FINAL

DAMAGE ASSESSMENT AND RESTORATION PLAN/ ENVIRONMENTAL ASSESSMENT

FOR MALONE SERVICE COMPANY SUPERFUND SITE, GALVESTON COUNTY, TEXAS CITY, TEXAS

July 28, 2015

Prepared by the:

Texas Commission on Environmental Quality
Texas General Land Office
Texas Parks and Wildlife Department
National Oceanic and Atmospheric Administration
and
United States Fish and Wildlife Service
acting on behalf of the
United States Department of the Interior

Executive Summary

This Final Damage Assessment and Restoration Plan/Environmental Assessment (DARP/EA) has been developed by the Texas Commission on Environmental Quality (TCEQ), Texas Parks and Wildlife Department, Texas General Land Office, National Oceanic and Atmospheric Administration of the U.S. Department of Commerce, and the U.S. Fish and Wildlife Service acting on behalf of the U.S. Department of the Interior (collectively, "the Trustees") to address natural resources (including ecological services) injured, lost or destroyed within Malone Service Company property and a portion of the nearby marsh in Galveston County, Texas City, Texas. Natural resource injuries and loss are due to releases of hazardous substances and subsequent response actions to address those releases.

The Malone Service Company (MSC) Superfund Site (the "Site") began operating in 1964 as a reclamation plant for waste oils and chemicals. Suit was filed against MSC by the State of Texas due to improper waste disposal and waste permit violations. Based on the finding by a jury that MSC violated its permits, judgment was entered against MSC on August 14, 1989 and became final in 1993. In 1995, the TCEQ filed an application for revocation of MSC's hazardous waste storage and injection well permits. The permits were revoked on May 6, 1997. In January 1996, prior to the final Order revoking the permits, all waste shipments to the Site ceased.

The Trustees determined that three categories of injury resulted at the Site: injury to estuarine marsh sediments, injury to terrestrial areas due to oiled wildlife, and injury to freshwater sediments.

Under this Final DARP/EA, the Trustees propose to compensate the public for the assessed injuries by the construction of approximately 70 acres of estuarine marsh habitat to address the 38.48 acre requirement, restoration of 25 acres of freshwater wetlands to address the 13.97 acre requirement, and enhancement of approximately 3 acres of terrestrial uplands to address the 2.73 acre requirement. These actions would result in the replacement of benthic resources and services lost and/or injured due to exposure to hazardous substances. These restoration actions would also result in the replacement of terrestrial resources lost and/or injured due to response activities associated with the Site. The proposed restoration alternatives are located near the Site. The proposed restoration alternatives would construct estuarine marsh habitat within the nearby Pierce Marsh, enhance freshwater wetlands west of the Site in Campbell Bayou in the Virginia Point Peninsula Preserve, and enhance terrestrial uplands at an area south of the Site in the Virginia Point Peninsula Preserve. These actions would be implemented by the Trustees pursuant to the terms of a settlement of natural resource damage claims for the Site embodied in a formal Consent Decree.

This Final DARP/EA addresses only injuries to natural resources and the lost services at the Site that are attributable to releases of hazardous substances and subsequent remedial actions. It does not address natural resource injuries outside the Site.

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ACRONYMS AND ABBREVIATIONS

Ag	Silver
AOC	Area of Concern
API	American Petroleum Institute
AR	Administrative Record
As	Arsenic
ATSDR	Agency for Toxic Substances and Disease Registry
BERA	Baseline Ecological Risk Assessment
BUDM	Benefical Use of Dredged Material
CAA	Clean Air Act
CD	Consent Decree
Cd	Cadmium
Cr	Chromium
Cu	Copper
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
C.F.R.	Code of Federal Regulations
COC	Chemical of Concern
CWA	Federal Water Pollution Control Act or Clean Water Act
CZMA	Coastal Zone Management Act
DARP/EA	Damage Assessment and Restoration Plan/Environmental Assessment
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
DDTr	Total DDT, DDD, and DDE
DOC	Department of Commerce
DOI	Department of Interior
DSAY	Discounted Service Acre Year
EA	Environmental Assessment
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
ERA	Ecological Risk Assessment
ERL	Effects Range Low

ERM	Effects Range Medium
ESA	Endangered Species Act
FWCA	Fish and Wildlife Coordination Act
FONSI	Finding of No Significant Impact
FM	Farm to Market Road
FS	Feasibility Study
GCWDA	Gulf Coast Waste Disposal Authority
GIS	Geographic Information System
GIWW	Gulf Intercoastal Water Way
GLO	Texas General Land Office
GMFMC	Gulf of Mexico Fishery Management Council
HCF	Habitat Conversion Factor
HEA	Habitat Equivalency Analysis
Hg	Mercury
HQ	Hazard Quotient
HW	Hazardous Waste
the Marsh	Estuarine marsh associated with the Site
MOU	Memorandum of Understanding
MSFCMA	Magnuson-Stevens Fishery Conservation and Management Act
MSC	Malone Service Company
NCP	National Oil and Hazardous Substances Contingency Plan
NEPA	National Environmental Policy Act
Ni	Nickel
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NOAEL	No Observable Adverse Effect Level
NPL	National Priorities List
NRDA	Natural Resource Damage Assessment
PAH	Polycyclic Aromatic Hydrocarbons
Pb	Lead
PCB	Polychlorinated Biphenyl
PEC	Probable Effect Concentration
PCL	Protective Concentration Limit

ppt	Parts per thousand
PRP	Potentially Responsible Party
RA	Remedial Action
RCRA	Resource Conservations and Recovery Act
RD	Remedial Design
ROD	Record of Decision
RI	Remedial Investigation
RHA	Rivers and Harbors Act
the Site	MSC Superfund Site
SLERA	Screening Level Ecological Risk Assessment
SWMU	Solid Waste Management Unit
SSI	Site Screening Inspection
TCEQ	Texas Commission on Environmental Quality
TEC	Threshold Effect Concentration
TexReg	Texas Register
TNRCC	Texas Natural Resources Conservation Commission (now TCEQ)
TPWD	Texas Parks and Wildlife Department
TRRP	Texas Risk Reduction Program
the Trustees	TCEQ, TPWD, GLO, NOAA, and USFWS
U.S.C.	United States Code
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
Zn	Zinc

SECTION 1
INTRODUCTION

This Final Damage Assessment and Restoration Plan/Environmental Assessment (DARP/EA) has been developed by the Texas Commission on Environmental Quality (TCEQ), Texas Parks and Wildlife Department (TPWD), Texas General Land Office (GLO), National Oceanic and Atmospheric Administration (NOAA) of the U.S. Department of Commerce (DOC), and the U.S. Fish and Wildlife Service (USFWS) acting on behalf of the U.S. Department of Interior (DOI) (collectively known as the Trustees) to quantify and propose sufficient compensation for natural resources (including ecological services[1]) injured, lost, or destroyed within the Malone Service Company property and an adjacent estuarine marsh in Galveston County, Texas City, Texas. Natural resource injuries and loss are due to releases of hazardous substances and subsequent response actions.

The Malone Service Company (MSC) Superfund Site (the Site) is bordered to the east by Western Galveston Bay and to the northeast by Swan Lake, an embayment of Galveston Bay (Figure 1-1). The estuarine marsh associated with the Site (the Marsh) evaluated for injury is shown on Figure 1-2. The Site encompasses approximately 150 acres, of which the former operating area is approximately 75 acres. MSC began operating the site in 1964 as a reclamation plant for waste oils and chemicals. The MSC facility was permitted as a commercial storage, processing, and disposal facility authorized to store and process industrial solids in 1984. The permit authorized the discharge of storm water runoff.

Suit was filed against MSC by the State of Texas due to improper waste disposal and waste permit violations. Based on a jury finding that MSC seriously violated its permits, judgment was entered against MSC on August 14, 1989 and became final in 1993. In 1995, the TCEQ filed an application to revoke MSC's hazardous waste storage and injection well permits. After a hearing requested by MSC, the permits were revoked on May 6, 1997. All waste shipments to the Site ceased in January 1996 prior to the final Order revoking the permits.

The Trustees determined that three categories of injury resulted at the Site: 1) benthic invertebrate injury in marsh estuarine sediments adjacent to the Site; 2) injury to wildlife due to oil in a terrestrial environment on-site; and 3) injury to freshwater resources such as benthic invertebrates and wildlife exposed to contaminated sediments on-site. The Trustees determined the required estuarine wetland restoration acreage is 38.48 acres; the required freshwater restoration acreage is 13.97 acres; and the required terrestrial restoration acreage is 2.73 acres.

[1] *Services* is defined in 43 C.F.R. § 11.14(nn) as the "physical and biological functions performed by the resource including the human uses of those functions. These services are the result of the physical, chemical, or biological quality of the resource."

Texas City

La Marque

Swan Lake

Lower Galveston Bay

Pelican Island

Bayou Vista

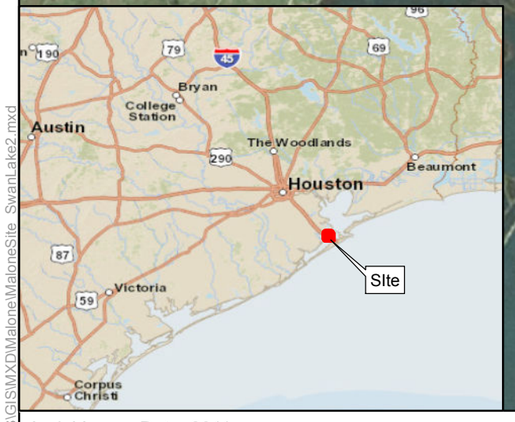
Malone Service Company (MSC) Site

Tiki Island

Galveston

West Bay

Gulf of Mexico



Aerial Image Date: 2011

2 1 0 2 Miles

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Figure 1-1

Malone Service Company
Site Location

Aerial Image Date: 2011

900 450 0 900 Feet

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Figure 1-2

Malone Service Company in Relation to Swan Lake and Lower Galveston Bay

This Final DARP/EA describes the Trustees' assessment of the natural resource injuries attributable to hazardous substances released and response actions at the Site. It does not address any natural resource injuries outside the Site. Further, this Final DARP/EA presents the restoration alternatives considered and identifies the proposed restoration alternatives to compensate for injuries to natural resources at the Site. The injury assessment and restoration actions proposed herein were developed by the Trustees. The selected proposed restoration actions are located in the vicinity of the Site. These actions would be implemented by the Trustees pursuant to the terms of a settlement of natural resource damage claims for the Site embodied in a formal Consent Decree.

1.1 Authority

This Final DARP/EA was prepared jointly by the Trustees pursuant to their respective authorities and responsibilities as natural resource trustees under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), 42 U.S.C. §§ 9601 *et seq*.; the Federal Water Pollution Control Act, 33 U.S.C. §§ 1251 *et seq*. (also known as the Clean Water Act or CWA), and other applicable federal or state laws, including Subpart G of the National Oil and Hazardous Substances Contingency Plan (NCP), at 40 C.F.R. §§ 300.600 through 300.615, and DOI's CERCLA natural resource damage assessment regulations at 43 C.F.R. Part 11 (Natural Resource Damage Assessment, or NRDA, regulations), which provide guidance for the natural resource damage assessment and restoration planning process under CERCLA.

CERCLA applies to sites contaminated with hazardous substances and to releases of such substances. In addition to addressing the cleanup of contaminated sites, CERCLA establishes liability for the injury to, destruction of, or loss of natural resources caused by releases of hazardous substances. Damages recovered for these losses must be used to restore, replace, rehabilitate or acquire equivalent natural resources or services, in accordance with a restoration plan developed by designated natural resource trustees.

CERCLA is the primary statute under which the Trustees are acting in releasing this Final DARP/EA. It identifies the specific projects proposed to restore and compensate for natural resource injuries and losses attributable to hazardous substances released at the Site. Issuance of this Final DARP/EA is part of the restoration planning process under CERCLA, and is consistent with all applicable provisions pertaining to natural resource damages.

1.2 NEPA Compliance

In addition to fulfilling the CERCLA statutory requirement for a publicly vetted restoration plan, this Final DARP/EA also satisfies the federal Trustees' obligation to analyze environmental impacts of restoration actions pursuant to the NEPA, 42 U.S.C. §§ 4321 *et seq.* NOAA will be the lead federal agency for the NEPA evaluation. Actions undertaken by the Trustees to restore natural resources or services under CERCLA and other federal laws are subject to the NEPA and the regulations guiding its implementation at 40 C.F.R. Parts 1500 - 1508. NEPA and its implementing regulations outline the responsibilities of federal agencies when preparing environmental documentation for proposed projects. In general, federal agencies contemplating implementation of a major federal action must produce an environmental impact statement (EIS) if the action is expected to have significant impacts on the quality of the human environment. When it is uncertain whether the proposed action is likely to have significant impacts, federal

agencies prepare an environmental assessment (EA) to evaluate the need for an EIS. If the EA demonstrates that the proposed action will not significantly impact the quality of the human environment, the agency issues a Finding of No Significant Impact (FONSI), which satisfies the requirements of NEPA, and no EIS is required. For a proposed restoration plan, if a FONSI determination is made, the Trustees then issue a final restoration plan describing the selected restoration action(s).

In accordance with NEPA and its implementing regulations, this Final DARP/EA summarizes the current environmental setting; describes the purpose and need for restoration actions; identifies alternative actions; assesses their applicability and potential impact on the quality of the physical, biological, and cultural environment; and summarizes the opportunity the Trustees provided for public participation in the decision-making process. This information will be used to make a threshold determination as to whether preparation of an EIS is required prior to selection of the final restoration action.

1.3 Public Participation

The Trustees prepared this Final DARP/EA to provide the public with information on the natural resource injuries and service losses assessed in connection with the releases attributed to the Site; restoration alternatives considered to compensate for those injuries; the process used by the Trustees to identify both the proposed restoration alternative and the rationale for its selection; and the environmental impacts associated with the various restoration alternatives. Accordingly, this document serves to satisfy the Trustees' obligation to (1) base their restoration actions on a publicly vetted restoration plan under CERCLA and (2) seek public input under NEPA on potential environmental impacts associated with the restoration alternatives.

The draft of this DARP/EA was made available for review and comment by the public for a period of 30 days beginning on June 26, 2015 which was the publication date of the notice of availability of the Draft DARP in the Texas Register. There were no comments received during the comment period and therefore the Draft DARP/EA was released as Final on July 28, 2015.

1.4 Administrative Record

The Trustees maintain records documenting the information considered and actions taken by the Trustees during this assessment and restoration planning process. These records comprise the Trustees' administrative record (AR) supporting this Final DARP/EA. The AR is available for review by interested members of the public and may be requested by contacting Mr. Richard Seiler at the address provided above.

Arrangements must be made in advance to review or obtain copies of these records. Access to and copying of these records is subject to all applicable laws and policies including, but not limited to, laws and policies relating to copying fees and the reproduction or use of any copyrighted material.

SECTION 2
PURPOSE AND NEED FOR RESTORATION

The purpose of the identified restoration actions is to compensate the public for natural resources injured, lost or destroyed, including the loss of the services associated with injured resources within the Site and an adjacent estuarine marsh in Galveston County, Texas City, Texas, due to releases of hazardous substances and subsequent response actions. The authority to pursue such actions is based CERCLA which establishes liability for the injury to, destruction of, or loss of natural resources and their services caused by releases of hazardous substances. Damages recovered for these losses must be used to restore, replace, rehabilitate, or acquire equivalent natural resources or services, in accordance with a restoration plan developed by designated natural resource trustees.

This section generally describes the area of the Site affected by releases of hazardous substances by the potential responsible parties (PRPs); summarizes the response actions that were, will be, or are expected to be undertaken to address that contamination; and summarizes the Trustees' assessment of natural resource injuries and service losses attributable to that contamination and the associated compensation requirements.

2.1 Overview of the Site

The Site is located at 5300 Campbell Bayou Road, Texas City, Galveston County, Texas. Figure 2-1 shows the location of the Site in relation to the surrounding industrial facilities. The closed Solutia South 20 site borders the Site on the southwest. The Gulf Coast Waste Disposal Authority (GCWDA) Campbell Bayou facility is located on the western border of the facility. Northwest of the Site is a closed Texas City landfill (USEPA, 2015). A preserved marsh and wetlands owned by SCENIC GALVESTON, Inc. border the southern portions of the Site (Figure 1-2).

The Site encompasses approximately 150 acres. Figure 2-2 is a map of the features of the Site evaluated for injury or referenced in this Final DARP/EA. The northeastern portion of the Site (100 acres) was developed for the storage, processing, and disposal of industrial hazardous waste. The developed acreage contained numerous waste handling areas; which included storage tanks, two American Petroleum Institute (API) separators, a settling pond (Earthen Impoundment), a closed waste collection pond (Oil Pit), and two deep subsurface injection wells (WDW-73 and WDW-138). The northwestern portion of the Site (undeveloped 50 acres) contains the Freshwater Pond that collected storm water and a Laydown Area. (A Laydown Area is a cleared area used for the storage of equipment and supplies.) The entire facility is encircled by a 14-foot high flood control "hurricane" levee. The Earthen Impoundment, Oil Pit, and Freshwater Pond were excavated through the shallow channel sand aquifer into the underlying clay layer, allowing the sludge pit in the Earthen Impoundment and Oil Pit to potentially communicate contaminants to the shallow groundwater. However, findings from the 2006 Remedial Investigation (RI) demonstrated that groundwater contamination is immediate to the source areas and contaminated groundwater has not migrated off-site (URS, 2006).

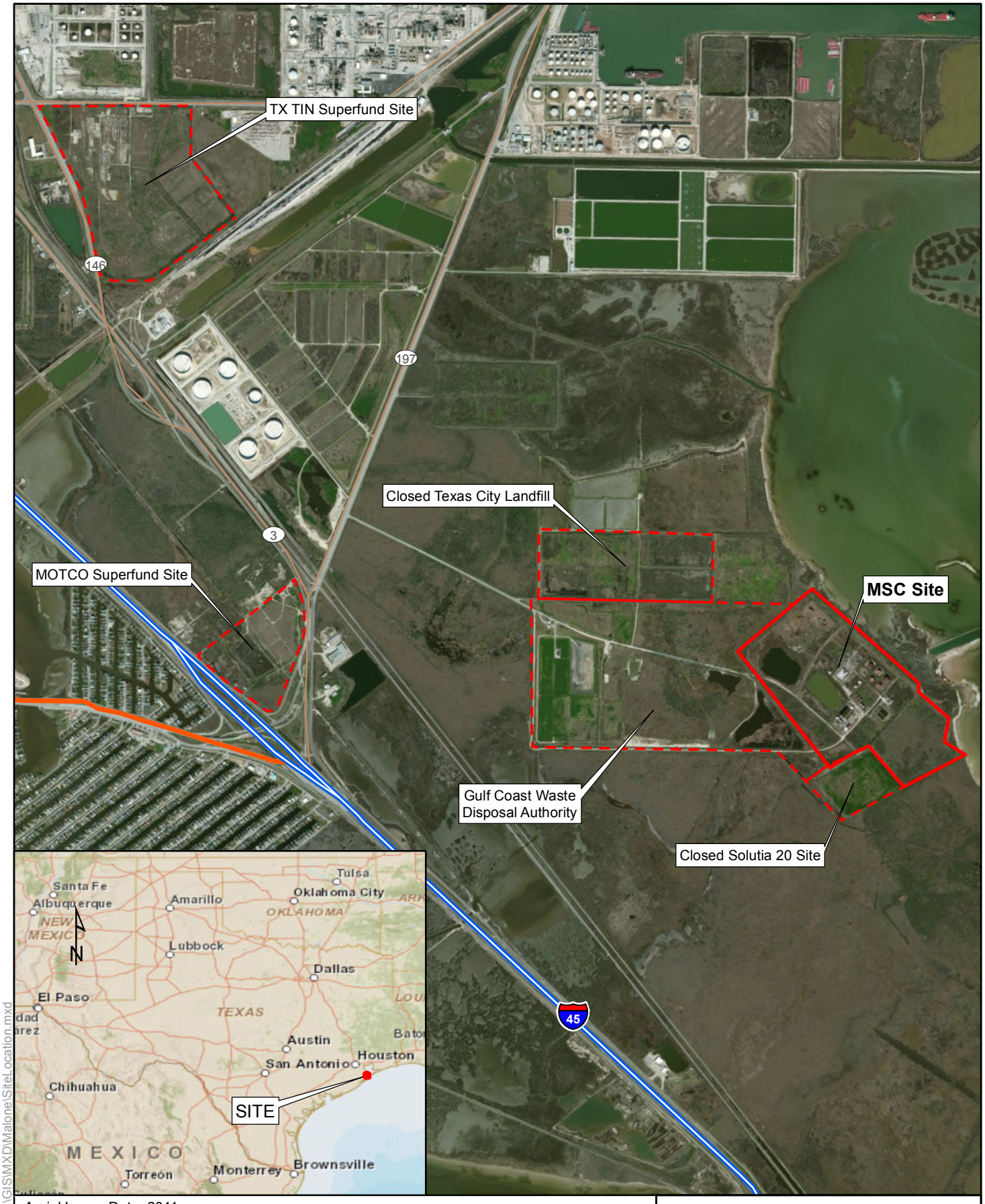

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Figure 2-1

Site Location and Surrounding Facilities

Aerial Image Date: 2011

250 125 0 250 Feet

Note: WDW-73 and WDW-138 are the deep subsurface injection wells

Figure 2-2

Malone Service Company
Site Features

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2.2 Operational History of the Site

MSC began operating the Site in 1964 as a reclamation plant for waste oils and chemicals. Six storage and disposal pits, reclaiming tanks, and a burning pit were authorized by the Texas Water Pollution Control Board to operate under Permit No. 01049. The facility was permitted to dispose liquid hazardous and non-hazardous waste by means of deep well injection under Injection Well Permit Nos. WDW-73 and WDW-138. Injection Permit No. WDW-73 was issued in 1970 and Injection Permit No. WDW-138 was issued in 1977. The MSC facility was permitted as a commercial storage, processing, and disposal facility authorized to store and process industrial solid waste under TCEQ Hazardous Waste (HW) Permit No. HW-50003 issued on September 14, 1984. The permit authorized the receipt of Class 1 and Class 2 industrial solid waste with the exception of waste containing polychlorinated biphenyls (PCB), explosives, and radioactive or nuclear waste material. The permit authorized discharge of storm water runoff (URS, 2004).

During early operations, incoming waste was placed into two earthen, unlined pits formed by excavating the sand of a paleochannel that crosses from southwest to southeast beneath the Site. Waste with high solids or high water content was placed in the larger pit, referred to as the Settling Pond or Sludge Pit. The oil fraction that rose to the top of the larger pit was skimmed off the surface and deposited into the smaller pit, known as the Oil Pit (see Figure 2-2). This oil was then pumped to one of several tanks for treatment, after which it was resold as waste oil for energy recovery (USEPA, 2003). Subsequently, MSC added one and then a second API separator to replace the pits (URS, 2004).

The Site received a variety of waste products from surrounding industries, including acids and caustics; contaminated residues and solvents; gasoline and crude oil tank bottoms; contaminated earth and water from chemical spill cleanups; general industrial plant waste; phenolic tar; and waste oil. Liquids injected into the two deep wells included wastewater submitted to the facility for disposal, storm water from the Sludge Pit, Oil Pit, and separators, and decontamination water collected in the separators.

Suit was filed against MSC by the State of Texas due to improper waste disposal and waste permit violations. Based on a jury finding that MSC violated its permits, judgment was entered against MSC on August 14, 1989 and became final in 1993. In 1995, TCEQ filed an application for revocation of MSC's hazardous waste storage and injection well permits. After a hearing, requested by MSC, the permits were revoked on May 6, 1997. In January 1996, prior to the final Order revoking the permits, all waste shipments to the Site ceased (TNRCC, 1998).

2.3 Summary of Response Actions

Over the years, the Site has been the subject of investigations, activities (*e.g.*, maintenance of storm water), removal actions, and assessments (USEPA, 2015), as summarized below:

Initial Site Characterization

- Under contract to EPA, A.T. Kearney and Camp, Dresser & McKee conducted a preliminary review of the available site information followed by a visual site inspection in August 1988 (Kearney, 1989). The purpose of these activities was to identify releases or potential releases requiring investigation at hazardous waste management facilities.

Solid waste management units (SWMU) and other areas of concern (AOC) were identified during the inspection.

- The TCEQ conducted a Screening Site Inspection (SSI) in January 1997. SSI activities included on-site and off-site reconnaissance, record searches, on-site and off-site sample collection, and interviews with site representatives (Texas Natural Resource Conservation Commission [TNRCC], 1998).
- USEPA conducted removal actions at the Site from 1999 to 2000. Approximately 918,024 gallons of oil were sent to recyclers and cement kilns.
- The Site was proposed to the National Priorities List (NPL) on August 24, 2000, and was placed on the NPL on June 14, 2001.

Remedial Investigation/Feasibility Study

- An Administrative Order on Consent (the "Order") for the remedial investigation/feasibility study (RI/FS) was issued by USEPA on September 29, 2003 to the Malone Cooperating Parties.
- USEPA Region 6 approved the RI/FS Work Plan for the Site on June 29, 2005. An investigation to determine risk and nature and extent of contamination was conducted.
- The Final RI document was approved by USEPA on June 14, 2006. RI evaluation included the identification of chemicals of concern (COC), the delineation of contamination (nature and extent), as well as human health and ecological risk assessments.
- The Final Screening Level Ecological Risk Assessment (SLERA)/Baseline Ecological Risk Assessment (BERA) Work Plan document was completed in 2006. The Final BERA was approved by EPA in 2007.
- In 2007, approximately 169,100 gallons of oil were recycled and solids from the weir boxes and frac tanks were placed into on-site areas containing sludge, such as the Oil Pit. Including water disposed of in the on-site injection well, WDW-138, 796,041 gallons of liquids were removed from tanks on the Site (Project Navigator, 2008).
- The treatability study was approved by EPA on March 6, 2008 and determined that solidification of sludge and placement of solidified sludge and unsolidified contaminated soil into an on-site Resource Conservations and Recovery Act (RCRA) Subtitle C equivalent cell/landfill would be an effective remedy.
- Throughout the investigation and initial feasibility phases of the project, storm water was managed in the tank berms, separators, Oil Pit and Sludge Pit by disposal into the underground injection well as needed to maintain freeboards at 12 inches or greater. In addition, storm water accumulated in ditches was discharged (after analytical data demonstrated that concentrations were below USEPA/TCEQ-approved discharge criteria) after Hurricane Ike in September 2008.

Consent Decree and Remedial Actions

- The EPA Superfund Division Director signed the Record of Decision (ROD) on September 30, 2009. The ROD presents the selected remedy for sludge waste and contaminated soil and groundwater at the Site. Remediation must address approximately 215,000 cubic yards of sludge and 160,000 cubic yards of contaminated soil. The

identified remedy is the solidification/stabilization of the sludge (source material) which exists in the Earthen Impoundment, API separators and above ground storage tanks. The consolidation of solidified material will be in an above ground RCRA Subtitle "C" equivalent cell. The shallow contaminated soil will not be solidified, but will be excavated and consolidated in the "C" cell. The shallow contaminated groundwater is Class 3 (non-drinking water); therefore, it will be monitored to document if the plume remains on-site. If off-site migration is probable, the plume will be subject to an active remedy.

