
Falcon Refinery

Ingleside, Texas

EPA Facility ID: TXD086278058

Basin: North Corpus Christi Bay

HUC: 12110201

Executive Summary

The Falcon Refinery site encompasses approximately 42 ha (104 acres) adjacent to Redfish Bay in a mixed residential and industrial area near Ingleside, San Patricio County, Texas. Since 1980, the refinery has been operated intermittently; it is currently being utilized for storage in some remaining tanks. Numerous spills and leaks have occurred at the property as a result of leaking ASTs, drums, and pipelines and accidents during operations. Spills have also occurred in wetlands along the pipeline. Metals, PAHs, and pesticides have been detected in soil and sediment samples collected at the site and downgradient of the site during numerous investigations conducted by state and federal agencies. Surface water runoff and sediment transport are the primary pathways for the migration of contaminants from the site to NOAA trust resources. The habitats of primary concern to NOAA are Redfish Bay on the Intercoastal Waterway and the wetlands surrounding the site. Secondary habitats of concern are Corpus Christi Bay to the south and Aransas Bay to the north. NOAA trust resources that use these habitats include estuarine and marine fish species, invertebrates, and sea turtles.

Site Background

The Falcon Refinery site is a former refinery that encompasses approximately 42 ha (104 acres) adjacent to Redfish Bay in a mixed residential and industrial area near Ingleside, San Patricio County, Texas. The site also includes a loading dock facility on Redfish Bay northeast of the main Falcon Refinery property. The Falcon Refinery property is bordered to the southeast and northeast by wetlands. The wetlands to the northeast are connected to Redfish Bay by a culvert approximately 1.3 km (0.8 mi) downgradient from the main Falcon Refinery property. Redfish Bay connects Corpus Christi Bay to the Gulf of Mexico (Figure 1).

Since 1980, the refinery has been operated intermittently; it is currently being utilized for storage in some remaining tanks. The Falcon Refinery site features included the main processing area, aboveground storage tanks (ASTs), the loading dock facility, several pipelines connecting to the facility to the loading dock and other areas of interest, an aeration pond, a wastewater clarifier, an oil/water separator, and a lab/office building (Figure 2). Drums containing wastes such as caustics, oils, and unidentified materials were also stored on the property. EPA has been overseeing an emergency removal of features which posed an immediate threat to human health and the environment. Containment berms surround the AST areas, although there have been numerous breaches in the berms (TNRCC 2000).

When it was operating, the facility principally refined crude oil into fuel products, including naphtha, jet fuel, kerosene, diesel oil, and fuel oil (TNRCC 2000). In addition, materials containing other hazardous substances were sometimes refined at the facility (USEPA 2002). Crude oil and fuel products were transferred between barges at the loading dock

