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Portsmouth Naval Shipyard

Kittery, Maine
CERCLIS #ME7170022019

Site Exposure Potential

Portsmouth Naval Shipyard is located on 112-hectare Seavey Island at the confluence of Portsmouth Harbor and the lower Piscataqua River (Figure 1) in Kittery, Maine. Portsmouth Harbor forms the mouth of the Piscataqua River and is part of the Great Bay Estuary system, which extends about 32 to 40 km into New Hampshire. The site is approximately 4 km inland from the Atlantic Ocean.

The shipyard has been a government facility since 1800 and was built by placing fill among a small group of islands. The primary activities at the shipyard include the repair, overhaul, modernization, and refueling of nuclear submarines. Most of the activities at the shipyard involve heavy industrial operations. There are three operating dry docks on the south and west sides of the island. Over the years, a wide variety of compounds associated with the construction and maintenance of naval vessels have been used and disposed of at the site. Activities that generate hazardous wastes include paint stripping, degreasing and metal surface cleaning operations, cleaning and flushing of hydraulic and cooling systems, and sand blasting. The shipyard has 376 buildings and trade shops, including sheet metal, welding, piping, mechanical, and electrical shops, and a Controlled Industrial Area that includes the dry docks and submarine berths in the western

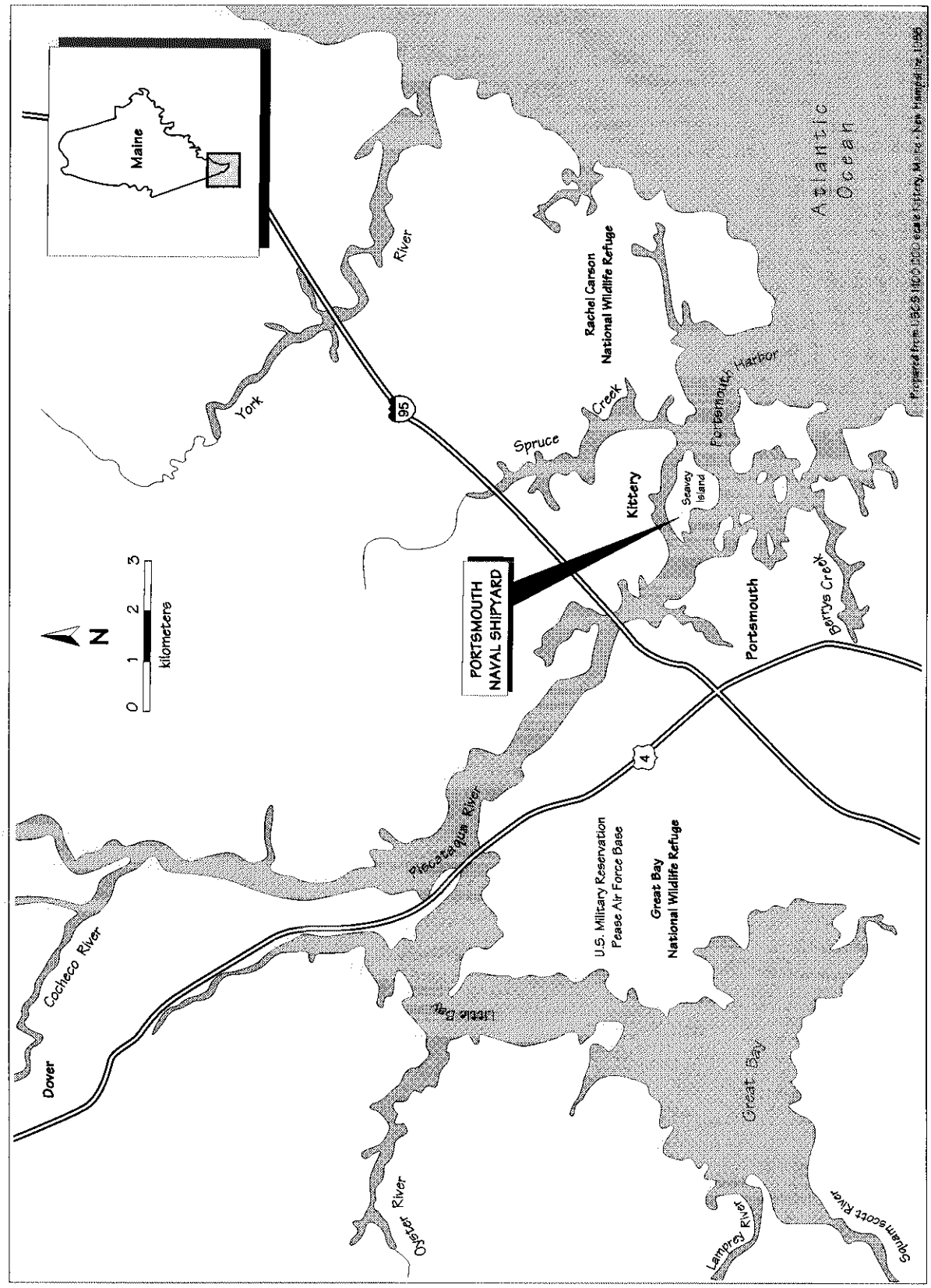

Figure 1. Portsmouth Naval Shipyard in Kittery, Maine.

portion of the island. Industrial wastes are currently collected for pretreatment before disposal at the municipal waste plant in Kittery, Maine.

Thirteen solid waste management units (SWMUs) are being studied for corrective action under RCRA. The SWMUs include former disposal areas, underground storage tanks, industrial waste outfalls (which ceased discharge in 1975), storage areas (still in operation), and a ten-hectare landfill where hazardous wastes were disposed from 1945 to 1975 (NCCOSC and EPA 1993). Table 1 lists each of the thirteen SWMUs that requires corrective action, along with period of operation and types of waste disposed. Figure 2 shows the locations of these SWMUs on the island.

