Coastal and Estuarine

Hazardous Waste Site Reports

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Acronyms and abbreviations

AST	Above-ground Storage Tank
AWQC	Ambient water quality criteria for the protection of aquatic life
BEHP	bis(2-ethylhexyl)phthalate
bgs	below ground surface
BHC	benzene hexachloride
BNA	base, neutral, and acid-extractable organic compounds
BOD	biological oxygen demand
BSL	brine sludge lagoon
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
cfs	cubic feet per second
cm	centimeter
COC	contaminant of concern
COD	chemical oxygen demand
COE	U.S. Army Corps of Engineers
CRC	Coastal Resource Coordinator
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethylene
DDT	dichlorodiphenyltrichloroethane
DNAPL	dense non-aqueous phase liquid
DNT	dinitrotoluene
DOD	U.S. Department of Defense
DOI	U.S. Department of the Interior
EPA	U.S. Environmental Protection Agency
ERL	Effects Range - Low
ERM	Effects Range - Median
ft	foot
ha	hectare
HMX	cyclotetramethylene tetranitramine
HRS	Hazard Ranking System
HUC	Hydrologic Unit Code
kg	kilogram
km	kilometer
L	liter
LNAPL	light, non-aqueous phase liquid
LOEL	lowest observed effects level
m	meter
mi	mile
m^3/second	cubic meter per second
µg/g	micrograms per gram (ppm)
µg/kg	micrograms per kilogram (ppb)
µg/L	micrograms per liter (ppb)
µR/hr	microroentgens per hour
MEK	methyl ethyl ketone a.k.a. 2-Butanone
mg	milligram
mg/kg	milligrams per kilogram (ppm)
mg/L	milligrams per liter (ppm)
mR/hr	milliroentgens per hour
NAPL	non-aqueous phase liquid
NFA	no further action
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
OU	operable unit
PAH	polycyclic (or polynuclear) aromatic hydrocarbon
PA/SI	Preliminary Assessment/Site Investigation
PCB	polychlorinated biphenyl
PCE	perchloroethylene (aka tetrachloroethylene)

pCi/g	picocuries per gram
PCP	pentachlorophenol
PNRS	Preliminary Natural Resource Survey
ppb	parts per billion
ppm	parts per million
ppt	parts per thousand or parts per trillion
PRP	Potentially Responsible Party
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
RD/RA	Remedial Design/Remedial Action
RDX	cyclonite
RI/FS	Remedial Investigation/Feasibility Study
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act of 1986
SVOC	semi-volatile organic compound
TCA	1,1,1-trichloroethane
TCE	trichloroethylene
TCL	Target Compound List
TNT	trinitrotoluene
TPH	total petroleum hydrocarbons
TSS	total suspended solids
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UST	underground storage tank
VOC	volatile organic compound
<	less than
>	greater than

Introduction

The National Oceanic and Atmospheric Administration (NOAA) regularly evaluates hazardous waste sites that are proposed for addition to the National Priorities List (NPL), a U.S. Environmental Protection Agency (USEPA) listing of sites that have undergone preliminary assessment and site inspection to determine which locations pose the greatest threat. The NPL is compiled under authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 (United States Code, Title 42, Chapter 103). This volume identifies hazardous waste sites that could impact natural resources for which NOAA acts as a federal trustee under the National Oil and Hazardous Substances Pollution Contingency Plan (commonly referred to as the National Contingency Plan or NCP) (Code of Federal Regulations, Title 40, Part 300). NOAA serves as the federal trustee for marine and estuarine natural resources, including fish, shellfish, corals, marine mammals and the habitats that support these organisms.

Waste site reports of the type included in this volume often represent NOAA's first examination of a site. NOAA has published 385 waste site reports. Appendix Table 1 provides a summary of all the Coastal and Estuarine Hazardous Waste Site Reviews published to date.

Not all hazardous waste sites will affect NOAA trust resources; NOAA is concerned about sites located near trust resources and their habitats in states along the Atlantic Ocean including Puerto Rico and the Virgin Islands, along the Pacific Ocean including Hawaii and the Pacific Islands, the Gulf of Mexico, and the Great Lakes. NOAA works with USEPA to identify, assess, and mitigate the risks posed to natural resources from the release of hazardous chemicals and pollutants. NOAA also works directly with responsible parties to restore injured natural resources through habitat protection and restoration projects.

NOAA uses information from this volume to establish priorities for further site investigations. NOAA's Regional Resource Coordinators will follow up on sites that appear to pose ongoing problems. These scientists work with other agencies and trustees to communicate any concerns to the USEPA. They also review sampling and monitoring plans for the sites, help plan the investigation, and set objectives for site cleanups. This coordinated approach protects all natural resources, not just those for which NOAA is a steward. The USEPA can use the waste site reports to help identify the types of information that may be needed to complete environmental assessments of the sites. Other federal and state trustees can use the reports to help evaluate the potential impacts to their resources.

Each waste site report contains an executive summary and three distinct sections. The first section, Site Background, describes the site, previous site operations and disposal practices, and pathways by which contaminants could migrate to NOAA trust resources. The second section, NOAA Trust Resources, describes the species, habitats, and commercial and recreational fisheries near the site. The final section, Site-Related Contamination, identifies the contaminants of concern to NOAA and describes contaminant distribution at the site.

In addition to the waste site reports, this volume contains a list of acronyms and abbreviations (p. vii) and a glossary of terms (p. 89) that commonly appear throughout the reports. Appendix Table 1 lists all of the waste site reports that NOAA has published to date.

Chemical-Specific Screening Guidelines

Most waste site reports contain a table that focuses on the contaminants in different media that have potential to degrade natural resources. These site-specific tables highlight only a few of the many contaminants often found at hazardous waste sites. We compare the chemical concentrations reported in the tables against published screening guidelines for surface water, groundwater, soil, and sediment. Because contaminant releases from hazardous waste sites to the environment can span many years, we are concerned about long-term effects to natural resources. This is why we compare site contaminant levels against screening guidelines for chronic effects rather than for short-term effects.

Contaminant levels at each site are compared to site-specific or regional-specific criteria (or guidelines) when available. In the absence of such data, the contaminant levels detected in surface water and groundwater are compared to the ambient water quality criteria (AWQC; USEPA 2002, 2006); contaminants detected in sediment are compared to the effects range-low (ERL) values (Long and Morgan 1991) and threshold effects concentrations (TECs; MacDonald et al. 2000a). Only when there is a soil pathway for the migration of contaminants to NOAA trust resources do we examine contaminant levels in soil samples. Chemical concentrations in soil that exceed screening guidelines can indicate a potential source of contamination. Contaminants detected in soil are compared to ecological soil screening levels (USEPA 2005) and values from the Oak Ridge National Laboratory final preliminary remediation goals (ORNL-PRGs; Efroymson et al. 1997). Any exceptions to these guidelines are noted in the contaminant table.

There are no national criteria for sediment comparable to the AWQC established for water. In the absence of national criteria, we compare sediment concentrations to several published screening guidelines (Long and Morgan 1991; MacDonald et al. 1996; MacDonald et al. 2000a; MacDonald et al. 2000b). Studies that associate contaminant concentrations in sediment with biological effects provide guidance for evaluating contaminant concentrations that could harm sediment-dwelling aquatic organisms. These studies include Long and MacDonald 1992; Long et al. 1995; MacDonald et al. 1996; Smith et al. 1996; Long et al. 1998; and Kemble et al. 2000. However, screening guidelines are often based on effects from individual chemicals. Their application may be difficult when evaluating biological effects that could be attributed to combined effects from multiple chemicals, unrecognized chemicals, or physical parameters that were not measured.

NOAA's National Status and Trends Program has used chemical and toxicological evidence from a number of modeling, field, and laboratory studies to determine the ranges of chemical concentrations associated with toxic biological effects (Long and Morgan 1991; Long and MacDonald 1992):

- No Effects Range — the range of concentrations over which toxic effects are rarely observed;
- Possible Effects Range — the range of concentrations over which toxic effects are occasionally observed; and
- Probable Effects Range — the range of concentrations over which toxic effects are frequently observed.

Two slightly different methods (Long and Morgan 1991; MacDonald 1993) were used to determine these chemical ranges. Long and Morgan (1991; Long et al. 1995) compiled chemical data associated with adverse biological effects. The data were ranked to determine where a chemical concentration was associated with an adverse effect (the ERL) — the lower 10th percentile for the data set in which effects were observed or predicted. Sediment samples were not expected to be toxic when all chemical concentrations were below the ERL values.

MacDonald (1993) modified the approach used by Long and Morgan (1991) to include both the “effects” and “no effects” data, whereas Long and Morgan used only the “effects” data. TELs were derived by taking the geometric mean of the 15th percentile of the “effects” data and the 50th percentile of the “no effects” data.

Although different percentiles were used for these two methods, their results closely agree (Kemble et al. 2000). We do not advocate one method over the other, and we use both screening guidelines to help focus cleanup efforts in areas where natural resources may be at risk from site-related contaminants.

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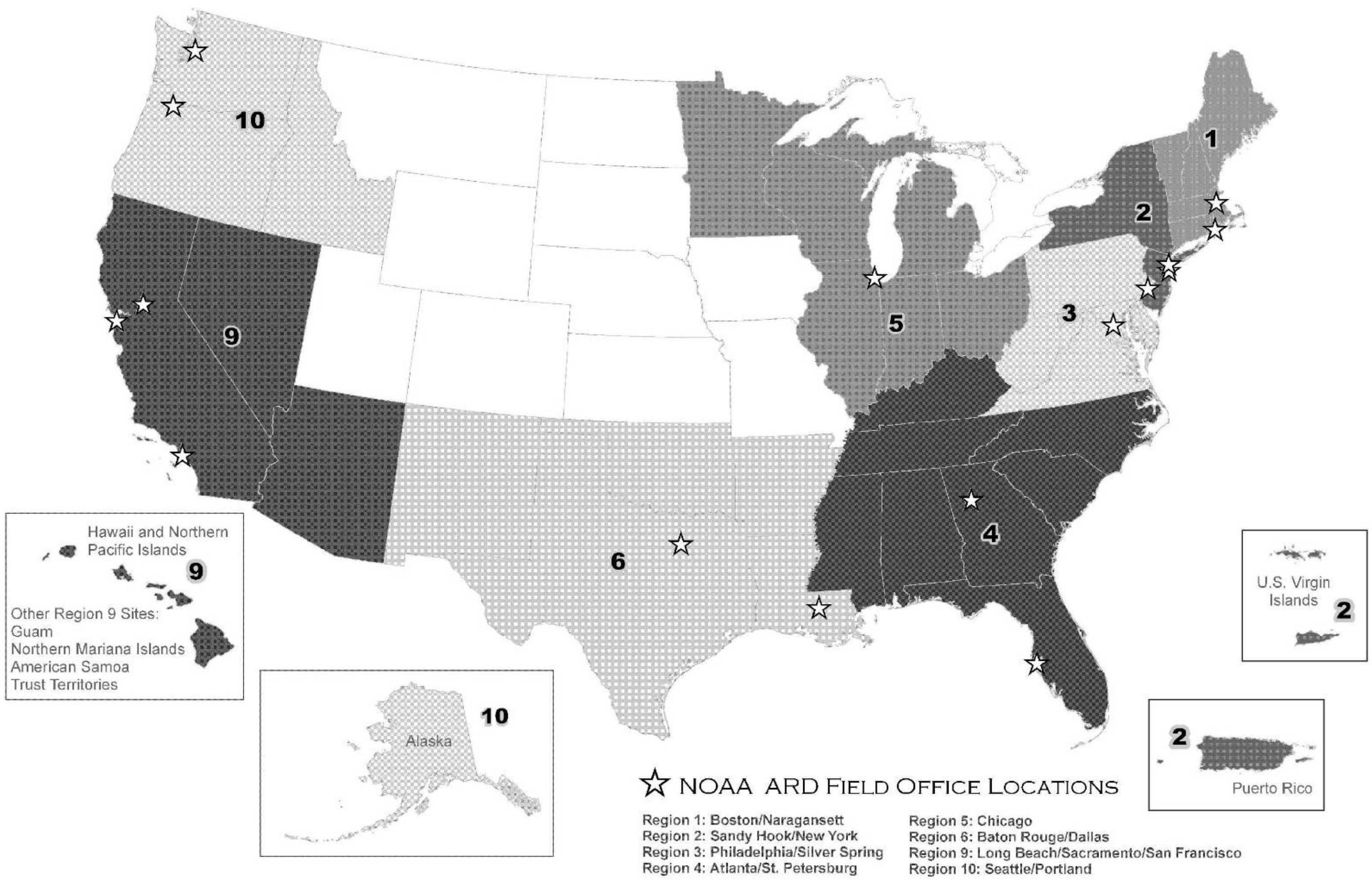

Crown Vantage Landfill

Alexandria Township, New Jersey
EPA Facility ID: NJN000204492
Basin: Middle Delaware-Musconetcong
HUC: 02040105

Executive Summary

The Crown Vantage Landfill site is an inactive industrial landfill adjacent to the Delaware River in Alexandria Township, New Jersey. From the late 1930s to the early 1970s, the landfill largely received waste from nearby paper mills. PAHs, pesticides, PCBs, herbicides, SVOCs, and metals have been detected during numerous investigations of the site. Adjacent to the site, the Delaware River provides habitat to several NOAA trust resources including the anadromous alewife, American shad, blueback herring, striped bass, and white perch and the catadromous American eel. Surface water runoff, erosion, and flooding are the primary pathways for the migration of contaminants from the site to NOAA trust resources in the Delaware River, the habitat of concern to NOAA.

Site Background

The Crown Vantage Landfill site is an inactive industrial landfill on 4 ha (10 acres) in Alexandria Township, Hunterdon County, New Jersey. The property is bordered to the west by the Delaware River and lies within the river's floodplain (Figures 1 and 2).

From the late 1930s to the early 1970s, the landfill largely received waste from nearby paper mills, including soil, ash, paper-fiber sludge, metal construction debris, and drums containing varnish, shellac, methyl ethyl ketone, inks, and dyes (Weston 2004). While it was active, the landfill was often intentionally set on fire to reduce the volume of waste and was accidentally set on fire when hot ashes were deposited at the landfill (Weston 2004). The landfill has been inactive since the early 1970s.

Polycyclic aromatic hydrocarbons (PAHs), pesticides, polychlorinated biphenyls (PCBs), herbicides, semivolatile organic compounds (SVOCs), and metals were detected at the site during numerous investigations conducted from 1991 to 2003 (Weston 2004). In 2003, floodplain soil samples were collected adjacent to the western face of the landfill and surface water and sediment samples were collected from the Delaware River adjacent to the landfill. During the 2003 investigation, visible signs that the landfill has been flooded by the Delaware River were observed (Weston 2004).

In 1992, some of the drums and paper products on the surface of the landfill were removed from the site. In 2002, approximately 100 more drums containing detectable concentrations of volatile organic compounds (VOCs), phenols, pesticides, PCBs, and cyanide were removed (Weston 2004). The Crown Vantage Landfill site was placed on the U.S. Environmental Protection Agency's (USEPA) National Priorities List on April 27, 2005 (USEPA 2005a).

Surface water runoff, erosion, and flooding are the primary pathways for the migration of contaminants from the site to NOAA trust resources in the Delaware River. In 2004, the

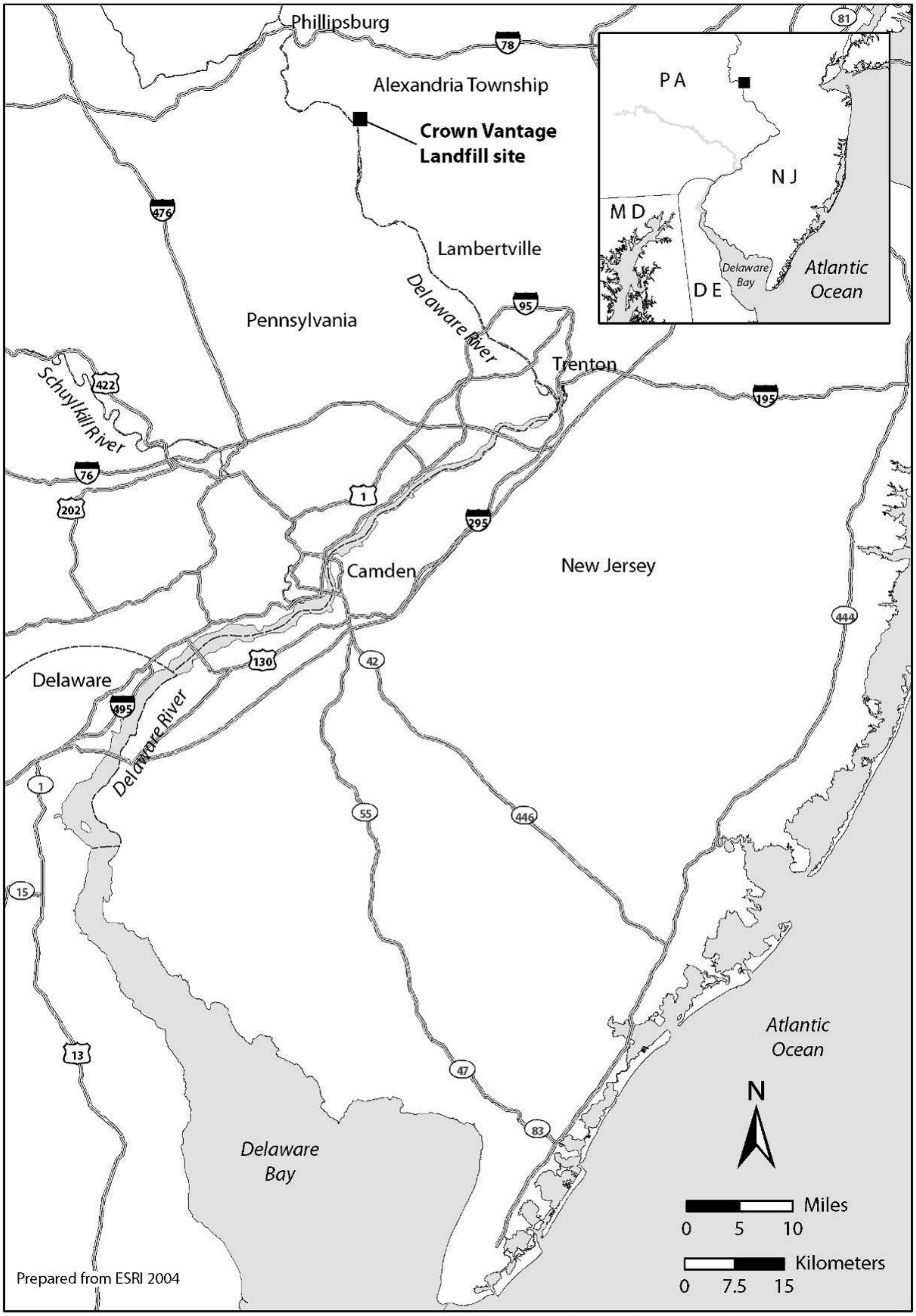

Figure 1. Location of the Crown Vantage Landfill site in Alexandria Township, New Jersey.

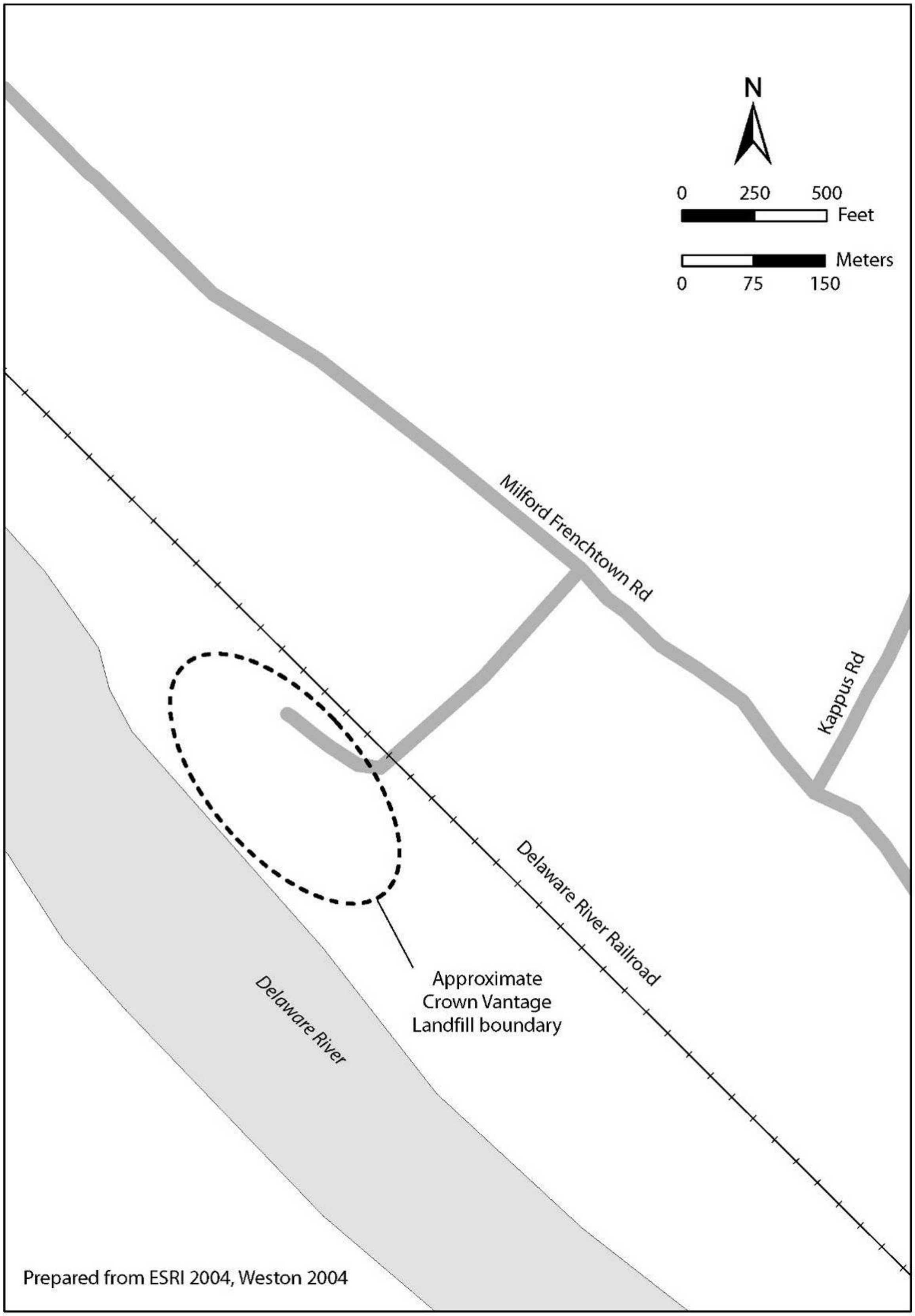

Figure 2. Detail of the Crown Vantage Landfill property.

USEPA reinforced damaged portions of the landfill that had eroded as a result of flooding of the Delaware River (USEPA 2005a). Only the most severely damaged portions of the landfill were reinforced; other sections still need to be stabilized to prevent further erosion (USEPA 2005a).

NOAA Trust Resources

The Crown Vantage Landfill site lies within the floodplain of the Delaware River, which is the habitat of concern to NOAA. Near the site, the Delaware River is a free-flowing, low-gradient river system that is 200 to 400 m (656 to 1,312 ft) wide and approximately 0.6 to 3.5 m (2 to 11 ft) deep (Koffman 1988).

The Delaware River provides habitat to several NOAA trust resources, including anadromous and catadromous species. The anadromous alewife, American shad, blueback herring, striped bass, and white perch and the catadromous American eel are all found in the vicinity of the site (Boriek 2004; Table 1). There are no dams downstream of the site that could impede fish passage.

Table 1. NOAA trust resources present in the Delaware River near the Crown Vantage Landfill site (Steiner 2000; Versar 2003; Boriek 2004; Lorantas 2005a, 2005b; NJDEP 2005).

Species		**Habitat Use**			**Fisheries**	
Common Name	Scientific Name	Spawning Area	Nursery Area	Adult Habitat	Comm.	Rec.
ANADROMOUS FISH						
Alewife	*Alosa pseudoharengus*	♦	♦	♦		♦
American shad	*Alosa sapidissima*	♦	♦	♦	♦	♦
Blueback herring	*Alosa aestivalis*	♦	♦	♦		♦
Striped bass	*Morone saxatilis*			♦		♦
White perch	*Morone americana*			♦	♦	♦
CATADROMOUS FISH						
American eel	*Anguilla rostrata*			♦		

American shad, the largest member of the herring family, are present in most reaches of the Delaware River. Adult American shad live in marine waters until they are ready to spawn, then they migrate into freshwater streams. In the Delaware River, American shad most commonly spawn upstream of Lambertville, New Jersey, which includes the area adjacent to the site (NJDEP 2005).

Alewife and blueback herring are closely related species with similar life histories. Adult alewife and blueback herring live in nearshore marine waters until they migrate into rivers, including the Delaware River, to spawn. In the Delaware River, alewife and blueback herring spawn in habitat several miles upstream of the tidal line, which includes the reach adjacent to the Crown Vantage Landfill site (Steiner 2000).

White perch are also found in the reach of the Delaware River adjacent to the Crown Vantage Landfill site (Versar 2003). White perch spawn in both the tidal and non-tidal portions of the Delaware River downstream of Lambertville, New Jersey, which is approximately 24 km (15 mi) downstream of the site (Lorantas 2005a).

Adult striped bass are found in the reach of the Delaware River adjacent to the site (Versar 2003). Striped bass, which are anadromous fish native to the Delaware River, mostly spawn downstream of the site in the tidally influenced freshwater section of the river, which extends from near Camden, New Jersey, to Trenton, New Jersey (Lorantas 2005b). Juvenile striped bass remain in the tidally influenced section of the Delaware River for approximately two years before they migrate to coastal waters, where they continue to mature (Lorantas 2005b).

The catadromous American eel, which spawns in the ocean and then migrates to fresh water, uses the section of the Delaware River adjacent to the site as a migratory corridor (Boriek 2004).

American shad and white perch are important commercial fisheries in Delaware Bay, which is downstream of the site (Sutton et al. 1996). Recreational fishing of alewife, American shad, blueback herring, striped bass, and white perch occurs adjacent to the site (Versar 2003). Several warm-water fish species, including bluegill, brown bullhead, channel catfish, and rock bass, are also fished recreationally from the river near the site (Versar 2003).

A statewide consumption advisory is in effect for certain fish and shellfish because of dioxin, mercury, and PCB contamination (NJDEP 2006). The New Jersey Department of Environmental Protection's fish consumption advisory for the Delaware River between Phillipsburg and Trenton recommends reduced consumption of American eel, channel catfish, and striped bass for the general public and no consumption for high-risk individuals (NJDEP 2006). The advisory recommends reduced consumption of white sucker and smallmouth bass for both the general public and high-risk individuals. Consumption of largemouth bass from waters near the Crown Vantage Landfill site is not restricted for the general public; reduced consumption is recommended for high-risk individuals (NJDEP 2006).

Site-Related Contamination

During 2003, 14 sediment and 30 soil samples were collected at the Crown Vantage Landfill site and analyzed for metals, pesticides, PCBs, and SVOCs, which include PAHs (Weston 2004). The sediment samples and eight of the soil samples were also analyzed for VOCs (Weston 2004). Surface water samples were also collected during this investigation, but the analytical results were not available in the documents reviewed for this report. Metals and PAHs are the primary contaminants of concern to NOAA at the Crown Vantage Landfill site.

Table 2 summarizes the maximum concentrations of contaminants of concern to NOAA detected in sediment and soil samples during the site investigations and compares them to relevant screening guidelines. Site-specific or regionally specific screening guidelines are always used when available. In the absence of such guidance, the screening guidelines for sediment in a freshwater environment are the threshold effects concentrations (TECs; MacDonald et al. 2000), and the screening guidelines for soil are the Oak Ridge National Laboratory final preliminary remediation goals (ORNL-PRGs; Efroymson et al. 1997) and the USEPA's ecological soil screening guidelines (USEPA 2005b). Exceptions to these

Table 2. Maximum concentrations of contaminants of concern to NOAA at the Crown Vantage Landfill site (Weston 2004). Contaminant values in bold exceed or are equal to screening guidelines.

	Soil (mg/kg)		Sediment (mg/kg)	
Contaminant	Soil	ORNL-PRG[a]	Sediment	TEC[b]
METALS/INORGANICS				
Arsenic	**16**	9.9	7.6	9.79
Cadmium	**12.0**	0.36[c]	**5.6**	0.99
Chromium[d]	**5,500**	0.4	**48**	43.4
Copper	**4,500**	60	**52**	31.6
Lead	**34,000**	40.5	**80**	35.8
Mercury	**3.3**	0.00051	**0.21**	0.18
Nickel	**64**	30	**46**	22.7
Selenium	**9.8**	0.21	6.0	NA
Zinc	**3,800**	8.5	**620**	121
PAHs				
Acenaphthene	**230**	20	<0.65	0.290[e]
Acenaphthylene	0.083	NA	0.051	0.160[e]
Anthracene	460	NA	**0.20**	0.0572
Benz(a)anthracene	**820**	0.1[f]	**0.65**	0.108
Benzo(a)pyrene	**700**	0.1[f]	**0.62**	0.15
Benzo(b)fluoranthene	**740**	0.1[f]	0.58	NA
Benzo(k)fluoranthene	**560**	0.1[f]	0.50	13.4[e]
Chrysene	1.2	NA	**0.76**	0.166
Dibenz(a,h)anthracene	**220**	0.1[f]	**0.12**	0.033
Fluoranthene	1,600	NA	**1.5**	0.423
Fluorene	0.13	NA	**0.091**	0.0774
Indeno(1,2,3-cd)pyrene	**370**	0.1[f]	**0.37**	0.330[e]
2-Methylnaphthalene	0.06	NA	0.050	NA
Naphthalene	**0.16**	0.1[f]	0.057	0.176
Phenanthrene	**1,300**	0.1[f]	**0.85**	0.204
Pyrene	**1,900**	0.1[f]	**1.3**	0.195
PESTICIDES/PCBs				
4,4'-DDE	<0.0040	NA	**0.0048**	0.00316
4,4'-DDT	**2.8**	0.7[f]	**0.059**	0.00416
Dieldrin	<0.0040	0.000032[c]	<0.0037	0.0019
Aroclor 1254	**2.0**	0.371[g]	<0.037	0.0598[g]
Aroclor 1260	<0.040	0.371[g]	**0.26**	0.0598[g]

a: Oak Ridge National Laboratory (ORNL) final preliminary remediation goals (PRG) for ecological endpoints (Efroymson et al. 1997).
b: Threshold Effects Concentration (TEC). Concentration below which harmful effects are unlikely to be observed (MacDonald et al. 2000).
c: Ecological soil screening guidelines (USEPA 2005b).
d: Screening guidelines represent concentrations for Cr^{+6}
e: Freshwater upper effects threshold (UET) for bioassays. The UET represents the concentration above which adverse biological impacts would be expected.
f: Canadian Council of Ministers of the Environment (CCME) soil quality guidelines for the protection of environmental and human health (CCME 2004).
g: Screening guideline is for Total PCBs.
NA: Screening guidelines not available.
< : Indicates that the analyte was not detected above the concentration shown.

screening guidelines, if any, are noted on Table 2. Only maximum concentrations that exceeded relevant screening guidelines or for which no screening guidelines are currently available, 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. The general areas where samples were collected are depicted on Figure 2.

Sediment

Seven metals were detected in sediment samples taken from the Delaware River near the Crown Vantage Landfill site at maximum concentrations that exceeded screening guidelines; one metal for which no screening guideline is currently available was also detected (Table 2).