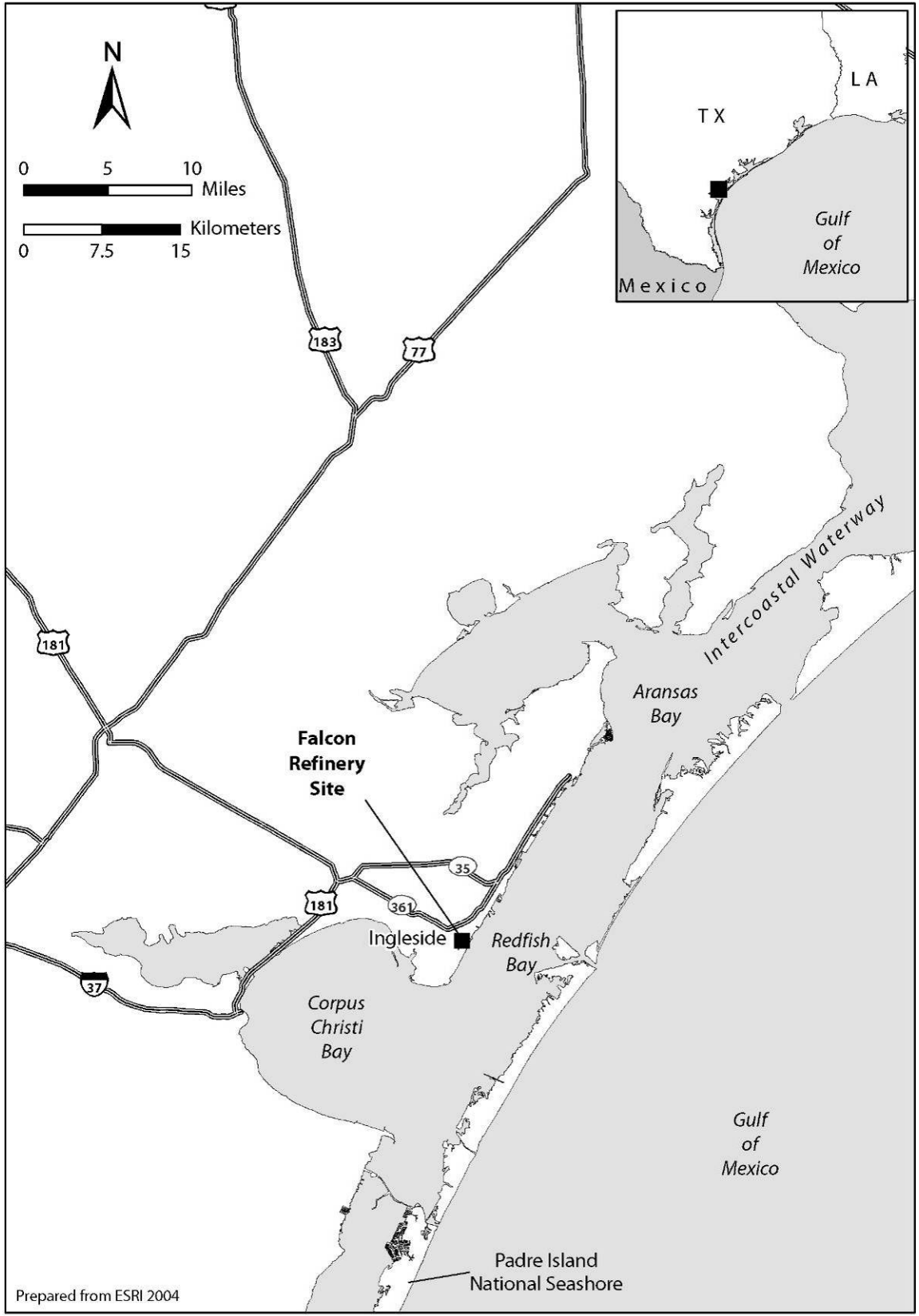


Figure 1. Location of the Falcon Refinery site near Ingleside, Texas.

