500022014

2015 Remedial Action Annual Effectiveness Report

Alcoa (Point Comfort) / Lavaca Bay Superfund Site

March 31, 2016

2015 Remedial Action Annual Effectiveness Report
Alcoa (Point Comfort)/Lavaca Bay Superfund Site

March 2016

ALCOA

Table of Contents

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

LIST OF ACRONYMS AND ABBREVIATIONS

°C	degrees Celsius
Alcoa	Alcoa Inc. and Alcoa World Alumina Atlantic, L.L.C.
CAPA	Chlor-Alkali Process Area
CCND	Calhoun County Navigation District
CD	Consent Decree
CDF	confined disposal facility
cm	centimeter
cm/s	centimeters per second
CSM	conceptual site model
DGT	Diffusive Gradient in Thin Film
DMPA	Dredge Materials Placement Area
DNAPL	dense nonaqueous phase liquid
EE/CA	Engineering Evaluation/Cost Analysis
ESD	Explanation of Significant Differences
g/d	grams per day
GPA	Gypsum Placement Area
meHg	methylmercury
mg	milligram
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
mph	miles per hour
MS3	Mainland Shoreline No. 3
MT/d	metric tons per day
ng/g	nanograms per gram
ng/L	nanograms per liter
NGVD	National Geodetic Vertical Datum
OC	organic carbon

OMMP	Operation, Maintenance and Monitoring Plan
PAH	polycyclic aromatic hydrocarbon
PCO	Point Comfort Operations
PCOR	Preliminary Close Out Report
ppm	parts per million
RAAER	Remedial Action Annual Effectiveness Report
RAO	remedial action objective
RDR	Remedial Design Report
RI	Remedial Investigation
ROD	Record of Decision
Site	Alcoa (Point Comfort)/Lavaca Bay Superfund Site
SOW	Statement of Work
THg	total mercury
TOC	total organic carbon
TSS	total suspended solid
USEPA	U.S. Environmental Protection Agency

TEXT

1 INTRODUCTION

1.1 Objective

This 2015 Remedial Action Annual Effectiveness Report (RAAER) for the Alcoa (Point Comfort)/Lavaca Bay Superfund Site (Site) in Point Comfort, Texas, satisfies the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act Consent Decree (CD)/Statement of Work (SOW) between Alcoa (Alcoa Inc. and Alcoa World Alumina Atlantic, L.L.C.), the United States of America, and the State of Texas, entered in the United States District Court, Southern District, on the effective date of March 1, 2005 (United States et al. 2005).

The objective of the RAAER is to create an integrated assessment of the progress towards achieving the overall Site remediation goals using results from all monitoring performed subsequent to the lodging of the CD.

1.2 Consent Decree and Statement of Work Requirements for the RAAER

Per the SOW attached to the CD (United States et al. v. Alcoa Inc. et al. 2005), the RAAER needs to adhere to the following guidelines:

> *...shall be prepared to evaluate the effectiveness of the RA [Remedial Action] including, but not limited to, an evaluation of the performance of the hydraulic control system at CAPA, natural recovery of sediments in Lavaca Bay, trends in fish/shellfish tissue values, and an evaluation of O&M activities. In preparing the report, Settling Defendants shall use the O&M [Operation and Maintenance] and Performance Monitoring data collected and any data collected during construction of the remedy. The Annual Effectiveness Report shall be submitted to EPA in accordance with the schedule contained in the Remedial Action Work Plan.* (p. 7-1)

The Remedial Action Work Plan (Alcoa 2005a) specifies that the RAAER be submitted by March 31 of the year following the completion of each monitoring program.

The SOW attached to the CD states that the specific topics to be discussed in the RAAER include the following:

- Site information;
- Media description;
- Treatment system description;
- Treatment system performance;

- Observations and lessons learned; and
- Verification that site conditions have not changed and there have been no land use or property development changes that may affect the remedial action.

1.3 Site Description and Status of Remedial Activities

As per United States et al. v. Alcoa Inc. et al. (2005), the Site is defined in the CD as follows:

> *...the Alcoa/Lavaca Bay Superfund Site, generally consisting of the Plant, Dredge Island, Formosa Tract, and portions of Lavaca Bay, Cox Bay, Cox Creek, Cox Cove, Cox Lake (Cox Creek, Cox Cove, and Cox Lake are also known as Huisache Creek, Cove and Lake) and western Matagorda Bay located in Calhoun County, Texas, and areas containing hazardous substances depicted generally on the map attached as Appendix C. (Note: map from CD not presented herein)* (p. 11)

Although all areas of the Site were investigated during the Remedial Investigation (RI), the risk assessments indicated that only certain parts of Lavaca Bay, Dredge Island, and two areas on the Plant/Mainland (the Chlor-Alkali Process Area [CAPA] and the Witco Area) required development of remedial action objectives (RAOs) and subsequent remediation. Remediation of the Site, as described in the Record of Decision (ROD; USEPA 2001), consisted of actions that were initiated prior to the ROD (some of which were completed prior to the ROD and some of which are ongoing), and several future actions. This RAAER presents monitoring information that reflects the effects of both the completed actions and the ongoing activities. The following remedial actions either have been completed or represent an ongoing activity at the Site:

- Stabilization of Dredge Island (completed as a non-time critical removal action prior to the ROD);
- Removal of CAPA sediment and sediment near Dredge Island (completed as a treatability study prior to the ROD);
- Extraction and treatment of groundwater at the CAPA (initiated as a treatability study prior to the ROD and continuing as an ongoing remedial action pursuant to the CD);
- Dredging of the Witco Channel (performed as part of routine Plant maintenance prior to the ROD);
- Installation of a soil cap at the CAPA with institutional controls to manage exposure to soil (completed prior to the ROD);
- Removal of Building R-300 at the CAPA (completed prior to the ROD);
- Natural recovery of sediments (ongoing activity);
- Institutional controls to manage exposure to finfish and shellfish (ongoing activity)
- Installation of a dense nonaqueous phase liquid (DNAPL) containment system (slurry wall vertical barrier) at the Witco Area (installed in 2006);

- Installation of soil caps at the Witco Area with institutional controls to manage exposure to soil (installed in 2006); and
- Dredging of the Witco Marsh (completed in 2006).

On May 23, 2007, the U.S. Environmental Protection Agency (USEPA) published notice that an Explanation of Significant Differences (ESD) had been signed for the Site. The ESD (USEPA 2007a) indicates that enhanced natural recovery north of Dredge Island is no longer a necessary component of remedial action for the Site and states that although the remediation goal for sediment in open water areas of Lavaca Bay has been achieved, Alcoa will continue to monitor mercury levels in fish and marsh sediment. Results from the ongoing monitoring are to be updated in the annual RAAER. The ESD goes on to indicate that the USEPA will review the report to determine if the remedy continues to be protective of human health and the environment. In addition, if USEPA determines that the remedy is not protective, the USEPA can require Alcoa to undertake additional response actions.

The Preliminary Close Out Report (PCOR) for the Site was signed by USEPA on July 23, 2007 (USEPA 2007b). The PCOR documents that all construction activities required by the ROD (USEPA 2001) were completed. Long-term monitoring of red drum (*Sciaenops ocellata*) and juvenile blue crab (*Callinectes sapidus*) is required to evaluate the recovery of mercury levels in fish and shellfish.

The CD specifies certain performance monitoring activities to evaluate the effectiveness of the remedy. The scopes of each of these monitoring activities are contained in the Remedial Design Reports (RDRs) and/or Operation, Maintenance and Monitoring Plans (OMMPs) attached to the CD. The CD documents that govern operation, maintenance, and monitoring for currently completed or ongoing activities are as follows:

- CAPA RDR and OMMP (Appendix A);
- Lavaca Bay Sediment Remediation and Long-Term OMMP (Appendix H);
- Lavaca Bay Finfish and Shellfish OMMP (Appendix I);
- Dredge Island OMMP (Appendix D);
- CAPA Soils RDR and OMMP (Appendix F);
- Witco Tank Farm DNAPL Containment System RDR and OMMP (Appendix B); and
- Witco Area Soils RDR and OMMP (Appendix G).

As discussed below, additional activities have been performed in response to the first Five-Year Review Report by the USEPA (2011).

The RDRs and OMMPs provide detailed descriptions of the performance monitoring that is summarized in this RAAER. Although the general scopes of the relevant OMMPs are described subsequently, the reader is directed to the RDR and OMMP documents for specific details about each monitoring program. Due to the large size of the RDR and OMMP documents, they are not reproduced here.

The USEPA issued the first Five-Year Review Report in June 2011 (USEPA 2011) and provided the following summary. The USEPA (2011) review concluded:

> *...that the completed and ongoing remedial activities and natural recovery processes have resulted in downward trends of mercury concentrations in open water sediment and marsh sediment. Overall, a significant amount of sediment recovery has occurred since sampling conducted during the Remedial Investigation (RI) in 1996. Small localized areas of open water sediment are not recovering as quickly as predicted in the Feasibility Study. Average mercury concentrations of red drum tissue measured in the Closed Area of Lavaca Bay continue to exhibit positive and negative inter-annual fluctuations. The fluctuations appear to be related in part to remediation and in part to physical, chemical and biological conditions not influenced by remedial activities.*
>
> *Based on the data review, document review, and site inspection, the following issues have been identified:*
>
> - *Empirical sediment recovery rates indicate that natural recovery of open-water sediment mercury concentrations is occurring, but at a somewhat slower rate than predicted in the* Feasibility Study. *The Marsh 14 Island left by the Dredge Island non-time critical removal action, and perhaps to a lesser extent Mainland Shoreline No. 3 and the Witco Harbor and channel appear to serve as an ongoing source of mercury-contaminated soil and sediment to Lavaca Bay. These soils and sediment appear to be decreasing the rate of sediment recovery predicted in the Feasibility Study.*
>
> - *Due to bimodal and/or outlier data distributions, it is difficult to determine temporal trends in marsh sediment concentrations. In order to calculate an accurate average sediment concentration in marshes, it is appropriate to review the statistical design of the marsh sediment monitoring program to assess whether the number and placement of samples should be modified to better capture the variability in sediment concentrations and to improve the understanding of temporal trends.*
>
> - *Mercury studies performed at the beginning of the RI indicated that methylation occurs at a shallow depth (often one or two centimeters at depth). A smaller core sample interval, closer to the sediment surface may provide more useful information about where and how methylmercury enters the food web.*

- *Inspections at Dredge Island are conducted quarterly and indicate that the island is in good shape and the performance objectives are met. Erosion of the interior side slopes of the confined disposal facility (CDF) caused by wave action of water in the CDF continues to be the most significant maintenance issue. Other items that need to be addressed on Dredge Island include: 1) erosion of the un-vegetated areas of the exterior side-slopes; 2) possible damage to the northeast decant structure below the mud line; 3) corrosion of metal portions of the decant structures; and 4) vegetation within the stone armor on the exterior side-slopes.*

<u>Actions Needed</u>

To address the issues identified during the first five-year review, the following recommendations and follow-up actions have been identified:

- *Develop a plan to perform a focused, additional remedial measure in the area of the Dredge Island stabilization project, in order to assess whether the rate of finfish/shellfish tissue recovery can be accelerated.*

- *Assess the statistical design of the marsh sediment monitoring program to determine whether the number and placement of samples can be modified to better capture the variability in sediment concentrations and to improve the understanding of temporal trends.*

- *Evaluate a smaller core sample interval, closer to the sediment surface for future sediment sampling to provide more useful information about where and how methylmercury enters the food web.*

- *Address the following issues related to the Dredge Island Stabilization Project:*
  - *Erosion of the interior side slops of the CDF caused by wave action of water in the CDF continues to be the most significant maintenance issue.*
  - *Erosion of the un-vegetated areas of the exterior side-slopes*
  - *Possible damage to the northeast decant structure below the mud line*
  - *Corrosion of metal portions of the decant structures*
  - *Vegetation within the stone armor on the exterior side-slopes.*

The status of these recommendations and follow-up actions is summarized as follows:

1. Remedial measures

a. Marsh 14 response action
    i. 2012 Five-Year Review Response Action Plan: Submitted on June 28, 2012, received USEPA comments on July 10, 2012, and submitted revised Remedial Action Plan on July 25, 2012 (Alcoa 2012a); this plan was approved by USEPA on August 14, 2012
    ii. Marsh 14 Dredging: Submitted Dredge Notice on May 13, 2013, and dredging was conducted in June 2013 (decanting occurred through August 2013)
    iii. Response Action Completion Report for the Activities Conducted Under the 2012 Five-Year Review Response Action Plan: Submitted on September 26, 2013 (Alcoa 2013b)
b. Mainland Shoreline No. 3 (MS3) Area: Alcoa has requested the opportunity to re-evaluate options for managing this area given current plans for site operations curtailment. Additional sampling work is planned for later this year to further characterize the distribution of mercury-containing soils in this area, and we propose that this work would be followed by an evaluation of remedial options.

2. Statistical Design of Marsh Sampling Plan: Addressed in Section 3.3.1 of the 2012 RAAER (Alcoa 2013a). The statistical review concluded that the use of the Dixon Q-test to remove outliers in the marsh sediment data set is appropriate, and the number of sample locations in the marsh sampling program are adequate.
3. Evaluation of Smaller Sediment Core Interval: Addressed in Sections 2.3 and 3.3.1 of the 2012 RAAER (Alcoa 2013a). Sediment data were collected in the 0 to 2 centimeter (cm) interval in 2012 to help provide more focused and useful information on the distribution of mercury in sediment. Core intervals of 0 to 5 cm were also sampled in 2012 to provide comparison with historical data sets. The target sample interval in subsequent annual monitoring events is 0 to 2 cm (although as described in the 2014 RAAER, the open water sediment core interval was 0 to 5 cm).
4. Dredge Island Stabilization Project Issues: All maintenance issues identified for the Dredge Island Stabilization Project were addressed during a maintenance event conducted in 2011, as described in the 2011 RAAER (Alcoa 2012b). Alcoa continues to monitor the condition of the metal decant structure.

Based on monitoring results from sampling activities conducted subsequent to the Marsh 14 dredging in 2013, Alcoa made the following recommendations in the 2014 RAAER (Alcoa 2015a):

> *Focused, site-specific studies of MeHg [methylmercury] in marsh sediment and uptake of MeHg to the food web in the northern part of the Closed Area are recommended to assess whether additional adaptive sediment management tools are feasible to accelerate the rate of tissue recovery. The studies should focus on Marshes 1, 2, 5 and 6, which have relatively high MeHg concentrations and are proximate to juvenile blue*

crab sampling locations with elevated mercury levels relative to other parts of the Closed Area.

Studies of mercury fate and transport are recommended in areas that are potential sources to the system through remobilization of sediments. The focus of these studies would be the areas north and east of Dredge Island.

Work plans for these studies will be developed and submitted to the agency for review and approval prior to implementation in 2015.

The red drum tissue collection, processing and analysis procedures will be reviewed to evaluate the cause of three anomalous moisture values observed in the 2014 data. Revisions to the OMMP, if needed, will be drafted and submitted to the agency for review and approval. (p. 4-3)

As follow up to the 2014 RAAER recommendations, Alcoa designed a series of studies to answer the following questions (Alcoa 2015b):

A. With total mercury levels in the causeway marsh sediments approaching levels in the Adjacent Open Area[1] of Lavaca Bay, why has there not been a commensurate reduction in the mercury levels in red drum and juvenile blue crab in the vicinity of these marshes? The findings from studies related to this issue can be used to evaluate the existence of site-specific conditions in the marshes where enhanced methylation and uptake can occur even in the presence of low total mercury concentration in surficial sediments.
B. Could red drum be accumulating a significant portion of their mercury burden through an uptake pathway that is not being monitored? The findings from studies related to this issue can be used to evaluate whether alternative mercury uptake pathways need to be considered in evaluating options to address elevated mercury levels in red drum, and which prey items are most useful in tracking progress towards red drum recovery.
C. Are there ongoing sources of the inorganic mercury on sediments transported into areas where conditions are favorable for enhanced methylation and uptake into the food web such as the causeway marshes? The findings from studies related to this issue can be used to determine whether additional source controls may be necessary to address movement of inorganic mercury into areas where it can be readily methylated and enter the food web.
D. Are the fundamental findings from the Mercury Reconnaissance Study conducted in 1996 (Alcoa 1996) still valid in terms of the depth of methylation and the locations in the Bay system where high rates of mercury methylation and uptake are believed to occur? The findings from

[1] The area outside of the Closed Area, which is sampled as the reference area to determine the progress of remediation efforts in reducing fish tissue mercury concentrations, has been referred to historically as the Open Area or the Adjacent Area. For the purposes of future reporting, this area is herein referred to as the Adjacent Open Area.

studies related to this issue can be used to assess whether revisions to the conceptual site model (CSM) for mercury methylation are necessary and what locations should be considered as focus areas for evaluation of possible additional actions.

Seven site-specific studies were developed to provide information to address these questions. The Fall 2015 supplemental data collection studies were submitted and approved as indicated below:

- Submitted Work Plans for Studies 1 and 3 on September 15, 2015 (Alcoa 2015b), and received USEPA approval on September 25, 2015;
- Submitted Work Plans for Studies 2, 5, 6, 7A, 7B, and 7C on September 18, 2015 (Alcoa 2015c), and received USEPA approval on Studies 2, 7A, and 7B on September 25, 2015;
- Submitted Alcoa's Response to USEPA comments on Studies 5, 6, and 7C on October 5, 2015 (Alcoa 2015d), and received USEPA approval on Studies 5, 6, and 7C on October 8, 2015;
- Submitted Work Plan for Study 4 on October 5, 2015; a Revised Work Plan was submitted on October 21, 2015 (Alcoa 2015e), and USEPA approval was received on October 8, 2015; and
- Submitted revisions to Study 7C on November 24, 2015 (Alcoa 2015f), and received USEPA approval on those revisions on December 1, 2015.

The studies are summarized in Table 1.3-1 and described in more detail in Sections 2.4, 2.6, and 2.10.

The red drum tissue collection, processing, and analysis procedures are addressed in Section 2.5 of this 2015 RAAER.

2 OVERVIEW OF OPERATION AND MAINTENANCE AND PERFORMANCE MONITORING PROGRAMS

2.1 CAPA Groundwater Extraction and Treatment System

The CAPA groundwater extraction and treatment system began full-scale operation in May 1998. The primary system components are four groundwater extraction wells, an air stripper that removes volatile organic compounds from the groundwater, and a series of carbon vessels that remove mercury. Ancillary piping, filters, pumps, tanks, and other elements comprise the rest of the system. The objective of the groundwater extraction system is to provide hydraulic control of that portion of the dissolved mercury plume that was believed to contribute over 98% of the mercury mass flux from Zone B groundwater to Lavaca Bay prior to groundwater control. A treatability test conducted in 1997 and 1998 indicated that an aggregate extraction rate of approximately 10 gallons per minute from the four extraction wells creates a cone of depression that extends parallel to the shoreline along the line of wells.

The system has operated continuously since 1998, with only minor interruptions for maintenance or troubleshooting or during power interruptions at the Point Comfort Operations (PCO) facility. Detailed information for the CAPA groundwater extraction and treatment system, including the results of investigations and system design, is provided in the CAPA Focused Investigation Data Report (Alcoa 1998) and CAPA Groundwater Treatability Study Data Report (Alcoa 1999).

Operations, maintenance, and monitoring were conducted in 2015 in accordance with the CAPA Groundwater RDR and OMMP (Appendix A of the CD). The various maintenance activities, operational checks, and sampling requirements are summarized in Table 3-3 of the RDR and OMMP. In 2015, the only non-routine maintenance activity conducted at the CAPA was the replacement of the piping that connects the extraction wells to the treatment system. This poly-vinyl chloride piping was replaced during the period of August to September 2015.

The discharge standards for the system effluent are shown in Table 3-1 of the RDR and OMMP. A summary of the CAPA groundwater extraction and treatment system performance for 2015 is provided in Section 3.1 of this report.

2.2 CAPA Offshore Surface Water Sampling

As discussed in the 2006 RAAER (Alcoa 2007a), the performance objective for this component of the OMMP was achieved in 2006, and it is no longer part of the annual monitoring program.

2.3 Routine Lavaca Bay Sediment Monitoring

A key factor in the success of the Lavaca Bay remedy is the reduction of sediment mercury concentrations through targeted sediment removal efforts, capping, enhanced natural recovery, and/or natural recovery. The purpose of the sediment monitoring program is to verify that source control and remedial measures have been effective in reducing sediment concentrations to acceptable levels.

As described in the Lavaca Bay Sediment Remediation and Long-Term OMMP (Appendix H of the CD), the sediment monitoring program was designed to evaluate surface (0 to 5 cm) sediment mercury concentrations from open water and marsh areas within the Closed Area. The boundaries of the Closed Area are defined in the Texas Department of Health's order against the taking of finfish and shellfish for consumption. The open water sediment sampling protocol has been modified over time to improve its utility. The changes are documented in the 2012 RAAER (Alcoa 2013a, Section 2.3) as well as prior RAAERs. The sample depth intervals and monitoring parameters are summarized in Table 2.3-1.

The CD requires that the open water sediment monitoring program be performed until a mean mercury concentration of less than 0.5 milligrams per kilogram (mg/kg; i.e., parts per million [ppm]) dry weight is measured in the Closed Area in 2 consecutive years (United States et al. v. Alcoa Inc. et al. 2005). This occurred in 2004 and 2005 when average concentrations of 0.293 ppm and 0.276 ppm, respectively, were measured in surface open water sediment samples from the Closed Area (Alcoa 2006a). Thus, the performance objective of the open water sediment monitoring program established in the CD has been met. However, Alcoa has elected to continue monitoring the northern half of the open water sediment sampling grid (Figure 2.3-1) on a voluntary basis as part of its ongoing effort to better understand trends in fish tissue concentrations in the Closed Area of Lavaca Bay. In 2009, Alcoa decided to adjust the open water sediment monitoring from annually to even-numbered years. However, as part of an expanded sampling effort, open water sediment samples in the northern half of the sediment sampling grid (i.e., samples matching the even-year routine sampling) were collected in 2015. Additional open water sediment sampling occurred as part of a supplemental data collection effort, as described in Section 2.4.

The CD states that the objective of the marsh performance standard is to attain an average mercury concentration in each marsh of less than 0.25 mg/kg dry weight. Monitoring is to occur annually until the remediation goals are met for two consecutive events. If the marsh sediment monitoring data attain the remediation goal for two consecutive annual events in a given marsh, monitoring of that marsh is complete, even if monitoring of other marshes continues. Marshes other than 11 and 14 are currently monitored on a voluntary annual basis in an ongoing effort to better understand trends in fish tissue concentrations in the northern part of the Closed Area of Lavaca Bay (Figures 2.3-2a through 2.3-2c).

The marsh sediment sampling protocol has been modified over time to improve its utility. Based on a review of the 2007 supplemental data presented in the Amended 2007 RAAER (Alcoa 2008b), measurements of methylmercury (meHg) and total organic carbon (TOC) were added to the analytical suite for the 2008 and subsequent marsh monitoring programs. The changes are documented in the 2012 RAAER (Alcoa 2013a, Section 2.3) as well as prior RAAERs. The sample depth intervals and monitoring parameters for annual marsh sediment are summarized in Table 2.3-1.

2.4 Fall 2015 Supplemental Data Collection Studies: Sediment Monitoring

2.4.1 Supplemental Study No. 2: Methylmercury Sampling in Open Water Sediment

The Fall 2015 Supplemental Study No. 2 (see Appendix A2) sampled select open water surface sediment stations in the northern part of the Closed Area to provide quantitative information on the meHg and TOC concentrations of sediment that could be potentially re-suspended and deposited in downgradient locations. Methylmercury, moisture content, and TOC were measured in the 28 open water sediment stations (Figure 2.4-1). These locations were chosen because they are upwind of most of the shoreline marshes, are relatively close to the marshes, and have elevated meHg concentrations based on the 2012 monitoring data. Sampling and analytical protocols for meHg, moisture content, and TOC were the same as those employed in the fall 2012 monitoring event (Alcoa 2013a).

As part of this supplemental study, the variance in the meHg results was investigated by sampling select marsh locations in triplicate. Ten marsh sediment locations selected from the annual monitoring locations were sampled, split into triplicate samples, and submitted as blind field duplicates to the laboratory for meHg and moisture content analyses. These locations were Marshes 1-1R, 1-11R, 2-5R, 3-1R, 5-1R, 5-2R, 6-2R, 6-5R, 7-1R, and 7-6R (Figure 2.4-2). These field duplicates allowed assessment of the total variance in meHg measurements due to sampling and analysis.

The analytical laboratory also performed matrix spike/matrix spike duplicate analysis on sediment samples from Lavaca Bay per the existing Quality Assurance Project Plan (i.e., the 28 open water and 10 marsh location sampling efforts included an additional 5% of samples).

2.4.2 Supplemental Study No. 4: Phase 1 Methylation Study

The Fall 2015 Supplemental Study No. 4 (see Appendix C) was designed to update the understanding of methylation processes and uptake in the Closed Area by:

- Collecting data to help identify areas of enhanced methylation within the Closed Area and guiding the design of a more comprehensive methylation study to be conducted in 2016; and
- Field testing new sampling methodologies that could be deployed in the 2016 Methylation Study.

The objectives and technical approaches are summarized below. The detailed technical approaches and methodologies provided in the approved Work Plan (Alcoa 2015e).

The Fall 2015 methylation study tested two new field sampling methods, voltammetry and Diffusive Gradient in Thin Film (DGT) devices, for potential use in the 2016 methylation study.

Voltammetry is an electroanalytical method used to determine dissolved redox chemical concentrations in the sediment porewater by measuring the current as the potential is varied. The voltammetry results are used to determine if stronger reducing conditions, which are related to higher methylation rates, exist in the marsh sediments in the Closed Area. DGT probes for meHg are a sorption device used to measure solute concentrations in sediments and water. DGT probes employ a binding agent that accumulates solutes (e.g., meHg) quantitatively after their passage through a well-defined diffusion layer (Zhang and Davison 1995). DGT data were evaluated to see if they could be correlated with meHg uptake in the sentinel organisms (e.g., juvenile blue crab) in Lavaca Bay and the sediment redox conditions of the different sampling areas.

Colocated core samples were also collected at the voltammetry and DGT sampling locations and analyzed at a high resolution to provide sediment chemistry data to compare with the redox and meHg porewater profiles provided by the voltammetry and DGT tests.

Focused sampling was also conducted in fall 2015 as part of this study to evaluate if bioturbation could be an important factor in the understanding of meHg production and uptake in Lavaca Bay sediments. Burrowing macroinvertebrates can influence meHg production and accumulation by controlling the nature of the redox conditions in the sediments; affecting diffusive fluxes of meHg from the sediments; or redistributing legacy mercury within the zones of active biological methylation in the sediments, creating the potential for methylation, mobilization, and bioaccumulation.

Study 4 sample locations are shown in the following figures:

- Figure 2.4-3: Adjacent Open Area marsh sediment samples collected at existing Adjacent Open Area juvenile blue crab stations (total mercury, meHg, TOC, and moisture content of marsh sediment);
- Figure 2.4-4: Juvenile blue crab samples (total mercury and moisture content); and
- Figure 2.4-5: Voltammetry, DGT, core chemistry (total mercury, meHg, TOC, moisture content, sulfate, and sulfide) measurements, and benthic community analysis.

2.4.3 Supplemental Study No. 5: Focused Sediment and Prey Sampling In and Near Marshes

The Fall 2015 Supplemental Study No. 5 (see Appendix B4) collected additional information in areas of potential enhanced meHg uptake to the food web based on elevated mercury in sediment and juvenile blue crabs observed in prior sampling events. Sediment samples were collected during the fall 2015 sediment monitoring program at 13 locations in or near marshes. These 13 sampling locations included:

- 7 locations in shallow water offshore of the fringe marsh in areas shown to contain abundant growth of algae;
- 3 locations in the fringe marsh near the confluence of Witco Channel and Witco Harbor;
- 2 locations on the northwestern side of Dredge Island near sampling station CLO5803; and
- 1 new location in Marsh 1 near Ditch Y (Figures 2.4-6 and 2.4-7).

Three mud crab samples were collected from the seven locations in the shallow waters where there was abundant algae growth (Figure 2.4-8). The sediment samples were analyzed for total mercury, meHg, moisture content, and TOC. The mud crab samples were analyzed for total mercury.

Sediment sampling and analytical protocols were identical to marsh sediment sampling (0- to 2-cm sediment depth interval). A piston corer was used at all locations. Mud crabs analyzed for this study were collected from oyster shells and shell clusters removed from the open bay bottom using a small oyster dredge. Composite samples consisted of 10 to 25 individual mud crabs, and sample weight ranged from 5 to 15 grams. Sample processing and analytical protocols were otherwise the same as the protocols used for juvenile blue crab samples.

2.4.4 Supplemental Study No. 6: Additional Open Water Sediment Monitoring

The Fall 2015 Supplemental Study No. 6 (see Appendix A3) collected additional open water sediment samples near MS3. Cores collected in 2007 within the Witco Channel near MS3 have elevated mercury concentrations at depth (Figure 2.4-9; see Section 3.7.4). These concentrations are notable because they could be associated with sediments that accumulated after the December 2001 to January 2002 dredging of the channel and would be expected to have relatively low concentrations based on surface sediment mercury concentrations. The 2015 core samples were designed to update the understanding of current mercury concentrations in surficial and at-depth sediments in the Witco and Alcoa channels in the vicinity of MS3 and the Witco Area.

Total mercury, meHg, TOC, and moisture content were measured on sectioned sediment cores collected at the six locations shown on Figure 2.4-9. These areas are potentially exposed to erosional/re-suspension hydrodynamic forces proximate to MS3 and the Witco Harbor. The sample collection protocol was identical to the methods used in the RI Phase 2 detailed mercury core study. The cores were sliced into a 0- to 2-cm interval, and into 15-cm intervals thereafter, to hard bottom or the depth last dredged (i.e., 2 to 15 cm, 15 to 30 cm, 30 to 45 cm, or 45 to 60 cm).

2.5 Routine Finfish and Shellfish Monitoring

The purpose of the Lavaca Bay Finfish and Shellfish OMMP (Appendix I of the CD) is to collect and evaluate data to determine whether the remediation goals established in the CD have been met. The monitoring is also conducted to investigate whether mercury levels in fish tissue have been reduced such that the overall human health risk throughout Lavaca Bay approaches that which would be present, but for the historical PCO facility. Mercury concentrations in red drum tissue are used as an indicator for risk, and the remediation goal for Lavaca Bay will be met when the mean mercury concentration of red drum collected in the Closed Area has recovered to a level that is not significantly greater than the mean level measured in red drum collected from the Adjacent Open Area. As discussed in Section 3.8.2, a rigorous statistical approach is used to compare the mercury concentrations of Closed Area and Adjacent Open Area red drum tissue samples and to determine when the remediation goal has been met.

The Lavaca Bay Finfish and Shellfish OMMP provides for the collection of information to assess short-term trends in tissue recovery and to qualitatively evaluate remedy effectiveness. Trends in concentrations of red drum and juvenile blue crab are evaluated graphically. The OMMP states that increasing trends, based on multiple annual events, indicate that the sediment remediation efforts are not effective at reducing tissue concentrations and would warrant consideration of additional remedial measures. Decreasing trends, also based on multiple annual events, indicate that the sediment remedies are having the desired effects, subject to quantitative confirmation by statistical comparison of Closed Area and Adjacent Open Area red drum tissue samples. Static or fluctuating trends indicate that multiple parameters are influencing tissue concentrations, and further monitoring, and possible consideration, of additional remedial measures may be necessary.

The average mercury concentration for red drum tissue samples from the Closed Area was higher in 2014 than in 2013. However, three samples with high mercury concentrations, including the sample with the highest concentration, had anomalously low moisture levels. The moisture content of a sample is used by the analytical laboratory in a mathematical conversion of the mercury concentration for the sample including moisture (wet weight) to the mercury concentration for the sample without moisture (dry weight). Consequently, the amount of moisture in a tissue sample can have a significant impact on the calculated dry weight mercury concentration.

A review of Alcoa's sample processing procedures did not uncover a specific reason for the unusually low moisture levels, but in an effort to prevent moisture loss from tissue samples in the future, sample storage and shipping procedures have been modified. The Standard Operating Procedures for tissue processing have been changed to reduce the amount of time between sample collection and analysis, and to require that samples which must be held overnight are kept in a freezer at 0 degrees Celsius (°C).

Red drum tissue samples were sealed in pre-weighed sample containers and were shipped (overnight) to the analytical laboratory on the same day that they were collected. Composite samples (juvenile blue crabs, killifish, grass shrimp, and mud crabs) were shipped (overnight) to the analytical laboratory on the same day that they were collected whenever possible. Composite tissue samples are composed of multiple organisms, which may be collected over consecutive days. Composite samples that were not shipped immediately were held in a refrigerator (0 to 4°C) until the organisms required to complete the sample were captured and processed. All tissue samples were analyzed for total mercury and moisture content.

During the fall 2015 monitoring event, Alcoa collected 30 red drum from 12 sampling stations in the Closed Area and 30 red drum from 10 sampling stations (three fish per station) in the Adjacent Open Area (Figures 2.5-1 and 2.5-2). In the Closed Area, three red drum samples each were collected from 8 of the 10 Closed Area stations that had been sampled in 2014. For the other two Closed Area stations sampled in 2014, only one red drum was caught at LVB5504 (on Dredge Island) and two red drum were caught at LVB5513 (on the mainland shoreline near the Bauxite docks; Figure 2.5-1). To provide the 30 Closed Area red drum samples required for annual monitoring, three fish were collected from two alternate stations in the Closed Area: two fish from CLO5806 in the Witco Harbor and one fish from CLO5817 on an oyster reef south of the Alcoa tug dock (Figure 2.5-1).

Routine annual monitoring also includes the collection of juvenile blue crab samples from established shoreline marsh stations in the Closed Area and Adjacent Open Area. Juvenile blue crabs were selected for this purpose because they exhibit a high rate of growth during the sample collection period, have a small home range, and feed predominantly on benthic detritus and algae. Juvenile blue crab concentrations reflect changes in the availability of sediment-bound mercury more quickly than red drum tissue concentrations, and the short-term trend in juvenile blue crab tissue concentration can be used as a qualitative indicator of remedy effectiveness.

During the 2015 annual monitoring event, 30 juvenile blue crab samples were collected from ten marsh stations in the Adjacent Open Area and 30 juvenile blue crab samples were collected from ten marsh stations in the Closed Area (Figures 2.5-1 and 2.5-2). The 20 stations sampled during the 2015 monitoring event were the same stations monitored during 2014. Nine juvenile blue crab samples were also collected from four stations near MS3 to supplement the annual monitoring—1 from SUP0018, 3 from SUP0023, 2 from SUP0025, 3 from SUP0027—in order to assess potential mercury uptake in this area (Figure 2.4-8).

2.6 Fall 2015 Supplemental Data Collection Studies: Finfish and Shellfish Monitoring

2.6.1 Supplemental Study No. 1: Killifish and Grass Shrimp Monitoring

The Fall 2015 Supplemental Study No. 1 (see Appendix B2) was designed to investigate two additional prey items that appear to be significant components of the red drum diet. Gulf killifish (*Fundulus grandis*) and grass shrimp (*Palaemonetes pugio*) were collected based on the following considerations:

- Killifish collected from Alcoa marshes for the 1997 Bay System and Bird Prey Item Study (Alcoa 1997a) had higher average mercury concentrations than any other prey species evaluated. They are linked to the intertidal marsh habitat by their feeding habits and life history. Killifish are a common red drum prey item species (Reagan 1985) but were not found in red drum during gut content studies conducted by Alcoa in 2011 and 2012.
- Grass shrimp collected from Alcoa marshes for the 1997 Bay System and Bird Prey Item Study (Alcoa 1997a) were found to have average total mercury concentrations that were only exceeded by the mercury concentrations of killifish, fiddler crabs, and juvenile blue crabs (from the northeastern part of the Closed Area called Zone 1 [Figure 2.5-1]). Fiddler crabs are considered a semi-terrestrial crab and are not commonly consumed by red drum. Grass shrimp commonly feed on epiphytic algae and organic detritus attached to vegetation and are a common red drum prey species (Reagan 1985; Overstreet and Heard 1978).

Prey items were collected from locations in the Closed Area where juvenile blue crabs had exhibited higher than average mercury concentrations in previous sampling efforts (Figure 2.4-8). A composite killifish sample consisted of between 1 to 5 fish with a minimum sample weight of 5 grams. A composite grass shrimp sample consisted of 50 or 100 individual shrimp with a minimum sample weight of approximately 15 grams. Prey item samples were processed and analyzed for total mercury and moisture content according to Alcoa Standard Operating Procedures (Alcoa 1997b, 2003, 2005b).

Thirty composite grass shrimp samples were collected from ten Closed Area locations, and five samples were collected from five Adjacent Open Area locations (Figures 2.4-8 and 2.6-1). Nineteen composite killifish samples were collected from 11 Closed Area locations, and four samples were collected from four Adjacent Open Area locations.

2.6.2 Supplemental Study No. 3: Qualitative Gut Content Study

The Fall 2015 Supplemental Study No. 3 (see Appendix B3) provided qualitative information on the prey items consumed by the red drum collected for routine monitoring. This information will help Alcoa assess spatial and seasonal trends in consumption of prey items that may have different mercury contents.

Alcoa identified and documented the gut contents of all of the red drum sampled for the annual monitoring study. These data provide a snapshot of what the red drum were feeding on at the time the study was conducted. Conducting gut content surveys on all future sampling events will provide a database of red drum feeding trends over time.

The survey was conducted according to Benchmark Standard Operating Procedure SOP-BESI-515. The stomach of each red drum that was caught was removed, and its contents were placed on a clean cutting board. The items in the gut were identified, photographed, weighed, and documented on the gut content datasheet. Gut contents were not analyzed for mercury.

2.7 Dredge Island Inspections

An Engineering Evaluation/Cost Analysis (EE/CA) for a non-time critical removal action was conducted by Alcoa for the Dredge Island in 1997 (Alcoa 1997c). A streamlined risk evaluation, prepared as part of the EE/CA, indicated that mercury from Dredge Island could enter Lavaca Bay via erosion of mercury-contaminated soils. Based on that finding, the EE/CA documented the selection of a removal action that would minimize the potential of the release of mercury from the island due to either uncontrolled erosion during normal storm events or due to the effects of more intense storms (e.g., hurricanes).

The removal action was conducted between 1998 and 2001, and is referred to as the Dredge Island Stabilization Project. The project included relocating the contents of the Dredge Materials Placement Areas (DMPAs) that contained elevated levels of mercury (approximately 523,000 cubic yards) into the Gypsum Placement Areas (GPAs). In addition, the containment dikes surrounding the GPAs were raised so that they would not be overtopped during a 100-year storm event (i.e., a storm event that has a probability of occurring once within 100 years). This required increasing 10,700 linear feet of dike to an approximate elevation of 30 feet mean sea level. As part of this work, most of the marshes on the north end of the island were removed. Erosion protection and runoff control structures were also installed on the island. The final design and as-built drawings for the Dredge Island Stabilization Project are contained in the *Dredge Island Removal Action Plan, Volume 4 – Phase 1 Dredge Island Stabilization Completion Report* (Alcoa 2002).

The performance objective for the Dredge Island Stabilization Project is to interrupt the potential direct exposure pathway of contaminants in soils and sediments from Dredge Island as a result of a significant storm event or uncontrolled erosion during storm water runoff. The removal action and reconfiguration of Dredge Island was designed to achieve this objective through engineering means. The remaining tasks for Alcoa include preservation of the integrity of the reconfigured island through periodic inspections and maintenance and/or repairs, as needed.

The requirements provided in the OMMP for Dredge Island include inspection of the following primary components:

- The access bridge from the mainland to the northern shore of Dredge Island;
- The 10,500 lineal feet of the Alcoa confined disposal facility (CDF) containment dikes;
- The storm protection on the Alcoa CDF dike exterior, including the armor layer, under-layer, and dike toe protection;
- The gravel erosion protection on the exterior dike slopes above the armor protections and the interior dike slopes above 26.5 feet (NGVD [National Geodetic Vertical Datum] 1929);
- The 25-foot-long concrete emergency spillway;
- The two dredge decant structures including the discharge structures;
- The two water stops installed in the Calhoun County Navigation District (CCND) CDF dikes; and
- The road on the Alcoa CDF dikes.

The access bridge was damaged during Hurricane Claudette in 2003, and subsequent Dredge Island inspections have not included detailed inspections of the bridge. However, Alcoa continues to maintain signage and navigational lighting to prevent access to, and collision with, the bridge.

Several Dredge Island maintenance issues were identified in the First Five-Year Review Report (USEPA 2011). These issues were addressed during a maintenance event conducted in 2011, as described in the 2011 RAAER (Alcoa 2012b). Inspections conducted in 2014 indicated the need to perform maintenance on Dredge Island, as discussed in Section 3.3.

2.8 CAPA Soil Cap Inspections

Soils contaminated with mercury greater than the applicable risk-based values were identified during the RI at the CAPA. These soils were generally associated with the area to the west of the former Building R-300 and encompassed an area of approximately 1.8 acres. The RAO for CAPA soils was to reduce the future exposure potential of site workers to mercury in soils at the CAPA. A clay/gravel cap was installed, which was graded for storm water drainage, and the storm water management structures were modified to collect only surface runoff. The grading objective was met by compaction of a clay sub-grade over the entire area, from approximately several inches thick at the perimeter to 1.2 feet thick at the center. A 6-inch crushed limestone material was then placed over the compacted clay sub-grade. To limit usage of the area by Plant and contractor personnel, 3-by-6-feet warning signs were placed on the north and west sides of the capped area. In addition, a memorandum was distributed to Plant employees to inform workers of the upgrades made to the area, the restrictions on the capped area, and the disciplinary actions for not complying with the restrictions. Additional information is contained in the CAPA Soils RDR and OMMP (Appendix F of the CD). A similar memorandum is distributed annually for review by Site workers.

An inspection and maintenance program was developed for the capped area, as described in the RDR and OMMP (Appendix F of the CD). This program consists of quarterly inspections and maintenance as required. The main components of the inspection are:

- Cap integrity (e.g., signs of vehicular traffic, burrowing, erosion);
- Vegetation growth;
- Signage integrity (e.g., upright and legible);
- Storm drains free of debris; and
- No equipment or waste storage.

All items noted on the inspections are corrected as soon as practicable.

2.9 Witco Area Inspections

The containment of DNAPL-containing polycyclic aromatic hydrocarbons (PAHs) and the capping of PAH-impacted soils at the Witco Area were components of the remedy as described in the CD. DNAPL and sediments/soil visibly contaminated with PAHs have been observed at several locations at the Witco Area during previous investigations. In addition, surface soils in portions of the Witco Area exhibited elevated concentrations of PAHs that exceeded RAOs associated with potential on-site worker exposure to surface soils. Additional information is contained in the Former Witco Area DNAPL Containment System and Witco Area Soils RDR and OMMPs.

Construction was performed during the period of March 8 to December 29, 2006. The following remedial construction activities were performed:

- Construction of a new drainage channel, including the removal of visually impacted sediments;
- Construction of a 100-foot-long soil attapulgite slurry wall;
- Construction of a soil cap in the former tank farm area; and
- Removal of an oil/water separator and construction of a soil cap in the former processing area.

A Construction Completion Report (Alcoa 2007b) was submitted in June 2007, and operations and maintenance activities were initiated in July 2007, as follows:

- Quarterly inspections (for 2 years, annually thereafter) of the drainage channel;
- Quarterly inspections of the soil caps at the former tank farm and oil/water separator;
- Placement of signage regarding prohibition of activities at the site (a management memorandum was developed and distributed at the facility);
- Inspections of the DNAPL collection sump (monthly for 6 months, quarterly thereafter until 2 years after construction, frequency to be reviewed at that time based on findings); and
- Removal of any DNAPL that collects in the sump.

A memorandum was distributed to Plant employees to inform workers of upgrades made to the area, the capped area restrictions, and the disciplinary actions for not complying with the restrictions. A similar memorandum has been submitted annually for review by Site workers.

2.10 Assessment of Sediment and Mercury Transport into the Causeway Cove Marsh Areas

The Fall 2015 Supplemental Study No. 7 (see Appendix D1 to D3) was designed to increase understanding of sediment and mercury transport to the area north of Dredge Island from the Witco and Alcoa channels and the Witco Cut. The information developed from these studies will assist in developing and evaluating options to address elevated mercury levels in red drum in the Closed Area going forward. The work is intended to build upon the significant body of information developed during the RI phase of the project as well as prior remedial actions implemented at the site. The work consisted of three studies, overviews of which are provided in the following subsections.

2.10.1 Supplemental Study No. 7A: Rhodamine Dye Tracer Study

This study informed the understanding of flow patterns and potential sediment transport routes in the Witco and Alcoa channels, the shallow water north of Dredge Island, and in the Causeway Cove area. Rhodamine dye was released in the Witco Channel and measured for 48 hours in the channels, the shallow water north of Dredge Island, and the Causeway Cove area. The measurements consisted of continuous monitoring at three locations in the Causeway Cove area as well as manual transects that were run twice a day (once in the morning and once in the afternoon) over 2 days (Figure 2.10-1).

2.10.2 Supplemental Study No. 7B: Witco Turbidity and Velocity Study

This study evaluated the potential pathways and sediment transport of water flowing between the Alcoa and Witco channels and the Causeway Cove area. Turbidity and water velocity were monitored continuously at three locations north of Dredge Island and two locations within the Witco and Alcoa channels (Figures 2.10-1 and 2.10-2). The three northern locations were colocated with Rhodamine dye monitoring stations. Turbidity data were collected at these three northern locations for 1 week before fouling of the monitors prevented accurate measurements. Water velocity data were collected at two of the three northern stations for 2 months and at the third station for 1 month. Full water-column velocity profiling and turbidity monitoring were conducted for a 48-hour period at the two locations within the Witco and Alcoa channels. These data were collected to evaluate the sources of sediment moving from the channels to the Causeway Cove area.

2.10.3 Supplemental Study No. 7C: Water Column Mercury Study

This study informed the understanding of mercury concentrations and mercury transport in the Witco Harbor and areas north and east of Dredge Island. Five Teledyne ISCO sampling stations were deployed at existing structures in the causeway area, the Alcoa and Witco channels, and the channel marker south of Dredge Island (Figure 2.10-3). Water samples to analyze for total mercury and TOC measurements were collected during the course of four distinct flow-and-ebb tidal cycles.

In the Witco Harbor, the sediment and mercury re-suspension generated by movement of fully loaded barges was assessed. Water samples were collected within the sediment plume generated by the barge movement, and water current and turbidity transects were conducted across the mouth of Witco Harbor.

3 MONITORING RESULTS

3.1 CAPA Groundwater Extraction and Treatment System

The primary monitoring results for the CAPA groundwater extraction and treatment system are provided in Tables 3.1-1, 3.1-2, 3.1-3, 3.1-4, and 3.1-5. Selected potentiometric data are shown on Figures 3.1-1, 3.1-2, 3.1-3, and 3.1-4. The potentiometric contours for the areas near Lavaca Bay utilize a surface water elevation for Lavaca Bay measured at a tidal gauge (CA Bay) located south of the recovery wells. In other words, contouring assumes that Lavaca Bay is in hydraulic connection with Zone B, as has been demonstrated previously due to the deep dredging of the Alcoa Channel. Graphs showing the concentrations of mercury and carbon tetrachloride in samples from the recovery wells over time are shown on Figures 3.1-5 and 3.1-6. The concentrations of mercury and carbon tetrachloride in the samples from the recovery wells have decreased over time since the groundwater extraction and treatment system has been operating. Field records and logs from system operational checks and maintenance activities are kept in project binders and maintained in the project filing system.

The data collected from the treatment system indicate that it is operating efficiently and as designed. Hydraulic control has been achieved and appears to be effectively reducing the potential for migration of mercury-impacted groundwater in Zone B west of former Building R-300 to Lavaca Bay. This conclusion is based on the evaluation of potentiometric surfaces created from water-level data collected from pumping and observation wells located at the CAPA. Concentrations of mercury and volatile organic compounds in system effluent samples were all less than the discharge standards listed in the RDR and OMMPs. Therefore, all performance standards were met during 2015.

3.2 CAPA Offshore

The performance objective for this component of the OMMP was achieved in 2006, and it is no longer part of the annual monitoring program.

3.3 Dredge Island Inspections

Dredge Island inspections were conducted quarterly throughout 2015. The inspection records are provided in Appendix E. The inspections indicate that the island is in stable condition and the performance objectives are met. Erosion of the interior side slopes of the CDF caused by wave action of water in the CDF continues to be the most significant maintenance issue, but no repairs are required at this time. Vegetation on the dikes and armor stone of Dredge Island was removed during 2015 to address this ongoing maintenance issue.

Inspections and maintenance will continue at the frequency described in the RDR and OMMPs.

3.4 CAPA Soil Cap Inspections

Quarterly inspections were conducted during 2015 as required by the RDRs/OMMPs. The inspection records are contained in Appendix F. The most common maintenance issue is the presence of vegetation, which must be controlled to maintain cap integrity.

Inspections and maintenance will continue at the frequency described in the RDR and OMMPs.

3.5 Witco Area Inspections

Inspections were conducted at the Witco Area in 2015 as required by the RDRs and OMMPs. Inspections records are contained in Appendix G.

The major conclusions of the 2015 inspections are as follows:

- No DNAPL has been observed in the collection sump since its installation. Several methods have been used to detect the presence of DNAPL, including the use of an interface probe, a weighted bailer, and weighted rope (to check for visual evidence of dark or oily substances).
- The soil caps are functioning well and no damage has been observed. Mowing is performed on a regular basis.

Inspections and maintenance will continue at the frequency described in the RDR and OMMPs.

3.6 Verification of Site Conditions and Land Use

Site conditions and land uses within the Site remain consistent with those described in the ROD. The Texas Department of Health order against the taking of finfish and shellfish within the Closed Area remains current. Recently, Alcoa has announced that aluminum refining operations at the facility will be curtailed as of June 2016. The action of the curtailment will not affect future land use at the facility, which will remain industrial in nature. The curtailment will reduce marine operations in Lavaca Bay near the facility.

As described in the 2013 RAAER (Alcoa 2014), industrial development projects at and adjacent to the Calhoun Port Authority harbor (previously called the Calhoun County Navigation District or CCND) have been proposed in the past. These projects have included the widening and deepening of the Matagorda Ship Channel and various other liquefied natural gas and energy-related projects. Discussion of these projects with the various stakeholder entities indicated the potential for project-related dredging activities to occur within the footprint of areas known to contain buried sediments with residual mercury contamination associated with the Site. As of the date of this RAAER, Alcoa has not been made aware of any project that would result in the disturbance of mercury-contaminated sediments during 2016.

3.7 Sediment Trends and Observations

3.7.1 Spatial and Temporal Trends in Total Mercury Sediment Concentrations from the Open Water Closed Area

The long-term sediment monitoring program includes the collection of samples from open water and marsh sediment within the Closed Area. Open water sampling has focused in the northern part of the Closed Area since 2004. Figure 1 in Appendix A1 shows the spatial distribution of mercury results for 2015. Starting in the Alcoa Channel and moving counter-clockwise, the sediments east of Dredge Island have concentrations that range from 0.13 mg/kg to 0.48 mg/kg, with an average of about 0.28 mg/kg, excluding one outlier near the bauxite docking area (station SMP0048, mercury concentration equal to 2.88 mg/kg). The three Witco Harbor stations have similar concentrations, with an average of 0.29 mg/kg. The open water sediment concentrations are lower in the Causeway Cove area, with concentrations ranging from 0.08 to 0.33 mg/kg and an average of 0.17 mg/kg. Along the north and west shoreline (not including the marsh data) of Dredge Island, some relatively higher mercury concentrations are present, including a maximum of 0.429 mg/kg (station SUP0107) and an average of 0.24 mg/kg. However, concentrations decline once west of Dredge Island, with a range of 0.05 to 0.2 mg/kg and an average of about 0.1 mg/kg.

To assess the trends in the open water sediment mercury concentrations, the Closed Area was divided into ten sub-areas as shown on Figure 3.7-1. This subdivision is an attempt to take account of the spatial pattern in concentration and to recognize the possibility that recovery could vary across the Closed Area, depending on proximity to the original source locations and the impact of background concentrations where levels are approaching these concentrations. Surface sediment sampling depths within the sub-areas were modified over the years (Table 2.3-1). Total mercury concentrations do not show significant variability between 0 to 2 cm and 0 to 5 cm depths (Figure 3.7-2) and are thus considered comparable for trend analyses.

Figure 3.7-2 shows trends in the surface sediment mercury concentrations for these ten sub-areas. No marsh data are included in this analysis, and the trends observed in the marshes are discussed separately below. Most of the sub-areas have been recovering at half-times[2] in the range of 7 to 13 years. This includes Alcoa Channel, Witco Channel, Witco Harbor, MS3, North Dredge Island, Causeway Cove East, and West Dredge Island, although the trend for West Dredge Island shows

[2] Half-time is the time required for the average mercury concentration to decrease to half of its initial value. Half-times are calculated for a best fit line through the data assuming an exponential decay. The half-time is equivalent to log(2) divided by the mercury decay constant for each sub-area.

significant variability. Causeway Cove West, Northwest Dredge Island, and the West Open Water have been recovering more slowly. It is likely that the slower recoveries in Causeway Cove West and West Open Water reflect the relatively low concentrations in those two regions. The rate for Northwest Dredge Island appears to reflect an absence of recovery prior to 2007 and recovery since then. The half-time is significantly shorter (12 years; Figure 3.7-3) when using just the data since 2007.

3.7.2 Spatial and Temporal Trends in Total Mercury Sediment Concentrations from Marshes

Nine marshes were sampled in 2015 (Marshes 1, 2, 3, 5, 6, 7, 14, 15, and 19) to assess total and meHg concentrations. The results are shown in Appendix A1. All of the marshes except for Marshes 7 and 15 had met the RAO of 2 consecutive years with less than 0.25 mg/kg total mercury by 2014[3] (Alcoa 2015). The 2015 data indicate that these last two marshes have now reached the RAO, with Marsh 7 at 0.21 mg/kg and Marsh 15 at 0.02 mg/kg (Table 3.7-1). Similar to 2014, Marsh 19 continues to have one outlier; when that is removed, the average is below the RAO. The 2015 average total mercury concentrations in most marshes are below 0.1 mg/kg.

Half-times were calculated for the marshes using all available data (i.e., no outliers removed except for one sample in 2010 in Marsh 1; Figures 3.7-4a through c). Most have been recovering, with half-times ranging from 3 to 13 years. The marshes in the Causeway Cove area (Marshes 1, 2, and 3) have been recovering more slowly. Marsh 1 has shown essentially no recovery (half-time of 231 years). These marshes have average mercury concentrations of 0.1 mg/kg or less. Marshes 6 and 19 contain a wide range of concentrations, and this variability compromises trend analysis. The presence of high concentrations at some locations in these marshes could indicate the potential for these areas to be ongoing sources of mercury to Lavaca Bay.

3.7.3 Methylmercury Patterns in Surface Sediments

Methylmercury was measured in samples of the top 2 cm of sediment for 3 of the last 6 years (2011, 2012, and 2015) and only in the fall, which is not the period of peak methylation based on the findings from the Mercury Reconnaissance Study (Alcoa 1996). It was measured in earlier years, but at a different depth increment (0 to 5 cm). Results for the stations that had data for the last 3 years sampled are shown on Figures 3.7-5a through 3.7-5c. No open water samples were taken in 2011. The results indicate no consistent spatial patterns, though the highest values tend to be in the northeast portion of the Closed Area. Examining these same data normalized for organic carbon (OC; Figures 3.7-6a through 3.7-6c) shows consistently elevated concentrations in Causeway Cove open water sediments and in the

[3] Outliers in the data sets had been removed for the RAO assessment. They were identified using the Dixon-Q test, which is appropriate for small data sets. The data set for each marsh was tested within each year for outliers, with a Q-table level of confidence of 99%.

east shore marshes. The relatively high values in the Causeway Cove open water sediments mean that these sediments could be important to the marshes if resuspension, transport, and deposition produce a significant pathway. That issue will be further explored in the Spring 2016 Methylation Study.

Carbon-normalizing the marsh mercury concentrations provides some insight to the relative importance of the different marshes as sources of mercury to the food web. The dose at the base of the food web is defined by the carbon-normalized concentrations because consumption is keyed to carbon (Figure 3.7-7). Large variations in concentration exist, but generally the highest concentrations in 2015 occurred in the more northerly marshes (1 to 6), particularly in the Causeway Cove marshes (1 to 3). This pattern suggests that food web uptake may be greatest in these marshes, which is consistent with the spatial patterns in mercury measured in juvenile blue crab (see Section 3.9).

Ten marsh locations (see Appendix A2) were sampled and analyzed for meHg in triplicate to assess the total variance in meHg concentrations due to sampling and analysis. Variability between samples was low, with an average difference from the mean of 17% for both minima and maxima (Table 3.7-2). The largest variability was found at Marsh-2-5R (Figure 2 of Appendix A2), with the maximum and minimum concentrations 43% greater and 50% less than the mean value for the station. In general, as concentrations increase, a slight reduction in variability is seen, with the three highest concentration stations—Marsh-6-2R, Marsh-5-5R, and Marsh-3-1R—having the lowest percent difference from the mean.

3.7.4 Down-core Profiles of Total and Methylmercury in Depositional Areas

Cores were collected in 2007 within the sediments deposited in the Witco Channel near MS3 since it was last dredged in the period of December 2001 to January 2002. Several of these cores have elevated mercury concentrations at depth and peak 30 to 90 cm below the sediment surface (Figure 2.4-9 and Figures 3.7-8a through 3.7-8c). The pattern in the cores suggests that high concentration sediments were laid down and gradually buried. The source of the high mercury concentrations is unknown, but a reasonable hypotheses is that high concentrations along the wall or slope of the channel eroded into the channel shortly after the dredging event. If true, mercury-containing sediments in the areas bordering the channel represent a potential ongoing source of mercury. Sampling was conducted in 2015 to supplement the data set from the 2007 study (see Appendix A3).

Figure 2.4-9 indicates the locations sampled for down-core mercury sediment concentrations in 2015, and vertical profiles of total mercury and meHg are on Figures 3.7-9a through 3.7-9c and 3.7-10a through 3.7-10c, respectively. Results for 2015 are similar to those in 2007, with many of the cores showing increasing mercury trends at depth. These results provide further evidence of a mercury source in the vicinity of the MS3 area.

3.8 Red Drum Recovery

This section provides an evaluation of red drum mercury monitoring data, including a review of temporal trends and a statistical comparison of mean red drum concentrations in the Closed and Adjacent Open Areas.

3.8.1 Closed Area Red Drum Trends

The mean mercury concentrations each year in red drum tissue samples collected during fall monitoring events since 1997 are provided in Table 3.8-1, and box-and-whisker plots[4] of the data are shown on Figure 3.8-1. These plots provide a visual sense of the spread and skewness and a qualitative way to visually compare the sample sets among years. As shown on Figure 3.8-1, each year includes a wide range of concentrations, and there is considerable overlap of concentrations among the years.

The geographic distribution of 2015 red drum mercury concentrations is illustrated on Figure 3.8-2. The highest concentrations were mostly found in the Alcoa and Witco channels and in Causeway Cove. This pattern holds when multiple years are grouped, as shown on Figure 3.8-3 for 2010 to 2015 and on Figure 3.8-4 for 2002 to 2015. The robustness of this geographic pattern indicates that the greatest exposure occurs in the channel areas and Causeway Cove, and it is likely that this exposure accounts for the higher Closed Area average concentration in comparison to the Adjacent Open Area average concentration. This correlates well with the finding that the highest mercury concentration in juvenile blue crabs occurs in the channel area from MS3 north to Causeway Cove (see Section 3.9). These areas contain excellent fish and crab habitat, probably produce an abundance of prey, and therefore hold fish better than areas with poorer habitat.

In previous years, the red drum concentration distribution was divided into high (>1.75 mg/kg total mercury), intermediate, and low (<0.5 mg/kg total mercury) groups that presumably reflected different sub-populations of fish. The low group concentrations mirrored those of Adjacent Open Area red drum and were presumed to be reflective of Adjacent Open Area fish that ventured into the Closed Area and were caught there. This presumption was supported by breaks in the slope of the concentration distribution. However, for this year's data, a clear separation of the concentration distribution is not evident (Figure 3.8-5). This year's analysis focused more on the geographic distribution of concentrations within the Closed Area, which seems to provide additional insights regarding exposure patterns.

[4] Box-and-whisker plots are a way to display the distribution of concentrations obtained each year and show the median, the range between the 25th and 75th percentile highest values (defined by the box and called the Interquartile Range [IQR]), and the highest and lowest values that fall inside limits defined by 1.5 times the IQR plus or minus the 75th or 25th percentile values (shown by the whiskers). Values beyond those limits are displayed as individual points.

Closed Area red drum mercury concentrations show no consistent trend over the last 12 or more years (Figure 3.8-6). Year-to-year variability and what appear to be trends over a few years likely reflect noise due to factors such as variations in diet, bioenergetics, movement, and intermixing of sub-populations. The lack of a long-term trend means a lack of a long-term trend in the diet of these fish, as diet is the dominant source of red drum mercury.

To provide a perspective on how the Closed Area red drum mercury concentrations compare to those of the Adjacent Open Area, the 2015 average concentration at each capture station in the Closed Area is shown as a ratio to the average of all samples from the Adjacent Open Area (Figure 3.8-7). Ratios in the range of 3 to 4 are characteristic of locations along the eastern Closed Area from Causeway Cove south through the Alcoa Channel. Lower ratios are characteristic of more southern and western locations. The location on the west side of Dredge Island is within a factor of two of the Open Area.

The geographic patterns of Closed Area red drum mercury concentrations provide evidence that the key to reducing mercury concentrations lies in reducing prey mercury concentrations along the eastern corridor from Causeway Cove south to approximately MS3 at the northern end of the Alcoa Channel. Insights into conditions along this corridor come from the sediment coring near MS3 (Section 3.7.4), juvenile blue crab mercury data discussed in Section 3.9, studies on mercury sources and fate and transport discussed in Section 3.12, and studies on methylation discussed in Section 3.13.

3.8.2 Statistical Comparison of Mean Red Drum Mercury Concentrations in the Closed and Adjacent Open Areas

In accordance with the methods prescribed in the OMMP, statistical analyses were conducted to evaluate whether to reject the hypothesis that in 2015 the Closed Area red drum mercury concentrations have reached levels statistically indistinguishable from the Adjacent Open Area. The hypothesis is stated as follows:

$$\text{Null Hypothesis: } [Hg_{\text{Closed}}] = [Hg_{\text{Open}}] \text{ or } [Hg_{\text{Closed}}] - [Hg_{\text{Open}}] = 0$$

$$\text{Alternative Hypothesis: } [Hg_{\text{Closed}}] > [Hg_{\text{Open}}] \text{ or } [Hg_{\text{Closed}}] - [Hg_{\text{Open}}] > 0$$

To support the test, the OMMP specifies the following:

- Sample up to 30 red drum each from the Adjacent Open Area and Closed Area for mercury analysis. Due to logistical constraints, this target number may not be achievable. As long as the total sample sizes from each area are reasonably close to the target, the statistical test can accommodate the variability from the ideal target sample size.
- Evaluate assumptions of normality using normal quantile plots and a Kolmogorov-Smirnov goodness-of-fit test. Evaluate equality of variance using a Bartlett test.

- Transformations to the data should be made as appropriate. If the data are better fitted to a log-normal distribution, a logarithmic transformation may be appropriate prior to conducting the means testing. Quantile plots and a Kolmogorov-Smirnov goodness-of-fit test will be used to determine whether the untransformed or transformed data are more appropriate for use in the means test.

- If data are normally distributed, conduct a parametric means test (t-test). If the data are not normally distributed, conduct a non-parametric means test (Wilcoxon/Mann-Whitney or equivalent).
- Conduct a post-hoc power analysis using the variance, mean differences, and sample size from the data to establish the event-specific decision error rates.
  - If necessary, discuss deviations from the statistical test assumptions.
  - For years that [Hg_{Closed}] > [Hg_{Open}], the post-hoc power analysis will not inform the decision making.
  - For years when [Hg_{Closed}] = [Hg_{Open}], the post-hoc power analysis will provide the probability that a false positive error might have been made. To ensure that a Type II error has not been made when the null hypothesis is not rejected, statistical test assumptions should be met and the test power should be greater than 95%.

Sixty red drum tissue samples were analyzed for mercury in 2015, 30 from the Closed Area and 30 from the Adjacent Open Area (see Appendix B1 for details on the sampling and individual results). The conformance of the distributions of the two 30 sample sets with a theoretical normal probability distribution was evaluated visually and statistically.

Cumulative probability plots of the sample sets are shown on Figure 3.8-5 using arithmetic (left) and log scales (right) for the data. Both sets plot as reasonably straight lines for both scales, and the better conformance to normal or log-normal distributions is not obvious. Goodness-of-fit tests (Shapiro-Wilk and Kolmogorov-Smirnov) indicate that the data better track a normal distribution. Thus, the data were not transformed for the statistical testing.

The equality of the variance of the Adjacent Open Area and Closed Area was assessed using a Levene test, which is a modern replacement for the Bartlett test. This test rejected the hypothesis of equal variance ($p = 1.8 \times 10^{-6}$).

Because both sample sets conform to normally distributions, but with differing variance, the hypothesis of equal means was evaluated using a t-test and the non-parametric Mann-Whitney U test. Both tests indicate that the mean of the Closed Area samples is significantly higher than the mean of the Adjacent Open Area samples (Table 3.8-2; $p<0.001$). The RAO of having mean mercury concentrations in the Closed Area and the Adjacent Open Area be comparable has not been achieved.

3.9 Juvenile Blue Crab Recovery

Juvenile blue crabs are monitored to evaluate recovery. They are useful in this regard because they reflect exposure conditions in the vicinity of where they are captured and they respond rapidly to changes in exposure. Moreover, they are an important prey for red drum and provide an understanding of mercury trends in likely red drum prey.

3.9.1 Temporal and Spatial Trends in Juvenile Blue Crab Averages

Box and whisker plots of the annual juvenile blue crab data of the Closed Area and Adjacent Open Area (Figure 3.9-1) show downward trends evident in narrowing distributions and declining median and maximum values. In 2015, the Closed Area data exhibit the smallest spread on record and the lowest mean and maximum. The mean is 0.1 mg/kg, which is about half of the value characteristic of the period from 2006 to 2011 and twice the 2015 mean for the Adjacent Open Area.

Mercury concentrations in juvenile blue crab exhibit a geographic pattern, as shown on Figure 3.9-2. The highest concentrations are found in the Causeway Cove marshes, north of Dredge Island, near Witco Harbor, and around MS3. The areas that contain the highest concentrations of juvenile blue crab coincide with the areas that had the highest red drum concentrations, as discussed in Section 3.8.1. The lowest concentrations of 2015 juvenile blue crabs (< 0.1 ppm total mercury) were found in the southern part of the Closed Area.

Ratios between 2015 Closed Area blue crab concentrations and the 2015 Adjacent Open Area average provide a perspective on the geographic pattern (Figure 3.9-3). The highest ratios are in the corridor from Causeway Cove to MS3. These ratios, which mostly fall between 3 and 4, are similar to the ratios for red drum discussed earlier and shown on Figure 3.8-7. Further south and west, the ratios tend to be lower. The lowest ratio was found on the western side of Dredge Island, closest to the Adjacent Open Area. Red drum prey should have ratios that match red drum, and ratios for juvenile blue crab are evidence that Closed Area red drum likely feed and accumulate mercury mostly from the Causeway Cove to MS3 corridor.

The geographic pattern in juvenile blue crab concentrations suggests that temporal trends may exhibit a pattern that is not evident when tracking the Closed Area as a whole. Therefore, trends at individual stations were examined.

3.9.2 Trends at Individual Juvenile Blue Crab Stations

Juvenile blue crab concentrations within the Closed Area show declining mercury concentration trends at most stations (Figures 3.9-4a through 3.9-4d). However, the Witco Harbor, Marsh 19, and Marsh 1 and 2 stations remain relatively high, with mercury concentrations near 0.2 mg/kg, and show little decline in recent years. This further suggests that these areas likely account for the levels and lack of trend in Closed Area red drum.

Juvenile blue crab mercury data collected in the vicinity of Marsh 15 (near the former Marsh 14 area) are significantly lower than in years prior to the Marsh 14 removal in 2013 (Figure 3.9-4c). The step change in concentrations indicates a benefit due to remediation of the adjacent Marsh 14 and illustrates the rapid response of juvenile blue crab to changes in exposure.

3.10 Mercury in Other Prey Species

Red drum and other predator fish consume a variety of prey. Juvenile blue crabs are used as a surrogate for all prey based on abundance, home range, feeding strategy, and the fact that they are an important prey item for red drum. Other prey have been occasionally monitored over the course of the project, and several of these (grass shrimp and killifish) were resampled in 2015 (see Appendix B2). Samples were collected and analyzed in the vicinity of a number of the juvenile blue crab monitoring locations.

3.10.1 Characteristics of Additional Prey Species

Killifish collected from Alcoa marshes for the 1997 prey item study (Alcoa 1997a) had higher average mercury concentrations than any other prey species evaluated. Killifish are linked to the intertidal marsh habitat by their feeding habits and life history. The fish typically live more than one season, and some adult fish may be 2 to 3 years of age. The high levels of mercury found in killifish in the Closed Area may be the result of this extended exposure period. Killifish feed throughout the water column, consuming small fish, insects, benthic algae, and crustaceans. They share benthic algae and organic detritus with juvenile blue crabs but also prey on small organisms living in the water column. Literature indicates killifish are a common red drum prey species, but they have been rarely found in the stomachs of red drum collected by Alcoa for annual fall monitoring. Killifish may be less available to red drum during the fall when Alcoa collects annual monitoring samples. Killifish may be found at all marsh sample stations sampled by Alcoa, but they are more concentrated around pools and washouts along the shoreline. Shoreline pools usually hold water during low tide and provide a refuge for small fish.

Grass shrimp collected from Alcoa marshes for the 1997 prey item study (Alcoa 1997a) were found to have average total mercury concentrations that were less than the mercury concentrations of killifish, fiddler crabs, and blue crabs. (Fiddler crabs are considered semi-terrestrial crabs and are not commonly consumed by red drum.) Grass shrimp commonly feed on epiphytic algae and organic detritus attached to vegetation. Grass shrimp are a common red drum prey species, especially for immature fish, but they have been observed in the stomach contents of mature fish (20 to 28 inches total length) collected by Alcoa for their annual monitoring study and are likely to be found at all Alcoa marsh sample stations.

Mud crabs collected from shell hash and coarse sediment bottom areas for the 1997 prey item study (Alcoa 1997a) were found to have average total mercury concentrations similar to juvenile blue crabs. Mud crabs are common red drum prey items that prefer to live on algae-covered surfaces offshore of marsh areas.

3.10.2 Results of 2015 Prey Item Studies

Grass shrimp samples from Marsh 1 in the Causeway Cove had the highest levels of total mercury (Figure 3.10-1). Grass shrimp collected from stations CLO5802 (between Marsh 1 and Marsh 2) and LVB5508 (near Witco Marsh) had the second and third highest levels of total mercury, respectively. Mercury concentrations for grass shrimp from stations CLO5814, CLO6802, and LVB5513 (all east of Dredge Island on the southern end of the Alcoa Channel) were bracketed by the mercury concentrations of samples from Adjacent Open Area stations (Figure 3.10-1; station numbers for Adjacent Open Area stations are marked with the letter A). These results suggest that the availability of mercury at these three Closed Area stations is similar to mercury availability at the Adjacent Open Area stations sampled for this study.

Similarly, killifish samples from Marsh 1 in Causeway Cove had the highest levels of total mercury (Figure 3.10-2). Killifish collected from stations CLO5802 and CLO5803 (on the northwest tip of Dredge Island) had the second and third highest levels of total mercury. Mercury concentrations for all killifish samples from station LVB5504 (northeast of Dredge Island near the site of the Marsh 14 removal) were bracketed by the mercury concentrations in killifish from Adjacent Open Area stations (Figure 3.10-2; station numbers for Adjacent Area stations are marked with the letter A). Again, these results suggest that the availability of mercury at station LVB5504 is comparable to mercury availability at the Adjacent Open Area stations sampled for this study.

Mud crabs collected in the vicinity of the Causeway marshes and Witco Harbor had similar concentrations at all stations (Figure 2 of Appendix B4). Three of the seven locations sampled are comparable in location to 2015 juvenile blue crab sampling stations: juvenile blue crab stations CLO5802, LVB5508, and Marsh 1-1R; and mud crab stations CLO7006, CLO7014, and CLO7005, respectively. Mercury concentrations between both species at all three stations are similar in concentration (Figure 3.10-3), indicating prey items that inhabit marsh and algae-covered sediments north of Dredge Island likely have comparable mercury exposure.

3.10.3 Historical Prey Item Trends

Prey species were collected in the Closed Area in 1997[5] through 2001. The marsh locations in 1997 were generalized spans of marsh area and are not equivalent locations to current Closed Area sampling

[5] 1997 sampling was not conducted at discrete locations.

stations. Of the species collected during previous prey item sampling programs, only grass shrimp, killifish, juvenile blue crabs, and mud crabs were sampled at comparable stations in 1997 and 2015. Grass shrimp, killifish, and juvenile blue crabs were also sampled at similar stations between 1998 and 2001.

Mercury trends for all prey species show overall declining concentrations since remedial activities began. At all sampling locations, 2015 juvenile blue crab concentrations are lower than measured in 1997 (Figure 3.10-4). Data collected in the period from 1998 to 2000 at stations CLO5900 (southeast Dredge Island) and LVB5513 (near the onshore Lagoon) show variable concentrations, with notably higher values than those measured in 1997 or 2015. These higher concentrations may indicate the influence of the Dredge Island removal activities that occurred during this time period.

Similar to juvenile blue crab, 2015 killifish tissue concentrations are lower than 1997 concentrations at almost all sampling locations (Figure 3.10-5). Samples collected in the vicinity of Marsh 1 and 2 show little change, possibly reflecting the lack of decline seen in the Causeway Cove marsh sediment mercury concentrations. Stations sampled in 1998 have higher tissue concentrations than in either 1997 or 2015, consistent with the belief that the Dredge Island remedial activity may have increased mercury exposure to organisms in the Closed Area.

Grass shrimp were the most consistently sampled prey species, with eight stations sampled on at least 3 different years (Figure 3.10-6). Grass shrimp concentration trends mirror those in juvenile blue crab and killifish. All stations show a decline in concentration from 1997 to 2015, indicating an overall declining trend in mercury levels for these species. Variable mercury levels measured in 1999 and 1998 are likely associated with impacts from Dredge Island remedial activities.

Mud crabs were the least consistently sampled prey species, with only three comparable sample locations in 1997 and 2015 (Figure 3.10-7). Similar to juvenile blue crab and grass shrimp, mud crab samples collected near LVB5508 (in the mouth of Witco Harbor) and in the vicinity of Marsh 1 and 2 saw declines in mercury tissue concentrations since 1997. Conversely, the same trend is not seen in samples collected near Marsh 3. However, this comparison reflects samples collected near the shoreline in 1997 and further from shore in 2015. The spatial disparity between the sample locations may contribute to the differences seen in mercury concentrations, and these changes may not be reflective of actual changes over time within Marsh 3 biota.

3.11 Gut Content Comparative Results

The gut content study provided qualitative information about the biota consumed by red drum and allowed the assessment of spatial and seasonal trends in the red drum diet. The contents of the stomachs of each red drum collected and processed for the 2015 annual monitoring study were removed, sorted, and identified.

3.11.1 Results of 2015 Gut Content Study

Legal-sized red drum (508 to 711 millimeters in total length [TL]) were collected and processed by Benchmark Ecological Services, Inc., at the clean laboratory in the Alcoa PCO facility in Point Comfort, Texas. Red drum were collected for the annual monitoring effort between October 6, 2015, and December 29, 2015.

A detailed description of the methods for collecting red drum is provided in Appendix B1. This gut content study was conducted according to procedures developed by Alcoa for gut content surveys conducted in 2011 and 2012. From the 2015 results, the following observations can be made:

- When 2015 results from both marshes and reefs from the Closed Area and Adjacent Open Area were combined, the dominant prey species was sand eels followed by white shrimp. Blue crabs were the third most common prey item (Figure 3.11-1).
- The number of fish collected in 2015 from marshes and reefs in the Closed Area was different from the number collected from marshes and reefs in the Adjacent Open Area. This potential source of variability could not be avoided as the samplers are required to accept all legal-sized red drum as they are collected. In 2015 in the Closed Area, 24 red drum were collected from reef stations, and 6 fish were collected from marsh stations. In Adjacent Open Areas, the results were more balanced where 12 red drum were collected from reef stations and 18 fish were collected from marsh stations. Typically, more stone crabs and sand eels are found in fish collected from reefs; the gut contents of fish from marsh stations generally have more white shrimp and blue crabs (Figures 3.11-1 and 3.11-2).
- Juvenile blue crabs were rarely the most abundant species in the gut but were consistently found in red drum, regardless of the time of year.

3.11.2 Comparison to Previous Gut Content Studies

The results for gut content studies conducted in 2011, 2012, and 2015 were compared to provide data on the diets of red drum collected for the Alcoa annual monitoring studies. The prey items observed in the red drum stomachs can be significantly different from one year to the next. The list of prey items available in marshes is usually different from the list of prey items available on reefs. Even though the annual monitoring studies are conducted at the same time each year (first weeks of fall), weather patterns and water conditions are never the same. The availability of prey items is usually linked to water conditions existing before and during the sampling period. By comparing the 3 years of studies, the following observations can be made:

- When results for 2011, 2012, and 2015 from both marshes and reefs from Closed and Adjacent Open Areas are combined, the dominant prey species is small finfish followed blue crab. White shrimp are the third most common prey item (Figure 3.11-3).
- The number of fish collected from each habitat is different from Closed to Adjacent Open areas and different from year to year (Table 3.11-1). This cannot be avoided, as the samplers are required to accept all legal-sized red drum as they are collected. This source of variability can influence the results of the study.
- Assortment of prey items available to red drum may be different from year to year. During the 2011 sample collection, Lavaca Bay was impacted by a red tide event. Small pelagic fish species (gizzard shad, menhaden, and striped mullet) were stunned by the toxins, and they were easy prey for red drum. In many of the fish collected in 2011, the volume of shad and mullet was significantly higher than in 2012 or 2015. In a normal year, the dominant prey items in red drum stomachs are crabs and shrimp.
- However, when results for 2011, 2012, and 2015 from both marshes and reefs from Closed and Adjacent Open areas are combined, it is clear that there is very little difference over time between the types of prey items available to red drum collected for these studies from different areas and different habitats (Figure 3.11-4).

These data show how variable the red drum diet can be within one annual collection; however, when combined with data from previous collections, the overall variability is reduced. It is recommended that Alcoa continue to collect gut content data during future monitoring events. These studies will provide useful information about the numerous factors that can influence the red drum diet and may help identify ecological conditions that favor mercury bioaccumulation.

3.12 Transport of Sediment and Mercury to the Causeway Cove Area

Field studies were conducted in fall 2015 to understand the potential for sediment and mercury transport from the Witco and Alcoa channels and the Witco Harbor to the area north of Dredge Island. The goal was to determine whether mercury originating from the channel and harbor sediment and any shoreline sources plays a role in slowing recovery in the causeway marshes and other regions in the northeast portion of the Closed Area.

3.12.1 Field Studies

The work consisted of the following three studies:

- Rhodamine Dye Tracer Study: The purpose of this study was to inform the understanding of flow patterns and potential sediment transport routes in the Witco and Alcoa channels and the shallow water north of Dredge Island and in the Causeway area. Rhodamine dye was released in the Witco Channel and measured north and west of this point for 48 hours after release. The details of this study are presented in Appendix D1.

- Witco Turbidity and Velocity Study: The purpose of this study was to evaluate the potential pathways and sediment transport of water flowing between the Alcoa and Witco channels and the Causeway Cove area. Turbidity and water velocity at three locations north of Dredge Island were monitored for a 1-month period. The details of this study are presented in Appendix D2.
- Water Column Mercury Study: This study was intended to inform the understanding of mercury concentrations and mercury transport in the Alcoa and Witco channels and the areas north and east of Dredge Island. Five ISCO sampling stations were deployed for 1 month at existing structures in the causeway area, the Alcoa and Witco channels, and the channel marker south of Dredge Island. Water samples were collected once a week during the course of one flow and ebb tidal cycle. Samples were split into filtered and unfiltered aliquots: unfiltered samples were analyzed for total mercury, TOC, and total suspended solids; filtered samples were analyzed for total mercury, and TOC. The details of this study are presented in Appendix D3.

Monitoring efforts during these studies centered on fixed stations located in three channels: the two channels connecting the Causeway Cove area with Lavaca Bay to the south and the channel running east to west between Dredge Island and the line of oyster reefs forming the southern boundary of Causeway Cove (Figure 2.10-1). The relatively deep channel due north of Witco Channel is termed the "east channel," and the wider, somewhat shallower channel that exists midway along the line of oyster reefs is termed the "mid-reef channel." The station in the east to west channel is termed the "west channel."

The dye study also included monitoring from a boat along paths within and to the south of Causeway Cove (Figure 2.10-1), and the water column mercury study (Study 7C ISCO Study) also included a station at the northern end of the Alcoa Channel and at the southern tip of Dredge Island (though no station in the west channel; Figure 2.10-3).

The dye study identified the major flow pathways to the area north of Dredge Island, transport within that area, and dilution along the pathway. The measurements of velocity and turbidity allowed estimation of the net solids fluxes to the area north of Dredge Island and an evaluation of the influence of shipping activities and weather events on those fluxes. Coupled with the dye study, these data provided an understanding of solids load and fate. The weekly water column mercury measurements provided some understanding of the increase in mercury flux as water flowed through the Alcoa and Witco channels and the transport of mercury to the area north of Dredge Island. The spatial gradients in concentration provided some indication of potential source areas of mercury.

3.12.2 Flow Patterns

Water moving up the Alcoa and Witco channels during flood tide was deflected to the west and then to the northwest as evidenced by aerial photographs of the visible dye plume 1 hour after the dye release in the Witco Channel (Figure 3.12-1). Much of this water enters Causeway Cove through the mid-reef channel and the open water just west of the terminus of the reefs. The arrows drawn on Figure 3.12-1 indicate the inferred transport pathways. Mass flux calculations for the first full tidal cycle after the dye release indicate that transport through the mid-reef channel was approximately 10 times greater than transport to the west (Table D1-3). Little of the dye entered through the east channel. Little of the dye exited Causeway Cove on ebb tide, suggesting little ebb tide flow opposite to the flood tide flow under the conditions of the study. Once in Causeway Cove, the dye slowly propagated to the northeast, as evidenced by concentrations measured along boat-run transects 21.5 to 25 hours after the dye release (Figure 3.12-2). Plots of concentration along transects indicated in blue on Figure 3.12-2 show a trend of increasing concentration to the northeast (Figure 3.12-3).

Net transport calculated from month-long velocity monitoring is mostly to the north and west, indicating a pattern in which flood water moves from the Alcoa and Witco channels into Causeway Cove and to the west and then exits Lavaca Bay on the west side of Dredge Island.

At the west channel, net transport was to the west for most of the monitored periods (top panel, Figures 3.12-4 and 3.12-5). The only exceptions are a November 16-17 weather event (discussed below) and October 14, when there were relatively small volumes to the east, presumably due to a period of sustained winds out of the south at 10 to 14 miles per hour (mph).

At the mid-reef and east channels, net transport was mostly into Causeway Cove (middle and bottom panels, respectively, on Figures 3.12-4 and 3.12-5). The exceptions mirror those in the west channel, but the net volumes out of the Causeway Cove are relatively small compared to the volumes entering at the Causeway Cove.

Taken together, the dye study and the velocity monitoring study show that the flow patterns are such that suspended sediment and mercury in the Alcoa and Witco channels is transported into Causeway Cove and to the west. This counterclockwise circulation around Dredge Island is consistent with what was estimated by a hydrodynamic model of Lavaca Bay developed in the mid-1990s (HydroQual 1998).

The flow patterns in the system are determined by the large-scale tidal and wind forcing. This is evident in the matching patterns of hourly average velocity direction and magnitude at the three channel stations (Figures 3.12-6a through f). During flood tide, water typically circulates to the north and west. No strong reversal occurs during ebb flows, which are characterized by lower velocities and variable circulation. High and sustained wind velocities can alter this pattern as evidenced on

November 16 to 17. From 1100 hours on the 16th to 1100 hours on the 17th, winds came from the south at an average sustained speed of 16 mph with several hours above 20 mph and gusts as high as 29 mph. During this period, flood flow circulation reversed from the typical north and west pattern to a south and east pattern (Figures D2-5b and D2-5c of Appendix D2). Presumably, this weather event pushed water north on the west side of Dredge Island and forced a circulation east and south as water moved toward the Causeway Cove.

Inside Causeway Cove, the dye study data indicate that water currents slow, and flows hug the southern portion above the oyster reefs. The slower moving water gradually disperses to the northeast towards the marshes at the eastern boundary of Causeway Cove. The lingering dye concentrations seen in Causeway Cove indicate water circulation patterns are low energy, and water entering Causeway Cove may have an extended residence time.

3.12.3 Sediment Transport

Turbidity measurements at the three channel stations showed a pulse of sediment transport at the beginning of flood tide (Figure 3.12-7). This sediment was not likely locally derived because the velocities at each location were too low to erode bed sediments. Such erosion typically requires velocities greater than 60 centimeters per second (cm/s). It is possible that unconsolidated sediments (i.e., a fluff layer) contributed, as these can be resuspended at the velocities recorded.

A fluff layer is common in estuaries and bays and is frequently called a mobile pool. It oscillates between the water column and the bottom over the tidal cycle. It is notable that the timing of the pulses of sediment transport differed among the three locations, with the pulse appearing earliest in the east channel and latest at the west channel. The time shift suggests propagation of a pulse that originated from the Witco and/or Alcoa channels with little additional contribution as water flowed to the north and west.

Sediment mass flux from October 13, 2015, to October 18, 2015, was calculated for the west and mid-reef channels. For almost all the monitored tidal cycles, both channels experienced greater flux to the north and west than to the south and east (Figure 3.12-8). Summing the two stations, the net flux roughly averages 10 metric tons per day (MT/d). While the source of this net sediment load cannot be determined from this study, it is possible that the Alcoa and Witco channels contribute to the sediment entering and depositing in the Causeway Cove.

A short-term study of sediment transport from the Alcoa Channel to the Witco Channel and through the Witco Channel was conducted over a 42-hour period from January 11 to 12, 2016. Velocity and turbidity were monitored at stations located at the southern and northern ends of the Witco Channel (Figure 2.10-2). Mid-depth and near bottom velocities tracked each other and peaked during flood tide at about 0.2 cm/s at the southern station and 0.15 cm/s at the northern station (Figure 3.12-9). Ebb velocities were much lower and without a consistent directional pattern, supporting the finding that water flowing north during flood tide moves south on the west side of Dredge Island during ebb. Near-surface velocities were variable and did not correlate with the deeper velocities and likely reflected the impact of wind shear. Turbidity did not exhibit a clear tidal signal, but it exhibited different patterns at the two stations. At the southern station, TSS estimated from the turbidity exhibited no vertical gradient, indicating it was composed of very light particles with very low settling velocities at a concentration of about 10 milligrams per liter (mg/L; Figure 3.12-10, bottom panel). In contrast, a vertical gradient existed at the northern station from about 10 mg/L near surface to about 20 mg/L near bottom (Figure 3.12-10, top panel). Thus, settleable solids entered the water column between the stations.

3.12.4 Mercury Transport

The measurements of water column mercury conducted during 2015 (see Appendix D3) indicate that mercury enters the water column as water flows north through the Alcoa and Witco channels and west and northwest into Causeway Cove. Mercury on the solids in the water column ranged from less than 0.1 mg/kg south of Dredge Island to about 0.2 mg/kg north of MS3. Dissolved mercury increased from 1 nanograms per liter (ng/L) south of Dredge Island to an average of 2.8 ng/L and 2.0 ng/L at the mid-reef station at the southern boundary of Causeway Cove during flood and ebb tides, respectively (Figures 3.12-11a and 3.12-11b).

At the rough average net solids flux of 10 MT/d and a particulate concentration of 0.2 mg/kg, the net particulate mercury load to the north and west during the October 2015 study was about 2 grams per day (g/d). At the average flow in the Witco Channel of about 30 cubic meters per second during the roughly 10-hour flood tide and a dissolved mercury concentration of 2 ng/L, an additional 2 g/d would be moving to the north and west.

3.12.5 Mercury Loading from Shipping-induced Resuspension in Witco Harbor

Monitoring the transit of one tug and barge into and out of Witco Harbor (see Appendix D3) indicated that the associated resuspension resulted in an estimated 130 kilograms of suspended sediment transport out of Witco Harbor and into the water moving through the Witco Channel. Mercury concentrations in the resuspended sediment ranged from 0.1 to 0.5 mg/kg. Conservatively assuming the tug- and barge-related solids had a mercury concentration 0.5 mg/kg, the tug and barge caused about 65 milligrams (mg) of mercury to be transported out of Witco Harbor. Given the estimate that 4 g/d of mercury was transported north and west from the Witco Channel during the monitored period, this single tug and barge resuspension event would have added a little less than 2% to that load.

3.13 Methylation Processes

An important element of the CSM for the project is the premise that decreases in meHg concentrations in sediment will accompany decreases in total mercury (THg) concentrations in sediment. Temporal trends in THg and meHg concentrations in sediment are evaluated to assess this component of the CSM natural recovery remedy.

Measurements of THg and meHg concentrations in surficial sediment samples from Marshes 1, 2, 3, 5, 6, and 7 are used in this evaluation. Marshes 1 and 2 are in the Causeway Cove area. Marsh 3 borders the transition from the Causeway Cove to the Witco Channel area. Marshes 5, 6, and 7 are in the MS3 area.

The period from 2008 to 2015 was examined, which includes data for each year from 2008 to 2012 and for 2015. The 2008 to 2010 data are for the top 5 cm of sediment, whereas the 2011 to 2015 data are for the top 2 cm of sediment. The change in depth interval likely complicates the interpretation of trends for meHg because the Fall 2015 Methylation Study and the Mercury Reconnaissance Study found significant gradients in meHg concentration over the top 5 cm, with concentrations tending to peak in the top 1 to 2 cm. Thus, there may be a low bias in the early data relative to the later data, which was considered in the interpretation of the trends.

Data collected during the Fall 2015 methylation study can provide some insight into the amount of bias that might be present in the evaluation of data collected at two different depth intervals. Cores were collected in three of these marshes, and analyzed in one-cm increments. The results are averaged for the 0- to 2-cm and 0- to 5-cm depth intervals as shown below:

- Marsh 1-3R (meHg (nanograms per gram [ng/g]-OC)
  - 0 to 2 cm: 213
  - 0 to 5 cm: 159
  - Ratio: 1.34
- Marsh 2-2R (meHg (ng/g)-OC)
  - 0 to 2 cm: 136
  - 0 to 5 cm: 79
  - Ratio: 1.72
- Marsh 6-5R (meHg (ng/g)-OC)
  - 0 to 2 cm: 66
  - 0 to 5 cm: 48
  - Ratio: 1.38

This evaluation suggests that the 2008 to 2010 meHg concentrations in the 0- to 2-cm depth interval may have been 1.3 to 1.7 times higher than the values found in the 0- to 5-cm depth interval. Thus, the marshes discussed below that exhibit decreasing trends in sediment meHg may actually have greater rates of decline than indicated by the available data.

The data were collected in the fall of each year, which likely facilitates their use for assessing long-term trends. Surficial sediment meHg concentration varies seasonally and the Mercury Reconnaissance Study found the greatest variation in the spring to early summer during the period of greatest methylation. During the remainder of the year, the levels were fairly stable.

The THg and meHg sediment data are normalized for OC concentrations since organic matter is the principal sorbent, and normalization is recognized as helpful in removing noise in trends that might be due to sample-to-sample variations in OC concentration. The trends in mean concentrations of THg and meHg expressed as mg and ng/kg OC, respectively, are shown on Figures 3.13-1 through 3.13-6 for the six marshes examined.

Overall, THg and meHg exhibit similar trends. Marsh 1 shows no trend for either parameter, and Marshes 3, 5, 6, and 7 show downward trends for both parameters, with somewhat greater drops for THg, which may be the consequence of the depth interval change noted above. The one evident exception is Marsh 2, for which there is about a 40% drop in THg but no downward trend in meHg. While it is possible that the change in depth increment masks a downward trend in meHg, the difference between this marsh and the others is striking. The possibility that THg and meHg concentrations are somewhat uncoupled and that meHg concentrations can be maintained as THg concentrations drop in certain marshes is the subject of the Spring 2016 Methylation Study, which is designed to aid the evaluation of factors influencing methylation in the Causeway Cove marshes.

The methylation investigation conducted in the fall of 2015, and detailed in Appendix C, provided initial information on the physical-chemical processes that control meHg production, and tested measurement tools for identifying areas of enhanced meHg production and uptake in the Closed Area. Two new methodologies were tested:

- DGT probes for measurement of total mercury and meHg concentrations in porewater, and
- Voltammetry to measure sediment redox conditions.

The sediment core collection and field DGT placement demonstrated the ability to provide representative profiles of both THg and meHg solid phase and porewater concentrations. The voltammetry work indicated that strongly reducing conditions did not exist at any of the stations sampled in October 2015. While oxygen depletion occurred within 1 to 2 cm of sediment surface and reduced manganese was measured, there were little or no dissolved iron or sulfides in upper 10 cm of the sediment. Redox conditions vary by season and we anticipate strongly reducing conditions in the spring 2016 survey.

The average porewater meHg concentration from single-core measurements at 9 stations was 1.3 ng/L, which is within the range of concentrations (1.21 to 1.97 ng/L) measured in Lavaca Bay during the Mercury Reconnaissance Study in the winter of 1997 (Bloom et al. 1999). That study found much higher concentrations in spring and we anticipate finding higher values in the spring 2016 study.

Overall, the Fall 2015 sampling efforts were successful and provide a good basis for the expanded sampling effort planned for the expected period of peak sediment meHg production in spring of 2016. Sampling during peak production will provide further insights regarding the site-specific factors that contribute to enhanced meHg production in sediments in certain locations in the Closed Area.

4 CONCLUSIONS AND RECOMMENDATIONS

Based on the extensive studies conducted in the fall of 2015 together with the information developed from the annual sediment and biota monitoring program the following conclusions can be made:

- Recovery is ongoing in surface sediments, juvenile blue crabs, and other prey items through the majority of the Closed Area as evidenced by downward trends in mercury levels (see Sections 3.7.1, 3.9.1, and 3.10.3)
- Average mercury concentrations in red drum in the Closed Area have not shown a similar recovery.
- Results from the fall 2015 and earlier studies confirm the primary elements of the CSM that supported the 2001 ROD. This includes information to support that:
  - Mercury in biota is primarily derived from a sediment based food web;
  - Marsh areas tend to have higher bioaccumulation potential;
  - Reduction in total mercury concentrations can be accelerated by control of ongoing sources
  - Major ongoing sources were identified during the RI (residual sources may now be more important as the system shows continued recovery)
  - Burial is the principal mechanism by which sediment total mercury concentrations decline;
  - Reductions in mercury levels in sediments will result in reductions in mercury levels in biota (observed for most juvenile blue crab locations and supplemental prey items but not for red drum)

- New findings relevant for the CSM include the following:
  - Half times for surface sediments in most areas has been about 10 to 12 years, which is slower than the 1 to 9 years estimated in the FS;
  - Sediment and biota in a small part of the Closed Area are recovering more slowly than other parts of the Closed Area. This area can generally be described as the eastern nearshore portion of the Closed Area from MS3 to Causeway Cove. That portion of the Closed Area appears to influence the average red drum mercury concentration for the Closed Area based on elevated prey concentrations in those areas and elevated sediment concentrations in portions of those areas.
  - Residual mercury sources may exist in sediments and soils in the vicinity of MS3, in the shallows adjacent to the Alcoa and Witco channels (including Witco Harbor) and along the northwest edge of Dredge Island. The responsible transport mechanisms may include natural and vessel-induced resuspension, groundwater inflow and pore-water diffusion, sloughing along steep channel slopes, and erosion from intertidal or adjacent soils.

Based on those findings and conclusions, the following recommendations are made for the next 12-month reporting period:

- Conduct an expanded methylation study during the peak of the 2016 spring methylation period to 1) understand why meHg may not be declining in some areas as total mercury levels decline and 2) understand what specific site conditions are associated with high levels of meHg generation. This study will also include an evaluation of whether meHg generated in other parts of the Bay system is transported into the marsh areas and significantly contributes to uptake by biota. A work plan for this study was submitted to USEPA in late March; the work is planned for April 2016.
- Conduct a high-resolution water column sampling program in the vicinity of the Alcoa and Witco channel areas to evaluate dissolved and particulate mercury levels in support of identifying potential residual mercury sources in this area. This work is proposed to be conducted in the spring of 2016, and a work plan will be submitted for USEPA review and approval.
- Following the receipt of the data from these two studies, implement a study to further analyze mercury concentrations in bottom and near-shore sediments in areas that may represent ongoing residual sources (e.g., MS3 and Witco Channel); submittal of a work plan for this study is expected in September with implementation, upon approval, coincident with the annual sediment sampling performed during the fourth quarter of 2016.
- Communicate the study results with the USEPA upon completion, continue to update and refine the CSM, and incorporate the results of the studies into a specific remedial actions plan (e.g., present results in the 2017 RAAER) as determined to be needed to reduce mercury levels in red drum.

5 REFERENCES

Alcoa, 1996. *Remedial Investigation Work Plan Volume B2C: Data Report Mercury Reconnaissance Study*, Alcoa (Point Comfort) Lavaca Bay Superfund Site.

Alcoa, 1997a. *1997 Bay System and Bird Prey Item Study.*

Alcoa, 1997b. *RI Workplan for the Alcoa (Point Comfort)/Lavaca Bay Superfund Site, Volume B2e: Bay System Fish and Bird Prey Item Study Sampling and Analysis Plan.* March 1997.

Alcoa, 1997c. *Engineering Evaluation/Cost Analysis (EE/CA) for a Non-Time Critical Removal Action at the Dredge Island, Alcoa (Point Comfort)/Lavaca Bay Superfund Site.* July 1997.

Alcoa, 1998. *Chlor-Alkali Process Area Focused Investigation Data Report (Volume B6L), Alcoa (Point Comfort)/Lavaca Bay Superfund Site.* July 1998.

Alcoa, 1999. *Chlor-Alkali Process Area Groundwater Treatability Study Data Report (Volume M3), Alcoa (Point Comfort)/Lavaca Bay Superfund Site.* October 1999.

Alcoa, 2002. *Dredge Island Removal Action Plan, Volume 4 - Phase 1 Dredge Island Stabilization Completion Report, Alcoa (Point Comfort)/Lavaca Bay Superfund Site.* August 2002.

Alcoa, 2003. Standard Operating Procedures (2003).

Alcoa, 2005a. *Remediation Action Work Plan, Alcoa (Point Comfort)/Lavaca Bay Superfund Site.* August 2005.

Alcoa, 2005b. Standard Operating Procedures (2005).

Alcoa, 2006a. *2005 Remedial Action Annual Effectiveness Report.* Alcoa (Point Comfort)/Lavaca Bay Superfund Site. March 3, 2006.

Alcoa, 2006b. Revisions to Lavaca Bay Marsh Monitoring Program, memorandum dated October 6, 2006, submitted to USEPA October 13, 2006.

Alcoa, 2007a. *2006 Remedial Action Annual Effectiveness Report.* Alcoa (Point Comfort)/Lavaca Bay Superfund Site. March 30, 2007.

Alcoa, 2007b. *Construction Completion Report, Witco Area Remedial Actions.* Alcoa (Point Comfort)/Lavaca Bay Superfund Site. June 2007.

Alcoa, 2008a. *2007 Remedial Action Annual Effectiveness Report, Alcoa (Point Comfort)/Lavaca Bay Superfund Site.* March 31, 2007.

Alcoa, 2008b. *Amended 2007 Remedial Action Annual Effectiveness Report, Alcoa (Point Comfort)/Lavaca Bay Superfund Site.* October 23, 2008.

Alcoa, 2012a. *2012 Five-Year Review Response Action Plan, Alcoa, June 27, 2012* (Revised July 25, 2012 in response to Agency comments).

Alcoa, 2012b. *2011 Remedial Action Annual Effectiveness Report, Alcoa (Point Comfort)/Lavaca Bay Superfund Site*. March 2012.

Alcoa, 2013a. *2012 Remedial Action Annual Effectiveness Report, Alcoa (Point Comfort)/Lavaca Bay Superfund Site*. March 2013.

Alcoa, 2013b. *Response Action Completion Report for the Activities Conducted Under the 2012 Five-Year Review Response Action Plan, Alcoa, September 25, 2013.* Submitted to EPA on September 26, 2013.

Alcoa, 2015a. *2014 Remedial Action Annual Effectiveness Report.* Alcoa (Point Comfort)/Lavaca Bay Superfund Site. March 31, 2015.

Alcoa, 2015b. *Fall 2015 Supplemental Data Collection for Lavaca Bay, Texas. Study 1. Focused Prey Item Study. Study 3. Qualitative Gut Content Study.* September 15, 2015.

Alcoa, 2015c. *Fall 2015 Supplemental Data Collection for Lavaca Bay, Texas. Study 2. Methylmercury Sediment Sampling in Open Waters. Study 5. Focused Sediment and Prey Sampling In and Near Marshes. Study 6. Additional Open Water Sediment Sampling. Study 7A. Rhodamine Dye Tracer Study. Study 7B. Witco Turbidity and Velocity Study. Study 7C. Water Column Mercury Study.* September 18, 2015

Alcoa, 2015d. Response to USEPA comments on Studies 5, 6, and 7C. October 5, 2015

Alcoa, 2015e. *Fall 2015 Supplemental Data Collection for Lavaca Bay, Texas. Study 4. Methylation Study. Revised Work Plan.* October 21, 2015

Alcoa, 2015f. *Fall 2015 Supplemental Data Collection for Lavaca Bay, Texas. Proposed Revisions Study 7C. Water Column Mercury Study.* November 24, 2015.

HydroQual (HydroQual, Inc.), 1998. *Development and Application of a Modeling Framework to Evaluate Hurricane Impacts on Surficial Mercury Concentrations in Lavaca Bay*. Prepared for Aluminum Company of America, Point Comfort, Texas. Project No. ACOA 0020. April 10, 1998.

Overstreet, R.M., and W.R. Heard, 1978. Food of the Red Drum, *Sciaenops ocellata*, from Mississippi Sound. *Gulf Research Reports* 6(2)131-135.

Reagan, R.E., 1985. *Species Profiles: Life Histories and Environmental Requirements of Coastal Fishes and Invertebrates (Gulf of Mexico)*. Red drum. U.S. Fish and Wildlife Service Biological Report 82(11.36), USACE TR EL-82-4. 16pp.

United States et al. v. Alcoa Inc., et al., 2005. Consent Decree for CERCLA Response Actions and Response Costs (Civil Action Number V: 04-CV-119). February.

USEPA (U.S. Environmental Protection Agency), 2001. Record of Decision for the Alcoa (Point Comfort)/Lavaca Bay Superfund Site. December 2001.

USEPA, 2007a. Explanation of Significant Differences for the Alcoa (Point Comfort)/Lavaca Bay Superfund Site. May. 23, 2007.

USEPA, 2007b. Preliminary Close Out Report for the Alcoa (Point Comfort)/Lavaca Bay Superfund Site. July 23, 2007.

USEPA, 2011. *Five-Year Review Report, Alcoa (Point Comfort)/Lavaca Bay Superfund Site*. June 2011.

Zhang, H., and W. Davison, 1995. Performance characteristics of diffusion gradients in thin films for the in situ measurement of trace metals in aqueous solutions. *Anal. Chem*. 67(19):3391-3400.

TABLES

Table 1.3-1

Overview of Fall 2015 Supplemental Studies

Study No.	Scope	Study Designed to Address Hypothesis (see text): A	B	C	D
1	Add new prey items (killifish and grass shrimp) to juvenile blue crab monitoring stations	✓	✓	✓	
2	Add methylmercury to annual marsh sediment analyte list and to a subset of the Closed Area open-water sediment locations	✓			✓
3	Document the gut content of the red drum collected as part of the fall 2015 annual monitoring program		✓		
4	Conduct a Phase 1 Methylation Study to develop an initial dataset and verify test methods	✓	✓		✓
5	Expand sediment sampling locations in the marshes where juvenile blue crab have elevated mercury concentrations	✓	✓		
6	Collect additional sediment samples at locations in the Witco Channel and near Mainland Shoreline No. 3			✓	
7	Conduct a dye tracer study, turbidity and velocity study, and water column mercury study in the Witco Channel and the area north and east of Dredge Island			✓	

Table 2.3-1
Summary of Annual Sediment Monitoring Protocols

Year of Sample Collection	Date of RAAER	Open-water Sediment Sample Depth Interval		Marsh Sediment Sample Depth Interval		Open-water Sediment Analytes		Marsh Sediment Analytes	
		0 - 5 cm	0 - 2 cm	0 - 5 cm	0 - 2 cm	Hg	Hg, MeHg, TOC	Hg	Hg, MeHg, TOC
Fall 2005	March 2006	X		X		X		X	
Fall 2006	March 2007	X		X		X		X	
Fall 2007	March 2008	X		X		X		X	
Fall 2008	March 2009	X		X					X
Fall 2009	March 2010			X					X
Fall 2010	March 2011	X		X		X			X
Fall 2011	March 2012		X		X		X		X
Fall 2012	March 2013	X	X		X		X		X
NA	March 2014								
Fall 2014	March 2015	X			X	X		X	
Fall 2015	March 2016		X		X		X		X

Notes:
Detailed sampling protocol provided in Appendix A of each RAAER.
cm = centimeter
Hg = mercury
MeHg = methylmercury
NA = not applicable
TOC = total organic carbon

Table 3.1-1
CAPA Groundwater Treatment System
Analytical Results
Treatment System Effluent

Sample Tap	Date	Analytical Results (mg/L)[1,2]																		pH	Comments
		Mercury			Carbon Tetrachloride			Chloroform			Methylene Chloride			Tetrachloroethene			Trichloroethene				
		Q[3]	Result	Flag[4]	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag		
Treated Groundwater Discharge Standards (mg/L)[5]			0.01			0.38			0.325			NA[6]			0.164			NA		6.0 - 9.0	
ST-C[7]	5/18/98		0.0019		<	0.001		<	0.001		<	0.001		<	0.001		<	0.001			
	5/29/98		0.00035		<	0.001		<	0.001		<	0.002		<	0.001		<	0.001			
	6/4/98		0.00021		<	0.001		<	0.001		<	0.002		<	0.001		<	0.001			
	6/9/98																			7.00	
	6/10/98		0.00041		<	0.001		<	0.001		<	0.002		<	0.001		<	0.001			
	6/18/98		0.00021		<	0.001		<	0.001		<	0.002		<	0.001		<	0.001			
	6/24/98		0.00027		<	0.001		<	0.001		<	0.002		<	0.001		<	0.001			
	7/1/98		0.00017			0.00041	J	<	0.001		<	0.002		<	0.001		<	0.001			
	7/1/98		0.0009																		Duplicate
	7/2/98																			5.17	
	7/8/98		0.00016		<	0.001		<	0.001		<	0.002		<	0.001		<	0.001		5.20	
	7/15/98		0.00018		<	0.001		<	0.001		<	0.002		<	0.001		<	0.001		6.00	
	7/22/98		0.00027		<	0.001		<	0.001		<	0.002		<	0.001		<	0.001			
	7/28/98		0.00042		<	0.001		<	0.001		<	0.002		<	0.001		<	0.001		6.45	
	8/5/98		0.00047		<	0.001		<	0.001		<	0.002		<	0.001		<	0.001		6.42	
	8/12/98		0.00042		<	0.001		<	0.001		<	0.002		<	0.001		<	0.001		6.52	
	8/19/98		0.00075		<	0.001		<	0.001		<	0.002		<	0.001		<	0.001			
	8/25/98		0.00052		<	0.001		<	0.001		<	0.002		<	0.001		<	0.001		6.86	
	9/2/98		-0.0007	J	<	0.001		<	0.001		<	0.002		<	0.001		<	0.001		6.73	
	9/9/98		0.00027	J	<	0.001		<	0.001		<	0.002		<	0.001		<	0.001		6.82	
	9/16/98		0.0010		<	0.001		<	0.001		<	0.002		<	0.001		<	0.001			
	9/23/98		0.0010		<	0.001		<	0.001		<	0.002		<	0.001		<	0.001		7.10	
	10/1/98		0.00076		<	0.001		<	0.001		<	0.002		<	0.001		<	0.001			
	10/7/98		0.00090		<	0.001		<	0.001		<	0.002		<	0.001		<	0.001		7.12	
	10/14/98		0.00173		<	0.001		<	0.001		<	0.002		<	0.001		<	0.001		6.40	
	10/21/98		0.00053		<	0.001		<	0.001		<	0.002			0.0001	J	<	0.001		6.23	
	10/28/98		0.00050		<	0.001		<	0.001		<	0.002		<	0.001		<	0.001		6.31	
	11/4/98		0.00053		<	0.001		<	0.001		<	0.002		<	0.001		<	0.001		6.41	
	11/11/98		0.00007		<	0.001		<	0.001		<	0.002		<	0.001		<	0.001		6.45	
	11/18/98		0.00045		<	0.001		<	0.001		<	0.002		<	0.001		<	0.001		6.56	
	11/24/98		0.00012	J	<	0.001		<	0.001		<	0.002		<	0.001		<	0.001		6.51	
	12/2/98		0.00034		<	0.001		<	0.001		<	0.002		<	0.001		<	0.001		6.64	
	12/9/98		0.00038		<	0.001		<	0.001		<	0.002		<	0.001		<	0.001		6.85	
	12/16/98		0.00070		<	0.001		<	0.001		<	0.002		<	0.001		<	0.001		6.89	
	12/22/98		0.0010		<	0.001		<	0.001		<	0.002		<	0.001		<	0.001		6.92	
	12/29/98		0.0008			0.00028	J	<	0.001		<	0.002		<	0.001		<	0.001		5.53	
	1/6/99		0.00073		<	0.001		<	0.001		<	0.002		<	0.001		<	0.001		6.03	
	1/13/99		0.00033	J	<	0.001		<	0.001			0.00008	J	<	0.001		<	0.001		5.74	
	1/20/99																				
	1/26/99		0.00048		<	0.001		<	0.001		<	0.002		<	0.001		<	0.001		5.70	
	2/3/99		0.00058		<	0.001		<	0.001			0.001	J		0.00029	J	<	0.001		7.08	
	2/17/99		0.00078	J	<	0.001		<	0.001			0.0012	J		0.00036	J	<	0.001		7.13	
	2/24/99		0.00128		<	0.001		<	0.001			0.0019	J		0.00037	J	<	0.001		6.63	
	3/5/99		0.00159		<	0.001		<	0.001			0.0018	J		0.00036	J	<	0.001		6.65	
	3/10/99		0.00116		<	0.001		<	0.001			0.0017	J	<	0.001		<	0.001		6.68	
	3/17/99		0.00064		<	0.001		<	0.001		<	0.002		<	0.001		<	0.001		7.08	
	3/24/99		0.00002	J	<	0.001		<	0.001			0.0016	J		0.000042	J	<	0.001		7.06	
	4/1/99		0.00023	J	<	0.001			0.00027	J		0.0022			0.00014	J	<	0.001		6.96	
	4/6/99		0.00020	J	<	0.001		<	0.001			0.0019	J	<	0.001		<	0.001		6.87	
	4/13/99		0.00070	J	<	0.001			0.00075	J		0.002	J	<	0.001		<	0.001		6.98	
	4/21/99		0.00120		<	0.001			0.00104			0.0018	J	<	0.001		<	0.001		6.98	
	4/28/99		0.00110		<	0.001			0.00224		<	0.002			0.00037	J	<	0.001		6.97	
	5/5/99		0.00066		<	0.001			0.00363		<	0.002			0.00029	J	<	0.001		7.00	
	5/12/99		0.00143			0.00065	J		0.00644		<	0.002		<	0.001		<	0.001		7.15	
	5/19/99		0.00169			0.00039	J		0.00482			0.00076	J	<	0.001		<	0.001		6.82	
	5/26/99		0.00135			0.00131			0.00884			0.00051	J	<	0.001		<	0.001		7.25	
	6/2/99		0.00201			0.00261			0.01224			0.00046	J	<	0.001		<	0.001		6.93	
	6/9/99		0.00181			0.00915			0.01922			0.000302	J	<	0.001		<	0.001		7.02	
	6/16/99		0.00148			0.01192			0.02667			0.00022	J	<	0.001		<	0.001		6.92	
	6/23/99		0.00228			0.0214			0.03472			0.000117	J	<	0.001		<	0.001		7.23	
	6/30/99		0.00076			0.01999			0.03766		<	0.002		<	0.001		<	0.001		6.68	
	7/14/99																			7.04	

Table 3.1-1
CAPA Groundwater Treatment System
Analytical Results
Treatment System Effluent

Sample Tap	Date	Analytical Results (mg/L)[1,2]																		pH	Comments
		Mercury			Carbon Tetrachloride			Chloroform			Methylene Chloride			Tetrachloroethene			Trichloroethene				
		Q[3]	Result	Flag[4]	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag		
Treated Groundwater Discharge Standards (mg/L)[5]			0.01			0.38			0.325			NA[6]			0.164			NA		6.0 - 9.0	
ST-A	7/22/99																			7.82	Carbon change out
	7/28/99																			7.82	
	8/4/99																			7.23	
	8/11/99																			7.51	
	8/18/99																			6.92	
	8/25/99		0.00086			0.004364			0.000146	J	<	0.002		<	0.001		<	0.001		6.94	
	9/1/99		0.00014	J		0.00486		<	0.001		<	0.002		<	0.001		<	0.001		6.95	
	9/8/99		0.000425	J		0.003008		<	0.001		<	0.002		<	0.001		<	0.001		7.21	
	9/15/99		0.00043	J		0.002892			0.000185	J	<	0.002		<	0.001		<	0.001		7.06	
	9/22/99		0.00089			0.002616			0.000152	J	<	0.002		<	0.001		<	0.001		7.21	
	9/29/99		0.00006	J		0.003224		<	0.001		<	0.002		<	0.001		<	0.001		7.27	
	10/6/99		0.00018	J		0.002757			0.000408		<	0.002		<	0.001		<	0.001		7.49	
	10/13/99		0.00021	J		0.00291			0.000788	J	<	0.002		<	0.001		<	0.001		7.36	
	10/20/99		0.00059			0.00136			0.001111		<	0.002		<	0.001		<	0.001		7.28	
	10/27/99		0.00033	J		0.003327			0.00275		<	0.002		<	0.001		<	0.001		7.22	
	11/3/99		0.00002	J		0.003567			0.004421		<	0.002		<	0.001		<	0.001		7.61	
	11/10/99		0.00118	J		0.003112			0.00622		<	0.002		<	0.001		<	0.001		7.50	
	11/17/99		0.00089	J		0.004599			0.009552		<	0.002		<	0.001		<	0.001		7.65	
	11/23/99		0.00062	J		0.007814			0.012587		<	0.002		<	0.001		<	0.001		7.22	
	12/2/99		0.00072	J		0.012289			0.016635		<	0.002		<	0.001		<	0.001		7.14	
	12/8/99		0.00072	J		0.011109			0.017479		<	0.002		<	0.001		<	0.001		7.33	
	12/15/99		0.00041	J		0.014068			0.013601		<	0.002		<	0.001		<	0.001		7.37	
	12/22/99		0.00040	J		0.01353			0.013122		<	0.002		<	0.001		<	0.001		7.40	
	12/29/99		0.00013	J		0.010233			0.016454		<	0.002		<	0.001		<	0.001		7.00	
	1/5/00		0.00074	J		0.021707			0.025836		<	0.002		<	0.001		<	0.001		7.41	
	1/12/00		0.00011	J		0.035346			0.036077		<	0.002		<	0.001		<	0.001		7.38	
	1/19/00		0.00061	J		0.062926			0.048082		<	0.002		<	0.001		<	0.001		7.06	
	1/26/00		0.00044	J		0.07067			0.042044		<	0.002		<	0.001		<	0.001		6.86	
	2/2/00		0.00010	J		0.115509			0.052529		<	0.002		<	0.001		<	0.001		6.82	
	2/9/00		0.00014	J		0.155503			0.059467		<	0.002		<	0.001		<	0.001		7.01	
	2/16/00		0.00016	J		0.177621			0.060686		<	0.002		<	0.001		<	0.001		6.80	
	2/24/00		0.00097			0.00194		<	0.001		<	0.002		<	0.001		<	0.001		7.66	
ST-B	3/3/00		0.00026	J	<	0.001		<	0.001		<	0.002		<	0.001		<	0.001		8.90	Carbon change out
	3/9/00		0.00011	J	<	0.001		<	0.001		<	0.002		<	0.001		<	0.001		7.20	
	3/15/00		0.00034	J	<	0.001		<	0.001		<	0.002		<	0.001		<	0.001		7.70	
	3/22/00		0.00002	J	<	0.001		<	0.001		<	0.002		<	0.001		<	0.001		7.10	
	3/29/00		0.00030	J	<	0.001		<	0.001		<	0.002		<	0.001		<	0.001		7.05	
	4/4/00		0.00030		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.58	
	4/12/00		0.00060			0.008		<	0.001		<	0.005		<	0.001		<	0.001		7.10	
	4/19/00	<	0.00020		<	0.001		<	0.001		<	0.005			0.004		<	0.001		7.06	
	4/26/00	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.60	
	5/3/00	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.57	
	5/10/00	<	0.00040		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.49	
	5/17/00	<	0.00040		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.55	
	5/24/00		0.00110		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.45	
	5/31/00	<	0.00020		<	0.001			0.003		<	0.005		<	0.001		<	0.001		6.80	
	6/7/00	<	0.00020			0.01			0.005		<	0.005		<	0.001		<	0.001		6.87	
	6/14/00	<	0.00020		<	0.001			0.011		<	0.005		<	0.001		<	0.001			
	6/21/00		0.00030		<	0.001			0.019		<	0.005		<	0.001		<	0.001			
	6/29/00	<	0.00020			0.01			0.022		<	0.005		<	0.001		<	0.001			
	7/6/00		0.00020			0.013			0.029		<	0.005		<	0.001		<	0.001		6.75	
	7/12/00	<	0.00040			0.012			0.026		<	0.005		<	0.001		<	0.001		6.57	
	7/19/00	<	0.00020			0.02			0.032		<	0.005		<	0.001		<	0.001		7.05	
	7/26/00	<	0.00020			0.026			0.041		<	0.005		<	0.001		<	0.001		6.58	
	8/2/00		0.00030			0.038			0.037		<	0.005		<	0.001		<	0.001		6.35	
	8/9/00		0.00020			0.055			0.042		<	0.005		<	0.001		<	0.001			
	8/16/00		0.00030			0.07			0.05		<	0.005		<	0.001		<	0.001		6.41	
	8/23/00		0.00030			0.076			0.051		<	0.005		<	0.001		<	0.001		6.80	
	8/29/00		0.00020			0.095			0.052		<	0.005		<	0.001		<	0.001		6.43	
ST-C	9/6/00		0.00580		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		8.43	Carbon change out
	9/12/00	<	0.00100		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.91	
	9/19/00	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		8.27	

Table 3.1-1
CAPA Groundwater Treatment System
Analytical Results
Treatment System Effluent

Sample Tap	Date	Analytical Results (mg/L)[1,2]																		pH	Comments
		Mercury			Carbon Tetrachloride			Chloroform			Methylene Chloride			Tetrachloroethene			Trichloroethene				
		Q[3]	Result	Flag[4]	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag		
Treated Groundwater Discharge Standards (mg/L)[5]			0.01			0.38			0.325			NA[6]			0.164			NA		6.0 - 9.0	
ST-C Continued	9/27/00		0.00100		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.12	
	10/3/00	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.97	
	10/11/00	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.21	
	10/18/00		0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.88	
	10/25/00		0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.95	
	11/1/00		0.00030		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.13	
	11/8/00		0.00030		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.18	
	11/15/00		0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.40	
	11/21/00		0.00040		<	0.001			0.001		<	0.005		<	0.001		<	0.001		7.36	
	11/28/00		0.00040		<	0.001			0.002		<	0.005		<	0.001		<	0.001		7.01	
	12/6/00		0.00040		<	0.001			0.002		<	0.005		<	0.001		<	0.001		7.56	
	12/13/00		0.00030			0.001			0.002		<	0.005		<	0.001		<	0.001		6.98	
	12/20/00		0.00040			0.002			0.003		<	0.005		<	0.001		<	0.001		7.34	
	12/27/00		0.00030			0.003			0.004		<	0.005		<	0.001		<	0.001		7.64	
	1/3/01		0.00020			0.003			0.003		<	0.005		<	0.001		<	0.001		7.14	
	1/10/01		0.0004			0.007			0.005		<	0.005		<	0.001		<	0.001		7.20	
	1/17/01		0.0004			0.011			0.006		<	0.005		<	0.001		<	0.001		7.48	
	1/24/01		0.00030			0.014			0.007		<	0.005		<	0.001		<	0.001		7.27	
	1/30/01		0.00040			0.018			0.008		<	0.005		<	0.001		<	0.001		7.29	
	2/6/01		0.00030			0.021			0.009		<	0.005		<	0.001		<	0.001		7.30	
	2/14/01		0.00040			0.026			0.01		<	0.005		<	0.001		<	0.001		7.36	
	2/22/01		0.00030			0.032			0.011		<	0.005		<	0.001		<	0.001		7.40	
	2/28/01		0.00030			0.033			0.011		<	0.005		<	0.001		<	0.001		7.38	
	3/7/01		0.00630			0.039			0.013		<	0.005		<	0.001		<	0.001		7.48	
	3/15/01		0.00040			0.071			0.02		<	0.005		<	0.001		<	0.001		7.16	
	3/21/01		0.00040			0.087			0.023		<	0.005		<	0.001		<	0.001		6.89	
	3/28/01		0.00040			0.087			0.02		<	0.005		<	0.001		<	0.001		6.79	
	4/4/01		0.00050			0.12			0.025		<	0.005		<	0.001		<	0.001		6.54	
	4/11/01		0.00040			0.14			0.03		<	0.005		<	0.001		<	0.001		7.49	
ST-A	4/19/01	<	0.00020			0.001		<	0.001		<	0.005		<	0.001		<	0.001		8.98	Carbon change out
	4/26/01	<	0.00020			0.0001		<	0.001		<	0.005		<	0.001		<	0.001		8.71	
	5/2/01	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.80	
	5/9/01		0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.08	
	5/16/01	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.95	
	5/23/01	<	0.00020			0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.90	
	5/30/01	<	0.00020			0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.92	
	6/7/01	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.05	
	6/13/01	<	0.00020			0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.85	
	6/20/01	<	0.00020			0.002		<	0.001		<	0.005		<	0.001		<	0.001		7.04	
	6/27/01	<	0.00020			0.002		<	0.001		<	0.005		<	0.001		<	0.001		6.94	
	7/3/01	<	0.00020			0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.96	
	7/11/01	<	0.00020			0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.94	
	7/17/01	<	0.00200			0.001		<	0.001		<	0.005		<	0.001		<	0.001			
	7/25/01	<	0.00020			0.18			0.01		<	0.005		<	0.001		<	0.001		6.99	
	8/1/01	<	0.00020			0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.01	
	8/9/01	<	0.00020			0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.93	
	8/15/01		0.00020			0.001			0.002		<	0.005		<	0.001		<	0.001		6.80	
	8/21/01	<	0.00020			0.001			0.003		<	0.005		<	0.001		<	0.001		6.90	
	8/30/01		0.00030			0.001			0.004		<	0.005		<	0.001		<	0.001		6.96	
	9/5/01		0.00020			0.002			0.005		<	0.005		<	0.001		<	0.001		6.98	
	9/14/01	<	0.00020			0.003			0.009		<	0.005		<	0.001		<	0.001			
	9/21/01	<	0.00020			0.005			0.012		<	0.005		<	0.001		<	0.001		6.94	
	9/24/01		0.00020			0.006			0.012		<	0.005		<	0.001		<	0.001		6.98	
	10/1/01	<	0.00020			0.006			0.01		<	0.005		<	0.001		<	0.001		7.01	
	10/9/01	<	0.00100			0.006			0.011		<	0.005		<	0.001		<	0.001		6.91	
	10/15/01	<	0.00100			0.008			0.011		<	0.005		<	0.001		<	0.001		6.94	
	10/22/01	<	0.00020			0.009			0.013		<	0.005		<	0.001		<	0.001		7.44	
	10/29/01		0.00050			0.014			0.013		<	0.005		<	0.001		<	0.001		7.03	
	11/5/01	<	0.00100			0.16			0.015		<	0.005		<	0.001		<	0.001		7.07	
	11/12/01	<	0.00100			0.019			0.015		<	0.005		<	0.001		<	0.001		7.51	
	11/20/01	<	0.00100			0.015			0.012		<	0.005		<	0.001		<	0.001		7.73	
	11/28/01		0.00100			0.014			0.011		<	0.005		<	0.001		<	0.001		7.30	

Table 3.1-1
CAPA Groundwater Treatment System
Analytical Results
Treatment System Effluent

Sample Tap	Date	Analytical Results (mg/L)[1,2]																		pH	Comments
		Mercury			Carbon Tetrachloride			Chloroform			Methylene Chloride			Tetrachloroethene			Trichloroethene				
		Q[3]	Result	Flag[4]	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag		
Treated Groundwater Discharge Standards (mg/L)[5]			0.01			0.38			0.325			NA[6]			0.164			NA		6.0 - 9.0	
ST-A Continued	12/4/01	<	0.00100			0.02			0.013		<	0.005		<	0.001		<	0.001		7.49	
	12/10/01		0.00020			0.022			0.013		<	0.005		<	0.001		<	0.001		7.44	
	12/21/01		0.00020			0.038			0.015		<	0.005		<	0.001		<	0.001		7.26	
	12/27/01		0.00030			0.046			0.015		<	0.005		<	0.001		<	0.001		7.21	
	1/2/02	<	0.00020			0.0039			0.014		<	0.005		<	0.001		<	0.001		7.20	
	1/7/02	<	0.00020			0.038			0.013		<	0.005		<	0.001		<	0.001		7.20	
	1/14/02		0.00030			0.055			0.17		<	0.005		<	0.001		<	0.001		7.14	
	1/21/02		0.00020			0.066			0.017		<	0.005		<	0.001		<	0.001		7.18	
	1/29/02		0.00030			0.066			0.017		<	0.005		<	0.001		<	0.001		7.11	
	2/4/02	<	0.00020			0.066			0.016		<	0.005		<	0.001		<	0.001		7.11	
	2/11/02	<	0.00020			0.069			0.014		<	0.005		<	0.001		<	0.001		7.15	
ST-B	2/21/02		0.07500		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		8.11	Carbon change out
	2/25/02		0.03100		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.69	
	3/4/02	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.32	
	3/11/02	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.17	
	3/18/02	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.14	
	3/25/02	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.07	
	4/2/02	<	0.00100		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.09	
	4/8/02	<	0.00100		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.07	
	4/15/02		0.02200		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.08	
	4/22/02		0.00100		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.11	
	4/30/02	<	0.00100		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.92	
	5/6/02		0.04800		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.98	
	5/13/02		0.14		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.03	
	5/20/02	<	0.0002		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.10	
	5/29/02	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.14	
	6/3/02	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.11	
	6/10/02	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.02	
	6/18/02		0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.10	
	6/24/02		0.00030		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.07	
	7/1/02	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.05	
	7/8/02		0.00030		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.13	
	7/15/02		0.00040		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.02	
	7/23/02		0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.10	
	7/29/02		0.00050		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.00	
	8/5/02		0.00050		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001			
	8/12/02	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		8.16	
	8/19/02	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.10	
	8/26/02		0.00030		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.04	
	9/3/02	<	0.00020		<	0.001			0.001		<	0.005		<	0.001		<	0.001		7.16	
	9/11/02	<	0.00020		<	0.001			0.001		<	0.005		<	0.001		<	0.001		7.04	
	9/16/02	<	0.00020		<	0.001			0.002		<	0.005		<	0.001		<	0.001		7.06	
	9/23/02	<	0.00020		<	0.001			0.003		<	0.005		<	0.001		<	0.001		6.96	
	9/30/02	<	0.00020			0.002			0.005		<	0.005		<	0.001		<	0.001		6.99	
	10/8/02	<	0.00020			0.002			0.006		<	0.005		<	0.001		<	0.001			
	10/15/02	<	0.00020			0.002			0.006		<	0.005		<	0.001		<	0.001			
	10/22/02		0.00020			0.005			0.008		<	0.005		<	0.001		<	0.001		6.77	
	10/28/02		0.00040			0.008			0.01		<	0.005		<	0.001		<	0.001		7.13	
	11/4/02		0.00060			0.009			0.011		<	0.005		<	0.001		<	0.001		7.07	
	11/13/02	<	0.00020			0.013			0.011		<	0.005		<	0.001		<	0.001		6.80	
	11/20/02		0.00030			0.017			0.011		<	0.005		<	0.001		<	0.001		6.73	
	11/25/02		0.00020			0.018			0.013		<	0.005		<	0.001		<	0.001		6.91	
	12/2/02	<	0.00020			0.02			0.014		<	0.005		<	0.001		<	0.001		6.95	
	12/9/02	<	0.00020			0.027			0.014		<	0.005		<	0.001		<	0.001		7.20	
ST-C	12/16/02	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.91	Carbon change out
	12/23/02	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.22	
	1/3/03	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.13	
	1/6/03	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.04	
	1/14/03	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.21	
	1/22/03	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.43	
	1/27/03	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.15	
	2/3/03		0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.10	

Table 3.1-1
CAPA Groundwater Treatment System
Analytical Results
Treatment System Effluent

Sample Tap	Date	Analytical Results (mg/L)[1,2]																		pH	Comments
		Mercury			Carbon Tetrachloride			Chloroform			Methylene Chloride			Tetrachloroethene			Trichloroethene				
		Q[3]	Result	Flag[4]	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag		
Treated Groundwater Discharge Standards (mg/L)[5]			0.01			0.38			0.325			NA[6]			0.164			NA		6.0 - 9.0	
ST-C Continued	2/11/03	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.22	
	2/18/03		0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.04	
	2/24/03	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.15	
	3/3/03	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.11	
	3/10/03	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.17	
	3/18/03		0.00030		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001			
	3/24/03	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.20	
	4/3/03	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.88	
	4/8/03	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.15	
	4/15/03		0.00060		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.12	
	4/22/03	<	0.00020		<	0.001			0.001		<	0.005		<	0.001		<	0.001		6.61	
	4/29/03	<	0.00020		<	0.001			0.001		<	0.005		<	0.001		<	0.001		7.12	
	5/5/03	<	0.00020		<	0.001			0.002		<	0.005		<	0.001		<	0.001		7.01	
	5/13/03	<	0.00020		<	0.001			0.002		<	0.005		<	0.001		<	0.001			
	5/19/03	<	0.00020		<	0.001			0.003		<	0.005		<	0.001		<	0.001		7.10	
	5/28/03	<	0.00020		<	0.001			0.003		<	0.005		<	0.001		<	0.001		7.24	
	6/2/03	<	0.00020		<	0.001			0.004		<	0.005		<	0.001		<	0.001		7.21	
	6/9/03		0.00060		<	0.001			0.004		<	0.005		<	0.001		<	0.001		6.97	
	6/17/03		0.00040		<	0.001			0.005		<	0.005		<	0.001		<	0.001		6.84	
	6/23/03		0.00030		<	0.001			0.005		<	0.005		<	0.001		<	0.001		7.06	
	6/30/03	<	0.00020		<	0.001			0.005		<	0.005		<	0.001		<	0.001		7.14	
	7/8/03	<	0.00020		<	0.001			0.005		<	0.005		<	0.001		<	0.001		7.04	
	7/14/03	<	0.00020		<	0.001			0.005		<	0.005		<	0.001		<	0.001		7.03	
	7/21/03	<	0.00020		<	0.001			0.006		<	0.005		<	0.001		<	0.001		7.14	
	7/28/03	<	0.00020			0.001			0.007		<	0.005		<	0.001		<	0.001		7.12	
	8/5/03	<	0.00020			0.003			0.008		<	0.005		<	0.001		<	0.001		6.99	
	8/11/03	<	0.00020			0.003			0.008		<	0.005		<	0.001		<	0.001		6.93	
	8/20/03	<	0.00020			0.006			0.011		<	0.005		<	0.001		<	0.001		7.10	
	8/29/03	<	0.00020			0.006			0.01		<	0.005		<	0.001		<	0.001		7.24	
	9/1/03	<	0.00020			0.006			0.01		<	0.005		<	0.001		<	0.001		8.61	
	9/8/03	<	0.0002			0.011			0.009		<	0.005		<	0.001		<	0.001		6.89	
	9/17/03	<	0.0002			0.011			0.009		<	0.005		<	0.001		<	0.001		6.95	
	9/22/03	<	0.00020			0.016			0.01		<	0.005		<	0.001		<	0.001		6.90	
	9/29/03	<	0.00020			0.017			0.01		<	0.005		<	0.001		<	0.001		6.88	
	10/6/03	<	0.00020			0.025			0.013		<	0.005		<	0.001		<	0.001		6.98	
	10/13/03	<	0.00020			0.027			0.011		<	0.005		<	0.001		<	0.001		6.92	
	10/20/03	<	0.00020			0.03			0.011		<	0.005		<	0.001		<	0.001		7.00	
	10/27/03	<	0.00020			0.033			0.01		<	0.005		<	0.001		<	0.001		7.00	
	11/3/03	<	0.00020			0.041			0.012		<	0.005		<	0.001		<	0.001		6.97	
	11/11/03		0.00030			0.036			0.01		<	0.005		<	0.001		<	0.001		6.68	
	11/17/03	<	0.00020			0.046			0.011		<	0.005		<	0.001		<	0.001		6.70	
	11/25/03	<	0.00020			0.036			0.008		<	0.005		<	0.001		<	0.001		6.95	
ST-A	12/2/03		0.00140		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.01	Carbon change out
	12/8/03		0.00170		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.04	
	12/15/03		0.00140		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.73	
	12/22/03		0.00200		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.95	
	1/1/04		0.00220		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.90	
	1/7/04		0.00150		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.97	
	1/13/04		0.00220		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.86	
	1/21/04		0.00180		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.85	
	1/27/04		0.00140		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.90	
	2/4/04		0.00170		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.88	
	2/10/04		0.00140		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.89	
	2/17/04		0.00100		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.87	
	2/23/04		0.00100		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.88	
	3/1/04		0.00080		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.88	
	3/8/04		0.00030		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.10	
	3/19/04	<	0.00020			0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.32	
	3/22/04	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.74	
	4/2/04	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.87	
	4/5/04	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.18	
	4/12/04		0.00060		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.00	

Table 3.1-1
CAPA Groundwater Treatment System
Analytical Results
Treatment System Effluent

Sample Tap	Date	Analytical Results (mg/L)[1,2]																		pH	Comments
		Mercury			Carbon Tetrachloride			Chloroform			Methylene Chloride			Tetrachloroethene			Trichloroethene				
		Q[3]	Result	Flag[4]	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag		
Treated Groundwater Discharge Standards (mg/L)[5]			0.01			0.38			0.325			NA[6]			0.164			NA		6.0 - 9.0	
ST-A Continued	4/20/04	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.72	
	5/5/04	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.68	
	5/10/04		0.00040		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.56	
	5/20/04		0.00030		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.83	
	5/24/04	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.15	
	6/1/04	<	0.00020		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.82	
	6/8/04		0.00050		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.80	
	6/14/04		0.00070		<	0.005		<	0.005		<	0.05		<	0.005		<	0.005		6.67	
	6/22/04		0.00070		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.87	
	6/30/04		0.00130		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.77	
	7/7/04		0.00140		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.92	
	7/13/04		0.00060		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.00	
	7/22/04		0.00100		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.70	
	7/27/04		0.00060		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.86	
	8/2/04		0.00100		<	0.005		<	0.005		<	0.05		<	0.005		<	0.005		6.89	
	8/10/04		0.00120		<	0.005		<	0.005		<	0.05		<	0.005		<	0.005		6.73	
	8/18/04		0.00150		<	0.005		<	0.005		<	0.05		<	0.005		<	0.005		6.68	
	8/25/04		0.00150		<	0.005		<	0.005		<	0.05		<	0.005		<	0.005		6.60	
	9/3/04		0.00120		<	0.005		<	0.005		<	0.05		<	0.005		<	0.005		6.78	
	9/8/04		0.00140		<	0.005		<	0.005		<	0.05		<	0.005		<	0.005		6.79	
	9/13/04		0.00040		<	0.005		<	0.005		<	0.05		<	0.005		<	0.005		6.82	
	9/20/04		0.00070		<	0.005		<	0.005		<	0.05		<	0.005		<	0.005		6.80	
	9/27/04		0.00120		<	0.001			0.002		<	0.005		<	0.001		<	0.001		6.88	
	10/6/04		0.00170			0.001			0.002		<	0.005		<	0.001		<	0.001		6.83	
	10/11/04		0.00100			0.001			0.002		<	0.005		<	0.001		<	0.001		7.02	
	10/21/04		0.00050			0.001			0.002		<	0.005		<	0.001		<	0.001		6.79	
	10/26/04	<	0.00020		<	0.005		<	0.005		<	0.05		<	0.005		<	0.005		6.73	
	11/1/04		0.00210			0.001			0.002		<	0.005		<	0.001		<	0.001		6.77	
	11/8/04		0.00120			0.002			0.003		<	0.005		<	0.001		<	0.001		6.71	
	11/15/04		0.00160			0.003			0.004		<	0.005		<	0.001		<	0.001		6.52	
	11/22/04		0.00160			0.004			0.003		<	0.005		<	0.001		<	0.001		7.03	
ST-B	11/29/04		0.00130		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.35	Carbon change out
	12/8/04		0.00070		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.80	
	12/13/04		0.00090		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.13	
	12/20/04		0.00130		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.95	
	12/28/04		0.00080		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.87	
	1/3/05		0.0022		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.69	
	1/11/05		0.003		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		8.66	
	1/17/05		0.0003		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.73	
	1/25/05		0.0005		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.14	
	2/1/05		0.0002		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.60	
	2/9/05		0.0003		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.00	
	2/14/05		0.0002		<	0.005		<	0.005		<	0.005		<	0.005		<	0.005		6.94	
	2/21/05		0.0004		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.91	
	2/28/05		0.0002		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.98	
	3/7/05		0.00028		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.08	
	3/14/05	B	0.00013		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.05	
	3/21/05	<	0.0002		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.84	
	3/29/05		0.00029		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.15	
	4/5/05		0.00023		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.87	
	4/11/05		0.00033		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.84	
	4/19/05	<	0.0002		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.72	
	4/27/05	B	0.0002		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.12	
	5/2/05	B	0.0002		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.14	
	5/9/05		0.00051		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.90	
	5/16/05	B	0.00026		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.71	
	5/24/05		0.00051		<	0.001		J	0.0002		<	0.005		<	0.001		<	0.001		6.83	
	5/30/05		0.00074		<	0.001		J	0.0002		<	0.005		<	0.001		<	0.001		6.83	
	6/6/05		0.00035		<	0.001		J	0.0004		<	0.005		<	0.001		<	0.001		6.88	
	6/13/05	<	0.0002	B	<	0.001		J	0.0004		<	0.005		<	0.001		<	0.001		7.00	
	6/23/05	<	0.0002		<	0.001		J	0.0003		<	0.005		<	0.001		<	0.001		6.40	

Table 3.1-1
CAPA Groundwater Treatment System
Analytical Results
Treatment System Effluent

Sample Tap	Date	Analytical Results (mg/L)[1,2]																		pH	Comments
		Mercury			Carbon Tetrachloride			Chloroform			Methylene Chloride			Tetrachloroethene			Trichloroethene				
		Q[3]	Result	Flag[4]	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag		
Treated Groundwater Discharge Standards (mg/L)[5]			0.01			0.38			0.325			NA[6]			0.164			NA		6.0 - 9.0	
ST-B	6/27/05		0.0005		J	0.0002		J	0.0006		<	0.005		<	0.001		<	0.001		7.82	
ST-C	7/7/05	<	0.0002		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.40	Carbon change out 6/29/05
	7/11/05		0.00032		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		8.07	
	7/18/05	<	0.0002		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.82	
	7/25/05		0.00037		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.85	
	8/2/05	<	0.0002		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.82	
	8/9/05	B	0.00014		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.36	
	8/15/05	<	0.0002		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.68	
	8/23/05	<	0.0002		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.89	
	8/29/05	<	0.0002		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.80	
	9/6/05	<	0.0002		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.90	
	9/13/05		0.00065		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.77	
	9/20/05	<	0.0002		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.59	
	9/30/05	<	0.0002		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.76	
	10/4/05	<	0.0002		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.91	
	10/12/05	<	0.0002		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.68	
	10/17/05	<	0.0002		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.77	
	10/25/05	<	0.0002		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.78	
	11/2/05	B	0.00011		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.79	
	11/9/05	B	0.00018		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.56	
	11/14/05		0.0004		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.82	
	11/23/05	<	0.0002		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.77	
	11/29/05	<	0.0002		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.68	
	12/5/05	<	0.0001		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.55	
	12/16/05	<	0.0001		<	0.001		<	0.001		J	0.0005		<	0.001		<	0.001		6.75	
	12/19/05	<	0.0001		<	0.001		<	0.001		J	0.0002		<	0.001		<	0.001		7.60	
	12/28/05	<	0.0001	Y	<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		7.60	
	1/5/06	B	0.0001		<	0.001		<	0.001		J	0.0002		<	0.001		<	0.001		6.63	
	1/10/06	B	0.0001		<	0.001		<	0.001		J	0.0003		<	0.001		<	0.001		6.68	
	1/17/06		0.0002		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.82	
	1/25/06	B	0.00017		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.89	
	1/31/06		0.00024		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.79	
	2/6/06	<	0.0002		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.85	
	2/13/06	<	0.0002		<	0.001		<	0.001		<	0.005		<	0.001		<	0.001		6.78	
	2/24/06	J	0.00019		<	0.0002		<	0.0002		<	0.0002		<	0.0002		<	0.0002		6.42	
	2/27/06	<	0.0001		<	0.0002		<	0.0002		<	0.0002		<	0.0002		<	0.0002		7.36	
	3/6/06	<	0.0001		H, <	0.0001		H, <	0.0002		H, <	0.0002		H, <	0.0002		H, <	0.0002		6.75	
	3/13/06		0.00057		<	0.0002		<	0.0002		<	0.0002		<	0.0002		<	0.0002		6.77	
	3/20/06		0.00032		<	0.0002		<	0.0002		<	0.0002		<	0.0002		<	0.0002		7.00	
	3/27/06	<	0.0001		<	0.0002		<	0.0002		<	0.0002		<	0.0002		<	0.0002		6.66	
	4/3/06	J	0.00018		<	0.0002		<	0.0002		<	0.0002		<	0.0002		<	0.0002		7.23	
	4/11/06	<	0.00013		<	0.00025		<	0.0002		<	0.00053		<	0.0002		<	0.00032		6.86	
	4/18/06	<	0.00013		<	0.00025		<	0.0002		<	0.00053		<	0.0002		<	0.00032		6.40	
	4/25/06	<	0.00013		<	0.00025		<	0.0002		<	0.00053		<	0.0002		<	0.00032		6.76	
	5/3/06	<	0.00013		<	0.00025		<	0.0002		<	0.00053		<	0.0002		<	0.00032		6.30	
	5/11/06		0.00052		<	0.00025		<	0.0002		<	0.00053		<	0.0002		<	0.00032		6.86	
	5/17/06		0.00038		<	0.00025		<	0.0002		<	0.00053		<	0.0002		<	0.00032		6.82	
	5/22/06	<	0.00013		<	0.00025		<	0.0002		<	0.00053		<	0.0002		<	0.00032		7.06	
	5/30/06	J	0.00015		<	0.00025		<	0.0002		<	0.00053		<	0.0002		<	0.00032		6.95	
	6/5/06	<	0.00013		<	0.00025		<	0.0002		<	0.00053		<	0.0002		<	0.00032		7.14	
	6/12/06	B	0.00038		<	0.00025		J	0.00026		<	0.00053		<	0.0002		<	0.00032		6.81	
	6/23/06	J	0.00016		<	0.00025		J	0.00039		<	0.00053		<	0.0002		<	0.00032		6.97	
	6/27/06	J	0.00018		<	0.00025		<	0.0002		<	0.00053		<	0.0002		<	0.00032		7.24	
	7/6/06	<	0.00013		<	0.00025		J	0.00048		<	0.00053		<	0.0002		<	0.00032		6.96	
	7/11/06	<	0.00013		<	0.00025		J	0.00053		<	0.00053		<	0.0002		<	0.00032		6.96	
	7/17/06	<	0.00013		<	0.00025			0.001		<	0.00053		<	0.0002		<	0.00032		7.01	
	7/24/06	B	0.00028		<	0.00025			0.001		<	0.00053		<	0.0002		<	0.00032		6.81	
	7/31/06		0.00026		J	0.00031			0.0017		<	0.00053		<	0.0002		<	0.00032		6.90	
	8/7/06		0.00022		J	0.00042			0.0017		<	0.00053		<	0.0002		<	0.00032		6.98	
	8/16/06	<	0.00013		J	0.0007			0.0024		<	0.00053		<	0.0002		<	0.00032		6.64	
	8/23/06	J	0.00018		J	0.00069			0.0026		<	0.00053		<	0.0002		<	0.00032		6.80	
	8/29/06	<	0.00013		J	0.00088			0.0029		<	0.00053		<	0.0002		<	0.00032		6.73	

Table 3.1-1
CAPA Groundwater Treatment System
Analytical Results
Treatment System Effluent

Sample Tap	Date	Analytical Results (mg/L)[1,2]																		pH	Comments
		Mercury			Carbon Tetrachloride			Chloroform			Methylene Chloride			Tetrachloroethene			Trichloroethene				
		Q[3]	Result	Flag[4]	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag		
Treated Groundwater Discharge Standards (mg/L)[5]			0.01			0.38			0.325			NA[6]			0.164			NA		6.0 - 9.0	
ST-C Continued	9/6/06	J	0.00017		J	0.00057			0.0022		<	0.00053		<	0.0002		<	0.00032		6.77	
	9/13/06	J	0.00017		J	0.00095			0.0027		<	0.00053		<	0.0002		<	0.00032		6.58	
	9/18/06	<	0.00013			0.001			0.0033		<	0.00053		<	0.0002		<	0.00032		6.94	
	9/26/06	<	0.00013			0.0015			0.0038		<	0.00053		<	0.0002		<	0.00032		6.88	
	10/3/06	<	0.00013			0.0017			0.0037		<	0.00053		<	0.0002		<	0.00032		6.78	
	10/9/06		0.00046			0.0015			0.0031		<	0.00053		<	0.0002		<	0.00032		6.88	
	10/17/06		0.00022		J	0.00084			0.0026		<	0.00053		<	0.0002		<	0.00032		6.58	
	10/24/06		0.00026			0.0013			0.0038		<	0.00053		<	0.0002		<	0.00032		7.06	
	11/2/06		0.00024			0.0016			0.0036		<	0.00053		<	0.0002		<	0.00032		6.67	
	11/8/06	<	0.00013			0.0015			0.004		<	0.00053		<	0.0002		<	0.00032		7.04	
	11/15/06	<	0.00013			0.0014		B	0.0035		<	0.00053		<	0.0002		<	0.00032		6.78	
	11/21/06	<	0.00013			0.0016			0.0031		<	0.00053		<	0.0002		<	0.00032		7.00	
	11/27/06		0.00034			0.0019			0.0039		<	0.00053		<	0.0002		<	0.00032		7.26	
	12/5/06		0.00071			0.0021			0.0034		<	0.00053		<	0.0002		<	0.00032		6.67	
	12/14/06	<	0.00013			0.0027			0.0037		<	0.00053		<	0.0002		<	0.00032		6.93	
	12/20/06		0.00022			0.0032			0.0034		<	0.00053		<	0.0002		<	0.00032		7.08	
	12/27/06		0.00051			0.0029			0.003		<	0.00053		<	0.0002		<	0.00032		7.04	
	1/2/07	<	0.00013			0.0026			0.0026		<	0.00053		<	0.0002		<	0.00032		6.70	
	1/11/07	<	0.00013			0.0029			0.003		<	0.00053		<	0.0002		<	0.00032		6.88	
	1/18/07	J	0.00016			0.0023			0.0022		<	0.00053		<	0.0002		<	0.00032		6.40	
	1/25/07		0.00023			0.0026			0.0025		<	0.00053		<	0.0002		<	0.00032		6.58	
	2/1/07	<	0.00013			0.0023			0.0023		<	0.00053		<	0.0002		<	0.00032		6.63	
	2/8/07		0.00025			0.003			0.0028		<	0.00053		<	0.0002		<	0.00032		6.70	
	2/13/07		0.00023			0.0026			0.0023		<	0.00053		<	0.0002		<	0.00032		6.90	
	2/20/07		0.00035			0.0045			0.0032		<	0.00053		<	0.0002		<	0.00032		6.96	
	3/1/07	<	0.00013			0.0036			0.0029		<	0.00053		<	0.0002		<	0.00032		6.65	
	3/8/07	<	0.00013			0.0039			0.0032		<	0.00053		<	0.0002		<	0.00032		6.58	
	3/16/07	<	0.00013			0.003			0.0027		<	0.00053		<	0.0002		<	0.00032		6.61	
	3/19/07	<	0.00013			0.0034			0.0032		<	0.00053		<	0.0002		<	0.00032		6.56	
	3/27/07	<	0.00013			0.0026			0.0026		<	0.00053		<	0.0002		<	0.00032		6.86	
	4/3/07	<	0.00013			0.0045			0.0031		<	0.00053		<	0.0002		<	0.00032		6.40	
	4/12/07	<	0.00013			0.0036			0.0025		<	0.00053		<	0.0002		<	0.00032		6.36	
	4/19/07	<	0.00013			0.0042			0.0024		<	0.00053		<	0.0002		<	0.00032		6.29	
	4/24/07	J	0.00013			0.005			0.0031		<	0.00053		<	0.0002		<	0.00032		6.30	
	5/1/07	<	0.00013			0.0051			0.0026		<	0.00053		<	0.0002		<	0.00032		6.80	
	5/10/07	<	0.00013			0.0032			0.0025		<	0.00053		<	0.0002		<	0.00032		6.63	
	5/18/07	<	0.00013			0.0032			0.0023		<	0.00053		<	0.0002		<	0.00032		6.50	
	5/25/07	B	0.00033			0.0038			0.0029		<	0.00053		<	0.0002		<	0.00032		5.49	
	5/31/07	B	0.00073			0.0047			0.0022		<	0.00053		<	0.0002		<	0.00032		6.51	
	6/6/07		0.00031			0.0039			0.0021		<	0.00053		<	0.0002		<	0.00032		6.32	
	6/15/07		0.00038			0.0058			0.0022		<	0.00053		<	0.0002		<	0.00032		6.19	
	6/21/07		0.00038			0.0066			0.0024		<	0.00053		<	0.0002		<	0.00032		6.90	
	6/25/07	<	0.00013			0.0056			0.0025		<	0.00053		<	0.0002		<	0.00032		6.87	
	7/6/07		0.00027			0.0053			0.0019		<	0.00053		<	0.0002		<	0.00032		6.88	
	7/11/07		0.0002			0.0055			0.0021		<	0.00053		<	0.0002		<	0.00032		6.89	
ST-A	7/20/07		0.00096		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		7.32	Carbon change out 7/16/07
	7/23/07		0.00027		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.82	
	7/30/07		0.00027		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		7.38	
	8/6/07	<	0.00013		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.48	
	8/13/07	<	0.00013		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.93	
	8/20/07	<	0.00013		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.38	
	8/29/07	<	0.00013		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.93	
	9/5/07	<	0.00013		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.92	
	9/12/07	<	0.00013		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.93	
	9/20/07	J	0.00019		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.19	
	9/26/07		0.00021		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.78	
	10/1/07	J	0.00014		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.78	
	10/10/07	<	0.00013		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.78	
	10/18/07	<	0.00013		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.78	
	10/25/07	<	0.00013		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.97	
	10/29/07	<	0.00013		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.65	
	11/7/07	<	0.00013		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.20	

Table 3.1-1
CAPA Groundwater Treatment System
Analytical Results
Treatment System Effluent

Sample Tap	Date	Analytical Results (mg/L)[1,2]																		pH	Comments
		Mercury			Carbon Tetrachloride			Chloroform			Methylene Chloride			Tetrachloroethene			Trichloroethene				
		Q[3]	Result	Flag[4]	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag		
Treated Groundwater Discharge Standards (mg/L)[5]			0.01			0.38			0.325			NA[6]			0.164			NA		6.0 - 9.0	
ST-A Continued	11/16/07	<	0.00013		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		5.98	
	11/19/07	<	0.00013		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.81	
	11/29/07	<	0.00013		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.28	
	12/3/07	<	0.00013		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.30	
	12/11/07	<	0.00013		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.38	
	12/17/07	<	0.00013		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.66	
	12/26/07	<	0.00013		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.38	
	1/3/08	J	0.0014		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.99	
	1/9/08	<	0.00013		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.20	
	1/14/08	<	0.00013		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.35	
	1/23/08	<	0.00013		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.43	
	2/1/08		0.00027		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.22	
	2/7/08		0.00023		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.47	
	2/13/08		0.00031	B	<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.22	
	2/22/08	<	0.00013		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032			
	2/27/08		0.00024		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		5.68	
	3/5/08	<	0.00013		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		7.47	
	3/11/08	<	0.00013		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.38	
	3/20/08	<	0.00013		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.33	
	3/26/08	<	0.00013		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.60	
	4/4/08	<	0.00013		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.68	
	4/10/08	J	0.00017		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.65	
	4/18/08	<	0.00013		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.49	
	4/24/08		0.00027		<	0.00025		<	0.0002		<	0.001		J,B	0.00089		<	0.00032		6.32	
	4/28/08		0.00022		<	0.00025		<	0.0002		<	0.001		J,B	0.00049		<	0.00032		6.33	
	5/8/08		0.00021		<	0.00025		J	0.00038		<	0.001		<	0.0002		<	0.00032		6.56	
	5/15/08	J	0.00019		<	0.00025		J	0.00048		<	0.001		<	0.0002		<	0.00032		6.35	
	5/22/08		0.00021		<	0.00025		J	0.00061		<	0.001		<	0.0002		<	0.00032		6.19	
	5/28/08	<	0.00013		<	0.00025		J	0.00071		<	0.001		<	0.0002		<	0.00032		6.05	
	6/4/08	<	0.00013		<	0.00025		<	0.0002		<	0.001		<	0.0002		<	0.00032		6.96	
	6/11/08	<	0.00013		<	0.00025		J	0.00097		<	0.001		<	0.0002		<	0.00032		6.88	
	6/20/08	<	0.00013		<	0.00025			0.0011		<	0.001		<	0.0002		<	0.00032		6.88	
	6/27/08		0.00049		<	0.00025			0.0012		<	0.001		<	0.0002		<	0.00032		6.76	
	7/2/08	<	0.00013		<	0.00025			0.0013		<	0.001		<	0.0002		<	0.00032		6.75	
	7/8/08	J	0.00016		<	0.00025			0.0013		<	0.002		<	0.0002		<	0.00032		6.75	
	7/14/08		0.00033		<	0.00025			0.0014		<	0.002		<	0.0002		<	0.00032		7.07	
	7/22/08	J	0.00016		<	0.00025		<	0.0002		<	0.002		<	0.0002		<	0.00032		6.88	
	7/31/08	<	0.00013			0.0011			0.0016		<	0.002		<	0.0002		<	0.00032		6.74	
	8/4/08		0.00021		J	0.00083			0.0021		<	0.002		<	0.0002		<	0.00032		6.74	
	8/11/08	<	0.00013			0.0011			0.0019		<	0.002		<	0.0002		<	0.00032		6.34	
	8/21/08		0.00026			0.0018			0.002		<	0.002		<	0.0002		<	0.00032		6.74	
	8/25/08		0.00028			0.0036			0.0018		<	0.002		<	0.0002		<	0.00032		6.55	
	9/4/08		0.00051			0.033			0.0033		<	0.002		<	0.0002		<	0.00032		6.77	
	9/8/08		0.00038			0.057			0.005		<	0.002		<	0.0002		<	0.00032		6.74	
	9/19/08	<	0.00013			0.065			0.0071		<	0.002		<	0.0002		<	0.00032		6.67	
	9/25/08	<	0.00013			0.09			0.0089		<	0.002		<	0.0002		<	0.00032		6.93	
ST-B	10/3/08		0.00072			0.0017		<	0.0002		<	0.002		<	0.0002		<	0.00032		6.64	Carbon change out 10/2/08
	10/9/08		0.00086		J	0.00096		<	0.0002		<	0.002		<	0.0002		<	0.00032		6.64	
	10/13/08		0.00091		J	0.00059		<	0.0002		<	0.002		<	0.0002		<	0.00032		7.01	
	10/22/08		0.00071		J	0.00062		<	0.0002		<	0.002		<	0.0002		<	0.00032		6.95	
	10/27/08		0.00093		<	0.00025		<	0.0002		<	0.002		<	0.0002		<	0.00032		6.95	
	11/6/08		0.00048		J	0.0007		<	0.0002		<	0.002		<	0.0002		<	0.00032		6.93	
	11/14/08		0.00038		<	0.00025		<	0.0002		<	0.002		<	0.0002		<	0.00032		6.44	
	11/21/08		0.00027		J	0.00043		<	0.0002		<	0.002		<	0.0002		<	0.00032		6.93	
	11/26/08		0.00055		<	0.00025		<	0.0002		<	0.002		<	0.0002		<	0.00032		6.66	
	12/3/08		0.00032		<	0.00025		<	0.0002		<	0.002		<	0.0002		<	0.00032		6.77	
	12/11/08		0.00029		J	0.00044		<	0.0002		<	0.002		<	0.0002		<	0.00032		6.60	
	12/19/08		0.00025		<	0.00025		<	0.0002		<	0.002		<	0.0002		<	0.00032		6.90	
	12/22/08		0.00033		<	0.00025		<	0.0002		<	0.002		<	0.0002		<	0.00032		7.01	

Table 3.1-1
CAPA Groundwater Treatment System
Analytical Results
Treatment System Effluent