Maximum concentrations of cadmium, chromium, copper, lead, mercury, nickel, and zinc were detected in sediment samples collected from the Delaware River adjacent to the southwest end of the landfill. Maximum concentrations of cadmium and zinc exceeded the TECs by a factor of approximately five. Maximum concentrations of lead and nickel exceeded the TECs by a factor of approximately two. The maximum concentration of copper exceeded the TEC by a factor of approximately 1.5. Maximum concentrations of chromium and mercury slightly exceeded the TECs.

The maximum concentration of selenium was detected in a sediment sample collected approximately 760 m (2,493 ft) downstream of the landfill boundary. No screening guideline is currently available for comparison to the maximum concentration of selenium detected in the soil samples.

Ten PAHs were detected in sediment samples taken from the Delaware River near the Crown Vantage Landfill site at maximum concentrations that exceeded screening guidelines, and two PAHs for which no screening guidelines are currently available were also detected (Table 2).

Maximum concentrations of anthracene, benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, 2-methylnaphthalene, phenanthrene, and pyrene were detected in sediment samples collected from the Delaware River adjacent to the northwest corner of the landfill. Concentrations of benz(a)anthracene and pyrene exceeded the TECs by a factor of six. Maximum concentrations of benzo(a)pyrene, chrysene, and phenanthrene exceeded the TECs by a factor of approximately four, while maximum concentrations of anthracene and fluoranthene exceeded the TECs by a factor of approximately three. Maximum concentrations of fluorene and indeno(1,2,3-cd)pyrene slightly exceeded the screening guidelines. No screening guidelines are currently available for comparison to the maximum concentrations of benzo(b)fluoranthene and 2-methylnaphthalene.

The maximum concentration of dibenz(a,h)anthracene was detected in a sample collected from the Delaware River adjacent to the southwest corner of the landfill. The maximum concentration of dibenz(a,h)anthracene exceeded the TEC by a factor of three.

Two pesticides were detected in sediment samples taken from the Delaware River near the Crown Vantage Landfill site at maximum concentrations that exceeded screening guidelines (Table 2). The maximum concentration of 4,4’-DDT, which was detected in a sample collected from the Delaware River adjacent to the southwest corner of the landfill, exceeded the TEC by one order of magnitude.

The maximum concentration of 4,4'-DDE, which was detected in a sample collected from the Delaware River adjacent to the northwest corner of the landfill, exceeded the TEC by a factor of 1.5.

The maximum concentration of PCB Aroclor 1260, which was measured in a sample collected from the Delaware River adjacent to the west side of the landfill, exceeded the TEC by a factor of four.

<u>Soil</u>

Nine metals were detected in soil samples collected from the Crown Vantage Landfill site at maximum concentrations that exceeded screening guidelines (Table 2).

Maximum concentrations of cadmium, copper, nickel, selenium, and zinc were detected in a soil sample collected from the west side of the landfill adjacent to the Delaware River. The maximum concentration of zinc exceeded the ORNL-PRG by two orders of magnitude. The maximum concentrations of cadmium, copper, and selenium exceeded screening guidelines by one order of magnitude. The maximum concentration of nickel exceeded the ORNL-PRG by a factor of two.

Maximum concentrations of arsenic, chromium, lead, and mercury were detected in a soil sample collected from the northwest corner of the landfill. The maximum concentrations of chromium, mercury, and lead exceeded the ORNL-PRGs by four, three, and two orders of magnitude, respectively. The maximum concentration of arsenic exceeded the ORNL-PRG by a factor of approximately 1.5.

All the PAHs listed in Table 2 were detected in soil samples collected from the west side of the landfill adjacent to the Delaware River. The maximum concentrations of ten PAHs exceeded screening guidelines, and six PAHs for which no screening guidelines are currently available, were also detected in the soil samples.

The maximum concentrations of phenanthrene and pyrene exceeded the screening guidelines by four orders of magnitude. The maximum concentrations of benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene exceeded the screening guidelines by three orders of magnitude. The maximum concentration of acenaphthene exceeded the screening guideline by one order of magnitude. The maximum concentration of naphthalene exceeded the screening guideline by a factor of approximately 1.5. No screening guidelines are currently available for comparison to the maximum concentrations of acenaphthylene, anthracene, chrysene, fluoranthene, fluorene, and 2-methylnaphthalene detected in the soil samples.

One pesticide was detected in a soil sample collected from the west side of the landfill adjacent to the Delaware River at maximum concentrations that exceeded the screening guidelines. The maximum concentration of 4,4'-DDT exceeded the screening guideline by a factor of four.

The maximum concentration of PCB Aroclor 1254 exceeded the screening guideline by a factor of five in a sample collected from the west side of the landfill adjacent to the Delaware River.

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Lawrence Aviation Industries, Inc.

Port Jefferson Station, New York
EPA Facility ID: NYD002041531
Basin: Northern Long Island
HUC: 02030201

Executive Summary

The Lawrence Aviation Industries, Inc. (Lawrence Aviation) site in Port Jefferson Station, Suffolk County, New York, is approximately 2 km (1.2 mi) south of Port Jefferson Harbor, an inlet of Long Island Sound. From 1959 to the present, the site has been used by Lawrence Aviation Industries, Inc. for the manufacturing of titanium sheet metal. Metals, VOCs, acids and acid sludges, oils, solvents, and ink were stored on site, and the facility has been cited by county and state agencies for numerous environmental violations. Metals, PAHs, pesticides, PCBs, and VOCs are the contaminants of concern to NOAA at this site. NOAA trust resources present within Port Jefferson Harbor and Long Island Sound include the federally endangered Kemp's Ridley sea turtle, anadromous and marine fishes, as well as shellfish and the catadromous American eel. Groundwater, surface water, and sediment transport are the primary pathways for the migration of contaminants from the site to NOAA trust resources. The primary habitat of concern to NOAA is Port Jefferson Harbor.

Site Background

The Lawrence Aviation Industries, Inc. (Lawrence Aviation) site occupies approximately 50 ha (124 acres) in Port Jefferson Station, Suffolk County, New York. The site is approximately 2 km (1.2 mi) south of Port Jefferson Harbor, an inlet of Long Island Sound (Figure 1). From 1959 to the present, the site has been used for the manufacturing of titanium sheet metal, which was used mostly in the aviation industry. The facility has been cited by county and state agencies for numerous environmental violations. In the 1970s, the facility discharged waste liquids directly to a sump that overflowed and became an unlined lagoon (Figure 2). Samples collected from the lagoon contained chromium, nitrates, and fluoride in excess of groundwater discharge limits. In 1980, the facility crushed more than 1,600 drums and allowed liquid wastes to spill directly onto the ground. The drums contained volatile organic compounds (VOCs), acids and acid sludges, salt wastes, hydraulic oils, and other wastes from the manufacturing process. In 1990, the state discovered more than 2,000 drums at the site; these drums contained waste solvents, acids, oil, ink, and untreated acidic sludge (Weston 1999).

The site is bordered to the north by the Long Island Railroad and Sheep Pasture Road, to the east and west by residential single-family homes, and to the south by a utility company right-of-way. Directly west of the site is a recycling facility for yard waste (CDM 2005a).

Groundwater, surface water, and sediment transport are the primary pathways for the migration of contaminants from the site to NOAA trust resources. Groundwater was encountered between 2.4 m (8 ft) and 84 m (276 ft) below ground surface (bgs). Groundwater flow is to the north and northwest toward Port Jefferson Harbor (Weston 1999). Old Mill Pond and Old Mill Creek, which are north of the site (Figure1), are fed by groundwater (CDM 2005b). Old Mill Creek drains to Port Jefferson Harbor through a culvert for approximately 122 m (400 ft). Soils at the site are predominantly loamy to sandy in

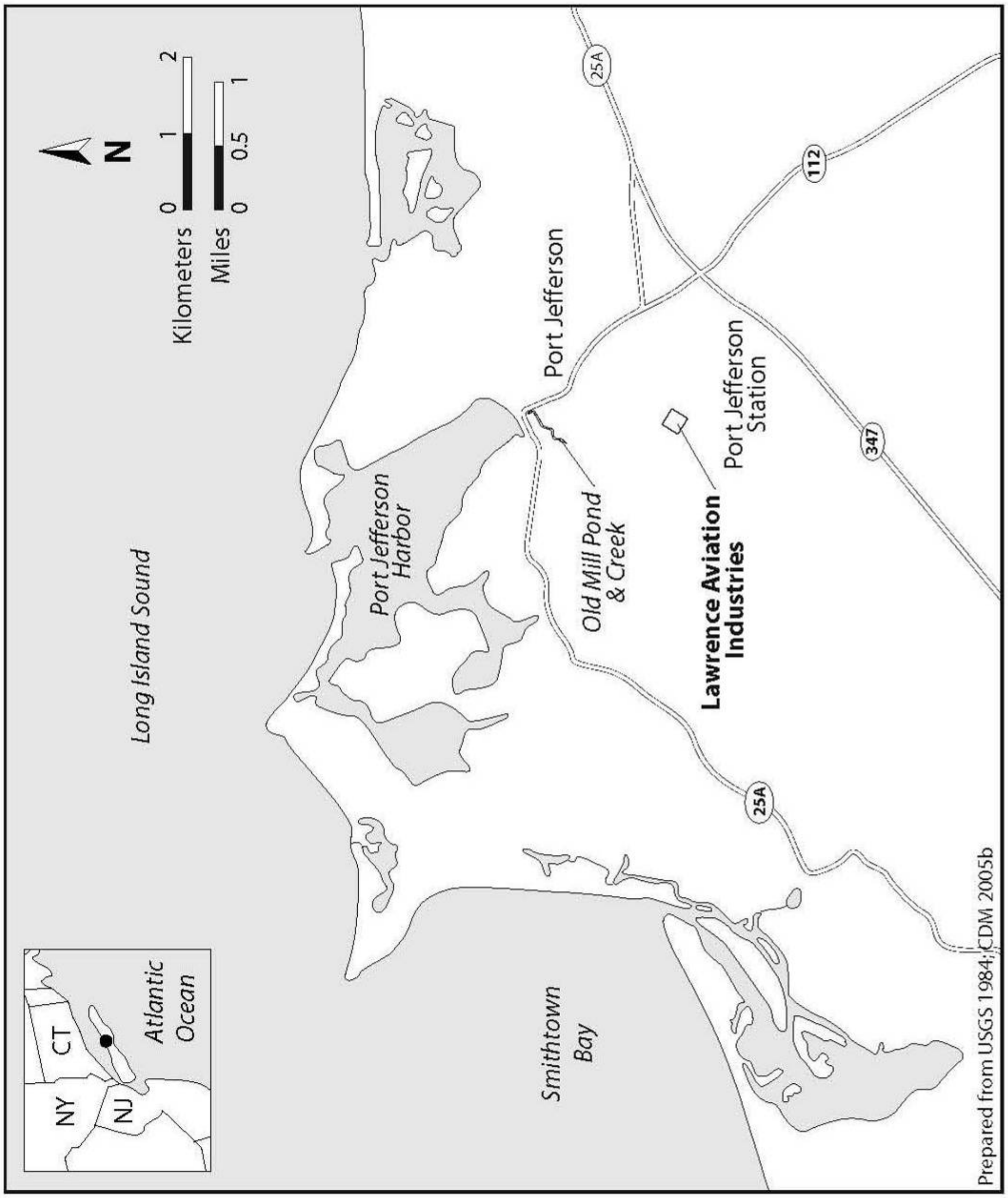

Figure 1. Location of the Lawrence Aviation Industries Inc. site in Port Jefferson Station, New York.

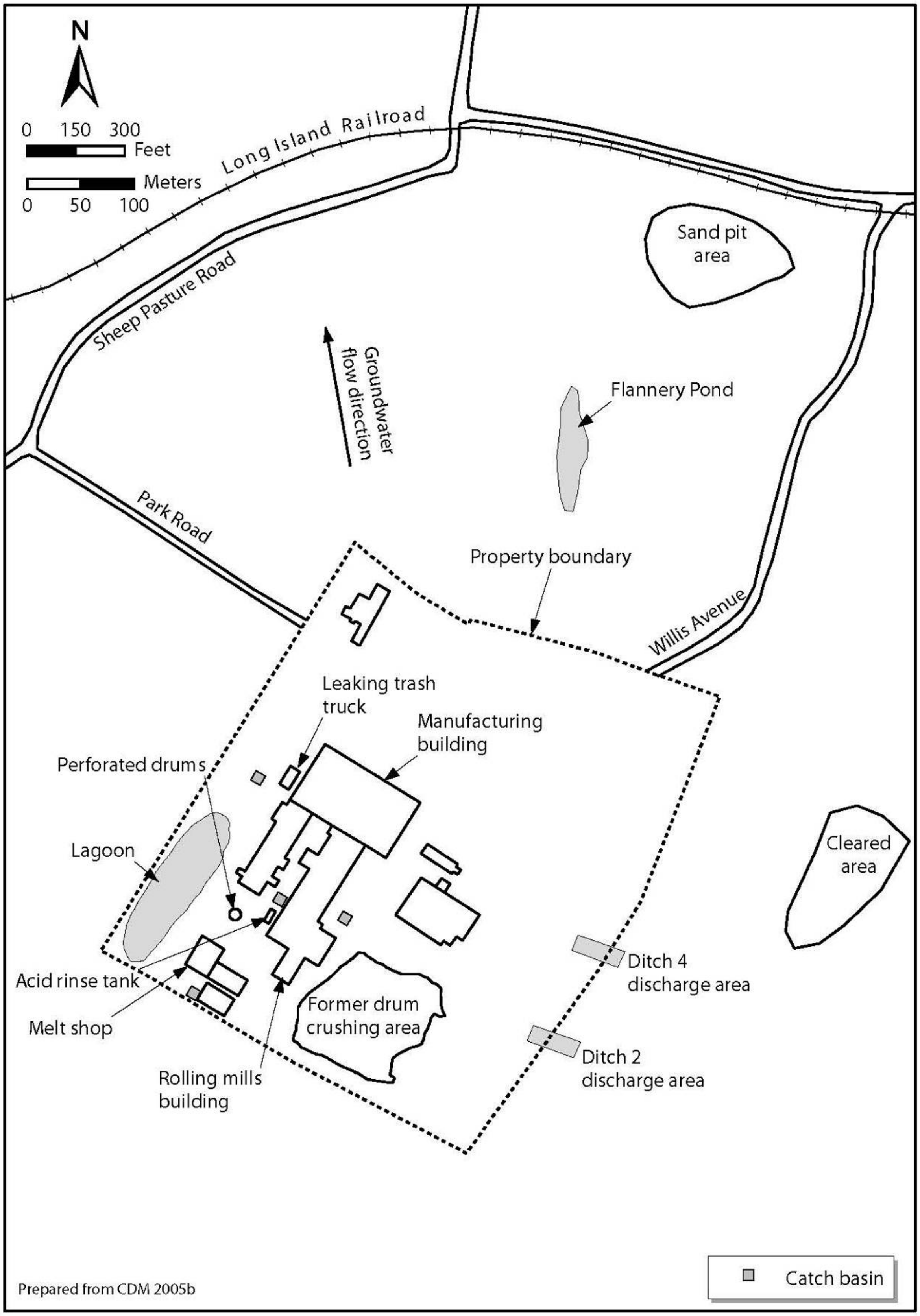

Figure 2. Detail of the Lawrence Aviation Industries Inc. property.

texture (CDM 2005b). The catch basins on the property received surface water runoff from the Lawrence Aviation facility (CDM 2005b). Although it is likely that the catch basins are connected to the sanitary sewer system, information regarding where the catch basins discharge was not available in the documents reviewed to prepare this report.

The site was proposed to the National Priorities List (NPL) on October 22, 1999 and was placed on the NPL on February 4, 2000 (USEPA 2005b). A remedial investigation/feasibility study was initiated in July 2001. From March to November 2004, drums and other containers were removed by the U.S. Environmental Protection Agency (USEPA). Overall, approximately 1,300 drums and other containers were processed. Drums and containers in good condition were disposed of off site. Drums and containers that could not be removed from the site because of their poor condition were placed in an area behind a berm for evaluation (CDM 2005b).

NOAA Trust Resources

The primary habitat of concern to NOAA is Port Jefferson Harbor, an embayment within the Long Island Sound estuary. Old Mill Creek is a secondary habitat of concern, because it is possible that American eel migrate into the creek from the harbor via the culvert that connects the two (Guthrie 2006). Numerous marine and anadromous species that are present within the bay and estuary use these waters for spawning, rearing, and adult habitat (Table 1). In 1987, the harbor was designated a Significant Coastal Fish and Wildlife Habitat by the state of New York (NYSDOS 2004). In 1988, Long Island Sound was identified as an Estuary of National Significance (NYSDEC 2005a).

Port Jefferson Harbor is a shallow embayment on the south-central shore of Long Island Sound. Long Island Sound is a large coastal estuary that measures 170 km (106 mi) in length and 34 km (21 mi) in width. The sound has more than 800 km (497 mi) of shoreline (Long Island Sound Foundation 2005). Most of the harbor ranges from 1.8 to 9.1 m (6 to 30 ft) in depth below the mean low water level (NYSDOS 2004). The harbor is protected by two barrier islands that allow an opening to the sound of only 300 m (984 ft) (USGS 1967) (Figure 1). Despite the small opening, salinity is generally over 20 parts per thousand; very little freshwater input to the harbor occurs. Bottom substrates range from silts to sands.

Small forage species such as bay anchovy, gobies, killifish, northern pipefish, oyster toadfish, sheepshead minnow, and silversides spend their entire lives within estuaries and are common to abundant in nearshore areas of Long Island Sound. Atlantic herring and Atlantic menhaden, which are also common-to-abundant forage species, usually spawn in coastal waters; the larvae are transported to estuaries, where they reside through adulthood (Stone et al. 1994).

Larger demersal species such as skates, windowpane, and winter flounder are common to abundant and spend all or most of their lives in the estuary. Spawning can occur either in bays or in coastal waters of the sound (Stone et al. 1994).

Several cod species, including Atlantic tomcod, pollock, and red hake, are present in Long Island Sound, but these species are not as common in the sound as in more northern estuaries. Atlantic tomcod spawn in nearly fresh water and reside in waters of low salinity. Pollock and red hake spawn in coastal waters; the larvae are transported to bays, where they reside as juveniles and adults (Stone et al. 1994).

Table 1. NOAA trust resources present in the Long Island Sound estuary near the Lawrence Aviation Industries, Inc. site (Stone et al. 1994; NYSDEC 2005b; Young 2005).

Species		**Habitat Use**			**Fisheries**	
Common Name	Scientific Name	Spawning Area	Nursery Area	Adult Habitat	Comm.	Rec.
ANADROMOUS FISH						
Alewife	*Alosa pseudoharengus*		♦	♦		
American shad	*Alosa sapidissima*		♦	♦		
Blueback herring	*Alosa aestivalis*		♦	♦		
Rainbow smelt	*Osmerus mordax mordax*		♦	♦		
Shortnose sturgeon	*Acipenser brevirostrum*		♦	♦		
Striped bass	*Morone saxatilis*		♦	♦	♦	♦
White perch	*Morone americana*		♦	♦		♦
CATADROMOUS FISH						
American eel	*Anguilla rostrata*			♦		♦
MARINE/ESTUARINE FISH						
American sand lance	*Ammodytes americanus*		♦	♦		
Atlantic herring	*Clupea harengus harengus*		♦	♦		
Atlantic mackerel	*Scomber scombrus*		♦	♦		
Atlantic menhaden	*Brevoortia tyrannus*		♦	♦		
Atlantic tomcod	*Microgadus tomcod*		♦	♦		♦
Bay anchovy	*Anchoa mitchilli*		♦	♦		
Black seabass	*Centropristis striata*		♦	♦	♦	♦
Bluefish	*Pomatomus saltatrix*		♦	♦	♦	♦
Butterfish	*Peprilus triacanthus*		♦	♦		
Cunner	*Tautogolabrus adspersus*		♦	♦		
Gobie	*Gobiosoma spp.*	♦	♦	♦		
Hogchoker	*Trinectes maculatus*	♦	♦	♦		
Killifish	*Fundulus spp.*	♦	♦	♦		
Northern pipefish	*Syngnathus fuscus*	♦	♦	♦		
Northern searobin	*Prionotus carolinus*	♦	♦	♦		
Pollock	*Pollachius virens*		♦	♦		
Red hake	*Urophycis chuss*		♦	♦		
Oyster toadfish	*Opsanus tau*	♦	♦	♦		
Scup	*Stenotomus chrysops*		♦	♦	♦	♦
Sheepshead minnow	*Cyprinodon variegatus variegatus*	♦	♦	♦		
Silverside	*Menidia spp.*	♦	♦	♦		
Skate	*Raja spp.*	♦	♦	♦		
Tautog	*Tautoga onitis*		♦	♦	♦	♦
Weakfish	*Cynoscion regalis*		♦	♦	♦	♦
Windowpane	*Scophthalmus aquosus*	♦	♦	♦		
Winter flounder	*Pseudopleuronectes americanus*	♦	♦	♦	♦	♦
SEA TURTLES						
Kemp's Ridley sea turtle	*Lepidochelys kempii*		♦			
INVERTEBRATES						
American lobster	*Homarus americanus*	♦	♦	♦	♦	♦
Blue crab	*Callinectes sapidus*		♦	♦	♦	♦
Blue mussel	*Mytilus edulis*	♦	♦	♦		
Daggerblade grass shrimp	*Palaemonetes pugio*	♦	♦	♦		
Eastern oyster	*Crassostrea virginica*	♦	♦	♦		
Northern quahog	*Mercenaria mercenaria*	♦	♦	♦	♦	♦
Sevenspine bay shrimp	*Crangon septemspinosa*	♦	♦	♦		
Softshell clam	*Mya arenaria*	♦	♦	♦		
			♦	♦		

Most of the remaining marine/estuarine species (Table 1) exhibit the common marine lifestyle of spawning in coastal areas followed by larval transport to estuaries, where the juveniles rear. Adults are present in the estuaries seasonally, usually moving offshore during the winter (Stone et al. 1994).

Many of the East Coast anadromous species are common to abundant in Long Island Sound. Juvenile alewife, American shad, blueback herring, striped bass, and white perch rear in bays through the summer and fall. Adults generally dwell in coastal areas of the sound (Stone et al. 1994).

Several species of shellfish spend their entire lives within the estuary. The northern quahog and eastern oyster are common in Long Island Sound. American lobster, daggerblade grass shrimp, and sevenspine bay shrimp are common to abundant, spending most or all of their lives within the sound. Blue crab are common but not as abundant as they are in estuaries farther south on the East Coast. Both juvenile and adult blue crab are present in the estuary, while brooding females generally move offshore (Stone et al. 1994).

The Kemp's Ridley sea turtle, listed as federally endangered by NOAA and as endangered in New York State, uses Long Island Sound as juvenile habitat (NYSDEC 2005b).

Areas of Long Island Sound in the vicinity of Port Jefferson Harbor support commercial and recreational fisheries for fish and shellfish. American lobster, hard clam, and long fin squid are the most valuable commercial fisheries (NYSDEC 2005c). The fish most actively sought by recreational and commercial fishers are black seabass, bluefish, scup, striped bass, tautog, weakfish, and winter flounder (Young 2005).

A health advisory is in effect Long Island Sound and some other marine waters of New York State because of polychlorinated biphenyl (PCB) contamination. The advisory recommends that women of child bearing age and children not eat fish of any species from these waters. For the general public, the advisory recommends limited consumption of no more than one meal per week of bluefish and American eel and no more than one meal per month of striped bass. There is also an advisory against consuming the hepatopancreas of crab and lobster in all waters of New York State because of PCB, cadmium, and dioxin contamination (NYSDOH 2007).

Site-Related Contamination

Samples of surface water, sediment, groundwater, and surface soil were collected from the Lawrence Aviation site during a screening-level ecological risk assessment and remedial investigation (CDM 2005a; CDM 2005b). The surface water samples were collected from 21 locations and the sediment samples from 24 locations in Port Jefferson Harbor, Flannery Pond, Old Mill Pond, Old Mill Creek, and catch basins. The groundwater samples were collected from 22 monitoring wells, public supply wells, and residential wells on the Lawrence Aviation property and neighboring properties at depths between 2.4 m (8 ft) and 84 m (276 ft) bgs. The surface soil samples were collected from 67 locations on the Lawrence Aviation property and an area approximately 183 m (600 ft) southwest of the property. The contaminants of concern to NOAA are metals, polycyclic aromatic hydrocarbons (PAHs), pesticides, PCBs, and VOCs.

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 the absence of such guidance, the screening guidelines for groundwater and surface water are the ambient water quality criteria (AWQC; USEPA 2002); the screening guidelines for sediment in a freshwater environment (such as Old Mill Creek, Old Mill Pond, and catch basins) are the threshold effects concentrations (TECs; MacDonald et al. 2000); and the screening guidelines for soil are the Oak Ridge National Laboratory final preliminary remediation goals (ORNL-PRGs; Efroymson et al. 1997) and the USEPA's ecological soil screening guidelines (USEPA 2005a). Exceptions to these screening guidelines, if any, are noted on Table 2. Only maximum concentrations that exceeded relevant screening guidelines, or for which there are currently no screening guidelines available, are discussed below. When known, the general sampling locations (refer to Figure 2) are also provided for maximum concentrations that exceeded screening guidelines or do not have screening guidelines.

<u>Surface Water</u>

Nine metals were detected in surface water samples collected from the Lawrence Aviation site at concentrations that exceeded the AWQC (Table 2). The maximum concentrations of cadmium, chromium, copper, mercury, nickel, selenium, silver, and zinc were detected in samples collected from the catch basin on the south side of the Lawrence Aviation property. The maximum concentrations of cadmium and copper exceeded the AWQC by two orders of magnitude. The maximum concentrations of chromium and zinc exceeded the AWQC by one order of magnitude. The maximum concentrations of mercury, nickel, and silver exceeded the AWQC by factors of four, three, and two, respectively. The maximum concentration of selenium slightly exceeded the AWQC.

The maximum concentration of lead, which was detected in a sample collected from the catch basin on the west side of the Lawrence Aviation property, exceeded the AWQC by two orders of magnitude.

<u>Sediment</u>

Eight metals were detected in sediment samples collected from the Lawrence Aviation site at concentrations that exceeded the TECs. The maximum concentrations of cadmium, copper, mercury, and zinc were detected in samples collected from the catch basin near the melt shop. The maximum concentrations of copper and zinc exceeded the TECs by an order of magnitude. The maximum concentrations of cadmium and mercury exceeded the TECs by factors of nine and three, respectively.

The maximum concentrations of lead and nickel were detected in samples collected from the catch basin east of the rolling mills building. Maximum concentrations of lead and nickel exceeded the TECs by factors of four and three, respectively. The maximum concentration of arsenic, which was detected in a sample collected from the south end of Old Mill Creek, exceeded the TEC by a factor of 1.5. The maximum concentration of chromium, which was detected in a sample collected from the catch basin near the acid rinse tank, also exceeded the TEC by a factor of 1.5.

Eleven PAHs were detected in sediment samples collected from the Lawrence Aviation site at maximum concentrations that exceeded the TECs, and one PAH was also detected for which there is currently no screening guideline available. The maximum concentrations of

Table 2. Maximum concentrations of contaminants of concern to NOAA at the Lawrence Aviation Industries, Inc. site (CDM 2005a; CDM 2005b). Contaminant values in bold exceed or are equal to screening guidelines.

	Soil (mg/kg)		**Water (µg/L)**			**Sediment (mg/kg)**	
Contaminant	Soil	ORNL-PRG[a]	Ground-water	Surface Water	AWQC[b]	Sediment	TEC[c]
METALS/INORGANICS							
Arsenic	**17**	9.9	18	42	150	**15**	9.79
Cadmium	**18**	0.36[d]	ND	**73**	0.25[e]	**9.2**	0.99
Chromium[f]	**270**	0.4	8.2	**120**	11	**63**	43.4
Copper	**120**	60	ND	**6,500**	9[e]	**920**	31.6
Lead	**790**	40.5	**320**	**1,500**	2.5[e]	**140**	35.8
Mercury	**0.4**	0.00051	0.7	**3.3**	0.77[g]	**0.5**	0.18
Nickel	**160**	30	**120**	**170**	52[e]	**68**	22.7
Selenium	**2.1**	0.21	**35**	**6.5**	5.0[h]	ND	NA
Silver	**3**	2	ND	**7.4**	3.2[e,i]	ND	4.5[j]
Zinc	**600**	8.5	**270,000**	**11,000**	120[e]	**1,600**	121
PAHs							
Acenaphthene	ND	20	N/A	ND	520[k]	**0.3**	0.290[j]
Anthracene	ND	NA	N/A	ND	NA	**0.6**	0.0572
Benz(a)anthracene	ND	NA	N/A	ND	NA	**1.4**	0.108
Benzo(a)pyrene	ND	NA	N/A	ND	NA	**1.2**	0.15
Benzo(b)fluoranthene	0.04	NA	N/A	ND	NA	1.6	NA
Benzo(k)fluoranthene	ND	NA	N/A	ND	NA	1.2	13.4[j]
Chrysene	0.09	NA	N/A	ND	NA	**1.6**	0.166
Dibenz(a,h)anthracene	ND	NA	N/A	ND	NA	**0.2**	0.033
Fluoranthene	0.14	NA	N/A	ND	NA	**3.7**	0.423
Fluorene	ND	NA	N/A	ND	NA	**0.4**	0.0774
Indeno(1,2,3-cd)pyrene	ND	NA	N/A	ND	NA	**1**	0.330[j]
Phenanthrene	0.13	NA	N/A	ND	NA	**3.1**	0.204
Pyrene	0.12	NA	N/A	ND	NA	**2.7**	0.195
PESTICIDES/PCBs							
Aldrin	0.03	NA	N/A	ND	3.0[i]	ND	0.040[j]
4,4'-DDD	0.004	NA	N/A	ND	0.6[i,k]	ND	0.00488
4,4'-DDE	0.3	NA	N/A	ND	1050[i,k]	**0.091**	0.00316
4,4'-DDT	0.6	NA	N/A	ND	0.001[l]	**0.094**	0.00416
Dieldrin	**0.02**	0.000032[d]	N/A	ND	0.056	**0.019**	0.0019
Endrin	0.002	NA	N/A	ND	0.036	**0.055**	0.00222
Gamma-BHC (Lindane)	0.0004	NA	N/A	ND	0.95[i]	ND	0.00237
Heptachlor	ND	NA	N/A	ND	0.0038	**0.034**	0.010[j]
Heptachlor Epoxide	ND	NA	N/A	ND	0.0038	**0.0086**	0.00247
Total PCBs	**4.2**	0.371	N/A	N/A	0.014	**6**	0.0598
VOCs							
cis-1,2-Dichloroethene	ND	NA	10	2.9	11,600[i,k]	0.15	NA
Trichloroethene	ND	NA	1,200	0.3	21,900[k]	**3**	0.041[m]

Table 2 continued on next page

Table 2, *cont*.

a: Oak Ridge National Laboratory (ORNL) final preliminary remediation goals (PRG) for ecological endpoints (Efroymson et al. 1997).
b: Ambient water quality criteria for the protection of aquatic organisms (USEPA 2002). Freshwater chronic criteria presented.
c: Threshold Effects Concentration (TEC). Concentration below which harmful effects are unlikely to be observed (MacDonald et al. 2000).
d: Ecological soil screening guidelines (USEPA 2005a).
e: Criterion expressed as a function of total hardness; concentrations shown correspond to hardness of 100 mg/L $CaCO_3$.
f: Screening guidelines represent concentrations for $Cr.^{+6}$
g: Derived from inorganic, but applied to total mercury.
h: Criterion expressed as total recoverable metal.
i: Chronic criterion not available; acute criterion presented.
j: Freshwater upper effects threshold (UET) for bioassays. The UET represents the concentration above which adverse biological impacts would be expected.
k: Lowest observable effects level (LOEL) (USEPA 1986).
l: Expressed as total DDT.
m: Apparent Effects Threshold for Neanthes bioassays (PTI 1988).
NA: Screening guidelines not available.
N/A: Contaminant not analyzed for.
ND: Not detected.

acenaphthene, anthracene, fluorene, and phenanthrene were detected in samples collected south of Old Mill Pond. The maximum concentrations of phenanthrene and anthracene exceeded the TECs by one order of magnitude. The maximum concentration of fluorene exceeded the TEC by a factor of five, while the maximum concentration of acenaphthene slightly exceeded the TEC.

