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US ARMY CORPS OF ENGINEERS
NEW ENGLAND DISTRICT
Total Environmental Restoration Contract
USACE CONTRACT NUMBER: DACW33-03-D-0006
Task Order No. 0007

Final 2009 Bathymetric Survey of Pilot Underwater Cap New Bedford Harbor Superfund Site

New Bedford Harbor Superfund Site
New Bedford, MA

March 2010

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ACE-J23-35BG0702-M17-0009

SDMS DocID 507213

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1.0 INTRODUCTION

This report is intended to briefly summarize the 2009 bathymetric data collected from the pilot underwater cap area at the New Bedford Harbor Superfund Site. These data were used to update information about the cap area and cap thickness, which are presented in this report.

2.0 BATHYMETRIC SURVEY

CR Environmental Inc. completed the bathymetric survey of the pilot cap on Wednesday, March 25, 2009. The bathymetric data collected were referenced to National Geodetic Vertical Datum 1929 (NGVD 29) and were later converted to Mean Lower Low Water (MLLW) vertical datum by Jacobs staff using the local conversion factor of -1.44 feet. This conversion was made because the previous bathymetric surveys conducted by Apex and associated bathymetric data were all presented relative to MLLW.

At the time of the 2009 survey, the GPS used to record the elevation at the point used for survey control (datum) recorded an erroneous value. The elevation of the datum was measured 0.91 feet lower than the true elevation relative to NGVD 29. This offset was realized after the point was surveyed to NGVD 29 by Meridian and Associates on January 27, 2010 (Attachment A). Once the error was discovered, the values of the 2009 MLLW survey were then raised 0.909 feet above the GPS datum measurement such that they represent the true MLLW.

The CR Environmental survey gathered data at a line spacing of 25 feet in a northwest to southeast orientation. This is consistent with historical post-placement surveys of the pilot cap area that were conducted by Apex Companies, LLC for the New Bedford Harbor Development Commission (Apex, 2007).

Weather Conditions:
Temperature: 40º Fahrenheit
Wind: 10-20 knots from the north
Seas: 1-2 feet

QA/QC Checks:
A summary of quality control analysis results can be found in Table 1.

3.0 DISCUSSION

The pilot underwater cap was placed in 2005 to test how well a cap in New Bedford Harbor would perform. The cap was placed by split hull scows which dropped dredged material over the Intended Cap Area (Figure 1). Since the placement of material, there have been bathymetric surveys performed in 2005, 2006, and 2007 by Apex; and in 2009 by CR Environmental Inc. to monitor the size and thickness of the placed material. The Apex figures presenting the 2005, 2006, and 2007 bathymetric surveys are presented in Attachment B. The March 2009 and prior pilot cap bathymetric surveys were used to compare the pre- and post-placement bathymetry for each year a survey was taken (2005, 2006, 2007, and 2009). These comparisons generated cap statistics for each of these years, which were calculated for the Intended Cap Area and the Full Placement Area. The Intended Cap Area is the area which was designated in the original design to be capped (Figure 1).

The Full Placement Area is the area which actually received cap material during the cap construction (Apex, 2007). The boundary of the Full Placement Area was determined yearly by identifying the 0.5 foot contour around the placed material. The Full Placement Area for 2009 was determined to be 20.41 acres which is a 1.7 percent decrease in area from 2007 (20.76 acres). The Full Placement Area for previous years is as follows (Figure 2):

- 2005 = 18.90 Acres (Apex, 2007),
- 2007 = 20.76 Acres (Apex, 2007), and
- 2009 = 20.41 Acres.

The reported thickness of cap material contained within the Intended Cap Area also decreased between 2007 and 2009. This is a change from the previous years (2005 to 2007) where it is theorized that the flattening out of cap peaks provided material which

settled into the valleys therefore increasing the cap thickness in the valleys. Statistics and coverage percentages for the Intended Cap Area are presented on Figure 3.

4.0 SUMMARY

Overall the pilot cap continues to perform well, with the area of cap which is at least 1 foot thick currently reported at 96.3 percent of the Intended Cap Area. There also appears to be some smoothing or erosion of ridge tops in certain cap areas.

The area and thickness of the Intended Cap Area has remained relatively consistent from 2007 through 2009, except for two areas along the western boundary and other smaller areas between ridges (Figure 3). From 2007 to 2009, there was a reduction of the reported area of the cap with a thickness greater than 2 feet from 74.6 percent to 61.4 percent (note that the cap thickness statistics were recalculated by Apex in 2007 to reflect improved site terminology and definitions). This reduction is more evident in the following two areas along the western boundary of the Intended Cap Area:

- Area A, which is located along the northwestern boundary; and
- Area B, which is located along the middle of the western boundary (Figure 3).