Sample Tap	Date	Analytical Results (mg/L)[1,2]																		pH	Comments
		Mercury			Carbon Tetrachloride			Chloroform			Methylene Chloride			Tetrachloroethene			Trichloroethene				
		Q[3]	Result	Flag[4]	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag		
Treated Groundwater Discharge Standards (mg/L)[5]			0.01			0.38			0.325			NA[6]			0.164			NA		6.0 - 9.0	
	12/31/08		0.00022		<	0.00025		<	0.0002		<	0.002		<	0.0002		<	0.00032		6.84	
	1/7/09		0.000419		U	0.0005		U	0.0005		J	0.00076		U	0.0006		U	0.0005		6.70	ALS Laboratory Group (2009)
	1/13/09		0.00026		U	0.0005		U	0.0005		U	0.0005		U	0.0006	—	U	0.0005		6.97	
	1/23/09		0.00119		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		6.97	
	1/29/09		0.000288		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.07	
	2/4/09		0.000282		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.04	
	2/10/09	J	0.00009		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		6.72	
	2/19/09	J	0.000091		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		6.59	
	2/26/09	J	0.000079		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		6.98	
	3/4/09	J	0.0016		J	0.0017		U	0.0005		U	0.0005		U	0.0006		U	0.0005		6.77	
	3/10/09	J	0.00012		J	0.0022		J	0.00069		U	0.0005		U	0.0006		U	0.0005		6.90	
	3/19/09	J	0.000057		J	0.0025		J	0.00079		U	0.0005		U	0.0006		U	0.0005		6.60	
	3/26/09	J	0.000191		U	0.0005		J	0.0013		U	0.0005		U	0.0006		U	0.0005		6.65	
	4/2/09		0.000213			0.0072		J	0.0018		U	0.0005		U	0.0006		U	0.0005		7.11	
	4/7/09	J	0.000196			0.0074		J	0.0018		U	0.0005		U	0.0006		U	0.0005		6.61	
	4/17/09	J	0.000155			0.0099		J	0.0024		U	0.0005		U	0.0006		U	0.0005		6.75	
	4/23/09		0.00021			0.014		J	0.0031		U	0.0005		U	0.0006		U	0.0005		6.67	
	5/1/09	J	0.000045			0.012		J	0.0032		U	0.0005		U	0.0006		U	0.0005		6.72	
	5/5/09	J	0.000151			0.015		J	0.0034		U	0.0005		U	0.0006		U	0.0005		7.18	
	5/15/09	J	0.00017			0.019		J	0.0044		U	0.0005		U	0.0006		U	0.0005		6.90	
	5/21/09		0.000357			0.023		J	0.0041		U	0.0005		U	0.0006		U	0.0005		7.16	
	5/29/09		0.000266			0.018		J	0.0044		U	0.0005		U	0.0006		U	0.0005		7.01	
	6/1/09		0.000251			0.025			0.0051		U	0.0005		U	0.0006		U	0.0005		6.98	
	6/8/09		0.000379			0.031			0.0056		U	0.0005		U	0.0006		U	0.0005		6.87	
	6/18/09		0.000284			0.03			0.0059		U	0.0005		J	0.00065		U	0.0005		7.13	
	6/22/09		0.000222			0.03			0.0059		U	0.0005		U	0.0006		U	0.0005		7.20	
ST-C	7/3/09	U	0.000042		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.94	
	7/9/09	U	0.000042		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.40	
	7/15/09	U	0.000042		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		6.95	
	7/22/09	J	0.000074		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		6.93	
	7/31/09	J	0.000065		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.05	
	8/7/09	J	0.000074		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.03	
	8/13/09	J	0.000082		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.59	
	8/20/09	J	0.000096		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.38	
	8/26/09	J	0.000094		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.40	
	9/3/09	J	0.000111		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.18	
	9/11/09	J	0.00014		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.09	
	9/15/09	J	0.000158		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.20	
	9/25/09	J	0.000126		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.36	
	10/1/09	J	0.000127		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		6.93	
	10/6/09	J	0.000188		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		6.76	
	10/16/09	J	0.000096		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		6.90	
	10/22/09	J	0.00014		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.04	
	10/28/09	J	0.000176		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		6.99	
	11/4/09	J	0.000156		J	0.0027		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.00	
	11/10/09	J	0.000106		U	0.0005		J	0.0005		U	0.0005		U	0.0006		U	0.0005		7.09	
	11/16/09	J	0.000122		U	0.0005		J	0.00061		U	0.0005		U	0.0006		U	0.0005		6.99	
	11/24/09	J	0.000132		U	0.0005		J	0.00065		U	0.0005		U	0.0006		U	0.0005		7.05	
	11/30/09	J	0.000165		J	0.0027		J	0.00091		U	0.0005		U	0.0006		U	0.0005		6.97	
	12/8/09	J	0.00014		J	0.0015		J	0.0011		U	0.0005		U	0.0006		U	0.0005		7.04	
	12/15/09	J	0.00014		U	0.005		J	0.0013		U	0.0005		U	0.0006		U	0.0005		7..05	
	12/21/09	J	0.000096			0.0052		J	0.0014		U	0.0005		U	0.0006		U	0.0005		6.97	
	12/28/09	J	0.000165		J	0.0045		J	0.0016		U	0.0005		U	0.0006		U	0.0005		7.17	
	1/5/10	J	0.000096			0.0063		J	0.0017		U	0.0005		U	0.0006		U	0.0005		7.08	
	1/12/10	J	0.000131			0.0116		J	0.0046		J	0.002		U	0.0006		U	0.0005		6.42	
	1/19/10	J	0.000131			0.0069		J	0.0026		U	0.0005		U	0.0006		U	0.0005		6.18	
	1/25/10	J	0.000092		J	0.0039		J	0.0018		U	0.0005		U	0.0006		U	0.0005		6.38	
	2/1/10	J	0.000139			0.013		J	0.0037		U	0.0005		U	0.0006		U	0.0005		7.73	
	2/11/10	J	0.000141			0.033			0.0076		U	0.0005		U	0.0006		U	0.0005		6.60	

Table 3.1-1
CAPA Groundwater Treatment System
Analytical Results
Treatment System Effluent

Sample Tap	Date	Analytical Results (mg/L)[1,2]																		pH	Comments
		Mercury			Carbon Tetrachloride			Chloroform			Methylene Chloride			Tetrachloroethene			Trichloroethene				
		Q[3]	Result	Flag[4]	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag		
Treated Groundwater Discharge Standards (mg/L)[5]			0.01			0.38			0.326			NA[6]			0.164			NA		6.0 - 9.0	
ST-C Continued	2/17/10	J	0.000144			0.036			0.0082		U	0.0005		U	0.0006		U	0.0005		7.32	
	2/22/10	J	0.000108			0.032			0.0089		U	0.0005		U	0.0006		U	0.0005		6.77	
	3/2/10	J	0.000145			0.038			0.0083		U	0.0005		U	0.0006		U	0.0005		7.03	
	3/10/10	J	0.00016			0.044			0.009		U	0.0005		U	0.0006		U	0.0005		6.39	
ST-A	3/17/10	U	0.000042		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		8.14	Carbon change out
	3/22/10	U	0.000042		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		8.46	
	3/31/10	U	0.000042		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.03	
	4/6/10	J	0.000084		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.20	
	4/12/10	U	0.000042		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.63	
	4/22/10	U	0.000042		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.44	
	4/28/10	J	0.000083		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		6.87	
	5/4/10	J	0.000043		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		6.62	
	5/10/10	J	0.000081		U	0.0005		J	0.00078		U	0.0005		U	0.0006		U	0.0005		6.75	
	5/20/10	U	0.000042		U	0.0005		J	0.0014		J	0.00077		U	0.0006		U	0.0005		6.58	
	5/24/10	J	0.000149		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		6.76	
	6/2/10	U	0.000042		U	0.0005		J	0.0017		U	0.0005		U	0.0006		U	0.0005		7.02	
	6/7/10	J	0.000066		J	0.0043		J	0.0019		U	0.0005		U	0.0006		U	0.0005		7.00	
	6/14/10	J	0.000088		J	0.0011		J	0.0021		U	0.0005		U	0.0006		U	0.0005		7.28	
	6/23/10	J	0.000159		J	0.0025		J	0.0032		U	0.0005		U	0.0006		U	0.0005		6.71	
	7/1/10	U	0.000042		J	0.0032		J	0.0044		U	0.0005		U	0.0006		U	0.0005		6.51	
	7/6/10	J	0.000049			0.066		J	0.0042		U	0.0005		U	0.0006		U	0.0005		6.48	
	7/12/10	U	0.000042			0.0061			0.0055		U	0.0005		U	0.0006		U	0.0005		6.99	
	7/22/10	J	0.000092			0.0084			0.007		U	0.0005		U	0.0006		U	0.0005		7.64	
	7/26/10	J	0.000069			0.0085			0.0071		U	0.0005		U	0.0006		U	0.0005		7.61	
	8/2/10	J	0.000069			0.015			0.0076		U	0.0005		U	0.0006		U	0.0005		7.40	
	8/12/10	U	0.000042			0.012			0.0081		U	0.0005		U	0.0006		U	0.0005		6.39	
	8/18/10	J	0.000078			0.016			0.0082		U	0.0005		U	0.0006		U	0.0005		6.51	
	8/23/10	J	0.00008			0.021			0.0096		U	0.0005		U	0.0006		U	0.0005		6.79	
	8/30/10	J	0.000075			0.02			0.0096		U	0.0005		U	0.0006		U	0.0005		6.85	
	9/8/10	U	0.000042			0.021			0.0092		U	0.0005		U	0.0006		U	0.0005		6.34	Carbon change out 9/10/10
ST-C	9/14/10	U	0.000042		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		8.53	
	9/20/10	J	0.000043		U	0.0005		U	0.0005		U	0.0005		J	0.0011		U	0.0005		7.37	
	9/27/10	U	0.000042		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		8.12	
	10/4/10	U	0.000042		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.15	
	10/12/10	U	0.000042		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.13	
	10/18/10		0.000439		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.18	
	10/28/10	J	0.000043		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		6.86	
	11/4/10	U	0.000042		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.62	
	11/8/10	U	0.000042		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.15	
	11/15/10	J	0.000048		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.43	
	11/23/10	U	0.000042		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		6.33	
	11/29/10	U	0.000042		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		6.96	
	12/6/10	J	0.000043		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.11	
	12/14/10	U	0.000042		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		6.83	
	12/21/10	J	0.000075		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		6.88	
	12/28/10	J	0.000061		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		4.78	
	1/3/11	U	0.000042		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.16	
	1/13/11	U	0.000042		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		6.86	
	1/17/11	U	0.000042		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.78	
	1/24/11	U	0.000042		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.53	
	1/31/11	U	0.000042		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.51	
	2/7/11	J	0.000058		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		6.58	
	2/14/11	J	0.000052		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.63	
	2/24/11	U	0.000042		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.79	
	3/1/11	J	0.000057		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		8.36	
	3/11/11	U	0.000042		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.80	
	3/18/11	J	0.000060		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.66	
	3/25/11	J	0.000054		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.10	

Table 3.1-1
CAPA Groundwater Treatment System
Analytical Results
Treatment System Effluent

Sample Tap	Date	Analytical Results (mg/L)[1,2]																		pH	Comments
		Mercury			Carbon Tetrachloride			Chloroform			Methylene Chloride			Tetrachloroethene			Trichloroethene				
		Q[3]	Result	Flag[4]	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag		
Treated Groundwater Discharge Standards (mg/L)[5]			0.01			0.38			0.325			NA[6]			0.164			NA		6.0 - 9.0	
ST-C Continued	4/1/11	J	0.000084		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		8.22	
	4/6/11	J	0.000055		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		8.44	
	4/13/11	U	0.000042		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		8.36	
	4/19/11	J	0.000055		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		8.07	
	4/25/11	J	0.000076		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		8.04	
	5/3/11	J	0.000049		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		7.18	
	5/13/11	J	0.000045		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		6.73	
	5/20/11	J	0.000048		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		6.75	
	5/26/11	J	0.000047		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		6.81	
	6/2/11	U	0.000042		U	0.0018		U	0.0010		U	0.0013		U	0.0017		U	0.0011		7.02	
	6/8/11	J	0.000060		U	0.0018		U	0.0010		U	0.0013		U	0.0017		U	0.0011		7.60	
	6/16/11	J	0.000079		U	0.0018		U	0.0010		U	0.0013		U	0.0017		U	0.0011		7.43	
	6/22/11	J	0.000084		U	0.0018		U	0.0010		U	0.0013		U	0.0017		U	0.0011		7.23	
	6/30/11	J	0.000104		U	0.0018		U	0.0010		U	0.0013		U	0.0017		U	0.0011		7.32	
	7/7/11	J	0.000078		U	0.0018		U	0.0010		U	0.0013		U	0.0017		U	0.0011		7.50	
	7/11/11	J	0.000126		U	0.0018		U	0.0010		U	0.0013		U	0.0017		U	0.0011		7.25	
	7/22/11	J	0.000092		U	0.0018		U	0.0010		U	0.0013		U	0.0017		U	0.0011		7.38	
	7/29/11	J	0.000101		U	0.0018		U	0.0010		U	0.0013		U	0.0017		U	0.0011		7.38	
	8/4/11	J	0.000079		U	0.0018		U	0.0010		U	0.0013		U	0.0017		U	0.0011		7.27	
	8/8/11	J	0.000082		U	0.0018		U	0.0010		U	0.0013		U	0.0017		U	0.0011		7.34	
	8/19/11	J	0.000104		U	0.0018		U	0.0010		U	0.0013		U	0.0017		U	0.0011		7.14	
	8/25/11	J	0.000108		U	0.0018		U	0.0010		U	0.0013		U	0.0017		U	0.0011		7.39	
	9/1/11	J	0.000077		U	0.0018		U	0.0010		U	0.0013		U	0.0017		U	0.0011		7.17	
	9/6/11	J	0.000102		U	0.0018		U	0.0010		U	0.0013		U	0.0017		U	0.0011		7.00	
	9/12/11	J	0.000110		U	0.0018		U	0.0010		U	0.0013		U	0.0017		U	0.0011		6.82	
	9/19/11		0.00195		U	0.0018		U	0.0010		U	0.0013		U	0.0017		U	0.0011		7.26	
	9/26/11	J	0.000049		U	0.0018		U	0.0010		U	0.0013		U	0.0017		U	0.0011		6.99	
	10/3/11	J	0.000084		U	0.0018		U	0.0010		U	0.0013		U	0.0017		U	0.0011		7.22	
	10/10/11	J	0.000051		U	0.0018		U	0.0010		U	0.0013		U	0.0017		U	0.0011		7.24	
	10/17/11	J	0.000091		U	0.0018		U	0.0010		U	0.0013		U	0.0017		U	0.0011		7.20	
	10/27/11	J	0.001100		U	0.0018		U	0.0010		U	0.0013		U	0.0017		U	0.0011		7.18	
	11/4/11	U	0.000042		U	0.0018		J	0.0015		U	0.0013		U	0.0017		U	0.0011		6.58	
	11/11/11	J	0.000084		U	0.0018		J	0.0013		U	0.0013		U	0.0017		U	0.0011		6.85	
	11/16/11	J	0.000071		U	0.0018		J	0.0016		U	0.0013		U	0.0017		U	0.0011		6.50	
	11/20/11	J	0.000083		U	0.0018		J	0.0017		U	0.0013		U	0.0017		U	0.0011		6.35	
	12/2/11	U	0.000042		U	0.0018		J	0.0014		U	0.0013		U	0.0017		U	0.0011		6.58	
	12/9/11	J	0.000052		U	0.0018		J	0.0014		U	0.0013		U	0.0017		U	0.0011		6.58	
	12/16/11		0.001480		U	0.0018		J	0.0015		U	0.0013		U	0.0017		U	0.0011		6.42	
	12/20/11	J	0.000048		U	0.0018		J	0.0016		U	0.0013		U	0.0017		U	0.0011		6.64	
	12/30/11	J	0.000046		U	0.0018		J	0.0013		U	0.0013		U	0.0017		U	0.0011		7.25	
	1/5/12	J	0.000113		U	0.0018		J	0.0012		U	0.0013		U	0.0017		U	0.0011		7.02	
	1/12/12	J	0.000097		U	0.0018		J	0.0010		U	0.0013		U	0.0017		U	0.0011		6.90	
	1/17/12	J	0.000150		U	0.0018		J	0.0016		U	0.0013		U	0.0017		U	0.0011		7.39	
	1/23/12	J	0.000094		U	0.0018		J	0.0015		U	0.0013		U	0.0017		U	0.0011		7.20	
	2/1/12	J	0.000138		U	0.0018		J	0.0022		U	0.0013		U	0.0017		U	0.0011		7.48	
	2/6/12	J	0.000063			0.0400		J	0.0150		U	0.0013		U	0.0017		U	0.0011		8.66	
	2/15/12	J	0.000180			0.0240		J	0.0049		U	0.0013		U	0.0017		U	0.0011		7.41	
	2/22/12	J	0.000169			0.0390			0.0063		U	0.0013		U	0.0017		U	0.0011		7.65	
	2/27/12	J	0.000152			0.0540			0.0068		U	0.0013		U	0.0017		U	0.0011		7.14	
ST-A	3/9/12	U	0.000042		U	0.0018		U	0.0010		U	0.0013		U	0.0017		U	0.0011		7.20	Carbon change out 3/8/12
	3/12/12	U	0.000042		U	0.0018		U	0.0010		U	0.0013		U	0.0017		U	0.0011		7.30	
	3/23/12	U	0.000042		U	0.0018		U	0.0010		U	0.0013		U	0.0017		U	0.0011		7.41	
	3/28/12	U	0.000042		U	0.0018		U	0.0010		U	0.0013		U	0.0017		U	0.0011		7.32	
	4/4/12	U	0.000042		U	0.0018		U	0.0010		U	0.0013		U	0.0017		U	0.0011		6.82	
	4/12/12	U	0.000042		U	0.0018		U	0.0010		U	0.0013		U	0.0017		U	0.0011		6.69	
ST-B	4/17/12	U	0.000042		U	0.0018		U	0.001		U	0.0013		U	0.0017		U	0.0011		6.74	Carbon change out 4/16/12
	4/25/12	U	0.000042		U	0.0018		U	0.001		U	0.0013		U	0.0017		U	0.0011		6.96	
	5/2/12	U	0.000042		U	0.0018		U	0.001		U	0.0013		U	0.0017		U	0.0011		6.68	

Table 3.1-1
CAPA Groundwater Treatment System
Analytical Results
Treatment System Effluent

Sample Tap	Date	Analytical Results (mg/L)[1,2]																		pH	Comments
		Mercury			Carbon Tetrachloride			Chloroform			Methylene Chloride			Tetrachloroethene			Trichloroethene				
		Q[3]	Result	Flag[4]	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag		
Treated Groundwater Discharge Standards (mg/L)[5]			0.01			0.38			0.325			NA[6]			0.164			NA		6.0 - 9.0	
ST-B Continued	5/10/12	U	0.000042		U	0.0018		U	0.001		U	0.0013		U	0.0017		U	0.0011		6.79	
	5/18/12	U	0.000042		U	0.0018		U	0.001		U	0.0013		U	0.0017		U	0.0011		6.68	
	5/25/12	U	0.000042		U	0.0018		U	0.001		U	0.0013		U	0.0017		U	0.0011		6.64	
	5/31/12	U	0.000042		U	0.0018		U	0.001		U	0.0013		U	0.0017		U	0.0011		6.26	
	6/6/12	U	0.000042		U	0.0018		U	0.001		U	0.0013		U	0.0017		U	0.0011		6.23	
	6/11/12	U	0.000042		U	0.0018		U	0.001		U	0.0013		U	0.0017		U	0.0011		6.62	
	6/18/12	U	0.000042		U	0.0018		U	0.001		U	0.0013		U	0.0017		U	0.0011		6.71	
	6/27/12	U	0.000042		U	0.0018		U	0.001		U	0.0013		U	0.0017		U	0.0011		6.54	
	7/2/12	J	0.000059		U	0.0018		U	0.001		U	0.0013		U	0.0017		U	0.0011		6.64	
	7/13/12	J	0.000048		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.62	
	7/20/12	U	0.000042		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.46	
	7/24/12	U	0.000042		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.62	
	8/2/12	U	0.000042		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.53	
	8/10/12	See Note 8 below			U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.43	
	8/15/12	U	0.000042		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.43	
	8/23/12	U	0.000042		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.28	
	8/29/12	U	0.000042		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		7.27	
	9/7/12	U	0.000042		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		7.27	
	9/13/12	U	0.000042		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		7.88	
	9/21/12	U	0.000042		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.36	
	9/28/12	U	0.000042		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.72	
	10/3/12	U	0.000042		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.35	
	10/10/12	U	0.000042		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.05	
	10/18/12	U	0.000042		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.16	
	10/26/12	U	0.000042		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.21	
	11/2/12	J	0.000056		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.15	
	11/8/12	U	0.000042		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.46	
	11/15/12	U	0.000042		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.67	
	11/19/12	U	0.000042		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.51	
	11/29/12	U	0.000042		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		7.33	
	12/6/12	U	0.000042		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		7.00	
	12/13/12	J	0.000052		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.59	
	12/19/12	U	0.000042		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.14	
	12/28/12	U	0.000042		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.18	
	1/3/13	U	0.000042		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.56	
	1/10/13	J	0.000052		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.44	
	1/14/13	J	0.000046		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.38	
	1/25/13	U	0.000042		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.21	
	2/1/13	U	0.000042		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.25	
	2/5/13	J	0.000044		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.28	
	2/11/13	U	0.000042		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.44	
	2/18/13	J	0.000046		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.24	
	2/24/13	U	0.000042		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.45	
	3/7/13	J	0.000044		U	0.001		J	0.0013		U	0.001		U	0.001		U	0.001		6.41	
	3/15/13	J	0.000044		U	0.001		J	0.0020		U	0.001		U	0.001		U	0.001		6.36	
	3/21/13	J	0.000068		U	0.001		J	0.0023		U	0.001		U	0.001		U	0.001		7.15	
	3/27/13	J	0.000056		U	0.001		J	0.0022		U	0.001		U	0.001		U	0.001		8.08	
	4/4/13	U	0.000042		U	0.001		J	0.0033		U	0.001		U	0.001		U	0.001		7.80	
	4/11/13	U	0.000042		U	0.001		J	0.0028		U	0.001		U	0.001		U	0.001		7.29	
	4/17/13	J	0.000086		U	0.001		J	0.0039		U	0.001		U	0.001		U	0.001		7.17	
	4/26/13	J	0.000046		U	0.001		J	0.0045		U	0.001		U	0.001		U	0.001		7.15	
	5/2/13	J	0.000118		U	0.001		J	0.0046		U	0.001		U	0.001		U	0.001		7.16	
	5/9/13	J	0.000047		U	0.001		J	0.0049		U	0.001		U	0.001		U	0.001		7.15	
	5/15/13	U	0.000042		U	0.001		J	0.0045		U	0.001		U	0.001		U	0.001		7.20	
	5/23/13	U	0.000042		J	0.0012		J	0.0047		U	0.001		U	0.001		U	0.001		6.90	
	5/28/13	U	0.000042		J	0.0015		J	0.0044		U	0.001		U	0.001		U	0.001		7.13	
	6/4/13	U	0.000042		J	0.0021		J	0.0042		U	0.001		U	0.001		U	0.001		7.19	
	6/11/13	J	0.000073		J	0.0025		J	0.0037		U	0.001		U	0.001		U	0.001		7.05	

Table 3.1-1
CAPA Groundwater Treatment System
Analytical Results
Treatment System Effluent

Sample Tap	Date	Analytical Results (mg/L)[1,2]																		pH	Comments
		Mercury			Carbon Tetrachloride			Chloroform			Methylene Chloride			Tetrachloroethene			Trichloroethene				
		Q[3]	Result	Flag[4]	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag		
Treated Groundwater Discharge Standards (mg/L)[5]			0.01			0.38			0.325			NA[6]			0.164			NA		6.0 - 9.0	
ST-B Continued	6/19/13	J	0.000075		J	0.0032		J	0.0042		U	0.001		U	0.001		U	0.001		7.68	
	6/24/13	J	0.000074		J	0.0032		J	0.0040		U	0.001		U	0.001		U	0.001		7.15	
	7/2/13	J	0.000061		J	0.0034		J	0.0039		U	0.001		U	0.001		U	0.001		7.30	
	7/10/13	J	0.000043		J	0.0041		J	0.0037		U	0.001		U	0.001		U	0.001		6.91	
	7/16/13	J	0.000091		J	0.0048		J	0.0037		U	0.001		U	0.001		U	0.001		6.87	
	7/23/13	J	0.000061		J	0.0061		J	0.0039		U	0.001		U	0.001		U	0.001		6.81	
	8/2/13	U	0.000040		J	0.0065		J	0.0041		U	0.001		U	0.001		U	0.001		6.83	
	8/6/13	J	0.000086			0.0078		J	0.0045		U	0.001		U	0.001		U	0.001		6.68	
	8/15/13	J	0.000075			0.0086		J	0.0037		U	0.001		U	0.001		U	0.001		6.76	
	8/22/13	J	0.000074			0.0083		J	0.0042		U	0.001		U	0.001		U	0.001		6.79	
	8/26/13	J	0.000093			0.0082		J	0.0041		U	0.001		U	0.001		U	0.001		6.81	
	9/5/13	J	0.000092			0.011		J	0.0043		U	0.001		U	0.001		U	0.001		6.74	
	9/13/13	J	0.000072			0.014		J	0.0039		U	0.001		U	0.001		U	0.001		6.70	
ST-C	9/20/13	J	0.000086		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.84	Carbon change out 9/16/13
	9/26/13	J	0.000053		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.77	
	10/1/13	U	0.00004		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.61	
	10/7/13	U	0.00004		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.67	
	10/17/13	U	0.00004		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.43	
	10/25/13	J	0.000076		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.56	
	10/31/13	J	0.000059		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.39	
	11/7/13	J	0.000095		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.48	
	11/15/13	J	0.000105		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.44	
	11/18/13	J	0.00006		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.42	
	11/25/13	J	0.000057		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.39	
	12/5/13	J	0.000069		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.40	
	12/13/13	J	0.00004		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.43	
	12/17/13	J	0.000054		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.44	
	12/23/13	J	0.000052		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.41	
	1/3/14	J	0.000123		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		6.36	
	1/9/14	J	0.000111		U	0.0006		U	0.0006		U	0.001		U	0.0006		U	0.0005		6.26	
	1/16/14	J	0.000075		U	0.0006		U	0.0006		U	0.001		U	0.0006		U	0.0005		6.29	
	1/23/14	J	0.000081		U	0.0006		U	0.0006		U	0.001		U	0.0006		U	0.0005		6.41	
	1/26/14	J	0.00006		U	0.0006		U	0.0006		U	0.001		U	0.0006		U	0.0005		6.43	
	2/7/14	J	0.000064		U	0.0006		U	0.0006		U	0.001		U	0.0006		U	0.0005		6.40	
	2/10/14	J	0.000066		U	0.0006		U	0.0006		U	0.001		U	0.0006		U	0.0005		6.32	
	2/18/14	J	0.000047		U	0.0006		U	0.0006		U	0.001		U	0.0006		U	0.0005		6.36	
	2/24/14	U	0.00004		U	0.0006		U	0.0006		U	0.001		U	0.0006		U	0.0005		6.32	
	3/4/14	U	0.00004		U	0.0006		U	0.0006		U	0.001		U	0.0006		U	0.0005		6.44	
	3/10/14	J	0.000042		U	0.0006		U	0.0006		U	0.001		U	0.0006		U	0.0005		6.37	
	3/20/14	J	0.000044		U	0.0006		U	0.0006		U	0.001		U	0.0006		U	0.0005		6.32	
	3/24/14	J	0.000062		U	0.0006		U	0.0006		U	0.001		U	0.0006		U	0.0005		6.35	
	4/3/14	J	0.000048		U	0.0006		U	0.0006		U	0.001		U	0.0006		U	0.0005		6.25	
	4/10/14	U	0.00004		U	0.0006		U	0.0006		U	0.001		U	0.0006		U	0.0005		6.25	
	4/17/14	J	0.000081		U	0.0006		U	0.0006		U	0.001		U	0.0006		U	0.0005		6.34	
	4/23/14	J	0.000086		U	0.0006		U	0.0006		U	0.001		U	0.0006		U	0.0005		6.22	
	4/29/14	J	0.000042		U	0.0005		U	0.0002		U	0.0004		U	0.0003		U	0.0002		6.25	
	5/7/14	J	0.000084		U	0.0006		U	0.0006		U	0.001		U	0.0006		U	0.0005		6.25	
	5/13/14	J	0.000058		U	0.0006		U	0.0006		U	0.001		U	0.0006		U	0.0005		6.28	
	5/22/14	J	0.000097		U	0.0006		U	0.0006		U	0.001		U	0.0006		U	0.0005		6.32	
	5/27/14	U	0.00004		U	0.0006		U	0.0006		U	0.001		U	0.0006		U	0.0005		6.27	
	6/6/14	J	0.000047		U	0.0006		U	0.0006		U	0.001		U	0.0006		U	0.0005		6.24	
	6/11/14	J	0.000067		U	0.0006		U	0.0006		U	0.001		U	0.0006		U	0.0005		6.20	
	6/19/14	J	0.000083		U	0.0006		U	0.0006		U	0.001		U	0.0006		U	0.0005		6.14	
	6/23/14	J	0.000097		U	0.0006		U	0.0006		U	0.001		U	0.0006		U	0.0005		6.36	
	6/30/14	J	0.000127		U	0.0006		J	0.0008		U	0.001		U	0.0006		U	0.0005		6.46	
	7/9/14	J	0.000055		U	0.0006		J	0.0008		U	0.001		U	0.0006		U	0.0005		6.27	
	7/15/14	J	0.000126		U	0.0006		J	0.0010		U	0.001		U	0.0006		U	0.0005		6.25	
	7/21/14	J	0.000095		U	0.0006		J	0.0011		U	0.001		U	0.0006		U	0.0005		6.91	

Table 3.1-1
CAPA Groundwater Treatment System
Analytical Results
Treatment System Effluent

Sample Tap	Date	Analytical Results (mg/L)[1,2]																		pH	Comments
		Mercury			Carbon Tetrachloride			Chloroform			Methylene Chloride			Tetrachloroethene			Trichloroethene				
		Q[3]	Result	Flag[4]	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag		
Treated Groundwater Discharge Standards (mg/L)[5]			0.01			0.38			0.325			NA[6]			0.164			NA		6.0 - 9.0	
ST-C Continued	7/29/14	U	0.000040		U	0.0006		J	0.0010		U	0.001		U	0.0006		U	0.0005		6.93	
	8/4/14	U	0.000040		U	0.0006		J	0.0014		U	0.001		U	0.0006		U	0.0005		7.07	
	8/15/14	J	0.000063		U	0.0006		J	0.0021		U	0.001		U	0.0006		U	0.0005		7.10	
	8/18/14	J	0.000097		J	0.00067		J	0.0026		U	0.001		U	0.0006		U	0.0005		7.21	
	8/25/14	J	0.000074		U	0.0006		J	0.0020		U	0.001		U	0.0006		U	0.0005		7.11	
	9/3/14	J	0.000107		U	0.0006		J	0.0023		U	0.001		U	0.0006		U	0.0005		6.42	
	9/12/14	J	0.000040		J	0.0013		J	0.0021		U	0.001		U	0.0006		U	0.0005		6.55	
	9/15/14	J	0.000129		U	0.0006		J	0.0007		U	0.001		U	0.0006		U	0.0005		6.39	
	9/23/14	J	0.000113		J	0.00084		J	0.0019		U	0.001		U	0.0006		U	0.0005		6.31	
	9/30/14	J	0.000102		J	0.00086		J	0.0021		U	0.001		U	0.0006		U	0.0005		6.73	
	10/8/14	J	0.000099		J	0.0009		J	0.0023		U	0.001		U	0.0006		U	0.0005		6.36	
	10/17/14	J	0.000113		J	0.00077		J	0.0018		U	0.001		U	0.0006		U	0.0005		6.34	
	10/23/14	J	0.000127		J	0.0012		J	0.0020		U	0.001		U	0.0006		U	0.0005		6.32	
	10/31/14	J	0.000091		J	0.0035		J	0.0027		U	0.001		U	0.0006		U	0.0005		6.29	
	11/3/14	J	0.000095		J	0.0039		J	0.0030		U	0.001		U	0.0006		U	0.0005		6.28	
	11/14/14	J	0.000078		J	0.0025		J	0.0028		U	0.001		U	0.0006		U	0.0005		6.28	
	11/21/14	J	0.000141		J	0.0038		J	0.0033		U	0.001		U	0.0006		U	0.0005		6.27	
	11/26/14	J	0.000100		J	0.0046		J	0.0032		U	0.001		U	0.0006		U	0.0005		6.34	
	12/4/14	J	0.000156			0.0052		J	0.0036		U	0.001		U	0.0006		U	0.0005		6.45	
	12/12/14	J	0.000152			0.0055		J	0.0037		U	0.001		U	0.0006		U	0.0005		6.27	
	12/15/14	J	0.000151			0.0056		J	0.0039		U	0.001		U	0.0006		U	0.0005		6.32	
	12/26/14	J	0.000064		J	0.0041		J	0.0034		U	0.001		U	0.0006		U	0.0005		6.37	
	12/31/14	J	0.000112		J	0.0046		J	0.0031		U	0.001		U	0.0006		U	0.0005		6.33	
	1/8/15	J	0.000113			0.0059		J	0.0033		U	0.010		U	0.0050		U	0.0050		6.20	
	1/15/15	J	0.000107			0.0063		J	0.0029		U	0.0010		U	0.00060		U	0.00050		6.19	
	1/21/15	J	0.000112			0.0058		J	0.0035		U	0.0010		U	0.00060		U	0.00050		6.22	
	1/27/15	J	0.000164			0.0086		J	0.0038		U	0.0010		U	0.00060		U	0.00050		6.16	
	2/4/15	J	0.000162			0.0094		J	0.0034		U	0.0010		U	0.00060		U	0.00050		6.08	
	2/11/15	J	0.000136			0.0098		J	0.0038		U	0.0010		U	0.00060		U	0.00050		6.28	
	2/19/15	J	0.000116			0.0096		J	0.0034		U	0.0010		U	0.00060		U	0.00050		6.38	
	2/27/15	J	0.0000520			0.0066		J	0.0027		U	0.0010		U	0.00060		U	0.00050		6.35	
	3/6/15	J	0.000139			0.011		J	0.0029		U	0.0010		U	0.00060		U	0.00050		NM[5]	pH probe not working properly
	3/10/15	J	0.000132			0.011		J	0.0030		U	0.0010		U	0.00060		U	0.00050		6.47	
	3/18/15	J	0.0000760			0.012		J	0.0038		U	0.0010		U	0.00060		U	0.00050		6.34	
	3/26/15	J	0.0000670			0.012		J	0.0035		U	0.0010		U	0.00060		U	0.00050		6.60	
	4/3/15	J	0.0000970			0.013		J	0.0036		U	0.0010		U	0.00060		U	0.00050		6.62	
	4/6/15	J	0.0001380			0.013		J	0.0036		U	0.0010		U	0.00060		U	0.00050		6.55	
	4/14/15	J	0.0000400			0.012		J	0.0026		U	0.0010		U	0.00060		U	0.00050		6.37	
	4/22/15	J	0.0000840			0.015		J	0.0029		U	0.0010		U	0.00060		U	0.00050		6.53	
	4/28/15	J	0.000153			0.012		J	0.0026		U	0.0010		U	0.00060		U	0.00050		6.64	
	5/7/15	J	0.000150			0.014		J	0.0025		U	0.0010		U	0.00060		U	0.00050		6.72	
	5/13/15	J	0.000113			0.011		J	0.0023		U	0.0010		U	0.00060		U	0.00050		6.51	
	5/21/15	J	0.000104			0.011		J	0.0025		U	0.0010		U	0.00060		U	0.00050		6.67	
	5/27/15	J	0.000126			0.011		J	0.0024		U	0.0010		U	0.00060		U	0.00050		6.47	
	6/5/15	J	0.000126			0.016		J	0.0025		U	0.0010		U	0.00060		U	0.00050		6.62	
	6/12/15	J	0.0000880			0.015		J	0.0024		U	0.0010		U	0.00060		U	0.00050		7.25	
	6/19/15	J	0.000132			0.016		J	0.0023		U	0.0010		U	0.00060		U	0.00050		7.46	
	6/24/15	J	0.000155			0.017		J	0.0024		U	0.0010		U	0.00060		U	0.00050		6.82	
	7/2/15	J	0.0001440			0.015		J	0.0021		U	0.0010		U	0.00060		U	0.00050		6.67	
	7/6/15	J	0.000163		U	0.00060		J	0.0022		U	0.0010		U	0.00060		U	0.00050		6.80	
	7/15/15	J	0.0000480			0.013		J	0.0024		U	0.0010		U	0.00060		U	0.00050		NM	
	7/24/15	J	0.0000720			0.016		J	0.0022		U	0.0010		U	0.00060		U	0.00050		6.89	
	7/28/15	J	0.000101			0.015		J	0.0020		U	0.0010		U	0.00060		U	0.00050		6.88	
	8/3/15	J	0.000165			0.014		J	0.0019		U	0.0010		U	0.00060		U	0.00050		7.36	
	8/10/15		0.000233			0.014		J	0.0020		U	0.0010		U	0.00060		U	0.00050		7.50	
	8/21/15	J	0.0000640			0.013		J	0.0021		U	0.0010		U	0.00060		U	0.00050		7.28	
	8/26/15	J	0.0000610			0.013		J	0.0020		U	0.0010		U	0.00060		U	0.00050		6.52	
	9/3/15	U	0.0000400			0.013		J	0.0017		U	0.0010		U	0.00060		U	0.00050		7.45	

Table 3.1-1
CAPA Groundwater Treatment System
Analytical Results
Treatment System Effluent

Sample Tap	Date	Analytical Results (mg/L)[1,2]																		pH	Comments
		Mercury			Carbon Tetrachloride			Chloroform			Methylene Chloride			Tetrachloroethene			Trichloroethene				
		Q[3]	Result	Flag[4]	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag		
Treated Groundwater Discharge Standards (mg/L)[5]			0.01			0.38			0.325			NA[6]			0.164			NA		6.0 - 9.0	
ST-C Continued	9/11/15	J	0.0000820			0.014		J	0.0019		U	0.0010		U	0.00060		U	0.00050		7.13	
	9/18/15	J	0.000133			0.014		J	0.0021		U	0.0010		U	0.00060		U	0.00050		7.18	
	9/25/15	J	0.000117			0.013		J	0.0019		U	0.0010		U	0.00060		U	0.00050		7.31	
	9/29/15		0.000228			0.013		J	0.0016		U	0.0010		U	0.00060		U	0.00050		7.32	
	10/8/15	J	0.000132			0.012		J	0.0020		U	0.0010		U	0.00060		U	0.00050		7.41	
	10/16/15	J	0.000127			0.012		J	0.0014		U	0.0010		U	0.00060		U	0.00050		7.39	
	10/21/15	J	0.000141			0.012		J	0.0016		U	0.0010		U	0.00060		U	0.00050		6.70	
	10/28/15		0.000202			0.012		J	0.0012		U	0.0010		U	0.00060		U	0.00050		6.90	
	11/5/15	J	0.000175			0.015		J	0.0012		U	0.0010		U	0.00060		U	0.00050		6.76	
	11/13/15	J	0.000160			0.011		J	0.0013		U	0.0010		U	0.00060		U	0.00050		7.08	
	11/19/15	J	0.000184			0.013		J	0.0013		U	0.0010		U	0.00060		U	0.00050		6.71	
	11/23/15	J	0.000190			0.012		J	0.0012		U	0.0010		U	0.00060		U	0.00050		6.79	
	12/4/15	J	0.000136			0.012		J	0.0012		U	0.0010		U	0.00060		U	0.00050		6.65	
	12/11/15	J	0.000127			0.013		J	0.0015		U	0.0010		U	0.00060		U	0.00050		7.27	
	12/15/15	J	0.000157			0.014		J	0.0015		U	0.0010		U	0.00060		U	0.00050		7.29	
	12/23/15	J	0.000171			0.015		J	0.0011		U	0.0010		U	0.00060		U	0.00050		6.88	
	12/31/15	J	0.0000960			0.011		J	0.0012		U	0.0010		U	0.00060		U	0.00050		6.40	

NOTES:
1) mg/L - milligrams per liter
2) Grey cells indicate analyses not requested
3) Q - Qualifier
< - Not detected (ND) at a value greater than the reporting limit (RL), for data prior to 2/24/06.
< - Not detected at a value greater than the method detection limit (MDL). (noted in Result column, for data 2/24/06 to 12/31/08.)
U - Not detected at a value greater than the method detection limit (MDL). (MDL noted in Result column, for data 12/31/08 to present)
B - Indicates that a value for an inorganic analysis is an estimate. It is used when a compound is determined to be 12/31/08 but at a concentration less than the quantitation limit of the method, for data prior to 2/24/06.
B - Indicates that the compound was found in the blank sample for both inorganic and metals analysis, for data 2/24/06 to 12/31/08.
H - Indicates a sample was prepped or analyzed beyond the specified holding time
J - Value for an organic analysis is an estimate, for data prior to 2/24/06.
J - Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value, for data 2/24/06 to present.
* - LCS or LCSD exceeds the control limits
4) Flag
B - Indicates that an analyte is present in the method blank as well as in the sample.
J - Value is an estimate; result falls within the MDL and the limit of quantitation (LQ) (Lancaster Laboratories).
Y - Used to identify a spike or spike duplicate recovery is outside the specified quality control limits
5) Treated groundwater discharge limitations recommended by the EPA in a letter dated 7/20/1998 to Mr. Ron Weddell.
6) NA - Not applicable
7) ST - Sample tap; sample tap either (A, B, or C) depends on arrangement of carbon canisters, which changes after each carbon change out.
8) Metals sample container was not received by laboratory.

Table 3.1-2
CAPA Groundwater Treatment System
Analytical Results
Recovery Wells

Sample Locations	Date	Analytical Results (mg/L)[1,2]																		pH	Comments
		Mercury			Carbon Tetrachloride			Chloroform			Methylene Chloride			Tetrachloroethene			Trichloroethene				
		Q[3]	Result	Flag[4]	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag		
CA050B	5/18/98		3.900			52.0			1.30		<	0.5000			0.330		<	0.500			
	5/29/98		4.200			116			1.80		<	0.2000			0.340		<	0.100			
	7/1/98		4.000			125			2.10		<	0.1000			0.340		<	0.100			
	7/28/98		3.300			128			1.90		<	0.2000			0.310		<	0.100			
	8/25/98		3.400			130			2.00		<	0.2000			0.290		<	0.100			
	12/22/98		2.200			142			2.30			0.0120	J		0.240			0.004	J		
	4/28/99		1.800			89.0			1.60		<	0.2000			0.190		<	0.100			
	6/30/99		1.700			50.0			1.40		<	0.1000			0.160		<	0.050			
	10/20/99		1.520			44.3			0.93		<	0.1000			0.099		<	0.050			
	2/2/00		1.460			77.4			0.90		<	0.0500			0.110		<	0.025			
	9/27/00		0.440			40.0			1.10		<	1.0000		<	0.200		<	0.200			
	1/10/01		1.080			74.0			1.10		<	2.0000		<	0.400		<	0.400			
	5/30/01		0.940			74.0			1.10		<	2.0000		<	0.500		<	0.500			
	10/22/01		0.780			75.0			0.90		<	4.0000		<	0.800		<	0.800			
	3/25/02		0.450			14.0			0.50		<	0.5000		<	0.100		<	0.100			
	8/12/02		0.690			53.0			0.70		<	2.0000		<	0.500		<	0.500			
	1/3/03		0.700			65.0			0.70		<	2.0000		<	0.500		<	0.500			
	5/19/03		0.870			70.0			0.80		<	2.0000		<	0.400		<	0.400			
	10/6/03		0.790			64.0			0.80		<	2.0000		<	0.500		<	0.500			
	2/23/04		0.410			64.0			0.90		<	2.0000		<	0.500		<	0.500			
	7/13/04		0.710			68.0			0.80		<	2.0000		<	0.500		<	0.500			
	11/29/04		0.960			78.0			0.80		<	2.0000		<	0.400		<	0.400			
	5/16/05		0.813			34.0			0.47		<	1.0000		J	0.110		<	0.200			
	5/3/06		0.590			38.0			0.64		J,B	0.1300		J	0.140		<	0.064			
	9/20/07		1.600			69.0			0.68		<	0.4000		J	0.260		<	0.130			
	10/13/08		0.540			39.0			0.52		<	0.8000		J	0.140		<	0.120			
	7/9/09		0.503			40.0			0.42		<	0.0005			0.120			0.013			
	7/6/10		0.393			52.0			0.45		U	0.0005			0.140			0.013			
	7/22/11		0.404			35.0			0.45		U	0.0650		J	0.110		U	0.055		6.81	
	9/28/12		0.394			25.0			0.34		U	0.0250		J	0.079		U	0.025		7.00	
	9/26/13		0.350			31.0			0.33		U	0.0250		J	0.080		U	0.025		6.89	
	9/5/14		0.486			32.0		J	0.30		U	0.1000		U	0.060		U	0.050		6.65	
	9/29/15		0.604			40			0.33		U	0.050		J	0.074		U	0.025		6.82	
CA051B	5/18/98		0.980			73.0			1.20		<	0.5000		<	0.500		<	0.500			
	5/29/98		0.880			94.0			1.60		<	0.2000			0.110		<	0.100			
	7/1/98		0.760			79.0			1.80		<	0.2000			0.110		<	0.100			
	7/28/98		0.610			69.0			1.50		<	0.1000			0.078		<	0.050			
	8/25/98		0.540			64.0			1.60		<	0.0500			0.075			0.007	J		
	12/22/98		0.360			59.0			2.00		<	0.0200			0.083		<	0.020			
	4/28/99		0.370			37.0			1.60		<	0.0500			0.061			0.004	J		
	6/30/99		0.330			29.0			1.60			0.0050	J		0.063			0.004	J		
	10/20/99		0.342			37.2			1.50		<	0.0200			0.072			0.006	J		
	2/2/00		0.312			40.5			1.40		<	0.0200			0.060			0.005	J		
	9/27/00		0.201			21.0			1.50		<	1.0000		<	0.200		<	0.200			
	1/10/01		0.370			11.0			0.98		<	0.2000			0.060		<	0.050			
	5/30/01		0.160			12.0			1.00		<	0.5000		<	0.100		<	0.100			
	10/22/01		0.560			52.0			7.00		<	2.0000		<	0.400		<	0.400			
	3/25/02		0.045			13.0			1.20		<	0.5000		<	0.100		<	0.100			
	8/12/02		0.072			15.0			1.20		<	0.0050			0.050			0.005			
	1/3/03		0.067			5.6			0.92		<	0.0010			0.040		<	0.002			
	5/19/03		0.101			17.0			0.87		<	0.1000			0.040		<	0.020			
	10/6/03		0.096			15.0			0.90		<	0.5000		<	0.100		<	0.100			
	2/23/04		0.049			4.4			0.73		<	0.1000			0.040		<	0.020			
	7/13/04		0.040			4.3			0.83		<	0.1000			0.050		<	0.020			
	11/29/04		0.150			21.0			0.90		<	1.0000		<	0.200		<	0.200			
	5/16/05		0.116			9.7			0.73		<	0.2500		J	0.038		<	0.050			
	5/3/06		0.081			12.0			0.72		J,B	0.0520		J	0.045		<	0.016			
	9/20/07		0.130			12.0			0.75		<	0.0800		J	0.029		<	0.026			
	10/13/08		0.065			12.0			0.54		<	0.1600		J	0.035		<	0.025			

Table 3.1-2
CAPA Groundwater Treatment System
Analytical Results
Recovery Wells

Sample Locations	Date	Analytical Results (mg/L)[1,2]																		pH	Comments
		Mercury			Carbon Tetrachloride			Chloroform			Methylene Chloride			Tetrachloroethene			Trichloroethene				
		Q[3]	Result	Flag[4]	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag		
CA051B Continued	7/9/09		0.0958			8.5			0.41		<	0.0005			0.026		J	0.0044			
	7/6/10		0.0134			1.6			0.32		U	0.0005			0.023		J	0.0067			
	7/22/11		0.0268			5.0			0.44		U	0.0065		J	0.025		U	0.0055		6.60	
	9/28/12		0.02040			9.8			0.36		U	0.0100		J	0.019		U	0.0100		6.71	
	9/26/13		0.00702			1.8			0.25		U	0.0010			0.020			0.0053		6.70	
	9/5/14		0.00722			1.8			0.18		U	0.0050		J	0.0079		J	0.0050		6.49	
	9/29/15		0.0367			5.1			0.34		U	0.010		J	0.019		J	0.0057		6.76	
CA052B	5/18/98		5.800			49.0			1.80		<	0.5000			1.400		<	0.500			
	5/29/98		0.300			64.0			2.50		<	0.2000			1.800			0.092	J		
	6/24/98		0.230																		
	7/1/98		0.320			66.0			2.20		<	0.2000			1.500			0.076	J		
	7/28/98		0.240			72.0			1.60		<	0.1000			1.000			0.051			
	8/25/98		0.270			207			1.80		<	0.2000			1.200			0.062	J		
	4/28/99		0.250			34.0			1.40		<	0.1000			0.400			0.020	J		
	6/30/99		0.090			23.0			0.90		<	0.0400			0.400			0.016	J		
	10/20/99		0.870			55.1			2.30			0.0290			0.480			0.025	J		
	2/2/00		0.047			12.0			0.70			0.0013	J		0.150			0.008			
	9/27/00		0.044			25.0			1.10		<	1.0000		<	0.200		<	0.200			
	1/10/01		0.060			16.0			0.60		<	0.5000		<	0.100		<	0.100			
	5/30/01		0.031			21.0			0.80		<	0.5000			0.100		<	0.100			
	10/22/01		0.036			21.0			0.60		<	1.0000		<	0.200		<	0.200			
	3/25/02		0.024			22.0			0.60		<	1.0000		<	0.200		<	0.200			
	8/12/02		0.025			22.0			0.50		<	0.5000			0.100		<	0.100			
	1/3/03		0.025			16.0			0.60		<	0.5000			0.100		<	0.100			
	5/19/03		0.025			17.0			0.50		<	0.5000			0.100		<	0.100			
	10/6/03		0.023			18.0			0.50		<	0.5000			0.100		<	0.100			
	2/23/04		0.025			18.0			0.50		<	0.5000			0.100		<	0.100			
	7/13/04		0.018			19.0			0.40		<	0.5000			0.200		<	0.100			
	11/29/04		0.020			17.0			0.40		<	0.5000			0.100		<	0.100			
	5/16/05		0.020			12.0			0.39		<	0.5000		J	0.077		<	0.100			
	5/3/06		0.016			10.0			0.38		J,B	0.1100		J	0.079		<	0.032			
	9/20/07		0.025			13.0			0.40		<	0.0800			0.140		<	0.026			
	10/13/08		0.014			8.0			0.29		<	0.1600		J	0.056		<	0.025			
	7/9/09		0.013			10.0			0.27		<	0.0005			0.074		J	0.003			
	7/6/10		0.007			8.8			0.26		U	0.0005			0.098		J	0.003			
	7/22/11		0.006			9.9			0.30		U	0.0320		J	0.079		U	0.028		6.83	
	9/28/12		0.005			8.7			0.24		U	0.0200		J	0.070		U	0.020		6.89	
	9/26/13		0.003			8.7			0.20		U	0.0100			0.064		U	0.010		6.93	
	9/5/14		0.004			8.3			0.18		U	0.0100			0.054		U	0.005		6.76	
	9/29/15		0.00410			5.6			0.20		U	0.010			0.068		U	0.0050		7.08	
CAOU23B	5/18/98		3.900			88.0			2.60		<	0.5000		<	0.500		<	0.500			
	5/29/98		2.500			118			3.40			0.0400	J		0.640			0.026	J		
	7/1/98		2.400			112			3.40			0.0550	J		0.630			0.025	J		
	7/28/98		2.400			119			3.40			0.0250	J		0.620		<	0.100			
	8/25/98		2.800			124			3.40			0.0320			0.550		<	0.100			
	12/22/98		1.400			127			3.60			0.0390	J		0.790			0.044			
	4/28/99		1.200			81.0			2.80		<	0.2000			0.600		<	0.100			
	6/30/99		1.200			54.0			3.00			0.0430	J		0.590			0.031	J		
	10/20/99		0.089			23.6			0.83			0.0045	J		0.301			0.016			
	2/2/00		0.705			58.9			2.20			0.0156	J		0.472			0.026			
	9/27/00		0.780			45.0			2.00		<	1.0000			0.400		<	0.200			
	1/10/01		0.044			48.0			2.00		<	1.0000			0.400		<	0.200			
	5/30/01		0.500			25.0			0.80		<	1.0000			0.200		<	0.200			
	10/22/01		0.410			38.0			1.30		<	1.0000			0.500		<	0.200			
	3/25/02		0.220			52.0			19.00		<	2.0000			0.500		<	0.400			
	8/12/02		0.450			36.0			1.30		<	1.0000			0.400		<	0.200			

Table 3.1-2
CAPA Groundwater Treatment System
Analytical Results
Recovery Wells

Sample Locations	Date	Analytical Results (mg/L)[1,2]																		pH	Comments
		Mercury			Carbon Tetrachloride			Chloroform			Methylene Chloride			Tetrachloroethene			Trichloroethene				
		Q[3]	Result	Flag[4]	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag		
CAOU23B Continued	1/3/03		0.490			44.0			1.40		<	2.0000			0.500		<	0.400			
	5/19/03		0.230			31.0			1.80		<	1.0000			0.400		<	0.200			
	10/6/03		0.260			31.0			2.20		<	1.0000			0.500		<	0.200			
	2/23/04		0.270			32.0			2.00		<	1.0000			0.600		<	0.200			
	7/13/04		0.300			36.0			1.50		<	1.0000			0.600		<	0.200			
	11/29/04		0.310			40.0			1.60		<	1.0000			0.600		<	0.200			
	5/16/05		0.259			36.0			1.60		J	0.0420			0.520		J	0.064			
	5/3/06		0.140			28.0			1.70		J,B	0.1500			0.410		<	0.064			
	9/20/07		0.250			26.0			1.20		<	0.2000			0.380		J	0.076			
	10/13/08		0.140			21.0			1.10		<	0.4000			0.350		<	0.063			
	7/9/09		0.141			20.0			1.00		J	0.0036			0.310			0.039			
	7/6/10		0.123			20.0			1.20		J	0.0034			0.450			0.051			
	7/22/11		0.102			15.0			0.89		U	0.0320			0.310		J	0.031		6.77	
	9/28/12		0.085			14.0			0.77		U	0.0250			0.250		J	0.029		6.86	
	9/26/13		0.084			14.0			0.82		U	0.0100			0.300		J	0.030		7.09	
	9/5/14		0.174			16.0			0.64		U	0.0100			0.280		J	0.036		6.67	
	9/29/15		0.172			16			0.83		U	0.050			0.30		J	0.045		6.96	

NOTE:
1) mg/L - milligrams per liter
2) Grey cells indicate analyses not requested.
3) Q - Qualifier.
< - Not detected (ND) at a value greater than the reporting limit (RL), for data prior to 2/24/06.
< - Not detected at a value greater than the method detection limit (MDL), noted in Result column, for data 2/24/06 to 12/31/08.
U - Not detected at a value greater than the method detection limit (MDL), noted in Result column, for data 12/31/08 to present.
B - Indicates that the compound was found in the blank sample for both inorganic and metals analysis, for data 2/24/06 to 12/31/08.
J - Value for an organic analysis is an estimate, for data prior to 2/24/06.
J - Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value, for data 2/24/06 to present.
4) Flag
J - Value is an estimate; result falls within the MDL and the limit of quantitation (LQ) (Lancaster Laboratories).

Table 3.1-3
CAPA Groundwater Treatment System
Analytical Results
Stripper Effluent

Sample Tap	Date	Analytical Results (mg/L)[1,2]																		pH	Comments
		Mercury			Carbon Tetrachloride			Chloform			Methylene Chloride			Tetrachloroethene			Trichloroethene				
		Q[3]	Result	Flag[4]	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag	Q	Result	Flag		
ST-9	5/18/98					0.63			0.034			0.0016			0.002		<	0.001			
	5/29/98		1.7																		
	6/10/98		1.0																		
	6/24/98		0.6																		
	7/1/98					0.33			0.018			0.00047	J		0.00079	J	<	0.001			
	7/28/98					0.32			0.019			0.00017	J		0.00062	J	<	0.001			
	8/25/98					0.26			0.018		<	0.002			0.00062	J	<	0.001			
	9/23/98					0.17			0.013		<	0.002			0.001		<	0.001			
	10/1/98					0.29			0.021		<	0.002			0.0008	J	<	0.001			
	10/7/98					0.037			0.006		<	0.002		<	0.001		<	0.001			
	12/16/98					0.026			0.0009		<	0.002		<	0.001		<	0.001			
	2/17/99					0.146			0.00324		<	0.002			0.001		<	0.001			
	3/10/99					0.050415			0.001822		<	0.002			0.00034	J	<	0.001			
	4/6/99					0.30273			0.006957		<	0.002			0.003346		<	0.001			
	5/5/99					0.872			0.062		<	0.002			0.007			0.0004	J		
	9/1/99					0.178			0.007		<	0.002			0.000979	J	<	0.001			
	9/29/99					0.033			0.0009		<	0.002			0.000204	J	<	0.001			
	10/27/99					11.931			0.516	J	<	0.002			0.172	J	<	0.001			
	2/24/00					0.00607			0.000256	J	<	0.002		<	0.001		<	0.001			
	8/9/00				<	0.001		<	0.001		<	0.005		<	0.001		<	0.001			
	10/5/00					0.048			0.011		<	0.005		<	0.001		<	0.001			
	1/10/01					0.001		<	0.001		<	0.005		<	0.001		<	0.001			
	5/30/01					0.005			0.021		<	0.005		<	0.001		<	0.001			
	10/22/01				<	0.001		<	0.001		<	0.005		<	0.001		<	0.001			
	3/25/02				<	0.001		<	0.001		<	0.005		<	0.001		<	0.001			
	8/12/02				<	0.001			0.006		<	0.005		<	0.001		<	0.001			
	1/3/03					0.003		<	0.001		<	0.005		<	0.001		<	0.001			
	5/19/03					0.001		<	0.001		<	0.005		<	0.001		<	0.001			
	10/6/03					0.001		<	0.001		<	0.005		<	0.001		<	0.001			
	11/3/03					0.001		<	0.001		<	0.005		<	0.001		<	0.001			
	2/23/04					0.002		<	0.001		<	0.005		<	0.001		<	0.001			
	7/13/04				<	0.001		<	0.001		<	0.005		<	0.001		<	0.001			
	11/29/04					0.001		<	0.001		<	0.005		<	0.001		<	0.001			
	5/16/05					0.001		J	0.4		<	0.005		<	0.001		<	0.001			
	6/13/05		0.106	B																	
	1/5/06				J	0.0007		J	0.0002		<	0.005		<	0.001		<	0.001			
	9/18/06				<	0.00025			0.001		<	0.00053		<	0.0002		<	0.00032			
	7/20/07				<	0.00025			0.0016		<	0.001		<	0.0002		<	0.00032			
	11/29/07				J	0.00042		<	0.0002		<	0.001		<	0.0002		<	0.00032			
	3/20/08				J	0.00073		<	0.0002		<	0.001		<	0.0002		<	0.00032			
	10/22/08					0.034			0.0014		<	0.002		J	0.0005		<	0.00032			
	11/26/08					0.0023		J	0.0002		<	0.002		<	0.0002		<	0.00032			
	3/4/09				J	0.0016		U	0.0005		U	0.0005		U	0.0006		U	0.0005			ALS Laboratory Group (2009)
	12/8/09				J	0.00069		U	0.0005		U	0.0005		U	0.0006		U	0.0005			
	3/10/10				U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005			
	8/18/10				J	0.0038		J	0.0037		U	0.0005		U	0.0006		U	0.0005			
	8/30/10		0.18		U	0.0005		U	0.0005		U	0.0005		U	0.0006		U	0.0005		6.77	
	3/18/11		0.188		J	0.0016		U	0.0005		U	0.0005		U	0.0006		U	0.0005		8.03	
	7/29/11		0.177		U	0.0018		U	0.001		U	0.0013		U	0.0017		U	0.0011		7.8	
	3/23/12		0.142		U	0.0018		U	0.001		U	0.0013		U	0.0017		U	0.0011		7.89	
	9/28/12		0.117		J	0.0011		U	0.001		U	0.001		U	0.001		U	0.001		6.91	
	3/27/13		0.124		U	0.001		U	0.001		U	0.001		U	0.001		U	0.001		8.54	
	9/26/13		0.124		J	0.0018		U	0.001		U	0.001		U	0.001		U	0.001		7.21	
	3/24/14		0.116		J	0.00085		U	0.0006		U	0.001		U	0.0006		U	0.0005		6.56	
	9/5/14		0.155		J	0.0045		U	0.0006		U	0.001		U	0.0006		U	0.0005		6.72	
	3/10/15		0.138		U	0.00060		U	0.00060		U	0.0010		U	0.00060		U	0.00050		6.45	
	9/29/15		0.0278		J	0.0035		J	0.0013		U	0.0010		U	0.00060		U	0.00050		6.97	

NOTES:
1) mg/L - milligrams per liter
2) Grey cells indicate analyses not requested.
3) Q - Qualifier
< - Not detected (ND) at a value greater than the reporting limit (RL), for data prior to 2/24/06.
< - Not detected at a value greater than the method detection limit (MDL). (noted in Result column, for data 2/24/06 to 12/31/08.)
U - Not detected at a value greater than the method detection limit (MDL). (MDL noted in Result column, for data 12/31/08 to present)
J - Value for an organic analysis is an estimate, for data prior to 2/24/06.
J - Result is less than the RL but greater than or equal to the MDL and the concentration is an approximate value, for data 2/24/06 to present.
4) Flag
B - Indicates that an analyte is present in the method blank as well as in the sample.
J - Value is an estimate; result falls within the MDL and the limit of quantitation (LQ) (Lancaster Laboratories).

Table 3.1-4
CAPA Groundwater Treatment System
Recovery Well Pumping Data

Year	Month	CA050B (gal)[1]	CA051B (gal)	CA052B (gal)	CA0U23B (gal)	Total Influent (gal)
1998	June	94,940	120,650	44,346	59,007	318,943
	July	94,464	143,035	46,670	103,993	388,162
	August	82,659	123,384	0	86,436	292,479
	September	52,560	168,124	27,020	13,602	261,306
	October	148,429	106,740	0	45,082	300,251
	November	84,170	70,057	0	90,008	244,235
	December	134,556	143,925	0	140,915	419,396
	TOTAL	**691,778**	**875,915**	**118,036**	**539,043**	**2,224,772**
1999	January	56,244	58,568	38,400	57,835	211,047
	February	43,480	41,230	14,454	66,873	166,037
	March	32,402	52,900	17,521	57,332	160,155
	April	86,908	73,850	25,635	89,265	275,658
	May	52,110	43,020	30,810	53,470	179,410
	June	51,070	50,110	32,000	52,310	185,490
	July	94,520	137,330	70,210	98,850	400,910
	August	60,300	91,700	62,790	63,870	278,660
	September	54,440	84,460	55,250	61,830	255,980
	October	59,750	118,130	65,400	82,860	326,140
	November	61,620	84,320	63,950	67,910	277,800
	December	33,170	41,080	38,180	37,680	150,110
	TOTAL	**686,014**	**876,698**	**514,600**	**790,085**	**2,867,397**
	CUMULATIVE TOTAL, ALL WELLS					**5,092,169**
2000	January	63,290	84,390	71,800	77,950	297,430
	February	77,580	96,090	84,360	79,630	337,660
	March	79,810	101,600	81,090	70,760	333,260
	April	58,820	75,800	63,660	56,470	254,750
	May	90,340	67,330	76,340	74,720	308,730
	June	94,060	111,140	73,990	83,730	362,920
	July	88,230	65,640	46,950	67,490	268,310
	August	60,300	91,700	62,790	63,870	278,660
	September	37,980	84,460	55,250	61,830	239,520
	October	103,210	67,430	77,250	96,270	344,160
	November	102,960	71,210	91,510	93,480	359,160
	December	90,830	2,450	76,480	41,210	210,970
	TOTAL	**947,410**	**919,240**	**861,470**	**867,410**	**3,595,530**
	CUMULATIVE TOTAL, ALL WELLS					**8,687,699**
2001	January	106,250	57,650	83,430	88,310	335,640
	February	65,070	29,070	75,050	100,330	269,520
	March	69,460	62,430	65,310	86,790	283,990
	April	71,520	57,640	52,830	63,090	245,080
	May	120,620	79,750	81,700	52,480	334,550
	June	61,820	56,160	89,260	47,550	254,790
	July	52,500	61,180	74,640	66,440	254,760
	August	69,270	72,300	118,580	81,120	341,270
	September	44,410	49,250	77,680	77,570	248,910
	October	107,030	33,520	66,620	47,870	255,040
	November	59,710	16,210	53,650	48,180	177,750
	December	81,500	81,500	71,100	60,800	294,900
	TOTAL	**909,160**	**656,660**	**909,850**	**820,530**	**3,296,200**
	CUMULATIVE TOTAL, ALL WELLS					**11,983,899**
2002	January	98,390	36,800	95,520	61,250	291,960
	February	74,600	28,450	72,020	52,110	227,180
	March	42,770	58,080	55,110	54,960	210,920
	April	84,520	85,820	75,770	82,670	328,780
	May	50,210	49,080	68,130	70,820	238,240
	June	83,990	77,020	64,090	73,860	298,960
	July	103,700	91,110	123,550	89,760	408,120
	August	79,220	75,700	80,840	73,170	308,930
	September	68,450	67,680	65,470	57,150	258,750
	October	83,260	83,700	83,860	86,470	337,290
	November	47,870	49,790	71,700	70,480	239,840
	December	83,500	74,330	67,720	82,790	308,340
	TOTAL	**900,480**	**777,560**	**923,780**	**855,490**	**3,457,310**

Table 3.1-4
CAPA Groundwater Treatment System
Recovery Well Pumping Data

Year	Month	CA050B (gal)[1]	CA051B (gal)	CA052B (gal)	CA0U23B (gal)	Total Influent (gal)
2002	**CUMULATIVE TOTAL, ALL WELLS**					**15,441,209**
2003	January	84,500	58,060	51,490	73,880	267,930
	February	49,680	48,730	52,040	23,230	173,680
	March	110,080	110,650	62,330	75,600	358,660
	April	83,350	64,460	73,230	60	221,100
	May	56,140	67,810	66,560	36,000	226,510
	June	80,680	89,200	62,490	35,640	268,010
	July	91,660	93,820	96,350	39,310	321,140
	August	64,540	77,480	94,940	29,610	266,570
	September	94,950	104,220	127,540	49,560	376,270
	October	36,780	83,190	100,920	68,590	289,480
	November	231,100	38,770	88,930	58,910	417,710
	December	110,190	27,090	108,400	24,090	269,770
	TOTAL	**1,093,650**	**863,480**	**985,220**	**514,480**	**3,456,830**
	CUMULATIVE TOTAL, ALL WELLS					**18,898,039**
2004	January	129,290	55,140	128,330	4,280	317,040
	February	97,630	59,860	58,300	35,060	250,850
	March	118,330	82,990	104,600	80,830	386,750
	April	76,220	51,410	52,430	61,080	241,140
	May	46,090	57,900	43,250	44,740	191,980
	June	66,830	62,810	64,390	49,780	243,810
	July	65,080	47,690	60,780	44,380	217,930
	August	67,980	79,900	61,700	45,780	255,360
	September	16,150	98,950	71,040	51,720	237,860
	October	15,930	42,940	69,920	50,340	179,130
	November	103,390	93,870	93,770	54,780	345,810
	December	64,540	77,000	76,890	56,320	274,750
	TOTAL	**867,460**	**810,460**	**885,400**	**579,090**	**3,142,410**
	CUMULATIVE TOTAL, ALL WELLS					**22,040,449**
2005	January	78,750	35,700	65,760	47,560	227,770
	February	103,650	88,410	92,250	65,270	349,580
	March	95,120	47,260	78,380	51,580	272,340
	April	96,680	51,890	81,280	51,610	281,460
	May	103,370	102,640	89,680	38,940	334,630
	June	95,330	11,800	29,580	16,830	153,540
	July	64,660	54,670	56,790	18,940	195,060
	August	74,190	68,130	64,470	22,380	229,170
	September	73,810	75,280	63,620	38,040	250,750
	October	84,450	20,350	73,040	52,010	229,850
	November	125,440	18,950	99,370	38,910	282,670
	December	94,040	62,280	53,740	16,780	226,840
	TOTAL	**1,089,490**	**637,360**	**847,960**	**458,850**	**3,033,660**
	CUMULATIVE TOTAL, ALL WELLS					**25,074,109**
2006	January	91,090	65,510	62,440	67,880	286,920
	February	99,040	69,830	180	24,420	193,470
	March	82,410	69,150	40,220	50,430	242,210
	April	107,470	96,190	105,340	43,880	352,880
	May	130,240	79,280	127,530	73,690	410,740
	June	95,670	96,640	102,141	57,010	351,461
	July	114,830	110,010	131,199	67,870	423,909
	August	86,450	83,190	108,970	57,850	336,460
	September	5,190	113,640	146,870	74,010	339,710
	October	0	95,820	99,390	16,770	211,980
	November	36,240	93,710	68,760	43,920	242,630
	December	93,760	66,030	48,040	27,460	235,290
	TOTAL	**942,390**	**1,039,000**	**1,041,080**	**605,190**	**3,627,660**
	CUMULATIVE TOTAL, ALL WELLS					**28,701,769**
2007	January	56,240	73,810	0	59,320	189,370
	February	47,980	68,410	33,980	28,040	178,410
	March	41,510	41,310	34,260	33,140	150,220
	April	56,420	67,350	57,220	51,730	232,720
	May	57,130	55,440	56,500	28,740	197,810
	June	76,370	79,230	68,240	45,520	269,360

Table 3.1-4
CAPA Groundwater Treatment System
Recovery Well Pumping Data

Year	Month	CA050B (gal)[1]	CA051B (gal)	CA052B (gal)	CA0U23B (gal)	Total Influent (gal)
2007	July	86,610	70,410	43,660	31,250	231,930
	August	22,350	100,910	6,030	41,540	170,830
	September	58,700	73,050	51,800	12,340	195,890
	October	81,650	115,960	88,890	18,300	304,800
	November	17,440	77,710	80,430	50	175,630
	December	39,410	83,380	101,580	30,440	254,810
	TOTAL	**641,810**	**906,970**	**622,590**	**380,410**	**2,551,780**
	CUMULATIVE TOTAL, ALL WELLS					**31,253,549**
2008	January	75,870	85,800	71,610	48,490	281,770
	February	49,440	52,010	49,930	21,670	173,050
	March	28,360	89,270	77,750	34,140	229,520
	April	115,960	111,690	123,590	54,420	405,660
	May	61,950	65,360	97,900	43,270	268,480
	June	117,100	59,990	77,420	24,440	278,950
	July	90,450	96,410	113,900	51,380	352,140
	August	89,370	94,570	86,520	57,080	327,540
	September	77,560	88,830	37,870	56,980	261,240
	October	111,200	119,510	130,040	49,750	410,500
	November	117,320	89,360	107,970	45,400	360,050
	December	118,970	99,220	109,240	44,320	371,750
	TOTAL	**1,053,550**	**1,052,020**	**1,083,740**	**531,340**	**3,720,650**
	CUMULATIVE TOTAL, ALL WELLS					**34,974,199**
2009	January	102,620	98,940	68,640	39,400	309,600
	February	89,130	133,220	88,930	42,180	353,460
	March	89,510	97,320	84,060	44,870	315,760
	April	120,620	66,890	106,260	63,360	357,130
	May	78,350	90,300	101,380	60,280	330,310
	June	80,660	77,260	88,190	45,520	291,630
	July	91,040	100,080	98,360	53,990	343,470
	August	75,240	72,520	88,650	39,080	275,490
	September	89,350	75,160	91,560	46,250	302,320
	October	96,500	95,480	102,630	49,900	344,510
	November	113,300	99,640	111,400	52,860	377,200
	December	105,430	124,530	76,840	46,590	353,390
	TOTAL	**1,131,750**	**1,131,340**	**1,106,900**	**584,280**	**3,954,270**
	CUMULATIVE TOTAL, ALL WELLS					**38,928,469**
2010	January	52,720	57,060	56,230	38,510	204,520
	February	83,730	89,630	91,960	59,560	324,880
	March	65,750	84,780	103,060	63,970	317,560
	April	90,970	89,470	94,390	34,190	309,020
	May	61,190	68,940	84,160	55,090	269,380
	June	60,580	60,580	81,780	55,590	258,530
	July	87,350	93,790	89,940	66,060	337,140
	August	75,280	80,100	98,830	77,610	331,820
	September	78,290	68,920	82,540	28,350	258,100
	October	70,800	62,941	86,310	45,620	265,671
	November	84,990	93,090	87,220	71,100	336,400
	December	80,300	74,120	78,910	62,000	295,330
	TOTAL	**891,950**	**923,421**	**1,035,330**	**657,650**	**3,508,351**
	CUMULATIVE TOTAL, ALL WELLS					**42,436,820**
2011	January	78,430	71,580	92,590	63,870	306,470
	February	63,050	55,840	48,380	34,460	201,730
	March	76,350	36,750	82,880	58,020	254,000
	April	71,410	53,250	90,600	75,830	291,090
	May	99,970	12,790	82,730	51,340	246,830
	June	44,800	162,810	32,220	68,900	308,730
	July	99,970	103,510	78,120	64,040	345,640
	August	101,610	102,590	75,780	65,340	345,320
	September	98,190	95,810	81,800	66,250	342,050
	October	89,080	71,740	92,250	74,890	327,960
	November	54,220	61,580	67,800	46,580	230,180
	December	46,060	35,400	53,940	28,430	163,830
	TOTAL	**923,140**	**863,650**	**879,090**	**697,950**	**3,363,830**
	CUMULATIVE TOTAL, ALL WELLS					**45,800,650**

Table 3.1-4
CAPA Groundwater Treatment System
Recovery Well Pumping Data

Year	Month	CA050B (gal)[1]	CA051B (gal)	CA052B (gal)	CA0U23B (gal)	Total Influent (gal)
2012	January	62,760	58,550	77,300	55,730	254,340
	February	116,490	115,930	130,622	87,250	450,292
	March	55,560	54,010	62,618	40,490	212,678
	April	86,230	88,490	85,780	62,650	323,150
	May	127,780	127,410	117,720	80,910	453,820
	June	98,460	69,470	97,250	53,250	318,430
	July	103,630	123,240	118,450	71,570	416,890
	August	120,300	137,100	142,630	61,240	461,270
	September	91,690	97,780	61,210	55,010	305,690
	October	91,890	87,080	124,050	66,130	369,150
	November	124,220	106,210	125,230	65,740	421,400
	December	116,910	85,380	116,720	45,790	364,800
	TOTAL	**1,195,920**	**1,150,650**	**1,259,580**	**745,760**	**4,351,910**
	CUMULATIVE TOTAL, ALL WELLS					**50,152,560**
2013	January	113,370	77,990	116,270	66,770	374,400
	February	112,590	95,460	75,310	70,800	354,160
	March	98,780	92,420	96,280	66,770	354,250
	April	89,340	82,670	90,170	61,090	323,270
	May	116,300	65,810	132,000	80,830	394,940
	June	125,010	82,630	106,160	44,350	358,150
	July	121,530	84,250	108,210	62,060	376,050
	August	141,140	90,940	125,180	72,250	429,510
	September	105,950	81,600	96,240	56,930	340,720
	October	125,250	115,720	115,850	78,450	435,270
	November	107,610	83,470	90,570	62,050	343,700
	December	130,840	79,140	105,340	70,960	386,280
	TOTAL	**1,387,710**	**1,032,100**	**1,257,580**	**793,310**	**4,470,700**
	CUMULATIVE TOTAL, ALL WELLS					**54,623,260**
2014	January	145,420	88,720	122,080	78,900	435,120
	February	110,220	72,030	95,290	61,110	338,650
	March	121,620	69,560	116,190	72,990	380,360
	April	111,760	91,620	123,420	78,860	405,660
	May	104,770	78,750	117,760	76,870	378,150
	June	111,550	85,960	124,430	82,170	404,110
	July	69,490	71,810	95,010	65,810	302,120
	August	89,790	82,060	80,530	70,360	322,740
	September	121,190	62,520	130,350	83,330	397,390
	October	70,820	72,170	97,650	64,820	305,460
	November	63,310	61,890	78,490	54,850	258,540
	December	125,550	103,600	125,340	88,360	442,850
	TOTAL	**1,245,490**	**940,690**	**1,306,540**	**878,430**	**4,371,150**
	CUMULATIVE TOTAL, ALL WELLS					**58,994,410**
2015	January	97,570	64,200	93,990	66,320	322,080
	February	82,520	108,400	95,260	73,180	359,360
	March	81,380	93,950	88,580	68,370	332,280
	April	96,290	116,820	111,520	84,410	409,040
	May	88,710	100,050	91,040	71,870	351,670
	June	84,870	84,330	82,880	64,320	316,400
	July	75,060	101,030	91,420	77,630	345,140
	August	41,420	56,320	41,350	42,420	181,510
	September	25,610	75,880	44,700	53,690	199,880
	October	102,540	77,780	100,610	4,350	285,280
	November	98,660	76,390	101,330	0	276,380
	December	117,190	74,430	91,210	15,340	298,170
	TOTAL	**991,820**	**1,029,580**	**1,033,890**	**621,900**	**3,677,190**
	CUMULATIVE TOTAL, ALL WELLS					**62,671,600**

NOTE:
1) gal - gallons

Table 3.1-5
CAPA Groundwater Treatment System
Approximate Mass of Mercury Removed
Recovery Wells

Year	Month	CA050B Cumulative Flow	CA050B Mercury				CA051B Cumulative Flow	CA051B Mercury				CA052B Cumulative Flow	CA052B Mercury				CA0U23B Cumulative Flow	CA0U23B Mercury				Mercury Removed, All Wells
		(gal)[1]	Q	(mg/L)[2,3]	Flag	(lbs)[4]	(gal)	Q	(mg/L)	Flag	(lbs)	(gal)	Q	(mg/L)	Flag	(lbs)	(gal)	Q	(mg/L)	Flag	(lbs)	(lbs)
1998	June	94,940		4.200		3.328	120,650		0.880		0.886	44,346		0.300		0.111	59,007		2.500		1.231	5.56
	July	94,464		4.000		3.153	143,035		0.760		0.907	46,670		0.320		0.125	103,993		2.400		2.083	6.27
	August	82,659		3.300		2.276	123,384		0.610		0.628	0		0.240		0.000	86,436		2.400		1.731	4.64
	September	52,560		3.400		1.491	168,124		0.540		0.758	27,020		0.270		0.061	13,602		2.800		0.318	2.63
	October	148,429		3.400		4.212	106,740		0.540		0.481	0		0.270		0.000	45,082		2.800		1.053	5.75
	November	84,170		3.400		2.388	70,057		0.540		0.316	0		0.270		0.000	90,008		2.800		2.103	4.81
	December	134,556		3.400		3.818	143,925		0.540		0.649	0		0.270		0.000	140,915		2.800		3.293	7.76
	TOTAL	**691,778**				**20.67**	**875,915**				**4.62**	**118,036**				**0.30**	**539,043**				**11.81**	**37.40**
1999	January	56,244		2.200		1.033	58,568		0.360		0.176	38,400		0.270		0.087	57,835		1.400		0.676	1.97
	February	43,480		2.200		0.798	41,230		0.360		0.124	14,454		0.270		0.033	66,873		1.400		0.781	1.74
	March	32,402		2.200		0.595	52,900		0.360		0.159	17,521		0.270		0.039	57,332		1.400		0.670	1.46
	April	86,908		2.200		1.596	73,850		0.360		0.222	25,635		0.270		0.058	89,265		1.400		1.043	2.92
	May	52,110		1.800		0.783	43,020		0.370		0.133	30,810		0.250		0.064	53,470		1.200		0.535	1.52
	June	51,070		1.800		0.767	50,110		0.370		0.155	32,000		0.250		0.067	52,310		1.200		0.524	1.51
	July	94,520		1.700		1.341	137,330		0.330		0.378	70,210		0.090		0.053	98,850		1.200		0.990	2.76
	August	60,300		1.700		0.855	91,700		0.330		0.253	62,790		0.090		0.047	63,870		1.200		0.640	1.79
	September	54,440		1.700		0.772	84,460		0.330		0.233	55,250		0.090		0.041	61,830		1.200		0.619	1.67
	October	59,750		1.700		0.848	118,130		0.330		0.325	65,400		0.090		0.049	82,860		1.200		0.830	2.05
	November	61,620		1.520		0.782	84,320		0.342		0.241	63,950		0.870		0.464	67,910		0.089		0.050	1.54
	December	33,170		1.520		0.421	41,080		0.342		0.117	38,180		0.870		0.277	37,680		0.089		0.028	0.84
	TOTAL	**686,014**				**10.59**	**876,698**				**2.51**	**514,600**				**1.28**	**790,085**				**7.39**	**21.77**
	CUMULATIVE TOTAL	***1,377,792***				***31.26***	***1,752,613***				***7.14***	***632,636***				***1.58***	***1,329,128***				***19.20***	***59.17***
2000	January	63,290		1.520		0.803	84,390		0.342		0.241	71,800		0.870		0.521	77,950		0.089		0.058	1.62
	February	77,580		1.460		0.945	96,090		0.312		0.250	84,360		0.047		0.033	79,630		0.705		0.469	1.70
	March	79,810		1.460		0.972	101,600		0.312		0.265	81,090		0.047		0.032	70,760		0.705		0.416	1.69
	April	58,820		1.460		0.717	75,800		0.312		0.197	63,660		0.047		0.025	56,470		0.705		0.332	1.27
	May	90,340		1.460		1.101	67,330		0.312		0.175	76,340		0.047		0.030	74,720		0.705		0.440	1.75
	June	94,060		1.460		1.146	111,140		0.312		0.289	73,990		0.047		0.029	83,730		0.705		0.493	1.96
	July	88,230		1.460		1.075	65,640		0.312		0.171	46,950		0.047		0.018	67,490		0.705		0.397	1.66
	August	60,300		1.460		0.735	91,700		0.312		0.239	62,790		0.047		0.025	63,870		0.705		0.376	1.37
	September	37,980		1.460		0.463	84,460		0.312		0.220	55,250		0.047		0.022	61,830		0.705		0.364	1.07
	October	103,210		0.440		0.379	67,430		0.201		0.113	77,250		0.044		0.028	96,270		0.780		0.627	1.15
	November	102,960		0.440		0.378	71,210		0.201		0.119	91,510		0.044		0.034	93,480		0.780		0.609	1.14
	December	90,830		0.440		0.334	2,450		0.201		0.004	76,480		0.044		0.028	41,210		0.780		0.268	0.63
	TOTAL	**947,410**				**9.05**	**919,240**				**2.28**	**861,470**				**0.83**	**867,410**				**4.85**	**17.00**
	CUMULATIVE TOTAL	***2,325,202***				***40.30***	***2,671,853***				***9.42***	***1,494,106***				***2.40***	***2,196,538***				***24.05***	***76.17***
2001	January	106,250		1.080		0.958	57,650		0.370		0.178	83,430		0.060		0.042	88,310		0.044		0.032	1.21
	February	65,070		1.080		0.586	29,070		0.370		0.090	75,050		0.060		0.038	100,330		0.044		0.037	0.75
	March	69,460		1.080		0.626	62,430		0.370		0.193	65,310		0.060		0.033	86,790		0.044		0.032	0.88
	April	71,520		1.080		0.645	57,640		0.370		0.178	52,830		0.060		0.026	63,090		0.044		0.023	0.87
	May	120,620		1.080		1.087	79,750		0.370		0.246	81,700		0.060		0.041	52,480		0.044		0.019	1.39
	June	61,820		0.940		0.485	56,160		0.160		0.075	89,260		0.031		0.023	47,550		0.500		0.198	0.78
	July	52,500		0.940		0.412	61,180		0.160		0.082	74,640		0.031		0.019	66,440		0.500		0.277	0.79
	August	69,270		0.940		0.543	72,300		0.160		0.097	118,580		0.031		0.031	81,120		0.500		0.338	1.01
	September	44,410		0.940		0.348	49,250		0.160		0.066	77,680		0.031		0.020	77,570		0.500		0.324	0.76
	October	107,030		0.940		0.840	33,520		0.160		0.045	66,620		0.031		0.017	47,870		0.500		0.200	1.10
	November	59,710		0.780		0.389	16,210		0.560		0.076	53,650		0.036		0.016	48,180		0.410		0.165	0.65
	December	81,500		0.780		0.531	81,500		0.560		0.381	71,100		0.036		0.021	60,800		0.410		0.208	1.14
	TOTAL	**909,160**				**7.45**	**656,660**				**1.71**	**909,850**				**0.33**	**820,530**				**1.85**	**11.34**
	CUMULATIVE TOTAL	***3,234,362***				***47.75***	***3,328,513***				***11.13***	***2,403,956***				***2.73***	***3,017,068***				***25.90***	***87.51***
2002	January	98,390		0.780		0.640	36,800		0.560		0.172	95,520		0.036		0.029	61,250		0.410		0.210	1.05
	February	74,600		0.780		0.486	28,450		0.560		0.133	72,020		0.036		0.022	52,110		0.410		0.178	0.82
	March	42,770		0.780		0.278	58,080		0.560		0.271	55,110		0.036		0.017	54,960		0.410		0.188	0.75
	April	84,520		0.450		0.317	85,820		0.045		0.032	75,770		0.024		0.015	82,670		0.220		0.152	0.52
	May	50,210		0.450		0.189	49,080		0.045		0.018	68,130		0.024		0.014	70,820		0.220		0.130	0.35
	June	83,990		0.450		0.315	77,020		0.045		0.029	64,090		0.024		0.013	73,860		0.220		0.136	0.49
	July	103,700		0.450		0.389	91,110		0.045		0.034	123,550		0.024		0.025	89,760		0.220		0.165	0.61
	August	79,220		0.690		0.456	75,700		0.072		0.045	80,840		0.025		0.017	73,170		0.450		0.275	0.79
	September	68,450		0.690		0.394	67,680		0.072		0.041	65,470		0.025		0.014	57,150		0.450		0.215	0.66
	October	83,260		0.690		0.479	83,700		0.072		0.050	83,860		0.025		0.017	86,470		0.450		0.325	0.87
	November	47,870		0.690		0.276	49,790		0.072		0.030	71,700		0.025		0.015	70,480		0.450		0.265	0.59
	December	83,500		0.690		0.481	74,330		0.072		0.045	67,720		0.025		0.014	82,790		0.450		0.311	0.85
	TOTAL	**900,480**				**4.70**	**777,560**				**0.90**	**923,780**				**0.21**	**855,490**				**2.55**	**8.36**
	CUMULATIVE TOTAL	***4,134,842***				***52.45***	***4,106,073***				***12.03***	***3,327,736***				***2.94***	***3,872,558***				***28.45***	***95.87***

Table 3.1-5
CAPA Groundwater Treatment System
Approximate Mass of Mercury Removed
Recovery Wells

Year	Month	CA050B					CA051B					CA052B					CA0U23B					Mercury Removed, All Wells
		Cumulative Flow	Mercury				Cumulative Flow	Mercury				Cumulative Flow	Mercury				Cumulative Flow	Mercury				
		(gal)[1]	Q	(mg/L)[2,3]	Flag	(lbs)[4]	(gal)	Q	(mg/L)	Flag	(lbs)	(gal)	Q	(mg/L)	Flag	(lbs)	(gal)	Q	(mg/L)	Flag	(lbs)	(lbs)
2003	January	84,500		0.700		0.494	58,060		0.067		0.032	51,490		0.025		0.011	73,880		0.490		0.302	0.84
	February	49,680		0.700		0.290	48,730		0.067		0.027	52,040		0.025		0.011	23,230		0.490		0.095	0.42
	March	110,080		0.700		0.643	110,650		0.067		0.062	62,330		0.025		0.013	75,600		0.490		0.309	1.03
	April	83,350		0.700		0.487	64,460		0.067		0.036	73,230		0.025		0.015	60		0.490		0.000	0.54
	May	56,140		0.700		0.328	67,810		0.067		0.038	66,560		0.025		0.014	36,000		0.490		0.147	0.53
	June	80,680		0.870		0.586	89,200		0.101		0.075	62,490		0.025		0.013	35,640		0.230		0.068	0.74
	July	91,660		0.870		0.665	93,820		0.101		0.079	96,350		0.025		0.020	39,310		0.230		0.075	0.84
	August	64,540		0.870		0.469	77,480		0.101		0.065	94,940		0.025		0.020	29,610		0.230		0.057	0.61
	September	94,950		0.870		0.689	104,220		0.101		0.088	127,540		0.025		0.027	49,560		0.230		0.095	0.90
	October	36,780		0.790		0.242	83,190		0.096		0.067	100,920		0.023		0.019	68,590		0.260		0.149	0.48
	November	231,100		0.790		1.524	38,770		0.096		0.031	88,930		0.023		0.017	58,910		0.260		0.128	1.70
	December	110,190		0.790		0.726	27,090		0.096		0.022	108,400		0.023		0.021	24,090		0.260		0.052	0.82
	TOTAL	**1,093,650**				**7.14**	**863,480**				**0.62**	**985,220**				**0.20**	**514,480**				**1.48**	**9.45**
	CUMULATIVE TOTAL	***5,228,492***				***59.60***	***4,969,553***				***12.65***	***4,312,956***				***3.14***	***4,387,038***				***29.93***	***105.32***
2004	January	129,290		0.790		0.852	55,140		0.096		0.044	128,330		0.023		0.025	4,280		0.260		0.009	0.93
	February	97,630		0.790		0.644	59,860		0.096		0.048	58,300		0.023		0.011	35,060		0.260		0.076	0.78
	March	118,330		0.410		0.405	82,990		0.049		0.034	104,600		0.025		0.022	80,830		0.270		0.182	0.64
	April	76,220		0.410		0.261	51,410		0.049		0.021	52,430		0.025		0.011	61,080		0.270		0.138	0.43
	May	46,090		0.410		0.158	57,900		0.049		0.024	43,250		0.025		0.009	44,740		0.270		0.101	0.29
	June	66,830		0.410		0.229	62,810		0.049		0.026	64,390		0.025		0.013	49,780		0.270		0.112	0.38
	July	65,080		0.710		0.386	47,690		0.040		0.016	60,780		0.018		0.009	44,380		0.300		0.111	0.52
	August	67,980		0.710		0.403	79,900		0.040		0.027	61,700		0.018		0.009	45,780		0.300		0.115	0.55
	September	16,150		0.710		0.096	98,950		0.040		0.033	71,040		0.018		0.011	51,720		0.300		0.129	0.27
	October	15,930		0.710		0.094	42,940		0.040		0.014	69,920		0.018		0.011	50,340		0.300		0.126	0.25
	November	103,390		0.710		0.613	93,870		0.040		0.031	93,770		0.018		0.014	54,780		0.300		0.137	0.80
	December	64,540		0.960		0.517	77,000		0.150		0.096	76,890		0.020		0.013	56,320		0.310		0.146	0.77
	TOTAL	**867,460**				**4.66**	**810,460**				**0.41**	**885,400**				**0.16**	**579,090**				**1.38**	**6.61**
	CUMULATIVE TOTAL	***6,095,952***				***64.25***	***5,780,013***				***13.07***	***5,198,356***				***3.30***	***4,966,128***				***31.31***	***111.93***
2005	January	78,750		0.960		0.631	35,700		0.150		0.045	65,760		0.020		0.011	47,560		0.310		0.123	0.81
	February	103,650		0.960		0.830	88,410		0.150		0.111	92,250		0.020		0.015	65,270		0.310		0.169	1.13
	March	95,120		0.960		0.762	47,260		0.150		0.059	78,380		0.020		0.013	51,580		0.310		0.133	0.97
	April	96,680		0.960		0.775	51,890		0.150		0.065	81,280		0.020		0.014	51,610		0.310		0.134	0.99
	May	103,370		0.813		0.701	102,640		0.116		0.099	89,680		0.020		0.015	38,940		0.259		0.084	0.90
	June	95,330		0.813		0.647	11,800		0.116		0.011	29,580		0.020		0.005	16,830		0.259		0.036	0.70
	July	64,660		0.813		0.439	54,670		0.116		0.053	56,790		0.020		0.009	18,940		0.259		0.041	0.54
	August	74,190		0.813		0.503	68,130		0.116		0.066	64,470		0.020		0.011	22,380		0.259		0.048	0.63
	September	73,810		0.813		0.501	75,280		0.116		0.073	63,620		0.020		0.010	38,040		0.259		0.082	0.67
	October	84,450		0.813		0.573	20,350		0.116		0.020	73,040		0.020		0.012	52,010		0.259		0.112	0.72
	November	125,440		0.813		0.851	18,950		0.116		0.018	99,370		0.020		0.016	38,910		0.259		0.084	0.97
	December	94,040		0.813		0.638	62,280		0.116		0.060	53,740		0.020		0.009	16,780		0.259		0.036	0.74
	TOTAL	**1,089,490**				**7.85**	**637,360**				**0.68**	**847,960**				**0.14**	**458,850**				**1.08**	**9.76**
	CUMULATIVE TOTAL	***7,185,442***				***72.11***	***6,417,373***				***13.75***	***6,046,316***				***3.44***	***5,424,978***				***32.39***	***121.68***
2006	January	91,090		0.813		0.618	65,510		0.116		0.063	62,440		0.020		0.010	67,880		0.259		0.147	0.84
	February	99,040		0.813		0.672	69,830		0.116		0.068	180		0.020		0.000	24,420		0.259		0.053	0.79
	March	82,410		0.813		0.559	69,150		0.116		0.067	40,220		0.020		0.007	50,430		0.259		0.109	0.74
	April	107,470		0.813		0.729	96,190		0.116		0.093	105,340		0.020		0.017	43,880		0.259		0.095	0.93
	May	130,240		0.590		0.641	79,280		0.081		0.054	127,530		0.016		0.017	73,690		0.140		0.086	0.80
	June	95,670		0.590		0.471	96,640		0.081		0.065	102,141		0.016		0.014	57,010		0.140		0.067	0.62
	July	114,830		0.590		0.565	110,010		0.081		0.074	131,199		0.016		0.018	67,870		0.140		0.079	0.74
	August	86,450		0.590		0.426	83,190		0.081		0.056	108,970		0.016		0.015	57,850		0.140		0.068	0.56
	September	5,190		0.590		0.026	113,640		0.081		0.077	146,870		0.016		0.020	74,010		0.140		0.086	0.21
	October	0		0.590		0.000	95,820		0.081		0.065	99,390		0.016		0.013	16,770		0.140		0.020	0.10
	November	36,240		0.590		0.178	93,710		0.081		0.063	68,760		0.016		0.009	43,920		0.140		0.051	0.30
	December	93,760		0.590		0.462	66,030		0.081		0.045	48,040		0.016		0.006	27,460		0.140		0.032	0.54
	TOTAL	**942,390**				**5.35**	**1,039,000**				**0.79**	**1,041,080**				**0.15**	**605,190**				**0.89**	**7.18**
	CUMULATIVE TOTAL	***8,127,832***				***77.45***	***7,456,373***				***14.54***	***7,087,396***				***3.58***	***6,030,168***				***33.28***	***128.86***
2007	January	56,240		0.590		0.277	73,810		0.081		0.050	0		0.016		0.000	59,320		0.140		0.069	0.40
	February	47,980		0.590		0.236	68,410		0.081		0.046	33,980		0.016		0.005	28,040		0.140		0.033	0.32
	March	41,510		0.590		0.204	41,310		0.081		0.028	34,260		0.016		0.005	33,140		0.140		0.039	0.28
	April	56,420		0.590		0.278	67,350		0.081		0.046	57,220		0.016		0.008	51,730		0.140		0.060	0.39
	May	57,130		0.590		0.281	55,440		0.081		0.037	56,500		0.016		0.008	28,740		0.140		0.034	0.36
	June	76,370		0.590		0.376	79,230		0.081		0.054	68,240		0.016		0.009	45,520		0.140		0.053	0.49
	July	86,610		0.590		0.426	70,410		0.081		0.048	43,660		0.016		0.006	31,250		0.140		0.037	0.52
	August	22,350		0.590		0.110	100,910		0.081		0.068	6,030		0.016		0.001	41,540		0.140		0.049	0.23
	September	58,700		0.590		0.289	73,050		0.081		0.049	51,800		0.016		0.007	12,340		0.140		0.014	0.36
	October	81,650		1.600		1.090	115,960		0.130		0.126	88,890		0.025		0.019	18,300		0.250		0.038	1.27
	November	17,440		1.600		0.233	77,710		0.130		0.084	80,430		0.025		0.017	50		0.250		0.000	0.33
	December	39,410		1.600		0.526	83,380		0.130		0.090	101,580		0.025		0.021	30,440		0.250		0.064	0.70
	TOTAL	**641,810**				**4.33**	**906,970**				**0.73**	**622,590**				**0.10**	**380,410**				**0.49**	**5.65**
	CUMULATIVE TOTAL	***8,769,642***				***81.78***	***8,363,343***				***15.26***	***7,709,986***				***3.69***	***6,410,578***				***33.77***	***134.50***

Table 3.1-5
CAPA Groundwater Treatment System
Approximate Mass of Mercury Removed
Recovery Wells

Year	Month	CA050B					CA051B					CA052B					CA0U23B					Mercury Removed, All Wells
		Cumulative Flow	Mercury				Cumulative Flow	Mercury				Cumulative Flow	Mercury				Cumulative Flow	Mercury				
		(gal)[1]	Q	(mg/L)[2,3]	Flag	(lbs)[4]	(gal)	Q	(mg/L)	Flag	(lbs)	(gal)	Q	(mg/L)	Flag	(lbs)	(gal)	Q	(mg/L)	Flag	(lbs)	(lbs)
2008	January	75,870		1.600		1.013	85,800		0.130		0.093	71,610		0.025		0.015	48,490		0.250		0.101	1.22
	February	49,440		1.600		0.660	52,010		0.130		0.056	49,930		0.025		0.010	21,670		0.250		0.045	0.77
	March	28,360		1.600		0.379	89,270		0.130		0.097	77,750		0.025		0.016	34,140		0.250		0.071	0.56
	April	115,960		1.600		1.548	111,690		0.130		0.121	123,590		0.025		0.026	54,420		0.250		0.114	1.81
	May	61,950		1.600		0.827	65,360		0.130		0.071	97,900		0.025		0.020	43,270		0.250		0.090	1.01
	June	117,100		1.600		1.564	59,990		0.130		0.065	77,420		0.025		0.016	24,440		0.250		0.051	1.70
	July	90,450		1.600		1.208	96,410		0.130		0.105	113,900		0.025		0.024	51,380		0.250		0.107	1.44
	August	89,370		1.600		1.193	94,570		0.130		0.103	86,520		0.025		0.018	57,080		0.250		0.119	1.43
	September	77,560		1.600		1.036	88,830		0.130		0.096	37,870		0.025		0.008	56,980		0.250		0.119	1.26
	October	111,200		0.540		0.501	119,510		0.065		0.065	130,040		0.014		0.015	49,750		0.140		0.058	0.64
	November	117,320		0.540		0.529	89,360		0.065		0.048	107,970		0.014		0.013	45,400		0.140		0.053	0.64
	December	118,970		0.540		0.536	99,220		0.065		0.054	109,240		0.014		0.013	44,320		0.140		0.052	0.65
	TOTAL	**1,053,550**				**10.99**	**1,052,020**				**0.97**	**1,083,740**				**0.19**	**531,340**				**0.98**	**13.14**
	CUMULATIVE TOTAL	***9,823,192***				***92.77***	***9,415,363***				***16.24***	***8,793,726***				***3.88***	***6,941,918***				***34.75***	***147.65***
2009	January	102,620		0.540		0.462	98,940		0.065		0.054	68,640		0.014		0.008	39,400		0.140		0.046	0.57
	February	89,130		0.540		0.402	133,220		0.065		0.072	88,930		0.014		0.010	42,180		0.140		0.049	0.53
	March	89,510		0.540		0.403	97,320		0.065		0.053	84,060		0.014		0.010	44,870		0.140		0.052	0.52
	April	120,620		0.540		0.544	66,890		0.065		0.036	106,260		0.014		0.012	63,360		0.140		0.074	0.67
	May	78,350		0.540		0.353	90,300		0.065		0.049	101,380		0.014		0.012	60,280		0.140		0.070	0.48
	June	80,660		0.540		0.363	77,260		0.065		0.042	88,190		0.014		0.010	45,520		0.140		0.053	0.47
	July	91,040		0.503		0.382	100,080		0.096		0.080	98,360		0.013		0.011	53,990		0.141		0.064	0.54
	August	75,240		0.503		0.316	72,520		0.096		0.058	88,650		0.013		0.010	39,080		0.141		0.046	0.43
	September	89,350		0.503		0.375	75,160		0.096		0.060	91,560		0.013		0.010	46,250		0.141		0.054	0.50
	October	96,500		0.503		0.405	95,480		0.096		0.076	102,630		0.013		0.011	49,900		0.141		0.059	0.55
	November	113,300		0.503		0.476	99,640		0.096		0.080	111,400		0.013		0.012	52,860		0.141		0.062	0.63
	December	105,430		0.503		0.443	124,530		0.096		0.100	76,840		0.013		0.009	46,590		0.141		0.055	0.61
	TOTAL	**1,131,750**				**4.92**	**1,131,340**				**0.76**	**1,106,900**				**0.13**	**584,280**				**0.69**	**6.50**
	CUMULATIVE TOTAL	***10,954,942***				***97.70***	***10,546,703***				***17.00***	***9,900,626***				***4.01***	***7,526,198***				***35.44***	***154.14***
2010	January	52,720		0.503		0.221	57,060		0.096		0.046	56,230		0.013		0.006	38,510		0.141		0.045	0.32
	February	83,730		0.503		0.351	89,630		0.096		0.072	91,960		0.013		0.010	59,560		0.141		0.070	0.50
	March	65,750		0.503		0.276	84,780		0.096		0.068	103,060		0.013		0.012	63,970		0.141		0.075	0.43
	April	90,970		0.503		0.382	89,470		0.096		0.072	94,390		0.013		0.011	34,190		0.141		0.040	0.50
	May	61,190		0.503		0.257	68,940		0.096		0.055	84,160		0.013		0.009	55,090		0.141		0.065	0.39
	June	60,580		0.503		0.254	60,580		0.096		0.048	81,780		0.013		0.009	55,590		0.141		0.065	0.38
	July	87,350		0.393		0.286	93,790		0.013		0.010	89,940		0.007		0.005	66,060		0.123		0.068	0.37
	August	75,280		0.393		0.247	80,100		0.013		0.009	98,830		0.007		0.006	77,610		0.123		0.080	0.34
	September	78,290		0.393		0.257	68,920		0.013		0.008	82,540		0.007		0.005	28,350		0.123		0.029	0.30
	October	70,800		0.393		0.232	62,941		0.013		0.007	88,310		0.007		0.005	45,620		0.123		0.047	0.29
	November	84,990		0.393		0.278	93,090		0.013		0.010	87,220		0.007		0.005	71,100		0.123		0.073	0.37
	December	80,300		0.393		0.263	74,120		0.013		0.008	78,910		0.007		0.005	62,000		0.123		0.064	0.34
	TOTAL	**891,950**				**3.31**	**923,421**				**0.41**	**1,035,330**				**0.09**	**657,650**				**0.72**	**4.53**
	CUMULATIVE TOTAL	***11,846,892***				***101.00***	***11,470,124***				***17.41***	***10,935,956***				***4.10***	***8,183,848***				***36.16***	***158.67***
2011	January	78,430		0.393		0.257	71,580		0.013		0.008	92,590		0.007		0.005	63,870		0.123		0.066	0.34
	February	63,050		0.393		0.207	55,840		0.013		0.006	48,380		0.007		0.003	34,460		0.123		0.035	0.25
	March	76,350		0.393		0.250	36,750		0.013		0.004	82,880		0.007		0.005	58,020		0.123		0.060	0.32
	April	71,410		0.393		0.234	53,250		0.013		0.006	90,600		0.007		0.005	75,830		0.123		0.078	0.32
	May	99,970		0.393		0.328	12,790		0.013		0.001	82,730		0.007		0.005	51,340		0.123		0.053	0.39
	June	44,800		0.393		0.147	162,810		0.013		0.018	32,220		0.007		0.002	68,900		0.123		0.071	0.24
	July	99,970		0.404		0.337	103,510		0.027		0.023	78,120		0.006		0.004	64,040		0.102		0.055	0.42
	August	101,610		0.404		0.343	102,590		0.027		0.023	75,780		0.006		0.004	65,340		0.102		0.056	0.42
	September	98,190		0.404		0.331	95,810		0.027		0.021	81,800		0.006		0.004	66,250		0.102		0.056	0.41
	October	89,080		0.404		0.300	71,740		0.027		0.016	92,250		0.006		0.004	74,890		0.102		0.064	0.38
	November	54,220		0.404		0.183	61,580		0.027		0.014	67,800		0.006		0.003	46,580		0.102		0.040	0.24
	December	46,060		0.404		0.155	35,400		0.027		0.008	53,940		0.006		0.003	28,430		0.102		0.024	0.19
	TOTAL	**923,140**				**3.07**	**863,650**				**0.15**	**879,090**				**0.05**	**697,950**				**0.66**	**3.92**
	CUMULATIVE TOTAL	***12,770,032***				***104.08***	***12,333,774***				***17.56***	***11,815,046***				***4.14***	***8,881,798***				***36.82***	***162.59***
2012	January	62,760		0.404		0.212	58,550		0.027		0.013	77,300		0.006		0.004	55,730		0.102		0.047	0.28
	February	116,490		0.404		0.393	115,930		0.027		0.026	130,622		0.006		0.006	87,250		0.102		0.074	0.50
	March	55,560		0.404		0.187	54,010		0.027		0.012	62,618		0.006		0.003	40,490		0.102		0.034	0.24
	April	86,230		0.404		0.291	88,490		0.027		0.020	85,780		0.006		0.004	62,650		0.102		0.053	0.37
	May	127,780		0.404		0.431	127,410		0.027		0.028	117,720		0.006		0.005	80,910		0.102		0.069	0.53
	June	98,460		0.404		0.332	69,470		0.027		0.016	97,250		0.006		0.005	53,250		0.102		0.045	0.40
	July	103,630		0.404		0.349	123,240		0.027		0.028	118,450		0.006		0.006	71,570		0.102		0.061	0.44
	August	120,300		0.404		0.406	137,100		0.027		0.031	142,630		0.006		0.007	61,240		0.102		0.052	0.50
	September	91,690		0.394		0.301	97,780		0.020		0.017	61,210		0.005		0.003	55,010		0.085		0.039	0.36
	October	91,890		0.394		0.302	87,080		0.020		0.015	124,050		0.005		0.005	66,130		0.085		0.047	0.37
	November	124,220		0.394		0.408	106,210		0.020		0.018	125,230		0.005		0.005	65,740		0.085		0.047	0.48
	December	116,910		0.394		0.384	85,380		0.020		0.015	116,720		0.005		0.005	45,790		0.085		0.032	0.44
	TOTAL	**1,195,920**				**4.00**	**1,150,650**				**0.24**	**1,259,580**				**0.06**	**745,760**				**0.60**	**4.89**
	CUMULATIVE TOTAL	***13,965,952***				***108.07***	***13,484,424***				***17.80***	***13,074,626***				***4.20***	***9,627,558***				***37.42***	***167.49***

Table 3.1-5
CAPA Groundwater Treatment System
Approximate Mass of Mercury Removed
Recovery Wells

Year	Month	CA050B					CA051B					CA052B					CA0U23B					Mercury Removed, All Wells
		Cumulative Flow	Mercury				Cumulative Flow	Mercury				Cumulative Flow	Mercury				Cumulative Flow	Mercury				
		(gal)[1]	Q	(mg/L)[2,3]	Flag	(lbs)[4]	(gal)	Q	(mg/L)	Flag	(lbs)	(gal)	Q	(mg/L)	Flag	(lbs)	(gal)	Q	(mg/L)	Flag	(lbs)	(lbs)
2013	January	113,370		0.394		0.373	77,990		0.020		0.013	116,270		0.005		0.005	66,770		0.085		0.047	0.44
	February	112,590		0.394		0.370	95,460		0.020		0.016	75,310		0.005		0.003	70,800		0.085		0.050	0.44
	March	98,780		0.394		0.325	92,420		0.020		0.016	96,280		0.005		0.004	66,770		0.085		0.047	0.39
	April	89,340		0.394		0.294	82,670		0.020		0.014	90,170		0.005		0.004	61,090		0.085		0.043	0.35
	May	116,300		0.394		0.382	65,810		0.020		0.011	132,000		0.005		0.006	80,830		0.085		0.057	0.46
	June	125,010		0.394		0.411	82,630		0.020		0.014	106,160		0.005		0.004	44,350		0.085		0.031	0.46
	July	121,530		0.394		0.400	84,250		0.020		0.014	108,210		0.005		0.005	62,060		0.085		0.044	0.46
	August	141,140		0.394		0.464	90,940		0.020		0.015	125,180		0.005		0.005	72,250		0.085		0.051	0.54
	September	105,950		0.350		0.309	81,600		0.007		0.005	96,240		0.003		0.002	56,930		0.084		0.040	0.36
	October	125,250		0.350		0.366	115,720		0.007		0.007	115,850		0.003		0.003	78,450		0.084		0.055	0.43
	November	107,610		0.350		0.314	83,470		0.007		0.005	90,570		0.003		0.002	62,050		0.084		0.043	0.36
	December	130,840		0.350		0.382	79,140		0.007		0.005	105,340		0.003		0.003	70,960		0.084		0.050	0.44
	TOTAL	***1,387,710***				**4.39**	***1,032,100***				**0.14**	***1,257,580***				**0.05**	**793,310**				**0.56**	***5.13***
	CUMULATIVE TOTAL	***15,353,662***				***112.46***	***14,516,524***				***17.93***	***14,332,206***				***4.24***	***10,420,868***				***37.98***	***172.62***
2014	January	145,420		0.350		0.425	88,720		0.007		0.005	122,080		0.003		0.003	78,900		0.084		0.055	0.49
	February	110,220		0.350		0.322	72,030		0.007		0.004	95,290		0.003		0.002	61,110		0.084		0.043	0.37
	March	121,620		0.350		0.355	69,560		0.007		0.004	116,190		0.003		0.003	72,990		0.084		0.051	0.41
	April	111,760		0.350		0.326	91,620		0.007		0.005	123,420		0.003		0.003	78,860		0.084		0.055	0.39
	May	104,770		0.350		0.306	78,750		0.007		0.005	117,760		0.003		0.003	76,870		0.084		0.054	0.37
	June	111,550		0.350		0.326	85,960		0.007		0.005	124,430		0.003		0.003	82,170		0.084		0.057	0.39
	July	69,490		0.350		0.203	71,810		0.007		0.004	95,010		0.003		0.002	65,810		0.084		0.046	0.26
	August	89,790		0.350		0.262	82,060		0.007		0.005	80,530		0.003		0.002	70,360		0.084		0.049	0.32
	September	121,190		0.486		0.492	62,520		0.007		0.004	130,350		0.004		0.004	83,330		0.174		0.121	0.62
	October	70,820		0.486		0.287	72,170		0.007		0.004	97,650		0.004		0.003	64,820		0.174		0.094	0.39
	November	63,310		0.486		0.257	61,890		0.007		0.004	78,490		0.004		0.003	54,850		0.174		0.080	0.34
	December	125,550		0.486		0.509	103,600		0.007		0.006	125,340		0.004		0.004	88,360		0.174		0.128	0.65
	TOTAL	**1,245,490**				**4.07**	**940,690**				**0.06**	**1,306,540**				**0.04**	**878,430**				**0.83**	**5.00**
	CUMULATIVE TOTAL	***16,599,152***				***116.53***	***15,457,214***				***17.99***	***15,638,746***				***4.28***	***11,299,298***				***38.81***	***177.61***
2015	January	97,570		0.486		0.396	64,200		0.007		0.004	93,990		0.004		0.003	66,320		0.174		0.096	0.50
	February	82,520		0.486		0.335	108,400		0.007		0.007	95,260		0.004		0.003	73,180		0.174		0.106	0.45
	March	81,380		0.486		0.330	93,950		0.007		0.006	88,580		0.004		0.003	68,370		0.174		0.099	0.44
	April	96,290		0.486		0.391	116,820		0.007		0.007	111,520		0.004		0.004	84,410		0.174		0.123	0.52
	May	88,710		0.486		0.360	100,050		0.007		0.006	91,040		0.004		0.003	71,870		0.174		0.104	0.47
	June	84,870		0.486		0.344	84,330		0.007		0.005	82,880		0.004		0.003	64,320		0.174		0.093	0.45
	July	75,060		0.486		0.304	101,030		0.007		0.006	91,420		0.004		0.003	77,630		0.174		0.113	0.43
	August	41,420		0.486		0.168	56,320		0.007		0.003	41,350		0.004		0.001	42,420		0.174		0.062	0.23
	September	25,610		0.604		0.129	75,880		0.037		0.023	44,700		0.004		0.002	53,690		0.172		0.077	0.23
	October	102,540		0.604		0.517	77,780		0.037		0.024	100,610		0.004		0.003	4,350		0.172		0.006	0.55
	November	98,660		0.604		0.497	76,390		0.037		0.023	101,330		0.004		0.003	0		0.172		0.000	0.52
	December	117,190		0.604		0.591	74,430		0.037		0.023	91,210		0.004		0.003	15,340		0.172		0.022	0.64
	TOTAL	**991,820**				**4.36**	**1,029,580**				**0.14**	**1,033,890**				**0.04**	**621,900**				**0.90**	**5.44**
	CUMULATIVE TOTAL	***17,590,972***				***120.90***	***16,486,794***				***18.12***	***16,672,636***				***4.32***	***11,921,198***				***39.71***	***183.05***

Notes:
1) gal - gallons
2) mg/L - milligrams per liter
3) Mercury samples collected during the month were reported as that months' concentration. If a sample was not collected during a specific month, the previous month's result was reported.
4) lbs - pounds

Table 3.7-1
Summary of Marsh Sediment Mercury Concentrations

Marsh	2004	2005	2006	2007	2008	2009	2010	2011	2012	2014	2015
Marsh 1/2	0.263	0.495									
Marsh 1			0.111	0.153	0.097	0.112	0.113	0.131	0.094	0.098	0.098
Marsh 2			0.066	0.064	0.084	0.073	0.081	0.064	0.062	0.062	0.035
Marsh 3	0.279	0.298	0.129	0.211	0.111	0.155	0.148	0.116	0.132	0.093	0.064
Marsh 5	0.644	0.495	0.367	0.275	0.375	0.399	0.405	0.286	0.200	0.231	0.124
Marsh 6	N.A.	0.337	0.377	0.386	0.748	0.422	0.384	0.300	0.219	0.188	0.178
Marsh 7	0.625	0.347	0.297	0.279	0.422	0.391	0.219	0.381	0.308	0.139	0.207
Marsh 11	0.019	0.0205	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.	N.A.
Marsh 14	0.626	0.587	1.05	0.909	1.26	1.109	0.535	0.719	N.A.	Removed	Removed
Marsh 15	0.943	0.273	0.369	0.327	0.418	0.374	0.440	0.480	0.287	0.034	0.022
Marsh 19	0.447	0.478	0.126	0.214	0.155	0.201	0.210	0.353	2.055	0.095	0.068

Notes:

Concentrations are milligrams per kilogram dry weight.

Marsh locations are shown in Appendix A of the annual RAAER.

Basic data are provided in Appendix A of the annual RAAER.

Remediation goal is 0.25 mg/kg measured in two consecutive years (Highlighted green if < 0.25 mg/kg).

Text is highlighted in red if outliers were removed (details in text of annual RAAER).

Marshes 1 and 2 were sampled as a single marsh in 2004 and 2005, but beginning in 2006, they are sampled separately.

N.A. = not analyzed

Table 3.7-2
Results of meHg Triplicate Sampling in Marshes 1 through 7

Station ID	meHg (ng/g) dry wt	Mean meHg (ng/g) dry wt	% Difference from Mean: Max Concentration	% Difference from Mean: Minimum Concentration	meHg Range (ng/g) dry wt
Marsh-1-1R	0.444	0.42	13%	20%	0.14
	0.472				
	0.334				
Marsh-1-11R	0.417	0.57	26%	26%	0.30
	0.712				
	0.571				
Marsh-2-5R	0.659	0.61	43%	51%	0.58
	0.877				
	0.301				
Marsh-3-1R	0.914	0.92	6%	6%	0.11
	0.976				
	0.862				
Marsh-5-1R	0.769	0.85	20%	11%	0.26
	1.02				
	0.752				
Marsh-5-5R	0.937	0.97	9%	5%	0.14
	1.06				
	0.927				
Marsh-6-2R	1.25	1.19	5%	7%	0.10
	1.21				
	1.11				
Marsh-6-5R	0.568	0.64	19%	12%	0.20
	0.764				
	0.599				
Marsh-7-1R	0.190	0.16	18%	9%	0.04
	0.148				
	0.147				
Marsh-7-6R	0.496	0.51	19%	16%	0.18
	0.609				
	0.428				

Table 3.8-1

Summary of Red Drum and Juvenile Blue Crap Tissue Data 1997-2015

Red Drum Sampling Event	Closed Area		Adjacent Open Area	
	Number of Samples	Mean HG (mg/kg ww)	Number of Samples	Mean HG (mg/kg ww)
4Q 1997	34	1.41	27	0.51
2001 Annual	30	1.33	15	0.49
2002 Annual	22	1.03	8	0.64
2003 Annual	29	1.09	30	0.48
2004 Annual	29	0.76	32	0.47
2005 Annual	30	0.87	36	0.48
2006 Annual	30	1.17	30	0.43
2007 Annual	30	1.29	30	0.65
2008 Annual	30	0.9	30	0.40
2009 Annual	30	0.85	30	0.38
2010 Annual	30	0.88	30	0.38
2011 Annual	30	1.17	30	0.33
2012 Annual	30	1.06	30	0.40
2014 Annual	29	1.06	28	0.40
2015 Annual	30	1.32	30	0.42
Juvenile Blue Crab Sampling Event	**Number of Samples**	**Mean HG (mg/kg ww)**	**Number of Samples**	**Mean HG (mg/kg ww)**
4Q 1997	49	0.59	27	0.19
2001 Annual	33	0.48	16	0.22
2002 Annual	71	0.26	26	0.11
2003 Annual	30	0.25	30	0.07
2004 Annual	31	0.14	30	0.07
2005 Annual	27	0.22	30	0.05
2006 Annual	30	0.21	30	0.08
2007 Annual	30	0.18	30	0.08
2008 Annual	30	0.16	30	0.06
2009 Annual	30	0.22	30	0.09
2010 Annual	30	0.23	30	0.09
2011 Annual	30	0.17	30	0.06
2012 Annual	30	0.14	30	0.06
2014 Annual	30	0.18	30	0.07
2015 Annual	30	0.10	30	0.04

Note:

mg/kg ww = milligrams per kilogram wet weight

Table 3.8-2
Summary of 2015 Red Drum Tissue Mercury Results

Area	Sample Size	Mean HG (mg/kg ww)[1]	Standard Deviation
Closed	30	1.32	0.544
Adjacent Open	30	0.42	0.137

Notes:
1 = Basic data are presented in Appendix B.
mg/kg ww = milligrams per kilogram wet weight

Table 3.11-1
Number of Red Drum Caught in the Adjacent Open and Closed Areas in 2011, 2012, and 2015

Year	Number of Red Drum Caught in the Closed Area		Number of Red Drum Caught in the Adjacent Open Area	
	Reef	Marsh	Reef	Marsh
2011	14	7	5	17
2012	17	13	6	24
2015	24	6	12	18

FIGURES

Routine Open-water Sediment Locations

Location ID

0 500 1,000 Feet

Notes:
2009 0.5m DOQQ (Point Comfort Quad)
Calhoun County, Texas

2015 RAAER

2015 Routine Open-water Sediment Sampling Locations

ALCOA PCO

Project: 98003-078

Date: 01/14/2016

Figure 2.3-1

M:\98003\076\2015 Sample Studies\Field Sampling Study Summary\RAAER Updated Figures 2016\arc\2.3-1.mxd

Routine Marsh Sediment Locations

Location ID

Marsh ID

0 200 400 Feet

Notes:
2009 0.5m DOQQ (Point Comfort Quad)
Calhoun County, Texas

2015 RAAER

2015 Routine Marsh Sediment Monitoring Locations: Marshes 1, 2, and 3

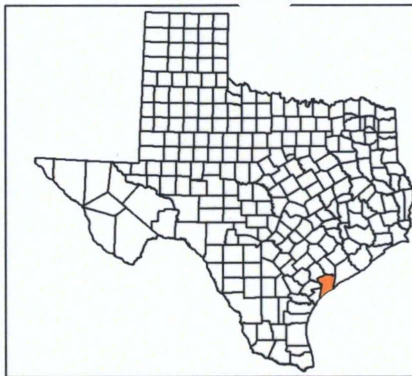
ALCOA PCO

Project: 98003-078

Date: 01/14/2016

Figure 2.3-2a

M:\98003\076\2015 Sample Studies\Field Sampling Study Summary\RAAER Updated Figures 2016\arc\2.3-2a



Routine Marsh Sediment Locations

Location ID

Marsh ID

0 150 300 Feet

Notes:
2009 0.5m DOQQ (Point Comfort Quad)
Calhoun County, Texas

2015 RAAER

2015 Routine Marsh Sediment Monitoring Locations: Marshes 5, 6, and 7

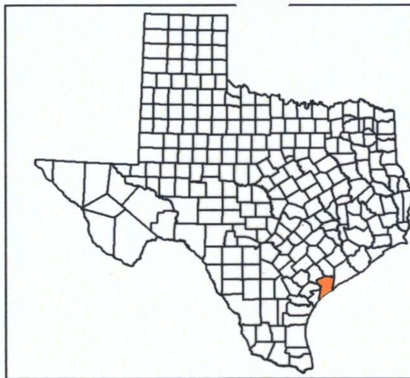
ALCOA PCO

Project: 98003-078

Date: 01/14/2016

Figure 2.3-2b

M:\98003\076\2015 Sample Studies\Field Sampling Study Summary\RAAER Updated Figures 2016\arc\2.3-2b



Routine Marsh Sediment Locations

Location ID

Marsh ID

0 200 400 Feet

Notes:

2009 0.5m DOQQ (Point Comfort Quad)
Calhoun County, Texas

2015 RAAER

2015 Routine Marsh Sediment Monitoring Locations: Marshes 15 and 19

ALCOA PCO

Project: 98003-078

Date: 01/14/2016

Figure 2.3-2c

M:\98003\076\2015 Sample Studies\Field Sampling Study Summary\RAAER Updated Figures 2016\arc\2.3-2c

Open-water Sample Locations for Methylmercury and TOC Analysis

Location ID

0 500 1,000 Feet

Notes:
2009 0.5m DOQQ (Point Comfort Quad)
Calhoun County, Texas

2015 RAAER

Supplemental Study No. 2 Open-water Sediment Monitoring Locations for Methylmercury and TOC Analysis

ALCOA PCO

Project: 98003-080

Date: 01/14/2016

Figure 2.4-1

M:\98003\076\2015 Sample Studies\Field Sampling Study Summary\RAAER Updated Figures 2016\arc\2.4-1.mxd

Triplicate Marsh Sediment Locations

Location ID

0 500 1,000 Feet

Notes:
2009 0.5m DOQQ (Point Comfort Quad)
Calhoun County, Texas

2015 RAAER

Supplemental Study No. 2
Triplicate Sediment Sampling
Locations for Variance Analysis

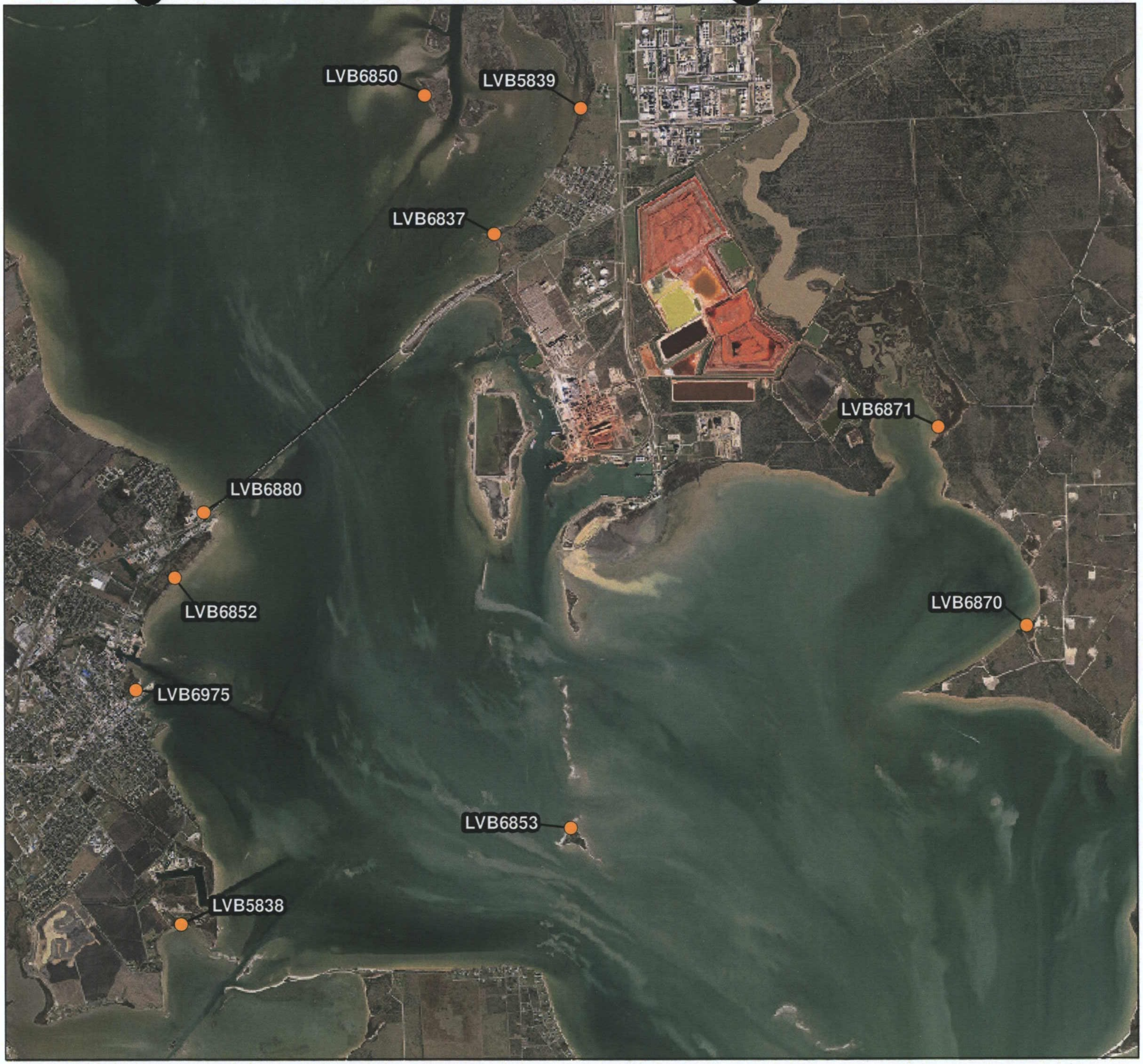
ALCOA PCO

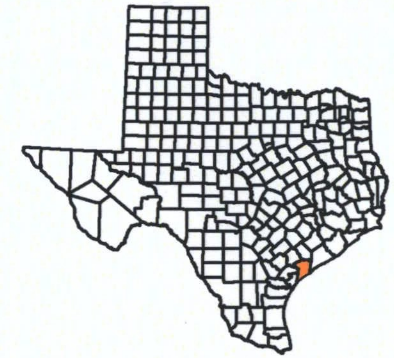
Project: 98003-080

Date: 01/14/2016

Figure 2.4-2

M:\98003\076\2015 Sample Studies\Field Sampling Study Summary\RAAER Updated Figures 2016\arc\2.4-2





Open Area Blue Crab Sediment Locations

Station ID

0 0.75 1.5 Miles

Notes:

2009 0.5m DOQQ (Point Comfort Quad)
Calhoun County, Texas

2015 RAAER

Supplemental Study No. 4
Sediment Sampling Locations
at Adjacent Open Area
Juvenile Blue Crab Stations

ALCOA PCO

Project: 98003-080

Date: 01/14/2016

Figure 2.4-3

M:\98003\076\2015 Sample Studies\Field Sampling Study Summary\RAAER Updated Figures 2016\arc\2.4-3

2015 Additional Marsh 1 Juvenile Blue Crab Sample Locations

Area of Marsh 1 with average meHg concentrations in the 2008 to 2012 period less than the average meHg concentration of Adjacent Area marshes measured in 2007

Station ID

0 150 300 Feet

Notes:
2009 0.5m DOQQ (Point Comfort Quad)
Calhoun County, Texas

2015 RAAER

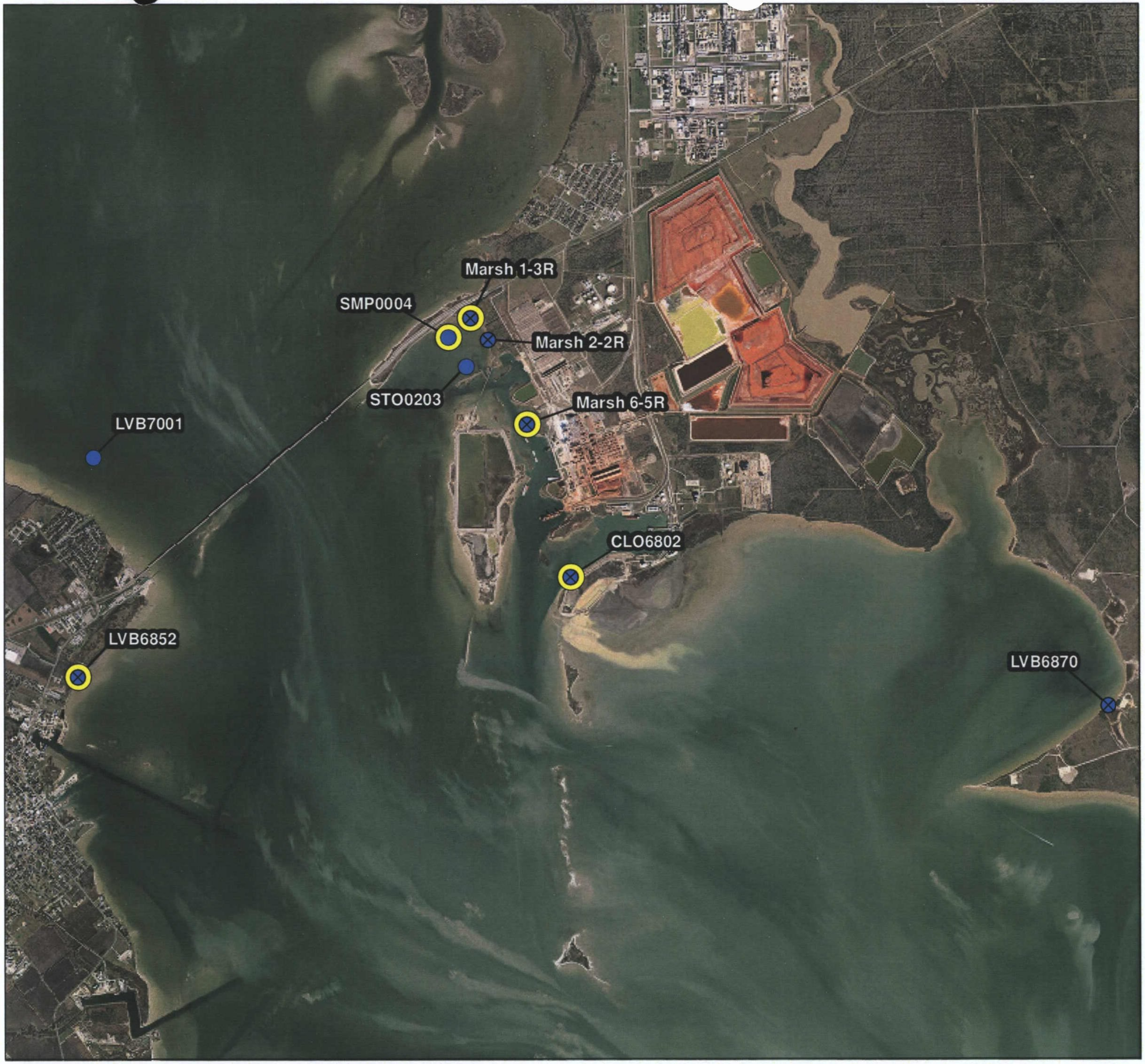
Supplemental Study No. 4
Additional Marsh 1 Juvenile
Blue Crab Sampling Locations

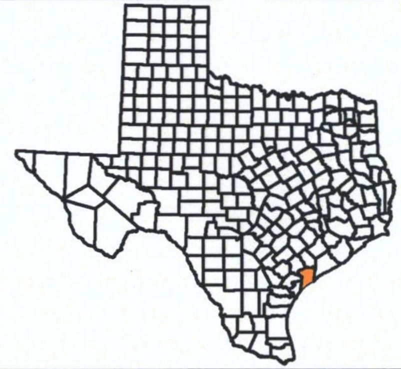
ALCOA PCO

Project: 98003-079
Date: 01/14/2016

Figure 2.4-4

M:\98003\076\2015 Sample Studies\Field Sampling Study Summary\RAAER Updated Figures 2016\arc\2.4-4.mxd





Open-water Locations
Marsh Locations
Benthic Locations
Station ID

0 0.75 1.5 Miles

Notes:

2015 RAAER

Supplemental Study No. 4 Additional Sediment and Benthic Community Sample Locations

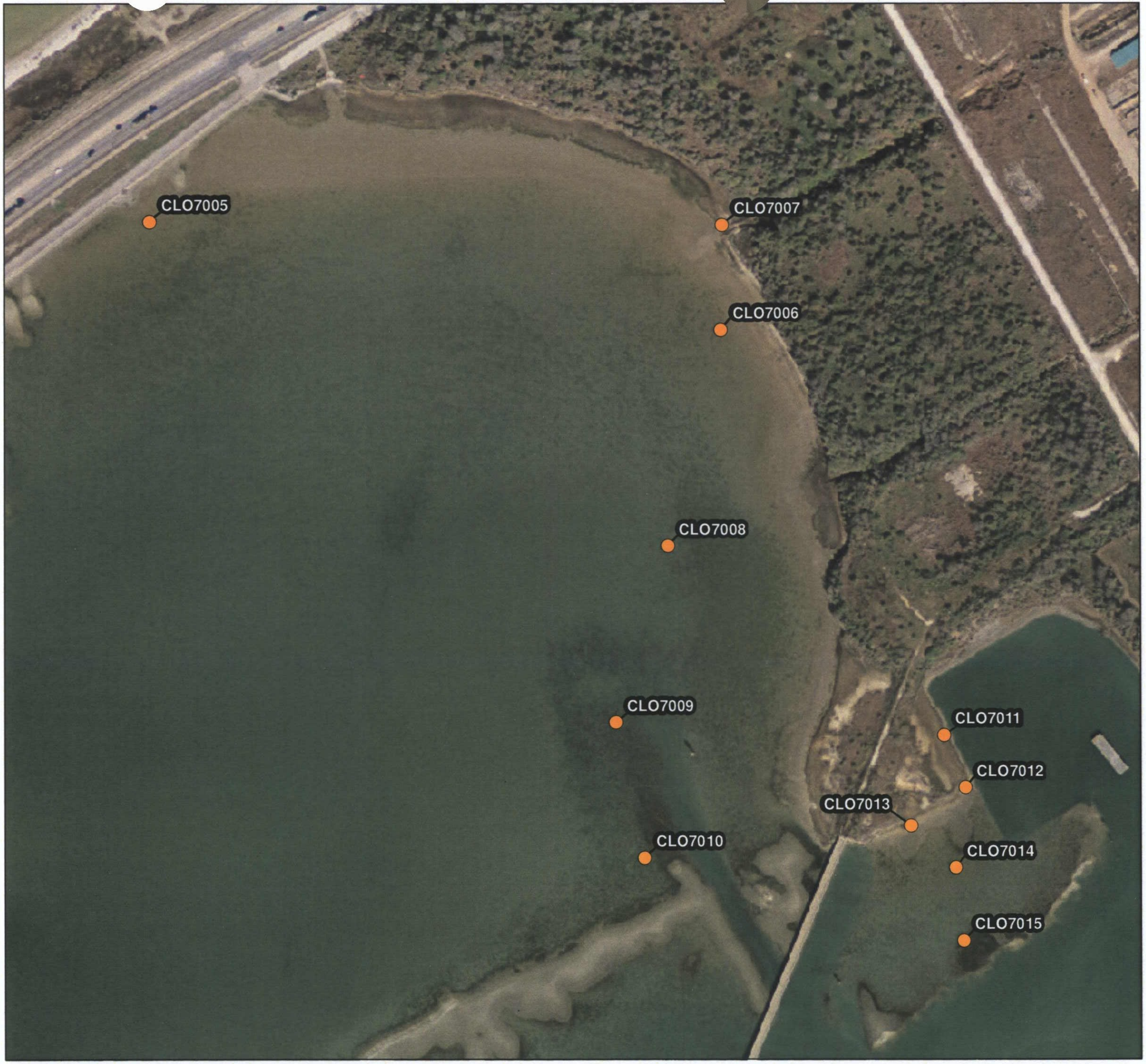
ALCOA PCO

Project: 98003-080

Date: 01/14/2016

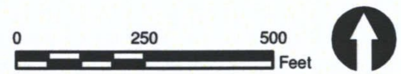
Figure 2.4-5

M:\98003\076\2015 Sample Studies\Field Sampling Study Summary\RAAER Updated Figures 2016\arc\2.3-2b



Sample Locations near Witco Channel and Harbor

Station ID



Notes:

Locations CLO7005 and ClO7006 moved due to unsuitable habit for Mud Crabs

2009 0.5m DOQQ (Point Comfort Quad)
Calhoun County, Texas

2015 RAAER

Supplemental Study No.5 Sediment Locations near Witco Channel and Witco Harbor

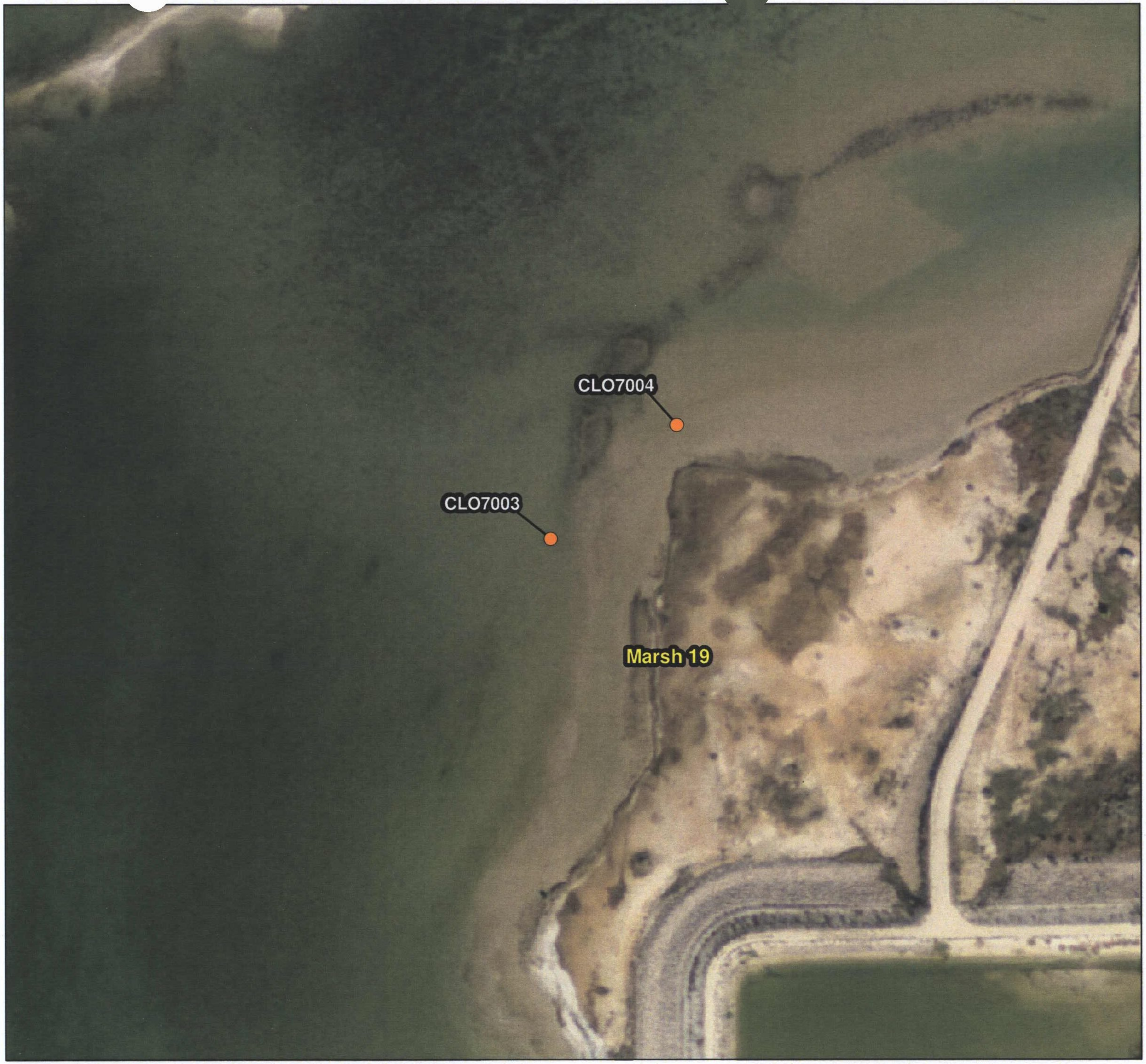
ALCOA PCO

Project: 98003-080

Date: 01/14/2016

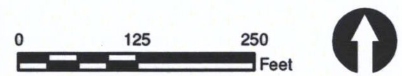
Figure 2.4-6

M:\98003\076\2015 Sample Studies\Field Sampling Study Summary\RAAER Updated Figures 2016\arc\2.4-7.mxd



Sample Locations near Marsh 19

Location ID



Notes:
2009 0.5m DOQQ (Point Comfort Quad)
Calhoun County, Texas

2015 RAAER

Supplemental Study No. 5
Sediment Locations near Marsh 19

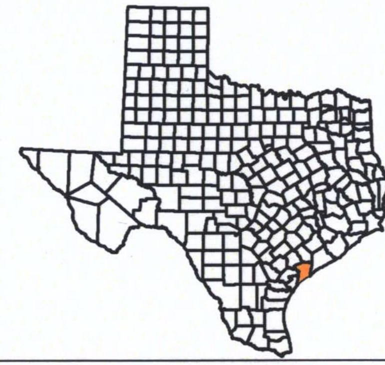
ALCOA PCO

Project: 98003-080

Date: 01/14/2016

Figure 2.4-7

M:\98003\076\2015 Sample Studies\Field Sampling Study Summary\RAAER Updated Figures 2016\arc\2.4-7.mxd



- Study 1 Grass Shrimp Locations
- Study 1 Gulf Killifish Locations
- Study 4 Juvenile Blue Crab Locations
- Study 5 Mud Crab Locations
- Mainland Shoreline #3 Juvenile Blue Crab Locations
- ## Location ID

0 1,000 2,000 Feet

Notes:
2009 0.5m DOQQ (Point Comfort Quad)
Calhoun County, Texas

2015 RAAER

Supplemental Study Closed Area Prey Item Sampling Locations

ALCOA PCO

Project: 98003-079

Date: 01/14/2016

Figure 2.4-8

M:\98003\076\2015 Sample Studies\Field Sampling Study Summary\RAAER Updated Figures 2016\arc\2.6-1b.mxd

LEGEND

- 2015 Supplemental Study 6 Core Locations
- 2007 Supplemental Study 5 Core Locations

Total Hg (mg/kg)

- 0.00 - 0.10
- 0.11 - 0.25
- 0.26 - 0.50
- 0.51 - 0.75
- 0.76 - 1.00
- 1.01 - 2.00
- 2.01 - 10.00
- > 10.00

0 200 400
Feet

NOTES:
Total Hg concentration color scale indicates the Supplemental Study 5 maximum core segment concentration.

2015 RAAER

Supplemental Study No. 6
Open Water Sediment
Sampling Locations

ALCOA PCO

Project: 150002-02.03

Date: 01/12/2016

Figure 2.4-9

Q:\Jobs\Alcoa_0002\Lacava_Bay\Maps\2016_01\Figure2_4-5_OpenWaterSampling.mxd jsfox 1/12/2016 11:13:38 AM

Notes:
2009 0.5m DOQQ (Point Comfort Quad)
Calhoun County, Texas

2015 RAAER

2015 Routine Closed Area Finfish and Shellfish Sampling Locations

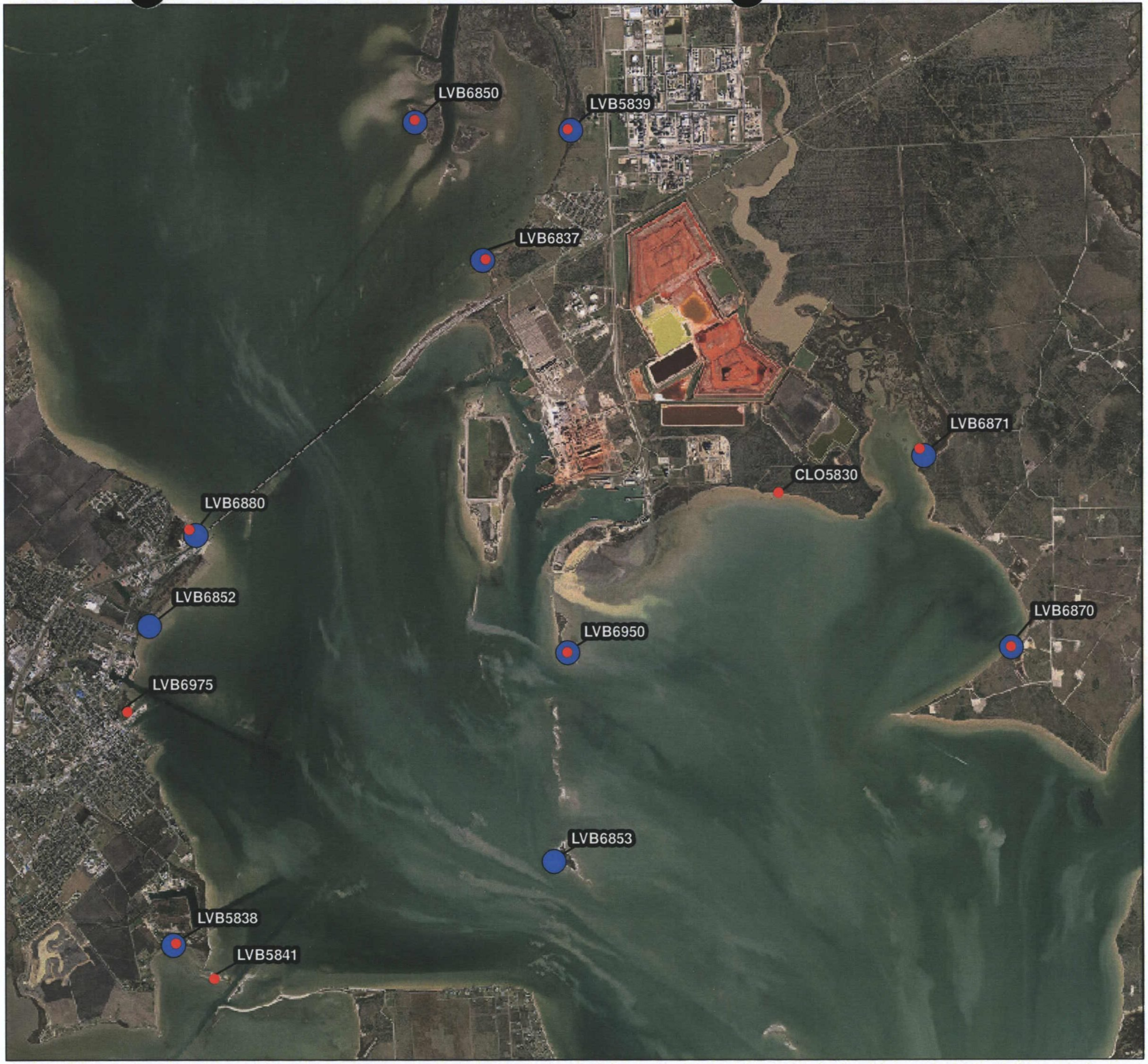
ALCOA PCO

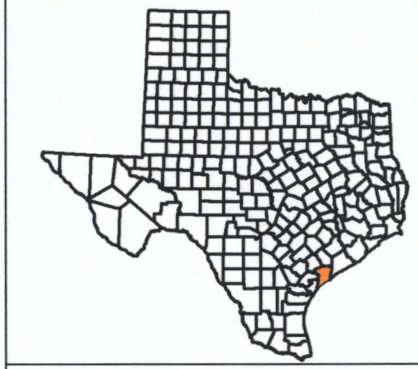
Project: 98003-077

Date: 01/14/2016

Figure 2.5-1

M:\98003\076\2015 Sample Studies\Field Sampling Study Summary\RAAER Updated Figures 2016\arc\2.5-1.mxd





Open Area Red Drum Locations

Open Area Juvenile Blue Crab Locations

Location ID

0 0.75 1.5 Miles

Notes:

2009 0.5m DOQQ (Point Comfort Quad)
Calhoun County, Texas

2015 RAAER

2015 Routine Adjacent Open Area Finfish and Shellfish Sampling Locations

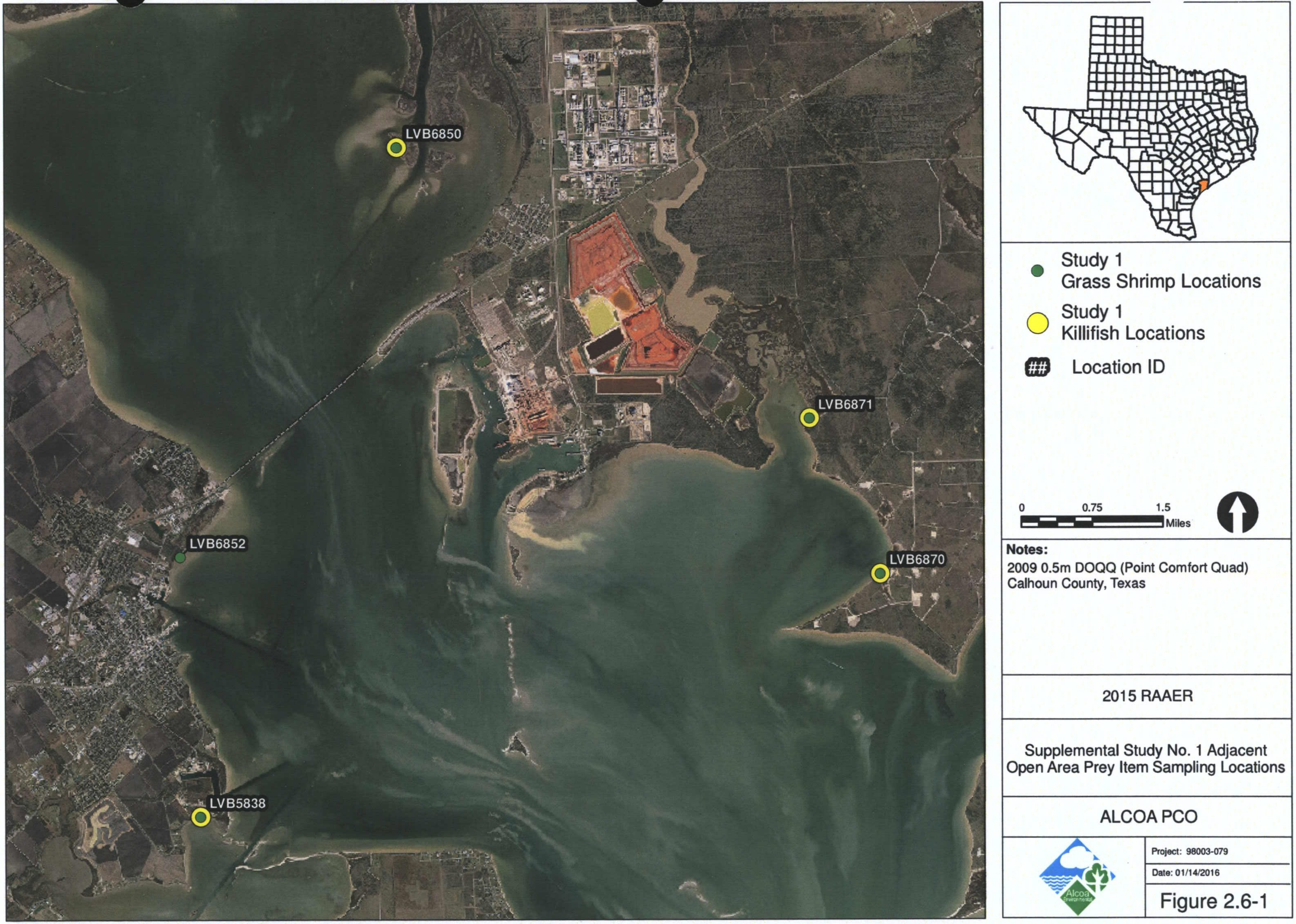
ALCOA PCO

Project: 98003-077

Date: 01/14/2016

Figure 2.5-2

M:\98003\076\2015 Sample Studies\Field Sampling Study Summary\RAAER Updated Figures 2016\arc\2.5-2.mxd



Notes:
2009 0.5m DOQQ (Point Comfort Quad)
Calhoun County, Texas

2015 RAAER

Supplemental Study No. 1 Adjacent Open Area Prey Item Sampling Locations

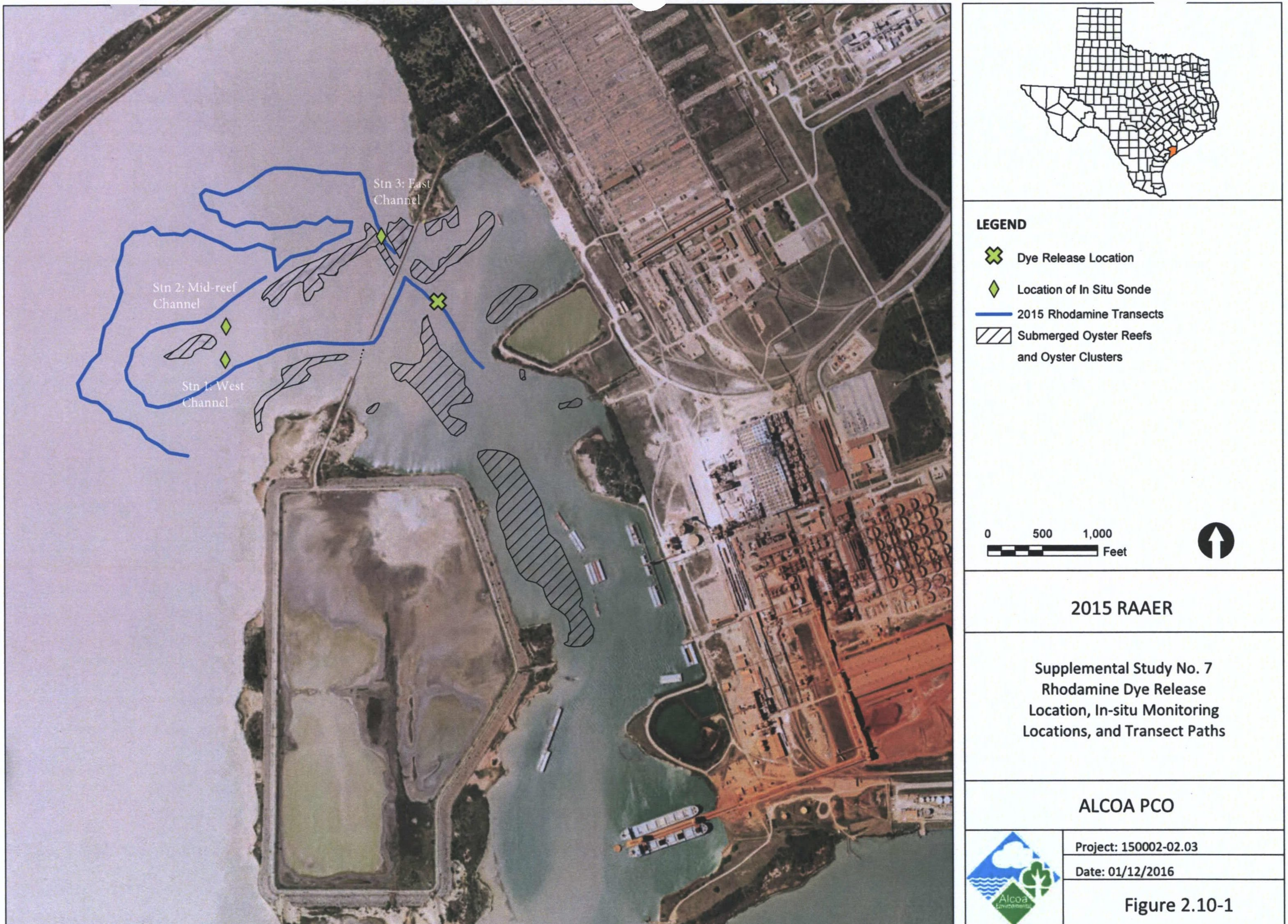
ALCOA PCO

Project: 98003-079

Date: 01/14/2016

Figure 2.6-1

M:\98003\076\2015 Sample Studies\Field Sampling Study Summary\RAAER Updated Figures 2016\arc\2.6-1b.mxd



2015 RAAER

Supplemental Study No. 7
Rhodamine Dye Release Location, In-situ Monitoring Locations, and Transect Paths

ALCOA PCO

Project: 150002-02.03

Date: 01/12/2016

Figure 2.10-1

Q:\Jobs\Alcoa_0002\Lacava_Bay\Maps\2016_01\Figure2_10-1_Transects.mxd jsfox 1/12/2016 2:42:13 PM

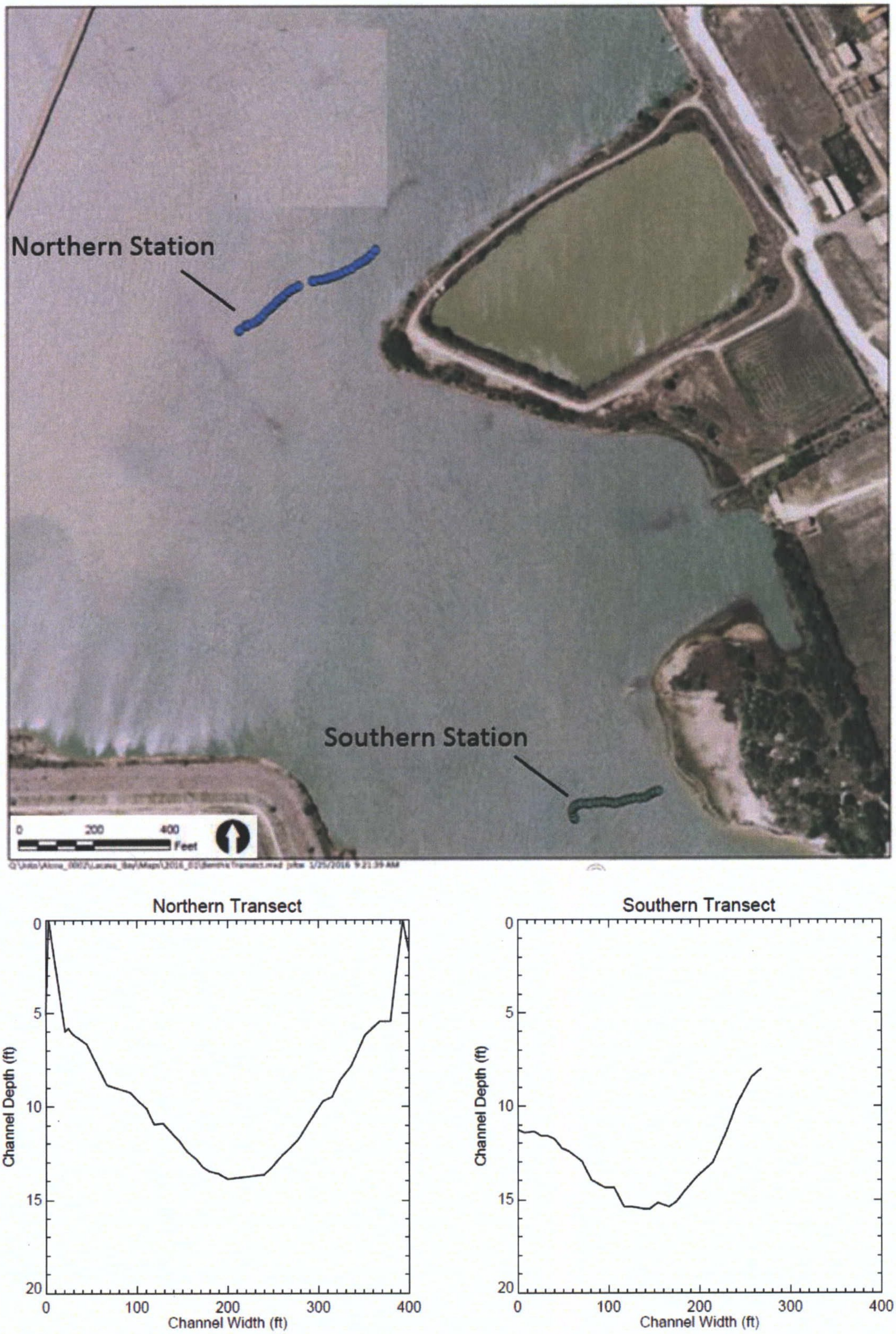


Figure 2.10-2
Supplemental Study 7C Water Column Profiling ADCP Station Locations and Cross Sections
2015 RAAER
Alcoa

\\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\documents\Reports\RAAERs\2015RAAER\Appendices\D3\Figure D3-2.docx

Q:\Jobs\Alcoa_0002\Lavaca_Bay\Maps\2016_03\LavacaBayISCOLocations.mxd jsfox 3/23/2016 3:36:07 PM

LEGEND

ISCO Locations

0 500 1,000 Feet

2015 RAAER

Supplemental Study 7C ISCO Water Sampling Station Locations

ALCOA PCO

Project: 150002-02.03

Date: 03/23/2016

Figure 2.10-3

EXPLANATION

CA018B	Well Designation
○	Monitoring Well
●	Piezometer
◉	Recovery Well
◪	Tidal Gauge
—1.5—	Estimated Potentiometric Surface Contour (Ft) C.I. = 0.5 Ft
▨	Area of Drawdown of Potentiometric Surface Caused by Pumping (not contoured)

STATE OF TEXAS
MATTHEW K. WICKHAM
GEOLOGY
LIC. # 5330
LICENSED
PROFESSIONAL GEOSCIENTIST

0 60 120 Feet

Notes:
1. Groundwater elevations measured in pumping wells are probably influenced by well inefficiencies.
2. Groundwater elevations are corrected for salinity effects.
3. Only wells measured for water levels are shown on this figure.
4. Surface water elevation used for contouring is from tidal gauge located southwest of CAPA (CA Bay).

