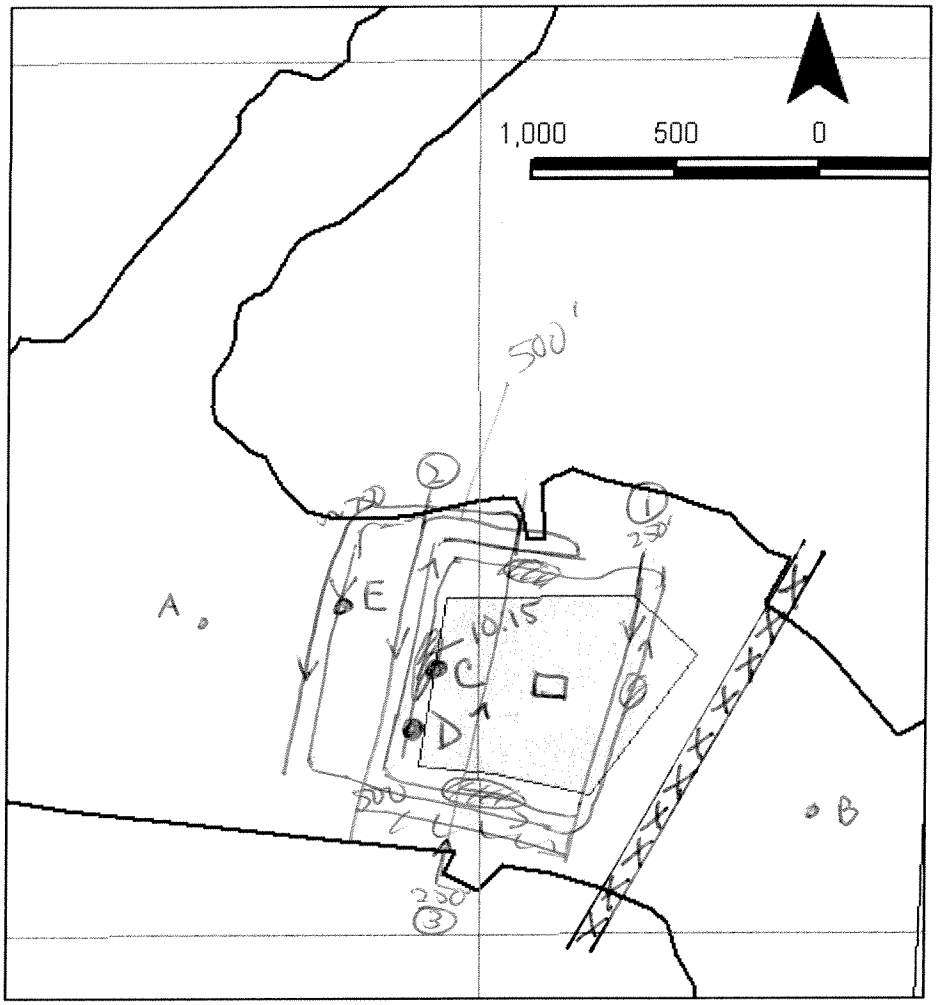
DATE (mm/dd/yy): 10-3-08 **INITIALS:** PMD **WEATHER:** 10-15 kts. W

MONITORING PERIOD (hh:mm) From: _____ **To:** _____ **TIDE STAGE** HS ME (LS) MF

DREDGING ACTIVITY:

Dredging (Disposal)

Mystic R. CAD cell
Scow Draft 14'
Release 0959



ADCP TRANSECTS:

Map Ref	Time	File Name/Notes
1	0959	#18
2	1059	#023
3		

CTD PROFILES:

Map Ref	Time	Station ID/Notes
A	0854	DS21 File#014
B	0911	DS22 #016
C	1017	DS23 #019
D	1026	DS24 #020
~~E~~	~~1036~~	~~DS25 #021 PD~~
E	1040	DS25 #022

FISH PASSAGE:

NOTES:

PREDICTED TIDES (stage @ hh:mm) HS @ ME @ LS @ 0820 MF @

ADCP 47cm deep.
Depart Hingham 0635. Arrive Mystic R. CAD cell 0740.
Begin Dry run. 32 depth bins. ADCP Ree #13 test run.
0855 Begin Ref samples.
On recovery of ADCP found cover on. Calibration will be different for this set. Run test. Backscatter didn't look much different. But cover back on & tried but with air trapped got no signal. So if Air were present would have been noticeable.

DREDGE PLUME WATER QUALITY MONIORING FIELD LOG

BATTELLE **Survey ID**: BH083

Duxbury Project Number: G606444 **Project Title**: Boston Harbor Dredge Plume Monitoring

DATE (mm/dd/yy): 10-03-08 **INITIALS:** PMD **WEATHER:** 10-15 w/ gusts W.

MONITORING PERIOD (hh:mm) From: _____ **To:** _____ **TIDE STAGE** (HS) ME LS MF

DREDGING ACTIVITY:

Dredging (Disposal)

Mystic R. CAD

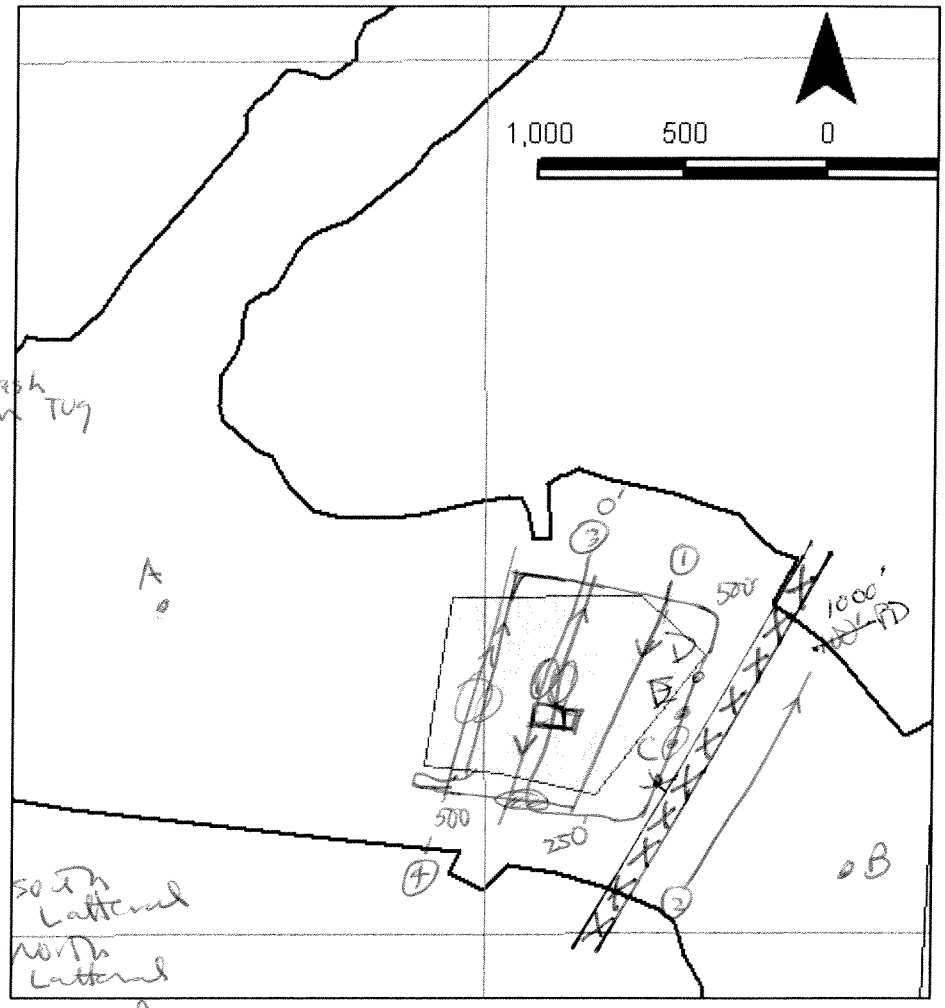
Release 1607

ADCP TRANSECTS:

Map Ref	Time	File Name/Notes
1	1607	File #033
2	1632	#035 Prop wash fm Tug
3	1638	#036
4	1642	#037

CTD PROFILES:

Map Ref	Time	Station ID/Notes
A	1409	DS31 ADCP File #029
B	1420	DS32 #030
C	1625	DS33 #34 - South Lattend
D	1646	DS34 #38 North Lattend
E	1653	DS35 #39 centroid



FISH PASSAGE:

NOTES:

PREDICTED TIDES (stage @ hh:mm) HS @ 1429 ME @ LS @ MF @

Increased to 36 depth bins for high tide. File #28 @ 1402 velocity bkgd. Surface flow to E, mid + bottom flow to W. 1425 standby for dump. Sandblasting The Tokin Bridg. Draft = 21'+. Shear in W.C. results in plume not coherent. Difficult to trace. Was visible on ADCP along some transect by week. Depart @ 1700. Arrive Hewitts Cove 1805

Appendix 2

Chain of Custody Records

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Boston Harbor Maintenance Dredge Program

Contract No. G606444

Sample Custody Form

Today's Date : 10/3/2008 5:00:55 P

Laboratory : Alpha Analytical

Chain-of-Custody # : BH083-TS-0001
Survey ID : BH083
Analysis ID : TS
Analysis Description : Total Suspended Solids

