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RCRA FACILITY ASSESSMENT

BETHLEHEM STEEL CORPORATION
LACKAWANNA PLANT

Lackawanna, New York

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EXECUTIVE SUMMARY

INTRODUCTION

The Bethlehem Steel Corporation (BSC) Lackawanna Plant in Lackawanna, New York [Figure 1] was investigated by the National Enforcement Investigations Center (NEIC) at the request of the EPA Region II Air and Waste Management Division. The investigation was conducted under authority of the Resource Conservation and Recovery Act (RCRA).

The Lackawanna Plant has RCRA interim status [EPA ID No. NYD002134880], under the delegated State program, for three hazardous waste management units. BSC has, reportedly, not used the units since 1983 and has submitted closure plans to EPA and the New York State Department of Environmental Conservation (NYSDEC) for these units. Closure of two of the units has been suspended pending a decision by EPA on delisting petitions for wastes in them. Closure of the third unit (tar decanter sludge pit) is scheduled for the summer of 1988. Because the waste management units were not closed before January 26, 1983, BSC is subject to the RCRA permit requirements for the units.*

The 1984 Hazardous and Solid Waste Amendments (HWSA) to RCRA [Section 3004(u)], require that a RCRA permit must address releases of hazardous waste or constituents from any solid waste management unit (SWMU), regardless of the time at which waste was placed in the unit. A solid waste management unit is defined as any discernible waste management unit at a RCRA facility from which hazardous constituents might migrate, irrespective of whether the unit was intended for the management of solid and/or hazardous waste. The SWMU definition includes containers, tanks, surface impoundments, waste piles, land treatment units, landfills, incinerators and underground injection wells, including those units defined as "regulated units" under RCRA. It includes recycling units, wastewater treatment units and other units, which

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* *40 CFR Part 270.1(c)*

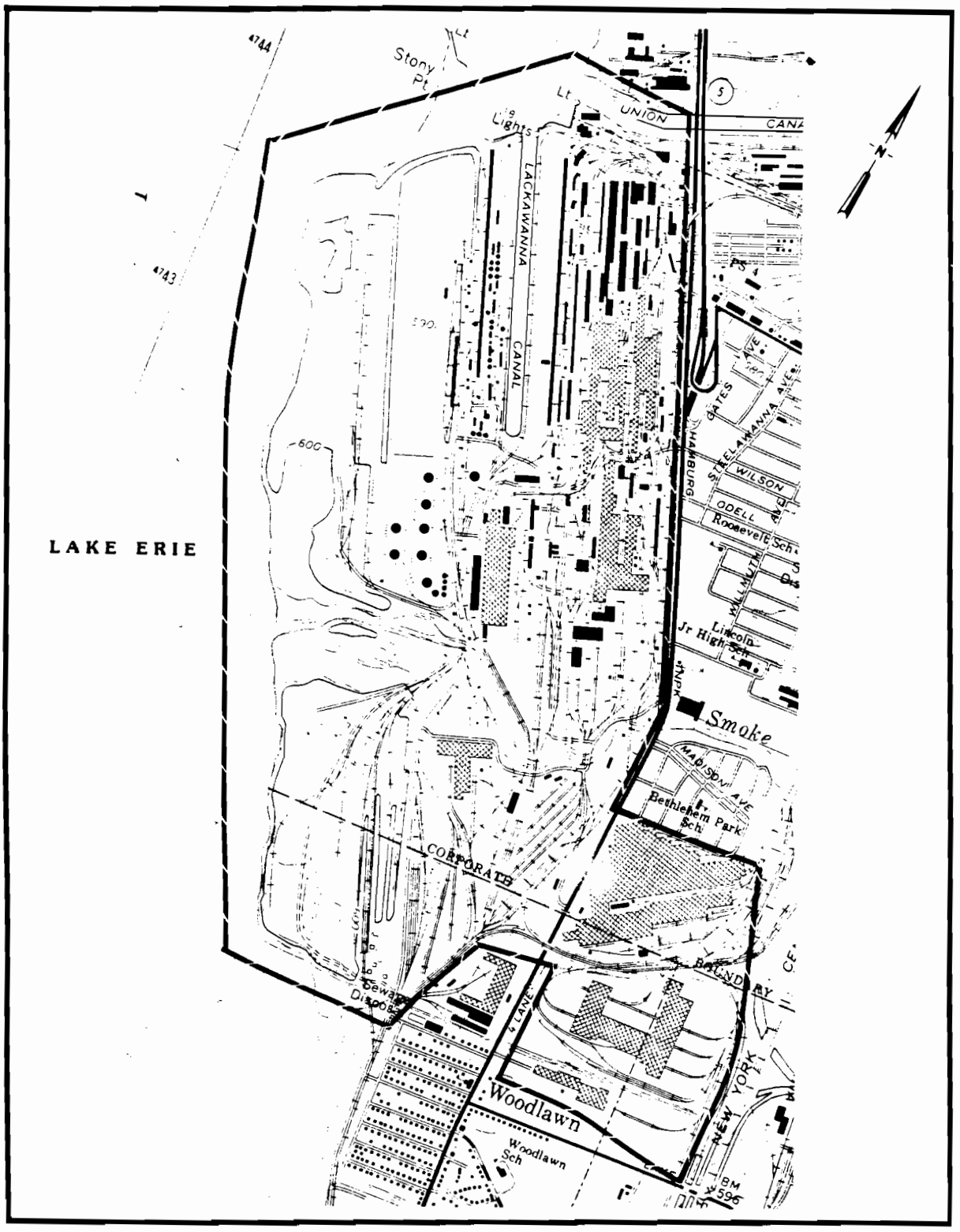

FIGURE 1

BETHLEHEM STEEL CORPORATION

LACKAWANNA PLANT

——— PROPERTY BOUNDARY

EPA has generally exempted from standards applicable to hazardous waste management units. Finally, it includes areas contaminated by routine, systematic and deliberate discharges from process areas.*

As a result of this requirement, EPA Region II sent three letters to BSC (dated March 22, 1985; August 27, 1985; and July 6, 1986), pursuant to Section 3007 of RCRA, requesting information on releases from active and inactive SWMUs. The BSC responses to the three letters were determined by EPA Region II to be incomplete.

Following receipt of the first two responses, EPA Region II directed a contractor, PRC, Inc., to conduct a RCRA Preliminary Review of the Lackawanna Plant during the spring of 1986. A Preliminary Review is the initial part of a RCRA Facility Assessment (RFA), which is part of a phased process developed by EPA for implementing the corrective action requirements of HWSA and is based primarily on an evaluation of government file information. The objective is to determine if a more thorough site investigation is necessary. PRC concluded that additional site investigation was necessary at the Lackawanna Plant to determine the types and quantities of wastes generated by the plant and to identify disposal locations for potentially hazardous materials.

As a result of the preliminary review and the response to the third 3007 letter, EPA Region II determined that the second phase of the RFA (visual site inspection) was necessary. NEIC was subsequently requested to conduct a modified visual site inspection at the Lackawanna Plant with the following objectives:

(1) Determine the types of wastes generated

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* *The SWMU definition is presented in "RCRA Facility Assessment Guidance" dated October 1986, by EPA Office of Solid Waste. Although not stated in the guidance document, the SWMU definition is derived from the definitions of "solid waste" and "solid waste management" presented in Section 1004 of RCRA.*

(2) Identify active and inactive SWMUs containing or potentially containing hazardous waste or hazardous constituents*

(3) Provide information to assist EPA Region II in determining whether further site investigation is necessary to identify, characterize and remediate releases of hazardous waste or hazardous constituents.

To accomplish the investigation objectives, NEIC personnel reviewed file information in the offices of EPA Region II, NYSDEC Central and Region IX offices and Erie County Health Department. Site visits were made by NEIC at the Lackawanna Plant during:

January 18 to 27, 1988
March 14 to 18, 1988
May 17 to 20, 1988

A process analysis of operations at the Lackawanna Plant was conducted to identify those that generated, stored, treated and/or disposed of solid or liquid wastes. Company documents applicable to waste management were reviewed and the areas where potentially hazardous wastes were generated, treated and/or disposed of were observed. The documents reviewed include descriptions of waste generating processes, waste analyses, engineering studies, operating manuals, production records, blueprints and hazardous waste manifests for wastes shipped offsite for disposal. Selected documents were copied for further evaluation at NEIC.

Aerial photographs, dating back to 1938, compiled by both EPA and BSC, were reviewed by NEIC personnel for determining locations and approximate periods of operation of various processes and waste management areas [Appendix A]. Some of the solid waste management units, described in this report, were identified only from these photographs.

Most site operations were shut down in 1983. Much of the process equipment in the shutdown portions of the plant had either been removed or was being dismantled at the time of the NEIC site visits. In order to better

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* *Hazardous wastes are defined in 40 CFR Part 261; hazardous constituents are listed in Appendix VIII of 40 CFR Part 261.*

understand those operations, NEIC personnel went to the Bethlehem Steel-Burns Harbor Plant, near Gary, Indiana, on March 21, 1988 to observe active blast furnace, basic oxygen furnace, sinter plant, primary mill and slag processing operations. Those operations at the Burns Harbor Plant were similar to those at the Lackawanna Plant and produced the same waste streams.

SUMMARY OF FINDINGS AND CONCLUSIONS

Operations at the Lackawanna Plant were started by Seneca Steel in about 1900. In 1922, Bethlehem Steel Corporation purchased the plant and expanded it into a fully integrated steel plant. The Lackawanna Plant ultimately became the fourth largest iron and steel producing plant in the country. Design capacity of the plant was 7 million tons of steel annually and products included coke, coke by-products, structural steel, steel coils, bars and speciality products. Most operations were shut down in 1983 due to financial problems.

WASTES GENERATED

Process operations at the Lackawanna Plant were investigated to determine the types and quantities of wastes generated and how those wastes were managed. For the purpose of this report, plant operations are divided into three general groups, which include: (1) processing of coal into coke and other products; (2) processing of iron ore into iron, steel, and finished products and (3) support operations.

Coal processing at the Lackawanna Plant involves producing coke and by-product chemicals from compounds released from the coal during the coking process. The by-product chemicals include coal tar, sodium phenolate, ammonium sulfate, naphthalene, light oil, elemental sulfur and cleaned coke oven gas, which is used onsite as a fuel. From 1941 to 1970, BSC operated a coal tar distillation unit which produced coal tar pitch and carbolic oils. At one time, the light oil was distilled to produce benzene, toluene and xylene.

The major iron ore processing operations at the Lackawanna Plant included: iron making in blast furnaces with an associated sintering plant, steel making in open hearth and basic oxygen furnaces, hot and cold forming mills and fabrication shops.

Support operations included: a tank farm for tar and fuel oil, roll shops, a foundry, acetylene and producer gas generators, electrical and vehicle repair, machine shops and lime and oxygen plants.

In about 1970, a series of Water Quality Control Stations (WQCSs) were constructed to treat process wastewaters generated at the Lackawanna Plant [Table 1]. The WQCSs also generate waste streams containing listed hazardous constituents.

Table 2 lists the principal waste streams from plant operations identified during the NEIC investigation. BSC has not analyzed most of the waste streams to determine if they contained hazardous constituents. Waste streams were "suspected" of containing hazardous constituents based on process and literature reviews. As indicated by Table 2, many of the wastes generated by Lackawanna Plant operations were disposed of onsite, principally in the slag fill area on the west side of the plant, which contains many of the major solid waste management units.

SOLID WASTE MANAGEMENT UNITS

During the NEIC investigation, 110 solid waste management units (SWMUs), suspected of containing hazardous wastes or constituents, were identified . The SWMUs are in both the process and slag fill areas and include suspected deposits in water courses within the property boundary. Because of limited historical information on some site operations, additional SWMUs may exist at the Lackawanna Plant.

The process area SWMUs are listed in Table 3 and shown on Figure 2. SWMUs identified in the slag fill area [Table 4 and Figure 3] include only units or areas discernible on the ground and/or in aerial photographs. Wastes containing hazardous constituents are potentially present throughout the entire fill area.

The principal hazardous waste streams historically generated by the Lackawanna Plant include tar decanter sludge, ammonia still lime sludge and pickling liquor. The tar and ammonia still lime sludges were disposed of in discernible units beginning in about 1970, which indicates about 50 years of disposal in non-discernible units. Pickling liquor was discharged to surface water until about 1970; however, some went into a surface impoundment beginning in the late 1950s.

Table 1

SUMMARY OF WATER QUALITY CONTROL STATIONS
Bethlehem Steel Corporation - Lackawanna Plant

Station	Operation Served	Receiving Water	Sludge Disposal
1	45" x 90" Slabbing Mill	Slabbing mill return water trench to Smoke Creek	Sinter plant via scale pit and SFA*
2	Bar Mills	Smoke Creek	Sinter plant via scale pits and SFA
3	BOF Scrubber	South return water trench to Smoke Creek	Sinter plant via blast furnace final thickener and SFA
3A	Sinter Plant Scrubber	South return water trench to Smoke Creek	SFA
4	South Mill Complex	South return water trench to Smoke Creek	Sinter plant via scale pit and SFA
5	North Mill Complex	North return water trench to Union Ship Canal	Sinter plant via scale pit and SFA
6	Hot Strip Mill	Smoke Creek	SFA
7	Cold Strip Mill/ Galvanizing	Smoke Creek	SFA
8	Coking/Slag Quench Area	Groundwater in SFA	NA
9	Blast Furnace	Ship Canal**	Sinter plant

* *Slag fill area*

** *Blast furnace scrubber water was also discharged to the North and South Return Water Trenches, as described in the accompanying text.*

Table 2

SUMMARY OF WASTE STREAMS AND DISPOSAL AREAS
Bethlehem Steel Corporation - Lackawanna Plant

Process Waste Streams	Known or Suspected Hazardous Constituents Present	Disposal in Surface Water	Disposal in Slag Fill Area
Coking (1903-present)			
1. Coke quench water	X	X	
2. Ammonia still lime sludge	X*		X
3. Treated weak ammonia liquor (to WQCS No. 8)	X	X	X
4. Tar sludges from tank cleanings	X		X
5. Tar decanter sludge	X*		X
6. Ammonium sulfate crystalizer cooling tower blowdown	X	X	
7. Acid tar sludge	X		X
8. Final cooler cooling tower blowdown	X	X	
9. Final cooler cooling tower sludge	X		X
10. Still bottoms from benzol plant	X		X
11. Agitator sludge from benzol plant	X		X
12. Muck oil from benzol plant	X		X
13. Benzol plant wastewater (to WQCS No. 8)	X	X	X
14. Spent carbonate solution	X		X
15. Foul gas stream condensate	X		X
16. Spent bauxite catalyst	X		X
Blast Furnaces (1922**-1983)			
1. Slag	X		X
2. Debris***			X
3. Dust from dust collector	X		X
4. Scrubber water discharge	X	X	
5. Overflow from thickeners	X	X	
6. Sludge from BF primary and final thickeners			X
Sinter Plant (1950-1983)			
1. Precipitator dust	X		X
2. Thickener sludge	X		X
3. Thickener overflow	X	X	
4. Debris			X

Table 2 (cont.)

Process Waste Streams	Known or Suspected Hazardous Constituents Present	Disposal in Surface Water	Disposal in Slag Fill Area
Open Hearth Furnaces (1922-1976)			
1. Slag	X		X
2. Debris			X
3. Dust from precipitators	X		X
Scrap Melter (1977-1978)			
1. Slag	X		X
2. Precipitator dust	X		X
3. Debris			X
BOF (1964-1983)			
1. Slag	X		X
2. Debris			X
3. Kish			X
4. Baghouse dust (containing lead)	X		X
5. Lime dust			X
6. WQCS No. 3 overflow		X	
7. Primary thickener sludge	X		X
8. Clarifier sludge - BF final thickener	X		X
9. Final thickener sludge	X		X
Hot Forming Mills (North Complex 1922-1983; South Complex 1922-1978) (Hot strip 1935-1983; Bar 1922-present)			
1. Mill scale	X		X
2. Scarfer spittings			X
3. Reheat furnaces brick			X
4. Scale and scarfer pit overflow	X	X	
5. Overflow from WQCS Nos. 1,2,4,5,6	X	X	
6. Sludge from WQCS Nos. 1,2,4,5,6	X		X
7. Oil from WQCS Nos. 1,2,4,5,6	X		X
8. Spent acid solutions*			
billet preparation	X	X	X
bar mill billet pickling	X	X	X
10"/12"bar mill coil pickler	X	X	X
13" bar mill coil pickler	X	X	X
coating shop			
hot strip mill pickler	X	X	X

Table 2 (cont.)

Process Waste Streams	Known or Suspected Hazardous Constituents Present	Disposal in Surface Water	Disposal in Slag Fill Area
Cold Forming Mill (1940 -present)			
1. Spent pickle liquor*	X	X	X
2. Tandem mill sump overflow	X	X	
3. Tandem mill sump solids (scale and oil)	X		X
4. Building rubble			X
5. Waste oil	X	X	X
Galvanizing (1962-present)			
1. Spent caustic	X	X	
2. Spent acid	X	X	X
3. Rinse water		X	
4. Spent flux	X	X	
5. Spent flux filters	X		
6. Galv. mill sump solids	X		X
7. Air scrubber water	?	X	
8. Wasted oakite soln.	X	X	
9. WQCS No. 7 overflow		X	
10. WQCS No. 7 sludge - SFA	X		X
11. Lime grit from WQCS No. 7			X
Buffalo Speciality Products (early 1900s - present)			
1. Scrap steel			
2. Waste oil	X		X
Buffalo Tank Company (early 1900s - 1982)			
1. Hydraulic oil	X		X
2. Empty paint cans	X		X
3. Cleaning solvents	X		X
Expanded Joist Mill (early 1900s - mid-1970s)			
1. Paint residues/filters	X		X
2. Cleaning solvents	X		X
3. Hydraulic oil	X		X
Roll Shops (1922-present)			
1. Sludge	X		X

Table 2 (cont.)

Process Waste Streams	Known or Suspected Hazardous Constituents Present	Disposal in Surface Water	Disposal in Slag Fill Area
Foundry (early 1900s-1978)			
1. Sand	X		X
2. Debris			
Producer Gas (unknown)			
1. Coal or coke ash	X		X
Locomotive/Crane Repair, Vehicle Maintenance,and Machine Shops (early 1900s to 1983)			
1. Waste oil	X		X
2. Debris	X		X
Electric Windings and Machine Shop (unknown - present)			
1. Waste chlorinated solvent	X		X
2. Water soluble degreaser	X		X
Acetylene Generator Building (unknown)			
1. Spent carbide			X
Lime Plant (1964-1983)			
1. Used brick			X
Oxygen Plant (1957-1983)			
1. Waste water	X	X	
2. Spent solvent/sludge	X		

* *Listed hazardous waste in 40 CFR Part 261*

** *The year 1922 is indicated if Units were operating when BSC acquired the plant and a more specific date was not available.*

*** *BSC personnel reported that debris from Lackawanna Plant operations includes bricks, wood, paper, hoses, tires, conveyor belts, steel scrap, carbon fines (kish) and miscellaneous wastes from plant cleanup.*

Table 3

SOLID WASTE MANAGEMENT UNITS IN PROCESS AREAS
Bethlehem Steel Corporation - Lackawanna Plant

Map Number (Figure 2)	Area/Unit
	Coking Area
P-1	Quench water pit, North Station
P-2	Quench water pit, Arctic Station
P-3	Quench water pit, Central Station
P-4	Quench water pit, A Station
P-5	Quench water pit, B Station
P-6	Lime sludge settling basin
P-7	Abandoned lime settling basin
P-8	Waste oil storage tanks
P-9	Abandoned tar decanter sludge pits
P-10	Contaminated soil in area near ball mill
P-11	Benzol plant tank storage area
P-12	Spill cleanup soil storage area
	Ironmaking
	WQCS No. 9 (Blast furnace scrubber water)
P-13	A-B primary thickener
P-14	C primary thickener
P-15	F-G primary thickener
P-16	H-J primary thickener
P-17	Final thickener
P-18	Cooling tower, hot and cold wells
	WQCS No. 3A (Sinter plant scrubber water)
P-19	Thickener
P-20	Scrubber sump
	Steelmaking
	WQCS No. 3 (BOF scrubber water)
P-21	North scalping tank
P-22	South scalping tank
P-23	Primary thickener
P-24	North clarifier
P-25	South clarifier
P-26	Cooling tower
P-27	Final thickener

Table 3 (cont.)

Map Number (Figure 2)	Area/Unit
	Hot Forming Mills
	WQCS No.1 (Slabbing mill process water)
P-28	Main settling tank
P-29	Five sand filters
P-30	North (main) scale pit
P-31	South (trimmer) scale pit
P-32	Scarfer pit
	WQCS No. 2 (Bar mill process water)
P-33	10"and 12" mills scale pit
P-34	13" mill scale pit
P-35	Process water pit (pouring reel pit)
P-36	One sand filter
P-37	Treated water storage tank
	WQCS No. 4 (South mill complex process water)
P-38	Scale pit (54" mill)
P-39	Scale pit (48" mill)
P-40	Scale pit (14", 18", 28" and 35" mills)
P-41	Main settling tank
P-42	Five sand filters
	WQCS No. 5 (North mill complex process water)
P-43	Scale pit (44" mill)
P-44	Scale pit (40" mill)
P-45	Scale pit (36" mill)
P-46	Scale pit (32" mill)
P-47	Scale pit (30" mill)
P-48	Scale pit (21" mill)
P-49	Scarfer pit (44" mill)
P-50	Scarfer pit (40" mill)
P-51	Scarfer pit (30" and 21" mills)
P-52	Main settling tank
P-53	Seven sand filters

Table 3 (cont.)

Map Number (Figure)	Area/Unit
	WQCS No. 6 (Hot strip mill process water)
P-54	Runout table spray water pit
P-55	Scale pit
P-56	Main settling basin
P-57	Twenty-four sand filters
P-58	Bar Mill east acid sump (coil pickling area)
P-59	Bar Mill west acid sump (billet prep. area)
P-60	Bar Mill waste solution tank
P-61	Hot strip mill acid pit
P-62	Mill scale storage area 1
P-63	Mill scale storage area 2
P-64	Scale pit at 8" bar mill
	Cold Forming Mills
	WQCS No. 7
P-65	Tandem mill sump
P-66	Pickling rinse water pit
P-67	Spent pickle liquor pit
P-68	Galvanizing mill sump
P-69	Main treatment tank and assoc. facil.
P-70	Waste oil storage tank
P-71	Sump station wet well for old acid sewer line from galvanizing mill
P-72	Galvanizing mill sump sludge storage area
P-73	Drum storage area east of cold strip mill
	Support Operations
P-74	Waste storage piles (tar and fuel tank bottoms mixed with coke breeze)
P-75	Tank storage area for No. 6 fuel oil and petroleum tar

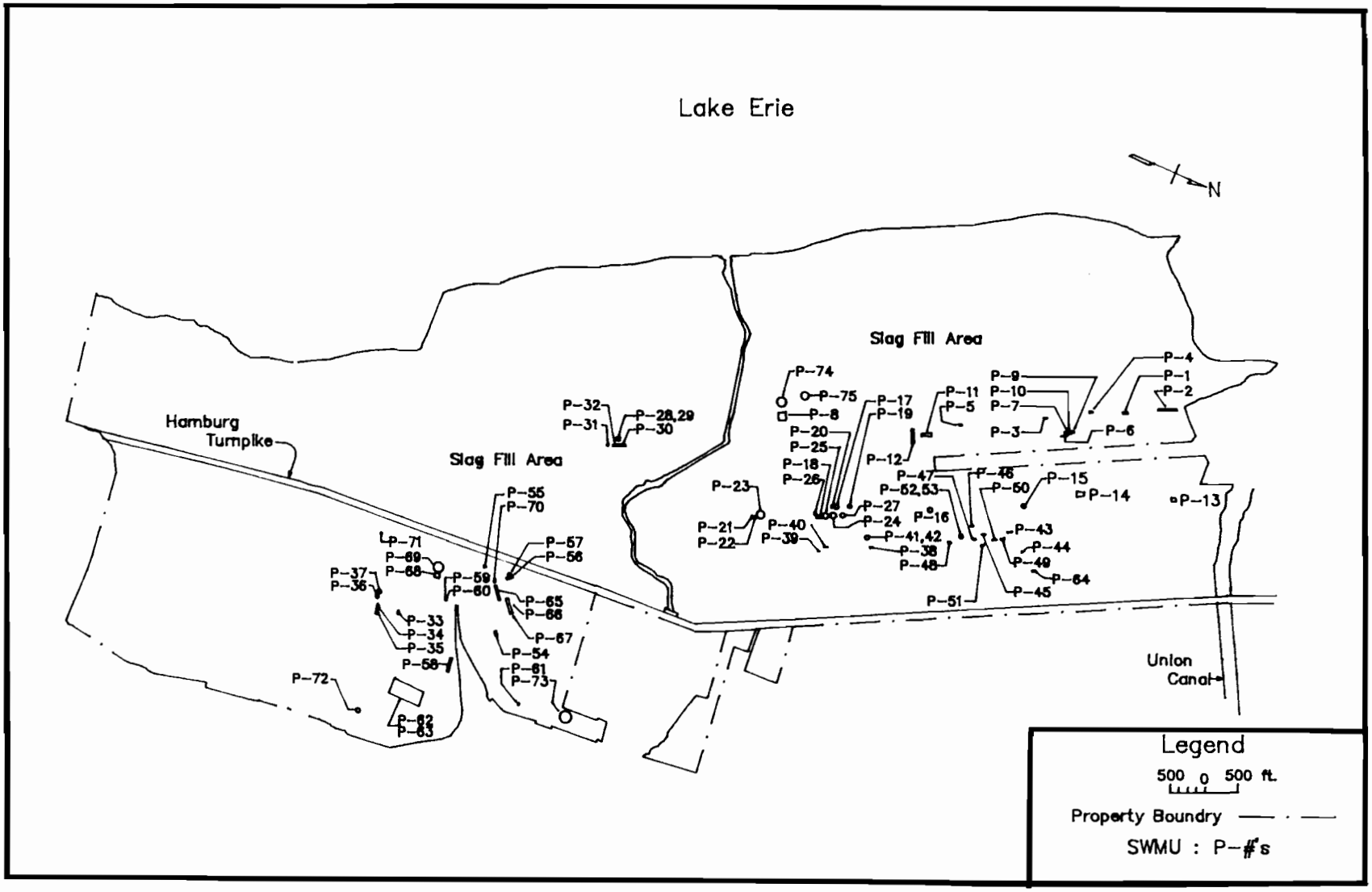

FIGURE 2

PROCESS AREA SOLID WASTE MANAGEMENT UNITS

Table 4

SOLID WASTE MANAGEMENT UNITS IN THE SLAG FILL AREA
Bethlehem Steel Corporation - Lackawanna Plant

Map Number (Figure 3)	Unit	Waste Streams Received
S-1	Surface impoundment A	Sludges from WQCS Nos. 1, 2, 4, 5 and 6 and waste oil from plant operations*
S-2	Surface impoundment B	Sludge from final thickener and WQC 7*
S-3	Surface impoundment C (hazardous waste unit)	Sludges from BOF and blast furnace final thickeners, WQCS No. 3a, cooling tower hot well, and ammonia still lime sludge. Probably also received dredged material from Smoke Creek*
S-4	Surface impoundment D	Dredged material from Smoke Creek.
S-5	Surface impoundment E	Sludge from WQCS Nos. 1,2,4,5 and 6, and waste oil from plant operations*
S-6	Surface impoundment F	Sludge from BOF final thickener and WQCS No. 7*
S-7	Surface impoundment G	Sludge from BOF final thickener and WQCS No. 7*
S-8	Surface impoundment H	Not used**
S-9	Waste pile I	Blast furnace slag
S-10	Slag quench area J	BOF slag, treated weak ammonia liquor and benzol plant wastewater
S-11	Landfill K	Spent pickle liquor, discarded drums from plant operations, open hearth precipitator dust and lime dust
S-12	Asbestos landfill L	Asbestos from building demolition
S-13	Coal tar sludge (hazardous waste unit)	Tar decanter sludge, acid tar sludge, impoundment M slag
S-14	General rubble landfill N	Discarded material from plant operations

Table 4 (cont.)

