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## Terry Creek Dredge Spoil/ Hercules Outfall

Brunswick, Georgia  
CERCLIS #GAD982112658

### ■ Site Exposure Potential

The Terry Creek Dredge Spoil Areas/Hercules Outfall site is located on coastal estuarine marshlands approximately 1 km northeast of downtown Brunswick, Glynn County, Georgia. The site is bordered by Dupree Creek, Terry Creek, and the Back River (Figure 1). Dupree Creek flows south along the western edge of the site into Terry Creek, which continues approximately 2 km east until it merges with the Back River. The Back River then flows 3 km southeast and enters St. Simons Sound approximately 5 km from the site. St. Simons Sound joins the Atlantic Ocean about 5 km farther downstream.

From 1948 to 1981, the principal product of Hercules, Inc. (formerly Hercules Powder Plant), located on Dupree Creek, was the pesticide toxaphene. From 1966 to 1972, Hercules discharged 100-140 kg of toxaphene daily to Dupree Creek via a wastewater outfall (Figure 2). In 1972, installation of a wastewater treatment system reduced toxaphene discharges to less than 0.5 kg per day. By 1975, Hercules had obtained an NPDES permit for its Dupree Creek outfall that restricted discharge to a daily maximum of about 0.5 kg of toxaphene, and a monthly average of about 0.2 kg toxaphene per day. Subsequent permit renewals gradually reduced permitted discharges. The current permit allowance is

