DRAFT
REMEDIAL ALTERNATIVES MEMORANDUM

FOR THE
GULFCO MARINE MAINTENANCE
SUPERFUND SITE
FREEPORT, TEXAS

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LIST OF ACRONYMS

1,2,3-TCP - 1,2,3-trichloropropane
ARARs - Applicable or Relevant and Appropriate Requirements
AST – Aboveground Storage Tank
BaP - Benzo(a)pyrene
BERA – Baseline Ecological Risk Assessment
CERCLA – Comprehensive Environmental Response, Compensation and Liability Act
COI – Chemicals of Interest
COPEC – Chemicals of Potential Ecological Concern
CSM – Conceptual Site Model
DDT – dichlorodiphenyltrichloroethane
EPA – United States Environmental Protection Agency
FS – Feasibility Study
GRG - Gulfco Restoration Group
NEDR – Nature and Extent Data Report
NPL – National Priorities List
O&M - Operation and Maintenance
PAH – Polynuclear Aromatic Hydrocarbon
PBW – Pastor, Behling & Wheeler, LLC
PCB – Polychlorinated Biphenyl
PRG - Preliminary Remediation Goal
PSA - Potential Source Area
PSCR - Preliminary Site Characterization Report
RAM - Remedial Alternatives Memorandum
RAO - Remedial Action Objective
RI – Remedial Investigation
RI/FS – Remedial Investigation/Feasibility Study
SLERA – Screening-Level Ecological Risk Assessment
SOW – Statement of Work
TCEQ – Texas Commission on Environmental Quality
TCRA - Time Critical Removal Action
TDS - Total Dissolved Solids
TNRCC – Texas Natural Resource Conservation Commission
TCE - Trichloroethene
UAO – Unilateral Administrative Order
USFWS - United States Fish and Wildlife Service

1.0 INTRODUCTION

The United States Environmental Protection Agency (EPA) named the former site of Gulfco Marine Maintenance, Inc. (Gulfco) in Freeport, Brazoria County, Texas (the Site) to the National Priorities List (NPL) in May 2003. The EPA issued a modified Unilateral Administrative Order (UAO), effective July 29, 2005, which was subsequently amended effective January 31, 2008. The UAO required Respondents to conduct a Remedial Investigation and Feasibility Study (RI/FS) for the Site. Pursuant to Paragraphs 17 through 28 of the Statement of Work (SOW) for the RI/FS, included as an Attachment to the UAO, a RI/FS Work Plan and a Sampling and Analysis Plan were prepared for the Site. These documents were approved with modifications by EPA on May 4, 2006 and were finalized on May 16, 2006. This Remedial Alternatives Memorandum (RAM) has been prepared in accordance with Paragraphs 44 and 45 of the SOW and Section 5.10 of the approved RI/FS Work Plan (the Work Plan) (PBW, 2006). The memorandum was prepared by Pastor, Behling & Wheeler, LLC (PBW), on behalf of LDL Coastal Limited LP (LDL), Chromalloy American Corporation (Chromalloy) and The Dow Chemical Company (Dow), collectively known as the Gulfco Restoration Group (GRG). Figure 1 provides a map of the Site vicinity, while Figure 2 provides a Site map.

1.1 PURPOSE AND ORGANIZATION

As described in the SOW, the purpose of the RAM is to develop a range of remedial alternatives and screen those alternatives in relation to the Remedial Action Objectives (RAOs) and the more specific Preliminary Remediation Goals (PRGs) for the Site. Consistent with EPA guidance regarding reporting and communication during the alternative development and screening process (Section 4.5 of EPA, 1988), the RAM provides written documentation of the methods, rationale, and results of the alternative screening. As such, the RAM provides the foundation for the more detailed analysis of alternatives in the FS.

Consistent with its role as an interim deliverable for the FS, the RAM has been organized to match the suggested format for the technology and alternative screening sections of the FS as provided in EPA, 1988. Site background information is provided below in Section 1.2. The identification and screening of technologies is discussed in Section 2. The development and screening of alternatives is described in Section 3. Memorandum conclusions are provided in Section 4. References are listed in Section 5. Consistent with SOW requirements and as

specified in the Work Plan, Appendix A summarizes the chemical, location, and action-specific Applicable or Relevant and Appropriate Requirements (ARARs) for each of the alternatives.

1.2 SITE BACKGROUND

1.2.1 Site Description

The Site is located in Freeport, Texas at 906 Marlin Avenue (also referred to as County Road 756) (Figure 1). The Site consists of approximately 40 acres within the 100-year coastal floodplain along the north bank of the Intracoastal Waterway between Oyster Creek approximately one mile to the east and the Texas Highway 332 bridge approximately one mile to the west. Marlin Avenue divides the Site into two primary areas (Figure 2). For the purposes of descriptions in this report, Marlin Avenue is approximated to run due west to east. The 20-acre upland property south of Marlin Avenue (the South Area) was created from dredged material from the Intracoastal Waterway and developed for industrial uses. It contains multiple structures, a dry dock, an aboveground storage tank (AST) tank farm, and two barge slips connected to the Intracoastal Waterway. The property to the north of Marlin Avenue (the North Area) contains some upland areas created from dredge spoil, but most of this area is considered wetlands, as per the United States Fish and Wildlife Service (USFWS) Wetlands Inventory Map (Figure 3). The North Area contains three adjacent closed surface impoundments and two ponds, the "Fresh Water Pond" immediately east of the impoundments, and a smaller pond to the southeast (referred to as the "Small Pond" hereafter). Site investigation activities (described below) identified a localized area of buried debris immediately south of the former surface impoundments.

The South Area is zoned as "W-3, Waterfront Heavy" by the City of Freeport. This designation provides for commercial and industrial land use, primarily port, harbor, or marine-related activities. The North Area is zoned as "M-2, Heavy Manufacturing." Restrictive covenants prohibiting any land use other than commercial/industrial and prohibiting groundwater use have been filed for all parcels within both the North and South Areas. Additional restrictions requiring any building design to preclude indoor vapor intrusion have been filed for Lots 55, 56 and 57 (see Figure 2 for lot designations and boundaries). A further restriction requiring EPA and Texas Commission on Environmental Quality (TCEQ) notification prior to any building construction

has also been filed for Lots 55, 56, and 57. Copies of these restrictions for Lots 55, 56, 57 are provided in Appendix B.

Adjacent property to the north, west and east of the North Area is unused and undeveloped. Adjacent property to the east of the South Area is currently used for industrial purposes while to the west the property is currently vacant and previously served as a commercial marina. The Intracoastal Waterway bounds the Site to the south. Residential areas are located south of Marlin Avenue, approximately 300 feet west of the Site, and 1,000 feet east of the Site.

1.2.2 Site History

The Site's operating history, as constructed through historical aerial photographs, personnel interviews, operating information, investigation report summaries, and regulatory agency correspondence, inspection reports and memoranda/communication records, is discussed in detail in the Work Plan. A summary of the RI activities at the Site is provided below.

RI activities at the Site were initiated in 2006. These activities included the collection and analyses of soil, sediment, surface water, groundwater, and fish tissue samples. Results of these analyses were summarized in a Nature and Extent Data Report (NEDR) (PBW, 2009), which was approved by EPA on April 29, 2009. A summary of the NEDR findings relative to the areas addressed in this RAM is provided in Section 1.2.3 below.

A Final Baseline Human Health Risk Assessment (BHHRA) (PBW, 2010a) was prepared based on the data presented in the NEDR and was approved by EPA on March 5, 2010. A Final Screening-Level Ecological Risk Assessment (SLERA) (PBW, 2010b) was approved by EPA on June 9, 2010. Based on the SLERA conclusions, a Baseline Ecological Risk Assessment (BERA) was performed. Data collected for the BERA were presented in a Preliminary Site Characterization Report (PSCR) (URS, 2010b), which was approved by EPA on December 8, 2010. The BERA Report (URS, 2011) is currently in preparation.

A Time Critical Removal Action (TCRA) is currently being performed to remove residual material in the tanks at the AST Tank Farm. The Removal Action Report (PBW, 2011a) documenting the TCRA activities is currently in preparation.

1.2.3 Nature and Extent of Contamination

Key information pertaining to the former surface impoundments, and the nature and extent of chemicals of interest (COIs) in Site environmental media is summarized below. The nature and extent information data were previously provided in the NEDR (PBW, 2009a).

Former Surface Impoundments

The former surface impoundments consist of three earthen lagoons used for the storage of wash waters generated from barge cleaning operations. Covering an area of approximately 2.5 acres combined, the impoundments were reportedly three feet deep and contained a natural clay liner (TNRCC, 2000). The impoundments were closed in 1982 in accordance with a Texas Water Commission approved plan (Carden, 1982). Closure activities were reported to include: (1) removal of liquids and most of the impoundment sludges; (2) solidification of residual sludge that was difficult to excavate; (3) and capping with three-feet of clay and a hard-wearing surface (Guevara, 1989). As shown on a topographic survey of the area (Figure 4), the impoundments cap extends approximately 1.5 to 2.5 feet above surrounding grade. The cap crown slope is about 2% with slopes of 5 to 1 (horizontal to vertical) or less at the cap edge.

The construction materials, thickness, and condition of the former surface impoundments cap were evaluated through drilling and sampling of four borings through the cap, geotechnical testing of representative cap material (clay) samples, and performance of a field inspection of the cap, including observation of desiccation cracks, erosion features, and overall surface condition. As shown in Table 1, the surface impoundment cap thicknesses at the four boring locations ranged from 2.5 feet to greater than 3.5 feet. The geotechnical properties (Atterberg Limits, and Percent Passing # 200 Sieve) of the cap material as listed in Table 1 are consistent with those recommended for industrial landfill cover systems in TCEQ Technical Guideline No. 3 (TCEQ, 2009a) and the vertical hydraulic conductivities were all better (i.e., less) than the TCEQ guideline of 1×10^{-7} cm/sec.

The cap field inspection was performed on August 3, 2006. The cap appeared to be in generally good condition with no significant desiccation cracks or erosion features observed on the cap surface or slopes. The cap surface consisted of a partially vegetated crushed oyster shell surface overlying the clay layer. Some sporadic indications of animal (e.g., crab) penetrations of the cap

surface were observed. Occasional debris (e.g., scrap wood and telephone poles) was observed on the surface and several large bushes (approximate height of three feet) were observed, mostly near the cap edges. Drilling rig and other heavy equipment (i.e. support truck) traffic across the western end of the cap in conjunction with Site investigation activities has resulted in surface rutting of the cap in this area.

Nature and Extent of COIs in Environmental Media

The nature and extent of COIs in Site environmental media was investigated in the RI through the installation and/or collection of 17 Site Intracoastal Waterway sediment samples, 9 background Intracoastal Waterway sediment samples, 4 Site Intracoastal Waterway surface water samples, 4 background Intracoastal Waterway surface water samples, 33 Site fish tissue samples, 36 background fish tissue samples, 190 South Area soil samples, 10 background soil samples, 41 off-site soil samples, 4 former surface impoundment cap soil borings, 29 North Area soil samples, 56 wetland sediment samples, 6 wetland surface water samples, 8 pond sediment samples, 6 pond surface water samples, 30 monitoring wells, 8 temporary piezometers, 5 permanent piezometers, and three soil borings. Most of these samples were analyzed for the list of COIs identified in the RI/FS Work Plan. Supplemental sampling of wetland sediments was performed in June 2010 and then additional samples were collected as part of BERA activities as described in Section 1.2.5 below. The nature and extent investigation locations (except for background sample locations) are plotted on Plate 1. The investigation conclusions as reported in the NEDR are summarized by area/media below. The extent of COIs in these media were determined through comparisons to extent evaluation comparison criteria identified in the RI/FS Work Plan as described in the NEDR.

- Intracoastal Waterway Sediments – Certain polynuclear aromatic hydrocarbons (PAHs) and 4,4'-DDT were the only COIs detected in Site Intracoastal Waterway sediment samples at concentrations exceeding extent evaluation comparison values. These exceedences were limited to sample locations within or on the perimeter of the barge slip areas. Based on these data, the lateral extent of contamination in Intracoastal Waterway sediments, as defined by COIs concentrations above extent evaluation criteria, was identified as limited to several small localized areas within the two Site barge slips. A vertical extent evaluation does not apply to this medium.

- Intracoastal Waterway Surface Water – No COIs were detected at concentrations above their respective extent evaluation criteria in Intracoastal Waterway surface water samples collected adjacent to the Site.

- South Area Soils – COIs detected in South Area soils at concentrations exceeding extent evaluation criteria included certain metals, polychlorinated biphenyls (PCBs) and PAHs. The lateral extent of contamination in South Area soils, as defined by COI concentrations above their respective extent evaluation criteria, was identified as limited to the South Area of the Site and potentially a small localized area immediately adjacent to the Site on off-site Lot 20 immediately to the west of the Site. The vertical extent of COIs at concentrations above extent evaluation criteria in unsaturated South Area soils was identified as limited to depths less than four feet, as no exceedences were observed in any of the samples from this depth.

- North Area Soils – The only COIs detected in at least one North Area soil sample at concentrations exceeding their respective extent evaluation criteria were arsenic, iron, lead, 1,2,3-trichloropropane (1,2,3-TCP), trichloroethene (TCE), benzo(a)pyrene (BaP), dibenz(a,h)anthracene, and PCBs. The lateral extent of contamination in North Area soils, as defined by these few COI exceedences, was identified as limited to several small localized areas within this part of the Site where upland soils are present (i.e., within the area surrounded by wetlands). The vertical extent of COIs at concentrations above extent evaluation criteria in North Area soils extends to the saturated zone in some locations. Within the extent of North Area soil contamination, a small localized area of buried debris (rope, wood fragments, plastic, packing material, etc.) was encountered south of the former surface impoundments (locations NE3MW05, SB-204, SB-205, and SB-206 as shown on Plate 1). The projected extent of this buried debris area was estimated based on data from these locations and a June 1974 aerial photograph in which what appears to be the area is visible (Appendix C).

- Wetland Sediments – COIs detected in at least one wetland sediment sample at concentrations exceeding their respective extent evaluation criteria included certain metals, pesticides and PAHs. The lateral extent of contamination in wetland sediments, as defined by COIs concentrations above extent evaluation criteria, was identified as limited to specific areas within the Site boundaries and small localized areas immediately

north and east of the Site. The vertical extent of COIs at concentrations above extent evaluation criteria in wetland sediments was identified as limited to the upper one foot of unsaturated sediment.

- Wetland Surface Water – Acrolein, copper, mercury, and manganese were the only COIs detected in at least one wetland surface water sample at concentrations exceeding their respective extent evaluation comparison values. The lateral extent of contamination in wetland surface water, as defined by COIs concentrations above extent evaluation criteria, was identified as limited to localized areas within and immediately north of the Site. A vertical extent evaluation does not apply to this medium.

- Ponds Sediment – Zinc and 4,4'-DDT were the only COIs detected in at least one pond sediment sample at concentrations exceeding their respective extent evaluation comparison values. These exceedences were all limited to the "Small Pond" at the Site, which effectively defined the extent of contamination in pond sediments. A vertical extent evaluation does not apply to this medium.

- Ponds Surface Water – Arsenic, manganese, silver and thallium were the only COIs detected in at least one pond surface water sample at concentrations exceeding their respective extent evaluation comparison values. The lateral extent of pond surface water contamination, as defined by these exceedences, is limited to the extent of the two ponds. A vertical extent evaluation does not apply to this medium.

- Groundwater – The uppermost water-bearing unit at the Site, Zone A, is generally encountered at an average depth of approximately 10 feet bgs and has an average thickness of approximately 8 feet. Saturated conditions were encountered at depths as shallow as several feet in some borings near the former surface impoundments and in other areas of the Site. Although some semivolatile organic compounds (SVOCs) and metals were detected in Zone A groundwater at concentrations exceeding extent evaluation comparison values, VOCs, particularly chlorinated solvents, their degradation products, and benzene, were the predominant COIs detected in groundwater. The extent of VOCs exceeding extent evaluation comparison values was generally limited to a localized area within the North Area, roughly over the southern half of the former surface impoundments area and a similarly sized area immediately to the south (Figure 5). The

next underlying water-bearing unit, Zone B, is generally encountered at an average depth of approximately 20 feet bgs and has an average thickness of approximately 7 feet. The lateral extent of contamination in this zone was limited to VOCs detected in a single well (NE3MW30B) located south of the former surface impoundments. The vertical extent of contamination in groundwater is limited to Zones A and B.

1.2.4 Contaminant Fate and Transport

Potential routes of migration for Site contaminants occur in the primary transport media of air, surface water/sediment (including runoff during storm events), and groundwater. Contaminant migration routes in these media are often interrelated. The physical and chemical characteristics of COIs and their potential transport media affect the degree of contaminant persistence and rate of migration within that media. A detailed contaminant fate and transport discussion will be provided in the RI Report (PBW, 2011b) currently in preparation. For the purposes of this RAM, key considerations from that discussion are highlighted below.

Potential Air Transport Pathways

Potential airborne contaminants at the Site consist predominantly of particles, as volatile COIs were generally not detected above screening levels in near surface (1 to 2 foot depth interval) soil samples (as specified in the Work Plan, surface soil samples were not analyzed for VOCs) and generally would not be expected to persist in surface soils. Thus potential contaminant transport via air is predominantly in the solid phase. In general, only fine-grained particles are susceptible to transport in air. COIs associated with the scrap metal present in surface fill soils in the South Area and some parts of the North Area would generally not be transported via the air pathway due to the size and density of these materials. Similarly, the predominantly vegetated and moist surface soils/sediments in the North Area are not generally conducive to dust generation and particle transport. The predominant wind direction in the region is from the southeast and south (TCEQ, 2009b). Thus, potential contaminant migration via the air transport pathway would generally be toward the north and northwest from Site Potential Source Areas (PSAs). Surface samples in the North Area generally downwind from the South Area PSAs most likely to contribute metals to surface particles, such as the sand blasting areas, did not indicate elevated concentrations of metals above extent evaluation levels, and thus airborne transport from these areas appears limited. Similarly lead concentrations in surface soil samples collected on Lots 19

and 20 directly west of the Site were relatively low and not indicative of significant air transport of contaminants from Site PSAs via entrainment and subsequent deposition of particles.

Potential Surface Water/Sediment Transport Pathways

The primary surface water/sediment pathways for potential contaminant migration from Site PSAs are: (1) erosion/overland flow to wetland areas north and east of the Site from the North Area due to rainfall runoff and storm/tide surge; and (2) erosion/overland flow to the Intracoastal Waterway from the South Area as a result of rainfall runoff and extreme storm surge/tidal flooding events. The low topographic slope of the Site and adjacent areas is not conducive to high runoff velocities or high sediment loads. Consequently, surface soil particles would not be readily transported in the solid phase. Additionally, the vegetative cover in the North Area serves to minimize soil erosion and resulting sediment load transport with surface water in these areas. Dissolved loads associated with surface runoff from the North Area would likewise be expected to be minimal due to the absence of exposed PSAs, generally low COI concentrations in North Area surface soils/sediments, and the relatively low solubilities of those COIs (primarily, pesticides, PAHs, and/or metals) that are present. Within the South Area, some PSAs, such as the sand blasting area, are exposed and COIs are present above extent evaluation levels at the ground surface. Exposed soils (primarily fill material) and indications of surface soil erosion are present within this area. Local areas of soil erosion and subsequent sediment deposition are apparent at the northern ends of the barge slips in Lots 21 and 22. The inference of surface soil erosion into the ends of the barge slips is supported by similar PAHs in sediment samples from the end of the barge slips and in nearby surface soil samples; however, the general absence of PAHs or other COIs in other areas of the barge slips toward the Intracoastal Waterway or within the waterway itself, suggests limited migration of COI-containing sediments.

Groundwater Transport Pathways

The groundwater pathway for potential transport of groundwater COIs is lateral migration within Zones A and B and vertical migration from Zone A to Zone B in areas where the clay separating Zone A and Zone B pinches out or is of minimal thickness. Vertical migration to deeper water-bearing zones below Zone B is effectively precluded by the thick (greater than 25 feet) and low vertical hydraulic conductivity (7×10^{-9} cm/sec) clay below Zone B.

Evaluations of the groundwater contaminant plume stability, the presence of potential contaminant biodegradation daughter products, and geochemical conditions favorable to biodegradation will be described in the RI report. These evaluations provide multiple lines of evidence for biodegradation of groundwater COIs and potential for limited future migration. The net overarching effect of fate and transport processes within the context of overall groundwater movement rates and directions can be assessed by considering the extent of observed contaminant migration relative to the timeframe over which that migration may have occurred. In the case of the Gulfco site, such an assessment is made through examination of the lateral extent of the primary groundwater COIs in Zone A relative to the operational period of the associated PSA, the former surface impoundments.

Barge cleaning operations at the Site began in 1971. The impoundments are visible in the 1974 aerial photograph in Appendix C. The impoundments were closed in 1982. Thus, contaminants introduced into the impoundments through barge wash waters and associated sludges have had the potential to migrate in groundwater for at least as long as 27 years (1982 to 2009) and potentially as long as 38 years (1971 to 2009). As shown on Figure 5, the lateral extent of contaminants in Zone A is generally limited to an area of approximately 200 ft or less (and in many cases, much less) from the boundary of the former surface impoundments. Dividing this distance by the potential migration period estimates of 27 to 38 years would correspond to contaminant migration rates of approximately 5 ft/year to 7 ft/year, which are consistent with both the low estimated velocity of groundwater in Zone A (discussed in the RI report) and further reductions in contaminant migration due to biodegradation. The limited extent of contaminant migration, low groundwater velocity and demonstrated contaminant degradation also predict limited potential for future migration, as is further supported by the general stability of the dissolved COI plumes.

1.2.5 Risk Assessment

Risk assessment provides a context for evaluating the significance of site contaminants, and is used to support risk management decisions for a site. Below are the summaries of the risk assessment activities for this Site. Human health and ecological receptors were considered in these evaluations under baseline conditions (i.e., prior to any remediation at the Site).

Human Health Risk Assessment

The Final BHHRA (PBW, 2010a) was submitted to EPA on March 31, 2010. The BHHRA used data collected during the RI to evaluate the completeness and potential significance of potential human health exposure pathways indentified in the Conceptual Site Model (CSM) first presented in the Work Plan. These pathways, as updated and presented in the BHHRA, are shown for the South Area in Figure 6 and for the North Area in Figure 7. The BHHRA evaluated the potential significance of the complete human health exposure pathways indicated in these figures and concluded that there were not unacceptable cancer risks or non-cancer hazard indices for any of the five current or future exposure scenarios except for future exposure to an indoor industrial worker if a building is constructed over impacted groundwater in the North Area.