Map Number (Figure 3)	Unit	Waste Streams Received
S-15	General rubble landfill O	Discarded material from plant operations
S-16	Spent pickle liquor sludge landfill P (hazardous waste unit)	Spent pickle liquor
S-17	Vaccuum carbonate blowdown landfill Q	Spent carbonate solution from hydrogen sulfide stripper
S-18	Lime dust and kish landfill R	Lime dust and carbon fines
S-19	Murphy's mountain landfill AA	Discarded material from plant operations
S-20	Drying area for sludge from impoundment F	Sludge from BOF final thickener and WQCS 7*
S-21	Sludge storage area***	WQCS 3 sludge
S-22	Vaccuum carbonate blow-down impoundment south of Smoke Creek***	Spent carbonate solution from hydrogen sulfide stripper
S-23	Tar pit adjacent to spent pickle liquor landfill***	Acid tar wastes from coking operation, tar tank cleanings and coke breeze
S-24	Tar pit north of lime plant***	Tar waste from coking operation
S-25	Landfill/impoundment under north end of coal pile***	Unspecified wastes
S-26	Fill area near Coke Battery No. 8***	Unspecified wastes
S-27	Sludge disposal area	Sludge from impoundment A
S-28	Drum landfill ***	Unspecified wastes
S-29	Drum landfill***	Unspecified wastes

* *May contain wastes normally put in other impoundments.*
** *Identified as an SWMU because the dikes were constructed using fine-grained material separated from plant debris, which is suspected of containing hazardous constituents.*
*** *Identified only from aerial photographs*

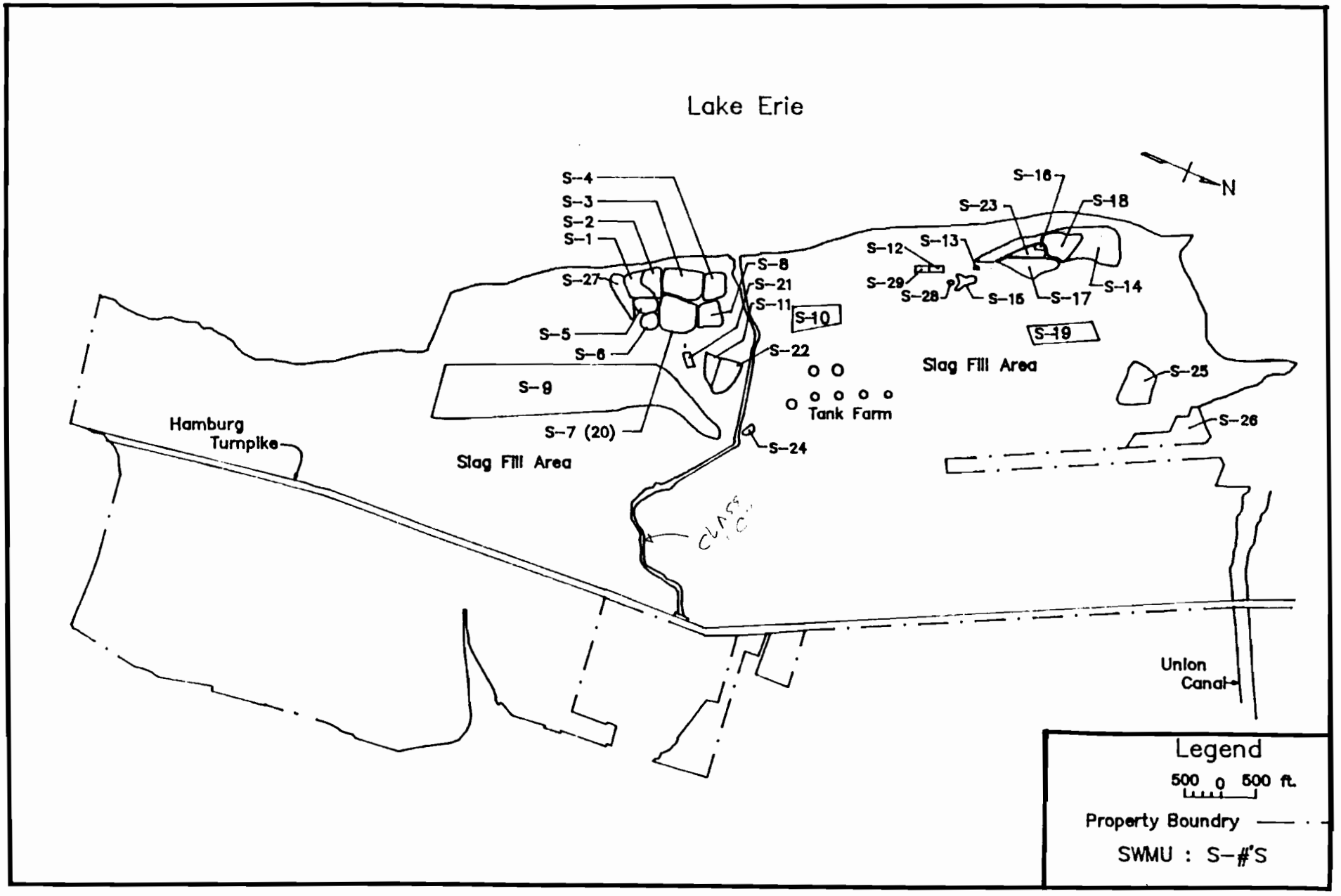

FIGURE 3

SLAG FILL AREA SOLID WASTE MANAGEMENT UNITS

Six water courses within the boundaries of the Lackawanna plant [Table 5 and Figure 4] have received discharges that contained or potentially contained hazardous waste or constituents. Settled material in these water courses may contain these compounds and may be releasing them to the environment.

INDICATIONS OF HAZARDOUS WASTE RELEASE

Groundwater monitoring data were reviewed in conjunction with other information for indications of waste releases from the identified SWMUs.

The data reviewed indicated the presence of hazardous constituents in groundwater in the slag fill area that are also present in both the process wastes generated at the Lackawanna Plant and the SWMUs. The hazardous constituents included benzene, naphthalene, phenolic compounds and several chlorinated organic compounds [Table 6]. Although the data indicate that a release has occurred, the information is not sufficient to determine the extent of the release and specific source(s) of the hazardous constituents detected.

No analytical data are available to indicate whether there have been releases from SWMUs in the process areas; however, because wastes containing hazardous constituents were placed directly on the ground (which constitutes disposal under RCRA), the potential for release is high from several process area SWMUs. These include benzol plant product storage area, mill scale storage piles, storage area for sump sludge on the east side of the galvanizing mill and tar waste/fuel mixture storage piles.

Table 5

WATER COURSES AND EFFLUENT WASTE STREAMS RECEIVED
Bethlehem Steel Corporation - Lackawanna Plant

Water Course	Waste Streams Received
Blasdell Creek	Waste pickle liquor, oil
South return water trench	Blast furnace scrubber discharges and effluents from mill settling pits, WQCS Nos. 3, 3A and 4
North return water trench	Blast furnace scrubber water discharges and WQCS No. 5 effluent
Slabbing mill return water trench	Discharge from WQCS No. 1
Smoke Creek	Waste pickle liquor, oil, cleaning and coating solutions from the galv. mill, settling pit overflows from the cold strip, hot strip and bar mills, south and slabbing mill return water trenches and effluents from WQCS Nos. 2, 6 and 7
Ship Canal	Various contaminated coking wastes, blast furnace wastes, effluent from WQCS No. 9

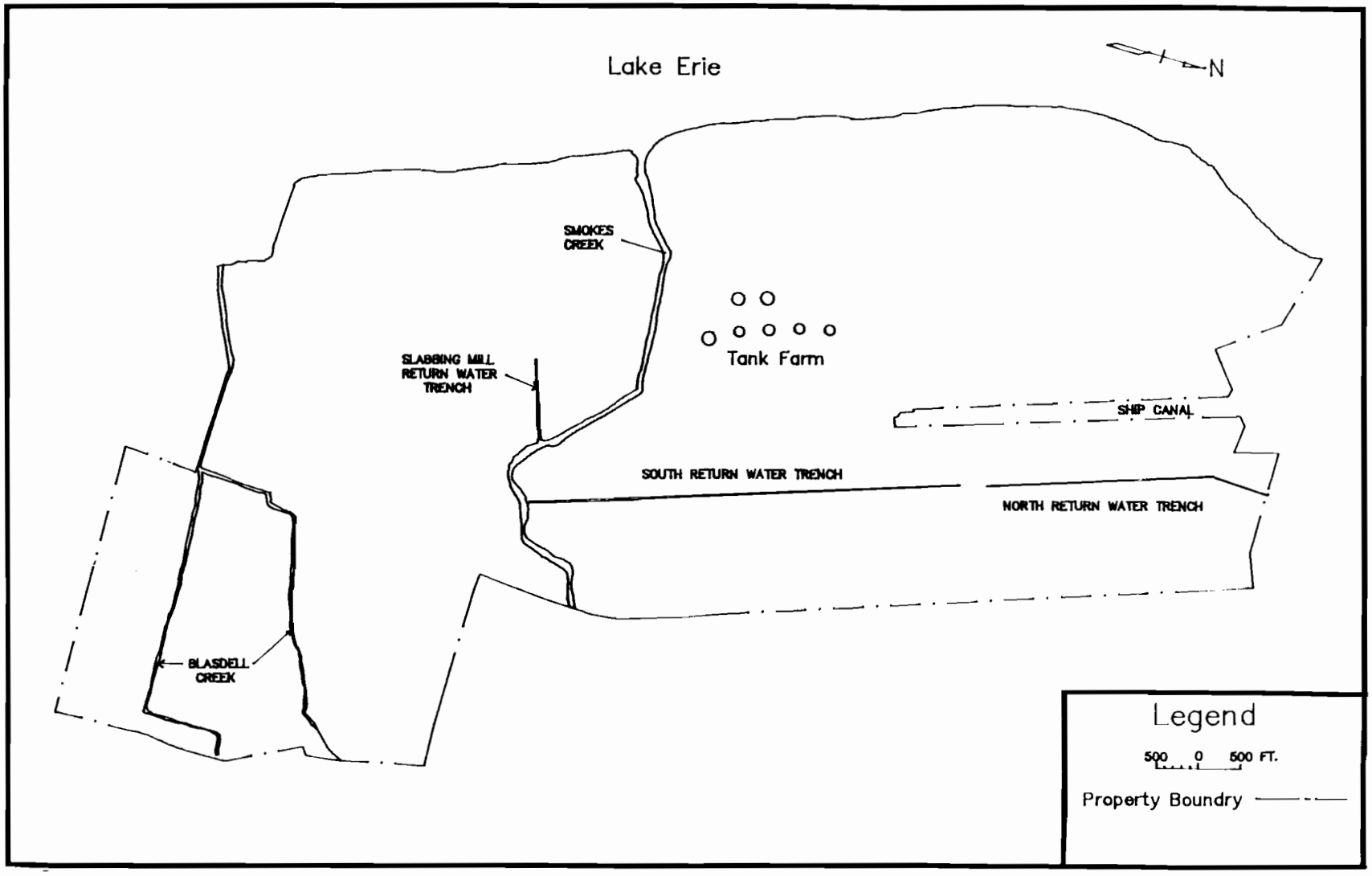

FIGURE 4

WATER COURSES

Table 6

GROUND-WATER DATA MONITORING FROM RCRA WELLS*
Bethlehem Steel Corporation - Lackawanna Plant

Selected Parameters	Well:	MW-1U1			MW-1D1			MW-1D2			MW-1D3			MW-1D4		
	Date:	6/86	11/87	1/88	6/86	11/87	1/88	6/86	11/87	1/88	6/86	11/87	1/88	6/86	11/87	1/88
Benzene		<1	430	340	<1	9	8	<1	42	40	<1	57	40	<1	74	70
Toluene		<1	89	61	<1	7	9	<1	26	28	<1	22	20	<1	26	26
Naphthalene		<1	93	80	<1	<10*	<10*	<1	720E	220	<1	49	39	<1	62	50
Phenol		85	18	11	25	<10*	<10	540	130	73	155	74	36	220	110	73
2,4-Dimethylphenol		<10	16	16	<10	<10	<10	50	28	20	40	<10*	<10*	50	13	11

Table 6 (cont.)

GROUND-WATER DATA MONITORING FROM RCRA WELLS*

Selected Parameters	Well:	MW-2U1			MW-2D2			MW-2D3			MW-2D4		
	Date:	6/86	11/87	1/88	6/86	11/87	1/88	6/86	11/87	1/88	6/86	11/87	1/88
Trans-1,2-Dichloroethene		<1	17	12	<1	<5	<5	<1	<5	<5	<1	<5	<5
Trichloroethene		<1	36	32	<1	<5	<5	2	<5	<5	<1	<5	<5
Benzene		<1	23	28	<1	<5*	<5	<1	31	39	<1	41	18
Toluene		<1	16	16	<1	<5*	<5*	<1	31	27	<1	46	19
Ethylbenzene		<1	14	12	<1	<5*	<5*	<1	12	11	<1	15	<5*
Naphthalene		<1	570E	180	<1	<10*	<10	<1	210	160	<1	290	150
Phenol		45	21	<10*	10	<10*	<10	45	<10*	<10	10	<10*	<10*
2,4-Dimethylphenol		<10	46	23	<10	<10*	<10	10	<10*	<10*	<10	<10*	<10*

* *Results in micrograms per litter (µg/L)*
** *Compound present below measurable detection limit.*
E *Estimated Value*

(Source: Groundwater Quality Assessment Report, dated January 1988 and prepared by Ecology and Environment)

TECHNICAL REPORT

SITE DESCRIPTION

Operations at the Lackawanna Plant were started by Seneca Steel in about 1900. In 1922, Bethlehem Steel Corporation purchased the plant and expanded it to a fully integrated steel plant. The Lackawanna plant ultimately became the fourth largest iron and steel producing plant in the country. The BSC property is about 2.5 miles long and 1 mile wide along the Lake Erie shore. Design capacity of the plant was 7 million tons of steel annually and products included coke, coke by-products, structural steel, steel coils, bars and specialty products. Employment reached a maximum of about 22,000 in 1975. Due to financial problems, most plant operations were shut down in 1983. Current employment is about 1500.

Production units at the Lackawanna Plant have included: by-product coke ovens; blast, open hearth and basic oxygen furnaces; a sintering plant; hot and cold forming mills; lime and oxygen plants and supporting operations. At the time of the NEIC investigation, operations included only coking, a cold forming mill and a bar mill.

When most plant operations were shut down in 1983, many of the wastes were no longer generated and Company records indicate that hazardous wastes were no longer disposed of onsite. Following the shut down, BSC began dismantling portions of the plant and major portions of the plant were demolished before and during the NEIC investigation. In addition, reclamation of blast furnace slag for use as a construction aggregate is ongoing.

Surface waters on the BSC property include Smoke Creek, Blasdell Creek and the Ship Canal. The facility is divided approximately in half to the north and south by Smoke Creek. Blasdell Creek is located near the southern property line. Both creeks discharge into Lake Erie. The 4,000-foot long ship canal at the north end of the facility was used primarily for receiving iron ore, limestone, fuel and coal shipments.

The BSC property has been expanded into Lake Erie by an average of 1,300 feet since the early 1900s [Figure 5]. Approximately 440 acres were created by landfilling wastes, primarily slag from the iron and steel production.

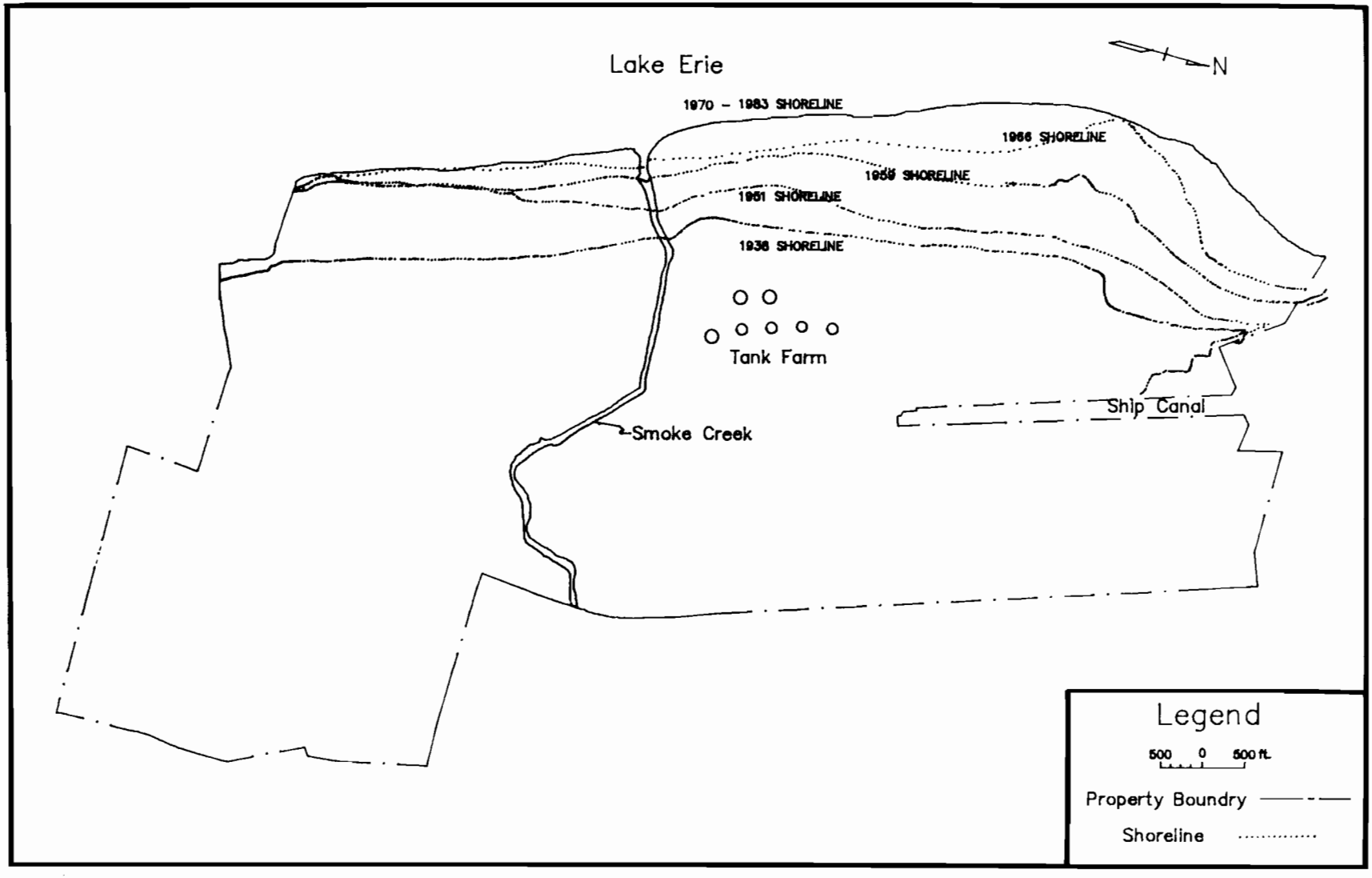

FIGURE 5

SHORELINE MAP

The area is referred to as the slag fill area. Most of the process wastes identified were, at one time, disposed of in this area. Generally, before about 1950, most of the process waste streams were co-disposed with plant rubble and slag at non-specific locations in the slag fill area. Beginning in about 1950, unlined surface impoundments and landfills were constructed to receive the process wastes.

The surface of the slag fill area is an average of about 40 feet above the mean lake elevation. In addition, as much as 18 to 25 feet of fill is present between the water table (which approximates the lake level) and the original lake bottom.* Variations in the topography exist due to excavations and material stockpiles. Extensive road and railroad systems were constructed on the slag fill, which were used for transporting wastes to disposal sites. The road systems were expanded as additional ground was created by filling.

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* *"Summary Report, Monitoring Well Program, Lackawanna Plant, Bethlehem Steel Corporation," dated March 27, 1981, prepared by Dames and Moore, Cranford, NJ.*

PROCESS ANALYSIS AND WASTE MANAGEMENT

Process operations at the Lackawanna Plant were investigated to determine the types and quantities of wastes generated, and how those wastes were managed. For the purpose of this report, plant operations are divided into three general groups, which include: (1) processing of coal into coke and other products; (2) processing of iron ore into iron, steel, and finished products; and (3) support operations. Coal processing is discussed first because the principal products derived from it are used in the processing of iron ore into finished products, and it is the major source of hazardous wastes and wastes containing hazardous constituents disposed of onsite.

The following sections describe each process or group of similar processes (process group), the period the process was operated, wastes produced by the process and waste management practices. Descriptions of the processes were derived primarily from discussions with BSC personnel and were supplemented by information presented in effluent guidelines development documents for iron and steel manufacturing* and other references. The reported operating periods and descriptions of specific process and waste management operations were provided by BSC personnel based on records and, in some instances, personal recollections.

The plant straddles the Hamburg Turnpike with most of BSC property on the west side of the highway [Figure 6]. Operations on the west side of the highway include coking, iron and steel making, and hot forming mills. On the east side of the highway are bar, cold forming, and hot forming mills.

COAL PROCESSING

Coal processing at the Lackawanna Plant involves producing coke, coke gas and by-product chemicals from compounds released from the coal during the coking process. Coke is a carbon-rich clinker that is used as a carbon source and fuel to heat and melt iron ore in blast furnaces. It is produced by

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* *Document titled "Development Document for Effluent Limitations Guidelines and Standards for the Iron and Steel Manufacturing Point Source Category, Doc. No. EPA 440/1-82/024, dated May 1982, Volumes I through VI.*

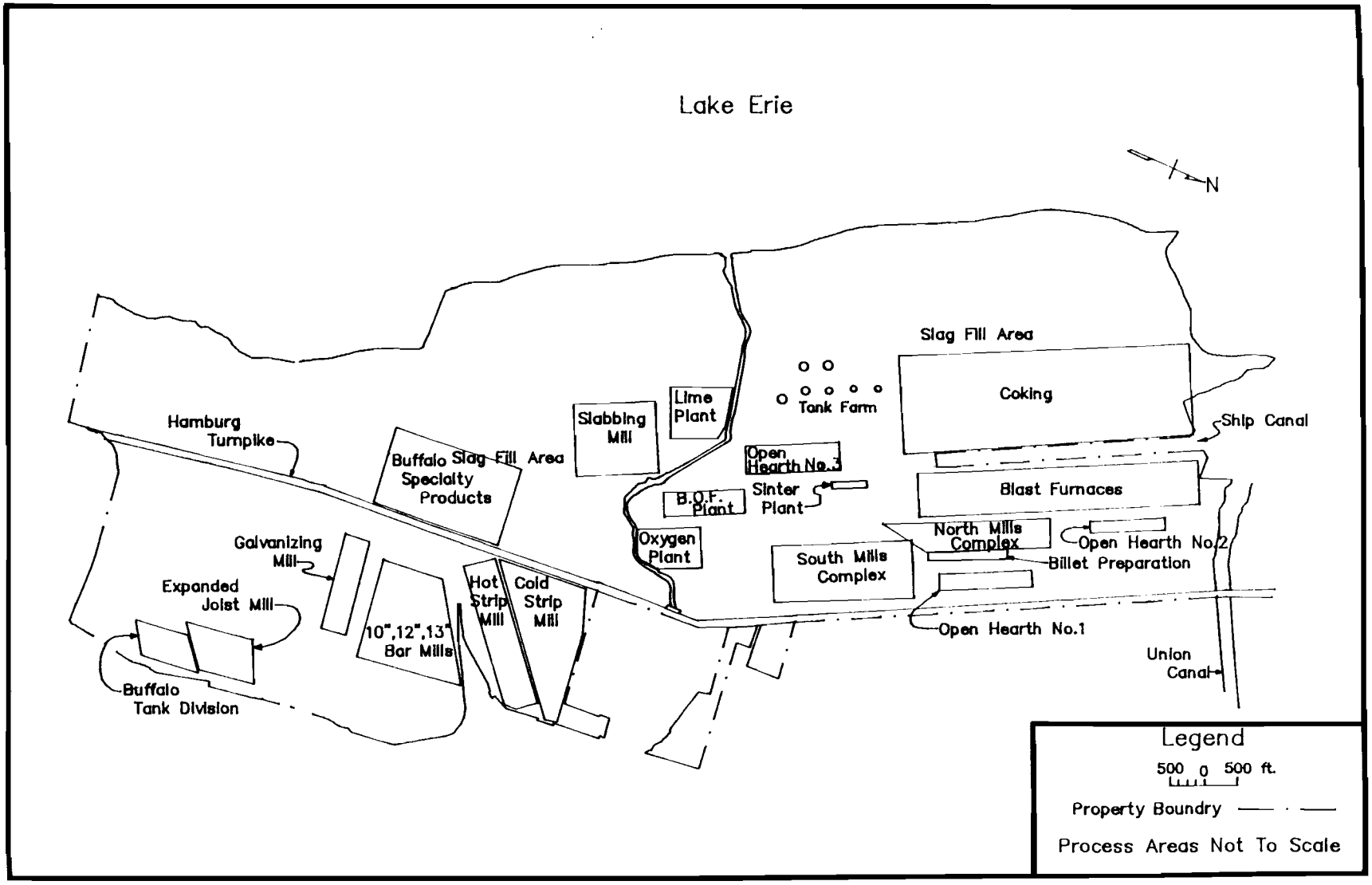

FIGURE 6

PROCESS AREA

heating coal in sealed chambers (ovens) in the absence of air. A group of ovens built as a single structure forms a coke-oven battery. During the coking process, volatile components of the coal are released into the exhaust (coke oven) gas. At the Lackawanna Plant, the volatile components are removed from the coke oven gas in a by-product plant, which produces a variety of chemicals [Figure 7]. The coking and by-product recovery processes and management of contaminated waste streams are described in the following.

Coking

Coal is barged to the facility and stockpiled in an area west of the coke ovens. Until the 1960s, coal was also stored in areas south and west of the slabbing mill on the eastern portion of the slag fill area. Coal consumption for coking has varied widely over the years. Approximately 3.8 million tons were consumed in 1967, while current annual consumption is about 1.16 million tons (3200 tons per day).

Otto-Hoffman regenerative coke ovens, which did not have by-product recovery, were operated from 1903 to 1922. Since 1920, nine by-product coke-oven batteries have been constructed and operated at the BSC plant [Table 7]. BSC records indicate no more than seven batteries were operated at one time. Operations have been limited to two or three batteries since 1978 and, currently, only batteries 7, 8 and 9 are operating.

After the coal charge is loaded into an oven, it is sealed and heated (1600 to 2300 °F) for 14 to 36 hours. At the end of the heating period, the oven is opened and the hot coke is pushed out into a railroad car. The railroad car is then moved to a "quench" station where it is positioned beneath a stack and a water spray system. The Lackawanna Plant had five quench stations, only three of which are currently being used. The active ones are the "A", North, and Arctic stations; the inactive ones are the Central and "B" stations.

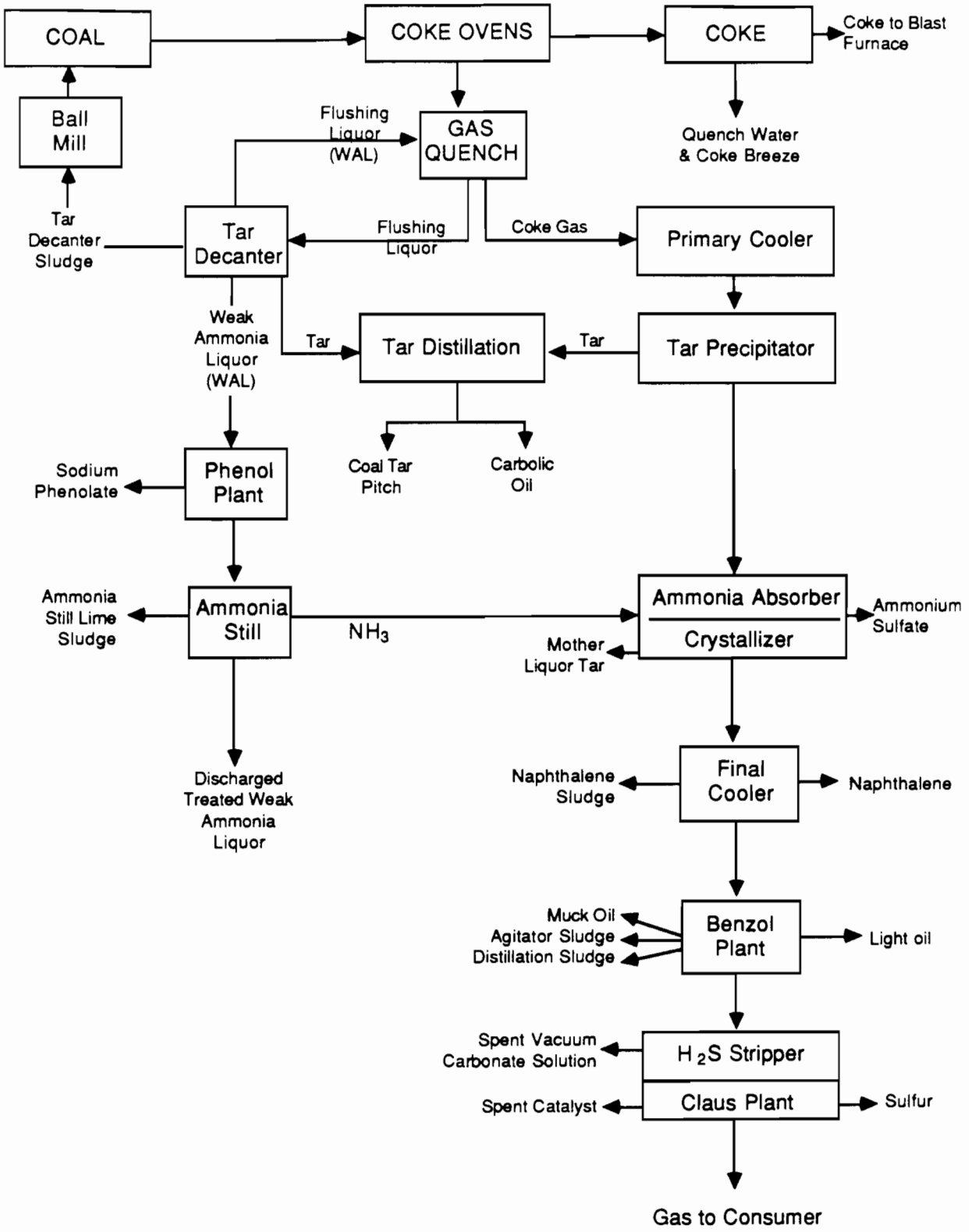

Figure 7
COKE OVEN AND BY-PRODUCTS PLANT FLOW DIAGRAM
BETHLEHEM STEEL CORPORATION - LACKWANNA PLANT

Table 7

COKE OVEN BATTERIES
Bethlehem Steel Corporation - Lackawanna Plant

Battery Number	Years Operated*	Number of Ovens	Associated Quench Station
1	1920-1970	NI**	NI
2	1922-1970	NI	NI
3	1924-1977	57	NI
4	1926-1977	57	NI
5	1941-1977	76	NI
6	1943-1977	76	NI
7	1952-Present	76	Arctic
8	1962-Present	76	Arctic
9	1970-Present	76	A and North

* *Approximate years batteries were operated. Batteries were not operated continuously during the entire period.*
** *No information*

During quenching, water is sprayed onto the coke to cool it. According to the effluent guidelines development document, approximately 500 gallons of water per ton of coke are typically used for quenching. Spent quench water drains from the railroad car into a settling pit, which overflows to a second (clear water) pit. Steam rising through the stack loses particulates into horizontal trays. After the quench is completed, water is sprayed on the trays to remove the accumulated particulates. This water also drains to the settling pit. Presently, the water from the clear water pit is pumped to a storage tank where makeup water is added for use in the next quench.