The maximum concentrations of benz(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, dibenz(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, and pyrene were detected in samples collected from the north end of Old Mill Creek. The maximum concentrations of benz(a)anthracene, chrysene, and pyrene exceeded the TECs by one order of magnitude. The maximum concentrations of fluoranthene, benzo(a)pyrene, and dibenz(a,h)anthracene exceeded the TECs by factors of nine, eight, and six, respectively. The maximum concentration of indeno(1,2,3-cd)pyrene exceeded the TEC by a factor of three. No screening guideline is currently available for comparison to the maximum concentration of benzo(b)fluoranthene detected in the sediment samples.

Total PCBs and six pesticides were detected in sediment samples collected from the Lawrence Aviation site at maximum concentrations that exceeded the TECs. The maximum concentrations of total PCBs, 4,4'-DDE, and endrin were detected in samples collected from the catch basin east of the rolling mills building. The maximum concentration of total PCBs exceeded the TEC by two orders of magnitude. The maximum concentrations of 4,4'-DDE and endrin exceeded the TECs by one order of magnitude. The maximum concentrations of 4,4'-DDT and dieldrin, which were detected in samples collected from the catch basin near the acid rinse tank, also exceeded the TECs by one order of magnitude. The maximum concentration of heptachlor epoxide, which was detected in a sample collected from the north end of Old Mill Creek, exceeded the TEC by a factor of 3.5. The maximum concentration of heptachlor, which was detected in a sample collected from the catch basin near the melt shop, also exceeded the TEC by a factor of 3.5.

One VOC was detected in sediment samples collected from the Lawrence Aviation site at a maximum concentration that exceeded the screening guideline, and one VOC was also detected for which no screening guideline is currently available. The maximum concentrations of trichloroethene and cis-1,2-dichloroethene were detected in samples collected from the Old Mill Pond. The maximum concentration of trichloroethene exceeded the screening guideline by one order of magnitude. No screening guideline is currently available for comparison to the maximum concentration of cis-1,2-dichloroethene detected in the sediment samples.

<u>Groundwater</u>

Four metals were detected in groundwater samples collected from the Lawrence Aviation site at maximum concentrations that exceeded the AWQC. The maximum concentration of zinc, which was detected in a sample collected from near Sheep Pasture Road to the west of the Lawrence Aviation property, exceeded the AWQC by three orders of magnitude. The maximum concentration of lead, which was detected in a sample collected from a well approximately 1.2 km (0.75 mi) to the northwest of the Lawrence Aviation property, exceeded the AWQC by two orders of magnitude. The maximum concentrations of selenium and nickel were detected in samples collected near Park Road, to the northwest of the Lawrence Aviation property. The maximum concentrations of selenium and nickel exceeded the AWQC by factors of seven and two, respectively.

<u>Soil</u>

Ten metals were detected in soil samples collected from the Lawrence Aviation site at maximum concentrations that exceeded screening guidelines. The maximum concentrations of cadmium, chromium, copper, lead, mercury, nickel, and silver were detected in samples collected from the former drum crushing area. The maximum concentrations of chromium and mercury exceeded the ORNL-PRGs by two orders of magnitude. The maximum concentration of cadmium exceeded the USEPA's ecological soil screening guideline by one order of magnitude, and the maximum concentration of lead exceeded the ORNL-PRG by one order of magnitude. The maximum concentrations of nickel and copper exceeded the ORNL-PRGs by factors of five and two, respectively. The maximum concentration of silver slightly exceeded the ORNL-PRG.

The maximum concentration of selenium, which was detected in a sample collected from the Ditch 4 discharge area on the east side of the Lawrence Aviation property, exceeded the ORNL-PRG by one order of magnitude. The maximum concentration of zinc, which was detected in a sample collected near the melt shop, also exceeded the ORNL-PRG by one order of magnitude. The maximum concentration of arsenic, which was detected in a sample collected from the Ditch 2 discharge area on the east side of the Lawrence Aviation property, exceeded the ORNL-PRG by a factor of two.

Five PAHs, for which no screening guidelines are currently available, were detected in soil samples collected from the Lawrence Aviation site. The maximum concentration of benzo(b)fluoranthene was detected in a sample collected from the former drum crushing area. The maximum concentration of chrysene was detected in a sample taken from the sand pit area at the north end of the site. The maximum concentrations of fluoranthene, phenanthrene, and pyrene were detected in samples taken from the cleared area on the west side of the site. No screening guidelines are currently available for comparison to the maximum concentrations of PAHs detected in the soil samples.

Total PCBs and one pesticide were detected in soil samples collected from the Lawrence Aviation site at maximum concentrations that exceeded screening guidelines, and six pesticides were also detected for which no screening guidelines are currently available. The maximum concentrations of dieldrin and total PCBs were detected in samples taken from the lagoon on the west side of the site. The maximum concentration of dieldrin exceeded the USEPA's ecological soil screening guideline by two orders of magnitude. The maximum concentration of total PCBs exceeded the ORNL-PRG by one order of magnitude. The maximum concentrations of aldrin and 4,4'-DDT were detected in samples taken from the former drum crushing area. The maximum concentrations of 4,4'-DDD, 4,4'-DDE, and endrin were detected in samples taken just north of the Lawrence Aviation property line. The maximum concentration of gamma-BHC (lindane) was detected in a sample taken from the sand pit area. No screening guidelines are currently available for comparison to the maximum concentrations of 4,4'-DDT, 4,4'-DDD, 4,4'-DDE, aldrin, endrin, and gamma-BHC detected in the soil samples.

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McGuire Air Force Base #1

Wrightstown, New Jersey
EPA Facility ID: NJ0570024018
Basin: Crosswicks-Neshaminy
HUC: 02040201
Basin: Lower Delaware
HUC: 02040202

Executive Summary

McGuire Air Force Base #1, which is situated on the upper reaches of the Crosswicks Creek and Rancocas Creek watersheds, has provided support, maintenance, and logistics for USAF aircraft since 1937. The USAF's Installation Restoration Program has identified 17 contaminant source areas, most of which are adjacent to tributary streams of Crosswicks Creek and Rancocas Creek. Metals, PAHs, pesticides, and PCBs have been detected in surface water, sediment, groundwater, and soil samples collected at the base and downgradient of the base, during investigations conducted by the USAF and the USEPA. Surface water runoff and sediment transport are the primary pathways for the migration of contaminants from the site to NOAA trust resources; groundwater transport is a secondary pathway. The habitats of primary concern to NOAA are Crosswicks Creek, including North Run and South Run, and the North Branch of Rancocas Creek, including Jacks Run and Larkins Run. Crosswicks Creek and the North Branch of Rancocas Creek are tributaries of the Delaware River. The NOAA trust resource present in the vicinity of the site is the catadromous American eel.

Site Background

The McGuire Air Force Base #1 site (McGuire site, the base) is an active facility that encompasses approximately 1,415 ha (3,497 acres) in a rural area of Wrightstown, Burlington County, New Jersey. The McGuire site lies within the Crosswicks Creek and Rancocas Creek watersheds, which discharge to the Delaware River (Figure 1). The base is bordered to the north by Wrightstown and to the east, south, and west by the U.S. Army's Fort Dix military installation. Two streams, North Run and South Run, traverse the base. Major wetlands are present along both streams, which are tributaries of Crosswicks Creek. Jacks Run and Larkins Run, which are tributaries of the North Branch of Rancocas Creek, drain a small area of the southern portion of the base (Figure 2). The base lies within the Pinelands National Reserve (Figure 1).

From 1937 to 1948, the base was under the control of the U.S. Army. In 1948, jurisdiction over the facility was transferred to the U.S. Air Force (USAF). The base has served as headquarters of the New Jersey Air National Guard, Military Transport Service, Military Airlift Command and Air Mobility Command, and provided support, aircraft maintenance, logistics, aircraft fueling, and fuel storage for USAF aircraft. Since 1994, the base has supported worldwide airlifts for the 305th Air Mobility Wing to place military forces into combat situations.

Metals, polycyclic aromatic hydrocarbons (PAHs), pesticides, and polychlorinated biphenyls (PCBs) have been detected in surface water, sediment, groundwater, and soil samples

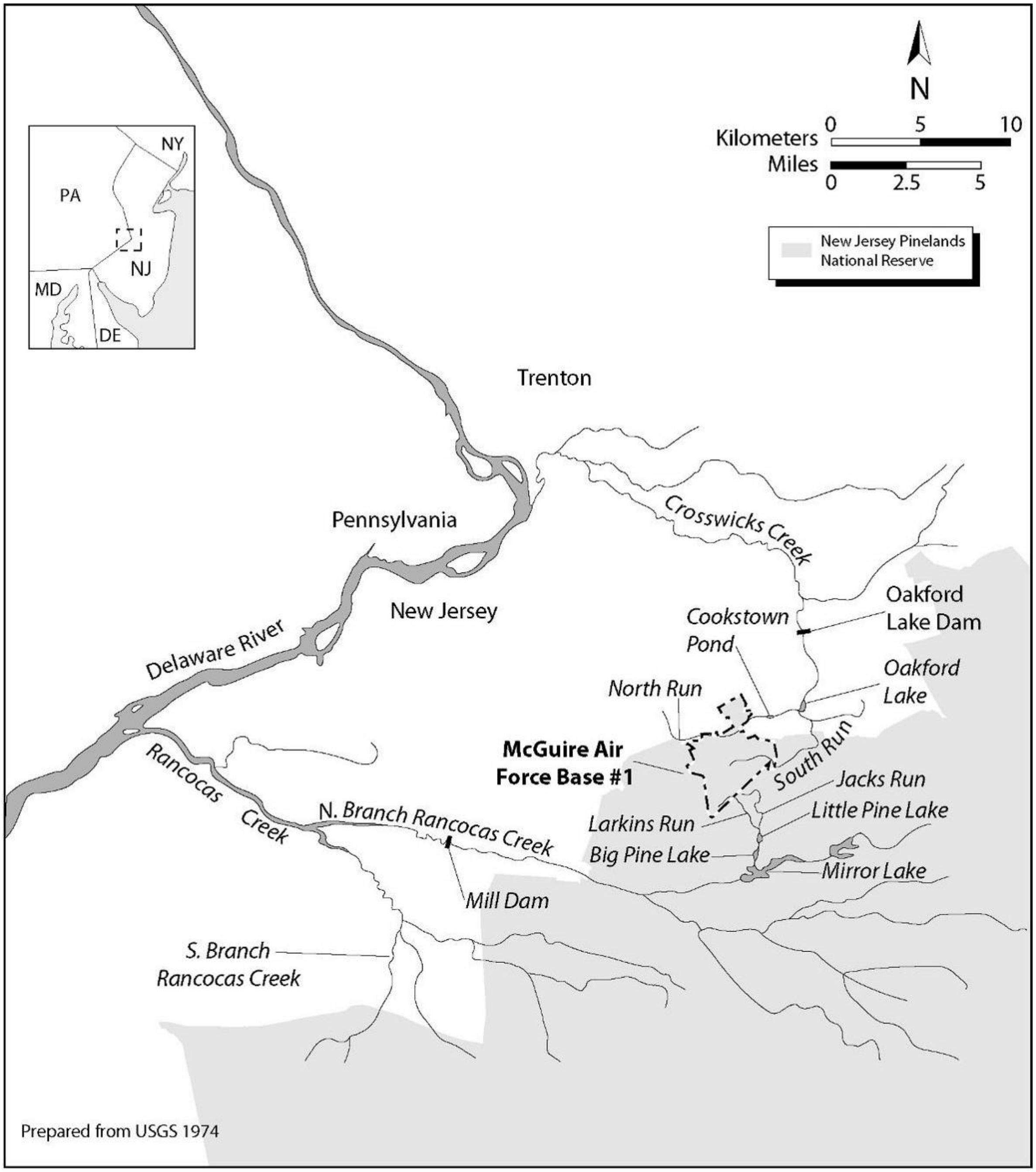

Figure 1. Location of the McGuire Air Force Base # 1 site in Wrightstown, New Jersey.

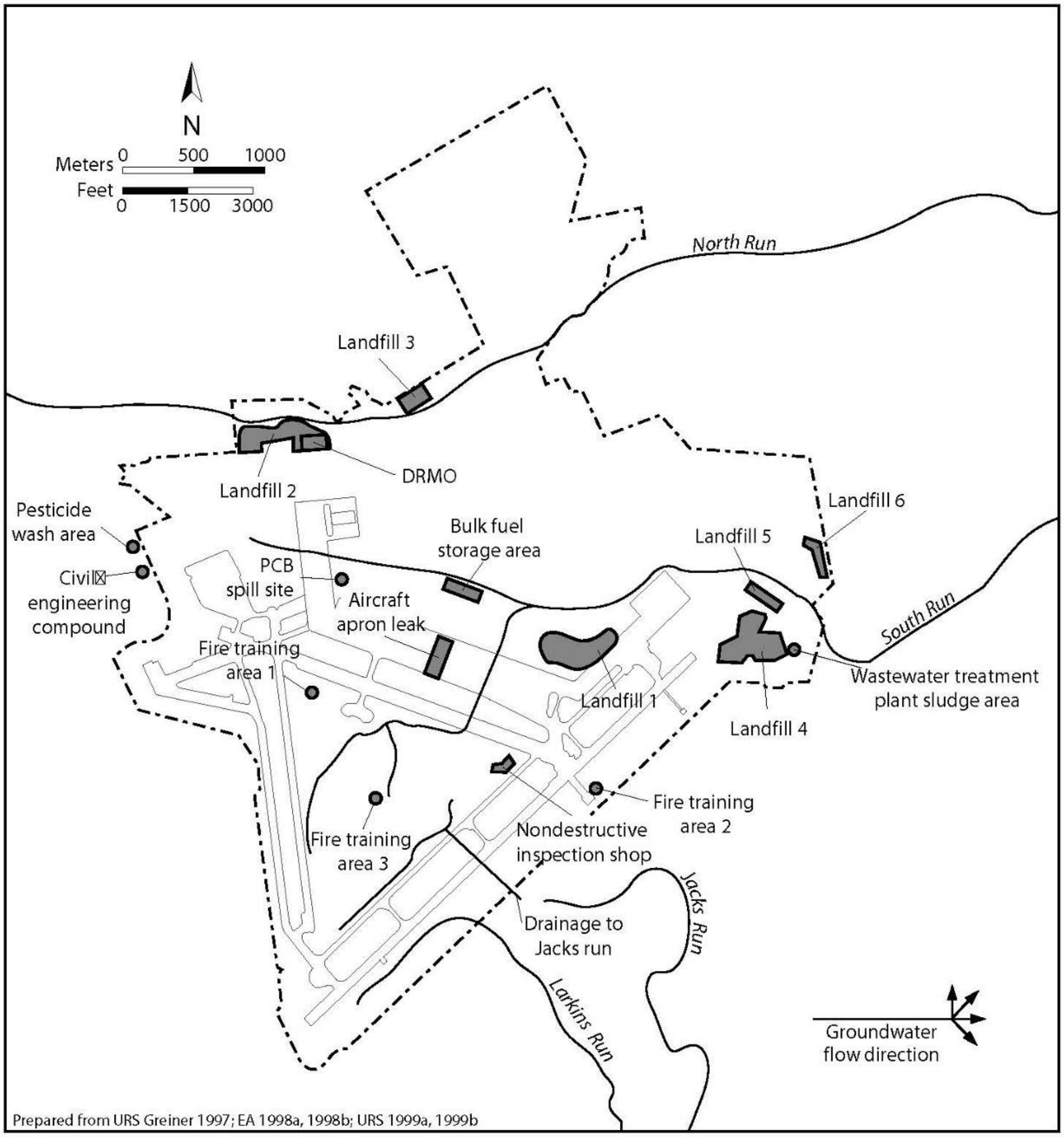

Figure 2. Detail of the McGuire Air Force Base #1 property.

collected at the base and downgradient of the base, during investigations conducted by the USAF and the U.S. Environmental Protection Agency (USEPA). Potential contaminant source areas on the McGuire site include several landfills and fuel storage, fire training, and sludge disposal areas. Numerous preliminary investigations and site assessments have been conducted at 17 source areas under the USAF's Installation Restoration Program (EA 1998a, 1998b; URS 1999a, 1999b; URS Greiner 1997). Table 1 describes each of the 17 source areas and the nearby NOAA trust habitats.

The McGuire site was proposed to the National Priorities List (NPL) on July 22, 1999, and was placed on the NPL on October 22, 1999 (USEPA 2005a). In 2002, the Federal Facilities Assessment Branch and the Agency for Toxic Substances and Disease Registry (ATSDR) completed a public health assessment for the McGuire site (ATSDR 2002). A remedial investigation and feasibility study initiated by the USEPA on June 30, 2003, is ongoing (USEPA 2005a).

Surface water runoff and sediment transport are the primary pathways for the migration of contaminants from the site to NOAA trust resources; groundwater transport is a secondary pathway. Surface water runoff is directed to diversion structures, drainage ditches, and storm sewers, which discharge to North Run and its tributaries in the northern portion of the base, to South Run and its tributaries in the central portion of the base, and to drainage ditches in the southern portion of the base. These drainage ditches empty into Jacks Run and Larkins Run south of the base (Figure 2). Groundwater beneath the site is encountered from 0.3 to 6.1 m (1 to 20 ft) below ground surface (URS Greiner 1997). Groundwater beneath the site flows to the north, northeast, east, and southeast before discharging to the nearest surface water body (URS Greiner 1997).

NOAA Trust Resources

The habitats of primary concern to NOAA are Crosswicks Creek, including tributaries North Run and South Run, and the North Branch of Rancocas Creek, including tributaries Jacks Run and Larkins Run. Crosswicks Creek and the North Branch of Rancocas Creek are tributaries of the Delaware River.

As shown on Figure 1, North Run flows to the northeast to Cookstown Pond. North Run then flows from the outlet of Cookstown Pond to empty into Oakford Lake on Crosswicks Creek. South Run flows to the east and turns north before also discharging into Crosswicks Creek, which then flows north to Oakford Lake. From its Oakford Lake outlet, Crosswicks Creek flows approximately 32 km (20 mi) before discharging to the Delaware River.

Jacks Run and Larkins Run flow to the south before discharging into Little Pine Lake. Little Pine Lake flows into Big Pine Lake. From the mouth of Big Pine Lake, Jacks Run converges with Mirror Lake on the North Branch of Rancocas Creek. The North Branch of Rancocas Creek flows approximately 48 km (30 mi) before converging with the South Branch of Rancocas Creek to form Rancocas Creek, which discharges to the Delaware River.

The migration of anadromous fish is blocked by dams on Crosswicks Creek and the North Branch of Rancocas Creek that are at least 15 km (9 mi) downstream of the base. The dams nearest the site that block fish passage are the Oakford Lake Dam on Crosswicks Creek and the Mill Dam on North Branch of Rancocas Creek (Figure 1). Fish passage facilities for both streams are in various stages of the design process (USACE 2005).

Table 1. Contaminant source areas identified on McGuire Air Force Base #1 (URS Greiner 1997; EA 1998a, 1998b; URS 1999a, 1999b; ATSDR 2002).

Source Area	Period of Operation	Source Area Size	Description of the Source Area	NOAA Trust Habitat Near Source Area
Landfill 1	Unknown	12 ha (30 acres)	Located on southern portion of the base. General refuse and unidentified waste were found at the landfill.	Adjacent to South Run
Landfill 2	1950-1956	5.1 ha (12.6 acres)	Located on the northwestern portion of the base. All base-generated wastes, including drums of waste oil and industrial chemicals, were placed in excavated trenches down to 6 m (20 ft).	Adjacent to North Run
Landfill 3	1956-1957	1 ha (2.5 acres)	Located along northern border of the base. General refuse, drums of unknown chemicals, scrap materials, and coal ash were buried in 5.5- to 6-m (18- to 20-ft) excavations.	Adjacent to North Run
Landfill 4	1958-1970s	7.3 ha (18 acres)	Located on the southeastern portion of the base. General base refuse, coal ash, and other industrial chemicals were placed in excavated trenches down to 4.5 m (15 ft).	Adjacent to unnamed tributary of South Run
Landfill 5	1970-1973	1.9 ha (4.7 acres)	Located on the southeasterrn portion of the base. Primarily construction debris, coal ash, and scrap metal were disposed of at the landfill. Chemical wastes may have occasionally been disposed of at the landfill.	Adjacent to South Run
Landfill 6	1973-1976	2.2 ha (5.4 acres)	Located on the southern portion of the base. General refuse, including concrete, metal, wood, glass, paper, and plastic, was disposed in trenches excavated to 4.5 m (15 ft). Disposal of hazardous substances at the landfill has not been documented.	Adjacent to South Run
Bulk Fuel Storage Area	1963-present	4 ha (10 acres)	Eight above ground storage tanks that store jet fuel and heating oil located on the central portion of the base. Fuel spills of up to 2 million L (528,344 gal) were documented in 1967, 1984, 1987, and 1993. Sludge from tanks, fly ash, coal, and slag were disposed or buried at the bulk fuel storage area.	Adjacent to unnamed tributary of South Run
Aircraft Apron Fuel Leak	1988	Unknown	Located on the south-central portion of the base. In 1988, a JP-4 jet fuel line ruptured, releasing an unknown volume of fuel that percolated into the shallow groundwater.	About 550 m (1,804 ft) from unnamed tributary of South Run
PCB Spill Site	1982	Unknown	Approximately 280 to 760 L (74 to 200 gal) of PCB-containing transformer oil was spilled in this area in 1982.	Approximately 227 m (745 ft) from unnamed tributary of South Run

Table 1 continued on next page

Table 1, *cont.*

Civil Engineering Compound	1950s	0.8 ha (2 acres)	Located on the northwestern portion of base. Fifty 208-L (55-gal) drums of waste oil and solvents were allegedly buried in this area in the 1950s.	Approximately 457 m (1,499 ft) from unnamed tributary of South Run
DRMO	Unknown	2 ha (5 acres)	Located on the northwestern portion of the base. Drums containing chemical and petroleum wastes and out-of-service transformers possibly containing PCBs were disposed of in this area. Bulk liquid wastes were also stored in the area in a 37,800-L (9,986-gal) underground storage tank.	Adjacent to North Run
Pesticide Wash Area	Unknown	Unknown	Located on the northwestern portion of the base. Pesticide spray equipment was washed and rinsed on a paved pad in this area. Runoff from the paved area discharged into a drainage ditch.	Approximately 457 m (1,499 ft) from unnamed tributary of South Run
Fire Training Area 1	Unknown	46 m (151 ft) diameter	Located on the central portion of the base. Waste oils, waste aviation gasoline, jet fuels, hydraulic fluids, spent solvents, and alcohols were used in this area.	Approximately 457 m (1,499 ft) from South Run
Fire Training Area 2	1958-1973	15 to 23 m (49 to 75 ft) diameter	Located on the southern portion of the base. Jet fuel was used during fire training exercises in this area.	About 700 m (2,297 ft) from unnamed tributary of Jack's Run
Fire Training Area 3	1970s-1980s	91 m (299 ft) diameter	Located on the southern central portion of the base. Jet fuel was used during fire training exercises in this area.	Adjacent to unnamed tributary of South Run
NDI Shop Drain Fields	1966-1972	0.61 ha (1.5 acres) 0.8 ha (2 acres)	Located on the southern portion of the base. Penetrants, emulsifiers, and developers were periodically disposed of onto a drain field in this area and were allowed to percolate into the soils.	About 300 m (984 feet) from a tributary of Jack's Run
WWTP Sludge Disposal Area	1970-1980	0.2 ha (0.5 acre)	Located on the southeastern border of the base. Sludge from a wastewater treatment plant was dewatered in this area by placing it onto unlined drying beds.	Adjacent to a tributary of South Run

The NOAA trust resource present in the vicinity of the McGuire site is the catadromous American eel, which is ubiquitous throughout the entire Delaware River basin. American eel enter rivers as juveniles and reside in freshwater habitats throughout their adult lives, migrating widely in most river systems. American eel are capable of traversing lowhead dams and small waterfalls. Because of this ability, the species is able to access the upper reaches of streams even when most anadromous species are blocked (Carberry 2000; Smith 2005).

Recreational fishing occurs in both Crosswicks Creek and Rancocas Creek, particularly in impoundments such as Mirror Lake on the North Branch of Rancocas Creek and the lower reaches of Crosswicks Creek. Warm-water resident freshwater species are targeted by recreational fishers. Fish resources in both streams are actively managed by the State of New Jersey (Carbury 2000). There is no commercial fishery in the vicinity.

The New Jersey Department of Environmental Protection (NJDEP) has issued a statewide fish and shellfish consumption advisory for PCBs and dioxins (NJDEP 2006). The fish consumption advisory for the lower Delaware River recommends reduced consumption of American eel, striped bass, white catfish, channel catfish, and white perch for the general public and no consumption for high-risk individuals. The NJDEP has also issued a statewide freshwater fish consumption advisory for mercury. The fish consumption advisory for the Pinelands Region recommends that the general public consume no more than one meal per month of largemouth bass and chain pickerel and no more than one meal per week of brown bullhead, yellow bullhead, and sunfish. It is recommended that high-risk individuals not consume largemouth bass, chain pickerel, brown bullhead, or yellow bullhead and eat no more than one meal per month of sunfish (NJDEP 2006).

Site-Related Contamination

Large numbers of surface water, sediment, groundwater, and soil samples have been collected over the years during numerous environmental investigations conducted at the McGuire site. These samples have been analyzed for a wide range of environmental contaminants, including semivolatile organic compounds (including PAHs), metals, pesticides, and PCBs.

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, regionally specific screening guidelines include the New Jersey Residential Direct Contact Soil Cleanup Criteria (RDCSCC; NJDEP 1999) and the New Jersey Groundwater Quality Standards (GWQS; NJDEP 2005). In the absence of such site-specific or regionally specific guidance, the screening guidelines for water are the ambient water quality criteria (AWQC; USEPA 2002); the screening guidelines for sediment in a freshwater environment are the threshold effects concentrations (TECs; MacDonald et al. 2000); and the screening guidelines for soil are the Oak Ridge National Laboratory final preliminary remediation goals (ORNL-PRGs; Efroymson et al. 1997) and the USEPA's ecological soil screening guidelines (USEPA 2005b). Exceptions to these screening guidelines, if any, are noted in Table 2. Only maximum concentrations that exceeded one or more relevant screening guidelines, or for which there are no screening guidelines currently available, 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. The general sampling locations discussed below are depicted on Figure 2.

<u>Surface Water</u>

Eight metals were detected in surface water samples collected from the McGuire site at maximum concentrations that exceeded screening guidelines. The maximum concentrations of arsenic, cadmium, chromium, copper, lead, nickel, selenium, and zinc were detected in samples collected from North Run in the vicinity of the Defense Reutilization and Marketing Office (DRMO) storage facility. The maximum concentration of arsenic exceeded the GWQS by three orders of magnitude. The maximum concentration of lead exceeded the AWQC by two orders of magnitude and the GWQS by one order of magnitude. The maximum concentrations of cadmium and chromium exceeded the AWQC by one order of magnitude and the GWQS by factors of five and seven, respectively. The maximum concentration of copper exceeded the AWQC by one order of magnitude. The maximum concentration of zinc exceeded the AWQC by a factor of five. The maximum concentration of selenium exceeded the AWQC by a factor of four. The maximum concentration of nickel exceeded the AWQC by a factor of three and the GWQS by a factor of two.

One PAH for which no screening guideline is currently available was detected in a surface water sample collected from the McGuire site: the maximum concentration of 2-methylnaphthalene occurred in a sample taken from South Run.

Table 2. Maximum concentrations of contaminants of concern to NOAA at the McGuire Air Force Base #1 site (URS Greiner 1997; EA 1998a, 1998b; URS 1999a,1999b). Contaminant values in bold exceed or are equal to screening guidelines.

	Soil (mg/kg)			Water (µg/L)				Sediment (mg/kg)	
Contaminant	Soil	ORNL-PRG[a]	New Jersey RDCSCC[b]	Ground-water	Surface Water	AWQC[c]	New Jersey GWQS[d]	Sedi-ment	TEC[e]
METALS/INORGANICS									
Arsenic	**57**	9.9	20	**420**	**96**	150	0.02	**14**	9.79
Cadmium	**37**	0.36[f]	39	**190**	**19**	0.25[g]	4	**12**	0.99
Chromium[h]	**190**	0.4	270	**1,200**	**480**	11	70	**59**	43.4
Copper	**100**	60	600	**3,200**	**340**	9[g]	1,300	**71**	31.6
Lead	**600**	40.5	400	**490**	**330**	2.5[g]	5	**170**	35.8
Mercury	**0.54**	0.00051	14	**8.5**	0.64	0.77[i]	2	**0.74**	0.18
Nickel	**50**	30	250	**810**	**170**	52[g]	100	**24**	22.7
Selenium	**5.5**	0.21	63	**41**	**21**	5.0[j]	40	3.9	NA
Silver	**3.6**	2	110	3	2.9	3.2[g,k]	40	**7.1**	4.5[l]
Zinc	**570**	8.5	1,500	**1,200**	**590**	120[g]	2,000	**340**	121
PAHs									
Acenaphthene	1.1	20	3,400	3	ND	520[m]	400	**32**	0.290[l]
Acenaphthylene	0.23	NA	NA	0.3	ND	NA	NA	**1.2**	0.160[l]
Anthracene	1.6	NA	10,000	2	ND	NA	2,000	**57**	0.0572
Benz(a)anthracene	**2.5**	0.1[n]	0.9	**0.9**	ND	NA	0.05	**120**	0.108
Benzo(a)pyrene	**1.8**	0.1[n]	0.66	**0.2**	ND	NA	0.005	**90**	0.15
Benzo(b)fluoranthene	**1.9**	0.1[n]	0.9	**0.3**	ND	NA	0.05	130	NA
Benzo(k)fluoranthene	**1.6**	0.1[n]	0.9	0.2	ND	NA	0.5	**43**	13.4[l]
Chrysene	2.4	NA	9	**20**	ND	NA	5	**130**	0.166
Dibenz(a,h)anthracene	0.03	0.1[n]	0.66	ND	ND	NA	0.005	**7.2**	0.033
Fluoranthene	5.5	NA	2,300	4	ND	NA	300	**380**	0.423
Fluorene	1.3	NA	2,300	2	ND	NA	300	**39**	0.0774
Indeno(1,2,3-cd)pyrene	**0.97**	0.1[n]	0.9	**0.1**	ND	NA	0.05	**38**	0.330[l]
2-Methylnaphthalene	97	NA	NA	110	12	NA	NA	2.3	NA
Naphthalene	**250**	0.1[n]	230	200	ND	620[m]	300	**0.82**	0.176
Phenanthrene	**6**	0.1[n]	NA	10	ND	NA	NA	**330**	0.204
Pyrene	**3.7**	0.1[n]	1,700	3	ND	NA	200	**300**	0.195
PESTICIDES/PCBs									
Aldrin	**0.082**	NA	0.04	**0.062**	ND	3.0[k]	0.002	**0.6**	0.040[l]
Chlordane	ND	NA	NA	ND	ND	0.0043	0.01	**0.89**	0.00324
4,4'-DDD	1.2	NA	3	0.017	ND	0.6[k,m]	0.1	**0.98**	0.00488
4,4'-DDE	1.8	NA	2	0.039	ND	1,050[k,m]	0.1	**2.3**	0.00316
4,4'-DDT	**7.2**	0.7[n]	2	**0.092**	ND	0.001[o]	0.1	**2**	0.00416
Dieldrin	**6**	0.000032[f]	0.042	**0.44**	**0.085**	0.056	0.002	**0.9**	0.0019
Endrin	0.031	NA	17	ND	ND	0.036	2	**0.017**	0.00222
Heptachlor	0.019	NA	0.15	**0.0048**	ND	0.0038	0.008	ND	0.010[l]
Heptachlor Epoxide	0.1	NA	NA	**0.041**	ND	0.0038	0.004	**0.092**	0.00247
PCBs	**3,100**[p]	0.371	0.49	**0.87**[q]	ND	0.014	0.02	**0.47**[p]	0.0598

Table 2 continued on next page

Table 2, *cont*.

a: Oak Ridge National Laboratory (ORNL) final preliminary remediation goals (PRG) for ecological endpoints (Efroymson et al. 1997).
b: Human health criteria for New Jersey Residential Direct Contact Soil Cleanup Criteria (RDCSCC) (NJDEP 1999).
c: Ambient water quality criteria for the protection of aquatic organisms (USEPA 2002). Freshwater chronic criteria presented.
d: New Jersey Groundwater Quality Standard (GWQS) (NJDEP 2005).
e: Threshold Effects Concentration (TEC). Concentration below which harmful effects are unlikely to be observed (MacDonald et al. 2000).
f: Ecological soil screening guidelines (USEPA 2005b).
g: Criterion expressed as a function of total hardness; concentrations shown correspond to hardness of 100 mg/L $CaCO_3$.
h: Screening guidelines represent concentrations for Cr^{+6}
i: Derived from inorganic, but applied to total mercury.
j: Criterion expressed as total recoverable metal.
k: Chronic criterion not available; acute criterion presented.
l: Freshwater upper effects threshold (UET) for bioassays. The UET represents the concentration above which adverse biological impacts would be expected.
m: Lowest observable effects level (LOEL) (USEPA 1986).
n: Canadian Council of Ministers of the Environment (CCME) environmental quality guidelines for agricultural land uses (CCME 2003).
o: Expressed as total DDT.
p: Aroclor 1260.
q: Aroclor 1254.
NA: Screening guidelines not available.
ND: Not detected.