2015 RAAER

POTENTIOMETRIC SURFACE OF ZONE B GROUNDWATER (3/10/2015)

ALCOA PCO

Alcoa Environmental

Project: 150002-02.03

Date: 03/23/2016

Figure 3.1-1

EXPLANATION

CA018B	Well Designation
○	Monitoring Well
•	Piezometer
◉	Recovery Well
◪	Tidal Gauge
—*1.5*—	Estimated Potentiometric Surface Contour (Ft) C.I. = 0.5 Ft
(hatched area)	Area of Drawdown of Potentiometric Surface Caused by Pumping (not contoured)

0 60 120 Feet

Notes:
1. Groundwater elevations measured in pumping wells are probably influenced by well inefficiencies.
2. Groundwater elevations are corrected for salinity effects.
3. NM = Not measured.
4. Only wells measured for water levels are shown on this figure.
5. Surface water elevation used for contouring is from tidal gauge located southwest of CAPA (CA Bay).

2015 RAAER

POTENTIOMETRIC SURFACE OF ZONE B GROUNDWATER (6/5/2015)

ALCOA PCO

Alcoa Environmental

Project: 150002-02.03

Date: 03/23/2016

Figure 3.1-2

EXPLANATION

CA018B	Well Designation
○	Monitoring Well
•	Piezometer
●	Recovery Well
◪	Tidal Gauge
—*1.5*—	Estimated Potentiometric Surface Contour (Ft) C.I. = 0.5 Ft
(hatched area)	Area of Drawdown of Potentiometric Surface Caused by Pumping (not contoured)

STATE OF TEXAS
MATTHEW K. WICKHAM
GEOLOGY
LIC. # 5330
LICENSED
PROFESSIONAL GEOSCIENTIST

0 60 120 Feet

Notes:
1. Groundwater elevations measured in pumping wells are probably influenced by well inefficiencies.
2. Groundwater elevations are corrected for salinity effects.
3. Only wells measured for water levels are shown on this figure.
4. Surface water elevation used for contouring is from tidal gauge located southwest of CAPA (CA Bay).

2015 RAAER

POTENTIOMETRIC SURFACE OF ZONE B GROUNDWATER (9/30/2015)

ALCOA PCO

Alcoa Environmental

Project: 150002-02.03

Date: 03/23/2016

Figure 3.1-3

EXPLANATION

CA018B Well Designation

Monitoring Well

Piezometer

Recovery Well

Tidal Gauge

1.5 Estimated Potentiometric Surface Contour (Ft) C.I. = 0.5 Ft

Area of Drawdown of Potentiometric Surface Caused by Pumping (not contoured)

STATE OF TEXAS
MATTHEW K. WICKHAM
GEOLOGY
LIC. # 5330
LICENSED
PROFESSIONAL GEOSCIENTIST

0 60 120 Feet

Notes:
1. Groundwater elevations measured in pumping wells are probably influenced by well inefficiencies.
2. Groundwater elevations are corrected for salinity effects.
3. Only wells measured for water levels are shown on this figure.
4. Surface water elevation used for contouring is from tidal gauge located southwest of CAPA (CA Bay).

2015 RAAER

POTENTIOMETRIC SURFACE OF ZONE B GROUNDWATER (12/31/2015)

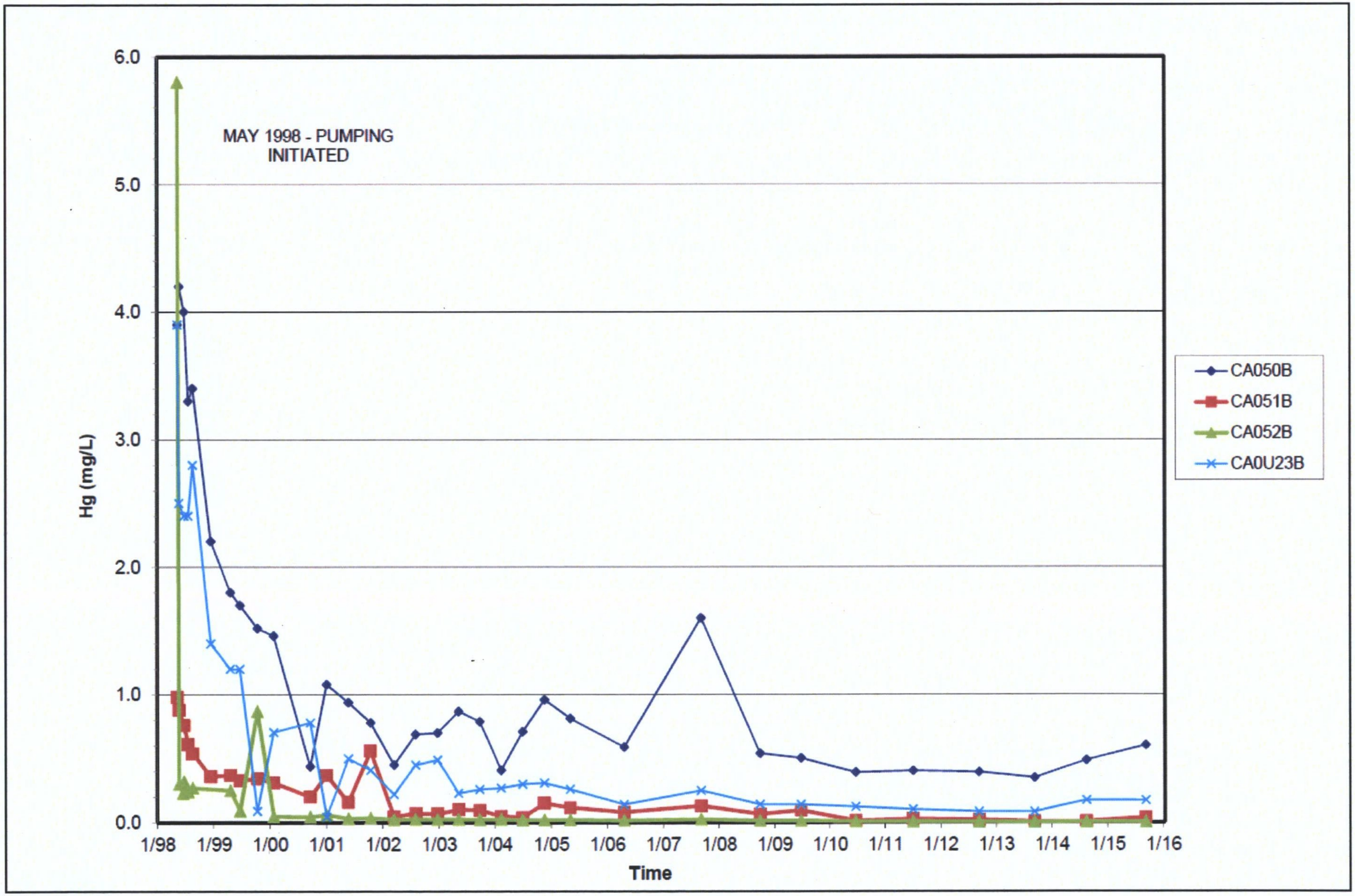
ALCOA PCO

Alcoa Environmental

Project: 150002-02.03

Date: 03/23/2016

Figure 3.1-4



\\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\documents\Reports\RAAERs\2015RAAER\Figures and Tables\Section 3\Section 3.1 Figures.pdf

Figure 3.1-5
CAPA Groundwater Treatment System, Recovery Wells – Analytical Results
Mercury (Hg) vs Time
2015 RAAER
Alcoa

\\austin2D_drive\Projects\Alcoa\Lavaca_Bay\documents\Reports\RAAERs\2015RAAER\Figures and Tables\Section 3\Section 3.1 Figures.pdf

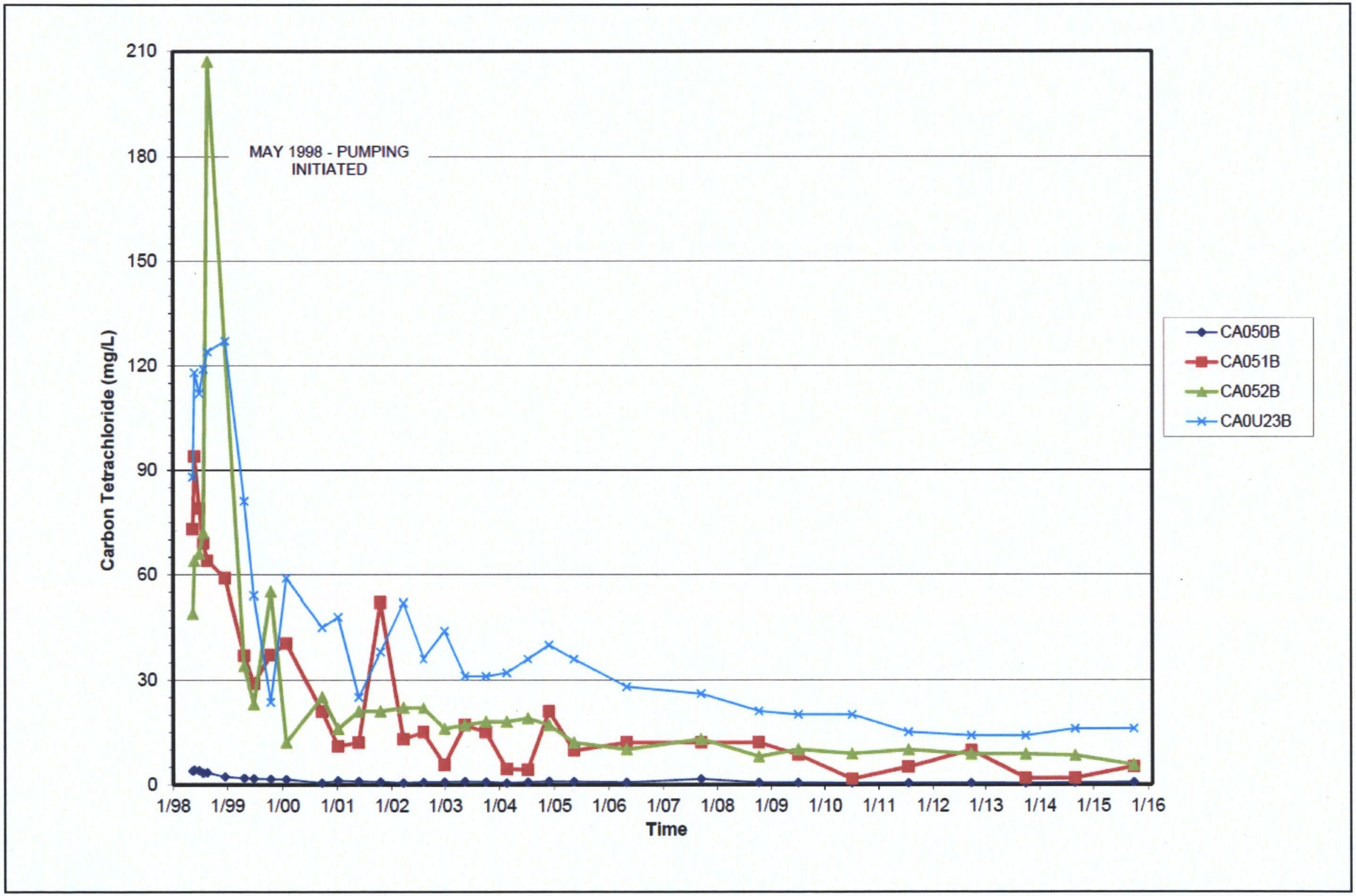
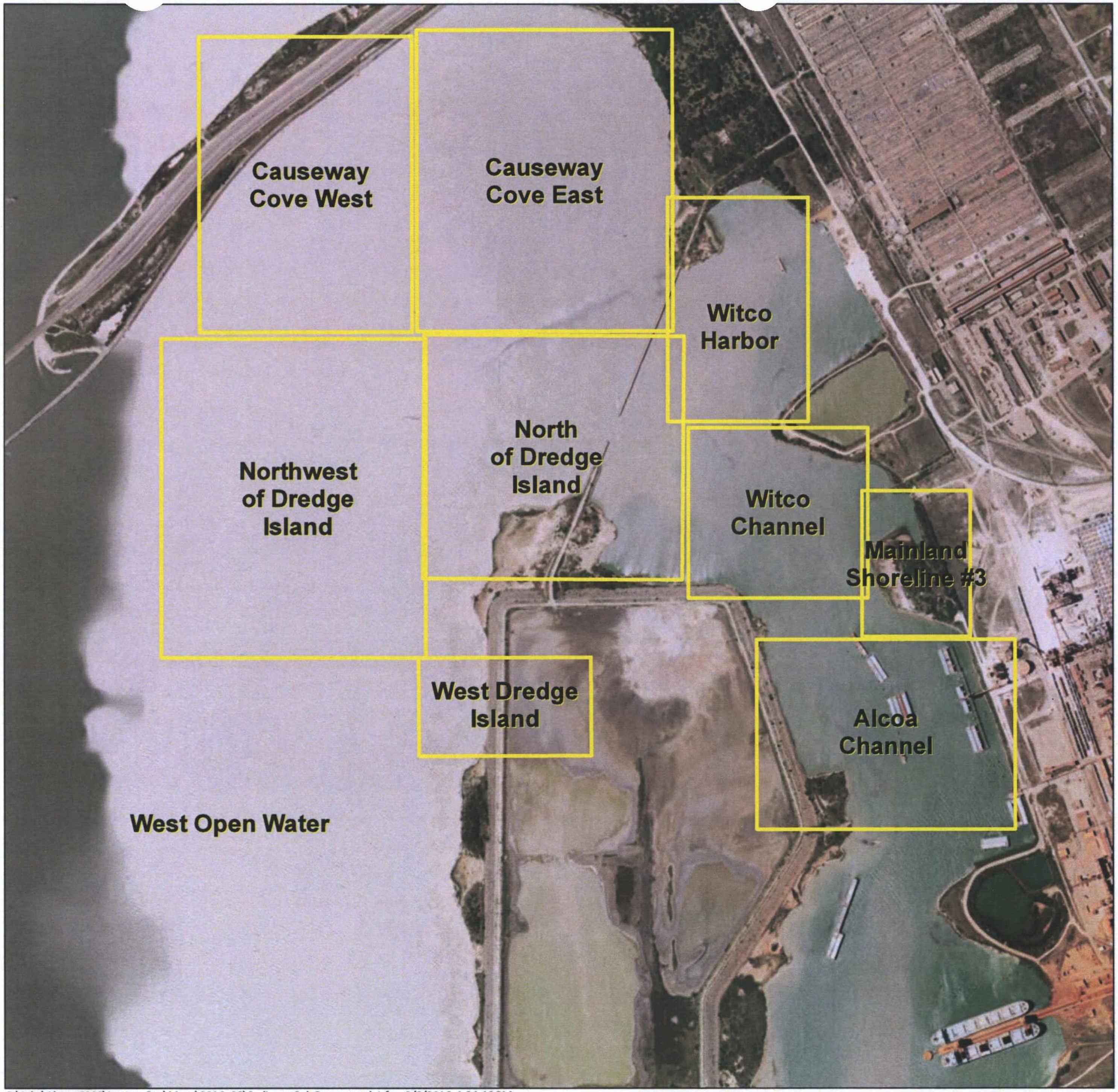


Figure 3.1-6
CAPA Groundwater Treatment System, Recovery Wells – Analytical Results
Carbon Tetrachloride vs Time
2015 RAAER
Alcoa



LEGEND

Sediment Sub-areas

0 500 1,000 Feet

2015 RAAER

Closed Area Sediment Sub-areas

ALCOA PCO

Project: 150002-02.03

Date: 02/03/2016

Figure 3.7-1

Q:\Jobs\Alcoa_0002\Lacava_Bay\Maps\2016_02\SedimentSubGroups.mxd jsfox 2/3/2016 1:34:46 PM

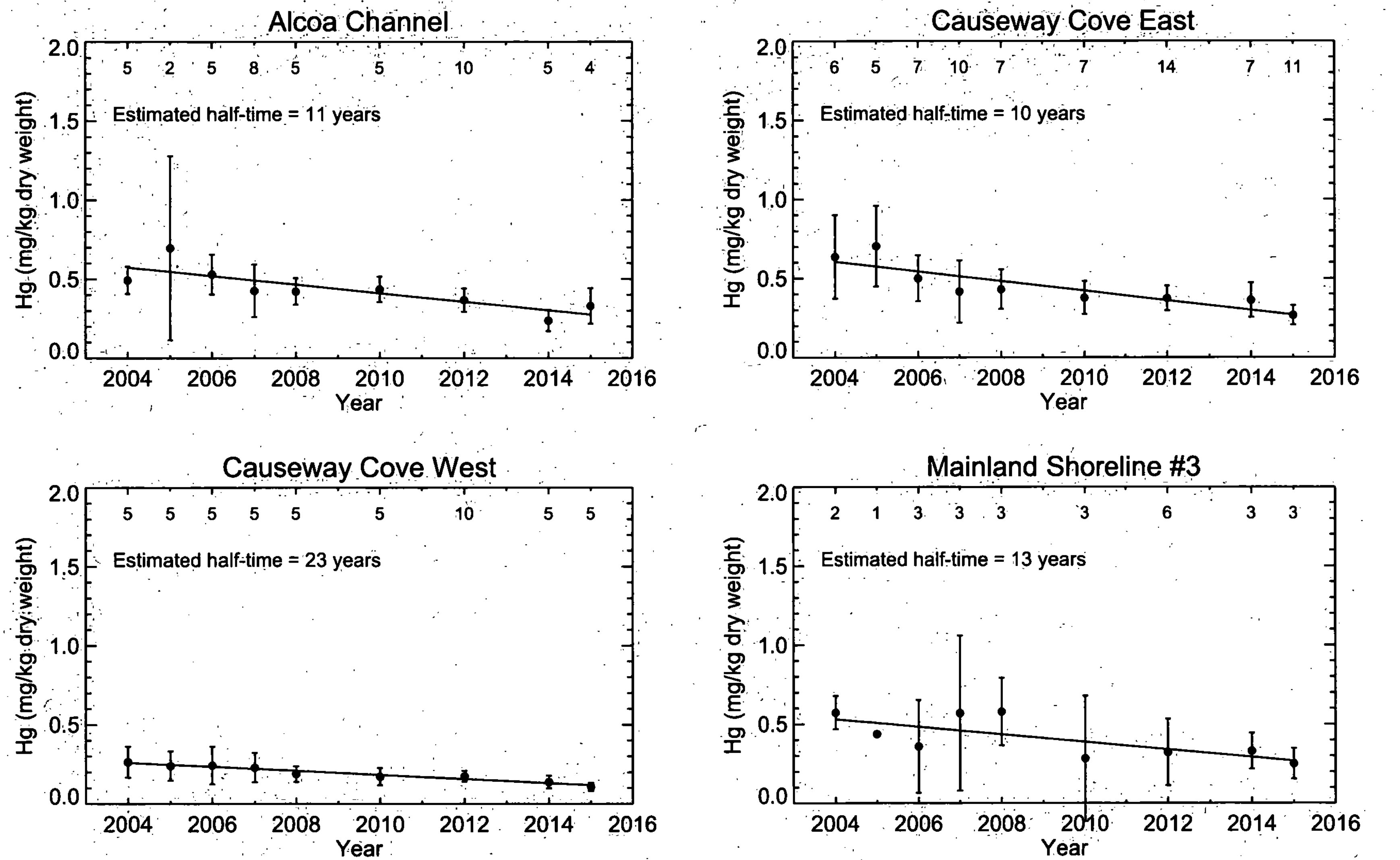


Figure 3.7-2a

Closed Area Open-water Sediment Sub-area Total Mercury Trends

Notes: Non-detect values set to MDL. Surface samples 0-2 cm and 0-5 cm included in averaging. Values at the top of the panel represent number of data points for each year. Outliers excluded from averaging: 2.88 mg/kg Hg in Alcoa Channel in 2015 and 1.25 mg/kg Hg in Northwest of Dredge Island in 2014. Half-time = -log(2) / regression slope

CF/HS - \\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\Analysis\Hg_Trends\sediment_hg_temporal_160128.pro
Mon Mar 21 09:16:54 2016

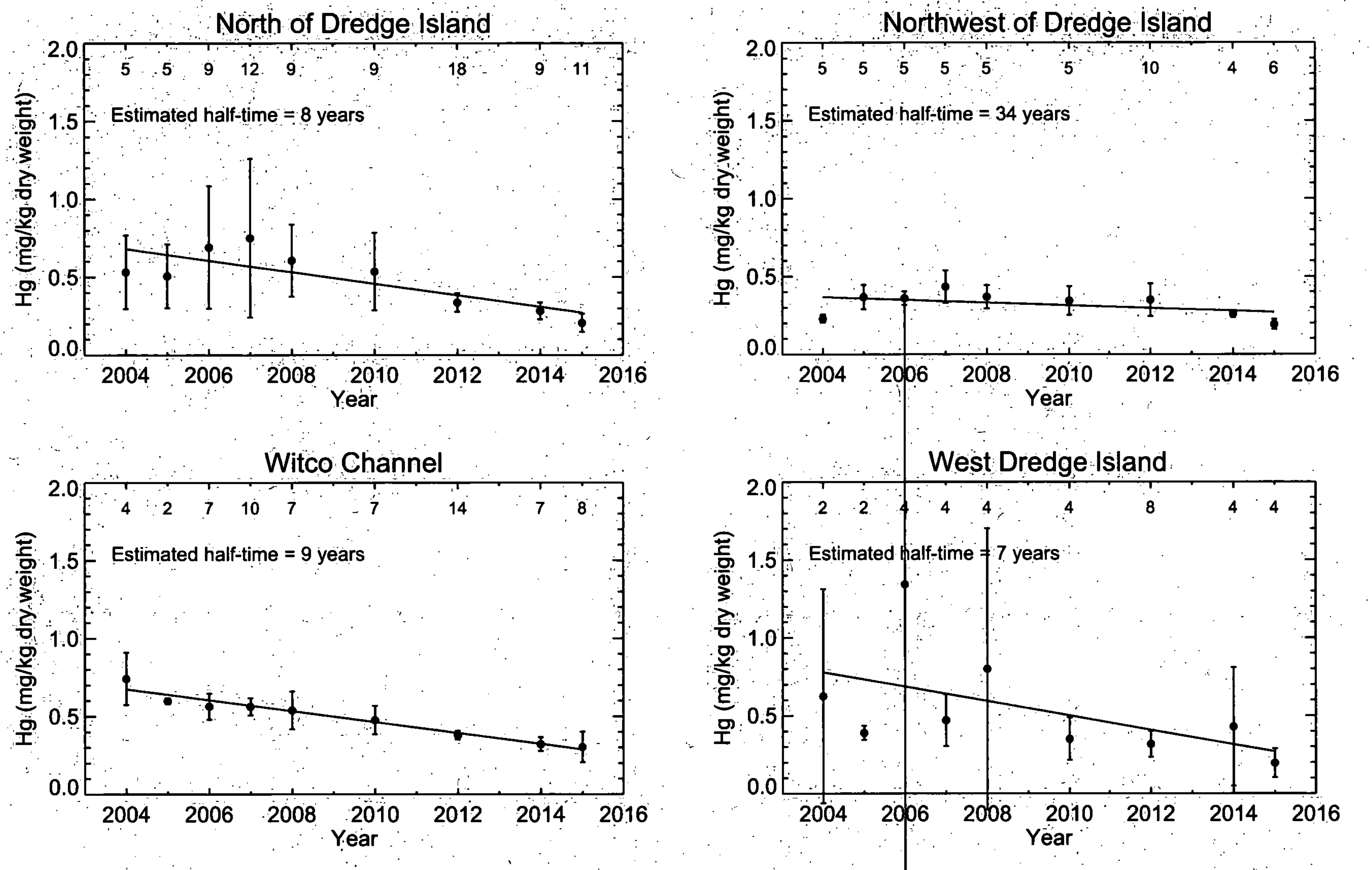


Figure 3.7-2b

Closed Area Open-water Sediment Sub-area Total Mercury Trends

Notes: Non-detect values set to MDL. Surface samples 0-2 cm and 0-5 cm included in averaging. Values at the top of the panel represent number of data points for each year. Outliers excluded from averaging: 2.88 mg/kg Hg in Alcoa Channel in 2015 and 1.25 mg/kg Hg in Northwest of Dredge Island in 2014. Half-time = -log(2) / regression slope

CF/HS - \\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\Analysis\Hg_Trends\sediment_hg_temporal_160128.pro
Mon Mar 21 09:16:55 2016

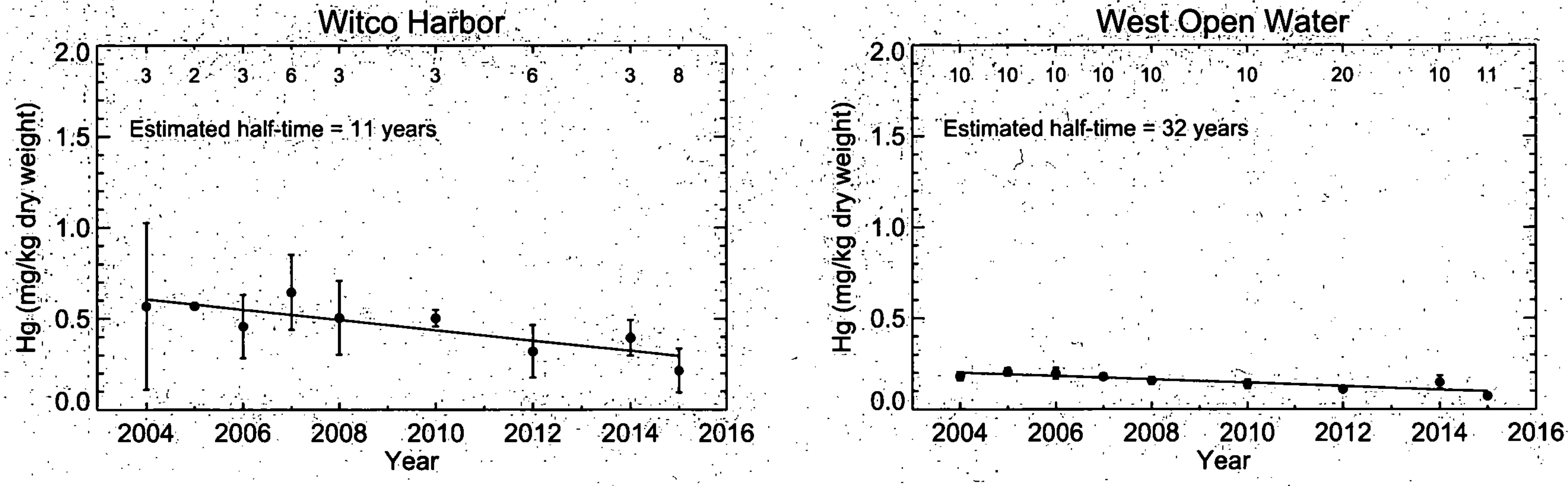


Figure 3.7-2c

Closed Area Open-water Sediment Sub-area Total Mercury Trends

Notes: Non-detect values set to MDL. Surface samples 0-2 cm and 0-5 cm included in averaging. Values at the top of the panel represent number of data points for each year. Outliers excluded from averaging: 2.88 mg/kg Hg in Alcoa Channel in 2015 and 1.25 mg/kg Hg in Northwest of Dredge Island in 2014. Half-time = -log(2) / regression slope

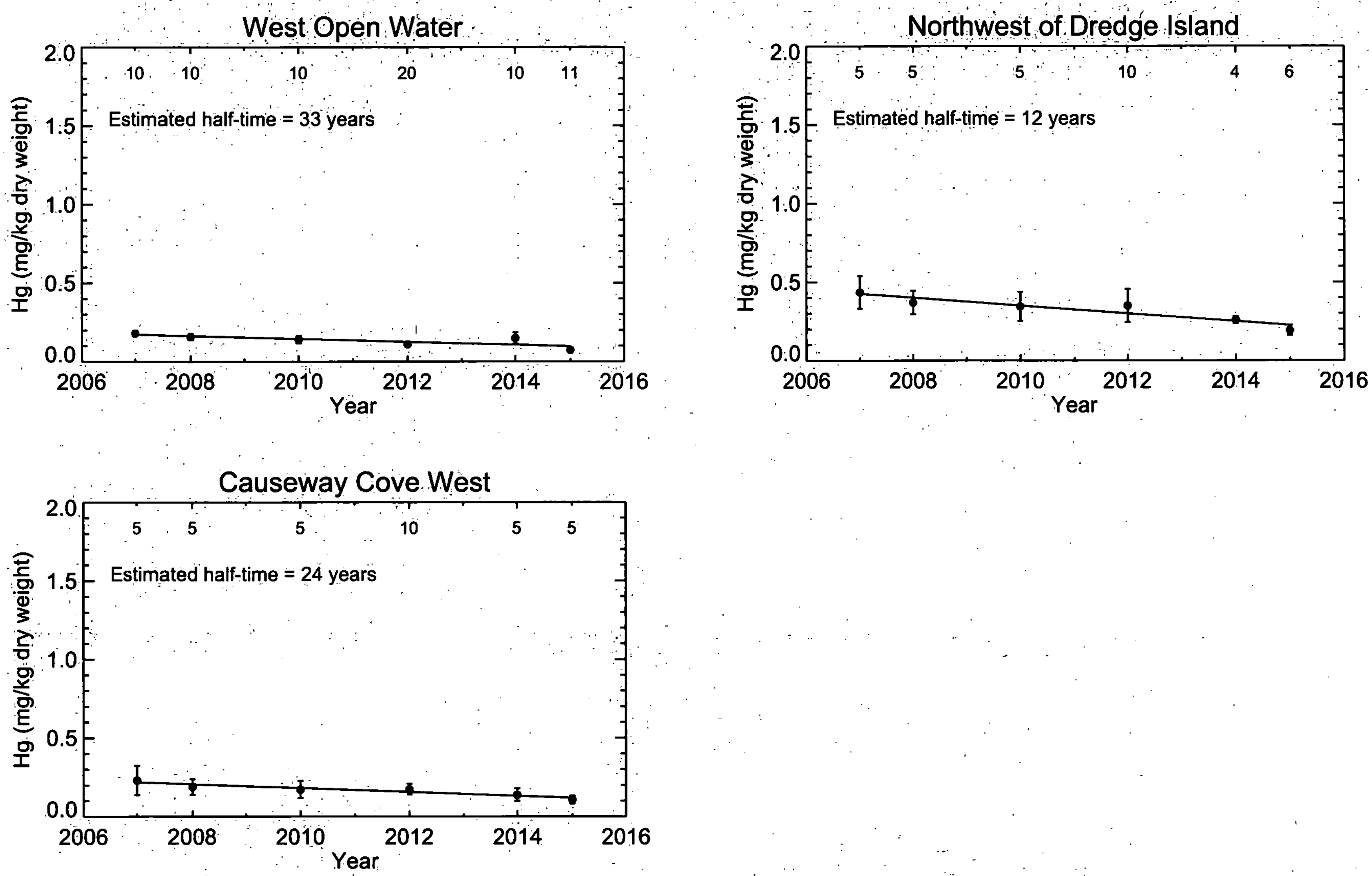


Figure 3.7-3

Western Closed Area Open-water Sediment Sub-area Total Mercury Trends

Notes: Non-detect values set to MDL. Surface samples 0-2 cm and 0-5 cm included in averaging. Values at the top of the panel represent number of data points for each year. Outliers excluded from averaging: 1.25 mg/kg Hg in Northwest of Dredge Island in 2014. Half-time = -log(2) / regression slope

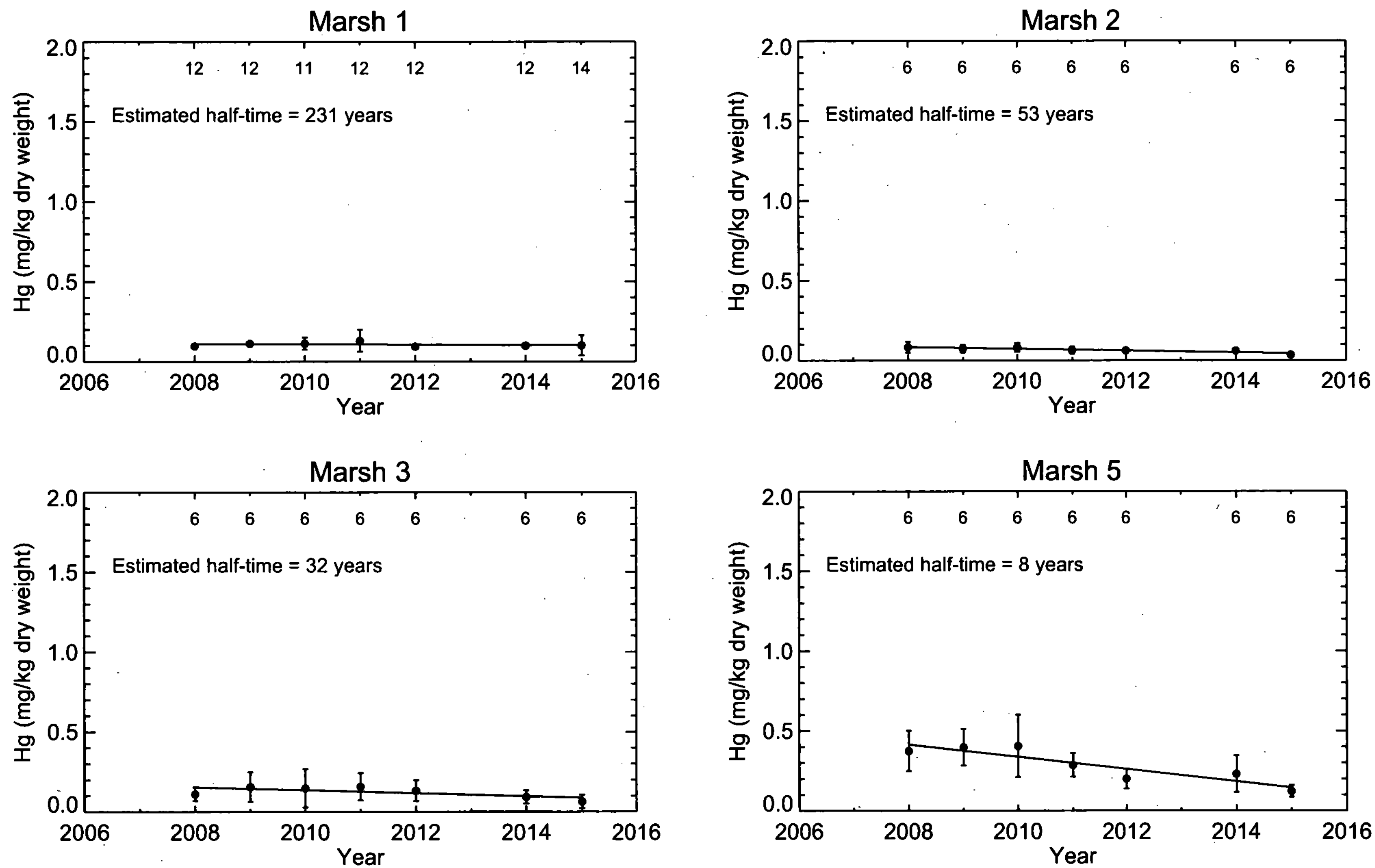


Figure 3.7-4a

Closed Area Marsh Total Mercury Trends

Notes: Non-detect values set to MDL. Surface samples 0-2 cm and 0-5 cm included in averaging. Values at the top of the panel represent number of samples. 11.5 mg/kg outlier excluded in Marsh 1 in 2010. Half-time = -log(2) / regression slope

CF/HS - \\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\Analysis\Hg_Trends\sediment_hg_temporal_160128.pro
Mon Mar 21 09:14:34 2016

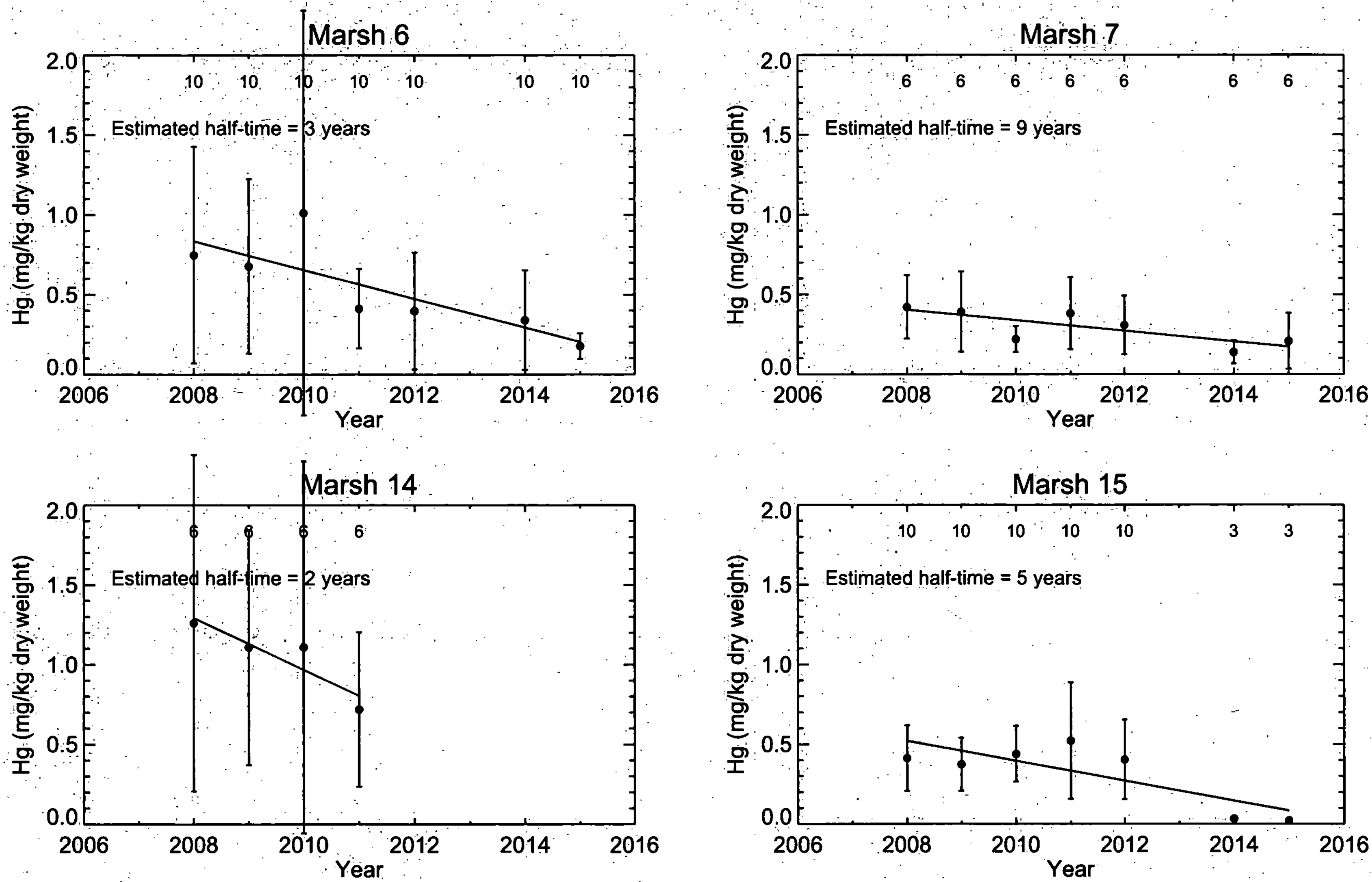


Figure 3.7-4b

Closed Area Marsh Total Mercury Trends

Notes: Non-detect values set to MDL. Surface samples 0-2 cm and 0-5 cm included in averaging.
Values at the top of the panel represent number of samples. 11.5 mg/kg outlier excluded in Marsh 1 in 2010.
Half-time = -log(2) / regression slope

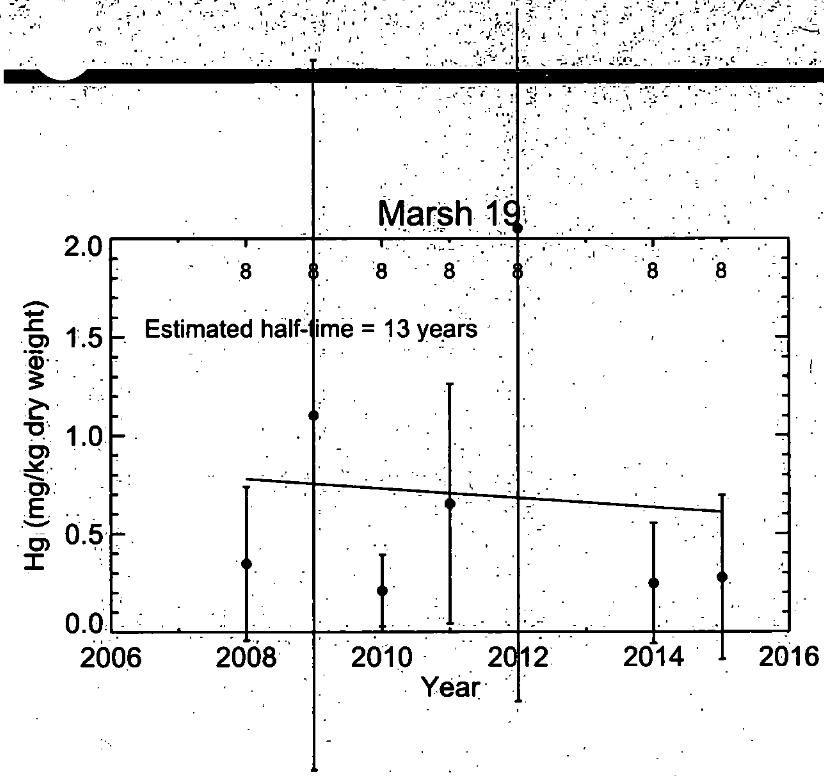


Figure 3.7-4c

Closed Area Marsh Total Mercury Trends

Notes: Non-detect values set to MDL. Surface samples 0-2 cm and 0-5 cm included in averaging.
Values at the top of the panel represent number of samples. 11.5 mg/kg outlier excluded in Marsh 1 in 2010.
Half-time = -log(2) / regression slope

CF/HS - \\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\Analysis\Hg_Trends\sediment_hg_temporal_160128.pro
Mon Mar 21 09:14:35 2016

\\orcas\GIS\Jobs\Alcoa_0002\Lavaca_Bay\Maps\2016_03\LavacaBayMethylHgResults.mxd eiverson 3/21/2016 5:14:16 PM

LEGEND

Methylmercury Sediment Concentration (0-2 cm; ng/g)

- 1 - 0.25
- 0.251 - 0.5
- 0.501 - 0.75
- 0.751 - 1
- 1.001 - 2
- 2.001 - 3
- > 3

0 1,000 2,000 Feet

NOTES:
Methylmercury results in sediment are shown in ng/g dry weight

2015 RAAER

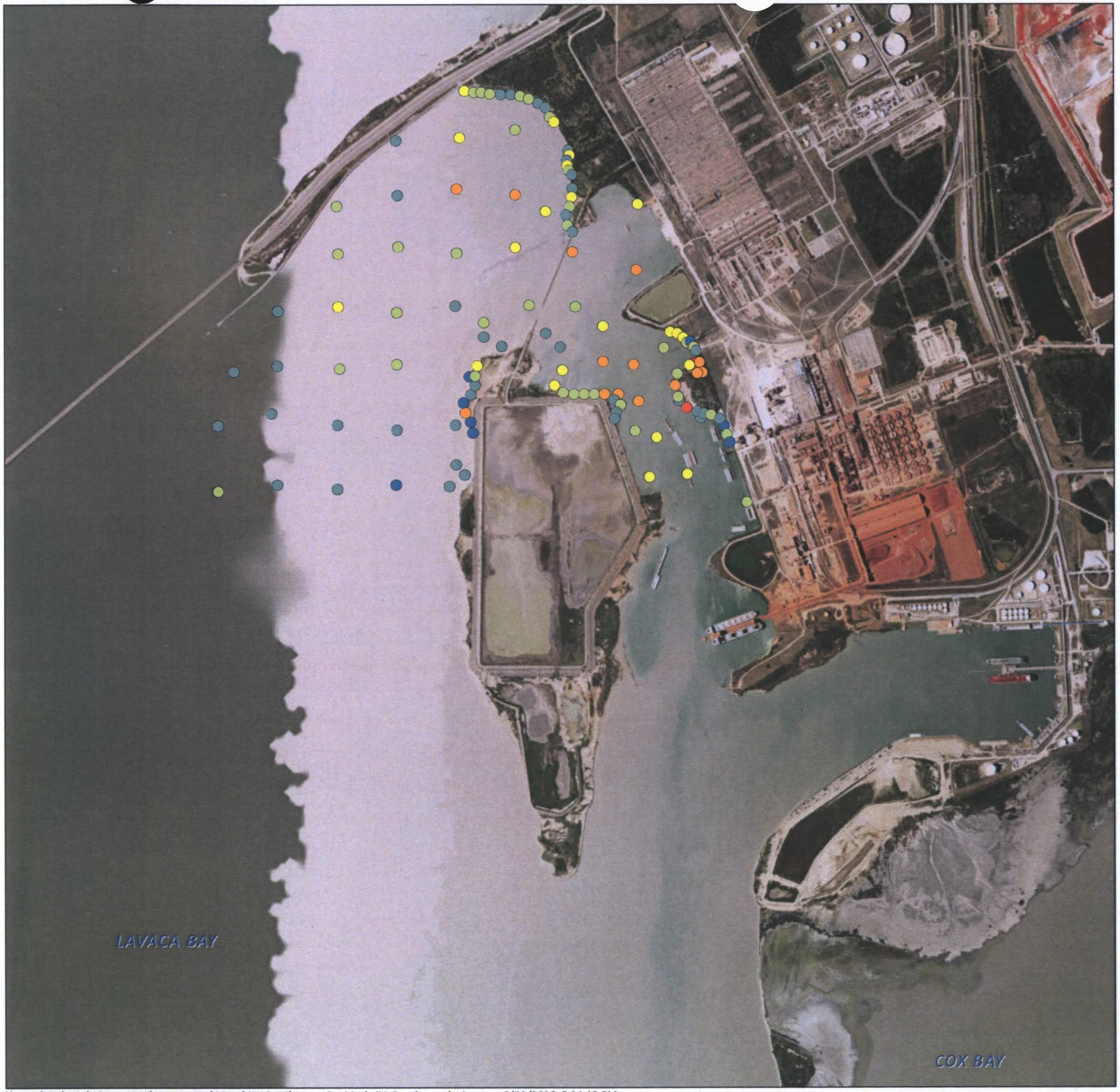
Methylmercury in Surface (0-2 cm) Sediment in the Closed Area (2011)

ALCOA PCO

Project: 150002-02.03

Date: 03/21/2016

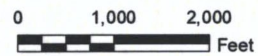
Figure 3.7-5a



LEGEND

Methylmercury Sediment Concentration (0-2 cm; ng/g)

- 1 - 0.25
- 0.251 - 0.5
- 0.501 - 0.75
- 0.751 - 1
- 1.001 - 2
- 2.001 - 3
- > 3



NOTES:
Methylmercury results in sediment are shown in ng/g dry weight

2015 RAAER

Methylmercury in Surface (0-2 cm) Sediment in the Closed Area (2012)

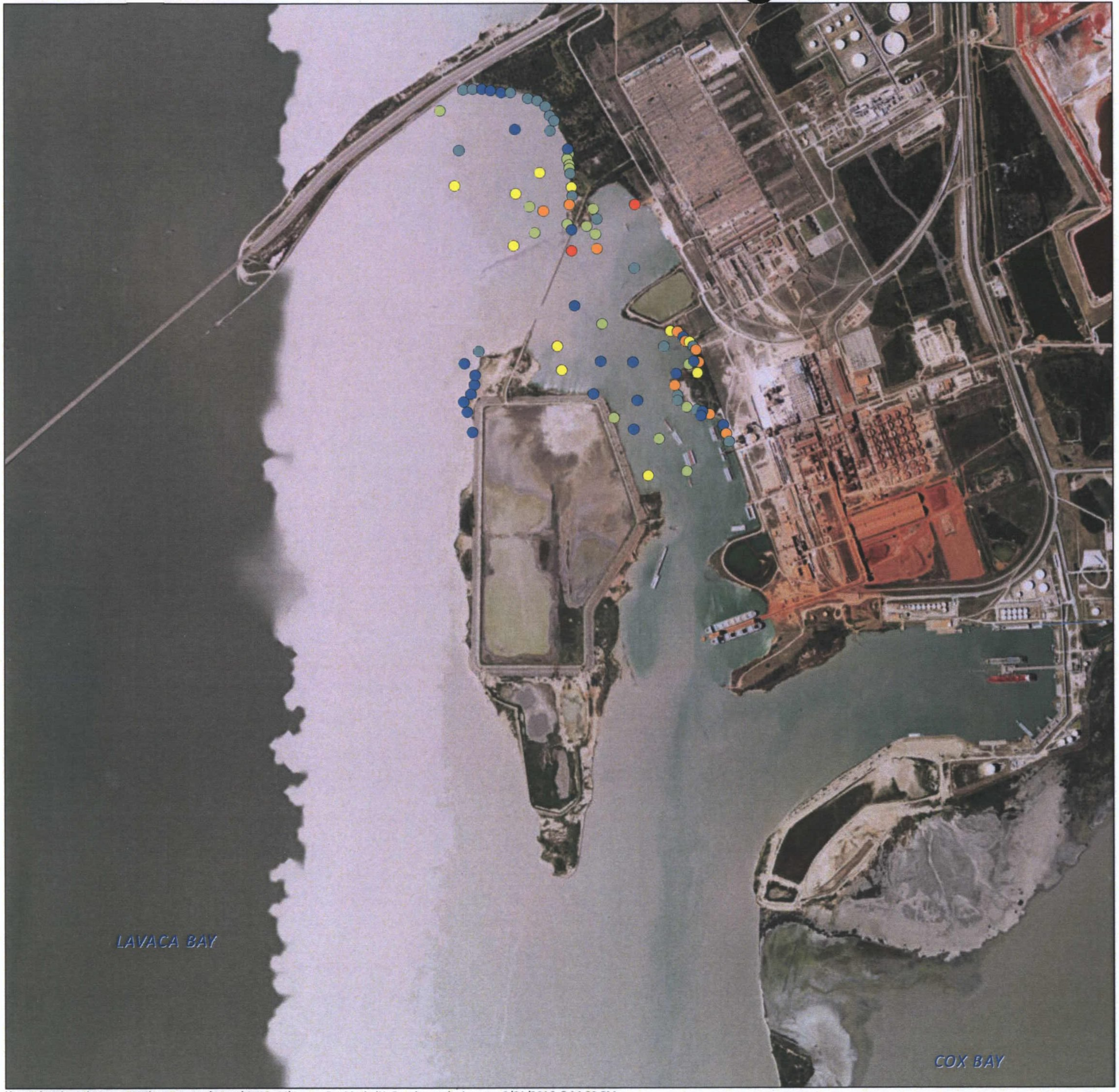
ALCOA PCO

Project: 150002-02.03

Date: 03/21/2016

Figure 3.7-5b

\\orcas\GIS\Jobs\Alcoa_0002\Lavaca_Bay\Maps\2016_03\LavacaBayMethylHgResults.mxd eiverson 3/21/2016 5:14:18 PM



LEGEND

Methylmercury Sediment Concentration (0-2 cm; ng/g)

- 1 - 0.25
- 0.251 - 0.5
- 0.501 - 0.75
- 0.751 - 1
- 1.001 - 2
- 2.001 - 3
- > 3

0 1,000 2,000 Feet

NOTES:
Methylmercury results in sediment are shown in ng/g dry weight

2015 RAAER

Methylmercury in Surface (0-2 cm) Sediment in the Closed Area (2015)

ALCOA PCO

Project: 150002-02.03

Date: 03/21/2016

Figure 3.7-5c

\\orcas\GIS\Jobs\Alcoa_0002\Lavaca_Bay\Maps\2016_03\LavacaBayMethylHgResults.mxd eiverson 3/21/2016 5:14:20 PM

LEGEND

Methylmercury (ng/g-OC)
(0-2 cm)

- 0 - 25
- 25 - 50
- 50 - 100
- 100 - 200
- 200 - 300
- 300 - 400
- > 400

0 1,000 2,000 Feet

NOTES:
Methylmercury results in sediment are shown in ng/g-OC dry weight

2015 RAAER

Organic Carbon Normalized Methylmercury in Surface (0-2cm) Sediment in the Closed Area (2011)

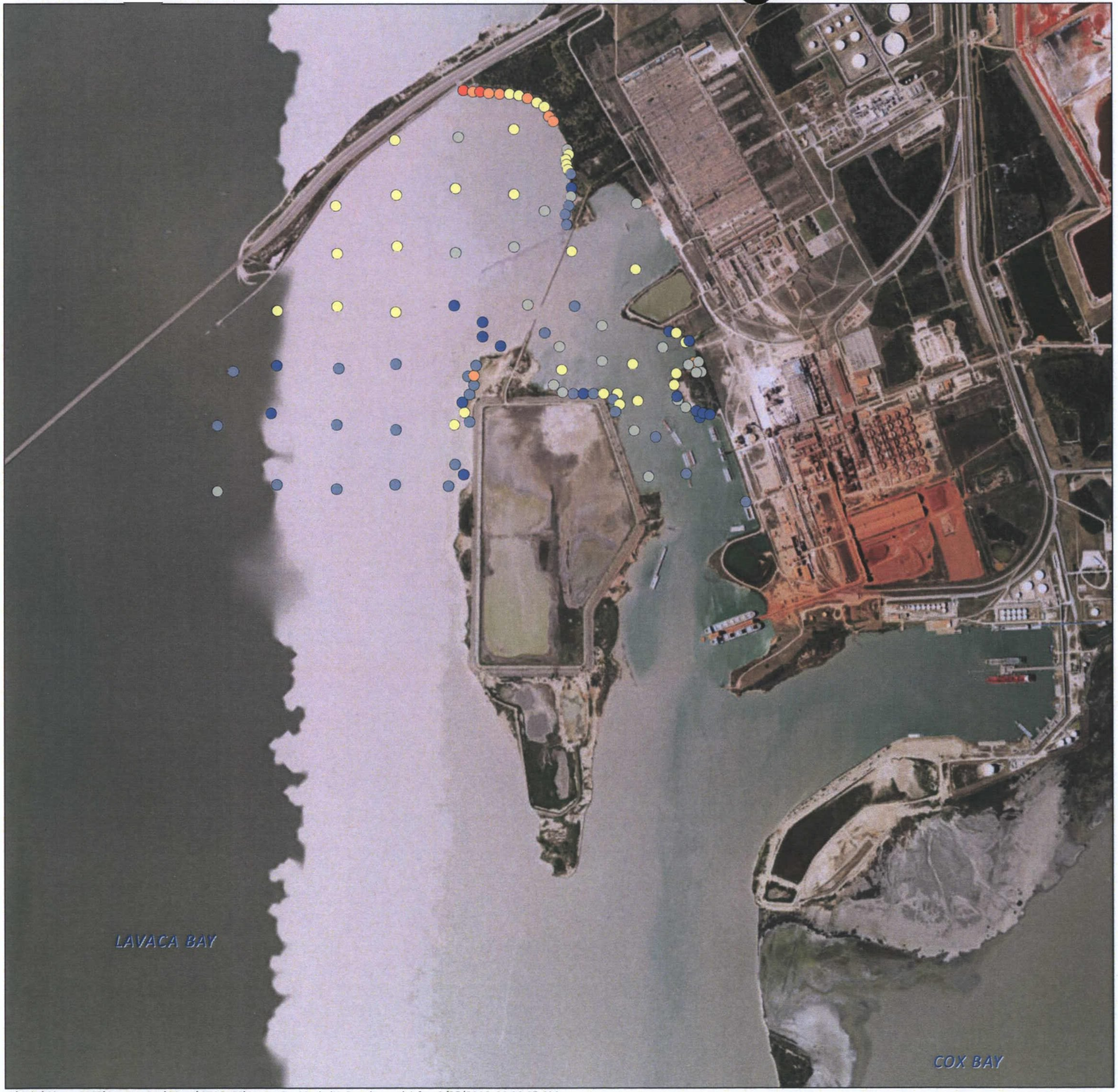
ALCOA PCO

Project: 150002-02.03

Date: 03/25/2016

Figure 3.7-6a

Q:\Jobs\Alcoa_0002\Lavaca_Bay\Maps\2016_03\LavacaBayMethylHgResults.mxd jsfox 3/25/2016 10:03:03 AM



LEGEND

Methylmercury (ng/g-OC)
(0-2 cm)

- 0 - 25
- 25 - 50
- 50 - 100
- 100 - 200
- 200 - 300
- 300 - 400
- > 400

0 1,000 2,000
Feet

NOTES:
Methylmercury results in sediment are shown in ng/g-OC dry weight

2015 RAAER

Organic Carbon Normalized Methylmercury in Surface (0-2cm) Sediment in the Closed Area (2012)

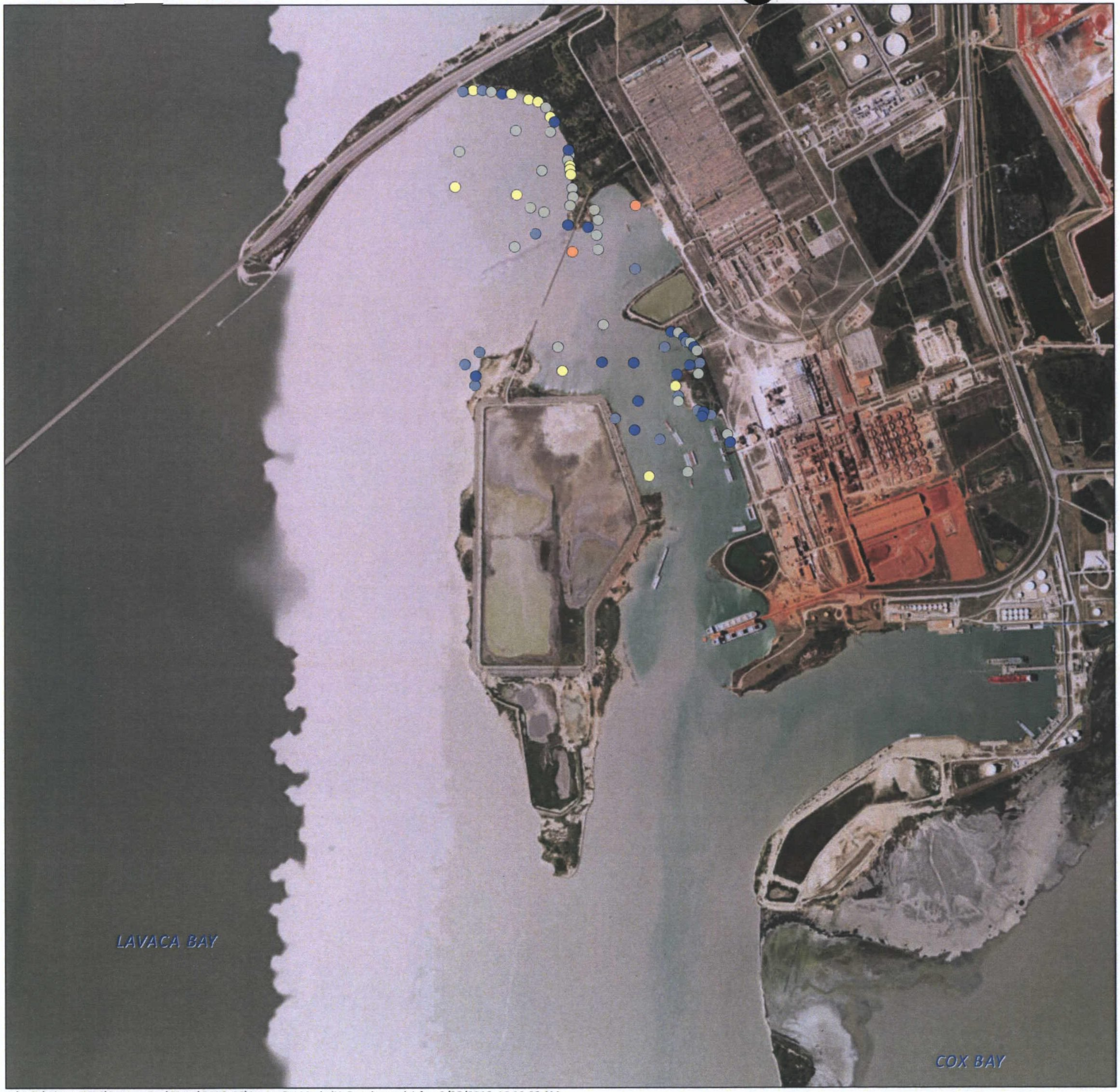
ALCOA PCO

Project: 150002-02.03

Date: 03/25/2016

Figure 3.7-6b

Q:\Jobs\Alcoa_0002\Lavaca_Bay\Maps\2016_03\LavacaBayMethylHgResults.mxd jsfox 3/25/2016 10:03:05 AM



LEGEND

Methylmercury (ng/g-OC)
(0-2 cm)

- 0 - 25
- 25 - 50
- 50 - 100
- 100 - 200
- 200 - 300
- 300 - 400
- > 400

0 1,000 2,000 Feet

NOTES:
Methylmercury results in sediment are shown in ng/g-OC dry weight

2015 RAAER

Organic Carbon Normalized Methylmercury in Surface (0-2cm) Sediment in the Closed Area (2015)

ALCOA PCO

Project: 150002-02.03

Date: 03/25/2016

Figure 3.7-6c

Q:\Jobs\Alcoa_0002\Lavaca_Bay\Maps\2016_03\LavacaBayMethylHgResults.mxd jsfox 3/25/2016 10:03:06 AM

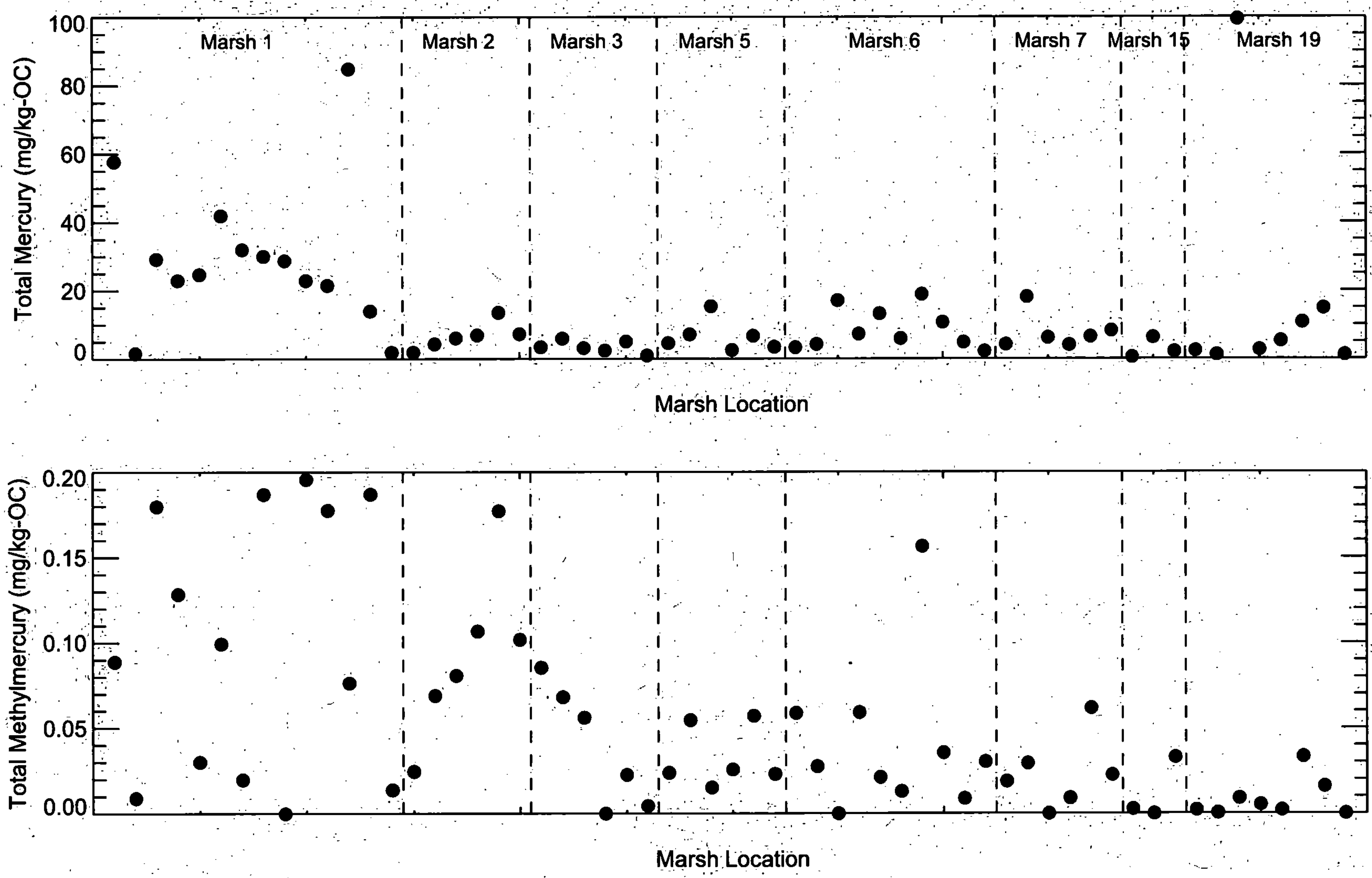


Figure 3.7-7

2015 Organic Carbon Normalized Mercury Concentrations in Marsh Sediments

Notes: 2015 sampling data shown. Individual marsh locations plotted.

CH - \\nereus\D_Drive\Projects\ALCOA\Lavaca_Bay\IDL\Marsh_spatials.pro
Mon Mar 21 10:36:26 2016

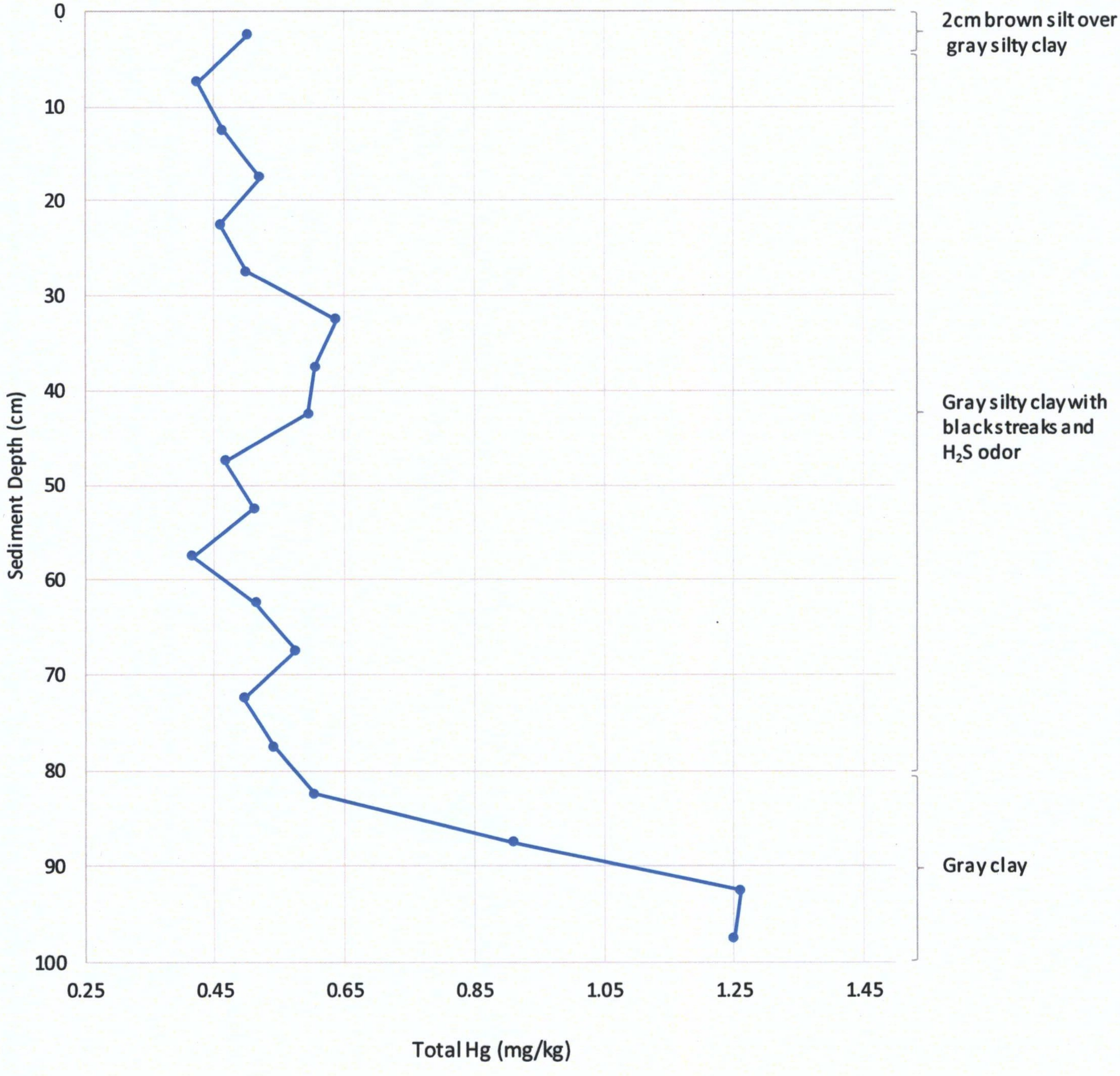


Figure 3.7-8a
2007 Supplemental Study 5 Location 0514 Mercury Profile
2015 RAAER
Alcoa

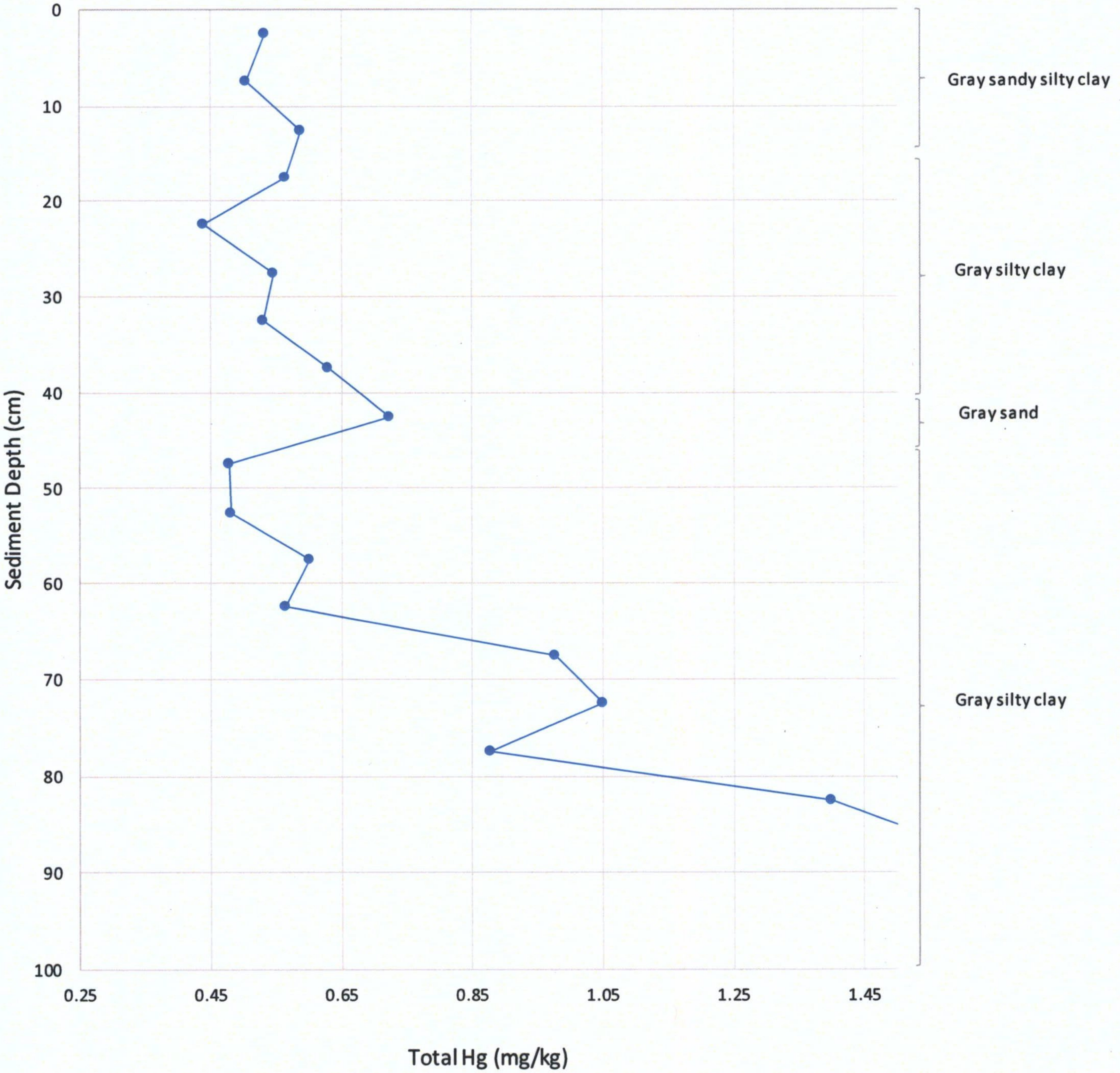


Figure 3.7-8b
2007 Supplemental Study 5 Location 0513 Mercury Profile
2015 RAAER
Alcoa

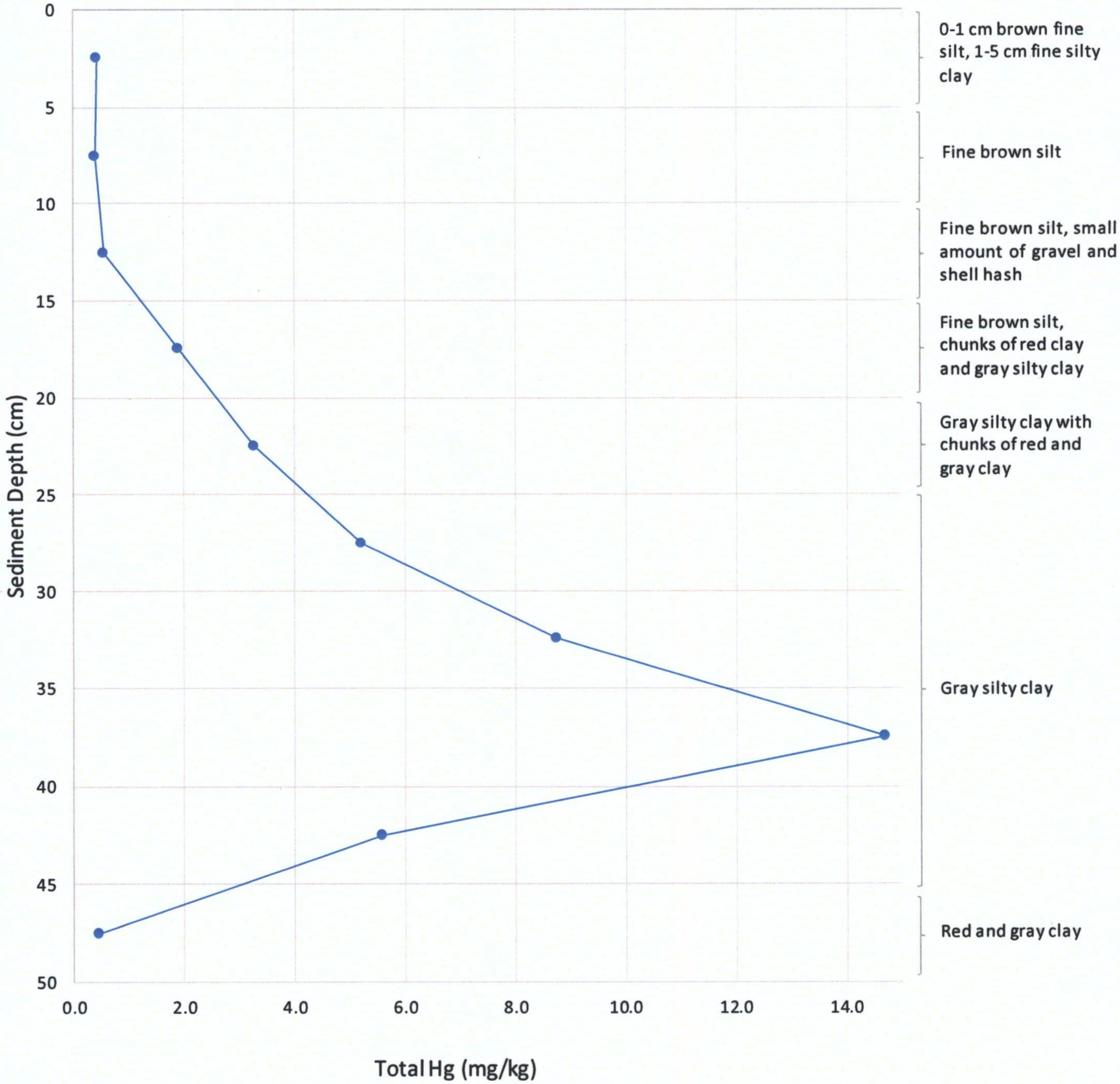
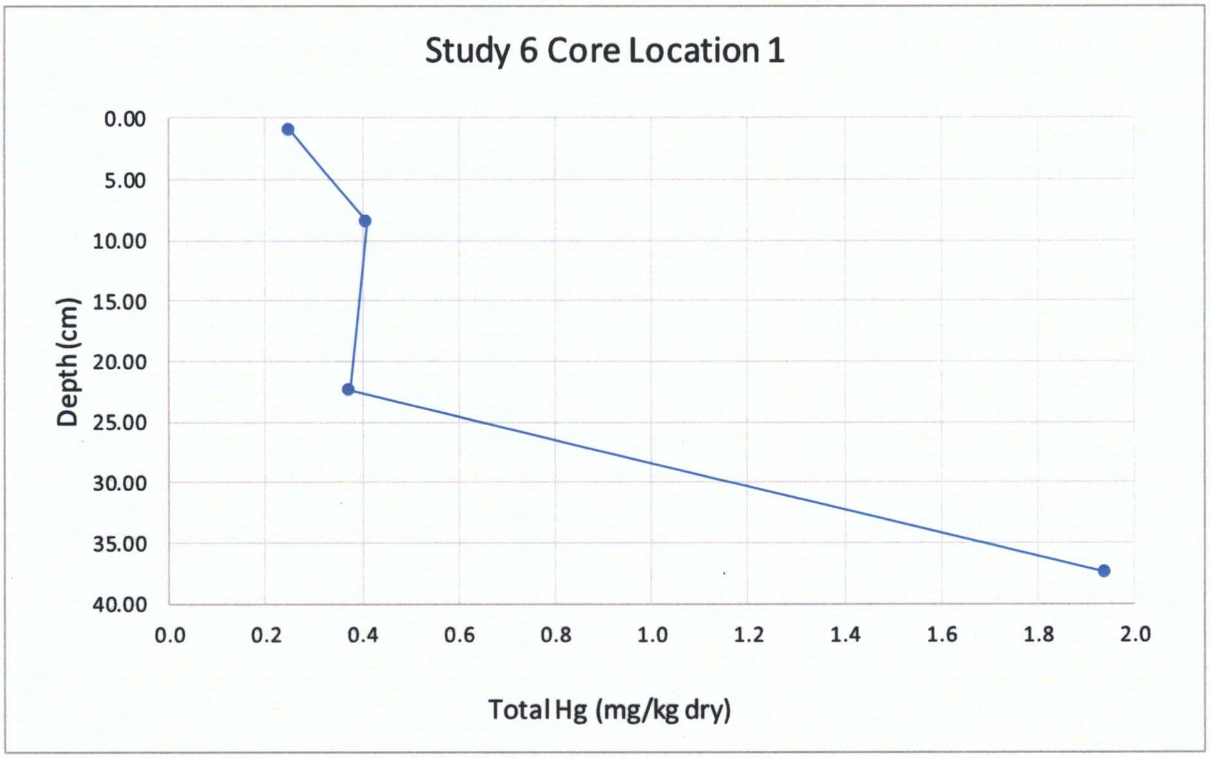


Figure 3.7-8c
2007 Supplemental Study 5 Location 0512 Mercury Profile
RAAER 2015
Alcoa



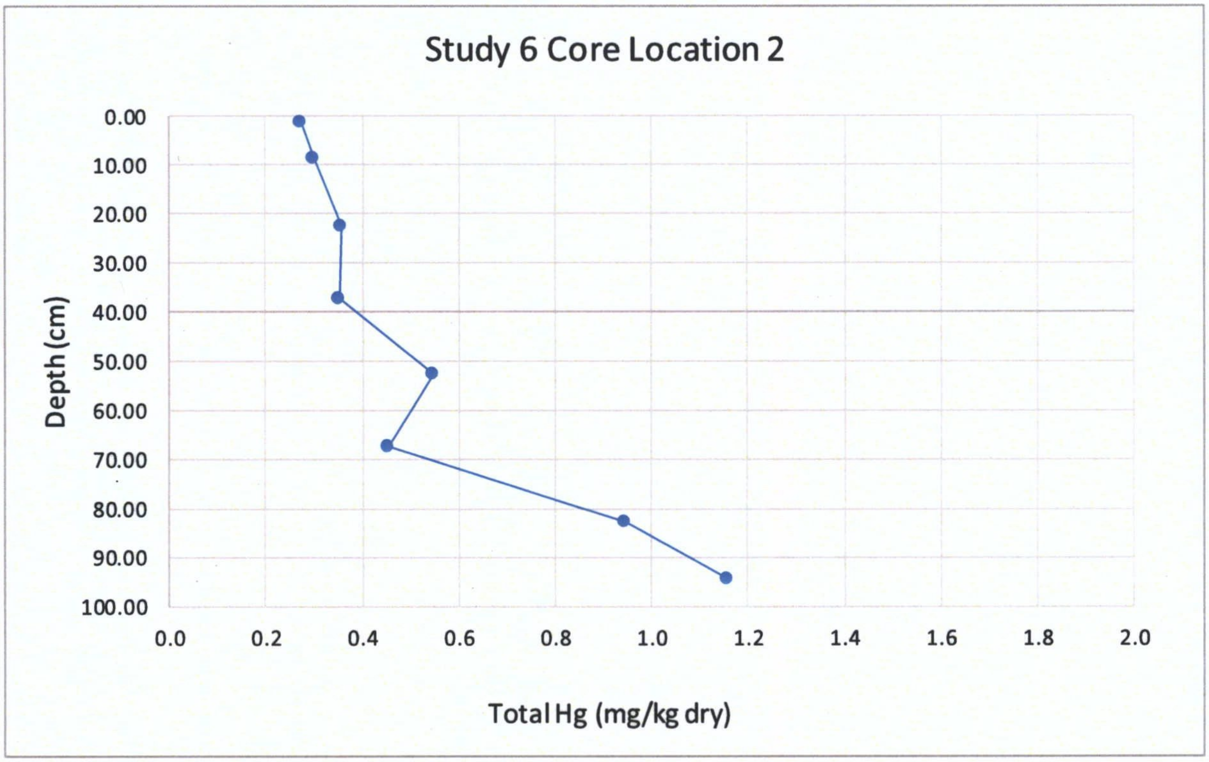
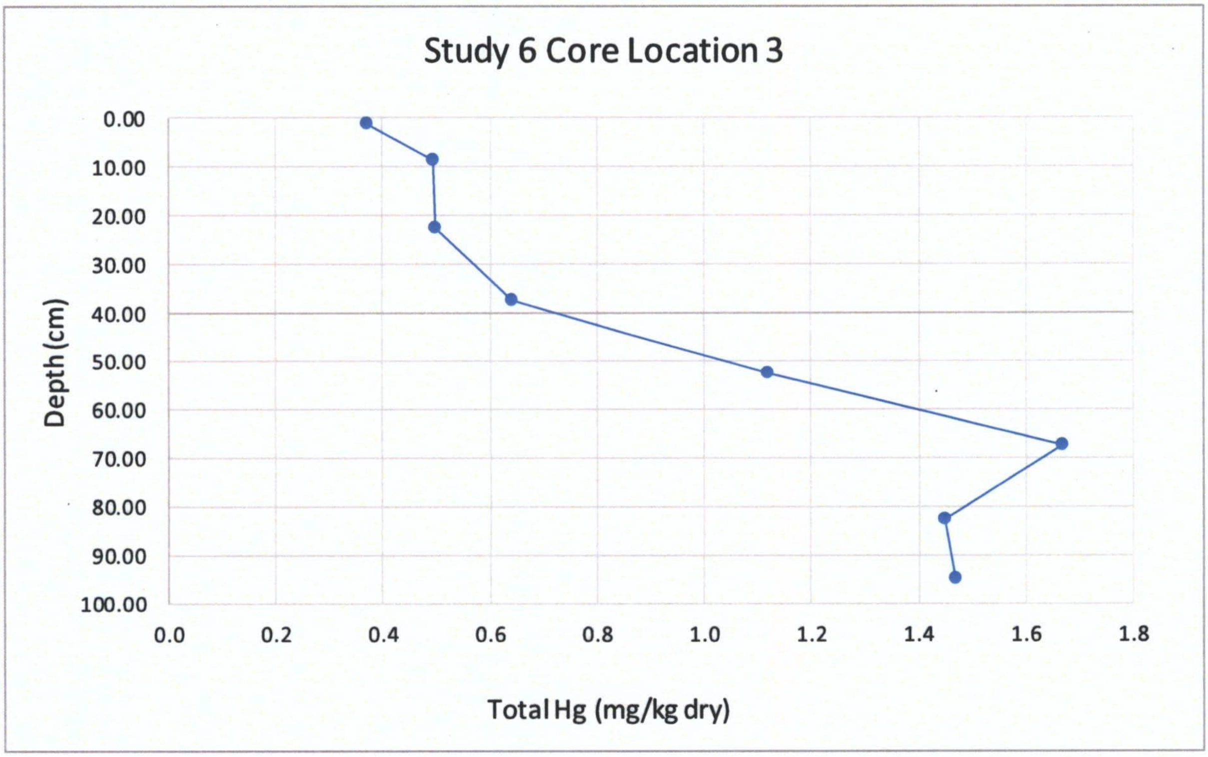


Figure 3.7-9a
2015 Supplemental Study 6 Total Mercury Profiles
RAAER 2015
Alcoa



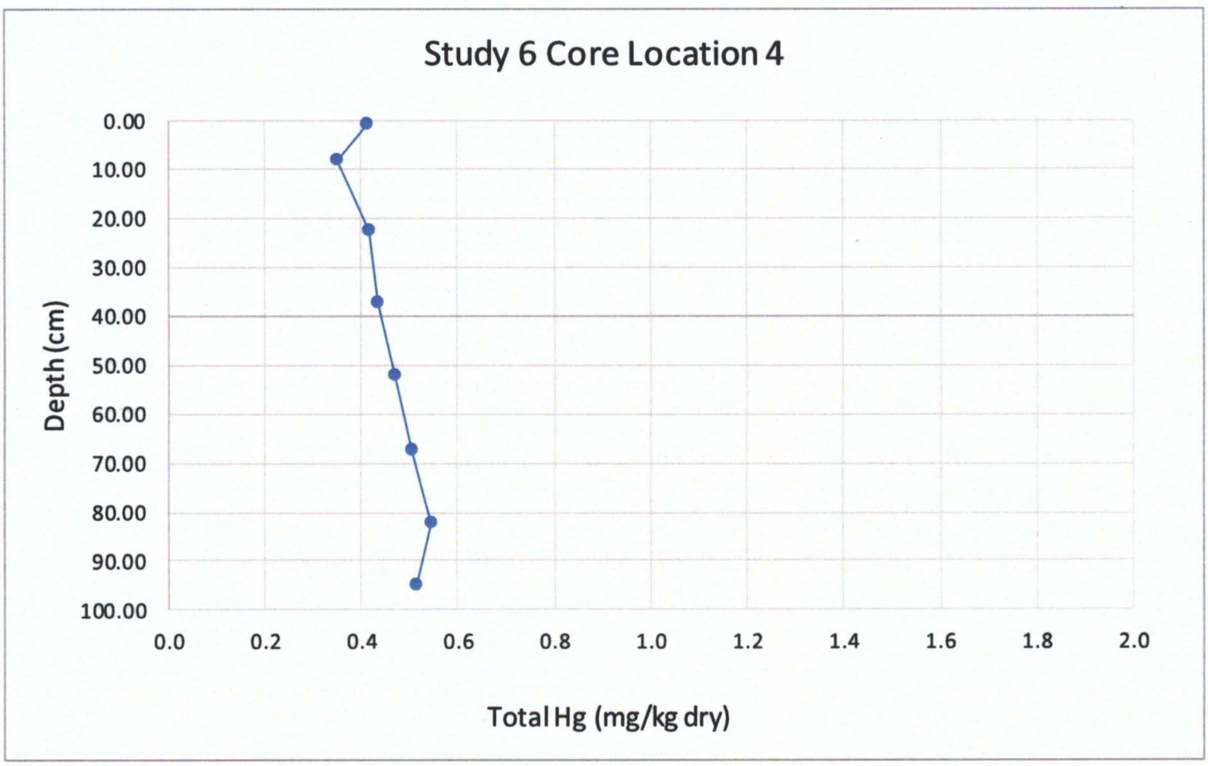
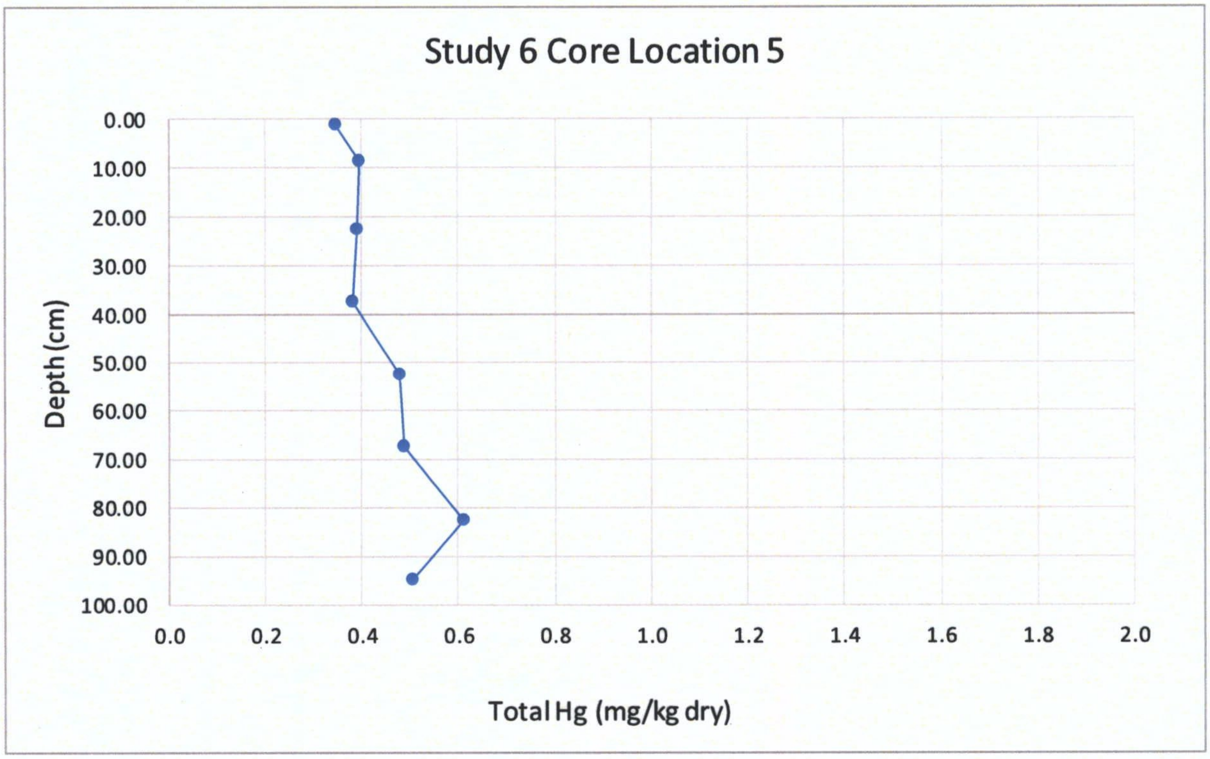


Figure 3.7-9b
2015 Supplemental Study 6 Total Mercury Profiles
RAAER 2015
Alcoa



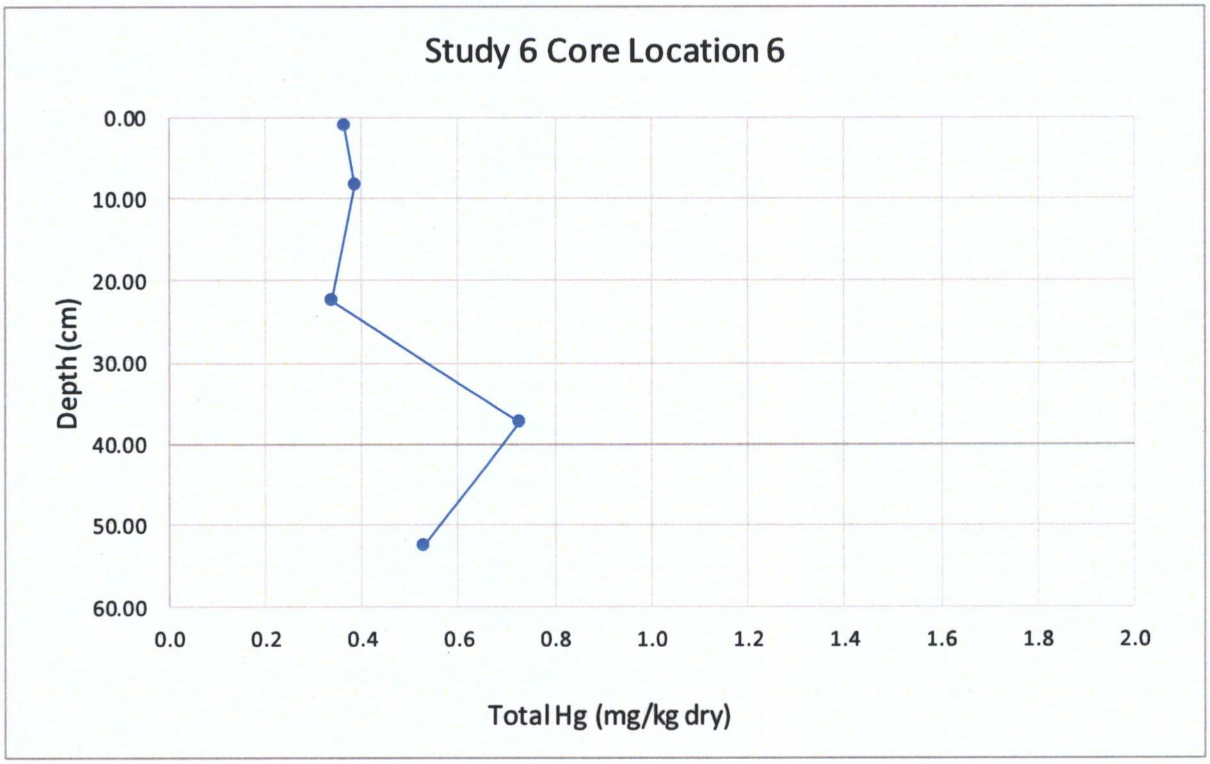
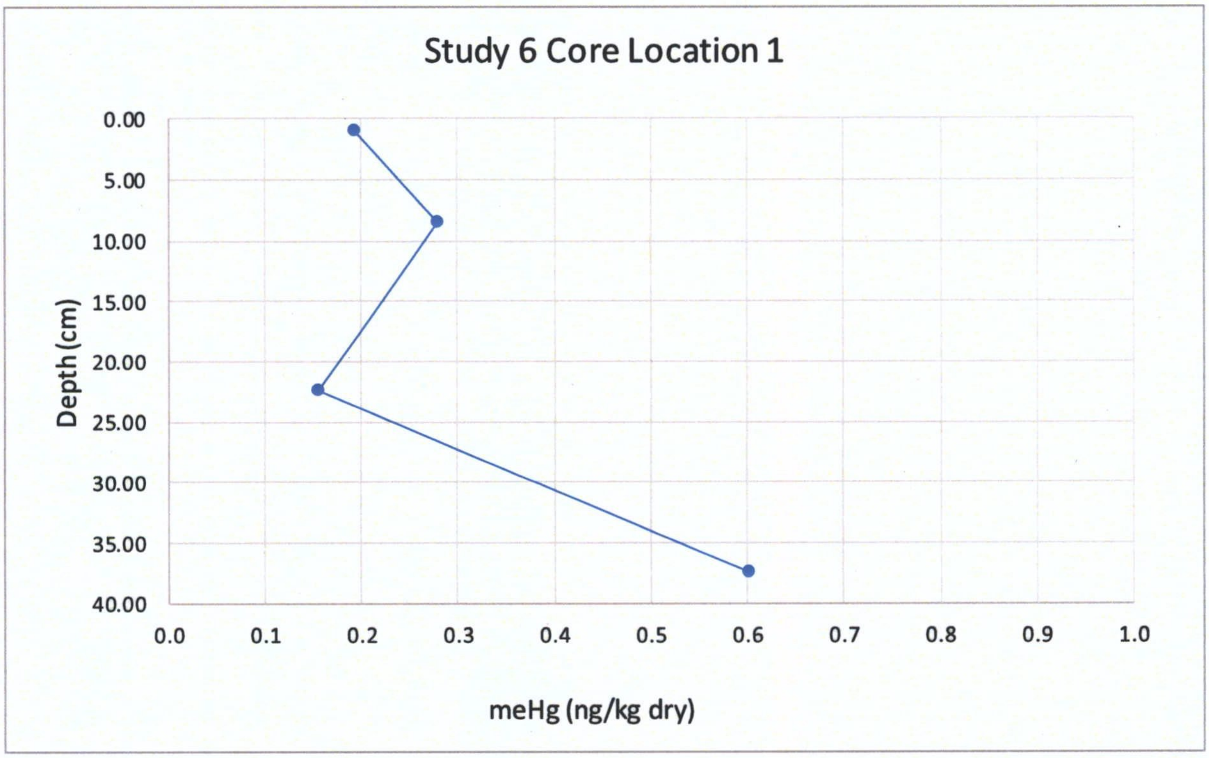


Figure 3.7-9c
2015 Supplemental Study 6 Total Mercury Profiles
RAAER 2015
Alcoa



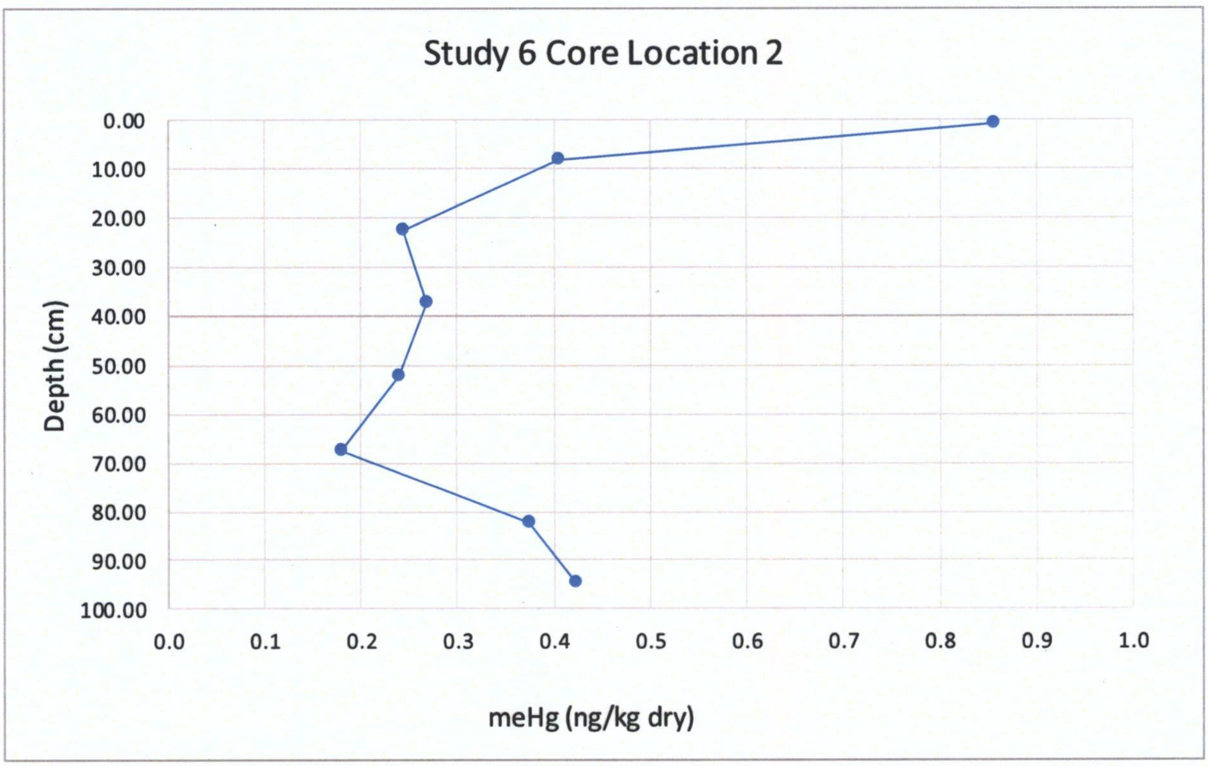
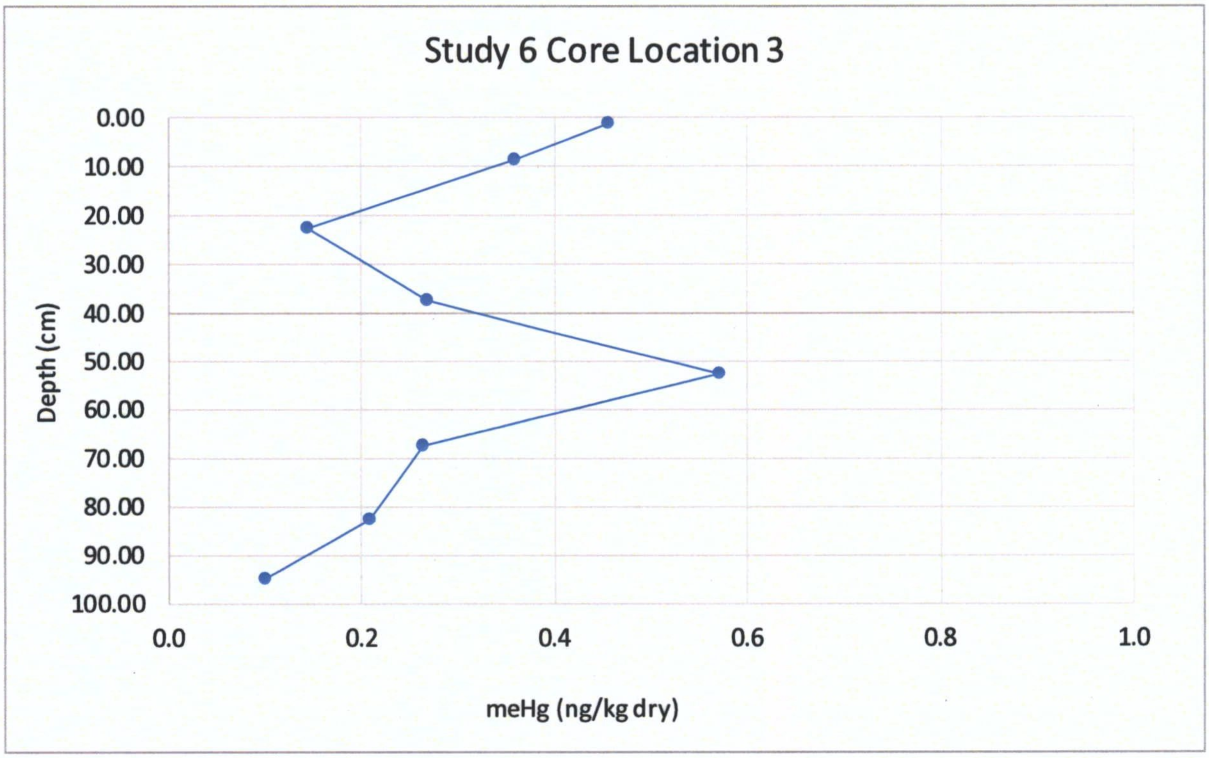


Figure 3.7-10a
2015 Supplemental Study 6 Methylmercury Profiles
RAAER 2015
Alcoa



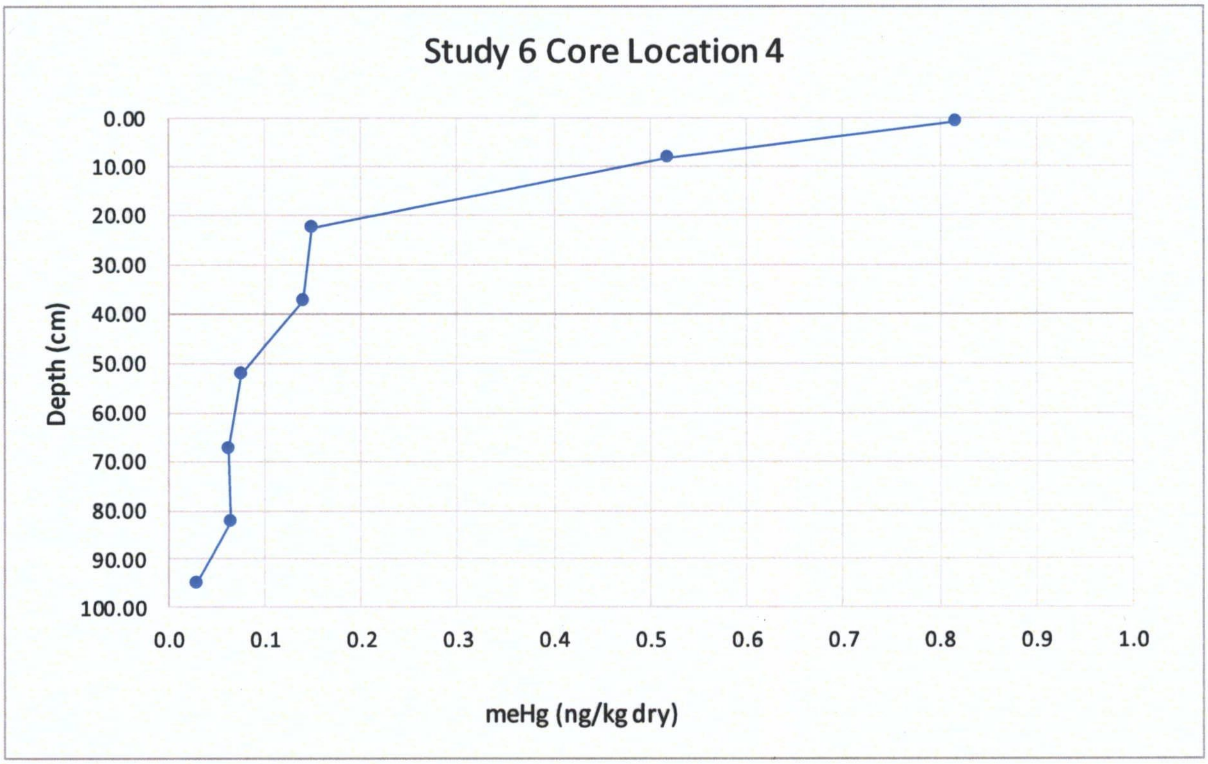
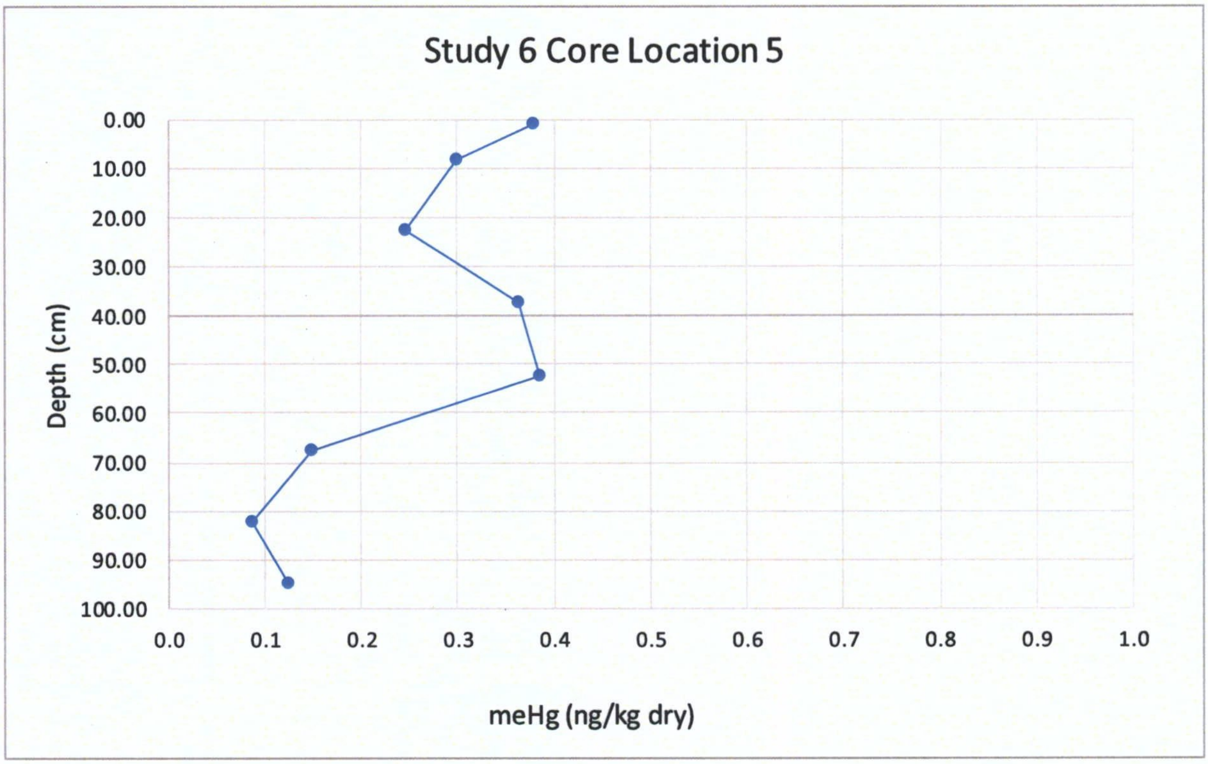


Figure 3.7-10b
2015 Supplemental Study 6 Methylmercury Profiles
RAAER 2015
Alcoa



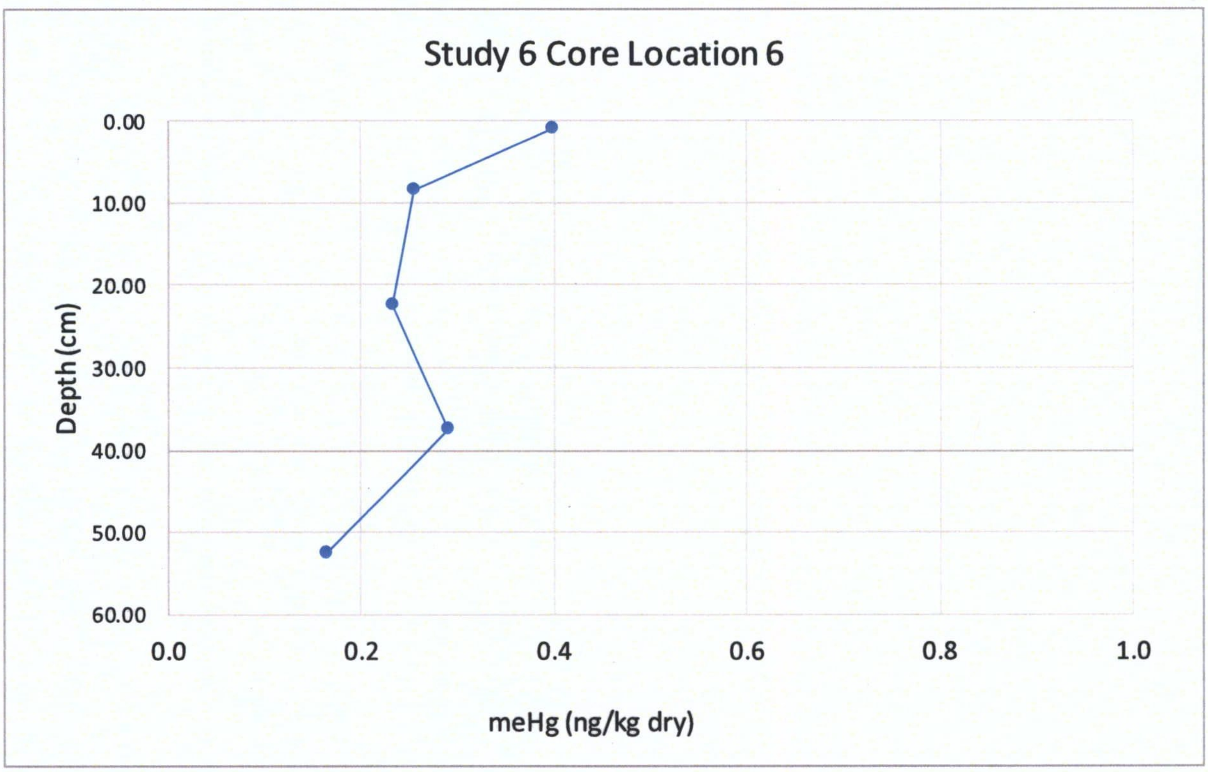


Figure 3.7-10c
2015 Supplemental Study 6 Methylmercury Profiles
RAAER 2015
Alcoa

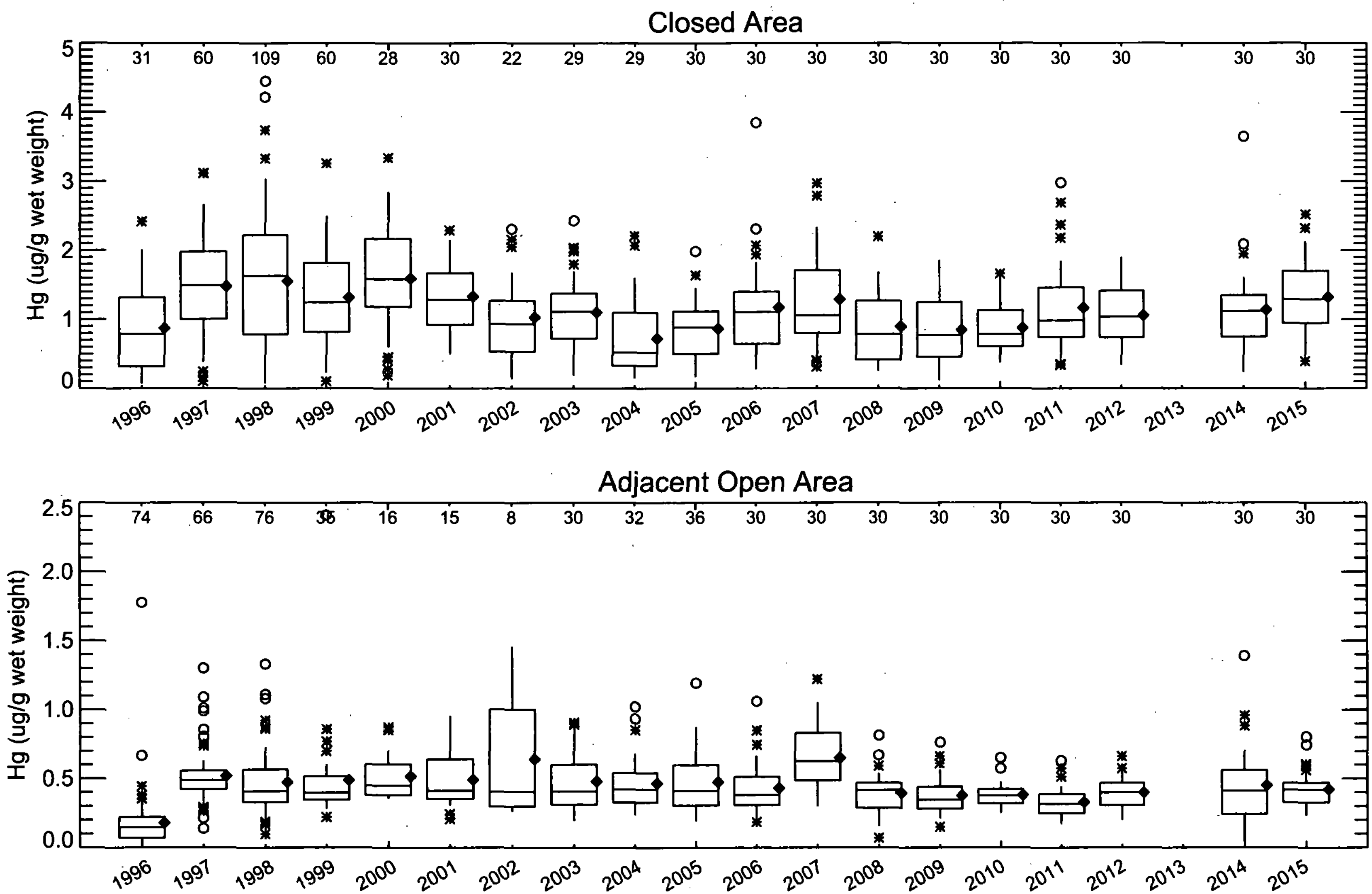
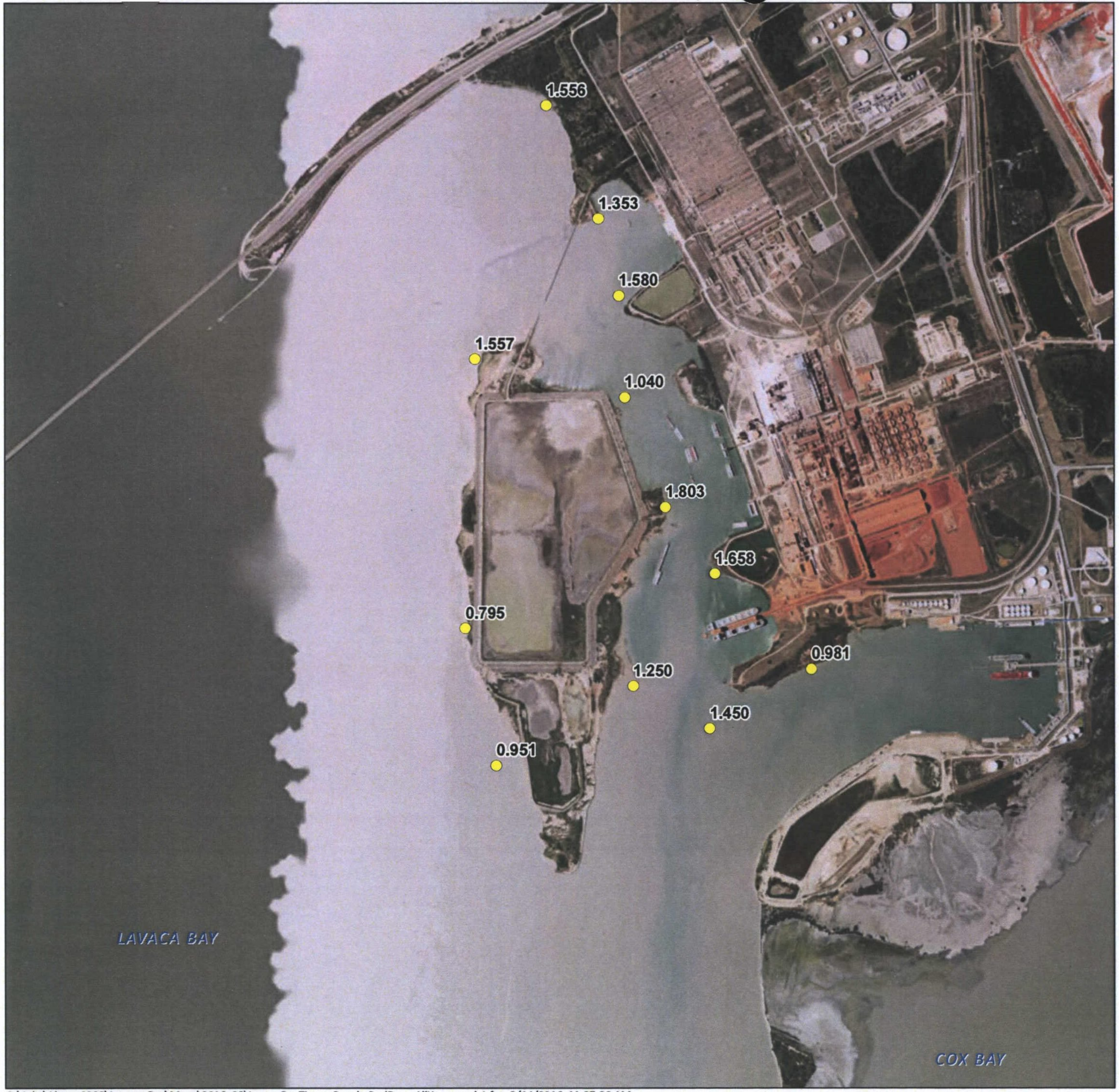


Figure 3.8-1

Lavaca Bay Red Drum Tissue Mercury Concentrations by Year, 1996-2015

CF - \\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\Analysis\Hg_Trends\tissue_trend_analysis_boxplots.pro
Mon Mar 21 16:00:06 2016



LEGEND

Red Drum Stations (2015)

0 1,000 2,000 Feet

NOTES:
Total mercury (Hg) results are shown in ug/g wet weight. 2 to 3 fish collected at each station. Average concentrations shown.

2015 RAAER

Closed Area Average Red Drum Total Mercury (2015)

ALCOA PCO

Project: 150002-02.03

Date: 02/01/2016

Figure 3.8-2

Q:\Jobs\Alcoa_0002\Lavaca_Bay\Maps\2016_03\LavacaBayTissureResultsRedDrumAllYears.mxd jsfox 3/14/2016 11:37:20 AM

Total Mercury Concentrations shown in ug/g

\\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\documents\Presentations\20160315_EPAMeeting_Houston\new red drum slide 2010-2015 All StnAvg.pptx

Figure 3.8-3
Closed Area Station Red Drum Average Mercury Concentration, 2010-2015
2015 RAAER
Alcoa

Total Mercury Concentrations shown in ug/g

\\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\documents\Presentations\20160315_EPAMeeting_Houston\new red drum slide_2002-2015.pptx

Figure 3.8-4
Closed Area Station Red Drum Average Mercury Concentration, 2002-2015
2015 RAAER
Alcoa

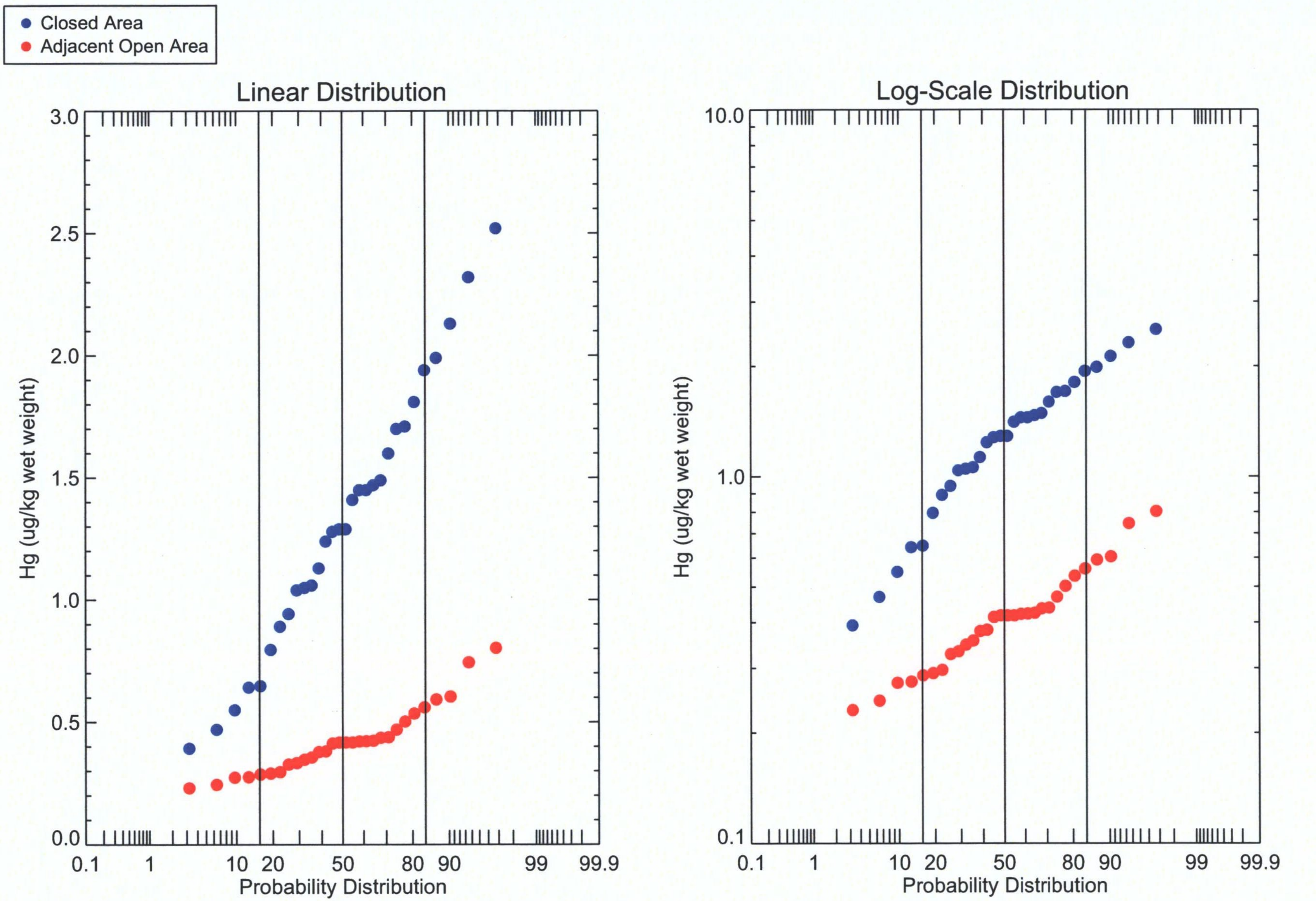


Figure 3.8-5

Lavaca Bay 2015 Red Drum Mercury Distributions

CF - \\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\Analysis\RAAER_2015\Tissue_ProbPlots\Red_Drum_Probplots.pro
Fri Mar 18 15:00:10 2016

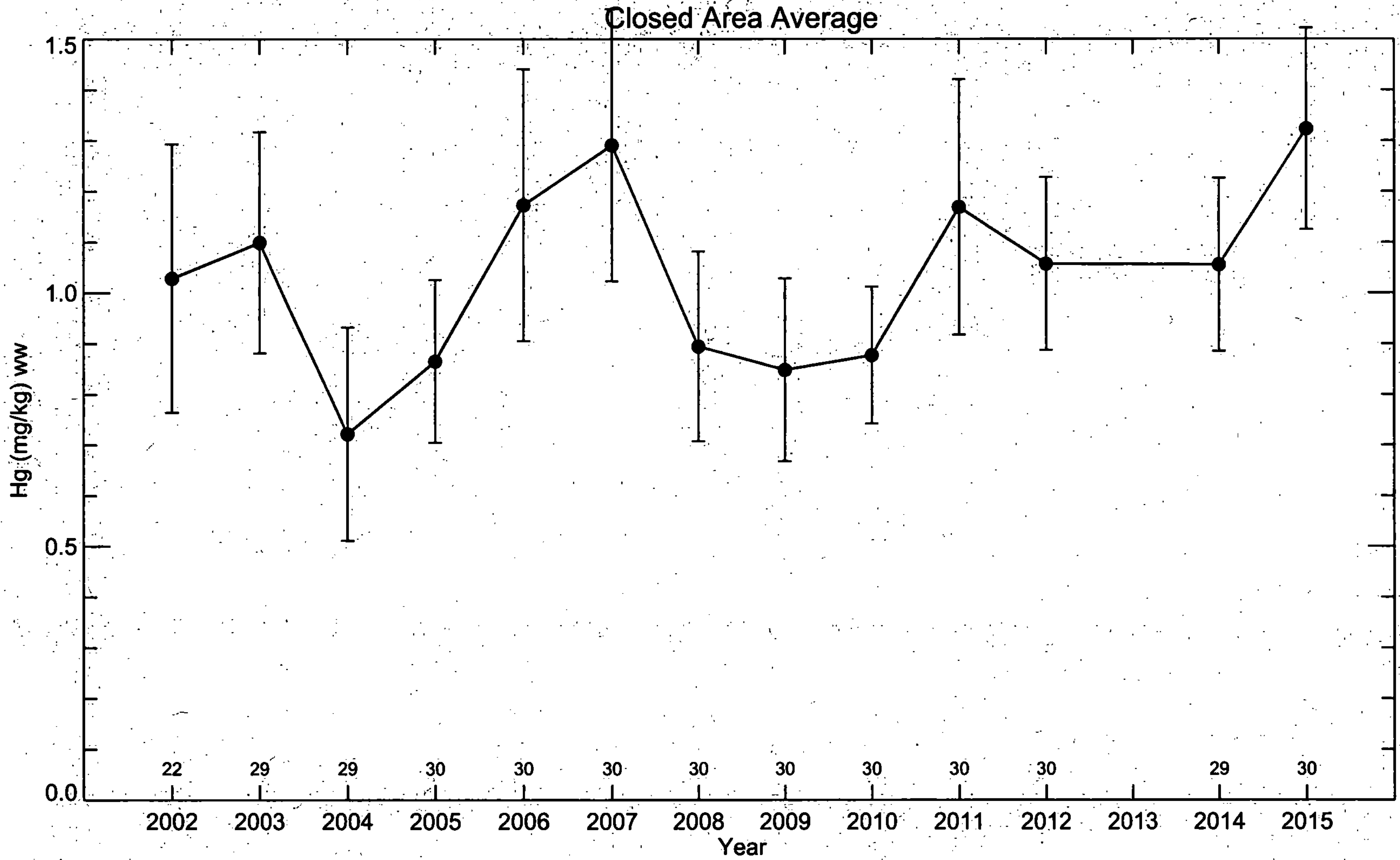
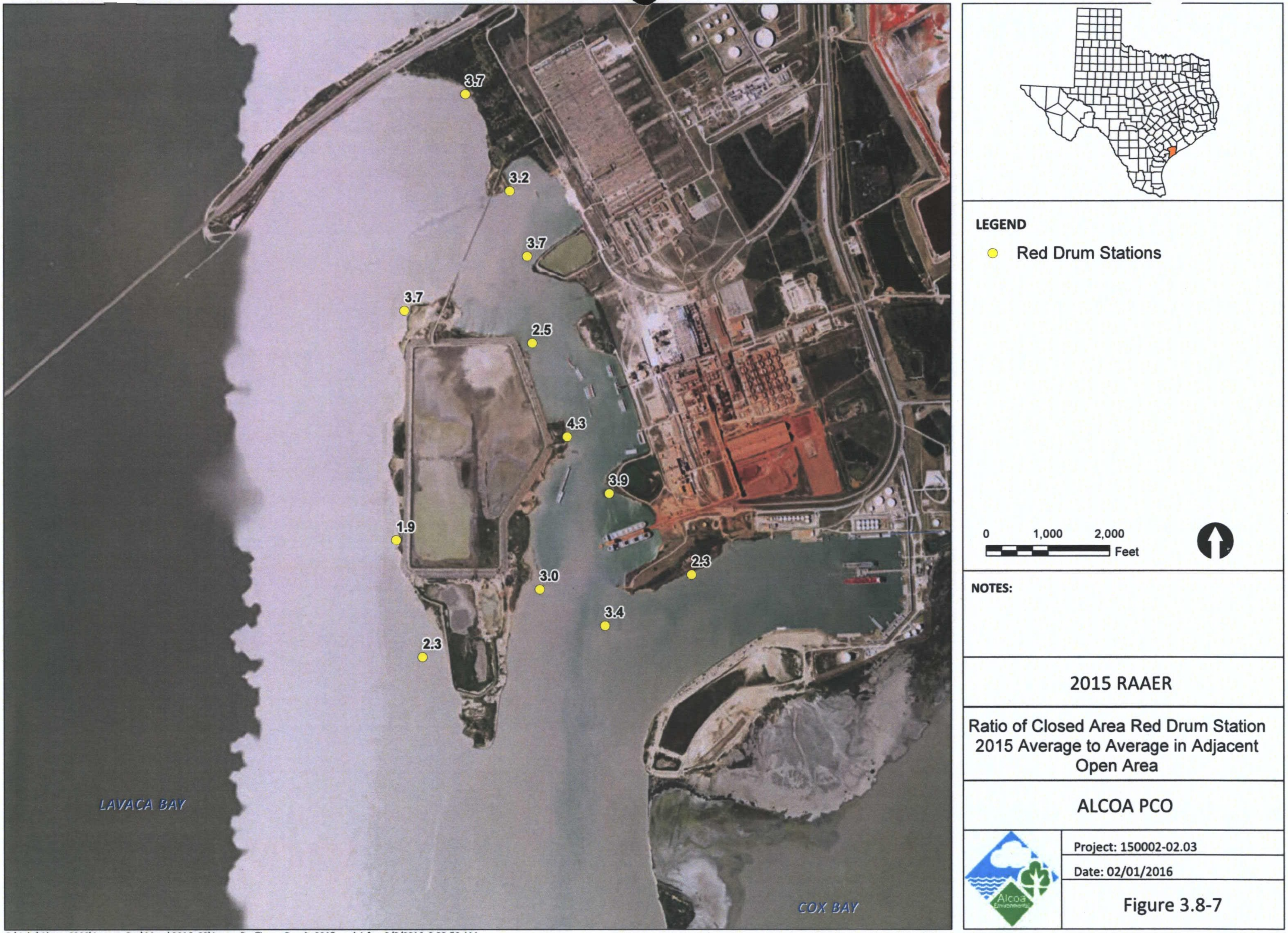


Figure 3.8-6

Lavaca Bay Red Drum Mercury Concentrations in Closed Area

Notes: Values at bottom of panel represent number of samples. One 3.65 mg/kg outlier in 2014 removed. Error bars represent 2 standard errors

sm - \\nereus\D_Drive\Projects\ALCOA\Lavaca_Bay\Analysis\Hg_Trends\tissue_temporals.pro
Mon Mar 21 16:52:19 2016



NOTES:

2015 RAAER

Ratio of Closed Area Red Drum Station 2015 Average to Average in Adjacent Open Area

ALCOA PCO

Project: 150002-02.03

Date: 02/01/2016

Figure 3.8-7

Q:\Jobs\Alcoa_0002\Lacava_Bay\Maps\2016_02\LavacaBayTissueResults2015.mxd jsfox 2/2/2016 9:22:59 AM

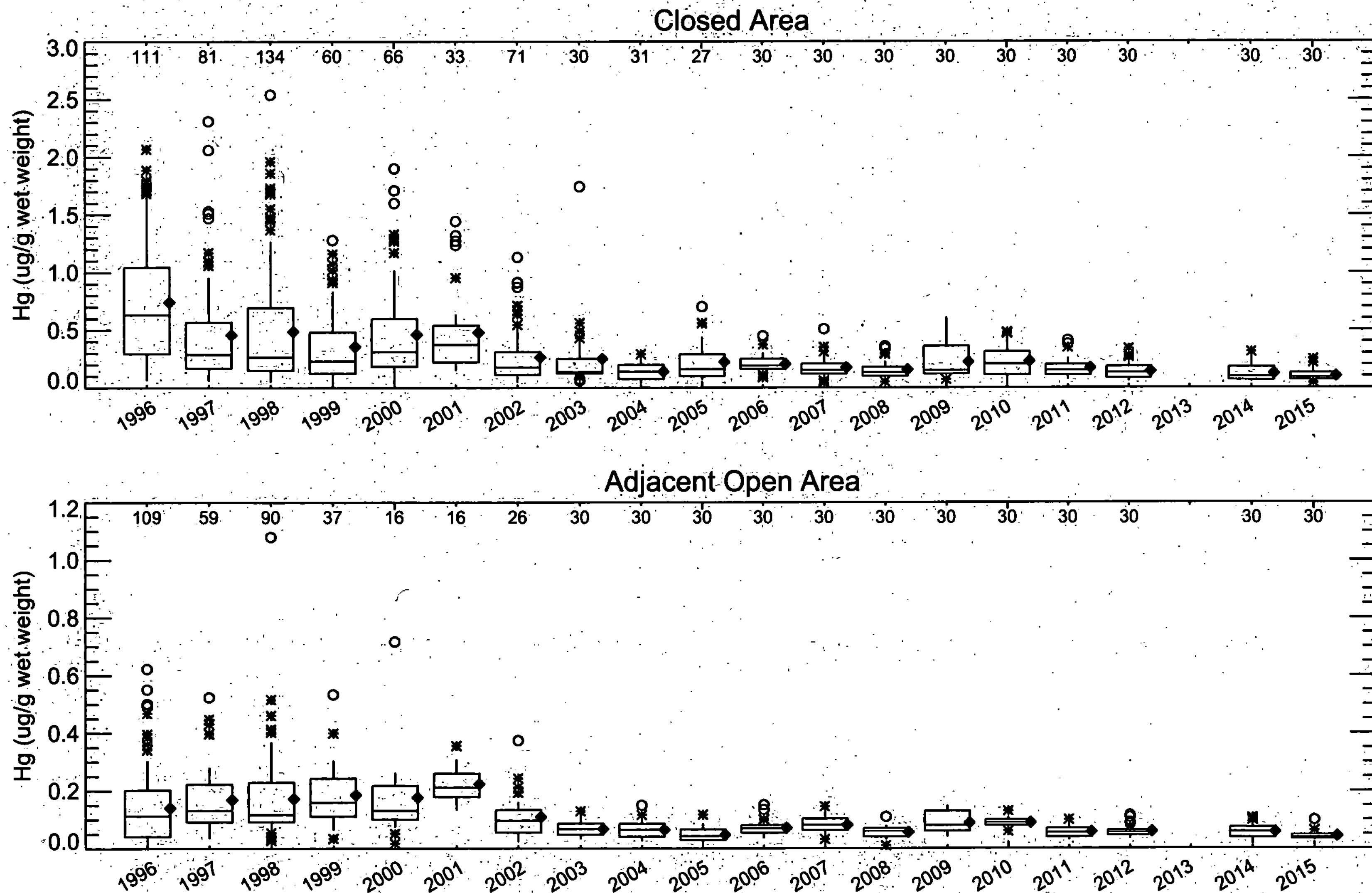


Figure 3.9-1
Lavaca Bay Juvenile Blue Crab Mercury Concentrations by Year, 1996-2015

Juvenile Blue Crab

0 1,000 2,000 Feet

NOTES:
Total mercury (Hg) results are shown in ug/g wet weight

2015 RAAER

Closed Area 2015 Average
Juvenile Blue Crab Total Mercury

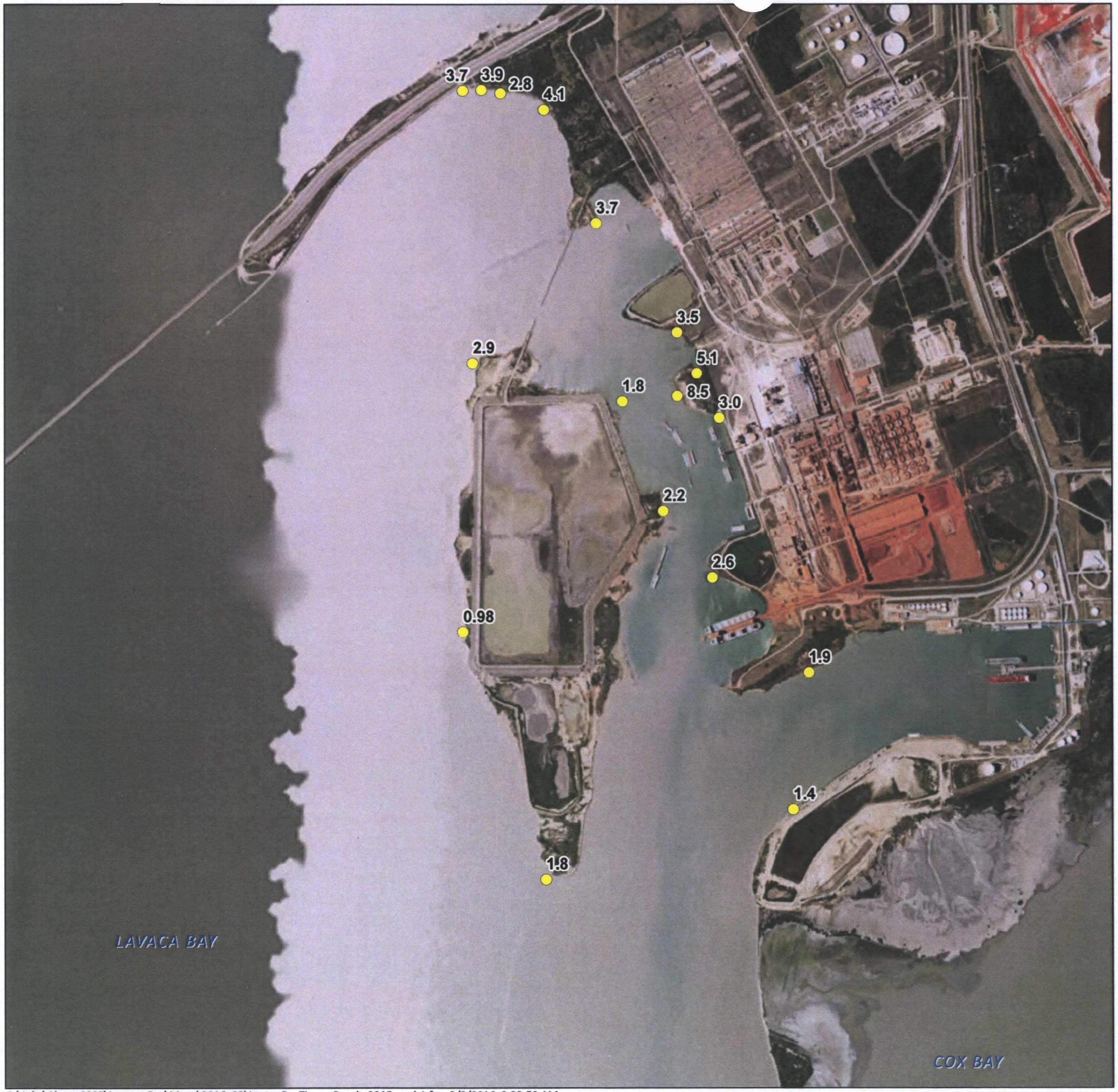
ALCOA PCO

Project: 150002-02.03

Date: 02/01/2016

Figure 3.9-2

Q:\Jobs\Alcoa_0002\Lacava_Bay\Maps\2016_02\LavacaBayTissureResults2015.mxd jsfox 2/2/2016 7:58:58 AM



LEGEND

Juvenile Blue Crab Stations

0 1,000 2,000 Feet

NOTES:

2015 RAAER

Ratio of Closed Area Juvenile Blue Crab Station 2015 Average to Average in Open Adjacent Area

ALCOA PCO

Project: 150002-02.03

Date: 02/01/2016

Figure 3.9-3

Q:\Jobs\Alcoa_0002\Lacava_Bay\Maps\2016_02\LavacaBayTissureResults2015.mxd jsfox 2/2/2016 9:22:50 AM

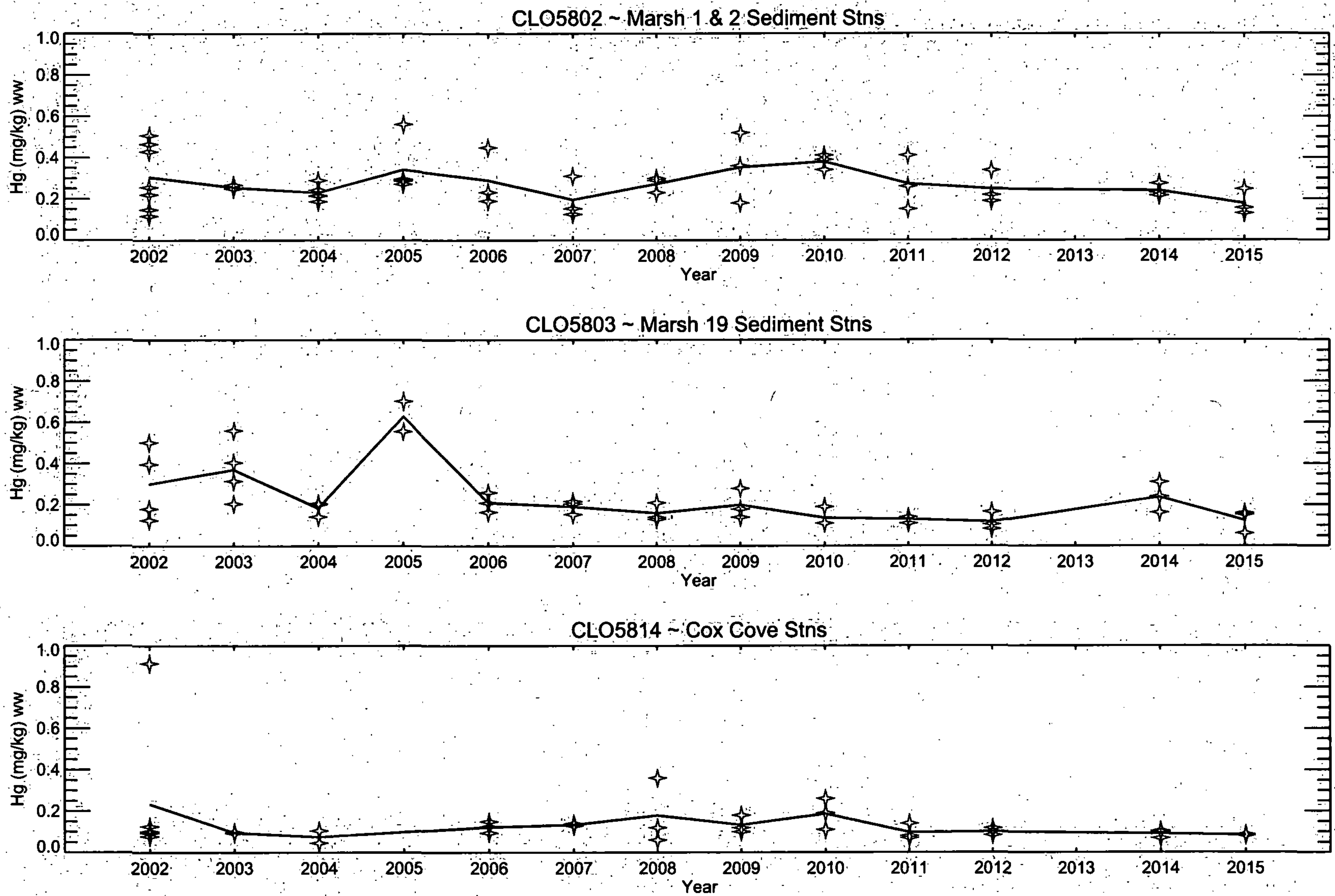


Figure 3.9-4a

Closed Area Blue Crab Mercury Trends by Station

Notes: Average sample concentration plotted as straight line underlying individual sample concentrations.

CF - \\nereus\d_drive\Projects\ALCOA\Lavaca_Bay\Analysis\Hg_Trends\bluecrab_temporals_w2015sm.pro
Fri Mar 18 15:28:52 2016

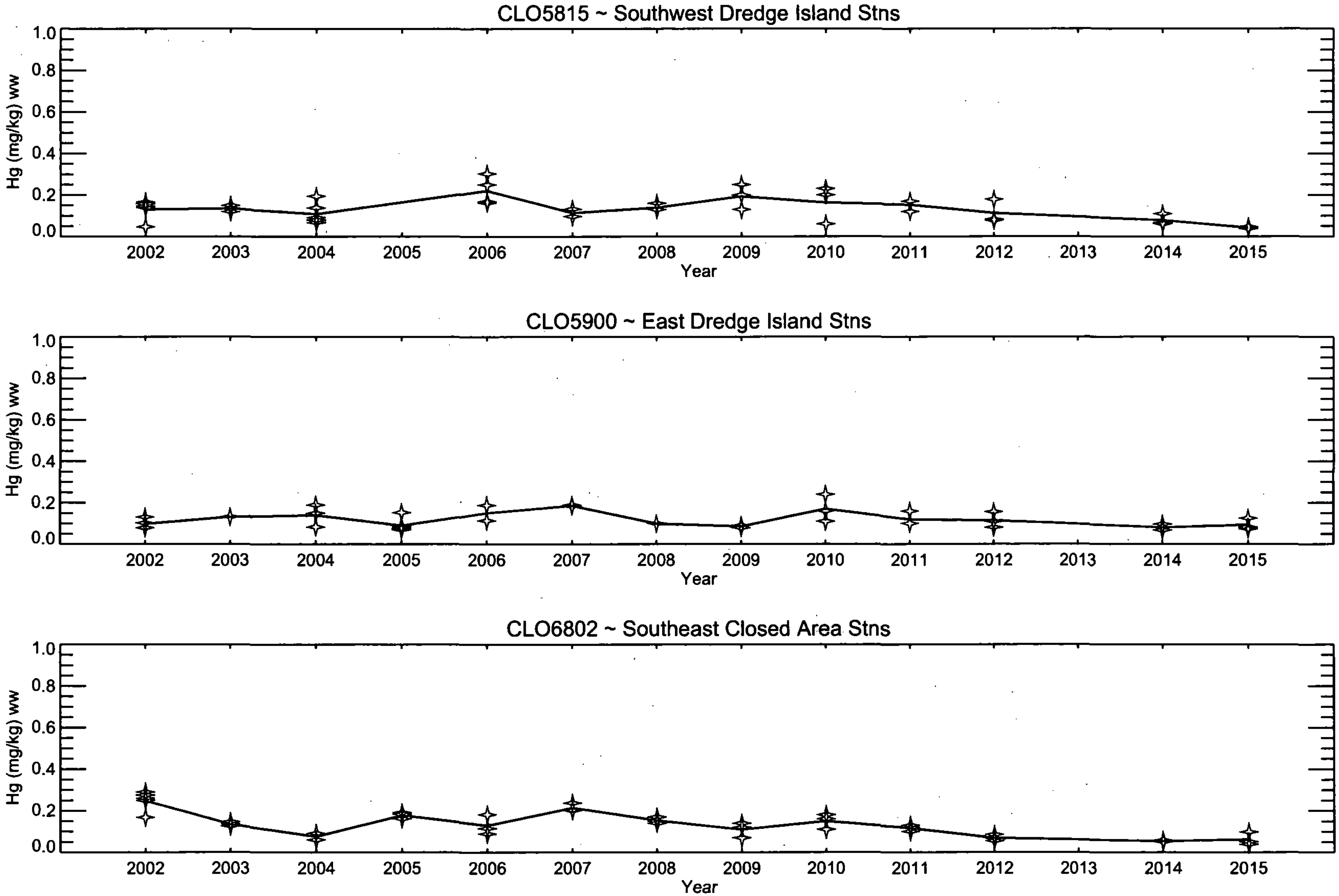


Figure 3.9-4b

Closed Area Blue Crab Mercury Trends by Station

Notes: Average sample concentration plotted as straight line underlying individual sample concentrations.

CF - \\nereus\d_drive\Projects\ALCOA\Lavaca_Bay\Analysis\Hg_Trends\bluecrab_temporals_w2015sm.pro
Fri Mar 18 15:28:54 2016

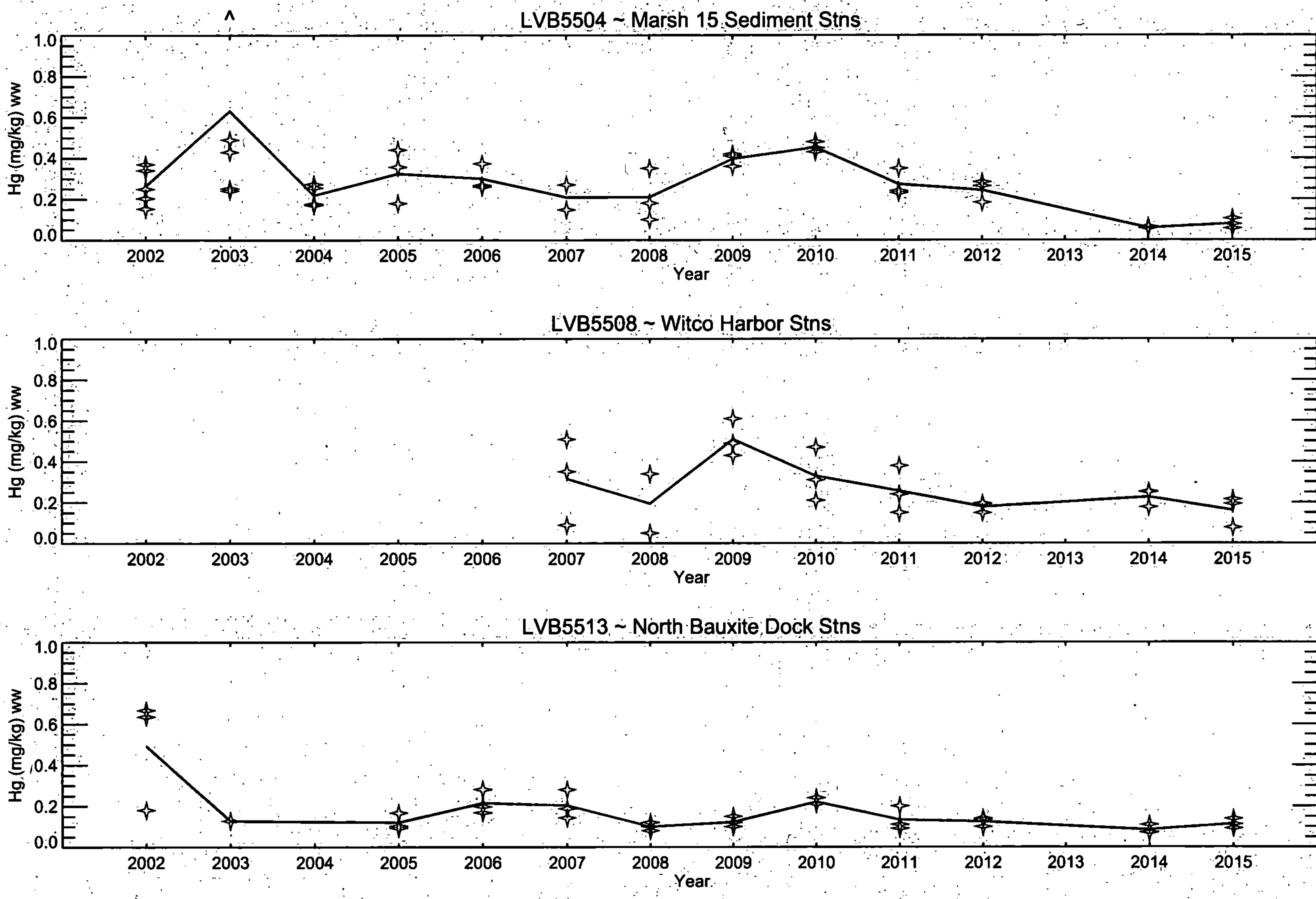


Figure 3.9-4c

Closed Area Blue Crab Mercury Trends by Station

Notes: Average sample concentration plotted as straight line underlying individual sample concentrations.

CF - \\nereus\d_drive\Projects\ALCOA\Lavaca_Bay\Analysis\Hg_Trends\bluecrab_temporals_w2015sm.pro
Fri Mar 18 15:28:55 2016

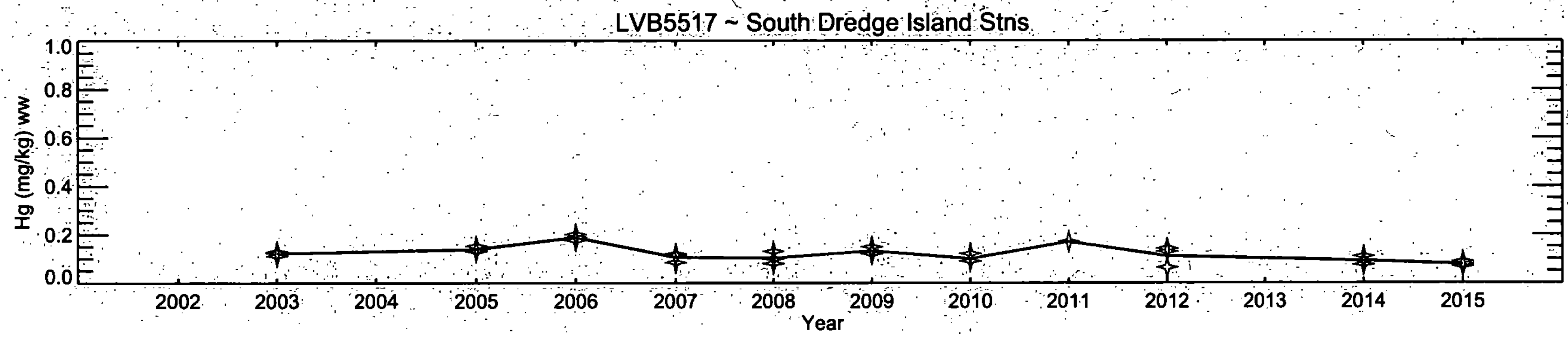


Figure 3.9-4d

Closed Area Blue Crab Mercury Trends by Station

Notes: Average sample concentration plotted as straight line underlying individual sample concentrations.

