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REGION III, EPA
PHILADELPHIA, PA

RECORD OF DECISION

FOR THE HALBY CHEMICAL SITE

NEW CASTLE COUNTY, DELAWARE

June 1991

SCANNED
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File# DE067
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DECLARATION
FOR
RECORD OF DECISION

SITE NAME AND LOCATION

Halby Chemical Site
Wilmington, New Castle County, Delaware

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial action for Operable Unit 1 of the Halby Chemical Site, New Castle County, Delaware, developed in accordance with the requirements of the Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision document explains the factual and legal basis for selecting the remedy for Operable Unit 1 for this site.

The State of Delaware concurs in the remedy selected by the Environmental Protection Agency (EPA). This decision is based on the Administrative Record for this site. An index of the Administrative Record upon which the selection of the remedial action is based is attached as Appendix II.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDY

This operable unit is the first of two operable units for the Halby Chemical Site. Operable Unit 1 (OU1) for the site addresses the principal threat posed by soil contamination within the process plant area of the site. Operable Unit 2 (OU2) for the site will address contamination of the air, groundwater, sediments in the outfall area and tidal marsh area, and sediments and surface water within the lagoon and drainage ditch. The soil

inside the process plant area (OU1) poses an unacceptable health risk to workers because of the potential for direct contact, ingestion, or inhalation of contaminated soil. The selected remedy involves the excavation of the top 6 inches of contaminated surface soil in the process plant area followed by stabilization and replacement. An asphalt cap is to be placed over the stabilized material.

The major components of the selected remedy includes the following:

1. Consolidate all debris on-site into one area
2. Perform a soil grid sampling activity to determine the extent of remediation within the process plant area
3. Perform a treatability study to identify a proper stabilization formula
4. Excavate the top 6 inches of contaminated surface soil
5. Stabilize excavated soil
6. Backfill stabilized soil
7. Cover the stabilized soil with an asphalt cap
8. Implement deed restrictions and public education programs
9. Perform long-term monitoring and maintenance.

STATUTORY DETERMINATIONS

The selected remedy for OU1 is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost-effective. By stabilizing the contaminated surface soils within the process plant area, this remedy satisfies the statutory preference for remedies that employ treatment that reduce toxicity, mobility, or volume as a principal element and utilize permanent solutions and alternative treatment technologies to the maximum extent practicable.

However, because treatment of the subsurface soils within the process plant area was not found to be practicable, the selected remedy will result in hazardous substances remaining on-site above health-based levels. Consequently, a review will be conducted within five years after commencement of remedial action

to ensure that the remedy continues to provide adequate protection of human health and the environment. A separate Proposed Plan and Record of Decision will be issued when the studies associated with OU2 are completed.

UNITED STATES ENVIRONMENTAL
PROTECTION AGENCY

for Edwin B. Erickson
Regional Administrator
Region III

6-28-91
Date

"The State of Delaware concurs
in the remedy selected by EPA"

Edwin H. Clark II, Secretary
Department of Natural Resources and
Environmental Control

27 June 1991
Date

DECISION SUMMARY

1. SITE NAME, LOCATION AND DESCRIPTION

The Halby Chemical Site presently owned by the Brandywine Chemical Company consists of approximately 14 acres of land in Wilmington, New Castle County, Delaware. Located in a highly industrialized area near the Port of Wilmington, the site is bordered to the northeast, northwest, and south by the Conrail Railroad, Interstate 495, and Terminal Avenue, respectively. Figure 1 shows the location and approximate property boundaries of the Halby Chemical Site. Located in an area zoned industrial, the Halby Chemical Site primarily has been used for heavy industry.

a. Site Description - Major site features are shown on Figure 2 and include the following areas. The fenced area in the southeastern corner of the site constitutes the former Halby Chemical Plant (hereinafter, referred to as the process plant area). Major components within the fenced area include wastewater/runoff conveyance system, buildings, 37 tanks, drums, machinery, and a railroad spur. There are no known underground storage tanks on-site. As indicated on Figure 2, the buildings include: 1) a large three-story steel structure that housed the chemical plant; and 2) a three story split level brick building containing office space, a machine shop, a motor storage room, a warehouse for chemical drums, a file storage area, and a boiler room annex. The steel structure consists of dilapidated structural members, inactive reactors, and exposed piping. There are 23 horizontal tanks and 14 vertical tanks on-site. These tanks were used to store bulk chemicals including ammonium thiocyanate, sulfuric acid, caustic solutions, acetic acid, isopropyl alcohol, sodium disulfide and toluene.