Ecological Risk Assessment

The Final SLERA (PBW, 2010b) used data collected during the RI and was submitted to EPA on May 3, 2010. The SLERA concluded that it was necessary to proceed to the next phase of EPA's ecological risk assessment process by completing a BERA. The BERA addresses the potential for adverse ecological effects to the chemicals of potential ecological concern (COPECs) and receptors identified in the SLERA through a site-specific assessment. The necessity to move the ecological risk process into a site-specific BERA was based on exceedences of protective ecological benchmarks for direct contact toxicity to invertebrates in the sediment in the wetlands and Intracoastal Waterway, soil in the North Area, and surface water in the wetlands as described in the SLERA. No literature-based food chain hazard quotients (HQs) exceeded unity (1) in the SLERA and, as such, adverse risks to higher trophic level receptors are unlikely and were not evaluated further through the BERA process.

Based on the SLERA conclusions and per the study outlined in the BERA Work Plan & Sampling and Analysis Plan (BERA WP/SAP) (URS, 2010a), the BERA included analytical chemistry analysis and toxicity testing of soil, sediment, and surface water samples corresponding to a gradient of COPEC concentrations. Figures 8 and 9 show the relevant pathways and receptors of potential concern that were evaluated in the BERA. The BERA data, as presented in the PSCR (URS, 2010b), indicate the following:

- The testing of *Neanthes arenaceodentata* showed no statistically significant differences between the North Area soil samples and the reference samples.
- Toxicity testing of wetland sediment using *Neanthes arenaceodentata* and *Leptocheirus plumulosus* showed no statistically significant differences between the Site wetland sediment samples and the reference wetland samples for either the growth or mortality endpoints.
- The toxicity testing of wetland surface water using *Artemia salina* showed no consistent mortality trends.
- Toxicity testing of Intracoastal Waterway sediment using *Neanthes arenaceodentata* and *Leptocheirus plumulosus* showed no statistically significant differences between the Site Intracoastal Waterway sediment samples and the Intracoastal Waterway reference samples for either the growth or mortality endpoints.
- There were no observable trends between concentration, benchmark exceedences, and observed toxicity.

These data suggest that adverse ecological risks from direct exposure to invertebrates in the soils, sediments and surface water are unlikely. Accordingly and consistent with discussions with EPA and TCEQ representatives in the BERA data review and planning meeting on December 1, 2010, ecological-based PRGs were not developed for this Site.

The BERA Report (URS, 2011) documenting the above conclusions is currently in preparation.

2.0 IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLGIES

2.1 INTRODUCTION

As described in EPA guidance (EPA, 1988) the remedial alternatives development and screening process consists of the following six general steps:

- Development of remedial action objectives;
- Development of general response actions;
- Identification of volumes or areas to which the general response actions might be applied;
- Identification and screening of technologies applicable to each general response action;
- Identification and evaluation of technology process options to select a representative process for each technology type; and
- Assembly of representative technologies into alternatives.

Consistent with the goal of organizing this RAM to correspond to the suggested format for the technology and alternative screening sections of the FS, Sections 2.2 through 2.4 below describe how the first five steps of this process are used to select remedial technologies for consideration at the Site. The assembly of these technologies into remedial alternatives in the sixth step is described in Section 3.1.

2.2 REMEDIAL ACTION OBJECTIVES

RAOs consist of medium-specific goals for protecting human health and the environment. As such, RAOs are developed for those exposure pathways identified as posing an unacceptable risk to either: (1) human receptors as described in the BHHRA; and/or (2) ecological receptors based on data developed in the BERA. As noted previously, the BERA (URS, 2011) is currently in preparation and has not been reviewed by EPA. Based on data presented in the approved PSCR and discussions with EPA and TCEQ representatives on December 1, 2010, it is anticipated that the RAOs for this Site will not be based on ecological endpoints given the lack of potential risk to these receptors. RAOs were identified for two areas/media at the Site based on concerns related to future human health exposure: (1) the Former Surface Impoundments; and (2) North Area groundwater. The RAOs for these areas are described below.

2.2.1 Former Surface Impoundments

As noted previously, the former surface impoundments contain residual barge cleaning wash water sludge that was reportedly solidified when the impoundments were closed by capping in 1982 in accordance with the Texas Water Commission approved plan (Carden, 1982). This residual sludge, along with wash waters stored in the impoundments prior to closure, is believed to be the source of the VOCs and other chemicals detected in North Area groundwater in the impoundments vicinity. The cap inspection described previously documented the cap to be in generally good condition with no significant desiccation cracks or erosion features and generally acceptable side slopes, although some penetrations, surface debris, large bushes and surface rutting were observed. An inspection after Hurricane Ike did not indicate significant damage. In addition, a localized area of buried debris was identified immediately south of the former surface impoundments. Based on this information, the RAOs for this area are: (1) to reduce the potential for waste (i.e., residual sludge and/or buried debris) exposure, through future surface erosion and/or cap penetration; and (2) to reduce the potential for increased contaminant loading from waste to groundwater through cap failure.

Numeric PRGs have not been calculated to support this RAO because the risk issue of concern identified for the former surface impoundments is not quantifiable. Potential future exposure to buried debris and waste in the former surface impoundments is highly uncertain and may not occur, therefore, numeric PRGs are not appropriate.

2.2.2 Groundwater

The NEDR and BHHRA note that groundwater in affected water-bearing units at the Site (Zones A and B) and the next underlying water-bearing unit (Zone C) is not useable as a drinking water source due to naturally high total dissolved solids (TDS) concentrations. Consequently, the only potentially unacceptable human health risks associated with COIs detected in Site groundwater are for the pathway involving volatilization of VOCs from North Area groundwater to a hypothetical indoor air receptor. This conclusion is based on the continued stability of the current COI plume, both in terms of lateral extent in Zones A and B and the absence of COIs in deeper water-bearing units. Restrictive covenants currently in place for Lots 55 through 57 (shown on Figure 2), which encompass the area of the VOC plume (as shown on Figure 5), require EPA and TCEQ notification and approval prior to construction of any buildings on these parcels. The

covenants (included as Appendix B to this memorandum) also advise that response actions, such as protection against indoor vapor intrusion, may be necessary prior to building construction. Thus, the RAOs for contaminated groundwater are: (1) to verify, on an ongoing basis, the continued stability of the VOC plume in Zones A and B, both in terms of lateral extent and absence of impacts above screening levels to underlying water bearing units; and (2) to maintain, as necessary, protection against potential exposures to VOCs at levels posing an unacceptable risk via the groundwater to indoor air pathway.

As described in the SLERA (PBW, 2010b), there are no complete exposure pathways for ecological receptors to contact COIs in groundwater and, as such, this RAO was developed to be protective of potential future exposure to human receptors. Numeric PRGs were not calculated for this pathway since the deed restrictions will effectively prevent future exposure.

2.3 GENERAL RESPONSE ACTIONS

While RAOs are generally focused on specific potential exposure pathways, media and/or contaminant levels, general response actions describe the types of actions to be taken to satisfy the identified RAOs. As described in EPA guidance (EPA, 1988), general response actions may include treatment, containment, excavation, extraction, disposal, institutional controls, or a combination of those. General response actions, along with preliminary estimates of the area/volumes to be addressed by those response actions (as applicable) are described below for each of the two areas/media for which RAOs were identified in Section 2.2. For the purposes of this RAM, the "no action" response action is not included in the discussions below; however, consistent with EPA guidance (EPA, 1988), the "no action" alternative will be evaluated in the FS.

2.3.1 Former Surface Impoundments

The RAOs for the former surface impoundments area are: (1) to reduce the potential for waste exposure through future surface erosion and/or cap penetration; and (2) to reduce the potential for increased contaminant loading from waste to groundwater through cap failure. The general response actions to address these RAOs for the former surface impoundment residual wastes are:

- Containment;
- On-site Treatment; and
- Excavation/Off-site Management.

A containment-based response action would entail either repair/upgrade or replacement of the existing former surface impoundment cap and extension of the upgraded cap over the buried debris area. An on-site treatment-based response action would include cap removal followed by either: (1) in-situ treatment through physical, biological, or chemical means; or (2) waste/debris excavation and treatment followed by on-site disposal of the treated material. An off-site management-based response action would involve excavation of the former surface impoundment sludge material and buried debris followed by shipment to an off-site facility for treatment, and/or disposal.

The former surface impoundments share many similarities with municipal landfill sites addressed under CERCLA. As described in EPA's *Feasibility Study Analysis for CERCLA Municipal Landfill Sites* (EPA, 1994b), municipal landfill (MLF) sites on the NPL are characterized by large volumes of heterogeneous waste, frequently including municipal waste co-disposed with industrial and/or hazardous waste. The volume and characteristics of wastes at these sites along with the disposal history is variable and often uncertain, with typical COIs including a variety of VOCs, SVOCs, and potentially inorganic compounds and metals (EPA, 1994b). The former surface impoundments at the Gulfco site contain an undetermined volume of waste, consisting of a heterogeneous mixture of residual industrial sludge from former barge cleaning operations and soils reportedly added to stabilize the sludge at the time of closure. Similarly, the specific volume of buried debris observed immediately south of the former surface impoundments has not been determined.

EPA has established containment as the presumptive remedy for CERCLA MLFs (EPA, 1993). This designation was based on a review of remedial alternatives analyses performed at multiple MLFs (EPA, 1991) and is consistent with EPA expectations that containment technologies will generally be appropriate for waste that poses relatively low long-term threat or where treatment is impracticable (EPA, 1994b). As defined in the presumptive remedy guidance (EPA, 1993), containment relates primarily to containment of the landfill mass and/or treatment of landfill gas (produced by the decay of putrescible material in municipal waste within the landfill). Containment may also include leachate or groundwater control at the landfill perimeter, and/or

institutional controls, as necessary. Potential long-term groundwater response actions, if any, at MLFs are beyond the scope of the presumptive remedy. One of the purposes of a presumptive remedy is to facilitate a streamlined evaluation of remedial alternatives during the FS. In effect, the establishment of containment as a presumptive remedy fulfills the FS requirements for screening of potential remedial technologies and assembly of remedial alternatives, and allows the remedial alternatives evaluation to proceed directly to the screening of remedial alternatives.

Given the similarities of the former surface impoundments to CERCLA MLFs, the technology screening performed at multiple MLF sites to support containment as a presumptive remedy (EPA, 1994b) can effectively serve as the technology screening for the former surface impoundments at the Gulfco site. As such, Section 2.4 of this RAM includes a discussion of the technology identification and screening process for containment-based alternatives only. Similarly, Section 3.0 assembles and evaluates only containment-based alternatives. Since putrescible wastes were not reported within the former surface impoundments and were generally not observed in the debris area, production of landfill gas is not a likely concern and thus landfill gas management has not been included as a component of the containment-based remedial alternatives considered in Section 3.0. In the same way, given the nature of the waste material within the former surface impoundments and the buried debris area, the shallow water table at the Site, and the demonstrated extent and stability of the associated VOC groundwater plume, leachate collection and perimeter groundwater control are not included in the containment alternatives discussed for this area in Section 3.0.

The former surface impoundments and the buried debris area cover a projected area of approximately 3 acres, as shown on Figure 4. This acreage encompasses the entire area within the existing cap and the projected boundary of the buried debris area as estimated from the aerial photograph in Appendix C.

2.3.2 Groundwater

The RAOs for groundwater are: (1) to verify, on an ongoing basis, the continued stability of the VOC plume in Zones A and B, both in terms of lateral extent, and the absence of impacts above screening levels to underlying water-bearing units; and (2) to maintain, as necessary, protection against potential exposures to VOCs at levels posing an unacceptable risk via the groundwater to indoor air pathway. The general response actions to address these RAOs for groundwater are:

- Monitoring/Institutional Controls;
- Containment; and
- In-situ Treatment.

A monitoring/institutional controls response action would include ongoing groundwater monitoring to demonstrate continued plume stability and review/evaluation of the current restrictive covenant requiring EPA and TCEQ notification and approval prior to construction of buildings and advising protection against indoor vapor intrusion as part of any building construction. A containment response action could entail either construction of a physical barrier, such as a slurry wall to contain affected groundwater or a groundwater collection and treatment system to provide hydraulic containment. An in-situ treatment response action would involve injection of reagents to facilitate biological or chemical treatment of the VOCs such that concentrations were reduced to levels protective of the potential groundwater to indoor air pathway and potential future migration. The identification and screening of potential technologies for these general response actions is performed in Section 2.4.2. The general extent of groundwater contamination as indicated by VOC concentrations in Zone A exceeding their respective extent evaluation comparison values is shown on Figure 5. VOC isoconcentration maps providing the basis of the extent area shown in this figure are provided in the NEDR. Additional explanation of these data will be provided in the RI Report (PBW, 2011b).

2.4 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

Prior to developing remedial alternatives for the general response actions described in Section 2.3, it is necessary to identify potentially applicable remedial technologies for each area/medium and screen the technologies to select only those processes that would be potentially effective at meeting the RAOs and are implementable. In the sections below, potentially applicable remedial technologies and process options are identified for the general response actions and are screened in accordance with procedures in EPA guidance (EPA, 1988). The following screening criteria were applied to each technology/process option to determine if the technology was applicable to the specific general response action being considered, and thus worthy of more detailed analysis:

- Effectiveness
    - Potential effectiveness in meeting RAOs

  - Potential impacts to human health and the environment
  - Reliability/applicability to Site COIs and conditions

- Implementability
  - Technical/administrative feasibility of implementing the technology

- Cost
  - Capital/Operation and Maintenance (O&M) costs relative to other technologies (i.e., low, moderate, high, etc.)

2.4.1 Former Surface Impoundments

The general response actions for the former surface impoundments are:

- Containment;
- On-site Treatment; and
- Excavation/off-site management.

As described in Section 2.3.1, the former surface impoundments are similar to CERCLA MLFs for which EPA has identified containment as a presumptive remedy. As such, the technology screening presented in Table 2 for this area focuses on containment and related technologies. Institutional and access controls are evaluated in Table 2 as supporting technologies for a containment-based response action and not as a stand-alone technology. Consistent with the former surface impoundments RAOs of: (1) reducing the potential for waste (i.e., residual sludge and/or buried debris) exposure, through future surface erosion and/or cap penetration; and (2) reducing the potential for increased contaminant loading from waste to groundwater, through cap failure, three capping technologies were evaluated in Table 2. Of these, repair and upgrade of the existing cap was retained for use in developing potential remedial alternatives based on a higher effectiveness, higher implementability, and lower capital cost as described in Table 2.

2.4.3 Groundwater

The general response actions for groundwater are:

- Monitoring/Institutional Controls;
- Containment; and
- In-situ Treatment.

Table 3 presents the technologies considered for these general response actions and summarizes the screening process by which these technologies were evaluated. Two monitoring/institutional control technologies (restrictive covenants and groundwater monitoring) were included in this evaluation. Both of these were retained for further evaluation and use in developing remedial alternatives.

Four physical containment technologies were screened in Table 3. These included two slurry wall technologies, sheet piling, and permeable reaction walls (designed to let groundwater pass but contain contaminants). Due to very high costs and concerns over potential adverse impacts to large areas of Site wetlands during construction, none of these technologies were retained for further evaluation.

Containment by hydraulic control was considered through the screening of four technologies, groundwater extraction via vertical wells and three subsurface drain technologies (conventional interceptor trenches, single pass trenching drains, and horizontal wells). Due to high costs, and/or low implementability for the subsurface drain technologies, the vertical extraction well option was retained as the hydraulic control technology for further evaluation and use in developing remedial alternatives.

Twelve treatment technologies, including two biological process options, nine physical/chemical process options, and one thermal process option, were considered for management of collected groundwater. As noted in Table 3, many of these technologies were characterized by low effectiveness, relatively lower implementability, and/or moderate to high costs. As a result of this screening, low profile aeration was retained as the aqueous phase treatment technology for further evaluation and use in developing remedial alternatives. Similarly, catalytic oxidation was retained as the vapor phase treatment technology for further evaluation and use in developing remedial alternatives.

Three post-treatment discharge options were considered: on-site discharge through injection wells, off-site discharge to the City of Freeport Publically Owned Treatment Works (POTW), and direct discharge to the Intracoastal Waterway. As detailed in Table 3, the POTW discharge was the surviving option from this screening, due to less stringent treatment requirements (and thus lower treatment costs) and lesser potential implications from any treatment system upsets.

In-situ treatment technologies were evaluated through biological and chemical treatment options. Due to the low effectiveness and low implementability of these technologies at the Site, neither was retained for further evaluation.

3.0 DEVELOPMENT AND SCREENING OF ALTERNATIVES

Consistent with the remedial alternatives development and screening process described in EPA guidance (EPA, 1988) and summarized previously in Section 2.1 of this RAM, the sixth (and final step) of the process is the assembly of representative technologies retained from the screening evaluation into remedial alternatives. This step is described in Section 3.1, below, for each of the two affected media/areas for which RAOs were identified. Section 3.2 provides a screening evaluation of these alternatives for effectiveness, implementability, and cost as recommended in EPA guidance (EPA, 1988). A detailed analysis of these alternatives against the nine CERCLA evaluation criteria will be performed in the FS to be prepared upon approval of this RAM.

3.1 DEVELOPMENT OF ALTERNATIVES

Table 4 illustrates how surviving technology options for the former surface impoundments, and affected groundwater were combined into three Site-wide remedial alternatives. Brief descriptions of each of these alternatives are provided below:

- Alternative 1 – No Action. Consideration of a no action alternative is specified in EPA guidance (EPA, 1988). This alternative serves as a baseline against which other alternatives are evaluated. Under this alternative, no remedial action or institutional controls (beyond those currently in place) are implemented. This alternative effectively represents the baseline conditions evaluated in the BERA and BHHRA.

- Alternative 2 – Former Surface Impoundments Containment and Groundwater Controls/Monitoring. This alternative uses containment and institutional control technologies to address RAOs for the former surface impoundments, and affected groundwater. It includes the following: (1) upgrade/repair of the existing cap at the former surface impoundments through surface debris and brush removal from the cap, grading/compaction of the existing clay cap, placement of an additional clay layer over the existing cap, extension of the existing cap over the nearby buried debris area, placement of a topsoil layer over the clay cap, and vegetation of the cap surface; (2) deed recordation of the former surface impoundment and buried debris area, including filing of a restrictive covenant prohibiting disturbance of the cap; (3) fencing (three-strand

barbed wire) of the capped area; (4) review/evaluation of the current restrictive covenants prohibiting groundwater use on Lots 55 through 57 of the Site and requiring protection against indoor vapor intrusion for building construction on these lots; and (5) annual groundwater monitoring to confirm continued stability of the affected groundwater plume. It should be noted that the current restrictive covenants described in Item 4 above are included in Appendix B herein.

- Alternative 3 – Impoundment and Groundwater Containment. This alternative uses containment technologies to addresses RAOs for the former surface impoundments, and affected groundwater. It includes the following: (1) upgrade/repair of the existing cap at the former surface impoundments through surface debris and brush removal from the cap, grading/compaction of the existing clay cap, placement of an additional clay layer over the existing cap, extension of the existing cap over the nearby buried debris area, placement of a topsoil layer over the clay cap, and vegetation of the cap surface; (2) deed recordation of the former surface impoundment and buried debris area, including filing of a restrictive covenant prohibiting disturbance of the cap; (3) fencing (three-strand barbed wire) of the capped area; (4) review/evaluation of current restrictive covenants prohibiting groundwater use on Lots 55 through 57 of the Site and requiring protection against indoor vapor intrusion for building construction on these lots; (5) installation/operation of a series of vertical groundwater extraction wells to provide hydraulic control of affected groundwater; (6) treatment of collected groundwater using low profile aeration with off-gas treatment by catalytic oxidation; (7) discharge of treated groundwater to the City of Freeport POTW; and (8) annual groundwater monitoring to verify the effectiveness of groundwater hydraulic control.

3.2 SCREENING OF ALTERNATIVES

3.2.1 Introduction

As described in EPA guidance (EPA, 1988), remedial alternatives are developed to meet the identified RAOs for each area/medium of interest. During screening, the assembled alternatives are evaluated to ensure that they protect human health and the environment from each potential pathway of concern at the Site. Thus for the alternative screening, the assembled alternatives are

evaluated against short-term and long-term aspects of effectiveness, implementability, and cost. These criteria are defined in the EPA guidance (EPA, 1988) for alternatives screening as follows:

- Effectiveness - This criterion pertains to the effectiveness of each alternative in protecting human health and the environment and the reductions in toxicity, mobility and volume that it will achieve. Short-term effectiveness is evaluated relative to the alternative construction and implementation period. Long-term effectiveness is evaluated relative to the period after the remedial action is complete. Reduction of toxicity, mobility, or volume refers to changes in contaminant or contaminated media characteristics by the use of treatment that decreases inherent risks or threats.

- Implementability – This criterion pertains to the technical and administrative feasibility of constructing, operating, and maintaining each alternative. Technical feasibility refers to the ability to construct, reliably operate, and meet technology-specific requirements until a remedial action is complete. It also includes the operation, maintenance, replacement, and monitoring, or technical components of alternatives into the future after the remedial action is complete (as applicable). Administrative feasibility includes both the ability to obtain any necessary approvals from regulatory agencies and the availability of treatment, storage, and disposal services and capacity.

- Cost – Both capital and O&M costs are considered for this criterion. Cost evaluation is performed on a present worth basis to evaluate expenditures that occur over different time periods.

3.2.2 Alternative 1 – No Action

The no action alternative is not effective at providing additional protection of human health and the environment with regard to the identified RAOs in either the short- or long-term. Similarly, this alternative achieves no reductions in toxicity, mobility and volume. Since the alternative entails no action, it is readily implemented and has no associated capital or operation and maintenance (O&M) costs. CERCLA requires evaluation of a no action alternative, so Alternative 1 is retained for detailed analysis in the FS.

