Middlesex Sampling Plant

Middlesex, NJ

EPA Facility ID: NJ0890090012

Basin: Raritan

HUC: 02030105

Executive Summary

The Middlesex Sampling Plant (MSP) was used for sampling, analysis, storage, and shipment of uranium, thorium, and beryllium ores from 1943 to 1955. Radioactive substances, trace elements, and PAHs have been measured at elevated concentrations in facility soils. Elevated concentrations of trace elements were detected in surface water and sediment samples collected from the South Drainage Ditch at the MSP. Radioactive substances have also been detected in surface water and sediment, although screening guidelines are not available for comparison. There is an American shad restoration program in the Raritan River, and suitable habitat for alewife in Ambrose and Green brooks. No one has undertaken sampling in Ambrose and Green brooks downstream from the site.

Site Background

The Middlesex Sampling Plant (MSP) covers approximately 3.9 hectares (9.6 acres) in Middlesex, Middlesex County, New Jersey (Figure 1). The property is located about 1.3 km (0.8 miles) from Ambrose Brook, which joins Green Brook 2.9 km (1.8 miles) downstream. Green Brook flows for 0.3 km (0.2 miles) to the Raritan River, which then flows for 25 km (16 miles) before discharging into Raritan Bay.

The MSP property was used primarily for sampling, analysis, storage, and shipment of uranium, thorium, and beryllium ores from 1943 to 1955 under contract with the Atomic Energy Commission and the Manhattan Engineer District. After 1955, the site was used only for storage and limited sampling of thorium residues. Beginning in 1980, the control of contamination associated with the MSP was managed under the U.S. Department of Energy (DOE) Formerly Utilized Sites Remedial Action Program (Redmon 1997). This program was transferred by congressional action to the U.S. Army Corps of Engineers in the fiscal year 1998.

Two former waste sources on the site were identified as the Middlesex Municipal Landfill (MML) Waste Pile and the Vicinity Property (VP) Waste Pile (USEPA 1998). These sources were removed in two separate removal actions. The MML waste pile (23,800 m^3/31,130 cy) was removed in 1998 and the VP waste pile (26,900 m^3/35,180 cy) was removed in 1999 (Carpenter 2000). The MML Pile contained soil contaminated with pitchblende (high-grade uranium ore) that was originally placed at the landfill. The material was returned to MSP for interim storage when radiological surveys at MML showed that remediation was required. The VP Pile consisted of radioactive soil and material from properties in the vicinity that had been contaminated from MSP activities. It also contained material excavated from the South Drainage Ditch during a removal action. Soil and asphalt contaminated during site activities remain on several areas of the site, comprising an estimated volume of 13,000 m^3 (17,000 cy) (U.S. DOE 1995; USEPA 1998; Carpenter 2000).