Large quantities of drums and containers are present on-site. A 1987 photographic analysis conducted by the Environmental Photographic Interpretation Center of the Environmental Protection Agency (EPA) reported approximately 684 drums on-site. Labels on drums and other containers on-site indicate the drums contain the following substances:

* acetone
* ammonia thiocyanate
* 1-butanol
* 1-ethyl acetate
* ethylene glycol
* isopropanol 99
* methanol
* methylene chloride
* perchloroethylene (or tetrachloroethylene)
* toluene
* xylene
* aromatic 100
* germicidal solvent degreaser
* odorless mineral spirits
* caustic soda
* sodium bicarbonate

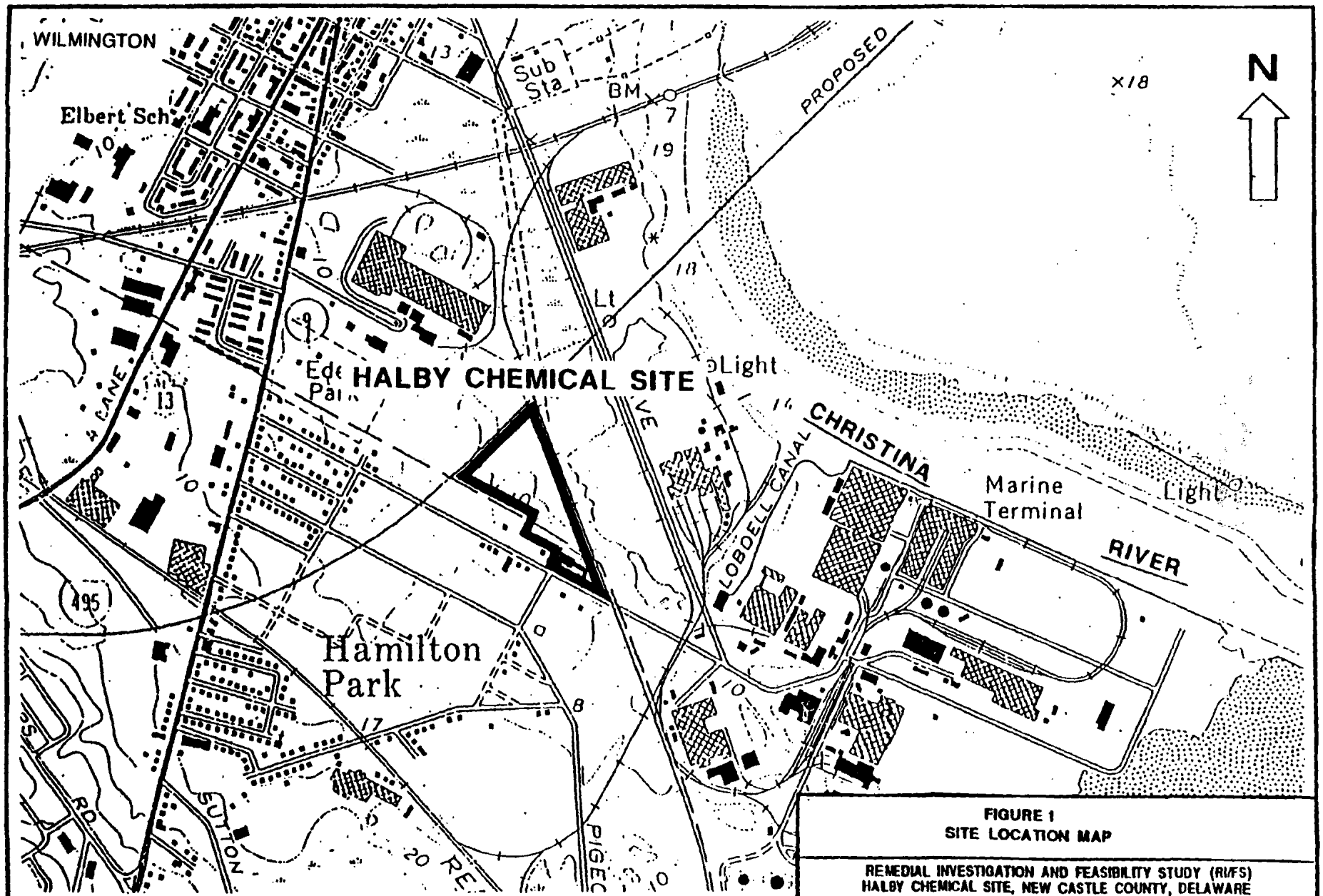

FIGURE 1
SITE LOCATION MAP

REMEDIAL INVESTIGATION AND FEASIBILITY STUDY (RI/FS)
HALBY CHEMICAL SITE, NEW CASTLE COUNTY, DELAWARE

North	EPA Contract No. 68-01-7250
	EPA Work Assignment No. 119-3LL7
	Ebasco Subcontract No. 4236-RP-0005
AEPCO	AEPCO Project No. 1023-554