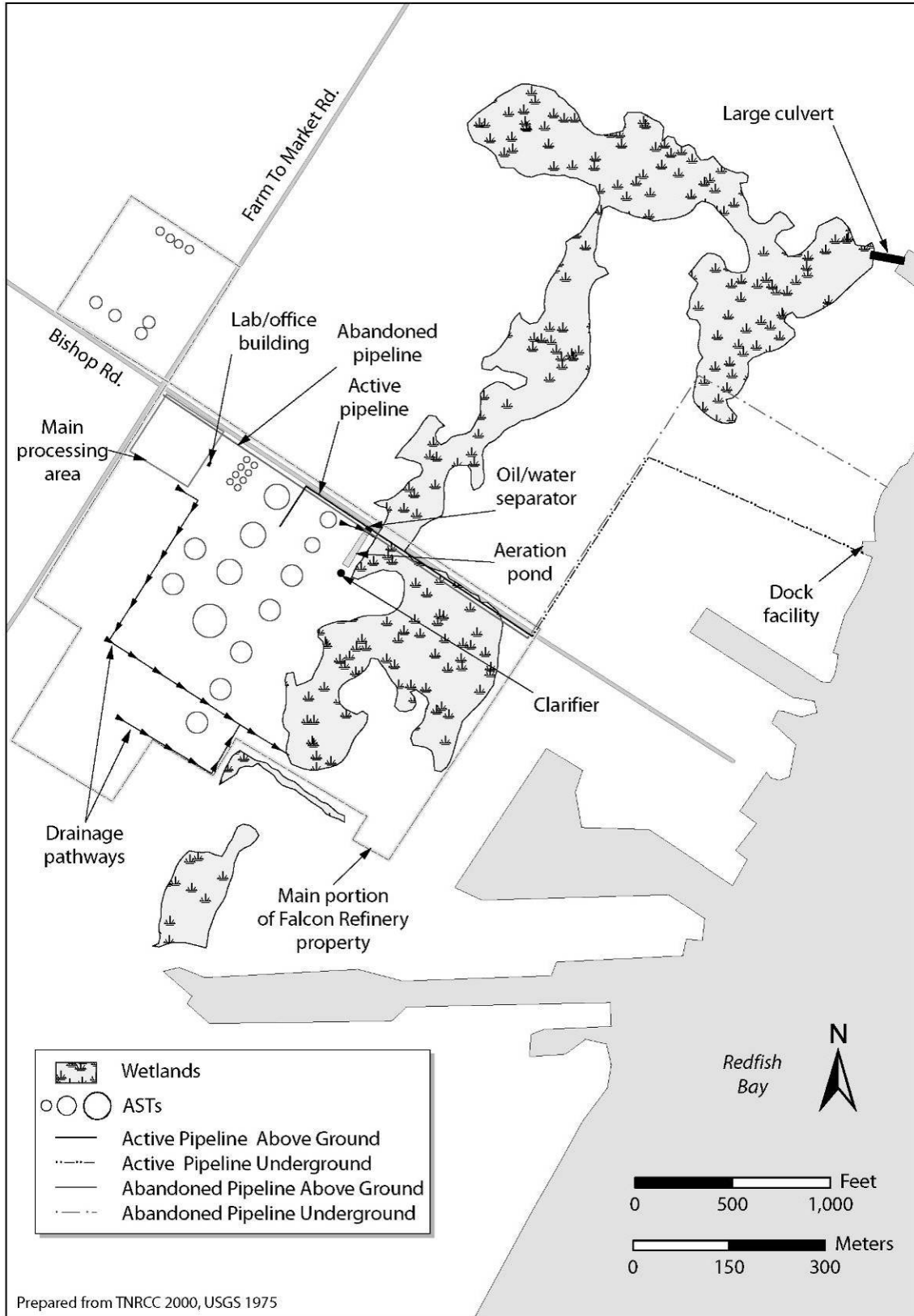


Figure 2. Detail of the Falcon Refinery property.

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and ASTs on the main property via an intricate pipeline system. A section of the pipeline is shown on Figure 2.

Numerous releases of contaminants have occurred at the property as a result of leaking ASTs and drums, leaks in the pipelines, and accidents during operations. Contaminants were also released to wetlands along the pipelines. Wastes from the refining process were periodically dumped on the ground throughout the property. In 1985, the wastewater treatment system was inoperable; during that time, untreated wastewater was placed in ASTs and discharged throughout the bermed AST areas. No other containment structures were present in these areas to prevent the migration of hazardous wastes to the wetlands on the property and downgradient of the property (TNRCC 2000). The aeration pond is lined, but the berms surrounding the pond showed signs of erosion and possible flooding during an investigation conducted by the Texas Natural Resource Conservation Commission (TNRCC) in 2000 (TNRCC 2000). The facility lies within the 100-year floodplain (TNRCC 2002).

Metals, polycyclic aromatic hydrocarbons (PAHs), and pesticides have been detected in soil and sediment samples collected at the site and downgradient of the site during numerous investigations conducted by state and federal agencies. The TNRCC and the U.S. Environmental Protection Agency (USEPA) conducted an expanded site inspection at the Falcon Refinery site in November 2000 and prepared a hazard ranking system package for the site in February 2002. In April 2004, the Texas Department of Health and the Agency for Toxic Substances and Disease Registry completed a public health assessment (ATSDR 2004) for the site. The Falcon Refinery site was proposed to the National Priorities List on September 5, 2002 (USEPA 2006), but was never formally listed.