3.2.3 Alternative 2 – Impoundment Containment and Groundwater Controls/Monitoring

Alternative 2 addresses the former surface impoundments RAOs of reducing the potential for waste exposure and reducing the potential for increased contaminant loading from the impoundment wastes to groundwater by upgrading the existing cap and implementing institutional controls and fencing to protect the cap. These remedy components are effective in protecting human health and the environment during the short-term as no wastes would be exposed during construction, and they also provide long-term protection for the RAOs. No reductions in toxicity, mobility and volume of the impoundment wastes through treatment are achieved by this alternative.

The groundwater RAOs of verifying continued VOC plume stability and maintaining protection against potential VOC exposures via the groundwater to indoor air pathway are addressed by the groundwater monitoring program and by the current restrictive covenants described previously. These alternative components are effective in protecting human health and the environment in accordance with the groundwater RAOs. No reductions in toxicity, mobility and volume of groundwater contamination through added treatment are achieved by this alternative; however, it should be noted that the natural attenuation processes occurring in Site groundwater provide natural biological treatment that would, over time, be expected to provide a reduction in toxicity, mobility, and/or volume.

All components of Alternative 2 are readily implemented. Cap upgrades, fencing, institutional controls and monitoring programs are all commonly used technologies that are very feasible from both technical and administrative perspectives.

A preliminary cost evaluation of Alternative 2 for the purposes of this alternative screening is provided in Table 5. Key assumptions regarding cap upgrade material volumes, fencing lengths, and monitoring program requirements are listed in this table. The preliminary total present worth cost, including contingencies for this alternative is projected at $ 700,000.

This preliminary screening determined that Alternative 2 is effective, implementable and of estimable cost. Thus Alternative 2 is retained for a more detailed analysis in the FS.

3.2.4 Alternative 3 – Impoundment and Groundwater Containment

Alternative 3 addresses the former surface impoundments RAOs of reducing the potential for waste/debris exposure and reducing the potential for increased contaminant loading from the impoundment wastes to groundwater by upgrading the existing cap, and implementing institutional controls and fencing to protect the cap. These remedy components are effective in protecting human health and the environment during the short-term as no wastes would be exposed during construction, and they also provide long-term protection for the RAOs. No reductions in toxicity, mobility and volume of the impoundment wastes through treatment are achieved by this alternative.

The groundwater RAOs of verifying continued VOC plume stability and maintaining protection against potential VOC exposures via the groundwater to indoor air pathway are addressed through hydraulic control of groundwater and by the restrictive covenants described previously. Hydraulic control of groundwater is maintained by groundwater extraction, treatment by air stripping and discharge to the City of Freeport POTW. These alternative components are effective in protecting human health and the environment in accordance with the groundwater RAOs. Although some reductions in toxicity, mobility and volume of groundwater contamination through treatment are achieved by this alternative, the groundwater objective is containment and thus toxicity, mobility and volume reductions to levels obviating the need for ongoing containment are not expected. The natural attenuation processes occurring in Site groundwater that provide natural biological treatment mentioned previously may also over time provide reductions in toxicity, mobility, and/or volume.

All components of Alternative 3 are readily implemented. Off-site waste disposal, cap upgrades, fencing, institutional controls and groundwater extraction and treatment are all commonly used technologies that are very feasible from both technical and administrative perspectives. Adequate off-site waste management capacity is available through multiple commercial facilities. Although not confirmed, it is reasonable to expect adequate sanitary sewer line and treatment capacity is available at the City of Freeport POTW. In-depth discussions with the City regarding capacity, pre-treatment requirements, etc. would be needed prior to further consideration of this alternative.

A preliminary cost evaluation of Alternative 3 for the purposes of this alternative screening is provided in Table 6. Key assumptions regarding cap upgrade material volumes, fencing lengths,

groundwater extraction/treatment rates, and monitoring program requirements are listed in this table. The preliminary total present worth cost, including contingencies for this alternative is projected at $ 3,500,000.

This preliminary screening determined that Alternative 3 is effective, implementable and of estimable cost. Thus Alternative 3 is retained for a more detailed analysis in the FS.

4.0 CONCLUSIONS

The purpose of the RAM is to develop a range of remedial alternatives and screen those alternatives in relation to the RAOs in order to allow a more detailed analysis of alternatives in the FS. RAOs were identified for two areas/media at the Site based on concerns related to future human health exposure: (1) the Former Surface Impoundments; and (2) North Area groundwater. The RAOs for the former surface impoundments area are: (1) to reduce the potential for waste exposure through future surface erosion and/or cap penetration; and (2) to reduce the potential for increased contaminant loading from waste to groundwater through cap failure. The RAOs for groundwater are: (1) to verify, on an ongoing basis, the continued stability of the VOC plume in Zones A and B, both in terms of lateral extent, and the absence of impacts above screening levels to underlying water-bearing units; and (2) to maintain, as necessary, protection against potential exposures to VOCs at levels posing an unacceptable risk via the groundwater to indoor air pathway.

General response actions were identified to address the above RAOs. Remedial technologies potentially applicable to those general response actions were screened and the surviving technologies were then assembled into remedial alternatives. Based on this process the following remedial alternatives were developed:

- Alternative 1 – No Action. Under this alternative, no remedial action or institutional controls (beyond those currently in place) are implemented. This alternative serves as a baseline against which other alternatives are evaluated.

- Alternative 2 – Former Surface Impoundments Containment and Groundwater Controls/Monitoring. This alternative uses containment and institutional control technologies to addresses RAOs for the former surface impoundments, and affected groundwater. It includes the following: (1) upgrade/repair of the existing cap at the former surface impoundments through surface debris and brush removal from the cap, grading/compaction of the existing clay cap, placement of an additional clay layer over the existing cap, extension of the existing cap over the nearby buried debris area, placement of a topsoil layer over the clay cap, and vegetation of the cap surface; (2) deed recordation of the former surface impoundment and buried debris area, including filing of a restrictive covenant prohibiting disturbance of the cap; (3) fencing (three-strand

barbed wire) of the capped area; (4) review/evaluation of current restrictive covenants prohibiting groundwater use on Lots 55 through 57 of the Site and requiring protection against indoor vapor intrusion for building construction on these lots; and (5) annual groundwater monitoring to confirm continued stability of the affected groundwater plume.

- Alternative 3 – Impoundment and Groundwater Containment. This alternative uses containment technologies to addresses RAOs for the former surface impoundments, and affected groundwater. It includes the following: (1) upgrade/repair of the existing cap at the former surface impoundments through surface debris and brush removal from the cap, grading/compaction of the existing clay cap, placement of an additional clay layer over the existing cap, extension of the existing cap over the nearby buried debris area, placement of a topsoil layer over the clay cap, and vegetation of the cap surface; (2) deed recordation of the former surface impoundment and buried debris area, including filing of a restrictive covenant prohibiting disturbance of the cap; (3) fencing (three-strand barbed wire) of the capped area; (4) review/evaluation of current restrictive covenants prohibiting groundwater use on Lots 55 through 57 of the Site and requiring protection against indoor vapor intrusion for building construction on these lots; (5) installation/operation of a series of vertical groundwater extraction wells to provide hydraulic control of affected groundwater; (6) treatment of collected groundwater using low profile aeration with off-gas treatment by catalytic oxidation; (7) discharge of treated groundwater to the City of Freeport POTW; and (8) annual groundwater monitoring to verify the effectiveness of groundwater hydraulic control.

These three alternatives were screened against the initial criteria of short-term and long-term aspects of effectiveness, implementability, and cost. As a result of that process, all three were retained for a detailed analysis relative to the full suite of nine CERCLA evaluation criteria in the FS.

5.0 REFERENCES

Carden, Clair A., 1982. Fish Marine Services, Freeport, Texas, Pond Closure Certification. August 18.

City of Freeport (Freeport), 2009. Code of Ordinances. American Legal Publishing. http://www.amlegal.com/nxt/gateway.dll/Texas/freeport_tx/cityoffreeporttexascodeofordinances?f=templates$fn=default.htm$3.0$vid=amlegal:freeport_tx. Accessed June 25, 2009.

Fish Engineering & Construction, Inc. (Fish), 1981. Letter from G.J. Gill to Texas Department of Water Resources (TDWR). November 17.

Guevara, Jairo, 1989, Record of Communication for Reconnaissance Inspection of Former Surface Impoundments of Fish Engineering & Construction, Inc. November 28.

Pastor, Behling & Wheeler, LLC (PBW), 2006. Final RI/FS Work Plan, Gulfco Marine Maintenance Site, Freeport, Texas. May 16.

Pastor, Behling & Wheeler, LLC (PBW), 2009. Final Nature and Extent Data Report, Gulfco Marine Maintenance Site, Freeport, Texas. May 20, 2009.

Pastor, Behling & Wheeler, LLC (PBW), 2010a. Final Baseline Human Health Risk Assessment, Gulfco Marine Maintenance Site, Freeport, Texas. March 31.

Pastor, Behling & Wheeler, LLC (PBW), 2010b. Final Screening-Level Ecological Risk Assessment Report, Gulfco Marine Maintenance Site, Freeport, Texas. May 3.

Pastor, Behling & Wheeler, LLC (PBW), 2011a. Tank Removal Action Report, Gulfco Marine Maintenance Site, Freeport, Texas. In preparation.

Pastor, Behling & Wheeler, LLC (PBW), 2011b. Remedial Investigation Report, Gulfco Marine Maintenance Site, Freeport, Texas. In preparation.

Texas Commission on Environmental Quality (TCEQ), 2009a. Technical Guideline No. 3 – Landfills. Revised June 12.

Texas Commission on Environmental Quality (TCEQ), 2009b. Houston Intercontinental Airport Wind Rose. http://www.tceq.state.tx.us/assets/public/compliance/monops/air/windroses/iahall.gif. Accessed July 3, 2009.

Texas Department of Water Resources, 1982a. Letter to Mr. C. J. Gill, Fish Engineering and Construction, Inc. February 26.

Texas Department of Water Resources, 1982b. Letter to Mr. C. J. Gill, Fish Engineering and Construction, Inc. May 21.

Texas Natural Resource Conservation Commission (TNRCC), 2000. Screening Site Inspection Report, Gulfco Marine Maintenance, Inc. Freeport, Brazoria County, Texas TXD 055 144 539. Prepared in cooperation with the U.S. Environmental Protection Agency. July.

Texas Water Commission (TWC), 1985. Technical Guideline No. 1 - Waste Evaluation/Classification. Revised December 6.

United States Environment Protection Agency (EPA), 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (Interim Final). OSWER Directive 9355.3-01. EPA/540/G-89/004. October.

United States Environment Protection Agency (EPA), 1989a. Determining When Land Disposal Restrictions (LDRs) Are Applicable to CERCLA Response Actions. Superfund LDR Guide #5. OSWER Directive 9347.03-05FS. July.

United States Environment Protection Agency (EPA), 1989b. RCRA ARARs: Focus on Closure Requirements. OSWER Directive 9234.0-04FS. October.

United States Environment Protection Agency (EPA), 1991. Conducting Remedial Investigations/Feasibility Studies for CERCLA Municipal Landfill Sites. OSWER Directive 9355.3-11. EPA/540/P-91/001. February.

United States Environment Protection Agency (EPA), 1993. Presumptive Remedy for CERCLA Municipal Landfill Sites. OSWER Directive 9355.0-49FS. EPA/540/F-93/035. September.

United States Environment Protection Agency (EPA), 1994a. Considering Wetlands at CERCLA Sites. OSWER Publication 9280.0-03. EPA/540/R-94/019. May.

United States Environment Protection Agency (EPA), 1994b. Feasibility Study Analysis for CERCLA Municipal Landfill Sites. OSWER Directive 9356.0-03. EPA/540/R-94/081. August.

United States Environment Protection Agency (EPA), 2000. A Guide to Developing and Documenting Cost Estimates During the Feasibility Study. OSWER Directive 9355.0-75. EPA/540/R-00/002. July.

United States Fish and Wildlife Service (USFWS), 2008. National Wetlands Inventory, Online Wetlands Mapper. http://wetlandsfws.er.usgs.gov/wtlnds/launch.html. Accessed July 9, 2008.

URS Corporation (URS), 2010a, Final Baseline Ecological Risk Assessment Work Plan & Sampling and Analysis Plan, Gulfco Marine Maintenance Site, Freeport, Texas. September 2.

URS Corporation (URS), 2010b, Final Preliminary Site Characterization Report, Gulfco Marine Maintenance Site, Freeport, Texas. November 30.

URS Corporation (URS), 2011, Baseline Ecological Risk Assessment Report, Gulfco Marine Maintenance Site, Freeport, Texas. In preparation.

TABLES

TABLE 1 - FORMER SURFACE IMPOUNDMENTS CAP MATERIAL DATA

Boring Location	Cap Material Description[1]	Observed Cap Thickness (ft)	Liquid Limit[2] (%)	Plastic Limit[2] (%)	Plasticity Index[2] (%)	Percent Passing # 200 Sieve[3] (%)	Moisture Content[4] (%)	Vertical Hydraulic Conductivity[5] (cm/sec)
ND1GT01	Sandy Lean Clay	2.9	48	16	32	70	20	3.5×10^{-8}
ND2GT02	Lean Clay with Sand	>3.5	49	14	35	84	23	1.4×10^{-8}
NE1GT03	Lean Clay with Sand	2.5	49	13	35	74	19	5.0×10^{-9}
NE2GT04	Fat Clay	3.6	58	15	43	88	26	5.9×10^{-9}
TCEQ Technical Guideline No. 3 Recommended Value/Range			--	--	10 - 35	>20	--	$<1.0 \times 10^{-7}$

Notes:
1. Crushed oyster shell surface observed above clay cap at all four boring locations.
2. ASTM Method D 4318
3. ASTM Method D 1140
4. ASTM Method D 2216
5. US Army Corps of Engineers, Engineering Manual Method 1110-2-1906

TABLE 2 – SCREENING OF FORMER SURFACE IMPOUNDMENT REMEDIATION TECHNOLOGIES

General Response Action	Remedial Technology	Process Options	Description	Effectiveness	Implementability	Relative Cost	Site Considerations / Comments	Retained for Further Consideration ?	Reason for Elimination
Institutional and Access Controls	Access and Land Use Controls	Deed Recordation/ Restrictive Covenants	Deed recordation of solid waste management unit. Restrictive covenant prohibiting disturbance of cap.	High - effective when combined with capping technology.	High – easily implemented	Low Capital Low O&M	Supporting technology for containment response action.	**Yes**	NA
		Fencing	Construction/ maintenance of barbed wire fence to protect against unauthorized (trespasser) access to cap.	High – effective when combined with capping technology.	High – easily implemented	Low Capital Low O&M	Supporting technology for containment response action.	**Yes**	NA
Containment	Capping	Existing Cap Upgrade	Upgrade/ repair of existing cap through debris/ brush removal, extension over buried debris, and surface slope/drainage improvement.	High – reduces potential for waste exposure and increased contaminant loading to groundwater. Minimal impact to adjacent wetlands.	High – easily implemented	Low Capital Low O&M		**Yes**	NA

TABLE 2 – SCREENING OF FORMER SURFACE IMPOUNDMENT REMEDIATION TECHNOLOGIES

General Response Action	Remedial Technology	Process Options	Description	Effectiveness	Implementability	Relative Cost	Site Considerations / Comments	Retained for Further Consideration ?	Reason for Elimination
		Cap Removal/ Replacement with New Clay Cap	Removal of existing cap, construction of new 3 foot compacted clay cap with vegetated cover.	Moderate – high long term effectiveness, but exposes waste during construction and expanded construction activities may have impacts on adjacent wetlands.	Moderate	Moderate Capital Low O&M	Would require off-site disposal of existing cap material.	No	Lower effectiveness, implementability, and higher cost than existing cap upgrade.
		Cap Removal/ Replacement with New RCRA Cap	Removal of existing cap, construction of new RCRA cap (clay liner, FML, drainage layer/ geotextile, and vegetated cover).	Moderate – high long term effectiveness, but exposes waste during construction and expanded construction activities may have impacts on adjacent wetlands.	Moderate	High Capital Low O&M	Would require off-site disposal of existing cap material.	No	Lower effectiveness, implementability, and higher cost than existing cap upgrade.

TABLE 3 – SCREENING OF GROUNDWATER REMEDIATION TECHNOLOGIES

General Response Action	Remedial Technology	Process Options	Description	Effectiveness	Implementability	Relative Cost	Site Considerations / Comments	Retained for Further Consideration?	Reason for Elimination
Monitoring/ Institutional Controls	Access and Land Use Controls	Restrictive Covenants	Restrictive covenant prohibiting groundwater use and requiring protection against indoor vapor intrusion for building construction.	High – protects against direct exposure to contaminated groundwater and potential exposure to VOCs from the groundwater to indoor air pathway.	High - Easily Implemented	Low Capital Low O&M	Does not address RAO for verification of plume stability, so must be combined with groundwater monitoring to be completely effective.	**Yes**	NA
	Monitoring	Groundwater Monitoring	Annual monitoring of wells near former surface impoundments to confirm continued plume stability.	High – provides direct evaluation of continued plume stability.	High - Easily Implemented	Low Capital Moderate O&M	Does not address RAO for protecting against potential exposures to VOCs via groundwater to indoor air pathway, so would need to be combined with restrictive covenant.	**Yes**	NA
Physical Containment	Vertical Barriers	Excavated Slurry Wall	Trench excavated to clay below Zone B (approx. depth of 40 feet) and filled with soil/ bentonite (or attapulgite) slurry. Wall formed in – situ.	Moderate –high long term effectiveness through physical barrier against contaminated groundwater migration. Likely to have significant short-term effects on wetlands.	Moderate – high TDS groundwater will likely require specialized slurry (attapulgite). May be difficult to work in wetland area.	Very High Capital Low O&M	Does not address RAO for protecting against potential exposures to VOCs via groundwater to indoor air pathway, so would need to be combined with restrictive covenant.	No	Very high capital cost, potential impacts to wetlands.

TABLE 3 – SCREENING OF GROUNDWATER REMEDIATION TECHNOLOGIES

General Response Action	Remedial Technology	Process Options	Description	Effectiveness	Implementability	Relative Cost	Site Considerations / Comments	Retained for Further Consideration?	Reason for Elimination
		Vibrating Beam Slurry Wall	Vibrating beam forced into ground with cement bentonite (attapulgite) slurry and FML installed as beam is withdrawn. Wall formed in-situ.	Moderate –high long term effectiveness through physical barrier against contaminated groundwater migration. Likely to have significant short-term effects on wetlands.	Moderate – may be difficult to work in wetland area.	Very High Capital Low O&M	Does not address RAO for protecting against potential exposures to VOCs via groundwater to indoor air pathway, so would need to be combined with restrictive covenant.	No	Very high capital cost, potential impacts to wetlands.
		Sheet Piling	Steel/concrete piling driven through soil into clay below Zone B (approx. depth of 40 feet).	Moderate – long term effectiveness may be reduced by corrosivity of high TDS groundwater. Likely to have significant short-term effects on wetlands.	Moderate – may be difficult to work in wetland area.	Very High Capital Low O&M	Does not address RAO for protecting against potential exposures to VOCs via groundwater to indoor air pathway, so would need to be combined with restrictive covenant.	No	Very high capital cost, potential impacts to wetlands.

TABLE 3 – SCREENING OF GROUNDWATER REMEDIATION TECHNOLOGIES

General Response Action	Remedial Technology	Process Options	Description	Effectiveness	Implementability	Relative Cost	Site Considerations / Comments	Retained for Further Consideration?	Reason for Elimination
		Permeable Reaction Wall	Excavated trench perpendicular to groundwater flow direction filled with material to treat groundwater as it flows across trench.	Moderate – has shown to be effective for chlorinated VOCs, but effectiveness complicated by potential plugging due to high TDS. Likely to have significant short-term effects on wetlands.	Low – would require excavation to base of Zone B (approx. depth of 35 feet), variable groundwater flow direction would require significant wall length to intercept all potential flow directions.	Very High Capital Low O&M	Does not address RAO for protecting against potential exposures to VOCs via groundwater to indoor air pathway, so would need to be combined with restrictive covenant.	No	Very high capital cost, potential impacts to wetlands.
Collection for Hydraulic Containment	Groundwater Extraction	Extraction Wells	Series of wells drilled through soil to extract groundwater. Would require extraction from two uppermost water-bearing units.	Moderate – Low permeability water-bearing units may require close well spacing.	Moderate – will likely require numerous wells in two water-bearing units.	Moderate Capital Moderate O&M	Does not address RAO for protecting against potential exposures to VOCs via groundwater to indoor air pathway, so would need to be combined with restrictive covenant.	**Yes**	NA
	Subsurface Drains	Interceptor Trenches	Trench excavated to base of Zone B and perforated pipe/porous media installed to collect groundwater.	Moderate - Effective for low permeability soils. Likely to have significant short-term effects on wetlands.	Moderate – May be difficult to implement. Projected depth approx. 35 feet.	High Capital Low O&M	Significant excavation required.	No	High capital cost, potential impacts to wetlands, implementa-tion difficulties.

