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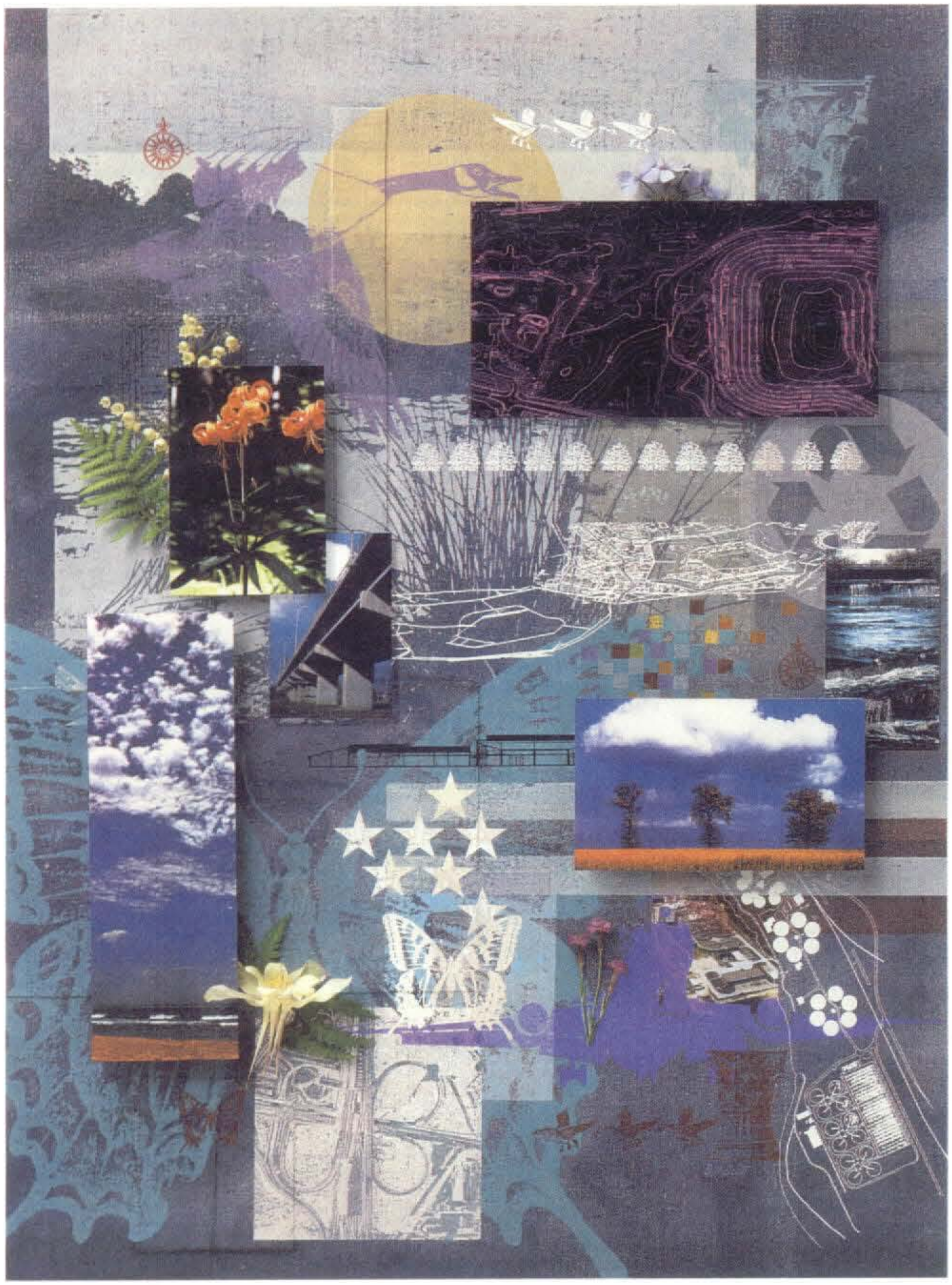

Description of Current Conditions

Bethlehem Steel Corporation

Sparrows Point, Maryland

Volume I

Prepared by:

Rust Environment & Infrastructure
Harrisburg and Philadelphia offices

January 1998

Quality through teamwork

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1.0 INTRODUCTION

1.1 PURPOSE

This *Description of Current Conditions Report* (DCC Report) has been prepared to satisfy the requirements of Section V-B1 of the Multimedia Consent Decree (Consent Decree) among Bethlehem Steel Corporation (BSC), the Maryland Department of the Environment (MDE), and the U.S. Environmental Protection Agency Region III (EPA) [United States of America, et al. v. Bethlehem Steel Corporation, Civil Action No. JFM-97-558, entered October 8, 1997 in U.S. District Court for the District of Maryland]. The complete text of this section of the Consent Decree is as follows:

> *Within ninety (90) calendar days of the effective date of this Consent Decree, BSC shall submit to EPA and MDE for approval a Description of Current Conditions at the Facility ("Description"). This Description shall address the items in Task I of the Site Wide Investigation Scope of Work contained in Attachment C.*

By agreement among the parties, the due date for submission of the DCC Report was extended by 14 calendar days.

This DCC Report describes the current conditions at BSC's Sparrows Point Facility that are relevant to RCRA Corrective Action and supplements the Final RCRA Facility Assessment Phase II Report (RFA Report) dated August 12, 1993. It serves as the starting point for planning and conducting a Site-Wide Investigation (SWI) of BSC's Sparrows Point Facility. The SWI will provide a basis from which any subsequent Corrective Measures activities will be studied and/or implemented.

The DCC Report addresses the items in "Task I: Description of Current Conditions" of Attachment C of the Consent Decree (Site Wide Investigation Scope of Work) consistent with the understanding contained in the second introductory paragraph to Section V of the Consent Decree (Corrective Measures Work to be Performed). Table 1-1 lists the Scope of Work items and shows how and where they are addressed in the DCC Report.

1.2 REPORT ORGANIZATION

Volume I of the DCC Report is organized as follows:

- Section 1 -- Introduction.
- Section 2 -- Facility Background -- provides a brief overview of the physical setting of the site, a summary of the facility's use and history, and descriptions of previous investigations performed at the site.
- Section 3 -- Evaluation of Potential Contaminant Sources --provides information that describes current conditions for Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs) that are potential sources of releases to the environment and are therefore relevant to RCRA Corrective Action at BSC's Sparrows Point Facility, including the procedures used for screening

out SWMUs identified in the RFA Report and for identifying chemicals of potential interest (COPIs) at the SWMUs retained for further investigation. It also provides descriptions of six additional AOCs not identified in the RFA Report.

- Section 4 -- Evaluation of Potential Migration Pathways -- provides an extensive characterization of the groundwater migration pathway and summarizes key information relevant to the air migration pathway. Because stormwater discharges from the site are regulated under a NPDES permit, the surface water (runoff) migration pathway is not discussed.

- Section 5 -- Evaluation of Potential Receptors -- provides information on ecological conditions, potential on-site and off-site ecological receptors, regional ecological exposures to contaminants, off-site land uses and human receptors, on-site human receptors, and preliminary risk assessment conceptual models for on-site and off-site ecological and human receptors.

- Section 6 -- Implementation of Interim Measures -- provides information on the Interim Measure being conducted at the Rod and Wire Mill Sludge Bins Area.

- Section 7 -- References.

In Volume I of the DCC Report, figures and tables are located following the text of each chapter. Appendices are contained in Volume II of the DCC Report.

Table 1-1
DCC Report Content Checklist
Bethlehem Steel Corporation
Sparrows Point, Maryland

Scope of Work Items	How Addressed in DCC Report
TASK I: DESCRIPTION OF CURRENT CONDITIONS BSC shall submit for MDE/EPA approval a report providing the background information pertinent to the facility, the nature of contamination, and the interim measures as set forth below. The data gathered during any relevant previous investigations or inspections and other relevant data shall be included.	The Description of Current Conditions (DCC) Report was submitted to EPA and MDE on January 20, 1998 in accordance with the Multimedia Consent Decree.
A. Facility Background BSC's report shall summarize the regional location, pertinent boundary features, general facility physiography, hydrogeology, and historical use of the facility for the treatment, storage, or disposal of solid wastes, hazardous wastes and hazardous constituents. BSC's report shall include:	Facility Background is addressed in Section 2.
1. Map(s) based on existing information and records depicting the following: a. General geographic location; b. Property lines, with the owners of all adjacent property clearly indicated; c. Topography (with a contour interval of 2 feet and a scale of 1 inch = 100 feet), waterways, all known wetlands, floodplains, water features, drainage patterns; d. All tanks, buildings, utilities, paved areas, easements, rights-of-way, and other features;	a. General location is shown in Figure 2-1. b. Property lines and off-site owners are shown in Figure 5-1. c. & d. Topography, natural site features, and man-made site features are shown in the Topographic Map set included with the DCC Report (contour interval of 1 ft and scale of 1 inch = 50 ft).

Table 1-1
DCC Report Content Checklist
Bethlehem Steel Corporation
Sparrows Point, Maryland

Scope of Work Items	How Addressed in DCC Report
(1. Maps... cont'd) e. All solid waste, hazardous waste, and hazardous constituent treatment, storage, or disposal areas active after November 19, 1980; f. All known past solid waste, hazardous waste and hazardous constituent treatment, storage, or disposal areas and all known spill, fire, or other accidental release locations regardless of whether they were active on November 19, 1980; g. All known past and present product and waste underground tanks or piping; h. Surrounding land uses (residential, commercial, agricultural, recreational); and i. Location of all production and groundwater monitoring wells. These wells shall be clearly labeled. Ground and top of casing elevations shall be included (these elevations may be included as an attachment). All maps shall be consistent with the requirements set forth in 40 C.F.R. Section 270.14 and be of sufficient detail and accuracy to locate and report all current and future work performed at the site;	e., f., & g. Solid waste, hazardous waste, hazardous constituent, fire, spill, underground tank, and piping features relevant to RCRA Corrective Action at the BSC Sparrows Point Facility are shown in Figure 3-1. h. Surrounding land uses are shown in Figure 5-8. i. Production well locations are shown in Figure 4-8. Monitoring well locations are shown in Figures 3-9, 6-2, 6-3, 6-5, 6-6, and 6-7, and in Appendix 2C.
2. History and description of ownership and operation, solid waste, hazardous waste and hazardous constituent generation, and treatment, storage, and disposal activities at the facility;	Ownership and operation are addressed in Section 2, and waste generation, treatment, storage, and disposal activities are addressed in Sections 2 and 3.

Table 1-1
DCC Report Content Checklist
Bethlehem Steel Corporation
Sparrows Point, Maryland

Scope of Work Items	**How Addressed in DCC Report**
3. Approximate dates or periods of past product and waste spills, identification of the materials spilled, the amount spilled, the location of the spills, and a description of the response actions conducted (local, state, or Federal response units or private parties), including any inspection reports or technical reports generated as a result of the response; and	Past spills are addressed in Section 2.3.5 and Appendix 2A.
4. Summary of past permits requested and/or received, any enforcement actions and their subsequent responses.	Environmental permits are addressed in Section 2.3.6, Tables 2-1, 2-2, and 2-3, and Appendix 2B.
B. <u>Natural and Extent of Contamination</u> BCS shall prepare and submit a preliminary report describing the existing information on the nature and extent of contamination.	The nature and extent of contamination is addressed in Section 3 (sources), Section 4 (migration pathways), and Section 5 (receptors).
1. BSC's report shall summarize all possible source areas of contamination. This, at a minimum, should include all regulated units, solid waste management units, spill areas, and other suspected source areas of contamination. For each area, BSC shall identify the following: a. Location of unit/area (which shall be depicted on a facility map); b. Quantities of solid wastes, hazardous wastes and/or hazardous constituents; c. Hazardous waste and/or hazardous constituents, to the extent known; and d. Identification of areas where additional information is necessary.	Potential sources of contamination are addressed in Section 3 and located in Figure 3-1. Potential sources requiring additional consideration are identified throughout the text of Section 3 and summarized in Table 3-2. Chemicals of potential interest (hazardous waste and/or hazardous constituents) are discussed throughout the text of Section 3 and Summarized in Tables 3-3 and 3-4.

Table 1-1
DCC Report Content Checklist
Bethlehem Steel Corporation
Sparrows Point, Maryland

Scope of Work Items	How Addressed in DCC Report
2. BSC shall prepare an assessment and description of the existing degree and extent of contamination. This should include: a. Available monitoring data and qualitative information on locations and levels of contamination at the facility; b. All potential migration pathways including information on geology, pedology, hydrogeology, physiography, hydrology, water quality, meteorology, and air quality; and c. Potential impact(s) on human health and the environment, including demography, groundwater and surface water use, and land use.	a. Available monitoring data and information on contaminant levels is addressed in Sections 2.4 and 4.2.4 b. Potential migration pathways are addressed in Section 4. c. Potential receptors are addressed in Section 5.
C. Implementation of Interim Measures BSC's report shall document interim measures which were, or are, being undertaken at the facility. This report shall include:	Interim Measures are addressed in Section 6. The Interim Measure (IM) at the Rod and Wire Mill is the only IM in place at the Facility.
1. Objectives of the interim measures: how the measure is mitigating a potential treat to human health and the environment and/or is consistent with and integrated into any long-term solution at the facility;	The initial conditions and effectiveness of the IM at the Rod and Wire Mill are addressed in Sections 6.2.1 and 6.2.3.
2. Design, construction, operation, and maintenance requirements;	The components and operation of the IM at the Rod and Wire Mill are addressed in Section 6.2.2.
3. Schedules for Design, construction, operation and maintenance, and monitoring; and	The operation, maintenance, and monitoring requirements are addressed in Section 6.2.4 and Appendix 6A.
4. Schedule for progress reports.	The schedule for progress reports is addressed in Section 6.2.4.

2.0 FACILITY BACKGROUND

2.1 INTRODUCTION

The purpose of this section is to present general facility background information for the BSC Sparrows Point site. This section provides a brief overview of the physical setting of the site, a summary of the facility's use and history, and descriptions of previous investigations performed at the site.

The overview of the physical setting includes discussions of land use, physiography, climate, regional geology, and regional hydrogeology. The summary of facility use and history includes brief discussions of iron and steel production, coal chemical and by-product recovery systems, and waste generation and management systems, as well as descriptions of the shipyard, the sequence of fill placement at the facility, and information on spills and regulatory permits.

2.2 FACILITY SETTING

2.2.1 Location and Surrounding Land Use

The BSC Sparrows Point facility is located in Baltimore County, Maryland at the southeast corner of the Baltimore metropolitan area, approximately nine miles from the downtown area. The facility occupies all of a peninsula which is bounded to the west by Bear Creek; to the south by the Patapsco River; and to the east by Jones Creek, Old Road Bay, and residential areas of the City of Edgemere. The facility is bounded to the north by the Sparrows Point Country Club. Figure 2-1 is a Location and Topographic Map of Sparrows Point prepared using the currently available U.S. Geological Survey (USGS) topographic maps for the site. Because the most recent revision of these maps occurred in 1974, they do not represent the current conditions of the site. The current physical conditions of the site are shown in Figure 2-2, an aerial photograph of the site taken in October 1995. A Site Map of the Sparrows Point facility, modified from a BSC CADD drawing, is shown on Figure 2-3. The approximate center of the site is located at N39° 13' 47" latitude and W76° 28' 66" longitude. The site is approximately 2300 acres.

Zoning maps were obtained from the Baltimore County Office of Zoning and Planning. Map G-2, dated January 1986 and updated partially to December 1989, indicates that the BSC Sparrows Point site is zoned Manufacturing Heavy - Industrial, Major (MH-IM). Surrounding property zoning classifications include the following: Manufacturing Light (ML), Resource Conservation (RC), Density Residential (DR), Business Roadside (BR), Business Major (BM), Business Local (BL), and Residential Office (RO). The Sparrows Point Country Club is located north of the BSC facility on the other side of the Peninsula Expressway. Light industrial and commercial properties are located northeast of the site and northwest of the site on the other side of Bear Creek. Residential areas of Edgemere and Fort Howard are located northeast of the site and east of the site on the other side of Jones Creek and Old Road Bay. Residential areas of Dundalk are located northwest of the site on the other side of Bear Creek.

2.2.2 Physiography, Topography and Surface Drainage

Physiographically, the Baltimore area is situated within the Atlantic Slope region which is further subdivided into the Piedmont Plateau and Coastal Plain provinces (Figure 2-4). The Sparrows Point facility is wholly located in the Coastal Plain Province. The Coastal Plain is the relatively low part of the Atlantic Slope and is bounded on the east by the edge of the Continental Shelf in the Atlantic Ocean and on the west by the Piedmont Plateau. The boundary between the Coastal Plain and the Piedmont Plateau is known as the Fall Line and is characterized by a zone of rapids and/or waterfalls in the streams flowing from the relatively steeper Piedmont Plateau onto the Coastal Plain (Bennett and Meyers, 1952; Ryan, 1953; and Crowley et al., 1971).

The topographic development of the Atlantic Slope region is directly related to the regional geology. Topographic elevations in the Coastal Plain are generally less than 300 feet above mean sea level (msl) whereas elevations in the Piedmont Plateau can exceed 500 feet msl. The Piedmont Plateau is underlain by relatively hard, structurally complex, crystalline Pre-Cambrian and early Paleozoic rocks. The Coastal Plain is underlain by relatively soft, generally unindurated, easily eroded sediments of the Cretaceous, Tertiary, and Quaternary Systems. These Coastal Plain sediments are underlain by the crystalline Pre-Cambrian and early Paleozoic rocks which extend from the Piedmont Plateau and are generally referred to as "basement" rocks (Bennett and Meyers, 1952; and Ryan, 1953).

As previously discussed, the Sparrows Point facility is located on a peninsula (Figure 2-1). Currently, the peninsula is bordered by water on three sides with its land connection predominantly to the north and northeast. The peninsula is bounded to the east by Old Road Bay and Jones Creek; to the south by the Patapsco River; and to the west by Bear Creek, all of which directly or indirectly drain to the Chesapeake Bay (USGS, 1969) located southeast of the site. In 1916, prior to the site's development as a major steel manufacturing facility, the northern portion of the peninsula was divided by Humphrey Creek and the land connection for each of the sections was to the northeast (Figure 2-5).

The current ground surface at the Sparrows Point site is relatively flat. All major topographic features (such as buildings, landfills, and material stockpiles) are manmade. Throughout most of the peninsula, the elevation of the ground surface is between 10 and 20 feet msl (USGS, 1969). The average elevation is about 15 feet msl. In the southern portion of the site, there are several man-made landforms (raw and byproduct material stockpiles) that exceed 20 feet msl in elevation. Stockpile elevations are dynamic but in general are maintained in maximum pile heights of approximately 40 to 75 feet depending on location and material characteristics (D'Appolonia, January 1980). Greys Landfill, located near the northwestern corner of the property, has an elevation of approximately 65 feet msl.

Surface water runoff is diverted and collected by a network of culverts, underground pipes, and drainage ditches within the process areas of the plant. The stormwater is then discharged to Bear Creek, Jones Creek/Old Road Bay, and the Patapsco River. Prior to 1970, much of the stormwater from the northern part of the site was discharged to Humphrey Creek and subsequently to Bear Creek. Between 1950 and 1970, the Tin Mill Canal (SWMU 1) was constructed within portions of Humphrey Creek which continued to receive stormwater from the northern part of the site. Since about 1970, stormwater runoff from the northern part of the site has discharged to the Tin Mill Canal, and been conveyed to Humphrey Creek Wastewater Treatment Plant (HCWWTP) for treatment.

Thirty-five outfalls (001, 012-014, 016-019, 021, 030, 032-038, 042, 044, 046, 054-057, 059-063, 065-066, 068-071) are covered under the current NPDES Permit Reapplication Update (BSC, June 1993). Eleven outfalls discharge to Jones Creek and/or Old Road Bay. Six outfalls discharge to Bear Creek. Eighteen outfalls discharge to the Patapsco River. Outfall 014 discharges to Bear Creek and is the discharge point for stormwater runoff and process wastewater treated at HCWWTP. A.T. Kearney (1993) reported that stormwater runoff from approximately two-thirds of the facility discharges through outfalls 012, 013, 014, 017, 018 and 021. Stormwater also discharges from outfalls 001 and 016.

The Shipyard, formerly known as the BethShip Division, is located along the west-central edge of the site and had 18 permitted outfalls (NPDES Permit No. MD0001180) that conveyed varying amounts of steam condensate, stormwater runoff, drinking water fountain drainage, and freeze protection flow. The Shipyard property and its operations were sold to Baltimore Marine Industries, Inc. (BMI) on or about October 2, 1997. BMI now owns and operates the Shipyard and is responsible for negotiating the terms of a new NPDES permit with MDE.

The RFA Report (A.T. Kearney, 1993) indicated that several portions of the site are located within the 100-year floodplain, including the Tin Mill Canal Area (SWMUs 1-9), the Humphrey Creek Wastewater Treatment Plant Area (SWMUs 10-17), the Chrome Recovery Area (SWMUs 18-26), and Humphrey Impoundment (SWMU 190). According to the flood insurance map for the plant area (Community Panel 240010 0555B, effective date March 2, 1981) the 100-year floodplain elevation is 9 feet msl.

2.2.3 Climate and Meteorology

Climatic information for the Sparrows Point area is compiled mostly from data collected at the Baltimore-Washington International (BWI) Airport which is located approximately 10 miles southwest of the site. Baltimore lies in the mid-Atlantic region of the east coast of the U.S. in the upper Chesapeake Bay area. The climate is moderately humid and is characterized by warm summers and relatively mild winters.

Large semi-permanent high pressure systems of warm air masses are common in the summertime. July is the warmest month with an average maximum daily temperature of 87° F and an average daily minimum temperature of 67° F. January is typically the coldest month with an average maximum daily temperature of 42° F and an average daily minimum temperature of 25° F. The annual mean average temperature is 56° F.

The average annual precipitation is approximately 42 inches. The average annual snowfall is 21 inches. Snow typically occurs on 22 days during the winter season and is often mixed with rain and/or sleet.

At the BWI Airport, the prevailing wind is from the west to west-northwest with wind speeds annually averaging nine knots with gusts to 67 knots. Summer months typically produce the highest wind velocities, particularly during thunderstorm conditions. Manmade structures tend to minimize any severe wind conditions.

On-site monitoring of meteorological conditions has been performed since September 1995 and continues on an on-going basis. The on-site data through January 1997 are presented and discussed in Section 4.3.

2.2.4 Regional Geology

The general geologic stratigraphy of the Baltimore area is shown on Figure 2-6, and a geologic map of the Baltimore area is presented as Figure 2-7. The crystalline Pre-Cambrian and early Paleozoic basement rocks are unconformably overlain by the Patuxent Formation which is conformably overlain by the Arundel Formation. The Arundel Formation is unconformably overlain by the Patapsco Formation which represents the uppermost Cretaceous sediments. Pleistocene sediments unconformably overlie the Cretaceous sediments (Chapelle, 1985). In places, Recent deposits of natural and anthropogenic origin overlie the Pleistocene sediments.

2.2.4.1 Basement Rocks

The basement rock surface forms a structure named the Salisbury Embayment, which is part of a larger basement structure called the Chesapeake-Delaware Embayment (Chapelle, 1985). The basement rocks in the Baltimore area outcrop along the Fall Line and dip to the southeast with a slope of approximately 90 feet per mile (Bennett and Meyers, 1952). Figure 2-8 is a structure map for the top of the basements rocks and shows the altitude (in feet below sea level) at which these rocks will be encountered.

In general, the Coastal Plain sediments thicken to the southeast and comprise a wedge-shaped mass lapping over the east-sloping crystalline-rock floor (Figure 2-9). The strike of the formations is generally northeast and the oldest Coastal Plain sediments crop out along the Fall Line in sequential northeast-oriented bands (Bennett and Meyers, 1952; and Ryan, 1953).

2.2.4.2 Patuxent Formation

The Patuxent Formation is the lowermost unit of the Potomac Group. The Patuxent sediments consist primarily of quartzose gravel and sand interbedded with silty clay lenses. The thickness ranges from 50 to 250 feet. The average grain size of the sediments generally decreases (fining upward sequence) from the base to the top of the unit. Gravel and coarse sand with only minor amounts of silty clay comprise the basal section, while the upper section is comprised mainly of fine sand and silty clay. Figure 2-10 is an outcrop and structure map of the top of the Patuxent Formation and shows the area where this formation is exposed at the ground surface and the altitude at which the formation will be encountered.

The Patuxent Formation in the Baltimore Area originated as a continental deposit (Chapelle, 1985). The formation is generally unfossiliferous; however, plant fossils have been found in a few locations

(Bennett and Meyers, 1952). The sedimentological record indicates a fluvial braided-stream depositional environment that through time evolved into a meandering stream environment with overbank and levee deposits (Chapelle, 1985).

2.2.4.3 Arundel Formation

The Arundel Formation, or Arundel Clay, is the middle unit of the Potomac Group. In the Baltimore area it is a red to red-yellow, dense, plastic clay with thin lenses of silt. The composition of the clay is predominantly kaolinite and illite. The Arundel Clay ranges in thickness from 25 to 200 feet and thickens to the east and south. Figure 2-11 is an isopach map of the Arundel showing the thickness of the formation in the Baltimore area. The variable thickness of the formation is likely due to post-depositional erosion (Chapelle, 1985). Figure 2-12 is a structure map that shows the altitude of the top of the Arundel Formation and a northwest-trending erosional depression that is apparent in the Dundalk and Sparrows Point areas (Bennett and Meyers, 1952).

The depositional environment of the Arundel is interpreted as a non-marine, low-energy, meandering stream on a broad flat flood plain or marshy paleoenvironment (Chapelle, 1985). Dinosaurian fauna have been reported in some localities and pyritic and lignitic plant fossils have been described.

2.2.4.4 Patapsco Formation

The Patapsco Formation is the upper-most unit in the Potomac Group. In the Baltimore area, the Patapsco is comprised of interbedded sands, silts, and clays, and its thickness ranges from 0 to 200 feet. The finer-grained silt- and clay-size sediments comprise 40 to 60 percent of the formation. The remaining sand-size sediments are mostly quartz and trace amounts of feldspar and heavy minerals. (Chapelle, 1985).

The Patapsco was also deposited under non-marine continental conditions. Individual fining upward beds 5 to 20 feet thick are common in outcrop. These fining upward units indicate that a meandering-stream depositional environment was present during the Patapsco sedimentation (Chapelle, 1985).

2.2.4.5 Pleistocene Formations

Quaternary sediments of Pleistocene age are present directly above the Cretaceous sediments of the Potomac Group at thicknesses from 0 to 150 feet (Bennett and Meyers, 1952; Chapelle, 1985; and Bachman and Wilson, 1984). The sand, gravel, and clay that comprises the Pleistocene sediments are divided into two generalized formations: upland deposits and lowland deposits. This distinction is based on the relative altitude of the terraces they form. The upland deposits are generally mapped as the Brandywine, Sunderland, and Wicomico Formations. These deposits are not widespread and are present as thin caps on high ridges and hills. The lowland deposits are mostly mapped as the Talbot Formation and occur generally below an altitude of 50 feet. The lowland deposits are relatively widespread and are well exposed along the shore area of the Chesapeake Bay and its estuaries (Chapelle, 1985).

The Pleistocene sedimentary record indicates both marine and non-marine origins for the deposits in the Baltimore area. The lowland deposits of the Talbot Formation are interpreted to be related to the evolution of the Susquehanna River and the Chesapeake Bay. Figure 2-13 is an isopach map of the Pleistocene deposits showing the thickness of these deposits in the Baltimore area. The thickness of the deposits indicates that the ancient Susquehanna River eroded into the Patapsco Formation during the Pleistocene. Marine sediments were then deposited during a glacially associated transgression of the sea (Bennett and Meyers, 1952). A possible paleochannel is represented by the northwest-southeast trending band of thicker sediments (50 to 75 feet) which are present in the vicinity of the current Patapsco River. The increased thickness of the Talbot deposits to over 125 feet in the Sparrows Point area may also indicate an area of deeper channel erosion and subsequent backfill. The interpreted location of other paleochannels has been annotated on Figure 2-13.

2.2.4.6 Recent Deposits

Recent sedimentary deposits are also present in the Baltimore area. They are generally fine-grained, thin deposits. These deposits are usually not differentiated from the Pleistocene deposits in water well records (Bennett and Meyers, 1952). Made-land or anthropogenic deposits are also present at the surface in the Baltimore area. These deposits are generally not mapped geologically, but they can be identified by comparing historic information (maps and photos) with current information.

2.2.5 Regional Hydrogeology

The water-bearing properties of the geologic formation in the Baltimore area are shown in Figure 2-6. Aquifers in the Patuxent and Patapsco Formations are the primary groundwater sources in the Baltimore area. Local water supplies can be produced from the Talbot (i.e., Pleistocene) Formation. In areas close to estuaries, water supply wells in any of these formations are susceptible to chloride contamination.

2.2.5.1 Patuxent Aquifer

The aquifer in the Patuxent Formation is a significant source of groundwater for the Baltimore area. The most productive zone of the Patuxent Formation is the braided-stream facies. In the Baltimore Area, the term "Patuxent Aquifer" generally refers to this facies. Transmissivities of the Patuxent aquifer increase to the southeast and range from about 20 cm^2/sec in the center of Baltimore to nearly 75 cm^2/sec near Sparrows Point. Storage coefficient values are reported to range from 0.00019 to 0.000038. The Arundel Formation is the upper confining bed of the Patuxent aquifer and the crystalline bedrock generally acts as a lower confining bed (Bennett and Meyers, 1952; and Chapelle, 1985). Vertical hydraulic conductivity values of the Arundel have been reported at 10^{-8} to 10^{-10} cm/sec (Chapelle, 1985).

Both current and historic discharge from the Patuxent aquifer is primarily through water-well withdrawals. Historic use of the Patuxent aquifer dates back to the 1850's. By 1900, the total pumpage in the Baltimore area was approximately 7 Mgal/d. By the end of World War II, approximately 28 Mgal/d were being pumped. By 1982, the pumpage had decreased to about 11 Mgal/day. The potentiometric surfaces of the Patuxent aquifer in the Baltimore area for 1945 and as approximated under pre-pumping conditions are shown on Figure 2-14. The approximate potentiometric surface for 1982 is shown on Figure 2-15. A review of these maps indicates that there has been a rise in water levels from 1945 (peak usage) to 1982 in response to the decrease in water production. The Patuxent aquifer is recharged through outcrop exposures of the Patuxent Formation along the fall line to the northwest of the Sparrows Point area (Figure 2-15).

Elevated chloride concentrations caused by saltwater encroachment has been documented in the Patuxent aquifer since the 1930's. Figure 2-16 shows the mapped extent of saltwater encroachment for the years 1945 and 1982. Elevated chloride concentrations are typically located in areas near the Patapsco River and are believed to be related to subcrops of the Patuxent formation beneath the river channel (Chapelle, 1985).

2.2.5.2 Patapsco Aquifer

The aquifer in the Patapsco Formation is also a source of groundwater for the Baltimore area. A sand facies in the lower part of the Patapsco Formation is considered the principal source of water in the Patapsco aquifer. Transmissivity values for the lower sand facies are reported to range from 20 to 40 cm^2/sec, and storage coefficients are reported to range from 0.0027 to 0.000053. The Patapsco aquifer is predominantly unconfined in the Baltimore area because the formation outcrops or subcrops throughout much of the area and therefore has no upper confining bed. Where the Patapsco is confined (i.e., as at Sparrows Point), the overlying Pleistocene sediments serve as the upper confining bed and the Arundel Formation is the lower confining bed. Vertical hydraulic conductivities for the Pleistocene sediments have been reported to range from 10^{-6} to 10^{-9} cm/sec. In some parts of the Baltimore area, including the Sparrows Point site, the Patapsco Formation contains a well-defined "middle clay bed" that separates the lower sand facies from the upper part of the formation (Bennett and Meyers, 1952; and Chapelle, 1985). Where this occurs, the upper part of the Patapsco is also a source of groundwater, although it is less reliable and produces smaller yields.

The Patapsco aquifer was used as a source of groundwater prior to 1900 and during the early part of the 20th century. Because the Patapsco aquifer widely subcrops beneath the brackish Patapsco River, elevated chloride concentrations became a major problem in areas near the Patapsco River estuary. By 1945, almost all water production from the Patapsco had ended due to excessive chloride in the Harbor, Canton, and Dundalk areas. The BSC plant was the only major user of the Patapsco aquifer in 1945. Water production totaled about 3 Mgal/d; however, by the late 1940's and 1950's, many of the Sparrows Point wells were affected by elevated chlorides and were abandoned. As of 1985, there was no major use of the Patapsco aquifer in the immediate vicinity of the Patapsco River estuary. Figure 2-17 shows the potentiometric surface of the Patapsco aquifer for the years 1945 and 1982. Figure 2-18 shows the areal distribution of elevated chloride concentrations in 1945 and 1982. A review of these maps shows that the groundwater level has recovered significantly since pumping in the Sparrows Point area was reduced; and, likewise, the area impacted by elevated chloride levels has been reduced (Chapelle, 1985).

The Patapsco aquifer is recharged through outcrop exposures of the Patapsco Formation to the northwest of the Sparrows Point area (Figure 2-17). In 1945, significant discharge occurred in the Sparrows Point through water-well withdrawal. With the cessation of pumping since 1945, and the consequent recovery of water levels in the aquifer, discharge now occurs through subcrop exposures into the bay or estuaries (1982 map in Figure 2-17).

A vertical gradient between the Patuxent and Patapsco Aquifers can be seen from the potentiometric surface information presented in Figures 2-14, 2-15, and 2-17. In 1945, the elevations of the potentiometric surfaces for the Patuxent and Patapsco aquifers at Sparrows Point were - 60 feet msl and -40 feet msl respectively, indicating a downward vertical gradient from the Patapsco aquifer to the Patuxent aquifer. In 1982, the elevations of the potentiometric surfaces were -27 to -38 feet msl and +1 feet msl. The potential for downward groundwater movement from the Patapsco to the Patuxent aquifer exists; however, the Arundel Formation separates the two aquifers and serves as an aquitard, substantially limiting direct hydraulic communication between the two aquifers.

2.2.5.3 Pleistocene Groundwater

Although not commonly done, local supplies of groundwater can be developed in the Pleistocene lowland deposits of the Talbot Formation in the Baltimore area. Wide variations have been reported for the transmissivity of water-bearing zones in the Talbot Formation in the Sparrows Point area. This variability is due to the discontinuous and lenticular nature of the water-bearing sand and gravel deposits caused by the interfingering of marine and fluvial facies within the Talbot Formation (Bennett and Meyers, 1952). Several wells completed in the Talbot Formation at Sparrows Point (Bal-Gf 42, 43, 58, 62, 66, 69, and 141 to 153) are now abandoned. Yields were reported at about 25 to 50 gallons per minute (gpm). Elevated chloride concentrations in the Talbot Formation is wide-spread along the Patapsco River and its estuaries, and salt-water encroachment is a significant factor limiting development of water supplies in the Talbot Formation (Bennett and Meyers, 1952).

Groundwater recharge to the Talbot Formation occurs primarily through the percolation of local precipitation to the water table. Discharge is primarily by natural means to springs and surface waters of local rivers, streams, and estuaries.

2.3 FACILITY USE AND HISTORY

2.3.1 Overview

Pennsylvania Steel built the first furnace at Sparrows Point in 1887. The first iron was cast in 1889. Bethlehem Steel Corporation (BSC) purchased the Sparrows Point facility in 1916 and enlarged it by building mills to produce hot rolled sheet, cold rolled sheet, galvanized sheet, tin mill products, and steel plate. These products are still produced today.

During peak production in 1959, the facility operated 12 coke oven batteries, 10 blast furnaces, and four open hearth furnaces. The coke ovens ceased operations in December 1991. Demolition work began in June 1992 and was completed by November 1993 for batteries 1-6, and 9-10. Batteries 7 and 8 had been removed during the 1980's. Batteries A, 11, and 12 are being torn down.

BSC currently operates L blast furnace. H and J furnaces formerly operated as backups during L furnace maintenance. Only these three furnaces remain today. Furnaces A-G and K were demolished and removed from the site during a period between 1979-1985.

Steel is currently made in two Basic Oxygen Furnaces (BOFs). Open Hearth furnace shops # 1, #2, #3, and #4, which were formerly used for steel production, are no longer in service. Other iron and steel making operations and associated facilities are discussed later in this section.

2.3.2 Steel Manufacturing Operations

Steel manufacturing involves handling of vast amounts of raw materials including coke, iron ore, limestone, and scrap steel, as well as recovering byproducts and managing waste materials. The locations of the various general operating facilities are shown in Figure 2-19. The operations and/or processes listed below either were or are performed at the Sparrows Point facility:

- Iron and Steel Production
    - Raw Material Handling
    - Coke Production
    - Sinter Production
    - Iron Production
    - Steel Production and Semi-Finished Product Preparation
    - Finished Product Preparation
    - Discontinued Finished Product Operations
- Coal Chemical Recovery System
    - Coal Chemical Plants
    - Benzene and Litol Plants
    - Hydrogen Cyanide Strippers
    - Desulfurization Plant and Sulfur Recovery
- Other Byproducts Recovery Systems
    - Ammonia Removal Plant
    - Green Pellet Plant
    - Ball Mill
    - Palm Oil Recovery (non-BSC)
    - Slag Processing (non-BSC)
- Wastewater Treatment Systems
    - Bio-Oxidation Plant
    - Blast Furnace/Sinter Plant Water Treatment System
    - BOF Water Treatment System
    - Chromium High Density Sludge (HDS) Plant
    - Tin Mill Canal and Humphrey Creek Wastewater Treatment Plant
- Solid Waste Management
    - Greys Landfill
    - Coke Point Landfill
    - Humphrey Impoundment
- Air Pollution Control

The following sections present brief descriptions of these operations and/or processes.

2.3.2.1 Iron and Steel Production

Iron- and steel-making involves raw material handling, coke production, sinter production, iron production, steel production, semi-finished product preparation, and finished product preparation.

Raw Material Handling

Most of the raw materials used in the production of iron and steel are stockpiled in the ore pier area located in the south-central portion of the site. The raw materials include iron ore, coke, crushed limestone, quartz gravel, sand, mill scale, and pellet fines.

Coke Production

Coke was produced on site for use as a fuel in the iron-to-steel making process. A total of 13 coke oven batteries were used between the 1930's and 1991 at which time the coke ovens ceased operations. Ten of the coke oven batteries have been removed. Demolition of batteries 1-6 was completed in May 1991. Batteries 7 and 8 had been demolished during the 1980's. Demolition work on batteries 9 and 10 began in June 1992 and was completed by November 1993. Batteries A, 11, and 12 are currently being torn down. During the period of active coke production, coal was stored in an area located north of Coke Point Landfill and southwest of the Benzene\Litol Plant.

Sinter Production

BSC used to have seven sinter strands, and now there is only one. Sinter is an agglomerated and fused mixture of fine-sized materials such as iron ore, coke breeze, fluxstone, mill scale, and flue dust used to charge the blast furnaces. After fusing, the sinter product is crushed and screened. Undersized sinter fragments are recycled, and acceptably sized sinter is air cooled, screened again, then sent to charge the blast furnaces.

Iron Production

Iron is produced in blast furnaces where iron ore (or iron-bearing pellets), sinter, coke, and limestone are continuously fed into the top of the furnace. Solid materials are ultimately heated by the hot air and fuel injected in the lower section of the furnace and from coke burning. Molten iron forms from the heating and reaction with these gases. The limestone reacts with the ore impurities to form slag which floats atop the molten iron. The slag is separated and transferred directly to the granulated Slag Plant and then taken to an on-site processing area. The iron is drawn from the furnace bottom to hot metal cars for transport to the steel making furnaces. Currently, only blast furnace L is operating. H and J furnaces are not in operation.

Steel Production and Semi-Finished Product Preparation

Molten iron and ferrous scrap metal are refined by oxidation in the steel-making process. Once refined, alloys are added to the molten iron for the desired grade of steel. Currently, Bethlehem uses two Basic Oxygen Furnaces (BOFs) to produce steel. Slag is also generated in this process and is taken to the reprocessing area on-site. The steel is continuously cast and semi-finished steel slabs are cut to proper lengths at two strands of the Continuous Caster for further processing at either the Plate Mill or Hot Strip Mill.

Finished Product Preparation

Finished steel is produced in various portions of the site at the Plate Mill and two Finishing Mills (the Cold Sheet Mill, and the Tin Mill). These mills generate various steel products, all to customer specifications, including hot-rolled sheets and strips, cold-rolled sheets, and flat plates. Some of the products are galvanized, coated with corrosion-resistant alloys (i.e., galvalume or chrome), or tin-plated at the Coating Lines located in the Cold Sheet Mill and the Tin Mill.

Discontinued Finished Product Operations

Two other mills in the northwestern portion of the site, the Rod and Wire Mill and the Pipe Mill, are no longer active. These mills operated between the 1940's and early 1980's producing rods, wire products, and pipes. Activities at the Rod and Wire Mill associated with the leaching of zinc ore and a subsequent treatment process to remove cadmium impurities resulted in contaminated soil and groundwater. In 1986, BSC initiated a groundwater remediation program under Maryland Department of the Environment (MDE) Complaint and Order C-O-85-179 dated February 25, 1985. Current remediation activities include on-going in-situ leaching of contaminated soil and treatment of groundwater pumped from a network of extraction wells. This Interim Measure is described in more detail in Section 6.

2.3.2.2 Coal Chemical Recovery System

During the coke production years, the coal chemical recovery system consisted of several individual plants that operated for raw coke gas treatment. These plants were located in the southwest portion of the site, and included the A and B Coal Chemicals Plants (CCP), the Benzene and Litol Plants, two Hydrogen Cyanide Strippers, and the Desulfurization Plant and Sulfur Recovery. The history and current status of these plants are discussed below.

Coal Chemical Plants

Raw coke oven gas was initially treated at the A or B Coal Chemical Plant (CCP). The A CCP (which served coke oven batteries 1-6 and battery A beginning in the 1930's) and B CCP (which served batteries 11 and 12 beginning in the 1950's) both ceased operations in 1991. These plants contained various oil/water separators, scrubbers, saturators, cooling towers, tar decanters, and numerous tanks. The plant units have been removed or are in the process of being removed.

Benzene and Litol Plants

The Benzene and Litol Plants were distillation and cracking plants, used for the purification of light oil into benzene, toluene, and xylene and operated from the late 1940's through 1986. These plant's contained numerous tanks, coolers, absorbers, and scrubbers. All plant units have been removed.

Hydrogen Cyanide Strippers

Two Hydrogen Cyanide Strippers were used for the removal of hydrogen cyanide from gas generated at the A and B CCPs, and from wastewaters generated in the treatment of this gas. One stripper removed the cyanide from the final cooler condensate. The other removed the cyanide from the coke oven gas before distribution of the gas to the plant. All plant units have been removed.

Desulfurization Plant and Sulfur Recovery

The original Sulfur Recovery Plant operated from the late 1960s through the late 1980s, and it removed about one-third of the sulfur from the A and B CCP coke oven gas. This unit was torn down and replaced with a new unit that would have fully desulfurized the gas. The new unit, which is still in place, was never operated because the coke ovens were shut down in 1991.

2.3.2.3 Other Byproducts Recovery Systems

Byproduct recovery systems that were formerly operated at the BSC facility include the Ammonia Recovery Plant, the Green Pellet Plant, and the Ball Mill. Byproduct recovery systems that are still operated include Palm Oil Recovery, and Slag Reprocessing.

Ammonia Removal Plant

Excess weak ammonia liquor from the A and B CCP coking operations was temporarily stored in a one-million gallon tank prior to pumping it to the Ammonia Removal Plant. At the Ammonia Removal Plant, the liquor was added to a lime slurry, and then sent to a clarifier to remove suspended solids. The pre-limer clarifier sludge was beneficially re-used at the Humphrey Creek Wastewater Treatment Plant for pH adjustment. The clarified liquor went to the Bio-Oxidation Plant for phenol treatment. The ammonia removal treatment process is no longer done at Sparrows Point because the Coke Oven was shut down in 1991.

Green Pellet Plant

The Green Pellet Plant, located in the open hearth furnace shop area near the south-central portion of the site, operated from the early 1970's to approximately 1980. Here, unfired (green) iron ore pellets were manufactured from open hearth and basic oxygen furnace fume dust. The pellets were then charged back into the furnaces. The plant was demolished in 1990.

Ball Mill

The Ball Mill was located west of the coke ovens. There are no reported startup dates, but the mill ceased operations in the 1980's. Coal tar and material from the tar decanter, which formed from the quenching of coke oven gases, was recovered here and processed to a liquid for beneficial use as fuel at the Pennwood Power Station or at the Open Hearths.

Palm Oil Recovery (non-BSC)

The Palm Oil Recovery (PORI) operation, which is independent of BSC and was recently purchased by U.S. Filter, receives and processes waste oils generated by BSC throughout the Sparrows Point facility. PORI operations began around 1950 and are active today under the new ownership. Waste oil is received by an oil/water separator and discharged to a holding tank. Wastewaters are then piped to an earthen lagoon where the waste oil is skimmed and recovered. Wastewaters are discharged (under non-BSC NPDES permit) to the Tin Mill Canal, and further treated at the HCWWTP. Treated wastewaters are then discharged under BSC's NPDES permit to Bear Creek through outfall 014.

Slag Reprocessing (non-BSC)

Slag generated at the Blast Furnace and the BOF is processed on site by C.J. Langenfelder, Inc. At the Blast Furnace, hot slag is dumped in holding bins and sprayed with water to cool and solidify the material. Molten slag from the BOF is tapped from the steel-making vessel into containers (thimbles) for transport to the slag-processing facility where it is dumped and sprayed with water. Cooled, solidified slag is dug from the Blast Furnace slag bins or from piles at the slag facility and separated by crushing and screening into various sizes suitable for sale. Some of the BOF slag is recycled to the iron-making operation.

2.3.2.4 Wastewater Treatment Systems

The generation of a variety of wastewaters, waste pickling liquors, and other aqueous wastes is part of the routine procedures for steel making and steel processing. The RFA Report identified various wastewater treatment plants, scale pits, sumps, tanks, and other pollution control devices associated with the steel making and processing activities. Some of the more important plants/systems are briefly discussed below.

Bio-Oxidation Plant

Most of the wastewater treated at the Bio-Oxidation Plant came from the Ammonia Removal Plant, the Benzene and Litol Plants, and from the A CCP Hydrogen Cyanide Stripper. The treatment system, which is currently being used to treat residual liquids from the dismantling projects in the Coke Oven Area, consists of various tanks, skimmers, oil/water separators, mixing chambers, aeration basins, and thickeners. During operation of the plant, sludge is recycled back to the aeration basin, while clarified (treated) wastewater is discharged through point source location 121 (an internal monitoring point) and subsequently to the Patapsco River through NPDES outfall 021.

Blast Furnace/Sinter Plant Water Treatment System

The Blast Furnace/Sinter Plant Water Treatment System processes water from the Sinter Plant scrubbers and treats slurry from the Blast Furnace recycled water system for soluble zinc and cyanide. The treatment system consists of a thickener, a belt press filter, and two spent pickle liquor tanks. Dewatered sludge (non-hazardous) is disposed in Greys Landfill and water is discharged through NPDES permitted outfall 101.

BOF Water Treatment System

The BOF gas cleaning water treatment system is a recycle system that treats water from four (4) BOF scrubbers used to remove suspended particulates from BOF process gas generated during the production of steel. The treatment system consists of various tanks and settling equipment. Solids are removed and disposed at Greys Landfill. Excess water (blowdown) is sent to the HCWWTP for final discharge through NPDES outfall 014.

Chromium High Density Sludge (HDS) Plant

In 1987 the Chromium High Density Sludge (HDS) Plant (which is called the Chrome Recovery Plant in the RFA) was installed to process chromium-bearing wastewater generated during chromium plating and passivating operations at the Tin Mill. The wastewater treatment system includes several tanks (i.e., reduction, neutralization, flocculation), pH adjustment, thickening, and filtering of solids. Sludge from the treatment process is sent offsite for proper disposal. Treated wastewater is sent to the Humphrey Creek Wastewater Treatment Plant (HCWWTP).

Tin Mill Canal and Humphrey Creek Wastewater Treatment Plant

The Tin Mill Canal (TMC) is a man-made canal constructed in slag fill and located in the northern half of the site. The TMC primarily serves as a conveyance for industrial wastewater discharged from several site facilities. The canal also receives stormwater runoff. The TMC is approximately 7700 feet long, 30 to 50 feet wide, and averages approximately 15 feet in depth. Wastewater flows generally east to west toward the Humphrey Creek Waste Water Treatment Plant (HCWWTP). The eastern portion of the TMC began operating in the early 1950's. The western (remaining) portions of the canal and HCWWTP were completed and began operating in approximately 1969. Treated wastewaters discharge through NPDES outfall 014 to Bear Creek.

2.3.2.5 Solid Waste Management

Solid wastes have been disposed or managed primarily at three areas within the Sparrows Point site: Greys Landfill, Coke Point Landfill, and Humphrey Impoundment.

Greys Landfill

Greys Landfill occupies approximately 40 acres in the northwest corner of the site and is a solid waste disposal area. This unit is currently active and had formerly operated under Maryland Solid Waste and Controlled Hazardous Substances (CHS) Permit No. A074. The landfill is surrounded by a slag berm and is divided into cells assigned for specific wastes including various sludges, centrifuge cakes, dusts, cleanup materials, and asbestos-bearing wastes.

In the northeast corner of Greys Landfill is the Tar Decanter Cell, also known as the Closed CHS Cell. This unit is a 1.5-acre RCRA-regulated disposal cell that received various coal tar sludge, slag, dusts, filter cakes, and miscellaneous debris. The unit was closed and capped in 1984 under a closure plan submitted to MDE in April 1983 and approved in August 1983. The cap consisted of 2.5 feet of slag overlain by three inches of asphalt paving that has been re-paved twice since 1984.

Coke Point Landfill

Coke Point Landfill is located in the southwest corner of the site. The Coke Point Landfill currently occupies approximately 40 acres. The land area that now contains Coke Point Landfill was created (through the placement of slag fill) between 1957 and 1971. The area apparently received discarded materials during that time; but there is no clear starting date for the operation. Since 1971, the area has been used as a landfill and waste disposal area. The landfill received a variety of non-hazardous waste that generally included foundry dust, waste sand, slag, refractories, and various other dusts.

The Coke Oven Sweepings Pile is an area located within the northern portion of the landfill unit that received maintenance sweepings from the Coke Oven Area. These sweepings included coke ash that had been segregated from other solid wastes. The pile currently contains a variety of materials including demolition debris, baghouse dust, and construction rubble.

Humphrey Impoundment

Humphrey Impoundment is located in the northwest portion of the site between the Rod and Wire Mill and the Tin Mill Canal and occupies approximately 43 acres. Between 1950 and 1970, Humphrey Creek existed as open water (the impoundment did not yet exist) and received wastewater discharges from various steel processing areas including the Cold Sheet Mill, the Hot Strip Mill, the Tin Mill, and the Rod and Wire Mill. When the Tin Mill Canal was completed in 1969, these discharges were routed through the canal to the Humphrey Creek Wastewater Treatment Plant (HCWWTP) for treatment.

Between 1970 and 1985, Humphrey Impoundment was used as a dewatering area for sludges generated at various on-site wastewater treatment plants including the BOF Water Treatment System, the HCWWTP, the Blast Furnace/Sinter Plant Water Treatment System, and the former Open Hearth Furnace Water Treatment System. Since 1985, it has been used on several occasions for emergency-basis sludge dewatering when upsets have occurred in one of the wastewater treatment systems. The MDE has been notified of these uses prior to their occurrence.

2.3.2.6 Air Pollution Control

Various air pollution control devices including baghouses, electrostatic precipitators, scrubbers, cyclones, and tower washers are used across the site. Primary air emissions locations include the blast furnaces, the sinter plant, coke ovens, and the BOFs. The handling of solid and aqueous waste-streams associated with air pollution control has been described above. All air emissions subject to pollution control efforts are regulated under the Clean Air Act and are not within the scope of the Site-Wide Investigation to be performed at the Sparrows Point site.

2.3.3 Shipyard Operations

The Shipyard is located along the west-central edge of the site boundary (Figure 2-3) and occupies approximately 200 acres of which about 75 acres are shipways (water). The western boundary of the Shipyard abuts the Patapsco River. The Shipyard, which has been used for shipbuilding and maintenance since 1891, was operated by the BethShip Division of BSC until or about October 2, 1997, at which time the property and operations were sold to Baltimore Marine Industries, Inc. (BMI).

At the time of its sale to BMI, the Shipyard contained approximately 45 buildings and numerous additional structures including hoists and cranes; and open, paved and unpaved, work and storage areas. There were also moveable work spaces including a barge, a floating dock, and two water treatment trailers containing portable tri-butyl tin (TBT) carbon absorber units that operated under Baltimore County Permit No. WWDP1161.

During its operation by BethShip, the Shipyard had 18 permitted outfalls (NPDES Permit No. MD0001180) that conveyed varying amounts of steam condensate, stormwater runoff, drinking water fountain drainage, and freeze protection flow to the Patapsco River.

BethShip relied on outside contractors for the disposal of solid and hazardous wastes. Solid (non-hazardous) wastes were primarily landfilled off-site (i.e., not on BSC property); however, some dredge spoil pile and shot-blast materials were sent to Greys Landfill. (No wastes generated by BMI will be accepted at Greys or Coke Point Landfills.) Hazardous wastes, which included waste oils, paint wastes, and parts-washer solvents, were disposed at approved and permitted off-site facilities.

2.3.4 Fill Placement

Slag, a byproduct of iron- and steel-making, has been used as an on-site fill material since operations began at the Sparrows Point facility. Two studies have been conducted to evaluate the history of the Sparrows Point land-reclamation or filling operations. The first study was conducted by the U.S. Environmental Protection Agency (EPA). The EPA produced a two volume report in June 1985 entitled "Site Analysis, Bethlehem Steel Plant, Sparrows Point, Maryland." This report was based on an evaluation of aerial photography for the following dates: April 23, 1938; August 23, 1952; February 14, 1953; September 25, 1957; October 10, 1960; March 16, 1963; February 21, 1966; October 11, 1971; November 5, 1971; May 18, 1979; and June 23, 1983.

The second study was an unpublished, internal BSC evaluation conducted by Ed Wilson and Joe Mendelson (Wilson and Mendelson, 1993). A land plat for the site, dated August 1916 and January 1917 (Coonan, 1917) was used as the basis of BSC's land reclamation evaluation. No other maps or photographs of the site were found for the period prior to 1916/1917; thus, the extent of any land reclamation activity prior to 1916/1917 is unknown. The most recent aerial photograph (BSC, April 1996) was used as the basis of the current site conditions for the evaluation. Figure 2-20 shows the land reclamation and slag placement history at Sparrows Point developed by BSC and summarized below.

In January 1917, the BSC Sparrows Point facility consisted of approximately 2166 acres of land (Coonan, 1917). Humphrey Creek was a northeast trending embayment in the northern portion of the site. It drained to Bear Creek and was reported to have contained fresh water. A tributary to Humphrey Creek called Blockhouse Cove extended well into the central part of the site from the southern side of Humphrey Creek. Greys Creek, an embayment oriented east-southeast, was present to the north of Humphrey Creek. The Town of Sparrows Point was present in the south central portion of the site.

By April 1938, steel manufacturing operations were well established, particularly on the eastern side of Sparrows Point. Blockhouse Cove had been completely reclaimed, and a bridge partially dammed the opening to Bear Creek. A significant portion of the southern end of the site had been reclaimed. A small amount of land along the southern edge of the site was reclaimed between the late 1930's and the late 1950's. The northeast end of Humphrey Creek, two small tributaries to Jones Creek, and some land north of the current Shipyard were also reclaimed by that time. By 1971, all of the Humphrey Creek estuary had been reclaimed, and the Tin Mill Canal had been constructed within the slag fill. In addition, Greys Creek and an additional area along the southern boundary of the site had been completely reclaimed.

2.3.5 Spill History

BSC has maintained a log of spill incidents dating back to September 1984. This log, which is presented in Appendix 2A, identifies the date of the spill, its location, the nature of the substance spilled, the amount spilled, and comments concerning the cause of the spill. There was a significant reduction in the number of spills after the coal chemical plants were shut down in 1991. In addition to reportable spills identified in the log, small (non-reportable) spills have occurred throughout the facility.

2.3.6 Permit History

The BSC Sparrows Point Facility maintains active permits under the Clean Air Act (CAA) and the NPDES program of the Clean Water Act (CWA). Information on these permits is summarized in Tables 2-1 and 2-2. Information on environmental permits for the Shipyard is presented in Appendix 2B. BSC has also had permits for solid and/or hazardous waste management under Maryland's Solid Waste and Controlled Hazardous Substance (CHS) and EPA's RCRA regulatory programs. Information on these permits is summarized in Table 2-3.

2.4 PREVIOUS INVESTIGATIONS

Several site-specific environmental and hydrogeologic investigations have been prepared for the BSC Sparrows Point facility. Figure 2-21 shows the general locations of the previous investigations indexed by the reference numbers listed below. Key figures and tables from selected reports are included in Appendix 2C. Information from these investigations has been extracted for use in compiling and understanding the regional geology and hydrogeology of the Sparrows Point site.

1. LETTER REPORT, PHASE I INVESTIGATION, EXISTING WASTE DISPOSAL AREAS: D'Appolonia, August 8, 1980.

   This report presented an evaluation of the Sparrows Point geology and hydrology based on review of available literature. A review of boring logs, particularly in the Coke Point Landfill and Humphrey Creek Impoundment area, was also conducted. This review indicated that the borings were located primarily in the Pleistocene Talbot Formation; that the deposits were heterogeneous and anisotropic; and that the sand, silt, and clay units were commonly cross-bedded and discontinuous. Bay muds were present beneath the slag fill in the former estuaries, such as Humphrey Creek and Greys Creek. A Phase II investigation was recommended.

2. ADDENDUM, PHASE I INVESTIGATION, REVIEW OF EXISTING WELL INFORMATION, EVALUATION OF REGULATORY REQUIREMENTS, PHASE II SCOPE OF WORK AND COST ESTIMATE, EXISTING WASTE DISPOSAL AREAS: D'Appolonia, December 22, 1980.

   This report presents a review of available groundwater well information and water use at the Sparrows Point site. The Pleistocene water-bearing zones were historically used as a groundwater supply in the Rail Mill and Old Town Water Station areas. The Old Town Water Station wells were used to supply domestic water to the Town of Sparrows Point until the early 1900's when they were abandoned due to elevated chloride concentrations. Excessive chloride levels in the Upper and Lower Patapsco are also documented. Information obtained from the USGS indicated that the Pleistocene deposits historically produced brown water that was high in humic acid and low in pH.

3. REPORT, PHASE II INVESTIGATION, HUMPHREYS CREEK IMPOUNDMENT AND GRAYS LANDFILL EXISTING WASTE DISPOSAL AREAS: D'Appolonia, July, 1981.

   The Phase II investigation included drilling three borings at Humphrey Creek Impoundment and three borings at Greys Landfill to further define the site geology. Piezometers were installed at Humphrey Creek Impoundment (7) and at Greys Landfill (4) to further define the site hydrology. Soil and water samples were collected and analyzed. Based on the investigation, it was determined that the uppermost aquifer in the Humphrey Creek Impoundment area which could be impacted by waste disposal operations was in the Pleistocene deposits. Thick impervious clay layers, which served as a confining layer, were delineated between the slag fill and the Pleistocene aquifer in the Humphrey Creek area. The Pleistocene aquifer and the Upper Patapsco aquifer were reported to be hydraulically connected and confined in the Humphrey Creek area. The Pleistocene/Patapsco contact was encountered at elevation of -67.5 feet msl in the Humphrey Creek Impoundment area and at -14 to -41 feet msl in Greys Landfill area. Permeabilities in the slag fill ranged from 10^{-3} cm/sec to 10^{-4} cm/sec. Permeabilities for Pleistocene sand samples ranged from 10^{-1} cm/sec to 10^{-3} cm/sec while permeabilities for finer grained Pleistocene samples ranged from 10^{-4} cm/sec to 10^{-6} cm/sec. Permeabilities for the Upper Patapsco sands ranged from 10^{-2} to 10^{-4} cm/sec. A generalized stratigraphic column and several stratigraphic cross-sections were prepared.

4. REPORT, GROUNDWATER MONITORING PLAN, HUMPHREYS CREEK IMPOUNDMENT AND GRAYS LANDFILL EXISTING WASTE DISPOSAL AREAS: D'Appolonia, December 1981.

   This report summarizes the information obtained during the Phase I and Phase II investigations and presents a formal plan for monitoring the waste disposal areas in accordance with RCRA requirements.

5. PHASE I EVALUATION , SHALLOW GROUNDWATER CONDITIONS, HUMPHREYS IMPOUNDMENT AND GRAYS LANDFILL: Whitman, Requardt and Associates, February 20, 1984.

   Whitman, Requardt and Associates (Whitman) conducted an investigation of the shallow groundwater conditions at the Humphrey Impoundment and Greys Landfill. Eight groundwater monitoring wells were installed at each facility. The Humphrey Impoundment wells ranged from 21 to 45 feet in depth and encountered slag fill from 21 to 42 feet thick. Clay, silt, and sand deposits were encountered below the fill. The Greys Landfill wells ranged from 16 to 30 feet in depth and encountered slag fill from 2 to 27 feet thick. Clay, silt, and sand deposits were encountered below the fill. Groundwater samples were analyzed. Whitman concluded that contaminant concentrations were insignificant and that the impact of discharges to Bear Creek would be negligible.

6. FINAL REPORT, PRELIMINARY HAZARDOUS WASTE INVESTIGATION, ROD AND WIRE MILL PLATING SLUDGE BIN AREA, SPARROWS POINT, MARYLAND: Woodward-Clyde Consultants, March 4, 1985.

   This investigation focused on the Rod and Wire Mill area. Tasks included a literature review, geophysical exploration, exploratory borings (6) and well installation (5), laboratory analysis, and hydrogeological analysis and report preparation. The groundwater was determined to flow to the northwest in August 1984 and to the east-northeast in October 1984. Drinking water standards were exceeded for total dissolved solids, sulfate, iron, manganese, cadmium, pH, zinc, and lead. Evidence of soil contamination from lead, cadmium, pH, total chromium, and barium was detected. Cadmium was the only parameter that exceeded the EP Toxicity standard.

7. PHASE I REPORT ON ROD AND WIRE MILL SLUDGE BIN STORAGE AREA INVESTIGATION, SPARROWS POINT PLANT: Baker/TSA, Inc., June 1986.

   This investigation at the Rod and Wire Mill Sludge Bin Storage Area was a follow-up investigation to the Woodward-Clyde report dated March 4, 1985. Baker/TSA, Inc. (Baker) installed and sampled two soil borings and seven groundwater monitoring wells. Two groundwater flow systems were designated: a shallow aquifer and a deep aquifer. The shallow aquifer extended 10 to 15 feet below ground surface and was reported to be perched, and the deep aquifer extended to about 30 feet below ground level. Groundwater flow in the shallow aquifer was interpreted as radial while flow in the deep aquifer was interpreted as being to the west-southwest (consistent with the local surface water and topographic trend). Permeabilities, groundwater gradients, and flow velocities were calculated. Stratigraphic cross-sections and groundwater flow maps were prepared. Cadmium was determined to be present in the soil adjacent to the sludge bins. Higher levels of cadmium were observed in the groundwater than in the soil.

8. PHASE II REPORT ON ROD AND WIRE MILL SLUDGE BIN STORAGE AREA INVESTIGATION, SPARROWS POINT PLANT: Baker/TSA, Inc., November 1986.

   This report is the second report on the Rod and Wire Mill Sludge Bin Storage Area prepared by Baker. Additional monitoring well clusters and shallow soil borings were installed as part of the Phase II activities. Two rounds of groundwater sampling were conducted. In this report, three groundwater systems were designated: the shallow system (~15 feet deep), the intermediate system (~30 feet deep), and the deep system (~60 feet deep). The shallow groundwater system was determined to radially flow toward the northwest, west, and southwest. The intermediate groundwater system was determined to flow ultimately to the southwest. The deep groundwater system was determined to flow generally eastward. Slug test permeabilities in the shallow system ranged from 10^{-4} to 10^{-6} cm/sec, in the intermediate system from 10^{-3} to 10^{-6} cm/sec, and in the deep zone from 10^{-6} to 10^{-8} cm/sec. Groundwater contamination was detected in the shallow and intermediate systems but not in the deep system. Baker concluded that pumping of groundwater from two wells (BW-24 & BW-27) could control the intermediate groundwater system contaminant plume and that the shallow contaminant plume was limited due to discontinuous sediment facies.

9. REPORT ON GROUNDWATER INVESTIGATION STUDY PROGRAM AT HUMPHREYS IMPOUNDMENT AND GRAYS LANDFILL, SPARROWS POINT PLANT, BETHLEHEM STEEL CORPORATION: Baker/TSA, Inc., July 1987.

   This report was prepared in response to a Complaint and Order (C-0-85-179) issued by the State of Maryland Department of Health and Mental Hygiene which required BSC to submit plans and schedules for updated studies related to determining the extent and configuration of groundwater impacts from Greys Landfill and Humphrey Impoundment. The investigation included the installation of 28 additional monitoring wells and 12 staff gages on adjacent streams and water bodies, monthly water level measurements, and data evaluation. Quarterly groundwater sampling was conducted. The report concluded that localized effects on groundwater quality at both Greys Landfill and Humphrey Impoundment were apparent. The effects on water quality for Humphrey Impoundment were noted in the slag and Pleistocene units near the west and southwest end of the impoundment. Water quality effects in the slag unit at Greys Landfill were detected near the north central perimeter of the landfill. The Pleistocene units were not significantly affected except in one well located near an affected slag well.

   Groundwater flow in the slag and Pleistocene units at Humphrey Impoundment was determined to ultimately discharge to the west into Bear Creek or to the east and south to the Tin Mill Canal. Groundwater flow in the slag unit at Greys Landfill was determined to be partially radial and to ultimately discharge west to northwest toward Bear Creek. Groundwater flow in the Pleistocene unit at Greys Landfill was also determined to be partially radial and to ultimately discharge west to northwest toward Bear Creek. Calculated permeabilities for the slag unit ranged from 1.7×10^{-2} to 1.6×10^{-4} cm/sec. Calculated permeabilities for the Pleistocene unit ranged from 2.1×10^{-2} to 9.4×10^{-5} cm/sec.

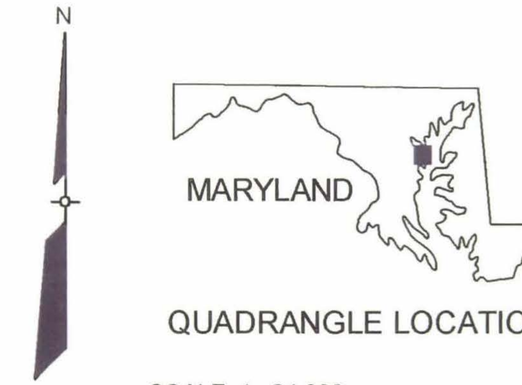
At Humphrey Impoundment, the affected groundwater parameters included elevated levels for pH, TOC, ammonia, cyanide, 2,4-dimethylphenol, and trichloroethylene. The levels were determined to not represent a significant concern to human health or the environment.

At Greys Landfill, the affected groundwater parameters in the slag unit included elevated and reduced levels for pH and elevated levels for sulfate, iron, manganese, cyanide, 2,4-dimethylphenol, and benzene. The levels were determined to not represent a significant concern to human health or the environment. In the Pleistocene unit, elevated levels of sodium, chloride, sulfate, 2,4-dimethylphenol, and benzene were detected in the groundwater. The levels were determined to not represent a significant concern to human health or the environment. A groundwater quality assessment program was proposed to confirm the effect on groundwater quality at each site.

10. HYDROGEOLOGICAL STUDY OF THE GRAYS LANDFILL SITE AT THE SPARROWS POINT PLANT: CH2M HILL, November 1992.

This report focused on understanding the hydrogeological conditions at the Greys Landfill using existing information. Greys Creek was reclaimed, beginning in 1957, and the landfill extends over the southwestern portion of the former estuary. In 1992, the landfill encompassed approximately 40 acres and 34 monitoring wells had been installed (during previous investigations) within and near the landfill. The uppermost subsurface unit is described as slag fill, typically 5 to 10 feet thick except in the former creek where it is 15 to 20 feet thick. Beneath the slag are Pleistocene deposits consisting primarily of silts and clays with interbedded discontinuous sand lenses. The Pleistocene deposits range in thickness from 20 to 40 feet. The Pleistocene/Upper Patapsco Formation contact is characterized by dense (high SPT blow counts in boring logs) light-colored sands with occasional lenses of clay or silt. None of the borings intercepted the lower contact of the Patapsco.

The hydrogeology was characterized as consisting of three aquifers; the surficial aquifer, the Patapsco aquifer and the Patuxent aquifer. The Patuxent aquifer was not studied. The surficial aquifer and the Pleistocene aquifer were reported to be hydraulically connected and unconfined. The combined surficial and Pleistocene water-table aquifers were determined to be mounded in the landfill area, and the flow direction was determined to be partially radial with a horizontal average linear velocity of 0.8 to 5 ft/yr. The Patapsco aquifer was reported to be confined, but the confining pressure was not determined for the landfill area. The flow direction was determined to be southerly.



QUADRANGLE LOCATION

SCALE: 1 : 24,000

Map Derived From U.S.G.S. 7.5 Minute Topographic Quadrangle Sparrows Point & Curtis Bay, MD (1969, Photo Revised 1974)

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FIGURE 2-1

LOCATION AND TOPOGRAPHIC MAP

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998

200123

DECEMBER 22, 1997

FIG2119.CVS

NOTE: INFORMATION DERIVED FROM PHOTOGRAPH TAKEN BY AIR SURVEY CORPORATION 10/13/95.

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FIGURE 2-2

AERIAL PHOTOGRAPH OF SITE
OCTOBER 1995

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998

200123

BSFIG22.DGN

DECEMBER 22, 1997

SCALE IN FEET

0 200 400 600 800 1000

NOTE:

1. MAP DERIVED FROM ORIGINAL BETHLEHEM STEEL CADD DRAWING NO. 5092 FILE: MAPS.DWG

BETHLEHEM STEEL CORP.

RUST

Rust Environment & Infrastructure Inc.

FIGURE 2-3

SITE MAP

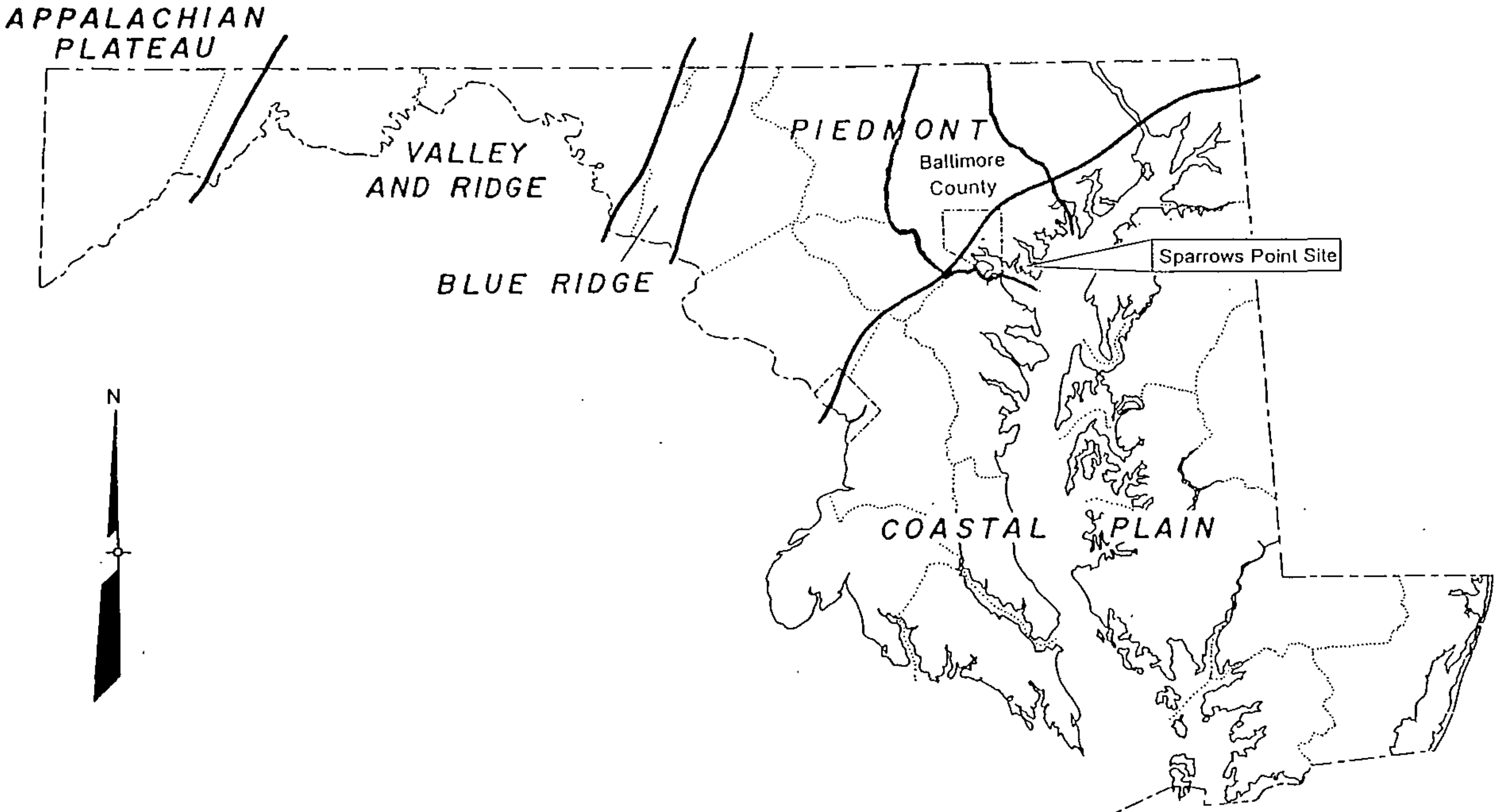
BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998 200123

DECEMBER 22, 1997

0123S002.DGN

FIG 2-4.CVS DECEMBER 22, 1997



Note: Modified from Crowley and Others, 1971

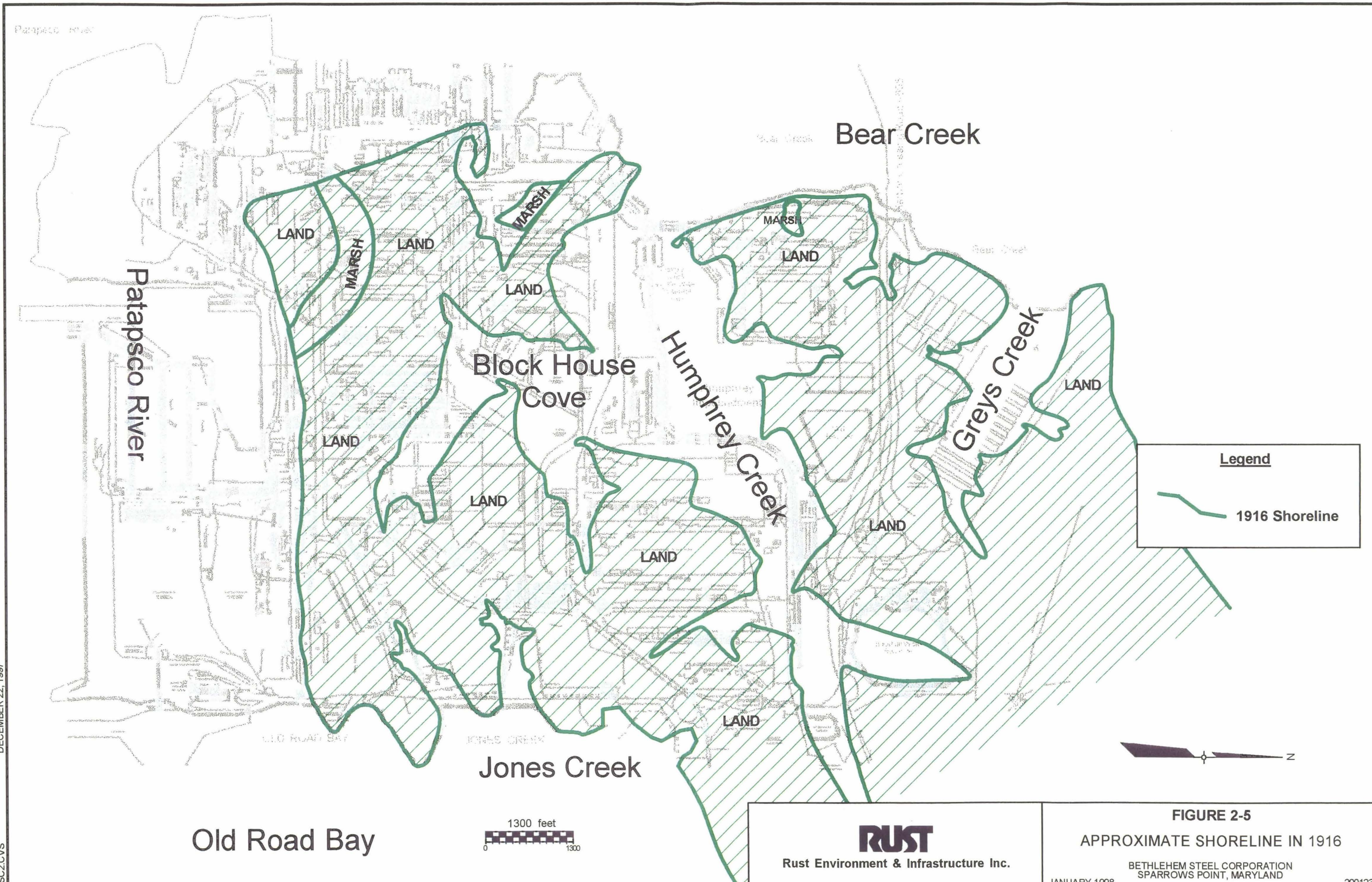
Rust Environment & Infrastructure Inc.

FIGURE 2-4

PHYSIOGRAPHIC PROVINCES OF MARYLAND

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998 200123



DECEMBER 22, 1997

BSC2.CVS

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FIGURE 2-5

APPROXIMATE SHORELINE IN 1916

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998

200123

System	Series	Stratigraphic unit		Stage[1]	Thickness (feet)	Dominant lithologic character	Water-bearing properties
Quaternary and Tertiary	Holocene Pleistocene	Lowland and upland deposits Talbot Formation		-	0-100	Sand, silty clay, and gravel; tan to rusty orange; predominantly quartz, illite and kaolinite.	Capable of yielding moderate quantities of water, but not commonly used as an aquifer in the Baltimore area. Subject to brackish-water encroachment in area adjacent to estuaries.
Cretaceous	Lower Cretaceous	Potomac Group	Patapsco Formation[2]	Albian	0-200	Sand, interbedded with lenses of silty clay; predominantly quartz, illite, and kaolinite.	Yields large quantities of water. Hydraulically connected with overlying Pleistocene sands. Subject to brackish-water encroachment in areas adjacent to estuaries.
			Arundel Formation	Aptian	25-200	Clay, interbedded with lenses of sandy silt; lignitic material common; predominantly illite and kaolinite.	Functions as a confining bed.
			Patuxent Formation	? Barremian	50-250	Sand, gravel, interbedded with discontinuous lenses of clayey silt. Predominantly quartz. Iron-oxide cementation common in outcrop area.	Most important water-bearing formation in the Baltimore area. Yields large quantities of water, particularly in lower part of the formation. Subject to brackish-water contamination where overlying Arundel Formation has been removed by Pleistocene erosion.
Paleozoic and Precambrian		Crystalline Rocks (basement)		-	Unknown	Complex assemblage of schist, gneiss, and gabbro.	Yields small to moderate quantities of water west of the Fall Line. Not an important water-bearing formation in the Coastal Plain.

[1] From Doyle, Van Campo, and Lugardon (1975).
[2] Designated Lower and Lowermost Upper Cretaceous by the U.S. Geological Survey.

Note: Modified from Crowley and Others, 1971

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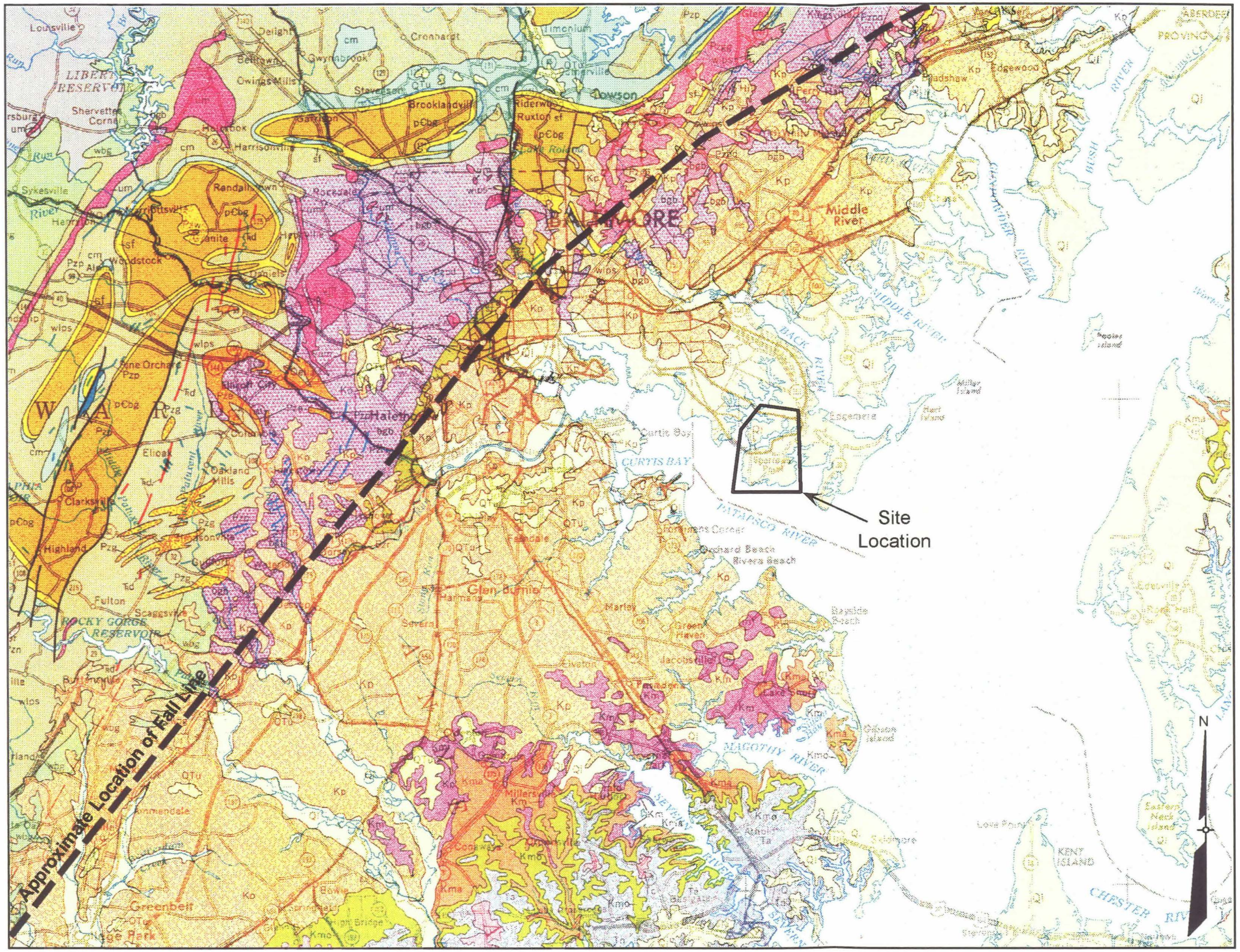
FIGURE 2-6

GENERALIZED REGIONAL STRATIGRAPHY

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998 200123



COASTAL PLAIN STRATIGRAPHY

QUATERNARY — Pleistocene to Recent

Ql — Lowland Deposits
Gravel, sand, silt and clay. Medium- to coarse-grained sand and gravel; cobbles and boulders near base; commonly contains reworked Eocene glauconite; varicolored silts and clays; brown to dark gray lignitic silty clay; contains estuarine to marine fauna in some areas; thickness 0 to 150 feet.

CRETACEOUS

Kmo — Monmouth Formation
Dark gray to reddish-brown, micaceous, glauconitic, argillaceous, fine- to coarse-grained sand, thickness 0 to 100 feet.

Kma — Matawan Formation
Dark gray , micaceous, glauconitic, argillaceous, fine-grained sand and silt; absent in outcrop south-west of Patuxent River; thickness 0 to 70 feet.

Km — Magothy Formation
Loose, white, cross-bedded, "sugary", lignitic sands and dark gray, laminated silty clays; white to orange-brown, iron-stained, subrounded quartzose gravels in western Anne Arundle County; absent in outcrop southwest of Patuxent River; thickness 0 to 60 feet.

Kp — **Potomac Group**
Interbedded quartzose gravels; protoquartzitic to ortho-quartzitic argillaceous sands; and white, dark grey, and multicolored silts and clays; thickness 0 to 800 feet.

Patapsco Formation
Gray, brown, and red variegated silts and clays; lenticular, cross-bedded, argillaceous, subrounded sands; minor gravels; thickness 0 to 400 feet.

Arundel Formation
Dark gray and maroon lignitic clays; abundant siderite concretions; present only in Baltimore-Washington area; thickness 0 to 100 feet.

Patuxent Formation
White or light gray to orange-brown, moderately sorted, cross-bedded, argillaceous, angular sands and subrounded quartz gravels; silts and clays subordinate, predominantly pale gray; thickness 0 to 250 feet.