The thickness of the cap in these two areas of the Intended Cap Area has changed noticeably from the original July 26, 2005 Apex bathymetric survey through the subsequent January 12, 2006 and October 06, 2007 Apex bathymetric surveys (Attachment B). Some increase in cap thickness was detected in these areas between 2005 and 2006, followed by a general decease in thickness observed in 2007 and 2009.

As reported herein, within the footprint of the Intended Cap Area, the area of cap that is greater than 1 foot in thickness has been slightly reduced from 98.4 percent in 2007 to 96.3 percent in 2009. Similarly, within the same footprint, the area of cap greater than 2 feet in thickness has decreased from 74.6 percent in 2007 to 61.4 percent in 2009.

When evaluated in context with the 2005, 2006, and 2007 bathymetric surveys (Figure 3) the thickness statistics indicate overall stability with year-to-year variability.

All surveys by all bathymetric contractors illustrated the process of ridge and valley leveling over time. This process causes ridges to decrease in thickness and valleys to increase in thickness, resulting in measured increases in cap areas with thicknesses greater than 1 foot in years 2005 through 2007. The leveling process is assumed to be occurring from the natural behavior of sediment redistribution in a tidal environment; however, it cannot be confirmed without collection of core samples and observation of redistribution of cap material. The measured decrease in cap area where the thickness is greater than 1 foot in 2009 coincided with a change in bathymetric contractor. Future surveys will likely distinguish whether change in bathymetric contractor was a contributing variable to the summary statistics or whether the trend towards increasing thicknesses noted in previous surveys continues.

5.0 REFERENCES

Apex Companies, LLC., Memorandum, *Bathymetric Survey – EPA Operable Unit #3 (OU#3) New Bedford Harbor Superfund Site*; Jay Borkland, Greg Dolan, Kris van Naerssen; October 23, 2007.

FIGURES

CBI

CBI

CBI

TABLE

Table 1
Summary of Quality Control Analysis Results
Pilot Underwater Cap;
March 25, 2009

QC PARAMETER	RESULT	DESCRIPTION
Cross-Tie Comparisons		
Number of Comparisons	649	
Arithmetic Mean of Comparisons (feet)	-0.02	Measurement bias within data set. ACOE EM 1110-2-1003 (Ch. 3) spec = +/- 0.25 feet
Standard Deviation of Comparisons (feet)	0.23	
Arithmetic Mean of Absolute Values (feet)	0.02	Overall accuracy within data set.
95th Percentile Confidence Level (feet)	0.02	For mean of entire data set. ACOE EM 1110-2-1003 (Ch. 3) spec = +/- 0.5 feet
Bar/Staff Check		
Number of Comparisons	2	Pre- and Post-Survey.
Depth of Comparisons	5, 10	Suitable for Project Depth.
Echo Sounder vs. Bar Plate	5.2 v. 5.0; 10.2 v. 10.0	Bar plate. Sounding data adjusted for offset.
Sound Velocity Comparisons		
Number of Comparisons	2	Pre- and Post- Survey, during both Flood and Ebb. Survey conducted during rising and falling tides.
Depth of Comparisons	Surface - 10 feet	Mid-water column.
Range of Values	1460 - 1467	meters/second.
Velocity Utilized	1459.3	meters/second (precision limited by echo sounder entry increments).
Maximum possible depth variability at 5 foot depth	0.01	Conservatively assume 7 m/s hypothetical error.
Maximum possible depth variability at 10 foot depth	0.03	Conservatively assume 15 m/s hypothetical error.
Latency Tests		
Number of Comparisons	1	
Range of Results (seconds)	0.3	System has no defensible latency delays. Value within DGPS position accuracy limitation.
Position error (feet) at survey speed (~3 MPH)	~2'	Feet along track. This value is substantially less than specified DGPS horizontal accuracy.