TABLE 3 – SCREENING OF GROUNDWATER REMEDIATION TECHNOLOGIES

General Response Action	Remedial Technology	Process Options	Description	Effectiveness	Implementability	Relative Cost	Site Considerations / Comments	Retained for Further Consideration?	Reason for Elimination
		Single Pass Trenching	Modified trenching method. Installs pipe and porous media in one continuous process.	Moderate - Effective for low permeability soils. Likely to have significant short-term effects on wetlands.	Low - difficult to implement. Max installation depth (without benching) typically 25 feet.	High Capital Low O&M	Cannot be installed to required depth without significant excavation.	No	High capital cost, low implement-ability.
		Horizontal Wells	Directional drilling methods used to install a lateral collection well at desired depth.	Moderate – generally more effective than vertical wells for large areas with low permeability water-bearing units.	Low - difficult to implement. Would require wells in multiple water-bearing units.	High Capital Low O&M	Not cost effective for trench length required.	No	High capital cost, low implement-ability.
On-site Treatment of Collected Ground-water	Biological	Aerobic	In - vessel degradation of organics by micro-organisms in an aerobic environmental.	Low - chlorinated organics toxic / inhibitory to conventional biological systems.	High	Moderate Capital Moderate O&M		No	Low effectiveness
		Anaerobic	In – vessel degradation of organics by micro-organisms in an anaerobic environmental.	Low - chlorinated organics toxic / inhibitory to conventional biological systems.	High	Moderate Capital Moderate O&M		No	Low effectiveness

TABLE 3 – SCREENING OF GROUNDWATER REMEDIATION TECHNOLOGIES

General Response Action	Remedial Technology	Process Options	Description	Effectiveness	Implementability	Relative Cost	Site Considerations / Comments	Retained for Further Consideration?	Reason for Elimination
	Physical / Chemical	Precipitation / Sedimentation	Adjustments to chemical equilibrium to separate contaminants through settling or flotation.	Effective for sludge separation. Not effective for organics.	Moderate	Moderate Capital Moderate O&M		No	Not effective for organics.
		Packed Tower Aeration	Water and air passed through a media column to facilitate transfer of volatile contaminants from water to air.	High - effective for organics found in groundwater. Typical application for high flow rates.	Moderate – potential scaling/ fouling issues may complicate implementability.	Moderate Capital Moderate O&M	Not a destruction technology. Organic vapors will require emission controls. Chemical addition may be needed to address potential scaling/ fouling issues.	No	Similar performance to low profile aeration, but slightly lower implement-ability and higher O&M costs.
		Low Profile Aeration	Water and air passed through a series of trays to facilitate transfer of volatile contaminants from water to air.	High - effective for organics found at Site. Typical application for lower flow rates.	High – handles scale/fouling issues more easily than packed tower.	Moderate Capital Moderate O&M	Not a destruction technology. Organic vapors will require emission controls. Chemical addition may be needed to address potential scaling/ fouling issues.	**Yes**	

TABLE 3 – SCREENING OF GROUNDWATER REMEDIATION TECHNOLOGIES

General Response Action	Remedial Technology	Process Options	Description	Effectiveness	Implementability	Relative Cost	Site Considerations / Comments	Retained for Further Consideration?	Reason for Elimination
		Bubble Aeration	Diffused air applied to water in a baffled vessel to facilitate transfer of volatile contaminants from water to air.	High - effective for organics found at Site.	Low – will require significant vapor control / management.	Moderate Capital Moderate O&M	Not a destruction technology. Organic vapors will require emission controls.	No	Low implement-ability
		High Temperature Stripping	Similar to packed tower aeration, except water is heated to increase volatility of Compounds to improve removal efficiency.	High - effective for organics found at Site.	High – relatively easy to implement. Most applicable for semi-volatile organics.	High Capital Moderate O&M	Not a destruction technology. Organic vapors will require emission controls.	No	High cost
		Carbon Adsorption	Adsorption of dissolved contaminants onto granular activated carbon.	Low – not effective for all organics found at site.	Moderate - potentially complicated by sludge / high dissolved solids in groundwater.	Low Capital Variable O&M	Not a destruction technology. Carbon replaced / regenerated when adsorption capacity reached. Upstream filtration required to prevent clogging.	No	Low effectiveness.

TABLE 3 – SCREENING OF GROUNDWATER REMEDIATION TECHNOLOGIES

General Response Action	Remedial Technology	Process Options	Description	Effectiveness	Implementability	Relative Cost	Site Considerations / Comments	Retained for Further Consideration?	Reason for Elimination
		Reverse Osmosis	Under high pressures, groundwater forced through a membrane which removes contaminants.	Low - not effective for organics.	Low - complicated by high dissolved solids in groundwater.	Moderate Capital Moderate O&M	Not applicable to organics in groundwater.	No	Low effectiveness.
		Ion Exchange	Groundwater passes through a bed of resin where ions in the water are exchanged with ions from the resin.	Low - not effective for organics.	Low - complicated by high dissolved solids in groundwater.	Moderate Capital Moderate O&M	Not applicable to organics in groundwater.	No	Low effectiveness.
		UV Oxidation	Ozone, hydrogen peroxide and / or UV radiation applied to groundwater to destroy contaminants.	High - effective for organics found at site.	Moderate - complicated by high dissolved solids in groundwater.	Moderate Capital Moderate O&M	Organics converted to carbon dioxide and water.	No	Lower implement-ability and higher overall cost than other physical technologies.
	Thermal Destruction	Catalytic Combustion	Direct injection of water for combustion in the presence of a catalyst in a refractory lined vessel.	High - effective destruction of organics.	High	High Capital High O&M		No	High cost

TABLE 3 – SCREENING OF GROUNDWATER REMEDIATION TECHNOLOGIES

General Response Action	Remedial Technology	Process Options	Description	Effectiveness	Implementability	Relative Cost	Site Considerations / Comments	Retained for Further Consideration?	Reason for Elimination
On-site Treatment of Air Emissions from Ground water Treatment Process	Physical / Chemical	Carbon Adsorption	Vapor phase adsorption of VOCs onto carbon.	Low – not effective for all VOCs (e.g., methylene chloride)	Moderate – relatively easy to install, but frequent carbon vessel change outs and monitoring likely required.	Low Capital High O&M (due to high carbon usage).	Not effective for all VOCs and high carbon usage for others.	No	Low effectiveness, high cost.
	Thermal	Catalytic Oxidation	Passes heated air over specialized oxidation catalyst.	High – effective for mixed VOC airstreams.	Moderate – will require natural gas or propane supply	High Capital Moderate O&M	Will likely require caustic scrubber to neutralize acid vapors.	**Yes**	
		Thermal Destruction	Combustion of organic vapors at temperatures >1,000 °F	High	Moderate – will require natural gas or propane supply	High Capital High O&M	Will likely require caustic scrubber to neutralize acid vapors.	No	Higher cost than catalytic oxidation.
Discharge	On-site Discharge	Injection wells	Injection of treaded groundwater to shallow aquifer.	Moderate - may increase gradients across site and increase rate of groundwater extraction.	Low - Low permeability water-bearing units may require numerous injection wells. Significant potential for well scaling/fouling.	Moderate Capital Moderate O&M	May alter groundwater flow direction. Would need to meet substantive injection well permit requirements.	No	Low implement-ability
	Off-site Discharge	Publically Owned Treatment Works (POTW)	Discharge of treated groundwater to City of Freeport POTW.	High - effective discharge method. Lower potential implications from treatment system upset than for direct ICWW discharge.	High – Potentially easily implemented. Treatment requirements and capacity of sewers in vicinity of Site would need to be determined.	Low Capital Low O&M	Discharge permit/contact required. Effluent monitoring required. Sewer line located adjacent to Site.	**Yes**	

TABLE 3 – SCREENING OF GROUNDWATER REMEDIATION TECHNOLOGIES

General Response Action	Remedial Technology	Process Options	Description	Effectiveness	Implementability	Relative Cost	Site Considerations / Comments	Retained for Further Consideration?	Reason for Elimination
		Intracoastal Waterway (ICWW)	Discharge of treated groundwater to ICWW.	High - effective discharge method. More stringent effluent requirements (and thus higher treatment cost) than POTW.	High - easily implemented.	Low Capital Low O&M	TPDES permit required. Effluent monitoring required.	No	Higher treatment costs than POTW discharge option due to more stringent effluent standards. Higher potential implications from treatment system upset than POTW discharge option.
In-situ Treatment	Biological Treatment	Enhancement of existing biological processes in groundwater	Uses system of injection and extraction wells and/or probes to introduce reagents designed to promote/ enhance natural anaerobic processes conducive to VOC bioremediation	Low - has shown to be effective for chlorinated VOCs, but effectiveness complicated by generally low permeability of water-bearing units which would make complete reagent delivery difficult.	Low – will likely require numerous wells in two water-bearing units.	Moderate Capital Moderate O&M		No	Low effectiveness Low implement-ability

TABLE 3 – SCREENING OF GROUNDWATER REMEDIATION TECHNOLOGIES

General Response Action	Remedial Technology	Process Options	Description	Effectiveness	Implementability	Relative Cost	Site Considerations / Comments	Retained for Further Consideration?	Reason for Elimination
	Chemical Treatment	In-situ addition of chemical reagents to oxidize or reduce groundwater contaminants.	Uses system of injection and extraction wells and/or probes to introduce chemical reagents designed to chemically oxidize or reduce groundwater contaminants.	Low - has shown to be effective for chlorinated VOCs, but effectiveness complicated by generally low permeability of water-bearing units which would make complete reagent delivery difficult.	Low – will likely require numerous wells in two water-bearing units.	Moderate Capital Moderate O&M		No	Low effectiveness Low implement-ability

TABLE 4 – SITE-WIDE REMEDIAL ALTERNATIVES

General Response Action		1 No Action	2 Impoundment Containment and Groundwater Controls / Monitoring	3 Impoundment and Groundwater Containment
Area/ Medium	Technology/ Option			
Former Surface Impoundments	No Action	●		
	Deed Recordation/ Restrictive Covenants		●	●
	Fencing		●	●
	Existing Cap Upgrade		●	●
Groundwater	No Action	●		
	Restrictive Covenants		●	●
	Monitoring		●	●
	Extraction via Vertical Wells			●
	Low Profile Aeration			●
	Catalytic Oxidation			●
	Discharge to POTW			●

TABLE 5 - ALTERNATIVE 2 SCREENING-LEVEL COST EVALUATION

Component No.	Component Description	Key Assumptions	Quantity	Unit	Unit Cost	Estimated Cost Capital	Estimated Cost Annual O&M
1	**Cap Upgrade**						
	Contractor Mobilization		1	LS		$10,000	-
	Site Preparation, Brush/Debris Removal		4	acre	$3,000	$12,000	-
	Surface Grading/Recompaction of Existing Cap		3	acre	$5,000	$15,000	-
	Clay Cap Extension		3,500	cy	$20	$70,000	-
	Top Soil		6,600	cy	$20	$132,000	-
	Vegetation		136,000	sf	$0.04	$5,440	-
	Engineering Design/Project Management/ Construction Management/ Reporting	Assumed at 30% of construction components cost (per EPA, 2000).				$73,332	-
	Maintenance (mowing)		1	LS		$0	$2,000
	Inspection	Semi-annual and after major storms.	4	events	$500	$0	$2,000
	Future Cap Repair	Assumes $5,000 repair every 5th year.				$0	$1,000
	Cap Upgrade Subtotal					**$317,772**	**$5,000**
2	**Institutional Controls**						
	Deed Recordation/Restrictive Covenant	Includes review/evaluation of current restrictive covenants, and deed recordation of the former surface impoundment and buried debris area, including filing of a restrictive covenant prohibiting disturbance of the cap	1	LS		$10,000	-
	Institutional Controls Subtotal					**$10,000**	**$0**
3	**Fencing**						
	Fence Construction	Barbed wire fence with gate at south end. Fence area is 375 ft. by 485 ft. Fence inspection/repair included in cap inspection and repair costs.	1,720	ft	$3	$5,160	-
	Fencing Subtotal					**$5,160**	**$0**

TABLE 5 - ALTERNATIVE 2 SCREENING-LEVEL COST EVALUATION

Component No.	Component Description	Key Assumptions	Quantity	Unit	Unit Cost	Estimated Cost Capital	Estimated Cost Annual O&M
4	**Groundwater Monitoring**						
	Groundwater Monitoring	Assumes annual sampling of 9 Zone A wells, 4 Zone B wells, 1 Zone C well with analyses for VOCs.	1	LS			$11,400
	Well Repair/Replacement	Assumes repair of well head/protective casing required at 2 wells per year.	2	wells	$500		$1,000
	Plugging/abandonment of monitoring wells no longer in use.	Assumes plugging of 20 Zone A wells (wells in South Area and MW05 (due to location within expanded cap area).	1	LS		$10,000	-
	Groundwater Monitoring Subtotal					**$0**	**$11,400**
	Subtotal					**$333,000**	**$16,400**
	Contingency	Assumed at 20% (10% scope + 10% bid) per EPA, 2000.				$67,000	$3,300
	Subtotal with Contingency					$400,000	$19,700
	Present Worth of Annual Costs	Assume 30 years at 5% discount factor.				$303,000	
	Total Preliminary Estimated Cost	Includes present worth of annual costs.				**$700,000**	

Notes:
[1]LS = Lump Sum Estimate

TABLE 6 - ALTERNATIVE 3 SCREENING-LEVEL COST EVALUATION

Component No.	Component Description	Key Assumptions	Quantity	Unit	Unit Cost	Estimated Cost	
						Capital	Annual O&M
1	**Cap Upgrade**						
	Contractor Mobilization		1	LS		$10,000	-
	Site Preparation, Brush/Debris Removal		4	acre	$3,000	$12,000	-
	Surface Grading/Recompaction of Existing Cap		3	acre	$5,000	$15,000	-
	Clay Cap Extension		3,500	cy	$20	$70,000	-
	Top Soil		6,600	cy	$20	$132,000	-
	Vegetation		136,000	sf	$0.04	$5,440	-
	Engineering Design/Project Management/ Construction Management/ Reporting	Assumed at 30% of construction components cost (per EPA, 2000).				$73,332	-
	Maintenance (mowing)		1	LS		$0	$2,000
	Inspection	Semi-annual and after major storms.	4	events	$500	$0	$2,000
	Future Cap Repair	Assumes $5,000 repair every 5th year.				$0	$1,000
	Cap Upgrade Subtotal					**$317,772**	**$5,000**
2	**Institutional Controls**						
	Deed Recordation/Restrictive Covenant	Includes review/evaluation of current restrictive covenants, and deed recordation of the former surface impoundment and buried debris area, including filing of a restrictive covenant prohibiting disturbance of the cap	1	LS		$10,000	-
	Institutional Controls Subtotal					**$10,000**	**$0**
3	**Fencing**						
	Fence Construction	Barbed wire fence with gate at south end. Fence area is 375 ft. by 485 ft. Fence inspection/repair included in cap inspection and repair costs.	1,720	ft	$3	$5,160	-
	Fencing Subtotal					**$5,160**	**$0**

TABLE 6 - ALTERNATIVE 3 SCREENING-LEVEL COST EVALUATION

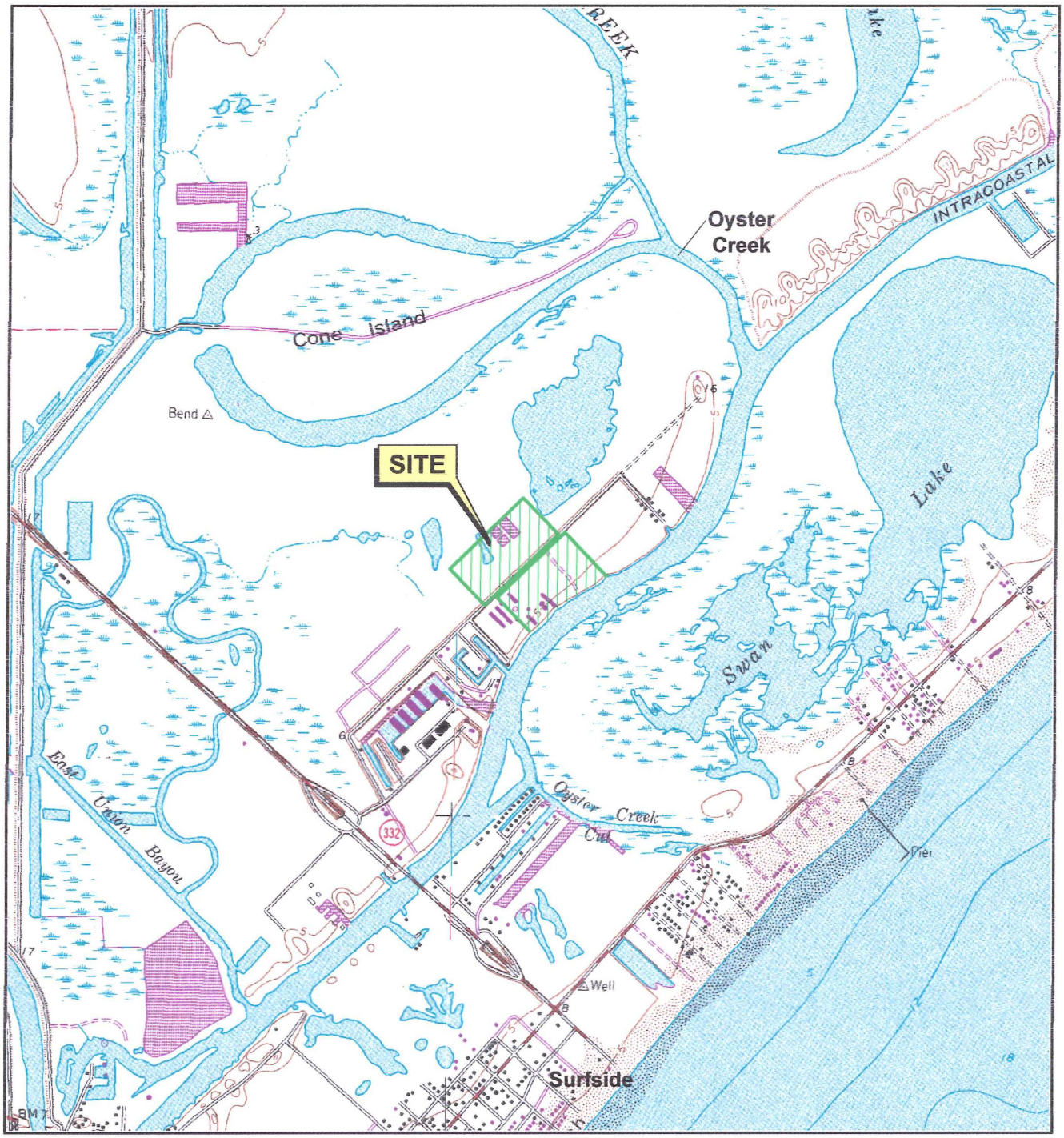
Component No.	Component Description	Key Assumptions	Quantity	Unit	Unit Cost	Estimated Cost	
						Capital	Annual O&M
4	**Groundwater Extraction/Treatment for Hydraulic Control**						
	Extraction Wells	Assume 14 extraction wells installed in Zone A immediately west and south of capped area (approx. 50 ft. spacing). Assume 6 extraction wells installed in Zone B. Assumes wells 6 in. diam. Includes pump costs and installation. Includes pump replacement every 10 years	20	wells	$8,000	$160,000	$10,000
	Piping	Includes piping from well to treatment compound and piping from treatment compound to POTW conncection at Marlin Ave.	700	ft	$25	$17,500	
	Treatment Compound Containment	Assume 50 ft. by 50 ft. concrete slab with 2 ft containment walls	1	LS		$10,000	
	Treatment Compound Fence	Assume chain link fence with barbed wire.	200	ft	$20	$4,000	
	Sedimentation/Surge Tank	Assume 1,000 gal poly tank	1	LS		$3,000	
	Low Profile Aeration Unit	Assume treatment system flow rate of 40 gpm. Annual O&M cost includes maintenance/cleaning and assumes one equipment replacement during 30 year evaluation period.	1	LS		$25,000	$10,000
	Catalytic Oxidation Unit	Assume vapor flowrate of 650 scfm. O&M costs include assumption of catalyst replacement ($20,000) every 5 years.	1	LS		$400,000	$10,000
	POTW Connection	Includes application preparation/submittal and connection construction.	1	LS		$10,000	
	Electrical/Controls Installation		1	LS		$15,000	
	Electricity		1	LS			$15,000
	Natural Gas	Fuel for catalytic oxidation unit.	1	LS		$3,000	$40,000
	Effluent Sampling/Analysis		12	mo.	$500		$3,954
	POTW Charges	Assume 40 gpm system discharge.	200	10,000 gal	$38.40		$7,680
	Groundwater Monitoring	Assumes annual sampling of 9 Zone A wells, 4 Zone B wells, 1 Zone C well with analyses for VOCs.	1	LS			$11,400
	Well Repair/Replacement	Assumes repair of well head/protective casing required at 2 wells per year.	2	wells	$500		$1,000
	Plugging/abandonment of monitoring wells no longer in use.	Assumes plugging of 20 Zone A wells (wells in South Area and MW05 (due to location within expanded cap area).	1	LS		$10,000	-
	Engineering Design/Project Management/ Construction Management/ Reporting	Assumed at 25% of construction components cost (per EPA, 2000).				$164,375	
	Groundwater Extraction/Treatment for Hydraulic Control Subtotal					**$821,875**	**$109,034**

TABLE 6 - ALTERNATIVE 3 SCREENING-LEVEL COST EVALUATION

Component No.	Component Description	Key Assumptions	Quantity	Unit	Unit Cost	Estimated Cost	
						Capital	Annual O&M
	Subtotal	Sum of components subtotals.				**$1,155,000**	**$114,034**
	Contingency	Assumed at 20% (10% scope + 10% bid) per EPA, 2000.				$231,000	$22,800
	Subtotal with Contingency					$1,386,000	$136,800
	Present Worth of Annual Costs	Assume 30 years at 5% discount factor.				$2,103,000	
	Total Preliminary Estimated Cost	Includes present worth of annual costs.				**$3,500,000**	

Notes:
[1]LS = Lump Sum Estimate

FIGURES



QUADRANGLE LOCATION

N

Scale in Feet

0 1000 2000

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 1

SITE LOCATION MAP

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: DEC., 2010	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

Source:
Base map taken from http://www.tnris.state.tx.us Freeport, Texas 7.5 min. U.S.G.S. quadrangle, 1974.

EXPLANATION

Gulfco Marine Maintenance Site Boundary (approximate)

Lot Boundary (approximate)

N

Approx. Scale in Feet

0 125 250

Source of photo: H-GAC, Texas aerial photograph, 2006.