8 Walkup Drive
Westborough MA 01581
Mr. Nickolas Corso
508-898-9220 (Phone) (Fax)

Bottle ID :	Bottle ID :	Sampling Date :	Station ID :	Depth Code:	Ck 1	Ck 2	Ck 3
	BH083049TS1	10/3/2008 8:55:58 AM	DS21	E	☑	☑	☐
	BH08304ATS1	10/3/2008 8:56:22 AM	DS21	C	☑	☑	☐
	BH083052TS1	10/3/2008 9:13:17 AM	DS22	E	☑	☑	☐
	BH083053TS1	10/3/2008 9:13:40 AM	DS22	C	☑	☑	☐
	BH083075TS1	10/3/2008 10:19:46 AM	DS23	E	☑	☑	☐
	BH083076TS1	10/3/2008 10:20:28 AM	DS23	C	☑	☑	☐
	BH08307ETS1	10/3/2008 10:30:07 AM	DS24	E	☑	☑	☐
	BH08307FTS1	10/3/2008 10:30:39 AM	DS24	C	☑	☑	☐
	BH083087TS1	10/3/2008 10:42:11 AM	DS25	E	☑	☑	☐
	BH083088TS1	10/3/2008 10:42:51 AM	DS25	C	☑	☑	☐
	BH0830ADTS1	10/3/2008 2:11:52 PM	DS31	E	☑	☑	☐
	BH0830AETS1	10/3/2008 2:12:30 PM	DS31	C	☑	☑	☐
	BH0830B6TS1	10/3/2008 2:22:15 PM	DS32	E	☑	☑	☐
	BH0830B7TS1	10/3/2008 2:22:42 PM	DS32	C	☑	☑	☐

Shipping Condition - Room Temperature: _____ Cold(ice): ✓ Frozen(dry ice): _____
Received Condition - Room Temperature: _____ Cold(ice): _____ Frozen(dry ice): _____

Relinquished By / Date / Time / Company / Transport-Airbill #	Received By / Date / Time / Company
Paul Dragos / 10-3-08 / 1930 / Battelle	PATRICK CURRAN / 10-6-08 / 0925 / Battelle
PATRICK CURTAN / 10-6-08 / 1027 / Battelle	10/6/08 1027 ACPHS

Boston Harbor Maintenance Dredge Program
Contract No. G606444
Sample Custody Form

Today's Date : 10/3/2008 5:00:55 P

Laboratory : Alpha Analytical

Chain-of-Custody # : BH083-TS-0001
Survey ID : BH083
Analysis ID : TS
Analysis Description : Total Suspended Solids

8 Walkup Drive
Westborough MA 01581
Mr. Nickolas Corso
508-898-9220 (Phone) (Fax)

Bottle ID :	Bottle ID :	Sampling Date :	Station ID :	Depth Code:	Ck 1	Ck 2	Ck 3
	BH0830CETS1	10/3/2008 4:29:25 PM	DS33	E	☑	☑	☐
	BH0830CFTS1	10/3/2008 4:30:07 PM	DS33	C	☑	☑	☐
	BH0830DCTS1	10/3/2008 4:48:20 PM	DS34	E	☑	☑	☐
	BH0830DDTS1	10/3/2008 4:48:50 PM	DS34	C	☑	☑	☐
	BH0830E5TS1	10/3/2008 4:54:27 PM	DS35	E	☑	☑	☐
	BH0830E6TS1	10/3/2008 4:54:57 PM	DS35	C	☑	☑	☐

Shipping Condition - Room Temperature: _____ Cold(ice): ✓ Frozen(dry ice): _____
Received Condition - Room Temperature: _____ Cold(ice): _____ Frozen(dry ice): _____

Relinquished By / Date / Time / Company / Transport-Airbill #	Received By / Date / Time / Company
Paul Dragos / 10-3-08 / 1930 / Battelle	Patrick Curran / 10-6-08 / 0925 / Battelle
Patrick Curran / 10-6-08 / 1028 / Battelle	10/6/08 1028 ALPHA

Appendix 3

In situ CTD/Turbidity Profile Results

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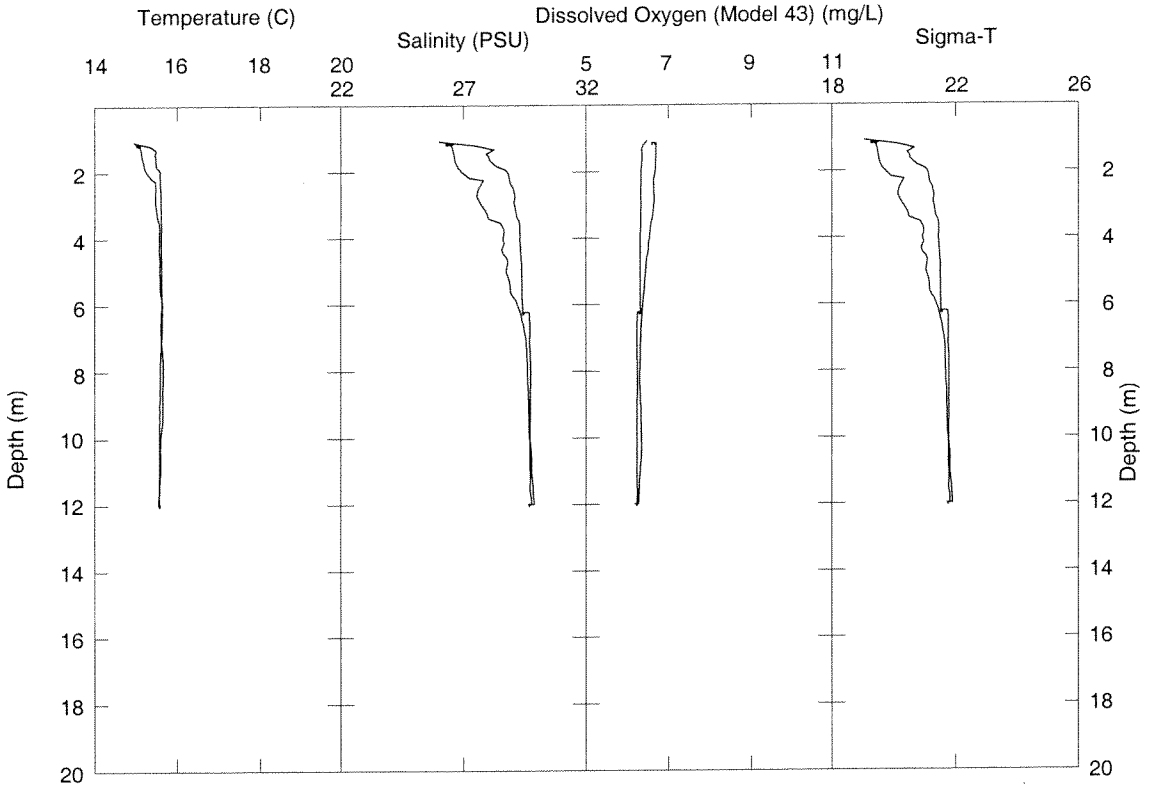