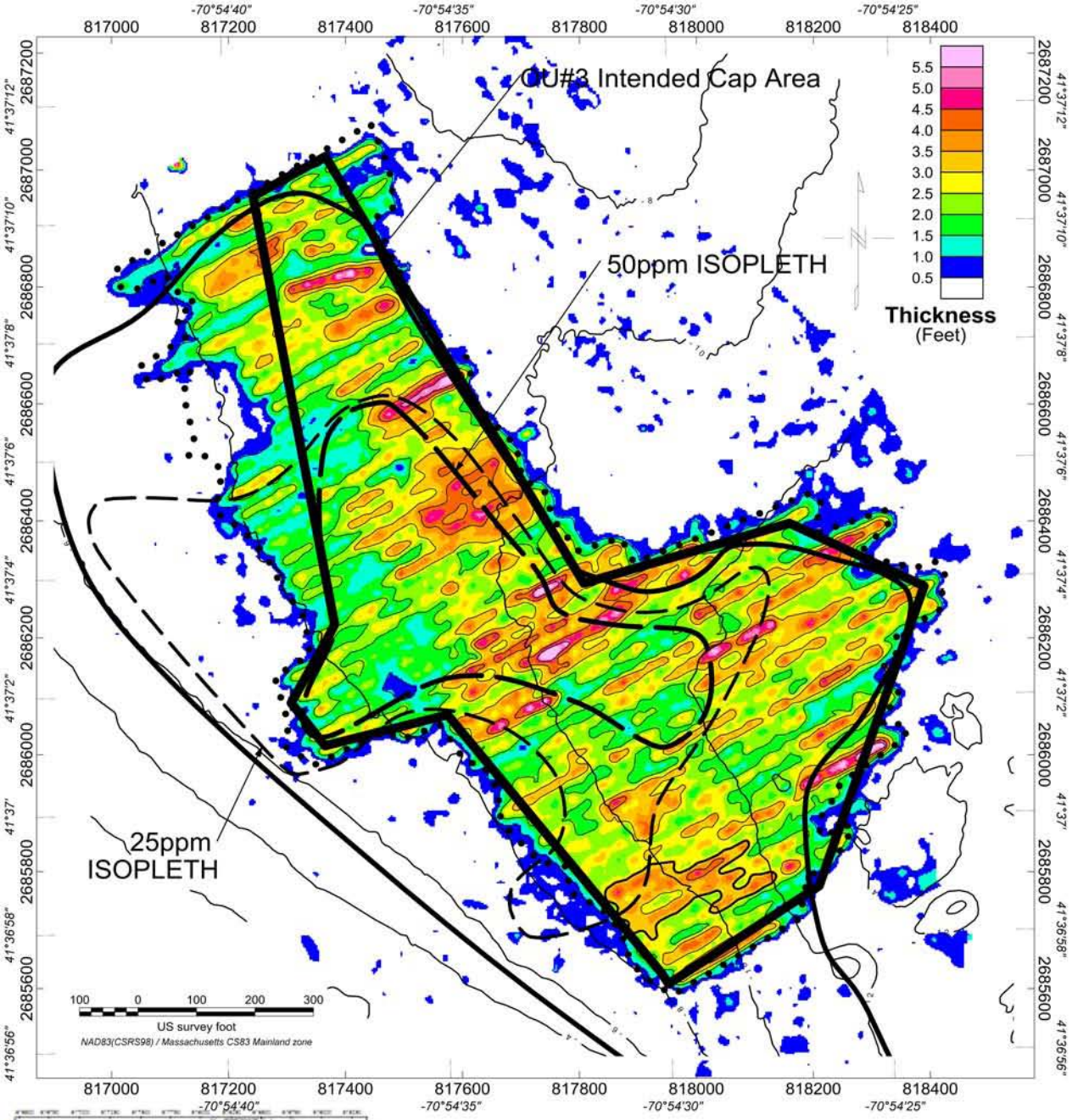
ATTACHMENT A

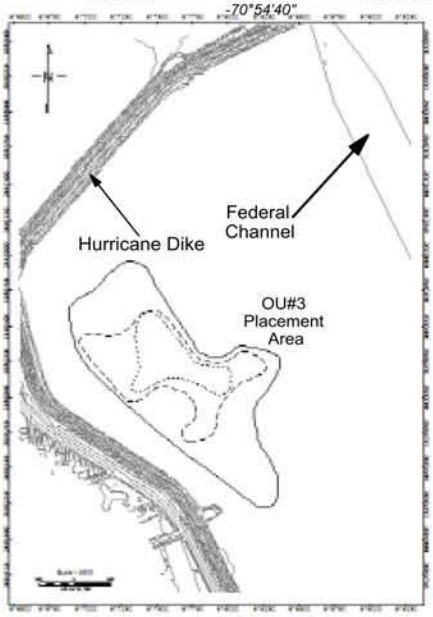
Meridian Associates Survey of Benchmark CP 4