Until an undetermined time, quench water was discharged to the ship canal. Solids removed from the quench station settling pits were sold as product (coke breeze). According to the effluent guidelines development document, once-through quench water could contain low net concentrations (in milligram per liter range) of cyanides and phenolic compounds; both are listed hazardous constituents.

At the Lackawanna Plant, blowdown from cooling towers for the ammonia sulfate crystallizer and the final cooler (discussed below) are used as makeup water for coke quench. Reportedly, only 10% of the make-up water for

two quench stations comes from these sources; the primary source of make-up water for the coke quench stations is Lake Erie (plant water).

Company officials estimated a total of 35 gallons per minute (gpm) from the final cooler and crystallizer cooling towers are used in the coke quenching process at A-Station. Flow rates to North-Station, which also receives these wastewaters, are not measured. Analyses provided by BSC show the wastewater samples contained phenol concentrations ranging from 300 to 500 milligrams per liter (mg/L) and cyanide from 2 to 27 mg/L. Samples from North-Station quench waters also contained these compounds but concentrations were much lower than in the wastewater from the process units (less than 1 mg/L). According to the effluent guidelines document, other hazardous constituents present in final cooler blowdown include benzene, toluene, and naphthalene.

By-Product Recovery Plant

After leaving the coke ovens, the hot gas is quenched and initially cleaned with a "flushing liquor," which is reused following treatment (settling). Excess flushing liquor is processed [Figure 7] to produce coal tar, sodium phenolate and ammonia. The coke oven gas, after being quenched with the flushing liquor, goes through a series of cleaning/chemical manufacturing operations that produce more coal tar, ammonium sulfate, naphthalene, light oil, elemental sulfur, and clean gas, which is used onsite as a fuel. Between 1941 and 1970, BSC operated a coal tar distillation unit which produced coal tar pitch and carbolic oils. At one time, the light oil was distilled to produce benzene, toluene, and xylene.

Waste generation and management procedures from the by-product plant are discussed below. The discussion begins with processing of the flushing liquor and is followed by processing of the gas subsequent to quenching. A list of the wastes produced from each of the processes in the by-products plant is presented in Table 8.

Table 8

COKING BY-PRODUCT WASTE STREAMS
AND DISPOSAL LOCATION
Bethlehem Steel Corporation - Lackawanna Plant

Waste Stream/Period	Disposal Location
Ammonia Still Lime Sludge*	
1920 to 1983 (31,000 tons)**	SFA***
1983 to 1984	Offsite
Treated Weak Ammonia Liquor	
1920 to 1970 (3,500 million gallons - mgal)	Ship Canal
1970 to 1983 (800 mgal)	SFA
1983 to present	Municipal treatment plant
Coal Tar Tank Bottoms	
1920 to 1980	SFA
1980 to present	Solid fuel stock pile
Tar Decanter Sludge*	
1920 to 1960 (13 mgal)	SFA
1960 to 1983	Coal Tar (periodically to SFA)
1983 to 1984	Offsite
1984 to present	Coke ovens
Ammonium Sulfate Crystalizer Cooling Tower Blowdown	
1920 to present	Ship canal/ coke quench
Acid Tar Sludge (Mother Liquor Tar)	
1920 to 1982 (1.5 mgal)	SFA
1982 to present	Coke ovens

Table 8 (cont.)

Waste Stream/Period	Disposal Location
Final Cooler Cooling Tower Blowdown	
1920 to present	Ship canal/ coke quench
Naphthalene Sludges	
1920 to 1983 (0.65 mgal)	SFA
1983 to present	Coal Tar
Benzol Plant Still Bottoms	
1930 to 1964 (7.4 mgal)	SFA
Agitator Sludge	
1930 to 1964 (7.4 mgal)	SFA
Muck Oil	
1930 to 1982 (4.8 mgal)	SFA
1982 to present	Coke ovens
Benzol Plant Wastewater	
1920 to 1970	Ship Canal
1970 to 1983	SFA
1983 to present	Process
Spent Carbonate Solution	
1950 to 1982 (3 mgal)	SFA
1982 to present	Ammonia Still
Foul Gas Stream Condensate	
1954 to 1974	SFA
1982 to present	Final Cooler
Spent Bauxite Catalyst	
1974 to 1982 (126,000 lbs)	SFA
1982 to present	Offsite

* *Listed hazardous wastes*

** *All waste quantities are estimates based on information provided by Bethlehem Steel Corporation*

*** *SFA - slag fill area*

Flushing Liquor Processing

The flushing liquor, after quenching the hot gas, drains to settling (decanter) tanks. In the decanter tanks, the flushing liquor solution separates into three fractions: Weak ammonia liquor (WAL), coal tar and tar decanter sludge. The WAL is recirculated as flushing liquor; excess liquor is sent to be processed into chemical products. The coal tar is recovered as a product and the sludge is currently recycled back to the coke ovens as a coal additive.

Weak Ammonia Liquor Processing - Excess flushing liquor goes to the sodium phenolate operation and the ammonia still. According to Company officials, these units were brought on line in the 1920s.

In the sodium phenolate operation, phenol in the WAL is recovered through a solvent extraction process using the light oil from the benzol plant (discussed below). Phenol in the light oil is then reacted with sodium hydroxide to form sodium phenolate. No waste streams are produced by this process. Treated WAL from the sodium phenolate operation is pumped to the ammonia still.

The ammonia still removes free and fixed ammonia from the WAL. Until 1983, the unit was operated using calcium hydroxide (lime), which generated ammonia still lime sludge (ASLS). The ASLS was collected in one of two settling basins, then removed for disposal in the slag fill area. Beginning in early 1983, it was, reportedly, shipped offsite for disposal. In October 1983, BSC began using sodium carbonate (soda ash) instead of lime in the process and ASLS production ceased, according to Company personnel.

Company officials estimated that 11,000 tons of ASLS were generated from 1961 to 1982 (approximately 500 tons annually). ASLS is a listed hazardous waste (hazardous waste number K060). Hazardous constituents present in the ASLS include cyanide, naphthalene, phenolic compounds, and arsenic.

Originally, there were two lime settling basins. One was abandoned in about 1960 and Company officials stated that it was filled and covered. The newer settling basin is part of the operating system receiving treated WAL.

Treated WAL from the ammonia still lime settling basin was discharged to the Ship Canal until about 1970. Beginning in about 1970, the treated WAL was used to quench slag from the basic oxygen furnace in a pit excavated in the slag fill area (discussed in the Iron Ore Processing section). In 1975, a surge tank was installed at the southeast corner of the slag quench pit and was designated WQCS No. 8.

When steel making operations were discontinued in 1983, the treated WAL was discharged to the publically-owned treatment works (POTW) in Lackawanna. (Tank No. 16 located in the coal tar distillation plant is currently used as holding tank for the treated WAL prior to discharge.)

Approximately 3,500 million gallons of treated WAL were discharged to the Ship Canal between 1920 and 1970. Company officials estimated an additional 800 million gallons of treated WAL was used for quenching slag between 1970 and 1983. Hazardous constituents present in treated WAL include cyanide, selenium, benzene, toluene, phenols, and naphthalene.

Crude Coal Tar Processing - Crude coal tar from the decanters was further processed in the coal tar distillation plant between 1941 and 1970 to produce coal tar pitch and carbolic oils. The crude coal tar from the tar decanters was pumped through overhead pipes to the distillation plant, which was run on a continuous feed basis. According to Company officials, water removed from the tar was the only residual material generated. The wastewater was recirculated to the tar decanters for flushing liquor makeup.

The coal tar distillation plant is now used for storage and loading operations of crude coal tar. In addition, two tanks (formerly used for

carbolic oil storage) now contain waste oil. According to company officials, the oil was removed from seven large fuel oil storage tanks (described below).

Coal tar tank bottoms (tar sludges) were generated from the cleaning of tar storage tanks in the distillation plant. BSC records indicate that tar tanks 11 and 15 were cleaned in 1978 and 1980, respectively. The tar sludges were mixed with coke breeze, coal fines and rubble, as stabilizer, before being disposed of in the slag fill area.

Tar Decanter Sludge Processing - The tar decanter sludge is currently being recycled to the coke ovens; however, in the past it was disposed of in the slag fill area. Decanter tank tar sludge is a listed hazardous waste (hazardous waste number K087). Hazardous constituents present in the sludge include: coal tar, benzene, toluene, naphthalene, phenolic compounds, and cresols.

Tar decanter sludge was disposed of in the slag fill area from 1920 to 1960. A ball mill was installed in 1960 to pulverize the sludge so that it could be blended into the coal tar. When the ball mill was down for maintenance, the tar sludges were taken to the slag fill area for disposal. In 1983, new specifications for coal tar precluded blending it with tar decanter sludge.

Prior to the ball mill being installed, a concrete lined pit was used for holding tar sludge. The pit was adjacent to the tar decanters. According to Company officials, the pit was filled and covered when the ball mill was installed.

During 1983, the tar decanter sludge was taken offsite for disposal. In 1984, BSC began applying the tar decanter sludge to coal charged to the coke ovens. The tar sludge is processed in the ball mill and transferred to a heated tank at the coal mixer building. The liquified tar is sprayed on the coal as it is carried on a conveyor. According to company officials, all of the tar decanter sludge generated is currently being recycled to the coke ovens by this process.

Based on information provided by BSC, tar decanter sludge is generated at a rate of approximately 0.18 gallons per ton of coal. The rate is based on average coal consumption (3200 tons per day) and tar decanter sludge production (about 580 gallons per day.)

Coke Oven Gas Processing After Quenching

After the coke oven gas is quenched with flushing liquor, it passes through primary coolers and a tar precipitator unit. Neither the primary cooler nor the tar precipitator produce contaminated waste streams. Tar from the precipitator is currently combined with the coal tar from the decanters for storage before offsite shipment. After the tar precipitator, the gas goes through a series of processing units that produce ammonium sulfate, naphthalene, light oil, and elemental sulfur.

Ammonium Sulfate Unit - Ammonia from the ammonia still is injected into the coke oven gas just ahead of an ammonia absorber, where the gas contacts a sulfuric acid solution (mother liquor). The resulting solution is drained to a crystallizer where ammonium sulfate crystals are precipitated. The crystals are then removed and dried. The crystallizer has an associated cooling tower; blowdown from the tower is used for quenching coke, as previously discussed.

A tar sludge accumulates in the ammonia absorber and is removed with the mother liquor solution. The tar is skimmed off of the solution into a "tar buggy." The acid tar sludge (also called mother liquor tar in some BSC documents) was disposed of in the slag fill area from 1920 to 1982. Since 1982, the acid tar sludge has been recycled to the coke ovens with the tar decanter sludge. BSC personnel estimated that about 25,000 gallons of mother liquor tar are generated annually.

The RCRA Part A Application for Interim Status, submitted to EPA for the Lackawanna Plant, identified the acid tar sludge as a characteristic hazardous waste (corrosivity-hazardous waste No. D002). It would probably contain the same hazardous constituents as the tar decanter sludge, which is a listed hazardous waste.

Naphthalene Unit - After the ammonia absorber, the coke oven gas flows to final coolers where naphthalene becomes entrained in the contact cooling water. The water flows from the final coolers to rectangular, concrete, below-grade tanks (flotation beds). The naphthalene forms a floating mass on the surface of the water in the beds and is removed by paddle-type skimmers.

Water from the flotation beds is piped to a cooling tower, then returned to the final coolers. Blowdown from the tower is used for quenching coke, as previously discussed. Naphthalene sludges accumulate in the hot and cold wells of the cooling tower and in the flotation beds. These sludges were disposed of in the slag fill area from 1920 to 1983. Reportedly, since 1983, the naphthalene sludges have been combined with the naphthalene product, which is blended into the coal tar. Company officials estimated that 50 cubic yards of naphthalene sludge are generated annually. Naphthalene is a listed hazardous constituent.

Light Oil Recovery Unit - After the naphthalene recovery unit, the coke oven gas goes to the light oil recovery (benzol) plant, which was started in 1930. A petroleum wash oil is used to extract the light oils from the gas stream, and the light oils are then separated from the wash oil by steam stripping. Until 1964, the recovery operation included distillation of the light oil to separate the benzene, toluene, and xylene. Waste streams from the benzol plant have included still bottoms, agitator sludge, muck oil, and wastewaters.

Still bottoms were generated during the fractional distillation of light oil and were disposed of in the slag fill area. Company officials estimated that 600 gallons per day of still bottoms were generated from 1930 to 1964. Hazardous constituents present in the still bottoms include benzene, toluene, and naphthalene.

The agitator sludge was generated from an acid and caustic treatment of crude light oils and light oil compounds (benzene, toluene, and xylene). Sulfuric acid was used to further purify the light oils and

then the mixture was neutralized with caustic soda. The resulting sludge, removed from the oil, could contain residual amounts of acids and light oil compounds.* Company officials estimated that 600 gallons per day of agitator sludge were generated from 1930 to 1964, which was disposed of in the slag fill area. Hazardous constituents likely to be present in the agitator sludge include benzene, toluene, and naphthalene.

Wash oil becomes contaminated with carbonaceous solids and residual amounts of the compounds present in the light oil (benzene, toluene, and naphthalene, which are hazardous constituents). Wash oil muck (muck oil) is generated in the wash oil purifier and wash oil decanter during the recovery of light oils. According to Company officials, the muck oil was disposed of in the slag fill area until 1983. Starting in 1983, the Company began recycling this oil to the coke ovens (about 250 gallons per day).

Wastewater is also generated by the benzol plant and includes water from building floor drains, tank pad drains and tank drains. The wastewater is collected in the south interceptor sump (south sump), which is designed as an oil/ water separator. The oil overflow is held in a separate compartment until being pumped back into the light oil recovery process. The water flows to a different compartment. Until 1970, the water from the south sump was pumped to a second sump, the agitator sump and then discharged to the Ship Canal.

In 1970, water from the south sump was redirected to a holding tank, number 2 pollution tank. The water in this tank is referred to as benzol wastewater. Water in the number 2 tank was used with the treated WAL for quenching slag from the basic oxygen furnaces in a pit in the slag fill area (discussed in the section on Iron Ore Processing).

When the steel making operations were discontinued in 1983, BSC ceased pumping benzol wastewater to WQCS No. 8. The wastewater flow was again redirected and pumped from number 2

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* *Chemistry of Coal Utilization by the National Research Council (U.S.) Committee on Chemical Utilization, published by Wiley in 1945.*

pollution tank back to the by-products plant as make-up water. Oil is periodically pumped off the benzol wastewater in number 2 pollution tank and added to the muck oil.

Analytical results for samples of benzol plant wastewater from coke making by-product plants have shown hazardous constituents including benzene, toluene, naphthalene and various phenolic compounds.* The concentrations of these compounds ranged from 5 to 500 mg/L.

Sulfur Recovery Unit - The desulfurization and sulfur recovery units are the final processes in the by-product plant. Operation of the desulfurization plant began in the early 1950s. A carbonate solution was used to strip hydrogen sulfide from the coke oven gas before it was pumped to the onsite users. The sulfur recovery unit, which began operation in 1975, also had the capability of removing hydrogen cyanide using a bauxite catalyst. The wastes, generated from these units, include spent vacuum carbonate solution, condensate and spent bauxite catalyst.

The vacuum carbonate solution is a soda ash and water mixture. The solution becomes fouled during the removal of hydrogen sulfide from the coke oven gas. About 90,000 gallons of spent carbonate solution are generated annually. BSC analytical data for the spent solution show percent levels of thiocyanate and low (milligrams per liter) levels of cyanide and selenium.**

The spent carbonate solution was disposed of in the slag fill area from 1950 to 1984. Company officials reported that since 1984, it has been used as a supplement to the soda ash used in the ammonia still.

During the first 25 years of operation, a portion of the gas (foul gas) in the desulfurization unit was burned in a flare tower. The foul gas

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* *Effluent guidelines document and untitled draft data report submitted to EPA Office of Solid Waste by Midwest Research Institute in 1987.*

** *Technical Report 8-0511E dated March 7, 1988 by Acts Testing Labs, Inc., Buffalo, New York*

stream, when burned, generated a condensate that was collected in drums and disposed of in the slag fill area. According to Company officials, the condensate contained cyanide (Prussian blue). When the sulfur recovery plant was brought on line in 1975, the foul gas stream was directed through the bauxite catalyst for cyanide removal. The flaring operation was also discontinued at this time.

BSC records indicate that 14,000 pounds of spent bauxite catalyst have been generated annually since 1975. The spent catalyst was disposed in the slag fill area until 1982, when the sulfur plant was shut down. Since the plant became operational again in 1987, the catalyst has been disposed of offsite. The spent catalyst was tested in 1984 to determine if it was a RCRA characteristic hazardous waste. Analytical data, provided by BSC, showed that the spent catalyst contains low levels of cyanide (0.18 to 1.8 milligrams/kilogram) and sulfur, but it was not reactive.*

The desulfurization unit continued to operate while the sulfur plant was down. Condensate from the foul gas, described above, was reportedly recirculated to the final coolers from 1982 to 1987.

IRON ORE PROCESSING

The major iron ore processing operations at the Lackawanna Plant included: iron making in blast furnaces with an associated sintering plant, steel making in open hearth and basic oxygen furnaces, hot and cold forming mills, and fabrication shops. A list of specific operations and respective operating periods is presented in Table 9. Process operations, waste generation, management, and characterization are discussed below.

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* *Environmental Laboratory Analytical Results, dated December 10, 1984, prepared by the ARO Corporation, Buffalo, New York*

Table 9

IRON PROCESSING OPERATIONS
Bethlehem Steel Corporation - Lackawanna Plant

Operation	Active Period*
Ironmaking	
Blast Furnace A	1922-1975
Blast Furnace B	1922-1975
Blast Furnace C	1943-1980
Blast Furnace F	1931-1980
Blast Furnace G	1932-1974
Blast Furnace H	1932-1974
Blast Furnace J	1953-1983
Sinter Plant	1950-1983
Steel Making	
Open Hearth Shop No. 1	1922-late 1960s
Open Hearth Shop No. 2	1922-1976
Open Hearth Shop No. 3	1922-1976
Scrap Melter	1977-1978
Basic Oxygen Furnace	1964-1983
Hot Forming Mills	
North Complex	
44" Blooming	1922-1983
40" Blooming	1922-1975
36" Roughing	1922-1983
32" Rail	1922-1978
30" Roughing	1922-1983
21" Finishing	1922-1983
South Complex	
54" Blooming	1922-1978
48" Structural	1922-1978
35" Structural	1922-1978
28" Structural	1922-1978
18" Structural	1922-1978
14" Structural	1922-1978

Table 9 (cont.)

Operation	Active Period*
Slab Mill	
45" x 90" Slabbing	1961-1983
Bar Mill	
13" Bar	1976-present
12" Bar	1941-1981
10" Bar	1947-1977
8" Bar (part of north complex)	1922-1965
Strip Mill	
79" Hot Strip	1935-1983
Cold Forming Mills	
Cold Strip	1940-present
Galvanizing	1962-present
Fabrication Shops	
Buffalo Speciality Products	Early 1900s-present
Buffalo Tank Company	Early 1900s-1982
Expanded Joist Mill	Early 1900s-mid-1970s

* *Approximate dates; the year 1922 is listed if the unit was operating when BSC acquired the plant and no other date was found.*

Iron Making

Blast Furnaces

Molten iron was produced in seven blast furnaces located in a north-south line on the east side of the ship canal. Blast furnaces are large cylindrical, brick-lined structures that are loaded (charged) primarily with coke, iron ores, limestone and sinter (produced in an onsite plant after 1950). During operation of a blast furnace, the coke is ignited to produce heat to melt the charge while pre-heated air is blown into the furnace to support the combustion. As the charge melts, molten iron and slag form. The slag floats on top of the iron and is drawn off (tapped) through a tapping hole. The molten iron is also tapped through a hole below the slag tapping hole.

Process wastes from the blast furnaces include slag and contaminants removed from the exhausted gases. Molten slag was transported by rail to the slag fill area where it was dumped and allowed to solidify. The primary disposal area for the last 40 to 50 years has been in trenches in the southwestern portion of the property. The slag has been recovered since about 1940 by Buffalo Crushed Stone for use as an aggregate for concrete, granular subareas for roads, fill and other commercial uses. Slag production for 1974 was estimated to be about 3,100 tons per day.

Results of a general analysis of blast furnace slag submitted to NYSDEC by BSC in 1974 indicate that the principal constituents are oxides of calcium (38%), silicon (37%) and magnesium (12.5%). Detailed analytical results for blast furnace slag were not available from BSC. Results of tests conducted on the slag for BSC in 1981 and 1985 indicated that it does not exhibit the characteristic of EP toxicity.

The blast furnaces were relined with brick about every 5 years. The used brick was disposed of in the slag fill area. No analytical results were available for the brick.

Blast furnace exhaust gas is flammable and has, reportedly, always been recovered at the Lackawanna Plant for use as a fuel. About one-third of the gas

produced was used for pre-heating air blown into the furnaces. The gas was used elsewhere to fuel air compressors that precede pre-heating units (stoves), and to underfire coke ovens, boilers and reheating furnaces in the mills.

Exhaust gases from the blast furnaces were first passed through a dry dust collector, to remove the larger particulates and then through a wet scrubber. Supplemental fuels could be injected into the blast furnace with the heated air, which could affect the hazardous constituent content of the resulting waste solids. These supplemental fuels included cleaned coke gas, No. 2 fuel oil, and coal tar (at blast furnaces C, H and J).

Analytical results for the BSC blast furnace dust and scrubber water were not available. An EP toxicity test, conducted for BSC on the dust in 1983, indicated that metals concentrations in the extract did not exceed reference values. No analytical results for the scrubber water were available; however, the effluent guidelines development document indicates that it typically contains phenol, cyanide, lead, and benzo(a)pyrene, which are listed hazardous constituents.

Until 1950, dust from the blast furnace dry collectors was disposed of in the slag fill area. After 1950, it was used as feedstock in the sinter plant. No information on the dust composition was found during the investigation.

The scrubber water was discharged to the ship canal until about 1950, when four primary and one final above-grade, steel settling tanks (thickeners) were installed to treat it. The primary thickeners were near the blast furnaces and were designated by the respective furnace scrubber(s) they served. No analytical results for the overflows and underflows (sludges) from the thickeners were available from BSC; however, the streams would be expected to contain the hazardous constituents present in the scrubber water.

Overflows from thickeners A-B, C and F-G were discharged to the north return water trench, which drains northward along the eastern side of the blast furnaces to the Union Ship Canal. Overflow from thickener H-J was discharged to the south return water trench, which drains southward along the eastern side of the blast furnaces to Smoke Creek.

In 1970, the primary thickener overflows were combined and routed to the south end of the ship canal. Sheet piling was installed across the ship canal about 100 feet north of the south end to form a "treatment basin" for the thickener overflow. Digester sludge from the Lackawanna municipal wastewater treatment plant was added to the treatment basin to degrade phenol and cyanide in the thickener discharge, according to BSC personnel. This treatment basin was operated until about 1979, when a cooling tower (designated WQCS No. 9*) was installed. Water from the cooling tower was recycled back to the blast furnace scrubbers; blowdown (about 10% of the flow) was discharged to the ship canal.

Sludge from the primary thickeners was piped to the blast furnace final thickener, which is on the east side of the sinter plant (described below). Overflow from the final thickener was also discharged to the south end of the Ship Canal where it was combined with flows from the primary thickeners when the treatment basin was completed.

Sludge from the final thickener was piped to the sinter plant where it flowed into a rotating leaf-type filter press for dewatering. The filter cake was used as a raw material in the sintering process and the filtrate was returned to the final thickener. Beginning in 1967, blast furnace final thickener sludge was sometimes trucked to the slag fill area. After 1970, the frequency was increased and then was stopped in 1978.

The sludge was shipped to the slag fill area because it contained sludge from the basic oxygen furnace (BOF) primary thickener and clarifiers (discussed below), which adversely affected sinter composition. The resultant poor-quality sinter caused problems in operating the blast furnaces. Shipment of the blast furnace final thickener sludge to the slag fill area was stopped after new treatment facilities were constructed for the BOF thickener sludge.

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* *The designation "WQCS No. 9" was used by BSC only for the cooling tower. However, as used in this report, the designation refers to all treatment units where the blast furnace scrubber water was managed.*

Sinter Plant

Sintering is a process where iron-rich fine materials wasted from other plant processes, such as mill scale, are fused into clinkers that are used as an iron source, together with ore, in blast furnaces. The process includes mixing the raw materials, ignition, and combustion on a traveling grate in the sinter machine, agglomeration of the sinter, cooling and screening. Near the head end of the traveling grate, the surface of the raw materials is ignited by a gas-fired furnace located over the bed. As the mixture moves along on the traveling grate, air is drawn down through the mixture to wind boxes to enhance combustion and to sinter (fuse) the fine particles. As the bed burns, carbon dioxide, cyanides, sulfur compounds, chlorides, and fluorides are driven off with the gases, according to the effluent guidelines development document. Also, oil and grease, typically present on the mill scale, is vaporized and driven off.

A sinter plant was built at the Lackawanna Plant in about 1950. The primary raw materials, used to make the sinter, were iron ore fines; mill scale; blast furnace thickener sludge; dust from the blast furnace dust catchers and sinter plant electrostatic precipitator; limestone; dolomite and coke breeze (generally, coke that will pass a 3/4-inch mesh screen). The sinter machine was fired with both desulfurized coke gas and natural gas.

The sinter plant had two gas and dust scrubbing systems. Fumes and dusts from the hot sinter bed, ignition furnace and sinter bed windboxes were originally ducted to an electrostatic precipitator. Dust from the precipitator was both recycled back to the sinter machine and disposed of in the slag fill area.

No analytical results for the precipitator dust were available from BSC. The effluent guidelines development document indicates that sinter plant precipitator dust typically contains iron oxide, coke fines, alkaline salts and other metallic oxides. BSC had the dust tested in 1983 to determine if it was a characteristic hazardous waste;* the test results indicated it was not.

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* *Tested for the characteristics identified in 40 CFR Part 261, Subpart C.*

In 1982, a wet scrubber system was installed to replace the electrostatic precipitator. The system included both a gas scrubber and an above-grade, steel settling tank (thickener) to treat blowdown from the system (about 10 percent of flow). The thickener, designated as WQCS No. 3A, was located on the east side of the sinter plant, just north of the blast furnace final thickener. In addition to settling solids, the pH was adjusted with lime at the thickener. The pH of the blowdown ranged from about 3.5 to 4, according to BSC design drawings. Thickener overflow was discharged to the south return water trench and the sludge was disposed of in the slag fill area.