One pesticide was detected in a surface water sample collected from the McGuire site. The maximum concentration of dieldrin, which was detected in a sample taken from South Run in the vicinity of the bulk fuel storage area, exceeded the AWQC by a factor of 1.5 and the GWQS by one order of magnitude.

Sediment

Nine metals were detected in sediment samples collected from the McGuire site at maximum concentrations that exceeded screening guidelines, and one metal was also detected for which no screening guideline is currently available. The maximum concentrations of arsenic, cadmium, chromium, copper, nickel, and zinc were detected in samples collected from North Run in the vicinity of the DRMO storage facility. The maximum concentration of cadmium exceeded the TEC by one order of magnitude. The maximum concentrations of zinc and copper exceeded the TECs by factors of three and two, respectively. The maximum concentrations of arsenic and chromium exceeded the TECs by factors of under 1.5, and the maximum concentration of nickel slightly exceeded the TEC.

The maximum concentration of lead, which was detected in a sediment sample collected from the bulk fuel storage area, exceeded the TEC by a factor of five.

The maximum concentrations of mercury and selenium were detected in samples collected from Jacks Run. The maximum concentration of mercury exceeded the TEC by a factor of four. No screening guideline is currently available for comparison to the maximum concentration of selenium detected in the sediment samples.

The maximum concentration of silver, which was detected in a sample collected from South Run in the vicinity of Landfill 4, exceeded the TEC by a factor of 1.5.

Fourteen PAHs were detected in sediment samples taken from the McGuire site at maximum concentrations that exceeded screening guidelines, and two PAHs were also detected for which no screening guidelines are currently available. The maximum concentrations of all 16 detected PAHs (Table 2) occurred in samples taken from South Run. The maximum concentrations of anthracene, benz(a)anthracene, phenanthrene, and pyrene exceeded the TECs by three orders of magnitude. The maximum concentrations of acenaphthene, benzo(a)pyrene, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, and indeno(1,2,3-cd)pyrene exceeded the TECs by two orders of magnitude. The maximum concentrations of acenaphthylene, naphthalene, and benzo(k)fluoranthene exceeded the TECs by factors of 7.5, five, and three, respectively. No screening guidelines are currently available for comparison to the maximum concentrations of benzo(b)fluoranthene and 2-methylnaphthalene detected in the sediment samples.

Eight pesticides were detected in sediment samples taken from the McGuire site at maximum concentrations that exceeded screening guidelines. The maximum concentrations of aldrin, chlordane, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, dieldrin, and heptachlor epoxide were detected in samples taken from South Run. The maximum concentrations of chlordane, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, and dieldrin exceeded the TECs by two orders of magnitude. The maximum concentrations of aldrin and heptachlor epoxide exceeded the TECs by one order of magnitude.

The maximum concentration of endrin, which was detected in a sample taken from Landfill 4, exceeded the TEC by a factor of eight.

One PCB Aroclor was detected in sediment samples taken from the McGuire site at a maximum concentration that exceeded screening guidelines. The maximum concentration of Aroclor 1260, which was detected in a sample taken from North Run in the vicinity of Landfill 3 and the DRMO storage facility, exceeded the TEC by a factor of eight.

Groundwater

Nine metals were detected in groundwater samples collected from the McGuire site at maximum concentrations that exceeded screening guidelines. The maximum concentrations of arsenic, chromium, copper, lead, mercury, nickel, selenium, and zinc were detected in samples collected from monitoring wells throughout the bulk fuel storage area. The maximum concentration of arsenic exceeded the GWQS by four orders of magnitude and the AWQC by a factor of three. The maximum concentrations of cadmium, chromium, and lead exceeded the AWQC by two orders of magnitude and the GWQS by one order of magnitude. The maximum concentration of copper exceeded the AWQC by two orders of magnitude and the GWQS by a factor of 2.5. The maximum concentration of nickel exceeded the AWQC by one order of magnitude and the GWQS by a factor of eight. The maximum concentration of mercury exceeded the AWQC by one order of magnitude and the GWQS by a factor of four. The maximum concentration of zinc exceeded the AWQC by one order of magnitude.

The maximum concentration of selenium, which was detected in a sample taken from a monitoring well in the aircraft apron area, exceeded the AWQC by a factor of eight and slightly exceeded the GWQS.

Five PAHs were detected in groundwater samples taken from the McGuire site at maximum concentrations that exceeded screening guidelines, and three PAHs were also detected for which no screening guidelines are currently available. The maximum concentrations of acenaphthylene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene were detected in samples taken from monitoring wells throughout Landfill 4. The maximum concentration of benzo(a)pyrene exceeded the GWQS by one order of magnitude. The maximum concentrations of benzo(b)fluoranthene and indeno(1,2,3-cd)pyrene exceeded the GWQS by factors of six and two, respectively. No screening guideline is currently available for comparison to the maximum concentration of acenaphthylene detected in the groundwater samples.

The maximum concentrations of benz(a)anthracene and chrysene were detected in samples taken from monitoring wells throughout the aircraft apron area. The maximum concentration of benz(a)anthracene exceeded the GWQS by one order of magnitude. The maximum concentration of chrysene exceeded the GWQS by a factor of four.

The maximum concentration of 2-methylnaphthalene was detected in a sample taken from a monitoring well in the bulk fuel storage area. The maximum concentration of phenanthrene was detected in a sample taken from a monitoring well in Landfill 2. No screening guidelines are currently available for comparison to the maximum concentrations of 2-methylnaphthalene and phenanthrene detected in the groundwater samples.

Five pesticides were detected in groundwater samples collected from the McGuire site at maximum concentrations that exceeded screening guidelines. The maximum concentrations of aldrin, heptachlor, and heptachlor epoxide were detected in samples taken from Landfill 4. The maximum concentration of aldrin exceeded the GWQS by one order of magnitude. The maximum concentration of heptachlor epoxide exceeded the AWQC and the GWQS by one order of magnitude. The maximum concentration of heptachlor slightly exceeded the AWQC.

The maximum concentration of 4,4'-DDT, which was detected in a sample taken from Landfill 2, exceeded the AWQC by one order of magnitude,.

The maximum concentration of dieldrin, which was detected in a sample taken from the DRMO storage facility, exceeded the GWQS by two orders of magnitude and the AWQC by a factor of eight.

One PCB Aroclor was detected in a groundwater sample taken from Landfill 2. The maximum concentration of Aroclor 1254 exceeded the AWQC and the GWQS by one order of magnitude.

Soil

Ten metals were detected in soil samples taken from the McGuire site at maximum concentrations that exceeded screening guidelines. The maximum concentrations of arsenic, cadmium, lead, and selenium were detected in samples taken from the bulk fuel storage area. The maximum concentration of cadmium exceeded the USEPA ecological soil screening guideline by two orders of magnitude. The maximum concentration of selenium exceeded the ORNL-PRG by one order of magnitude. The maximum concentration of lead exceeded the ORNL-PRG by one order of magnitude and the RDCSCC by a factor of 1.5. The maximum concentration of arsenic exceeded the ORNL-PRG by a factor of six and the RDCSCC by a factor of three.

The maximum concentrations of chromium and silver were detected in soil samples taken from Landfill 6. The maximum concentration of chromium exceeded the ORNL-PRG by two orders of magnitude. The maximum concentration of silver exceeded the ORNL-PRG by a factor of two.

The maximum concentrations of copper, mercury, and zinc were detected in soil samples taken from Landfill 5. The maximum concentration of mercury exceeded the ORNL-PRG by three orders of magnitude. The maximum concentration of zinc exceeded the ORNL-PRG by one order of magnitude. The maximum concentration of copper exceeded the ORNL-PRG by a factor of two.

The maximum concentration of nickel, which was detected in a sample taken from Landfill 2, exceeded the ORNL-PRG by a factor of two.

Eight PAHs were detected in soil samples taken from the McGuire site at maximum concentrations that exceeded screening guidelines, and two PAHs were also detected for which no screening guidelines are currently available. The maximum concentrations of 2-methynaphthalene and naphthalene were detected in samples taken from the DRMO storage facility. The maximum concentration of naphthalene exceeded the Canadian Council of Ministers of the Environment (CCME) environmental quality guidelines for agricultural land uses by three orders of magnitude and slightly exceeded the RDCSCC. No screening guideline is currently available for comparison to the maximum concentration of 2-methylnaphthalene detected in the soil samples.

The maximum concentrations of acenaphthylene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene were detected in samples taken from Landfill 5. The maximum concentration of benzo(a)pyrene exceeded the CCME environmental quality guideline by one order of magnitude and the RDCSCC by a factor of three. The maximum concentration of benzo(b)fluoranthene exceeded the CCME environmental quality guideline by one order of magnitude and the RDCSCC by a factor of two. The maximum concentration of indeno(1,2,3-cd)pyrene exceeded the CCME environmental quality guideline by almost one order of magnitude and slightly exceeded the RDCSCC. No screening guideline is currently available for comparison to the maximum concentration of acenaphthylene detected in the soil samples.

The maximum concentrations of benz(a)anthracene, benzo(k)fluoranthene, phenanthrene, and pyrene were detected in samples taken from Landfill 2. The maximum concentration of benz(a)anthracene exceeded the CCME environmental quality guideline by one order of magnitude and the RDCSCC by a factor of three. The maximum concentration of benzo(k)fluoranthene exceeded the CCME environmental quality guideline by one order of magnitude and the RDCSCC by a factor of two. The maximum concentrations of phenanthrene and pyrene exceeded the CCME environmental quality guidelines by one order of magnitude.

Three pesticides were detected in soil samples taken from the McGuire site at maximum concentrations that exceeded screening guidelines, and one pesticide was also detected for which no screening guideline is currently available. The maximum concentrations of aldrin and dieldrin were detected in samples taken from Landfill 4. The maximum concentration of dieldrin exceeded the USEPA ecological soil screening guideline by five orders of magnitude and the RDCSCC by two orders of magnitude. The maximum concentration of aldrin exceeded the RDCSCC by a factor of two.

The maximum concentrations of 4,4’-DDT and heptachlor epoxide were detected in samples taken from the DRMO storage facility. The maximum concentration of 4,4’-DDT exceeded the CCME environmental quality guideline by one order of magnitude and the RDCSCC by a factor of 3.5. No screening guideline is currently available for comparison to the maximum concentration of heptachlor epoxide detected in the soil samples.

One PCB Aroclor was detected in soil samples taken from the McGuire site at a maximum concentration that exceeded screening guidelines. The maximum concentration of Aroclor 1260 exceeded both the ORNL-PRG and the RDCSCC by three orders of magnitude.

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Pesticide Warehouse I

Arecibo, Puerto Rico
EPA Facility ID: PRD987367349
Basin: Cibuco-Guajataca
HUC: 21010002

Executive Summary

The Pesticide Warehouse I site is an active pesticide warehouse in a rural-industrial area of Arecibo, Puerto Rico. The facility is approximately 3 km (2 mi) south of a 2,200-ha (5,436-acre) estuarine wetland area called Caño Tiburones, which has been designated as a natural reserve by the Puerto Rico Department of Natural Resources. Since 1953, pesticides, insecticides, herbicides, and fertilizers have been prepared and stored at the facility. Metals, PAHs, and pesticides have been detected in soil and groundwater samples taken from the Pesticide Warehouse I site. The primary contaminants of concern to NOAA are metals and pesticides. The habitat of primary concern to NOAA in the vicinity of the site is the Caño Tiburones. NOAA trust resources present in the Caño Tiburones wetland include catadromous and amphidromous fish species and amphidromous invertebrates, including blue crab and several prawn and shrimp species. Groundwater is the primary pathway for the migration of contaminants from the site to NOAA trust resources.

Site Background

The Pesticide Warehouse I site is an active pesticide warehouse in a rural-industrial area of Arecibo, Puerto Rico. The Pesticide Warehouse I property is approximately 0.4 ha (1 acre) in area. The site is bordered to the south by State Road 2, to the north by Interstate 22, and to the east and west by agricultural lands. The facility is approximately 3 km (2 mi) south of a 2,200-ha (5,436-acre) estuarine wetland area called Caño Tiburones (Figure 1), which has been designated as a natural preserve by the Puerto Rico Department of Natural Resources.

Since 1953, pesticides, insecticides, herbicides, and fertilizers have been prepared and stored at the facility for use on pineapple crops in the surrounding area. An underground storage tank, a gasoline pump, two warehouses, and a small shed are present on the property. The layout of the Pesticide Warehouse I site is shown on Figure 2.

During preparation, pesticides are mixed in tanker trucks with water taken from a well that is southeast of the property; mixing occurs on a bermed platform adjacent to the main warehouse. During the mixing process, excess pesticides enter a grate-covered sump under the mixing platform. The wastewater is reportedly collected and recycled daily (Weston 2003a). An unlined pathway carries surface runoff, which flows to the east from the mixing platform. Drain outlets in the floor of the main warehouse discharge directly to the ground (Roy F. Weston 1997).

During a 1988 preliminary assessment, the Puerto Rico Environmental Quality Board documented that excess pesticides had been discharged directly to the ground during the mixing process and during weekly cleaning of the main warehouse. In addition, empty pesticide containers and bags were observed in an excavated pit in the northwest corner of the property (Weston 2003a). During numerous investigations conducted by the U.S.

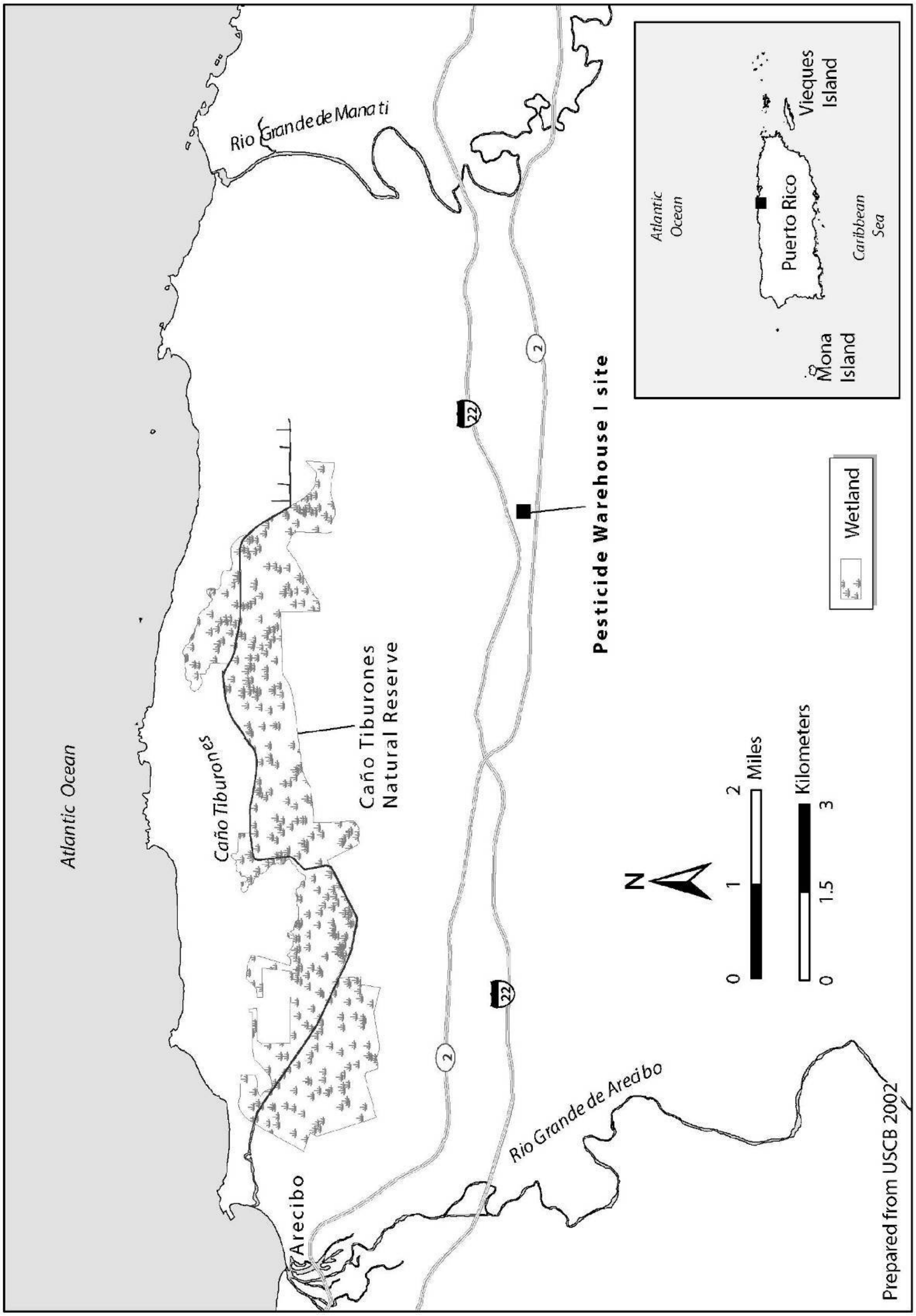

Figure 1. Location of the Pesticide Warehouse I site in Arecibo, Puerto Rico.

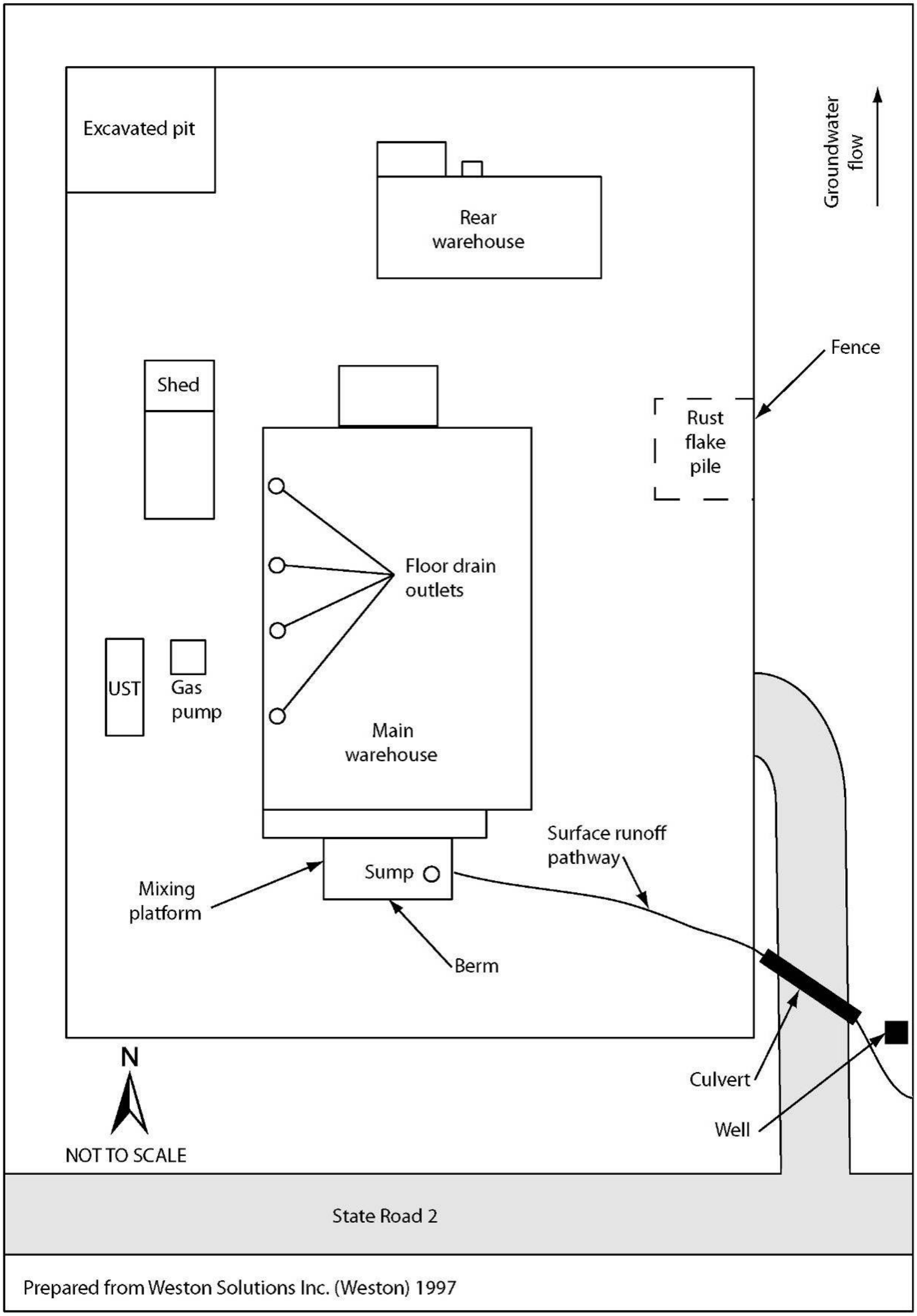

Figure 2. Detail of the Pesticide Warehouse I property.

Environmental Protection Agency (USEPA) and the Puerto Rico Environmental Quality Board, aldrin, endrin, endrin aldehyde, gamma-chlordane, toxaphene, diazinon, diuron, heptachlor epoxide, dieldrin, and 4,4'-DDE have been detected in soil and groundwater (Roy F. Weston 1997; Weston 2003a, 2003b). The site was proposed for placement on the National Priorities List on September 23, 2004 (USEPA 2006a).

Surface water runoff flows through the property before entering a culvert in the southeast corner; the culvert discharges into an off-site drainage ditch that parallels State Road 2. The drainage ditch continues past the property's well (Figure 2), where it dissipates into a vegetated area adjacent to the well.

Groundwater is the primary pathway for the migration of contaminants from the site to NOAA trust resources. The topography surrounding the site is characterized by numerous sinkholes and limestone hills. The aquifer under the site is a karst aquifer. Groundwater in the area flows north toward the Atlantic Ocean.

NOAA Trust Resources

The habitat of primary concern to NOAA is the Caño Tiburones, an estuarine wetland approximately 3 km (2 mi) north of the site that connects to the Atlantic Ocean. Historically, the Caño Tiburones was one of the largest freshwater wetlands in Puerto Rico, covering approximately 6,000 ha (15,000 acres). It included a canal system with weirs at its connections to the Atlantic Ocean (Yoshioka 2005). Today the wetland covers approximately 2,400 ha (6,000 acres); it is bounded to the west by the Rio Grande de Arecibo and to the east by the Rio Grande de Manati.

A large portion of the wetland system lies below sea level. Since 1949, the area has been pumped dry to recover land for agricultural purposes (ACJV 2005). In 1998, the Puerto Rico Department of Natural Resources designated the area as a natural reserve. As a result, a portion of the area is no longer pumped dry and has been allowed to flood, creating an estuarine wetland with deeper canals weaving through it. The Caño Tiburones natural reserve receives salt water from the Atlantic Ocean and fresh water from the karst aquifer to the south. Groundwater entering the wetland creates a range of salinities (Yoshioka 2005).

NOAA trust resources present in the Caño Tiburones include catadromous and amphidromous fish species and amphidromous invertebrates, including blue crab and several prawn and shrimp species (Table 1). Fishes likely to be found in the wetlands include migratory river species common to the tropics. Numerous prawn and shrimp species also are expected to spawn, rear, and forage in Caño Tiburones (Lilyestrom 2006; Yoshioka 2006).

The native freshwater fish and invertebrate species found in Puerto Rico are compulsory migrators that must spend a portion of their life cycle in estuarine or marine waters (Yoshioka 2002). Puerto Rican native freshwater fish and invertebrates are best described as amphidromous and iteroparous. The term amphidromous refers to predominately freshwater species that require estuarine or marine waters to complete their larval phases; iteroparous means they do not die after spawning. Following fertilization in fresh water, eggs and larvae are carried downstream by the current to estuaries, and fish and shrimp larvae spend several months maturing in marine or estuarine waters. Shrimp larvae enter marine and estuarine waters as non-feeders; when the salinity reaches 12 parts per thousand and above, the larvae molt and begin feeding before reentering freshwater

Table 1. NOAA trust resources present in Caño Tiburones near the Pesticide Warehouse I site (Lilyestrom 2006; Yoshioka 2006).

Species		**Habitat Use**			**Fisheries**	
Common Name	Scientific Name	Spawning Area	Nursery Area	Adult Habitat	Comm.	Recreational / Subsistence
CATADROMOUS FISH						
American eel	*Anguilla rostrata*		♦	♦		♦
AMPHIDROMOUS FISH						
Bigmouth sleeper	*Gobiomorus dormitor*	♦	♦	♦		♦
Bonefish	*Albula vulpes*					♦
Burro grunt	*Pomadasys crocro*				♦	
Common snook	*Centropomus undecimalis*		♦	♦	♦	♦
Dog snapper	*Lutjanus jocu*		♦	♦	♦	♦
Fat sleeper	*Dormitator maculatus*	♦	♦	♦		
Flagfin mojarra	*Eucinostomus melanopterus*				♦	♦
Horse-eye jack	*Caranx latus*		♦	♦	♦	♦
Irish pompano	*Diapterus auratus*				♦	♦
Mountain mullet	*Agonostomus monticola*	♦	♦	♦		♦
Permit	*Trachinotus falcatus*				♦	♦
Rhombic mojarra	*Diapterus rhombeus*				♦	♦
River goby	*Awaous banana*	♦	♦	♦		
Sirajo goby[a,b]	*Sicydium plumieri*	♦	♦	♦		♦
Spinycheek sleeper[a,b]	*Eleotris pisonis*	♦	♦	♦		
Swordspine snook	*Centropomus ensiferus*					
Tarpon	*Megalops atlanticus*	♦	♦	♦		♦
Tilapia[a]	*Oreochromis mossambicus*	♦	♦	♦	♦	♦
Western mosquitofish	*Gambusia affinis*	♦	♦	♦		
White mullet	*Mugil curema*		♦	♦	♦	
Yellowfin mojarra	*Gerres cinereus*		♦	♦	♦	♦
AMPHIDROMOUS INVERTEBRATES						
Blue crab	*Callinectes sapidus*		♦	♦		
Bocourt swimming crab	*Callinectes bocourti*		♦	♦		
Dana swimming crab	*Callinectes danae*		♦	♦		
Rugose swimming crab	*Callinectes exasperatus*		♦	♦		
Cascade river prawn	*Macrobrachium heterochirus*	♦	♦	♦		♦
Unnamed river prawn[c]	*Macrobrachium crenulatum*	♦	♦	♦		
Unnamed river prawn[c]	*Macrobrachium faustinum*	♦	♦	♦		
Bigclaw river shrimp	*Macrobrachium carcinus*	♦	♦	♦		♦
Cinnamon river shrimp	*Macrobrachium acanthurus*	♦	♦	♦		♦
Unnamed river shrimp[b,c]	*Atya innocous*	♦	♦	♦		♦
Unnamed river shrimp[b,c]	*Atya lanipes*	♦	♦	♦		♦
Unnamed river shrimp[b,c]	*Atya scabra*	♦	♦	♦		♦
Unnamed river shrimp[b,c]	*Jonga serrei*	♦	♦	♦		
Unnamed river shrimp[b,c]	*Micratya poeyi*	♦	♦	♦		
Unnamed river shrimp[b,c]	*Potimirrim americana*	♦	♦	♦		
Unnamed river shrimp[b,c]	*Potimirrim mexican*	♦	♦	♦		
Unnamed river shrimp[b,c]	*Xiphocaris elongata*	♦	♦	♦		

a: Common names are from Lilyestrom 2006.
b: Scientific names are from Yoshioka 2006.
c: No common names were available.

systems as juveniles. These fish and shrimp spend the majority of their life cycles in the middle to upper reaches of natural freshwater rivers and lagoons (Yoshioka 2002).

Commercial fisheries in the Caño Tiburones include burro grunt, common snook, dog snapper, horse-eye jack, Irish pompano, permit, tilapia, white mullet, and flagfin, rhombic, and yellowfin mojarra. Recreational fishing and subsistence fishing for most of the fish and invertebrate species listed in Table 1 occurs in the Caño Tiburones (Lilyestrom 2006; Yoshioka 2006). Sirajo goby, considered a delicacy, is fished in its larval stage. The larger *Macrobrachium* prawns, *Atya* shrimp, American eel, and several species of amphidromous fishes are among the NOAA trust species that are fished recreationally in the Caño Tiburones (Lilyestrom 2006; Yoshioka 2006). Many of the larger shrimp species are important for native celebrations. No fish consumption advisories are in effect for the Caño Tiburones at this time (Lilyestrom 2006).

Site-Related Contamination

Groundwater and soil samples were collected at the Pesticide Warehouse I site during environmental investigations conducted in 1996 and 2003. The samples were analyzed for metals, semivolatile organic compounds (including polycyclic aromatic hydrocarbons [PAHs]), volatile organic compounds, pesticides, and polychlorinated biphenyls (PCBs). The primary contaminants of concern to NOAA are metals and pesticides.