- From the mid-1800s to 1904, early settlers established a cemetery located off of Campbell Bayou Road, south of Texas City, which became known as Campbell's Bayou Cemetery. Approximately 36 burials took place at the cemetery. As part of the RA, it was determined that an existing on-site cemetery must be moved to complete the Site cleanup. Descendants agreed to the removal of the remains and interment in a perpetual care cemetery. Removal began April 7, 2014 and was completed on June 11, 2014.
- A Consent Decree (CD), which binds the parties to implement the Remedial Design (RD) and Remedial Action (RA) phases for the site, was negotiated between USEPA and the PRPs and filed by the court on September 24, 2012.
- EPA received a general RD/RA Work Plan from the MCP on October 31, 2012, and approved the document in final form on May 28, 2013. The PRPs completed Phase-1 RD field investigation activities (tank, soil, slurry wall, *etc*.) on June 28, 2013.
- Remedial Action/cleanup activities began on April 7, 2014 and are expected to be completed in 2016.

Contaminants of Concern (COCs) evaluated at the Site and nearby marsh to determine injuries to resources were polycyclic aromatic hydrocarbons (PAH), PCBs, dichlorodiphenyltrichloroethane (DDT) and metabolites, and metals (arsenic, cadmium, chromium, copper, lead, nickel, mercury, and zinc).

2.4 Strategy for Assessing Resource Injuries and Compensation Requirements

The Trustees conducted the NRDA to reliably identify the nature and extent of natural resource injuries attributable to releases of hazardous substances to the Site from the PRPs' facilities, to identify injuries from completed or planned response actions, to quantify the resulting resource and ecological service losses, and to provide the technical basis for determining the need for, type of, and amount of restoration appropriate to compensate the public for those losses.

As noted in Subsection 1.1, the assessment process is guided by NRDA regulations issued under CERCLA and found at 43 C.F.R. Part 11. The injury assessment process has two stages: 1) resource injury evaluation and 2) resource and service loss quantification. A number of factors are considered in identifying and quantifying resource injuries, including, but not limited to:

- the hazardous COCs;
- the specific natural resources and ecological services of concern;
- the evidence indicating exposure, pathway and injury;
- the mechanism(s) by which injury to natural resources of concern would occur;

- the type, degree, spatial and temporal extent of injury; and
- the type(s) of restoration that would be appropriate and feasible for use as compensation.

To evaluate injury to natural resources associated with the release of hazardous materials and response activities at the Site, the Trustees reviewed existing information, including remedial investigation data, ecological risk assessments (SLERA and BERA), and open scientific literature, and applied their collective knowledge and understanding of the function of the terrestrial and aquatic ecosystems at and near the Site. Identifying and understanding the COCs for the Site, as well as their pathways to and potential effects on ecological receptors, are key to the Trustees' approach to injury assessment. Metals, PAHs, PCBs, and DDT and its metabolites were identified as the primary COCs for natural resource damage assessment purposes for the Site.

The Trustees determined that three categories of injury resulted at the Site:

1) benthic invertebrate injury in the estuarine marsh sediments,
2) injury to wildlife due to oil in the terrestrial portion of the Laydown Area, and
3) injury to the benthic community and wildlife utilizing freshwater sediments on-site.

Several areas within the Site were evaluated for freshwater sediment injury since they contain freshwater habitat for part or all of the year (*i.e.*, a portion of the Laydown Area and Freshwater Pond). Additionally, the Earthen Impoundment, Oil Pit, API separators, Maintenance Area Pits and 800 Tank Area were evaluated as freshwater wetland habitat (see Figure 2-2). Evaluation of the RI samples for the Laydown Area indicated this area was approximately 50% wet, 50% dry based on sample classification and aerial photographs. Therefore, the Laydown Area habitat character was categorized as 50% wetland, 50% dry upland for purposes of determining injury.

Data from site-specific studies as well as results of studies reported in the scientific literature were used to identify and estimate resource injuries in the Site and marsh sediments, as part of a Habitat Equivalency Analysis (HEA) (NOAA, 2000). HEA is recognized as a valid and reliable procedure for quantifying ecological losses and for scaling or evaluating their restoration equivalent. Data generated by the previous studies of the Site were used to create a spatial representation of the distribution of COCs across the Site and the Marsh relative to the different habitat areas by plotting the data on aerial photographs using software combining database and geographic information system (GIS) packages (ArcMap 10).

SECTION 3
THE AFFECTED ENVIRONMENT

In restoration planning, the Trustees' emphasis was on the areas and resources directly affected by the historical releases of hazardous substances to the Site from the PRPs' facilities and the remedy; however, the Trustees also recognized that injured resources are part of a larger ecological system – Swan Lake in the Galveston Bay Estuary. Accordingly, in development of this Final DARP/EA, appropriate restoration opportunities within that system were considered. Under this approach, the Trustees are better able to compensate for resource injuries while also taking into account the multiple ecological benefits of restoration within the larger ecosystem.

This section provides additional information on the physical, biological, and cultural environments within Swan Lake and the Galveston Bay Estuary, in which the restoration actions identified in this Final DARP/EA would occur, consistent with NEPA requirements. Information in this section, together with other information in this document, provides the basis for the Trustees' evaluation of the potential environmental impacts of the alternative restoration actions listed in Section 7 (*Evaluation of Restoration Alternatives*). The scope of the environmental impacts addressed in this Final DARP/EA include those on wildlife, fish and invertebrates, essential fish habitat, threatened and endangered species, water and sediment quality, air quality, cultural resources, hazardous and toxic waste, and environmental justice.

3.1 The Physical Environment

The Site is located within the coastal plain ecoregion. Much of the area consists of marsh and slow-moving coastal bayous. The Site is bordered to the east by Galveston Bay and to the northeast by Swan Lake, a sub-bay of Lower Galveston Bay (Figures 1-1 and 1-2). Several industrial facilities, including the closed Solutia South 20 site, the GCWDA Campbell Bayou facility, and a closed Texas City landfill are located west of the Site (Figure 2-1). Protected marsh and wetlands owned by SCENIC GALVESTON, Inc. border the southern portions of the Site. The Site encompasses approximately 150 acres, of which the former operating area is approximately 100 acres. Terrestrial and aquatic habitats are present within the Site, which is encircled by a 14-foot high flood control "hurricane" levee. Figure 3-1 identifies those on-site features evaluated for injury and general habitat categories assumed in the evaluation.

3.1.1 The Terrestrial Environment

The northeastern portion of the Site, which is approximately 100 acres, was developed for the storage, processing, and disposal of industrial hazardous waste. This area includes the storage tanks, process areas, and buildings. The footprint of the former operating area remains highly disturbed with paved surfaces and remnant structures. The northwestern portion of the Site (undeveloped 50 acres) does not contain any industrial features, but the Laydown Area was used for equipment storage. The Laydown Area contains both terrestrial and aquatic habitats. The less disturbed, or quasi-natural, peripheral terrestrial habitats within the Site consist mainly of mixed grasses, other gramminoids, and forbs in the slightly higher and better-drained areas to the south and east.

Aerial Image Date: 2011

250 125 0 250 Feet

Habitat Designation

- Estuarine Wetland
- Freshwater Wetland
- 50% Freshwater Wetland and 50% Terrestrial

Figure 3-1

Malone Service Company
Site Features and Habitat Designations Evaluated in the HEA

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3.1.2 The Aquatic Environment

The aquatic environment for this assessment includes both on-site freshwater resources and off-site estuarine resources.

3.1.2.1 On-site Freshwater Resources

In the west side of the Site, the terrain is lower and poorly drained, and includes the Freshwater (storm water collection) pond and the Laydown Area (URS, 2006) (Figures 2-2 and 3-1). The Freshwater Pond is an excavated pit with a volume of approximately 20,000,000 gallons (267,000 cubic feet) (MSC, 1994). During Site operations, water from the Freshwater Pond was pumped to a tank and was then used to clean waste hauling trucks and for filter backwashing. Water from the Freshwater Pond was also used for the plant's firefighting system (Kearney, 1989).

The drainage ditch system throughout the facility historically discharged into the Freshwater Pond. During operation, the Site drainage system collected storm water and any spills that escaped the containment areas in the plant process areas. Reportedly, as of 1988, MSC had no plant spills into the drainage system. Today the Site storm water discharges straight into the Marsh through the permitted outfall. However, there is a small drainage feature that provides a connection between the Laydown Area and the Freshwater Pond. When the storm water from the Site drainage ditches is discharged, the Laydown Area water also drains (since this area slopes toward the drainage laterally) causing water levels in the Freshwater Pond to also lower. Water levels are known to visibly decrease in the Freshwater Pond after a discharge event.

Freshwater resources were created on-site by standing water around Site facilities such as the Earthen Impoundment, Oil Pit, API separators, 800 Tank area, and Maintenance Area pits, hence the designation of the area as freshwater wetlands on Figure 3-1. Wildlife was attracted to the freshwater that accumulated in these areas, which provided a potential pathway for contact with Site COCs.

3.1.2.2 Estuarine Marsh

The Marsh is located directly adjacent to the Site on the east and northeast, extending to the shore of Swan Lake and Galveston Bay and to the south. Approximately 1.61 miles (8,500 feet) of wetlands frontage is adjacent to the Site (TNRCC, 1998). This adjacent (off-site) intertidal salt marsh habitat to the north is dominated by stands of smooth cordgrass (*Spartina alterniflora*), saltgrass (*Distichlis spicata*), and needle rush (*Juncus roemerianus*), with several meandering small tidal creeks and pockets of water. Narrow elevated areas exist near the outer edges of the marsh with inclusions of sumpweed (*Iva frutescens*) and scattered eastern baccharis (*Baccharis halimifolia)*. Bayward from these features are sandflats that are exposed during low tidal stages.

The Swan Lake/Galveston Bay wetlands in the Site vicinity are classified as both estuarine, intertidal, unconsolidated shoreline, irregularly exposed and estuarine, intertidal, emergent, persistent, regularly flooded. Wetlands are also identified along the shell islands between Swan Lake and Galveston Bay. The National Wetlands Inventory Map for the Virginia Point quadrangle classifies the swamp/marsh land adjacent to the Site as being intertidal, estuarine, unconsolidated shore, irregularly exposed lands, and intertidal estuarine, emergent, persistent, regularly flooded lands. These areas follow the shoreline of Swan Lake and along the southeast and south along the shoreline of Galveston Bay to Virginia Point. The Site area and areas

adjacent to the site to the north, west, and south are classified as being primarily uplands (DOI, 1992).

MSC was issued a permit by the U.S. Army Corps of Engineers (USACE) on December 18, 1980 for the construction and maintenance of a bulkhead in the wetland area adjacent to Swan Lake (Application No. 4720). The purpose of this bulkhead was to complete the flood protection levee surrounding the facility (see Figures 2-1 and 3-1). Construction of this levee isolated and encroached upon 1.38 acres of existing wetland and upland areas. To mitigate encroachment on the wetlands, MSC planted 2.38 acres of smooth cordgrass adjacent to Swan Lake (MSC, 1994).

3.1.2.3 Swan Lake and Lower Galveston Bay

The Site is located adjacent to the south shore of Swan Lake and the western shore of Lower Galveston Bay (Figures 1-1 and 1-2). Swan Lake and Lower Galveston Bay are part of the Galveston Bay System. The water bodies are geographically naturally separated by a series of small shell islands, but are connected through Campbell Bayou. USACE completed the construction of intermittent rock jetties across the mouth of Swan Lake as a part of the remedy for the Tex Tin Superfund Site in spring of 2007 (Figure 2-1). Swan Lake is approximately one mile wide and one quarter miles long (approximately 2.4 square miles). The southern shores of Swan Lake and the shell islands are tidally influenced wetlands and marshes. The depth of Swan Lake ranges to approximately 3 feet and the substrate consists of varying depths of semi-consolidated, fine-grained organic mud overlying a firm clay substrate. There is free exchange of water between Swan Lake and Galveston Bay.

The Galveston Bay Estuary is the seventh largest estuary in the United States and the largest in Texas. Galveston Bay Estuary is a system composed of four main bodies (Galveston Bay, Trinity Bay, West Bay, and East Bay) and several small, shallow, productive side bays. The estuary is typically 6 to 12 feet deep. The surface area of the estuary is approximately 600 square miles. The estuary contains significant amounts of coastal wetlands that provide nursery areas for the estuarine fishery resources and important habitat for avian and mammalian fauna. Approximately 61% of the estuarine shoreline is vegetated by intertidal emergent plant communities, or coastal wetlands, totaling 108,200 acres. The upper and lower portions of the estuary are designated by the TCEQ for contact recreation, high quality aquatic habitat, and shell fish waters.

3.2 The Biological Environment

The Galveston Bay watershed provides important habitat for wildlife, including migratory waterfowl, shorebirds, and wading birds and also serves as a valuable nursery and breeding habitat for numerous estuarine-dependent sport and commercial fish and shellfish. Habitats of the Bay ecosystem include a variety of freshwater and estuarine marshes, riparian forests, and open water communities.

Freshwater Wetlands and Pond

Habitat west of the Freshwater Pond and in the Laydown Area is mainly freshwater marsh and scattered shrubs (primarily eastern baccharis) and a few clumps of scrub-shrub. The littoral (shallow, marginal) zone of the Freshwater Pond is dominated by common reed (*Phragmites* sp.) except along the southwestern edge. Along the eastern and parts of the northern shore of the

Freshwater Pond are clumps of black willows (*Salix nigra*), which are essentially the only tree-sized plants on the northwest end of the site. The Freshwater Pond contains an undetermined number of species of fish. Waterfowl (mostly seasonal) and alligators (*Alligator mississippiensis*) were observed in the pond (TNRCC, 1998).

Salt Marsh

Salt marshes can be found at and around the margins of bays and estuaries, backs of barrier islands, and old flood tide deltas near closed inlets with regular saltwater tides. Salt marsh vegetation is dominated by smooth cordgrass at the lower elevations (low marsh) typically between mean low tide and mean high tide. Zonation of vegetation occurs within the intertidal with zones of black needle rush, smooth cordgrass, and sometimes other brackish marsh species.

Salt marsh communities are highly productive due to the dynamic environment in which they are found. This productivity drives the export of dissolved nutrients and carbon to estuarine waters. These ecosystems also provide valuable a food source and habitat for many juvenile and adult organisms. The benthos and flora of salt marshes contribute to a detritus-based food web and provide feeding and breeding grounds for a variety of fish and invertebrates. Many saltwater fish spend their first year in salt marshes, taking advantage of the high concentrations of prey and reduced predation risk. In this setting, organic matter is regularly removed and sediment deposited by the tides. Under optimal conditions (*i.e.*, presence of a coarse-grain sediment source) tidal sedimentation causes a rise in the marsh surface and landward migration of the marsh. Sediment may also be deposited on the shoreline, causing estuarine-ward progradation (*i.e.*, progressive deposition of sediment) of the marsh. Marshes on the backsides of barrier islands may be subject to episodic burial by sand overwash. Salt marshes are distinguished from all other community types by the dominance of smooth cordgrass, as well as by their tidal, saltwater environments. Relatively narrow zones of brackish marsh at the upper edge are considered part of the salt marsh, but larger expanses in the heads of creeks and in the interior of large marsh islands are considered separate brackish marsh communities.

Brackish/Intermediate Marsh

Brackish marshes are distinguished by their tidal environment and usually by the dominance of black needle rush. This marsh type is found along the margins of bays and estuaries somewhat removed from connection with the sea, so that salinity is diluted by freshwater inflow and tidal range is generally less than in salt marshes. Those marshes in areas with substantial regular lunar tides have a regular input of nutrients, which makes them highly productive. In addition to high inflow of nutrients, regularly flooded marshes are typically supplied with abundant sediment and may produce tidal mud flats and estuarine-ward progradation of the marsh. Areas with only irregular wind tidal flooding have much less nutrient input, less mineral sedimentation, and accumulate relatively more organic matter. They lack mud flats and their estuarine edges are scarped and erosional. As sea level rises, mineral or organic sedimentation causes the marsh surface to rise; the landward edge will migrate landward; and changes in tidal inlets may cause changes in salinity.

Tidal Freshwater Marsh

This marsh type is found at the margins of estuaries, or drowned rivers and creeks, where they are regularly or irregularly flooded with freshwater tides. Historically, this marsh type was extensive, but its range has steadily reduced since the mid-1940s due to numerous factors, including

subsidence, sea-level rise, saltwater intrusion, and altered hydrology as a result of river and channel dredging. Tidal freshwater marshes are sustained largely through tidal flooding, which brings in nutrients derived from seawater and varying amounts of sediment to the community. Regularly flooded marshes are reported to have high productivity, equivalent to salt marshes at the same latitude (Odum *et al*., 1984). Irregularly flooded marshes and marshes in areas with little mineral sediment are assumed less productive. In contrast to tidal salt marshes, which are commonly dominated by a single plant species (*e.g*., smooth cordgrass) tidal freshwater marshes have high species richness and diversity, and are characterized by plants restricted to freshwater or low salinities. Tidal freshwater marsh is distinguished from adjacent swamp forest and upland forests by the lack of a dominant tree or shrub layer.

Wetland Forest (Evergreen, Deciduous, and Mixed)

Wetland forests, besides being broken into evergreen, deciduous, and mixed are classified further by their flooding frequency. Those areas that experience permanent to semi-permanent flooding are deepwater swamps while those receiving only seasonal riverine pulses are generally characterized as bottomland hardwood forests. The distinction is not only made because of flooding regime, but the species composition that occurs as a result. Deepwater swamps are typically characterized by bald cypress (*Taxodium distichum*) and tupelo (*Nyssa* spp.). Bottomland hardwood forests usually occur as an ecotone between aquatic and upland ecosystems but have distinct vegetation and soil characteristics. Vegetation in bottomland hardwood forests is dominated by diverse community of trees adapted to the wide variety of environmental conditions on the floodplain. Typical species include black willow, red maple (*Acer rubrum*), green ash (*Fraxinus pennsylvanica*), laurel oak (*Quercus laurifolia*), American elm (*Ulmus americana*), and sweetgum (*Liquidambar styraciflua*).

Productivity in forested wetlands is strongly tied to hydrology and nutrient regime. Forested floodplains are generally more productive than still-water wetlands due to inputs of nutrients from other freshwater sources than rainfall or groundwater. Root systems of forested wetlands contribute to the organic sediments of these ecosystems, which are an important source of nutrients for microorganisms and benthic invertebrates. The large amount of detritus accumulation also contributes to high nutrient loading rates. Tidal forested freshwater wetlands are shown to be effective tertiary processors for wastewater runoff.

Aquatic Biota

Galveston Bay supports a diverse assemblage of aquatic life, including plants (both vascular and non-vascular) and animals (invertebrates, fish, mammals, reptiles, *etc*.). Several organisms found within the Galveston Bay system are among those vital to the economy of Texas, as well as a significant element of outdoor recreational opportunities.

The waters of the Galveston Bay support species important for commercial and recreational usage and provide habitat for the following organisms: white shrimp (*Litopenaeus setiferus*) and brown shrimp (*Farfantepenaeus aztecus*), blue crab (*Callinectes sapidus*), eastern oyster (*Crassostrea virginica*), spotted seatrout (*Cynoscion nebulosus*), sand seatrout (*Cynoscion arenarius*), Atlantic croaker (*Micropogonius undulatus*), red drum (*Scienops ocellatus*), black drum (*Pogonius cromis*), southern kingfish (*Menticirrhus americanus*), Gulf kingfish (*Menticirrhus littoralis*), sheepshead (*Argosargus probatocephalus*), southern flounder (*Paralichthyes lethostigma),* striped mullet (*Mugil cephalus*), sea catfish (*Galeichthys felis*), Gulf menhaden (*Brevoortia patronus*), and gafftopsail catfish (*Bagre marinus*).

Numerous other estuarine and marine resources are also found in the Galveston Bay Estuary, including bay anchovy *(Anchoa mitchilli*), silver perch (*Bairdiella chrysoura*), bottlenose dolphins (*Tursiops truncates*), bull shark (*Carcharhinus leucas*), sheepshead minnow (*Cyprinodon variegatus*), gizzard shad (*Dorosoma cepedianum*), Gulf killifish (*Fundulus grandis*), code goby (*Gobiosoma robustum*), pinfish (*Lagodon rhomboides*), spot (*Leiostomus xanthurus*), silversides (*Menidia* spp.), Gulf flounder (*Paralichthys albigutta*), Spanish mackerel (*Scomberomorus maculatus*), bay squid (*Lolliguncula brevis*), hard clam (*Mercenaria mercenaria*), grass shrimp (*Palaemonetes pugio*), and common rangia (*Rangia cuneata*). Kemp's ridley sea turtles (*Lepidochelys kempii*) are observed frequently in Galveston Bay.

The estuary is used a seasonal foraging area as they migrate along the Texas coast to and from their primary nesting grounds. Estuarine organisms of commercial, recreational, and ecological importance typically have inshore and offshore components of their life histories. Many species in the Galveston Bay estuary spawn offshore or near estuary passes, and their larvae or post larvae migrate into the estuarine nursery area to grow and develop prior to offshore migration and maturation. Cordgrass habitat is the primary nursery habitat for important forage fish such as killifish species (*Fundulus spp.)*. Other taxa such as birds, reptiles, and mammals use estuarine habitats for feeding, refuge, and reproduction. Many estuarine-dependent species of fish are harvested from Galveston Bay, including flounder, Atlantic croaker, spotted seatrout, sand seatrout, and red drum. In addition, five species of invertebrates (oysters, blue crabs, and three penaeid shrimps) are harvested from the Galveston Bay Estuary. During their juvenile stages, these organisms utilize estuarine habitats such as marshes, seagrass beds, oyster reefs, and mudflats for feeding and protection. Many species are more abundant in vegetated habitats such as emergent marshes and submerged aquatic vegetation than in subtidal non-vegetated habitats. Fishery production is directly proportional to wetlands acreage.

The sediments within Swan Lake and the Galveston Bay Estuary support benthic organisms, including various annelid worms, small crustaceans (amphipods, isopods, copepods, and juvenile decapods), mollusks, and other small bottom-dwellers in salt marshes and unvegetated subtidal sediments. Among these benthic organisms are herbivores (eating algae or other live plant material), detritivores (feeding on decaying organic matter in surface sediments or sediment-bound nutrients and organic substances not generally available to epiphytic or pelagic organisms), carnivores (preying on other benthic organisms), and omnivores (a combination). These organisms provide the nutritional base for developing stages of many finfish and shellfish and, thus, affect all trophic levels in the Galveston Bay Estuary. The activities of benthic organisms are important in conditioning wetlands and subtidal habitats and in the decomposition and nutrient cycling that occur in these areas. In sum, benthic communities provide important ecological services primarily related to food production, decomposition and energy cycling that affect nearly all organisms within an estuarine system. A potential adverse impact on benthic populations has the potential to impact biota in nearly all trophic levels of the Galveston Bay Estuary.

Freshwater prey species such as western mosquitofish (*Gambusia affinis*) and sailfin mollies (*Poecilia latipinna*) are common in the freshwater wetlands. Freshwater invertebrates are dominated by larval and adult insects with a few crustacean species. These common prey are available to foraging nekton and wading birds.

Terrestrial Biota

The southern marshes and wetland forests of Texas are home to a wide variety of wildlife. White-tailed deer (*Odocoileus virginianus*) are abundant throughout the state. Common small mammals include bats (order Chiroptera), swamp rabbit (*Sylvilagus aquaticus*), raccoon (*Procyon lotor*), Virginia opossum (*Didelphis virginiana),* striped skunk (*Mephitis mephitis),* eastern fox squirrel (*Sciurus niger*), nutria (*Myocastor coypus*), and beaver (*Castor canadensis).*

Alligators are common in southern Texas bayous and were observed in the MSC Freshwater Pond. Other reptiles found in the state include turtles, lizards, and both poisonous and non-poisonous snakes. Snakes found in Texas include the coral snake (*Micrurus fulvius tenere*), western pygmy rattler (*Sistrurus miliarius streckeri*), canebrake rattler (*Crotalus horridus*), copperhead (*Agkistrodon contortrix*), Texas rat snake (*Elaphe obsoleta lindheimeri),* speckled kingsnake (*Lampropeltis getula holbrooki*), and water moccasin (*Agkistrodon piscivorus*). Common reptiles also found within the terrestrial areas include the Texas diamondback terrapin (*Malaclemys terrapin littoralis),* skinks (Family *Scincidae*), and red-eared slider (*Chrysemys scripta elegans*).

Birds

More than one-half of the bird species of North America are resident in the state or spend a portion of their migration there. All the species of waterfowl found in Texas can be found in wetlands or waters along the Gulf (including marine, estuarine, and freshwater) at some time of year. Some of these can be very abundant in ideal conditions. They include several species of ducks and geese that spend winters on the tidal marshes along the Gulf coast. The most familiar of the state's water birds include the laughing gull (*Larus atricilla*), royal tern (*Sterna maxima*), brown pelican (*Pelecanus occidentalis*), great egret (*Ardea alba*), white-faced ibis (*Plegadis chihi*), and black skimmer (*Rynchops niger*). Birds found in the wetlands include the marsh wren (*Cistothorus palustris*), seaside sparrow (*Ammodramus maritimus*), red-winged blackbird (*Agelaius phoeniceus*), Wilson's plover (*Charadrius wilsonia*), Wilson's snipe (*Gallinago delicate*), woodcock (*Scolopax minor*), and species of sandpipers (*Actitis* spp.). The mottled duck (*Anas fulvigula*) is a year-round resident in the area.

Shorebirds, songbirds, waterfowl, and raptors are known to migrate, winter and breed along the Texas Coast. In addition, Pierce Marsh, a nearby intertidal marsh complex, is located on the Central Migratory Flyway within the area encompassed by the Texas Mid-Coast Initiative Area of the Gulf Coast Joint Venture of the North American Waterfowl Management Plan. It contains high priority populations of wintering ducks as well as shore and wading birds most commonly associated with coastal wetlands.

The Texas Colonial Waterbird Society has designated the shell islands as the Swan Lake Bird Rookery that serves as a breeding ground for the following species (USEPA, 1998):

- Gull-billed Tern (*Gelochelidon nilotica*)
- Forster's Tern (*Sterna forsteri*)
- Black Skimmer
- Various gulls (subfamily Larinae)
- Various herons and egrets (family Ardeidae)

Within a 4-mile radius of the Site, at least one Migratory Songbird Stopover Fallout site (Moody Ranch) has been identified. Bird rookeries for multiple species were identified within the target distance, including:

- Colony #600-420, Swan LakeColony #600-421, Tiki Island
- Colony #600-422, Marker 52 Spoil IslandColony #600-423, Jigsaw Island
- Colony #600-424, North Deer IslandColony #600-425, Down Deer Spoil Island
- Colony #600-426, South Deer IslandColony #600-427, Gangs Bayou
- Colony #600-440. Texas City DikeColony #600-441, Port Bolivar
- Colony #600-442, Little Pelican IslandColony #600-445, Port Industrial Boulevard
- Colony #600-446, American FenceColony#600-540, Campeche Cove

3.3 The Cultural and Human Environment

The nearest residential center to the Site is Bayou Vista, approximately 1.5 miles to the southwest across Interstate 45 along State Highway 6. The population of Bayou Vista in 2010 was 1,537 persons. A residential section of Texas City is approximately 4 miles north of the Site. The population of Texas City in 2010 was 45,099 persons (U.S. Census Bureau, 2014).