According to the effluent guidelines development document, sinter plant scrubber water is similar in composition to blast furnace wastewaters in that both contain cyanide, phenols and toxic metals (cadmium, chromium, lead and nickel), which are listed hazardous constituents. Overflows and sludges from WQCS No. 3A are expected to also contain these hazardous constituents; however, no analytical results for these parameters were available from BSC.

The second gas cleaning system controls emissions from material transfer points (e.g., conveyors, raw materials storage bins and feeders). This was a wet scrubber system that discharged to the blast furnace final thickener (previously discussed).

Steel Making

Steel is an alloy of iron which contains less than 1.0% carbon. Steel making is basically a process in which carbon, silicon, phosphorous, manganese and other impurities present in the raw hot metal (molten iron) or steel scrap are oxidized to specific minimum levels. At the Lackawanna Plant, steel was made in both open hearth and basic oxygen furnaces (BOF).

The principal raw materials used in the open hearth and BOF furnaces were molten iron (from the blast furnaces), steel scrap, limestone, burnt lime, dolomite, fluorospar and iron ores. Carbon content may be increased, if necessary, by adding coal to the furnace. Steels of varying metallurgical compositions were produced by adding alloying agents either in the steel making furnace or to the holding (teeming) ladle after the molten steel is tapped

from the furnace. Molten steel in the teeming ladle was poured into ingot molds. The ingots were removed from the molds in the "stripping building" and composed the initial feedstock for the hot forming mills described below.

Charging and support operations for the two types of furnaces were very similar at the Lackawanna Plant. The principal difference between them, so far as the NEIC investigation determined, is the number of furnaces and handling of waste residuals, which are discussed below.

Open Hearth Furnaces

The Lackawanna Plant had three open hearth furnace shops, designated as 1, 2 and 3, which had a total of 35 furnaces. There were 14 furnaces in the No. 1 shop, 10 in the No. 2 shop and 11 in the No. 3 shop. The No. 1 shop was near the north end of the east side of the plant next to the Hamburg turnpike. The No. 2 shop was just east of the B and C blast furnaces and the No. 3 shop was just south of the Ship Canal.

Each open hearth furnace was a brick-lined vessel with two burners positioned on the lip, which were used alternately to heat the charge. One or two water-cooled lances were positioned vertically above some of the furnaces to supply air or oxygen. The burners in the furnaces at the three shops were fired with coke oven gas and No. 6 fuel oil. In addition, at the No. 2 and 3 shops, coal tar and pitch could be used in lieu of No. 6 fuel oil. The No. 2 shop had one 20,000-gallon storage tank for coal tar and pitch and the No. 3 shop had three. The No. 3 shop also had one tank for storage of No. 6 fuel oil.

Molten slag from the open hearth furnaces was disposed of in the slag fill area near the blast furnace slag and in the area just north of Smoke Creek. No analysis of the slag was available from BSC; however, it would probably be similar to the BOF slag described below.

The open hearth furnaces were relined with brick about every 2 or 3 months. The waste brick was disposed of in the slag fill area.

In 1962, electrostatic precipitators were installed to clean the exhaust gases from the open hearth furnaces in No. 2 and 3 shops. Dust collected from the precipitators was disposed of in the slag fill area. No analysis of the precipitator dust was available from BSC.

Scrap Melter

From August 1977 until September 1978, BSC melted scrap metal in a large cupola constructed in the No. 2 open hearth shop. The melted scrap was used to charge the BOF. The scrap melter was charged with cold iron, steel scrap, coke, and burnt lime. Exhaust gases were cleaned using the existing precipitator for the shop, and then were burned to pre-heat the combustion air used by the melter. Slag and solids from the precipitator were disposed of in the slag fill area. No analysis of the scrap melter slag was available from BSC.

Basic Oxygen Furnace

The Lackawanna Plant had three BOF vessels in one shop, which was southeast of open hearth shop No. 3. Each pear-shaped, brick-lined BOF vessel was supported by two cylindrical pins (trunions) protruding from it. The trunions were geared to electric motors so that the vessel could be tilted during charging and tapping. During operation, a water-cooled oxygen lance was lowered into the vessel to just above the charge (bath) and oxygen was injected at supersonic velocities. The oxygen caused agitation of the bath and rapid oxidation of iron and dissolved carbon, silicon, manganese, and phosphorous. Argon was also injected through ports (tuyeres) in the bottom of the vessel to increase bath agitation.

About 40% of the BOF slag was recycled to the blast furnaces; the remainder was taken to the slag fill area. The slag was taken to the northern part of the fill area until about 1970, when the BOF slag quench pit was constructed. Wastewater from the coking operation, collected in the storage tank at WQCS No. 8 (discussed in the Coal Processing section) was used to quench the slag. After quenching, the BOF slag was taken to the northern area for disposal and recovery. BSC data for 1974 indicates that the BOF shop produced about 1,725 tons of slag per day.

BSC general analysis of BOF slag in 1974 indicates that the principal constituents are oxides of calcium (43%), iron (22%) and silicon (20%). Detailed analyses were not available from BSC. Results of tests conducted on the slag for BSC in 1985 indicated that it does not exhibit the characteristic of EP toxicity. Conflicting results were obtained by NYSDEC in 1984, which indicated that the slag was hazardous because the EP extract contained concentrations of lead, chromium and cadmium that exceeded the reference levels.

Exhaust gases from the BOFs were passed through a wet scrubber that was installed when the shop was built. Detailed analyses of the wet scrubber water discharge were not available from BSC. The effluent guidelines development document indicates that the scrubber water typically contains chromium, lead, cadmium and chloroform, which are listed hazardous constituents. Residuals from treatment of the scrubber water are expected to also contain these constituents.

Between 1964 and 1966, the scrubber water was treated in an above-grade steel settling tank (primary thickener). In 1966, two above-grade, steel (scalping) tanks, operated in parallel, were added and used to settle shot-size steel particles out of the waste stream. These units were the first part of what was to become WQCS No. 3 and were adjacent to the north end of the BOF shop. Overflow from the scalping tanks went to the primary thickener, which in turn, discharged to the south return water trench. Solids settling in the scalping tanks were pumped out with a "sand sucker" air-lift-type pump into railroad cars and taken to the sinter plant for use as a raw material. Sludge from the primary thickener was piped to the blast furnace final thickener near the sinter plant until 1978, as previously discussed.

In 1970, two concrete, partially-below-grade clarifiers were built near the southeast corner of the sinter plant to treat overflow from the BOF primary thickener. When the clarifiers were built, they were designated as WQCS No. 3. Company personnel were uncertain about whether the scalping tanks and primary thickener were included in WQCS No. 3 because of the different location. Because the units were used to treat the same waste stream as the clarifiers, they are part of a common treatment system and are collectively

designated as WQCS No. 3 for the purpose of this report. Overflow from the clarifiers was discharged to the south return water trench until about 1978.

In 1978, a cooling tower and BOF final thickener were added to WQCS No. 3. The cooling tower received overflow from the two clarifiers. The cooling tower effluent was either used as makeup in the plant water system or discharged to the south return water trench. The BOF final thickener received sludge from the BOF primary thickener and the clarifiers. Overflow from the BOF final thickener went to the south return water trench. Sludge from this thickener went to surface impoundments in the slag fill area until 1983, when most of the Lackawanna Plant was shut down.

The final thickener sludge was tested for EP toxicity in 1980, and none of the metals concentrations in the extract exceeded the reference values. No analytical results for the overflows or sludges were available from BSC.

Waste residuals were also generated from other processes at the BOF shop. These included a baghouse serving the area where molten iron was transferred to the charging ladle, another baghouse collected lead-bearing dust when alloying was done during transfer of the molten steel from the teeming ladle to an ingot mold, and a third baghouse collected lime dust at a transfer point. The baghouse dust from the iron transfer point was principally carbon and is called "kish." It was disposed of in the slag fill area from 1966 until 1983, when the BOF shop was shut down.

The lead bearing dust from the alloying operation was disposed of in the slag fill area from 1974 until 1982. During 1982 and 1983, it was shipped offsite as a hazardous waste (RCRA hazardous waste code D008) for disposal. Plant personnel estimated that the plant generated about 91,000 pounds per year of this waste.

The lime dust was sent to the lime plant for recycling from 1964 to 1981; from 1981 to 1983, it was disposed of in the slag fill area.

Hot Forming Mills

Hot forming is a process in which hot steel, initially in solid ingot form, is reduced in cross section through a series of "stands" consisting of paired rollers forced together by hydraulic pressure. The axes of the rollers may be either vertical or horizontal and may alternate from one stand to the next.

The Lackawanna Plant had five hot forming mill areas: north mill complex, south mill complex, slabbing mill, hot strip mill, and bar mills. One of the bar mills (8-inch mill) was in the north mill complex; the others were on the east side of the Hamburg Turnpike. In conjunction with hot forming, some of the Lackawanna Plant mills had pickling and coating operations, which are discussed following a description of the general process.

The basic product flow, common to the Lackawanna Plant mills, begins with a reheating unit. At the mills receiving steel ingots, reheating was done in a "soaking pit;" in subsequent mills, reheating was done in a furnace. After removal from the reheating unit, the hot metal feedstock was conveyed through the rolling stands until the desired product or intermediate was obtained. The stand rollers and the steel being worked were sprayed with water for cooling and to remove scale. In some mills, surface imperfections in the product or intermediate, were removed by melting a thin layer of the metal (scarfing) and blowing it off with water jets to produce small metal fragments called "spittings."

The reheating units were fired with either coke or blast furnace gas. The scarfer units were fired with natural gas and oxygen. Neither the reheating units nor the scarfers had combustion emission controls. The reheating units were lined with refactory brick, which was periodically replaced. Waste bricks were disposed of in the slag fill area.

Cooling water from the mill stands flowed into a sluice (under the stand line), which drained to a scale settling pit. In the slabbing mill, there was an additional pit for scale removed from trimmings. The wastewater contained scale and hydraulic oil leaked from the stands, pumps, and other related equipment. Separate settling pits were constructed for settling the scarfer

spittings. There were a total of 16 scale and 4 scarfer spittings settling pits [Table 10], which were rectangular, below-grade concrete structures.

Overflow from the settling pits was discharged directly to surface water until about 1970, when WQCS Nos. 1, 2, 4, 5 and 6 were constructed. The disposition of liquids and solids from those stations is presented in Table 1. Until about 1950, solids (mostly scale) from the settling pits were disposed of in the slag fill area. After 1950, the solids went to the sinter plant.

BSC general analytical results from 1974 for a dried sample of the sludge/scale from the hot strip mill (WQCS No. 6) indicated that it contained iron (71%) and oil (24%). BSC personnel stated that the oil content of waste streams going to the WQCSs serving the other hot forming mills was generally much less. According to a l986 analysis conducted for BSC, scale from the 13-inch bar mill contained only 2.3% oil and grease. The scale was also tested to determine if it was a characteristic hazardous waste; it was not. The analytical results also indicated that the scale contained 0.2 milligrams per kilogram of cyanide. Cyanide is a listed hazardous constituent and petroleum-based lubricants typically contain hazardous constituents.

Between 1950 and 1983, the scale was used in the sinter plant. Currently, scale from the 13-inch bar mill is being stockpiled on the east side of the mill and on the east side of the galvanizing building. The oil content of the scale limits its use in sintering because the oil produces visible emissions. To avoid exceeding visible emission limitations at the Lackawanna sinter plant, the oil content of the scale had to be less than 1%.

Each of the WQCSs serving the hot forming mill had provisions and tankage for oil recovery. BSC personnel stated that the oil recovered before and after the WQCSs were installed would have been hauled away by a recycler and/or disposed of in the slag fill area. It was reportedly disposed of in the slag fill area both in bulk and in drums.

Table 10

SUMMARY OF SETTLING PITS AT HOT FORMING MILLS
Bethlehem Steel Corporation - Lackawanna Plant

Hot Forming Mills	Years of Operation	Scale Pit	Scarfer Pit
North Complex			
44" Blooming	1922-1983	X	X
40" Blooming	1922-1975	X	X
36" Roughing	1922-1983	X	
32" Rail	1922-1978	X	
30" Roughing	1922-1983	X	
21" Finishing	1922-1983	X	
30" and 21" Mill Scarfing Pit	1965-1983		X
South Complex			
54" Blooming	1922-1978	X	
48" Structural	1922-1978	X	
35", 28", 18" and 14" Structural Mills	1922-1978	X	
Other			
45" x 90" Slab	1961-1983	X(2)	X
13" Bar	1976-present	X	
10" and 12" Bar	1941-1981	X	
8" Bar	1922-1965	X	
79" Hot Strip	1935-1983	X(2*)	

* *Includes scale pit and runout table spray water pit*

Billet Preparation Shop 1 Pickler

Pickling is a process where the steel surface is chemically cleaned (usually with hydrochloric or sulfuric acid) of scale, rust and other materials. Spent pickle liquor (an acid solution) is a listed hazardous waste (hazardous waste number K062). Billet preparation shop 1 was on the eastern side of the north mill complex. The billets were pickled (cleaned) with sulfuric acid from an undetermined starting date until 1968. Plant drawings indicate that the billet shop was formerly a mill. Waste acid was trucked to the slag fill area from this pickler.

Billet Pickling at 10-Inch/12-Inch Bar Mill

A sulfuric acid pickling operation for billets was operated at the north end of the storage area on the west side of the 10-inch/12-inch bar mill until about 1974. Waste acid drained to a below-grade sump on the south side of Blasdell Creek and was pumped to the creek until the mid-1950s.* After that time, it was collected and taken by truck to the slag fill area for disposal.

Coil Pickling at 10-Inch/12-Inch Bar Mill

A sulfuric acid pickling operation for coil steel was operated at the north end of the finishing area on the east side of the 10-inch/12-inch bar mill until about 1975. Waste acid drained to a below-grade sump on the north side of the pickling shop from where it probably flowed by gravity to Blasdell Creek until the mid-1950s.* After that time, it was collected and taken by truck to the slag fill area for disposal.

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* *The time period, 1950's, is based on aerial photographs showing a pit in the slag fill area which company officials identified as a waste acid disposal pit. Additionally, a 1967 report prepared by a BSC consultant indicated that waste acids that used to go to Blasdell Creek were being taken to a surface impoundment.*

Coil Pickling and Coating at 13-Inch Bar Mill

The coil pickling and coating shop at 13-inch bar mill is in the southeast corner of the building and has been operated since 1976. It has 15 tanks, numbered 1 though 15, that are used for pre-cleaning with caustic, pickling with sulfuric acid and coating with phosphate and stearate solutions. Waste generation and disposal practices are shown in Table 11.

Hot Strip Mill Pickler

A sulfuric acid pickler was operated at the east end of the hot strip mill building until the mill was shut down in 1983. Waste acid was discharged to Blasdell Creek until the mid 1950s. After that time, it was collected and taken by truck to the slag fill area for disposal.

Cold Forming Mill

Cold forming is the process in which unheated steel products are progressively reduced in thickness by passing them through a series of rolling stands. The cold forming mill at the Lackawanna Plant (called the "cold strip mill") was completed in about 1940 and uses coil (strip) steel as the feedstock. The cold strip mill operation begins with descaling and pickling the steel; then it is cold rolled in the "tandem mill." After rolling, the coils may be shipped directly to customers or they may be annealed or galvanized. As a final step, the steel may be tempered, which is done by rolling through a single-stand.

In 1970, WQCS No. 7 was installed to treat wastewater, from the cold strip mill and the galvanizing mill, using physical/chemical methods. The station discharges to Smoke Creek and sludge is disposed of in the slag fill area. No analytical results for the effluent or sludge from WQCS No. 7 were available from BSC. In 1980 and 1983, a total of three sludge samples were tested for EP toxicity. The extract was analyzed for metals and none exceeded the reference values.

Lime grit from a slaker at the station was also disposed of in the slag fill area from 1970 to 1983.

Table 11

13-INCH BAR MILL PICKLING OPERATION
WASTE GENERATION AND DISPOSAL
Bethlehem Steel Corporation - Lackawanna Plant

Tank Number	Content/Use	Waste Disposal
1	Bonderlube (stearate-base coating) dip tank	Contents disposed of every 4 to 5 years. Between 1978 and 1983 took 2,000 gal. to SFA*; 1,000 gal. disposed of offsite in 1983 and again in 1978
2	Parcolene No. 24, mild basic dip to clean acid from metal	One load of 3,000 gal. to SFA in 1983
3	Cold water rinse tank following tanks 4 and 5; overflow pumped to tanks 4 and for makeup	
4	Phosphate coating (zinc phosphate/ phosphoric acid)	Spent solutions and sludges from tanks 4 and 5 (about 12,000 gal. per year) were disposed of at SFA between 1978 and 1983; from 1983 to present, contents of tank 3 were "boiled off," then supernantant from 4 and 5 were added and boiled off; sludge in 4 and 5 shipped offsite
5	Phosphate coating (zinc phosphate/ phosphoric acid); nitric acid is added as a replenisher	
6	Caustic tank for degreasing coils before pickling	One 3,000 gal. load to SFA in 1980
7	Rinse tank following tank 6; overflow is used as makeup for tank 6	

Table 11 (cont.)

Tank Number	Content/Use	Waste Disposal
8	Dip tank for 10% lime solution; presently use tank 8 for "boiling down" waste solutions	Between 1979 and 1983, about 3,500 gal./yr. of spent lime solution from tanks 8 and 9 were taken to the SFA for disposal; between 1983 and the present most was taken offsite for disposal; 16,000 gal. at WQCS No. 7 during the fall of 1987
9	Dip tank for 10% lime solution	
10	Hot water rinse; overflow is used for acid makeup in tank 15	
11	Cold water rinse; overflow is used for acid makeup in tank 15	
12 through 15	Acid dip tanks; normally have two in operation, one boiling down spent acid, and one down	Between 1976 and 1982, spent acid was treated in a KSF acid tower, which produced "salt crystals" that were sold to Canadians as a cattle feed supplement; from July 1982 to August 1987 acid was shipped offsite, for disposal or reuse; from August 1987, acid was shipped to Canadian publicly-owned treatment works for reuse
Waste Solution	Received spent solutions from tanks 1 to 9 above	Tank contents picked up by plant services dept.; after 1983, material tested, then taken to WQCS No. 7

* *SFA refers to the slag fill area*

Cold Strip Mill Pickling Shop

The cold strip mill was built with three pickling lines, which were preceded by a scale breaker. The scale breaker is a set of offset rollers, which the steel strip is passed through, and is followed by high pressure water jets to remove the scale. The water and scale flow to a waste pit called the "acid rinse pit" (discussed below).

The three pickling lines were operated until 1975, when a fire destroyed the pickling building. After the fire, rubble from the pickling building was disposed of in the northern part of the slag fill area. The three pickling lines were subsequently returned to service; however, the No. 1 and No. 2 lines were shut down in 1978 and 1983, respectively. Tanks in the No. 1 and 2 pickling lines are presently used to store acid when the No. 3 line is down for repairs.

From 1940 to 1969, sulfuric acid was used in the picklers and hydrochloric acid was used from 1970 to the present. The acid type was changed as WQCS No. 7 was coming online, which also received acid (hydrochloric acid) from the galvanizing mill; the change was reportedly made so as to have compatible acids. From 1940 to 1970, spent pickle liquor and rinse water from the cold strip mill drained to a sump on the south side of the pickler shop. From the sump, the spent solutions were discharged to Smoke Creek about 250 feet upstream from the confluence of the creek and the south return water trench.

In about 1970, concurrent with construction of WQCS No. 7, a new below-grade, 20,000-gallon waste acid pit was constructed near the old one. The pit is constructed of (from the outside inward) sheet piling, concrete and acid resisting brick. Waste acid was pumped from the pit to an above-grade 40,000-gallon storage tank at WQCS No. 7. Rinse water from the pickler and water from the scale breaker ahead of the pickler are routed to the old pickle liquor pit, from where they are pumped to WQCS No. 7 for treatment.

Between 1970 and 1982, the spent pickle liquor collected in the storage tank at WQCS No. 7 was both disposed of in the slag fill area and sold for reuse. After 1982, disposal in the slag fill area reportedly ceased and the acid

was sold for reuse. Beginning in 1986, the acid was also used in the treatment process at WQCS No. 7.

Tandem Mill

The tandem mill currently has four rolling stands, operated in series, through which the pickled coils are passed. A solution of oil (5%), detergent and water is sprayed on the stand rollers and steel to dissipate heat and provide lubrication. The solution drains to the tandem mill sump in the basement. Also draining to the sump are oil leaks from the hydraulic stands and pumps, lubricating oil mixed with the coolant solution and compressor oil. Petroleum based lubricants and oils typically contain listed hazardous constituents.

The sump has an approximate capacity of 30,000 gallons and is concrete-lined. Between 1940 and 1970, the sump discharged to Smoke Creek. The sump was cleaned about yearly until approximately 1982 and the material removed was disposed of in the slag fill area. From 1970 to the present, the tandem sump discharge was treated in WQCS No. 7. In addition, an automatic oil skimmer was installed on the sump, from which oil is pumped to a small holding tank in the basement. Oil is pumped from the holding tank to a 15,000-gallon storage tank at the southwest corner of the hot strip mill slab holding yard. Oil from the tank is presently shipped offsite for recycling, but may have been disposed of in the slag fill area in the past.

Annealing

During cold rolling, the steel becomes hard and brittle. To make the steel more ductile, it is heated in an annealing furnace. While in the annealing furnace, the steel is heated in an inert atmosphere ("DX" gas, which was produced onsite*) to prevent scale formation. The DX gas was produced from natural gas using heat and steam to drive the reaction. The only waste stream produced by the DX gas plant was non-contact cooling water, which was discharged to Smoke Creek.

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* *DX gas is about 75% nitrogen, 10% hydrogen, 10% carbon monoxide and 5% carbon dioxide, according to a December 29, 1987 analytical report provided by BSC.*

Galvanizing

Galvanizing is a hot coating process where clean steel is immersed in a bath of molten zinc to deposit a thin layer of the metal onto the steel surface. The galvanizing mill at the Lackawanna Plant was completed in 1962 and uses coiled strip steel from the tandem mill for feedstock. The steel coils are placed on one of two payoff reels, which feed the continuous hot dip galvanizing line. Before reaching the molten zinc tank, the steel strip passes through several tanks where it is cleaned with caustic and acid, with intermediate and final water rinses, then passed through a flux tank. After the steel comes out of the zinc bath, it goes through a water quench followed by a chemical treatment tank and a dryer.

Process wastewater from the galvanizing mill, which includes spent caustic solution (initially, 8 to 10% sodium hydroxide) and spent cleaning acid solution (initially, 17% hydrochloric acid), was discharged to Smoke Creek from 1962 to 1970. The discharge was through the same outfall as the spent pickling liquor from the cold strip mill, which was about 250 feet upstream from the confluence of the creek with the south return water trench. The old acid (process water) sewer line from the galvanizing mill drained west to a sump near the Hamburg Turnpike, from where the acid was pumped into line running north toward the cold strip mill. The below-grade, concrete sump was lined with acid resistant brick; it has been backfilled with slag.

Between 1970 and 1984, the process wastewater from the mill have gone to a below-grade concrete "galvanizing mill sump" on the south side of WQCS No. 7. Water from the sump is treated at the station. Beginning in 1984, the spent hydrochloric acid was drained to a tanker parked on the north side of the galvanizing mill. The tanker was used to haul the acid to the spent pickle liquor pit at the cold strip mill. About 4000 gal per month of waste acid is currently generated by the galvanizing mill.

Solids that settle out of the waste stream in the sump are periodically removed. Between 1970 and 1985, this sludge was disposed of in the slag fill area. In 1985, the sludge was taken to a temporary storage area in the southeast corner of the field east of the galvanizing mill building. Analysis of the

sludge in 1983 revealed that it contained more than 6 milligrams per liter of cyanide, which is a listed hazardous constituent. Company officials could not explain the source of the cyanide.

The flux solution (zinc ammonium chloride) tank was cleaned out annually until about 1981 when a filtering system was installed; then it was cleaned out quarterly. Until 1970, the cleanings were discharged with other wastes to Smoke Creek. Since 1970, the cleanings have gone to WQCS No. 7. The spent filters were shipped offsite for disposal as a hazardous waste between 1981 and 1987; afterward they were no longer considered hazardous waste and went to a sanitary landfill. Results of the EP toxicity test conducted in 1986, indicated that the extract contained 0.5 milligrams per liter of cadmium, which is a listed hazardous constituent.

The final chemical tank on the galvanizing line contains a chromic and phosphoric acid solution for final polishing and cleaning of the zinc-coated steel. Until 1970, overflow and spillage were discharged to Smoke Creek through the waste acid line. After 1970, this discharge went to WQCS No. 7. The solution contains chromium, which is a listed hazardous constituent. The material safety data sheet (MSDS) for the chemical used in the solution indicates that the pH is less than 1 and that the pH of a 5% solution is 1.4; therefore, the waste solution is probably a characteristic (corrosivity) hazardous waste.

The galvanizing mill has two wet scrubbers for air emissions; one for the tanks ahead of the zinc tank and one for the zinc tank. The scrubbers discharge to WQCS No. 7. No analytical results for the scrubber water were available from BSC.

Fabrication Shops

BSC operated three fabrication shops at the south end of the plant property, which included Buffalo Speciality Products, Buffalo Tank Company and the expanded joist mill. These shops were sold in 1983, 1985, and 1986, respectively, and are currently being operated by new owners. Some of the processes are still being operated, while some have been completely replaced.

Because of the scope of the NEIC investigation, general information on the three fabrication shops was obtained from BSC personnel; however, the plants were not inspected to obtain detailed information. These operations are described below.

Buffalo Speciality Products

The principal products of the Buffalo Speciality Products plant were highway guard rails and steel culverts. Custom stamping and punching were also done at this plant. The plant was built in the early 1900s and is currently being operated by a new owner. The main wastes from the plant were scrap steel, which was recycled, and waste oil (hydraulic and lubricating). BSC officials stated that the waste oil was disposed of in the slag fill area. Petroleum based oil typically contains listed hazardous waste constituents.

Buffalo Tank Company

The Buffalo Tank Company plant was built in the early l900s as part of Seneca Steel. In 1922, it became a subsidiary of BSC that manufactured tanks, until it was shut down in about 1982. BSC personnel identified hydraulic oil and empty paint cans as the principal wastes generated by this operation. These wastes were disposed of in the slag fill area. Company representatives also speculated that solvent cleaning solutions were also produced by the plant and disposed of with the other wastes.

Expanded Joist Mill

Large structural members for industrial buildings were made at the joist mill from beams made elsewhere at the Lackawanna Plant. The mill was built in the early 1900s, as part of Seneca Steel, and shut down in the mid-1970s. Wastes included paint residues, solvent cleaning solutions, paint house filters and hydraulic oil, which were drummed and disposed of in the slag fill area. These materials probably included listed hazardous wastes and/or contained hazardous constituents.

SUPPORT OPERATIONS

In general, information on support operations, which were closed, was very limited. They produced varying quantities of wastes that were disposed of in the slag fill area. Some of the waste streams contained or probably contained hazardous constituents; therefore, this discussion is included to provide additional information on the Lackawanna Plant.

Tar and Oil Storage

There are seven 3- to 4-million-gallon-capacity tanks (numbered 1 through 7) adjacent to the tar distillation plant that were used for storing No. 6 fuel oil and coal tar [Figure 8]. All tanks were used at one time for No. 6 fuel oil. Tanks 2, 3 and 4 were used for petroleum tar and some may have been used for coal tar.

In 1987, the tanks were cleaned. The tar bottoms cleaned from the tanks were mixed with coke breeze and coal fines to create a solid fuel. This material has been stockpiled onsite adjacent to the storage tanks and, according to Company officials, is being sold as a fuel product.

Roll Shops

There were four roll shops at the Lackawanna Plant where rollers from the mill stands were resurfaced. The shops were designated as the 54-inch mill shop, main shop, 12-inch bar mill shop and the cold strip mill shop. In the first three shops, the rolls were turned on a lathe; in the cold mill shop, the rollers were ground. The lathe turnings were recycled.

Grindings from the cold mill shop were disposed of in the slag fill area until 1983. From 1983 until 1987, they were manifested offsite as a hazardous waste because of the chromium content (chrome content in EP toxicity test extract exceeded reference value). In 1987, the waste was retested and found to be non-hazardous. The roll shop sludge disposed of in the slag fill area contained chromium, a listed hazardous constituent and may have been a hazardous waste.