Surface water runoff and groundwater are the potential pathways of contaminant transport from the site to NOAA trust resources and associated habitats. Before 1970, all facility sewage was discharged to the river via sewer outfalls although only stormwater runoff is discharged now. Before the Industrial Waste Treatment Plant was built in 1976, industrial wastes also were discharged directly to the river through outfalls. Surface water runoff flows from Seavey Island into the Piscataqua River as direct runoff or through a stormwater collection system that directs most drainage through various outfalls and ditches around the island. The island is relatively flat with elevations ranging from 3 to 6 m above high water. The shorelines are a combination of steep, rocky banks and low-lying marshlands.

Groundwater on Seavey Island occurs at shallow depths in unconfined, glacial outwash sands and gravels. The permeability of the saturated zone on Seavey Island is not known, although it may be highly variable due to the variety of subsurface materials present. Depth to groundwater varies as a result of recharge, discharge, and tidal fluctuations from approximately 4.3 m at mean low tide to 1.7 m at mean high tide. Recharge to the groundwater comes from the infiltration of precipitation. Much of the shipyard is developed, resulting in reduced groundwater recharge in those areas. Groundwater outflow to the Piscataqua River and the estuary surrounding the island probably accounts for most of the natural discharge from Seavey Island. Leachate rates in disposal areas may increase where there is a significant tidal influence on the groundwater table, especially in highly permeable areas. There is no groundwater development or groundwater monitoring wells at the facility.

NOAA Trust Habitats and Species

Habitats of concern to NOAA are surface water and associated bottom substrates of the Piscataqua River and Portsmouth Harbor near Seavey Island. The shoreline of Seavey Island is predominantly bulkheaded along the southeast corner of the island. The remaining shoreline has areas of rock ledge, rocky beach, and intermittent

Table 1. Selected solid waste management units at PNSY.