CF - \\nereus\d_drive\Projects\ALCOA\Lavaca_Bay\Analysis\Hg_Trends\bluecrab_temporals_w2015sm.pro
Fri Mar 18 15:28:55 2016

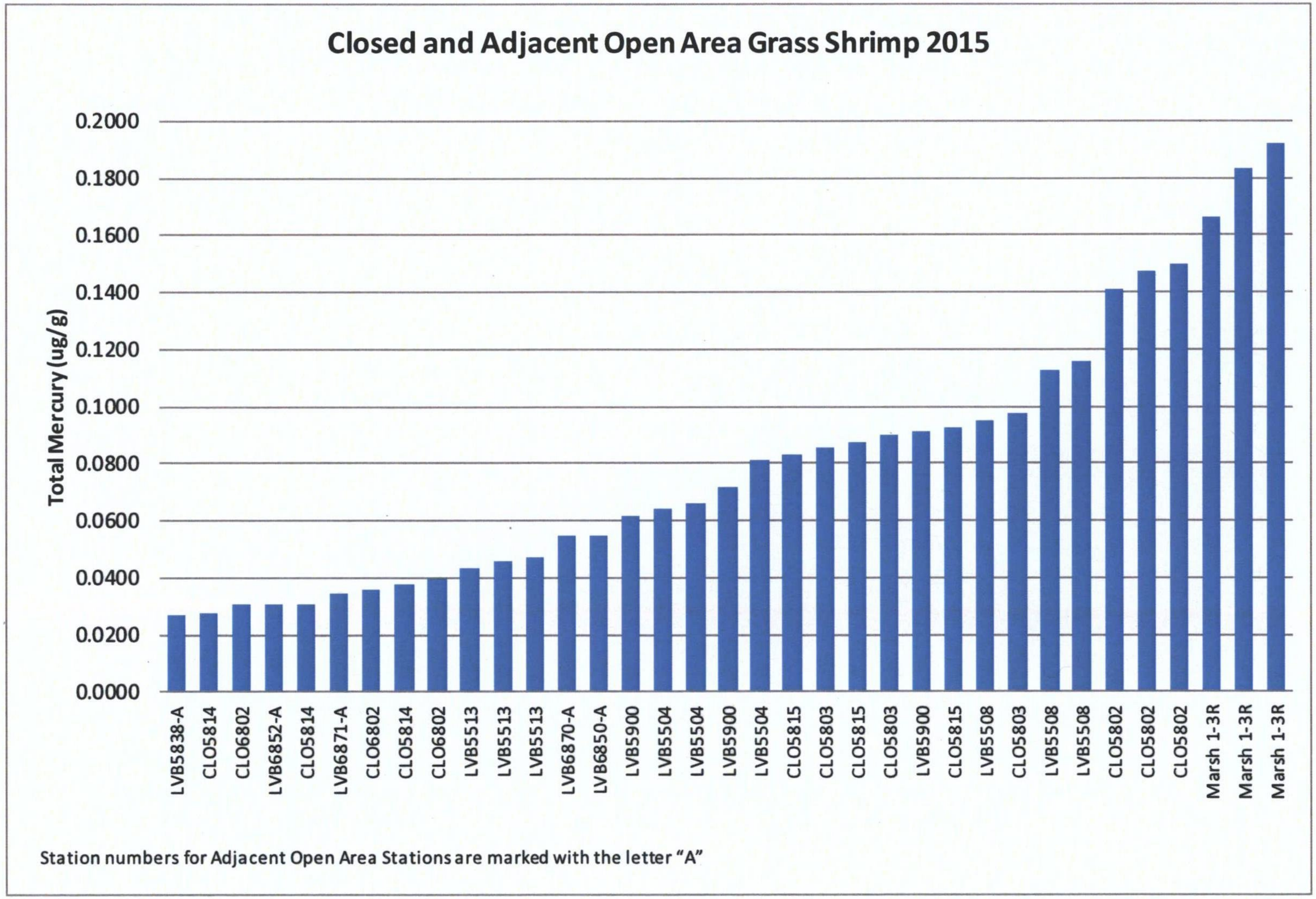
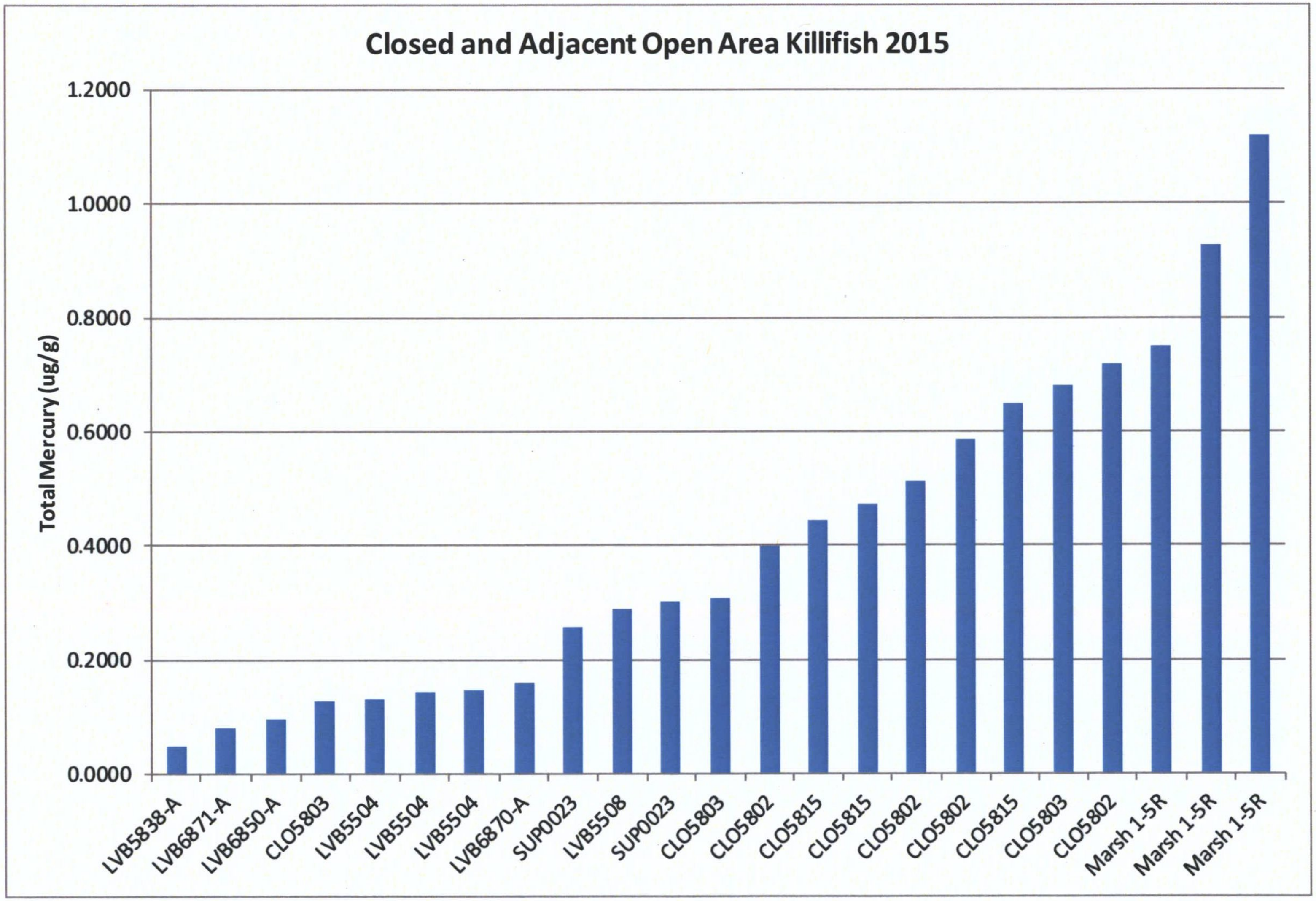


Figure 3.10-1
Closed and Adjacent Open Area Grass Shrimp 2015
2015 RAAER
Alcoa

\\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\documents\Reports\RAAERs\2015RAAER\Figures and Tables\Section 3\Figure 3.10-2 Closed and Adj Area Killifish 2015.docx



Station numbers for Adjacent Area Stations are marked with the letter "A"

Figure 3.10-2
Closed and Adjacent Open Area Killifish 2015
2015 RAAER
Alcoa

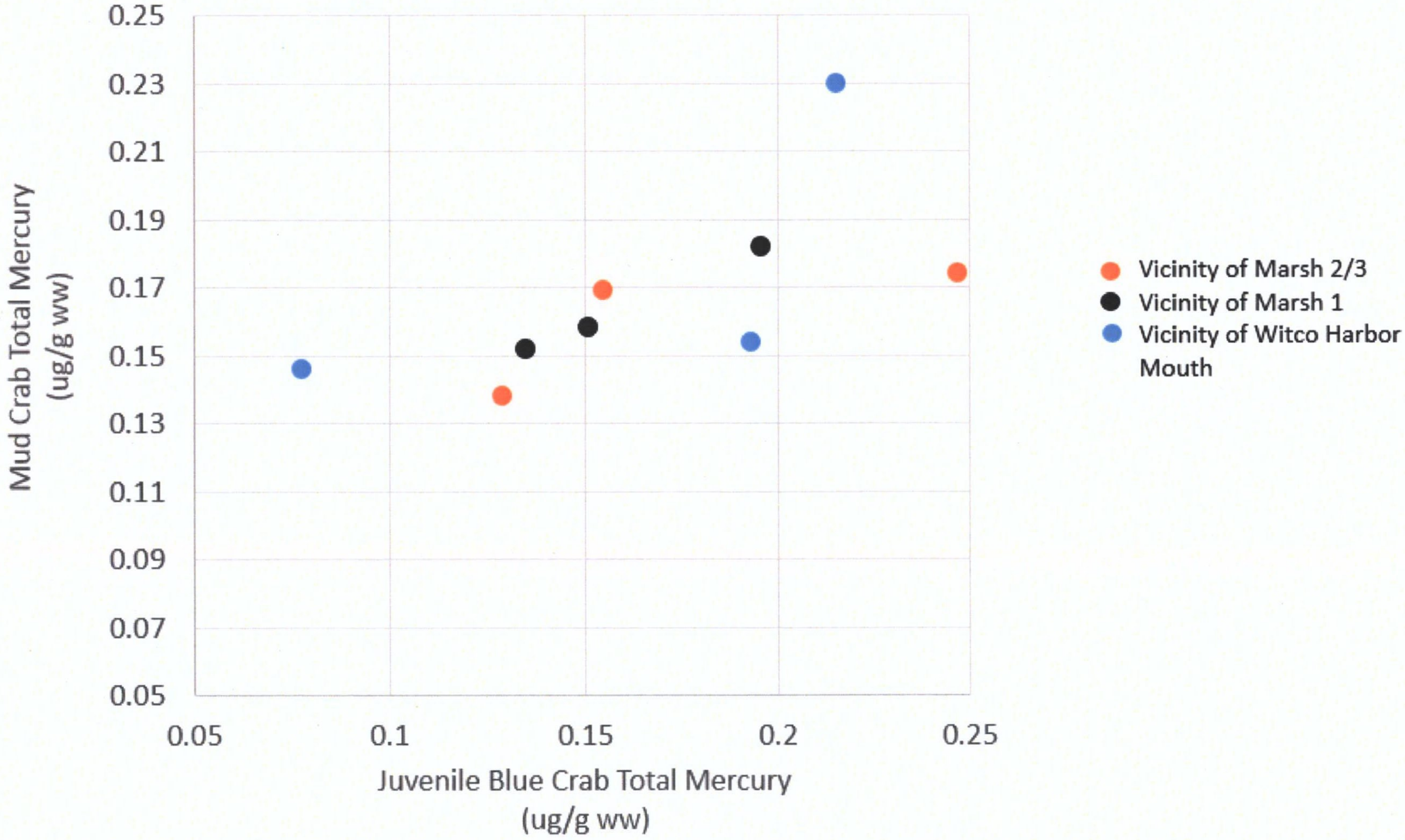


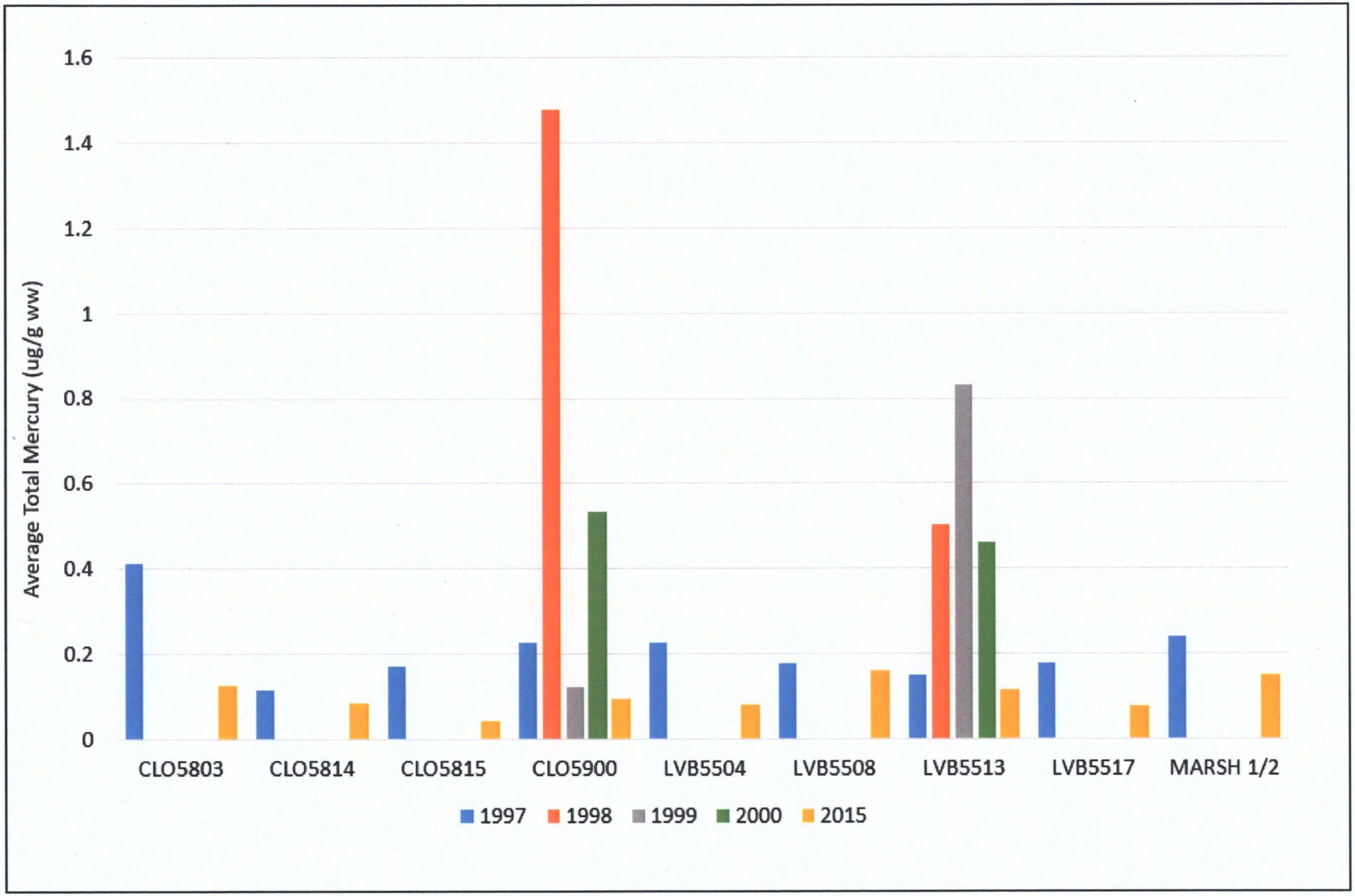
Figure 3.10-3

2015 Closed Area Juvenile Blue Crab and Mud Crab Mercury Concentrations

Notes: 3 sets of comparably located stations shown: CLO5802/CLO7006; LVB5508/CLO7014; Marsh 1-1R/CLO7005.

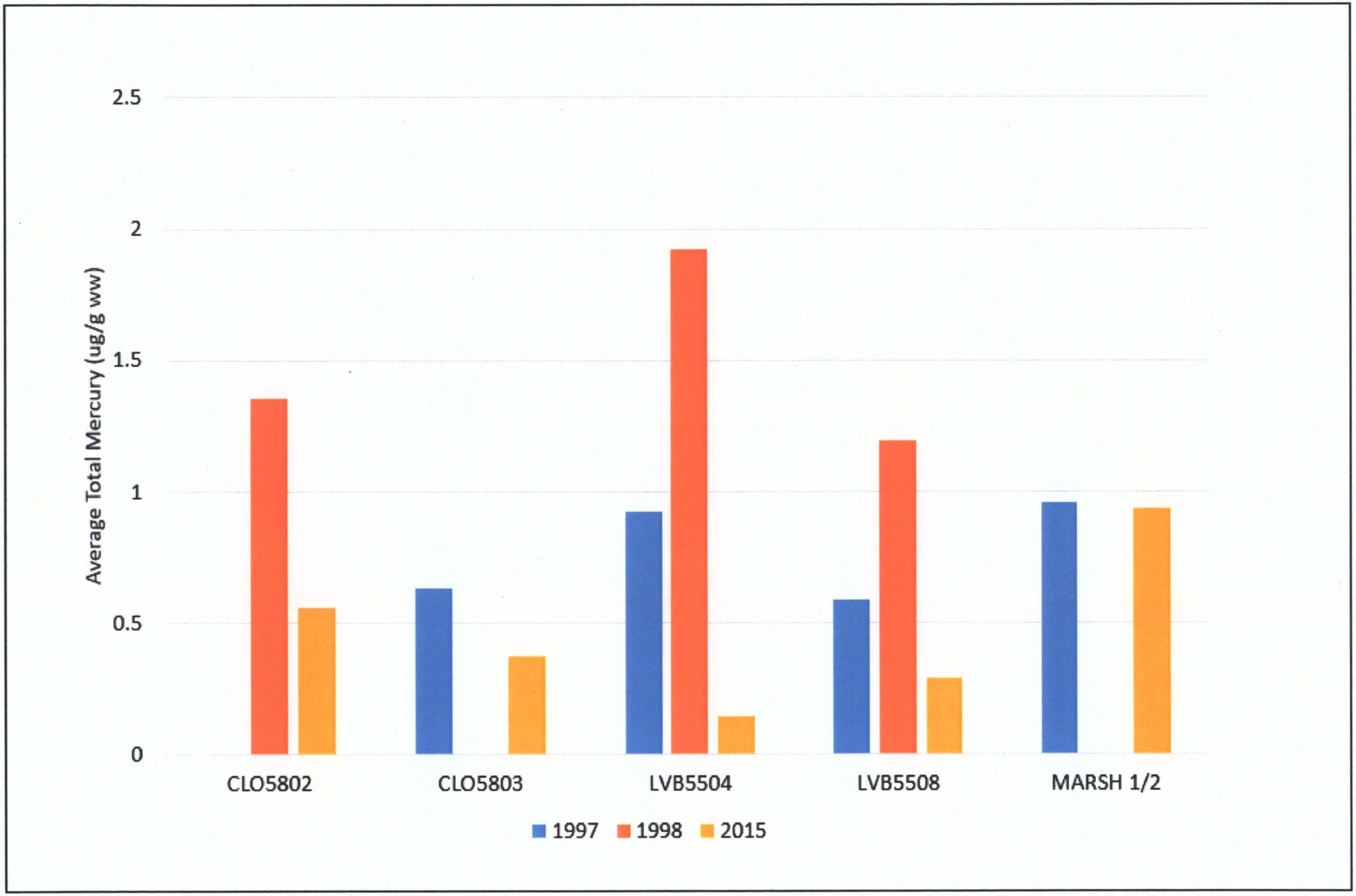
2015 RAAER

Alcoa



\\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\documents\Reports\RAAERs\2015RAAER\Figures and Tables\Section 3\Indvidual Figures\Figure 3.10-4.docx

Figure 3.10-4
Historical Closed Area Juvenile Blue Crab Mercury Trends
2015 RAAER
Alcoa



\\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\documents\Reports\RAAERs\2015RAAER\Figures and Tables\Section 3\Indvidual Figures\Figure 3.10-5.docx

Figure 3.10-5
Historical Closed Area Gulf Killifish Mercury Trends
2015 RAAER
Alcoa

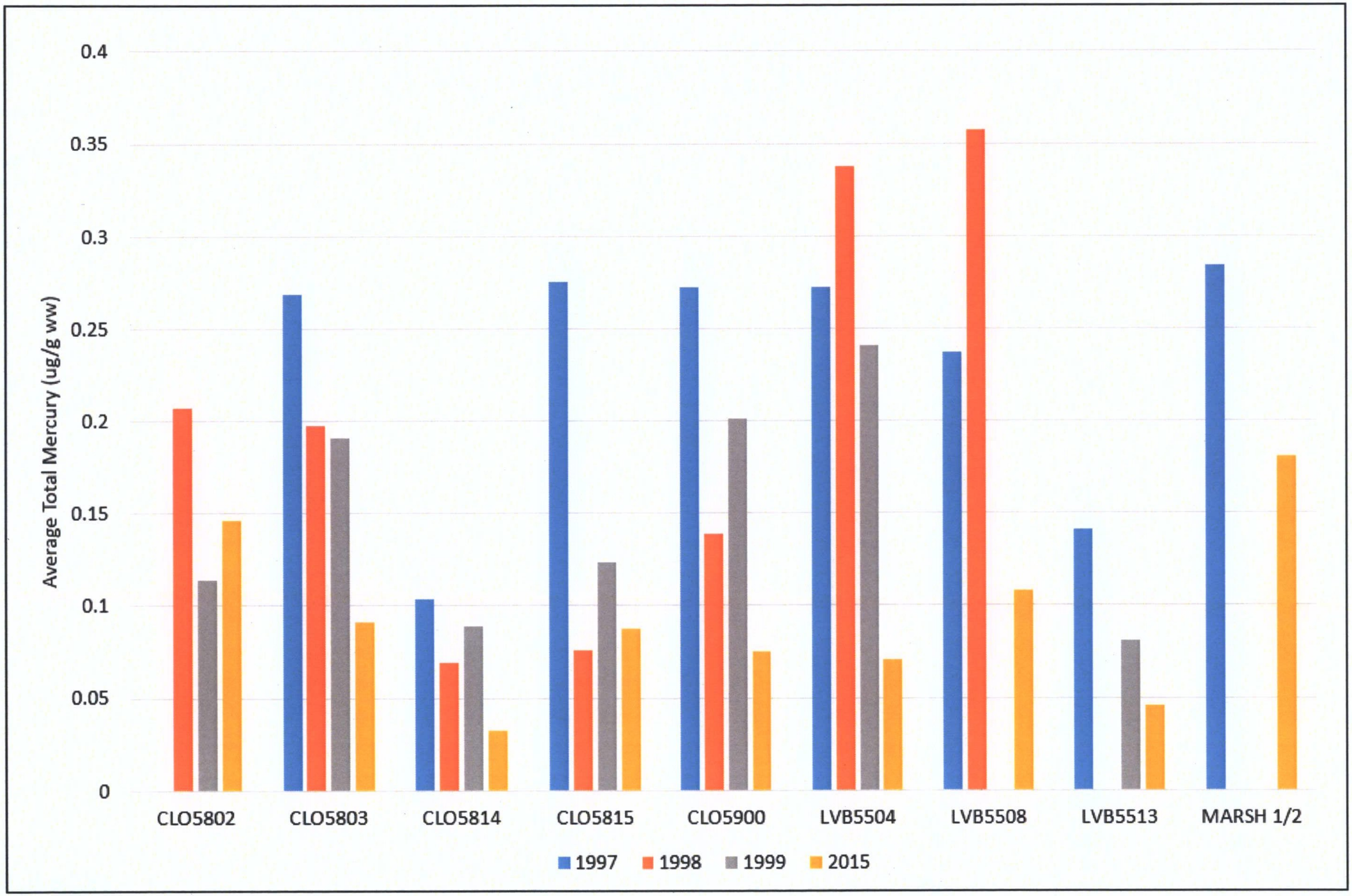
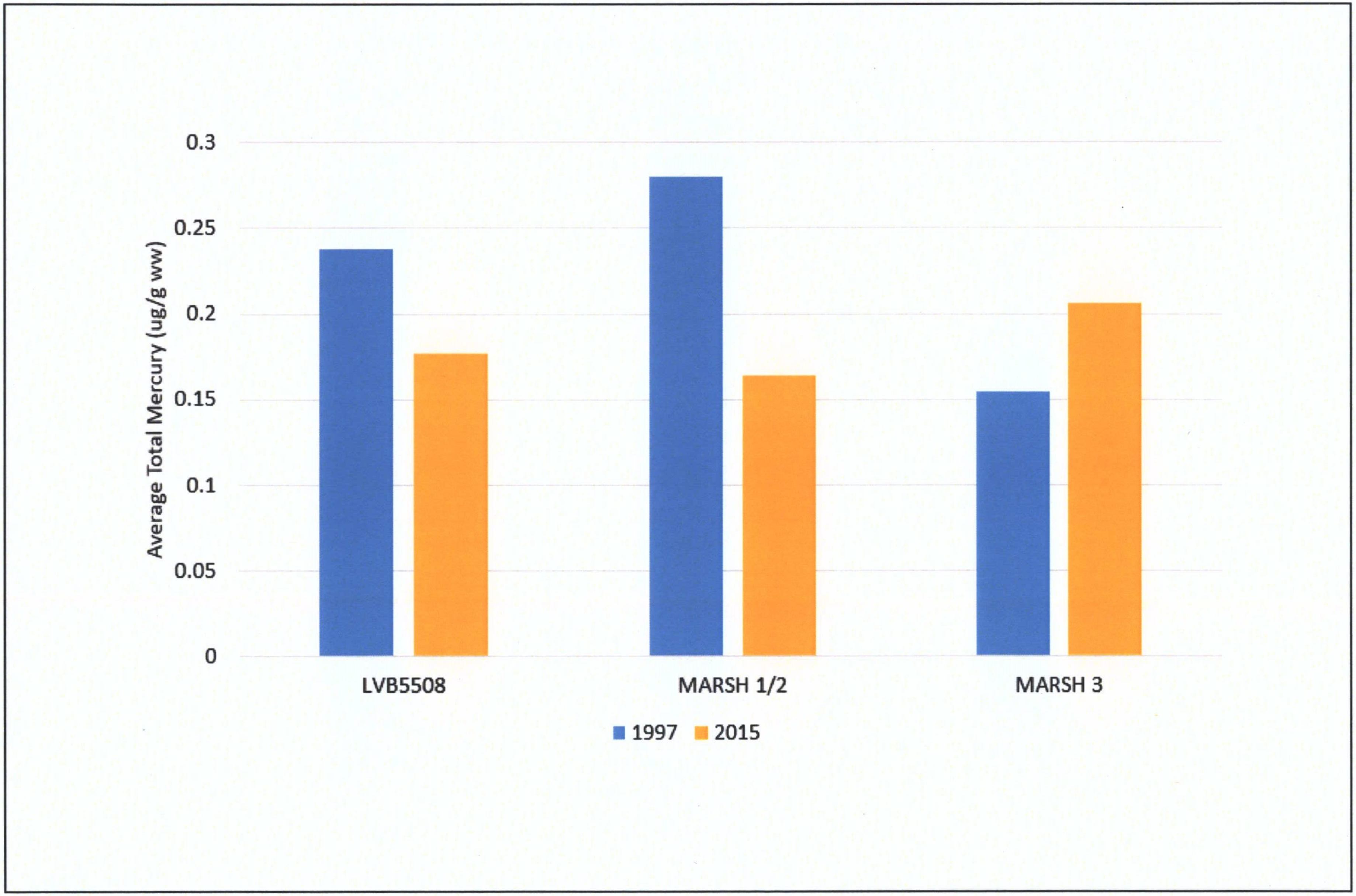


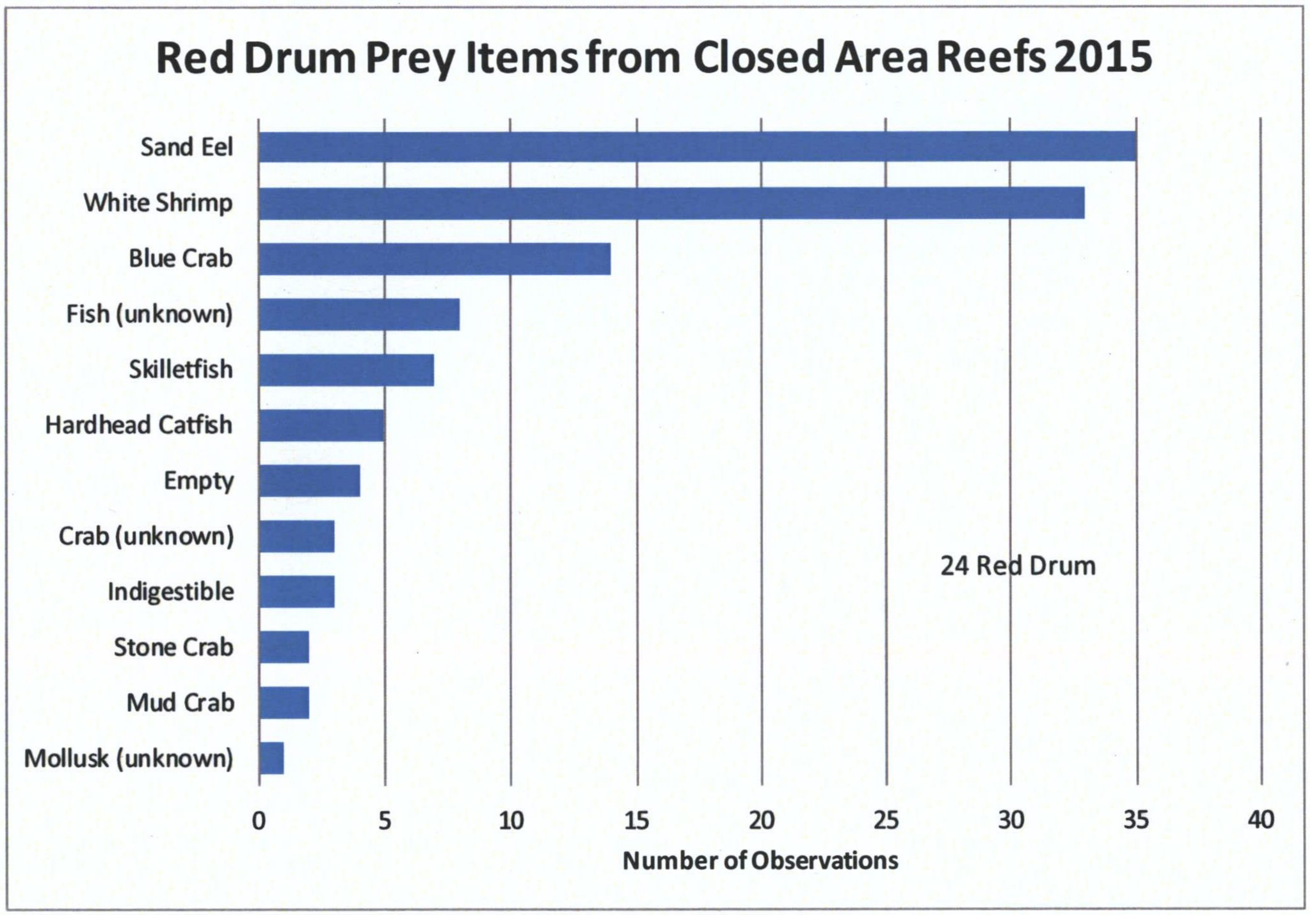
Figure 3.10-6
Historical Closed Area Grass Shrimp Mercury Trends
2015 RAAER
Alcoa

\\austin2\D_drive\Projects\Alcoa\Laveca_Bay\documents\Reports\RAAERs\2015RAAER\Figures and Tables\Section 3\Indvidual Figures\Figure 3.10-6.docx



\\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\documents\Reports\RAAERs\2015RAAER\Figures and Tables\Section 3\Indvidual Figures\Figure 3.10-7.docx

Figure 3.10-7
Historical Closed Area Mud Crab Mercury Trends
2015 RAAER
Alcoa



\\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\documents\Reports\RAAERs\2015RAAER\Figures and Tables\Section 3\Figure 3.11-1 Red Drum Prey Items from Closed Area Reef.docx

Figure 3.11-1
2015 Red Drum Prey Items from Closed Area Reefs
2015 RAAER
Alcoa

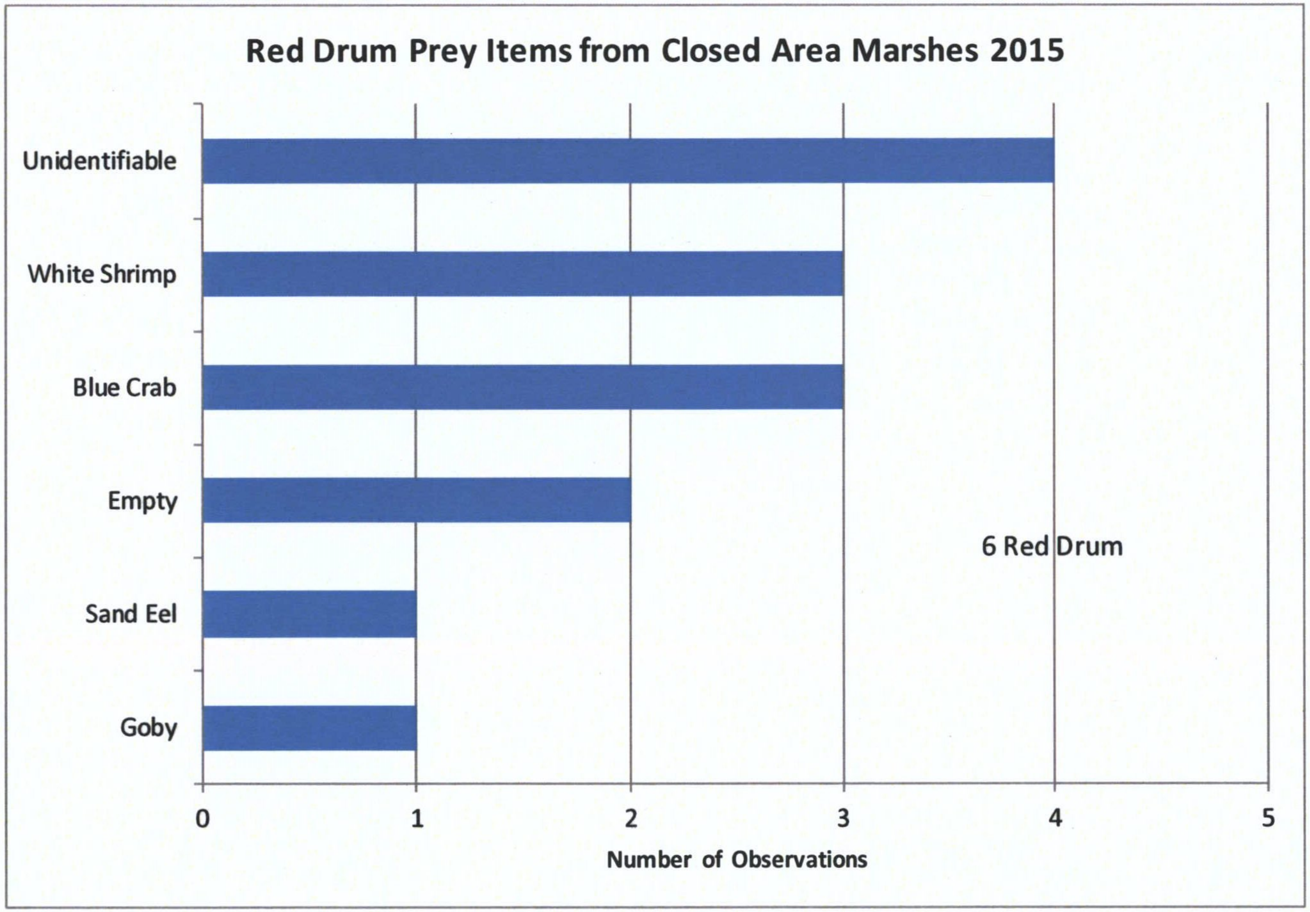
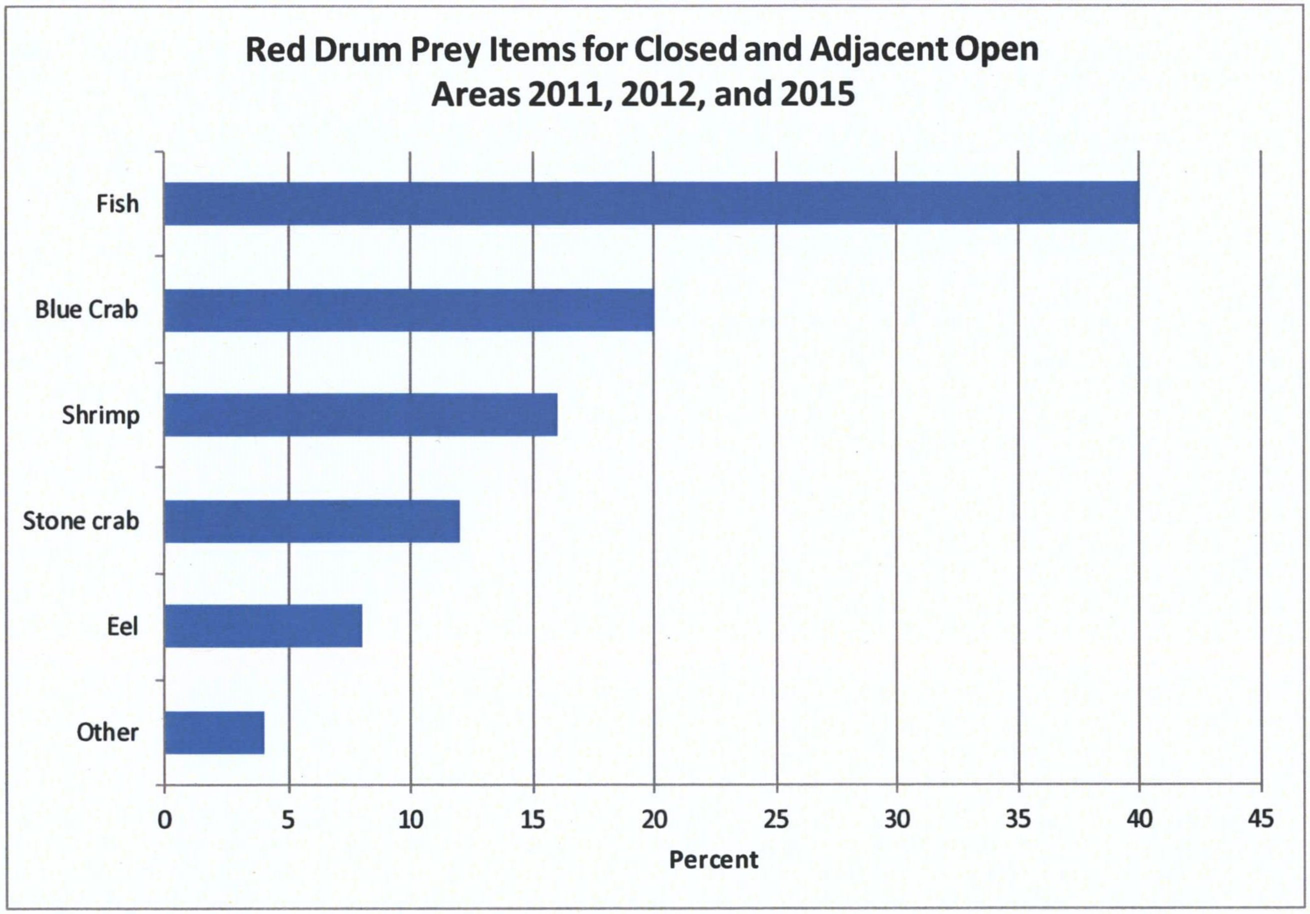


Figure 3.11-2
2015 Red Drum Prey Items from Closed Area Marshes
2015 RAAER
Alcoa



\\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\documents\Reports\RAAERs\2015RAAER\Figures and Tables\Section 3\Figure 3.11-3 Red Drum Prey Items from Closed and Adjacent Areas 2011, 2012, 2015.docx

Figure 3.11-3
Red Drum Prey Items for Closed and Adjacent Open Areas 2011, 2012, and 2015
2015 RAAER
Alcoa

\\austin2D_drive\Projects\Alcoa\Lavaca_Bay\documents\Reports\RAAERs\2015RAAER\Figures and Tables\Section 3\Figure 3.11-4 Red Drum Prey Items from Closed Areas Compared to Adjacent Areas 2011, 2012, 2015.docx

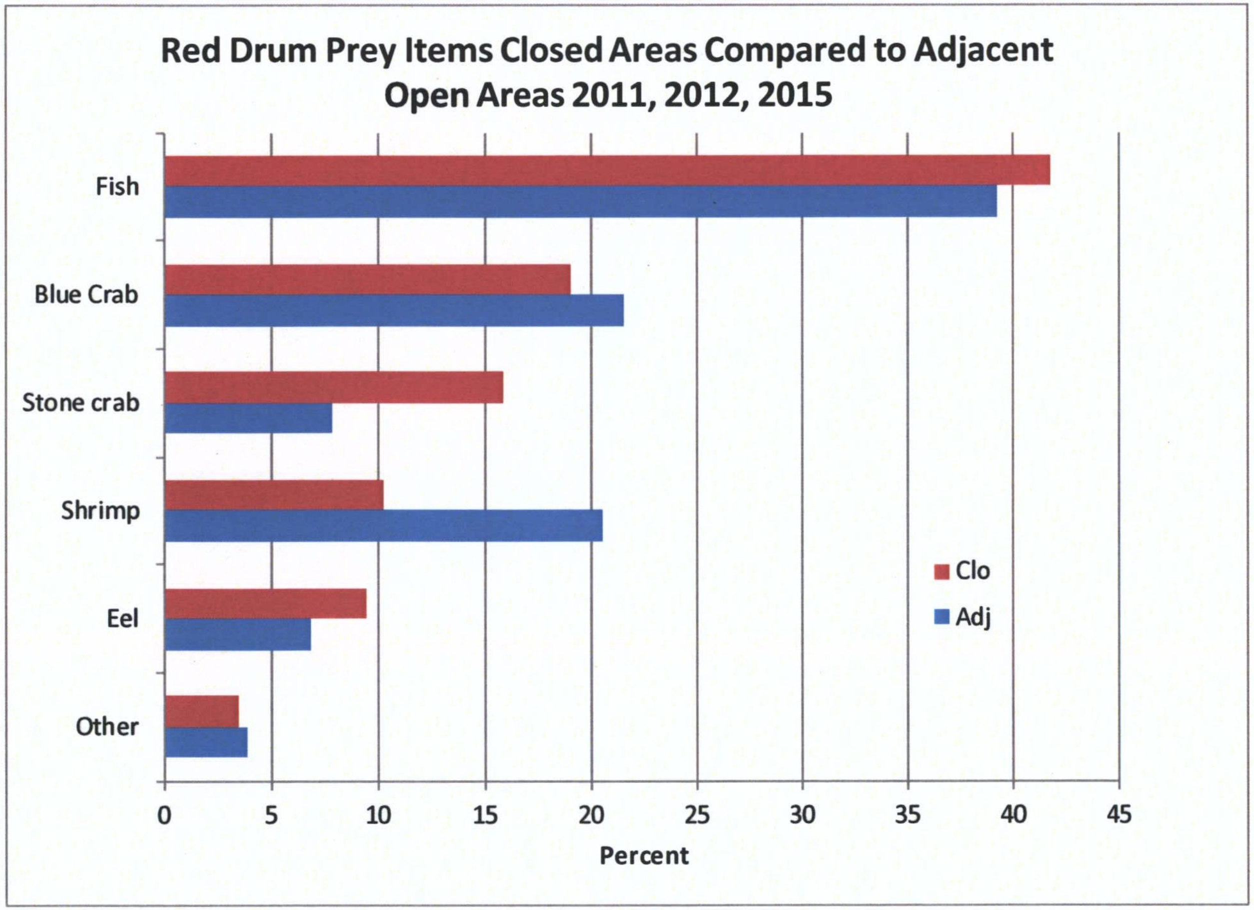
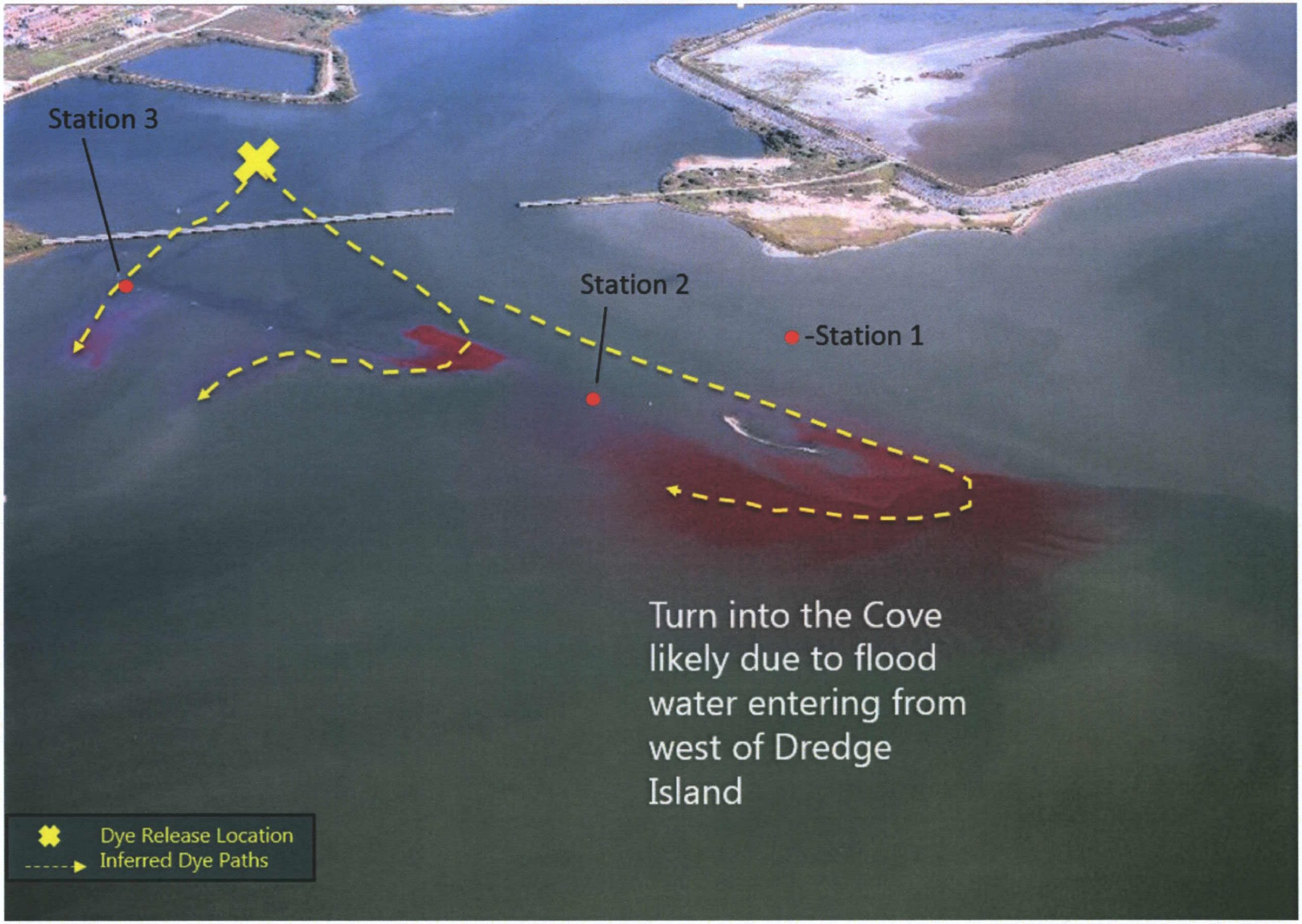


Figure 3.11-4

Red Drum Prey Items for Closed Areas Compared to Adjacent Open Areas 2011, 2012, and 2015

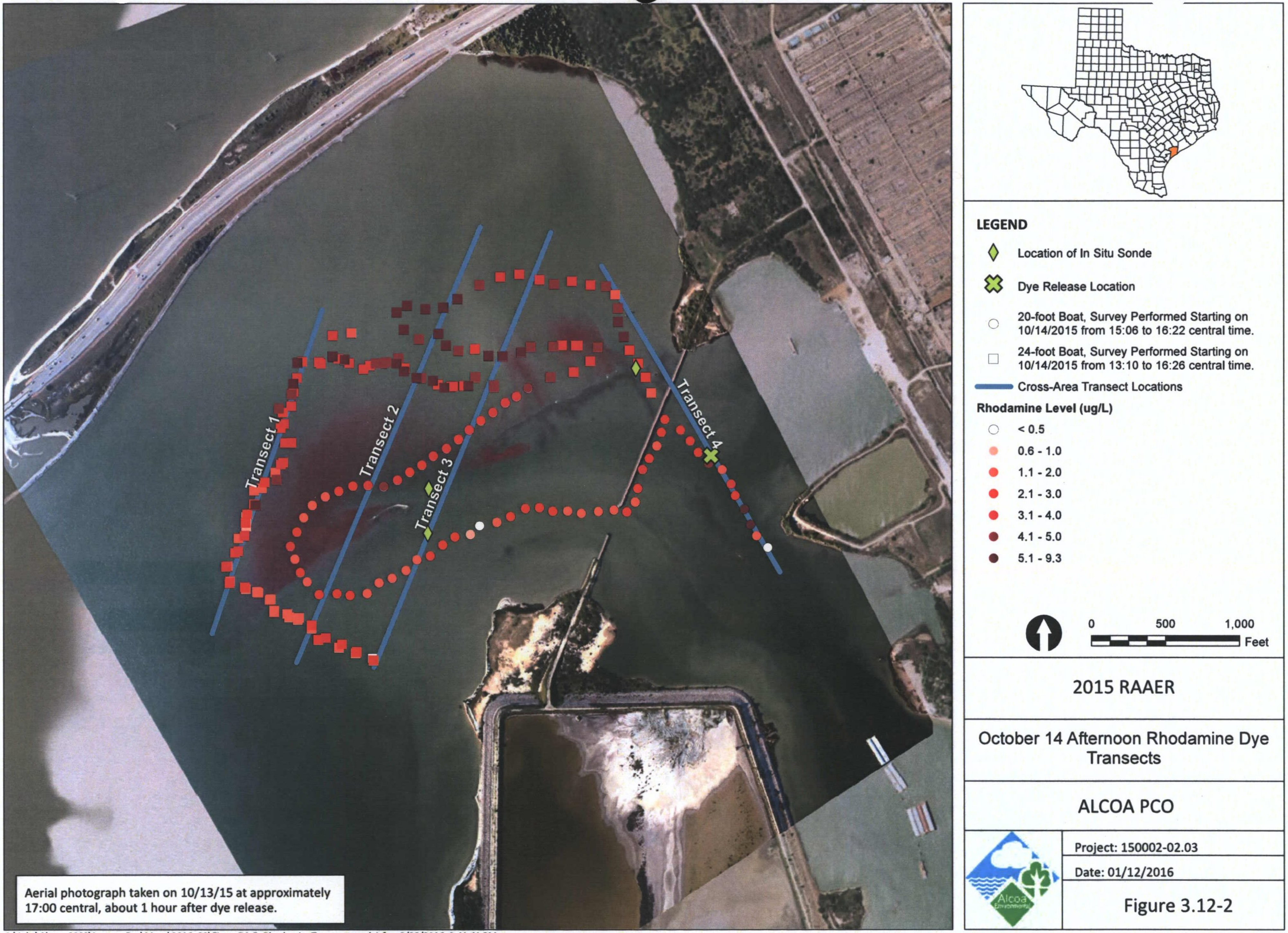
2015 RAAER

Alcoa



\\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\documents\Reports\RAAERs\2015RAAER\Appendices\D1\Figure D1-3.docx

Figure 3.12-1
Rhodamine Dye Release Pathway
2015 RAAER
Alcoa



2015 RAAER

October 14 Afternoon Rhodamine Dye Transects

ALCOA PCO

Project: 150002-02.03

Date: 01/12/2016

Figure 3.12-2

Q:\Jobs\Alcoa_0002\Lavaca_Bay\Maps\2016_02\FigureD1-5_RhodamineTransects.mxd jsfox 2/23/2016 2:41:41 PM

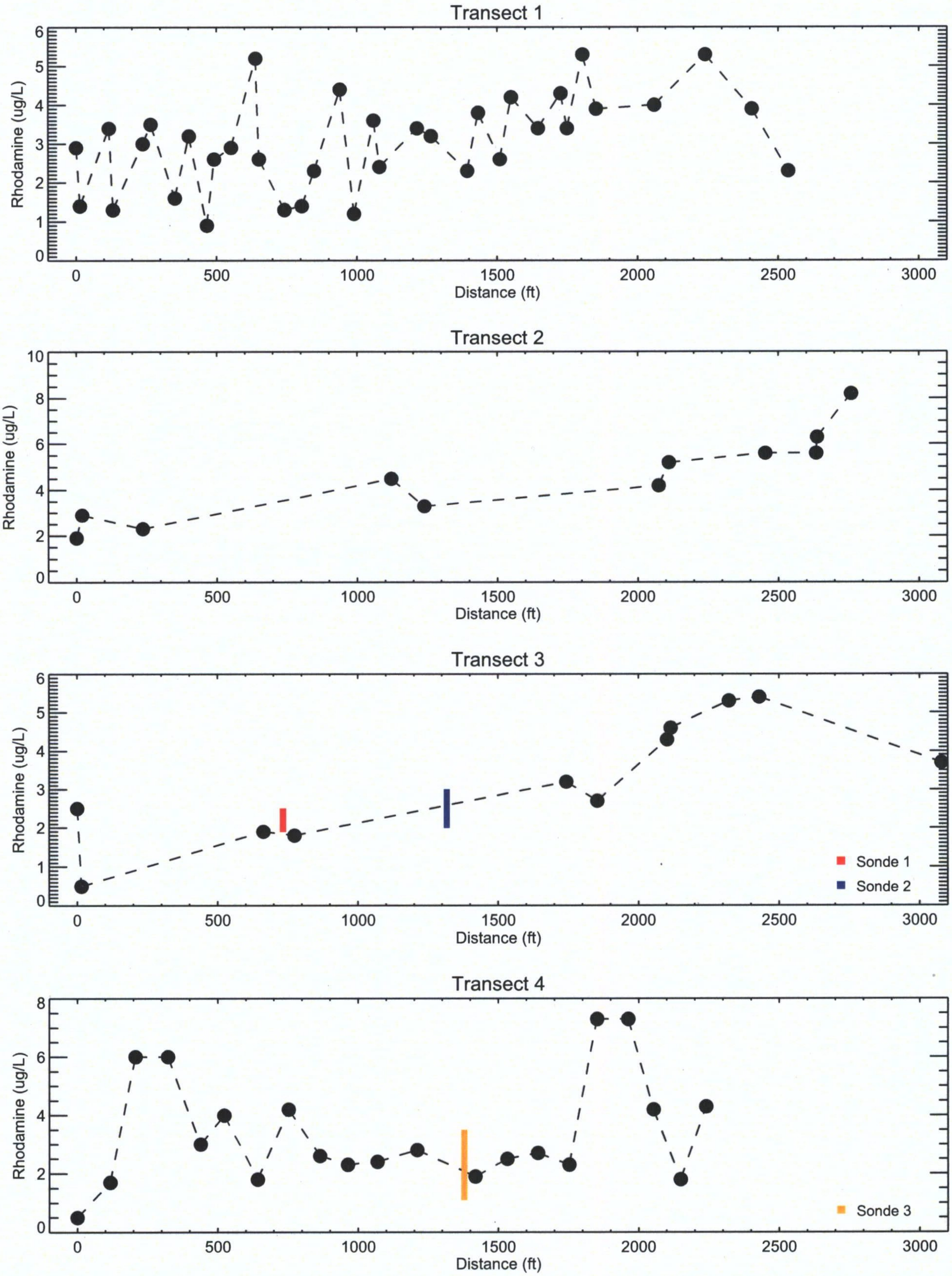
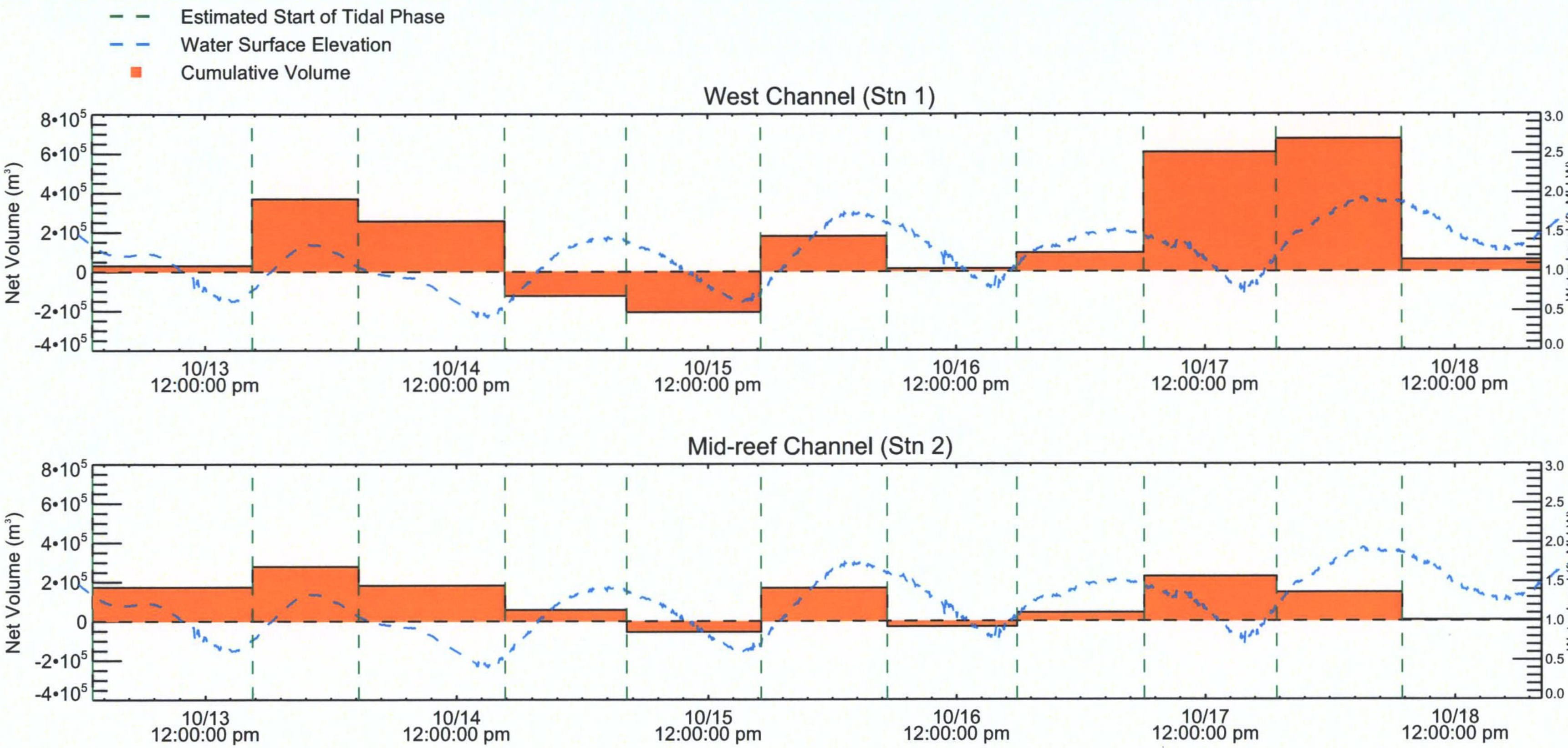


Figure 3.12-3

Supplemental Study 7 Rhodamine Dye Transect Concentrations - 10/14/15 Afternoon

Notes: Transect concentrations and distances correspond to labeled transects in Figure 3.12-5 map. Transect distances increase from the most southerly location (distance = 0) to most the northerly. Concentration data collected 21.5 to 25 hours after dye release. Range of sonde data collected during time of transects plotted at approximate distance of sonde along transect. Sonde data corrected for negative values.



East Channel (Stn 3)
Data Unavailable

Figure 3.12-4

Causeway Cove Study 7 Station Cumulative Net Volume per Tidal Phase

Notes: Water level data taken from NOAA station: 8773259 (Port Lavaca) when available. CTD diver water level data adjusted to account for NOAA tide height. Water velocity data filtered for measurements <= 55 cm/s. Velocity data averaged by minute, then averaged over tidal 6-minute average period. Cumulative values summed for each tidal period. Start of flood and ebb tides assigned to 2 hours after estimated high or low tide. High and Low tide times from http://tides.mobilegeographics.com.

cf - \\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\Analysis\Sup_Studies_2015\Study7\IDL\lb_stn_current_temporals.pro
Mon Mar 21 10:48:38 2016

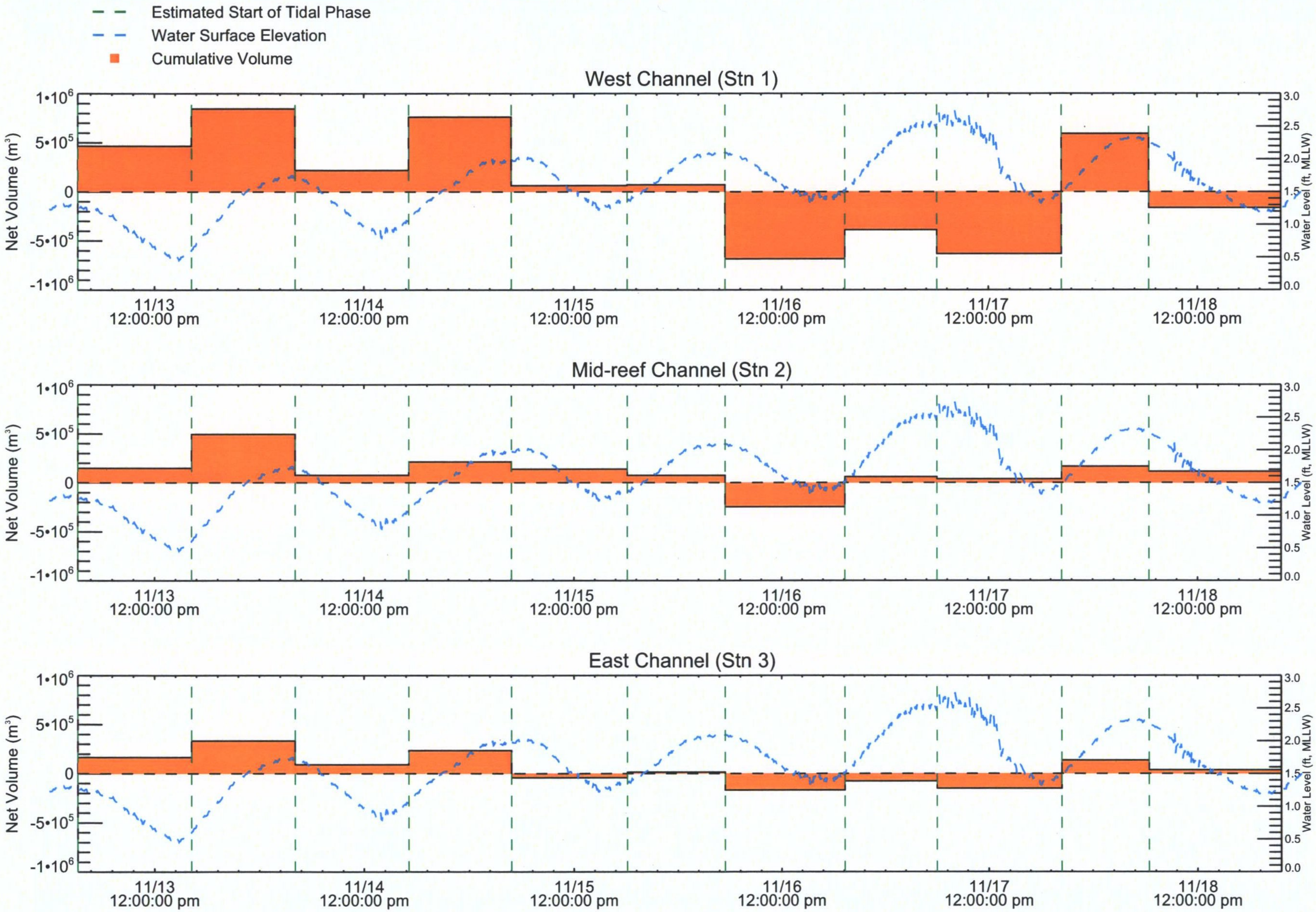
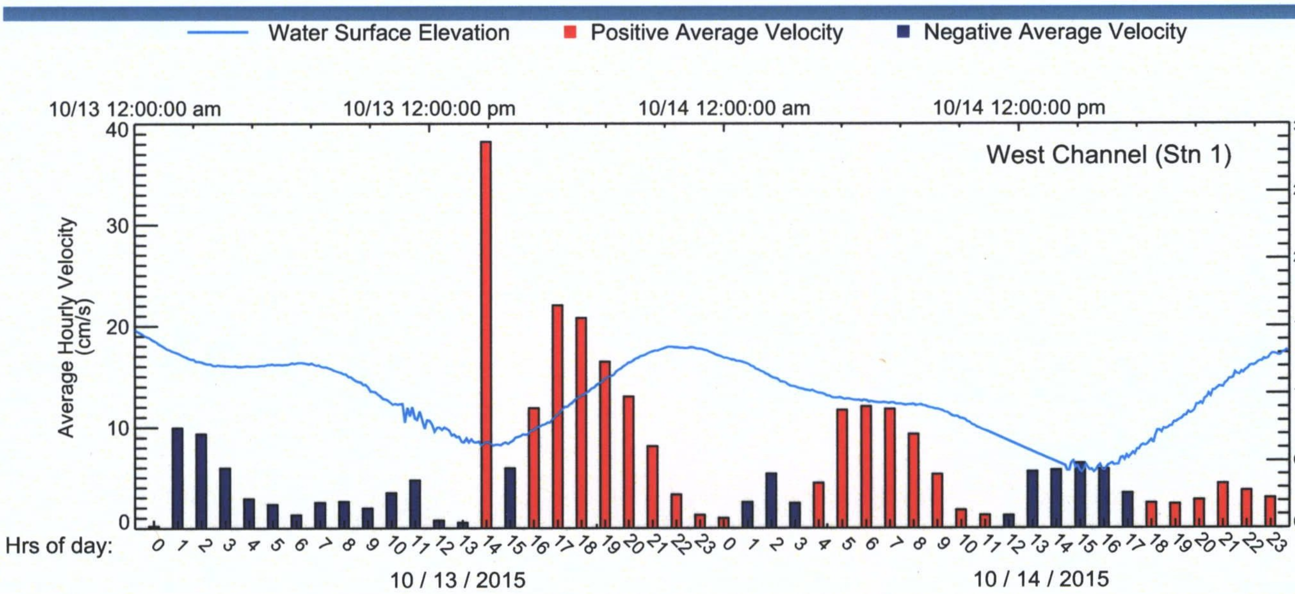


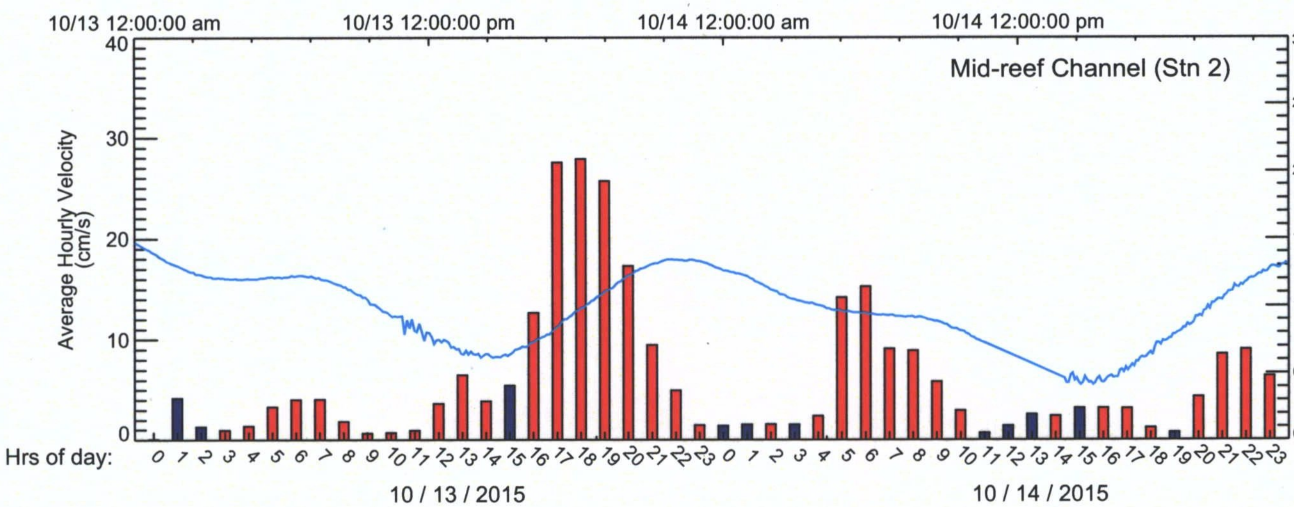
Figure 3.12-5

Causeway Cove Study 7 Station Cumulative Net Volume per Tidal Phase

Notes: Water level data taken from NOAA station: 8773259 (Port Lavaca) when available. CTD diver water level data adjusted to account for NOAA tide height. Water velocity data filtered for measurements <= 55 cm/s. Velocity data averaged by minute, then averaged over tidal 6-minute average period. Cumulative values summed for each tidal period. Start of flood and ebb tides assigned to 2 hours after estimated high or low tide. High and Low tide times from http://tides.mobilegeographics.com.

cf - \\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\Analysis\Sup_Studies_2015\Study7\IDL\lb_stn_current_temporals.pro
Mon Mar 21 10:49:49 2016





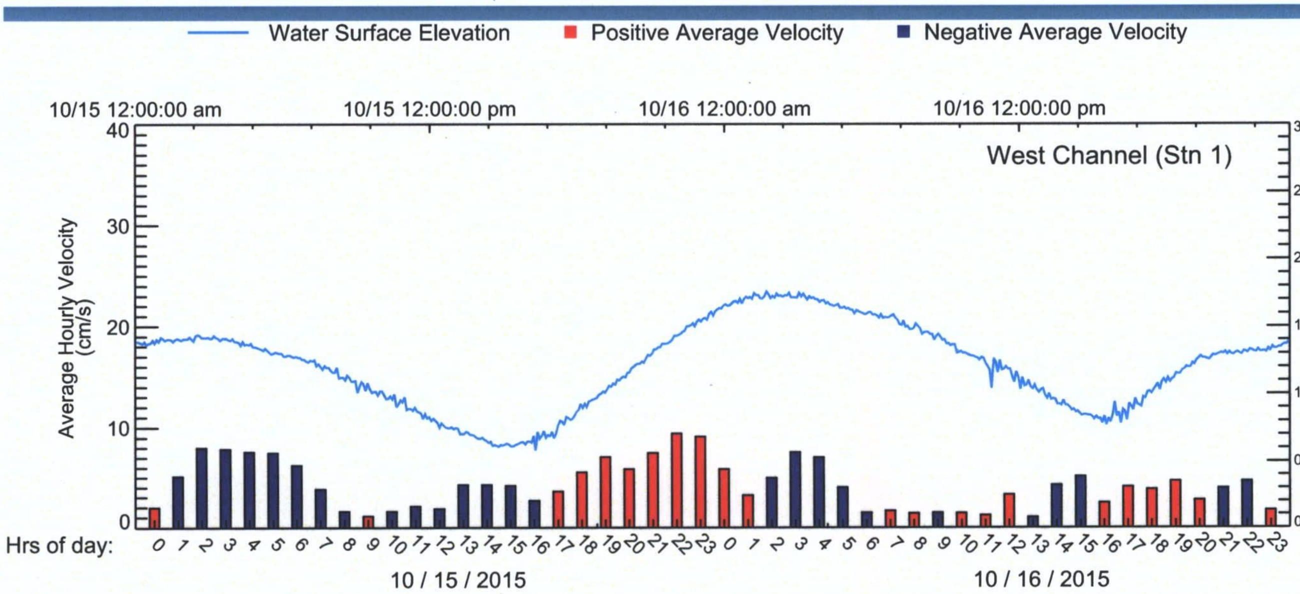
East Channel (Stn 3)
Data Unavailable

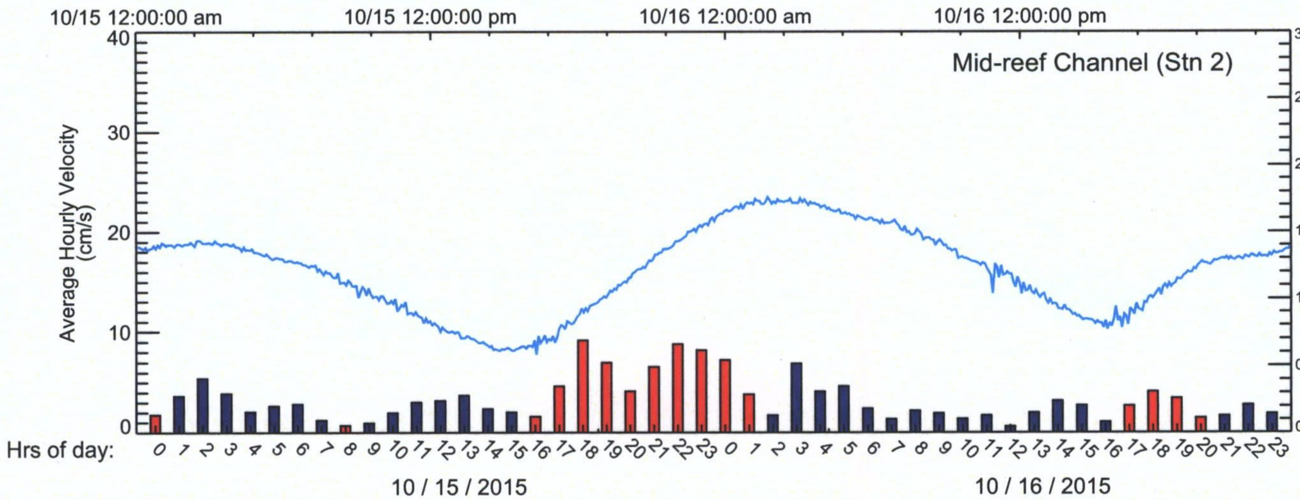
Figure 3.12-6a

North Dredge Island Hourly Average Water Velocity

Notes: Water level data taken from NOAA station: 8773259 (Port Lavaca) when available. CTD diver water level data adjusted to account for NOAA tide height. Water velocity data filtered for measurements <= 55 cm/s. Velocity data averaged by minute; then postive and negative average values calculated by hour and summed.

cf - \\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\Analysis\Sup_Studies_2015\Study7\IDL\LB_All_Stn_Hrly_Currents.pro



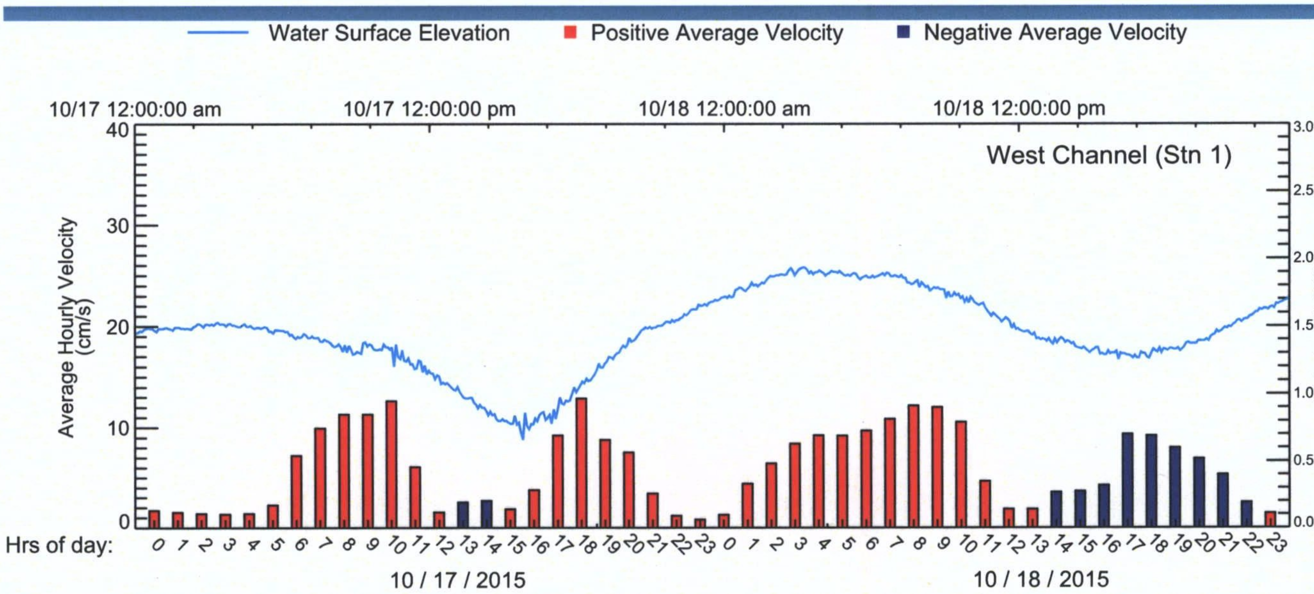


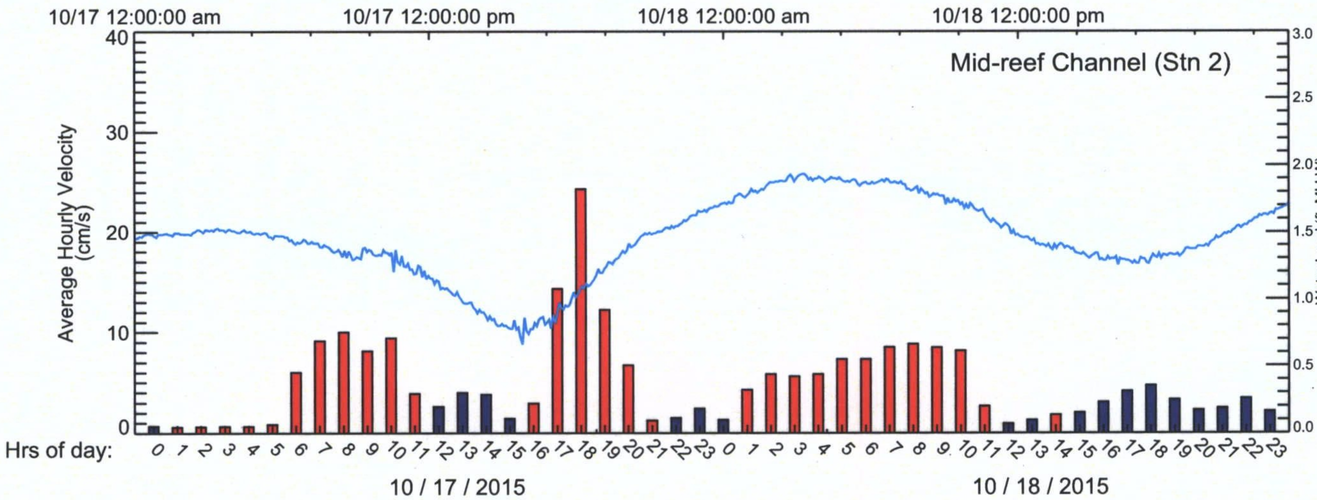
East Channel (Stn 3)
Data Unavailable

Figure 3.12-6b

North Dredge Island Hourly Average Water **Velocity**

Notes: Water level data taken from NOAA station: 8773259 (Port Lavaca) when available. CTD diver water level data adjusted to account for NOAA tide height. Water velocity data filtered for measurements <= 55 cm/s. Velocity data averaged by minute; then postive and negative average values calculated by hour and summed.





East Channel (Stn 3)
Data Unavailable

Figure 3.12-6c

North Dredge Island Hourly Average Water Velocity

Notes: Water level data taken from NOAA station: 8773259 (Port Lavaca) when available. CTD diver water level data adjusted to account for NOAA tide height. Water velocity data filtered for measurements <= 55 cm/s. Velocity data averaged by minute; then postive and negative average values calculated by hour and summed.

cf - \\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\Analysis\Sup_Studies_2015\Study7\IDL\LB_All_Stn_Hrly_Currents.pro

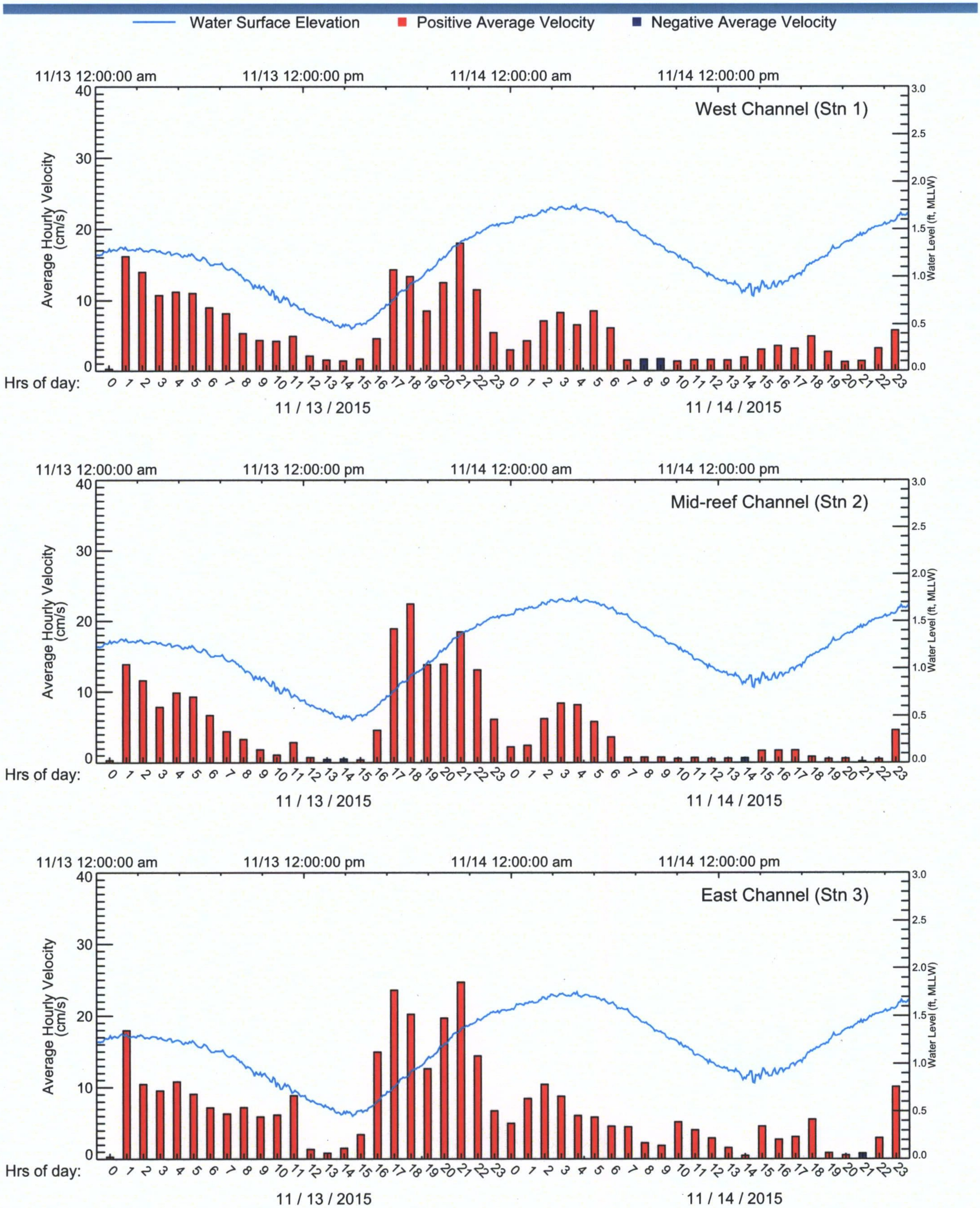


Figure 3.12-6d

North Dredge Island Hourly Average Water Velocity

Notes: Water level data taken from NOAA station: 8773259 (Port Lavaca) when available. CTD diver water level data adjusted to account for NOAA tide height. Water velocity data filtered for measurements <= 55 cm/s. Velocity data averaged by minute; then postive and negative average values calculated by hour and summed.

cf - \\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\Analysis\Sup_Studies_2015\Study7\IDL\LB_All_Stn_Hrly_Currents.pro

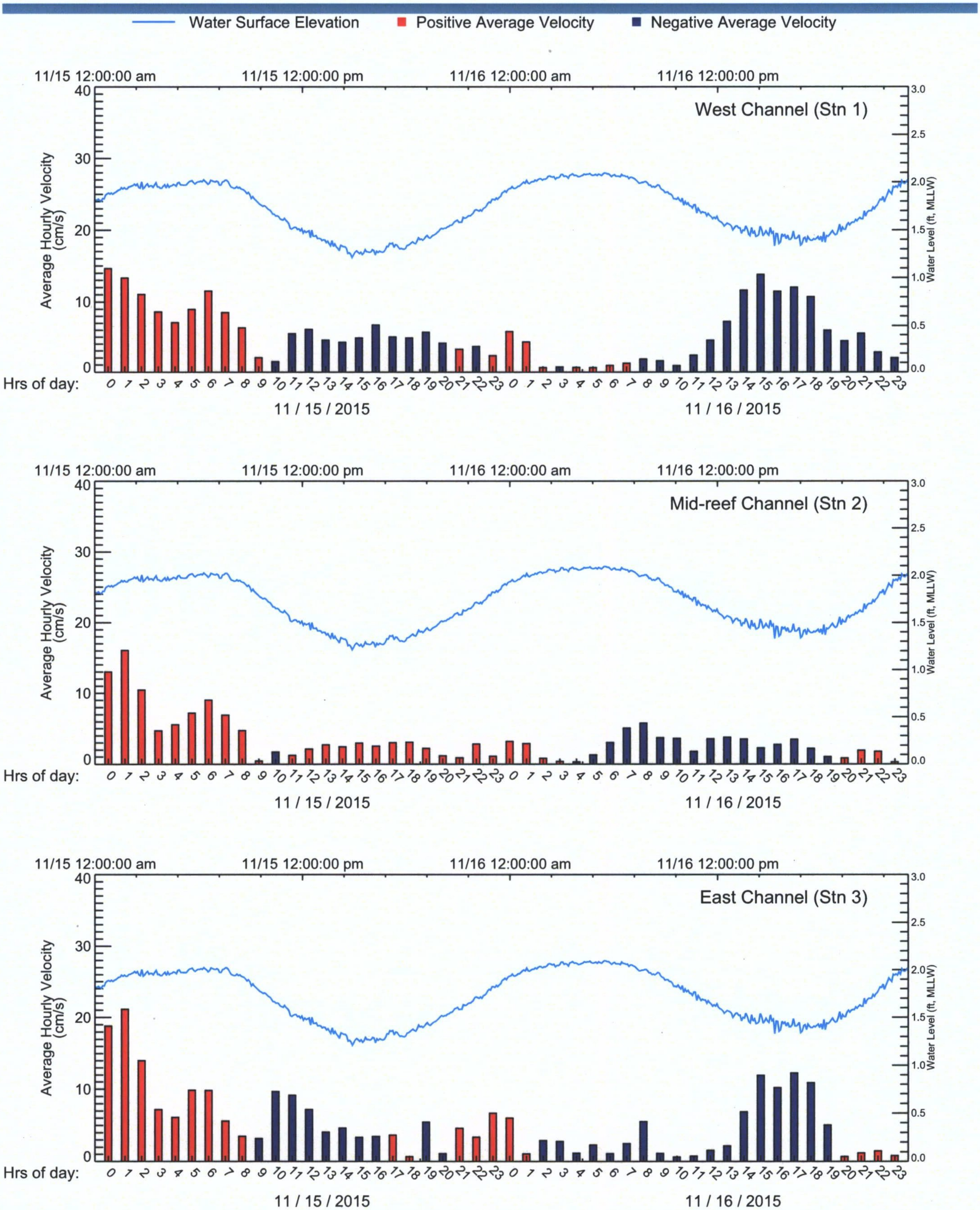


Figure 3.12-6e

North Dredge Island Hourly Average Water Velocity

Notes: Water level data taken from NOAA station: 8773259 (Port Lavaca) when available. CTD diver water level data adjusted to account for NOAA tide height. Water velocity data filtered for measurements <= 55 cm/s. Velocity data averaged by minute; then postive and negative average values calculated by hour and summed.

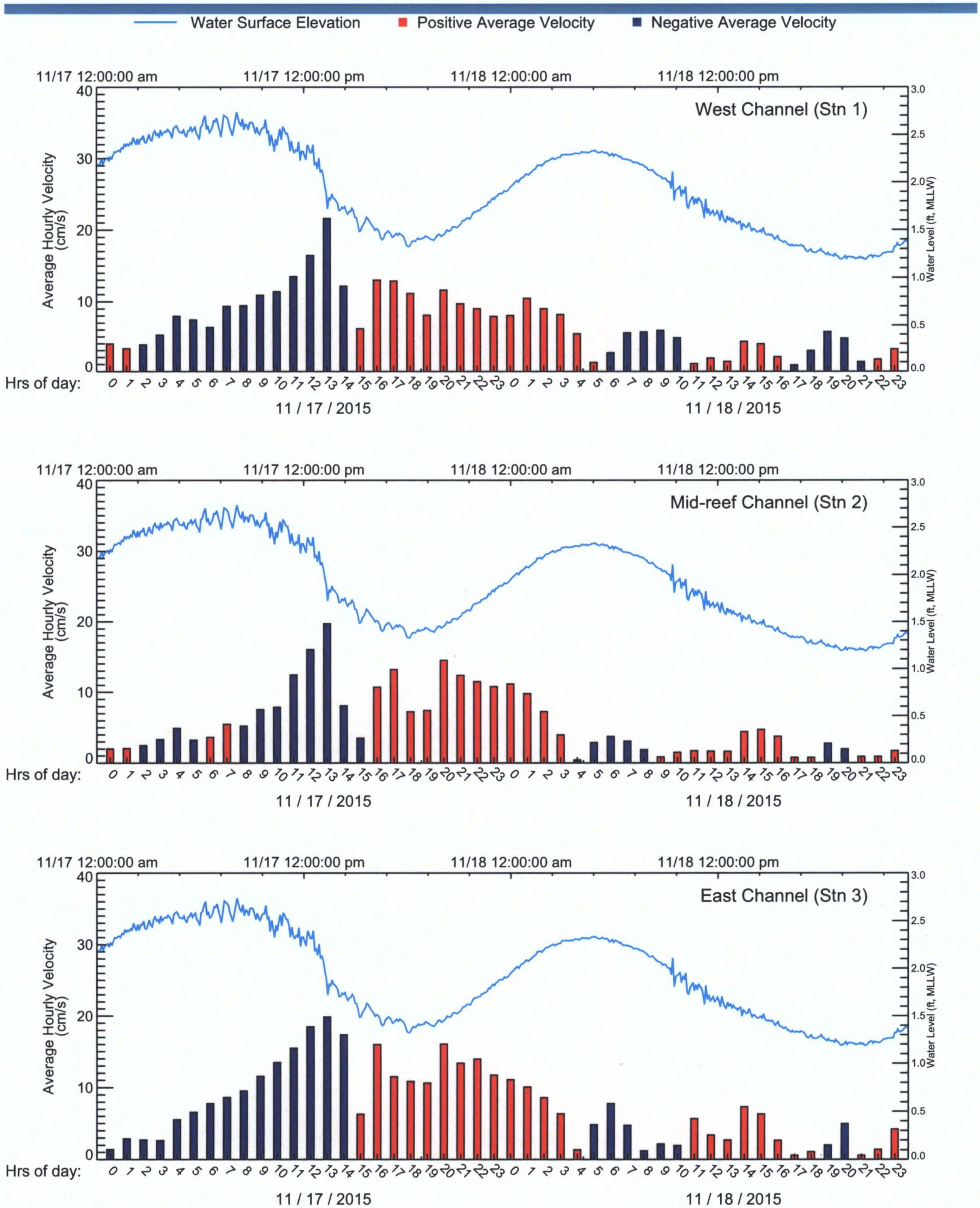


Figure 3.12-6f

North Dredge Island Hourly Average Water Velocity

Notes: Water level data taken from NOAA station: 8773259 (Port Lavaca) when available. CTD diver water level data adjusted to account for NOAA tide height. Water velocity data filtered for measurements <= 55 cm/s. Velocity data averaged by minute; then postive and negative average values calculated by hour and summed.

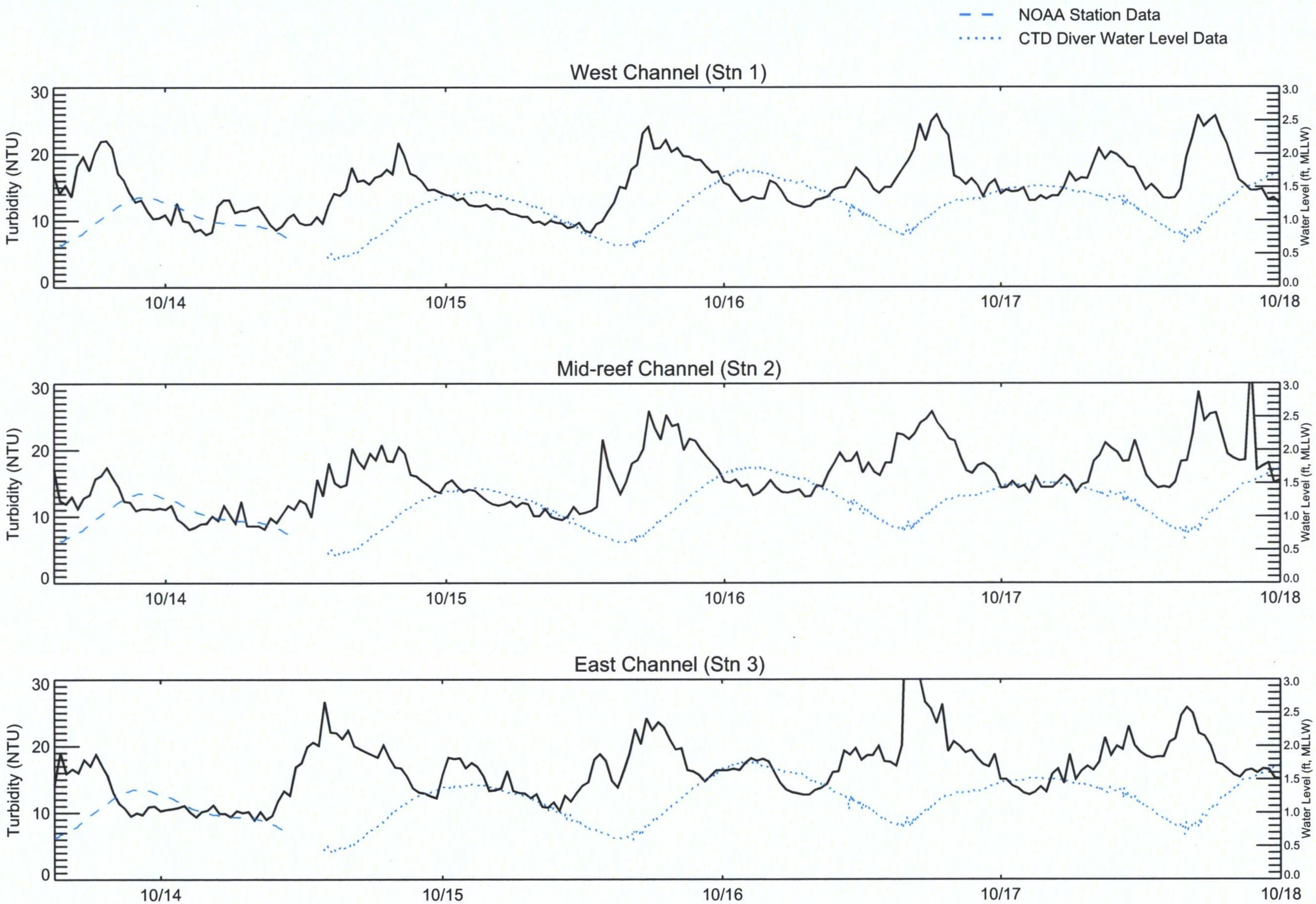
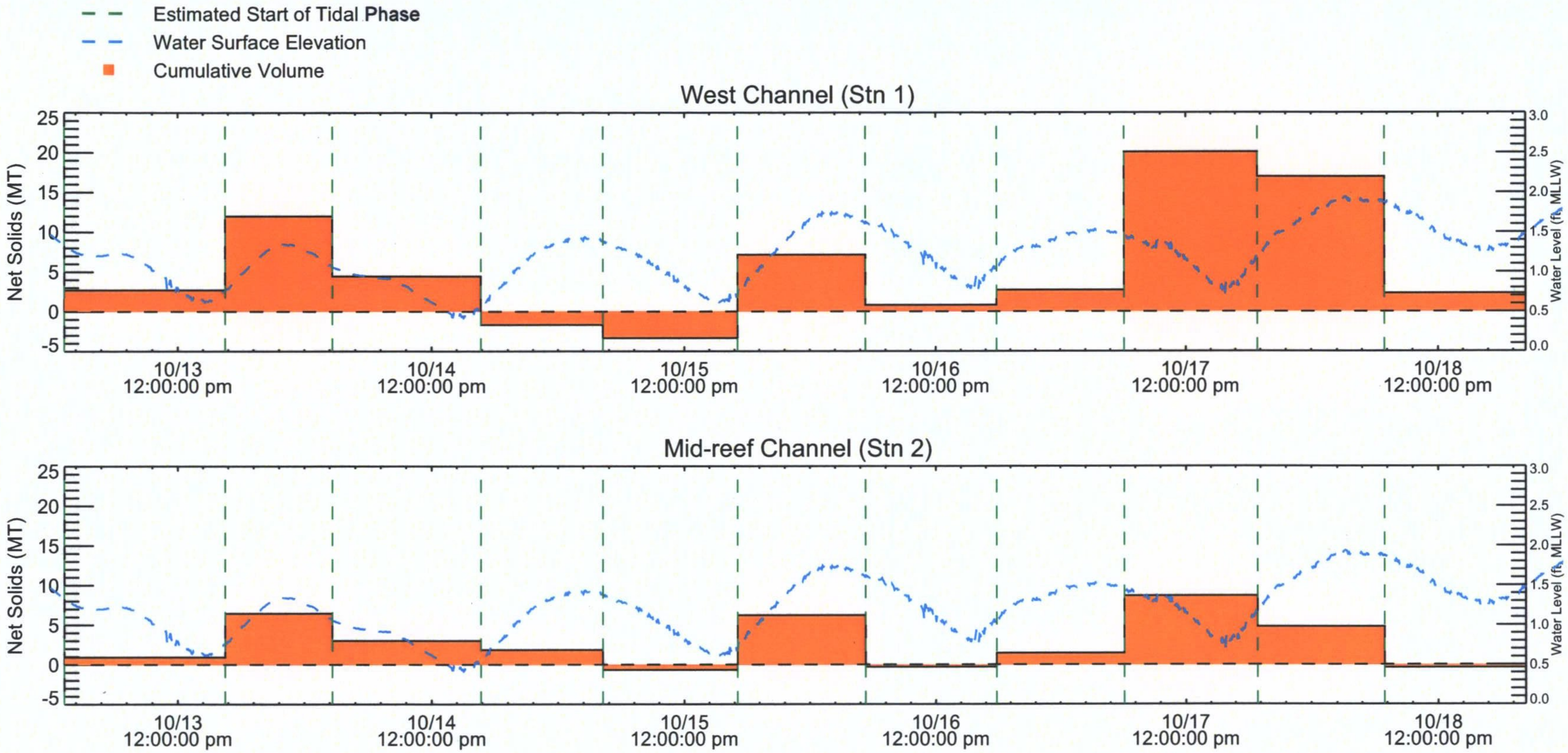


Figure 3.12-7

Supplemental Study 7B Station Turbidity

Notes: Water level data taken from NOAA station: 8773259 (Port Lavaca) when available.
CTD diverwater level data adjusted to account for NOAA tide height.

cf - \\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\Analysis\Sup_Studies_2015\Study7\IDL\Turbidity_Temporals_for_memo.pro
Fri Mar 18 17:57:01 2016



East Channel (Stn 3)
Data Unavailable

Figure 3.12-8

Causeway Cove Study 7 Station Cumulative Net Solid Flux per Tidal Phase

Notes: Water level data taken from NOAA station: 8773259 (Port Lavaca) when available. CTD diver water level data adjusted to account for NOAA tide height. Water velocity data filtered for measurements <= 55 cm/s. Velocity data averaged by minute. Then averaged over tidal 6-minute period. 30-minute turbidity averages assigned to respective 6-minute tidal periods. 1 NTU assigned 1.6 mg/L TSS. Cumulative values summed for each tidal period. Start of flood and ebb tides assigned to 2 hours after estimated high or low tide. High and low tide times from http://tides.mobilegeographics.com.

cf - \\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\Analysis\Sup_Studies_2015\Study7\IDL\lb_stn_current_temporals.pro
Fri Mar 18 18:03:18 2016

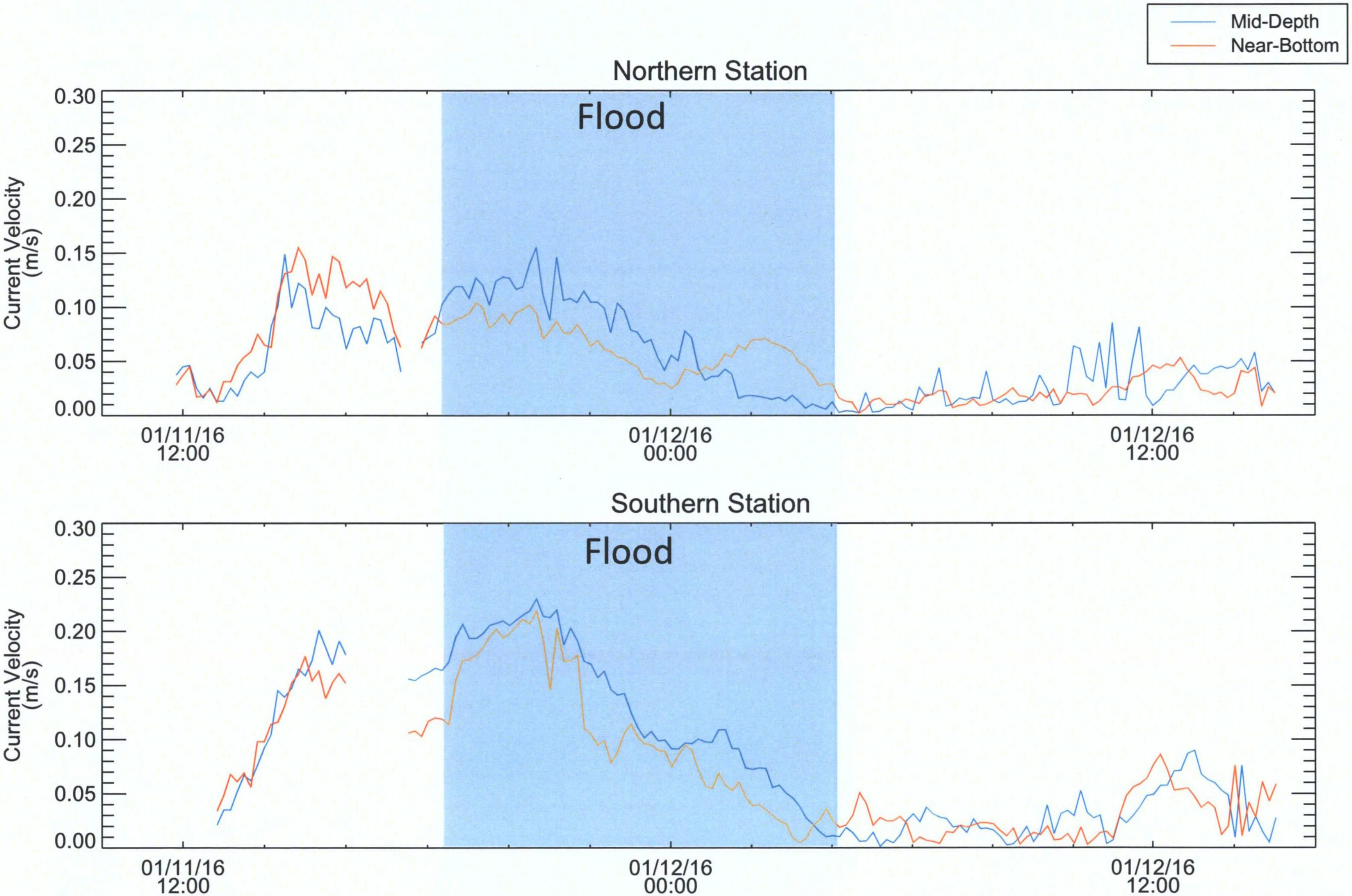


Figure 3.12-9
Study 7C Water Column Profiling Station Current Velocities

HS/CF - \\AUSTIN2\D_drive\Projects\Alcoa\Lavaca_Bay\Analysis\ADCP\LB_ADCP_stationary_atan2_20160321.pro
Mon Mar 21 11:35:26 2016

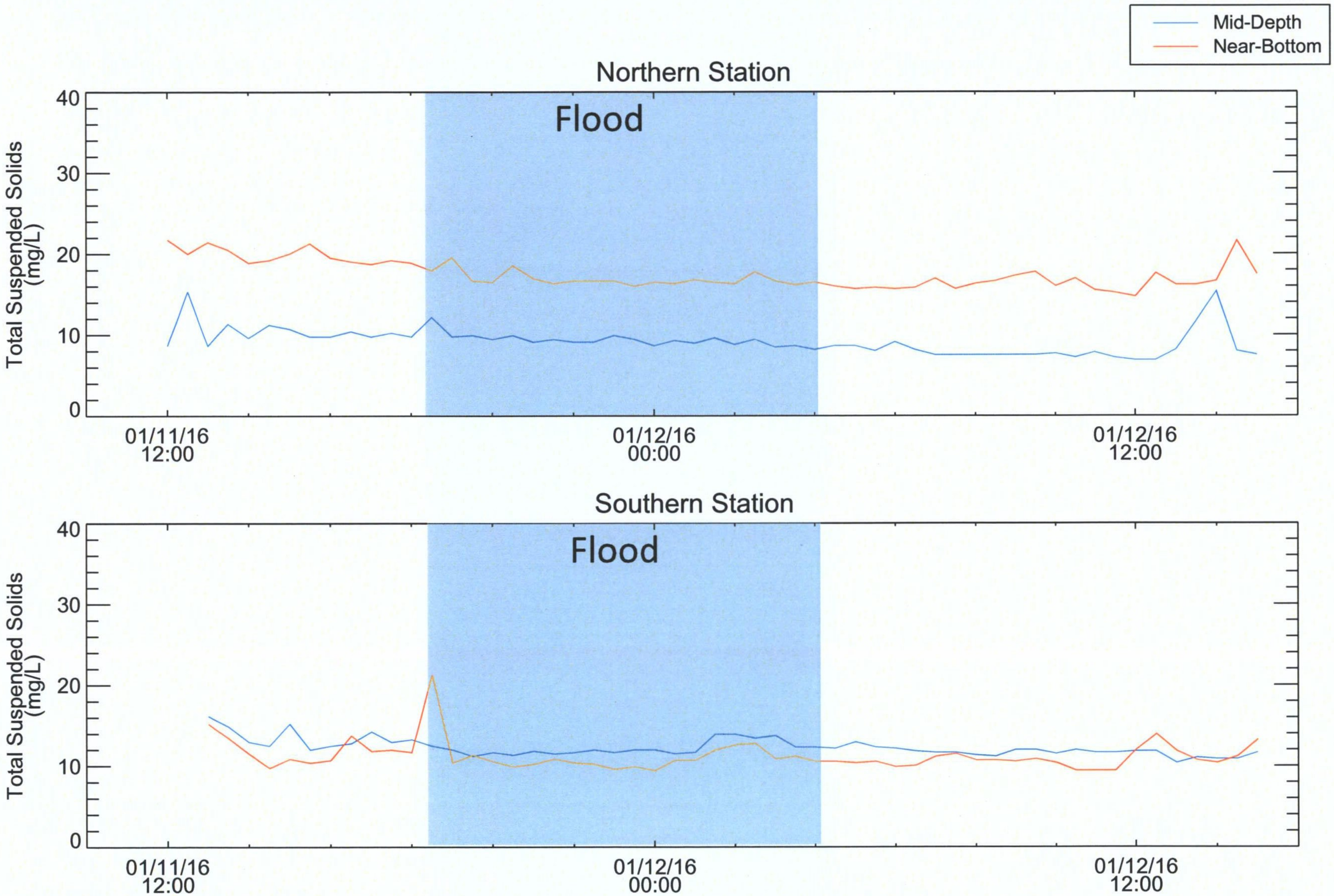
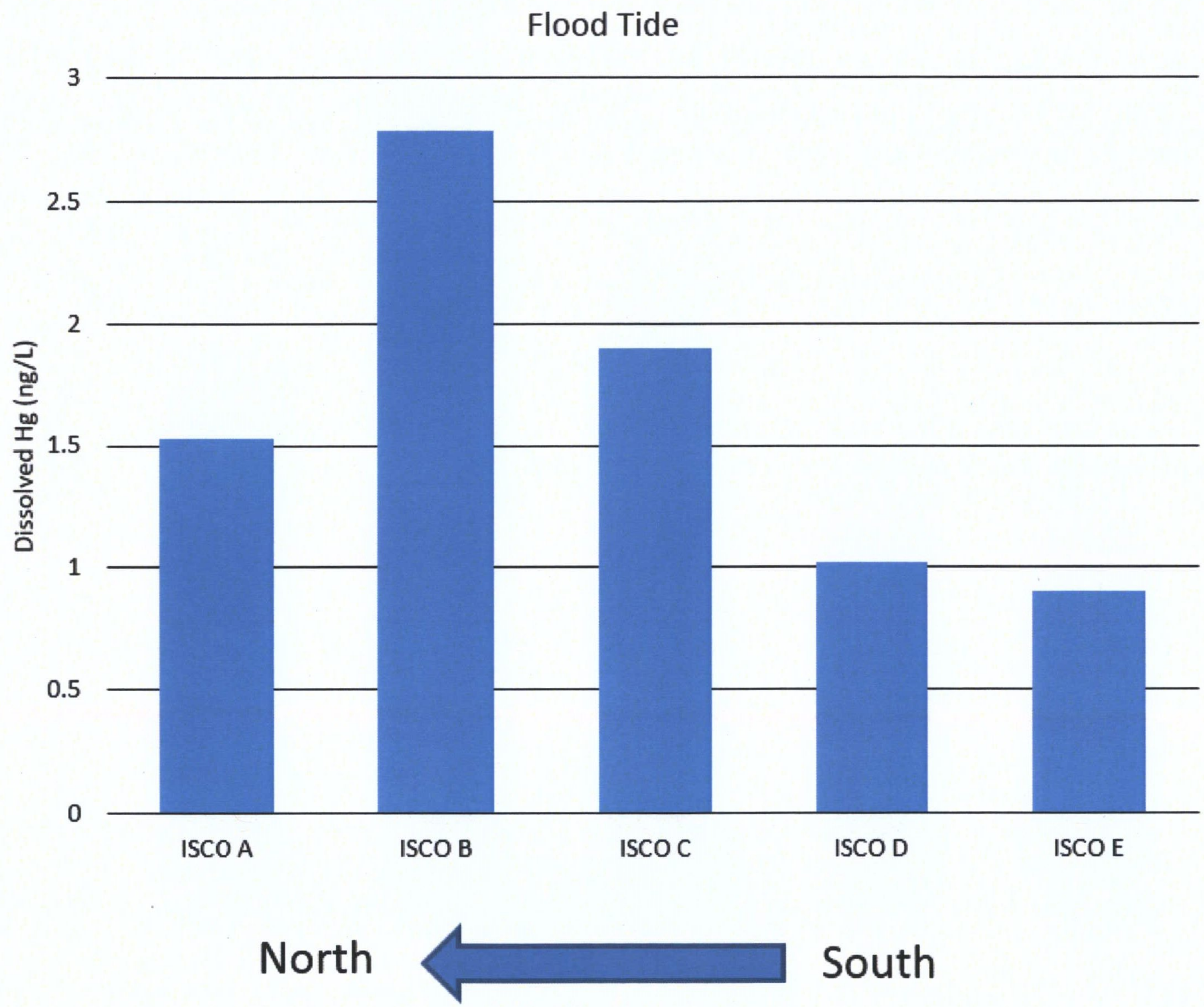


Figure 3.12-10

Study 7C Water Column Profiling Station Total Suspended Solids

Notes: Assume 1 NTU turbidity = 1.6 mg/L TSS.

HS/CF - \\AUSTIN2\D_drive\Projects\Alcoa\Lavaca_Bay\Analysis\ADCP\LB_ADCP_stationary_atan2_20160321.pro
Mon Mar 21 11:35:26 2016



See Figure 2.10-3 for ISCO locations

Figure 3.12-11a
Study 7C Water Column Sampling Station Average Dissolved Mercury Concentrations
2015 RAAER
Alcoa

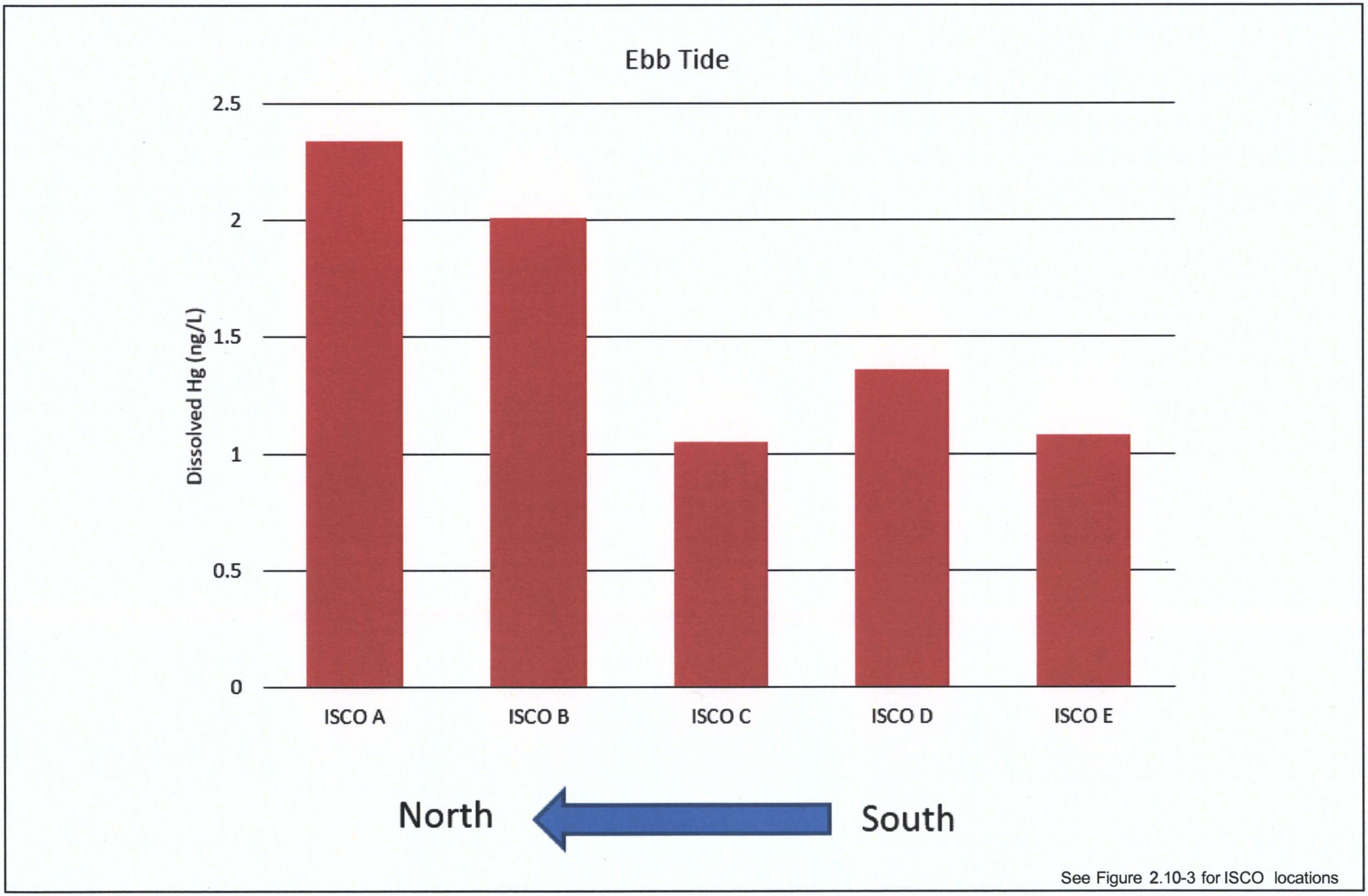
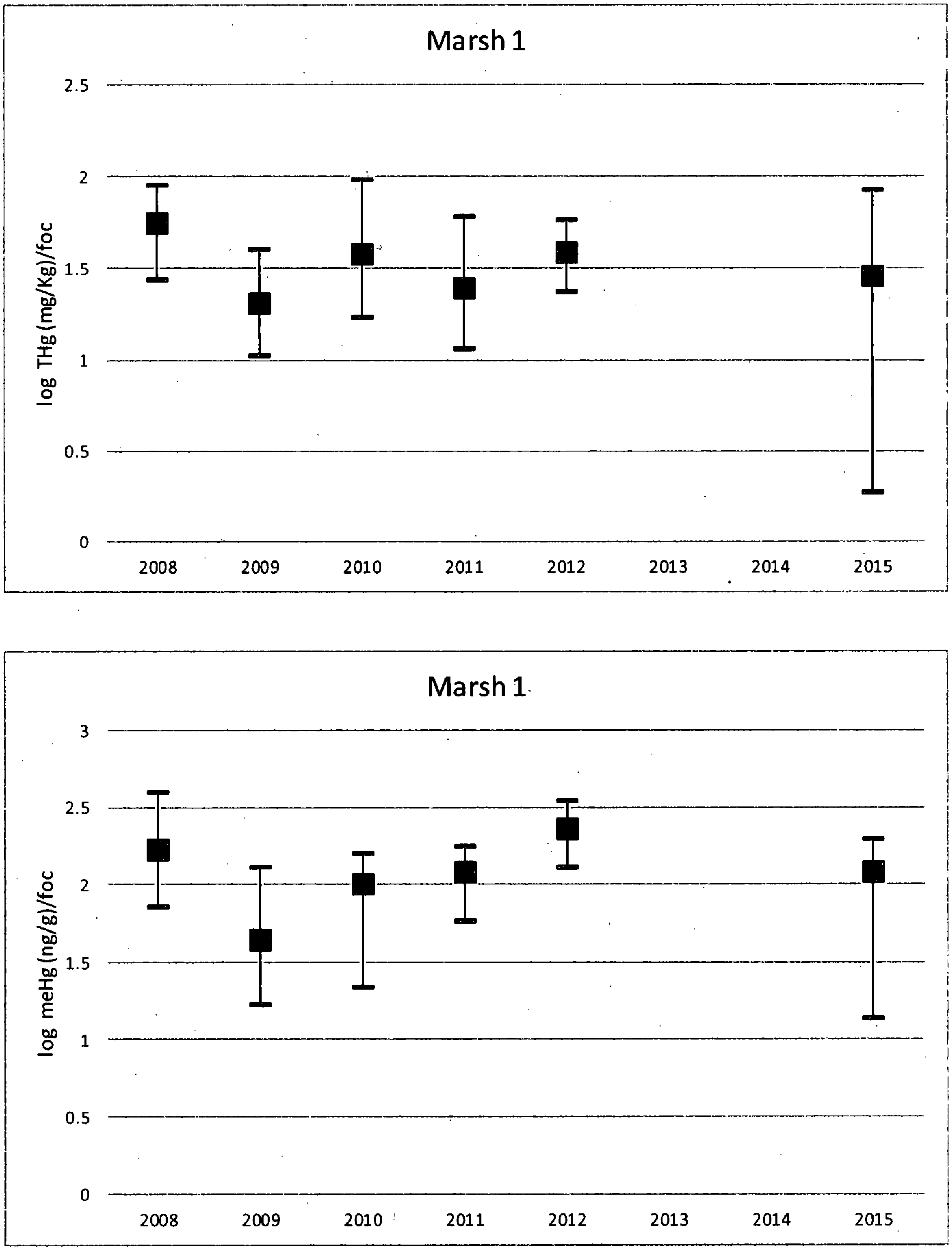
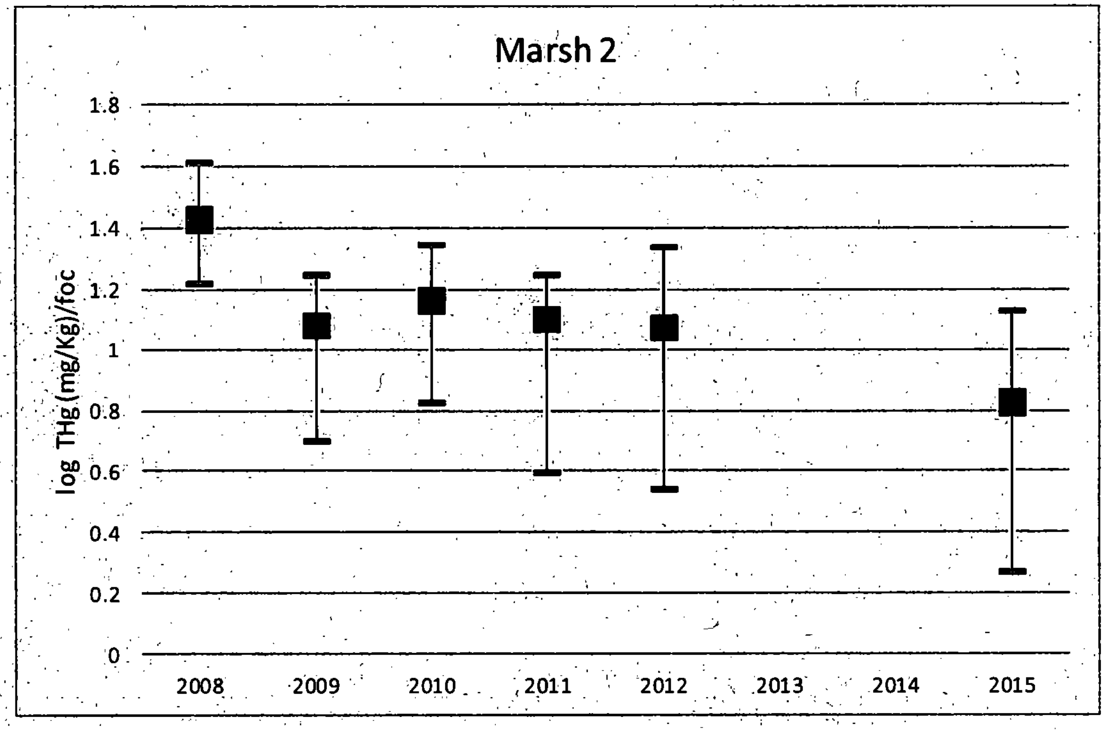


Figure 3.12-11b
Study 7C Water Column Sampling Station Average Dissolved Mercury Concentrations
2015 RAAER
Alcoa



\\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\documents\Reports\RAAERs\2015RAAER\Figures and Tables\Section 3\Individual Figures\Figure 3.13-1.docx

Figure 3.13-1
Total Mercury and Methylmercury Sediment Trends in Marsh 1
2015 RAAER
Alcoa



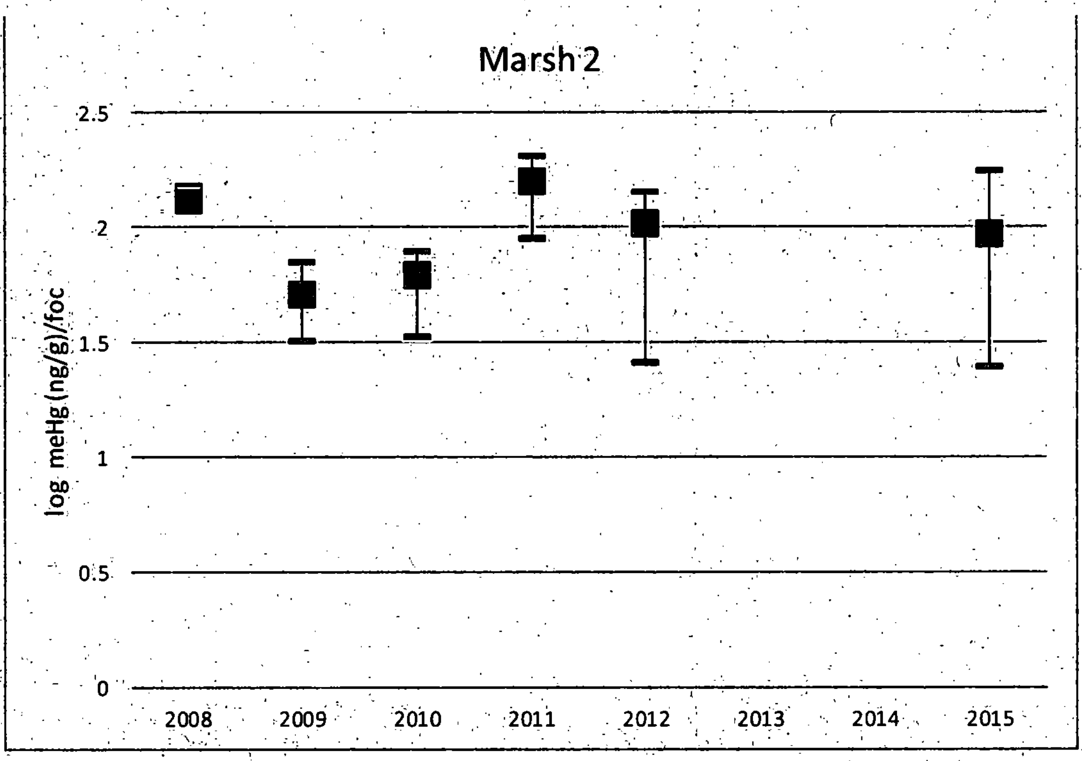
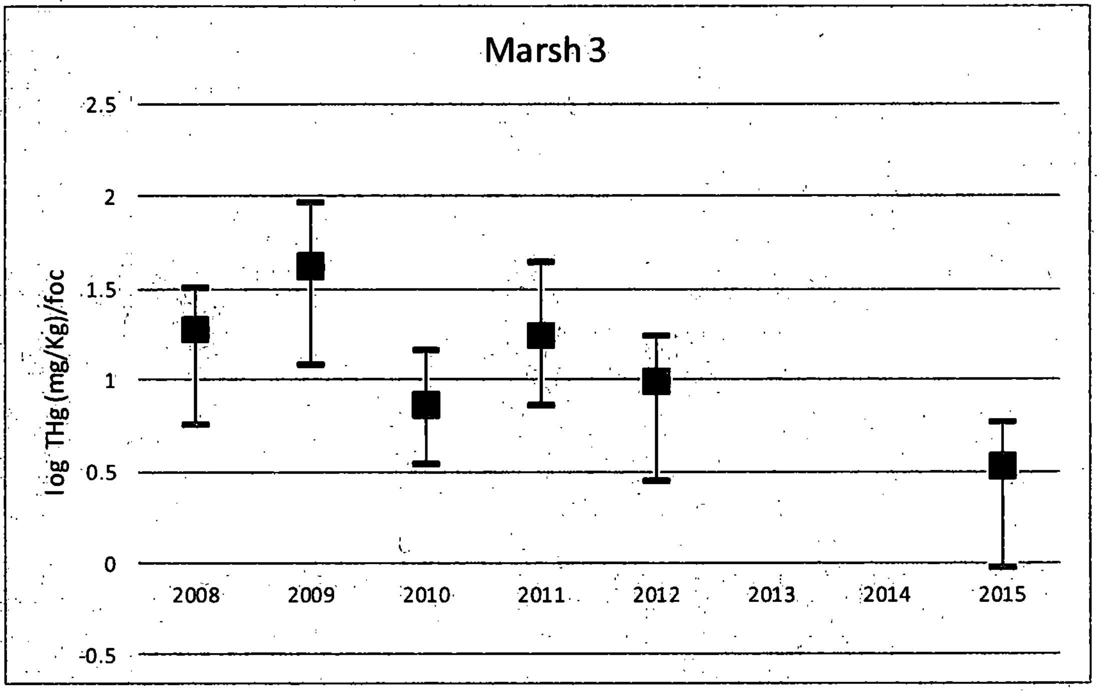


Figure 3.13-2
Total Mercury and Methylmercury Sediment Trends in Marsh 2
2015 RAAER
Alcoa



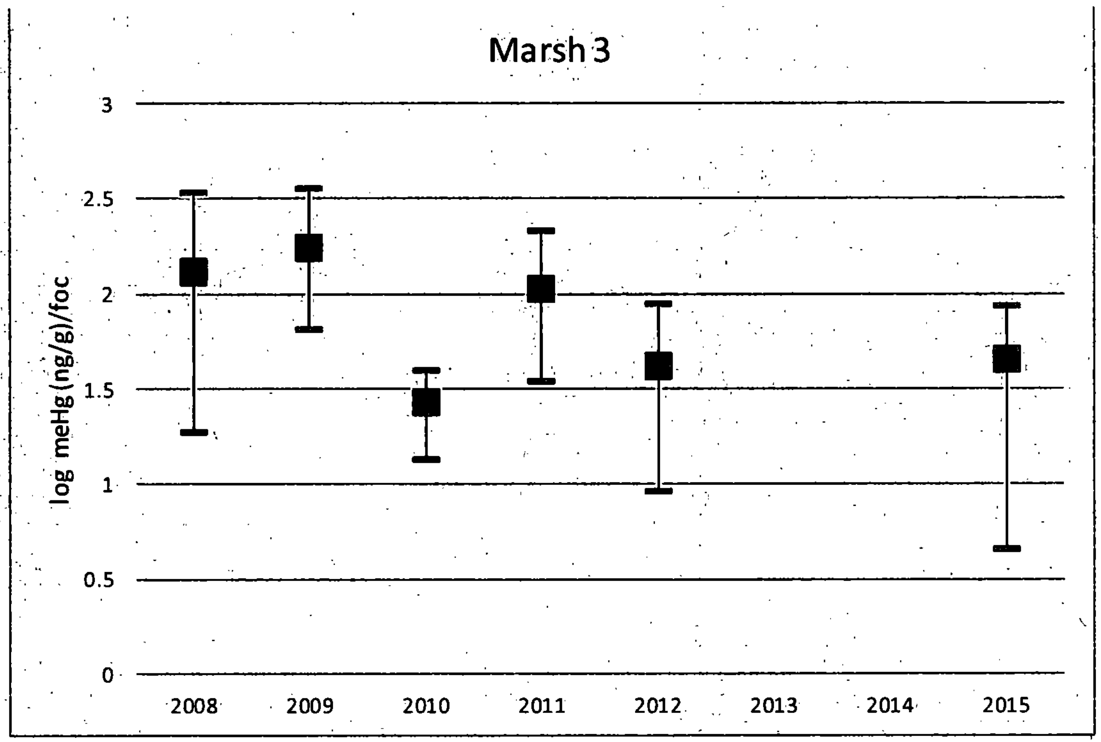


Figure 3.13-3
Total Mercury and Methylmercury Sediment Trends in Marsh 3
2015 RAAER
Alcoa

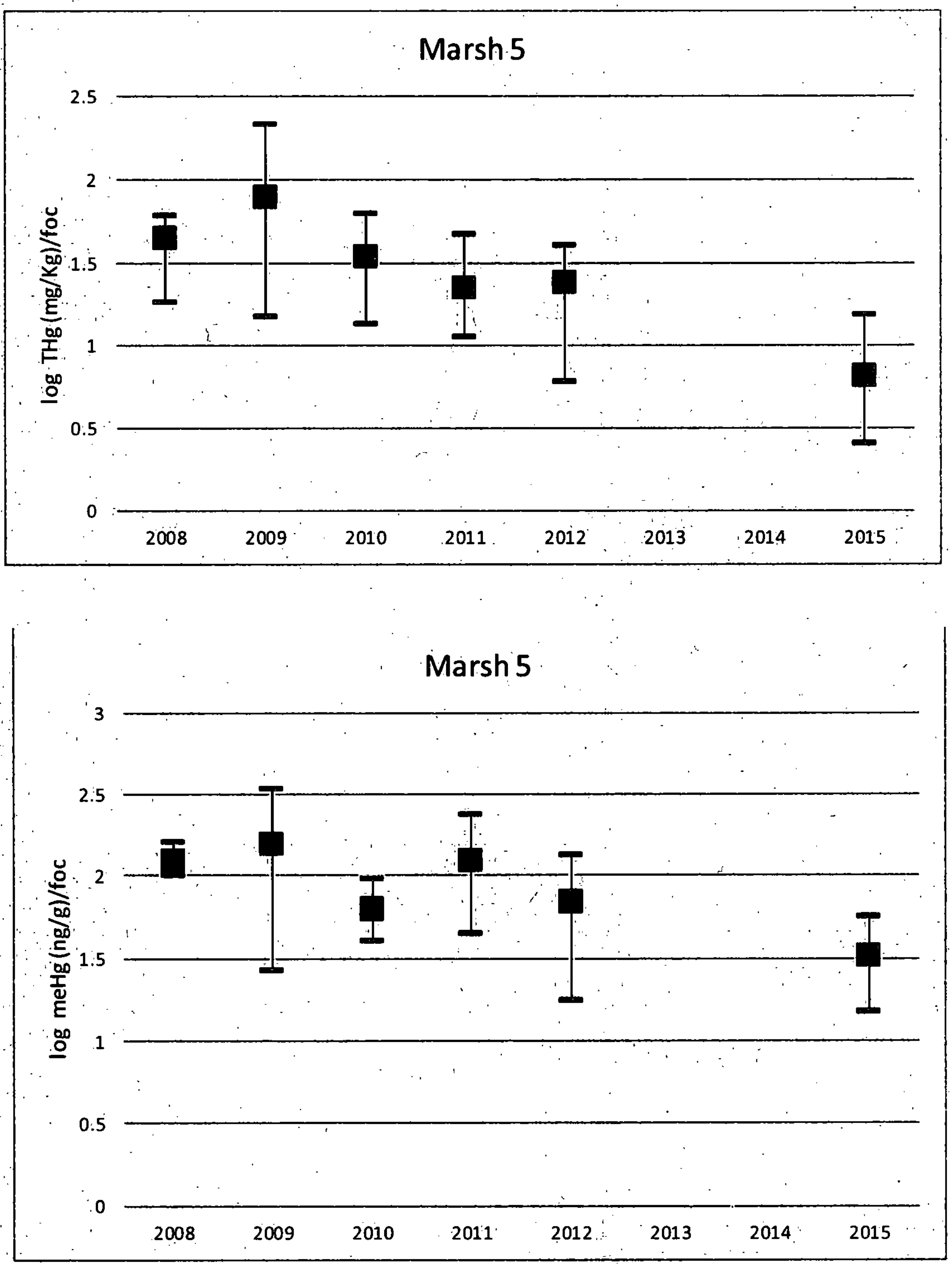
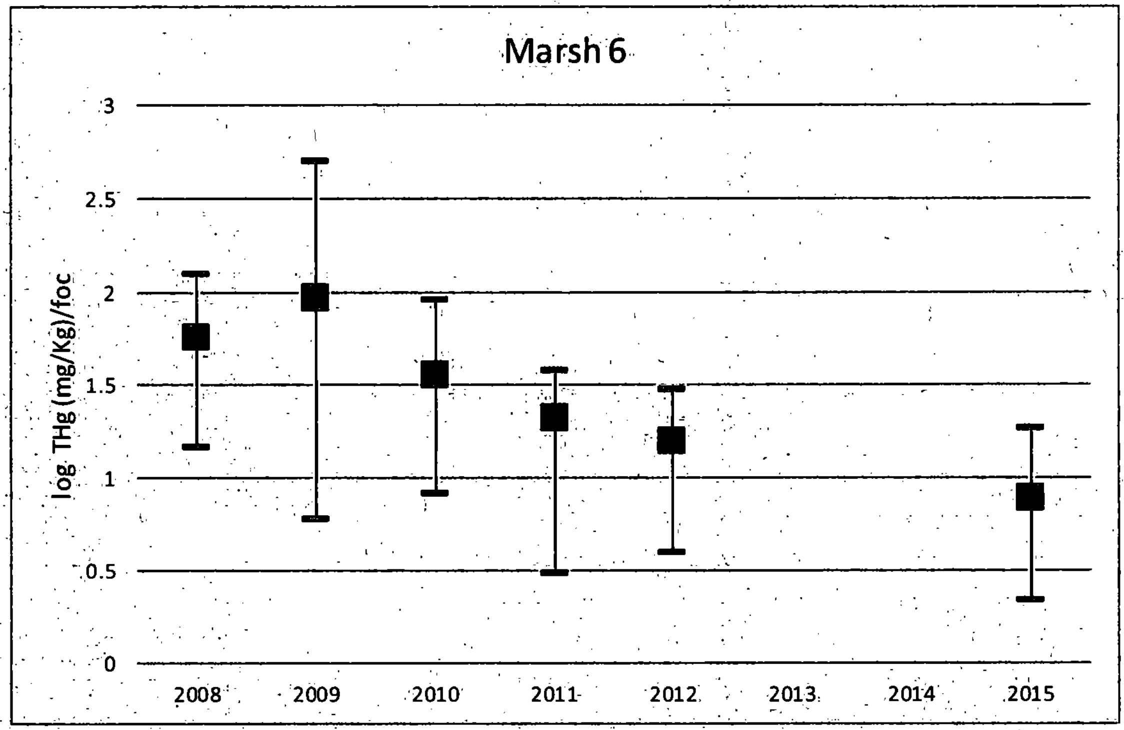
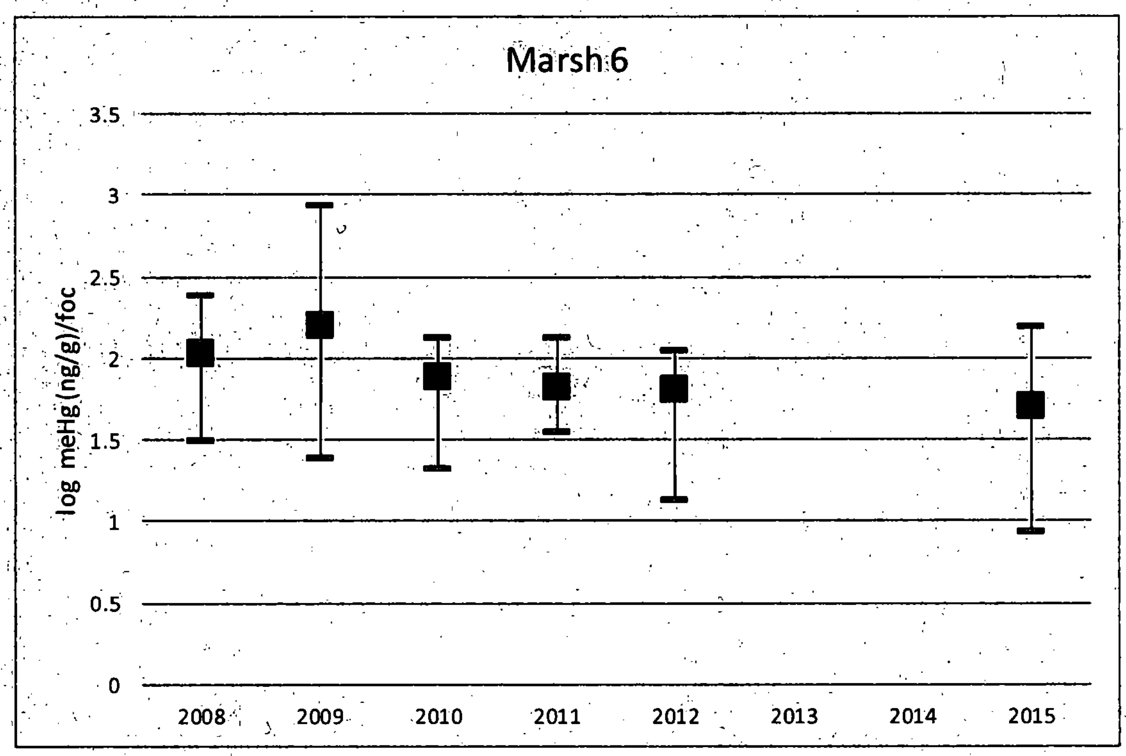


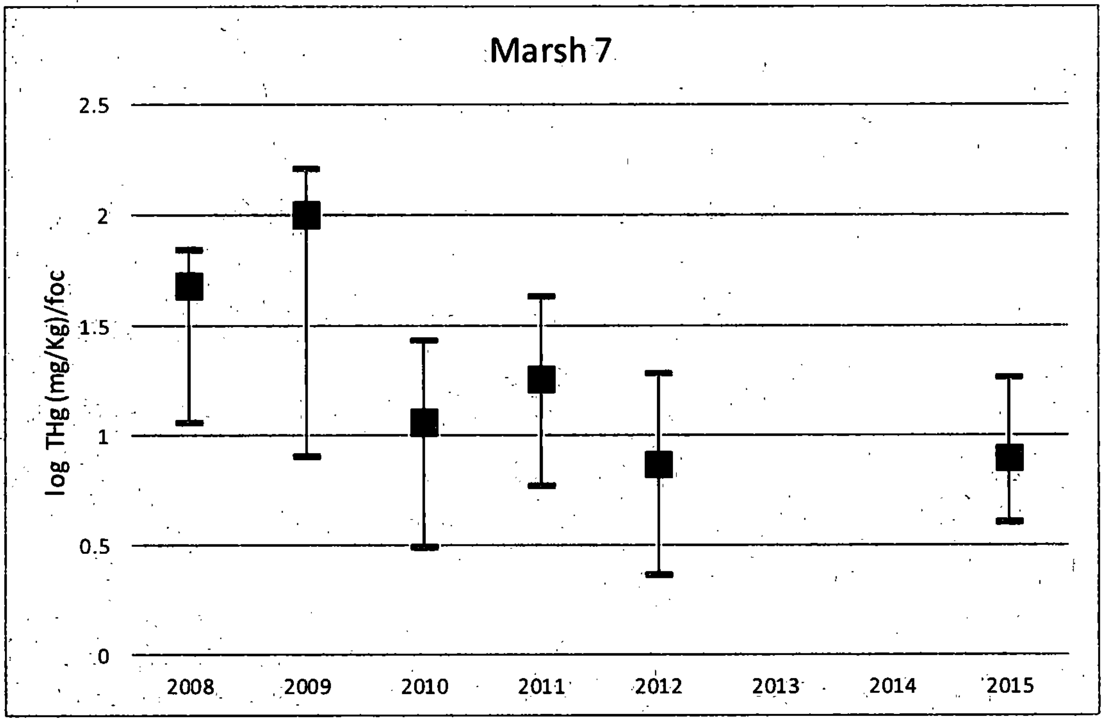
Figure 3.13-4
Total Mercury and Methylmercury Sediment Trends in Marsh 5
2015 RAAER
Alcoa

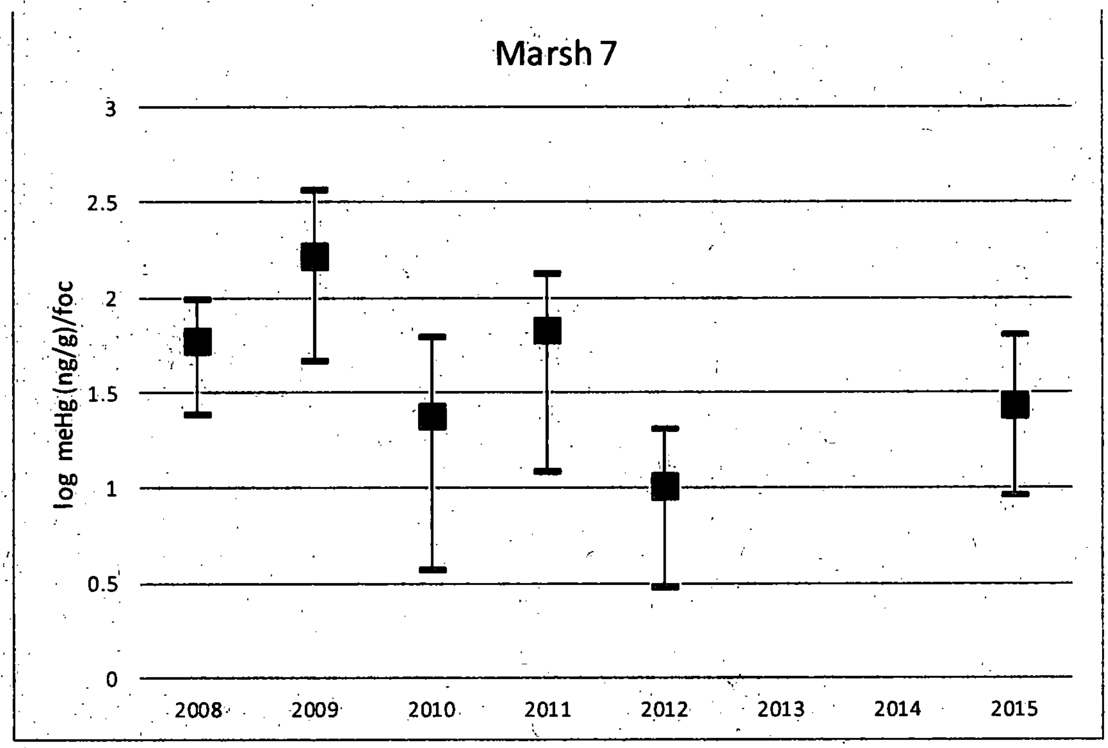




\\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\documents\Reports\RAAERs\2015RAAER\Figures and Tables\Section 3\Individual Figures\Figure 3.13-5.docx

Figure 3.13-5
Total Mercury and Methylmercury Sediment Trends in Marsh 6
2015 RAAER
Alcoa





\\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\documents\Reports\RAAERs\2015RAAER\Figures and Tables\Section 3\Individual Figures\Figure 3.13-6.docx

Figure 3.13-6
Total Mercury and Methylmercury Sediment Trends in Marsh 7
2015 RAAER
Alcoa

Appendix A1

Lavaca Bay Annual Sediment Monitoring Study 2015

March 2016

ALCOA

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

ALS	- ALS Laboratory Group/Laboratory
GPS	- Global Positioning System
Hg	- Mercury
ID	- Identification
OMMP	- Operation Maintenance and Monitoring Plan
RAAER	- Remedial Action Annual Effectiveness Report
RAO	- Remedial Action Objective

1.0 INTRODUCTION

The approved remedial action plan for the Alcoa/Lavaca Bay Superfund Site focuses on eliminating ongoing sources of mercury to the bay, reducing surface sediment concentrations of mercury and polycyclic aromatic hydrocarbons, and ultimately reducing mercury concentrations in fish tissue. A key factor in the Lavaca Bay remedy is the reduction in sediment mercury concentrations through targeted sediment removal efforts, capping, enhanced natural recovery, and/or natural recovery. In accordance with the provisions of the Lavaca Bay Sediment Remediation and Long-Term Monitoring Plan Operations, Maintenance and Monitoring Plan (OMMP; Appendix – to the Consent Decree, March 2005), surface sediment within open water and marshes of the Closed Area adjacent to the Point Comfort Facility will be sampled and analyzed annually for total mercury to document the effectiveness of the remedial action plan.

The Consent Decree requires that the marsh sediment monitoring program be performed until all designated marshes have met the Remedial Action Objective (RAO) for marsh sediment (0.25 mg/kg dry weight). An average total mercury concentration is calculated for each marsh and compared to the marsh sediment RAO. Sediment will be monitored in each marsh until the mean mercury concentration in the marsh is less than the RAO.

In 2015, the RAO for marsh sediments has been met in all marshes. Marsh 14 and sections of Marsh 15 were removed as part of the remediation dredge event near Dredge Island conducted in 2013. Pursuant to the Consent Decree, annual monitoring of sediments in Marsh 11 was discontinued in 2007. Alcoa elected to continue annual monitoring of sediment in Marshes 1, 2, 3, and 19 on a voluntary basis as part of their ongoing effort to better understand trends in tissue concentrations in the Closed Area of Lavaca Bay.

The Consent Decree requires that the open water sediment monitoring program be performed until a mean mercury concentration of less than 0.5 mg/kg dry weight is measured in the Closed Area in two consecutive years. As documented in the 2005 RAAER (Alcoa 2007), this occurred in 2004 and 2005 when the average concentrations of 0.293 ppm and 0.276 ppm, respectively, were measured in open water surface sediment samples from the Closed Area. Thus, the performance objective of the open water sediment monitoring program established in the Consent Decree has been met. However, Alcoa has elected to continue monitoring the northern half of the open water sediment sampling grid on a voluntary basis as part of their ongoing effort to better understand trends in tissue concentrations in the Closed Area of Lavaca Bay.

In addition to the annual sediment total mercury analysis, methylmercury (meHg), and total organic carbon (TOC) analyses were added for the marsh sample stations.

1.1 PURPOSE AND SCOPE

The voluntary open water sediment monitoring program in 2015 consisted of a single surface sediment sample collected from each of the 58 stations shown in Figure 1. The top 2 cm of sediment were subsampled from an Ekman grab sampler and analyzed for Total Hg. Sample locations and results for total Hg are shown in Figure 1. Marshes 1, 2, 3, 5, 6, 7, 15, and 19 were sampled and analyzed for total Hg, meHg, and TOC. Seven of the ten sample stations included in Marsh 15 were not sampled in 2015 because these areas were dredged in 2013. The OMMP requires that marsh sediment samples be analyzed for total mercury.

This document presents a summary of sampling and analytical methods and the results of the 2015 annual sediment monitoring study. A detailed description of the methods and procedures for this study are presented in the OMMP.

1.2 SITE DESCRIPTION

Alcoa Point Comfort Operations is located in Calhoun County, Texas, adjacent to Lavaca Bay. The area in the bay adjacent to the Alcoa Plant is associated with elevated mercury concentrations in fish tissue and is closed to the taking of finfish and shellfish for consumption by order of the Texas Department of Health. This area is referred to as the Closed Area. The Remedial Investigation identified the Closed Area as an area where open water and marsh sediment contains elevated mercury concentrations. The study area and sampling strategy for the open water sediment samples and marsh sediment samples within the Closed Area are documented in the OMMP.

2.0 METHODS

Sediment samples for the 2015 annual sediment monitoring study were collected and processed by Benchmark Ecological Services, Inc. (Benchmark). Samples collected for total Hg and TOC were analyzed by ALS Laboratory Group (ALS) in Houston, Texas, and samples analyzed for meHg were analyzed by Battelle Marine Laboratory in Sequim, Washington. Open water samples were collected and processed on 17 December 2015, 18 December 2015, and 30 December 2015. The top 2 cm of sediment at open water sample stations were analyzed for total mercury. Marsh samples were collected on 10 December and 11 December 2015. Marsh samples consisted of the top 2 cm of sediment and were analyzed for total Hg, meHg, and TOC. Validation and evaluation of the analytical results was conducted by Environmental Chemistry Services, Inc., in Houston, Texas.

2.1 SAMPLE STATIONS

Sample stations were located using coordinates provided by Alcoa. The coordinates were entered into a sub-meter Global Positioning System (GPS), and the GPS was used to position personnel over the sample station. Actual coordinates for the final sample station locations were recorded using the sub-meter differential GPS. Open water sediment sample station locations are shown in Figure 1, and marsh sediment stations are shown in Figures 2a, 2b, and 2c.

2.2 SAMPLE COLLECTION

Open water sediment sample stations are in areas where water depth is between 2-5 feet. Water is too deep to employ the hand core used in shallow marsh sediment sampling stations. An Ekman sampler was used to collect a sample that was approximately 25 cm x 25 cm x 20 cm.

Onboard the sample vessel, a subsample of the top 2 cm of sediment were removed from the Ekman using a clean, disposable 60 mL syringe and placed in a pre-cleaned, labeled, 4-ounce sample jar. The lower end of the syringe barrel (needle lock) was cut off to transform the syringe barrel into an open cylinder. The open end of the syringe barrel was placed on the surface of the sediment, and while holding the syringe piston stationary, the barrel was pushed 2 cm into the sediment sample and a 0–2 cm depth sub-sample was collected. The syringe was marked at 2 cm to ensure proper depth was sampled. Three sub-samples were removed with the syringe from each Ekman grab to provide the volume of sediment required for analysis. New (clean) syringes were used to collect and process each sample. The three sub-samples were thoroughly homogenized. Sediment samples were analyzed for total Hg by ALS in Houston, Texas.

In shallow marshes, the Eckman sampler was not used due to grass roots and other obstructions. Marsh sediment samples were collected using pre-cleaned 6-inch-long polycarbonate core tubes. Core tubes were inserted into the sediment approximately 5 to 10 cm, the bottom of each core was capped, and the core was removed from the sediment. Sediment cores were processed in the field by extruding the top 2 cm of sediment and placing the sediment immediately into sample jars using a new (clean) disposable plastic spoon for each sample. Marsh sediment samples were analyzed for total Hg and TOC by ALS in Houston, Texas, and meHg by Battelle in Sequim, Washington.

Sample containers were labeled with the sample ID, collection date, time, and intended analysis and were placed in re-sealable plastic bags, bubble wrapped, and immediately placed in an insulated chest for storage and transport. Total Hg and TOC samples were stored with ice, and meHg samples were placed on dry ice.

Sample station coordinates, sample IDs, and sample collection dates for the open water stations are listed in Table 1. Sample station IDs, sample IDs, and sample collection dates for the marsh stations are listed in Table 2. A Chain of Custody form was completed for all samples collected.

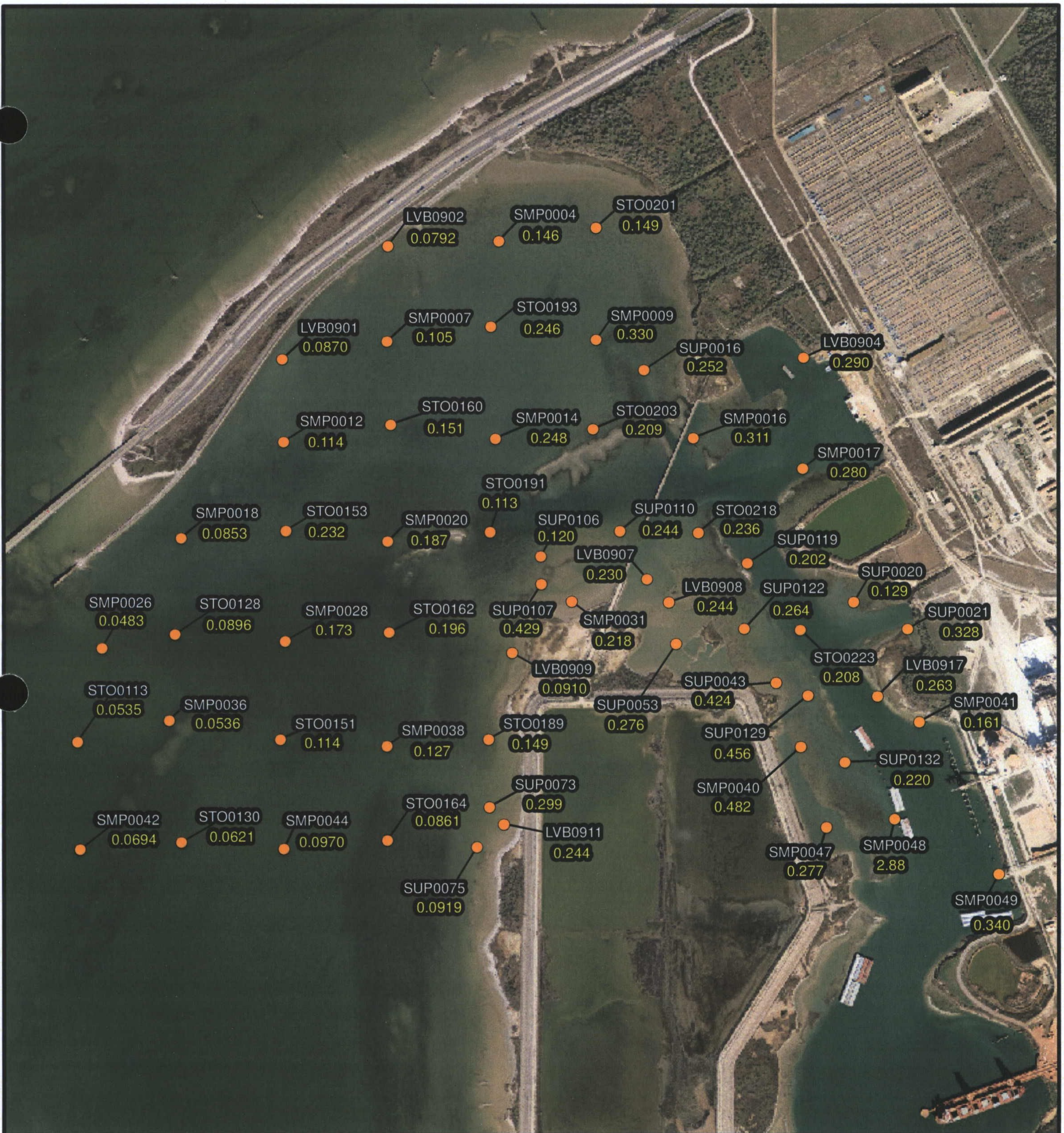
3.0 ANALYTICAL RESULTS

Sediment samples from open water stations (0–2 cm) and marsh stations (0–2 cm) were analyzed for Total Hg (Method 7471A) and percent moisture by ALS in Houston, Texas. In addition, marsh stations were analyzed for methylmercury and TOC. Methylmercury was analyzed by Battelle in Sequim, Washington, and TOC was analyzed by ALS in Houston, Texas. Total mercury results were reported in mg/kg as dry weight, methylmercury results were reported as ng/g as dry weight, and TOC results were reported in wt% as dry weight. Benchmark received all final data packets on 13 February 2016. Data validation and evaluation was completed by Environmental Chemistry Services on 19 February 2016.

Open water sediment station numbers, sample IDs, analytical results, and percent moisture are listed for each sample in Table 1. Marsh sediment station numbers, sample identification numbers, and analytical results are listed in Table 2. The analytical results for the individual samples from each marsh were mathematically averaged in this report to produce the average mercury concentration for each marsh as required by the OMMP. Open water and marsh sediment analytical results are shown in the Figures listed in Table 3.

Analytical results for sediment samples were validated according to the Standard Operating Procedure Data Validation (Appendix E) in the Quality Assurance Project Plan Alcoa (Point Comfort)/Lavaca Bay Superfund Site (22 August 2005). All analytical results were validated and may be included in the data used to evaluate the effectiveness of the approved remedy and to meet monitoring requirements specified in the Consent Decree.