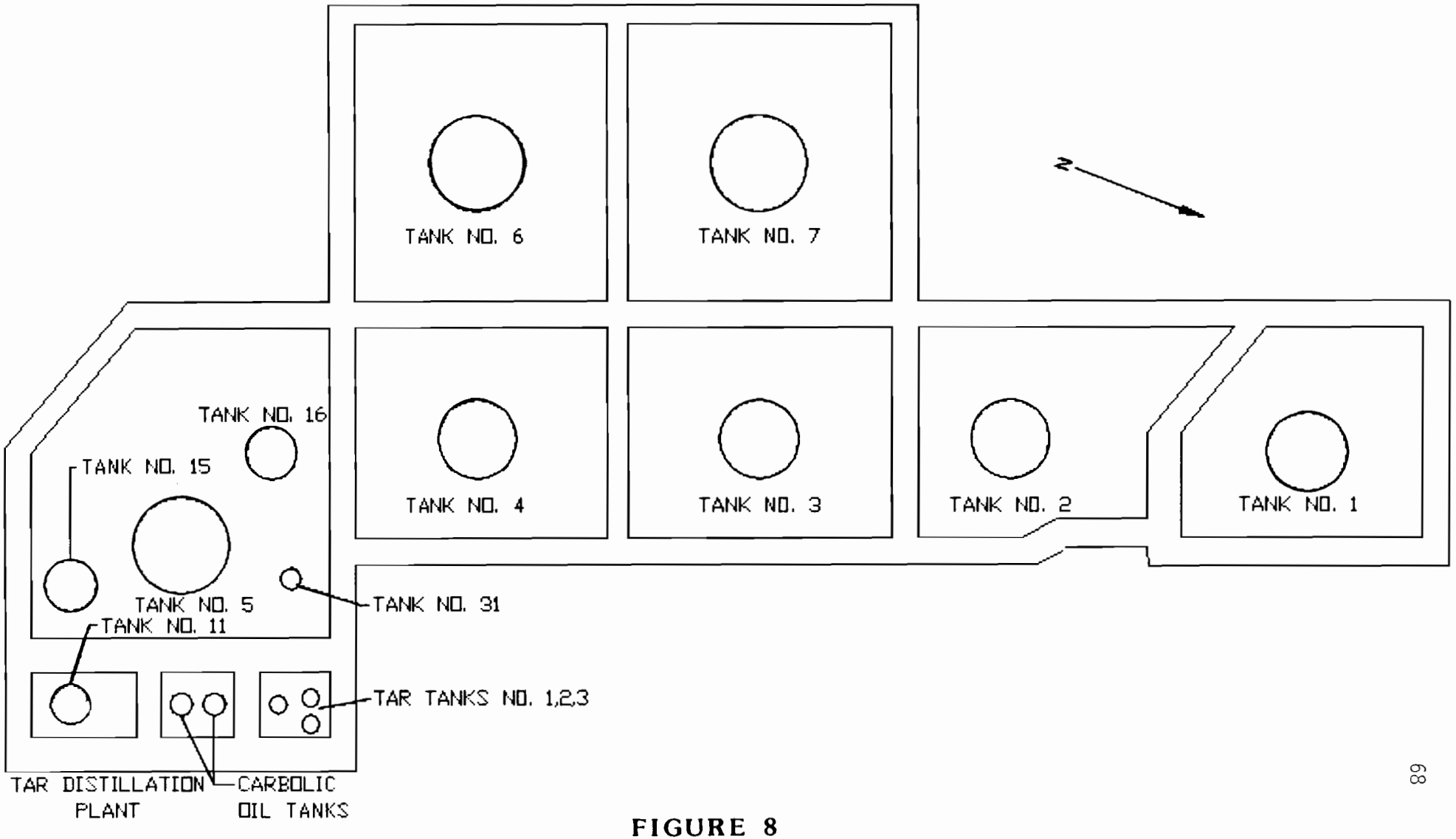

FIGURE 8

COAL TAR AND FUEL OIL STORAGE TANKS

Foundry

BSC operated a foundry at the Lackawanna Plant until about 1978, to cast iron, steel and brass parts for in-plant use. Wastes generated by the operation, including casting sand and binders, were disposed of in the slag fill area. One chemical used in the process, possibly as a cleaner or solvent, was Linoil 742 made by Ashland Chemical, which contains kerosene and mineral spirits.

Producer Gas

BSC has no site specific information on the producer gas building just west of open hearth shop No. 1. However, a 1959 BSC reference manual states that producer gas is a fuel made by passing air and steam continuously through the hot (coal or coke) fuel bed.* The gas was developed for firing open-hearth steel furnaces. BSC personnel indicated that the coal or coke ash from the process would have been disposed of in the slag fill area. Whether this waste stream contained hazardous constituents could not be determined.

Locomotive/Crane Repair, Vehicle Maintenance and Machine Shops

BSC operated several shops for maintaining vehicles and equipment. The primary wastes generated from these shops were oil, used tires and debris, which were disposed of in the slag fill area. In more recent years, the oil was taken by a recycler. Petroleum based oils typically contain hazardous constituents.

Electric Winding and Machine Shops

The electric windings and machine shops repaired motors and other electrical equipment for the Lackawanna Plant. Wastes from these shops included 1,1,1-trichloroethane (a listed hazardous waste - F001), used as a degreaser, Penetone 423, a water soluble degreaser and waste oil. These wastes were disposed of in the slag fill area; the trichloroethane was disposed of in drums.

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* *Reference Manual titled "Handling of Fuels, Hazardous Gases and Liquids" issued by the Bethlehem Steel Combustion Committee in January, 1959 and revised in 1970.*

Acetylene Generator Building

BSC has very limited information on the small acetylene generator building, which is just northeast of the sinter plant. Acetylene gas was, reportedly, produced by reacting calcium carbide with water. The spent carbide was probably taken to the slag fill area for disposal.

Lime Plant

The lime plant produced burnt lime for the BOF shop and was just west of it on the south side of Smoke Creek. The plant was built in about 1964 and had three rotating-table-type kilns for heating the limestone feedstock. Particulate air emissions from the kiln were trapped in a baghouse, which was installed in 1977. Lime dust from the baghouse was used in the BOF. Used refractory bricks from the lime plant were disposed of in the slag fill area. This waste stream is not expected to have contained hazardous constituents.

Oxygen Plant

The oxygen plant was just east of the BOF shop. It consisted of four units (numbered 1 through 4), which were owned and operated by the Linde Division of Union Carbide. Information on the units was provided by the Safety, Health and Environmental Affairs Department of the Linde Division in Danbury, Connecticut, in response to a request from NEIC.

The units were started up in 1957 and shutdown in November 1983. Unit 1 produced oxygen and nitrogen, units 2 and 3 produced oxygen only, and unit 4 produced oxygen and argon. The gases were produced from atmospheric air through compression, purification, and distillation.

The units produced wastewater, which consisted of cooling tower blowdown, coolers backwash water, and condensate from intercoolers, moisture separation equipment and steam lines. The wastewater was discharged to Smoke Creek through a permitted outfall [State Pollutant Discharge Elimination System (SPDES) Permit No. NYD0000205]. The information provided does not indicate whether hazardous constituents were

present in the discharge; however, the permit had a limitation for total chromium and organics.

Other wastes included spent degreasing solvent (1,1,1-trichloroethane), mineral spirits, oil, cooling tower sludge, and trash. These wastes were reportedly shipped offsite for disposal. The plant had a RCRA generator identification number (NYD000706226) for shipping hazardous wastes offsite.

SOLID WASTE MANAGEMENT UNITS

More than 100 solid waste management units (SWMUs) suspected of containing hazardous waste or constituents were identified during the NEIC investigation. Those units are listed and described in this section. The SWMUs are in both the process and slag fill areas and include suspected deposits in water courses within the property boundary. Because of limited historical information on some site operations, additional SWMUs may exist at the site.

PROCESS AREA SWMUs

The process area SWMUs are listed in Table 12 and shown on Figure 9. Most of these and the waste streams they received are discussed in the Process Analysis and Waste Management section of this report. The areas not previously discussed and those needing supplemental explanations are as follows:

- Coke Quench Stations (Map No. P-1 through 5)

  The coke quench station settling pits were included as SWMUs because they received water containing hazardous constituents. Of primary concern are quench stations A and North because they are being used to manage wastewaters from the final coolers and ammonia sulfate crystalizer. Hazardous constituents present in the final cooler and ammonia sulfate crystalizer wastewater include: benzene, naphthalene, and phenolic compounds.

- Abandoned Lime Settling Basin (Map No. P-7)

  A lime settling basin on the south side of liquor storage tank No. 4 was used to collect ammonia still lime sludge. The settling basin is shown on a BSC drawing (No. 48591). The drawing indicates the pit was to be abandoned. Company officials did not know the date of construction of the existing settling basin nor the date of abandonment of the original settling basin. Ammonia still lime sludge is a listed hazardous waste.

Table 12

SOLID WASTE MANAGEMENT UNITS IN PROCESS AREAS
Bethlehem Steel Corporation - Lackawanna Plant

Map Number (Figure 9)	Area/Unit
	Coking Area
P-1	Quench water pit, North Station
P-2	Quench water pit, Arctic Station
P-3	Quench water pit, Central Station
P-4	Quench water pit, A-Station
P-5	Quench water pit, B-Station
P-6	Lime sludge settling basin
P-7	Abandoned lime settling basin
P-8	Waste oil storage tanks
P-9	Abandoned tar decanter sludge pits
P-10	Contam. soil in area near ball mill
P-11	Benzol plant tank storage area
P-12	Spill cleanup soil storage area
	Ironmaking
	WQCS No. 9 (Blast furnace scrubber water)
P-13	A to B primary thickener
P-14	C primary thickener
P-15	F to G primary thickener
P-16	H to J primary thickener
P-17	Final thickener
P-18	Cooling tower, hot and cold wells
	WQCS No. 3A (Sinter plant scrubber water)
P-19	Thickener
P-20	Scrubber sump
	Steelmaking
	WQCS No. 3 (BOF scrubber water)
P-21	North scalping tank
P-22	South scalping tank
P-23	Primary thickener
P-24	North clarifier
P-25	South clarifier
P-26	Cooling tower
P-27	Final thickener

Table 12 (cont.)

Map Number (Figure 9)	Area/Unit
	Hot Forming Mills
	WQCS No. 1 (Slabbing mill process water)
P-28	Main settling tank
P-29	Five sand filters
P-30	North (main) scale pit
P-31	South (trimmer) scale pit
P-32	Scarfer pit
	WQCS No. 2 (Bar mill process water)
P-33	10" and 12" mills scale pit
P-34	13" mill scale pit
P-35	Process water pit (pouring reel pit)
P-36	One sand filter
P-37	Treated water storage tank
	WQCS No. 4 (South mills process water)
P-38	Scale pit (54" mill)
P-39	Scale pit (48" mill)
P-40	Scale pit (14", 18", 28" and 35" mills)
P-41	Main settling tank
P-42	Five sand filters
	WQCS No. 5 (North mills process water)
P-43	Scale pit (44" mill)
P-44	Scale pit (40" mill)
P-45	Scale pit (36" mill)
P-46	Scale pit (32" mill)
P-47	Scale pit (30" mill)
P-48	Scale pit (21" mill)
P-49	Scarfer pit (44" mill)
P-50	Scarfer pit (40" mill)
P-51	Scarfer pit (30" and 21" mills)
P-52	Main settling tank
P-53	Seven sand filters
	WQCS No. 6 (Hot strip mill process water)
P-54	Runout table spray water pit
P-55	Scale pit
P-56	Main settling basin
P-57	Twenty-four sand filters

Table 12 (cont.)

Map Number (Figure 9)	Area/Unit
	WQCS No. 6 (cont.)
P-58	Bar Mill east acid sump (coil pickling area)
P-59	Bar Mill west acid sump (billet prep. area)
P-60	Bar Mill waste solution tank
P-61	Hot strip mill acid pit
P-62	Mill scale storage area 1
P-63	Mill scale storage area 2
P-64	Scale pit at 8" bar mill
	Cold Forming Mills
	WQCS No. 7
P-65	Tandem mill sump
P-66	Pickling rinse water pit
P-67	Spent pickle liquor pit
P-68	Galvanizing mill sump
P-69	Main treatment tank and assoc. facil.
P-70	Waste oil storage tank
P-71	Pump station wet well for old acid sewer line from galvanizing mill
P-72	Galvanizing mill sump sludge storage area
P-73	Drum storage area east of cold strip mill
	Support Operations
P-74	Waste storage piles (tar and fuel tank bottoms mixed with coke breeze)
P-75	Tank storage area for No. 6 fuel oil and petroleum tars

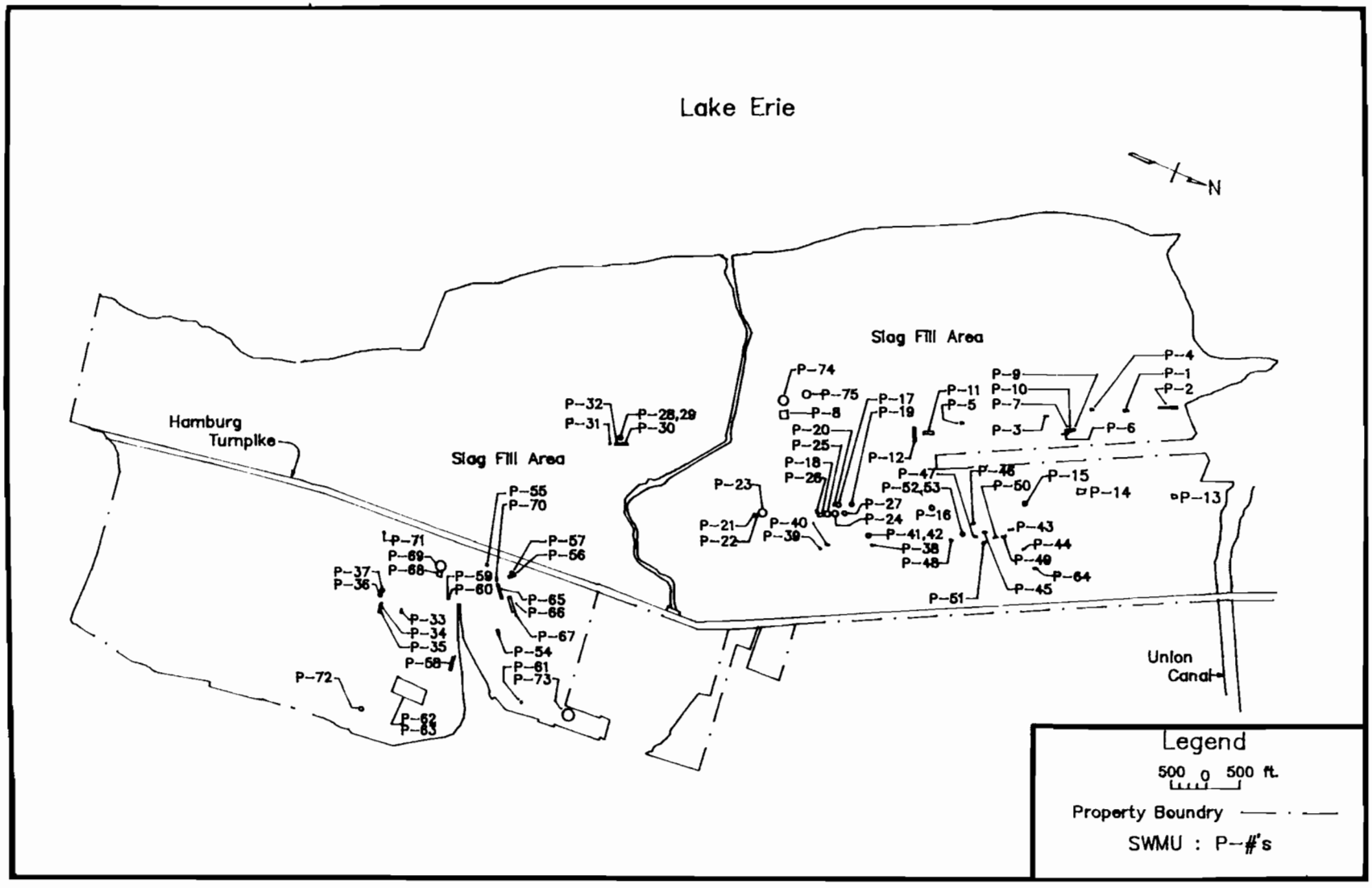

FIGURE 9

PROCESS AREA SOLID WASTE MANAGEMENT UNITS

- Waste Oil Storage Tanks (Map No. P-8)

  Two storage tanks located in the coal tar distillation plant contain waste oil. The waste oil was approximately 18 to 24 inches deep in what were estimated to be 20,000-gallon-capacity tanks. These are above-grade, vertical tanks previously used for storing carbolic oil from the tar distillation plant. According to Company officials, this was a petroleum waste oil being temporarily stored in the tanks. Hazardous constituents present in petroleum based oils include benzene and naphthalene.

- Abandoned Decanter Tar Sludge Pit(s) (Map No. P-9)

  A tar pit(s) adjacent to the tar decanters was used for tar sludge prior to the ball mill operation. A BSC drawing (No. 48591*) shows a structure that was to be abandoned. According to Company officials, it was filled and covered. Decanter tar sludge is a listed hazardous waste.

- Tar Decanter Sludge Contaminated Area (Map No. P-10)

  The ground area around the tar sludge ball mill may be contaminated with tar and sludge as result of routine spillage during operation of the mill. The ball mill has been operated since 1960. Tar decanter sludge is a listed hazardous waste.

- Benzol Plant Tank Storage Area (Map No. P-11)

  The ground around the tanks in the benzol plant product storage area was stained, and according to Company officials had received routine releases during product transfer operations. The area includes storage tanks 1 to 17. Hazardous constituents present in the light oil include: benzene, toluene, and naphthalene.

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* *Drain Piping at Lime Settling Basin: Drawing #48591, revised August 1976; Wilputte Coke Oven Division.*

- Spill Cleanup Storage Area (Map No. P-12)

  Contaminated soil, from a 5,000-gallon spill of petroleum wash oil in 1987, was collected and piled on a liner. The pile is located in the area previously occupied by light oil storage tanks 18 to 31. Hazardous constituents likely present in the wash oil include benzene, toluene, and naphthalene.*

- Mill Scale Storage Areas (Map No. P-62 and P-63)

  The oily mill scale is stored on unlined ground and may release contaminants to it. The mill scale has alternately been a waste and a recyclable material. Hazardous constituents present in petroleum-based oils include benzene and naphthalene.

- Waste Oil Storage Tank At Cold Strip Mill (Map No. P-70)

  Waste oil from the tandem mill sump is piped to this tank for temporary storage. Hazardous constituents present in petroleum based oils typically contain hazardous constituents.

- Drum Storage Area At Cold Strip Mill (Map No. P-73)

  The drum storage area, as identified by BSC personnel, was listed as an SWMU because of stained soil in the southeastern portion. The identity of the material causing the stain was unknown; however chemicals used in the mills, such as oils, were stored there.

- Waste (Fuel) Storage Piles (Map No. P-74)

  The ground beneath the tar fuel piles may contain hazardous constituents leached from the coal tar into the ground. Hazardous constituents present in coal tar include: coal tar, cresol, benzene, toluene, naphthalene, and phenolic compounds.

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* *Spill Report: May 19, 1987; W.T. Birmingham, BSC to Bruce Wager, NYDEC*

- Tar and Fuel Oil Storage Tank Area (Map No. P-75)

  BSC personnel stated that spills of coal tar and petroleum products have occurred in the storage tank area. Because these materials contain hazardous constituents, the area was identified as a, SWMU. In addition, a BSC drawing dipicting historical Lake Erie shorelines* indicates substantial buildup of the area beneath the storage tanks (relative to other areas) between 1900 and 1929. Wastes disposed there may contain hazardous constituents.

SLAG FILL AREA SWMUs

The slag fill area of the BSC plant has been used for waste disposal since iron and steel making operations began in about 1900. Wastes containing hazardous constituents are potentially present throughout the entire fill area. SWMUs identified in the slag fill area [Table 13 and Figure 10] include only units or areas discernible on the ground and/or in aerial photographs. The boundaries of the areas were taken, in most cases, directly from aerial photographs using electronic methods (computer and digitizing pallet). Some of the general disposal area boundaries were poorly defined. Consequently, the boundaries shown on Figure 10 for such areas are approximate.

The principal hazardous waste streams historically generated by the Lackawanna Plant include tar decanter sludge, ammonia still lime sludge and pickling liquor. The tar and ammonia still lime sludges were disposed of in discernible units beginning in about 1970, which indicates about 50 years of disposal in non-discernible units. Pickling liquor was discharged to surface water until about 1970; however, some went into a surface impoundment beginning in the late 1950s.

The suspected presence of hazardous waste or constituents in most of these units is supported by BSC and effluent guidelines development document

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* *Drawing submitted by BSC as Appendix I-1 to the September I986 3007 letter response to EPA. Drawing is titled "Shoreline Changes 1900-1986 Bethlehem Steel Corporation Lackawanna Site" and was prepared by Environmental Resource Managers, Inc. of West Chester, Pa.*

APPENDICES

A AERIAL PHOTOGRAPHS REVIEWED DURING NEIC INVESTIGATION

B GROUNDWATER MONITORING DATA

APPENDIX A

AERIAL PHOTOGRAPHS REVIEWED DURING NEIC INVESTIGATION

Table 13

SOLID WASTE MANAGEMENT UNITS IN THE SLAG FILL AREA
Bethlehem Steel Corporation - Lackawanna Plant

Map No. (Figure 10)	Unit	Waste Streams Received
S-1	Surface impoundment A	Sludges from WQCS Nos. 1, 2, 4, 5 and 6, and waste oil from plant operations*
S-2	Surface impoundment B	Sludge from final thickener and WQCS No. 7*
S-3	Surface impoundment C	Sludges from BOF and blast furnace final thickeners, WQCS Nos. 3a, and 9, cooling tower hot well, and ammonia still lime sludge. Probably also received dredged material from Smoke Creek*
S-4	Surface impoundment D	Dredged material from Smoke Creek
S-5	Surface impoundment E	Sludge from WQCS Nos. 1,2,4,5 and 6, and waste oil from plant operations*
S-6	Surface impoundment F	Sludge from BOF final thickener and WQCS No. 7*
S-7	Surface impoundment G	Sludge from BOF final thickener and WQCS No. 7*
S-8	Surface impoundment H	Not used**
S-9	Waste pile I	Blast furnace slag
S-10	Slag quench area J	BOF slag, weak ammonia liquor and benzol plant wastewater
S-11	Landfill K	Spent pickle liquor, discarded drums from plant operations, open hearth precipitator dust, and lime dust

Table 13 (cont.)

Map No. (Figure 10)	Unit	Waste Streams Received
S-12	Asbestos landfill L	Asbestos from building demolition
S-13	Coal tar sludge impoundment M	Tar decanter sludge, acid tar sludge, slag
S-14	General rubble landfill N	Discarded material from plant operations
S-15	General rubble landfill O	Discarded material from plant operations
S-16	Spent pickle liquor sludge landfill P	Spent pickle liquor
S-17	Vaccuum carbonate blowdown landfill Q	Spent carbonate solution from hydrogen sulfide stripper
S-18	Lime dust and kish landfill R	Lime dust and carbon fines
S-19	Murphy's mountain landfill AA	Discarded material from plant operations
S-20	Drying area for sludge from impoundment F	Sludge from BOF final from thickener and WQCS No. 7*
S-21	Sludge storage area	WQCS No. 3 sludge
S-22	Vaccuum carbonate blowdown impoundment south of Smoke Creek	Spent carbonate solution from hydrogen sulfide stripper
S-23	Tar pit adjacent to spent pickle liquor landfill	Acid tar wastes from coking operation, tar tank cleanings and coke breeze
S-24	Tar pit north of lime plant	Tar waste from coking operation

Table 13 (cont.)

Map No. (Figure 10)	Unit	Waste Streams Received
S-25	Landfill/impoundment under north end of coal pile	Unspecified wastes
S-26	Fill area near Coke Battery No. 8	Unspecified wastes
S-27	Sludge disposal area	Sludge from impoundment A
S-28	Drum landfill	Unspecified wastes
S-29	Drum landfill	Unspecified wastes

* *May contain wastes normally put in other impoundments.*

** *Identified as an SWMU because dikes were constructed, in part, from the fine fraction of plant debris segregated from the coarse fraction and BOF slag through the slag recovery operation in the northern part of the slag fill area. Because plant debris is suspected of containing hazardous constituents, the material used to construct the impoundment dikes may be contaminated.*

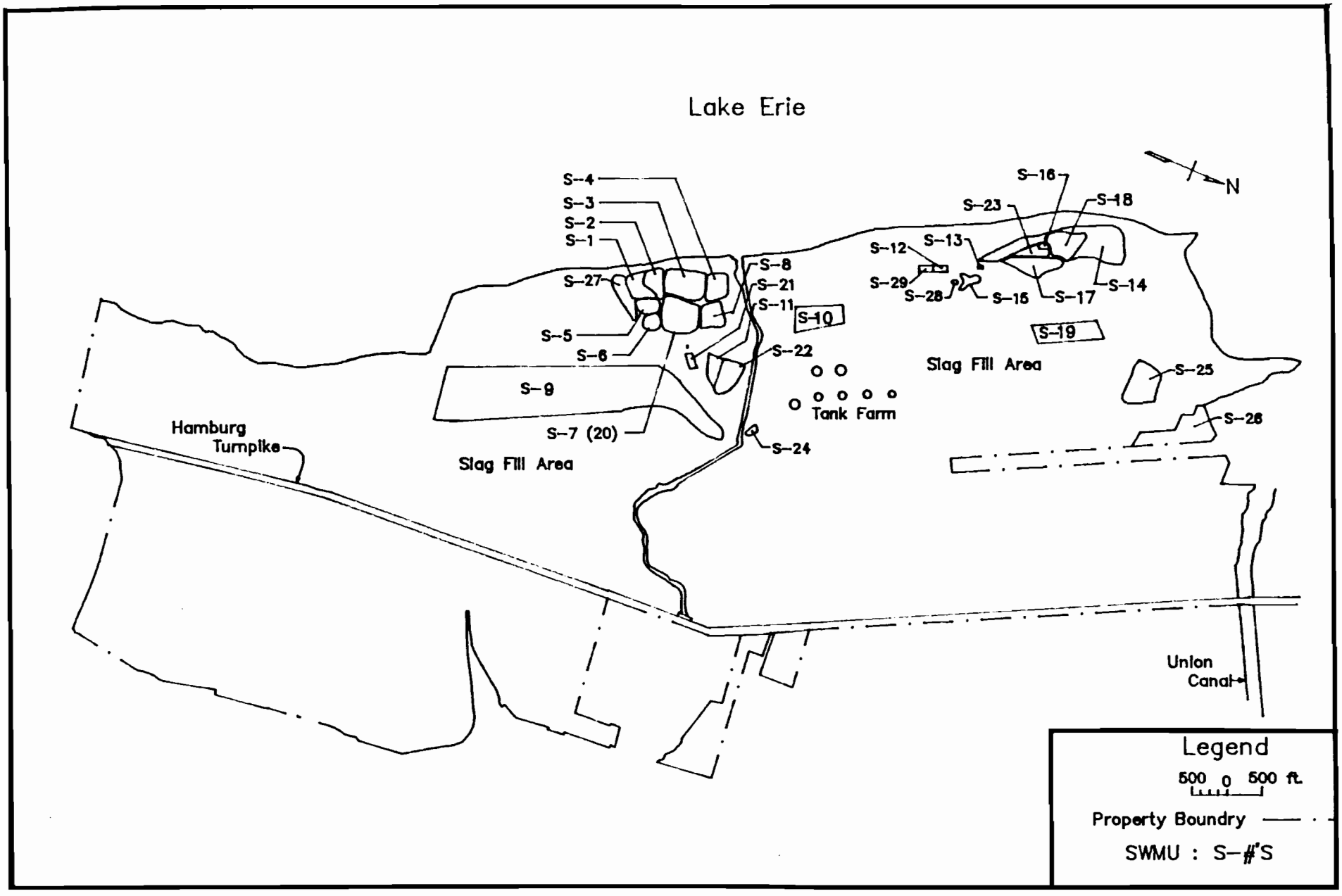

FIGURE 10

SLAG FILL AREA SOLID WASTE MANAGEMENT UNITS

information, which is discussed in the previous section of this report. The letter designations given to some units (e.g., surface impoundment A) were previously assigned by BSC personnel; they are included here for cross-reference to various Company reports.

Several of the identified SWMUs, such as the asbestos landfill (Map No. S-12), general rubble landfills (Map Nos. S-14 and S-15) and others were included because process wastes were routinely co-disposed with other wastes (debris, etc.). For example, most production areas had waste bins that "anything and everything" was dumped into for subsequent disposal in the slag fill area. These materials could have included waste oils, solvents, chemicals containing hazardous constituents and the listed hazardous wastes. Several BSC documents indicated that tar sludges were used as "binder" for rubble fill. Furthermore, the waste haulers (plant services personnel), reportedly, did not always take waste to the designated disposal site.