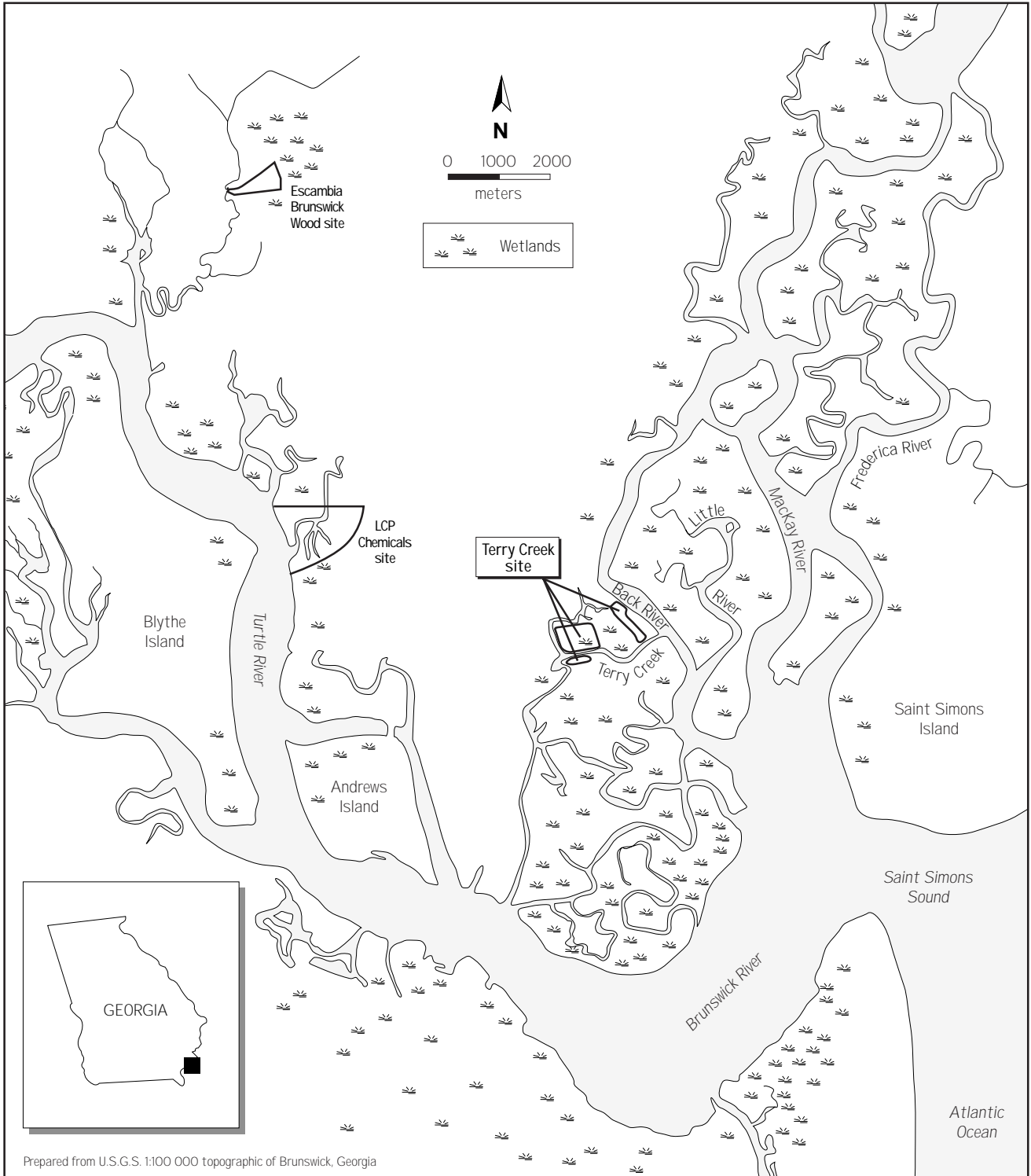


Figure 1. Location of the Terry Creek Dredge Spoil Areas/Hercules Outfall Superfund site in Brunswick, Georgia.