Solid Waste Management Units	Period of Operation	Types of Waste Disposed
Industrial Waste Outfalls	1945 - 1975	Unspecified liquid industrial wastes were discharged into the Piscataqua River via sewer lines connected to three outfalls at Berths 6, 11, and 13.
DRMO Storage Yard (formerly DPDO)	1958-1986	Lead and nickel-cadmium battery elements, motors, scrap metal, typewriters, and paper products.
Jamaica Island Landfill	1945-1978	Plating sludges, asbestos insulation, VOCs, contaminated dredge spoils, acetylene and chlorine gas cylinders, waste paints and oils, and incinerator ash.
Mercury Burial Sites	1973-1975	Mercury-contaminated wastes in six concrete vaults.
Battery Acid Storage Tank 24	1974-1984 (Taken out of service in 1984 after 5-cm hole discovered; tank removed in 1986)	UST west of Berth 5 along Piscataqua River used to store waste battery acid and lead sludge from battery repair and submarine decommissioning; sulfuric acid contaminated with lead.
Jamaica Island Landfill Waste Oil Tanks	1943-present	Two 30,000-liter USTs used to store oily wastes prior to off-site disposal.
Boiler Blowdown Tank No. 25	1974-present	Located west of Dry Dock 2. UST used to collect and cool boiler blow-down water from power plant before discharged to sewer system; boiler water contains sodium sulfate, sodium hydroxide, and sodium phosphate.
Rinsewater Tank No. 27	1974-1989 (Pumped out in 1989)	UST received acidic rinsewater from two above-ground rinsewater tanks.
Rinsewater Tank No. 34	1974-1991 (Still in place, report-edly not cleaned out)	UST used to hold acidic rinsewater and metal residue from metal-descaling operation.
Acid/Alkaline Drain Tank No. 28	1974-? (No longer in use)	UST held variety of wastes, including acid and alkaline metal surface-cleaning residue and cyanide.
Chemical Cleaning Facility Tank No. 26	1974-1991 (Pumped out in 1991)	UST used to store waste acid and alkaline-metal, surface-cleaning solutions and solid residues.
Oil/Water Dumpsters	1960-present	About 40 dumpsters in three dry dock areas receive cleaning wastes from submarine bilges and various tanks.
Fuel Oil Spill	1973	No. 6 fuel oil pipeline ruptured; contaminated soil excavated.

patches of wetland (Grout personal communication 1993). The main channel of the Piscataqua River (along the southern shore of the island) averages approximately 20 m deep and approximately 250 to 800 m wide (NOAA 1991). Surface water of Portsmouth Harbor and the Piscataqua River surrounding Seavey Island have strong currents, ranging from 5 to 10 knots, and an average tidal amplitude of 2.7 m. The slower-moving Back Channel flows along the north side of the island. The Piscataqua River estuary is generally well mixed with a salinity gradient