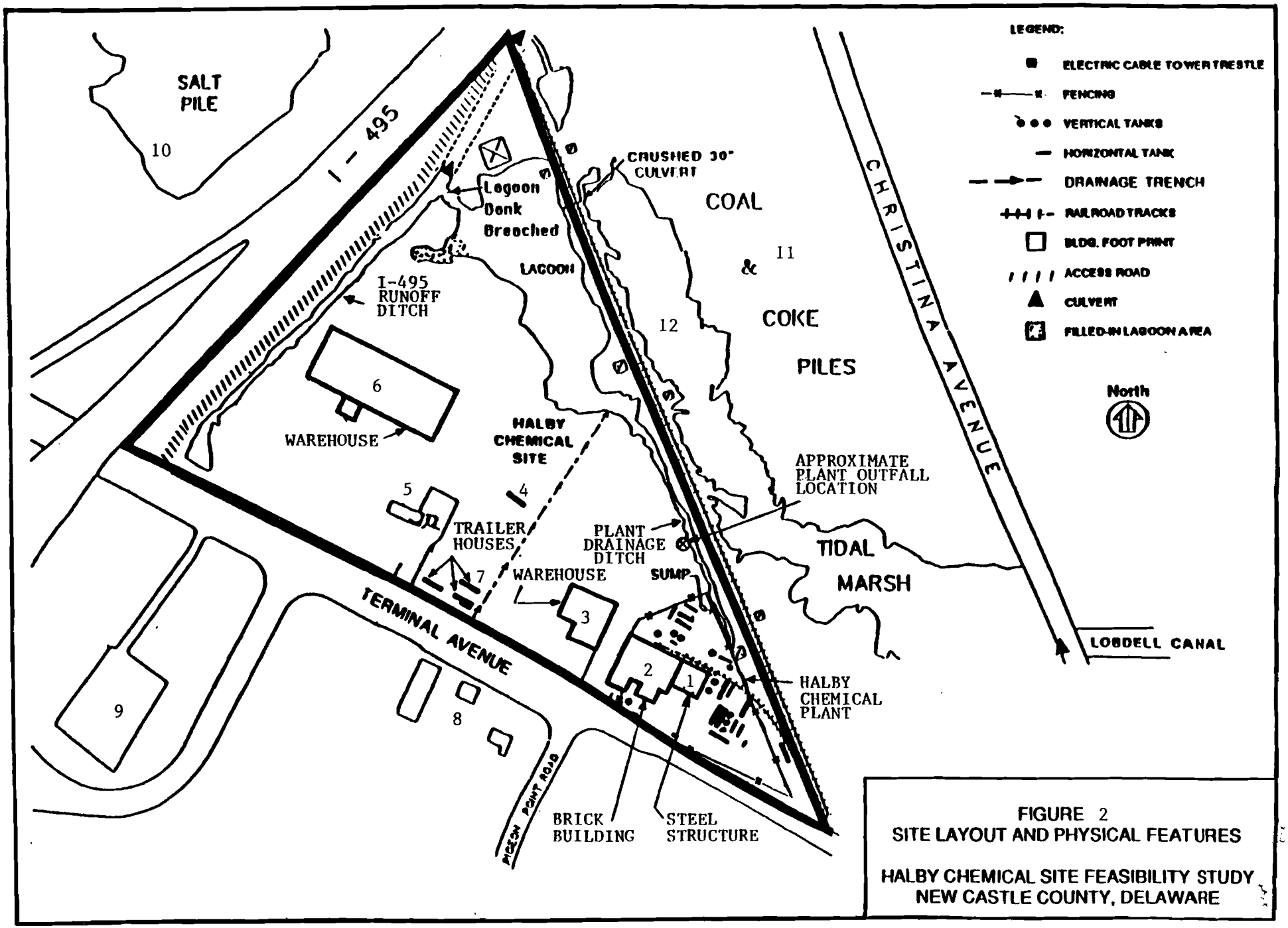

FIGURE 2
SITE LAYOUT AND PHYSICAL FEATURES

HALBY CHEMICAL SITE FEASIBILITY STUDY
NEW CASTLE COUNTY, DELAWARE

According to the facility owner, these drums are clean drums containing the chemicals to be distributed to end users. Bulk chemicals are shipped to the site via rail or trucks and stored in tanks outdoors. The chemicals are later dispensed into the fresh drums. Drums that are awaiting shipment to clients are either stored in the warehouse building or outdoors in the fenced area.

A drainage ditch originates at the rear of the process plant area and flows northwest to a lagoon. The lagoon is breached along the northwest bank causing a direct hydraulic connection with the drainage ditch which parallels I-495. The I-495 drainage ditch directs surface runoff from the highway to the Christina River. Due to their direct hydraulic connection with the Christina River both the ditch and lagoon are under tidal influence. Water levels in the lagoon fluctuate 2 to 3 feet with each tidal cycle. An access road is situated between the I-495 drainage ditch and the highway. A warehouse (identified as 3 on Figure 2) is located immediately northwest of the process plant area which presently houses several automobile repair businesses. Areas north and west of this warehouse are used for storage of tractor trailers, cars, railroad cars, trolley cars and other miscellaneous machinery. A drainage trench flowing northeast-southwest bisects the site. The process plant area, warehouse and storage areas, as discussed above, are located east of the trench. The area west of the trench excluding the lagoon and drainage ditch have been filled raising the grade several feet above the area east of the trench. Primary features west of the drainage trench include a tire repair business housed in a small trailer (4), a truck stop (5) which includes two filling islands and a small office, and a large warehouse (6) used to store steel. The areas north and east of the warehouse are also utilized for steel storage. Both the warehouse and filling area appear to straddle the property line.

Off-site areas, which are indicated on Figure 2, include the following:

- Area 7 is a residential area consisting of three small house trailers.
- Area 8 consists of an asphalt plant, restaurant, and other miscellaneous businesses.
- Area 9 is utilized by the Delaware Department of Transportation for equipment and materials storage.
- Area 10 is situated northwest of the site on the opposite side of I-495. This area is utilized by a local contractor to store salt between unloading from the Port of Wilmington marine terminal (located 0.5 miles east of the site) and its final destination.

- Area 11 is situated north and northeast of the site on the opposite side of the Conrail Railroad tracks. The area is utilized by the same contractor mentioned above for storage of petroleum coke. The coke is stored in this area prior to shipment from the Port of Wilmington to overseas destinations.