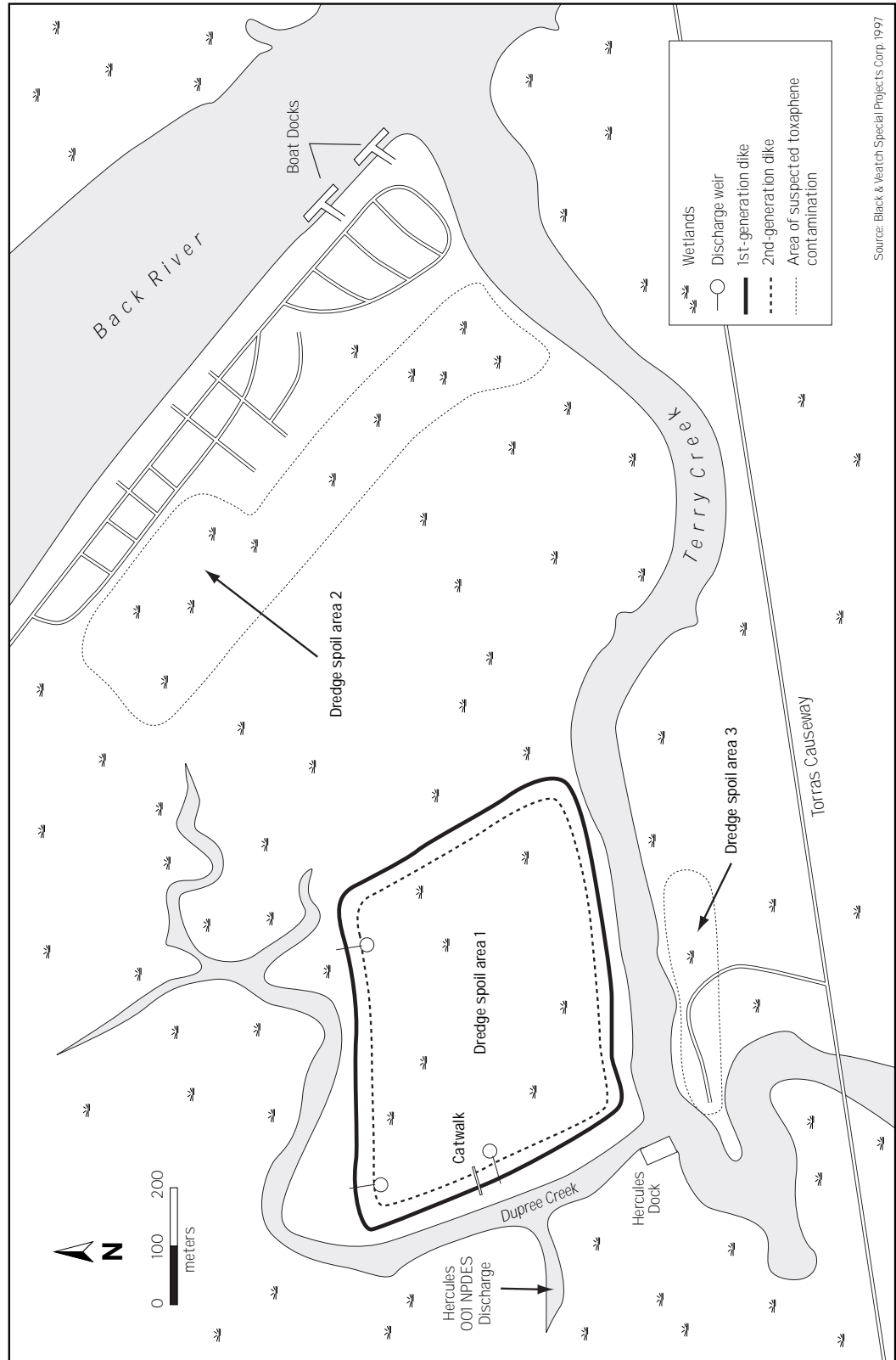


Figure 2. Detail of Terry Creek Dredge Spoil Areas/Hercules Outfall site.

an average of about 0.025 kg per day. There were six documented violations of the NPDES permit between 1988 and 1993 (Black & Veatch Special Projects Corp. 1997).

The U.S. Army Corps of Engineers (USACE) began dredging Terry Creek in 1938. Three tracts of land were set aside to accommodate the dredge spoils; these areas are identified as Dredge Spoil Area 1 (29 ha), Area 2 (23 ha), and Area 3 (3 ha; Figure 2). In 1972, Hercules, EPA, and the Georgia Environmental Protection Division agreed to restrict future disposal of dredge spoils to Area 1 following a spill of an unknown quantity of toxaphene into Dupree Creek from a barge at the Hercules dock. While Area 1 continues to receive dredge spoils, Areas 2 and 3 have been converted to residential property. Maintenance dredging of Terry Creek occurred in 1940, 1942, 1946, 1972, 1978, 1982, 1986, 1987, and 1988 (Black & Veatch Special Projects Corp. 1997).

Surface runoff, direct discharge to surface waters, and tidal transport are the contaminant pathways of primary concern to NOAA. When dredged sediments and water are placed into Dredge Spoil Area 1, solids settle out, and the excess water drains into Dupree Creek via three weirs on the north and west sides. Although the dredge spoils are contained by a two-generation, 7-m high dike, the second-generation dike was constructed using contaminated dredge material. Aerial photos of the impoundment show many complete and partial breaches of the dike, and contaminated water and sediments flowing into

Dupree and Terry creeks (Bionetics 1991). Tidal currents have carried toxaphene upstream 1.2 km to the origin of Dupree Creek (U.S. EPA 1997a). There is an unmapped pipeline that extends from inside the southwest corner of the dike to Terry Creek (Taylor 1995).

Areas 2 and 3 have no features restricting surface runoff and associated contaminants from entering the waterways. Runoff from Dredge Spoil Areas 2 and 3 flows northeast and north to the Back River and Terry Creek, respectively (U.S. EPA 1997a).

## ■ NOAA Trust Habitats and Species

The habitats of concern to NOAA are surface water, bottom substrates, wetlands, and riparian zones associated with Dupree Creek, Terry Creek, the Back River, and St. Simons Sound. Estuarine fish, anadromous fish, and invertebrate species are the primary resources of interest to NOAA (Table 1).

Dupree and Terry Creeks are low-gradient, tidal streams of intermediate salinities (15-30 ppt). Both streams are typically 50 to 70 m wide and less than 1 m deep. Near the site the lower Back River is between 200 and 500 m wide and up to 9 m deep, with salinities generally ranging from 20 to 30 ppt. Sediments range from organically enriched silts to fine sands. Vast salt marsh wetlands are next to all three tidal streams. The wetlands near the site are dominated by smooth

Table 1. NOAA trust species using habitats associated with Dupree and Terry creeks, the lower Back River, and St. Simons Sound near the site.