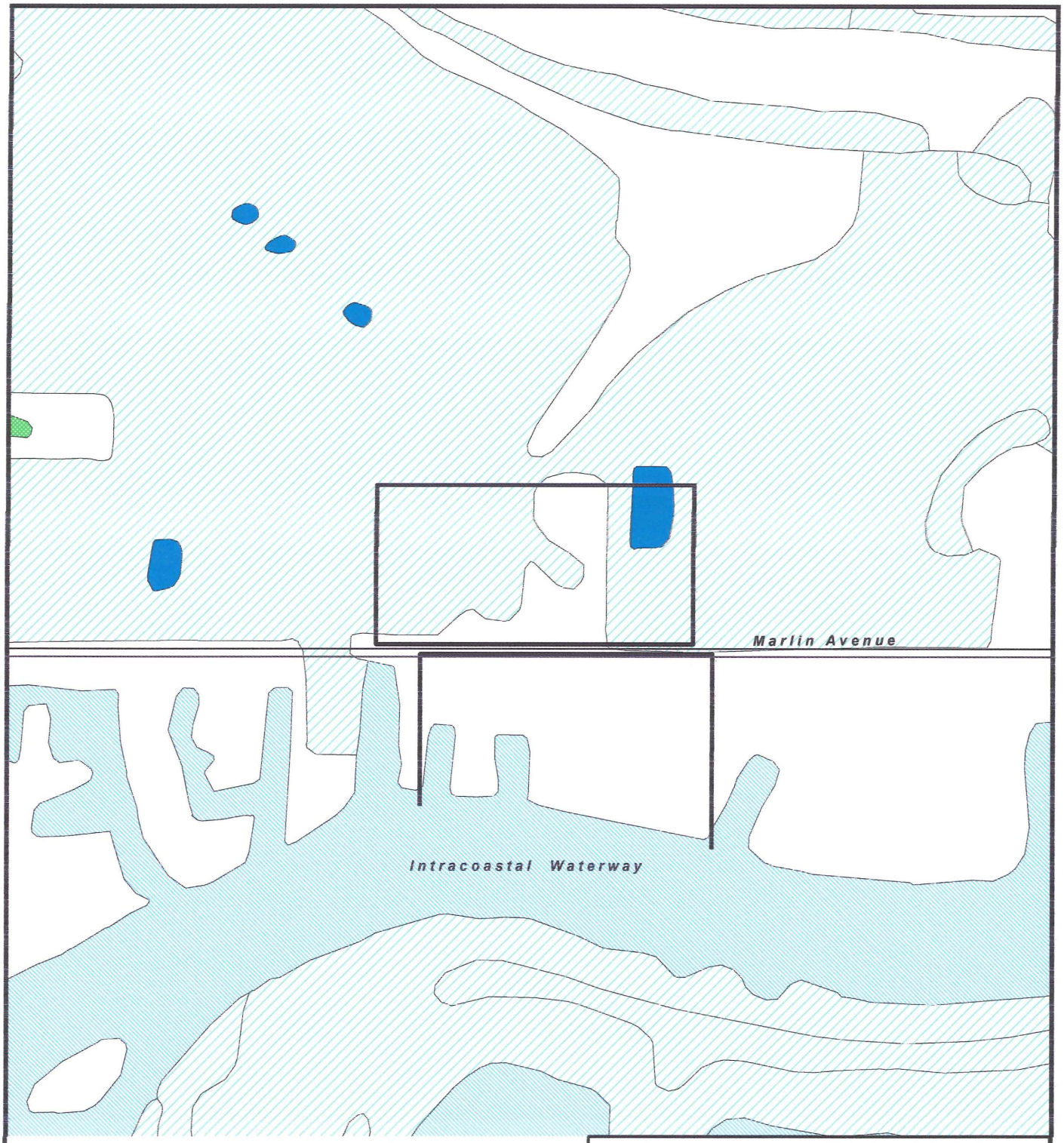
GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 2

SITE MAP

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: DEC., 2010	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



EXPLANATION

- Approx. Site Boundary
- Upland Area
- Estuarine and Marine Deepwater
- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Pond

N

Approx. Scale in Feet

0 300 600

Source:
U.S. Fish & Wildlife Service, Wetlands Online Mapper, 2008.

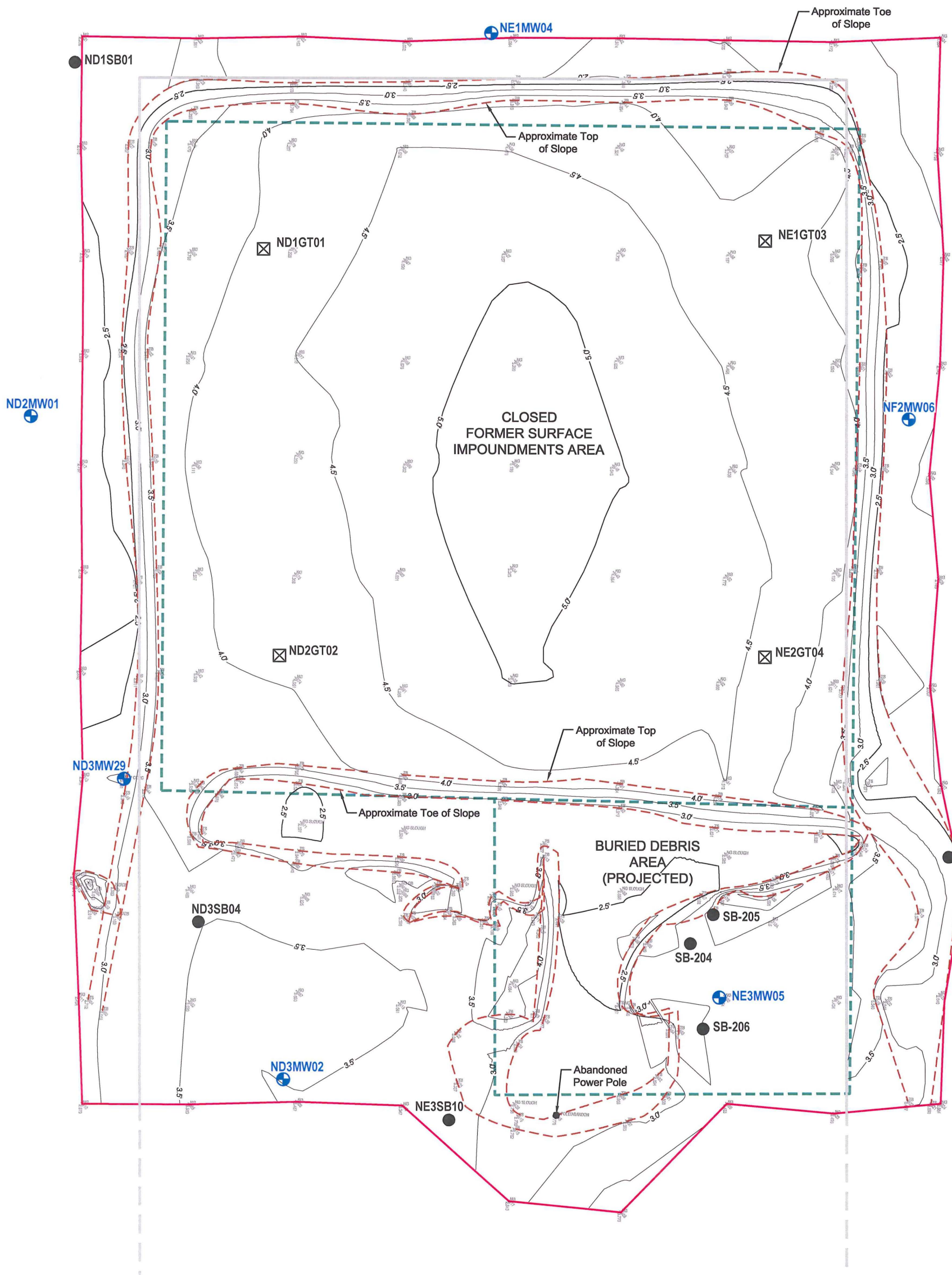
GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 3

WETLAND MAP

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: DEC., 2010	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



EXPLANATION

- Monitoring Well Location
- Geotechnical Soil Boring
- Soil Boring Location
- Elevation Measurement Location
- 2.0' — Ground Surface Elevation (Ft Mean Sea Level, NGVD 29) - Minor Contour Line
- 2.5' — Ground Surface Elevation (Ft Mean Sea Level, NGVD 29) - Major Contour Line
- Extent of Surface Impoundments and Buried Debris Area (Projected)
- Top/Toe of Slope (Approximate)
- Lot 56 Property Line
- Limits of Topographic Survey

Approx. Scale in Feet

0 25 50

Source: Doyle & Wachtstetter, Inc. Field Survey May 26, 2009.

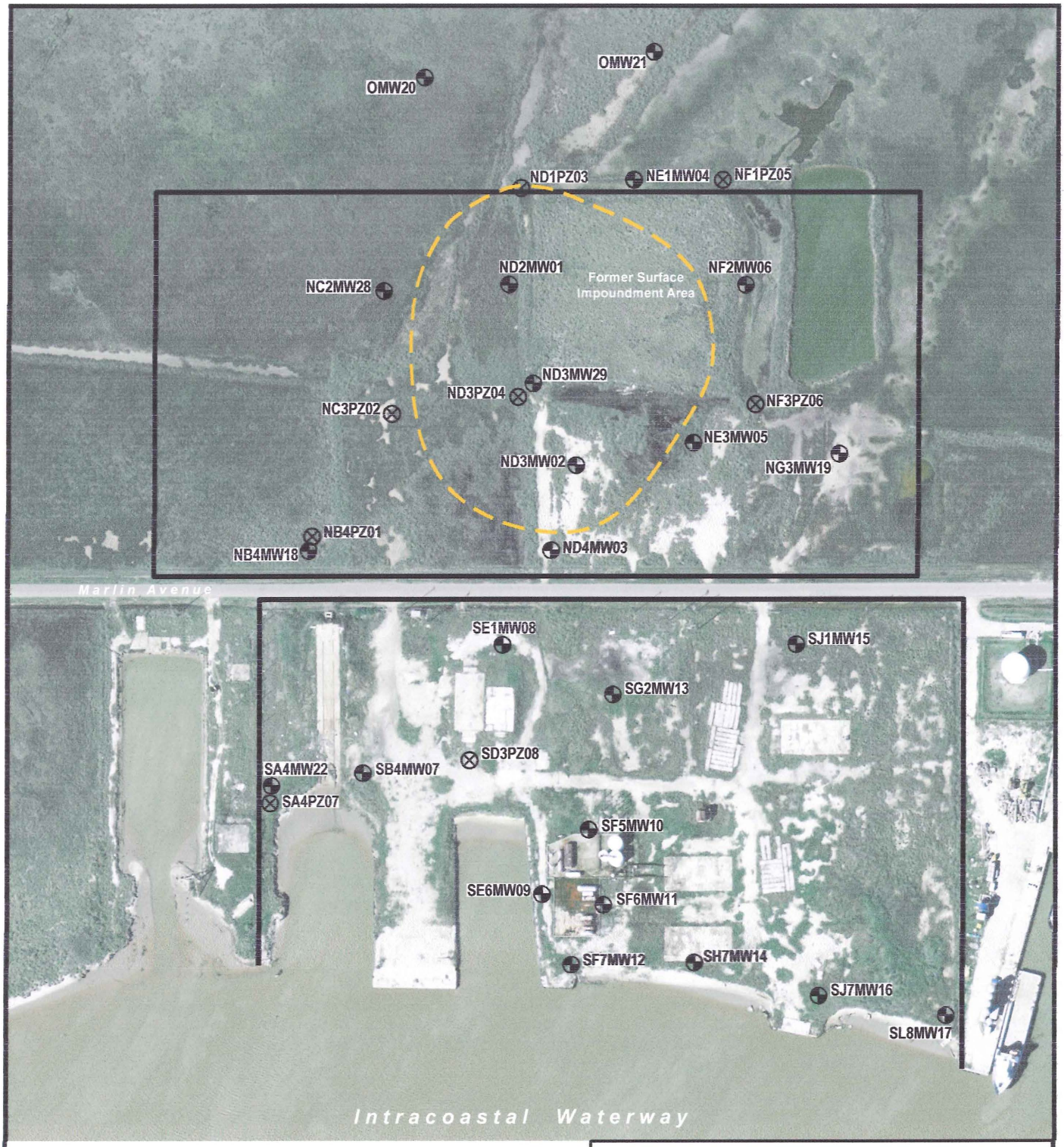
GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 4

FORMER SURFACE IMPOUNDMENTS TOPOGRAPHIC MAP

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: DEC., 2010	CHECKED: EFP	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



EXPLANATION

- Gulfco Marine Maintenance Site Boundary (approximate)
- Approximate Extent of Area with One or More VOCs Exceeding Extent Evaluation Comparison Criteria (Defined in Nature and Extent Data Report) in The Most Recent Sample from Each Well/Piezometer
- Monitoring Well Location - Zone A
- Temporary Piezometer - Zone A

Approx. Scale in Feet

0 125 250

Source of photo: H-GAC, Texas aerial photograph, 2006.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 5

APPROXIMATE EXTENT OF VOC PLUME IN ZONE A

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: DEC., 2010	CHECKED: EFP	

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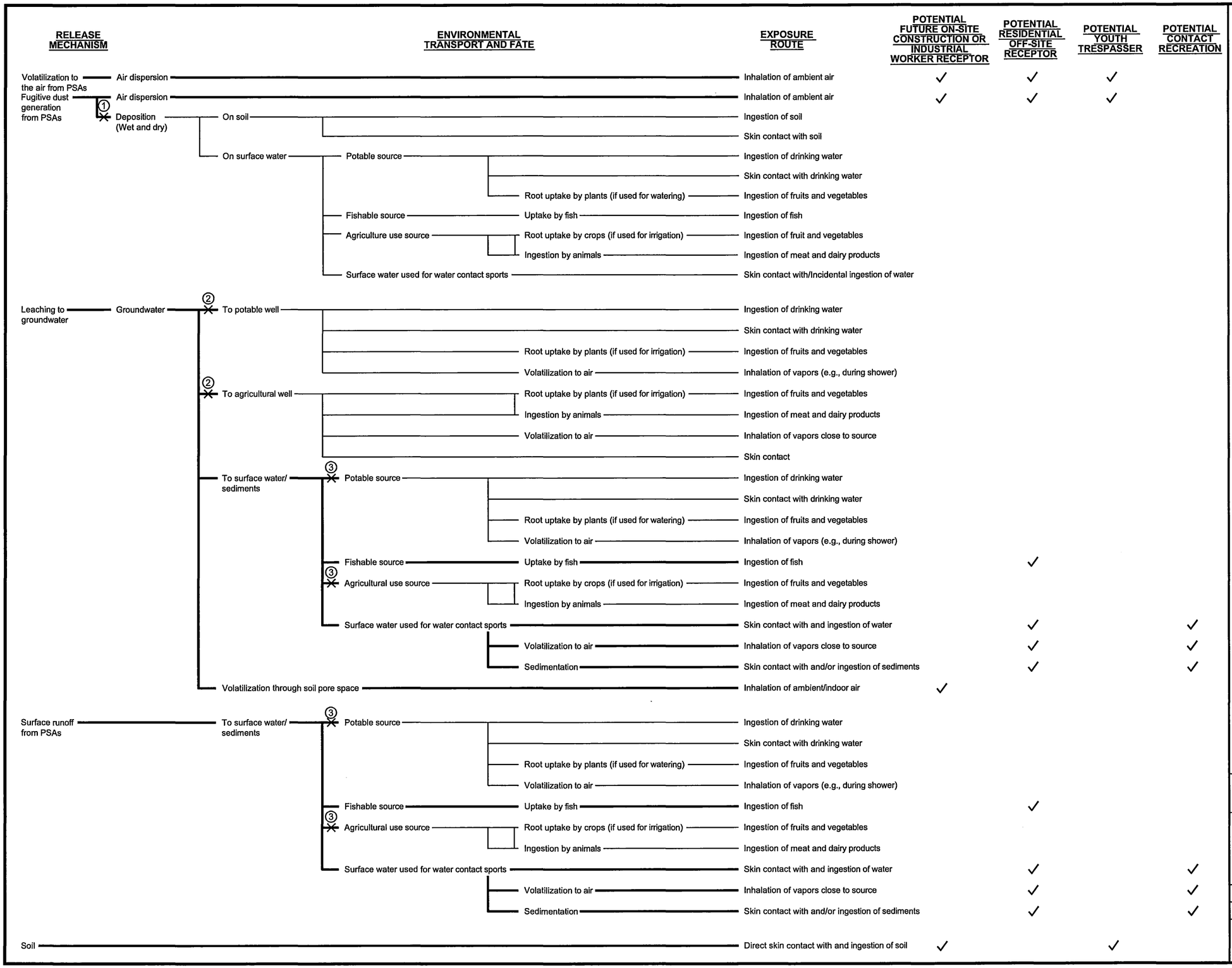

LEGEND:

Pathway is Incomplete

Pathway is Complete, Significance evaluated in Baseline Human Health Risk Assessment (BHHRA)

NOTES:

1. Based on surface soil samples collected on Lots 19 and 20, it does not appear that significant entrainment and subsequent deposition of particulates has occurred at the Site or at off-site locations.
2. No water supply or agricultural wells are in use in the Site vicinity and groundwater in the uppermost water-bearing units is not usable due to high total dissolved solids concentrations. The incompleteness of this pathway is contingent on the continued stability of the groundwater contaminant plume within the uppermost, non-potable water-bearing units at the Site.
3. Surface water is not a potable or agricultural source due to high salinity.

✓ Indicates potential receptor for complete migration pathway.

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 6

HUMAN HEALTH CONCEPTUAL SITE MODEL SOUTH AREA

PROJECT: 1352	BY: ZGK	REVISIONS:
DATE: DEC., 2010	CHECKED: KHT	

PASTOR, BEHLING & WHEELER, LLC
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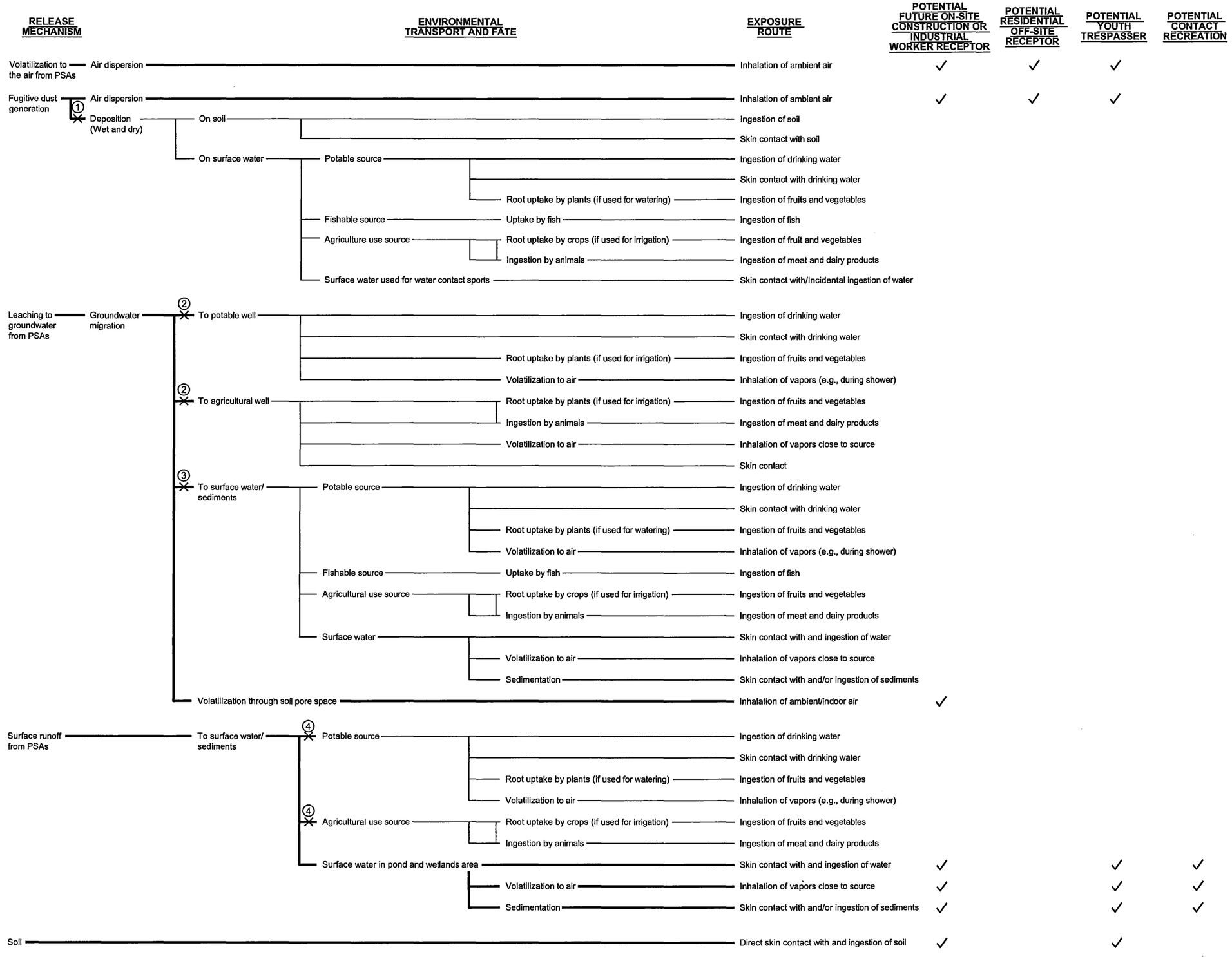


LEGEND:

—✕— Pathway is Incomplete

—— Pathway is Complete, Significance evaluated in Baseline Human Health Risk Assessment (BHHRA)

NOTES:

1. The high moisture content and vegetated nature of the limited surface soils in the North Area are not conducive to significant dust generation, dispersion and subsequent deposition.
2. No water supply or agricultural wells are in use in the Site vicinity and groundwater in the uppermost water-bearing units is not usable due to high total dissolved solids concentrations. The determination of this pathway as incomplete is contingent on the continued stability of the groundwater contaminant plume within the uppermost, non-potable water-bearing units at the Site.
3. Groundwater communication with North Area surface water features (e.g., ponds, wetlands) is not significant due to water table elevations below the shallow depths of these features and the low permeability of underlying clay soils.
4. Nearby surface water is not used for agricultural use or drinking water.

✓ Indicates potential receptor for complete migration pathway.