CBI

ATTACHMENT B

Apex Figures; October 2007





STATISTICS

Intended Cap Area: AREA OF CAP ~15.24 ACRES
THICKNESS OF CAP >1-FOOT 98.4%
>2-FOOT 74.6%

Full Placement Area: AREA OF CAP ~20.76 ACRES
THICKNESS OF CAP >1-FOOT 88.9%
>2-FOOT 61.7%

Statistics Notes:
1. Statistics of "Intended Cap Area" indicates material from "peaks" continues to fill in the "valleys", increasing the overall percentage of "Intended Cap Area" covered by 1' or more of cap.
2. Statistics of the "Full Placement Area" indicates some "winnowing" of material at the edges of the cap, slightly decreasing the cap thickness at the edges as material 'toes-out'.

GENERAL NOTES:
1. BATHYMETRIC INFORMATION COLLECTED BY APEX COMPANIES FROM 10/02/07 TO 10/06/07. BATHYMETRY WAS REFERENCED TO THE MEAN LOWER LOW WATER (MLLW) DATUM. THE ISOPACH (CAP THICKNESS) SURFACE WAS CONSTRUCTED BY SUBTRACTING THE DIGITAL TERRAIN MODEL (DTM) FOR THE PRE-PLACEMENT SURVEY CONDUCTED BY COLER & COLANTONIO (06/2005) FROM THE DTM CONSTRUCTED USING THE 10/02/07 THROUGH 10/06/07 DATA. DTM SURFACES WERE CONSTRUCTED USING GEOSOFT'S OASIS MONTAJ'S MINIMUM CURVATURE ALGORITHMS.
2. CAP THICKNESS CONTOUR INTERVAL IS 1-FOOT.
3. STATISTICS CALCULATED USING AUTOCAD 2007 EXTENDED STATISTICS FOR THE ISOPACH DTM. STATISTICS CALCULATED FOR AREA FILLED WITHIN THE PLACEMENT FOOTPRINT.
4. PRE-PLACEMENT BASEMAP SUPPLIED BY U.S. ARMY CORPS OF ENGINEERS AND HAS NOT BEEN FIELD VERIFIED.
5. 2-FOOT BATHYMETRIC CONTOURS SHOWN ON THE PRE-PLACEMENT SURVEY PERFORMED BY COLER & COLANTONIO 6/23/05. CONTOURS REPRESENT MINIMUM CURVATURE EXISTING CONDITIONS SURFACE CONSTRUCTED BY GEOSOFT'S OASIS MONTAJ.
6. INTENDED CAP AREA = AREA THAT WAS DESIGNATED IN THE DESIGN TO BE CAPPED.
FULL PLACEMENT AREA = AREA THAT ULTIMATELY RECEIVED CAP MATERIAL DURING CAP CONSTRUCTION.