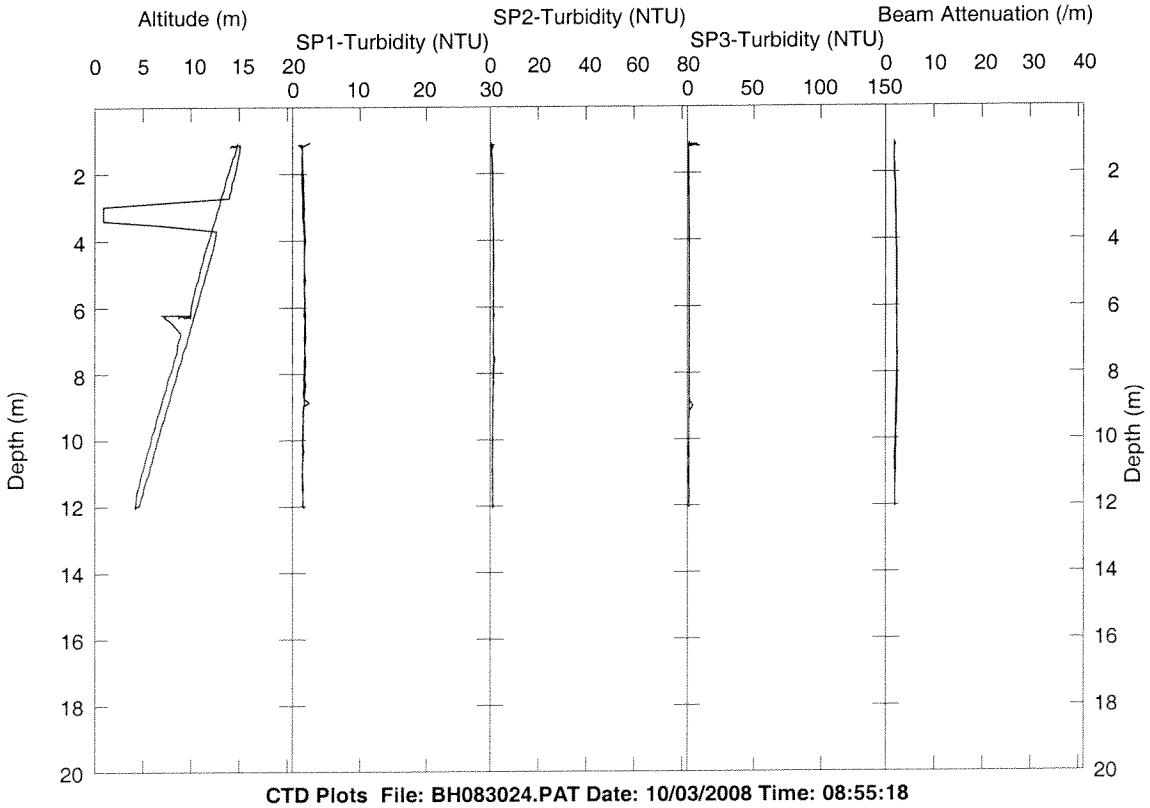

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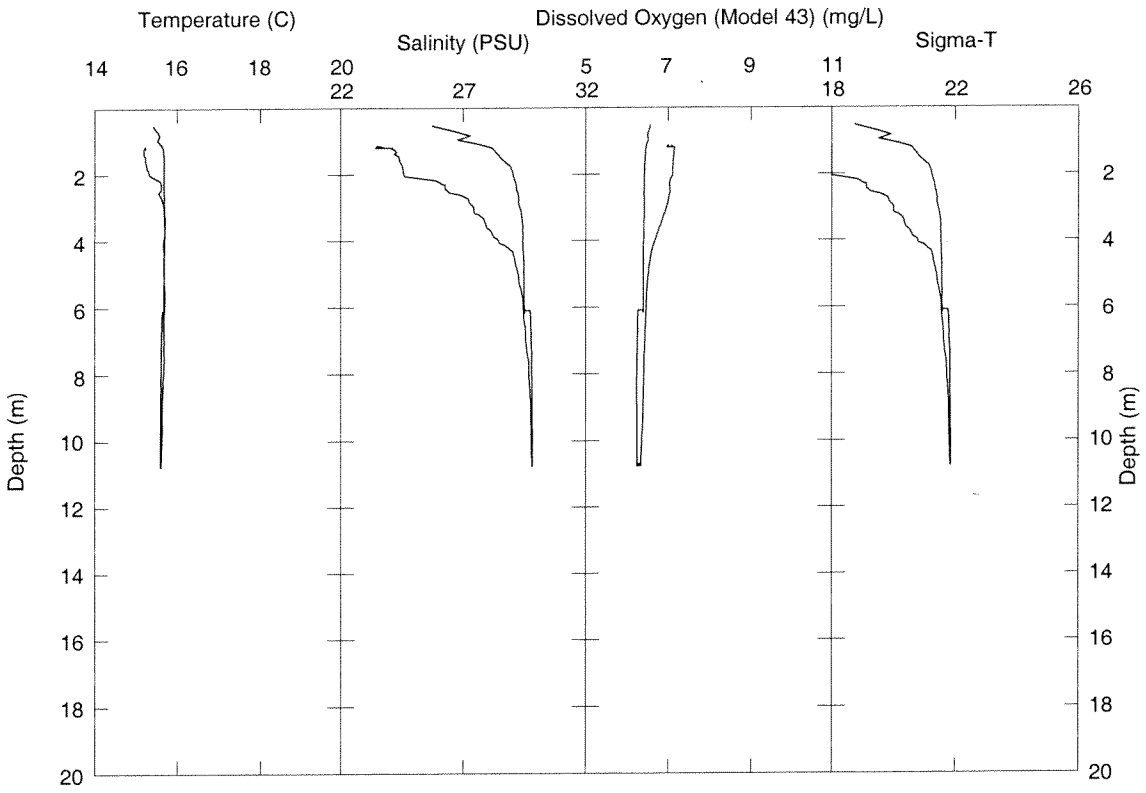

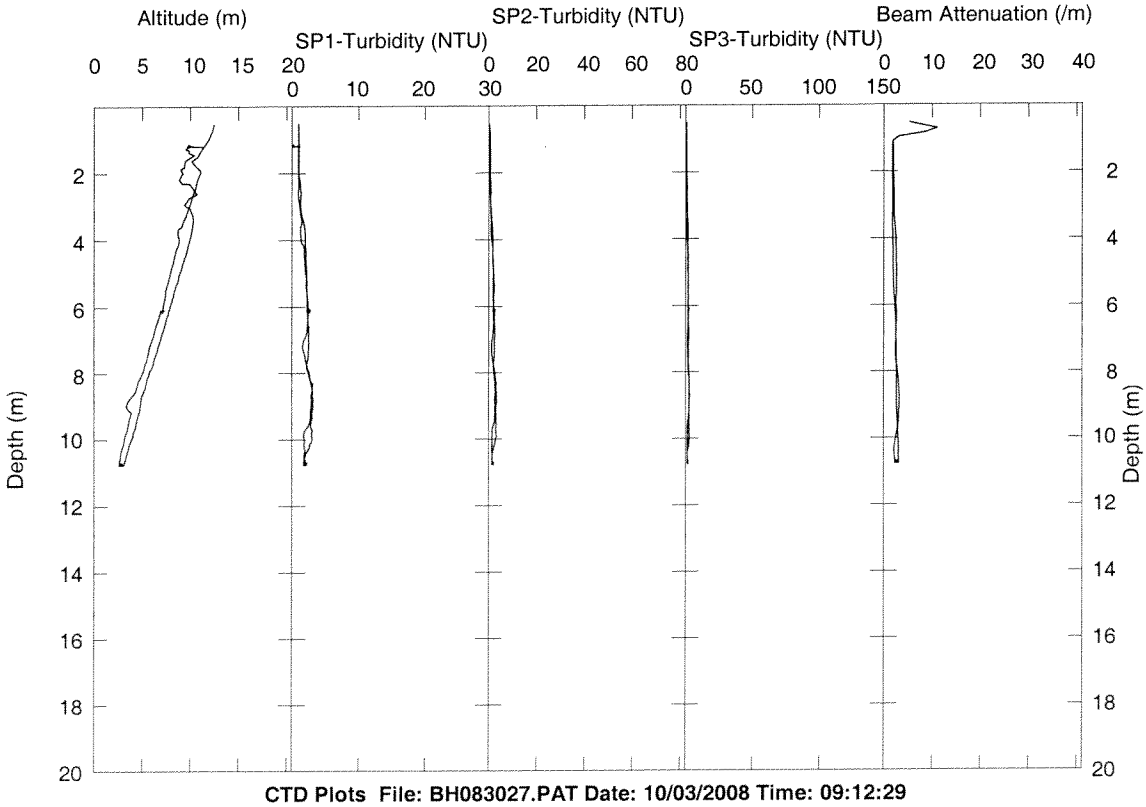

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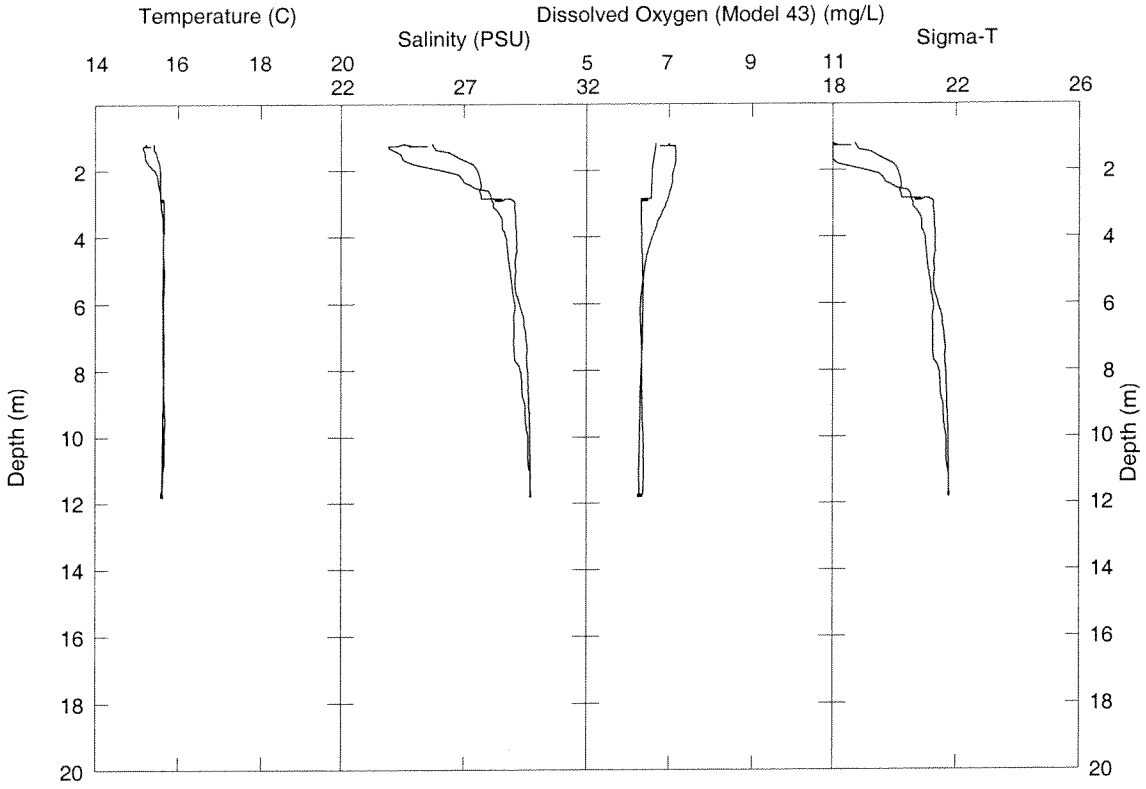