The dikes of surface impoundment H (Map No. S-8), which was never used, were constructed, in part, of fine materials screened from general plant rubble and slag. Consequently, it is identified as an SWMU. Supplemental information for six other units is presented in the following:

- Waste Pile I (Map No. S-9)

  Waste pile I is bounded on the east by the projected 1900 shore line (derived from a BSC shoreline map previously referenced) and on the west by the 1938 shore line. The area of waste pile I and west to Lake Erie is primarily blast furnace slag as indicated by the aerial photographs and descriptions of site activities by BSC personnel. The slag is being used for a variety of commercial purposes (such as road construction).

  Use of the slag for these purposes began in about 1940. After that date, disposal of wastes identified as containing hazardous constituents, such as tarry wastes, would probably have interferred with the recovery process. Before about 1940, however, any waste could have been potentially put in the area, including those

containing hazardous constituents. Furthermore, the land area available for waste disposal was fairly limited. As a result, the portion of the slag fill area active between about 1900 and 1940 is identified as an SWMU.

- Tar Pit north of Lime Plant (Map No. S-24)

The tar pit identified by map number S-24 is visible in a 1938 aerial photograph and, currently, as a tar seepage area. Coke plant personnel stated that the pit may have been used for acid tar sludge. The size of the pit could not be accurately determined from the photograph.

- Landfill/Impoundment Under Coal Pile (Map No. S-25)

Aerial photographs taken in 1951, 1955 (approximate date) and 1959 show pits, containing dark material, west of the north end of coke battery 8. The pit area is within the present coal pile area. The material in the pits is suspected to be coking wastes because of the proximity to the coke batteries. As discussed in the Coal Processing section of this report, most of the coking and by-product plant wastes contain hazardous constituents.

- Fill area near Coke Battery No. 8 (Map No. S-26)

The bank area at the northwest corner of the ship canal was filled sometime between 1938 and 1951. The 1938 aerial photograph shows a channel going from the coking area to the area subsequently filled. The water in the area where the channel flow enters the ship canal appears much darker than the rest of the water in the canal. If the channel carried process water, contaminated sediments near the outfall in the fill area would be expected. Also, the nature of the material used to fill in the area is unknown. For these reasons, the fill area was identified as an SWMU.

- Drum Landfill (Map No. S-29)

  A BSC aerial photograph dated September 30, 1981, first shows an excavation that appears to be a southward extension of the tar decanter sludge landfill. The excavation is observable in two subsequent BSC aerial photographs, dated April 2, 1982 and September 30, 1982. Company officials stated that the pit was excavated for tar sludge but that it was backfilled with excavated material and, to their knowledge, never used. A few drums can be seen in the southwest corner of the excavation in the September 1982 photograph. For this reason, the area is identified as an SWMU.

WATER COURSES

Six water courses within the boundaries of the Lackawanna plant [Table 14 and Figure 11] have received discharges that contained or potentially contained hazardous waste or constituents. Settled material in these water courses may contain these compounds and may be releasing them to the environment.

Two of the water courses, Smoke Creek and the Ship Canal, have been dredged to remove excess sediment; however the extent of dredging could not be determined. Dredgings from Smoke Creek were disposed of primarily in surface impoundment D, which was constructed in about 1970, with some overflowing into surface impoundment C, as discussed above. The Ship Canal was dredged by the U. S. Corps of Engineers at the expense of BSC in 1971, 1974, 1977 and 1981. The dredged material was taken to the diked area adjacent to the north end of the slag fill area (Disposal Area No. 2).

Table 14

WATER COURSES AND INFLUENT WASTE STREAMS
Bethlehem Steel Corporation - Lackawanna Plant

Water Course	Influent Waste Streams
Blasdell Creek	Waste pickle liquor, oil
South return water trench	Blast furnace scrubber discharges, effluents from mill settling pits, and WQCS Nos. 3, 3A, and 4
North return water trench	Blast furnace scrubber water discharges and WQCS No. 5 effluent
Slabbing mill return water trench	Discharge from WQCS No. 1
Smoke Creek	Waste pickle liquor, oil, cleaning coating solutions from the galv. mill, settling pit overflows from the cold strip, hot strip and bar mills, south and slabbing mill return water trenches and Effluents from WQCS Nos. 2, 6 and 7
Ship Canal	Various contaminated coking wastes, blast furnace wastes, effluents from WQCS No. 9

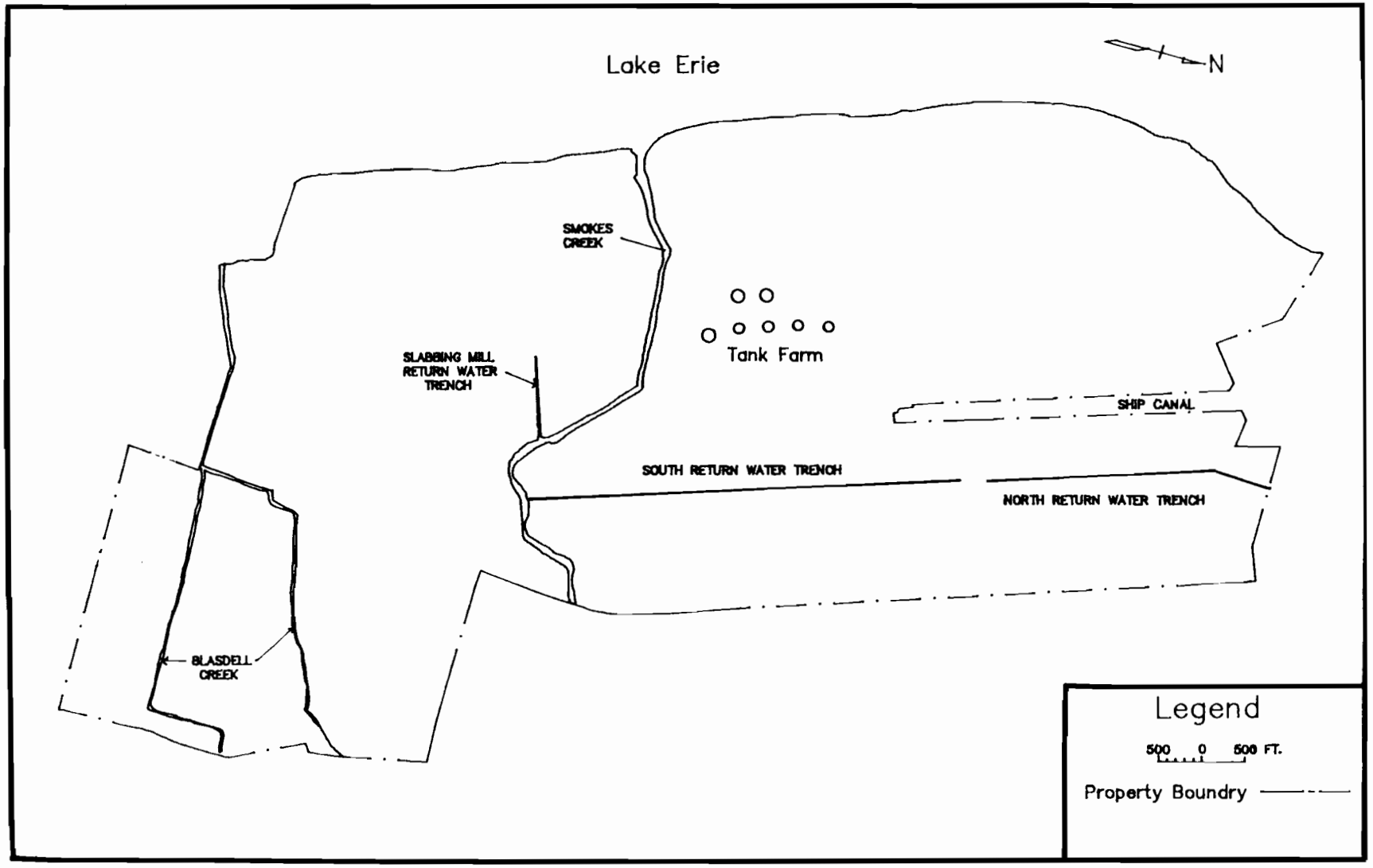

FIGURE 11

WATER COURSES

INDICATION OF WASTE RELEASES FROM SOLID WASTE MANAGEMENT UNITS

During the NEIC investigation, groundwater monitoring data were reviewed in conjunction with other information for indictions of waste releases from the SWMUs identified in the previous section of this report. A release means any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment, but excluded releases otherwise permitted under law.*

The data reviewed revealed the presence of hazardous constituents in groundwater beneath the slag fill area that are also present in both the process wastes generated at the Lackawanna Plant and the SWMUs. Although the data indicate that a release has occurred, the information is not sufficient for determining the specific source(s) of the hazardous constituents detected. No analytical data are available to indicate whether there have been releases from SWMUs in the process areas; however, because wastes containing hazardous constituents were placed directly on the ground, the potential for release is high from several process area SWMUs.

Monitoring wells were installed adjacent to the three hazardous waste management units in 1985 [Table 15 and Figure 12], in response to a Consent Order between EPA Region II and BSC. A RCRA detection monitoring program was then initiated on the wells. Statistical evaluation of the detection monitoring data triggered a groundwater quality assessment program. The program was implemented during the fall of 1987 and a final report was submitted to EPA and NYSDEC in March 1988. The report indicated that additional site investigation was necessary.

Data presented in the assessment program report** [Appendix B] indicate that hazardous constituents such as benzene, naphthalene, phenol compounds, and several chlorinated solvents were present in groundwater samples

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* *Neither the RCRA statute nor the promulgated regulations present a "release" definition EPA policy is to use the definition presented in Section 101(22) of the Comprehensive Environmental Response, Liability and Compensation Act (CERCLA).*

** *"Groundwater Quality Assessment Plan, Bethlehem Steel Corporation, Final Report," dated March 1988, prepared by Ecology and Environment, Inc., Lancaster, NY.*

Table 15

CONSTRUCTION DETAILS FOR MONITORING WELLS*

Monitoring Well	Date Installed	Bottom of Screen (ft.)	Screen Length (ft.)	Sand-Pack Length (ft.)	Bentonite Seal Length (ft.)
MW-1D1	2/21/85	43	10	13	26.5
MW-1D2	2/05/85	45	10	14.5	22.5
MW-1D3	2/13/85	44	10	14	22
MW-1D4	1/31/85	42.5	10	15	21.5
MW-1U1	3/27/84	64.5	30	38.5	19
MW-2D2	3/08/85	63	10	12.5	44
MW-2D3	3/26/85	66.5	10	12.5	47.5
MW-2D4	3/20/85	60.5	10	12.5	41.5
MW-2U1	3/06/85	60	10	12.5	41

* *Details common to all wells*

Wells are constructed of 5" schedule 40 PVC.
Well screens are 5" PVC No. 10 (0.010") slot with flush threaded joints fitted with a 5" PVC threaded cap.
Annular seals consist of about 5 feet of concrete grout overlying a bentonite and sand grout which overlies a 2-foot bentonite plug.

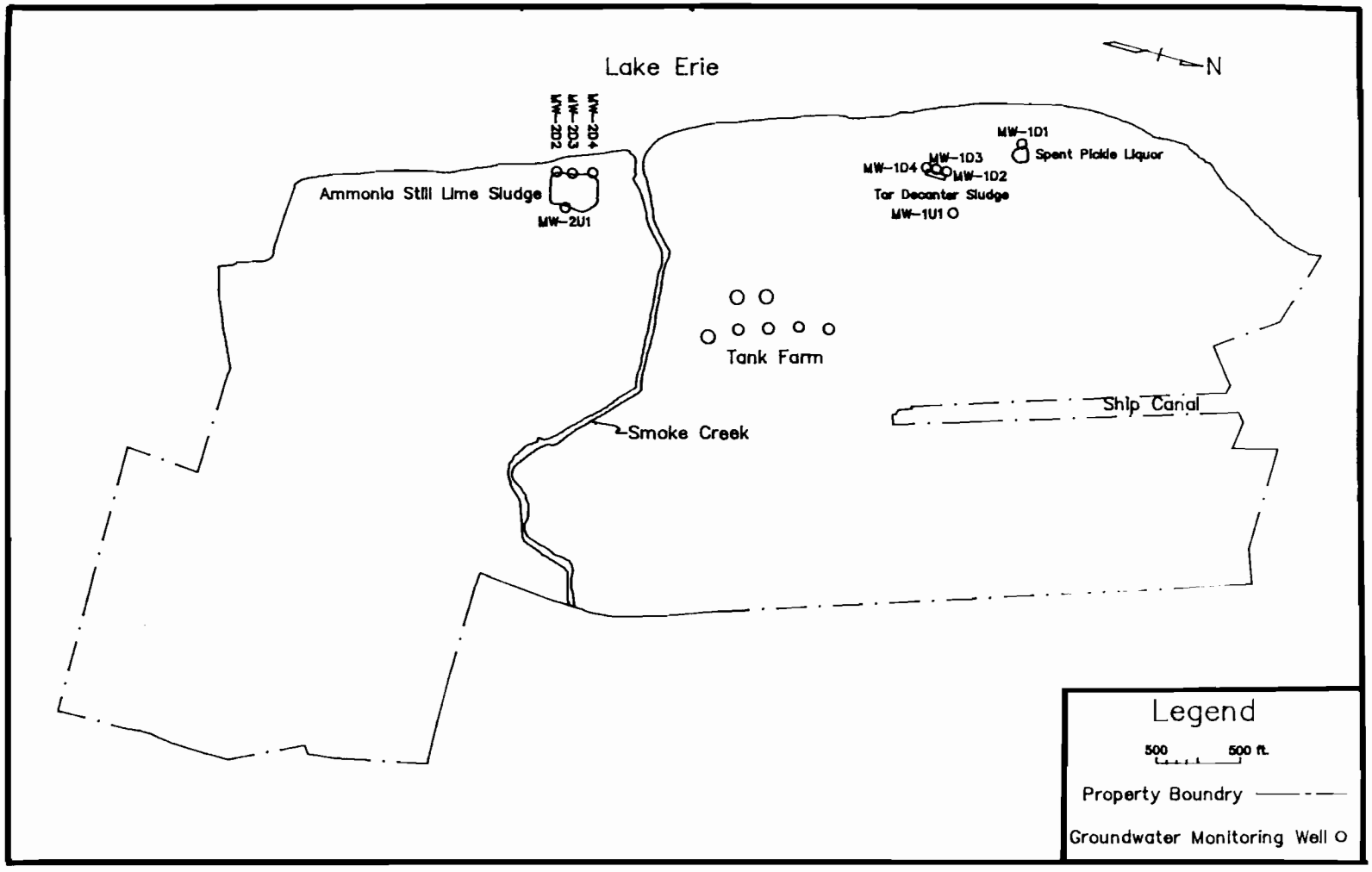

FIGURE 12

GROUNDWATER MONITORING WELLS

collected from wells in the slag fill area [Table 16]. In several cases, the chemicals were measured at higher concentrations in the samples from the wells upgradient from the regulated units. These compounds are present in several Lackawanna Plant waste streams, specifically, in coking wastes (including those from the by-product recovery operation), which have been disposed in the fill area since at least 1920.

Releases from wastes mixed with the slag or within the SWMUs would not be impeded either by the units or the slag. None of the SWMUs in the slag fill area are lined, so there is no barrier to prevent release into the slag. Permeability tests conducted on the slag fill material yielded relatively high values (equivalent to values for sand and gravel).*

At several of the process area SWMUs, wastes containing hazardous constituents have been placed directly on the ground, which constitutes disposal under RCRA, with no constructed barrier to prevent a release. Consequently, there is a high potential for a release from these units either with runoff or by leaching into groundwater. The units include the benzol plant product storage area, mill scale storage piles, storage area for dredgings on the east side of the galvinizing mill and tar waste/fuel mixture storage piles.

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* *"Summary Report, Monitoring Well Program, Lackawanna Plant, Bethlehem Steel Corporation," dated March 27, 1981, prepared by Dames and Moore, Cranford, NJ.*

Table 16

GROUND-WATER DATA MONITORING FROM RCRA WELLS*
Bethlehem Steel Corporation - Lackawanna Plant

Selected Parameters	Well:	MW-1U1			MW-1D1			MW-1D2			MW-1D3			MW-1D4		
	Date:	6/86	11/87	1/88	6/86	11/87	1/88	6/86	11/87	1/88	6/86	11/87	1/88	6/86	11/87	1/88
Benzene		<1	430	340	<1	9	8	<1	42	40	<1	57	40	<1	74	70
Toluene		<1	89	61	<1	7	9	<1	26	28	<1	22	20	<1	26	26
Naphthalene		<1	93	80	<1	<10*	<10*	<1	720E	220	<1	49	39	<1	62	50
Phenol		85	18	11	25	<10*	<10	540	130	73	155	74	36	220	110	73
2,4-Dimethylphenol		<10	16	16	<10	<10	<10	50	28	20	40	<10*	<10*	50	13	11

Table 16 (cont.)

GROUND-WATER DATA MONITORING FROM RCRA WELLS*

Selected Parameters	Well:	MW-2U1			MW-2D2			MW-2D3			MW-1D3		
	Date:	6/86	11/87	1/88	6/86	11/87	1/88	6/86	11/87	1/88	6/86	11/87	1/88
Trans-1,2-Dichloroethene		<1	17	12	<1	<5	<5	<1	<5	<5	<1	<5	<5
Trichloroethene		<1	36	32	<1	<5	<5	2	<5	<5	<1	<5	<5
Benzene		<1	23	28	<1	<5*	<5	<1	31	39	<1	41	18
Toluene		<1	16	16	<1	<5*	<5*	<1	31	27	<1	46	19
Ethylbenzene		<1	14	12	<1	<5*	<5*	<1	12	11	<1	15	<5*
Naphthalene		<1	570E	180	<1	<10*	<10	<1	210	160	<1	290	150
Phenol		45	21	<10*	10	<10*	<10	45	<10*	<10	10	<10*	<10*
2,4-Dimethylphenol		<10	46	23	<10	<10*	<10	10	<10*	<10*	<10	<10*	<10*

* *Results in µg/L*
** *Compound present below measurable detection limit.*
E Estimated Value

(Source: Groundwater Quality Assessment Report, dated January 1988 and prepared by Ecology and Environment)

APPENDIX A
AERIAL PHOTOGRAPHS REVIEWED DURING NEIC INVESTIGATION

Date	Source	Frame Number(s)	Area Covered
8/38	EPA/EPIC*	-	Whole plant
8/38	EPA/EPIC	-	North end of plant and area to north
4/42	EPA/EPIC	-	Whole plant
4/42	EPA/EPIC	-	North end of plant and area to north
10/51	EPA/EPIC	-	Whole plant
10/51	EPA/EPIC	-	North end of plant and area to north
~1955	BSC**	-	Whole plant
5/59	EPA/EPIC	ARF6V16	Area north of plant
5/59	EPA/EPIC	ARF6V18	Northern part of plant
5/59	EPA/EPIC	ARF6V20	Southern part of plant
5/63	EPA/EPIC	-	Whole plant
5/63	EPA/EPIC	-	North end of plant and area to north
6/66	EPA/EPIC	ARF1GG159	Southern 2/3 of plant
6/66	EPA/EPIC	ARF1GG161	Northern 1/2 of plant
8/69	BSC	-	Whole plant
10/70	EPA/EPIC	51-0065	Whole plant
4/72	BSC	11371-18	S. of Smoke Creek in SFA
4/72	BSC	11371-31	N. of Smoke Creek in SFA
9/72	EPA/EPIC	-	Whole plant
9/72	EPA/EPIC	-	North end of plant and area to north
4/73	BSC	11897-11	N. of Smoke Creek in SFA
4/73	BSC	11897-13	N. of Smoke Creek in SFA
4/74	EPA/EPIC	-	Whole plant
4/74	EPA/EPIC	-	North end of plant and area to north
4/75	BSC	13101-06	N. of Smoke Creek in SFA
4/75	BSC	13101-09	S. of Smoke Creek in SFA
7/75	BSC	13319-03	N. of Smoke Creek in SFA

APPENDIX A (cont.)

Date	Source	Frame Number(s)	Area Covered
4/76	BSC	136683-10	N. of Smoke Creek in SFA
4/76	BSC	136683-12	N. of Smoke Creek in SFA
4/76	BSC	136683-14	N. of Smoke Creek in SFA
10/76	BSC	14001-05	N. of Smoke Creek in SFA
4/77	BSC	14296-01	N. of Smoke Creek in SFA
4/77	BSC	14296-03	N. of Smoke Creek in SFA
4/77	BSC	14296-13	S. end of Ship Canal and adj. process areas
4/77	BSC	14296-22	BOF and slabbing mill
4/77	BSC	14296-27	S. of Smoke Creek in SFA
8/77	BSC	14548-06	N. of Smoke Creek in SFA
8/77	BSC	14548-08	N. of Smoke Creek in SFA
3/78	BSC	15101-16	N. of Smoke Creek in SFA
3/78	BSC	15101-18	N. of Smoke Creek in SFA
3/78	BSC	15101-22	S. of Smoke Creek in SFA
6/78	EPA/EPIC	-	Northern part of plant
6/78	EPA/EPIC	-	Southern part of plant
8/78	EPA/EPIC	-	Whole plant
8/78	EPA/EPIC	-	North end of plant and area to north
9/78	BSC	15481-04	N. of Smoke Creek in SFA
4/79	BSC	15922-08	N. of Smoke Creek in SFA
4/79	BSC	15922-10	N. of Smoke Creek in SFA
4/80	BSC	16685-02	N. of Smoke Creek in SFA
4/80	BSC	16685-03	N. of Smoke Creek in SFA
9/80	BSC	17041-03	N. of Smoke Creek in SFA
9/80	BSC	17041-14	N. of Smoke Creek in SFA
9/80	BSC	17041-18	S. of Smoke Creek in SFA
9/80	BSC	-	Area south of Smoke Creek
9/80	BSC	-	Whole plant
4/81	BSC	17337-22	S. end SFA, N. of Smoke Cr
8/81	EPA/EPIC	1651609	Southern portion of plant
8/81	EPA/EPIC	1651610	Northern portion of plant
9/81	BSC/EPAII***	17561-11	N. of Smoke Creek in SFA
9/81	BSC/EPAII	17561-15	S. of Smoke Creek in SFA

APPENDIX A (cont.)

Date	Source	Frame Number(s)	Area Covered
4/82	BSC/EPAII	17808-04	N. of Smoke Creek in SFA
4/82	BSC/EPAII	17808-08	S. of Smoke Creek in SFA
4/82	BSC	17808-10	
4/82	BSC	17808-12	
4/82	BSC	17808-14	
9/82	BSC/EPAII	18013-20	N. of Smoke Creek in SFA
9/82	BSC/EPAII	18013-24	S. of Smoke Creek in SFA
3/83	EPA/EPIC	-	Whole plant
3/83	EPA/EPIC	-	North end of plant and area to the north
mid-84	BSC/EPAII		N. of Smoke Creek in SFA
mid-84	BSC/EPAII	-	S. of Smoke Creek in SFA
9/87	BSC	-	N. half of plant
9/87	BSC	-	S. half of plant

* *Photograph provided by U.S. Environmental Protection Agency/Environmental Photographic Interpretation Center*

** *Photograph provided by Bethlehem Steel Corporation*

*** *Photograph provided by BSC to EPA Region II*

APPENDIX B

GROUNDWATER MONITORING DATA

GROUNDWATER QUALITY ASSESSMENT PLAN BETHLEHEM STEEL CORPORATION FINAL REPORT

March 1988

Prepared for:

BETHLEHEM STEEL CORPORATION
2603 Hamburg Turnpike
P.O. Box 310
Lackawanna, New York 14218-0310

ecology and environment, inc.
BUFFALO CORPORATE CENTER
368 PLEASANTVIEW DRIVE, LANCASTER, NEW YORK 14086, TEL. 716/684-8060
International Specialists in the Environment

APPENDIX A

TABULATED ANALYTICAL RESULTS

Table A-1

JANUARY 1988 FIELD DATA

Station	Time (Hrs.)	Well	HNU (ppm)	Ground-water Elevation (Ft.)*	Temp. (°F)	pH_1	pH_2	pH_3	pH_4	Cond. 1 x 10^3	Cond. 2 x 10^3	Cond. 3 x 10^3	Cond. 4 x 10^3	Avg. pH (S.U.)	Avg. Cond. x 10^3
1	08:30	MW-1U1	<1	574.23	54.9	11.8	11.41	11.39	11.31	2.13	2.76	2.84	2.14	11.48	2.47
2	10:50	MW-1D1	<1	575.32	59.8	7.32	7.28	7.06	7.01	11.33	11.22	11.23	11.24	7.17	11.26
3	11:40	MW-1D2	<1	573.57	60.0	11.66	11.62	11.64	11.61	2.89	2.89	2.89	2.85	11.63	2.88
4	12:05	MW-1D3	<1	574.14	59.5	11.56	11.59	11.58	11.58	3.01	3.01	3.04	3.00	11.58	3.02
5	12:45	MW-1D4	<1	573.64	59.3	11.48	11.51	11.50	11.49	2.75	2.74	2.74	2.73	11.50	2.74
6	13:10	MW-1D4	<1	573.64	60.1	11.50	11.51	11.53	11.53	2.74	2.74	2.74	2.74	11.52	2.74
7	14:45	MW-2U1	<1	574.86	60.4	22.62	11.62	11.67	11.71	4.20	4.19	4.19	4.19	11.66	4.19
8	15:35	MW-2D2	<1	573.82	60.3	9.64	9.66	9.69	9.67	2.38	2.38	2.38	2.38	9.67	2.38
9	16:20	MW-2D3	<1	573.94	60.4	10.33	10.37	10.39	10.46	2.41	2.41	2.40	2.41	10.39	2.41
10	16:50	MW-2D4	<1	574.11	60.9	10.38	10.42	10.42	10.42	2.55	2.55	2.55	2.55	10.41	2.55
11	--	Field Blank	<1	--	--	--	--	--	--	--	--	--	--	--	--

*These values were measured on February 24, 1988

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LABORATORY REPORT

FOR

BETHLEHEM STEEL CORPORATION
GROUNDWATER ASSESSMENT PLAN

U-7163

Job No.: U-7163			RE: BH6020			
Sample Date: 1/13/88			P.O. No.:			
Date Received: 1/13/88			Sampled By: E & E, Inc.			
Sample Type: Water			Delivered By: E & E, Inc.			
E & E Lab. No. 88-	14202	14203	14204	14205	14206	14207
Customer No.						
Sample Identity	MW-1U1	MW-1D1	MW-1D2	MW-1D3	MW-1D4	MW-1D4
	Results in: mg/L unless noted					
Antimony	<0.060	<0.060	<0.060	<0.060	<0.060	<0.060
Arsenic	0.018	0.016	<0.005	<0.005	<0.005	<0.005
Barium	0.126	0.206	0.060	0.078	0.084	0.086
Cadmium	<0.005	0.013	<0.005	<0.005	<0.005	<0.005
Calcium	246	2,100	298	312	246	266
Chromium	0.025	0.043	<0.010	<0.010	<0.010	<0.010
Lead	0.020	0.030	<0.005	0.008	<0.005	<0.005
Magnesium	9.25	56.9	0.102	0.467	0.131	0.108
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nickel	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Potassium	76.0	257	135	124	134	128
Selenium	<0.005	<0.005	0.010	0.010	0.010	0.012
Silver	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Sodium	94.5	47.5	88.4	88.8	89.0	88.7
Thallium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005

Analytical References:

"Methods for the Chemical Analysis of Water and Wastes," EPA-600/4-79-020, March 1983.

Supervising Analyst: [signature]

Date: 2/22/88

ecology and environment, inc.
International Specialists in the Environment

LABORATORY REPORT

FOR

BETHLEHEM STEEL CORPORATION
GROUNDWATER ASSESSMENT PLAN

U-7163.1

Job No.: U-7163			RE: BH 6020			
Sample Date: 1/13/88			P.O. No.:			
Date Received: 1/13/88			Sampled By: E & E, Inc.			
Sample Type: Water			Delivered By: E & E, Inc.			
E & E Lab. No. 88-	14208	14209	14210	14211	14212	
Customer No.						
Sample Identity	MW-2U1	MW-2D2	MW-2D3	MW-2D4	Field Blank	
	Results in: mg/L unless noted					
Antimony	<0.060	<0.060	<0.060	<0.060	<0.060	
Arsenic	<0.005	<0.005	<0.005	<0.005	<0.005	
Barium	0.066	0.042	0.059	0.080	<0.010	
Cadmium	<0.005	<0.005	<0.005	<0.005	<0.005	
Calcium	384	178	192	212	2.47	
Chromium	<0.010	<0.010	0.025	<0.010	<0.010	
Hexavalent Chromium	<0.010	<0.010	<0.010	<0.010	<0.010	
Lead	<0.05	0.008	0.015	0.006	<0.005	
Magnesium	0.418	3.06	1.21	13.0	<0.100	
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	
Nickel	<0.015	<0.015	<0.015	<0.015	<0.015	
Potassium	212	161	146	174	<0.50	
Selenium	0.019	<0.005	<0.005	<0.005	<0.005	
Silver	<0.010	<0.010	<0.010	<0.010	<0.010	
Sodium	252	245	240	243	0.270	
Thallium	<0.005	<0.005	<0.005	<0.005	<0.005	

Analytical References:

"Methods for the Chemical Analysis of Water and Wastes," EPA-600/4-79-020, March 1983.