Map Derived From Maryland Geologic Map, 1968

SCALE: 1 : 250,000

NOTE: FALL LINE IS THE APPROXIMATE CONTACT BETWEEN THE PIEDMONT PLATEAU & THE COASTAL PLAIN PHYSIOGRAPHC PROVINCES

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FIGURE 2-7

REGIONAL GEOLOGIC MAP

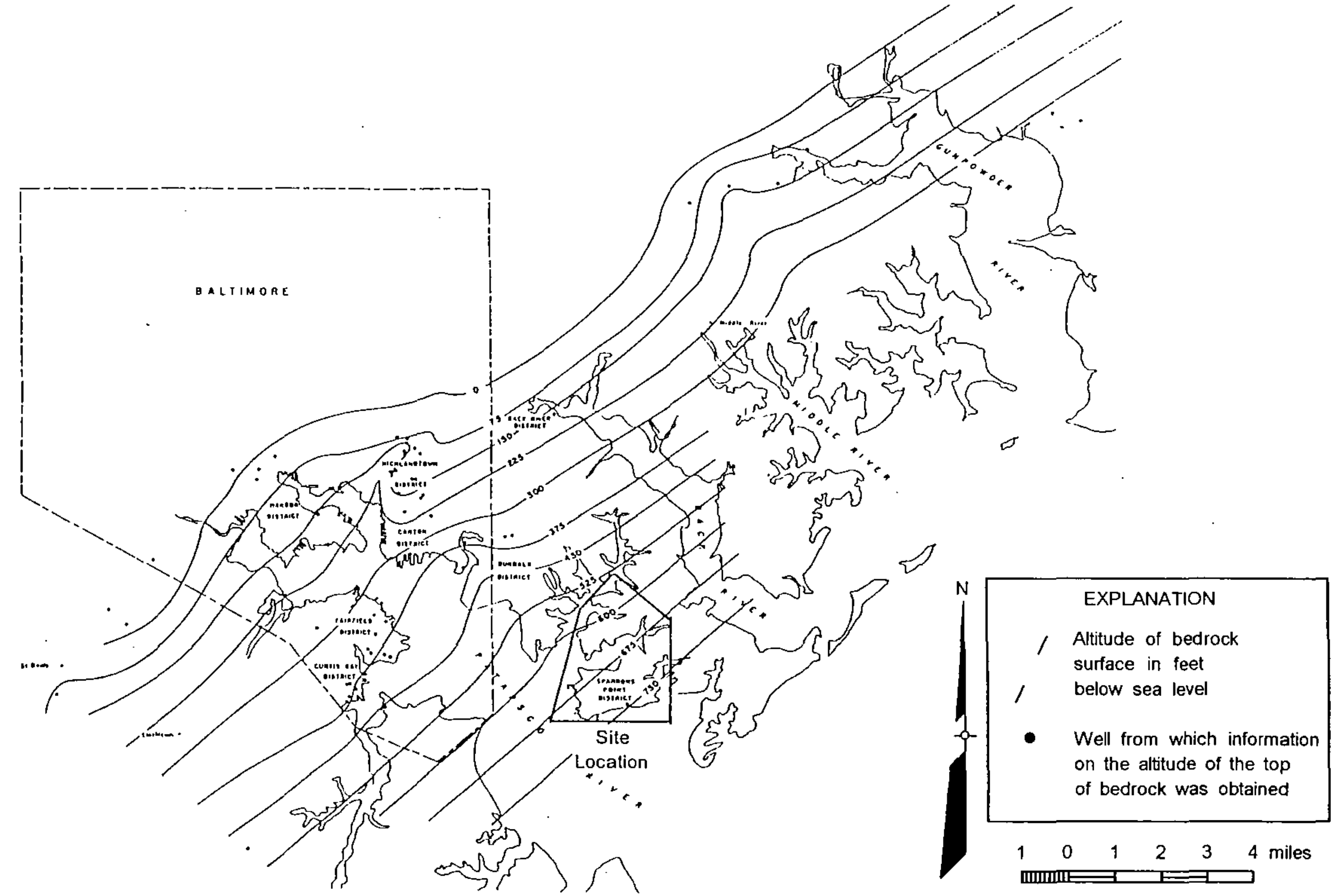
BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998

200123

DECEMBER 22, 1997

FIG2-7.CVS



NOTE: TAKEN FROM BENNETT AND MEYER, 1952

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FIGURE 2-8

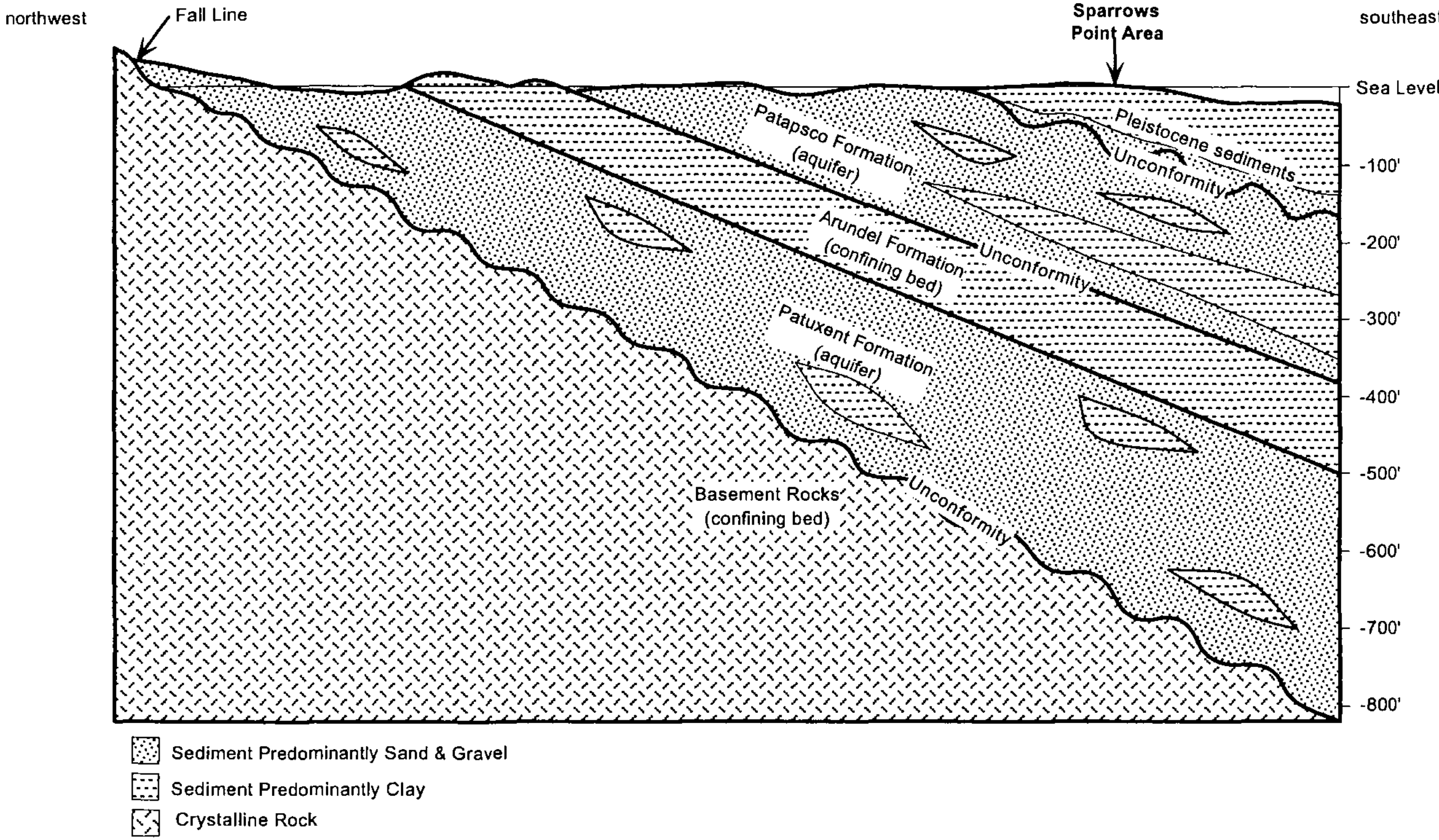
ALTITUDE OF THE BASEMENT ROCK SURFACE

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998

200123

FIG2-9.CVS DECEMBER 22, 1997



NOTE: MODIFIED FROM BENNETT AND MEYER, 1952 & CHAPELLE, 1985

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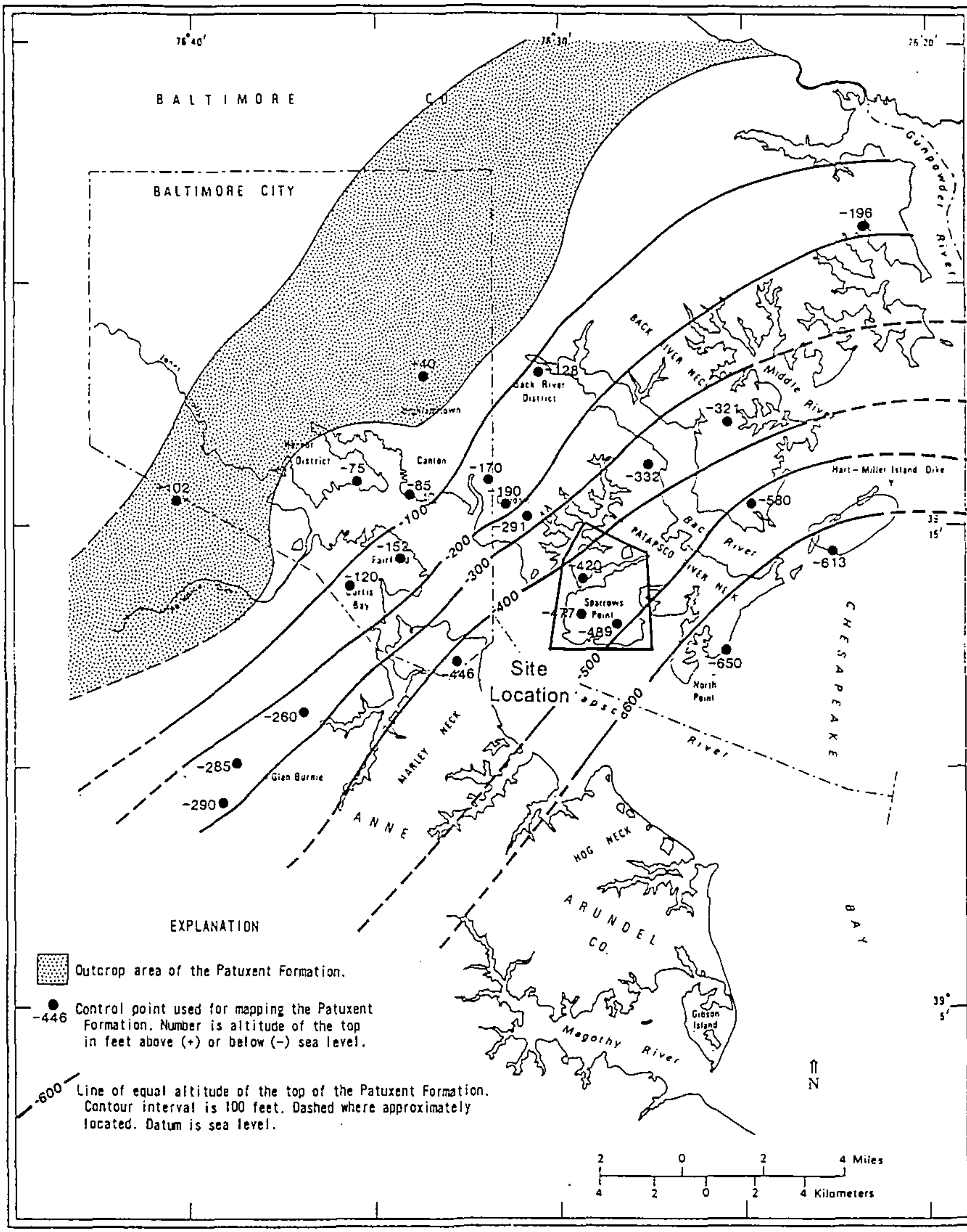
FIGURE 2-9
GENERALIZED REGIONAL GEOLOGIC CROSS-SECTION

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998 200123



NOTE: MAP TAKEN FROM CHAPELLE, 1985

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FIGURE 2-10

OUTCROP AREA AND ALTITUDE OF THE PATUXENT FORMATION

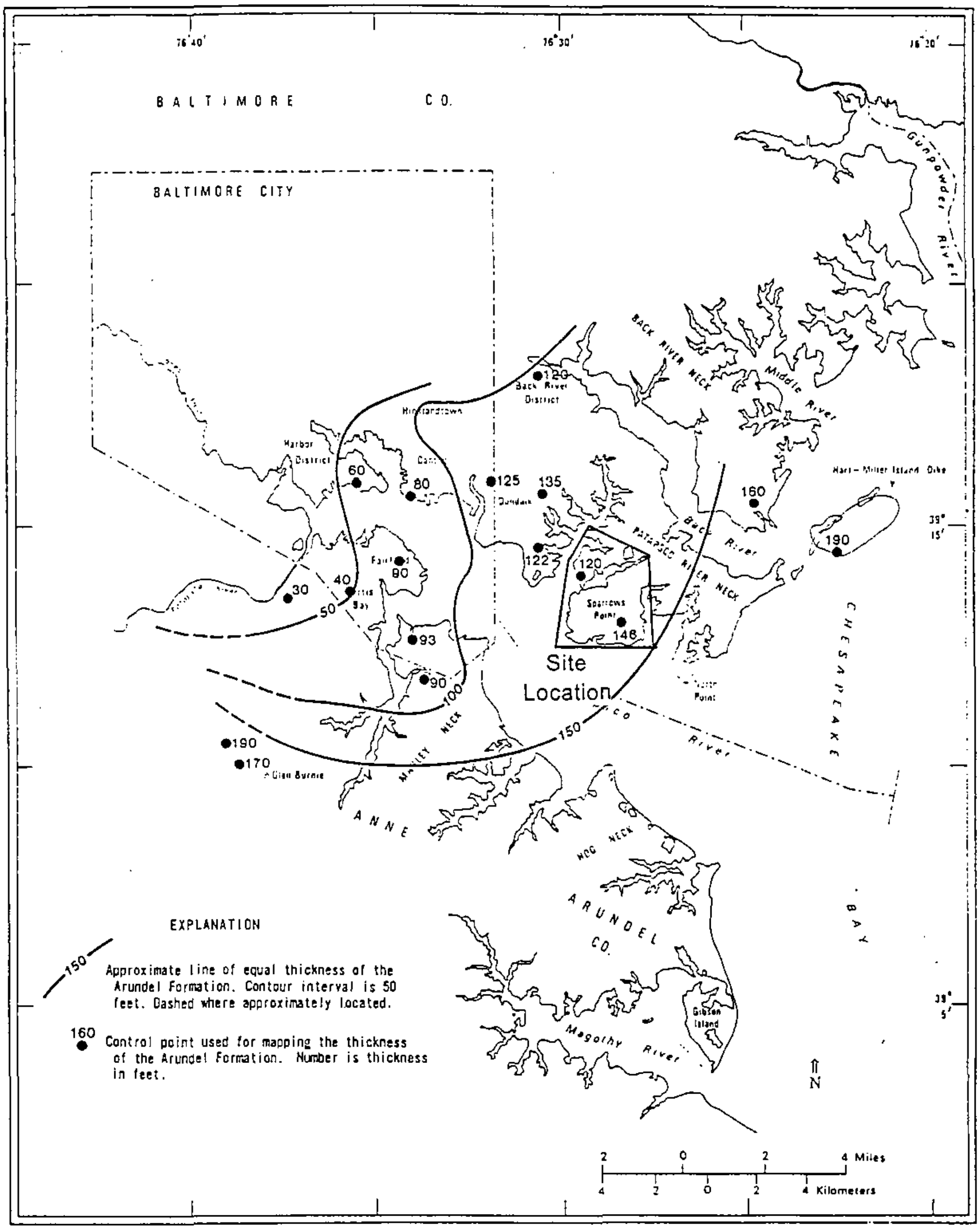
BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998

200123

DECEMBER 22, 1997

FIG2-10.CVS



NOTE: MAP TAKEN FROM CHAPELLE, 1985

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FIGURE 2-11

THICKNESS OF THE ARUNDEL FORMATION

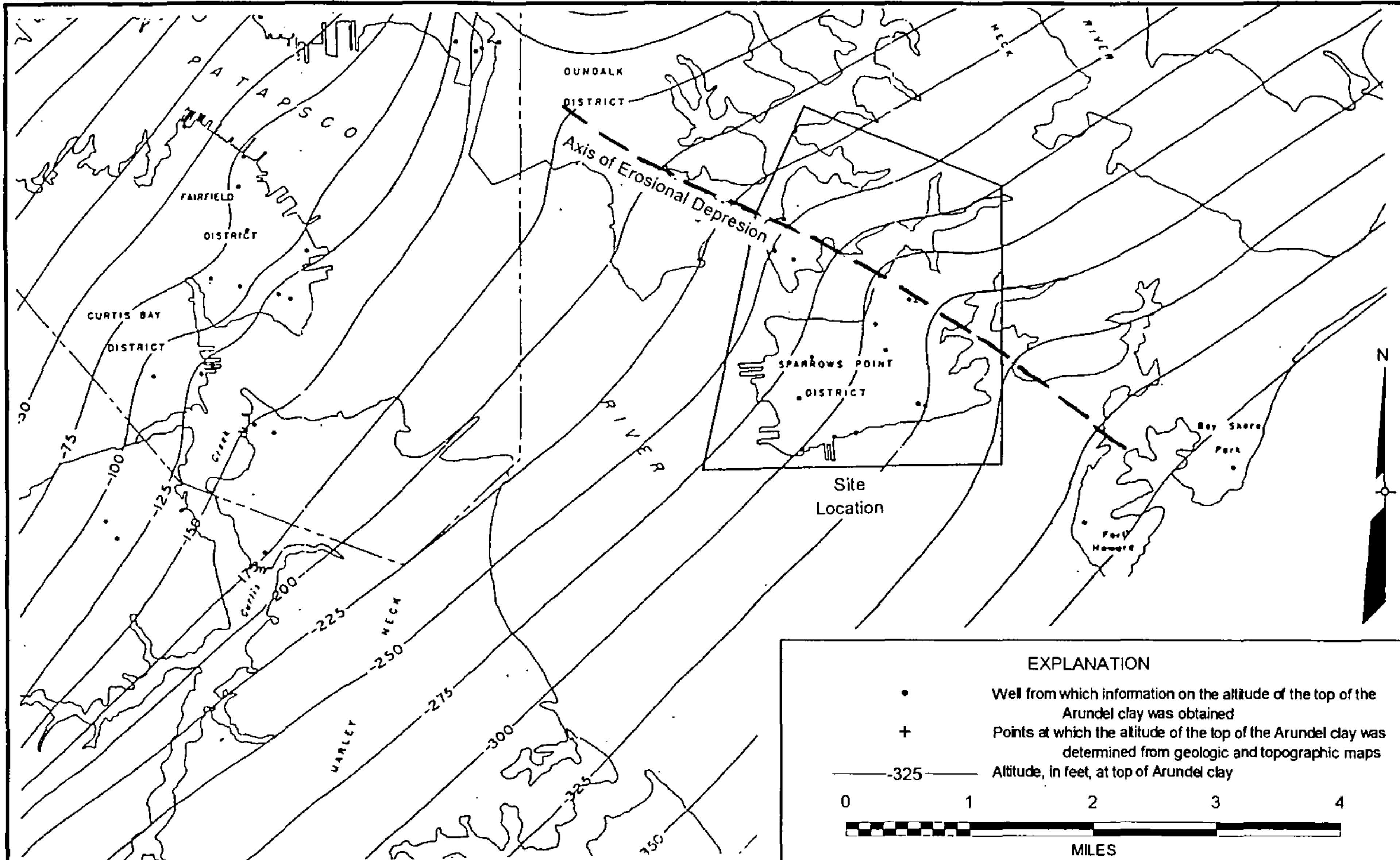
BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998 200123

DECEMBER 22, 1997

FIG2-11.CVS

FIG2-12.CVS DECEMBER 22, 1997



NOTE: TAKEN FROM BENNETT AND MEYER, 1952

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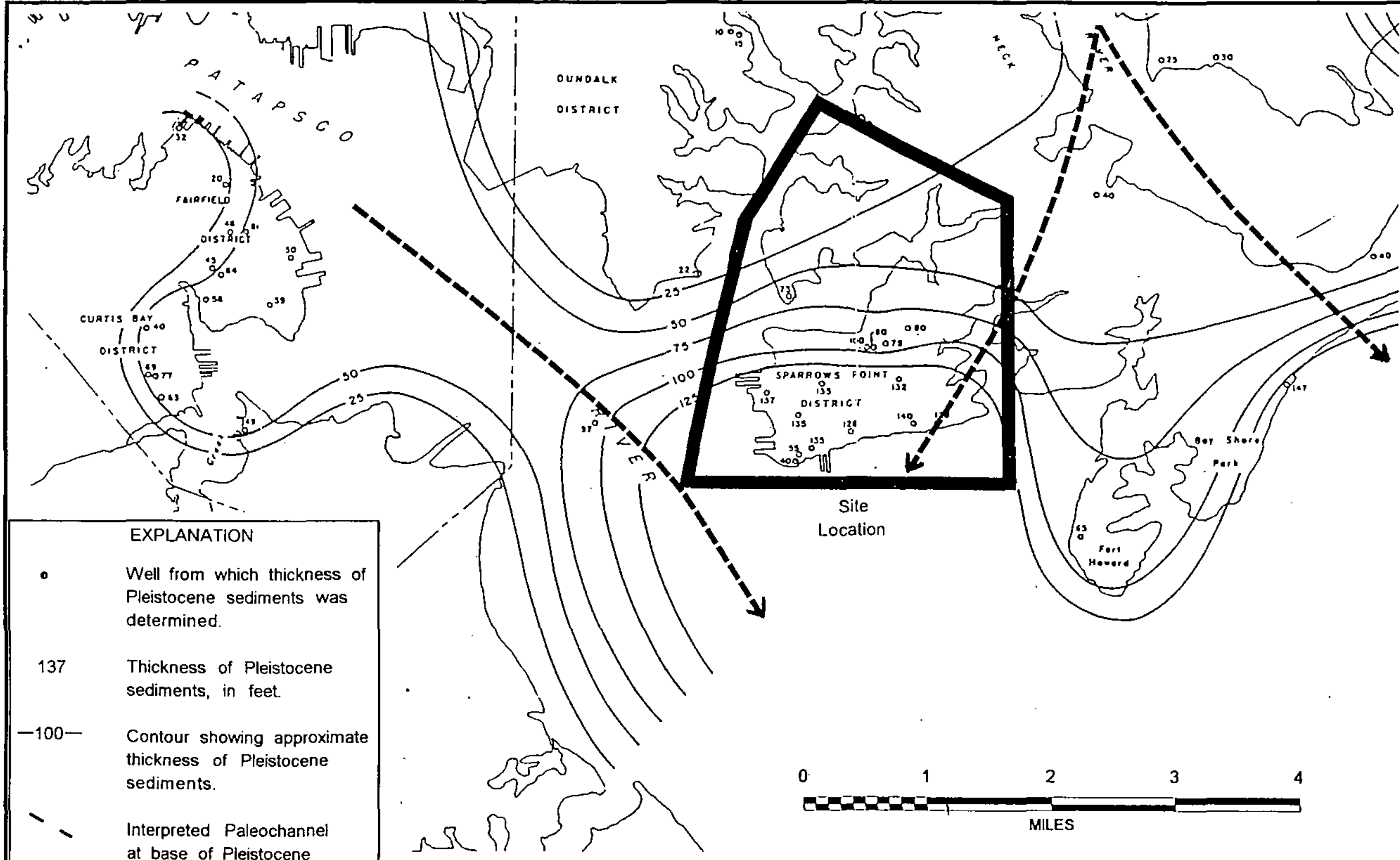
FIGURE 2-12

ALTITUDE OF THE ARUNDEL FORMATION

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998 200123



EXPLANATION

o	Well from which thickness of Pleistocene sediments was determined.
137	Thickness of Pleistocene sediments, in feet.
—100—	Contour showing approximate thickness of Pleistocene sediments.
— —	Interpreted Paleochannel at base of Pleistocene

NOTE: MODIFIED FROM BENNETT AND MEYER, 1952

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FIGURE 2-13

THICKNESS OF THE PLEISTOCENE DEPOSITS

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998

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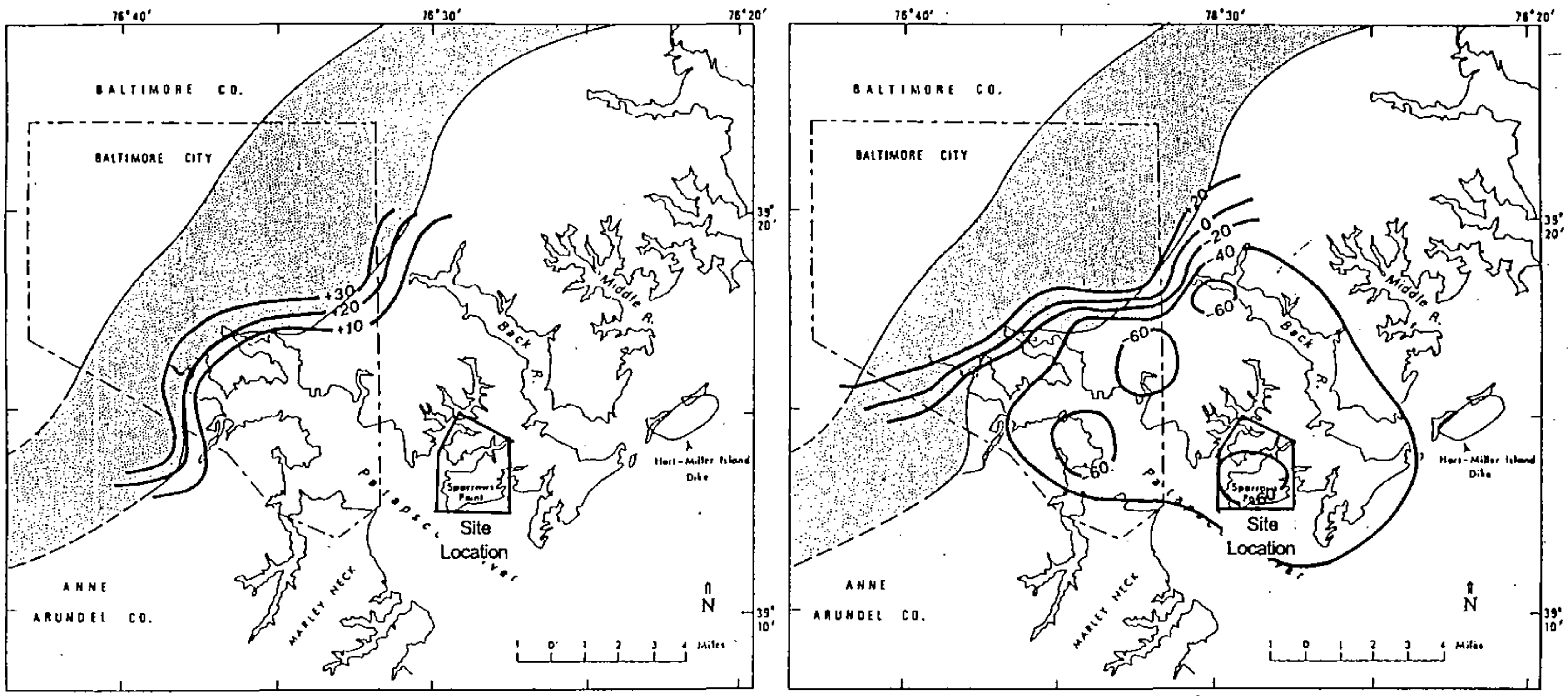
FIG2-14.CVS DECEMBER 22, 1997



A. Approximate prepumping potentiometric surface.

B. Approximate 1945 potentiometric surface. (Modified from Bennett and Meyer, 1952).

EXPLANATION

Outcrop area of the Patuxent aquifer.

+10 Contour showing the altitude of the potentiometric surface. Contour interval is 10 feet. Datum is sea level.

Geologic Contact--Dashed where approximate.

EXPLANATION

Outcrop area of the Patuxent aquifer.

+20 Contour showing the altitude of the potentiometric surface above (+) and below (-) sea level. Contour interval is 20 feet.

Geologic Contact--Dashed where approximate.

NOTE: TAKEN FROM CHAPELLE, 1985

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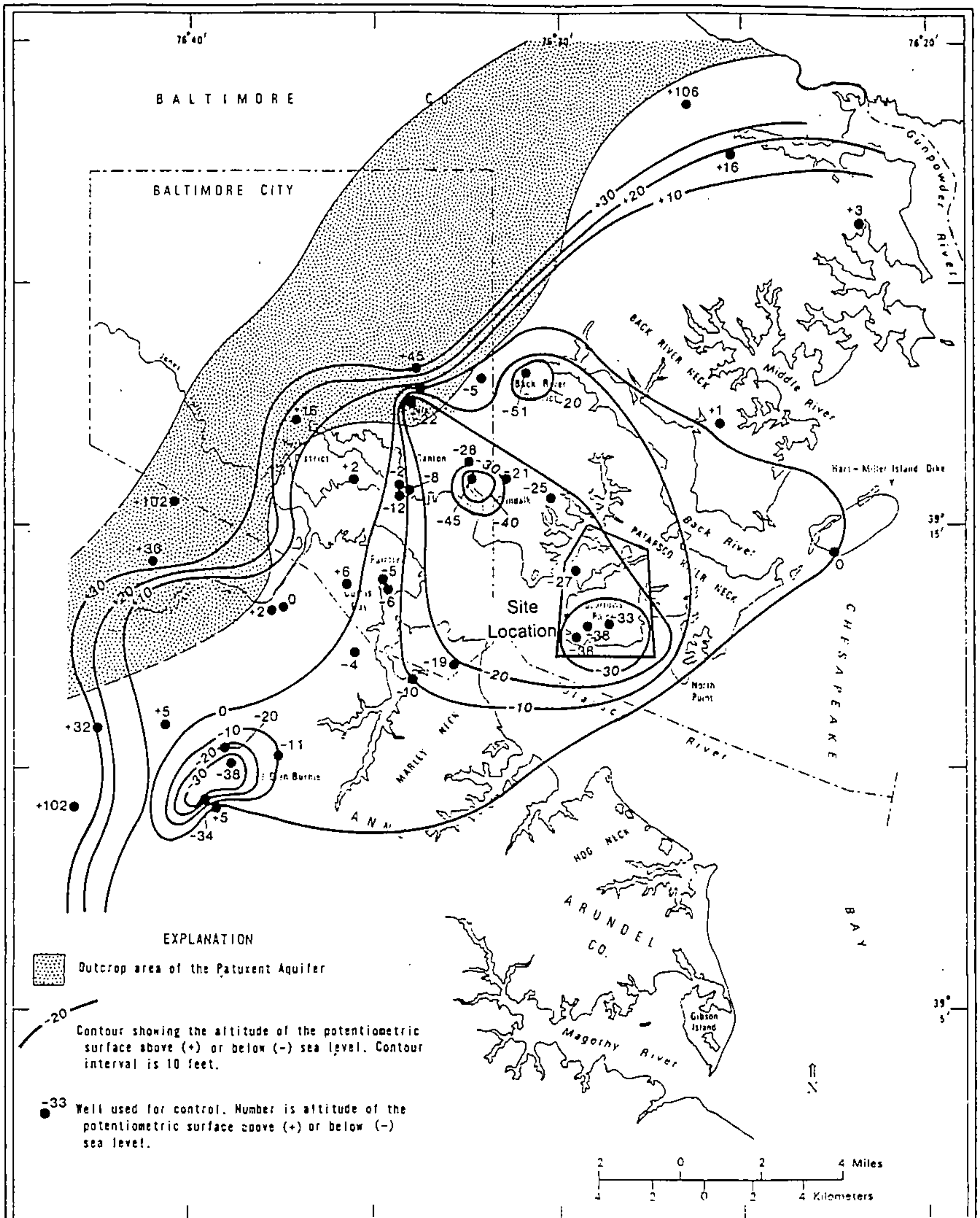
FIGURE 2-14

POTENTIOMETRIC SURFACE OF THE PATUXENT AQUIFER - PREPUMPING AND 1945

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998 200123



NOTE: MAP TAKEN FROM CHAPELLE, 1985

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FIGURE 2-15

POTENTIOMETRIC SURFACE OF THE PATUXENT AQUIFER - 1982

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

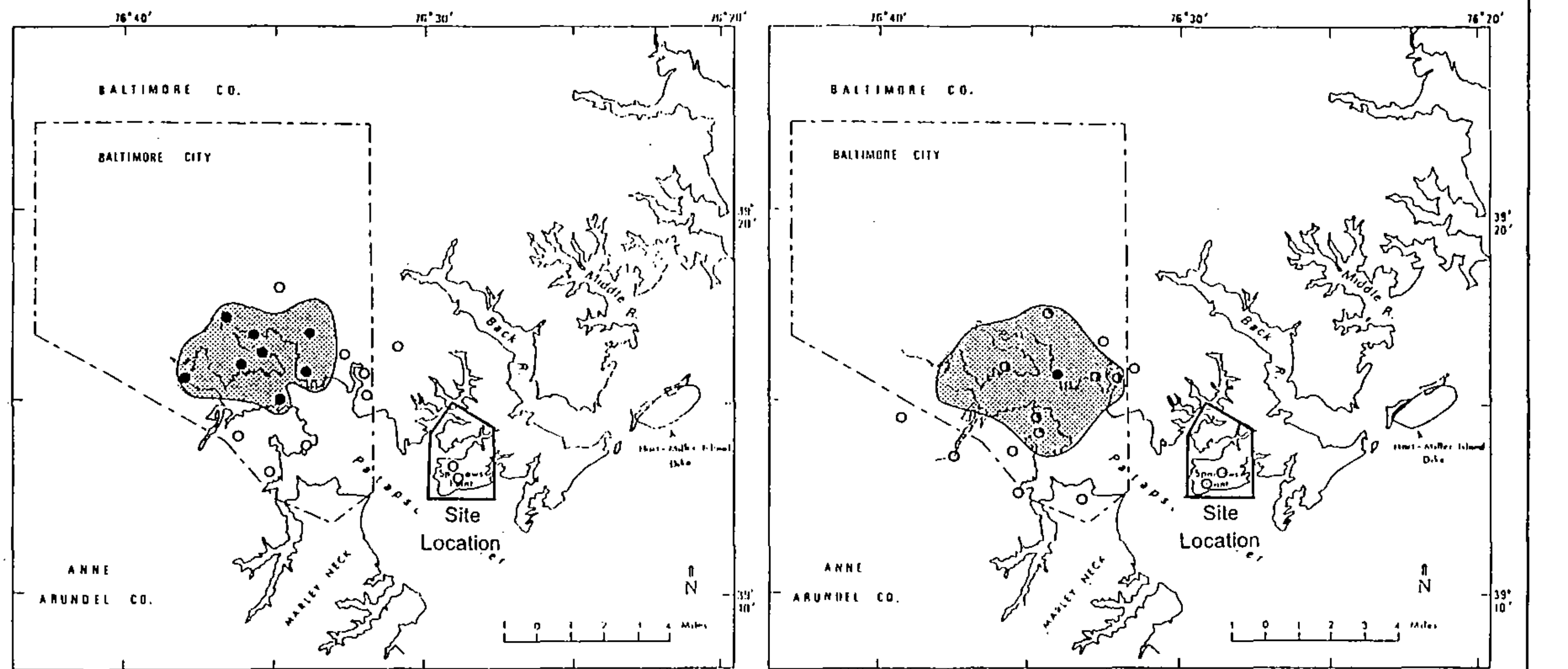
JANUARY 1998

200123

DECEMBER 22, 1997

FIG2-15.CVS

FIG2-16.CVS DECEMBER 22, 1997



A. 1945 distribution of chloride. (Modified from Bennett and Meyer, 1952)

B. 1982 distribution of chloride

EXPLANATION (A)

Chloride concentration:
- ○ Less than 15 mg/L.
- ◐ Between 15 and 300 mg/L.
- ● Greater than 300 mg/L.

▒ Approximate areal distribution of chloride contamination.

EXPLANATION (B)

Chloride concentration:
- ○ Less than 15 mg/L.
- ○ Between 15 and 1,000 mg/L.
- ○ Between 1,000 and 4,000 mg/L.
- ● Between 4,000 and 6,000 mg/L.

▒ Approximate areal distribution of chloride contamination.

NOTE: TAKEN FROM CHAPELLE, 1985

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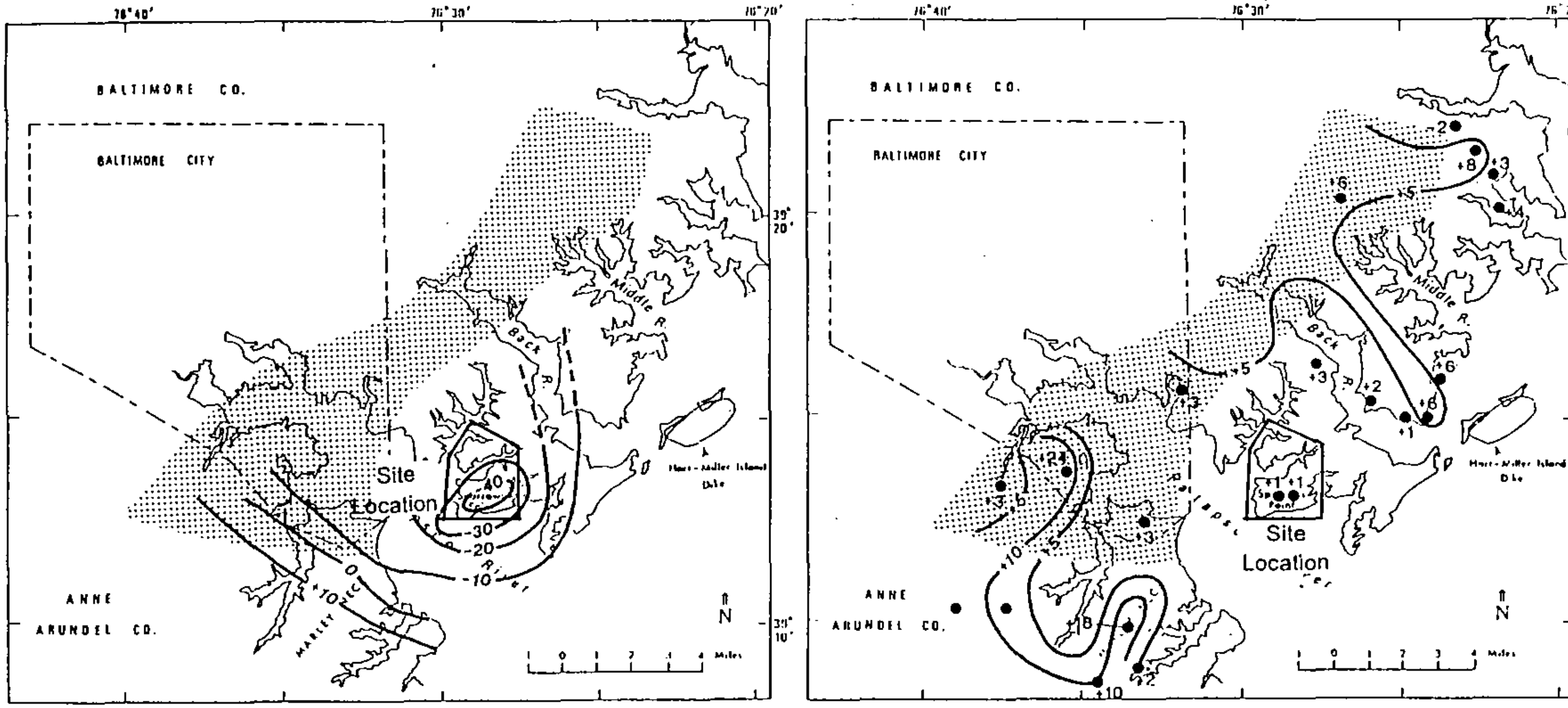
FIGURE 2-16
DISTRIBUTION OF CHLORIDE CONTAMINATION IN THE PUTUXENT AQUIFER - 1945 AND 1982
BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998 200123



A. Approximate 1945 potentiometric surface. (Modified from Bennett and Meyer, 1952)

B. Approximate 1982 potentiometric surface.

EXPLANATION

-20 — Contour showing the altitude of the potentiometric surface in feet above (+) or below (-) sea level. Contour interval is 10 feet. Dashed where approximate.

EXPLANATION

+10 — Contour showing the altitude of the potentiometric surface. Contour interval is 5 feet. Datum is sea level.

•+6 Well used for water-level control. Number is water level in feet above (+) or below (-) sea level.

NOTE: MODIFIED FROM CHAPELLE, 1985

Approximate Patapsco Formation Outcrop Area

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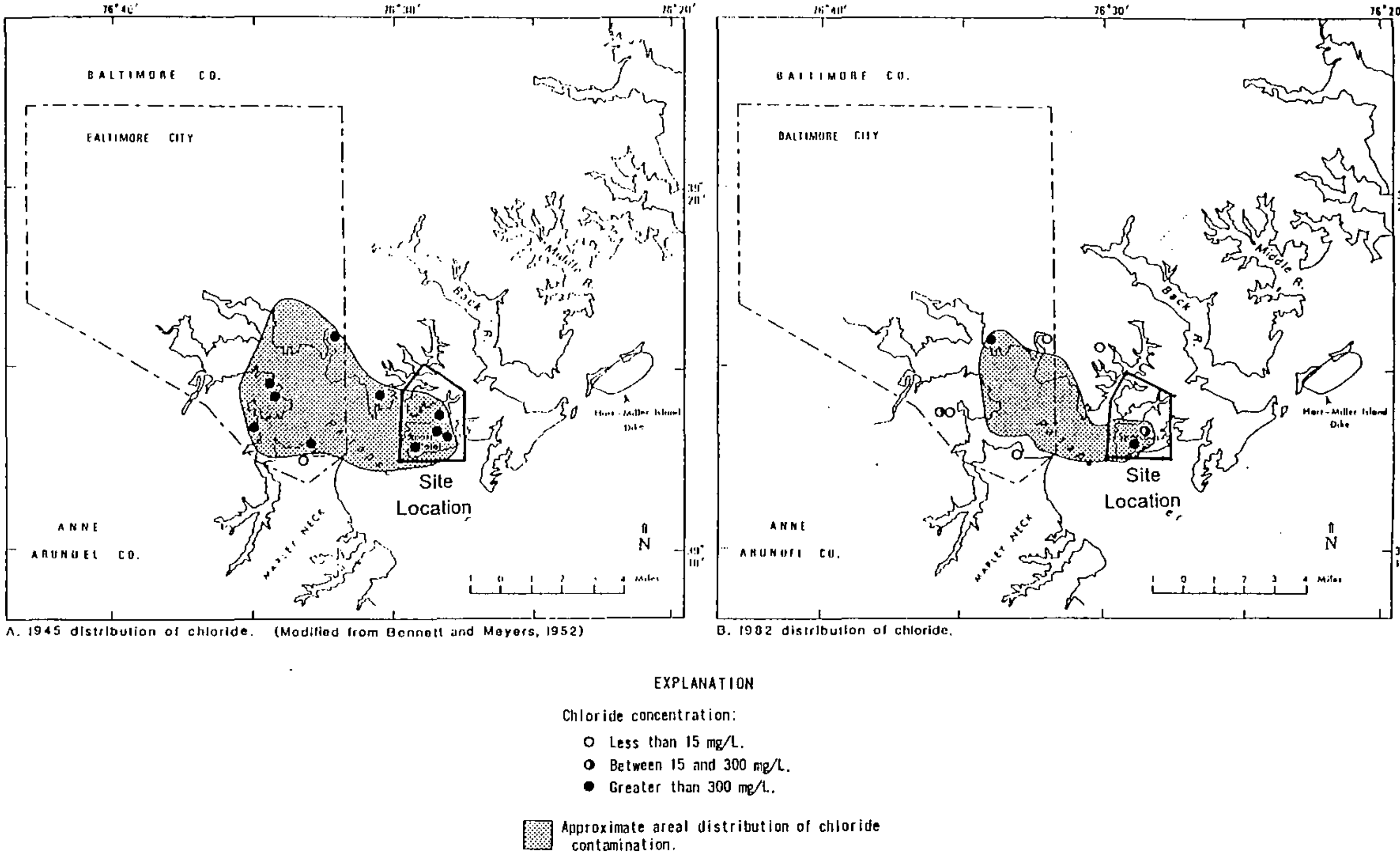
FIGURE 2-17

POTENTIOMETRIC SURFACE OF THE PATAPSCO AQUIFER - 1945 AND 1982

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998

200123



A. 1945 distribution of chloride. (Modified from Bennett and Meyers, 1952)

B. 1982 distribution of chloride.

NOTE: TAKEN FROM CHAPELLE, 1985

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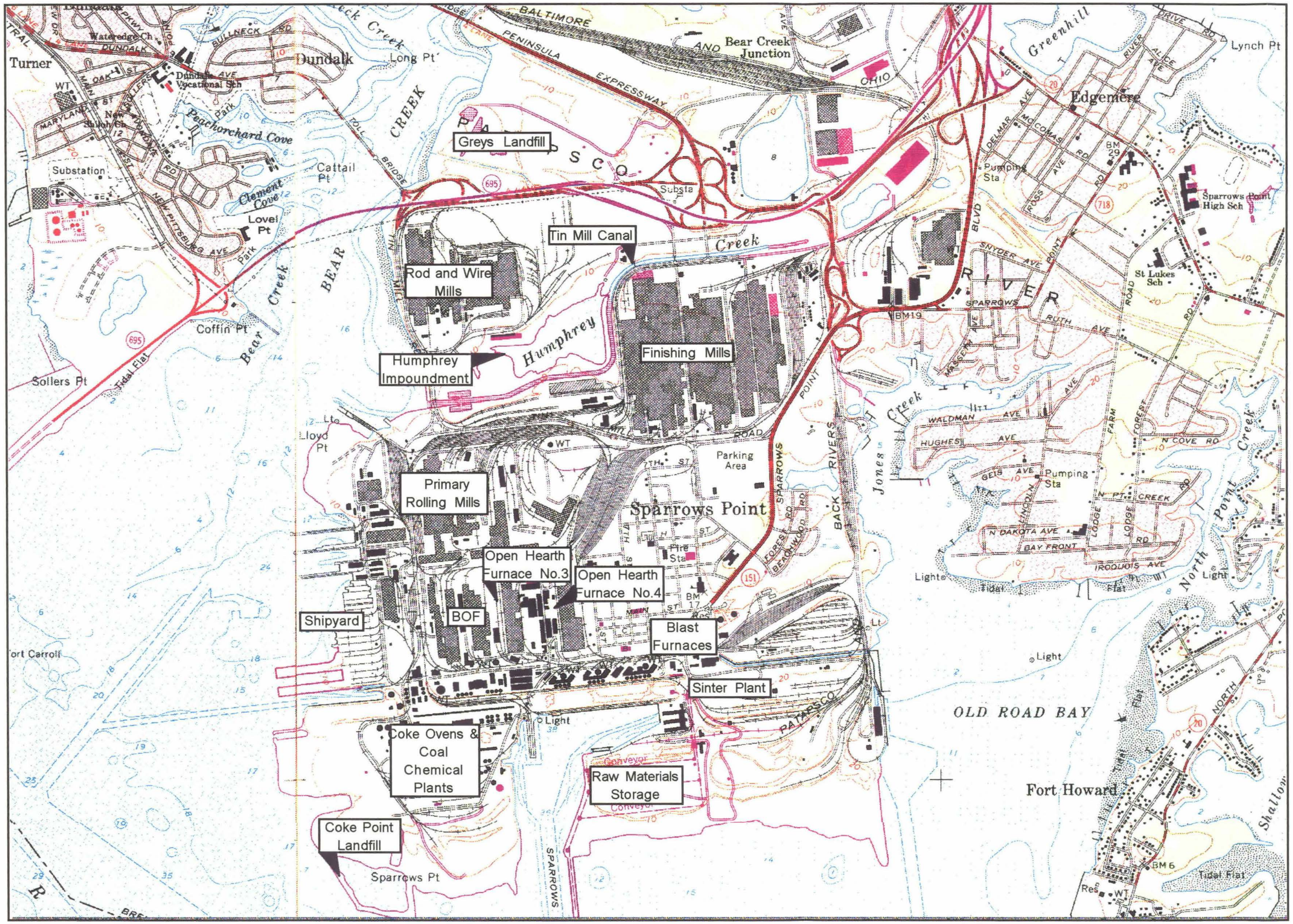
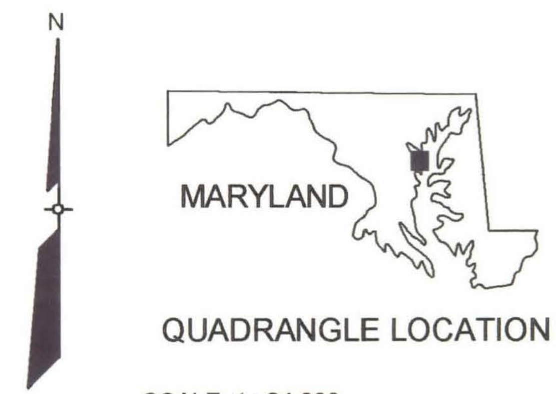
FIGURE 2-18
DISTRIBUTION OF CHLORIDE CONTAMINATION IN THE PATAPSCO AQUIFER - 1945 AND 1982
BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998 200123





QUADRANGLE LOCATION

SCALE: 1 : 24,000

Map Derived From U.S.G.S. 7.5 Minute Topographic Quadrangle Sparrows Point & Curtis Bay, MD (1969, Photo Revised 1974)

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FIGURE 2-19

GENERAL FACILITIES LOCATION MAP

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998

200123

DECEMBER 22, 1997

FIG2119.CVS

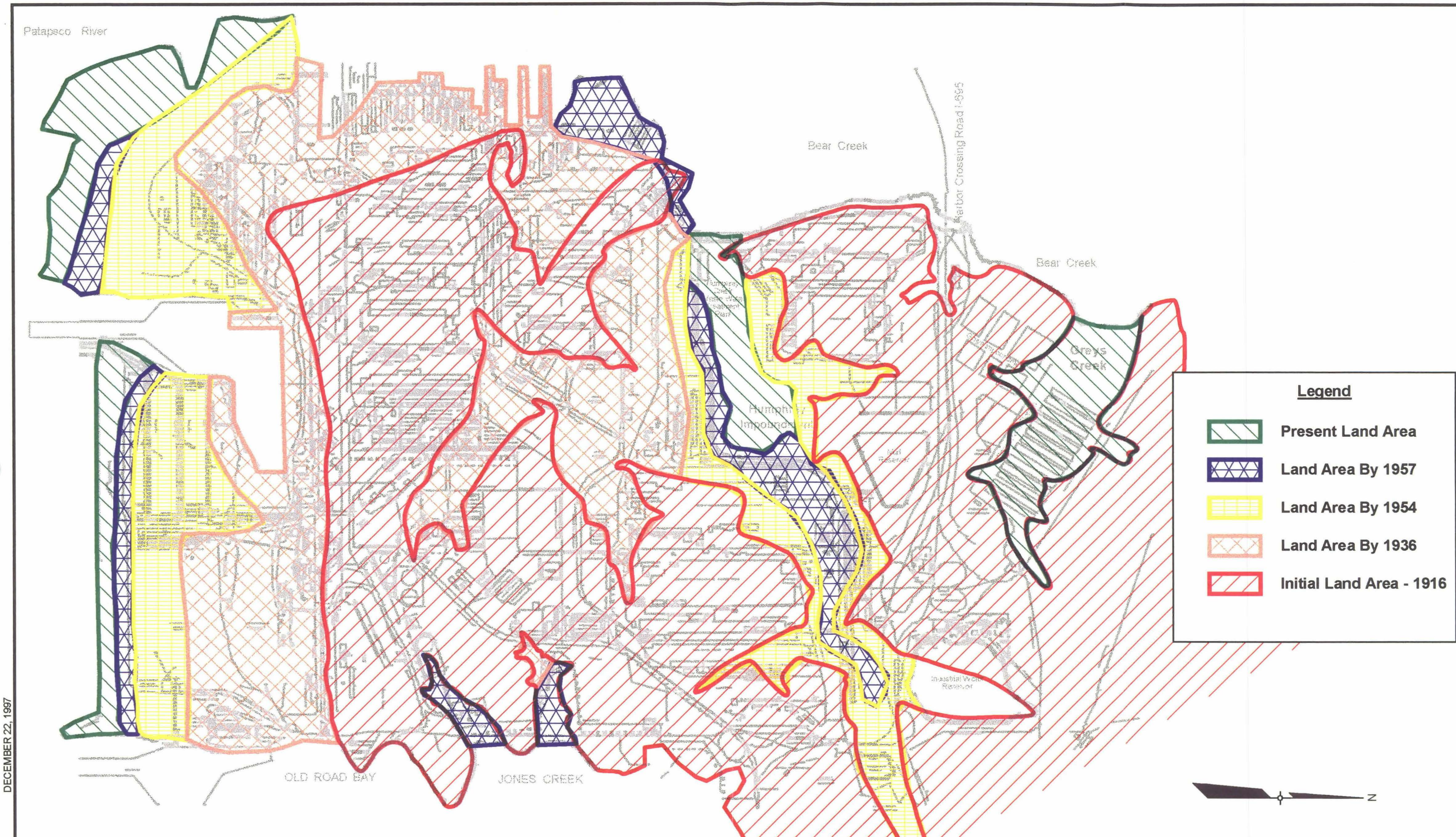

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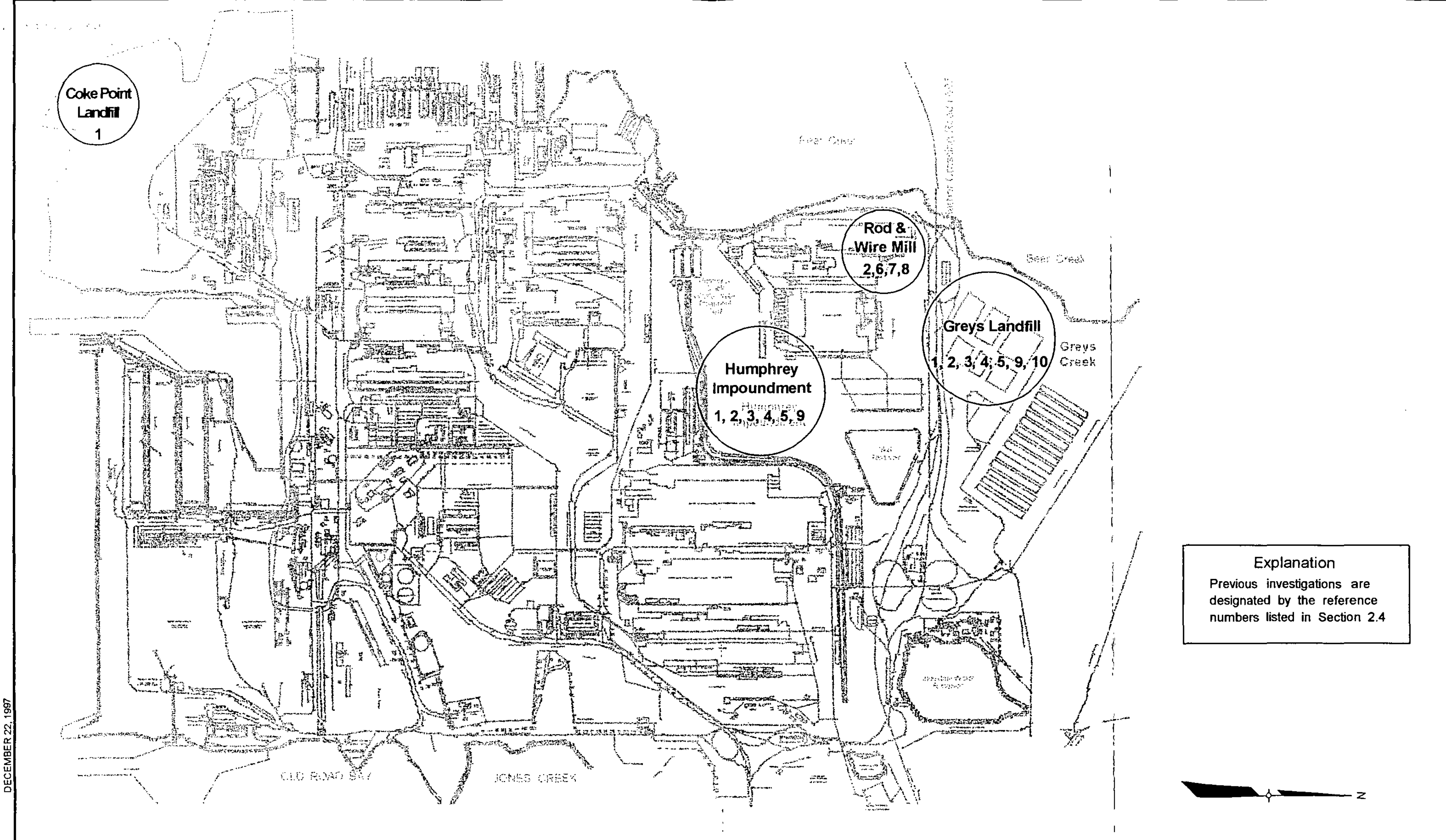
FIGURE 2-20
LAND RECLAMATION/SLAG PLACEMENT HISTORY
BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND
JANUARY 1998
200123

DECEMBER 22, 1997
BSC2.CVS



DECEMBER 22, 1997

BSC2.CVS

Rust Environment & Infrastructure Inc.

FIGURE 2-21

LOCATIONS OF PREVIOUS INVESTIGATIONS

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998

200123

Table 2-1
Summary of Clean Air Permit Information
Bethlehem Steel Corporation
Sparrows Point, Maryland

Unit	Registration Number	Permit to Construct Number	Permit to Construct Date	Comments
No. 1 Pennwood Boiler	5-0941-90			Nos. 1 and 2 share the same registration
No. 2 Pennwood Boiler	5-0941-90			Nos. 1 and 2 share the same registration
No. 3 Pennwood Boiler	5-0414-90			
No. 4 Pennwood Boiler	5-0415-90			
B' Street Boiler No. 201	4-1123-79			Nos. 201 and 202 share the same registration
B' Street Boiler No. 202	4-1123-79			Nos. 201 and 202 share the same registration
A' Coke Oven Battery		03-79-6-00897	Jun. 19, 1979	Ovens and baghouse share same number
A' Battery Baghouse		03-79-6-00897	Apr. 15, 1980	Ovens and baghouse share same number
1-6, 10, 11, and 12 Coke Oven Batteries	6-0936-79			Demolished
A' and B' Coal Chemical Recovery Plants	6-0937-79			Not Operating
A' and B' Coal Handling Plants	6-0934-79			Not Operating
New Coal Chemical Plant Additions		03-6-0937M	Oct. 30, 1991	Not Operating
H' and J' Blast Furnaces	6-0938-79			Not Operating
L' Blast Furnace	6-0939-79	03-6-00839	May 27, 1975	Furnace and baghouse share same documents
L' Baghouse Old	6-0939-79	03-6-00839	May 27, 1975	Furnace and baghouse share same documents
L' Fce. Baghouse New		03-6-0393M	Oct. 1, 1993	
No. 7 Sinter Strand	6-0941-79			
No. 7 Strand Burnt Lime Silo and Baghouse	6-0941-79	03-6-0941M	Sep. 29, 1989	
No. 4 Open Hearth	6-0942-79			Not Operating

Table 2-1
Summary of Clean Air Permit Information
Bethlehem Steel Corporation
Sparrows Point, Maryland

Unit	Registration Number	Permit to Construct Number	Permit to Construct Date	Comments
Ore Handling Plant	6-0940-79			
BOF and Continuous Caster	6-0943-79			
BOF Slag Skimmer Baghouse		03-6-0943	Dec. 15, 1983	
BOF Desulf. Baghouse		03-6-0943	Feb. 15, 1983	
BOF Old Reladling Baghouse		03-6-0943	Dec. 16, 1981	Demolished
BOF Raw Materials Baghouses		03-6-0943M	Jun. 8, 1995	
BOF Reladling Baghouse New		03-6-0943M	May 7, 1996	
BOF Lime Mag Storage Silo	9-0950-84			
Continuous Caster LTS Baghouse		03-06-0943	Feb. 15, 1983	
Tin Mill	6-0949-79			
Primary Mills	6-0945-79			Not Operating
Plate Mill	6-0946-96			
Plate Mill In and Outs Modernization		03-6-0946M	Mar. 24, 1997	
Cold Sheet Mill	6-0948-79			
No. 3 Galvalume Line Modernization		03-6-0948M	Dec. 30, 1996	
No. 4 Coating Line Original		03-6-1732N	Dec. 27, 1991	
No. 4 Coating Line Revised		03-6-1732M	Nov. 19, 1996	
68" Hot Strip Mill	6-0947-79	6-0947R	Aug. 4, 1989	
68" Slab Slitting		03-6-2219N	Jun. 11, 1996	

Table 2-1
Summary of Clean Air Permit Information
Bethlehem Steel Corporation
Sparrows Point, Maryland
Page 3 of 3

Unit	Registration Number	Permit to Construct Number	Permit to Construct Date	Comments
56" Slag Slitting	6-2207-96	03-6-2207N	May 28, 1996	
Coke Oven Gas Space Heaters	5-0756-79			Not Operating
Natural Gas Space Heaters	5-0757-79			
Propane Space Heaters	5-0758-79			Not Operating
No. 2 Oil Space Heaters	4-1701-79			
No. 4 Oil Space Heaters	4-1700-79			Demolished
Rod Mills	6-0950-79			Not Operating
Scrap Preparation	6-0952-79			
Gasoline Storage Tanks Old	9-0428-82			Demolished
HCWWTP Lime Silo	9-0948-80			
Chrome Recovery Lime Silo	09-0949-87			
Rod and Wire Mill	6-0951-79			Not in service
Billet Grinder Baghouse		03-6-0950	June 18, 1982	Not in service
Pipe Mill	6-0951-79			Demolished

Table 2-2
Summary of Clean Water Act Permit Information
Bethlehem Steel Corporation
Sparrows Point, Maryland

NPDES Permit History

Date	Permit No.	Action
07/74	EPA - MHD0001201 MD - 74-DP-0064	Original Permit Issued
10/85	EPA - MD0001201 MD - 79-DP-0064	New Permit Issued
04/90		Permit Application Submitted to MDE

Identification of Condition Agreement, Etc.	Affected Outfalls		Brief Description of Project	Final Compliance Date	
	No.	Source of Discharge		Re-quired	Pro-jected
Maryland Department of Health and Mental Hygiene v. Bethlehem Steel Consent Order dated 10/10/85	001 014 021	Blast Furnace and Sinter Plant Finishing Mills Coke Ovens	Required construction is complete. Interim limitations remain in effect until Section 301(g) variances and net limitations requests are acted upon.		
Maryland Department of Environment Complaint and Order #AO-93-0071 dated 2/24/93 and amended 4/15/93	012 013 014 021 121	Noncontact cooling Noncontact cooling Finishing mills Coke ovens Coke ovens	Requires a detailed plan describing the corrective measures which have been implemented to correct the various NPDES permit exceedances which occurred at the various outfalls. Such plan was submitted on April 19, 1993.		
	012 013 017 018 032	Noncontact cooling Noncontact cooling Noncontact cooling Noncontact cooling Noncontact cooling	Requires a detailed plan describing the corrective measures which have been implemented to ensure compliance with COMAR 26.08.03.06C(2) chlorine limitations. Such plan was submitted on April 19, 1993		4/94

Table 2-3
Summary of Solid and Hazardous Waste Permit Information
Bethlehem Steel Corporation
Sparrows Point, Maryland

Date	Event or Action
unknown date before 1982	An agency of the state of Maryland issued a solid waste permit to Bethlehem Steel Corporation.
September 1, 1982	The Waste Management Administration in the Office of Environmental Programs of the Maryland Department of Health and Mental Hygiene (DHMH, the predecessor agency to the Maryland Department of the Environment) renewed the permit, issuing Facility Permit No. A074 to Bethlehem Steel Corporation. The permit was both a hazardous and a non-hazardous waste permit. It addressed solid waste handling and disposal throughout the facility, including Greys Landfill, Coke Point, and Humphrey Impoundment. The stated expiration date was August 31, 1985, but the permit provided that it would automatically continue pending agency action on a timely application for renewal.
February 1984	In response to a request from the agency, Bethlehem submits an application for a hazardous waste permit to the Waste Management Administration
March 1985	In partial compliance with an order issued by DHMH in February, 1985, Bethlehem submitted information about the wastes generated at Sparrows Point, and about those wastes disposed of in Greys Landfill and Humphrey Impoundment.
March 1985	Bethlehem asked DHMH to advise whether any additional information was needed to constitute an application for renewal of Permit A074. DHMH did not identify any additional information.

Table 2-3
Summary of Solid and Hazardous Waste Permit Information
Bethlehem Steel Corporation
Sparrows Point, Maryland

Date	Event or Action
March 1987	Bethlehem amended its February 1984 application
November 1992	Bethlehem amended its application for renewal of Permit No. A074 to eliminate all hazardous waste activities needing a permit except the storage of PCB wastes in the Skelp Mill, which required a Maryland hazardous waste permit.
April 1993	Bethlehem withdrew any application for a RCRA permit.
March 1994	In response to a request from the Maryland Department of the Environment (MDE), Bethlehem submitted an amended application containing detailed information on the planned storage of PCB wastes in the Skelp Mill.
June 1, 1995	MDE renewed permit A074 (for the first time since 1982) as a permit to store PCB waste in the Skelp Mill. MDE took the position that the other parts of Permit No. A074 terminated upon issuance of the new permit, but that the non-hazardous solid waste disposal units at the facility could continue to operate without a permit unless they were altered or extended. The Consent Decree addresses these units in Section VII C.

3.0 EVALUATION OF POTENTIAL CONTAMINANT SOURCES

3.1 INTRODUCTION

3.1.1 Purpose and Organization of Section

The purpose of this section is to provide information that describes current conditions for Solid Waste Management Units (SWMUs) and Areas of Concern (AOCs) that are potential sources of releases to the environment and are therefore relevant to RCRA Corrective Action at BSC's Sparrows Point Facility. This section supplements and updates the Final RCRA Facility Assessment Phase II Report (RFA Report) prepared for EPA by A.T. Kearney and dated August 12, 1993.

This section provides descriptions of the procedures used for screening out SWMUs and for identifying chemicals of potential interest (COPIs) at the SWMUs retained for further investigation. It also provides descriptions and discussions of SWMUs that are not screened out, descriptions and discussions of AOCs identified in the RFA Report, and descriptions and discussions of six additional AOCs not identified in the RFA. The information presented in this section is based on three sources: 1) the RFA Report, 2) BSC files (including correspondence, analytical data summaries, permit information, site investigation reports, closure reports, monitoring/sampling reports, and remediation reports), and 3) recent on-site inspections.

3.1.2 Overview of RFA Report

The SWMUs and AOCs described in this report were previously identified in the RFA Report, which updated the Draft Interim RFA Report prepared by PRC Environmental Management on April 12, 1988. A total of 203 SWMUs and 28 AOCs were identified during the Visual Site Inspection (VSI) conducted by A.T. Kearney on June 17-21 and 24-25, 1991. Descriptions for 41 of the SWMUs and 26 of the AOCs were provided in the RFA Report.

In the RFA Report, the following codes were assigned to each SWMU/AOC to describe the rationales used in determining the respective release potential:

SD = SWMU Description included in Section 4.0 of the RFA Report
AD = AOC Description included in Section 4.0 of the RFA Report
I = Units located indoors and not observed to be releasing
TP = Treatment process units managing waste not observed to be releasing
NR = Units located outdoors but not observed to be releasing
NH = Units managing non-hazardous waste
RS = Units which no longer exist and were removed from site
AI = Additional information needed to assess potential for release
CV = Units covered within an AOC description (AOC area in parentheses) in RFA Report

The SWMUs and AOCs are listed in Table 3-1, which is a modified version of Table IV-I in the RFA Report. In Table 3-1, the SWMUs and AOCs are grouped into 28 areas based on their function and similarity to surrounding activities. For the purposes of the Site Wide Investigation, the areas identified in the RFA have been combined or modified into 12 "Facility Areas." These major Facility Areas are shown on Figure 3-1 (following Section 3 text).

3.2 SWMU/AOC SCREENING AND COPI SELECTION PROCEDURES

3.2.1 SWMU/AOC Screening

As provided for in Attachment B of the Consent Decree (Conceptual Plan for the Site Wide Investigation), SWMUs described in the RFA Report as "not observed to be releasing" can be screened out from further consideration. This is consistent with the concept presented on page four of the RFA Report cover letter (EPA, 1993), which indicated that only those SWMUs that had the potential for significant environmental impact would be described in the RFA Report. A total of 115 SWMUs were designated as "not observed to be releasing", and not proposed for further action. Therefore, these SWMUs screen out and will not be discussed in this DCC Report.

Four SWMUs designated as removed from the site (RS), and two AOCs designated as requiring additional information (AI) in the RFA Report are also screened out from further consideration as discussed below. The "RS" SWMUs are the Former J Furnace Thickener (SWMU 160), A-G & K Furnaces (SWMU 161), Tar Decanter Buggies (SWMU 185), and the Tar Storage Box Area (SWMU 186). The Former J Furnace Thickener screens out because it was similar in construction and operation to the H Furnace Thickener (SWMU 155), and was part of the overall treatment system at J Furnace which included Precipitators, a Gas Washer, a Scrubber, and a Dust Catcher (SWMUs 156-159), all of which were "not observed to be releasing". A-G & K Furnaces screen out because they were process units, not waste management units. The Tar Decanter Buggies and Tar Storage Box Area screen out because they were mobile equipment used within the Coke Oven Area, which will be investigated as a Special Study Area as identified in Attachment B of the Consent Decree and within which releases specifically attributable to this equipment could not be discriminated. The "AI" AOCs are the Pipe Mill Process Area (AOC AA) and the Rod and Wire Mill Process Area (AOC AB). These AOCs screen out because they are process areas, not waste management areas, and because specific SWMUs and AOCs within these process areas have been separately identified.

Thus, of the 203 SWMUs and 28 AOCs identified in the RFA Report, a total of 84 SWMUs and 26 AOCs remain for further consideration in this DCC Report. The descriptions presented in the following sections of this report focus on these SWMUs and AOCs. The majority of SWMU descriptions provided in this report are consolidated, modified, and updated versions of descriptions in a Solid Waste/Material Management Units Inventory report prepared by Baker Environmental, Inc. for Bethlehem (Baker, 1990), along with information provided in the RFA Report. The locations of the SWMUs and AOCs being considered in this DCC Report are shown on Figure 3-1.

3.2.2 COPI Selection

According to EPA guidance documents, investigations of releases from SWMUs should focus on the subset of hazardous waste (including hazardous constituents) that are likely to have been released at a particular site, based on available information. The following criteria provide the technical basis for developing a list of COPIs associated with SWMUS located within any of the major groups of plant operations that are presented in this report:

- The COPIs are associated with the SWMU based on knowledge of the SWMU or the process associated with the SWMU, site historical records, Material Safety Data Sheets, SARA Title III Reports, EPA Effluent Limitation Guideline Development Documents, and/or knowledge based on RCRA investigations at other Bethlehem sites, and

- The COPIs are cited as a basis for listing an iron and steel making waste as hazardous in Appendix VII to 40 CFR Part 261 or identified as hazardous constituents in Appendix VIII of 40 CFR Part 261, and

- The COPIs are specifically capable of being analyzed using an SW-846 analytical method (i.e., are in the Appendix IX constituents list).

The resultant list of COPIs generated for each SWMU or AOC summarizes those COPIs that are expected to be found or are known or suspected to be present. Historical data derived from various sources and evaluated as part of the COPI list development are referenced in the succeeding sections and presented throughout Appendix 3A as necessary.

3.3 SOLID WASTE MANAGEMENT UNITS (SWMUs)

In the following sections, SWMUs are identified in numeric order as they appear in the RFA Report. Descriptions and background information of the respective units are provided, followed by a brief description of EPA concerns, new information (or action) generated since the RFA was written, further action proposed, and finally, a listing of COPIs associated with the SWMU.

3.3.1 Tin Mill Canal Area

SWMU 1: **Tin Mill Canal (TMC)**
SWMU 2: **TMC Discharge Pipes**
SWMU 3: **TMC Oil Skimming Devices (5)**
SWMU 4: **TMC Dredging Containment Areas (5)**
SWMU 5: **TMC Waste Oil Storage Tanks (5)**
SWMU 6: **TMC Impoundments (4)**
SWMU 7: **Recent TMC Embankment Dredgings**
SWMU 8: **TMC Brill Skimmer Pits (2)**
SWMU 9: **Former TMC Oil Collection Dumpster**

Descriptions

These nine SWMUs are located in the Tin Mill Canal Facility Area (Figure 3-1), and are part of the "Tin Mill Canal and Finishing Mills Special Study Area" identified in Attachment B of the Consent Decree (Conceptual Plan for the Site Wide Investigation). The Tin Mill Canal (SWMU 1) is a man-made canal constructed in slag fill and located in the northern half of the site. The TMC is approximately 7700 feet long, 30-50 feet wide, and averages approximately 15 feet in depth. The TMC primarily serves as a conveyance for industrial wastewater discharged from several site facilities. Wastewater generally flows east to west to the Humphrey Creek Waste Water Treatment Plant (HCWWTP). The influent process wastewater flow rate is approximately 40,000 gallons per minute. The canal also receives stormwater runoff and non-contact cooling water.

According to the RFA Report, wastewater discharges to the TMC through 23 Discharge Pipes (SWMU 2) from the manufacturing processes formerly conducted at the Rod and Wire Mill and the Pipe Mill (no longer in operation), and currently conducted at the Finishing Mills (the Cold Sheet Mill, and the Tin Mill), the Hot Strip Mill, and the Primary Rolling Mills. The following industrial wastewater has been discharged to the TMC as indicated:

Historical Only
- wastewater from electroplating
- passivation wastewater
- plating bath wastewater, sludge, and slurry

Historical and Current
- rinsewater from caustic cleaning
- air scrubber wastewater
- oily wastes
- process wastewater from steel-making operations
- cooling water

Beneficially Re-Used
- spent pickle liquor (SPL)
- pickle rinse water (PRW)
- spent caustic solutions

The RFA Report indicated that there were five oil skimming devices (SWMU 3) used for oil recovery. These include two belt skimmers and three brill skimmers. The belt skimmers are located near the Tin Mill Boiler House. Here, recovered oil is temporarily stored in two steel tanks prior to transfer to the Palm Oil Recovery (now U.S. Filter) Plant. One brill skimmer is located upstream of the Chromium HDS Recovery Plant and discharges recovered oil to an aboveground storage tank (SWMU 5). The other two brill skimmers are located between the Chromium HDS Plant and HCWWTP and discharge to an underground steel tank with a capacity of approximately 4,000 gallons and a vertical aboveground steel tank with a capacity of approximately 10,000 gallons. These tanks are located where the Brill Skimmer Pits (SWMU 8) used to be situated. SWMU 9 had previously received oil from the two upstream skimming devices and was replaced by SWMU 5.

The TMC is occasionally dredged to maintain flow and prevent back-ups in the Finishing Mills (the Cold Sheet Mill, and the Tin Mill) and the Hot Strip Mill. During approximately the past 10 years, the dredgings (SWMU 7) have been temporarily placed along the banks of the canal. From the mid 1970's until 1984, dredgings were temporarily stored in five dewatering storage units (SWMU 4). These units consisted of slag dikes with capacities ranging from approximately 175 to 1,000 cubic yards. Here, dredgings were placed and allowed to dewater back into the TMC. These containment areas have been inactive since 1984 and are located as follows (Baker, 1990):

Dewatering Unit	Location
No.1	Approximately 400' East of HCWWTP on the north side of TMC
No.2	Approximately 1500' East of HCWWTP on the north side of TMC
No.3	Approximately 1/2-mile East of HCWWTP on the north side of TMC
No.4	Approximately 9/10-mile East of HCWWTP on the south side of TMC
No.5	Approximately 1200' East of HCWWTP on the north side of TMC

According to the RFA Report, dredgings were formerly placed in four TMC Impoundments (SWMU 6) for drying prior to disposal at Greys Landfill (SWMU 93). Three of these impoundments were located near the HCWWTP, and one was near Humphrey Impoundment to the west. Based on descriptions provided in the RFA Report, the former impoundments (SWMU 6), correspond to (and duplicate) four of the five units described as SWMU 4. The locations of the units are shown on Figure 3-2.

EPA Concerns

The TMC (SWMU 1) and the TMC Discharge Pipes (SWMU 2) are described in the RFA Report. EPA is concerned with these units because of the history and nature of the wastes conveyed through the canal (discussed below) even though the waste-stream is treated and ultimately discharged under a National Pollutant Discharge Elimination System (NPDES) permit (at outfall 014).

New Information

There are currently 12 active process sewers that discharge to the TMC from the following production facilities:

- Hot Strip Mill
- Cold Sheet Mill including Galvanizing and Galvalume Lines and #3 and #4 Pickle Lines
- Halogen Tin Coating Line
- Halogen No. 8 Tin Free Steel Chrome Type Coating Line
- Basic Oxygen Furnace Department including the Continuous Caster Department
- Plate Mill
- Chromium HDS Plant

The process wastewater includes contact and non-contact cooling water, spent pickling (SPL) and cleaning rinsewater (including caustic rinsewater), and stormwater runoff from the above facilities.

The SPL and cleaning rinsewater are beneficially re-used at the Chromium HDS Plant and HCWWTP. The discharge locations along with descriptions of contributing flows from each discharge point are shown on Figure 3-3.

Recommendations

The TMC is part of the "Tin Mill Canal and Finishing Mills Special Study Area" identified in Attachment B of the Consent Decree (Conceptual Plan for the Site Wide Investigation). Based on the nature of wastes previously or currently discharged to the TMC, and based on the requirement to investigate the Special Study Area, further action is proposed for SWMU 1.

By evaluating the TMC (SWMU 1) as part of a Special Study Area, the materials discharged through SWMU 2 that are co-mingled within the canal would also be evaluated. Therefore, it is proposed that an evaluation of SWMU 2 be included in the overall evaluation of the TMC (SWMU 1).

Any releases from SWMUs 3, 5, 8, and 9, which function (or previously functioned) as waste oil recovery units, would be characterized by evaluating the TMC (SWMU 1) as part of a Special Study Area because the wastes managed by these SWMUs came from the TMC. Therefore, it is proposed that an evaluation of SWMUs 3, 5, 8, and 9 be included in the overall evaluation of the TMC (SWMU 1).

Any releases from SWMUs 4, 6, and 7 would be characterized by an overall evaluation of SWMU 1 as part of a Special Study Area because the dredging storage units manage wastes collected from the TMC. Therefore, it is proposed that an evaluation of SWMUs 4, 6, and 7 be included in the overall evaluation of the TMC (SWMU 1).

COPIs

The COPI list for the TMC (discussed below) was developed in light of what is known about the materials historically or currently discharged into the TMC and the solids that have accumulated in the TMC, without regard to their classification under the hazardous waste laws.

Information on the chemical nature of the solids in the TMC appeared in the RFA Report. These results are summarized in Appendix 3A-Table 1A (Table IV-4B of the RFA Report). Additional data are presented in Appendix 3A-Tables 1A-G. TCLP results indicated all concentrations were below regulatory levels. The RFA Report also identified (on Table IV-4A) very low level concentrations of Volatile Organic Compounds (VOCs) and Semi-Volatile Organic Compounds (SVOCs) as being present in the TMC dredgings (SWMU 7). Analytical results indicate that the dredgings do not exhibit any hazardous waste characteristics. These data are shown on Appendix 3A-Table 2.

Based on available information, and process knowledge, the following COPIs are associated with SWMUs 1-9:

- Metals -- specifically cadmium, chromium, nickel, lead, and zinc.

- Cyanide.

- Purgeable Aromatics -- specifically benzene, toluene, ethylbenzene, xylenes, 1,3-dichlorobenzene, and 1,4-dichlorobenzene.

- Chlorinated Solvents -- specifically chloroform, tetrachloroethylene, trichloroethylene, cis- and trans-1,2-dichloroethylene, 1,1-dichloroethylene, vinyl chloride, 1,1,1-trichloroethane, 1,2-dichloroethane, 1,1-dichloroethane, and chloroethane.

- Polynuclear Aromatic Hydrocarbons -- specifically acenaphthene, acenaphthylene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene.

3.3.2 Humphrey Creek Wastewater Treatment Plant (HCWWTP) Area

SWMU 14: HCWWTP Spent Pickle Liquor (SPL) Discharge Point

Descriptions

The Spent Pickle Liquor (SPL) Discharge Point (SWMU 14) was designated in the RFA Report as a unit requiring additional information to assess release potential.

EPA Concerns

No specific details that describe the nature of wastes managed by nor the general conditions of this unit were provided in the RFA report.

New Information

Contrary to the implication that SWMU 14 is located at HCWWTP (based on its grouping with other SWMUs identified at in that area), the Spent Pickle Liquor Discharge Point is not located at HCWWTP. SPL enters the TMC at one location, the Cold Sheet Mill sewer 033B, which is located well upstream of the treatment plant (see Figure 3-3).

Recommendations

Because SWMU 14 relates to the beneficial reuse of SPL in the TMC, it is part of a treatment process, not a waste management unit. Furthermore, because it discharges into the TMC, its "releases" are not releases to the environment but controlled discharges of a wastewater treatment chemical. Therefore, no further action is proposed for SWMU 14.

COPIs

There are no COPIs associated with SWMU 14 because no further action is proposed.

3.3.3 Chromium HDS Plant Area

SWMU 26: Chrome Recovery Filtrate Sump

Description

According to the RFA Report, the Chrome Recovery Filtrate Sump (SWMU 26) was the only SWMU located in the Chromium HDS Plant (which is called Chrome Recovery Plant in the RFA), that was not considered to be part of the treatment process. A general description of SWMU 26 provided in the RFA Report was limited to a brief summary of available information in tabular form (RFA Report Table IV-5). SWMU 26 was identified as a unit designed to carry process wastewater to the TMC Discharge Pipes (SWMU 2).

EPA Concerns

No specific details that describe the nature of wastes managed by nor the general condition of this unit were provided in the RFA Report.

New Information

The Chromium HDS Plant consists of various treatment process units located approximately two-thirds of the downstream distance along the TMC on the southern side of the TMC (Figure 3-1). SWMU 26 was identified in the RFA Report as a unit designed to carry process wastewater to the TMC Discharge Pipes (SWMU 2). However, this is not the case; this unit functions as part of the treatment process to collect liquids from spills and leakage from other Chromium HDS Plant units that are routed back into the system through the Floc Tank (SWMU 20). SWMU 26 is a concrete sump with 1,500 gallons capacity, and has been in operation since 1987 (Baker, 1990). A flow diagram of the secondary containment and sumps at the Chromium HDS Plant is shown in Figure 3-4. During an April 10, 1997 inspection, the concrete was observed to be intact with no visible cracks or leaks, and the sump was operating properly.

Recommendations

Because SWMU 26 is a wastewater treatment process unit observed to be non-releasing, and the condition of the unit was confirmed during a recent inspection, no further action is proposed.

COPIs

No COPIs are associated with SWMU 26 because no further action is proposed.

3.3.4 Rod Mill Area

SWMU 27:	**Rod Mill Remediation Area (Sludge Bin Storage Area)**
SWMU 28:	**Northwest Pond**
SWMU 29:	**East Pond**
SWMU 30:	**Rod Mill Equalization Tanks (2)**
SWMU 38:	**Cadmium Treatment Trenches**
SWMU 39:	**Rod Mill Scale Pits (2)**
SWMU 44:	**Rod Mill Cooling Tower**
SWMU 45:	**Rod Mill Trenches/Sumps**

Descriptions

These SWMUs are located in or near the Rod and Wire Mill, which is situated along the western edge of the Rod and Wire & Pipe Mills Facility Area as shown on Figure 3-1.

The primary waste generated at the Rod Mill was the result of leaching roasted zinc ore with sulfuric acid. A sludge containing impurities (iron and cadmium) was then removed from the leaching solution. This process generated high purity zinc powder. This operation began in the 1940's and ceased in the 1980's. Pure zinc was also dissolved between 1972 and 1980. The leaching process occurred in large tanks located inside the north end of the Rod and Wire Mill building. In the 1950's through the early 1970's, the acidic leach residue was stored in the Northwest Pond (SWMU 28) until about 1959 when filters were installed to dewater the residues as they were produced. Dewatered sludge generated during this process was temporarily stored on the ground outside the north end of the mill in the current Remediation Area (SWMU 27), which is also known as the Sludge Bin Storage Area. In the early 1970's, sludge bins were installed in this area to collect the dewatered sludge, which was sold for cadmium recovery. Filtrate from sludge dewatering was re-used for wire plating processes. Any excess filtrate was discharged to the East Pond (SWMU 29) until 1971 after which it was sent to HCWWTP for treatment. SWMUs 28 and 29 were investigated in 1986 as part of the remediation system project, and it was determined that no significant soil contamination was present in either pond area. Production of sludge and filtrate ceased when the mill operations were shut down in the early 1980's (Baker, 1986).

In 1986 BSC initiated a groundwater remediation program under Maryland Department of the Environment (MDE) Complaint and Order C-O-85-179, dated February 25, 1985. Groundwater exhibited elevated levels of cadmium and zinc, and residual soil contamination existed in the Sludge Bin Storage Area (SWMU 27).

The remediation project consists of groundwater being pumped from shallow and intermediate wells to a small equalization tank which then discharges to two Rod Mill Equalization Tanks (SWMU 30). These tanks are constructed of steel, lined with acid-resistant bricks, and have a capacity of 10,000 gallon each (Baker, 1990). Use of these tanks began in 1986 and continues today. The location of SWMUs at the north end of the Rod and Wire Mill are shown in Figure 3-5, and specific details of the current remediation activities are provided in Section 6 of this report.

The general descriptions of SWMUs 38 and 45 provided in the RFA Report were limited to a brief summary of available information in tabular form (RFA Report Table IV-5). The Cadmium Treatment Trenches (SWMU 38) and the Rod Mill Trenches/Sumps (SWMU 45) were identified in the RFA Report as units associated with piping designed to transport cadmium contaminated groundwater and contact cooling water, respectively, to the TMC Discharge Pipes (SWMU 2).

The two Rod Mill Scale Pits (SWMU 39) and the Rod Mill Cooling Tower (SWMU 44) were designated in the RFA Report as units managing non-hazardous waste. No descriptions of these units were provided in the RFA report.

EPA Concerns

SWMUs 27-30 were described in the RFA Report. EPA is concerned with these units because of the nature of wastes managed by these units and known releases of cadmium and zinc to the soil and groundwater.

No specific details that describe the nature of wastes managed by nor the general condition of SWMUs 38, 39, 44, and 45 were provided in the RFA Report.

New Information

SWMU 38 is actually a trench system constructed of high-density polyethylene that leads to a concrete sump. This SWMU functions to manage process overflow and spillage from the surrounding groundwater treatment units. Wastewater managed by this unit are sent back into the treatment system and not to the TMC. This unit began operating in 1986 and is currently active. During an April 10, 1997 site inspection, this unit was observed to be intact with no cracks or leaks.

SWMU 39 has been inactive since the Rod Mill ceased operations in the early 1980's. One of the Scale Pits is located near the southwest corner of the Rod Mill. This concrete structure is partially above ground, and measures approximately 25 feet wide by 70 feet long and 6 feet deep. The unit was used to collect non-hazardous mill scale. During a site visit conducted in June 1996, the pit was observed to contain stormwater. There are no known releases from this pit.

The second pit is located near the Rod Mill Cooling Tower (SWMU 44) and is approximately 30 feet wide by 50 feet long and 6 feet deep. Similar to the other pit, this unit is partially above ground, and was used to collect non-hazardous mill scale. Stormwater was also observed in this pit during a site visit in June 1996. There are no known releases from this pit.

The Cooling Tower (SWMU 44) is an aboveground tank of unknown capacity constructed of cedar. This unit managed non-hazardous contact cooling water used to pick up mill scale. The water was first sent to the Mill Scale Pits (SWMU 39), where the solids were settled out, then sent back to the Tower for re-use. There are no known releases from this tank.

The RFA Report indicated that the Rod Mill Trenches/Sumps (SWMU 45) managed contact cooling and were in operation as of the date of report publication (1991). These units were concrete and brick-lined trenches beneath the Rod Mill equipment that operated between the 1940's to the late 1980s and, when active, discharged to the TMC via sewer 027.

Recommendations

Because the remediation system in the Sludge Bin Storage Area (SWMU 27) is currently an active Interim Measure, and because its condition was confirmed during an April 10, 1997 site inspection, no further action is proposed for SWMU 27 (other than continued operation of system as described in Section 6).

Because the Northwest and East Ponds (SWMUs 28 and 29) were investigated in 1986 and found to require no action, and because the current remediation system is addressing any possible groundwater impacts, no further action is proposed for SWMUs 28 and 29.

Because the Equalization Tanks (SWMU 30) are part of the active remediation system (i.e., treatment process), and because they are located inside the north end of the Rod Mill, no further action is proposed for SWMU 30.

Because wastewater managed by SWMU 38 are sent back into the treatment system and not to the TMC, and because the integrity of this unit was confirmed during an April 10, 1997 site inspection, no further action is proposed for SWMU 38.

Because there are no known releases from the two Rod Mill Scale Pits (SWMU 39) nor the Rod Mill Cooling Tower (SWMU 44) and because these units managed non-hazardous waste, no further action is proposed for SWMUs 39 and 44.

Because it managed contact cooling water which could have picked up oils and dissolved metals from the Rod Mill processes and released them to the environment, the Rod Mill Trenches/Sumps (SWMU 45) should be retained for further evaluation.

COPIs

Based on process knowledge, the following COPIs are associated with SWMU 45:

- Metals -- specifically cadmium, chromium, nickel, lead, and zinc.

- Polynuclear Aromatic Hydrocarbons -- specifically acenaphthene, acenaphthylene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene.

3.3.5 Pipe Mill Area

SWMU 48: Pipe Mill Zinc Ammonium Chloride Sludge Storage Area
SWMU 49: Pipe Mill Trenches/Sumps

Descriptions

The Pipe Mill Area is located in the eastern part of the Rod and Wire Mill & Pipe Mills Facility Area (Figure 3-1). SWMUs located within the Pipe Mill Area include the Zinc Ammonium Chloride Sludge Storage Tanks (SWMU 48) and the Pipe Mill Trenches/Sump (SWMU 49). Brief descriptions of these units were provided in the RFA Report.

SWMU 48 is currently inactive and was used for the management of zinc ammonium chloride sludge and contaminated soil. The unit is located outside the northern end of the Pipe Mill, and consists of an area where 55-gallon drums were stored on pallets that rested on sandy soil, gravel and asphalt. Fewer than 30 drums containing waste zinc ammonium chloride were temporarily stored for less than 90 days. This unit was closed in 1984 under a Closure Plan approved by MDE on December 12, 1983. Facility closure was certified by Whitman, Requardt & Associates on May 8, 1984 (Baker, 1990).

The general description of SWMU 49 provided in the RFA Report was limited to a brief summary of available information in tabular form (RFA Report Table IV-5). The Pipe Mill Trenches/Sumps (SWMU 49) were identified as a unit associated with piping designed to transport process wastewater from the Pipe Mill to the TMC Discharge Pipes (SWMU 2) and ultimately to the TMC. This unit began operations in the 1950's, was dismantled in 1983, and no longer discharges to the TMC.

EPA Concerns

There was one reported release at SWMU 48 that resulted in some contaminated soil that was excavated (RFA, 1994). There are no indications that post-excavation confirmatory soil samples were collected. During the VSI, this excavated area was observed to be approximately 8 feet square by 4.5 feet deep.

No specific details that describe the nature of wastes managed by nor the general condition of SWMU 49 were provided in the RFA Report.

New Information

During an April 10, 1997 site inspection, the entire Pipe Mill area was observed. The open excavation at SWMU 48 noted during the 1991 VSI was apparently filled in, and there were no visible signs of its former boundaries. During the same inspection, the Trenches/Sumps (SWMU 49) were covered with earthen material and were not readily visible.

The Pipe Mill is currently in the process of being demolished. This project will remove all structures above the ground surface, but will not involve subsurface excavations. The project is scheduled for completion during 1998.

Recommendations

Because SWMU 48 is inactive and was closed in 1984, because wastes were stored for less than 90 days, and because there is only one recorded release incident associated with this unit along with the excavation of approximately 11 cubic yards of soil, no further action is proposed for SWMU 48.

It is proposed that SWMU 49 be addressed as part of a "post-demolition confirmation project." This project would involve focused sampling and analysis of soil and/or fill materials remaining at the ground surface upon completion of the Pipe Mill demolition project. Its purpose would be to determine if any residual contamination is present. Its scope could be extended to include AOC Z (Pipe Mill Acid Tanks) which is also in the Pipe Mill Area.

COPIs

Based on process knowledge, the following COPIs are associated with SWMU 49:

- Metals -- specifically chromium, nickel, lead, and zinc.
- Polynuclear Aromatic Hydrocarbons -- specifically acenaphthene, acenaphthylene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene.

3.3.6 Billet Prep Area

SWMU 53: Billet Prep Trenches & Blind Sumps

Descriptions

The Billet Prep Area is located in the southeastern corner of the Rod and Wire & Pipe Mills Facility Area (Figure 3-1).

The general description of the Billet Prep Trenches & Blind Sumps (SWMU 53) provided in the RFA Report was limited to a brief summary of available information in tabular form (RFA Report Table IV-5). SWMU 53 was identified as a unit associated with piping designed to transport process wastewater to the TMC Discharge Pipes (SWMU 2) and ultimately to the TMC. This unit began operating in the 1960's and was active at the time of the 1991 VSI.

EPA Concerns

No specific details that describe the nature of wastes managed by nor the general condition of SWMU 53 were provided in the RFA Report.

New Information

Use of SWMU 53 was discontinued sometime around 1993 or 1994. There are currently no discharges from this unit. Non-hazardous process wastewater was generated from benign, dye-penetrant solutions used during previous grinding wheel operations. The trenches and sumps were filled in when the Billet Prep building was converted to an area that is currently used for steel plate storage and shipping. Good housekeeping practices are maintained in this area.

Recommendations

Based on the nature of the materials potentially present in the water managed by the Billet Prep Trenches & Blind Sumps (SWMU 53), no further action is proposed.

COPIs

There are no COPIs associated with SWMU 53 because no further action is proposed.

3.3.7 Coating Lines Area

SWMU 54: The Coating Lines Blind Sumps

Descriptions

The Coating Lines Blind Sumps (SWMU 54), are located within the Coating Lines Area in the southwestern portion of the Cold Sheet Mill. The Cold Sheet Mill is located in the central portion of the Finishing Mills Facility Area (See Figure 3-1). The Finishing Mills are included with the Tin Mill Canal in a Special Study Area identified in Attachment B of the Consent Decree (Conceptual Plan for the Site Wide Investigation).

The general description of SWMU 54 provided in the RFA Report was limited to a brief summary of available information in tabular form (RFA Report Table IV-5). SWMU 54 was generally described as a unit associated with piping designed to transport process wastewater to the TMC Discharge Pipes (SWMU 2). According to the RFA Report, use of this unit began in the 1950's and continues today.

EPA Concerns

No specific details that describe the nature of wastes managed by nor the general condition of this unit were provided in the RFA Report.

New Information

Waters managed by this unit are contained within the Coating Lines system and not discharged to the TMC. This unit is a concrete-lined pit in the basement floor that serves to contain spillage and/or leakage from the coating lines process area situated one floor above the blind sump.

Recommendations

Based on its location and the possibility of releases (albeit of limited volume), it is proposed that SWMU 54 be included in the evaluation of the "Tin Mill Canal and Finishing Mills Special Study Area" identified in Attachment B of the Consent Decree (Conceptual Plan for the Site Wide Investigation).

COPIs

Based on process knowledge, the following COPIs are associated with SWMU 54:

- Metals -- specifically chromium, nickel, lead, and zinc

3.3.8 Cold Sheet Mill Area

SWMU 58: Cold Sheet Mill Piping
SWMU 59: Tandem Mill Trench System

Descriptions

The Cold Sheet Mill (CSM) is located near the central portion of the Finishing Mills Facility Area (see Figure 3-1). The Finishing Mills are included with the Tin Mill Canal in a Special Study Area identified in Attachment B of the Consent Decree (Conceptual Plan for the Site Wide Investigation).

The general descriptions for the CSM Piping and Tandem Mill Trench System (SWMUs 58 and 59, respectively) provided in the RFA Report were limited to a brief summary of available information in tabular form (RFA Report Table IV-5). SWMUs were identified as units associated with piping designed to transport process wastewater and oily process wastewater, respectively, to the TMC Discharge Pipes (SWMU 2). SWMU 58 began operating in the 1940's while SWMU 59 began in the 1950's. Use of both units continues today.

EPA Concerns

No specific details that describe the nature of wastes managed by nor the general condition of these units were provided in the RFA Report.

New Information

Wastewater from both of these units is currently transported to PORI (SWMUs 71-73) where waste oil is separated from the wastewater. The wastewater enters the TMC as a non-BSC NPDES permitted discharge. As indicated in a response to 1987 EPA information requests, cold rolling wastewater have been sampled and analyzed after oil-skimming treatment at PORI.

Supporting documentation is provided in Appendix 3B. There is no available information indicating that any release from SWMUs 58 or 59 has occurred.

A review of available sewer line maps shows that the Cold Sheet Mill Piping (SWMU 58) system consists primarily of concrete trenches, with some (acid) brick sewers, and some open or box trenches. Sewer line maps also indicate that the Tandem Mill Trench System (SWMU 59) consists primarily of concrete trenches with some (acid) brick sewers.

Recommendations

Because SWMUs 58 and 59 currently release wastewater (via non-BSC NPDES discharge from PORI) to the TMC (SWMU 1) where they are co-mingled with other waste streams, treated at HCWWTP, and discharged through an NPDES permitted outfall, it is proposed that evaluation of these units be included in the evaluation of the "Tin Mill Canal and Finishing Mills Special Study Area" identified in Attachment B of the Consent Decree (Conceptual Plan for the Site Wide Investigation).

COPIs

Based on process knowledge, the following COPIs are associated with SWMUs 58 and 59.

- Metals -- specifically chromium, nickel, lead, and zinc.
- Cyanide.
- Purgeable Aromatics -- specifically benzene, toluene, ethylbenzene, xylenes, 1,3-dichlorobenzene, and 1,4-dichlorobenzene.
- Chlorinated Solvents -- specifically chloroform, tetrachloroethylene, trichloroethylene, cis- and trans-1,2-dichloroethylene, 1,1-dichloroethylene, vinyl chloride, 1,1,1-trichloroethane, 1,2-dichloroethane, 1,1-dichloroethane, and chloroethane.
- Polynuclear Aromatic Hydrocarbons -- specifically acenaphthene, acenaphthylene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene.

3.3.9 Hot Strip Mill Area

SWMU 62: Hot Strip Mill Basins (3)
SWMU 63: Hot Strip Mill Waste Oil Tank
SWMU 64: Hot Strip Mill Oil Skimmer System

Descriptions

The Hot Strip Mill is located east of the Finishing Mills Facility Area (Figure 3-1). The Hot Strip Mill Basins, Waste Oil Tank, and Oil Skimmer System (SWMUs 62-64) were described in the RFA Report and are shown in Figure 3-6. These units are located outside the southeast end of the Hot Strip Mill (HSM) and serve as settling basins to remove the mill scale from the process water so it can be recycled. Mill scale that accumulates in the North and South Basins is transferred to Coke Point for metals recovery. Wastewater from the North and South Basins are discharged to the Hot Strip Mill Cooling Tower (SWMU 65). Slab-cooling wastewater, initially collected in the Central Basin (SWMU 62), are also discharged to SWMU 65. Waste oil recovered by the Oil Skimmer System (SWMU 64), which is physically above SWMU 62, is temporarily stored in the Waste Oil Tank (SWMU 63) then transferred to PORI (SWMUs 71-73) where the waste oil is further reclaimed. These units began operating around 1950 and they are currently active.

During the 1991 VSI, a waste pile of mill scale was observed on the ground next to the north basin. This pile was placed there during upgrades to the Hot Strip Mill. Mill scale and oil was also observed on the surrounding ground, and on the outer walls of the basins, which were noted to be cracked. The piles of material resulted from the transfer of mill scale from SWMU 62 to rail cars.

EPA Concerns

SWMUs 62-64 were described in the RFA Report. EPA is concerned with these units because of the nature of wastes managed by these units, the general condition of the basin walls (SWMU 62), and known releases to the surrounding area.

New Information

Mill scale consists predominantly of iron, and may contain trace amounts of chromium and nickel. There are no organic constituents associated with mill scale other than potential lubricating oil and hydraulic fluid components.

The TMC (SWMU 1) accepts discharges from the North and South Basins during system blowdowns.

Recommendations

Based on the condition of the basin walls and the nature of wastes managed by SWMU 62, this unit is proposed for further action.

SWMUs 63 and 64 are part of a waste recovery system with no known or reported releases. Any previous releases from these units would likely be characterized by an evaluation of the general SWMU 62 area due to their proximity. Therefore, it is proposed that SWMUs 63 and 64 be included in the evaluation of SWMU 62.

COPIs

Based on process knowledge, the following COPIs are associated with SWMUs 62, 63, and 64:

- Metals -- specifically chromium, nickel, lead, and zinc.

- Polynuclear Aromatic Hydrocarbons -- specifically acenaphthene, acenaphthylene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene.

3.3.10 Palm Oil Recovery, Inc. (PORI) Area

SWMU 71: PORI Oil/Water Separator
SWMU 72: PORI Holding Tank
SWMU 73: PORI Lagoon

Descriptions

The PORI area SWMUs listed above are located along the north-central edge of the Finishing Mills Facility Area (Figure 3-1). As shown on Figure 3-7, PORI, a separate corporate entity that leases property from BSC, operates an Oil/Water Separator, a Holding Tank, and a Lagoon (SWMUs 71-73).

Each of these SWMUs are described in the RFA Report. PORI operations adhere to stringent requirements for the inflow quality of waste oil because the waste oil is reprocessed for resale and to meet NPDES discharge criteria. Generally, SWMU 71 receives waste oil and water from the cold rolling operations at the facility. Recovered oil discharges from the separator to the Holding Tank (SWMU 72). Wastewater are then piped to the Lagoon (SWMU 73), where additional waste oil is skimmed and transferred back to SWMU 71. Wastewater from the Lagoon is discharged to the TMC (SWMU 1) through an non-BSC NPDES permitted outfall. The TMC wastewater are further treated at the HCWWTP and ultimately discharged through an NPDES permitted outfall (014).

EPA Concerns

SWMUs 71-73 were described in the RFA Report. The earthen Lagoon was observed to have oil-stained sides during the 1991 VSI. EPA is concerned with these units because of the nature of wastes managed by these units, the general condition of the Lagoon (SWMU 73), and known releases to the surrounding area (i.e., oil staining in the area).

New Information

The waste oil recovery system is now operated by U.S. Filter. However, consistent with the RFA Report, PORI will continue to be used in this report.

The waste oil processed by PORI includes lubricating oil and hydraulic fluids from BSC operations. BSC's contributions account for approximately 100,000 to 120,000 gallons per month, or about 5-12% of the total inflow. Non-BSC sources (primarily Safety Kleen) contribute the remaining portion of the nearly 1 million gallons per month of waste oils processed by PORI. These additional oils are primarily crank case oil and some lubricating oil. All oils accepted by PORI are tested for flash, pH, halogenated solvents, and PCBs. Materials containing PCBs or excessive chlorinated solvents are not accepted for reprocessing.

Recommendations

Because of the condition of the Lagoon sides, and the nature of wastes managed by SWMU 73, this unit is proposed for further action.

SWMUs 71 and 72 are part of a waste oil recovery system with no known or reported releases. Any previous release from either of these units would be characterized by an evaluation of the general SWMU 73 area due to their proximity. Therefore, it is proposed that SWMUs 71 and 72 be included in the evaluation of SWMU 73.

COPIs

Based on process knowledge and available information, the following COPIs are associated with SWMUs 71, 72, and 73:

- Metals -- specifically chromium, nickel, lead, and zinc.

- Purgeable Aromatics -- specifically benzene, toluene, ethylbenzene, and xylenes.

- Chlorinated Solvents -- specifically chloroform, tetrachloroethylene, trichloroethylene, cis- and trans-1,2-dichloroethylene, 1,1-dichloroethylene, vinyl chloride, 1,1,1-trichloroethane, 1,2-dichloroethane, 1,1-dichloroethane, and chloroethane.

- Polynuclear Aromatic Hydrocarbons -- specifically acenaphthene, acenaphthylene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene.

- Polychlorinated Biphenyls.

3.3.11 Tin Mill Area

SWMU 84: Tin Mill Trenches/Sumps
SWMU 86: Tin Mill Sump (Acid Area Monitoring)

Descriptions

The Tin Mill Area is located in the western portion of the Finishing Mills Facility Area (Figure 3-1). The Finishing Mills are included with the Tin Mill Canal in a Special Study Area identified in Attachment B of the Consent Decree (Conceptual Plan for the Site Wide Investigation).

The general descriptions for the Tin Mill Trenches/Sumps and Sump (Acid Area Monitoring), SWMUs 84 and 86, respectively, were limited to a brief summary of available information in tabular form (RFA Report Table IV-5). These SWMUs were identified as units associated with piping designed to transport process wastewater to the TMC Discharge Pipes (SWMU 2). SWMU 84 manages non-contact cooling water, and pickling process wastewater. The non-contact cooling water is discharged to the TMC, and the pickling wastewater is pumped to the SPL Tank (AOC W-discussed later) from which it is either discharged at a controlled rate to the TMC via sewer 033B for use as a wastewater treatment chemical or dispatched in tanker trucks to POTWs as a wastewater treatment chemical. SWMU 86 handles pickling wastewater. Both units began operating in the 1950's, and they are being used today.

EPA Concerns

No specific details that describe the nature of wastes managed by nor the general condition of these units were provided in the RFA Report.

New Information

A review of available sewer line maps shows that the Tin Mill Trenches and Sumps (SWMUs 84 and 86) system consists primarily of concrete and (acid) brick-lined concrete sewers, with some open or box trenches.

Recommendations

Because SWMUs 84 and 86 are located within the Finishing Mills Facility Area, it is proposed that evaluation of these units be included in the "Tin Mill Canal and Finishing Mills Special Study Area" identified in Attachment B of the Consent Decree (Conceptual Plan for the Site Wide Investigation).

COPIs

Based on process knowledge, the following COPIs are associated with SWMUs 84 and 86:

- Metals -- specifically chromium, nickel, lead, and zinc.
- Cyanide.

3.3.12 Halogen Lines Area

SWMU 88: Halogen Lines Trenches/Sumps

Description

The Halogen Lines are located in the Tin Mill in the northwestern corner of the Finishing Mills Facility Area (Figure 3-1). The Finishing Mills are included with the Tin Mill Canal in a Special Study Area identified in Attachment B of the Consent Decree (Conceptual Plan for the Site Wide Investigation).

The general description for the Halogen Lines Trenches/Sumps (SWMU 88) provided in the RFA Report was limited to a brief summary of available information in tabular form (RFA Report Table IV-5). SWMU 88 was identified as a unit associated with piping designed to transport passivation wastewater and spent chemical treatment solution to the TMC Discharge Pipes (SWMU 2). SWMU 88 began operating in 1963 and is being used today.

EPA Concerns

No specific details that describe the nature of wastes managed by nor the general condition of this unit were provided in the RFA Report.

New Information

There are multiple, segregated systems of trenches and sumps associated with the halogen lines. Chromium-bearing discharges from the halogen lines go to the Chromium HDS Plant (SWMUs 18-26). Oily wastewater and rinsewater from the halogen lines go to the TMC.

Recommendations

Because SWMU 88 is located within the Finishing Mills Facility Area, it is proposed that evaluation of these units be included in the "Tin Mill Canal and Finishing Mills Special Study Area" identified in Attachment B of the Consent Decree (Conceptual Plan for the Site Wide Investigation).

COPIs

Based on process knowledge and available information the following COPIs are associated with SWMU 88:

- Metals -- specifically chromium, nickel, zinc and lead.
- Cyanide.

3.3.13 Rolling Plate Mill Area

SWMU 92: Rolling Mill Scale Pit

Descriptions

The Rolling Mill Scale Pit (SWMU 92) was designated in the RFA Report as a unit managing non-hazardous waste. No description of this unit was provided in the RFA Report.