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 the absence of such guidance, the screening guidelines for groundwater are the ambient water quality criteria (AWQC; USEPA 2006b), and the screening guidelines for soil are the Oak Ridge National Laboratory final preliminary remediation goals (ORNL-PRGs; Efroymson et al. 1997) and the USEPA's ecological soil screening guidelines (USEPA 2005). Exceptions to these screening guidelines, if any, are noted on Table 2. Only maximum concentrations that exceeded relevant screening guidelines, or for which there are currently 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. The general sampling locations discussed below are depicted on Figure 2.

<u>Groundwater</u>

Two pesticides were detected in groundwater samples collected from the Pesticide Warehouse I site at maximum concentrations that exceeded screening guidelines. The maximum concentrations of dieldrin and heptachlor epoxide were detected in samples collected from the well southeast of the Pesticide Warehouse I property. The maximum concentration of heptachlor epoxide exceeded the AWQC by one order of magnitude, and the maximum concentration of dieldrin exceeded the AWQC by a factor of four.

<u>Soil</u>

Eight metals were detected in soil samples taken from the Pesticide Warehouse I site at maximum concentrations that exceeded screening guidelines. The maximum concentrations of arsenic and chromium were detected in soil samples taken from the surface runoff pathway in the southeastern corner of the property. The maximum

Table 2. Maximum concentrations of contaminants of concern to NOAA at the Pesticide Warehouse I site. Contaminant values in bold exceed or are equal to screening guidelines (Roy F. Weston 1997; Weston 2003a; 2003b).

	Soil (mg/kg)		Water (µg/L)	
Contaminant	Soil	ORNL-PRG[a]	Groundwater	AWQC[b]
METALS/INORGANICS				
Arsenic	**23**	9.9	0.38	150
Cadmium	**2.9**	0.36[c]	ND	0.25[d]
Chromium[e]	**73**	0.4	5.2	11
Copper	**150**	60	8.4	9.0[d]
Lead	**63**	40.5	1.7	2.5[d]
Mercury	**0.23**	0.00051	ND	0.77[f]
Nickel	**50**	30	0.94	52[d]
Selenium	ND	0.21	0.80	5.0[g]
Silver	1.6	2	0.029	3.2[d,h]
Zinc	**1,900**	8.5	10	120[d]
PAHs				
Fluoranthene	0.043	NA	ND	NA
Phenanthrene	0.052	NA	ND	NA
Pyrene	0.12	NA	ND	NA
PESTICIDES/PCBs				
Aldrin	0.007	NA	ND	3.0[h]
4,4'-DDD	0.000096	NA	ND	0.6[h,i]
4,4'-DDE	0.0019	NA	0.2	1050[h,i]
4,4'-DDT	0.00011	NA	ND	0.001[j]
Dieldrin	ND	0.000032[c]	**0.22**	0.056
Endrin	0.021	NA	0.0098	0.036
Gamma-BHC (Lindane)	0.00005	NA	ND	0.95[h]
Heptachlor	0.0043	NA	ND	0.0038
Heptachlor Epoxide	0.0011	NA	**0.05**	0.0038
Toxaphene	3.7	NA	ND	0.0002

a: Oak Ridge National Laboratory (ORNL) final preliminary remediation goals (PRG) for ecological endpoints (Efroymson et al. 1997).
b: Ambient water quality criteria for the protection of aquatic organisms (USEPA 2006b). Freshwater chronic criteria presented.
c: Ecological soil screening guidelines (USEPA 2005).
d: Criterion expressed as a function of total hardness; concentrations shown correspond to hardness of 100 mg/L $CaCO_3$.
e: Screening guidelines represent concentrations for $Cr.^{+6}$
f: Derived from inorganic, but applied to total mercury.
g: Criterion expressed as total recoverable metal.
h: Chronic criterion not available; acute criterion presented.
i: Lowest observable effects level (LOEL; USEPA 1986).
j: Expressed as total DDT.
NA: Screening guidelines not available.
ND: Not detected.

concentration of chromium exceeded the ORNL-PRG by two orders of magnitude, and the maximum concentration of arsenic exceeded the ORNL-PRG by a factor of two.

The maximum concentration of cadmium, which was detected in a soil sample taken from an area just south of the surface runoff pathway in the southeastern corner of the property, exceeded the USEPA's ecological soil screening guideline by a factor of eight.

The maximum concentrations of copper, lead, and nickel were detected in soil samples taken from the eastern border of the property in the vicinity of the rust flake pile. The maximum concentration of copper exceeded the ORNL-PRG by a factor of 2.5, and the maximum concentrations of lead and nickel exceeded the ORNL-PRGs by a factor of 1.5.

The maximum concentration of mercury, which was detected in a soil sample taken from an area just west of the property, exceeded the ORNL-PRG by two orders of magnitude.

The maximum concentration of zinc, which was detected in a soil sample taken from the area just west of the main warehouse, also exceeded the ORNL-PRG by two orders of magnitude.

Three PAHs were detected in soil samples taken from the Pesticide Warehouse I property. The maximum concentrations of fluoranthene, phenanthrene, and pyrene were detected in soil samples taken from the drainage ditch just south of the well that is southeast of the property. No screening guidelines are currently available for comparison to the maximum concentrations of these three PAHs detected in the soil samples.

Nine pesticides were detected in soil samples taken from the Pesticide Warehouse I site. The maximum concentrations of aldrin, endrin, heptachlor, and toxaphene were detected in soil samples taken from the surface runoff pathway in the southeastern corner of the Pesticide Warehouse I property. The maximum concentration of 4,4'-DDD was detected in a sample taken from the area just west of the excavated pit in the northwestern portion of the property. The maximum concentration 4,4'-DDE was detected in a sample taken from the area just west of the main warehouse. The maximum concentration of 4,4'-DDT was detected in a sample taken just west of the property. The maximum concentrations of gamma-BHC (Lindane) and heptachlor epoxide were detected in samples taken from the area just west and north, respectively, of the rear warehouse. No screening guidelines are currently available for comparison to the maximum concentrations of these nine pesticides detected in the soil samples.

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Curtis Bay Coast Guard Yard

Anne Arundel County, Maryland
EPA Facility ID: MD4690307844
Basin: Gunpowder-Patapsco
HUC: 02060003

Executive Summary

The Curtis Bay Coast Guard Yard is southeast of Baltimore, Maryland, along the eastern bank of Curtis Creek, which borders the site to the south and west. The Curtis Bay Coast Guard Yard's current mission is to provide core industrial support for the U.S. Coast Guard, including the design, construction, overhaul, repair, and modification of ships and boats. Metals, PAHs, pesticides, and PCBs have been detected in various environmental media at the site and are the primary contaminants of concern to NOAA. Surface water from the site drains into Curtis Creek, a tidally influenced stream. Curtis Creek, which flows into Curtis Bay, provides habitat to a number of NOAA trust resources, including anadromous and catadromous fish species.

Site Background

The Curtis Bay Coast Guard Yard site is in a densely developed industrial and non-industrial area approximately 10 km (6 mi) southeast of downtown Baltimore in Anne Arundel County, Maryland (Figure 1). The site encompasses approximately 46 ha (114 acres) and contains significant marine and shipbuilding facilities, including numerous administration buildings, industrial shops, equipment staging areas, piers, bulkheads, and both paved and unpaved parking lots (Tetra Tech NUS Inc. 2000). The site lies in the 100 and 500-year flood plains. The Curtis Bay site is bordered to the south and west by Curtis Creek and to the east by Arundel Cove which bisects the eastern portion of the site (Tetra Tech NUS Inc. 2000) (Figure 2).

The Curtis Bay Coast Guard Yard was established as a U.S. Coast Guard training academy and boat repair facility in 1899. Industrial development at the yard began in 1906. By 1910, the Curtis Bay Coast Guard Yard was a fully operational shipbuilding and repair facility. In 1941, a bulkhead was constructed extending into Curtis Creek. Three piers and two floating dry docks were built and moored along the piers (Figure 2). Operations at the facility included vessel repair and overhaul, as well as various manufacturing activities and buoy construction. These operations continued through the 1970s. Throughout the 1980s and 1990s, manufacturing operations were reduced. During the 1990s, major activities at the facility centered around the construction of a 3,500-ton shiplift, which is used to lift large ships out of the water. The Curtis Bay Coast Guard Yard's current mission is to provide core industrial support for the Coast Guard, including the design, construction, overhaul, repair, and modification of ships and boats (Tetra Tech NUS Inc. 2000).

In 1993, an initial preliminary assessment was completed for the Curtis Bay Coast Guard Yard site. In a site inspection conducted in 2000, a total of nine areas of potential contamination were identified. Table 1 lists the nine areas, the activities that took place at each, and the potential contamination within each area (Tetra Tech NUS Inc. 2000).

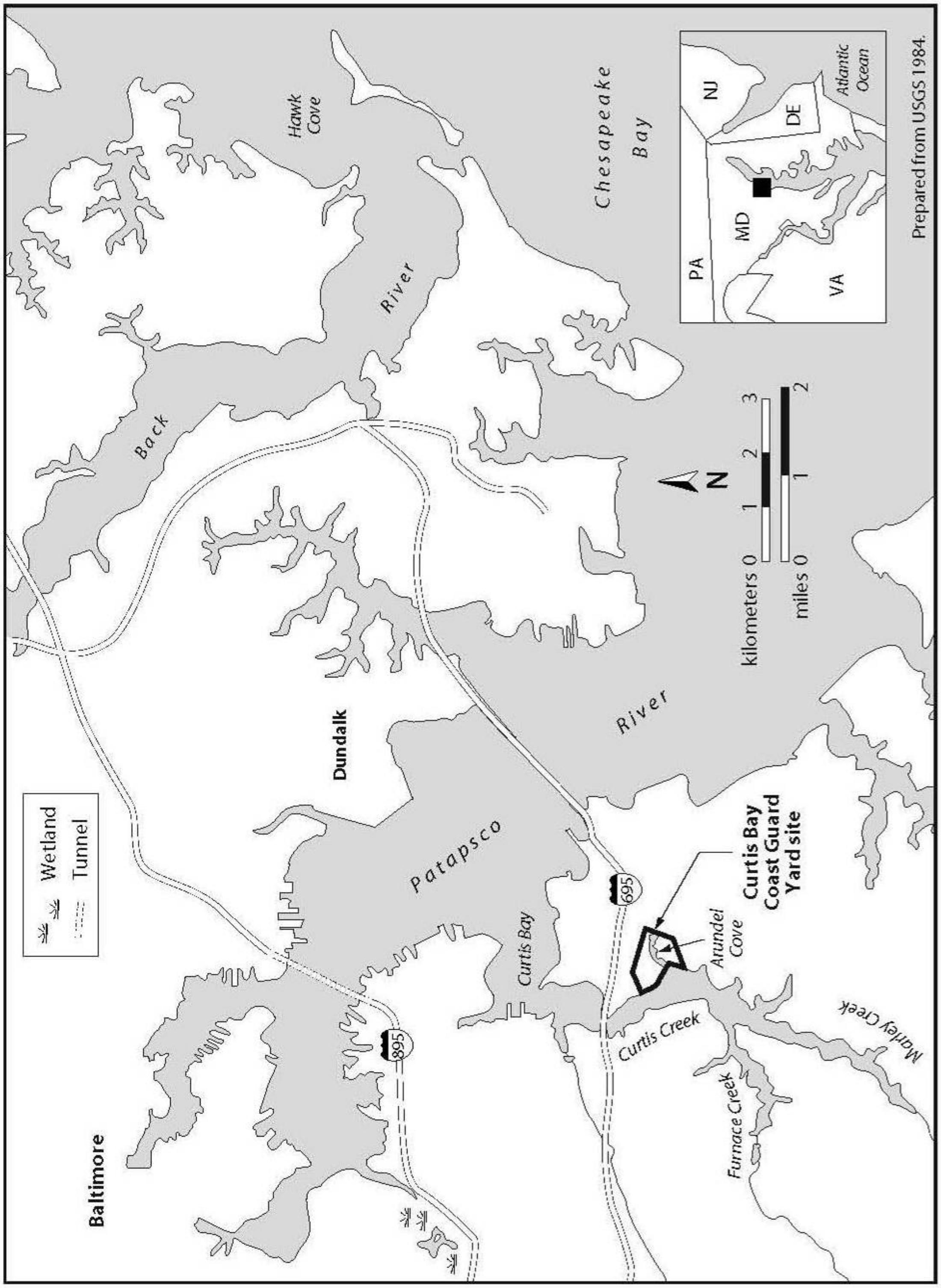

Figure 1. Location of Curtis Bay Coast Guard Yard site, Anne Arundel County, Maryland.

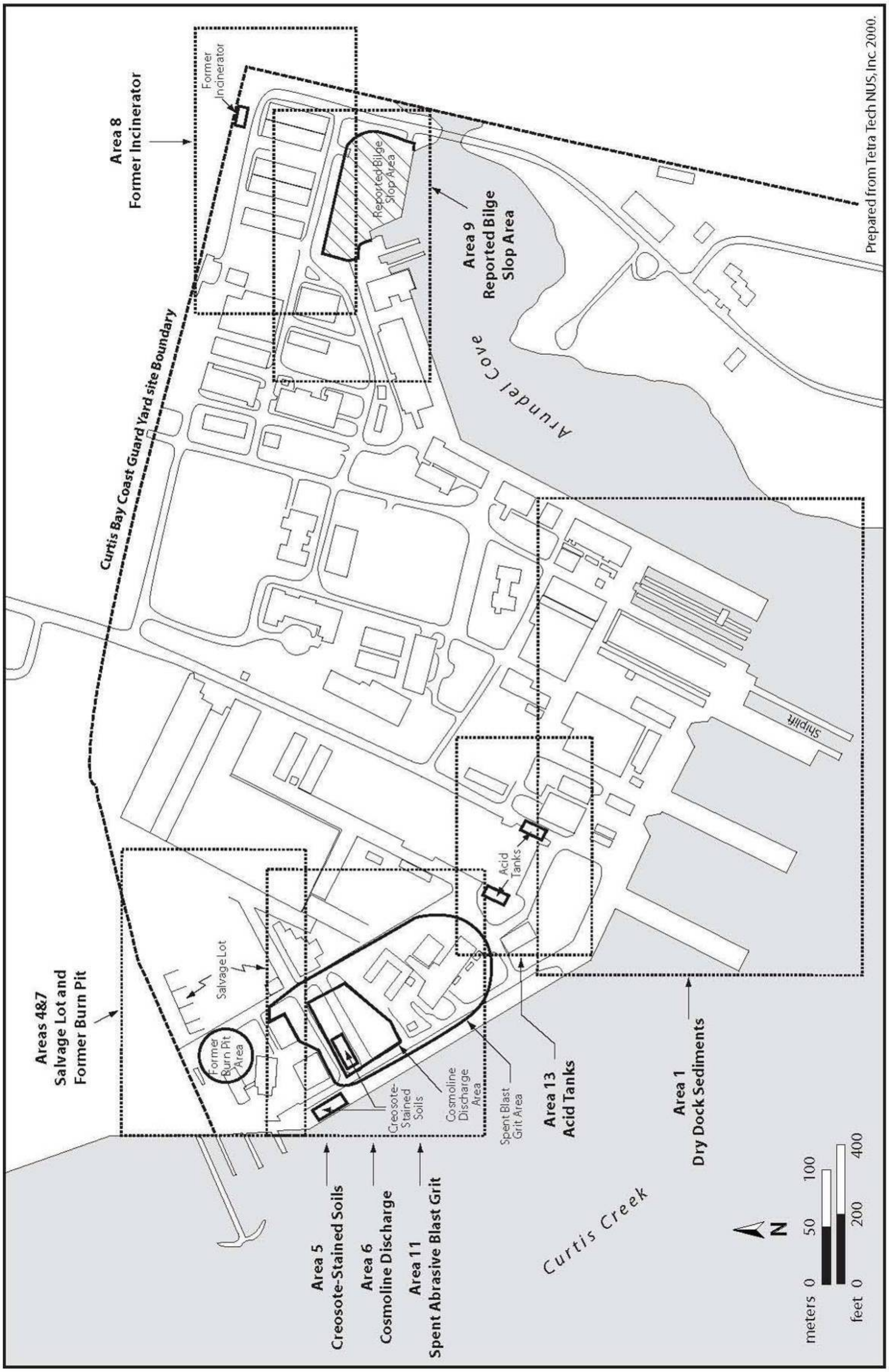

Figure 2. Detail of Curtis Bay Coast Guard Yard property.

Table 1. Identified areas of potential contamination at the Curtis Bay Coast Guard Yard site (Tetra Tech NUS Inc. 2000).

Identified Areas of Potential Contamination	Description of Area Uses
Area 1 - Dry Dock Sediments	Blast-grit metal cleaning operations were conducted in this area. Sediment surrounding the dry docks potentially contains heavy metals as a result of these operations.
Area 4 - Salvage Lot	This area was used for storing scrap metal, 55-gallon drums of lubricating oil, lead-acid batteries, transformers, and possibly transformer oil. The area is currently unpaved and oil-stained soil has been observed.
Area 5 - Creosote-Stained Soils	This area was reportedly used for a creosote coating operation; however, the Coast Guard could not confirm whether the creosote operation ever took place. Currently, part of this area is paved and part is covered with gravel, and there is no evidence of creosote staining on either of these surfaces.
Area 6 - Cosmoline Discharge	Cosmoline, a corrosion-inhibiting material, was reportedly discharged on the ground in Area 6.
Area 7 - Former Burn Pit	The burn pit was used as a waste-oil burn pit. The area also housed leaking underground storage tanks containing diesel fuel. This area is now developed with paved surfaces, buildings, lawn areas, and volleyball and basketball courts.
Area 8 - Former Incinerator	This area was the location of an incinerator used to burn wood, paper, and cardboard. Records of ash disposal practices have not been identified. The incinerator has been removed and the area has been graded and seeded.
Area 9 - Reported Bilge Slop Area	This area was used as an all-purpose storage and work area. It was also reportedly used to discharge bilge water, as a scrap metal storage yard, for burning and dumping, and possibly as a disposal area for ash from the former incinerator (Area 8). The area is currently a parking lot.
Area 11 - Spent Abrasive Blast Grit Area	Spent blast-grit was observed on the ground surface of Area 11. Soil samples collected from the area indicated that low concentrations of PCBs and lead were present in the soil.
Area 13 - Acid Tanks	Two underground storage tanks were used to store rinse water from a hydrofluoric acid cleaning process in this area. It was determined that trivalent chromium was present in the tanks; however, the tanks have been closed in place (filled with sand). A single above-ground storage tank has replaced them and is located in a building.

Soil samples collected from the Curtis Bay Coast Guard Yard site indicate that the site has been contaminated with metals, polycyclic aromatic hydrocarbons (PAHs), pesticides, polychlorinated biphenyls (PCBs), and dioxins (USEPA 2001a). Because the sources of contamination are not contained, there is the possibility that hazardous substances could migrate into adjacent surface waters (USEPA 2001b).

Surface water runoff is the primary pathway for the migration of contaminants from the site to NOAA trust resources; sediment transport is a secondary pathway. The majority of the site's shoreline consists of bulkheads and piers, allowing for the direct runoff of surface water into the adjacent water bodies (USEPA 2001b). The surface water pathway includes Curtis Creek and Arundel Cove. Surface water runoff from the site generally flows to the south or to the east. Surface water is also directed to the facility's storm sewer system, which is ultimately discharged into Curtis Creek.

On September 5, 2002, the site was placed on the National Priorities List.

A remedial investigation/feasibility study, which is still in progress, was initiated at the site in 2003 (USEPA 2006).

NOAA Trust Resources

The surface waters and associated bottom substrates of Curtis Creek, including Arundel Cove, are the trust habitats of primary concern to NOAA. Curtis Bay is a secondary habitat of concern. Curtis Creek is a tidally influenced, small to medium-sized stream used for recreation and fishing. Arundel Cove is a small arm of Curtis Creek. Curtis Creek flows to the north, approximately 3 km (2 mi), before emptying into Curtis Bay, downgradient of the site. Curtis Bay flows to the east approximately 1 km (0.6 mi) before discharging into the Patapsco River, which flows to the southeast for approximately 13 km (8 mi) before emptying into Chesapeake Bay. Sensitive environments, as identified under the Coastal Zone Management Act, have been identified along Arundel Cove, Curtis Creek, the Patapsco River, and Chesapeake Bay. These habitats are used by state and federally threatened or endangered species and are state-designated areas for the protection or maintenance of aquatic life (USEPA 2001b).

Table 2 lists the NOAA trust resources present in Curtis Creek and Curtis Bay. Curtis Creek, including Arundel Cove, provides spawning, nursery, and adult habitat for anadromous fish, such as alewife, blueback herring, and white and yellow perch. The catadromous American eel is also found in Curtis Creek, which provides adult habitat for the eels (Jordan 2002). Curtis Bay provides spawning, nursery, and adult habitat for numerous marine and estuarine species as listed in Table 2. Atlantic rangia, which are a type of clam, and blue crab can also be found in Curtis Bay.

No information regarding commercial fisheries in Curtis Bay and Curtis Creek was available at the time of this report. Commercial fisheries in the Patapsco River include American eel, Atlantic menhaden, striped bass, and white perch (Lewis 2002). Atlantic rangia and blue crabs are present in the Patapsco River; however, the river and Curtis Bay are closed to shellfish harvesting because of high levels of pollution (Webb 2002). There is recreational fishing of several NOAA trust resources in Curtis Creek and Curtis Bay (Table 2; Jordan 2002).

Fish consumption advisories in effect for the Patapsco River recommend avoiding all consumption of channel and white catfish and American eel from the Patapsco River because of PCB and pesticide contamination in fish tissues. Reduced consumption of white perch is recommended for the general public and no consumption is recommended for high risk individuals. It is recommended that brown bullhead be consumed at reduced quantities by all individuals. The advisory also recommends reduced consumption of blue crab meat and no consumption of the crab hepatopancreas from the Patapsco River because of elevated PCB concentrations. A statewide consumption advisory, which recommends reduced consumption for high risk individuals, is in effect for small and largemouth bass because of methylmercury contamination. Besides the statewide advisory, there are currently no fish consumption advisories in effect for Curtis Creek or Curtis Bay (MDE 2006).

Table 2. NOAA trust resources present in Curtis Bay and Curtis Creek near the Curtis Bay Coast Guard Yard site (Jordan 2002).

Species		**Habitat Use**			**Fisheries**	
Common Name	Scientific Name	Spawning Area	Nursery Area	Adult Habitat	Comm.	Rec.
ANADROMOUS FISH						
Alewife	*Alosa pseudoharengus*	♦	♦			♦
Blueback herring	*Alosa aestivalis*	♦	♦			♦
Striped bass	*Morone saxatilis*		♦			♦
White perch	*Morone americana*	♦	♦	♦		♦
Yellow perch	*Perca flavescens*	♦	♦	♦		♦
CATADROMOUS FISH						
American eel	*Anguilla rostrata*			♦		♦
MARINE/ESTUARINE FISH						
Atlantic croaker	*Micropogonias undulatus*		♦			♦
Atlantic menhaden	*Brevoortia tyrannus*		♦			
Atlantic silverside	*Menidia menidia*	♦	♦	♦		
Bay anchovy	*Anchoa mitchilli*		♦	♦		
Gizzard shad	*Dorosoma cepedianum*	♦	♦	♦		
Hogchoker	*Trinectes maculatus*	♦	♦	♦		
Mummichog	*Fundulus heteroclitus*	♦	♦	♦		
Spot croaker	*Leiostomus xanthurus*		♦			♦
Striped killifish	*Fundulus majalis*	♦	♦	♦		
INVERTEBRATES						
Blue crab	*Callinectes sapidus*		♦	♦		
Atlantic rangia	*Rangia cuneata*		♦	♦		

Site-Related Contamination

Surface water, sediment, and soil samples were collected during sampling events conducted in 1999. The samples were analyzed for metals, VOCs, SVOCs, pesticides, and PCBs (Tetra Tech NUS Inc. 2000).

The primary contaminants of concern to NOAA are metals, PAHs, and PCBs. Table 2 provides a summary of the maximum contaminant concentrations detected during the site investigations and compares them to appropriate screening guidelines. Site-specific or regionally specific screening guidelines such as the Region III Biological Technical Assistance Group (BTAG) screening levels for soil (USEPA 1995) are always used when available. In the absence of site-specific or regionally specific guidance, the screening guidelines for water are the ambient water quality (AWQC; USEPA 2002) and the screening guidelines for marine sediment are the effects range-lows (ERLs; Long et al. 1998). The screening guidelines for soil are the Oak Ridge National Laboratory final preliminary remediation goals (ORNL-PRGs; Efroymson et al. 1997) and the USEPA's ecological soil screening guidelines (USEPA 2005), with exceptions as noted on Table 2. Only maximum contaminant concentrations that exceeded the screening guidelines, or contaminants for which there are currently no screening guidelines, are discussed below. When known, the general sampling locations are provided. The general areas where samples were collected are depicted in Figure 2.

<u>Surface water</u>

The maximum concentrations of two metals were detected in surface water samples from the Area 1 dry docks. The maximum concentration of copper exceeded the AWQC by a factor of more than three, and the maximum concentration of zinc exceeded the AWQC by a factor of more than two.

No PAHs, PCBs, or pesticides were detected in the surface water samples.

<u>Sediment</u>

Sediment samples collected from Curtis Creek in Area 1 contained the maximum concentrations of ten metals. Maximum concentrations of copper, selenium, and silver exceeded the ERL guidelines by at least one order of magnitude. Concentrations of arsenic were as much as seven times greater than the ERL. Lead, mercury, and zinc concentrations exceeded ERL guidelines by a factor of six. The maximum concentration of nickel was five times greater than the ERL. Cadmium and chromium concentrations slightly exceeded the ERL.

The maximum concentrations of three PAHs were detected in sediment from Area 1. Fluoranthene and pyrene exceeded the ERL by a factor of four and three, respectively. Bis (2-ethylhexyl) phthalate was also detected; however, there is currently no screening guideline available for comparison to the detected concentrations in the sediment samples.

The maximum PCB concentrations were detected in sediment from Area 1. PCBs were detected at a maximum concentration that exceeded the ERL guideline by more than an order of magnitude.

<u>Soil</u>

Soil samples were collected from throughout the site. Metals, PAHs, pesticides, PCBs, and dioxins were detected.

The maximum concentrations of the metals reported in Table 2, except mercury, were detected in soil samples from Area 9. The maximum concentration of lead exceeded the BTAG screening level by six orders of magnitude. The maximum concentration of chromium exceeded the BTAG screening level by four orders of magnitude. Zinc exceeded the ORNL-PRGs by three orders of magnitude. The maximum concentration of cadmium exceeded the USEPA soil screening guidelines by two orders of magnitude and silver exceeded the ORNL-PRGs by one order of magnitude. The maximum concentrations of arsenic and nickel exceeded the ORNL-PRGs by a factor of four, while selenium exceeded the BTAG screening level by a factor of four.

The maximum concentration of mercury occurred in a sample from Area 7. Mercury exceeded the BTAG screening level by three orders of magnitude.

Twelve PAHs were detected in soil samples from the site, with the majority of the maximum concentrations occurring in samples from Areas 7 and 9.

Maximum concentrations of four PAHs were detected in samples from Area 7. Concentrations of acenaphthene and naphthalene exceeded the BTAG screening level by one order of magnitude. No screening guidelines are currently available for comparison to the maximum concentrations of bis-(2-ethylhexyl)phthalate or 2-methylnaphthalene detected in the soil samples.

The maximum concentration of acenaphthylene, which slightly exceeded the BTAG screening level, was detected in a sample collected from Area 8.

The remaining seven PAHs listed in Table 3 were detected at maximum concentrations in samples from Area 9. Concentrations of benz(a)anthracene, chrysene, fluoranthene, phenanthrene, and pyrene were two orders of magnitude greater than the BTAG screening levels. Anthracene and fluorene concentrations exceeded the BTAG screening levels by one order of magnitude.

Maximum concentrations of five pesticides were detected in soil samples taken from the site. The maximum concentrations of 4,4'-DDT, endrin, and toxaphene occurred in samples from Area 8. The maximum concentration of the pesticide 4,4'-DDT exceeded the BTAG screening level by a factor of five. There are no screening guidelines currently available for comparison to the maximum concentrations of endrin or toxaphene detected in the soil samples.

The maximum heptachlor concentration was detected in a sample from Area 9. There is no screening guideline currently available for comparison to the heptachlor concentrations detected in the soil samples.

The maximum concentration of PCBs occurred in a sample collected from Area 4. Concentrations of PCBs exceeded the BTAG screening level by a factor of nine.

The maximum dioxin/furan toxic equivalent value (TEQ) was detected in a sample from Area 7. The dioxin/furan TEQ exceeded the BTAG screening level by three orders of magnitude.

Table 3. Maximum concentrations of contaminants of concern to NOAA detected at the Curtis Bay Coast Guard Yard site (Tetra Tech NUS, Inc. 2000). Contaminant values in bold exceeded screening guidelines.

	Soil (mg/kg)		Water (µg/L)		Sediment (mg/kg)	
Contaminant	Soil	BTAG[a] Screening Levels	Surface Water	AWQC[b]	Sediment	ERL[c]
METALS/INORGANICS						
Arsenic	**48**	9.9[d]	ND	36	**59**	8.2
Cadmium	**68**	0.36[e]	ND	8.8	**1.4**	1.2
Chromium[f]	**220**	0.0075	ND	50	**140**	81
Copper	**33,000**	60[d]	**12**	3.1	**570**	34
Lead	**22,000**	0.01	ND	8.1	**300**	46.7
Mercury	**120**	0.058	ND	0.094[g]	**0.88**	0.15
Nickel	**130**	30[d]	ND	8.2	**110**	20.9
Selenium	**7.6**	1.8	ND	71	**10**	1.0[h]
Silver	**23**	2[d]	ND	1.9[i]	**19**	1
Zinc	**44,000**	8.5[d]	**200**	81	**880**	150
PAHs						
Acenaphthene	**2.9**	0.1	ND	710[j]	ND	0.016
Acenaphthylene	**0.18**	0.1	ND	300[i,j,k]	ND	0.044
Anthracene	**8.6**	0.1	ND	300[i,j,k]	ND	0.0853
Benz(a)anthracene	**16**	0.1	ND	300[i,j,k]	ND	0.261
Bis-(2-ethylhexyl) phthalate	3.7	NA	ND	NA	1.5	NA
Chrysene	**16**	0.1	ND	300[i,j,k]	ND	0.384
Fluoranthene	**30**	0.1	ND	16[j]	**2.5**	0.6
Fluorene	**6.6**	0.1	ND	300[i,j,k]	ND	0.019
2-Methylnaphthalene	26	NA	ND	300[i,j,k]	ND	0.07
Naphthalene	**6.4**	0.1	ND	2350[i,j]	ND	0.16
Phenanthrene	**26**	0.1	ND	NA	ND	0.24
Pyrene	**27**	0.1	ND	300[i,j,k]	**2.2**	0.665
PESTICIDES/PCBs						
4,4'-DDE	0.081	0.1	ND	14[j]	ND	0.0022
4,4'-DDT	**0.57**	0.1	ND	0.001[l]	ND	0.00158
Dieldrin	0.007	0.1	ND	0.0019	ND	0.00002
Endosulfan (alpha + beta)	0.0051	0.1	ND	0.0087	ND	NA
Endrin	0.009	NA	ND	0.0023	ND	NA
Heptachlor	0.0029	NA	ND	0.0036	ND	0.0003[h]
Total PCBs	**3.6**	0.371[d]	ND	0.03	**0.42**	0.0227
Toxaphene	0.49	NA	ND	0.0002	ND	NA
DIOXINs/FURANs						
TEQ (Toxic Equivalent Value)[m]	**0.017**[k]	3.15×10^{-6}[d]	N/A	NA	N/A	3.6×10^{-6}[h]

a: Region III Biological Technical Assistance Group (BTAG) screening levels for fauna (USEPA 1995).
b: Ambient water quality criteria for the protection of aquatic organisms (USEPA 2002). Marine chronic criteria presented.
c: Effects range-low (ERL) represents the 10th percentile for the dataset in which effects were observed or predicted in studies compiled by Long et al. (1998).
d: Oak Ridge National Laboratory (ORNL) final preliminary remediation goals (PRG) for ecological endpoints (Efroymson et al. 1997).
e: Ecological soil screening guidelines (USEPA 2005).
f: Screening guidelines represent concentrations for Cr^{+6}.
g: Derived from inorganic, but applied to total mercury.
h: Marine apparent effects threshold (AET) for bioassays. The AET represents the concentration above which adverse biological impacts would be expected.
i: Chronic criterion not available; acute criterion presented.
j: Lowest Observable Effect Level (LOEL) (USEPA 1986).
k: Value for chemical class.
l: Expressed as Total DDT.
m: Maximum toxic equivalent value (TEQ) is provided. Each dioxin/furan is assigned a toxic equivalency factor (TEF) relative to 2,3,7,8 tetrachlorodibenzodioxin, which is the most toxic in this group of compounds. In order to determine the toxicity of a mixture of dioxin/furan compounds the measured concentration of the individual dioxin/furans is multiplied by its assigned TEF. The results are summed to produce a TEQ.
NA: Screening guidelines not available.
ND: Not detected.