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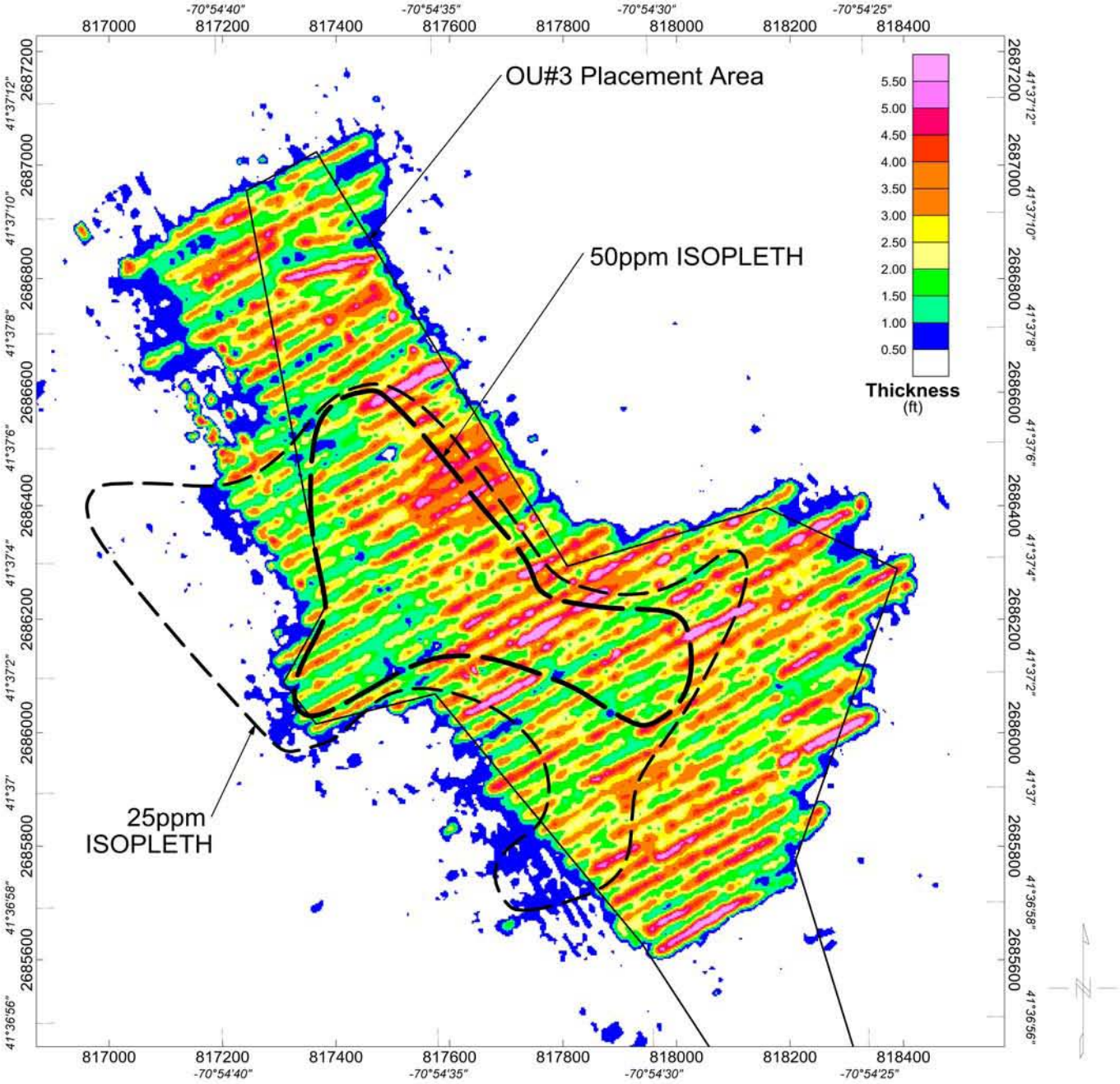
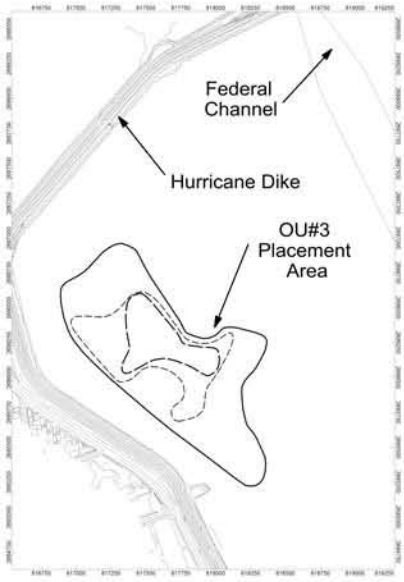
Suite 200
Boston
MA 02110

10/06/07 CAP THICKNESS
OU#3 Placement Area Survey

Thickness of CAP
Constructed By Subtracting Pre and Post Final Placement Surveys

Apex Companies, LLC





100 0 100 200 300

US survey foot

NAD83(CSRS98) / Massachusetts CS83 Mainland zone

STATISTICS

AREA OF CAP ~18.9 ACRES
THICKNESS OF CAP >1-FOOT 98%
>2-FOOT 70%

NOTES

1. BATHYMETRIC INFORMATION COLLECTED BY APEX ENVIRONMENTAL ON 01/12/06. BATHYMETRY WAS REFERENCED TO THE MEAN LOWER LOW WATER (MLLW) DATUM. THE ISOPACH (CAP THICKNESS) SURFACE WAS CONSTRUCTED BY SUBTRACTING THE DIGITAL TERRAIN MODEL (DTM) FOR THE PRE-PLACEMENT SURVEY CONDUCTED BY COLER & COLANTONIO FROM THE DTM CONSTRUCTED BY THE 01/12/06 DATA. DTM SURFACES WERE CONSTRUCTED USING GEOSOFTS OASIS MONTAJ'S MINIMUM CURVATURE ALGORITHMS.
2. CAP THICKNESS CONTOUR INTERVAL IS 1-FOOT.
3. STATISTICS CALCULATED USING AUTOCAD 2005 EXTENDED STATISTICS FOR THE ISOPACH DTM. STATISTICS CALCULATED FOR AREA FILLED WITHIN THE PLACEMENT FOOTPRINT.
4. BASEMAP SUPPLIED BY U.S. ARMY CORPS OF ENGINEERS AND HAS NOT BEEN FIELD VERIFIED.
5. 2-FOOT BATHYMETRIC CONTOURS SHOWN OF THE PRE-PLACEMENT SURVEY PERFORMED BY COLER & COLANTONIO 6/23/05. CONTOURS REPRESENT MINIMUM CURVATURE EXISTING CONDITIONS SURFACE CONSTRUCTED BY GEOSOFT'S OASIS MONTAJ.