EPA Concerns

No specific details that describe the nature of wastes managed by nor the general condition of SWMU 92 was provided in the RFA Report.

New Information

The Rolling Mill Scale Pit (SWMU 92) is located outdoors on the southwest side of the Plate Mill (See Figure 3-1). The unit consists of a concrete vessel that currently manages mill scale. There are no known releases from this unit.

Recommendations

Because there are no known releases from the Rolling Mill Scale Pit, and because this unit manages non-hazardous waste, no further action is proposed for SWMU 92.

COPIs

No COPIs are associated with SWMU 92 because no further action is proposed.

3.3.14 Greys Landfill Area

SWMU 93: Greys Landfill
SWMU 94: Greys Tar Decanter Cell

Descriptions

The Greys Landfill Area is located in the northwest portion of the facility (Figure 3-1), and is a Special Study Area identified in Attachment B of the Consent Decree (Conceptual Plan for the Site Wide Investigation). Detailed descriptions of Greys Landfill (SWMU 93) and the Tar Decanter Cell (SWMU 94) were provided in the RFA Report.

Greys Landfill (SWMU 93) occupies approximately 40 acres in the northwest corner of the facility, and consists of a solid waste disposal area. The landfill is surrounded by a slag berm and is divided into cells assigned for specific wastes (Figure 3-8). Historically, these wastes primarily included:

- Oily sludge,
- Asbestos-bearing wastes,
- Centrifuge cake from the HCWWTP,
- Blast furnace/sinter plant centrifuge cake,
- Open Hearth air pollution dust,
- BOF filter press cake,
- Spill clean-up material,
- Waste sand-blasting materials,
- Tin Mill Canal dredgings (periodically from before November 1980 to 1984), and
- Various dusts and sludges collected by vacuum trucks.

According to the RFA, an oil pit located near the center of the landfill (as it existed prior to 1973) was used to store waste oil, muck, dirt, and solvent/oily sludges (A.T. Kearney, 1993). Use of the pit was discontinued during that year when it caught fire, and remaining liquids were pumped out and disposed off-site. Approximately 10,000 to 20,000 cubic yards of non-pumpable materials were then excavated and disposed in the northwest portion of the landfill.

The landfill previously operated under Maryland Controlled Hazardous Substances and Solid Waste Permit No. A074. Wastes disposed in the landfill are summarized in Appendix 3A-Table 3. Waste characteristic data from various sources are shown in Appendix 3A-Tables 4A-O.

The Tar Decanter Cell (SWMU 94), is a 1.5-acre impoundment located in the northeast corner of Greys Landfill (SWMU 93) that generally received the following wastes:

- Blast Furnace pipeline residue,
- BOF slag,
- Coke Oven pushing emission control baghouse dust,
- Coal tar decanter sludge (Hazardous Waste Code K087-containing phenols, naphthalene),
- Ingot Mold Yard waste sodium silicate from ingot mold steel topping operations,
- Iron and Brass Foundry dusts (occasionally exhibited D008-lead characteristics),
- Wire Mill Leach Plant filter cake (exhibited D006-cadmium characteristics), and
- Miscellaneous steel making process waste including wood, plastic and rubber.

The Coal Tar decanter sludge was last disposed in January 1983. Also on that date, approximately 30 pounds of Iron and Brass Foundry dust were disposed in the cell. Specific wastes disposed in the Tar Decanter Cell are summarized in Appendix 3A-Table 5. Waste characteristic data are summarized in Appendix 3A-Tables 6A-C.

The unit operated from the early 1980's until January 1983. A closure plan was submitted to MDE in April 1983 and approved in August 1983 (Appendix 3B). Closure activities, which began in September 1983 and ended in December 1983, included capping with approximately 2.5 feet of slag and then 3 inches of asphalt.

EPA Concerns

SWMUs 93 and 94 were described in the RFA Report. EPA is concerned with these units because of the nature of the various wastes managed throughout the history of the units, known releases to the underlying groundwater, and limited release controls (the landfill is unlined).

New Information

A review of a 1966 aerial photograph included in a Site Analysis completed by BSC and the EPA (EPA, 1985) indicates no evidence of any pits near the center of the landfill interpreted as the waste oil pits previously mentioned. Approximately six liquid-filled pits near the center of the landfill area were identified on a 1971 photograph. By 1979 the landfill had undergone significant changes in layout, and appeared similar to the layout shown on Figure 3-8. In 1979, less than approximately one-half of the oily sludge cell (in the northwest corner of the landfill) that contained excavated waste oil pit material was earthen covered.

Recommendations

Greys Landfill (SWMU 93) and the Tar Decanter Cell (SWMU 94) contained within it are a Special Study Area identified in Attachment B of the Consent Decree (Conceptual Plan for the Site Wide Investigation). In accordance with the requirements of the Consent Decree, further action is proposed for SWMUs 93 and 94.

COPIs

As documented in several waste identification, evaluation and disposal reports previously submitted to EPA by BSC, Greys Landfill (SWMU 93) receives non-hazardous waste (Baker, 1985). In addition, analytical results for specific wastes disposed in Greys Landfill were provided to EPA in response to a 1987 information request. Supporting documentation is provided in Appendix 3B.

Baker sampled groundwater wells associated with the landfill between 1986 and 1992. Analytical results indicated that groundwater exhibited low concentrations of various metals (primarily lead), cyanide, SVOCs (primarily phenol and naphthalene),VOCs, and ammonia. In addition, EA Engineering, Science, and Technology, Inc., in a January 1994 Final Phase III Environmental Site Assessment report, indicated that groundwater in one well (GL-8s on the eastern landfill boundary-Figure 3-9) contained TCA, toluene, and carbon disulfide. Historical data are summarized in Appendix 3A-Tables 7A-E. In addition, the Iron and Brass Foundry dust placed in SWMU 94 occasionally exhibited the characteristic of EP Toxicity for lead (Appendix 3A-Table 7A).

In November 1996, groundwater samples were collected from wells associated with the Closed CHS Cell (SWMU 94) as part of a Comprehensive Monitoring Evaluation (CME) required by MDE. A summary of the analytical results is included in this report as Appendix 3A-Table 7E.

Based on process knowledge and available information, the following COPIs are associated with SWMUs 93 and 94:

- Metals -- specifically arsenic, cadmium, chromium, nickel, lead, and zinc.
- Cyanide.
- Purgeable Aromatics -- specifically benzene, toluene, ethylbenzene, xylenes, 1,3-dichlorobenzene, and 1,4-dichlorobenzene.
- Carbon disulfide.
- Polynuclear Aromatic Hydrocarbons -- specifically acenaphthene, acenaphthylene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene.
- Acid Extractables -- specifically phenol, 2,4-dimethylphenol, 2,4-dichlorophenol, 2,4,6-trichlorophenol, 4-nitrophenol, and pentachlorophenol.

- Other SVOCs -- specifically o-cresol, m-cresol, and pyridine.

- Polychlorinated Biphenyls.

3.3.15 Coke Battery Area

SWMU 105: Battery A Waste Oil Accumulation Area
SWMU 108: Mechanical Shop Waste Oil Accumulation Area

Descriptions

The Coke Battery Area is generally located in the north and central portions of the Coke Oven Facility Area (Figure 3-1). The Coke Oven Area is a Special Study Area identified in Attachment B of the Consent Decree (Conceptual Plan for the Site Wide Investigation). All coke ovens were taken out of service by December 6, 1991. Two SWMUs, the Battery A Waste Oil Accumulation Area (SWMU 105), and the Mechanical Shop Waste Oil Accumulation Area (SWMU 108), are described in the RFA Report.

SWMU 105 is located in the southwest corner of Battery A Area. Waste oils from coke-making processes were stored in 55-gallon drums on pallets or placed in an open-topped dumpster on a slag/gravel/ash base. Oil from the dumpster was pumped into tanker trucks and transported to PORI (SWMUs 71-73). Oil from the drums that did not contain PCBs or chlorinated solvents were transported to PORI. Oil that tested positive for any of these constituents was sent off-site. Drums were observed to be rusted, deteriorating, and leaking, and staining was evident at the base of the unit during the 1991 VSI.

As described in the RFA Report, SWMU 108, the Mechanical Shop Waste Oil Accumulation Area, is located near the Truck Dock 328 in the Coke Battery Area. This unit is described in the RFA Report as an outdoor unpaved area where drums storing accumulated waste oil and grease recovered from the coke ovens and maintenance shop activities are kept on wooden pallets. Filled drums are sent off-site. Most of the drums were empty during the 1991 VSI, but oil staining was observed on the surrounding ground.

EPA Concerns

No specific details that describe the nature of wastes managed by nor the general condition of either SWMU 105 or 108 were provided in the RFA Report. Visual staining at the base of both units was observed during the 1991 VSI.

New Information

The RFA Report indicated that the oil testing positive for PCB or chlorinated solvent constituents at SWMU 105 may have been sent to a wastewater treatment plant. This is a factual error: no oil was ever sent to a wastewater treatment plant either on-site or off-site. During an April 24, 1997 site inspection, no drums were observed at SWMU 105, and no oil staining was apparent in the surrounding area.

During an April 10, 1997 site inspection, no drums were observed in the SWMU 108 area (they had been removed in 1991), and no oil staining was apparent in the surrounding area.

Recommendations

Based on field observations during the 1991 VSI, further action is proposed for both SWMU 105 and SWMU 108.

COPIs

Based on process knowledge and available information the following COPIs are associated with SWMU 105 and 108.

- Metals -- specifically chromium, nickel, lead, and zinc

- Chlorinated Solvents -- specifically chloroform, tetrachloroethylene, trichloroethylene, cis- and trans-1,2 dichloroethylene, 1,1-dichloroethylene, vinyl chloride, 1,1,1-trichloroethane, 1,2-dichloroethane, 1,1-dichloroethane, and clororethane.

- Polynuclear Aromatic Hydrocarbons -- specifically acenaphthene, acenaphthylene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, napthalene, phenanthrene, and pyrene.

- Polychlorinated Biphenyls

3.3.16 B Coal Chemical Plant (B CCP) Area

SWMU 112:	**B CCP Tar Storage Tank Containment Areas**
SWMU 113:	**B CCP Underground Weak Ammonia Pipeline**
SWMU 114:	**B CCP Acid Tank Containment Pad**
SWMU 115:	**B CCP Acid Tanks**
SWMU 116:	**B CCP Ammonia Clarifier Tank**
SWMU 117:	**B CCP Lime Collection Bin**
SWMU 118	**B CCP Ammonia Stills (2)**
SWMU 119:	**B CCP Ammonia Saturator**
SWMU 120:	**B CCP Acid Surge Tank**
SWMU 121:	**B CCP Wash Oil Coolers (Spiral)**
SWMU 122:	**B CCP Wash Oil Coolers (Shell and Tube)**
SWMU 123:	**B CCP Wash Oil Decanters**
SWMU 124:	**B CCP Wastewater Holding Tank**
SWMU 125:	**B CCP Wash Oil Circulating Tank**
SWMU 126:	**B CCP Scrubbers**

SWMU 127: B CCP Waste Oil Bin
SWMU 128: B CCP API Light Oil Separators (2)
SWMU 129: B CCP Muck Tank
SWMU 130: B CCP Million Gallon Weak Ammonia Tank

Descriptions

The B Coal Chemical Plant (B CCP) is located near the south-central portion of the Coke Oven Facility Area (Figure 3-1). The Coke Oven Area is a Special Study Area identified in Attachment B of the Consent Decree (Conceptual Plan for the Site Wide Investigation). SWMUs 112-130 were identified collectively in the RFA Report as units of concern even though it was not possible to determine which individual units had released or were releasing. Staining was observed throughout the area during the VSI. The units in the B CCP operated as part of a raw coke gas treatment process system. No specific details of individual SWMUs were provided in the RFA Report. These units correspond to the description provided in the RFA Report for AOC U, B CCP Process Area.

EPA Concerns

No specific details that describe the nature of wastes managed by nor the general condition of any SWMU was provided in the RFA Report. EPA is concerned with these units because of the nature of the materials processed at the plant, numerous spills (as reported in the RFA Report), and the inability to assess which units were releasing.

New Information

Generally, these SWMUs include various aboveground tanks, bins, separators, decanters, coolers, clarifiers and other units used in the raw coke gas treatment processes. The B CCP shut down between 1990 and 1991, and is in the process of being decontaminated, dismantled, and either recycled on-site as scrap metal or removed from the site. To date, SWMUs 112-123 have been cleaned and removed from the site while SWMU 126 is in the process of being demolished. SWMUs 124, 125, and 127-130 still remain on site. No analytical testing was completed on soil material surrounding units that were removed.

Recommendations

The listing of individual SWMUs is redundant with the listing of the B CCP Process Area as a whole (AOC U). In addition, these SWMUs are located in the Coke Oven Area which is a Special Study Area identified in Attachment B of the Consent Decree (Conceptual Plan for the Site Wide Investigation). Therefore, it is proposed that SWMUs 112-130 be addressed as an AOC (consistent with RFA Report) as part of further action required for the Coke Oven Special Study Area.

COPIs

Based on process knowledge, the following COPIs are associated with SWMUs 112-130:

- Metals -- specifically arsenic.
- Cyanide.
- Purgeable Aromatics -- specifically benzene, toluene, ethylbenzene, and xylenes.
- Carbon disulfide.
- Polynuclear Aromatic Hydrocarbons -- specifically acenaphthene, acenaphthylene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene.
- Acid Extractables -- specifically phenol, 2,4-dimethylphenol, 2,4-dichlorophenol, 2,4,6-trichlorophenol, 4-nitrophenol, and pentachlorophenol.
- Other SVOCs -- specifically o-cresol, m-cresol, and pyridine.

3.3.17 A Coal Chemical Plant (A CCP) Area

SWMU 136:	**A CCP Sulfuric Acid Tank Containment**
SWMU 137:	**A CCP Cyanide Stripper/Stack**
SWMU 138:	**A CCP Oil/Water Separator**
SWMU 139:	**A CCP Former Tar Decanters (3)**
SWMU 140:	**A CCP Acid Saturator Tanks**
SWMU 141:	**A CCP Overflow Skimmer Box**
SWMU 142:	**A CCP Wash Oil Decanters**
SWMU 143:	**A CCP Scrubbers**
SWMU 144:	**A CCP Wastewater Holding Tank**
SWMU 145:	**A CCP Wash Oil Holding Tank**
SWMU 146:	**A CCP Sump**

Descriptions

The A Coal Chemical Plant (A CCP) is located near the east-central portion of the Coke Oven Facility Area (Figure 3-1). The Coke Oven Area is a Special Study Area identified in Attachment B of the Consent Decree (Conceptual Plans for the Site Wide Investigation).

SWMUs 136-146 were identified collectively in the RFA Report as units of concern even though it was not possible to determine which individual units had released or were releasing. The units in the A CCP operated as part of a raw coke gas treatment process system. No specific details of individual SWMUs were provided in the RFA Report. These units correspond to the description provided in the RFA Report for AOC M, A CCP Process Area.

EPA Concerns

No specific details that describe the nature of wastes managed by nor the general condition of any SWMU was provided in the RFA Report. EPA is concerned with these units because of the nature of the materials processed at the plant, numerous spills (as reported in the RFA Report), and the inability to assess which units were releasing.

New Information

Similar to the B CCP, the A CCP SWMUs include various aboveground tanks, bins, separators, decanters, coolers, and other units used in the raw coke gas treatment processes. The A CCP shut down between 1990 and 1991, and is in the process of being decontaminated, dismantled and recycled on-site as scrap metal or removed from the site. To date, SWMUs 136-138, and 140-146 have been removed from the site. SWMU 139 has been cleaned but remains on site. No analytical testing was completed on soil material surrounding units that were removed.

Recommendations

The listing of individual SWMUs is redundant with the listing of the A CCP Process Area as a whole (AOC M). In addition, these SWMUs are located in the Coke Oven Area, which is a Special Study Area identified in Attachment B of the Consent Decree (Conceptual Plans for the Site Wide Investigation). Therefore, it is proposed that SWMUs 136-146 be addressed as an AOC (consistent with the RFA Report) as part of further action required for the Coke Oven Special Study Area.

COPIs

Based on process knowledge, the following COPIs are associated with SWMUs 136-146:

- Metals -- specifically arsenic.
- Cyanide.
- Purgeable Aromatics -- specifically benzene, toluene, ethylbenzene, and xylenes.
- Carbon disulfide.
- Polynuclear Aromatic Hydrocarbons -- specifically acenaphthene, acenaphthylene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene.
- Acid Extractables -- specifically phenol, 2,4-dimethylphenol, 2,4-dichlorophenol, 2,4,6-trichlorophenol, 4-nitrophenol, and pentachlorophenol.
- Other SVOCs -- specifically o-cresol, m-cresol, and pyridine.

3.3.18 Benzene/Litol (B/L) Plant Area

SWMU 147:	**B/L Oil/Water Separator**
SWMU 148:	**B/L Tank Sludge Staging Area**
SWMU 149:	**B/L Tank Sludge Accumulation Area**
SWMU 150:	**B/L Litol Plant Catalyst Drum Station**
SWMU 151:	**B/L Waste Oil Accumulation Area**
SWMU 152:	**B/L Litol Drum Staging Area**
SWMU 153:	**B/L Benzene Truck Loading Area**

Descriptions

The Benzene/Litol (B/L) Plant is located in the western portion of the Coke Oven Facility Area (Figure 3-1). The Coke Oven Area is a Special Study Area identified in Attachment B of the Consent Decree (Conceptual Plan for the Site Wide Investigation). SWMUs 147-153 were identified collectively in the RFA Report as units of concern even though it was not possible to determine which individual units had released or were releasing.

The units in the B/L Plant operated as part of a treatment process for the purification of light oil into benzene, toluene, and xylene. No specific details of individual SWMUs were provided in the RFA Report. These units correspond to the description provided in the RFA Report for AOC L, Benzene and Litol Plant. During the 1991 VSI it was undetermined which unit(s) had released, based on observed staining throughout the area and strong benzene odors noted.

EPA Concerns

No specific details that describe the nature of wastes managed by nor the general condition of any SWMU was provided in the RFA Report. EPA is concerned with these units because of the nature of the materials processed at the plants, numerous spills (as reported in the RFA Report), and the inability to assess which units were releasing.

New Information

The B/L Plant operated from the 1940's through 1986, and has been decontaminated, dismantled and recycled on-site as scrap metal or removed from the site. To date, all seven SWMUs have been cleaned and removed from the site. No analytical testing was completed on soil material surrounding units that were removed.

Recommendations

The listing of individual SWMUs is redundant with the listing of the B/L Plant Area as a whole (AOC L). In addition, these SWMUs are in the Coke Oven Area, which is a Special Study Area identified in Attachment B of the Consent Decree (Conceptual Plan for the Site Wide Investigation). Therefore, it is proposed that SWMUs 147-153 be addressed as an AOC (consistent with the RFA report) as part of further action required for the Coke Oven Special Study Area.

COPIs

Based on process knowledge, the following COPIs are associated with SWMUs 147-153:

- Metals -- specifically arsenic.
- Purgeable Aromatics -- specifically benzene, toluene, ethylbenzene, and xylenes.
- Acid Extractables -- specifically phenol, 2,4-dimethylphenol, 2,4-dichlorophenol, 2,4,6-trichlorophenol, 4-nitrophenol, and pentachlorophenol.

3.3.19 Furnace Area

SWMU 165: L Furnace Slag Piles

Descriptions

The L Furnace Slag Piles (SWMU 165) were designated in the RFA Report as a unit managing non-hazardous waste. No description of this unit was provided in the RFA Report.

EPA Concerns

No specific details that describe the nature of wastes managed by, nor the general condition of SWMU 165 were provided in the RFA Report.

New Information

The L Furnace Slag Piles (SWMU 165) manages slag, which is a by-product of the iron making process and not a waste material. There are currently two active slag piles. One each is on the east and west side of the L Blast Furnace (see Figure 3-1). The slag is allowed to cool, and is then crushed and screened for re-use.

Recommendations

Because this unit is associated with a by-product (and not a waste), no further action is proposed for SWMU 165.

COPIs

No COPIs are associated with SWMU 165 because no further action is proposed.

3.3.20 Humphrey Impoundment Area

SWMU 190: Humphrey Impoundment

Descriptions

Humphrey Impoundment (SWMU 190) is located in the northwest portion of the site (Figure 3-1) along the northern side of the downstream section of Tin Mill Canal (SWMU 1). The Humphrey Impoundment is a Special Study Area identified in Attachment B of the Consent Decree (Conceptual Plan for the Site Wide Investigation). This SWMU is described in the RFA Report as an approximate 43-acre unit filled with slag and other miscellaneous material to form the impoundment base.

Initially, as open water (the original Humphrey Creek which discharged to Bear Creek), the unit was used to receive wastewater from various steel processing areas including the Hot Strip Mills, the Cold Sheet Mills, the Tin Mill, and the Rod and Wire Mills. Between 1950 and 1970 process wastewater was discharged through pipes currently identified in the RFA Report as SWMU 2. When the TMC was completed in 1970, the discharge pipes were routed to discharge to the TMC. Between 1970 and 1985, SWMU 190 was then used as a sludge dewatering area for the following (1994 RFA; Baker, 1990):

- BOF slurry,
- Blast Furnace "G, H, J, K, and L" thickener sludge,
- HCWWTP sludge
- Sinter plant slurry,
- (No.4) Open Hearth slurry,
- Waste oil pit sludge, and
- Pre-limer clarifier sludge

Since 1985 Blast Furnace/Sinter Plant slurry and BOF slurry is placed into the impoundment only on an emergency basis. All of the wastes listed have been determined to be non-hazardous. Waste characteristic data are summarized in Appendix 3A-Tables 8 A-F.

Waste oil from plant operations were formerly accumulated in an on-site pit. The waste oil was pumped from this pit and processed by an oil recovery contractor. Non-recoverable residue was occasionally removed from the pit and placed in Humphrey Impoundment (Baker, 1990).

EPA Concerns

SWMU 190 was described in the RFA Report. EPA is concerned with this unit because of the nature of wastes managed by this unit, and because a release to the environment is suspected due to its design (i.e., slag base and sides).

New Information

There is no new information for SWMU 190.

Recommendations

The Humphrey Impoundment is a Special Study Area identified in Attachment B of the Consent

Decree (Conceptual Plan for the Site Wide Investigation). As required by the Consent Decree, further action is proposed for SWMU 190 to evaluate potential releases from this unit.

COPIs

In 1986, Baker collected quarterly groundwater samples from 4 shallow (i.e., slag unit) wells and 5 deeper (i.e., Pleistocene unit) wells. Analytical data provided in Appendix 3A-Tables 9A-C, indicate that several metals, SVOCs, VOCs, and other inorganics were detected in groundwater. In addition, in 1982, pit sludge was tested and found not to be EP Toxic nor contaminated with PCBs (Baker, SWMU 1990).

Based on process knowledge and available information, the following COPIs are associated with SWMU 190:

- Metals -- specifically arsenic, cadmium, chromium, nickel, lead, and zinc.
- Cyanide.
- Purgeable Aromatics -- specifically benzene, toluene, ethylbenzene, xylenes, 1,3-dichlorobenzene, and 1,4-dichlorobenzene.
- Chlorinated Solvents -- specifically chloroform, tetrachloroethylene, trichloroethylene, cis- and trans-1,2-dichloroethylene, 1,1-dichloroethylene, vinyl chloride, 1,1,1-trichloroethane, 1,2-dichloroethane, 1,1-dichloroethane, and chloroethane.
- Polynuclear Aromatic Hydrocarbons -- specifically acenaphthene, acenaphthylene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene.
- Acid Extractables -- specifically phenol, 2,4-dimethylphenol, 2,4-dichlorophenol, 2,4,6-trichlorophenol, 4-nitrophenol, and pentachlorophenol.

3.3.21 Coke Point Landfill Area

SWMU 191: **Coke Point Landfill**
SWMU 192: **Coke Oven Sweepings Pile**

Descriptions

As described in the RFA Report, these SWMUs are located at the southwestern edge of the facility adjacent to the Patapsco River (Figure 3-1). The Coke Point Landfill is a Special Study Area identified in Attachment B of the Consent Decree (Conceptual Plan for the Site Wide Investigation). The landfill (SWMU 191) is unlined, and receives a variety of non-hazardous waste. Until 1995 it operated under Maryland Solid Waste and CHS Permit No. A074 at which time MDE decided that the current landfill did not require a permit. The wastes currently and historically managed by

SWMU 191 include:

- Foundry waste,
- Waste sand,
- Silica, shot blasting, and swing saw dust,
- Sinter plant grit,
- Kish (graphite, slag, and iron),
- A Battery baghouse dust,
- Non-hazardous spill cleanup material,
- Road sweeper and vacuum truck dust,
- Slag and refractories,
- Railroad car cleaning materials, and
- Patapsco and Back River Railroad track cleanup material.

The Coke Oven Sweepings Pile (SWMU 192) is located within the northern portion of the landfill unit, and is comprised of sweepings from the coke batteries. These sweepings include coke ash segregated from solid wastes. The solid wastes are disposed in dumpsters. There are no available analytical data associated with either SWMU.

EPA Concerns

SWMUs 191 and 192 were described in the RFA Report. EPA is concerned with these units because of the nature and wide variety of wastes managed by these units, the absence of release controls, and the relative proximity to the Patapsco River.

New Information

The Coke Point Landfill currently occupies approximately 41 acres. A review of a 1938 aerial photograph included in a Site Analysis completed by BSC and the EPA (EPA, 1985) indicates no evidence of the landfill at that time. On a 1952 photograph, manmade land had extended the shoreline southward. The made land continued to expand, as shown on a 1957 photograph, along with the initial development of the landfill. The landfill is located on slag fill, not soil as indicated in the RFA Report.

Recommendations

The Coke Point Landfill is a Special Study Area identified in Attachment B of the Consent Decree (Conceptual Plan for the Site Wide Investigation). As required by the Consent Decree, further action is proposed for SWMUs 191 and 192 to evaluate potential releases associated with previous and current landfill activities.

COPIs

Based on available information, the following COPIs are associated with SWMUs 191 and 192:

- Metals -- specifically arsenic, cadmium, chromium, nickel, lead, and zinc.
- Cyanide.
- Purgeable Aromatics -- specifically benzene, toluene, ethylbenzene, xylenes, 1,3-dichlorobenzene, and 1,4-dichlorobenzene.
- Chlorinated Solvents -- specifically chloroform, tetrachloroethylene, trichloroethylene, cis- and trans-1,2-dichloroethylene, 1,1-dichloroethylene, vinyl chloride, 1,1,1-trichloroethane, 1,2-dichloroethane, 1,1-dichloroethane, and chloroethane.
- Carbon disulfide.
- Polynuclear Aromatic Hydrocarbons -- specifically acenaphthene, acenaphthylene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene.
- Acid Extractables -- specifically phenol, 2,4-dimethylphenol, 2,4-dichlorophenol, 2,4,6-trichlorophenol, 4-nitrophenol, and pentachlorophenol.
- Other SVOCs -- specifically o-cresol, m-cresol, and pyridine.
- Polychlorinated Biphenyls.

3.3.22 Miscellaneous SWMUs

3.3.22.1 SWMU 194: Waste Oil Stabilizing/Packing Area

Description

The Waste Oil Stabilization/Packing Area (SWMU 194) described in the RFA Report is located outside the northern end of the Former Skelp Mill Building within the Primary Rolling Mills Facility Area (Figure 3-1). This unit consists of a concrete pad on soil/gravel and 28 dumpsters that were used to manage waste oil contaminated with soil, speedy dry and grease. The RFA Report indicated that no releases to the ground have been documented, but the concrete pad was observed to be severely cracked and (oil) stained.

EPA Concerns

SWMU 194 was described in the RFA Report. EPA is concerned with this unit because of the nature of wastes managed by this unit (waste oil contaminated soil) and because there are no release controls. In addition, a release to the environment is suspected due to the condition of the unit observed during the 1991 VSI.

New Information

During an April 10, 1997 site inspection, no containers were observed to be present. The concrete pad was present, and plants were observed to be growing through some of the cracks in the concrete as well as in the areas surrounding the pad. The dark soil surrounding the pad exhibited no oily features nor petroleum-type odors.

Recommendations

Based on field observations during the 1991 VSI, further action is proposed for SWMU 194.

COPIs

Based on available information, the following COPIs are associated with SWMU 194:

- Metals -- specifically chromium, nickel, lead, and zinc.

- Polynuclear Aromatic Hydrocarbons -- specifically acenaphthene, acenaphythylene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene.

3.3.22.2 SWMU 195: Former ERS Oily Wastewater Tank

Description

The RFA Report designated SWMU 195, the Former ERS Oily Wastewater Tank, as requiring additional information to assess the potential for release. No description was provided in the RFA Report.

EPA Concerns

No specific details that describe the nature of wastes managed by nor the general condition of SWMU 195 was provided in the RFA Report.

New Information

This unit consisted of a steel aboveground tank of unknown capacity located to the north of the Electrical Repair Shop (ERS) in the Open Hearth Furnace Facility Area (See Figure 3-1). Electrical motors were occasionally steam cleaned, and the wash waters were sent to the tank. Oil was separated out and sent to PORI (SWMUs 71-73). The tank was removed sometime during the late 1980's or early 1990's. No analytical data are available for this area.

Recommendations

Because the ERS Oily Wastewater Tank has been removed from the site, the potential risk for any future release has been eliminated. However, it is unknown what impacts previous activities may have on the surrounding area. Therefore, further action is proposed to assess potential releases associated with previous activities.

COPIs

Based on available information, the following COPIs are associated with SWMU 195:

- Metals -- specifically chromium, nickel, lead, and zinc.
- Polynuclear Aromatic Hydrocarbons -- specifically acenaphthene, acenaphthylene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene.

3.3.22.3 SWMU 196: Stormwater Sewer System

Descriptions

The Stormwater Sewer System (SWMU 196) is generally described in the RFA Report as a network of underground pipes, culverts, open ditches, and pits located throughout the facility that leads to 49 outfalls permitted for treated industrial wastewater and stormwater under NPDES Permit (MD0001201) and State Discharge Permit (No.79-DP-0064A).

EPA Concerns

SWMU 196 was described in the RFA Report. EPA is concerned with this unit because of the uncertain integrity of the system (primarily underground), previous exceedances of NPDES pH limits, and the likelihood of having discharged hazardous wastes in the past given the unit's history.

New Information

As stated above, the RFA Report indicates that there are a total of 49 permitted outfalls. However, according to Bethlehem's NPDES permit reapplication update, dated June 10, 1993, there are a total of 35 permitted outfalls of which 29 discharge treated industrial wastewater combined with stormwater to Bear Creek, the Patapsco River, Jones Creek River, and Old Road Bay (Figure 3-10). Sixteen of the 35 permitted outfalls discharge only stormwater. The stormwater drainage areas and respective outfalls are shown on Figure 3-11. A summary of each outfall, contributing flows, and the receiving water is provided in Appendix 3B along with water flow schematics for different plant areas.

Recommendations

Because all stormwater sewer system discharges are through NPDES-permitted outfalls, no further action is proposed for SWMU 196.

COPIs

There are no COPIs associated with SWMU 196 because no further action is proposed.

3.3.22.4 SWMU 198: Spent Pickle Liquor Sump and Trench System

Descriptions

The Spent Pickle Liquor Sump and Trench System (SWMU 198) is located in the north-central part of the Finishing Mills Facility Area (Figure 3-1). The Finishing Mills are included in a Special Study Area identified in Attachment B of the Consent Decree (Conceptual Plan for the Site Wide Investigation).

In the RFA Report, the description for the SPL Sump and Trench System (SWMU 198) was limited to a brief summary of available information in tabular form (RFA Report Table IV-5). SWMU 198 was identified in the RFA Report as a unit associated with piping designed to transport process wastewater from two aboveground steel storage tanks (AOC W) to the TMC Discharge Pipes (SWMU 2).

EPA Concerns

No specific details that describe the nature of wastes managed by nor the general condition of this unit were provided in the RFA Report.

New Information

Contrary to its characterization in the RFA Report, this unit collects spent pickle solution within the Cold Sheet and Tin Mills and conveys it to the SPL storage tanks (AOC W). SWMU 198 began operating in the 1970's and is currently used today. A schematic diagram showing the SPL flow process and discharge to the TMC is depicted on Figure 3-12.

Recommendations

Because SWMU 198 manages spent pickle solution within the Finishing Mills Facility Area, it is proposed that evaluation of this unit be included in the "Tin Mill Canal and Finishing Mills Special Study Area" identified in Attachment B of the Consent Decree (Conceptual Plan for the Site Wide Investigation).

COPIs

Based on process knowledge, the following COPIs are associated with SWMU 198:

- Metals -- specifically chromium, nickel, lead, and zinc.

3.4 AREAS OF CONCERN

In the following sections, AOCs are identified in alphabetic order as they appear in the RFA Report. Descriptions and background information of the respective areas are provided, followed by a brief description of EPA concerns, new information (or action) generated since the RFA was written, further action proposed, and finally, a listing of COPIs associated with the AOCs.

3.4.1 AOC A: Former 3/21/91 PCB Spill Area

Descriptions

A 55-gallon drum of PCB oil was accidently ruptured when the drum struck a transformer enclosure after a hoist lost power while moving. This resulted in a release of PCB oil inside the Motor Room of the 56" Hot Strip Mill Building at AOC A. See Figure 3-6 for the site location. The spill area reportedly was isolated, cleaned and sampled. According to the RFA Report, sampling results indicated that the site had been remediated with respect to PCBs.

EPA Concerns

Additional information regarding the cleanup of the area was unavailable at the time of the 1991 VSI.

New Information

This spill incident is summarized in Appendix 2A. A wipe sample of the area was collected on July 29, 1992. The analytical result is shown in Appendix 3B. Also included in Appendix B are notes that summarize sample collection and cleanup efforts in the spill area. As this information indicates, the spill area was sealed with an epoxy paint on July 31, 1992.

Recommendations

Because the incident occurred inside with low potential for an environmental release, analytical results were below applicable cleanup standards, and the area was sealed with an epoxy paint since the time of the spill, no further action is proposed for AOC A.

COPIs

No COPIs are associated with AOC A because no further action is proposed.

3.4.2 AOC B: Former 1988 PCB Spill Area

Descriptions

The PCB spill incident at AOC B (Figure 3-1) occurred within the Tin Mill Building at the Number 10 Tin Line on November 9, 1988. The concrete area was reportedly cleaned and sealed with an epoxy paint. Analytical results of samples collected by EPA, indicated that the area was uncontaminated (1991 RFA).

EPA Concerns

Additional information regarding the cleanup of the area was unavailable at the time of the 1991 VSI.

New Information

According to BSC spill incident reports, approximately 400-450 gallons of PCB transformer oil spilled onto a concrete floor at the Tin Mill Number 10 Line when a transformer fell to the ground and ruptured. The spill incident is summarized in Appendix 2A. Analytical data indicate that PCB concentrations in (wipe) samples were below cleanup standards applicable at the time of the spill. A chronology of events regarding sample collection and cleanup efforts in the spill area is presented in Appendix 3B. Also included are analytical results from several sampling events.

Recommendations

Because cleanup of the spilled oil was completed in an expedient manner, analytical results were below applicable cleanup standards, the spill area was sealed with an epoxy paint, and the fact that the incident occurred inside with low potential for an environmental release, no further action is proposed for AOC B.

COPIs

No COPIs are associated with AOC B because no further action is proposed.

3.4.3 AOC C: Former ERS PCB Spill Area

Descriptions

The Former ERS PCB Spill Area (AOC C), identified in the RFA Report is located within the general Open Hearth Furnace Facility Area. Figure 3-1 shows the approximate location of AOC C. Approximately 16 tons of soil and asphalt were removed and disposed off-site. Approximately 19 soil samples were collected and analyzed. The results indicated that the area was remediated such that PCB concentrations in the soil were below the applicable EPA guideline of 25 ppm. The area was backfilled with slag.

EPA Concerns

Additional information regarding the cleanup of the area was unavailable at the time of the 1991 VSI.

New Information

The RFA Report indicated that in May 1985, transformers awaiting repair at the ERS, leaked approximately 20-30 gallons of PCB oil onto the soil. No such incident is indicated on BSC's inventory list of spill incidents (Appendix 2A). The remediation efforts described in the RFA Report correspond more accurately to a spill incident that occurred on October 18, 1990 near the northeast corner of the ERS shop. This spill incident is summarized in Appendix 2A. As documented in a January 28, 1991 spill report letter from BSC to the MDE, approximately 20 gallons of PCB contaminated oil was released to a soil area of approximately 15 feet by 20 feet in dimension when a PCB-containing transformer was struck by a vehicle and ruptured.

After soil removal, a sample grid was established for the collection of 19 soil samples. Analytical results ranged from 0.2 to 13.3 ppm PCB concentrations. As described in the spill incident narrative found in Appendix 3B, clean soil was used to backfill the excavation and not slag as indicated in the RFA Report. A chronology of events regarding sample collection and cleanup efforts in the spill area is presented in Appendix 3B.

Recommendations

Because cleanup of the spilled oil was completed in an expedient manner, and analytical results were below applicable cleanup standards, no further action is proposed for AOC C.

COPIs

No COPIs are associated with AOC C because no further action is proposed.

3.4.4 AOC D: Former PCB Spill Area (Sheet Mill)

Descriptions

On January 28, 1986 an apparent PCB oil-bearing transformer leak was detected in the area of AOC D, which is located near the No.1 and 2 Galvanizers inside the Cold Sheet Mill Building (Figure 3-1). A report of a leak was also recorded on July 2, 1986 (BSC notes, 1986). The concrete floor was scrubbed with kerosene and soap and water over the course of three months, but contamination existed within concrete floor core samples to a depth of four inches. No remediation was reported, but the affected floor area was encapsulated with epoxy paint.

EPA Concerns

Additional information regarding the cleanup of the area was unavailable at the time of the 1991 VSI.

New Information

The spill incident is summarized in Appendix 2A. Analytical results from wipe samples collected on March 17, 1988 indicated PCB concentrations above applicable cleanup standards. Additional wipe samples were collected in August 1988. The analytical results indicated that elevated levels of PCBs still existed. Rigorous efforts to clean the spill area were completed by October 13, 1988, and eight additional wipe samples were collected on the same day prior to sealing the area with epoxy paint. Analytical results indicated two samples exhibited elevated PCB concentrations. Core samples of the concrete at these two locations were then collected on February 1, 1989, but no standards were applicable for PBCs in concrete. Final wipe samples were collected on February 22, 1988 adjacent to the core sample holes, and above the epoxy painted surface. Analytical results indicated PCB concentrations below the applicable standards. A chronology of events regarding sample collection and cleanup efforts in the spill area is presented in Appendix 3B. Also included are analytical results from the various sampling events.

Recommendations

Because cleanup of the spilled oil was completed in an expedient manner, final analytical results were below applicable cleanup standards, the spill area was sealed with an epoxy paint, and the fact that the incident occurred inside with low potential for an environmental release, no further action is proposed for AOC D.

COPIs

No COPIs are associated with AOC D because no further action is proposed.

3.4.5 AOC E: 6 PCB Transformers

Descriptions

AOC E, 6 PCB Transformers, located near the Ore Piers on the southern site boundary, was described in the RFA Report as an area characterized by three cranes, each containing two PCB transformers. Although the cranes are approximately 20 years old, the transformers are reportedly in good shape.

EPA Concerns

Because the cranes are mobile, the transformers are occasionally located directly above the Patapsco River.

New Information

The PCB transformers were replaced by non-PCB transformers in 1995. The removal, disposal, and replacement of these transformers were described in a PCB Completion Report found in Appendix 3B.

Recommendations

Because the risk of a PCB oil release to the river and surrounding area has been eliminated, no further action is proposed for AOC E.

COPIs

No COPIs are associated with AOC E because no further action is proposed.

3.4.6 AOC F: Former Slab Cut Off Spill Area

Descriptions

AOC F represents an area where approximately 30 gallons of hydraulic oil spilled on February 5, 1990. The spill discharged to the ground at the southwestern end of the Slabbing Mill between the Slab Yard and Soaking Pits. Although this spill incident was a one time event, soil in the area was observed to be oil-stained during the 1991 VSI. This spill incident is summarized in Appendix 2A.

EPA Concerns

Additional information regarding the cleanup of the area was unavailable at the time of the 1991 VSI.

New Information

During an April 10, 1997 site inspection no oil-stained soil was observed.

Recommendations

Because of field observations, and the fact that the spill incident was a one-time event of a small quantity of oil, no further action is proposed for AOC F.

COPIs

No COPIs are associated with AOC F because no further action is proposed.

3.4.7 AOC G: Former Diesel Fuel Spill Area (Slab Haul Road)

Descriptions

The Former Diesel Fuel Spill Area (AOC G), as reported in the RFA Report, was actually a series of waste oil applications to the road surface for dust control. The impacted area was on the west side of Slab Haul Road (Figure 3-1). Approximately 50 tons of contaminated soil was removed and the remediation deemed acceptable by MDE.

EPA Concerns

Additional information regarding the cleanup of the area was unavailable at the time of the 1991 VSI.

New Information

The series of waste oil applications actually represented several asphalt paving episodes. Several thin layers of asphalt were observed during the soil removal activities.

Recommendations

Based on MDE approval of previous soil removal and remediation, no further action is proposed for AOC G.

COPIs

No COPIs are associated with AOC G because no further action is proposed.

3.4.8 AOC H: Mason's Garage Area

Descriptions

Mason's Garage Area (AOC H) is located in the Blast Furnace Area. The RFA Report described four underground storage tanks that were removed in 1989, specifically one 8,000 gallon and one 10,000 gallon gasoline UST, one 10,000 gallon diesel UST, and one waste oil UST of unknown capacity. The condition of the tanks (i.e., holes, corroded) along with visual inspection of soil and water in the tank pit indicated that a release had occurred. Soil and groundwater sample analytical results indicated elevated levels of TPH and BTEX. The waste oil was sampled for PCBs and all analytical results were below limits of detection. Approximately 60-80 tons of contaminated soil were removed and disposed off-site (Geraghty & Miller, 1992).

EPA Concerns

During the 1991 VSI, it was observed that one of the tank removal locations had not been filled in, and that several drums were present in stained areas located in the north and southeastern portions of the SWMU area. No confirmatory post-excavation analytical data are available.

New Information

According to a UST Closure Report prepared by Geraghty & Miller, Inc., a total of three tanks were removed (Geraghty & Miller, 1992), not four USTs as indicated in the RFA Report. The first tank removed was a steel 10,000 gallon UST used for gasoline storage. No visual signs or odors indicated that any release had occurred. Soil samples were collected for TPH and BTEX analyses. The TPH concentration was 66 mg/kg, while BTEX concentrations were below the detection limits in soil collected from the tank pit. One soil sample collected beneath the piping trench exhibited a TPH concentration of 160 mg/kg. Soil and water BTEX concentrations for all samples were below the minimum detectable levels.

Two additional steel tanks were discovered during the removal of the gasoline tank and were subsequently removed along with associated piping. Each tank was constructed of steel with approximately 500-600 gallons capacity. Both tanks were used for waste oil storage.

The waste oil was tested for total halogens and PCBs. Analytical results indicated the concentrations of these constituents were below the minimum detectable level. Soil and water BTEX concentrations were detected above the minimum detectable level. A description of events regarding all tank removal and sample collection activities is presented in Appendix 3B along with analytical results.

During an April 10, 1997 site inspection the area of the open excavation noted in the RFA Report had been filled, and the excavation limits were not apparent. No drums were present.

Recommendations

Based on available analytical information presented in Appendix 3B, residual low concentrations of BTEX constituents existed in the soil and groundwater after the tanks were removed. There is no information available indicating that post-excavation soil samples were collected. Further action to evaluate UST closure/soil excavation activities is proposed for AOC H.

COPIs

Based on available information, the following COPIs are associated with AOC H:

- Metals -- specifically chromium, nickel, lead, and zinc.
- Purgeable Aromatics -- specifically benzene, toluene, ethylbenzene, and xylenes.
- Polynuclear Aromatic Hydrocarbons -- specifically acenaphthene, acenaphthylene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene.

3.4.9 AOC I: Former 1991 Acid Leak Area

AOC I, the Former 1991 Acid Leak Area, is located inside the Tin Mill in the Finishing Mills Facility Area (see Figure 3-1). The Finishing Mills are included with the TMC in a Special Study Area identified in Attachment B of the Consent Decree (Conceptual Plan for the Site Wide Investigation). Apparently, an overflow line leaked acid that flowed beneath the process tanks into a trench that discharges to the TMC (SWMU 1). The line was repaired shortly thereafter on June 23, 1991. The RFA Report indicates that this area was observed to be poorly maintained during the VSI.

EPA Concerns

Additional information regarding the cleanup of the area was unavailable at the time of the 1991 VSI.

New Information

RFA Report information regarding this AOC is not consistent with any spill incident recorded on the summary of spills (Appendix 2A), particularly around the time the line was repaired.

Recommendations

Regardless of discrepancies with the spill report summary, the spill was a one time incident, not a persistent or continuing problem, and the leaky line was repaired. Therefore, no further action is proposed for AOC I.

COPIs

No COPIs are associated with AOC I because no further action is proposed.

3.4.10 AOC J: Acid Tanks

Descriptions

Six sulfuric Acid Tanks (AOC J) are located outside and on the east side of the Tin Mill (Figure 3-1). The RFA Report indicates that these tanks are approximately 30 years old, of unknown capacities, and are in poor condition. Two of the six are out of commission due to leaks that occurred in 1990. The Tin Mill Sump (SWMU 86) is located beneath the tanks and discharges to the TMC (SWMU 1).

EPA Concerns

The Sump and gravel beneath the tanks were observed to be stained. The stain was undefined. Additional information regarding the cleanup of the area was unavailable at the time of the 1991 VSI.

New Information

No new information is available for AOC J.

Recommendations

Because of known leaks, and the fact that spills or leaks from the tanks would release wastewater to the TMC (SWMU 1), where they would co-mingle with other waste streams, be treated at

HCWWTP, and discharged through an NPDES permitted outfall, it is proposed that evaluation of AOC J be included in an overall evaluation of the TMC (SWMU 1).

COPIs

Based on process knowledge, the following COPIs are associated with AOC J:

- Metals-specifically chromium, nickel, lead, and zinc.

3.4.11 AOC K: Truck Dock #9's Former Diesel Spill & Diesel Fuel UST Area

Descriptions

The Truck Dock #9's Former Diesel Spill & Diesel Fuel UST Area (AOC K) is located outside the northern end of the Hot Strip Mill Building (Figure 3-1). The RFA Report indicates that a spill of unknown quantity occurred during an unspecified date as a result of a broken fuel line or valve when fuel oil was pumped from a tanker truck to the tank at the dock. According to the RFA Report a 10,000 gallon diesel UST was removed between 1989 and 1990, and sample results indicated that no contamination existed.

EPA Concerns

Additional information regarding the cleanup of the area was unavailable at the time of the 1991 VSI.

New Information

BSC records indicate that an 8,000 gallon steel No.2 fuel oil UST was removed on February 13, 1990, not a 10,000 gallon tank as stated in the RFA Report. Although corrosion pitting was observed over most of the tank exterior, no apparent integrity problems were observed with the bitumastic coated UST. Water and soil samples from the excavation area show BTEX concentrations were below the minimum detectable levels. A description of events regarding tank removal and sample collection activities is presented in Appendix 3B along with analytical results.

Recommendations

Because the spill was a one time incident, the UST was removed, and no contamination was apparent, no further action is proposed for AOC K.

COPIs

No COPIs are associated with AOC K because no further action is proposed.

3.4.12 AOC L: Benzene/Litol Process Area (SWMUs 147-153)

AOC L, the Benzene/Litol Process Area, is comprised of SWMUs 147-153. These SWMUs are described above in Section 3.3.18.

3.4.13 AOC M: A Coal Chemical Plant Area (SWMUs 136-146)

AOC M, The A Coal Chemical Plant Area, is comprised of SWMUs 136-146. These SWMUs are described above in Section 3.3.17.

3.4.14 AOC N: Bio-Oxidation Ferric Chloride Spill Site

Descriptions

AOC N is an area adjacent to the clarifiers in the Bio-Oxidation Plant that was contaminated by a ferric chloride spill. A drain in the secondary containment for the clarifiers was left open and about 100 gallons of ferric chloride were released to soils outside the containment area. The soil materials were neutralized and transferred to Coke Point Landfill (SWMU 191) or Greys Landfill (SWMU 93).

EPA Concerns

No post-removal soil samples were collected to confirm remediation efforts.

New Information

The ferric chloride was released within the containment area when high winds apparently caused debris to strike and fracture a pipe. The spilled solution did not enter the sewer system. The incident was discovered on November 16, 1989, and was described in a January 26, 1990 quarterly spill report from BSC to MDE. The spill incident is summarized in Appendix 2A, and a copy of the spill description is provided in Appendix 3B.

Recommendations

Because the spill was a one time incident, contaminated soil was treated with a neutralizing chemical application and removed, and ferric chloride is not considered a hazardous constituent no further action for AOC N is proposed.

COPIs

No COPIs are associated with AOC N because no further action is proposed.

3.4.15 AOC O: Hydraulic Oil Storage Area

Descriptions

The RFA Report indicates that AOC O consisted of approximately 20 drums stored outside on soil and gravel on the east side of the Pipe Mill (Figure 3-1). The drums were described as rusty with some containing unidentified fluids while some were empty.

EPA Concerns

Additional information regarding the cleanup of the area was unavailable at the time of the 1991 VSI.

New Information

Non-hazardous, water-based hydraulic oil was managed in this area until the Pipe Mill ceased operations in the late 1980's. During an April 25, 1997 site inspection the area described as AOC O in the RFA Report contained no drums. The area was overgrown with vegetation, and general debris was lightly scattered about. No staining was observed. There are no records available documenting the drum removal date.

Recommendations

Because of field observations, and the non-hazardous nature of the hydraulic oil managed in this area, no further action is proposed for AOC O.

COPIs

No COPIs are associated with AOC O because no further action is proposed.

3.4.16 AOC P: Former Naphthalene Plant Tank & Pit

Descriptions

The Former Naphthalene Plant Tank & Pit (AOC P), is located in the B CCP area near the central portion of the Coke Oven Facility Area (Figure 3-1). The Coke Oven Area is a Special Study Area identified in Attachment B of the Consent Decree (Conceptual Plan for the Site Wide Investigation). This oil tank and pit unit were formerly used in the naphthalene recovery process. According to the RFA Report, the B CCP has been inactive for approximately 20 years, but the tank and pit still exist. During the 1991 VSI this unit was observed to be rusted and corroded.

EPA Concerns

EPA is concerned with this area because of the nature of wastes managed at the area, and because of the general condition of the tank and pit.

New Information

The BCCP has been inactive since 1990, not for the past 20 years as indicated in the RFA Report. The tank and pit have been demolished as part of the coke oven decommissioning activities, and are no longer on site.

Recommendations

AOC P is located within the Coke Oven Area, which is a Special Study Area identified in Attachment B of the Consent Decree (Conceptual Plan for the Site Wide Investigation). Although the tank and pit have been removed from the site, further action is proposed for AOC P as part of the required evaluation of the Coke Oven Special Study Area.

COPIs

Based on process knowledge, the following COPIs are associated with AOC P:

- Metals -- specifically arsenic.
- Cyanide.
- Purgeable Aromatics -- specifically benzene, toluene, ethylbenzene, and xylenes.
- Chlorinated Solvents -- specifically chloroform, tetrachloroethylene, trichloroethylene, cis- and trans-1,2-dichloroethylene, 1,1-dichloroethylene, vinyl chloride, 1,1,1-trichloroethane, 1,2-dichloroethane, 1,1-dichloroethane, and chloroethane.
- Carbon disulfide.
- Polynuclear Aromatic Hydrocarbons -- specifically acenaphthene, acenaphthylene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene.
- Acid Extractables -- specifically phenol, 2,4-dimethylphenol, 2,4-dichlorophenol, 2,4,6-trichlorophenol, 4-nitrophenol, and pentachlorophenol.
- Other SVOCs -- specifically o-cresol, m-cresol, and pyridine.

3.4.17 AOC Q: Former Diesel Fuel UST Area (Slab Haul Road)

Descriptions

The RFA Report indicates that a diesel fuel UST (AOC Q) of unknown age and capacity was removed sometime between 1989 and 1990 from the east side of Slab Haul Road east of the Slabbing Mill (Figure 3-1). Contaminated soil was removed and the remediation was approved by MDE.

EPA Concerns

Additional information regarding the cleanup of the area was unavailable at the time of the 1991 VSI.

New Information

The description of this AOC provided in the RFA Report is not consistent with any BSC records of an UST removal either in the date range indicated, or in the Slab Mill area shown on Figure IV-13 or the photographs in the RFA Report. There was an aboveground diesel fuel tank in the general vicinity that was removed around the time stated in the RFA Report. No correspondence documenting MDE approval (as reported in the RFA Report) of the soil remediation efforts is available.

The description of this AOC provided in the RFA Report is consistent, however, with activities associated with a December 6, 1989 UST removal from the east side of the Human Resources building near the eastern end of Slab Haul Road where a steel, 1000-gallon, No.2 fuel oil tank was removed. Corrosion pitting was observed on the outer tank surface (Geraghty & Miller, 1992). Soil BTEX concentrations were at or below minimum detectable levels. A description of events regarding tank removal and sample collection activities is presented in Appendix 3B along with analytical results.

Recommendations

Based on agency approval of removal and remediation activities, and analytical results of soil samples, no further action is proposed for AOC Q.

COPIs

No COPIs are associated with AOC Q because no further action is proposed.

3.4.18 AOC R: Underground Weak Ammonia Pipeline Spill Sites (3)

Descriptions

AOC R, Underground Weak Ammonia Pipeline Spill Sites (3), is located near the eastern end of the Coke Oven facility Area (Figure 3-1). The Coke Oven Area is a Special Study Area identified in Attachment B of the Consent Decree (Conceptual Plan for the Site Wide Investigation). This area is characterized by an underground pipeline that transported excess A CCP ammonia liquor from a holding tank to the excess tank. The pipeline is located between "A" and 11 and 12 coke batteries, and was replaced in 1990 by an overhead pipeline. BSC spill reports submitted to MDE provided the following information on the three underground line ammonia liquor spill releases:

Date	Spill Area	Spill Report
4/4/89	Near the No.6 Quencher	Second quarter report for 1989
5/15/89	Near the No.6 Quencher	Second quarter report for 1989
8/5/89	Near the No.6 Quencher	Third quarter report for 1989

The 4/4/89 spill resulted from a deteriorated section of pipe that leaked. The spill occurred near the No.6 Quencher. A ten foot section was subsequently replaced. An unknown quantity was lost and none of the spilled liquor was recovered.

Ammonia liquor was observed emerging from the ground near the No.6 Quencher on 5/15/89 as a result of a failed patch on the underground line. The patch was subsequently repaired. An unknown quantity was lost and none of the spilled liquor was recovered.

Similar to the previous incident, ammonia liquor was observed emerging from the ground near the No.6 Quencher on 8/5/89 as a result of a leaking underground line. A section of pipe was subsequently replaced. An unknown quantity was lost and none of the spilled liquor was recovered.

EPA Concerns

EPA is concerned with this area because the overall cumulative effect of the reported spill incidents is unknown. Additional information regarding the cleanup of the spill areas was unavailable at the time of the 1991 VSI.

New Information

No new information is presented.

Recommendations

AOC R is located in the Coke Oven Area, which is a Special Study Area identified in Attachment B of the Consent Decree (Conceptual Plan for the Site Wide Investigation). Because of the nature of wastes managed by, and the various documented spills from the pipeline, further action is proposed for AOC R as part of the required evaluation of the Coke Oven Special Study Area.

COPIs

Based on process knowledge, the following COPIs are associated with AOC R:

- Metals -- specifically arsenic.
- Cyanide.
- Purgeable Aromatics -- specifically benzene, toluene, ethylbenzene, and xylenes.

- Carbon disulfide.
- Polynuclear Aromatic Hydrocarbons -- specifically acenaphthene, acenaphthylene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene.
- Acid Extractables -- specifically phenol, 2,4-dimethylphenol, 2,4-dichlorophenol, 2,4,6-trichlorophenol, 4-nitrophenol, and pentachlorophenol.
- Other SVOCs -- specifically o-cresol, m-cresol, and pyridine.

3.4.19 AOC S: Former Chromic Acid Spill Area

Descriptions

AOC S, the Former Chromic Acid Spill Area, is located inside the Coatings Lines section of the Cold Sheet Mill Building (Figure 3-1). The RFA Report indicates that, sometime around September 1990, 26,000 to 27,000 gallons of chromic acid overflowed from a process tank and discharged to a process sewer (sump).

An environmental remediation/restoration contractor removed the waste and decontaminated the basement area. No samples are known to have been collected during or subsequent to the remediation activities.

EPA Concerns

Additional information regarding the cleanup of the area was unavailable at the time of the 1991 VSI.

New Information

An anonymous phone call was placed to the MDE concerning a sump overflow which led to a "pencil-thin" stream of chromic acid down an elevator shaft to the basement beneath the Number Four Coating Line in the Cold Sheet Mill Building. The remediation effort conducted by Envirite consisted of pumping out the sump, and cleaning the sump and basement area. No correspondence summarizing these activities is available, nor is the event recorded in the summary of spill incidents found in Appendix 2B.

Recommendations

Although no confirmatory samples were collected during the remediation, the activities associated with AOC S occurred primarily inside and resulted in a one time de minimis release to the TMC. For these reasons, no further action is proposed for AOC S.

COPIs

No COPIs are associated with AOC S because no further action is proposed.

3.4.20 AOC T: Former Diesel Fuel UST (Cold Sheet Mill)

Descriptions

The Former Diesel Fuel UST Area, AOC T, is located outside and near the southwest corner of the Cold Sheet Mill Building (see Figure 3-1). The 10,000-gallon UST, used for storage of diesel fuel was removed sometime between late 1989 and early 1990. There were no indications that a release had occurred. Soil analytical data indicated that the area was not contaminated.

EPA Concerns

Additional information regarding the cleanup of the area was unavailable at the time of the 1991 VSI.

New Information

The steel tank, formerly located at Truck Dock 51A, was removed on November 27, 1989. Although corrosion pitting was observed on the tank exterior and near the end seams, no apparent integrity problems were observed with the bitumastic coated UST. BTEX concentrations in water were below the minimum detectable levels. BTEX concentrations in soil ranged from below detection for benzene to 129 μg/kg total xylenes. A description of events regarding tank removal and sample collection activities is presented in Appendix 3B along with analytical results.

Recommendations

Because the tank was removed, and water and soil analytical results indicate low concentrations of BTEX constituents, no further action is proposed for AOC T.

COPIs

No COPIs are associated with AOC T because no further action is proposed.

3.4.21 AOC U: B Coal Chemicals Plant Process Area (SWMUs 112-130)

AOC U, the B Coal Chemical Plant Process Area, is comprised of SWMUs 112-130. These SWMUs are described above in Section 3.3.16.

3.4.22 AOC V: Former Spent Pickle Liquor Tanks (2)

Descriptions

Two Former Spent Pickle Liquor Tanks (AOC V) were located outside the north end of the Hot Strip Mill (Figure 3-1). The RFA Report indicates that these aboveground storage tanks were removed in approximately 1986. The area was observed to be covered with (undefined) stained gravel during the 1991 VSI.

EPA Concerns

Additional information regarding the cleanup of the area was unavailable at the time of the 1991 VSI.

New Information

The description of this AOC is consistent with and duplicates the description of SWMU 70 (Hot Strip Mill Former Spent Pickling Liquor Tank Site) provided in the RFA Report (Table IV-4): AOC V and SWMU 70 are identical.

Recommendations

SWMU 70 was designated as a non-releasing unit. As such, it was not identified in the RFA Report as requiring further action. Therefore, an evaluation of AOC V is unnecessary and, no further action is proposed for AOC V.

COPIs

No COPIs are associated with AOC V because no further action is proposed.

3.4.23 AOC W: Spent Pickle Liquor Tanks

Descriptions

The RFA Report identifies two 60,000 gallon rubber lined steel SPL Tanks (AOC W) located outside the north end of the Cold Sheet Mill Building (Figure 3-1). Heavy staining of soil and gravel underneath the tanks was observed during the 1991 VSI. The stain was undefined. In addition, the tanks were observed to be bulging, buckling and rusty. There is no indication that any release had been reported. According to the RFA, no analytical data are available for AOC W.

EPA Concerns

EPA is concerned with this area because of the nature of the wastes managed at this area, and because of the general condition of the tanks.

New Information

Since the 1970's, the tanks have been used to store spent pickle liquor from the Cold Sheet Mill and Tin Mill Pickling operations prior to shipment to POTWs, transfer to HDS system at No.7 Sinter Strand, or metered discharge to HCWWTP via the TMC.

BSC indicated in a response report to 1987 EPA information requests (Bethlehem, 1988) that only overflows from these tanks are discharged to the TMC (via sewer 034). The area immediately beneath the storage tanks (AOC W) is underlain by a bed of limestone gravel to help neutralize the SPL should a leak or spill occur. Bulges described in the RFA Report were only in the sprayed insulation and not in the tanks, which are in good condition. Documentation listing sources and locations of possible overflows of SPL to the TMC between 1980 and 1987 is provided in Appendix 3B. A schematic diagram showing the SPL flow process and discharge to the TMC is depicted on Figure 3-12.

Recommendations

Because of its proximity to the TMC, and the fact that spills or leaks from the tanks would release wastewater to the TMC (SWMU 1) where they would co-mingle with other waste streams, be treated at HCWWTP, and discharged through an NPDES permitted outfall, it is proposed that evaluation of AOC W be included in the overall evaluation of the TMC.

COPIs

Based on process knowledge, the following COPIs are associated with AOC W:

- Metals -- specifically chromium, nickel, lead, and zinc.

3.4.24 AOC X: Unknown Aboveground Tank

Descriptions

The Unknown Aboveground Storage Tank (AOC X) is briefly described in the RFA Report. It is located on south side of the Rod Mill (Figure 3-1). Few details were provided, but rust was noted on the tank, and the surrounding area was stained.

EPA Concerns

No specific details that describe the nature of wastes managed by this AOC were provided in the RFA Report. The general condition of the tank is an apparent concern.

New Information

The description of the tank is generally consistent with the Rod and Wire Mill Cleaning House SPL Tanks described by Baker (1990). According to Baker, there are actually two rubber-lined steel tanks that contained SPL from the Wire Mill Cleaning House while it was bled to the TMC. Some of the SPL was sent to a POTW and some to an off-site manufacturing facility. These tanks have been out of service since the time the Rod Mill closed in the early 1980's. There were no reported releases from this unit. No other information is available.

Recommendations

It is proposed that AOC X be assessed for possible releases to the environment.

COPIs

Based on available information, the following COPIs are associated with AOC X:

- Metals -- specifically chromium, nickel, lead, and zinc.

3.4.25 AOC Y: Pipe Mill Selenium Testing Area

Descriptions

The Pipe Mill Selenium Testing Area, AOC Y, is located in the Pipe Mill (Figure 3-1). The RFA Report indicates that this area contained non-tested slag in the Pipe Mill, which became inactive in 1983. The selenium-bearing slag was removed and replace with new slag.

EPA Concerns

Additional information regarding the area was unavailable at the time of the 1991 VSI.

New Information

During an April 10, 1997 site inspection no evidence of the slag was observed. The exact date range that this AOC existed is not known, but it is believed to be a relatively short period.

Recommendations

Because this AOC was located inside and for only a short period, and because the operations have ceased, there is virtually no potential for any environmental release. Therefore, no further action is proposed for AOC Y.

COPIs

No COPIs are associated with AOC Y because no further action is proposed.

3.4.26 AOC Z: Pipe Mill Acid Tanks

Descriptions

The Pipe Mill Acid Tanks (AOC Z) are situated between the Pipe Mill and the Galvanizing Building (Figure 3-1). The four steel tanks were observed to be rusted and containing visible holes during the 1991 VSI. Two of the tanks are supported above a stained gravel bed, while the other two are situated above a trench containing railroad tracks and a heavily stained sump. The staining was undefined in the RFA Report. The sump flows to the TMC (SWMU 1) through one of the Discharge Pipes (SWMU 2). It is believed, but not confirmed, that the tanks were used to store (sulfuric) acid. There are no reported releases from this unit. The tanks were reportedly out of use since before 1980.

EPA Concerns

No specific details that describe the nature of wastes managed by this AOC were provided in the RFA Report. The general condition of the tanks is an apparent concern.

New Information

During an April 10, 1997 site inspection the tanks were observed to be in a condition consistent with the description in the RFA Report. No staining of the underlying gravel and sump was observed as indicated in the RFA Report. Gravel with light vegetation was observed.

Recommendations

It is proposed that AOC Z be addressed as part of the post-demolition confirmation project for the Pipe Mill.

COPIs

Based on process knowledge, the following COPIs are associated with AOC Z:

- Metals-specifically chromium, nickel, lead, and zinc.

3.5 NON-RFA AREAS

The AOCs described in the following sections were not identified during the RFA. They are identified in this DCC Report as additional Areas of Concern warranting further action to characterize potential impacts and releases.

3.5.1 Shipyard

Description

The Shipyard was not included in the 1991 VSI, nor was any description provided in the RFA Report. A description is, however, provided in this report since BSC recognizes that this active area of the site has a long history of activities and because this area has been specifically included in the scope of the Site-Wide Investigation by the Consent Decree.

The Shipyard is located along the west-central edge of the site boundary (Figure 3-1) and occupies approximately 200 acres of which about 75 acres are shipways (water). The western boundary of the Shipyard abuts the Patapsco River. The Shipyard, which has been used for shipbuilding and maintenance since 1891, was operated by the BethShip Division of BSC until or about October 2, 1997, at which time the property and operations were sold to Baltimore Marine Industries, Inc. (BMI). As part of its efforts related to the sale of the Shipyard, BSC performed a Phase I Environmental Site Assessment in January 1997.

At the time of its sale to BMI, the Shipyard contained approximately 45 buildings and numerous additional structures including hoists and cranes; and open, paved and unpaved, work and storage areas. There were also moveable work spaces including a barge, a floating dock, and two water treatment trailers containing portable tri-butyl tin (TBT) carbon absorber units that operated under Baltimore County Permit No. WWDP1161.

During its operation by BethShip, the Shipyard had 18 permitted outfalls (NPDES Permit No. MD0001180) that conveyed varying amounts of steam condensate, stormwater runoff, drinking water fountain drainage, and freeze protection flow to the Patapsco River.

BethShip relied on outside contractors for the disposal of solid and hazardous wastes. Solid (non-hazardous) wastes were primarily landfilled off-site (i.e., not on BSC property); however, some dredge spoil pile and shot-blast materials were sent to Greys Landfill. (No wastes generated by BMI will be accepted at Greys or Coke Point Landfills.) Hazardous wastes, which included waste oils, paint wastes, and shop parts washers, were disposed at approved and permitted off-site facilities.

At the time of its sale, there were no USTs on the property. The last USTs had been removed in 1993. Three had been located just south of the Drum Storage Building (former Pickler Building, No.73). Two had been used for the storage of unleaded gasoline, and one had been used for storing diesel fuel. Available records indicate that an additional tank, used for storing No.2 fuel oil, was removed in 1993. This tanks had been located at the rear of the Pipe Shop Building. All tanks were closed in accordance with applicable MDE regulations.

At the time of its sale, there were 11 transformers on the property that contained >500 ppm of PCBs. One was located near the southeastern end of the Shipyard Warehouse Building, two were in the Fabricating Shop (Building 21) located near the southeast end of the site, one was located at Way 6, one was located at Way 9, two were on the north side of the Panel Shop (Building 16), two were in the South Tool Room (Building 70) and Transformer Building, one was outside the east-Central portion of the panel Shop, and one was outside the east side of the Blast & Paint Building. All transformers had been labeled, secured, appeared to be in good condition, and did not appear to be leaking or in danger of leaking.

During its operation by BethShip, the North Storage Yard had been used for outside storage of equipment and materials. This area is approximately 55 acres, and with the exception of a large pile of dredge spoil stored in the southwest portion of the yard, it was mostly unused at the time the Shipyard was sold. This material was reportedly non-hazardous dredgings from the ship channels and turning basin. Sometime between 1985 and 1987 the dredging contractor could not dispose of approximately 5000 cubic yards of dredgings that contained excess debris (e.g., pipe, wood, etc.), so the material was returned to the North Yard.

In 1985, the Shipyard removed accumulated drums from the North Yard, and transferred them offsite for proper treatment and disposal. The drums had contained mostly oils and greases.

In early 1991, the North StorageYard area became the focus of an MDE inspection subsequent to a complaint filed with the Baltimore County Air Quality Management office. The complaint stemmed from a dust pile placed on the ground just west of some recycling equipment. The dust originated from the Grit Recycling Plant baghouse. TBT, a non-hazardous pesticide, was alleged to be mixed within the dust pile. The site inspection indicated otherwise, and the pile was transferred to Greys Landfill.

An area known as Area 34, which was located in the west-central portion of the site, was the subject of MDE complaints and NOVs in the late 1980's and early 1990's. In 1991, the MDE ordered BethShip to investigate the extent of contamination and cleanup Area 34 in response to site inspection that found spillage and discharge to the ground from eighteen 55-gallon drums of waste paint related materials.

Recommendations

Based on available information concerning the Shipyard, two areas within it are proposed for further investigation -- Area 34 and the North Yard. Area 34 needs to be examined to follow up on the 1991 MDE Administrative Order relating to waste paint materials, and the North Yard needs to be examined to follow up on possible residual effects from the storage of drums containing waste oils and greases.

COPIs

Based on available information, the following COPIs are associated with the Area 34:

- Metals -- specifically cadmium, lead, and zinc.

- Purgeable Aromatics -- specifically benzene, toluene, ethylbenzene, and xylenes.

Based on available information, the following COPIs are associated with the North Yard:

- Metals -- specifically chromium, nickel, lead, and zinc.

- Purgeable Aromatics -- specifically benzene, toluene, ethylbenzene, and xylenes.

- Polynuclear Aromatic Hydrocarbons -- specifically acenaphthene, acenaphthylene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene.

3.5.2 "County Lands"

Descriptions

Property assessment reports were completed for five parcels of land owned by BSC that were under consideration to be sold to Baltimore County. These parcels, referred to as "County Lands," and designated as Parcel 1A, 1B, 2, 3A, and 3B, are located within the Sparrows Point facility (Figure 3-13.) The following reports were reviewed and consolidated into a County Lands Summary Report (Rust, 1996):

- Level II Assessment Report completed by ERM, Inc., dated August 1987
- EA Engineering Environmental Testing Report, dated September 1988
- EA Engineering Phase III Environmental Site Assessment Report, dated January 1994

The County Lands Summary Report serves as the primary source of information for the following descriptions and COPI listings.

<u>Parcel 1A</u>

Descriptions

Parcel 1A is located near the northern property boundary (Figure 3-13) and is comprised of the BSC Spare Parts Yard and Contractor Storage and Staging Area. This parcel is approximately 82 acres in size and is bounded by the Peninsular Expressway to the north, a cloverleaf on-ramp to Interstate 695 to the east, Greys Landfill to the south, and Bear Creek to the west. Generally, the Spare Parts Yard consists of temporarily stored steel machinery and other steel and metallic equipment from various plant facilities. Primary areas of concern discussed in the ERM report include the following (all of which have since been removed):

- An earthen oil pit behind the C.J. Langenfelder and Son Vehicle Maintenance Shop in the Contractor Area.
- An underground storage tank in the C.J. Langenfelder and Son area.
- Two gas pumps and an associated pump island in the Blumenthal Kahn Electric Company area.
- Over 250 full or partially full, unlabeled drums and/or containers (some leaking) in the Contractor Area (some oil staining).

- A 1,000-gallon UST containing No.2 fuel oil east of Greys Landfill adjacent to three buildings.

Primary area of concern discussed in the EA reports was an area of contamination defined as the Coal Tar Area located in the southeastern end of Parcel 1A. A report prepared by Groundwater Technology was reviewed by EA, and refers to a Soil Vapor Extraction (SVE) pilot system for extraction of VOCs. Several soil samples were obtained during the EA environmental testing effort that indicated elevated levels of PAH's volatile organics, and semi-volatiles, indicative of coal tar and solvents.

Recommendations

There are four areas within Parcel 1A that should be included for further investigation of possible releases to the environment. These are the former fuel and oil tanks in the Contractor Area, the former fuel tank near Greys Landfill, the former drum storage area in the Contractor Area, and the Coal Tar Area.

COPIs

Based on available information, the following COPIs are associated with the Contractor tank area and the Greys Landfill tank area:

- Metals -- specifically chromium, nickel, lead, and zinc.
- Purgeable Aromatics -- specifically benzene, toluene, ethylbenzene, and xylenes.
- Polynuclear Aromatic Hydrocarbons -- specifically acenaphthene, acenaphthylene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene.

Based on available information, the following COPIs are associated with the former drum storage area:

- Metals -- specifically chromium, nickel, lead, and zinc.
- Purgeable Aromatics -- specifically benzene, toluene, ethylbenzene, and xylenes.
- Chlorinated Solvents -- specifically chloroform, tetrachloroethylene, trichloroethylene, cis- and trans-1,2-dichloroethylene, 1,1-dichloroethylene, vinyl chloride, 1,1,1-trichloroethane, 1,2-dichloroethane, 1,1-dichloroethane, and chloroethane.
- Polynuclear Aromatic Hydrocarbons -- specifically acenaphthene, acenaphthylene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene.

Based on available information, the following COPIs are associated with the Coal Tar Area:

- Metals -- specifically arsenic.
- Cyanide.
- Purgeable Aromatics -- specifically benzene, toluene, ethylbenzene, xylenes, 1.3-dichlorobenzene, and 1,4-dichlorobenzene.
- Polynuclear Aromatic Hydrocarbons -- specifically acenaphthene, acenaphthylene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene.
- Acid Extractables -- specifically phenol, 2,4-dimethylphenol, 2,4-dichlorophenol, 2,4,6-trichlorophenol, 4-nitrophenol, and pentachlorophenol.
- Other SVOCs -- specifically o-cresol, m-cresol, and pyridine.

Parcel 1B

Descriptions

Parcel 1B is located along the northern property boundary (Figure 3-13) and is primarily comprised of vegetation-covered slag-fill previously intended for waste disposal. However, only the southeastern end was ever used for this purpose, and the majority of the parcel remains as unused landfill cells. This parcel is approximately 43 acres in size and is bounded by Peninsular Expressway to the south, a paved road to the east, a marshalling yard owned by the Baltimore and Ohio Railroad to the north, and a dirt road adjacent to Bear Creek to the west. Primary areas of concern include the following:

- One million tons of Open Hearth slurry were disposed in the southeast corner of Parcel 1B between 1968 and 1978.
- The presence of low levels of vinyl chloride, dichloroethane, and dichloroethene in well W-6.

Recommendations

The area around well W-6 should be assessed to determine the nature of this apparent release to the environment. Based on the nature and composition of Open Hearth slurry, this area does not need to be assessed.

COPIs

Based on the available following COPIs are associated with the well W-6 area:

- Chlorinated Solvents -- specifically chloroform, tetrachloroethylene, trichloroethylene, cis- and trans-1,2-dichloroethylene, 1,1-dichloroethylene, vinyl chloride, 1,1,1-trichloroethane, 1,2-dichloroethane, 1,1-dichloroethane, and chloroethane.

Parcel 2

Descriptions

Parcel 2 is located near the northwestern property boundary (Figure 3-13) and ERM identified four areas that comprise this parcel- the Pipe Mill Complex, the open area north of the Mill, the Pipe Storage and Contractor Laydown Yard, and the Mud Reservoir. This parcel is approximately 145 acres in size and is bounded by Rod Mill Road to the west, South Pipe Mill Road to the south, North Point Boulevard to the east, and Bethlehem Boulevard to the north. Primary areas of concern discussed in the ERM report include the following (all of which are associated with the Pipe Mill Complex):

- Four 10,000 gallon underground storage tanks located in the Lap Weld Building adjacent to Craneway #51 (since removed).
- Approximately fifty transformers staged in No. 1 Warehouse (since removed).
- Several oil filled sumps.

The ERM report also discussed the Mud Reservoir which received dredge spoil from Humphrey Creek from the 1930's until 1970 and mud and clay from Humphrey Impoundment since 1970. Six soil samples were obtained from a depth of 3 to 4 feet in the reservoir as part of the Level II assessment. Only TOC, oil and grease, and EP Toxicity metals were evaluated. Elevated oil and grease and TOC concentrations were noted in only one sample, and no elevated metals concentrations were detected.

Recommendations

The three areas within the Pipe Mill Complex should be further assessed for residual contamination. It is proposed that this be done as part of the post-demolition confirmation project for the Pipe Mill.

COPIs

Based on available information, the following COPIs are associated with the tanks and sumps:

- Metals -- specifically chromium, nickel, lead, and zinc.

- Purgeable Aromatics -- specifically benzene, toluene, ethylbenzene, and xylenes.

- Polynuclear Aromatic Hydrocarbons -- specifically acenaphthene, acenaphthylene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene.

Based on available information, the following COPIs are associated with the transformer staging area:

- Polychlorinated Biphenyls.

Parcels 3A and 3B

Descriptions

Parcel 3A is located along the east-central property boundary (Figure 3-13) and ERM identified three areas that comprise this parcel -- the former townsite (Sparrows Point) to the south, an athletic field to the north, and a middle area between the two. This parcel is approximately 105 acres in size and is bounded by Sparrows Point Boulevard to the west, three 10-million gallon tanks to the south, Wharf Road and a Patapsco and Black Rivers Railroad Company marshalling yard along Jones Creek to the east, and a cloverleaf to the north.

Parcel 3B is located adjacent to and northeast of Parcel 3A. Parcel 3B is approximately 24 acres in size and is bounded by the Pleasant Yacht Club and Wharf Road to the west, Jones Creek to the south, another marina and a wooded area to the east, and a cloverleaf on-ramp to Highway 151 to the north.

Primary areas of concern on Parcel 3A discussed in the ERM report include:

- Former Townsite -- the abandoned Sparrows Point sewage treatment facility was still in existence at the time of the ERM assessment. The sewage treatment facility was noted as fenced-in and comprised of several wooden structures, a pump house, and a 10-foot tall imhoff or sedimentation/digestion tank, similar to a septic tank. According to the EA Engineering Phase III Report, the sewage facility has been dismantled.

- Middle Area-An outfall network (NPDES outfalls 016 and 017) and oil skimmer station. Oily sludges were noted along the banks of this network.

There were no significant concerns in any report regarding Parcel 3B.

Recommendations

No further action is proposed for the former sewage treatment plant based on the nature of the equipment and the wastewater treated at the plant, and because it has been demolished. No further action is proposed for the outfall network because it currently operates under NPDES permit.

COPIs

There are no COPIs associated with Parcels 3A and 3B because no further action is proposed.

3.5.3 Central Supply Fuel Storage Tanks

Descriptions

The Central Supply Fuel Storage Tanks are located at the Central Supply Building and Warehouse on the northwest side of the plant near Highway 151 (Figure 3-1). Three underground storage tanks were used to supply No. 4 fuel oil for space heating at the warehouse. Two of the tanks were 20,000 gallon capacity located on the northwest side of the building in the truck dock 500 bay; one inside the building, the other outside the building. The third tank is 12,000 gallon capacity located just outside on the east side of the building. All tanks were taken out of service in September 1987 and filled with grout under permit number 97715 issued August 11, 1987. The tanks were opened, pumped of residual oil, power washed and then pumped full of grout. These tanks were taken out of service after Petro-Tite tests performed in November and December 1986 revealed unacceptable leakage rates from the 20,000 gallon tank at truck dock 500 and the 12,000 gallon tank.

Three soil borings were advanced by Baker Engineers in June 1987. Boring EW-1 was advanced 15 feet reporting slight fuel odor encountered at 6 feet and 10 feet. Boring EW-2 was advanced 20 feet with reports of slight fuel odors throughout the boring. Boring EW-3 was advanced 15 feet with fuel odors reported throughout, and floating product encountered at 8.5 feet. Monitoring wells were installed in each of these borings.

Daily water and product removal activities were initiated in one of the wells on February 27, 1989. Logs of this activity show that when pumping activities began, approximately ten gallons of liquid was extracted each day. Of the ten gallons, one quart to one pint was free product was extracted. By May 1989, the free product volume had increased to three quarts. Free product volume varied over the next three years from one pint to two quarts, and diminish to less than a pint by the middle of 1992. Only trace amounts were being recorded by early 1995. For the last year, no detectable amounts are being recorded.

Recommendations

The Central Supply Fuel Storage Area should be assessed for residual contamination associated with the release of fuel oil from the tanks in this area.

COPIs

Based upon the knowledge of the contents of this tank, the following COPIs are associated with the Central Supply Fuel Storage Area:

- Purgeable Aromatics -- specifically benzene, toluene, ethylbenzene, and xylenes.
- Polynuclear Aromatic Hydrocarbons -- specifically acenaphthene, acenaphthylene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene.

3.5.4 No. 10 Fuel Oil Tank

Descriptions

The No. 10 Fuel Oil Tank was a 2.3-million gallon aboveground tank used for storing No. 6 fuel oil. It was located at the intersection of Ship Yard Road and Blast Furnace Road. The tank is reported to have been taken out of service in 1977.

In April 1987, oil began surfacing in the coal dock slip near the No. 10 Fuel Oil Tank. The Marine Safety Office of the U.S. Coast Guard became involved in monitoring clean up actions in the slip and to determine the source of the oil in the slip. No. 10 Fuel Oil Tank was suspected due to its apparent state of disrepair. On April 30, 1987, a trench was dug between No. 10 Fuel Oil Tank and the bulkhead to the slip to see if oil was migrating from the tank to the slip. Oil was found in the trench and had to be removed from the trench.

In May 1987, it was discovered that 161,000 gallons of rainwater laden with fuel oil had accumulated in the tank during the 10 years it remained out of service. This material was pumped out of the tank, but oil continued to surface in the coal dock slip. In July 1987, general soil excavation began between the tank and the slip. Excavation continued as far as possible to the limits of the tank foundation. Approximately 500 gallons of oil was recovered, and 2,600 CY of soil were removed. Some of the soil was oil saturated. Jet-Blast was hired to clean the inside of the tank and eventually removed an additional 29,000 gallons of residual oil.

Demolition of the tank began in August 1987. After the tank was removed, the concrete foundation beneath was observed to be cracked and stained with oil. Demolition of the foundation began in October 1987. Soil saturated with heavy oil was discovered. Groundwater Technology Inc. was hired in January 1988 to formulate a remediation plan. Six monitoring wells were installed in the vicinity of the tank during March 1988, and an effort was made to inoculate the surrounding soil with bacteria to accelerate biodegradation of residual oil materials. This approach was not successful due to high salinity in the soil from tidal influences. ERM was hired in June 1988 to continue the work. A flexible membrane cap was proposed along with continued pumping of the excavated hole. No further reports from the Coast Guard are available on the results of this work.

New Information

A review of aerial photographs dated 1938, 1952, 1957, 1971, 1983 and 1996 indicate that as many as eight additional aboveground tanks were located in the general vicinity of the No. 10 Fuel Oil Tank. They have all been removed. The No. 10 Fuel Oil Tank area remains somewhat excavated. No further reports of oil migration have been filed. A recent on-site examination revealed no further information.

Recommendations

The No. 10 Fuel Oil Tank area should be assessed for residual contamination associated with the release of fuel oil from this tank.

COPIs

Based upon the knowledge of the contents of this tank, the following COPIs are associated with this added area of concern:

- Purgeable Aromatics -- specifically benzene, toluene, ethylbenzene, and xylenes.

- Polynuclear Aromatic Hydrocarbons -- specifically acenaphthene, acenaphthylene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, phenanthrene, and pyrene.

3.5.5 Hot Strip Mill Drum Handling Area

Descriptions

The Hot Strip Mill Drum Handling Area is located in front of the pumphouse at the Truck Dock 5. At various times in the past, as many as 150 drums of waste oil, solvents, materials cleaned out of sumps and pits, and floor sweepings have been stored in this area.

Recommendations

It is proposed that the Hot Strip Mill Drum Handling Area be assessed to determine if any releases have occurred as a result of the drum handling and storage in this area.

COPIs

Based on process knowledge and available information the following COPIs are associated with this added area of concern:

- Metals -- specifically chromium, nickel, lead, and zinc

- Chlorinated Solvents -- specifically chloroform, tetrachloroethylene, trichloroethylene, cis- and trans-1,2 dichloroethylene, 1,1-dichloroethylene, vinyl chloride, 1,1,1-trichloroethane, 1,2-dichloroethane, 1,1-dichloroethane, and clororethane.

- Polynuclear Aromatic Hydrocarbons -- specifically acenaphthene, acenaphthylene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, napthalene, phenanthrene, and pyrene.

3.5.6 Coke Oven Gas Drip Legs

Descriptions

Coke oven gas was distributed to many areas within the Sparrows Point facility by pipeline for use as a fuel. Distribution lines ran from the Coke Oven Area to other Facility Areas including the Sinter Plant, Shipyard, Finishing Mills, Rod and Wire & Pipe Mills, and various other points in between.

As coke oven gas is distributed, it cools allowing condensate to drop out in the distribution pipeline. This condensate was removed from the pipeline at drip legs located throughout the distribution system. The condensate was typically discharged to the ground.

New Information

The coke plant has been shut down since 1991. When it shut down, no gas was available to be distributed. As such, many of the gas distribution lines became dormant and have been abandoned. Several have been converted to natural gas distribution lines.

Recommendations

It is proposed that the COPIs associated with coke oven gas condensate be added to the list of parameters used for analysis of any samples collected in areas served by the coke oven gas distribution system.

COPIs

- Purgeable Aromatics -- specifically benzene, toluene, ethylbenzene, and xylenes.
- Polynuclear Aromatic Hydrocarbons -- specifically naphthalene.
- Other SVOCs -- specifically pyridine.

3.6 SUMMARY

The following points summarize the results of the SWMU and AOC evaluation:

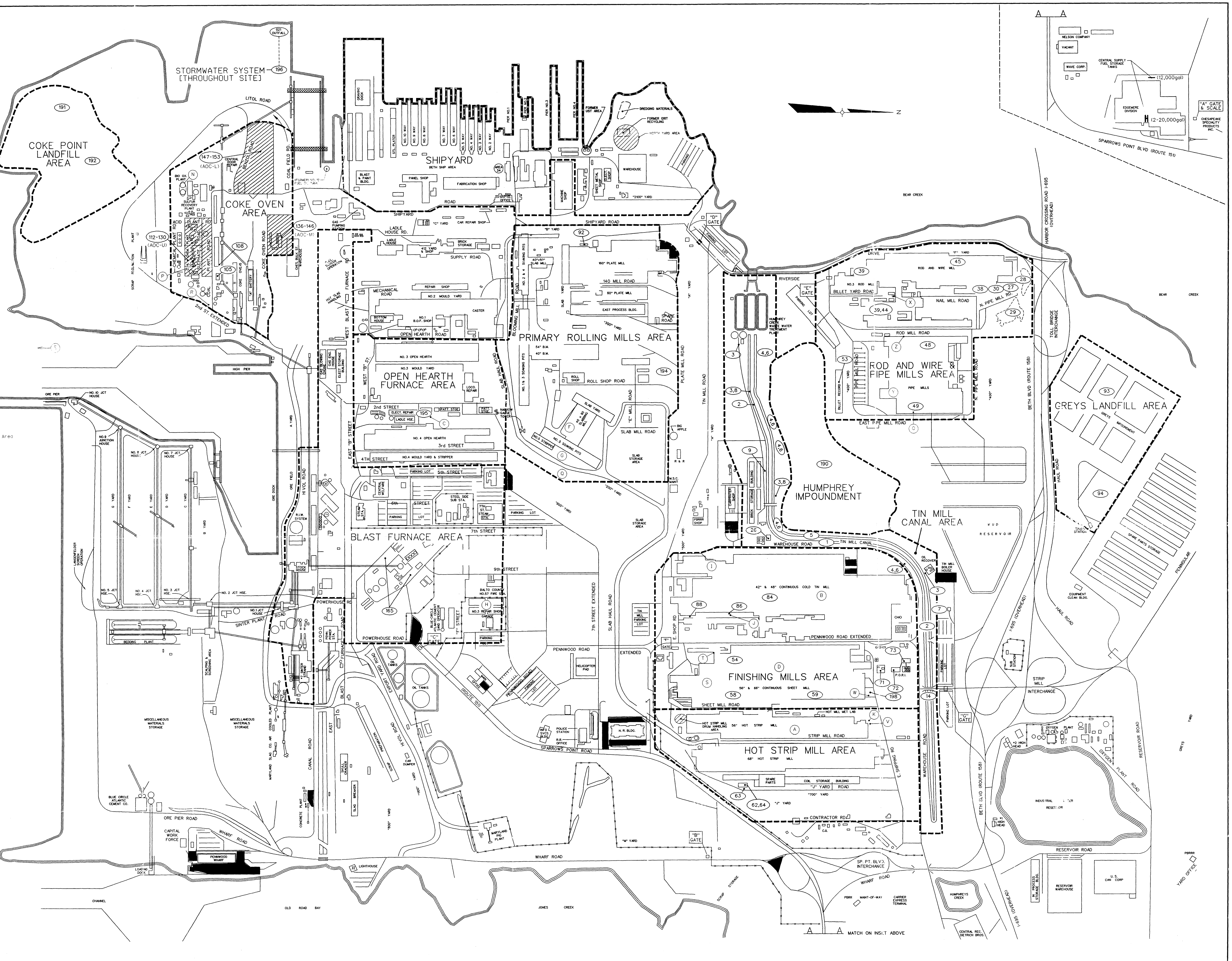
- The RFA Report listed a total of 84 SWMUs and 26 AOCs that did not screen out as part of the RFA procedures.
- No further action is proposed for 14 of these SWMUs and 16 of these AOCs on the basis of available data, the non-hazardous nature of wastes managed, or post-RFA designation as low or non-releasing potential.
- Further action is proposed for the remaining 70 SWMUs and 10 AOCs

The recommendations for each of the SWMUs and AOCs not screened out during the RFA Report are summarized in Table 3-2 along with a brief explanation of the reasons for each recommendation. The COPIs identified for each RFA SWMU or AOC that is recommended for further action in this DCC Report are summarized in Table 3-3.

This DCC Report includes descriptions for six additional (non-RFA) AOCs. These AOCs, which include the Shipyard, the County Lands, the Central Supply Fuel Storage Tank, the No. 10 Fuel Oil Tank, the Hot Strip Mill Drum Handling Area, and the Coke Oven Gas Drip Legs, are proposed for further action. The COPIs identified for specific areas within these additional AOCs are summarized in Table 3-4.

SWMU No./ AOC Letter	SWMU/AOC NAME
	TIN MILL CANAL AREA
	Tin Mill Canal Area
1	Tin Mill Canal
2	TMC Discharge Pipes
3	TMC Oil Skimming Devices (5)
4	TMC Dredging Containment Areas (5)
5	TMC Waste Oil Storage Tanks (5)
6	TMC Impoundments (4)
7	Recent TMC Embankment Dredgings
8	TMC Brill Skimmer Pits (2)
9	Former TMC Oil Collection Dumpster
	Humphrey Creek Wastewater Treatment Plant (HCWWTP) Area
14	HCWWTP Spent Pickle Liquor (SPL) Discharge Point
198	SPL Sump and Trench System
	Chrome Recovery Plant Area
26	Chrome Recovery Filtrate Sump
	AOCs
	ROD AND WIRE & PIPE MILLS AREA
	Rod Mill Area
27	Rod Mill Remediation Area
28	Northwest Pond
29	East Pond
30	Rod Mill Equalization Tanks
38	Cadmium Treatment Trenches
39	Rod Mill Scale Pits
44	Rod Mill Cooling Tower
45	Rod Mill Trenches/Sumps
	Pipe Mill Area
48	Pipe Mill Zinc Ammonium Chloride Sludge Storage Area
49	Pipe Mill Trenches/Sump
	Billet Prep Area
53	Billet Prep Trenches & Blind Sumps
	AOCs
[illegible]	Hydraulic Oil Storage Area
[illegible]	Unknown Aboveground Storage Tank
[illegible]	Pipe Mill Selenium Testing Area
[illegible]	Pipe Mill Acid Tanks (4)
	FINISHING MILLS AREA
	Coating Lines Area
54	Coating Lines Blind Sumps
	Cold Sheet Mill Area
58	Cold Sheet Mill Piping
59	Tandem Mill Trench System
	Palm Oil Recovery, Inc. (PORI) Area
71	PORI Oil/Water Separator
72	PORI Holding Tank
73	PORI Lagoon
	Tin Mill Area
84	Tin Mill Trenches/Sumps
86	Tin Mill Sump (Acid Area Monitoring)
	Halogen Area
88	Halogen Lines Trenches/Sumps
	AOCs
[illegible]	Former 1988 PCB Spill Area
[illegible]	Former PCB Spill Area (Sheet Mill)
[illegible]	Former 1991 Acid Leak Area
[illegible]	Acid Tanks
[illegible]	Former Chromic Acid Spill Area
[illegible]	Former Diesel Fuel UST (Cold Sheet Mill)
	HOT STRIP MILL AREA
62	Hot Strip Mill Basins (3)
63	Hot Strip Mill Waste Oil Tank
64	Hot Strip Mill Oil Skimmer System
	AOCs
A	Former 3/21/91 PCB Spill Area
K	Truck Dock #9's Former Diesel Spill & Diesel Fuel UST Area
V	Former SPL Tanks (2)
	OPEN HEARTH FURNACE AREA
	AOCs
C	Former ERS PCB Spill Area
	Miscellaneous SWMUs
195	Former ERS Oily Wastewater Tank
	PRIMARY ROLLING MILLS AREA
	Rolling Plate Mill Area
92	Rolling Mill Scale Pit
	Miscellaneous SWMUs
194	Waste Oil Stabilizing/Packing Area
	AOCs
F	Former Slab Cut Off Spill Area
G	Former Diesel Fuel Spill Area (Slab Haul Road)
Q	Former Diesel Fuel UST Area (Slab Haul Road)
	GREYS LANDFILL AREA
93	Greys Landfill
94	Greys Tar Decanter Cell
	BLAST FURNACE AREA
	Furnace Area
165	L Furnace Slag Piles
	AOCs
H	Mason's Garage Area
	COKE OVEN AREA
	[illegible] Battery Area
105	Battery A Waste Oil Accumulation Area
108	Mechanical Shop Waste Oil Accumulation Area
	B Coal Chemical Plant (B CCP) Area
112	B CCP Tar Storage Tank Containment Areas
113	B CCP Underground Weak Ammonia Pipeline
114	B CCP Acid Tank Containment Pad
115	B CCP Acid Tanks
116	B CCP Ammonia Clarifier Tank
117	B CCP Lime Collection Bin
118	B CCP Ammonia Stills (2)
119	B CCP Ammonia Saturator
120	B CCP Acid Surge Tank
121	B CCP Wash Oil Coolers (Spiral)
122	B CCP Wash Oil Coolers (Shell and Tube)
123	B CCP Wash Oil Decanters
124	B CCP Wastewater Holding Tank
125	B CCP Wash Oil Circulating Tank
126	B CCP Scrubbers
127	B CCP Waste Oil Bin
128	B CCP API Light Oil Separators (2)
129	B CCP Muck Tank
130	B CCP Million Gallon Weak Ammonia Tank
	A Coal Chemical Plant (A CCP) Area
136	A CCP Sulfuric Acid Tank Containment
137	A CCP Cyanide Stripper/Stack
138	A CCP Oil/Water Separator
139	A CCP Former Tar Decanters (3)
140	A CCP Acid Saturator Tanks
141	A CCP Overflow Skimmer Box
142	A CCP Wash Oil Decanters
143	A CCP Scrubbers
144	A CCP Wastewater Holding Tank
145	A CCP Wash Oil Holding Tank
146	A CCP Sump
	Benzene/Litol (B/L) Plant Area
147	B/L Oil/Water Separator
148	B/L Tank Sludge Staging Area
149	B/L Tank Sludge Accumulation Area
150	B/L Litol Plant Catalyst Drum Station
151	B/L Waste Oil Accumulation Area
152	B/L Litol Drum Staging Area
153	B/L Benzene Truck Loading Area
	AOCs
L	Benzene/Litol Process Area
M	A Coal Chemicals Plant Area
N	Bio-Oxidation Ferric Chloride Spill Site
P	Former Naphthalene Plant Tank & Pit
R	Underground Weak Ammonia Pipeline Spill Sites (3)
U	B Coal Chemicals Plant Process Area
	COKE POINT LANDFILL AREA
191	Coke Point Landfill
192	Coke Oven Sweeping Waste Pile
	HUMPHREY IMPOUNDMENT
190	Humphrey Impoundment
	OTHER SWMUs AND AOCs
	SWMUs
196	Stormwater Sewer System
	AOCs
E	6 PCB Transformers
	NON-RFA AREAS OF CONCERN
	Shipyard – Area 34
	– North Yard Area
	Central Supply Fuel Storage Tanks
	No. 10 Fuel Oil Tank
	Hot Strip Mill Drum Handling Area
	Coke Oven Gas Drip Legs (Throughout Site)
	County Lands (See Figure 3-13)

DECEMBER 22, 1997



LEGEND:

(151) SWMU CONSIDERED FOR FURTHER ACTION (IN RFA)

(A) AOC CONSIDERED FOR FURTHER ACTION

SCALE IN FEET

0 200 400 600 800 1000

NOTES:

1. SWMU/AOC DESIGNATIONS PROVIDED BY A.T. KEARNEY, INC. IN AUGUST 12, 1993 FINAL RCRA FACILITY ASSESSMENT PHASE II REPORT
2. MAP DERIVED FROM ORIGINAL BETHLEHEM STEEL CADD DRAWING NO. 5092 FILE: MAPS.DWG

BETHLEHEM STEEL CORP.