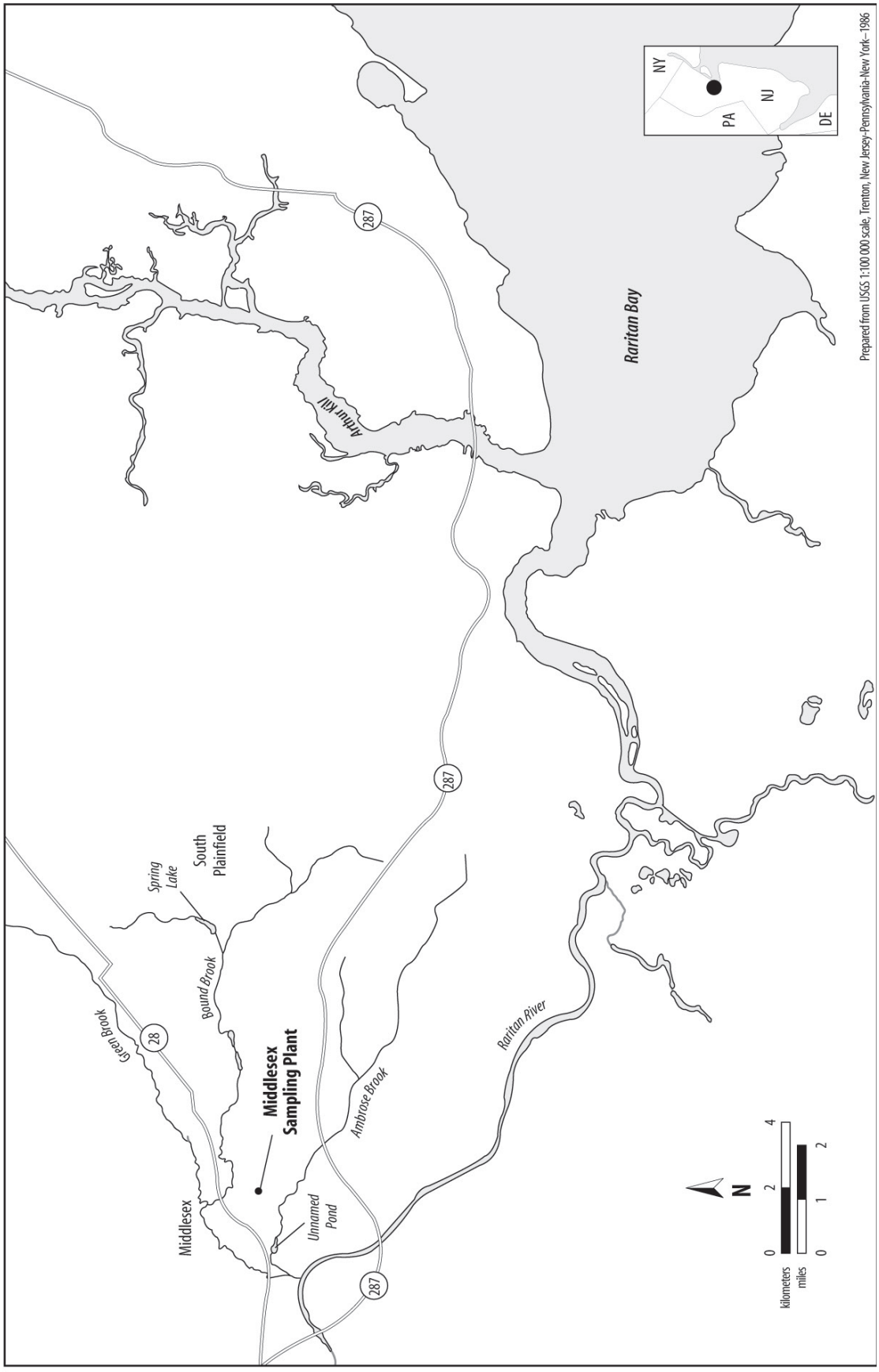

Figure 1. Location of the Middlesex Sampling Plant in Middlesex, New Jersey.