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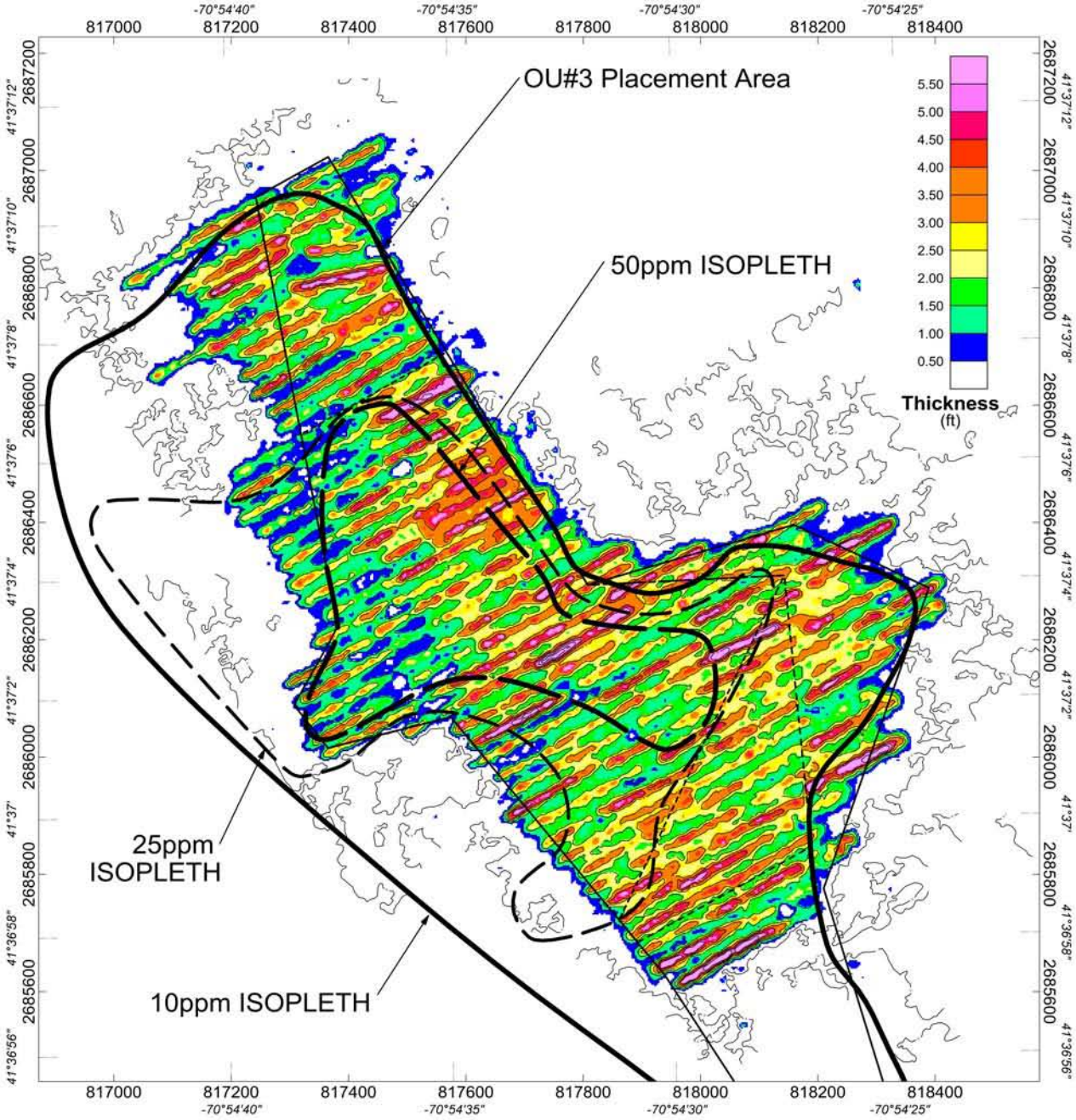
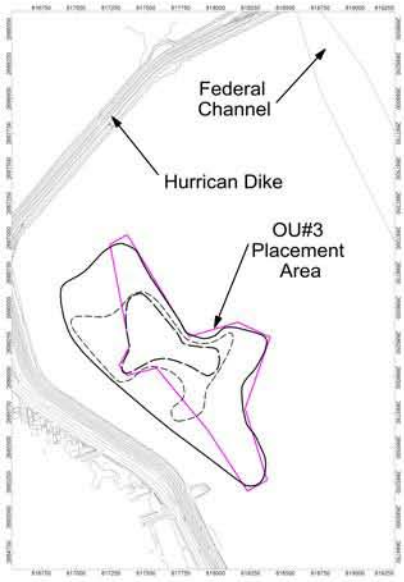
Apex environmental, inc.