RUST

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FIGURE 3-1

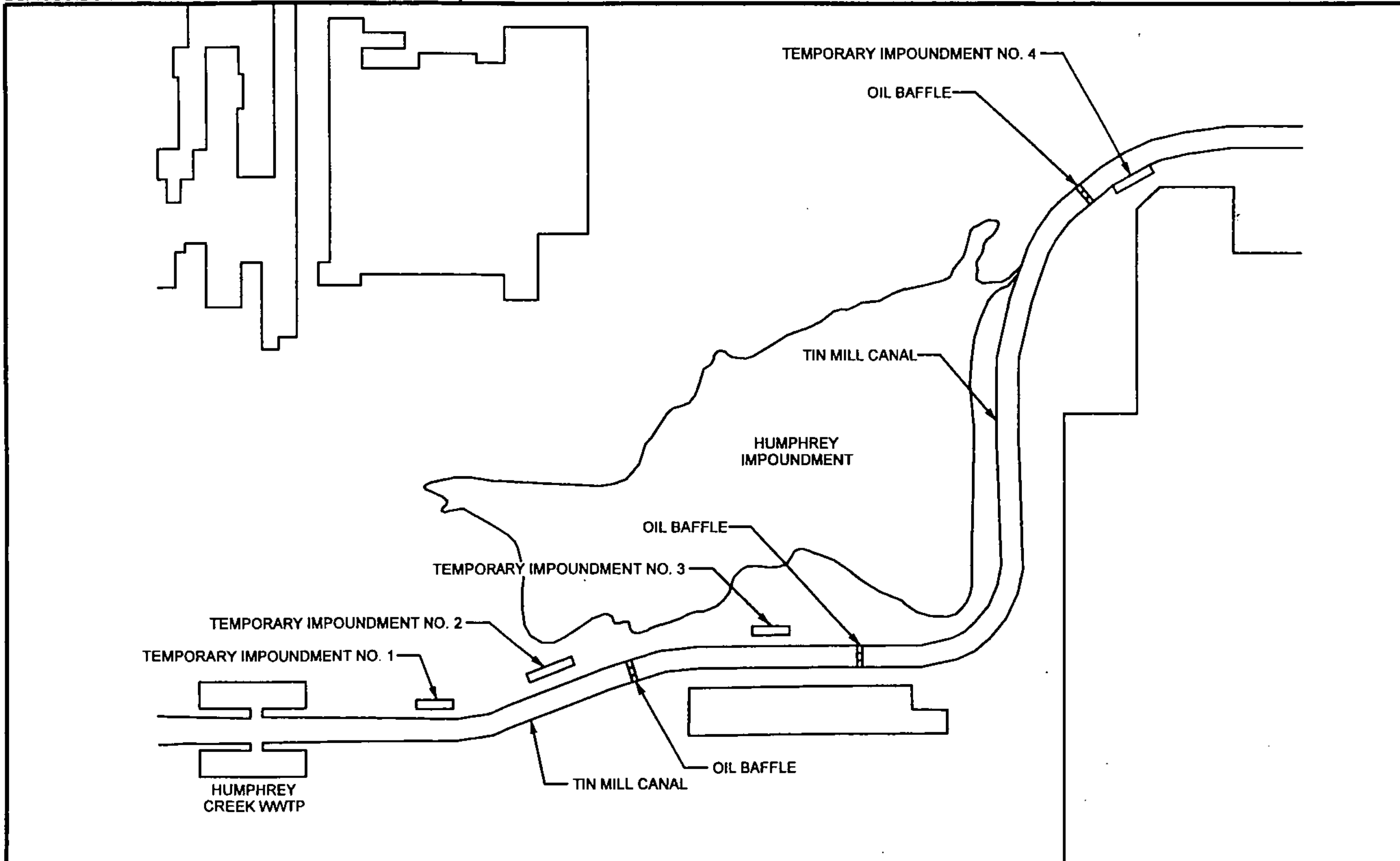
LOCATION OF SWMUs, AOCs, AND FACILITY AREAS

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998 200123

0123S001.DGN

BSFIG30.DGN DECEMBER 22, 1997



NOT TO SCALE

Figure derived from Baker/TSA, Inc. Identification and Classification of Wastes being disposed in Grays Landfill and Humphreys Impoundment, September 1986.

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FIGURE 3-2

TMC IMPOUNDMENT LOCATIONS

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998 200123

BSFIG33.DGN DECEMBER 22, 1997

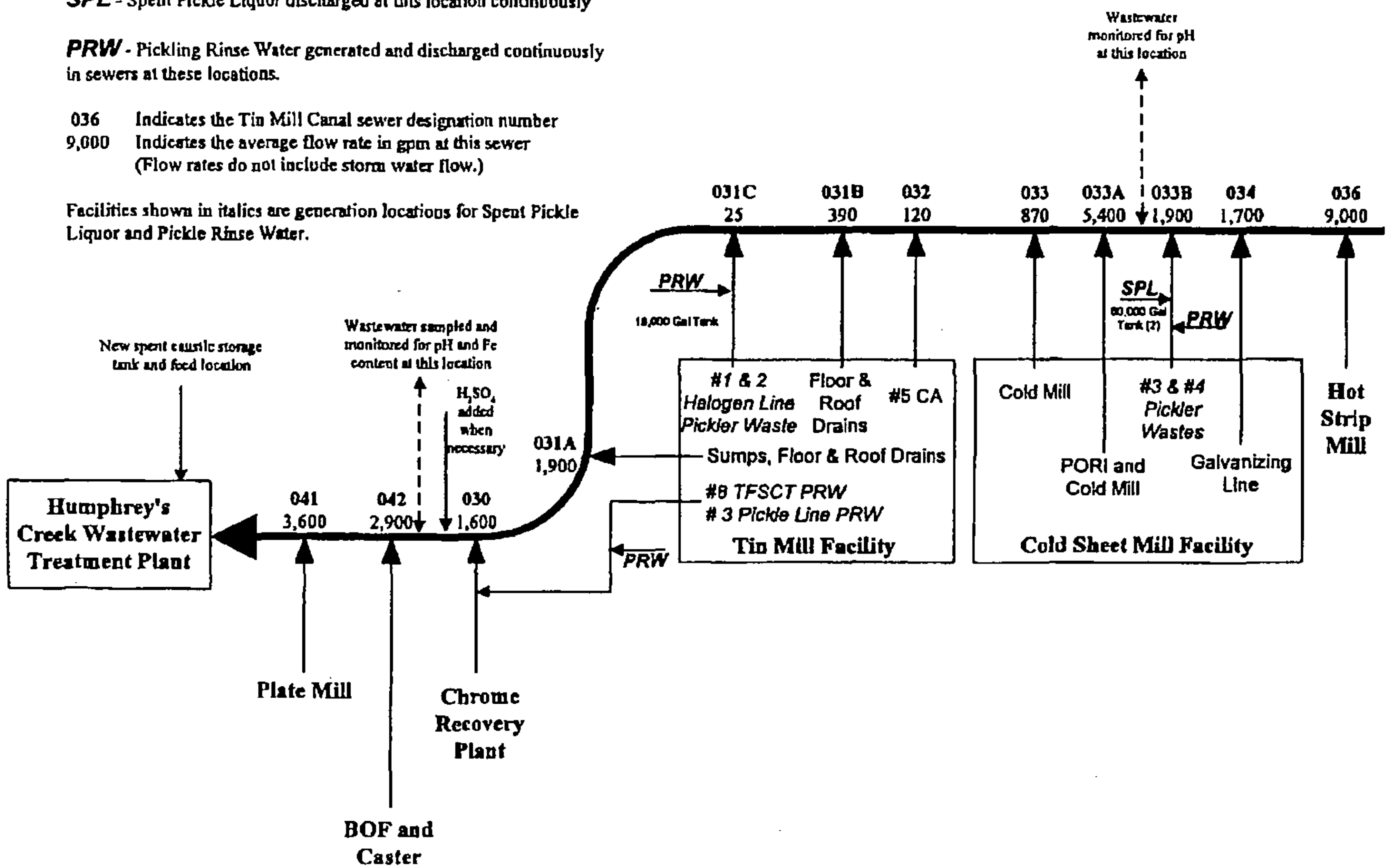
Notes:

SPL - Spent Pickle Liquor discharged at this location continuously

PRW - Pickling Rinse Water generated and discharged continuously in sewers at these locations.

036 Indicates the Tin Mill Canal sewer designation number
9,000 Indicates the average flow rate in gpm at this sewer (Flow rates do not include storm water flow.)

Facilities shown in italics are generation locations for Spent Pickle Liquor and Pickle Rinse Water.



NOT TO SCALE

Figure derived from Figure 2-1 in Bethlehem Steel Corporation Sparrows Point Division Beneficial Reuse of Strong Caustic Solutions Work Plan, December 1997.

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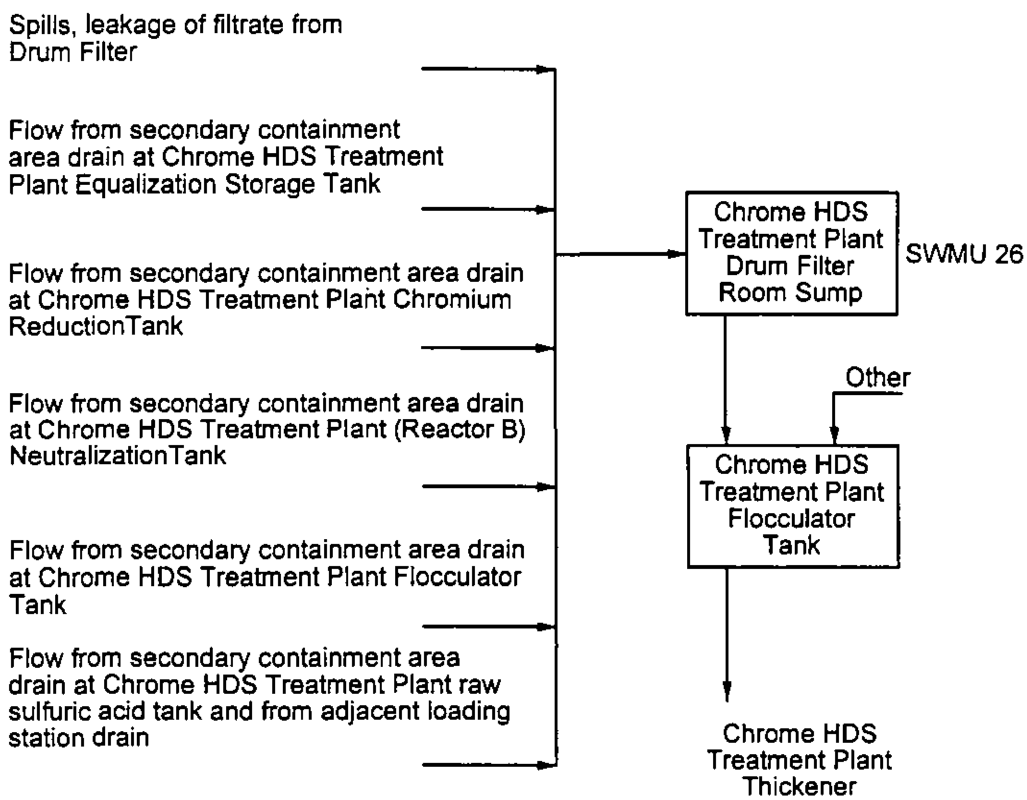
FIGURE 3-3
INDUSTRIAL DISCHARGES TO TIN MILL CANAL

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998 200123



DECEMBER 22, 1997

Note: Figure derived from Baker Environmental, Inc. schematic diagram TM36 in Solid Waste/Material Management Units Inventory, September 1, 1990.

SCALE: NONE

RUST

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FIGURE 3-4

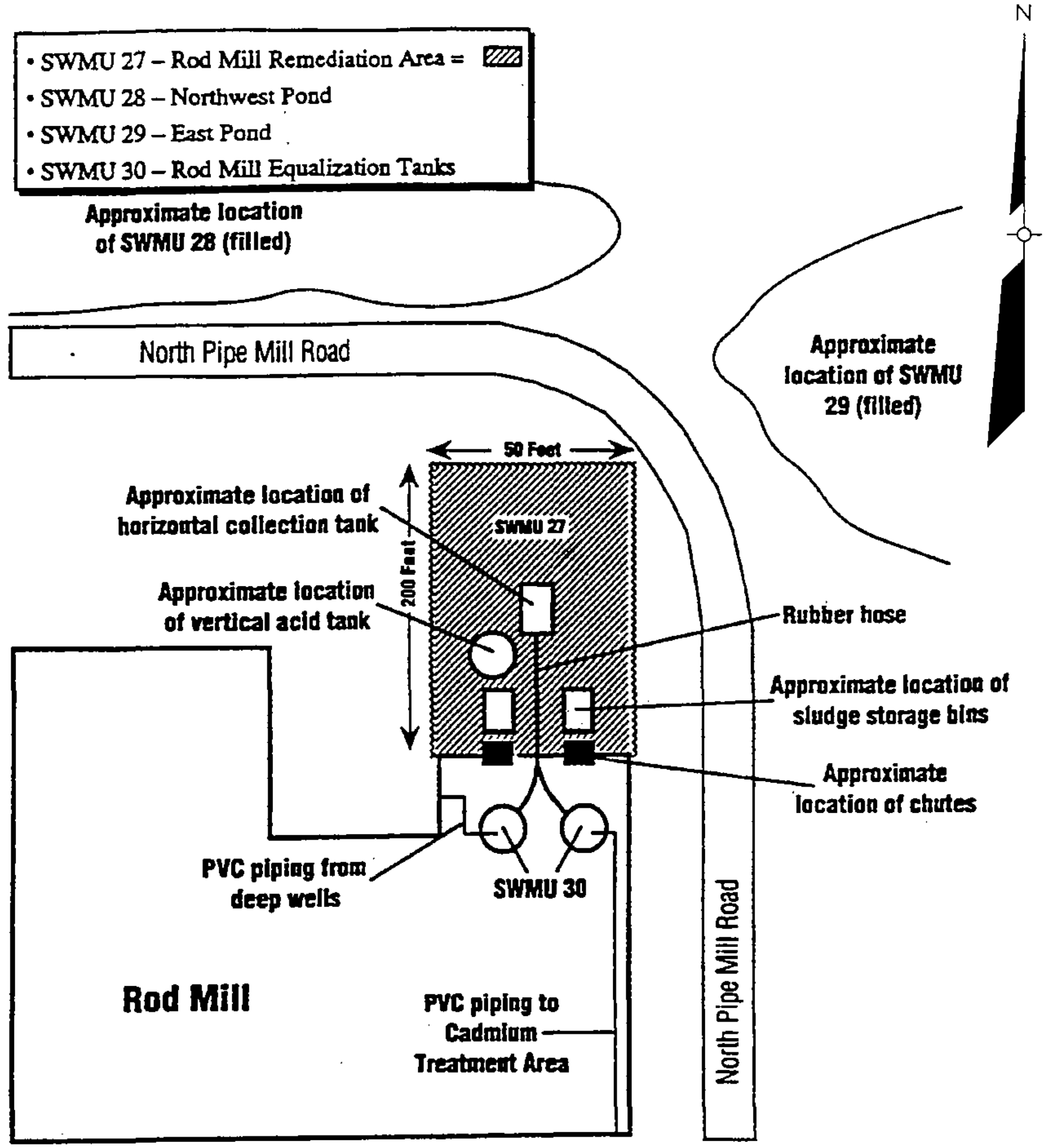
CHROME HDS TREATMENT PLANT
DRUM FILTER ROOM SUMP

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998

200123

BSFIG21.DGN



DECEMBER 22, 1997

Notes: Figure derived from A.T. Kearney, Inc., Figure IV-2 in Final RCRA Facility Assessment Phase II Report, August 12, 1993

Shallow and intermediate wells, and the acid sprinkler system are located throughout the Remediation Area. The deep wells are not located in this mapped area.

SCALE: NONE

RUST
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FIGURE 3-5
GROUNDWATER REMEDIATION SYSTEM
ROD MILL AREA

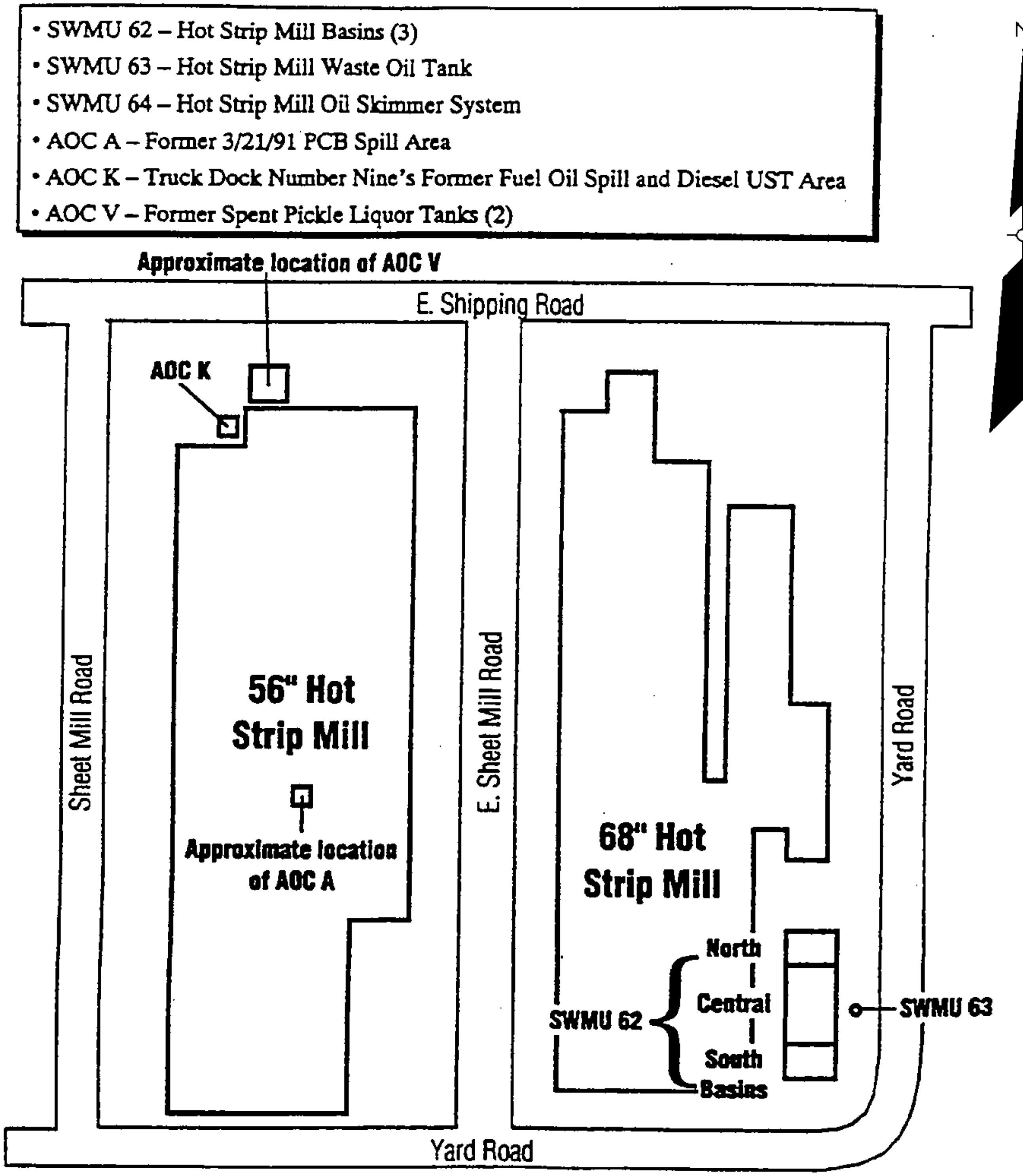
BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998

200123

BSFIG15.DGN

- SWMU 62 – Hot Strip Mill Basins (3)
- SWMU 63 – Hot Strip Mill Waste Oil Tank
- SWMU 64 – Hot Strip Mill Oil Skimmer System
- AOC A – Former 3/21/91 PCB Spill Area
- AOC K – Truck Dock Number Nine's Former Fuel Oil Spill and Diesel UST Area
- AOC V – Former Spent Pickle Liquor Tanks (2)



Notes: Figure derived from A.T. Kearney, Inc., Figure IV-4 in Final RCRA Facility Assessment Phase II Report, August 12, 1993

SWMU 64 is located on top of SWMU 62

SCALE: NONE

RUST

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FIGURE 3-6

HOT STRIP MILL AREA SWMUs

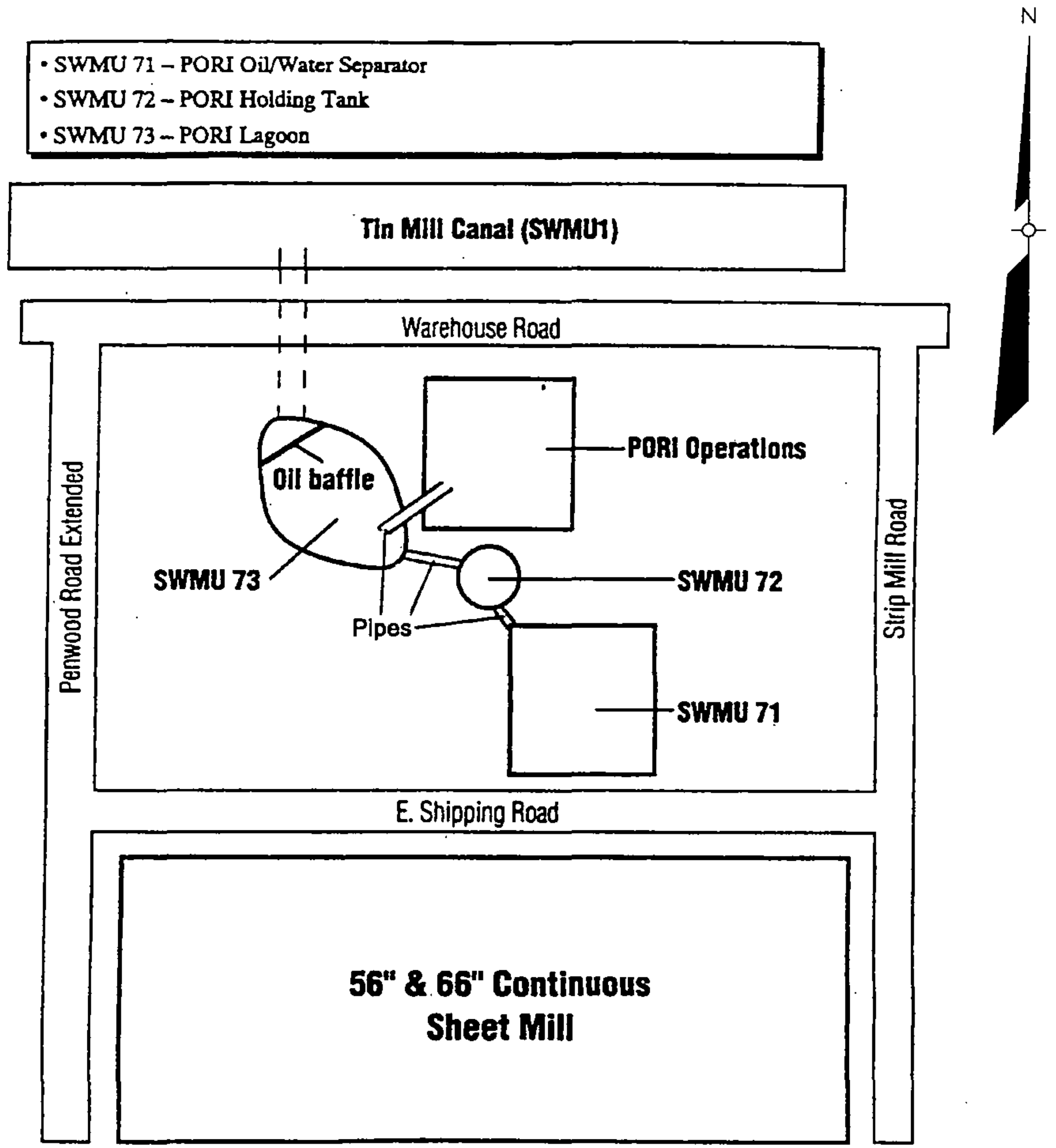
BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998

200123

DECEMBER 22, 1997

BSFIG14.DGN



Note:. Figure derived from A.T. Kearney, Inc., Figure IV-5 in Final RCRA Facility Assessment Phase II Report, August 12, 1993

SCALE: NONE

RUST

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FIGURE 3-7

PORI AREA SWMUs

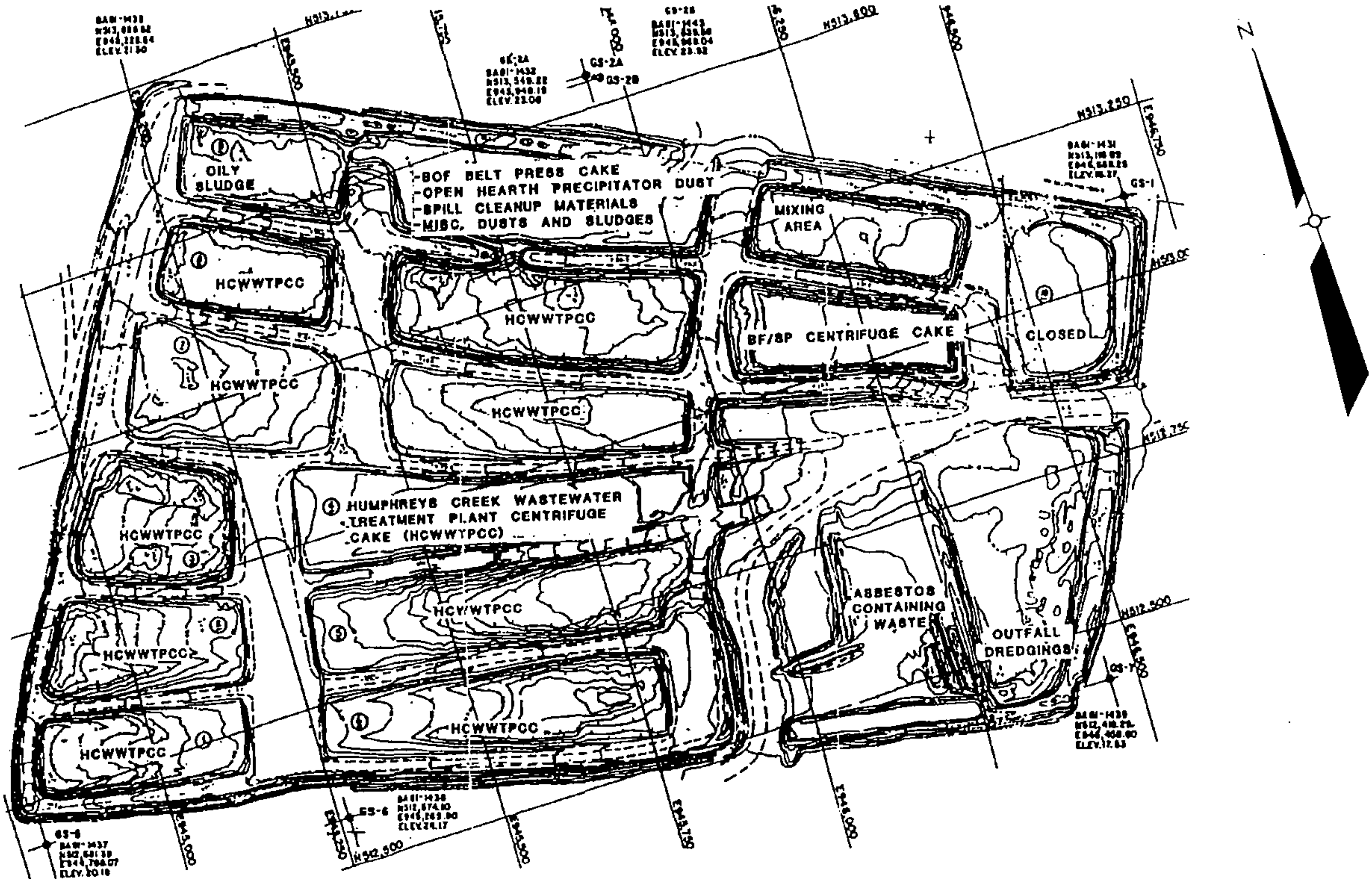
BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998

200123

DECEMBER 22, 1997

BSFIG16.DGN



Note: Figure derived from Environmental Resources Management, Inc., Figure 3 in Level II Environmental Assessment Phase II Report, Sparrows Point Properties (Draft), August 1987

Rust Environment & Infrastructure Inc.

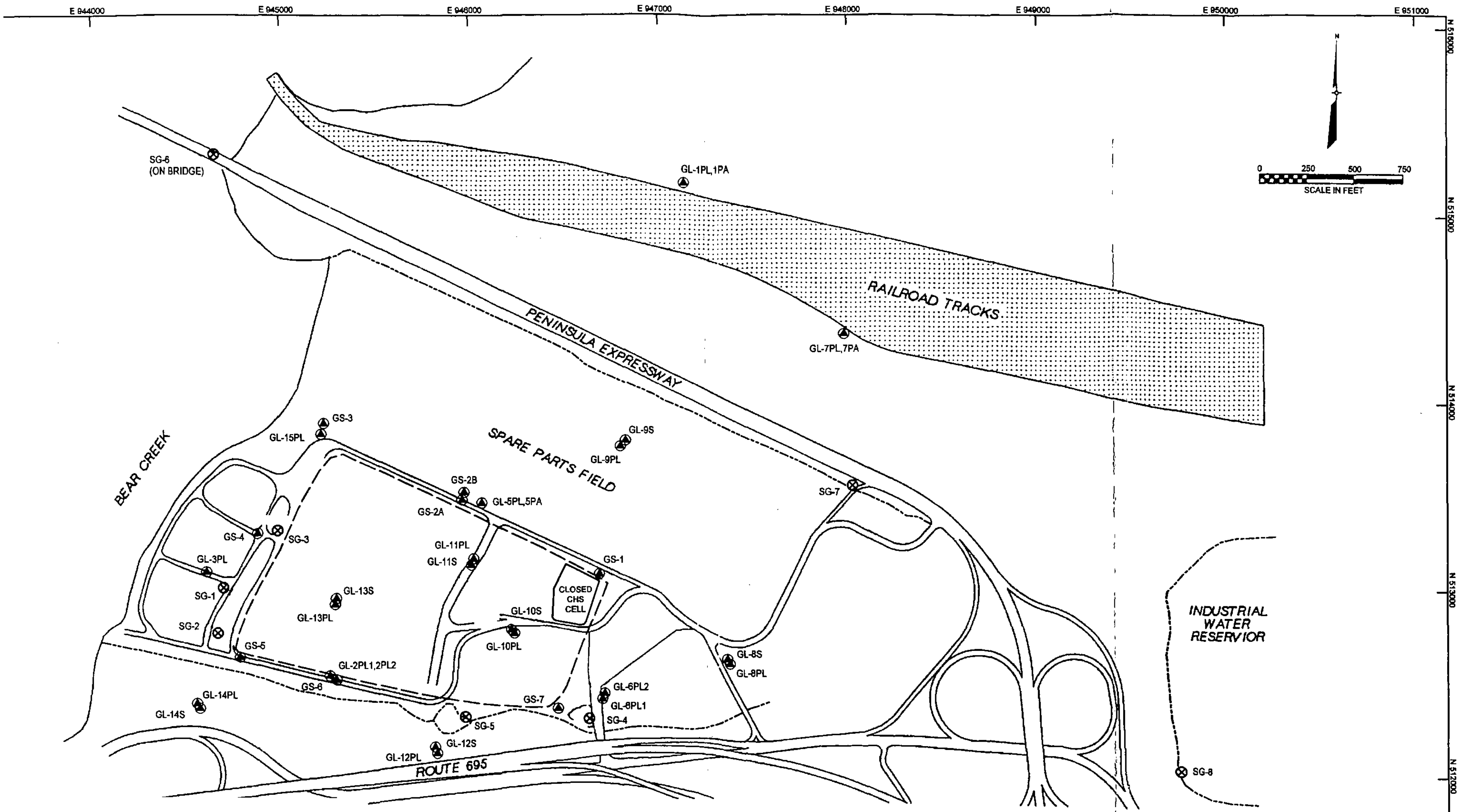
FIGURE 3-8

GREYS LANDFILL LAYOUT

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998

200123



LEGEND

GL-13	EXISTING WELL/WELL CLUSTER
SG-2	STAFF GAUGE LOCATION
— — —	APPROXIMATE LANDFILL BOUNDARY
-------	DRAINAGE

NOTE: BASE MAP DERIVED FROM CH2M HILL FIGURE 1-2 IN HYDRGEOLOGICAL STUDY OF THE GRAYS LANDFILL SITE AT THE SPARROWS POINT PLANT, NOVEMBER 1992

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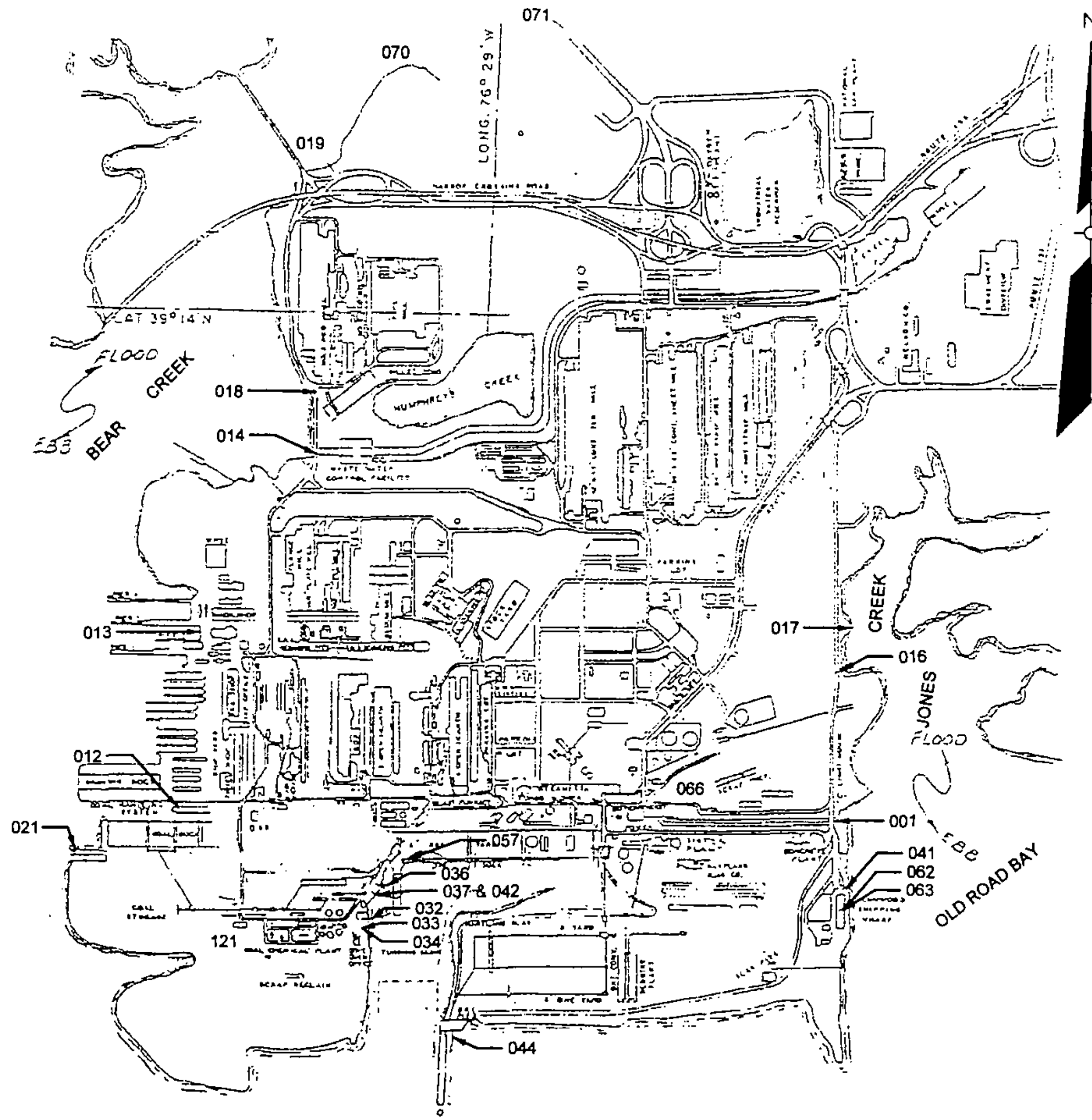
FIGURE 3-9
GROUNDWATER MONITORING WELLS AT GREYS LANDFILL
BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998 200123

DECEMBER 22, 1997

BSFIG31.DGN



Note: Figure derived from Bethlehem Steel Corp., Attachment 1 in NPDES Permit reapplication update, June 10, 1993

SCALE: 1"=2400'

RUST

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FIGURE 3-10

OUTFALL LOCATIONS

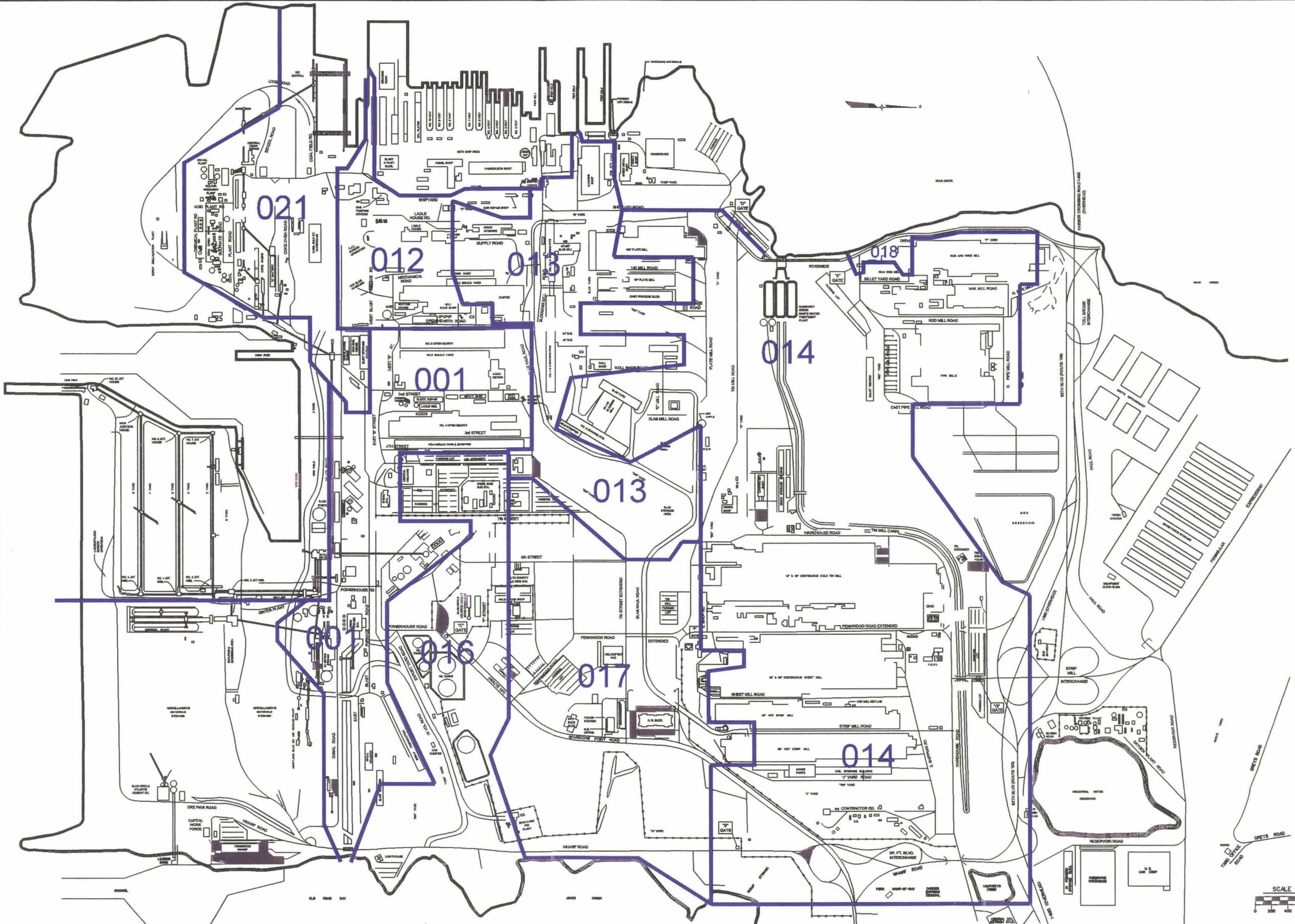
BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998

200123

DECEMBER 22, 1997

BSFIG19.DGN



APPROXIMATE AREA		
OUTFALL	SQUARE FEET	ACRES
001	8606040	198
012	3188476	73
013	7675178	176
014	33633682	772
016	6740391	155
017	10982632	252
021	5819370	134

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FIGURE 3-11

STORMWATER DRAINAGE AREAS

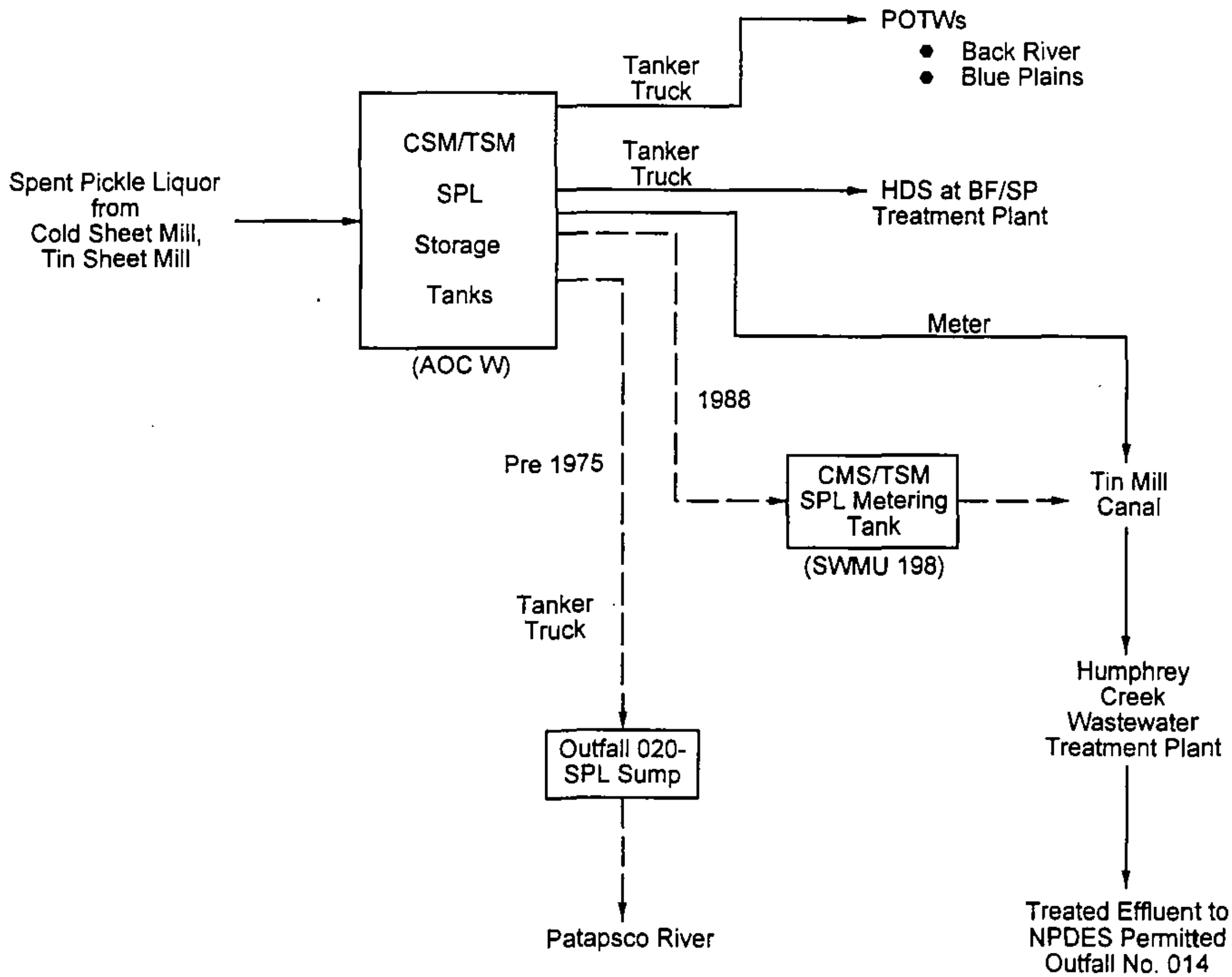
BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998

200123

DECEMBER 22, 1997

BSFIG32.DGN



Note: Figure derived from Baker Environmental, Inc. schematic diagram CS9 in Solid Waste/Material Management Units Inventory, September 1, 1990.

SCALE: NONE

RUST

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FIGURE 3-12

CMS/TMS SPL FLOW DIAGRAM

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998

200123

DECEMBER 22, 1997

BSFIG12.DGN

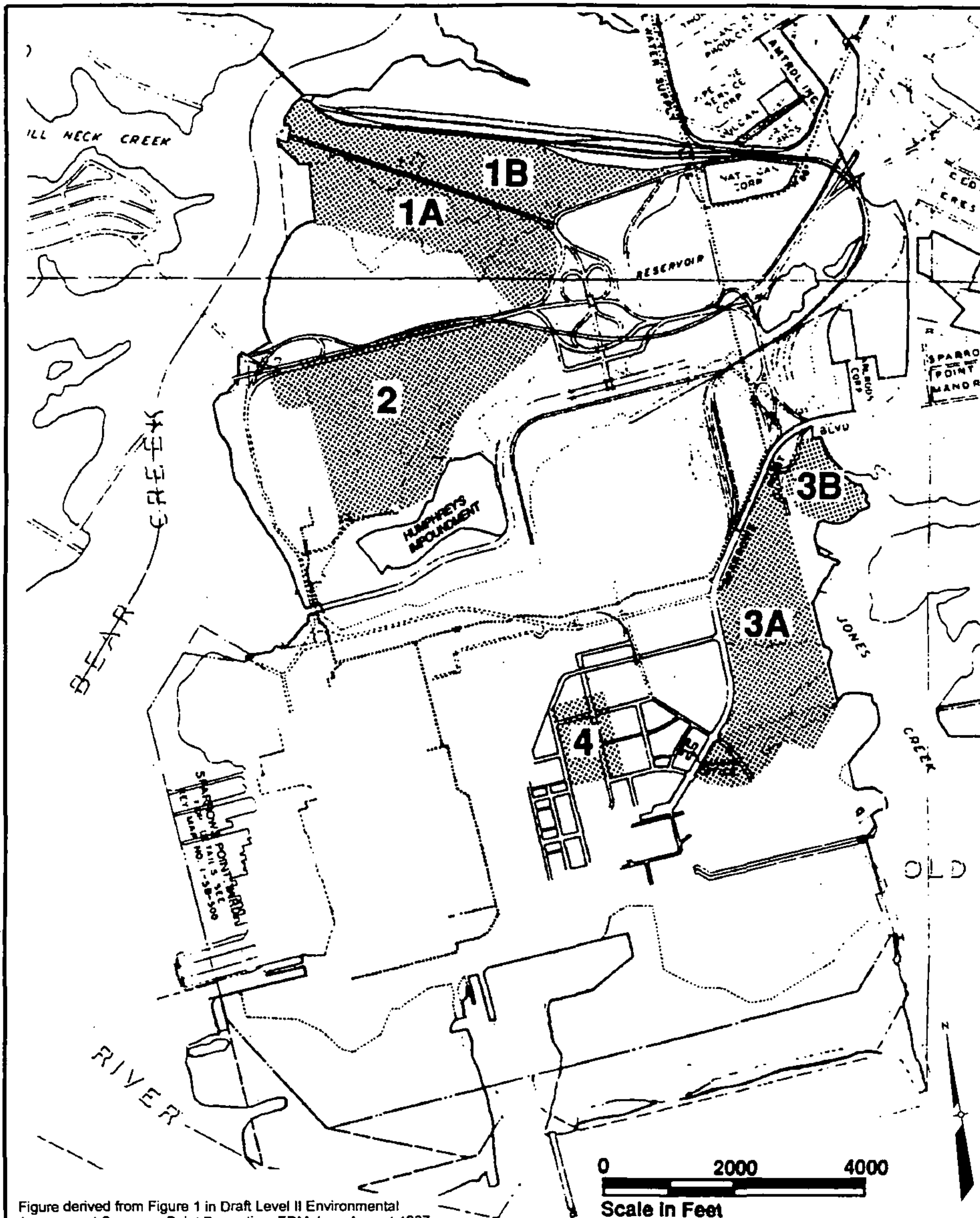

Figure derived from Figure 1 in Draft Level II Environmental Assessment Sparrows Point Properties, ERM, Inc., August 1987.

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FIGURE 3-13
COUNTY LANDS SITE LOCATION MAP
BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998

200123

DECEMBER 22, 1997

BSFIG34.DGN

Table 3-1
Summary of SWMUs and AOCs Listed in RFA Report
Bethlehem Steel Corporation
Sparrows Point, Maryland

SWMU No./ AOC Letter	SWMU/AOC NAME	RFA CODE
	Tin Mill Canal Area	
1	Tin Mill Canal	SD
2	TMC Discharge Pipes	SD
3	TMC Oil Skimming Devices	SD
4	TMC Dredging Containment Areas	SD
5	TMC Waste Oil Storage Tanks	SD
6	TMC Impoundments	SD
7	Recent TMC Embankment Dredgings	SD
8	TMC Brill Skimmer Pits	SD
9	Former TMC Oil Collection Dumpster	SD
	Humphrey Creek Wastewater Treatment Plant (HCWWTP) Area	
10	HCWWTP Settling Basins	TP
11	HCWWTP Thickeners	TP
12	HCWWTP Aerators	TP
13	HCWWTP Wastweater Chemical Treating Building	TP
14	HCWWTP Spent Pickle Liquor (SPL) Discharge Point	AI
15	HCWWTP Centrifuges	TP
16	HCWWTP Sludge Collection Box	TP
17	HCWWTP Old Alum Tank	TP
	Chrome Recovery Area	
18	Chrome Recovery Reduction Tank	TP
19	Chrome Recovery Neutralization Tank	TP
20	Chrome Recovery Floc Tank	TP
21	Chrome Recovery Thickener	TP
22	Chrome Recovery Sand Filters/Clarifier	TP
23	Chrome Recovery Rotary Filter Press	TP
24	Chrome Recovery Sludge Box	TP
25	Chrome Recovery Piping	TP
26	Chrome Recovery Filtrate Sump	SD
	Rod Mill Area	
27	Rod Mill Remediation Area	SD
28	Northwest Pond	SD
29	East Pond	SD
30	Rod Mill Equalization Tanks	SD
31	Cadmium Treatment Reactor A Tank	TP

Table 3-1
Summary of SWMUs and AOCs Listed in RFA Report
Bethlehem Steel Corporation
Sparrows Point, Maryland

SWMU No./ AOC Letter	SWMU/AOC NAME	RFA CODE
	Rod Mill Area	
32	Cadmium Treatment Alkalination Tank	TP
33	Cadmium Treatment Thickener	TP
34	Cadmium Treatment Sand Filter	TP
35	Cadmium Treatment Piping	TP
36	Cadmium Treatment Filter Press	TP
37	Cadmium Treatment Sludge Collection Box	TP
38	Cadmium Treatment Trenches	SD
39	Rod Mill Scale Pits (2)	NH
40	Rod Mill Cleaning House Containment	NR
41	Rod Mill Former Waste TCE Storage	I
42	Rod Mill Waste Oil Storage Tank	NR
43	Rod Mill Chloroethane Storage Tank	NR
44	Rod Mill Cooling Tower	NH
45	Rod Mill Trenches/Sumps	SD
	Pipe Mill Area	
46	Pipe Mill Various 55-gallon Drums	I
47	Pipe Mill Oil/Water Separator	NR
48	Pipe Mill Zinc Ammonium Chloride Sludge Storage Area	SD
49	Pipe Mill Trenches/Sump	SD
	Billet Prep Area	
50	Billet Prep Waste Oil Storage Tank	NR
51	Billet Prep Rinsewater Collection Tanks	I
52	Billet Prep Baghouse Collectors	NR
53	Billet Prep Trenches & Blind Sumps	SD
	Coating Lines Area	
54	Coating Lines Blind Sumps	SD
	Cold Sheet Mill Area	
55	Cold Sheet Mill Quencher	I
56	Cold Sheet Mill Scrubbers	I
57	Cold Sheet Mill Wet Well	I
58	Cold Sheet Mill Piping	SD
59	Tandem Mill Trench System	SD
60	Cold Sheet Mill Empty Drum Storage Area	NR
61	Cold Sheet Mill Waste Oil Staging Area	NR

Table 3-1 Summary of SWMUs and AOCs Listed in RFA Report Bethlehem Steel Corporation Sparrows Point, Maryland Page 3 of 8		
SWMU No./ AOC Letter	**SWMU/AOC NAME**	**RFA CODE**
	Hot Strip Mill Area	
62	Hot Strip Mill Basins	SD
63	Hot Strip Mill Waste Oil Tank	SD
64	Hot Strip Mill Oil Skimmer System	SD
65	Hot Strip Mill Cooling Tower	NR
66	Hot Strip Mill Waste Oil Collection Point	NR
67	Hot Strip Mill Waste Oil Accumulation Area	I
68	Hot Strip Mill Pickling Area	I
69	Hot Strip Mill Satellite Accumulation Area	I
70	Hot Strip Mill Former SPL Tank Site	NR
	Palm Oil Recovery, Inc. (PORI) Area	
71	PORI Oil/Water Separator	SD
72	PORI Holding Tank	SD
73	PORI Lagoon	SD
	Green Pellet Area	
74	Green Pellet Plant Thickeners	NR
	Steel Making Area	
75	Scrubbers Open Hearth Furnace #4	NR
76	Caster Dust Baghouse Storage Area	NR
77	Desulfurizer Baghouse	NR
78	Desulfurizer Collection Dumpsters	NR
79	Skimmer Baghouse	NR
80	Skimmer Baghouse Collection Dumpsters	NR
81	Former Open Hearth #3 Site	NR
82	Former Open Hearth #1 Site	NR
83	Caster Baghouse	NR
	Tin Mill Area	
84	Tin Mill Trenches/Sumps	SD
85	Tin Mill Abatement System	NR
86	Tin Mill Sump (Acid Area Monitoring)	SD
87	Tin Mill Waste Oil Satellite Accumulation Area	NR
	Halogen Lines Area	
88	Halogen Lines Trenches/Sumps	SD
89	Halogen Lines Oil Skimmer	NR

Table 3-1
Summary of SWMUs and AOCs Listed in RFA Report
Bethlehem Steel Corporation
Sparrows Point, Maryland

SWMU No./ AOC Letter	SWMU/AOC NAME	RFA CODE
	Halogen Lines Area	
90	Halogen Lines Waste Pickle Liquor Tank	NR
91	Halogen Lines Waste Plating Solution Tank	NR
	Rolling Plate Mill Area	
92	Rolling Mill Scale Pit	NH
	Greys Landfill Area	
93	Greys Landfill	SD
94	Greys Tar Decanter Cell	SD
95	Greys Trash Transfer Station	NR
	Sinter Plant Area	
96	Sinter Plant Thickener	NR
97	Sinter Plant High Density Sludge (HDS) Tank	NR
98	Sinter Plant Centrifuge Waste Pile	NR
99	Sinter Plant Drum Separator	NR
100	Sinter Plant Former Lime Grit Box	NR
101	Sinter Plant SPL Tanks	NR
	Coke Battery Area	
102	Battery 12 Trash Collection Area	NR
103	Battery 11 and 12 Quench Pit	NR
104	Battery A Trash Collection Area	NR
105	Battery A Waste Oil Accumulation Area	SD
106	Former 1-10 Batteries	NR
107	Coke Oven Gas Main	NR
108	Mechanical Shop Waste Oil Accumulation Area	SD
	Coke Battery Area	
109	AKJ Tar Decanter Batch Tank	NR
110	AKJ Tar Decanter Buckets	NR
111	Battery A Baghouse	NR
	B Coal Chemical Plant (B CCP) Area (AOC U)	
112	B CCP Tar Storage Tank Containment Areas	CV(U)
113	B CCP Underground Weak Ammonia Pipeline	CV(U)
114	B CCP Acid Tank Containment Pad	CV(U)

Table 3-1
Summary of SWMUs and AOCs Listed in RFA Report
Bethlehem Steel Corporation
Sparrows Point, Maryland

SWMU No./ AOC Letter	SWMU/AOC NAME	RFA CODE
	B Coal Chemical Plant (B CCP) Area (AOC U)	
115	B CCP Acid Tanks	CV(U)
116	B CCP Ammonia Clarifier Tank	CV(U)
117	B CCP Lime Collection Bin	CV(U)
118	B CCP Ammonia Stills	CV(U)
119	B CCP Ammonia Saturator	CV(U)
120	B CCP Acid Surge Tank	CV(U)
121	B CCP Wash Oil Coolers (Spiral)	CV(U)
122	B CCP Wash Oil Coolers (Shell and Tube)	CV(U)
123	B CCP Wash Oil Decanters	CV(U)
124	B CCP Wastewater Holding Tank	CV(U)
125	B CCP Wash Oil Circulating Tank	CV(U)
126	B CCP Scrubbers	CV(U)
127	B CCP Waste Oil Bin	CV(U)
128	B CCP API Light Oil Separators	CV(U)
129	B CCP Muck Tank	CV(U)
130	B CCP Million Gallon Weak Ammonia Tank	CV(U)
	Bio-Oxidation Plant Area	
131	Bio-Oxidation Plant Wastewater Tank	NR
132	Bio-Oxidation Plant 1 MMG Wastewater Tank	NR
133	Bio-Oxidation Plant Depurators	NR
134	Bio-Oxidation Plant Aeration Basins	NR
135	Bio-Oxidation Plant Clarifiers	NR
	A Coal Chemical Plant (A CCP) Area (AOC M)	
136	A CCP Sulfuric Acid Tank Containment	CV(M)
137	A CCP Cyanide Stripper/Stack	CV(M)
138	A CCP Oil/Water Separator	CV(M)
139	A CCP Former Tar Decanters	CV(M)
140	A CCP Acid Saturator Tanks	CV(M)
141	A CCP Overflow Skimmer Box	CV(M)
142	A CCP Wash Oil Decanters	CV(M)
143	A CCP Scrubbers	CV(M)
144	A CCP Wastewater Holding Tank	CV(M)
145	A CCP Wash Oil Holding Tank	CV(M)
146	A CCP Sump	CV(M)

Table 3-1
Summary of SWMUs and AOCs Listed in RFA Report
Bethlehem Steel Corporation
Sparrows Point, Maryland

SWMU No./ AOC Letter	SWMU/AOC NAME	RFA CODE
	Benzene/Litol (B/L) Plant Area (AOC L)	
147	B/L Oil/Water Separator	CV(L)
148	B/L Tank Sludge Staging Area	CV(L)
149	B/L Tank Sludge Accumulation Area	CV(L)
150	B/L Litol Plant Catalyst Drum Station	CV(L)
151	B/L Waste Oil Accumulation Area	CV(L)
152	B/L Litol Drum Staging Area	CV(L)
153	B/L Benzene Truck Loading Area	CV(L)
	Furnace Area	
154	H Furnace Dust Catcher	NR
155	H Furnace Wastewater Thickener	NR
156	J Furnace Precipitators	NR
157	J Furnace Gas Washer	NR
158	J Furnace Scrubber	NR
159	J Furnace Dust Catcher	NR
160	Former J Furnace Thickener	RS
161	A-G & K Former Furnaces	RS
162	L Furnace Baghouse	NR
163	L Furnace Thickeners	TP
164	L Furnace Gas Scrubbers	TP
165	L Furnace Slag Piles	NH
	H&J Furnace RIW Area	
166	RIW Pipeline	TP
167	RIW Sumps (2)	TP
168	RIW Holding Tank	TP
169	RIW Clarifying Tank	TP
	Pilot Plant Area	NR
170	Pilot Plant Slurry Mixing Tank	NR
171	Pilot Plant Holding Tank	NR
172	Pilot Plant Hydrocyclone	NR
	BOF Area	
173	BOF Scrubbers	NR

Table 3-1
Summary of SWMUs and AOCs Listed in RFA Report
Bethlehem Steel Corporation
Sparrows Point, Maryland

SWMU No./ AOC Letter	SWMU/AOC NAME	RFA CODE
	BOF Area	
174	BOF Thickeners	NR
175	BOF Sand Collection Area	NR
176	BOF Reclaimed Tank	NR
177	BOF Mixing Tank	NR
178	BOF Recycle Tank	NR
179	BOF Belt Press Station	NR
180	BOF Reladle Baghouse	NR
181	BOF Separator	NR
	Miscellaneous	
182	Former Tar Tanks at Fuel Station	NR
183	Ball Mill Tank	NR
184	Ball Mill Waste Oil/Tar Dumpster	NR
185	Tar Decanter Buggies	RS
186	Tar Storage Box Area	RS
187	Langenfelder Wastewater Treatment Tank	NR
188	Former Sulfur Recovery Plant	NR
189	Nail Mill Drum Storage Area	NR
190	Humphrey Impoundment	SD
191	Coke Point Landfill	SD
192	Coke Oven Sweepings Pile	SD
193	Regulated Storage Area	NR
194	Waste Oil Stabilizing/Packing Area	SD
195	Former ERS Oily Wastewater Tank	AI
196	Stormwater Sewer System	SD
197	Mason's Garage Drums	NR
198	SPL Sump and Trench System	SD
199	Bio-Oxidation Plant Oil/Water Separator	NR
200	Bio-Oxidation Plant Depurator Oil Storage Tanks	NR
201	Coke Battery Repair Shop Baghouse	NR
202	BOF Treatment Plant Pipeline	NR
203	Bio-Oxidation Plant Scum Collection Chamber	NR
	AOCs	
A	Former 3/21/91 PCB Spill Area	AD
B	Former 1988 PCB Spill Area	AD
C	Former ERS PCB Spill Area	AD
D	Former PCB Spill Area (Sheet Mill)	AD

Table 3-1
Summary of SWMUs and AOCs Listed in RFA Report
Bethlehem Steel Corporation
Sparrows Point, Maryland

SWMU No./ AOC Letter	SWMU/AOC NAME	RFA CODE
	AOCs	
E	6 PCB Transformers	AD
F	Former Slab Cut Off Spill Area	AD
G	Former Diesel Fuel Spill Area (Slab Haul Road)	AD
H	Mason's Garage Area	AD
I	Former 1991 Acid Leak Area	AD
J	Acid Tanks	AD
K	Truck Dock #9's Former Diesel Spill & Diesel Fuel UST Area	AD
L	Benzene/Litol Process Area	AD
M	A Coal Chemicals Plant Area	AD
N	Bio-Oxidation Ferric Chloride Spill Site	AD
O	Hydraulic Oil Storage Area	AD
P	Former Naphthalene Plant Tank & Pit	AD
Q	Former Diesel Fuel UST Area (Slab Haul Road)	AD
R	Underground Weak Ammonia Pipeline Spill Sites	AD
S	Former Chromic Acid Spill Area	AD
T	Former Diesel Fuel UST (Cold Sheet Mill)	AD
U	B Coal Chemicals Plant Process Area	AD
V	Former SPL Tanks	AD
W	SPL Tanks	AD
X	Unknown Aboveground Storage Tank	AD
Y	Pipe Mill Selenium Testing Area	AD
Z	Pipe Mill Acid Tanks	AD
AA	Pipe Mill Process Area	AI
AB	Rod and Wire Mill Process Area	AI

SD = SWMU Description included in Section 4 of the RFA document
AD = AOC Description provided in RFA Report
I = Units located indoors and not observed to be releasing
TP = Treatment process units managing waste not observed to be releasing
NR = Units located outdoors but not observed to be releasing
NH = Unit managing non-hazardous waste
RS = Unit that no longer exists and was removed from site
AI = Additional information needed to assess potential for release
CV = Units of concern, inability to assess which unit was releasing

Table 3-2
Recommendation Summary of SWMUs/AOCs Not Screened Out in RFA Report
Bethlehem Steel Corporation
Sparrows Point, Maryland

SWMU No./ AOC Letter	SWMU/AOC NAME	RECOMMENDED ACTION	BASIS FOR RECOMMENDATION
1	Tin Mill Canal	Further Action	Consent Decree "Special Study Area"
2	TMC Discharge Pipes	Further Action	Include in SWMU 1 Evaluation
3	TMC Oil Skimming Devices (5)	Further Action	Include in SWMU 1 Evaluation
4	TMC Dredging Containment Areas (5)	Further Action	Undifferentiated with SWMU 6, include in SWMU 1 Evaluation
5	TMC Waste Oil Storage Tanks (5)	Further Action	Include in SWMU 1 Investigation
6	TMC Impoundments (4)	Further Action	Undifferentiated with SWMU 4, include in SWMU 1 Evaluation
7	Recent TMC Embankment Dredgings	Further Action	Include in SWMU 1 Evaluation
8	TMC Brill Skimmer Pits (2)	Further Action	Include in SWMU 1 Evaluation
9	Former TMC Oil Collection Dumpster	Further Action	Include in SWMU 1 Evaluation
14	HCWWTP Spent Pickle Liquor Discharge Point	**No Further Action**	Part of treatment process, discharge is beneficially reused
26	Chrome Recovery Filtrate Sump	**No Further Action**	Non-releasing unit, wastes managed within closed treatment system
27	Rod Mill Remediation Area	**No Further Action**	IM groundwater remediation under MDE C-O-85-179
28	Northwest Pond	**No Further Action**	IM groundwater remediation under MDE C-O-85-179
29	East Pond	**No Further Action**	IM groundwater remediation under MDE C-O-85-179
30	Rod Mill Equalization Tanks (2)	**No Further Action**	IM groundwater remediation under MDE C-O-85-179
38	Cadmium Treatment Trenches	**No Further Action**	Manages groundwater treatment process overflow, re-enters system
39	Rod Mill Scale Pits (2)	**No Further Action**	No known releases, managed non-hazardous waste
44	Rod Mill Cooling Tower	**No Further Action**	No known releases, managed non-hazardous waste
45	Rod Mill Trenches/Sumps	Further Action	Potential for environmental release
48	Pipe Mill Zinc Ammonium Chloride Sludge Storage Area	**No Further Action**	Inactive unit, one release with subsequent soil remediation
49	Pipe Mill Trenches/Sump	Further Action	Focused closure-oriented project
53	Billet Prep Trenches & Blind Sumps	**No Further Action**	Managed non-hazardous material
54	Coating Lines Blind Sumps	Further Action	Include in SWMU 1 Evaluation
58	Cold Sheet Mill Piping	Further Action	Discharges to TMC via SWMU 2, include in SWMU 1 Evaluation
59	Tandem Mill Trench System	Further Action	Discharges to TMC via SWMU 2, include in SWMU 1 Evaluation
62	Hot Strip Mill Basins (3)	Further Action	Condition of basins
63	Hot Strip Mill Waste Oil Tank	Further Action	Include in SWMU 62 evaluation
64	Hot Strip Mill Oil Skimmer System	Further Action	Include in SWMU 62 evaluation
71	PORI Oil/Water Separator	Further Action	Include in SWMU 73 evaluation
72	PORI Holding Tank	Further Action	Include in SWMU 73 evaluation
73	PORI Lagoon	Further Action	Condition of lagoon
84	Tin Mill Trenches/Sumps	Further Action	Discharges to TMC via SWMU 2, include in SWMU 1 Evaluation
86	Tin Mill Sump (Acid Area Monitoring)	Further Action	Discharges to TMC via SWMU 2, include in SWMU 1 Evaluation
88	Halogen Lines Trenches/Sumps	Further Action	Include in SWMU 1 Evaluation
92	Rolling Mill Scale Pit	**No Further Action**	No known releases, manages non-hazardous waste
93	Greys Landfill	Further Action	Consent Decree "Special Study Area"
94	Greys Tar Decanter Cell	Further Action	Unit contained within SWMU 93
105	Battery A Waste Oil Accumulation Area	Further Action	Field observations of 1991 VSI
108	Mechanical Shop Waste Oil Accumulation Area	Further Action	Field observations of 1991 VSI
112	B CCP Tar Storage Tank Containment Areas	Further Action	Within Consent Decree "Special Study Area"
113	B CCP Underground Weak Ammonia Pipeline	Further Action	Within Consent Decree "Special Study Area"
114	B CCP Acid Tank Containment Pad	Further Action	Within Consent Decree "Special Study Area"
115	B CCP Acid Tanks	Further Action	Within Consent Decree "Special Study Area"
116	B CCP Ammonia Clarifier Tank	Further Action	Within Consent Decree "Special Study Area"

Table 3-2
Recommendation Summary of SWMUs/AOCs Not Screened Out in RFA Report
Bethlehem Steel Corporation
Sparrows Point, Maryland

SWMU No./ AOC Letter	SWMU/AOC NAME	RECOMMENDED ACTION	BASIS FOR RECOMMENDATION
117	B CCP Lime Collection Bin	Further Action	Within Consent Decree "Special Study Area"
118	B CCP Ammonia Stills (2)	Further Action	Within Consent Decree "Special Study Area"
119	B CCP Ammonia Saturator	Further Action	Within Consent Decree "Special Study Area"
120	B CCP Acid Surge Tank	Further Action	Within Consent Decree "Special Study Area"
121	B CCP Wash Oil Coolers (Spiral)	Further Action	Within Consent Decree "Special Study Area"
122	B CCP Wash Oil Coolers (Shell and Tube)	Further Action	Within Consent Decree "Special Study Area"
123	B CCP Wash Oil Decanters	Further Action	Within Consent Decree "Special Study Area"
124	B CCP Wastewater Holding Tank	Further Action	Within Consent Decree "Special Study Area"
125	B CCP Wash Oil Circulating Tank	Further Action	Within Consent Decree "Special Study Area"
126	B CCP Scrubbers	Further Action	Within Consent Decree "Special Study Area"
127	B CCP Waste Oil Bin	Further Action	Within Consent Decree "Special Study Area"
128	B CCP API Light Oil Separators (2)	Further Action	Within Consent Decree "Special Study Area"
129	B CCP Muck Tank	Further Action	Within Consent Decree "Special Study Area"
130	B CCP Million Gallon Weak Ammonia Tank	Further Action	Within Consent Decree "Special Study Area"
136	A CCP Sulfuric Acid Tank Containment	Further Action	Within Consent Decree "Special Study Area"
137	A CCP Cyanide Stripper/Stack	Further Action	Within Consent Decree "Special Study Area"
138	A CCP Oil/Water Separator	Further Action	Within Consent Decree "Special Study Area"
139	A CCP Former Tar Decanters (3)	Further Action	Within Consent Decree "Special Study Area"
140	A CCP Acid Saturator Tanks	Further Action	Within Consent Decree "Special Study Area"
141	A CCP Overflow Skimmer Box	Further Action	Within Consent Decree "Special Study Area"
142	A CCP Wash Oil Decanters	Further Action	Within Consent Decree "Special Study Area"
143	A CCP Scrubbers	Further Action	Within Consent Decree "Special Study Area"
144	A CCP Wastewater Holding Tank	Further Action	Within Consent Decree "Special Study Area"
145	A CCP Wash Oil Holding Tank	Further Action	Within Consent Decree "Special Study Area"
146	A CCP Sump	Further Action	Within Consent Decree "Special Study Area"
147	B/L Oil/Water Separator	Further Action	Within Consent Decree "Special Study Area"
148	B/L Tank Sludge Staging Area	Further Action	Within Consent Decree "Special Study Area"
149	B/L Tank Sludge Accumulation Area	Further Action	Within Consent Decree "Special Study Area"
150	B/L Litol Plant Catalyst Drum Station	Further Action	Within Consent Decree "Special Study Area"
151	B/L Waste Oil Accumulation Area	Further Action	Within Consent Decree "Special Study Area"
152	B/L Litol Drum Staging Area	Further Action	Within Consent Decree "Special Study Area"
153	B/L Benzene Truck Loading Area	Further Action	Within Consent Decree "Special Study Area"
165	L Furnace Slag Piles	No Further Action	No known releases, manages non-hazardous waste
190	Humphrey Impoundment	Further Action	Consent Decree "Special Study Area"
191	Coke Point Landfill	Further Action	Consent Decree "Special Study Area"
192	Coke Oven Sweeping Waste Pile	Further Action	Contained within SWMU 191
194	Waste Oil Stabilizing/Packing Area	Further Action	Field observations of 1991 VSI
195	Former ERS Oily Wastewater Tank	Further Action	Unkown impacts from previous activities
196	Stormwater Sewer System	No Further Action	Storm water and industrial wastewater combined as NPDES permitted discharge
198	SPL Sump and Trench System	Further Action	Discharges to TMC via SWMU 2, include in SWMU 1 Investigation

Table 3-2
Recommendation Summary of SWMUs/AOCs Not Screened Out in RFA Report
Bethlehem Steel Corporation
Sparrows Point, Maryland

SWMU No./ AOC Letter	SWMU/AOC NAME	RECOMMENDED ACTION	BASIS FOR RECOMMENDATION
A	Former 3/21/91 PCB Spill Area	No Further Action	One time incident occurred indoors, low release potential
B	Former 1988 PCB Spill Area	No Further Action	One time incident occurred indoors, low release potential
C	Former ERS PCB Spill Area	No Further Action	One time incident, soil remediation met EPA guidelines for PCBs
D	Former PCB Spill Area (Sheet Mill)	No Further Action	One time incident occurred indoors and remediated, low release potential
E	6 PCB Transformers	No Further Action	PCB oil replaced by mineral oil 7/27/95
F	Former Slab Cut Off Spill Area	No Further Action	No current evidence of impact
G	Former Diesel Fuel Spill Area (Slab Haul Road)	No Further Action	Soil remediation approved by MDE
H	Mason's Garage Area	Further Action	UST closure/soil remediation completed but no confirmatory sampling
I	Former 1991 Acid Leak Area	No Further Action	One time incident discharged to TMC
J	Acid Tanks	Further Action	Condition of tanks, and known releases
K	Truck Dock #9's Former Diesel Spill & UST Area	No Further Action	One time incident, subsequent UST closure indicated no soil contamination
L	Benzene/Litol Process Area	Further Action	Within Consent Decree "Special Study Area"
M	A Coal Chemicals Plant Area	Further Action	Within Consent Decree "Special Study Area"
N	Bio-Oxidation Ferric Chloride Spill Site	No Further Action	One time incident of non-hazardous constituent
O	Hydraulic Oil Storage Area	No Further Action	Unit managed non-hazardous, water-based hydraulic oil
P	Former Naphthalene Plant Tank & Pit	Further Action	Former unit within Consent Decree "Special Study Area"
Q	Former Diesel Fuel UST Area (Slab Haul Road)	No Further Action	UST removal and closure approved by MDE
R	Underground Weak Ammonia Pipeline Spill Sites (3)	Further Action	History of spills, within Consent Decree "Special Study Area"
S	Former Chromic Acid Spill Area	No Further Action	One time incident primarily indoors with limited discharge to the TMC
T	Former Diesel Fuel UST (Cold Sheet Mill)	No Further Action	UST removed, confirmatory soil samples indicated no contamination
U	B Coal Chemicals Plant Process Area	Further Action	Within Consent Decree "Special Study Area"
V	Former SPL Tanks (2)	No Further Action	Area same as SWMU 70 (non-releasing unit)
W	SPL Tanks	Further Action	Discharges to TMC via SWMU 2, include in SWMU 1 Evaluation
X	Unknown Aboveground Storage Tank	Further Action	Focused closure-oriented project
Y	Pipe Mill Selenium Testing Area	No Further Action	Former operations located indoors, low release potential
Z	Pipe Mill Acid Tanks	Further Action	Focused closure-oriented project

[shaded box] = Denotes SWMU or AOC recommended for no further action

Table 3-3
General Summary-Chemicals of Potential Interest
Bethlehem Steel Corporation
Sparrows Point, Maryland

SWMU No./ AOC Letter	SWMU/AOC NAME	Inorganics							Organics						
		Metals							VOCs			SVOCs			
									Purgeable	Chlorinated	Carbon		Acid		
		As	Cd	Cr	Ni	Pb	Zn	Cyanide	Aromatics	Solvents (3)	Disulfide	PAHs (4)	Extractables (5)	Other (6)	PCBs
1-9	Tin Mill Canal SWMUs 1-9	-	x	x	x	x	x	x	x (1)	x	-	x	-	-	-
45	Rod Mill Trenches/Sumps	-	x	x	x	x	x	-	-	-	-	x	-	-	-
49	Pipe Mill Trenches/Sump	-	-	x	x	x	x	-	-	-	-	x	-	-	-
54	Coating Lines Blind Sumps	-	-	x	x	x	x	-	-	-	-	-	-	-	-
58	Cold Sheet Mill Piping	-	-	x	x	x	x	x	x (1)	x	-	x	-	-	-
59	Tandem Mill Trench System	-	-	x	x	x	x	x	x (1)	x	-	x	-	-	-
62-64	Hot Strip Mill SWMUs 62-64	-	-	x	x	x	x	-	-	-	-	x	-	-	-
71-73	PORI SWMUs 71-73	-	-	x	x	x	x	-	x (2)	x	-	x	-	-	x
84	Tin Mill Trenches/Sumps	-	-	x	x	x	x	x	-	-	-	-	-	-	-
86	Tin Mill Sump (Acid Area Monitoring)	-	-	x	x	x	x	x	-	-	-	-	-	-	-
88	Halogen Lines Trenches/Sumps	-	-	x	x	x	x	x	-	-	-	-	-	-	-
93	Greys Landfill	x	x	x	x	x	x	x	x (1)	-	x	x	x	x	x
94	Greys Tar Decanter Cell	x	x	x	x	x	x	x	x (1)	-	x	x	x	x	x
105	Battery A Waste Oil Accumulation Area	-	-	x	x	x	x	-	-	x	-	x	-	-	x
108	Mechanical Shop Waste Oil Accumulation Area	-	-	x	x	x	x	-	-	x	-	x	-	-	x
112-130	B Coal Chemical Plant (B CCP) Area (AOC U)	x	-	-	-	-	-	x	x (2)	-	x	x	x	x	-
136-146	A Coal Chemical Plant (A CCP) Area (AOC M)	x	-	-	-	-	-	x	x (2)	-	x	x	x	x	-
147-153	Benzene/Litol (B/L) Plant Area (AOC L)	x	-	-	-	-	-	-	x (2)	-	-	-	x	-	-
190	Humphrey Impoundment	x	x	x	x	x	x	x	x (1)	x	-	x	x	-	-
191	Coke Point Landfill	x	x	x	x	x	x	x	x (1)	x	x	x	x	x	x
192	Coke Oven Sweepings Pile	x	x	x	x	x	x	x	x (1)	x	x	x	x	x	x
194	Waste Oil Stabilizing/Packing Area	-	-	x	x	x	x	-	-	x	-	x	-	-	-
195	Former ERS Oily Wastewater Tank	-	-	x	x	x	x	-	-	x	-	x	-	-	-
198	SPL Sump and Trench System	-	-	x	x	x	x	-	-	-	-	-	-	-	-

Table 3-3
General Summary-Chemicals of Potential Interest
Bethlehem Steel Corporation
Sparrows Point, Maryland
Page 2 of 2

SWMU No./ AOC Letter	SWMU/AOC NAME	Inorganics							Organics						
		Metals							VOCs			SVOCs			
		As	Cd	Cr	Ni	Pb	Zn	Cyanide	Purgeable Aromatics	Chlorinated Solvents (3)	Carbon Disulfide	PAHs (4)	Acid Extractables (5)	Other (6)	PCBs
H	Mason's Garage Area	-	-	x	x	x	x	-	x (2)	-	-	x	-	-	-
J	Acid Tanks	-	-	x	x	x	x	-	-	-	-	-	-	-	-
L	Benzene/Litol Process Area	x	-	-	-	-	-	-	x (2)	-	-	-	x	-	-
M	A Coal Chemicals Plant Area	x	-	-	-	-	-	x	x (2)	-	x	x	x	x	-
P	Former Naphthalene Plant Tank & Pit	x	-	-	-	-	-	x	x (2)	x	x	x	x	x	-
R	Underground Weak Ammonia Pipeline Spill Site	x	-	-	-	-	-	x	x (2)	-	x	x	x	x	-
U	B Coal Chemicals Plant Process Area	x	-	-	-	-	-	x	x (2)	-	x	x	x	x	-
W	SPL Tanks	-	-	x	x	x	x	-	-	-	-	-	-	-	-
X	Unknown Aboveground Storage Tank	-	-	x	x	x	x	-	-	-	-	-	-	-	-
Z	Pipe Mill Acid Tanks	-	-	x	x	x	x	-	-	-	-	-	-	-	-

(1) Benzene, toluene, ethylbenzene, xylenes-total (BTEX), 1,3-dichlorobenzene and 1,4-dichlorobenzene

(2) Benzene, toluene, ethylbenzene, and xylenes-total (BTEX) only

(3) Chlorinated solvents -- specifically chloroform, tetrachloroethylene, trichloroethylene, cis- and trans-1,2-dichloroethylene, 1,1-dichloroethylene, vinyl chloride, 1,1,1-trichloroethane, 1,2-dichloroethane, 1,1-dichloroethane, and chloroethane.

(4) Polynuclear Aromatic Hydrocarbons -- specifically acenaphthene, acenaphthylene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, 'fluorene, indeno (1,2,3-cd) pyrene, naphthalene, phenanthrene, and pyrene

(5) Acid Extractables -- specifically phenol, 2,4-dimethylphenol, 2,4-dichlorophenol, 2,4,6-trichlorophenol, 4-nitrophenol, and pentachlorophenol

(6) Other SVOCs -- specifically o-cresol, m-cresol, and pyridine

Table 3-4
Non-RFA Areas of Concern-Chemicals of Potential Interest
Bethlehem Steel Corporation
Sparrows Point, Maryland

AOC NAME	Inorganics							Organics						
	Metals							VOCs			SVOCs			
	As	Cd	Cr	Ni	Pb	Zn	Cyanide	Purgeable Aromatics	Chlorinated Solvents (4)	Carbon Disulfide	PAHs (5)	Acid Extractables (7)	Other (8)	PCBs
Shipyard														
Area 34	-	x	-	-	x	x	-	x (1)	-	-	-	-	-	-
North Yard	-	-	x	x	x	x	-	x (1)	-	-	x	-	-	-
County Lands														
Parcel 1A - Contractors/Greys Landfill Tank Areas	-	-	x	x	x	x	-	x (1)	-	-	x	-	-	-
Parcel 1A - Former Drum Storage Area	-	-	x	x	x	x	-	x (1)	x	-	x	-	-	-
Parcel 1A - Coal Tar Area	x	-	-	-	-	-	x	x (2)	-	-	x	x	x	-
Parcel 1B - Well W-6 Area	-	-	-	-	-	-	-	-	x	-	-	-	-	-
Parcel 2 - Tanks and Sumps	-	-	x	x	x	x	-	x (1)	-	-	x	-	-	-
Parcel 2 - Transformer Staging Area	-	-	-	-	-	-	-	-	-	-	-	-	-	x
Central Supply Fuel Storage Tanks	-	-	-	-	-	-	-	x (1)	-	-	x	-	-	-
No. 10 Fuel Oil Tank	-	-	-	-	-	-	-	x (1)	-	-	x	-	-	-
Hot Strip Mill Drum Handling Area	-	-	x	x	x	x	-	-	x	-	x	-	-	-
Coke Oven Gas Drip Legs	-	-	-	-	-	-	-	x (3)	-	-	x (6)	-	x (9)	-

(1) Benzene, toluene, ethylbenzene, and xylenes-total (BTEX)

(2) Benzene, toluene, ethylbenzene, xylenes-total (BTEX), 1,3-dichlorobenzene and 1,4-dichlorobenzene

(3) Benzene only

(4) Chlorinated solvents -- specifically chloroform, tetrachloroethylene, trichloroethylene, cis- and trans-1,2-dichloroethylene, 1,1-dichloroethylene, vinyl chloride, 1,1,1-trichloroethane, 1,2-dichloroethane, 1,1-dichloroethane, and chloroethane.

(5) Polynuclear Aromatic Hydrocarbons -- specifically acenaphthene, acenaphthylene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, fluoranthene, 'fluorene, indeno (1,2,3-cd) pyrene, naphthalene,phenanthrene, and pyrene

(6) Polynuclear Aromatic Hydrocarbons -- specifically naphthalene

(7) Acid Extractables -- specifically phenol, 2,4-dimethylphenol, 2,4-dichlorophenol, 2,4,6-trichlorophenol, 4-nitrophenol, and pentachlorophenol

(8) Other SVOCs -- specifically o-cresol, m-cresol, and pyridine

(9) Other SVOCs -- pyridine only

4.0 EVALUATION OF POTENTIAL MIGRATION PATHWAYS

4.1 INTRODUCTION

The purpose of this section is to present information characterizing potential pathways for the migration of chemicals of potential interest from the BSC Sparrows Point site to its surroundings. This section provides an extensive characterization of the groundwater migration pathway and summarizes key information relevant to the air migration pathway -- the two primary migration pathways at the site. Because stormwater discharges from the site are regulated under a NPDES permit, the surface water (runoff) migration pathway is not discussed. (Possible impacts of historic runoff are considered to be a receptor issue rather than a migration pathway issue, and are therefore discussed in Section 5.) On-site media transfer pathways (e.g., volatilization, wind erosion, and leaching) are also not discussed because these processes are readily characterized by standard fate-and-transport modeling.

The characterization of the groundwater migration pathway includes detailed discussions of the geology and hydrogeology of the site, and presents a conceptual model of groundwater flow for the site relative to the potential for horizontal and vertical contaminant migration. Groundwater quality data and information on water supply and usage are also presented.

4.2 GROUNDWATER MIGRATION PATHWAY

This section presents site-specific information about the geology and hydrogeology of the BSC Sparrows Point site. This information is a necessary framework for evaluating the potential movement of chemicals of potential interest (COPIs) through the groundwater migration pathway. Geologic and hydrogeologic maps and cross-sections were constructed to evaluate the available data and are presented in this section.

4.2.1 Site Geology

The Sparrows Point facility is located within the Coastal Plain Physiographic Province, which is the relatively low-lying portion of the Atlantic Slope. The unconsolidated sediments beneath Sparrows Point rest on a surface of Precambrian and Early Paleozoic crystalline bedrock that slopes downward to the southeast. The unconsolidated sediments include (from youngest to oldest) Recent fill deposits (man-made) consisting primarily of iron- and steel-making slag; the Pleistocene Talbot Formation; the Upper Cretaceous Patapsco Formation; the Upper Cretaceous Arundel Formation; and the Lower Cretaceous Patuxent Formation. The Cretaceous formations comprise the Potomac Group. Figure 4-1 is a geologic map of the Sparrows Point area (Cleaves and Edwards, 1968).

Groundwater flow and potential migration pathways are controlled by the physical characteristics of the fill, soil, and rock materials in the subsurface. Therefore, existing deep well logs, monitoring well logs, and numerous soil boring logs from the site were evaluated to characterize the nature and distribution of various earth materials beneath the site. Much of this data was in raw form and had not been previously compiled or interpreted. Figure 4-2 is a generalized stratigraphic column showing the geologic units present at the Sparrows Point site. It is based on interpretations of the existing site data performed during preparation of this Description of Current Conditions Report.

The various data sources used to develop the generalized stratigraphic column are discussed below followed by descriptions of the geologic formations as they occur at the site.

4.2.1.1 Information Sources

Numerous wells and soil borings have been drilled at the Sparrows Point site. This section describes the different types of existing subsurface information and their use in this investigation.

Deep Wells

Nearly 200 water production wells (deep wells) have been installed at the Sparrows Point site since the early 1900's. As of the early 1950's, 25 wells had been completed in the Pleistocene sediments; 116 wells had been completed in the Patapsco Formation; 40 wells had been completed in the Patuxent Formation; and 10 wells had been completed at unknown depths.

Many of the deep well logs from the Sparrows Point site were used by the U.S. Geological Survey as part of a geology and groundwater study of the Baltimore area (Bennett and Meyers, 1952). Bennett and Meyers identified and correlated the geologic stratigraphy in deep wells from Sparrows Point with the geologic stratigraphy in numerous well logs throughout the Baltimore area. This work serves to link the site-specific stratigraphy of Sparrows Point with the generally accepted regional stratigraphy of the Baltimore and Atlantic Coastal Plain areas.

The available well information was screened to create a set of reliable well data that could be used for further evaluation and interpretation. The screening process deleted any well that could not be precisely located on the site and any well that did not have a detailed well log. Appendix 4A presents a tabular summary of key geologic data for the 41 wells that met these screening criteria.

From the set of reliable well data, 15 deep wells representative of site-specific conditions were used to develop cross-sections for the Sparrows Point site. The cross-sections illustrate the relatively simple geologic stratigraphy beneath the facility. The locations of the cross-sections and the deep wells used to construct the cross-sections are shown on Figure 4-3, and the cross-sections are presented in Figures 4-4 to 4-7. Stratigraphic interpretation and correlation of the deep well logs was complicated by variations in the level of detail and consistency among the logging methods used, and by the similarity and discontinuous nature of many of the stratigraphic units.

As of March 1997, there are 22 deep wells present at the site. Figure 4-8 shows the locations of these wells, and Appendix 4B presents a list summarizing their status as of May 1996 (as annotated). Only six wells (Blast Furnace #2, Blast Furnace #3, Town Well #4, Hot Strip Well #3, Caster Well #1, and Caster Well #2) are currently being operated. Information regarding the pumping rate and use of the active wells is presented in Section 4.2.5. Several of the stand-by wells still have pumps installed; however, the operational status of these pumps is unknown.

Shallow Wells

In addition to the deep wells, numerous groundwater monitoring wells (shallow wells) have also been completed at the site. Appendix 4C primarily lists and summarizes construction information for these monitoring wells. The monitoring wells are completed in the Recent and Pleistocene deposits and to a lesser extent in the upper part of the Patapsco Formation. Most of the monitoring wells at the site are located in three areas in the northwestern part of the site -- Greys Landfill, Humphrey Impoundment, and the Rod and Wire Mill. Although the logs for these wells do provide a good understanding of conditions in these three areas, their limited spatial distribution precludes their use for developing a site-wide understanding of geologic conditions.

Soil Borings

Approximately 1,800 soil borings have been completed at the site as part of foundation or environmental investigations. Most of the soil borings are less than 150 feet deep and were completed in the Recent and Pleistocene deposits; and some borings do extend into the upper part of the Patapsco Formation. Unlike the monitoring wells, which were limited in their spatial distribution, the soils borings are distributed throughout the Sparrows Point site and can be used to develop a site-wide understanding of geologic conditions within the Recent and Pleistocene deposits.

Using geographic location, depth of boring, and level of detail as selection criteria, a set of soil boring data representative of site conditions was compiled for evaluation and interpretation. Appendix 4D presents a summary of the selected borings. Five soil boring cross-sections of the upper stratigraphy of the Sparrows Point site were constructed for this report using these borings. The locations of the soil boring cross-sections and the borings used to construct the cross-sections are shown on Figure 4-9, and the cross-sections are presented in Figures 4-10 to 4-15.

4.2.1.2 Geologic Formations

As previously stated, the stratigraphy of the site consists of unconsolidated sedimentary units of Recent, Pleistocene, and Cretaceous age which overlie Precambrian to Early Paleozoic bedrock. These geologic units/formations are listed below from youngest to oldest:

- Recent fill deposits (primarily iron- and steel-making slag)
- Pleistocene Talbot Formation
- Upper Cretaceous Patapsco Formation
- Upper Cretaceous Arundel Formation
- Lower Cretaceous Patuxent Formation
- Precambrian and Early Paleozoic crystalline bedrock

Figure 4-2 is a generalized stratigraphic column which shows the geologic and hydrostratigraphic units beneath the Sparrows Point site and their interrelationships. The following sections discuss and interpret the information gathered for this report regarding each stratigraphic unit.

Recent Fill Deposits

The Recent fill deposits are manmade and are primarily related to land reclamation associated with the expansion and development of the Sparrows Point facility. The fill deposits consist primarily of iron- and steel-making slag that was placed as both "hot-poured" and "cold-poured" materials. The "hot-poured" slag cooled in place, often producing massive blocks of very hard material that are extremely difficult to drill through. The "cold-poured" slag has the consistency of a gravelly, silty, sand. Although relatively porous and permeable, the cold-poured slag can be difficult to drill through because the angularity of the individual pieces helps them lock together.

Land reclamation and fill placement occurred in three modes: 1) stream channels and estuaries that originally extended into the Sparrows Point peninsula were filled; 2) the entire southern shoreline of the peninsula was expanded southward into the Patapsco River; and 3) fill was placed throughout the site to level grades. The pattern and sequence of fill placement is shown in Figure 2-20. Some clay units have been described on boring logs within slag deposits. These clay deposits are probably the result of localized non-slag fill operations. As expected, the fill deposits are thickest (up to 40 feet) in the historic stream channels and estuaries, particularly Humphrey Creek, Greys Creek, Jones Creek, and Old Road Bay. The thicker slag deposits in the historic channels can be seen on the soil boring cross-section (Figures 4-10 to 4-15).

Talbot Formation

The Pleistocene Talbot Formation is the uppermost naturally occurring geologic unit in most areas of the site and underlies Recent fill deposits. Some Recent deposits of alluvial origin may be present at the top of the Talbot Formation in the former estuaries; however, even if present, they are not usually logged as separate units because they are difficult to distinguish from the underlying Pleistocene sediments. The Talbot Formation is about 40 to 145 feet thick with an average thickness of 88 feet. It thickens to the southeast, and the top of the formation occurs at elevations ranging from +10 feet msl (i.e., the current ground surface) to -30 feet msl at Sparrows Point.

The sediments comprising the Talbot Formation are predominantly clays, organic clays, silts and muds ranging in color from/to blue, brown, yellow, grey, green, red, and black. Discontinuous beds or lenses of coarser-grained sand and gravel do occur within the formation, and may represent bed-load deposits from former river channels. These coarser-grained lenses occur more frequently near the top and bottom of the formation, and are somewhat rare within the middle of the formation. The coarse-grained lenses also occur more frequently in the northern part of the site as shown in the soil boring cross-sections (Figures 4-10 to 4-15). The overall fining upward sequence of the sediments is indicative of a transgressive sea level event during the Pleistocene glacial period. The contact with the underlying Upper Cretaceous Patapsco Formation was interpreted from the soil descriptions and/or Standard Penetration Test Blow counts (N values). The Pleistocene sediments generally exhibited lower N values than the denser Patapsco sediments. A color change in the sediment to white is also common at the Patapsco contact.

Patapsco Formation

The Upper Cretaceous Patapsco Formation underlies the Talbot Formation throughout the Sparrows Point site. It is about 145 to 255 feet thick with an average thickness of 189 feet. The Patapsco Formation thickens to the southeast, and the top of the formation occurs at elevations of -30 to -143 feet msl at Sparrows Point.

The sediments comprising the Upper Cretaceous Patapsco Formation consist predominantly of sand and gravel interbedded with lenses of sandy clay. Colors vary from/to red, brown, gray, white, and grey. The upper section of the Patapsco Formation contains more fine-grained sediments than the lower section of the Patapsco Formation. The lower unit, which is generally considered to form the main aquifer, is predominantly coarse-grained and often exhibits a gravel unit at the base. In the Sparrows Point area, a middle clay bed is present between the upper and lower sections of the Patapsco Formation. This clay stratum contains some sand and silty sand lenses, and tends to be sandier wherever it is thin. Although Bennett and Meyers (Bennett and Meyers, 1952) suggest that the clay may pinch out locally to the southeast of the Sparrows Point area, the existing subsurface data for Sparrows Point indicate that the middle clay is continuous throughout the site area.

Arundel Formation

The Upper Cretaceous Arundel Formation underlies the Patapsco Formation throughout the Sparrows Point site. It is about 20 to 180 feet thick with an average thickness of 100 feet. The top of the Arundel Formation occurs at elevations of -233 to -333 feet msl at Sparrows Point.

The sediments comprising the Arundel Formation are predominantly dense, plastic clays with nodules of iron oxide and a few discontinuous lenses of sand. The color varies from/to red, red-yellow, brown, and blue. The Arundel is present throughout the site. The thinnest section of the Arundel is reported in well Gf-16 which is located in the Tin Mill area. The overlying formations are generally thicker where the Arundel is thin. There is no apparent thickness trend in the Arundel, and this is most likely due to the erosion of its upper surface prior to deposition of the Patapsco sediments. Cross-section B-A (Figure 4-4) indicates that the formation becomes somewhat sandier to the east-southeast.