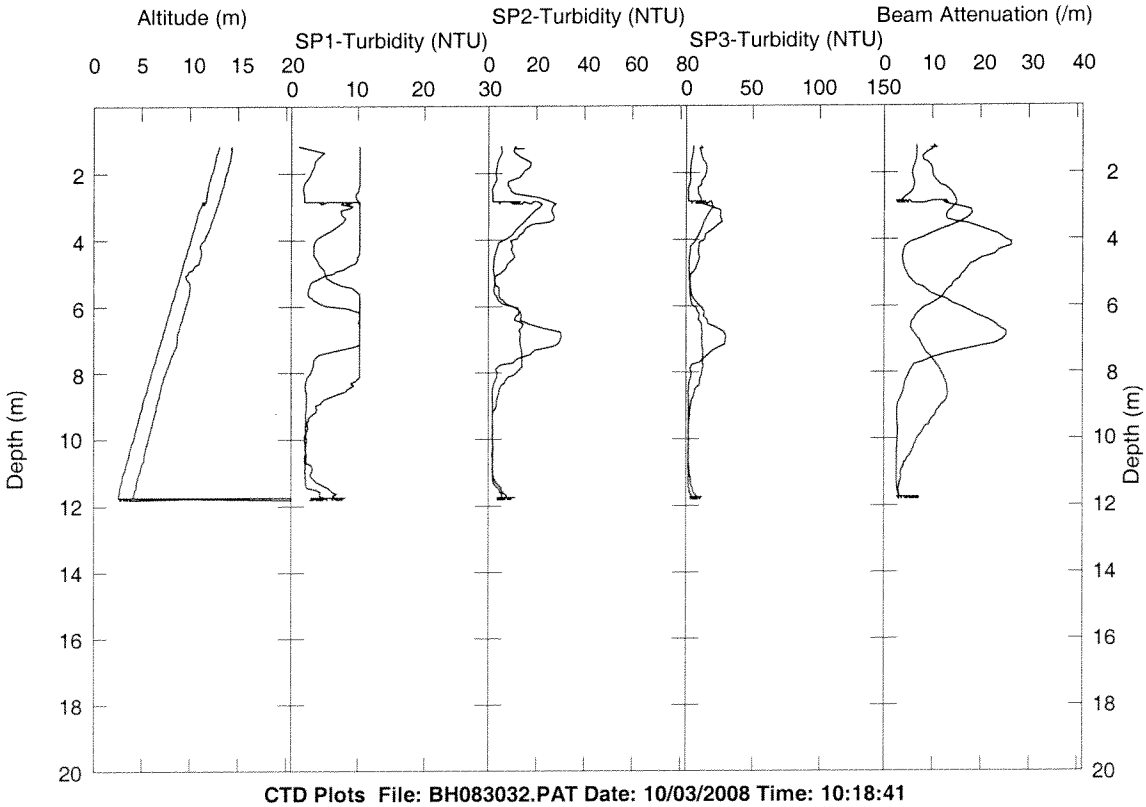

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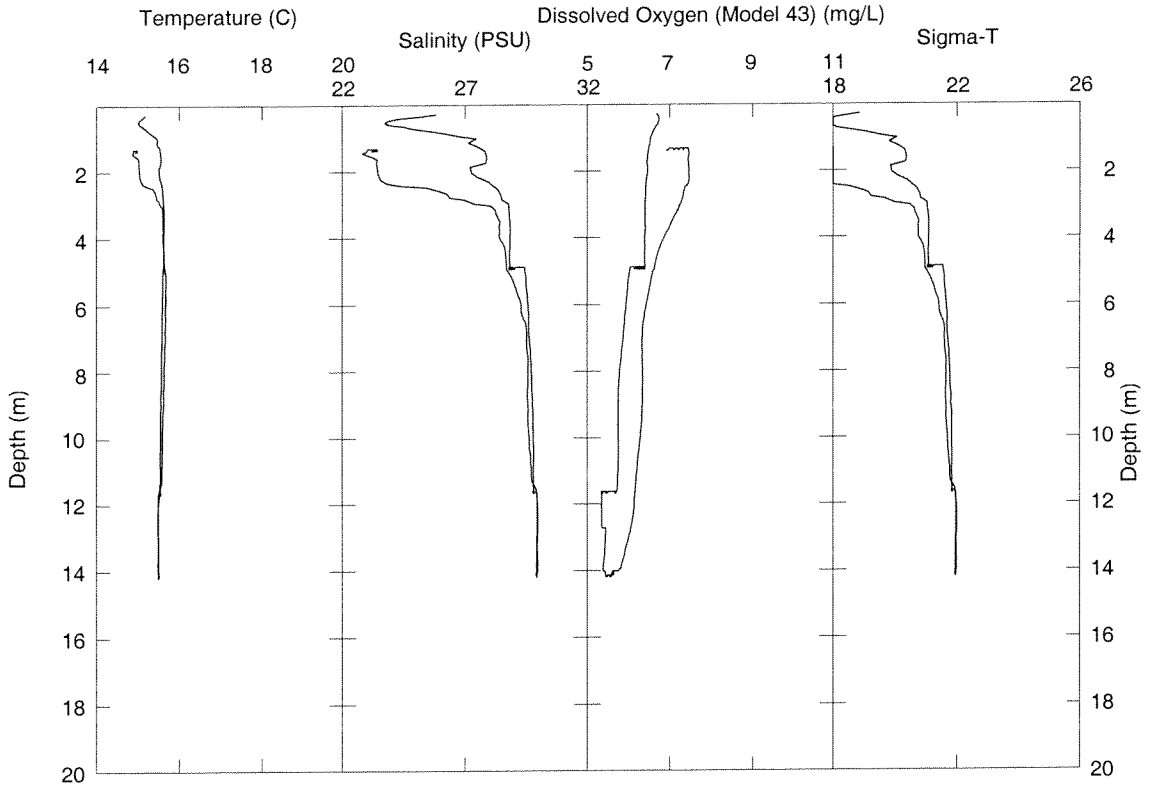

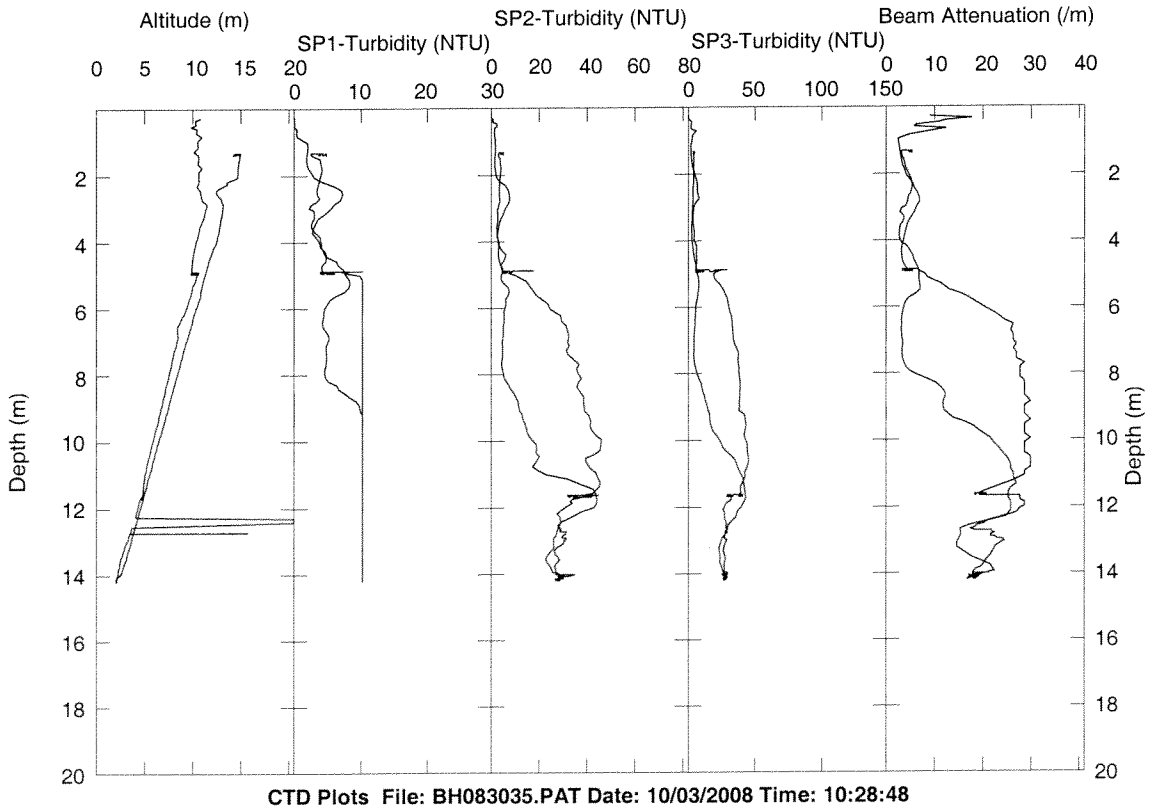

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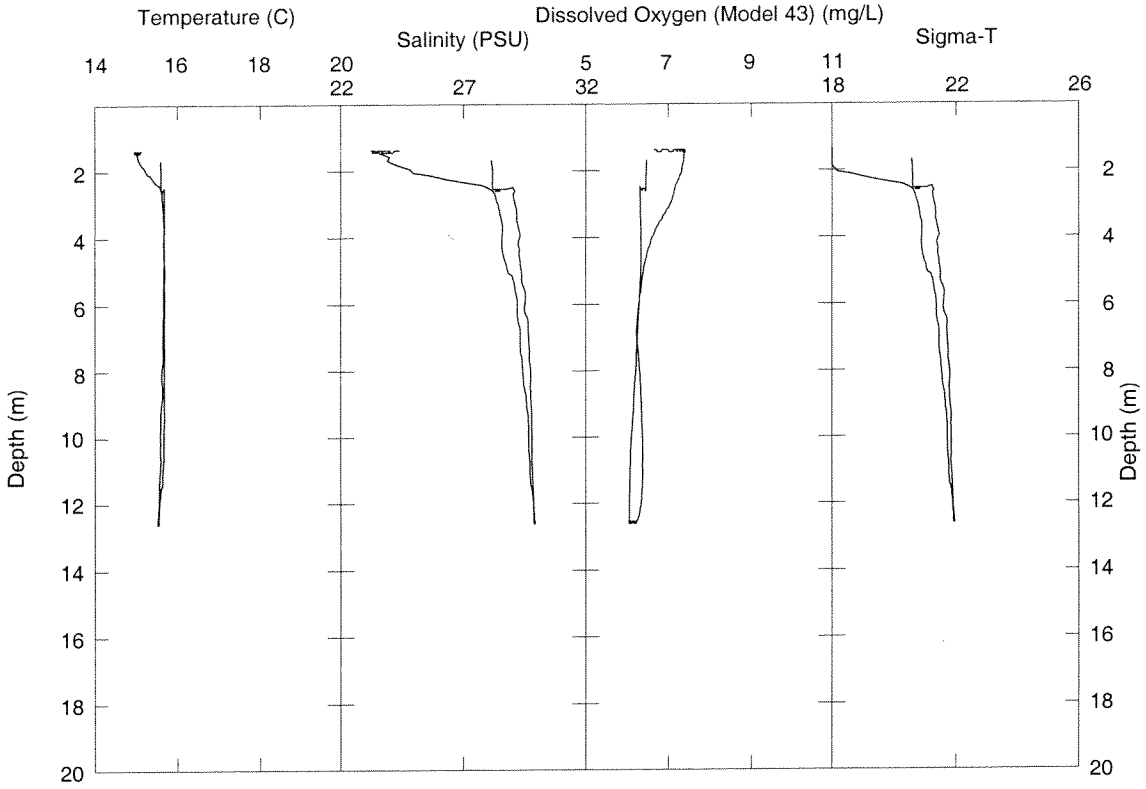