Surface water runoff and sediment transport are the primary pathways for the migration of contaminants from the site to NOAA trust resources. Information on the groundwater pathway was not available at the time this report was written. Surface water runoff from the Falcon Refinery property drains to on-site wetlands in the southeast portion of the property. The on-site wetlands drain to other wetlands downgradient of the property, which in turn discharge to Redfish Bay via a culvert.

NOAA Trust Resources

The habitats of primary concern to NOAA are Redfish Bay on the Intercoastal Waterway and the wetlands surrounding the site. Secondary habitats of concern are Corpus Christi Bay to the south and Aransas Bay to the north. All three water bodies are considered estuaries of the Gulf of Mexico. Redfish Bay connects Corpus Christi Bay to the Gulf of Mexico approximately 13 km (8 mi) east of the site (Figure 1).

In 2000, the Texas Parks and Wildlife Department (TPWD) created the Redfish Bay State Scientific Area (RBSSA) under the Seagrass Conservation Management Plan. The RBSSA, which encompasses approximately 13,000 ha (32,100 acres), supports habitats that include seagrass beds, oyster reefs, marshes, and mangroves (TPWD 2006a). In addition, the northern portion of Redfish Bay lies within the Mission-Aransas National Estuarine Research Reserve, which was designated by NOAA in 2006 (NOAA 2006; UTMSI 2006a). NOAA trust resources that use these habitats (Table 1) include estuarine and marine fish species, invertebrates, and sea turtles.

Redfish Bay is a shallow, bar-built estuary with water depths ranging from 0.6 to 4 m (2 to 13 ft). Bar-built estuaries are created when an offshore sand bar partially encloses a body of

Table 1. NOAA trust resources present in Redfish, Corpus Christi, and Aransas Bays near the Falcon Refinery site (Nelson 1992; STRP 2006; TPWD 2006b; UTMSI 2006b).

Species		Habitat Use			Fisheries	
Common Name	Scientific Name	Spawning Area	Nursery Area	Adult Habitat	Comm.	Rec.
MARINE/ESTUARINE FISH						
Atlantic croaker	<i>Micropogonias undulatus</i>		♦	♦	♦	♦
Bay anchovy	<i>Anchoa mitchilli</i>	♦	♦	♦		♦
Black drum	<i>Pogonias cromis</i>	♦	♦	♦	♦	♦
Bull shark	<i>Carcharhinus leucas</i>		♦	♦	♦	♦
Code goby	<i>Gobiosoma robustum</i>	♦	♦	♦		
Crevalle jack	<i>Caranx hippos</i>		♦	♦		♦
Florida pompano	<i>Trachinotus carolinus</i>		♦	♦		♦
Gulf killifish	<i>Fundulus grandis</i>	♦	♦	♦		♦
Gulf menhaden	<i>Brevoortia patronus</i>		♦	♦		♦
Hardhead catfish	<i>Ariopsis felis</i>	♦	♦	♦		♦
Pinfish	<i>Lagodon rhomboides</i>		♦	♦		♦
Red drum	<i>Sciaenops ocellatus</i>		♦	♦		♦
Sand seatrout	<i>Cynoscion arenarius</i>	♦	♦	♦		♦
Sheepshead	<i>Archosargus probatocephalus</i>	♦	♦	♦	♦	♦
Sheepshead minnow	<i>Cyprinodon variegatus</i>	♦	♦	♦		♦
Silver perch	<i>Bairdiella chrysoura</i>	♦	♦	♦		♦
Siversides	<i>Menidia species</i>	♦	♦	♦		
Southern flounder	<i>Paralichthys lethostigma</i>		♦	♦	♦	♦
Spot	<i>Leiostomus xanthurus</i>		♦	♦		♦
Spotted seatrout	<i>Cynoscion nebulosus</i>	♦	♦	♦		♦
Striped mullet	<i>Mugil cephalus</i>		♦	♦	♦	♦
INVERTEBRATES						
Atlantic brief squid	<i>Lolliguncula brevis</i>	♦	♦	♦		
Blue crab	<i>Callinectes sapidus</i>	♦	♦	♦	♦	♦
Brown shrimp	<i>Farfante penaeus aztecus</i>		♦	♦	♦	♦
Daggerblade grass shrimp	<i>Palaemonetes pugio</i>	♦	♦	♦		♦
Eastern oyster	<i>Crassostrea virginica</i>	♦	♦	♦	♦	♦
Gulf stone crab	<i>Menippe adina</i>	♦	♦	♦	♦	♦
Hard clam	<i>Mercenaria species</i>	♦	♦	♦		♦
Pink shrimp	<i>Farfante duorarum</i>		♦	♦	♦	♦
White shrimp	<i>Litopenaeus setiferus</i>		♦	♦	♦	♦
SEA TURTLES						
Hawksbill sea turtle	<i>Eretmochelys imbricata</i>		♦	♦		
Kemp's ridley sea turtle	<i>Lepidochelys kempii</i>		♦	♦		
Leatherback sea turtle	<i>Demochelys coriacea</i>		♦	♦		