Supervising Analyst: Gary Hahn III

Date: 3/1/88

QUALITY CONTROL FOR PRECISION
RESULTS OF ANALYSIS OF REPLICATE
ANALYSES OF WATER SAMPLES

U-7163.2

Parameter	E & E Laboratory No. 88-	(mg/L)		Relative Percent Difference (RPD)
		Original Analysis	Replicate Analysis	
Antimony	14204	<0.060	<0.060	--
	14212	<0.060	<0.060	--
Arsenic	14204	<0.005	<0.005	--
	14212	<0.005	<0.005	--
Barium	14204	0.060	0.061	2
	14212	<0.010	<0.010	--
Cadmium	14204	<0.005	<0.005	--
	14212	<0.005	<0.005	--
Calcium	14212	2.47	1.02	83
Chromium	14204	<0.010	<0.010	--
	14212	<0.010	<0.010	--
Hexavalent Chromium	14212	<0.010	<0.010	--
Lead	14204	<0.005	<0.005	--
	14212	<0.005	<0.005	--
Magnesium	14212	<0.100	<0.100	--
Mercury	14208	<0.0002	<0.0002	--

RESULTS OF WATER ANALYSIS FOR PRIORITY POLLUTANT
PURGEABLE ORGANIC COMPOUNDS BY GC/MS

(all results in ug/L)

U-7163.8

Compound	E & E Lab. No. 88-	14202	14203	14204	14205	14206
	Sample Identity	MW-1U1	MW-1D1	MW-1D2	MW-1D3	MW-1D4
chloromethane		<10	<10	<10	<10	<10
bromomethane		<10	<10	<10	<10	<10
vinyl chloride		<10	<10	<10	<10	<10
chloroethane		<10	<10	<10	<10	<10
methylene chloride		<5*	<5*	<5*	<5*	<5*
1,1-dichloroethene		<5	<5	<5	<5	<5
1,1-dichloroethane		<5	10	<5	<5	<5
trans-1,2-dichloroethene		<5	<5	<5	<5	<5
chloroform		<5	<5	<5	<5	<5
1,2-dichloroethane		<5	<5	<5	<5	<5
1,1,1-trichloroethane		<5	<5	<5	<5	<5
carbon tetrachloride		<5	<5	<5	<5	<5
bromodichloromethane		<5	<5	<5	<5	<5
1,2-dichloropropane		<5	<5	<5	<5	<5
trans-1,3-dichloropropene		<5	<5	<5	<5	<5
trichloroethene		<5	10	<5	<5	<5
chlorodibromomethane		<5	<5	<5	<5	<5
1,1,2-trichloroethane		<5	<5	<5	<5	<5
benzene		340	8	40	40	66
cis-1,3-dichloropropene		<5	<5	<5	<5	<5
2-chloroethylvinyl ether		<10	<10	<10	<10	<10
bromoform		<5	<5	<5	<5	<5
tetrachloroethene		<5	<5	<5	<5	<5
1,1,2,2-tetrachloroethane		<5	<5	<5	<5	<5
toluene		61	9	28	20	26
chlorobenzene		<5*	<5	<5	<5	<5
ethylbenzene		<5*	7	6	<5*	<5*

*Compound present below measurable detection limit.

RESULTS OF WATER ANALYSIS FOR PRIORITY POLLUTANT
PURGEABLE ORGANIC COMPOUNDS BY GC/MS

(all results in ug/L)

U-7163.9

Compound	E & E Lab. No. 88-	14207	14208	14209	14210	14211
	Sample Identity	MW-1D4	MW-2U1	MW-2D2	MW-2D3	MW-2D4
chloromethane		<10	<10	<10	<10	<10
bromomethane		<10	<10	<10	<10	<10
vinyl chloride		<10	<10	<10	<10	<10
chloroethane		<10	<10	<10	<10	<10
methylene chloride		<5*	9	<5*	5	7
1,1-dichloroethene		<5	<5	<5	<5	<5
1,1-dichloroethane		<5	5	<5*	<5*	<5
trans-1,2-dichloroethene		<5	12	<5	<5	<5
chloroform		<5	<5	<5	<5	<5
1,2-dichloroethane		<5	<5	<5	<5	<5
1,1,1-trichloroethane		<5	<5	<5	<5	<5
carbon tetrachloride		<5	<5	<5	<5	<5
bromodichloromethane		<5	<5	<5	<5	<5
1,2-dichloropropane		<5	<5	<5	<5	<5
trans-1,3-dichloropropene		<5	<5	<5	<5	<5
trichloroethene		<5	32	<5	<5*	<5
chlorodibromomethane		<5	<5	<5	<5	<5
1,1,2-trichloroethane		<5	<5	<5	<5	<5
benzene		70	28	<5	39	18
cis-1,3-dichloropropene		<5	<5	<5	<5	<5
2-chloroethylvinyl ether		<10	<10	<10	<10	<10
bromoform		<5	<5	<5	<5	<5
tetrachloroethene		<5	<5	<5	<5	<5
1,1,2,2-tetrachloroethane		<5	<5	<5	<5	<5
toluene		25	16	<5*	27	19
chlorobenzene		<5	<5	<5	<5	<5
ethylbenzene		<5*	12	<5*	11	<5*

*Compound present below measurable detection limit.

RESULTS OF WATER ANALYSIS FOR PRIORITY POLLUTANT
PURGEABLE ORGANIC COMPOUNDS BY GC/MS

(all results in ug/L)

U-7163.10

Compound	E & E Lab. No. 88-	14212	Method Blank			
	Sample Identity	Field Blank				
chloromethane		<10	<10			
bromomethane		<10	<10			
vinyl chloride		<10	<10			
chloroethane		<10	<10			
methylene chloride		6	6			
1,1-dichloroethene		<5	<5			
1,1-dichloroethane		<5	<5			
trans-1,2-dichloroethene		<5	<5			
chloroform		<5*	<5			
1,2-dichloroethane		<5	<5			
1,1,1-trichloroethane		<5	<5			
carbon tetrachloride		<5	<5			
bromodichloromethane		<5*	<5			
1,2-dichloropropane		<5	<5			
trans-1,3-dichloropropene		<5	<5			
trichloroethene		<5	<5			
chlorodibromomethane		<5	<5			
1,1,2-trichloroethane		<5	<5			
benzene		<5	<5			
cis-1,3-dichloropropene		<5	<5			
2-chloroethylvinyl ether		<10	<10			
bromoform		<5	<5			
tetrachloroethene		<5	<5			
1,1,2,2-tetrachloroethane		<5	<5			
toluene		<5	<5*			
chlorobenzene		<5	<5			
ethylbenzene		<5	<5			

*Compound present below measurable detection limit.

QUALITY CONTROL FOR PRECISION
RESULTS OF ANALYSIS OF REPLICATE
ANALYSES OF WATER SAMPLES

U-7163.11

Compound	E & E Lab. No. 88-14211	(ug/L)		Relative Percent Difference (RPD)
		Original Analysis	Replicate Analysis	
chloromethane		<10	<10	--
bromomethane		<10	<10	--
vinyl chloride		<10	<10	--
chloroethane		<10	<10	--
methylene chloride		7	7	0
1,1-dichloroethene		<5	<5	--
1,1-dichloroethane		<5	<5	--
trans-1,2-dichloroethene		<5	<5	--
chloroform		<5	<5	--
1,2-dichloroethane		<5	<5	--
,1,1-trichloroethane		<5	<5	--
carbon tetrachloride		<5	<5	--
bromodichloromethane		<5	<5	--
1,2-dichloropropane		<5	<5	--
trans-1,3-dichloropropene		<5	<5	--
trichloroethene		<5	<5	--
chlorodibromomethane		<5	<5	--
1,1,2-trichloroethane		<5	<5	--
benzene		18	14	25
cis-1,3-dichloropropene		<5	<5	--
2-chloroethylvinyl ether		<10	<10	--
bromoform		<5	<5	--
tetrachloroethene		<5	<5	--
1,1,2,2-tetrachloroethane		<5	<5	--
toluene		19	17	11
chlorobenzene		<5	<5	--
ethylbenzene		<5*	<5*	--

*Compound present below measurable detection limit.

QUALITY CONTROL FOR ACCURACY: PERCENT RECOVERY OF SURROGATE SPIKES

U-7163.12

Compound	E & E Laboratory No. 88-	Amount Added (ug/L)	Amount Determined (ug/L)	Percent Recovery
1,2-dichloroethane-D4	14202	50	55	110
	14203	50	53	106
	14204	50	52	104
	14205	50	55	110
	14206	50	52	104
	14207	50	52	104
toluene-D8	14202	50	42	84
	14203	50	44	88
	14204	50	46	92
	14205	50	49	98
	14206	50	47	94
	14207	50	45	90
4-bromofluorobenzene	14202	50	48	96
	14203	50	42	84
	14204	50	45	90
	14205	50	47	94
	14206	50	45	90
	14207	50	44	88

These recoveries are acceptable to EPA Contract Lab Program (CLP) guidelines.

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QUALITY CONTROL FOR ACCURACY: PERCENT RECOVERY OF SURROGATE SPIKES

U-7163.13

Compound	E & E Laboratory No. 88-	Amount Added (ug/L)	Amount Determined (ug/L)	Percent Recovery
1,2-dichloroethane-D4	14208	50	52	104
	14209	50	54	108
	14210	50	51	102
	14211	50	53	106
	14212	50	52	104
toluene-D8	14208	50	45	90
	14209	50	45	90
	14210	50	46	92
	14211	50	45	90
	14212	50	47	94
4-bromofluorobenzene	14208	50	44	88
	14209	50	46	92
	14210	50	43	86
	14211	50	44	88
	14212	50	47	94

These recoveries are acceptable to EPA Contract Lab Program (CLP) guidelines.

ECOLOGY AND ENVIRONMENT'S, INC.

A N A L Y T I C A L S E R V I C E S C E N T E R

RESULTS OF WATER ANALYSIS FOR PRIORITY POLLUTANT
BASE/NEUTRAL EXTRACTABLE COMPOUNDS BY GC/MS

(all results in ug/L)

U-7163.14

Compound	E & E Lab. No. 88-	14202	14203	14204	14205	14206
	Sample Identity	MW-1U1	MW-1D1	MW-1D2	MW-1D3	MW-1D4
bis(2-chloroethyl)ether		<10	<10	<10	<10	<10
1,3-dichlorobenzene		<10	<10	<10	<10	<10
1,4-dichlorobenzene		<10	<10	<10	<10	<10
1,2-dichlorobenzene		<10	<10	<10	<10	<10
bis(2-chloroisopropyl)ether		<10	<10	<10	<10	<10
N-nitrosodipropylamine		<10	<10	<10	<10	<10
hexachloroethane		<10	<10	<10	<10	<10
nitrobenzene		<10	<10	<10	<10	<10
isophorone		<10	<10	<10	<10	<10
bis(2-chloroethoxy)methane		<10	<10	<10	<10	<10
1,2,4-trichlorobenzene		<10	<10	<10	<10	<10
naphthalene		80	<10*	220	39	50
hexachlorobutadiene		<10	<10	<10	<10	<10
hexachlorocyclopentadiene		<10	<10	<10	<10	<10
2-chloronaphthalene		<10	<10	<10	<10	<10
dimethyl phthalate		<10	<10	<10	<10	<10
acenaphthylene		<10*	19	130	10	11
fluorene		<10*	<10*	34	10	<10*
acenaphthene		<10*	<10*	<10*	<10*	<10*
2,4-dinitrotoluene		<10	<10	<10	<10	<10
2,6-dinitrotoluene		<10	<10	<10	<10	<10
diethylphthalate		<10	<10	<10	<10	<10
4-chlorophenyl phenyl ether		<10	<10	<10	<10	<10
N-nitrosodiphenylamine		<10	<10	<10	<10	<10
4-bromophenyl phenyl ether		<10	<10	<10	<10	<10
hexachlorobenzene		<10	<10	<10	<10	<10
phenanthrene		14	<10*	24	11	11
anthracene		<10*	<10*	<10*	<10	<10*
di-n-butyl phthalate		<10*	<10*	<10*	<10*	<10*
fluoranthene		<10*	<10*	<10*	<10*	<10*
benzidine		<50	<50	<50	<50	<50
pyrene		<10*	<10*	<10*	<10*	<10*
butyl benzyl phthalate		<10	<10	<10	<10	<10
3,3'-dichlorobenzidine		<20	<20	<20	<20	<20
benzo(a)anthracene		<10*	<10	<10	<10	<10
bis(2-ethylhexyl)phthalate		11	11	<10*	<10*	<10*
chrysene		<10*	<10	<10	<10	<10
di-n-octyl phthalate		<10*	<10*	<10*	<10*	<10*
benzo(b)fluoranthene		<10*	<10	<10	<10	<10
benzo(k)fluoranthene		<10	<10	<10	<10	<10
benzo(a)pyrene		<10	<10	<10	<10	<10
indeno(1,2,3-cd)pyrene		<10	<10	<10	<10	<10
dibenzo(a,h)anthracene		<10	<10	<10	<10	<10
benzo(ghi)perylene		<10	<10	<10	<10	<10

*Compound present below measurable detection limit.

ECOLOGY AND ENVIRONMENT'S, INC.
A N A L Y T I C A L S E R V I C E S C E N T E R

RESULTS OF WATER ANALYSIS FOR PRIORITY POLLUTANT
ACID EXTRACTABLE COMPOUNDS BY GC/MS

(all results in ug/L)

U-7163.15

Compound	E & E Lab. No. 88-	14202	14203	14204	14205	14206
	Sample Identity	MW-1U1	MW-1D1	MW-1D2	MW-1D3	MW-1D4
phenol		11	<10	72	36	73
2-chlorophenol		<10	<10	<10	<10	<10
2-nitrophenol		<10	<10	<10	<10	<10
2,4-dimethylphenol		16	<10	20	<10*	11
2,4-dichlorophenol		<10	<10	<10	<10	<10
4-chloro-3-methylphenol		<10	<10	<10	<10	<10
2,4,6-trichlorophenol		<10	<10	<10	<10	<10
2,4-dinitrophenol		<50	<50	<50	<50	<50
4-nitrophenol		<50	<50	<50	<50	<50
4,6-dinitro-2-methylphenol		<50	<50	<50	<50	<50
pentachlorophenol		<50	<50	<50	<50	<50

*Compound present below measurable detection limit.

ECOLOGY AND ENVIRONMENT'S, INC.

A N A L Y T I C A L S E R V I C E S C E N T E R

RESULTS OF WATER ANALYSIS FOR PRIORITY POLLUTANT
BASE/NEUTRAL EXTRACTABLE COMPOUNDS BY GC/MS

(all results in ug/L)

U-7163.16

Compound	E & E Lab. No. 88-	14207	14208	14209	14210	14211
	Sample Identity	MW-1D4	MW-2U1	MW-2D2	MW-2D3	MW-2D4
bis(2-chloroethyl)ether		<10	<10	<10	<10	<10
1,3-dichlorobenzene		<10	<10	<10	<10	<10
1,4-dichlorobenzene		<10	<10	<10	<10	<10
1,2-dichlorobenzene		<10	<10	<10	<10	<10
bis(2-chloroisopropyl)ether		<10	<10	<10	<10	<10
N-nitrosodipropylamine		<10	<10	<10	<10	<10
hexachloroethane		<10	<10	<10	<10	<10
nitrobenzene		<10	<10	<10	<10	<10
isophorone		<10	<10	<10	<10	<10
bis(2-chloroethoxy)methane		<10	<10	<10	<10	<10
1,2,4-trichlorobenzene		<10	<10	<10	<10	<10
naphthalene		50	180	<10	160	150
hexachlorobutadiene		<10	<10	<10	<10	<10
hexachlorocyclopentadiene		<10	<10	<10	<10	<10
2-chloronaphthalene		<10	<10	<10	<10	<10
dimethyl phthalate		<10	<10	<10	<10	<10
acenaphthylene		12	67	<10*	31	21
fluorene		<10*	35	<10*	20	18
acenaphthene		<10*	<10*	<10	<10*	<10*
2,4-dinitrotoluene		<10	<10	<10	<10	<10
2,6-dinitrotoluene		<10	<10	<10	<10	<10
diethylphthalate		<10	<10	<10	<10	<10
4-chlorophenyl phenyl ether		<10	<10	<10	<10	<10
N-nitrosodiphenylamine		<10	<10	<10	<10	<10
4-bromophenyl phenyl ether		<10	<10	<10	<10	<10
hexachlorobenzene		<10	<10	<10	<10	<10
phenanthrene		12	39	<10	20	33
anthracene		<10*	<10*	<10	<10*	<10*
di-n-butyl phthalate		<10*	<10*	<10*	<10*	<10*
fluoranthene		<10*	<10*	<10	<10*	<10*
benzidine		<50	<50	<50	<50	<50
pyrene		<10*	<10*	<10	<10*	<10*
butyl benzyl phthalate		<10	<10	<10	<10	<10
3,3'-dichlorobenzidine		<20	<20	<20	<20	<20
benzo(a)anthracene		<10	<10	<10	<10	<10
bis(2-ethylhexyl)phthalate		<10*	10	<10*	15	<10*
chrysene		<10	<10	<10	<10	<10
di-n-octyl phthalate		<10	<10*	<10*	<10*	<10*
benzo(b)fluoranthene		<10	<10	<10	<10	<10
benzo(k)fluoranthene		<10	<10	<10	<10	<10
benzo(a)pyrene		<10	<10	<10	<10	<10
indeno(1,2,3-cd)pyrene		<10	<10	<10	<10	<10
dibenzo(a,h)anthracene		<10	<10	<10	<10	<10
benzo(ghi)perylene		<10	<10	<10	<10	<10

*Compound present below measurable detection limit.

ECOLOGY AND ENVIRONMENT'S, INC.
A N A L Y T I C A L S E R V I C E S C E N T E R

RESULTS OF WATER ANALYSIS FOR PRIORITY POLLUTANT
ACID EXTRACTABLE COMPOUNDS BY GC/MS

(all results in ug/L)

U-7163.17

Compound	E & E Lab. No. 88-	14207	14208	14209	14210	14211
	Sample Identity	MW-1D4	MW-2U1	MW-2D2	MW-2D3	MW-2D4
phenol		76	<10*	<10	<10	<10
2-chlorophenol		<10	<10	<10	<10	<10
2-nitrophenol		<10	<10	<10	<10	<10
2,4-dimethylphenol		11	23	<10	<10*	<10*
2,4-dichlorophenol		<10	<10	<10	<10	<10
4-chloro-3-methylphenol		<10	<10	<10	<10	<10
2,4,6-trichlorophenol		<10	<10	<10	<10	<10
2,4-dinitrophenol		<50	<50	<50	<50	<50
4-nitrophenol		<50	<50	<50	<50	<50
4,6-dinitro-2-methylphenol		<50	<50	<50	<50	<50
pentachlorophenol		<50	<50	<50	<50	<50

*Compound present below measurable detection limit.

ECOLOGY AND ENVIRONMENT'S, INC.

A N A L Y T I C A L S E R V I C E S C E N T E R

RESULTS OF WATER ANALYSIS FOR PRIORITY POLLUTANT
BASE/NEUTRAL EXTRACTABLE COMPOUNDS BY GC/MS

(all results in ug/L)

U-7163.18

Compound	E & E Lab. No. 88-	14212	Method Blank			
	Sample Identity	Field Blank				
bis(2-chloroethyl)ether		<10	<10			
1,3-dichlorobenzene		<10	<10			
1,4-dichlorobenzene		<10	<10			
1,2-dichlorobenzene		<10	<10			
bis(2-chloroisopropyl)ether		<10	<10			
N-nitrosodipropylamine		<10	<10			
hexachloroethane		<10	<10			
nitrobenzene		<10	<10			
isophorone		<10	<10			
bis(2-chloroethoxy)methane		<10	<10			
1,2,4-trichlorobenzene		<10	<10			
naphthalene		<10	<10			
hexachlorobutadiene		<10	<10			
hexachlorocyclopentadiene		<10	<10			
2-chloronaphthalene		<10	<10			
dimethyl phthalate		<10	<10			
acenaphthylene		<10	<10			
fluorene		<10	<10			
acenaphthene		<10	<10			
2,4-dinitrotoluene		<10	<10			
2,6-dinitrotoluene		<10	<10			
diethylphthalate		<10	<10			
4-chlorophenyl phenyl ether		<10	<10			
N-nitrosodiphenylamine		<10	<10			
4-bromophenyl phenyl ether		<10	<10			
hexachlorobenzene		<10	<10			
phenanthrene		<10	<10			
anthracene		<10	<10			
di-n-butyl phthalate		<10*	<10*			
fluoranthene		<10	<10			
benzidine		<50	<50			
pyrene		<10	<10			
butyl benzyl phthalate		<10	<10			
3,3'-dichlorobenzidine		<20	<20			
benzo(a)anthracene		<10	<10			
bis(2-ethylhexyl)phthalate		<10*	<10*			
chrysene		<10	<10			
di-n-octyl phthalate		<10*	<10*			
benzo(b)fluoranthene		<10	<10			
benzo(k)fluoranthene		<10	<10			
benzo(a)pyrene		<10	<10			
indeno(1,2,3-cd)pyrene		<10	<10			
dibenzo(a,h)anthracene		<10	<10			
benzo(ghi)perylene		<10	<10			

*Compound present below measurable detection limit.

ECOLOGY AND ENVIRONMENT'S, INC.
A N A L Y T I C A L S E R V I C E S C E N T E R

RESULTS OF WATER ANALYSIS FOR PRIORITY POLLUTANT
ACID EXTRACTABLE COMPOUNDS BY GC/MS

(all results in ug/L)

U-7163.19

Compound	E & E Lab. No. 88-	14212	Method Blank			
	Sample Identity	Field Blank				
phenol		<10	<10			
2-chlorophenol		<10	<10			
2-nitrophenol		<10	<10			
2,4-dimethylphenol		<10	<10			
2,4-dichlorophenol		<10	<10			
4-chloro-3-methylphenol		<10	<10			
2,4,6-trichlorophenol		<10	<10			
2,4-dinitrophenol		<50	<50			
4-nitrophenol		<50	<50			
4,6-dinitro-2-methylphenol		<50	<50			
pentachlorophenol		<50	<50			

APPENDIX C

GROUNDWATER QUALITY ASSESSMENT, PHASE II

ecology and environment, inc.

195 SUGG ROAD, P.O. BOX D, BUFFALO, NEW YORK 14225, TEL. 716-632-4491, TELEX 91-9183

International Specialists in the Environment

December 21, 1987

Mr. Robert Allen
Bethlehem Steel Corporation
P.O. Box 310
Lackawanna, New York 14218

Dear Mr. Allen:

Please find enclosed the groundwater monitoring results for HWM-1 and HWM-2. These results include the field and laboratory analytical results of the 11 samples (nine wells, one duplicate, and one field blank) collected on November 6, 1987. These analyses were conducted in accordance with the "HWM-1 and HWM-2 Groundwater Quality Assessment Plan, Bethlehem Steel Corporation, Lackawanna, New York, July.1987" (GWQAP).

Field Results:

All wells were purged on November 5, 1987, by Mr. Oran Burkett of Burkett Drilling under the supervision and with the assistance of Mr. Jon Nickerson and Mr. Don Johnson of Ecology and Environment, Inc. A four-inch submersible pump was utilized to remove a minimum of three well volumes. The pump was decontaminated between wells as outlined on the GWQAP. One exception to this was well MW-2D2. Well MW-2D2 was hand-bailed on November 6, as pump failure precluded purging it on November 5.

All wells were sampled on November 6, 1987, by Jon Nickerson and Don Johnson. Mr. Larry Thomas and Ms. Nancy Overfield of the NYSDEC and Mr. Jim Scheer, BSC, observed. The pH, conductivity and temperature were measured in replicate in the field. A field duplicate (MW-2D3) and a field blank sample were also collected for QA/QC purposes. The field test data are enclosed as attachment A. All samples were preserved in the field as outlined in the GWQAP and transported to Ecology and Environment's Analytical Services Center (ASC) under chain of custody the same day.

Analytical Results

The analytical results are enclosed as attachment B. Analyses were performed according to the procedures set forth in "Methods for the Chemical Analysis of Water and Wastes," EPA-600/4-79-020, March 1983; "Methods for Organic Chemical Analysis of Municipal and Industrial Wastewater," EPA-600/4-82-037, July 1982; and "Test Methods for Evaluating Solid Wastes, Physical/Chemical Methods," SW-846, Second Edition, USEPA 1982.

A thorough review of all the data has been conducted to verify validity. Accuracy (surrogate and matrix spike recovery) and precision (relative percent difference) were all found to be within acceptable USEPA guidelines. Field and method blanks were found to be acceptable.

Very low levels of methylene chloride were detected in the field and method blanks and in the samples. This contamination can probably be attributed to the laboratory.

Trace to very low levels of phthalates were also detected in the blanks and samples. This type of contamination is usually attributed to rubber products, tubing, etc. The low levels observed probably do not reflect any groundwater contamination.

The field duplicate (Stations 7 and 8 - MW-2D3) exhibited acceptable precision for all parameters analyzed, except in the TOX runs.

Schedule

We have scheduled the next round of sampling for the week beginning January 10, 1987. We will contact you prior to that date with our precise plans.

Sincerely,

Michael J. Hanchak

Michael J. Hanchak

MJH:bf-48
Encl.

Field Test Data
Bethlehem Steel Corporation
November 6, 1987

Station	Time	Well #	HnU	WLevel	Temp.	pH_1	pH_2	pH_3	pH_4	Cond[1]	Cond[2]	Cond[3]	Cond[4]
1	0920	MW-1U1	<1ppm	15.4	47.8	11.23	11.29	11.26	11.24	13.08×10^2	13.44×10^2	13.65×10^2	13.84×10^2
2	1005	MW-1D1	<1	36.44	50.9	6.60	7.03	6.84	6.94	6.35	6.64	4.72	5.31
3	1050	Mw-1D2	<1	37.86	47.1	11.35	11.32	11.31	11.33	1.63	1.69	1.66	1.69
4	1120	MW-1D3	<1	37.86	46.3	11.27	11.38	11.37	11.39	1.67	1.75	1.79	1.79
5	1150	MW-1D4	<1	37.75	45.7	10.28	10.35	10.44	10.49	1.68	1.64	1.65	1.69
6	1220	MW-2U1	<1	54.45	53.1	10.21	10.17	10.35	10.61	2.69	2.80	2.77	2.93
7	1320	MW-2D3	<1	62.4	48.5	10.58	10.61	10.63	10.59	1.69	1.65	1.67	1.66
8	1345	MW-2D3	<1	63.4	——	10.56	10.58	10.57	10.63	1.67	1.82	1.83	1.77
9	1455	MW-2D4	<1	56.4	47.5	10.18	10.29	10.29	10.25	1.76	1.76	1.89	1.78
10	1535	MW-2D2	<1	59.2	50.6	10.13	10.11	10.11	10.10	1.79	1.84	1.85	1.83
11	1602	Field Blank	1	——	——	——	——	——	——	——	——	——	——

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International Specialists in the Environment

LABORATORY REPORT

FOR

BETHLEHEM STEEL CORPORATION

U-6788

Job No.: U-6788			RE: BH-6020			
Sample Date: 11/6/87			P.O. No.:			
Date Received: 11/6/87			Sampled By: E & E, Inc.			
Sample Type: Water			Delivered By: E & E, Inc.			
E & E Lab. No. 87-	11844	11845	11846	11847	11848	11849
Customer No.						
Sample Identity	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6
	Results in: mg/L unless noted					
Chloride	200	190	3,100	180	94	88
Sulfate	210	400	1,000	430	320	600
Alkalinity	340	490	110	440	430	540
Nitrate-Nitrogen	<0.1	0.14	0.12	0.11	<0.1	0.10
Total Cyanide*	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Organic Halogens	0.026	0.085	<0.005	<0.005	0.007	0.056
	<0.005	0.089	<0.005	0.007	<0.005	0.055
	<0.005	0.14	0.014	<0.005	<0.005	0.055
	<0.005	0.080	<0.005	<0.005	<0.005	0.055

*A matrix interference prevented achieving low detection limits on certain samples.