Much of the surrounding area is zoned industrial. The Texas City Industrial Complex is located 2 miles north of the site and includes petrochemical plants, refineries, shipyards, and waste management areas.

The Campbell Bayou Cemetery (Figure 2-2) was located on site between Unit 900 and the Oil Pit. It was the burial grounds of some of the first European settlers of Campbell's Bayou. Joseph and Mary Campbell settled almost 1,500 acres of land on Swan Lake in 1838. Prior to that, Joseph Campbell served aboard four privateers with Jean Lafitte, a famous French pirate. The Campbells and other early settlers of the area were reportedly buried in the cemetery.

Galveston Bay and its adjacent wetlands support a wide range of commercial and recreational fishing. Primary species fished include blue crab, red drum, black drum, mangrove snapper (*Lutjanus griseus*), spotted sea trout, southern flounder, and Atlantic croaker. The Galveston Bay area supports several important commercial fisheries. Large quantities of shrimp, oysters, and blue crab are harvested in upper and lower Galveston Bay, as well as in the surrounding salt marshes and throughout the rest of the estuary. White shrimp, brown shrimp, and eastern oysters are economically important species found in the system. Commercial harvest of finfish also occurs at low levels. These human activities are dependent on the condition of the coastal and marine habitats.

3.4 Threatened and Endangered Species

The Endangered Species Act (ESA) of 1973 (16 U.S.C. §§1531 *et seq*.) requires federal agencies to conserve endangered and threatened species and to conserve the ecosystems upon which these species depend. Numerous endangered and threatened species are seasonal or occasional visitors to the Galveston Bay Estuary coastal ecosystem (the Estuary). Most species would be present in the Estuary incident to migration through the area. None of these species were considered to be at risk of direct injury due to the discharge of hazardous substances from the Site. The Estuary's

habitats provide general support for any threatened and endangered species migrating through or utilizing these communities.

The potential occurrence of federally and/or state listed threatened or endangered wildlife species in the vicinity of the Site is summarized in Table 3-1, based on recent county list maintained by the Texas Parks and Wildlife Department. Of the 24 bird, mammal, and reptile species listed for Galveston County by the agencies, at least 11 (three reptiles and eight birds) may occur in one or both of the local habitats for sufficient periods to incur some level of dietary exposure to contaminants. One of the species, the Attwater's greater prairie-chicken (*Tympanuchus cupido attwateri*), is not likely to occur in the immediate vicinity of the Site.

Most of the protected species identified as potentially occurring at or near the Site would be expected only, or primarily, to forage in the adjacent saltmarsh and/or associated surface waters (*e.g.*, sea turtles).

Table 3-1
Federal and State Threatened and Endangered Species Potentially Utilizing the Site

		Status[1]		Local Habitats[2]		
Common Name	**Scientific Name**	**Federal**	**State**	**Inland**	**Marsh**	**Comments**
Reptiles						
Alligator snapping turtle	*Macrochelys temminckii*		T	No	No	Lack of hydrologic connection to other habitat (TPWD, 2014)
Atlantic hawksbill sea turtle	*Eretmochelys imbricate*	LE	E	No	No	Seldom in areas this far into Gulf estuaries (Landry *et al.* 1997)
Green sea turtle	*Chelonia mydas*	LT	T	No	No	Seldom in areas this far into Gulf estuaries (Landry *et al.* 1997)
Kemp's Ridley sea turtle	*Lepidochelys kempii*	LE	E	No	Yes	Occasional occurrence near outer fringe of marsh
Leatherback sea turtle	*Dermochelys coriacea*	LE	E	No	No	Seldom in areas this far into Gulf estuaries (Landry *et al.* 1997)
Loggerhead sea turtle	*Caretta caretta*	LT	T	No	Yes	Occasional occurrence near outer fringe of marsh
Texas horned lizard	*Phrynosoma cornutum*		T	No	No	Highly unlikely due to local lack of sandy soil (Henke and Fair 1998)
Timber rattlesnake	*Crotalus horridus*		T	No	No	Lack of nearby forested habitat (TPWD, 2014)
Fish						
Smalltooth sawfish	*Pristis pectinata*	LE	E	No	No	Extirpated in Texas.
Birds						
American peregrine falcon	*Falco peregrinus anatum*	DL	T	PM	No	Rare migrant only (TPWD, 2014)
Attwater's prairie-chicken	*Tympanuchus cupido attwateri*	LE	E	Yes	No	Historically known from Virginia Point Peninsula, could become present following on-site remedy
Bald eagle	*Haliaeetus leucocephalus*	DL	T	Yes	Yes	Likely only occasional due to lack of elevated perches
Eskimo curlew	*Numenius borealis*	LE	E	PM	PM	Extremely rare migrant; possibly extinct (Texas Ornithological Society, 1995)
Peregrine Falcon	*Falco peregrines*	DL	T	PM	No	Rare migrant only (TPWD, 2014)

		Status[1]		Local Habitats[2]		
Common Name	**Scientific Name**	**Federal**	**State**	**Inland**	**Marsh**	**Comments**
Piping plover	*Charadrius melodus*	LT	T	No	Yes	Occasional on flats associated with marsh
Reddish egret	*Egretta rufescens*		T	No	Yes	Likely to feed in marsh area
Sprague's pipit	*Anthus spragueii*	C		PM	No	Rare migrant only (TPWD, 2014)
White-faced ibis	*Plegadus chihi*		T	Yes	Yes	Prefers freshwater (TPWD, 2014)
White-tailed hawk	*Buteo albicaudatus*		T	Yes	Yes	Historically known as resident in general area
Whooping crane	*Grus Americana*	LE	E	PM	PM	Rare migrant only (Texas Ornithological Society, 1995; TPWD, 2014)
Wood stork	*Mycteria Americana*		T	No	No	Lack of nearby forested habitat (TPWD, 2014)
Mammals						
Louisiana black bear	*Ursus americanus luteolus*	LT	T	No	No	Lack of nearby forested habitat (TPWD, 2014)
Red Wolf	*Canis rufus*	LE	E	No	No	Extirpated (TPWD, 2014)
West Indian manatee	*Trichechus manatus*	LE	E	No	PM	Rare migrant only (Davis and Schmidly, 1994)

1. Listing status under federal Endangered Species Act and/or Texas rules: LE, LT = Federally Listed Endangered/Threatened; C = Federal Candidate for Listing, formerly Category 1 Candidate; DL= Federally Delisted; E, T = Sate Listed Endangered/Threatened. The species are listed based on TPWD's Galveston County Annotated County List of Rare Species, Last Revision 12/11/2014.

2. Habitats available to wildlife are broadly divided into the site (Inland), which includes a variety of terrestrial, freshwater wetland, and fresh water bodies, and the adjacent intertidal Marsh. Known or potential occurrences in the respective habitats of representatives of particular species are indicated as: "No" = absent or highly unlikely; "Yes" = present or highly likely to be present; and "PM" = potential migrant (*i.e.*, if present, likely to be very occasional).

3.5 Essential Fish Habitat

Congress enacted amendments to the Magnuson-Stevens Fishery Conservation and Management Act (MSFCMA) (PL 94-265) in 1996 that established procedures for identifying Essential Fish Habitat (EFH) and required interagency coordination to further the conservation of federally managed fisheries. Rules published by the National Marine Fisheries Service (NMFS) (50 C.F.R. §§ 600.805 - 600.930) specify that any federal agency that authorizes, funds or undertakes, or proposes to authorize, fund, or undertake an activity that could adversely affect EFH is subject to consultation provisions of the MSFCMA as described in the implementing regulations. This section and the associated impacts sections were prepared to meet these requirements. EFH is defined as "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." When referring to estuaries, it is further defined as "all waters and substrates (mud, sand, shell, rock, and associated biological communities) within these estuarine boundaries, including the sub-tidal vegetation (seagrasses and algae) and adjacent tidal vegetation (marshes and mangroves)" (Gulf of Mexico Fishery Management Council [GMFMC], 1998). The proposed project site and alternative sites are located in an area identified by the GMFMC as EFH for:

- White shrimp,
- Brown shrimp,
- Red drum,
- Bonnethead shark (*Sphyrna tiburo*)
- Blacktip shark (*Carcharhinus limbatus*)
- Bull shark, and
- Spanish mackerel

EFH for these species in the vicinity of the proposed and alternative sites includes estuarine emergent wetlands; estuarine mud, sand and shell substrates; and estuarine water column. Table 3-2 summarizes EFH for these species along with the potentially affected life stage. Detailed information on federally managed fisheries and their EFH is provided in the 1998 EFH amendment of the Fishery Management Plans for the Gulf of Mexico, prepared by the GMFMC, and in Appendix B of the 2006 Final Consolidated Atlantic Highly Migratory Species Fishery Management Plan prepared by the NMFS.

The following describes the preferred habitat, life history stages, and relative abundance of each EFH managed species based on information provided by GMFMC (1998) and the NMFS (2006).

Table 3-2
Major Essential Fish Habitat Categories for Managed Species in the Galveston Bay System

Species	Life Stages	Ecotype	Essential Fish Habitat
Brown Shrimp	• postlarvae • juvenile adult	marine estuarine	oyster reefs, emergent marshes, sand/shell bottoms, submerged aquatic vegetation, tidal creeks, inner marsh, mud bottoms sand/shell/soft bottoms
White Shrimp	• postlarvae • juvenile • subadult	estuarine	marsh edge, submerged aquatic vegetation, marsh ponds, inner marsh, oyster reefs
Red Drum	• postlarvae • juvenile adult	estuarine marine	emergent marsh, soft bottoms
		estuarine	soft bottoms
Spanish Mackerel	• juvenile • adult	marine estuarine	open water, clean sand substrate
Bonnethead Shark	• juvenile • adult	marine estuarine	shallow coastal waters, inlets and estuaries (depth<25 m)
Blacktip Shark	• juvenile	marine estuarine	sand/mud bottoms in shallow coastal waters (depth<25 m)
Bull Shark	• neonate • juvenile	marine estuarine	sand/mud bottoms in shallow coastal waters (depth<25 m)

Brown Shrimp

Brown shrimp eggs and larvae are demersal and occur offshore. Postlarval brown shrimp begin to migrate to estuaries as postlarvae through passes on flood tides at night mainly from February to April with a minor peak in the fall. In estuaries, brown shrimp postlarvae and juveniles are associated with shallow vegetated habitats but also are found over silty sand and non-vegetated mud bottoms. Postlarvae and juveniles were collected in salinity ranging from zero to 70 ppt (parts per thousand). The density of late postlarvae and juveniles is highest in marsh edge habitat and submerged vegetation, followed by tidal creeks, inner marsh, shallow open water and oyster reefs; in unvegetated areas muddy substrates seem to be preferred. Juveniles and sub-adults of brown shrimp occur from secondary estuarine channels out to the continental shelf but prefer shallow estuarine areas, particularly the soft, muddy areas associated with plant-water interfaces. Sub-adults migrate from estuaries at night on ebb tide on new and full moon. Abundance offshore correlates positively with turbidity and negatively with hypoxia (low levels of oxygen in the

water). Adult brown shrimp occur in neritic Gulf waters (*i.e.*, marine waters extending from mean low tide to the edge of the continental shelf) and are associated with silt, muddy sand, and sandy substrates (GMFMC, 1998). Adult brown shrimp are considered common in the lower Galveston Bay estuary from April to October. Juveniles are abundant year- round, peaking from April to October. Marine habitat is critically important to the reproduction and survival of shrimp. Adult brown shrimp occur throughout the Gulf's marine habitat to depths of about 110 meters. Larval shrimp feed on phytoplankton and zooplankton. Postlarvae feed on phytoplankton, epiphytes, and detritus. Juveniles and adults prey on amphipods, polychaetes, and chironomid larvae but also on algae and detritus (Pattillo *et al*., 1997). Habitat of these prey is essentially the same as that required by shrimp, both estuarine and marine.

White Shrimp

White shrimp are offshore and estuarine dwellers and are pelagic or demersal, depending on life stage. Their eggs are demersal and larval stages planktonic, both occurring in nearshore marine waters. Postlarvae migrate through passes mainly from May to November with peaks in June and September. Migration is in the upper 2 meters of the water column at night and at middepths during the day. Postlarval white shrimp become benthic once they reach the estuary, where they seek shallow water with muddy-sand bottoms high in organic detritus or marsh where they develop into juveniles. Postlarvae and juveniles inhabit mostly mud or peat bottoms with large quantities of decaying organic matter or vegetative cover. Densities are usually highest in marsh edge, followed by marsh ponds and channels, inner marsh, and oyster reefs. White shrimp juveniles prefer salinities of less than 10 ppt and can be found in tidal rivers and tributaries. As juveniles mature, they move to coastal areas where they mature and spawn. Adult white shrimp move from estuaries to coastal areas, where they are demersal and inhabit soft mud or silt bottoms (GMFMC, 1998). In the lower Galveston Bay estuary, adult white shrimp are common from July to March, while juveniles are highly abundant year-round. Marine habitat is critically important to the reproduction and survival of shrimp. Adult white shrimp occur throughout the Gulf's marine habitat to depths of about 40 meters. Larval shrimp feed on phytoplankton and zooplankton. Postlarvae feed on phytoplankton, epiphytes, and detritus. Juveniles and adults prey on amphipods, polychaetes, and chironomid larvae but also on algae and detritus (Pattillo, *et al*., 1997). Habitat of these prey is essentially the same as that required by shrimp, both estuarine and marine.

Red Drum

Red drum occupy a variety of habitats, ranging from depths of 40 meters offshore to very shallow estuarine waters. Spawning occurs in the Gulf near the mouths of bays and inlets in the fall and winter months. Eggs hatch mainly in the Gulf and larvae are transported into the estuary where they mature and before moving back to the Gulf to spawn. Adult red drum use estuaries, but tend to spend most of their time offshore as they age. They are found over a variety of substrates, including sand, mud, and oyster reefs, and can tolerate a wide range of salinities (GMFMC, 1998). Adult and juvenile red drum are common year-round in the lower Galveston Bay estuary. Estuaries are especially important to the larval, juvenile, and sub-adult red drum. Juvenile red drum are most abundant around marshes, preferring quiet, shallow, protected waters with muddy or grassy bottoms (Simmons and Breuer, 1962). Sub-adult and adult red drum prefer shallow bay bottoms and oyster reef substrates. Estuaries are also important to the prey species of red drum. This is essential to larvae, juvenile, and early adult red drum since they spend all their time in the estuary. Larval red drum feed mainly on shrimp, mysids, and amphipods, while juveniles feed on

more fish and crabs (Peters and McMichael, 1987). Adult red drum feed mainly on shrimp, blue crab, striped mullet, and pinfish. Protection of estuaries is important to maintain the essential habitat for red drum and because so many prey species of red drum are estuarine dependent (GMFMC, 1998).

Spanish Mackerel

Spanish mackerel are pelagic, occurring at depths to 75 meters throughout the coastal zone of the Gulf of Mexico. Adults are usually found along coastal areas, extending out to the edge of the continental shelf; however, they also display seasonal migrations and will inhabit high salinity estuarine areas at times. The occurrence of adults in Gulf estuaries is infrequent and rare. Spawning occurs in offshore waters during May through October. Nursery areas are in estuaries and coastal waters year-round. Larvae are most often found offshore from depths of 9 to 84 meters. Juveniles are found offshore, in the surf area, and sometimes in estuarine habitats. Juveniles prefer marine salinities and are not considered estuarine-dependent. The substrate preference of juveniles is clean sand; the preferences of other life stages are unknown (GMFMC, 1998). Adult and juvenile Spanish mackerel are considered common in the lower Galveston Bay estuary from April to October. Estuaries are important habitats for most of the major prey species of Spanish mackerel. They feed throughout the water column on a variety of fish, especially herrings. Squid, shrimp, and other crustaceans are also eaten. Most of their prey species are estuarine- dependent, spending all or a portion of their lifecycle in estuaries. Because of this Spanish mackerel are also dependent on the estuaries to some degree, and therefore, can be expected to be detrimentally affected if the productive capabilities of estuaries are seriously degraded (GMFMC, 1998).

Bonnethead Shark

Bonnethead sharks can be found on sand or mud bottoms in shallow coastal waters. The bonnethead shark is viviparous, reaching sexual maturity at about 30 inches. The pups are born in late summer and early fall, measuring 12 to 13 inches (Pullin *et al*., 2007). Juveniles inhabit shallow coastal waters up to 82 feet deep, inlets, and estuaries over sand and mud bottoms (NMFS, 2006; Pullin *et al*., 2007). They feed mainly on small fish, bivalves, crustaceans, and octopi (Pullin *et al.*, 2007.). Juveniles and adults occur year round in the project area.

Blacktip Shark

Blacktips are fast moving sharks, occurring in shallow waters and offshore surface waters of the continental shelf. Blacktips are viviparous and young are born in bay systems in late May and early June after a yearlong gestation period. The reproductive cycle occurs every two years. Juveniles are found in all Texas bay systems in a variety of habitats and shallow coastal waters from the shore to the 82-foot isobath (NMFS, 2006). They feed mainly on pelagic and benthic fish, cephalopods and crustaceans, and small rays and sharks (Pullin *et al.*, 2007). Neonate and juvenile blacktip sharks occur year round in the project area.

Bull Shark

Bull sharks are coastal and may be found inhabiting shallow waters, especially in bays, rivers, and lakes. They frequently move between fresh and brackish water and are capable of covering great distances. Adults are often found near estuaries and freshwater inflows to the sea (Pullin *et al*., 2007.). Bull sharks are viviparous, have a gestation period of a little less than one year, and it is assumed the reproductive cycle occurs every two years. Neonates and juveniles are found in

estuarine and coastal waters less than 25m deep (NMFS, 2006). They feed on bony fish, sharks, rays, shrimp, crabs, squid, sea urchins, and sea turtles (Pullin *et al.*, 2007). Neonate and juvenile bull sharks occur year round in the project area.

Other Marine Fishery Species

In addition to being designated EFH for the seven federally managed species listed above, Galveston Bay provides nursery and foraging habitat that supports various life stages of forage species and recreationally important marine fishery species such as spotted seatrout, southern flounder, grey snapper, Atlantic croaker, black drum, Gulf menhaden, striped mullet, blue crab, stone crab, pink shrimp, spot, pinfish, sheepshead, gizzard shad, bay anchovy, sheepshead minnow, Gulf killifish, and silversides. Such organisms serve as prey for other fish managed under the MSFCMA by the GMFMC (*e.g.*, red drum, mackerels, snappers, and groupers) and for highly migratory species managed by the NMFS (*e.g.*, billfish and sharks). Wetlands provide other estuarine support functions, including: 1) providing a physically recognizable structure and substrate for refuge and attachment above and below the sediment surface; 2) binding sediments; 3) preventing erosion; 4) collecting organic and inorganic material by slowing currents; and 5) providing nutrients and detrital matter to the Galveston Bay estuary. Moreover, Galveston Bay provides habitat for many benthic animals, including marine worms and crustaceans consumed by higher trophic level predators such as shrimp, crabs, and black drum. Benthic organisms also have a key role in the estuarine food web because they 1) mineralize organic matter, releasing important nutrients to be reused by primary producers; 2) act as trophic links between primary producers and primary consumers; and 3) aggregate dissolved organics within estuarine waters, which are another source of particulate matter for primary consumers.

SECTION 4
INJURY AND SERVICE LOSS EVALUATION

This section of the Final DARP/EA describes the Trustees' assessment of natural resource injuries due to hazardous substances released from the Site facilities. When conducting this assessment, the Trustees used historical data, scientific literature on contaminant effects, and results of the MSC ecological risk assessment, and related studies. All available relevant sediment data resulting from remedial investigations conducted for the Site were used, as well as other historical information on the presence of contaminants at the Site.

Although developed cooperatively with the PRPs, the assessment approach and resource injury and loss evaluation presented in this section is that of the Trustees, as the Trustees are solely responsible for ensuring that this assessment plan and its outcome are consistent with the goals of the NRDA process.

4.1 Scope of Injury Assessment

As a threshold evaluation, the nature and extent of the contamination at the Site that could be attributed to releases of hazardous substances from the MSC was examined. Areas with hazardous substances potentially from the facility were identified as "areas of potential concern." Within these general areas, the potential for natural resource injuries was then considered further based on the presence of hazardous substances at levels of concern (*i.e.*, concentrations with potential to adversely affect natural resources or services). Areas in which COCs were not likely to pose a substantial threat of injury to natural resources or services were excluded from further analysis.

This threshold evaluation considered information from many sources, including results of the work to characterize contaminants in the Site carried out in the RI, the MSC ecological risk assessments (ERA); records and information bearing on past and present operations from these facilities; scientific literature; as well as the Trustees' knowledge and understanding of the ecosystem in this area. Because much of this information arises from recent, comprehensive investigations of the Site conducted or supported by the TCEQ, EPA, the PRPs, and the Trustees, there is a high technical confidence that areas identified in this evaluation are appropriate for evaluating injury to natural resources and services associated with the contaminant releases.

This threshold evaluation showed that the potential for injury to natural resources associated with releases of hazardous substances from the facility is limited to MSC and the adjacent marsh, including the associated habitat and the biota utilizing this area. Accordingly, the Trustees' injury and service loss evaluation focused on resource injuries and losses in those areas.

4.2 Pathways to Trust Resources

Identifying and understanding the COCs for the Site, as well as their pathways to, and potential effects on, ecological receptors is critical to the Trustees' approach to injury assessment. A pathway is defined as the route or medium (for example, water or soil) through which hazardous substances are transported from the source of contamination to the natural resource of concern (43 C.F.R. § 11.14(dd)).

Records and information bearing on past operations at the MSC facility, including reports of releases in court documents, indicate the facilities released a number of different constituents, but principally those related to industrial processes, including petrochemicals, crude oil tank bottoms, and waste oils (See Subsection 4.3 – Chemicals of Concern).

Results of the Site ERA and other relevant data revealed that sediments in the Marsh and Freshwater Pond and the soil on-site were contaminated with hazardous substances characteristic of petrochemicals and facility waste, spills, and past housekeeping practices at the facility are, or were, sources of the hazardous substances located in MSC soil and sediment. Fish, benthic invertebrates, and wildlife receptors known to utilize these areas can come into contact with contamination in the soil, surface water, and sediment media on- and off-site.

4.3 Contaminants of Concern

One of the earliest steps in this NRDA process was to identify hazardous substances that should be included in the list of COCs. To develop this list, the Trustees worked cooperatively with the TCEQ and EPA during and after their preparation of the remedial investigation and ERA for the Site. The remedial investigation identified the nature and extent of hazardous substances and the ERA assessed ecological risks to biota due to contaminant exposures. That process led the Trustees to focus on various metals (arsenic, cadmium, chromium, copper, lead, nickel, mercury, silver, and zinc), PCBs, PAHs, and the organochlorine insecticide DDT (and metabolites) as the contaminants posing a threat to natural resources.

The MSC RI detected DDT, metals, PCBs, and PAHs in the sediments of MSC at concentrations exceeding sediment and soil benchmark screening guidelines. These benchmarks represent COC concentrations that are protective of benthic or soil invertebrate communities. The MSC ERA indicates the primary COCs within the Marsh that pose a potential residual ecological risk to biota due to exposure are metals; however, PCBs, pesticides, and PAHs were detected in the Marsh sediments. Metals, PCBs, PAHs, and dichlorodiphenyldichloroethylene (DDE) were considered constituents of interest in the Freshwater Pond sediments. Similarly, metals, PCBs and PAHs were assessed in the Laydown Area sediment. Thus, the Trustees focused the NRDA on natural resource injuries caused by these COCs. However, the cumulative effect of other COCs that exceeded protective concentration limits (PCLs) was also considered in the evaluation of injury to benthic organisms.

4.3.1 Polycyclic Aromatic Hydrocarbons

PAHs are ubiquitous, detected in sediment, soil, air, surface water, and plant and animal tissues. They are formed as a result of incomplete combustion of organic materials such as wood, coal, and oil and exist in the environment in quantity, from natural sources. PAHs are organic contaminants that tend to sorb to particulates and sediments. PAHs can bioaccumulate but do not tend to biomagnify. Fate of PAHs in sediment is believed to be biotransformation and biodegradation by benthic organisms (USEPA, 1980b). With elevated sediment PAH levels, benthic organisms obtain a majority of their PAHs from sediments through their ability to mobilize PAHs from the sediment/pore water matrix. The elevated levels in the tissues of these benthic organisms could provide a significant source of PAHs to predatory fish. However, fish (and other wildlife) have the ability to efficiently metabolize and degrade PAHs. Although biotransformation does occur, water-borne PAHs can be acutely lethal to invertebrates, fish, and amphibians; long term exposure to sub-lethal levels can impair survival, growth, and

reproduction. Similarly, exposure to sediment-associated PAHs can adversely affect the survival, growth, and reproduction of benthic invertebrates. Fish investigations show that exposure to PAH contamination can induce mortality and a variety of internal and external abnormalities. Sediments heavily contaminated with industrial waste PAHs have directly caused increased body burdens and increased frequency of liver neoplasia in fish (Eisler, 1987a).

4.3.2 Dichlorodiphenyltrichloroethane

DDT is an organochlorine insecticide that breaks down to the metabolites dichlorodiphenyldichloroethane (DDD) and DDE in the environment. All three isomers may be toxic to ecological receptors, therefore the assessment focused on them collectively (as DDTr). DDTr is highly hydrophobic (repelled from water) and is fairly soluble in organic solvents, fats and oils (lipophilic). Thus, DDTr tends to accumulate in the lipids of organisms (is bioaccumulative) and levels of DDTr in the tissues of organisms tend to increase at higher trophic positions in the food chain (biomagnifies). Further, DDTr is chemically stable, has low volatility, and a slow rate of biotransformation and degradation (ATSDR, 2002). When released into the environment, DDTr sorbs to soil or sediment and is highly persistent with a mean half-life around 17 years in sediments (MacKay et al., 1999). DDTr is a neurotoxin that inhibits normal ion exchange at the cellular level (resulting in central nervous system impairment) and also is an endocrine disrupting compound (its chemical structure mimics estrogen at sufficient exposure thereby resulting in reproductive and endocrine impairments). DDTr is known to cause eggshell thinning in exposed birds and is acutely toxic to aquatic receptors (ATSDR, 2002).

4.3.3 Polychlorinated Biphenyls

PCBs are a group of 209 synthetic halogenated aromatic hydrocarbons used extensively in the electricity-generating industry as insulation and cooling agents in transformers and capacitors, as well as lubricants, flame retardants, plasticizers, and waterproofing materials. PCBs tend to bind tightly to particulates, notably soil and sediment, for many years. Since 1979, virtually all uses of PCBs and their manufacture have been prohibited in the United States (Eisler, 1986). Monsanto Corporation produced a variety of PCB formulation under the trade name Aroclor. The various Aroclors are named specifically based on the percent of chlorine by weight. PCBs are extremely stable compounds slow to chemically degrade under environmental conditions. Microbial degradation depends on the degree and position of chlorination; bacteria readily transform lower chlorinated PCBs, but not the higher chlorinated PCBs (National Academy of Science, 1979). In freshwater fish, direct partitioning across the gill membrane of the blood:water interface controls PCB accumulation; however, dietary PCBs may significantly affect accumulation and exchange rates at the gill membrane (Rohrer *et al.*, 1982). In mammals, PCBs are readily absorbed through the gut, respiratory system, and skin. PCBs initially concentrate in the liver, blood, and muscle; eventually accumulating in the adipose tissue and skin. PCBs with lower number of chlorine atoms readily metabolize and are rapidly excreted in urine and bile. PCBs can be transferred to young mammals either through the placenta or in breast milk (USEPA 1980a). In plants, the lower chlorinated PCBs, being more water soluble and more volatile, are more abundant in crop plants than the higher chlorinated isomers. Aquatic invertebrates have an important role in the cycling of PCBs within and between ecosystems. PCB levels in invertebrates correlate positively with sediment concentrations (Eisler, 1986).