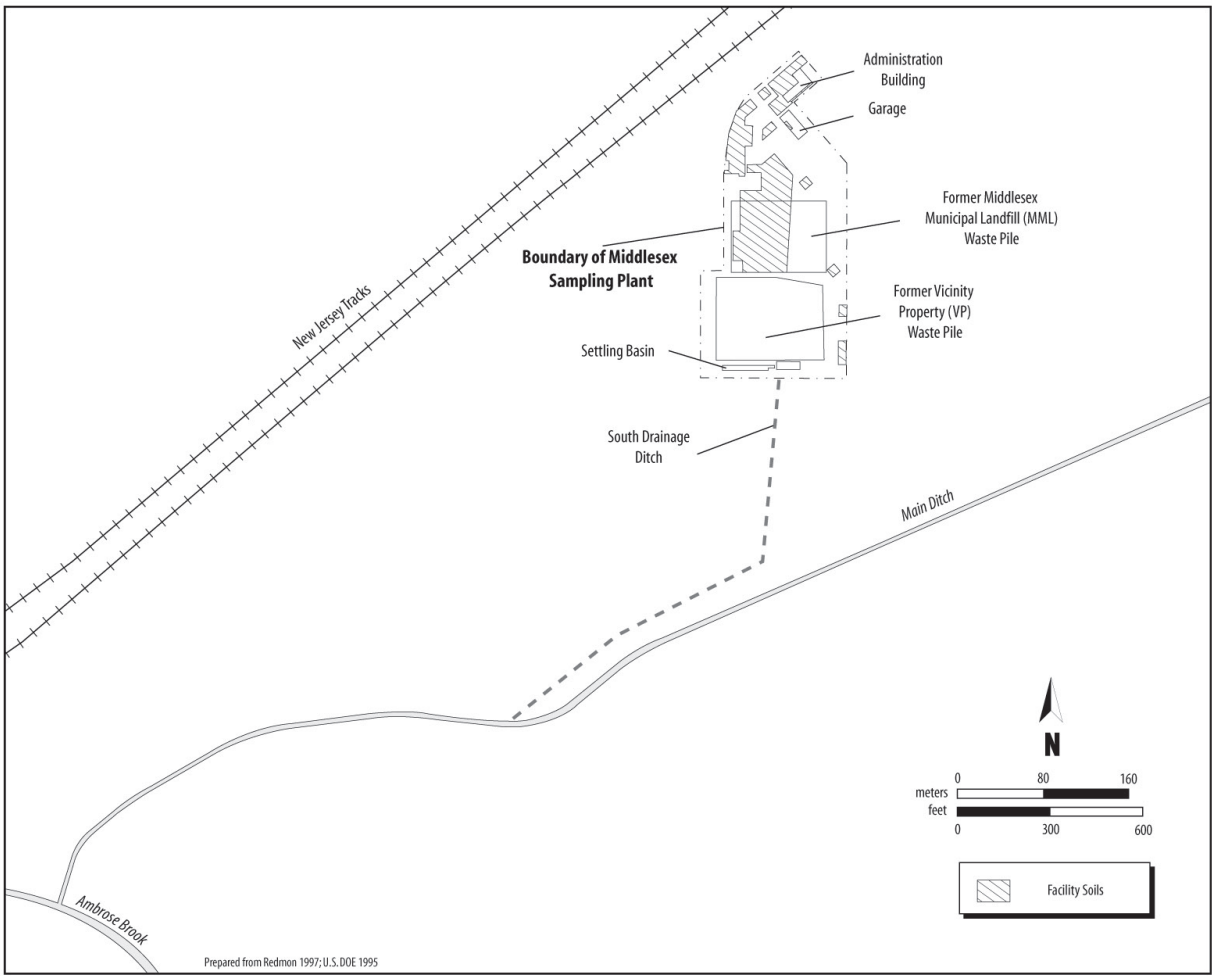

Figure 2. Detail of the Middlesex Sampling Plant.

Beginning in 1980, the U.S. Department of Energy (DOE) conducted investigations and environmental surveillance monitoring studies to determine the nature and extent of contamination from the site. A Hazard Ranking System Evaluation was completed in 1998 and EPA placed the site on the National Priorities List in January 1999.

The primary pathways of contaminant transport from the MSP to NOAA trust resources are surface water runoff and groundwater discharge. An underground drainage system conveys surface runoff from the site to South Drainage Ditch or to an on-site settling basin that also empties into the ditch (Figure 2). The South Drainage Ditch empties into the Main Ditch, which flows into Ambrose Brook. Soils at the site range from 0.45 to 2.4 m (1.5 to 8 ft) deep and are low to moderately permeable. The underlying red shale formation is relatively impermeable. Groundwater in the shallow zone of the aquifer system has a low-flow velocity and is approximately 3 m (10 ft) below the surface. Groundwater beneath the site flows south towards Ambrose Brook (USEPA 1994; U.S. DOE 1995).

NOAA Trust Resources

The NOAA trust habitats of primary concern are the surface water and sediments in Ambrose and Green brooks, small tributary streams within the Raritan River basin. The streams are between 4 and 10 m (13 and 33 ft) wide and 0.3 to 2 m (1 to 6.5 ft) deep. The streams are low-gradient, with warm water fish including sunfish, shiners, bullhead catfish, and carp (Barno 2000).

The catadromous American eel is the trust resource present in Ambrose and Green brooks. A dam forms an unnamed pond about 1 km (0.6 mi) downstream of the Main Ditch, but eel can traverse this dam and use upstream habitats. American eel stay in the habitats throughout the streams from juvenile to adult life stages (Barno 2000).

Over the past century, industrial and urban activities have contaminated the lower Raritan River watershed. For much of this time, fish communities have been composed largely of pollution-tolerant resident species. However, substantial improvements in water quality over the past 10 to 15 years have provided the impetus for an anadromous restoration program on the watershed (Barno 2000).

The New Jersey Department of Environmental Protection (NJDEP) runs an American shad restoration program on the Raritan River. From 1992 to 1997, adult American shad from the Delaware River basin were transplanted to the Raritan River to reestablish a spawning population. Naturally spawning populations of shad are now returning to the Raritan River, and migrate as far upstream as Raritan, where a dam blocks their passage at Nevius Street, approximately 10 km (6 mi) upstream from the confluence of Green Brook and the Raritan River. Water quality improvements have reestablished populations of alewife and striped bass in the Raritan River as far upstream as the Nevius Street dam. Anadromous fish have not been documented in Ambrose or Green brooks, probably because of poor water quality and degraded habitat (Barno 2000).