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water. Wave energy in the bay is low. Salinity levels are relatively high, ranging between 20 and 30 parts per thousand, and support extensive salt marshes and seagrass beds in the bay. Tidal flats and black mangrove stands are found throughout the bay and its islands (NOAA 2006).

Redfish Bay provides spawning, juvenile nursery, and adult habitat for numerous NOAA trust resources. Many of the estuarine and marine fish species listed in Table 1 generally spend their entire lives in estuaries. Resident estuarine species include bay anchovy, black drum, code goby, gulf killifish, hardhead catfish, sand seatrout, sheepshead, sheepshead minnow, silver perch, silversides, and spotted seatrout. These species can tolerate a wide range of salinities and temperatures (Nelson 1992).

Fish species that use the habitat of Redfish Bay for juvenile nursery and adult foraging include Atlantic croaker, crevalle jack, Florida pompano, gulf menhaden, pinfish, red drum, southern flounder, spot, and striped mullet. Adults of these species generally migrate offshore to spawn. After developing in deeper offshore waters, the larvae are transported by ocean currents into estuaries. Redfish Bay also provides juvenile nursery and adult habitat for bull sharks. Bull shark parturition, or birthing, occurs in shallow bays and estuaries. Adult and juvenile bull shark can be found in Redfish Bay from March through November (Nelson 1992).

Several invertebrate species listed in Table 1 are found in Redfish Bay and complete all of their life history cycles in estuaries. These species include Atlantic brief squid, blue crab, daggerblade grass shrimp, eastern oyster, gulf stone crab, and hard clam. Post-larval and juvenile brown, pink, and white shrimp, which generally spawn in offshore spawning grounds, are carried by ocean currents to estuaries after the eggs and larvae develop in deeper waters (Nelson 1992).

Sea turtles, including the hawksbill, leatherback, and Kemp's ridley, use Redfish Bay for nursery and adult habitat. All three sea turtles are listed as endangered under the Endangered Species Act. Nesting generally occurs in Mexico, Central America, and the islands of the Caribbean, although some nesting is known to occur in Texas. In 2006, Kemp's ridley sea turtles and nests were observed at the Padre Island National Seashore, south of Redfish Bay (STRP 2006).

Commercial fishing occurs in Redfish Bay for estuarine and marine fish species, including Atlantic croaker, black drum, bull shark, sheepshead, southern flounder, and striped mullet. In an effort to protect several fish species in the coastal waters of Texas, the TPWD has designated some commercial species as game species and banned their sale. Red drum and spotted seatrout can no longer be fished commercially in Redfish Bay.