4.3.4 Metals

Arsenic, cadmium, chromium, copper, lead, nickel, and zinc were all considered metals of interest in the Freshwater Pond and the Laydown Area. These same metals, plus mercury and silver were evaluated in the Marsh sediments. These metals can be found in industrial waste.

Arsenic - Toxicity of inorganic arsenic (As) depends on its valence state (-3, +3, or +5), and also on the physical and chemical properties of the compound in which it occurs. Trivalent (As+3) compounds are generally more toxic than pentavalent (As+5) compounds, and the more water soluble compounds are usually more toxic. As is one of the most toxic elements to fish. Young fish are more susceptible to As toxicity than adults. Bioconcentration of As in aquatic organisms is primarily in algae and lower invertebrates. Biomagnification in aquatic food chains does not appear to be significant, although some fish and invertebrates contain high levels of As compounds. Terrestrial plants may accumulate As by root uptake from the soil or by absorption of airborne As deposited on the leaves, and certain species may accumulate substantial levels (ATSDR, 1993).

Cadmium - Cadmium (Cd) occurs in nature in association with other metals such as zinc and lead. Cd tends to be more mobile in water than heavier metals; however, sorption to mineral surfaces and humic materials are important transport pathways. Cd induced toxicity is a function of water quality (*e.g*., salinity, water hardness, pH, alkalinity, and temperature). Mobility and bioavailability of Cd in aquatic systems is enhanced under conditions of low pH, low hardness, low suspended solids, high conductivity, and low salinity (Irwin *et al*., 1997). Cd in surface water accumulates more rapidly in the sediments than in living organisms. The toxicity of Cd in sediments is affected by sediment content of acid volatile sulfides and total organic carbon. Cd tends to bioaccumulate in fish, clams, and algae, especially in species living near cadmium-contaminated sediments. Aquatic and terrestrial organisms bioaccumulate Cd (Callahan *et al*., 1979). Because Cd accumulates in the kidney and liver rather than muscle, and because intestinal absorption of Cd is low, one would expect a low amount of biomagnification of Cd in the food chain (ATSDR, 1991). However, Cd is known to be taken up and bioaccumulated by food crops grown in contaminated soil (Munshower, 1977).

Chromium – Chromium (Cr) may be released into the environment from a number of municipal and industrial sources. Trivalent chromium [Cr (III)] and hexavalent chromium [Cr(VI)] are the two principal forms for Cr in the environment. The fate of Cr in aquatic systems varies depending on the form of the metal released and the environmental conditions in the receiving water system. Generally, Cr (III) forms associates with sediment, while Cr (VI) remains in the water column. Both forms of Cr are toxic to aquatic organisms, with Cr (VI) being the more toxic of the two. Dissolved Cr is highly toxic to aquatic plants and invertebrates, with short- and long-term exposures causing adverse effects on survival, growth, and reproduction. Fish are generally less sensitive to the effects of Cr than are invertebrates. Exposure to elevated levels of sediment-associated Cr causes acute and chronic toxicity to sediment-dwelling organisms. Dietary exposure to Cr also adversely effects survival, growth, and reproduction in avian and mammalian wildlife species.

Copper – Copper (Cu) may be released into the environment from a variety of agricultural, municipal and industrial sources. In aquatic systems, Cu tends to become associated with dissolved materials or suspended particles, including both organic and inorganic substances. Over time, these forms of Cu tend to become associated with biological tissues and bottom

sediments. Copper, particularly the dissolved form, is highly toxic to aquatic organisms, causing effects on the survival, growth, and reproduction of fish, invertebrates, and plants. Exposure to elevated levels of sediment-associated Cu causes acute and chronic toxicity to sediment-dwelling organisms. While avian and mammalian wildlife species tend to be less sensitive to the effects of Cu than are aquatic organisms, dietary exposure to elevated levels of Cu can cause organ damage, reduced growth, and mortality.

Lead – Although lead (Pb) may be released into the environment from natural sources, most of the Pb that occurs in aquatic systems is released due to human activities. Depending on the form of Pb discharged, Pb can remain dissolved in the water column or become associated with sediments upon release to aquatic system. Lead has been shown to be neither essential nor beneficial to living organisms. While dissolved Pb is not highly acutely toxic to aquatic organisms, longer-term exposure to relatively low levels of Pb can adversely affect the survival, growth and reproduction of fish, invertebrates, and, to a lesser extent, aquatic plants. Exposure to elevated levels of sediment-associated Pb causes acute and chronic toxicity to sediment-dwelling organisms. In birds and mammals, dietary exposure to elevated levels of Pb can cause damage to the nervous system and major organs, reduced growth, impaired reproduction and death.

Mercury- Mercury (Hg) is a naturally occurring metal found though out the environment as a result of the weathering of the earth's crust. Mining, smelting, and industrial discharge contributed significantly in the past and the combustion of fossil fuels continues to contribute to atmospheric Hg levels. Metallic mercury, mercuric sulfide, mercuric chloride and methyl mercury are common forms of mercury found naturally in the environment. Microorganisms and natural processes can alter mercuric compounds to other forms of mercury, such as methylmercury (ATSDR, 1994). Methylmercury can be bioconcentrated in organisms and biomagnified through food chains, returning mercury to wildlife in a concentrated form. Aquatic organisms rapidly accumulate methylmercury. Mercury in the aquatic environment and in the aquatic food chain is highly toxic and bioaccumulative. Mercury is not as toxic and bioaccumulative in the terrestrial environment and food chain as it is in the aquatic environment. Sublethal effects of mercury on birds include adverse effects on growth, development, reproduction, blood and tissue chemistry, metabolism and behavior. Early developmental stages, for both mammals, birds and fish, are the most sensitive, and organomercury compounds – especially methylmercury – are the more toxic than inorganic forms (Eisler, 1987b).

Nickel – Nickel (Ni) is released into the environment from natural sources and human activities, with the burning of fossil fuels and processing of Ni-bearing ores being the most important sources. Unlike many other metals, Ni is considered to be highly mobile in aquatic ecosysytems, repeatedly cycling between the water column, bottom sediments, and biological tissues. While there is little information available with which to assess the effects of sediment-associated Ni, exposure to dissolved Ni is known to adversely affect survival, growth, and reproduction for amphibians, fish, invertebrates, and aquatic plants. In birds and mammals, dietary exposure to elevated levels of Ni can result in reduced growth and survival.

Silver - Silver (Ag) is considered a rare metal and therefore much of it is recycled. Most Ag compounds that reach the water adsorb to particles and are deposited in aquatic sediments. Ag tends to bioconcentrate in limited amounts in algae, mussels, and other aquatic organisms. Studies of bottom-dwelling species such as clams, oysters, and scallops show that these species also bioaccumulate Ag. Silver nitrate is less toxic in seawater than in fresh water, which is

probably due to the low concentration of free silver ion in seawater because of the high levels of chloride.

Zinc - Zinc (Zn) is released into the environment as a result of various human activities, including electroplating, smelting and ore processing, mining, municipal wastewater treatment, combustion of fossil fuels and solid waste, and disposal of Zn-containing material. In aquatic systems, Zn can be found in several forms, including the toxic ionic form, dissolved forms (*i.e.*, salts), and various inorganic and organic complexes. While Zn can form associations with particulate matter and be deposited on bottom sediments, sediment-associated Zn can be remobilized in response to changes in physical-chemical conditions in the water body. The acute toxicity of dissolved Zn is strongly dependent on water hardness; however, the chronic toxicity is not. Long-term exposure to dissolved Zn has been shown to adversely affect the survival, growth, and reproduction of fish, invertebrates, and aquatic plants. Exposure to sediment-bound Zn may cause reduced survival and behavioral alterations in sediment-dwelling organisms. In birds and mammals, dietary exposure to elevated levels of Zn can cause impaired survival, growth, and health.

4.4 Assessment Strategy

In determining whether the hazardous substances in the Site and adjacent marsh were sufficient to cause harm to natural resources or resource services in these areas, the Trustees used a GIS database to compare contaminant concentrations from the two relevant sediment quality guidelines (see Section 5.4 for a discussion of the sediment quality standards) to those measured in the sediment to determine the geographic extent of the potential for natural resource injuries. Spatial analysis was also used to compare shallow benthic habitat areas with locations of elevated sediment contaminants. This analysis revealed the risk to resources was not equally distributed over the study area, but was limited in spatial extent. Overall, the Trustees' evaluation of potential natural resource injuries in the marsh, freshwater wetlands, freshwater pond, and terrestrial area relied primarily on available media contaminant chemistry data, professional judgment, and scientific literature.

The assessment completed by the Trustees quantified the resources provided by the restoration alternatives evaluated. The scale (or size) of the proposed restoration action should be one that provides a gained value equal to the magnitude of the losses. The process of determining the size of restoration is called restoration scaling. Restoration scaling requires a framework for quantifying the value of losses and for quantifying the benefits of restoration so the losses and benefits can be compared. The Trustees used the HEA as the framework for quantifying losses and benefits (NOAA, 2000). Discussion of the HEA is provided in Section 4.5.

4.4.1 Marsh

The data collected from the marsh sediments to support the RI for metals, PAHs, DDT and PCBs were evaluated by the Trustees. As described in the BERA, arsenic, cadmium, copper, lead, selenium, silver, zinc, total PCBs and DDT were found at concentrations exceeding their respective ecological benchmarks protective of benthic organisms. As shown on Figure 4-1, injury was categorized into high, low, and open water using the sediment RI data.

Aerial Image Date: 2011

250 125 0 250 Feet

Assessment Areas

- Site Boundary
- Estuarine Wetlands - High Injury
- Estuarine Wetlands - Low Injury
- Estuarine Wetlands - Open Water

Figure 4-1

Assessment Areas for the Marsh

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4.4.2 Freshwater Wetlands and Pond

The Freshwater Pond contains numerous species of fish, and waterfowl frequently utilize the pond. The steep sides minimize the area for wading birds, such as the white-faced ibis and snowy egret, to feed. Crayfish, inland silverside (*Menidia beryllina*), sheepshead minnow and mosquitofish were sampled from the Freshwater Pond to support the BERA. Arsenic, chromium, zinc, PAHs and PCBs were detected in the sediment from the Freshwater Pond at concentrations greater than the conservative screening values. The benthic invertebrate community is limited in the Freshwater Pond by the anoxic nature of the deeper portions of the pond. The BERA concluded that contaminants in sediments could pose a risk to benthic (*i.e.*, sediment dwelling) organisms.

A portion of the Laydown Area was assessed in the BERA as an aquatic area since it is intermittently wet. The BERA assessment of the ephemeral aquatic portions of the Laydown Area indicated potential unacceptable risk to benthic invertebrates.

The Earthen Impoundment, Oil Pit Unit 100 API Separator, Unit 1200 API Separator, 800 Tank, and Maintenance Area Pits were also evaluated individually as freshwater wetland resources since these facility areas accumulated surface water and were utilized as a freshwater resource by biota (benthic invertebrates, water column invertebrate community, small fish community, birds, and mammals). The size of each resource area was considered in relation to when each individual unit was placed into service and would have received oily waste. These areas are described in this document as freshwater wetlands at the Site.

4.4.3 Terrestrial Portion of Laydown Area

A portion of the Laydown Area was assessed in the BERA as a terrestrial area. During the RI, this area was described as overgrown with grasses, weeds, and small trees. There was also debris scattered throughout the area, such as tanks and other industrial equipment. Although the Laydown Area was generally covered in vegetation, there were isolated areas of denuded vegetation that appear to directly result from visible contamination to the surface soil. BERA assessment of terrestrial portions of the Laydown Area revealed potential unacceptable risk to plants, soil invertebrates, and small mammals, especially from PCBs.

4.5 Description of Habitat Equivalency Analysis

HEA is an accounting procedure that allows parties to identify "debits" (estimating habitat injuries or other resource service losses) caused by exposure to hazardous substances or remedial activities, and restoration "credits" required to compensate for assessed injuries or losses. The "credits" are ecological services gained by implementing a habitat restoration project. The scale, or size, of a restoration project should be such that it provides enough ecological service gains to offset the total of the losses.

The ecological service losses quantified using a HEA are used to identify the restoration requirements needed to compensate for injuries (generally in the form of habitat acreage). In this context, restoration is scaled to provide comparable habitat resources and ecological services (equivalency) between the lost and restored habitat resources and ecological services, adjusted through discounting to account for the difference in time when services gained through restoration are delivered.

The HEA requires the development of injury parameters to quantify lost resources and services. The parameters needed to estimate losses to natural resources include the size of the injury, the severity of injury, and how that severity of the injury changes over time. The severity of injury is determined by the condition of key or representative resources or services in the habitat (for example, primary production or macrofaunal density). The losses are quantified or converted to habitat acres and then quantified as lost service acre-years, where a service acre-year is the loss of one acre of habitat and its resources and services for a year.

Because the losses occur in different time periods, they are not directly comparable. People place more value on the use or consumption of goods and services in the present rather than postponing their use or consumption to some future time. To make the losses that occur in different time periods comparable, a discount factor is applied to the losses to determine discounted service acre-years (DSAY).

The Trustees consider the HEA to be an appropriate analytical tool for use to assess benthic and terrestrial resource losses for the Site. To quantify losses using the HEA, information or estimates of ecological service losses used to define the resource injuries are needed.

SECTION 5
EVALUATION OF INJURY

The Trustees' evaluation of the potential for injuries to natural resources, including recreational services losses, for this Site is summarized in the following subsections.

5.1 Evaluation of Potential Injuries to Surface Water Resources

Rainfall runoff and groundwater-to-surface water discharge from the Site enter Texas Water Quality Segment 2439 –Lower Galveston Bay– of the Upper Texas Coast Watershed. The Lower Galveston Bay segment encompasses approximately 140 square miles that include an embayment known as Swan Lake (Figure 1-1). The Trustees evaluated the potential for injury to organisms living in the water column due to contamination within MSC and the adjacent marsh. Because contaminant concentrations in surface water samples taken for the ERA were generally below relevant water quality standards, direct exposure was not considered a significant source of potential injury during the injury assessment. The potential for injury to aquatic receptors exposed to contaminants sorbed to suspended sediments was a pathway of concern to the Trustees.

The Trustees also examined the potential for interim water column losses due to past injury. Although past injuries and interim losses may have in fact occurred, quantifying any such loss retroactively is difficult given the limited supporting data available prior to 1999, and is unlikely to yield very accurate results. Additionally, in considering whether to address past losses, the Trustees recognized that the water quality standards used to evaluate the potential for injury to aquatic organisms are technically conservative (*i.e.*, are more likely to over-estimate potential risk). The Trustees also considered the nature of the exposure to aquatic organisms. Unlike benthic organisms, which are relatively sedentary, plankton and juvenile fish drift with water currents, thus reducing their exposure to contaminants present in the water column in these areas resulting in exposures more temporary in nature than for benthic organisms. This further reduces the likelihood that significant losses of aquatic organisms occurred in the past. Finally, the organic contaminants released by the PRPs tend to be hydrophobic in nature or metals and thus tend to partition (or bind) to sediments, rather than remain in the water column. For these and all preceding reasons, the Trustees found no significant potential for injury to water column organisms in the past.

As a final consideration, the Trustees recognized that most potential restoration projects undertaken to compensate for benthic injuries would ecologically benefit other resources, including water column organisms. Indeed, all the restoration alternatives evaluated in Section 6, except the "No Action" alternative, would benefit water column organisms and the potential for multiple environmental benefits for each alternative has been considered in identifying the proposed restoration projects to compensate for the benthic resource injury.

Because contaminant levels in surface waters do not currently pose a risk of injury to aquatic receptors, and historical data suggest a relatively small potential for past injury, the Trustees did not assess a specific injury to water column organisms.

5.2 Evaluation of Potential Injuries to Higher Trophic Level Organisms

Higher trophic level organisms include animals such as piscivorous fish, mammals, and birds. Potential injuries to such organisms may occur through direct exposure to contaminants, or indirect exposure through the consumption of contaminated prey.

The direct exposure route is frequently the most significant source of contaminants to fish, rather than piscivorous birds or mammals, because fish are continuously exposed through the surface waters and sediments that comprise their habitat. However, as discussed in Subsection 5.1, the focus of exposure and injury assessment is not on the surface water medium. As was the case with the evaluation of potential for injury to planktonic organisms, the contaminant levels in surface waters of the Freshwater Pond and Marsh are below levels likely to cause injury to most fish. Fish species that live in close association with sediments (*e.g.*, blue catfish, flatfish) have a potential for injury through direct contact with organochlorine (*e.g.*, DDT) contaminated sediments. In the injury assessment for this Site, however, the Trustees opted to treat these species as part of the benthic community since the pathway and potential effects among sediment dwelling species are similar and protection of the benthic community would allow for protection of the fish community. Losses due to potential injuries to fish species are, therefore, considered and encompassed in the analysis of injury to benthic resources.

The contaminants linked to the hazardous substance releases and observed to be present at high concentrations in the sediments of Freshwater Pond, Freshwater Wetlands, on-site Laydown Area and Marsh tend to biomagnify (increase in concentration from lower to higher trophic levels, or magnify up the food chain). Therefore, the potential for injury to higher trophic level organisms via indirect exposure to contaminants through their food chain is higher than if there were substantial concentrations of contaminants that do not biomagnify. Thus, the MSC ERA evaluated the risk of injury through indirect exposures for representative bird and wildlife species common to the area. The mallard, raccoon, marsh rice rat, and white-faced ibis were all specifically considered and served as surrogates for other potentially affected, upper trophic level organisms. The MSC ERA concluded that the potential risk to all these organisms from the contamination present in the Freshwater Pond and Marsh is negligible (URS, 2007).

The Trustees recognize that most potential restoration undertaken to compensate for benthic injuries would ecologically benefit other resources, including birds and mammals. As was true for surface water resources, the restoration alternatives evaluated in Section 6, except the No Action Alternative, would each benefit potentially affected birds and mammals either directly or indirectly. The potential multiple environmental benefits for each alternative have been considered in identifying the proposed restoration projects to compensate for the benthic resource injury and the proposed alternatives will provide many benefits to potentially affected avian species.

Because available information indicates that MSC Freshwater wetlands, Pond, Laydown Area, and Marsh sediment contamination does not pose significant risk for injury to exposed higher trophic level organisms, the Trustees did not assess a specific injury to these resources.

5.3 Evaluation of Potential Lost Recreational Use of Resources

Many natural resources support recreational activities or other public uses, and these human uses are considered part of the array of services these resources provide. The uses can, at times, be affected by the presence of hazardous substances.

The Trustees considered the potential for loss of recreational uses within the Marsh, including fishing, wildlife viewing, and boating, but found no information indicating that services of this nature were lost or diminished due to any contaminants released by the PRPs. The industrial nature of the area is very prohibitive to recreational activities, and access to the Marsh is limited to the public.

The area of the Marsh impacted by hazardous substances is the Lower Galveston Bay, identified by TCEQ as Texas Water Quality Segment 2439. Designated uses, as defined by the Texas Water Quality Standards, for this segment are primary contact recreation, high aquatic uses, and oyster waters. Terrestrial access to the Marsh is also restricted as the surrounding land is primarily private industrial property. No public boat ramps or other types of public access points are found along the bayou. Further, the Trustees could find no information indicating any active public use of the Site for recreation.

The Trustees, therefore, found little likelihood of lost recreational use of surface waters due to the contamination in MSC. Based on this analysis, the Trustees found that no recreational losses likely occurred due to releases from the PRPs facilities. On that basis, the Trustees did not assess any recreational losses due to the PRP releases.

5.4 Evaluation and Assessment of Injury to Benthic Resources (Habitat and Organisms)

The Trustees considered whether the contaminant levels present in the sediments of the Freshwater wetlands and Pond, Laydown Area and Marsh were sufficient to cause harm to the organisms living within, upon, or closely associated with those sediments, or otherwise adversely affect ecological services provided by this habitat. Organisms common to the area were considered in this analysis, including invertebrates and fish species viewed predominantly as bottom dwelling species (*e.g.*, flatfish, catfish).

Benthos is a broad term that describes aquatic organisms (primarily invertebrates) living on or in the sediments of an aquatic ecosystem. Benthic organisms often feed on organic detritus (decaying material) that is mixed with the top few centimeters of sediment or trapped in the silty fines that cover the sediment surface. Most other trophic niches (herbivores, predators, scavengers, *etc*.) are also represented in the benthic community. Benthic communities constitute an important part of the estuarine food web by utilizing sediment-bound nutrients and organic substances not generally available to epiphytic or pelagic organisms. The ecological services provided by benthos that can be affected by Site contaminants include:

Food and Production: Benthic populations include both meiofauna and macrofauna that are classified into groups based on their relationship with the sediments. These relationships include burrowing (infaunal), deposit feeders or epibenthic species. Benthic organisms are generally fast growing, adaptable, and serve as an important basal component of the estuarine food web. Infaunal and epibenthic organisms utilize nutritional resources (*i.e.*, bacteria, algae, and partially decomposed organic detritus) not available to larger organisms. Benthic organisms serve as an

important food source for fish, crabs, shrimp, and some birds that use the estuary. Productivity of this habitat affects all trophic levels in the estuary by providing the nutritional base for the developing stages of many finfish, shellfish, and some birds.

Conditioning and Improvement of Habitat: Many benthic species burrow through the sediments, increasing the oxygen content of deeper sediments and thereby allowing other organisms and aerobic bacteria to inhabit deeper sediment layers. In addition, the excavation of sediment re-introduces nutrients found at greater depths to the surface where grazers and deposit feeders can utilize them. The ingestion of sediments by deposit feeders occasionally results in the complete re-working of bottom sediments several times within a year.

Decomposition and Nutrient Cycling: A complex community of bacteria, meiofauna, and macrofauna contributes to the reduction and decomposition of organic matter and debris within the sediments. The process of decomposition is important for the cycling of carbon and nutrients back through the aquatic food web.

Thus, the benthic community provides important ecological services primarily related to food production, decomposition, and energy cycling. These services contribute to the productivity of the system and affect nearly all organisms within an estuarine system. Adverse impacts to benthic resources have the potential to impact biota in all trophic levels of the estuary by reducing the overall productivity of the system. Concentrations of metals and PAHs were detected in sediments above screening criteria (URS, 2007). Therefore, benthic resources were identified as an injury category and retained for further analysis.

The Trustees also compared COC concentrations from individual sediment sample locations to scientifically recognized screening values that are considered guidelines for sediment quality: the Effects Range Low (ERL) and Effects Range Medium (ERM) guidelines developed by Long and Morgan (1990) and Long *et al*. (1995) for the estuarine sediments and the threshold effect concentrations (TEC) and probable effect concentrations (PEC) developed by MacDonald *et al.* (2000) for the freshwater systems. These screening values were calculated from a large compilation of effects-based sediment data. ERM, ERL, TEC, and PEC values exist for some of the most commonly assessed contaminants, and will correspond to that particular contaminant. Adverse biological effects may occur at contaminant concentrations ranging between the ERL and the ERM and the TEC and PEC. Above the ERM and PEC, adverse effects are more likely and below the ERL and TEC adverse effects are less unlikely.

5.4.1 Sediment Quality Guidelines in Benthos Injury Assessment

For the estuarine Marsh, ERL and ERM sediment quality guidelines were used in the injury assessment. These values, developed by NOAA, are predictive numerical indicators of potential injury to sediment-dwelling organisms due to ingestion and bioaccumulation of sediment contaminants. Adverse biological effects (such as organ impairment or death) are improbable below ERL values and probable at contaminant concentrations at or above the ERM (Long & Morgan, 1990; Long & MacDonald, 1998). Long *et al*. (1998) found that the probability of observing toxicity to sediment-dwelling organisms generally increases with increased ERM quotients (Figure 5-1). The team utilized the ERM quotient method described by Long *et al.* (1998) to help determine injury to the Marsh sediments.

For the Freshwater Wetlands, TEC and PEC sediment quality values were used in a similar manner to the ERL and ERM method. TECs provide an accurate basis for predicting the absence

of sediment toxicity and PECs provide an accurate basis for predicting sediment toxicity. Mean PEC quotients are calculated to evaluate the combined effects of multiple contaminants in sediment and the use of the mean PEC method provided a reliable basis for assessing sediment quality conditions in freshwater systems (MacDonald *et al*. 2000). Figure 5-2 shows the relationship between the mean PEC quotient and the incidence of toxicity in freshwater sediments. The COCs for sediments in the Freshwater Wetland and Pond, Laydown Area and Marsh, their ERMs and PECs are presented in Table 5-1.