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Ryeland Road Arsenic Site

Heidelberg Township, Pennsylvania
EPA Facility ID: PAD981033459
Basin: Schuylkill
HUC: 02040203

Executive Summary

The Ryeland Road Arsenic site is in Heidelberg Township, Berks County, Pennsylvania. From 1920 to 1940, Standard Chemical Works Corporation and then Allegheny Chemical Corporation manufactured pesticides, fungicides, paints, varnishes, and sulfuric acid on the site. During pesticide manufacturing, arsenic was converted to arsenic acid, resulting in byproducts such as lead arsenate. The primary contaminants of concern to NOAA are arsenic, lead, and copper. Tulpehocken Creek and Blue Marsh Lake, which provide freshwater adult habitat for NOAA trust resources, are the habitats of concern to NOAA. NOAA trust resources present in the vicinity of Tulpehocken Creek and Blue Marsh Lake are the anadromous alewife and striped bass and the catadromous American eel. Groundwater transport and surface water runoff are the primary pathways for the migration of contaminants from the site to NOAA trust resources.

Site Background

The Ryeland Road Arsenic Site is in Heidelberg Township, Berks County, Pennsylvania (Figure 1). The site is in Heidelberg Township, southeast of the Womelsdorf Borough. The main portion of the site, which is approximately 3 ha (7.4 acres) in area, is bordered to the north by railroad tracks, to the south by Ryeland Road, and to the east and west by residential homes (Figure 2). An unnamed spring-fed creek, which ultimately connects to Tulpehocken Creek is north of the site.

The Ryeland Road Arsenic Site consists of four parcels on the north side of Ryeland Road and one parcel south of Ryeland Road (Figure 2). From 1920 to 1940, Standard Chemical Works Corporation and then Allegheny Chemical Corporation manufactured pesticides, fungicides, paints, varnishes, and sulfuric acid in a facility sited north of Ryeland Road. During pesticide manufacturing, arsenic was converted to arsenic acid. This process generated lead arsenate, calcium arsenate, and copper acetoarsenate as byproducts. After the manufacturing facility was closed and demolished, the northern property was divided into four residential parcels. The parcel to the south of Ryeland Road was reportedly used for waste disposal when the facility was in operation, and has remained undeveloped (USEPA 2005a).

Multiple site inspections and site assessments have been conducted at the Ryeland Road Arsenic Site. In 1984 and 1985, the Pennsylvania Department of Environmental Protection (PADEP) conducted a preliminary assessment and a site inspection. From 1985 to 2002, the U.S. Environmental Protection Agency (USEPA) conducted multiple removal actions; an expanded site inspection was completed in 2002 (Tetra Tech 2002). An ongoing remedial investigation/feasibility study was initiated in 2004.

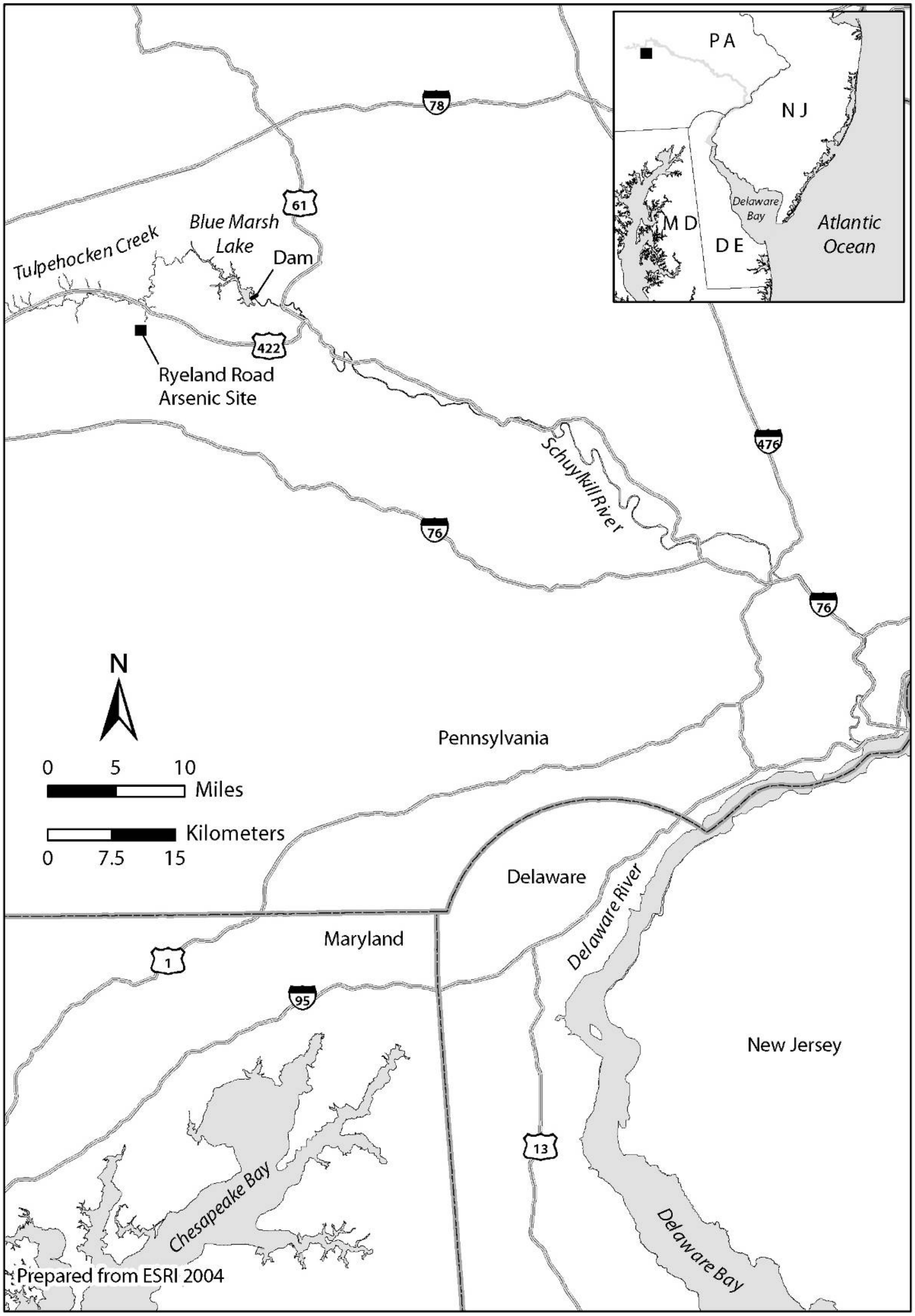

Figure 1. Location of the Ryeland Road Arsenic Site in Heidelberg Township, Pennsylvania.

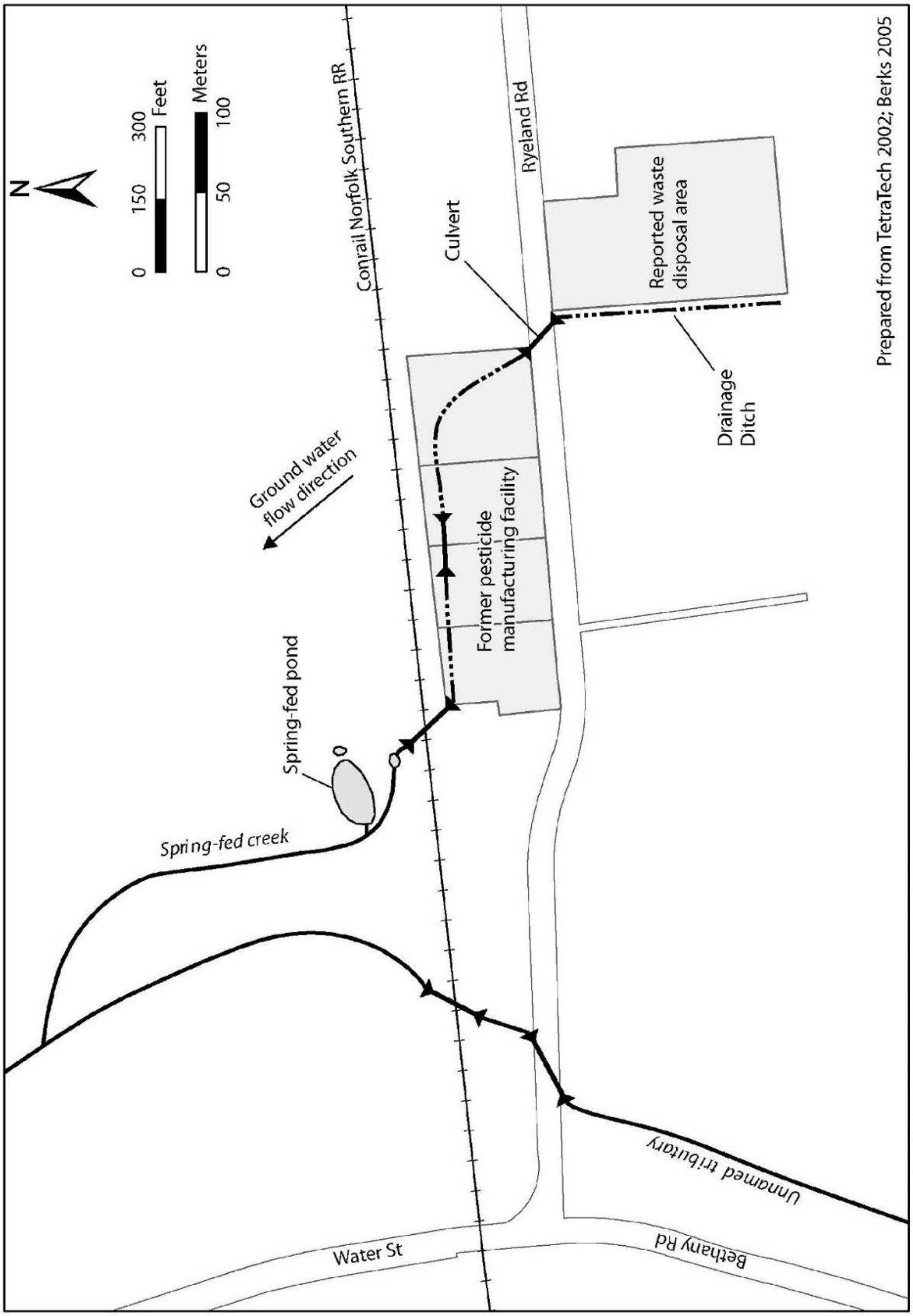

Figure 2. Detail of the Ryeland Road Arsenic Site property.

In 1984 and 1985, the PADEP found lead in a waste pile and identified elevated concentrations of lead and arsenic in surface water, sediment, and waste pile samples (Tetra Tech 2002). From 1985 to 1989, the USEPA removed approximately 4,100 m^3 (5,363 cy) of waste material and arsenic- and lead-contaminated soil from areas north and south of Ryeland Road. During the second phase of this removal action, arsenic- and lead-contaminated soil on three residential parcels was removed to a depth of 0.6 m (2 ft) and replaced with clean fill (USEPA 2004). In 2001, approximately 4,100 metric tons (4,519 tons) of arsenic- and lead-contaminated soil were removed from the undeveloped parcel south of Ryeland Road. In 2002, arsenic-contaminated soil in residential yards where the former facility had been located and in a backyard adjacent to the former facility, was excavated to a depth of 0.6 m (2 ft) and replaced with clean fill. The Ryeland Road Arsenic Site was proposed to the National Priorities List (NPL) on March 8, 2004 and was placed on the NPL on July 22, 2004 (USEPA 2004, 2005a).

Groundwater transport and surface water runoff are the primary pathways for the migration of contaminants from the site to NOAA trust resources. Surface water runoff flows into a drainage ditch that runs through the site and joins an unnamed spring-fed creek, which connects to an unnamed tributary of Tulpehocken Creek. Groundwater is encountered beneath the site at 8.5 m (28 ft) below ground surface. The groundwater flows to the northwest toward Tulpehocken Creek (Tetra Tech 2002). Soils on the Ryeland Road Arsenic Site range from silt loam to gravelly loam (USEPA 2004).

NOAA Trust Resources

The habitats of primary concern to NOAA are the surface waters of Tulpehocken Creek and Blue Marsh Lake. The drainage ditch that flows through the Ryeland Road Arsenic site empties into an unnamed spring-fed creek (Figure 2). The unnamed spring-fed creek joins an unnamed tributary of Tulpehocken Creek (Figure 2), which in turn becomes Blue Marsh Lake (Figure 1). At the base of Blue Marsh Lake dam, Tulpehocken Creek resumes its flow. Tulpehocken Creek flows for approximately 10 km (6 mi) before emptying into the Schuylkill River. The Schuylkill River joins the Delaware River, which discharges into Delaware Bay.

Blue Marsh Lake provides adult habitat to non-migrating NOAA trust resources (Table 1) (Chikotas 2005; PADEP 2005a). The Blue Marsh Lake dam prevents the upstream passage of migratory fish species. American eel were found in the lake in 1992 (PADEP 2005a), although that may have been a remnant population from before the dam was built (Chikotas 2005). The lake was stocked with alewife in 1982 and with striped bass on six occasions from 1994 to 2001 (PADEP 2005a). Alewife spawn in areas of slow current or still pools; when landlocked, they can reproduce in cool lakes (Steiner 2005). Blue Marsh Lake is a warm-water fishery (PADEP 2005a), so alewife might be spawning in Tulpehocken Creek and its tributaries. Striped bass require significant lengths of flowing water for successful spawning and generally exhibit little to no natural reproduction when confined to inland lakes (Steiner 2005).

There are no plans to breach the dam or install fish passage structures (Chikotas 2005). Therefore, migratory fish in the Schuylkill River are not trust resources of concern for the Ryeland Road Arsenic Site. No commercial fishery occurs on Tulpehocken Creek or Blue Marsh Lake. Recreational fishing of alewife and striped bass occurs in Blue Marsh Lake.

Table 1. NOAA trust resources present in Tulpehocken Creek and Blue Marsh Lake near the Ryeland Road Arsenic Site (Chikotas 2005; PADEP 2005a).

Species		**Habitat Use**			**Fisheries**	
Common Name	Scientific Name	Spawning Area	Nursery Area	Adult Habitat	Comm.	Rec.
ANADROMOUS FISH						
Alewife	*Alosa pseudoharengus*	♦	♦	♦		♦
Striped bass	*Morone saxatilis*			♦		♦
CATADROMOUS FISH						
American eel	*Anguilla rostrata*			♦		

A statewide fish-consumption advisory is in effect. The advisory recommends limited consumption of all sport fish (i.e., fish caught recreationally) to protect against exposure to unidentified contaminants (PADEP 2005b).

Site-Related Contamination

Soil, groundwater, surface water, and sediment samples were collected from the Ryeland Road Arsenic Site during the 2002 expanded site inspection (Tetra Tech 2002). The soil samples were collected from the four parcels north of Ryeland Road and a parcel just to the east of the former pesticide manufacturing facility. The groundwater samples were collected from drinking water wells at seven residences north and east of the Ryeland Road Arsenic Site. The sediment and surface water samples were collected from the spring-fed creek, the unnamed tributary downstream of the creek, and a spring-fed pond north of the railroad tracks (Figure 2).

The primary contaminants of concern to NOAA are arsenic, lead, and copper. Polycyclic aromatic hydrocarbons (PAHs) and pesticides such as DDE, lindane, and chlordane were also detected in sediment samples, and PAHs, polychlorinated biphenyls (PCBs), benzene, and pesticides were also detected in soil samples; however, the source material used in preparing this report did not provide the detected concentrations of these contaminants. For that reason, only metals concentrations are discussed below. Note that analytical results for metals are also incomplete in the source material.

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 the absence of such guidance, the screening guidelines for groundwater and surface water are the ambient water quality criteria (AWQC; USEPA 2002); the screening guidelines for sediment in a freshwater environment are the threshold effects concentrations (TECs; MacDonald et al. 2000); and the screening guidelines for soil are the Oak Ridge National Laboratory final preliminary remediation goals (ORNL-PRGs; Efroymson et al. 1997) and the USEPA's ecological soil screening guidelines (USEPA 2005b). 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.

Table 2. Maximum concentrations of contaminants of concern to NOAA at the Ryeland Road Arsenic Site (Tetra Tech 2002; USEPA 2004a). Contaminant values in bold exceed or are equal to screening guidelines.

	Soil (mg/kg)		**Water (µg/L)**			**Sediment (mg/kg)**	
Contaminant	Soil	ORNL-PRG[a]	Groundwater	Surface Water	AWQC[b]	Sediment	TEC[c]
METALS/INORGANICS							
Arsenic	**66,000**	9.9	**530**	**500**	150	**400**	9.79
Cadmium	**29**	0.36[d]	NAv	NAv	0.25[e]	**1.2**	0.99
Chromium[f]	**30**	0.4	NAv	NAv	11	30	43.4
Copper	**460**	60	**1,000**	NAv	9[e]	**79**	31.6
Lead	**150,000**	40.5	**190**	**5.5**	2.5[e]	**430**	35.8
Mercury	**1**	0.00051	NAv	NAv	0.77[g]	NAv	0.18
Nickel	**47**	30	NAv	NAv	52[e]	12	22.7
Selenium	**32**	0.21	NAv	NAv	5.0[h]	2.2	NA
Silver	1.5	2	NAv	NAv	3.2[e,i]	NAv	4.5[j]
Zinc	**1,200**	8.5	NAv	NAv	120[e]	NAv	121

a: Oak Ridge National Laboratory (ORNL) final preliminary remediation goals (PRG) for ecological endpoints (Efroymson et al. 1997).
b: Ambient water quality criteria for the protection of aquatic organisms (USEPA 2002). Freshwater chronic criteria presented.
c: Threshold Effects Concentration (TEC). Concentration below which harmful effects are unlikely to be observed (MacDonald et al. 2000).
d: Ecological soil screening guidelines (USEPA 2005b).
e: Criterion expressed as a function of total hardness; concentrations shown correspond to hardness of 100 mg/L $CaCO_3$.
f: Screening guidelines represent concentrations for Cr^{+6}.
g: Derived from inorganic, but applied to total mercury.
h: Criterion expressed as total recoverable metal.
i: Chronic criterion not available; acute criterion presented.
j: Freshwater upper effects threshold (UET) for bioassays. The UET represents the concentration above which adverse biological impacts would be expected.
NA: Screening guidelines not available.
NAv: Contaminant concentration not available in the documents reviewed.

<u>Surface Water</u>

Two metals were detected in surface water samples collected from the Ryeland Road Arsenic Site at maximum concentrations that exceeded screening guidelines. The maximum concentration of arsenic, which occurred in a sample collected from the spring-fed pond north of the former facility, exceeded the AWQC by a factor of three. The maximum concentration of lead, which occurred in a sample collected from the spring-fed creek north of the former facility, exceeded the AWQC by a factor of two.

Sediment

Four metals were detected in sediment samples collected from the Ryeland Road Arsenic Site at maximum concentrations that exceeded screening guidelines, and one metal was detected for which no screening guideline is currently available for comparison. The maximum concentrations of arsenic, cadmium, copper, and lead were detected in a sample collected from the spring-fed creek north of the former facility. The maximum concentrations of arsenic and lead exceeded the TECs by one order of magnitude. The maximum concentration of copper exceeded the TEC by a factor of 2.5. The maximum concentration of cadmium slightly exceeded the TEC. No screening guideline is available for comparison to the maximum concentration of selenium, which was detected in a sample collected from the spring-fed creek just downstream of its point of origin.

Groundwater

Three metals were detected in groundwater samples collected from the Ryeland Road Arsenic Site at maximum concentrations that exceeded screening guidelines. The maximum concentrations of copper and lead were detected in a sample collected from the storage tank for a residential drinking water well, adjacent to the former facility to the east. The maximum concentration of copper exceeded the AWQC by two orders of magnitude. The maximum concentration of lead exceeded the AWQC by one order of magnitude.

The maximum concentration of arsenic, which exceeded the AWQC by a factor of 3.5, was detected in a sample collected from a spring north of the undeveloped parcel.

Soil

Nine metals were detected in soil samples collected from the Ryeland Road Arsenic Site at maximum concentrations that exceeded screening guidelines. The source material used in preparing this report does not indicate the soil sampling locations. The maximum concentrations of arsenic, lead, and mercury exceeded the ORNL-PRGs by three orders of magnitude. The maximum concentrations of selenium and zinc exceeded the ORNL-PRGs by two orders of magnitude. The maximum concentration of chromium exceeded the ORNL-PRG by one order of magnitude, while the maximum concentration of cadmium exceeded the USEPA's ecological soil screening guideline by one order of magnitude. The maximum concentrations of copper and nickel exceeded the ORNL-PRGs by factors of eight and 1.5, respectively.

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Kennedy Generating Station

Jacksonville, Florida
Basin: Lower St. Johns
HUC: 03080103

Executive Summary

The Kennedy Generating Station (Kennedy Generating) site is on the west bank of the St. Johns River in Jacksonville, Florida. From 1909 to 1966, a wood preserving and treating facility was operated at the site. Leaks, spills, and poor waste management practices at the wood preserving and treating facility have lead to the release of hazardous substances from the site to groundwater beneath the site and sediment in the St. Johns River. The habitat of concern to NOAA at the site is the St. Johns River, which provides habitat for NOAA trust resources including anadromous, catadromous, and estuarine fish species.

Site Background

The Kennedy Generating Station (Kennedy Generating) site is on the west bank of the St. Johns River in Jacksonville, Florida at latitude 30° 21' 45" and longitude 81° 37' 30" (Figure 1). The Kennedy Generating site encompasses two parcels owned by the Jacksonville Electric Authority; a north parcel and a south parcel, which combined are 21 hectares (53 acres) (Figure 2). In 1910, Jacksonville Electric Authority purchased the north parcel and constructed a power generating plant that is still active. Jacksonville Electric Authority acquired the south parcel in 1977 to extend their power plant operations.

From 1909 to 1966, several different owners operated a wood preserving and treating facility on the south parcel. Products used at the facility for wood treating and preserving include creosote, zinc-meta-arsenite, chromated zinc chloride, a coal tar additive of unknown composition, and pentachlorophenol (PCP) (CH2M Hill 2003). Aerial photos of the site from 1959 show creosote storage tanks, treating cylinders, a treated lumber storage area, and a loading dock on the east side of the south parcel, near the river. Treated wood was shipped and chemicals used during the preserving and treating process were received at the loading dock (CH2M Hill 2003).

After the south parcel was sold to the Southern Railroad in 1966, the wood treating and preserving facility was dismantled and the property was cleared of all buildings and other structures. During the dismantling of the wood treating and preserving facility, approximately 30,000 to 50,000 gallons (110,000 to 190,000 liters) of creosote sludge from the creosote storage tanks were combined with wood shavings and buried in the northeast corner of the south parcel (CH2M Hill 2003). After the wood treating and preserving facility was dismantled, the south parcel was inactive until Jacksonville Electric Authority took over ownership in 1977.

Under the ownership of Jacksonville Electric Authority, the south parcel was primarily used for treatment and storage of wastewater from the power generating plant on the north parcel. During different periods, the wastewater was dealt with in different ways. From 1977 to 1985, the wastewater was stored in four unlined surface impoundments in the south-central portion of the south parcel. When the surface impoundments were

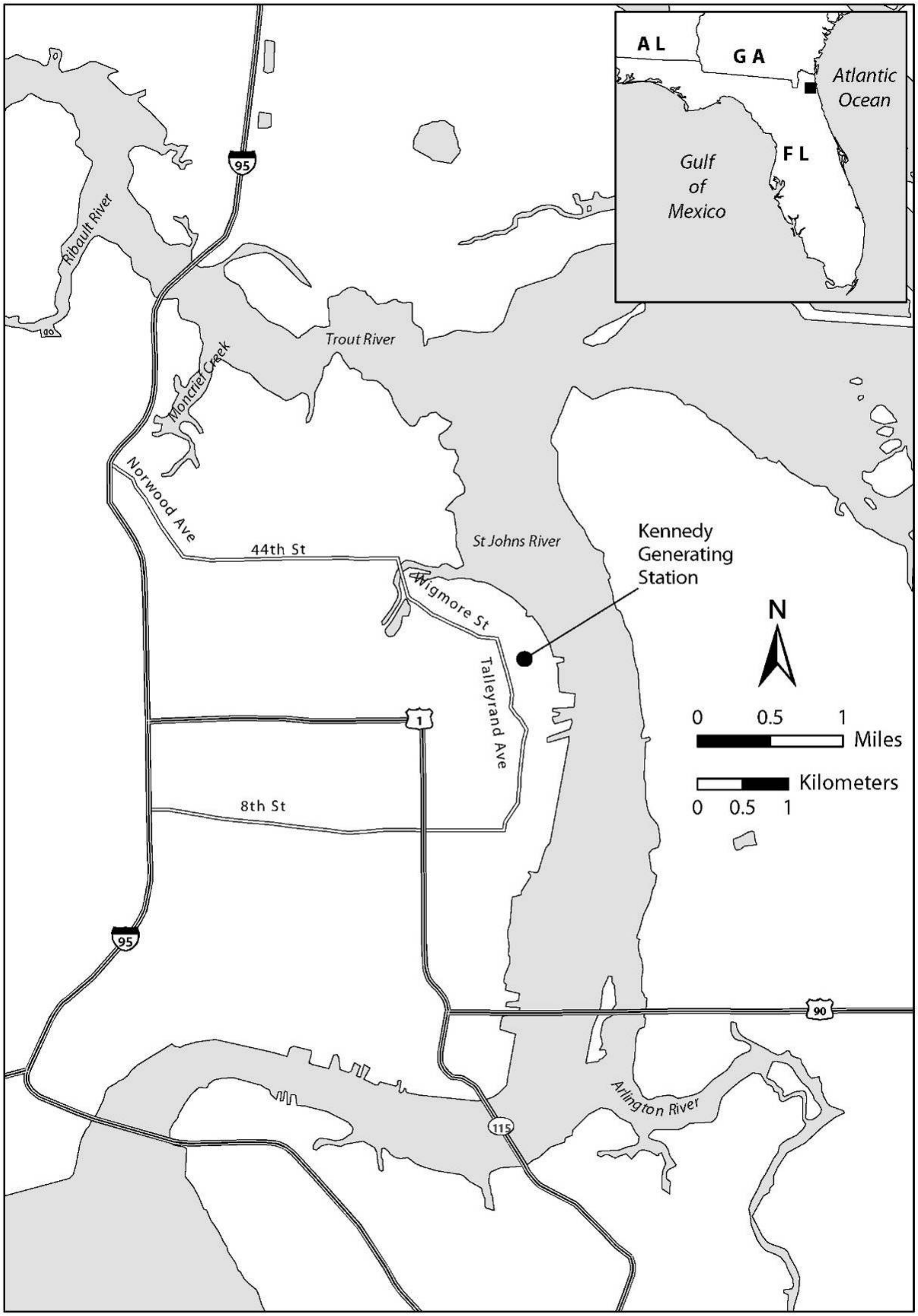

Figure 1. Location of the Kennedy Generating Station site, Jacksonville, Florida.

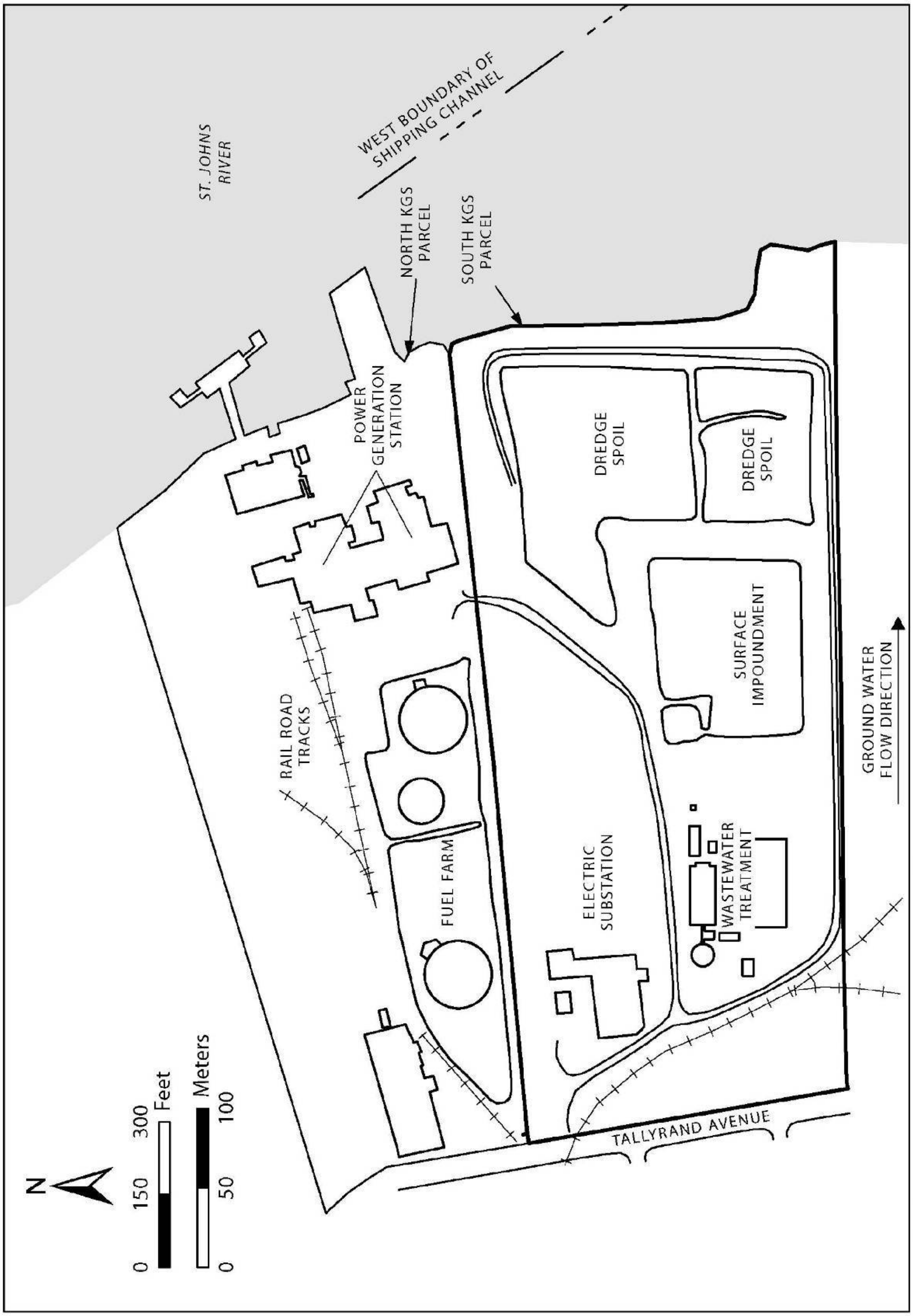

Figure 2. Detail of the Kennedy Generating Station property.

constructed, the interior walls were lined with limestone. Evaporation, neutralization from the limestone, and sedimentation of the wastewater occurred in the surface impoundments. Between 1984 and 1986, wastewater was sent through a neutralization unit on the north parcel before it was discharged into the surface impoundments (CH2M Hill 2003). After 1986, wastewater was diverted to a wastewater treatment plant that was built in the southwest corner of the south parcel before it was discharged into the surface impoundments. After 1991, wastewater was no longer stored in the surface impoundments. In 1995, sludge from the surface impoundments was excavated and disposed of off-site (CH2M Hill 2003).