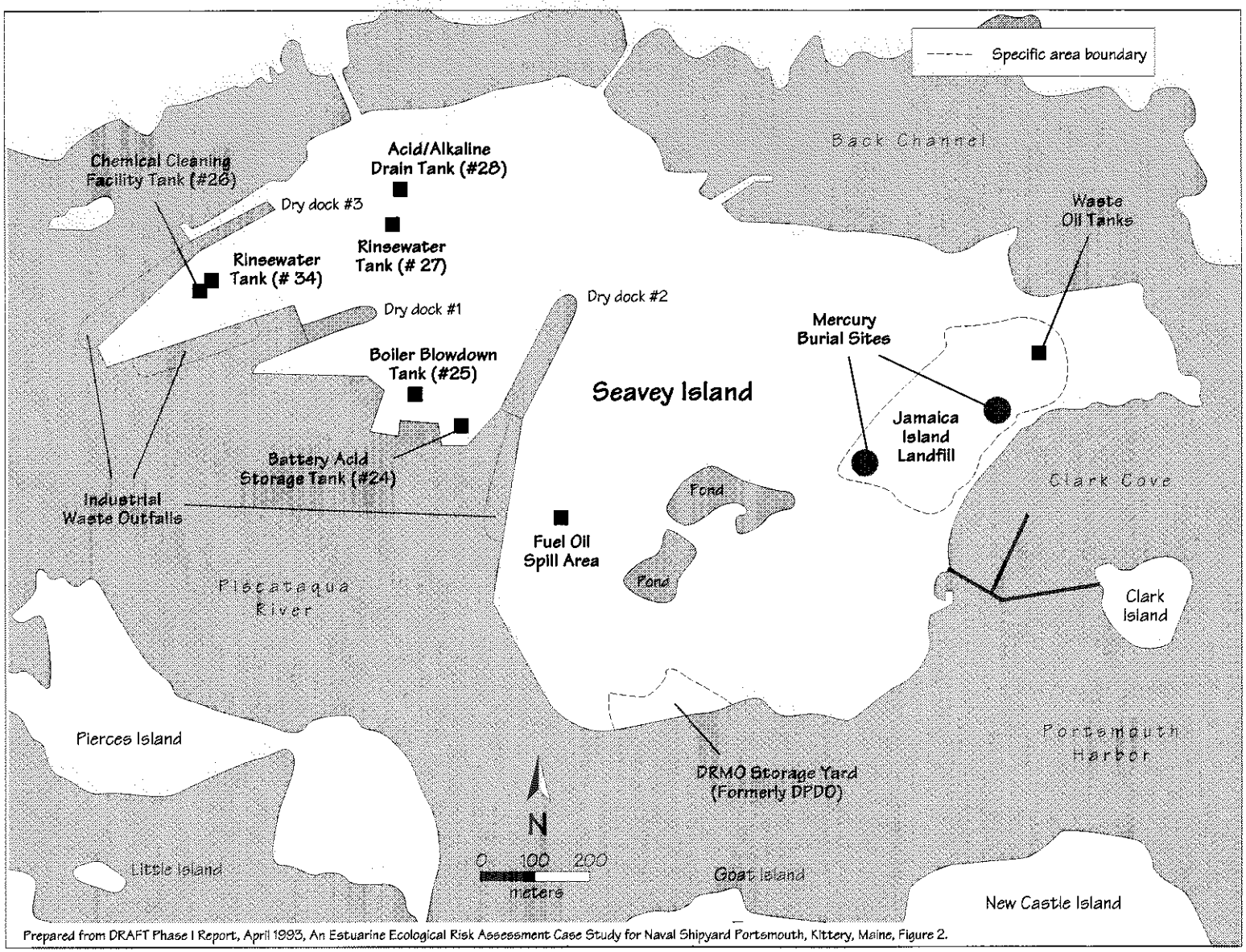

Figure 2. Detail of the Portsmouth Naval Shipyard site.

extending from the mouth of the harbor to the tributary rivers (TRC 1993). Salinities near the site commonly range from 27 to 34 ppt. Substrate at this reach of the river is primarily sand and mud (Grout personal communication 1993).

Near the site, the Piscataqua River and Portsmouth Harbor support diverse, abundant populations of NOAA trust resources (Table 2; Grout personal communication 1993). Numerous species migrate close to the site and reside for extended periods during sensitive life stages. Eleven species of anadromous fish migrate through the Piscataqua River. Although they have not been seen since the mid-1970s, the federally listed endangered shortnose sturgeon historically used the Piscataqua River near the site. Atlantic sturgeon, a species of concern in New Hampshire and Maine, may also inhabit surface water near the site. American shad and striped bass, both species of concern to the State of Maine, are seasonal inhabitants of nearshore water surrounding the site (Grout personal communication 1993).