FIGURES



N

0 830 1,660 Feet

Legend

- Open Water Sample Stations (Total Hg, %M, & TOC)
- ### Open Water Sample Station IDs
- 0.00 Open Water Hg Results (mg/kg- dry weight)

(0-2 cm Depth Interval)

Notes

2009 DOQQ

Lavaca Bay Annual Sediment Monitoring Study Fall 2015

Open Water Sample Stations and Total Hg Results

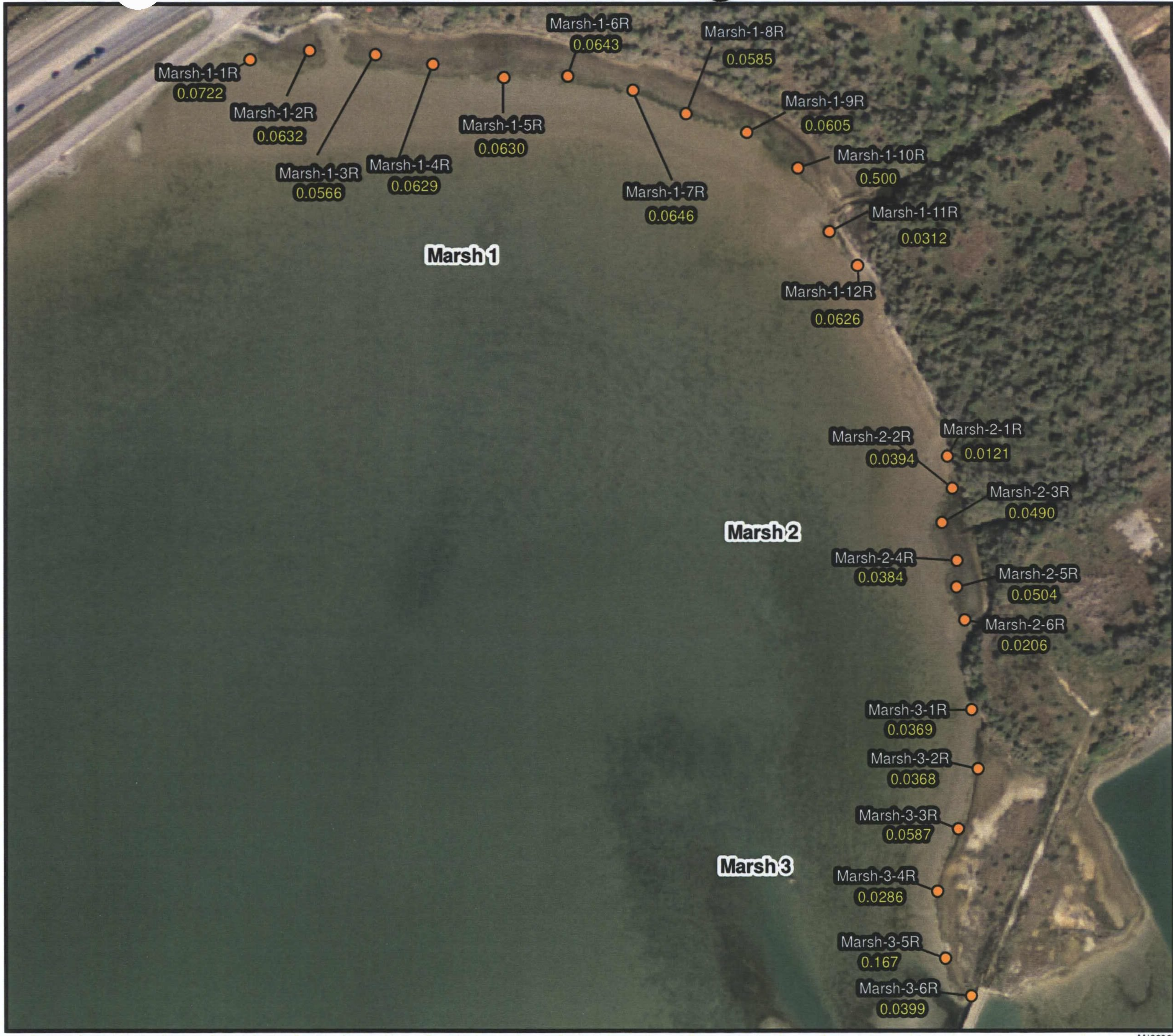
Alcoa Point Comfort Operations

Project: 98003-078

Date: 01/26/2015

Figure 1

M:\98003\078\arc\Post-sampling\Open_water\2015_OW_Stations_results.mxd



Legend

- Marsh Sample Stations
- ## Marsh Sample Station IDs
- 0.00 Marsh Total Hg Results (mg/kg- dry weight) (0-2 cm Depth Interval)

Notes

2009 DOQQ

Lavaca Bay Annual Sediment Monitoring Study Fall 2015

Marsh Sample Stations 1, 2 and 3 and Total Hg Results

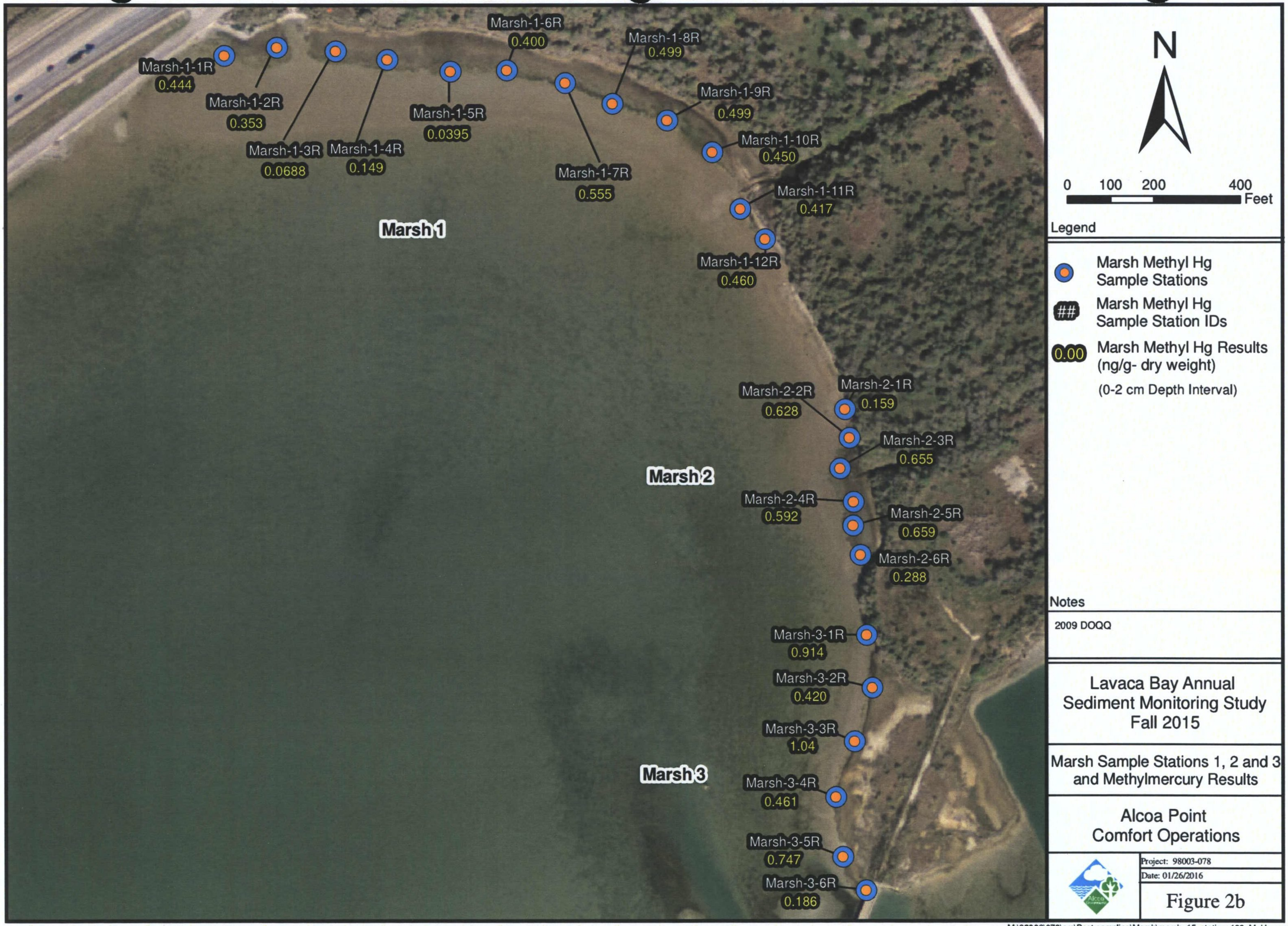
Alcoa Point Comfort Operations

Project: 98003-078

Date: 01/25/2016

Figure 2a

M:\98003\078\arc\Post-sampling\Marsh\marsh_15_stations123_Hg.mxd



M:\98003\078\arc\Post-sampling\Marsh\marsh_15_stations123_MeHg.mxd

Legend

- Marsh TOC Sample Stations
- ## Marsh TOC Sample Station IDs
- 0.00 Marsh TOC Result (wt%) (0-2 cm Depth Interval)

Notes

2009 DOQQ

Lavaca Bay Annual Sediment Monitoring Study Fall 2015

Marsh Sample Stations 1, 2 and 3 and Total Organic Carbon Results

Alcoa Point Comfort Operations

Project: 98003-078

Date: 01/26/2016

Figure 2c

M:\98003\078\arc\Post-sampling\Marsh\marsh_15_stations123_TOC.mxd

Legend

- Marsh Sample Stations
- ## Marsh Sample Station IDs
- 0.00 Marsh Total Hg Results (mg/kg- dry weight) (0-2 cm Depth Interval)

Notes

2009 DOQQ

Lavaca Bay Annual Sediment Monitoring Study Fall 2015

Marsh Sample Stations 5, 6 and 7 Total Hg Results

Alcoa Point Comfort Operations

Project: 98003-078

Date: 01/26/2016

Figure 3a

M:\98003\078\arc\Post-sampling\Marsh\marsh_15_stations567_Hg.mxd

Legend

Marsh Methyl Hg Sample Stations

Marsh Methyl Hg Sample Station IDs

0.00 Marsh Methyl Hg Results (ng/g-dry weight)

(0-2 cm Depth Interval)

Notes

2009 DOQQ

Lavaca Bay Annual Sediment Monitoring Study Fall 2015

Marsh Sample Stations 5, 6 and 7 Methyl Hg Results

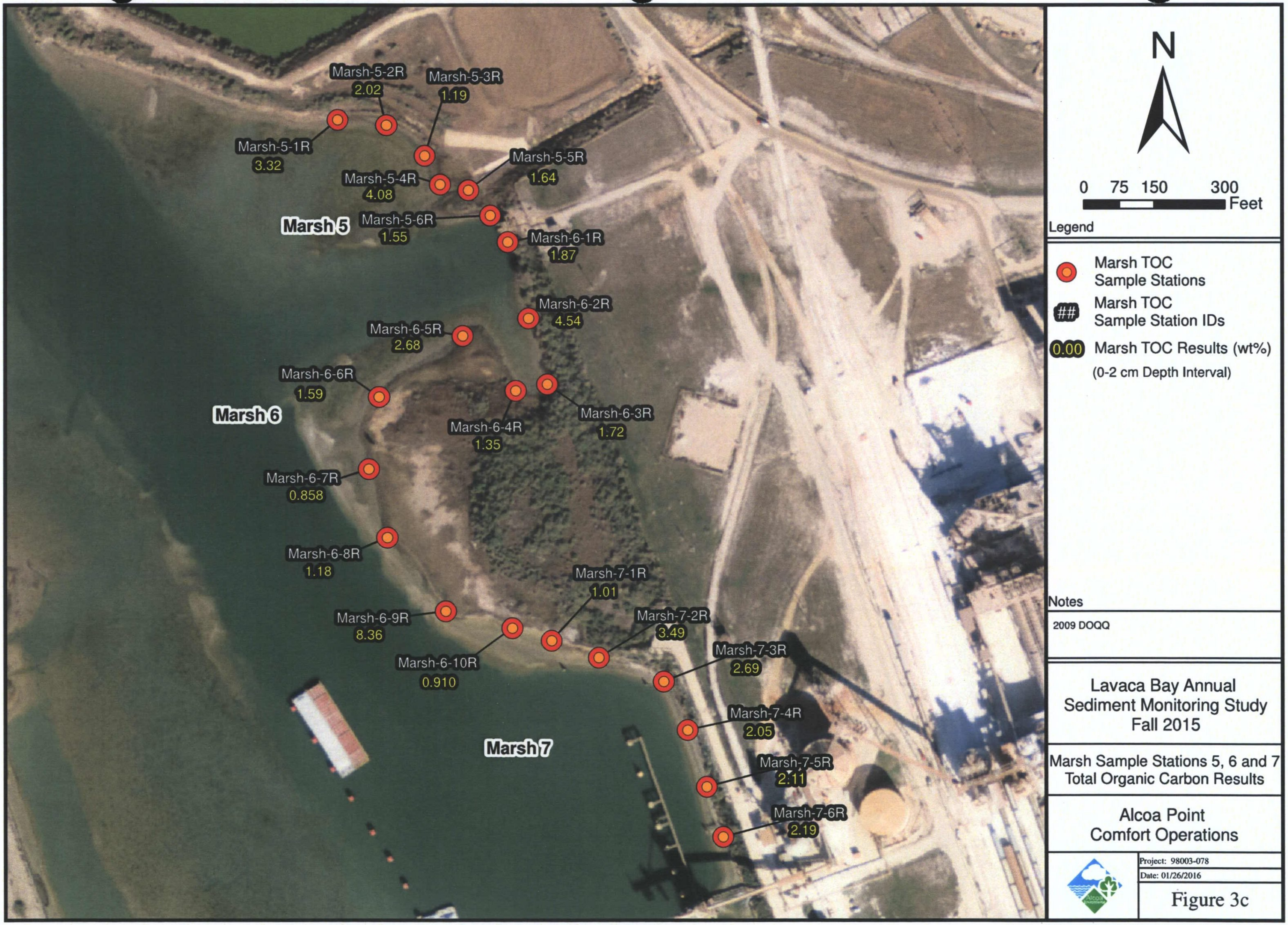
Alcoa Point Comfort Operations

Project: 98003-078

Date: 01/25/2016

Figure 3b

M:\98003\078\arc\Post-sampling\Marsh\marsh_15_stations567_Hg.mxd



M:\98003\078\arc\Post-sampling\Marsh\marsh_15_stations567_TOC.mxd

N

0 100 200 400 Feet

Legend

- Marsh Sample Stations
- ## Marsh Sample Station IDs
- 0.00 Marsh Total Hg Results (mg/kg- dry weight)

(0-2 cm Depth Interval)

Notes

2009 DOQQ

Lavaca Bay Annual Sediment Monitoring Study Fall 2015

Marsh Sample Stations 15 and 19 Total Hg Results

Alcoa Point Comfort Operations

Project: 98003-078

Date: 01/26/2016

Figure 4a

M:\98003\078\arc\Post-sampling\Marsh\marsh_15_stations1519_Hg

Legend

Marsh Methyl Hg Sample Stations

Marsh Methyl Hg Sample Station IDs

Marsh Methyl Hg Results (ng/g- dry weight)

(0-2 cm Depth Interval)

Notes

2009 DOQQ

Lavaca Bay Annual Sediment Monitoring Study Fall 2015

Marsh Sample Stations 15 and 19 Methyl Hg Results

Alcoa Point Comfort Operations

Project: 98003-078

Date: 01/26/2016

Figure 4b

M:\98003\078\arc\Post-sampling\Marsh\marsh_15_stations1519_MeHg.mxd

N

0 100 200 400 Feet

Legend

Marsh TOC Sample Stations

Marsh TOC Sample Station IDs

0.00 Marsh TOC Results (wt%) (0-2 cm Depth Interval)

Notes

2009 DOQQ

Lavaca Bay Annual Sediment Monitoring Study Fall 2015

Marsh Sample Stations 15 and 19 Total Organic Carbon Results

Alcoa Point Comfort Operations

Project: 98003-078

Date: 01/26/2016

Figure 4c

M:\98003\078\arc\Post-sampling\Marsh\marsh_15_stations1519_TOC.mxd

TABLES

Table 1 - 2015 Open Water Sediment Stations, Sample IDs, Field Data, and Results

Station ID	GPS Waypoint	Easting[1]	Northing[1]	Sample ID	Date	Time	Water Depth[2] (ft)	Total Hg			
								% M	(mg/kg) dry wt	SQL[3] (mg/kg)	Flag
SMP0042	0009	2749200.86	13430030.21	B12b-SE-17500	12/17/2015	8:15	6.7	44.1	0.0694	0.000852	
STO0130	0010	2749531.69	13429823.33	B12b-SE-17501	12/17/2015	8:24	6.1	33.5	0.0621	0.000728	
SMP0044	0011	2749335.29	13429051.54	B12b-SE-17502	12/17/2015	8:25	5.6	35.9	0.0970	0.000769	
STO0164	0012	2748795.16	13428987.77	B12b-SE-17503	12/17/2015	8:31	4.8	52.8	0.0861	0.00103	
SUP0075	0013	2748941.10	13429502.55	B12b-SE-17504	12/17/2015	8:42	2.9	32.4	0.0919	0.000701	
LVB0911	0014	2748593.50	13429629.96	B12b-SE-17505	12/17/2015	8:50	1.6	38.1	0.244	0.000807	
SUP0073	0015	2748648.32	13430035.97	B12b-SE-17506	12/17/2015	10:31	4.1	33.5	0.299	0.000738	
SDO0189	0016	2748395.59	13430139.81	B12b-SE-17507	12/17/2015	10:38	3.1	24.6	0.149	0.000638	
SMP0038	0017	2748145.75	13430569.17	B12b-SE-17508	12/17/2015	10:41	4.6	48.2	0.127	0.000926	
STO0151	0018	2748587.87	13430560.96	B12b-SE-17509	12/17/2015	10:45	5.2	42.9	0.114	0.000845	
SMP0036	0019	2749439.61	13430568.08	B12b-SE-17510	12/17/2015	10:56	5.8	28.3	0.0536	0.000668	
STO0113	0020	2749011.51	13430781.96	B12b-SE-17511	12/17/2015	11:00	6.6	31.6	0.0535	0.000714	
SMP0026	0021	2748169.38	13431094.44	B12b-SE-17513	12/17/2015	11:13	5.8	35.3	0.0483	0.000732	
STO0128	0022	2747742.91	13432103.17	B12b-SE-17514	12/17/2015	11:18	5.6	42.7	0.0896	0.000836	
SMP0028	0023	2748607.87	13431857.64	B12b-SE-17515	12/17/2015	11:22	5.5	54.4	0.173	0.00105	
STO0162	0024	2748615.34	13432745.81	B12b-SE-17516	12/17/2015	12:16	3.1	43.1	0.196	0.000888	
LVB0909	0025	2747605.63	13430450.37	B12b-SE-17517	12/17/2015	12:22	1.9	21.8	0.0910	0.000611	
SMP0031	0026	2747547.60	13430781.79	B12b-SE-17518	12/17/2015	12:30	1.3	53.2	0.218	0.00106	
SUP0107	0027	2747372.29	13430966.19	B12b-SE-17519	12/17/2015	12:35	1.4	28.5	0.429	0.000686	
SUP0106	0028	2747781.79	13431342.20	B12b-SE-17520	12/17/2015	12:40	2.9	23.3	0.120	0.000639	
STO0191	0029	2747160.63	13431354.75	B12b-SE-17521	12/17/2015	12:51	4.4	39.8	0.113	0.000800	
SMP0020	0030	2746947.20	13432175.66	B12b-SE-17522	12/17/2015	13:00	4.8	31.3	0.187	0.000707	
STO0153	0031	2746129.94	13433001.54	B12b-SE-17523	12/17/2015	13:08	5.4	52.7	0.232	0.00101	
SMP0018	0032	2746970.86	13432895.74	B12b-SE-17525	12/17/2015	13:12	5.7	27.8	0.0853	0.000680	
SMP0012	0033	2747351.63	13432646.53	B12b-SE-17526	12/17/2015	13:19	4.9	34.4	0.114	0.000731	
STO0160	0034	2746968.05	13433785.10	B12b-SE-17527	12/17/2015	13:23	4.6	38.4	0.151	0.000774	
SUP0014	0035	2746196.35	13433677.88	B12b-SE-17528	12/17/2015	13:29	4.4	54.8	0.248	0.00108	
SMP0007	0036	2745313.61	13433638.49	B12b-SE-17529	12/17/2015	13:35	4.1	28.7	0.105	0.000688	
LVB0901	0037	2744474.67	13432733.48	B12b-SE-17530	12/17/2015	13:40	4.3	27.0	0.0870	0.000664	
LVB0902	0038	2745305.28	13432877.66	B12b-SE-17531	12/17/2015	13:46	3.1	30.8	0.0792	0.000688	
SMP0004	0039	2746167.74	13432096.81	B12b-SE-17532	12/17/2015	15:17	3.0	31.1	0.146	0.000687	
STO0201	0040	2745334.91	13432210.68	B12b-SE-17533	12/17/2015	15:22	2.9	28.7	0.149	0.000676	
SUP0016	0041	2744486.64	13432073.20	B12b-SE-17534	12/17/2015	15:32	3.1	44.5	0.252	0.000880	
SMP0009	0042	2743672.59	13431298.85	B12b-SE-17535	12/17/2015	15:40	3.2	55.5	0.330	0.00111	

Table 1 - 2015 Open Water Sediment Stations, Sample IDs, Field Data, and Results

Station ID	GPS Waypoint	Easting[1]	Northing[1]	Sample ID	Date	Time	Water Depth[2] (ft)	Total Hg % M	Total Hg (mg/kg) dry wt	Total Hg SQL[3] (mg/kg)	Total Hg Flag
STO0193	0043	2744505.26	13431356.95	B12b-SE-17536	12/17/2015	15:55	3.4	45.7	0.246	0.000902	
STO0203	0044	2745309.97	13431274.39	B12b-SE-17537	12/17/2015	16:02	3.2	64.7	0.209	0.00134	
SUP0110	0045	2746126.55	13431348.44	B12b-SE-17538	12/17/2015	16:10	2.9	47.2	0.244	0.000890	
STO0218	0046	2746527.96	13431150.92	B12b-SE-17539	12/17/2015	16:15	2.2	46.9	0.236	0.000901	
LVB0907	0047	2746528.98	13430928.08	B12b-SE-17540	12/17/2015	16:22	2.8	56.3	0.230	0.00110	
LVB0908	0048	2746774.86	13430789.43	B12b-SE-17541	12/17/2015	16:41	7.5	67.5	0.244	0.00149	
SUP0053	0049	2746297.71	13430378.99	B12b-SE-17542	12/17/2015	16:50	7.2	70.2	0.276	0.00165	
LVB0904	0050	2745320.36	13430539.40	B12b-SE-17543	12/18/2015	8:20	6.4	73.5	0.290	0.00181	
SMP0017	0051	2744495.74	13430468.31	B12b-SE-17544	12/18/2015	8:30	7.2	67.8	0.280	0.00147	
SMP0016	0052	2743623.74	13430526.06	B12b-SE-17545	12/18/2015	9:00	3.4	65.2	0.311	0.00144	
SUP0119	0053	2743043.63	13430414.70	B12b-SE-17546	12/18/2015	9:10	5.6	60.1	0.202	0.00119	
SUP0020	0054	2742849.02	13429669.81	B12b-SE-17547	12/18/2015	9:15	2.8	50.7	0.129	0.000976	
SMP0021	0055	2743574.91	13429839.19	B12b-SE-17548	12/18/2015	9:25	2.8	57.2	0.328	0.00117	
STO0223	0056	2744457.18	13429687.10	B12b-SE-17549	12/18/2015	9:40	7.4	60.2	0.208	0.00120	
SUP0122	0057	2745302.71	13429635.11	B12b-SE-17550	12/18/2015	9:50	2.4	42.7	0.264	0.000856	
SUP0043	0058	2746112.46	13429689.11	B12b-SE-17551	12/18/2015	10:30	1.8	55.0	0.424	0.00109	
SUP0129	0059	2746117.71	13429148.04	B12b-SE-17552	12/18/2015	10:45	3.4	46.1	0.456	0.000937	
SMP0040	0060	2746232.25	13429010.74	B12b-SE-17554	12/18/2015	11:00	1.6	46.7	0.482	0.000938	
SUP0132	0061	2746020.38	13428832.35	B12b-SE-17555	12/18/2015	11:10	2.6	41.9	0.220	0.000876	
SUP0047	0062	2745309.20	13428885.38	B12b-SE-17556	12/18/2015	11:20	2.8	52.3	0.277	0.00102	
SMP0048	0064	2744487.57	13428816.18	B12b-SE-17557	12/18/2015	11:30	6.6	53.2	2.88	0.0106	
SMP0041	0065	2743673.59	13428870.13	B12b-SE-17558	12/18/2015	11:50	1.8	33.8	0.161	0.000754	
LVB0917	0066	2742870.60	13428813.27	B12b-SE-17559	12/18/2015	12:00	1.3	26.7	0.263	0.000659	
SMP0049	0087	2750159.69	13428611.01	B12b-SE-16753	12/30/2015	9:25	13.3	69.0	0.340	0.000470	

[1]Coordinates reported in NAD 1983 State Plane Texas South Central, Feet

[2] Water Depths are not calibrated to tidal level

[3]SQL - Sample Quantitation Limit

Table 2 - 2015 Marsh Sediment Stations, Sample IDs, and Results

Habitat	Station ID	Sample ID	Date	Total Hg				Methyl Hg			TOC	
				% M	(mg/kg) dry wt	SQL (mg/kg)	Flag	% M	(ng/g) dry wt	Flag	% M	(wt%) dry wt
Marsh 1	Marsh-1-1R	B12b-SE-16800	11/10/2015	26.8	0.0722	0.000688		29.7	0.444		26.8	0.247
	Marsh-1-2R	B12b-SE-16803	11/10/2015	30.5	0.0632	0.000694		28.2	0.353		30.5	0.275
	Marsh-1-3R	B12b-SE-16804	11/10/2015	26.8	0.0566	0.000643		28.9	0.0688		26.8	0.229
	Marsh-1-4R	B12b-SE-16805	11/10/2015	25.1	0.0629	0.000646		31.1	0.149		25.1	0.150
	Marsh-1-5R	B12b-SE-16806	11/10/2015	31.0	0.0630	0.000681		26.6	0.0395		31.0	0.197
	Marsh-1-6R	B12b-SE-16807	11/10/2015	24.4	0.0643	0.000663		27.6	0.400		24.4	0.214
	Marsh-1-7R	B12b-SE-16808	11/10/2015	26.8	0.0646	0.000672		30.5	0.555		26.8	0.348
	Marsh-1-8R	B12b-SE-16809	11/10/2015	28.0	0.0585	0.000673		27.1	0.499		28.0	0.255
	Marsh-1-9R	B12b-SE-16810	11/10/2015	26.0	0.0605	0.000654		27.7	0.499		26.0	0.281
	Marsh-1-10R	B12b-SE-16811	11/10/2015	27.2	0.500	0.000650		27.3	0.450		27.2	0.589
	Marsh-1-11R	B12b-SE-16812	11/10/2015	24.5	0.0312	0.000650		27.6	0.417		24.5	0.223
	Marsh-1-12R	B12b-SE-16815	11/10/2015	19.8	0.0626	0.000614		27.8	0.460		19.8	3.32
					0.0966				**0.361**			**0.527**
Marsh 2	Marsh-2-1R	B12b-SE-16818	11/10/2015	31.3	0.0121	0.000692		36.3	0.159		31.3	0.646
	Marsh-2-2R	B12b-SE-16816	11/10/2015	35.4	0.0394	0.000746		35.9	0.628		35.4	0.910
	Marsh-2-3R	B12b-SE-16817	11/10/2015	32.6	0.0490	0.000734		38.2	0.655		32.6	0.811
	Marsh-2-4R	B12b-SE-16819	11/10/2015	28.6	0.0384	0.000682		29.8	0.592		28.6	0.555
	Marsh-2-5R	B12b-SE-16820	11/10/2015	29.7	0.0504	0.000682		30.0	0.659		29.7	0.372
	Marsh-2-6R	B12b-SE-16823	11/10/2015	26.3	0.0206	0.000650		28.4	0.288		26.3	0.283
					0.0350				**0.497**			**0.596**
Marsh 3	Marsh-3-1R	B12b-SE-16824	11/10/2015	23.8	0.0369	0.000629		34.8	0.914		23.8	1.07
	Marsh-3-2R	B12b-SE-16827	11/10/2015	33.1	0.0368	0.000733		35.3	0.420		33.1	0.616
	Marsh-3-3R	B12b-SE-16828	11/10/2015	44.0	0.0587	0.000851		46.7	1.04		44.0	1.86
	Marsh-3-4R	B12b-SE-16829	11/10/2015	30.6	0.0286	0.000702	J	31.9	0.461		30.6	1.46
	Marsh-3-5R	B12b-SE-16830	11/10/2015	37.9	0.167	0.000781		35.0	0.747		37.9	3.30
	Marsh-3-6R	B12b-SE-16831	11/10/2015	20.3	0.0399	0.000616		23.2	0.186		20.3	4.19
					0.0613				**0.628**			**2.083**
Marsh 5	Marsh-5-1R	B12b-SE-16832	11/10/2015	30.1	0.148	0.000702		33.4	0.769		30.1	3.23
	Marsh-5-2R	B12b-SE-16835	11/10/2015	29.5	0.144	0.000689		36.3	1.10		29.5	2.02
	Marsh-5-3R	B12b-SE-16836	11/10/2015	38.4	0.183	0.000796		43.7	0.181		38.4	1.19
	Marsh-5-4R	B12b-SE-16837	11/10/2015	36.0	0.103	0.000774		45.3	1.05		36.0	4.08
	Marsh-5-5R	B12b-SE-16838	11/10/2015	36.4	0.110	0.000758		42.4	0.937		36.4	1.64
	Marsh-5-6R	B12b-SE-16841	11/10/2015	23.1	0.0539	0.000637		28.7	0.359		23.1	1.55
					0.1237				**0.733**			**2.285**

Table 2 - 2015 Marsh Sediment Stations, Sample IDs, and Results

Habitat	Station ID	Sample ID	Date	Total Hg % M	Total Hg (mg/kg) dry wt	Total Hg SQL (mg/kg)	Total Hg Flag	Methyl Hg % M	Methyl Hg (ng/g) dry wt	Methyl Hg Flag	TOC % M	TOC (wt%) dry wt
Marsh 6	Marsh-6-1R	B12b-SE-16842	11/10/2015	27.1	0.0621	0.000685		33.6	1.10		27.1	1.87
	Marsh-6-2R	B12b-SE-16843	11/10/2015	33.7	0.193	0.000733		37.0	1.25		33.7	4.54
	Marsh-6-3R	B12b-SE-16846	11/10/2015	58.5	0.202	0.00114	J-	55.1	1.71		58.5	1.72
	Marsh-6-4R	B12b-SE-16847	11/10/2015	44.0	0.0979	0.000884		49.4	0.798		44.0	1.35
	Marsh-6-5R	B12b-SE-16848	11/10/2015	50.9	0.354	0.00101		48.1	0.568		50.9	2.68
	Marsh-6-6R	B12b-SE-16851	11/10/2015	28.8	0.0939	0.000668		33.5	0.206		28.8	1.59
	Marsh-6-7R	B12b-SE-16852	11/10/2015	36.8	0.162	0.000800		44.3	1.34		36.8	0.858
	Marsh-6-8R	B12b-SE-16853	11/10/2015	31.7	0.126	0.000695		32.2	0.419		31.7	1.18
	Marsh-6-9R	B12b-SE-16854	11/10/2015	21.2	0.403	0.000625		21.7	0.737		21.2	8.36
	Marsh-6-10R	B12b-SE-16855	11/10/2015	31.2	0.0197	0.000693		36.5	0.276		31.2	0.910
					0.1714				**0.840**			**2.506**
Marsh 7	Marsh-7-1R	B12b-SE-16860	11/11/2015	32.0	0.0425	0.000712		34.0	0.190		32.0	1.01
	Marsh-7-2R	B12b-SE-16856	11/10/2015	39.5	0.632	0.000786		38.5	1.03		39.5	3.49
	Marsh-7-3R	B12b-SE-16871	11/11/2015	19.2	0.166	0.000601		25.7	0.473		19.2	2.69
	Marsh-7-4R	B12b-SE-16872	11/11/2015	18.0	0.0829	0.000592		17.5	0.186		18.0	2.05
	Marsh-7-5R	B12b-SE-16873	11/11/2015	31.5	0.137	0.000700		35.4	1.30		31.5	2.11
	Marsh-7-6R	B12b-SE-16874	11/11/2015	33.3	0.181	0.000749		37.7	0.496		33.3	2.19
					0.2069				**0.613**			**2.257**
Marsh 15	Marsh-15-1R	NA	NA	NA	NA	NA		NA	NA		NA	NA
	Marsh-15-2R	NA	NA	NA	NA	NA		NA	NA		NA	NA
	Marsh-15-3R	NA	NA	NA	NA	NA		NA	NA		NA	NA
	Marsh-15-4R	NA	NA	NA	NA	NA		NA	NA		NA	NA
	Marsh-15-5R	B12b-SE-16859	11/11/2015	30.0	0.0115	0.000582		27.9	0.0598		30.0	2.21
	Marsh-15-6R	NA	NA	NA	NA	NA		NA	NA		NA	NA
	Marsh-15-7R	NA	NA	NA	NA	NA		NA	NA		NA	NA
	Marsh-15-8R	NA	NA	NA	NA	NA		NA	NA		NA	NA
	Marsh-15-9R	B12b-SE-16857	11/11/2015	17.7	0.0127	0.000598	J-	24.2	0.0172	J	17.7	0.603
	Marsh-15-10R	B12b-SE-16858	11/11/2015	33.6	0.0326	0.000731		37.9	0.504		33.6	1.53
					0.0189				**0.194**			**1.448**
Marsh 19	Marsh-19-1R	B12b-SE-16866	11/11/2015	21.2	0.0839	0.000598		28.3	0.0737		21.2	3.53[3]
	Marsh-19-2R	B12b-SE-16863	11/11/2015	25.0	0.0306	0.000644		33.1	0.0100	U	25.0	2.54
	Marsh-19-3R	B12b-SE-16864	11/11/2015	37.9	1.74	0.00158		39.2	0.157		37.9	1.75
	Marsh-19-4R	B12b-SE-16865	11/11/2015	30.1	0.0430	0.000683		32.4	0.0845		30.1	1.62
	Marsh-19-5R	B12b-SE-16867	11/11/2015	23.6	0.0890	0.000628		24.1	0.0361	J	23.6	1.70
	Marsh-19-6R	B12b-SE-16868	11/11/2015	19.3	0.0728	0.000604		29.2	0.227		19.3	0.680
	Marsh-19-7R	B12b-SE-16869	11/11/2015	22.7	0.0909	0.000635		25.1	0.0980		22.7	0.613
	Marsh-19-8R	B12b-SE-16870	11/11/2015	15.0	0.0673	0.000570		20.4	0.0100	U	15.0	5.77
					0.2772				**0.087**			**2.275**

[1]Analytical results presented in dry weight.

[2]Analyte detected below quantitation limits.

[3]TOC was not detected in this sample, the result is shown as ½ the report limit and used to calculate the average TOC.

J - Analyte detected below quantitation limits.

J- Field duplicate criteria of 35% was not met, field duplicate was analyzed outside of max hold time

U - Analyzed but not detected above the MDL/SDL, Result recorded as Method Detection Limit

Table 3 – Figures Showing Open Water and Marsh Sediment Results

Study Area	Analyte	Figure ID
Open Water Stations	Total Hg	Figure 1a
Marshes 1, 2, and 3	Total Hg	Figure 2a
Marshes 1, 2, and 3	MeHg	Figure 2b
Marshes 1, 2, and 3	TOC	Figure 2c
Marshes 5, 6, and 7	Total Hg	Figure 3a
Marshes 5, 6, and 7	MeHg	Figure 3b
Marshes 5, 6, and 7	TOC	Figure 3c
Marshes 15 and 19	Total Hg	Figure 4a
Marshes 15 and 19	MeHg	Figure 4b
Marshes 15 and 19	TOC	Figure 4c

Appendix A2

Methylmercury Sediment Sampling in Open Waters

Study 2

March 2016

ALCOA

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

ALS	- ALS Laboratory Group/Laboratory
GPS	- Global Positioning System
Hg	- Mercury
ID	- Identification
OMMP	- Operation Maintenance and Monitoring Plan
RAAER	- Remedial Action Annual Effectiveness Report
RAO	- Remedial Action Objective
TOC	- Total Organic Carbon

1.0 INTRODUCTION

In accordance with Section 4.4 (Recommendations) of the 2014 Remedial Action Annual Effectiveness Report (RAAER), methylmercury analysis was conducted on annual open-water sediment samples north and east of Dredge Island. The work plan was submitted to the U.S. Environmental Protection Agency (USEPA) on September 18, 2015, (Alcoa 2015c) with approval received on September 25, 2015. Open-water sediment methylmercury data was collected to evaluate the methylmercury re-suspension/re-deposition pathway in the conceptual model and to update information on the potential for methylmercury uptake in the open-water areas north and east of Dredge Island. In addition, ten annual marsh sediment samples were collected in triplicate to confirm the accuracy and precision of methylmercury analysis.

1.1 PURPOSE AND SCOPE

The voluntary open-water sediment monitoring program in 2015 consisted of a single surface sediment sample collected from each of the 58 stations shown in Figure 1. The top 2 cm of sediment were subsampled from an Ekman grab sampler and routinely analyzed for total mercury. For this supplemental study, methylmercury and total organic carbon (TOC) analyses were added to the 28 of the 58 open-water samples collected, as shown in Figure 1. These locations were chosen because they are upwind of most of the shoreline marshes, are relatively close to the marshes, and had elevated methylmercury concentrations based on the 2012 monitoring data.

In addition, ten marsh sediment locations were split into triplicate samples and submitted to the analytical laboratory as blind field duplicates (Figure 2). The field duplicates allow the assessment of the total variance in methylmercury results due to sampling and analysis.

1.2 SITE DESCRIPTION

Alcoa Point Comfort Operations is located in Calhoun County, Texas, adjacent to Lavaca Bay. The area in the bay adjacent to the Alcoa Plant is associated with elevated mercury concentrations in fish tissue and is closed to the taking of finfish and shellfish for consumption by order of the Texas Department of Health. This area is referred to as the Closed Area. The Remedial Investigation identified the Closed Area as an area where open water and marsh sediment contains elevated mercury concentrations. The study area and sampling strategy for the open-water sediment samples and marsh sediment samples within the closed area are documented in the OMMP.

2.0 METHODS

Sediment samples for the 2015 annual sediment monitoring study were collected and processed by Benchmark Ecological Services, Inc. (Benchmark). Open water and marsh sediment sample methods and sample dates are provided in the *Lavaca Bay Annual Sediment Monitoring Study Fall 2015* (March 2016) report. Benchmark collected additional sediment from 28 open-water sample stations shown in Figure 1 for methylmercury and TOC analysis while conducting the annual monitoring study.

Triplicate sediment samples were collected and analyzed for methylmercury from the following marsh sample stations: Marsh 1-1R, 1-11R, 2-5R, 3-1R, 5-1R, 5-5R, 6-2R, 6-5R, 7-1R, and 7-6R. Triplicate samples were collected and processed while conducting the annual monitoring study.

Methylmercury was analyzed by Battelle Marine Sciences Laboratory (Battelle) in Sequim, Washington, and TOC was analyzed by ALS Laboratory Group (ALS) in Houston, Texas. Validation and evaluation of the analytical results was conducted by Environmental Chemistry Services, Inc., in Houston, Texas.

2.1 SAMPLE STATIONS

Sample stations were located using coordinates provided by Alcoa. The coordinates were entered into a sub-meter Global Positioning System (GPS), and the GPS was used to position personnel over the sample station. Actual coordinates for the final sample station locations were recorded using the sub-meter differential GPS. The 28 open water methylmercury and TOC sediment sample station locations are shown in Figure 1, and the 10 methylmercury triplicate marsh sediment stations are shown in Figure 2.

2.2 SAMPLE COLLECTION

Open water sediment samples were collected with an Eckman sampler and processed from the sediment surface down 2 cm as described in Section 2.2 of the *Lavaca Bay Annual Sediment Monitoring Study Fall 2015* (March 2016) report.

The top 2 cm of sediment from the ten marsh sample stations were collected using pre-cleaned 6-inch-long polycarbonate core tubes and processed from the sediment surface down 2 cm as described in Section 2.2 of the *Lavaca Bay Annual Sediment Monitoring Study Fall 2015* (March 2016) report.

3.0 ANALYTICAL RESULTS

Sediment samples from open water stations and marsh stations were analyzed for methylmercury by Battelle in Sequim, Washington, and TOC samples from open water sample stations were analyzed by ALS in Houston, Texas. Methylmercury results were reported in ng/g as dry weight, and TOC results were reported in wt% dry weight. Benchmark received all final data packets from ALS Laboratory on 8 February 2016. Data validation and evaluation was completed by Environmental Chemistry Services on 19 February 2016.

Open-water sediment station numbers, sample IDs, and analytical results are listed for each sample in Table 1 and shown in Figure 1. Marsh sediment station numbers sampled in triplicate, sample identification numbers, and analytical results are listed in Table 2 and shown in Figure 2.

Analytical results for sediment samples were validated according to the Standard Operating Procedure Data Validation (Appendix E) in the Quality Assurance Project Plan Alcoa (Point Comfort)/Lavaca Bay Superfund Site (22 August 2005). All analytical results were validated and may be included in the data used to evaluate the effectiveness of the approved remedy and to meet monitoring requirements specified in the Consent Decree.

FIGURES

N

0 530 1,060 Feet

Legend

- Open Water Methyl Hg Sample Stations
- ### Open Water Sample Station IDs
- 0.00 Open Water Methyl Hg Results (ng/g- dry weight)
- 0.00 Open Water TOC Results (% - dry weight)
- Methyl Hg Boundary

(0-2 cm Depth Interval)

Notes

2009 DOQQ

Lavaca Bay Annual Sediment Monitoring Study Fall 2015

Open Water Sample Stations Methylmercury and TOC Results

Alcoa Point Comfort Operations

Project: 98003-080

Date: 03/08/2016

Figure 1

M:\98003\080\rep\Study 2\Figure 1.mxd

M:\98003\080\arc\Figure 2.mxd

TABLES

Table 1 - Open Water Sediment Stations, Sample IDs, Field Data, and MeHg Results

Station ID	GPS Waypoint	Easting[1]	Northing[1]	Sample ID	Date	Time	Water Depth[2] (ft)	Total Hg				Methyl Hg			TOC	
								% M	(mg/Kg) dry wt	SQL[3] (mg/kg)	Flag	% M	(ng/g) dry wt	Flag	% M	(wt%) dry wt
SMP0004	0039	2746167.74	13432096.81	B12b-SE-17532	12/17/2015	15:17	3.0	31.1	0.146	0.00069		31.9	0.330		31.1	0.455
STO0201	0040	2745334.91	13432210.68	B12b-SE-17533	12/17/2015	15:22	2.9	28.7	0.149	0.00068		34.8	0.166		28.7	0.223
SUP0016	0041	2744486.64	13432073.20	B12b-SE-17534	12/17/2015	15:32	3.1	44.5	0.252	0.000880		53.0	1.05		44.5	1.28
SMP0009	0042	2743672.59	13431298.85	B12b-SE-17535	12/17/2015	15:40	3.2	55.5	0.330	0.00111		57.6	0.962		55.5	0.882
STO0193	0043	2744505.26	13431356.95	B12b-SE-17536	12/17/2015	15:55	3.4	45.7	0.246	0.0009		50.2	0.783		45.7	0.651
STO0203	0044	2745309.97	13431274.39	B12b-SE-17537	12/17/2015	16:02	3.2	64.7	0.209	0.00134		55.4	0.791		64.7	1.42
SUP0110	0045	2746126.55	13431348.44	B12b-SE-17538	12/17/2015	16:10	2.9	47.2	0.244	0.000890		48.6	U	U	47.2	0.843
STO0218	0046	2746527.96	13431150.92	B12b-SE-17539	12/17/2015	16:15	2.2	46.9	0.236	0.0009		46.8	0.0642		46.9	0.686
LVB0907	0047	2746528.98	13430928.08	B12b-SE-17540	12/17/2015	16:22	2.8	56.3	0.230	0.00110		58.7	0.686		56.3	0.678
LVB0908	0048	2746774.86	13430789.43	B12b-SE-17541	12/17/2015	16:41	7.5	67.5	0.244	0.00149		62.1	0.788		67.5	0.854
SUP0053	0049	2746297.71	13430378.99	B12b-SE-17542	12/17/2015	16:50	7.2	70.2	0.276	0.00165		63.9	0.922		70.2	0.740
LVB0904	0050	2745320.36	13430539.40	B12b-SE-17543	12/18/2015	8:20	6.4	73.5	0.290	0.00181		64.3	2.78		73.5	1.10
SMP0017	0051	2744495.74	13430468.31	B12b-SE-17544	12/18/2015	8:30	7.2	67.8	0.280	0.00147		57.9	0.255		67.8	0.906
SMP0016	0052	2743623.74	13430526.06	B12b-SE-17545	12/18/2015	9:00	3.4	65.2	0.311	0.00144		62.0	2.37		65.2	0.987
SUP0119	0053	2743043.63	13430414.70	B12b-SE-17546	12/18/2015	9:10	5.6	60.1	0.202	0.00119		58.6	0.590		60.1	0.712
SUP0020	0054	2742849.02	13429669.81	B12b-SE-17547	12/18/2015	9:15	2.8	50.7	0.129	0.00098		52.3	0.452		50.7	1.13
SMP0021	0055	2743574.91	13429839.19	B12b-SE-17548	12/18/2015	9:25	2.8	57.2	0.328	0.00117		57.5	0.0659		57.2	0.855
STO0223	0056	2744457.18	13429687.10	B12b-SE-17549	12/18/2015	9:40	7.4	60.2	0.208	0.00120		60.9	0.104		60.2	0.737
SUP0122	0057	2745302.71	13429635.11	B12b-SE-17550	12/18/2015	9:50	2.4	42.7	0.264	0.00086		38.7	0.108		42.7	0.577
SUP0043	0058	2746112.46	13429689.11	B12b-SE-17551	12/18/2015	10:30	1.8	55.0	0.424	0.00109		52.0	0.635		55.0	0.657
SUP0129	0059	2746117.71	13429148.04	B12b-SE-17552	12/18/2015	10:45	3.4	46.1	0.456	0.00094		48.1	0.0749		46.1	0.562
SMP0040	0060	2746232.25	13429010.74	B12b-SE-17554	12/18/2015	11:00	1.6	46.7	0.482	0.00094		40.0	0.0719		46.7	0.288
SUP0132	0061	2746020.38	13428832.35	B12b-SE-17555	12/18/2015	11:10	2.6	41.9	0.220	0.00088		56.4	0.603		41.9	1.85
SUP0047	0062	2745309.20	13428885.38	B12b-SE-17556	12/18/2015	11:20	2.8	52.3	0.277	0.00102		54.5	0.805		52.3	0.485
SMP0048	0064	2744487.57	13428816.18	B12b-SE-17557	12/18/2015	11:30	6.6	53.2	2.88	0.0106		48.5	0.596		53.2	1.02
SMP0041	0065	2743673.59	13428870.13	B12b-SE-17558	12/18/2015	11:50	1.8	33.8	0.161	0.00075		28.7	0.195		33.8	1.19
LVB0917	0066	2742870.60	13428813.27	B12b-SE-17559	12/18/2015	12:00	1.3	26.7	0.263	0.00066		27.5	0.298		26.7	0.495
SMP0049	0087	2750159.69	13428611.01	B12b-SE-16753	12/30/2015	9:25	13.3	69.0	0.340	0.000470		61.2	0.505		69.0	1.13

[1] Coordinates reported in NAD 1983 State Plane Texas South Central, Feet

[2] Water Depths are not calibrated to tidal level

[3] SQL - Sample Quantitation Limit

U - Analyzed but not detected above the MDL/SDL

Table 2 - Marsh Sediment MeHg Triplicate Results

Sample ID	Station ID	Date	Time	Percent Moisture	MeHg (ng/g) dry wt)
B12b-SE-16800	Marsh-1-1R	11/10/2015	09:10	29.7	0.444
B12b-SE-16801			09:15	28.8	0.472
B12b-SE-16802			09:20	27.4	0.334
B12b-SE-16812	Marsh-1-11R	11/10/2015	11:10	27.6	0.417
B12b-SE-16813			11:15	29.2	0.712
B12b-SE-16814			11:20	29.6	0.571
B12b-SE-16820	Marsh-2-5R	11/10/2015	12:55	30.0	0.659
B12b-SE-16821			13:00	33.3	0.877
B12b-SE-16822			13:05	29.3	0.301
B12b-SE-16824	Marsh-3-1R	11/10/2015	13:40	34.8	0.914
B12b-SE-16825			13:45	32.9	0.976
B12b-SE-16826			13:50	34.9	0.862
B12b-SE-16832	Marsh-5-1R	11/10/2015	14:50	33.4	0.769
B12b-SE-16833			15:00	34.1	1.02
B12b-SE-16834			15:05	33.0	0.752
B12b-SE-16838	Marsh-5-5R	11/10/2015	15:14	42.4	0.937
B12b-SE-16839			15:17	42.0	1.06
B12b-SE-16840			15:19	39.4	0.927
B12b-SE-16843	Marsh-6-2R	11/10/2015	15:35	37.0	1.25
B12b-SE-16844			15:37	36.2	1.21
B12b-SE-16845			15:39	38.3	1.11
B12b-SE-16848	Marsh-6-5R	11/10/2015	16:00	48.1	0.568
B12b-SE-16849			16:05	52.7	0.764
B12b-SE-16850			16:10	46.4	0.599
B12b-SE-16860	Marsh-7-1R	11/11/2015	09:00	34.0	0.190
B12b-SE-16861			09:05	34.1	0.148
B12b-SE-16862			09:10	34.1	0.147
B12b-SE-16874	Marsh-7-6R	11/11/2015	11:25	37.7	0.496
B12b-SE-16875			11:30	36.6	0.609
B12b-SE-16876			11:35	34.4	0.428
Average Value				**35.4**	**0.684**

Appendix A3

Additional Open Water Sediment Sampling

Study 6

March 2016

ALCOA

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

ALS	- ALS Laboratory Group/Laboratory
DGPS	- Differential Global Positioning System
ID	- Identification
OMMP	- Operation Maintenance and Monitoring Plan
RAAER	- Remedial Action Annual Effectiveness Report
RAO	- Remedial Action Objective

1.0 INTRODUCTION

In accordance with Section 4.4 (Recommendations) of the 2014 Remedial Action Annual Effectiveness Report (RAAER), sediment cores were collected from six sample stations and processed for Total mercury, methylmercury, and total organic carbon (TOC). The work plan was submitted to the U.S. Environmental Protection Agency (USEPA) on September 18, 2015, (Alcoa 2015c) with responses to USEPA comments submitted on October 5, 2015 (Alcoa 2015d). The study received approval from the USEPA on October 8, 2015. Cores collected in 2007 within the Witco Channel near Mainland Shoreline Area No. 3 had elevated mercury concentrations at depth. These concentrations are notable because they could be associated with sediments that accumulated after the December 2001 to January 2002 dredging of the channel, and relatively low post-dredge concentrations would be expected throughout this area based on surface sediment mercury concentrations.

1.1 PURPOSE AND SCOPE

Supplemental Study 6 included the collection of sediment cores at six locations shown in Figure 1. This study was conducted to update the understanding of current mercury concentrations in surficial and at-depth sediments in the Witco and Alcoa channels in the vicinity of Mainland Shoreline Area No. 3 and the Witco area. These data will provide information to better understand whether there may be an ongoing source of mercury in this area.

Sample collection protocol was identical to the methods used in the Remedial Investigation (RI) Phase 2 detailed mercury core study. A core tube was pushed through the sediment down to resistance or 100 cm (whichever was encountered first) at each of the six sample stations. The cores were processed into the following intervals: 0 to 2 cm, 2 to 15 cm, 15 to 30 cm, 30 to 45 cm, 45 to 60 cm, 60 to 75 cm, 75 to 90 cm, and 90 to 100 cm. Sediment samples were analyzed for total mercury, methylmercury, and TOC.

This document presents a summary of sampling and analytical methods and the results of the 2015 Supplemental Sediment Monitoring Study 6.

1.2 SITE DESCRIPTION

Alcoa Point Comfort Operations is located in Calhoun County, Texas, adjacent to Lavaca Bay. The area in the bay adjacent to the Alcoa Plant is associated with elevated mercury concentrations in fish tissue and is closed to the taking of finfish and shellfish for consumption by order of the Texas Department of Health. This area is referred to as the Closed Area. The Remedial Investigation identified the Closed Area as an area where open water and marsh sediment contains elevated mercury concentrations. The supplementary sediment collection occurred in this area directly adjacent to Mainland Shoreline No. 3.

2.0 METHODS

Sediment samples for the 2015 Supplemental Sediment Monitoring Study 6 sediment monitoring were collected and processed by Benchmark Ecological Services, Inc. (Benchmark). Samples collected for total mercury and TOC were analyzed by ALS Laboratory Group (ALS) in Houston, Texas. Samples collected for methylmercury were analyzed by Battelle Marine Sciences Laboratory (Battelle) in Sequim, Washington. Samples were collected on 21 December 2015 and 22 December 2015. Sediment samples from 0–2 cm, 2–15 cm, 15–30 cm, 30–45 cm, 45–60 cm, 60–75 cm, 75–90 cm, and 90–100 cm of sediment were analyzed for methylmercury, Total mercury, and TOC. Validation and evaluation of the analytical results was conducted by Environmental Chemistry Services, Inc., in Houston, Texas.

2.1 SAMPLE STATIONS

Sample stations were located using coordinates agreed upon by Alcoa prior to conducting the field study. The coordinates were entered into a sub-meter Differential Global Positioning System (DGPS), and the DGPS was used to position personnel over the sample station. Actual coordinates for the final sample station locations were recorded using the sub-meter precision satellite receiver. Sediment sample station locations are shown in Figure 1.

2.2 SAMPLE COLLECTION

Sediment samples were collected using pre-cleaned polycarbonate core tubes. Following sample collection, the samples were processed on board the sampling vessel. The sediment was extruded from the core tubes and processed into the sample cuts listed in Section 2.0. Methylmercury samples were removed directly from the core, placed in sample jars, and placed in an insulated cooler with dry ice. Sediment samples for total mercury and TOC analysis were placed in pre-cleaned stainless steel bowls, homogenized, placed in sample jars, and stored in an insulated cooler with ice. Total mercury and TOC were analyzed by ALS Laboratory in Houston, Texas. Methylmercury was analyzed by Battelle Laboratory in Sequim, Washington.

Sample containers were labeled with the sample ID, station ID, collection date, time, and intended analysis. These containers were placed in re-sealable plastic bags, bubble wrapped, and immediately placed in an insulated chest for storage and transport. Sediment samples designated for total mercury and TOC were hand-delivered to the ALS Laboratory in Houston for analysis. Methylmercury samples were frozen in insulated chests with dry ice and shipped overnight to Battelle Laboratory in Sequim.

Sample station coordinates, sample IDs, and sample collection dates for the open water stations are listed in Table 1. Sample station IDs, sample IDs, and sample collection dates for the marsh stations are listed in Table 2. A Chain of Custody form was completed for all samples collected.

3.0 ANALYTICAL RESULTS

Sediment samples were analyzed for methylmercury by Battelle in Sequim, Washington, and total mercury and TOC samples were analyzed by ALS in Houston, Texas. Methylmercury results were reported in ng/g, total mercury results were reported in mg/Kg, and TOC results were reported in wt%. All sediment results were reported based on dry weight. Benchmark received all final data packets from Battelle on 8 February 2016 and from ALS Laboratory on 21 January 2016. Data validation and evaluation was completed by Environmental Chemistry Services on 19 February 2016.

Sediment sample station numbers, sample IDs, analytical results, and percent moisture are listed for each sample in Table 1. Analytical results are shown in the Figure 1 and listed in Table 1.

Analytical results for sediment samples were validated according to the Standard Operating Procedure Data Validation (Appendix E) in the Quality Assurance Project Plan Alcoa (Point Comfort)/Lavaca Bay Superfund Site (22 August 2005). All analytical results were validated and may be included in the data used to evaluate the effectiveness of the approved remedy and to meet monitoring requirements specified in the Consent Decree.

FIGURES

LOC-5

Cut	Total Hg	Methyl Hg	TOC
0-2 cm	0.344	0.378	0.921
2-15 cm	0.396	0.298	0.684
15-30 cm	0.391	0.245	0.859
30-45 cm	0.381	0.362	0.725
45-60 cm	0.480	0.386	0.787
60-75 cm	0.488	0.148	0.944
75-90 cm	0.613	0.0867	0.686
90-100 cm	0.505	0.124	0.709

LOC-4

Cut	Total Hg	Methyl Hg	TOC
0-2 cm	0.413	0.816	0.820
2-15 cm	0.351	0.517	0.814
15-30 cm	0.417	0.149	0.628
30-45 cm	0.436	0.139	0.706
45-60 cm	0.471	0.0755	0.668
60-75 cm	0.504	0.0621	0.770
75-90 cm	0.546	0.0644	0.829
90-100 cm	0.514	0.0295	0.505

LOC-2

Cut	Total Hg	Methyl Hg	TOC
0-2 cm	0.272	0.857	1.07
2-15 cm	0.301	0.406	0.772
15-30 cm	0.359	0.243	0.831
30-45 cm	0.354	0.269	0.655
45-60 cm	0.547	0.239	0.698
60-75 cm	0.455	0.179	0.714
75-90 cm	0.946	0.374	0.559
90-99 cm	1.16	0.422	0.876

LOC-3

Cut	Total Hg	Methyl Hg	TOC
0-2 cm	0.369	0.457	0.912
2-15 cm	0.493	0.358	0.771
15-30 cm	0.497	0.144	0.731
30-45 cm	0.643	0.269	0.739
45-60 cm	1.12	0.570	0.656
60-75 cm	1.67	0.263	0.726
75-90 cm	1.45	0.209	0.666
90-100 cm	1.47	0.100	0.744

LOC-6

Cut	Total Hg	Methyl Hg	TOC
0-2 cm	0.364	0.399	0.730
2-15 cm	0.384	0.255	0.747
15-30 cm	0.337	0.232	0.653
30-45 cm	0.726	0.291	0.737
45-60 cm	0.526	0.163	0.749

LOC-1

Cut	Total Hg	Methyl Hg	TOC
0-2 cm	0.250	0.193	0.649
2-15 cm	0.409	0.278	0.700
15-30 cm	0.377	0.156	0.671
30-45 cm	1.94	0.601	0.629

N

0 75 150 300 Feet

Legend

Sample Station

Sample Station ID

Units

Total Hg: mg/kg - dry wt

Methyl Hg: ng/g - dry wt

TOC: wt% - dry wt

Notes

2014 DOQQ

Lavaca Bay Supplemental Study 6 Fall 2015

Study 6 Sample Stations and Analytical Results

Alcoa Point Comfort Operations

Project: 98003-080

Date: 03/10/2016

Figure 1

M:\98003\080\arc\Study_6_Hg_results_030816

TABLES

Table 1 - Study 6 Sediment Stations, Sample IDs, Field Data, and Analytical Results

Station ID	GPS Waypoint	Easting[1]	Northing[1]	Date	Time	Water Depth[2] (ft)	Sample ID	Cut	Total Hg				Methyl Hg			TOC	
									% M	(mg/kg) dry wt	SQL[3] (mg/kg)	Flag	% M	(ng/g) dry wt	Flag	(wt%) dry wt	SQL[3] (wt%)
LOC-1	0071	2749110.97	13429985.9	12/21/2015	14:01	17.5	B12b-SE-17565	0-2 cm	60.4	0.250	0.00128		52.4	0.193		0.649	0.0600
							B12b-SE-17566	2-15 cm	60.5	0.409	0.00122		51.2	0.278		0.700	0.0600
							B12b-SE-17567	15-30 cm	54.2	0.377	0.00109		51.2	0.156		0.671	0.0600
							B12b-SE-17568	30-45 cm	50.5	1.94	0.00200		48.8	0.601		0.629	0.0600
LOC-2	0068	2748799.80	13430380.40	12/21/2015	13:25	14.4	B12b-SE-17569	0-2 cm	67.7	0.272	0.00149		59.2	0.857		1.07	0.0600
							B12b-SE-17570	2-15 cm	69.1	0.301	0.00163		57.4	0.406		0.772	0.0600
							B12b-SE-17571	15-30 cm	62.2	0.359	0.00130		53.8	0.243		0.831	0.0600
							B12b-SE-17572	30-45 cm	58.9	0.354	0.00122		52.7	0.269		0.655	0.0600
							B12b-SE-17573	45-60 cm	56.2	0.547	0.00111		53.8	0.239		0.698	0.0600
							B12b-SE-17574	60-75 cm	60.2	0.455	0.00126		52.8	0.179		0.714	0.0600
							B12b-SE-17575	75-90 cm	53.6	0.946	0.00106		48.4	0.374		0.559	0.0600
							B12b-SE-17576	90-99 cm	52.5	1.16	0.00106		50.6	0.422		0.876	0.0600
LOC-3	0067	2748965.23	13430626.33	12/21/2015	12:51	5.5	B12b-SE-17577	0-2 cm	64.2	0.369	0.00143		56.5	0.457		0.912	0.0600
							B12b-SE-17578	2-15 cm	59.6	0.493	0.00119		54.0	0.358		0.771	0.0600
							B12b-SE-17579	15-30 cm	55.1	0.497	0.00105		51.9	0.144		0.731	0.0600
							B12b-SE-17580	30-45 cm	55.1	0.643	0.00107		52.3	0.269		0.739	0.0600
							B12b-SE-17581	45-60 cm	56.1	1.12	0.00109		53.5	0.570		0.656	0.0600
							B12b-SE-17582	60-75 cm	54.8	1.67	0.00223		53.3	0.263		0.726	0.0600
							B12b-SE-17583	75-90 cm	55.2	1.45	0.00112		51.4	0.209		0.666	0.0600
							B12b-SE-17585	90-100 cm	57.0	1.47	0.00114		54.8	0.100		0.744	0.0600
LOC-4	0072	2748494.21	13430865.54	12/22/2015	8:30	13.6	B12b-SE-17591	0-2 cm	73.4	0.413	0.00180		63.9	0.816		0.820	0.0600
							B12b-SE-17592	2-15 cm	66.3	0.351	0.00141		56.6	0.517		0.814	0.0600
							B12b-SE-17593	15-30 cm	60.7	0.417	0.00120	J-	55.2	0.149		0.628	0.0600
							B12b-SE-17594	30-45 cm	59.3	0.436	0.00120		53.9	0.139		0.706	0.0600
							B12b-SE-17595	45-60 cm	55.2	0.471	0.00108		53.3	0.0755		0.668	0.0600
							B12b-SE-17596	60-75 cm	59.7	0.504	0.00117		55.5	0.0621		0.770	0.0600
							B12b-SE-17597	75-90 cm	60.5	0.546	0.00119		56.3	0.0644		0.829	0.0600
							B12b-SE-17598	90-100 cm	51.9	0.514	0.00100		49.6	0.0295	J	0.505	0.0600

Table 1 - Study 6 Sediment Stations, Sample IDs, Field Data, and Analytical Results

Station ID	GPS Waypoint	Easting[1]	Northing[1]	Date	Time	Water Depth[2] (ft)	Sample ID	Cut	Total Hg % M	Total Hg (mg/kg) dry wt	Total Hg SQL[3] (mg/kg)	Total Hg Flag	Methyl Hg % M	Methyl Hg (ng/g) dry wt	Methyl Hg Flag	TOC (wt%) dry wt	TOC SQL[3] (wt%)
LOC-5	0073	2748209.94	13431240.08	12/22/2015	8:57	13.3	B12b-SE-17599	0-2 cm	75.6	0.344	0.00199		61.5	0.378		0.921	0.0600
							B12b-SE-17600	2-15 cm	68.8	0.396	0.00160		56.8	0.298		0.684	0.0600
							B12b-SE-17601	15-30 cm	63.6	0.391	0.00131		57.4	0.245		0.859	0.0600
							B12b-SE-17602	30-45 cm	65.2	0.381	0.00142		55.9	0.362		0.725	0.0600
							B12b-SE-17603	45-60 cm	63.7	0.480	0.00139		55.3	0.386		0.787	0.0600
							B12b-SE-17605	60-75 cm	62.2	0.488	0.00126		54.7	0.148		0.944	0.0600
							B12b-SE-17606	75-90 cm	57.6	0.613	0.00114		52.4	0.0867		0.686	0.0600
							B12b-SE-17607	90-100 cm	58.9	0.505	0.00116		54.5	0.124		0.709	0.0600
LOC-6	0069	2749014.23	13430058.52	12/21/2015	13:35	16.5	B12b-SE-17586	0-2 cm	62.2	0.364	0.00127		53.1	0.399		0.730	0.0600
							B12b-SE-17587	2-15 cm	61.1	0.384	0.00126		53.0	0.255		0.747	0.0600
							B12b-SE-17588	15-30 cm	59.9	0.337	0.00119		53.6	0.232		0.653	0.0600
							B12b-SE-17589	30-45 cm	62.7	0.726	0.00136		55.1	0.291		0.737	0.0600
							B12b-SE-17590	45-60 cm	63.0	0.526	0.00128		55.8	0.163		0.749	0.0600

[1]Coordinates reported in NAD 1983 State Plane Texas South Central, Feet

[2] Water Depths are not calibrated to tidal level

[3]SQL - Sample Quantitation Limit

Appendix B1

Lavaca Bay Finfish and Shellfish Monitoring Report 2015

March 2016

ALCOA

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0 INTRODUCTION

The Consent Decree (March 2005) for the Lavaca Bay Superfund Site requires annual monitoring of finfish and shellfish for total mercury. This document describes the work undertaken in 2015 to fulfill this requirement.

1.1 PURPOSE AND SCOPE

The objective of the program is to monitor the recovery of mercury levels in finfish and shellfish. The monitoring data collected under this program are used to assess the effectiveness of remedial actions implemented at the Site. This document presents a summary of sampling and analytical methods and the results of the 2015 monitoring study. A detailed description of the methods and procedures for this study are presented in the Lavaca Bay Finfish and Shellfish Operations, Maintenance, and Monitoring Plan (OMMP, Appendix I of the Consent Decree March 2005).

1.2 SITE DESCRIPTION

The Alcoa Point Comfort Operations Plant is located in Calhoun County, Texas, adjacent to Lavaca Bay. An area in the bay adjacent to the Alcoa Plant is associated with elevated mercury concentrations in fish tissue and is closed to the taking of finfish and blue crabs for consumption by order of the Texas Department of Health. This area is referred to as the "Closed Area" and is delineated in the figures contained in this report. The monitoring area specified in the OMMP includes both the Closed Area and designated areas outside the Closed Area (termed the "Adjacent Open Area").

2.0 METHODS

Red drum and juvenile blue crab tissue samples for the 2015 Finfish and Blue Crab Monitoring Study were collected and processed by Benchmark Ecological Services, Inc., and analyzed by Battelle Marine Sciences Laboratory (Battelle) in Sequim, Washington. Samples were collected between 1 October 2015 and 29 December 2015. Validation and evaluation of the analytical results were conducted by Environmental Chemistry Services, Inc., in Houston, Texas.

2.1 SAMPLE STATIONS

A total of 30 red drum samples were collected from 12 stations inside the Closed Area (Figure 1), and 30 samples were collected from 10 stations outside the Closed Area (Adjacent Area) (Figure 2). A total of 30 juvenile blue crab composite samples were collected from 10 stations inside the Closed Area

(Figure 3). Thirty composite samples were collected from 10 stations outside the Closed Area (Adjacent Area) (Figure 4).

As described in the OMMP (p. 3-3), the objectives for selecting sample stations are to achieve equal geographic representation of the four quadrants (or zones) within the Closed Area. As also stated in the OMMP (p. 3-3), netting success will be variable, and stations from which samples are collected and the number of samples per station will vary. The actual numbers of stations sampled for red drum and juvenile blue crab during the 2015 monitoring event are shown for each of the four Closed Area zones in Figures 1 and 3, respectively. Table 1 shows the number of red drum and juvenile blue crab samples collected per zone.

The distribution of red drum samples ranged from 3 samples in Zone 1 to 14 samples in Zone 2. The number of juvenile blue crab samples ranged from 3 samples in Zones 1 and 3 (3 samples per zone) to 15 samples in Zone 2. The uneven distribution of samples among the zones was due to the uneven distribution of suitable habitat within the Zones.

The primary objective for the placement of both Adjacent Open Area and Closed Area monitoring stations was to achieve uniform distribution of stations within the sampling areas. The goal was to establish stations that would provide a geographically uniform distribution of samples (OMMP, p. 3-3). The general goal for both sampling areas was to collect approximately the same number of samples from 10 to 12 stations, distributed evenly over the sampling area. Whenever possible, red drum and juvenile blue crab samples were collected from the same stations.

2.2 SAMPLE COLLECTION

2.1.1 Red Drum

Red drum were collected from the Closed Area and Adjacent Open Area between 6 October 2015 and 29 December 2015. In the Closed Area, 30 red drum tissue samples were collected from the 12 sample stations shown in Figure 1. In the Adjacent Open Area, 30 red drum tissue samples were collected from the 10 sample stations shown on Figure 2. Sampling was conducted from a 20-foot aluminum boat. A Global Positioning System (GPS) was used to determine the positions of all sample stations.

Red drum specimens were collected using gill nets (6 ft. x 150 ft.) with 6-inch stretch mesh. Multiple nets (1–3) were set at each sample station in the evening, and the nets were allowed to fish over night.

The nets were retrieved the following morning, and the fish were removed. Gill nets were set at stations shown in Figures 1 and 2. Red drum with total lengths between 508 and 711 mm (20 to 28 inches) were removed from the gill nets, placed in plastic bags, and labeled with station identification (ID), date, and time. Labeled bags were immediately placed in an insulated box with ice for storage. Undersized and oversized red drum and specimens of other species were returned to the water.

The following information (at a minimum) was recorded on data sheets:

- Station ID
- Gear type
- Water depth
- Initials of field personnel
- Set date
- Set time
- End date
- End time
- List of photo log entries

2.1.2 Juvenile Blue Crab

Juvenile blue crabs were collected from the Closed Area and Adjacent Areas between 1 October 2015 and 13 October 2015. In the Closed Area, 30 blue crab tissue samples were collected from 10 historical monitoring stations (Figure 3). In the Adjacent Open Area, 30 blue crab tissue samples were collected from 10 sample stations (Figure 4). Sampling was conducted from a 20-foot aluminum boat. A GPS was used to determine the positions of all sample stations.

Juvenile blue crabs were collected using barrel-type minnow traps baited with commercial crab bait (Gulf menhaden and mullet). Traps were checked every 24 to 72 hours. Crabs were removed from the traps, inspected, and sorted by size in a clean sorting tray. Injured, dead, undersized, and oversized blue crabs, as well as by-catch, were returned to the water. Crabs that were between 25–75 mm in width were retained. Width is the distance between the tips of the primary lateral spines of the carapace. Crabs collected in the field were placed in resealable bags labeled with station ID, date, and collection time. Labeled bags were immediately placed in an insulated chest with ice. Data sheets were used to record the same sample site information listed above for finfish samples.

2.3 SAMPLE PROCESSING

2.3.1 Red Drum

Red drum samples were processed on the date of collection in the Alcoa Clean Lab (located at the Alcoa Point Comfort Facility) and remained on ice until processing was complete. Fish were weighed, measured, scaled, and rinsed with deionized (DI) water. Data were recorded on tissue processing data sheets and are listed in Table 2 (Closed Area specimens) and Table 3 (Adjacent Open Area specimens). After scaling, fish were placed in clean plastic bags and returned to cold storage until all fish were scaled.

In the Clean Lab, the fish were again rinsed with DI water and placed on pre-cleaned Teflon cutting boards. The right fillet (with skin) was removed with pre-cleaned, hexane-rinsed stainless steel fillet knives. The fillets were cut into small cubes, mixed, and weighed (in grams). A random 50–100 g sub-sample was removed, weighed, and placed in a pre-cleaned sample container supplied by the analytical laboratory. Fillet weights and sample weights were recorded on sample processing data sheets and are listed in Tables 2 and 3 for Closed Area and Adjacent Area specimens, respectively. Sample jars were labeled with sample number, species, collection date, time, and initials of processing personnel.

The sample and container were placed into resealable plastic bags and stored at 4 ±2 degrees Celsius. A Chain of Custody form was completed for all samples collected. Sample containers were shipped to Battelle overnight on the date of processing.

2.3.2 Juvenile Blue Crab

Blue crabs were processed within 24 hours of collection in the Alcoa Clean Lab (located at the Alcoa Point Comfort Facility) and remained on ice or in a refrigerator until processing was complete. In the laboratory, crabs were rinsed with DI water and sorted by size on pre-cleaned Teflon cutting boards. Individual blue crabs were measured, weighed, and placed into sample containers. Each sample was a composite of five crabs measuring 25 to 75 mm in width. Individual crab weights and total sample weights were recorded on sample processing data sheets. Data associated with Closed Area and Adjacent Area juvenile blue crab monitoring are listed in Tables 4 and 5, respectively. Sample containers were labeled with the sample ID, collection date, time, and initials of processing personnel and were placed into resealable plastic bags in a secure refrigerator in the Clean Lab. Samples were shipped overnight to Battelle for analysis.

3.0 ANALYTICAL RESULTS

Red drum and juvenile blue crab samples were analyzed for total mercury and percent moisture by Battelle. Total mercury results were reported in µg/g as wet weight. Benchmark received the final data packet from the analytical laboratory on 15 January 2016, and Analytical QA/QC was completed by Environmental Chemistry Services on 21 January 2016. Analytical results for red drum collected from the Closed Area are presented in Table 2 and on Figure 1, and the results for red drum from the Adjacent

Open Area are presented in Table 3 and on Figure 2. Analytical results for juvenile blue crabs collected from the Closed Area monitoring stations are presented in Table 4 and on Figure 3, and results for juvenile blue crabs from the Adjacent Areas are presented in Table 5 and on Figure 4.

Analytical results for both red drum and juvenile blue crab samples were validated according to the Standard Operating Procedure Data Validation (Appendix E) in the Quality Assurance Project Plan Alcoa (Point Comfort)/Lavaca Bay Superfund Site (August 22, 2005). All analytical results were validated and may be included in the data used to evaluate the effectiveness of the approved remedy and to meet monitoring requirements specified in the Consent Decree.

N

0 1,500 3,000 Feet

Legend

- Red Drum Stations
- 0.00 Total Hg (ug/g ww)
- Zone Boundaries
- Closed Area Boundary

Notes

2009 0.5m DOQQ (Point Comfort)
Calhoun County, Texas

Lavaca Bay Finfish and Shellfish Monitoring Report 2015

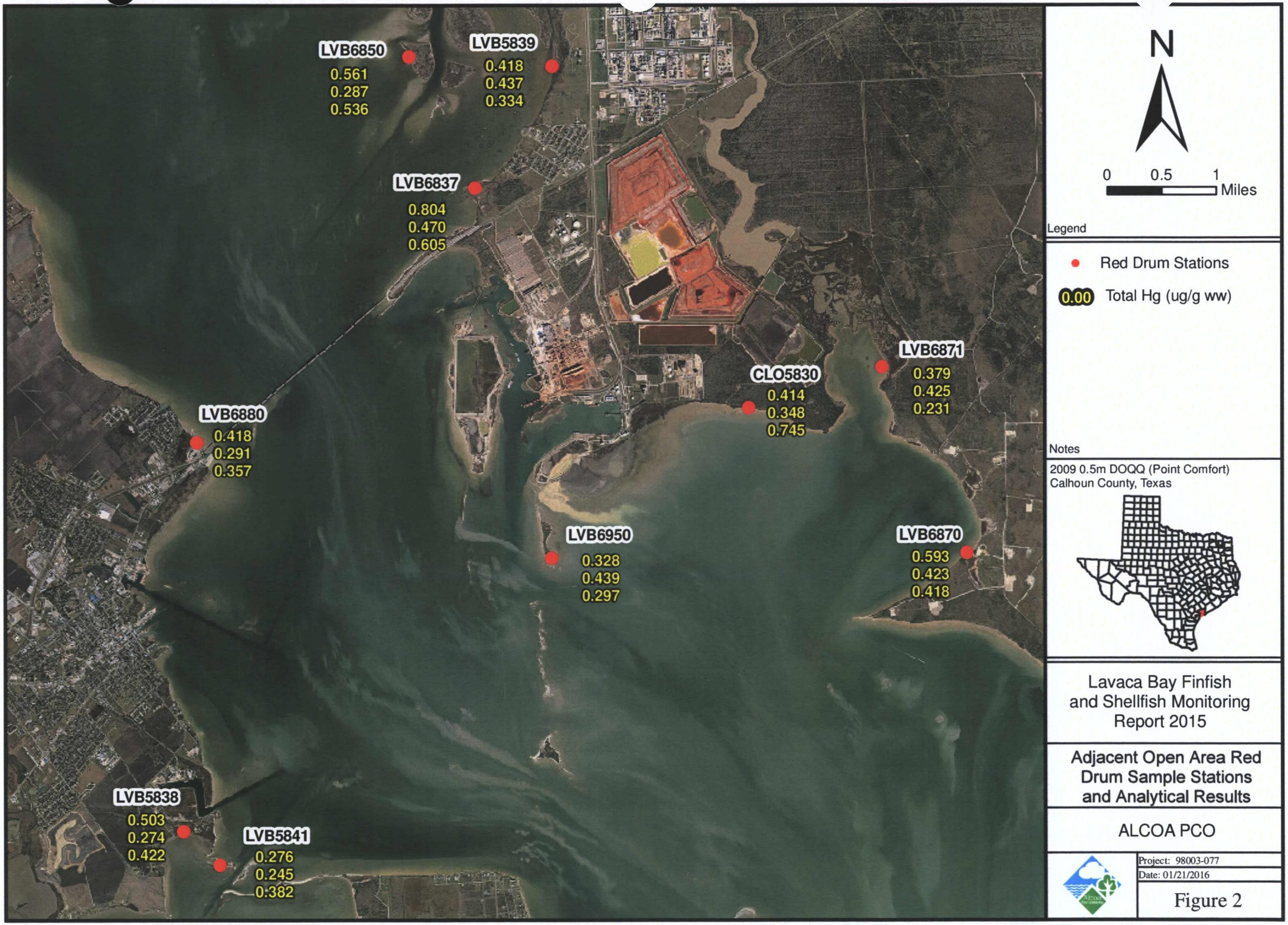
Closed Area Red Drum Sample Stations and Analytical Results

ALCOA PCO

Project: 98003-077
Date: 01/21/2016

Figure 1

M:\98003\077\arc\results\BLCresults\cls_rdr_15_results.mxd



M:\98003\077\arc\results\BLCresults\adj_rdr_15_results.mxd

Lavaca Bay Finfish and Shellfish Monitoring Report 2015

Closed Area Juvenile Blue Crab Sample Stations and Analytical Results

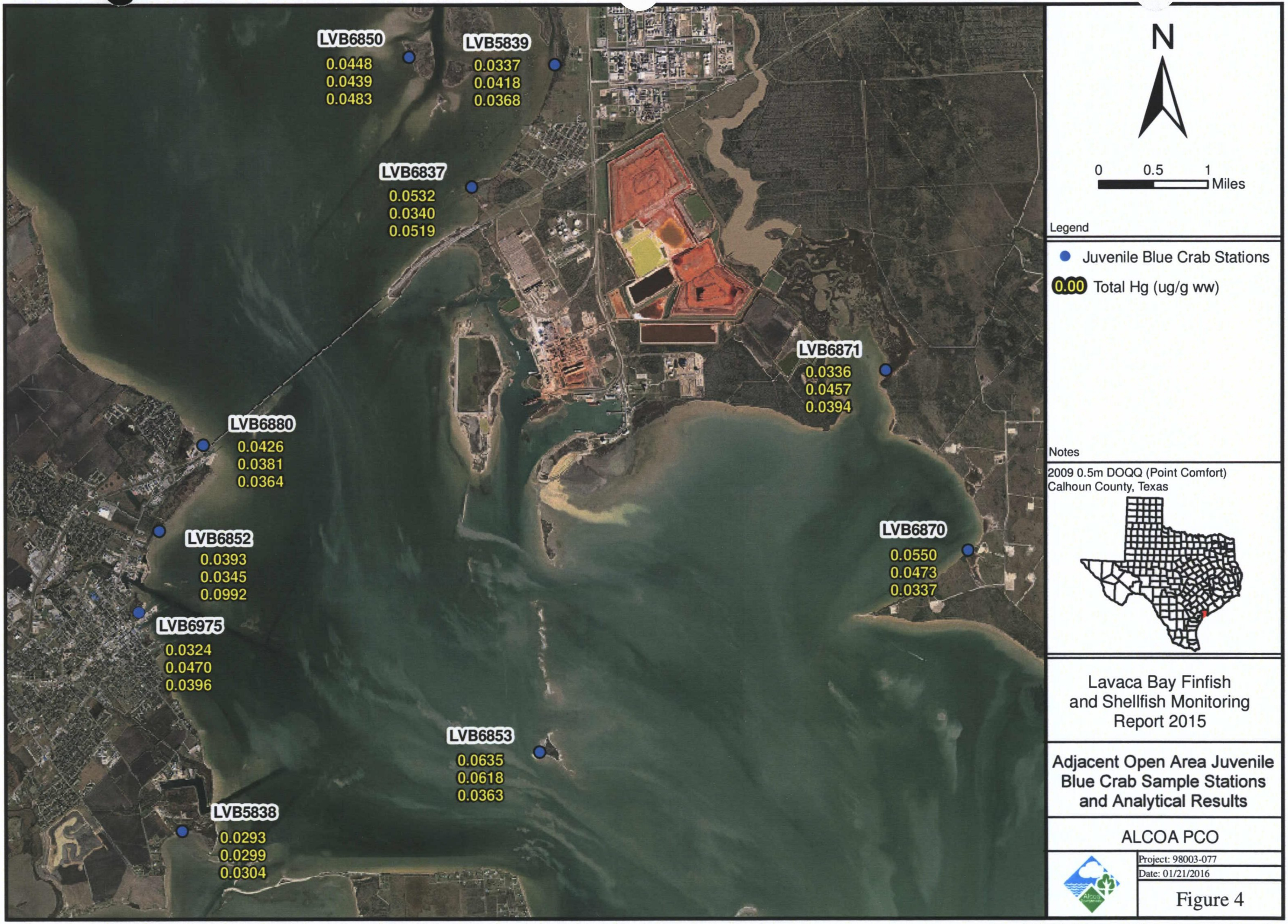
ALCOA PCO

Project: 98003-077

Date: 01/21/2016

Figure 3

M:\98003\077\arc\results\BLCresults\cls_blc_15_results.mxd



M:\98003\077\arc\results\BLCresults\adj_blc_15_results.m:

Table 1 – Tissue Samples Analyzed per Zone

Zone	Red Drum Samples	Juvenile Blue Crab Samples
Zone 1	3	3
Zone 2	14	15
Zone 3	6	3
Zone 4	7	9

Table 2 - Closed Area Red Drum Sample Stations, Sample IDs, Processing Data, and Analytical Results

Station ID	Sample ID	Date	Time	Total Length (mm)	Standard Length (mm)	Total Weight (g)	Tissue Weight (g)	Sample Weight (g)	Percent Moisture	Total Hg wet weight (µg/g)	Flag
CLO5803	B12b-TF-15302	10/6/2015	8:50	636	515	2620	326.6	67.1	81.2	1.13	
CLO5818	B12b-TF-15303	10/6/2015	10:25	609	525	2700	365.3	66.7	79.9	1.29	
CLO5818	B12b-TF-15304	10/6/2015	10:25	617	500	2210	257.7	61.7	80.7	1.05	
CLO5818	B12b-TF-15305	10/6/2015	10:25	613	490	2040	225.0	60.9	79.5	1.41	
CLO5900	B12b-TF-15306	10/6/2015	9:28	641	515	2480	315.0	65.4	79.5	2.13	
CLO5900	B12b-TF-15307	10/6/2015	9:28	631	519	2530	267.2	63.7	80.1	1.47	
CLO5802	B12b-TF-15308	10/7/2015	11:45	567	495	1960	250.4	62.7	79.4	1.70	
LVB5518	B12b-TF-15309	10/8/2015	9:40	623	500	2426	360.9	59.6	79.4	0.393	
LVB5518	B12b-TF-15310	10/8/2015	9:40	620	495	2470	346.5	62.0	79.6	0.470	
CLO5802	B12b-TF-15311	10/8/2015	11:10	597	480	1844	225.2	55.1	79.3	2.32	
CLO5814	B12b-TF-15312	10/27/2015	10:07	560	462	1720	189.5	51.3	79.5	0.642	
CLO5814	B12b-TF-15313	10/27/2015	10:07	533	438	1412	132.2	35.2	80.3	1.06	
CLO5814	B12b-TF-15314	10/27/2015	10:07	531	435	1482	144.8	48.5	78.7	1.24	
CLO5803	B12b-TF-15321	10/28/2015	9:08	641	520	2554	192.7	61.7	82.2	1.60	
CLO5803	B12b-TF-15322	10/28/2015	9:08	664	545	3247	280.5	57.1	81.1	1.94	
CLO5815	B12b-TF-15323	10/28/2015	9:40	637	513	2385	232.1	59.2	80.0	0.891	
CLO5802	B12b-TF-15327	11/3/2015	8:32	545	430	1706	245.9	65.7	79.0	0.648	
CLO5815	B12b-TF-15328	11/4/2015	8:38	613	490	2395	358.3	59.8	80.6	0.943	
LVB5518	B12b-TF-15329	11/4/2015	8:20	701	570	3200	444.3	62.7	80.7	1.99	
CLO5900	B12b-TF-15330	11/5/2015	9:30	543	430	1625	231.6	54.0	80.1	1.81	
LVB5508	B12b-TF-15331	11/5/2015	9:10	682	554	3204	384.1	55.8	81.5	1.49	
LVB5508	B12b-TF-15332	11/5/2015	9:10	624	510	2672	238.7	59.1	79.2	1.29	
LVB5513	B12b-TF-15335	11/12/2015	9:54	631	510	2448	308.0	54.4	80.4	2.52	
CLO5815	B12b-TF-15346	11/24/2015	8:00	706	580	3522	502.4	60.2	80.2	0.550	
LVB5504	B12b-TF-15349	11/30/2015	8:00	590	491	2084	260.1	64.9	80.4	1.04	
LVB5508	B12b-TF-15358	12/14/2015	8:05	665	545	3127	388.4	56.3	80.2	1.28	
LVB5513	B12b-TF-15359	12/15/2015	8:00	677	555	3134	370.3	54.0	80.0	0.796	
CLO5817	B12b-TF-15360	12/29/2015	9:20	524	426	1366	175.7	66.5	80.2	1.45	
CLO5806	B12b-TF-15361	12/29/2015	9:45	606	499	2468	231.5	61.0	79.0	1.71	
CLO5806	B12b-TF-15362	12/29/2015	9:45	611	494	2469	239.2	63.0	79.2	1.45	
Average Values				**615**	**501**	**2383**	**283.0**	**59.2**	**80.0**	**1.323**	

Table 3 - Adjacent Open Area Red Drum Sample Stations, Sample IDs, Processing Data, and Analytical Results

Station ID	Sample ID	Date	Time	Total Length (mm)	Standard Length (mm)	Total Weight (g)	Tissue Weight (g)	Sample Weight (g)	Percent Moisture	Total Hg wet weight (µg/g)	Flag
LVB6871	B12b-TF-15315	10/28/2015	10:45	700	575	3290	448.6	69.0	78.5	0.379	
LVB6871	B12b-TF-15316	10/28/2015	10:45	635	532	2752	301.1	55.2	79.6	0.425	
LVB6871	B12b-TF-15317	10/28/2015	10:45	657	541	2958	297.5	56.0	79.3	0.231	
LVB6870	B12b-TF-15318	10/28/2015	10:15	629	520	2355	248.6	57.8	80.3	0.593	
LVB6870	B12b-TF-15319	10/28/2015	10:15	654	535	2706	341.9	63.1	79.4	0.423	
LVB6870	B12b-TF-15320	10/28/2015	10:15	545	440	1505	146.5	45.9	78.4	0.418	
LVB6850	B12b-TF-15324	10/29/2015	8:21	521	425	1474	211.8	65.0	80.4	0.561	
LVB5839	B12b-TF-15325	10/29/2015	8:00	673	555	3311	454.5	68.8	80.0	0.418	
LVB5839	B12b-TF-15326	11/3/2015	7:25	635	520	2813	452.6	60.8	80.1	0.437	
LVB5838	B12b-TF-15333	11/9/2015	9:30	604	490	2242	328.1	51.6	79.9	0.503	
LVB5838	B12b-TF-15334	11/9/2015	9:30	689	555	3707	438.0	63.5	79.6	0.274	
LVB6837	B12b-TF-15337	11/16/2015	8:30	668	540	3137	409.7	63.7	79.2	0.804	
LVB5839	B12b-TF-15338	11/16/2015	7:20	684	555	3427	569.6	64.8	79.8	0.334	
LVB5841	B12b-TF-15339	11/23/2015	8:45	710	595	3775	410.2	58.1	77.8	0.276	
LVB6950	B12b-TF-15340	11/23/2015	10:20	588	480	2329	289.5	56.2	77.9	0.328	
LVB6950	B12b-TF-15341	11/23/2015	10:20	617	500	2520	369.1	56.3	79.6	0.439	
LVB6950	B12b-TF-15342	11/23/2015	10:20	571	465	1819	218.5	50.6	79.1	0.297	
LVB5841	B12b-TF-15343	11/24/2015	7:00	509	410	1311	193.2	51.1	79.2	0.245	
LVB5841	B12b-TF-15344	11/24/2015	7:00	705	575	3660	531.8	56.0	78.2	0.382	
LVB5838	B12b-TF-15345	11/24/2015	7:15	670	555	3044	340.2	57.9	79.6	0.422	
LVB6837	B12b-TF-15347	11/24/2015	8:34	683	555	3540	346.2	54.2	78.9	0.470	
LVB6880	B12b-TF-15348	11/24/2015	9:50	619	500	2427	272.5	54.9	78.9	0.418	
LVB5830	B12b-TF-15350	12/1/2015	7:00	684	565	3320	430.0	53.8	79.0	0.414	
LVB5830	B12b-TF-15351	12/1/2015	7:00	647	520	2629	355.5	55.7	79.3	0.348	
LVB5830	B12b-TF-15352	12/1/2015	7:00	614	530	3263	380.0	52.5	79.3	0.745	
LVB6880	B12b-TF-15353	12/7/2015	8:50	608	485	2341	338.5	51.2	78.2	0.291	
LVB6850	B12b-TF-15354	12/7/2015	8:00	668	540	3041	417.5	53.7	79.5	0.287	
LVB6850	B12b-TF-15355	12/7/2015	8:00	629	520	2671	387.4	52.7	79.6	0.536	
LVB6837	B12b-TF-15356	12/8/2015	7:50	688	560	3354	468.6	56.1	79.3	0.605	
LVB6880	B12b-TF-15357	12/8/2015	8:45	610	500	2440	270.0	52.9	79.9	0.357	
Average Values				**637**	**521**	**2772**	**355.6**	**57.0**	**79.3**	**0.422**	

Table 4 - Closed Area Juvenile Blue Crab Sample Stations, Sample IDs, Processing Data, and Analytical Results

Station ID	Sample ID	Date	Time	Width (mm)	Crab Weight (g)	Sample Weight (g)	Percent Moisture	Total Hg wet weight (µg/g)	Flag
LVB5504	B12b-TS-15836	10/2/15	10:52	26.0	1.2	14.5	66.6	0.0560	
				32.8	2.3				
				41.1	6.0				
				39.5	3.6				
				27.7	1.4				
LVB5504	B12b-TS-15837	10/2/15	10:52	26.4	1.6	21.3	66.6	0.105	
				30.2	2.1				
				47.2	7.9				
				42.9	5.0				
				40.5	4.7				
CLO5900	B12b-TS-15838	10/2/15	10:41	74.8	23.6	55.7	72.2	0.125	
				71.3	23.4				
				35.7	3.2				
				38.5	3.0				
				33.9	2.5				
CLO5815	B12b-TS-15839	10/2/15	9:28	52.3	7.4	14.8	72.6	0.0432	
				31.5	2.4				
				28.4	2.1				
				31.6	1.6				
				28.2	1.3				
CLO5900	B12b-TS-15840	10/2/15	10:41	30.5	2.3	28.8	73.2	0.0735	
				34.2	3.3				
				30.8	1.8				
				60.5	14.4				
				42.1	7.0				
CLO5900	B12b-TS-15841	10/5/15	11:55	41.7	5.5	21.7	66.6	0.0824	
				51.1	9.3				
				34.2	3.8				
				27.6	1.6				
				25.6	1.5				
CLO5802	B12b-TS-15842	10/2/15	9:12	68.2	19.9	47.6	70.6	0.129	
				66.9	17.9				
				27.0	1.3				
				35.5	4.7				
				38.1	3.8				
CLO5803	B12b-TS-15843	10/2/15	8:41	70.9	21.2	37.7	69.2	0.160	
				29.9	2.2				
				33.9	2.6				
				30.3	2.6				
				54.7	9.1				

Table 4 - Closed Area Juvenile Blue Crab Sample Stations, Sample IDs, Processing Data, and Analytical Results

Station ID	Sample ID	Date	Time	Width (mm)	Crab Weight (g)	Sample Weight (g)	Percent Moisture	Total Hg wet weight (µg/g)	Flag
CLO5803	B12b-TS-15844	10/5/15	12:25	30.2	3.2	46.2	64.6	0.152	
				74.6	26.2				
				26.7	2.0				
				56.3	11.4				
				31.2	3.4				
CLO5802	B12b-TS-15845	10/5/15	12:40	47.7	9.8	21.1	68.6	0.247	
				39.7	6.4				
				26.9	1.5				
				25.5	1.6				
				27.4	1.8				
LVB5504	B12b-TS-15846	10/5/15	12:05	28.4	1.9	10.2	64.7	0.0779	
				32.8	2.5				
				31.8	2.5				
				29.4	1.8				
				28.0	1.5				
LVB5513	B12b-TS-15847	10/2/15	10:26	58.4	15.9	56.5	65.7	0.138	
				63.0	15.0				
				28.4	1.7				
				51.6	15.4				
				50.0	8.5				
CLO5803	B12b-TS-15848	10/5/15	12:25	66.0	16.9	29.2	72.3	0.0613	
				32.6	3.1				
				38.1	5.5				
				25.3	1.7				
				27.4	2.0				
CLO5814	B12b-TS-15849	10/2/15	10:12	33.1	2.6	34.3	65.4	0.0812	
				43.2	5.0				
				58.9	14.5				
				48.6	9.5				
				32.2	2.7				
CLO5814	B12b-TS-15850	10/5/15	11:25	38.9	4.2	60.8	67.3	0.0874	
				64.5	19.0				
				53.4	13.5				
				25.2	1.2				
				74.8	22.9				
CLO5815	B12b-TS-15851	10/2/15	9:28	27.4	1.4	18.7	80.0	0.0384	
				25.5	1.2				
				26.0	1.4				
				25.5	1.4				
				65.4	13.3				

Table 4 - Closed Area Juvenile Blue Crab Sample Stations, Sample IDs, Processing Data, and Analytical Results

Station ID	Sample ID	Date	Time	Width (mm)	Crab Weight (g)	Sample Weight (g)	Percent Moisture	Total Hg wet weight (µg/g)	Flag
LVB5517	B12b-TS-15852	10/2/15	9:44	56.8	11.0	40.2	64.8	0.0882	
				38.0	4.4				
				32.4	2.3				
				26.8	1.7				
				70.4	20.8				
CLO6802	B12b-TS-15862	10/2/15	9:58	34.3	2.5	38.4	68.3	0.0976	
				67.1	23.6				
				26.9	1.5				
				34.7	4.1				
				46.7	6.7				
LVB5508	B12b-TS-15863	10/2/15	8:56	27.1	1.9	11.5	66.4	0.0776	
				32.2	2.9				
				32.6	3.5				
				29.2	1.8				
				26.8	1.4				
LVB5508	B12b-TS-15864	10/5/15	12:15	25.8	1.6	30.7	66.7	0.215	
				70.7	24.2				
				28.3	1.9				
				26.3	1.5				
				27.5	1.5				
CLO5815	B12b-TS-15869	10/5/15	12:55	28.8	1.6	9.6	66.7	0.0462	
				31.6	2.1				
				35.8	2.8				
				27.7	1.7				
				28.5	1.4				
LVB5517	B12b-TS-15871	10/5/15	13:05	65.8	17.6	28.6	68.3	0.0771	
				28.9	1.8				
				32.5	2.4				
				41.0	4.7				
				30.2	2.1				
LVB5517	B12b-TS-15872	10/7/15	17:18	25.3	1.0	16.9	67.7	0.0690	
				29.9	1.5				
				52.8	8.6				
				37.5	3.4				
				31.6	2.4				
CLO5802	B12b-TS-15873	10/5/15	12:40	25.2	1.4	44.2	74.5	0.155	
				46.5	8.8				
				58.7	10.9				
				33.4	3.4				
				60.3	19.7				

Table 4 - Closed Area Juvenile Blue Crab Sample Stations, Sample IDs, Processing Data, and Analytical Results

Station ID	Sample ID	Date	Time	Width (mm)	Crab Weight (g)	Sample Weight (g)	Percent Moisture	Total Hg wet weight (µg/g)	Flag
LVB5508	B12b-TS-15874	10/7/15	11:30	72.7	29.4	38.1	68.9	0.193	
				35.0	4.1				
				25.4	1.5				
				26.9	1.6				
				25.0	1.5				
CLO5814	B12b-TS-15876	10/7/15	9:20	63.2	18.1	50.8	67.8	0.0844	
				60.6	16.3				
				53.2	10.1				
				33.0	2.6				
				36.2	3.7				
CLO6802	B12b-TS-15879	10/7/15	9:30	29.3	2.0	16.4	74.9	0.0509	
				26.8	1.4				
				31.3	2.2				
				25.6	1.6				
				54.8	9.2				
LVB5513	B12b-TS-15880	10/7/15	11:00	60.8	13.9	37.4	68.6	0.0919	
				40.0	5.0				
				29.9	2.1				
				53.2	10.8				
				38.5	5.6				
LVB5513	B12b-TS-15881	10/12/15	10:25	56.5	12.8	45.1	69.8	0.111	
				37.4	3.4				
				30.8	2.2				
				55.2	8.2				
				67.8	18.5				
CLO6802	B12b-TS-15882	10/12/15	10:15	35.8	3.8	12.5	69.7	0.0383	
				30.3	2.0				
				32.6	2.5				
				36.7	1.6				
				33.9	2.6				
Average Values				**39.9**	**6.3**	**31.3**	**69.0**	**0.102**	

Table 5 - Adjacent Open Area Juvenile Blue Crab Sample Stations, Sample IDs, Processing Data, and Analytical Results

Station ID	Sample ID	Date	Time	Width (mm)	Crab Weight (g)	Sample Weight (g)	Percent Moisture	Total Hg wet weight (µg/g)	Flag
LVB6853	B12b-TS-15823	10/1/15	13:35	55.6	15.6	80.4	71.2	0.0635	
				56.8	17.2				
				71.8	33.6				
				47.6	9.5				
				37.8	4.5				
LVB6853	B12b-TS-15824	10/1/15	13:35	55.9	15.0	77.0	67.3	0.0618	
				64.6	23.0				
				49.7	10.4				
				61.6	18.7				
				50.6	9.9				
LVB6853	B12b-TS-15825	10/1/15	13:35	65.9	24.4	83.6	75.3	0.0363	
				59.3	19.5				
				51.0	11.8				
				45.6	8.7				
				61.7	19.2				
LVB5839	B12b-TS-15826	10/1/15	16:10	54.9	10.4	45.9	71.5	0.0337	
				50.5	11.2				
				59.7	13.7				
				40.4	5.5				
				37.3	5.1				
LVB5839	B12b-TS-15827	10/1/15	16:10	27.8	1.8	19.8	65.7	0.0418	
				48.4	8.7				
				33.5	3.8				
				30.6	2.9				
				28.5	2.6				
LVB5839	B12b-TS-15828	10/1/15	16:10	43.0	5.6	22.2	67.5	0.0368	
				35.5	3.9				
				32.9	3.7				
				33.2	2.8				
				40.9	6.2				
LVB6852	B12b-TS-15829	10/1/15	17:20	35.5	4.5	14.6	67.7	0.0393	
				35.6	3.9				
				30.0	2.1				
				29.6	2.3				
				26.2	1.8				
LVB6852	B12b-TS-15830	10/1/15	17:20	34.1	30.0	42.6	70.8	0.0345	
				25.0	1.5				
				41.2	6.3				
				27.5	1.8				
				33.2	3.0				

Table 5 - Adjacent Open Area Juvenile Blue Crab Sample Stations, Sample IDs, Processing Data, and Analytical Results

Station ID	Sample ID	Date	Time	Width (mm)	Crab Weight (g)	Sample Weight (g)	Percent Moisture	Total Hg wet weight (µg/g)	Flag
LVB6852	B12b-TS-15831	10/1/15	17:20	25.9	1.9	31.9	68.5	0.0992	
				28.9	2.5				
				38.7	5.2				
				30.2	2.3				
				63.5	20.0				
LVB6850	B12b-TS-15832	10/1/15	16:32	36.8	5.0	41.0	67.7	0.0448	
				53.5	11.3				
				34.0	4.7				
				51.5	9.0				
				48.9	11.0				
LVB6850	B12b-TS-15833	10/1/15	16:32	62.9	16.8	37.8	69.5	0.0439	
				48.5	7.8				
				43.5	5.7				
				27.7	2.3				
				41.9	5.2				
LVB6837	B12b-TS-15834	10/1/15	15:52	41.0	7.4	72.5	69.9	0.0532	
				72.7	23.5				
				53.7	10.7				
				70.3	23.1				
				51.2	7.8				
LVB5838	B12b-TS-15853	10/1/15	13:05	33.7	2.6	19.5	67.7	0.0293	
				29.5	2.0				
				30.6	2.4				
				31.8	2.2				
				55.7	10.3				
LVB5838	B12b-TS-15854	10/5/15	9:38	26.7	1.2	9.4	68.9	0.0299	
				36.0	3.5				
				27.2	1.6				
				26.8	1.7				
				26.8	1.4				
LVB6850	B12b-TS-15855	10/5/15	15:50	45.1	9.5	26.2	66.9	0.0483	
				36.0	3.5				
				44.6	5.8				
				29.5	2.5				
				40.5	4.9				
LVB6870	B12b-TS-15856	10/1/15	14:10	71.4	22.1	67.0	76.0	0.0550	
				66.7	18.1				
				60.7	14.3				
				55.3	10.5				
				26.4	2.0				

Table 5 - Adjacent Open Area Juvenile Blue Crab Sample Stations, Sample IDs, Processing Data, and Analytical Results

Station ID	Sample ID	Date	Time	Width (mm)	Crab Weight (g)	Sample Weight (g)	Percent Moisture	Total Hg wet weight (µg/g)	Flag
LVB6871	B12b-TS-15857	10/1/15	14:24	49.5	10.4	20.8	70.4	0.0336	
				35.1	3.6				
				30.2	2.6				
				26.8	2.1				
				27.8	2.1				
LVB6975	B12b-TS-15858	10/1/15	17:35	58.6	12.9	54.8	67.7	0.0324	
				61.9	16.5				
				57.0	12.8				
				41.5	5.4				
				46.8	7.2				
LVB6880	B12b-TS-15859	10/1/15	17:00	64.5	17.3	34.5	66.6	0.0426	
				52.6	9.5				
				29.5	1.9				
				26.9	1.6				
				39.7	4.2				
LVB6880	B12b-TS-15860	10/5/15	13:15	72.9	22.5	45.3	65.1	0.0381	
				34.0	2.6				
				42.9	5.7				
				54.0	11.7				
				32.8	2.8				
LVB6880	B12b-TS-15861	10/5/15	13:15	39.9	4.7	15.9	66.0	0.0364	
				30.3	2.8				
				37.9	4.1				
				33.3	2.7				
				26.5	1.6				
LVB6975	B12b-TS-15865	10/5/15	13:42	71.4	28.4	90.3	70.2	0.0470	
				70.5	20.0				
				72.2	21.6				
				59.9	14.4				
				47.4	5.9				
LVB6870	B12b-TS-15866	10/5/15	10:24	32.3	3.4	37.8	72.9	0.0473	
				36.0	9.7				
				45.4	9.7				
				51.0	8.1				
				43.2	6.9				
LVB5838	B12b-TS-15867	10/5/15	9:38	36.4	3.7	16.1	69.9	0.0304	
				37.3	5.0				
				25.4	1.7				
				27.8	1.6				
				37.2	4.1				

Table 5 - Adjacent Open Area Juvenile Blue Crab Sample Stations, Sample IDs, Processing Data, and Analytical Results

Station ID	Sample ID	Date	Time	Width (mm)	Crab Weight (g)	Sample Weight (g)	Percent Moisture	Total Hg wet weight (µg/g)	Flag
LVB6837	B12b-TS-15868	10/5/15	15:35	50.6	10.0	31.5	68.5	0.0340	
				36.5	3.1				
				47.1	6.3				
				32.0	2.5				
				51.9	9.6				
LVB6871	B12b-TS-15870	10/5/15	10:50	34.2	4.0	22.8	67.5	0.0457	
				43.9	7.8				
				38.1	4.2				
				32.8	3.3				
				31.9	3.5				
LVB6837	B12b-TS-15875	10/7/15	8:18	61.8	14.7	27.2	64.2	0.0519	
				46.6	6.6				
				30.9	3.2				
				25.0	1.2				
				29.0	1.5				
LVB6870	B12b-TS-15877	10/7/15	10:00	51.1	8.9	38.4	69.4	0.0337	
				31.6	2.7				
				26.9	2.1				
				68.2	22.2				
				31.3	2.5				
LVB6871	B12b-TS-15878	10/7/15	10:30	27.9	1.8	23.3	64.3	0.0394	
				48.6	10.5				
				36.6	5.3				
				32.9	2.9				
				29.5	2.8				
LVB6975	B12b-TS-15883	10/13/15	8:45	73.0	20.8	65.4	65.9	0.0396	
				66.8	19.0				
				44.1	5.3				
				43.1	6.3				
				59.1	14.0				
Average Values				**43.2**	**8.1**	**40.5**	**68.7**	**0.043**	

Appendix B2

Focused Prey Item Study

Study 1

March 2016

ALCOA

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0 INTRODUCTION

A key factor in the success of the Lavaca Bay Remedy is the reduction in tissue mercury concentrations through targeted source control efforts, sediment removal efforts, capping, enhanced natural recovery, and/or natural recovery. In accordance with Section 4.4 (Recommendations) of the 2014 Remedial Action Annual Effectiveness Report (RAAER), additional focused prey item studies were conducted to improve our understanding of the processes by which methylmercury enters the food web and bioaccumulates in predatory fish. The work plan was submitted to the USEPA on September 15, 2015, (Alcoa 2015b) and received approval from the USEPA on September 25, 2015.

1.1 PURPOSE AND SCOPE

The objective of Study 1 was to evaluate prey items that are not monitored on an annual basis but are frequently components in the red drum (*Sciaenops ocellatus*) diet and may uptake mercury from pathways other than subsurface sediment methylation. The prey item data collected in this study will be used to determine if the focus of the existing monitoring studies should be expanded to include other species that are components of the red drum diet.

The study objective was to collect 30 killifish samples and 30 grass shrimp samples from the ten Closed Area locations (three composite samples for each location) monitored for juvenile blue crabs in 2015. For comparison purposes, five killifish and five grass shrimp samples (one sample from each station) would be collected from five of the ten marshes sampled for juvenile blue crabs in the Adjacent Open Area.

1.2 SITE DESCRIPTION

The Alcoa Point Comfort Operations Plant is located in Calhoun County, Texas, adjacent to Lavaca Bay. An area in the bay adjacent to the Alcoa Plant is associated with elevated mercury concentrations in fish tissue and is closed to the taking of finfish and blue crabs for consumption by order of the Texas Department of Health. This area is referred to as the "Closed Area" and is delineated in the figures contained in this report. The monitoring area specified in the OMMP includes both the Closed Area and designated areas outside the Closed Area (termed the "Adjacent Open Area").

2.0 METHODS

Gulf killifish (*Fundulus grandis*) and grass shrimp (*Palaemonetes pugio*) tissue samples for Study 1 were collected and processed by Benchmark Ecological Services, Inc., and analyzed for total Hg by Battelle Marine Sciences Laboratory (Battelle) in Sequim, Washington. Samples were collected between

5 October 2015 and 29 December 2015. Validation and evaluation of the analytical results were conducted by Environmental Chemistry Services, Inc., in Houston, Texas.

2.1 SAMPLE STATIONS

The objective of the study was to collect gulf killifish and grass shrimp from the same sample stations that were sampled during the 2015 monitoring event for juvenile blue crabs. Killifish were collected from seven of the ten Closed Area marshes sampled for juvenile blue crabs (Figure 1) and four marshes in the Adjacent Open Area (Figure 2). Grass shrimp samples were successfully collected from ten stations inside the Closed Area (Figure 3), and five grass shrimp samples were collected from five stations in the Adjacent Area (Figure 4). A Global Positioning System (GPS) was used to determine the positions of all sample stations.

Table 1 shows the number of gulf killifish and grass shrimp samples collected by zone. The distribution of gulf killifish samples ranged from 0 samples in Zone 4 to 10 samples in Zone 2. The number of grass shrimp samples ranged from 3 samples in Zone 3 to 15 samples in Zone 2. The uneven distribution of samples among the zones was due to the uneven distribution of suitable habitat within the Zones.

2.2 SAMPLE COLLECTION

2.2.1 Gulf Killifish

Gulf killifish were collected from the Closed Area and Adjacent Areas between 5 October 2015 and 29 December 2015. In the Closed Area, 19 gulf killifish tissue samples were collected from 7 sample stations shown in Figure 1. In the Adjacent Area, 4 gulf killifish tissue samples were collected from 4 sample stations shown in Figure 2.

Gulf killifish were collected using barrel-type minnow traps baited with commercial crab bait (gulf menhaden and mullet). Traps were checked every 24 to 72 hours. Gulf killifish collected in the field were placed in resealable bags labeled with station ID, date, and collection time. Labeled bags were immediately placed in an insulated chest with ice.

The following information (at a minimum) was recorded on data sheets: Station ID, initials of field personnel, gear type, set date, set time, end date, end time, and water depth.

2.2.2 Grass Shrimp

Grass shrimp were collected from the Closed Area and Adjacent Open Areas between 13 October 2015 and 1 December 2015. In the Closed Area, 30 grass shrimp tissue samples were collected from the ten monitoring stations monitored for juvenile blue crab in 2015 (Figure 3). In the Adjacent Open Area, five grass shrimp tissue samples were collected from the five sample stations monitored for juvenile blue crab in 2015 (Figure 4).

Grass shrimp were collected in the field using dip nets and were placed in resealable bags labeled with station ID, date, and collection time. Labeled bags were immediately placed in an insulated chest with ice. Data sheets were used to record the same sample site information listed above for gulf killifish samples.

2.3 SAMPLE PROCESSING

2.3.1 Gulf Killifish

Gulf killifish samples were processed within 24 hours of collection in the Alcoa Clean Lab (located at the Alcoa Point Comfort Facility) and remained on ice until processing was complete. Fish were rinsed with deionized water, measured (total length), and weighed. Data were recorded on tissue processing data sheets and are listed in Table 2 (Closed Area specimens) and Table 3 (Adjacent Area specimens). The fish were then cut into 1-cm segments with a pre-cleaned scalpel and placed into sample containers provided by the laboratory.

Sample containers were labeled with the sample ID, collection date, time, and initials of processing personnel and were placed into resealable plastic bags in a secure refrigerator in the Clean Lab. Samples were shipped overnight to Battelle for analysis.

2.3.2 Grass Shrimp

Grass shrimp were processed within 24 hours of collection in the Alcoa Clean Lab (located at the Alcoa Point Comfort Facility) and remained on ice or in a refrigerator until processing was complete. In the laboratory, grass shrimp were rinsed with DI water, and a subset of ten specimens were laid out on pre-cleaned Teflon cutting boards. The ten individual shrimp were measured (total length), weighed, and placed into sample containers. Each sample was a composite of 100 grass shrimp. Individual shrimp weights (of the subset of ten shrimp) and total sample weights (100 grass shrimp) were recorded on sample processing data sheets. Data associated with Closed Area and Adjacent Open Area grass shrimp monitoring are shown in Tables 4 and 5, respectively. Sample containers were labeled with the sample ID, collection date, time, and initials of processing personnel and were placed into resealable plastic bags in a secure refrigerator in the Clean Lab. Samples were shipped overnight to Battelle for analysis.

3.0 ANALYTICAL RESULTS

Gulf killifish and grass shrimp samples were analyzed for total mercury and percent moisture by Battelle. Total mercury results were reported in µg/g as wet weight. Benchmark received the final data packet from the analytical laboratory on 15 January 2016, and Analytical QA/QC was completed by Environmental Chemistry Services on 21 January 2016. Analytical results for gulf killifish collected from the Closed Area are presented in Table 2, and the results for gulf killifish from the Adjacent Area are presented in Table 3. Analytical results for grass shrimp collected from the Closed Area monitoring stations are presented in Table 4, and results for grass shrimp from the Adjacent Areas are presented in Table 5.

N

0 1,500 3,000 Feet

Legend

- Gulf Killifish Sample Stations
- 0.00 Total Hg (ug/g) Wet Wt
- Zone Boundaries
- Closed Area

Notes

2009 0.5m DOQQ (Point Comfort)
Calhoun County, Texas

Lavaca Bay Supplemental Study 1 Fall 2015

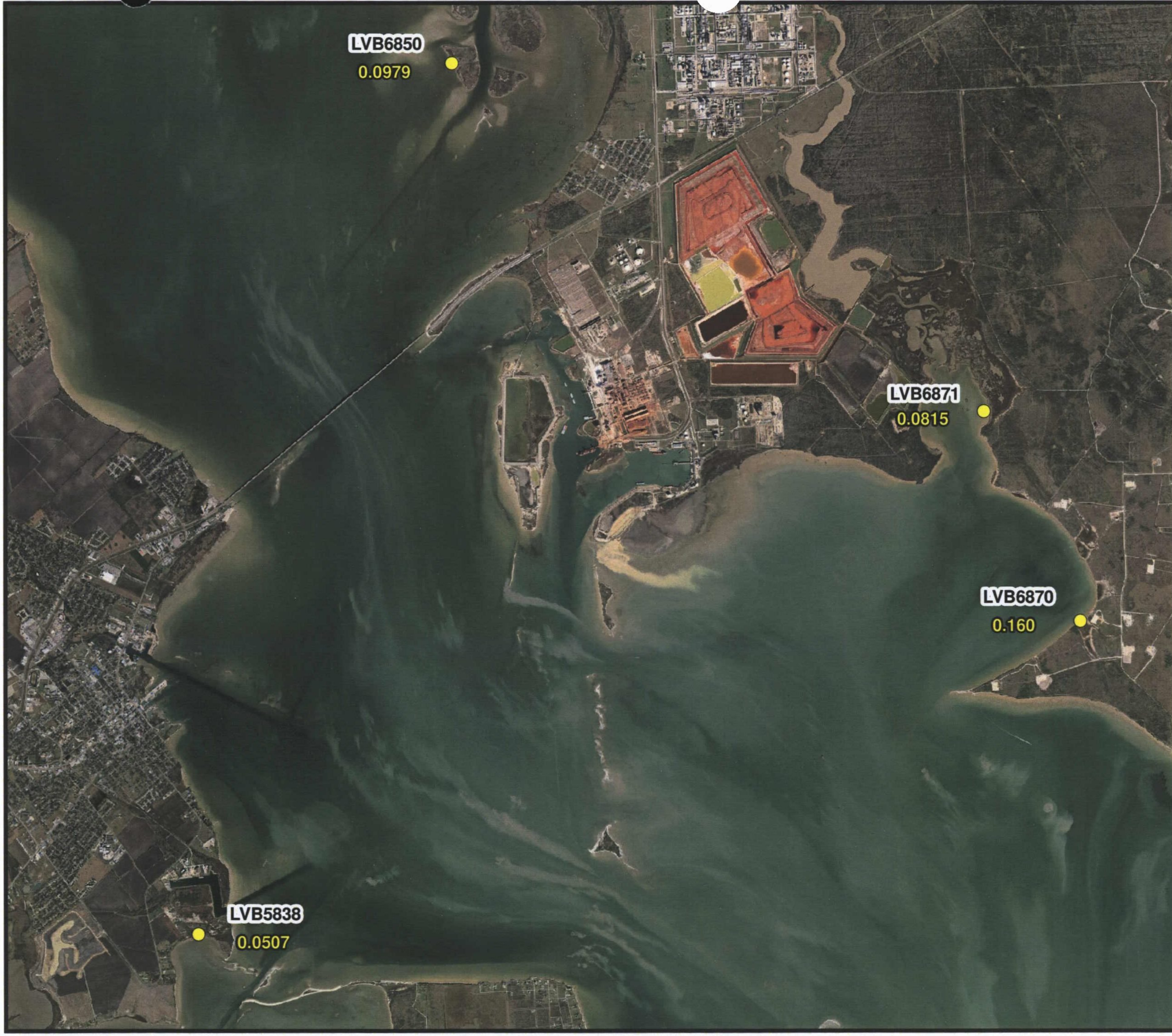
2015 Closed Area Killifish Sample Stations and Analytical Results

ALCOA PCO

Project: 98003-079
Date: 03/10/2016

Figure 1

M:\98003\079\arc\post sampling\GKF\cls_gkf_15_results.mxd



Legend

Gulf Killifish Sample Stations

0.00 Total Hg (ug/g) Wet Wt.

Notes

2009 0.5m DOQQ (Point Comfort)
Calhoun County, Texas

Lavaca Bay Supplemental Study 1 Fall 2015

2015 Adjacent Open Area Killifish Sample Stations and Analytical Results

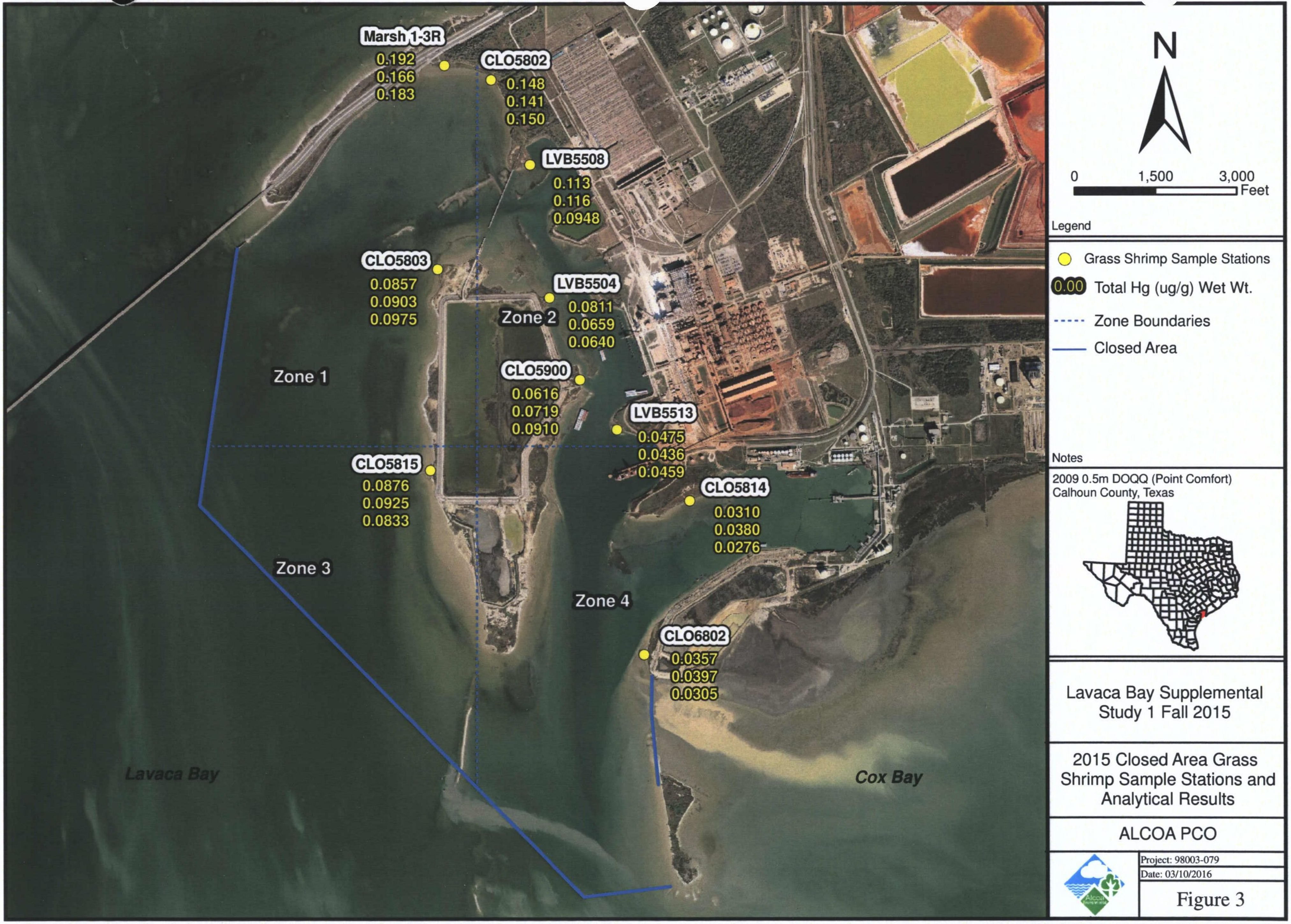
ALCOA PCO

Project: 98003-079

Date: 03/10/2016

Figure 2

M:\98003\079\arc\post sampling\GKF\adj_gkf_15_results.mxd



Lavaca Bay Supplemental Study 1 Fall 2015

2015 Closed Area Grass Shrimp Sample Stations and Analytical Results

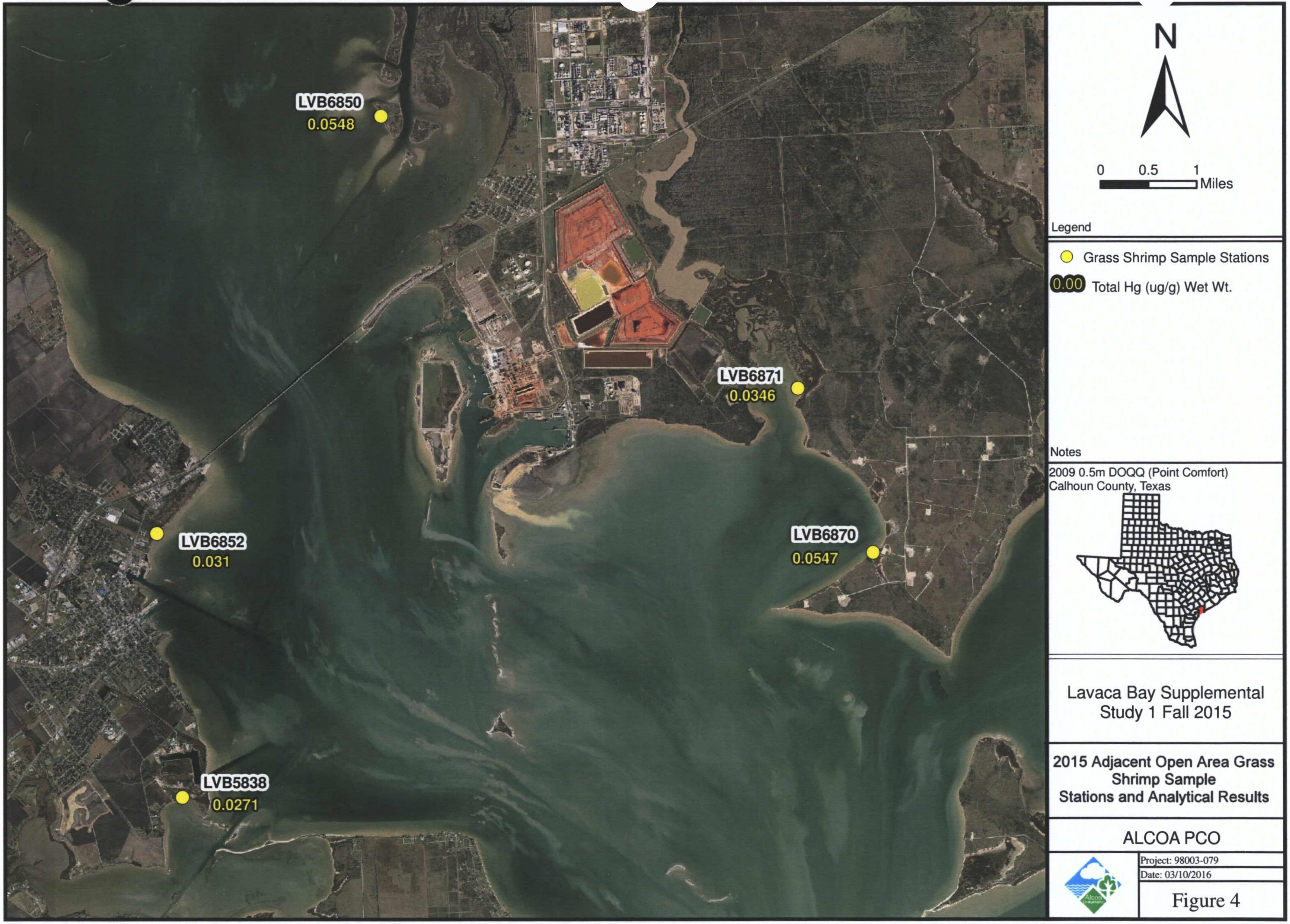
ALCOA PCO

Project: 98003-079

Date: 03/10/2016

Figure 3

M:\98003\079\arc\post sampling\P. pugio\cls_pugio_15_results.mxd



M:\98003\079\arc\post sampling\P. pugio\adj_pugio_15_results.mxd

Table 1 – Tissue Samples Collected by Zone

Zone	Gulf Killifish Samples	Grass Shrimp Samples
Zone 1	6	6
Zone 2	10	15
Zone 3	3	3
Zone 4	0	6

Table 2 - 2015 Closed Area Killifish Sample Stations, Sample IDs, Processing Data and Analytical Results

Station ID	Sample ID	Date	Time	Total Length (mm)	Standard Length (mm)	Organism Weight (g)	Sample Weight (g)	Percent Moisture	Total Hg wet weight (mg/kg)	Flag
CLO5802	B12b-TF-15428	11/6/15	12:15	107.0	83.0	18.2	38.2	73.8	0.718	
				98.0	83.0	12.6				
				51.5	39.0	1.9				
				58.0	46.0	3.0				
				54.0	42.0	2.5				
CLO5815	B12b-TF-15429	12/17/15	16:50	104.0	84.0	20.6	20.6	72.4	0.648	
CLO5815	B12b-TF-15430	12/17/15	16:50	85.0	67.0	8.8	13.2	72.2	0.473	
				66.0	57.0	4.4				
CLO5815	B12b-TF-15431	12/17/15	16:50	77.0	61.0	5.8	10.2	71.4	0.445	
				68.0	58.0	4.4				
CLO5803	B12b-TF-15432	12/17/15	17:00	97.0	80.0	12.4	12.4	72.4	0.682	
CLO5803	B12b-TF-15433	12/17/15	17:00	88.0	71.0	8.0	16.0	73.2	0.307	
				79.0	69.0	8.0				
CLO5803	B12b-TF-15434	12/17/15	17:00	84.0	68.0	8.1	11.8	73.5	0.127	
				53.0	41.0	2.0				
				42.0	35.0	1.7				
LVB5504	B12b-TF-15435	12/17/15	14:30	54.0	43.0	1.8	6.8	70.7	0.149	
				50.0	41.0	1.5				
				58.0	50.0	2.6				
				42.5	34.0	0.9				
LVB5504	B12b-TF-15436	12/17/15	14:30	41.0	33.0	0.8	8.0	72.6	0.145	
				56.0	45.0	2.3				
				47.0	38.0	1.2				
				47.0	36.0	1.3				
				58.0	47.0	2.4				
LVB5504	B12b-TF-15437	12/17/15	14:30	51.0	40.0	1.8	8.0	74.5	0.130	
				59.0	48.0	2.7				
				50.0	40.0	1.6				
				44.0	35.0	1.0				
				42.0	33.0	0.9				
LVB5508	B12b-TF-15438	12/17/15	15:15	76.0	63.0	5.9	5.9	68.0	0.289	
Marsh 1-5R	B12b-TS-15439	12/21/15	12:00	119.0	105.0	25.8	24.6	73.7	1.12	
Marsh 1-5R	B12b-TF-15440	12/21/15	12:00	91.5	83.5	12.6	12.1	71.9	0.927	
Marsh 1-5R	B12b-TF-15441	12/21/15	12:00	103.0	91.5	15.5	14.9	71.0	0.748	
CLO5802	B12b-TF-15442	12/21/15	12:15	85.0	76.0	8.5	8.4	70.4	0.586	
CLO5802	B12b-TF-15443	12/21/15	12:15	96.0	83.0	11.5	10.9	71.9	0.514	
CLO5802	B12b-TF-15444	12/21/15	12:15	93.0	81.0	23.7	11.6	72.7	0.401	
SUP0023	B12b-TF-15445	12/29/15	10:45	68.0	55.0	4.1	4.1	66.7	0.300	
SUP0023	B12b-TF-15446	12/29/15	10:45	64.0	53.0	2.9	4.0	69.5	0.259	
				41.0	31.0	1.1				
Average Values				68.7	56.7	6.4	12.7	71.7	0.472	

Table 3 - 2015 Adjacent Open Area Killifish Sample Stations, Sample IDs, Processing Data and Analytical Results

Station ID	Sample ID	Date	Time	Total Length (mm)	Standard Length (mm)	Organism Weight (g)	Sample Weight (g)	Percent Moisture	Total Hg wet weight (µ/g)	Flag
LVB6850	B12b-TF-15423	10/05/15	15:50	65	50	3.8	16.3	74.1	0.0979	
				62	49	3.1				
				69	55	4.5				
				58	48	2.7				
				55	44	2.2				
LVB6871	B12b-TF-15425	10/27/15	17:28	63	50	3.8	33.8	73.9	0.0815	
				104	84	20.0				
				73	58	6.2				
				54	39	2.1				
				50	41	1.7				
LVB5838	B12b-TF-15426	10/27/15	15:25	67	53	4.5	11.8	73.3	0.0507	
				51	40	1.7				
				54	41	2.0				
				49	39	1.8				
				52	39	1.8				
LVB6870	B12b-TF-15427	11/6/15	8:00	90	71	12.7	54.6	73.5	0.160	
				90	72	10.9				
				93	72	12.3				
				93	77	11.8				
				81	65	6.9				
Average Values				**69**	**54**	**5.8**	**29.1**	**73.7**	**0.097**	

Table 4 - 2015 Closed Area Grass Shrimp Sample Stations, Sample IDs, Processing Data, and Analytical Results

Station ID	Sample ID	Date	Time	Width[a] (mm)	Shrimp Weight[a] (g)	Sample Weight[cd] (g)	Percent Moisture	Total Hg wet weight (µg/g)	Flag
LVB5508	B12b-TS-15908	10/26/2015	15:00	27.0	0.2	8.9	76.3	0.113	
				17.0	<0.05				
				17.0	<0.05				
				22.0	<0.05				
				29.0	0.2				
				24.0	<0.05				
				20.0	<0.05				
				20.0	<0.05				
				18.0	<0.05				
				28.0	0.1				
LVB5508	B12b-TS-15909	10/26/2015	15:00	15.0	<0.05	9.5	76.1	0.116	
				15.0	<0.05				
				16.0	<0.05				
				22.0	0.1				
				18.0	<0.05				
				21.0	<0.05				
				27.0	0.3				
				19.0	<0.05				
				12.0	<0.05				
				30.0	0.3				
LVB5508	B12b-TS-15910	10/26/2015	15:00	20.0	<0.05	8.4	75.5	0.0948	
				24.0	0.1				
				20.0	0.1				
				18.0	<0.05				
				19.0	<0.05				
				20.0	<0.05				
				18.0	<0.05				
				16.0	<0.05				
				16.0	<0.05				
				20.0	0.1				
CLO5814	B12b-TS-15911	10/26/2015	16:45	26.0	0.1	8.5	75.6	0.0310	
				25.0	0.1				
				22.0	0.1				
				16.0	<0.05				
				25.0	0.3				
				23.0	0.3				
				16.0	<0.05				
				16.0	<0.05				
				25.0	0.2				
				30.0	0.2				
CLO5814	B12b-TS-15912	10/26/2015	16:45	18.0	<0.05	7.9	76.3	0.0380	
				23.0	0.1				
				16.0	<0.05				
				16.0	<0.05				
				20.0	<0.05				
				17.0	<0.05				
				21.0	0.1				
				21.0	<0.05				
				18.0	<0.05				
				17.0	<0.05				

Table 4 - 2015 Closed Area Grass Shrimp Sample Stations, Sample IDs, Processing Data, and Analytical Results

Station ID	Sample ID	Date	Time	Width[a] (mm)	Shrimp Weight[a] (g)	Sample Weight[cd] (g)	Percent Moisture	Total Hg wet weight (μg/g)	Flag
CLO5814	B12b-TS-15913	10/26/2015	16:45	15.0	<0.05	8.1	80.2	0.0276	
				17.0	<0.05				
				17.0	<0.05				
				21.0	0.2				
				26.0	0.2				
				16.0	<0.05				
				26.0	0.2				
				18.0	<0.05				
				18.0	<0.05				
				18.0	<0.05				
LVB5513	B12b-TS-15914	10/26/2015	16:20	20.0	<0.05	11.9	76.4	0.0475	
				19.0	<0.05				
				31.0	0.3				
				28.0	0.1				
				20.0	<0.05				
				16.0	<0.05				
				18.0	<0.05				
				34.0	0.4				
				16.0	<0.05				
				33.0	0.4				
LVB5513	B12b-TS-15915	10/26/2015	16:20	16.0	<0.05	10.8	76.3	0.0436	
				32.0	0.4				
				28.0	0.1				
				21.0	<0.05				
				26.0	0.1				
				20.0	<0.05				
				25.0	0.1				
				25.0	0.1				
				26.0	0.2				
				31.0	0.3				
LVB5513	B12b-TS-15916	10/26/2015	16:20	18.0	<0.05	11.7	75.4	0.0459	
				25.0	0.2				
				24.0	0.1				
				29.0	0.3				
				29.0	0.3				
				15.0	<0.05				
				30.0	0.3				
				17.0	<0.05				
				28.0	0.1				
				33.0	0.4				
LVB5900	B12b-TS-15917	10/26/2015	15:28	27.0	0.2	11.8	75.2	0.0616	
				24.0	0.2				
				22.0	<0.05				
				20.0	<0.05				
				21.0	<0.05				
				17.0	<0.05				
				18.0	<0.05				
				18.0	<0.05				
				22.0	<0.05				
				21.0	0.1				

Table 4 - 2015 Closed Area Grass Shrimp Sample Stations, Sample IDs, Processing Data, and Analytical Results

Station ID	Sample ID	Date	Time	Width[a] (mm)	Shrimp Weight[a] (g)	Sample Weight[cd] (g)	Percent Moisture	Total Hg wet weight (µg/g)	Flag
LVB5900	B12b-TS-15918	10/26/2015	15:28	22.0	<0.05	11.9	75.0	0.0719	
				14.0	<0.05				
				19.0	<0.05				
				25.0	0.1				
				27.0	0.2				
				26.0	0.1				
				19.0	<0.05				
				17.0	<0.05				
				17.0	<0.05				
				26.0	0.1				
LVB5900	B12b-TS-15919	10/26/2015	15:28	22.0	<0.05	9.9	65.0	0.0910	
				23.0	0.1				
				19.0	<0.05				
				22.0	<0.05				
				16.0	<0.05				
				31.0	0.3				
				28.0	0.2				
				31.0	0.3				
				34.0	0.3				
				16.0	<0.05				
LVB5504	B12b-TS-15920	10/26/2015	15:11	21.0	<0.05	13.6	76.7	0.0811	
				23.0	0.2				
				27.0	0.1				
				27.0	0.2				
				15.0	<0.05				
				26.0	0.2				
				29.0	0.2				
				23.0	0.1				
				28.0	0.2				
				28.0	0.2				
LVB5504	B12b-TS-15921	10/26/2015	15:11	20.0	<0.05	13.4	78.0	0.0659	
				25.0	0.1				
				25.0	0.1				
				25.0	0.1				
				26.0	0.2				
				20.0	<0.05				
				31.0	0.2				
				22.0	<0.05				
				20.0	<0.05				
				31.0	0.3				
LVB5504	B12b-TS-15922	10/26/2015	15:11	20.0	0.1	13.1	77.6	0.0640	
				25.0	0.2				
				27.0	0.2				
				28.0	0.2				
				29.0	0.3				
				18.0	<0.05				
				33.0	0.4				
				27.0	0.2				
				23.0	0.1				
				27.0	0.2				

Table 4 - 2015 Closed Area Grass Shrimp Sample Stations, Sample IDs, Processing Data, and Analytical Results

Station ID	Sample ID	Date	Time	Width[a] (mm)	Shrimp Weight[a] (g)	Sample Weight[cd] (g)	Percent Moisture	Total Hg wet weight (µg/g)	Flag
CLO5802	B12b-TS-15923	10/27/2015	12:13	19.0	<0.05	13.4	78.8	0.148	
				20.0	<0.05				
				27.0	0.3				
				18.0	<0.05				
				29.0	0.1				
				22.0	<0.05				
				19.0	<0.05				
				23.0	<0.05				
				24.0	<0.05				
				19.0	<0.05				
CLO5802	B12b-TS-15924	10/27/2015	12:13	24.0	0.1	16.1	78.0	0.141	
				19.0	<0.05				
				31.0	0.2				
				35.0	0.4				
				29.0	0.2				
				25.0	0.1				
				17.0	<0.05				
				28.0	0.2				
				21.0	<0.05				
				20.0	<0.05				
CLO5802	B12b-TS-15925	10/27/2015	12:13	18.0	<0.05	12.6	77.7	0.150	
				26.0	0.1				
				30.0	0.3				
				19.0	<0.05				
				25.0	0.1				
				16.0	<0.05				
				22.0	0.1				
				25.0	0.1				
				19.0	<0.05				
				31.0	0.2				
CLO6802	B12b-TS-15926	10/28/2015	12:08	18.0	<0.05	10.9	76.7	0.0357	
				20.0	<0.05				
				16.0	<0.05				
				23.0	0.1				
				22.0	0.1				
				22.0	<0.05				
				21.0	<0.05				
				19.0	<0.05				
				21.0	<0.05				
				25.0	0.1				
CLO6802	B12b-TS-15927	10/28/2015	12:08	27.0	0.2	11.9	76.8	0.0397	
				29.0	0.2				
				28.0	0.2				
				19.0	<0.05				
				19.0	<0.05				
				21.0	<0.05				
				18.0	<0.05				
				23.0	<0.05				
				20.0	<0.05				
				21.0	<0.05				

Table 4 - 2015 Closed Area Grass Shrimp Sample Stations, Sample IDs, Processing Data, and Analytical Results

Station ID	Sample ID	Date	Time	Width[a] (mm)	Shrimp Weight[a] (g)	Sample Weight[c,d] (g)	Percent Moisture	Total Hg wet weight (µg/g)	Flag
CLO6802	B12b-TS-15928	10/28/2015	12:08	20.0	0.2	12.5	81.1	0.0305	
				15.0	<0.05				
				24.0	0.1				
				24.0	0.1				
				25.0	0.2				
				30.0	0.5				
				19.0	<0.05				
				23.0	0.1				
				27.0	0.1				
				28.0	0.3				
CLO5815	B12b-TS-15929	10/28/2015	11:40	29.0	0.3	13.9	76.9	0.0876	
				28.0	0.4				
				28.0	0.3				
				26.0	0.2				
				26.0	0.3				
				27.0	0.3				
				26.0	0.2				
				23.0	0.1				
				25.0	0.2				
				23.0	<0.05				
CLO5815	B12b-TS-15930	10/28/2015	11:40	26.0	0.1	16.8	77.5	0.0925	
				16.0	<0.05				
				31.0	0.3				
				17.0	<0.05				
				25.0	0.2				
				30.0	0.3				
				30.0	0.5				
				18.0	<0.05				
				32.0	0.3				
				27.0	0.1				
CLO5815	B12b-TS-15931	10/28/2015	11:40	27.0	0.1	15.1[b]	77.4	0.0833	
				25.0	0.1				
				28.0	0.4				
				19.0	<0.05				
				29.0	0.3				
				29.0	0.4				
				29.0	0.3				
				24.0	<0.05				
				19.0	<0.05				
				32.0	0.3				
CLO5803	B12b-TS-15932	10/28/2015	9:25	26.0	0.1	10.3	79.3	0.0857	
				28.0	0.2				
				19.0	0.1				
				19.0	<0.05				
				16.0	<0.05				
				17.0	<0.05				
				20.0	0.1				
				22.0	0.1				
				18.0	<0.05				
				18.0	<0.05				

Table 4 - 2015 Closed Area Grass Shrimp Sample Stations, Sample IDs, Processing Data, and Analytical Results

Station ID	Sample ID	Date	Time	Width[a] (mm)	Shrimp Weight[a] (g)	Sample Weight[cd] (g)	Percent Moisture	Total Hg wet weight (µg/g)	Flag
CLO5803	B12b-TS-15933	10/28/2015	9:25	29.0	0.2	11.3	79.0	0.0903	
				28.0	0.2				
				19.0	<0.05				
				29.0	0.2				
				22.0	<0.05				
				26.0	0.2				
				19.0	<0.05				
				17.0	<0.05				
				25.0	0.1				
				18.0	<0.05				
CLO5803	B12b-TS-15934	10/28/2015	9:25	26.0	0.2	11.8	78.8	0.0975	
				19.0	<0.05				
				17.0	<0.05				
				17.0	<0.05				
				24.0	0.1				
				17.0	<0.05				
				24.0	0.2				
				17.0	<0.05				
				24.0	0.1				
				20.0	<0.05				
Marsh 1-3R	B12b-TS-15937	12/1/2015	12:00	30.0	0.2	14.5	76.5	0.192	
				24.0	0.1				
				24.0	0.1				
				32.0	0.2				
				31.0	0.3				
				26.0	0.2				
				22.0	0.1				
				23.0	0.1				
				18.0	<0.05				
				24.0	0.1				
Marsh 1-3R	B12b-TS-15938	12/1/2015	12:00	32.0	0.3	13.4	77.9	0.166	
				18.0	<0.05				
				22.0	<0.05				
				23.0	0.1				
				33.0	0.3				
				24.0	0.1				
				21.0	<0.05				
				19.0	<0.05				
				23.0	0.1				
				30.0	0.2				
Marsh 1-3R	B12b-TS-15939	12/1/2015	12:00	37.0	0.5	13.9	77.1	0.183	
				19.0	0.1				
				24.0	0.1				
				26.0	0.1				
				20.0	<0.05				
				25.0	0.1				
				21.0	<0.05				
				22.0	0.1				
				24.0	0.1				
				21.0	<0.05				
Average Values				22.9	0.0114	11.9	76.8	0.087	

a 10 represenative organisms recorded

b Total sample composed of 95 organisms

c Total sample composed of 100 organisms

d Sample weight of 100 organisms

Table 5 - 2015 Adjacent Open Area Grass Shrimp Sample Stations, Sample IDs, Processing Data, and Analytical Results

Station ID	Sample ID	Date	Time	Width [a] (mm)	Shrimp Weight [a] (g)	Sample Weight [cd] (g)	Percent Moisture	Total Hg wet weight (µg/g)	Flag
LVB6870	B12b-TS-15904	10/13/2015	10:02	NR	NR	NR	77.5	0.0547	
				NR	NR				
				NR	NR				
				NR	NR				
				NR	NR				
				NR	NR				
				NR	NR				
				NR	NR				
				NR	NR				
				NR	NR				
LVB5838	B12b-TS-15905	10/13/2015	9:00	NR	NR	NR	74.1	0.0271	
				NR	NR				
				NR	NR				
				NR	NR				
				NR	NR				
				NR	NR				
				NR	NR				
				NR	NR				
				NR	NR				
				NR	NR				
LVB6871	B12b-TS-15906	10/13/2015	10:40	NR	NR	NR	77.1	0.0346	
				NR	NR				
				NR	NR				
				NR	NR				
				NR	NR				
				NR	NR				
				NR	NR				
				NR	NR				
				NR	NR				
				NR	NR				
LVB6850	B12b-TS-15907	10/13/2015	8:20	NR	NR	NR	77.8	0.0548	
				NR	NR				
				NR	NR				
				NR	NR				
				NR	NR				
				NR	NR				
				NR	NR				
				NR	NR				
				NR	NR				
				NR	NR				
LVB6852	B12b-TS-15936	12/1/2015	14:00	39.0	0.5	17.6	79.5	0.031	
				32.0	0.3				
				19.0	<0.05				
				21.0	<0.05				
				24.0	0.2				
				25.0	0.2				
				27.0	0.2				
				27.0	0.1				
				18.0	<0.05				
				21.0	<0.05				
Average Values				25.3	0.1760	17.6	77.2	0.0404	

a. 10 represenative organisms recorded
b Total sample composed of 95 organisms
c. Total sample composed of 100 organisms
d Sample weight of 100 organisms

Appendix B3

Qualitative Gut Content Study

Study 3

March 2016

ALCOA

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

1.0 INTRODUCTION

A key factor in the success of the Lavaca Bay Remedy is the reduction in tissue mercury concentrations through targeted source control efforts, sediment removal efforts, capping, enhanced natural recovery, and/or natural recovery. In accordance with Section 4.4 (Recommendations) of the 2014 Remedial Action Annual Effectiveness Report (RAAER), supplemental studies concerning red drum diet were conducted to improve our understanding of the processes by which methylmercury bioaccumulates in red drum. The work plan was submitted to the USEPA on September 15, 2015, (Alcoa 2015b) and received approval from the USEPA on September 25, 2015.

1.1 PURPOSE AND SCOPE

The objective of Study 3 was to evaluate the contents of the stomachs of red drum collected for the 2015 monitoring event and to determine if prey items with elevated levels of mercury, other than the species routinely monitored, are being consumed by red drum (*Sciaenops ocellatus*). The prey item data collected during this study will be used to determine if the focus of the existing monitoring programs should be expanded beyond juvenile blue crab to include other species that are common components of the red drum diet.

The contents of the stomachs of each red drum collected and processed for the 2015 annual monitoring study were removed, sorted, and identified. Thirty fish were collected from the Open Area stations, and 30 fish were collected from Adjacent Open Area stations. The contents of the stomachs of each fish were examined for this study.

1.2 SITE DESCRIPTION

The Alcoa Point Comfort Operations Plant is located in Calhoun County, Texas, adjacent to Lavaca Bay. An area in the bay adjacent to the Alcoa Plant is associated with elevated mercury concentrations in fish tissue and is closed to the taking of finfish and blue crabs for consumption by order of the Texas Department of Health. This area is referred to as the “Closed Area” and is delineated in the figures contained in this report. The monitoring area specified in the OMMP includes both the Closed Area and designated areas outside the Closed Area (termed the “Adjacent Open Area”).

2.0 METHODS

Legal sized red drum (508–711 mm Total Length] [TL]) were collected and processed by Benchmark Ecological Services, Inc., at the clean lab in the Alcoa Point Comfort Facility (Point Comfort Operations), in Point Comfort, Texas. Red drum were collected for the annual monitoring effort between 6 October 2015 and 29 December 2015. None of the stomach contents collected for this study were chemically analyzed.

2.1 SAMPLE STATIONS

Legal-sized red drum were collected from 12 established stations in the Closed Area and 10 established stations in the Adjacent Open Area. Sample station locations are shown in Figures 1 and 2 in the *Lavaca Bay Finfish and Shellfish Monitoring Report 2015* (Appendix B). A Global Positioning System (GPS) was used to determine the positions of all sample stations.

Table 1 shows the number of red drum collected by zone. The distribution of red drum ranged from 3 fish in Zone 1 to 14 fish in Zone 2. The uneven distribution of samples among the zones was due to the uneven distribution of suitable habitat within the Zones.

2.2 SAMPLE COLLECTION

In the Closed Area, 30 red drum tissue samples were collected from the 12 sample stations. In the Adjacent Open Area, 30 red drum tissue samples were collected from the 10 sample stations. A Global Positioning System (GPS) was used to determine the positions of all sample stations.

A detailed description of the methods for collecting red drum for this study is provided in the *Lavaca Bay Finfish and Shellfish Monitoring Report 2015* (Appendix B). This study was conducted according to procedures developed by Alcoa for gut content surveys conducted in 2011 and 2012. The procedures are described in Benchmark Standard Operating Procedure SOP-BESI-515. Only red drum with total lengths between 508 and 711 mm (20 to 28 inches) were retained for this study. Undersized and oversized red drum and specimens of other species were returned to the water.

2.3 SAMPLE PROCESSING

Red drum samples were processed on the date of collection in the Alcoa Clean Lab (located at the Alcoa Point Comfort Facility) and remained on ice until processing was complete. Fish were weighed, measured, scaled, and rinsed with deionized (DI) water. Data were recorded on tissue processing data sheets and are provided in the *Lavaca Bay Finfish and Shellfish Monitoring Report 2015* (Appendix B). After scaling, fish were placed in clean plastic bags and returned to cold storage until all fish were scaled.

After the right fillet (with skin) was removed from each fish and placed in a sample container, the abdominal cavity was opened and the stomach was removed. The stomach was removed by cutting the esophagus just above the stomach and cutting the intestine just below the stomach. The stomach was cut open, contents were be removed, and placed on a clean cutting board.

Contents were separated by species, and counted. Prey items were photographed by species. Representatives of each prey species or category of contents was photographed and IDs were recorded on the gut content data sheet (Tables 2 and 3). Each prey species was weighed separately. All unidentifiable contents were weighed together as a separate item. All data were recorded on the gut content data sheet.

3.0 OBSERVATIONS

- The diet of red drum from Closed and Adjacent areas is generally the same within year.
- Assortment of prey items available to red drum is different year to year.
- Juvenile blue crabs are not the most abundant species in the gut but are consistently found in red drum, regardless of environmental conditions at the time of the sampling.
- There were 24 fish collected from reef stations and 6 fish from marsh stations in the Closed Area.
- Most common prey items from Closed Area reef stations were sand eels, white shrimp, and blue crabs (Figure 1).
- Most common identifiable prey items from closed marshes were white shrimp and blue crabs (Figure 2).
- Most common prey items from Adjacent Open Area reefs were white shrimp (Figure 3).
- Most common identifiable prey items from Adjacent Open Area marshes were blue crabs, sand eels, and white shrimp (Figure 4).