Figure 5-1
Relationship between the Incidence of Toxicity in Amphipod Survival Tests and Mean ERM Quotients (Long *et al.*, 1998)

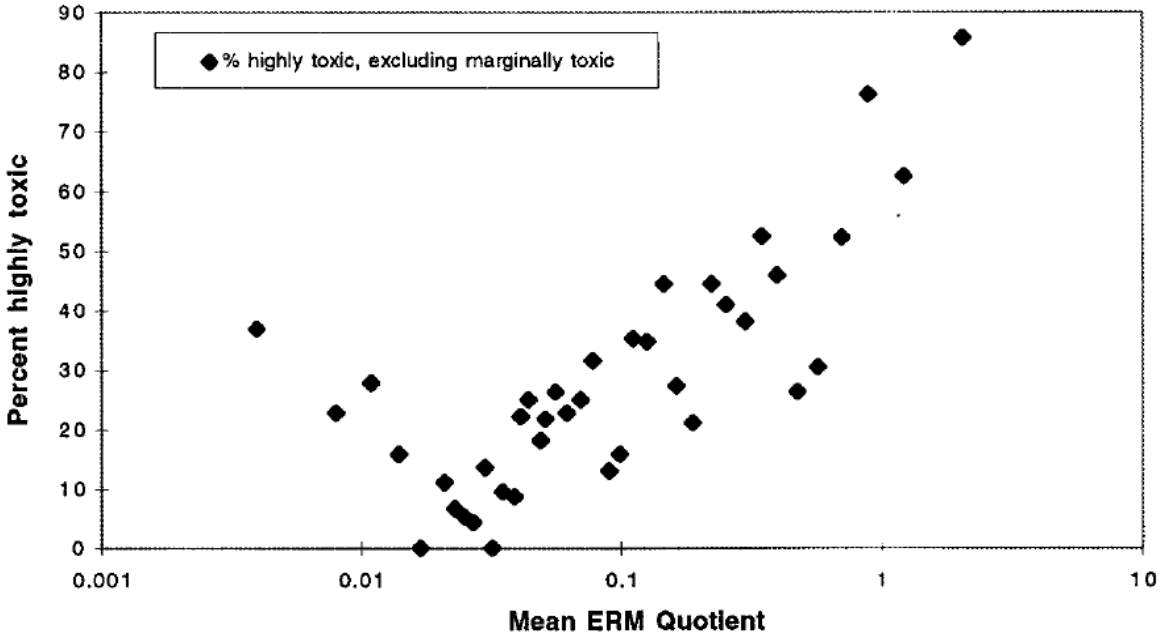


Figure 5-2
Relationship between Mean PEC Quotient and Incidence of Toxicity in Freshwater Systems (MacDonald *et al.*, 2000)

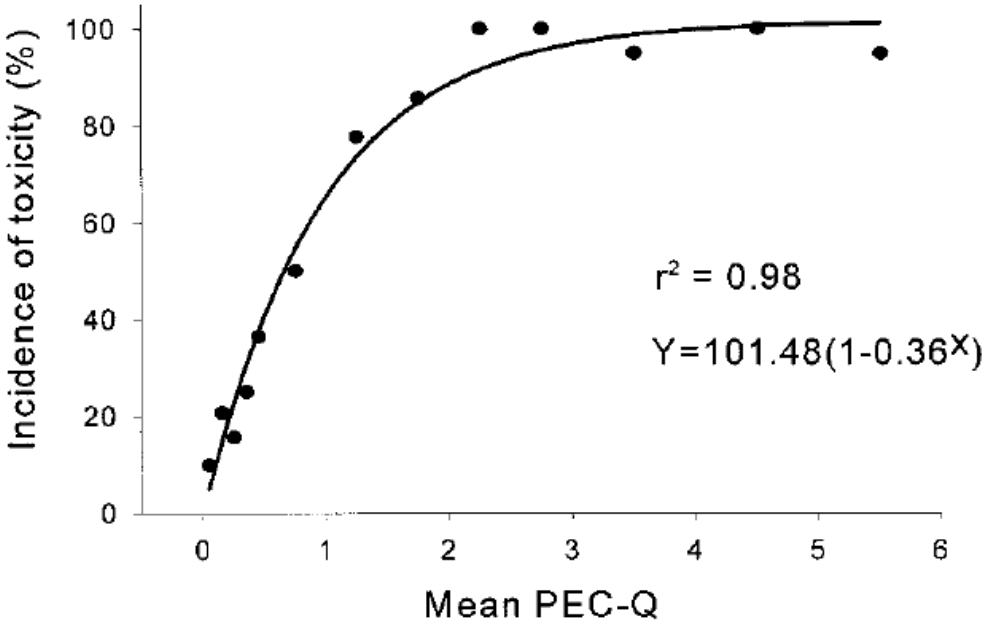


Table 5-1
Sediment COCs with Corresponding ERM and PEC Values (mg/kg dry weight)

COC	ERM Values (Long *et al.*, 1995)	PEC Values (MacDonald *et al.*, 2000)
Arsenic	70	33.0
Cadmium	9.60	4.98
Chromium	370	111
Copper	270	149
Lead	218	128
Mercury	0.71	Not Evaluated in Freshwater
Nickel	51.6	48.6
Silver	3.70	Not Evaluated in Freshwater
Zinc	410	459
4,4'-DDE	0.027	0.031
Total DDT	0.046	Not Evaluated in Freshwater
Total PCBs	0.180	0.67
Total PAH	44.8	22.8

5.4.2 Strategy for Estimating Benthos Injury

In evaluating and estimating losses, the Trustees identified the various sources of injury for benthic resources in the Freshwater Wetlands and Pond, Laydown Area and Marsh. Elevated levels of COCs result in a loss of benthos through toxic mechanisms. Losses are quantified by determining the time required for the injured resources to recover to pre-release and pre-remedy conditions through natural or enhanced means, as applicable, and the severity of injury. For the injury category (*i.e.*, COCs) the losses to benthic habitat were quantified by determining the likely severity of injury based on the available scientific information on potential biological effects.

5.4.3 HEA Injury Parameters

Inputs to the HEA for this injury assessment were based on sediment chemistry analytical results and conservative assumptions. A number of generic, conservative assumptions were associated with all areas assessed: 1) the discount rate is 3%, 2) the base year (the year from which a

discount is applied) is the year 2008, 3) recovery times depend on the source of the loss/injury, and 4) restoration would be initiated in 2014.[2]

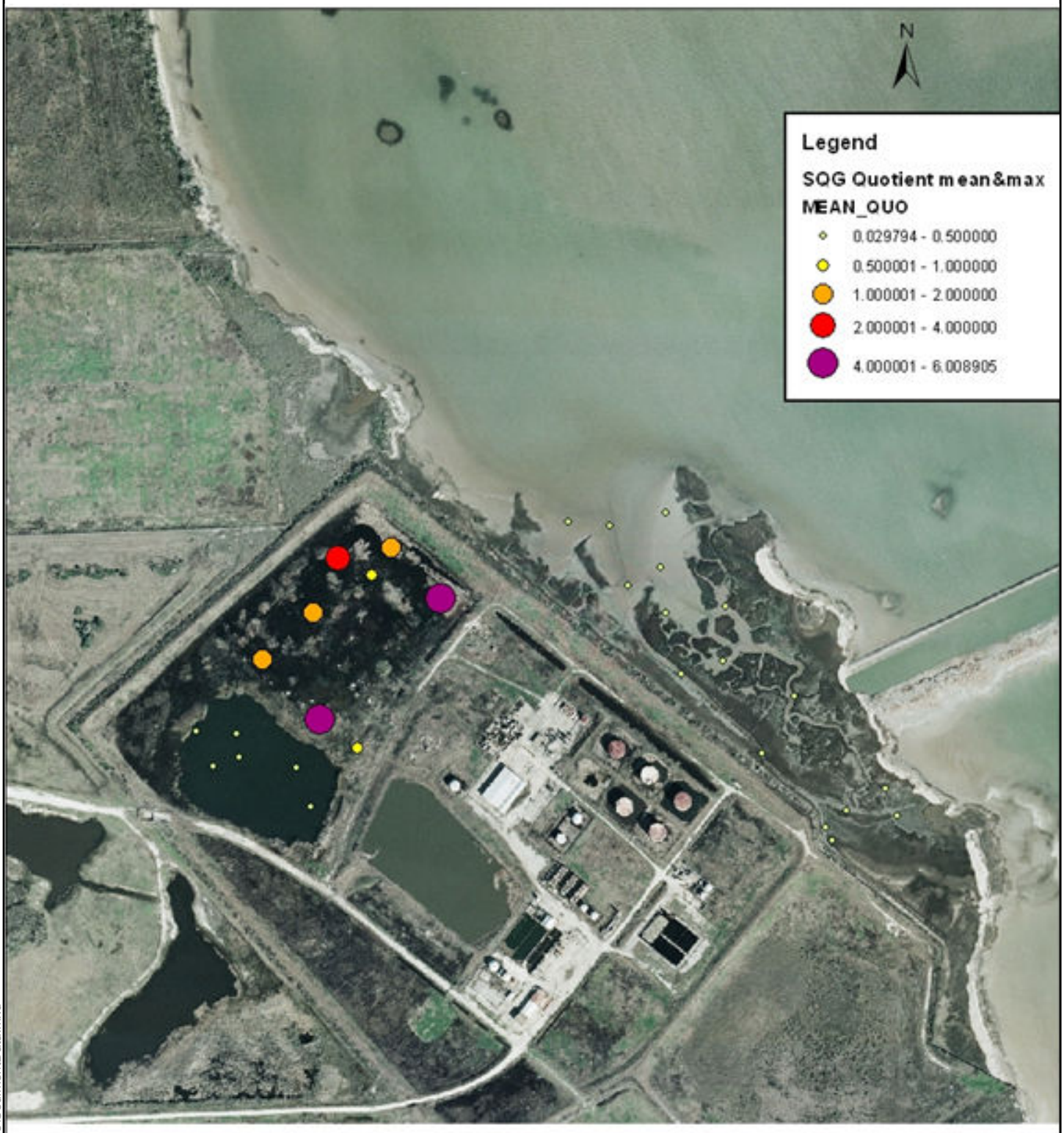
5.4.4 Injury Assessment and Loss Quantification - Marsh

The Trustees determined that the benthic habitat and the associated benthic macroinvertebrate community in the Marsh is a habitat and resource of concern associated with the Site. Benthic habitat (as defined in the risk assessment, consists of sediment from 0 to 6 inches in depth, in waters between +2 and -10 feet mean low tide) was therefore the habitat type pertinent in the injury assessment for the Marsh.

Trustees reviewed remedial investigation and SSI data and discussed the best approach to representing distribution of injury by level and geographic distribution. The Trustees evaluated the primary COCs (PCBs and various metals). During the RI process additional samples were collected to further delineate the PCB contamination indicated by the sparse SSI data. Since the resulting RI PCB samples were low in concentration, the Trustees decided not to base the injury on PCB concentrations. The Trustees chose to use the risk of toxicity associated with average ERM Quotients due to COC concentrations as a surrogate for injury.

Results of Marsh sediment chemistry analyses show that the contamination present in Marsh sediments has the potential to cause injury to exposed benthic organisms. The average ERM Quotient for samples collected within the marsh was 0.14. Figure 5-3 shows graphically the mean ERM Quotient output for the Marsh. The injury of 19.2% selected by the Trustees represents past injury to the Marsh. Since metals do not break down over time, and no remedial action (*i.e.*, excavation and clean fill) was planned for the Marsh, the Trustees assumed the 19.2% injury would continue from the past into perpetuity, which is represented in the HEA as 150 years from 2008, the base year of the HEA calculations. The total estuarine wetland restoration acreage owed the public due to benthic injury in the Marsh was determined to be 38.48 acres. Input values and Results of the injury analysis for the Marsh benthos are presented in Table 5-2.

[2] This assumption was made in the HEA, but the actual remediation and restoration schedule is delayed; however, recoveries are held in interest bearing account and interest will adjust for the delay in implementation.



2004 Aerial Photo

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Figure 5-3

Mean ERM/PEC Quotient for July and December 2005 Sediment Data

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Table 5-2
Benthic Injury HEA Input Parameters and Results for the Marsh, Freshwater Pond and Laydown Area Sediments

	COC Impact to Marsh Sediments	COC Impact to Freshwater Pond Sediments	COC Impact to Laydown Area Sediments
Base Year	2008	2008	2008
Discount Rate (%)	3	3	3
Initial Injury (Year)	0	0	0
Extent of Injury (acres)	20	6.1	7.35
Initial Level of Injury (%)	0	0	0
Level of Injury after 1st Recovery Phase	19.2 % in 14 years	22.4 % in 9 years	47.25 % in 9 years
Level of Injury after 2nd Recovery Phase	19.2 % in 194 years	22.44 % in 38 years	47.25 % in 38 years
Level of Injury after 3rd Recovery Phase	0 % in 195 years	0 % in 138 years	100 % in 38 years
Level of Injury after 4th Recovery Phase	--	--	100 % in 40 years
Level of Injury after 5th Recovery Phase	--	--	90 % in 44 years
End of Recovery Period (Years after injury)	194	180	342
Total Lost DSAYs	394.87	88.27	338.73
Restoration Goal	Estuarine Wetlands	Freshwater Wetlands	Freshwater
Relative Value	1.00	0.20	0.30
Restoration Habitat	394.87	17.65	101.62
Total Restoration	38.48	1.55	8.95

5.4.5 Injury Assessment and Loss Quantification – Freshwater Wetlands

Several areas within the Site were evaluated for freshwater sediment injury since they contain freshwater habitat for part or all of the year. Of these areas, some were evaluated strictly for injury due to contact oiling of wildlife due to lack of a benthic habitat and community, while others were evaluated for both oiled wildlife injury and benthic injury. The Earthen Impoundment, Oil Pit, API Separators, 800 Tank Area, and Maintenance Area Pits were all only evaluated for injury due to oiled wildlife, while the Laydown Area was evaluated for both types

of injury, and the Freshwater Pond was evaluated strictly based on benthic invertebrate injury alone as no evidence of direct oiling of resources was apparent.

Evaluation of RI samples for the Laydown area showed that this area was approximately 50% wet and 50% dry based on sample classification and aerial photographs. Accordingly, area habitat character was then categorized as 50% wetland and 50% dry upland for purposes of determining injury. While the Trustees agreed that wildlife impacts occurred over the full footprint of the Laydown Area, it was agreed that benthic invertebrate impacts occurred only over a subset of that footprint (the 50% that was wet). Due to the planned remedial cap that will cover the entire current Laydown area (as well as other areas), remedial injury will occur over the full footprint of the area; thus the benthic habitat was assumed lost once the remedy was implemented, which was assumed to occur in 2016, and all services provided by the habitat were set at 0% into the future from this point in time.

To determine freshwater benthic injury, the Trustees compared the concentration data to PEC values from peer reviewed literature. A mean PEC of 89% was selected as representative of magnitude risk and probability of injury for the area. The Laydown area habitat was considered to have provided a full range of ecological services prior to contamination and remedial activity, consisting of plant productivity 25%, Benthos productivity 25%, and Wildlife productivity 50%. The Trustees gauged this based on aerial photographs of the site taken prior to site operations and also on field observations of the current wet/dry prairie present. To calculate the injury to benthics, the 89% injury based on the mean PEC multiplied by the 25% benthic productivity to equal 22.25% injury to benthics for this area. Based on RI sample data, past injury was estimated to have increased until 1987; from 1987 until 2016, injury was assumed to occur at a steady state level. The benthic injury (22.25%) was then combined with the injury from direct oiling of wildlife (25%) for a total of 47.25% injury for the wetlands in the Laydown area. Spatially, the wildlife usage of the area overlaps with the habitat used by the benthic invertebrates, so it was appropriate to combine the two for a total wetland injury.

When the Trustees examined the data for the freshwater pond on-site, it became apparent that the PEC quotient was low, but the percentage of toxicity associated with those concentrations was high. Based on toxicity, the Trustees opted to proceed with evaluation of benthic injury for this area. Since the Laydown Area was the probable source of contamination in the pond based on COCs and the most likely sheet flow pathway, the timeline for injury in the pond reflects Laydown Area activity. The injury was assumed to have increased up to 22.44% during the past, up until the date of last use (1987). From 1987 until 2016, the injury was in a steady state of 22.44%, and after 2016 until 2306, the COCs are expected to attenuate and injury is expected to decline. The Trustees had many discussions concerning the contaminant attenuation rate in the pond. There is no clear sedimentation source for the pond, so it was unlikely COCs would be covered up with clean material, thereby cutting of the exposure pathway for benthic organisms, in the near future. The Trustees estimated 100 years for sedimentation and subsequent biodegradation of the COCs. Estimates of the extent or degree of injury for each area (Earthen Impoundment, Oil Pit, API separators, Maintenance Area Pits and Tank 400, 50% of the Laydown Area and Freshwater Pond) were then developed using peer- reviewed scientific literature, and best professional judgment consistent with the Trustees' collective resource expertise.

Based on the injury scenario outlined above, the total freshwater wetlands restoration acreage MCP owed the public was 13.97 acres (this is a combination of restoration requirements for the

Freshwater Pond, Earthen Impoundment, Oil Pit, API Separators, 800 Tank Area, Maintenance Area Pits and Laydown Area). Results of the injury analysis for the Freshwater Pond and Laydown Area benthos are presented in Table 5-2. Results of the injury analysis for the Earthen Impoundment, Oil Pit, API Separators, 800 Tank Area, and Maintenance Area Pits benthos are presented in Table 5-3.

Table 5-3
Benthic Injury HEA Input Parameters and Results for the Earthen Impoundment, Oil Pit, API Separators, 800 Tank and Maintenance Area Pits Sediments

	COC Impact to Earthen Impoundment Sediments	COC Impact to Oil Pit Sediments	COC Impact to Unit 100 API Separator Sediments	COC Impact to Unit 1200 API Separator Sediments	COC Impact to 800 Tank Sediments	COC Impact to Maintenance Area Pits Sediments
Base Year	2008	2008	2008	2008	2008	2008
Discount Rate (%)	3	3	3	3	3	3
Initial Injury (Year)	0	0	0	0	0	0
Extent of Injury (acres)	5.9	0.7	0.7	0.7	2.5	3
Initial Level of Injury (%)	25	35	15	15	25	35
Level of Injury after 1st Recovery Phase	25 % in 10 years	35 % in 9 years	15 % in 22 years	15 % in 13 years	25 % in 17 years	28 % in 1 year
Level of Injury after 2nd Recovery Phase	35 % in 11 years	11 % in 10 years	0 % in 23 years	0 % in 14 years	0 % in 20 years	28 % in 9 years
Level of Injury after 3rd Recovery Phase	35 % in 19 years	11 % in 42 years	0 % in 24 years	0 % in 15 years	--	0 % in 10 years
Level of Injury after 4th Recovery Phase	11 % in 20 years	0 % in 43 years	5 % in 29 years	5 % in 20 years	--	--
Level of Injury after 5th Recovery Phase	0 % in 52 years	--	5 % in 38 years	5 % in 29 years	--	--

	COC Impact to Earthen Impoundment Sediments	COC Impact to Oil Pit Sediments	COC Impact to Unit 100 API Separator Sediments	COC Impact to Unit 1200 API Separator Sediments	COC Impact to 800 Tank Sediments	COC Impact to Maintenance Area Pits Sediments
End of Recovery Period (Years after injury)	342	332	39	30	310	337
Total Lost DSAYs	110.86	9.02	4.59	2.55	12.88	22.69
Restoration Goal	Freshwater Wetlands	Freshwater Wetlands	Freshwater Wetlands	Freshwater Wetlands	Freshwater Wetlands	Freshwater Wetlands
Relative Value	0.25	0.20	0.20	0.20	0.30	0.20
Restoration Habitat Equivalent Total Lost DSAYs	27.72	1.80	0.92	0.51	3.86	4.54
Total Restoration Requirements (Acres)	2.44	0.16	0.08	0.04	0.34	0.40

5.4.6 Equivalent Injured Acres Ratio

The assessed benthic resource losses are for benthic injuries occurring in soft unvegetated bottom sediments also referred to as open water habitats. The restoration projects proposed to compensate for these losses involve creation and enhancement of brackish marsh. To determine the amount or scale of restoration needed to offset losses, the DSAYs lost due to injuries must be compared to DSAYs gained through restoration across these habitat types (open water versus marsh). The comparison is complicated by differences in functions or ecological productivity levels between these habitats. To translate the habitat losses into their "equivalent" in the target restoration habitat, it is necessary to identify a conversion factor or ratio to be used to adjust for the differences in relative productivity across these habitat types.

5.4.7 Summary of Proposed Injury Analysis for Benthic Resources

The Trustees found benthic resources in the Marsh, Freshwater Pond, and Laydown Area to be injured due to the effects of elevated concentrations of hazardous substances releases attributable to the PRPs facilities and the remediation planned to address this contamination. The Trustees quantified the injuries in terms of the ecological services of the benthos lost over time, until recovery to baseline conditions, using historical data and data collected for the Site ERA and based on sediment benchmark concentrations known or suspected to result in adverse effects in benthic populations. The analysis incorporated conservative technical judgments and assumptions regarding likely effects on benthos, including those of remedial actions known or expected within areas evaluated and the greater Site.

The quantification of benthic losses considered the present condition of the resource, the potential reduction in ecological services due to the injury, and accounted for service losses expected to occur due to the implementation of the remedy (dredging of the bayou). Because the proposed restoration action (freshwater wetland) for some injury areas had a higher ecological productivity than the habitat within which the injuries occurred, a freshwater wetlands equivalency ratio was applied to convert losses to their "equivalent" in the target restoration habitat. Results of this analysis (see Tables 5.2 and 5.3) show that compensation for assessed benthic resource losses is achieved by providing the ecological services of a constructed habitat.

5.5 Evaluation and Assessment of Injury to Terrestrial Resources (Habitat)

The evaluation of the terrestrial injury focused on one-half of the Laydown Area classified as dry upland habitat. Injury may be expressed in upper level trophic receptors as a percent impact plus percent impact to the terrestrial community (including plants, soil invertebrates). Overall terrestrial (upland) injury was determined as 25% based on evaluation of wildlife hazard quotients (HQ) from the BERA.

This injury assessment approach resulted in a conservative estimate of the total potential number of forested wetlands service acre-years lost due to the natural resource injuries at the Site. This quantification of total services lost is expressed as the number of DSAYs lost due to the assessed injuries. In this context, the assessed DSAYs represent the amount of total habitat services lost, in acre-years (adjusted to the present time).

5.5.1 HEA Injury Parameters

Inputs to the HEA for this injury assessment were based on current and historical conditions as well as anticipated remedial actions and informed by historical aerial photographs, and conservative assumptions. The following assumptions were associated with the analysis: 1) the discount rate is 3%, 2) the base year (the year from which a discount is applied) is the year 2008, 3) the onset of injury was calculated as year "0," 4) initial injuries/losses result in 25% loss of services, and 5) physical disturbance of the area associated with site work and the implementation of the remedy was initiated in 2013 and the construction of the RCRA "C" cell will be completed and the area permanently covered with grassy vegetation by 2016. The Trustees considered the fact that the cap being implemented as part of the site remedy would be vegetated "above and beyond the minimum" by installing coastal vegetation of greater habitat value than the minimum (*e.g.*, coastal Bermuda). Credit for a cap of diverse vegetation resulted in a 40% injury from the original Laydown area habitat (conversely, it would provide 60% services of the original habitat it replaced). Inputs of the injury analysis and results for the terrestrial habitat within the Laydown Area are presented in Table 5-4.

Table 5-4
Terrestrial Injury HEA Input Parameters and Results

	Laydown Area (Terrestrial	
Area Injured: 7.35 acres		
	% Injury	**Years after**
Initial Level of Injury	0 %	0
End of 1st Recovery Phase	25 %	9
End of 2nd Recovery Phase	25 %	35
End of 3rd Recovery Phase	100 %	35
End of 4th Recovery Phase	100 %	38
End of 5th Recovery Phase	40 %	43
End of Recovery Period	40 %	328
Total Lost DSAYs	183.67	--
Restoration Goal	Woodlands	--
Restoration Habitat Total Lost (DSAYs)	36.73	--
Total Habitat Construction Requirements (Acres)	2.73	--
Total Habitat Preservation Requirements (Acres)	1.30	--

5.5.2 Equivalent Injured Acres Ratio

The Trustees determined that the proposed restoration target for terrestrial losses was the preservation of existing or construction of wooded habitat. Often, the relative certainty associated with the preservation of existing habitat outweighs the high construction costs, long term commitment, and risks associated with construction of wooded habitats, another option for this mix of affected habitats. However, given the relatively low acreage requirement for offsetting losses, the Trustees also chose to evaluate the wooded habitat construction option for this case. To translate habitat losses into their "equivalent" in the target restoration habitat, it is necessary to identify a conversion factor or ratio to be used to adjust for differences in relative productivity across the habitat from the Laydown area to a woodland. The conversion factor for the terrestrial habitat type was developed in a similar approach to the benthic habitat factor. The Trustees relied on past experience and best professional judgment to identify ratios for each habitat type affected by the Site. Based on the relative ecological services, a habitat conversion factor of 0.2 was used to convert the 183.67 Total Lost DSAYs to 36.73 DSAYs of woodland habitat equivalent losses.

5.5.3 Summary of Proposed Injury Analysis for Terrestrial Resources

The Trustees determined that terrestrial resources were impacted by releases of Site related COCs and by the future construction of the RCRA "C" cell. The Trustees quantified the injuries in terms of the ecological services of the terrestrial environment lost over time, until recovery to maximum habitat conditions, using data generated during the RI and aerial photographs.

The quantification of terrestrial habitat losses considered the past condition of the resource, the reduction in ecological services due to the removal of habitat for construction of the remediation cell, and revegetation following construction. Results of this analysis reveal that compensation for assessed terrestrial habitat losses is achieved by providing ecological services equivalent to 36.73 woodland equivalent DSAYs.

5.5.4 Summary of Settlement

The Trustees recovered $3,109,000 on behalf of the public from the settling defendants and federal agencies in a Consent Decree entered by the U.S. District Court, Southern District of Texas, on July 13, 2012, in United States of America and State of Texas v. Alcoa Inc., et al., Case No. 3:12CV-00210. According to the terms of the Consent Decree, $102,828 were allocated to past NRDA costs incurred by the federal Trustees (DOI and NOAA), and $127,120 was allocated to past NRDA costs incurred by the state Trustees (TCEQ, TPWD, and TGLO). The remaining $2,878,962 was placed in the DOI Malone Natural Resource Damage Assessment and Restoration Fund to be used to reimburse the Trustees for future NRDA costs, and to restore, replace, rehabilitate, or acquire the equivalent of any natural resources or services injured, lost, or destroyed as a result of the release of hazardous substances at or from the Site (including the design, implementation, permitting (as necessary), monitoring, and oversight of restoration projects and compliance with the requirements of the law to conduct a restoration planning and implementation process).

SECTION 6
THE RESTORATION PLANNING PROCESS

The goal of restoration planning under CERCLA is to identify actions appropriate to restore, rehabilitate, replace, or acquire natural resources or services equivalent to those injured or lost as a result of releases of hazardous substances. The restoration planning process may involve two components: primary restoration and compensatory restoration. Primary restoration actions are designed to assist or accelerate the return of a resource, including its services, to pre-injury or baseline conditions. In contrast, compensatory restoration actions serve to compensate for the interim loss of resource services due to injury, pending the return of the resource to baseline conditions or service levels. The scale of a compensatory restoration project depends on the nature, extent, severity, and duration of the resource injury. Primary restoration actions that speed resource recovery reduce interim losses, as well as the amount of restoration required to compensate for those losses.

The Trustees approached restoration planning with the view that injured resources and associated services lost are part of an integrated ecological system and that the Lower Galveston Bay system represents the relevant geographical area for appropriate restoration actions. This helps to ensure that the benefits of restoration actions are related, or have an appropriate nexus, to the resource injuries and service losses being assessed for the Site.

In accordance with the NRDA regulations, the Trustees identified and evaluated a reasonable range of project alternatives capable of restoring ecological services comparable to those lost due to injury to natural resources at the Site. The alternatives identification and evaluation process addressed in Sections 6 – 8 of this Final DARP/EA are consistent with NEPA's requirement for an analysis and comparison of a reasonable range of alternatives for the proposed action. These alternatives were identified by first searching for potential projects within the watershed. The Trustees considered five restoration alternatives for the Marsh, four restoration alternatives for the freshwater wetlands and three restoration projects for terrestrial uplands for providing compensatory restoration for the injuries resulting from the release of hazardous substances associated with the Site. All potential restoration alternatives were evaluated based on the criteria presented in Section 6.2, and proposed alternatives were then evaluated to ensure that its size (e.g., acres) would appropriately compensate for the injuries resulting from the incident. The Trustees employed a service-to-service scaling method, where restoration actions provide natural resources and/or services of the same type and quality, and of comparable value as those lost. The "No Action" alternative was also included for consideration, as required by NEPA and the CERCLA NRDA regulations. Each alternative evaluated, the results of that evaluation, and the restoration action(s) the Trustees are proposing for implementation, are identified in the remaining sections of this document.