Patuxent Formation

The Lower Cretaceous Patuxent Formation underlies the Arundel Formation throughout the Sparrows Point site. It is about 323 feet thick at the site, and the top of the formation is encountered at elevations of approximately -330 to -480 feet msl. Cross-section B-A (Figure 4-4) indicates a general thickening of the formation to the east-southeast, which is consistent with the regional seaward thickening of the wedge of unconsolidated sediments overlying the basement rocks.

The sediments comprising the Patuxent Formation consist of interbedded and lenticular beds of gravel, sand, sandy clay, and clay. Colors range from/to brown, tan, red, and white. Coarse-grained sediments (sand and gravel) are predominant within the formation; and the finer-grained sediments (sandy clay and clay) generally occur as discontinuous beds or lenses as shown on Figures 4-4 to 4-7. A gravel bed is often present at the base of the formation.

Basement Rocks

The surface of the Pre-Cambrian and early Paleozoic basement rocks at Sparrows Point occurs at an elevation of approximately -600 to -750 feet msl. The basement rock surface dips to the southeast at approximately 75 feet per mile (Bennett and Meyers, 1952). Although several of the deep well logs from Sparrows Point describe the bedrock materials as "rock" or "granite rock of volcanic origin," the basement rocks of the Baltimore area are more reliably described as schist, granite, gneiss, and gabbro (Bennett and Meyers, 1952; Chapelle, 1985; and Hansen and Edwards, 1986).

4.2.2 Site Hydrogeology

The occurrence and movement of groundwater beneath the Sparrows Point facility is affected by the nature and distribution of the subsurface materials at the site. Although several hydrogeological investigations have been completed at specific areas of the site, these investigations do not provide a site-wide understanding of the groundwater conditions beneath the site. Thus, to characterize the hydrogeologic conditions beneath the Sparrows Point facility, the geologic information presented above has been evaluated to interpret how the subsurface materials comprising the geologic stratigraphy will affect the occurrence and movement of groundwater. From this evaluation, a "hydrostratigraphy" of the site has been developed. The site hydrostratigraphy, which consists of zones of more-permeable and less-permeable materials, provides a framework for identifying and understanding the groundwater flow systems beneath the site.

The hydrostratigraphy of the Sparrows Point site has been interpreted to consist of six zones of more-permeable materials and four zones of less-permeable materials. For the purposes of this Description of Current Conditions Report, the more-permeable zones will be called "hydrostratigraphic units" or "units" and the less-permeable zones will be called "aquitards." The hydrostratigraphic units and aquitards present at the Sparrows Point site are depicted on Figure 4-2 and are listed below (shallow to deep).

- Slag-Fill Hydrostratigraphic Unit (1)
- Upper Talbot Channel Hydrostratigraphic Unit (2)
- *Talbot Clay Aquitard (1)*
- Lower Talbot Channel Hydrostratigraphic Unit (3)
- Upper Patapsco Sand Hydrostratigraphic Unit (4)
- *Middle Patapsco Clay Aquitard (2)*
- Lower Patapsco Sand Hydrostratigraphic Unit (5)
- *Arundel Clay Aquitard (3)*
- Patuxent Sand Hydrostratigraphic Unit (6)
- *Crystalline Bedrock Aquitard (4)*

Groundwater flow will be primarily horizontal within the hydrostratigraphic units, and (to the limited extent that it does occur) primarily vertical across the three clay aquitards. Some vertical flow will also occur between adjacent hydrostratigraphic units (i.e., those not separated by an aquitard) because of the discontinuous nature of the more-permeable beds or lenses within the channel-type hydrostratigraphic units. The Crystalline Bedrock Aquitard functions as an essentially impermeable boundary at the bottom of overall groundwater system at the site.

The following sections describe in more detail each of the hydrostratigraphic units and aquitards identified at the site as well as their hydrogeologic interrelationships. Information from site-specific environmental studies is also summarized where applicable.

4.2.2.1 Slag-Fill Hydrostratigraphic Unit

The Slag-Fill Unit is comprised of Recent fill deposits composed of slag that was produced at the Sparrows Point site. It is the uppermost hydrostratigraphic unit at the site. The water table occurs within the Slag-Fill Unit, and the groundwater in the Slag-Fill Unit is unconfined. In some areas of the site, the Slag-Fill Unit is directly underlain by and connected to the coarser-grained beds or lenses within the Talbot Formation that comprise the Upper Talbot Channel Unit. In these areas, the Slag-Fill and Upper Talbot Channel Units form a single groundwater flow system. In much of the site, the Slag-Fill Unit is underlain by finer-grained silts and clays that comprise the Talbot Clay Aquitard. In these areas, groundwater flow in the Slag-Fill Unit is separated from groundwater flow in any underlying coarse-grained beds or lenses. As discussed below, these coarse-grained beds and lenses may represent the Upper Talbot Channel Unit or the Lower Talbot Channel Unit.

The Slag-Fill Unit is 0 to 40 feet thick and occurs primarily in former (historic) stream channels estuaries. Figures 4-10 to 4-15 show the cross-sectional distribution of the slag fill materials. The backfilled historic channels are evident as thicker intervals on the cross sections.

Rod and Wire Mill Area

Woodward-Clyde Consultants (1985) investigated the shallow hydrogeology in the area of the Rod and Wire Mill, which is located in the northwest part of the site. Borings performed for this study encountered up to 22 feet of fill consisting of slag, cinders, clay, and miscellaneous materials. There was no apparent trend to the variations in fill thickness. These fill materials are interpreted to correspond to the Slag-Fill Unit. The underlying soils were found to consist of interlayered clay- to gravel-sized sediments considered to be typical for the region. A fine-grained (and possibly organic) layer was encountered at an elevation of approximately -25 feet msl and varied in thickness from 35 to 52 feet. This fine-grained, low-permeability layer was considered to act as a lower confining unit (aquitard) for the fill in this area and is interpreted to correspond to the Talbot Clay Aquitard.

Baker (November 1986) also conducted a study in the Rod and Wire Mill area, and they identified three, distinct groundwater systems. These flow systems had different water level elevations and different groundwater flow patterns, and they were separated from each other by fine-grained deposits. The approximate depths of the three flow systems were found to be as follows: shallow system -- 0 to 15 feet; intermediate system -- 25 to 35 feet; deep system -- 50 to 60 feet. The shallow and intermediate groundwater systems defined by Baker are interpreted to represent the Slag-Fill and Upper Talbot Channel Units, whereas the deep system is interpreted to represent the Lower Talbot Channel Unit.

Hydraulic conductivity values for the Slag-Fill Unit in the Rod and Wire Mill area were found to range from 10^{-3} cm/sec to 10^{-4} cm/sec. Water level elevation data reported by Baker for 1986 ranged from +2.5 to +10 feet msl, and water levels for 1995 ranged from +8 to +10.5 feet msl (Baker, 1996). These measurements were collected under pumping conditions from a groundwater remediation system in the Rod and Wire Mill area. In 1986, only the intermediate flow system was being pumped; in 1995, both the shallow and intermediate flow systems were being pumped. Baker reported the general flow direction for the shallow system was to the northwest.

Humphrey Impoundment Area

A study of the Humphrey Impoundment area conducted by D'Appolonia (July 1981) indicated that this area of the site is underlain by about 25 feet of slag fill, about 35 feet of Pleistocene (Talbot) clay, and up to 55 feet of Pleistocene (Talbot) sand. The slag fill and Pleistocene (Talbot) sands were found to be hydraulically separated and are interpreted to represent the Slag Fill and Upper Talbot Channel hydrostratigraphic units.

Calculated permeabilities for the Slag-Fill Unit in the Humphrey Impoundment area ranged from 10^{-2} to 10^{-4} cm/sec (Baker, July 1987). Water level measurements in the Humphrey Impoundment area in 1981 ranged from +0.5 to +7 feet msl (D'Appolonia, July 1981), and in 1983 (Whitman, 1984) they ranged from +0.5 to +6 feet msl. The most recent report (Baker, July 1987) indicated a range in water levels from +1 to +8 feet msl. Groundwater flow was reported to be generally to the south and southwest.

Greys Landfill Area

A summary report of several previous investigations in the Greys Landfill area was prepared by CH2M HILL in 1992. The geologic data from these investigations extends from the ground surface to depths of approximately 70 feet. Permeable zones were reported to be present in a wide-spread surficial layer of slag fill, in discontinuous sand lenses within the predominantly fine-grained Pleistocene (Talbot) deposits, and in a deep sand layer interpreted as the Patapsco Formation.

The CH2M HILL report stated that the Surficial (slag) aquifer and the Pleistocene (Talbot) aquifer were hydraulically connected and unconfined in the Greys Landfill area. However, data collected from a recently completed Comprehensive Monitoring Evaluation (CME) of the Closed CHS Cell show a clear hydraulic separation and the presence of slight downward gradients between unconfined (water table) conditions in the slag materials and confined conditions in sand lenses within the predominantly fine-grained Pleistocene sediments.

Calculated permeabilities for the Slag-Fill Unit in the Greys Landfill area ranged from 10^{-2} to 10^{-4} cm/sec. In 1983, water level elevations ranged from +2.5 to +15 feet msl (Whitman, 1984). The most recent data in the CH2M HILL report indicated a range in water levels from +2 to +17 feet msl. Water levels measured during CME activities in March 1997 (which were typical of levels measured throughout a six-month monitoring period) ranged from 0.89 (well GL-15pl) to 17.57 (well GL-10s) feet msl.

4.2.2.2 Upper Talbot Channel Hydrostratigraphic Unit

The Upper Talbot Channel Unit is present beneath the Slag Fill Unit in some areas of the Sparrows Point site. It consists of discontinuous beds or lenses of channel-sand deposits situated toward the top of the Pleistocene Talbot Formation. The Upper Talbot Channel Unit can be in direct physical and hydraulic contact with the overlying Slag-Fill Unit (in which case it is unconfined), or isolated from the Slag-Fill Unit by part of the Talbot Clay Aquitard (in which case it is confined). The Upper Talbot Channel Unit is separated from the underlying Lower Talbot Channel Unit by the relatively impermeable fine-grained sediments which comprise the main portion of the Talbot Formation and the Talbot Clay Aquitard. The individual lenses within the Upper Talbot Channel Unit tend to be 5 to 10 feet thick, but some lenses are as much as 30 feet thick.

Rod and Wire Mill Area

As previously discussed, Baker (November 1986) conducted a study in the Rod and Wire Mill area which indicated that there were three groundwater flow systems, each having different groundwater flow directions and water level elevations. The intermediate system, which extended between depths of 25 to 35 feet, is interpreted to represent the Upper Talbot Channel Unit.

Hydraulic conductivity values for the Pleistocene sands (Upper Talbot Channel Unit) in the Rod and Wire Mill area were found to range from 10^{-1} cm/sec to 10^{-3} cm/sec. Water level elevation data in the Upper Talbot Channel Unit reported by Baker for 1986 ranged from +1.5 to +2.5 feet msl, and water level for 1995 ranged from -10 to +3 feet msl (Baker, 1996). These measurements were collected under pumping conditions from a groundwater treatment system at the Rod and Wire Mill site. In 1986, only the intermediate flow system was being pumped; in 1995, both the shallow and intermediate flow systems were being pumped. Baker reported the general flow direction for the intermediate system was to the southwest.

4.2.2.3 Talbot Clay Aquitard

The Talbot Clay Aquitard is present beneath the Slag-Fill and Upper Talbot Channel Units throughout the Sparrows Point site. It is comprised of relatively impermeable fine-grained sediments which comprise the main portion of the Talbot Formation. The Talbot Clay Aquitard separates the Slag-Fill and/or Upper Talbot Channel Units from the Lower Talbot Channel and/or Upper Patapsco Sand Units. In places, it also separates the Slag-Fill Unit from the Upper Talbot Channel Unit, and the Lower Talbot Channel Unit from the Upper Patapsco Sand Unit.

Chapelle (1985) reported that the hydraulic conductivity of the fine-grained Talbot Clay Aquitard ranged from 10^{-6} to 10^{-9} cm/sec. Based on a comparison of water levels in the overlying Slag-Fill and Upper Talbot Channel Units (approximately +1 to +10 feet msl) and water levels in underlying Lower Patapsco Sand Unit (+1 foot msl in 1982; Figure 2-17), there appears to be only a very slight downward gradient across the Talbot Clay Aquitard. Given this low gradient and the low permeabililty of the aquitard, there would be essentially no significant groundwater flow within or through the Talbot Clay Aquitard.

The use of 1982 water level data from the Lower Patapsco Sand Unit (which is not directly beneath the Talbot Clay Aquitard but underlies the Middle Patapsco Clay Aquitard and the Upper Patapsco Sand Unit) as indicative of water levels beneath the Talbot Clay Aquitard is considered valid because there has been no significant pumping from any of the hydrostratigraphic units above Patapsco Sand Unit since that time. The data presented in Section 2 show that water levels in the Lower Patapsco Sand Unit recovered from -40 feet msl in 1945 to +1 foot msl in 1982 as a result of reduced pumping within the unit; and it is therefore reasonable to conclude that water levels in overlying hydrostratigraphic units that might also have been depressed by prior pumping would recover at least as much.

4.2.2.4 Lower Talbot Channel Hydrostratigraphic Unit

The Lower Talbot Channel Unit is present beneath the Talbot Clay Aquitard in some areas of the Sparrows Point site. It consists of discontinuous beds or lenses of channel-sand deposits situated toward the bottom of the Pleistocene Talbot Formation. Groundwater within the Lower Talbot Channel Unit occurs under confined conditions. The Lower Talbot Channel Unit is separated from the overlying Upper Talbot Channel Unit by the relatively impermeable fine-grained sediments which comprise the main portion of the Talbot Formation and the Talbot Clay Aquitard. The Lower Talbot Channel Unit can be in direct physical and hydraulic contact with the underlying Upper Patapsco Sand Unit, or isolated from the Upper Patapsco Sand Unit by part of the Talbot Clay Aquitard. The individual lenses within the Lower Talbot Channel Unit tend to be 15 to 30 feet thick.

Rod and Wire Mill Area

As previously discussed, Baker (November 1986) conducted a study in the Rod and Wire Mill area which indicated that there were three groundwater flow systems, each having different groundwater flow directions and water level elevations. The deep system, which extended between depths of 50 to 60 feet, is interpreted to represent the Lower Talbot Channel Unit.

Hydraulic conductivity values for the Pleistocene sands (Lower Talbot Channel Unit) in the Rod and Wire Mill area were found to range from 10^{-3} cm/sec to 10^{-4} cm/sec. Water level elevation data in the Lower Talbot Channel Unit reported by Baker for 1986 ranged from -9 to +1 feet msl. These measurements were collected under pumping conditions from a groundwater treatment system at the Rod and Wire Mill site. At the time these measurements were made, the intermediate flow system was being pumped. Baker reported the general flow direction for the deep system was to the east.

Although contamination was present in the Upper Talbot Channel Unit at the Rod and Wire Mill, no groundwater contamination was detected in the Lower Talbot Channel Unit (Baker, November 1986). This information supports the interpretation that the Lower Talbot Channel Unit is hydrostratigraphically separated from the upper units by the Talbot Clay Aquitard, and that there is no significant groundwater flow through the Talbot Clay Aquitard.

Humphrey Impoundment Area

A study conducted by D'Appolonia (July 1981) indicated that permeable zones within the Talbot Formation and the underlying Patapsco Formation were hydraulically connected in the Humphrey Impoundment area. This information is interpreted as indicating that the Lower Talbot Channel Unit and the Upper Patapsco Sand Unit are connected in this part of the Sparrows Point site.

Calculated permeabilities for sands in the Lower Talbot Channel Unit in the Humphrey Impoundment area ranged from 10^{-2} to 10^{-6} cm/sec (Baker, July 1987).

4.2.2.5 Upper Patapsco Sand Hydrostratigraphic Unit

The Upper Patapsco Sand Unit is present below the Lower Talbot Channel Unit and/or the Talbot Clay Aquitard. This hydrostratigraphic unit is comprised of semi-continuous sand and sandy clay lenses in the upper portion of the Patapsco Formation. Groundwater in the Upper Patapsco Sand Unit occurs under confined conditions. The Upper Patapsco Sand Unit is separated from the underlying Lower Patapsco Hydrostratigraphic Unit by the Middle Patapsco Clay Aquitard. The Upper Patapsco Sand Unit is approximately 40 to 150 feet thick.

Figure 4-16 shows the potentiometric surface in the Upper Patapsco at the Sparrow Point site based on measurements taken in 1945. At that time, water level elevations in this unit ranged from -10 to -20 feet msl, and groundwater flow was to the southeast. As discussed above, with the reduction in pumping from the Patapsco Sand Units since 1945, water levels in these units are either known (the Lower Patapsco Sand Unit) or interpreted (the Upper Patapsco Sand Unit) to have recovered to elevations of around +1 foot msl.

Humphrey Impoundment Area

D'Appolonia's investigation in the Humphrey Impoundment area in 1981 encountered the Upper Patapsco Sand Unit in the form of white silty sands at depths of about 80 feet; but the total thickness was not determined. Hydraulic conductivity values in these sands ranged from 10^{-2} cm/sec to 10^{-4} cm/sec (D'Appolonia, July 1981).

Greys Landfill Area

A summary report of several previous investigations in the Greys Landfill area was prepared by CH2M HILL in 1992. The geologic data from these investigations extends from the ground surface to depths of approximately 70 feet. A deep sand layer overlain by fine-grained Pleistocene deposits and encountered at elevations of -14 to -41 feet msl is interpreted as the Upper Patapsco Sand Unit. Groundwater flow in this part of the Patapsco was reported to be to the south.

4.2.2.6 Middle Patapsco Clay Aquitard

The Middle Patapsco Clay Aquitard is a compact clay bed that is present throughout the site. This aquitard serves as the lower confining bed for the Upper Patapsco Sand Unit and as the upper confining bed for the Lower Patapsco Sand Unit. This clay bed is locally extensive in the vicinity of Baltimore (Bennett and Meyer, 1952). It ranges in thickness from 25 to 100 feet at the Sparrows Point site, and where it becomes thinner and also becomes more sandy.

Comparison of water levels in the Upper and Lower Patapsco Sand Unit in 1945 (Figures 2-17 and 4-16) shows that a downward gradient with head difference of 22 feet existed across the Middle Patapsco Clay at that time. As discussed above, with the reduction in pumping from the Patapsco Sand Units since 1945, water levels in these units are either known (the Lower Patapsco Sand Unit) or interpreted (the Upper Patapsco Sand Unit) to have recovered to elevations of around +1 foot msl. Thus, under current conditions, there may be essentially no significant groundwater flow within or through the Middle Patapsco Clay Aquitard.

4.2.2.7 Lower Patapsco Sand Hydrostratigraphic Unit

The Lower Patapsco Sand Unit is present below the Middle Patapsco Clay Aquitard. It consists of sand and gravel channel deposits and is present throughout the site. Groundwater in the Lower Patapsco Sand Unit occurs under confined conditions. The Lower Patapsco Sand Unit is hydraulically separated from the overlying Upper Patapsco Sand Unit by the Middle Patapsco Clay Aquitard and from the underlying Patuxent Sand Unit by the Arundel Clay Aquitard. This unit is present at an elevation of approximately -210 to -285 feet msl and ranges from 20 to 70 feet in thickness.

The Lower Patapsco Sand Unit is considered to be a regional aquifer. In the Sparrows Point area, most of the water production wells that had been completed in the Patapsco Formation were screened in this unit (rather than in the Upper Unit). Yields up to 770 gallons per minute have been reported (Bennett and Meyers, 1952). Permeabilities of the Lower Patapsco Sand Unit are moderate (10^{-4} cm/sec). The average storage coefficient is reported to be 0.00061 (Bennett and Meyers, 1952; and Chapelle, 1985).

In the past, artificial discharge from the Lower Patapsco Sand Unit has occurred through pumping of water production wells. The water level elevations in this unit under extreme pumping conditions in 1945 were approximately -40 feet msl. With the reduction in pumping from the Patapsco since 1945, water levels in this unit are known to have recovered to elevations of around +1 foot msl (Figure 2-17). Currently, no wells completed in this unit at the site are being pumped. Thus, water levels in this unit are anticipated to be similar to or higher than those in 1982.

4.2.2.8 Arundel Clay Aquitard

The Arundel Clay Aquitard is present below the Lower Patapsco Sand Unit and is comprised of the extremely dense, tight clay of the Arundel Formation. The Arundel Clay Aquitard is present throughout the site and is an important regional confining layer. It acts as the upper confining bed of the Patuxent Sand Unit and as the lower confining bed for the Lower Patapsco Sand Unit. The Arundel Aquitard is 50 to 180 feet thick and has very low vertical hydraulic conductivities ranging from 10^{-8} to 10^{-10} cm/sec (Chapelle, 1985).

Comparison of water levels in the Lower Patapsco Sand Unit and the Patuxent Sand Unit in 1982 (Figures 2-15 and 2-17) shows that a downward gradient with head difference of about 35 feet existed across the Arundel Clay at that time. Continued pumping from the Patuxent and no pumping from the Patapsco may be maintaining these conditions; however, if the rate of pumping from the Patuxent has decreased since 1982, water levels in that unit may have recovered somewhat and reduced the magnitude of the downward gradient. If a downward gradient is currently present, the potential for downward flow through the Arundel Aquitard would exist; however, due to the low permeability and thickness of this unit, the amount of flow would be substantially limited.

4.2.2.9 Patuxent Sand Hydrostratigraphic Unit

The Patuxent Sand Unit is present below the Arundel Clay Aquitard and is the lower-most hydrostratigraphic unit at the Sparrows Point site. It consists predominantly of sand and gravel channel deposits, most of which are good water production zones. Interbedded and discontinuous clay lenses may locally isolate some of the productive water zones. Groundwater in the Patuxent Sand Unit is under confined conditions. The Patuxent Sand Unit is hydraulically separated from the overlying Lower Patapsco Sand Unit by the Arundel Clay Aquitard, and it is underlain by the essentially impermeable Crystalline Bedrock Aquitard. The Patuxent Sand Unit is present at an elevation of approximately -330 feet to -479 feet msl and is up to about 325 feet thick.

The Patuxent Sand Unit is a regional water supply aquifer for Baltimore and Ann Arundel Counties, both of which are upgradient of the site. Water supply wells at Sparrows Point currently produce water from this unit. Yields up to 690 gallons per minute have been reported (Bennett and Meyers, 1952). Hydraulic conductivities of the Patuxent Sand Unit are moderately high (10^{-2} cm/sec). Reported storage coefficients range from 0.000011 to 0.0008 (Bennett and Meyers, 1952).

In 1945, water level elevations in the Patuxent aquifer under extreme pumping conditions were approximately -60 feet msl, and in 1982, under reduced pumping conditions, they ranged from -27 to -38 feet msl (Figures 2-14 and 2-15). Based on the 1982 water levels in the Patuxent, groundwater flow in the vicinity of the site was radially inward toward the site production wells. To the extent that continued pumping from the Patuxent at Sparrows Point has maintained water levels similar to those in 1982, groundwater flow across the site boundary would be inward and there would be essentially no opportunity for off-site impact. Because historic pumping had created an even greater water level depression in the Patuxent, this conclusion would apply historically as well.

4.2.3 Site-Wide Conceptual Hydrogeologic Model

A conceptual model of the site-wide hydrogeology has been developed based on the data presented and discussed above. One of the primary objectives of the initial phase of the Site-Wide Investigation will be to obtain the data necessary to confirm and/or refine this conceptual model. The key features of this model with respect to the migration of contaminants from releases at SWMUs or AOCs are as follows:

- The Slag-Fill Unit is the upper-most zone of moderate to high permeability. Groundwater flow in this unit will be primarily horizontal. Recharge to this unit occurs throughout the site as rainfall and snowmelt percolate to the water table. Discharge from this unit occurs to surface water along the perimeter of the site. Where the Slag-Fill Unit is thicker, it has the ability to transmit greater amounts of water. Thus, the slag-filled historic stream channels, such as Humphrey Creek, Block House Cove, and Greys Creek, act as local discharge zones within the site, receiving and concentrating groundwater flow from the historic land areas for ultimate discharge at the "mouths" of the historic channels.

  This effect is illustrated in Figure 4-17, which shows the locations of the historic stream channels, the interpreted configuration of the water table (based on the spatial distribution of recharge, discharge, and permeabililty within the unit), and the interpreted pattern of horizontal groundwater flow.

  Away from these slag-filled historic channels, groundwater will flow diffusely toward the historic and/or current shoreline. At all points along the current shoreline, surface-water tidal fluctuations will affect the movement of groundwater. Man-made topographic features, such as landfills, dredge-spoil impoundments, or material stockpiles, will locally mound the water table and influence the pattern of groundwater flow.

As the upper-most zone of moderate to high permeability, the Slag-Fill unit would have the greatest potential for contamination. Contaminants released at or to the ground surface would migrate with percolating recharge to the water table, move horizontally with the groundwater, and be discharged to the surface water adjacent to the site.

- The Upper Talbot Channel Unit is the second upper-most zone of moderate to high permeabililty. Where it is in direct hydraulic connection with the Slag-Fill Unit or where water-table mounding has created downward gradients, groundwater flow and contaminant migration from the Slag-Fill Unit into the Upper Talbot Channel Unit can and has occurred (e.g., at the Rod and Wire Mill and at Greys Landfill).

- The Talbot Clay Aquitard is the upper-most zone of low permeability. It separates the overlying Slag-Fill and Upper Talbot Channel Units from the underlying Lower Talbot Channel and Upper Patapsco Sand Units, and it is apparently a continuous, site-wide inhibitor of downward groundwater flow and contaminant migration. Factors contributing to the Talbot Clay Aquitard's ability to function as a barrier to downward flow include its low permeability, its thickness, and the apparent absence of significant vertical gradients across it. Evidence supporting the ability of the Talbot Clay Aquitard to prevent downward contaminant migration comes from findings at the Rod and Wire Mill where no contamination was found in the Lower Talbot Channel Unit.

- Beneath the Talbot Clay Aquitard, there is a sequence of alternating moderate-to-high and low permeability zones. The moderate-to-high permeability zones are the combined Lower Talbot Channel and Upper Patapsco Sand Units, the Lower Patapsco Sand Unit, and the Patuxent Sand Unit. The low permeabililty zones are the Middle Patapsco Clay Aquitard and the Arundel Clay Aquitard. Known historic impacts to water quality in the Patapsco Sand Units consist of elevated chloride concentrations caused by the intrusion of saline surface water in response to over-pumping from these hydrostratigraphic units. The cessation and/or significant reduction of pumping from these Patapsco Sand Units allowed water levels in them to recover to elevations of around +1 foot msl by 1982. Because this water level is only slightly lower than the elevation of the water table at the site, there are only very slight downward vertical gradients between the water table and the Lower Patapsco Sand Unit. Thus, there is currently very little potential for downward vertical flow or contaminant migration above the Arundel Clay.

A complicating factor in this model is the fact that several deep wells at the site were constructed using the "gravel-walled" method. This method well construction (no longer in use) involved the drilling of gravel-filled borings in the immediate vicinity of the cased well to increase the well's productive yield (Bennett and Meyers, 1952). The current status of gravel-filled borings at the site is not clear. Some of the borings may have been plugged when their wells were formally abandoned, and there is a significant potential for natural siltation and plugging of these borings due to the unconsolidated nature of the clays and other fine-grained sediments comprising the Aquitards.

Although these gravel-filled borings penetrated all geologic layers between the ground surface and the producing zone of the well, their current impact on the functional integrity of the three Aquitards beneath the site is thought to be minimal. The current impact of gravel-filled borings that penetrate the Talbot Clay and Middle Patapsco Clay Aquitards would be minimal because, as discussed above, there are only very slight downward gradients between the Lower Patapsco Sand and the water table. The historic impacts would also have been minimal because any contaminants migrating along these borings would have been immediately removed through the producing well. The current and historic impacts of borings penetrating the Arundel Clay Aquitard would be minimal for the same reason, and because groundwater flow in the Patuxent Sand Unit is inward toward the Sparrows Point site.

4.2.4 Groundwater Quality

Elevated chloride concentrations, induced by over-pumping of production wells from the Patapsco and permeable sections of the Pleistocene, have been documented since the early 1900's (Figure 2-18). Many of the Sparrows Point deep wells were abandoned due to these elevated chloride levels. The original water supply wells for the Town of Sparrows Point, some of which produced from the Pleistocene, were also abandoned for this reason. Salt water encroachment is common in wells which produce near the Chesapeake estuaries (Bennett and Meyers, 1952).

Environmental investigations of water quality have been performed in three areas -- at the Rod and Wire Mill, at Humphrey Impoundment, and at Greys Landfill -- all located in the northwest portion of the Sparrows Point site. The findings from these investigations are discussed below.

4.2.4.1 Rod and Wire Mill

Sludges from the mill operations were stored in piles and bins in this area. This practice resulted in the migration of cadmium, zinc, and other chemical constituents into the local groundwater system. Constituents that have exceeded drinking water standards (primary and secondary) include cadmium, iron, manganese, zinc, and sulfate. A groundwater remediation system was installed in 1986. A summary table of cadmium concentrations for the period from 1987 to 1995 is included in Appendix 4E. As of 1996, cadmium concentrations ranged from <0.005 mg/l (well BW-7) to 67.70 mg/l (well 88) in the shallow system (Slag-Fill Unit) and from 0.005 mg/l (well BW-15) to 34.00 mg/l (well BW-9) in the intermediate system (Upper Talbot Channel Unit).

4.2.4.2 Humphrey Impoundment

Humphrey Impoundment covers an area of approximately 43 acres and is situated within the former Humphrey Creek estuary. This estuary has been filled with slag and other miscellaneous material over the course of several decades. Slag forms the base of the impoundment. Minor impacts to the groundwater quality have been detected in the slag and Pleistocene sediments at Humphrey Impoundment. These impacts primarily consist of elevated levels for pH, TOC, ammonia, cyanide, 2,4-dimethylphenol, and trichloroethylene. Appendix 4E contains a summary table of constituent concentration detected in the slag and Pleistocene wells at the impoundment (Baker, July 1987).

4.2.4.3 Greys Landfill

The Greys Landfill area occupies approximately 40 acres and is the primary on-site facility for solid waste disposal. Groundwater samples collected from monitoring wells at the landfill indicate that the Slag Fill Unit has been affected by elevated and reduced pH levels and elevated levels of sulfate, iron, manganese, cyanide, 2-4-dimethylphenol, and benzene. Appendix 4E contains a summary table of constituent concentration detected in the slag wells at the landfill (Baker, July 1987). The Talbot sediments at Greys Landfill have been impacted by sodium, chloride, sulfate, 2-4-dimethylphenol, and benzene. Appendix 4E contains a summary table of constituent concentrations detected in the Pleistocene wells at the landfill (Baker, July 1987).

4.2.5 Water Supply and Usage

The purpose of this section is to present the water supply and usage demands that currently exist at BSC's Sparrows Point plant and the nearby communities. To differentiate the various types of water supply and usage, two specific categories are presented below: on-site water and community water.

4.2.5.1 On-Site Water

On-site water supply and usage is defined as water required by BSC necessary for conducting normal business operations. There are four sub-categories of on-site water use, some of which involve surface water. These categories are designated as Well Water, Salt Water, Industrial Water, and Potable Water.

Well Water

The Well Water used on site is groundwater derived from six deep wells. These wells are identified as follows: Blast Furnace #2, Blast Furnace #3, Town Well #4, Hot Strip Mill #3, Caster Well #1, and Caster Well #2. Figure 4-8 shows the location of the six active production wells. Blast Furnace Well #3 did not operate during the calendar year 1996. Based on review of all available records and reports, and on discussions with BSC personnel, these wells are all cased down to the Patuxent Formation and range from approximately 450 to 700 feet in depth. The average volume of well water used by the plant is approximately 3 million gallons per day (MGD). This water is used primarily for boiler feed-water makeup and distributed throughout the plant in steam-lines. It is also used for contact cooling at the Continuous Casters. Table 4-1 presents the available information for the Sparrows Point production wells.

Salt Water

Salt Water is taken in and returned to Old Road Bay at the Penwood inlet and discharge which are located between the steel scrap area and the slag reprocessing area in the southeast part of the site. The average volume of salt water used by the plant is approximately 250 MGD. This water is used for condenser water at the power plant and non-contact cooling at the Continuous Casters.

Industrial Water

Industrial Water is treated effluent obtained from the Back River Sewage Treatment plant located near Back River Neck, MD. The average volume of industrial water used by the plant is approximately 85 MGD. This water is used for preparation of plating solutions and pickling solutions in the Finishing Mills and for contact and non-contact cooling throughout the facility.

Potable Water

Potable Water is defined as "treated water purchased from the city of Baltimore, MD and fit for human consumption." This water is used for drinking and domestic purposes and for specialized processes that require a relatively high degree of purity and no bacteria content. This water is supplied from the Montebello Water Treatment plant and enters the plant through a 36-inch main along Greys Road. The average volume of potable water used by the plant is approximately 10 MGD.

4.2.5.2 Community Water

For the purposes of this report, Community water supply and usage only addresses potable water requirements as they pertain to drinking water and water for domestic use. This evaluation included all residents and industry within a two-mile radius of Sparrows Point. The information used to generate this section of the report was obtained from the Baltimore City Water Engineering Department (BCWED) (Dourney and Swatzbaugh, 1996; and Walter, 1996) and the Maryland Department of the Environment (MDE).

The Baltimore metropolitan area receives its potable drinking water from upland reservoirs. The east side of the city, including the communities of Dundalk, Edgemere, and Fort Howard, is serviced by the Montebello Water Treatment plant, which receives raw water from the Pretty Boy and Loch Raven Reservoir. These reservoirs are part of the Loch Raven river system. The Connewingo Dam reservoir, which is located on the Susquehanna River, is an auxiliary source of drinking water used during times of severe drought. 1990 Census data for Dundalk and Edgemere (most recent data available) indicate that only a very small percentage of residences currently obtain their drinking water from wells (Section 5.5.2).

4.3 AIR MIGRATION PATHWAY

This section presents information about site-specific meteorological conditions at Sparrows Point. This information is necessary for evaluating the potential migration of chemicals of potential interest (COPIs) through the various air pathways at and from the BSC Sparrows Point Facility.

Meteorological conditions are currently being monitored on-site at Sparrows Point by BSC. Meteorological sensing equipment continually measures wind direction, wind speed, temperature, and rainfall. Meteorological data have been continually collected on-site from September 1995 to the present. Table 4-2 provides a summary of the monthly average wind speed, temperature, and total rainfall measured at the facility. For calendar year 1996, the annual average wind speed was

6.7 miles per hour (mph), the average monthly temperature ranged from 32°F in January to 79°F in July, and the annual rainfall was 46.4 inches.

Monthly windroses that graphically portray the average wind direction and wind speed were prepared from the on-site meteorological data. Each "spoke" of the windrose represents the direction from which the wind was blowing. In general, the wind direction was mostly variable throughout the monitoring period, although a strong influence from south to west wind directions was observed in the 1996 data. Average wind speeds were fairly constant throughout the year.

The on-site wind speed and direction data were evaluated to determine if they could be used for air dispersion modeling. Typically, five years of National Weather Service (NWS) meteorological data are used for air dispersion modeling unless on-site data are available. To determine if the on-site data are suitable for modeling, the data were compared with data from the NWS monitoring site at the Baltimore Washington International (BWI) Airport and reviewed for completeness.

To compare the on-site data to the BWI//NWS data, annual windroses were generated for the years 1992 through 1996 from BWI/NWS and for 1996 from Sparrows Point. These windroses are located in Appendix 4F. The BWI/NWS data show mostly variable winds with a strong influence of wind originating from the west-northwest. The on-site data also show mostly variable winds but with a very strong influence of wind originating from the south. The on-site meteorological measurements were found to be almost 100 percent complete.

Based on this review, the on-site meteorological data were found to be suitable for use in air dispersion modeling. Furthermore, because there is a clear difference in the predominant wind direction between the meteorological data sources, the on-site meteorological data would be more representative of the potential migration of COPIs through air pathways at Sparrows Point.

4.4 DATA NEEDS

Initial data needs with respect to migrations pathways include the following:

- Generalized geologic and groundwater data to a depth of approximately 120 to 150 feet (into the top of the Patapsco Formation) at selected locations throughout the site, including characterization of subsurface materials, identification of stratigraphic relationships, determination of hydraulic properties, and measurement of water levels.

- Localized geologic and groundwater data to a depth of approximately 120 to 150 feet (into the top of the Patapsco Formation) at the five Special Study Areas (i.e., the TMC and Finishing Mills Area, Greys Landfill, Humphrey Impoundment, the Coke Oven Area, and Coke Point Landfill), including characterization of subsurface materials, identification of stratigraphic relationships, determination of hydraulic properties, and measurement of water levels.

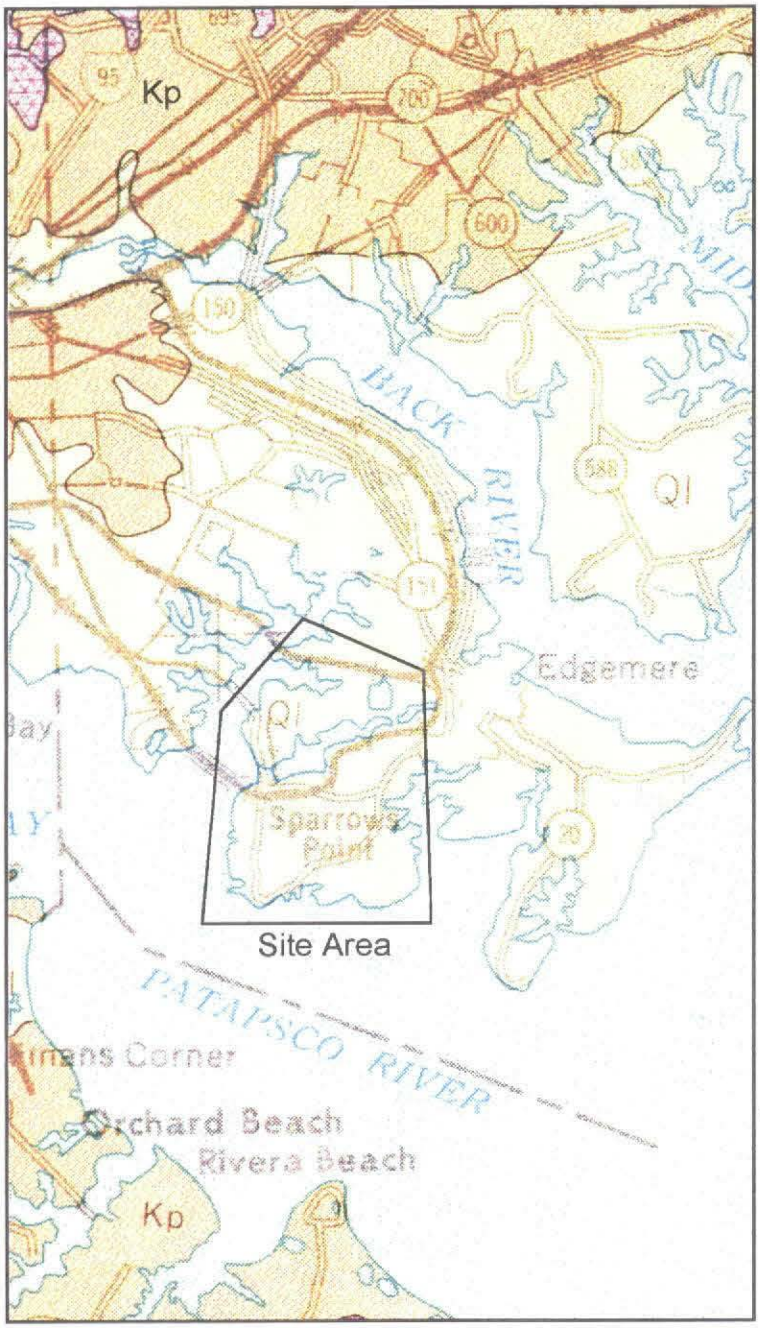
- Electronically logged and concurrently collected data on offshore tidal fluctuations (at several locations), groundwater levels in shallow flow systems (along transects extending from the shoreline into the site), and barometric pressure.

- Offshore water depth and bottom material composition and thickness data.

- Potential yield and major ion chemistry data for possible water supply aquifers beneath the site.

- Off-site groundwater use data.

These data would be used to confirm and refine the site-wide conceptual hydrogeologic model described above (Section 4.2.3), develop water level maps and flow nets for the Special Study Areas, assess the effects of tidal fluctuations on groundwater flow, identify the location of groundwater discharge zones in surface water adjacent to the site, assess the suitability of on-site groundwater for drinking/domestic use, and identify off-site groundwater receptors (if any). These activities would then support optimization of a sampling and analysis program for characterizing the nature and extent of contamination for COPIs at the BSC Sparrows Point Facility and for performing ecological and human health risk assessments.



QUATERNARY
Pleistocene to Recent

Ql — Lowland Deposits - Talbot Formation
Gravel, sand, silt and clay. Medium- to coarse-grained sand and gravel; cobbles and boulders near base; commonly contains reworked Eocene glauconite; varicolored silts and clays; brown to dark gray lignitic silty clay; contains estuarine to marine fauna in some areas; thickness 0 to 150 feet.

CRETACEOUS

Kp — **Potomac Group**
Interbedded quartzose gravels; protoquartzitic to ortho-quartzitic argillaceous sands; and white, dark grey, and multicolored silts and clays; thickness 0 to 800 feet.

Patapsco Formation
Gray, brown, and red variegated silts and clays; lenticular, cross-bedded, argillaceous, subrounded sands; minor gravels; thickness 0 to 400 feet.

Arundel Formation
Dark gray and maroon lignitic clays; abundant siderite concretions; present only in Baltimore-Washington area; thickness 0 to 100 feet.

Patuxent Formation
White or light gray to orange-brown, moderately sorted, cross-bedded, argillaceous, angular sands and subrounded quartz gravels; silts and clays subordinate, predominantly pale gray; thickness 0 to 250 feet.

N

NOTE: MAP DERIVED FROM MARYLAND GEOLOGIC MAP, 1968

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FIGURE 4-1
GEOLOGICAL MAP OF THE SPARROWS POINT AREA
BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

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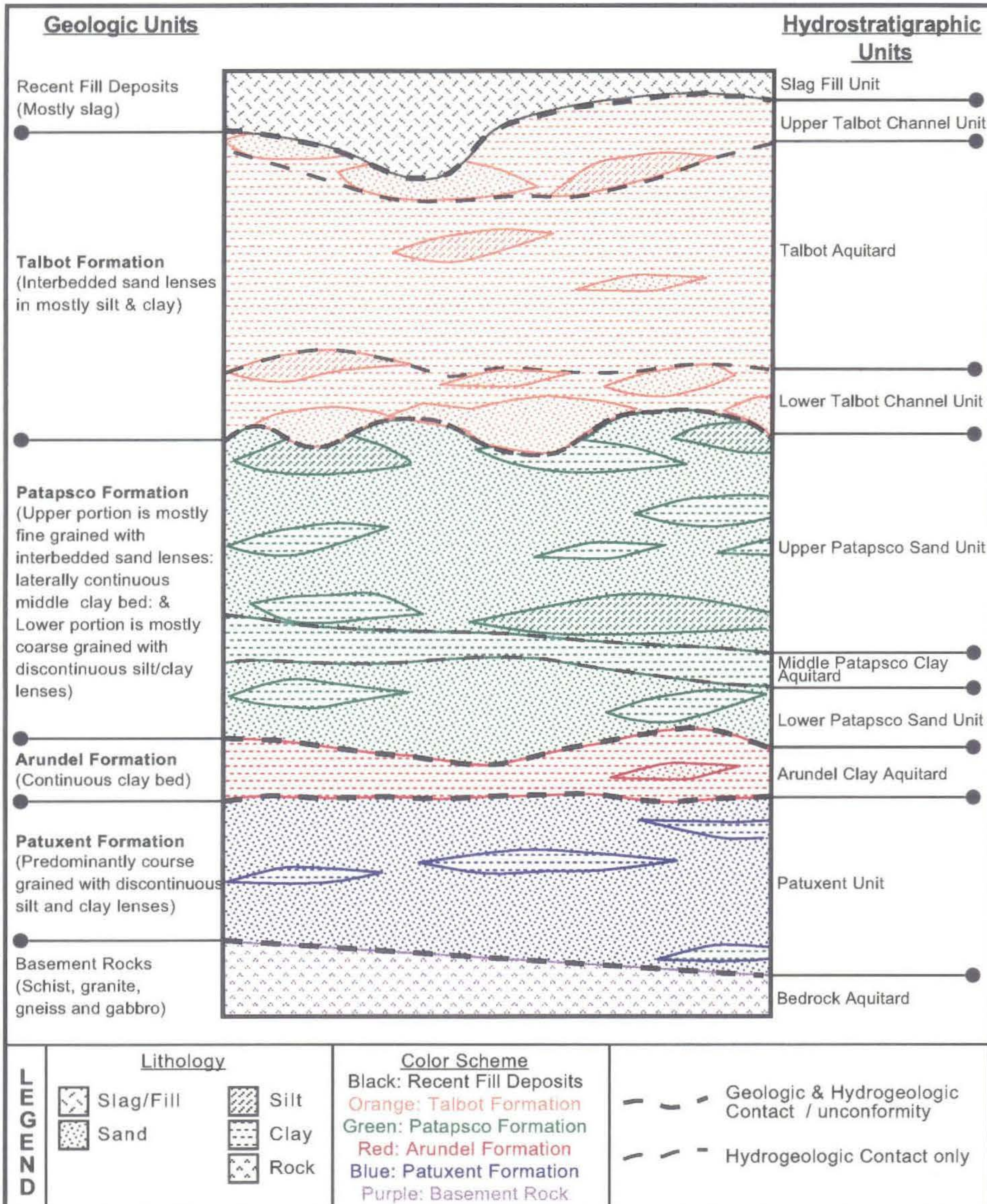
FIG4-1.CVS



DECEMBER 22, 1997

FIG4-2.CVS

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FIGURE 4-2

STRATIGRAPHIC COLUMN FOR SPARROWS POINT

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

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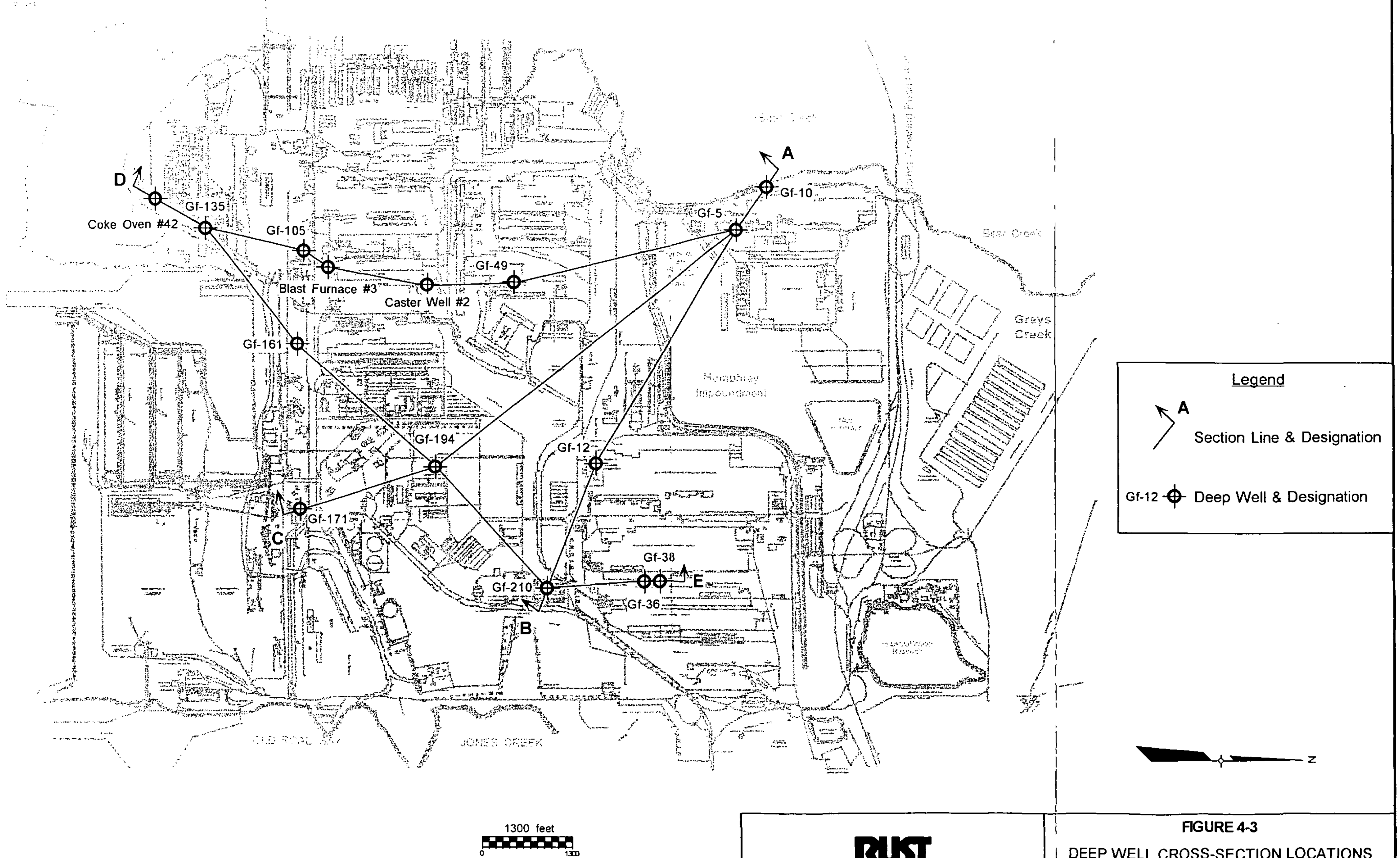

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FIGURE 4-3

DEEP WELL CROSS-SECTION LOCATIONS

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

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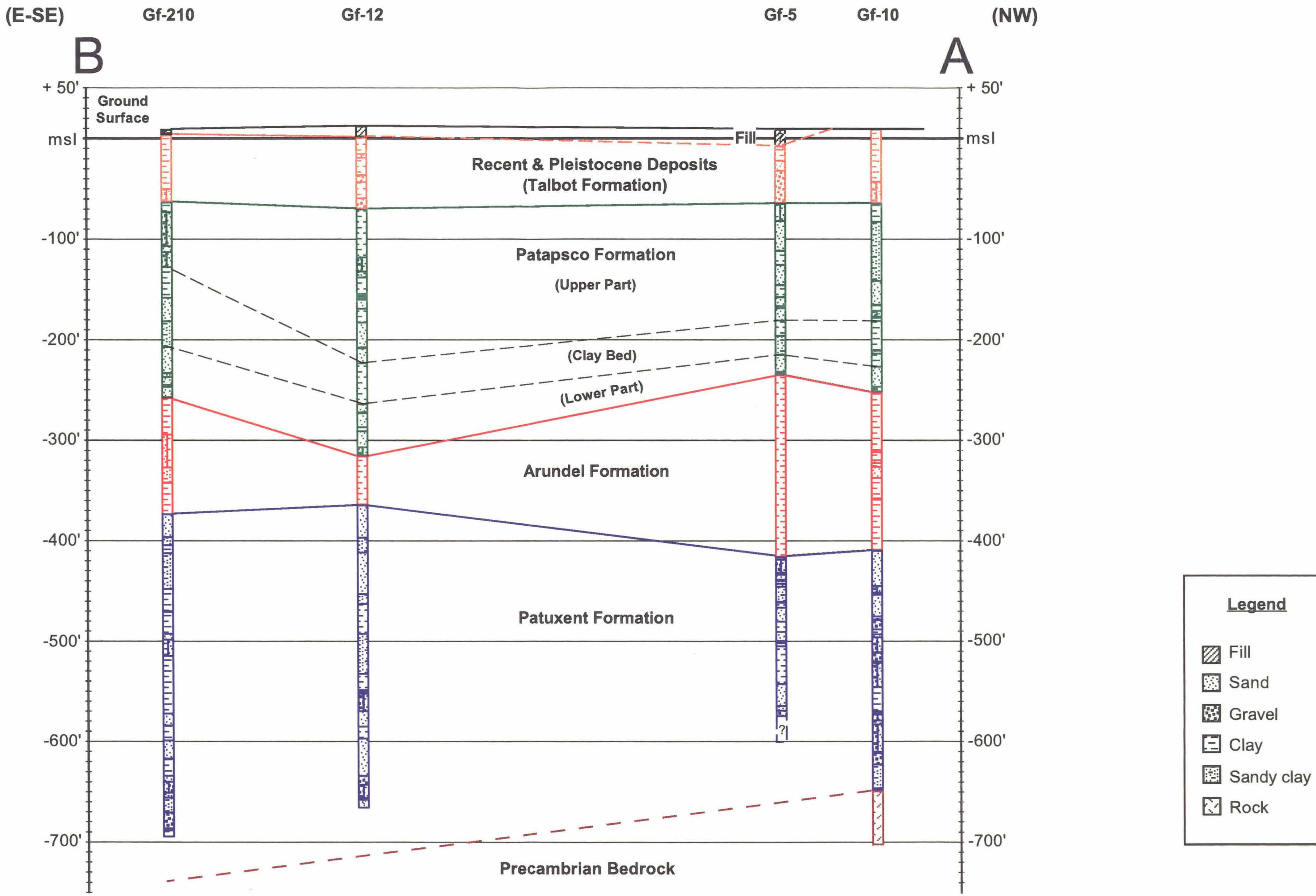

SCALE: 1" = 100' VERT. & 1" = 1000' HORZ.

LEGEND

Fill, Recent and Made-land	Arundel Formation, Cretaceous
Talbot Formation, Pleistocene	Patuxent Formation, Cretaceous
Patapsco Formation, Cretaceous	Basement Rock, Precambrian/Paleozoic

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FIGURE 4-4

DEEP WELL STRATIGRAPHIC CROSS-SECTION B-A

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

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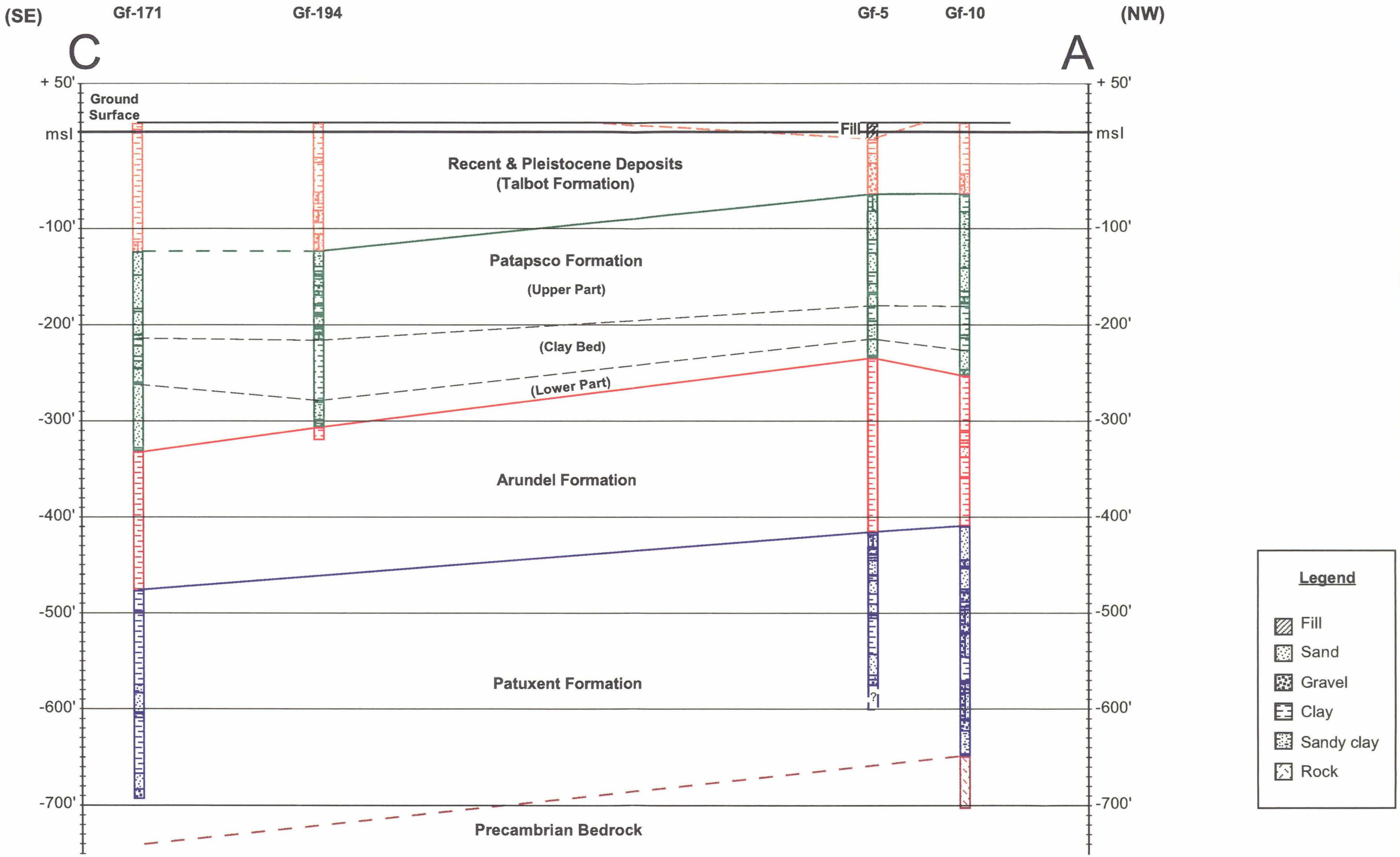
X-SEC.CVS



SCALE: 1" = 100' VERT. & 1" = 1000' HORZ.

LEGEND

- Fill, Recent and Made-land
- Talbot Formation, Pleistocene
- Patapsco Formation, Cretaceous
- Arundel Formation, Cretaceous
- Patuxent Formation, Cretaceous
- Basement Rock, Precambrian/Paleozoic

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FIGURE 4-5

DEEP WELL STRATIGRAPHIC CROSS-SECTION C-A

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

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X-SEC.CVS

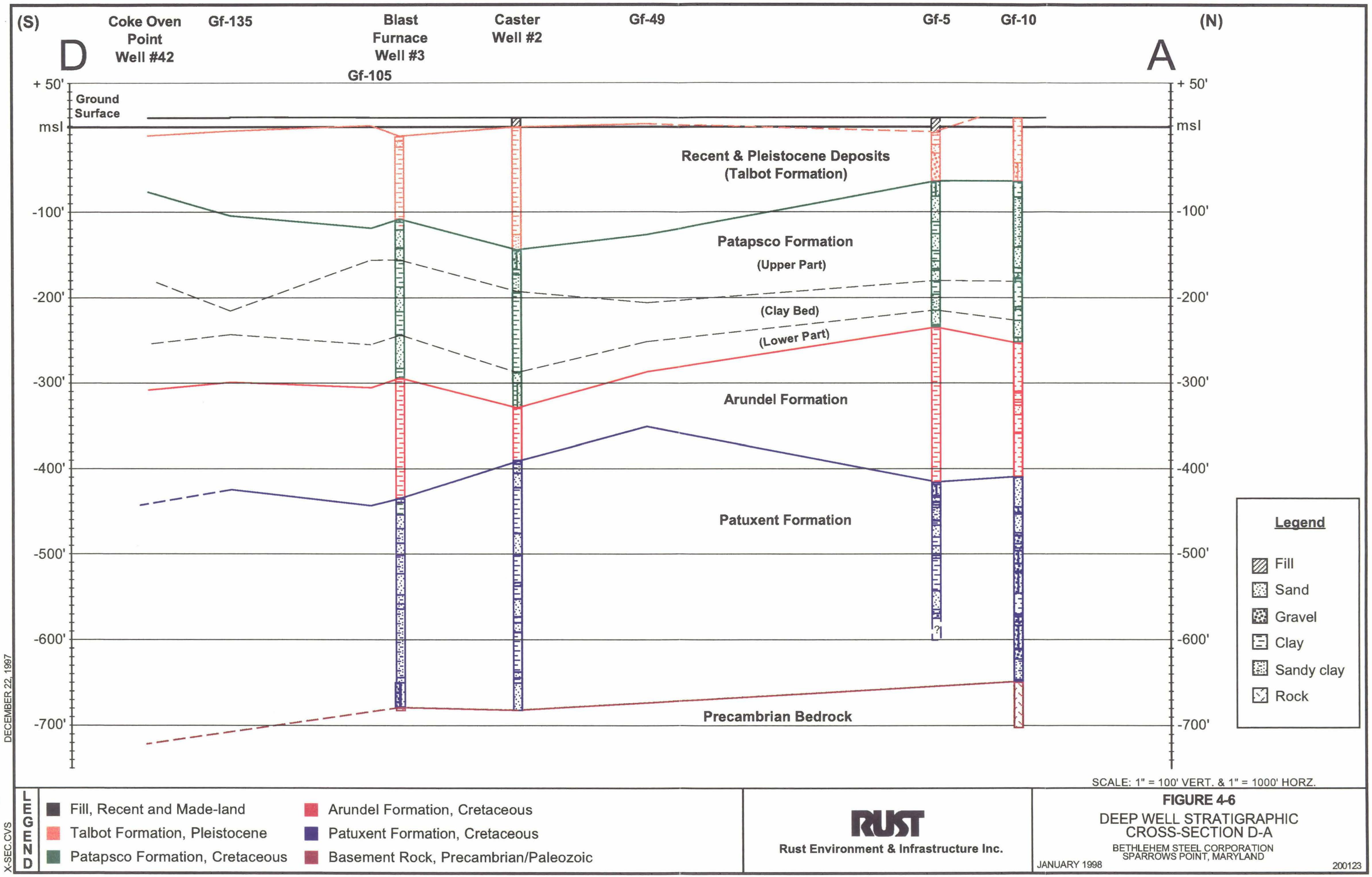

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FIGURE 4-6

DEEP WELL STRATIGRAPHIC CROSS-SECTION D-A

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

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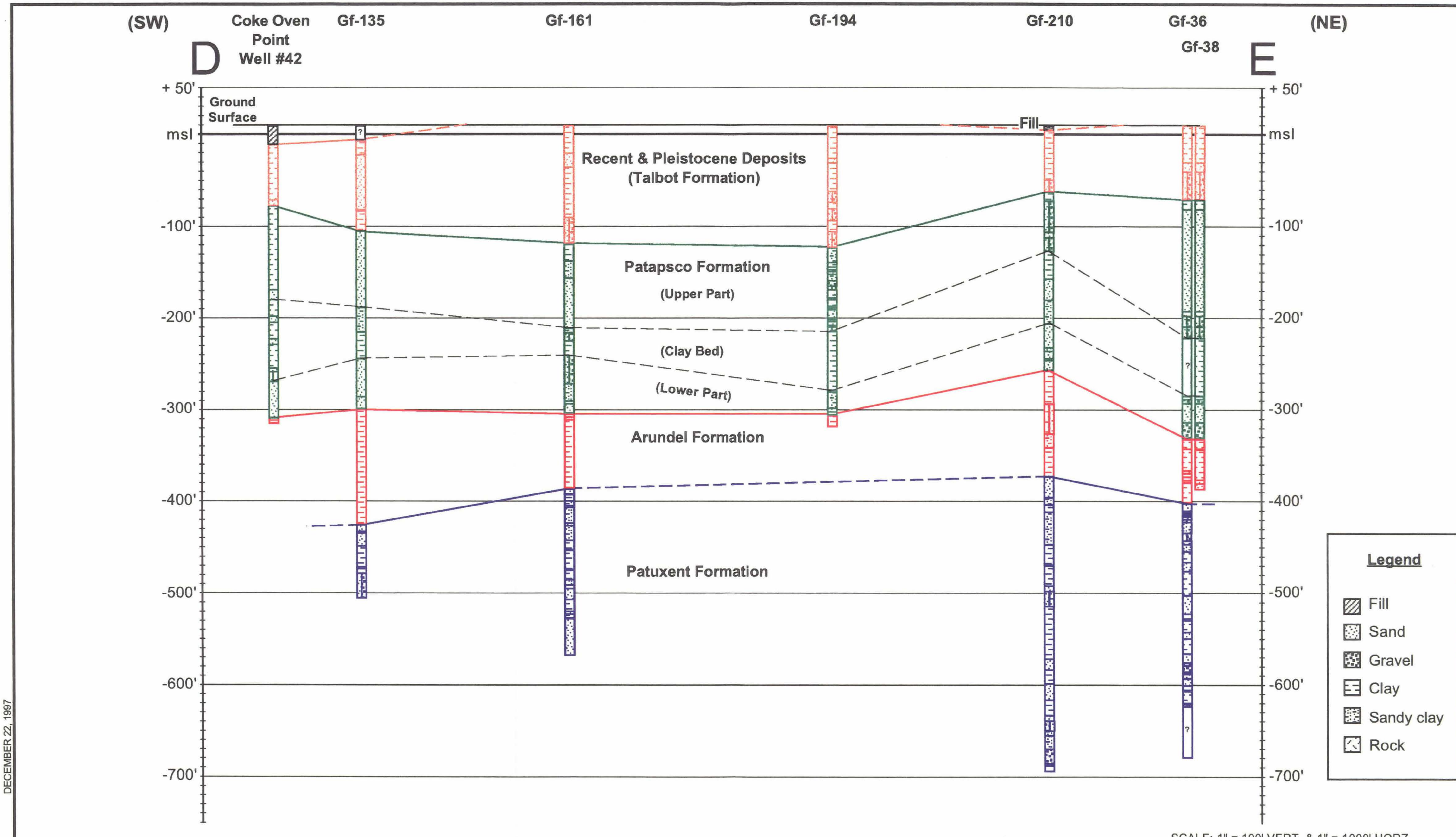

SCALE: 1" = 100' VERT. & 1" = 1000' HORZ.

LEGEND

- Fill, Recent and Made-land
- Talbot Formation, Pleistocene
- Patapsco Formation, Cretaceous
- Arundel Formation, Cretaceous
- Patuxent Formation, Cretaceous
- Basement Rock, Precambrian/Paleozoic

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FIGURE 4-7
DEEP WELL STRATIGRAPHIC CROSS-SECTION D-E
BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998

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X-SEC.CVS

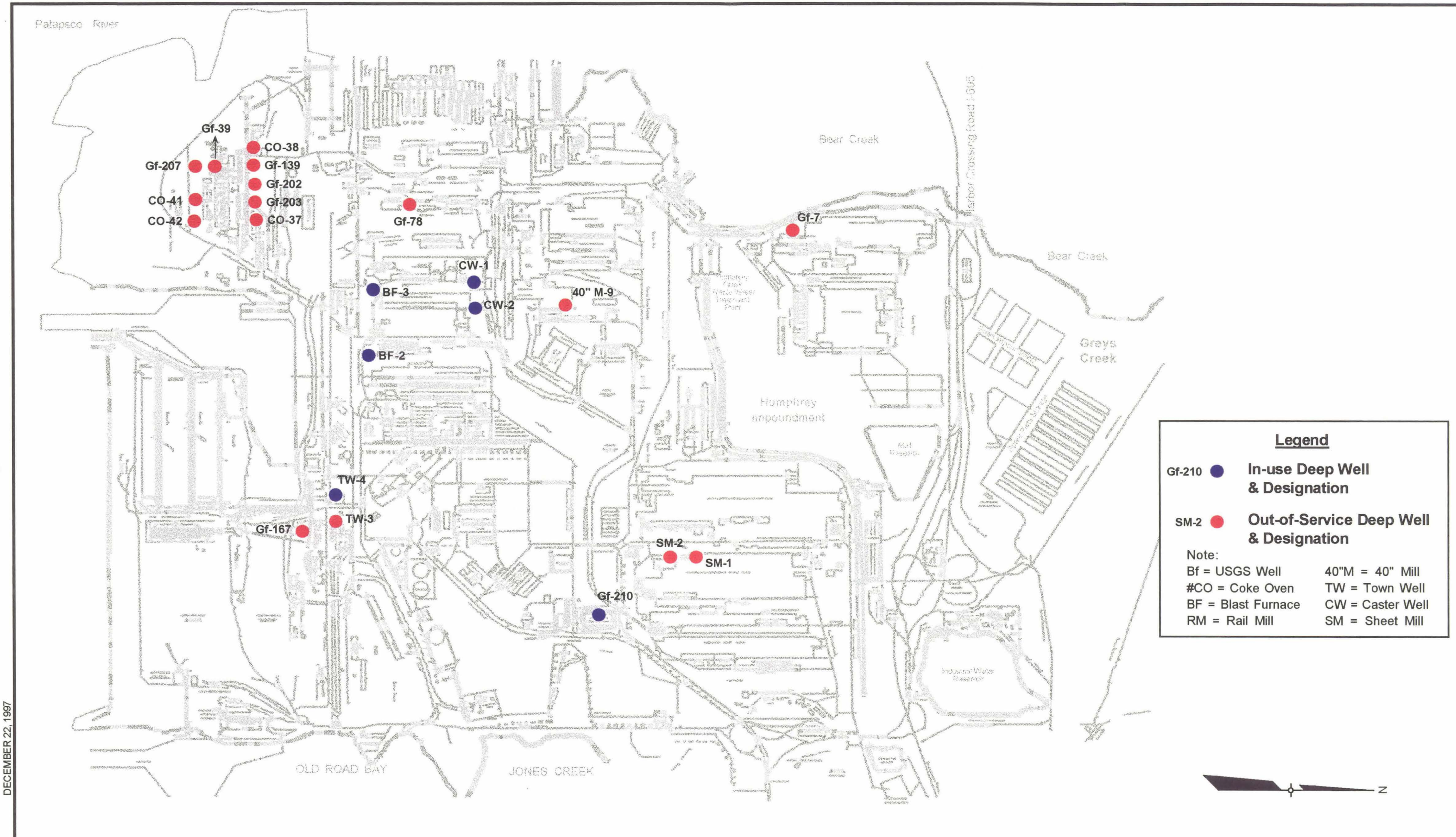

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FIGURE 4-8

LOCATION OF EXISTING DEEP WELLS

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

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BSC4.CVS

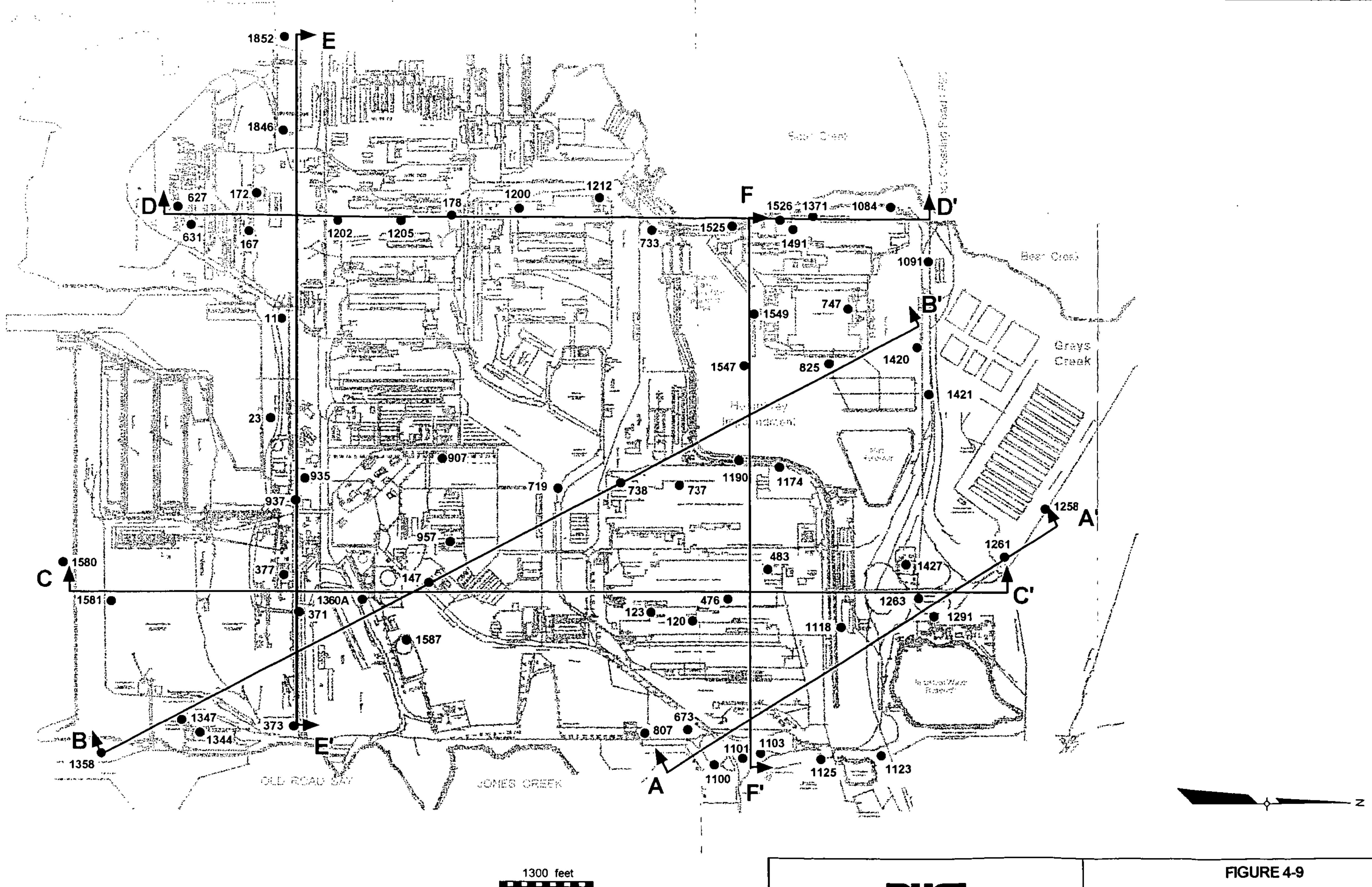

FIGURE 4-9

SOIL BORING CROSS-SECTION LOCATIONS

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

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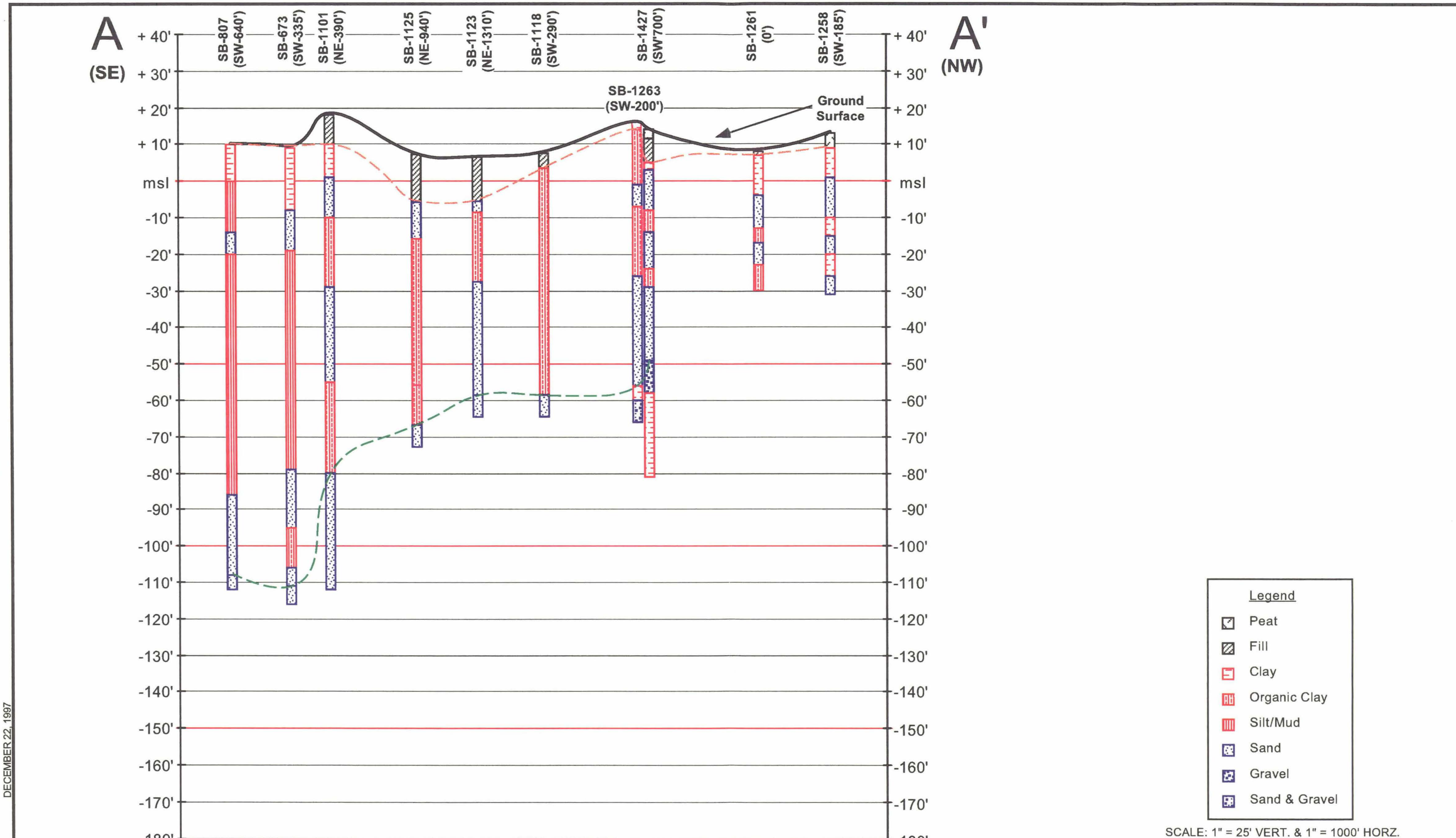
BSC4.CVS



DECEMBER 22, 1997

SBXSEC.CVS

LEGEND

- Top of Fill & Recent Materials/Ground Surface
- Top of Talbot Formation, Pleistocene
- Top of Patapsco Formation, Cretaceous

SB-483 (N-295') **Boring Designation & (Offset Direction - Distance)**

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FIGURE 4-10

SOIL BORING STRATIGRAPHIC CROSS-SECTION A-A'

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

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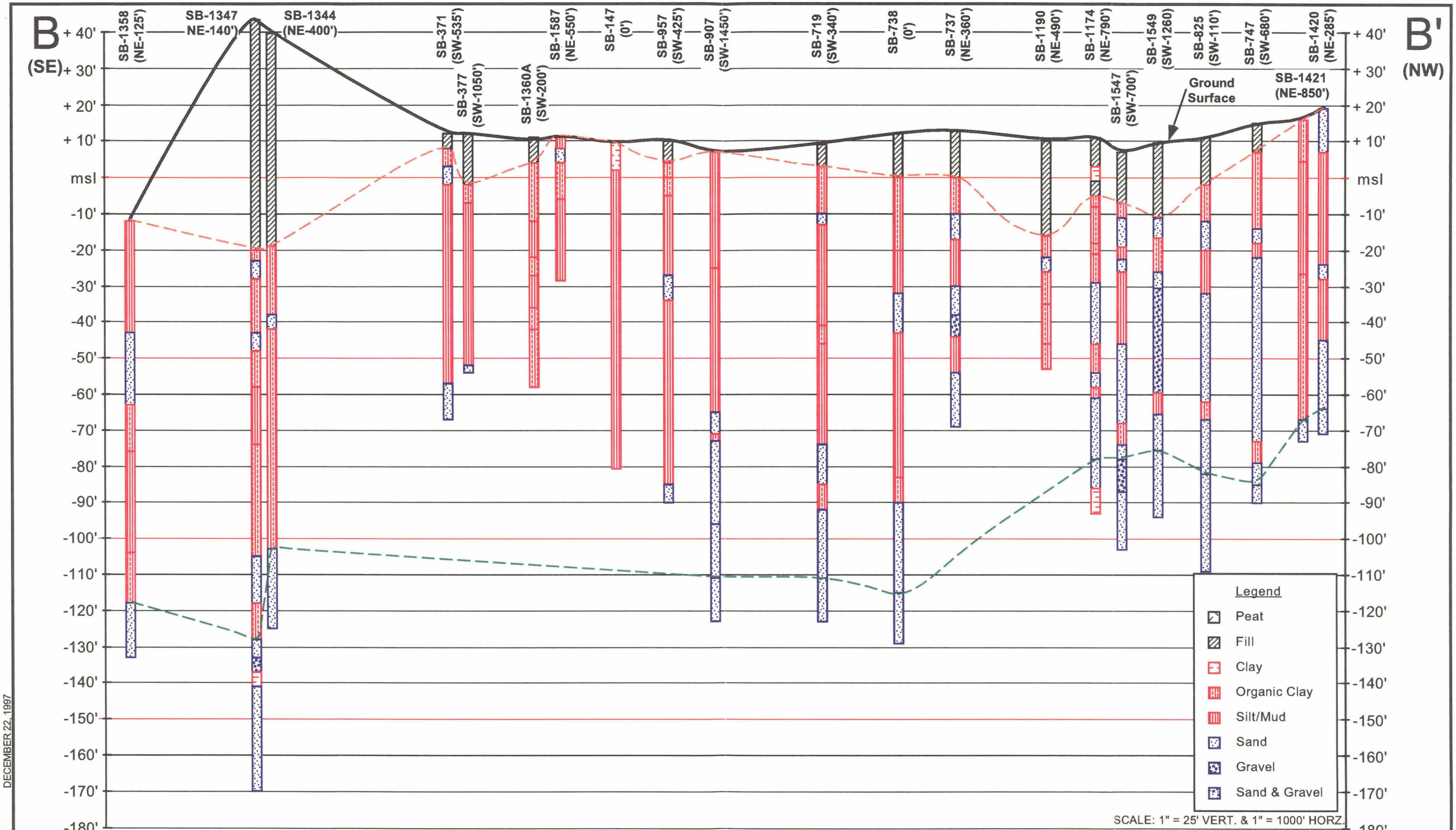

DECEMBER 22, 1997

SBXSEC.CVS

LEGEND

- Top of Fill & Recent Materials/Ground Surface
- Top of Talbot Formation, Pleistocene
- Top of Patapsco Formation, Cretaceous

SB-483 (N-295') Boring Designation & (Offset Direction - Distance)

RUST

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FIGURE 4-11

SOIL BORING STRATIGRAPHIC CROSS-SECTION B-B'

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

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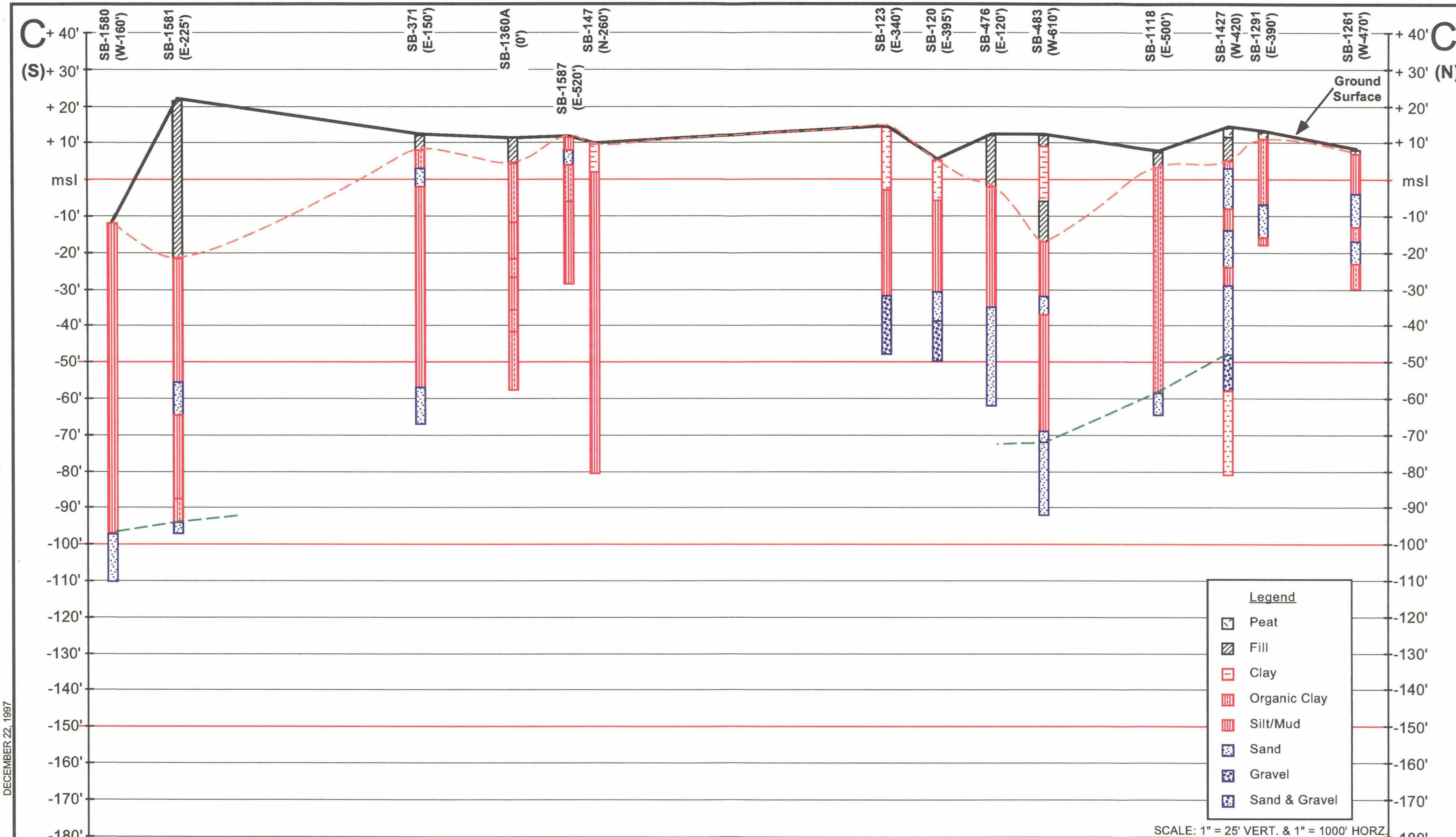

SBXSEC.CVS

LEGEND

- Top of Fill & Recent Materials/Ground Surface
- Top of Talbot Formation, Pleistocene
- Top of Patapsco Formation, Cretaceous

SB-483 (N-295') **Boring Designation & (Offset Direction - Distance)**

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FIGURE 4-12

SOIL BORING STRATIGRAPHIC CROSS-SECTION C-C'

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

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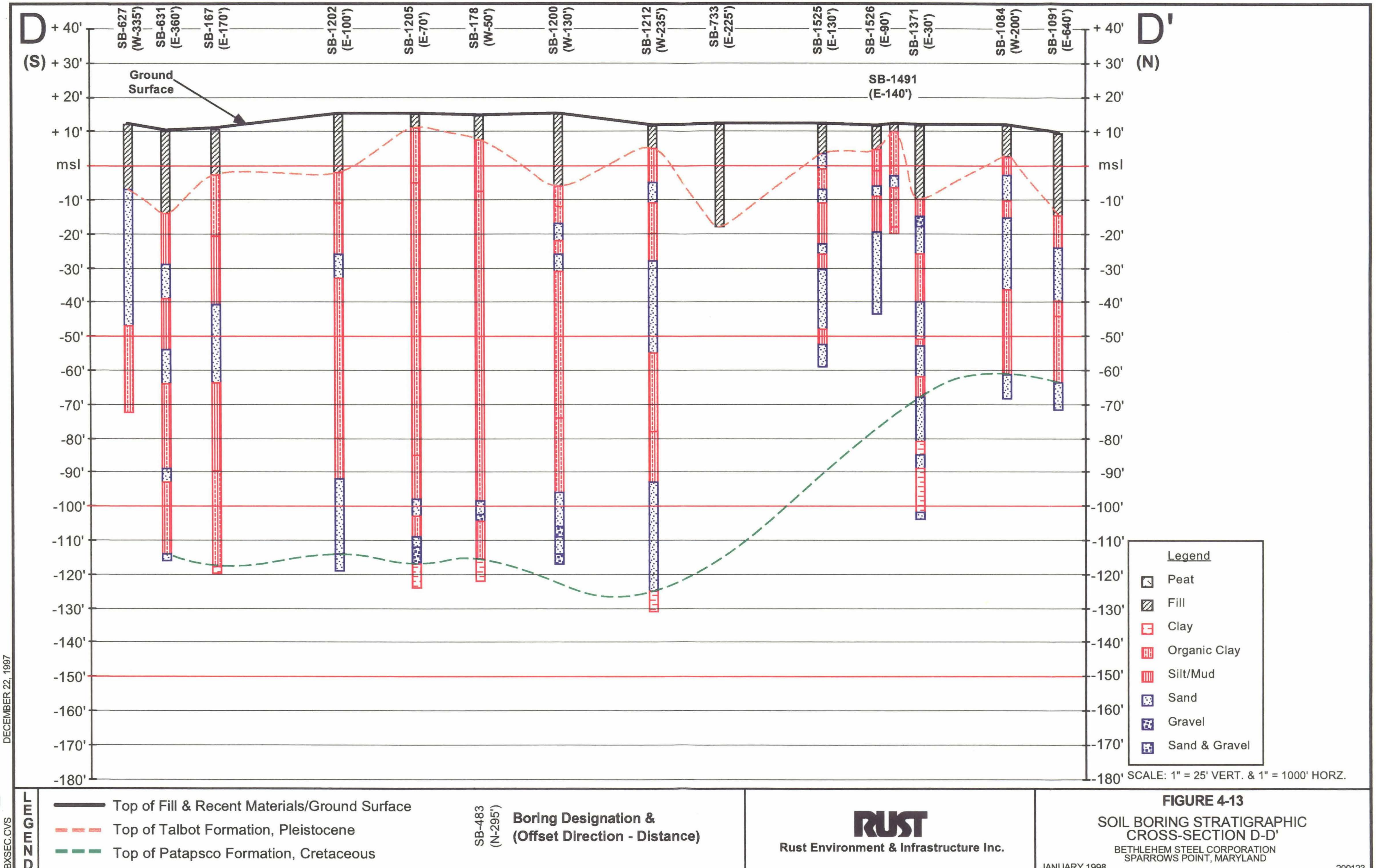

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FIGURE 4-13

SOIL BORING STRATIGRAPHIC CROSS-SECTION D-D'

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998

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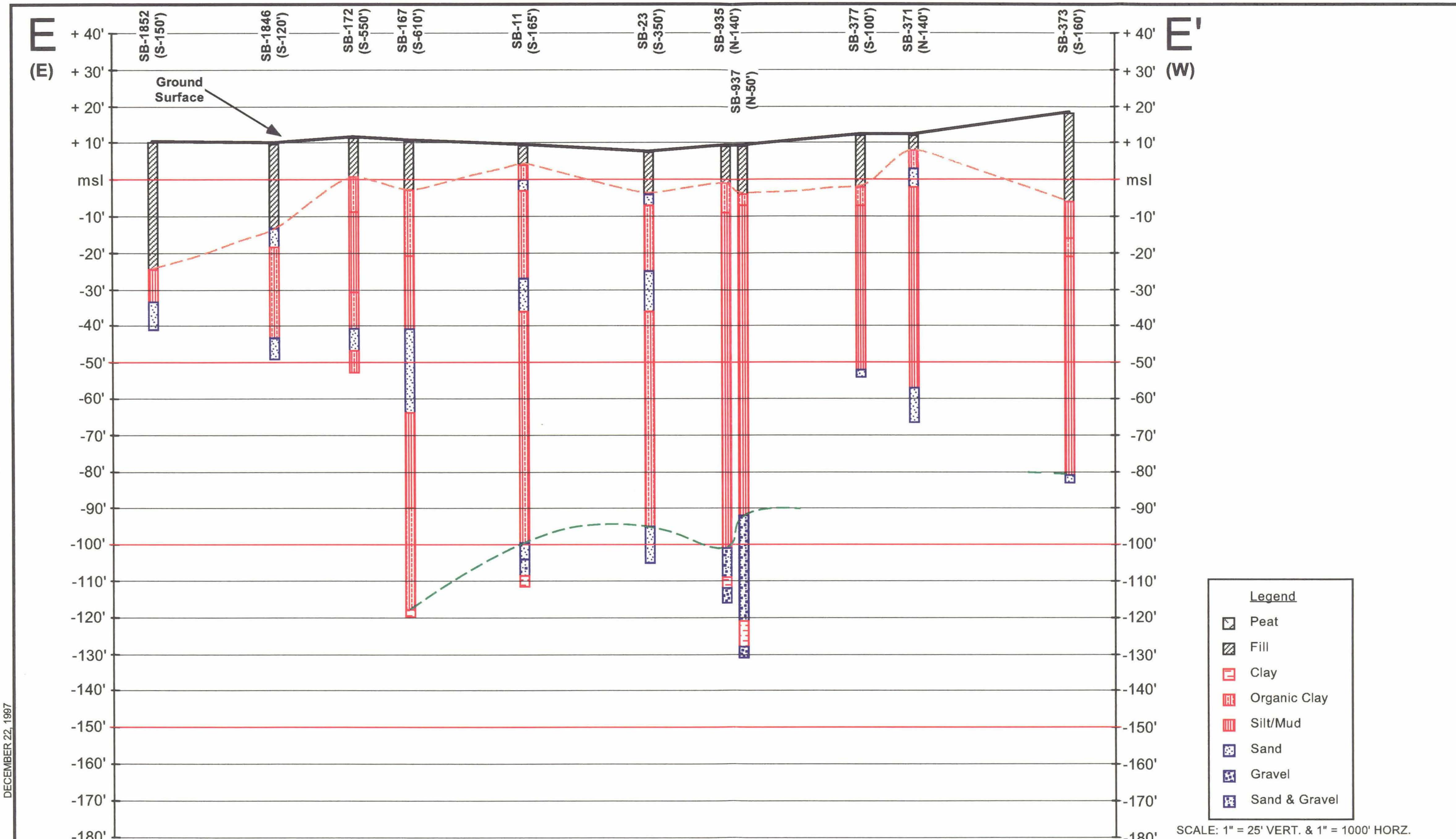
SBXSEC.CVS

DECEMBER 22, 1997



SCALE: 1" = 25' VERT. & 1" = 1000' HORZ.