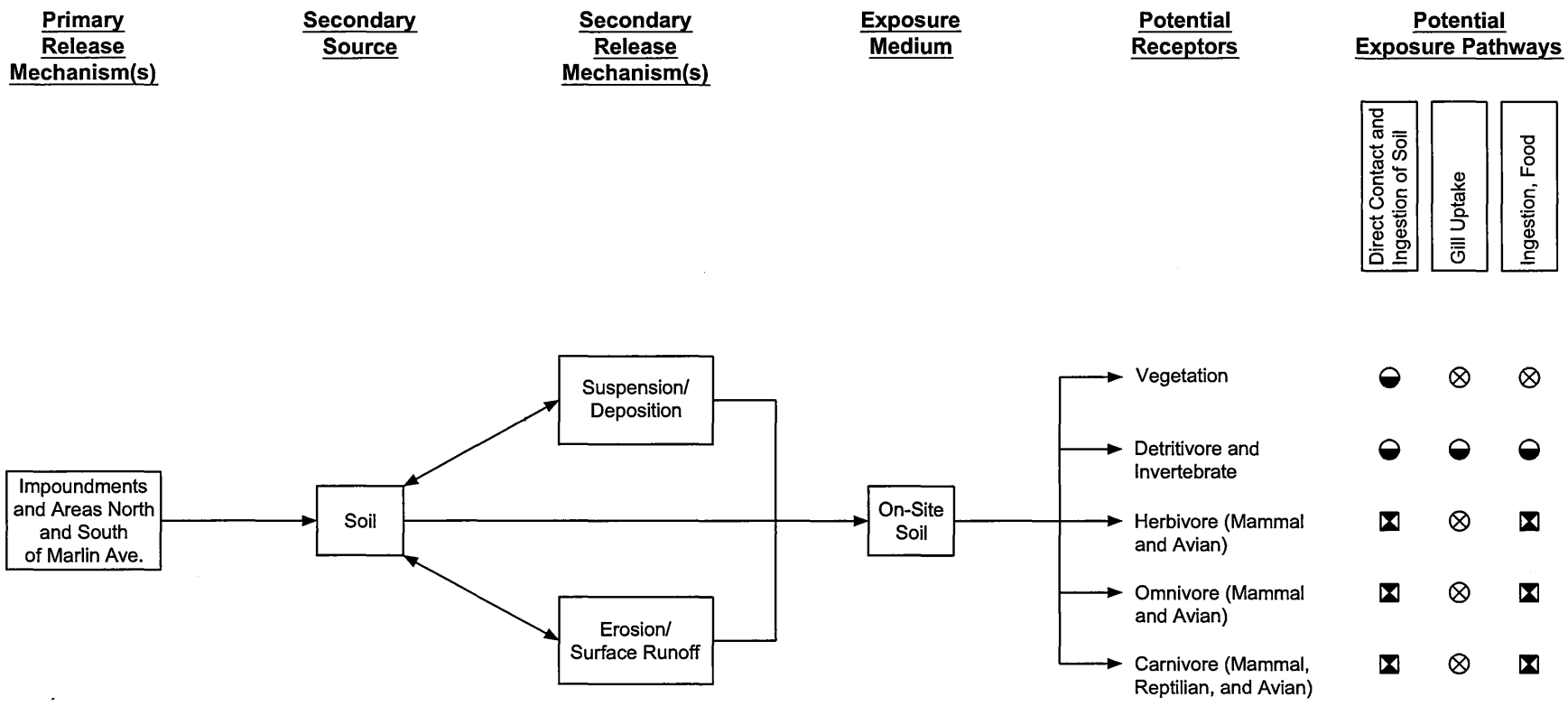
GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 7

HUMAN HEALTH CONCEPTUAL SITE MODEL NORTH AREA

PROJECT: 1352	BY: ZGK	REVISIONS:
DATE: DEC., 2010	CHECKED: KHT	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



LEGEND

- ⊠ No acceptable risk (Final SLERA conclusion)
- ■ Pathway is potentially complete
- ⊠ Pathway is incomplete
- ⊗ Pathway is not viable
- ◒ For South Area soils, pathway is mitigated by lack of complete exposure pathways. For North Area soils, pathway is potentially complete.

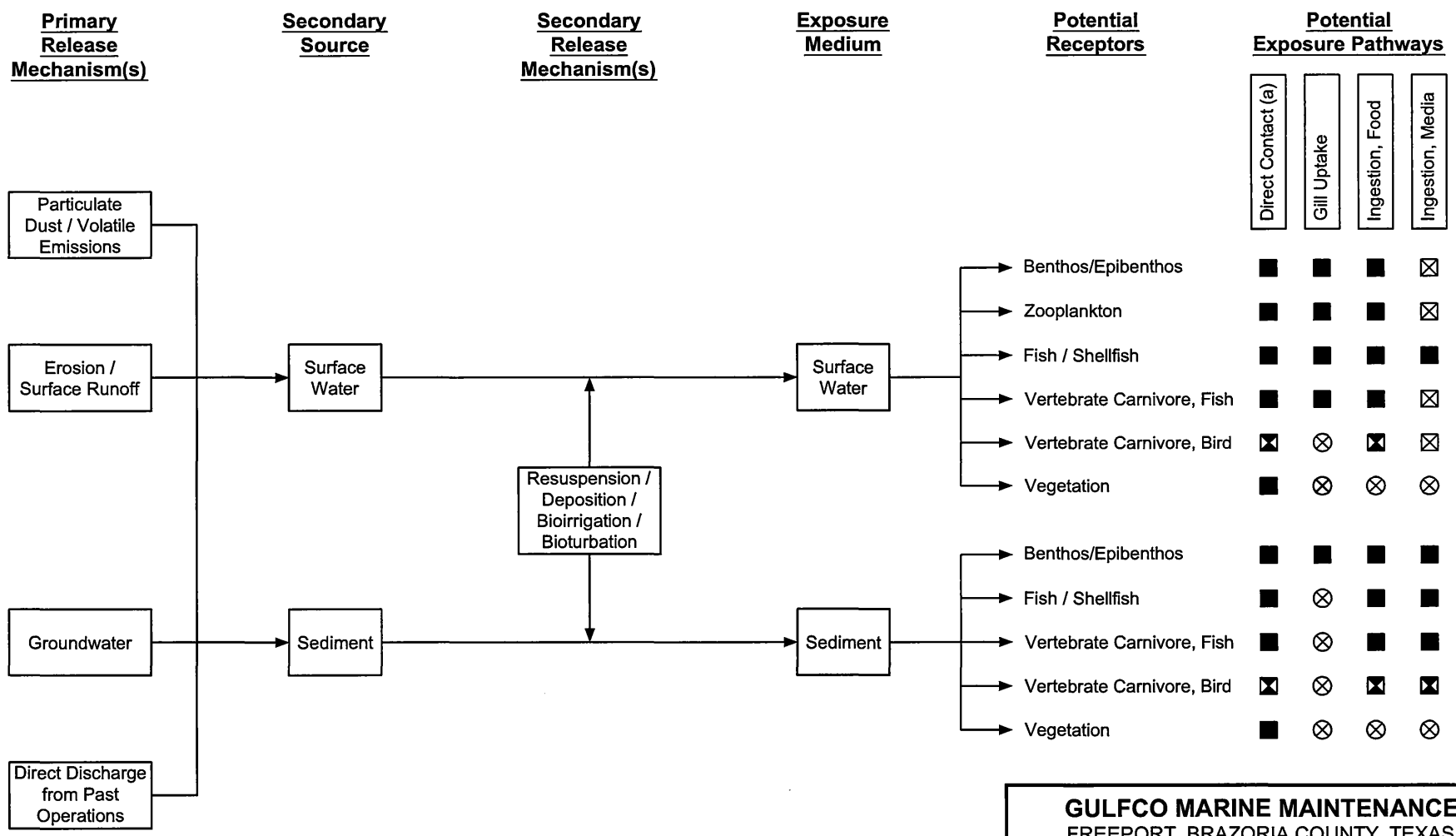
GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 8

CONCEPTUAL SITE MODEL -TERRESTRIAL ECOSYSTEM

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: DEC., 2010	CHECKED: KHT	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS



LEGEND

- ⊠ No acceptable risk (Final SLERA conclusion)
- ■ Pathway is potentially complete
- ☒ Pathway is incomplete
- ⊗ Pathway is not viable
- (a) Direct contact includes dermal absorption

GULFCO MARINE MAINTENANCE
FREEPORT, BRAZORIA COUNTY, TEXAS

Figure 9

CONCEPTUAL SITE MODEL -AQUATIC ECOSYSTEM

PROJECT: 1352	BY: ZGK	REVISIONS
DATE: DEC., 2010	CHECKED: KHT	

PASTOR, BEHLING & WHEELER, LLC
CONSULTING ENGINEERS AND SCIENTISTS

PLATE

APPENDIX A

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs) EVALUATION

A.1 INTRODUCTION

The purpose of this appendix is to identify applicable or relevant and appropriate requirements (ARARs) with which remedial actions must comply at the Gulfco Marine Maintenance Superfund Site (the Site). Applicable requirements are federal or state requirements that "specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site" (National Contingency Plan (NCP) Section 300.5). Relevant and appropriate requirements are federal or state requirements that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action or other circumstance at a CERCLA site, "address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site." (NCP Section 300.5). "To be considered" (TBC) materials include federal or state guidance, advisories, criteria, or proposed standards that may be useful in situations where no ARARs exist.

In accordance with the National Contingency Plan, remedial actions under CERCLA are required to meet the substantive requirements of other laws unless an ARAR waiver is granted by the lead regulatory agency. Compliance with the administrative requirements (e.g., permitting, administrative reviews, reporting, and recordkeeping) of other laws is not required under CERCLA. Consistent with EPA guidance (EPA, 1988), the substantive ARARs are divided into the three categories:

- **Chemical-specific requirements**– health- or risk-based numerical values or methodologies that specify the acceptable amount or concentration of a chemical that may be found in, or discharged to, the environment;

- **Location-specific requirements**– restrictions placed on the types of activities that can be conducted or on the concentration of hazardous substances that can be present solely because of the location where they will be conducted; and

- **Action-specific requirements**– technology or activity-based requirements or limitations on actions taken with respect to hazardous wastes.

A.2 CHEMICAL-SPECIFIC ARARs

RCRA waste classification requirements, specifically the RCRA hazardous waste criteria specified in 40 CFR 261 Subpart C, are chemical-specific ARARs that apply to wastes that are generated as part of Site remedial actions. These requirements, along with Texas waste classification rules provided in 30 TAC Subchapter R, would be used to determine the classification (i.e., hazardous or non-hazardous Class 1, 2, or 3) for any wastes, such as the former impoundment wastes, managed at an off-site treatment, storage or disposal facility.

Texas Risk Reduction Program (TRRP) Protective Concentration Levels (PCLs) specified in 30 *TAC* Chapter 350 serve as chemical-specific, TBC guidelines for the investigation/remediation of the Site. These PCLs, along with other EPA-specific chemical-specific criteria, were used to define the extent of contamination at the Site as described in the Nature and Extent Data Report (NEDR) (PBW, 2009). As TBCs, the TRRP PCLs were not used in place of the site-specific Baseline Human Health Risk Assessment (BHHRA) and Baseline Ecological Risk Assessment (BERA) to establish site-specific risk levels (and Remedial Action Objectives) for those areas of the Site that pose risk to human health or the environment.

A.3 LOCATION-SPECIFIC ARARs

Location-specific ARARs are divided into the following four sections:

A.3.1 Wetlands;
A.3.2 Critical Habitat for Endangered or Threatened Species;
A.3.3 Coastal Zones; and
A.3.4 Floodplains.

A.3.1 <u>Wetlands</u>

As described in Section 1.0, much of the North Area is considered wetlands on the USFWS Wetlands Inventory Map. Potential ARARs associated with wetlands are described in EPA's *Considering Wetlands at CERCLA Sites* (EPA, 1994a). As described therein, a primary potential ARAR related to wetlands is Section 404(b)(1) of the Clean Water Act (CWA), promulgated as regulation in 40 CFR 230.10, which generally prohibits discharge of dredged or fill material to wetlands, subject to consideration of

APPENDIX A

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS) EVALUATION

practicable alternatives and the use of mitigation measures. Section 404 would be considered an ARAR for Site remedial actions involving excavation of wetlands areas or placement of fill into wetlands for access road construction. Per 40 CFR 6.302(a), Executive Order 11990 further requires that any actions performed within wetland areas minimize the destruction, loss, or degradation of wetlands.

A.3.2 Critical Habitat for Endangered/Threatened Species

The Final SLERA (PBW, 2010b) notes a number of endangered/threatened species listed as present in Brazoria County by the US Fish and Wildlife service. None of these species have been noted at the Site but they are known to live in or on, feed in or on, or migrate through the Texas Gulf Coast and estuarine wetlands. Remedial actions that impact rare, threatened, and endangered species may be subject to applicable federal and state requirements. The Fish and Wildlife Coordination Act (16 USC 661 et. seq.), the Endangered Species Act of 1973 (16 USC 1531) and subsequent regulations govern the protection of critical habitat for endangered or threatened species. These regulations include:

- 40 *CFR* §6.302(h)—USEPA Procedures for Implementing Endangered Species Protection Requirements Under the Endangered Species Act;
- 40 *CFR* §230.30—Potential Impacts on Biological Characteristics of the Aquatic Ecosystem. Threatened and endangered species;
- 50 *CFR* Part 402—Interagency Cooperation—Endangered Species Act of 1973, as Amended; and
- 31 *TAC* §501.23(a)—Texas Coastal Coordination Council Policies for Development in Critical Areas, including 31 *TAC* §501.23(a)(7)(A) relating to endangered species.

The Endangered Species Act prohibits federal agencies' programs (e.g., CERCLA) from jeopardizing threatened or endangered species or adversely modifying habitats essential to their survival. Under 40 *CFR* §6.302(h) for actions where USEPA is the lead agency, the responsible party must identify designated endangered or threatened species or their habitat that may be affected by the remedial action.

Section 230.30 pertains to potential impacts of remedial action on threatened and endangered species, such as covering or otherwise directly killing species, or destruction of habitat to which these species are limited. If listed species or their habitat may be affected by a remedial action, formal consultation with

the USFWS, TPWD, and the NMFS must be undertaken, as appropriate. (50 *CFR* Part 402 provides procedures for interagency cooperation and interaction.) If the consultation reveals that the activity may jeopardize a listed species or habitat, mitigation measures need to be considered.

At the state level, 31 *TAC* §501.23(a)(7)(A) prohibits development in critical areas if the activity will jeopardize the continued existence of endangered or threatened species or will result in the destruction or adverse modification of their habitat. This section also specifies compensatory mitigation.

A.3.3 Coastal Zones

The Coastal Zone Management Act of 1972 (16 USC Section 1451 et. seq.) requires the development and implementation of programs to manage the land and water resources of the coastal zone, including ecological, cultural, historic, and aesthetic values. States must implement programs in conformity with EPA guidance. Remedial actions that impact the coastal zone are subject to 15 *CFR* Part 923—Coastal Zone Management Program Regulations. 15 *CFR* Part 923 administered by the National Oceanic and Atmospheric Administration (NOAA)—provides the criteria for approving state programs.

Texas' approved Coastal Management Program administered by the TCCC is recorded at 31 *TAC* Chapter 501. Specific criteria in this program include policies for development in critical areas as described above. Section 501.23(a)(7) states development in critical areas shall not be authorized if significant degradation will occur. Significant degradation occurs if an activity: threatens an endangered or threatened species or its habitat; violates any applicable surface water quality standards; violates a toxic effluent standard; adversely effects human health and welfare (including effects on fish, shellfish, wildlife, and the consumption of fish and wildlife); adversely effects aquatic ecosystems; or adversely effects generally accepted recreational aesthetics or economic value of the critical area.

A.3.4 Floodplains

As described in Section 1.0, the Site is located within the 100-year coastal floodplain. As such, remedial alternatives involving on-site treatment, storage or disposal facilities for RCRA hazardous waste at the Site are subject to the 40 CFR 264.18(b) requirements that they be designed, constructed, operated, and maintained to prevent washout of any hazardous waste by the 100-year flood. Per 40 CFR 6.302(b), Executive Order 11988 requires that any actions performed within the floodplain avoid adverse effects, minimize potential harm, and restore and preserve natural and beneficial values of the floodplain.

A.4 ACTION-SPECIFIC ARARs

Action-specific ARARs are divided into the following sections:

A.4.1 Former Surface Impoundments Cap Upgrade
A.4.2 Groundwater Extraction, Treatment and Discharge

A.4.1 Former Surface Impoundments Cap Upgrade

As described in Section 3.1, upgrade/repair of the existing cap at the former surface impoundments would involve surface debris and brush removal from the cap, grading/compaction of the existing clay cap, extension of the existing cap over the nearby buried debris area, placement of a topsoil layer over the clay cap and vegetation of the cap surface. RCRA requirements for capping of surface impoundments (40 CFR 264.228(a)(2)(iii)) specify that the final cover:

- provide long-term minimization of migration of liquids;
- function with minimum maintenance;
- promote drainage and minimize erosion;
- accommodate settling and subsidence so the cover's integrity is maintained; and
- have a permeability less than or equal to any bottom liner system or natural subsoils present.

As described in the guidance document *RCRA ARARs: Focus on Closure Requirements* (EPA, 1989b), the applicability of these requirements is contingent on the waste in the impoundments being a RCRA hazardous waste and the waste being disposed after the effective date of the regulations (November 19, 1980). In a November 17, 1981 letter to the Texas Department of Water Resources (TDWR)(Fish, 1981), G.J. Gill, Senior Vice-President of Fish Engineering & Construction, Inc. (Fish), reported that the surface impoundments were taken out of service on November 17, 1981 and requested a Class II non-hazardous classification for the impoundment wastes. This Class II designation was initially approved by TDWR in a February 26, 1982 letter (TDWR, 1982a), but was subsequently designated by TDWR in a May 21, 1982 letter (TDWR, 1982b) as Class I wastes (which apparently, based on TWC, 1985 could include both hazardous and non-hazardous waste), without clarification as to RCRA characteristics (i.e., hazardous or non-hazardous). Based on this uncertainty regarding the classification of the impoundment wastes, it is unclear whether the 40 CFR 264.228 RCRA cover requirements are applicable.

The determination of the relevance and appropriateness of RCRA requirements is based on multiple factors, including the nature of the waste, its hazardous properties, and the nature and purpose of the requirements being considered. Based on the reported removal of free liquids and most of the sludge from the former surface impoundments during closure (Guevara, 1989), the RCRA cover requirement to provide long-term minimization of migration of liquids is not relevant. The requirements that the cover function with minimum maintenance, promote drainage and minimize erosion, and accommodate settling and subsidence so integrity is maintained are consistent with the RAO to reduce the potential for waste (i.e., residual sludge and/or buried debris) exposure, through cap surface erosion and/or penetration. The requirement that the cover have a permeability less than or equal to any bottom liner system or natural subsoils present is not relevant to the RAO of reducing the potential for increased contaminant loading from waste to groundwater, through cap failure, although the measured hydraulic conductivities of cap clay samples (3.5×10^{-8} cm/sec or less, as listed on Table 2) are similar to what would be expected for the native clay soil in which the impoundments were constructed.

Although not related to the cap upgrade, a State ARAR for the former surface impoundments cap is the 30 TAC 335.5(a) requirement for the deed recordation of industrial solid waste disposal areas.

A.4.2 Groundwater Extraction, Treatment and Discharge

RCRA Unit-Specific Standards

If hydraulic control of affected groundwater is provided by a groundwater extraction and treatment system, the treatment system may be treating a hazardous waste (i.e., the contaminated groundwater may be characteristically hazardous due to concentrations of certain contaminants such as tetrachloroethene). Thus, the unit-specific RCRA design and operating standards for units that treat hazardous waste must be considered. In addition, several air emission standards must be considered.

Under RCRA, there are several exemptions from the unit-specific management standards for units that treat hazardous waste (40 *CFR* 264.1(g)). One of these units is a wastewater treatment unit. A wastewater treatment unit is defined in 40 CFR 260.10 as, "a device which: (1) is part of a wastewater treatment facility that is subject to regulation under either Section 402 or 307(b) of the Clean Water Act; (2) receives and treats or stores an influent wastewater that is a hazardous waste…; and (3) meets the definition of a tank or tank system."

The groundwater treatment system would meet all three criteria of a wastewater treatment unit and, thus, would not be subject to the unit-specific design and operating standards under RCRA. First, if the groundwater treatment system discharge to the City of Freeport POTW through an industrial discharge permit, the system would be subject to regulation under the Clean Water Act (i.e., through the industrial pre-treatment discharge limitations established by the POTW). Second, the groundwater treatment system would be treating an influent hazardous wastewater if the groundwater were classified as a hazardous waste due to the toxicity characteristic for one or more contaminants. Lastly, the treatment system would meet the definition of a tank in 40 CFR 260.10: "a stationary device, designed to contain an accumulation of hazardous waste which is constructed primarily of non-earthen materials (e.g., wood, concrete, steel, plastic) which provide structural support."

Air Emissions

The groundwater treatment system would use an air stripper to remove volatile organic chemicals (VOCs) from the groundwater. Air emissions will be generated by the treatment system that may be subject to several Federal and state air quality regulations. Specifically, the following regulations were considered for their applicability and are discussed in detail below:

- New Source Performance Standards (NSPS) (40 *CFR* Part 60);
- National Emission Standards for Hazardous Air Pollutants (NESHAPs) (40 *CFR* Parts 61 and 63);
- RCRA Air Emissions Requirements (40 *CFR* Part 264, Subparts AA, BB, and CC/30 *TAC* 335.152(a)(17) and (18));
- Control of Air Pollution from Volatile Organic Compounds (30 *TAC* Chapter 115); and
- Permits by Rule – Waste Processes and Remediation (30 *TAC* Chapter 106, Subchapter X).

Federal Clean Air Act regulations for NSPS and NESHAPs would not apply to a groundwater treatment system because it is not one of the regulated unit types in the NSPS or NESHAP rules. Likewise, RCRA-specific air emissions requirements will not apply due to the wastewater treatment unit exemption as described above. Texas state air emission standards, however, may potentially apply as ARARs.

There are two sections in 30 *TAC* Chapter 115 that could apply to the groundwater treatment system, including §§115.112 through 115.119, which regulate VOC emissions from storage vessels and

§§115.121 through 115.129, which regulate VOC emissions from vents. The groundwater treatment system, however, is likely exempt from the control and monitoring requirements of these regulations due to the relatively small size of the equipment and anticipated low emission rates (based on groundwater extraction/treatment flow rate and VOC concentrations in groundwater). Specifically, storage tanks with less than 1,000 gallons capacity are exempt from control requirements under §115.112(c)(1), Table I(b) and vent gas streams having a combined weight of VOCs less than or equal to 100 pounds in any continuous 24-hour period are exempt from control requirements of §115.121(a)(1), (see §115.127(a)(2)(A)).

State Permits By Rule regulations for remediation processes that could apply to the groundwater treatment system are provided in 30 TAC §106.533. This section describes the emissions rate limits (in lbs/hour) by compound that are required to qualify for permit by rule eligibility and specifies the performance requirements for emissions control devices under a permit by rule.