Species		Habitat Use			Fisheries	
Common Name	Scientific Name	Spawning Ground	Nursery Ground	Adult Forage	Comm. Fishery	Recr. Fishery
<u>ANADROMOUS/CATADROMOUS FISH</u>						
American eel	<i>Anguilla rostrata</i>		♦	♦		
American shad	<i>Alosa sapidissima</i>		♦	♦		
Atlantic sturgeon	<i>Acipenser oxyrinchus</i>		♦	♦		
Blueback herring	<i>Alosa aestivalis</i>		♦	♦		
<u>MARINE/ESTUARINE FISH</u>						
Atlantic croaker	<i>Micropogonias undulatus</i>		♦			♦
Atlantic menhaden	<i>Brevoortia tyrannus</i>		♦			
Bay anchovy	<i>Anchoa mitchilli</i>	♦	♦	♦		
Black drum	<i>Pogonias cromis</i>		♦	♦		♦
Bluefish	<i>Pomatomus saltatrix</i>		♦			
Mummichog	<i>Fundulus heteroclitus</i>	♦	♦	♦		
Pinfish	<i>Lagodon rhomboides</i>		♦	♦		
Red drum	<i>Sciaenops ocellatus</i>		♦			♦
Sheepshead	<i>Archosargus probatocephalus</i>		♦	♦		♦
Sheepshead minnow	<i>Cyprinodon variegatus</i>	♦	♦	♦		
Silversides	<i>Menidia spp.</i>	♦	♦			
Southern flounder	<i>Paralichthys lethostigma</i>		♦	♦		♦
Southern kingfish	<i>Menticirrhus americanus</i>		♦			
Spanish mackerel	<i>Scomberomorus maculatus</i>		♦			
Spot	<i>Leiostomus xanthurus</i>		♦	♦		♦
Spotted sea trout	<i>Cynoscion nebulosus</i>		♦	♦		♦
Striped mullet	<i>Mugil cephalus</i>		♦	♦		♦
Summer flounder	<i>Paralichthys dentatus</i>		♦			
Tarpon	<i>Megalops atlanticus</i>		♦			
Weakfish	<i>Cynoscion regalis</i>		♦			
<u>INVERTEBRATE SPECIES</u>						
Blue crab	<i>Callinectes sapidus</i>		♦	♦	♦	♦
Brown shrimp	<i>Penaeus aztecus</i>		♦	♦	♦	♦
Eastern oyster	<i>Crassostrea virginica</i>	♦	♦	♦		
Grass shrimp	<i>Palaemonetes pugio</i>	♦	♦	♦	♦	♦
Pink shrimp	<i>Penaeus duorum</i>		♦	♦	♦	♦
White shrimp	<i>Penaeus setiferus</i>		♦	♦	♦	♦
<u>MARINE REPTILES</u>						
Green sea turtle	<i>Chelonia mydas</i>			♦		
Kemp's Ridley sea turtle	<i>Lepidochelys imbricata</i>			♦		
Leatherback sea turtle	<i>Dermochelys coriacea</i>			♦		
Loggerhead sea turtle	<i>Caretta caretta</i>			♦		
<u>MARINE MAMMALS</u>						
Atlantic bottlenose dolphin	<i>Tursiops truncatus</i>			♦		
West Indian manatee	<i>Trichechus manatus</i>			♦		

cordgrass (*Spartina alterniflora*) and needlerush (*Juncus roemerianus*; U.S. DOI 1995). St. Simons Sound is a small, shallow (generally less than 20 m) coastal embayment that empties into the Atlantic Ocean (USGS 1993).

A variety of estuarine, anadromous, and catadromous fish species and several invertebrates use Dupree and Terry creeks, the lower Back River, and St. Simons Sound.

Species of fish known to use the Terry Creek site and associated salt marsh habitats include Atlantic croaker, red drum, spotted sea trout, tarpon, striped mullet, Atlantic menhaden, killifish, and American eel. Most of these species use the salt marsh and tidal stream habitats as a nursery. Invertebrates include American oyster, panaeid shrimp, and blue crab (U.S. DOI 1995).