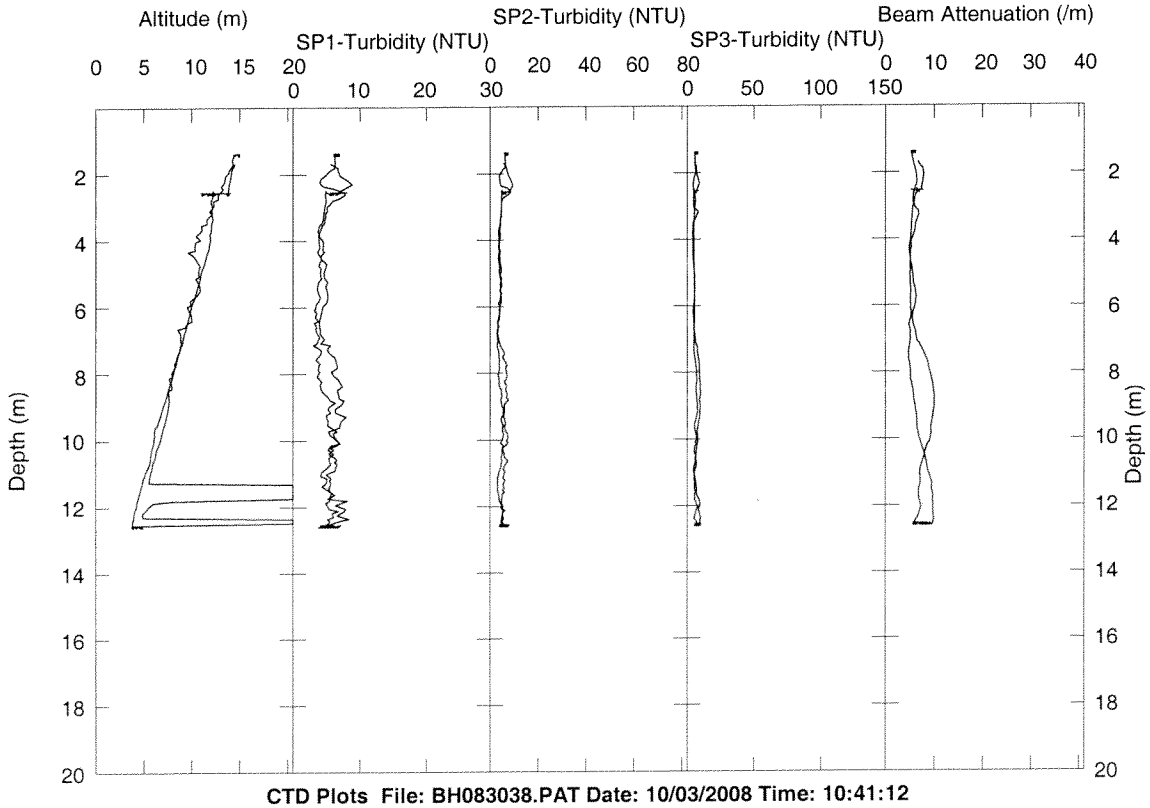

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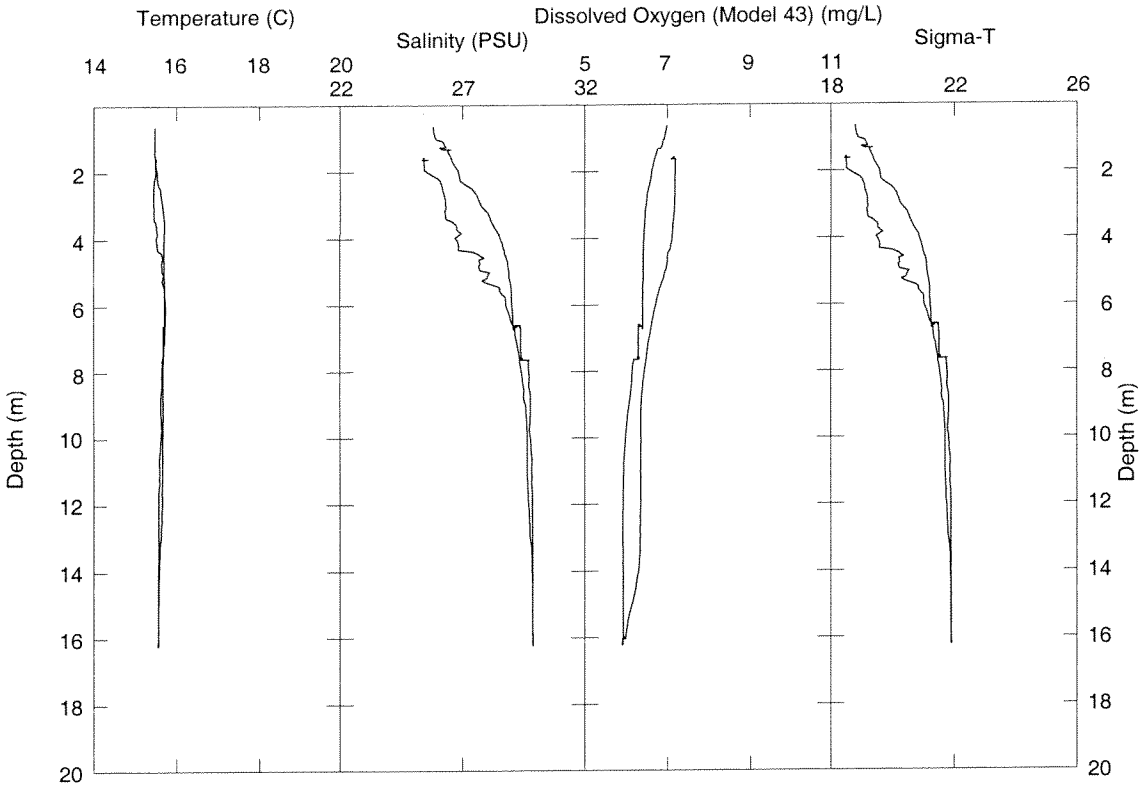