- Area 12 is the tidal marsh which is located north and northeast of the site between the railroad tracks and Area 11. The tidal marsh is connected to the Delaware River via the Lobdell Canal and the Christina River. The marsh fluctuates 2-3 feet over each tidal cycle. Historically, the on-site lagoon was connected to the tidal marsh by a 30-inch culvert constructed under the railroad track. Field observations indicate that the culvert is filled and crushed and therefore is no longer a conduit for flow between the lagoon and tidal marsh. However, the lagoon is hydraulically connected to the Christina River via the I-495 drainage ditch.

b. **Geology** - The Piedmont Uplands Section of the Piedmont Physiographic Province and the Coastal Plain Physiographic Province are present in New Castle County, Delaware. These two provinces are separated by a boundary designated as the Fall Line, which is situated approximately 1.25 miles north of the Halby Chemical Site. The Piedmont Province is located north of the Fall Line, while deposits of the Coastal Plain Province are south of this boundary. The site is located within the Coastal Plain Physiographic Province, approximately 1.25 miles south of the Fall Line. Based on reports published by the Delaware Geological Survey, the depth to weathered bedrock at this site is estimated to be approximately 100-150 feet.

In general, the lithology beneath the site consists of unconsolidated sands, gravels, silts, and clays of the Columbia and Potomac Formations and recent sediments, and weathered bedrock of the Wilmington Complex. The Potomac Formation unconformably lies on the weathered bedrock of the Wilmington Complex. The Cretaceous Age Potomac Formation is the basal sedimentary unit of the Coastal Plain sediments. The Potomac Formation is unconformably overlain by the Pleistocene Age Columbia Formation which is exposed at the surface except where overlain by the recent sediments deposited by the Christina and Delaware Rivers or fill material.

c. **Soils** - Soils within the process plant area and along the southern portion of the I-495 drainage ditch are mapped as the Aldino-Keyport-Mattapex-Urban land complex (AM) according to the United States Department of Agriculture Soil Survey, New Castle County, Delaware. This complex consists of gently sloping Aldino, Keyport, and Mattapex soils that have been disturbed for residential and/or commercial purposes to a degree that mapping each distinct soil type is impractical. Soils of the Aldino, Keyport and Mattapex series are generally deep and moderately well drained. The mapped soil types have been covered by a layer of fill material throughout much of the site area. Extensive filling took place west of the on-

site drainage trench prior to construction of the truck stop and warehouse.

d. Surface Water Hydrology - Storm water runoff in the vicinity of the site generally flows towards a drainage ditch which parallels I-495 and discharges into the Christina River. The drainage divide is roughly marked by the triangular perimeter of the site; that is, I-495, the Conrail railroad tracks, and Terminal Avenue. The drainage areas west of the railroad tracks, immediately north of the Halby Chemical Plant, and on the southern side of I-495 are all conveyed to the drainage ditch. The United States Geologic Survey (USGS) conducted an investigation of the relationship between the surface water in the tidal marsh and shallow groundwater at the site. Surface water and groundwater levels, tidal stage, and groundwater temperature data were collected for approximately four weeks. Findings of the USGS study indicate that no significant hydraulic connection exists between the shallow aquifer and the adjacent tidal water bodies at the site; this hydraulic connection will be investigated further in Operable Unit 2 for this site.

e. Groundwater Hydrology - Local groundwater was encountered between 3 and 5 feet above mean sea level in both the Columbia and Upper Potomac aquifers. Groundwater movement in the Columbia and Upper Potomac aquifers is generally to the northeast and north-northwest, respectively, toward the Christina River. The horizontal flow gradient of the Columbia aquifer is approximately 0.002 or a 2-foot vertical drop in water level for every 1000 feet horizontally. Both aquifers are affected by local pumping of the Forbes Steel Well, which is reportedly screened between 50 and 60 feet in the Upper Potomac aquifer and produces approximately 6000 gallons of water per day. Past reports have generally indicated a downward vertical flow gradient between the Columbia and Upper Potomac aquifers, indicating that groundwater would descend from the water table (Columbia) aquifer to the deeper (Upper Potomac) aquifer.