6.1 Restoration Evaluation Criteria

Consistent with the NRDA regulations, the following criteria were used to evaluate restoration project alternatives and identify the project proposed for implementation under this plan:

- *Criterion # 1: The extent to which each alternative is expected to meet the Trustees' restoration goals and objectives*: The primary goal of any restoration project is to provide a level and quality of resources and services comparable to those lost due to the assessed

injuries. In meeting that goal, the Trustees consider the potential relative productivity of the habitat to be restored and whether the habitat is being created or enhanced. Proximity to the injury and future management of the restoration site are also considered because management issues can influence the extent to which a restoration action meets its goals.

- *Criterion # 2: The cost to carry out the alternative*: The benefits of a project relative to its cost are a major factor in evaluating restoration alternatives. Factors that can affect and increase the costs of implementing the restoration alternatives may include project timing, access to the restoration site (*e.g.,* with heavy equipment or for public use), acquisition of state or federal permits, acquisition of land necessary to complete a project, measures necessary to provide for long-term protection of the restoration site, and the potential liability from project construction.
- *Criterion # 3: The likelihood of success of each project alternative*: The Trustees consider technical factors that represent risk to successful project construction, project function, or long-term viability of the restored habitat. Alternatives that are susceptible to future degradation or loss through contaminant releases or erosion are considered less viable. The Trustees also consider whether difficulties in project implementation are likely and whether long-term maintenance of project features is likely to be necessary and/or feasible.
- *Criterion # 4: The extent to which each alternative will avoid collateral injury to natural resources as a result of implementing the alternative*: Restoration actions should not result in additional losses of natural resources and should minimize the potential to affect surrounding resources during implementation. Projects with less potential to adversely impact surrounding resources are generally viewed more favorably. Compatibility of the project with the surrounding land use and potential conflicts with endangered species are also considered.
- *Criterion # 5: The extent to which each alternative benefits more than one natural resource or service*: This criterion addresses the interrelationships among natural resources, and between natural resources and the services they provide. Projects that provide benefits to more than one resource and/or yield more beneficial services overall, are viewed more favorably. For example, although recreational benefits are not an explicit objective in this Final DARP/EA, the potential for a restoration project to enhance recreational use of an area was considered favorably.
- *Criterion # 6: The effect of each alternative on public health and safety*: Projects that would negatively affect public health or safety are not appropriate.

6.2 Screening of Potential Project Alternatives

NRDA regulations give the Trustees discretion to prioritize the above criteria and to use additional criteria as appropriate. In developing this Final DARP/EA, Criterion #1 listed above was a primary consideration because it is paramount to ensure that the restoration action will compensate the public for the injuries to benthic and forested / wetland / prairie resources attributed to Site releases and the remedial process, consistent with the proposed assessment of compensation requirements for the Site. The following are brief descriptions of the projects identified as alternatives to compensate for injuries associated with hazardous substance releases from the Site, followed by a summary (Table 6.1) of each project's ability to satisfy the project

selection criterion #1 listed in the CERCLA NRDA regulations, the extent to which each alternative is expected to meet the Trustees' restoration goals and objectives:

6.2.1 Potential Projects to Address the Estuarine Marsh

A total of five projects and the No Action alternative were evaluated to address the estuarine marsh. The projects included both acquisition based projects and restoration projects.

Acquisition and Protection of Existing Marsh Habitat

- *Kohfeldt Marsh Acquisition*: This alternative involves acquisition and protection of marsh. The Kohfeldt property is near the site of the injury, but chemical constituents related to the Tex-Tin Superfund Site are still present.
- *Halls Bayou Acquisition*: This project site is approximately 14 miles from the Site. Halls Bayou is a more riparian freshwater area as compared to the MSC marsh and is a considerable distance from the Site.

Restoration (*i.e.*, creation and enhancement)

- *Swan Lake Marsh Creation*: This alternative involves marsh creation immediately adjacent to the site of the injury. The marsh creation would use off-site fill material.
- *Greens Lake Marsh Creation*: This alternative involves marsh creation at a project site approximately 11.5 kilometers from the Site. Marsh would be created using material from maintenance dredging of the adjacent Gulf Intercoastal Waterway (GIWW).
- *Pierce Marsh Creation*: This alternative involves marsh creation within the existing containment cells while maintaining significant marsh edge interface with shallow open water. Pierce Marsh (Figure 6-1) is located 3.75 miles southwest of the Site. This marsh construction project is expected to be implemented in a timely fashion using material from planned maintenance dredging of the GIWW.

6.2.2 Potential Projects to Address the Freshwater Wetlands

Four projects and the No Action alternative were evaluated to address the impacts to the freshwater on-site pond and wetlands on the Site. Figure 6-2 shows the potential project locations in relation to the Site.

- *On-site and Directly Off-site Wetland Creation Following Remediation*: This alternative involves enhancement of the existing MSC on-site freshwater pond by providing more gradual slope into the pond and planting vegetation (aquatic emergent and shoreline). Additionally, there are two freshwater ponds located directly to the west on Gulf Coast Waste Disposal property. The connection of the perched groundwater to the off-site ponds is unknown, but the perched groundwater does interact with the on-site pond. One aspect of this project would be to maintain and stabilize the water levels in the three ponds. This alternative could not be implemented until 2017 following remediation of the Site and the total acreage would most likely be less than 14 acres.
- *Texas City Prairie Preserve Borrow Ditch Enhancement*: This alternative involves management of water levels and salinities within the upper segments of a borrow ditch adjacent to the Texas City Hurricane Levee. This project would involve the enhancement of Segments 1 and 2 of the borrow ditch. Removal of silts and sediments from the drainage areas would restore water flow capabilities. Replacement of obsolete and failing

culverts with risers would allow collection of freshwater. The area would be managed as freshwater and intermediate marsh. This alternative would result in 17 acres of habitat, but the footprint would expand with these enhancements and there would be benefits downstream.

- *Virginia Point Peninsula Preserve Restoration of Former Gas Well Exploration Site into Freshwater Wetlands:* This alternative involves freshwater pond and wetland creation via re-grading of existing containment levees at a six acre site. The former gas well exploration site is located adjacent to Galveston Bay shoreline just south of the Site at the terminus of W. Roach Birding Trail.
- *Campbell Bayou Freshwater Wetland Restoration:* This alternative would restore the hydrological connection that has been interrupted by the placement of a road and landfill (i.e., landscape alterations). This project would enhance approximately 25 acres of emergent wetlands such that rainfall runoff would flow through the wetlands ensuring an outflow into tidal waters, increasing the volume of freshwater captured by the wetlands and the creation of hydro-period wetlands. The site location is near the Site.

Aerial Image Date: 2011

MSC Site Boundary

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1,000 500 0 1,000 Feet

Figure 6-1

Location of Pierce Marsh and Swan Lake

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Texas City Prairie Preserve
Borrow Ditch Enhancements

Dickinson Bay

Texas City
Prairie Preserve

Moses Lake

Texas City

La Marque

Campbell Bayou Freshwater
Wetland Restoration

Swan
Lake

Malone Service Company
(MSC) Site

Pelican Island

Bayou
Vista

Lower Galveston Bay

On-site and Off-site
Freshwater Pond Enhancements

Virginia Point Former Oil Well Pad

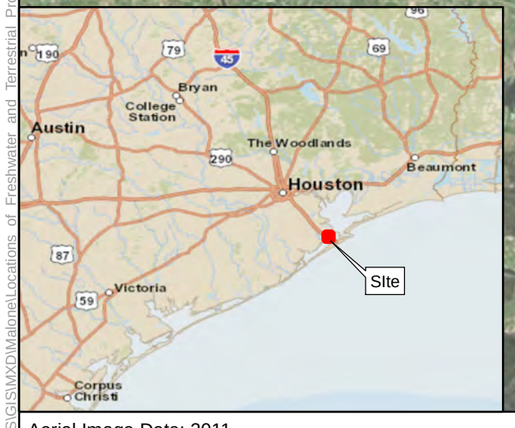
Virginia Point
Peninsula Preserve

Tiki Island

Galveston

Gulf of Mexico

West Bay



Aerial Image Date: 2011

MSC Site Boundary
Project Areas

2 1 0 2 Miles

Figure 6-2

Locations of Freshwater
and Terrestrial Projects

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6.2.3 Potential Restoration for Terrestrial Resources

Three projects and the No Action alternative were evaluated to address the impact to terrestrial resources on the Site.

- *On-site Terrestrial Enhancement:* This alternative would be enhancement of any upland areas on the Site following remediation; however, this would likely be limited to any elevated areas that would resist inundation of water and that would have sufficient soil depth to support native woody vegetation. The number of areas and final acreage for this project is unknown. Timing on this alternative is based on the remediation and would not be implemented until 2017.
- *Virginia Point Peninsula Preserve Removal of Invasive and Exotic Plant Species:* This alternative involves removal of non-native, invasive plants such as the Chinese tallow tree (*Tridica sebifera*), deep-rooted sedge (*Cyperus entrerianus*) and salt cedar (*Tamarix ramosissima*) within the Virginia Point Peninsula Preserve.
- *Virginia Point Peninsula Preserve Enhancement of Former Gas Well Exploration Site and Adjacent Areas into Upland Habitat:* This alternative involves upland habitat enhancement of currently elevated areas in which there is existing woody vegetation. Enhancement would consist of reintegration into coastal prairie or tree planting along elevated upland birding trail with existing adjacent freshwater borrow areas. Numerous trees, particularly hackberries, mulberries and willows were lost to Hurricane Ike in this area of the preserve, although the existing live oak colony survived.

6.2.4 No Action Alternative

No action would be taken to restore, rehabilitate, replace, or acquire natural resources or services equivalent to those lost in the estuarine marsh, freshwater wetland, and uplands due to hazardous substance releases from the Site or the remedial actions taken to prevent further or future harm at the Site.

Table 6-1
Summary of Each Project's Ability to Satisfy Criterion #1 Listed in the CERCLA NRDA Regulations: The extent to which each alternative is expected to meet the Trustees' restoration goals and objectives.

Restoration Project Alternative	No Significant Impediments to Implementation	Strong Nexus to Injured Habitats	Amount of Habitat Function Enhancement	Avoids Injury to Existing Resources	Retain for Detailed Analysis
Marsh					
Kohfeldt Marsh Acquisition	-	+	+	+	No
Halls Bayou Acquisition	-	--	+	+	No
Greens Lake Marsh Creation	-	+	+	-	No
Swan Lake Marsh Creation	++	++	+	++	No
Pierce Marsh Restoration	**++**	**++**	**++**	**++**	**Yes**
No Action	+	-	-	+	No
Freshwater Wetlands and Pond					
On-site Enhancement	-	++	--	+	No
Texas City Prairie Preserve Borrow Ditch Enhancement	+	++	--	+	No
Virginia Point Peninsula Point Preserve Restoration of Former Gas Well Exploration Site	+	++	--	-	No
Campbell Bayou Freshwater Wetland Restoration	+	++	++	+	**Yes**

Restoration Project Alternative	No Significant Impediments to Implementation	Strong Nexus to Injured Habitats	Amount of Habitat Function Enhancement	Avoids Injury to Existing Resources	Retain for Detailed Analysis
No Action	+	-	-	+	No
Terrestrial On-site					
On-site Terrestrial Enhancement	-	-	-	+	No
Virginia Point Peninsula Point Preserve Removal of Invasive and Exotic Plant Species	+	+	++	-	**Yes**
Virginia Point Peninsula Point Preserve Restoration of Former Gas Well Exploration Site and Adjacent Areas into Upland Habitat	+	+	++	-	**Yes**
No Action	+	-	-	+	No

(++) indicates very positive, (+) indicates positive, (-) indicates negative, and (--) indicates a very negative relationship between the project and that criterion. Section 7 provides a more detailed analysis.

The proposed restoration alternatives are identified above in bold. Section 7.0 provides further information regarding the basis for choosing the proposed restoration alternatives and the evaluation of the remaining non-preferred alternatives.

SECTION 7
CERCLA EVALUATION OF RESTORATION ALTERNATIVES

The Trustees evaluated various restoration alternatives for suitability to serve as compensatory restoration under CERCLA. This section describes the CERCLA analysis of the proposed alternatives as well as those that were considered less suitable and, therefore, eliminated from a further detailed impacts analysis. For the proposed alternatives, the federal Trustees also fully evaluated the environmental impacts under NEPA in Section 8. Detailed evaluations of the proposed restoration alternatives for each of the assessment areas as well as brief evaluations of the non-preferred alternatives and the No Action alternative are provided in the following subsections.

7.1 Marsh

7.1.1 Proposed Restoration Alternative – Marsh Restoration in Pierce Marsh

The restoration alternative proposed by the Trustees following the application of the evaluation criteria presented in Section 6.3 is salt marsh creation in Pierce Marsh. The description and analysis of the project below are based on a project-specific preliminary design concept rather than detailed engineering plans. The project will involve planning, engineering, design, permitting, and budget development for a shovel-ready project to restore approximately 70 acres of coastal wetlands within Pierce Marsh. While only 38.48 acres of marsh restoration are required to compensate for damages at the Site, this action contributes to a larger 70-acre habitat creation opportunity that will mitigate for environmental injuries from other cases. Any steps prior to construction are not expected to reduce the anticipated benefits of the project or affect the analyses conducted for ESA, EFH, or NEPA.

7.1.1.1 Restoration Site Description

Pierce Marsh, a 2,346-acre area located on the north shore of West Galveston Bay (Figure 6-1), was once part of Basford Lake, a salt marsh crisscrossed with channels and rich with fish and wildlife. Gradually, Pierce Marsh became inundated due to subsidence and much of that wildlife was lost. Since the late 1990s, several distinct marsh restoration activities, including marsh terracing and dredged material beneficial use, improved over 400 acres at the site. There is additional capacity within dredge material containment levees constructed for a recently implemented beneficial use project. This project would afford an opportunity to restore 70 acres of additional intertidal marsh using funds recovered as part of a settlement with the Malone Cooperating Parties. The marsh design will maintain significant edge interface with shallow open water within the containment cells.

7.1.1.2 Restoration Action

The Trustees intend to partner with USACE to use dredge material from the GIWW to increase elevation in open water areas of Pierce Marsh and make them suitable for the establishment and long-term sustainability of a shallow intertidal wetland. Project proponents will engage the services of experienced surveyors, coastal planners, and coastal engineering firms to conduct site assessments and analyses, design restoration plans, complete construction drawings, and prepare lease and permit applications to the State of Texas General Land Office and USACE.

7.1.1.3 Evaluation of Proposed Restoration

The beneficial use of dredged material to transform open water area into shallow coastal wetlands has proven to be a highly effective method of restoring and creating habitat for fish and wildlife, improving water quality and increasing needed storm buffers. Moreover, sediment used for habitat restoration remains in the active sediment system, tempering erosion and retaining existing habitat. Dredged materials are plentiful because of the need to maintain basins in channels for navigation, and the USACE actively supports beneficial use projects whenever feasible. But the proper placement of dredged materials used to restore or create viable wetland habitat is a challenging engineering task. It requires advance planning through careful site selection, preparation of engineering and design plans, environmental compliance, and permitting. Pierce Marsh has been identified as a favorable location for this process. Upon ultimate construction and planting with native marsh vegetation, this project will make a significant contribution to restoring the natural resources, ecosystems, fisheries, marine and wildlife habitats and coastal wetlands of the Gulf Coast region. This project will restore long-term resiliency of the natural resources, ecosystem fisheries, marine and wildlife habitats, and coastal wetlands.

7.1.2 Non-Preferred Alternatives – Marsh

Several projects were evaluated for application to address lost services in the estuarine marsh. The following paragraphs describe each of these projects and why they were not chosen as a preferred alternative project.

7.1.2.1 Non-Preferred Alternative – Kohfeldt Marsh Acquisition

This project would involve acquisition and protection of the area known as Kohfeldt Marsh, located directly north/northwest of the Site. The entire acquisition would consist of 327 acres, including a 50-acre capped municipal landfill and 227 acres of emergent wetlands, shallow ponds and channels, and former marsh areas converted to open water via channelization or shoreline erosion. The Kohfeldt marsh is in close proximity to the Site; however, a portion of the project area would not be included in any calculation of compensatory value. The landfill and open water areas contain contaminated sediments from the MSC Superfund Site, and an additional 49 acres were assessed as having some level of injury from the Tex Tin Superfund Site; as a result, these areas would provide less ecological services and create potential liability issues complicating acquisition.

7.1.2.2 Non-Preferred Alternative – Halls Bayou Acquisition

This project would involve the acquisition and protection of riparian habitat and salt marsh adjacent to Halls Bayou, located in Brazoria and Galveston Counties. Preservation of riparian habitat would contribute to the continued health of the downstream estuarine marsh; however, the Halls Bayou property is located approximately 14 miles from the Site and does not present the same kind of habitat present at Swan Lake; Halls Bayou is more of a riparian fresh water area and not an estuarine marsh complex.

7.1.2.3 Non-Preferred Alternative – Greens Lake Marsh Creation

This project would involve marsh creation using material from maintenance dredging of the adjacent GIWW. There are 50 to 100 acres of subsided and eroded marsh available for potential restoration; however, timing of the restoration action with the USACE operation and the maintenance schedule could prove difficult, and there has been little conceptual project development undertaken.

7.1.2.4 Non-Preferred Alternative – Swan Lake Marsh Restoration

This restoration action involves marsh creation through excavation of fill material overburden and filling of adjacent submerged areas to achieve intertidal elevations (Figure 7-1). Terrestrial uplands would be excavated to elevations similar to adjacent marshes. Some removed soil would be deposited in adjacent shallow open water areas to increase existing elevations to levels that would support emergent wetlands. This action would be expected to provide approximately 45 acres of intertidal flats that will be planted using plugs of smooth cord grass. The goals of this project would be to (1) to increase tidal exchange, thereby increasing the benthic productivity of the project area, and (2) to create an additional 45 acres of sustainable, functionally equivalent brackish marsh.

Building on the existing marsh complex and the use of fill material outside of the existing breakwaters would add to the productivity of the area. The site condition and features present opportunities to create and enhance brackish marsh through the re-establishment of elevations needed to support marsh vegetation and restoration of proper hydrologic exchange, respectively. As in the case of the proposed restoration at Pierce Marsh, optimizing wetland habitat by converting adjacent shallow open water areas to marsh is relatively non-disruptive to existing habitat and organism usage; however, this project is not as cost effective and would result in fewer acres of restored estuarine wetlands than the proposed restoration. If future circumstances allow, this alternative should still be considered a viable project.

Wa Chang Ditch

N

GCWDA

4. Mitigation Marsh

6. Conceptual Marsh / Beneficial Use Site

SWAN LAKE

5. Restoration Marsh

Industrial Canal

2. Mitigation Marsh

3. Breakwater Extension (6,100 LF)

1. Mitigation Breakwater (1,600 LF)

GALVESTON BAY

Source: Comprehensive Swan Lake Restoration Plan, April 2004

Figure 7-1

Comprehensive Swan Lake Restoration Plan

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7.2 Freshwater Wetlands and Pond

7.2.1 Proposed Alternative – Campbell Bayou Freshwater Wetland Restoration

The compensatory restoration alternative proposed by the Trustees following the application of the evaluation criteria presented in Section 6.3 is freshwater wetland restoration at Campbell Bayou (Figure 7-2). The description and analysis of the project below, as well as how the restoration project was scaled to restore natural resource and service injuries, are based on a project-specific preliminary design concept rather than detailed engineering plans. If the alternative is selected in the Final DARP/EA, the project will undergo an elevation survey to evaluate flow directions and watershed divides. This step is not expected to reduce the anticipated benefits of the project or affect the analyses conducted for ESA, EFH, or NEPA.

7.2.1.1 Restoration Site Description

Campbell Bayou is a historic flow channel located near the Site. Figure 7-2 shows the current condition of the area with the enhancement areas outlined and the proximity of the project to the Site. While the Bayou does not appear to have been a perennial flowing bayou prior to development, it acted as a catchment for rainfall runoff of the surrounding prairie and thus provided freshwater emergent wetland habitat for freshwater dependent species. The natural hydrologic regime has been significantly impacted by landscape alterations. The rate of deposition into these wetlands has been accelerated through the accumulation of organic detritus and some mineral sediments. These wetlands will soon become uplands without action. In their current state the wetlands do provide benefits to wildlife; however, their carrying capacity is limited by their restricted productivity. This goal of this project is to enhance the approximate 25 acres of emergent wetlands such that rainfall runoff flows through the wetlands, ensuring an outflow into tidal waters, increasing the volume of freshwater captured by the wetlands and the creation of longer hydro-period wetlands.

7.2.1.2 Restoration Action

The proposed restoration action involves the hydrologic restoration of a freshwater wetland through enhanced water flow and vegetation management. Implementation of this project will involve the following tasks:

- Elevation survey to evaluate flow directions and watershed divides;
- Evaluation of techniques to enhance flows through the wetlands;
    - Minimal levee placement (redirect water back into bayou from previous diversions);
    - Removal of material from the bayou thalweg (e.g., line drawn to join the lowest points along the entire length of the bayou defining its deepest channel) that supports different conditions (i.e., grading rather than ditching);
    - Possibly ditching through upland to re-connect bayou to tidal areas;
- Placement of a connecting culvert;
- Planting of desirable freshwater emergent species that include local and diverse species;
- Removal of invasive plants from surrounding area and from within bayou channel; and

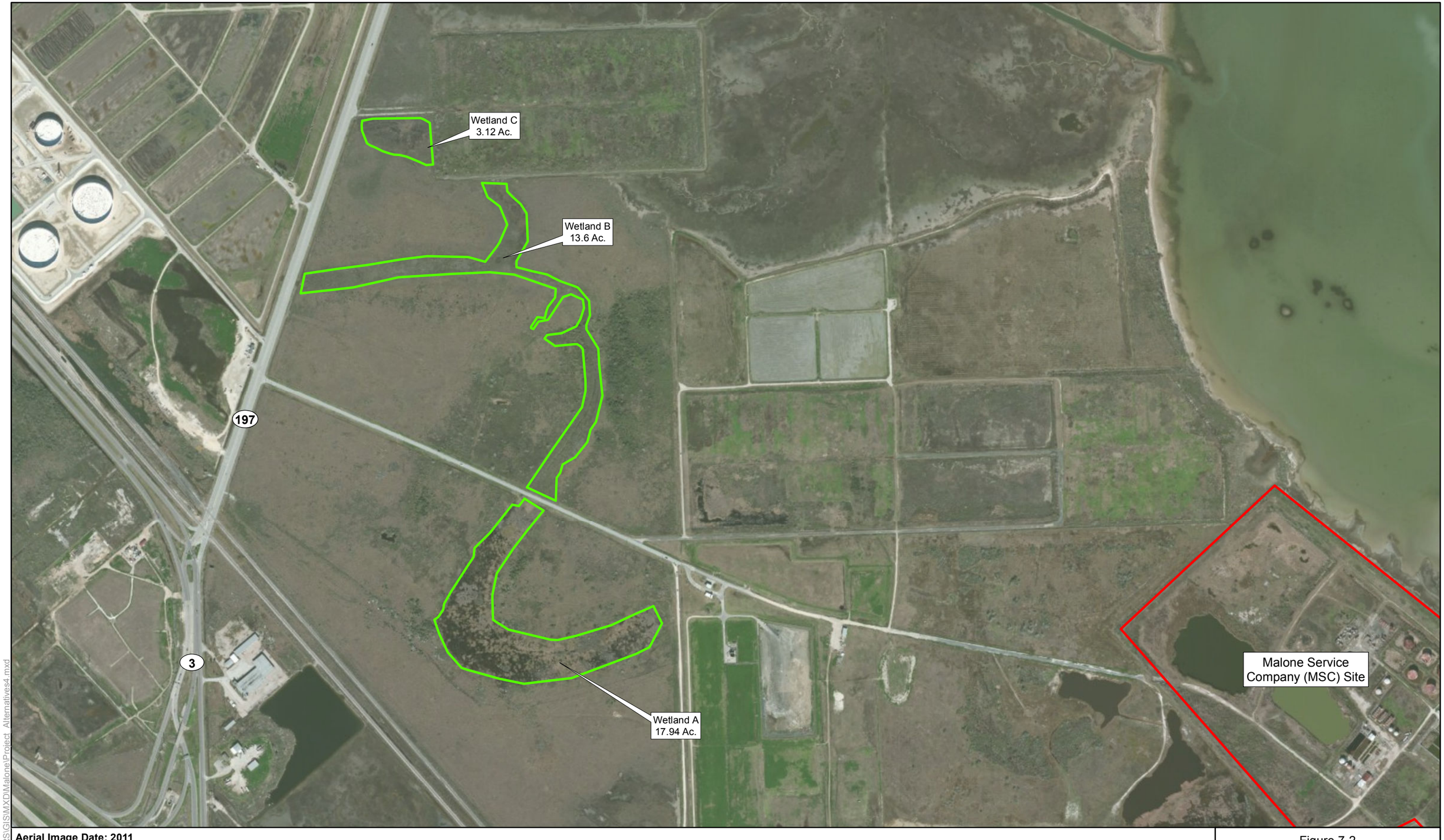

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Figure 7-2

Campbell Bayou
Freshwater Wetland Restoration

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- Monitoring to document performance and to provide relevant information for adaptive management.

The goals of the proposed project are (1) to increase freshwater flow and thereby productivity of the project area, and (2) to create an additional 25 acres of sustainable, functionally equivalent freshwater marsh.

7.2.1.3 Evaluation of Proposed Restoration

Optimizing freshwater wetland habitat by converting a transitional area into productive freshwater wetland is a relatively non-disruptive restoration alternative to existing habitat and organism usage. Freshwater wetland restoration can be implemented in this area without additional land acquisition costs because the restoration site is within property owned by SCENIC GALVESTON, Inc. which is also the future land owner of the Site. Conducting a habitat restoration project within Campbell Bayou will result in a larger area of protected, heterogeneous habitat than would be possible at other locations that are not presently under active conservation.

7.2.2 Non-Preferred Alternatives

Several projects were evaluated for application to address lost services in the freshwater wetlands and on-site freshwater Pond. The following paragraphs describe each of these projects and why they were not chosen as a proposed alternative project.

7.2.2.1 Non-Preferred Alternative – MSC On-site Pond and Off-site Pond Enhancement Following Remediation

This alternative involves enhancement of the existing MSC on-site pond by providing more gradual slope and planting vegetation (aquatic emergent and shoreline) for the pond and possibly connecting it with other ponds located directly west on Gulf Coast Waste Disposal property. This alternative could not be implemented until 2017 following remediation of the Site and the total acreage would ultimately be less than 14 acres. Figure 7-3 shows the MSC on-site pond and the nearby ponds. Additionally, the hydrological connectivity between the off-site ponds and the perched groundwater is unknown. Since a goal of this project would be to maintain water levels in the three ponds, additional groundwater investigation would be necessary.

Aerial Image Date: 2011

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Figure 7-3

On-site and Off-site Freshwater Wetland and Pond Enhancement

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7.2.2.2 Non-Preferred Alternative – Texas City Prairie Preserve Borrow Ditch Enhancement

The Texas City Prairie Preserve (TCPP), owned and managed by The Nature Conservancy, consists of more than 2,300 acres of diverse coastal habitats, including prairies, depressional wetlands, intertidal marshes, and mudflats. TCPP is a regionally important landscape for a variety of wildlife species, including the mottled duck. Mottled ducks are year-round visitors to TCPP. TCPP currently has suitable nesting habitat for this species. However, the availability of low salinity wetlands near the nesting habitat is a potential limiting factor for mottled duck recruitment at TPCC and adjacent lands.