Alewife, Atlantic silverside, Atlantic menhaden, blueback herring, and rainbow smelt are some of the most abundant finfish species found in the Piscataqua River system. These species represent important components of the forage base for larger predatory fish. Adult alewife and blueback herring commonly return to the Piscataqua River to spawn in upstream freshwater habitats from late April to mid-June. After spawning, adults return to marine environments by mid-July, while juveniles generally linger in the estuary before finally outmigrating by November. Atlantic silverside reside in the estuary year-round. Some menhaden spawn near the mouth of Portsmouth Harbor during June and July, although most individuals use the estuary only for foraging. Both adult and juvenile menhaden migrate offshore by September. Adult rainbow smelt enter the estuary in October and overwinter near the site. They generally spawn during April in small freshwater brooks and streams above the head of tide. Smelt generally migrate to offshore areas by May. Berrys Creek, approximately 3 km south of the site, provides important spawning and nursery habitat for populations of sea-run brown trout (Grout personal communication 1993).

Significant numbers of finfish are year-round residents near the site, including Atlantic tomcod, cunner, grubby, lumpfish, mummichog, northern searobin, northern pipefish, rock gunnel, smooth flounder, stickleback, and winter flounder. Major predators in the area include striped bass, bluefish, Atlantic tomcod, outmigrating juvenile Atlantic salmon, and American eel. Lobster, oyster, blue mussel, green crab, rock crab, and soft-shell clam abound in the estuary (Grout personal communication 1993).

Recreational fishing in Portsmouth Harbor and the Piscataqua River is primarily directed toward American shad, Atlantic tomcod, bluefish, lobster, oyster, pollock, rainbow smelt, sea-run brown trout, soft-shell clam, striped bass, white

Table 2. Major species that use the Piscataqua River near the site.

Species		Habitat Use			Fisheries	
Common Name	Scientific Name	Spawning Ground	Nursery Ground	Adult Forage	Comm. Fishery	Recr. Fishery
ANADROMOUS/CATADROMOUS SPECIES						
Shortnose sturgeon	*Acipenser brevirostrum*			♦		
Atlantic sturgeon	*Acipenser oxyrhynchus*			♦		
Blueback herring	*Alosa aestivalis*		♦	♦	♦	
Alewife	*Alosa pseudoharengus*		♦	♦	♦	
American shad	*Alosa sapidissima*		♦	♦		♦
American eel	*Anguilla rostrata*		♦	♦	♦	
White perch	*Morone americana*		♦	♦		♦
Striped bass	*Morone saxatilis*			♦		♦
Chinook salmon[1]	*Oncorhynchus tshawytscha*		♦	♦		
Rainbow smelt	*Osmerus mordax*		♦	♦	♦	♦
Sea lamprey	*Petromyzon marinus*		♦	♦		
Atlantic salmon	*Salmo salar*		♦	♦		
Sea-run brown trout[2]	*Salmo trutta*		♦	♦		♦
MARINE SPECIES						
American sandlance	*Ammodytes americanus*			♦		
Atlantic menhaden	*Brevoortia tyrannus*	♦	♦	♦	♦	
Black sea bass	*Centropristis striata*			♦		
Atlantic herring	*Clupea harengus*		♦	♦		
Banded killifish	*Fundulus diaphanus*	♦	♦	♦		
Mummichog	*Fundulus heteroclitus*	♦	♦	♦		
Atlantic cod	*Gadus morhua*			♦		
Stickleback	*Gasterosteus spp.*	♦	♦	♦		
Smooth flounder	*Liopsetta putnami*	♦	♦	♦		
Atlantic silverside	*Menidia menidia*	♦	♦	♦	♦	
Atlantic tomcod	*Microgadus tomcod*	♦	♦	♦		♦
Grubby	*Myoxocephalus aenaeus*	♦	♦	♦		
Lumpfish	*Cyclopterus lumpus*	♦	♦	♦		
Rock gunnel	*Pholis gunnellus*	♦	♦	♦		
Pollock	*Pollachius virens*		♦			♦
Bluefish	*Pomatus saltatrix*		♦	♦		3
Northern searobin	*Prionotus carolinus*	♦	♦	♦		
Winter flounder	*Pseudopleuronectes americanus*	♦	♦	♦		♦
Little skate	*Raja erinacea*			♦		
Winter skate	*Raja ocellata*			♦		
Windowpane	*Scophthalmus aquosus*			♦		
Northern pipefish	*Syngnathus fuscus*	♦	♦	♦		
Cunner	*Tautogolabrus adspersus*	♦	♦	♦		♦
Red hake	*Urophycis chuss*			♦		
White hake	*Urophycis tenuis*			♦		