Based on the RI findings there are three water bearing sands beneath the site: upper and lower sands in the Potomac Formation and the sands of the Columbia Formation. These sands are designated in this document as the Upper and Lower Potomac aquifers and Columbia aquifer, respectively. The Columbia and uppermost Potomac aquifers in the Port of Wilmington including the Halby Chemical Site and its vicinity are not viable sources of water supply. The groundwater in this area will be investigated further as part of Operable Unit 2 for this site. However, the hazardous constituents found in the groundwater during the RI are not the only reason that the aquifer is not a viable future source of water supply. Other reasons include inadequate yield, potential for brackish water intrusion, and man-made contamination. Removal of the contaminants from groundwater beneath the Halby Site would therefore have little impact on the likelihood that groundwater in this area would be used for water supply purposes. Public water is currently available to the population in this area.

2. SITE HISTORY AND ENFORCEMENT ACTIVITIES

a. Site History - From 1948 to 1977, sulfur compounds were produced at the Halby Chemical Site. The three principal products produced were ammonium thiocyanate, ammonium thioglycolate and isooctyl thioglycolate. Other products and by-products included ammonium sulfide, sodium sulfide, sodium thiocyanate, sodium hydrosulfide, potassium thiocyanate, and monoethanolamine thioglycolate.

From 1948 to 1964, all liquids from the Halby Chemical Plant flowed into the adjacent marsh (or lagoon). This unlined lagoon drained via the marsh into the Lobdell Canal and from there into the Christina River. The liquids from the site included cooling water, surface water runoff and acid wastewater. According to one of the site owners, the acid wastewater was at a pH between 3 and 6 and contained:

* 7% sodium chloride
* 15% sodium bisulfide
* ferrous sulfate
* ferric chloride
* isopropyl ether
* isooctyl alcohol

The acid wastewater flow from the plant was 6 to 7 gallons per minute (gpm). In the early 1960s, the acid wastewater was discharged into a pit, filled with limestone rocks, which partially neutralized it prior to its discharge into the lagoon.

From 1964 to 1972, the acid wastewater was discharged to public (county) sewers and, reportedly, only cooling water entered the lagoon. In 1972, Halby Chemical Company merged with and became a part of the Argus Chemical Company, a wholly-owned subsidiary of the Witco Corporation. Witco assumed control of the plant and began experimenting with wastewater treatment schemes. By 1975, Witco was periodically diverting the acid wastewater flow from the county sewer system to its pilot plant. The treated wastewater was discharged to the lagoon. A National Pollutant Discharge Elimination System (NPDES) permit was issued to Halby Chemical Company on July 1, 1977 to regulate discharges from the lagoon, which included cooling water and effluent from the process plant wastewater treatment plant, to nearby receiving waters (Lobdell Canal). The permit regulated pH, total suspended solids, Biological Oxygen Demand (BOD) and Chemical Oxygen Demand (COD) in the lagoon effluent.

The plant closed in August 1977 and the property was sold to Brandywine Chemical Company which receives bulk chemicals at the site and distributes them to end users. At some time between May 1977 and June 1983, the northwest bank of the lagoon was breached and the lagoon now drains through the drainage ditch along I-495 to the Christina River with tidal fluctuations.

According to property title records, a portion of the site (until 1969) and the adjacent properties (until 1974) were owned by the Pyrites Company. This company used the property to store pyrite ore.

Pyrite ore is an iron sulfide (FeS_2). Arsenic often replaces a sulfide molecule in the pyrite structure to form arsenopyrite (FeAsS) and the pyrite stored on the property reportedly contained arsenic. The Pyrites Company removed iron from the ore and made sulfuric acid. A portion of the adjacent properties is now used to store petroleum coke and coal.

b. **Previous Investigations** - The area surrounding and including the Halby Chemical Site has been the focus of several investigations by EPA, the State of Delaware's Department of Natural Resources and Environmental Control (DNREC), and the City of Wilmington. A principal source of background information on the site is the NUS Corporation's Site Inspection Report of the Halby Chemical Company, completed under a contract with EPA on January 10, 1986.