Invertebrate commercial fisheries in Redfish Bay include blue crab, brown shrimp, eastern oyster, gulf stone crab, pink shrimp, and white shrimp. All oysters sold in Texas must be certified to have met state and federal standards for harvesting, handling, processing, and storing (TPWD 2006b; UTMSI 2006b).

Recreational fishing occurs for most of the fish and invertebrate species listed in Table 1. Recreational fishers in the RBSSA are required to lift, drift, pole, or troll their boats through shallow areas to ensure that the seagrass beds are not damaged by propellers (TPWD 2006a).

The Texas Department of State Health Services has issued a statewide fish consumption advisory for the Gulf of Mexico, including all Texas coastal waters, because of mercury. The advisory recommends no consumption of king mackerel greater than 110 cm (43 in) and limited consumption of king mackerel between 94 cm (37 in) and 110 cm (43 in) (TPWD 2006c).

Site-Related Contamination

During the expanded site inspection conducted by the TNRCC in 2000, more than 30 soil samples were collected from the Falcon Refinery property. In addition, more than 30 sediment samples were collected from wetlands on the property, wetlands downgradient of the property, and Redfish Bay. The soil and sediment samples were analyzed for metals; semivolatile organic compounds, including PAHs; volatile organic compounds; pesticides; and polychlorinated biphenyls (PCBs). Based upon these samples, the primary contaminants of concern to NOAA are metals and PAHs.

Table 2 summarizes the maximum concentrations of contaminants of concern to NOAA detected during the site investigations and compares them to relevant screening guidelines. Site-specific or regionally specific screening guidelines are always used when available. In this case, the screening guidelines for sediment are the Texas Commission on Environmental Quality ecological benchmarks for sediment (EBS; TCEQ 2005). In the absence of site-specific or regionally specific guidance, the screening guidelines for soil are the Oak Ridge National Laboratory final preliminary remediation goals (ORNL-PRGs; Efromson et al. 1997) and the USEPA's ecological soil screening guidelines (USEPA 2005). Exceptions to these screening guidelines, if any, are noted in Table 2. Only maximum concentrations that exceeded relevant screening guidelines or for which there are no screening guidelines are discussed below. When known, the general sampling locations are also provided for maximum concentrations that exceeded screening guidelines or do not have screening guidelines.

Sediment

Two metals, 11 PAHs, and one pesticide were detected in sediment samples collected from the site at maximum concentrations that exceeded screening guidelines, and two pesticides for which no screening guidelines are available were also detected. The maximum concentrations of zinc and mercury, which were detected in sediment samples taken from the wetlands northwest of the loading dock facility, exceeded the EBS by factors of approximately three and two, respectively.

The maximum concentrations of PAHs were detected in sediment samples collected from Redfish Bay near the Falcon Refinery pipeline outlet. The maximum concentrations of anthracene, benz(a)anthracene, chrysene, dibenz(a,h)anthracene, fluoranthene, phenanthrene, and pyrene exceeded the EBS by one order of magnitude. The maximum concentration of benzo(a)pyrene exceeded the EBS by a factor of nine. The maximum concentrations of benzo(b)fluoranthene, benzo(k)fluoranthene, and indeno(1,2,3-cd)pyrene exceeded the relevant screening guideline (refer to Table 2) by a factor of two.

The maximum concentration of the pesticide 4,4'-DDT, which was detected in a sediment sample collected from the wetlands northwest of the loading dock facility, exceeded the EBS by three orders of magnitude. The maximum concentrations of endrin and heptachlor epoxide were detected in a sample from the on-site wetlands and a sample collected from

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Table 2. Maximum concentrations of contaminants of concern to NOAA at the Falcon Refinery site (USEPA 2000). Contaminant values in bold exceed or are equal to screening guidelines.