01/12/06 CAP THICKNESS
OU#3 Placement Area Survey

Thickness of CAP
Constructed By Subtracting Pre and Post Final Placement Surveys

Apex Environmental





Scale 1:2400

100 0 100 200 300

US survey foot

NAD83(CSRS98) / Massachusetts CS83 Mainland zone

STATISTICS

AREA OF CAP ~18.9 ACRES
THICKNESS OF CAP >1-FOOT 95%
>2-FOOT 65%

NOTES

1. BATHYMETRIC INFORMATION COLLECTED BY APEX ENVIRONMENTAL ON 7/26/05. BATHYMETRY WAS REFERENCED TO THE MEAN LOWER LOW WATER (MLLW) DATUM. THE ISOPACH (CAP THICKNESS) SURFACE WAS CONSTRUCTED BY SUBTRACTING THE DIGITAL TERRAIN MODEL (DTM) FOR THE PRE-PLACEMENT SURVEY CONDUCTED BY COLER & COLANTONIO FROM THE DTM CONSTRUCTED BY THE 7/26/05 DATA. DTM SURFACES WERE CONSTRUCTED USING GEOSOFTS OASIS MONTAJ'S MINIMUM CURVATURE ALGORITHMS.

2. CAP THICKNESS CONTOUR INTERVAL IS 1-FOOT.

3. STATISTICS CALCULATED USING AUTOCAD 2005 EXTENDED STATISTICS FOR THE ISOPACH DTM. STATISTICS CALCULATED FOR AREA FILLED WITHIN THE PLACEMENT FOOTPRINT.