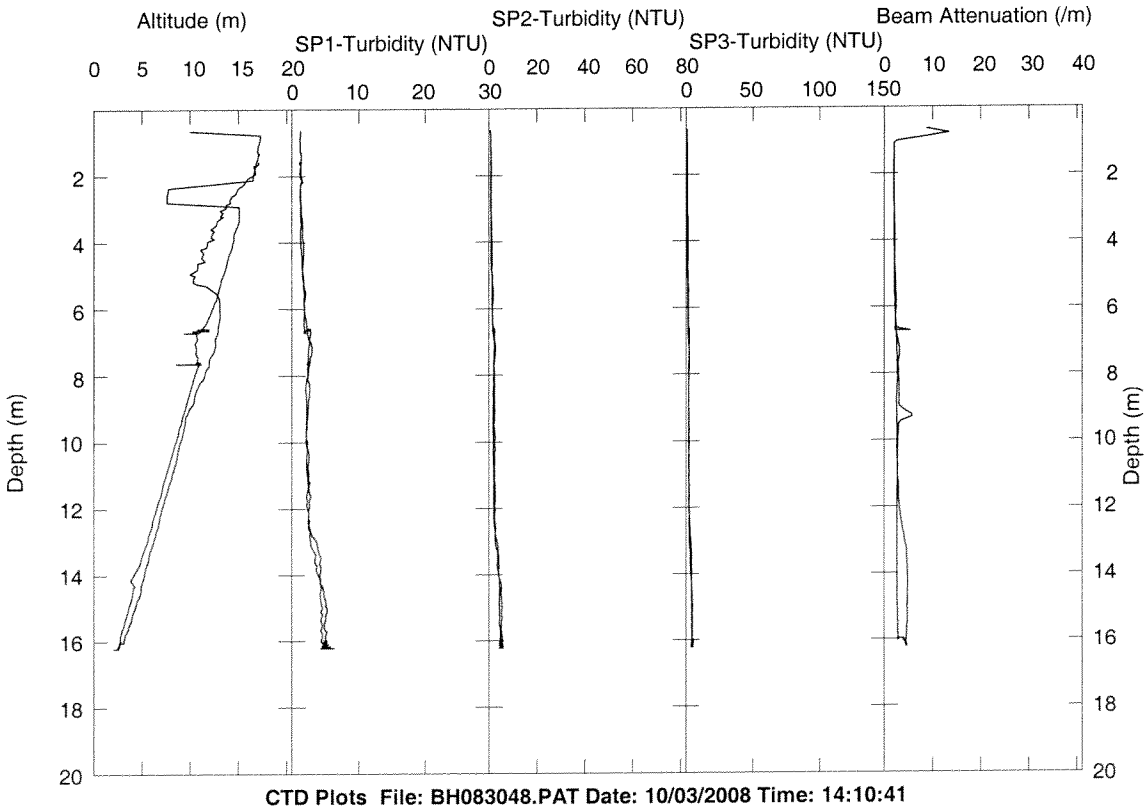

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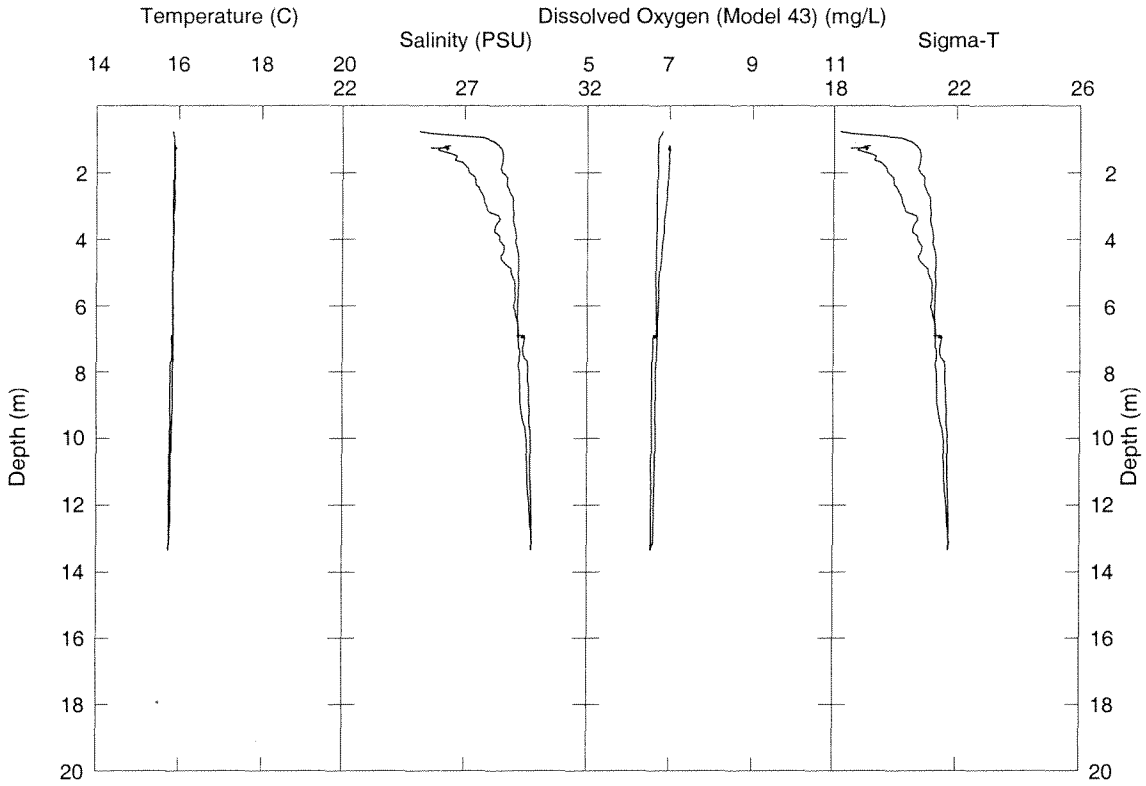

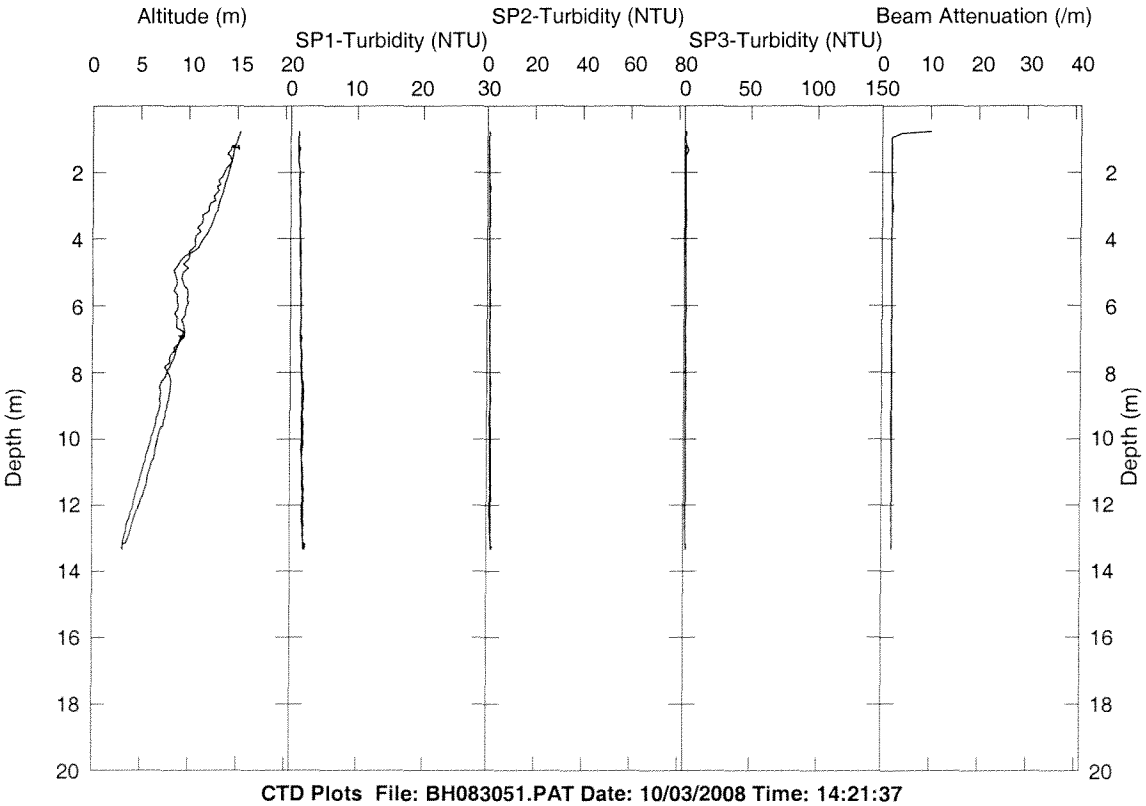

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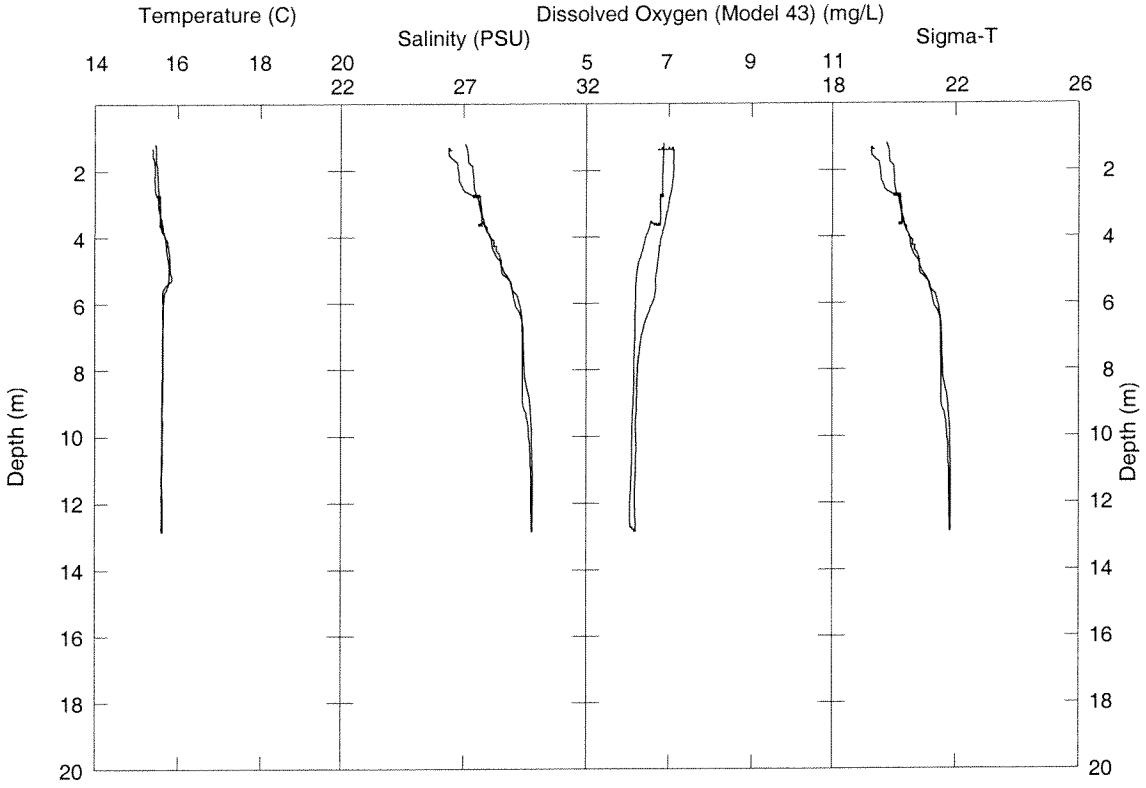