There are no commercial fisheries in area streams. Striped bass and American shad are fished recreationally in the Raritan River (Barno 2000).

In 1997, the New Jersey Department of Environmental Protection issued a consumption advisory for all fish in the Bound Brook watershed, because of PCB contamination (USEPA 2000). This fish consumption advisory is still in effect.

Site-Related Contamination

A 1983 characterization of MSP soils contains the best-documented data to define the extent of radiological contamination in property soils (U.S. DOE 1995). This investigation involved collecting samples throughout the MSP. In 1991, 33 boreholes were sampled across the property for analysis of trace elements and organic compounds. Ten composite samples from the MML Pile and 20 composite samples from the VP Pile were collected in 1991 for analysis of radioactive substances, trace elements, and organic compounds (U.S. DOE 1995; USEPA 1998).

Since 1982 groundwater has been sampled annually for radioactive substances at the MSP at 19 wells. Twelve wells were sampled for organic compounds from 1985 to 1991. Beginning in 1990, all groundwater wells were analyzed for trace elements. In 1992, the scope was reduced to six on-site wells sampled for radioactive substances, trace elements, and organic compounds (U.S. DOE 1995). Surface water and sediment samples have been monitored at three locations at various times since 1980. Samples were collected in the South Drainage Ditch from the outfall to approximately 800 m (0.5 mi) downstream in the Main Ditch, and have been analyzed for radioactive substances

Table 1. Maximum concentrations of contaminants of concern detected in environmental media collected from the MSP site from data presented in U.S. DOE (1995) and U.S. EPA (1998).

	Soil (mg/kg or pCi/g)		Water (mg/L or pCi/L)			Sediment (mg/kg or pCi/g)	
Contaminant	Soil/Waste Piles	Mean U.S.[a]	Surface Water	Ground-water	AWQC[b]	Sediment	TEL[c]
RADIOACTIVE SUBSTANCES							
Radium-226	740	NA	8.3	7.0	NA	54	NA
Radium-228	NA	NA	7.0	1.6	NA	7.6	NA
Thorium-230	NA	NA	2.6	1.9	NA	3.5	NA
Thorium-232	19	NA	0.42	0.33	NA	5.9	NA
Total uranium	NA	NA	74	30	NA	28	NA
Uranium-238	960	NA	NA	190	NA	120	NA
TRACE ELEMENTS							
Arsenic	500	5.2	4.9	2.4	190	4.9	5.9
Cadmium	2,100	0.06	8	<7	1.1	0.75	0.60
Copper	1,500	17	160	250	12	36	35.7
Lead	19,000	8.1	810	510	3.2	61	35
Silver	NA	0.05	9.3	<10	0.12	<1.6	1.0[d]
Zinc	2,000	48	280	2,200	110	700	123.1
PAHs							
Acenaphthene	0.33	NA	ND	ND	520[e]	NA	0.0067
Acenaphthylene	0.059	NA	ND	ND	300[f,g]	NA	0.00587
Anthracene	2.2	NA	ND	ND	300[f,g]	NA	0.0469
Benzo(a)anthracene	55	NA	ND	ND	300[f,g]	NA	0.0748
Benzo(a)pyrene	62	NA	ND	ND	300[f,g]	NA	0.0888
Benzo(b)fluoranthene	64	NA	ND	ND	300[f,g]	NA	NA
Benzo(g,h,i)perylene	37	NA	ND	ND	300[f,g]	NA	NA
Benzo(k)fluoranthene	36	NA	ND	ND	300[f,g]	NA	NA
Chrysene	60	NA	ND	ND	300[f,g]	NA	0.108
Dibenzo(a,h)anthrancene	33	NA	ND	ND	300[f,g]	NA	0.00622
Fluoranthene	29	NA	ND	ND	3,980[h]	NA	0.113
Fluorene	0.33	NA	ND	ND	300[f,g]	NA	0.0212
Ideno(1,2,3-cd)pyrene	37	NA	ND	ND	300[f,g]	NA	NA
Phenanthrene	9.4	NA	ND	ND	6.3[i]	NA	0.0867
Pyrene	25	NA	ND	ND	300[f,g]	NA	0.153