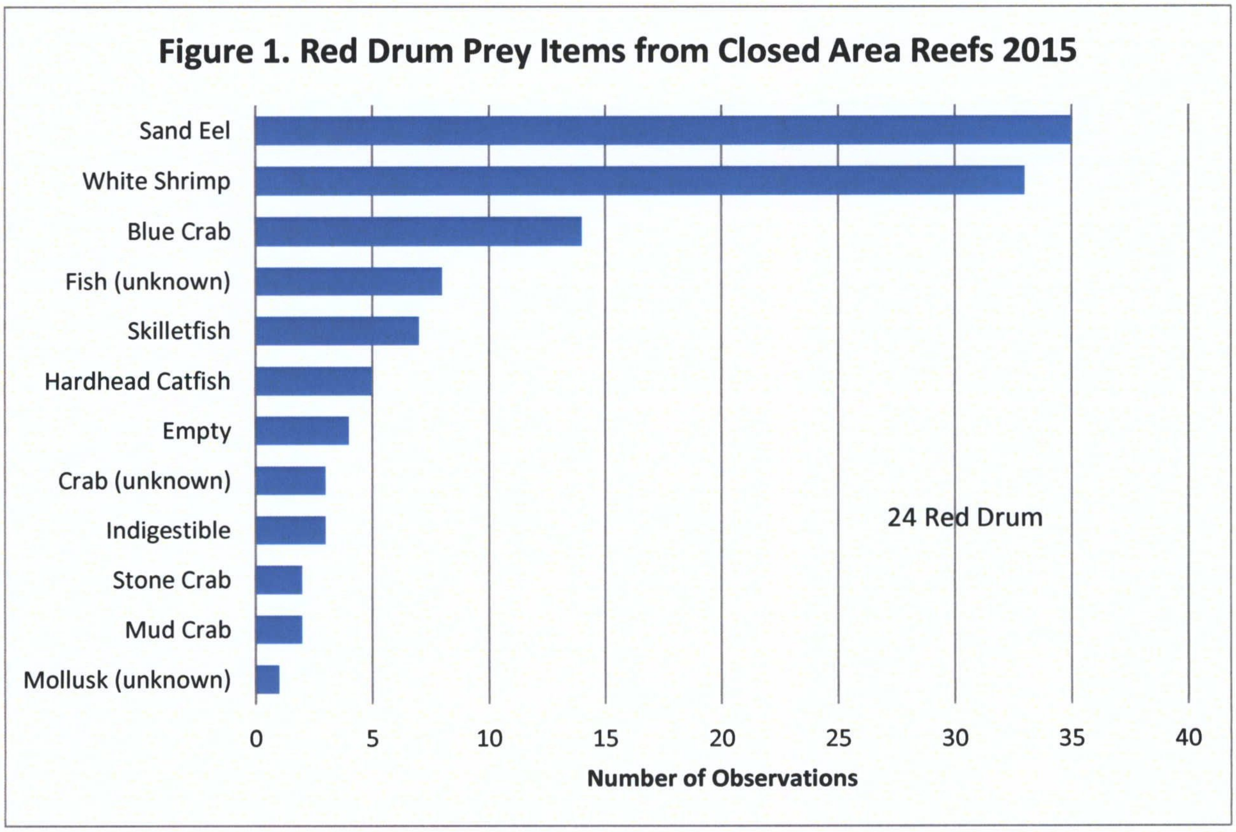


Figure 1. Red Drum Prey Items from Closed Area Reefs 2015
Sand Eel
White Shrimp
Blue Crab
Fish (unknown)
Skilletfish
Hardhead Catfish
Empty
Crab (unknown)
Indigestible
Stone Crab
Mud Crab
Mollusk (unknown)
24 Red Drum
0
5
10
15
20
25
30
35
40
Number of Observations

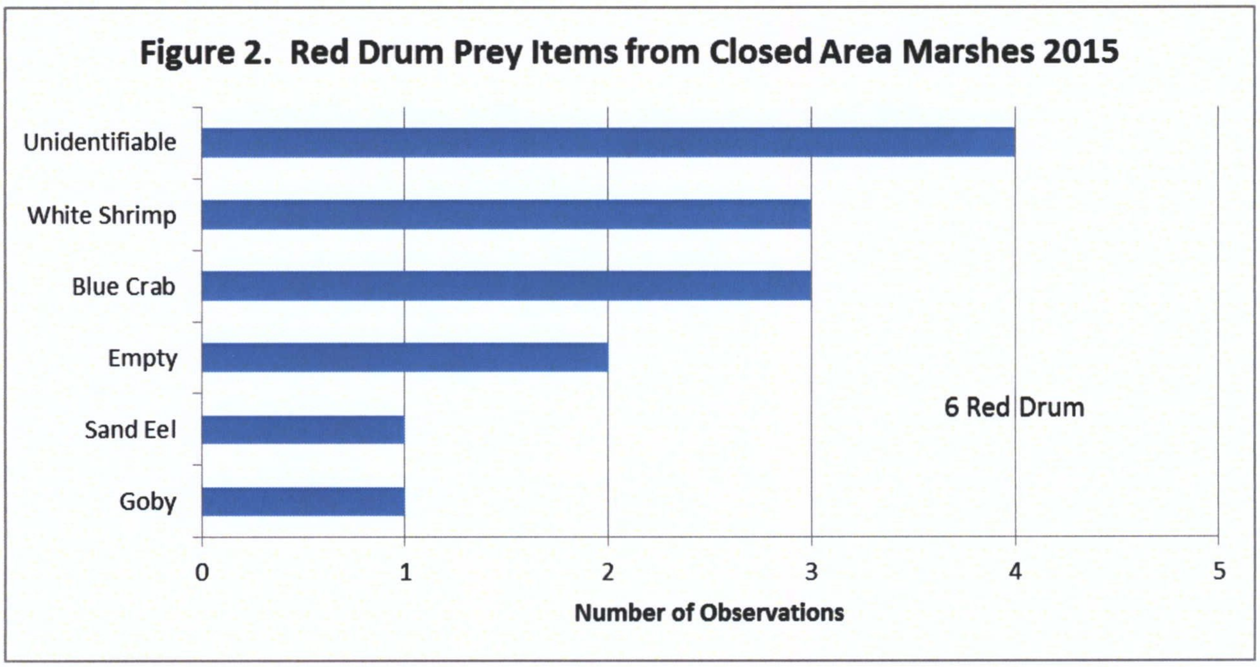


Figure 2. Red Drum Prey Items from Closed Area Marshes 2015
Unidentifiable
White Shrimp
Blue Crab
Empty
Sand Eel
Goby
6 Red Drum
0
1
2
3
4
5
Number of Observations

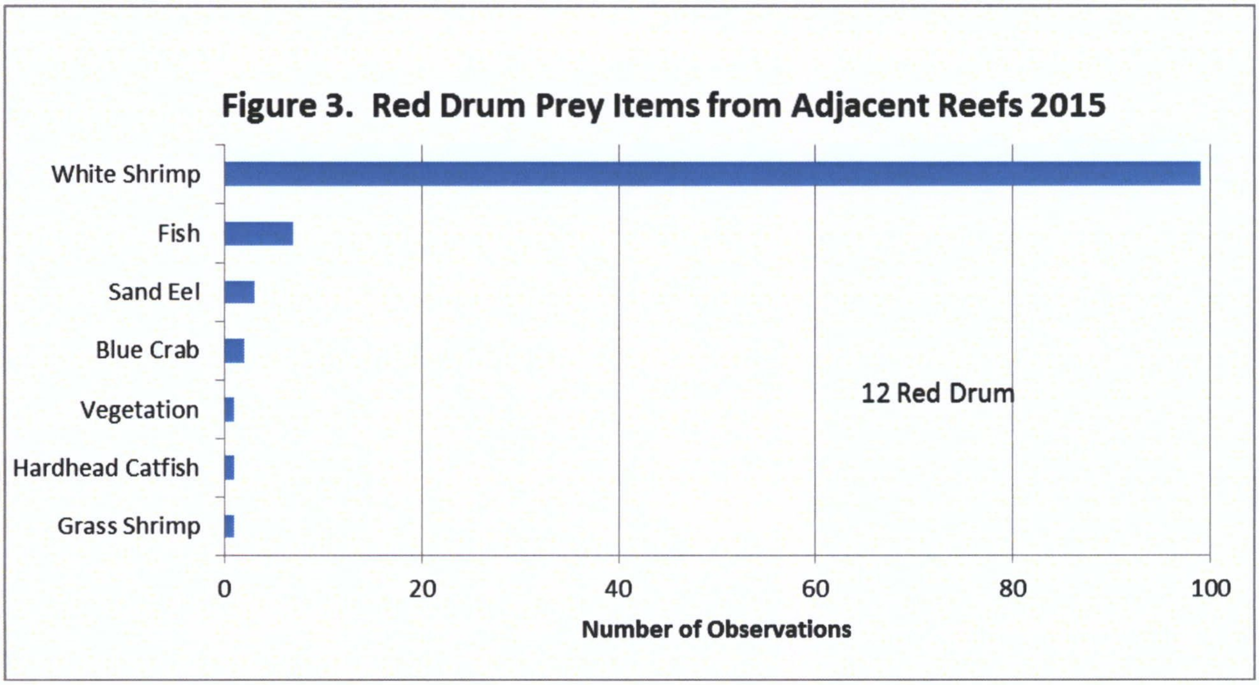


Figure 3. Red Drum Prey Items from Adjacent Reefs 2015
White Shrimp
Fish
Sand Eel
Blue Crab
Vegetation
Hardhead Catfish
Grass Shrimp
12 Red Drum
0
20
40
60
80
100
Number of Observations

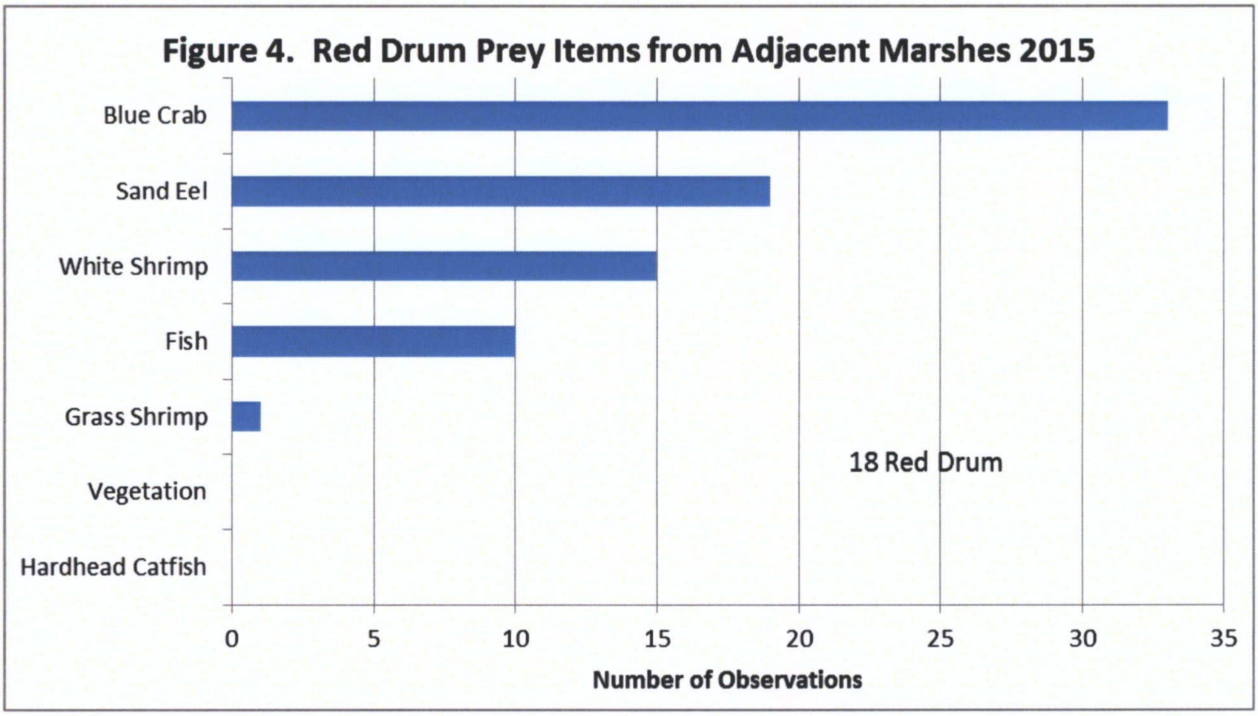


Figure 4. Red Drum Prey Items from Adjacent Marshes 2015
Blue Crab
Sand Eel
White Shrimp
Fish
Grass Shrimp
Vegetation
Hardhead Catfish
18 Red Drum
0
5
10
15
20
25
30
35
Number of Observations

Table 1 – Red Drum Collected by Zone

Zone	Red Drum
Zone 1	3
Zone 2	14
Zone 3	6
Zone 4	7

Table 2 - 2015 Closed Area Red Drum Gut Contents

Habitat	Station ID	Sample ID	Gut Content			Comments
			Species	Number	Weight (g)	
Reef	CLO5803	B12b-TF-15302	Hardhead Catfish	2	5.4	
	CLO5818	B12b-TF-15303	Stone Crab claws	2	2.0	
	CLO5818	B12b-TF-15304	No Gut Content	NA	NA	No photo
	CLO5818	B12b-TF-15305	Blue Crab (fragments)	6	5.1	
	CLO5900	B12b-TF-15306	Unidentifable Crab (fragments)	3	2.2	
	CLO5900	B12b-TF-15307	No Gut Content	NA	NA	No photo
	LVB5518	B12b-TF-15309	Unidentifiable Fish Spine	1	2.9	
	LVB5518	B12b-TF-15310	Hardhead Catfish shull and spine	1	1.2	
	CLO5803	B12b-TF-15321	Hardhead Catfish	1	2.4	
	CLO5803	B12b-TF-15322	Hardhead Catfish	1	6.3	
	CLO5815	B12b-TF-15323	No Gut Content	NA	NA	No photo
	CLO5815	B12b-TF-15328	Sand Eel	1	23.4	
			Indigestible matter	1		
	LVB5518	B12b-TF-15329	Mud Crab	1	28.4	
			Blue Crab	1		
			Unidentifiable Fish	3		
			Indigestible matter	2		
	CLO5900	B12b-TF-15330	Sand Eel	1	56.0	
			Skilletfish	4		
	LVB5508	B12b-TF-15331	Blue Crab (fragments)	1	0.6	
	LVB5508	B12b-TF-15332	Sand Eel	1	56.5	
	LVB5513	B12b-TF-15335	No Gut Content	NA	NA	No photo
	CLO5815	B12b-TF-15346	Unknown Mollusk	1	1.0	
	LVB5509	B12b-TF-15349	Blue Crab	1	18.9	
			White Shrimp	30+		
	LVB5508	B12b-TF-15358	Sand Eel	11	82.4	
			Blue Crab	2		
	LVB5513	B12b-TF-15359	Sand Eel	3	10.4	
	CLO5817	B12b-TF-15360	Mud Crab (well digested)	1	27.3	
	CLO5806	B12b-TF-15361	Blue Crab	2	203.6	
			Skilletfish	3		
			Sand Eel	17		
			White Shrimp	3		
			Unidentifiable Fish	3		
	CLO5806	B12b-TF-15362	Blue Crab	1+	132.0	
			Sand Eel	1+		
			Unidentifiable Fish	1+		

[1]NA - Gut cavity was empty

Table 2 - 2015 Closed Area Red Drum Gut Contents (Continued)

Habitat	Station ID	Sample ID	Gut Content			Comments
			Species	Number	Weight (g)	
Marsh	CLO5802	B12b-TF-15308	White Shrimp	2	17.1	
			Blue Crab (fragment)	1		
	CLO5802	B12b-TF-15311	No Gut Content	NA	NA	No photo
	CLO5814	B12b-TF-15312	No Gut Content	NA	NA	No photo
	CLO5814	B12b-TF-15313	Blue Crab (fragments)	unknown	3.8	
			White Shrimp (fragments)	unknown		
	CLO5814	B12b-TF-15314	Goby	1	0.5	
			Unidentifiable Organisms	4		
	CLO5802	B12b-TF-15327	Blue Crab	1	7.0	
			Sand Eel	1		

[1]NA - Gut cavity was empty

Table 3 - 2015 Adjacent Open Area Red Drum Gut Contents

Habitat	Station ID	Sample ID	Gut Content			Comments
			Species	Number	Weight (g)	
Reef	LVB6837	B12b-TF-15337	Blue Crab	1	2.9	
			Hardhead Catfish	1		
	LVB5841	B12b-TF-15339	Unidentifiable Fish	4	55.1	
			Sand Eel	2		
	LVB5841	B12b-TF-15343	White Shrimp	5	9.2	
	LVB5841	B12b-TF-15344	Unidentifiable Fish Spine	unknown	3.0	
	LVB6837	B12b-TF-15347	Large Blue Crab (fragments)	1	14.6	
			Vegetation	1		
	LVB6880	B12b-TF-15348	Unidentifiable Fish	unknown	59.7	
	LVB5830	B12b-TF-15350	White Shrimp	4	2.9	
	LVB5830	B12b-TF-15351	White Shrimp	24	18.0	
			Sand Eel	1		
			Grass Shrimp	1		
	LVB5830	B12b-TF-15352	White Shrimp	62	32.2	
	LVB6880	B12b-TF-15353	No Gut Content	NA	NA	No Photo
	LVB6837	B12b-TF-15356	No Gut Content	NA	NA	No Photo
	LVB6880	B12b-TF-15357	Unidentifiable Fish Parts	unknown	unknown	
			White Shrimp	4		
Marsh	LVB6871	B12b-TF-15315	White Shrimp	10	8.0	
			Unidentifiable Fish	1		
	LVB6871	B12b-TF-15316	Blue Crab	1	7.7	
	LVB6871	B12b-TF-15317	White Shrimp	1	3.3	
			Blue Crab	4		
	LVB6870	B12b-TF-15318	Partially-digested Blue Crab	1	unknown	
	LVB6870	B12b-TF-15319	No Gut Content	NA	NA	No Photo
	LVB6870	B12b-TF-15320	No Gut Content	NA	NA	No Photo
	LVB6850	B12b-TF-15324	Blue Crab	1	9.9	
	LVB5839	B12b-TF-15325	Silverside Minnow (Well-digested)	2	22.9	
			Blue Crab (Well-digested)	1		
	LVB5839	B12b-TF-15326	Unidentifiable Fish Spine	1	> 0.05	
	LVB5838	B12b-TF-15333	Sea Robins	2	7.4	
			Grass Shrimp	1		
	LVB5838	B12b-TF-15334	Sand Eel	7	44.7	
	LVB5839	B12b-TF-15338	White Shrimp	2	2.1	
	LVB6950	B12b-TF-15340	Sand Eel	9	14.6	
			Juvenile Blue Crab	8		
			Silverside Minnow	1		
			Unidentifiable Fish	unknown		

[1]NA - Gut cavity was empty

Table 3 - 2015 Adjacent Open Area Red Drum Gut Contents (Continued)

Habitat	Station ID	Sample ID	Gut Content			Comments
			Species	Number	Weight (g)	
Marsh	LVB6950	B12b-TF-15341	Juvenile Blue Crab	9	2.2	
			Sand Eel	2		
			Partially-digested fish	1		
	LVB6950	B12b-TF-15342	Juvenile Blue Crab	1	0.2	
	LVB5838	B12b-TF-15345	Blue Crab	5	132.9	
			White Shrimp	2		
			Sand Eel	1		
			Spartina organic matter	unknown		
	LVB6850	B12b-TF-15354	Large Blue Crab	2	35.8	
	LVB6850	B12b-TF-15355	Unidentifiable Fish	1	7.6	

[1]NA - Gut cavity was empty

Appendix B4

Focused Sediment and Prey Sampling In and Near Marshes

Study 5

March 2016

ALCOA

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

ALS	- ALS Laboratory Group
GPS	- Global Positioning System
Hg	- Mercury
ID	- Identification
meHg	- Methylmercury
OMMP	- Operation Maintenance and Monitoring Plan
RAAER	- Remedial Action Annual Effectiveness Report
RAO	- Remedial Action Objective
TOC	- Total Organic Carbon

1.0 INTRODUCTION

In accordance with Section 4.4 (Recommendations) of the 2014 Remedial Action Annual Effectiveness Report (RAAER), additional sediment and prey item samples (mud crabs) were collected near marshes where juvenile blue crabs have elevated total Hg concentrations. The work plan was submitted to the U.S. Environmental Protection Agency (USEPA) on September 18, 2015, (Alcoa 2015c) with responses to EPA comments submitted on October 5, 2015 (Alcoa 2015d). The study received approval from the USEPA on October 8, 2015. Sediment samples were analyzed for total Hg, methylmercury, and TOC, and tissue samples were analyzed for total Hg. Surface sediment (0 to 2 cm) was collected from 13 sample stations, and mud crabs were collected at 7 sample stations (3 crab samples/station). Sediment sample stations are shown in Figure 1, and mud crab sample stations are shown in Figure 2.

1.1 PURPOSE AND SCOPE

Sediment and tissue samples were collected to develop additional information on potential areas of enhanced methylmercury uptake to the food web in locations with elevated mercury in juvenile blue crab data. Thirteen sediment samples were collected from sample stations shown in Figure 1 and analyzed for total mercury, methylmercury, and total organic carbon (TOC). Twenty-one mud crab samples were collected from seven sample stations (three crab samples/station) shown in Figure 2 and were analyzed for total mercury.

1.2 SITE DESCRIPTION

Alcoa Point Comfort Operations is located in Calhoun County, Texas, adjacent to Lavaca Bay. The area in the bay adjacent to the Alcoa Plant is associated with elevated mercury concentrations in fish tissue and is closed to the taking of finfish and shellfish for consumption by order of the Texas Department of Health. This area is referred to as the Closed Area. The Remedial Investigation identified the Closed Area as an area where open water and marsh sediment contain elevated mercury concentrations. The study area and sampling strategy for the open water sediment samples and marsh sediment samples within the closed area are documented in the OMMP.

2.0 METHODS

Sediment and tissue samples were collected and processed by Benchmark Ecological Services, Inc. (Benchmark). Methylmercury in sediment was analyzed by Battelle Marine Sciences Laboratory (Battelle) in Sequim, Washington, and total mercury and TOC were analyzed by ALS Laboratory Group (ALS) in Houston, Texas. Sediment samples were collected on 11 November 2015, 22 December 2015, and 30 December 2015. Tissue total Hg was analyzed by Battelle. Tissue samples were collected on 1 December 2015 through 3 December 2015.

Validation and evaluation of the analytical results was conducted by Environmental Chemistry Services, Inc., in Houston, Texas.

2.1 SAMPLE STATIONS

Sample stations were located using coordinates provided by Alcoa. The coordinates were entered into a sub-meter Global Positioning System (GPS), and the GPS was used to position personnel over the sample station. Actual coordinates for the final sample station locations were recorded using the sub-meter differential GPS. Sediment sample station locations are shown in Figure 1, and the tissue sample stations are shown in Figure 2.

2.2 SAMPLE COLLECTION

Nine of the 13 sediment samples were collected from open-water sample stations, and 4 of the 13 samples were collected from marsh sample stations. Open water and marsh sediment samples were collected and processed using the methods described in Section 2.2 of the *Lavaca Bay Annual Sediment Monitoring Study Fall 2015* (March 2016) report. Sediment sample stations, sample IDs, and field data are in Table 1.

Tissue samples were collected using an oyster dredge. Clusters of oysters from each sample station were collected in the oyster dredge, mud crabs were removed from the oyster clusters, and placed in Ziplock™ bags. A sufficient number of mud crabs were collected from each sample station to process three samples/station. Mud crabs were processed using the same methods as the juvenile blue crab described in Section of the 2.3.2 of the *Lavaca Bay Finfish and Shellfish Monitoring Report 2015* (March 2016). Mud crab sample stations, sample IDs, and sample processing data are listed in Table 2.

3.0 ANALYTICAL RESULTS

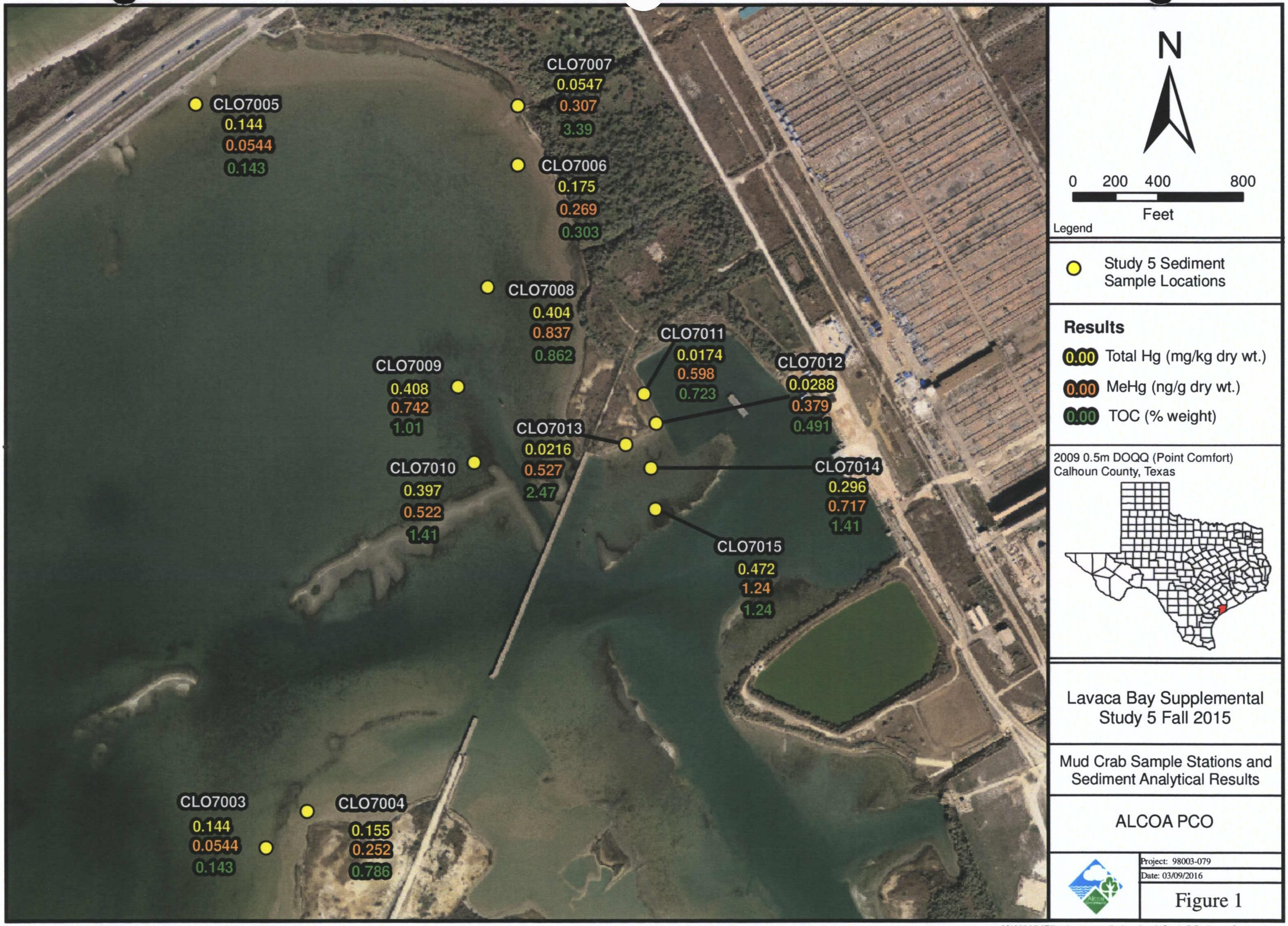
Study 5 sediment samples were analyzed for methylmercury by Battelle, and total mercury and TOC were analyzed by ALS. Sediment methylmercury results were reported in ng/g as dry weight, sediment samples were reported as mg/Kg dry weight, and sediment TOC results were reported in wt% dry weight.

Study 5 mud crab samples were analyzed for total mercury by Battelle, and results were reported as µg/g wet weight.

Benchmark received all final sediment data packets from Battelle on 8 February 2016 and from ALS Laboratory on 21 January 2016. Data validation and evaluation was completed by Environmental Chemistry Services on 19 February 2016.

Sediment station numbers, sample IDs, and analytical results are listed for each sample in Table 1 and shown in Figure 1. Mud crab station numbers, sample identification numbers, and analytical results are listed in Table 2 and shown in Figure 2.

Analytical results for sediment and tissue samples were validated according to the Standard Operating Procedure Data Validation (Appendix E) in the Quality Assurance Project Plan Alcoa (Point Comfort)/Lavaca Bay Superfund Site (22 August 2005). All analytical results were validated and may be included in the data used to evaluate the effectiveness of the approved remedy and to meet monitoring requirements specified in the Consent Decree.



M:\98003\079\arc\post sampling\mud crab\Study 5 Sediment Stations2.mxd

Legend

Mud Crab Sample Stations

0.00 Total Hg (ug/g) Wet Wt.

Notes

2009 0.5m DOQQ (Point Comfort)
Calhoun County, Texas

Lavaca Bay Supplemental Study 5 Fall 2015

Mud Crab Sample Stations and Tissue Analyical Results

ALCOA PCO

Project: 98003-079
Date: 01/21/2016

Figure 2

M:\98003\079\arc\post sampling\mud crab\mud_crab_15_results.mxd

Table 1 - Mud Crab Sediment Stations, Sample IDs, Field Data, and Analytical Results

Station ID	Easting[1]	Northing[1]	Sample ID	Date	Time	Water Depth[2] (ft)	Total Hg				Methyl Hg			TOC	
							% M	(mg/kg) dry wt	SQL[3] (mg/kg)	Flag	% M	(ng/g) dry wt	Flag	(wt%) dry wt	SQL (wt%)
CLO7003	2746256.95	13430539.61	B12b-SE-16750	12/30/2015	8:45	1.3	24.9	0.144	0.000664		28.1	0.054		0.143	0.0600
CLO7004	2746451.39	13430711.36	B12b-SE-16752	12/30/2015	9:00	1.1	28.8	0.155	0.000664		31.0	0.252		0.786	0.0600
CLO7005	2745926.59	13434047.22	B12b-SE-17609	12/22/2015	11:55	1.3	24.9	0.144	0.000664		27.6	0.723		0.143	0.0600
CLO7006	2747442.81	13433760.51	B12b-SE-17610	12/22/2015	12:05	1.5	26.5	0.175	0.000666	J-	28.8	0.269		0.303	0.0600
CLO7007	2747443.56	13434040.5	B12b-SE-16877	11/11/2015	12:30	0.8	19.7	0.0547	0.000595		22.8	0.307		3.39	0.0600
CLO7008	2747299.84	13433185.48	B12b-SE-17612	12/22/2015	12:14	3.2	50.3	0.404	0.00101		47.3	0.837		0.862	0.0600
CLO7009	2747160.90	13432715.42	B12b-SE-17613	12/22/2015	12:25	2.9	59.9	0.408	0.00121		55.2	0.742		1.01	0.0600
CLO7010	2747237.92	13432355.93	B12b-SE-17614	12/22/2015	12:37	2.5	53.1	0.397	0.00101		50.1	0.522		1.41	0.0600
CLO7011	2748038.79	13432681.1	B12b-SE-16878	11/11/2015	12:50	1.0	29.4	0.0174	0.000666		36.1	.598		0.723	0.0600
CLO7012	2748096.44	13432542.1	B12b-SE-16879	11/11/2015	12:57	1.5	27.5	0.0288	0.000673		33.5	0.379		0.491	0.0600
CLO7013	2747950.74	13432441.2	B12b-SE-16880	11/11/2015	13:05	1.5	26.8	0.0216	0.000644		39.1	0.527		2.47	0.0600
CLO7014	2748070.33	13432329.39	B12b-SE-17615	12/22/2015	12:48	2.0	39.4	0.296	0.000780		40.2	0.717		1.41	0.0600
CLO7015	2748091.56	13432135.93	B12b-SE-17616	12/22/2015	12:55	2.2	57.1	0.472	0.00112		49.8	1.24		1.24	0.0600

[1]Coordinates reported in NAD 1983 State Plane Texas South Central, Feet

[2] Water Depths are not calibrated to tidal level

[3]SQL - Sample Quantitation Limit

J- MS 84% and MSD 82% were below criteria of 85% to 115%

Table 2 - Mud Crab Tisue Sample Stations, Sample IDs, Processing Data, and Analytical Results

Station ID	Sample ID	Date	Time	Width (mm)	Crab Weight (g)	Sample Weight (g)	Percent Moisture	Total Hg Wet Weight (µg/g)	Flag
CLO7014	B12b-TS-15970	12/1/2015	14:30	22.0	3.8	12.8	63.2	0.230	
				12.0	0.5				
				14.0	0.9				
				12.0	0.5				
				12.0	0.6				
				17.0	1.6				
				8.0	0.2				
				10.0	0.3				
				9.0	0.3				
				21.0	3.5				
CLO7014	B12b-TS-15971	12/1/2015	14:30	17.0	1.5	9.2	61.9	0.154	
				17.0	1.4				
				6.8	<0.05				
				10.0	0.2				
				7.5	0.2				
				18.0	1.8				
				13.0	0.6				
				17.0	1.9				
				10.0	0.3				
				11.0	0.4				
CLO7014	B12b-TS-15972	12/1/2015	14:30	15.5	1.2	9.3	62.2	0.146	
				10.0	0.3				
				12.0	0.5				
				10.0	0.3				
				19.0	2.5				
				17.0	1.4				
				9.0	0.2				
				15.0	1.1				
				18.0	1.7				
				11.0	0.4				
CLO7010	B12b-TS-15973	12/1/2015	13:00	15.0	1.1	7.5	59.2	0.104	
				14.0	0.9				
				11.0	0.4				
				10.0	0.3				
				17.0	1.1				
				11.0	0.4				
				11.0	0.5				
				13.0	0.8				
				14.0	0.8				
				11.0	0.4				

Table 2 - Mud Crab Tisue Sample Stations, Sample IDs, Processing Data, and Analytical Results

Station ID	Sample ID	Date	Time	Width (mm)	Crab Weight (g)	Sample Weight (g)	Percent Moisture	Total Hg Wet Weight (µg/g)	Flag
CLO7010	B12b-TS-15974	12/1/2015	13:00	16.0	1.3	9.4	60.8	0.143	
				13.0	0.7				
				12.0	0.6				
				11.0	0.3				
				16.0	1.2				
				14.0	0.9				
				17.5	1.8				
				12.5	0.7				
				9.0	0.2				
				13.0	0.8				
CLO7010	B12b-TS-15975	12/1/2015	13:00	16.0	1.2	6.2	59.5	0.112	
				10.0	0.3				
				13.0	0.5				
				13.0	0.6				
				13.0	0.7				
				11.0	0.4				
				10.0	0.3				
				9.5	0.4				
				9.0	0.2				
				8.0	0.1				
CLO7015	B12b-TS-15976	12/1/2015	15:15	18.1	2.3	11.8	66.3	0.167	
				16.1	1.7				
				19.0	1.8				
				15.0	1.0				
				11.5	0.4				
				10.5	0.3				
				17.0	1.5				
				12.0	0.4				
				13.0	0.7				
				14.8	1.0				
CLO7015	B12b-TS-15977	12/1/2015	15:15	15.2	1.0	9.1	63.7	0.110	
				15.0	1.1				
				18.0	1.7				
				11.0	0.4				
				10.8	0.5				
				9.8	1.0				
				10.0	0.3				
				11.5	1.3				
				12.8	0.5				
				11.5	0.6				

Table 2 - Mud Crab Tisue Sample Stations, Sample IDs, Processing Data, and Analytical Results

Station ID	Sample ID	Date	Time	Width (mm)	Crab Weight (g)	Sample Weight (g)	Percent Moisture	Total Hg Wet Weight (µg/g)	Flag
CLO7015	B12b-TS-15978	12/1/2015	15:15	18.0	2.4	7.0	63.7	0.140	
				12.0	0.6				
				9.5	0.3				
				13.4	0.6				
				10.0	0.3				
				11.6	0.5				
				10.2	0.3				
				10.7	0.4				
				12.2	0.5				
				10.6	0.4				
CLO7009	B12b-TS-15979	12/1/2015	16:00	22.0	4.2	10.3	61.5	0.154	
				12.3	0.5				
				11.0	0.3				
				12.3	0.6				
				14.5	0.9				
				13.0	0.7				
				12.0	0.4				
				13.5	0.7				
				11.5	0.5				
				12.0	0.6				
CLO7009	B12b-TS-15980	12/1/2015	16:00	22.8	4.2	13.8	59.5	0.227	
				13.0	0.6				
				9.0	0.2				
				12.0	0.6				
				16.0	1.2				
				13.0	0.5				
				19.0	2.5				
				15.0	1.2				
				12.0	0.6				
				18.0	1.8				
CLO7009	B12b-TS-15981	12/1/2015	16:00	19.0	2.8	13.1	65.7	0.268	
				14.0	0.7				
				11.0	0.3				
				12.0	0.4				
				12.0	0.5				
				11.0	0.4				
				11.0	0.4				
				10.0	0.3				
				10.0	0.3				
				26.0	6.1				

Table 2 - Mud Crab Tisue Sample Stations, Sample IDs, Processing Data, and Analytical Results

Station ID	Sample ID	Date	Time	Width (mm)	Crab Weight (g)	Sample Weight (g)	Percent Moisture	Total Hg Wet Weight (µg/g)	Flag
CLO7008	B12b-TS-15982	12/2/2015	11:43	15.0	0.7	6.8	59.2	0.223	
				11.0	0.2				
				11.0	0.3				
				16.0	1.3				
				15.0	1.2				
				10.0	0.3				
				7.4	<0.05				
				12.0	0.5				
				15.0	1.1				
				8.0	<0.05				
CLO7008	B12b-TS-15983	12/2/2015	11:43	17.0	1.6	6.4	60.7	0.146	
				10.0	0.3				
				10.0	0.3				
				17.0	1.4				
				10.0	0.3				
				8.0	0.2				
				10.0	0.2				
				13.0	0.7				
				8.0	0.1				
				11.0	0.3				
CLO7008	B12b-TS-15984	12/2/2015	11:43	14.0	0.8	5.5	60.6	0.218	
				11.0	0.3				
				6.7	0.1				
				8.0	0.2				
				12.0	0.6				
				18.0	2.1				
				11.0	0.4				
				9.0	0.2				
				7.3	0.1				
				7.8	0.1				
CLO7006	B12b-TS-15985	12/3/2015	9:45	15.0	1.0	5.4	57.7	0.138	
				10.0	0.2				
				11.0	0.3				
				8.0	0.1				
				10.0	0.3				
				11.0	0.4				
				9.0	0.1				
				10.0	0.3				
				8.0	0.1				
				13.0	0.6				
				14.0	0.1				

Table 2 - Mud Crab Tisue Sample Stations, Sample IDs, Processing Data, and Analytical Results

Station ID	Sample ID	Date	Time	Width (mm)	Crab Weight (g)	Sample Weight (g)	Percent Moisture	Total Hg Wet Weight (µg/g)	Flag
CLO7006	B12b-TS-15986	12/3/2015	9:45	15.0	0.9	5.1	59.1	0.174	
				9.0	0.2				
				11.0	0.4				
				11.0	0.4				
				10.5	0.3				
				11.0	0.3				
				9.0	<0.05				
				9.0	0.2				
				9.4	0.2				
				9.4	0.2				
				11.0	0.5				
				9.0	0.1				
				8.4	0.2				
				7.5	0.2				
				8.5	0.2				
CLO7006	B12b-TS-15987	12/3/2015	9:45	8.7	0.2	4.9	60.0	0.169	
				16.0	0.9				
				13.0	0.5				
				10.5	0.3				
				8.7	0.3				
				10.0	0.2				
				9.0	0.2				
				8.3	0.2				
				7.4	0.1				
				8.0	0.2				
				6.5	<0.05				
				6.4	0.1				
				9.0	0.2				
				6.0	0.1				
				6.0	<0.05				
				6.0	0.1				
				5.0	<0.05				
				6.0	0.1				
				5.0	<0.05				
				4.0	<0.05				
				5.0	<0.05				
				4.0	<0.05				
				4.0	<0.05				
				4.0	<0.05				
				4.0	<0.05				

Table 2 - Mud Crab Tisue Sample Stations, Sample IDs, Processing Data, and Analytical Results

Station ID	Sample ID	Date	Time	Width (mm)	Crab Weight (g)	Sample Weight (g)	Percent Moisture	Total Hg Wet Weight (µg/g)	Flag
CLO7005	B12b-TS-15988	12/3/2015	9:10	8.0	0.1	5.3	58.8	0.158	
				19.0	2.0				
				12.0	0.5				
				8.0	0.1				
				14.0	0.5				
				8.0	0.2				
				14.0	0.7				
				10.0	0.3				
				9.0	0.1				
				8.0	0.2				
CLO7005	B12b-TS-15989	12/3/2015	9:10	16.0	1.1	5.7	57.8	0.152	
				14.0	0.7				
				16.0	1.0				
				8.0	0.1				
				9.0	0.3				
				12.0	0.4				
				9.5	0.3				
				11.0	0.3				
				11.0	0.4				
				11.0	0.4				
CLO7005	B12b-TS-15990	12/3/2015	9:10	15.0	0.9	5.8	58.3	0.182	
				11.0	0.4				
				17.0	1.1				
				9.0	0.2				
				9.0	<0.05				
				8.0	0.1				
				11.0	0.5				
				11.0	0.4				
				10.0	0.3				
				8.0	0.2				
				16.0	1.0				
Average Values				**11.6**	**0.7[a]**	**8.1[b]**	**60.9**	**0.167**	

J Chain-of-Custody not signed by sampler

J- 28 day hold time exceeded

U Sample result was less than 5 times average Method Blank

a Entire sample weights divided by total organism count

b Entire sample weight recorded

Appendix C

Update the Understanding of Methylation Processes and Uptake in the Closed Area

Study 4

March 2016

ALCOA

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

1 INTRODUCTION

Mercury concentrations in sediment are improving in the Closed Area but mercury concentrations in red drum tissues are not improving at a similar rate. This study was conducted to update the understanding of methylmercury production and uptake to red drum that was developed during the Remedial Investigation. Specific areas of focus include the physical-chemical processes that control methylmercury production as well as evaluating the best measurement tools for identifying areas of enhanced methylmercury production and uptake in the Closed Area. The study results will be used to support an evaluation of what further actions could be taken to reduce mercury levels in red drum in the Closed Area.

A phased approach was adopted to update the understanding of these complex processes. This first phase collected and evaluated data needed to design and implement a subsequent study. The first phase was implemented in October 2015 and is reported herein. The second phase of study will be performed in the spring of 2016 coincident with the expected peak methylmercury production in the Bay system.

Staff from Tetra Tech, Inc. and Texas Tech University conducted the sample processing. Support for sample collection was provided by Benchmark Ecological Services Inc. (BESI). Texas A&M University at Galveston were responsible for the identification of benthic infauna in sediment samples. The study plan to *Update the Understanding of Methylation Processes and Uptake in the Closed Area* was submitted to EPA on October 5, 2015 and approved.

1.1 Objectives

This supplemental study had 2 objectives:

1. Collection of additional data to help identify areas of enhanced methylation within the Closed Areas and guide the design of the spring 2016 methylation study
2. Field testing of new sampling methodologies that could be deployed in the spring 2016 methylation study.

The October 2015 methylation study tested two new field sampling methods, voltammetry and Diffusive Gradient in Thin Film (DGT) devices for potential use in the spring 2016 study. In addition, a benthic community/bioturbation analysis was conducted in select locations to support an understanding of the impact of bioturbation on methylmercury production and accumulation.

As part of these studies, standard measurements used in the 2007 methylmercury monitoring program (Alcoa, 2007), i.e., TOC, solid-phase total mercury and methylmercury concentrations, and sulfate and sulfide concentrations, were also measured to provide a basis of comparison to the results of previous mercury methylation measurements.

2 SURVEY LOCATIONS

Nine sediment sampling locations including seven marsh sediment stations and three open water sediment stations were selected for this study from those stations previously sampled (Figure 2-1 and 2-1). At each station, one 3-inch diameter core was collected for voltammetry and DGT, two to five 3-inch diameter cores were collected for analysis of total mercury, TOC, acid volatile sulfides (AVS), and grain size by ALS, and one 3-inch diameter core collected for methylmercury analysis by Battelle. A total of 116 cores were collected and analyzed.

In addition, four marsh stations and one open water station were selected for collection of benthic community samples. Ten 3-inch diameter cores comprising a total surface area of approximately 0.046 m^2 were collected for benthic community analysis at each station. One additional core was collected at each station to allow determination of grain size.

Cores were collected by BESI staff that are experienced in collection of cores and sampling within Lavaca Bay. Upon collection, the cores were capped on both the top and bottom and maintained in a vertical position until delivered to the central processing location located on the northwest corner of Dredge Island (Figure 2-2).

Figure 2-1 Location of October 2015 Field Sampling Stations

Circled stations were sampled. Stations LVB 7002 and LVB 5839 were proposed, but could not be sampled due to weather conditions.

Figure 2-2 Collected Cores Ready for Transport to Processing Station

Cores were held upright during transport.

Table 2-1

Number of Cores Collected at Sediment and Benthic Community Sampling Locations

Sample Location	Voltammetry and DGT Cores[1]	ALS Chemistry Cores[2]	Battelle Chemistry Cores[3]	Benthic Community Cores[4]	Total Cores
Marsh Sediment					
Marsh 1-3R	1	2	1	10+3	17
Marsh 2-2R	1	2+3	1		7
Marsh 6-5R	1	2	1	10+3	17
Marsh 11 (CLO6802)	1	2	1	10+3	17
LVB 6852	1	2	1	10+3	17
LVB 6870	1	2+3	1		7
Marsh Sediment Subtotal	*6*	*18*	*6*	*52*	*82*
Open Water Sediment					
Closed Area SMP 0004	1	2	1	10+3	17
Closed Area STO 203	1	2+2+3	1+1		10
Adjacent Open Area LVB 7001	1	2+3	1		7
Open Water Subtotal	*3*	*14*	*4*	*13*	*34*
Grand Total	**9**	**32**	**10**	**65**	**116**

[1] Voltammetry and DGT measurements made at 1-cm intervals, surface – 10 cm (1 core required)
[2] THg, TOC, SO_4, HS^-, moisture content measured at 1-cm intervals (surface – 10 cm) (2 cores required); grain size and moisture content at surface (3 cores required)
[3] meHg, moisture content measured at 1-cm intervals (surface – 10 cm) (1 core required)
[4] Benthic organisms identified and enumerated by depth interval (0 – 2 cm, 2 – 6 cm, 6 – 10 cm; grain size measured separately in each sampling interval. (multiple cores required, number dependent upon core diameter)

3 METHODS FOR SAMPLE PROCESSING AND ANALYSIS

Field sampling to support project objectives was conducted between 20 October and 24 October 2015 by staff from Tetra Tech Inc., Texas Tech University, and BESI. Weather conditions during the study period consisted of overcast skies, strong winds, and periods of rain associated with low pressure systems in the Gulf and Hurricane Patricia on the Pacific coast of Mexico. Due to weather conditions, sea level in Lavaca Bay was several feet higher than normal.

3.1 Voltammetry

Strongly reducing conditions are characteristic of sulfate reduction and are an important indicator of methylmercury production. Voltammetry is an electroanalytical method used to determine dissolved redox chemical concentrations in the sediment porewater by measuring the current as the potential is varied. Voltammetry profiles of reduced manganese (Mn^{2+}), iron (Fe^{2+}), and sulfide (HS^{-}) were used to define the redox conditions of the sediment porewater samples from marsh and open water sediment in both the Closed and Adjacent Open Areas.

The voltammetry measurements were performed on cores collected at stations identified in Figure 2-1 and Table 2 1. One core from each station was analyzed using voltammetry and DGT strips as described below.

A gold-mercury amalgam working electrode was calibrated in the lab for oxygen and manganese (II) in a 35 part per thousand solution of Instant Ocean (Grundy, 2013) (Figure 3 1). The manganese peaks were correlated to the expected peaks of Mn2+, Fe2+, and H2S to obtain the calibration values for the ferrous iron and hydrogen sulfide peaks (Brendel & Luther, 1995). Oxygen calibration was conducted on a daily basis at the processing station to monitor possible changes in the calibration values. Multiple scans were run to reduce transient effects.

Figure 3-1 Voltammetry probe inserted into sediment core

The reference electrode is held by the orange bracket. The working electrode is held by the aluminum bracket in the center. A DGT strip is inserted on the right side of the core.

Linear sweep voltammetry (LSV) scans were used to obtain the oxygen concentrations. Current for LSV begins at about 0 nA at 0.1V. It then increases to a plateau of 25-40 nA at about -0.3-0.4 V and at about -1.3 V it increases to a plateau usually about twice as high (50-80 nA). The two plateaus indicate reduction of oxygen to hydrogen peroxide, and hydrogen peroxide to water, respectively. The oxygen concentration was determined by comparing the current of the first plateau to the current achieved during the calibration of aerated water (Grundy 2013):

$$C_{O_2} = \frac{current\ of\ oxygen\ plateau\ of\ sample}{current\ of\ oxygen\ plateau\ of\ saturated\ solution} * concentration\ of\ sat.soln.$$

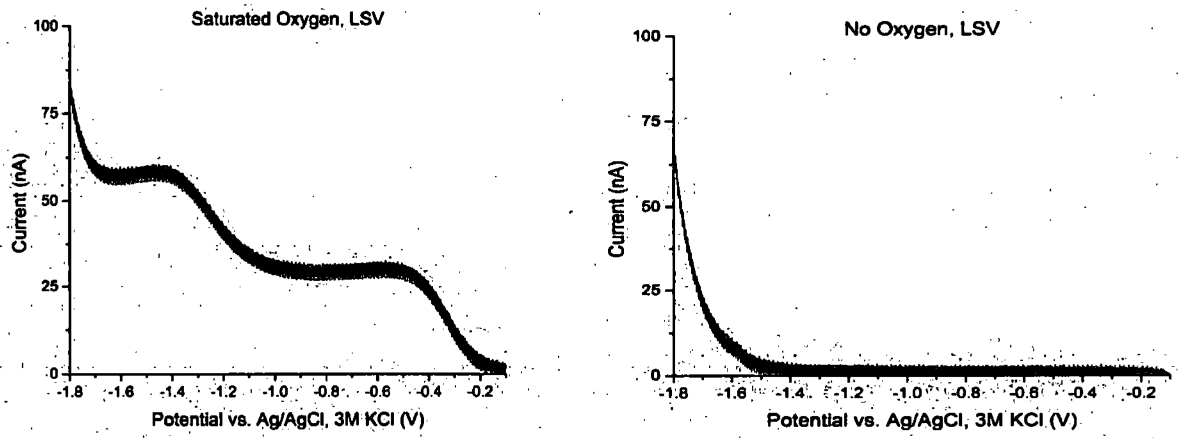


Figure 3-2 LSV Voltammagram of Freshwater With and Without Dissolved Oxygen (Grundy 2013)

Once the oxygen was depleted (Figure3-2, right), Square Wave voltammetry (SWV) scans were made to determine the redox species at predetermined depth. LSV scans were made each 0.2 cm, whereas SWV scans were made every 0.5 cm. Scans were done in triplicate. SWV scans were used to indicate redox species by integrating voltammogram peaks (Figure 3-3). Sulfide peaks generally occur at around -0.6V, iron(II) peaks at around -1.4V, and manganese(II) peaks at around -1.55V. These peaks shift slightly during a run due to pH, temperature, and the salinity of solution (Grundy 2013).

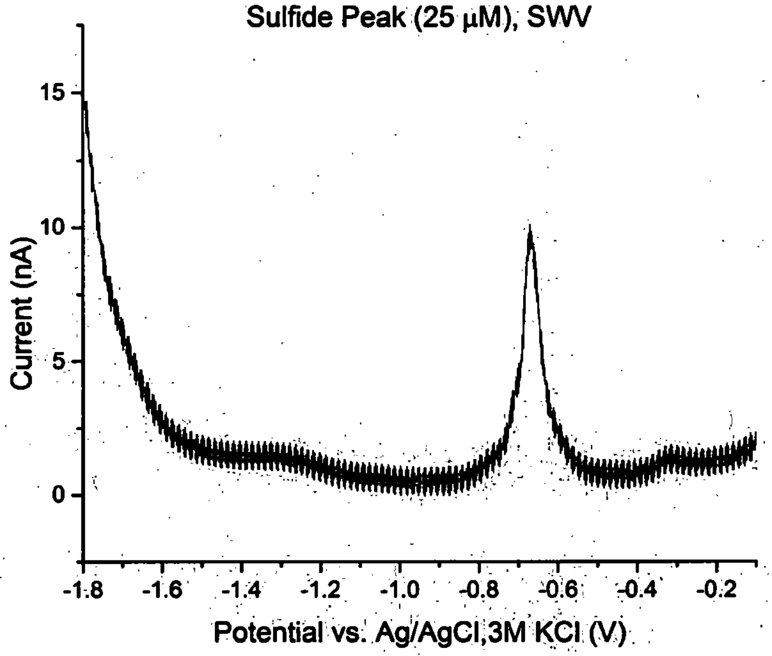


Figure 3-3 **SWV Voltammagram for Sulfide in Seawater (peak at -0.6 V) (Grundy 2013)**

The concentration of analyte in environmental samples were calculated using the peak height, calibration slopes and the following equation (Grundy 2013):

$$C = \frac{Peak\ height\ (or\ area)[nA]}{Calibration\ slope\ [nA/\mu M]}$$

Electroactive species of sulfide were reduced and became a part of the gold-mercury amalgam over time. To eliminate this effect, the electrodes were conditioned between scans to remove sulfide species from the amalgam. However, due to time constraints in the field, this step was conducted only at the upper scan and a constant accumulation of reduced sulfide was assumed over the core profile. During data analysis, the difference in sulfide peaks between the conditioned and unconditioned step was subtracted from the integrated peaks to obtain results as if preconditioning was done throughout the profile.

The LSV scans also indicated presence of sulfide. This was originally assumed to be due to amalgam accumulation. However, since the subtraction associated with preconditioning that was applied to SWV scans didn't completely remove these peaks, they were correlated to sulfide peaks based on the depth of the peak below the sediment surface. The depth at which the switch from LSV (aerobic) to SWV (anaerobic) scans was made always had both scans, so the peaks from both voltammograms (LSV and SWV) could be correlated, and the amount that was assumed to be correlated to the amalgam accumulation was subtracted from the LSV results.

3.2 DGT

Diffusive gradient in thin film (DGT) probes for methylmercury (MeHg) are a type of sorption device developed over 20 years ago for measuring solute concentrations in sediments and water. DGT probes employ a binding agent that accumulates solutes (e.g., meHg) quantitatively after their passage through a well-defined diffusion layer (Zhang and Davison, 1995). DGT probes have been used for meHg measurement by many researchers including Hammerschmidt et al. (2004) for Long Island Sound, Clarisse et al. (2009) for a lake in Ontario, Chloe et al. (2004) for San Francisco Bay-Delta, and Hines et al. (2004) for a lake in Minnesota. Clarisse et al. (2011) showed a strong correlation between meHg net production rates and labile meHg concentrations measured by DGT devices in San Francisco Bay.

DGT probes consist of a polyacrylamide gel and a membrane filter of known thickness that is used as the diffusive layer. A resin incorporated into a second gel layer serves as a binding agent. (Figure 3-4). The two gels are enclosed in a plastic frame that comprises the sampling device that is deployed in the sediment (Figure 3-5). Knowing the duration of deployment (t) and the surface area (A) of the diffusive layer in contact with the sediment and measuring the mass (M) of accumulated meHg in the resin layer, the flux (F) of the meHg from solution to the DGT probe can be calculated:

$$F = \frac{M}{At}$$

According to Frick's first law of diffusion, the flux can also be interpreted as the average concentration at the surface of the probe:

$$F = D\,\frac{C_i}{\Delta d}$$

where:

D = a diffusion coefficient, cm^2/s

C_i = Average concentration a the surface of the probe

Δd = diffusive gel thickness

C_i can be calculated from the mass of the meHg accumulated by the DGT resin for the known gel thickness, exposure time, and diffusion coefficient:

$$C_i = \frac{M\Delta d}{DAt}$$

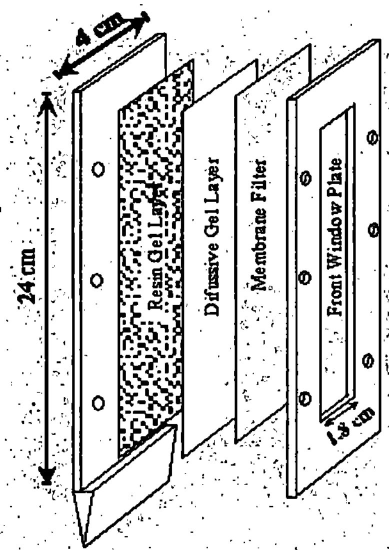


Figure 3-4 Schematic diagram of DGT gel and resin layers

Figure 3-5 Photograph of DGT Profilers Inserted into Core Tube

Gel side of strip is facing the sediment.

After the voltammetry was completed, DGT profilers were inserted into the sediment for the maximum available duration, which ranged from 23.7 hours to 46.2 hours, depending on the weather conditions and access to the field site.

During the incubation period, the cores were placed in an improvised flow-through system, which had a constant circulation of seawater to maintain temperature at ambient. During incubation, efforts were made to ensure that overlying water was present in all cores. However, some drainage below the surface of the cores was noted due to leakage of water through the bottom of the cores. This led to oxygen penetration into the surficial sediments of some of the cores, likely leading to greater oxidation at the surface of the core and reducing the amount of THg in an insoluble, precipitated form. It is also possible that some of the DGT was not saturated with water leading to uptake of THg via air diffusion. In either case, THg concentrations could be high and potentially non-representative in the first few centimeters. After incubation, the DGT profilers were placed on ice in double plastic bags, and sent to the lab for analysis.

In the laboratory, the resin gels were split in half along the depth axis. One side was then sectioned into 1 cm long increments for total mercury analysis, and the other side was sectioned into 2 cm increments for methylmercury analysis. This procedure was used to ensure sufficient material was present to measure porewater methylmercury concentrations: the increased area of methylmercury resin gels allowed for detectable concentrations of methylmercury.

3.3 Bulk Chemistry

Three cores were collected at each station for analysis of bulk chemistry. In addition, three cores were collected for grain size determinations of the 0-2 cm interval at those stations not sampled for benthic community.

One core from each station was sliced into 1-cm thick sections to 10-cm depth. These sections were submitted to Battelle Labs for the analysis of methylmercury and moisture content.

Two additional cores were sliced into 1-cm thick sections to 10-cm depth and the sediment from each corresponding depth interval composited. The composited sediments were then split into 3 separate sample jars, and submitted to ALS Labs for analysis of 1) total mercury, TOC, and percent moisture, 2) acid-volatile sulfides (AVS). After collection, the samples were placed on ice until delivery to the lab.

3.4 Benthic Community

Burrowing macroinvertebrates can influence methylmercury production and accumulation by: 1) controlling the nature of the redox conditions in the sediments; 2) affecting diffusive fluxes of methylmercury from the sediments; or 3) by the redistribution of legacy mercury within the zones of active biological methylation in the sediments, creating the potential for methylation, mobilization, and bioaccumulation.

To assess the role of the benthic infauna on bioturbation, the benthic infauna at five sample locations was collected using 3-inch diameter cores (Table 2-1). Ten cores were collected at each location for a total area sampled of approximately 0.046 m^2.

Upon delivery to the processing station, each core was sliced into three depth intervals (0 to 2 cm, 2 to 6 cm, 6 to 10 cm) by extruding the core into a pre-sized sleeve. The sections from each depth interval in the cores were composited and the sediment sieved through a 0.5 mm sieve. The material remaining on the sieve was then transferred to a sample jar and preserved in a 5 percent formalin solution. Benthic community samples were delivered to Dr. Gilbert Rowe's laboratory at Texas A&M University, Galveston for sorting, identification to lowest practical taxon, and enumeration.

An additional core was sectioned into the three depth intervals (0 to 2 cm, 2 to 6 cm, and 6 to 10 cm) and submitted for determination of grain size by ALS labs.

4 RESULTS

Results of the sediment chemistry and biological sampling are presented in this section.

4.1 Grain Size

Grain size is important in that it affects quantity and flux of porewater in the sediment and the burrowing ability of benthic infauna. Increased porewater flux can increase oxygenation of sediments and thereby reduce the potential for methylation. Sediment samples for the analysis of grain size were collected from three depth intervals (0-2 cm, 2-6 cm, and 6-10 cm), corresponding to the depths at which benthic community samples were collected, at five survey locations. Surficial (0-2 cm) grain size samples were collected from an additional four stations.

Inspection of the particle size distribution plots indicates that the majority of samples consisted of well sorted fine sands and silts. The resulting grain size data are plotted in Figure 4-1. In general, grain size appeared consistent throughout the core profiles. However, the three samples from shoreline station CLO 6802 (Marsh 11) exhibited a gradient of particle sizes with depth (Figure 4-2). The 0-2 cm depth intervals consisted of coarse material (fine gravels and coarse sands); the 2-6 cm interval was composed of coarse sands; and the deepest interval (6-10 cm) was primarily fine sands.

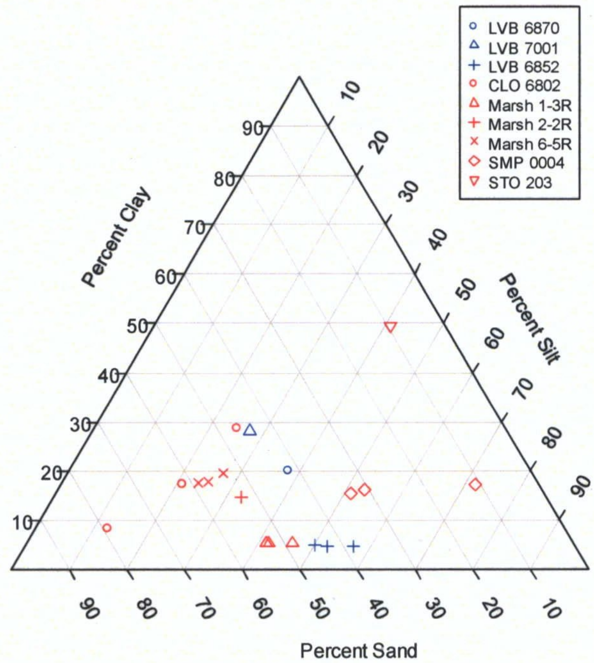


Figure 4-1 Triaxial Plot of Grain Size Distribution at Nine Stations in Lavaca Bay, October 2015

Samples from the Closed Area are shown in red, whereas samples from the Adjacent Open Area are shown in blue.

Two other samples exhibited differences from this general pattern. The surficial sample from STO 203 was finer than all other samples, consisting of 41% silts and 49% clays. The intermediate depth (2-6 cm) sample from SMP 004 was also fine, consisting of 72% silts. Both of these stations are located in open water in an embayment north of the Dredge Island causeway with limited water circulation.

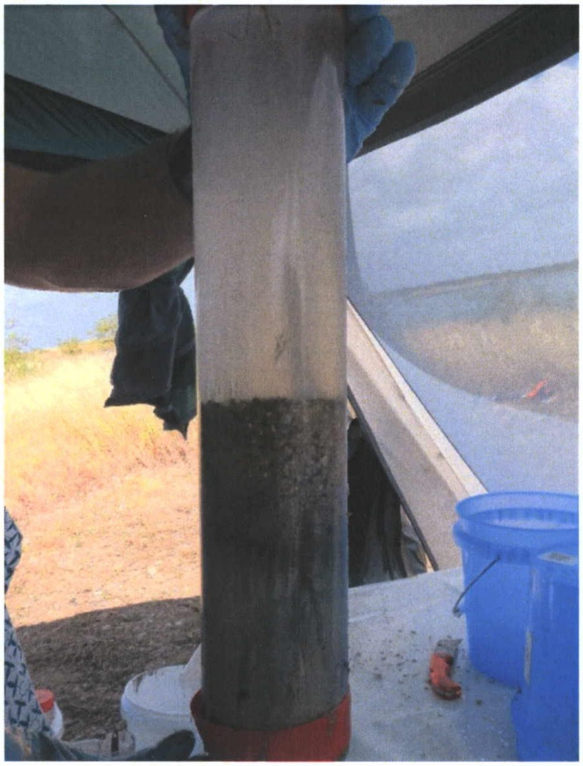


Figure 4-2 Core from CLO 6802 Showing Layering of Sediment Particle Sizes

4.2 Total Hg and Methylmercury (solid phase)

Table 4-1 provides a summary of the total (THg) and methylmercury (MeHg) measurements at the nine stations sampled in Special Study 4 as well as AVS and TOC measurements. As shown in Table 4-1 and Figure 4-3, the distributions are skewed with the mean values greater than the median. The variability in the measurements is reflected in the large values of the standard deviation and the coefficient of variation (CV, the ratio of the standard deviation to the mean). However, this level of variability is expected for the combined data set with samples from different habitats and different exposure to historical mercury releases. The complete data set is presented in Section 7.

Table 4-1
Sediment Chemistry Summary Statistics (n=100)

	Hg.t (mg/kg)	MeHg (ng/g)	AVS (µmole/g)	TOC (%)
Minimum	0.0035	0.01	0.01	0.1
1st Qu.	0.02	0.02	0.9	0.3
Median	0.05	0.13	1.6	0.7
Mean	0.11	0.32	2.6	1.0
3rd Qu.	0.16	0.38	3.8	1.1
Maximum	0.39	2.21	11.1	5.8
Standard Deviation	0.12	0.47	2.5	1.1
Coefficient of Variation	1.09	1.47	0.96	1.10

Table 4-2 presents the measured surficial (0 – 1 cm) and core-average total and methylmercury values for the four groups of stations. The highest THg concentrations were measured in the Closed Area Open Water stations. The two Adjacent Open Area Shoreline sampling locations (LVB6852 and LVB6870) and the single Adjacent Open Area Open Water sampling location (LVB7001) represent reference locations. The THg concentrations in the Closed Area Shoreline stations were higher than the THg concentrations in the Adjacent Open Area Shoreline sampling stations.

Table 4-3 presents the surficial total mercury concentrations for the three marsh stations sampled in this study. The THg value measured at Marsh 1-3R in this study (0.053 mg/kg) was less the values that had been measured in the sediment studies since 2008 (0.077 – 0.110 mg/kg), but the measured value was no different from to the value reported in the concurrent 2015 sediment study (0.057 mg/kg). The THg value measured at Marsh 2-2R in this study (0.057 mg/kg) was similar to previously measured values at the same location (0.039 – 0.086 mg/kg). Only at Marsh 6-5R was the value measured in this study (0.112 mg/kg) greatly different from the values measured during previous surveys and the concurrent 2015 sediment survey (0. 354 – 2.980 mg/kg).

MeHg concentrations in the sediments (solid phase) were consistently detected (Table 4-2) and meHg concentrations were an order of magnitude greater in the Closed Area stations (versus Adjacent Open Area Stations). The highest core-average meHg concentration was 0.75 ng/g at Station STO0203, where the maximum concentration in the core was 2.0 ng/g.

Table 4-2

Comparison of Solid-Phase Total and Methylmercury Sediment Concentrations

Group	Station	Total Mercury (mg/kg)		Methylmercury (ng/g)	
		Surficial	Core Average	Surficial	Core Average
Adjacent Open Area Shoreline	LVB6852	0.004	0.005	0.010	0.010
	LVB6870	0.016	0.020	0.509	0.072
Adjacent Open Area Open Water	LVB7001	0.027	0.052	0.121	0.057
Closed Area Shoreline	Marsh 1-3R	0.053	0.050	0.469	0.166
	Marsh 2-2R	0.057	0.043	0.811	0.208
	Marsh 6-5R	0.112	0.133	0.617	0.253
	CLO6802	0.006	0.007	0.010	0.036
Closed Area Open Water	SMP0004	0.222	0.159	0.895	0.421
	STO0203	0.313	0.336	0.573	0.750

Table 4-3

Total Mercury Concentrations (mg/kg) in Marshes During Earlier Surveys

Marsh	2008	2009	2010	2011	2012	2014	2015
1-3R	0.094	0.103	0.098	0.077	1.06	0.110	0.057
2-2R	0.065	0.069	0.058	0.086	0.081	0.073	0.039
6-5R	1.380	2.980	0.981	-	1.01	-	0.354

Correlations between sediment chemistry parameters are provided in Figure 4-3; correlations with an absolute value greater than 0.288, which was observed for 4 of the possible 15 pairs of parameters, are statistically significant at α=0.05. This figure provides a scatter plot of each pair of analytes above the diagonal; the diagonal elements are histograms of each analyte; and the below diagonal elements provide the correlation coefficient. The smoothing curve in each of the above diagonal scatterplots indicates the shape of the relationship between the pair of analytes. The strongest correlations are between total mercury and sediment methylmercury (r=0.71), while AVS also shows a strong correlation with total mercury (r=0.47) and sediment methylmercury (r=0.32) in sediment. Total organic concentration (TOC) is negatively correlated with all other parameters, due to a large number of low values of TOC. Porewater methylmercury concentrations are unrelated to any of the other parameters except for TOC.

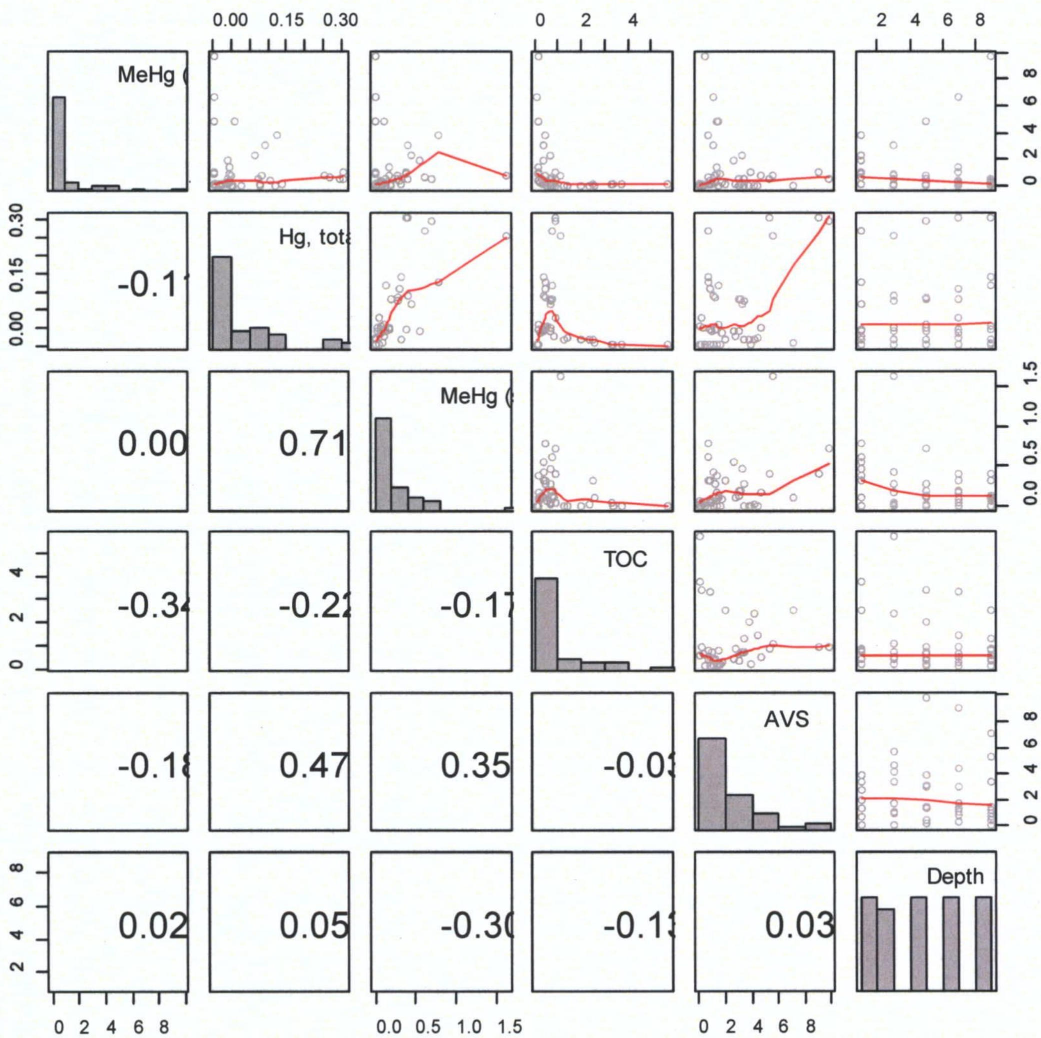


Figure 4-3 Correlation Plot of Porewater Methylmercury Relative to Bulk Sediment Chemistry Results

A single porewater methylmercury value of 83 ng/l was excluded from the plot to enable relationships with other analytes to be more clearly seen.

Bulk sediment measurements of methylmercury are positively correlated with total mercury and AVS (Figure 4-3).

Profiles of THg and meHg concentrations in the sediment (measured at the ALS and Battelle laboratories, respectively) are presented in Figure 4-4. These profiles show that the measured mercury concentrations at all sites were relatively constant with depth. Although the mercury concentrations are shown on a log scale, and this can mask small variations in the measured concentrations with depth. These figures also show how the measured mercury concentrations vary with respect to location. Open-Water stations from the Closed Area have the highest concentrations of total mercury and methylmercury in sediment. Shoreline stations from the Closed Area are next, followed by Open-Water stations and then Shoreline stations from the Adjacent Open Area.

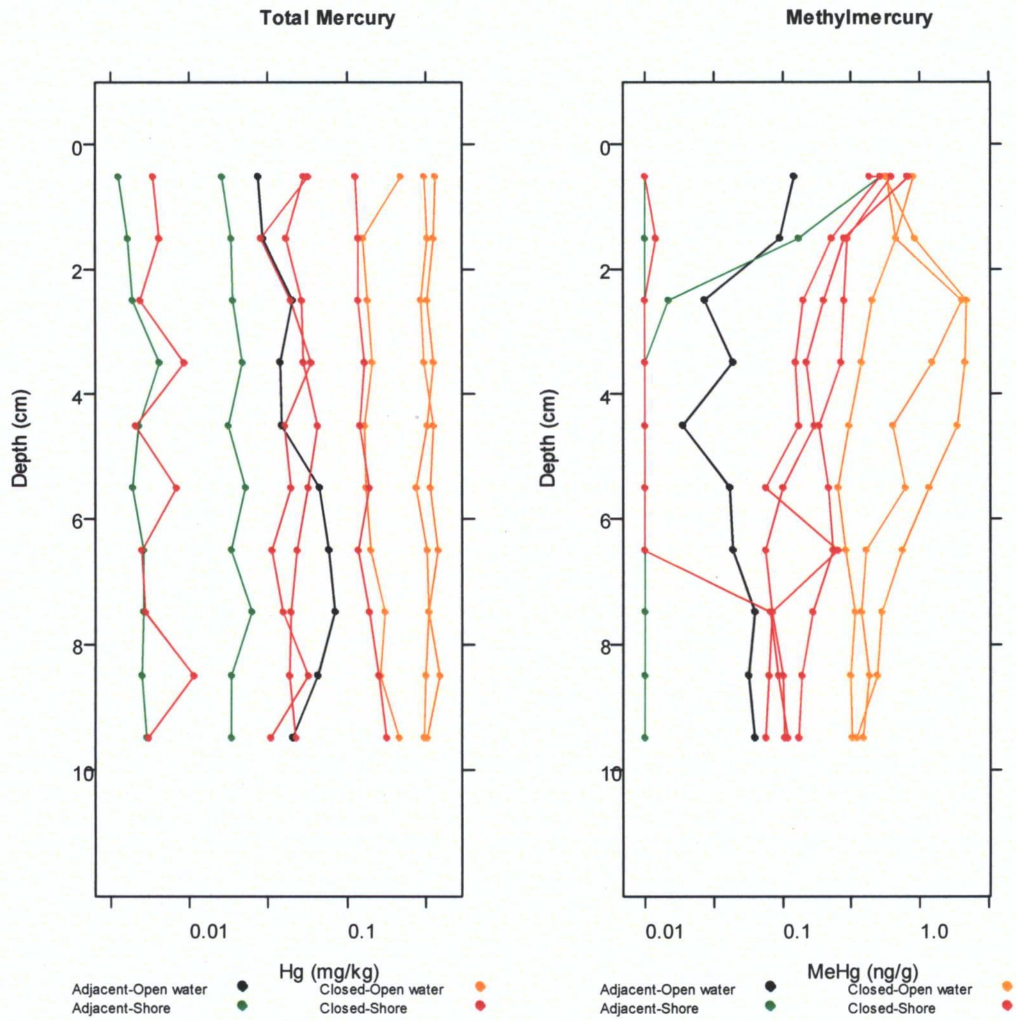


Figure 4-4 Total Mercury and Methylmercury Profiles in Bulk Sediment

4.3 Core Profiles: Porewater Methylmercury and Redox Chemistry

The mercury concentrations in porewater do not exhibit the same differences among the groups of stations as the solid-phase mercury concentrations seen in Figure 4-4. Figure 4-5 shows the measured concentrations for meHg in porewater as well as the AVS concentrations and redox conditions measured by voltammetry in the sediment cores at three stations representing different the different station groups: Adjacent Open Area Shoreline, Closed Area Shoreline, and Closed Area Open Water. The complete set of core profiles are shown in Section 7.

In general, the Closed Area Open Water and Closed Area Shoreline Stations show higher meHg porewater concentrations than those measured at the Adjacent Open Area Stations. The meHg porewater concentrations at Station LVB 6870, representing the Adjacent Shoreline locations, are less than 0.2 ng/L, while the maximum meHg porewater concentrations at the Closed Area stations shown in Figure 4-5 (Marsh 2-2R and STO0203) are approximately 1.0 ng/L.

Strong reducing conditions were not observed at any of the stations sampled in October 2015. While oxygen depletion occurred within 1 – 2 cm of sediment surface and reduced manganese was measured, there were little or no dissolved iron or sulfides in upper 10 cm of the sediment. The low AVS concentrations that were measured in the sediment profiles (< 15 uMole/g) were consistent with low sulfides measured by voltammetry. Example profiles of porewater meHg concentrations, AVS and sediment porewater redox conditions for three stations are provided in Figure 4-5.

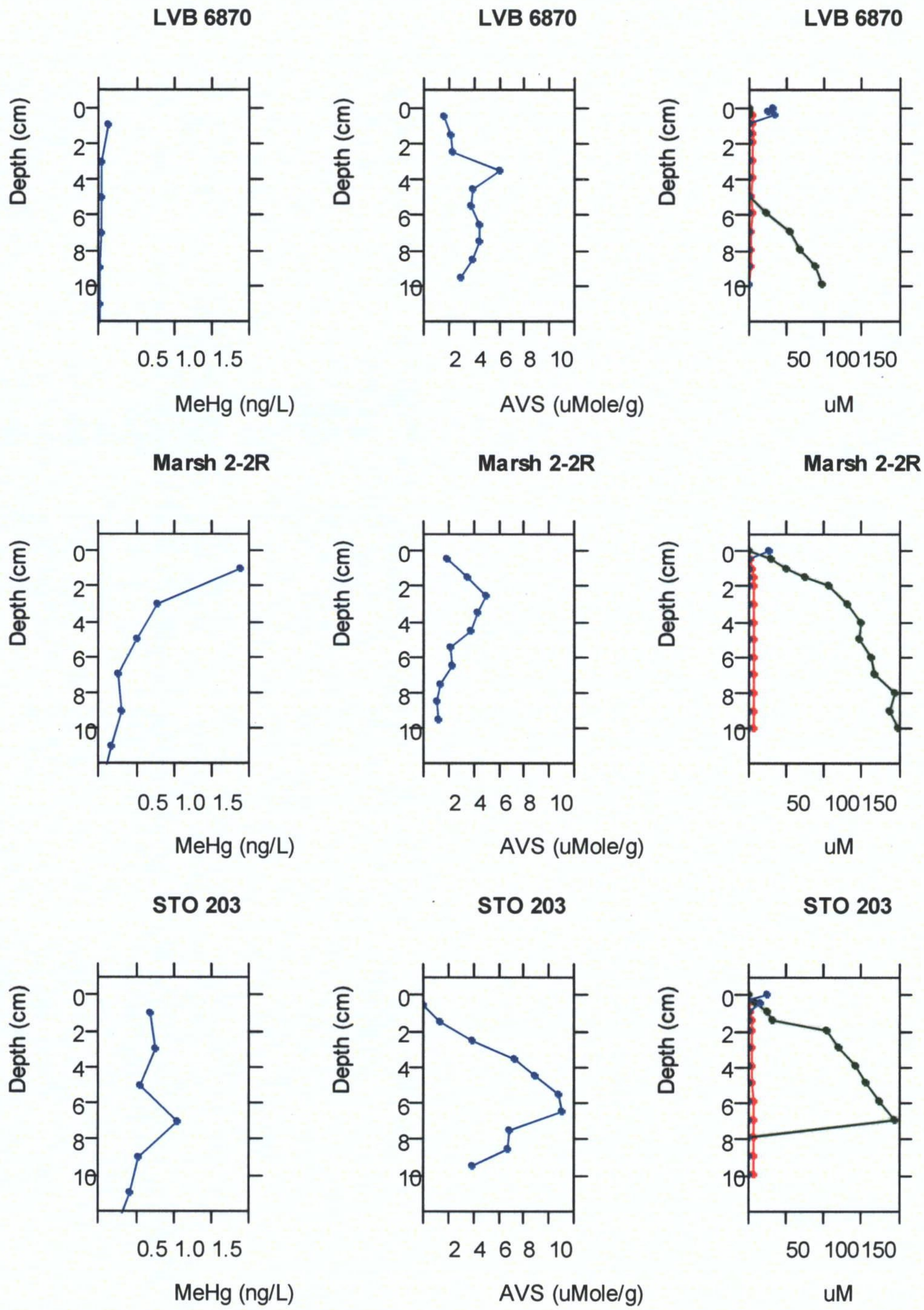


Figure 4-5 Porewater Methylmercury and Redox Chemistry at Selected Stations

LVB 6870 is an Adjacent Shoreline station; Marsh 2-2R is a Closed Area Shoreline station; and STO 203 is a Closed Area Open Water station. In the voltammetry plots, dissolved oxygen concentrations are shown in blue, manganese 2+ in dark green, and iron 2+ in brown.

4.4 Benthic Infauna

A total of 139 individuals of 25 species were obtained from the 15 samples (5 stations by 3 depths) collected. The number of individuals and species in each sample are summarized in Table 4-4 and are greatest in the surface samples (Figure 4-6). Total invertebrate densities ranged from 239 individuals/m^2 at Marsh 1-3R to 1,086 individuals/m^2 at CLO 6802. This range of densities is similar to that reported by Parametrix (1997). A summary of the benthic infaunal community at each station is provided in Appendix B.

Table 4-4

Number of Individuals and Species per Sample

Station	Depth Interval	Individuals per sample (0.046 m2)	Species
CLO 6802	0-2 cm	47	15
	2-6 cm	0	0
	6-10 cm	3	3
LVB 6852	0-2 cm	13	4
	2-6 cm	3	2
	6-10 cm	2	1
Marsh 1-3R	0-2 cm	5	4
	2-6 cm	3	2
	6-10 cm	3	3
Marsh 6-5R	0-2 cm	23	6
	2-6 cm	0	0
	6-10 cm	0	0
SMP 0004	0-2 cm	27	7
	2-6 cm	9	5
	6-10 cm	1	1

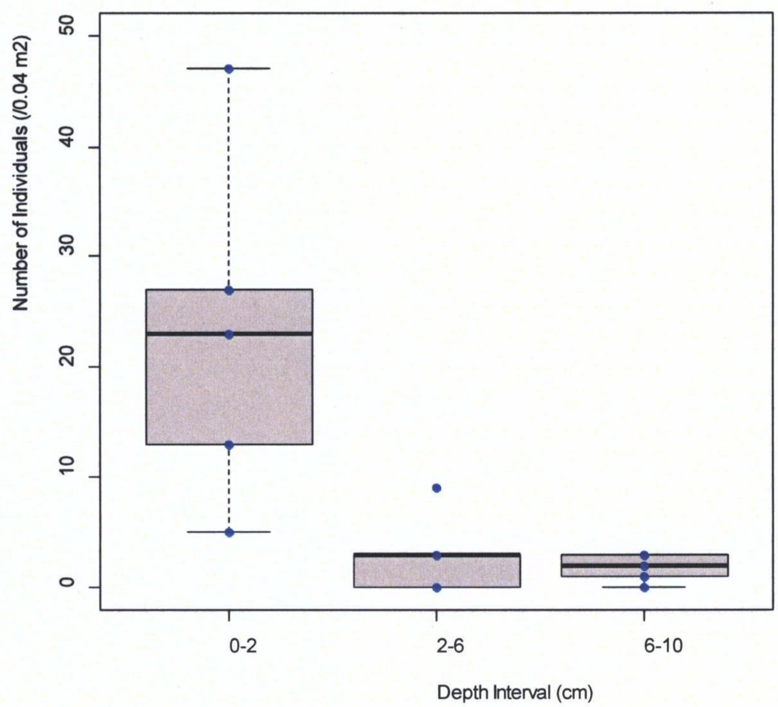


Figure 4-6 Depth Distribution of Benthic Infauna

Black bar represents the median number of individuals and the box represents the 25th to 75th percentile range. Blue dots represent individual samples.

The organisms in the surface samples included small tubiculous polychaetes, shallow burrowing amphipods, and shrimp. Station SMP 0004 was the only open water station sampled for biota, and was the only station that supported burrowing bivalves in the 2-6 cm depth interval. Total density at this station was 804 individuals/m^2. This station is the only one likely to experience bioturbation in deeper layers.

The sampled shoreline stations were all located within marsh environments which have significant vegetation and root structures which stabilize the sediment and make burrowing difficult for infauna. The marsh sediment conditions appear to limit significant bioturbation to the upper few centimeters. In contrast, the open water stations consist of un-vegetated muds which may be subject to greater levels of bioturbation.

5 SUMMARY

One of the objectives of the fall 2015 methylation study was to evaluate new methodologies for identifying areas of enhanced methylmercury production in sediments. With the persistence of elevated mercury concentrations in the biota, there may be other factors or site (location-specific) conditions that affect methylmercury production and bioaccumulation. The fall 2015 sampling results demonstrated that there are differences in methylmercury concentrations in the sediments, but the methylmercury concentrations measured in the sediments were not highly elevated, and the best indicator of methylmercury concentrations was the total mercury concentration.

There is evidence that the results of the fall 2015 sampling program did not represent peak conditions for methylmercury production in the sediments. In the fall 2015 survey the average meHg porewater concentration from single-core measurements at 9 stations was 1.3 ng/L. This value is within the range of the porewater meHg concentrations (1.21 – 1.97 ng/L) measured in Lavaca Bay during the Mercury Reconnaissance Study in the winter of 1997 (Bloom et al. 1999). However, the peak conditions for sediment methylmercury production appears to occur in the spring season. The average surficial porewater meHg concentration from 3 – 4 cores at each of the 14 locations measured during the Mercury Reconnaissance Study in the spring of 1996 in the Closed Area was 6.34 ng/L, with a maximum value of 45 ng/L. Figure 5-1 shows the seasonal variability sediment methylmercury concentrations observed in the Mercury Reconnaissance Study.

The fall 2015 sampling program was planned as the first phase of a two-phase study. One of the goals of the fall 2015 sampling program was to test new methodologies, e.g., the use of diffusive gradient in thin film (DGT) probes for methylmercury concentrations, and voltammetry to measure sediment redox conditions. The sediment core collection and field DGT placement demonstrated the ability to provide representative profiles of THg and meHg porewater concentrations. However, modifications in the sample collection and DGT incubation procedures need to be made to maintain water saturation of the cores at all times. Also, based on the fall 2015 results, the incubation time for the DGT samplers should be extended to 48 hours.

The field voltammetry measurements were time consuming, and we are exploring alternative methods and procedures in preparation for the 2016 spring sampling, such as coupling voltammetry measurements with direct oxygen and sulfide measurements via specific electrodes to confirm measurements. The potential use of specific oxygen, sulfide and redox microsensors in lieu of voltammetry is also being explored.

Overall, these 2015 sampling efforts were successful, and an expanded sampling effort is planned for the spring of 2016, during expected peak sediment methylmercury production, to further evaluate site specific factors which contribute to enhanced methylmercury production in sediments in certain locations in the Closed Area. The Spring 2016 Sampling and Analysis Plan will describe further modifications and enhancements to the sampling and analysis procedures.

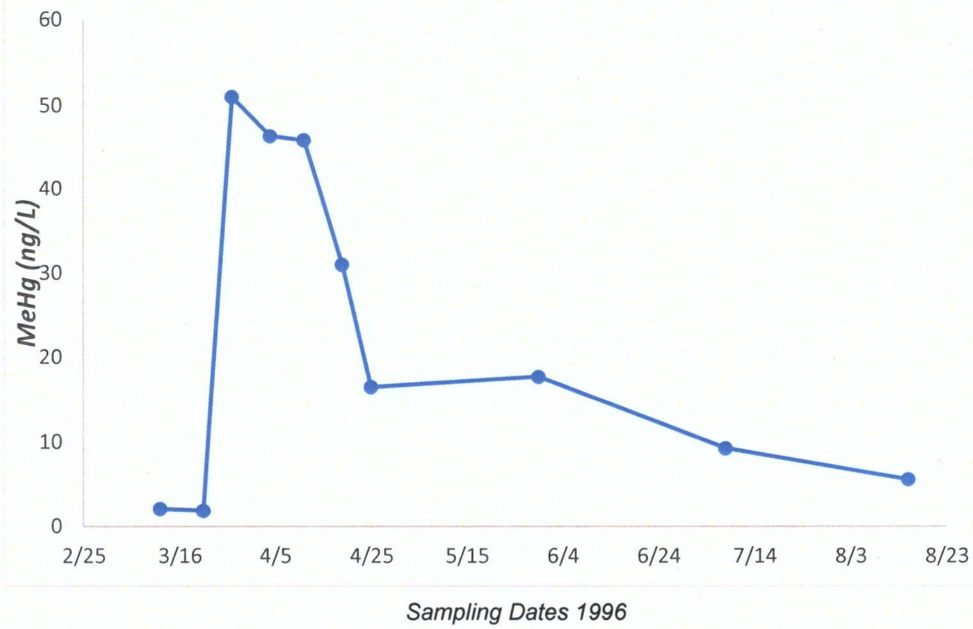


Figure 5-1 Seasonal Variability of Methylmercury Concentration in Lavaca Bay Sediments (Bloom et al., 1999)

6 REFERENCES

Alcoa, 1997. Alcoa (Point Comfort)/Lavaca Bay Superfund Site Draft Mercury Reconnaissance Study Data Report.

Alcoa, 2008. 2007 Remedial Action Annual Effectiveness Report, Alcoa (Point Comfort)/Lavaca Bay Superfund Site. October 23.

Bireta, P.J., (2015). Application of Diffusive Gradient in Thin-Film Passive Samplers to Assess Mercury Availability and Mobility in a Fresh Water River System. Austin: The University of Texas at Austin.

Brendel, P., and Luther, I.G., 1995. Development of a Gold Amalgam Voltammetric Microelectrode for the determination of Dissolved Fe, Mn, O2, and S(-II) in Porewaters of Marine and Freshwater Sediments. *Environ. Sci. Technol.*, 29,751-761.

Brouwer, H., 1995. Acid Volatile Sulfides (AVS) in Sediment. Journal of Chemical Education, 72 (2): 182-183.

Clarisse, O., D. Foucher, and H. Hintelmann, 2009. Methylmercury speciation in the dissolved phase of a stratified lake using the diffusive gradient in thin film technique. Environmental Pollution 157:987–993.

Clarisse, O., Dimock, B., Hintelmann, H., and Best, E.P., 2011. Predicting net mercury methylation in sediments using diffusive gradient in thin films measurements. Environmental Science & Technology 45(4), 1506-1512.

Chloe, K-Y, G.A. Gill, R.D. Lehman, S. Han, W.A. Heim, and K.H. Coale, 2004. Sediment-water exchange of total mercury and monomethylmercury in the San Francisco Bay-Delta. Limnol. Oceanogr. 49(5):1512–1527.

GmbH, E.A., 2016. TOC/TC analyses in soil with the vario TOC cube. Hanau, Germany: AN-A-160409-E-01.

Grundy, J., 2013. Standard Operating Procedure: Laboratory determination of oxygen, iron(II), manganese(II) and sulfide in surface water and porewater using voltammetry with a gold-mercury amalgam electrode. Austin: University of Texas.

Hammerschmidt, C.R. and W.F. Fitzgerald, 2004. Geochemical controls on the production and distribution of methylmercury in near-shore marine sediments. Environ. Sci. Technol. 38: 1487–1495.

Hines, N.A., P.L. Brezonik, and D.R. Engstrom, 2004. Sediment and Porewater Profiles and Fluxes of Mercury and Methylmercury in a Small Seepage Lake in Northern Minnesota. Environ. Sci. Technol. 38:6610–6617.

Parametrix, Inc., 1997. Bay System Sediment quality Triad Investigation for Mercury; Data Report; ALCOA (Point Comfort)/Lavaca Bay Superfund Site. Prepared for Aluminum Company of America, Point Comfort, TX.

United States Environmental Protection Agency (USEPA), 1991. Draft Analytical Method for Determination of Acid Volatile Sulfide in Sediment. Washington, D.C. USEPA: EPA-821-R-91-100.

United States Environmental Protection Agency (USEPA), 2001. Appendix to Method 1631: Total Mercury in Tissue, Sludge, Sediment, and Soil by Acid Digestion and BrCl Oxidation. Washington, D.C. USEPA: EPA-821-R-01-013.

United States Environmental Protection Agency (USEPA), 2001. Method 1630: Methyl mercury in water by distillation, aqueous ethylation, purge and trap, and CVAFS. Washington, D.C. USEPA: EPA-821-R-01-020.

Zhang, H., and Davison, W., 1995. Performance characteristics of diffusion gradients in thin films for the in situ measurement of trace metals in aqueous solution. Analytical Chemistry 67(19), 3391-3400.

7 DATA TABLES

This section provides the analytical data that were used in the analyses presented in this appendix. The data are presented in five section:

1) Sediment Chemistry
2) Porewater Methylmercury from DGT Strips
3) Voltammetry Results
4) Sediment Chemistry and redox Profiles for each station (Figures 7-1 to Figure 7-10)
5) Benthic Infaunal Community Data

Table 7-1
Sediment Chemistry

Sample_ID	Average Depth (cm)	AVS (umole/g)	Mercury, total (mg/kg)	MeHg (ng/g)	TOC (percent)
CLO 6802 (0-1)	0.5	0.023 J	0.00594	0.01 U	3.04
CLO 6802 (1-2)	1.5	0.035 J	0.00637	0.012	4.47
CLO 6802 (2-3)	2.5	0.077	0.00493	0.01 U	5.57
CLO 6802 (3-4)	3.5	0.01 U	0.00924	0.01 U	5.8
CLO 6802 (4-5)	4.5	0.103	0.0046	0.01 U	3.88
CLO 6802 (5-6)	5.5	0.296	0.00822	0.01 U	2.88
CLO 6802 (6-7)	6.5	0.74	0.005	0.01 U	3.7
CLO 6802 (7-8)	7.5	0.96	0.00518	0.082	2.93
CLO 6802 (8-9)	8.5	7.18	0.0106	0.094	2.52
CLO 6802 (9-10)	9.5	7.03	0.00546	0.109	2.56
LVB 5000 (0-1)	0.5	0.021 U	0.367	0.532	0.918
LVB 5000 (1-2)	1.5	0.9	0.358	0.905	0.922
LVB 5000 (2-3)	2.5	2.5	0.323	2.208	1.07
LVB 5000 (3-4)	3.5	6.2	0.355	2.108	1.01
LVB 5000 (4-5)	4.5	7.8	0.325	1.882	1.05
LVB 5000 (5-6)	5.5	6.5	0.28	1.158	0.985
LVB 5000 (6-7)	6.5	7.5	0.327	0.74	0.937
LVB 5000 (7-8)	7.5	4.4	0.335	0.532	1.08
LVB 5000 (8-9)	8.5	4	0.321	0.491	0.932
LVB 5000 (9-10)	9.5	1.29	0.31	0.343	0.88
LVB 6852 (0-1)	0.5	6.3	0.00351 J	0.01 U	0.155
LVB 6852 (1-2)	1.5	1.49	0.00411 J	0.01 U	0.156
LVB 6852 (2-3)	2.5	1.51	0.00435 J	0.01 U	0.194
LVB 6852 (3-4)	3.5	1.81	0.00649	0.01 U	0.169
LVB 6852 (4-5)	4.5	1.76	0.00473	0.01 U	0.139
LVB 6852 (5-6)	5.5	0.88	0.00434	0.01 U	0.134
LVB 6852 (6-7)	6.5	1.26	0.00512	0.01 U	0.112
LVB 6852 (7-8)	7.5	0.96	0.00509	0.01 U	0.128
LVB 6852 (8-9)	8.5	0.64	0.00496	0.01 U	0.133
LVB 6852 (9-10)	9.5	0.31	0.00537	0.01 U	0.126
LVB 6870 (0-1)	0.5	1.7	0.0162	0.509	2.62
LVB 6870 (1-2)	1.5	2.2	0.0183	0.13	2.39
LVB 6870 (2-3)	2.5	2.3	0.019	0.015	2.35
LVB 6870 (3-4)	3.5	6	0.0218	0.01 U	2.38
LVB 6870 (4-5)	4.5	3.9	0.0177	0.01 U	1.29
LVB 6870 (5-6)	5.5	3.8	0.0226	0.01 U	2.67
LVB 6870 (6-7)	6.5	4.4	0.0185	0.01 U	1.47
LVB 6870 (7-8)	7.5	4.5	0.0249	0.01 U	1.34
LVB 6870 (8-9)	8.5	3.9	0.0185	0.01 U	1.42
LVB 6870 (9-10)	9.5	2.93	0.0187	0.01 U	1.16

Sample_ID	Average Depth (cm)	AVS (umole/g)	Mercury, total (mg/kg)	MeHg (ng/g)	TOC (percent)
LVB 7001 (0-1)	0.5	3.1	0.01355	0.121	1.13
LVB 7001 (1-2)	1.5	2.34	0.0293	0.096	0.521
LVB 7001 (2-3)	2.5	1.13	0.0453	0.027	0.731
LVB 7001 (3-4)	3.5	0.73	0.038	0.043	0.673
LVB 7001 (4-5)	4.5	0.344	0.0389	0.019	0.43
LVB 7001 (5-6)	5.5	0.41	0.0661	0.041	0.875
LVB 7001 (6-7)	6.5	0.37	0.0769	0.043	1.06
LVB 7001 (7-8)	7.5	0.113	0.0838	0.063	0.769
LVB 7001 (8-9)	8.5	0.138	0.0659	0.057	0.593
LVB 7001 (9-10)	9.5	0.08	0.0449	0.063	0.436
Marsh 1-3R (0-1)	0.5	1.44	0.053	0.4695	0.19
Marsh 1-3R (1-2)	1.5	1.33	0.0408	0.228	0.144
Marsh 1-3R (2-3)	2.5	2.08	0.0517	0.141	0.0608
Marsh 1-3R (3-4)	3.5	2.26	0.0535	0.123	0.194
Marsh 1-3R (4-5)	4.5	1.51	0.0653	0.131	0.181
Marsh 1-3R (5-6)	5.5	1.51	0.0572	0.075	0.201
Marsh 1-3R (6-7)	6.5	1.31	0.0484	0.252	0.155
Marsh 1-3R (7-8)	7.5	1.31	0.0443	0.084	0.13
Marsh 1-3R (8-9)	8.5	1.01	0.0428	0.079	0.145
Marsh 1-3R (9-10)	9.5	0.77	0.0472	0.075	0.136
Marsh 2-2R (0-1)	0.5	1.93	0.0566	0.811	0.438
Marsh 2-2R (1-2)	1.5	3.45	0.0283	0.279	0.335
Marsh 2-2R (2-3)	2.5	5.01	0.0439	0.202	0.51
Marsh 2-2R (3-4)	3.5	4.3	0.0595	0.15	0.46
Marsh 2-2R (4-5)	4.5	3.8	0.0406	0.171	0.323
Marsh 2-2R (5-6)	5.5	2.14	0.0438	0.101	0.338
Marsh 2-2R (6-7)	6.5	2.26	0.0339	0.075	0.272
Marsh 2-2R (7-8)	7.5	1.3	0.0391	0.084	0.268
Marsh 2-2R (8-9)	8.5	1.16	0.0564	0.102	0.428
Marsh 2-2R (9-10)	9.5	1.25	0.0327	0.103	0.295
Marsh 6-5R (0-1)	0.5	3.45	0.112	0.617	0.7
Marsh 6-5R (1-2)	1.5	3.23	0.119	0.293	0.658
Marsh 6-5R (2-3)	2.5	3.37	0.119	0.282	0.711
Marsh 6-5R (3-4)	3.5	3.45	0.13	0.269	0.661
Marsh 6-5R (4-5)	4.5	3.88	0.12	0.184	0.746
Marsh 6-5R (5-6)	5.5	2.5	0.138	0.214	0.692
Marsh 6-5R (6-7)	6.5	3.29	0.119	0.231	0.6
Marsh 6-5R (7-8)	7.5	2.68	0.14	0.167	0.695
Marsh 6-5R (8-9)	8.5	2	0.159	0.139	0.594
Marsh 6-5R (9-10)	9.5	1.01	0.178	0.131	0.908
SMP 0004 (0-1)	0.5	0.55	0.222	0.895	0.442
SMP 0004 (1-2)	1.5	0.81	0.128	0.674	0.413
SMP 0004 (2-3)	2.5	1.27	0.137	0.452	0.431

Sample_ID	Average Depth (cm)	AVS (umole/g)	Mercury, total (mg/kg)	MeHg (ng/g)	TOC (percent)
SMP 0004 (3-4)	3.5	0.98	0.145	0.375	0.356
SMP 0004 (4-5)	4.5	1.18	0.131	0.308	0.387
SMP 0004 (5-6)	5.5	1.39	0.133	0.254	0.486
SMP 0004 (6-7)	6.5	0.51	0.142	0.289	0.526
SMP 0004 (7-8)	7.5	1.05	0.174	0.334	0.377
SMP 0004 (8-9)	8.5	0.63	0.164	0.31	0.319
SMP 0004 (9-10)	9.5	0.74	0.216	0.317	0.469
STO 203 (0-1)	0.5	0.067 J	0.313	0.573	0.975
STO 203 (1-2)	1.5	1.43	0.326	0.663	0.519
STO 203 (2-3)	2.5	3.97	0.298	2.017	1.06
STO 203 (3-4)	3.5	7.3	0.308	1.221	1.12
STO 203 (4-5)	4.5	8.9	0.354	0.628	0.955
STO 203 (5-6)	5.5	10.8	0.339	0.792	0.879
STO 203 (6-7)	6.5	11.1	0.381	0.404	0.874
STO 203 (7-8)	7.5	6.9	0.33	0.38	0.9
STO 203 (8-9)	8.5	6.7	0.39	0.43	0.78
STO 203 (9-10)	9.5	3.9	0.322	0.39	0.941

Table 7-2
Porewater Methylmercury from DGT Strips

	Depth (cm)							
Station	**1**	**3**	**5**	**7**	**9**	**11**	**12.5**	**14**
CLO 6802	0.12	0.09	0.1	0.09 J	0.08 J	0.04 J	0.03 J	0.03 J
LVB 6852	0.99	0.95	4.85	6.67	9.75	0.05 J	0.11 J	0.02 J
LVB 6870	0.14	0.03 J	0.04 J	0.03 J	0.01 J	0.02 J	0.02 J	0.03 J
LVB 7001	0.17	0.11	0.02 J	0.03 J	0.03 J	0.03 J	0.05 J	0.03 J
Marsh 1-3R	0.9	82.83	4.87	1.41	0.37	0.62	3.09	2.42
Marsh 2-2R	1.88	0.77	0.52	0.27	0.31	0.18	0.08 J	0.11 J
Marsh 6-5R	2.28	0.56	0.13	0.08	0.08 J	0.10 J	0.05 J	0.06 J
SMP 0004	3.89	3.09	0.74	0.45	0.10 J	0.18	0.22	0.28
STO 203	0.68	0.76	0.56	1.04	0.54	0.42	0.29	0.29

Table 7-3
Voltammetry Results

Station	Average Depth (cm)	O2 (uM)	Mn2+ (uM)	Fe2+ (uM)	HS- (uM)
CLO 6802	0	180.616	0.000	0.0	7.769
	0.2	43.148	0.000	0.0	1.779
	0.4	36.865	0.000	0.0	0.474
	0.6	23.100	0.000	0.0	11.502
	1.1	0.0	24.421	0.0	7.546
	1.6	0.0	39.259	0.0	7.894
	2	0.0	32.087	0.0	7.764
	3	0.0	63.849	0.0	7.145
	4	0.0	60.255	0.0	6.730
	5	0.0	64.674	0.0	5.265
	6	0.0	62.235	0.0	4.529
	7	0.0	30.382	0.0	3.729
	8	0.0	0.0	0.0	2.314
	9	0.0	0.0	0.0	1.502
	10	0.0	0.0	0.0	1.505
LVB 6852	0	154.873	0.0	0.0	8.498
	0.1	161.547	0.0	0.0	7.643
	0.2	147.451	0.0	0.0	7.880
	0.4	151.859	0.0	0.0	7.146
	0.6	138.384	0.0	0.0	7.733
	0.8	148.818	0.0	0.0	7.058
	1	80.643	0.0	0.0	4.232
	1.2	13.502	0.0	0.0	0.645
	1.7	0.0			0.383
	2.2	0.0			0.329
	2.7	0.0			0.655
	3.2	0.0			0.568
	3.7	0.0			0.568
	4.2	0.0			0.467
	4.7	0.0			0.451
	5.2	0.0			0.399
	5.7	0.0			0.423
	6.2	0.0			0.399
	6.7	0.0			0.395
	7.2	0.0			0.320
	7.7	0.0			0.355
	8.2	0.0			0.429
	8.7	0.0			0.464
	9.2	0.0			0.414

Station	Average Depth (cm)	O2 (uM)	Mn2+ (uM)	Fe2+ (uM)	HS- (uM)
	9.7	0.0			0.385
LVB 6870	0	32.527	0.0	0.0	2.090
	0.2	25.622	0.0	0.0	1.156
	0.4	33.892	0.0	0.0	5.068
	0.9	0.0	0.0	0.0	5.864
	1.4	0.0	0.0	0.0	5.530
	1.9	0.0	0.0	0.0	5.623
	2.9	0.0	0.0	0.0	4.860
	3.9	0.0	0.0	0.0	4.691
	4.9	0.0	0.0	0.0	4.298
	5.9	0.0	24.136	0.0	4.621
	6.9	0.0	54.910	0.0	4.325
	7.9	0.0	68.257	0.0	4.213
	8.9	0.0	89.522	0.0	4.092
	9.9	0.0	96.976	0.0	0.037
LVB 7001	0	28.425	0.0	0.0	0.000
	0.2	0.0	0.0	0.0	0.000
	0.4	0.0	0.0	0.0	13.328
	0.9	0.0	14.086	0.0	12.257
	1.4	0.0	22.718	0.0	13.412
	1.9	0.0	29.268	0.0	11.834
	2.4	0.0	38.896	0.0	6.936
	3.4	0.0	44.012	0.0	10.234
	4.4	0.0	50.395	0.0	9.120
	5.4	0.0	53.363	0.0	10.973
	6.4	0.0	63.710	0.0	9.095
	7.4	0.0	68.398	0.0	10.235
	8.4	0.0	81.502	0.0	8.795
	9.4	0.0	71.966	0.0	9.716
	10.4	0.0	57.656	0.0	8.819
Marsh 1-3R	0	47.420	0.0	0.0	17.082
	0.2	34.362	0.0	0.0	16.170
	0.4	0.0	0.0	0.0	25.197
	0.9	0.0	0.0	0.0	26.225
	1.4	0.0	0.0	0.0	25.735
	1.9	0.0	0.0	0.0	23.878
	2.9	0.0	0.0	0.0	20.619
	3.9	0.0	0.0	0.0	12.553
	4.9	0.0	17.719	0.0	12.353
	5.9	0.0	31.811	0.0	11.187
	6.9	0.0	32.217	0.0	12.206

Station	Average Depth (cm)	O2 (uM)	Mn2+ (uM)	Fe2+ (uM)	HS- (uM)
	7.9	0.0	41.125	0.0	11.005
	8.9	0.0	44.928	0.0	11.227
	9.9	0.0	0.0	0.0	13.492
	10.9	0.0	4.268	0.0	10.474
Marsh 2-2R	0	27.805	0.0	0.0	0.000
	0.5	0.0	30.731	0.0	3.414
	1	0.0	49.561	0.0	5.566
	1.5	0.0	74.027	0.0	6.945
	2	0.0	105.767	0.0	7.306
	3	0.0	130.286	0.0	8.439
	4	0.0	149.003	0.0	8.289
	5	0.0	145.915	0.0	8.619
	6	0.0	163.376	0.0	7.885
	7	0.0	167.041	0.0	8.504
	8	0.0	193.493	0.0	8.162
	9	0.0	187.859	0.0	8.682
	10	0.0	198.319	0.0	7.464
Marsh 6-5R	0	130.388	0.0	0.0	37.526
	0.2	63.181	0.0	0.0	10.986
	0.4	52.202	0.0	58.494	10.564
	0.9	0.0	0.0	24.206	14.522
	1.4	0.0	0.0	0.0	12.225
	1.9	0.0	0.0	0.0	10.804
	2.9	0.0	0.0	0.0	9.581
	3.9	0.0	0.0	0.0	8.768
	4.9	0.0	0.0	0.0	7.704
	5.9	0.0	7.666	0.0	7.510
	6.9	0.0	0.910	0.0	5.597
	7.9	0.0	11.419	0.0	4.913
	8.9	0.0	22.324	0.0	4.477
	9.9	0.0	16.815	0.0	6.251
SMP 0004	0	5.867	0.0	15.104	3.623
	0.1	5.001	0.0	0.0	0.258
	0.6	0.0	0.0	0.0	0.182
	1.1	0.0	0.0	0.0	0.113
	1.6	11.646	0.519	0.0	0.047
	2.1	0.000	5.307	0.0	0.043
	2.6	6.497	8.143	0.0	0.075
	3.1	0.0	8.755	0.0	0.018
	3.6	0.0	11.047	0.0	0.034
	4.1	11.124	11.425	0.0	0.034

Station	Average Depth (cm)	O2 (uM)	Mn2+ (uM)	Fe2+ (uM)	HS- (uM)
	4.6	0.0	12.402	0.0	0.072
	5.1	0.0	15.173	0.0	0.028
	5.6	7.560	15.553	0.0	0.042
	6.1	0.0	18.392	0.0	0.027
	6.6	8.064	16.286	0.0	0.054
	7.1	0.0	18.369	0.0	0.100
	7.6	0.0	19.076	0.0	0.120
	8.1	0.0	20.358	0.0	0.186
	8.6		29.786	0.0	0.127
	9.1		23.358	0.0	0.057
	9.6		23.004	0.0	0.171
	10.1		23.835	0.0	0.208
	10.6		24.800	0.0	0.293
	11.1		28.262	0.0	0.035
	11.6		27.432	0.0	0.164
	12.1		45.606	0.0	0.338
	12.6		29.245	0.0	0.368
STO 0203	0	26.700	0.0	0.0	0.0
	0.2	0.0	0.0	0.0	0.0
	0.4	16.027	9.192	0.0	0.0
	0.9	0.0	25.089	0.0	4.229
	1.4	0.0	31.488	0.0	4.507
	1.9	0.0	103.870	0.0	4.897
	2.9	0.0	119.620	0.0	5.741
	3.9	0.0	141.783	0.0	6.657
	4.9	0.0	155.487	0.0	6.547
	5.9	0.0	174.308	0.0	7.263
	6.9	0.0	193.179	0.0	6.947
	7.9	0.0	0.0	0.0	7.765
	8.9	0.0	0.0	0.0	7.387
	9.9	0.0	0.0	0.0	8.229

7.1 SEDIMENT PROFILE PLOTS

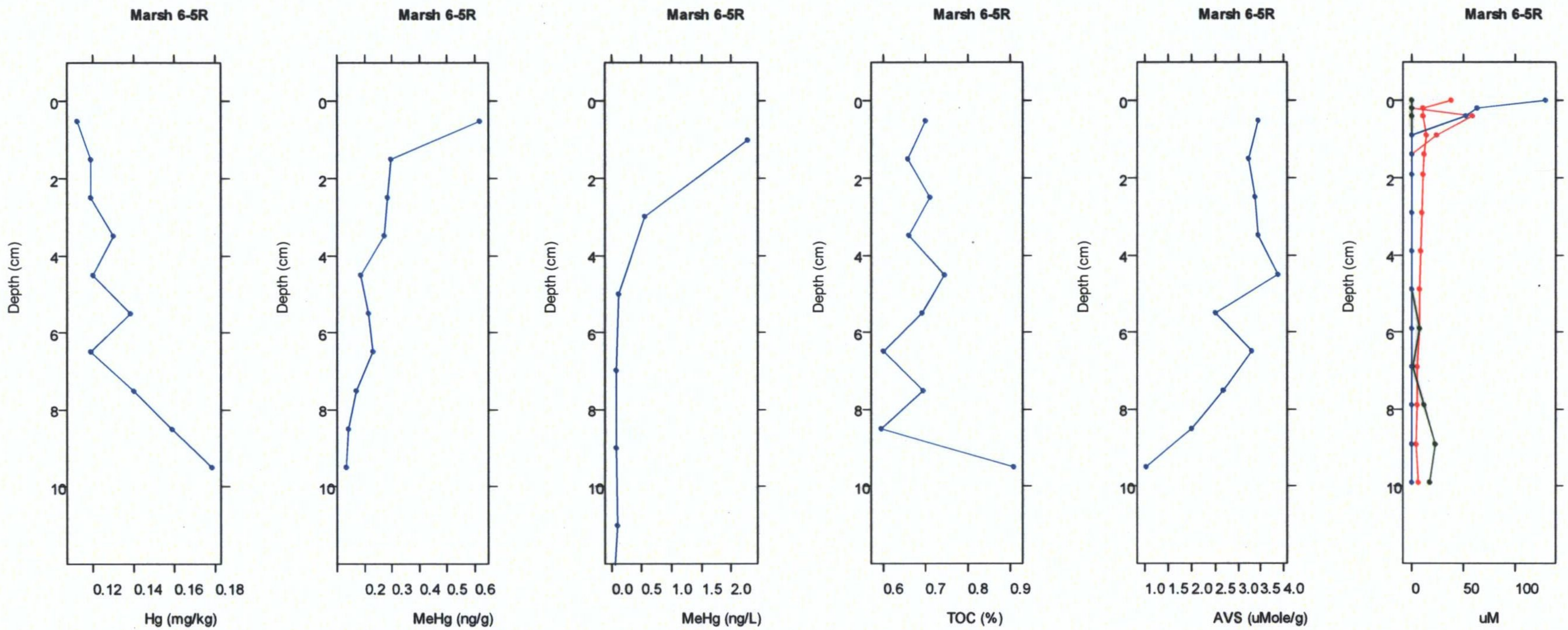


Figure 7-1 Sediment chemistry and redox profiles for Closed Area Shoreline Station Marsh 6-5R. Voltammetry color codes: Fe^{2+} brown; HS- red; Mn^{2+} dark green; O_2 blue.

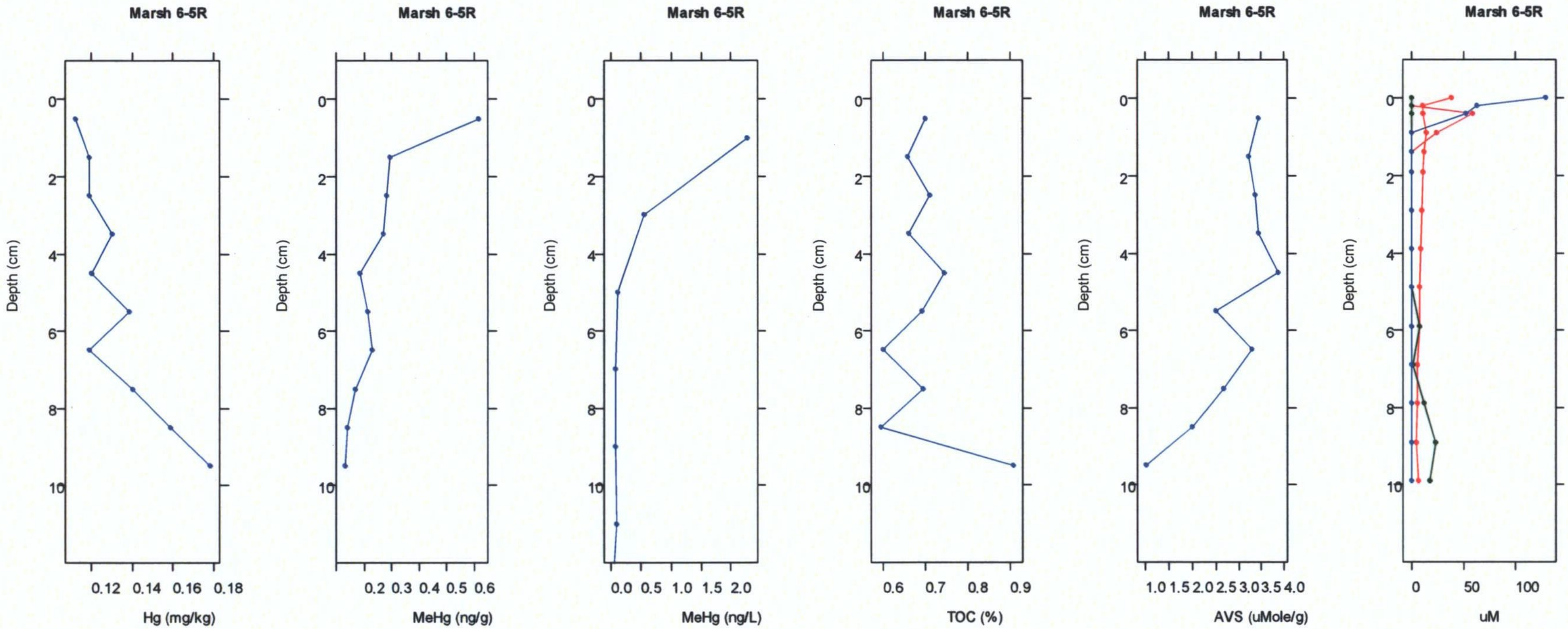


Figure 7-2 Sediment chemistry and redox profiles for Closed Area Shoreline Station Marsh 6-5R. Voltammetry color codes: Fe^{2+} brown; HS- red; Mn^{2+} dark green; O_2 blue.

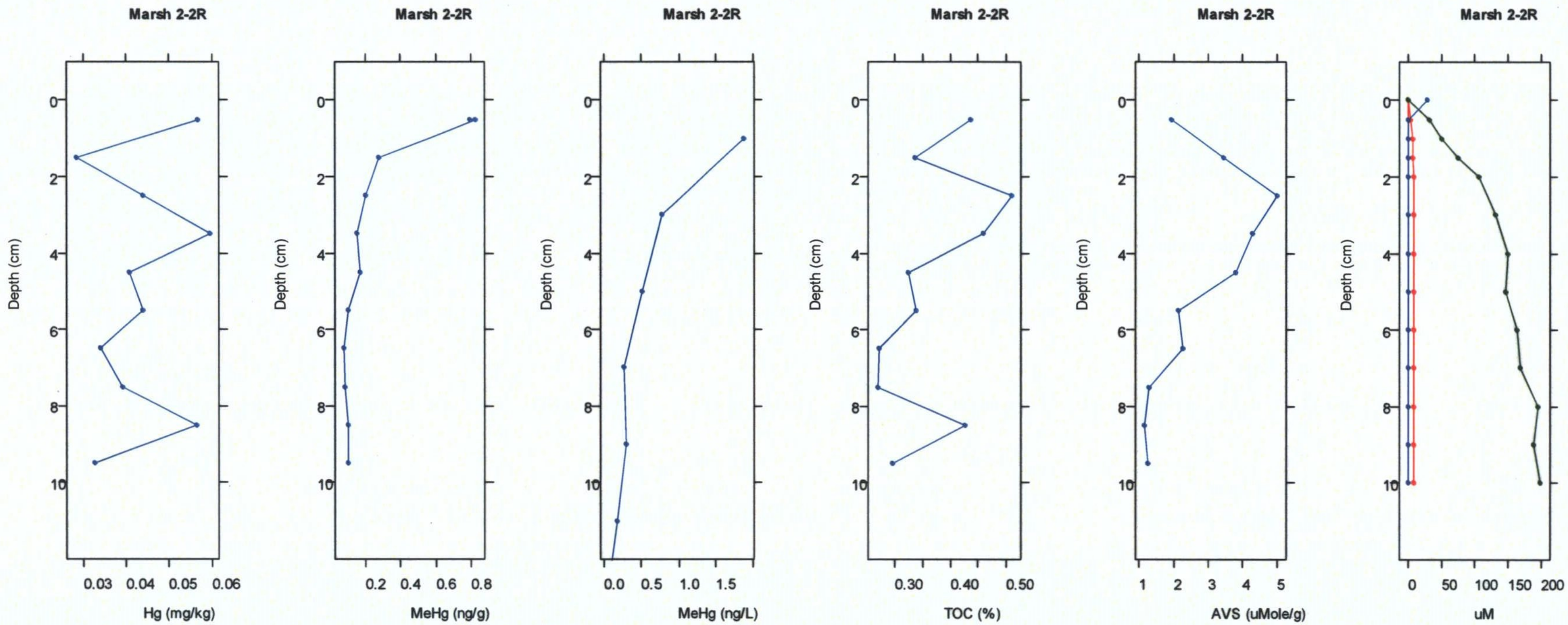


Figure 7-3 Sediment chemistry and redox profiles for Closed Area Shoreline Station Marsh 2-2R. Voltammetry color codes: Fe^{2+} brown; HS- red; Mn^{2+} dark green; O_2 blue.

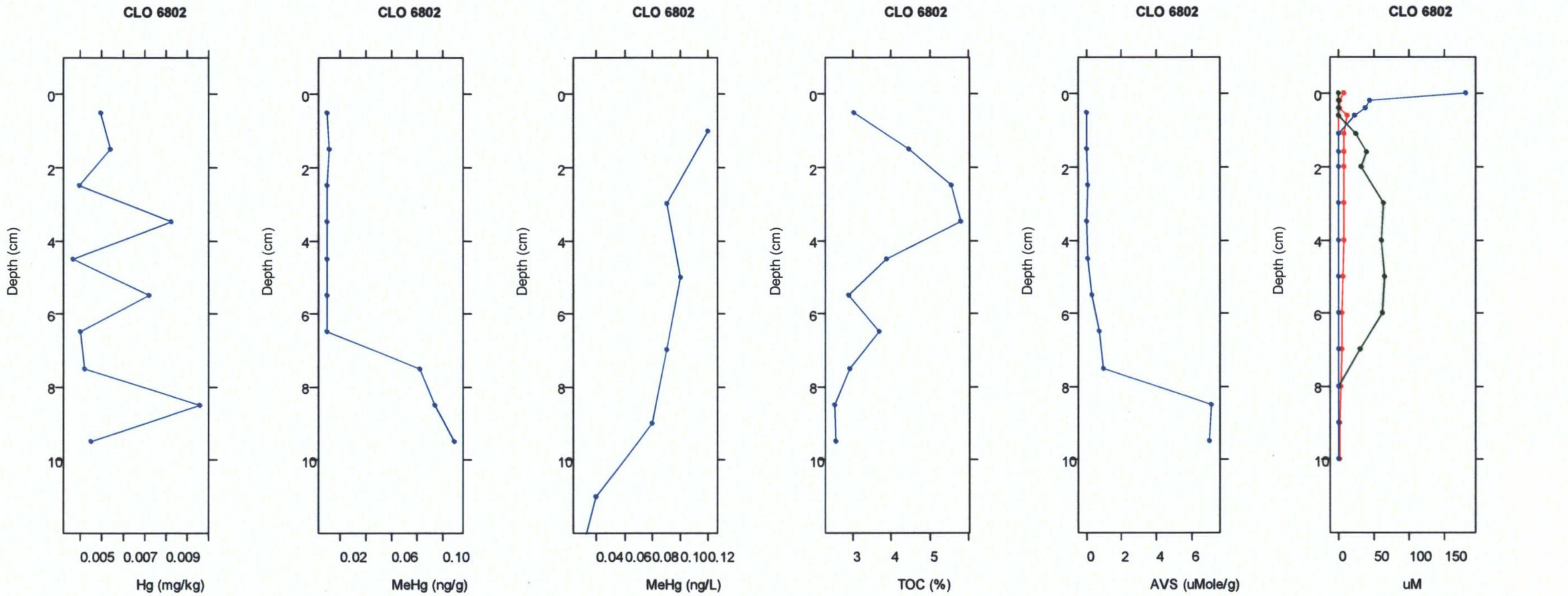


Figure 7-4 Sediment chemistry and redox profiles for Closed Area Shoreline Station CLO 6802. Voltammetry color codes: Fe^{2+} brown; HS- red; Mn^{2+} dark green; O_2 blue.

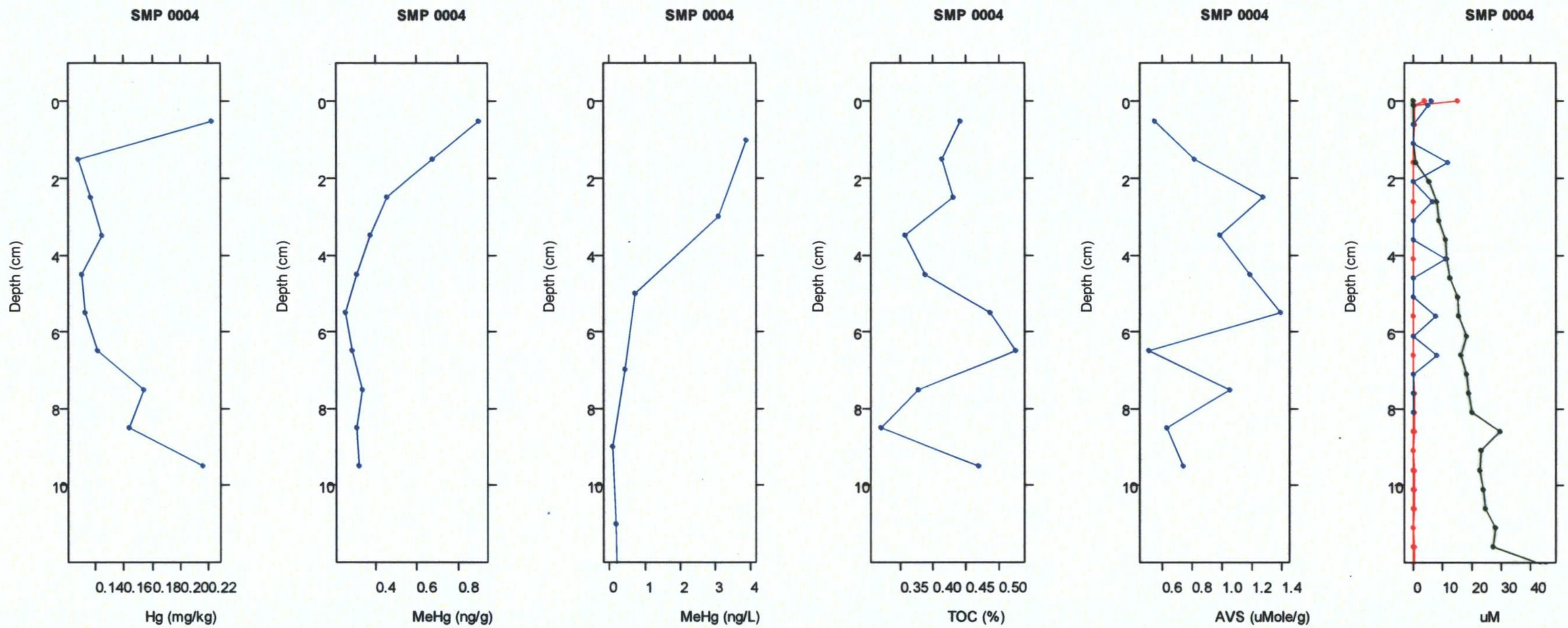


Figure 7-5 Sediment chemistry and redox profiles for Closed Area Open Water Station SMP 0004. Voltammetry color codes: Fe^{2+} brown; HS- red; Mn^{2+} dark green; O_2 blue.

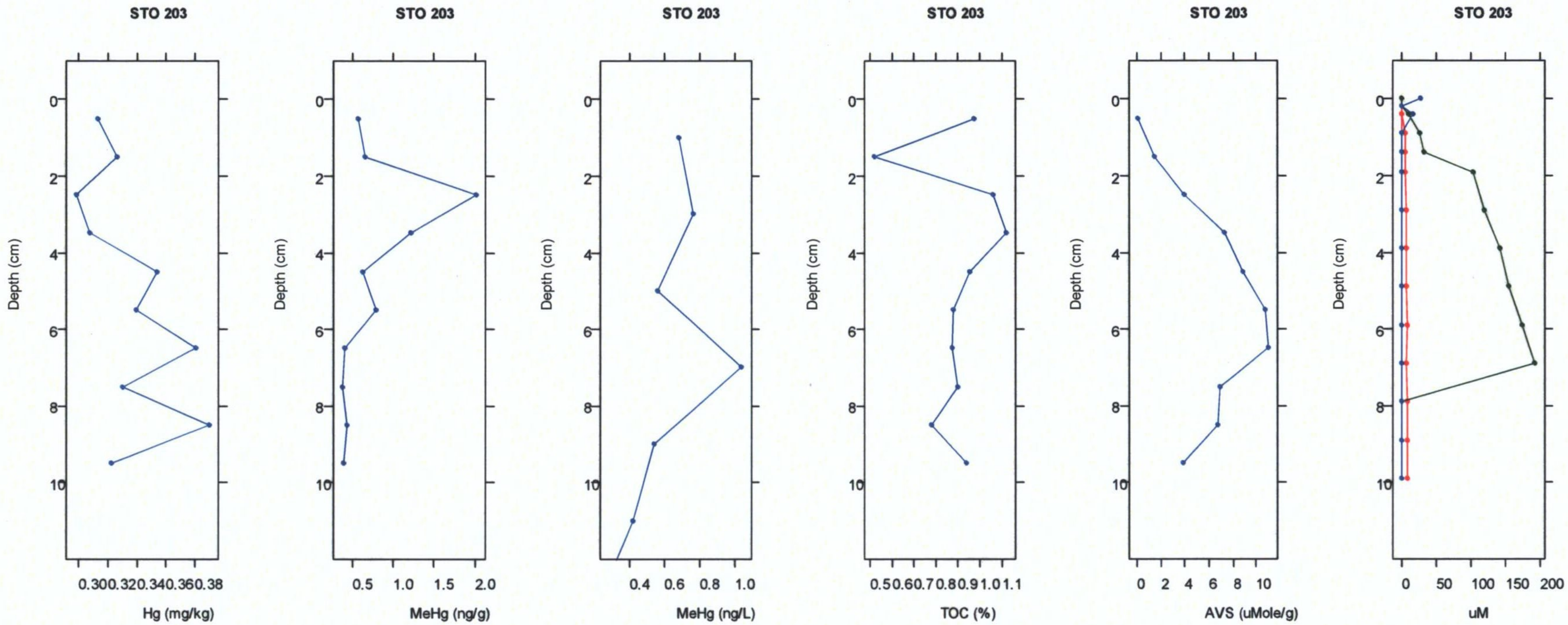


Figure 7-6 Sediment chemistry and redox profiles for Closed Area Open Water Station STO 203. Voltammetry color codes: Fe^{2+} brown; HS- red; Mn^{2+} dark green; O_2 blue.

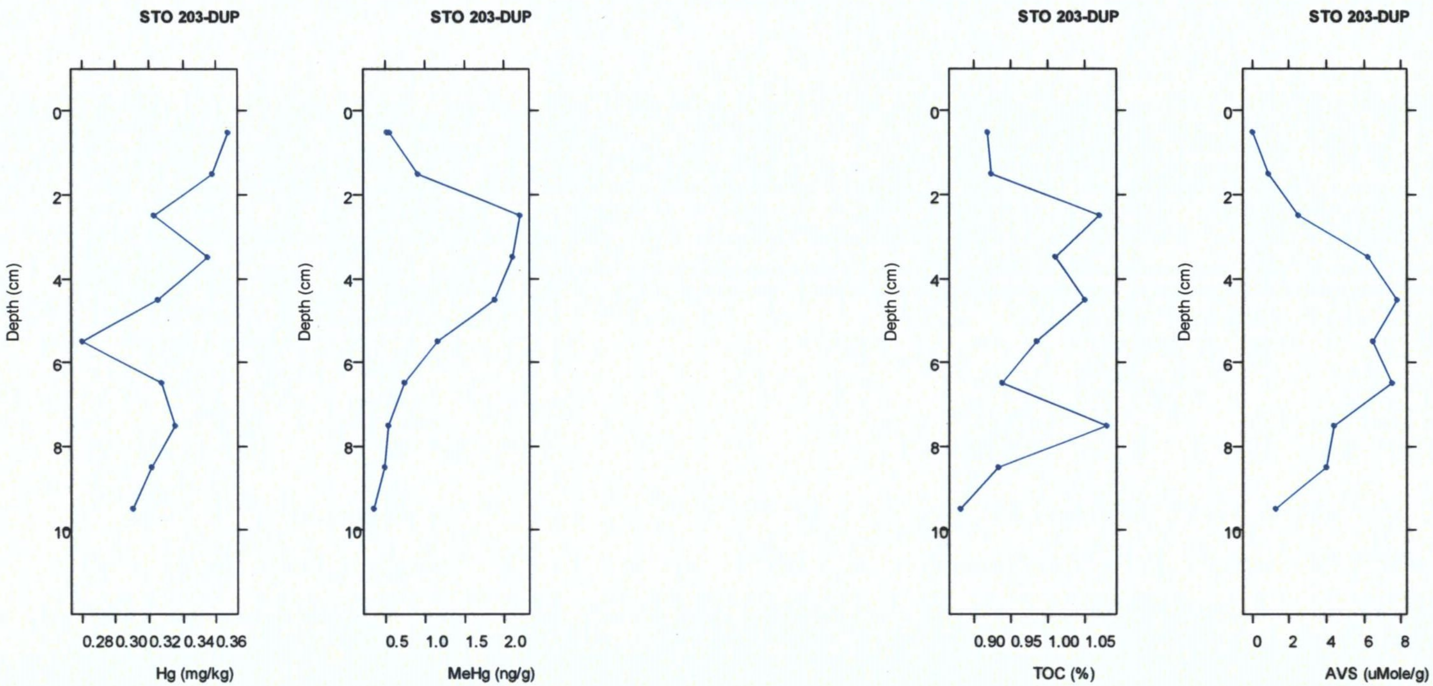


Figure 7-7 Sediment chemistry and redox profiles for Closed Area Open Water Station STO 203, duplicate chemistry profile. Voltammetry color codes: Fe^{2+} brown; HS- red; Mn^{2+} dark green; O_2 blue.

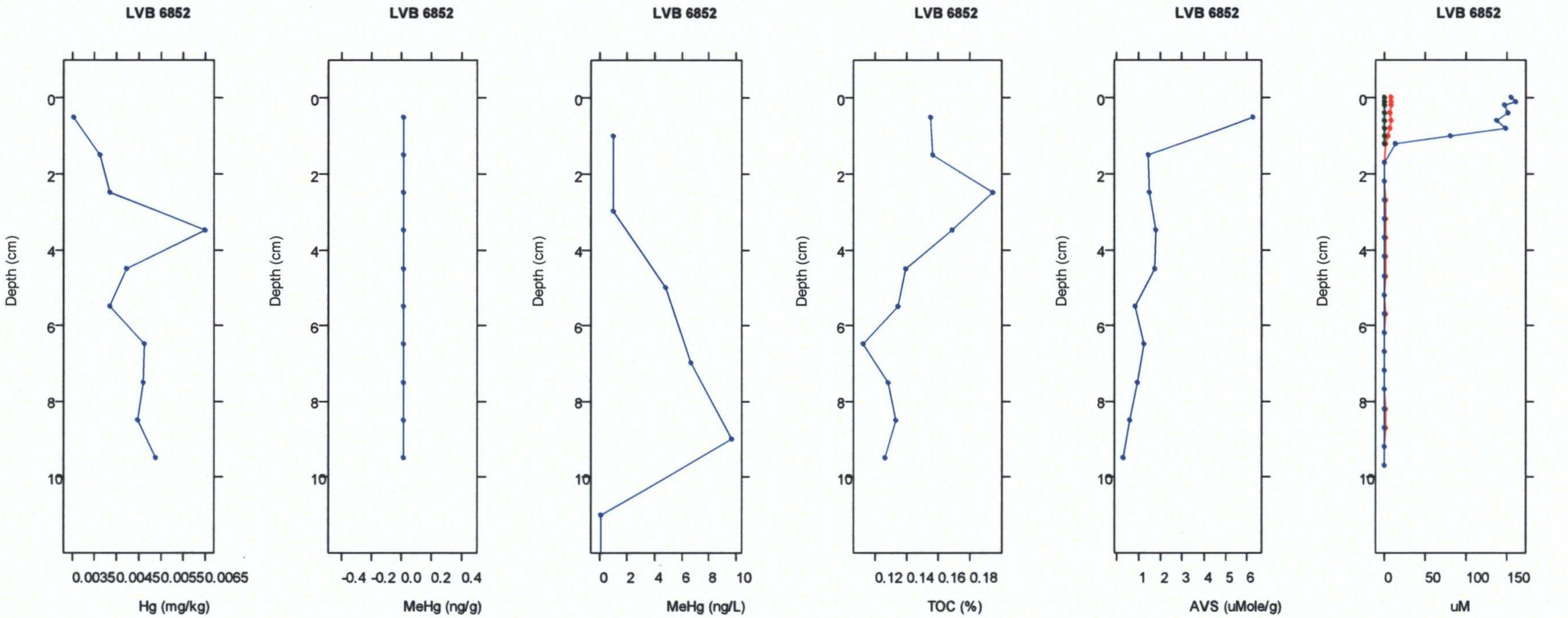


Figure 7-8 Sediment chemistry and redox profiles for Adjacent Open Area Shoreline Station LCB 6852. Sediment methylmercury concentrations were non-detect at all depths in this core. Voltammetry color codes: Fe^{2+} brown; HS- red; Mn^{2+} dark green; O_2 blue.

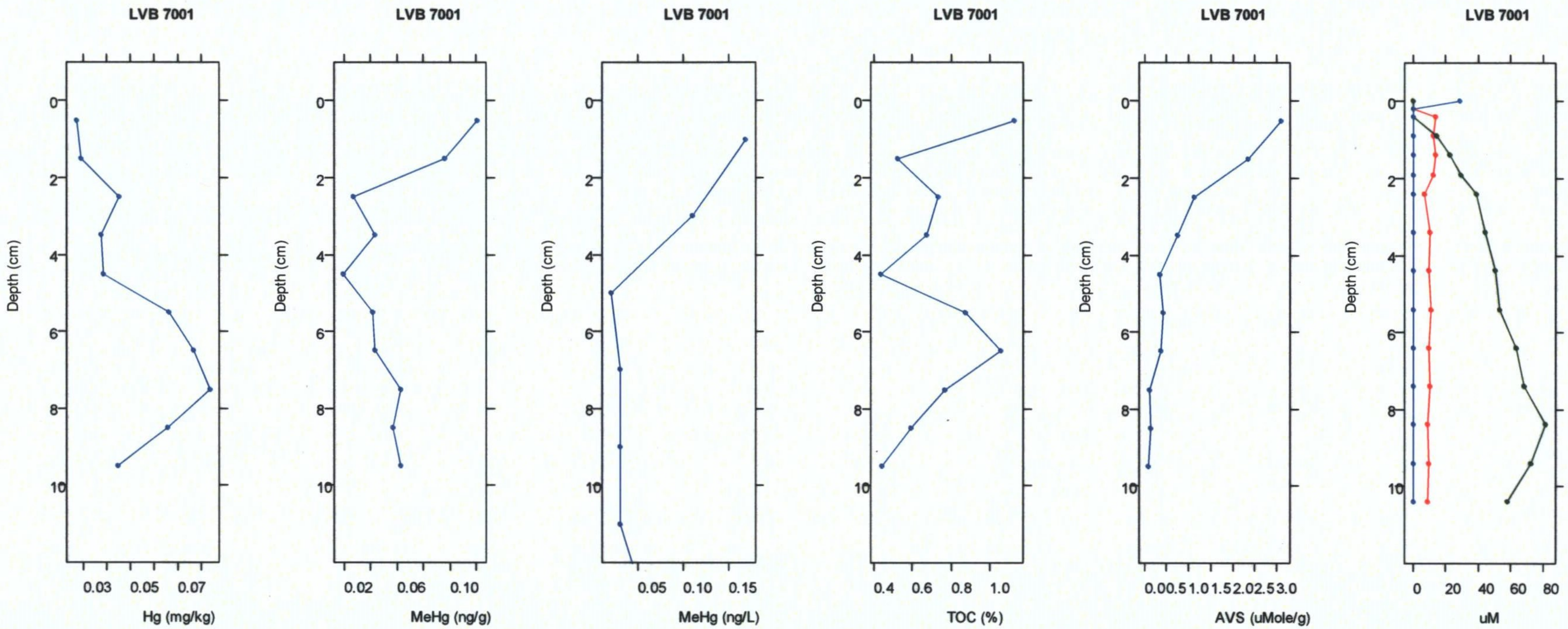


Figure 7-9 Sediment chemistry and redox profiles for Adjacent Open Water Station LCB 7001. Voltammetry color codes: Fe^{2+} brown; HS- red; Mn^{2+} dark green; O_2 blue.

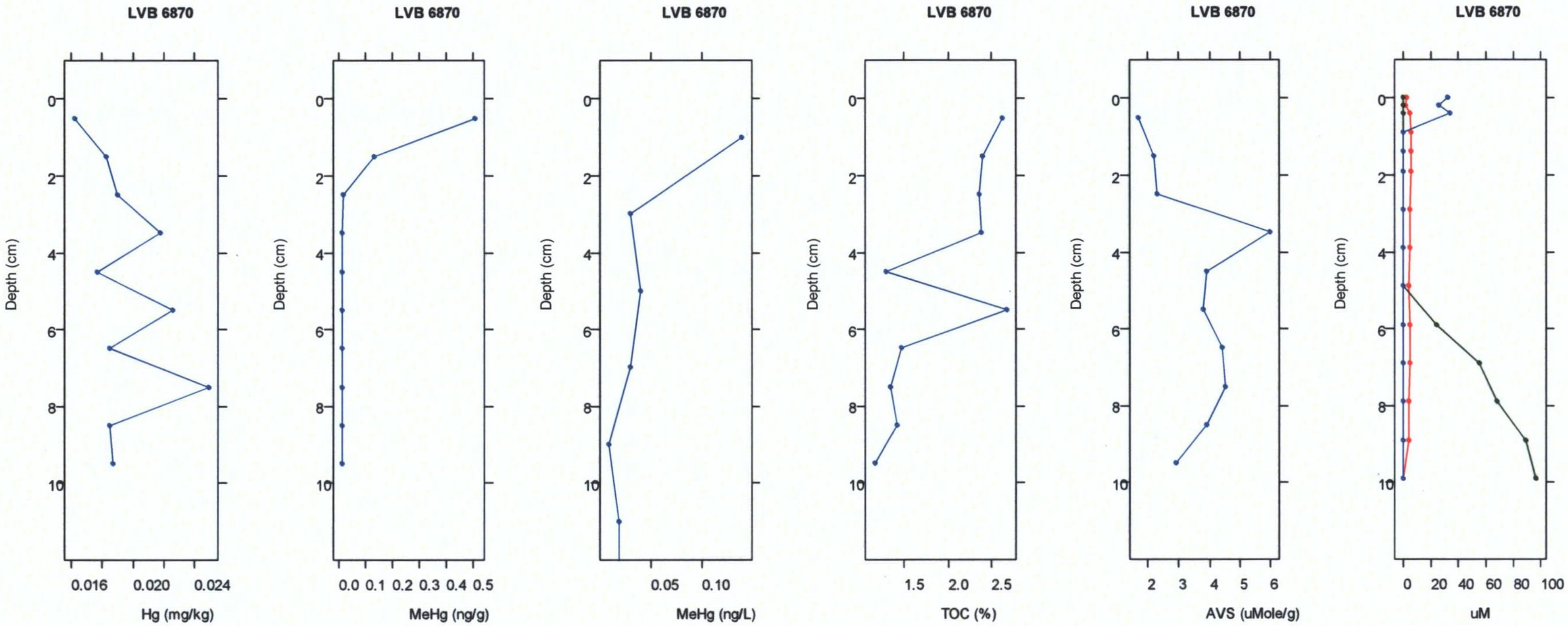


Figure 7-10 Sediment chemistry and redox profiles for Adjacent Open Area Shoreline Station LVB 6870. Voltammetry color codes: Fe^{2+} brown; HS- red; Mn^{2+} dark green; O_2 blue.

Table 7-4
Benthic Infaunal Community Data

			Sample ID											
Phylum	Taxon	Species	CLO 6802(0-2)	CLO 6802(6-10)	LVB 6852(0-2)	LVB 6852(2-6)	LVB 6852(6-10)	Marsh 1-3R(0-2)	Marsh 1-3R(2-6)	Marsh 1-3R(6-10)	Marsh 6-5R(0-2)	SMP 0004(0-2)	SMP 0004(2-6)	SMP 0004(6-10)
Annelida	Annelida	Capitella capitata	3	1	-	-	-	-	-	-	3	-	-	-
Annelida	Annelida	Eupolymnia crassicornis	1	-	-	-	-	-	-	-	-	-	-	-
Annelida	Annelida	Glycera capitata	-	-	-	-	-	-	-	-	-	2	1	-
Annelida	Annelida	Heteromastis filiformis	3	1	-	-	-	-	-	-	3	-	-	-
Annelida	Annelida	Lacydoniidae sp.	2	-	-	-	-	-	-	-	-	-	-	-
Annelida	Annelida	Nereis pelagica	5	1	1	1	2	1	1	1	-	8	2	-
Annelida	Annelida	Oligochaeta sp.	7	-	-	-	-	-	-	-	-	-	1	-
Annelida	Annelida	Paraprionospio pinnata	1	-	-	2	-	2	2	-	13	10	-	-
Annelida	Annelida	Spionidae sp.	3	-	-	-	-	-	-	-	-	-	-	-
Crustacea	Amphipod	Gammarus mucronatus	2	-	-	-	-	1	-	-	2	-	-	-
Crustacea	Amphipod	Monoculodes sp.	-	-	9	-	-	-	-	-	-	-	-	-
Crustacea	Cirripea	Balanus sp.	-	-	-	-	-	-	-	-	-	1	-	-
Crustacea	Cumacean	Oxyurostylis smithi	1	-	-	-	-	-	-	-	-	-	-	-
Crustacea	Decapod	Crab zoea	1	-	1	-	-	-	-	-	-	-	-	-
Crustacea	Decapod	Palaemonites sp.	1	-	2	-	-	-	-	-	-	-	-	-
Crustacea	Decapod	Penaeidae juvenile sp.	-	-	-	-	-	-	-	-	1	-	-	-
Crustacea	Tanaid	Tanaidae sp. 1	-	-	-	-	-	-	-	1	-	2	-	-
Crustacea	Tanaid	Tanaidae sp. 2	-	-	-	-	-	-	-	1	-	-	-	-
Mollusca	Bivalvia	Crassostrea virginica	-	-	-	-	-	-	-	-	1	-	-	-
Mollusca	Bivalvia	Modiolus sp.	1	-	-	-	-	-	-	-	-	-	-	-
Mollusca	Bivalvia	Mulinia lateralis	-	-	-	-	-	-	-	-	-	3	3	-
Mollusca	Bivalvia	Rangia flexulosa	-	-	-	-	-	-	-	-	-	1	2	-
Bryozoa	Bryozoa	Bryozoa sp.	3	-	-	-	-	-	-	-	-	-	-	-
Cnidaria	Cnidaria	Hydrozoa sp.	13	-	-	-	-	1	-	-	-	-	-	-
Sipunculida	Sipunculida	Sipunculida sp.	-	-	-	-	-	-	-	-	-	-	-	1

Appendix D1

Rhodamine Dye Tracer Study

Study 7A

March 2016

ALCOA

Appendix D1 – Rhodamine Dye Tracer Study

Introduction

This study was conducted in accordance with Section 4.4 (Recommendations) of the 2014 Remedial Action Annual Effectiveness Report (RAAER). The work plan was submitted to the USEPA on September 18, 2015, (Alcoa 2015c) and received approval from the USEPA on September 25, 2015.

Objective

The Lavaca Bay (bay) Causeway Cove is bounded on the south by a line of oyster reefs and on the north by a peninsula supporting the Route 35 Causeway (Figure D1-1). It is connected with the bay to the south by two gaps in the oyster reefs. A narrow, relatively deep channel exists due north of Witco Channel (termed the "east channel"), and a wider, somewhat shallower channel (termed the "mid-reef channel") exists about midway along the line of oyster reefs. The mid-reef channel has a mean low tide cross-section of about 1,070 square feet, which is approximately three times greater than that of the east channel. The goal of this study was to understand the extent to which flood tide moved water from Witco Channel into Causeway Cove and the transport within the Causeway Cove during subsequent tidal cycles.

Technical Approach

At the onset of flood tide on October 13, 2015, 50 liters of 20% Rhodamine WT, a soluble, non-toxic, red fluorescent dye, were released by boat at the north end of Witco Channel (Figure D1-2). The dispersal and transport of the dye was monitored visually using aerial photography and chemically using in situ and boat-mounted fluorometers. Four boat transects were run over a 48-hour period, and in situ monitoring was conducted at the stations shown on Figure D1-1. Boat transects monitored concentrations 2 feet below the water surface at approximately 100-feet intervals. In situ Rhodamine probes recorded water fluorescence every 15 minutes.

Data Collection

For 16 minutes, from 3:36 to 3:52 p.m., the Rhodamine WT solution was pumped 2 feet below the water surface at a continuous rate. Fluorescence measurements were recorded every 15 minutes by YSI 600 OMS water quality sondes with temperature, conductivity, and Rhodamine WT sensors at three locations as follows: two within oyster reef channels leading to Causeway Cove and the third within the center channel between the northwest edge of Dredge Island and the adjacent oyster reef, until the sondes were removed on October 16, 2015. Raw Rhodamine sonde data are provided electronically on the included disk.

Approximately 1 hour after the Rhodamine WT release, aerial photography of the area north of Dredge Island was conducted. Vertical photographs were taken at 4:59 and 5:24 p.m. Eighteen oblique images were shot between the two vertical images. Aerial photographs are provided electronically on the included disk.

Rhodamine transect data were collected during the following four transect events:

- October 14, 2015, 9:55 a.m. – 12:25 p.m.
- October 14, 2015, 13:10 p.m. – 4:26 p.m.
- October 15, 2015, 9:12 a.m. – 12:07 p.m.
- October 15, 2015, 15:30 p.m. – 6:00 p.m.

Appendix D1 – Rhodamine Dye Tracer Study

Sampling was conducted from 20- and 24-foot aluminum boats equipped with Global Positioning Systems to determine the coordinates of all sampling locations. The transect pathways were adjusted between events in response to water pathways and concentration gradients obtained from previous transects. Rhodamine transect data were collected using YSI 6920v2 sondes with Rhodamine WT probes.[1] Boat transect data are provided in Tables D1-1 and D1-2.

Water surface elevation data were downloaded from the Port Lavaca National Oceanic and Atmospheric Administration (NOAA) station (Station Number 8773259, Port Lavaca [TCOON], Texas).[2] Local elevation data were obtained from a CTD-Diver D1271' 10-meter gage that was deployed on the south side of the Dredge Island Bridge, approximately 50 feet southwest of the east channel reef border, from October 14, 2015, to December 17, 2015, and measured water depth at 6-minute intervals. Water depth data are provided electronically on the included disk.

Results and Discussion

The aerial photographs successfully recorded the visible dye plume. The images indicate that flow northward from the Witco and Alcoa channels during flood tide is deflected to the west by the oyster reefs and enters Causeway Cove. It does so mainly through the mid-reef channel and the open water just west of the terminus of the reefs. This pattern is evident in the vertical image of the dye plume taken 1 hour after the dye release (Figure D1-3), which shows that nearly all of the dye was transported to the west and into Causeway Cove. The arrows drawn on the photograph in Figure D1-3 indicate the inferred transport pathways.

Measurements taken at the fixed stations shown in Figures D1-1 and D1-2 indicate that most of the dye entered Causeway Cove through the mid-reef channel in a narrow pulse (Figure D1-4). An estimate of mass flux of Rhodamine WT dye at each station was calculated from the in situ measurements, channel cross sectional areas based on water tide gauge depths, and average water velocity measurements (Appendix D-2) recorded at each station. Mass flux calculations for the first full tidal cycle after the release indicate that transport through the mid-reef channel was approximately ten times greater than transport to the west of the oyster reef terminus (Table D1-3). Little of the dye entered through the east channel.

The dye carried past the mid-reef channel within the first 3 hours after release indicated that the currents rapidly transported the bulk of the dye to the west with little dispersion or dilution. Dye carried into the Causeway Cove area was gradually diluted and dissipated with concentrations of less than 4 micrograms per liter (μg/L) measured 48 hours after release (Figure D1-5a through Figure D1-5d).

Once in Causeway Cove, the dye slowly propagated to the northeast, as evidenced by concentrations measured along boat-run transects 21.5 to 25 hours after the dye release (Figure D1-5b). Plots of concentration along the transects, as shown in blue in Figure D1-5b, show a trend of increasing concentration to the northeast (Figure D1-6).

[1] Due to field and rental coordination limitations, turbidity measurements were unable to be collected during transect sampling.
[2] The NOAA data were unavailable from October 14, 2015, to November 11, 2015, and on November 23, 2015.

Appendix D1 – Rhodamine Dye Tracer Study

Summary and Conclusions

The oyster reefs north of Dredge Island act as a barrier and redirect tidal flows on an incoming tide from the Alcoa and Witco channels to the west where they largely enter Causeway Cove through the mid-reef channel. Water moving further west above Dredge Island is directed to the north and east as it moves past the western terminus of the oyster reefs, presumably due to a general northward flood tide flow along the west of Dredge Island.

Inside Causeway Cove, water currents slow, and flows hug the southern portion above the oyster reefs. The slower moving water gradually disperses to the northeast towards the marshes at the eastern boundary of Causeway Cove. The lingering dye concentrations seen in the transects indicate water circulation patterns within Causeway Cove are low energy, and water entering Causeway Cove may have an extended residence time.

The study occurred during conditions typical of the month-long period over which velocity was monitored at the channel stations and therefore likely has general applicability for non-event conditions. The velocity data showed that a strong southerly wind event reversed the general circulation (see Appendix D2) and thus a dye release during that condition would show a pattern much different from that measured in this study.