1: Species are propagated through stocking program.
2: Spawning occurs primarily in Berrys Creek (Grout personal communication 1993).
3: A general health advisory recommends limiting consumption of bluefish inhabiting or originating from the Mid-Atlantic Bight due to excessive concentrations of PCBs (Grout personal communication 1993).

Table 2., cont.
Major species that use the Piscataqua River near the site.

Species		Habitat Use			Fisheries	
Common Name	Scientific Name	Spawning Ground	Nursery Ground	Adult Forage	Comm. Fishery	Recr. Fishery
INVERTEBRATE SPECIES						
Atlantic rock crab	*Cancer irrorauts*	♦	♦	♦	♦	
Green crab	*Carcinus maenas*	♦	♦	♦		
American oyster	*Crassostrea virginica*	♦	♦	♦		4
Shrimp	*Crangon spp.*		♦			
Lobster	*Homarus americanus*		♦	♦	♦	4
Horseshoe crab	*Limulus polyphemus*	♦	♦	♦		
Hard shell clam	*Mercenaria mercenaria*	♦	♦	♦		
Soft shell clam	*Mya arenaria*	♦	♦	♦		4
Blue mussel	*Mytilus edulis*	♦	♦	♦		4
Deep sea scallop	*Placopecten magellanicus*		♦	♦	4	
Atlantic razor clam	*Siliqua costata*	♦	♦	♦		
Surf clam	*Spisula solidissima*	♦	♦	♦		

4: Except in Great Bay, no bivalve harvesting is permitted in the Piscataqua watershed due to excess levels of fecal coliform (Grout personal communication 1993).

perch, and winter flounder. Striped bass is the favored recreational species in the area; this fishery generally extends from May through October. Angling for sea-run brown trout is permitted from mid-October through late December. There is recreational shellfishing for blue mussel, oyster, and soft-shell clam in Great Bay (Grout personal communication 1993).

Lobstering is the largest commercial activity near the site, with a year-round rock crab fishery in the harbor. There is some harvesting of deep sea scallop near the mouth of the harbor. Because fishing gear classified as "movable tackle" is prohibited in New Hampshire and Maine inland waters, there are only small, isolated commercial finfish fisheries in Portsmouth Harbor and the Piscataqua River near the site. Commercial potting and spear fishing for American eel is common in the spring and summer. There is a small cast-net fishery for Atlantic silverside in the harbor and some gill-netting for bluefish and menhaden at the mouth of the harbor.

The menhaden fishery is primarily used as bait by striped bass, bluefish, and lobster harvesters. Rainbow smelt are targeted both commercially and recreationally primarily by hook-and-line tackle and some limited use of bow-nets. Alewife and blueback herring also constitute a commercial gill-net fishery during seasonal runs (Grout personal communication 1993)

The Great Bay Estuary is a large estuarine water embayment that is designated as a National Research Reserve under the National Estuary Program. The estuary joins the Piscataqua River via a smaller embayment, Little Bay, approximately 15 km upstream from the site. Numerous tributaries provide habitat to several anadromous

trust resources; the largest of these are the Lamprey and the Squamscott rivers, which discharge into Great Bay approximately 15 km and 16 km upstream from the site, respectively. A third important tributary of the Piscataqua River, with established anadromous runs, is the Cocheco River, joining the Piscataqua River approximately 16 km upstream from the site.