NA Data or screening guidelines not available.
ND Not detected; detection limit not available.
a Shacklette and Boerngen (1984), except for cadmium and silver which represent average concentrations in the earth's crust from Lindsay (1979).
b Ambient water quality criteria for the protection of aquatic organisms (USEPA 1999). Freshwater chronic criteria presented. Criterion expressed as a function of total hardness with the exception of arsenic and silver; concentrations shown correspond to hardness of 100 mg/L.
c Threshold Effects Level is the geometric mean of the 15th percentile of the effects data and the 50th percentile of the no-effects data. The TEL is intended to represent the concentration below which adverse biological effects rarely occurred (Smith et al. 1996).
d TEL not available; Effects Range-Low (ERL) value presented. The ERL represents the 10th percentile for the dataset in which effects were observed or predicted in studies compiled by Long et al. (1995).
e Lowest Observable Effect Level.
f Freshwater chronic criteria not available; marine acute value presented.
g Value for chemical class.
h Freshwater chronic criteria not available; freshwater acute value presented.
i Proposed criteria.

and trace elements. Surface water samples have also been analyzed for organic compounds (U.S. DOE 1995).

The primary contaminants of concern to NOAA are radioactive substances, trace elements, and PAHs. Table 1 summarizes the maximum reported contaminant concentrations in each type of environmental media. Although there are no screening guidelines available for radioactivity in soils, maximum concentrations of radium-226 and thorium-232 in soils and waste piles exceeded the DOE guideline of 5 pCi/g for the top 15 cm of soil (Redmon 1997). The maximum concentration of uranium-238 in soil, 960 pCi/g, exceeded the DOE guideline of 100 pCi/g (U.S. DOE 1995). In facility soils and waste piles, maximum concentrations of all trace elements for which data were available exceeded the screening guidelines. Elevated concentrations of PAHs were found in MSP soils and waste piles, although soil screening guidelines are not available for these compounds.

Radioactive substances were detected in groundwater, surface water, and sediment, but screening guidelines are not available. Maximum concentrations of copper, lead, and zinc exceeded their respective AWQC in both groundwater and surface water. The highest concentrations in surface water were generally measured in samples collected at the plant's outfall (Redmon 1997). In sediment, maximum concentrations of cadmium, copper, lead, silver, and zinc exceeded their respective TEL values (Redmon 1997).

References

Barno, L., Fisheries Biologist, Bureau of Freshwater Fisheries, New Jersey Department of Environmental Protection, Lebanon, New Jersey, personal communications, April 4, 2000 and October 27, 2000.

Carpenter, A., EPA Project Manager, personal communication citing the Final Work Plan for Subsurface Soil Sampling at the Middlesex Sampling Plant, USACE, August 2000, August 23, 2000.

Long, E.R., D.D. MacDonald, S.L. Smith and F.D. Calder. 1995. Incidence of adverse biological effects within ranges of chemical concentrations in marine and estuarine sediments. *Environ. Mgmt. 19*(1):81-97.

Redmon, M.E. 1997. Technical memorandum: Environmental surveillance results for 1996 for the Middlesex Sampling Plant. FUSRAP. Oak Ridge, Tennessee: U.S. Department of Energy.

Shacklette, H.T. and J.G. Boerngen. 1984. Element concentrations in soils and other surficial materials of the conterminous United States. USGS Professional Paper 1720. Washington, D.C.: U.S. Geological Survey.

Smith, S.L., D.D. MacDonald, K.A. Keenleyside, C.G. Ingersoll, and L.J. Field. 1996. A preliminary evaluation of sediment quality assessment values for freshwater ecosystems. *J. Great Lakes Res. 22*(3): 624-638.

U.S. DOE. 1995. Characterization report for the Middlesex Sampling Plant (Volume I). Oak Ridge, Tennessee: U.S. Department of Energy.

USEPA. 1994. Final draft, Middlesex Sampling Plant, Federal Facility SI review documentation package. U.S. Environmental Protection Agency.

USEPA. 1998. Final, hazard ranking system evaluation, Middlesex, Middlesex County, New Jersey. U.S. Environmental Protection Agency.

References *cont.*

USEPA. 1999. National Recommended Water Quality Criteria—Correction. Washington, D.C.: U.S. Environmental Protection Agency, Office of Water.

USEPA. 2000. Listing of Fish and Wildlife Consumption Advisories [webpage], U.S. Environmental Protection Agency, Office of Science and Technology. Available: www.epa.gov/ost/fish/epafish.pdf