Texas City is a port city situated on the southwest side of Galveston Bay. The Texas City Hurricane Levee, which was constructed between 1962 and 1987, is approximately 17 miles long and encircles Texas City, Moses Lake, and the TCPP. Adjacent and internal to the levee is a borrow ditch. This borrow ditch serves as the north and eastern boundaries of the TCPP. The borrow ditch, which drains a significant amount of rainwater from the grasslands of the TCPP, flows into the northern part of Moses Lake, where it is tidally influenced. The borrow ditch is divided into five segments along its course from State Highway 146 to Moses Lake. Crossing levees separate the borrow ditch into the five segments. Deteriorated and obstructed culverts provide minimal water flow among the segments and eventually into Moses Lake. Salinities and vegetative communities defer from the up-reaches of the borrow ditch down to the opening of Moses Lake. Acting somewhat like a miniature estuary, salinities progressively increase and plant diversity and vigor decrease along the borrow ditch to Moses Lake. Due to restricted water flow from the deteriorated and obstructed culverts, freshwater is impounded in the upper segments (segments 1 and 2) of the borrow ditch, creating dense stands of emergent vegetation that provide little habitat value and create concerns with mosquito production.

This alternative involves management of water levels and salinities within the upper segments of the borrow ditch, specifically Segments 1 and 2. Figure 7-4 shows the borrow ditch and surrounding area. This project would include:

- Removal of silts and sediments from the drainage areas to restore water flow capabilities; and
- Replacement of obsolete and failing culverts with risers to allow collection of freshwater.

Following restoration, this area would be managed as freshwater and intermediate marsh. This enhancement would provide additional habitat for the mottled duck. This alternative would result in 17 acres of habitat, but the footprint would expand in time and there would be additional benefits downstream. Additionally, the location of this project is north of Texas City and not near the Site (Figure 6-1).

7.2.2.3 Non-Preferred Alternative – Virginia Point Peninsula Preserve Restoration of Former Gas Well Exploration Site into Freshwater Wetlands

The Virginia Point Peninsula Preserve is owned by SCENIC GALVESTON, Inc., which is a community-based, all-volunteer habitat conservation service organization and Galveston Bay area land trust. SCENIC GALVESTON, Inc. was formed in 1992 specifically to create a high-visibility marsh preserve along the highway approach to Galveston Island. To meet and extend this goal, SCENIC GALVESTON, Inc. has acquired approximately 3000 acres of emergent

Aerial Image Date: 2011

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Figure 7-4

Texas City Prairie Preserve
Borrow Ditch Enhancement

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inter-tidal salt marsh and coastal prairie, including the Virginia Point Peninsula Preserve, which was acquired in early 2004.

This alternative involves freshwater pond and wetland creation via re-grading of existing containment levees at a 6-acre site. The former gas well exploration site is located adjacent to Galveston Bay shoreline just south of the Site at the terminus of W. Roach Birding Trail. Figure 7-5 shows the former gas well site. Although this project location is near the Site, the total acreage of restoration would not be sufficient to address injury to the freshwater pond and wetlands on the Site.

Aerial Image Date: 2011

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500 250 0 500 Feet

Figure 7-5

Virginia Point Peninsula Preserve
Former Gas Well Exploration

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7.3 Terrestrial Habitat On-site

7.3.1 Proposed Alternative – Removal of Invasive and Exotic Plants with Enhancement of Existing Terrestrial Areas on the Virginia Point Peninsula Point Preserve, including the Former Gas Exploration Site and Adjacent Areas

The compensatory restoration alternative proposed by the Trustees following the application of the evaluation criteria presented in Section 6.2.3 is the combination of removal of invasive plants followed by re-planting and enhancement of currently elevated areas within the Virginia Point Peninsula Preserve. The description and analysis of the project below, as well as how the restoration project was scaled to restore natural resource and service injuries, are based on a project-specific preliminary design concept rather than detailed engineering plans.

7.3.1.1 Restoration Site Description

The Virginia Point Peninsula Preserve is located just south of the Site (see Figure 6-1). This project involves removal of non-native, invasive plants such as the Chinese tallow tree (*Tridica sebifera*), deep-rooted sedge (*Cyperus entrerianus*) and salt cedar (*Tamarix ramosissima*) within the Virginia Point Peninsula Preserve. The project also involves upland habitat enhancement of currently elevated areas within the preserve in which there is existing woody vegetation. Enhancement would consist of reintegration into coastal prairie or tree planting around the former gas exploration site and along an elevated upland birding trail with existing adjacent freshwater borrow areas.

7.3.2 Non-Preferred Alternative – On-site Terrestrial Enhancement

This alternative would be enhancement of any upland areas on the Site following remediation; however, this would likely be limited to any elevated areas that would resist inundation of water and that would have sufficient soil depth to support native woody vegetation. The number of areas and final acreage for this project is unknown. Timing on this alternative is based on the remediation and therefore could not be implemented until 2017.

7.4 Non-Preferred Alternative – No Action

Both CERCLA and NEPA require consideration of a "No Action" alternative. Under the "No Action" alternative, the Trustees would take no action to restore, rehabilitate, replace, or acquire natural resources or services equivalent to those lost due to hazardous substance releases from the Site or the remedial actions taken to prevent further or future harm at the Site. Remedial actions proposed for or undertaken at the Site are of a nature that precludes natural recovery under this option. Interim resource services losses are also not compensated under this option.

The Trustees' natural resources damage assessment indicates benthic resources, oiled wildlife and terrestrial resources were injured due to hazardous substances released from the Site and will be further impacted by planned remedial actions. Response actions undertaken or planned for this Site will not fully allow the injured resource to recover, and these actions will not compensate the public for the resource services lost over time due to the injuries. Such compensation serves to make the public and the environment whole.

CERCLA allows the public to be compensated for such losses based on actions that restore, replace, or provide services equivalent to those lost. Within the Galveston Bay watershed, there are feasible and appropriate opportunities to restore, replace, or provide services equivalent to those lost due to the release of hazardous substances and subsequent benthic, wetland, and upland injury. Under the "No Action" alternative, restoration actions needed to make the environment and public whole for its losses would not occur. This is inconsistent with the goals of the natural resource damage provisions of CERCLA. The Trustees determined that the "No Action" alternative (*i.e.*, no compensatory restoration) should be rejected on this basis; however, as required under CERCLA and NEPA, the No Action alternative is evaluated in this Final DARP/EA.

SECTION 8
NEPA ENVIRONMENTAL CONSEQUENCES ANALYSIS

This section describes the federal Trustees' NEPA analysis of the environmental consequences arising from the proposed actions in terms of both context and intensity for NEPA purposes. For the proposed actions identified in this Final DARP/EA, the appropriate context for considering potential significance of the actions is local as opposed to national or worldwide.

8.1 Marsh

The proposed project involves 70 acres of marsh creation within existing containment cells while maintaining significant marsh edge interface with shallow open water in Pierce Marsh. This action will increase habitat function in Pierce Marsh and will generally provide improved nursery, foraging, and cover habitat for numerous species of fish that utilize fringe marsh, as well as other species that inhabit or utilize interior estuarine marsh and surrounding areas. Aesthetic and recreational benefits would be extended to human using the area.

8.1.1 Environmental and Socio-Economic Impacts Evaluation

Evaluation of the Proposed Project - The environmental and socio-economic impacts of the described restoration action in Pierce Marsh are largely beneficial. This proposed project entails the construction of areas suitable for the establishment of 70 acres of marsh within Pierce Marsh, a publicly protected and managed area. Given the setting and information available, the Trustees do not believe there is any meaningful uncertainty as to potential effects or unknown risks to the environment associated with implementing the selected actions. The proposed actions will benefit the surrounding marshes by restoring landscape continuity and improving landscape-scale hydrology. The increased marsh habitat resulting from this proposed action will also provide improved ecological function and additional areas for birds and other wildlife species to nest, forage, and seek protection.

Existing dredged material containment levees constructed for the 2005 Beneficial Use of Dredged Material (BUDM) project have sufficient capacity to support additional BUDM-constructed intertidal marsh. The marsh design will maintain significant edge interface with shallow open water within the containment cells. Excavation and filling activities associated with the construction of brackish emergent marsh will affect noise levels and the pursuit of recreational activities in the vicinity of the project area. However, these effects will be short-term and are not expected to influence long-term use of the area by the public. Beyond the short-term effects mentioned above, the proposed restoration work is expected to foster and enhance the ecological value and continued public use of the affected portion of Pierce Marsh through the improvements to the environment. Increases in productivity should improve species abundance and diversity and enhance public use of the area, especially for environmental education, recreational fishing, and bird watching. Implementation of this proposed project should not affect the local economy or its citizens; therefore, no socio-economic effects are expected.

Evaluation of the "No Action" Alternative – The NEPA requires consideration of a "no action" alternative. Under this alternative, no direct action would be taken to restore injured natural resources; instead, the natural processes for recovery of the injured natural resources

would be allowed to occur. The principal advantages of this approach are the ease of implementation and cost-effectiveness. This approach relies on the capacity of the ecosystem to "self-heal." While some natural recovery of the injured natural resources in the estuarine marsh adjacent to the Site has likely occurred over time, compensation for significant interim losses would not be provided under the No Action recovery alternative. Losses were suffered in the marsh, and technically feasible, cost-effective alternatives exist to compensate for these loses. Therefore, the no action alternative is not proposed as a compensatory restoration alternative.

8.1.2 Impacts of Proposed Alternative and No Action Alternative

The Trustees evaluated the potential for restoration actions associated with both the proposed and the No Action Alternative to impact the following: the physical environment (air and noise pollution, water quality, geological and energy resources, and contaminants), the biological environment (fisheries, vegetation, wildlife, and endangered species), the cultural and human use environment (environmental justice, recreation, traffic, and cultural resources), and the potential for cumulative impacts.

8.1.2.1 Physical Environment

Air Quality: Minor temporary adverse impacts would result from the proposed construction activities. Exhaust emissions from heavy equipment contain air pollutants, but these emissions would only occur during the construction phase of the project, the amounts would be small, and should be quickly dissipated by prevailing winds. There would be no long-term negative impacts to air quality.

No Action: There would be no negative impacts to air quality from the No Action Alternative.

Water Quality: In the short term, during the period of construction, earth moving activities (either the mining or placement of sediments) will increase turbidity in the immediate vicinity of Pierce Marsh and the adjacent marshes to some degree. Increased suspended sediments can affect benthic filter feeders and young fish by damaging gills and feeding tissues. Submerged aquatic vegetation may be affected by increased light attenuation in the water column. However, the tidal bay ecosystem is adapted to relatively high levels of suspended sediments, and best management practices (containment berms, erosion control, etc.) should be employed to minimize the extent, duration, and intensity of water quality impacts during construction. After construction is completed, the sediments should generally be stable as the material removed from the artificial uplands has already de-watered. Over the longer term, the selected restoration action will re-establish, enhance and increase estuarine marsh at the Site, and help improve local water quality via filtration of larger volumes of water as a result of more frequent exchange. The conversion of marsh habitat to open water habitat in Galveston Bay predicates the demand for the expansion of emergent vegetative communities in the area.

No Action: Under the No Action Alternative, surface water quality benefits anticipated in the greater Galveston Bay ecosystem due to the proposed compensatory actions would not occur.

Noise: Noise associated with earth-moving equipment represents a short-term adverse impact during the construction phase. It may periodically and temporarily disturb wildlife in the immediate vicinity of the site, or cause movement of wildlife away from the site to other

ecologically suitable areas of West Bay in the Galveston Bay Estuary. Similarly, recreating humans may avoid this area due to noise during construction, but as with wildlife, such disruption will be limited to the construction phase, and there are many comparable substitute recreation sites readily available within the general area. No long-term effects would occur as a result of noise during construction.

No Action: There would be no negative impacts to noise from the No Action Alternative.

Geology: The proposed restoration action does not include activities with the potential to directly or indirectly affect, positively or negatively, the geology of the area. The project site is currently comprises open water, artificial uplands, and emergent marsh. These habitats are not unique in the Galveston Bay Estuary. Artificial uplands and open water are displacing highly functional wetland habitat, resulting in a current net loss of habitats and habitat productivity compared to a pre-artificial disturbance condition. The marsh creation would improve wetland habitat function, but would not displace or diminish unique geographic areas. No unique or rare habitat would be destroyed due to project implementation.

No Action: The No Action Alternative would not result in any impacts to the geology of the area.

Energy: No energy production, transport, or infrastructure occurs in the immediate vicinity of Pierce Marsh. Further, none of the components of the proposed action involves activities or potential results that could directly or indirectly affect, positively or negatively, energy production, transport, or infrastructure in this area of coastal Texas.

No Action: The No Action Alternative would not result in any impacts to energy production, transport, or infrastructure.

Contaminants: Marsh creation activities are not expected to have any impacts on public health and safety. The marsh that would result from implementation of the proposed restoration project would not present any unique physical hazards to humans. No pollution or toxic discharges would be associated with marsh creation.

No Action: The No Action Alternative would not result in any contaminants released into the environment.

8.1.2.2 Biological Environment

The proposed project is within Pierce Marsh which is located on the Central Migratory Flyway. The Flyway is within the area encompassed by the Texas Mid-Coast Initiative Area of the Gulf Coast Joint Venture of the North American Waterfowl Management Plan. This area contains high priority populations of wintering ducks as well as shore and wading birds most commonly associated with coastal wetlands. Pierce Marsh is located near nesting islands in West Bay including North Deer Island, and thus serves as an important feeding area during nesting season. Wading birds and shorebirds utilize the mudflats and shallow marsh ponds located throughout the area.

During the active restoration phase of this proposed project, short-term and localized impacts that could occur include increased noise levels from vehicle traffic and use of large equipment. Increases in turbidity within and near the proposed project site during construction are also possible. These effects will be minor and short-term and are not expected to influence long-term

use of the area by wildlife such as wintering ducks, shore birds, or wading birds. Mobile fish and invertebrates would probably not be affected, since these would most likely leave the area and return after project completion. The Trustees do not believe that the proposed project would have a net adverse effect on vegetation and wildlife. There is no wetland vegetation at the proposed project site. Any wildlife that may be present in the area during restoration activities are likely mobile and would move during construction activity. There is adequate habitat adjacent to the area to they would have sufficient space for refuge during operations. Ultimately, the wildlife, invertebrate, and wetland plant communities would be positively impacted by the enhancement of wetland services that would be achieved through the proposed project restoration activities.

Increased turbidity and sedimentation near the project area may affect fish and filter feeders in the local area by clogging gills, increasing mucus production, and smothering organisms found in the shallow open-water area. Mobile fish and invertebrates would probably not be affected, since these would most likely leave the area and return after project completion. Increased noise levels due to the operation of earth-moving equipment would also cause mobile fish to leave the area until operations end. EFH would be positively impacted by the re-establishment and creation of marsh achieved through the proposed restoration action. The areas of marsh serve as habitat for prey species of some of the managed fish as well as provide a nursery for the larvae and juvenile stages of many managed species.

No Action: The Trustees do not believe that the No Action Alternative would have a net adverse effect on vegetation or wildlife. However, Swan Lake near the Site currently provides minimal marsh habitat.

Endangered Species: As noted in the DARP/EA (Section 3.4), several federal and state-listed species may be present in Galveston County. The proposed action is not likely to adversely affect threatened or endangered species or their designated critical habitats. The Trustees will ensure the proposed restoration actions will be in accordance with the ESA via the USACE permitting process. Some listed species, such as the brown pelican, white-face ibis, and bald eagle, would benefit from the restoration projects. Project implementation will be completed prior to migratory bird nesting season. Pierce Marsh is not near a rookery; however, the pipeline route will be managed to minimize disturbance of secretive marsh birds.

No Action: The Trustees do not believe that the No Action Alternative would have a net adverse effect on endangered species. Most of the protected species identified as potentially occurring at or near the Site and the proposed project site would be expected only, or primarily, to forage in the nearby saltmarsh and/or associated surface waters (*e.g.*, sea turtles, brown pelican).

8.1.2.3 Cultural and Human Environment

Environmental Justice: The proposed project does not have the potential to negatively or disproportionately affect minority or low-income populations in the Texas City area, including economically, socially, or in terms of conditions affecting their health. Restoration projects have been implemented in Pierce Marsh previously. The proposed restoration project has no unique attributes or characteristics in that regard. The proposed activities would help restore an environment that is of benefit to all citizens.

No Action: By taking No Action, there would be no enhanced benefits to the public from increased acreage of marsh. The lack of meaningful recovery would contribute negatively to the economic and social well-being of all citizens.

Recreation: The noise and increased turbidity of surface waters arising from earth-moving activities during project construction are expected to discourage and decrease recreational activities such as boating, fishing, and bird watching in the vicinity of the site during construction. Any such affect will be limited to the period of construction and should be minor, as there are many comparable substitute recreation sites readily available within Pierce Marsh. Over the longer term, the proposed restoration action will increase the quality, productivity, and quantity of marsh habitat in this area. The marsh habitat in Pierce Marsh is a foundation for many recreational activities (*e.g.*, fishing, bird watching, etc.) and the improvement in site conditions will enhance opportunities for, and quality of, a variety of recreational uses.

No Action: The No Action Alternative would not implement the proposed actions and therefore would not result in any increased opportunities for recreational use.

Traffic: Land-based equipment traffic will occur at the site during the period of construction. There is little to no other land-based traffic around Pierce Marsh, so no effects on other land-based traffic will occur. Once construction is complete, the added land-based equipment traffic will end. No long-term impacts to traffic in the area are indicated.

No Action: The No Action Alternative would have no effect on traffic in the area.

Cultural Resources: There are no known historic sites or significant cultural, scientific, or historic resources in the area that would be affected by the proposed restoration actions.

No Action: The No Action Alternative would have no effect on cultural resources in the area.

8.1.3 Cumulative Impacts of Proposed Restoration Project

The proposed restoration in Pierce Marsh is expected to result in cumulative, positive impacts by reversing the trend of conversion of estuarine marsh to open water within the greater Galveston Bay ecosystem. The direct effects of the potential project are local; however, the nature of a tidally-influenced estuarine system implies that both benefits and impacts to one area can affect the system on a regional scale. While the project actions would not result in any change in the larger current pattern of hydrologic discharge, boat traffic, economic activity, or land use, the creation of spawning habitat for estuarine fish species may contribute to an improved fishery. The addition of submerged aquatic vegetation and has the direct potential to improve water quality and indirectly through the establishment of filter feeding benthos. The creation and enhancement of wildlife habitat supplements existing habitat in the region, increasing the resiliency of bird and mammal populations that utilize the network of wetlands and wildlife corridors of the greater ecosystem. It is not likely the proposed restoration would have any additive effects to commercial marine vessel traffic, or vice versa, since the marsh creation project is outside of any shipping lane.

Overall, there are likely to be no significant adverse cumulative impacts from the proposed action. A net cumulative beneficial impact may result from the synergy with previous and current restoration efforts, as well as future restoration activities.

The proposed marsh restoration action in Pierce Marsh on the West Bay in the Galveston Bay Estuary included in this Final DARP/EA was considered in light of multiple planning efforts and opportunities in the region. This project builds upon prior and anticipated conservation activities implemented by the Texas natural resource agencies TPWD TCEQ, the Texas GLO, and partnerships and organizations such as the Galveston Bay Estuary Program, the Galveston Bay Foundation, and Ducks Unlimited. Further, the actions selected are intended to compensate the public, *i.e.*, make the public and the environment whole, for resources injuries caused by releases of hazardous substances into the watershed.

8.1.4 Cumulative Impacts of the No Action Alternative

The No Action Alternative is expected to result in cumulative negative impacts and would not provide the conditions necessary for recovery of the injured estuarine marsh. With No Action, key natural resources and services might not ever return to baseline. Marshes maintain the productivity of coastal ecosystems. They provide wildlife with nutrition and refuge from predators. Marsh wetlands can trap, precipitate, transform, recycle, and export waterborne sediments, nutrients, trace metals, and organic waste, and improve the quality of water leaving the marsh (Mitsch and Gosselink, 1993). Marshes are also effective in decreasing storm surge impacts. These ecosystems are increasingly threatened by human activities, such as coastal development, oil and gas exploration, marine transportation, and interruption of sediment cycles as well as natural events such as mean sea level rise, subsidence, catastrophic weather events, and high tides. If the proposed project is not implemented an opportunity would be lost to increase coastal wetlands and degradation of the shoreline will continue.

8.2 Freshwater Wetlands

This proposed project involves restoring approximately 25 acres of emergent wetlands in the Campbell Bayou area and would more than compensate for the 13.97 acres of habitat value lost on the Site. This action will manage rainfall runoff through the wetlands ensuring an outflow into tidal waters, increasing the volume of freshwater captured by the wetlands and the creation of hydro-period wetlands. As a result, areas currently underutilized by wildlife for foraging, nesting, and protection will be enhanced.

8.2.1 Environmental and Socio-Economic Impacts Evaluation

Evaluation of the Proposed Project - The environmental and socio-economic impacts of the described restoration action in Campbell Bayou are largely beneficial. This proposed project entails minimal levee placement, removal of material from the bayou thalweg, ditching, and planting activities. The actions associated with this project could potentially affect noise levels and the pursuit of recreational activities in the vicinity of the project area. However, these effects will be short-term and are not expected to influence long-term use of the area by the public. Beyond the short-term effects mentioned above, the area is expected to foster and enhance the ecological value and continued public use of the affected portion of the area through the improvements to the environment. Increases in productivity should improve species abundance and diversity at the site and enhance public use of the area, especially for environmental education, recreational fishing, and bird watching. Implementation of this project should not affect the local economy or its citizens; therefore, no socio-economic effects are expected. In their current state the wetlands in this area do provide benefits to wildlife; however, their carrying capacity is limited by their restricted productivity. Given the setting and information

available, the Trustees do not believe there is any meaningful uncertainty as to potential effects or unknown risks to the environment associated with implementing the proposed actions.

Evaluation of the "No Action" Alternative – The NEPA requires consideration of a "no action" alternative. Under this alternative, no direct action would be taken to restore injured natural resources. Instead, the natural processes for recovery of the injured natural resources would be allowed to occur. The principal advantages of this approach are the ease of implementation and cost-effectiveness. This approach relies on the capacity of the ecosystem to "self-heal;" however, remediation on the Site will likely limit the accumulation of freshwater and therefore the development of freshwater wetlands. Compensation for significant interim losses would not be provided under the No Action recovery alternative. Losses were suffered in the on the Site and technically feasible, cost-effective alternatives exist to compensate for these loses. Therefore, the no action alternative is not proposed as a compensatory restoration alternative.

8.2.2 Impacts of Proposed Alternative and No Action Alternative

The Trustees evaluated the potential for restoration actions associated with both the proposed and the No Action Alternative to impact the following: the physical environment (air and noise pollution, water quality, geological and energy resources, contaminants), the biological environment (fisheries, vegetation, wildlife and endangered species), the cultural and human use environment (environmental justice, recreation, traffic, and cultural resources), and the potential for cumulative impacts.

8.2.2.1 Physical Environment

Air Quality: Minor temporary adverse impacts would result from the selected construction activities. For example, earth moving equipment may be used to regrade an area, levee placement, or removal of material from the bayou. Exhaust emissions from this equipment contain air pollutants, but these emissions would only occur during the construction phase of the project, the amounts would be small, and should be quickly dissipated by prevailing winds. There would be no long-term negative impacts to air quality.

No Action: There would be no negative impacts to air quality from the No Action Alternative.

Water Quality: In the short term, during the period of construction, earth moving activities will increase turbidity in the area. The time period of construction is expected to be only a few weeks as minimal levee placement, removal of material from the bayou and placement of a culvert are not time intensive activities. After construction, regarding, and ditching is completed, water quality will significantly improve. Over the longer term, the selected restoration action will re-establish, enhance and increase the acreage of freshwater wetlands, and help improve local water quality via filtration of larger volumes of water as better management of rainfall will be in place.

No Action: Under the No Action Alternative, surface water quality benefits anticipated in the Campbell Bayou due to the proposed compensatory actions would not occur. As sedimentation continues to occur in the Campbell Bayou area, freshwater wetlands and ponded areas would become less over time till the area became only upland habitat. Freshwater wetlands would not be present on the Site following remediation. Under the No Action Alternative there would be no compensation of additional freshwater wetlands in the area.

Noise: Noise associated with earth-moving equipment represents a short-term adverse impact during the construction phase. It may periodically and temporarily disturb wildlife in the immediate vicinity. No long-term effects would occur as a result of noise during construction.

No Action: There would be no negative impacts to noise from the No Action Alternative.

Geology: The project site is currently comprises open wetlands and transitional upland areas in Campbell Bayou. These habitats are not unique to the area. Freshwater wetland restoration would improve wetland habitat function, but would not displace or diminish unique geographic areas. No unique or rare habitat would be destroyed due project implementation.

No Action: The No Action Alternative would not result in any impacts to the geology of the area.

Energy: No energy production, transport, or infrastructure occurs in the immediate vicinity of Campbell Bayou. Further, none of the components of the proposed action involves activities or potential results that could directly or indirectly affect, positively or negatively, energy production, transport, or infrastructure in this area of coastal Texas.

No Action: The No Action Alternative would not result in any impacts to energy production, transport, or infrastructure.

Contaminants: Freshwater wetlands restoration activities are not expected to have any impacts on public health and safety. No pollution or toxic discharges would be associated with wetlands creation.

No Action: The No Action Alternative would not result in any contaminants released into the environment.

8.2.2.2 Biological Environment

During the active restoration phase of this proposed project, short-term and localized impacts that could occur include increased noise levels from vehicle traffic and use of large equipment. Increases in turbidity within and near the proposed project site during construction are also possible. These effects will be minor and short-term and are not expected to influence long-term use of the area by wildlife such as wintering ducks, shore birds, or wading birds. The Trustees to not believe that the proposed project would have a net adverse effect on vegetation and wildlife. There is limited wetland vegetation at the proposed project site. Any wildlife that may be present in the area during restoration activities are likely mobile and would move during construction activity. There is adequate habitat adjacent to the area to they would have sufficient space for refuge during operations. Ultimately the wildlife, invertebrate, and wetland plant communities would be positively impacted by the enhancement of freshwater wetland services that would be achieved through the proposed project restoration activities.

No Action: The No Action Alternative would have a net adverse effect on vegetation or wildlife. As sedimentation continues to occur in the Campbell Bayou area, freshwater wetlands and ponded areas would become less over time till the area became only upland habitat. Freshwater wetlands would not be present on the Site following remediation. Under the No Action Alternative there would be no compensation of additional freshwater wetlands in the area.

Endangered Species: As noted in the DARP/EA (Section 3.4), several federal and state-listed species may be present in Galveston County. The proposed action - creation of freshwater wetlands within Campbell Bayou - is not likely to adversely affect threatened or endangered species or their designated critical habitats. The Trustees will confer with the USFWS and NOAA's NMFS concurrent with public review of the Final DARP/EA to ensure the proposed restoration actions will be in accordance with the ESA. Some listed species, such as the white-face ibis and bald eagle, would benefit from the restoration projects. None the less, project implementation will be completed prior to migratory bird nesting season.