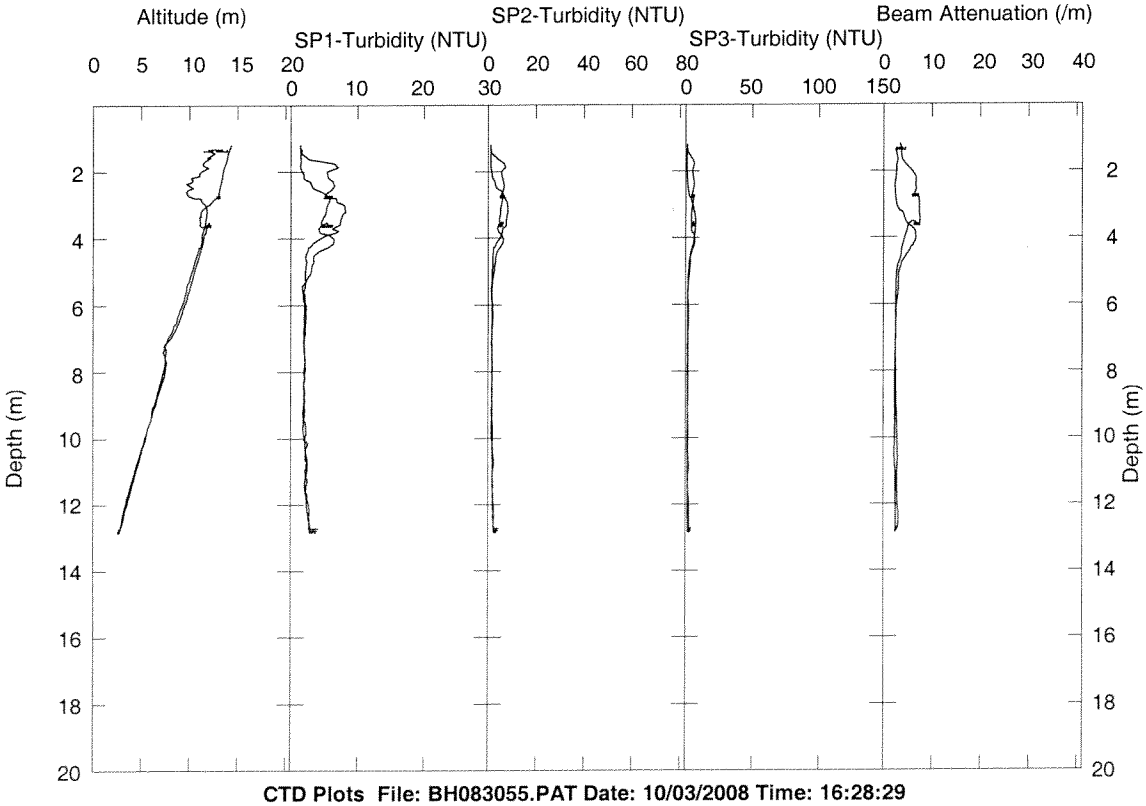

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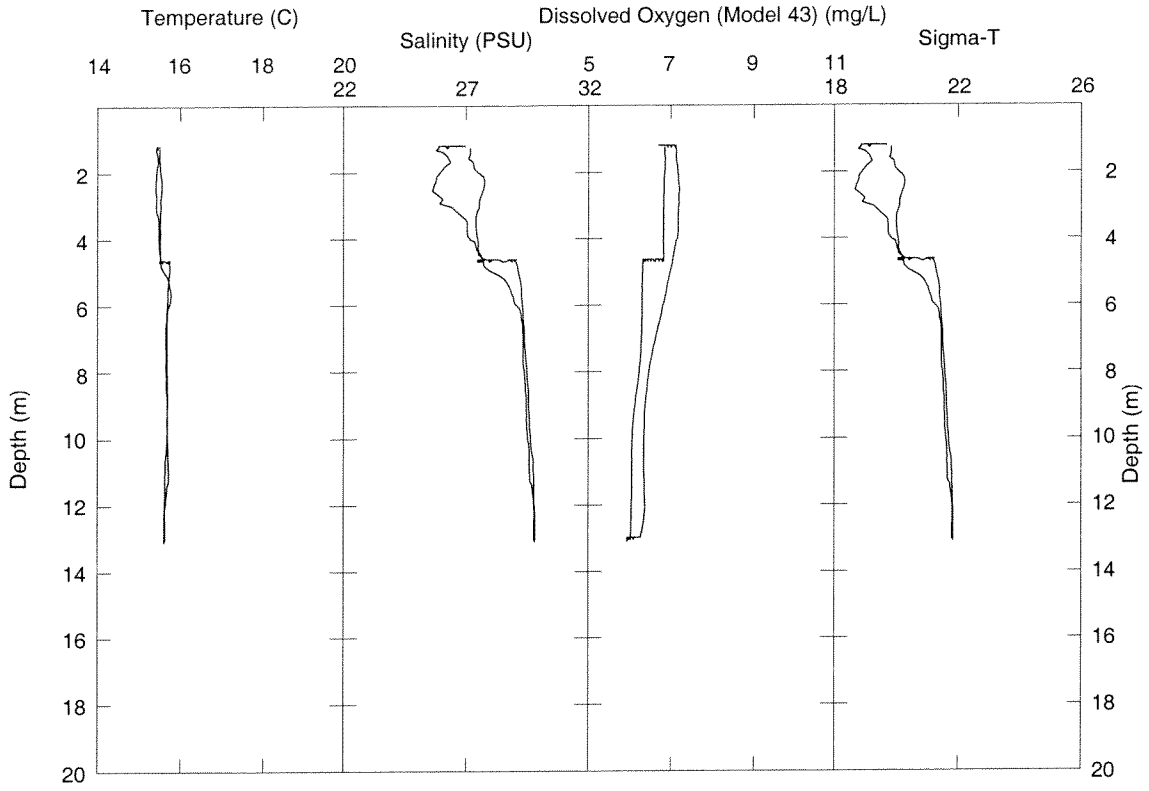