Compared to the tidal streams, the lower Back River and St. Simons Sound provide deeper, larger, more saline habitats for numerous estuarine fish and invertebrates. Common estuarine fish that use the area for juvenile rearing and adult residence include Atlantic menhaden, spotted sea trout, weakfish, Atlantic croaker, southern kingfish, black drum, spot, sheepshead, pinfish, and southern flounder. Anadromous species that use the Back River as a migratory corridor and juvenile nursery include Atlantic sturgeon, blueback herring, and American shad. The catadromous American eel is found throughout the basin using lower-salinity portions of the river as a nursery. Invertebrates found in the area include American

oyster, hard clam, brown shrimp, white shrimp, grass shrimp, and blue crab (Nelson et al. 1991).

Five aquatic species that may occur near the site are listed as threatened or endangered under the Federal Endangered Species Act. The endangered West Indian manatee, which is not a NOAA trust resource, has been observed feeding on smooth cordgrass near Terry Creek. Four species of sea turtle—loggerhead, Kemp's Ridley, leatherback, and green—have been regularly observed in St. Simons Sound, but sightings in the Back River have not been confirmed. In addition, the Atlantic bottlenose dolphin has been reported near the site. Dolphins are not listed as threatened or endangered, but are protected under the Federal Marine Mammal Protection Act (DOI 1995).

Commercial crab pots have been observed in both Dupree and Terry creeks (U.S. DOI 1995). There are commercial fisheries for blue crab and bait shrimp, and recreational fisheries for several finfish and crab throughout the estuary. Bivalve harvest is closed in the estuary, prompted by potential contamination from industrial discharges and urban non-point source contamination from Brunswick (NOAA 1995).

## ■ Site-Related Contamination

Field data collected since late 1995 indicate that soils, surface water, sediments, and biota near the Hercules outfall and the dredge spoil areas

contain elevated concentrations of site-related contaminants (Black & Veatch Special Projects Corp. 1997, U.S. EPA 1997b). The primary on-site contaminants of concern to NOAA are toxaphene and other pesticides, although trace elements and PAHs also were detected in elevated

concentrations. Maximum concentrations of these contaminants are summarized in Table 2 along with the appropriate screening guidelines.

Blue crab, mummichog, and larger fish captured in the spring of 1997 for a screening risk assess-

Table 2. Maximum concentrations of selected contaminants detected at the Terry Creek Dredge Spoil Areas/Hercules Outfall.

	Soil			Water		Sediment	
	On-site soils (mg/kg)	Community soils (mg/kg)	Mean U.S. <sup>a</sup> (mg/kg)	Surface water (µg/L)	AWQC <sup>b</sup> (µg/L)	On-site sediment (mg/kg)	ERLC (mg/kg)
<u>Trace Elements</u>							
Arsenic	16	19	5.2	13	36	19	8.2
Chromium	43	150	37	11	11	55	81
Copper	84	22	17	79	12	69	34
Lead	97	89	16	3	3.2	70	46.7
Mercury	0.32	0.21	0.058	1.8	0.012	0.59	0.15
Silver	7.3	NA	0.05	NA	0.12	<3	1.0
Zinc	73	120	48	NA	86	160	150
<u>Pesticides</u>							
Endrin	NA	NA	NA	0.11	0.002	<5.7	NA
4,4' DDD	NA	NA	NA	0.89	0.6 <sup>e</sup>	<5.7	NA
4,4' DDE	0.18	0.008	NA	<0.1	NA	0.10	0.0022
4,4' DDT	1.5	NA	NA	0.09	0.001	<5.7	0.0016 <sup>t</sup>
Toxaphene	330 <sup>d</sup>	37 <sup>d</sup>	NA	<5	0.0002	230 <sup>d</sup>	NA
<u>Organic Compounds</u>							
Total PAHs	0.42	27	NA	5	NA	3	4.02

a: Shacklette and Boerngen (1984), except for silver which represents average concentration in the earth's crust from Lindsay (1979).  
 b: Quality Criteria for Water (U.S. EPA 1993). Lowest value was chosen from fresh and marine water criteria because stream is tidally influenced.  
 c: Effects range-low; the concentration representing the lowest 10 percentile value for the data in which effects were observed or predicted in studies compiled by Long, et al. (1995).  
 d: Toxaphene analyses performed by EPA - ESD per method determined by EPA Toxaphene Task Force June 4, 1993.  
 e: Lowest Observed Effect Level (U.S. EPA 1993).  
 t: DDT total  
 ND: Not detected; detection limit not available.  
 NA: Screening guidelines not available; data not available.