Effluent Discharge

The effluent from a groundwater extraction and treatment system would be discharged to the City of Freeport POTW. The City's industrial discharge rates and ordinances would apply to this discharge. As such an industrial wastewater discharge permit is required by the City as discharge limits, monitoring and reporting would be subject to City standards described in Chapter 51 of the City of Freeport Code of Ordinances (Freeport, 2009).

APPENDIX B

RESTRICTIVE COVENANTS

RESTRICTIVE COVENANT FOR LIMITATION ON USES, CONSTRUCTION AND GROUNDWATER USE

Doc# 2009036113

STATE OF TEXAS §
§
COUNTY OF BRAZORIA §

ION

This Restrictive Covenant is filed to provide information concerning certain use limitations upon that parcel of real property (the "Property") described in Exhibits A and B, attached hereto and incorporated herein by reference, and which at the time of this filing is listed on the United States Environmental Protection Agency's ("EPA") National Priority List as a "Superfund Site."

As of the date of this Restrictive Covenant, the record owner of fee title to the Property is **LDL COASTAL LIMITED, L.P.**, a Texas limited partnership ("Owner"), with an address of c/o Allen Daniels, 6363 Woodway Drive, Suite 730, Houston, Texas 77057. The appropriate land use for the Property is commercial/industrial.

Owner has agreed to place the following restrictions on the Property in favor of The Dow Chemical Company ("Dow"), Chromalloy American Corporation ("Chromalloy"), the Texas Commission on Environmental Quality ("TCEQ"), the State of Texas and EPA.

NOW THEREFORE, in consideration of the premises and other good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, the following restrictive covenants in favor of Dow, Chromalloy, TCEQ, the State of Texas and EPA are placed on the Property, to-wit:

1. Commercial/Industrial Use.

The Property shall not be used for any purposes other than commercial/industrial uses, as that term is defined under 30 T.A.C §350.4(a)(13), and thus shall not be used for human habitation or for other purposes with a similar potential for human exposure. Portions of the soils and/or groundwater of the Property contain certain identified chemicals of concern. Future users of the Property are advised to review and take into consideration environmental data from publicly available sources (i.e. TCEQ and EPA) prior to utilizing the Property for any purpose.

2. Groundwater.

The groundwater underlying the Property shall not be used for any beneficial purpose, including: (1) drinking water or other potable uses; (2) the irrigation or watering of landscapes or (3) agricultural uses. For any activities that may result in potential exposure to the groundwater, a plan must be in place to address and ensure the appropriate handling, treatment and disposal of any affected soils or groundwater.

3. Construction.

Construction of any building on the Property is not advisable. If any person desires in the future to construct a building at the Property, the EPA and TCEQ must be notified and must approve of such construction in writing, as additional response actions, such as protection against indoor vapor intrusion, may be necessary before the Property may be built upon. The costs for any additional response actions will be borne by the party(s) desiring to construct upon the Property.

4. These restrictions shall be a covenant running with the land.

For additional information, contact:

The Dow Chemical Company
2030 Dow Center
8th Floor Legal Dept.
Midland, MI 48674
ATTN: General Counsel

Chromalloy American Corporation
C/O Sequa Corporation
200 Park Avenue
New York, NY 10166
ATTN: General Counsel

U.S. Environmental Protection Agency, Region 6
Superfund Division (6RC-S)
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733
ATTN: Assistant Regional Counsel

Texas Commission on Environmental Quality
P.O. Box 13087
Austin, TX 78711-3087
ATTN: Remediation Division

State of Texas
Office of the Texas Attorney General
Natural Resources Division
300 W. 15th Street
Austin, TX 78701

The restrictions imposed by this Restrictive Covenant may be rendered of no further force or effect only by a release executed by Dow, Chromalloy, TCEQ, the State of Texas and EPA or their successors and filed in the same Real Property Records as those in which this Restrictive Covenant is filed.

Executed this 28th day of July, 2009.

OWNER: **LDL COASTAL LIMITED, L.P., a Texas limited partnership**

By: **RAMWAY Management, L.L.C., a Texas limited liability company, its sole general partner**

By: _____

Name: Allen B. Daniels

Title: Manager

STATE OF TEXAS §
§
COUNTY OF Harris §

BEFORE ME, on this the 28 day of July, 2009, personally appeared Allen B. Daniels, Manager, of RAMWAY Management, L.L.C., a Texas limited liability company and the sole general partner of LDL Coastal Limited, L.P., a Texas limited partnership, known to me to be the person whose name is subscribed to the foregoing instrument, and acknowledged to me that he executed the same for the purposes and in the capacity herein expressed.

GIVEN UNDER MY HAND AND SEAL OF OFFICE, this the 28 day of July, 2009.

Meredith Anne Moran
Notary Public in and for the State of Texas

My Commission Expires: 12/13/2011

NOTARY PUBLIC STATE OF TEXAS
Meredith Anne Moran
My Commission Expires
12/13/2011

2662312.1/SP/73364/0238/052909

Exhibit A

Legal Description of the Property

Doyle & Wachtstetter, Inc
Surveying and Mapping • GPS/GIS

PARCEL No. 1, 5.0010 ACRE ENVIRONMENTAL MANAGEMENT TRACT
LOT 55 OF THE BRAZOS COAST INVESTMENT COMPANY SUBDIVISION, DIVISION 8
FREDERICK. J. CALVIT LEAGUE, ABSTRACT 51
BRAZORIA COUNTY, TEXAS

ALL THAT CERTAIN 5.0010 ACRE tract of land lying in and situated in the Frederick J. Calvit League, Abstract 51, Brazoria County, Texas, being all of Lot 55 of the Brazos Coast Investment Company Subdivision, Division 8 (B.C.I.C. Div. 8), according to the map or plat thereof recorded in Volume 2, Page 141 of the Brazoria County Plat Records (B.C.P.R.) and being the same tract of land conveyed by deed on August 6, 1999 from Janet Casciato-Northrup, Trustee of the Chapter 7 Bankruptcy Estate of Hercules Marine Services Corporation to LDL Coastal Limited, L.P., as recorded in Clerk's File No. 99-036339 of the Brazoria County Official Records (B.C.O.R.), the herein described tract of land being more particularly described by metes and bounds, using survey terminology which refers to the Texas State Plane Coordinate System, South Central Zone (NAD83), in which the directions are Lambert grid bearings and the distances are surface level horizontal lengths (S.F.= 0.99988752832) as follows

COMMENCING at a 3/4" iron rod found marking the North corner Lot 80, same being the West corner of Lot 81 of the aforementioned B.C.I.C. Div. 8 subdivision, located in the southeastern right-of-way boundary line of a 40 foot wide platted roadway of the said B.C.I.C. Div. 8 subdivision, said Point of Commencement being at Texas at State Plane Coordinate System position X=3155152.81 and Y=13556863.07, from which an old 3" x 3/4" hard-wood stake located in the southeastern right-of-way boundary line of a 40 foot wide platted roadway of the said B.C.I.C. Div. 8 subdivision, found marking the North corner of Lot 66, same being the and the West corner of Lot 67 bears South 42°51'47" West, a distance of 4620.94 feet (called 4620.00 feet), at Texas State Plane Coordinate System position X=3152009.76 and Y=13553476.39, herein located point of commencement and point of reference, being shown in 1952 Dow Chemical Company survey by Herman D. Smith, RPS #916, drawing number: B8-8-19000-10488;

THENCE South 42°51'47" West, coincident with the southeastern right-of-way boundary line of said 40 foot wide platted road, a distance of 1320.27 feet to a point for the North corner of Lot 76, same being the West corner of Lot 77 of the B.C.I.C. Div. 8 subdivision, at position X=3154254.79 and Y=13555895.45;

THENCE South 47°08'13" East, coincident with the southwestern boundary line of Lot 77, same being the northeastern boundary line of Lot 76 of the B.C.I.C. Div. 8 subdivision, a distance of 660.00 feet to the **POINT OF BEGINNING**, at a 5/8" iron rod with survey cap marked "WPD 4467" set, from which a 5/8" iron rod bears South 37°54' West, a distance of 11.7 feet, for the common corner of Lot 54, Lot 55, Lot 76 and Lot 77 of the B.C.I.C. Div. 8 subdivision and the North corner of the herein described 5.0010 acre tract, at position X=3154738.50 and Y=13555446.53;

131 Commerce Street • Clute, Texas 77531-5601
Phone: 979-265-3622 • Fax: 979-265-9940 • Email: DW-Surveyor.com

PARCEL No. 1, 5.0010 ACRE ENVIRONMENTAL MANAGEMENT TRACT
LOT 55 OF THE BRAZOS COAST INVESTMENT COMPANY SUBDIVISION, DIVISION 8
FREDERICK. J. CALVIT LEAGUE, ABSTRACT 51
BRAZORIA COUNTY, TEXAS

THENCE South 47°08'13" East, coincident with the southwestern boundary line of Lot 54, same being the northeastern boundary line of Lot 55 of the B.C.I.C. Div. 8 subdivision, at a distance of 640.00 feet pass a 5/8" iron rod with survey cap marked "WPD 4467" set in the apparent northwest right-of-way boundary line of the 80 foot wide Marlin Lane, known as Brazoria County Road #756, continuing a total distance of 660.00 feet to a point in the northwestern boundary line of a 40 foot wide platted roadway, at the South corner of Lot 54, same being the East corner of Lot 55 of the B.C.I.C. Div. 8 subdivision, from which an 1" iron pipe bears South 48°12' West, a distance of 1.6 feet, for the East corner of the herein described 5.0010 acre tract, at position X=3155222.22 and Y=13554997.62;

THENCE South 42°51'47" West, coincident with the northwestern right-of-way boundary line of said 40 foot wide platted road, same being the southeastern boundary line of Lot 55 of the B.C.I.C. Div. 8 subdivision, a distance of 330.07 feet to a point for the East corner of Lot 56, same being the South corner of Lot 55 of the B.C.I.C. Div. 8 subdivision, for the South corner of the herein described 5.0010 acre tract, at position X=3154997.71 and Y=13554755.72;

THENCE North 47°08'13" West, coincident with the northeastern boundary line of Lot 56, same being the southwestern boundary line of Lot 55, at a distance of 20.00 feet pass a 5/8" iron rod with survey cap marked "WPD 4467" set in the apparent northwest right-of-way boundary line of the 80 foot wide Marlin Lane, known as Brazoria County Road #756, continuing a total distance of 660.00 feet to a 5/8" iron rod with survey cap marked "WPD 4467" set at the common corner of Lot 55, Lot 56, Lot 75 and Lot 76 of the B.C.I.C. Div. 8 subdivision, for the West corner of the herein described 5.0010 acre tract, from which an iron rod with survey cap bears South 38°39' West, a distance of 11.8 feet, at position X=3154514.00 and Y=13555204.63;

THENCE North 42°51'47" East, coincident with the northwestern boundary line of Lot 55, same being the southeastern boundary line of Lot 76, a distance of 330.07 feet to the **POINT OF BEGINNING**, containing 5.0010 acres of land, more or less.

STATE OF TEXAS
REGISTERED
WM. PATRICK DOYLE
4467
PROFESSIONAL
LAND SURVEYOR

Wm. Patrick Doyle
Registered Professional Land Surveyor
Texas Registration Number 4467
March 24, 2009

This description is based on a survey, a plat of which, March 18, 2009 is on file in the office of Doyle & Wachtstetter, Inc.
Legal\pat\Gulfco Lot55 Environmental Management 5.00 Acre Tract BCIC8.doc

Doyle & Wachtstetter, Inc
Surveying and Mapping • GPS/GIS

PARCEL No. 2, 5.0010 ACRE ENVIRONMENTAL MANAGEMENT TRACT
LOT 57 OF THE BRAZOS COAST INVESTMENT COMPANY SUBDIVISION, DIVISION 8
FREDERICK. J. CALVIT LEAGUE, ABSTRACT 51
BRAZORIA COUNTY, TEXAS

ALL THAT CERTAIN 5.0010 ACRE tract of land lying in and situated in the Frederick J. Calvit League, Abstract 51, Brazoria County, Texas, being all of Lot 57 of the Brazos Coast Investment Company Subdivision, Division 8 (B.C.I.C. Div. 8), according to the map or plat thereof recorded in Volume 2, Page 141 of the Brazoria County Plat Records (B.C.P.R.) and being the same tract of land conveyed by deed on August 6, 1999 from Janet Casciato-Northrup, Trustee of the Chapter 7 Bankruptcy Estate of Hercules Marine Services Corporation to LDL Coastal Limited, L.P., as recorded in Clerk's File No. 99-036339 of the Brazoria County Official Records (B.C.O.R.), the herein described tract of land being more particularly described by metes and bounds, using survey terminology which refers to the Texas State Plane Coordinate System, South Central Zone (NAD83), in which the directions are Lambert grid bearings and the distances are surface level horizontal lengths (S.F.= 0.99988752832) as follows

COMMENCING at a 3/4" iron rod found marking the North corner Lot 80, same being the West corner of Lot 81 of the aforementioned B.C.I.C. Div. 8 subdivision, located in the southeastern right-of-way boundary line of a 40 foot wide platted roadway of the said B.C.I.C. Div. 8 subdivision, said Point of Commencement being at Texas at State Plane Coordinate System position X=3155152.81 and Y=13556863.07, from which an old 3" x 3/4" hard-wood stake located in the southeastern right-of-way boundary line of a 40 foot wide platted roadway of the said B.C.I.C. Div. 8 subdivision, found marking the North corner of Lot 66, same being the and the West corner of Lot 67 bears South 42°51'47" West, a distance of 4620.94 feet (called 4620.00 feet), at Texas State Plane Coordinate System position X=3152009.76 and Y=13553476.39, herein located point of commencement and point of reference, being shown in 1952 Dow Chemical Company survey by Herman D. Smith, RPS #916, drawing number: B8-8-19000-10488;

THENCE South 42°51'47" West, coincident with the southeastern right-of-way boundary line of said 40 foot wide platted road, a distance of 1980.40 feet to a point for the North corner of Lot 74, same being the West corner of Lot 75 of the B.C.I.C. Div. 8 subdivision, at position X=3153805.79 and Y=13555411.64;

THENCE South 47°08'13" East, coincident with the southwestern boundary line of Lot 75, same being the northeastern boundary line of Lot 74 of the B.C.I.C. Div. 8 subdivision, a distance of 660.00 feet to the **POINT OF BEGINNING**, at a 5/8" iron rod with survey cap marked "WPD 4467" set for the common corner of Lot 56, Lot 57, Lot 74 and Lot 75 of the B.C.I.C. Div. 8 subdivision and the North corner of the herein described 5.0010 acre tract, at position X=3154289.50 and Y=13554962.72;

131 Commerce Street • Clute, Texas 77531-5601
Phone: 979-265-3622 • Fax: 979-265-9940 • Email: DW-Surveyor.com

PARCEL No. 2, 5.0010 ACRE ENVIRONMENTAL MANAGEMENT TRACT
LOT 57 OF THE BRAZOS COAST INVESTMENT COMPANY SUBDIVISION, DIVISION 8
FREDERICK. J. CALVIT LEAGUE, ABSTRACT 51
BRAZORIA COUNTY, TEXAS

THENCE South 47°08'13" East, coincident with the southwestern boundary line of Lot 56, same being the northeastern boundary line of Lot 57 of the B.C.I.C. Div. 8 subdivision, at a distance of 640.00 feet pass a 5/8" iron rod with survey cap marked "WPD 4467" set in the apparent northwest right-of-way boundary line of the 80 foot wide Marlin Lane, known as Brazoria County Road #756, continuing a total distance of 660.00 feet to a point in the northwestern boundary line of a 40 foot wide platted roadway, at the South corner of Lot 56, same being the East corner of Lot 57 of the B.C.I.C. Div. 8 subdivision, for the East corner of the herein described 5.0010 acre tract, at position X=3154773.21 and Y=13554513.81;

THENCE South 42°51'47" West, coincident with the northwestern right-of-way boundary line of said 40 foot wide platted road, same being the southeastern boundary line of Lot 57 of the B.C.I.C. Div. 8 subdivision, a distance of 330.07 feet to a point for the East corner of Lot 58, same being the South corner of Lot 57 of the B.C.I.C. Div. 8 subdivision, for the South corner of the herein described 5.0010 acre tract, from which an iron rod with survey cap bears North 78°35' West, a distance of 22.4 feet, at position X=3154548.71 and Y=13554271.90;

THENCE North 47°08'13" West, coincident with the northeastern boundary line of Lot 58, same being the southwestern boundary line of Lot 57, at a distance of 20.00 feet pass a 5/8" iron rod with survey cap marked "WPD 4467" set in the apparent northwest right-of-way boundary line of the 80 foot wide Marlin Lane, known as Brazoria County Road #756, continuing a total distance of 660.00 feet to a 5/8" iron rod with survey cap marked "WPD 4467" set at the common corner of Lot 57, Lot 58, Lot 73 and Lot 74 of the B.C.I.C. Div. 8 subdivision, for the West corner of the herein described 5.0010 acre tract, from which an iron rod with survey cap bears South 38°39' West, a distance of 11.6 feet, at position X=3154065.00 and Y=13554720.82;

THENCE North 42°51'47" East, coincident with northwestern boundary line of Lot 57, same being the southeastern boundary line of Lot 74 of the B.C.I.C. Div. 8 subdivision, a distance of 330.07 feet to the **POINT OF BEGINNING**, containing 5.0010 acres of land, more or less.

STATE OF TEXAS
REGISTERED
WM. PATRICK DOYLE
4467
PROFESSIONAL
LAND SURVEYOR

Wm. Patrick Doyle
Registered Professional Land Surveyor
Texas Registration Number 4467
March 18, 2009

This description is based on a survey, a plat of which, February 17, 2009 is on file in the office of Doyle & Wachtstetter, Inc.
Legal\pat\Gulfco Lot57 Environmental Management 5.00 Acre Tract BCIC8.doc

Exhibit B

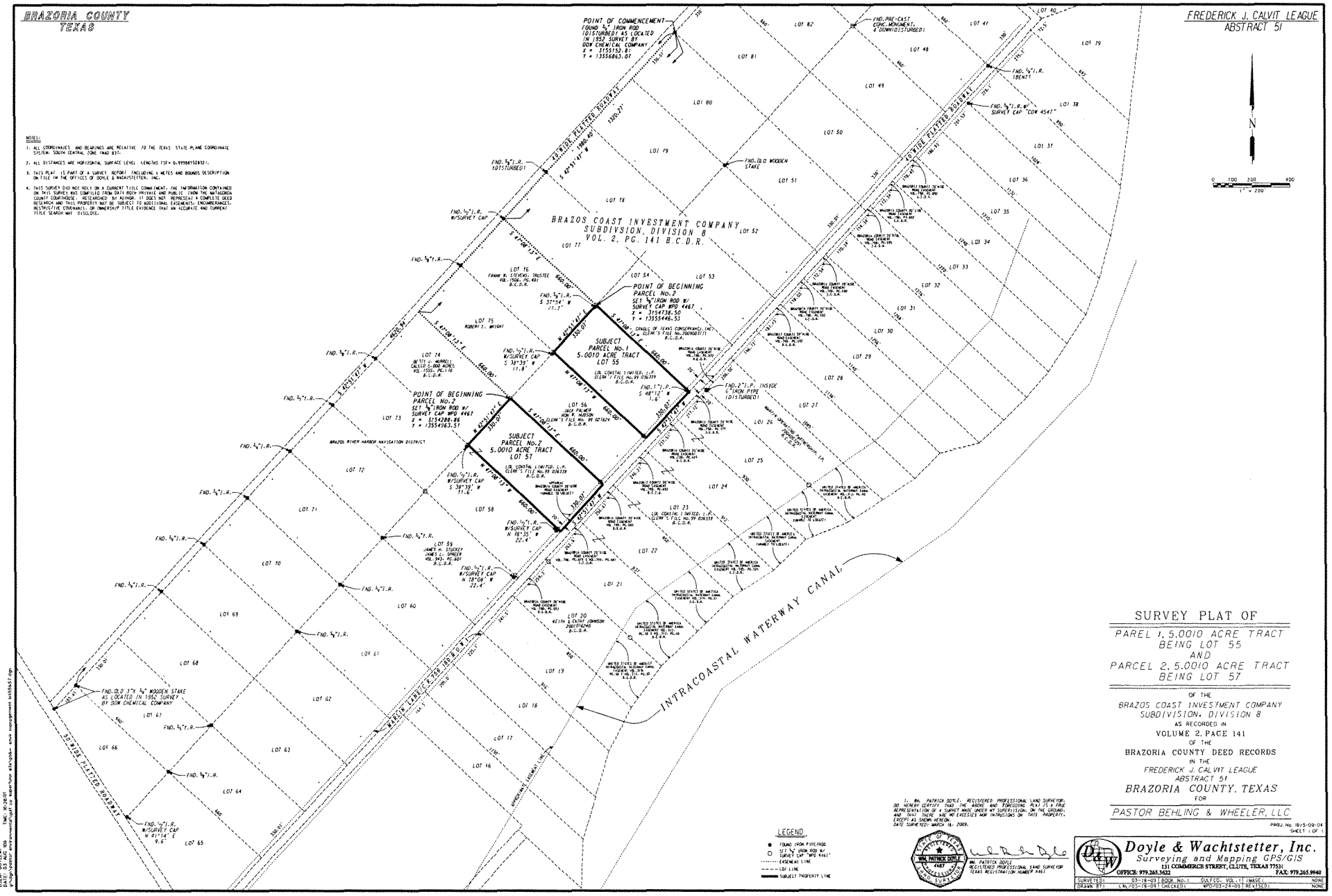
Plat Map of the Property – area covered by Restrictive Covenant for Limitation on Uses, Construction and Groundwater Use

BRAZORIA COUNTY
TEXAS

FREDERICK J. CALVIT LEAGUE
ABSTRACT 51

NOTES:

1. ALL COORDINATES AND BEARINGS ARE RELATIVE TO THE TEXAS STATE PLANE COORDINATE SYSTEM, SOUTH CENTRAL ZONE (NAD 83).
2. ALL DISTANCES ARE HORIZONTAL SURFACE LEVEL (ENGTHS TSF = 0.9998852682).
3. THIS PLAT IS PART OF A SURVEY REPORT INCLUDING 4 NOTES AND BOUNDS DESCRIPTION ON FILE IN THE OFFICES OF DOYLE & WACHTSTETTER, INC.
4. THIS SURVEY DID NOT RELY ON A CURRENT TITLE COMMITMENT. THE INFORMATION CONTAINED ON THIS SURVEY WAS COMPILED FROM DATA (BOTH PRIVATE AND PUBLIC) FROM THE WATAGORDA COUNTY COURTHOUSE. RESEARCHED BY NONAME. IT DOES NOT REPRESENT A COMPLETE DEED RESEARCH AND THIS PROPERTY MAY BE SUBJECT TO ADDITIONAL EASEMENTS, ENCUMBRANCES, RESTRICTIVE COVENANTS, OR OWNERSHIP TITLE EVIDENCE THAT AN ACCURATE AND CURRENT TITLE SEARCH MAY DISCLOSE.