The Delaware DNREC, in December 1983, prepared a Preliminary Assessment of the Halby Chemical Site under the Emergency and Remedial Response Information System (ERRIS). In February 1985, a Preliminary Hydrogeologic Investigation at the salt piles along I-495 was also prepared by the DNREC. The City of Wilmington commissioned a geotechnical investigation of the I-495 bulk storage area. The report for this investigation was prepared in August, 1986. According to the 1983 Delaware DNREC Preliminary Assessment, nearby residents had complained about lagoon overflow, hydrogen sulfide-like odors in the vicinity of the site, and numerous spills.

In March 1984, an EPA FIT III Team performed a Site Inspection (SI) of the facility. Odors were emanating from sediment samples taken from the on-site lagoon. Numerous drums and tanks were observed to be stored on the site. The soil around the drums was stained and several drums appeared to be leaking. A sample of the stained soil was taken. Analytical results for the samples collected during the SI showed high levels of the following organic and inorganic compounds:

acetone	naphthalene
benzene	chrysene
ethylbenzene	benzo(c)anthranthene
chloroform	acenaphthene
1,1,-dichloroethane	indeno(1,2,3,-cd)pyrene
1,1,1,-trichloroethane	carbon disulfide
trichloroethylene (TCE)	arsenic
tetrachloroethylene (PCE)	chromium
total xylenes	cyanide
2-butanone	mercury
4-methyl, 2-pentanone	lead
fluoranthene	

Migration from the site was evident in aqueous and sediment samples from the lagoon outfall, which contained elevated levels of various pollutants. Only one of three water supply wells located on-site was operational at the time of the inspection. This well showed

high levels of arsenic, mercury, cyanide, and TCE. The on-site wells were used for cooling water supply and not for potable water. The presence of these substances suggested that the groundwater underlying the site was contaminated.

In March 1985, EPA resampled the on-site production well. These samples were analyzed for thiocyanate compounds by a wet chemistry method. The results indicated that most of the cyanide discovered during the March 1984 sampling was actually thiocyanate, a compound that was manufactured at the facility.

In a City of Wilmington study of the bulk storage area immediately adjacent to the Halby Chemical Site, it was observed that the groundwater beneath this site was contaminated with various inorganic and organic constituents. In particular, national interim primary and secondary drinking water standards were exceeded for the following inorganics: chloride, sulfide, cyanide, arsenic, cadmium, selenium, and zinc. Analysis for priority pollutant organic compounds indicated the presence of low levels of two volatile organics which included toluene and trans-1,2-dichloroethene. Volatile compounds detected during the sampling and which are not on the EPA's priority pollutant list included 2,2-oxybis-propane, tetrahydrofuran, and acetone. The latter two were found in trace amounts and regarded as related to sampling analysis procedures and well construction. In addition, three unlisted base/neutral extractable organics were detected.

Several heavy metals were also identified in the City's study. These included arsenic, cadmium, cobalt, iron, manganese, nickel, selenium, strontium, and zinc. The presence of cobalt, nickel, and strontium, and the high concentrations of surfactants suggest that the storage of petroleum coke at the area adjacent to the Halby Chemical Site may also have contributed to the contamination of groundwater at the site.

Based on the Delaware DNREC study conducted on the salt piles along I-495, it was concluded that leachate from the salt piles had also contaminated the groundwater locally and posed a threat to the use of the aquifer for most water supply purposes, including public drinking water. Analyses of groundwater quality samples taken during this study indicated high levels of iron and manganese in every well. Sulfates were also found in high concentrations and it is speculated that these contaminant levels could be related to coal or slag piles that may have existed at or near the site in the past. High sulfate concentrations along with high iron and low pH are consistent with the presence of water leached through coal. Sodium and chloride were both found in high concentrations in various wells. Therefore, an additional potential source of groundwater contamination is associated with the salt piles on the opposite side of I-495.

There is also the possibility that the former operation of North American Smelting, a lead smelter plant which was located

approximately 1,000 feet west of the site may have contributed at least a portion of the lead and arsenic identified in surface soil and lagoon sediment samples in the area.

c. Enforcement Activities - EPA has identified the following potentially responsible parties (PRPs) associated with the Site: Argus Chemical Corporation, as the successor to Halby Chemical Co., Inc.; Witco Corporation, as the parent corporation to Argus Chemical Corporation; and Brandywine Chemical Company as the owner and operator of the site from 1977 to the present.