Currently an electric substation, a wastewater treatment plant, the remnants of surface impoundments associated with wastewater treatment, and dredge spoil impoundments are present on the south parcel (CH2M Hill 2003). The dredge spoil impoundments contain materials removed from the St. Johns River during maintenance dredging of the channel.

Contaminant Release

Leaks, spills, and poor waste management practices at the wood preserving and treating facility have lead to the release of hazardous substances from the Kennedy Generating site to habitats of concern to NOAA. Wastewater from the preserving and treating process was placed in small tanks for a short period and then was discharged into the St. Johns River through a wooden channel. Creosote that was spilled near the treating cylinders was pumped to the creosote storage tanks with a sump. If the sump overflowed, creosote would discharge to a ditch, which flowed to the St. Johns River. In the 1960s, any creosote that spilled from the creosote storage tanks was retained in the bermed area surrounding the storage tanks.

Investigations of the Kennedy Generating site, which began in 1983, have found contaminants associated with the wood preserving and treating facility in soil and groundwater collected from the south parcel, and sediment collected from the St. Johns River. A Resource Conservation and Recovery Act (RCRA) facility investigation was completed in 2003 (CH2M Hill 2003). Table 1 and the following discussion summarize the analytical results of the RCRA facility investigation and compares the contaminant concentrations to appropriate screening guidelines. The screening guidelines for groundwater are the ambient water quality criteria (AWQC; USEPA 2002) and the USEPA Region 4 ecological screening values (Region 4 ESVs; USEPA 2001). The screening guidelines for sediment are the effects range-low (ERL) values and the effects range-median (ERM) (Long et al. 1998), and the Region 4 ESVs (USEPA 2001). The screening guidelines for soil are the Region 4 ESVs (USEPA 2001).

Groundwater

Several metals were detected in groundwater at the site at concentrations greater than the AWQCs and Region 4 ESVs (Table 1). Of the metals, arsenic was detected most frequently. The maximum concentration of arsenic was one order of magnitude greater than the AWQCs and Region 4 ESVs and was detected in a sample collected from the northeast corner of the south parcel. Maximum concentrations of chromium and lead were detected in groundwater collected from wells in the south central portion of the south parcel. The maximum zinc concentration was detected in a groundwater sample collected approximately 150 m (492 ft) from the St. Johns River.

Table 1. Maximum concentrations of contaminants of concern detected at the Kennedy Generating Station site (CH2M Hill 2003). Contaminant values in bold exceed at least one screening guideline.

	Soil (mg/kg)		Water (µg/L)			Sediment (mg/kg)			
Contaminant	Soil	USEPA Region 4 Values[a]	Ground-water	AWQC[b]	USEPA Region 4 Values[a]	Sedi-ment	ERL[c]	ERM[c]	USEPA Region 4 Values[a]
METALS/INORGANICS									
Arsenic	**1,700**	10	**2,000**	36	36	**33**	8.2	70	1
Chromium[d]	**120**	0.4	**150**	50	103	47	81	370	52.3
Lead	**240**	50	**64**	8.1	8.5	**84**	46.7	218	30.2
Zinc	**1,100**	50	**600**	81	86	**140**	150	410	124
PAHs									
Acenaphthene	**190**	20	**3,800**	710[e]	9.7	**1,200**	0.016	0.5	0.33
Acenaphthylene	31	NA	ND	300[e,f,g]	NA	**57**	0.044	0.64	0.33
Anthracene	**750**	0.1	**4,300**	300[e,f,g]	NA	**700**	0.0853	1.1	0.33
Benz(a)anthracene	150	NA	**2,000**	300[e,f,g]	NA	**280**	0.261	1.6	0.33
Benzo(a)pyrene	**66**	0.1	ND	300[e,f,g]	NA	**110**	0.43	1.6	0.33
Benzo(b)fluoranthene	81	NA	**820**	300[e,f,g]	NA	**120**	1.8[h]	NA	NA
Benzo(k)flouranthene	67	NA	**820**	300[e,f,g]	NA	**110**	1.8[h]	NA	NA
Chrysene	140	NA	**2,000**	300[e,f,g]	NA	**270**	0.384	2.8	0.33
Dibenz(a,h)anthracene	58	NA	ND	300[e,f,g]	NA	**8.3**	0.0634	0.26	0.33
Fluoranthene	**280**	0.1	**27**	16[e]	1.6	**1,600**	0.6	5.1	0.33
Fluorene	230	NA	**3,800**	300[e,f,g]	NA	**1,100**	0.019	0.54	0.33
Indeno(1,2,3-cd)pyrene	62	NA	ND	300[e,f,g]	NA	**20**	0.6[h]	NA	NA
2-Methylnaphthalene	ND	NA	**960**	300[e,f,g]	NA	**990**	0.07	0.67	0.33
Naphthalene	**660**	0.1	**16,000**	2,350[e,f]	23.5	**1,600**	0.16	2.1	0.33
Phenanthrene	**230**	0.1	10,000	NA	NA	**1,500**	0.24	1.5	0.33
Pyrene	**260**	0.1	**3,600**	300[e,f,g]	NA	**1,100**	0.665	2.6	0.33
Total PAHs	ND	1.0	**18,000**	300[e,f,g]	NA	**10,000**	4.022	44.792	1.684
DIOXINs/FURANs									
TEQ (Toxic Equivalent Value)[i]	**8.1×10^{-4}**	3.2×10^{-6}	**1.8×10^{-5}**	NA	1.2×10^{-5}	ND	3.6×10^{-6}[h]	NA	2.4×10^{-6}

a: USEPA Region 4 recommended ecological screening values (USEPA 2001). Screening values used for groundwater are saltwater surface water values.

b: Ambient water quality criteria for the protection of aquatic organisms (USEPA 2002). Marine chronic criteria presented.

c: Effects range-low (ERL) and effects range-median (ERM) were compiled by Long et al. (1998).

d: Screening guidelines represent concentrations for $Cr.^{+6}$

e: Lowest Observable Effect Level (LOEL) (USEPA 1986).

f: Chronic criterion not available; acute criterion presented.

g: Value for chemical class.

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

i: Maximum toxic equivalant value (TEQ) is provided. Each dioxin/furan is assigned a toxic equivalency factor (TEF) relative to 2,3,7,8 tetrachlorodibenzodioxin, which is the most toxic in this group of compounds. In order to determine the toxicity of a mixture of dioxin/furan compounds the measured concentration of the individual dioxin/furans is multiplied by its assigned TEF. The results are summed to produce a TEQ.

NA: Screening guidelines not available.

ND: Not detected or not calculated.

Polycyclic aromatic hydrocarbons (PAHs) were detected in groundwater from the site at concentrations greater than the AWQCs and Region 4 ESV (Table 1). The majority of the

elevated PAH concentrations were detected in samples collected from the east side of the site; however 2-methylnaphthalene and naphthalene were detected at elevated concentrations in samples collected from the south central portion of the site. Of the PAHs, fluorene was detected most frequently and the maximum concentration exceeded the AWQC by one order of magnitude. The maximum concentrations of anthracene and pyrene also exceeded the AWQC by one order of magnitude. The maximum concentrations of benz(a)anthracene, chrysene, and naphthalene were six times greater than the AWQC. Maximum concentrations of acenaphthene and naphthalene exceeded the Region 4 ESVs by two orders of magnitude. The maximum concentration of total PAHs exceeded the AWQC by one order of magnitude.

<u>Sediment</u>

Arsenic and lead were detected in sediment at concentrations greater than the ERLs and the Region 4 ESVs (Table 1). The maximum arsenic and lead concentrations exceeded the ERLs by four and two times. respectively. Arsenic exceeded the Region 4 ESV by one order of magnitude. The locations of the maximum concentrations of arsenic and lead could not be determined from the information available for review at the time this report was prepared. Zinc was also detected in sediment at concentrations greater than the Region 4 ESVs.

PAHs were detected in sediment collected from the St. Johns River at concentrations greater than ERLs, ERMs, and Region 4 ESVs. Maximum concentrations of 12 PAHs were detected in sediment collected less than 122 m (400 ft) from the shoreline in the area where the loading dock once stood. Four maximum PAH concentrations were detected in sediment collected approximately 61 m (200 ft) downstream of the former loading dock. Benz(a)anthracene, benzo(a)pyrene, chrysene, fluoranthene, and fluorene were detected at concentrations greater than the ERL in over half of the sediment samples collected. All of the PAHs detected exceeded the ERL by at least one order of magnitude and eight PAHs also exceeded the ERM by at least an order of magnitude. The maximum concentration of total PAHs exceeded the ERL and Region 4 ESV by three orders of magnitude and exceeded the ERM by two orders of magnitude. In the nearshore area, PAHs have been detected at elevated concentrations as deep as 4.6 m (15 ft) below the sediment surface. The depth of sediment contamination had not been adequately assessed at the time this report was prepared.

<u>Soil</u>

Metals were detected in soil collected from the site at concentrations greater than the Region 4 ESVs. Maximum concentrations of arsenic, chromium, lead, and zinc were detected in samples collected from the southeast corner of the south parcel. The maximum concentration of arsenic exceeded the Region 4 ESVs by two orders of magnitude. Chromium and zinc were detected at concentrations one order of magnitude greater than the Region 4 ESVs. Chromium was detected in all the soil samples at concentrations greater than the Region 4 ESVs. Arsenic was detected in 65 percent of the samples at concentrations greater than the Region 4 ESVs.

Fifteen PAHs were detected in soil collected from the south parcel. The maximum concentrations of all PAHs were detected on the east side of the south parcel. Maximum concentrations of anthracene, fluoranthene, naphthalene, phenanthrene, and pyrene exceeded the Region 4 ESVs by three orders of magnitude. Benzo(a)pyrene was detected at a concentration two orders of magnitude greater than the Region 4 ESVs screening guideline in a sample collected from the southeast corner of the south parcel. The maximum acenaphthene concentration was more than nine times greater than the Region 4 ESVs screening guideline. Region 4 ESVs were not currently available for comparison with the remaining PAH concentrations that were detected in the soil samples.

Pathways

Contaminants have been released to habitats containing NOAA trust resources by several possible pathways including direct discharge, groundwater migration, and runoff.

Direct discharge of contaminants likely occurred when the wood preserving and treating facility was in operation. Wastewater at the facility was discharged directly into the St. Johns River (CH2M Hill 2003). This wastewater likely contained PAHs, metals, and other chemicals used for preserving and treating wood. Contaminants may also have been spilled into the St. Johns River when preserving and treating chemicals were received at the loading dock.

When the wood treating and preserving facility was dismantled creosote sludge mixed with wood shavings was buried in the northeast corner of the south parcel (CH2M Hill 2003). PAHs may have leached from the sludge into the surrounding groundwater, which then discharged into the St. Johns River. Groundwater beneath the site flows to the east into the St. Johns River at approximately 0.02 m (0.05 ft) per day (CH2M Hill 2003).

Most surface water runoff at the site flows east into the St. Johns River. Some runoff from the site flows into a drainage ditch that separates the north and south parcels. The location of the drainage ditch could not be determined from the information available for review at the time this report was prepared. Runoff also may flow into a low-lying area south of the site and then discharge into the St. Johns River. The low-lying area is a former drainage ditch that has been filled (CH2M Hill 2003).

The locations of the maximum concentrations of arsenic and lead could not be determined from the information available for review at the time this report was prepared.

NOAA Trust Resources

The habitat of concern to NOAA at the site is the St. Johns River. The St. Johns River is approximately 512 km (318 mi) in length and originates in Indian River County, Florida. The St. Johns River flows from south to north and parallels the east coast of Florida. The St. Johns River connects to the Atlantic Ocean in northeast Florida approximately 29 km (18 mi) downstream of the site.

The section of the river near the site, referred to as the Lower St. Johns River, has a deep and well-defined channel. The Lower St. Johns River is tidally influenced and during periods of low tide the water flows downstream at average speeds of 0.5 m/s (1.6 f/s)(FDEP 2005). This reach of the river is considered mesohaline, with salinities ranging from 15 to 25 parts per thousand (ppt). The Lower St. Johns River is a major transportation route for ships going to the Port of Jacksonville.

NOAA trust resources present in the Lower St. John River include anadromous, catadromous, and estuarine fish species (Table 2). Atlantic croaker, pinfish, southern flounder, spotted seatrout, striped mullet, and weakfish are abundant in the estuarine reach of the St Johns River during their adult, larvae, and juvenile life stages. Bay anchovy, Atlantic silversides, and mummichogs are abundant in the lower St. Johns River during all life stages. Sheepshead are commonly found in the lower St. Johns River during all adult and juvenile life stages (Nelson et al. 1991).

Table 2. NOAA trust resources present in the lower St. Johns River near the Kennedy Generating Station site (Nelson et al. 1991; FFWCC 2005; GSMFC 2004).

Species		**Habitat Use**			**Fisheries**	
Common Name	Scientific Name	Spawning Area	Nursery Area	Adult Habitat	Comm.	Rec.
ANADROMOUS FISH						
American shad	*Alosa sapidissima*		♦	♦		
Shortnose sturgeon	*Acipenser brevirostrum*			♦		
Striped bass	*Marone saxatilis*	♦	♦	♦		♦
CATADROMOUS FISH						
American eel	*Anguilla rostrata*		♦	♦		
MARINE/ESTUARINE FISH						
Atlantic croaker	*Micropogonias undulatus*		♦	♦	♦	
Atlantic silverside	*Menidia menidia*	♦	♦	♦		
Bay anchovy	*Anchoa mitchilli*	♦	♦	♦		
Mummichog	*Fundulus heteroclitus*	♦	♦	♦		
Pinfish	*Lagodon rhomboides*		♦	♦		
Sheepshead	*Archosargus probatocephalus*	♦	♦	♦	♦	
Southern flounder	*Paralichthys lethostigma*		♦	♦		♦
Spotted seatrout	*Cynoscion nebulosus*		♦	♦	♦	♦
Striped mullet	*Mugil cephalus*		♦	♦	♦	♦
Weakfish	*Cynoscion regalis*		♦	♦	♦	
INVERTEBRATES						
Blue crab	*Callinectes sapidus*	♦	♦	♦	♦	♦
Brown shrimp	*Farfante penaeus aztecus*		♦		♦	
Eastern oyster	*Crassostrea virginica*	♦	♦	♦		
White shrimp	*Litopenaeus setiferus*		♦		♦	

Several migratory fish species are present in the lower St Johns River (Table 2). Adult and juvenile blueback herring and American shad are common in the vicinity of the site (Nelson et al. 1991). The catadromous American eel is abundant in the estuary as an adult and during larval and juvenile stages. Striped bass are common in the tidally influenced portions of the lower St. Johns River during all life stages. A small number of shortnose sturgeon, which are listed as a federally threatened species, are present in the lower St Johns River as adults (Nelson at el. 1991).

Several invertebrates are present in the estuarine reach of the St. Johns River (Table 2). American oyster and blue crab are abundant in the lower St. Johns River during all life stages. Brown and white shrimp are abundant in the estuary as juveniles and during their larval stage (Nelson et al. 1991). Sampling has shown that sediment adjacent to the site supports an invertebrate population composed mostly of oligochaetes and polychaetes (CH2M Hill 2003).

Atlantic croaker, striped mullet, spotted seatrout, sheepshead, and weakfish are fished commercially in the lower St. Johns River and its tributaries. Invertebrates that were harvested commercially in significant numbers include blue crab, brown shrimp, and white shrimp (FFWCC 2005). Species commonly fished recreationally near the site include spotted seatrout, southern flounder, striped bass, striped mullet, and blue crab (GSMFC 2004).

Evidence of Injury

In 1997, consultants working on behalf of Jacksonville Electric Authority collected ten sediment samples from the river and characterized the benthic community in the samples (CDM 1997). The benthic community characterization indicated that sediment adjacent to the site generally contains low numbers and low diversity of benthic organisms. Two of the samples collected adjacent to the site contained large numbers of *Streblospio benedicti*, a benthic organism that is often dominant in areas with poor water quality.

In 1998, sediment samples were collected from the lower St. Johns River as part of a study to determine appropriate disposal options for sediment dredged from the shipping channel (PPB 1998). Elutriate and whole sediment bioassays were conducted on the sediment samples. The inland silverside *Menidia beryllina*, the mysid shrimp *Mysidopsis bahia*, and the sea urchin *Strongylocentrotus purpuratus* were used for the elutriate bioassays and the infaunal amphipod *Leptocheirus plumulosus* and the mysid shrimp *Mysidopsis bahia* were used for the whole sediment bioassays. The results of the bioassays conducted with sediment collected adjacent to the Kennedy Generating site indicate that the sediment at this location is toxic to aquatic life. The results for the elutriate bioassays were 0% survival for *Mysidopsis bahia* and *Menidia beryllina,* and 3% fertilization of *Strongylocentrotus purpuratus.* The results of the whole sediment bioassays were 0% survival for both *Leptocheirus plumulosus* and *Mysidopsis bahia.* Results of bioassays conducted with sediments collected just upstream and downstream of the Kennedy Generating site do not demonstrate toxicity. The biossay results for the sediment station adjacent to Kennedy Generating site were very different from the bioassays results for sediment from other areas of the river.

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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

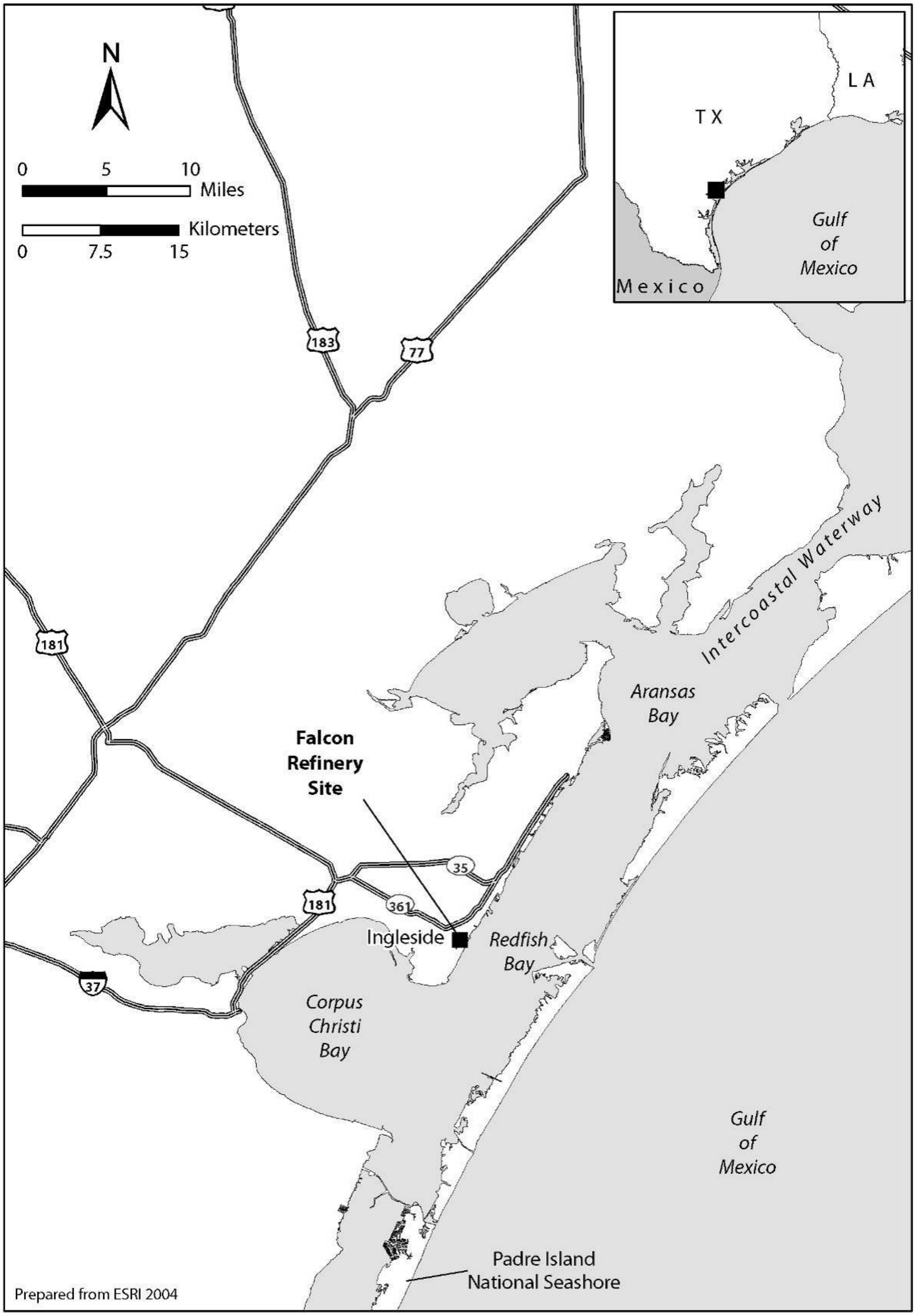

Figure 1. Location of the Falcon Refinery site near Ingleside, Texas.

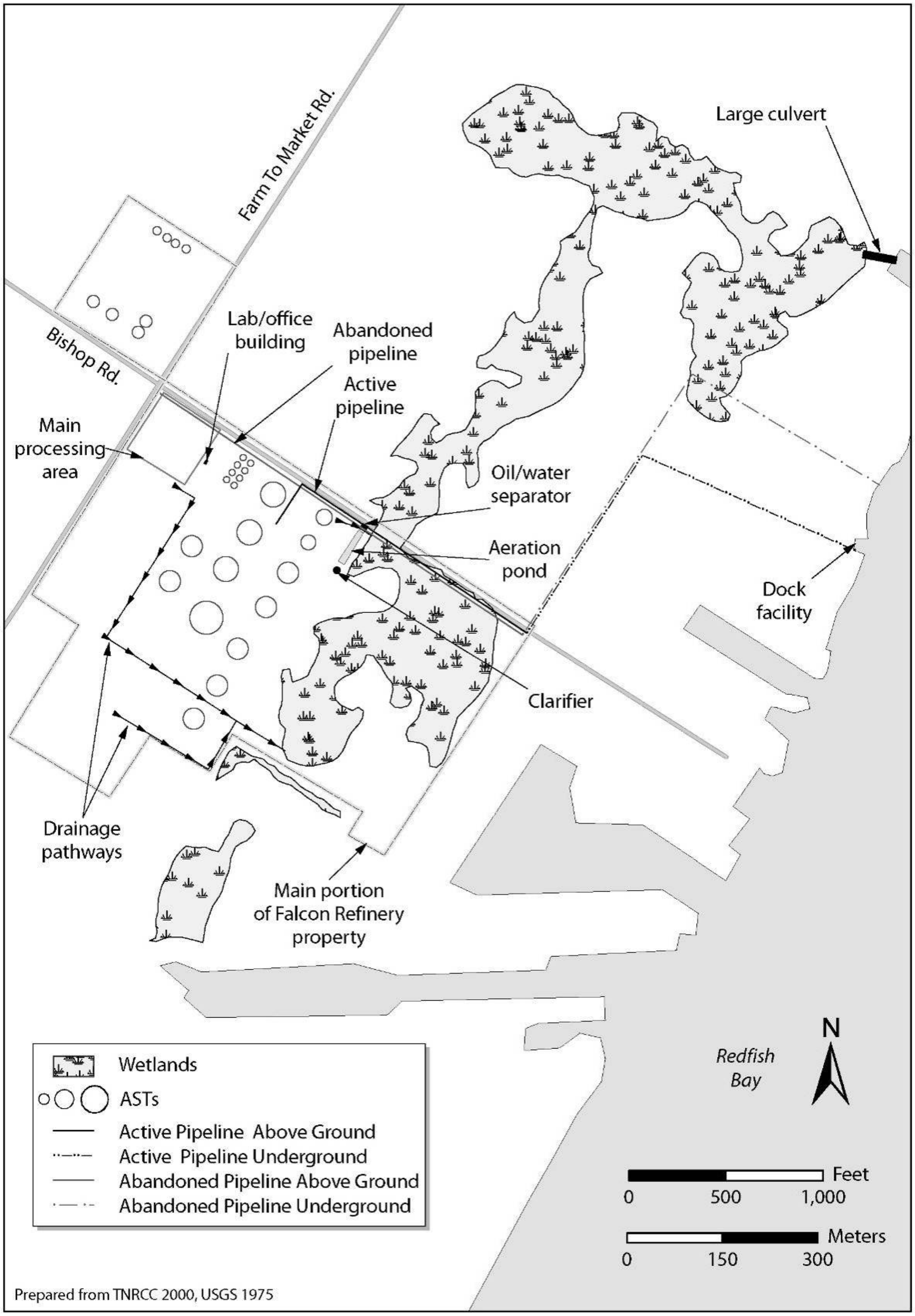

Figure 2. Detail of the Falcon Refinery property.

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

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; Efroymson 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.

<u>Sediment</u>

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

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.

	Soil (mg/kg)		Sediment (mg/kg)	
Contaminant	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 (Efroymson 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.

<u>Soil</u>

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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Glossary of terms

Adit Horizontal entrance to a mine.

Adult habitat The environment where an aquatic resource lives after reaching physical and sexual maturity.

Aestivation The dormant or sluggish state that some animals enter to cope with periods of hot and dry conditions.

Ambient water quality criteria (AWQC) The U.S. Environmental Protection Agency's (USEPA) compilation of nationally recommended water quality criteria, based on data and scientific judgments on pollutant concentrations and how they affect the environment or human health.[1]

Amphidromous refers to predominately freshwater species that require estuarine or marine waters for completion of larval phases.

Anadromous Migrating from marine waters to breed in freshwater. Examples of anadromous fish include salmon, river herring (alewife), and striped bass.

Aquifer An underground geological formation, or group of formations, containing water. Are sources of groundwater for wells and springs.

Aroclor A trade name for a group of polychlorinated biphenyls (PCBs).

Artesian aquifer An aquifer in which groundwater is confined under pressure by impermeable rock layers.

Baghouse dust Particles collected from the air by an air pollution system.

Bioavailable The fraction of the total chemical in the surrounding environment that is available for uptake by organisms. The environment may include water, sediment, suspended particles, and food items.

Biotransformation Chemical alteration of a substance within the body.

Body burden The amount of a chemical stored in the body at a given time, especially a potential toxin in the body as the result of exposure.

Boiler slag Molten inorganic material that drains to the bottom of the furnace when coal is being converted so that it can be used to create power.

Borehole A hole made with drilling equipment.

Brood To hatch eggs.

Capacitor An electric circuit element used to store charge temporarily.

Catadromous Living in fresh water but migrating to marine waters to breed. An example is the American eel.

Chemical affinity An attraction or force between particles that causes them to combine.

Coal tar A material obtained from the destructive distillation of coal in the production of coal gas. The crude tar contains a large number of organic compounds (e.g., benzene, naphthalene, methylbenzene, etc.), and is used as roofing, waterfproofing, and insulating compounds. It is also used as a raw material for dyes, drugs, and paints.

Confined aquifer An aquifer that is bounded above and below by impermeable rock layers.

Confluence The point where two or more streams meet or flow together.

Contaminants of concern Chemicals at a hazardous waste site that are likely to have an adverse effect on NOAA trust resources.

Contaminant partitioning In general, it is the tendency of a contaminant to be in the air, water, soil, or sediment based on the relative chemical affinities of that contaminant.

Decant To pour off without disturbing the sediment.

Demersal Dwelling at or near, sinking to, or deposited near the bottom of a body of water.

Depurate Elimination of a chemical from an organism by desorption, diffusion, excretion, egestion, biotransformation, or another route.

Desorption To remove an absorbed substance from.

Diadromous Fishes that migrate between fresh and salt water (e.g., salmon and American eel).

Effects range–low (ERL) NOAA sediment quality guidelines derived from the examination of a large number of individual contamination studies, all in salt water. The ERLs are indicative of contaminant concentrations below which adverse effects rarely occur.[2]

Egestion To discharge or excrete from the body.

Emergency Removal Action Steps taken to remove contaminated materials that pose imminent threats to local residents (e.g., removal of leaking drums or the excavation of explosive waste).[3]

Emergent plants/vegetation Rooted aquatic plants with some herbaceous vegetative parts that project above the water surface. Also referred to as emersed vegetation.

Emergent wetlands Class of wetland habitat characterized by erect, rooted, herbaceous hydrophytes, excluding mosses and lichens, that are present for most of the growing season.

Emergent wetland, subclass: non-persistent No obvious signs of emergent vegetation at certain seasons.

Emergent wetland, subclass: persistent Erect, rooted, herbaceous aquatic plants. Species that normally remain standing until the beginning of the next growing season.

Endangered species Animals, birds, fish, plants, or other living organisms threatened with extinction by anthropogenic (human-caused) or other natural changes in their environment.[3]

Endangered Species Act A 1973 act of Congress mandating that endangered and threatened species of fish, wildlife, and plants be protected and restored.

Environmental medium/media External conditions affecting the life, development, and survival of an organism, including air, water, and soil, which are the subject of regulatory concern and activities.

Ephemeral Short-lived or transitory.

Estuary, estuarine Region of interaction between rivers and nearshore marine waters, where tidal action and river flow mix fresh and salt water. Such areas include bays, mouths of rivers, salt marshes, and lagoons. These brackish water ecosystems shelter and feed marine life, birds, and wildlife. *See wetlands.*

Fish passage Features of a dam that enable fish to move around, through, or over without harm. Generally an upstream fish ladder or a downstream bypass system.

Flue A tunnel or conduit that connects a furnace to a chimney stack.

Forage To search for food.

Groundwater The supply of fresh water found beneath the earth's surface, which supplies wells and springs.[3]

Groundwater monitoring well See monitoring well.

Groundwater plume A visible or measurable discharge of a contaminant from a given point of origin into groundwater.

Habitat The place where a plant or animal species naturally lives and grows or characteristics of the soil, water, and biologic community (other plants and animals) that make this possible.

Habitat of concern The habitat that will be or is being affected by contaminants of concern from a hazardous waste site.

Hazardous ranking system/hazard ranking system package The principal screening tool used by the USEPA to evaluate risks to public health and the environment associated with abandoned or uncontrolled hazardous waste sites.[3]

Heavy metals Metallic elements with high atomic weights (e.g., mercury, chromium, cadmium, arsenic, and lead).

Hectare 2.471 acres or 10,000 square meters (m^2).

Heterogeneous Consisting of dissimilar parts or elements.