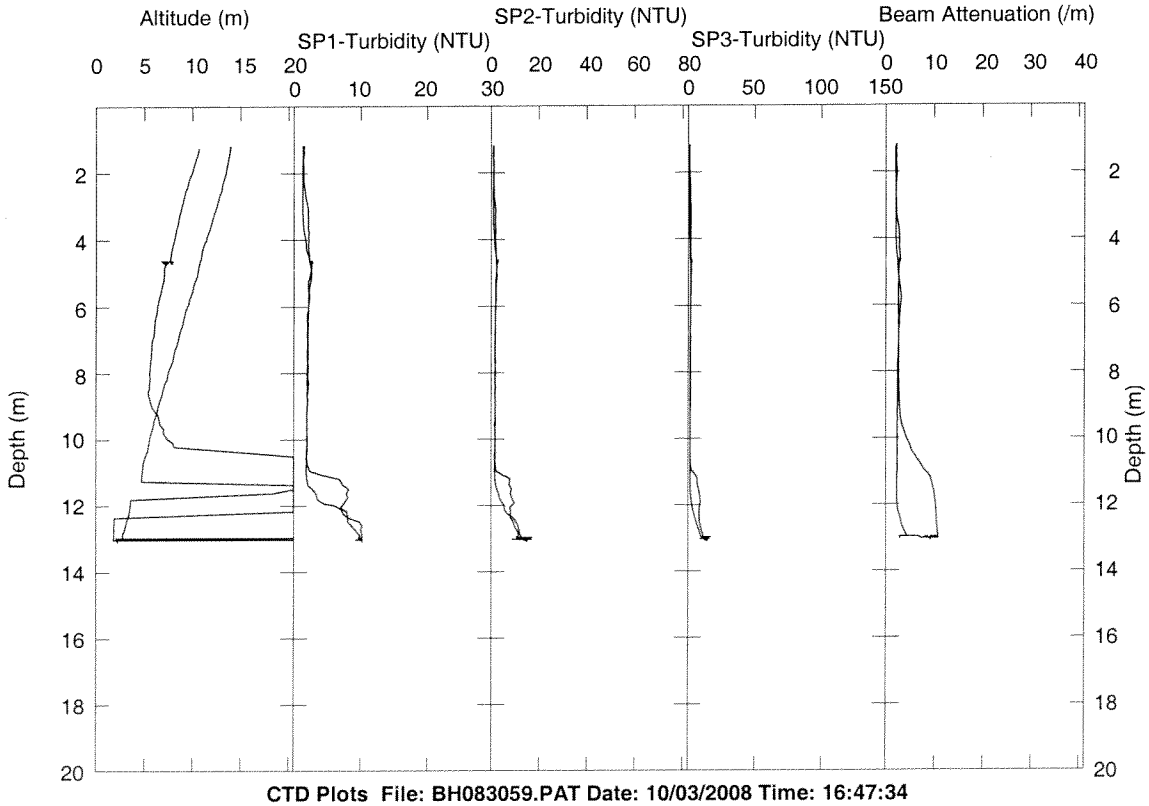

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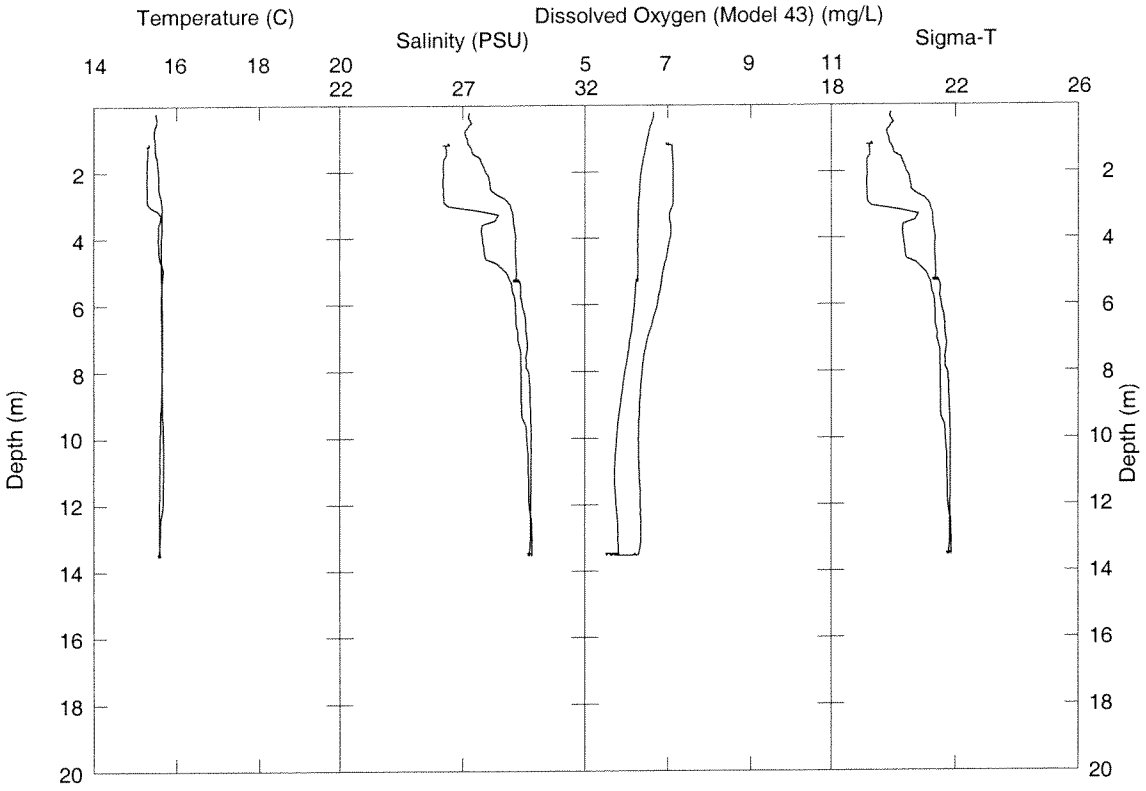

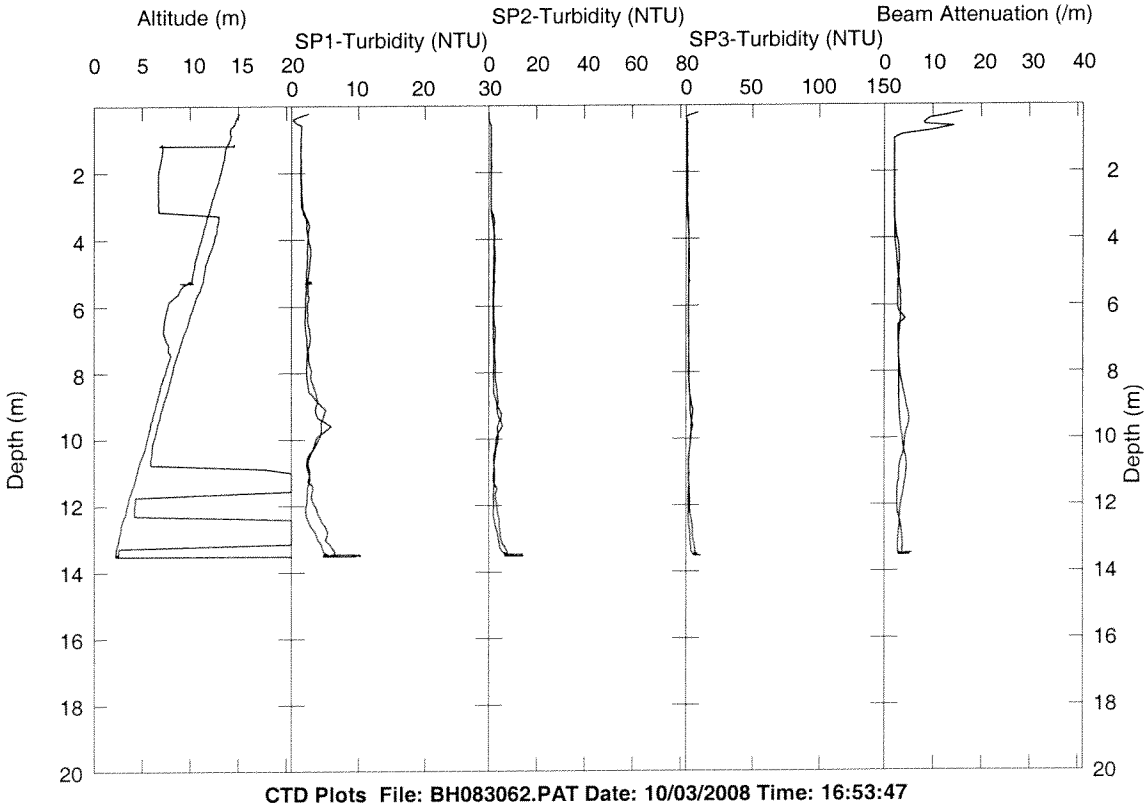

CTD Plots File: BH083062.PAT Date: 10/03/2008 Time: 16:53:47

Appendix 4

Bench Top Turbidimeter Results

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Station	Station Type	SampleID	Depth (ft)	Turbidity	SampleDateTime	Sample Depth
Lower Harbor Dredge Monitoring 9-Sept-08						
DS21	Reference	BH08304A	50.90000153	1.83	10/3/08 8:56	Mid Depth
DS21	Reference	BH083049	50.90000153	1.99	10/3/08 8:55	Near Bottom
DS22	Reference	BH083053	42.29999924	3.15	10/3/08 9:13	Mid Depth
DS22	Reference	BH083052	42.29999924	2.68	10/3/08 9:13	Near Bottom
DS23	Plume Centroid	BH083076	48.90000153	12.3	10/3/08 10:20	Mid Depth
DS23	Plume Centroid	BH083075	48.90000153	6.98	10/3/08 10:19	Near Bottom
DS24	South Lateral Extent	BH08307F	44	27.2	10/3/08 10:30	Mid Depth
DS24	South Lateral Extent	BH08307E	44.29999924	40.5	10/3/08 10:30	Near Bottom
DS25	North Lateral Extent	BH083088	45.29999924	7.06	10/3/08 10:42	Mid Depth
DS25	North Lateral Extent	BH083087	47.59999847	11.7	10/3/08 10:42	Near Bottom
DS31	Reference	BH0830AE	60	3.28	10/3/08 14:12	Mid Depth
DS31	Reference	BH0830AD	60	3.87	10/3/08 14:11	Near Bottom
DS32	Reference	BH0830B7	52.20000076	1.53	10/3/08 14:22	Mid Depth
DS32	Reference	BH0830B6	51.79999924	2.09	10/3/08 14:22	Near Bottom
DS33	South Lateral Extent	BH0830CF	49.5	4.14	10/3/08 16:30	Mid Depth
DS33	South Lateral Extent	BH0830CE	49.5	2.69	10/3/08 16:29	Near Bottom
DS34	North Lateral Extent	BH0830DD	46.29999924	4.73	10/3/08 16:48	Mid Depth
DS34	North Lateral Extent	BH0830DC	46.90000153	7.41	10/3/08 16:48	Near Bottom
DS35	Plume Centroid	BH0830E6	49.5	2.82	10/3/08 16:54	Mid Depth
DS35	Plume Centroid	BH0830E5	49.90000153	4.3	10/3/08 16:54	Near Bottom

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Appendix 5

Laboratory TSS Results

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SAMP_ID	ANALYSIS_METH	LAB_QC_CODE	DILUTION	ANALYTE	VALUE	LAB_QUAL	DETECT_LIMIT	UNIT	ANALYSIS_DATE
BH083049TS1	160.2	SA	1	TSS - Membrane	6.40		1.00	MG/L	10/09/2008
BH083049TS1DUP	160.2	DUP	1	TSS - Membrane	6.00		1.00	MG/L	10/09/2008
BH08304ATS1	160.2	SA	1	TSS - Membrane	5.00		1.00	MG/L	10/09/2008
BH083052TS1	160.2	SA	1	TSS - Membrane	6.20		1.00	MG/L	10/09/2008
BH083053TS1	160.2	SA	1	TSS - Membrane	5.20		1.00	MG/L	10/09/2008
BH083075TS1	160.2	SA	1	TSS - Membrane	16.2		1.00	MG/L	10/09/2008
BH083076TS1	160.2	SA	1	TSS - Membrane	35.2		1.00	MG/L	10/09/2008
BH08307ETS1	160.2	SA	1	TSS - Membrane	102		1.00	MG/L	10/09/2008
BH08307FTS1	160.2	SA	1	TSS - Membrane	85.0		1.00	MG/L	10/09/2008
BH083087TS1	160.2	SA	1	TSS - Membrane	35.2		1.00	MG/L	10/09/2008
BH083088TS1	160.2	SA	1	TSS - Membrane	21.3		1.00	MG/L	10/09/2008
BH0830ADTS1	160.2	SA	1	TSS - Membrane	8.20		1.00	MG/L	10/09/2008
BH0830AETS1	160.2	SA	1	TSS - Membrane	9.30		1.00	MG/L	10/09/2008
BH0830B6TS1	160.2	SA	1	TSS - Membrane	5.20		1.00	MG/L	10/09/2008
BH0830B7TS1	160.2	SA	1	TSS - Membrane	5.30		1.00	MG/L	10/09/2008
BH0830CETS1	160.2	SA	1	TSS - Membrane	6.70		1.00	MG/L	10/09/2008
BH0830CFTS1	160.2	SA	1	TSS - Membrane	9.00		1.00	MG/L	10/09/2008
BH0830DCTS1	160.2	SA	1	TSS - Membrane	20.5		1.00	MG/L	10/09/2008
BH0830DDTS1	160.2	SA	1	TSS - Membrane	12.8		1.00	MG/L	10/09/2008
BH0830E5TS1	160.2	SA	1	TSS - Membrane	9.30		1.00	MG/L	10/09/2008
BH0830E6TS1	160.2	SA	1	TSS - Membrane	10.2		1.00	MG/L	10/09/2008
	160.2	MB	1	TSS - Membrane	1.00	U	1.00	MG/L	10/09/2008
	160.2	LCS	1	TSS - Membrane	95.0			PCT_REC	10/09/2008