No Action: The Trustees do not believe that the No Action Alternative would have a net adverse effect on endangered species. Most of the protected species identified as potentially occurring at or near the Site or nearby Campbell Bayou area would be expected only, or primarily, to forage in the nearby saltmarsh and/or associated surface waters (*e.g.*, sea turtles, brown pelican).

8.2.2.3 Cultural and Human Environment

Environmental Justice: The proposed project does not have the potential to negatively or disproportionately affect minority or low-income populations in the Texas City area, including economically, socially or in terms of conditions affecting their health. Restoration projects have been implemented or are planned in the Campbell Bayou area. The proposed restoration project has no unique attributes or characteristics in that regard. The proposed activities would help restore an environment that is of benefit to all citizens.

No Action: By taking No Action, there would be no enhanced benefits to the public from increased acreage of marsh. The lack of meaningful recovery would contribute negatively to the economic and social well-being of all citizens.

Recreation: The noise and increased turbidity of surface waters arising from earth-moving activities during project construction are expected to discourage and decrease recreational activities in the vicinity of the site during construction. Any such affect will be limited to the short time period of construction and should be minor. Over the longer term, the selected restoration action will increase the quality, productivity, and quantity of freshwater wetland habitat. The restored freshwater wetland habitat in Campbell Bayou will provide a foundation for many recreational activities (*e.g.*, bird watching) and the improvement in site conditions will enhance opportunities for, and quality of, a variety of recreational uses.

No Action: The No Action Alternative would not implement the proposed actions and therefore would not result in any increased opportunities for recreational use.

Traffic: Land-based equipment traffic will occur at the Virginia Point Peninsula Point Preserve during the period of plant removal and replanting for transportation of materials. Once replanting is complete, the added land-based equipment traffic will end. No long-term impacts to traffic in the area are indicated.

No Action: The No Action Alternative would have no effect on traffic in the area.

Cultural Resources: There are no known historic sites or significant cultural, scientific, or historic resources in the area that would be affected by the proposed restoration actions.

No Action: The No Action Alternative would have no effect on cultural resources in the area.

8.2.3 Cumulative Impacts of Proposed Restoration Project

The proposed alternative is expected to result in cumulative, positive impacts by increasing the area and ecological function of freshwater wetland habitat. While the project actions would not result in any change in the larger current pattern of hydrologic discharge, economic activity or land use, the creation of freshwater wetlands would contribute to the overall ecological health of the area. The addition of wetland vegetation and has the direct potential to improve water quality and indirectly through the establishment of filter feeding benthos. The creation and enhancement of wildlife habitat supplements existing habitat in the region, increasing the resiliency of bird and mammal populations that utilize the network of wetlands and wildlife corridors of the greater ecosystem. Overall, there are likely to be no significant adverse cumulative impacts from the proposed action. A net cumulative beneficial impact may result from the synergy with previous and current restoration efforts, as well as future restoration activities. Further, the actions selected are intended to compensate the public, *i.e.*, make the public and the environment whole, for resources injuries caused by releases of hazardous substances into the watershed.

8.2.4 Cumulative Impacts of the No Action Alternative

The No Action Alternative is expected to result in cumulative, negative impacts and would not provide the conditions necessary for recovery of the injured freshwater wetlands. With No Action, key natural resources and services might not ever return to baseline. The natural hydrologic regime of the proposed project area has been significantly altered and an accelerated rate of deposition into the existing wetlands is occurring. These wetlands will soon become uplands within inclusion of some enhancement. Approximately 25 acres of freshwater wetlands can be gained by some relatively simple activities thus ensuring an outflow of freshwater into tidal waters, increasing the volume of freshwater captured by the wetlands and the creation of longer hydro-period wetlands. If the proposed project is not implemented an opportunity would be lost to increase coastal wetlands and degradation of Campbell Bayou will continue. Additionally, the public would not be compensated for the loss of freshwater wetlands associated with the Site.

8.3 Terrestrial

This project involves removal of non-native, invasive plants within the Virginia Point Peninsula Preserve. The project also involves upland habitat enhancement of currently elevated areas within the preserve in which there is existing woody vegetation. Enhancement would consist of reintegration into coastal prairie or tree planting around the former gas exploration site and along elevated upland birding trail with existing adjacent freshwater borrow areas.

8.3.1 Environmental and Socio-Economic Impacts Evaluation

Evaluation of the Proposed Project - Removal of invasive plants and planting activities associated with this project could potentially affect noise levels and the pursuit of recreational activities in the vicinity of the project area. However, these effects will be short-term and are not expected to influence long-term use of the area by the public. Beyond the short-term effects mentioned above, the area is expected to foster and enhance the ecological value and continued public use of the affected portion of the area through the improvements to the environment.

Increases in productivity should improve species abundance and diversity at the site and enhance public use of the area, especially for environmental education, recreational fishing, and bird watching. Implementation of this project should not affect the local economy or its citizens; therefore, no socio-economic effects are expected.

The project site is within the Virginia Point Peninsula Point Preserve, a protected and managed area. Given the setting and information available, the Trustees do not believe there is any meaningful uncertainty as to potential effects or unknown risks to the environment associated with implementing the proposed actions. The characteristics of the upland areas on the Virginia Point Peninsula Point Preserve are not unique. No unique or rare habitat would be destroyed due project implementation. The enhanced upland habitat resulting from this action will provide improved (from current conditions) areas for birds and other wildlife species to nest, forage, and seek protection.

Evaluation of the "No Action" Alternative – The NEPA requires consideration of a "no action" alternative. Under this alternative, no direct action would be taken to restore injured natural resources. Instead, the natural processes for recovery of the injured natural resources would be allowed to occur. The principal advantages of this approach are the ease of implementation and cost-effectiveness. This approach relies on the capacity of the ecosystem to "self-heal". Compensation for significant interim losses would not be provided under the No Action recovery alternative. Losses were suffered in the on the Site and technically feasible, cost-effective alternatives exist to compensate for these loses. Therefore, the no action alternative is not proposed as a compensatory restoration alternative.

8.3.2 Impacts of Proposed Alternative and No Action Alternative

The Trustees evaluated the potential for restoration actions associated with both the proposed and the No Action Alternative to impact the following: the physical environment (air and noise pollution, water quality, geological and energy resources, contaminants), the biological environment (fisheries, vegetation, wildlife and endangered species), the cultural and human use environment (environmental justice, recreation, traffic, and cultural resources), and the potential for cumulative impacts.

8.3.2.1 Physical Environment

Air Quality: There are no construction activities associated with this action; therefore, there would be no short or long-term impacts to air quality. Equipment (e.g., pick-up trucks) may be used to transport plants in and out of the preserve during implementation.

No Action: There would be no negative impacts to air quality from the No Action Alternative.

Water Quality: There should be no short- or long-term changes in water quality as a result of this action.

No Action: There would be no negative impacts to water quality from the No Action Alternative.

Noise: Noise associated with removal of invasive plants and replanting is expected to be minimal. The presence of field crews may temporarily disturb wildlife in the immediate vicinity. No long-term effects would occur as a result of noise during construction.

No Action: There would be no negative impacts to noise from the No Action Alternative.

Geology: The proposed restoration action does not include activities with the potential to directly or indirectly affect, positively or negatively, impact the geology of the area.

No Action: The No Action Alternative would not result in any impacts to the geology of the area.

Energy: No energy production, transport, or infrastructure occurs in the immediate vicinity of the Virginia Point Peninsula Point Preserve.

No Action: The No Action Alternative would not result in any impacts to energy production, transport, or infrastructure.

Contaminants: Upland restoration activities are not expected to have any impacts on public health and safety. No pollution or toxic discharges would be associated with the enhancement of upland vegetation placement.

No Action: The No Action Alternative would not result in any contaminants released into the environment.

8.3.2.2 Biological Environment

During the active restoration phase of this proposed project, short-term and localized impacts that could occur include increased noise levels from vehicle traffic used to transport crews to the areas of restoration and carry equipment. These effects will be minor and short-term and are not expected to influence long-term use of the area by wildlife such as small birds and mammals. The Trustees do not believe that the proposed project would have a net adverse effect on vegetation and wildlife. Any wildlife that may be present in the area during restoration activities are likely mobile and would move during removal of nonnative plants and replanting activity. There is adequate habitat adjacent to the area to they would have sufficient space for refuge during operations. Ultimately the wildlife, invertebrate, and upland plant communities would be positively impacted by the enhancement of terrestrial services that would be achieved through the proposed project restoration activities.

The Trustees do not believe that the No Action Alternative would have a net adverse effect on vegetation or wildlife.

Endangered Species: As noted in the DARP/EA (Section 3.4), several federal and state-listed species may be present in Galveston County. The proposed action - creation of native upland terrestrial areas - is not likely to adversely affect threatened or endangered species or their designated critical habitats. The Trustees will confer with the USFWS and NOAA's NMFS concurrent with public review of the Final DARP/EA to ensure the proposed restoration actions will be in accordance with the ESA.

No Action: The Trustees do not believe that the No Action Alternative would have a net adverse effect on endangered species. Most of the protected species identified as potentially occurring at or near the Site would be expected only, or primarily, to forage in the adjacent saltmarsh and/or associated surface waters (*e.g.*, sea turtles, brown pelican).

8.3.2.3 Cultural and Human Environment

Environmental Justice: The proposed project does not have the potential to negatively or disproportionately affect minority or low-income populations in the Texas City area, including economically, socially or in terms of conditions affecting their health. Restoration projects have been implemented in the Virginia Point Peninsula Preserve. The proposed restoration project has no unique attributes or characteristics in that regard. The proposed activities would help restore an environment that is of benefit to all citizens.

No Action: By taking No Action, there would be no enhanced benefits to the public from increased acreage of native uplands. The lack of meaningful recovery would contribute negatively to the economic and social well-being of all citizens.

Recreation: The restoration of upland areas on the Virginia Point Peninsula Point Preserve could enhance the current level of recreation experienced because of the placement of native vegetation and therefore increased wildlife use.

No Action: The No Action Alternative would not implement the proposed actions and therefore would not result in any increased opportunities for recreational use.

Traffic: Land-based equipment traffic will occur at the Virginia Point Peninsula Preserve during the period of plant removal and replanting with natives. Once planting is complete, the added land-based equipment traffic will end. No long-term impacts to traffic in the area are indicated.

No Action: The No Action Alternative would have no effect on traffic in the area.

Cultural Resources: There are no known historic sites or significant cultural, scientific, or historic resources in the area that would be affected by the proposed restoration actions. No federally recognized Texas Tribes or cultural, scientific, or historic resources are known to be located in the vicinity of the projects. Discussions with a State Historic Preservation Officer on March 12, 2015, requesting further information on a Civil War Fort located on the Virginia Point Peninsula Point Preserve resulted in a determination that the Civil War Fort is under water and not on the upland portion of the preserve; therefore, enhancement of upland terrestrial areas on the Virginia Point Peninsula Point Preserve will not impact the Civil War Fort.

No Action: The No Action Alternative would have no effect on cultural resources in the area.

8.3.3 Cumulative Impacts of Proposed Restoration Project

The proposed alternative is expected to result in cumulative, positive impacts by increasing the area and ecological function of native plant communities. While the project actions would not result in any change in the larger current pattern of economic activity or land use, the creation of native upland plant communities would contribute to the overall ecological health of the area. The creation and enhancement of wildlife habitat supplements existing habitat in the region, increasing the resiliency of bird and mammal populations that utilize the network of native plants and wildlife corridors of the greater ecosystem. Overall, there are likely to be no significant adverse cumulative impacts from the proposed action. A net cumulative beneficial impact may result from the synergy with previous and current restoration efforts, as well as future restoration

activities. Further, the actions selected are intended to compensate the public, *i.e.*, make the public and the environment whole, for resources injuries caused by releases of hazardous substances into the watershed.

8.3.4 Cumulative Impacts of the No Action Alternative

The No Action Alternative is expected to result in cumulative, negative impacts and would not provide the conditions necessary for recovery of the terrestrial uplands. With No Action, key natural resources and services might not ever return to baseline. If the proposed project is not implemented an opportunity would be lost to increase native upland plant community in the area. Additionally, the public would not be compensated for the loss of uplands associated with the Site.

SECTION 9
COMPLIANCE WITH OTHER KEY STATUTES; REGULATIONS AND POLICIES

The major federal environmental statute that guides the restoration of the injured resources and lost services for the Site is CERCLA. This statute sets forth a specific process for injury assessment and restoration planning, including public review. Additionally, the Trustees must comply with several additional federal, state, and local applicable statutes, regulations, and policies. Relevant, and potentially relevant, statutes, regulations, and policies are discussed below.

In addition to compliance with these statutes and regulations, the Trustees should consider relevant environmental or economic programs or plans that are ongoing or planned in or near the affected environment, and they should ensure that restoration projects neither impede nor duplicate such programs or plans. By coordinating restoration projects identified in this document with other relevant restoration programs and plans, the Trustees can enhance the overall effort to restore and improve the environment and resources affected by the Site.

Several of the restoration actions identified in this Final DARP/EA involve activities conducted in wetlands and waters of the United States. Therefore, these activities are subject to review and approval by the appropriate regulatory agencies. Compliance with other key statutes, regulations, and policies are presented in the following subsections.

9.1 Coastal Barrier Resources Act, 16 U.S.C. §§ 3501 *et seq.*

This Act designates various undeveloped coastal barrier islands for inclusion in the Coastal Barrier Resources System (areas adjacent to or contiguous with lands managed for conservation purposes). The Act also assigns various mapping and study requirements to the Secretary of the Interior and creates a Departmental Coastal Barriers Task Force. The United States Fish and Wildlife Service was assigned the responsibility to implement provisions of this Act. Swan Lake is in the coastal barrier resource system.

9.2 Clean Air Act, 42 U.S.C. §§ 7401 *et seq.*

The CAA is the primary federal statute for controlling air pollution in the United States. Both stationary sources of air pollution (e.g., factories, power generation facilities, etc.) and mobile sources (e.g., automobiles, trucks, backhoes) are regulated under the Act. As a result, the requirements of the CAA may apply to both the construction and operation of a pipeline infrastructure project, with the applicability of various requirements determined by a variety of factors, including the nature of the pipeline and associated infrastructure, the construction techniques used, and the existing air quality in the vicinity of the project. The construction of pipelines and related infrastructure can also trigger a variety of CAA requirements due to air emissions – principally diesel emissions – from equipment used in the construction of the project.

9.3 Bald and Golden Eagle Protection Act, 16 U.S.C. §§ 668-668c

The Bald and Golden Eagle Protection Act, enacted in 1940, and amended several times since then, prohibits anyone, without a permit issued by the Secretary of the Interior, from "taking" bald eagles, including their parts, nests, or eggs. The Act provides criminal penalties for persons who "take, possess, sell, purchase, barter, offer to sell, purchase or barter, transport, export or import, at any time or any manner, any bald eagle ... [or any golden eagle], alive or dead, or any part, nest, or egg thereof." The Act defines "take" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb." In addition to immediate impacts, this definition also covers impacts that result from human-induced alterations initiated around a previously used nest site during a time when eagles are not present, if, upon the eagle's return, such alterations agitate or bother an eagle to a degree that interferes with or interrupts normal breeding, feeding, or sheltering habits, and causes injury, death or nest abandonment.

9.4 Federal Water Pollution Control Act (Clean Water Act), 33 U.S.C. §§ 1251 *et seq.*, and the Rivers and Harbors Act of 1899, 33 U.S.C. §§ 401 *et seq.*

The Rivers and Harbors Act (RHA) regulates development and use of the nation's navigable waterways. Section 10 of the Act prohibits unauthorized obstruction or alteration of navigable waters and vests the U.S. Army Corps of Engineers with authority to regulate discharges of fill and other materials into such waters. Restoration actions that must comply with the substantive requirements of CWA Section 404 must also comply with the substantive requirements of Section 10. Compliance with the RHA is addressed as part of the CWA Section 404 permitting process.

9.5 Coastal Zone Management Act, 16 U.S.C. §§ 1451 *et seq.*

The goal of the Coastal Zone Management Act (CZMA) is to encourage states to preserve, protect, develop, and, where possible, restore and enhance the nation's coastal resources. Section 1456 of the CZMA requires that any federal action inside or outside of the coastal zone be consistent, to the maximum extent practicable, with the enforceable policies of a state's federally approved Coastal Zone Management Program. Regulations adopted under the CZMA outline procedures applicable to determining the consistency of federal actions with state approved plans. The Trustees believe the restoration action proposed in Section 6 of this Final DARP/EA is consistent with the Texas CZMA Program. NOAA and USFWS – the involved federal trustee agencies - will be submitting this determination to the Texas Natural Resource Trustees for review and concurrence.

9.6 Endangered Species Act of 1973, 16 U.S.C. §§1531 *et seq.*

The ESA requires federal agencies to conserve endangered and threatened species and to conserve the ecosystems upon which these species depend. Numerous endangered and threatened species are seasonal or occasional visitors to the Galveston Bay Estuary coastal ecosystem (the Estuary). Most species would be present in the Estuary incident to migration through the area. None of these species were considered to be at risk of direct injury due to the discharge of hazardous substances from the Site. The Estuary's habitats provide general support for any threatened and endangered species migrating through or utilizing these communities.

The potential occurrence of federally and/or state listed threatened or endangered wildlife species in the vicinity of the Site is summarized in Table 3-1, based on recent county list maintained by the Texas Parks and Wildlife Department. Of the 24 bird, mammal, and reptile species listed for Galveston County by the agencies, at least 11 (three reptiles and eight birds) may occur in one or both of the local habitats for sufficient periods to incur some level of dietary exposure to contaminants. One of the species, the Attwater's greater prairie-chicken (*Tympanuchus cupido attwateri*), is not likely to occur in the immediate vicinity of the site currently.

Most of the protected species identified as potentially occurring at or near the Site would be expected only, or primarily, to forage in the adjacent saltmarsh and/or associated surface waters (*e.g.*, sea turtles).

9.7 Fish and Wildlife Conservation Act, 16 U.S.C. §§ 2901 *et seq.*

This Act encourages all federal agencies to use their statutory and administrative authorities, to the maximum extent practicable and consistent with their statutory responsibilities, to conserve and to promote the conservation and protection of non-game fish and wildlife species and their habitats. The proposed restoration action will promote and conserve, and will have no adverse effect on, fish and bird habitat, including non-game fish and wildlife and their habitat.

9.8 Fish and Wildlife Coordination Act, 16 U.S.C. §§ 661 *et seq.*

The Fish and Wildlife Coordination Act (FWCA) requires that federal agencies consult with the USFWS, NOAA's NMFS, and state wildlife agencies regarding activities that affect, control, or modify waters of any stream or bodies of water, to minimize the adverse impacts of such actions on fish and wildlife resources and habitat. For restoration projects that move significant amounts of material into or out of coastal waters or wetlands, such as the restoration project proposed herein, these consultations are generally incorporated into the process of complying with Section 404 of the CWA, the RHA, or other required federal, permit, license, review or consultation requirements.

The Trustees coordinated directly with the USFWS, NMFS, and TPWD (the appropriate state wildlife agency under the FWCA) to develop the restoration plan proposed herein and believe the proposed restoration projects will have a positive effect on fish and wildlife resources.

9.9 Magnuson-Stevens Fishery Conservation and Management Act, as Amended and Reauthorized by the Sustainable Fisheries Act (Public Law 104-297) (Magnuson-Stevens Act), 16 U.S.C. §§1801 *et seq.*

The Magnuson-Stevens Act, as amended and reauthorized by the Sustainable Fisheries Act (Public Law 104-297), established a program to promote the protection of EFH through review of projects that affect or have the potential to affect such habitat that are conducted under federal permits, licenses, or other authorities. Once EFH is identified and described in fishery management plans by the appropriate fishery management council(s), federal agencies are obliged to consult with the Secretary of Commerce, via consultation with NOAA's NMFS with respect to any action proposed to be authorized, funded, or undertaken by such agency that *may* adversely impact any EFH.

The Trustees do not believe the proposed restoration projects will result in net adverse impact on any EFH designated under the Act; however, this will be considered during the USACE permit process currently underway.

9.10 Marine Mammal Protection Act, 16 U.S.C. §§ 1361 *et seq.*

The Marine Mammal Protection Act provides authority for the long-term management and protection of marine mammals, including maintenance of their ecosystem. It establishes a moratorium on the taking and importation of marine mammals and marine mammal products, with limited exceptions involving scientific research, incidental taking, subsistence activities by Alaskan natives, and hardship. The proposed restoration actions are not expected to affect any marine mammals because none are present in the location of the proposed projects.

9.11 Migratory Bird Treaty Act, 16 U.S.C. §§ 703 – 712

The Migratory Bird Treaty Act provides for the protection of migratory birds. The proposed restoration actions will have no adverse effect on migratory birds because the projects are not within 1000 feet of a rookery. Additionally, the marsh restoration project would be designed to minimize impacts to secretive marsh birds by minimizing the pipeline. Under the proposed restoration actions, no migratory birds will be pursued, hunted, taken, captured, killed, attempted to be taken, captured or killed, possessed, offered for sale, sold, offered to purchase, purchased, delivered for shipment, shipped, caused to be shipped, delivered for transportation, transported, caused to be transported, carried, or caused to be carried by any means whatever, received for shipment, transported or carried, or exported, at any time, or in any manner. While the Act does not specifically protect the habitats of migratory birds, conditions may be included in project permits (*e.g.*, restricting construction activities to avoid nesting season) to avoid or minimize negative impacts to migratory birds and to ensure compliance with the Act.

9.12 Migratory Bird Conservation Act, 16 U.S.C. §§ 715 *et seq.*

The Act provides authority for the U.S. DOI to acquire and manage lands for conservation of migratory birds. The proposed restoration actions will occur within the Pierce Marsh, Campbell Bayou and the Virginia Point Peninsula Point Preserve lands managed for the conservation of migratory birds and other wildlife. Additionally, the construction phase of the projects will be completed before migratory bird nesting season. The proposed restoration projects will preserve and create habitats important to USFWS efforts to conserve migratory birds and wildlife, consistent with this Act.

9.13 National Historic Preservation Act, 16 U.S.C. §§ 470 *et seq.*, and Archaeological Resources Protection Act, 16 U.S.C. § 470aa-mm

These statutes require federal agencies, or federally funded entities, to consider the impacts of their proposed actions on historic properties and cultural or archeological resources. The proposed restoration projects do not involve and will not occur near any site listed on the National Register of Historic Places and the Trustees have no information indicating there are known sites or properties eligible for listing on the National Register of Historic Places, or any cultural or archeological resources, in the vicinity of the project areas.

No federally recognized Texas Tribes are located in the vicinity of the restoration projects, thus a consultation was not necessary.

9.14 Executive Order Number 11514 (35 Fed. Reg. 4247) – Protection and Enhancement of Environmental Quality

This Executive Order directs federal agencies to monitor, evaluate, and control their activities in order to protect and enhance the quality of the nation's environment, to inform and seek the views of the public about these activities, to share data gathered on existing or potential environmental problems or control methods, and cooperate with other governmental agencies. The proposed projects and the release of this Final DARP/EA are consistent with the goals of this Order. The proposed projects are the product of inter-governmental cooperation and will protect and enhance the environment. The restoration planning process has and continues to provide the public with information about the restoration effort.

9.15 Executive Order 12898 (59 Fed. Reg. 7629) – Environmental Justice

This Executive Order directs federal agencies to identify and address, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority and low-income populations. There are no low-income or ethnic minority communities that would be adversely affected by the proposed projects. The proposed restoration projects will enhance the quality of the environment for all populations.

9.16 Executive Order Number 11988 (42 Fed. Reg. 26,951) – Floodplain Management, as augmented by Executive Order 13690 (80 Fed. Reg. 6,425) -- Establishing a Federal Flood Risk Management Standard and a Process for Further Soliciting and Considering Stakeholder Input

These Executive Orders requires federal agencies to reflect consideration of flood hazards and the natural and beneficial values served by floodplains in carrying out responsibilities involving federally financed or assisted construction and improvements and federal activities and programs affecting land use. While a proposed restoration project will take place within a floodplain, it is consistent with these Orders as it involves activities that will serve only to restore, expand, and preserve the beneficial values of the floodplain.

9.17 Executive Order Number 11990 (42 Fed. Reg. 26,961) – Protection of Wetlands

This Executive Order directs federal agencies to take action to minimize the destruction, loss, or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands in carrying out agency responsibilities for acquiring, managing, and disposing of federal lands and facilities; providing federally undertaken, financed, or assisted construction and improvements; and conducting federal activities and programs affecting land use, including water and related land resources planning, regulating, and licensing activities. The proposed restoration projects are compliant with this Executive Order as they will operate to create additional wetlands, and protect existing wetlands and the services they provide.

9.18 Executive Order Number 12962 (60 Fed. Reg. 30,769) – Recreational Fisheries

This Executive Order directs federal agencies to, among other things, foster and promote restoration that benefits and supports viable, healthy, and sustainable recreational fisheries. The proposed projects will enhance or create habitats that will help support and sustain recreational fisheries in the Lower Galveston Bay watershed

9.19 Executive Order Number 13112 (64 Fed. Reg. 6,183) – Invasive Species

The 1999 Executive Order 13112 requires that all federal agencies whose actions may affect the status of invasive species shall, to the extent practicable and permitted by law, 1) identify such actions, and 2) take actions specified in the Order to address the problem consistent with their authorities and budgetary resources; and 3) not authorize, fund or carry out actions that they believe are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere unless, "pursuant to guidelines that it has prescribed, the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm will be taken in conjunction with the actions." The Trustees do not believe that the proposed restoration projects have the potential to cause or promote the introduction or spread of invasive species. The upland terrestrial proposed project would, in fact, remove invasive species from the Virginia Point Peninsula Preserve.

9.20 Executive Order Number 13186 (66 Fed. Reg. 3,853) – Responsibility of Federal Agencies to Protect Migratory Birds

This Executive Order is a Memorandum of Understanding (MOU) between the U.S. Department of the Interior Bureau of Land Management and the U.S. Fish and Wildlife Service that outlines a collaborative approach to promote conservation of migratory bird populations. The purpose of the MOU is to strengthen migratory bird conservation by identifying and implementing strategies that promote conservation and avoid or minimize adverse impacts on migratory birds through enhanced collaboration. Section VIII part D of the MOU states "The Fish and Wildlife Service shall: provide identified special migratory bird habitats (e.g., migration corridors, stop-over habitats, waterfowl resorts, wintering sites, and ecological conditions important in nesting habitats) to aid in collaborative planning." The proposed freshwater and estuarine marsh projects will restore and enhance habitats that could be used for migratory birds.

9.21 Executive Order Number 13653 (78 Fed. Reg. 66,819) – Preparing the United States for the Impacts of Climate Change

Natural resources are critical to United States' economy, health, and quality of life. Under this 2013 Executive Order, changes are identified that must be made to land- and water-related policies, programs, and regulations to strengthen the climate resilience of our watersheds, natural resources, and ecosystems and the communities and economies that depend on them. Federal agencies will also evaluate how to better promote natural storm barriers such as dunes and wetlands as well as how to protect the carbon sequestration benefits of forests and lands to help reduce the carbon pollution that causes climate change. The proposed projects described in this Final DARP/EA will increase acreage of both estuarine and freshwater wetlands thereby meeting

the intent (e.g., promote natural storm barriers, reducing carbon pollution) of this Executive Order.

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SECTION 10
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