ment also show evidence of contamination. Maximum toxaphene concentrations (27 ppm) were found in forage fish collected near the Hercules outfall. In larger fish, contaminants that appear to be toxaphene were found in all samples, with fish from Dupree Creek most affected at concentrations of 3.9 ppm (U.S. EPA 1997b).

All “on-site” soil samples were collected from within the boundaries of Areas 1, 2, and 3 (Figure 2). Additional soil samples were collected from nearby areas (some residential) and labeled as “community” soils. These samples were mainly collected to the west and northwest of Area 1 on the opposite side of Dupree Creek and northwest of Area 2. Groundwater samples were collected from three wells in Area 3. Surface water and sediment samples were retrieved from the Back River, Terry Creek, and Dupree Creek, and wetland sediment samples were collected near the banks of these waterways (Black & Veatch 1997).

The trace elements arsenic, lead, mercury, and zinc in on-site soils, and in soils from the community surrounding the site, were found to exceed average U.S. soil concentrations. Copper and silver were also detected at elevated concentrations in on-site soils, while chromium exceeded the mean U.S. soil concentration in community soil samples. However, mercury was the only inorganic substance detected in groundwater samples at concentrations exceeding the AWQC by a factor greater than 10. In surface water, copper exceeded its AWQC in Terry Creek, as did mercury in Dupree Creek. Arsenic, copper, lead, mercury, and zinc concentrations all exceeded

ERL guidelines in sediment samples taken from Terry Creek and the Hercules outfall area. Sediment samples from wetlands to the east of Area 1 contained arsenic, copper, lead, and mercury concentrations at least twice the ERL guideline (Long et al. 1995).

Toxaphene and 4,4'-DDE were detected in both on-site and community soils, with the highest concentrations in on-site soils. Screening guidelines are not available for these pesticides in soil. Toxaphene was not detected in groundwater or surface water samples. Detection limits for toxaphene in surface water were not stated in the 1995-96 investigation, but a 1987 study reported a detection limit of 0.3 µg/L, far exceeding the AWQC chronic guidelines of 0.0002 µg/L (Costello 1987). On-site sediments contained concentrations of 4, 4'-DDE over 45 times the ERL. Toxaphene was measured at 29 mg/kg in on-site sediments and 31 mg/kg in wetland sediments from the upper reaches of Dupree Creek. A screening guideline for toxaphene in sediment was not available. In a 1995 study, toxaphene was measured at concentrations of 19 and 27 mg/kg in tissues from two fish samples collected in Terry Creek (Parsons and Auwarter 1997). Concentrations above 0.4 to 0.6 mg/kg wet weight may be hazardous to fish (Eisler and Jacknow 1985).

Concentrations of PAHs, including acenaphthene, fluorene, phenanthrene, anthracene, fluoranthene, pyrene, benzo(a)anthracene, chrysene, benzo(b and/or k) fluoranthene, benzo(a)pyrene, indeno(1,2,3-c,d)pyrene, and



benzo(g,h,i)perylene, were detected in both on-site and community soils, but screening guidelines for PAHs in soils have not been developed. No organic compounds were detected in groundwater samples. PAHs were detected in surface water, but an AWQC guideline for total PAHs has not been developed. Total PAHs were also measured in sediment samples, but did not exceed the ERL.

## ■ Summary

Terry Creek, Dupree Creek, the lower Back River, and St. Simons Sound provide important nursery and adult forage habitat for numerous trust species in the area of the Terry Creek Dredge Spoil Areas/Hercules Outfall site. Soils, surface water, sediments, and fish are contaminated to varying degrees with trace elements, pesticides, and PAHs. Surface water and sediments contain contaminants at concentrations that pose a threat to NOAA trust resources.

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