Several restoration programs focus on the Lamprey, the Exeter (the upper reach of the Squamscott River), and the Cocheco rivers. Between 1,000 and 1,500 spawning American shad are transported annually via truck from the Merrimack River in Massachusetts for release into the Exeter River. An Atlantic salmon restoration program annually releases between 200,000 and 300,000 Atlantic salmon fry, parr, and smolt into the Lamprey and Cocheco rivers. Since the mid-1980s, a chinook salmon stocking program has annually released approximately 400,000 smolts into the Lamprey River. The chinook salmon program is being evaluated to determine whether stocking efforts should continue. Approximately 5,000 sea-run brown trout yearlings are released each spring into Berrys Creek (Grout personal communication 1993).

A general health advisory recommends limited consumption of bluefish inhabiting or originating from the Mid-Atlantic Bight due to excessive PCB concentrations. Due to fecal coliform contamination, recreational and commercial harvesting of bivalves are prohibited within the Piscataqua watershed except for the surface waters of Great Bay (Grout personal communication 1993).

Sensitive habitats near the site include the Great Bay National Wildlife Reserve and the Rachel Carson National Wildlife Reserve. The Great Bay National Wildlife Reserve, situated along the Great Bay Estuary, provides habitat to numerous threatened and endangered species of plant and terrestrial wildlife. The Rachel Carson Wildlife Refuge, approximately 5 km east of the shipyard, primarily contains salt marsh and upland areas. No information regarding resource use of the refuge was available.

Harbor seals (*Phoca vitulina*) inhabit surface water surrounding the site during the winter months. Federally listed endangered whales are frequently seen just offshore in the Atlantic Ocean during seasonal migrations. These include humpback (*Megaptera noveangliae*), northern right (*Eubalaena glacialis*), finback (*Balaenoptera physalus*), and minke (*Balaenoptera acutorostrata*). Atlantic pilot whales (*Globicephala melaena*) rarely migrate into the Piscataqua River to forage (Grout personal communication 1993).

Site-Related Contamination

Data collected during site investigations indicate that soil, sediments, and surface water at the shipyard contain elevated concentrations of site-related contaminants. Cadmium (23 mg/kg), chromium (170 mg/kg), lead (147,000 mg/kg), and nickel (16,000 mg/kg) were detected in soil

samples collected at the Defense Reutilization and Marketing Office storage yard at concentrations far above their respective averages for U.S. soils (Loureiro 1985). Though completed in 1992 along with an addendum in 1993, an extensive soil and groundwater investigation conducted as part of the RCRA Facility Investigation was not available for this review.

The U.S. Navy and the U.S. Environmental Protection Agency conducted research in the Great Bay and Piscataqua River Estuary, and produced an estuarine ecological risk assessment for the shipyard (NCCOSC et al. 1993). Phase 1 of this study distinguished important ecological resources in the estuary and identified areas that appear to be under ecological stress. Table 3 shows maximum concentrations of contaminants detected in sediment and surface water collected during the risk assessment, and the screening guidelines used to evaluate these concentrations. Concentrations of copper, lead, mercury, zinc, phenanthrene, anthracene, fluoranthene, chrysene, benzo(a)pyrene, total PAHs, and PCBs in sediments each exceeded ERM screening guidelines. Clark Cove, near the Jamaica Island Landfill, represents an area of sediment deposition due to its location outside of the main flow of tidal currents. Clark Cove sediments had the highest or second highest concentrations for nearly all analytes, and sediments from the cove had the finest texture of all stations sampled. Sediments from the Clark Cove, Back Channel, and CIA/dry dock stations each contained contaminants at concentrations exceeding those shown to be toxic to aquatic organisms in other studies.