SURVEY PLAT OF

PAREL 1, 5.0010 ACRE TRACT
BEING LOT 55
AND
PARCEL 2, 5.0010 ACRE TRACT
BEING LOT 57

OF THE
BRAZOS COAST INVESTMENT COMPANY
SUBDIVISION, DIVISION 8
AS RECORDED IN
VOLUME 2, PAGE 141
OF THE
BRAZORIA COUNTY DEED RECORDS
IN THE
FREDERICK J. CALVIT LEAGUE
ABSTRACT 51
BRAZORIA COUNTY, TEXAS
FOR
PASTOR BEHLING & WHEELER, LLC

PROJ. No. 1915-09-04
SHEET 1 OF 1

I, WM. PATRICK DOYLE, REGISTERED PROFESSIONAL LAND SURVEYOR, DO HEREBY CERTIFY THAT THE ABOVE AND FORGOING PLAT IS A TRUE REPRESENTATION OF A SURVEY MADE UNDER MY SUPERVISION, ON THE GROUND, AND THAT THERE ARE NO EXCESSIVE WAR INTRUSIONS ON THIS PROPERTY, EXCEPT AS SHOWN HEREON.
DATE SURVEYED: MARCH 16, 2009.

WM. PATRICK DOYLE
REGISTERED PROFESSIONAL LAND SURVEYOR
TEXAS REGISTRATION NUMBER 4467

LEGEND
- FOUND IRON PIPE/RODS
- SET ¾" IRON ROD W/ SURVEY CAP "#PD 4467"
- EASEMENT LINE
- LOT LINE
- SUBJECT PROPERTY LINE

Doyle & Wachtstetter, Inc.
Surveying and Mapping GPS/GIS
131 COMMERCE STREET, CLUTE, TEXAS 77531
OFFICE: 979.265.3622 FAX: 979.265.9940

SURVEYED:	03-16-09	BOOK No.:	GULF50, VOL. 1	IMAGE:	NONE
DRAWN BY:	LAJ 05-19-09	CHECKED:	WPD 05-24-09	REVISED:	NONE

USER: DOYLEWP
DATE: 03 AUG 1999
P:\gis\pastor environmental\pt to waterway\pb-sbs- env management lot55&57.dgn
TIME: 10:28:01

Doc# 2009036113
Pages 10
08/13/2009 1:44PM
Official Public Records of
BRAZORIA COUNTY
JOYCE HUDMAN
COUNTY CLERK
Fees $52.00

Joyce Hudman

RESTRICTIVE COVENANT FOR LIMITATION ON USES, CONSTRUCTION AND GROUNDWATER USE

Doc# 2009036112

STATE OF TEXAS §
§
COUNTY OF BRAZORIA §

ION

This Restrictive Covenant is filed to provide information concerning certain use limitations upon that parcel of real property (the "Property") described in Exhibits A and B, attached hereto and incorporated herein by reference, and which at the time of this filing is listed on the United States Environmental Protection Agency's ("EPA") National Priority List as a "Superfund Site."

As of the date of this Restrictive Covenant, the record owners of fee title to the Property are Jack Palmer and Ron W. Hudson (individually, "Owner," and collectively, "Owners"). Mr. Palmer's address is 1509 Alta Vista, Alvin, Texas 77511. Mr. Hudson's address is 45 West Sienna Place, The Woodlands, Texas 77382. The appropriate land use for the Property is commercial/industrial.

The Property previously contained surface impoundments, which were closed in 1982 in accordance with the state industrial solid waste regulations and a closure plan as approved by the Texas Department of Water Resources.

Owners have agreed to place the following restrictions on the Property in favor of The Dow Chemical Company ("Dow"), Chromalloy American Corporation ("Chromalloy"), the Texas Commission on Environmental Quality ("TCEQ"), the State of Texas and EPA.

NOW THEREFORE, in consideration of the premises and other good and valuable consideration, the receipt and sufficiency of which is hereby acknowledged, the following restrictive covenants in favor of Dow, Chromalloy, TCEQ, the State of Texas and EPA are placed on the Property, to-wit:

1. Commercial/Industrial Use.

The Property shall not be used for any purposes other than commercial/industrial uses, as that term is defined under 30 T.A.C §350.4(a)(13), and thus shall not be used for human habitation or for other purposes with a similar potential for human exposure. Portions of the soils and/or groundwater of the Property contain certain identified chemicals of concern. Future users of the Property are advised to review and take into consideration environmental data from publicly available sources (i.e. TCEQ and EPA) prior to utilizing the Property for any purpose.

2. Groundwater.

The groundwater underlying the Property shall not be used for any beneficial purpose, including: (1) drinking water or other potable uses; (2) the irrigation or watering of landscapes or (3) agricultural uses. For any activities that may result in potential exposure to the groundwater,

a plan must be in place to address and ensure the appropriate handling, treatment and disposal of any affected soils or groundwater.

3. Construction.

Construction of any building on the Property is not advisable. If any person desires in the future to construct a building on the Property, the EPA and TCEQ must be notified and must approve of such construction in writing, as additional response actions, such as protection against indoor vapor intrusion, may be necessary before the Property may be built upon. The costs for any additional response actions will be borne by the party(s) desiring to construct upon the Property.

4. These restrictions shall be a covenant running with the land.

For additional information, contact:

The Dow Chemical Company
2030 Dow Center
8th Floor Legal Dept.
Midland, MI 48674
ATTN: General Counsel

Chromalloy American Corporation
C/O Sequa Corporation
200 Park Avenue
New York, NY 10166
ATTN: General Counsel

U.S. Environmental Protection Agency, Region 6
Superfund Division (6RC-S)
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733
ATTN: Assistant Regional Counsel

Texas Commission on Environmental Quality
P.O. Box 13087
Austin, TX 78711-3087
ATTN: Remediation Division

State of Texas
Office of the Texas Attorney General
Natural Resources Division
300 W. 15th Street
Austin, TX 78701

The restrictions imposed by this Restrictive Covenant may be rendered of no further force or effect only by a release executed by Dow, Chromalloy, TCEQ, the State of Texas and EPA or their successors and filed in the same Real Property Records as those in which this Restrictive Covenant is filed.

[THE REMAINDER OF THIS PAGE WAS INTENTIALLY LEFT BLANK. SIGNATURE PAGES CONTINUE ON NEXT PAGE]

Executed this 7th day of July, 2009.

OWNER: Jack Palmer

X Jack P. Palmer

STATE OF TEXAS §
§
COUNTY OF Brazoria §

BEFORE ME, on this the 7th day of July, 2009, personally appeared Jack Palmer, known to me to be the person whose name is subscribed to the foregoing instrument, and acknowledged to me that he executed the same for the purposes and in the capacity herein expressed.

GIVEN UNDER MY HAND AND SEAL OF OFFICE, this the 7th day of July, 2009.

Roxann Corona
Notary Public in and for the State of Texas

My Commission Expires: 10-23-2011

ROXANN CORONA
NOTARY PUBLIC
STATE OF TEXAS
10-23-2011

2662305.1/SP/73364/0238/070109

Executed this 6th day of July, 2009.

OWNER: Ron W. Hudson

Ronald W. Hud

STATE OF TEXAS §
§
COUNTY OF Montgomery §

BEFORE ME, on this the 6th day of July, 2009, personally appeared Ron W. Hudson, known to me to be the person whose name is subscribed to the foregoing instrument, and acknowledged to me that he executed the same for the purposes and in the capacity herein expressed.

GIVEN UNDER MY HAND AND SEAL OF OFFICE, this the 6th day of July, 2009.

Lisa L. Clow

Notary Public in and for the State of Texas

LISA L. CLOW
Notary Public, State of Texas
My Commission Expires 07-26-2009

My Commission Expires: July 26, 2009

2662305.1/SP/73364/0238/070109

Exhibit A

Legal Description of the Property

Doyle & Wachtstetter, Inc
Surveying and Mapping • GPS/GIS

5.0010 ACRE ENVIRONMENTAL MANAGEMENT TRACT
LOT 56 OF THE BRAZOS COAST INVESTMENT COMPANY SUBDIVISION, DIVISION 8
FREDERICK. J. CALVIT LEAGUE, ABSTRACT 51
BRAZORIA COUNTY, TEXAS

ALL THAT CERTAIN 5.0010 ACRE tract of land lying in and situated in the Frederick J. Calvit League, Abstract 51, Brazoria County, Texas, being all of Lot 56 of the Brazos Coast Investment Company Subdivision, Division 8 (B.C.I.C. Div. 8), according to the map or plat thereof recorded in Volume 2, Page 141 of the Brazoria County Plat Records (B.C.P.R.) and being the same tract of land conveyed by deed on May 12, 1999 from Fish Engineering and Construction, Inc. to Jack Palmer and Ron W. Hudson, as recorded in Clerk's File No. 99-021624 of the Brazoria County Official Records (B.C.O.R.), the herein described tract of land being more particularly described by metes and bounds, using survey terminology which refers to the Texas State Plane Coordinate System, South Central Zone (NAD83), in which the directions are Lambert grid bearings and the distances are surface level horizontal lengths (S.F.= 0.99988752832) as follows

COMMENCING at a 3/4" iron rod found marking the North corner Lot 80, same being the West corner of Lot 81 of the aforementioned B.C.I.C. Div. 8 subdivision, located in the southeastern right-of-way boundary line of a 40 foot wide platted roadway of the said B.C.I.C. Div. 8 subdivision, said Point of Commencement being at Texas at State Plane Coordinate System position X=3155152.81 and Y=13556863.07, from which an old 3" x 3/4" hard-wood stake located in the southeastern right-of-way boundary line of a 40 foot wide platted roadway of the said B.C.I.C. Div. 8 subdivision, found marking the North corner of Lot 66, same being the and the West corner of Lot 67 bears South 42°51'47" West, a distance of 4620.94 feet (called 4620.00 feet), at Texas State Plane Coordinate System position X=3152009.76 and Y=13553476.39, herein located point of commencement and point of reference, being shown in 1952 Dow Chemical Company survey by Herman D. Smith, RPS #916, drawing number: B8-8-19000-10488;

THENCE South 42°51'47" West, coincident with the southeastern right-of-way boundary line of said 40 foot wide platted road, a distance of 1650.34 feet to a point for the North corner of Lot 75, same being the West corner of Lot 76 of the B.C.I.C. Div. 8 subdivision, at position X=3154030.29 and Y=13555653.54;

THENCE South 47°08'13" East, coincident with the southeastern boundary line of Lot 76, same being the northeastern boundary line of Lot 75 of the B.C.I.C. Div. 8 subdivision, a distance of 660.00 feet to the **POINT OF BEGINNING**, at a 5/8" iron rod with survey cap marked "WPD 4467" set for the common corner of Lot 55, Lot 56, Lot 75 and Lot 76 of the B.C.I.C. Div. 8 subdivision and the North corner of the herein described 5.0010 acre tract, from which an iron rod with survey cap bears South 38°39' West, a distance of 11.8 feet, at position X=3154514.00 and Y=13555204.63;

131 Commerce Street • Clute, Texas 77531-5601
Phone: 979-265-3622 • Fax: 979-265-9940 • Email: DW-Surveyor.com

5.0010 ACRE ENVIRONMENTAL MANAGEMENT TRACT
LOT 56 OF THE BRAZOS COAST INVESTMENT COMPANY SUBDIVISION, DIVISION 8
FREDERICK. J. CALVIT LEAGUE, ABSTRACT 51
BRAZORIA COUNTY, TEXAS

THENCE South 47°08'13" East, coincident with the southwestern boundary line of Lot 55, same being the northeastern boundary line of Lot 56 of the B.C.I.C. Div. 8 subdivision, at a distance of 640.00 feet pass a 5/8" iron rod with survey cap marked "WPD 4467" set in the apparent northwest right-of-way boundary line of the 80 foot wide Marlin Lane, known as Brazoria County Road #756, continuing a total distance of 660.00 feet to a point in the northwestern boundary line of a 40 foot wide platted roadway, at the South corner of Lot 55, same being the East corner of Lot 56 of the B.C.I.C. Div. 8 subdivision, for the East corner of the herein described 5.0010 acre tract, at position X=3154997.71 and Y=13554755.72;

THENCE South 42°51'47" West, coincident with the northwestern right-of-way boundary line of said 40 foot wide platted road, same being the southeastern boundary line of Lot 56 of the B.C.I.C. Div. 8 subdivision, a distance of 330.07 feet to a point for the East corner of Lot 57, same being the South corner of Lot 56 of the B.C.I.C. Div. 8 subdivision, for the South corner of the herein described 5.0010 acre tract, at position X=3154773.21 and Y=13554513.81;

THENCE North 47°08'13" West, coincident with the northeastern boundary line of Lot 57, same being the southwestern boundary line of Lot 56, at a distance of 20.00 feet pass a 5/8" iron rod with survey cap marked "WPD 4467" set in the apparent northwest right-of-way boundary line of the 80 foot wide Marlin Lane, known as Brazoria County Road #756, continuing a total distance of 660.00 feet to a 5/8" iron rod with survey cap marked "WPD 4467" set at the common corner of Lot 56, Lot 57, Lot 74 and Lot 75 of the B.C.I.C. Div. 8 subdivision, for the West corner of the herein described 5.0010 acre tract, at position X=3154289.50 and Y=13554962.72;

THENCE North 42°51'47" East, coincident with northwestern boundary line of Lot 56, same being the southeastern boundary line of Lot 75 of the B.C.I.C. Div. 8 subdivision, a distance of 330.07 feet to the **POINT OF BEGINNING**, containing 5.0010 acres of land, more or less.

STATE OF TEXAS
REGISTERED
WM. PATRICK DOYLE
4467
PROFESSIONAL
LAND SURVEYOR

Wm. Patrick Doyle
Registered Professional Land Surveyor
Texas Registration Number 4467
March 24, 2009

This description is based on a survey, a plat of which, March 18, 2009 is on file in the office of Doyle & Wachtstetter, Inc.
Legal\pat\Gulfco Lot56 Environmental Management 5.00 Acre Tract BCIC8.doc

Exhibit B

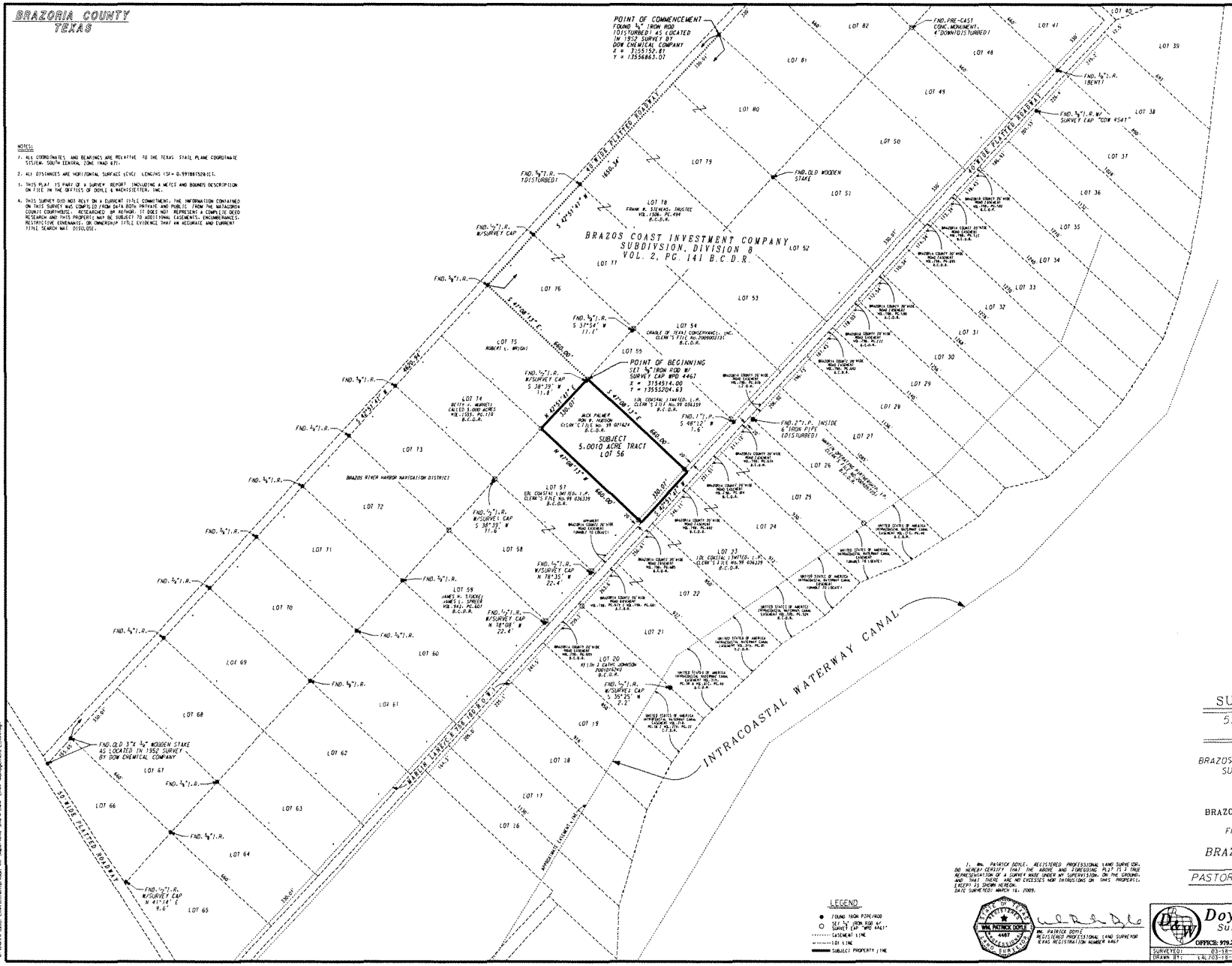
Plat Map of the Property – area covered by Restrictive Covenant for Limitation on Uses, Construction and Groundwater Use

BRAZORIA COUNTY
TEXAS

FREDERICK J. CALVIT LEAGUE
ABSTRACT 51

NOTES:

1. ALL COORDINATES AND BEARINGS ARE RELATIVE TO THE TEXAS STATE PLANE COORDINATE SYSTEM, SOUTH CENTRAL ZONE (NAD 83).
2. ALL DISTANCES ARE HORIZONTAL SURFACE (GVG) LENGTHS USE 0.9998852616%.
3. THIS PLAT IS PART OF A SURVEY REPORT INCLUDING A METES AND BOUNDS DESCRIPTION ON FILE IN THE OFFICES OF DOYLE & WACHTSTETTER, INC.
4. THIS SURVEY DID NOT RELY ON A CURRENT TITLE COMMITMENT. THE INFORMATION CONTAINED ON THIS SURVEY WAS COMPILED FROM DATA BOTH PRIVATE AND PUBLIC FROM THE BRAZORIA COUNTY COURTHOUSE. RESEARCHED BY AUTHOR. IT DOES NOT REPRESENT A COMPLETE DEED RESEARCH AND THIS PROPERTY MAY BE SUBJECT TO ADDITIONAL EASEMENTS, ENCUMBRANCES, RESTRICTIVE COVENANTS, OR OWNERSHIP TITLE EVIDENCE THAT AN ACCURATE AND CURRENT TITLE SEARCH MAY DISCLOSE.



SURVEY PLAT OF
5.0010 ACRE TRACT
BEING LOT 56
OF THE
BRAZOS COAST INVESTMENT COMPANY
SUBDIVISION, DIVISION 8
AS RECORDED IN
VOLUME 2, PAGE 141
OF THE
BRAZORIA COUNTY DEED RECORDS
IN THE
FREDERICK J. CALVIT LEAGUE
ABSTRACT 51
BRAZORIA COUNTY, TEXAS
FOR
PASTOR BEHLING & WHEELER, LLC

PROJ. No. 1915-09-04
SHEET 1 OF 1

I, WM. PATRICK DOYLE, REGISTERED PROFESSIONAL LAND SURVEYOR, DO HEREBY CERTIFY THAT THE ABOVE AND FOREGOING PLAT IS A TRUE REPRESENTATION OF A SURVEY MADE UNDER MY SUPERVISION, ON THE GROUND, AND THAT THERE ARE NO EXCESSES NOR INTRUSIONS ON THIS PROPERTY, EXCEPT AS SHOWN HEREON.
DATE SURVEYED: MARCH 16, 2009.

STATE OF TEXAS
REGISTERED
WM. PATRICK DOYLE
4467
PROFESSIONAL
SURVEYOR

WM. PATRICK DOYLE
REGISTERED PROFESSIONAL LAND SURVEYOR
TEXAS REGISTRATION NUMBER 4467

LEGEND
- FOUND IRON PIPE/ROD
- SET ½" IRON ROD W/ SURVEY CAP "WPD 4467"
- EASEMENT LINE
- LOT LINE
- SUBJECT PROPERTY LINE

Doyle & Wachtstetter, Inc.
Surveying and Mapping GPS/GIS
131 COMMERCE STREET, CLUTE, TEXAS 77531
OFFICE: 979.265.3022 FAX: 979.265.9940

SURVEYED:	03-18-09	BOOK No.:	CULCO VOL.:	IMAGE:	NONE
DRAWN BY:	KJ 03-18-09	CHECKED:	WPD 03-24-09	REVISED:	NONE

USER: DOYLEWP
DATE: 03 AUG 09
O:\Doyle\Project Environment\Calvit Sportland Step\PB&W Error Management\Lot56.dgn
TIME: 16:19:39

Doc# 2009036112
Pages 10
08/13/2009 1:44PM
Official Public Records of
BRAZORIA COUNTY
JOYCE HUDMAN
COUNTY CLERK
Fees $52.00

Joyce Hudman

APPENDIX C

JUNE 28, 1974 AERIAL PHOTOGRAPH

JUNE 28, 1974 AERIAL PHOTOGRAPH