Contaminant	Soil (mg/kg)		Sediment (mg/kg)	
	Soil	ORNL-PRG ^a	Sediment	TCEQ ^b EBS
METALS/INORGANICS				
Arsenic	23	9.9	4.4	8.2
Cadmium	0.79	0.36 ^c	0.076	1.2
Chromium	83	0.4	10	81
Copper	75	60	30	34
Lead	220	40.5	15	46.7
Mercury	1.2	0.00051	0.27	0.15
Nickel	57	30	11	20.9
Selenium	0.9	0.21	0.77	1.0 ^d
Zinc	220	8.5	410	150
PAHs				
Anthracene	ND	NA	1.5	0.0853
Benz(a)anthracene	1.8	NA	6	0.261
Benzo(a)pyrene	1	NA	3.7	0.43
Benzo(b)fluoranthene	0.99	NA	4.6	1.8 ^d
Benzo(k)fluoranthene	0.6	NA	3.1	1.8 ^d
Chrysene	4.8	NA	6.6	0.384
Dibenz(a,h)anthracene	0.22	NA	0.63	0.0634
Fluoranthene	0.66	NA	8.3	0.6
Indeno(1,2,3-cd)pyrene	0.56	NA	1.5	0.6 ^d
Phenanthrene	ND	NA	5.4	0.24
Pyrene	1.2	NA	11	0.665
PESTICIDES				
4,4'-DDD	0.0031	NA	0.0012	0.00122
4,4'-DDE	0.0093	NA	0.00095	0.00207
4,4'-DDT	0.005	NA	7.3	0.00119
Dieldrin	0.011	0.000032 ^c	ND	0.000715
Endrin	0.0013	NA	0.0016	NA
Heptachlor Epoxide	0.004	NA	0.00081	NA

a: Oak Ridge National Laboratory (ORNL) final preliminary remediation goals (PRG) for ecological endpoints (Efroymsen et al. 1997).

b: The Texas Commission on Environmental Quality (TCEQ) Ecological Benchmarks for Sediment (EBS) (TCEQ 2005) are the effects range-low (ERL) which represents the 10th percentile for the dataset in which effects were observed or predicted in studies compiled by Long et al. (1998). Marine value is presented.

c: Ecological soil screening guidelines (USEPA 2005).

d: Marine apparent effects threshold (AET) for bioassays. The AET represents the concentration above which adverse biological impacts would be expected.

NA: Screening guidelines not available.

ND: Not detected.

Redfish Bay south of the loading dock facility, respectively. No screening guidelines are available for comparison to the maximum concentrations of endrin and heptachlor epoxide.

Soil

Nine metals and one pesticide were detected in soil samples collected from the site at maximum concentrations that exceeded screening guidelines, and five pesticides and nine PAHs for which no screening guidelines are available were also detected.

The maximum concentrations of arsenic and copper were detected in soil samples collected from the southwest portion of the property. The maximum concentration of arsenic exceeded the ORNL-PRG by a factor of approximately two. The maximum concentration of copper slightly exceeded the ORNL-PRG. The maximum concentrations of cadmium, chromium, lead, mercury, nickel, selenium, and zinc were detected in soil samples collected southeast of the lab/office building. The maximum concentrations of mercury, chromium, and zinc exceeded the ORNL-PRGs by three orders, two orders, and one order of magnitude, respectively. The maximum concentrations of lead and selenium exceeded the ORNL-PRGs by factors of five and four, respectively. The maximum concentration of nickel exceeded the ORNL-PRG by a factor of two, while the maximum concentration of cadmium exceeded the USEPA ecological soil screening guideline by a factor of two.

The maximum concentrations of the PAHs benz(a)anthracene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene, fluoranthene, and indeno(1,2,3-cd)pyrene were detected in soil samples collected from the southwest portion of the property. The maximum concentrations of benzo(a)pyrene, chrysene, and pyrene were detected in soil samples collected southeast of the lab/office building. No screening guidelines are available for comparison to the maximum concentrations of these nine PAHs.

The maximum concentrations of six pesticides were detected in soil samples collected near the lab/office building. The maximum concentration of dieldrin exceeded the USEPA ecological soil screening guideline by two orders of magnitude. No screening guidelines are available for comparison to the maximum concentrations of 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, endrin, or heptachlor epoxide.

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