Data collected during this study impacted the design of Studies 7B, Witco Turbidity and Velocity Study, and Study 7C, Water Column Mercury Study. Namely, adjustments were made to address possible data gaps and lessons learned from these results. These adjustments included the following:

- Because results indicated that the mid-reef channel is a primary pathway for sediment and water transport into Causeway Cove, the mercury monitoring ISCO sampler located off the shoreline of the On-shore Lagoon was moved to the mid-reef channel.
- Results indicated sediment transported to Causeway Cove largely came from the Witco and Alcoa channels. This prompted expanding the scope of Study 7C to further understand the contributions from the Witco Harbor barge movements, Witco Channel, and Alcoa Channel. To do this, the following additions to study were made:
  - Water column profiling in the channels to measure the relative background contributions of sediments and thus particulate mercury from the Witco and Alcoa channels
  - Barge movement sampling to understand sediment and mercury resuspension from full barge movements within Witco Harbor and the impact of barge movements on sediment transport out of Witco Harbor

TABLES

Table D1-1a

October 14, 2015, Rhodamine Transect Data: 1st Transect – 24-ft Boat

Date: 10/14/2015 **Start Time:** 9:59

Personnel: CP, RM **End Time:** 12:25

WPT	Temperature °C	pH	Rhodamine µg/L	Conductivity µS/cm^3	Salinity	Latitude	Longitude
307	26.00	8.09	-4.3	36.06	22.78	28.66029	-96.57060
308	26.57	8.13	-4.3	36.11	22.76	28.66058	-96.57083
309	26.78	8.15	-2.9	36.08	23.10	28.66075	-96.57097
312	26.42	8.19	-4.7	35.90	22.60	28.66110	-96.57107
313	26.08	8.23	-4.3	35.86	22.58	28.66136	-96.57113
314	26.17	8.24	-4.3	35.86	22.59	28.66162	-96.57129
315	26.41	8.23	-2.6	35.87	22.60	28.66188	-96.57140
316	26.39	8.23	-3.8	35.99	22.65	28.66217	-96.57139
318	26.39	8.23	-5.2	35.88	22.60	28.66229	-96.57153
319	26.28	8.23	-4.1	35.82	22.56	28.66238	-96.57182
320	26.78	8.21	-4.7	36.16	22.81	28.66234	-96.57223
322	26.50	8.23	-4.8	36.13	22.78	28.66237	-96.57263
323	26.71	8.23	-4.9	36.08	22.72	28.66242	-96.57294
324	26.74	8.22	-4.7	36.16	22.76	28.66250	-96.57329
325	26.93	8.21	-3.9	36.31	22.89	28.66249	-96.57372
326	26.96	8.21	-4.4	36.31	22.90	28.66237	-96.57417
327	27.05	8.22	-0.8	36.26	22.85	28.66215	-96.57454
328	26.92	8.23	1.5	36.36	22.93	28.66188	-96.57494
329	26.96	8.24	0.2	36.31	22.89	28.66193	-96.57527
330	26.91	8.24	1.8	36.19	22.78	28.66196	-96.57558
332	26.70	8.25	2.1	35.97	22.68	28.66189	-96.57592
333	26.63	8.24	1.5	36.05	22.70	28.66184	-96.57626
334	26.54	8.25	-1.5	36.07	22.72	28.66170	-96.57664
335	26.57	8.26	-1.5	36.06	22.72	28.66158	-96.57693
336	26.60	8.25	-3.1	36.01	22.68	28.66142	-96.57719
337	26.69	8.25	1.6	36.12	22.75	28.66114	-96.57712

Table D1-1a

October 14, 2015, Rhodamine Transect Data: 1st Transect – 24-ft Boat

WPT	Temperature °C	pH	Rhodamine µg/L	Conductivity µS/cm³	Salinity	Latitude	Longitude
338	26.92	8.25	1.5	36.02	22.75	28.66090	-96.57690
339	27.58	8.24	2.1	36.38	22.92	28.66059	-96.57676
340	27.15	8.23	3.1	36.31	22.88	28.66031	-96.57668
342	26.90	8.25	5.2	36.07	22.71	28.66178	-96.57598
343	27.02	8.24	2.0	36.20	22.82	28.66156	-96.57578
344	27.17	8.23	1.5	36.16	22.75	28.66144	-96.57553
345	27.39	8.23	0.9	36.20	22.80	28.66129	-96.57525
346	27.31	8.22	-0.5	36.10	22.77	28.66120	-96.57491
348	27.42	8.22	-1.7	36.32	22.85	28.66116	-96.57468
349	27.47	8.22	-1.7	36.17	22.79	28.66114	-96.57436
350	27.29	8.22	-2.1	36.27	22.85	28.66112	-96.57390
352	27.39	8.21	-2.3	36.34	22.90	28.66106	-96.57374
353	27.44	8.21	-3.4	36.35	22.94	28.66110	-96.57343
354	27.32	8.21	-2.1	36.36	22.92	28.66113	-96.57312
355	27.44	8.20	-2.5	36.42	22.95	28.66114	-96.57282
356	27.31	8.20	-3.3	36.48	23.04	28.66118	-96.57248
357	27.96	8.20	-3.8	36.33	22.91	28.66120	-96.57221
358	27.30	8.19	-3.8	36.55	23.05	28.66123	-96.57187
359	27.33	8.19	-1.9	36.56	23.04	28.66111	-96.57176
360	27.52	8.20	-3.4	36.66	23.11	28.66084	-96.57202
362	27.45	8.20	-2.9	36.50	22.95	28.66073	-96.57229
363	27.29	8.21	-1.8	36.50	23.03	28.66064	-96.57260
364	27.27	8.21	-2.6	36.48	23.01	28.66052	-96.57291
365	27.33	8.22	-2.4	36.38	22.91	28.66040	-96.57316
366	27.29	8.22	-3.5	36.39	22.80	28.66028	-96.57344
367	27.42	8.22	-3.1	36.32	22.89	28.66014	-96.57370
368	27.33	8.22	-2.7	36.29	22.85	28.65992	-96.57393
369	27.93	8.22	-2.8	35.88	22.58	28.65981	-96.57428
370	27.64	8.23	-2.4	35.95	22.57	28.65969	-96.57449

Table D1-1a

October 14, 2015, Rhodamine Transect Data: 1st Transect – 24-ft Boat

WPT	Temperature °C	pH	Rhodamine µg/L	Conductivity µS/cm³	Salinity	Latitude	Longitude
372	27.92	8.23	-2.1	35.75	22.43	28.65947	-96.57470

Notes:

°C = degrees Celsius

µg/L = micrograms per liter

µS/cm³ = microsiemens per cubic centimeter

WPT = way point

Table D1-1b
October 14, 2015, Rhodamine Transect Data: 1st Transect – 20-ft Boat

Date: 10/15/2015 **Start Time:** 09:55/11:35
Personnel: NH, MJ **End Time:** 10:13/12:25

Time	WPT	Temperature °C	pH	Rhodamine µg/L	Conductivity µS/cm^3	Salinity	Latitude	Longitude
	28	26.94	8.18	0.8	36.05	22.70	28.65736	-96.56819
	29	26.87	8.20	0.4	35.88	22.59	28.65758	-96.56842
	30	26.92	8.20	0.3	35.91	22.59	28.65784	-96.56859
	31	26.90	8.20	0.4	35.96	22.63	28.65807	-96.56870
	32	27.02	8.22	0.1	35.86	22.66	28.65831	-96.56889
	33	27.10	8.24	1.5	36.18	22.79	28.65855	-96.56903
	34	27.02	8.24	0.8	36.14	22.76	28.65881	-96.56915
	35	27.10	8.22	1.1	36.23	22.83	28.65897	-96.56938
	36	27.21	8.22	0.7	36.34	22.90	28.65916	-96.56966
10:06	37	27.10	8.22	0.3	36.29	22.86	28.65936	-96.56989
	38	26.68	8.22	2.1	35.63	22.43	28.65957	-96.57011
10:09	39	26.84	8.22	1.9	35.69	22.48	28.65977	-96.57035
	40	26.79	8.21	1.8	36.19	22.82	28.65954	-96.57035
10:11	41	26.83	8.23	0.5	35.87	22.59	28.65931	-96.57057
10:12	42	26.75	8.23	1.9	35.98	22.67	28.65908	-96.57068
10:13	43	26.96	8.24	2.6	36.05	22.78	28.65882	-96.57083
11:35	44	27.17	8.24	1.5	35.28	22.22	28.65856	-96.57094
11:36	45	28.11	8.25	1.7	35.19	22.21	28.65834	-96.57103
11:37	46	27.21	8.26	1.5	35.1	21.96	28.65807	-96.57119
11:39	47	27.13	8.27	1.6	35.01	22.03	28.65806	-96.57142
11:40	48	27.28	8.27	1.3	34.77	21.93	28.65817	-96.57174
11:41	49	27.40	8.27	1.6	35.00	21.98	28.65818	-96.57206
11:42	50	27.20	8.28	0.9	34.95	21.94	28.65821	-96.57239
11:43	51	27.20	8.28	0.4	35.03	21.96	28.65820	-96.57271
11:45	52	27.31	8.29	1.8	34.77	21.79	28.65824	-96.57304
11:46	53	26.88	8.27	2.3	34.72	21.73	28.65816	-96.57333

Table D1-1b

October 14, 2015, Rhodamine Transect Data: 1st Transect – 20-ft Boat

Time	WPT	Temperature °C	pH	Rhodamine µg/L	Conductivity µS/cm³	Salinity	Latitude	Longitude
11:48	54	27.60	8.29	1.5	34.69	21.73	28.65809	-96.57362
11:49	55	27.20	8.29	2.2	34.62	21.69	28.65798	-96.57391
11:50	56	27.93	8.31	1.7	32.58	20.46	28.65787	-96.57419
11:51	57	27.81	8.32	4.8	34.31	21.48	28.65777	-96.57451
11:52	58	27.21	8.32	6.8	34.04	21.35	28.65767	-96.57477
11:53	59	27.39	8.33	6.8	33.95	21.24	28.65756	-96.57505
11:54	60	28.05	8.34	5.8	33.74	21.20	28.65743	-96.57536
11:55	61	27.13	8.33	4.9	33.97	21.23	28.65729	-96.57560
11:56	62	27.96	8.33	6.3	33.44	21.21	28.65718	-96.57592
11:57	63	27.87	8.34	3.8	33.71	20.77	28.65701	-96.57614
11:58	64	27.00	8.34	5.0	33.86	21.24	28.65689	-96.57643
11:59	65	27.82	8.35	25.4	33.17	20.69	28.65675	-96.57668
12:00	66	27.22	8.34	23.2	33.94	21.1	28.65666	-96.57697
12:01	67	28.05	8.34	2.7	32.77	20.56	28.65668	-96.57728
12:02	68	28.00	8.34	6.2	33.11	20.72	28.65675	-96.57756
12:03	69	27.97	8.35	2.4	33.18	20.83	28.65680	-96.57790
12:04	70	28.15	8.34	2.3	32.49	20.35	28.65706	-96.57801
12:05	71	27.79	8.34	4.0	34.50	21.65	28.65725	-96.57821
12:06	72	27.94	8.35	1.5	32.70	20.50	28.65758	-96.57817
12:07	73	27.86	8.35	2.2	32.80	20.45	28.65783	-96.57808
12:08	74	27.98	8.35	1.9	32.88	20.48	28.65809	-96.57797
12:09	75	28.04	8.35	0.8	33.10	20.62	28.65826	-96.57778
12:10	76	28.00	8.35	3.0	33.28	20.77	28.65845	-96.57756
12:11	77	27.72	8.33	4.4	33.54	21.35	28.65859	-96.57728
12:12	78	27.24	8.33	5.3	34.58	21.63	28.65865	-96.57700
12:13	79	27.69	8.34	5.0	34.48	21.73	28.65875	-96.57660
12:14	80	27.16	8.33	5.8	34.79	21.83	28.65874	-96.57633
12:15	81	27.34	8.33	6.8	34.61	21.68	28.65884	-96.57608
12:16	82	27.47	8.33	7.2	34.56	21.66	28.65892	-96.57584

Table D1-1b
October 14, 2015, Rhodamine Transect Data: 1st Transect – 20-ft Boat

Time	WPT	Temperature °C	pH	Rhodamine µg/L	Conductivity µS/cm^3	Salinity	Latitude	Longitude
12:17	83	27.74	8.33	7.6	34.52	21.61	28.65901	-96.57553
12:18	84	27.78	8.32	7.1	34.57	21.66	28.65922	-96.57532
12:19	85	27.92	8.31	6.4	34.67	21.74	28.65943	-96.57500
12:25		27.74	8.25	0.4	35.69	22.46		
12:25		27.83	8.32	6.4	34.61	21.69		

Notes:

°C = degrees Celsius

µg/L = micrograms per liter

µS/cm^3 = microsiemens per cubic centimeter

WPT = way point

Table D1-1c

October 14, 2015, Rhodamine Transect Data: 2nd Transect – 24-ft Boat

Date: 10/14/2015 **Start Time:** 13:41

Personnel: Kenneth **End Time:** 14:28

WPT	Temperature °C	pH	Rhodamine µg/L	Conductivity µS/cm^3	Salinity	Latitude	Longitude
373	27.91	7.97	4.6	36.36	22.90	28.66049	-96.57395
374	27.96	8.11	4.6	36.29	22.85	28.66065	-96.57433
376	28.06	8.16	3.6	35.95	22.61	28.66049	-96.57458
377	28.03	8.17	3.5	35.96	22.61	28.66048	-96.57480
378	27.98	8.18	5.2	36.11	22.72	28.66046	-96.57499
379	27.99	8.19	5.7	36.07	22.69	28.66059	-96.57522
380	27.91	8.20	5.2	36.02	22.66	28.66065	-96.57557
382	27.86	8.22	5.2	35.86	22.55	28.66078	-96.57583
383	27.89	8.22	6.4	35.81	22.51	28.66093	-96.57599
384	27.88	8.22	4.8	35.73	22.46	28.66095	-96.57621
385	27.87	8.23	4.5	35.61	22.37	28.66094	-96.57642
386	27.86	8.24	3.3	35.46	22.25	28.66084	-96.57667
387	27.88	8.24	3.3	35.31	22.16	28.66095	-96.57697
388	27.92	8.24	3.1	35.16	22.06	28.66104	-96.57720
389	27.95	8.24	4.0	35.06	21.99	28.66095	-96.57757
390	28.02	8.25	2.3	34.94	21.91	28.66100	-96.57796
392	27.99	8.25	3.9	34.97	21.93	28.66070	-96.57808
393	27.98	8.25	3.4	34.97	21.93	28.66044	-96.57815
394	27.96	8.24	3.4	34.99	21.94	28.66018	-96.57821
395	27.95	8.26	2.6	35.02	21.96	28.66006	-96.57839
396	27.97	8.27	3.8	34.91	21.89	28.65985	-96.57837
397	27.98	8.27	3.4	34.94	21.92	28.65950	-96.57836
398	28.00	8.27	2.4	34.62	21.68	28.65913	-96.57840
399	28.00	8.27	1.2	34.57	21.64	28.65895	-96.57857
400	27.98	8.27	2.3	34.55	21.64	28.65877	-96.57880
402	27.96	8.27	1.3	34.42	21.55	28.65862	-96.57902
403	27.94	8.28	2.6	34.35	21.49	28.65837	-96.57902
404	27.91	8.28	2.9	34.25	21.44	28.65819	-96.57917
405	27.89	8.28	0.9	34.11	21.36	28.65796	-96.57920
406	27.91	8.28	1.6	34.00	21.26	28.65774	-96.57937
407	27.91	8.28	3.0	34.09	21.33	28.65747	-96.57945
408	27.92	8.28	1.3	33.86	21.16	28.65723	-96.57961
409	27.93	8.28	1.4	33.74	21.08	28.65695	-96.57956
412	27.96	8.28	2.3	33.70	21.05	28.65683	-96.57925
413	27.97	8.28	1.4	33.72	21.07	28.65672	-96.57898
414	27.97	8.28	1.6	33.57	20.93	28.65658	-96.57874
415	27.99	8.29	1.2	33.55	20.95	28.65635	-96.57865
416	27.99	8.29	1.5	33.52	20.94	28.65632	-96.57839
417	27.99	8.29	1.4	33.45	20.87	28.65624	-96.57814

Table D1-1c

October 14, 2015, Rhodamine Transect Data: 2nd Transect – 24-ft Boat

WPT	Temperature °C	pH	Rhodamine µg/L	Conductivity µS/cm^3	Salinity	Latitude	Longitude
418	28.03	8.29	2.9	33.36	20.81	28.65610	-96.57788
419	28.07	8.29	3.1	33.39	20.84	28.65586	-96.57758
420	28.13	8.29	2.4	33.44	20.87	28.65573	-96.57725
422	28.20	8.29	2.3	33.57	20.99	28.65559	-96.57694
423	28.28	8.28	0.5	33.79	21.12	28.65546	-96.57661

Notes:

°C = degrees Celsius

µg/L = micrograms per liter

µS/cm^3 = microsiemens per cubic centimeter

WPT = way point

Table D1-1d

October 14, 2015 Rhodamine Transect Data: 3rd Transect – 24-ft Boat

Date: 10/14/2015 **Start Time:** 15:03

Personnel: Kenneth **End Time:** 16:26

WPT	Temperature °C	pH	Rhodamine µg/L	Conductivity µS/cm^3	Salinity	Latitude	Longitude
424	28.47	8.19	1.9	35.82	22.51	28.66028	-96.57063
425	28.62	8.19	2.5	35.95	22.60	28.66058	-96.57074
426	28.58	8.18	2.7	35.94	22.56	28.66084	-96.57089
427	28.52	8.17	2.3	36.32	22.86	28.66109	-96.57107
428	28.50	8.16	7.3	36.42	22.95	28.66134	-96.57118
429	28.36	8.15	7.3	36.65	23.09	28.66162	-96.57130
430	28.37	8.14	4.2	36.67	23.09	28.66186	-96.57130
432	28.41	8.14	1.8	36.65	23.09	28.66212	-96.57134
433	28.38	8.14	4.3	36.68	23.11	28.66228	-96.57154
434	28.28	8.14	3.1	36.54	23.02	28.66231	-96.57186
435	28.20	8.15	3.5	36.47	22.95	28.66239	-96.57226
436	28.14	8.16	4.6	36.37	22.90	28.66234	-96.57263
437	28.16	8.18	3.7	36.37	22.91	28.66243	-96.57294
438	28.18	8.18	4.0	36.37	22.90	28.66254	-96.57336
439	28.22	8.19	3.4	36.36	22.89	28.66250	-96.57376
440	28.27	8.19	4.2	36.31	22.85	28.66235	-96.57421
442	28.23	8.20	8.2	36.13	22.73	28.66210	-96.57467
444	28.2	8.20	6.3	36.00	22.64	28.66195	-96.57498
445	28.18	8.21	5.6	35.98	22.61	28.66193	-96.57535
447	28.18	8.22	6.3	35.83	22.53	28.66200	-96.57574
448	28.17	8.22	9.3	35.84	22.52	28.66188	-96.57596
449	28.16	8.23	4.6	35.62	22.37	28.66180	-96.57624
450	28.15	8.23	7.6	35.53	22.31	28.66173	-96.57655
452	28.15	8.23	1.6	35.48	22.25	28.66151	-96.57691
453	28.22	8.23	3.7	35.25	22.12	28.66147	-96.57731
454	28.17	8.25	6.0	35.82	22.52	28.66155	-96.57582
455	28.21	8.23	4.1	36.06	22.69	28.66137	-96.57550
456	28.28	8.22	5.6	36.06	22.69	28.66147	-96.57509
457	28.35	8.23	6.2	35.34	22.18	28.66125	-96.57493
458	28.35	8.22	4.9	35.44	22.26	28.66114	-96.57468
459	28.36	8.22	2.5	35.55	22.35	28.66117	-96.57433
460	28.39	8.22	5.4	35.31	22.16	28.66104	-96.57404
462	28.40	8.21	5.3	36.16	22.75	28.66102	-96.57375
463	28.33	8.20	8.3	36.39	22.91	28.66109	-96.57335
464	28.30	8.19	5.0	36.46	22.97	28.66119	-96.57315
465	28.28	8.19	4.6	36.56	23.02	28.66119	-96.57268
466	28.35	8.19	3.8	36.55	23.02	28.66120	-96.57249
467	28.39	8.19	3.1	36.55	23.02	28.66119	-96.57220
468	28.35	8.19	3.4	36.55	23.02	28.66119	-96.57216

Table D1-1d
October 14, 2015 Rhodamine Transect Data: 3rd Transect – 24-ft Boat

WPT	Temperature °C	pH	Rhodamine µg/L	Conductivity µS/cm³	Salinity	Latitude	Longitude
469	28.30	8.19	4.2	36.54	23.01	28.66115	-96.57174
470	28.54	8.20	3.6	36.42	22.93	28.66090	-96.57190
472	28.60	8.21	3.3	36.46	22.96	28.66070	-96.57226
473	28.43	8.21	4.1	36.46	22.95	28.66061	-96.57275

Notes:

°C = degrees Celsius

µg/L = micrograms per liter

µS/cm³ = microsiemens per cubic centimeter

WPT = way point

Table D1-1e

October 14, 2015, Rhodamine Transect Data: 4th Transect – 24-ft Boat

Date: 10/14/2015 **Start Time:** 16:39

Personnel: Kenneth **End Time:** 17:57

WPT	Temperature °C	pH	Rhodamine µg/L	Conductivity µS/cm^3	Salinity	Latitude	Longitude
476	28.40	8.23	4.3	35.37	22.17	28.66045	-96.57394
477	28.40	8.24	3.4	34.82	21.82	28.66064	-96.57434
478	28.44	8.24	5.7	34.76	21.78	28.66049	-96.57449
479	28.41	8.23	2.5	34.74	21.74	28.66048	-96.57484
480	28.38	8.22	2.4	34.55	21.63	28.66052	-96.57512
482	28.34	8.22	4.2	34.66	21.71	28.66065	-96.57547
483	28.32	8.22	2.6	34.84	21.84	28.66084	-96.57582
484	28.33	8.22	4.3	34.91	21.90	28.66103	-96.57594
485	28.28	8.22	4.6	35.23	22.13	28.66094	-96.57628
486	28.29	8.21	3.1	35.22	22.10	28.66090	-96.57654
487	28.22	8.21	5.4	35.88	22.56	28.66102	-96.57707
488	28.18	8.21	5.1	35.45	22.23	28.66108	-96.57732
489	28.18	8.21	3.9	35.65	22.41	28.66098	-96.57761
490	28.23	8.21	5.3	35.29	22.14	28.66098	-96.57806
492	28.23	8.20	5.3	35.25	22.12	28.66059	-96.57816
493	28.20	8.21	4.3	34.80	21.78	28.66040	-96.57820
494	28.25	8.22	4.2	34.46	21.56	28.66014	-96.57847
495	28.32	8.22	2.3	34.09	21.34	28.65978	-96.57844
496	28.32	8.22	3.2	33.79	21.10	28.65950	-96.57822
497	28.28	8.22	3.6	33.59	20.97	28.65910	-96.57845
498	28.26	8.22	4.4	33.43	20.85	28.65882	-96.57855
499	28.26	8.22	1.4	33.38	20.82	28.65867	-96.57886
500	28.24	8.23	5.2	33.31	20.78	28.65835	-96.57900
502	28.25	8.23	1.0	33.34	20.79	28.65814	-96.57920
503	28.24	8.22	2.6	33.31	20.78	28.65803	-96.57921
504	28.24	8.22	3.2	33.29	20.76	28.65779	-96.57924
505	28.24	8.23	3.5	33.27	20.75	28.65750	-96.57938
507	28.24	8.23	3.4	33.23	20.72	28.65722	-96.57965
508	28.29	8.23	2.9	33.17	20.68	28.65691	-96.57958
509	28.30	8.23	1.3	33.20	20.70	28.65680	-96.57923
513	28.30	8.23	2.0	33.17	20.67	28.65674	-96.57900
514	28.30	8.23	1.7	33.21	20.71	28.65660	-96.57873
515	28.28	8.23	1.6	33.21	20.71	28.65639	-96.57866
516	28.31	8.23	1.4	33.22	20.72	28.65626	-96.57835
517	28.31	8.23	1.2	33.24	20.74	28.65621	-96.57817
518	28.31	8.22	1.9	33.29	20.76	28.65604	-96.57788
519	28.30	8.22	2.3	33.34	20.80	28.65583	-96.57774
520	28.35	8.22	1.4	33.48	20.91	28.65567	-96.57732
522	28.40	8.22	1.8	33.71	21.05	28.65557	-96.57697

Table D1-1e

October 14, 2015, Rhodamine Transect Data: 4th Transect – 24-ft Boat

WPT	Temperature °C	pH	Rhodamine µg/L	Conductivity µS/cm^3	Salinity	Latitude	Longitude
523	28.39	8.23	2.5	33.91	21.18	28.65542	-96.57659

Notes:

°C = degrees Celsius

µg/L = micrograms per liter

µS/cm^3 = microsiemens per cubic centimeter

WPT = way point

Table D1-1f

October 14, 2015, Rhodamine Transect Data: 2nd Transect – 20-ft Boat

Date: 10/14/2015 **Start Time:** 15:06

Personnel: RM **End Time:** 16:22

Time	WPT	Temperature °C	pH	Rhodamine µg/L	Conductivity µS/cm^3	Salinity	Latitude	Longitude
15:06	86	28.54	8.23	0.5	36.04	22.65	28.65736	-96.56822
15:07	87	28.47	8.26	1.7	35.94	22.59	28.65758	-96.56845
15:10	88	28.40	8.28	6.0	35.72	22.44	28.65780	-96.56858
15:12	89	28.30	8.28	6.0	35.61	22.41	28.65809	-96.56870
15:12	90	28.32	8.28	3.0	35.77	22.48	28.65834	-96.56889
15:14	91	28.45	8.29	4.0	35.83	22.53	28.65856	-96.56898
15:15	92	28.41	8.32	1.8	34.81	21.8	28.65883	-96.56916
15:16	93	28.34	8.32	4.2	34.73	21.75	28.65895	-96.56944
15:17	94	28.33	8.33	2.6	34.37	21.52	28.65916	-96.56966
15:18	95	28.34	8.33	2.3	34.35	21.50	28.65937	-96.56983
15:19	96	28.37	8.34	2.4	34.15	21.34	28.65958	-96.57003
15:19	97	28.39	8.34	2.8	34.08	21.31	28.65978	-96.57036
15:25	98	28.39	8.35	2.4	34.00	21.25	28.65955	-96.57044
15:26	99	28.38	8.35	1.3	34.13	21.35	28.65930	-96.57054
15:27	100/101	28.41	8.36	2.4	34.40	21.53	28.65907	-96.57070
15:28	102	28.43	8.35	3.5	34.68	21.72	28.65886	-96.57085
15:29	103	28.40	8.34	2.3	34.77	21.79	28.65851	-96.57096
15:30	104	28.30	8.33	2.0	35.51	22.32	28.65826	-96.57101
15:30	105	28.32	8.33	2.4	35.48	22.28	28.65808	-96.57119
15:31	106	28.36	8.33	1.9	35.45	22.23	28.65812	-96.57147
15:32	107	28.39	8.33	1.8	35.52	22.27	28.65810	-96.57180
15:33	108	28.71	8.34	1.1	34.96	21.92	28.65807	-96.57216
15:34	109	28.87	8.36	2.0	34.83	21.8	28.65812	-96.57244
15:35	110	28.98	8.39	2.3	34.56	21.64	28.65812	-96.57276
15:36	111	28.90	8.38	2.4	34.56	21.63	28.65819	-96.57304
15:36	112	28.81	8.38	2.6	34.48	21.58	28.65818	-96.57333

Table D1-1f
October 14, 2015, Rhodamine Transect Data: 2nd Transect – 20-ft Boat

Time	WPT	Temperature °C	pH	Rhodamine µg/L	Conductivity µS/cm^3	Salinity	Latitude	Longitude
15:37	113	28.68	8.39	2.4	34.16	21.33	28.65804	-96.57365
15:39	114	28.67	8.4	1.8	33.48	20.89	28.65794	-96.57393
15:40	115	28.72	8.41	0.3	33.36	20.79	28.65788	-96.57431
15:41	116	28.66	8.41	0.7	33.28	20.74	28.65772	-96.57451
15:42	117	28.56	8.40	2.3	33.21	20.70	28.65768	-96.57483
15:43	118	28.51	8.39	3.0	33.10	20.62	28.65754	-96.57509
15:44	119	28.60	8.40	2.9	33.11	20.62	28.65734	-96.57536
15:45	120	28.67	8.40	1.8	32.62	20.27	28.65727	-96.57564
15:45	121	28.65	8.39	1.9	32.36	20.11	28.65708	-96.57588
15:46	122	28.55	8.39	2.0	32.35	20.11	28.65694	-96.57617
15:47	123	28.54	8.39	2.0	32.27	20.06	28.65686	-96.57644
15:48	124	28.49	8.39	2.0	32.17	19.98	28.65667	-96.57670
15:49	125	28.43	8.39	2.5	32.10	19.94	28.65664	-96.57706
15:50	126	28.41	8.39	2.9	32.06	19.92	28.65667	-96.57733
15:51	127	28.37	8.39	2.3	32.06	19.91	28.65666	-96.57771
15:52	128	28.37	8.39	2.0	32.09	19.94	28.65690	-96.57795
15:54	129	28.37	8.39	2.2	32.13	19.95	28.65708	-96.57809
15:55	130	28.36	8.39	1.6	32.19	20.01	28.65733	-96.57820
15:57	131	28.36	8.39	3.1	32.28	20.08	28.65757	-96.57829
15:58	132	28.38	8.39	2.9	32.35	20.12	28.65784	-96.57815
15:59	133	28.40	8.39	1.1	32.45	20.17	28.65810	-96.57800
16:03	134	28.52	8.39	1.6	32.58	20.24	28.65832	-96.57781
16:05	135	28.58	8.39	1.8	32.82	20.43	28.65848	-96.57753
16:07	136	28.44	8.39	2.8	33.48	20.88	28.65858	-96.57725
16:08	137	28.39	8.39	2.6	35.64	21.00	28.65867	-96.57695
16:09	138	28.36	8.39	3.3	33.99	21.25	28.65867	-96.57663
16:10	139	28.30	8.38	4.5	34.27	21.36	28.65865	-96.57631
16:11	140	28.43	8.39	3.5	33.84	21.14	28.65876	-96.57601
16:12	141	28.42	8.39	3.0	33.57	20.94	28.65891	-96.57576

Table D1-1f

October 14, 2015, Rhodamine Transect Data: 2nd Transect – 20-ft Boat

Time	WPT	Temperature °C	pH	Rhodamine µg/L	Conductivity µS/cm^3	Salinity	Latitude	Longitude
16:13	142	28.49	8.39	2.4	33.23	20.71	28.65903	-96.57550
16:13	143	28.53	8.40	3.2	33.11	20.63	28.65919	-96.57525
16:14	144	28.44	8.40	3.3	33.19	20.69	28.65933	-96.57497
16:15	145	28.54	8.40	2.4	33.50	20.90	28.65950	-96.57472
16:16	146	28.54	8.40	3.2	33.63	20.98	28.65967	-96.57449
16:18	147	28.53	8.39	2.7	33.80	21.14	28.65983	-96.57423
16:19	148	28.49	8.38	3.6	34.24	21.42	28.65998	-96.57397
16:20	149	28.52	8.38	3.7	34.38	21.50	28.66016	-96.57371
16:21	150	28.49	8.38	3.8	34.98	21.95	28.66027	-96.57347
16:22	151	28.59	8.37	4.3	35.39	22.21	28.66042	-96.57323

Notes:

°C = degrees Celsius

µg/L = micrograms per liter

µS/cm^3 = microsiemens per cubic centimeter

WPT = way point

Table D1-2a
October 15, 2015, Rhodamine Transect Data: 1st Transect – 20-ft Boat

Date: 10/15/2015 **Start Time:** 9:13
Personnel: RM, MJ **End Time:** 10:20

Time	WPT	Temperature °C	pH	Rhodamine µg/L	Conductivity µS/cm^3	Salinity	Latitude	Longitude
9:13	152	26.84	8.26	2.0	34.69	21.76	28.65741	-96.56816
9:14	153	26.82	8.28	2.6	34.77	21.77	28.65760	-96.56839
9:15	154	26.79	8.29	2.4	34.74	21.82	28.65782	-96.56857
9:16	155	26.85	8.29	2.2	34.90	21.95	28.65808	-96.56873
9:17	156	26.81	8.29	2.6	34.88	21.91	28.65832	-96.56886
9:17	157	26.79	8.31	1.5	34.37	21.63	28.65856	-96.56901
9:18	158	26.78	8.31	1.2	34.23	21.44	28.65879	-96.56916
9:18	159	26.56	8.31	2.8	34.25	21.57	28.65901	-96.56936
9:19	160	26.37	8.31	3.0	34.09	21.36	28.65917	-96.56963
9:20	161	26.48	8.32	2.6	34.84	21.17	28.65936	-96.56983
9:20	162	26.43	8.32	1.9	33.80	21.21	28.65952	-96.57009
9:21	163	26.37	8.31	1.1	33.82	21.17	28.65970	-96.57031
9:22	164	26.45	8.32	2.7	33.82	21.15	28.65953	-96.57038
9:24	165	26.71	8.33	1.3	33.81	21.14	28.65927	-96.57051
9:24	166	26.81	8.33	2.0	33.92	21.28	28.65904	-96.57065
9:25	167	26.85	8.33	1.0	33.95	21.25	28.65880	-96.57078
9:26	168	26.83	8.34	1.6	33.86	21.19	28.65854	-96.57093
9:28	169	26.81	8.33	1.8	33.84	21.18	28.65829	-96.57105
9:29	170	26.82	8.33	1.3	33.89	21.21	28.65810	-96.57122
9:29	171	26.81	8.33	1.8	33.81	21.16	28.65808	-96.57150
9:31	172	26.77	8.35	1.3	33.82	21.16	28.65808	-96.57183
9:32	173	26.75	8.35	1.9	33.73	21.11	28.65809	-96.57211
9:33	174	26.72	8.36	0.4	33.69	21.06	28.65811	-96.57246
9:34	175	26.72	8.35	0.1	33.65	21.03	28.65813	-96.57275
9:35	176	26.72	8.36	2.8	33.60	21.01	28.65812	-96.57304
9:36	177	26.73	8.35	1.1	33.56	21.01	28.65809	-96.57335

Table D1-2a
October 15, 2015, Rhodamine Transect Data: 1st Transect – 20-ft Boat

Time	WPT	Temperature °C	pH	Rhodamine µg/L	Conductivity µS/cm³	Salinity	Latitude	Longitude
9:37	178	26.71	8.35	1.7	33.53	21.02	28.65803	-96.57365
9:38	179	26.68	8.36	1.1	33.48	20.93	28.65796	-96.57395
9:39	180	26.67	8.36	1.1	33.44	20.90	28.65783	-96.57423
9:41	181	26.68	8.36	1.8	33.41	20.88	28.65775	-96.57451
9:42	182	26.67	8.36	1.9	33.35	20.84	28.65766	-96.57481
9:43	183	26.65	8.36	2.4	33.29	20.80	28.65756	-96.57511
9:44	184	26.60	8.36	1.8	33.25	20.77	28.65741	-96.57536
9:45	185	26.60	8.36	1.2	33.22	20.75	28.65723	-96.57564
9:47	186	26.71	8.36	2.7	33.23	20.75	28.65712	-96.57590
9:48	187	26.67	8.36	2.1	33.05	20.63	28.65695	-96.57617
9:49	188	26.67	8.36	0.9	33.07	20.64	28.65685	-96.57644
9:50	189	26.75	8.36	2.3	33.05	20.63	28.65674	-96.57673
9:51	190	26.75	8.36	2.3	33.04	20.59	28.65665	-96.57704
9:52	191	26.85	8.36	2.0	33.01	20.60	28.65661	-96.57734
9:54	192	26.91	8.36	2.3	33.05	20.62	28.65667	-96.57765
9:55	193	26.92	8.37	1.4	33.05	20.60	28.65692	-96.57776
9:59	194	26.96	8.36	2.5	33.01	20.60	28.65713	-96.57806
20:02	195	27.03	8.36	2.5	33.20	20.75	28.65732	-96.57819
20:02	196	26.92	8.37	2.3	33.03	20.62	28.65755	-96.57822
10:04	197	26.96	8.37	2.3	33.21	20.74	28.65782	-96.57808
10:05	198	26.99	8.37	1.4	33.23	20.72	28.65809	-96.57801
10:07	199	26.85	8.37	1.5	33.11	20.70	28.65827	-96.57775
10:08	200	26.72	8.37	2.4	33.17	20.70	28.65847	-96.57752
10:09	201	26.76	8.37	3.8	33.24	20.90	28.65858	-96.57725
10:10	202	26.87	8.36	1.9	33.50	20.99	28.65864	-96.57693
10:11	203	26.82	8.36	2.2	33.32	20.84	28.65870	-96.57663
10:12	204	26.93	8.36	2.2	33.45	20.92	28.65870	-96.57632
10:13	205	26.94	8.35	2.3	33.39	20.80	28.65873	-96.57603
10:14	206	26.89	8.37	1.8	33.33	20.83	28.65887	-96.57572

Table D1-2a
October 15, 2015, Rhodamine Transect Data: 1st Transect – 20-ft Boat

Time	WPT	Temperature °C	pH	Rhodamine µg/L	Conductivity µS/cm³	Salinity	Latitude	Longitude
10:15	207	26.99	8.37	2.2	33.65	80.98	28.65904	-96.57547
10:16	208	27.10	8.37	2.2	33.72	21.08	28.65920	-96.57525
10:17	209	26.74	8.38	2.0	33.50	20.95	28.65936	-96.57498
10:18	210	26.65	8.39	2.0	33.59	21.01	28.65951	-96.57473
10:19	211	26.70	8.39	2.4	33.60	21.01	28.65965	-96.57448
10:20	212	26.65	8.39	3.3	33.50	21.00	28.65979	-96.57420

Notes:

°C = degrees Celsius

µg/L = micrograms per liter

µS/cm³ = microsiemens per cubic centimeter

WPT = way point

Table D1-2b
October 15, 2015, Rhodamine Transect Data: 1st Transect – 24-ft Boat

Date: 10/15/2015 **Start Time:** 9:12
Personnel: Kenneth **End Time:** 10:20

WPT	Temperature °C	pH	Rhodamine µg/L	Conductivity µS/cm³	Salinity	Latitude	Longitude
524	26.22	8.00	1.5	35.19	22.16	28.66033	-96.57057
525	25.96	8.09	2.2	35.27	22.19	28.66058	-96.57083
526	25.97	8.11	0.9	35.07	22.04	28.66081	-96.57091
527	25.87	8.14	1.9	34.95	21.96	28.66106	-96.57107
528	25.87	8.15	1.3	34.95	21.95	28.66134	-96.57115
529	25.89	8.16	1.6	34.89	21.92	28.66158	-96.57127
530	25.95	8.16	2.2	34.96	21.96	28.66185	-96.57133
532	25.99	8.17	2.1	34.95	21.94	28.66216	-96.57138
533	26.05	8.17	1.0	34.93	21.94	28.66232	-96.57151
534	26.12	8.17	1.5	34.90	21.92	28.66232	-96.57185
535	26.19	8.19	1.3	34.90	21.92	28.66237	-96.57224
536	26.22	8.18	1.1	34.87	21.90	28.66237	-96.57260
537	26.27	8.18	0.7	35.07	22.01	28.66243	-96.57285
538	26.30	8.18	1.9	34.87	21.93	28.66249	-96.57341
539	26.36	8.18	2.5	34.93	21.94	28.66250	-96.57388
540	26.34	8.18	1.8	34.88	21.90	28.66241	-96.57414
542	26.39	8.18	1.2	34.87	21.90	28.66219	-96.57451
543	26.42	8.18	1.5	34.93	21.96	28.66199	-96.57490
544	26.44	8.18	0.9	34.81	21.86	28.66186	-96.57533
545	26.48	8.18	2.4	34.80	21.85	28.66200	-96.57585
546	26.49	8.18	1.6	34.76	21.82	28.66189	-96.57600
547	26.45	8.18	2.1	34.73	21.80	28.66173	-96.57596
548	26.51	8.18	0.8	34.77	21.82	28.66152	-96.57583
549	26.52	8.18	2.1	34.76	21.82	28.66144	-96.57551
550	26.51	8.18	2.3	34.75	21.82	28.66122	-96.57542
552	26.45	8.17	1.3	34.77	21.86	28.66108	-96.57504

Table D1-2b

October 15, 2015, Rhodamine Transect Data: 1st Transect – 24-ft Boat

WPT	Temperature °C	pH	Rhodamine µg/L	Conductivity µS/cm³	Salinity	Latitude	Longitude
553	26.44	8.17	1.6	34.76	21.82	28.66117	-96.57471
554	26.43	8.18	1.6	34.77	21.83	28.66113	-96.57429
555	26.45	8.18	1.5	34.74	21.80	28.66100	-96.57409
556	26.36	8.18	1.3	34.70	21.78	28.66101	-96.57376
557	26.32	8.18	2.1	34.69	21.77	28.66104	-96.57332
558	26.28	8.17	1.6	34.70	21.78	28.66115	-96.57312
559	26.25	8.18	2.2	34.74	21.86	28.66108	-96.57275
560	26.21	8.18	1.9	34.73	21.80	28.66125	-96.57244
562	26.23	8.18	1.8	34.75	21.81	28.66114	-96.57225
563	26.24	8.17	1.7	34.88	21.91	28.66112	-96.57176
564	26.26	8.17	1.8	34.76	21.82	28.66084	-96.57184
565	26.43	8.19	1.6	34.79	21.84	28.66069	-96.57224
566	26.61	8.19	1.9	34.81	21.85	28.66057	-96.57257
567	26.50	8.19	1.5	34.80	21.85	28.66041	-96.57281
568	26.48	8.19	1.5	34.72	21.82	28.66035	-96.57315
569	26.52	8.19	1.2	34.70	21.77	28.66028	-96.57349
570	26.52	8.19	1.2	34.67	21.75	28.66016	-96.57368
572	26.52	8.19	1.6	34.65	21.75	28.65995	-96.57391

Notes:

°C = degrees Celsius

µg/L = micrograms per liter

µS/cm³ = microsiemens per cubic centimeter

WPT = way point

Table D1-2c
October 15, 2015, Rhodamine Transect Data: 2nd Transect – 24-ft Boat

Date: 10/15/2015 **Start Time:** 10:36
Personnel: **End Time:** 12:07

WPT	Temperature °C	pH	Rhodamine µg/L	Conductivity µS/cm³	Salinity	Latitude	Longitude
573	26.60	8.19	1.8	34.71	21.79	28.66048	-96.57398
574	26.75	8.18	1.8	34.72	21.78	28.66047	-96.57394
575	26.82	8.18	1.6	34.71	21.78	28.66061	-96.57438
576	26.86	8.18	1.3	34.70	21.77	28.66049	-96.57481
577	26.92	8.17	1.4	34.70	21.77	28.66050	-96.57511
578	27.01	8.17	1.3	34.65	21.73	28.66066	-96.57542
579	26.97	8.17	1.3	34.56	21.65	28.66081	-96.57582
580	26.95	8.17	1.1	34.56	21.64	28.66090	-96.57602
582	27.00	8.17	1.4	34.50	21.63	28.66101	-96.57632
583	21.10	8.17	1.3	34.58	21.67	28.66089	-96.57653
584	27.32	8.19	0.9	34.66	21.75	28.66092	-96.57676
585	27.29	8.19	1.3	34.61	21.69	28.66091	-96.57717
586	27.31	8.17	0.9	34.57	21.68	28.66108	-96.57737
587	27.32	8.18	0.8	34.62	21.71	28.66100	-96.57759
588	27.26	8.18	1.1	34.66	21.76	28.66098	-96.57792
589	27.38	8.18	1.0	34.54	21.62	28.66071	-96.57823
590	27.39	8.18	0.6	34.48	21.60	28.66043	-96.57827
592	27.39	8.18	1.4	34.38	21.58	28.66012	-96.57841
593	27.39	8.18	1.4	34.32	21.49	28.65979	-96.57838
594	27.38	8.17	0.5	34.33	21.45	28.65952	-96.57830
595	27.47	8.17	1.2	34.21	21.42	28.65911	-96.57845
596	27.55	8.17	0.8	34.23	21.42	28.65880	-96.57862
597	27.59	8.16	1.5	34.27	21.45	28.65863	-96.57881
598	27.59	8.16	1.4	34.26	21.45	28.65831	-96.57889
599	27.62	8.16	1.6	34.29	21.46	28.65798	-96.57895
600	27.64	8.16	0.8	34.21	21.41	28.65778	-96.57921
602	27.64	8.16	1.1	34.17	21.36	28.65753	-96.57939

Table D1-2c
October 15, 2015, Rhodamine Transect Data: 2nd Transect – 24-ft Boat

WPT	Temperature °C	pH	Rhodamine µg/L	Conductivity µS/cm³	Salinity	Latitude	Longitude
603	27.61	8.16	1.7	34.11	21.34	28.65726	-96.57959
604	27.58	8.16	1.0	34.11	21.34	28.65691	-96.57950
605	27.62	8.16	1.4	34.13	21.36	28.65680	-96.57924
606	27.61	8.16	1.9	34.16	21.37	28.65676	-96.57903
607	27.61	8.16	1.4	34.16	21.38	28.65652	-96.57874
608	27.60	8.16	1.7	34.17	21.38	28.65635	-96.57863
609	27.64	8.16	1.9	34.15	21.39	28.65628	-96.57842
612	27.63	8.16	1.1	34.20	21.41	28.65621	-96.57813
613	27.56	8.16	1.0	34.40	21.51	28.65607	-96.57784
614	27.64	8.16	1.8	34.21	21.41	28.65585	-96.57768
615	27.63	8.17	1.9	34.18	21.40	28.65569	-96.57735
616	27.61	8.17	1.3	34.14	21.36	28.65547	-96.57706
617	27.50	8.17	1.1	34.47	21.61	28.65538	-96.57653

Notes:

°C = degrees Celsius

µg/L = micrograms per liter

µS/cm³ = microsiemens per cubic centimeter

WPT = way point

Table D1-2d
October 15, 2015, Rhodamine Transect Data: 2nd Transect – 20-ft Boat

Date: 10/15/2015 **Start Time:** 15:35
Personnel: RM, MJ **End Time:** 16:37

Time	WPT	Temperature °C	pH	Rhodamine µg/L	Conductivity µS/cm^3	Salinity	Latitude	Longitude
15:35	213	28.47	8.35	1.8	33.37	20.81	28.65704	-96.57815
15:37	214	28.44	8.40	1.4	33.45	20.87	28.65731	-96.57816
15:38	215	28.45	8.40	1.6	33.48	20.89	28.65756	-96.57823
15:39	216	28.43	8.40	1.5	33.49	20.90	28.65784	-96.57808
15:40	217	28.48	8.40	1.9	33.49	20.90	28.65811	-96.57803
15:42	218	28.48	8.40	1.9	33.48	20.88	28.65830	-96.57777
15:43	219	28.50	8.40	1.5	33.47	20.88	28.65850	-96.57755
15:44	220	28.67	8.41	1.3	33.69	21.02	28.65858	-96.57725
15:48	221	28.43	8.42	2.2	33.80	21.11	28.65867	-96.57663
15:49	222	28.43	8.41	2.1	33.73	21.06	28.65875	-96.57633
15:50	223	28.51	8.41	2.0	33.64	21.00	28.65880	-96.57605
15:51	224	28.52	8.42	1.7	33.60	20.97	28.65890	-96.57578
15:52	225	28.53	8.42	2.6	33.57	20.95	28.65905	-96.57551
15:53	226	28.53	8.42	2.8	33.57	20.95	28.65920	-96.57524
15:54	227	28.53	8.42	2.5	33.58	20.96	28.65933	-96.57500
15:56	228	28.54	8.42	1.9	33.61	20.97	28.65950	-96.57473
15:58	229	28.55	8.42	2.3	33.62	20.98	28.65966	-96.57447
15:59	230	28.58	8.43	1.8	33.86	21.15	28.65981	-96.57422
16:00	231	28.87	8.45	2.8	33.89	21.33	28.65999	-96.57396
16:01	232	28.75	8.45	2.3	33.92	21.42	28.66012	-96.57371
16:02	233	28.95	8.45	2.2	34.18	21.35	28.66027	-96.57342
16:03	234	28.81	8.44	3.3	34.15	21.35	28.66043	-96.57319
16:04	235	28.75	8.43	1.4	34.17	21.37	28.66053	-96.57289
16:05	236	28.75	8.44	3.1	34.19	21.37	28.66064	-96.57260
16:06	237	28.74	8.43	2.8	34.14	21.34	28.66076	-96.57232
16:07	238	28.69	8.44	2.3	34.13	21.33	28.66089	-96.57204

Table D1-2d

October 15, 2015, Rhodamine Transect Data: 2nd Transect – 20-ft Boat

Time	WPT	Temperature °C	pH	Rhodamine µg/L	Conductivity µS/cm^3	Salinity	Latitude	Longitude
16:07	239	28.68	8.44	2.2	33.99	21.23	28.66108	-96.57184
16:09	240	28.66	8.44	2.2	34.04	21.28	28.66124	-96.57188
16:10	241	28.59	8.44	2.1	34.14	21.34	28.66118	-96.57220
16:11	242	28.40	8.44	2.9	34.07	21.30	28.66112	-96.57251
16:12	243	28.40	8.44	2.5	34.14	21.35	28.66111	-96.57282
16:13	244	28.40	8.43	1.4	34.09	21.31	28.66106	-96.57313
16:14	245	28.46	8.43	2.8	34.21	21.39	28.66103	-96.57347
16:14	246	28.42	8.43	3.3	34.18	21.38	28.66104	-96.57375
16:15	247	28.44	8.43	2.9	34.28	21.44	28.66102	-96.57408
16:16	248	28.65	8.43	2.7	34.30	21.45	28.66108	-96.57437
16:17	249	28.81	8.44	3.0	34.25	21.41	28.66112	-96.57468
16:17	250	28.81	8.44	3.1	34.17	21.35	28.66118	-96.57498
16:18	251	28.67	8.44	3.1	34.14	21.34	28.66125	-96.57534
16:19	252	28.61	8.44	3.2	34.15	21.35	28.66138	-96.57556
16:22	253	28.56	8.44	2.8	34.13	21.33	28.66155	-96.57578
16:23	254	28.54	8.44	1.6	34.12	21.32	28.66172	-96.57601
16:24	255	28.51	8.44	2.5	33.98	21.22	28.66201	-96.57607
16:29	256	28.44	8.44	2.2	34.14	21.34	28.66235	-96.57132
16:30	257	28.58	8.45	2.4	34.06	21.29	28.66213	-96.57134
16:31	258	28.55	8.45	2.7	34.01	21.23	28.66185	-96.57132
16:32	259	28.55	8.44	2.5	33.94	21.20	28.66157	-96.57122
16:33	260	28.56	8.44	1.8	33.91	21.21	28.66133	-96.57117
16:34	261	28.54	8.43	2.4	33.82	21.15	28.66102	-96.57110
16:35	262	28.53	8.43	2.9	33.89	21.19	28.66081	-96.57091
16:36	263	28.64	8.42	3.0	33.86	21.16	28.66059	-96.57077
16:37	264	28.68	8.43	3.1	33.84	21.13	28.66036	-96.57059

Notes:

°C = degrees Celsius

µg/L = micrograms per liter

µS/cm^3 = microsiemens per cubic centimeter

WPT = way point

Table D1-2e

October 15, 2015, Rhodamine Transect Data: 3rd Transect – 24-ft Boat

Date: 10/15/2015 **Start Time:** 15:50

Personnel: Kenneth (BESI), CJP (AQ) **End Time:** 17:18

WPT	Temperature °C	pH	Rhodamine µg/L	Conductivity µS/cm^3	Salinity	Latitude	Longitude
618	28.42	8.02	1.3	34.62	21.68	28.65547	-96.57664
619	28.46	8.06	0.4	34.64	21.69	28.65556	-96.57694
620	28.48	8.07	1.4	34.55	21.63	28.65570	-96.57727
622	28.45	8.07	0.9	34.56	21.61	28.65577	-96.57773
623	28.44	8.08	0.8	34.60	21.67	28.65608	-96.57788
624	28.42	8.08	0.1	34.52	21.61	28.65624	-96.57814
625	28.45	8.09	1.4	34.56	21.63	28.65624	-96.57840
626	28.45	8.10	1.6	34.51	21.6	28.65636	-96.57867
627	28.44	8.10	1.8	34.56	21.64	28.65658	-96.57870
628	28.44	8.11	1.6	34.53	21.61	28.65675	-96.57908
629	28.43	8.11	1.0	34.53	21.61	28.65683	-96.57925
630	28.44	8.11	0.1	34.53	21.62	28.65695	-96.57948
632	28.44	8.12	1.9	34.56	21.64	28.65724	-96.57961
633	28.41	8.12	1.8	34.59	21.66	28.65756	-96.57946
634	28.39	8.13	1.6	34.62	21.68	28.65783	-96.57932
635	28.39	8.13	1.6	34.62	21.68	28.65790	-96.57915
636	28.39	8.14	1.3	34.62	21.68	28.65822	-96.57925
637	28.39	8.14	1.3	34.64	21.69	28.65835	-96.57898
638	28.42	8.14	0.8	34.64	21.69	28.65868	-96.57883
639	28.43	8.14	1.8	34.64	21.69	28.65884	-96.57866
640	28.46	8.15	1.5	34.69	21.73	28.65909	-96.57846
642	28.51	8.16	1.4	34.90	21.87	28.65950	-96.57835
643	28.47	8.15	1.8	34.83	21.82	28.65978	-96.57849
644	28.43	8.15	0.6	34.76	21.78	28.66005	-96.57839
645	28.43	8.16	1.3	34.72	21.75	28.66044	-96.57827
646	28.43	8.15	1.6	34.71	21.74	28.66072	-96.57825

Table D1-2e
October 15, 2015, Rhodamine Transect Data: 3rd Transect – 24-ft Boat

WPT	Temperature °C	pH	Rhodamine µg/L	Conductivity µS/cm^3	Salinity	Latitude	Longitude
647	28.41	8.16	1.8	34.26	21.70	28.66101	-96.57799
648	28.43	8.16	1.9	34.73	21.75	28.66084	-96.57754
649	28.44	8.16	0.9	34.76	21.78	28.66108	-96.57738
650	28.43	8.17	1.7	34.82	21.82	28.66096	-96.57711
652	28.49	8.18	1.9	35.13	22.04	28.66092	-96.57697
653	28.42	8.18	2.3	35.04	21.99	28.66074	-96.57665
654	28.44	8.18	1.8	34.97	21.93	28.66092	-96.57656
655	28.45	8.18	1.3	34.92	21.89	28.66097	-96.57629
656	28.45	8.18	1.6	34.86	21.84	28.66096	-96.57603
657	28.44	8.18	1.8	34.78	21.79	28.66081	-96.57571
658	28.44	8.18	1.4	34.78	21.79	28.66065	-96.57549
659	28.44	8.18	1.4	34.85	21.83	28.66052	-96.57512
660	28.43	8.18	1.1	34.86	21.85	28.66053	-96.57481
662	28.54	8.18	2.1	35.05	21.98	28.66053	-96.57442
663	28.64	8.19	1.2	35.29	22.14	28.66049	-96.57401

Notes:
°C = degrees Celsius
µg/L = micrograms per liter
µS/cm^3 = microsiemens per cubic centimeter
WPT = way point

Table D1-2f

October 15, 2015, Rhodamine Transect Data: 4th Transect – 24-ft Boat

Date: 10/15/2015 **Start Time:** 17:34

Personnel: Kenneth (BESI), CJP (AQ) **End Time:** 18:00

WPT	Temperature °C	pH	Rhodamine µg/L	Conductivity µS/cm^3	Salinity	Latitude	Longitude
664	28.55	8.19	1.6	35.25	22.12	28.66204	-96.57581
665	28.51	8.18	1.4	35.08	21.99	28.66187	-96.57540
666	28.42	8.18	1.3	35.35	22.19	28.66196	-96.57488
667	28.34	8.18	1.4	35.10	22.01	28.66221	-96.57455
668	28.34	8.18	2.2	35.03	21.96	28.66244	-96.57418
669	28.34	8.18	2.7	35.02	21.96	28.66251	-96.57388
670	28.33	8.18	1.6	35.07	21.99	28.66253	-96.57340
672	28.35	8.18	0.9	35.09	22.00	28.66246	-96.57293
673	28.32	8.18	1.3	35.21	22.09	28.66231	-96.57266
674	28.33	8.18	1.1	35.17	22.06	28.66235	-96.57222
675	28.48	8.16	1.4	34.93	21.90	28.66239	-96.57186
676	28.46	8.16	2.1	34.92	21.84	28.66228	-96.57156
677	28.44	8.17	2.4	34.97	21.91	28.66215	-96.57126

Notes:

°C = degrees Celsius

µg/L = micrograms per liter

µS/cm^3 = microsiemens per cubic centimeter

WPT = way point

Table D1-3
Westerly Rhodamine Dye Net Mass Flux During First Tidal Cycle After Dye Release

Location	Dye Mass[1,2,3,4] (grams)
Mid-reef Channel	11,600
Terminus of Oyster Reef	1,360

Notes:

[1] Flux calculations assume Rhodamine concentration and water velocity to be the same over the cross section as recorded in center of channel.

[2] Rhodamine dye concentrations are corrected for negative values and capped at the maximum range of the sonde.

[3] Water velocities are capped at 55 centimeters per second (cm/s). Velocities greater than 55 cm/s are assumed to be an artifact of boat traffic or external event influence.

[4] The CTD diver data were corrected against NOAA water depths for bias.

NOAA = National Oceanic and Atmospheric Administration

FIGURES

LEGEND

- Location of In Situ Sonde
- Submerged Oyster Reefs and Oyster Clusters

0 500 1,000 Feet

2015 RAAER

In-situ Monitoring Locations
North of Dredge Island

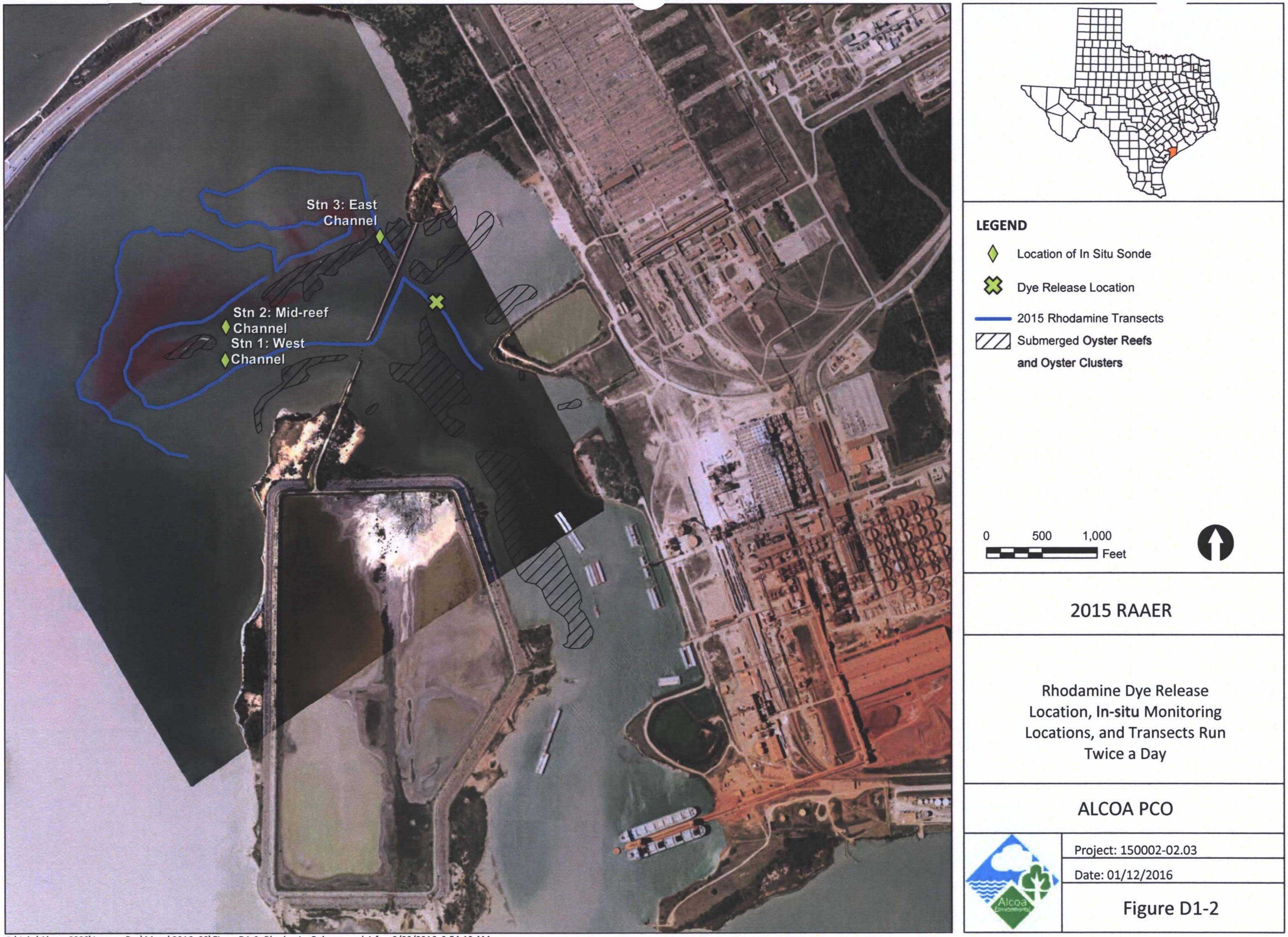
ALCOA PCO

Project: 150002-02.03

Date: 01/12/2016

Figure D1-1

Q:\Jobs\Alcoa_0002\Lavaca_Bay\Maps\2016_02\FigureD1-1_OysterReef.mxd jsfox 2/29/2016 10:06:53 AM



2015 RAAER

Rhodamine Dye Release Location, In-situ Monitoring Locations, and Transects Run Twice a Day

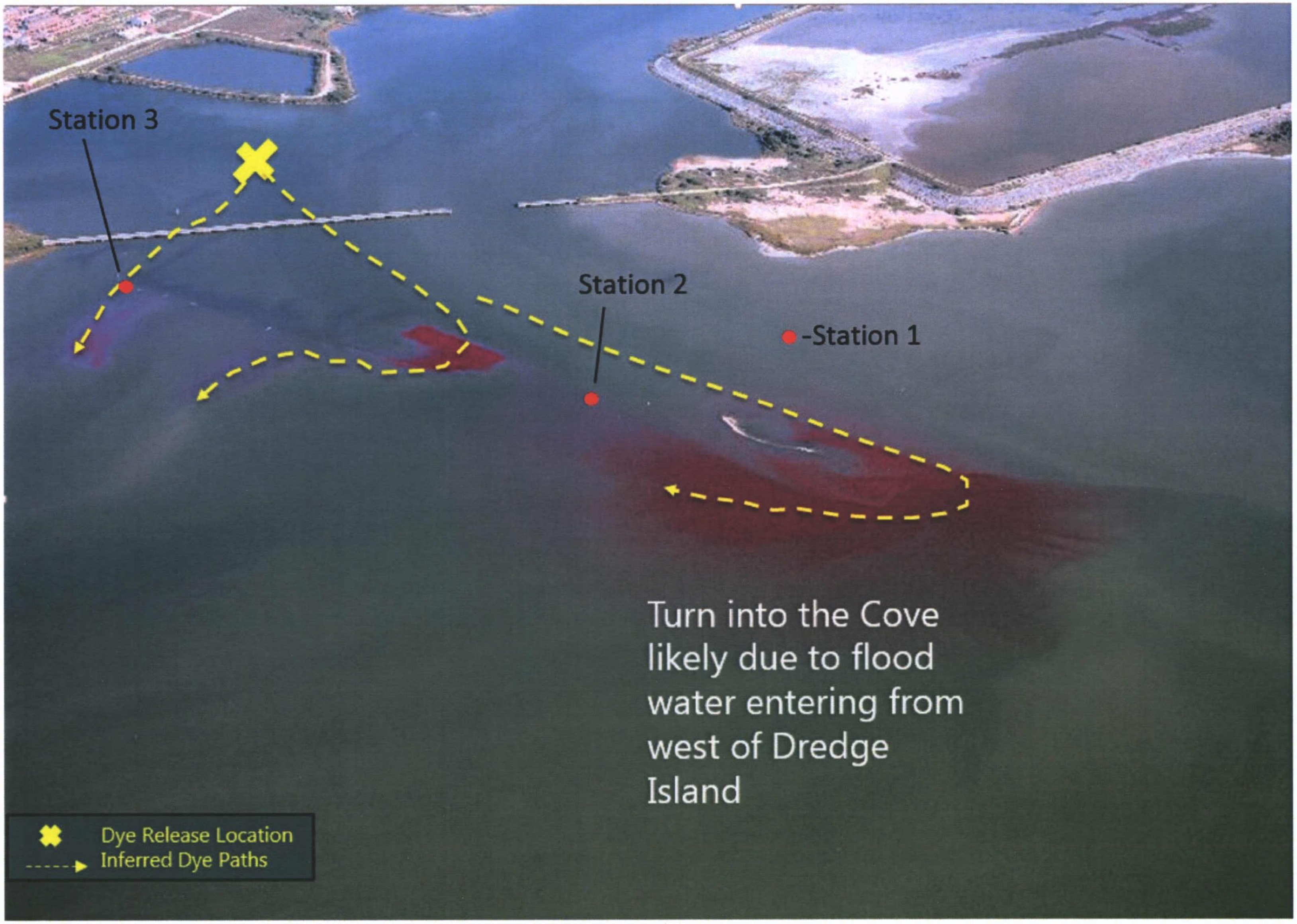
ALCOA PCO

Project: 150002-02.03

Date: 01/12/2016

Figure D1-2

Q:\Jobs\Alcoa_0002\Lavaca_Bay\Maps\2016_02\FigureD1-2_RhodamineRelease.mxd jsfox 2/29/2016 9:54:10 AM



\\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\documents\Reports\RAAERs\2015RAAER\Appendices\D1\Figure D1-3.docx

Figure D1-3
Rhodamine Dye Release Pathway
2015 RAAER
Alcoa

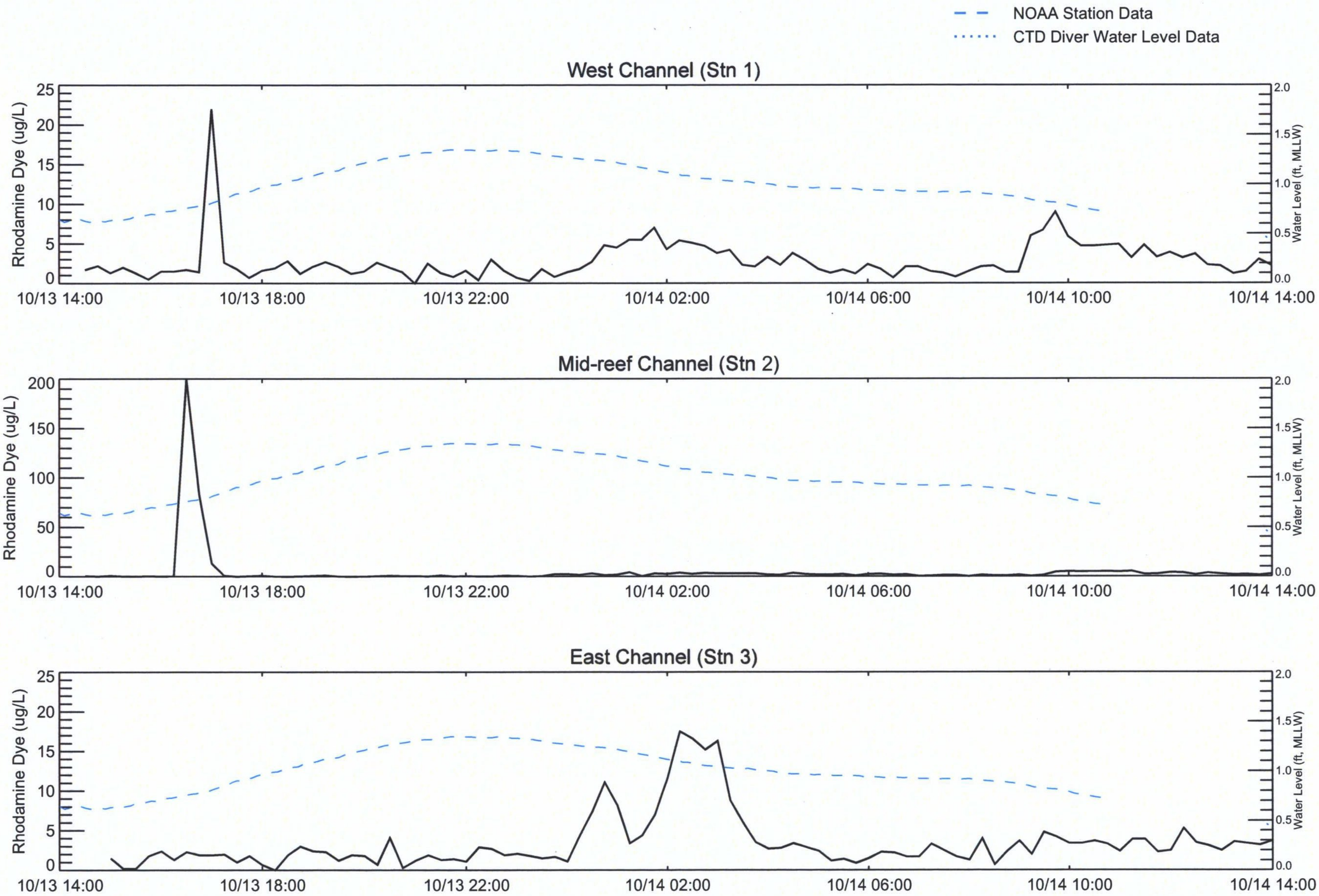
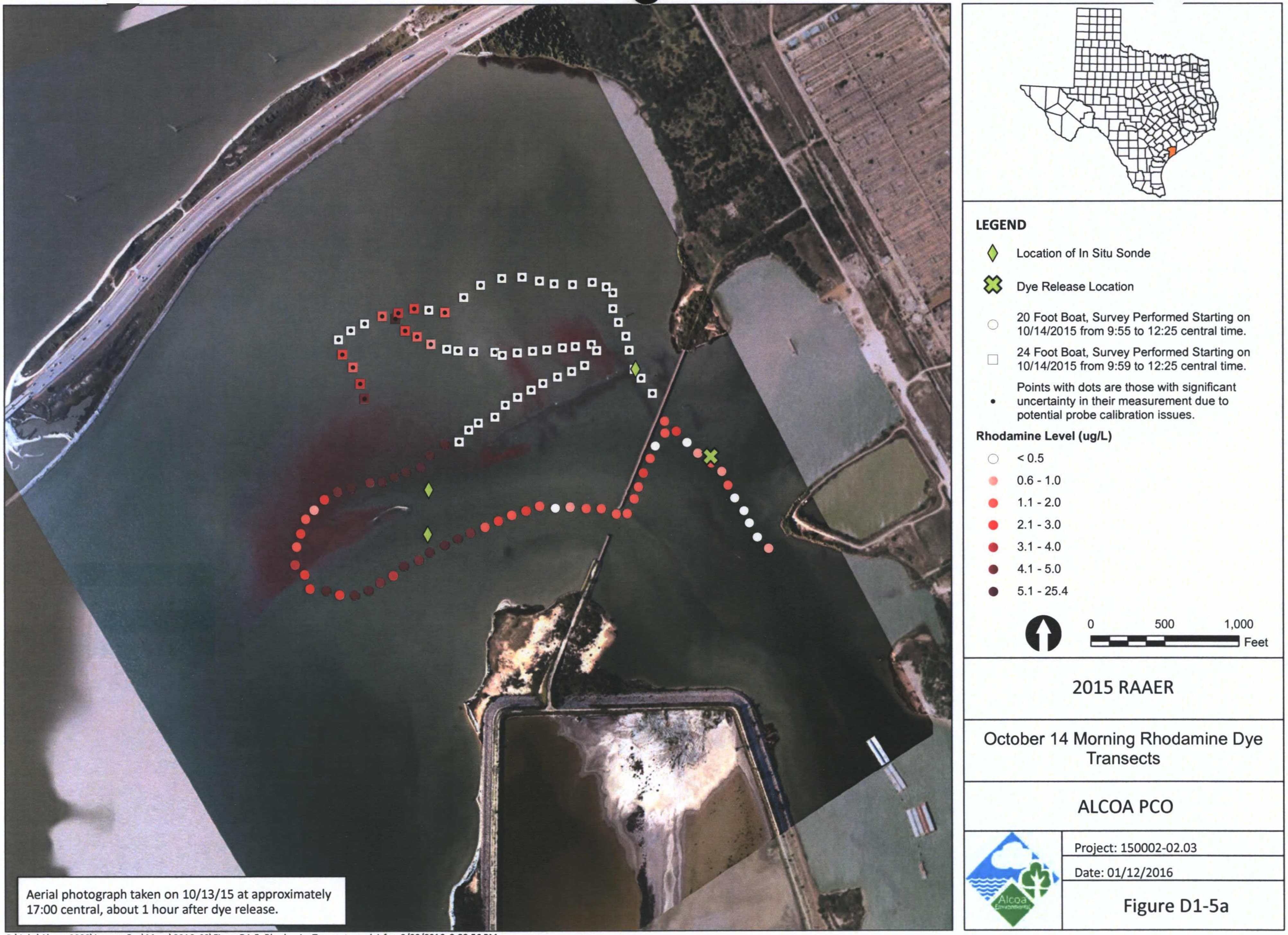


Figure D1-4

Supplemental Study 7 Station Rhodamine Dye Concentration

Notes: Water level data taken from NOAA station: 8773259 (Port Lavaca) when available. Sonde data corrected for negative values. Sonde 2 data capped at maxiumum instrument range. CTD diver water level data adjusted to account for NOAA tide height.

cf - \\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\Analysis\Sup_Studies_2015\Study7\IDL\Dye_Temporal_for_Memo.pro
Mon Feb 22 12:46:13 2016



2015 RAAER

October 14 Morning Rhodamine Dye Transects

ALCOA PCO

Project: 150002-02.03

Date: 01/12/2016

Figure D1-5a

Q:\Jobs\Alcoa_0002\Lavaca_Bay\Maps\2016_02\FigureD1-5_RhodamineTransects.mxd jsfox 2/23/2016 2:33:56 PM

LEGEND

- Location of In Situ Sonde
- Dye Release Location
- 20-foot Boat, Survey Performed Starting on 10/14/2015 from 15:06 to 16:22 central time.
- 24-foot Boat, Survey Performed Starting on 10/14/2015 from 13:10 to 16:26 central time.
- Cross-Area Transect Locations

Rhodamine Level (ug/L)

- < 0.5
- 0.6 - 1.0
- 1.1 - 2.0
- 2.1 - 3.0
- 3.1 - 4.0
- 4.1 - 5.0
- 5.1 - 9.3

0 500 1,000 Feet

2015 RAAER

October 14 Afternoon Rhodamine Dye Transects

ALCOA PCO

Project: 150002-02.03

Date: 01/12/2016

Figure D1-5b

Q:\Jobs\Alcoa_0002\Lavaca_Bay\Maps\2016_02\FigureD1-5_RhodamineTransects.mxd jsfox 2/23/2016 2:41:41 PM

LEGEND

- Location of In Situ Sonde
- Dye Release Location
- 20 Foot Boat, Survey Performed Starting on 10/15/2015 from 9:30 to 10:20 central time.
- 24 Foot Boat, Survey Performed Starting on 10/15/2015 from 9:12 to 12:07 central time.

Rhodamine Level (ug/L)

- < 0.5
- 0.6 - 1.0
- 1.1 - 2.0
- 2.1 - 3.0
- 3.1 - 4.0
- 4.1 - 5.0
- 5.1 - 9.3

0 500 1,000 Feet

2015 RAAER

October 15 Morning Rhodamine Dye Transects

ALCOA PCO

Project: 150002-02.03

Date: 01/12/2016

Figure D1-5c

Q:\Jobs\Alcoa_0002\Lavaca_Bay\Maps\2016_02\FigureD1-5_RhodamineTransects.mxd jsfox 2/29/2016 10:03:20 AM

Q:\Jobs\Alcoa_0002\Lavaca_Bay\Maps\2016_02\FigureD1-5_RhodamineTransects.mxd jsfox 2/29/2016 9:59:41 AM

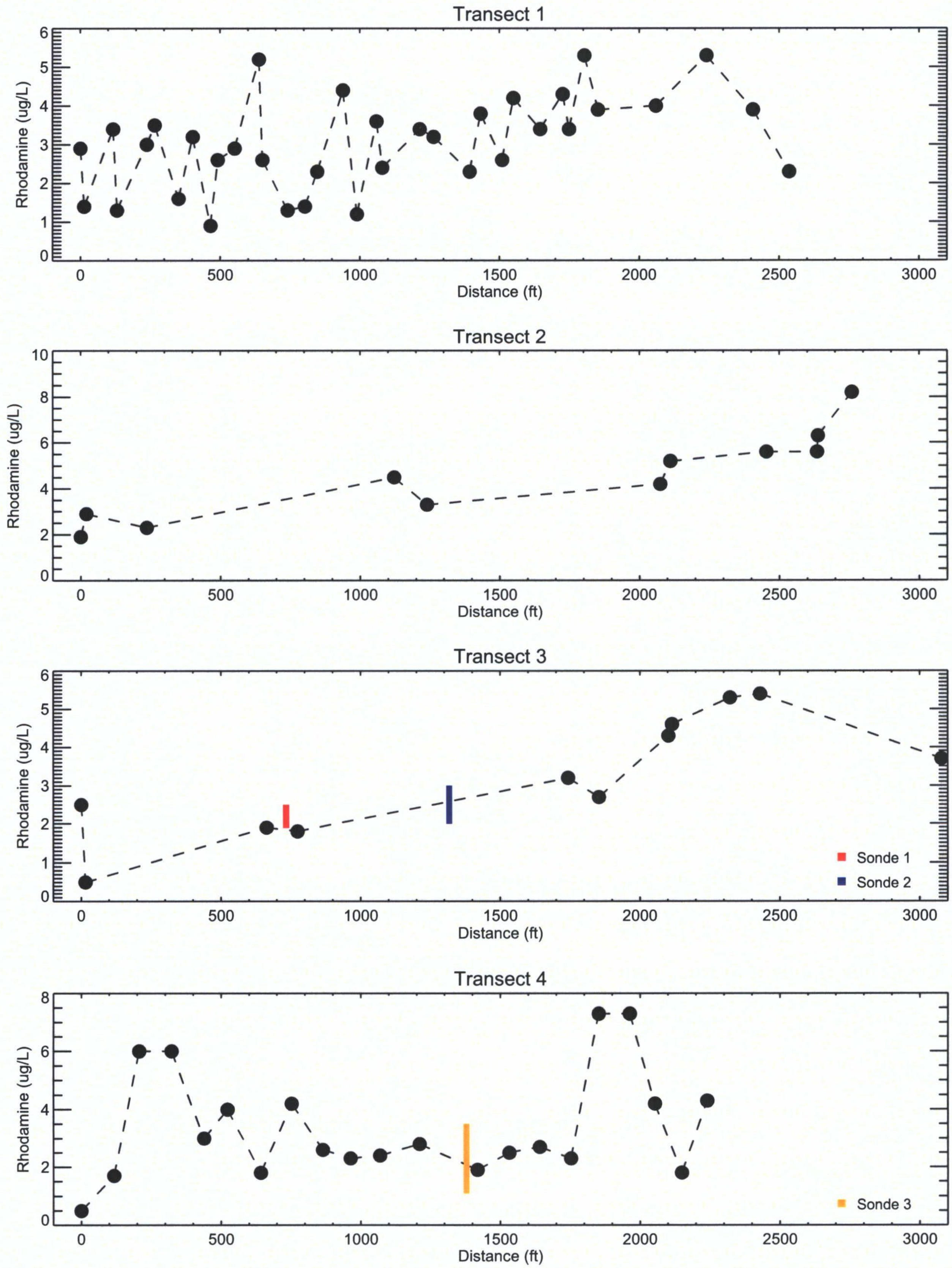


Figure D1-6

Supplemental Study 7 Rhodamine Dye Transect Concentrations - 10/14/15 Afternoon

Notes: Transect concentrations and distances correspond to labeled transects in Figure 4 map. Transect distances increase from the most southerly location (distance = 0) to most the northerly. Concentration data collected 21.5 to 25 hours after dye release. Range of sonde data collected during time of transects plotted at approximate distance of sonde along transect. Sonde data corrected for negative values.

Appendix D2

Witco Turbidity and Velocity Study

Study 7B

March 2016

ALCOA

Appendix D2 – Witco Turbidity and Velocity Study

Introduction

This study was conducted in accordance with Section 4.4 (Recommendations) of the 2014 Remedial Action Annual Effectiveness Report (RAAER). The work plan was submitted to the USEPA on September 18, 2015, (Alcoa 2015c) and received approval from the USEPA on September 25, 2015.

Objective

The Lavaca Bay (bay) Causeway Cove is bounded on the south by a line of oyster reefs and on the north by a peninsula supporting the Route 35 Causeway (Figure D2-1). It is connected with the bay to the south by two gaps in the oyster reefs. A narrow, relatively deep channel exists due north of Witco Channel (termed the "east channel"), and a wider, somewhat shallower channel (termed the "mid-reef channel") exists about midway along the line of oyster reefs. The mid-reef channel has a mean low tide cross-section of approximately 1,070 square feet, which is about three times greater than that of the east channel. The broader channel between Dredge Island and the western boundary of the oyster reefs is termed the "west channel". The goal of this study was to determine flow and sediment transport into the Causeway Cove.

Technical Approach

The bathymetries of the east, mid-reef, and west channels were surveyed to assess cross-sectional area and to facilitate locating in situ monitoring devices. Tilt Current Meters (TCMs) and conductivity, temperature, and turbidity probes were deployed for approximately 1 month at the deepest point along each channel cross-section (Figure D2-1).

Flow through each channel was calculated from the cross-sectional area and the velocity record. Turbidity measurements were used in conjunction with the calculated flows to estimate solids transport through each channel.

Data Collection

A Lowell Instruments MAT-1 Tilt Current Meter and YSI 600 OMS Optical Turbidity System were deployed at each of three locations and collocated with Rhodamine sondes deployed for Study 7A (Figure D2-1). TCMs collected acceleration, magnetic compass direction, and temperature measurements continuously at a rate of 16 hertz (Hz). TCM software calculated speed and direction of the current by the drag-tilt principle and averaged values by minute. Turbidity systems recorded 30-minute average conductivity, temperature, and turbidity.

Turbidity systems were deployed for approximately 4 weeks from October 13, 2015 to November 16, 2015. TCMs were deployed for approximately 2 months from October 9, 2015 to December 15, 2015. Due to equipment malfunction, velocity data at TCM station 3 were not recorded October 13, 2015 to November 8, 2015. Due to sensor fouling, turbidity measurements became unreliable on November 24, 2015, November 17, 2015, and November 20, 2015, for stations 1, 2, and 3, respectively. Raw TCM and turbidity data are provided electronically on the included disk.

Appendix D2 – Witco Turbidity and Velocity Study

Water surface elevation data were downloaded from the Port Lavaca National Oceanic and Atmospheric Administration (NOAA) station (Station Number 8773259, Port Lavaca [TCOON], Texas).[1] Local elevation data were obtained from a CTD-Diver D1271' 10-meter gage that was deployed at on the south side of the Dredge Island Bridge, approximately 50 feet southwest of the east channel reef border, from October 14, 2015 to December 17, 2015, and measured water depth at 6-minute intervals. Water depth data are provided electronically on the included disk.

Results and Discussion

Analysis of water velocity, tidal data, turbidity data, and mass flux at each station are discussed below. Due to fouling of the turbidity sensors, turbidity and sediment transport analyses were limited to the first week of equipment deployment.

Flow Direction

Water flows were examined relative to cross-channel transects at each of the stations. Velocities are termed positive if directed into Causeway Cove or to the west for the West Channel and are negative otherwise. Velocities in the mid-reef and east channels (stations 2 and 3) directed from 240 to 60 degrees were designated as positive, as were velocities between 150 to 330 degrees in the west channel (station 1). In the figures that follow, the positive velocities are shown as red and the negative as blue.

The first insights come from comparing hourly average water velocities among the three stations. This was done for October 13 to 18 and November 13 to 18. As seen in graphs of these data (Figures D2-2a through D2-2c and D2-3a through D2-3c), there is close correspondence among the stations in terms of direction and magnitude. This implies that large-scale forcing imposed by tide and wind dominates the flow patterns. Flood flows were characterized by higher velocities than ebb and a circulation to the north and west. Ebb flows were characterized by lower velocities and variable circulation.

Flow direction was influenced by wind when there were high and sustained wind velocities. This finding is evidenced in figures comparing water velocity and direction at the west and mid-reef channels with wind velocity and direction at the Calhoun County Airport (Figures D2-4a through D2-4c and D2-5a through D2-5c). For most of the study period, current velocity and direction exhibited no consistent relationship to the wind. However, on November 16 to 17, flood flow circulation reversed from the typical north and west pattern to a south and east pattern (Figures D2-5b and D2-5c). Winds from 1100 hours on the 16th to 1100 hours on the 17th were from the south at an average sustained wind of 16 miles per hour (mph) with several hours above 20 mph and gusts as high as 29 mph. Presumably, this weather event pushed water north on the west side of Dredge Island and forced a circulation east and south as water moved toward the Causeway Cove.

Additional discussion of each of the stations follows.

West Channel

Flood velocities were nearly always directed to the west with maxima between 10 and 20 centimeters per second (cm/s), though the October 13 flood exhibited velocities exceeding 20 cm/s. Ebb velocities were

[1] The NOAA data were unavailable from October 14, 2015, to November 11, 2015, and on November 23, 2015.

typically lower with maxima about 8 cm/s, and direction was more variable. During the November 16 to 17 weather event discussed above, velocities were nearly always directed to the east. They peaked at greater than 20 cm/s at 1300 hours on November 17.

Net water transport was to the west for most of this period (expressed as net volume in top panels of Figures D2-6 and D2-7). The only exceptions are the aforementioned November 16-17 weather event and October 14, when there were relatively small volumes to the east, presumably due to a period of sustained winds out of the south at 10-14 miles per hour.

Mid-reef Channel

Mid-reef channel hourly average velocities were more variable than exhibited at the west channel, with periods of velocities less than 5 cm/s interspersed with periods between 10 and 20 cm/s. Flood flow was almost always directed into Causeway Cove (positive), and ebb flow was more variable, with generally lower velocities. Consistent with the west channel, the highest flood velocities occurred on October 13 and approached 30 cm/s.

In a pattern similar to what occurred in the west channel, southeast flows carrying water out of Causeway Cove occurred on November 16 and on November 17. Velocities were much lower than at the west channel and peaked at 14 cm/s.

Net transport was into Causeway Cove for most of this period (middle panels of Figures D2-6 and D2-7). The exceptions mirror those in the west channel, but the net volumes out of Causeway Cove are relatively small compared to the volumes entering the Cove.

East Channel

Flood velocities were directed into Causeway Cove except during the November 16-17 weather event. They were typically in the range of 10-20 cm/s. Like the other channels, ebb velocities were lower and typically ranged from a few cm/s to about 10 cm/s. The volumes that moved through this channel are more than two times lower than the other channels (bottom panel of Figure D2-7).

Considering all three stations, the patterns measured indicate net transport from the Alcoa and Witco channels into Causeway Cove and to the west of Dredge Island. Water leaving the Cove area during ebb tide must, in general, exit the Cove to the west into the greater bay area south of the Causeway Bridge.

Turbidity Patterns

Turbidity measurements show a pulse of sediment transport at the beginning of flood tide (Figure D2-8). This sediment is not likely locally derived because the velocities at each location are too low to erode bed sediments. Such erosion typically requires velocities greater than 60 cm/s. It is possible that unconsolidated sediments (i.e., a fluff layer) contributed, as these unconsolidated sediments can be resuspended within the range of velocities recorded.

A fluff layer is common in estuaries and bays and is frequently called a mobile pool. It oscillates between the water column and the bottom over the tidal cycle. It is notable that the timing of the pulses of sediment transport differed among the three locations, with the pulse appearing earliest in the east channel and latest at the west channel. The time shift suggests propagation of a pulse that originated from the Witco and/or Alcoa channels with little additional contribution as water flowed to the north and west.

Appendix D2 – Witco Turbidity and Velocity Study

Sediment mass flux from October 14, 2015, to October 18, 2015, was calculated for the west and mid-reef channels. For almost all the monitored tidal cycles, both channels experienced greater flux to the north and west than to the south and east (Figure D2-9). While the source of this net sediment load cannot be determined from this study, it is possible that the Alcoa and Witco channels contribute to the sediment entering and depositing in the Causeway Cove. A subsequent study of sediment transport in these channels was conducted to provide insights about sediment source and is discussed in Section 3.12 of the 2015 RAAER and in Appendix D3.

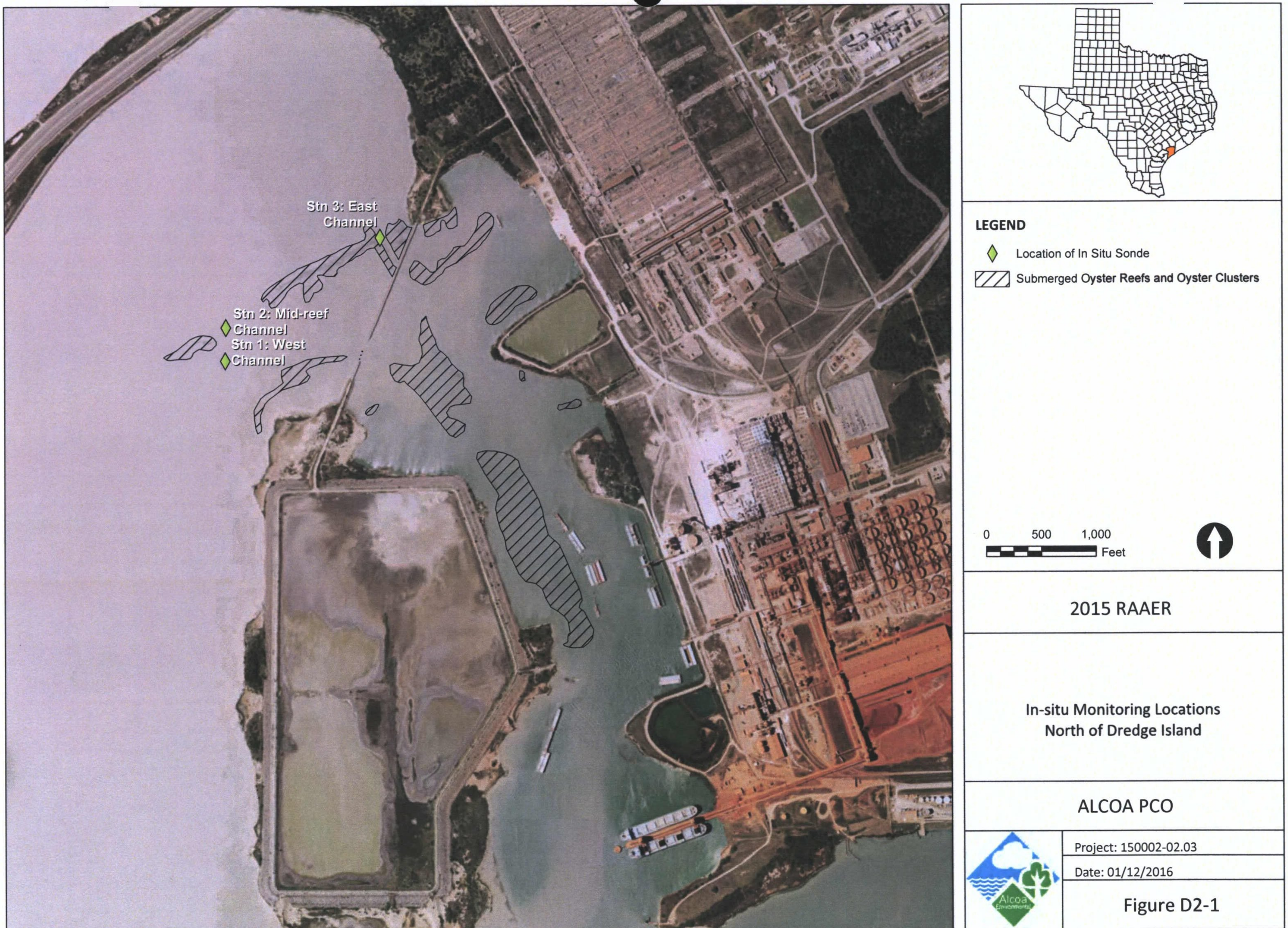
Summary and Conclusions

The velocity and turbidity study conducted in the Causeway Cove area revealed the general current patterns north of Dredge Island and shed light on a likely source of sediments that are transported into the Cove. Flood tide brings water north through the Alcoa and Witco channels. At the northeastern end of Dredge Island, the current encounters the shoreline of the Witco Harbor and submerged oyster reefs, dividing the pathway into the Causeway Cove. The majority of water follows the shoreline of Dredge Island and flows west, northwest through the mid-reef channel into the Cove area, and west through the west channel into the open bay region south of the Causeway Bridge. A smaller volume of water is transported north into the Cove area via the east channel.

Flood tide water transported into the Causeway Cove carries with it a pulse of suspended sediments. This sediment pulse is recorded at the channel stations in the order that they are encountered by the flood waters moving north and then west from the Alcoa and Witco channels. This suggests that sediments are eroded from within the channel areas and transported with flood tide into the Cove area. Current velocities, however, are too low to generate scour of the underlying parent bed; therefore, the sediments suspended by the tidal currents are likely part of a mobile pool of unconsolidated sediments existing on top of the parent bed.

The velocity monitoring covered a range of conditions, including a southerly wind event, and therefore provide a good understanding of the types of patterns that exist. The turbidity monitoring covered a small sub-set of this period and did not include the wind event. Thus, conclusions about sediment transport are likely applicable only to the typical non-event conditions.

FIGURES



2015 RAAER

In-situ Monitoring Locations
North of Dredge Island

ALCOA PCO

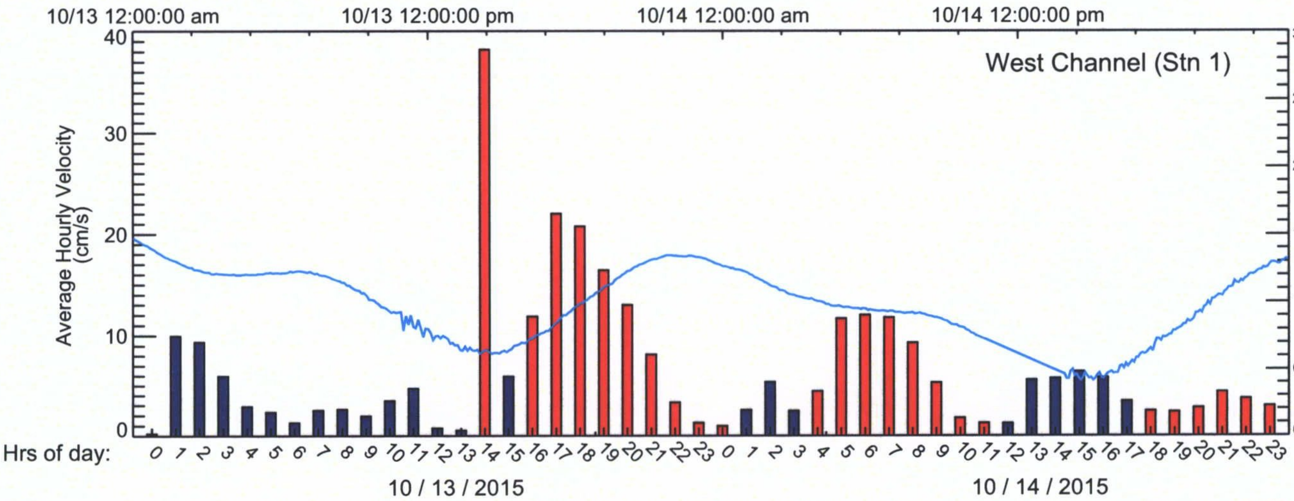
Project: 150002-02.03

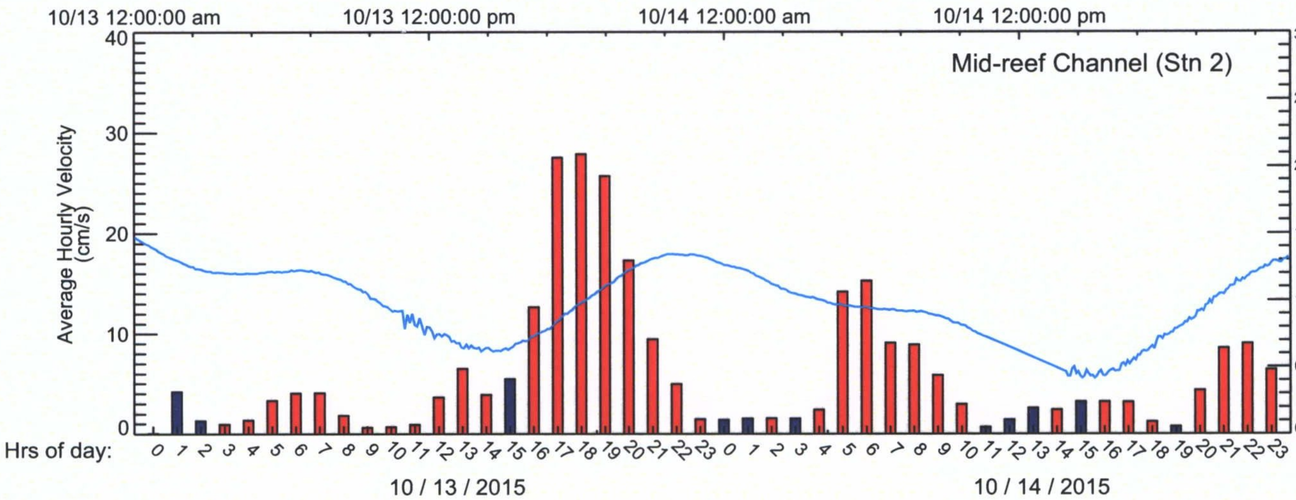
Date: 01/12/2016

Figure D2-1

Q:\Jobs\Alcoa_0002\Lavaca_Bay\Maps\2016_02\FigureD1-1_OysterReef.mxd jsfox 2/29/2016 10:06:53 AM

Water Surface Elevation ■ Positive Average Velocity ■ Negative Average Velocity





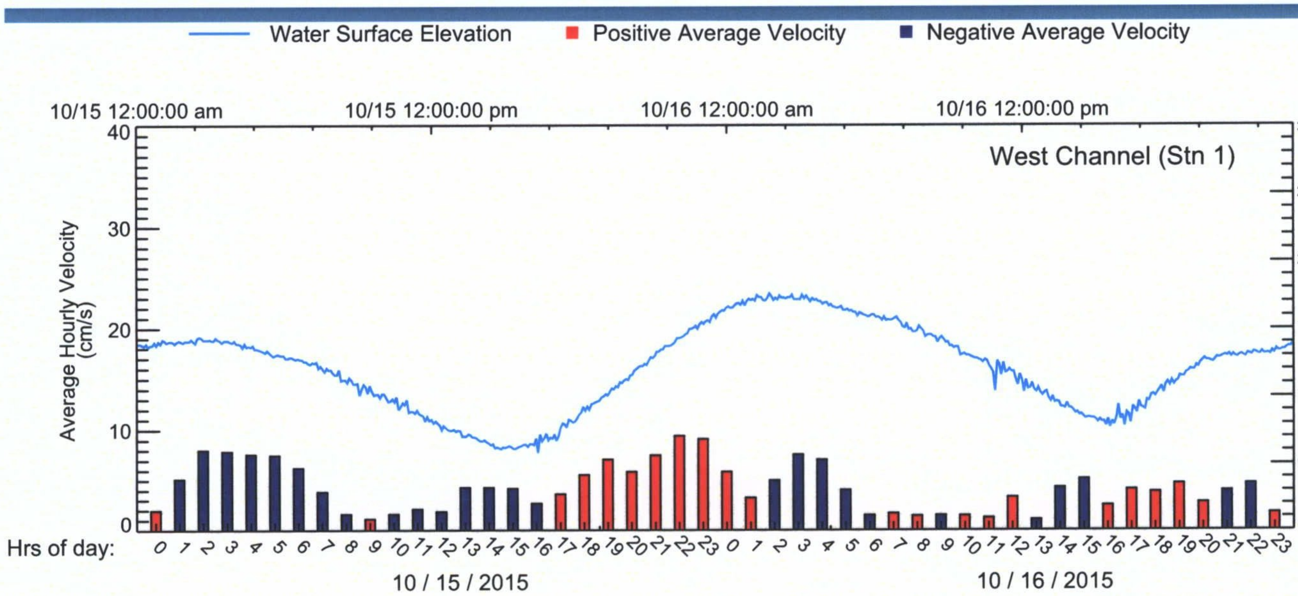
East Channel (Stn 3)
Data Unavailable

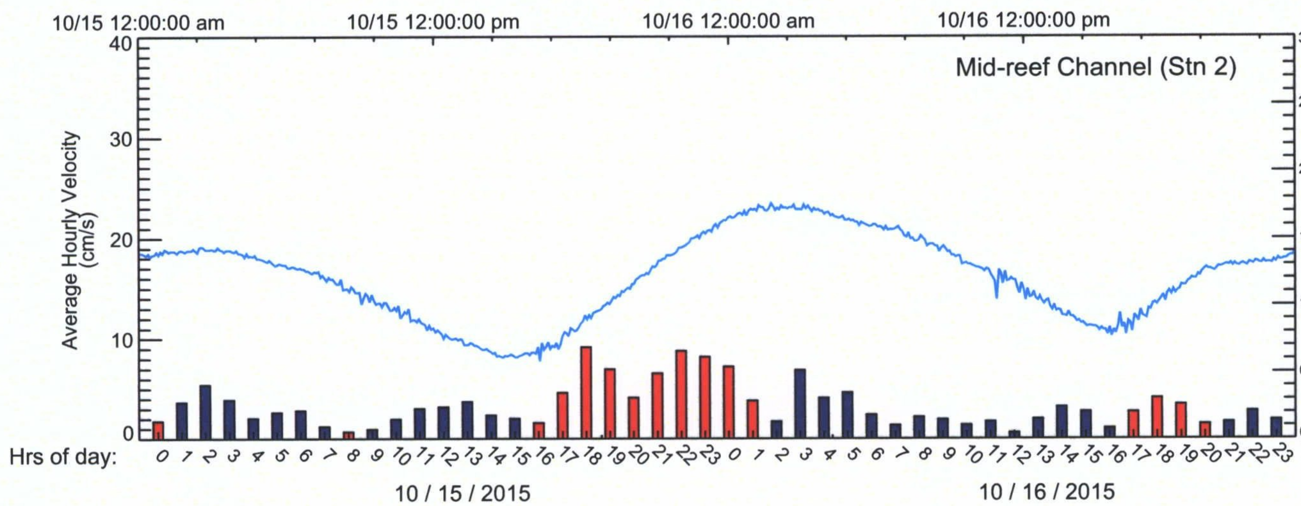
Figure D2-2a

North Dredge Island Hourly Average Water **Velocity**

Notes: Water level data taken from NOAA station: 8773259 (Port Lavaca) when available. CTD diver water level data adjusted to account for NOAA tide height. Water velocity data filtered for measurements <= 55 cm/s. Velocity data averaged by minute; then postive and negative average values calculated by hour and summed.

cf - C:\Projects\Alcoa\Lavaca_Bay\Analysis\Sup_Studies_2015\Study7\IDL\LB_All_Stn_Hrly_Currents.pro





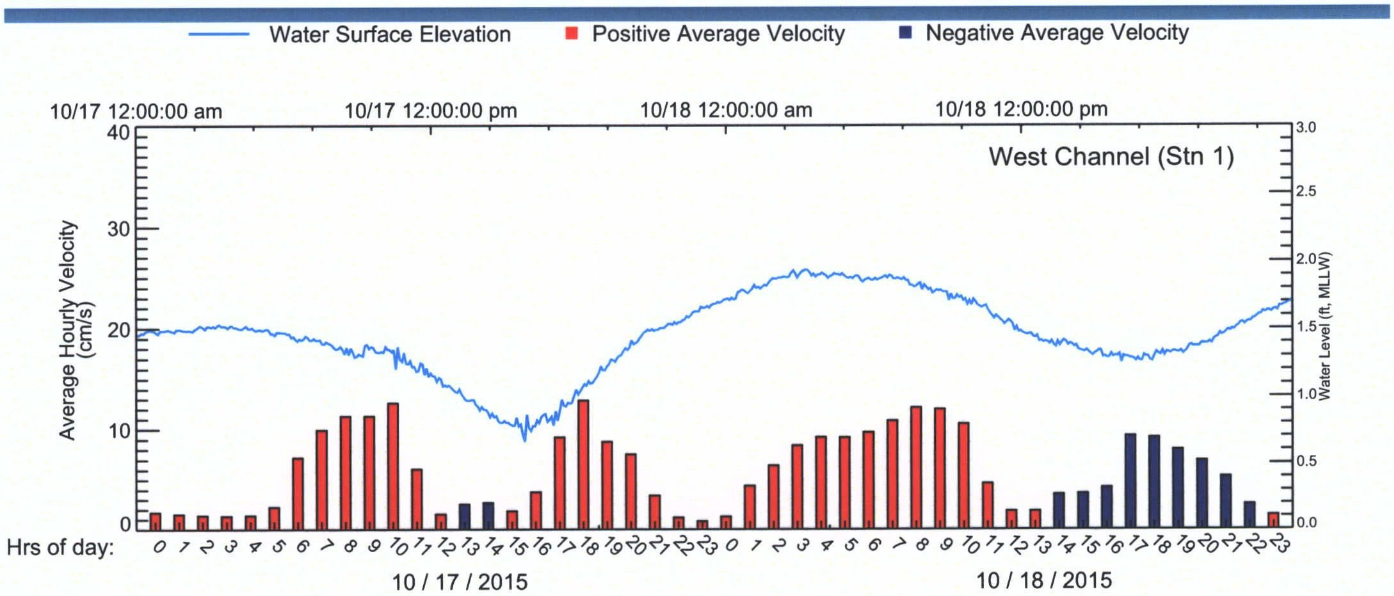
East Channel (Stn 3)
Data Unavailable

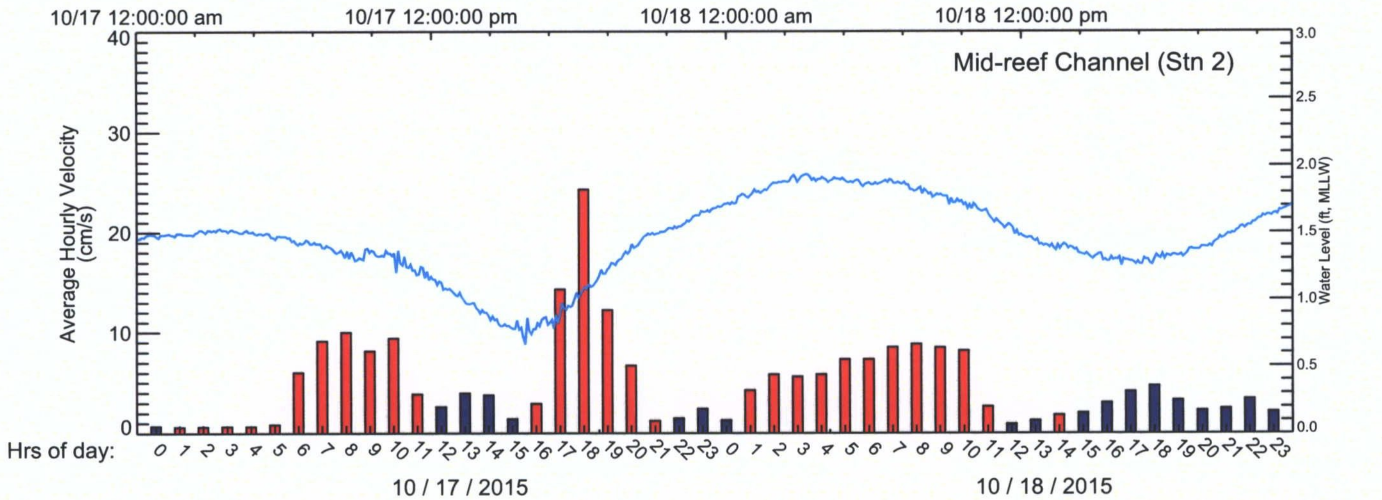
Figure D2-2b

North Dredge Island Hourly Average Water **Velocity**

Notes: Water level data taken from NOAA station: 8773259 (Port Lavaca) when available. CTD diver water level data adjusted to account for NOAA tide height. Water velocity data filtered for measurements <= 55 cm/s. Velocity data averaged by minute; then postive and negative average values calculated by hour and summed.

cf - C:\Projects\Alcoa\Lavaca_Bay\Analysis\Sup_Studies_2015\Study7\IDL\LB_All_Stn_Hrly_Currents.pro





East Channel (Stn 3)
Data Unavailable

Figure D2-2c

North Dredge Island Hourly Average Water **Velocity**

Notes: Water level data taken from NOAA station: 8773259 (Port Lavaca) when available. CTD diver water level data adjusted to account for NOAA tide height. Water velocity data filtered for measurements <= 55 cm/s. Velocity data averaged by minute; then postive and negative average values calculated by hour and summed.

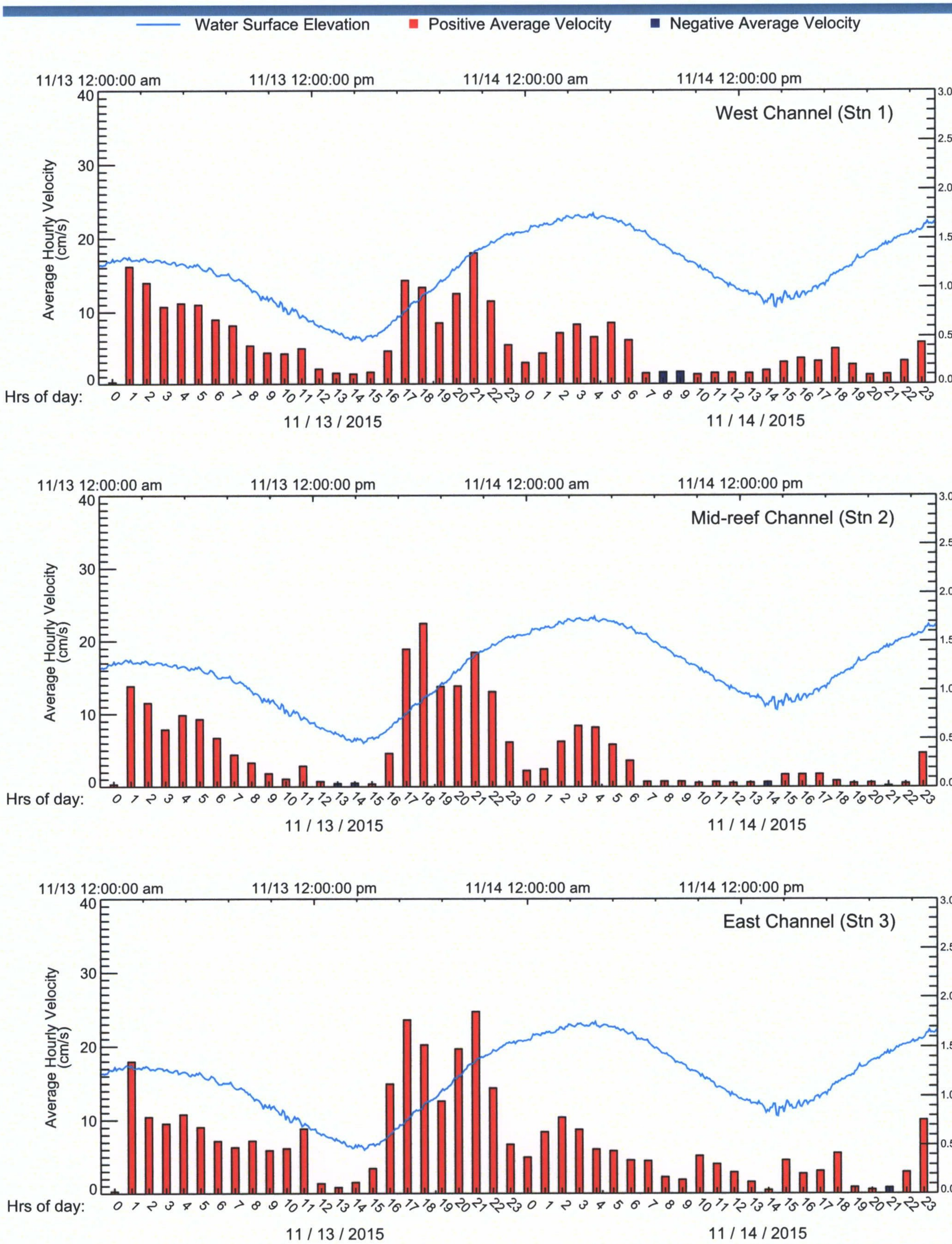


Figure D2-3a

North Dredge Island Hourly Average Water Velocity

Notes: Water level data taken from NOAA station: 8773259 (Port Lavaca) when available. CTD diver water level data adjusted to account for NOAA tide height. Water velocity data filtered for measurements <= 55 cm/s. Velocity data averaged by minute; then postive and negative average values calculated by hour and summed.

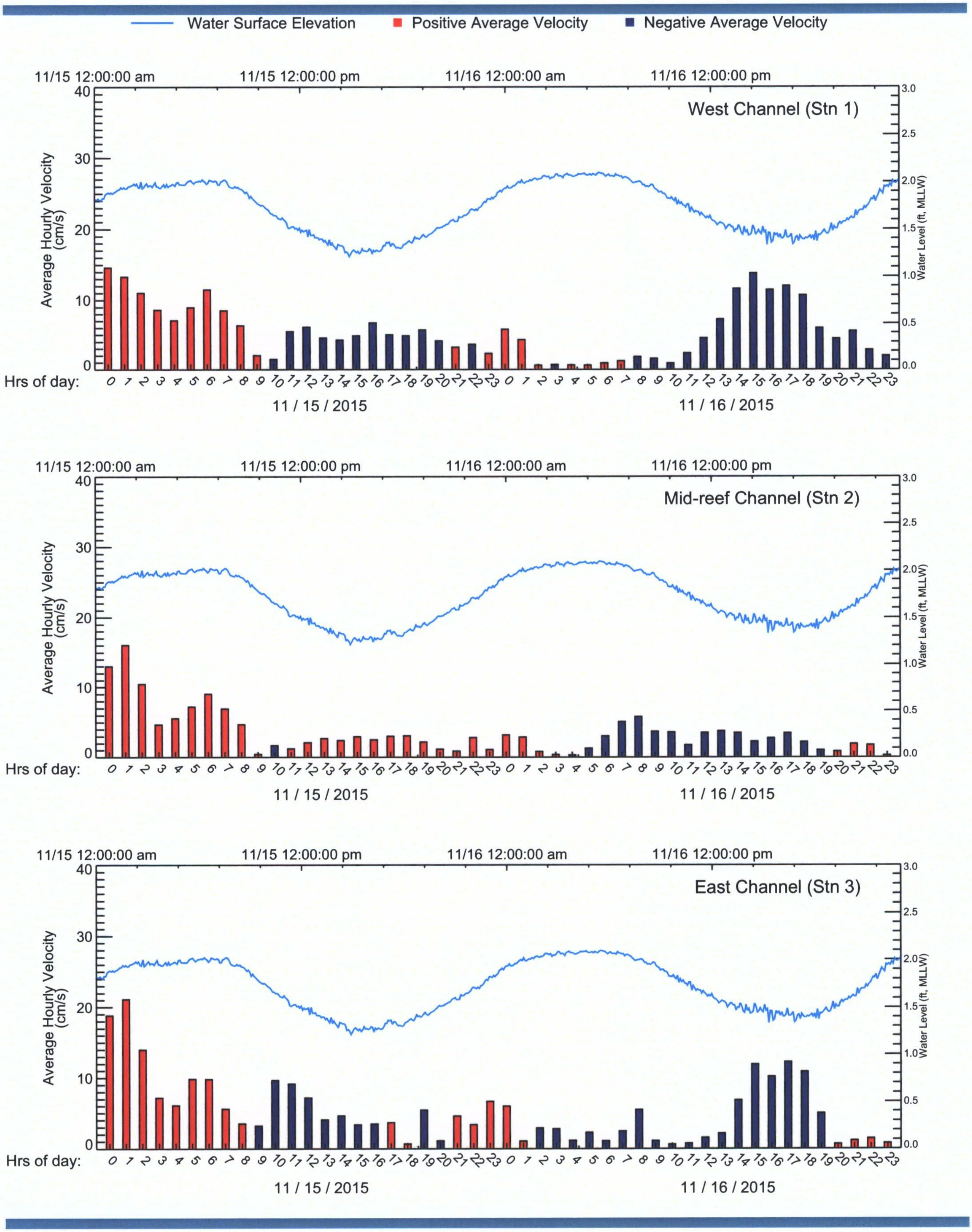


Figure D2-3b

North Dredge Island Hourly Average Water Velocity

Notes: Water level data taken from NOAA station: 8773259 (Port Lavaca) when available. CTD diver water level data adjusted to account for NOAA tide height. Water velocity data filtered for measurements <= 55 cm/s. Velocity data averaged by minute; then postive and negative average values calculated by hour and summed.

cf - C:\Projects\Alcoa\Lavaca_Bay\Analysis\Sup_Studies_2015\Study7\IDL\LB_All_Stn_Hrly_Currents.pro

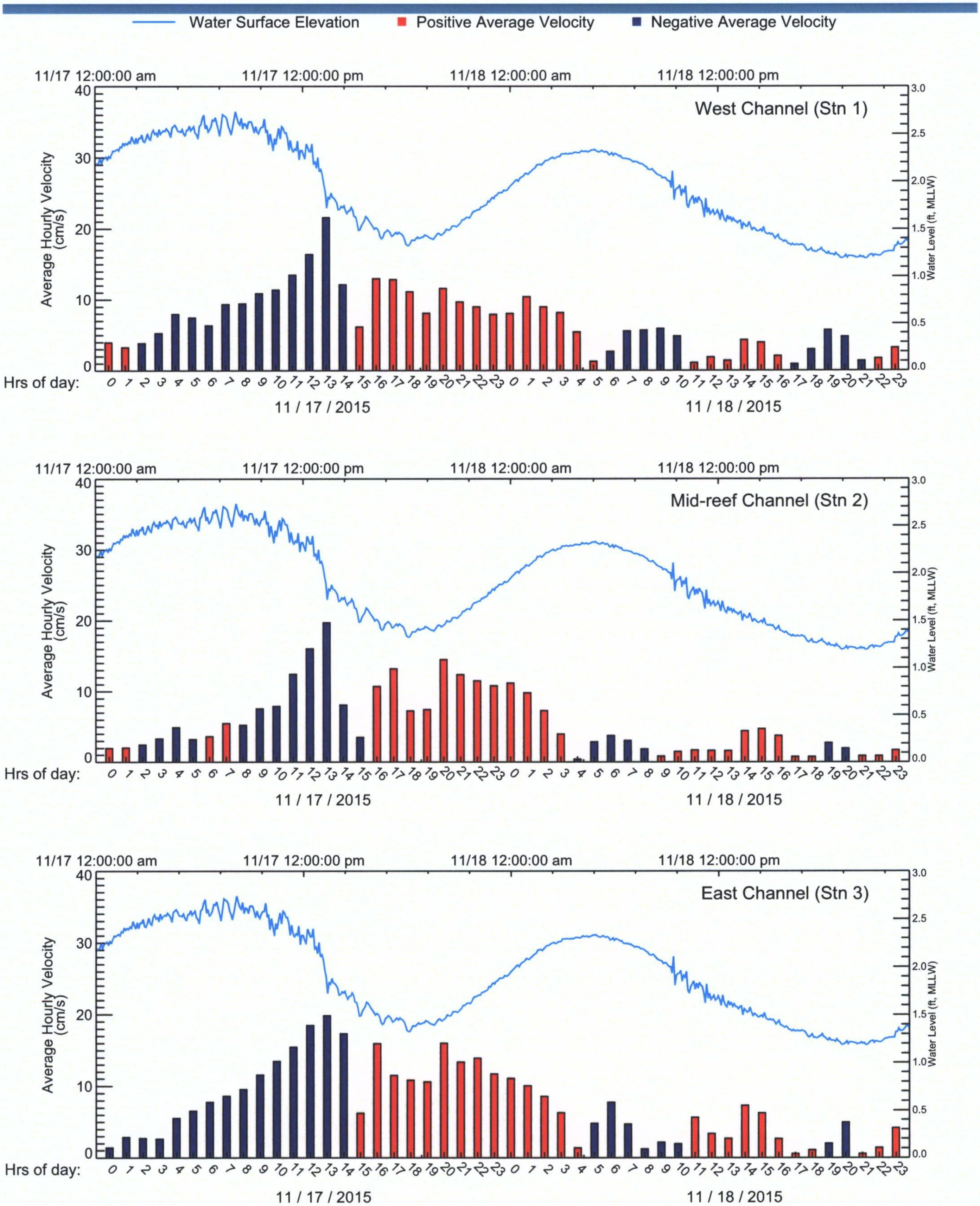


Figure D2-3c

North Dredge Island Hourly Average Water Velocity

Notes: Water level data taken from NOAA station: 8773259 (Port Lavaca) when available. CTD diver water level data adjusted to account for NOAA tide height. Water velocity data filtered for measurements <= 55 cm/s. Velocity data averaged by minute; then postive and negative average values calculated by hour and summed.

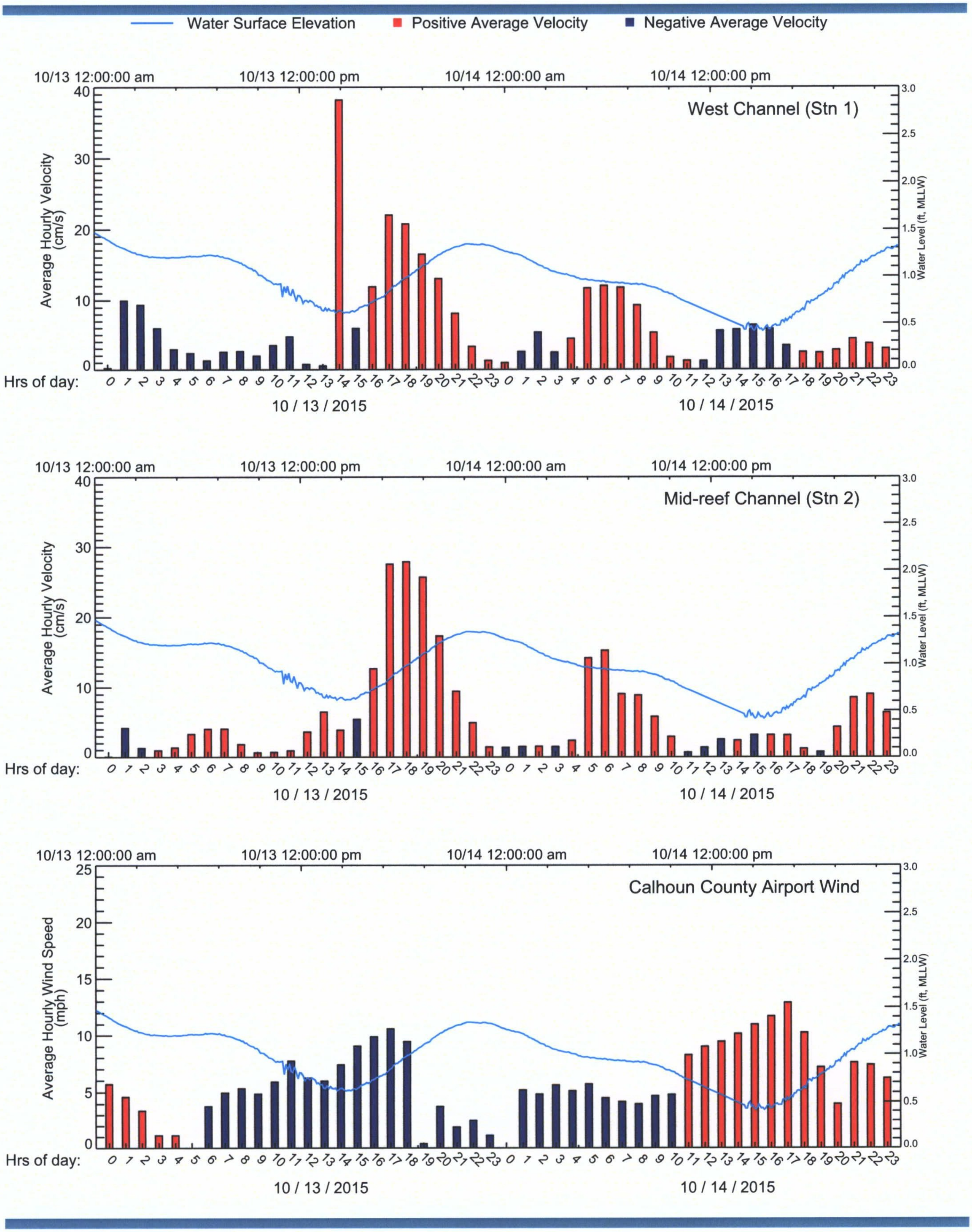


Figure D2-4a

Dredge Island Stn 1 and Stn 2 Water and Calhoun County Airport Wind Hourly Average Velocity

Notes: Water level data taken from NOAA station: 8773259 (Port Lavaca) when available. CTD diver water level data adjusted to account for NOAA tide height. Water velocity data filtered for measurements <= 55 cm/s. Velocity data averaged by minute then; postive and negative average values calculated by hour and summed. Wind data taken from PKV weather station. Negative values indicate winds blowing from 270-360 degrees and 0-90 degrees. Positive values indicate winds blowing from 90-270 degrees. If hourly average wind direction from due east or due west, wind speed set to zero for plotting.

cf - C:\Projects\Alcoa\Lavaca_Bay\Analysis\Sup_Studies_2015\Study7\IDL\Stn1_Stn2_Wind_Hrly_Avgs.pro

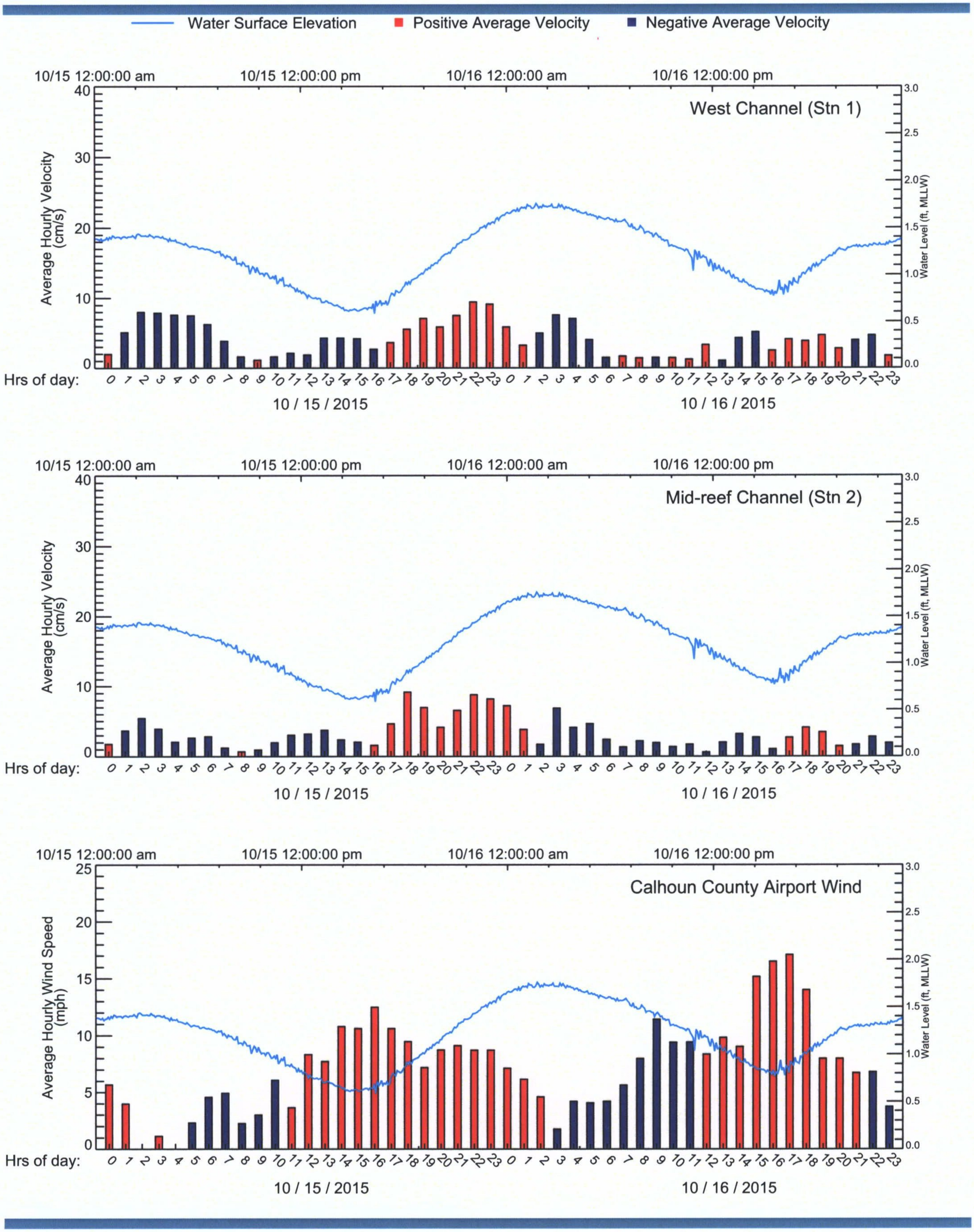


Figure D2-4b

Dredge Island Stn 1 and Stn 2 Water and Calhoun County Airport Wind Hourly Average Velocity

Notes: Water level data taken from NOAA station: 8773259 (Port Lavaca) when available. CTD diver water level data adjusted to account for NOAA tide height. Water velocity data filtered for measurements <= 55 cm/s. Velocity data averaged by minute then; postive and negative average values calculated by hour and summed. Wind data taken from PKV weather station. Negative values indicate winds blowing from 270-360 degrees and 0-90 degrees. Positive values indicate winds blowing from 90-270 degrees. If hourly average wind direction from due east or due west, wind speed set to zero for plotting.

cf - C:\Projects\Alcoa\Lavaca_Bay\Analysis\Sup_Studies_2015\Study7\IDL\Stn1_Stn2_Wind_Hrly_Avgs.pro

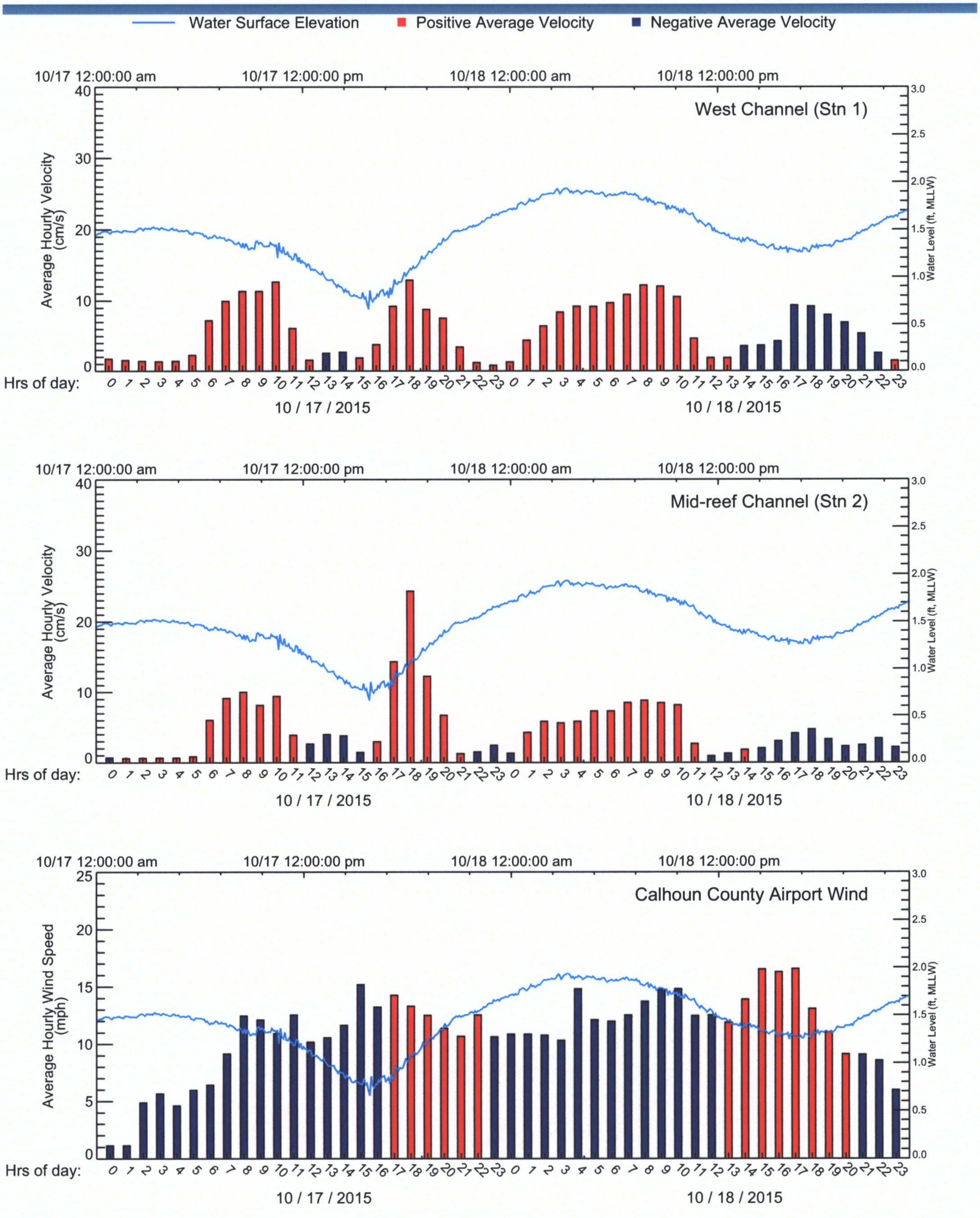


Figure D2-4c

Dredge Island Stn 1 and Stn 2 Water and Calhoun County Airport Wind Hourly Average Velocity

Notes: Water level data taken from NOAA station: 8773259 (Port Lavaca) when available. CTD diver water level data adjusted to account for NOAA tide height. Water velocity data filtered for measurements <= 55 cm/s. Velocity data averaged by minute then; postive and negative average values calculated by hour and summed. Wind data taken from PKV weather station. Negative values indicate winds blowing from 270-360 degrees and 0-90 degrees. Positive values indicate winds blowing from 90-270 degrees. If hourly average wind direction from due east or due west, wind speed set to zero for plotting.

cf - C:\Projects\Alcoa\Lavaca_Bay\Analysis\Sup_Studies_2015\Study7\IDL\Stn1_Stn2_Wind_Hrly_Avgs.pro

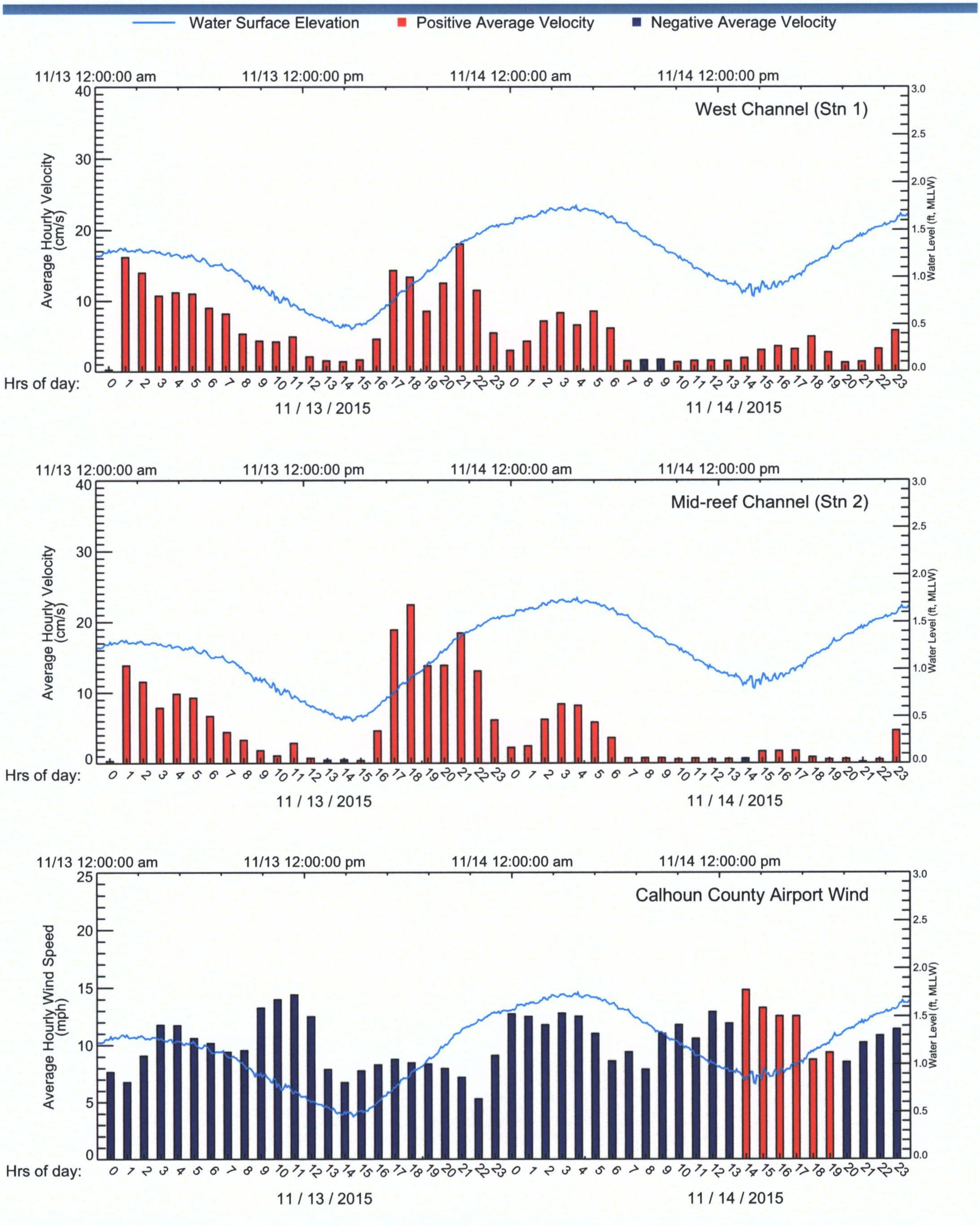


Figure D2-5a

Dredge Island Stn 1 and Stn 2 Water and Calhoun County Airport Wind Hourly Average Velocity

Notes: Water level data taken from NOAA station: 8773259 (Port Lavaca) when available. CTD diver water level data adjusted to account for NOAA tide height. Water velocity data filtered for measurements <= 55 cm/s. Velocity data averaged by minute then; postive and negative average values calculated by hour and summed. Wind data taken from PKV weather station. Negative values indicate winds blowing from 270-360 degrees and 0-90 degrees. Positive values indicate winds blowing from 90-270 degrees. If hourly average wind direction from due east or due west, wind speed set to zero for plotting.

cf - C:\Projects\Alcoa\Lavaca_Bay\Analysis\Sup_Studies_2015\Study7\IDL\Stn1_Stn2_Wind_Hrly_Avgs.pro

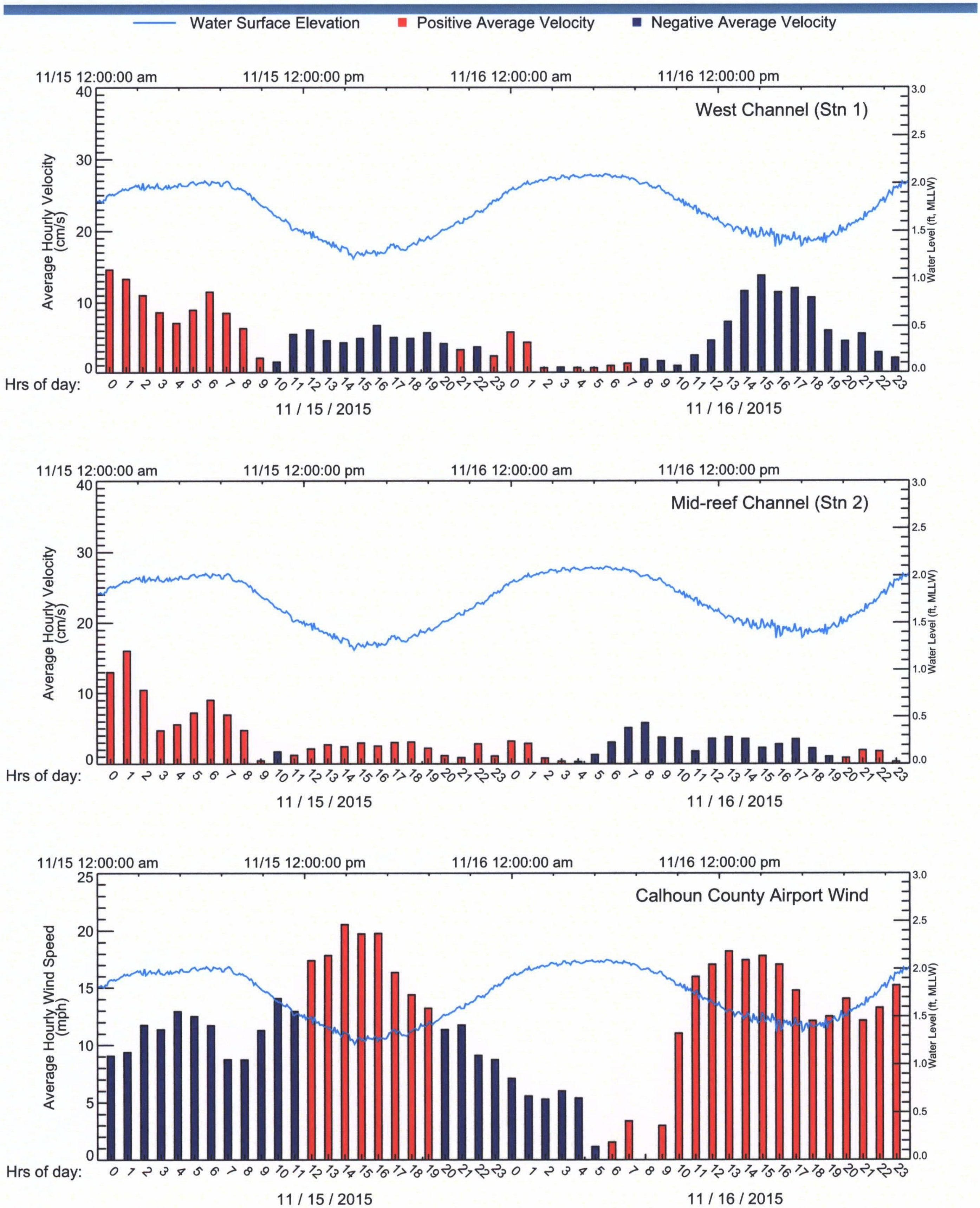


Figure D2-5b

Dredge Island Stn 1 and Stn 2 Water and Calhoun County Airport Wind Hourly Average Velocity

Notes: Water level data taken from NOAA station: 8773259 (Port Lavaca) when available. CTD diver water level data adjusted to account for NOAA tide height. Water velocity data filtered for measurements <= 55 cm/s. Velocity data averaged by minute then; postive and negative average values calculated by hour and summed. Wind data taken from PKV weather station. Negative values indicate winds blowing from 270-360 degrees and 0-90 degrees. Positive values indicate winds blowing from 90-270 degrees. If hourly average wind direction from due east or due west, wind speed set to zero for plotting.

cf - C:\Projects\Alcoa\Lavaca_Bay\Analysis\Sup_Studies_2015\Study7\IDL\Stn1_Stn2_Wind_Hrly_Avgs.pro

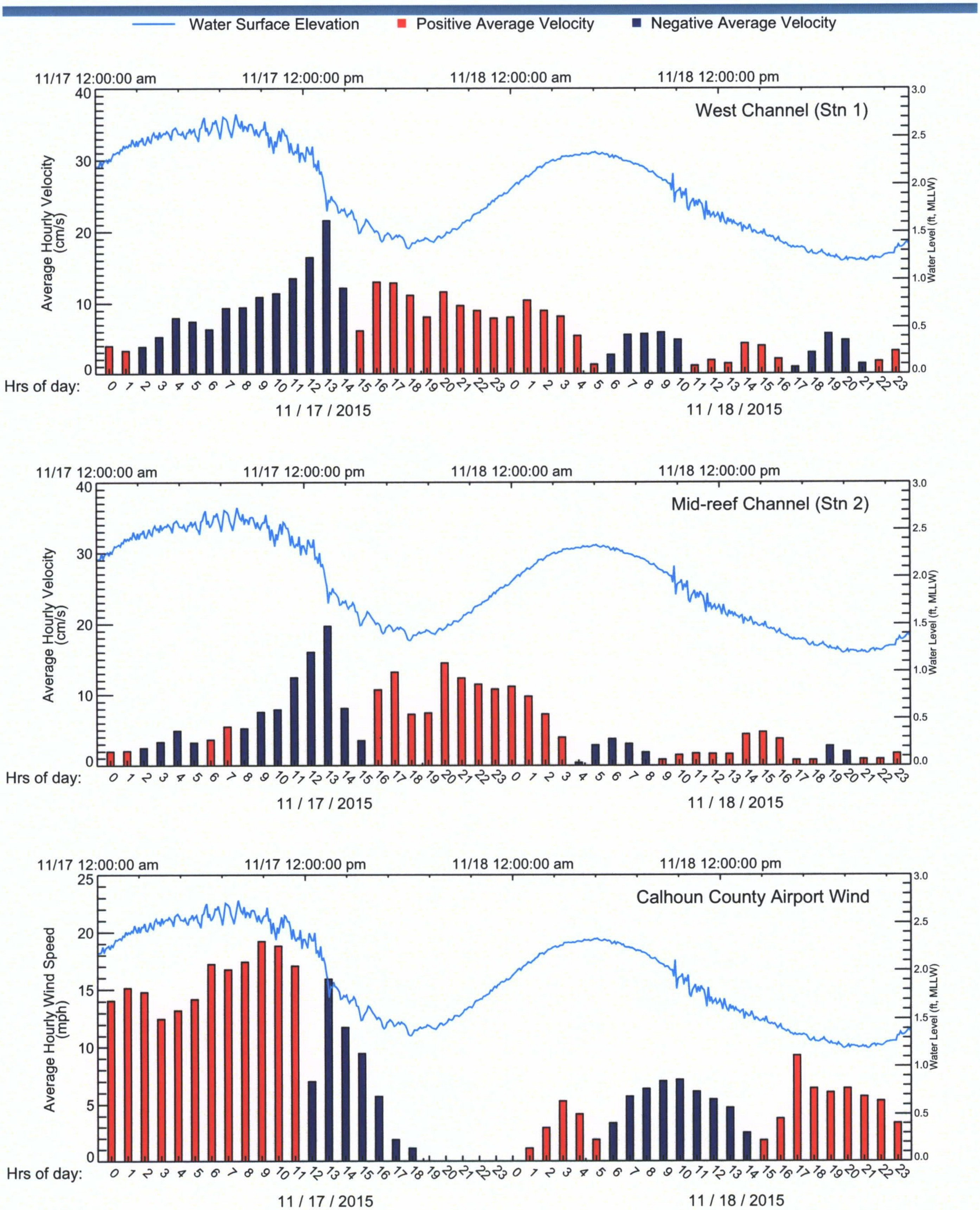
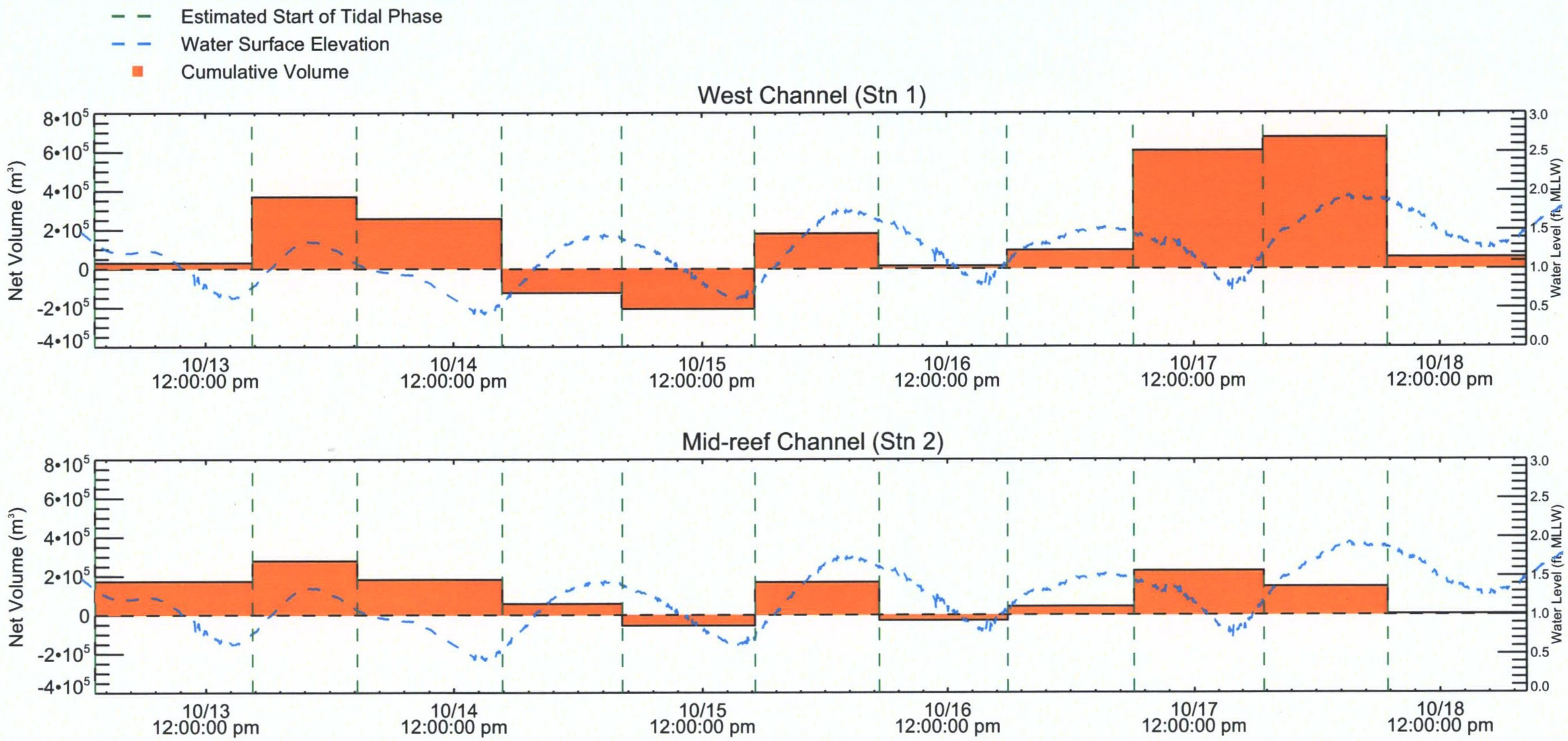


Figure D2-5c

Dredge Island Stn 1 and Stn 2 Water and Calhoun County Airport Wind Hourly Average Velocity

Notes: Water level data taken from NOAA station: 8773259 (Port Lavaca) when available. CTD diver water level data adjusted to account for NOAA tide height. Water velocity data filtered for measurements <= 55 cm/s. Velocity data averaged by minute then; postive and negative average values calculated by hour and summed. Wind data taken from PKV weather station. Negative values indicate winds blowing from 270-360 degrees and 0-90 degrees. Positive values indicate winds blowing from 90-270 degrees. If hourly average wind direction from due east or due west, wind speed set to zero for plotting.

cf - C:\Projects\Alcoa\Lavaca_Bay\Analysis\Sup_Studies_2015\Study7\IDL\Stn1_Stn2_Wind_Hrly_Avgs.pro



East Channel (Stn 3)
Data Unavailable

Figure D2-6

Causeway Cove Study 7 Station Cumulative Net Volume per Tidal Phase

Notes: Water level data taken from NOAA station: 8773259 (Port Lavaca) when available. CTD diver water level data adjusted to account for NOAA tide height. Water velocity data filtered for measurements <= 55 cm/s. Velocity data averaged by minute, then averaged over tidal 6-minute average period. Cumulative values summed for each tidal period. Start of flood and ebb tides assigned to 2 hours after estimated high or low tide. High and Low tide times from http://tides.mobilegeographics.com.

cf - \\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\Analysis\Sup_Studies_2015\Study7\IDL\lb_stn_current_temporals.pro
Mon Mar 21 10:48:38 2016

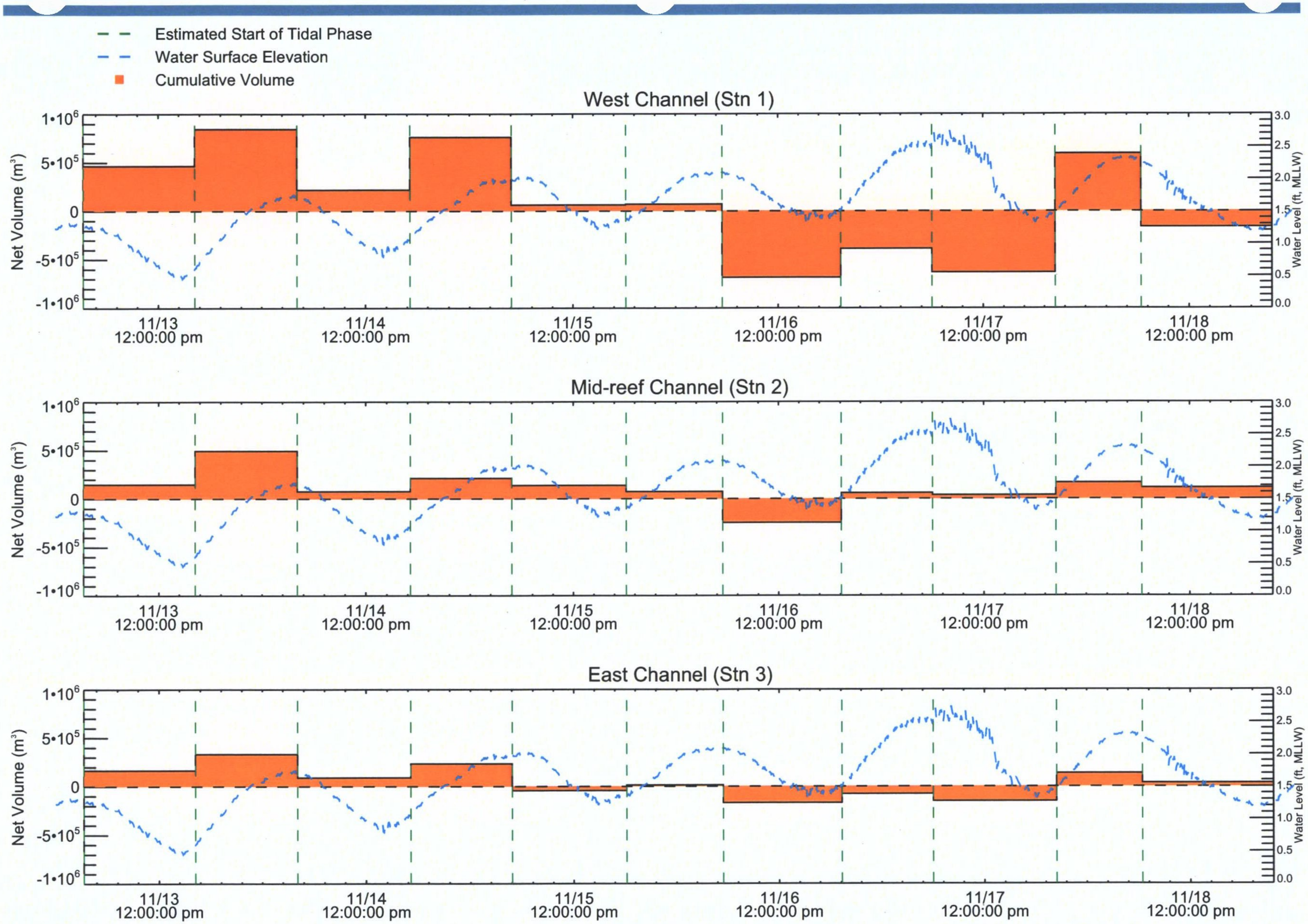


Figure D2-7

Causeway Cove Study 7 Station Cumulative Net Volume per Tidal Phase

Notes: Water level data taken from NOAA station: 8773259 (Port Lavaca) when available. CTD diver water level data adjusted to account for NOAA tide height. Water velocity data filtered for measurements <= 55 cm/s. Velocity data averaged by minute, then averaged over tidal 6-minute average period. Cumulative values summed for each tidal period. Start of flood and ebb tides assigned to 2 hours after estimated high or low tide. High and Low tide times from http://tides.mobilegeographics.com.

cf - \\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\Analysis\Sup_Studies_2015\Study7\IDL\lb_stn_current_temporals.pro
Mon Mar 21 10:49:49 2016

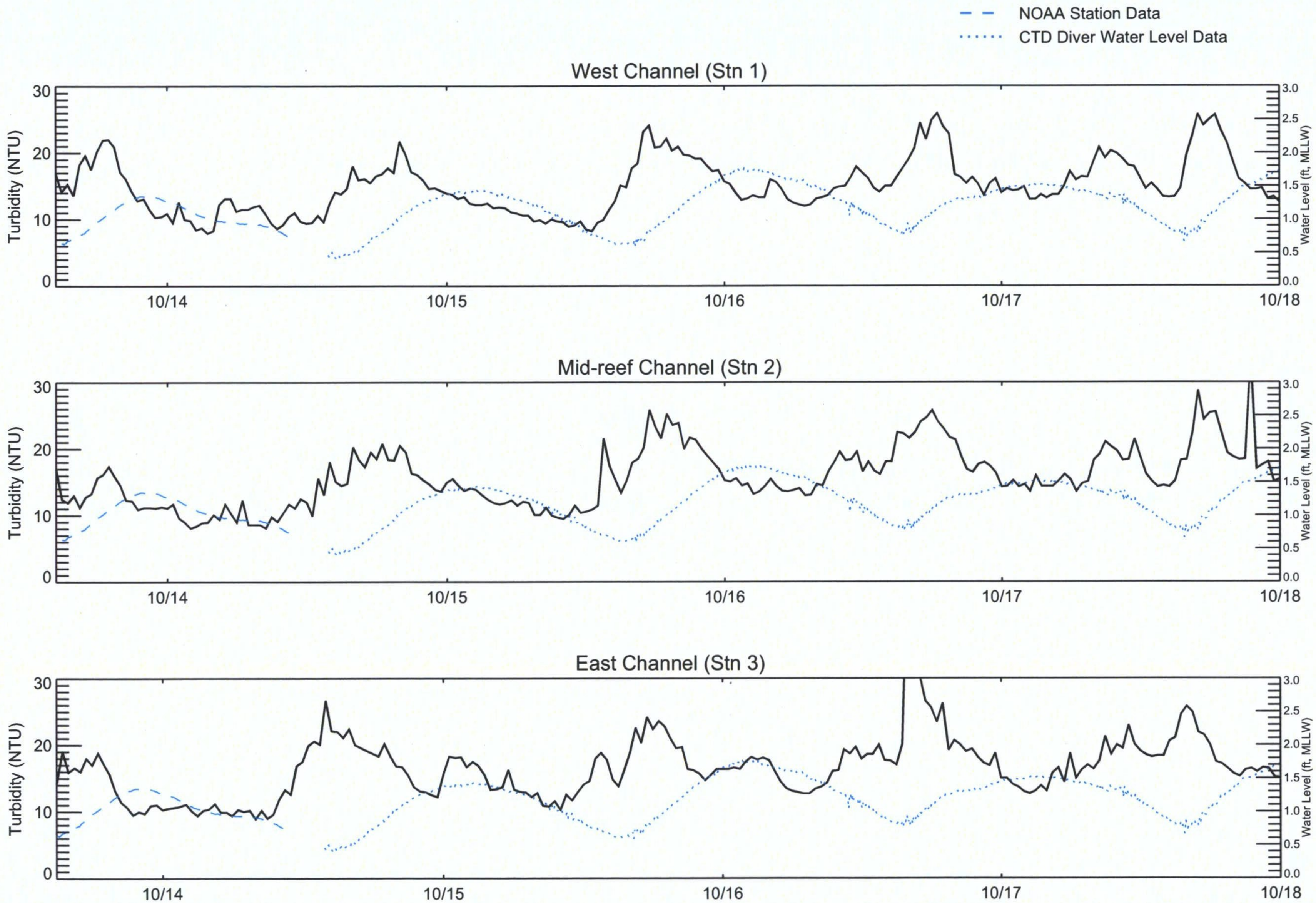
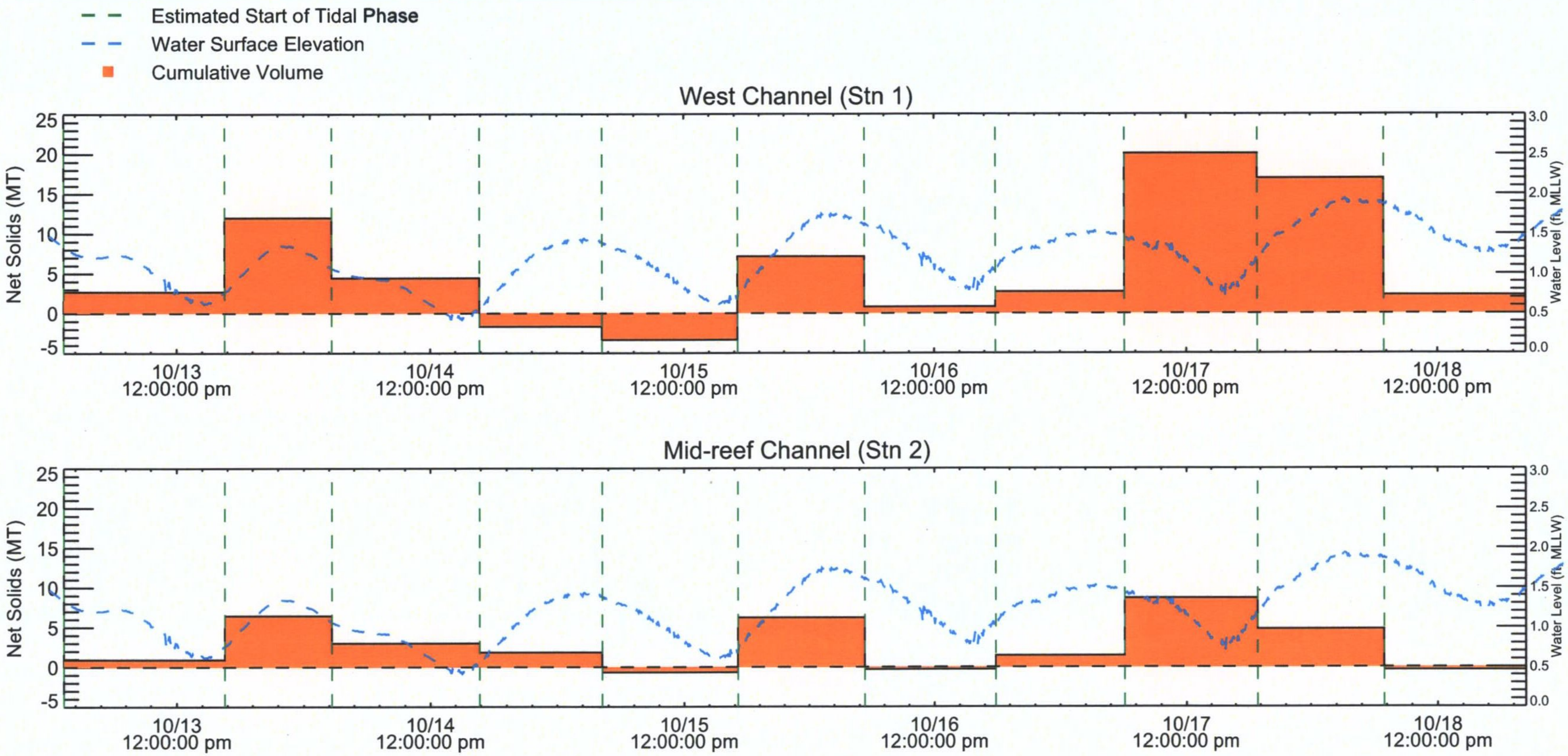


Figure D2-8

Supplemental Study 7B Station Turbidity

Notes: Water level data taken from NOAA station: 8773259 (Port Lavaca) when available.
CTD diverwater level data adjusted to account for NOAA tide height.

cf - \\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\Analysis\Sup_Studies_2015\Study7\IDL\Turbidity_Temporals_for_memo.pro
Tue Mar 01 11:03:38 2016



East Channel (Stn 3)
Data Unavailable

Figure D2-9

Causeway Cove Study 7 Station Cumulative Net Solid Flux per Tidal Phase

Notes: Water level data taken from NOAA station: 8773259 (Port Lavaca) when available. CTD diver water level data adjusted to account for NOAA tide height. Water velocity data filtered for measurements <= 55 cm/s. Velocity data averaged by minute. Then averaged over tidal 6-minute period. 30-minute turbidity averages assigned to respective 6-minute tidal periods. 1 NTU assigned 1.6 mg/L TSS. Cumulative values summed for each tidal period. Start of flood and ebb tides assigned to 2 hours after estimated high or low tide. High and Low tide times from http://tides.mobilegeographics.com.

cf - C:\Projects\Alcoa\Lavaca_Bay\Analysis\Sup_Studies_2015\Study7\IDL\lb_stn_current_temporals.pro
Thu Mar 03 14:45:16 2016

Appendix D3

Water Column Mercury Study

Study 7C

March 2016

ALCOA

Appendix D3 – Water Column Mercury Study

Introduction

This study was conducted in accordance with Section 4.4 (Recommendations) of the 2014 Remedial Action Annual Effectiveness Report (RAAER). The work plan was submitted to the U.S. Environmental Protection Agency (USEPA) on September 18, 2015, (Alcoa 2015c) with revisions submitted on November 24, 2015. The study received approval from the USEPA on December 1, 2015.

Objective

Three field studies were conducted to determine if suspended solids and mercury levels increased as water flowed through the Alcoa and Witco channels and whether barge and tug movement in Witco Harbor added appreciably to the sediment and mercury moving north of Dredge Island. The studies included:

- Barge Movement in Witco Harbor
- Solids Transport in Alcoa and Witco Channels
- Water Column Mercury Profiles

These studies were of an exploratory nature meant to identify sources but were not designed to fully quantify magnitude.

Technical Approach

Barge Movement in Witco Harbor

On January 14, 2016, velocity and turbidity were measured at the mouth of Witco Harbor before, during, and after the transit of a barge from Witco Channel to the Witco Harbor dock and back. Surface water grab samples were collected at four times and locations during this transit: 1) in the mouth of Witco Harbor before the barge movement; 2) within the wake of the barge as it passed into Witco Harbor; 3) within the barge plume while the barge was docking; 4) within the wake of the barge as it passed out of Witco Harbor. Water grab samples were analyzed for total mercury and total suspended solids (TSS).

The monitoring at the mouth of Witco Harbor consisted of repeatedly traversing a transect across the mouth and measuring velocity using a vessel-mounted Acoustic Doppler Current Profiler (ADCP) and turbidity using a probe lowered from the boat. The transect was traversed 13 times over a period of about 3 hours (Figure D3-1). The ADCP measured water depth, current velocity, and current direction water column profiles at sub-second intervals, and turbidity was measured at approximately 10-second intervals.

Flow across the transects was calculated from the water depth and velocity data. Water surface elevation data were downloaded from the Port Lavaca National Oceanic and Atmospheric Administration (NOAA) station (Station Number 8773259, Port Lavaca [TCOON], Texas). Water surface elevation change measured at the NOAA station during the duration of the barge study and the surface area of Witco Harbor were used to calculate the volume of water transported out of the harbor. The flow estimates and turbidity measurements were used to calculate solids transport across the transect.

Appendix D3 – Water Column Mercury Study

Mercury transport was estimated using particulate concentrations estimated from the grab sample data and the solids transport.

Solids Transport in the Alcoa and Witco Channels

The ADCP velocity and turbidity profiles at the southern and northern ends of Witco Channel were measured between January 11 and January 13, 2016 (Figure D3-2). The ADCP measurements were recorded every 10 minutes, and turbidity measurements were recorded every 30 minutes. These data were used to assess the nature of sediments moving from Alcoa Channel to Witco Channel and changes to the solids load as water traversed the Witco Channel.

Water Column Mercury Profiles

Five ISCO samplers were deployed one day a week from November 19, 2015, through December 17, 2015, to measure mercury in filtered and unfiltered surface water samples during flood and ebb tide. They were located on existing structures as follows: 1) one at the Dredge Island Bridge between the causeway marshes and Witco Harbor; 2) one at Mainland Shoreline Area No. 3; 3) one in the mid-reef channel; 4) one in the shallow water offshore from Marsh 1; and 5) one on a channel marker south of Dredge Island to determine background concentrations (Figure D3-3). Hourly water samples were collected for 24 hours during each deployment. Because a goal was to measure particulate mercury and mercury flux due to solids transport, the samples with the highest turbidity measurements within a tidal phase (ebb or flood) were composited for mercury. Total and dissolved mercury concentration gradients allowed for the identification of potential source areas.

Data Collection

Barge Movement in Witco Harbor

Transect monitoring on January 14, 2016, was conducted at the following times:

- Four transects were run before the barge and tug arrived at Witco Harbor:
  - 10:30 – 10:49
  - 10:51 – 11:00
  - 11:02 – 11:14
  - 11:16 – 11:26
- Three transects were run while the barge and tug were inside Witco Harbor:
  - 12:20 – 12:30
  - 12:31 – 12:39
  - 12:40 – 12:49
- Six transects were run after the barge and tug exited Witco Harbor:
  - 13:03 – 13:11
  - 13:12 – 13:23
  - 13:24 – 13:33
  - 13:34 – 13:47
  - 13:48 – 13:53
  - 13:55 – 14:04

Appendix D3 – Water Column Mercury Study

Using a Teledyne RD Instruments Workhorse Sentinel ADCP 1,200-kilohertz (kHz) unit mounted to the bottom of the work vessel, water depth, current direction, and current velocity measurements were taken at cell size depths of 0.25 meters. The ADCP data are provided electronically on the included disk.

Using a 6920 V2 YSI sonde equipped with a turbidity meter, turbidity measurements were collected 2 feet below the water surface approximately every 10 feet along the path of the transects. Turbidity data are provided electronically on the included disk.

Solids Transport in the Alcoa and Witco Channels

Teledyne RD Instruments Workhorse Sentinel ADCP 1,200-kHz units were positioned on the sediment bed at each location. The units stand 0.4055 meters in height, and readings are provided for every 0.61 meter cell depth starting 1.18 meters above the ADCP. Measurements of water depth and current velocity began on January 11, 2016, at 11:40 and 12:29 for the Witco Harbor and Alcoa Channel stations, respectively. The ADCPs ceased taking water profile measurements on January 13, 2016, at 6:25 at the mouth of Witco Harbor and at 6:11 in the Alcoa Channel.

Three 6920 V2 YSI sondes equipped with turbidity meters were deployed at each station to measure turbidity in the top, middle, and bottom water column layers. The YSIs at the mouth of Witco Harbor were set to 2-, 6-, and 10-foot depths, and the YSIs in the Alcoa Channel were set to 2-, 7-, and 11-foot depths. The YSIs began collecting turbidity measurements at 12:00 and 13:00 on January 11, 2016, for the Witco and Alcoa Channel stations, respectively. Both stations recorded turbidity until 6:00 on January 13, 2016.

The ADCP and YSI equipment at both stations were pulled twice during the deployment: once to check equipment calibration and once to allow for ship traffic to pass safely. The ADCP and turbidity data are provided electronically on the included disk.

Water Column Mercury Profiles

Each hourly sample was measured for turbidity on site, and the samples during flood tide with the highest turbidity and the samples during ebb tide with the highest turbidity were composited and submitted for analysis. Each composite sample was split into filtered and unfiltered aliquots. Unfiltered samples were analyzed for TSS, whereas filtered samples were measured for total organic carbon. Total mercury was measured in both. Samples were not analyzed for methylmercury due to the unpredictability of methylation processes in the sample jars during the 24-hour ISCO deployment. Analytical results are provided in Table D3-1.

The designation of flood and ebb tide periods was based on water surface elevation data downloaded from the Port Lavaca NOAA station (Station Number 8773259 Port Lavaca (TCOON), TX)[1]. Local elevation data were obtained from a CTD-Diver D1271' 10-meter gage that was deployed on the south side of the Dredge Island Bridge, approximately 50 feet southwest of the east channel reef border, from

[1] NOAA data were unavailable from October 14, 2015, to November 11, 2015, and on November 23, 2015.

October 14, 2015, to December 17, 2015. Water depth data are provided electronically on the included disk.

Results and Discussion

Barge Movement

TSS and mercury concentrations in the plume generated by the tug and barge greatly exceeded background levels (Figure D3-4 and Table D3-2). Measurements for both mercury and TSS were 5 to 10 times higher as the tug and barge entered the harbor, and 25 to 50 times higher for mercury, and 20 to 30 times higher for TSS during docking and as the tug and barge exited the harbor.

Except for the sample collected as the vessel exited, calculated solids normalized mercury concentrations were similar to levels measured in the water column monitoring program discussed below. This result suggests that prop wash resuspended unconsolidated surficial sediments characteristic of the water column, perhaps from a mobile pool. The concentration as the vessel exited is more consistent with bed sediment concentrations, suggesting that prop wash had eroded the underlying parent bed.