DECEMBER 22, 1997

SBXSEC.CVS

LEGEND

- Top of Fill & Recent Materials/Ground Surface
- Top of Talbot Formation, Pleistocene
- Top of Patapsco Formation, Cretaceous

SB-483 (N-295') Boring Designation & (Offset Direction - Distance)

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FIGURE 4-14

SOIL BORING STRATIGRAPHIC CROSS-SECTION E-E'

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

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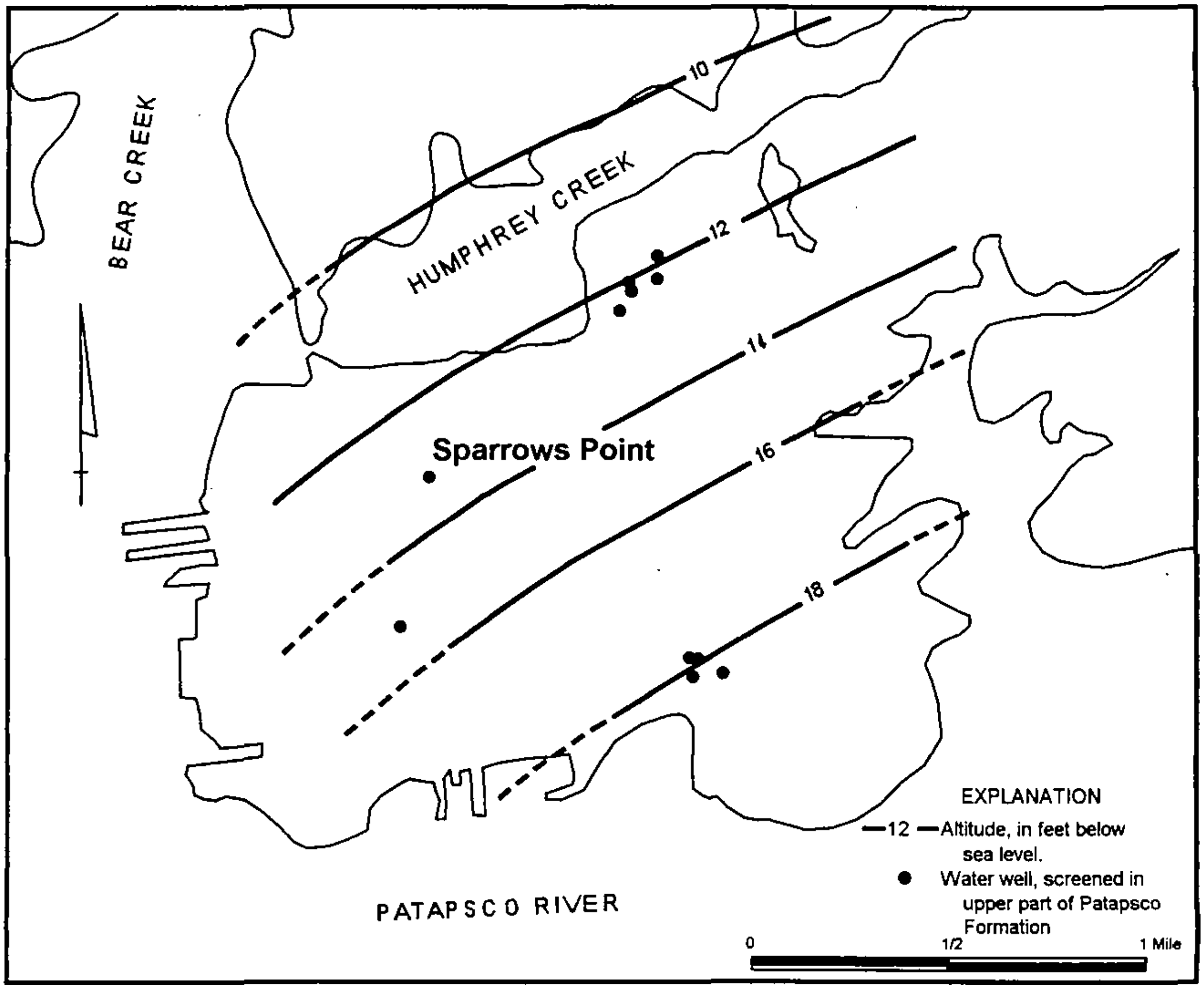

NOTE: MODIFIED FROM BENNETT AND MYER, 1952

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FIGURE 4-16

POTENTIOMETRIC SURFACE OF THE UPPER PATAPSCO - 1945

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998

200123

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FIG4-16.CVS

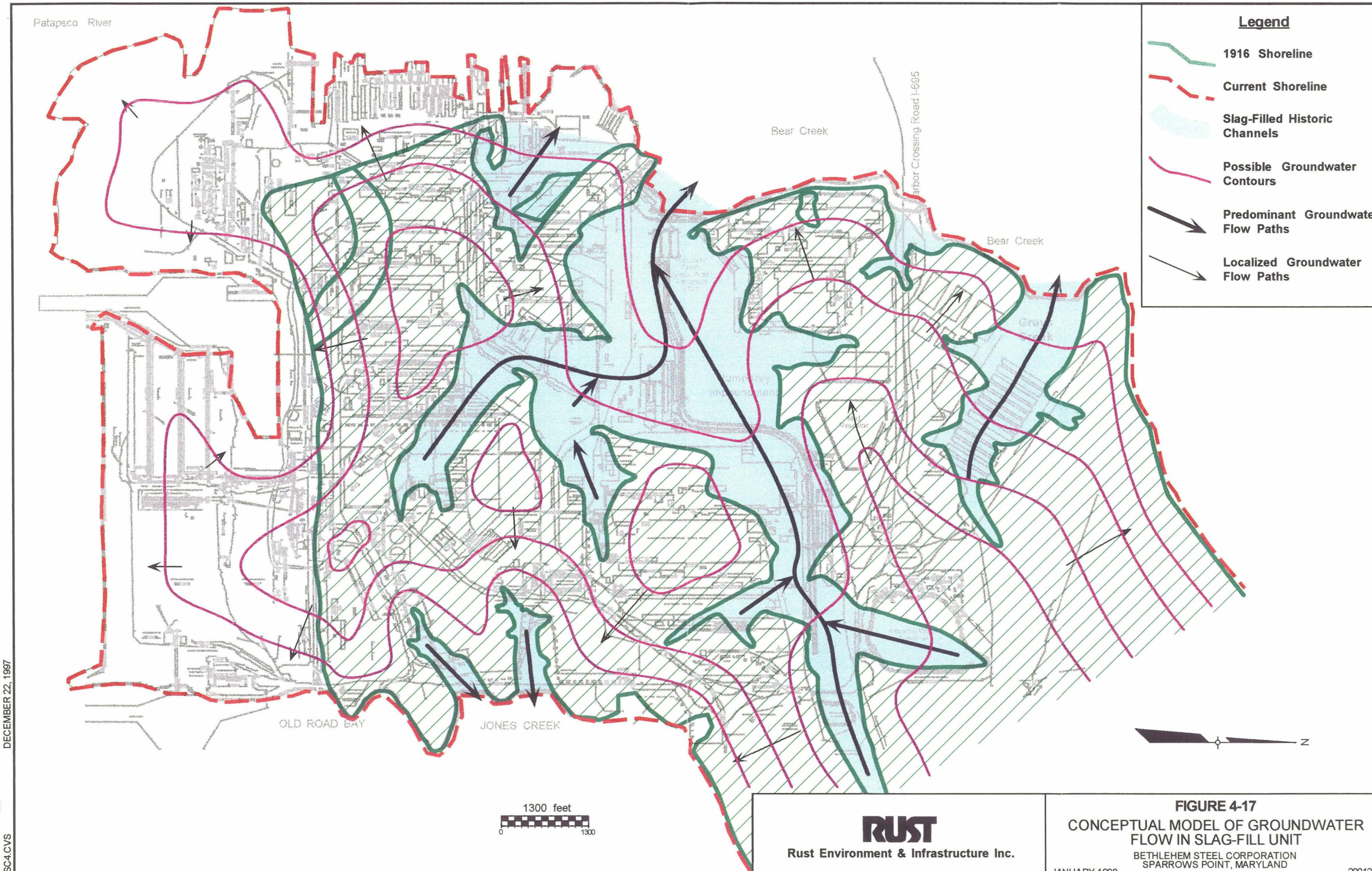

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FIGURE 4-17

CONCEPTUAL MODEL OF GROUNDWATER FLOW IN SLAG-FILL UNIT

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

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Table 4-1
Summary Production Well Information
Bethlehem Steel Corporation
Sparrows Point, Maryland

USGS Well #	BSC Well #	Date Installed	Total Depth (ft)	Surface Casting (ft)	Screened Interval (ft)	Producing Formation	Capacity (g.p.m.)	Static Head (ft) & Date
na	Blast Furnace #2	?	708	400	547-554 571-585 655-660 668-675 679-708	Patuxent	785	?
na	Blast Furnace #3	1960	691	400	gravel packed from 400 to 685	Patuxent	625	103 in 1960
Gf-220	Town Well #4	1969	742	691	691 - 732	Patuxent	500	94 in 1969
Gf-32	Hot Strip Mill Well #3	1937	668	335	525.8-536.1 571.2-577.7 637.6-668	Patuxent	445	103 in 1937
na	Caster Well #2	1984	691	450	gravel packed from 400 to 685	Patuxent	830	65 in 1984
na	Caster Well #1	1984	691	450	gravel packed from 400 to 685	Patuxent	830	65 in 1984

Table 4-2
Monthly Average Wind Speed, Temperature, and Total Rainfall
Bethlehem Steel Corporation
Sparrows Point, Maryland

Month	Average Wind Speed (mph)	Average Temperature (°F)	Total Rainfall (inches)
9/95	5.6	69	3.2
10/95	5.6	63	6.1
11/95	6.9	44	3.8
12/95	5.9	34	1.6
1/96	6.8	32	2.2
2/96	7.6	37	1.0
3/96	7.9	42	2.3
4/96	9.4	57	4.4
5/96	6.9	64	4.4
6/96	6.5	77	5.3
7/96	6.3	79	5.7
8/96	4.8	78	2.3
9/96	6.2	72	6.7
10/96	5.7	59	4.2
11/96	5.9	43	3.2
12/96	6.9	42	4.7
1/97	8.0	35	2.0
Annual	**Average Annual Wind Speed (mph)**	**Average Annual Temperature (°F)**	**Total Annual Rainfall (inches)**
1996 Summary	6.7	57	46.4

5.0 EVALUATION OF POTENTIAL RECEPTORS

5.1 INTRODUCTION

The purpose of this section is to present information describing potential receptors and their potential exposure to hazardous wastes and/or hazardous constituents released at or from the BSC Sparrows Point site. This section provides descriptions of ecological conditions at and in the vicinity of the site, potential on-site and off-site ecological receptors, regional ecological exposures to contaminants, off-site land uses and human receptors, on-site human receptors, and preliminary risk assessment conceptual models for on-site and off-site ecological and human receptors.

5.2 ECOLOGICAL CONDITIONS

This section describes the on-site and off-site ecological conditions. As discussed below, these conditions may limit habitat availability and therefore the number and significance of potential receptor populations. The on-site descriptions are based on recent reconnaissance surveys of the property and inspection of recent aerial photographs of the site. The off-site descriptions are based on the published results of numerous studies conducted in the Baltimore Harbor/Patapsco River region over the past several years. The BSC Sparrows Point facility is physically situated near the mouth of this highly industrialized watershed. These studies document the presence of regional impacts to the aquatic environment. Summaries of many of these studies are included in this report because an understanding of the regional conditions is necessary for evaluating the existing conditions of the aquatic environment at the Sparrows Point facility.

5.2.1 General Ecological Setting

The BSC Sparrows Point facility is located on a large peninsula in the lower Patapsco River. The site is bounded on the east by Old Road Bay, on the south by the Patapsco River, and on the west by the Patapsco River and Bear Creek. The lower Patapsco River is commonly referred to as the Outer Baltimore Harbor or the Outer Harbor. The entire Baltimore Harbor, including the Inner, Middle, and Outer Harbor, extends from the Baltimore City area downstream to the mouth of the Patapsco River.

The Patapsco River drains some of Maryland's most heavily urbanized and industrialized areas. The sediment, water quality, and ecological conditions in the Baltimore Harbor have been affected by the industrial and urbanized nature of the region (Coastal Environmental Services, Inc., 1995). A recent study of the Patapsco and Back River Watersheds (Coastal Environmental Services, Inc., 1995) indicates that there are approximately 200 NPDES-permitted industrial and municipal discharges in the 685 square miles of the watershed. Land use data for 1990 from the Maryland Office of Planning indicate that 44 percent of the land in the watershed is developed, 24 percent is in agricultural use, 30 percent is forested, and the remaining 2 percent is barren land, wetland, and water.

In a recent water quality inventory, the Maryland Department of the Environment (MDE) classified water quality in the Baltimore Harbor as "fair" (MDE, 1994). High ammonia and orthophosphate levels, elevated nutrients (nitrate and total phosphorus), and very low dissolved oxygen levels have been observed in the lower Patapsco River. The MDE water quality inventory cites a number of factors contributing to the "fair" water quality, fish consumption advisories, and swimming bans in the Baltimore Harbor. These factors include high levels of nutrients, elevated turbidity, urban and suburban runoff, elevated levels of chlordane, poor flushing characteristics in tributary creeks, and high bacterial levels.

5.2.2 Terrestrial Environmental Conditions

5.2.2.1 Overview

The following description of the terrestrial environment at Sparrows Point is based on aerial photographs (April 1996 and January 1997), and observations made during two site reconnaissances conducted by Rust Environment & Infrastructure (Rust) staff on May 8, 1996 and on February 10 and 11, 1997. A complete natural resource inventory of the terrestrial environment was not conducted for this report. Figure 5-1 is a map of the Sparrows Point peninsula showing the natural resource features on the property (i.e., key vegetated areas, ponds, narrow beaches, and intertidal flats).

Little "natural" environment exists at the Sparrow's Point facility. Most of the areas that are presently vegetated have had some previous land disturbance and nearly the entire shoreline of Sparrows Point has been hardened with slag, concrete debris material, or bulkheaded. However, there are areas of woods, meadows, intertidal beaches/flats, ponds, and wetlands, particularly in the northern and northeastern portion of the site. Only a few wetlands were identified on the property. These scattered areas provide fragmented habitat typically supportive of small and medium-sized mammals, passerine birds, raptors, waterfowl, and wading birds.

In general, most of the habitat areas identified are not located in proximity to any SWMUs or AOCs. Thus, relatively few receptor populations are potentially exposed to contamination in the terrestrial areas of the property.

5.2.2.2 Habitat Areas

Habitat areas are shown on Figure 5-1 and consist mainly of deciduous wooded areas and herbaceous or mixed herbaceous/scrub meadows. These vegetated areas are located predominantly in the northern and northeastern portions of the site and are described briefly below. There are a number of other vegetated areas within the boundaries of the facility that are not included on Figure 5-1, chiefly the roadway interchanges and the mowed grassed areas near the administrative buildings. The roadway interchanges are primarily maintained grass areas with scattered scrub vegetation. There are no significant vegetative communities within the industrial areas of the site.

Area A

A large sparsely vegetated area between I-695 and the Tin Mill Canal (Area A), incorporating the area known as Humphrey Impoundment, has undergone substantial alteration in the past by excavation and fill activities. The northern half of this area includes a wetland area referred to as Mud Reservoir on the map. The uplands in this area are characterized by a mixed herbaceous and scrub meadow community with scattered patches of trees. Prevalent species observed in this area include tree-of-heaven (*Ailanthus altissima*), goldenrod (*Solidago spp.*), common reed (*Phragmites australis*), asters (*Aster spp.*), Queen Anne's lace (*Daucus carota*), ragweed (*Ambrosia artemisiifolia*), groundsel tree (*Baccharis halimifolia*), Mexican bamboo (*Polygonum cuspidatum*), and various species of grasses. This area provides marginal habitat which typically supports small mammals such as field mice and passerine birds and feeding opportunities for various species of raptors. A large portion of this area is slated for construction of a new cold sheet mill.

The southern portion of this area basically encompasses the area known as Humphrey Impoundment, which has been filled in over the years and is characterized by dense thickets of *Phragmites*. This area is located in the vicinity of several SWMUs and AOCs and is itself identified as an SWMU (No. 190).

Area B

A wooded area in the eastern portion of the property, located between Sparrows Point Boulevard and Jones Creek and opposite of the facility administrative buildings, was formerly a residential community for BSC workers. An adjacent meadow area may have once served as the community park area (old ball field, gravel parking area). These areas, shown as Area B on Figure 5-1, are located in a portion of the property where there are no SWMUs or AOCs. All buildings have been removed from this area but the asphalt pavement of the abandoned streets remains. The wooded area is characterized by a mature stand of hardwood species and thick understory. Dominant species in this area include American beech (*Fagus grandifolia*), oaks (*Quercus spp.*), sweet gum (*Liquidambar styraciflua*), red maple (*Acer rubrum),* tulip poplar (*Liriodendron tulipifera*), sycamore (*Plantanus occidentalis*), eastern red cedar (*Juniperus virginiana*), groundsel tree (*Baccharis halimifolia*), poison ivy (*Toxicodendron radicans*), honeysuckle (*Lonicera japonica*), goldenrod (*Solidago spp.*), Queen Anne's lace (*Daucus carota*), and milkweed (*Ascepias spp.).* The meadow provides good habitat typically supportive of rabbits, other small mammals, and passerine birds and feeding opportunities for raptors. The wooded area provides habitat typically supportive of passerine birds and small and medium-sized mammals (e.g., raccoons, possums, squirrels).

Future land use of Area B is expected to change, as this area has been identified by the County as a potential industrial park.

Area C

Areas surrounding Greys Landfill (Area C) have become well-established with woods and meadows, and there are a few small ponds between the landfill and Bear Creek. The Tar Decanter Cell (Closed CHS Cell), which is contained within the landfill, and the landfill itself are SWMUs. Common species in the Greys Landfill area include black cherry (*Prunus serotina*), cottonwood (*Populus deltoides*), tree-of-heaven (*Ailanthus altissima*), white mulberry (*Morus alba*), black locust (*Robinia pseudoacacia*), royal paulownia (*Paulownia tomentosa*), groundsel tree (*Baccharis halimifolia*), common reed (*Phragmites australis*), sumac (*Rhus sp.*), poison ivy (*Toxicodendron radicans*), trumpet creeper (*Campsis radicans*), Virginia creeper (*Parthenocissus quinquefolia*), honeysuckle (*Lonicera japonica*), and goldenrod (*Solidago sp.*). The re-vegetated areas around Greys Landfill provide limited habitat value (shelter, food, water source) which is typically supportive of small and medium-sized mammals, passerine birds, and raptors. With the exception of two small segments of marsh and intertidal flat, the shoreline adjacent to Greys Landfill is steep, hardened with slag material and generally an inhospitable habitat for terrestrial or avian species.

Area D

The area lying along the north and south sides of the P&BR railroad yard in the northwestern portion of the site (Area D) consists of a large section of hardwoods and a mixed scrub/herbaceous meadow. This area is relatively isolated from the industrial activities of the facility and is further buffered from human activity along its boundaries by Bear Creek and the golf course at the Sparrows Point Country Club. This area is not located in proximity to any SWMUs or AOCs. This area contains the greatest length (roughly 4,500 feet) of naturalized shoreline on the BSC Sparrows Point property. Nearly the entire length of this shoreline (north of the Peninsular Expressway) is characterized by a sandy beach/flat exposed during low tides. The beach/flat transitions to a tidal marsh cove that forms the property boundary with the golf course. A vegetative species reconnaissance was not conducted in this area. Aerial photographs of this area indicate the presence of a few small water bodies and a few small wetland areas. The wooded and scrub meadow habitat in this area could support small and medium-sized mammals, passerine birds, and raptors. This area may also provide habitat for deer, as it adjoins larger open space areas to the north of the BSC property. The intertidal/beach zone along the shoreline offers good feeding opportunities for wading birds, and the near-shore wooded vegetation provides potential roosting areas for these same species. An osprey nest is located in the open area along the railyard tracks. Raccoon and fox tracks were identified in this general area during the February 10, 1997 reconnaissance.

Area E

The High Head Reservoir (Area E) is a man-made impoundment created for storage of the facility's "industrial water" supply (see Section 4.2.5). The reservoir is not in the vicinity of any SWMUs or AOCs. Except for the northern shoreline of this water body, nearly the entire perimeter of this reservoir is developed with industrial features. The northern shoreline is characterized by a wooded buffer and narrow beach/flat fringe at the water's edge. Seagulls and ducks were observed in this area during the February 11, 1997 reconnaissance. The reservoir provides a source of water to mammals that may venture over from the large vegetated area to the northwest along the P&BR rail yard and likely supports limited populations of fish species that typically inhabit small impoundments.

Area F

A large meadow and wooded area are located in the far northeastern corner of the property (Area F). The area is bisected by a few railroad spurs and is located adjacent to a major highway interchange. The meadow area is dominated by *Phragmites* reed grass. Although this area was not field reviewed, the wooded area appears to be dominated by hardwood species. This area is not located in the vicinity of any SWMUs or AOCs. Because of its proximity to surrounding industrial development and roadways and the predominance of *Phragmites*, the area is of limited habitat value for passerine bird species and small to medium-sized mammals. Three nearby water bodies and a marsh located to the south and west provide sources of water for medium-sized mammal species that may inhabit this meadow.

Area G

Two ponds, approximately 10 acres and 2.5 acres in size, and a 3.5-acre palustrine marsh, all in close proximity to one another, are located in the northeastern portion of the property (Area G). No SWMUs or AOCs are in the vicinity of these pond and marsh areas. Both ponds are bordered by a narrow fringe of trees which offer riparian shade and roosting perches for bird species. Small areas of wetlands were also identified along the margins of both ponds. This small complex of open water and marsh provides habitat for a variety of species of waterfowl, wading birds, passerine birds, and small and medium-sized mammals. The habitat value is very localized, as the immediate surrounding areas are densely developed. Several muskrat lodges were observed in the marsh and a pair of mute swans have successfully reared young on the smaller pond. The larger pond is known to support species of sunfish.

Area H

The northeastern-most edge of the site abutting Jones Creek offers some limited riparian habitat value (Area H). This small peninsula of land jutting into Jones Creek has been built up with fill over a number of years. There are no SWMUs or AOCs in or near this area. A large part of this area appears to have been used as a railyard and possible storage area. A narrow fringe of upland woods borders the BSC side of a narrow inlet to Jones Creek. The opposite shoreline of this inlet is characterized by a dense residential community with an extensive system of boat docks. The narrow wooded fringe offers limited shading and roosting opportunities for various species of birds. An intertidal sand/mud flat lies along the relatively shallow shoreline of the BSC property in this area. Because of the proximity of the docks, it is unlikely that this inlet provides significant breeding or feeding activity during the active boating season. This area provides habitat to small numbers of small and medium-sized mammals, and it is not too distant from larger habitat areas off-site and east of Sparrows Point Boulevard.

Area I

Four peninsula-like features extend into Jones Creek along the eastern facility boundary. All appear to have been altered by fill deposits over several years. One is fully developed into two marinas. Of the other three, only the peninsula referred to as "Fire Island" (Area I) offers any natural habitat. The other two are sparsely vegetated with a predominantly slag shoreline. None of the shoreline areas along Jones Creek are near any SWMUs or AOCs. Nearly half of Fire Island is wooded, and its shoreline is also slag but with a more gradual slope that has become vegetated. Along significant portions of its shoreline, a narrow beach and sand/mud bar has formed at the base of this slope and in the intertidal zone. The combination of this shoreline and fringing trees provides a good temporary refuge for several species of birds, particularly wading species. Several great blue herons were observed along this shoreline during the February 11, 1997 reconnaissance.

Industrial Areas

The industrial areas of the facility are nearly devoid of vegetation. Pioneer plant species have become sparsely established in abandoned facility areas, but not in any density that would provide habitat value. The most common pioneer species observed included cottonwood (*Populus deltoides*) seedings and saplings, goldenrod (*Solidago spp.*), common reed (*Phragmites australis*), chickweed (*Stellaria spp.*), and pepper grass (*Lepidium virginicum*).

The southern bluff-like shoreline of the Coke Point Landfill, while characterized by slag rubble, has become an attractive area to gulls during their breeding season. Numerous gulls were observed nesting on the slag mounds in this area during the May 8, 1996 reconnaissance. Gulls were also observed in the vicinities of the Bio-oxidation Plant and A Battery in the Coke Oven Area. The gulls in these areas appear to be transients with activities limited to simply resting and not feeding or nesting. All three of these areas are either in the vicinity of or are identified as SWMUs or AOCs.

5.2.2.3 Shoreline

Much of the shoreline at the BSC Sparrows Point facility has been hardened with slag material. A few areas of sandy beach or intertidal flat have formed at the base of the slag embankments. These areas and an apparently natural beach/flat shoreline along the northeast facility boundary along Bear Creek are highlighted on Figure 5-1. Some segments of the shoreline within the turning basin and along the shipyard have been bulkheaded.

The slag shoreline areas vary in terms of material consistency, height, degree of slope, and vegetative cover. The slag material along the shoreline includes consolidated and semi-consolidated fines, gravel and cobble size material, boulder size material, and concrete and brick rubble debris. The slag embankment sections vary from 5 to 50 feet in height and from nearly vertical to moderately sloping. Vegetative cover on these embankments is typically non-existent to very sparse and consists mainly of grasses and scattered salt bushes. Where the slag slopes are more gradual, a roughened (rock-like) intertidal and beach zone has developed. These slag and debris beaches and intertidal areas are too interspersed with shoreline segments that are more bluff-like to distinguish them on Figure 5-1.

The natural and naturalized sandy beaches and exposed intertidal flats, and to a lesser degree similar slag areas, provide foraging opportunities for wading and shorebird species. However, these areas are rather limited in comparison with the larger stretches of inhospitable shoreline. Shoreline feeding activity was not observed during either reconnaissance of the shoreline areas. None of the shoreline beach areas identified along the entire facility boundary are above the high tide line such that nesting opportunities would be available.

5.2.3 Aquatic Environmental Conditions

Sparrows Point is located near the mouth of the Patapsco River in the area commonly referred to as the Outer Baltimore Harbor. The lower Patapsco River extends upstream into the Baltimore City area where it branches into the Northwest Harbor and Middle Branch. All of these harbor segments of the Patapsco River are characterized by heavy industry and shipping terminals which becomes more intensified upstream towards the City of Baltimore. The peninsula-like Sparrows Point facility extends into the Outer Harbor with several miles of shoreline bordering on Jones Creek, Old Road Bay, the lower Patapsco River, and Bear Creek. A large shipping channel and turning basin also extends into the facility property from the southern shoreline. There are no natural streams within the BSC property and only a few onsite surface water features.

The Baltimore Harbor and the Sparrows Point facility are in a "well mixed" aquatic environment in which the influences of tidal flow significantly affect both pollutant transport and sediment settlement. Because of these tidal influences and because of the significant number of regional sources of pollution, tracking contaminants to their sources and assigning responsibility for contaminant concentrations in the water column and sediments will be difficult.

The following subsections describe the characteristics of the Patapsco River watershed and the water and sediment quality in areas surrounding the facility. This information was synthesized from existing documents, research papers and databases based on past studies conducted throughout the watershed. While these studies show a gradual improvement in contaminant levels in the aquatic environment and in aquatic populations, the studies also document the regional impacts to the aquatic environment. This information provides an understanding of the regional conditions which is necessary for evaluating the existing conditions of the aquatic environment at the Sparrows Point facility.

5.2.3.1 Watershed Loadings

A study of the loadings of chemical and nutrient inputs to the tidal portion of the Baltimore Harbor/Patapsco River was prepared in 1992 for the Baltimore Regional Council of Governments by the Chesapeake Research Consortium (Warner et al., 1991). The database includes all direct discharges of nutrients and chemicals from both industrial and municipal point sources. Non-point source chemical inputs were estimated using available data for atmospheric deposition, stormwater runoff, groundwater discharge, and chemical spills. The study found that overall loadings of nutrients and toxicants are generally greater for point sources than nonpoint sources for most of the measured parameters and that urban stormwater runoff appears to be the major cause of nonpoint source pollution.

Thirteen sub-watershed segments in the lower Patapsco River were established for analysis of contaminant loadings. Segments 7 (Lower Bear Creek), 8 (Upper Bear Creek), 9 (Outer Harbor), and 12 (Old Road Bay) are located within the vicinity of Sparrows Point.

The Lower Bear Creek Segment is characterized by nonpoint and point source discharges from both sides of the creek. Data from the BSC steel plant and shipyard facility, two additional industrial facilities, as well as atmospheric deposition, were used to estimate loads for 22 chemicals which are discharged to this segment. More than 4,000 pounds of total nitrogen, 37 pounds of bis(2-ethylhexyl)phthalate, and 960 pounds of iron were estimated to be released daily.

The Upper Bear Creek Segment encompasses several small creeks, is primarily residential, and is probably most impacted by urban stormwater runoff, marina effects, and industrial nonpoint source pollution. Only atmospheric deposition data were available for this segment and all chemical loadings are under 2 pounds per day, except for iron, which has an estimated loading of approximately 6 pounds per day.

The Outer Harbor Segment is characterized by a shoreline that is approximately 40 percent undeveloped, 40 percent industrial, and 20 percent residential. In addition to the BSC facility, data from another industrial facility, two Baltimore Gas and Electric facilities, one publicly-owned wastewater treatment plant, as well as atmospheric deposition, were used to estimate loads of 28 chemicals which are discharged to this segment. Approximately 27 pounds of lead, 43 pounds of copper, 264 pounds of iron, 57 pounds of cyanide, 4,700 pounds of residual chlorine, and 3,500 pounds of total nitrogen were estimated to be released daily to this segment.

The Old Road Bay Segment is described as heavily industrialized. BSC's Penwood outfall (001) is located within this segment. Data from BSC and atmospheric deposition data were used to estimate loads to this segment. The largest loading (123 pounds per day) of bis(2-ethylhexyl)phthalate occurs in this segment.

Comparison of the segments adjacent to Sparrows Point with other segments included in this study showed that the Middle Harbor, located just upstream of the Key Bridge (Interstate 695), receives the largest number of chemicals (49 chemicals), has the largest number of point source dischargers (17), and some of the largest contaminant loadings to the tidal Patapsco River. Conversely, the Outer Harbor, Lower Bear Creek, and Old Road Bay segments also receive some of the largest chemical loads in Baltimore Harbor but from relatively few point sources. The impact of contaminant loadings on the aquatic environment depends on the volume of water in each segment as well as the flushing times so direct comparison of loadings would not be accurate in predicting environmental effects.

Comparisons of industrial chemical and nutrient loading data for three assessment periods spanning 20 years were performed revealing a substantial reduction of loadings over the period from 1970 to 1990. Only nickel, cyanide, and base/neutral organics showed possible increased loadings, some of which may be attributable to changes in analytical methods over this time period. The apparent reduction in chemical loadings over the entire Patapsco/Baltimore Harbor is attributed to three main factors: improved industrial pretreatment, reductions in flows from major dischargers, and the closure of some facilities (Holland et al., 1988 and Scott et al., 1991 as reviewed by Warner et al., 1991).

5.2.3.2 Water Quality

Bay Ambient Toxicity Study

In 1990, 1991, and 1994, the Patapsco River and the mouth of Bear Creek were included in a Bay-wide ambient toxicity study (Hall et al., 1991; 1992; 1996) which included the sampling and analysis of the water column for conventional water quality parameters, inorganic contaminants, and some organic parameters. The Bear Creek station sampled for this study was located approximately 75 meters offshore from the BSC facility in the mouth of Bear Creek. Two Patapsco River stations were located near the navigation channel in the vicinity of the I-695 bridge and just offshore (about

½ mile) from the shipyard (Figure 5-2). This study also included stations in other portions of the Baltimore Harbor (Middle Branch, Northwest Harbor, and Curtis Bay).

None of the conventional water quality parameters exceeded the water quality standards (Table 5-1) at any of the stations near Sparrows Point. Of the inorganic parameters, the measured concentration of nickel exceeded the chronic aquatic life standard of 8.3 ug/L (Table 5-2). Because mercury concentrations were less than the detection limit, it is uncertain whether the chronic aquatic life criteria (0.025 ug/L) and the human health criteria for the consumption of fish (0.146 ug/L) were met or exceeded. None of the organic parameters (Table 5-3) had concentrations above detection limits. Hall et al., (1996) concluded that the results for all six of the Baltimore Harbor stations suggest that occasional toxicity can be observed in the water column at these various locations, but that possible causes of toxicity cannot be identified. They also concluded that high, potentially toxic concentrations of metals are generally not available in the water column.

Routine Surface Water Monitoring

As part of its Chesapeake Bay monitoring program, the MDE maintains a water quality monitoring station in the lower Patapsco River immediately downstream of the Key Bridge (I-695) just offshore of Hawkins Point (Station MWT5.1). Station MWT5.1 is located along the central channel about 1 mile west of the western shore of Sparrows Point. The Patapsco River in this area is classified as estuarine and is designated as a Class I water (Water Contact Recreation and Protection of Aquatic Life). Surface-water samples are collected 20 times per year at four different depths and analyzed for a number of physical and chemical constituents.

A review of the data collected for Station MWT5.1 from 1986 to 1990 reveals that these waters are moderately enriched with nutrients. High chlorophyll levels result in elevated turbidity and frequent algal blooms. Total chlorophyll levels were generally high (> 50 ug/L) in some replicate samples from May to early November each year, with some replicates ranging from 100-500 mg/L in the months of June to August (Maryland SAS Database, 1996).

Low dissolved oxygen concentrations (<5 mg/L) are associated with a stratified water column and high algal production, and anoxic conditions (<2 mg/L) have been reported for summer months. In general, dissolved oxygen concentrations at the Station MWT5.1 were below the Maryland water quality standards for Class I Waters (≥5.0 mg/L) every year between 1984 and 1995 during the period between April/May and late October/November (Maryland SAS Database, 1996). Dissolved oxygen concentrations were generally lowest for bottom samples and samples collected below the pycnocline limit.

The pH field measurements recorded at the Station MWT5.1 were generally within the Maryland water quality standards (≥6.5 and ≤ 8.5 standard pH units; Maryland SAS Database, 1996). All measurements except for some of the replicate samples in May and June 1988 were above the lower limit of 6.5. A few measurements, generally during the months of May to October, were greater than the upper limit of 8.5 but usually no greater than 9.0. Exceptions in which pH measurements were greater than 9.0 occurred in some replicate samples during May from 1992 to 1995.

5.2.3.3 Sediment Quality

A number of studies have been completed on the sediment quality in the lower Patapsco River and the entire Baltimore Harbor watershed. In general, these studies have found a widespread but patchy distribution of sediment contamination that decreases in the downstream direction (Eskin, et al., 1996). The sediment conditions have generally improved in the recent past. Studies have also found contradictory evidence about sediment toxicity due largely to differences in the bioavailability of the metals.

Bay Ambient Toxicity Study

As part of a Bay-wide ambient toxicity study, Hall et al. (1991, 1992, and 1996) analyzed metals in sediments sampled at a station on Bear Creek in 1990, 1991, and 1994, and at two stations in the Patapsco River (navigation channel at I-695 and offshore (formerly) BSC's Shipyard) in 1994. All three stations (Figure 5-2) were analyzed for semi-volatile compounds and pesticides in the 1994 study. Results of these analyses are shown on Tables 5-4, 5-5, and 5-6.

Reported levels of lead, chromium, and zinc exceeded the "Effects Range-Medium" (ER-M) screening levels (Long and Morgan, 1990). Copper and mercury exceeded the "Effects Range-Low" (ER-L) screening levels at all three stations during 1994, but did not exceed these levels during the 1990 and 1991 sampling events at the Bear Creek station. Cadmium exceeded the ER-M at only the Bear Creek station in 1994. In 1994, arsenic exceeded the ER-L at all three stations and the ER-M at the mid-channel station on the Patapsco River. Nickel levels exceeded the ER-L at all three stations in 1994 and the ER-M level at the Patapsco River station offshore BSC's Shipyard. Similar exceedances were also reported at the other Baltimore Harbor stations (Curtis Bay, Northwest Harbor, and Middle Branch).

Naphthalene and phenanthrene exceeded the ER-M in the Patapsco River offshore (formerly) BSC's Shipyard, and benzo(a)pyrene exceeded the ER-M in Bear Creek and in the Patapsco River offshore BSC's Shipyard. Pyrene and dibenzo(a,h)anthracene exceeded the ER-M at all three sampling stations. No pesticide values exceeded the ER-L or ER-M screening levels in this study.

Routine Sediment Monitoring

Data on sediment contaminations in the Baltimore Harbor have been collected annually by the MDE since 1986 as part of its tributary sediment contaminant monitoring program. The data, along with data for other areas of the Chesapeake Bay, have been synthesized in a report by the EPA Chesapeake Bay Program for the years 1984-1991 (Eskin et al., 1996). There are nine sediment sampling stations in three transects on the Patapsco River located in the vicinity of Sparrows Point (Figure 5-3). One transect is located on the upstream or northwest side of the Key Bridge, and two transects are located on the downstream or southeast side of the bridge. Within each transect, one station is located northeast of the central dredged channel, one station adjacent to the channel, and one station southwest of the channel.

The Eskin et al. (1996) report includes data on sediment concentrations of metals, total organic carbon and sediment grain size distribution for 1986 through 1991; concentrations of polycyclic aromatic hydrocarbons for 1986, 1987, and 1991; and selected pesticides and chlorinated organic compounds for 1991. The data were averaged over the study period for each sampling station and thus do not reflect an annual temporal pattern.

The Eskin, et al. report includes a graphical representation of metals data for each year and a graphical comparison between the 1991 data and data for 1973 reported by Villa and Johnson (1974) (Appendix 5A). In general, sediment concentrations of trace metals in 1991 averaged about 50 percent less than the corresponding measurement from the 1973 study (Eskin et al., 1996). Nickel, an exception to this trend, did not differ substantially between the two studies (Eskin et al., 1996).

Comparisons were also made to the No Observable Effects Level (NOEL) and the Probable Effects Level (PEL), which are respectively the threshold concentration for possible toxic effects to aquatic biota and the concentration above which toxic effects to aquatic biota are considered probable (MacDonald, 1993). A summary of the data for each of the sediment constituents is included in Appendix 5A. The locations of the stations referenced are shown in Figure 5-3.

5.3 POTENTIAL ECOLOGICAL RECEPTORS

5.3.1 On-Site Populations

Because of the developed character of the property and limited habitat available, the potential for a significant on-site ecological receptor population is limited and confined mostly to areas where vegetation has become re-established or along sections of the shoreline. Small and medium-sized mammals, gulls, and passerine birds are the predominant fauna inhabiting the pockets of wooded and meadow habitats that exist on site. Many of these species derive their source of food from lower forms of organisms inhabiting the soils and partially decomposed materials above the soil layer.

Raptors and red fox appear to dominate the predatory guild on site. Because there are so few on-site aquatic features, there are relatively few on-site aquatic populations. Water, wading, and shore birds are the most obvious animals inhabiting the site, with the greater concentrations of these species occurring along the shorelines of the property. These species appear to be feeding on intertidal and offshore aquatic organisms. The following provides a more detailed discussion of the species observed on site or probable occurrence of species based on habitat features.

5.3.1.1 Avian Populations

Avian populations at the Sparrows Point and in the near-shore areas include relatively small numbers of raptors, passerine species, wading birds, shore birds, and various species of waterfowl. The following describes the observations made during two reconnaissances conducted by Rust Environment & Infrastructure personnel on May 8, 1996 and February 10 and 11, 1997.

Sea gulls account for the largest group of birds observed at the Sparrows Point. Ring-billed gulls (*Larus delawarensis*) and herring gulls (*Larus argentatus*) were noticeably more abundant than great black-backed gulls (*Larus marinus*). Gulls were observed both in flight and congregating in several areas of the facility, with heavier concentrations in the Coke Point Landfill area. Gulls were also observed in the vicinities of the Bio-Oxidation Plant and A Battery in the Coke Oven Area. The gulls in these two areas appear to be transients with activities limited to simply resting and not feeding or nesting. All three of these areas are located either in the vicinity of, or are identified as, SWMUs or AOCs. During the May 8, 1996 reconnaissance, numerous gulls were observed nesting on the slag mounds at Coke Point Landfill. The slag cobble and gravel material has a consistency similar to the preferred nesting habitat for some species of gulls, which probably accounts for the congregation of gulls at this site. At the time of the May 8, 1996 reconnaissance, none of the gull eggs had hatched. Coke Point Landfill is used annually by gulls as a nesting area and nest hatchlings are commonly observed in the spring. Several ring-billed, herring, and black-backed gulls were also observed on the water and near-shore areas of the High Head Reservoir, which is located in the northwestern portion of the BSC facility. Evidence of seagull feeding activity (shells) and roosting (feces) were noted along the concrete rubble/debris shoreline of the shipyard along Bear Creek and on the docks of the two yacht clubs along Jones Creek.

Five osprey (*Pandion haliaetus*) nests are present within the facility boundaries. The locations of these nests, typically situated at the tops of utility poles, were at the P& BR railroad yard, the scrap preparation yard, the Pennwood shipping wharf, near the coal storage yard, and between the coal storage yard and Coke Point Landfill. The approximate locations of these nests are shown on Figure 5-1. Three of these nests are in the general vicinity of SWMUs or AOCs. During the May 8, 1996 reconnaissance, ospreys were observed on or near these nests. These nests are usually active and productive in most years. Osprey activities on site are limited to seasonal nesting and rearing of young (in the nest). Ospreys are fish eaters and typically feed offshore in deeper water bodies.

On February 11, 1997, a flock of thirteen great blue herons (*Ardea herodias*) was observed standing along a narrow beach on the southeast shoreline of Fire Island. There is no apparent evidence of a rookery in the wooded areas of Fire Island. Fire Island is not in the vicinity of any SWMUs or AOC. A few great blue herons were observed in the upper end of High Head Reservoir and the pond in the headwaters of Humphrey Creek. While great blue herons were not observed elsewhere during either reconnaissance, a few additional locations along the property shoreline and internal areas provide suitable opportunities for wading, feeding, and roosting. These areas are located along the Bear Creek shoreline north of the P&BR railroad yard, the northern-most BSC shoreline along Jones Creek, and in two ponds and a marsh located in the northeastern portion of the property south of Bethlehem Boulevard.

American coots (*Fulica americana*) were observed (about three dozen total) on February 10 and 11, 1997 in two areas: High Head Reservoir and near the mouth of the turning basin at the southern end of the property. About 90 canvasback ducks (*Aythya valisineria*) were also observed in two areas: near the mouth of the turning basin and in a narrow inlet located between the Coke Point Landfill and the dredge settling basins.

The presence of waterfowl within and in the nearshore areas of the property is most likely a seasonal or transient occurrence. The impoundments and embayments are quiet areas where these species can retreat during bad weather. Waterfowl activities are limited to swimming/floating and foraging. No suitable nesting habitat exists in these areas and no rearing of young would occur in these areas for this reason.

Sightings of the following species (in flight) were also made during the two reconnaissance visits: barn swallows (*Hirundo rustica*), starlings (*Sturnus vulgaris*), crow (*Corvus sp.*), Carolina chickadee (*Parus carolinensis*), northern mocking bird (*Mimus polyglottos*), mourning dove (*Zenaida macroura*), double-crested cormorant (*Phalacrocorax auritus*), merganser (*Mergus sp.*), tern (*Sterna sp.*), mallards (*Anas platyrhynchos*), and sparrows (*Zonotrichia sp.*). During the February 1997 reconnaissance, several medium-sized stick nests (from a previous year) typical of breeding blackbird colonies were observed in a wooded fringe area along the northern-most BSC property boundary along Jones Creek. The following species also occasionally occur onsite: bobwhite quail (*Colinus virginianus*), wood ducks (*Aix sponsa*), various species of hawks (*Buteo spp.*), red-winged blackbird (*Agelaius phoeniceus*) and a breeding pair of mute swans (*Cygnus olor*). The swans reportedly have visited the site for four years and successfully raised a brood of four in 1996. The area preferred by the swans is the two ponds located in the northeastern portion of the site. Neither pond is in proximity of any SWMUs or AOC. Two bald eagles (*Haliaeetus leucocephalus*) roosted on the site for one week during 1995.

Correspondence received from the Maryland Department of Natural Resources (DNR), Fish, Heritage and Wildlife Administration (1996) indicates that there is a known Colonial Waterbird Nesting Site located within 1 mile of the facility. The U.S. Fish and Wildlife Service indicated that a black crowned night heron rookery exists along the north shore of the Patapsco River in the vicinity of the Key Bridge (I-695) (Foley, pers. comm., 1996), which is likely the same colony referred to by the Maryland DNR. This agency also indicated that the open waters adjacent to the facility are known historic waterfowl concentration areas during the wintering period (November 1 to April 30).

5.3.1.2 Mammalian Populations

The only mammalian observation made during the May 8, 1996 site reconnaissance was rabbit scat in the abandoned coke processing area. Anecdotal information from the site staff indicates occasional occurrences of fox. A red fox (*Vulpes vulpes*) road kill was spotted near the interchange of Sparrow's Point Boulevard and I-695 during a site visit on November 7, 1997. During the February 10 and 11, 1997 reconnaissance fox tracks were observed in the areas of Greys Landfill, the railroad yard north of Greys Landfill, and the large meadow area between Tin Mill Canal and I-695.

Several muskrat (*Ondatra zibethicus*) lodges were observed in the marsh area located immediately south of the Deitrich Industries building and north of a P&BR railroad spur during the February 10 and 11, 1997 reconnaissance. A burrow in the bank of the nearby pond just south of this marsh, possibly that of a muskrat, was also noted.

A snowfall just prior to the February 10 and 11, 1997 reconnaissance enabled numerous observations of rabbit (*Sylvilagus floridanus*) and other small mammal tracks in the large meadow area between the Tin Mill Canal and I-695. This meadow area offers a high diversity of vegetative cover types including dense scrub thickets, scattered trees, and mixed grasses and forbs that would support a number of species of small mammals. Rabbit tracks were also observed in the Greys Landfill area.

A white-tailed deer (*Odocoileus virginianus*) was observed in the Greys Landfill area several years ago. Gray squirrels (*Sciurus carolinensis*) are present in three areas of the property: the area surrounding the main administrative building, the large wooded area directly east of the administrative building, and the wooded area lying north of the Peninsular Expressway and the P&BR railroad yard.

5.3.1.3 Reptile and Amphibian Populations

Habitat suitable for a variety of species of turtles, snakes, toads, and frogs exists only in limited areas of the property. The range of frogs and turtles are probably limited to those areas where access to water bodies or wetlands is available. No species sightings or evidence of these groups were observed during either reconnaissance.

There have been occasional sightings of turtles in the immediate vicinity of the ponds in the northeastern portion of the site. This area also provides habitat opportunities for other amphibians and reptiles. Area D, the area which lies on both sides of the P&BR railroad yard, is the only other location on the property that contains habitat suitable for reptile and amphibian species.

Areas that have become re-established with vegetation such as Greys Landfill (Area C), the abandoned residential area (Area B), and the meadow/Humphrey's Impoundment area (Area A) are not expected to support significant reptile or amphibian communities because of previous land usages, current surrounding activities and the isolated location of these areas.

5.3.2 Off-Site Populations

The following summary of past studies presents a characterization of the aquatic communities that are present in the Baltimore Harbor. Some of these species represent potential receptor organisms in the risk assessment study to be conducted at BSC. The presence or absence of species and the composition and abundance of populations can be greatly influenced by many factors -- particularly the physical conditions of the nearshore environment. The Sparrows Point facility is physically located at the mouth of a large urbanized watershed which is subjected to high volumes of river flows and tidal fluctuations. Because of its peninsular exposure within the surrounding large water bodies, high energy wave action also aggravates the nearshore environment. In addition, much of the BSC shoreline is hardened, and lacks natural vegetated shoreline areas, submerged aquatic vegetative beds, wetlands or quiet embayments. In combination, all of these features contribute to a generally unfavorable nearshore environment surrounding the facility.

5.3.2.1 Fish Populations

General Studies

The earliest comprehensive survey of fish species in the Baltimore Harbor was performed in 1970 by Koo et al. (1975). Twenty-one species of adult fish were reported with white perch being the dominant species. A high number of juvenile white perch were also reported suggesting that Baltimore Harbor is a nursery area for this species.

Wiley (1975) reported several indicators of stressed fish populations in Baltimore Harbor. An absence of bottom dwelling fish compared to a reference area was attributed to polluted bottom sediments. White perch were reported to have increased incidents of infected lateralis systems and deteriorated fin tissue as water temperatures increased with summer.

Dovel (1975) captured fish eggs, larvae, young, and adults within the entire Baltimore Harbor. Dovel found six species of fish in the Patapsco River main stem. Bay anchovy eggs were found throughout the entire Harbor, indicating that Bay anchovies spawn in the Harbor. Hogchoker fish eggs were the only other fish eggs found. Dovel concluded that alosids and white perch spawn close to the Harbor in freshwater areas. Hogchoker, the most common species in the Chesapeake Bay, was noticeably absent in the Harbor. The use of the Harbor for early life stages of marine fish was determined to be more limited than was previously thought.

Striped bass spawning has not been observed in the Patapsco River since the 1960s (Patapsco/Back Rivers Watershed Study, September 1995), probably due to low freshwater inflow (Coastal Environmental Services, Inc., 1995). Apparently, the watershed does not support more than small populations of anadromous herrings, possibly due to low freshwater flow as well as impediments such as dams and tributary blockages.

Small spot may occur in high numbers in the Harbor in summer months. Although high densities of menhaden have also been observed, mortalities are not uncommon and are attributed to high oxygen consumption by schooling fish and low dissolved oxygen levels present during summer months (Funderbunk et al., 1991, Richkus et al., 1991).

BSC Impingement and Entrainment Study

To evaluate the effect of impingement and entrainment at BSC's two water intake stations (located along Old Road Bay and in the turning basin), entrained fish egg and larvae were sampled between April 5, 1979 to September 21, 1979. Only one fish egg was found during the entrainment study. The highest number of fish larvae per cubic meter was observed between June and September. The most abundant fish larvae observed, listed in declining order of abundance, were tidewater silverside, naked goby, bay anchovy, and yellow perch. Most of these species are ubiquitous spawners and are not ecologically sensitive. The study concluded that the low numbers of fish larvae and absence of fish eggs indicate that Old Road Bay and the turning basin are not a major spawning or nursery area, and that the Sparrows Point intakes have minimal impact on fish reproduction.

Subsequent to the egg and larvae sampling, impinged fish sampling was performed at the BSC water intakes from November 1979 to November 1980. A total of 37,567 impinged fish were collected and identified at the Pennwood and Central intakes. Eight species were observed at both intakes, and an additional 16 species were observed at the Pennwood intake. The most abundant species observed at the Pennwood intake included menhaden, spot, and gizzard shad listed in decreasing order of abundance. Only 175 fish under four inches in length were found at either intake.

Commercial Fish Landings

Table 5-7 presents a summary of commercial fish landings (in pounds per year) recorded for the entire Patapsco River (Maryland Department of Natural Resources, 1996). Fish landings were highest over the 20-year period for blue crab, both hard and soft shell (beginning 1982), menhaden, striped bass, and white perch. There were no recorded menhaden landings after 1985 (except in 1995), and no landings were recorded for striped bass between 1985 and 1991 (due to the fishing moratorium on this species). American eel landings began occurring in fairly substantial numbers beginning in 1989. Catfish, carp, and bluefish landings were recorded in fairly high numbers throughout the 20-year period.

MDNR Fish Studies

The Maryland Department of Natural Resources (MDNR) is conducting fish studies in various tributaries of the Chesapeake Bay as part of an effort to develop and evaluate an index of biotic integrity for tidal waters and estuaries (Carmichael et al., 1992). The purpose of this effort is to determine if a multimetric index of biotic integrity, based on fish assemblages, can be used to quantify urbanization and other land use effects on living resources in estuarine environments and document the effectiveness of ecological remediation efforts.

In 1994, a station on the lower Patapsco River was added to the MDNR study (Maryland Department of Natural Resources, 1996). The fish community was sampled by seining and trawling three times during the months of July, August, and September. The seine sampling station is located in the near-shore area off Coffin Point at the mouth of Bear Creek, and the trawl area is located in mid-channel of the Patapsco downstream of the Key Bridge (Figure 5-4). Two near-shore seine hauls were pulled for each sampling event. Seining accounted for 99 percent of the total catch. Only 22 individuals, represented by two species, were collected in the bottom trawls. The earlier MDNR surveys captured the majority of the fish by seine with many of the bottom trawls capturing no fish.

Table 5-8 presents the results of the 1994 study. A total of 2,326 individuals captured during the three sampling events was represented by 15 species and 11 families. The dominant species were Atlantic silversides (*Menidia menidia*), a resident planktivorous species, accounting for 46 percent of the total catch. Three species represented more than 90 percent of the overall catch. In descending abundance, these included Atlantic silversides, white perch (*Morone americana*), and striped bass (*Morone saxatilis*). Nine species were represented by fewer than 10 individuals, and five species were represented by only one or two individuals. Estuarine species represented 48 percent of the total catch. Anadromous species represented 49 percent of the total catch. Only a few individuals of two species classified as benthic feeders were captured in the seine collections.

Most of the resident species are planktivorous species. White perch and striped bass, both carnivorous species, are semi-anadromous and anadromous, respectively. Both species are important recreational and commercial species. The presence of juvenile striped bass and juvenile white perch is significant and shows that these species are reproducing successfully in the area. The catch of anadromous species was dominated by the semi-anadromous white perch representing 82 percent of the total anadromous catch.

5.3.2.2 Macroinvertebrate Populations

Benthic communities within Baltimore Harbor have historically been depauperate due to poor habitat and stressed by low dissolved oxygen conditions and by contaminated sediments. However, overall contaminant loadings have decreased from the 1970's to the present due to changes in industrial practices as well as a decline in the number of industries in the Baltimore Harbor area. Because benthic assemblages are commonly used as indicators of habitat quality, these changes in pollutant inputs should be reflected in changes in the benthic community within Baltimore Harbor. In fact, an improvement in overall benthic community condition has been shown from the 1970's to the present (Ranasinghe et al., 1996).

Early Studies

Some of the first studies of the benthic community within Baltimore Harbor were conducted in the early 1970's. As part of a study performed by Rudich et al. (1973), benthic sampling was conducted in the area of Sparrows Point to assess conditions prior to the development of a proposed fill area offshore of Sparrows Point. The study found that physical conditions typically supportive of healthy benthic populations were not found in any of the samples, and no vegetation or algae were found within the proposed fill area. Less than one-half of the stations had living organisms present. The organisms present consisted mainly of mollusks and oligochaetes which are generally highly tolerant of pollution. The assessment concluded that the proposed fill area did not appear capable of supporting a permanent population of benthic organisms.

Only three species of benthic organisms, primarily oligochaete worms, were found in a Patapsco River Estuary study performed by Johns Hopkins University (as reviewed by Rudich et al., 1973). All three species are tolerant of excessive organic enrichment and low levels of dissolved oxygen. The Sparrows Point station had the lowest species diversity compared to other stations.

Pfitzenmeyer (1975) reported that the distribution of benthic species in the Baltimore Harbor area in 1970 appeared to be more influenced by water and sediment contamination than by variability in salinity. In general, the abundance and diversity of mollusks decreased from the Harbor mouth to the Inner Harbor. Gastropod mollusks were absent and some amphipod species were rare despite suitable habitat and salinity. The lower Patapsco River and Old Road Bay were classified by Pfitzenmeyer (1975) as "semi-healthy," while all tributaries sampled (including Bear Creek, Northwest Branch, Upper Middle Branch, Curtis Creek and Curtis Bay) were classified as "polluted." Conversely, based on an examination of the fossil record of foraminiferal distribution in the Patapsco River and Baltimore Harbor, Ellison et al. (1986) concluded that the distribution of species appears to be related more to salinity than to pollution.

Other studies have found that the abundance of benthic organisms has increased in the lower Patapsco River between the 1970's and 1980's. In particular, abundance of the amphipod, *Leptocheirus plumulosus,* a fairly sensitive species used as a sediment bioassay organism, has greatly increased in Baltimore Harbor between 1980 and 1987. However, the abundance of benthic organisms in Baltimore Harbor is still lower than in similar habitats of the Choptank, Chester, and Nanticoke Rivers (Coastal Environmental Services, Inc., 1995).

Chesapeake Bay Monitoring Program

Benthic communities have been studied in the Maryland portion of the Chesapeake Bay since July 1984 as one component of the Chesapeake Bay Monitoring Program (Ranasinghe et al., 1996). Benthic communities were sampled eight to ten times per year from July 1984 through June 1989 from 70 fixed stations in the Maryland portion of the Chesapeake Bay. From July 1989 to December 1995, a stratified random design was used in which samples were collected six times per year from 31 established strata including stations located within the Patapsco River near Sparrows Point.

According to data analyzed between 1984 and 1990, as reported in Shaughnessy et al. (1990), the Sparrows Point area has primarily low mesohaline conditions with anoxic to hypoxic conditions observed in some areas. During the summers between 1984 and 1990, a substantial portion of the high mesohaline bottom area supporting low-diversity benthos was related to bottom-water areas affected by hypoxia. In contrast, in August of 1989 and 1990, 8 to 48 percent of the bottom area in the low mesohaline habitat was characterized by depauperate benthic communities but no more than 2 percent of these areas were affected by hypoxic waters in both years evaluated. The numbers of benthic species per sample and biomass were consistently lower in Baltimore Harbor compared to the mid-reaches of the Bay. In the lower Patapsco River, total benthic abundances, number of species, and dissolved oxygen concentrations increased from the 1970s to the 1980s with substantial increases beginning 1984.

Benthic Index of Biotic Integrity

The Maryland Department of Natural Resources recently published a summary of data trends through 1995 (Ranasinghe et al., 1996) in which they calculated a Benthic Index of Biotic Integrity (B-IBI). The B-IBI is a multi-attribute index that identifies the degree to which a benthic assemblage meets Community Restoration Goals as determined by the Chesapeake Bay Program. The Restoration Goals describe characteristics of benthic assemblages expected at "clean" sites and provide a benchmark against which to measure the relative condition of benthic assemblages across habitat types to assess habitat "health." Some of the attributes considered in the B-IBI include total benthic abundance, biomass, diversity, and the abundance of pollution-indicative and pollution- sensitive species. The Bay Program has ranked sites that have a B-IBI of greater than 3 as meeting the Chesapeake Bay Program Restoration Goals. A B-IBI of 2.6 to 3 is considered marginal, 2 to 2.6 degraded, and less than 2 severely degraded.

In general, over one-half of the Maryland portion of the Chesapeake Bay failed the Restoration Goal, but most stations had a B-IBI of greater than 2. Within Baltimore Harbor, current condition (1993-1995) mean B-IBI values were marginal for the Middle Branch (Inner Harbor) station, degraded for the Outer Harbor station, and severely degraded for the Bear Creek and Curtis Bay stations. Other stations sampled only in 1995 in the vicinity of Sparrows Point, including a station in Old Road Bay, a station in the Outer Harbor navigational channel, and two stations near the mouth of the Patapsco River, all met the Restoration Goal. The distribution of marginal or degraded conditions described in Maryland report (Ranasinghe et al., 1996) suggests that the benthic community may be related to anoxia in the deeper navigation channel and in areas of more restricted circulation.

Historical Trends

As part of the State of Maryland Chesapeake Bay monitoring and data analysis effort, five Outer Harbor stations sampled by Johns Hopkins in 1972 and twelve Inner Harbor stations sampled by Pfitzenmeyer in 1970 were resampled in 1995 and the data were compared to look at historical trends, after standardizing for changes in sampling gear, sampling depth, and silt-clay content. The

Johns Hopkins Outer Harbor sites, which are in close proximity to Sparrows Point (Figure 5-5), showed significant improvement in number of taxa, species diversity, and total abundance between 1972 and 1995, with total benthic abundance doubling from the 1972 to the 1995 samples. The Inner Harbor stations that were first sampled in 1970 did not show a significant difference in number of taxa or total abundance in 1995, but did show an increase in the number of species present.

Ranasinghe et al. (1996) looked at the trends in the benthic assemblages at the Middle Branch station in the Inner Harbor (Station 22) and at Station 23 in the Outer Harbor near Sparrows Point (Figure 5-5). They found that the benthic condition has improved at both stations over the sampling period from 1984 through 1995. In particular, the number of taxa increased at both stations and species diversity increased at the Outer Harbor station. There was also a trend toward decreasing abundance of pollution tolerant taxa at both stations. The three dominant taxa found at both stations were the bivalve mollusks *Macoma mitchelli* and *Macoma balthica*, and the deposit feeding polychaete *Heteromastus filiformis*. All of these organisms showed increasing abundance trends, and none of them are considered indicative of pollution, suggesting an improvement in environmental conditions.

Spatial Trends

Table 5-9 summarizes benthic data collected by the State of Maryland (Ranasinghe et al. 1996) during summer 1994 and 1995 at stations in the Inner Harbor (Middle Branch), the Outer Harbor, Bear Creek, Old Road Bay, Curtis Bay and the Back River. Figure 5-5 shows the station locations. The dominant organisms found at these stations include polychaete worms and bivalve mollusks with generally lesser densities of chironomids, oligochaetes and amphipod crustaceans.

In general, the Outer Harbor, Inner Harbor, and Old Road Bay stations appear comparable in number of benthic taxa, species diversity, and evenness of distribution of individuals among species. As defined in Weisberg et al.(in press), there appear to be more pollution-sensitive species in the Inner Harbor, more pollution-indicative species in the Outer Harbor, and an even mix of species in Old Road Bay. However, many of the species found do not fall into either category, and all three of these stations have fewer pollution indicative species than all other species combined. In addition, at the Outer Harbor and Old Road Bay stations, the amphipod *Leptocheirus plumulosus*, a fairly sensitive species used as a sediment bioassay organism, was present in the samples taken.

The Bear Creek stations showed a lower number of taxa and diversity of benthic species with variable percentages of pollution-indicative and pollution-sensitive species. The Curtis Bay and Back River stations showed the lowest number of taxa and species diversity and also had the samples with the muddiest sediments (highest silt-clay percentage). Both of these stations had a majority of pollution-indicative species present.

Comparison of the above data within the same station, as well as between stations in close proximity, shows that there is a great degree of variation in sediment composition within a small area. In addition, there is a trend toward increasing taxa richness with decreasing station depth, indicating that shallower stations have a greater number of benthic species. These results suggest that differences in station depth and sediment composition may be as influential as potential toxicity in causing depauperate benthic communities. According to Weisberg et al. (in press), the sand-mud

(40 percent silt-clay content) threshold was the only sediment measure that affected benthic composition during the analyses performed to develop the B-IBI index.

Summary

In summary, benthic communities within Baltimore Harbor have shown improvement from the 1970's to the present, although localized conditions occur where the benthic communities are still classified as "poor" (Shaughnessy, 1990, as reviewed by the Patapsco/Back Rivers Watershed Study, 1995). Variations in the benthic community can occur over short distances and between years due to changes in depth and sediment composition, with the sand-mud threshold important in determining the number and types of species present. The Outer Harbor area around the Sparrows Point site has shown significant improvement within the past decade in the abundance and diversity of benthic organisms, with many of the stations meeting the Chesapeake Bay Restoration Goals (B-IBI greater than 3) set by the State of Maryland. The Outer Harbor stations that show degraded conditions, as indicated by the B-IBI, are in shallow embayments or in the deeper main channel, where depth, sediment composition, and anoxia due to restricted circulation patterns may influence benthic composition as much as sediment contamination. The stations in the Outer Harbor and Old Road Bay near Sparrows Point compare favorably with the Inner Harbor area and show a greater abundance and diversity of benthic organisms than found in Curtis Bay within the Patapsco River and in the Back River.

5.3.2.3 Commercial Shellfish

Approximately 3.8 million square yards of oyster bars were reported in the area off Sparrows Point (from Old Road Bay to Soller Point) between the mid to late 1800s and early 1900s, but this resource was apparently depleted by 1912. Oysters now occur in this area in low numbers, but harvestable populations occur only near the mouth of the Patapsco River (Coastal Environmental Services, Inc., 1995). There are no current advisories on blue crab consumption from the Patapsco River and blue crabs are common enough to support a fishery (Coastal Environmental Services, Inc., 1995).

Soft shell clams occur in low densities in the Baltimore Harbor, but low salinity limits their upstream distribution (Coastal Environmental Services, Inc., 1995). The highest densities are found near the mouth of the Harbor where habitat conditions (salinity and substratum) are most ideal (Coastal Environmental Services, Inc., 1995).

5.3.3 Threatened and Endangered Species

Correspondence from the U.S. Fish & Wildlife Service (1996) indicates that the American falcon (*Falco peregrinus anatum*), currently listed as a federally endangered species, nests on the Key Bridge (I-695). Except for occasional transient individuals, the Service indicated that no other federally listed or proposed endangered or threatened species are known to exist in the vicinity of the facility. Two bald eagles (*Haliaeetus leucocephalus*) roosted on the BSC site for one week during 1995 but have not been seen onsite since. Bald eagles are federally listed as a threatened species. There are no habitat areas onsite that would provide more than a transient roosting area for eagles.

5.4 REGIONAL ECOLOGICAL EXPOSURES TO CONTAMINANTS

In the two previous sections, regional aquatic conditions and potential aquatic receptors have been described using data from numerous published studies in the Baltimore Harbor/Patapsco River region. This section summarizes data from these and other studies on the toxicity effects of exposure to the water and sediment conditions existing in this region, and on the accumulation of contaminants in aquatic organisms living the in water and sediment in this region. This information provides a regional context within and against which conditions at Sparrows Point will have to be assessed.

5.4.1 Water Column Toxicity Tests

As part of a three-year pilot study designed to evaluate ambient toxicity in the Chesapeake Bay watershed, Hall et al. (1991, 1992, and 1996) conducted a series of water column and sediment bioassays for several stations throughout the Chesapeake Bay. A station at the mouth of Bear Creek, located 75 meters off from the Sparrows Point Facility, was included for all three years of this study (Figure 5-2). Two additional stations in proximity of Sparrows Point were added in the 1994 tests (near the navigation channel at I-695 and offshore (formerly) BSC's Shipyard).

The following tests were conducted in 1990 and 1991 with water collected from the Patapsco River: 8-day copepod (*Eurytemora affinis*) life-cycle test; 8-day grass shrimp (*Palaemonetes pugio*) survival and growth test; and 8-day sheepshead minnow (*Cyprindodon variegatus*) growth and survival test. In 1991, an 8-day mysid shrimp (*Mysidopsis bahia*) survival, growth, and reproduction test was added. These tests were repeated again in 1994 at which time two 48-hour coot clam (*Mulinia lateralis*) embryo/larval tests were also performed. Survival, growth, and reproduction data from these tests are presented in Tables 5-10 and 5-11.

Mean brood survival of *Eurytemora affinis* in the controls were significantly lower than those exposed to ambient water, which may have been related to available phytoplankton and nutrients. Ambient water contains phytoplankton and nutrients in addition to concentrations applied during feeding. Survival results of *Eurytemora affinis* in the 1990 test and the first set of tests in 1991 were similar to the control groups. While survival of *Eurytemora affinis* was lower in the ambient test than the controls in the second 1991 set of tests, these differences were reported to be not significant (Hall et al., 1992). The 1994 test results indicate no significant difference between the *Eurytemora* in the controls group and those exposed to ambient water.

Survival of grass shrimp exposed to ambient water was reduced in comparison to the control group during the 1990 tests. Growth of the grass shrimp exposed to ambient water was comparable to growth in the control group. In the two 1991 test sets, both survival and growth of grass shrimp exposed to ambient water were similar to the control group. The 1994 test results indicated that survival of grass shrimp in the control group and those exposed to ambient conditions were not significantly different.

There was no significant difference in growth and survival test results of sheepshead minnows in the control groups and those exposed to ambient water for all three years of the study.

Mysid shrimp survival was not significantly reduced in ambient water when compared with the controls. However, growth of mysids was greater in the ambient water when compared to the controls. Because all surviving females had eggs, the researchers (Hall et al., 1992) detected no effect using this endpoint. Hall et al. (1992) did report a significant reduction in the proportion of immature mysids (and increase in mature mysids) at the Patapsco River station when compared with the controls or other ambient locations. Hall et al. (1992) reported that an increase in the proportion of mature mysids does not necessarily suggest the presence of adverse conditions, but it does reflect a difference from the control that is defined as normal.

In the first of the coot clam embryo/larval tests, the percent of normal shell development was significantly reduced at stations in the Inner, Middle, and Outer Baltimore Harbors, in Bear Creek, in Curtis Bay, and in the Severn and Magothy Rivers. In the second round of tests, there were no significant effects except in the Magothy River.

The results of these studies indicate no consistent evidence that water column toxicity exists in the vicinity of the Sparrows Point facility.

5.4.2 Sediment Toxicity Tests

As part of EPA's Chesapeake Bay program, sediment toxicity studies have been conducted by various researchers at several locations in Baltimore Harbor in the vicinity of Sparrows Point including locations in Bear Creek and the Patapsco River. These studies have included bioassy testing and bioavailability testing.

5.4.2.1 Bioassay Studies

Maryland Sediment Toxicity Study

In 1990, an investigation of sediment toxicity was undertaken to evaluate the effect of contaminated sediments on benthic community habitats in the Maryland portion of Chesapeake Bay (Shaughnesy et al., 1990). As part of this effort, 10-day static sediment toxicity tests were conducted using the amphipods *Hyalella azteca* and *Leptocheirus plumulosus* and sediments collected from various sources in the Chesapeake Bay including a station in Bear Creek (exact latitude/longitude not given) (Shaughnessy et al., 1990). The test results for Bear Creek averaged between 45 percent and 50 percent survival for *Hyalella azteca* and 8.8 percent survival for *Leptocheirus plumulosus*. Survival rates for these same species in sediments from Curtis Bay averaged 78 percent and 50 percent respectively, and survival rates in sediments from the Chester River averaged 47.5 percent and 65 percent.

Harbor Sediment Toxicity Study

In a study conducted by Pinkney and Rzemien (1993), ten stations were sampled in Bear Creek from its mouth to a point just upstream of the I-695 bridge on three separate occasions (Figure 5-6). Three of these stations were sampled in May, three in June and four in October 1992. In addition, six stations were sampled in the lower Patapsco River, with three stations sampled in May and three in June 1992. Four of these stations are located near the central navigation channel offshore of

Sparrows Point and downstream of the I-695 bridge, and two are located just offshore of Stoney Point between Stoney Creek and Rock Creek.

The sediment toxicity tests involved 10-day static tests with *Leptocheirus plumulosus*, an amphipod, using sediments collected from the top two centimeters. The results of the tests indicated that sediments from the Bear Creek area were somewhat toxic with 100 percent mortality occurring on a few occasions (Pinkney and Rzemien, 1993). The results (Table 5-12) also indicate significant spatial variability in toxicity among the Bear Creek stations. For example, in May 1992 the percentage survival ranged from 5 to 60 percent, in June 1992 from 5 to 100 percent, and in October 1992 from zero to 90 percent. Sediments from the Patapsco River stations were less toxic with results consistently between 95 percent and 100 percent survival for the six samples.

Bay Ambient Toxicity Study

Hall et al. (1991, 1992, and 1996) performed a variety of water column and sediment-toxicity tests in 1990, 1991, and 1994 as part of a Chesapeake Bay-wide study to evaluate ambient toxicity. A station located at the mouth of Bear Creek was included in this study (Figure 5-2) as well as two stations in the Patapsco River (near the navigation channel at I-695 and offshore BSC's Shipyard). Samples from the Bear Creek station were collected outside the mixing zone of BSC's outfall 014 discharge at a location approximately 75 meters from shore and at a depth of 2 meters.

For the 1991 and 1992 studies, twenty-day sediment toxicity tests were conducted using four organisms: grass shrimp (*Palaemonetes pugio*), two amphipod species (*Lepidactylus dytiscus and Hyalella azteca*), and a polychaete worm (*Streblospio benedicti*). For the 1994 study, toxicity tests were conducted using *L.dytiscus, S. benedicti,* eggs of the sheepshead minnow (*Cyprinodon variegatus*), and an amphipod (*Leptocheirus plumulosus*). Survival was recorded after 10 days and 20 days of exposure to the sediments, and growth data were recorded after 20 days of exposure to the sediments. The results of these tests are summarized in Tables 5-13 and 5-14.

The Bear Creek sediments did not show toxic conditions for the survival and growth of grass shrimp in the 1991 and 1992 tests. Amphipod (*L. dytiscus*) and polychaete worm (*Streblospio benedicti*) growth was not statistically different from those organisms exposed to the control samples in the 1990 test set. Amphipod growth was not significantly different from the control group in the first 1991 test set, but was significantly less than the control group in the second 1991 test set. In the 1994 tests, survival of *S. benedicti* and *L. dytiscus* was significantly less at the Bear Creek station and one Patapsco River (offshore BSC's Shipyard) station when compared to the control. At day 20, the Patapsco River station near the navigation channel did not produce significant mortality for either of these two species as compared to the control.

Because worms are commonly found in muddy sediments, a regression analysis was run on data from clean sediments of varying particle size to enable the worm survival data to be adjusted for sediment effects. In addition, because of the high sand and low organic content of the sediments, the second set of worm treatments in 1991 (September 27, 1991 to October 17, 1991) was fed every third day for the duration of the test to prevent starvation-induced mortality of the organisms. The growth of worms in this second 1991 set was not significantly different from the control group.

Growth reduction (length) in worms was observed at the Bear Creek and the Patapsco River station offshore of the shipyard, but not at the Patapsco River station near I-695 and the navigation channel.

In the sheepshead minnow egg tests, the Bear Creek, Patapsco River (offshore (formerly) BSC's Shipyard), and two other Baltimore Harbor stations (Northwest Harbor and Curtis Bay) had the lowest survival when compared to the control and other stations in the Chesapeake Bay. In the 1994 tests, there were no *L. plumulosus* survivors in the Bear Creek or the Northwest Harbor samples.

5.4.2.2 Bioavailability Studies

General Studies

Chemical toxicity in sediments is influenced by many factors which affect the binding capabilities of a particular sediment (Hall et al., 1992). Toxicity of non-ionic organic chemicals is related to the organic content of the sediments (DiToro, 1990 as reviewed by Hall et al., 1992). Metal-sulfide complexes are highly insoluble, and the presence of significant sulfide complexes can limit the bioavailability of certain metals. For some metals (i.e., cadmium, nickel, and lead), the concentration of acid volatile sulfide (AVS) present in sediments has recently been shown to control the bioavailability of the metal (Hoffman et al., 1995). AVS is a measure of the easily extractable fraction of the total sulfide content on sediment mineral surfaces.

Free metal-ion toxicity effects may occur when the AVS content of the sediment is exceeded by the metal concentration (on a molar ratio of 1:1). However, Hansen et al. (1996) suggest that simultaneously extracted metal (SEM; the metal extracted by the AVS analytical method) is a better indicator of potentially bioavailable metal than total metal concentrations. AVS can vary by season in response to sulfur cycles, which are related to temperature and productivity, leading to seasonal variations in the bioavailability of metals (Hansen et al., 1996).

Bay Ambient Toxicity Study

As part of the studies conducted by Hall et al. (1991, 1992, and 1996), sediment samples were analyzed for Total Organic Carbon (TOC), AVS and SEM. In evaluating the AVS values, they calculated the ratio of the sum of the SEM to the total AVS. If the SEM:AVS ratio was less than one, it was assumed that sufficient AVS was present in the sediment to bind with the metals making them less bioavailable and therefore non-toxic (Hall et al., 1992 and 1996). Metal toxicity was determined to be less predictable, but generally more likely, with SEM:AVS ratios greater than one. However, if the total metals concentration is very low, toxic effects might not be observed at all.

The sediments collected from Bear Creek in August 1991, September 1991, and October 1994 had SEM:AVS ratios of 0.946, 1.113, and 0.136 (Table 5-15). SEM:AVS ratios collected from the two Patapsco River stations were 0.165 (navigation channel, I-695) and 0.258 (offshore BSC's Shipyard). Because these ratios are less than one, toxicity due to metals would not normally be indicated (Hall et al.,1996). However, Hall et al., (1996) suggests that the greatly elevated AVS in Bear Creek and Curtis Bay sediments could cause the formation of sulfuric and other acids in the anoxic zones and lead to mortality. They also noted that because of the high SEM value in the Bear Creek sediments, the potential exists for toxicity to occur when these sediments are exposed to oxidizing conditions, whether in an aerated toxicity test or during winter storm events. As shown in Table 5-16, 93 to 95 percent of the SEM in Bear Creek and approximately 79 percent of the SEM in the Patapsco River was due to zinc.

Toxicity Prediction Study

In a more recent study, Hansen et al. (1996) recommended that the difference between molar concentrations of SEM and AVS (SEM-AVS) should be used as a measure of metals bioavailability instead of SEM:AVS ratios. They suggested that the SEM-AVS can provide important insight into the extent of additional available binding capacity, the magnitude by which AVS has been exceeded, and, when organism response is considered, the potential magnitude of importance of other metal binding phases.

Hansen et al. (1996) examined the relationship between total metal concentrations, interstitial metal concentrations and SEM:AVS ratios, and toxicity to organisms exposed to sediments from numerous stations, including 14 stations located in Bear Creek and the Patapsco River (Figure 5-7). Sediments were collected from Bear Creek and the Patapsco River in February 1992. Concentrations in the water were reported as the sum of the interstitial water toxic units (IWTU) of detectable metal. IWTU is the sum of μg metal/L interstitial water divided by the 10-day LC50 (water-only) in μg/L for each of the five metals evaluated (i.e., Cd, Cu, Ni, Pb, and Zn). Thus, 50 percent mortality is expected with sediments having 1.0 IWTUs. They used 0.5 IWTUs to indicate sediments unlikely to cause significant mortality, and 0.01 IWTUs to indicate interstitial water samples that contain no detectable metal (Figure 5-7).

Sediment characteristics from the 14 stations are summarized in Table 5-17. Concentrations of TOC ranged from 0.13 to 7.38 percent, silt and clay from 4 to 99 percent, SEM from 0.64 to 31.0 μmole/g, AVS from 0.40 to 304 μmol/g, and SEM:AVS ratios from 0.10 to 16.7. Hansen et al. (1996) found that seven of the fourteen sediment samples were toxic to the amphipod *Ampelisca abdita*, which included seven of the nine sediments with the highest dry weight metals concentrations (12.5 to 31.8 μmole/g). Sediments that were found to be non-toxic contained metals concentrations from 0.6 to 21.0μmole/g.

Hansen et al. (1996) reported that both toxic and non-toxic sediments had ≤0.03 IWTUs of metal, and noted that given the absence of detectable interstitial water metal, there appeared to be no relation between the SEM:AVS ratios for these sediments and sediment toxicity. For example, five sediments having SEM:AVS ratios > 1.0 were not toxic and seven of the sediments having SEM:AVS ratio < 1.0 were toxic (Table 5-17). They concluded that toxicity observed in these Bear Creek/Patapsco River sediments was not correlated with metal concentrations.

5.4.2.3 Summary of Sediment Toxicity

The science of sediment toxicity is an area of active research. As the bioavailability studies referenced above show, there are many factors that can influence sediment toxicity. One area of research has focused on the development of reliable methods for predicting toxicity. The results of recently published research point out several uncertainties associated with the factors that influence toxicity. In addition, the various predictive approaches that are being developed have had conflicting results.

The growth and survival tests indicate variable results in some of sediments taken from Bear Creek and the Patapsco River. Some of the test results showed significant spatial variability among the Bear Creek stations. Variable results were also found among the difference species, whereby toxicity was indicated for some species but not others. In other cases, where growth and survival were reduced, the results where not statistically different from the control groups. The results of these studies suggest that there may be many factors influencing toxicity.

5.4.3 Accumulations of Contaminants in Aquatic Organisms

The MDE investigates the levels of contaminants in fish tissue in the Patapsco River through a standard monitoring program called the CORE Fish Tissue Network. The results from selected years of sampling and analysis are summarized and compared to the U.S. Food and Drug Administration (FDA) Action and Tolerance Levels for pesticides/PCBs, and metals in Tables 5-18 through 5-23. The following is a brief description of the results (Garreis and Murphy, 1986a&b; and Murphy, personal communication, as presented in Coastal Environmental Services, Inc., 1995).

5.4.3.1 Blue Crabs

Tables 5-18 and 5-19 summarize the levels of various pesticides/PCBs and metals in tissues of blue crab taken from the Baltimore Harbor in 1983 and 1990. In 1983, only one blue crab tissue sample exceeded the screening level for chlordane. In 1990, there were no exceedances of the organic contaminant screening levels. The only metal in blue crab tissue to exhibit exceedance of a screening level was lead. Forty-two of the 65 crab samples from the Baltimore Harbor analyzed in 1983 exceeded this screening level (for children 2-5 years old) while 13 of the 16 crab samples analyzed in 1990 exceeded this level. None of the crab samples collected in 1983 or 1990 exceeded the lead screening level for adult consumers. A comparison of the 1983 and 1990 metal levels in blue crab tissue show a marked decrease in concentration for cadmium and chromium. Levels of arsenic and mercury observed in 1990 are similar but slightly lower than levels observed in 1983.

Garreis and Murphy (1986b, as described in Coastal Environmental Services, Inc., 1995) reported no statistically significant differences between Baltimore Harbor crabs and those from other Chesapeake Bay tributaries in 1983 for tissue levels of zinc and cadmium. Tissue levels of mercury were slightly higher in Baltimore Harbor crabs, while arsenic levels were significantly lower in Baltimore Harbor crabs than levels from other Bay tributaries. Tissue levels of lead and chromium levels were reported to be similar in Baltimore Harbor crabs as in other Bay tributaries. Tissue levels of copper were reported to be similar to crab tissue levels from western shore tributaries and significantly higher than levels in crabs from other Bay tributaries.

5.4.3.2 Fin Fish

In 1985 and 1990, finfish were collected from Baltimore Harbor and analyzed for tissue concentration of pesticides, PCBs, and metals (Garreis and Murphy, 1986a as described in Coastal Environmental Services, Inc., 1995). Not all of the data for 1990 are available. The results of this survey are summarized and compared to FDA action and tolerance levels in Tables 5-20 and 5-21. The chlordane screening criteria were exceeded in a number of the white perch, American eel, and channel catfish samples. The PCB screening level was exceeded by only one of the 19 American eel samples. All of the white perch and American eel samples from 1985 exceeded the lead screening level criteria for young children (two to five years of age). In 1986, the Maryland Department of Health and Mental Hygiene issued an advisory against the consumption of American eel and channel catfish from Baltimore Harbor.

5.4.3.3 Softshell Clams

In 1993, softshell clams were collected from the mouth of the Patapsco River just off the southern shoreline between Rock Point and Frankie Point and analyzed for organics and inorganics. None of the clam tissue samples exceeded any of the screening level criteria (Tables 5-22 and 5-23).

5.4.3.4 Summary of Contaminant Accumulations

The data sets for the fish tissue studies are small and too limited to draw definitive conclusions about tissue contaminant levels in organisms in the vicinity of Sparrows Point. However, the results indicate that there is no significant contamination of fish tissue in the outer Baltimore Harbor. The results indicate similarities in tissue concentrations of some metals (zinc, cadmium, lead, chromium) in specimens taken from other Bay tributaries. The results also indicate a marked decrease in concentrations of cadmium and chromium in crab tissue between 1983 and 1990. Except for exceedances of lead in the tissues of white perch and American eel, two nonresident species, and exceedances of chlordane and PCBs in white perch, American eel and channel catfish no exceedances of screening criteria for other pesticides or metals (arsenic, cadmium chromium, and nickel) tested in fin fish were recorded.

5.5 OFF-SITE HUMAN RECEPTORS

5.5.1 Regional Setting

The BSC Sparrows Point Facility is located within a diverse area characterized predominantly by industrial and residential properties. The area surrounding the facility also includes commercial, agricultural, and recreational areas, as well as undeveloped resource-conservational lands. The Sparrows Point peninsula is bordered on the west by Bear Creek; on the south by the Patapsco River; on the east by Jones Creek and Old Road Bay; and on the northeast by residential areas of the City of Edgemere. The Sparrows Point Country Club and various active industrial enterprises are situated immediately adjacent to the northern facility boundary. Residential areas of the City of Dundalk are situated on the western side of Bear Creek approximately 0.4 mile from Sparrows Point. Railroads and three major public roadways (i.e., I-695, Peninsular Expressway, and Bethlehem Blvd.) traverse the northern portion of the BSC property.

Figure 5-8 shows the land uses in the vicinity of Sparrows Point. This map is based on information compiled from two sources: 1) direct observations by Rust staff during site/area visits in 1996 and 1997; and 2) the Dundalk-Patapsco Neck Zoning-Map (Baltimore County Base Map Series, Sheet Number 4A, dated September 1994). According to the Baltimore County Office of Planning, the

BSC Sparrows Point Facility is zoned "Manufacturing Heavy/Industrial Major." This zoning classification extends off-site to various private industrial sites located to the north and northeast of BSC property.

5.5.1.1 Edgemere and Vicinity

As shown in Figure 5-8, the City of Edgemere is located northeast of and adjacent to the BSC property. Edgemere is a medium-density, urban-residential area (i.e., permitted by Baltimore County for 3.5 to 5.5 residential units per acre of land). Edgemere is characterized by single family homes and duplexes, with yards, lawns, and garages. Some of the homes located adjacent to surface water bodies also have docks and boats in their backyards. Although less commonly observed during site/area visits, apartment complexes are also present. Edgemere has some open areas such as City parks and undeveloped lots with meadows and trees (some of these open areas are designated by Baltimore County as Resource Conservation Zones -- shown in green on Figure 5-8).

Community businesses in Edgemere are frequently located along major streets and boulevards. These businesses include restaurants, bars, convenience stores, a grocery store, car wash, banks, laundromats, printing shop, liquor store, furniture store, auto service stations and garages, fuel vendors (i.e., heating oil), and meeting halls such as a VFW Post. Public schools (elementary and secondary schools) and churches also occur within City limits. Several boat yards and marinas are located along Jones Creek and North Point Creek.

Areas in the vicinity of Edgemere (i.e., those areas located east and southeast of Edgemere) include Resource Conservation Zones and the residential community of Ft. Howard (which is approximately 0.8 mile east of Sparrows Point across Old Road Bay; Figure 5-8). Ft. Howard is also the site of a Veterans Hospital. The Resource Conservation Zones that occur near Ft. Howard and Edgemere include rural residences, farms with cultivated fields and livestock (e.g., cattle), undeveloped greenspace (meadows, woods and wetlands), and public recreational areas.

The major public recreational site in the area is North Point State Park located northeast of Ft. Howard (Figure 5-8). North Point State Park has hiking trails and campgrounds. Recreational activities at the park also include fishing from the shoreline and boating. There are no swim beaches at North Point State Park.

5.5.1.2 Nearby Industrial Properties

Various active industrial enterprises are situated immediately adjacent to the northern/northeastern BSC Facility boundary (Figure 5-9). The off-site areas located to the north and northeast of BSC property are zoned predominantly as "Manufacturing Heavy/Industrial Major," and to a lesser extent as "Manufacturing Light" (i.e., assembly plants, processing facilities, automotive services, etc.). Several of these industrial properties also contain undeveloped private lots and open fields that are vegetated with grasses, scrub, bushes, and trees.

5.5.1.3 Sparrows Point Country Club

The Sparrows Point Country Club is a 250-acre, wooded, water-front site adjacent to the BSC facility's northern property boundary (Figures 5-8 and 5-9). A significant portion of the country club tract consists of open, grass-covered fairways alternating with stands of trees. The portion of the country club immediately next to BSC property is wooded. According to the Baltimore County Office of Planning, most of the country club property is classified as "Resource Conservation 20," which represents a County-designated "Critical Area" (i.e., an area zoned to protect the natural resources of the Chesapeake Bay Critical Area). In addition to a 27-hole golf course, the country club offers its members an olympic-size pool, four lighted tennis courts, a 78-slip yacht basin, picnic grounds, a trap and skeet range, and a clubhouse with dining and banquet facilities. There are no swim beaches at the Sparrows Point Country Club. According to country club staff, swim beaches are not characteristic of this region, and swimming from the shoreline would be unusual due to shallow and/or rocky conditions.

5.5.1.4 Dundalk

The City of Dundalk is located across Bear Creek west of BSC property. As shown in Figure 5-8, Dundalk is characterized by medium- and high-density, urban-residential areas (i.e., permitted by Baltimore County for 3.5 to 5.5 and 10.5 to 16 residential units per acre, respectively). Dundalk consists largely of single family homes (including multi-story units) with yards, lawns, and garages. Some of the homes located adjacent to surface water bodies also have docks and boats in their backyards. Apartment buildings and numerous brick row-house/townhouse complexes (two- and three-stories) are also present in Dundalk. This City has some open areas such as parks, wetlands, and undeveloped fields covered by grasses and trees, and some of these open areas are designated by Baltimore County as Resource Conservation Zone Critical Areas (shown in green on Figure 5-8).

Community businesses in Dundalk are concentrated along major streets and boulevards. These businesses include restaurants, bars, auto service stations and garages, power-equipment dealerships, a veterinary clinic, liquor stores, convenience stores, and a truck rental business. A public library, several public schools (elementary and secondary schools), and churches also occur within City limits. Other educational institutions include Dundalk Community College and Southeastern Vocational-Tech School.

Other land uses in Dundalk include areas zoned "Manufacturing Light," such as warehouse-type buildings (located north of the Peninsula Expressway, south of Lynch Cove), the Maryland Transportation Authority (located along I-695 near Bear Creek), and the Dundalk Marine Terminal (Maryland Port Administration located on the Patapsco River). Another segment of land located to the south of the Dundalk Marine Terminal (along the Patapsco River) is zoned "Manufacturing Heavy/Industrial Major." This site includes the Riverside Power Plant (G. & E. Company).

5.5.2 Population Characteristics

The most recent US Census Data (1990) for Edgemere and Dundalk are provided as Appendix 5B. These data include population demographics (e.g., population size, age, and sex distributions), as well as statistics on education levels, household incomes, home values, commuting times, occupations, and hours/weeks worked on an annual basis.

5.5.2.1 Residents of Edgemere

Edgemere has a total population of 9,226 persons (4,676 males and 4,550 females). The 1990 census data indicate that 2,588 families comprise this community. Approximately eight percent of Edgemere's population are children less than seven years old (ages 0 - 6 years), and 13 percent are either older children or adolescents (ages 7 - 17 years). Forty-six percent of Edgemere's total population is employed (these employees are defined as persons older than 15 years). Most of the employment occurs in manufacturing, retail trade, and construction. Only 0.4 percent of jobs among Edgemere residents are associated with agriculture, forestry, or fisheries.

Edgemere has 197 vacant households and 3,340 inhabited households, and 79 percent of these latter housing units are owner-occupied (while the remainder are renter-occupied). The Baltimore County Department of Health (BCDH), which provided a summary of population characteristics (also included in Appendix 5B), reports a five-year stability rate of 68 percent (i.e., the percentage of households that are occupied by residents who moved into their current [1990] homes prior to 1985).

The US Census data for 1990 (most recent available data) indicate that 3,523 housing units obtain water from a "public system or private company" whereas only five housing units are listed as "drilled individual well" with respect to "water source."

5.5.2.2 Residents of Dundalk

Dundalk has a total population of 65,800 persons (31,804 males and 33,996 females). The US Census Data indicate that 18,795 families comprise this community. Approximately nine percent of Dundalk's population are children less than seven years old (ages 0 - 6 years), and 12 percent are either older children or adolescents (ages 7 - 17 years). Forty-seven percent of Dundalk's total population is employed (these employees are defined as persons older than 15 years). Most of the employment occurs in manufacturing, retail trade, construction, transportation, finance, health services, and public administration. Only 0.4 percent of jobs among Dundalk residents are associated with agriculture, forestry, or fisheries.

Dundalk has 868 vacant households and 25,596 inhabited households, and 72 percent of these latter housing units are owner-occupied (while the remainder are renter-occupied). The five-year stability rate for Dundalk is 66 percent (i.e., the percentage of households that are occupied by residents who moved into their current [1990] homes prior to 1985). In addition, approximately 40 percent of occupied households have been inhabited by the same residents for longer than 20 years. Twenty-eight percent of households have been stable for 31 or more years (conversely, in 72 percent of Dundalk households, occupants have moved at least once during the past 30 [or fewer] years).

The US Census data for 1990 (most recent available data) indicate that 26,448 housing units obtain water from a "public system or private company" whereas only 16 housing units are listed as "drilled or dug individual well" with respect to "water source."

5.5.2.3 Tenant Workers

Tenant workers are on-site (on-facility) employees who work for private companies that lease industrial space from BSC or are employed as subcontractors to BSC. Because these workers are not covered by BSC health and safety policies, they are treated conceptually as a select subgroup of off-site receptors (USEPA, 1996).

Tenant workers at Sparrows Point are employed by the companies listed below, performing various work activities and coming into contact with SWMUs and AOCs as follows:

- C.J. Langenfelder, Inc. has approximately 90 to 100 employees routinely on site performing a wide range of maintenance and housekeeping activities throughout the site. These activities include slag reprocessing and involve regular use of Coke Point Landfill.

- Mobile Dredge and Pumping has approximately 10 employees routinely on site performing liquid and sludge handling activities throughout the site. This "core" group is supplemented with additional staff as needed for larger projects. Their activities involve work at sumps in the Finishing Mills.

- U.S. Filter/Palm Oil Recovery, Inc. (PORI) has approximately 10 to 20 employees routinely on site reprocessing used oils at their facility located north of the Cold Sheet Mill. The RFA Report identified three SWMUs at the PORI facility.

- Blue Circle Cement has employees routinely on site producing dry cement and concrete mixes at their facility located along Old Road Bay in the southeast part of the site. Their activities do not bring them into contact with any SWMU or AOC.

- Maryland PIG has employees routinely on site reprocessing scrap for iron-making at their facility located along Old Road Bay near Fire Island. Their activities do not bring them into contact with any SWMU or AOC.

- Chesapeake Steveadors have employees routinely on site performing tasks related to the unloading of raw materials at the ore dock, the turning basin, and the Pennwood shipping wharf. Their activities do not bring them into contact with any SWMU or AOC.

- Baltimore County Fire Department has 43 firefighters rotating through shifts so that 11 are on site at any given time. They are based at the Police and Fire Station located just west of the main BSC offices, but they may be called upon to fight fires anywhere on site.

- 7&7 performs large demolition projects for BSC (such as the demolition of the coke batteries and the coal chemical, benzene and litol plants). These projects can employ 10 to 20 workers, and last for 12 to 48 months, but only a few management or supervisory staff are routinely on site. The demolition projects have had and will continue to have safety programs and monitoring requirements.

5.6 ON-SITE HUMAN RECEPTORS

The historical land use at Sparrows Point has been "industrial" for the past 110 years. Pennsylvania Steel built the first furnace there in 1887. The first iron was cast two years later. BSC purchased the facility in 1916 and expanded the iron manufacturing by constructing mills to produce hot-rolled sheet, cold-rolled sheet, galvanized sheet, Galvalume sheet, tin mill products, and steel plate. These major steel-making operations continue today. During peak production in 1959, the facility operated 12 coke oven batteries, 10 blast furnaces, and four open hearth furnace shops with a total workforce of 30,000 employees. Currently, just over 5,000 employees work at the facility.

5.6.1 Population Characteristics

BSC ranks as the largest industrial employer in Maryland with a current workforce of 5,220. These 5000+ employees are classified into 78 employment categories (see Table 5-24). The age of this workforce varies from 18 to over 65 years. The average age is 48; the median age is 50. The average employment duration (all personnel) at the facility is 23.4 years. The median employment duration is 27.8 years.

To address worker exposure, a questionnaire was used to identify which BSC workers have jobs that might take them outdoors to a SWMU or AOC. This questionnaire focused on workers' behaviors -- where they go outdoors at the facility, their tasks, and what personal protective equipment (PPE) they wear, if any. The last page of the questionnaire contains a listing of potential project sites -- those SWMUs and AOCs being considered by BSC for further evaluation under the site-wide investigation. The questionnaire was completely by plant foremen and supervisors primarily during interviews conducted with by BSC Environmental Health and Safety staff. Table 5-24 indicates the extent of this process. The detailed results of the questionnaires are provided in Appendix 5C.

The following summarizes BSC worker activities conducted outdoors within the SWMU/AOC's identified in this Description of Current Conditions Report. The summary is based on the information contained in the 27 questionnaires/interviews completed/conducted by BSC supervisors and contractors.

5.6.1.1 Tin Mill Canal Area

Four of the Department 434 Instrumentation personnel (14 individuals total) spend approximately four days a year servicing level controls and valves in the Tin Mill Canal Area. Standard PPE consisting of hard hat, eye protection, steel-toed work boots, and hand protection are required during all work activities. Additional PPE including face shields, chemical resistant gloves, and tyvek suits are required when working on acid line equipment.

Up to four of the Department 414 Supplemental Work Force personnel (60 individuals total) spend approximately six days a year in the Tin Mill Canal Area conducting repair and maintenance on the oil skimming equipment. Standard PPE and disposable tyvek suits are required during work activities.

Four of the Department 671 Cold Sheet Operators personnel (737 individuals total) spend a portion of each day (<8 hours a day, 250 days a year) in the Tin Mill Canal oil skimming areas. Standard PPE and disposable suits are required during work activities in this area.

Two of the Department 401 Maintenance Services personnel (95 individuals total) spend approximately two days a year in the Tin Mill Canal area working in a supervisory role in relation to maintenance activities. Standard PPE is required.

Five of the Department 405 Construction Technicians (64 individuals total) spend approximately three days a year working outdoors in the Tin Mill Canal area on exterior building construction and repair activities. Standard PPE is required.

A total of 24 of the Department 330 Utilities personnel (121 individuals total) spend a portion of each day (<8 hours a day) up to 250 days a year in the Tin Mill Canal area monitoring control equipment and cleaning sample collection points which are related to or near the Tin Mill Canal discharge pipes, oil skimming devices, dredging containment areas, waste oil storage tanks, collecting samples at the HCWWTP spent pickle liquor discharge point, and checking the spent pickle liquor tanks. Standard PPE along with face shields, chemical resistant gloves and suits are required during work activities.

Two of the Department 437 Pennwood Power House personnel (30 individuals total) spend approximately 250 days a year outdoors conducting outfall monitoring and checking equipment within the Tin Mill Canal area boundaries. Standard PPE is required during work activities.

Department 860 Real Estate personnel (5 individuals total) spend approximately one day a year outdoors in the Tin Mill Canal area working on walkway and fencing repairs. Standard PPE is required.

Up to four of the Department 403 Mobile Equipment/Plant Garage personnel (106 individuals total) are estimated to spend a portion of 150 days a year working in the oil skimmer areas, a portion of each day (<8 hours a day, 250 days a year) with the dredging operation and a portion of 50 days a year hauling the oil collection containers. Standard PPE and disposable tyvek suits are used during work activities.

Department 406 General Labor personnel (30 individuals total) spend 40 to 48 days a year in the Tin Mill Canal embankment dredgings, discharge pipes, and general canal areas working at the outfalls and vactoring (vacuuming) oil or oil skimming. Standard PPE including wet gear equipment is required.

Department 322 Materials Control personnel (37 individuals total) spend approximately two to four days a year checking on material or parts verification related to equipment maintenance. Standard PPE is required.

One of the Department 311 Police personnel (9 individuals total) spends a large portion of the year conducting security, off-shift inspections, and lock-up duties. Standard PPE is required.

Up to four of the Department 450 Utilities Maintenance personnel (31 individuals total) spend 12 to 15 days a year performing maintenance activities on the oil skimming equipment. Standard PPE, tyvek suits, and gloves are required.

5.6.1.2 Rod and Wire Mill Area

Two of the Department 414 Supplemental Workforce personnel (60 individuals total) spend approximately four days a year outdoors in the Rod and Wire Mill area repairing overhead doors. Standard PPE and tyvek suits are required.

Up to two of the Department 330 Utilities personnel (121 individuals total) are estimated to spend a portion of 200 days a year monitoring the cadmium recovery operation. Standard PPE is required.

Department 860 Real Estate personnel (5 individuals total) spend approximately 12 days a year outdoors in the Rod and Wire Mill area working on roadways. Standard PPE is used.

Up to four of the Department 463 & 481 Pipefitters personnel (75 individuals total) are estimated to spend four to six days in the Rod and Wire Mill area repairing leaking piping systems and servicing valves. Standard PPE is required.