Cadmium, chromium, copper, mercury, nickel, and zinc were detected in water samples collected from seeps near the Jamaica Island Landfill at concentrations exceeding marine chronic AWQC. Copper, mercury, and nickel were detected in water next to Seavey Island at concentrations exceeding marine AWQC (Table 3).

The ecological risk assessment included an investigation of contamination in tissue of both deployed and indigenous mussels. Contaminant concentrations measured in indigenous mussels were similar to those in deployed mussels. For indigenous mussels, the highest concentrations of chromium, nickel, silver, PAHs, and PCBs were measured in animals collected from the Upper Piscataqua River and Little Bay. The highest concentrations of lead were measured in mussels collected from the main channel near the island. Concentrations of lead and chromium in indigenous mussel tissues were elevated 2 to 11 times expected background concentrations. Concentrations of mercury in mussels collected from stations in the Great Bay Estuary were above background concentrations.

Summary

Trace elements, PCBs, and PAHs have been detected in soil, sediment, and surface water associated with the shipyard at concentrations that may pose a risk to NOAA trust resources. Sediment depositional areas next to Seavey Island

Table 3. Maximum concentrations of selected analytes in sediment and surface water at PNSY.

	Sediment (mg/kg)				Surface Water (ug/l)			
Analyte	Grab[1]	Core[1]	ERL[2]	ERM[3]	River	Seep	Freshwater AWQC[4]	Marine AWQC[4]
TRACE ELEMENTS								
Arsenic	29	18	8.2	70	4.0	7.0	190	36
Cadmium	2.0	1.1	1.2	9.6	9.0	13	1.1+	9.3
Chromium	210	340	81	370	16	310	11	50
Copper	91	530	34	270	300	3100	12+	2.9
Lead	120	420	46.7	223	3.0	3.0	3.2+	8.5
Mercury	0.58	1.9	.15	0.71	17	320	0.12+	0.025
Nickel	1.1	1.3	20.9	51.6	46	15	160+	8.3
Zinc	380	2000	150	410	18	220	110+	86
PAHs								
Anthracene	0.65	1.9	0.085	1.1	NA	ND	NA	NA
Benzo(a)pyrene	0.86	2.3	0.43	1.6	NA	ND	NA	NA
Benzo(e)pyrene	0.58	1.9	NA	NA	NA	ND	NA	NA
Chrysene	1.3	3.2	0.384	2.8	NA	ND	NA	NA
Fluoranthene	1.8	14	0.60	5.1	NA	ND	NA	p16
Fluorene	0.25	0.28	0.019	0.54	NA	ND	NA	NA
Phenanthrene	1.6	6.2	0.24	1.5	NA	ND	6.3p	4.6p
Pyrene	1.5	10	0.665	2.6	NA	ND	NA	NA
Total PCBs	0.47	0.11	0.0227	0.18	NA	ND	0.014	0.03
PESTICIDES								
p,p-DDD	0.018	0.062	0.002	NA	NA	ND	NA	NA
p,p-DDE	0.0059	0.016	0.002	NA	NA	ND	NA	NA

1: Core samples taken at unknown subsurface depth. Grab samples generally taken at surface.
2: 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 and MacDonald (1992).
3: Effects range median (Long and MacDonald 1992).
4: Ambient water quality criteria for protection of aquatic organisms. Freshwater and marine chronic presented (U.S. EPA 1993).
+: Value is dependent on hardness (100 mg $CaCO_3$ mg/l used).
p: Proposed value.
NA: Not analyzed or not available.
ND: Not detected.

are of particular concern, especially in the Clark Cove and the Back Channel areas. Of the current major contaminant sources on the island, the Jamaica Island Landfill and the Defense Reutilization and Marketing Office Storage Yard probably pose the most significant risks to aquatic biological receptors because of their elevated contaminant concentrations and proximity to the Piscataqua River and Portsmouth Harbor. Both of these habitats support diverse, abundant populations of NOAA resources.

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