Hydrologic Unit Code (HUC) The United States is divided into hydrologic units for water resource planning and data management. Hydrologic units represent natural and human-imposed areas. Each HUC is a unique eight-digit number. The first two digits indicate the major geographic area or region, the second two digits indicate the sub-region, the third two digits indicate the accounting units, and the fourth two digits indicate the cataloging units. Cataloging units are also called "watersheds."

Hydrophyte (1) Plants that grow in water or saturated soils. (2) Any macrophyte that grows in wetlands or aquatic habitats on a substrate that is at least periodically deficient in oxygen because of excessive water content.

Ingot A mass of metal that is cast in a standard shape for convenient storage or transportation.

Inorganic compounds Chemical substances of mineral origin, not of basically carbon structure.

Intertidal That area of the shore between the high and low water marks; the intertidal zone of oceans and estuaries is regularly covered and exposed by the tides.

Invertebrate An animal without a spinal column or backbone.

Isomers Different substances that have the same formula.

Iteroparous Animals that do not die after spawning.

Juvenile habitat The environment in which an organism lives from one year of age until sexual maturity.

Karst A type of topography that results from dissolution and collapse of carbonate rocks such as limestone and dolomite and characterized by closed depressions or sinkholes, caves, and underground drainage.[4]

Leachate Water that collects contaminants as it trickles through wastes, pesticides or fertilizers. Leaching may occur in farming areas, feedlots, and landfills, and may result in hazardous substances entering surface water, ground water, or soil.[3]

Lowhead dam Dams that range from a six-inch drop off to a 25- foot drop off.

Macrophyte A plant that can be seen without the aid of optics.

Mainstem The principal channel of a drainage system into which other smaller streams or rivers flow.

Marine Of or relating to the sea.

Marsh A type of wetland that does not accumulate appreciable peat deposits (partially decomposed plants and other organic materials that can build up in poorly drained wetland habitats) and is dominated by plants with little or no woody tissue. *See wetland.*

Materiel The equipment, apparatus, and supplies of a military force.

Mean U.S. soil screening guidelines Average concentrations of inorganic compounds found in natural soils of the United States.

Metals Chemical elements with particular properties that include being good conductors of electricity and heat; in these reports, generally synonymous with inorganic compounds.

Migratory corridor, migratory route A body of water that adult fish travel through but do not remain in for any significant time.

Monitoring well (1) A well used to obtain water quality samples or measure groundwater levels. (2) A well drilled to collect groundwater samples for the purpose of physical, chemical, or biological analysis to determine the amounts, types, and distribution of contaminants beneath a site.

National Priorities List A list of hazardous waste sites, compiled by the USEPA, where hazardous wastes have been found and the initial evaluation shows a significant risk to human health or the environment. NPL sites are often called "Superfund sites" because Superfund money can be used by the USEPA to investigate and clean up these sites.

Neutralization Decreasing the acidity or alkalinity of a substance by adding alkaline or acidic materials, respectively.

NOAA trust resources Natural resources in coastal and marine areas, including the anadromous and catadromous fish that migrate between freshwater and coastal and marine areas.

Nursery habitat The habitat where larvae or juveniles settle, seek shelter, feed, and mature.

Oligohaline A low salinity region of an estuary, typically 0.5 to 5.0 parts per thousand salinity.

Order of magnitude A change in the value of a quantity or unit by a factor of 10.

Ordnance Military materiel, such as weapons, ammunition, artillery, combat vehicles, and equipment.

Organic compounds / chemicals / substances / materials Naturally occurring (animal- or plant-produced) or synthetic substances containing mainly carbon, hydrogen, nitrogen, and oxygen.[3]

Outfall The point where wastewater or drainage discharges from a sewer pipe, ditch, or other conveyance to a receiving body of water.[5]

Palustrine wetland a wetland beyond the influence of tidal brackish waters and typically dominated by persistent vegetation that remain standing into the next growing season; most inland wetlands fall into this classification; located in upland areas.

Pathway (for migration of contaminants) The physical course a chemical or pollutant takes from its source to the exposed organism.[3]

Pelagic Living or occurring in the open sea.

Pentachlorophenol (PCP) A manufactured chemical that is not found naturally in the environment. It was used as a biocide and wood preservative, and was one of the most heavily used pesticides in the United States. Now, only certified applicators can purchase and use this chemical. It is still used in industry as a wood preservative for power line poles, railroad ties, cross arms, and fence posts.[6]

Pesticides Substances or mixtures thereof intended for preventing, destroying, repelling, or mitigating any pest.[3]

Polychlorinated biphenyls (PCBs) A group of synthetic organic compounds that can cause a number of different harmful effects. There are no known natural sources of PCBs in the environment. PCBs are either oily liquids or solids and are colorless to light yellow.[6]

Polycyclic aromatic hydrocarbons (PAHs) A group of chemicals that are formed during the incomplete burning of coal, oil, gas, wood, garbage, or other organic substances, such as tobacco and charbroiled meat. Also referred to as polycyclic aromatic hydrocarbons (PAHs).[6]

Rearing habitat *See nursery habitat.*

Remediation Cleanup or other methods used to remove or contain a toxic spill or hazardous materials from a Superfund site.[3]

Rinsate The solution remaining after something is rinsed.

Rock flour Very finely powdered rock, produced when rocks are ground together.

Runoff That part of precipitation, snowmelt, or irrigation water that runs off the land into streams or other surface-water. It can carry pollutants from the air and land into receiving waters.

Salinity A measurement of the amount (usually in parts per thousand) of salt in water.

Salmonid Fish of the family Salmonidae, which includes salmon and steelhead.

Sediment The organic material that is transported and deposited by wind and water.

Semivolatile organic compounds (SVOCs) Organic compounds that volatilize slowly at standard temperature (20°C and 1 atm pressure).

Slag The glassy waste product created during the smelting of metal ores.

Spawning habitat The habitat where fish reproduce.

Steam (or boiler) blowdown To control solids in the boiler water

Stormwater Precipitation that accumulates in natural and/or constructed storage and stormwater systems during and immediately following a storm event.

Storm sewer A system of pipes (separate from sanitary sewers) that carries water runoff from buildings and land surfaces.[3]

Substrate The composition of a streambed, including either mineral or organic materials.[7]

Sump A low-lying place such as a pit, that receives drainage.

Superfund Money collected from a special tax on chemicals and raw petroleum that is appropriated by Congress. These funds are used to investigate, evaluate, and clean up the worst hazardous waste sites in the U.S. These sites are listed on the NPL.

Supratidal The area of the shore above the normal high-tide line.

Surface water All water naturally open to the atmosphere (rivers, lakes, reservoirs, ponds, streams, impoundments, seas, estuaries, etc.).

Surface water runoff Precipitation, snow melt, or irrigation water in excess of what can infiltrate the soil surface and be stored in small surface depressions.[3]

Tailings Residue of raw material or waste separated out during the processing of crops or mineral ores.[3]

Threatened species Plants and animals whose numbers are very low or decreasing rapidly. Threatened species are not endangered species yet, but are likely to become endangered in the future.[8]

Threshold Effects Concentration (TEC) Concentration below which harmful effects are unlikely to be observed.

Threshold effect level (TEL) The concentration of a contaminant below which negative biological effects are expected to occur only rarely.

Trace elements In these reports, generally synonymous with inorganic compounds.

Trust resources *See NOAA trust resources.*

Trustee (for natural resources) The party responsible for maintaining the original characteristics of our land, water, and the plants and animals that live there. NOAA is a federal trustee for natural resources that spend any portion of their life cycle in a marine or estuarine environment; and their habitats.

Unconfined aquifer An aquifer that is not confined under pressure and is bounded by permeable layers.

Uptake The transfer of a chemical into or onto an aquatic organism.

Volatile organic compounds (VOCs) Organic compounds that evaporate readily.[6]

Wastewater The spent or used water from a home, community, farm, or industry, which contains dissolved or suspended matter.

Water Quality Criteria Levels of water quality expected to render a body of water suitable for its designated use. Criteria are based on specific levels of pollutants that would make the water harmful if used for drinking, swimming, farming, fish production, or industrial processes.

Water table The level of groundwater.

Watershed The region draining into a river, river system, or other body of water.

Wetland An area that is saturated by surface or groundwater with vegetation adapted for life under those soil conditions including marshes, estuaries, swamps, bogs, and fens.

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[1] http://www.epa.gov/waterscience/criteria/ (accessed August 2005).

[2] http://response.restoration.noaa.gov/cpr/sediment/SPQ.pdf (accessed August 2005).

[3] http://www.epa.gov/OCEPAterms/ (accessed August 2005).

[4] http://water.usgs.gov/pubs/circ/circ1166/nawqa91.e.html (accessed August 2005).

[5] http://www.forester.net/sw_glossary.html (accessed August 2005).

[6] http://www.atsdr.cdc.gov/toxprofiles/ (accessed August 2005).

[7] http://www.streamnet.org/pub-ed/ff/Glossary/ (accessed August 2005).

[8] http://www.epa.gov/espp/coloring/especies.htm (accessed August 2005).

Appendix

Table 1. List of the 377 hazardous Waste Site Reports published by NOAA to date. Sites in bold italics are included in this volume.

Region 1

Connecticut	Date	EPA Facility ID
Barkhamsted-New Hartford Landfill	1989	CTD980732333
Beacon Heights Inc. Landfill	1984	CTD07212206
Broad Brook Mill	2003	CT0002055887
Gallups Quarry	1989	CTD108960972
Kellogg-Deering Well Field	1987	CTD98067081
New London Naval Submarine Base	1990	CTD980906515
O'Sullivans Island	1984	CTD98066799
Raymark Industries, Inc.	1996	CTD001186618
Yaworski Waste Lagoon	1985	CTD00977496

Maine		
Brunswick Naval Air Station	1987	ME8170022018
Callahan Mining Corp	2004	MED980524128
Eastland Woolen Mill	2002	MED980915474
McKin Company	1984	MED980524078
O'Connor Company	1984	MED980731475
Portsmouth Naval Shipyard	1995	ME7170022019
Saco Municipal Landfill	1989	MED980504393

Massachusetts		
Atlas Tack Corporation	1989	MAD001026319
Blackburn & Union Privileges	1993	MAD982191363
Cannon Engineering	1984	MAD980525232

Region 1 *cont.*

Massachusetts *cont.*	**Date**	**EPA Facility ID**
Charles George Land Reclamation	1987	MAD003809266
General Electric - Housatonic River	1999	MAD002084093
Groveland Wells 1 & 2	1987	MAD980732317
Hanscom Air Force Base	1995	MA8570024424
Haverhill Municipal Landfill	1985	MAD980523336
Industri-Plex 128	1987	MAD076580950
Natick Research, Development, and Engineering Center	1995	MA1210020631
Naval Weapons Industrial Reserve Plant	1995	MA6170023570
New Bedford Harbor	1984	MAD980731335
Nyanza Chemical Waste Dump	1987	MAD990685422
South Weymouth Naval Air Station	1995	MA2170022022
Sullivan's Ledge	1987	MAD980731343
U.S. Army Materials Technology Laboratory	1995	MA0213820939

New Hampshire		
Beede Waste Oil	1997	NHD018958140
Coakley Landfill	1985	NHD06442415
Dover Municipal Landfill	1987	NHD98052019
Fletcher's Paint Works and Storage	1989	NHD001079649
Grugnale Waste Disposal Site	1985	NHD06991103
Mohawk Tannery	2005	NHD981889629
New Hampshire Plating Co., Inc.	1992	NHD001091453
Pease Air Force Base	1990	NH7570024847
Savage Municipal Water Supply	1985	NHD98067100
Sylvester’s	1985	NHD09936354

Rhode Island		
Centredale Manor Restoration Project	2005	RID981203755
Davis Liquid Waste	1987	RID980523070
Kingston Dump/URI Disposal Area	1992	RID981063993
Naval Construction Battalion Center	1990	RI6170022036

Region 1 *cont.*

Rhode Island *cont.*	**Date**	**EPA Facility ID**
Naval Education Training Center	1990	RI6170085470
Peterson-Puritan, Inc.	1987	RID055176283
Picillo Farm	1987	RID980579056
Rose Hill Regional Landfill	1989	RID980521025
Stamina Mills Inc.	1987	RID980731442
Western Sand and Gravel	1987	RID009764929

Vermont		
BFI Sanitary Landfill	1989	VTD980520092
Elizabeth Mine	2003	VTD988366621
Ely Copper Mine	2003	VTD988366571
Old Springfield Landfill	1987	VTD00086023

Region 2

New Jersey		
Albert Steel Drum	1984	NJD00052515
American Cyanamid	1985	NJD00217327
Atlantic Resources	2004	NJD981558430
Bog Creek Farm	1984	NJD06315715
Brick Township Landfill	1984	NJD98050517
Brook Industrial Park	1989	NJD078251675
Chemical Control	1984	NJD00060748
Chemical Insecticide Corporation	1990	NJD980484653
Chipman Chemical (Reagent Chemical Company)	1985	NJD98052889
Cornell Dubilier Electronics, Inc.	1999	NJ981557879
Cosden Chemical Coatings Corp.	1987	NJD00056553
Crown Vantage Landfill	***2007***	***NJN000204492***
Curcio Scrap Metal Inc.	1987	NJD01171758
De Rewal Chemical Company	1985	NJD98076137
Denzer and Schafer X-Ray	1984	NJD04664440

Region 2 *cont.*

New Jersey *cont.*	**Date**	**EPA Facility ID**
Diamond Alkali/Diamond Shamrock Corporation	1984	NJD98052899
Diamond Head Oil Refinery Div.	2004	NJD092226000
Emmell's Septic Landfill	2002	NJD980772727
FAA Technical Center Atlantic City Airport	1990	NJ9690510020
Federal Creosote	2007	NJ0001900281
Garden State Cleaners	1989	NJD053280160
Global Sanitary Landfill	1989	NJD063160667
Hercules, Inc.	1984	NJD00234905
Higgins Disposal Service	1989	NJD053102232
Higgins Farm	1989	NJD981490261
Horseshoe Road Dump	1984	NJD9806636
Horseshoe Road Industrial Complex	1995	NJD980663678
Ideal Cooperage	1984	NJD98053290
Industrial Latex	1989	NJD981178411
Jackson Township Landfill	1984	NJD98050528
Kauffman & Minteer	1989	NJD002493054
Kin-Buc Landfill	1984	NJD04986083
Koppers Company	1984	NJD00244511
Krysowaty Farm	1985	NJD98052983
LCP Chemicals, Inc.	1999	NJD079303020
Lightman Drum Company	2007	NJD014743678
Martin Aaron, Inc.	2003	NJD014623854
McGuire Air Force Base #1	***2007***	***NJ0570024018***
Middlesex Sampling Plant	2002	NJ0890090012
Mobil Chemical Company	1984	NJD00060675
NL Industries	1984	NJD06184324
Perth Amboy's PCBs	1984	NJD98065390
PJP Landfill	1984	NJD98050564
Puchack Well Field	1999	NJD981084767
Quanta Resources	2004	NJD000606442
Roebling Steel Company	1984	NJD07373225
Roosevelt Drive-In	1984	NJD03025048

Region 2 *cont.*

New Jersey *cont.*	**Date**	**EPA Facility ID**
Route 561 Dump	2002	NJ0000453514
Sayreville Landfill	1984	NJD98050575
Sayreville Pesticide	1984	NA
Scientific Chemical Processing, Inc.	1984	NJD07056540
South Jersey Clothing Company	1989	NJD980766828
Syncon Resins	1984	NJD06426381
T. Fiore Demolition, Inc. Site	1984	NA
Toms River Chemical Company	1984	NA
United States Avenue Burn	2002	NJ0001120799
Universal Oil Products, Inc.	1984	NJD00200510
Ventron/Velsicol	1984	NJD98052987
White Chemical Company	1984	NJD00123918
Williams Property	1984	NJD98052994
Woodbrook Road Dump	2005	NJSFN0204260
Zschiegner Refining Company	1999	NJD986643153

New York		
Action Anodizing	1989	NYD072366453
Applied Environmental Services	1985	NYD98053565
Brookhaven National Laboratory	1990	NY7890008975
C & J Disposal Site	1989	NYD981561954
Carroll and Dubias Sewage Disposal	1989	NYD010968014
Computer Circuits	2002	NYD125499673
Consolidated Iron and Metal	2004	NY0002455756
Ellenville Scrap Iron and Metal	2003	NYSFN0204190
Jones Sanitation	1987	NYD98053455
Lawrence Aviation Industries, Inc.	***2007***	***NYD002041531***
Li Tungsten	1992	NYD986882660
Liberty Industrial Finishing	1985	NYD00033729
MacKenzie Chemical Works	2004	NYD980753420
Marathon Battery	1984	NYD01095975
Mattiace Petrochemical Company, Inc.	1989	NYD000512459

Region 2 *cont.*

New York *cont.*	**Date**	**EPA Facility ID**
North Sea Municipal Landfill	1985	NYD98076252
Old Roosevelt Field Contaminated Groundwater Area	2003	NYSFN0204234
Peter Cooper	1999	NYD980530265
Port Washington Landfill	1984	NYD98065420
Rowe Industries Groundwater Contamination	1987	NYD98148695
Sidney Landfill	1989	NYD980507677
Smithtown Groundwater Contamination	2003	NY0002318889
Stanton Cleaners Area Ground Water Contamination	2002	NYD047650197

Puerto Rico		
Clear Ambient Service	1984	PRD09041613
Frontera Creek	1984	PRD98064096
Naval Security Group Activity (NSGA)	1989	PR4170027383
Pesticide Warehouse I	***2007***	***PRD987367349***
Pesticide Warehouse III	2004	PRD987367299
Scorpio Recycling, Inc.	2005	PRD987376662
V&M/Albaladejo Farms	1997	PRD987366101
Vega Baja Solid Waste Disposal	2002	PRD980512669

Virgin Islands		
Island Chemical Company	1996	VID980651095
Tutu Wellfield	1993	VID982272569

Region 3

Delaware		
Army Creek Landfill	1984	DED98049449
Cokers Sanitation Services Landfills	1986	DED98070486
Delaware City PVC	1984	DED98055166
Delaware Sand & Gravel Landfill	1984	DED00060597
Dover Air Force Base	1987	DE857002401
Dover Gas and Light Company	1987	DED98069355
E.I. DuPont Newport Landfill	1987	DED98055512

Region 3 *cont.*

Delaware *cont.*	**Date**	**EPA Facility ID**
Halby Chemical Company	1986	DED98083095
Kent County Landfill	1989	DED980705727
Koppers Company Facilities	1990	DED980552244
National Cash Register Corporation	1986	DED04395838
New Castle Spill Site	1984	DED05898044
New Castle Steel	1984	DED98070525
Old Brine Sludge	1984	DED98070489
Pigeon Point Landfill	1987	DED98049460
Sealand Limited	1989	DED981035520
Standard Chlorine of Delaware, Inc.	1986	DED04121247
Sussex County Landfill	1989	DED980494637
Tybouts Corner Landfill	1984	DED00060607
Wildcat Landfill	1984	DED98070495

Maryland		
68th Street Dump/Industrial Enterprises	2002	MDD980918387
Aberdeen, Michaelsville Landfill	1986	MD3210021355
Aberdeen Proving Ground – Edgewood Area	1986	MD2210020036
Andrews Air Force Base	2003	MD0570024000
Anne Arundel County Landfill	1989	MDD980705057
Beltsville Agricultural Research Center	1995	MD0120508940
Brandywine DRMO	2003	MD9570024803
Bush Valley Landfill	1989	MDD980504195
Central Chemical Corporation	1999	MDD003061447
Curtis Bay Coast Guard Yard	***2007***	***MD4690307844***
Fort George G. Meade	1997	MD9210020567
Joy Reclamation Co.	1984	MDD030321178
Naval Air Station Patuxent River	1996	MD7170024536
Ordnance Products, Inc.	1995	MDD982364341
Sand, Gravel and Stone	1984	MDD980705164
Southern Maryland Wood Treating	1987	MDD980704852
Woodlawn County Landfill	1987	MDD980504344

Region 3 *cont.*

Pennsylvania	Date	EPA Facility ID
Austin Avenue Radiation Site	1993	PAD987341716
Boarhead Farms	1989	PAD047726161
Bridesburg Dump	1984	PAD98050840
Butler Tunnel	1987	PAD98050845
Crater Resources, Inc.	1993	PAD980419097
Croydon TCE	1986	PAD98103500
Douglassville Disposal Site	1987	PAD00238486
Elizabethtown Landfill	1989	PAD980539712
Enterprise Avenue	1984	PAD98055291
FMC Marcus Hook, aka East Tenth St. Industrial Area	1996	PAD980714505
Foote Mineral Company	1993	PAD077087989
Hellertown Manufacturing Company	1987	PAD00239074
Jacks Creek/Sitkin Smelting & Refining.	1989	PAD980829493
Keyser Avenue Borehole	1989	PAD981036049
Lower Darby Creek Area	2003	PASFN0305521
Metal Bank of America	1984	PAD04655709
Occidental Chemical/Firestone	1989	PAD980229298
Paoli Railyard	1987	PAD98069259
Publicker Industries	1990	PAD981939200
Recticon/Allied Steel Corporation	1989	PAD002353969
Revere Chemical Company	1986	PAD05139549
Rohm and Haas Landfill	1986	PAD09163797
Ryeland Road Arsenic Site	***2007***	***PAD981033459***
Salford Quarry	1997	PAD980693204
Tinicum National Environmental Center	1986	PA614351544
Tysons Dump	1985	PAD98069202
UGI Columbia Gas Plant	1995	PAD980539126
U.S. Navy Ships Parts Control Center	1996	PA3170022104
Wade (ABM) Site	1984	PAD98053940

Virginia		
Abex Corporation	1989	VA980551683

Region 3 *cont.*

Virginia *cont.*	**Date**	**EPA Facility ID**
Arrowhead Associates Inc./Scovill Corporation	1989	VAD042916361
Atlantic Wood Industries, Inc.	1987	VAD99071041
C and R Battery Co., Inc.	1987	VAD04995791
Chisman Creek	1984	VAD98071291
Former Nansemond Ordnance Depot	2002	VAD123933426
Fort Eustis	1996	VA6210020321
Kim-Stan Landfill	2002	VAD077923449
Langley Air Force Base	1995	VA2800005033
Marine Corps Combat Development Command Quantico	1995	VA1170024722
Naval Amphibious Base Little Creek	2002	VA5170022482
Naval Surface Weapons Center, Dahlgren Laboratory	1993	VA7170024684
Naval Weapons Station Yorktown	1993	VA8170024170
Norfolk Naval Base	1997	VA6170061463
NWS Yorktown - Cheatham Annex	2004	VA3170024605
Saunders Supply Company	1987	VAD00311738
St. Juliens Creek Annex (U.S. Navy)	2007	VA5170000181
USN Norfolk Naval Shipyard	1999	VA1170024813

Washington D.C.		
Washington Naval Yard	1999	DC91700243100

Region 4

Alabama		
American Brass, Inc.	2002	ALD98186846
Ciba-Geigy Corporation	1990	ALD001221902
Olin Chemical Corporation	1990	ALD008188708
Redwing Carriers, Inc.	1989	ALD980844385

Region 4 *cont.*

Florida	Date	EPA Facility ID
62nd Street Dump	1984	FLD98072887
Agrico Chemical Company	1989	FLD980221857
American Creosote Works	1984	FLD00816199
Broward County/21st Manor Dump	1992	FLD9819300506
Chem-Form, Inc.	1990	FLD080174402
Harris Corporation/General Development Utilities	1986	FLD00060233
Helena Chemical Company	1993	FLD053502696
Kassouf-Kimerling	1984	FLD00060233
Kennedy Generating Station	***2007***	***NA***
MRI Corporation	1997	FLD088787585
Munisport Landfill	1984	FLD08453544
Naval Air Station Cecil Field	1990	FL5170022474
Naval Air Station Jacksonville	1990	FL6170024412
Naval Air Station Whiting Field	1996	FL2170023244
Pensacola Naval Air Station	1990	FL9170024567
Picketville Landfill	1984	FLD98055635
Solitron Microwave	2002	FLD045459526
Standard Auto Bumper Corporation	1989	FLD004126520
Stauffer Chemical Company	1993	FLD004092534
Stauffer Chemical Company	1993	FL010596013
Tyndall Air Force Base	1997	FL1570024124
United Metals, Inc.	2004	FLD098924038
Woodbury Chemical Company	1989	FLD004146346

Georgia		
Brunswick Wood Preserving	1997	GAD981024466
Camilla Wood Preserving	1999	GAD008212409
Terry Creek Dredge Spoil/Hercules Outfall	1997	GAD982112658

Mississippi		
Chemfax, Inc.	1995	MSD008154486
Davis Timber Company	2004	MSD046497012

Region 4 *cont.*

Mississippi *cont.*	**Date**	**EPA Facility ID**
Gautier Oil Company, Inc.	1989	MSD098596489
Picayune Wood Treating Site	2007	MSD065490930

North Carolina		
ABC One Hour Cleaners	1989	NCD024644494
Camp Lejeune Marine Corps Base: Site 21 Lot 40	1989	NC6170022580
FCX, Incorporated	1989	NCD981475932
New Hanover County Airport Burn Pit	1989	NCD981021157
Potter's Septic Tank Services Pits	1989	NCD981023260
Reasor Chemical Company	2004	NCD986187094

South Carolina		
Geiger (C&M Oil)	1984	SCD98071127
Helena Chemical Company	1989	SCD058753971
Koppers Company, Inc., Charleston Plant	1993	SCD980310239
Macalloy Corporation	2004	SCD003360476
Savannah River Plant	1990	SC1890008989
Wam Chem, Inc.	1984	SCD03740536

Region 5

Wisconsin		
Ashland/Northern States Power Lakefront	2007	WISFN0507952
Fox River NRDA/PCB Releases	2003	WI0001954841

Region 6

Louisiana		
Bayou Sorrell	1984	LAD98074554

Region 6 *cont.*

Louisiana *cont.*	**Date**	**EPA Facility ID**
Delatte Metals	2002	LAD052510344
Devil's Swamp Lake	2007	LAD981155872
Madisonville Creosote Works	1997	LAD981522998
Mallard Bay Landing Bulk Plant	2004	LA0000187518

Texas		
ALCOA (Point Comfort/Lavaca Bay)	1995	TXD008123168
Bailey Waste Disposal	1985	TXD98086464
Brine Service Company	2004	TX0000605264
Brio Refining, Inc.	1989	TXD980625453
Crystal Chemical Company	1989	TXD990707010
Dixie Oil Processors	1989	TXD089793046
Falcon Refinery	***2007***	***TXD086278058***
French Limited	1989	TXD980514814
Gulfco Marine Maintenance	2007	TXD055144539
Highlands Acid Pits	1989	TXD980514996
Malone Service Company, Inc.	2003	TXD980854789
Motco Corp.	1984	TXD98062985
Palmer Barge Line	2005	TXD068104561
Patrick Bayou	2003	TX000605329
Sikes Disposal Pits	1989	TXD980513956
Star Lake Canal	2007	TX0001414341
State Marine	1999	TXD099801102
Tex-Tin Corporation	1989	TXD062113329

Region 9

American Samoa		
Taputimu Farm	1984	ASD98063765

Region 9 *cont.*

California	Date	EPA Facility ID
Alviso Dumping Areas	1985	NA
Camp Pendleton Marine Corps Base	1990	CA2170023533
Coast Wood Preserving	1984	CAD06301588
Cooper Drum Company	1993	CAD055753370
CTS Printex, Inc.	1989	CAD009212838
Del Amo	1992; 2004	CAD029544731
Del Norte County Pesticide Storage Area	1984	CAD00062617
El Toro Marine Corps Air Station	1989	CA6170023208
Fort Ord Army Base	1990	CA7210020676
GBF, Inc. Dump	1989	CAD980498562
GBF/Pittsburg Landfill	1993	CAD980498562
Hewlett-Packard	1989	CAD980884209
Intersil, Inc., and Siemens Components	1989	CAD041472341
Iron Mountain Mine	1989	CAD980498612
Jasco Chemical Corporation	1989	CAD009103318
Liquid Gold Oil Corporation	1984	CAT00064620
McCormick & Baxter Creosoting Company	1993	CAD009106527
MGM Brakes	1984	CAD00007412
Moffett Field Naval Air Station	1986	CA217009007
Montrose Chemical Corportion	1985	CAD00824271
Naval Air Station Alameda	1989	CA2170023236
Naval Weapons Station	1989	CA7170024528
Naval Weapons Station Concord	1993	CA7170024528
Naval Station Treasure Island – Hunters Point Annex	1989	CA1170090087
Pacific Coast Pipelines	1989	CAD980636781
Riverbank Army Ammunition Depot	1989	CA7210020759
Sola Optical USA, Inc.	1989	CAD981171523
Travis Air Force Base	1990	CA5570024575
Zoecon Corporation/ Rhone-Poulenc, Incorporated	1985	CAT00061135

Guam	Date	EPA Facility ID
Andersen Air Force Base	1993	GU6571999519

Region 9 *cont.*

Hawaii

Del Monte Corporation (Oahu Plantation)	1995	HID980637631
Pearl City Landfill	1984	HID980585178
Pearl Harbor Naval Complex	1992	HI4170090076

Region 10

Alaska

Elmendorf Air Force Base	1990	AK8570028649
Fort Richardson	1995	AK6214522157
Klag Bay Site	2002	AK0002364768
Naval Air Station Adak	1993	AK7170090099
Standard Steel	1990	AK980978787

Idaho

Blackbird Mine	1995	IDD980725832
Stibnite/Yellow Pine Mining Area	2003	ID9122307607

Oregon

Allied Plating, Inc.	1987	ORD009051442
Gould, Inc.	1984	ORD095003687
Harbor Oil	2004	ORD071803985
Martin-Marietta Aluminum Co.	1987	ORD052221025
McCormick & Baxter Creosoting Company	1995	ORD009020603
Northwest Pipe and Casing Company	1993	ORD980988307
Portland Harbor	2003	ORSFN1002155
Stauffer Chemical Company	1984	NA
Taylor Lumber and Treating	2005	ORD009042532
Teledyne Wah Chang	1985	ORD050955848
Union Pacific Tie Treating Facility	1990	ORD009049412

Region 10 *cont.*

Washington

Aluminum Company of America (ALCOA)	1989	WAD009045279
American Crossarm and Conduit Company	1989	WAD057311094
Bonneville Power Administration, Ross Complex	1990	WA1891406349
Centralia Landfill	1989	WAD980836662
Commencement Bay, Nearshore Sites	1984	WAD980726368
Commencement Bay, South Tacoma	1984	WAD980726301
Hamilton Island Landfill	1992	WA5210890096
Hanford – Areas 100, 200, 300, 1100	1989	WA3890090075
Harbor Island	1984	WAD980722839
Jackson Park Housing Complex	1995	WA3170090044
Kent Highlands Landfill	1989	WAD980639462
Lower Duwamish Waterway	2003	WA0002329803
Naval Air Station Whidbey Island Ault Field	1986	WA5170090059
Naval Air Station Whidbey Island Seaplane Base	1986	WA6170090058
Northwest Transformer	1989	WAD027315621
Oeser Company	1997	WAD008957243
Old Navy Dump	1996	WA8680030931
Pacific Sound Resources	1995	WAD009248287
Puget Sound Naval Shipyard	1995	WA2170023418
Quendall Terminal	1985; 2007	WAD980639215
Tulalip Landfill	1992	WAD980369256
U.S. Naval Submarine Base, Bangor	1990	WA5170027291
Western Processing	1984	WAD009487513
Wyckoff Company Eagle Harbor	1986	WAD009248295

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December 2007

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