One of the Department 311 Police personnel (9 individuals total) spends a large portion of the year conducting security, observation, and lock-up duties. Standard PPE is required.

One of the Department 673 Plate Mill personnel (329 individuals total) spends 60 days a year in the billet prep trenches and blind sump area. No work task or PPE description given.

5.6.1.3 Finishing Mills Area

Twelve of the Department 449 Tin Mill personnel (90 individuals total) spend a portion of each day, 250 days a year, checking the Tin Mill trenches/sumps, Tin Mill sump acid monitoring and acid tanks areas for system leaks. Standard PPE is required unless a leak is detected then additional PPE is required.

Department 434 Instrumentation personnel (14 individuals total) spend approximately four days a year working on level controls and valves. They also spend approximately eight days a year in the hot strip mill basins and two days a year in the acid tanks area performing instrument maintenance activities. Standard PPE and face shields, chemical resistant gloves, and tyvek suits are required.

Department 401 Maintenance Services personnel (95 individuals total) spend 12 days a year in the hot strip mill basins area and six days a year in the acid tank area supervising maintenance activities. Standard PPE is required.

Department 330 Utilities personnel (12 individuals total) spend a portion of each day (<8 hours a day, 250 days a year) in the Finish Mill area monitoring control instrumentation and checking on utility related operations equipment. Standard PPE is required.

Up to 18 of the Department 463/481 Pipefitters personnel spend a portion of 250 days a year maintaining piping systems in the Finishing Mills Area. Standard PPE is required. Up to six of the Pipefitters spend 16 days a year in the Tin Mill sump and acid tanks areas maintaining piping system lines. This work requires standard PPE and acid protection equipment.

Up to four of the Department 451 CSM Mechanics and Electricians personnel (81 individuals total) are estimated to spend 10 to 20 days a year performing maintenance activities in the coating lines blind sumps area of the Finishing Mill. Standard PPE is required.

Up to four of the Department 457 CSM Control personnel (58 individuals total) are estimated to spend 10 to 20 days a year working near the Finish Mill acid tanks and four to six people work 250 days a year on the recovery waste acid system. Standard PPE, face shields, chemical resistant gloves, and tyvek suits are required.

Department 406 General Labor personnel (30 individuals total) spend a portion of 240 days a year in the coating lines blind sumps, hot strip mill basins, and tin mill trenches/sumps areas washing down and vactoring (vacuuming) oil. Standard PPE including wet gear equipment is required.

One of the Department 670 Hot Strip Operators (297 individuals total) spends approximately 250 days a year in the hot strip mill basins area operating an overhead crane. Standard PPE is required.

5.6.1.4 Primary Rolling Mills Area

Two of the Department 401 Maintenance Services personnel (95 individuals total) are estimated to spend 6 days a year in the Primary Rolling Mills area working in a supervisory capacity on maintenance related activities. Standard PPE is required.

Department 330 Utilities (121 individuals total), one person spends a portion of each day (<8 hours, 250 days a year) in the Primary Rolling Mills area checking on utility related systems and responding to utility related maintenance calls. Standard PPE is required.

Department 305 Safety Health and Environmental personnel (9 individuals total) spend approximately two days a year conducting exposure monitoring and investigating health and safety related issues. Standard PPE and thermal face shields are required.

Department 860 Real Estate personnel (5 individuals total) spend approximately 12 days a year working on the roadways in this area. Standard PPE is required.

Two of the Department 463/481 Pipefitters personnel spend four to six days a year maintaining piping systems in the Primary Rolling Mills Area. Standard PPE is required.

Department 406 General Labor personnel (30 individuals total) spend a portion of 100 days a year in the coating lines blind sumps, hot strip mill basins, and tin mill trenches/sumps areas washing down and vactoring (vacuuming) oil. Standard PPE including wet gear equipment is required.

Three of the Department 673 Plate Mill personnel (329 individuals total) spend up to 120 days a year in the rolling mill scale pit area. No work task or PPE description given.

5.6.1.5 Greys Landfill Area

Up to four of the Department 414 Supplemental Work Force personnel (60 individuals total) are estimated to spend approximately four days a year in the Greys Landfill area loading and unloading materials. Standard PPE is required. Use of disposable dust masks are reported.

One to two of the Department 401 Maintenance Services personnel (95 individuals total) are estimated to spend approximately six days a year in this area working in a supervisory capacity on maintenance projects. Standard PPE is required.

Department 305 Safety Health and Environmental personnel (9 individuals total) spend two days a year working and responding to health and safety issues in the Greys Landfill area. Standard PPE is required.

Two of the Department 403 Mobile Equipment/Plant Garage personnel (106 individuals total) haul sludge to the landfill on an as needed basis estimated to be 3-4 times a week up to 200 days a year. Standard PPE is required.

Two of the Department 406 General Labor personnel (30 individuals total) spend a portion of 250 days a year hauling debris/waste to the landfill. Standard PPE is required.

Two of the C. J. Lagenfelder & Sons personnel (100 individuals total) spend a portion of 250 days a year at the Greys Landfill operating dragline and bulldozer machinery. Standard PPE is required.

5.6.1.6 Humphrey Impoundment

Eleven of the Department 330 Utilities personnel (121 individuals total) spend a portion of 250 days a year collecting sludge samples and cleaning strainers in the Humphrey's Impoundment area. Standard PPE and chemical resistant gloves are required.

Up to four of the Department 401 Maintenance Services personnel (95 individuals total) are estimated to spend two days a year in the Humphrey's impoundment area working in a supervisory role on maintenance projects. Standard PPE is required.

Department 860 Real Estate personnel (5 individuals total) spend approximately 24 days a year servicing a trash compactor located within the boundaries of the Humphrey's Impoundment area.

5.6.1.7 Coke Point Landfill

C. J. Lagenfelder & Sons personnel (100 individuals total) spend approximately 10,000 man hours in the Coke Point Landfill area operating screening and metal recovery equipment. Standard PPE is required.

5.6.1.8 Coke Plant Area

Two of the Department 414 Supplemental Work Force personnel (60 individuals total) spend approximately four days a year outdoors in the Coke Plant area working on overhead door maintenance. Standard PPE is required.

One to two of the Department 401 Maintenance Services personnel (95 individuals total) are estimated to spend three days a year outdoors in the Coke Plant area, B Coal Chemicals Plant (B CCP) process area working in a supervisory role on maintenance projects. Standard PPE is required.

Department 311 Police personnel (9 individuals total) conduct very limited visits to the Coke Plant area for security and lock-up purposes. Standard PPE is required.

One of the Department 428 Blast Furnace personnel (29 individuals total) spends 150 days a year in the P, R, U, M and L areas of the Coke Plant area conducting site inspection activities. No PPE reported.

5.6.2 BSC Occupational Health Program

5.6.2.1 Overview

BSC provides an Occupational Health Program for its workforce that promotes safe work practices and protects employee health. "It is Bethlehem's policy to provide a safe and healthful workplace for its employees, to evaluate and control all recognized hazards, and to comply with all Federal, State, and local safety and health laws and regulations applicable to its operations. Management at all levels is responsible for implementing programs to ensure the safety and health of employees while at work. All employees have a responsibility for working in a manner which is safe and healthful for themselves and their fellow employees" (BSC Occupational Health Manual). The health and safety program is designed to mitigate potential chemical (i.e., coke oven emissions) and physical hazards (i.e., heat and noise). This program is implemented through the following measures:

- employee education: promoted through distribution of the BSC Occupational Health Manual and through formal training sessions and periodic 'refreshers.'

- health and safety experts: BSC has staffed the Sparrows Point Facility with a core group of "in-house" professional health and safety personnel (i.e., Environmental Health Engineering [EHE] staff) who provide leadership, expertise, and technical support to plant department heads, site/group supervisors, and foremen.

- hazard communication: distribution of memoranda and bulletins from the Joint Plant Safety and Health Steering Committee on various topics such as new safety policies or updates and clarifications of existing safety policies and procedures. Examples of these topics include safety eyeglass program, contractor safety equipment, required medical examinations, and testing for hazardous atmospheres. These communication materials are also filed in an easily-accessed manual entitled "Safety and Health Policies for the Sparrows Point Division."

- standard operating procedures: development and implementation of health and safety policies and procedures affecting all employees and/or select subpopulations. These standard operating procedures are significant in their scope and are discussed below.

5.6.2.2 Standard Operating Procedures

Standard operating procedures have been developed to address the following areas: environmental health records and reporting; engineering controls and work practices; policies pertaining to specific chemicals (i.e., inorganic lead), chemical groups, or plant processes; training; the use of Personal Protective Equipment (PPE); and environmental monitoring.

Environmental Health Records and Reports

Record-keeping is an integral part of the BSC Occupational Health Program. Record-keeping procedures were developed for compliance with OSHA record-keeping requirements. "Each operating department must keep records documenting: 1) the proper use of personal protective equipment; and 2) employee training relative to health hazards" (BSC Occupational Health Manual). BSC health and safety staff also maintain documentation of environmental monitoring data and medical surveillance reports. These records are preserved for at least the duration of employment plus 40 years. Employees are guaranteed access to their medical and exposure records.

In those situations where an employee may have been exposed to a contaminant concentration exceeding its permissible limit, this employee is notified in writing of the exposure measurement and of the actions implemented to reduce the exposure to within allowable limits.

Engineering Controls and Work Practices

BSC utilizes engineering controls and/or administrative and work-practice controls to reduce or eliminate potential exposures to chemical agents (via inhalation of ambient air or skin contact) and physical agents (i.e., heat and noise). Engineering controls involve either "process modification" (i.e., substitution of process materials with less toxic alternatives) or "control systems" (i.e., general ventilation systems or local exhaust ventilation systems). Examples of work-practice controls are the rotation of workers between jobs, the use of vacuum cleaning instead of dry sweeping, the practice of good house-keeping procedures, and restricting access to certain areas.

Chemical-Specific Policies

BSC has also developed health and safety policies pertaining to specific chemicals (i.e., inorganic lead, asbestos), chemical groups (i.e., cleaners/solvents), and plant processes (i.e., "coating line"). These policies are translated into various health and safety programs consisting of one or more components: hazard communication (i.e., employee "right-to-know" training), environmental monitoring, engineering controls, the use of PPE, and/or medical surveillance.

An example of these policies is the BSC corporate policy regarding inorganic lead. Each BSC facility having potential employee exposures at or above the action level has issued a program for implementing the OSHA Lead Standard. BSC has identified the specific plant operations that may cause worker exposure to lead, and the workers involved with these operations are the focus of the corporate lead program:

- Melting and pouring lead babbitt (iron and brass foundry)
- Melting and pouring lead brass (iron and brass foundry)
- Sawing gates and risers from castings (iron and brass foundry)
- Melting babbitts out of bearings (iron and brass foundry)
- Burning on coated steel (ironworkers)
- Scrap preparation (mobile equipment -- scrap yard)
- Scrapping or repairing old railroad cars (car repair shop).

The corporate lead program involves employee training on OSHA's Lead Standard and on understanding the potential health hazards from over-exposure to lead, exposure monitoring (periodic personal air sampling), medical surveillance (when the OSHA air-quality action level is exceeded), and engineering controls and/or respiratory protection to reduce lead exposures.

In addition to the corporate policy on lead, BSC has developed chemical- or process-specific programs for asbestos, material control including cleaners and solvents, metals, and gas hazards. BSC has also issued to Sparrows Point workers various "safety-contact bulletins" (right-to-know information) on PCBs, solvents, halogenated hydrocarbons, reactive chemicals, and corrosive chemicals.

Training

Employee education in health and safety principles, practices, and procedures is accomplished through formal training sessions and periodic 'refreshers' applicable to those employees who might come into contact with potentially hazardous environments (i.e., those employees working in a location or performing a task which could potentially generate [or otherwise be associated with] air concentrations of chemicals above their health-based action levels and/or OSHA Permissible Exposure Limits). Training focuses on learning the recognition of potential hazards, the methods and work practices used to prevent exposures, and the components of any chemical-specific safety procedures or standards that may apply to select employee groups.

Numerous training programs are conducted at the Sparrows Point Facility. One example of these programs is the annual refresher training performed in compliance with the OSHA Standard "Hazardous Waste Operations and Emergency Response" (29 CFR 1910.120). BSC considers this training to be mandatory for the following groups of employees:

- Cold Sheet and Tin Mill picklers
- Cold Sheet and Tim Mill coating-lines workers
- Chrome Recovery Plant operators
- Rod and Wire Mill Groundwater Treatment Plant operators
- Field sampling and outfall monitoring crew

- Mill Services Department (oil-handling-and-storage crew)
- Mobile equipment operators
- Railroad environmental employees and supervisors
- Police Department
- Environmental Control Department
- PCB crew
- Plant Labor Department (Number 406).

These employees are informed about the hazards of chemicals that may be encountered in association with spills or while performing specific job tasks. They are instructed in OSHA-mandated site safety procedures including the correct operation of air monitoring equipment, safe procedures for confined-space entry, hazard recognition, incident response, and the proper use of PPE to prevent dermal contact, incidental ingestion, or inhalation of chemical contaminants.

Personal Protective Equipment

The standard PPE requirements for all BSC workers includes the following: 1) safety shoes with metatarsal protection; 2) certified safety glasses with side shields; 3) non-conductive hard hats; and 4) clothing made of hard-finished cotton material (i.e., denim), wool, or other approved (heat-resistant/flame-retardant) fabric. Additional PPE is provided to employees wherever it is required for protection against chemical skin contact, noise, and/or airborne contaminants. Examples include chemical resistant gloves, Tyvek suits, ear protectors, and/or respirators.

As documented in the BSC Occupational Health Manual, BSC's policy is to promote engineering controls as the preferred methodologies for the reduction or elimination of exposures to airborne contaminants. When effective engineering controls are not feasible (or while they are being instituted), appropriate respiratory protection is used in accordance with the Maryland Occupational Safety and Health Standard on Respiratory Protection. The Sparrows Point respiratory protection program is managed by BSC Environmental Health Engineering (EHE) staff. The program includes environmental monitoring to determine those job positions/tasks warranting respirator use, training in respirator use, medical evaluations, and maintenance of respiratory protective equipment.

Environmental Monitoring

The BSC Occupational Health Manual presents general approaches to assessing potential exposures to chemical agents. This manual also outlines the sampling procedures available for investigating the workplace environment.

Supervisors are responsible for understanding the potential hazards of their work areas and sites and for conducting qualitative surveys of these areas. They are expected to maintain familiarity with the chemicals utilized and/or potentially released from their work areas (by reviewing purchase records, the MSDSs supplied by vendors of raw materials, and previous BSC industrial hygiene or environmental data). Supervisors are responsible for discussing potential hazards with their workers and for inspecting and making direct observations of workplace conditions. When warranted, supervisors are also trained to use direct reading instruments such as portable carbon monoxide monitors, hydrogen sulfide monitors, and combustible gas analyzers.

Periodic hazard exposure assessments using chemical-specific sampling techniques are the responsibility of BSC's professional EHE staff. These individuals perform personal-zone monitoring and general-area sampling for gases, vapors, and particulates. EHE staff use colorimetric detector tubes, sampling pumps with sorbent tubes, filter cassettes with battery-powered personal sampling pumps, dosimetry badges, and other devices. On the basis of OSHA requirements, industry guidelines, and/or their professional judgement, EHE staff select the sampling techniques and analytical methods appropriate to the specific work environment, and determine the necessary number of samples and sampling durations. Some chemicals are covered under OSHA standards; EHE staff then utilize these standards to define the required monitoring protocols and techniques. EHE staff are also available to plan and implement biological monitoring (when warranted). An historical database is kept at the facility that details all of the industrial hygiene data that have been obtained related to worker exposure to spills, leaks, etc.

5.7 PRELIMINARY RISK ASSESSMENT CONCEPTUAL MODELS

To identify potential exposure pathways for ecological and human receptors at/near this facility, preliminary health risk assessment conceptual models have been developed for the BSC Sparrows Point Facility. A preliminary risk assessment conceptual model schematically describes the potential relationship between the source materials at the site and any likely exposed "receptor" population. It details the possible sources and the potentially contaminated environmental media at a site, and then describes the various exposure pathways by which these populations could come into contact with the chemical contaminants in these media. A complete exposure pathway includes four components: 1) a contaminant source, 2) a transport mechanism for the contaminant, 3) a point of contact with a receptor, and 4) a means of intake or uptake into the receptor. Conceptual site models have been developed separately for off-site and on-site receptor populations.

A conceptual ecological site model has been developed that describes the main pathways by which ecological receptors could be exposed to contaminants originating from identified SWMUs and AOCs. The conceptual ecological site model is based on preliminary information collected from the hydrogeological conceptual model (Section 4), existing literature, and a brief reconnaissance of the site. This conceptual model will be refined and tested as future data are collected about site specific conditions. Field sampling for the purpose of risk assessment studies have not been conducted and no contaminant fate and transport analyses have been conducted.

Potential ecological risk associated with onsite SWMUs and AOCs exists only where a complete pathway exists between the contaminant source and the habitat areas and where a receptor population exists or where the receptor population is absent due to site-specific contamination. The determination and magnitude of risk is based not only on these factors, but also whether contaminants are present in sufficient concentrations and are bioavailable to receptor populations. As discussed below, a number of habitat areas at the Sparrows Point facility are clearly not within proximity or downgradient of any SWMUs or AOCs. In these instances, a complete pathway does not exist and no further work in these areas is proposed.

In other cases, information necessary to evaluate the completeness of an exposure pathway is lacking; therefore, the conceptual model presumes that the pathways identified are complete. This provides a conservative starting point for the risk assessment study that will be conducted. The exposure route may be in the form of primary receptor contact (i.e., dermal, ingestion) or exposure via consumption of contaminated food sources (i.e., receptor biomagnification), which may manifest in acute or chronic consequences. Further evaluation of contaminants present in the environment, their concentrations, and bio-availability will be conducted to refine the conceptual model.

5.7.1 Preliminary Off-Site Receptor Conceptual Models

5.7.1.1 Off-Site Ecological Receptor Exposure Pathways

Figure 5-10 depicts the various exposure pathways by which off-site ecological receptors could be exposed to contaminants originating from SWMUs or AOCs. Perhaps the most significant potential ecological pathway is via the discharge of contaminated groundwater to the surrounding nearshore environment of the Patapsco River, Bear Creek, and Jones Creek. Groundwater movement at the site generally follows the subsurface paleochannels or filled historic stream channels in a westerly direction and ultimately discharges at the "mouths" of these paleochannels (Figure 4-17). Away from the direct influence of these historic channels, groundwater movement flows more diffusely towards these channels or towards the current shoreline. Groundwater exposure pathways that are complete are limited to those pathways where contaminants originating from SWMUs and AOCs located in the recharge zones of the historic channels have migrated and discharged to the surrounding nearshore areas.

Potential exposure points to receptors occur in the sediments and interstitial water where groundwater discharges to the surface water. However, ecological risk exists only if benthic organisms reside in this environment or the absence of receptors is due to site-specific contamination. Past studies indicate that benthic populations in the lower Patapsco River are neither abundant or diverse, which may be due to physical, physicochemical, regional or site-specific conditions. Benthic surveys will need to be conducted of this near shore environment as well as reference sites to evaluate this issue. Once groundwater has discharged to surface waters surrounding the site (Jones Creek, Patapsco River, and Bear Creek) contaminant concentrations become quickly diluted and influenced by tidal fluctuations and river flows. Regional studies of the water column indicate that the lower Patapsco has "fair" water quality, although it is moderately enriched with nutrients and experiences low dissolved oxygen concentrations from late spring through early fall. Further studies will be required to evaluate the quality of the groundwater/surface water interface and the rate of dilution within the water column.

Bioaccumulation of contaminants in secondary receptors can occur through the consumption of contaminated food sources. Macroinvertebrate organisms, which live in the sediments, are relatively immobile and represent an important food source to higher organisms. Their localized existence makes benthic macroinvertebrates the most likely trophic level at risk from continuous exposure of contaminants (if it exists). Because the nearshore environments are subject to vigorous wave action and currents, lack vegetation, and apparently have a depauperate benthic community, it is unlikely that these areas are significant fish foraging, spawning or nursery grounds.

Secondary receptors may also include shorebirds and wading birds and some resident species of fish exposed through regular consumption of contaminated food sources such as macroinvertebrates. The bioaccumulation potential will be highest where habitat conditions are conducive to foraging activity (i.e., along the intertidal beaches and flats or where a relatively healthy macroinvertebrate community exists). In order to determine pathway completeness and whether ecological risk exists, further study of the intertidal and nearshore areas will be necessary to determine the presence of receptors, the type and frequency of receptor activity, and the concentrations and bioavailability of contaminants.

Because a number of SWMUs and AOCs are located in the recharge zones of paleochannels and filled historic stream channels that drain westerly towards Bear Creek, these channels are potential conveyances for contaminants (Figures 3-1 and 4-17). A number of potential exposure points are located along the Bear Creek shoreline, from Coke Point up to and including the shoreline along Greys Landfill where these channels discharge. Habitat conditions along this shoreline are generally unfavorable for secondary receptor activity i.e., avifaunal foraging. Field studies will be conducted during the risk assessment to evaluate the presence of receptor populations, receptor activity, and the concentration and bioavailability of contaminants in these areas.

None of the shoreline areas along Jones Creek are proximal to any SWMUs or AOCs (Figures 3-1 and 4-17), and two historic channels (Figure 4-17) that drain easterly towards Jones Creek do not contain any identified SWMUs or AOCs in the recharge zones and are not identified as complete pathways for this conceptual model. However, SWMUs and AOCs located in or near the Hot Strip Mill (Figure 3-1) appear to be located within the recharge area of localized groundwater pathways (Figure 4-17) and may discharge to the upper portion of Jones Creek. Because this stretch of the Jones Creek shoreline has habitat features (beaches, intertidal flats), this area represents a potentially complete exposure pathway to primary and possibly secondary receptors.

In this localized section of Jones Creek, macroinvertebrates inhabiting the nearshore and intertidal areas and resident avifaunal and fish populations feeding on these benthic populations are potential receptor populations. Bioaccumulation in the benthic population from direct exposure and biomagnification in secondary receptors via consumption of contaminated macroinvertebrates are the potential exposure routes posed in this model. Further studies are needed to determine whether receptor populations exist along this shoreline and the level of receptor activity. In addition, further evaluation of groundwater movements and the concentrations and bioavailability of any contaminants in the affected media will be necessary to determine pathway completeness and whether receptors utilizing this portion of the shoreline are at risk.

A large stretch of shoreline along the Patapsco River between Gull Point and the ore pier (south of storage yards) is not proximal to any SWMUs or AOCs and groundwater discharging to this portion of the shoreline does not originate in areas identified as SWMUs or AOCs (Figures 3-1 and 4-17). Therefore, this stretch of the Patapsco shoreline is not a potential exposure area that poses a significant risk to receptors utilizing this area. However, west of this area localized groundwater originating in the Coke Point Landfill and Coke Oven Area may discharge diffusely to the surrounding shoreline along the Patapsco River posing a potential risk to primary receptors inhabiting the intertidal and nearshore substrate. This is the only shoreline area along the Patapsco River identified as a potentially complete pathway.

Only a few small areas of the Coke Point/Coke Oven shoreline along the Patapsco River have the physical attributes (beach, intertidal flat) that provide birds with foraging opportunities. Therefore, this would not represent a regular feeding area for such species and secondary avifaunal exposure is not considered significant along this shoreline. The use of this shoreline as a fish spawning or nursery ground is highly unlikely due to high energy wave action and currents. Nor is it likely that a significant resident fish population exists along this segment of the Patapsco shoreline that would be exposed via consumption of contaminated macroinvertebrates. Further field studies are necessary to determine what receptor populations are present and level of receptor activity. In addition, further evaluation of groundwater movement and the concentration and bioavailability of contaminants in affected media would be necessary to determine pathway completeness and whether receptors utilizing this portion of the shoreline are at risk.

There are no natural streams on the property that discharge to the surrounding water bodies and current stormwater discharges from the site are regulated under a NPDES permit. For these reasons, the surface runoff pathway to offsite areas is not considered in this conceptual model. Nevertheless, there may have been impacts to sediment quality due to historic runoff, and even though these effects will be difficult to discriminate within the regional setting (as discussed above in Section 5.2), some effort to assess these impacts will be required.

5.7.1.2 Off-Site Human Receptor Exposure Pathways

The preliminary off-site conceptual model shown in Figure 5-11 describes the various potential exposure pathways by which off-site human populations could come into contact with potential contaminants originating in on-site environmental media under the existing land use conditions at the BSC Sparrows Point Facility. Off-site individuals who could have contact with site contaminants are people who live near the site (residents of Edgemere and Dundalk, Maryland); work at an adjacent industrial facility; play golf at the Sparrows Point Country Club; or visit Bear Creek, the Patapsco River, or Old Road Bay for recreational purposes (i.e., boating and fishing).

In the case of these human receptors, exposure would consist of inhalation of contaminated ambient air in and around their residences, work areas or recreational areas; ingestion of site contaminants that may have bioaccumulated in the tissues of locally-caught fin fish and shellfish; and incidental ingestion and/or dermal contact with site contaminants in surface waters and sediments adjacent to the site.

As the facility is partially fenced and guarded 24 hours per day, nearby people do not have ready access on the property and therefore would not have direct contact with the source areas.

Another receptor population that is considered to be "off-site" for the preliminary health risk assessment conceptual model is "tenant workers." As mentioned previously, tenant workers are on-site (on-facility) employees who work for private companies that lease industrial space from BSC or are employed as subcontractors to BSC. Because these workers are not covered by BSC health and safety policies, they are treated conceptually as a select subgroup of off-site receptors (USEPA, 1996). These individuals could, in addition to the exposure pathways discussed above, have some direct contact with contaminants in on-site soils at SWMUs or AOCs. Currently, BSC has not obtained similar worker safety/health information for these tenant individuals, as described in 5.6.1 and 5.6.2.

Table 5-25 summarizes the off-site receptor groups and exposure pathways addressed in this preliminary health risk assessment conceptual model. These off-site receptors and their potential exposures are described in more detail below.

Nearby Residents

Nearby residents of Edgemere and Dundalk (Figure 5-8) represent a receptor population with the potential for exposure to site contaminants under current conditions at the site. Because possible trespassers are considered under the on-site scenarios, nearby residents, as a group, are considered to have primarily indirect contact with site contaminants (i.e., exposure to contaminants that might migrate away from the site).

Specifically, nearby residents are potentially exposed to site contaminants via inhalation of fugitive dust and gases that are emitted from one or more of the SWMUs or AOCs at the facility. Although off-facility dispersion of dust and VOCs is expected to decrease the chemical concentrations in ambient air, this pathway is complete and thus selected for inclusion in the preliminary risk assessment conceptual model.

Nearby residents are unlikely to be exposed to site contaminants in groundwater because shallow groundwater apparently discharges directly to Bear Creek, the Patapsco River, and Old Road Bay; flow in the deep groundwater system is inward toward the site; and public drinking water supplies are derived from upland/inland surface water sources. Nearby residents, therefore, are not anticipated to have any significant contact with groundwater contaminants under current conditions.

Some local residents do have boats docked in the area and may fish in surface waters adjacent to the site. Certain individuals may also trespass on the BSC Sparrows Point Facility on occasion. Site personnel have observed people fishing in the main channel of the River, and evidence of trespassing on the BSC shoreline does exist. Because these activities are likely to represent only a small fraction of the individuals in these communities, these potential exposures routes are not viewed as significant routes of exposure to these general populations and therefore have not been included in the residential "receptor" group. Instead, they are addressed separately and specifically under recreational users of the regional surface water bodies and under on-site trespassers.

Nearby residents are, therefore, envisioned to contact site chemicals only via the following two exposure routes:

- Inhalation of gaseous emissions (dispersed from on-site soil into off-site air).
- Inhalation of particulate emissions (dispersed from on-site soil into off-site air).

Off-Site Workers

The second potentially exposed human receptor population considered under current land use conditions of this site consists of off-site (nearby) workers. These adult receptors are evaluated conceptually because of their known proximity to the facility (Figures 5-8 and 5-9). Off-site workers include those personnel employed by the industrial firms located to the north and east of the facility as well as employees at commercial enterprises and businesses in Edgemere (i.e., restaurants, automotive service stations, banks, grocery stores, etc.).

As with the local residents, the primary contact by these off-site workers with site contaminants is considered to be indirect and would be by exposure (inhalation) to contaminants that migrate as airborne emissions of dusts and VOCs.

Off-site workers are unlikely to be exposed to contaminants in groundwater for the same reasons described above for the nearby resident population. Off-site workers as a group are also not considered to fish in adjacent surface waters or trespass on the BSC property.

Off-site workers are, therefore, envisioned to contact site chemicals only via the following two exposure routes:

- Inhalation of gaseous emissions (dispersed from on-site soil into off-site air).
- Inhalation of particulate emissions (dispersed from on-site soil into off-site air).

Nearby Country Club Golfers

Golfers (adults) at the nearby Sparrows Point Country Club represent a third potentially exposed human receptor population considered under the current land use scenario. These recreational users of private, developed greenspace (located adjacent to BSC property) are assumed to walk the outdoor fairways occasionally (i.e., one or two afternoons per week during the warmer months of the year).

As with the off-site worker and resident populations, the primary contact by golfers with site chemicals would be indirect, and would be by exposure (inhalation) to contaminants that might migrate from facility SWMUs/AOCs as airborne emissions of VOCs and dusts

Golfers are, therefore, envisioned to contact site chemicals only via the following two exposure routes:

- Inhalation of gaseous emissions (dispersed from on-site soil into off-site air).
- Inhalation of particulate emissions (dispersed from on-site soil into off-site air).

Recreational Users of Adjacent Surface Waters

Recreational users of Bear Creek, the Patapsco River, or Old Road Bay (including Jones Creek) represent a fourth potentially exposed human receptor population considered under the off-site current land use scenario. There are numerous boat launches, marinas, boat yards, and yacht clubs in the Edgemere-Dundalk region, and boating and yachting appear to be popular recreational activities in this area.

Recreational fishing from boats, such as "crabbing" (i.e., fishing for blue crabs), may take place in the surface waters surrounding Sparrows Point. According to MDNR Fisheries staff, crabbing appears to be popular in some of the bays and coves along the Patapsco River especially along its southwestern shore (i.e., on the opposite side of the river from Sparrows Point).

In the opinion of MDNR Fisheries staff, recreational fishing for fin fish is not common in the Outer Baltimore Harbor because the Patapsco River is a busy transit route for commercial shipping and because better fishing areas are readily accessible. An example of a preferred fin-fishing location is the Man O'War Shoal (where the Patapsco River joins Chesapeake Bay), approximately five miles east of Sparrows Point. Nevertheless, observations by BSC personnel have revealed that occasional fishing from boats does occur off-shore from the BSC Sparrows Point Facility in the main channel of the Patapsco River. According to the MDNR, the most popular game fish are black sea bass and white perch.

The surface water and sediments along the BSC shoreline represent a potential exposure point for recreational users. Rust staff visited numerous locations along the shoreline to document its general characteristics and to identify potential "recreational" sites. This information, shown in Figure 5-1, is a generalization of actual conditions because shoreline features were found to be highly variable.

In general, most of the shoreline along the BSC property boundary is comprised of slag materials (i.e., gravel, cobbles, and boulders) and/or 'demolition-like' debris (i.e., concrete slabs and bricks). Recreational access from an offshore boat appears to be limited in most areas by the rugged, rocky nature of the slag materials within tidal zones, the steep terrain, and/or the dense vegetation ('scrub' and/or trees) growing along the inland embankments adjacent to the tidal zones. Nevertheless, evidence of trespassing along the shore has been observed.

Recreational users of adjacent surface water bodies are, therefore, envisioned to contact site contaminants via the following two exposure routes:

- Ingestion of fin fish and shellfish.
- Incidental ingestion and dermal contact with surface water and sediment.

Tenant Workers

On-site tenant workers (adults) are a fifth potentially exposed human receptor population considered under this preliminary conceptual model. Tenant workers are those individuals who work for companies that lease industrial space from BSC or are employed as subcontractors to BSC. Because these workers are not covered by BSC health and safety policies, they are treated conceptually as a select subgroup of off-site receptors (USEPA, 1996).

As discussed above in Section 5.5.2.3, tenant workers employed by C.J. Langenfelder, Mobile-Dredge & Pump, PORI, 7&7 and the Baltimore County Fire Department could come into contact with SWMUs/AOCs. These select subpopulations of tenant workers (i.e., those who visit one or more SWMUs/AOCs) are assumed to be individuals who could be exposed directly to contaminated media on-site. These workers could have direct incidental contact with contaminants in surface soil. Inhalation of volatilized chemicals and windblown dust at this site are additional exposure pathways that are potentially complete for these individuals. Individual company health and safety information and requirements will be evaluated to determine the potential significance of these possible exposure pathways.

On-site drinking water wells do not exist at the site, making groundwater an incomplete exposure pathway for on-site tenant workers. Potable and process waters for these tenants are obtained from the same sources described above for BSC employees. Furthermore, current on-site tenant workers are not allowed to contact surface water and sediment along the shoreline. The occupational activities of these workers do not bring them into contact with the surrounding surface water bodies.

Tenant workers are, therefore, envisioned to potentially contact site chemicals only via the following four exposure routes in this preliminary conceptual model:

- Limited incidental ingestion of surface soil at specific SWMUs/AOCs.
- Limited dermal contact with surface soil at specific SWMUs/AOCs.
- Inhalation of gaseous emissions (dispersed from soil at SWMUs/AOCs).
- Inhalation of particulate emissions (dispersed from soil at SWMUs/AOCs).

5.7.2 Preliminary On-Site Receptor Conceptual Models

5.7.2.1 On-Site Ecological Receptor Exposure Pathways

Figure 5-12 illustrates the various exposure pathways by which on-site ecological receptors could be exposed to potential contaminants originating from onsite SWMUs and AOCs. In general, little natural habitat exists on the property as most of the property is occupied by industrial land uses and related activities (Figure 5-1). With a few exceptions, as discussed below, most of the habitat areas on the property are not proximal to identified SWMUs or AOCs (Figure 3-1). For many of these areas (northern portion of Area A, Areas B, D, E, F, G, the land portions of Area H, and Area I) no contaminant pathway exists because they are not located near AOCs or SWMUs nor are they down gradient of any groundwater pathways. Further evaluation of these areas is not proposed.

Open water areas identified in the northeastern portion of the site, including two ponds and one water supply reservoir (Areas G and E, Figure 5-1), and the few onsite wetlands (northern portion of Area A, pockets in Area D, and Area G, Figure 5-1) are not in the vicinity of any SWMUs or AOCs. These areas are also located upgradient of groundwater pathways that originate in recharge areas containing SWMUs and AOCs. Therefore, there are no complete pathways to these areas and no further study of these areas is proposed.

The only surface waters within the facility boundaries identified as potential pathways are the ponds located in the Greys Landfill and a ditch located between the Peninsular Expressway and Greys Landfill (Figure 5-1). These areas are recharged from precipitation, surface runoff and possibly groundwater discharge, and are proximal to Greys Landfill and the Tar Decanter Cell, which are identified as SWMUs. These water bodies offer a possible source of drinking water to local fauna and may contain aquatic life.

Potential receptor populations include invertebrates and larger life forms (amphibians, reptiles, fish) that may inhabit these ponds and larger animals that may ingest the water directly or feed on the lower organisms. The potential for bioaccumulation and/or biomagnification to higher life forms are assessment endpoints that would be evaluated when the risk assessment is conducted. If contaminants are present in these ponds the pathway could be completed through dermal contact, the direct ingestion of water or consumption of contaminated food sources. Field studies will be conducted in the initial phases of the risk assessment to determine the existence of any receptors and the type and level of receptor activity. In addition, further evaluation of groundwater movement and the concentration and bioavailability of affected media will also be necessary to determine pathway completeness and whether receptors are at risk.

The industrial areas of the site offer no significant natural habitat, which greatly reduces the opportunity for resident terrestrial populations. Greys Landfill and the Coke Point Landfill are the only industrial areas where further studies are needed to evaluate whether a significant receptor population exists and whether any contaminants present in the soils and/or vegetation pose a significant risk to receptors. The most likely terrestrial receptor populations include smaller life forms inhabiting the surficial soils, small and medium-sized mammals, and possibly predatory species. With the exception of the seasonal breeding colony of gulls along the bluff of the Coke Point Landfill, a resident bird population is not evident, particularly among the passerine species. Because vegetation is sparse or of low food value potential consumption of vegetation is not expected to be a significant contaminant exposure route. Foraging on macroinvertebrates could be a potential exposure route for larger organisms which feed upon these organisms.

Other pathways may include incidental ingestion of contaminated soil particles and dermal exposure by resident terrestrial species. Although these exposure routes are not expected to be significant, they will be evaluated during the initial steps of the risk assessment where sampling and analysis of the various media in habitat areas will be conducted to determine which pathways are complete. Bioaccumulation via predation and consumption of carrion are other possible exposure routes. However, because of the range of the predatory species (e.g., raptors, fox), it is not likely that their diets would consist solely of food sources derived from the BSC habitats.

5.7.2.2 On-Site Human Receptors Exposure Pathways

The preliminary on-site human receptor conceptual model shown in Figure 5-11 describes the various exposure pathways by which the on-site human populations could come into contact with potential contaminants in on-site environmental media under existing land use conditions. On-site individuals who could be directly exposed to potential site contaminants are those who work on-site (i.e., select subpopulations of BSC workers) and those who might illegally trespass on the site.

In the case of these receptors, exposure would consist of inhalation of contaminated ambient air in and around their work areas; incidental ingestion and/or dermal contact with site contaminants in on-site soils at specific SWMUs or AOCs; and incidental ingestion and/or dermal contact with site contaminants in surface waters and sediments adjacent to the site.

Table 5-26 summarizes the on-site receptor groups and exposure pathways addressed in this preliminary health risk assessment conceptual model. These on-site receptors and their potential exposures are described in more detail below.

On-Site BSC Workers

On-site BSC workers are involved in iron and steel manufacturing, maintenance activities, transportation, construction and repair, waste handling and/or treatment, and environmental monitoring and sampling. As listed on Table 5-24, only specific subpopulations of BSC workers actually perform outdoor tasks at or near areas with potentially contaminated media. Their site visits, which occur either intermittently or at regular intervals, are for various purposes and jobs.

Each group of BSC workers that enter a SWMU/AOC has been trained to recognize chemical hazards and has been instructed in OSHA-mandated site safety procedures including the use of PPE. The required use of PPE and training are intended to minimize dermal contact with surface soils and also to limit the potential for soil ingestion due to incidental hand-to-mouth behavior.

Inhalation of windblown dust from surface soil at this facility is an exposure pathway that is complete for the subpopulations of BSC workers who visit SWMUs/AOCs. BSC industrial hygiene (IH) staff have indicated that their present employee health and safety program is in compliance with OSHA regulations and therefore adequate to protect their workers from chemical injury. This program includes the collection of personal and area IH data associated with specific indoor or outdoor tasks.

The inhalation of VOC emissions from surface and subsurface soils at SWMUs/AOCs is also viewed as a complete exposure pathway. Although this may represent a potentially minor exposure pathway, due to the fact that VOC emissions are likely to readily disperse in outdoor air to low ambient levels, this pathway is nevertheless selected for inclusion in this preliminary on-site conceptual model for BSC workers.

On-site drinking water wells do not exist at the site. Potable water is purchased from the City of Baltimore and is conveyed to the facility from the Monte Bella water treatment plant via a 72 inch under-harbor water main. Six deep on-site groundwater wells are used to supply water for boiler feed-water make-up and contact cooling at the Continuous Casters. Thus, workers have no potential for incidental contact (ingestion or dermal contact) with groundwater and groundwater is considered an incomplete exposure pathway for the on-site BSC workers.

On-site BSC workers also do not contact surface water and sediment along the shoreline. The occupational activities of these workers do not bring them into contact with the surrounding surface water bodies, and none of the Supervisor Questionnaires indicated that any worker's routinely contact surface water/sediment along the perimeter of the facility.

Select subpopulations of on-site BSC workers are, therefore, envisioned to potentially contact site chemicals only via the following four exposure routes:

- Limited incidental ingestion of contaminated surface soil at SWMUs/AOCs.
- Limited dermal contact with contaminated surface soil at SWMUs/AOCs.
- Inhalation of gaseous emissions (dispersed from soil at select areas).
- Inhalation of particulate emissions (dispersed from soil at select areas).

Trespassers

Trespassers are one of the current receptor populations that could be exposed directly to contaminated media at this site. Although it does occur, several factors serve to minimize the likelihood of trespassing at the site. All roadway entrances to the property and several of the perimeter areas are posted with "no trespassing" and "private property" signs. Access to active manufacturing areas is controlled by gates manned by security staff, gates with surveillance cameras, and pedestrian turnstiles activated by key-cards. The BSC Police Department has nine officers on staff, and these officers are assisted by 40 subcontracted Burns Security personnel. All BSC employees are instructed to contact the police if they ever observe unauthorized persons anywhere on-site. Two police vehicles are usually on patrol, inspecting all areas of the facility throughout the day.

According to the BSC Sparrows Point Police Department, trespassing occurs infrequently at the Sparrows Point Facility. The BSC Police removed 34 trespassers from BSC property in 1995 and 49 trespassers in 1996. The majority of trespassing incidents (about 59 percent) occur within outlying or perimeter areas or BSC parking lots, while the remainder are associated with active manufacturing areas. Most of the trespassers are typically found while driving or sitting in their personal vehicles.

Trespassers may also gain access to the BSC Facility from the shoreline. According to Police Chief Rogers, most of the documented cases of shoreline trespassing are associated with boats "in distress" (i.e., persons who come ashore for some type of assistance). Wading at the shoreline has been observed but has also been characterized as rare. Because much of the shoreline at the facility consists of slag and rocks, is very steep, or is thickly vegetated, wading by trespassers (leading to on-site access) is restricted to the few beach zones along the shoreline (Figure 5-1).

For the purpose of the preliminary on-site conceptual model, the trespasser is assumed to be a local adult who occasionally enters the site illegally by automobile or by wading in along the shoreline. Trespassers are not assumed to enter those areas at the site that are enclosed by security fences. Because of the limited potential for access, trespassers are expected to have infrequent direct contact with on-site media (surface soil at SWMUs or AOCs).

Trespassers are also assumed to come into contact (transiently) with surface water and sediment at the shoreline of the property during wading. However, their frequency of contact is envisioned to be much less than that for recreational users and would consist primarily of skin contact on the legs and feet.

Trespassers could also be exposed to fugitive dust or gaseous emissions from SWMUs and AOCs. Although this exposure pathway is probably complete, the generation of significant levels of respirable particulates (PM_{10} fraction) through wind erosion is unlikely to occur very extensively due to the coarse, granular texture of the slag soils at this facility. Portions of the site are also covered by vegetation, pavement, concrete, and buildings.

Trespasser exposure to subsurface contamination (soils or groundwater) is considered a highly unlikely exposure pathway, because they are generally on-site for short periods of time, and the nature of the slag soils precludes easy excavation with hand tools.

Trespassers are, therefore, envisioned to contact site contaminants via the following exposure routes:

- Limited incidental ingestion of contaminated surface soil at SWMUs/AOCs
- Limited dermal contact with contaminated surface soil at SWMUs/AOCs
- Dermal contact with shoreline surface water while wading
- Dermal contact with shoreline sediment while wading
- Inhalation of gaseous emissions (dispersed from on-site soil into ambient air)
- Inhalation of particulate emissions (dispersed from on-site soil into ambient air).

5.8 DATA NEEDS

Initial data needs with respect to potential ecological receptors include the following:

- Aquatic habitat data including offshore water depth, light penetration depth, water temperature and salinity, bottom material composition and thickness, and tidal current/wave energy data.

- Abundance and diversity data for the potential aquatic and terrestrial receptor populations; for comparison purposes, these data are needed for locations potentially affected by the BSC Facility and at reference stations that would not be affected by the BSC Facility.

- Exposure contact frequency and duration data for secondary receptor populations (bird, mammal, and fish predators), especially characterization of foraging activity and residency time in the environment.

This site-specific information would be used to test and refine the preliminary risk conceptual models for ecological receptors. It would allow qualitative evaluation of exposure pathway completeness and receptor population significance, and would serve as the basis for the development of proposed measurement and assessment end points.

Initial data needs with respect to potential human receptors include the following:

- Population demographics and behavior data for the various tenant employees at the facility, including number of employees on site, turnover rates, locations worked at, and activities performed.

- Health and safety programs and requirements for the various tenant organizations at the facility, including training programs, location and/or activity specific PPE requirements, and monitoring programs.

These data would be used with the existing data on BSC workers to develop site-specific exposure models for the quantitative human health risk assessment.

Ultimately, data on the nature and extent of contamination of COPIs at the BSC Sparrows Point Facility will be needed to perform the ecological and human health risk assessments.

FIGURE 5-1
NATURAL RESOURCE FEATURES MAP

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

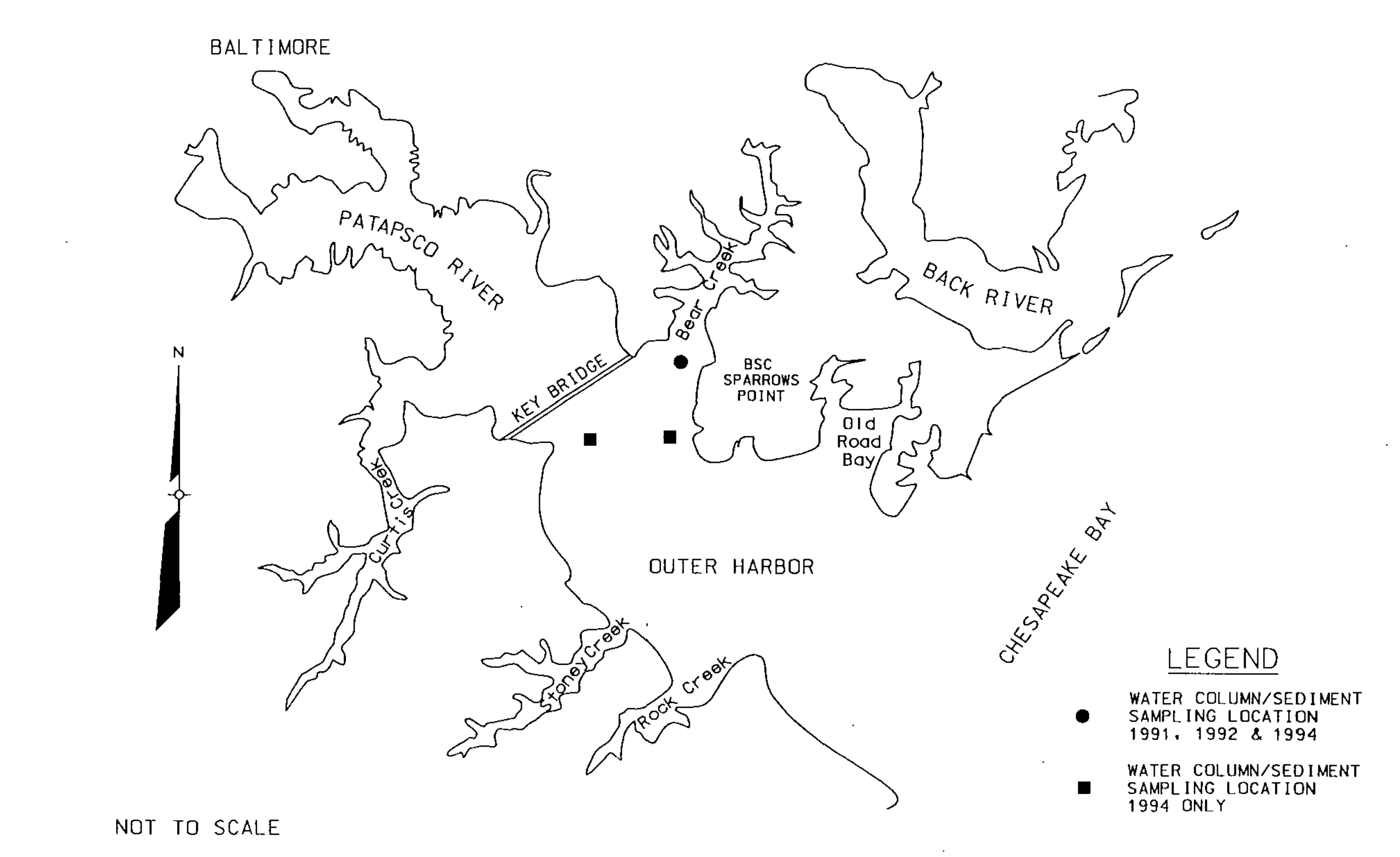
DATE 12-22-97
PROJECT NO 200123
FILENAME SPARROWS.DWG

RUST
Rust Environment & Infrastructure Inc.

FAIRLESS HILLS
DRN JTP
DES EAN
CHK
APP

NO | REVISIONS | DRN | CHK | DATE

200123-1.DGN DECEMBER 22, 1997



SOURCE: HALL ET AL., 1991 & 1992.
HALL ET AL., 1996.

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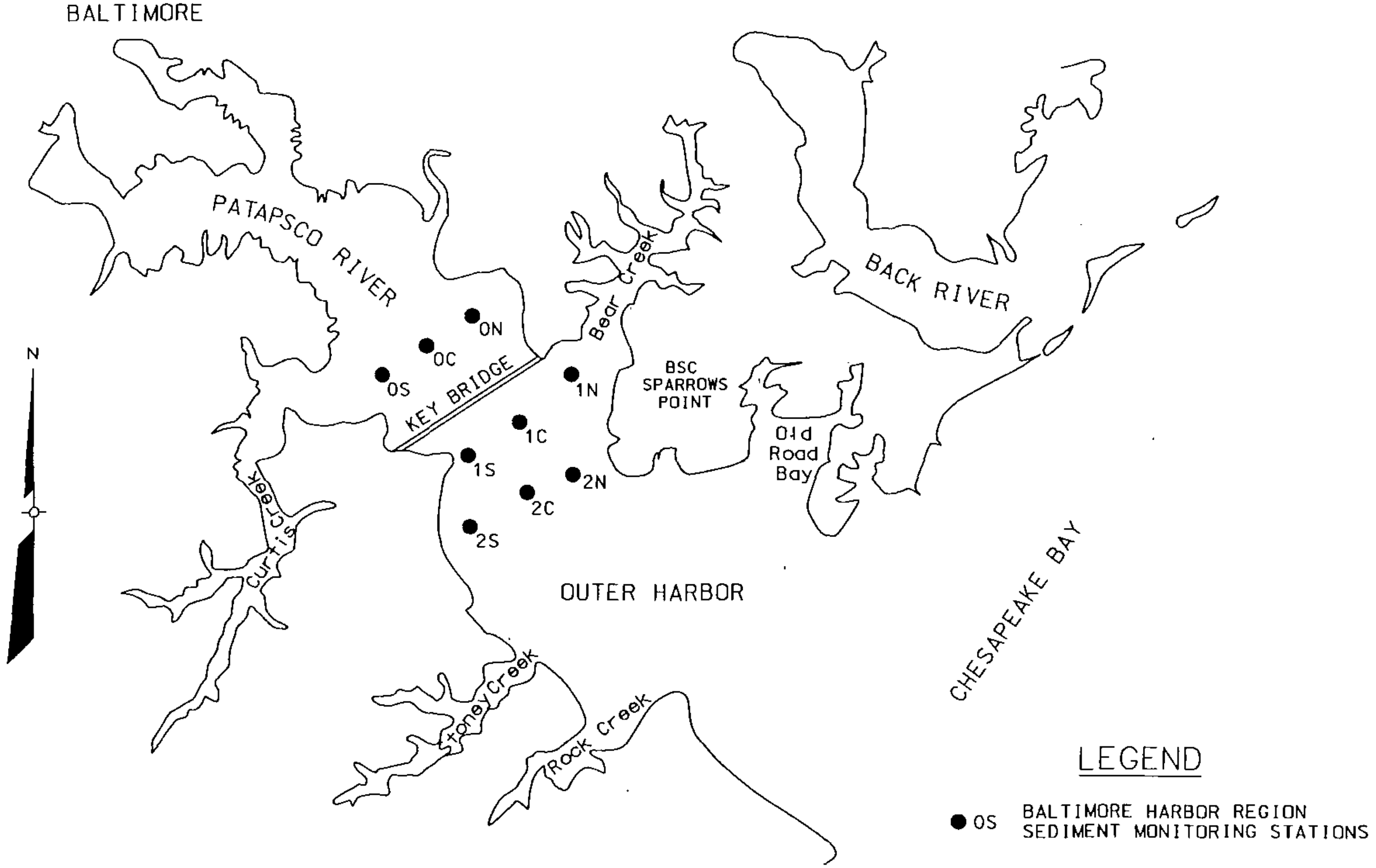
FIGURE 5-2

SURFACE WATER AND SEDIMENT SAMPLING LOCATIONS NEAR SPARROWS POINT

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998 200123

200123-1.DGN DECEMBER 22, 1997



NOT TO SCALE

SOURCE: ESKIN ET AL., 1996.

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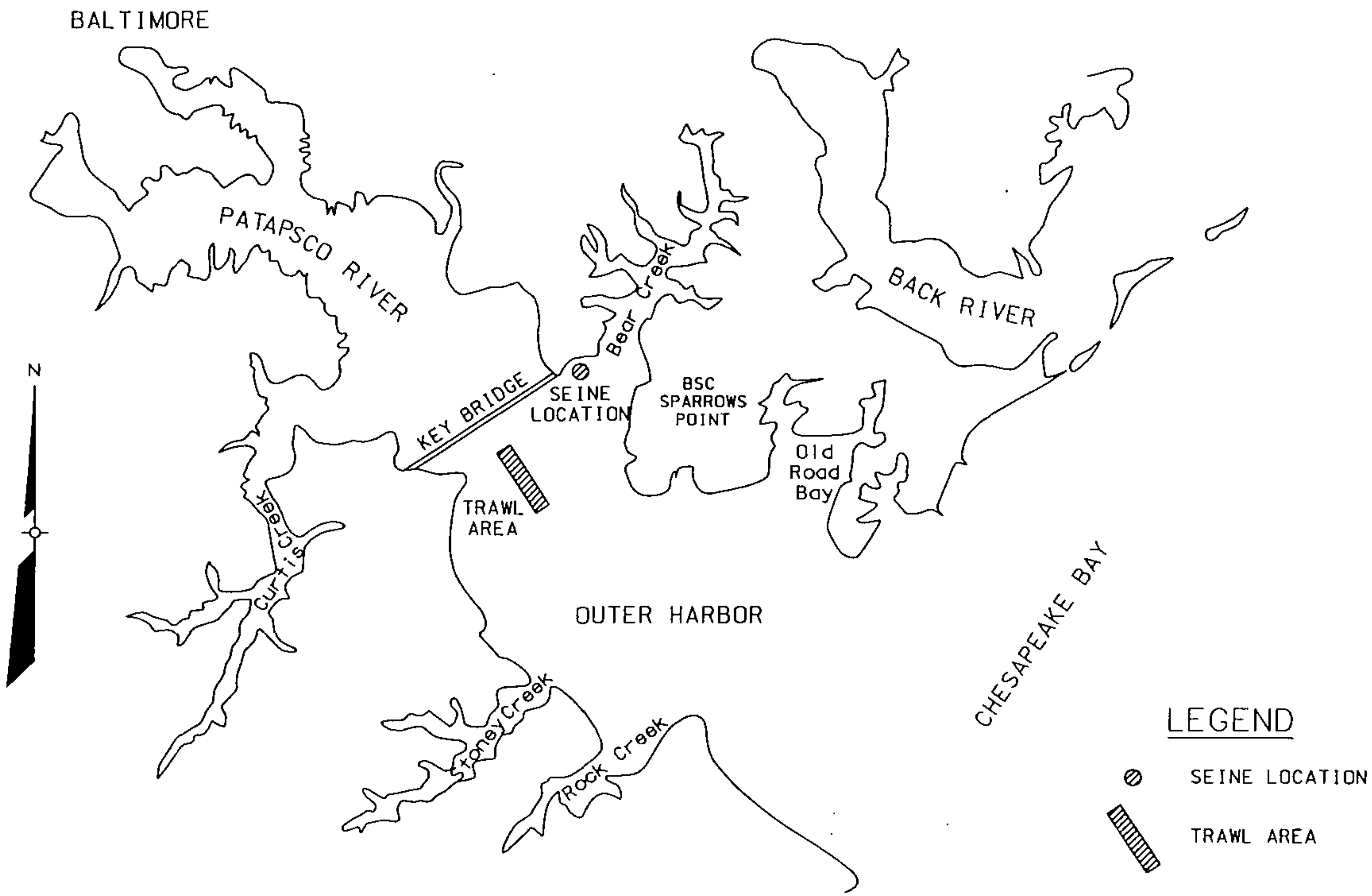
FIGURE 5-3

BALTIMORE HARBOR REGION SEDIMENT MONITORING STATIONS

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998 200123

200123-1.DGN DECEMBER 22, 1997



NOT TO SCALE

SOURCE: MARYLAND DEPARTMENT OF NATURAL RESOURCES RESOURCE ASSESSMENT SERVICE.

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FIGURE 5-4

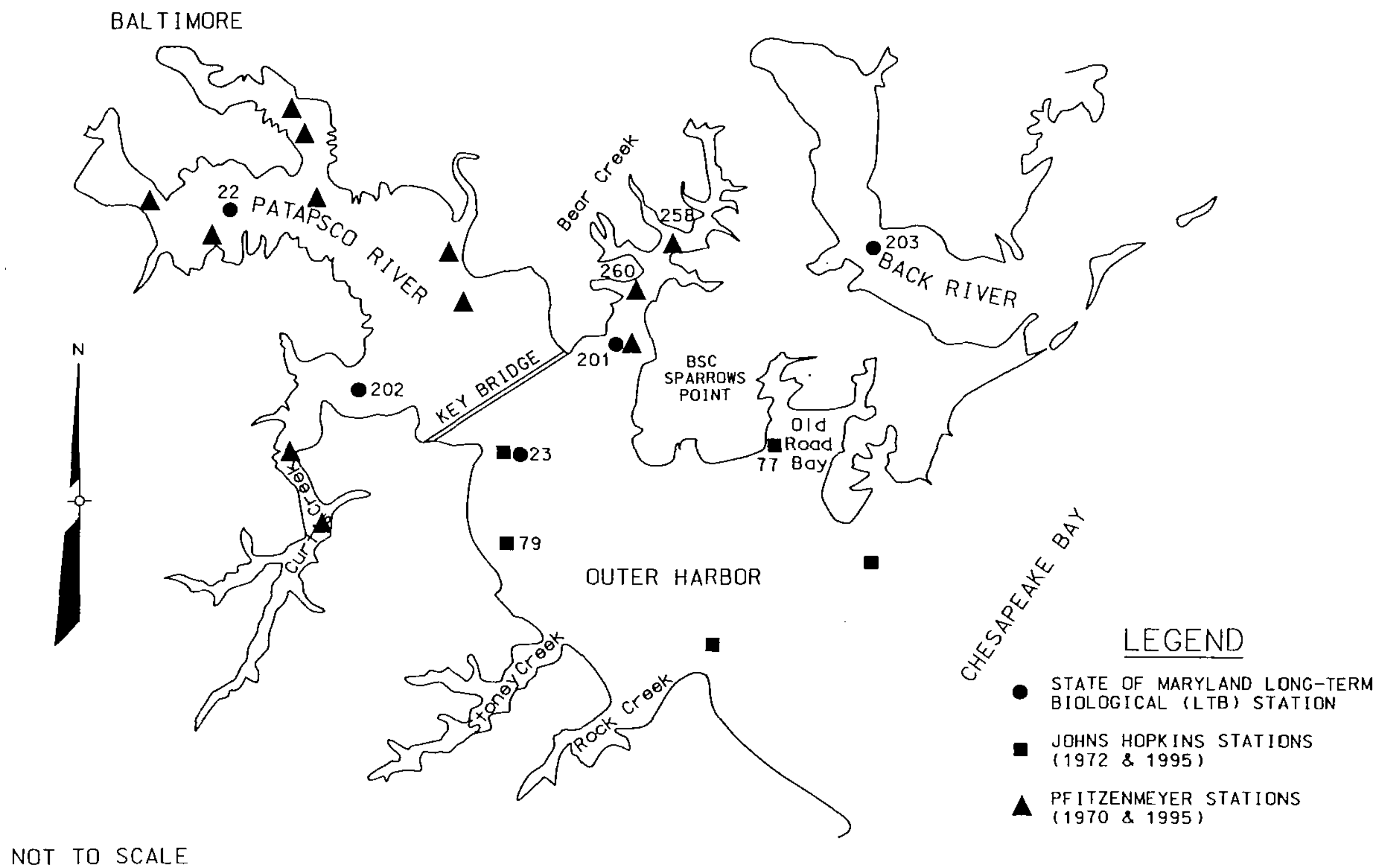
MDNR SEINING AND TRAWLING LOCATIONS

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998

200123

200123-1.DGN DECEMBER 22, 1997



SOURCE: MARYLAND DEPARTMENT OF NATURAL RESOURCES RESOURCE ASSESSMENT SERVICE.

RUST
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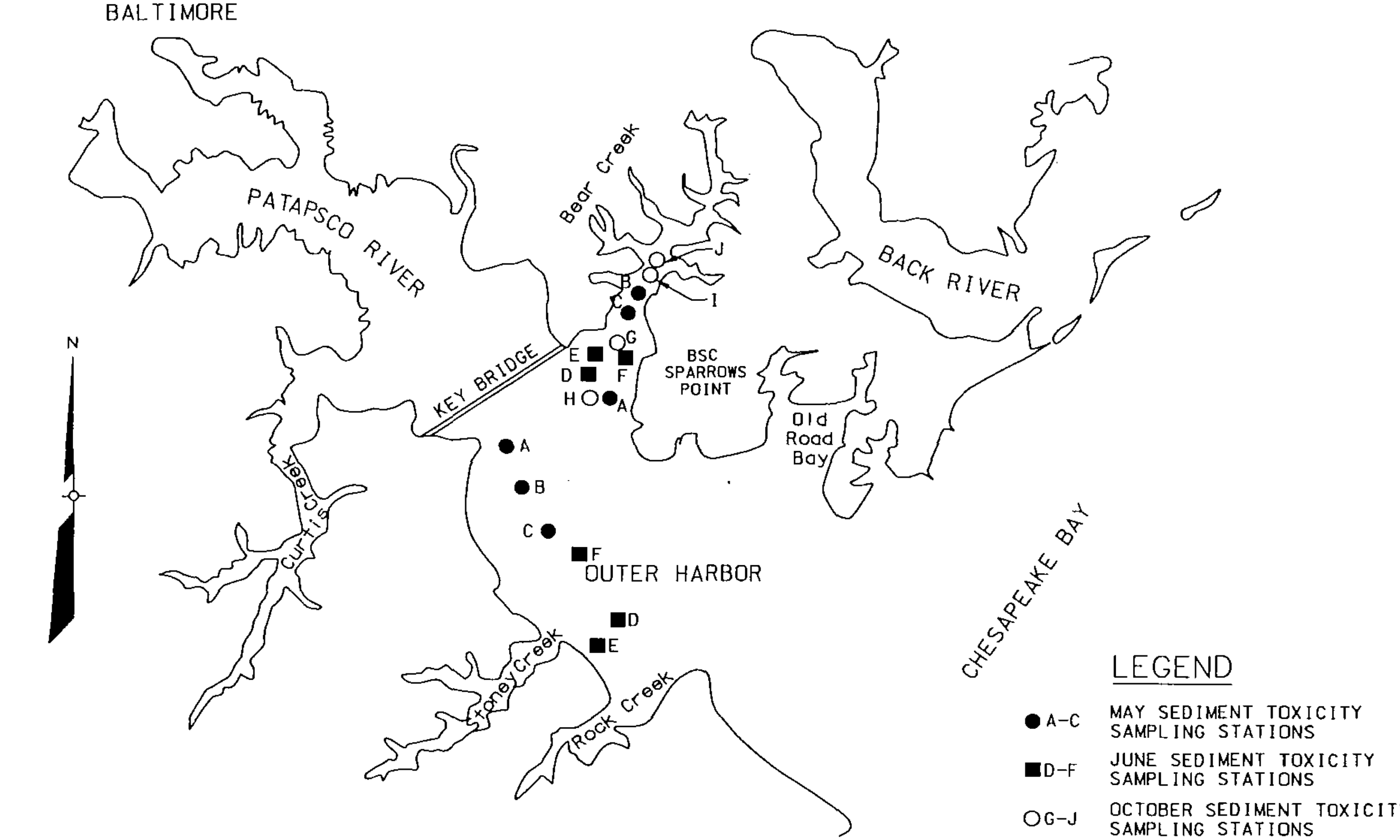
FIGURE 5-5

BENTHIC COMMUNITY SAMPLING LOCATIONS

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998 200123

200123-1.DGN DECEMBER 22, 1997



NOT TO SCALE

SOURCE: PINKNEY AND RZEMIEN. 1993.

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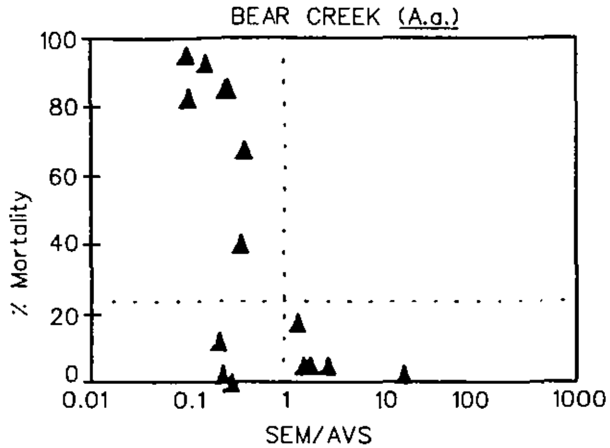
FIGURE 5-6

SEDIMENT TOXICITY
SAMPLING STATIONS

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

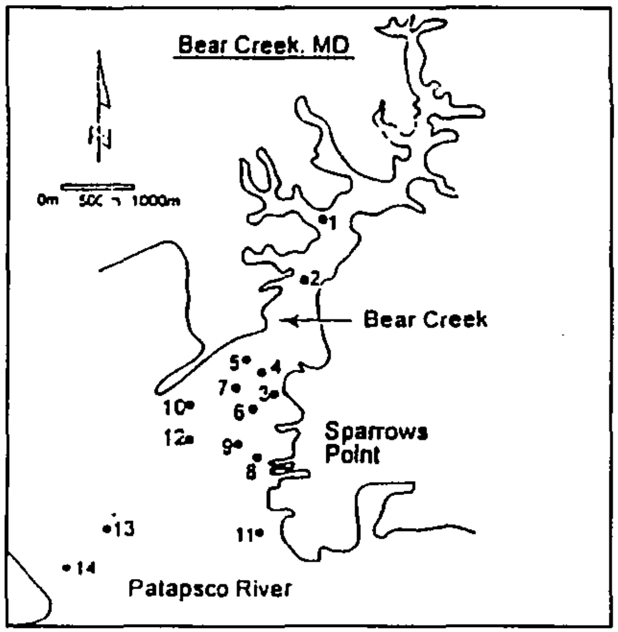
JANUARY 1998 200123

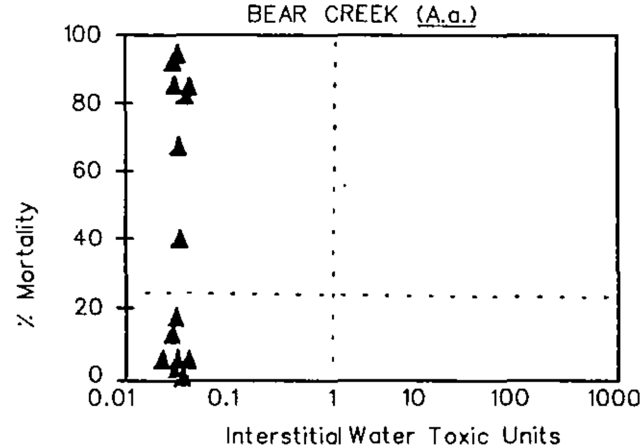
B38718-2.DGN DECEMBER 22, 1997



Percent mortality of amphipod (Ampelisca abdita) as a function of SEM/avs ratios in sediments.

The vertical dashed lines indicate concentrations below which mortality is not expected. The horizontal dashed line at 24% mortality indicates the approximate mortality at which statistically significant effects are expected.





Percent mortality of amphipod (Ampelisca abdita) as a function of IWTUs of Cd, Cu, Ni, Pb, and Zn.

The vertical dashed lines indicate concentrations below which mortality is not expected. The horizontal dashed line at 24% mortality indicates the approximate mortality at which statistically significant effects are expected.

NOT TO SCALE

SOURCE: HANSEN ET AL., 1996.

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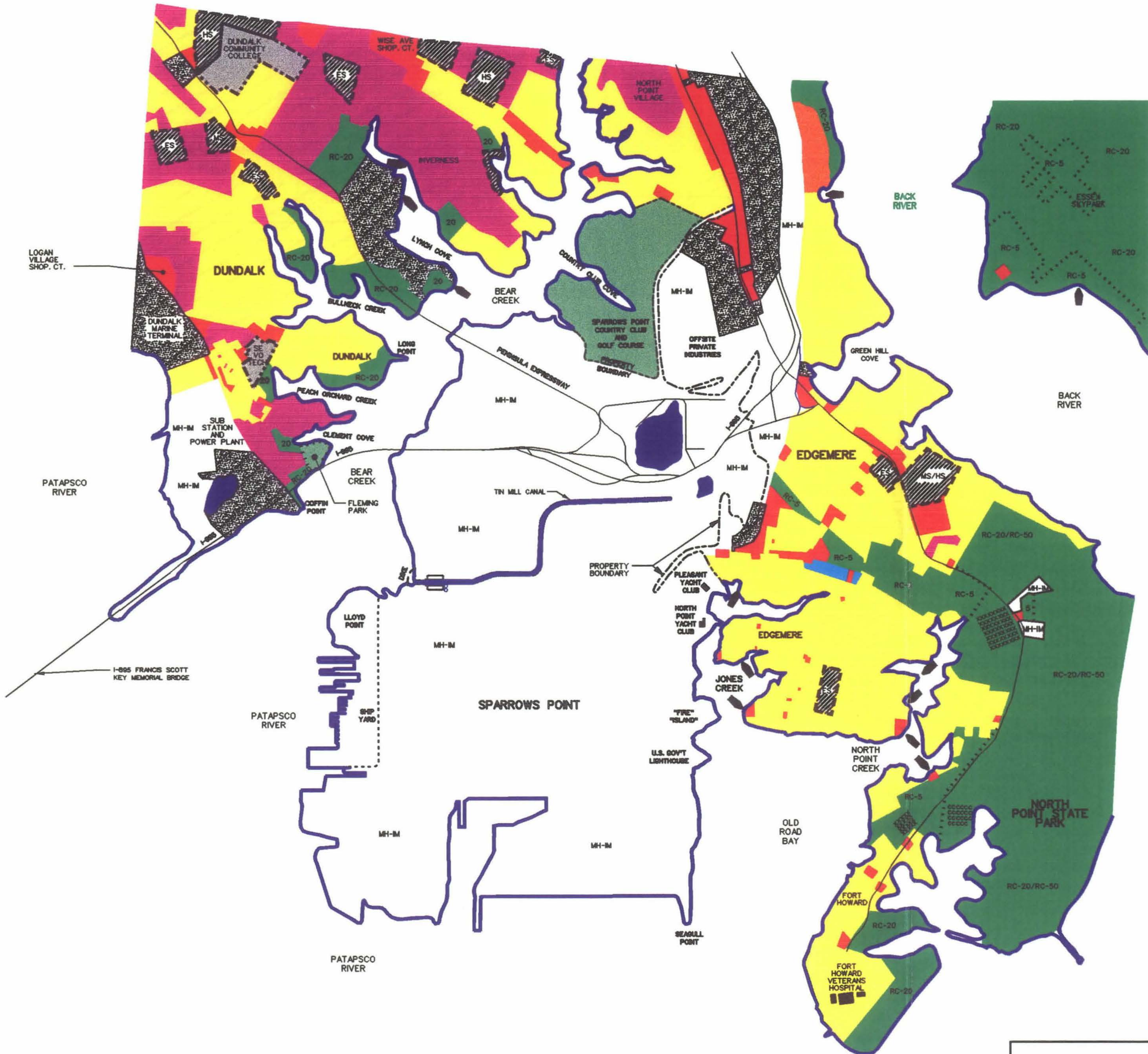
FIGURE 5-7
TOXICITY PREDICTION STUDY
SAMPLING STATIONS

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998 200123



LEGEND

- MH-IM — MANUFACTURING HEAVY and INDUSTRIAL MAJOR
- ML/MLR (MANUFACTURING LIGHT) i.e., LIGHT INDUSTRY SUCH AS ASSEMBLY PLANTS
- LOW DENSITY URBAN RESIDENTIAL AREA PERMITTED FOR MAX. OF 1-2 UNITS/ACRE
- MEDIUM DENSITY URBAN RESIDENTIAL AREA PERMITTED FOR MAX. OF 3.5-5.5 UNITS/ACRE
- HIGH DENSITY URBAN RESIDENTIAL AREA PERMITTED FOR MAX. OF 10.5-16 UNITS/ACRE
- COMMERCIAL BUSINESS
- COMMUNITY BUSINESS
- SCHOOLS: ES-ELEMENTRY SCHOOL
  MS-MIDDLE SCHOOL
  HS-HIGH SCHOOL
- BALTIMORE COUNTY RESOURCE CONSERVATION ZONES:
  RC-5: AREAS DESIGNATED FOR LOW DENSITY RESIDENTIAL DEVELOPMENT IN APPROPRIATE RURAL AREAS
  RC-20: NATURAL RESOURCE, AGRICULTURAL AND RESIDENTIAL AREAS ZONED FOR THE PROTECTION OF THE NATURAL RESOURCES OF THE CESAPEAKE BAY CRITICAL AREA
  RC-50: NATURAL RESOURCE, AGRICULTURAL AND RESIDENTIAL AREAS ZONED FOR THE PROTECTION OF AGRICULTURE IN A MANNER CONSISTENT WITH THE CHESAPEAKE BAY CRITICAL AREA
- CULTIVATED/TILLED AGRICULTURAL FIELDS
- CATTLE GRAZING
- MARINA

N

SCALE 0' 1500' 3000'

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FIGURE 5-8

REGIONAL LAND USE MAP

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998

200123

DECEMBER 22, 1997

FIG5-8.DGN

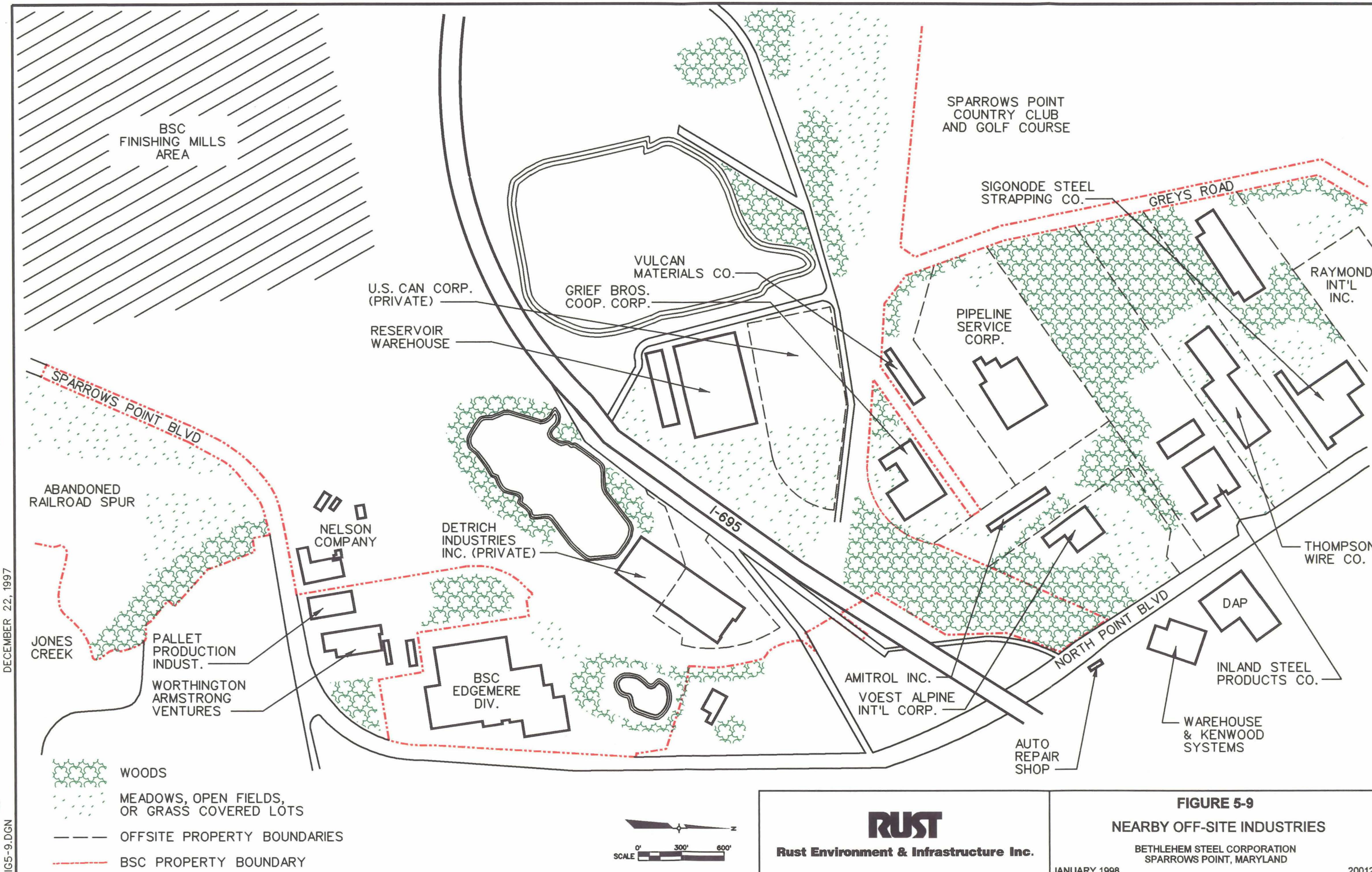

FIGURE 5-9

NEARBY OFF-SITE INDUSTRIES

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998

200123

DECEMBER 22, 1997

FIG5-9.DGN

FIG5-10.DGN DECEMBER 22, 1997

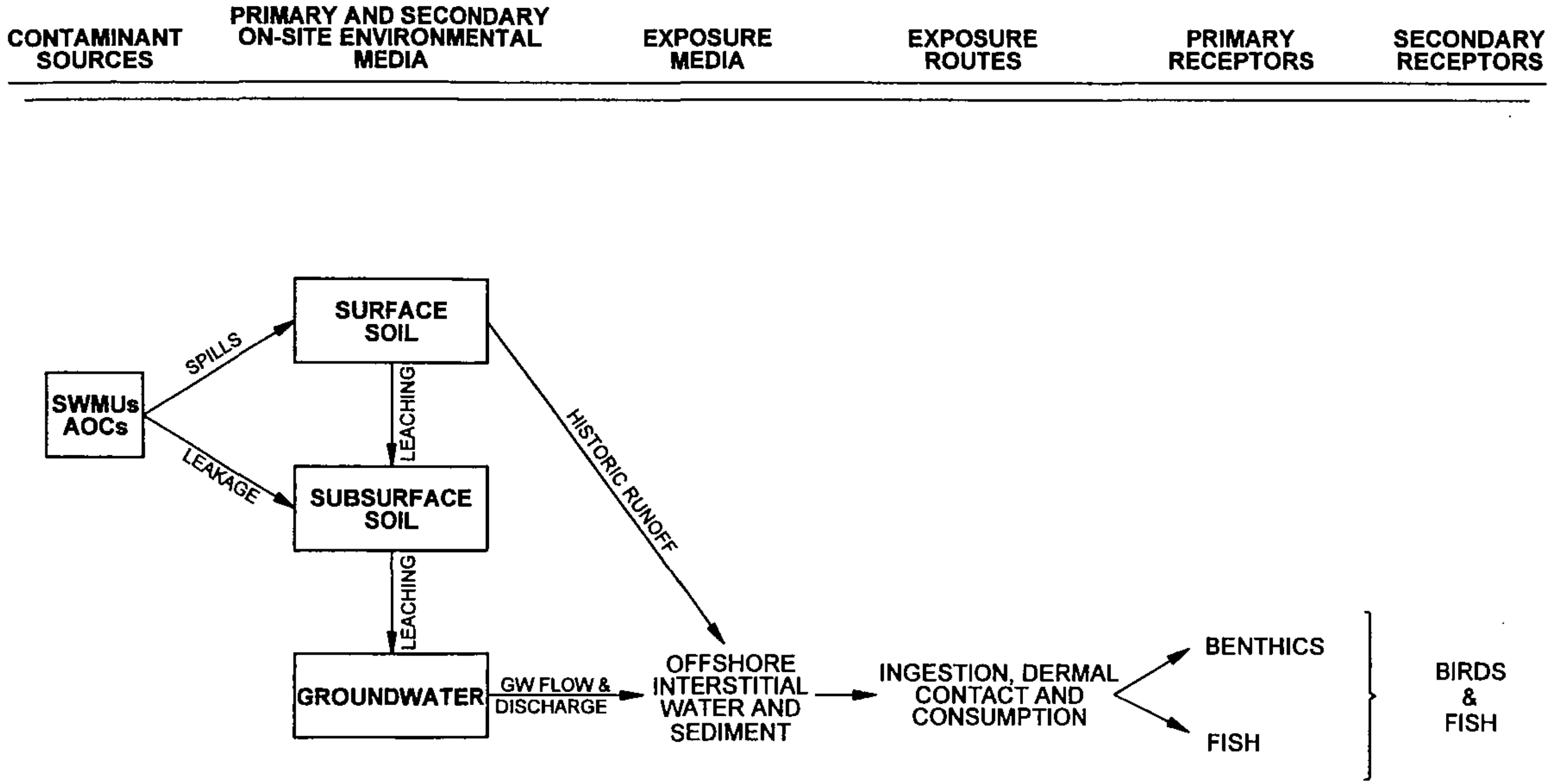

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FIGURE 5-10

PRELIMINARY CONCEPTUAL MODEL
OFF-SITE ECOLOGICAL

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998 200123

PRECUR.DGN DECEMBER 22, 1997

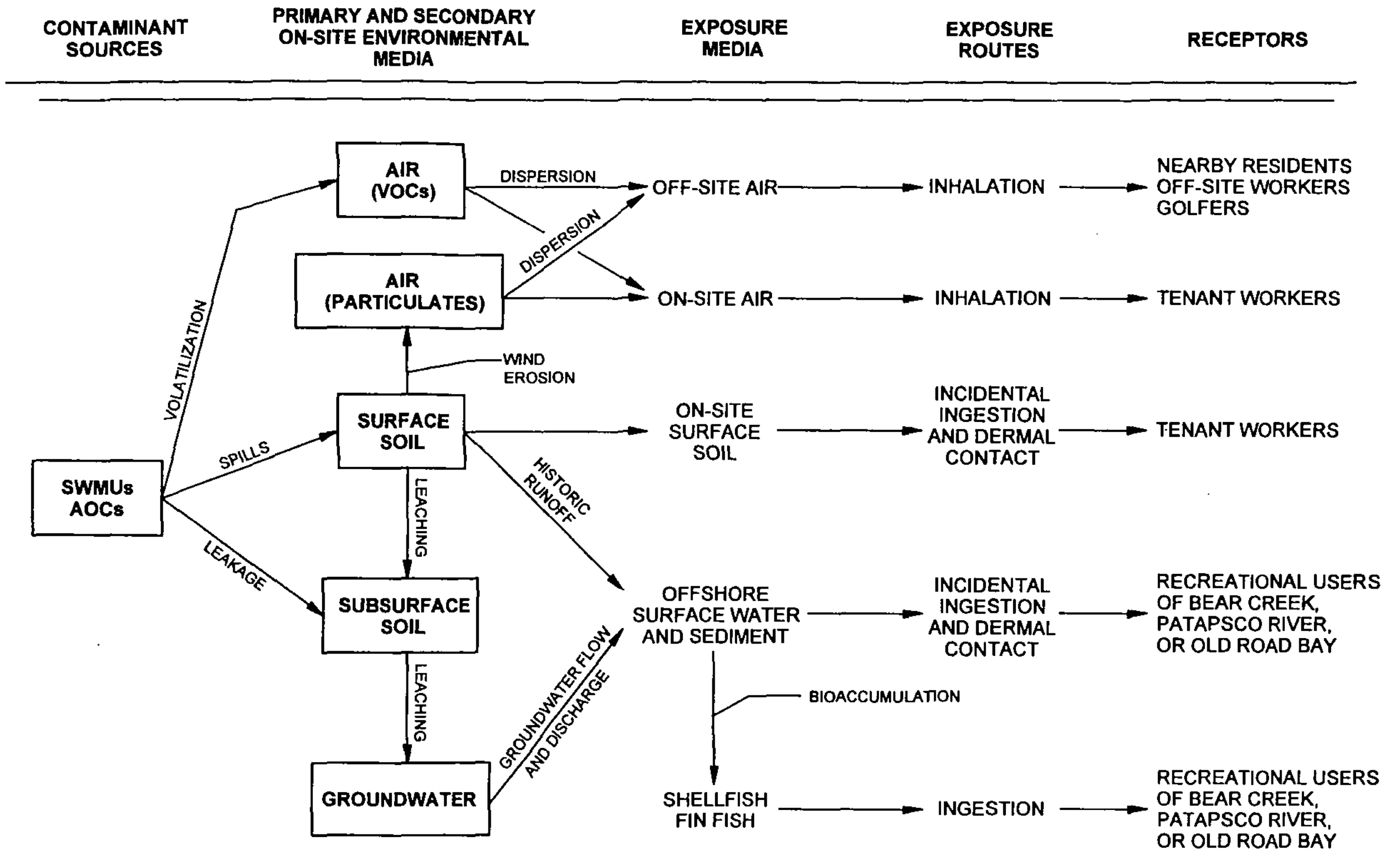

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FIGURE 5-11

PRELIMINARY CONCEPTUAL MODEL
OFF-SITE HUMAN

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998 200123

FIG5-12.DGN DECEMBER 22, 1997

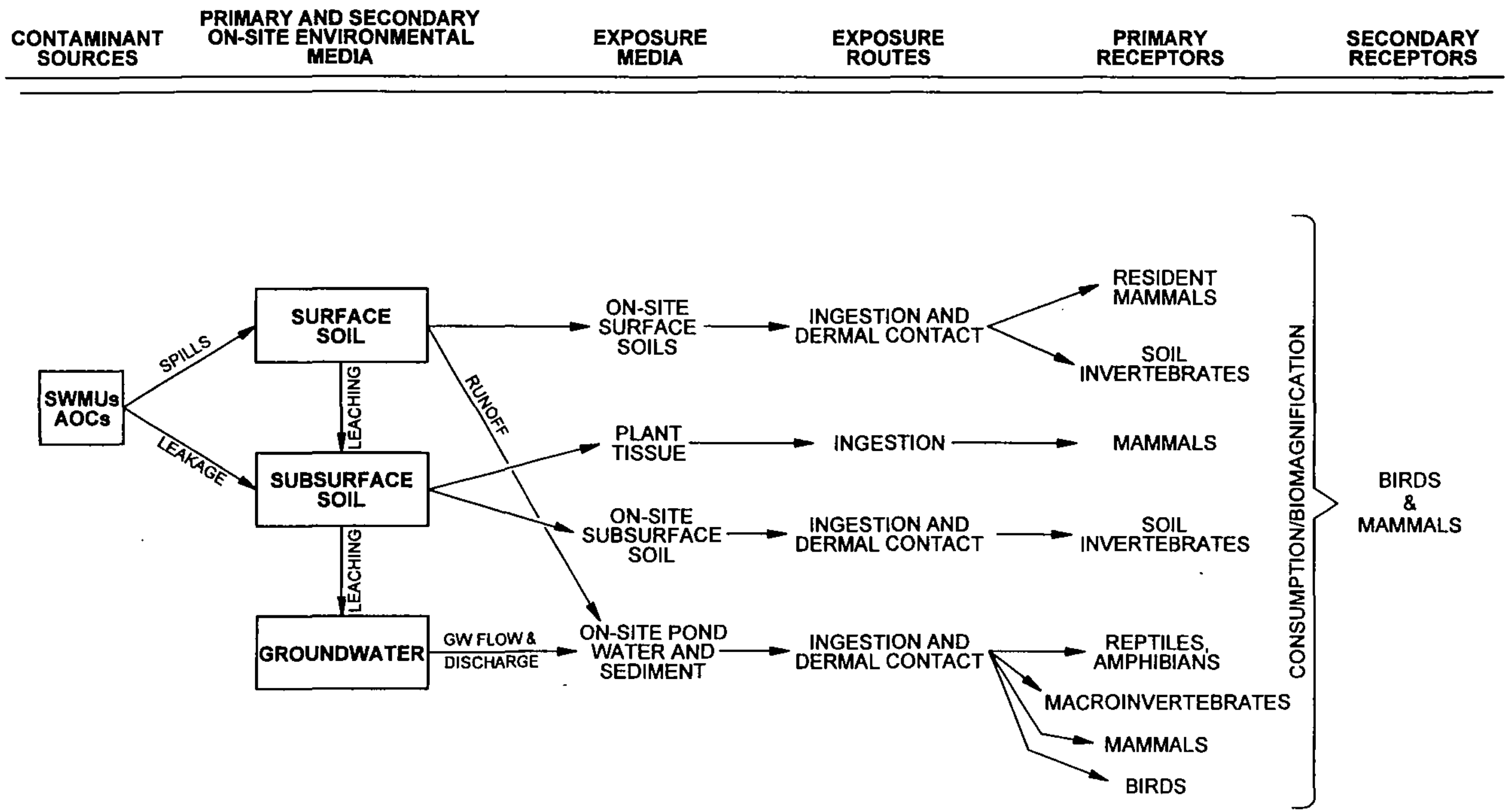

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FIGURE 5-12

PRELIMINARY CONCEPTUAL MODEL
ON-SITE ECOLOGICAL

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998 200123

PRECUR.DGN DECEMBER 22, 1997

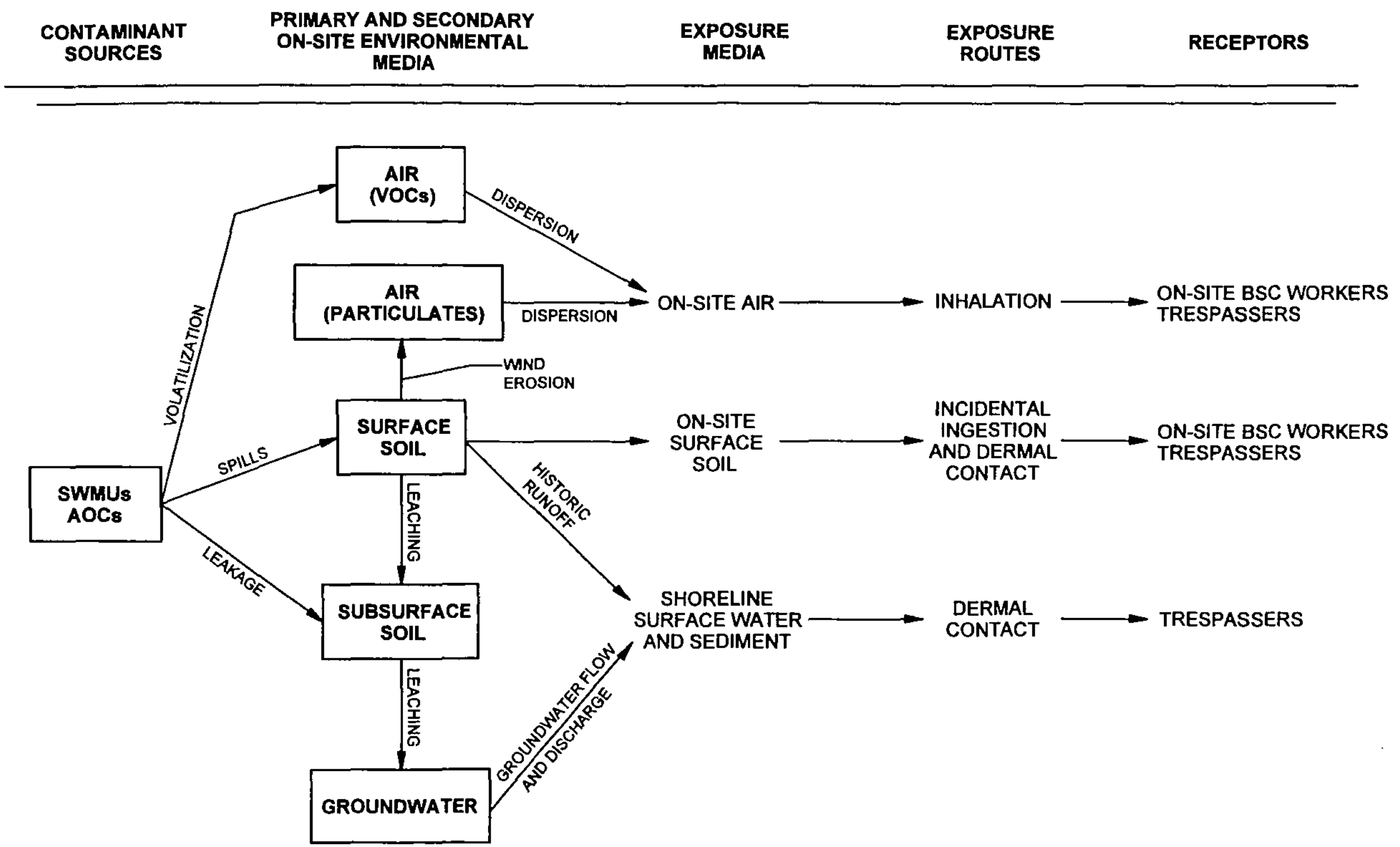

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FIGURE 5-13

PRELIMINARY CONCEPTUAL MODEL
ON-SITE HUMAN

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998 200123

Table 5-1 Conventional Water Quality Parameters Near Sparrows Point Bethlehem Steel Corporation Sparrows Point, Maryland					
Station Sampling (date)	**Temp. (°C)**	**Salinity (ppt)**	**Dissolved Oxygen (mg/ℓ)**	**Conductivity (μmhos/cm)**	**pH**
Bear Creek (near mouth)					
8/13/90	24.0	7.5	8.8	12,200	
8/16/90	28.0	6.8	9.3	11,600	
8/19/90	27.8	6.3	7.2	11,200	
10/11/94	17.5	11.0	7.8	15,000	7.98
10/14/94	16.0	12.0	6.1	15,000	7.60
10/17/94	16.0	11.5	8.3	15,000	7.97
Patapsco River (navigation channel, I-695)					
10/11/94	16.0	11.0	8.2	15,000	7.80
10/14/94	15.0	12.0	7.5	15,500	7.84
10/17/94	14.0	12.0	7.2	15,000	7.65
Patapsco River (offshore BSC's Shipyard)					
10/11/94	18.0	11.5	7.2	16,000	7.88
10/14/94	16.5	12.0	6.9	15,500	7.86
10/17/94	15.5	12.0	6.7	15,500	7.63
Maryland Water Quality Standard					
	< 32°	no standard	≥ 5 mg/ℓ	no standard	> 6.5 and < 8.5

Source: Hall et al., 1991 and 1996

Table 5-2
Concentration of Inorganic Parameters in Surface Water Near Sparrows Point
Bethlehem Steel Corporation
Sparrows Point, Maryland

Inorganic Parameters	Unit	MD Standards			Bear Creek (near mouth)		Patapsco River (navigation channel, I-695)		Patapsco River (offshore BSC's Shipyard)	
		Aquatic Life		Human Health						
		Acute	Chronic		Date	Conc.	Date	Conc.	Date	Conc.
Aluminum	µg/ℓ				8/13/90	20.30				
					8/16/90	5.40				
Arsenic	µg/ℓ			50	8/13/90	<3.00	10/12-20/94	2.2	10/12-20/94	1.37
					8/16/90	<3.00				
					10/12/94	1.13				
Cadmium	µg/ℓ	43	9.3	5	8/13/90	<2.00	10/12-20/94	<0.50	10/12-20/94	<0.50
					8/16/90	<2.00				
					10/12/94	<0.50				
Chromium (total)	µg/ℓ	1100	50		8/13/90	<3.00	10/12-20/94	<0.50	10/12-20/94	1.40
					8/16/90	<3.00				
					10/12/94	<0.50				
Copper	µg/ℓ	6.1			8/13/90	<2.00	10/12-20/94	1.90	10/12-20/94	2.08
					8/16/90	<2.00				
					10/12/94	3.85				
Mercury	µg/ℓ	2.1	0.025	2	8/13/90	<0.20	10/12-20/94	<0.25	10/12-20/94	<0.25
					8/16/90	<0.20				
					10/12/94	<0.25				
Nickel	µg/ℓ	75	8.3	100	8/13/90	10.80	10/12-20/94	<5.0	10/12-20/94	<5.0
					8/16/90	6.50				
					10/12/94	<5.0				
Lead	µg/ℓ	140	5.6	50	8/13/90	<2.00	10/12-20/94	<5.0	10/12-20/94	<5.0
					8/16/90	<2.00				
					10/12/94	<5.0				
Selenium	µg/ℓ	300	71	50	8/13/90	<30.00	10/12-20/94	0.25	10/12-20/94	<0.72
					8/16/90	<30.00				
					10/12/94	<0.25				
Zinc	µg/ℓ	95	86		8/13/90	<5.00	10/12/94	<10.0	10/12/94	<10.0
					8/16/90	<5.00				
					10/12/94	<10.0				

Source: Hall et al., 1991 and 1996

Table 5-3
Concentration of Organic Parameters in Surface Water Near Sparrows Point
Bethlehem Steel Corporation
Sparrows Point, Maryland

Organic Parameters	Unit	MD Standards			Bear Creek (near mouth)	
		Aquatic Life		Human Health		
		Acute	Chronic		Date	Conc.
Aroclor 1248	μg/ℓ				8/13/90	<0.05
					8/16/90	<0.05
Aroclor 1254	μg/ℓ				8/13/90	<0.05
					8/16/90	<0.05
Aroclor 1260	μg/ℓ				8/13/90	<0.05
					8/16/90	<0.05
DDE	μg/ℓ				8/13/90	<0.02
					8/16/90	<0.02
Toxaphene	μg/ℓ	0.21	0.0002	3	8/13/90	<0.20
					8/16/90	<0.20
Chlordane	μg/ℓ				8/13/90	<0.02
					8/16/90	<0.02
Perylene	μg/ℓ				8/13/90	<0.70
					8/16/90	<0.70
Fluorene	μg/ℓ				8/13/90	<0.90
					8/16/90	<0.90
Phenanthene	μg/ℓ				8/13/90	<0.70
					8/16/90	<0.70
Anthracene	μg/ℓ				8/13/90	<0.70
					8/16/90	<0.70
Fluoranthrene	μg/ℓ				8/13/90	<1.10
					8/16/90	<1.10
Pyrene	μg/ℓ				8/13/90	<1.00
					8/16/90	<1.00
Benzo(a)anthracene	μg/ℓ				8/13/90	<1.70
					8/16/90	<1.70
Chrysene	μg/ℓ				8/13/96	<0.70
					8/16/90	<0.70

Source: Hall et al., 1991 and 1996

Note: Organic parameters not analyzed in 1994 study.