Analytical References:

"Methods for the Chemical Analysis of Water and Wastes," EPA-600/4-79-020, March 1983 and "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, Second Edition, U.S. EPA, 1982.

Supervising Analyst: Gary Hahn IS

Date: 12/2/87

ecology and environment, inc.
International Specialists in the Environment

LABORATORY REPORT

FOR

BETHLEHEM STEEL CORPORATION

6788.1

Job No.: U-6788			RE: BH-6020			
Sample Date: 11/6/87			P.O. No.:			
Date Received: 11/6/87			Sampled By: E & E, Inc.			
Sample Type: Water			Delivered By: E & E, Inc.			
E & E Lab. No. 87-	11850	11851	11852	11853	11854	
Customer No.						
Sample Identity	Station 7	Station 8	Station 9	Station 10	Station 11	
	Results in: mg/L unless noted					
Chloride	330	330	380	390	0.5	
Sulfate	630	720	700	760	<5	
Alkalinity	99	88	98	56	1.0	
Nitrate-Nitrogen	<0.1	<0.1	<0.1	<0.1	<0.1	
Total Cyanide	<0.1	<0.1	<0.1	0.14	<0.01	
Total Organic Halogens	0.035	0.048	0.020	0.022	<0.005	
	0.033	0.048	0.018	0.019	<0.005	
	0.027	0.031	0.024	0.016	<0.005	
	0.027	0.050	0.016	0.028	<0.005	

Analytical References:

"Methods for the Chemical Analysis of Water and Wastes," EPA-600/4-79-020, March 1983 and "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods," SW-846, Second Edition, U.S. EPA, 1982.

Supervising Analyst: [signature]

Date: 12/7/87

LABORATORY REPORT

FOR

BETHLEHEM STEEL CORPORATION

U-6788.2

Job No.: U-6788			RE: BH-6020			
Sample Date: 11/6/87			P.O. No.:			
Date Received: 11/6/87			Sampled By: E & E, Inc.			
Sample Type: Water			Delivered By: E & E, Inc.			
E & E Lab. No. 87-	11844	11845	11846	11847	11848	11849
Customer No.						
Sample Identity	Station 1	Station 2	Station 3	Station 4	Station 5	Station 6
	Results in: mg/L unless noted					
Hexavalent Chromium	<0.010	<0.010	<0.010	<0.010	<0.010	NR
Antimony	<0.060	<0.060	<0.060	<0.060	<0.060	<0.060
Arsenic	0.011	0.005	<0.005	<0.005	<0.005	0.005
Beryllium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chromium	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Lead	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Selenium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Silver	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Thallium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Nickel	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015

NR: Analysis not requested

Analytical References:

"Methods for the Chemical Analysis of Water and Wastes," EPA-600/4-79-020, March 1983.

Supervising Analyst: Gary Hahn ITS

Date: 12/23/87

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International Specialists in the Environment

LABORATORY REPORT

FOR

BETHLEHEM STEEL CORPORATION

U-6788.3

Job No.: U-6788			RE: BH-6020			
Sample Date: 11/6/87			P.O. No.:			
Date Received: 11/6/87			Sampled By: E & E, Inc.			
Sample Type: Water			Delivered By: E & E, Inc.			
E & E Lab. No. 87-	11850	11851	11852	11853	11854	
Customer No.						
Sample Identity	Station 7	Station 8	Station 9	Station 10	Station 11	
	Results In: mg/L unless noted					
Antimony	<0.060	<0.060	<0.060	<0.060	<0.060	
Arsenic	0.006	0.006	<0.005	<0.005	<0.005	
Beryllium	<0.005	<0.005	<0.005	<0.005	<0.005	
Cadmium	<0.005	<0.005	<0.005	<0.005	<0.005	
Chromium	0.012	<0.010	<0.010	0.020	<0.010	
Lead	<0.010	<0.010	<0.010	<0.010	<0.005	
Mercury	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	
Selenium	<0.005	<0.005	<0.005	<0.005	<0.005	
Silver	<0.010	<0.010	<0.010	<0.010	<0.010	
Thallium	<0.005	<0.005	<0.005	<0.005	<0.005	
Nickel	<0.015	<0.015	<0.015	<0.015	<0.015	

Analytical References:

"Methods for the Chemical Analysis of Water and Wastes," EPA-600/4-79-020, March 1983.

Supervising Analyst: Gary Hahnlen

Date: 12/3/87

QUALITY CONTROL FOR PRECISION
RESULTS OF ANALYSIS OF REPLICATE
ANALYSES OF WATER SAMPLES

U-6788.4

Parameter	E & E Laboratory No. 87-	(mg/L) Original Analysis	(mg/L) Replicate Analysis	Relative Percent Difference (RPD)
Antimony	11854	<0.060	<0.060	---
Arsenic	11854	<0.005	<0.005	---
Beryllium	11854	<0.005	<0.005	---
Cadmium	11854	<0.005	<0.005	---
Chromium	11854	<0.010	<0.010	---
Lead	11854	<0.005	<0.005	---
Mercury	11853	<0.0002	<0.0002	---
Selenium	11854	<0.005	<0.005	---
Silver	11854	<0.010	<0.010	---
Thallium	11854	<0.005	<0.005	---
Nickel	11854	<0.015	<0.015	---
Chloride	11853	390	390	0
Sulfate	11853	760	650	16
Nitrate-Nitrogen	11852	<0.1	<0.1	---
Total Cyanide	11854	<0.01	<0.01	---
Alkalinity	11854	1.0	1.0	0

RESULTS OF WATER ANALYSIS FOR PRIORITY POLLUTANT
PURGEABLE ORGANIC COMPOUNDS BY GC/MS

(all results in ug/L)

U-6788.6

Compound	E & E Lab. No. 87-	11844	11845	11846	11847	11848
	Sample Identity	Station 1	Station 2	Station 3	Station 4	Station 5
chloromethane		<10	<10	<10	<10	<10
bromomethane		<10	<10	<10	<10	<10
vinyl chloride		<10	<10	<10	<10	<10
chloroethane		<10	<10	<10	<10	<10
methylene chloride		5	5	5	5	5
1,1-dichloroethene		<5	<5	<5	<5	<5
1,1-dichloroethane		<5	10	<5	<5	<5
trans-1,2-dichloroethene		<5	<5	<5	<5	<5
chloroform		<5	<5	<5	<5	<5
1,2-dichloroethane		<5	<5	<5	<5	<5
1,1,1-trichloroethane		<5	<5*	<5	<5	<5
carbon tetrachloride		<5	<5	<5	<5	<5
bromodichloromethane		<5	<5	<5	<5	<5
1,2-dichloropropane		<5	<5	<5	<5	<5
trans-1,3-dichloropropene		<5	<5	<5	<5	<5
trichloroethene		<5	9	<5	<5	<5
chlorodibromomethane		<5	<5	<5	<5	<5
1,1,2-trichloroethane		<5	<5	<5	<5	<5
benzene		430	9	42	57	74
cis-1,3-dichloropropene		<5	<5	<5	<5	<5
2-chloroethylvinyl ether		<10	<10	<10	<10	<10
bromoform		<5	<5	<5	<5	<5
tetrachloroethene		<5	<5	<5	<5	<5
1,1,2,2-tetrachloroethane		<5	<5	<5	<5	<5
toluene		89	7	26	22	26
chlorobenzene		<5*	<5	<5	<5	<5
ethylbenzene		<5*	8	6	<5*	<5*

*Compound present below measurable detection limit.

QUALITY CONTROL FOR ACCURACY: PERCENT RECOVERY
FOR SPIKED WATER SAMPLES

U-6788.5

Parameter	E & E Laboratory No. 87-	Original Value	Amount Added	Amount Determined	Percent Recovery
		(mg/L)			
Antimony	11854	<0.060	0.5	0.484	97
Arsenic	11854	<0.005	0.04	0.040	100
Beryllium	11854	<0.005	0.05	0.051	102
Cadmium	11854	<0.005	0.05	0.051	102
Chromium	11854	<0.010	0.2	0.212	106
Lead	11854	<0.005	0.02	0.020	100
Mercury	11853	<0.0002	0.004	0.0036	90
Selenium	11854	<0.005	0.01	0.009	90
Silver	11854	<0.010	0.05	0.052	104
Thallium	11854	<0.005	0.05	0.046	92
Nickel	11854	<0.015	0.5	0.510	102
Total Cyanide	11841*	<0.01	0.11	0.11	100

*This represents 10% QC. This is not one of your samples but was analyzed in the same batch as your samples.

RESULTS OF WATER ANALYSIS FOR PRIORITY POLLUTANT
PURGEABLE ORGANIC COMPOUNDS BY GC/MS

(all results in ug/L)

U-6788.7

Compound	E & E Lab. No. 87-	11849	11850	11851	11852	11853
	Sample Identity	Station 6	Station 7	Station 8	Station 9	Station 10
chloromethane		<10	<10	<10	<10	<10
bromomethane		<10	<10	<10	<10	<10
vinyl chloride		<10	<10	<10	<10	<10
chloroethane		<10	<10	<10	<10	<10
methylene chloride		6	6	6	6	6
1,1-dichloroethene		<5	<5	5	<5	<5
1,1-dichloroethane		6	<5*	<5	<5	<5
trans-1,2-dichloroethene		17	<5*	<5	<5	<5
chloroform		<5	<5	<5	<5	<5
1,2-dichloroethane		<5	<5	<5	<5	<5
1,1,1-trichloroethane		<5	<5	<5	<5	<5
carbon tetrachloride		<5	<5	<5	<5	<5
bromodichloromethane		<5	<5	<5	<5	<5
1,2-dichloropropane		<5	<5	<5	<5	<5
trans-1,3-dichloropropene		<5	<5	<5	<5	<5
trichloroethene		36	<5*	<5*	<5	<5
chlorodibromomethane		<5	<5	<5	<5	<5
1,1,2-trichloroethane		<5	<5	<5	<5	<5
benzene		23	36	31	41	<5*
cis-1,3-dichloropropene		<5	<5	<5	<5	<5
2-chloroethylvinyl ether		<10	<10	<10	<10	<10
bromoform		<5	<5	<5	<5	<5
tetrachloroethene		<5	<5	<5	<5	<5
1,1,2,2-tetrachloroethane		<5	<5	<5	<5	<5
toluene		16	34	31	46	<5*
chlorobenzene		<5	<5	<5	<5	<5
ethylbenzene		14	13	12	15	<5*

*Compound present below measurable detection limit.

RESULTS OF WATER ANALYSIS FOR PRIORITY POLLUTANT
PURGEABLE ORGANIC COMPOUNDS BY GC/MS

(all results in ug/L)

U-6788.8

Compound	E & E Lab. No. 87-	11854	Method Blank			
	Sample identity	Station 11				
chloromethane		<10	<10			
bromomethane		<10	<10			
vinyl chloride		<10	<10			
chloroethane		<10	<10			
methylene chloride		6	6			
1,1-dichloroethene		<5	<5			
1,1-dichloroethane		<5	<5			
trans-1,2-dichloroethene		<5	<5			
chloroform		<5	<5			
1,2-dichloroethane		<5	<5			
1,1,1-trichloroethane		<5	<5			
carbon tetrachloride		<5	<5			
bromodichloromethane		<5	<5			
1,2-dichloropropane		<5	<5			
trans-1,3-dichloropropene		<5	<5			
trichloroethene		<5	<5			
chlorodibromomethane		<5	<5			
1,1,2-trichloroethane		<5	<5			
benzene		<5	<5			
cis-1,3-dichloropropene		<5	<5			
2-chloroethylvinyl ether		<10	<10			
bromoform		<5	<5			
tetrachloroethene		<5	<5			
1,1,2,2-tetrachloroethane		<5	<5			
toluene		<5*	<5*			
chlorobenzene		<5	<5			
ethylbenzene		<5	<5			

*Compound present below measurable detection limit.

QUALITY CONTROL FOR ACCURACY: PERCENT
RECOVERY OF SURROGATE SPIKES

U-6788.9

Compound	E & E Laboratory No. 87-	Amount Added (ug/L)	Amount Determined (ug/L)	Percent Recovery
1,2-dichloroethane-D4	11844	50	54	108
	11845	50	54	108
	11846	50	54	108
	11847	50	53	106
	11848	50	53	106
	11849	50	41	82
toluene-D8	11844	50	51	102
	11845	50	49	98
	11846	50	47	94
	11847	50	48	96
	11848	50	47	94
	11849	50	43	86
4-bromofluorobenzene	11844	50	51	102
	11845	50	49	98
	11846	50	50	100
	11847	50	44	88
	11848	50	53	106
	11849	50	47	94

These recoveries are acceptable to EPA Contract Lab Program (CLP) guidelines.

QUALITY CONTROL FOR ACCURACY: PERCENT RECOVERY OF SURROGATE SPIKES

U-6788.10

Compound	E & E Laboratory No. 87-	Amount Added (ug/L)	Amount Determined (ug/L)	Percent Recovery
1,2-dichloroethane-D4	11850	50	55	110
	11851	50	46	92
	11852	50	43	86
	11853	50	45	90
	11854	50	46	92
toluene-D8	11850	50	51	102
	11851	50	47	94
	11852	50	47	94
	11853	50	45	90
	11854	50	47	94
4-bromofluorobenzene	11850	50	56	112
	11851	50	50	100
	11852	50	50	100
	11853	50	51	102
	11854	50	48	96

These recoveries are acceptable to EPA Contract Lab Program (CLP) guidelines.

QUALITY CONTROL FOR ACCURACY:
PERCENT RECOVERY OF WATER MATRIX SPIKE
(Sample #11854)

U-6788.11

Compound	(ug/L)			Percent Recovery	EPA QC Limits (advisory)
	Original Result	Amount Added	Amount Determined		
1,1-Dichloroethene	<5	50	35	70	61 - 145
Trichloroethene	<5	50	42	84	71 - 120
Chlorobenzene	<5	50	46	92	75 - 130
Toluene	<5*	50	43	86	76 - 125
Benzene	<5	50	40	80	76 - 127

*Compound present below measurable detection limit.

ECOLOGY AND ENVIRONMENT'S, INC.
ANALYTICAL SERVICES CENTER

RESULTS OF WATER ANALYSIS FOR PRIORITY POLLUTANT
BASE/NEUTRAL EXTRACTABLE COMPOUNDS BY GC/MS

(all results in ug/L)

U-6788.12

Compound	E & E Lab. No. 87-	11844	11845	11846	11847	11848
	Sample Identity	Station 1	Station 2	Station 3	Station 4	Station 5
bis(2-chloroethyl)ether		<10	<10	<10	<10	<10
1,3-dichlorobenzene		<10	<10	<10	<10	<10
1,4-dichlorobenzene		<10	<10	<10	<10	<10
1,2-dichlorobenzene		<10	<10	<10	<10	<10
bis(2-chloroisopropyl)ether		<10	<10	<10	<10	<10
N-nitrosodipropylamine		<10	<10	<10	<10	<10
hexachloroethane		<10	<10	<10	<10	<10
nitrobenzene		<10	<10	<10	<10	<10
isophorone		<10	<10	<10	<10	<10
bis(2-chloroethoxy)methane		<10	<10	<10	<10	<10
1,2,4-trichlorobenzene		<10	<10	<10	<10	<10
naphthalene		93	<10*	720 E	49	62
hexachlorobutadiene		<10	<10	<10	<10	<10
hexachlorocyclopentadiene		<10	<10	<10	<10	<10
2-chloronaphthalene		<10	<10	<10	<10	<10
dimethyl phthalate		<10	<10	<10	<10	<10
acenaphthylene		<10*	13	120	13	13
fluorene		<10*	<10*	27	<10*	10
acenaphthene		<10*	<10*	<10*	<10*	<10*
2,4-dinitrotoluene		<10	<10	<10	<10	<10
2,6-dinitrotoluene		<10	<10	<10	<10	<10
diethylphthalate		<10	<10	<10	<10	<10
4-chlorophenyl phenyl ether		<10	<10	<10	<10	<10
N-nitrosodiphenylamine		<10	<10	<10	<10	<10
4-bromophenyl phenyl ether		<10	<10	<10	<10	<10
hexachlorobenzene		<10	<10	<10	<10	<10
phenanthrene		13	<10*	25	13	15
anthracene		<10*	<10	<10*	<10	<10*
di-n-butyl phthalate		<10*	<10*	<10*	<10*	<10*
fluoranthene		<10*	<10	<10*	<10	<10*
benzidine		<50	<50	<50	<50	<50
pyrene		<10	<10	<10*	<10	<10*
butyl benzyl phthalate		<10	<10	<10	<10	<10
3,3'-dichlorobenzidine		<20	<20	<20	<20	<20
benzo(a)anthracene		<10	<10	<10	<10	<10
bis(2-ethylhexyl)phthalate		<10*	12	<10*	<10*	17
chrysene		<10	<10	<10	<10	<10
di-n-octyl phthalate		<10*	<10*	12	<10*	19
benzo(b)fluoranthene		<10	<10	<10	<10	<10
benzo(k)fluoranthene		<10	<10	<10	<10	<10
benzo(a)pyrene		<10	<10	<10	<10	<10
indeno(1,2,3-cd)pyrene		<10	<10	<10	<10	<10
dibenzo(a,h)anthracene		<10	<10	<10	<10	<10
benzo(ghi)perylene		<10	<10	<10	<10	<10

*Compound present below measurable detection limit.
E = Estimated value, exceeds calibrated range.

ECOLOGY AND ENVIRONMENT'S, INC.
ANALYTICAL SERVICES CENTER

RESULTS OF WATER ANALYSIS FOR PRIORITY POLLUTANT
ACID EXTRACTABLE COMPOUNDS BY GC/MS

(all results in ug/L)

U-6788.13

Compound	E & E Lab. No. 87-	11844	11845	11846	11847	11848
	Sample Identity	Station 1	Station 2	Station 3	Station 4	Station 5
phenol		18	<10*	130	74	110
2-chlorophenol		<10	<10	<10	<10	<10
2-nitrophenol		<10	<10	<10	<10	<10
2,4-dimethylphenol		16	<10	28	<10*	13
2,4-dichlorophenol		<10	<10	<10	<10	<10
4-chloro-3-methylphenol		<10	<10	<10	<10	<10
2,4,6-trichlorophenol		<10	<10	<10	<10	<10
2,4-dinitrophenol		<50	<50	<50	<50	<50
4-nitrophenol		<50	<50	<50	<50	<50
4,6-dinitro-2-methylphenol		<50	<50	<50	<50	<50
pentachlorophenol		<50	<50	<50	<50	<50

*Compound present below measurable detection limit.

ECOLOGY AND ENVIRONMENT'S, INC.
A N A L Y T I C A L S E R V I C E S C E N T E R

RESULTS OF WATER ANALYSIS FOR PRIORITY POLLUTANT
BASE/NEUTRAL EXTRACTABLE COMPOUNDS BY GC/MS

(all results in ug/L)

U-6788.14

Compound	E & E Lab. No. 87-	11849	11850	11851	11852	11853
	Sample Identity	Station 6	Station 7	Station 8	Station 9	Station 10
bis(2-chloroethyl)ether		<10	<10	<10	<10	<10
1,3-dichlorobenzene		<10	<10	<10	<10	<10
1,4-dichlorobenzene		<10	<10	<10	<10	<10
1,2-dichlorobenzene		<10	<10	<10	<10	<10
bis(2-chloroisopropyl)ether		<10	<10	<10	<10	<10
N-nitrosodipropylamine		<10	<10	<10	<10	<10
hexachloroethane		<10	<10	<10	<10	<10
nitrobenzene		<10	<10	<10	<10	<10
isophorone		<10	<10	<10	<10	<10
bis(2-chloroethoxy)methane		<10	<10	<10	<10	<10
1,2,4-trichlorobenzene		<10	<10	<10	<10	<10
naphthalene		570 E	210	230	290	<10*
hexachlorobutadiene		<10	<10	<10	<10	<10
hexachlorocyclopentadiene		<10	<10	<10	<10	<10
2-chloronaphthalene		<10	<10	<10	<10	<10
dimethyl phthalate		<10	<10	<10	<10	<10
acenaphthylene		95	35	21	29	<10*
fluorene		37	19	21	23	<10*
acenaphthene		<10*	<10*	<10*	<10*	<10
2,4-dinitrotoluene		<10	<10	<10	<10	<10
2,6-dinitrotoluene		<10	<10	<10	<10	<10
diethylphthalate		<10	<10	<10	<10	<10
4-chlorophenyl phenyl ether		<10	<10	<10	<10	<10
N-nitrosodiphenylamine		<10	<10	<10	<10	<10
4-bromophenyl phenyl ether		<10	<10	<10	<10	<10
hexachlorobenzene		<10	<10	<10	<10	<10
phenanthrene		45	21	24	51	<10*
anthracene		10	<10*	<10*	<10*	<10
di-n-butyl phthalate		<10*	<10*	<10*	<10*	<10*
fluoranthene		<10*	<10*	<10*	<10*	<10
benzidine		<50	<50	<50	<50	<50
pyrene		<10*	<10*	<10*	<10*	<10
butyl benzyl phthalate		<10	<10	<10	<10	<10
3,3'-dichlorobenzidine		<20	<20	<20	<20	<20
benzo(a)anthracene		<10	<10	<10	<10	<10
bis(2-ethylhexyl)phthalate		14	14	23	14	39
chrysene		<10	<10	<10	<10	<10
di-n-octyl phthalate		<10*	<10*	14	<10*	21
benzo(b)fluoranthene		<10	<10	<10	<10	<10
benzo(k)fluoranthene		<10	<10	<10	<10	<10
benzo(a)pyrene		<10	<10	<10	<10	<10
indeno(1,2,3-cd)pyrene		<10	<10	<10	<10	<10
dibenzo(a,h)anthracene		<10	<10	<10	<10	<10
benzo(ghi)perylene		<10	<10	<10	<10	<10

*Compound present below measurable detection limit.

E = Estimated value, exceeds calibrated range.

ECOLOGY AND ENVIRONMENT'S, INC.

A N A L Y T I C A L S E R V I C E S C E N T E R

RESULTS OF WATER ANALYSIS FOR PRIORITY POLLUTANT
ACID EXTRACTABLE COMPOUNDS BY GC/MS

(all results in ug/L)

U-6788.15

Compound	E & E Lab. No. 87-	11849	11850	11851	11852	11853
	Sample Identity	Station 6	Station 7	Station 8	Station 9	Station 10
phenol		21	<10*	<10	<10*	<10*
2-chlorophenol		<10	<10	<10	<10	<10
2-nitrophenol		<10	<10	<10	<10	<10
2,4-dimethylphenol		46	<10*	<10*	<10*	<10*
2,4-dichlorophenol		<10	<10	<10	<10	<10
4-chloro-3-methylphenol		<10	<10	<10	<10	<10
2,4,6-trichlorophenol		<10	<10	<10	<10	<10
2,4-dinitrophenol		<50	<50	<50	<50	<50
4-nitrophenol		<50	<50	<50	<50	<50
4,6-dinitro-2-methylphenol		<50	<50	<50	<50	<50
pentachlorophenol		<50	<50	<50	<50	<50

*Compound present below measurable detection limit.

ECOLOGY AND ENVIRONMENT'S, INC.
A N A L Y T I C A L S E R V I C E S C E N T E R

RESULTS OF WATER ANALYSIS FOR PRIORITY POLLUTANT
BASE/NEUTRAL EXTRACTABLE COMPOUNDS BY GC/MS

(all results in ug/L)

U-6788.16

Compound	E & E Lab. No. 87-	11854	Meth Blan			
	Sample Identity	Station 11				
bis(2-chloroethyl)ether		<10	<10			
1,3-dichlorobenzene		<10	<10			
1,4-dichlorobenzene		<10	<10			
1,2-dichlorobenzene		<10	<10			
bis(2-chloroisopropyl)ether		<10	<10			
N-nitrosodipropylamine		<10	<10			
hexachloroethane		<10	<10			
nitrobenzene		<10	<10			
isophorone		<10	<10			
bis(2-chloroethoxy)methane		<10	<10			
1,2,4-trichlorobenzene		<10	<10			
naphthalene		<10	<10			
hexachlorobutadiene		<10	<10			
hexachlorocyclopentadiene		<10	<10			
2-chloronaphthalene		<10	<10			
dimethyl phthalate		<10	<10			
acenaphthylene		<10	<10			
fluorene		<10	<10			
acenaphthene		<10	<10			
2,4-dinitrotoluene		<10	<10			
2,6-dinitrotoluene		<10	<10			
diethylphthalate		<10	<10			
4-chlorophenyl phenyl ether		<10	<10			
N-nitrosodiphenylamine		<10	<10			
4-bromophenyl phenyl ether		<10	<10			
hexachlorobenzene		<10	<10			
phenanthrene		<10	<10			
anthracene		<10	<10			
di-n-butyl phthalate		<10*	<10*			
fluoranthene		<10	<10			
benzidine		<50	<50			
pyrene		<10	<10			
butyl benzyl phthalate		<10	<10			
3,3'-dichlorobenzidine		<20	<20			
benzo(a)anthracene		<10	<10			
bis(2-ethylhexyl)phthalate		<10*	<10*			
chrysene		<10	<10			
di-n-octyl phthalate		12	<10*			
benzo(b)fluoranthene		<10	<10			
benzo(k)fluoranthene		<10	<10			
benzo(a)pyrene		<10	<10			
Indeno(1,2,3-cd)pyrene		<10	<10			
dibenzo(a,h)anthracene		<10	<10			
benzo(ghi)perylene		<10	<10			

*Compound present below measurable detection limit.

ECOLOGY AND ENVIRONMENT'S, INC.
A N A L Y T I C A L S E R V I C E S C E N T E R

RESULTS OF WATER ANALYSIS FOR PRIORITY POLLUTANT
ACID EXTRACTABLE COMPOUNDS BY GC/MS

(all results in ug/L)

U-6788.17

Compound	E & E Lab. No. 87-	11854	Method Blank			
	Sample Identity	Station 11				
phenol		<10	<10*			
2-chlorophenol		<10	<10			
2-nitrophenol		<10	<10			
2,4-dimethylphenol		<10	<10			
2,4-dichlorophenol		<10	<10			
4-chloro-3-methylphenol		<10	<10			
2,4,6-trichlorophenol		<10	<10			
2,4-dinitrophenol		<50	<50			
4-nitrophenol		<50	<50			
4,6-dinitro-2-methylphenol		<50	<50			
pentachlorophenol		<50	<50			

*Compound present below measurable detection limit.

QUALITY CONTROL FOR PRECISION
RESULTS OF ANALYSIS OF REPLICATE
ANALYSES OF WATER SAMPLES

U-6788.18

Compound	E & E Lab. No. 87-11846	ug/L		Relative Percent Difference (RPD)
		Original Analysis	Replicate Analysis	
bis(2-chloroethyl)ether		<10	<10	—
1,3-dichlorobenzene		<10	<10	—
1,4-dichlorobenzene		<10	<10	—
1,2-dichlorobenzene		<10	<10	—
bis(2-chloroisopropyl)ether		<10	<10	—
N-nitrosodipropylamine		<10	<10	—
hexachloroethane		<10	<10	—
nitrobenzene		<10	<10	—
isophorone		<10	<10	—
bis(2-chloroethoxy)methane		<10	<10	—
1,2,4-trichlorobenzene		<10	<10	—
naphthalene		720 E	720 E	0
hexachlorobutadiene		<10	<10	—
hexachlorocyclopentadiene		<10	<10	—
2-chloronaphthalene		<10	<10	—
dimethyl phthalate		<10	<10	—
acenaphthylene		120	120	0
fluorene		27	29	7.1
acenaphthene		<10*	<10*	—
2,4-dinitrotoluene		<10	<10	—
2,6-dinitrotoluene		<10	<10	—
diethylphthalate		<10	<10	—
4-chlorophenyl phenyl ether		<10	<10	—
N-nitrosodiphenylamine		<10	<10	—
4-bromophenyl phenyl ether		<10	<10	—
hexachlorobenzene		<10	<10	—
phenanthrene		25	27	7.7
anthracene		<10*	<10*	—
di-n-butyl phthalate		<10*	<10*	—
fluoranthene		<10*	<10*	—
benzidine		<50	<50	—
pyrene		<10*	<10*	—
butyl benzyl phthalate		<10	<10	—
3,3'-dichlorobenzidine		<20	<20	—
benzo(a)anthracene		<10	<10	—
bis(2-ethylhexyl)phthalate		<10*	<10*	—
chrysene		<10	<10	—
di-n-octyl phthalate		12	<10*	—
benzo(b)fluoranthene		<10	<10	—
benzo(k)fluoranthene		<10	<10	—
benzo(a)pyrene		<10	<10	—
indeno(1,2,3-c,d)pyrene		<10	<10	—
dibenzo(a,h)anthracene		<10	<10	—
benzo(g,h,i)perylene		<10	<10	—

*Compound present below measurable detection limit.
E = Estimated value, exceeds calibrated range.