Some of the sediment resuspended in Witco Harbor was transported out of Witco Harbor, as evidenced by visual observations and turbidity measurements taken along the transects at the harbor mouth. Turbidity increased beginning about 15 minutes after the barge moved into Witco Harbor and remained elevated until 45 minutes after barge left the harbor (Figure D3-5). Turbidity peaked at a TSS equivalent of 130 milligrams per liter (mg/L)[2] just after the barge left Witco Harbor

Water velocity along the Witco Harbor mouth transect prior to the influence of the tug and barge was low and of random-like bearing. More organized patterns with higher velocities occurred under the influence of the tug and barge and likely reflected prop wash and boat wake currents (Figure D3-6a through D3-6c). Rather than relying on these measurements to estimate net water movement out of Witco Harbor, the changes in water surface elevation, derived from the preliminary NOAA Port Lavaca station water level measurements recorded during the time of the transects, were used in conjunction with the surface area of Witco Harbor to calculate flow out of Witco Harbor. These rates, coupled with the TSS equivalent of the average turbidity level along each transect, were used to calculate solids flux (Figure D3-7). The total flux over the study period was 245 kilograms (kg), of which 130 kg was associated with elevated TSS due to the tug and barge.

Conservatively assuming the tug- and barge-related solids had the highest mercury concentration measured in the plume of 0.5 milligrams per kilogram (mg/kg), the tug and barge caused about 65 milligrams (mg) of mercury to be transported out of Witco Harbor.

[2] For the purpose of the current Lavaca Bay studies, 1 nephelometric turbidity unit is assumed equivalent to 1.6 milligrams per liter of total suspended solids.

Appendix D3 – Water Column Mercury Study

Solids Transport in the Alcoa and Witco Channels

Mid-depth and near bottom water currents at the northern and southern ends of the Witco Channel exhibited consistent patterns during the first tidal cycle of the study (Figure D3-8). This consistency broke down, and some of the patterns seemed anomalous after the ADCP units were redeployed following removal due to the passing of a large ship. Because of the possibility that the ship or the action of removing and redeploying the units influenced measurements after redeployment, the data prior to the ship interference are the focus here.

Velocity was about 2 centimeters per second (cm/s) at both stations when monitoring commenced at mid-ebb and rapidly rose to about 12 cm/s at the northern station and 20 cm/s at the southern station. A decline followed but was not tracked for about 30 to 60 minutes while the calibration of the ADCP units was checked. Monitoring resumed at the beginning of flood, and both stations exhibited rising velocities that peaked about 3 hours into flood at values matching the earlier peaks. Velocities declined through the rest of flood to less than 1 cm/s at the northern station and 1–2 cm/s at the southern station. Low velocities persisted through ebb, with some increase after mid-ebb, mirroring the previous ebb cycle but lower in magnitude. The higher velocities at the southern station reflect a smaller cross section (Figure D3-2). Based on a northern station cross section of about 340 square meters (m^2) and a flood average velocity of about 8 cm/s, the average flow over the flood was approximately 30 cubic meters per second (m^3/s).

Currents at both stations and both depths were directed along and up the channel, which is oriented N 30° W (330° compass heading) from the start of monitoring through the end of flood (Figure D3-9). Current direction of the low ebb velocities was variable and tended to be oriented somewhat cross-channel, suggesting little net movement down the channel.

Turbidity at the southern station expressed as equivalent TSS was relatively constant at about 10 mg/L for the entire monitoring period up until the time the equipment had to be removed because of the passing ship and was nearly identical at the mid-depth and near-near bottom locations (Figure D3-10). The lack of vertical differences in TSS means the suspended solids have very low settling velocities and are likely composed of fine particles such as clays. This situation is consistent with the downstream deep Alcoa Channel being an effective trap for settleable solids.

The bottom water at the northern station had roughly twice the TSS of the southern station, whereas the mid-depth water mirrored the 10 mg/L moving north from the southern station. Thus, settleable solids had entered the water column between the two stations and were transported to the northern station. These solids could have originated from sloughing at the edges of the channel or resuspension of unconsolidated sediments on the channel bottom.

Water Column Mercury Profiles

Particulate and dissolved mercury concentrations during flood tide increased moving from south to north, though the patterns differed somewhat (Figure D-11). Particulate mercury increased between the south end of Dredge Island (ISCO E) and Mainland Shoreline #3 (MS3; ISCO D). Over the four events that both locations were sampled, the average increased from 0.07 mg/kg to 0.18 mg/kg. Moving further north, there was little change in the averages. In contrast, dissolved mercury concentrations at the south end of Dredge Island and MS3 were similar at about 1 nanogram per liter (ng/L). Dissolved mercury increased from MS3 to the north end of the Witco Channel (ISCO C) and the mid-reef station north of Dredge Island (ISCO B), which had the highest average at 2.8 ng/L.

The ebb tide spatial pattern was generally similar to flood, supporting the overall finding that mercury sources to the water column exist along the sampled corridor.

Summary and Conclusions

Collectively, the three studies show a pattern of water and sediment transport to the north and west between Dredge Island and the Alcoa shoreline. Mercury levels in the water column increase from south to north along this pathway. Tug and barge activity in Witco Harbor resuspends sediment and mercury, some of which is carried out of Witco Harbor and into the general circulation pattern.

Some perspective on mercury transport is provided by these studies. Flood flow in the Witco Channel having 2 ng/L of dissolved mercury and 0.2 mg/kg of particulate mercury would have a total mercury concentration of 5 ng/L at 15 mg/L of suspended solids. At an average flood flow of 30 m^3/s, the mercury loading would be 0.5 grams per hour or about 5 grams over a 10-hour flood cycle. The estimated mercury load out of Witco Harbor from the single tug and barge transit of 65 mg adds about 1.3% to this mass. Caution must be taken in inferring the overall impact of tug and barge transits from this single event. The extent to which is characteristic of all such transits is unknown.

Overall, the results characterize conditions typical of the Bay given that they occurred when the circulation patterns represented typical non-event conditions in which there is counterclockwise circulation around Dredge Island. Atypical conditions that occur during high wind events could be much different. The velocity monitoring discussed in Appendix D2 showed that high winds from the south reversed the typical circulation. Such events likely cause resuspension that could be important to mercury transport and the contributions of various sediment sources.

TABLES

Table D3-1
2015 ISCO Water Sampling Results

Sample ID	Date	Time	Tidal Stage	ISCO Sampler	Sampling Event	Analytical Results			
						Total Hg (ng/L)	TOC (mg/L)	TSS (mg/L)	Dissolved Hg (ng/L)
						Result	Result	Result	Result
B12b-SW-17000	11/20/2015	5:00	Ebb	A	Sample Event 1	4.83	5.18	13.1	NA
B12b-SW-17001						NA	5.43	NA	3.32
B12b-SW-17002	11/19/2015	16:00	Flood			NA	5.57	NA	1.98
B12b-SW-17003						6.08	5.20	14.8	NA
B12b-SW-17004	11/20/2015	5:00	Ebb	B		NA	4.73	NA	1.68
B12b-SW-17005						3.25	4.72	11.5	NA
B12b-SW-17006	11/19/2015	20:00	Flood			NA	5.00	NA	1.19
B12b-SW-17007						5.30	4.96	20.6	NA
B12b-SW-17008	11/20/2015	7:00	Ebb	C		NA	4.88	NA	1.83
B12b-SW-17009						4.42	4.8	14.7	NA
B12b-SW-17010	11/19/2015	17:00	Flood			NA	5.57	NA	2.91
B12b-SW-17011						4.70	4.86	14.8	NA
B12b-SW-17012	11/20/2015	3:00	Ebb	D		NA	4.88	NA	1.06
B12b-SW-17013						4.17	4.65	14.5	NA
B12b-SW-17014	11/19/2015	17:00	Flood			NA	4.68	NA	0.924
B12b-SW-17015						5.01	4.67	15.8	NA
B12b-SW-17016	11/20/2015	7:00	Ebb	E		NA	4.82	NA	1.33
B12b-SW-17017						3.80	4.54	19.9	NA
B12b-SW-17018	11/19/2015	20:00	Flood			NA	4.75	NA	1.24
B12b-SW-17019						2.39	4.71	18.8	NA

Table D3-1
2015 ISCO Water Sampling Results

Sample ID	Date	Time	Tidal Stage	ISCO Sampler	Sampling Event	Analytical Results Total Hg (ng/L) Result	TOC (mg/L) Result	TSS (mg/L) Result	Dissolved Hg (ng/L) Result
B12b-SW-17020	12/1/2015	19:00	Flood	A	Sample Event 1.5	7.75	2.85	26.6	NA
B12b-SW-17021						NA	3.04	NA	1.03
B12b-SW-17022	12/1/2015	18:00	Flood	B		9.75	2.84	47.2	NA
B12b-SW-17023						NA	3.01	NA	5.07
B12b-SW-17024	12/1/2015	18:00	Flood	C		11.6	2.74	45.7	NA
B12b-SW-17025						NA	2.81	NA	3.55
B12b-SW-17026	12/1/2015	16:00	Flood	D		9.19	2.79	48	NA
B12b-SW-17027						NA	2.77	NA	1.49
B12b-SW-17028	12/1/2015	16:00	Flood	E		3.98	3.01	43.2	NA
B12b-SW-17029						NA	3.41	NA	1.04
B12b-SW-17030	12/3/2015	12:00	Flood	A	Sample Event 2	7.70	2.86	29.2	NA
B12b-SW-17031						NA	3.04	NA	1.15
B12b-SW-17032	12/4/2015	3:00	Ebb			4.97	2.8	3.1	NA
B12b-SW-17033						NA	4.21	NA	1.16
B12b-SW-17034	12/3/2015	11:00	Flood	B		3.96	2.81	14.9	NA
B12b-SW-17035						NA	5.06	NA	0.931
B12b-SW-17036	12/4/2015	3:00	Ebb			2.83	2.9	13.6	NA
B12b-SW-17037						NA	3.4	NA	1.20
B12b-SW-17038	12/3/2015	13:00	Flood	C		4.37	2.64	19.6	NA
B12b-SW-17039						NA	5.01	NA	1.28
B12b-SW-17040	12/4/2015	3:00	Ebb			2.46	2.77	12.4	NA
B12b-SW-17041						NA	2.86	NA	0.782
B12b-SW-17042	12/3/2015	10:00	Flood	D		2.22	2.76	32	NA
B12b-SW-17043						NA	2.9	NA	0.524
B12b-SW-17044	12/4/2015	3:00	Ebb			2.13	2.98	8.53	NA
B12b-SW-17045						NA	3.16	NA	2.09
B12b-SW-17046	12/3/2015	9:00	Flood	E		2.13	3.1	26.9	NA
B12b-SW-17047						NA	3.3	NA	0.880
B12b-SW-17048	12/4/2015	4:00	Ebb			2.14	3.04	10.5	NA
B12b-SW-17049						NA	3.3	NA	0.915

Table D3-1
2015 ISCO Water Sampling Results

Sample ID	Date	Time	Tidal Stage	ISCO Sampler	Sampling Event	Analytical Results: Total Hg (ng/L) Result	TOC (mg/L) Result	TSS (mg/L) Result	Dissolved Hg (ng/L) Result
B12b-SW-17050	12/8/2015	8:00	Flood	A	Sample Event 3	3.85	4.39	15.0	NA
B12b-SW-17051						NA	7.13	NA	1.47
B12b-SW-17052	12/9/2015	5:00	Ebb			3.82	4.3	10.6	NA
B12b-SW-17053						NA	4.39	NA	0.969
B12b-SW-17054	12/8/2015	17:00	Flood	B		2.32	4.13	13.4	NA
B12b-SW-17055						NA	4.27	NA	1.39
B12b-SW-17056	12/9/2015	5:00	Ebb			1.75	4.26	12.6	NA
B12b-SW-17057						NA	4.59	NA	1.28
B12b-SW-17058	12/8/2015	17:00	Flood	C		2.72	4.06	15.2	NA
B12b-SW-17059						NA	4.21	NA	1.02
B12b-SW-17060	12/9/2015	3:00	Ebb			2.90	4.21	10.4	NA
B12b-SW-17061						NA	4.33	NA	0.875
B12b-SW-17062	12/8/2015	20:00	Flood	E		5.52	3.49	31.0	NA
B12b-SW-17063						NA	3.61	NA	0.641
B12b-SW-17064	12/9/2015	3:00	Ebb			4.21	3.58	25.0	NA
B12b-SW-17065						NA	3.6	NA	0.930

Table D3-1
2015 ISCO Water Sampling Results

Sample ID	Date	Time	Tidal Stage	ISCO Sampler	Sampling Event	Analytical Results			
						Total Hg (ng/L)	TOC (mg/L)	TSS (mg/L)	Dissolved Hg (ng/L)
						Result	Result	Result	Result
B12b-SW-17070	12/16/2015	12:00	Ebb	A	Sample Event 4	18.5	3.59	42.4	NA
B12b-SW-17071						NA	3.7	NA	3.93
B12b-SW-17072	12/17/2015	3:00	Flood			7.56	2.79	24.2	NA
B12b-SW-17073						NA	2.92	NA	2.03
B12b-SW-17074	12/16/2015	13:00	Ebb	B		6.47	3.36	19	NA
B12b-SW-17075						NA	3.55	NA	3.86
B12b-SW-17076	12/17/2015	1:00	Flood			9.15	2.82	32	NA
B12b-SW-17077						NA	3.02	NA	5.30
B12b-SW-17078	12/16/2015	12:00	Ebb	C		5.37	2.87	20	NA
B12b-SW-17079						NA	3.05	NA	0.728
B12b-SW-17080	12/17/2015	00:00	Flood			8.13	2.81	30.6	NA
B12b-SW-17081						NA	2.84	NA	0.762
B12b-SW-17082	12/16/2015	12:00	Ebb	D		5.15	2.89	19.2	NA
B12b-SW-17083						NA	3.17	NA	0.939
B12b-SW-17084	12/17/2015	00:00	Flood			8.91	2.8	31.4	NA
B12b-SW-17085						NA	2.97	NA	1.13
B12b-SW-17086	12/16/2015	11:00	Ebb	E		6.44	3.36	24.2	NA
B12b-SW-17087						NA	3.53	NA	1.13
B12b-SW-17088	12/17/2015	00:00	Flood			4.54	3.12	35.2	NA
B12b-SW-17089						NA	3.14	NA	0.720

Notes:

Matrix Spike/Matrix Spike Duplicate Performed

Hg = mercury

mg/L = milligrams per liter

ng/L = nanograms per liter

TOC = total organic carbon

TSS = total suspended solid

Table D3-2
Witco Harbor Barge Plume TSS and Mercury Concentrations

Sample	Total Suspended Solids (mg/L)	Total Mercury (ng/L)	Solids Normalized Total Mercury (mg/kg)
Background	10	2.2	0.22
Vessel Entering	136	11	0.08
Vessel Docking	328	47.5	0.15
Vessel Exiting	205	99.4	0.48

Notes:

mg/kg = milligrams per kilogram

mg/L = milligrams per liter

ng/L = nanograms per liter

TSS = total suspended solids

FIGURES

LEGEND

Turbidity Transects

- Transect 1
- Transect 2
- Transect 3
- Transect 4
- Transect 5
- Transect 6
- Transect 7
- Transect 8
- Transect 9
- Transect 10
- Transect 11
- Transect 12
- Transect 13

0 100 200 Feet

NOTES:
Notes (if any) go here, otherwise the legend, scale bar and north arrow can be expanded into this space if more room is needed.

2015 RAAER

Turbidity Transects

ALCOA PCO

Project: 150002-02.03

Date: 01/06/2016

Figure D3-1

Q:\Jobs\Alcoa_0002\Lacava_Bay\Maps\2016_01\TurbidityTransect.mxd jsfox 1/25/2016 9:10:07 AM

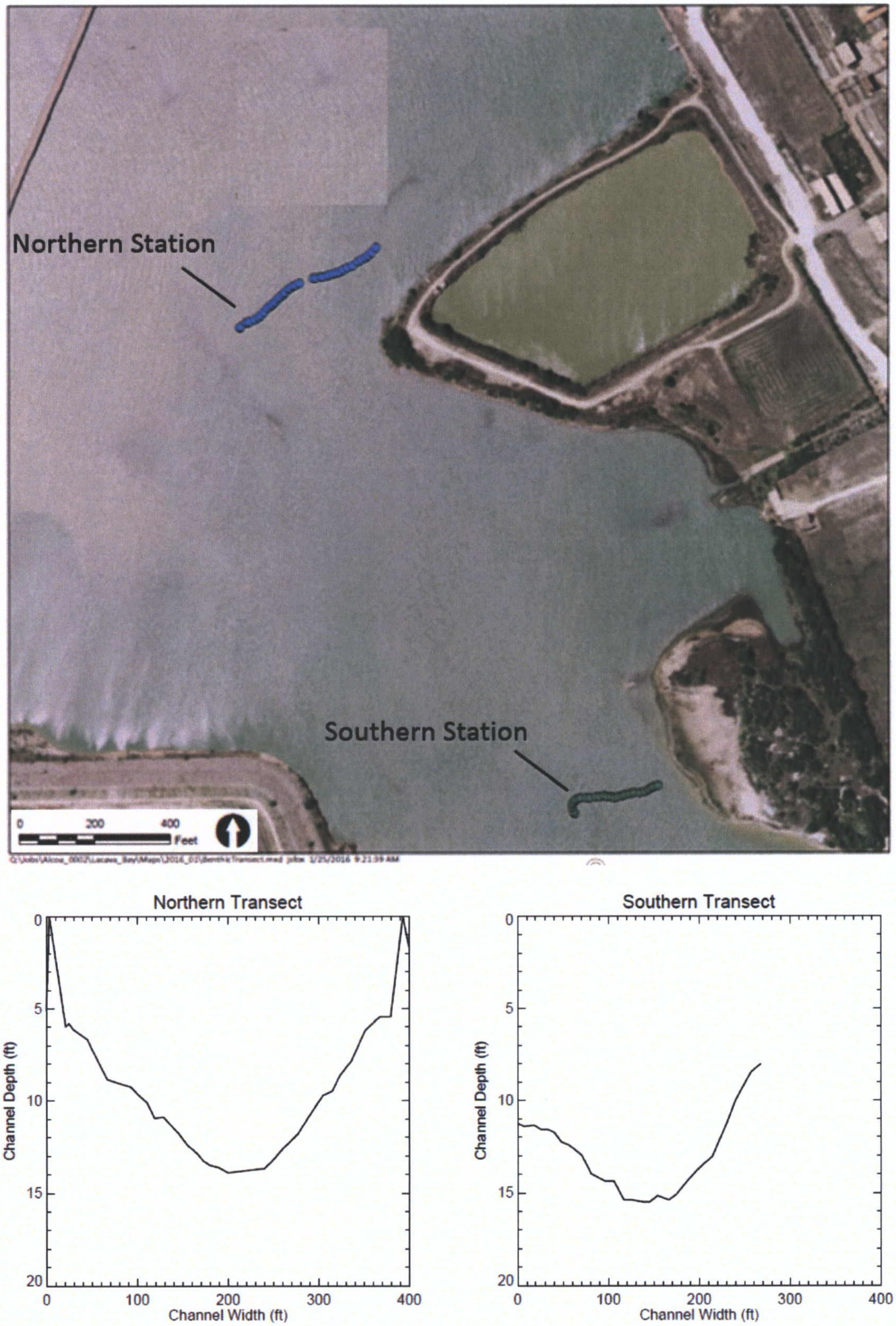
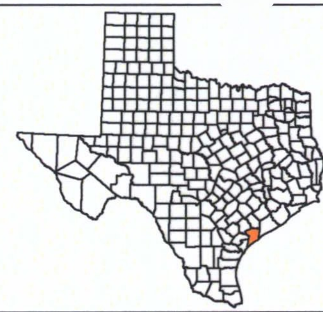


Figure D3-2
Study 7C Water Column Profiling ADCP Station Locations and Cross Sections
2015 RAAER
Alcoa

\\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\documents\Reports\RAAERs\2015RAAER\Appendices\D3\Figure D3-2.docx



LEGEND

- ISCO Locations

0 500 1,000 Feet

2015 RAAER

Study 7C ISCO Water sampling Station Locations

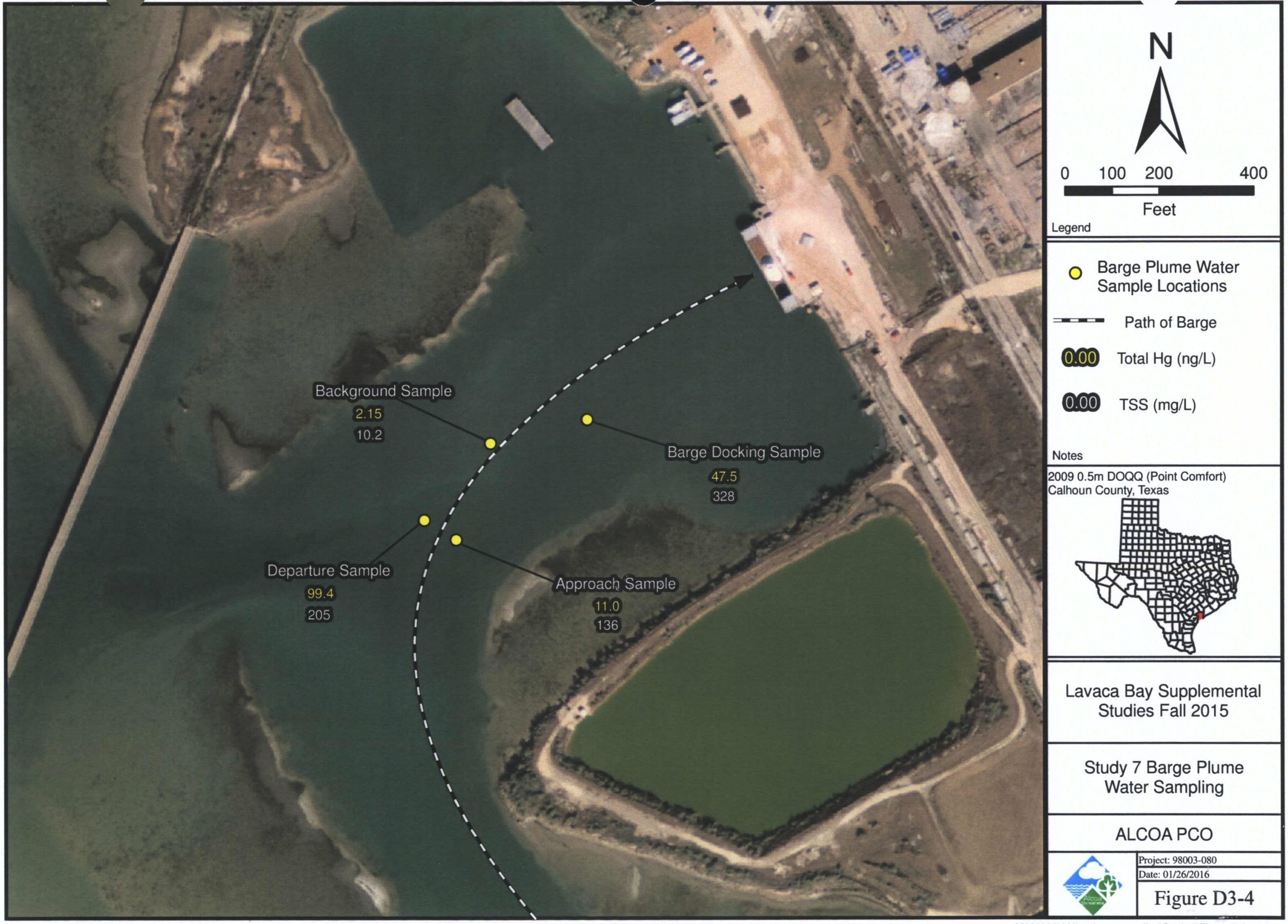
ALCOA PCO

Project: 150002-02.03

Date: 03/23/2016

Figure D3-3

Q:\Jobs\Alcoa_0002\Lavaca_Bay\Maps\2016_03\LavacaBayISCOLocations.mxd jsfox 3/23/2016 3:36:07 PM



Lavaca Bay Supplemental Studies Fall 2015

Study 7 Barge Plume Water Sampling

ALCOA PCO

Project: 98003-080

Date: 01/26/2016

Figure D3-4

M:\98003\080\arc\post sampling\Study 7\Figure 7-2.mxd

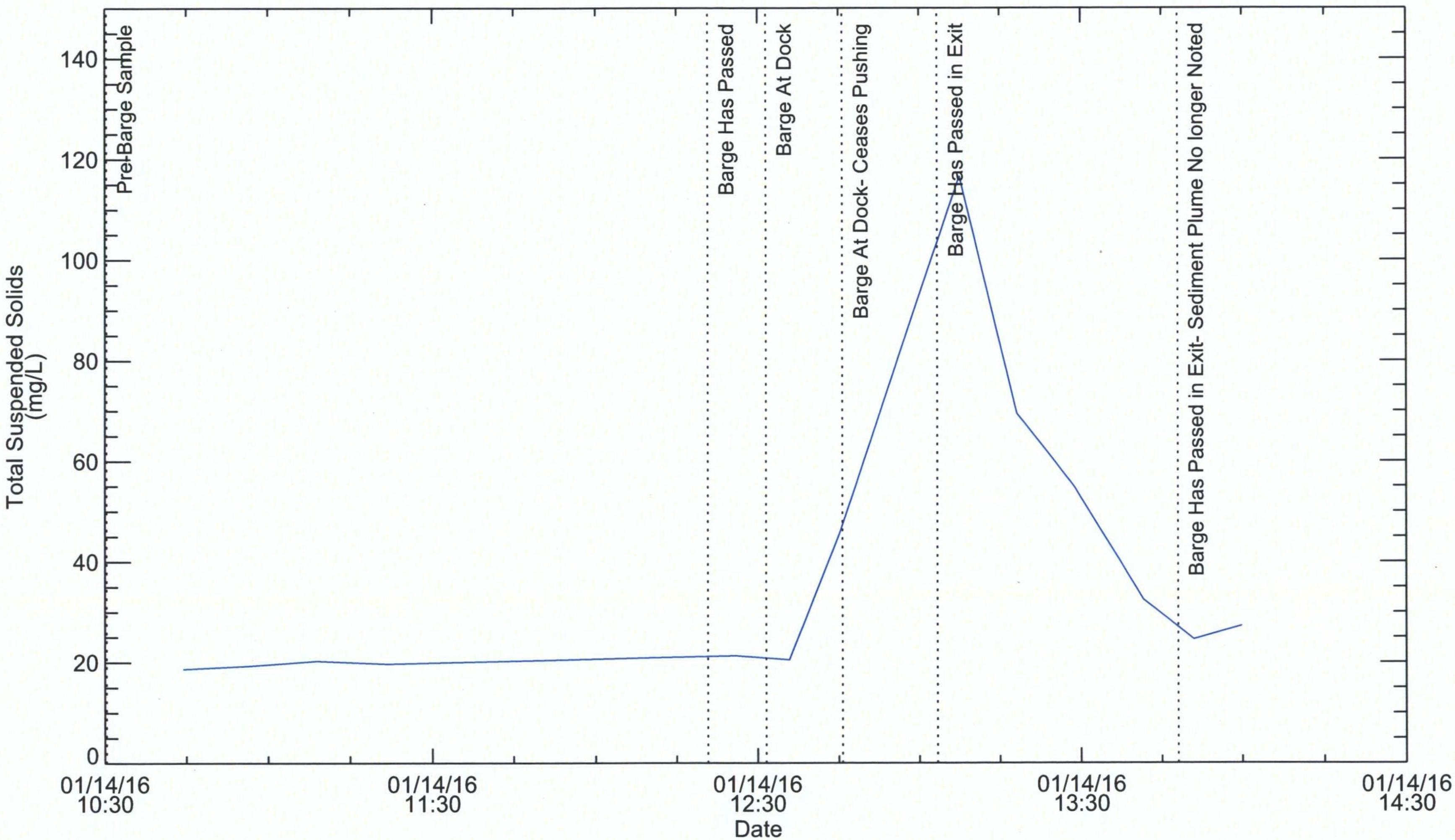


Figure D3-5

Time Series of Average Total Suspended Solids for ADCP Transects Across Witco Harbor

Notes: TSS plotted at mean time for each transect.

HS - \\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\Analysis\Sup_Studies_2015\Study7\Barge_Study\LB_ADCP_transects_avgTSS_20160226.pro
Thu Mar 17 11:06:15 2016

Transect 1 - Pre-Barge Sample

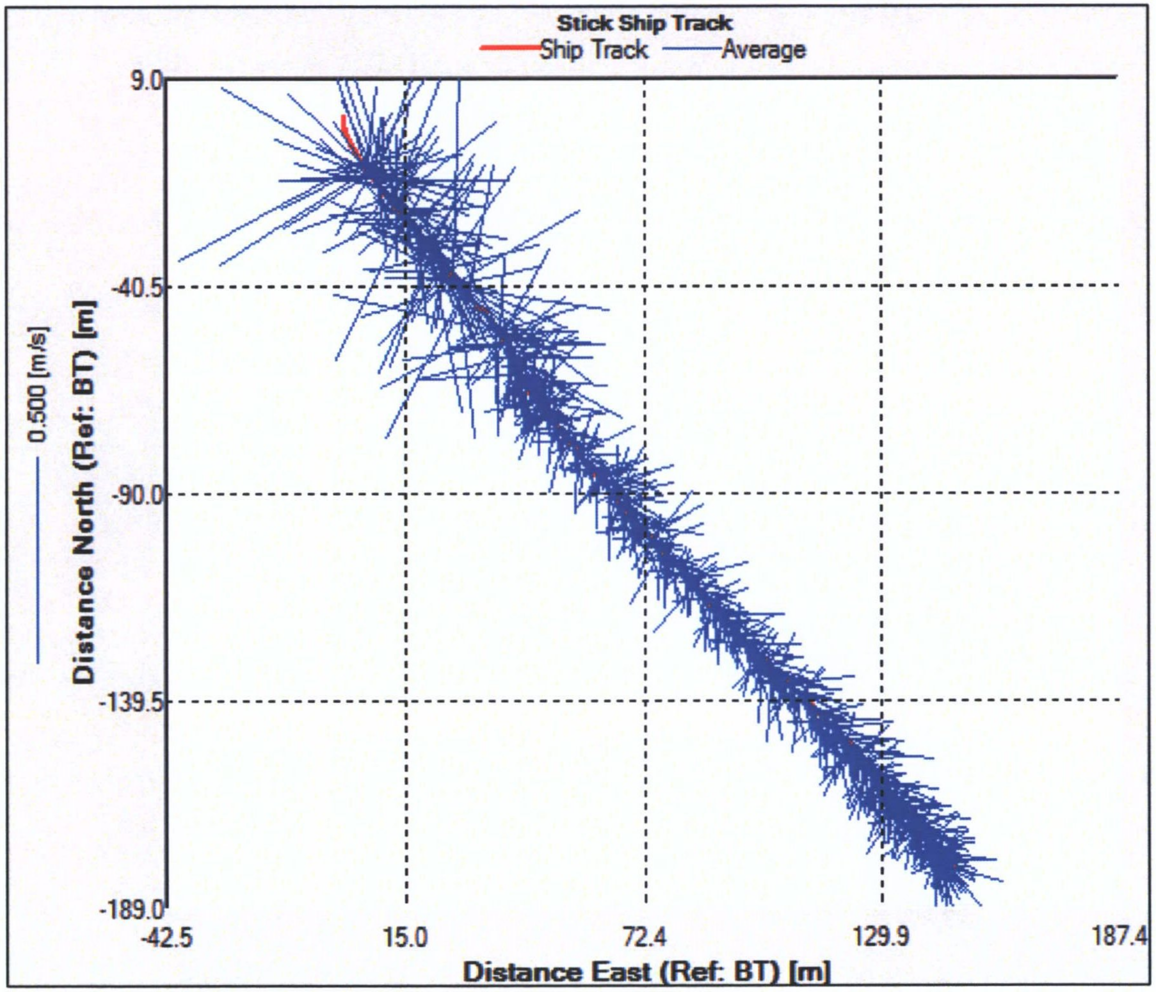


Figure D3-6a
7C Witco Harbor Barge Movement Transect 1 Bearing and Velocity
2015 RAAER
Alcoa

Transect 2 - Pre-Barge Sample

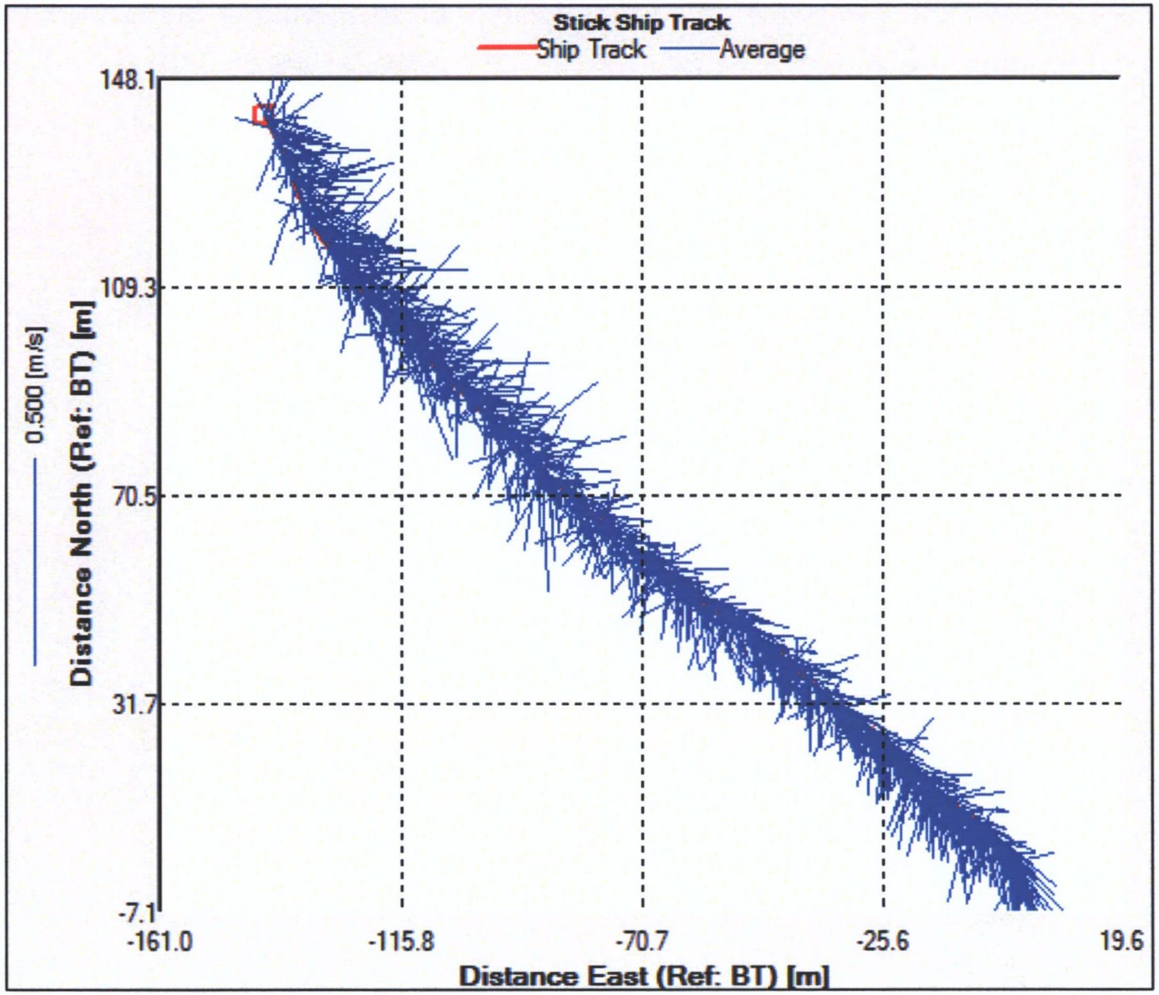


Figure D3-6b
7C Witco Harbor Barge Movement Transect 2 Bearing and Velocity
2015 RAAER
Alcoa

Transect 6 - Barge at Dock Sample

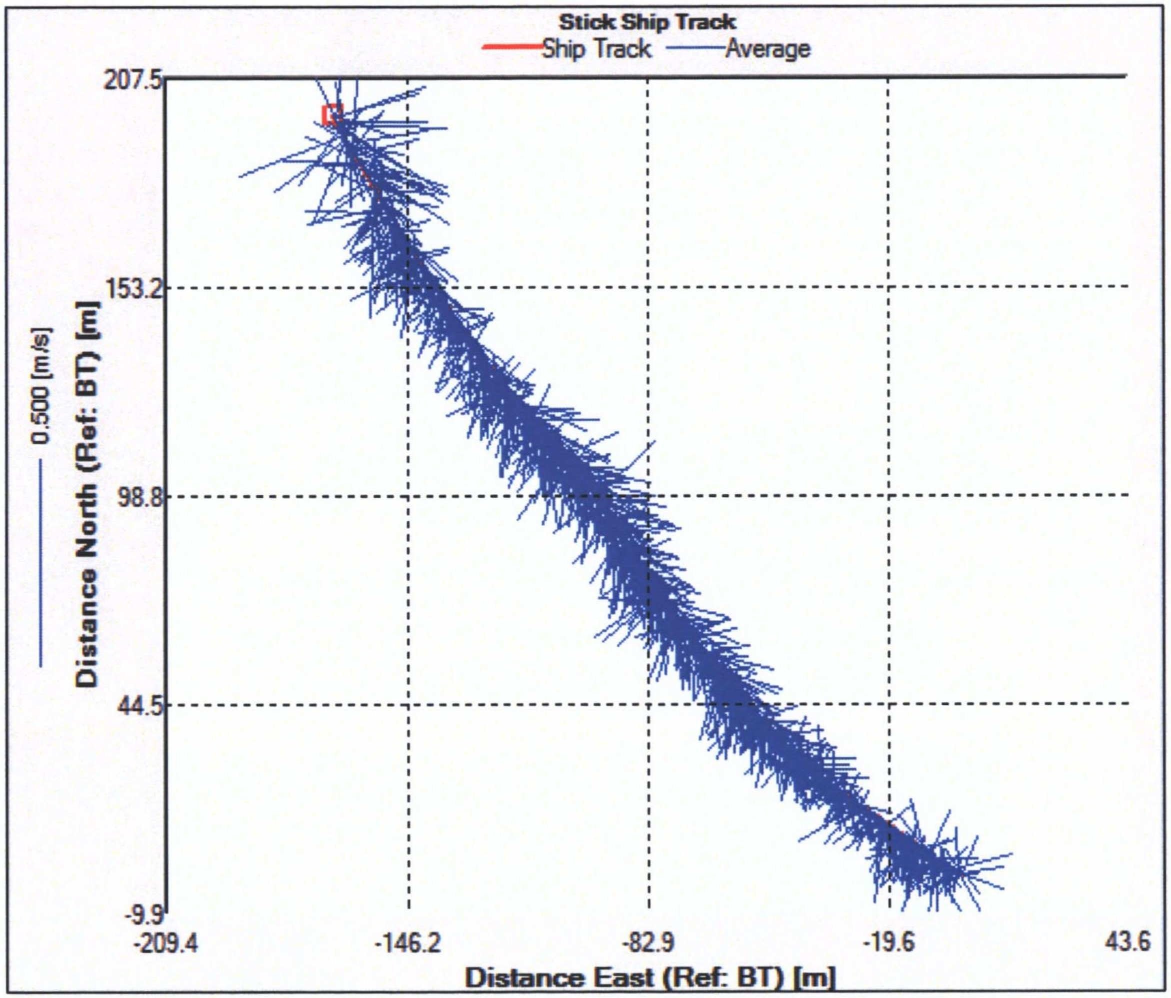


Figure D3-6c
7C Witco Harbor Barge Movement Transect 6 Bearing and Velocity
2015 RAAER
Alcoa

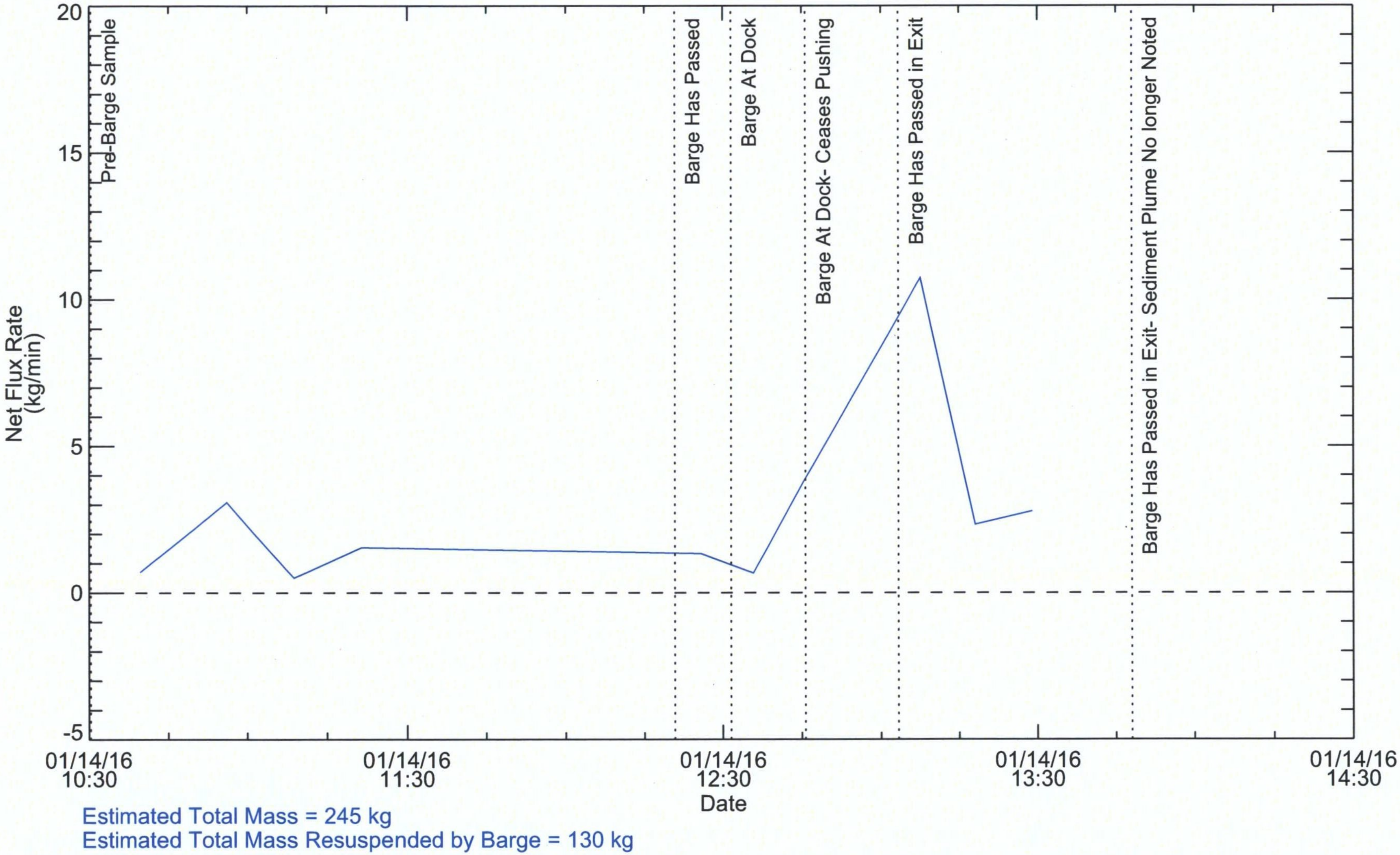


Figure D3-7

Witco Harbor Barge Movement Mass Flux

Notes: Mass transported out of Witco Harbor shown as positive value. Water level data from NOAA station: 8773259 (Port Lavaca). Net flux plotted at mean time for each transect. Transect 12 and 13 data omitted due to unlikely rapid water elevation changes recorded at NOAA station.

cf - \\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\Analysis\Sup_Studies_2015\Study7\Barge_Study\WSEL_Mass_Flux.pro
Thu Mar 17 11:13:59 2016

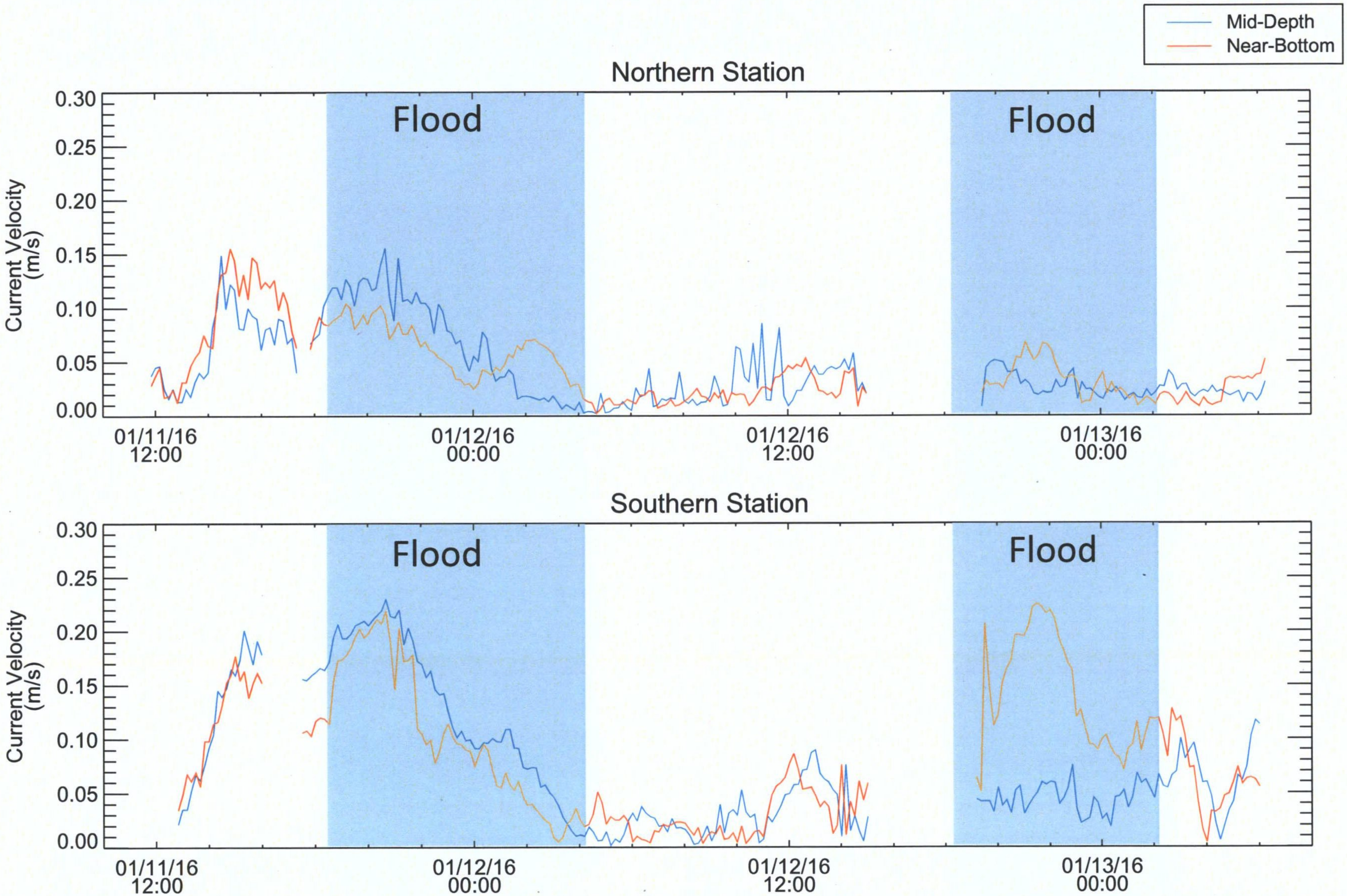


Figure D3-8

Study 7C Water Column Profiling Station Current Velocities

HS/CF - \\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\Analysis\ADCP\LB_ADCP_stationary_atan2_20160321.pro
Tue Mar 22 12:45:18 2016

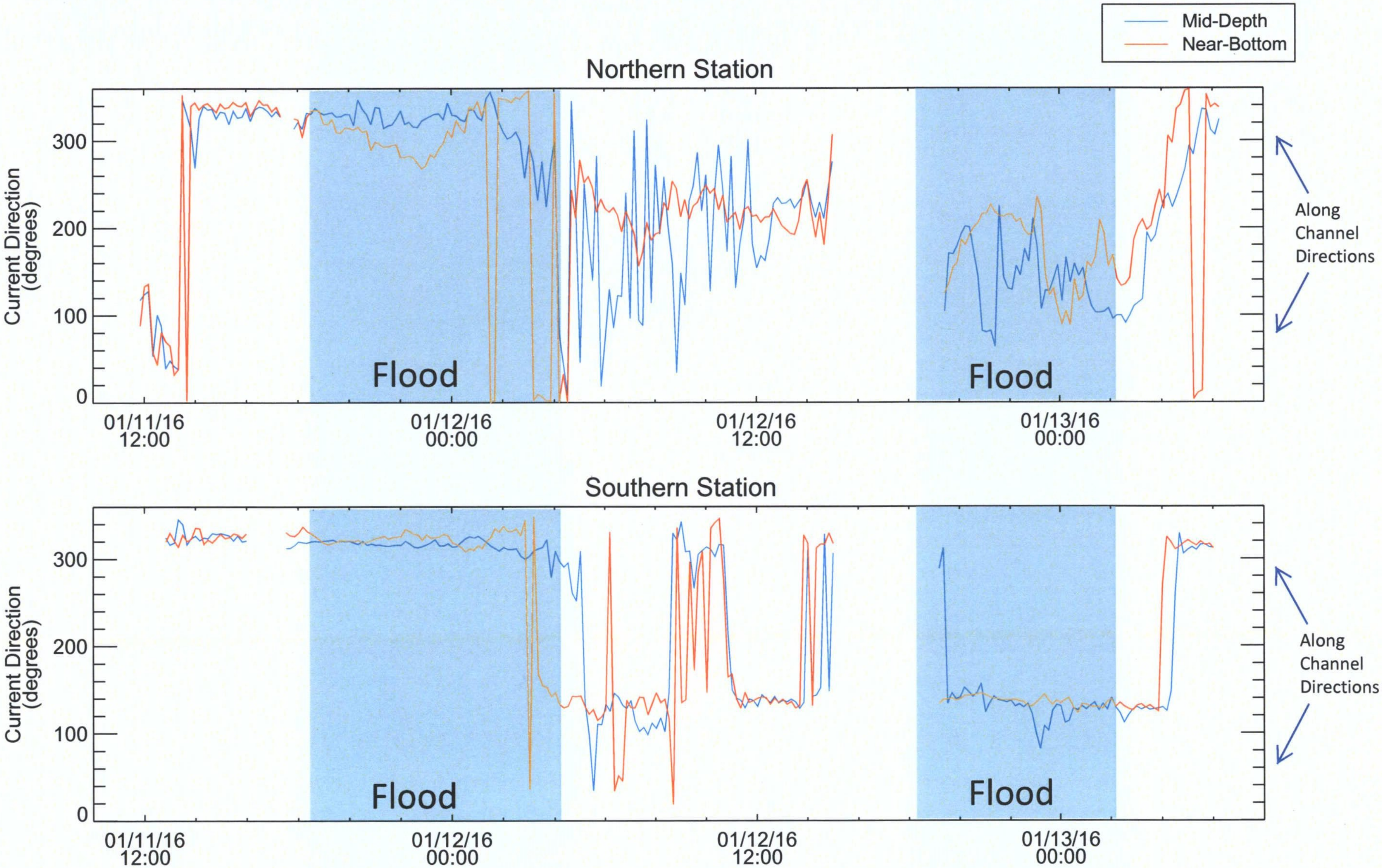


Figure D3-9

Study 7C Water Column Profiling Station Current Velocities

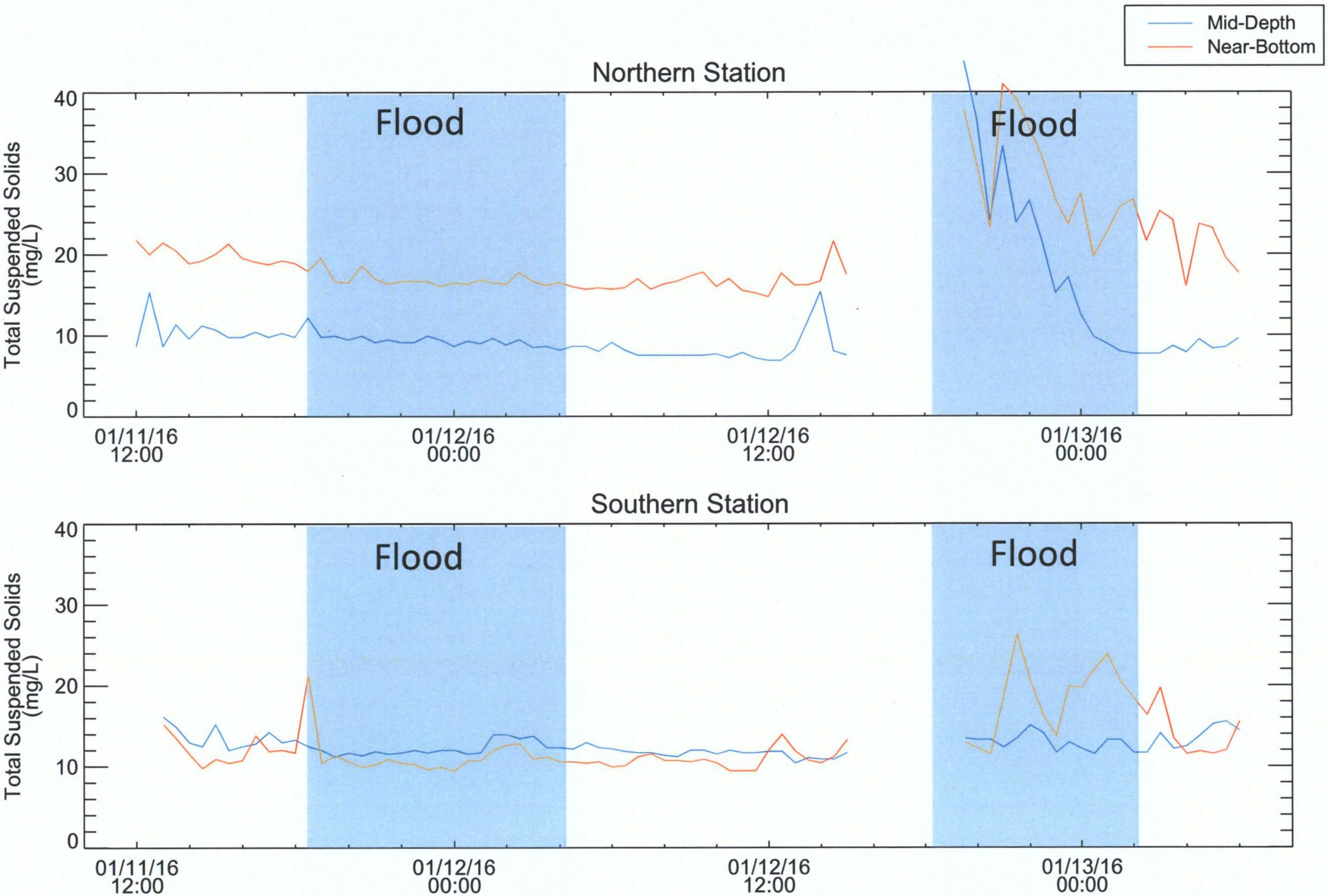


Figure D3-10

Study 7C Water Column Profiling Station Total Suspended Solids

Notes: Assume 1 NTU turbidity = 1.6 mg/L TSS.

HS/CF - \\austin2\D_drive\Projects\Alcoa\Lavaca_Bay\Analysis\ADCP\LB_ADCP_stationary_atan2_20160321.pro
Tue Mar 22 12:45:19 2016

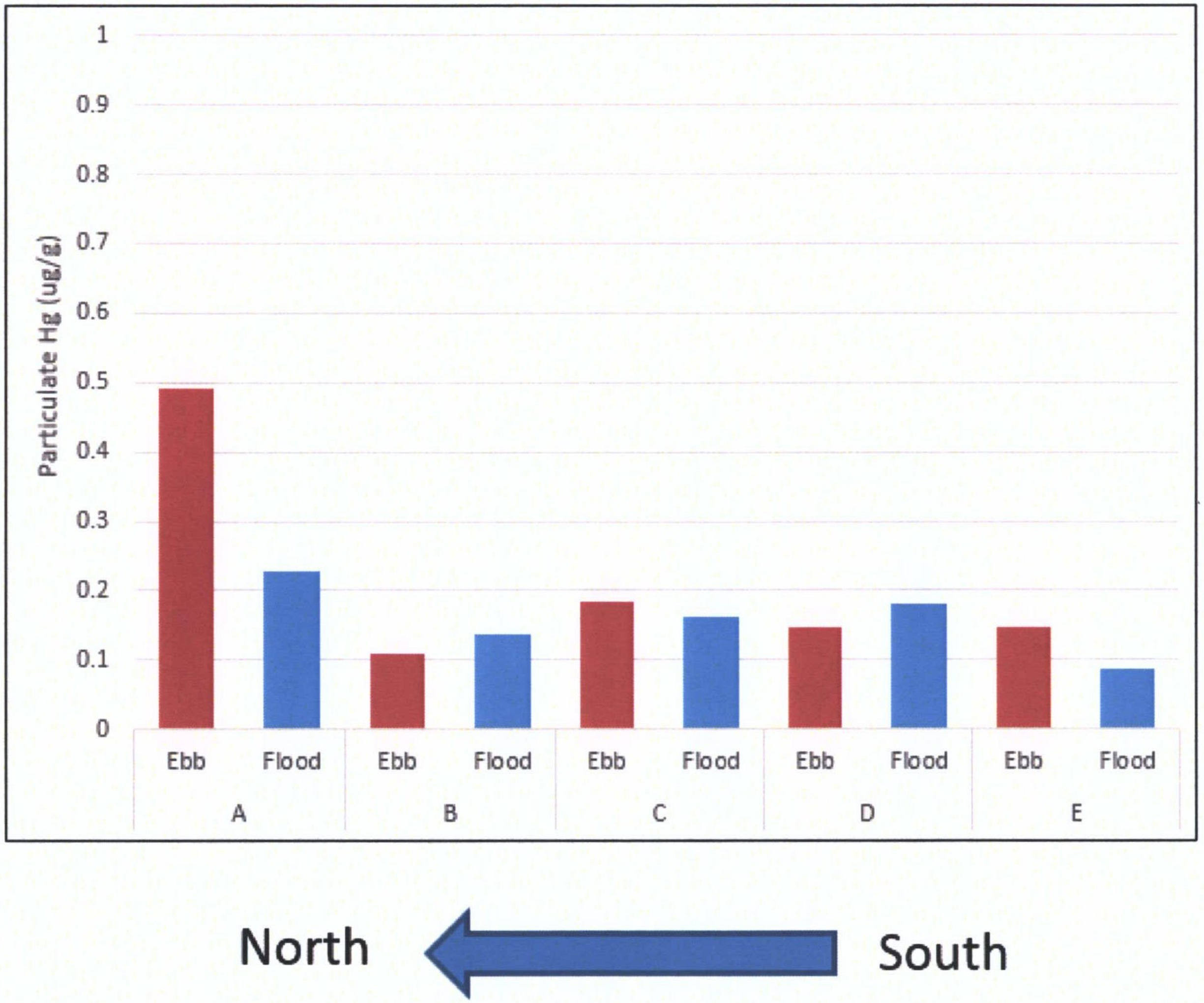


Figure D3-11
Study 7C Water Column Sampling Station Average Particulate Mercury Concentrations
2015 RAAER
Alcoa

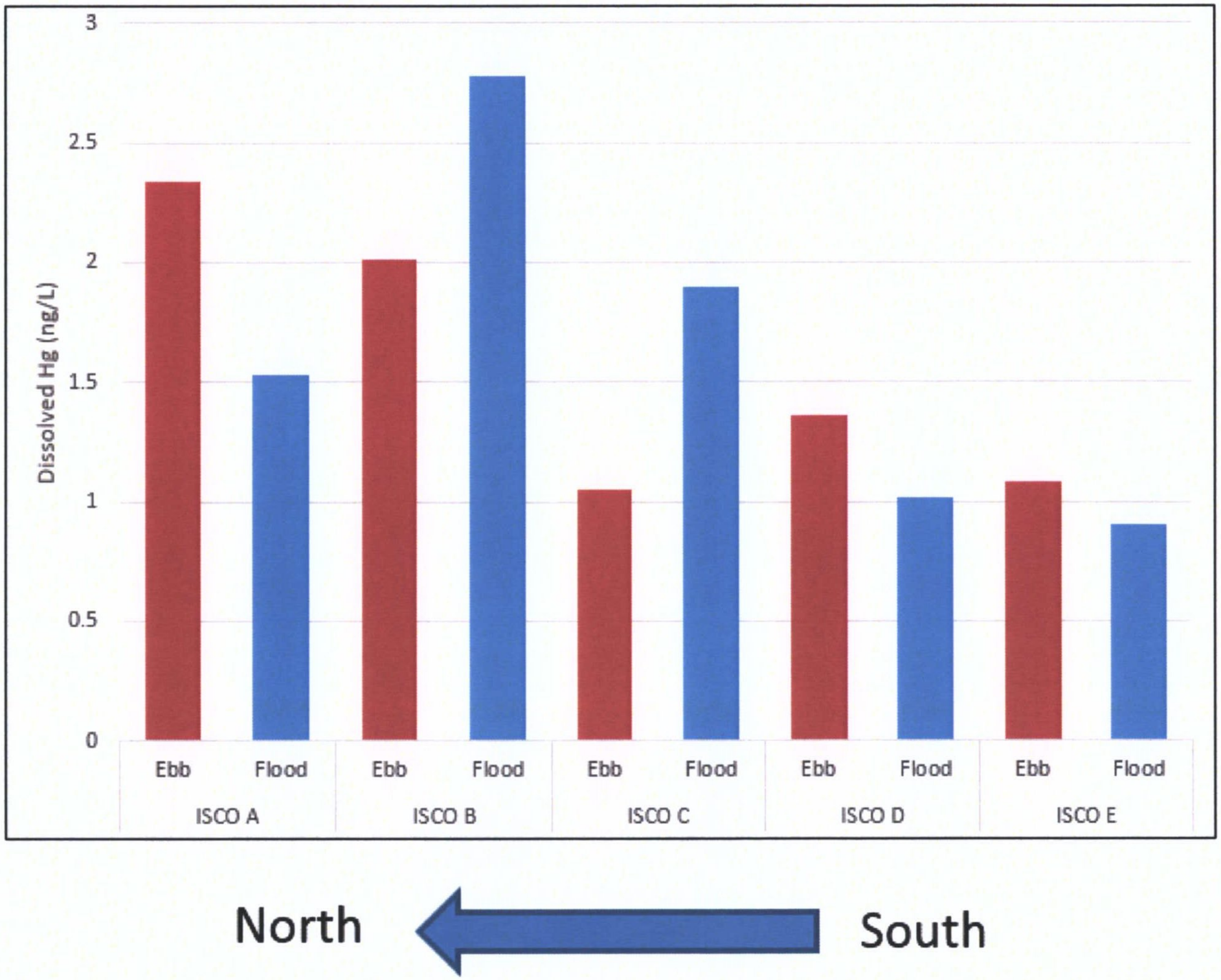


Figure D3-12
Study 7C Water Column Sampling Station Average Dissolved Mercury Concentrations
2015 RAAER
Alcoa

Appendix E

Dredge Island Inspection Records

March 2016

ALCOA

DREDGE ISLAND INSPECTION RECORD

Inspector's Name: Stephen Grahmann	**Date:** 03/29/2015 (1Q15)
Weather: Mostly Cloudy, South Wind at 20 mph	**Time Begin:** 1030
Temperature: 73° F	**Time End:** 1200
SEG accompanied by Benchmark Ecological Services, Inc. during the inspection.	**Inspector's Signature:** Stephen Grahmann

SPECIFIC ITEM TO INSPECT	TYPICAL PROBLEMS ENCOUNTERED	CONDITIONS OBSERVED		COMMENTS OR CORRECTIVE ACTION(S) IMPLEMENTED AND DATES
		NORMAL	ABNORMAL	
General Dredge Island	Erosion Deterioration Settling/Ponding Uplift Washouts Rodent Holes Vegetation	X X X X X X ☐	☐ ☐ ☐ ☐ ☐ ☐ X	Shoreline bank cut observed near the northeast dike toe of the exterior slope. It is associated with the previous dredging event of Marsh 13. Cut does not extend to the dike cross section but future erosion could eventually chase back into the toe of the dike. This should be monitored as part of future inspections. Minor erosion observed on North entry ramp, along the top half of the ramp. All original vehicular signs and some of the reflectors on Island are damaged and/or knocked down. New signs have been placed in a few locations during 2011 maintenance event on the island. Some of these signs have also been knocked down by the strong winds. Slight to moderate vegetation on the road and moderate to heavy vegetation along the sides of the roads, interior dikes, outer dikes, and on toes of the exterior dikes. Hard to inspect some areas of the dikes and ramps thoroughly due to the heavy vegetation. Some rutting of the road and gravel of the exterior dike on the northeast side of the CDF caused by the heavy equipment used during the previous dredging event. Large trees/bushes are forming in the gravel of the inner and outer dikes and in the armor. Action will need to be taken in the future to remove all unwanted vegetation.
Access Bridge	Deterioration Damage Navigation Lights	☐ ☐ ☐	X X X	Conditions similar to previous 4Q14 report. Bridge abutments severely eroded. Hazard signs indicating presence of water hazards appear in good condition. Detailed inspection of the bridge was not performed as part of this site visit.
CDF Dike	Erosion Deterioration Damage Vegetation	☐ X X X	X ☐ ☐ ☐	Minor erosion has been noted on the interior dikes and on the access ramp in several locations. There is very little water inside the CDF, most of which is from recent rain events. Minor erosion observed in areas of the exterior dike side slope where the entry ramp meets the dike. The exterior CDF dike appears to overall be in good condition. The CDF dike appears stable and there is no required action at this time, however, water levels in the CDF should be maintained as low as possible, and erosion rills on the dike's interior and exterior should continue to be monitored during quarterly inspections. The material placed during the previous dredging event appears to be at the same or higher elevation than the dike on the northeast side of the

DREDGE ISLAND INSPECTION RECORD

				CDF. These locations may need to be leveled out so that the material is below the top of the dike to prevent runoff from exiting the CDF interior. Minor to moderate geomembrane exposed along the portions of the interior dike on all sides of the dike. Action in the near future may be necessary. The geomembrane component of the water stop on the CPA dike, near the Alcoa CDF station 23+00, is exposed due to severe erosion of the overlying topsoil. There are also large erosion rills on the exterior of the dike. Erosion in this area currently does not appear to impact the CDF dikes but should continue to be monitored during quarterly inspections. Was unable to view exterior for seepage due to large amounts of vegetation and low tidal conditions. There was no seepage noted from the top of the dike.
Stone Storm Protection	Erosion Settlement Stone Deterioration Stone Movement Fabric Exposure Damage Vegetation	X X X X X X ☐	☐ ☐ ☐ ☐ ☐ ☐ X	No damage observed. Significant vegetation present in areas. The amount of trees/bushes that are pushing through the armor has increased since the last inspection. Action to remove the vegetation will be necessary in the near future. Due to safety concerns associated with walking on the armor stone, this inspection was conducted without traversing the stone on the exterior dike slopes. The exterior dike locations were observed via the dike crest.
Gravel Erosion Protection	Erosion Fabric Exposure Deterioration Damage	☐ ☐ ☐ ☐	X X X X	The inside slope of the north sections of the east and west dikes have been repaired several times since the construction of the CDF due to erosion but geotextile fabric and overlying gravel erosion protection originally constructed on the interior slope was not placed as part of the work. These sections are currently showing minor to moderate erosion. Most of the remaining sections of the dikes' inside slope exhibit minor to moderate erosion and loss of gravel protection. No immediate action is required at these locations but they should continue to be monitored. Lack of geotextile and overlying gravel erosion protection on the slope interiors does not appear to be problematic as long as the water levels are kept low to prevent severe interior erosion.
Emergency Spillway	Obstructions Cracks in Concrete Deterioration Damage	X X X X	☐ ☐ ☐ ☐	Generally good condition. Slight erosion and some cracks in the concrete. Slight erosion has occurred along the outer and inner edge of the spillway. Some localized concrete deterioration observed.

DREDGE ISLAND INSPECTION RECORD

Decant Structures	Weir Board Elevation Depth of Water Obstructions Deterioration Rust/Corrosion Damage Overflow Quality (NA) Overflow Quantity Flap Gate	X X X □ □ X □ X X	□ □ □ X X □ □ □ □	As of January 2012, the North Structure will be placed under restricted access until a thorough structural and safety inspection of this structure can be performed by a qualified structural engineer. All inspections will be completed visually from the catwalk of the structure. This recommendation was made due to the severe visual corrosion of the structural I-beam sections. North Structure: Coated surfaces on structure exhibiting moderate to severe rusting and pitting on handrails. Channel iron also exhibits moderate to severe corrosion. Severe corrosion of the structural I-beam sections was observed. The majority of the structural I-beams are not visible without removal of the grates and access of the structure interior. Therefore, the interior I-beam was not observed during this inspection. Plastic around the top of structure is in good condition. There is no discharge observed coming from the North Decant Structure. The area around the structure is dry. South Structure: Several stop logs were removed to allow water to decant during the previous dredging event and have not been replaced. Minor rust observed on handrails and channel iron. A section of angle iron used to guide the stop logs in the slots has broken loose from the welds and show severe corrosion. The plastic around the top of the structure appears to be in good condition. There is no discharge observed coming from the South Decant Structure.
Gravel Road	Potholes Ponding Deterioration Washouts Vegetation	X X X X □	□ □ □ □ X	Generally in good condition. Some rutting at several locations. Moderate rutting on north east side of CDF due to the heavy equipment used during the previous dredging event. Some minor to moderate vegetation present on road. There is some slight erosion on the sides of portions of the road. There are several areas of thin gravel and geomembrane exposure. Action will need to be taken to remove the vegetation from the roadways in the near future.
Water Stops	Erosion Membrane Exposed Deterioration Damage	□ □ X X	X X □ □	Severe erosion, fines accumulation, and geomembrane exposed at water stop on the inside CPA dike as previously reported. Moderate erosion on the exterior of the East CPA Dike. Severe erosion on the exterior of the West CPA Dike. Continue to monitor.
Reflectors Station Tags	Intact/Reflecting Intact/Legibility	X X	□ □	Some reflectors and traffic signage observed to be leaning or entirely down on the ground. If the island is to be used for vehicular traffic in the future, a more detailed review of the reflectors and traffic signage should be completed.

FIRST QUARTER 2015
DREDGE ISLAND INSPECTION PHOTO LOG

ALCOA PCO – Point Comfort, Texas

1 – Viewing east side of the North Ramp

2 – North Ramp, viewing north toward bridge

3 – Top of North Ramp, viewing east

4 – North Inner Dike, viewing erosion damage

5 – Northeast Corner Outer Dike, viewing moderate exposure of the geomembrane

6 – Northeast Corner Outer Dike, viewing west

FIRST QUARTER 2015
DREDGE ISLAND INSPECTION PHOTO LOG

ALCOA PCO – Point Comfort, Texas


7 – Northeast Corner Inner Dike, viewing west


8 –East Inner Dike, viewing south


9 – East Outer Dike, viewing north


10 – North Outfall


11 – North Decant Structure


12 –Intrusive trees and vegetation in exterior gravel protection

FIRST QUARTER 2015
DREDGE ISLAND INSPECTION PHOTO LOG

ALCOA PCO – Point Comfort, Texas

13 – Southeast Inner Dike, viewing southwest

14 – Southeast Inner Dike, viewing water level inside CDF

15 – Southeast Corner Outer Dike, viewing north

16 – Southeast Corner Inner Dike, viewing north

17 – Southeast Corner Inner Dike, viewing west

18 – Southeast Corner Outer Dike, viewing west

FIRST QUARTER 2015
DREDGE ISLAND INSPECTION PHOTO LOG

ALCOA PCO – Point Comfort, Texas

19 – South Dike, viewing exposed geomembrane

20 – Southwest Corner Inner Dike, viewing north

21 – Southwest Corner Outer Dike, viewing north

22 – South Outfall

23 – South Decant Structure

24 – South Decant Structure, viewing water level in the CDF

25 – Northwest Outer Dike, viewing south

26 – Northwest Corner Inner Dike, viewing south

27 – Northwest Corner of Inner Dike, viewing water level in CDF

28 – Northwest Corner Outer Dike, viewing west

29 – Northwest Corner Inner Dike, viewing east

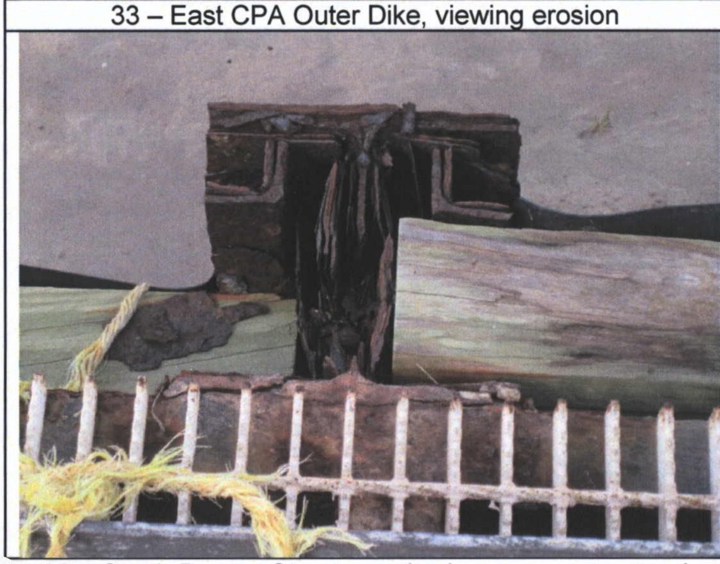
30 – Emergency Spillway, viewing minor deterioration of the concrete

31 – Emergency Spillway, viewing minor washout along edge

32 – West Dike, viewing vegetation in roadway

33 – East CPA Outer Dike, viewing erosion

34 – North Decant Structure, viewing inside structure



36 – South Decant Structure, viewing rust on structural members

37 – Viewing sign that was knocked down due to strong winds

DREDGE ISLAND INSPECTION RECORD

Inspector's Name: Kevin Dworsky	Date: 06/24/2015 (2Q15)
Weather: Partly Cloudy, East Wind at 5 mph	Time Begin: 0900
Temperature: 82° F	Time End: 1100
KBD accompanied by Benchmark Ecological Services, Inc. during the inspection.	Inspector's Signature:

SPECIFIC ITEM TO INSPECT	TYPICAL PROBLEMS ENCOUNTERED	CONDITIONS OBSERVED		COMMENTS OR CORRECTIVE ACTION(S) IMPLEMENTED AND DATES
		NORMAL	ABNORMAL	
General Dredge Island	Erosion Deterioration Settling/Ponding Uplift Washouts Rodent Holes Vegetation	X X X X X X ☐	☐ ☐ ☐ ☐ ☐ ☐ X	Shoreline bank cut observed near the northeast dike toe of the exterior slope. It is associated with the previous dredging event of Marsh 13. Cut does not extend to the dike cross section but future erosion could eventually chase back into the toe of the dike. This should be monitored as part of future inspections. All original vehicular signs and some of the reflectors on Island are damaged and/or knocked down. New signs have been placed in a few locations during 2011 maintenance event on the island. Some of these signs have also been knocked down by the strong winds. Moderate vegetation on the road and moderate to heavy vegetation along the sides of the roads, interior dikes, outer dikes, and on toes of the exterior dikes. Hard to inspect some areas of the dikes and ramps thoroughly due to the heavy vegetation. Some rutting of the road and gravel of the exterior dike on the northeast side of the CDF caused by the heavy equipment used during the previous dredging event. Large trees/bushes are forming in the gravel of the inner and outer dikes and in the armor. Vegetative control measures are scheduled for later in the year.
Access Bridge	Deterioration Damage Navigation Lights	☐ ☐ ☐	X X X	Conditions similar to previous 1Q15 report. Bridge abutments severely eroded. Hazard signs indicating presence of water hazards appear in good condition. Detailed inspection of the bridge was not performed as part of this site visit.
CDF Dike	Erosion Deterioration Damage Vegetation	☐ X X X	X ☐ ☐ ☐	Minor erosion has been noted on the interior dikes and on the access ramp in several locations. There is water inside the CDF, most of which is from recent rain events. Minor erosion observed in areas of the exterior dike side slope where the entry ramp meets the dike. The exterior CDF dike appears to overall be in good condition. The CDF dike appears stable and there is no required action at this time, however, water levels in the CDF should be maintained as low as possible, and erosion rills on the dike's interior and exterior should continue to be monitored during quarterly inspections. The material placed during the previous dredging event appears to be at the same or higher elevation than the dike on the northeast side of the CDF. These locations may need to be leveled out so that the material is below the top of the dike to prevent runoff from exiting the CDF interior.

DREDGE ISLAND INSPECTION RECORD

				Minor to moderate geomembrane exposed along the portions of the interior dike on all sides of the dike. Action in the near future may be necessary. The geomembrane component of the water stop on the CPA dike, near the Alcoa CDF station 23+00, is exposed due to severe erosion of the overlying topsoil. There are also large erosion rills on the exterior of the dike. Erosion in this area currently does not appear to impact the CDF dikes but should continue to be monitored during quarterly inspections. Was unable to view exterior for seepage due to large amounts of vegetation and low tidal conditions. There was no seepage noted from the top of the dike.
Stone Storm Protection	Erosion Settlement Stone Deterioration Stone Movement Fabric Exposure Damage Vegetation	X X X X X X ☐	☐ ☐ ☐ ☐ ☐ ☐ X	No damage observed. Significant vegetation present in areas. The amount of trees/bushes that are pushing through the armor has increased since the last inspection. Due to safety concerns associated with walking on the armor stone, this inspection was conducted without traversing the stone on the exterior dike slopes. The exterior dike locations were observed via the dike crest.
Gravel Erosion Protection	Erosion Fabric Exposure Deterioration Damage	☐ ☐ ☐ ☐	X X X X	The inside slope of the north sections of the east and west dikes have been repaired several times since the construction of the CDF due to erosion but geotextile fabric and overlying gravel erosion protection originally constructed on the interior slope was not placed as part of the work. These sections are currently showing minor to moderate erosion. Most of the remaining sections of the dikes' inside slope exhibit minor to moderate erosion and loss of gravel protection. No immediate action is required at these locations but they should continue to be monitored. Lack of geotextile and overlying gravel erosion protection on the slope interiors does not appear to be problematic as long as the water levels are kept low to prevent severe interior erosion.
Emergency Spillway	Obstructions Cracks in Concrete Deterioration Damage	X X X X	☐ ☐ ☐ ☐	Generally good condition. Slight erosion and some cracks in the concrete. Slight erosion has occurred along the outer and inner edge of the spillway. Some localized concrete deterioration observed.
Decant Structures	Weir Board Elevation Depth of Water Obstructions Deterioration Rust/Corrosion Damage Overflow Quality (NA) Overflow Quantity Flap Gate	X X X ☐ ☐ X ☐ X X	☐ ☐ ☐ X X ☐ ☐ ☐ ☐	As of January 2012, the North Structure will be placed under restricted access until a thorough structural and safety inspection of this structure can be performed by a qualified structural engineer. All inspections will be completed visually from the catwalk of the structure. This recommendation was made due to the severe visual corrosion of the structural I-beam sections. North Structure: Coated surfaces on structure exhibiting moderate to severe rusting and pitting on handrails. Channel iron also exhibits moderate to

DREDGE ISLAND INSPECTION RECORD

				severe corrosion. Severe corrosion of the structural I-beam sections was observed. The majority of the structural I-beams are not visible without removal of the grates and access of the structure interior. Therefore, the interior I-beam was not observed during this inspection. Plastic around the top of structure is in good condition. There is no discharge observed coming from the North Decant Structure. South Structure: Several stop logs were removed to allow water to decant during the previous dredging event and have not been replaced. Minor rust observed on handrails and channel iron. A section of angle iron used to guide the stop logs in the slots has broken loose from the welds and show severe corrosion. The plastic around the top of the structure appears to be in good condition. Water is around the structure (5.80' below the top of the grate to the top of the water). Inside the structure, the water level is 17.65' below the top of the grate. The total depth of the decant structure is 18.08'. There is no discharge observed coming from the South Decant Structure outfall. It was noted that there was water going into the structure from inside the CDF.
Gravel Road	Potholes Ponding Deterioration Washouts Vegetation	X X X X ☐	☐ ☐ ☐ ☐ X	Generally in good condition. Some rutting at several locations. Moderate rutting on north east side of CDF due to the heavy equipment used during the previous dredging event. Some minor to moderate vegetation present on road. There is some slight erosion on the sides of portions of the road. There are several areas of thin gravel and geomembrane exposure.
Water Stops	Erosion Membrane Exposed Deterioration Damage	☐ ☐ X X	X X ☐ ☐	Severe erosion, fines accumulation, and geomembrane exposed at water stop on the inside CPA dike as previously reported. Moderate erosion on the exterior of the East CPA Dike. Severe erosion on the exterior of the West CPA Dike. Continue to monitor.
Reflectors Station Tags	Intact/Reflecting Intact/Legibility	X X	☐ ☐	Some reflectors and traffic signage observed to be leaning or entirely down on the ground. If the island is to be used for vehicular traffic in the future, a more detailed review of the reflectors and traffic signage should be completed.

SECOND QUARTER 2015
DREDGE ISLAND INSPECTION PHOTO LOG

ALCOA PCO – Point Comfort, Texas

1 – Viewing east side of the North Ramp

2 – Viewing west side of the North Ramp

3 – North Ramp, viewing washout

4 – North Inner Dike, viewing erosion damage

5 – Northeast Corner Outer Dike, viewing moderate exposure of the geomembrane

6 – Northeast Corner Outer Dike, viewing west

SECOND QUARTER 2015
DREDGE ISLAND INSPECTION PHOTO LOG

ALCOA PCO – Point Comfort, Texas


7 – Northeast Corner Inner Dike, viewing west


8 – Northeast Corner Inner Dike, viewing south


9 – East Outer Dike, viewing north


10 – North Outfall


11 – North Decant Structure


12 –Intrusive trees and vegetation in exterior gravel protection

SECOND QUARTER 2015
DREDGE ISLAND INSPECTION PHOTO LOG

ALCOA PCO – Point Comfort, Texas

13 – Southeast Inner Dike, viewing southwest

14 – Southeast Outer Dike, historic seepage area

15 – Southeast Corner Outer Dike, viewing north

16 – Southeast Corner Inner Dike, viewing north

17 – Southeast Corner Inner Dike, viewing west

18 – Southeast Corner Outer Dike, viewing west

19 – South Dike, viewing exposed geomembrane

20 – Southwest Corner Inner Dike, viewing north

21 – Southwest Corner Outer Dike, viewing north

22 – South Outfall

23 – South Decant Structure

24 – South Decant Structure, viewing water level inside the structure

25 – Northwest Corner Outer Dike, viewing south

26 – Northwest Corner Inner Dike, viewing south

27 – Northwest Corner of Inner Dike, viewing water level in CDF

28 – Northwest Corner Outer Dike, viewing east

29 – Northwest Corner Inner Dike, viewing east

30 – Emergency Spillway, viewing minor deterioration of the concrete


31 – Emergency Spillway, viewing minor washout along edge


32 – East CPA Inner Dike, viewing erosion and exposure of liner


33 – East CPA Outer Dike, viewing erosion


34 – Viewing damaged bridge to island


36 – View erosions at toe of bridge


37 – Viewing sign that was knocked down due to strong winds

DREDGE ISLAND INSPECTION RECORD

Inspector's Name: Stephen Grahmann	Date: 09/23/2015 (3Q15)
Weather: Mostly Clear, North Wind at 5 mph	Time Begin: 0900
Temperature: 71° F	Time End: 1100
SEG accompanied by Benchmark Ecological Services, Inc. during the inspection.	Inspector's Signature: *(signature)*

SPECIFIC ITEM TO INSPECT	TYPICAL PROBLEMS ENCOUNTERED	CONDITIONS OBSERVED		COMMENTS OR CORRECTIVE ACTION(S) IMPLEMENTED AND DATES
		NORMAL	ABNORMAL	
General Dredge Island	Erosion	X	☐	Shoreline bank cut observed near the northeast dike toe of the exterior slope. It is associated with the previous dredging event of Marsh 13. Cut does not extend to the dike cross section but future erosion could eventually chase back into the toe of the dike. This should be monitored as part of future inspections. All original vehicular signs and some of the reflectors on Island are damaged and/or knocked down. New signs have been placed in a few locations during 2011 maintenance event on the island. Some of these signs have also been knocked down by the strong winds. Slight to moderate vegetation on the road and moderate to heavy vegetation along the sides of the roads, interior dikes, outer dikes, and on toes of the exterior dikes. Hard to inspect some areas of the dikes and ramps thoroughly due to the heavy vegetation. Some rutting of the road and gravel of the exterior dike on the northeast side of the CDF caused by the heavy equipment used during the previous dredging event. Large trees/bushes are forming in the gravel of the inner and outer dikes and in the armor.
	Deterioration	X	☐	
	Settling/Ponding	X	☐	
	Uplift	X	☐	
	Washouts	X	☐	
	Rodent Holes	X	☐	
	Vegetation	☐	X	
Access Bridge	Deterioration	☐	X	Conditions similar to previous 2Q15 report. Bridge abutments severely eroded. Hazard signs indicating presence of water hazards appear in good condition. Detailed inspection of the bridge was not performed as part of this site visit.
	Damage	☐	X	
	Navigation Lights	☐	X	
CDF Dike	Erosion	☐	X	Minor erosion has been noted on the interior dikes and on the access ramp in several locations. There is water inside the CDF, most of which is from recent rain events. Minor erosion observed in areas of the exterior dike side slope where the entry ramp meets the dike. The exterior CDF dike appears to overall be in good condition. The CDF dike appears stable and there is no required action at this time, however, water levels in the CDF should be maintained as low as possible, and erosion rills on the dike's interior and exterior should continue to be monitored during quarterly inspections. The material placed during the previous dredging event appears to be at the same or higher elevation than the dike on the northeast side of the CDF. These locations may need to be leveled out so that the material is below the top of the dike to prevent runoff from exiting the CDF interior.
	Deterioration	X	☐	
	Damage	X	☐	
	Vegetation	X	☐	

DREDGE ISLAND INSPECTION RECORD

				Minor to moderate geomembrane exposed along the portions of the interior dike on all sides of the dike. Action in the near future may be necessary. The geomembrane component of the water stop on the CPA dike, near the Alcoa CDF station 23+00, is exposed due to severe erosion of the overlying topsoil. There are also large erosion rills on the exterior of the dike. Erosion in this area currently does not appear to impact the CDF dikes but should continue to be monitored during quarterly inspections. Was unable to view exterior for seepage due to large amounts of vegetation and low tidal conditions. There was no seepage noted from the top of the dike.
Stone Storm Protection	Erosion Settlement Stone Deterioration Stone Movement Fabric Exposure Damage Vegetation	X X X X X X ☐	☐ ☐ ☐ ☐ ☐ ☐ X	No damage observed. Significant vegetation present in areas. The amount of trees/bushes that are pushing through the armor has increased since the last inspection. Due to safety concerns associated with walking on the armor stone, this inspection was conducted without traversing the stone on the exterior dike slopes. The exterior dike locations were observed via the dike crest.
Gravel Erosion Protection	Erosion Fabric Exposure Deterioration Damage	☐ ☐ ☐ ☐	X X X X	The inside slope of the north sections of the east and west dikes have been repaired several times since the construction of the CDF due to erosion but geotextile fabric and overlying gravel erosion protection originally constructed on the interior slope was not placed as part of the work. These sections are currently showing minor to moderate erosion. Most of the remaining sections of the dikes' inside slope exhibit minor to moderate erosion and loss of gravel protection. No immediate action is required at these locations but they should continue to be monitored. Lack of geotextile and overlying gravel erosion protection on the slope interiors does not appear to be problematic as long as the water levels are kept low to prevent severe interior erosion.
Emergency Spillway	Obstructions Cracks in Concrete Deterioration Damage	X X X X	☐ ☐ ☐ ☐	Generally good condition. Slight erosion and some cracks in the concrete. Slight erosion has occurred along the outer and inner edge of the spillway. Some localized concrete deterioration observed.
Decant Structures	Weir Board Elevation Depth of Water Obstructions Deterioration Rust/Corrosion Damage Overflow Quality (NA) Overflow Quantity Flap Gate	X X X ☐ ☐ X ☐ X X	☐ ☐ ☐ X X ☐ ☐ ☐ ☐	As of January 2012, the North Structure will be placed under restricted access until a thorough structural and safety inspection of this structure can be performed by a qualified structural engineer. All inspections will be completed visually from the catwalk of the structure. This recommendation was made due to the severe visual corrosion of the structural I-beam sections. North Structure: Coated surfaces on structure exhibiting moderate to severe rusting and pitting on handrails. Channel iron also exhibits moderate to severe corrosion. Severe corrosion of the

DREDGE ISLAND INSPECTION RECORD

				structural I-beam sections was observed. The majority of the structural I-beams are not visible without removal of the grates and access of the structure interior. Therefore, the interior I-beam was not observed during this inspection. Plastic around the top of structure is in good condition. There is no discharge observed coming from the North Decant Structure. The area around the structure is dry. South Structure: Several stop logs were removed to allow water to decant during the previous dredging event and have not been replaced. Minor rust observed on handrails and channel iron. A section of angle iron used to guide the stop logs in the slots has broken loose from the welds and show severe corrosion. The plastic around the top of the structure appears to be in good condition. There is no discharge observed coming from the South Decant Structure.
Gravel Road	Potholes Ponding Deterioration Washouts Vegetation	X X X X ☐	☐ ☐ ☐ ☐ X	Generally in good condition. Some rutting at several locations. Moderate rutting on north east side of CDF due to the heavy equipment used during the previous dredging event. Some minor to moderate vegetation present on road. There is some slight erosion on the sides of portions of the road. There are several areas of thin gravel and geomembrane exposure. Action will need to be taken to remove the vegetation from the roadways in the near future.
Water Stops	Erosion Membrane Exposed Deterioration Damage	☐ ☐ X X	X X ☐ ☐	Severe erosion, fines accumulation, and geomembrane exposed at water stop on the inside CPA dike as previously reported. Moderate erosion on the exterior of the East CPA Dike. Severe erosion on the exterior of the West CPA Dike. Continue to monitor.
Reflectors Station Tags	Intact/Reflecting Intact/Legibility	X X	☐ ☐	Some reflectors and traffic signage observed to be leaning or entirely down on the ground. If the island is to be used for vehicular traffic in the future, a more detailed review of the reflectors and traffic signage should be completed.

THIRD QUARTER 2015
DREDGE ISLAND INSPECTION PHOTO LOG

ALCOA PCO – Point Comfort, Texas

1 – Viewing east side of the North Ramp

2 – Viewing west side of the North Ramp

3 – North Ramp, viewing washout

4 – North Inner Dike, viewing recent dredge placement

5 – Northeast Corner Outer Dike, viewing moderate exposure of the geomembrane

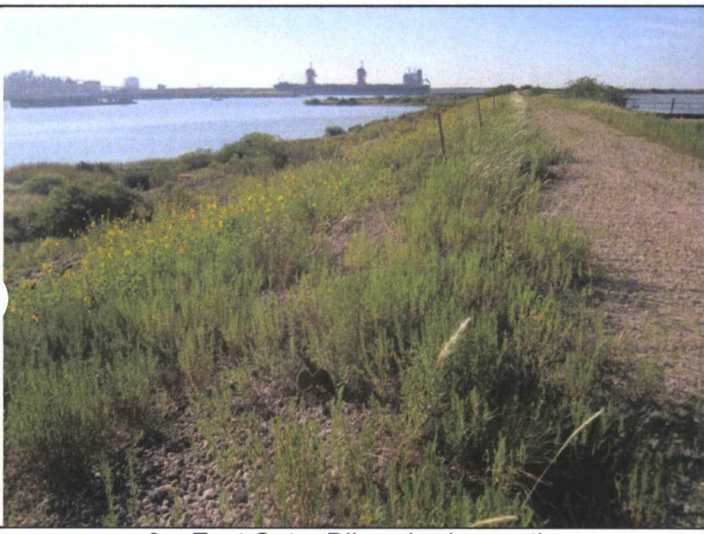
6 – Northeast Corner Outer Dike, viewing west

THIRD QUARTER 2015
DREDGE ISLAND INSPECTION PHOTO LOG

ALCOA PCO – Point Comfort, Texas

7 – Northeast Corner Inner Dike, viewing west

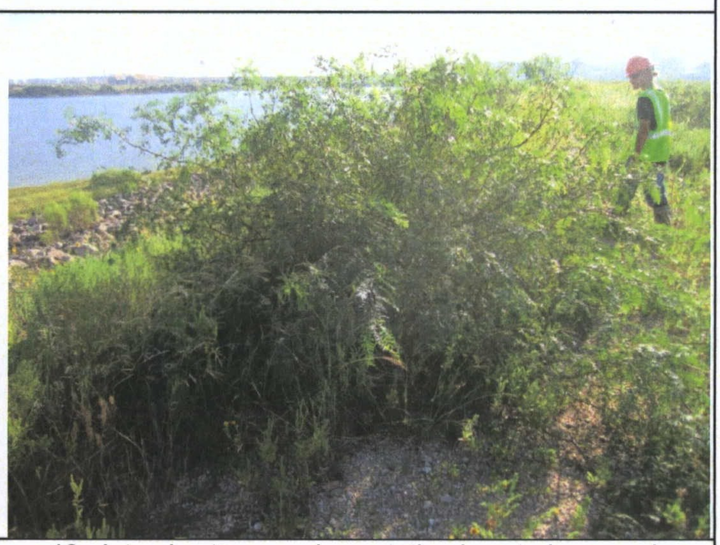
8 – Northeast Corner Inner Dike, viewing south



9 – East Outer Dike, viewing north

10 – North Outfall

11 – North Decant Structure



12 –Intrusive trees and vegetation in exterior gravel protection

THIRD QUARTER 2015
DREDGE ISLAND INSPECTION PHOTO LOG

ALCOA PCO – Point Comfort, Texas

13 – Southeast Inner Dike, viewing southwest

14 – Southeast Outer Dike, historic seepage area

15 – Southeast Corner Outer Dike, viewing north

16 – Southeast Corner Inner Dike, viewing north

17 – Southeast Corner Inner Dike, viewing west

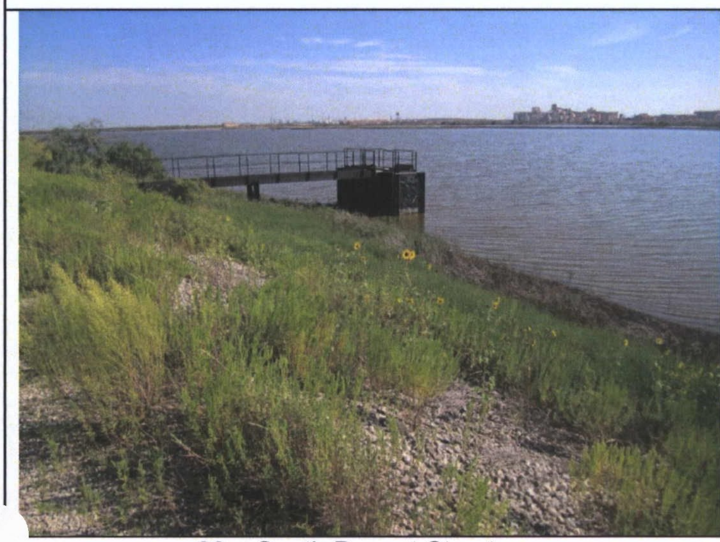
18 – Southeast Corner Outer Dike, viewing west

19 – South Dike, viewing exposed geomembrane

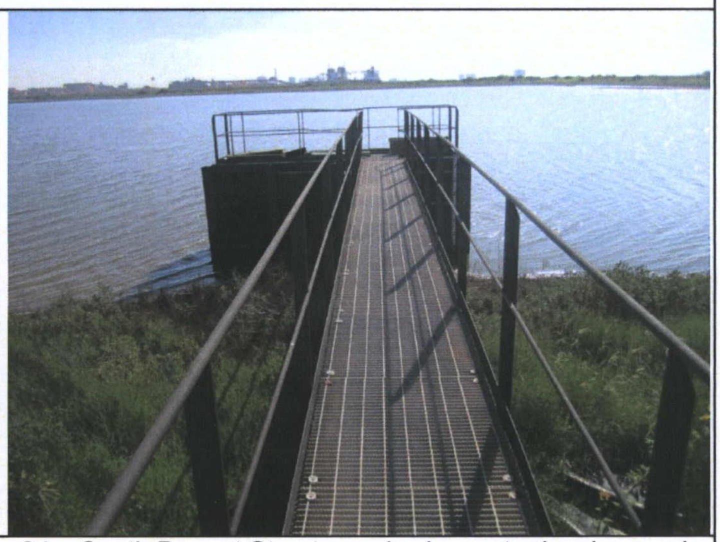
20 – Southwest Corner Inner Dike, viewing north

21 – Southwest Corner Outer Dike, viewing north

22 – South Outfall



23 – South Decant Structure



24 – South Decant Structure, viewing water level around the structure

25 – West Dike, viewing north

26 – Northwest Corner Inner Dike, viewing south

27 – Northwest Corner of Inner Dike, viewing water level in CDF

28 – Northwest Corner Outer Dike, viewing east

29 – Northwest Corner Inner Dike, viewing east

30 – Emergency Spillway, viewing minor deterioration of the concrete

THIRD QUARTER 2015
DREDGE ISLAND INSPECTION PHOTO LOG

ALCOA PCO – Point Comfort, Texas

31 – Emergency Spillway, viewing minor washout along edge

32 – East CPA Inner Dike, viewing erosion and exposure of liner

33 – East CPA Outer Dike, viewing erosion

34 – Viewing vegetation in the middle of the road

36 – View North Decant Structure deterioration

37 – Viewing sign that was knocked down due to strong winds

SITE INSPECTION LOG

Inspector's Name: Dan Bullock, P.E. (BBA, LLC)
Weather: Clear
Temperature: Approx. 60-65 F

Daniel B. Bullock

2/3/16
Rev1

STATE OF TEXAS
DANIEL B. BULLOCK
82596
REGISTERED
PROFESSIONAL ENGINEER

Inspector's Signature:
Daniel B. Bullock

Inspection Date: 12-17-15
Time Begin: Approx. 9:40 a.m.
Time End: Approx. 12:20 p.m.

Sheet: 1 of 2

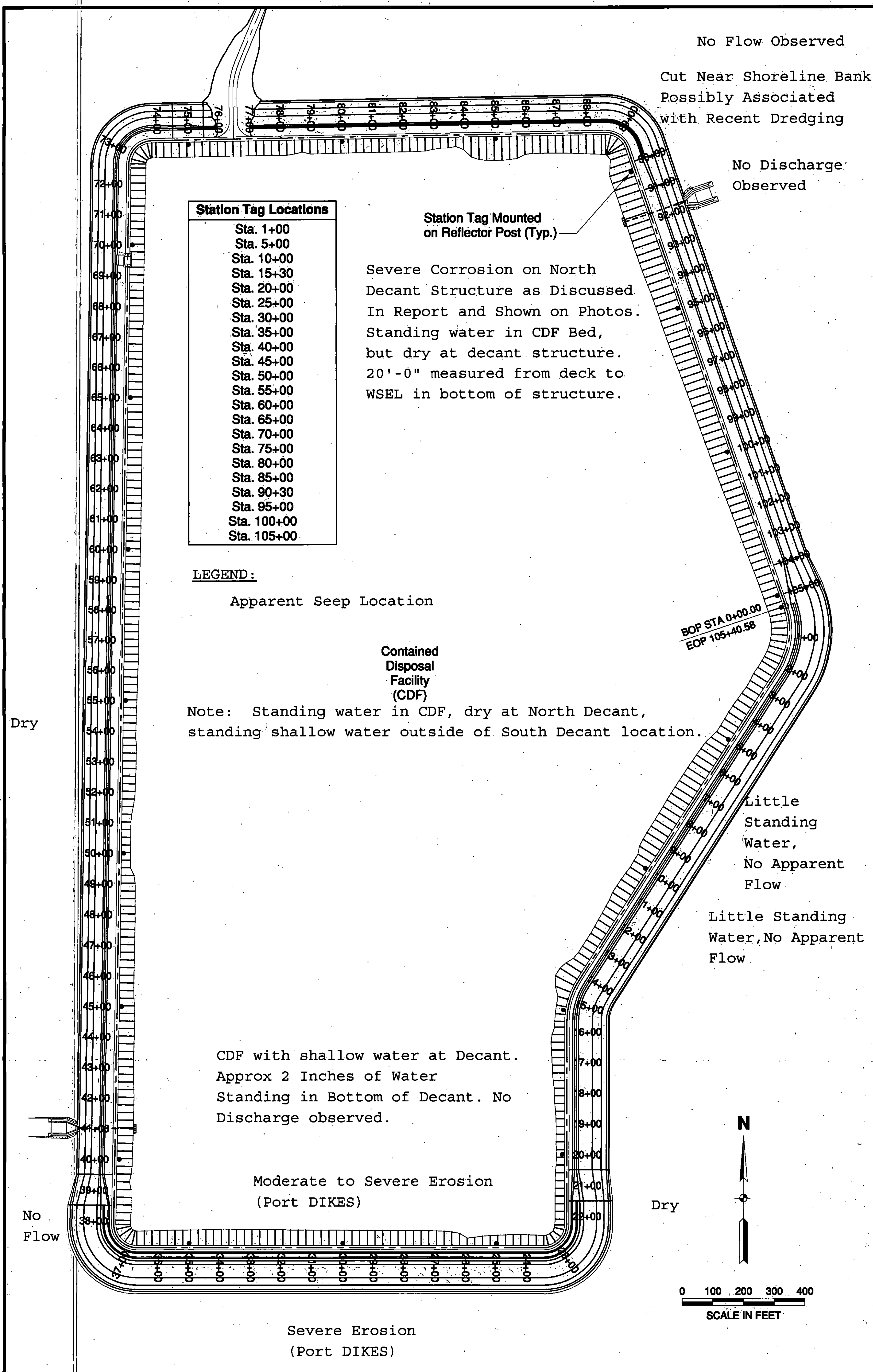
Specific Item to Inspect	Typical Problems Encountered	Conditions Observed		Comments or Corrective Action(s) Implemented and Dates
		Normal	Abnormal	
General Dredge Island	Erosion Deterioration Settling/Ponding Uplift Washouts Rodent Holes	☒ ☒ ☒ ☒ ☒ ☒	☐ ☐ ☐ ☐ ☐ ☐	Shoreline bank cut observed (as was last year) near northeast dike toe of exterior slope. Appears possibly associated with recent dredging. Cut does not extend to dike cross section but future erosion could eventually chase back into toe of dike. Monitor as part of future inspections. Minor erosion observed on North entry ramp, along edges of ramp crest. Vehicle traffic signs and reflectors need replacement/repair if island to be used for vehicular traffic – which is currently not the case.
Access Bridge	Deterioration Damage Navigation Lights	☐ ☐ ☐	☒ ☒ ☒	Conditions similar to those observed and reported in 12/19/06 inspection report (bridge substantially damaged/removed). Detailed inspection of bridge not performed as part of this site visit. Bridge abutments severely eroded.
CDF Dike	Erosion Deterioration Damage Vegetation	☒ ☒ ☒ ☒	☐ ☐ ☐ ☐	The geomembrane component of the water stop on the Port dike, near the Alcoa CDF Station 23+00 (east side) and Station 37+00 (west side), is exposed due to severe erosion of the overlying topsoil cover material (see attached photos) as noted in previous inspections. Some small (approx. 1 inch dia.) holes observed in exposed geomembrane. Erosion in these areas currently does not appear to impact the CDF dikes but should continue to be monitored during quarterly inspections. CDF dikes appear in generally good condition, with vegetation recently removed.
Stone Storm Protection	Erosion Settlement Stone Deterioration Stone Movement Fabric Exposure Damage	☒ ☒ ☒ ☒ ☒ ☒	☐ ☐ ☐ ☐ ☐ ☐	No damage observed. Vegetation recently removed – should continue to implement weed control program and periodic visual monitoring.
Gravel Erosion Protection	Erosion Fabric Exposure Deterioration Damage	☐ ☐ ☐ ☐	☒ ☒ ☒ ☒	The inside slopes of north dike, and north section of west and east dikes, have been repaired a couple of times since CDF construction (due to erosion issues) but geotextile fabric and overlying gravel erosion protection originally constructed on the interior slopes were not replaced as part of the repair work. Most of the remaining sections (generally along the south) of dike inside slope areas exhibit minor erosion and loss of gravel protection, no immediate action is required at these locations but they should continue to be monitored. Lack of geotextile and overlying gravel erosion protection on slope interiors does not appear to be problematic as long as water levels are kept low to prevent interior erosion.
Emergency Spillway	Obstructions Cracks in Concrete Deterioration Damage	☒ ☒ ☒ ☒	☐ ☐ ☐ ☐	Generally good condition. Some localized, minor, surficial concrete deterioration observed. Minor erosion, likely from localized rainfall runoff (not discharge) from concrete structure observed at upstream and downstream inverts of structure.

Decant Structures	Weir Board Elevation Depth of Water Obstructions Deterioration Rust/Corrosion Damage Overflow Quality (NA) Overflow Quantity Flap Gate	☒ ☒ ☒ ☐ ☐ ☒ ☐ ☒ ☒	☐ ☐ ☐ ☒ ☒ ☐ ☐ ☐ ☐	North Structure: Severe corrosion of structural steel was observed during this limited visual inspection. The majority of steel was not visible; however, the sample port (roughly 1 ft x 1 ft) section of the surface grate was removed to provide limited observation of the structure interior. Based on limited observation, the upper several feet of structural steel appeared to be in worse condition than steel at greater depths below the surface grate. Based on site observations of surface and near surface steel (see attached photos) it is recommended that personnel access to this structure (beyond access walkway), and use of the structure for operational purposes, be restricted until a thorough structural and safety inspection of this structure can be completed by a qualified structural engineer. Handrails and channel iron slots containing the stoplogs on the structure exhibit severe corrosion, per attached photos. CDF surface at decant was dry during inspection, with no on-going discharge. From deck to water surface inside structure measured 20'-0". Plastic wrap around the structure was in place. South Structure: Generally minor to moderate rust observed on south decant structure hand rails and channel iron slots containing the stoplogs, with a few isolated areas of severe corrosion. Conditions appear to have worsened since last annual inspection. Adjustment of stoplogs likely difficult in areas due to corrosion of structure and broken welds (see attached photos). The majority of structural steel was not visible; however, the sample port (roughly 1 ft x 1 ft) section of the surface grate was removed to provide limited observation of the structure interior. Based on limited observation, the upper several feet of structural steel appeared to be in worse condition (exhibiting moderate corrosion) than steel at greater depths below the surface grate. Outside decant structure was shallow water (see photos). Inside decant structure contained approximately 2 inches of standing water in the bottom. No discharge operations observed at south structure location. Plastic wrap around structure in place. *Note: Terms used for this inspection to describe corrosion observations may include "mild or minor", "moderate" or "severe" – and are not based on steel inspection standards but simply offered to provide reader relative scale of limited visual observations made during this site inspection.*
Gravel Road	Potholes Ponding Deterioration Washouts	☒ ☒ ☒ ☒	☐ ☐ ☐ ☐	Generally good condition; some rutting and thin gravel surface observed at various locations, and some underlying geotextile fabric exposed in areas. Vegetation has recently been removed – should continue to implement vegetation control program and continue to monitor.
Water Stops	Erosion Membrane Exposed Deterioration Damage	☐ ☐ ☒ ☒	☒ ☒ ☐ ☐	Erosion and fines accumulation observed near water stop areas. Observed in previous inspections. Appears to be associated with Port CDF dikes. Geomembrane exposed on Port CDF dike water stop areas as discussed under the CDF dike inspection item above. Continue to monitor.
Reflectors Station Tags	Intact/Reflecting Intact/Legibility	☒ ☒	☐ ☐	Some reflectors and traffic signage observed to be damaged or entirely down on the ground. If island is to be used for vehicular traffic in the future (currently it is not due to no access bridge), a more detailed review of reflectors and traffic signage should be completed.

Note:
Due to identified safety concerns associated with walking on armor stone, this inspection was conducted without traversing the stone on exterior dike slopes. Exterior dike locations were observed via dike crest or by waterside inspection from a boat.

FIGURE 4-3: Typical Inspection Log

12-17-2015 DI Inspection



Station Tag Locations
Sta. 1+00
Sta. 5+00
Sta. 10+00
Sta. 15+30
Sta. 20+00
Sta. 25+00
Sta. 30+00
Sta. 35+00
Sta. 40+00
Sta. 45+00
Sta. 50+00
Sta. 55+00
Sta. 60+00
Sta. 65+00
Sta. 70+00
Sta. 75+00
Sta. 80+00
Sta. 85+00
Sta. 90+30
Sta. 95+00
Sta. 100+00
Sta. 105+00

URS

4-4

FIGURE 4-2
STATION NUMBER LOCATIONS

Vol. 4, Rev. D-0
October 2001

DREDGE ISLAND SITE INSPECTION PHOTOGRAPHS
12/17/2015

North Entry Ramp (facing Northwest)

North Exterior Slope (facing East)

At North Entry Ramp Facing West

East Dike Exterior Slope (facing south)

(Note: Varying photo quality due to use of multiple cameras, including digital and disposable)

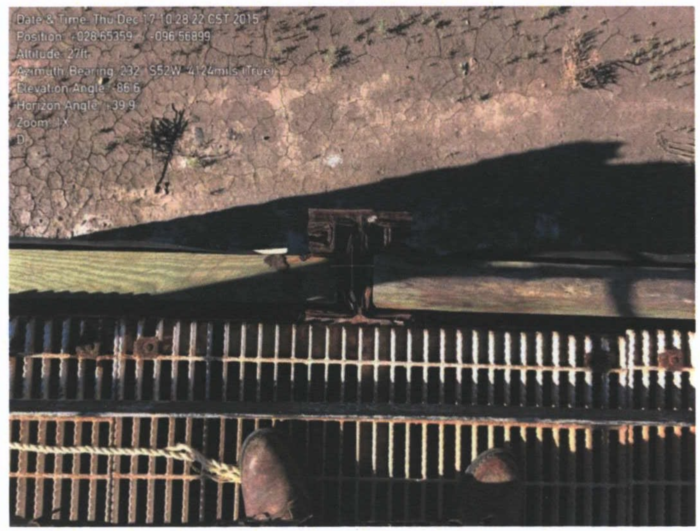
DREDGE ISLAND SITE INSPECTION PHOTOGRAPHS

12/17/2015

East Dike Interior Slope (facing south)

Northeast Corner, Interior Slope (facing north)

North Decant Structure

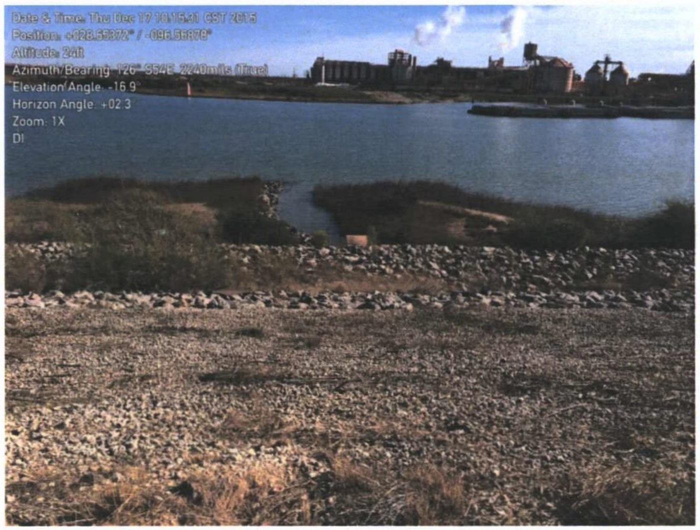


North Decant Structure Corrosion

DREDGE ISLAND SITE INSPECTION PHOTOGRAPHS
12/17/2015

North Decant Structure Corrosion

East Exterior Dike Facing North



North Decant Structure Outfall

East Dike, Historic Seep Area No. 4

DREDGE ISLAND SITE INSPECTION PHOTOGRAPHS
12/17/2015

East Dike, Historic Seep Area No. 5 in Background

Southeast End, Exterior Slope, Facing South

Southeast End Facing Northeast, Interior Slope

South end, Facing West, Exterior Slope

DREDGE ISLAND SITE INSPECTION PHOTOGRAPHS
12/17/2015

Port CDF Erosion at East Water Stop – Interior Slope

Port CDF Erosion Near Southeast Corner of DI

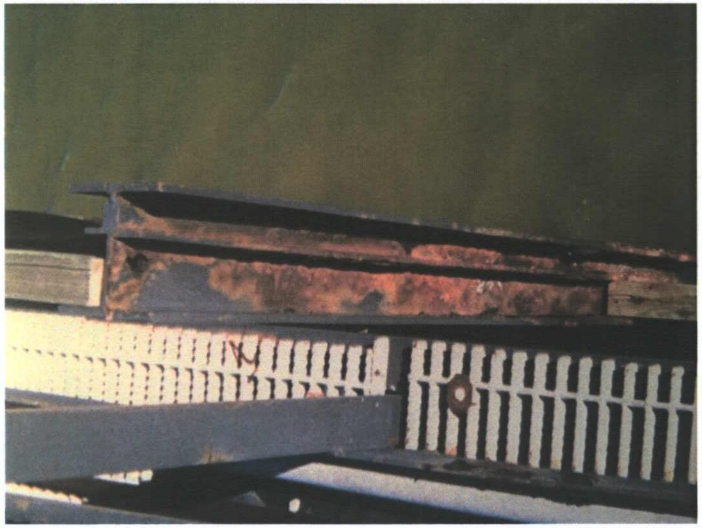
Southwest Corner Interior Slope, South Decant in Background

Port CDF Erosion at West Water Stop – Interior Slope

DREDGE ISLAND SITE INSPECTION PHOTOGRAPHS
12/17/2015

South Decant Structure

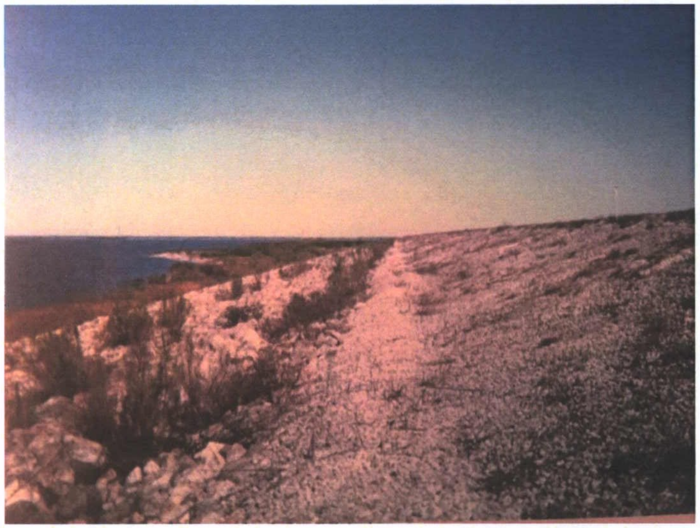
South Decant Structure



Corrosion at South Decant Structure

South Decant Structure Corrosion

DREDGE ISLAND SITE INSPECTION PHOTOGRAPHS
12/17/2015



Southwest Corner Exterior Slope, Facing North

West Dike Toe at Historic Seep No. 7

West Dike, Spillway

Northwest Corner, Inside Slope, Facing East

DREDGE ISLAND SITE INSPECTION PHOTOGRAPHS
12/17/2015

Port CDF, South Dike Erosion

Port CDF, South Dike Erosion

Appendix F
CAPA Cap Inspection Records

March 2016

ALCOA

CAPA CAP INSPECTION RECORD

Date: 03/30/2015 **Time Started:** 13:00 **Time Ended:** 13:45

Weather Conditions: 75°F, Partly Cloudy, Wind: 10 mph

Observations/Comments:

ITEM TO INSPECT	TYPICAL PROBLEMS ENCOUNTERED	CONDITIONS		COMMENTS, CORRECTIVE ACTIONS NEEDED, COORECTIVE ACTIONS IMPLEMENTED (WITH DATE)
		Normal	Abnormal	
Cap	Erosion	√		Southwest corner is showing signs of erosion due to runoff. Some soil has migrated off the cap.
	Settling	√		None observed.
	Ponding	√		Signs of minor ponding in various locations. Currently no standing water on the cap.
	Washouts	√		None observed.
	Holes	√		None observed.
	Vehicle Ruts	√		Some minor ruts from routine herbicide treatment. Northeast corner continues to be driven over.
	Intrusive Vegetation	√		Some vegetation - continue herbicide treatment. Would recommend spraying the whole cap rather than spot treatment.
Signage	In Place	√		Good condition.
	Legible	√		Legible.
Storm Drains	Grates	√		Northwest corner grate is damaged from being driven over but still functions adequately.
	Debris	√		Large amount of vegetation covering the west drain.
Equipment or Wastes	Proper Storage	√		Waste stored in system containment or at satellite collection stations.
Extraction Wells	Controllers	√		In good working order.
	Boxes	√		Good condition.
	Electrical	√		Good condition.
	Conduit	√		Good condition.
	Transfer Piping		√	Secondary containment piping has broken away from the boxes.
Treatment System	Equipment	√		A hole was found in the exhaust pipe. Used rubber tape to seal up the hole until it gets fixed.
	Building		√	Some support members showing signs of rust and pieces of the roof are loose. There are large leaks that occur during a heavy rain storm. Stairway has been boarded up and access has been limited by barriers, locks, and boarded up entry ways. There is severe damage to the roof.
	Leaks	√		None observed.
	Odors	√		None observed.

Additional Comments or Observations: Cap and system is in good condition. All well piping from the wells to the system will be replaced later this year. All secondary piping will be replaced at that time. The exhaust stack for the aeration tray will need to be replaced soon.

Inspector:

Stephen Grahmann

Inspectors Signature:

Steph Gr

PASTOR, BEHLING & WHEELER, LLC

620 E. Airline

Victoria, Texas 77901

Phone: 361-573-6443 Fax: 361-573-6449

FIRST QUARTER 2015
CAPA CAP INSPECTION PHOTO LOG

ALCOA PCO – Point Comfort, Texas

1 - Cap, view Northeast from Southwest corner

2 - Cap, storm sewer drain at R-301

3 – Cap, West storm sewer drain

4 – Cap, Northwest corner storm drain

5 – Cap, North storm drain

6 – Cap, North storm drain

FIRST QUARTER 2015
CAPA CAP INSPECTION PHOTO LOG

ALCOA PCO – Point Comfort, Texas

7 – Cap, view Southeast from Northwest corner

8 – Cap, view Southwest from Northeast corner

9 – Cap, view Northwest from Southeast corner

10 – Cap, view of damage to Northeast corner

11 – Cap, current vegetation

12 – Cap, Ruts from herbicide treatment and soil building up on edge of cap

13 – Viewing northern side of building

14 – Building, showing damaged roof

15 – Building, viewing system

16 – Building, viewing corridor

17 – Viewing monitoring wells and recovery wells

18 – Viewing system effluent outfall

CAPA CAP INSPECTION RECORD

Date: 06/25/2015 **Time Started:** 08:15 **Time Ended:** 09:15

Weather Conditions: 80°F, Partly Cloudy, Wind: South at < 5

Observations/Comments:

ITEM TO INSPECT	TYPICAL PROBLEMS ENCOUNTERED	CONDITIONS		COMMENTS, CORRECTIVE ACTIONS NEEDED, COORECTIVE ACTIONS IMPLEMENTED (WITH DATE)
		Normal	Abnormal	
Cap	Erosion	√		Southwest corner is showing signs of erosion due to runoff. Cap has accumulated soil/alumina dust on the surface. Some of the soil/alumina dust has migrated off the cap.
	Settling	√		None observed.
	Ponding	√		Signs of minor ponding in various locations. Currently no standing water on the cap.
	Washouts	√		None observed.
	Holes	√		None observed.
	Vehicle Ruts	√		Some minor ruts from routine herbicide treatment. Northeast corner continues to be driven over.
	Intrusive Vegetation	√		Some vegetation - continue herbicide treatment. Would recommend spraying the whole cap during the first half of the year rather than spot treatment.
Signage	In Place	√		Good condition.
	Legible	√		Legible.
Storm Drains	Grates	√		Northwest corner grate is damaged from being driven over but still functions adequately.
	Debris	√		Large amount of vegetation covering the west drain. Some debris on the northwest corner grate.
Equipment or Wastes	Proper Storage	√		Waste/chemicals stored in system containment or at satellite collection stations.
Extraction Wells	Controllers	√		In good working order.
	Boxes	√		Good condition.
	Electrical	√		Good condition.
	Conduit	√		Good condition.
	Transfer Piping		√	Secondary containment piping has broken away from the boxes.
Treatment System	Equipment		√	A hole was found in the exhaust pipe. Tape has not held, will need to repair.
	Building		√	Some support members showing signs of rust and pieces of the roof are loose. There are large leaks that occur during a heavy rain storm. Stairway has been boarded up and access has been limited by barriers, locks, and boarded up entry ways. There is severe damage to the roof.
	Leaks	√		None observed.
	Odors	√		None observed.

Additional Comments or Observations: Cap and system is in good condition. All well piping from the wells to the system will be replaced later this year. All secondary piping will be replaced at that time. The exhaust stack for the aeration tray will need to be replaced soon.

Inspector:
Kevin Dworsky

Inspectors Signature:

PASTOR, BEHLING & WHEELER, LLC
620 E. Airline
Victoria, Texas 77901
Phone: 361-573-6443 Fax: 361-573-6449

SECOND QUARTER 2015
CAPA CAP INSPECTION PHOTO LOG

ALCOA PCO – Point Comfort, Texas

1 - Cap, view Northeast from Southwest corner

2 - Cap, storm sewer drain at R-301

3 – Cap, West storm sewer drain

4 – Cap, Northwest corner storm drain

5 – Cap, North storm drain

6 – Viewing signage

SECOND QUARTER 2015
CAPA CAP INSPECTION PHOTO LOG

ALCOA PCO – Point Comfort, Texas

7 – Cap, view Southeast from Northwest corner

8 – Cap, view Southwest from Northeast corner

9 – Cap, view Northwest from Southeast corner

10 – Cap, view of damage to Northeast corner

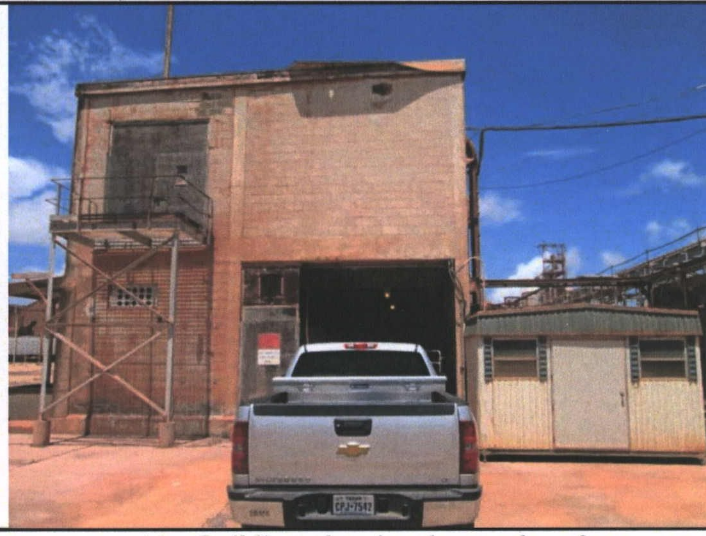
11 – Cap, current vegetation

12 – Cap, Ruts from herbicide treatment and soil building up on edge of cap

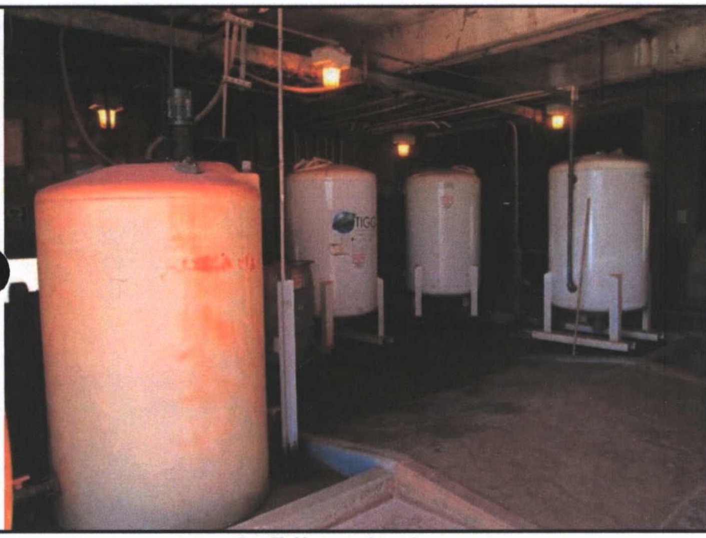
SECOND QUARTER 2015
CAPA CAP INSPECTION PHOTO LOG

ALCOA PCO – Point Comfort, Texas

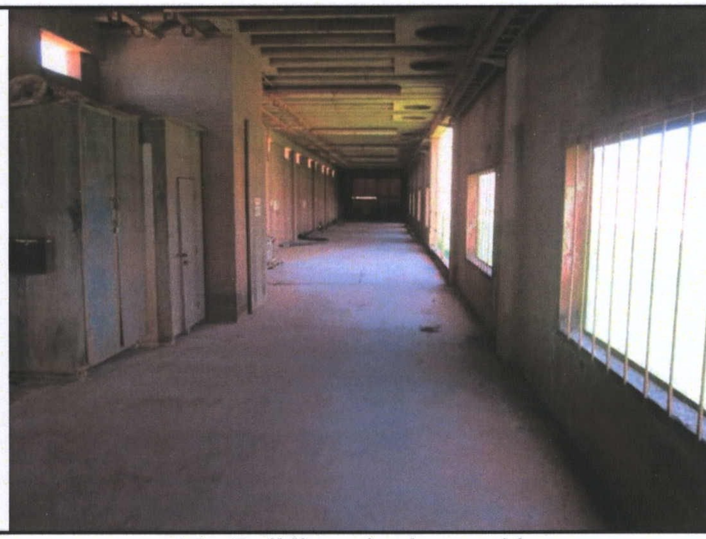
13 – Viewing northern side of building



14 – Building, showing damaged roof



15 – Building, viewing system



16 – Building, viewing corridor

17 – Viewing monitoring wells and recovery wells – Looking north

18 – Viewing monitoring wells and recovery wells – Looking south

CAPA CAP INSPECTION RECORD

Date: 09/24/2015 **Time Started:** 16:00 **Time Ended:** 16:45

Weather Conditions: 90°F, Partly Cloudy, Wind: East at 5 mph

Observations/Comments:

ITEM TO INSPECT	TYPICAL PROBLEMS ENCOUNTERED	CONDITIONS Normal	CONDITIONS Abnormal	COMMENTS, CORRECTIVE ACTIONS NEEDED, COORECTIVE ACTIONS IMPLEMENTED (WITH DATE)
Cap	Erosion	√		There is a buildup of soil/alumina/bauxite dust that has accumulated on the cap. Difficult to see the limestone cover. Some soil/alumina/bauxite has migrated off the cap.
	Settling	√		None observed.
	Ponding	√		Signs of minor ponding in various locations. Currently no standing water on the cap.
	Washouts	√		None observed.
	Holes	√		None observed.
	Vehicle Ruts	√		Some minor ruts from routine herbicide treatment. The ruts are in the soft overlying material, not in the limestone cap. Northeast corner continues to be driven over.
	Intrusive Vegetation	√		Some vegetation - continue herbicide treatment. Would recommend spraying the whole cap rather than spot treatment during the first half of each year.
Signage	In Place	√		Good condition.
	Legible	√		Legible.
Storm Drains	Grates	√		Northwest corner grate is damaged from being driven over but still functions adequately.
	Debris	√		Large amount of vegetation covering the west drain.
Equipment or Wastes	Proper Storage	√		Waste/chemicals stored in system containment or at satellite collection stations.
Extraction Wells	Controllers	√		In good working order.
	Boxes	√		Good condition.
	Electrical	√		Good condition.
	Conduit	√		Good condition.
	Transfer Piping	√		Good condition. All secondary containment and transfer piping has been recently replaced.
Treatment System	Equipment		√	A hole was found in the exhaust pipe. Needs to be repaired.
	Building		√	Some support members showing signs of rust and pieces of the roof are loose. There are large leaks that occur during a heavy rain storm. Stairway has been boarded up and access has been limited by barriers, locks, and boarded up entry ways. There is severe damage to the roof.
	Leaks	√		None observed.
	Odors	√		None observed.

Additional Comments or Observations: Cap and system is in good condition. The exhaust stack for the aeration tray will need to be replaced soon.

Inspector:

Stephen Grahmann

Inspectors Signature:

Steph Gr

PASTOR, BEHLING & WHEELER, LLC

620 E. Airline

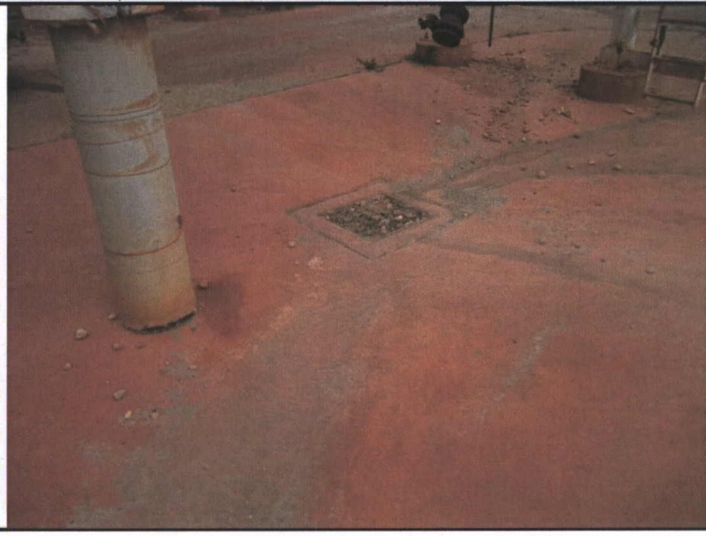
Victoria, Texas 77901

Phone: 361-573-6443 Fax: 361-573-6449

THIRD QUARTER 2015
CAPA CAP INSPECTION PHOTO LOG

ALCOA PCO – Point Comfort, Texas

1 - Cap, view Northeast from Southwest corner



2 - Cap, storm sewer drain at R-301

3 – Cap, West storm sewer drain

4 – Cap, Northwest corner storm drain

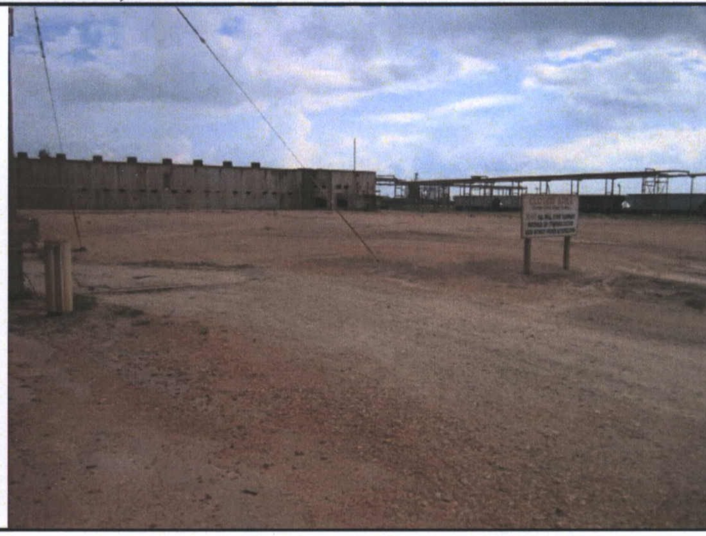
5 – Cap, North storm drain

6 – Cap, North storm drain

THIRD QUARTER 2015
CAPA CAP INSPECTION PHOTO LOG

ALCOA PCO – Point Comfort, Texas

7 – Cap, view Southeast from Northwest corner



8 – Cap, view Southwest from Northeast corner

9 – Cap, view Northwest from Southeast corner

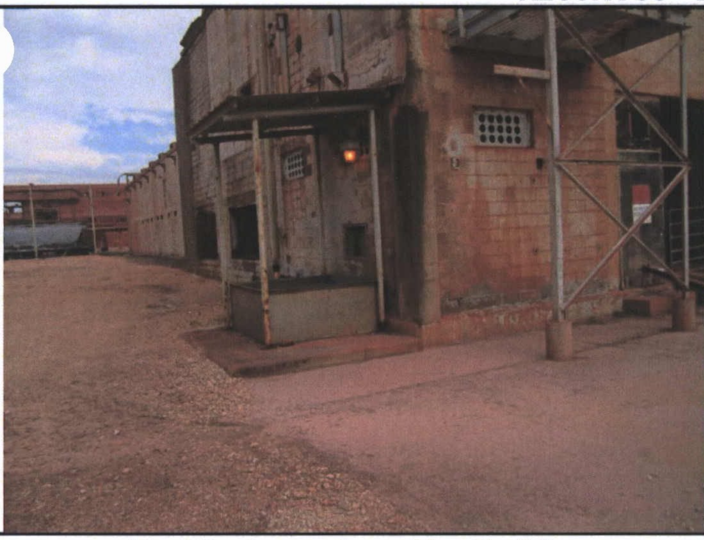
10 – Cap, view of damage to Northeast corner

11 – Cap, current vegetation

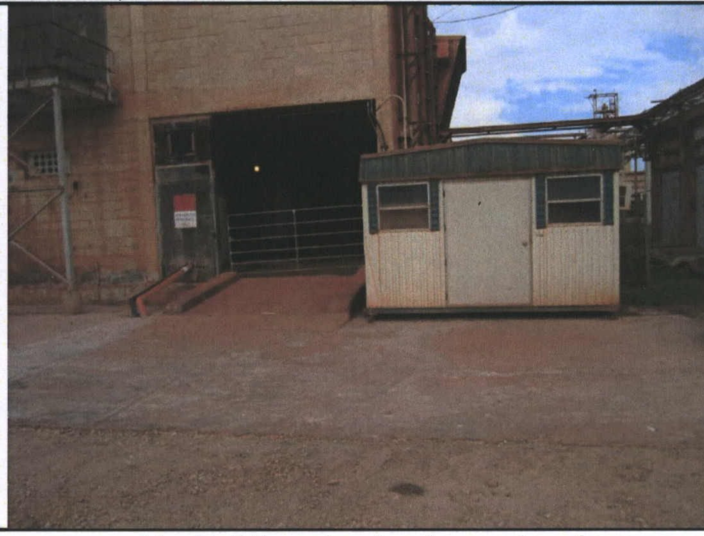
12 – Cap, Minor ruts from herbicide treatment and soil building up on edge of cap

THIRD QUARTER 2015
CAPA CAP INSPECTION PHOTO LOG

ALCOA PCO – Point Comfort, Texas



13 – Viewing northern side of building



14 – Building, showing damaged roof

15 – Building, viewing system

16 – Building, viewing corridor

17 – Viewing monitoring wells and recovery wells

18 – Viewing system effluent outfall

CAPA CAP INSPECTION RECORD

Date: 12/28/2015 **Time Started:** 15:00 **Time Ended:** 15:45

Weather Conditions: 51°F, Clear Sky, Wind: Northwest at 18 mph

Observations/Comments:

ITEM TO INSPECT	TYPICAL PROBLEMS ENCOUNTERED	CONDITIONS		COMMENTS, CORRECTIVE ACTIONS NEEDED, COORECTIVE ACTIONS IMPLEMENTED (WITH DATE)
		Normal	Abnormal	
Cap	Erosion	√		There is a buildup of soil/alumina/bauxite dust that has accumulated on the cap. Difficult to see the limestone cover. Some soil/alumina/bauxite has migrated off the cap.
	Settling	√		None observed.
	Ponding	√		Signs of minor ponding in various locations. Currently no standing water on the cap.
	Washouts	√		None observed.
	Holes	√		None observed.
	Vehicle Ruts	√		Some minor ruts from routine herbicide treatment. The ruts are in the soft overlying material, not in the limestone cap. Northeast corner continues to be driven over.
	Intrusive Vegetation	√		Some spotty vegetation - continue herbicide treatment. Would recommend spraying the whole cap rather than spot treatment during the first half of each year.
Signage	In Place	√		Good condition.
	Legible	√		Legible.
Storm Drains	Grates	√		Northwest corner grate is damaged from being driven over but still functions adequately.
	Debris	√		Large amount of vegetation covering the west drain.
Equipment or Wastes	Proper Storage	√		Waste/chemicals stored in system containment or at satellite collection stations. All equipment handling the affected groundwater is within secondary containment.
Extraction Wells	Controllers	√		In good working order.
	Boxes	√		Good condition.
	Electrical	√		Good condition.
	Conduit	√		Good condition.
	Transfer Piping	√		Good condition.
Treatment System	Equipment		√	A hole was found in the exhaust pipe. Needs to be repaired.
	Building		√	Some support members showing signs of rust and pieces of the roof are loose. There are large leaks that occur during a heavy rain storm. Stairway has been boarded up and access has been limited by barriers, locks, and boarded up entry ways.
	Leaks	√		None observed.
	Odors	√		None observed.

Additional Comments or Observations: Cap and system is in good condition. The exhaust stack for the aeration tray will need to be replaced soon.

Inspector:
Kevin Dworsky

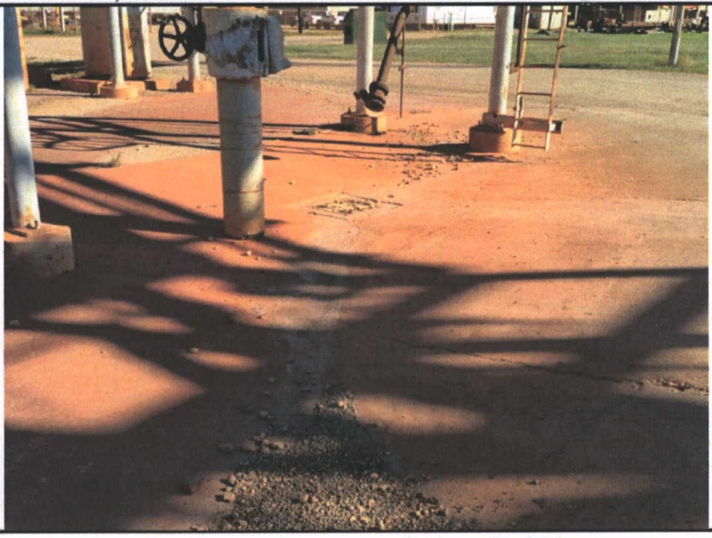
Inspectors Signature:

PASTOR, BEHLING & WHEELER, LLC
620 E. Airline
Victoria, Texas 77901
Phone: 361-573-6443 Fax: 361-573-6449

FOURTH QUARTER 2015
CAPA CAP INSPECTION PHOTO LOG

ALCOA PCO – Point Comfort, Texas

1 - Cap, view Northeast from Southwest corner



2 - Cap, storm sewer drain at R-301

3 – Cap, West storm sewer drain

4 – Cap, Northwest corner storm drain

5 – Cap, North storm drain

6 – Cap, North storm drain

FOURTH QUARTER 2015
CAPA CAP INSPECTION PHOTO LOG

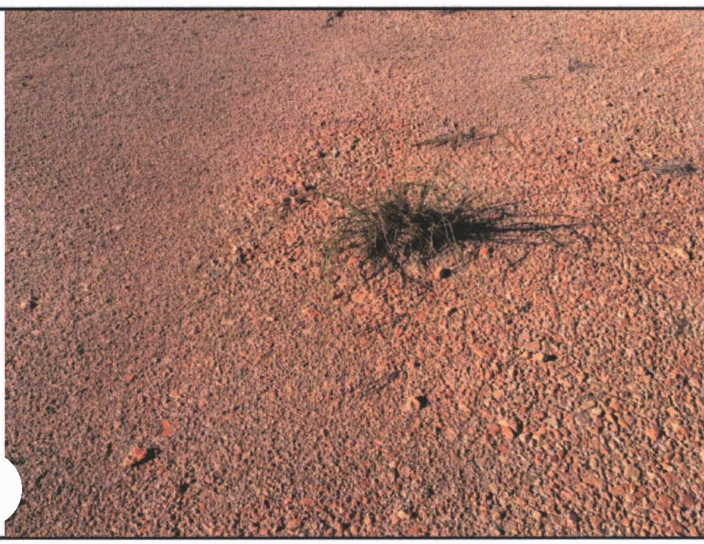
ALCOA PCO – Point Comfort, Texas

7 – Cap, view Southeast from Northwest corner

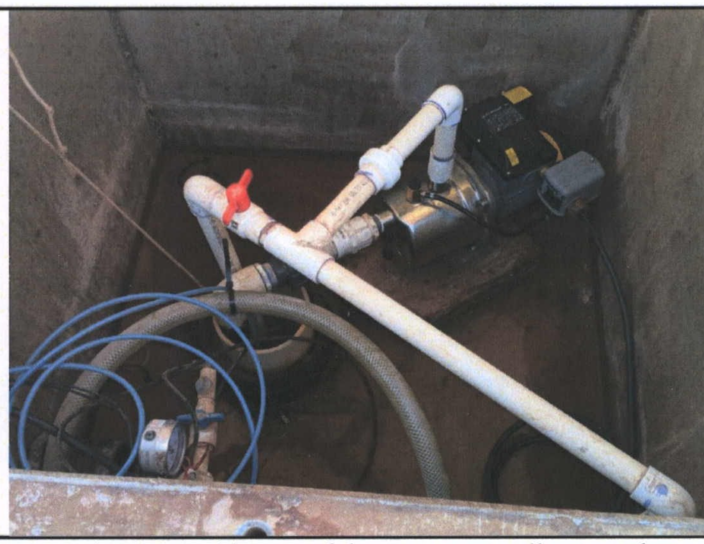
8 – Cap, view Southwest from Northeast corner

9 – Cap, view Northwest from Southeast corner

10 – Cap, view of damage to Northeast corner



11 – Cap, current vegetation

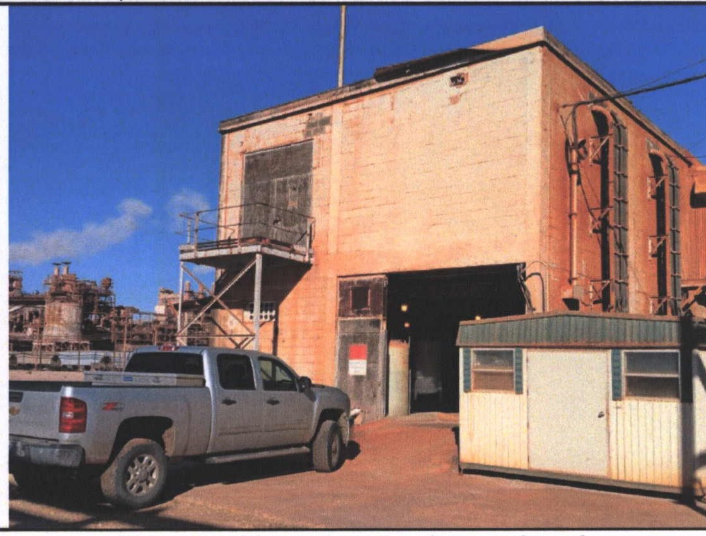


12 – Viewing inside one of the recovery well system boxes

FOURTH QUARTER 2015
CAPA CAP INSPECTION PHOTO LOG

ALCOA PCO – Point Comfort, Texas

13 – Viewing northern side of building



14 – Building, showing damaged roof

15 – Building, viewing system

16 – Building, viewing corridor

17 – Viewing monitoring wells and recovery wells

18 – Viewing system effluent outfall

Appendix G

Witco Inspection Records

March 2016

ALCOA

WITCO AREA INSPECTION RECORD

Date: 03/30/2015 **Time Started:** 13:45 **Time Ended:** 14:30

Weather Conditions: 78° F, partly cloudy sky, wind: 10 mph

Observations/Comments:

AREA	ITEM	CONDITIONS		COMMENTS, CORRECTIVE ACTIONS NEEDED, COORECTIVE ACTIONS IMPLEMENTED (WITH DATE)
		Normal	Abnormal	
Drainage Channel	Cracks in Concrete	√		Old cracks, no new ones in the channel.
	Obstructions	√		Heavy vegetation in upper section of the channel.
	Erosion	√		Slight erosion underneath the inlet pipes.
	Deterioration	√		Deterioration continues in upper section of the channel below the Soil Cap Rip Rap.
	Washouts	√		Slight washout at the toe of the channel.
	Rip Rap	√		Slight movement and some vegetation.
Soil Cap (Tank Farm)	Erosion	√		None observed.
	Settlement	√		Evidence of ponding and standing water.
	Vegetation	√		Healthy vegetation; continue with shredding of cap.
	Intrusive Trees	√		None observed.
	Drainage/Rip Rap	√		Heavy vegetation and intrusive trees; need vegetation control.
	Animal Damage	√		None observed.
	Vehicle Ruts	√		Some old signs of rutting.
	Damage	√		None observed.
Soil Cap (O/W Separator)	Erosion	√		None observed.
	Settlement	√		Areas of standing water.
	Vegetation	√		Healthy vegetation; continue with shredding of cap.
	Damage		√	Minor old rutting.
Slope from Cap to Channel	Erosion	√		Minor signs of erosion.
	Slumping	√		None observed.
	Vegetation		√	Heavy vegetation in area.
Signage	Damage	√		Good condition
	Illegible	√		Good condition
DNAPL Collection Sump	Damage	√		Unable to place cap on sump due to location of lid.
	Product Level	√		

Additional Comments or Observations: Continue shredding the Witco Area and remove vegetation from the rip rap area of the cap drainage and the edge of the drainage channel. Institute vegetation control for the slope and top of lower drainage channel which includes weed eating of the vegetation. The deterioration of the old portion of the drainage channel and the heavy vegetation in it is currently not a concern unless the flow is restricted or there are signs of seepage from the cap. Monitor wells are in good condition.

Inspector:

Stephen Grahmann

Inspectors Signature:

Stephen Grahmann

PASTOR, BEHLING & WHEELER, LLC

620 E. Airline

Victoria, Texas 77901

Phone: 361-573-6443 Fax: 361-573-6449

FIRST QUARTER 2015
WITCO INSPECTION PHOTO LOG

ALCOA PCO – Point Comfort, Texas

1 - Northeast corner, viewing Southwest

2 - Northwest corner, viewing Southeast

3 – Southwest corner, viewing Northeast

4 - Southeast corner, viewing Northwest

5 - Slope between tank farm and drainage channel/marsh

6 - Slope between tank farm and drainage channel/marsh

7 – View of silt fence located at the bottom of the cap slope

8 – Viewing monitor well located next to the drainage channel

9 - View of rip rap at the end of the drainage channel

10 - View of West end of drainage channel, viewing West

11 - View of East end of drainage channel, viewing East

12 - View of drainage rip rap from tank farm cap

13 - View of vegetation in drainage rip rap from drainage channel

14 - View of heavily vegetated channel east of the cap rip rap

15 - View of deteriorating side slope on channel

16 - View of heavy vegetation along the top edge of drainage channel

17 – View of minor erosion under inlet pipe

18 - View of monitoring well

WITCO AREA INSPECTION RECORD

Date: 06/24/2015 **Time Started:** 13:15 **Time Ended:** 14:00

Weather Conditions: 87° F, partly cloudy sky, wind: south at 8 mph

Observations/Comments:

AREA	ITEM	CONDITIONS		COMMENTS, CORRECTIVE ACTIONS NEEDED, COORECTIVE ACTIONS IMPLEMENTED (WITH DATE)
		Normal	Abnormal	
Drainage Channel	Cracks in Concrete	√		Few old cracks, no new ones in new (west) portion of the channel.
	Obstructions	√		Vegetation is heavy in the old (east) portion of the channel. Vegetation is hanging into the new portion of the drainage channel.
	Erosion	√		Slight erosion underneath the inlet pipes, old.
	Deterioration	√		Old marks on concrete, cause is unknown. Areas of the old drainage channel continue to deteriorate. Signs of deterioration around some of the inlet drains.
	Washouts	√		None observed.
	Rip Rap	√		Slight movement and some vegetation.
Soil Cap (Tank Farm)	Erosion	√		None observed.
	Settlement	√		Few low areas but currently no standing water.
	Vegetation	√		Healthy vegetation; continue with shredding of the cap.
	Intrusive Trees	√		None observed.
	Drainage/Rip Rap	√		Heavy vegetation and intrusive trees; need vegetation control.
	Animal Damage	√		None observed.
	Vehicle Ruts	√		Some rutting observed on the cap.
	Damage	√		None observed.
Soil Cap (O/W Separator)	Erosion	√		None observed.
	Settlement	√		Some low areas but currently no standing water.
	Vegetation	√		Healthy vegetation; continue with shredding of cap. Do not shred if the cap is wet.
	Damage		√	Minor to moderate rutting on cap.
Slope from Cap to Channel	Erosion	√		Minor signs of erosion.
	Slumping	√		None observed.
	Vegetation		√	Heavy vegetation in area. Need to apply vegetation control.
Signage	Damage	√		Good condition
	Illegible	√		Good condition
DNAPL Collection Sump	Damage	√		Unable to place cap on sump due to location of lid.
	Product Level	√		WL in sump = 3.54' BMP, no DNAPL, 12.72' TD

Additional Comments or Observations: Continue shredding the Witco Area and remove vegetation from the rip rap area of the cap drainage and the edge of the drainage channel. Institute vegetation control for the slope and top of lower drainage channel which includes weed eating of the vegetation. Remove the intrusive vegetation along the side of the channel. The deterioration of the old portion of the drainage channel and the heavy vegetation in it is currently not a concern unless the flow is restricted or there are signs of seepage from the cap. Monitor wells are in good condition.

Inspector:

Kevin Dworsky

Inspectors Signature:

PASTOR, BEHLING & WHEELER, LLC

620 E. Airline

Victoria, Texas 77901

Phone: 361-573-6443 Fax: 361-573-6449

SECOND QUARTER 2015
WITCO INSPECTION PHOTO LOG

ALCOA PCO – Point Comfort, Texas

1 - Northeast corner, viewing Southwest

2 - Northwest corner, viewing Southeast

3 – Southwest corner, viewing Northeast

4 - Southeast corner, viewing Northwest

5 - Slope between tank farm and drainage channel/marsh

6 - Slope between tank farm and drainage channel/marsh

SECOND QUARTER 2015
WITCO INSPECTION PHOTO LOG

ALCOA PCO – Point Comfort, Texas

7 – View of silt fence located at the bottom of the cap slope

8 - Northeast Witco (Oil/Water Seperator) Cap, viewing South

9 - View of rip rap at the end of the drainage channel

10 - View of West end of drainage channel, viewing West

11 - View of East end of drainage channel, viewing East

12 - View of drainage rip rap from tank farm cap

SECOND QUARTER 2015
WITCO INSPECTION PHOTO LOG

ALCOA PCO – Point Comfort, Texas

13 - View of vegetation in drainage rip rap from drainage channel

14 - View of heavily vegetated channel east of the cap rip rap

15 - View of deteriorating side slope on channel

16 - View of rutting on the Northeast Witco (Oil/Water Separator) Cap

17 – View of heavy vegetation along top edge of channel

18 - View of monitoring well

WITCO AREA INSPECTION RECORD

Date: 09/25/2015 **Time Started:** 14:45 **Time Ended:** 15:30

Weather Conditions: 90° F, partly cloudy sky, wind: north at 10 mph

Observations/Comments:

AREA	ITEM	CONDITIONS		COMMENTS, CORRECTIVE ACTIONS NEEDED, COORECTIVE ACTIONS IMPLEMENTED (WITH DATE)
		Normal	Abnormal	
Drainage Channel	Cracks in Concrete	√		Old cracks, no new ones in the channel.
	Obstructions	√		Heavy vegetation in upper section of the channel.
	Erosion	√		Slight erosion underneath the inlet pipes.
	Deterioration	√		Deterioration continues in upper section of the channel below the Soil Cap Rip Rap.
	Washouts	√		Slight washout at the toe of the channel.
	Rip Rap	√		Slight movement and some vegetation.
Soil Cap (Tank Farm)	Erosion	√		None observed.
	Settlement	√		Evidence of ponding and standing water.
	Vegetation	√		Healthy vegetation; continue with shredding of cap.
	Intrusive Trees	√		None observed.
	Drainage/Rip Rap	√		Heavy vegetation and intrusive trees; need vegetation control.
	Animal Damage	√		None observed.
	Vehicle Ruts	√		Some old signs of rutting.
	Damage	√		None observed.
Soil Cap (O/W Separator)	Erosion	√		None observed.
	Settlement	√		Areas of standing water.
	Vegetation	√		Healthy vegetation; continue with shredding of cap.
	Damage	√		Minor old rutting.
Slope from Cap to Channel	Erosion	√		Minor signs of erosion.
	Slumping	√		None observed.
	Vegetation		√	Heavy vegetation in area.
Signage	Damage	√		Good condition
	Illegible	√		Good condition
DNAPL Collection Sump	Damage	√		Unable to place cap on sump due to location of lid.
	Product Level	√		WL in sump = 3.83' BMP, no DNAPL, 12.73' TD

Additional Comments or Observations: Continue shredding the Witco Area and remove vegetation from the rip rap area of the cap drainage and the edge of the drainage channel. Institute vegetation control for the slope and top of lower drainage channel which includes weed eating of the vegetation. The deterioration of the old portion of the drainage channel and the heavy vegetation in it is currently not a concern unless the flow is restricted or there are signs of seepage from the cap. Monitor wells are in good condition.

Inspector:

Stephen Grahmann

Inspectors Signature:

Stephen Grahmann

PASTOR, BEHLING & WHEELER, LLC

620 E. Airline

Victoria, Texas 77901

Phone: 361-573-6443 Fax: 361-573-6449

THIRD QUARTER 2015
WITCO INSPECTION PHOTO LOG

ALCOA PCO – Point Comfort, Texas

1 - Northeast corner, viewing Southwest

2 - Northwest corner, viewing Southeast

3 – Southwest corner, viewing Northeast

4 - Southeast corner, viewing Northwest

5 - Slope between tank farm and drainage channel/marsh

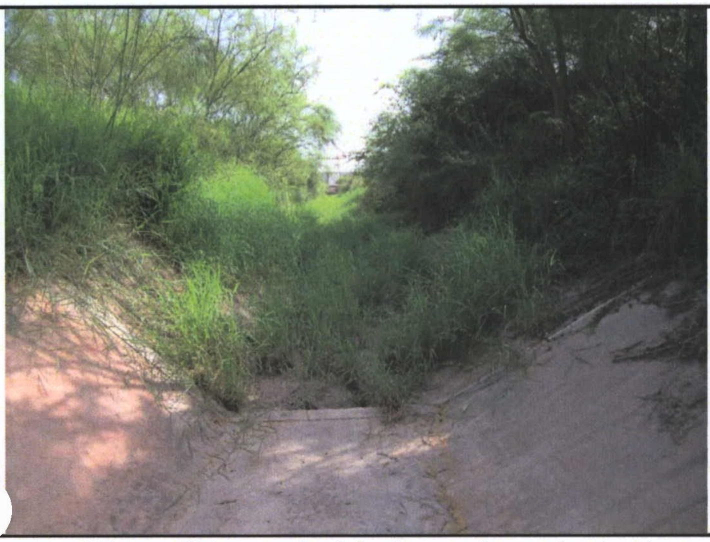
6 - Slope between tank farm and drainage channel/marsh

7 – View of intrusive vegetation on edge of channel

8 – Viewing monitor well located next to the drainage channel

9 - View of rip rap at the end of the drainage channel

10 - View of West end of drainage channel, viewing West



11 - View of East end of drainage channel, viewing East

12 - View of drainage rip rap from tank farm cap

THIRD QUARTER 2015
WITCO INSPECTION PHOTO LOG

ALCOA PCO – Point Comfort, Texas

13 - View of vegetation in drainage rip rap from drainage channel

14 - View of vegetation at the edge of the channel

15 - View from edge of channel into the bay

16 - View of heavy vegetation along the top edge of drainage channel

17 – View of minor erosion under inlet pipe

18 - View of monitoring well

WITCO AREA INSPECTION RECORD

Date: 12/28/2015 **Time Started:** 14:15 **Time Ended:** 15:00

Weather Conditions: 51° F, clear sky, wind: west at 15 mph

Observations/Comments:

AREA	ITEM	CONDITIONS		COMMENTS, CORRECTIVE ACTIONS NEEDED, COORECTIVE ACTIONS IMPLEMENTED (WITH DATE)
		Normal	Abnormal	
Drainage Channel	Cracks in Concrete	√		Few old cracks, no new ones in new (west) portion of the channel.
	Obstructions	√		Vegetation is hanging into the new portion of the drainage channel. Some grass cutting from recent mowing of east (old) portion of channel.
	Erosion	√		Slight erosion underneath the inlet pipes, old.
	Deterioration		√	Old marks on concrete, cause is unknown. Areas of the east (old) drainage channel continue to deteriorate. Signs of deterioration around some of the inlet drains.
	Washouts	√		Some signs at the west end of channel.
	Rip Rap	√		Slight movement and some vegetation.
Soil Cap (Tank Farm)	Erosion	√		None observed.
	Settlement	√		Few low areas but currently no standing water.
	Vegetation	√		Healthy vegetation; continue with shredding of the cap. Recently shredded.
	Intrusive Trees	√		None observed.
	Drainage/Rip Rap		√	Heavy vegetation and intrusive trees; needs vegetation control.
	Animal Damage	√		None observed.
	Vehicle Ruts	√		None observed.
	Damage	√		None observed.
Soil Cap (O/W Separator)	Erosion	√		None observed.
	Settlement	√		Some low areas but currently no standing water.
	Vegetation	√		Healthy vegetation; continue with shredding of cap. Do not shred if the cap is wet. Recently shredded.
	Damage	√		Minor rutting on cap.
Slope from Cap to Channel	Erosion	√		None observed.
	Slumping	√		None observed.
	Vegetation		√	Heavy vegetation in area. Need to apply vegetation control.
Signage	Damage	√		Good condition
	Illegible	√		Good condition
DNAPL Collection Sump	Damage	√		Unable to place cap on sump due to location of lid.
	Product Level	√		WL in sump = 3.62' BMP, no DNAPL, 12.72' TD

Additional Comments or Observations: Continue shredding the Witco Area and remove vegetation from the rip rap area of the cap drainage and the edge of the drainage channel. Institute vegetation control for the slope and top of lower drainage channel which includes weed eating of the vegetation. Remove the intrusive vegetation along the side of the channel. The deterioration of the old portion of the drainage channel, although severe, is currently not a concern unless the flow is restricted or there are signs of seepage from the cap. Monitor wells are in good condition.

Inspector:
Kevin Dworsky

Inspectors Signature:

PASTOR, BEHLING & WHEELER, LLC
620 E. Airline
Victoria, Texas 77901

Phone: 361-573-6443 Fax: 361-573-6449

FOURTH QUARTER 2015
WITCO INSPECTION PHOTO LOG

ALCOA PCO – Point Comfort, Texas

1 - Northeast corner, viewing Southwest

2 - Northwest corner, viewing Southeast

3 – Southwest corner, viewing Northeast

4 - Southeast corner, viewing Northwest

5 - Slope between tank farm and drainage channel/marsh

6 - Slope between tank farm and drainage channel/marsh

7 – View of silt fence located at the bottom of the cap slope

8 - Northeast Witco (Oil/Water Seperator) Cap, viewing South

9 - View of rip rap at the end of the drainage channel

10 - View of West end of drainage channel, viewing West

11 - View of East end of drainage channel, viewing East

12 - View of drainage rip rap from tank farm cap

13 - View of vegetation in drainage rip rap from drainage channel

14 - View of heavily vegetated channel east of the cap rip rap

15 - View of deteriorating side slope on channel

16 - View of rutting on the Northeast Witco (Oil/Water Separator) Cap

17 – View of minor movement of the Rip Rap at east end of channel

18 - View of monitoring well