Table 5-4
Concentration of Inorganic Parameters in Sediment Near Sparrows Point
Bethlehem Steel Corporation
Sparrows Point, Maryland

Parameter	Unit	Bear Creek (near mouth)				Patapsco River (navigation channel, I-695)	Patapsco River (offshore BSC's Shipyard)
		August 1990	August 1991	September 1991	October 1994	October 1994	October 1994
Aluminum	μg/g	575.0	674	7.32	8,210.0	24,500.0	30,400.0
Cadmium	μg/g	4.89	1.646	1.254	12.3	1.47	2.19
Arsenic	μg/g	3.2	3.77	3.72	52.6	93.5	64.0
Chromium	μg/g	157.0	107.8	130.6	1,340.0	362.0	396.0
Copper	μg/g	20.6	14.22	16.79	207.0	144.0	154.0
Mercury	μg/g	0.022	0.011	0.024	0.380	0.414	0.441
Nickel	μg/g	7.0	4.2	4.8	44.5	47.3	56.0
Lead	μg/g	55.8	23.0	37.8	267.0	118.0	178.0
Selenium	μg/g	0.55	0.37	0.24	5.19	7.15	3.98
Tin	μg/g	83.0	42.0	56.0	537.0	3.77	16.0
Zinc	μg/g	603.1	382.6	455.3	2,420.0	557.0	695.0

Source: Hall et al., 1991, 1992, and 1996

Note: Single-underlined values represent concentrations exceeding "Effects Range-Low", and double-underlined values represent concentrations exceeding "Effects Range-Medium" levels as defined by Long and Morgan (1990).

Table 5-5
Concentration of Semi-Volatiles in Sediment Near Sparrows Point
Bethlehem Steel Corporation
Sparrows Point, Maryland

Parameter	Unit	Detection Limit	Bear Creek (near mouth)	Patapsco River (navigation channel, I-695)	Patapsco River (offshore BSC's Shipyard)
Naphthalene	$\mu g/g$	0.0050	0.21		<u>4.41</u>
Acenaphthene	$\mu g/g$	0.0020			0.06
Fluorene	$\mu g/g$	0.0020		0.05	0.15
Phenanthrene	$\mu g/g$	0.0020	0.98	0.909	<u>4.48</u>
Anthracene	$\mu g/g$	0.0002	0.052	0.058	0.296
Fluoranthene	$\mu g/g$	0.0030	1.82	0.701	2.08
Pyrene	$\mu g/g$	0.0030	<u>6.94</u>	<u>2.2</u>	<u>5.54</u>
Benzo(a)anthracene	$\mu g/g$	0.0003	0.784	0.34	1.03
Chrysene	$\mu g/g$	0.0003		0.501	1.2
Benzo(a)pyrene	$\mu g/g$	0.0002	<u>3.81</u>	2.14	<u>5.32</u>
Indeno(1,2,3-cd)pyrene	$\mu g/g$	0.0002	3.24	2.31	6
Dibenzo(a,h)anthracene	$\mu g/g$	0.0003	<u>3.55</u>	<u>1.12</u>	<u>2.55</u>
Benzo(g,h,i)perylene	$\mu g/g$	0.0001	2.35	1.58	3.94

Source: Hall et al., 1996

Note: Underlined values represent concentrations exceeding "Effects Range-Medium" levels for selected polynuclear aromatic hydrocarbons, as defined by Long and Morgan, 1990.

Table 5-6
Concentration of Pesticides in Sediment Near Sparrows Point
Bethlehem Steel Corporation
Sparrows Point, Maryland

Parameter	Unit	Detection Limit	Bear Creek (near mouth)	Patapsco River (navigation channel, I-695)	Patapsco River (offshore BSC's Shipyard)
Hexachlorobenzene	$\mu g/g$	0.0035			
Aldrin	$\mu g/g$	0.0041			
Alpha-BHC	$\mu g/g$	0.0061			
Beta-BHC	$\mu g/g$	0.0058			
DDD	$\mu g/g$	0.0034		0.0053	
DDE	$\mu g/g$	0.0027			
DDT	$\mu g/g$	0.0023			
Dieldrin	$\mu g/g$	0.0093			
Endrin	$\mu g/g$	0.0076	0.027		
Heptachlor	$\mu g/g$	0.0030			
Heptachlor Epoxide	$\mu g/g$	0.0015		tr.	
Alpha-Chlordane	$\mu g/g$	0.0007			tr.
Gamma-Chlordane	$\mu g/g$	0.0016	tr.		tr.
Alachlor	$\mu g/g$	0.0050	0.0258		
Metolachlor	$\mu g/g$	0.0065	0.0157	0.01340	0.02770
Trifluralin	$\mu g/g$	0.0038	tr.	tr.	tr.
Chlorpyrifos	$\mu g/g$	0.0016			
Fenvalerate	$\mu g/g$	0.0017			
Lindane	$\mu g/g$	0.0043	tr.		
Permethrin	$\mu g/g$	0.0077			
2,3',5-Trichlorobiphenyl	$\mu g/g$	0.0031	0.0261		
2,4,4'-Trichlorobiphenyl	$\mu g/g$	0.0012	0.0057		
2,2',4,4'-Trichlorobiphenyl	$\mu g/g$	0.0013			
Methoxychlor	$\mu g/g$	0.0026	0.0032		

Source: Hall et al., 1996

Table 5-7
Patapsco River Commercial Fish Landings 1975 to 1995
Bethlehem Steel Corporation
Sparrows Point, Maryland

Year	Bluefish	Carp	Catfish	Gizzard Shad	Herring	Hickory Shad	Menhaden	Sea Trout, Gray (Weakfish)	Shad, American	Striped Bass	White Perch	Yellow Perch	Blue Crab, Hard	Blue Crab, Soft	Eel
1975	1,380	229	586	5	190	90	15,411	24	5	16,634	4,298	16			
1976	110	35	21		7	2	3,640		1	1,601	1,400				
1977	1,448	28	131		10		3,075			520	1,251				
1978	255	20	136		20		3,280		4	227	527				
1979	109		1,220				1,714			6,557	1,077				
1980	1,085	4	28	103	17	6	1,070	13		3,563	616				
1981	63		140		249		1,825	15		10,456	580				
1982	575		573		25	24	1,415		15	523	487		629,366	12,008	
1983	25	13	426				1,535		52	379	354		410,065	18,733	
1984	25		225				110	2		685	170		166,338	1,910	
1985	415	1,147	62		390		145				786		222,079	6,197	
1986	153							95			92		777,815	7,847	
1987	117	471	1,683								1,822	3,415	367,789	25,540	
1988	5	730	2,645		325						7,840	10,035	218,434	2,049	
1989			205								285		151,372	1,869	45
1990			117								480		413,244	5,121	1,635
1991			1,320								3,575		326,691	2,494	4,806
1992		40	62		28			4		11,388	1,436		91,345	946	2,443
1993			200							6,881	2,702		307,859	2,519	905
1994										2,329	640		184,486	1,158	233
1995	40						900			19,628	4,812		74,567	1,045	7,460

Source: Maryland Department of Natural Resources, Fisheries Services

Note: Units are pound per year.

Table 5-8 Results of MDNR Patapsco River Fishery Study 1994 Bethlehem Steel Corporation Sparrows Point, Maryland							
Fish Species	**Trophic Level**	**Resident/ Nonresident**	**Bottom Trawl**	**Seine Catch (7/18/94)**	**Seine Catch (8/15/94)**	**Seine Catch (9/19/94)**	**Summary**
Atlantic Menhaden	Planktivore	Nonresident	-----	5	-----	-----	5
Atlantic Needlefish	Carnivore	Nonresident	-----	-----	-----	10	10
Atlantic Silverside	Planktivore	Resident	7	692	367	10	1076
Bay Anchovy	Planktivore	Resident	15	-----	-----	22	37
Bluefish - juvenile	Carnivore	Nonresident	-----	1	-----	-----	1
Gizzard Shad	Planktivore	Resident	-----	2	-----	11	13
Hogchoker	Benthic	Resident	-----	1	-----	-----	1
Inland Silverside	Planktivore	Resident	-----	9	-----	-----	9
Mummichog	Planktivore	Resident	-----	1	1	-----	2
Pumpkinseed	Planktivore	Resident	-----	-----	1	-----	1
Silvery Minnow	Planktivore	Resident	-----	-----	9	-----	9
Spot -juvenile	Benthic	Nonresident	-----	3	4	2	9
Striped Bass- juvenile	Carnivore	Nonresident	-----	71	104	12	187
Striped Bass- 1 year	Carnivore	Nonresident	-----	1	9	9	19
Striped Killifish	Planktivore	Resident	-----	-----	5	-----	5
White Perch- juvenile	Carnivore	Nonresident	-----	54	10	3	67
White Perch -1 year	Carnivore	Nonresident	-----	-----	319	559	878
Yellow Perch- 1year	Carnivore	Resident	-----	-----	2	-----	2
Total # Species				12	9	8	
Total # Estuarine Individuals				697	380	47	
Total # Anadromous Individuals				126	442	583	
# Species Comprising 90% of the catch				3	3	2	

Table 5-9
State of Maryland Benthic Data 1994 and 1995
Bethlehem Steel Corporation
Sparrows Point, Maryland

General Area	Inner Harbor (Middle Branch)		Outer Harbor				Bear Creek				Old Road Bay	Curtis Bay	Back River
Sampling Station Locations													
Station Number	22	22	23	23	79	79	201	201	258	260	77	202	203
Sampling Year	1994	1995	1994	1995	1994	1995	1994	1995	1995	1995	1995	1995	1995
Physical Parameters													
Silt Clay (%)	76.13	85.48	70.73	13.20	61.73	88.05	77.56	11.20	5.01	94.05	90.17	94.18	97.48
D.O. (mg/L)	5.7	4.0	6.2	4.3	6.6	7.7	6.3	5.7	6.7	5.4	5.5	6.1	6.8
Depth (m)	3.3	4.0	5.2	6.0	2.5	0.6	3.1	4.0	2.5	4.0	1.2	6.0	2.0
Salinity (ppt)	5.30	12.60	5.20	13.20	0.00	0.80	4.80	11.20	10.70	11.10	6.7	13.00	5.30
Ecological Metrics													
No. Of Taxa (Taxa Richness)	10	14	12	8	10	20	2	13	19	7	15	3	7
Shannon-Weiner Index (H')	1.236	2.137	1.877	1.583	0.981	2.096	0.561	0.339	2.101	0.229	2.214	0.332	0.725
Pielou's measure of evenness (J')	0.537	0.81	0.755	0.761	0.426	0.7	0.809	0.132	0.713	0.118	0.817	0.303	0.373
% Pollution Sensitive Species (1)	40.0	21.4	25.0	0.0	0.0	5.0	0.0	7.7	21.1	14.3	13.3	0.0	28.6
% Pollution Indicative Species (1)	0.0	14.3	8.3	37.5	60.0	40.0	100.0	23.1	10.5	42.9	20.0	66.7	71.4

Source: Ranasinghe et al. 1996 (Volume 2)

Note: *(1)* As defined in Weisburg et al. (In Press)

Table 5-10
Survival Data for Toxicity Tests With Water from Bear Creek and Patapsco River
Bethlehem Steel Corporation
Sparrows Point, Maryland

Test Dates	Species	Station	Cumulative Percent Survival Per Day							
			1	2	3	4	5	6	7	8
August 14, 1990 to August 21, 1990	*Eurytemora affinis*	Bear Creek				87				95
		Control				93				100
	Cyprinodon variegatus	Bear Creek	100	100	100	100	100	100	100	100
		Control	100	100	100	100	100	100	100	100
	Palaemonetes pugio	Bear Creek	100	98	86	64	61	61	61	61
		Control	100	100	100	100	100	100	100	98
August 13, 1991 to August 21, 1991	*Eurytemora affinis*	Bear Creek								97
		Control								90
	Cyprinodon variegatus	Bear Creek	100	100	100	100	100	100	100	100
		Control	100	100	100	100	100	100	100	100
	Palaemonetas pugio	Bear Creek	100	100	100	98	95	93	88	85
		Control	100	100	100	98	93	78	68	60
	Mysidopsis bahia	Bear Creek	100	100	93	85	85	85	85	85
		Control	96	93	93	89	89	85	85	82
September 24, 1991 to October 2, 1991	*Eurytemora affinis (1)*	Bear Creek								57
		Control (HW)								93
		Control (IR)								90
	Cyprinodon variegatus	Bear Creek	100	100	100	100	100	100	100	93
		Control	100	100	100	100	100	100	100	98
	Palaemonetes pugio	Bear Creek	100	98	98	98	98	85	85	83
		Control	100	100	100	100	98	93	90	88
	Mysidopsis bahia	Bear Creek	100	100	100	98	98	98	98	98
		Control	100	100	100	100	100	100	100	98

Table 5-10
Survival Data for Toxicity Tests With Water from Bear Creek and Patapsco River
Bethlehem Steel Corporation
Sparrows Point, Maryland

Test Dates	Species	Station	Cumulative Percent Survival Per Day							
			1	2	3	4	5	6	7	8
October 11, 1994 to October 20, 1994	*Eurtyemora affinis*	Bear Creek								72.6 (2)
		Patapsco River (navigation channel, I-695)								83.4 (2)
		Patapsco River (offshore BSC's Shipyard)								69.2 (2)
		Control								93.2 (2)
	Cyprinodon variegatus	Bear Creek	100	100	100	100	100	100	100	100
		Patapsco River (navigation channel, I-695)	100	100	100	100	100	100	100	100
		Patapsco River (offshore BSC's Shipyard)	100	100	100	100	100	100	100	100
		Control	100	100	100	100	100	100	100	100
	Palaemonetes pugio	Bear Creek	100	100	100	100	100	100	100	96
		Patapsco River (navigation channel, I-695)	100	100	100	100	100	100	100	96
		Patapsco River (offshore BSC's Shipyard)	100	100	100	100	96	96	96	96
		Control	100	96	96	96	92	92	92	88

Source: Hall et al., 1991, 1992, and 1996

Notes: *(1)* *Eurytemora affinis* control water was HW (groundwater plus sea salts) and IR (Indian River, Delaware).
(2) Mean survival after 8 day test.

Table 5-11
Reproduction and Growth Data for Toxicity Tests with Water from Bear Creek and Patapsco River
Bethlehem Steel Corporation
Sparrows Point, Maryland

Dates	Station	n	Mean Brood Size		Standard Error	
Copepod (*Eurytemora affinis*) Brood Size Comparisons Following 8-Day Exposures:						
August 14, 1990 to August 21, 1990	Bear Creek	10	66.1		10.2	
	Control	6	10.7		3.7	
August 14, 1991 to August 21, 1991	Bear Creek	5	27.4		7.2	
	Control	5	2.6		2.4	
September 24, 1991 to October 2, 1991	Bear Creek	4	38.3		15.7	
	Control (HW) *(1)*	5	36.6		12.3	
	Control (IR) *(1)*	5	63.6		6.8	
Dates	**Station**	**n**	**Mean Length (mm)**	**S.E.**	**Mean Dry Weight (mg)**	**S.E.**
Sheepshead Minnow Larvae (*Cyprinodon variegatus*) Growth Comparisons						
August 14, 1990 to August 21, 1990	Bear Creek	16	6.13	0.22	0.46	0.04
	Control	12	6.08	0.21	0.30	0.13
August 14, 1991 to August 21, 1991	Bear Creek	25			0.81	0.04
	Control	25			0.82	0.07
September 24, 1991 to October 2, 1991	Bear Creek	24			1.16	0.22
	Control	23			1.25	0.17
October 11, 1994 to October 19, 1994	Bear Creek	39			1.42	0.092
	Patapsco River (navigation channel, I-695)	30			1.52	0.056
	Patapsco River (offshore BSC's Shipyard)	39			1.18	0.076
	Control	38			1.44	0.064

Table 5-11
Reproduction and Growth Data for Toxicity Tests with Water from Bear Creek and Patapsco River
Bethlehem Steel Corporation
Sparrows Point, Maryland

Dates	Station	n	Mean Dry Weight (mg)	Standard Error
Grass Shrimp (*Palaemonetes pugio*) Growth Comparisons				
August 14, 1990 to August 21, 1990	Bear Creek	11	0.40	0.02
	Control	12	0.41	0.02
August 14, 1991 to August 21, 1991	Bear Creek	20	0.74	0.03
	Control	20	0.70	0.02
September 24, 1991 to October 2, 1991	Bear Creek	25	1.08	0.08
	Control	25	1.05	0.10
October 12, 1994 to October 20, 1994	Bear Creek	24	0.88	0.050
	Patapsco River (navigation channel, I-695)	24	0.78	0.042
	Patapsco River (offshore BSC's Shipyard)	24	0.77	0.034
	Control	22	0.81	0.047
Dates	**Station**	**n**	**Mean Dry Weight (mg)**	**Standard Error**
Mysis Shrimp (*Mysidopsis bahia*) Growth Comparison				
September 24, 1991 to October 2, 1991	Patapsco River	20	0.30	0.01
	Control	25	0.23	0.01

Source: Hall et al., 1991, 1992, and 1996

Notes: *(1)* *Eurytemora affinis* control water was HW (ground water plus sea salts) and IR (Indian River, Delaware).

Table 5-12
Survival Data for Toxicity Tests with Sediment from Bear Creek and Patapsco River - 1992
Bethlehem Steel Corporation
Sparrows Point, Maryland

Stratum	Dates	Sta.	Latitude	Longitude	Percent Silt-Clay	No. of Replicate Beakers	10 Day Static Percent Survival of *Leprocheirus plumulous*
Bear Creek	May 1992	A	39°13.10	76°30.11	79.32	1	60.0
		B	39°14.27	76°29.66	79.04	1	5.0
		C	39°14.10	76°29.92	88.86	1	15.0
	June 1992	D	39°13.15	76°30.52	47.17	1	100.0
		E	39°13.48	76°30.52	59.16	1	60.0
		F	39°13.58	76°29.89	75.58	1	5.0
	October 1992	G	39°14.00	76°29.77	93.99	3	0.0 0.0 0.0
		H	39°13.08	76°30.25	94.88	3	45.0 85.0 90.0
		I	39°14.58	76°29.70	96.63	3	0.0 0.0 15.0
		J	39°14.24	76°29.49	------	3	5.0 20.0 20.0
Patapsco River	May 1992	A	39°12.84	76°31.75	95.09	1	100.0
		B	39°12.20	76°31.35	87.89	1	95.0
		C	39°11.80	76°30.03	81.86	1	95.0
	June 1992	D	39°10.61	76°29.80	89.08	1	95.0
		E	39°10.38	76°30.09	84.72	1	95.0
		F	39°11.38	76°29.32	77.38	1	100.0

Source: Pinkney and Rzemien, 1993

Table 5-13
Survival Data for Toxicity Tests with Sediment from Bear Creek and Patapsco River 1990, 1991, and 1994
Bethlehem Steel Corporation
Sparrows Point, Maryland

		Percent Survival							
		Aug. 28, 1990 to Sept. 17, 1990		**Aug. 16, 1991 to Sept. 5, 1991**		**Sept. 27, 1991 to Oct. 17, 1991**		**Oct. 11, 1994 to Nov. 1, 1994**	
Species	**Station**	**Day 10**	**Day 20**	**Day 10**	**Day 20**	**Day 10**	**Day 20**	**Day 10**	**Day 20**
Grass shrimp *(Palaemonetes pugio)*	Control	99	95	99	99	98	97	NS	NS
	Bear Creek	100	95	100	97	98	98	NS	NS
Amphipod *(Lepidactylus dytiscus)*	Control	98	83	96	72	95	69	99 *(1)*	91 *(1)*
	Bear Creek	54	13	71	32	46	8	26 *(1)*	8 *(1)*
	Patapsco River (navigation channel, I-695)	NS	NS	NS	NS	NS	NS	77 *(1)*	66 *(1)*
	Patapsco River (offshore BSC's Shipyard)	NS	NS	NS	NS	NS	NS	76 *(1)*	60 *(1)*
Amphipod *(Hyalella azteca)*	Control			92	76	86	62	NS	NS
	Bear Creek			20	2	9	2	NS	NS
Polychaete Worm *(Streblospio benedicti)*	Control	100	100	100*(1)*	90	98	87	100	83
	Bear Creek	58	52	92 *(1)*	77	80	70	53 *(1)*	44 *(1)*
	Patapsco River (navigation channel, I-695)	NS	NS	NS	NS	NS	NS	75 *(1)*	63 *(1)*
	Patapsco River (offshore BSC's Shipyard)	NS	NS	NS	NS	NS	NS	47 *(1)*	37 *(1)*
Sheepshead Minnow *(Cyprinodon variegatus)*	Control	NS	NS	NS	NS	NS	NS		94 *(2)*
	Bear Creek	NS	NS	NS	NS	NS	NS		4 *(2)*
	Patapsco River (navigation channel, I-695)	NS	NS	NS	NS	NS	NS		6 *(2)*
	Patapsco River (offshore BSC's Shipyard)	NS	NS	NS	NS	NS	NS		42 *(2)*

Table 5-13
Survival Data for Toxicity Tests with Sediment from Bear Creek and Patapsco River 1990, 1991, and 1994
Bethlehem Steel Corporation
Sparrows Point, Maryland
Page 2 of 2

Species	Station	Percent Survival							
		Aug. 28, 1990 to Sept. 17, 1990		Aug. 16, 1991 to Sept. 5, 1991		Sept. 27, 1991 to Oct. 17, 1991		Oct. 11, 1994 to Nov. 1, 1994	
		Day 10	Day 20	Day 10	Day 20	Day 10	Day 20	Day 10	Day 20
Amphipod *(Leptocheirus plumulosus)*	Control	NS	NS	NS	NS	NS	NS	84	74
	Bear Creek	NS	NS	NS	NS	NS	NS	0	0
	Patapsco River (navigation channel, I-695)	NS	NS	NS	NS	NS	NS	80	76
	Patapsco River (offshore BSC's Shipyard)	NS	NS	NS	NS	NS	NS	82	64

Source: Hall et al., 1991, 1992, and 1996

Notes: *(1)* Percent survival adjusted for predicted particle size effects.
(2) Percent survival = 1 - [(dead fish + dead eggs at test termination)/(# eggs exposed)] * 100
NS Not sampled/tested

Table 5-14
Growth Data From Toxicity Tests With Sediment from Bear Creek and the Patapsco River
Bethlehem Steel Corporation
Sparrows Point, Maryland

Criteria	Grass Shrimp *(Palaemontes pugio)*			Amphipod *(Lepidactylus dytiscus)*					Amphipod *(Hyalella azteca)*			Worms *(Streblospio benedicti)*					Amphipod *(Leptocheirus plumulosus)*				
							Patapsco River								Patapsco River					Patapsco River	
	Initial Measurements	Control	Bear Creek	Initial Measurements	Control	Bear Creek	(navigation Channel, I-695)	(offshore BSC's Shipyard)	Initial Measurements	Control	Bear Creek	Initial Measurements	Control	Bear Creek	(Navigation Channel, I-695)	(Offshore BSC's Shipyard)	Initial Measurements	Control	Bear Creek	(Navigation Channel, I-695)	(Offshore BSC's Shipyard)
AUGUST 28, 1990 TO SEPTEMBER 17, 1990																					
Replicates	—	5	5	—	5	5	NT	NT	NT	NT	NT	—	5	4	NT	NT	NT	NT	NT	NT	NT
Weight (mg)	18.13	32.56	28.35	1.07	1.10	1.59	NT	NT	NT	NT	NT	0.54	0.11	0.10	NT	NT	NT	NT	NT	NT	NT
S.E.	—	2.20	0.89	—	0.08	0.10	NT	NT	NT	NT	NT	—	0.04	0.82	NT	NT	NT	NT	NT	NT	NT
Length (mm)	19.54	23.74	22.34	3.32	4.44	4.56	NT	NT	NT	NT	NT	6.25	4.92	4.24	NT	NT	NT	NT	NT	NT	NT
S.E.	—	0.65	0.30	—	0.17	0.10	NT	NT	NT	NT	NT	—	0.61	0.23	NT	NT	NT	NT	NT	NT	NT
AUGUST 16 1991 TO SEPTEMBER 5, 1991																					
Replicates	—	5	5	—	5	5	NT	NT	—	5	5	—	5	5	NT	NT	NT	NT	NT	NT	NT
Weight (mg)	14.47	20.18	21.96	0.95	0.97	1.01	NT	NT	0.14	0.16	0.16	0.014	0.05	0.056	NT	NT	NT	NT	NT	NT	NT
S.E.	0.00	0.73	1.67	0.00	0.09	0.03	NT	NT	0.00	0.07	0.00	0.000	0.010	0.006	NT	NT	NT	NT	NT	NT	NT
Length (mm)	23.10	24.78	25.02	6.96	7.41	7.78	NT	NT	3.35	5.10	4.90	2.92	7.63	6.02	NT	NT	NT	NT	NT	NT	NT
S.E.	0.45	0.23	0.52	0.19	0.29	0.31	NT	NT	0.41	0.07	0.64	0.12	0.32	0.12	NT	NT	NT	NT	NT	NT	NT
SEPTEMBER 27, 1991 TO OCTOBER 17, 1991																					
Replicates	—	5	5	—	5	5	NT	NT	—	5	5	—	5	5	NT	NT	NT	NT	NT	NT	NT
Weight (mg)	14.45	12.33	12.98	0.84	1.02	1.15	NT	NT	0.02	0.12	0.13	0.03	0.04	0.05	NT	NT	NT	NT	NT	NT	NT
S.E.	0.00	1.00	0.56	0.00	0.09	0.09	NT	NT	0.00	0.02	0.10	0.00	0.00	0.01	NT	NT	NT	NT	NT	NT	NT
Length (mm)	—	20.20	18.77	6.57	8.13	6.90	NT	NT	2.73	4.20	3.21	5.53	4.35	5.24	NT	NT	NT	NT	NT	NT	NT
S.E.	—	0.55	0.28	0.15	0.23	0.28	NT	NT	0.06	0.24	0.26	0.25	0.15	0.14	NT	NT	NT	NT	NT	NT	NT
OCTOBER 11, 1994 TO NOVEMBER 1, 1994																					
Replicates	NT	NT	NT	—	5	0	4	5	NT	NT	NT	—	5	4	5	5	—	5	0	5	5
Weight (mg)	NT	NT	NT	0.282	0.372	0	0.625	0.462	NT	NT	NT	0.027	0.030	0.021	0.037	0.008	0.068	0.487	0	0.433	0.343
S.E.	NT	NT	NT	0.021	0.102	0	0.115	0.098	NT	NT	NT	0.006	0.006	0.004	0.008	0.002	0.004	0.054	0	0.110	0.048
Length (mm)	NT	NT	NT	4.050	4.341	0	5.764	5.336	NT	NT	NT	4.39	5.364	3.478	4.973	3.676	4.000	6.514	0	6.795	6.229
S.E.	NT	NT	NT	0.079	0.050	0	0.486	0.332	NT	NT	NT	0.294	0.239	0.229	0.112	0.524	0.074	0.190	0	0.32	0.221

Source: Hall et al., 1991, 1992, and 1996)

Notes: NT = Not Tested
Initial weight and length represent the mean and SD of 5 replicates of 20 animals each species at the start of the test.

Table 5-15
Bioavailability Indicator Data for Sediment from Bear Creek and Patapsco River
Bethlehem Steel Corporation
Sparrows Point, Maryland

Station	Date	TOC (percent)	Mean AVS (μmol/g)	Mean SEM μmol/g	SEM:AVS Ratio
Bear Creek	August 1991	<0.37	6.41	6.062	0.946
Bear Creek	September 1991	<0.37	5.58	6.206	1.113
Bear Creek	October 1994	6.23	294.00	39.872	0.136
Patapsco River (navigation channel, I-695)	October 1994	3.97	69.51	11.441	0.165
Patapsco River (offshore BSC's Shipyard)	October 1994	4.60	59.69	15.412	0.258

Source: Hall et al., 1992 and 1996

Table 5-16
SEM Analysis for Sediment from Bear Creek and Patapsco River
Bethlehem Steel Corporation
Sparrows Point, Maryland

Station	Date	Mean Concentration (μmol/g)					
		Cadmium	Lead	Copper	Nickel	Zinc	Sum
	Detection Limits	0.0003	0.005	0.0006	0.0004	0.0005	
Bear Creek	Aug. 1991	0.022	0.119	0.161	0.090	5.669	6.062
Bear Creek	Sept. 1991	0.025	0.123	0.174	0.081	5.803	6.206
Bear Creek	Oct. 1994	0.268	0.872	0.000	0.516	38.216	39.872
Patapsco River (navigation channel, I-695)	Oct. 1994	0.154	0.676	1.175	0.443	8.993	11.441
Patapsco River (offshore BSC's Shipyard)	Oct. 1994	0.154	1.135	1.198	0.621	12.304	15.412

Source: Hall et al., 1992 and 1996

Notes: All mercury values were below detection limits of 0.00005 in both sets for all sites.

Table 5-17
Summary of Toxicity Prediction Study Data for Sediment from Bear Creek
Bethlehem Steel Corporation
Sparrows Point, Maryland

Station	Percent TOC	Percent Silt/Clay	Total Divalent Metals, $\mu g/g$						SEM $\mu mol/g$	AVS $\mu mol/g$	SEM/ AVS	IWTU	Percent Mortality
			Cd	Cu	Ni	Pb	Zn	$\sum\mu mol$					
1.	7.1	99	8.8	206	54	195	1,576	29.3	29.3	268	0.11	0.03	82
2.	7.38	97	10	228	62	212	1,700	31.8	31.0	304	0.10	0.03	95
3.	5.75	97	5.4	265	60	209	1,140	23.7	20.4	76.1	0.27	0.03	85
4.	5.47	96	4.8	207	56	175	958	19.7	17.6	70.1	0.25	0.02	85
5.	6.15	80	3.4	151	38	162	566	12.5	17.3	45.3	0.38	0.03	68
6.	3.32	58	4.8	191	50	173	1,000	20.1	16.7	46.6	0.36	0.03	40
7.	0.13	7	0.0	3.2	2.0	3.0	36	0.6	0.64	0.40	1.60	0.03	5
8.	5.19	97	5.8	254	49	250	1,110	23.1	23.2	146	0.16	0.02	92
9.	4.4	93	4.2	241	53	274	978	21.0	19.5	89.2	0.22	0.03	12
10.	0.17	5	0.2	9.4	4.9	9.4	69	1.3	1.27	0.45	2.82	0.03	5
11.	4.61	98	2.6	140	51	162	617	13.3	11.9	50.0	0.24	0.03	2
12.	0.16	4	0.2	41	2.8	7.4	43	1.4	0.74	0.40	1.87	0.02	5
13.	4.19	94	1.7	139	47	128	459	10.6	9.96	7.20	1.38	0.03	18
14.	3.14	91	1.3	97	39	88	346	7.9	6.79	0.40	16.7	0.03	2
Ref. *(1)*	3.89	87	0.8	32	28	13	141	3.5	2.85	9.75	0.29	0.03	0

Source: Hansen et al., 1996

Notes: *(1)* Reference sediments from Long Island Sound, lower Narragansett Bay, or a clean site nearby.

Table 5-18 Pesticide/PCB Concentrations in Baltimore Harbor Blue Crabs Bethlehem Steel Corporation Sparrows Point, Maryland								
	Aldrin & Dieldrin (ppm)	**Chlordane (ppm)**	**DDT, DDE, and DDD (ppm)**	**Endrin (ppm)**	**Heptachlor and H. Epoxide (ppm)**	**Mirex (ppm)**	**PCBs (ppm)**	**Toxaphene (ppm)**
Screening Levels *(1)*	(0.3)	(0.3)	(5.0)	(0.3)	(0.3)	(0.1)	(2.0)	(5.0)
Blue Crabs (1983) *(2)*								
Number of Exceedances	0	1	0	0	0	0	0	0
Number of Samples	14	14	14	14	14	14	14	14
Range *(3)*	<0.0005 - 0.027 *(4)*	<0.0005 - 0.625	0.009 - 0.208	all <0.0005	<0.0005 - 0.177 *(5)*	all <0.0005	0.076 - 1.162 *(6)*	all <0.01
Blue Crab (1990) *(7)*								
Number of Exceedances	0	0	0	0	0	0	0	0
Number of Samples	15	16	16	16	16	14	14	16
Range	<0.001 - 0.003	<0.0096 - 0.122	<0.012 - 0.033	all <0.0023	all <0.0029	all <0.01	0.032 - 1.074	all <0.124

Notes:

(1) These values for organic chemicals are the FDA Action Levels.

(2) In 1983 study, eight samples were 6-crab composites; the remainder were individual crabs. All muscle and hepatopancreas ("mustard") from each crab was included in each sample (Garreis and Murphy, 1986a). Since the mustard is the crab liver, which is known to concentrate many contaminants, its inclusion contributes significantly to contaminant concentrations of the sample.

(3) The "less than" value indicates non-detect results and the value provided is the detection level reported in Garreis and Murphy (1986). After publication, the laboratory revised its estimate of detection levels for this data set as follows (4/15/88 memorandum from Garreis): dieldrin (0.007), chlordane (0.01), DDT (0.02), DDE (0.07), DDD (0.04), endrin (0.004), heptachlor epoxide (0.004), mirex (0.05), toxaphene (0.23).

(4) Deildrin only.

(5) Heptachlor epoxide only.

(6) All PCB values from this survey are considered overestimates (4/15/88 memorandum from Garreis).

(7) In 1990 study, all samples were 6-crab composites. All muscle and hepatopancreas from each crab was included in each sample (D. Murphy, Personal Communication). Since the mustard is the crab liver, which is known to concentrate many contaminants, its inclusion contributes significantly to contaminant concentrations of the sample.

Table 5-19
Metal Concentrations in Baltimore Harbor Blue Crabs
Bethlehem Steel Corporation
Sparrows Point, Maryland

	Arsenic	Cadmium	Chromium	Nickel	Lead		Mercury
Screening Levels (ppm, wet weight) *(1)*	43 (children 2 to 5 years)	3 (all ages)	11 (all ages)	70 (adult consumers)	3.9 (adult consumers)	0.6 (children 2 to 5 years)	1.0 (all)
Blue Crabs (1983) *(2)*							
Number of Exceedances	0	0	0	No Data	0	42 *(3), (4), (5)*	0
Number of Samples	38	65	65	No Data	65	65	82
Range (ppm)	<0.01 - 0.29	0.12 - 1.13	<0.50 - 2.9	No Data	<0.50 - 3.70		0.003 - 0.045
Blue Crab (1990) *(6)*							
Number of Exceedances	0	0	0	0	0	13 *(4), (5)*	0
Number of Samples	14	16	16	16	16	16	15
Range (ppm)	<0.05 - 0.17	0.04 - 0.64	<0.50 - 0.60	0.21 - 3.34	0.50 - 2.60		0.014 - 0.031

Notes:

(1) These values for all metals, except mercury, reflect the most restrictive value calculated from FDA guidance using the 90th percentile consumption rate for crustaceans, i.e., approximately 15.3 lbs/yr Baltimore Harbor crab meat for adults, 13.6 lb/yr for children 5 years and up, and 8 lbs/year for young children 2 to 5 years. The screening value for mercury is the FDA Action Level, which is protective of all consumers.

(2) In 1983 study, ten samples were 6-crab composites; the remainder were individual crabs. All muscle and hepatopancreas ("mustard") from each crab was included in each sample (Garreis and Murphy, 1986a). Since the mustard is the crab liver, which is known to concentrate many contaminants, its inclusion contributes significantly to contaminant concentrations of the sample.

(3) The FDA Guidance on lead in shellfish, which is the source of the lead screening values, was published in August 1993. Prior to that time, no federal guidance existed for lead in shellfish.

(4) Although more than half the samples exceed the screening level for young children (a preliminary assessment level), careful review of the contaminant and toxicological data for lead indicate that this does not represent a significant health hazard, when viewed in comparison with other exposure pathways for urban residents.

(5) The lead screening level of 0.6 is protective of children ages 2 to 5 who consume 8 pounds of crabmeat (approximately 192 crabs) per year from Baltimore Harbor. Only five of 16 samples exceed the screening value for children ages 6 and up who consume 13.6 pounds Baltimore Harbor crabmeat (approximately 326 crabs) per year. Just three of 16 samples exceed the screening value for pregnant women who consume 15.3 pounds Baltimore Harbor crabmeat (approximately 365 crabs) per year. The screening value for all adults (3.9 ppm) is protective of adults consuming 15.3 pounds of Baltimore Harbor crabmeat (approximately 365 crabs) per year.

(6) In 1990 study, all samples were 6-crab composites. All muscle and hepatopancreas from each crab was included in each sample (D. Murphy, Personal Communication). Since the mustard is the crab liver, which is known to concentrate many contaminants, its inclusion contributes significantly to contaminant concentrations of the sample.

Table 5-20
Pesticide/PCB Concentrations in Baltimore Harbor Finfish
Bethlehem Steel Corporation
Sparrows Point, Maryland

	Aldrin & Dieldrin (ppm)	Chlordane (ppm)	DDT, DDE, and DDD (ppm)	Endrin (ppm)	Heptachlor and H. Epoxide (ppm)	Mirex (ppm)	PCBs (ppm)	Toxaphene (ppm)
Screening Levels *(1)*	(0.3)	(0.3)	(5.0)	(0.3)	(0.3)	(0.1)	(2.0)	(5.0)
White Perch (1985) *(2)*								
Number of Exceedances	0	2	0	0	0	0	0	0
Number of Samples	31	31	31	31	31	31	31	31
Range *(3)*	<0.01 - 0.017	<0.004 - 0.614	all <0.13	all <0.004	<0.011 - 0.021	all <0.05	<0.07 - 0.92 *(3)*	all <0.23
American Eel (1985) *(4), (5)*								
Number of Exceedances	0	9	0	0	0	0	1	0
Number of Samples	19	19	19	19	19	19	19	19
Range	<0.01 - 0.048	0.08 - 0.668	<0.13 - 0.142	all <0.004	0.013 - 0.037	all <0.05	0.14 - 2.34 *(3)*	all <0.23
Brown Bullhead (1985) *(6)*								
Number of Exceedances	0	0	0	0	0	0	0	0
Number of Samples	7	7	7	7	7	7	7	7
Range	all <0.01	0.02 - 205	all <0.13	all <0.004	<0.011 - 0.012	all <0.05	0.07 - 0.14 *(3)*	all <0.23
Channel Catfish (1985) *(4), (7)*								
Number of Exceedances	0	3	0	0	0	0	0	0
Number of Samples	4	4	4	4	4	4	4	4
Range	<0.01 - 0.027	0.187 - 0.858	<0.13 - 0.251	all <0.004	<0.011 - 0.029	all <0.05	0.34 - 1.46 *(3)*	all <0.23

Notes:
(1) These values for organic chemicals are the FDA Action Levels.
(2) In this data set, two samples are 10-fish composites; the remainder are individual fish. All samples are fillets.
(3) All PCB values from this survey are considered over-estimates (4/15/88).
(4) A fish consumption advisory is currently in effect for American eel and channel catfish from Baltimore Harbor.
(5) All American eel samples were individual organisms, which had been beheaded, skinned and gutted prior to analysis.
(6) All brown bullhead samples are individual fish. All samples are fillets.
(7) All channel catfish samples are individual fish. All samples are fillets.

Table 5-21
Metal Concentrations in Baltimore Harbor Finfish
Bethlehem Steel Corporation
Sparrows Point, Maryland

	Arsenic	Cadmium	Chromium	Nickel	Lead		Mercury
Screening *(1)*	43 (children 2 to 5 years)	3 (all ages)	11 (all ages)	70 (adult consumers)	3.9 (adult consumers)	0.6 (children 2 to 5 years)	1.0 (all)
White Perch (1985) *(2)*							
Number of Exceedances	0	0	0	No Data	0	1	0
Number of Samples	1	1	1		1	1	1
Range	0.20	1.10	<0.5		0.8		0.051
White Perch (1990) *(3)*							
Number of Exceedances	No Data	0	0	0	0	0	0
Number of Samples		1	1	1	1		0.019
Range		<0.01	<0.5	<0.05	<0.5		0.019
American Eel (1985) *(4), (5)*							
Number of Exceedances	0	0	0	No Data	0	11 *(6)*	0
Number of Samples	12	11	11		11	11	14
Range	0.14 - 0.25	0.36 - 1.42	<0.5 - 1.1		1.2 - 3.2 *(7)*		0.0040 - 0.036
Brown Bullhead (1990) *(8)*							
Number of Exceedances	No Data	0	0	0	0	0	0
Number of Samples		1	1	1	1	1	1
Range		<0.01	<0.5	<0.05	<0.5		0.019
Channel Catfish (1985) *(2), (9)*							
Number of Exceedances	0	0	0	No Data	0	0	0
Number of Samples	4	4	4		4	4	4
Range	0.015 - 0.20	1.34 - 2.21	all <0.5		all <0.5		0.0010 - 0.024

Notes:

(1) These values for all metals, except mercury, reflect the most restrictive value calculated from FDA guidance using the 90th percentile consumption rate for crustaceans (approximately 15.3 lbs/year for adults, 13.6 lbs/year for children 5 years and up, 8.0 lbs/year for young children 2 to 5 years). The screening value for mercury is the FDA Action Level, which is protective of all consumers.

(2) The white perch sample from 1985 is a composite sample of the fillets from ten fish.

(3) The white perch sample from 1990 is a composite sample of the fillets from five fish

(4) A fish consumption advisory is currently in effect for American eel and channel catfish from Baltimore Harbor.

(5) All American eel samples from 1985 are individual fish, which had been beheaded, skinned and gutted prior to analysis.

(6) The lead screening level of 0.6 is protective of children ages 2 to 5 who consume 8 pounds of eel meat from Baltimore Harbor per year. The screening value for adults (3.9 ppm) is protective of adults consuming 15.2 pounds of eel meat from Baltimore Harbor per year.

(7) It should be noted that these eel samples were analyzed with all bones except the head. As bone is the primary repository for lead, lead levels in the eel meat alone would fall below the values presented here.

(8) The brown bullhead sample from 1990 is a composite sample of the fillets from five fish.

(9) All four channel catfish samples from 1985 are fillet samples from individual fish.

Table 5-22
Pesticide/PCB Concentrations in Outer Baltimore Harbor *(1)* Softshell Clams
Bethlehem Steel Corporation
Sparrows Point, Maryland

	Aldrin & Dieldrin (ppm)	**Chlordane (ppm)**	**DDT, DDE, and DDD (ppm)**	**Endrin (ppm)**	**Heptachlor and H. Epoxide (ppm)**	**Mirex (ppm)**	**PCBs (ppm)**	**Toxaphene (ppm)**
Screening Levels *(2)*	(0.3)	(0.3)	(5.0)	(0.3)	(0.3)	(0.1)	(2.0)	(5.0)
Softshell Clam (1993) *(3)*								
Number of Exceedances	0	0	0	0	0	0	0	0
Number of Samples	3	3	3	3	3	3	3	3
Range	all <0.0009	<0.002 - 0.005	all <0.0029	all <0.0004	<0.0004 - 0.0007	all <0.0016	<0.01 - 0.023	all <0.019

Notes: *(1)* All of these clams were collected in the area of the northern Anne Arundel County coast between Rock Pt and Frankie Pt. These are the closest soft shell clams to Baltimore Harbor, as no clams or oysters are found inside the Rock Pt - North Pt boundary.

(2) These values for organic chemicals are the FDA Action Levels.

(3) In this data set, there were three 30-clam composite samples.

Table 5-23
Metal Concentrations in Outer Baltimore Harbor *(1)* Softshell Clams
Bethlehem Steel Corporation
Sparrows Point, Maryland

	Arsenic	Cadmium	Chromium	Nickel	Lead		Mercury
Screening Values *(2)*	43 (children 2 to 5 years)	3 (all ages)	11 (all ages)	70 (adult consumers)	3.9 (adult consumers)	0.6 (children 2 to 5 years)	1.0 (all)
Softshell Clam (1993) *(3)*							
Number of Exceedances	0	0	0	0	0	0	0
Number of Samples	4	4	4	4	4	4	4
Range (ppm)	all <0.05	0.04 - 0.20	all <0.5	0.69 - 1.35	<0.50 - 0.6		0.005 - 0.0100

Notes:

(1) All of these clams were collected in the area off the northern Ann Arundel County coast between Rock Pt and Frankie Pt. These are the closest soft shell clams to Baltimore Harbor, as no clams or oysters are found inside the Rock Pt - North Pt boundary.

(2) These values for all metals, except mercury, reflect the most restrictive value calculated from FDA guidance using the 90th percentile consumption rate for crustaceans, i.e., approximately 15.3 lbs/year soft shell clams from this site for adults, 13.6 lb/year for children 5 years and up, and 8 lbs/year for young children 2 to 5 years. The screening value for mercury is the FDA Action Level, which is protective of all consumers.

(3) This data set includes four 30-clam composite samples.

Table 5-24
BSC Worker Categories and SWMU/AOC Contact
Bethlehem Steel Corporation
Sparrows Point, Maryland

Department		Total Number of Employees	Manager(s) A,B Interviewed
301	Division Office	14	None
302	Accounting	20	None
303	Inform. Techn.	15	None
304	Product Sched.	83	None
305	Safety-Health & Env.	9	Art Williamson
306	Labor Relations	8	None
308	Personnel Planning & Development	27	None
309	Operations Analysis	23	None
311	Police	9	Mark Sutherin
312	Protection Serv. Mgmt.	11	Myrl Smith
313	Purchasing	12	None
314	Quality Assurance	119	None
315	Techn. Serv	69	None
318	Transportation	7	None
322	Materials Control	37	Tad Torrence
323	Outside Processing	4	None
330	Utilities	121	R.D. Dawson, Joe Robier III, Mark Freedman, Robert Conrad
343	HR/CR Sheet Mktg.	4	None
344	Coated Sheet Mktg.	9	None
345	Plate Mktg.	5	None
346	Tin Sales Mktg.	6	None
347	Special Sales Mktg.	2	None
348	Customer Services	34	None

Table 5-24
BSC Worker Categories and SWMU/AOC Contact
Bethlehem Steel Corporation
Sparrows Point, Maryland

Department		Total Number of Employees	Manager(s) A,B Interviewed
349	Customer Engineering	7	None
401	Maintenance Services	95	Helen Topper
403	Mobile Equipment/Plant Garage	289	John Mirabile, Bruce Langston, Gary Roller, Doug Norris
405	Construct. Techn.	5	Don Henderson
406	General Labor	25	Ken Iwanaski
407	General Repair (Primary Side)	39	Ted Dahlstrom Myrl Smith
408	Plant Housekeeping	25	Jim Helsel
409	Roofing/Painting	20	Don Henderson
413	Blast Furn. - Assign. Mech./Electr.	107	Dave Saul Dou Krtanjek
414	Suppl. Force	60	Myrl Smith
415	Shutdown Oper.	1	None
416	Shutdown Oper.	3	None
421	Steelmaking-Assign. Mech. Electr.	81	None
422	HSM-Assign. Mech./Electr.	93	J. Doliner Howard Ralyea
423	INU Workers	96	Dan Christopher
426	Plate Mill - Assign. Mech./Electr.	46	Tom Smith Joe Klaus
427	Coke Oven- Assign. Control	5	Don Krtanjek
428	Blast Furnace - Assign. Control	65	Dave Saul Don Krtanjek
429	Steelmaking - Assign. Control	73	None
432	HSM - Assign. Control	71	J. Dolinar Howard Ralyea

Table 5-24
BSC Worker Categories and SWMU/AOC Contact
Bethlehem Steel Corporation
Sparrows Point, Maryland

434	Instrumentation	14	Ray Warwick
435	Refrigeration	15	Steve Stachowiak
437	Penwood Power HS	30	Mark Freedman
438	Electr. Repair Shop	46	Wes Phipps Bob Wynn
439	Finishing Electr.	43	Ray Warwick
443	Electr. Construction	64	None
444	Primary Electronics	12	Ray Warwick
446	Plate Mill - Assign. Control	41	Tom Smith
447	Shutdown Oper.	2	
448	Shutdown Oper.	1	
449	Tin Mill - Assign. Mech./ Electr.	83	Norman Downey, Jon Whitsel, Tom Leach
450	Utilities Maintenance	29	John Wade
451	CSM - Assign. Mech./Electr.	81	Charlie Fader Bill Williams
457	CSM - Assign. Control	58	Charlie Fader Bill Williams
458	Tin Mill - Assign. Control	95	Tom Leach
460	#2 Machine Shop	127	None
463	ST&S Pipefitters	21	Ken Stevens
466	ST&S Machine Shop	14	Norm Miller
468	Fabrication Technol.	17	None
469	Scale Repair	3	None
480	Primary Roll Shop	16	None
481	Pipefitters	54	Ken Stevens
483	Finishing Roll Shops	53	None

Table 5-24
BSC Worker Categories and SWMU/AOC Contact
Bethlehem Steel Corporation
Sparrows Point, Maryland

497	Capital Work Force	44	Joe Greeley
512	Coke Oven Oper.	3	
520	Blast Furnace Oper.	253	None
530	Steelmaking Oper.	315	None
539	Inform. Tech. Staff	8	None
670	Hot Strip Oper.	297	Joe Doliner
671	Cold Sheet Oper.	737	Tom Branch
672	Tin Mill Oper.	451	Tom Leach, Chuck Yeager, Marion Lawson
673	Plate Mill Oper.	329	Tom Smith Lou Karczeski
707	Chespk. Stevedrs.	1	None
710	Rep Sne - Pool	2	None
860	Real Estate	7	Jim Helsel
	TOTAL	**5270**	

A. None indicates that no manager was interviewed because BSC Health and Safety personnel determined that no individual in this department has any contact with any of the designated SWMUs/AOCs associated with this study.

B. Blank space indicates that no information could be obtained to date.

Table 5-25
Exposure Pathways For Off-Site Receptors
Bethlehem Steel Corporation
Sparrows Point, Maryland

Potential Sources of Contamination	Exposure Pathways	Nearby Residents	Off-site Workers	Country Club Golfers	Recreational Visitors	Tenant Workers
SWMU/AOC-specific areas (only those SWMUs/ AOCs with surface soil contamination)	Incidental ingestion of and dermal contact with on-site surface soil					X
Location-specific zones (shoreline areas where slag is absent)	Incidental ingestion of and dermal contact with shoreline surface water/sediment				X	
Facility-wide sources (only those SWMUs/ AOCs with metals or SVOCs in soil)	Inhalation of particulates	X	X	X		X
Facility-wide sources (only those SWMUs/ AOCs with VOCs in soil)	Inhalation of VOCs	X	X	X		X
Facility-wide sources (groundwater discharges to offshore surface water/sediment)	Ingestion of fin fish and shellfish				X	

Notes: **X** = Potentially complete exposure pathway.
VOCs = Volatile organic compounds.
SVOCs = Semi-volatile organic compounds.

Table 5-26
Exposure Pathways For On-Site Receptors
Bethlehem Steel Corporation
Sparrows Point, Maryland

Potential Sources of Contamination	Exposure Pathways	Trespassers	On-site BSC Workers
SWMU/AOC-specific areas (only those SWMUs/ AOCs with surface soil contamination)	Incidental ingestion of and dermal contact with on-site surface soil	X	X
Location-specific zones (shoreline areas where slag is absent)	Dermal contact with shoreline surface water/sediment	X	
Facility-wide sources (only those SWMUs/ AOCs with metals or SVOCs in soil)	Inhalation of particulates	X	X
Facility-wide sources (only those SWMUs/ AOCs with VOCs in soil)	Inhalation of VOCs	X	X
Facility-wide sources (groundwater discharges to offshore surface water/sediment)	Ingestion of fin fish and shellfish		

Notes: **X** = Potentially complete exposure pathway.
VOCs: Volatile organic compounds.
SVOCs: Semi-volatile organic compounds.

6.0 IMPLEMENTATION OF INTERIM MEASURES

6.1 INTRODUCTION

The purpose of this chapter is to provide an overview of Interim Measures currently active at BSC's Sparrows Point Facility. There is only one Interim Measure currently active at the site -- an on-going project to remediate soil and groundwater contamination at the Rod and Wire Mill Sludge Bin Storage Area.

From about 1940 until the early 1980's (when the Rod and Wire Mill was shut down), one of the operations performed at the mill involved the leaching of zinc ore with sulfuric acid to produce a zinc sulfate electrolyte for electrogalvanizing of wire products. The acidic leach residues, which included precipitated impurities (i.e., iron and cadmium), were stored in a pond north of the mill (SWMU 28, the Northwest Pond; Figure 6-1) until about 1959 when vacuum and filter presses were installed to dewater the residues. From about 1959 until 1971, the dewatered sludge was stored temporarily on the ground in the area that became the Sludge Bin Storage Area (SWMU 27; Figure 6-1) prior to being sold for off-site recovery of cadmium. During this time period, the liquid filtrate was either recycled to the electroplating operation or stored in a second pond located northeast of the mill (SMWU 29, the East Pond; Figure 6-1). From 1971 until the mill closed in the early 1980's, bins were used to collect the dewatered sludge, and the excess filtrate was sent to HCWWTP for treatment.

6.2 ROD AND WIRE MILL REMEDIATION SYSTEM

6.2.1 Initial Conditions

In mid-1984, BSC initiated investigations of possible contamination from past waste disposal practices in the vicinity of the Sludge Bin Storage Area located at the north end of the Rod and Wire Mill (Figure 6-1). The investigations continued through late 1986 and incorporated requirements from Complaint and Order C-O-85-179 dated February 25, 1985 issued by the State of Maryland Department of Health and Mental Hygiene (Woodward Clyde Consultants, 1985; Baker/TSA, Inc., June 1986 and November 1986).

The investigations determined that soil and groundwater in and near the Sludge Bin Storage Area contained elevated levels of cadmium and zinc. Soil impacts, which included a maximum cadmium concentration of 11,000 ppm and a maximum zinc concentration of 98,000 ppm, were found to be limited both horizontally and vertically to the immediate vicinity of the former storage area. Some of the soil at the Sludge Bin Storage Area was found to exceed the EP Toxicity test criteria for cadmium. Soils in the Northwest and East Ponds did not contain elevated cadmium, but the East Pond did show elevated zinc.

Groundwater impacts were found in two of the three groundwater flow systems identified in the Sludge Bin Storage Area. The shallow flow system (depths of 10 to 15 feet) was found to contain elevated cadmium levels only in the general vicinity of the former storage area. The limited extent of these impacts was attributed to the interbedding of sandy and clayey soil lenses in this zone. A maximum cadmium concentration of 1,150 ppm was measured in Well 88. The intermediate flow system (depths of about 30 feet) was found to contain elevated cadmium levels over a broader area that extended southwest of the former storage area. The broader area of impact and its extension to the southwest were attributed to the relatively clean, sandy nature of the soils in this zone and a southwesterly direction of groundwater flow. A maximum cadmium concentration of 157 ppm was measured in Well BW-27. The initial extents of cadmium in the shallow and intermediate flow systems are shown in Figures 6-2 and 6-3. No groundwater impacts were found in the deep flow system (depths of about 60 feet).

6.2.2 Description of Interim Measure

The remediation system implemented at the Sludge Bin Storage Area included pumping of contaminated groundwater from the shallow and intermediate flow systems, treatment of the extracted groundwater, and in-situ leaching of contaminated soil. In 1986, a pilot groundwater pumping and treatment system was installed and operated. Groundwater was pumped from two intermediate wells (BW-24 and BW-27) and treated using BSC's High Density Sludge (HDS) process. The HDS process uses elevated pH (9 or higher) to precipitate metal hydroxides as a dense, easily filterable sludge. The precipitates are thickened and filtered into a cake containing about 50 percent zinc (dry basis) and 3 percent cadmium. The treated effluent contains less than 0.20 ppm cadmium and less than 0.75 ppm zinc. A process flow diagram for the treatment process is presented in Figure 6-4.

In 1987, pumping from the two intermediate wells continued, pumping from three existing shallow wells was initiated (88, 89, and 90), and the in-situ leaching of residual metals in the soils was begun. The in-situ leaching consisted of sprinkling a synthetic acid rain (potable water adjusted to a pH of about 4.5 with sulfuric acid) over the soils in the immediate vicinity of the former storage area. In 1988, the number of shallow wells being pumped was increased to ten; and in 1990 and 1991, these wells were enlarged to accommodate more efficient and economical pumping equipment. An additional intermediate pumping well was added in 1994. These milestones and other key activities from each year of the remediation system's operation are summarized in Appendix 6A.

Over 10 years of operation (during non-winter months), approximately 25.2 million gallons have been pumped from the intermediate wells, and approximately 3.4 million gallons have been pumped from the shallow wells. During the past five years, the annual amounts pumped from the intermediate wells have ranged from 1.15 to 4.39 million gallons, and the annual amounts pumped from the shallow wells have ranged from 0.22 to 0.66 million gallons.

6.2.3 Effectiveness of Interim Measure

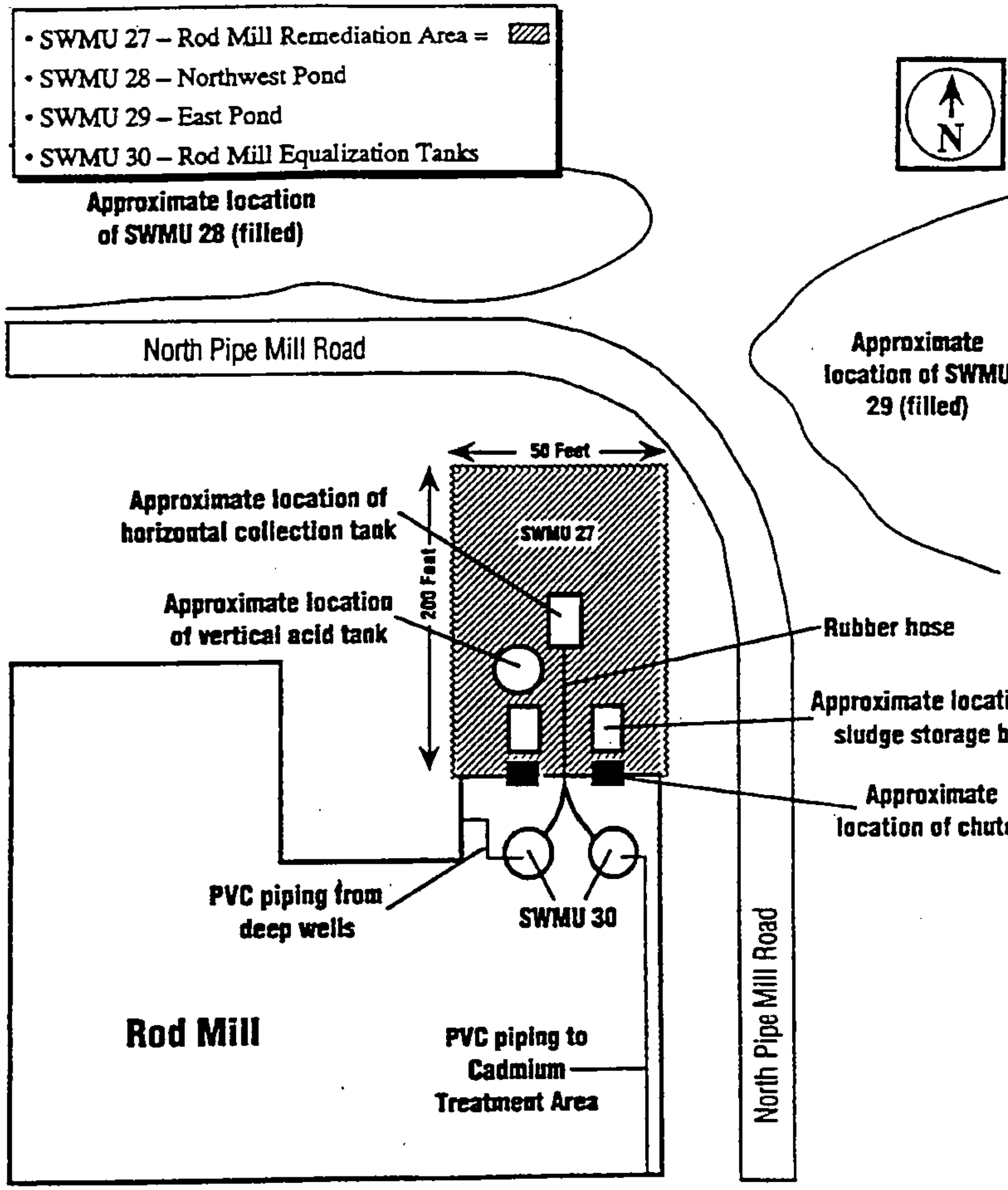
As early as 1987, it was evident that the remediation system was effectively controlling the migration of cadmium in the intermediate groundwater flow system. Continued operation and adjustment of the remediation system have been beneficial in sustaining this effect. As shown in Figure 6-5, pumping from the shallow system has created a cone of depression as much as three feet deep extending throughout the former storage area, effectively capturing the contaminated groundwater in this zone as wells as recovering the synthetic rain applied to the soils.

Tables 6-1 and 6-2 show the results of annual monitoring for cadmium in the shallow and intermediate flow systems through the end of 1996 (the data for 1997 are not yet available). In the eight shallow wells that had the highest initial cadmium concentrations (88, 90, 93, 94, 97, 89A, 93A, and 97A), the cadmium concentrations have been reduced by about 93 percent. Figure 6-6 shows the current extent of cadmium in the shallow flow system.

In the four intermediate wells that had the highest initial cadmium concentrations (BW-4, BW-6, BW-24, and BW-27), the cadmium concentrations have been reduced by about 89 percent. Cadmium concentrations have remained essentially unchanged in Well BW-9, and this issue was addressed in 1994 by installing the third intermediate pumping well in this area. Figure 6-7 shows the current extent of cadmium in the intermediate flow system. Although concentrations in both flow systems continue to decline each year, the rate of improvement is clearly decreasing with time.

6.2.4 On-Going Activities

The remediation system was operated during 1997 in accordance with the Operating and Maintenance Plan contained in the Report of 1996 Remediation and Monitoring Activities (Baker, 1997). Table 6-3 presents the monitoring requirements applicable to the activities scheduled for 1997. The 1997 report of operations is in the process of being prepared and is due to be submitted to EPA and MDE by January 31, 1998 (in accordance with Section V-A1 of the Consent Decree). This report will include a proposed operations and maintenance plan for 1998.



Notes: This map is not drawn to scale
Shallow and intermediate wells, and the acid sprinkler system are located throughout the Remediation Area
The deep wells are not located in this mapped area

DECEMBER 22, 1997

Note: Figure derived from A.T. Kearney. Inc., Figure IV-2 in Final RCRA Facility Assessment Phase II Report, August 12, 1993

SCALE: NONE

RUST
Rust Environment & Infrastructure Inc.

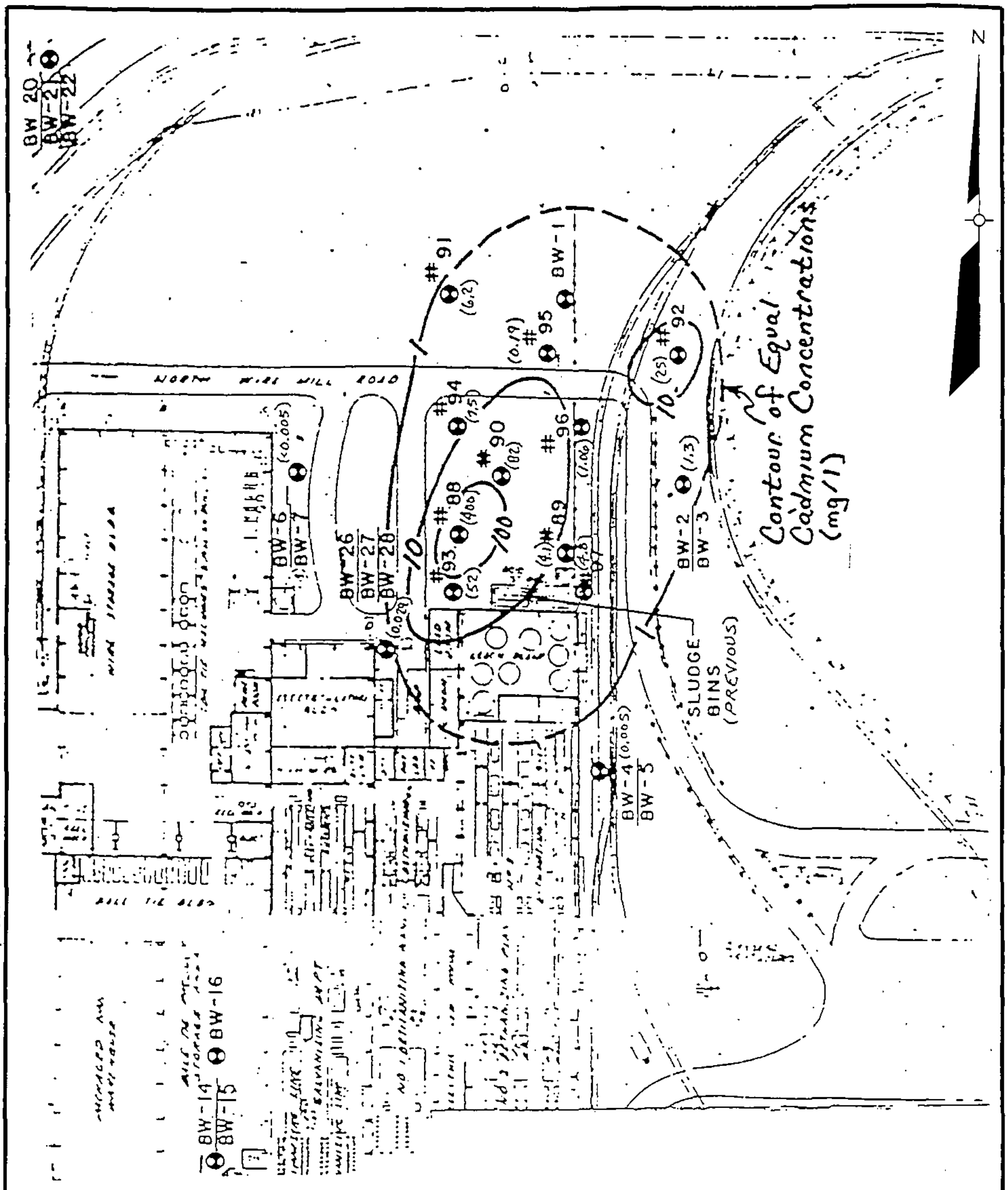
FIGURE 6-1
LOCATION OF ROD AND WIRE MILL SLUDGE BIN STORAGE AREA INTERIM MEASURES

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998

200123

BSFIG29.DGN



Note: Figure derived from Baker Environmental, Inc. Figure 2 in Report of 1995 Remediation and Monitoring Activities, Sludge Bins Storage Area Closure, Rod and Wire Mill, Sparrows Point Plant

SCALE: 1" = 100'

DECEMBER 22, 1997

BSFIG23.DGN

RUST

Rust Environment & Infrastructure Inc.

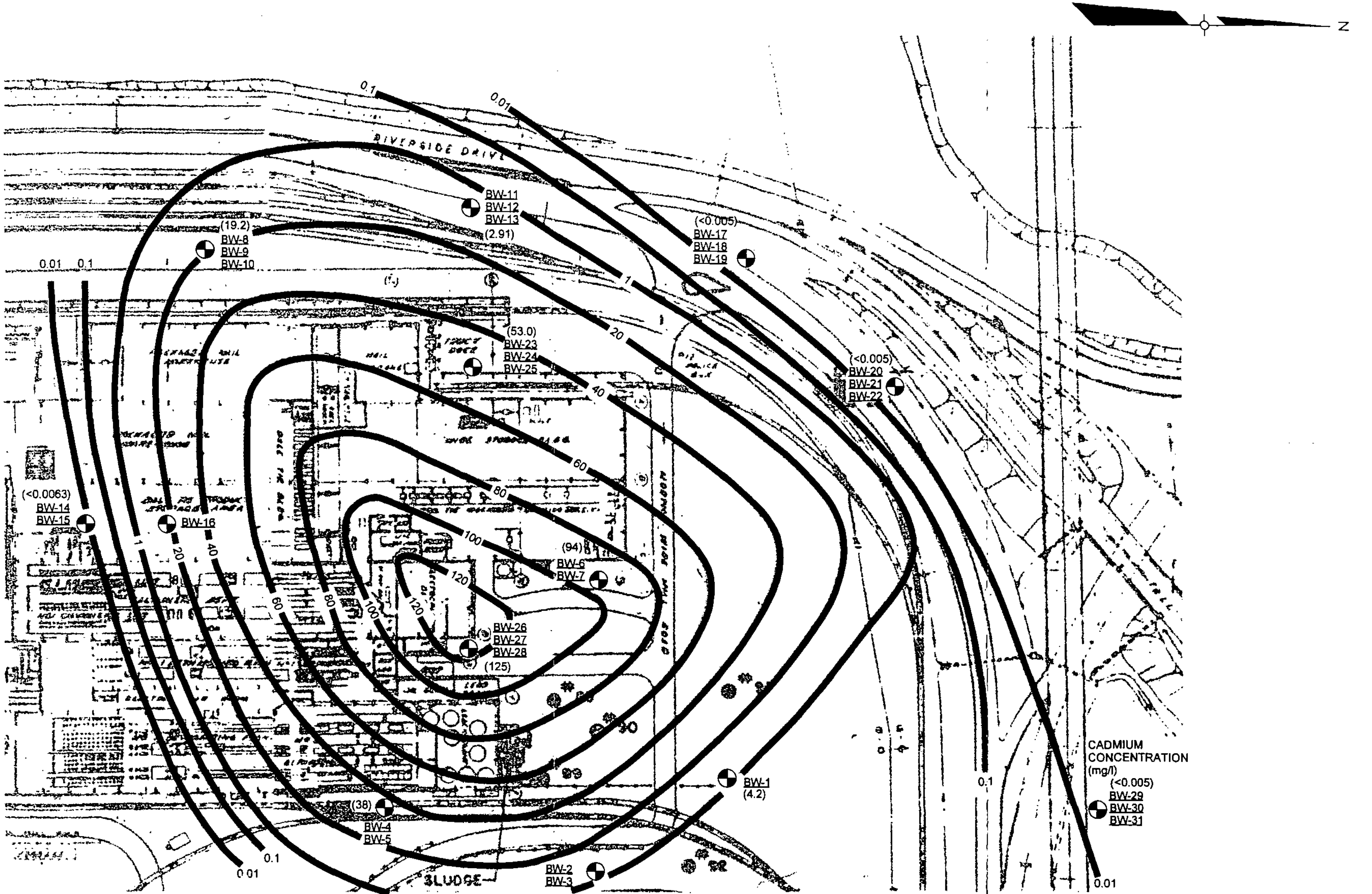
FIGURE 6-2

INITIAL EXTENT OF SHALLOW CADMIUM CONTAMINATION (1989)

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998

200123



Note: Figure derived from Baker Environmental, Inc. Figure 4 (Jan. 1992) in Report of 1995 Remediation and Monitoring Activities, Sludge Bins Storage Area Closure, Rod and Wire Mill, Sparrows Point Plant

SCALE: NONE

RUST

Rust Environment & Infrastructure Inc.

FIGURE 6-3

INITIAL EXTENT OF INTERMEDIATE CADMIUM CONCENTRATION (1986)

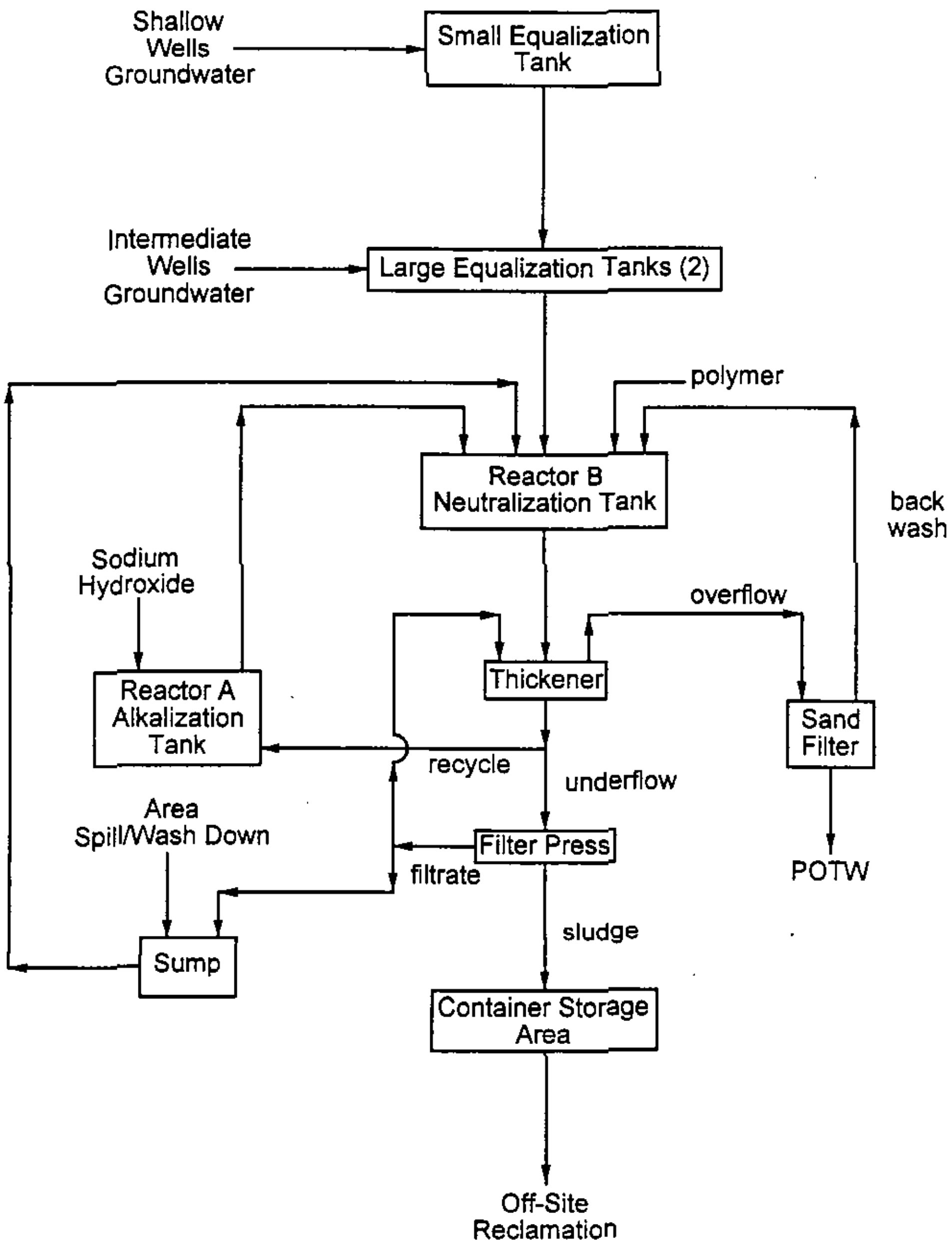
BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998

200123

DECEMBER 22, 1997

BSFIG27.DGN



Note: Figure derived from Baker Environmental, Inc. schematic diagram WM7 in Solid Waste/Material Management Units Inventory, September 1, 1990.

SCALE: NONE

DECEMBER 22, 1997

BSFIG28.DGN

Rust Environment & Infrastructure Inc.

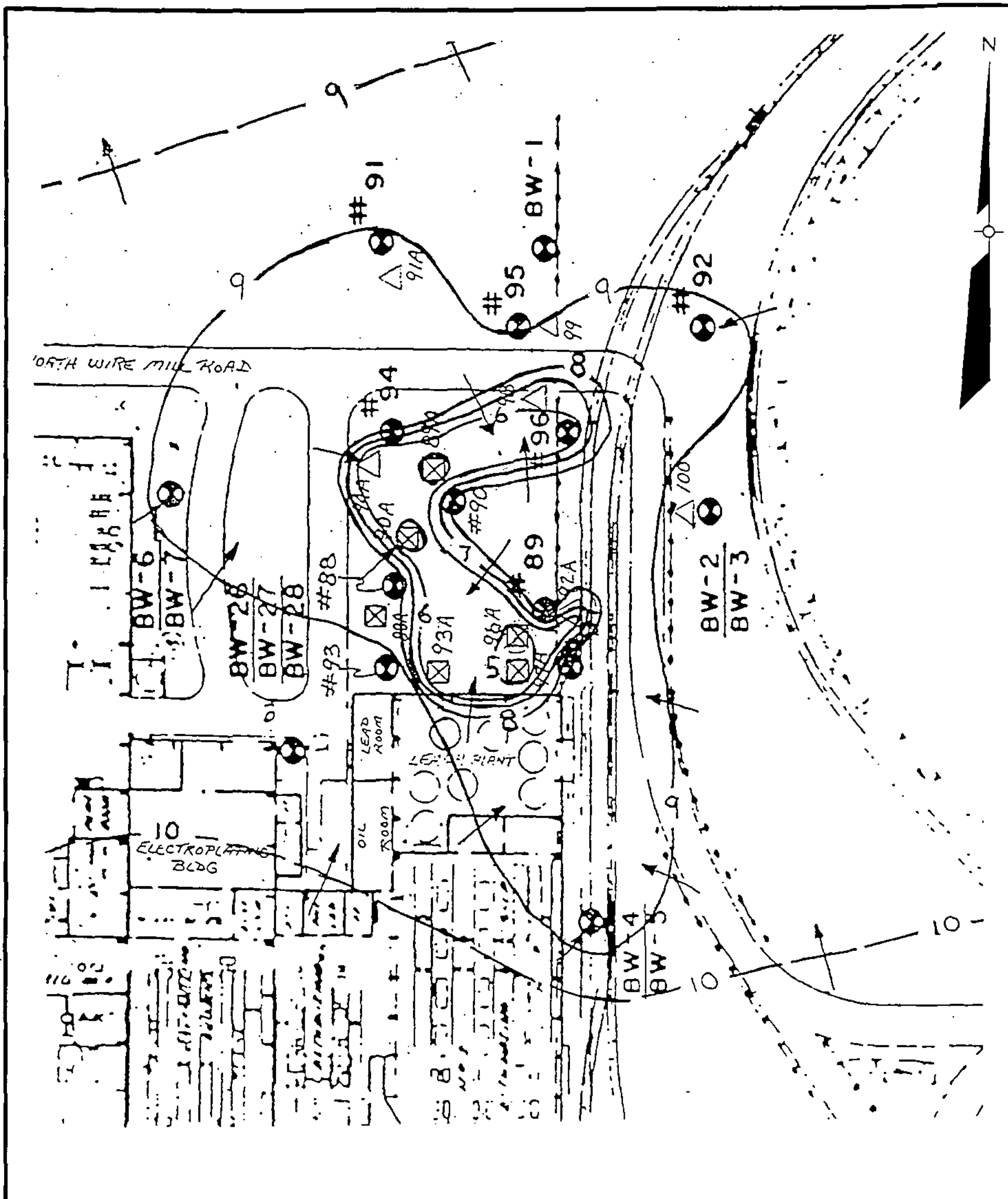
FIGURE 6-4

ROD AND WIRE MILL IM TREATMENT FLOW DIAGRAM

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998

200123



Note: Figure derived from Baker Environmental, Inc. Figure 6 in Report of 1996 Remediation and Monitoring Activities, Sludge Bins Storage Area Closure, Rod and Wire Mill, Sparrows Point Plant

SCALE: 1" = 70'

RUST

Rust Environment & Infrastructure Inc.

FIGURE 6-5

CURRENT RESPONSE TO SHALLOW GROUNDWATER WITHDRAWAL (1996)

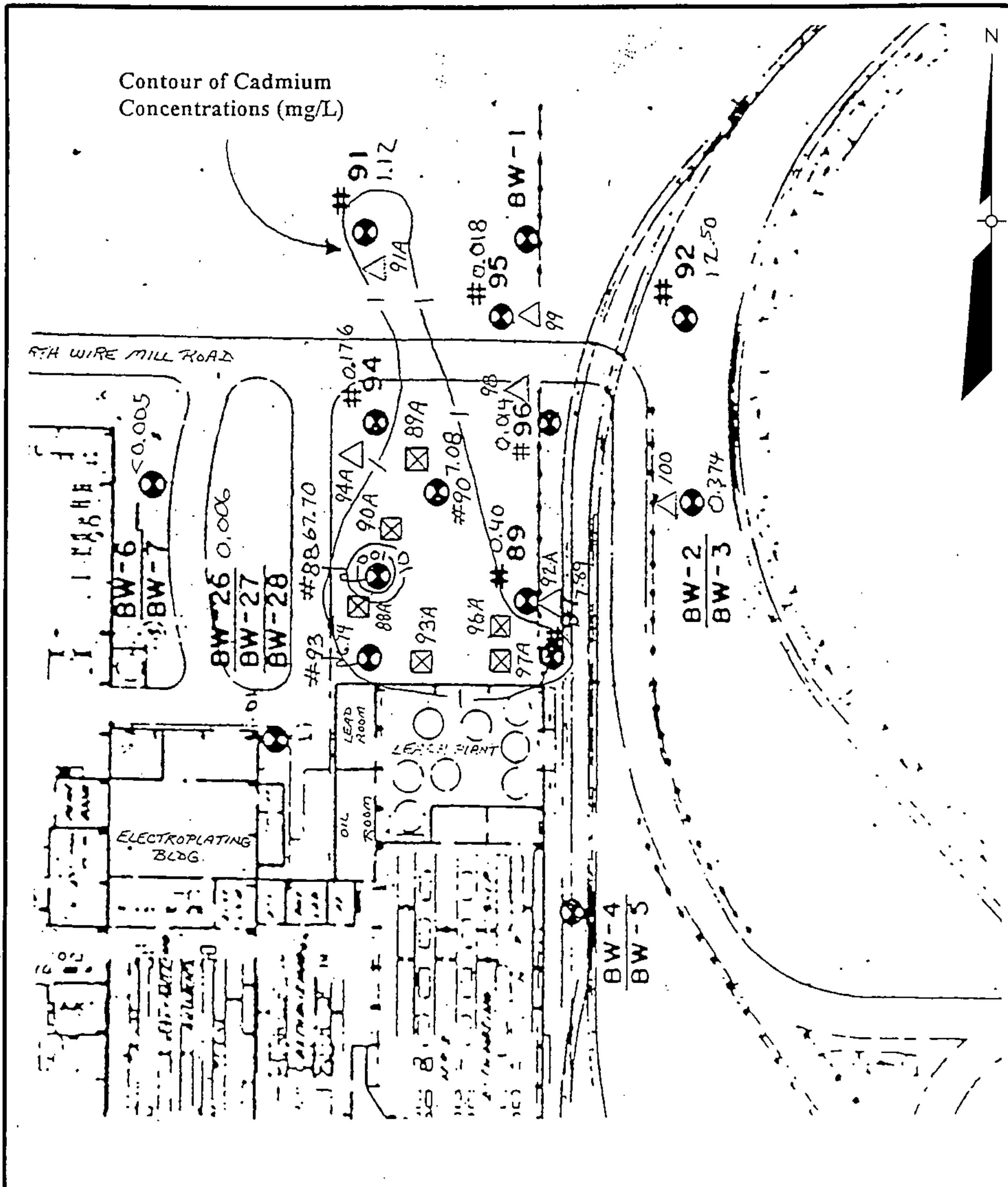
BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998

200123

DECEMBER 22, 1997

BSFIG26.DGN



Note: Figure derived from Baker Environmental, Inc. Figure 3 in Report of 1996 Remediation and Monitoring Activities, Sludge Bins Storage Area Closure, Rod and Wire Mill, Sparrows Point Plant

SCALE: 1" = 70'

Rust Environment & Infrastructure Inc.

FIGURE 6-6

CURRENT EXTENT OF SHALLOW CADMIUM CONTAMINATION (1996)

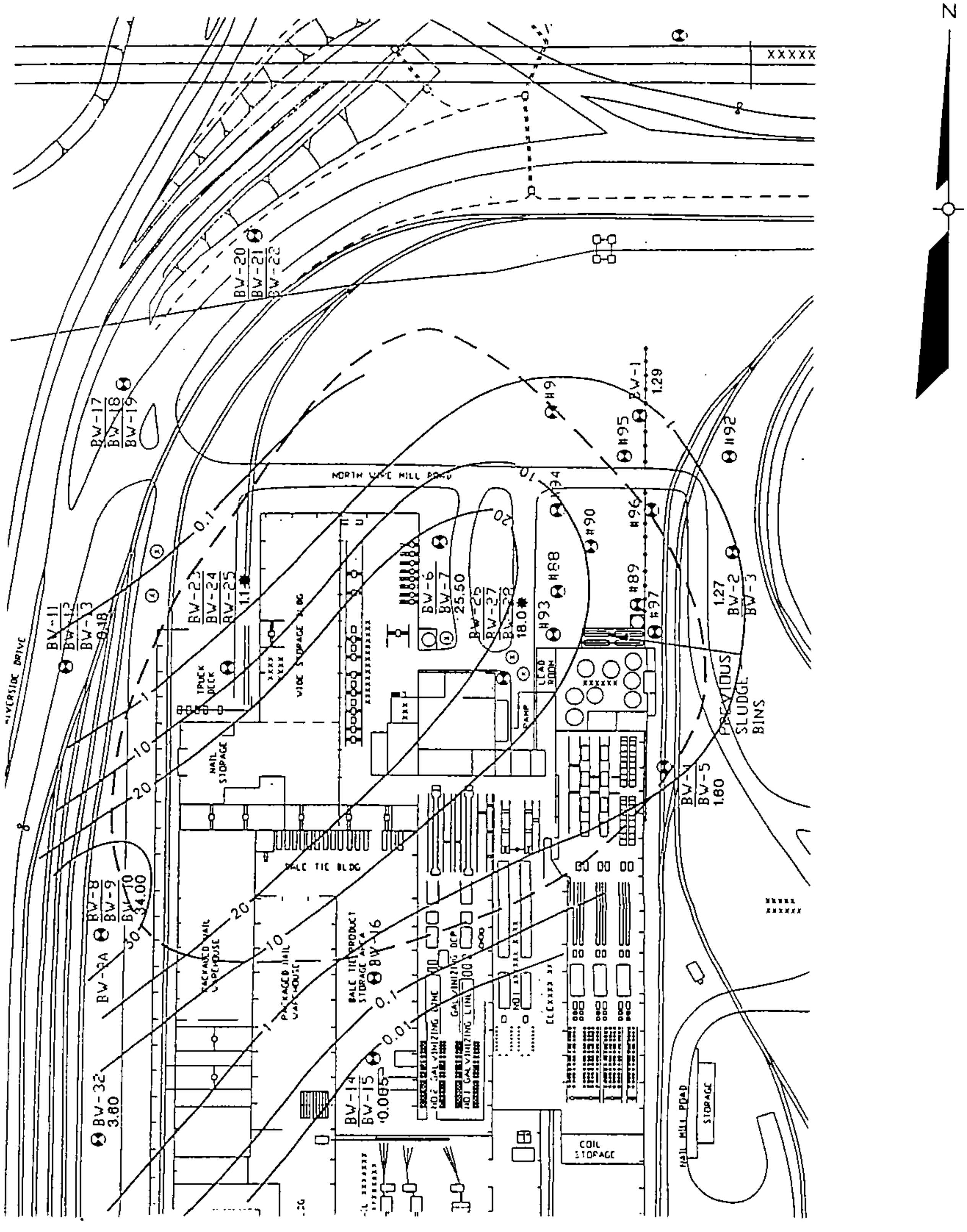
BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998

200123

DECEMBER 22, 1997

BSFIG24.DGN



Note: Figure derived from Baker Environmental, Inc. Figure 5 in Report of 1996 Remediation and Monitoring Activities, Sludge Bins Storage Area Closure, Rod and Wire Mill, Sparrows Point Plant

SCALE: 1" = 140'

DECEMBER 22, 1997

RUST

Rust Environment & Infrastructure Inc.

FIGURE 6-7

CURRENT EXTENT OF INTERMEDIATE CADMIUM CONCENTRATION (1996)

BETHLEHEM STEEL CORPORATION
SPARROWS POINT, MARYLAND

JANUARY 1998

200123

BSFIG25.DGN

Table 6-1
Summary of Cadmium Concentrations in Groundwater - Shallow Wells
Bethlehem Steel Corporation
Sparrows Point, Maryland

Shallow Wells	Initial Sampling Results [mg/l (date)]	End 1987 (mg/l)	End 1988 (mg/l)	End 1989 (mg/l)	End 1990 (mg/l)	End 1991 (mg/l)	End 1992 (mg/l)	End 1993 (mg/l)	End 1994 (mg/l)	End 1995 (mg/l)	End 1996	
											(mg/l)	% of Initial
88	1150 (10/85)	1160	440	400	180	153	156	94.3	136	122	67.70	6
89	19.5 (10/85)	7	7.3	4.1	2.7	1.78	3.30	2.33	1.26	1.64	0.40	2
90	164 (10/85)	82	76	82	14.7	7.5	17	15.4	13.80	7.03	7.08	4
91	13 (10/85)	3.6	3.6	6.2	2.4	8.9	4.70	3.43	1.99	1.26	1.12	9
92	11 (10/85)	16.9	28	25	13.2	10.2	5.00	6.74	9.36	4.91	12.50	114
93	103 (8/88)	-	24.5	52	27.2	23.4	48.5	29.7	53.60	9.08	6.74	7
94	34.5 (8/88)	-	25	7.5	13.8	1.62	3.60	4.19	5.63	0.26	0.18	1
95	0.18 (8/88)	-	0.35	0.19	0.048	0.023	0.035	0.026	0.04	0.05	0.02	11
96	24 (8/88)	-	8.9	1.06	0.11	0.11	0.49	0.079	0.35	0.03	0.01	0
97	48.5 (8/88)	-	2.4	4.8	13.8	16.0	12.9	10.0	11.1	8.90	7.89	16
98*	1.20 (4/91)	-	-	-	-	0.53	1.74	1.66	1.12	0.36	(1)	30
99*	0.35 (4/91)	-	-	-	-	0.12	3.8	0.31	0.24	0.24	(1)	69
100*	0.88 (4/91)	-	-	-	-	0.54	1.86	0.83	0.24	0.22	(1)	25
88A*	20 (6/90)	-	-	-	15	5.6	7.9	6.6	0.98	4.40	(1)	22
89A*	49 (6/90)	-	-	-	10	3.9	7.7	5.8	5.30	2.40	(1)	5
90A*	26 (6/90)	-	-	-	18	2.3	3.4	8.1	0.18	1.70	(1)	7
91A*	2.55 (4/91)	-	-	-	-	1.34	1.52	1.88	0.71	1.00	(1)	39
92A*	1.72 (4/91)	-	-	-	-	0.68	0.62	0.70	0.22	0.22	(1)	13
93A*	100 (6/90)	-	-	-	62	35	8.8	41	16	3.20	(1)	3
94A*	1.74 (4/91)	-	-	-	-	1.56	0.45	2.9	0.39	0.28	(1)	16
96A*	9.8 (6/90)	-	-	-	8.9	3.7	2.5	2.8	1.38	0.51	(1)	5
97A*	46 (6/90)	-	-	-	36	9.6	7.0	13	23	8.00	(1)	17
BW-3	2 (10/85)	1.5	1.92	1.3	1.6	1.23	1.18	0.291	0.70	0.62	0.37	19
BW-7	0.03 (10/85)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-
BW-26	0.9 (6/86)	0.15	0.17	0.029	0.008	0.0082	0.0081	0.0135	0.005	0.008	0.006	1

Source: Baker Environmental, Inc., Final Report of 1996 Remediation and Monitoring Activities, Sludge Bins Storage Area Closure, Rod and Wire Mill, Sparrows Point Plant, January 1997

(1) Denotes data from end of 1995. No 1996 cadmium data is available from these wells.
* Denotes current groundwater withdrawal well

Table 6-2
Summary of Cadmium Concentrations in Groundwater - Intermediate Wells
Bethlehem Steel Corporation
Sparrows Point, Maryland

Inter-Mediate Wells	Initial Sampling Results [mg/l (date)]	End 1987 (mg/l)	End 1988 (mg/l)	End 1989 (mg/l)	End 1990 (mg/l)	End 1991 (mg/l)	End 1992 (mg/l)	End 1993 (mg/l)	End 1994 (mg/l)	End 1995 (mg/l)	End 1996	
											(mg/l)	% of Initial
BW-1	4.2 (10/85)	4.6	3.0	3.3	4.1	4.36	2.44	2.58	2.96	1.98	1.29	30
BW-2	1.8 (10/85)	2.4	2.3	2.5	2.0	1.84	1.89	2.55	1.55	1.53	1.27	70
BW-4	38 (10/85)	7.6	3.6	3.0	4.6	2.73	1.98	0.711	2.51	0.91	1.60	4
BW-6	94 (10/85)	70	82.5	70	53.4	56.0	45.5	30.7	24.60	24.90	25.50	27
BW-9	17.3 (6/86)	48	42	48	51.6	47.5	40.0	31.7	38.20	29.60	34.00	197
BW-9B*	5.8 (6/94)	-	-	-	-	-	-	-	2.6	2.5	1.10	19
BW-12	2.7 (6/86)	1.4	1.146	0.74	0.64	0.82	0.75	0.257	0.44	0.26	0.18	7
BW15	<0.005 (6/86)	0.013	<0.005	<0.005	0.009	0.0055	0.0094	0.0105	0.018	0.015	<0.005	-
BW-24*	62 (6/86)	52	36	36	32	20	19	18	3.8	1.7	1.10	2
BW-27*	157 (6/86)	65	55	46	31	27	26	23	22	20	18.00	11
BW-32	26.6 (3/88)	-	17	21	14.6	11.4	8.40	6.3	7.51	5.44	3.60	14

Source: Baker Environmental, Inc., Report of 1995 Remediation and Monitoring Activities, Sludge Bins Storage Area Closure, Rod and Wire Mill, Sparrows Point Plant

* Denotes current groundwater withdrawal well

Table 6-3
Summary of 1997 Rod and Wire Mill IM Monitoring Requirements
Bethlehem Steel Corporation
Sparrows Point, Maryland

	Daily
1.	Quantity pumped from intermediate depth wells BW-9B, BW-24 (replacement), BW-27 and shallow wells 88A, 89A, 90A, 91A, 92A, 93A, 94A, 96A, 97A, 98, 99, and 100
2.	Quantity and pH of water applied for in-situ soil leaching
3.	Influent/effluent quality at treatment plant (TSS, pH, cadmium, zinc)
4.	Quantity treated
	Monthly
1.	Groundwater levels at BW-9B, BW-24 (replacement), and BW-27
2.	Quality (cadmium, zinc) at BW-9B, BW-24 (replacement), and BW-27
	Quarterly
1.	Groundwater levels (shallow & intermediate wells [including pumping wells] and staff gauge)
2.	Quality (cadmium, zinc) at: Shallow wells BW-3, BW-7, BW-26, 88, 89, 90, 91, 92, 93, 94, 95, 96, and 97
3.	Quality (cadmium, zinc) at: Intermediate depth wells BW-1, BW-2, BW-4, BW-6, BW-9, BW-12, BW-15, and BW-32
4.	Quality (cadmium, zinc) at: Pumping wells 88A, 89A, 90A, 91A, 92A, 93A, 94A, 96A, 97A, 98, 99, and 100

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