4. BASEMAP SUPPLIED BY U.S. ARMY CORPS OF ENGINEERS AND HAS NOT BEEN FIELD VERIFIED.

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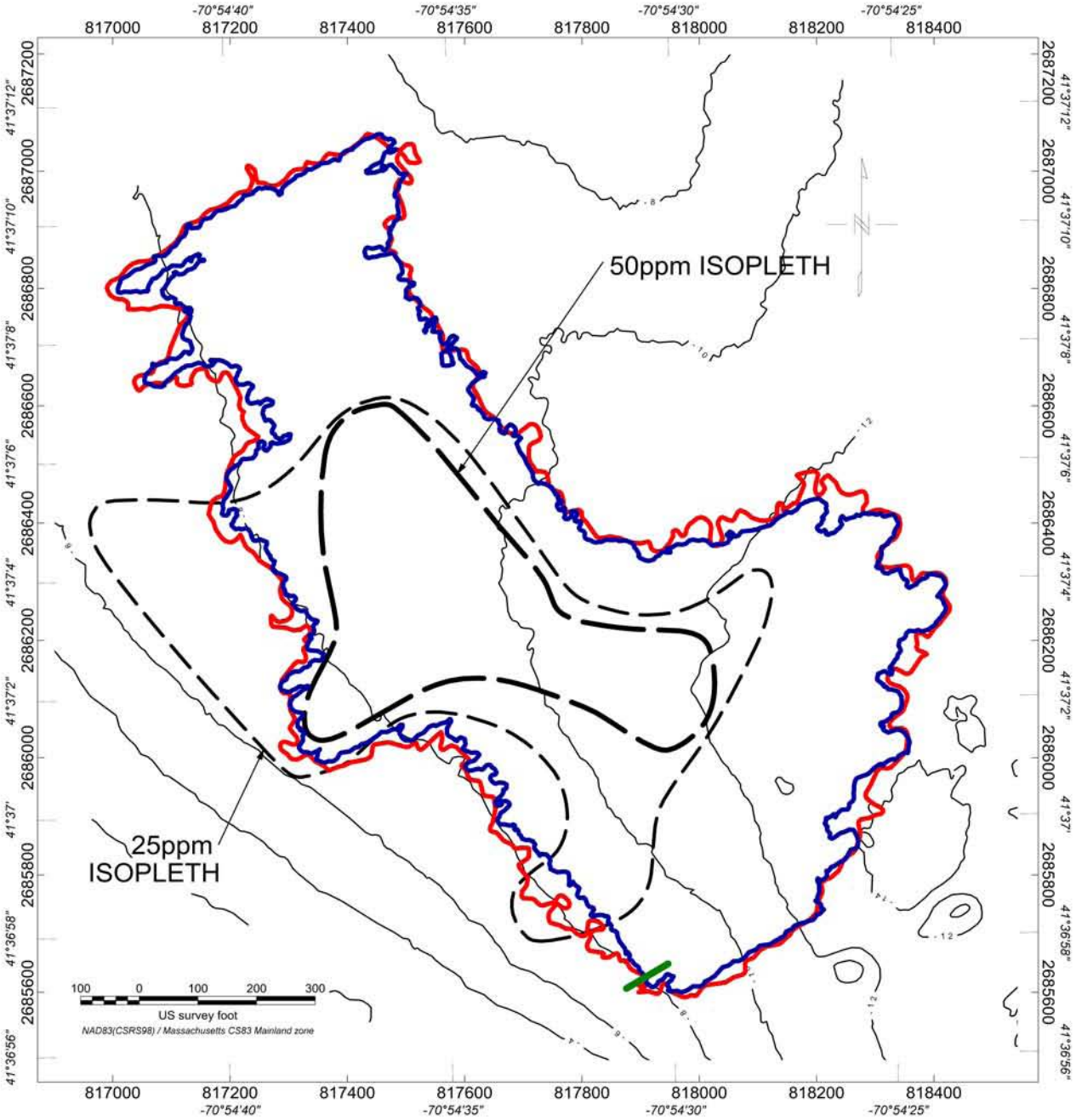
07/26/05 CAP THICKNESS
OU#3 Placement Area Survey

Thickness of CAP
Constructed By Subtracting Pre and Final Placement Surveys

Apex Environmental



2007 OU#3 CAP Footprint: AREA OF CAP ~20.76 ACRES

2005 OU#3 CAP Footprint: AREA OF CAP ~18.9 ACRES

Cross-Section Location

GENERAL NOTES:

1. CAP FOOTPRINT AREA DETERMINED AT THE 0.5-FOOT CONTOUR INTERVAL.
2. 2007 BATHYMETRIC INFORMATION COLLECTED BY APEX COMPANIES FROM 10/02/07 TO 10/06/07. BATHYMETRY WAS REFERENCED TO THE MEAN LOWER LOW WATER (MLLW) DATUM. THE 2007 ISOPACH (CAP THICKNESS) SURFACE WAS CONSTRUCTED BY SUBTRACTING THE DIGITAL TERRAIN MODEL (DTM) FOR THE PRE-PLACEMENT SURVEY CONDUCTED BY COLER & COLANTONIO (06/2005) FROM THE DTM CONSTRUCTED USING THE 10/02/07 THROUGH 10/06/07 DATA.
3. THE 2005 ISOPACH (CAP THICKNESS) SURFACE WAS CONSTRUCTED BY SUBTRACTING THE DIGITAL TERRAIN MODEL (DTM) FOR THE PRE-PLACEMENT SURVEY CONDUCTED BY COLER & COLANTONIO (06/2005) FROM THE DTM CONSTRUCTED USING BATHYMETRIC DATA COLLECTED BY APEX ON 7/26/2005.
4. PRE-PLACEMENT BASEMAP SUPPLIED BY U.S. ARMY CORPS OF ENGINEERS AND HAS NOT BEEN FIELD VERIFIED.
5. DTM SURFACES WERE CONSTRUCTED USING GEOSOFT'S OASIS MONTAJ'S MINIMUM CURVATURE ALGORITHMS.
6. CAP THICKNESS CROSS SECTIONS WERE CONSTRUCTED IN GEOSOFT'S OASIS MONTAJAND IN AUTOCAD.

CAP Footprint Comparisons
OU#3 Placement Area Survey

2005 vs. 2007 CAP Footprint
CAP Area Constructed at 0.5-Foot Contour Interval

Apex Companies, LLC