On April 17, 1986 the aforementioned PRPs received Special Notice Letters inviting them to perform the Remedial Investigation/ Feasibility Study (RI/FS) Report. Brandywine, Argus and Witco declined to conduct the RI/FS, and the RI/FS was performed with Superfund monies. After the completion of the RI, Witco offered to do the FS. The Agency declined the offer, as it contravenes EPA's policy to split the RI/FS process. In addition, a change in contractors would have delayed the completion of the FS and the issuance of the ROD.

3. HIGHLIGHTS OF COMMUNITY PARTICIPATION

Pursuant to CERCLA §§ 113(K)(2)(B)(i-v) and 117, the RI/FS Report and the Proposed Plan for the Halby Chemical Site were released to the public for comment on April 19, 1991. These two documents were made available to the public in the administrative record located in an information repository maintained at the EPA Docket Room in Region III and at the Wilmington Institute Library in Wilmington, Delaware. The notice of availability for these documents was published in The News Journal on April 19, 1991. A public comment period on the documents was held from April 19, 1991, to June 3, 1991. In addition, a public meeting was held on May 2, 1991. At this meeting, representatives from EPA answered questions about problems at the site and the remedial alternatives under consideration. A response to the comments received during the public comment period is included in the Responsiveness Summary, which is part of this Record of Decision (ROD).

4. SCOPE AND ROLE OF OPERABLE UNIT

As with many Superfund sites, the problems at the Halby Chemical Site are complex. As a result, EPA has organized the remedial work into two Operable Units. The scope of both of the Operable Units can be summarized as follows:

- Operable Unit 1: Contamination of soils inside the process plant area.

- Operable Unit 2: Contamination of the air, groundwater, sediments in the outfall area adjacent to the process plant, sediments in the area east of the Halby property which includes the tidal marsh area, and sediments and surface water within the lagoon and adjacent ditch next to the process plant.

This ROD addresses Operable Unit 1 at the site. The contaminated soil inside the process plant area was determined to be the principal threat at the site due to the potential for direct contact health risks to on-site workers. The remedial action objective for Operable Unit 1 is to prevent current and future exposure to contaminated soils in the process plant area at the Halby Chemical Site.

Further investigations will be conducted concerning the groundwater, air releases, sediment in the outfall area adjacent to the process plant, the area east of the Halby property including the tidal marsh area, and sediments and surface water located within the lagoon and drainage ditch next to the process plant. A separate Proposed Plan and ROD will be issued when the studies associated with Operable Unit 2 are completed.

5. SUMMARY OF SITE CHARACTERISTICS

The soil at the process plant area poses unacceptable health risks to workers due to the potential for direct contact, ingestion, or inhalation of contaminated soil. Up to 10,300 cubic yards of contaminated sediment could require remediation. There were no discernible waste piles, impoundments, or containers/drum storage areas visible in the process plant area during the initial site reconnaissance for the RI/FS. Existing tanks and containers on-site are used to store raw chemicals but not wastes. Thirteen soil sampling stations were located within the process plant area during Phase I and II sampling (Figure 3). Soil samples were collected from areas around storage tanks or stained soil within the process plant area.

a. TCL Metals - The 17 metals identified in the process plant area at concentrations exceeding twice the background level are shown in Table 1. Arsenic, lead and zinc concentrations are also shown in Figure 4. The most significant metals identified within the process plant area are discussed below. Arsenic was identified at 11 of the 13 sampling locations within the process plant area. Elevated concentrations were identified at stations SSS-09 (1,130 mg/kg) and SSS-25A (1,700 mg/kg), which are situated north of the railroad spur track. These locations are separated by sampling station SSS-10, which showed a concentration of 74.1 mg/kg. Arsenic levels identified at other locations within the process plant area are commonly in the 30-80 mg/kg range, even at depth (SSS-23). Thus, the elevated concentrations at SSS-09 and SSS-25 may be associated with spills.

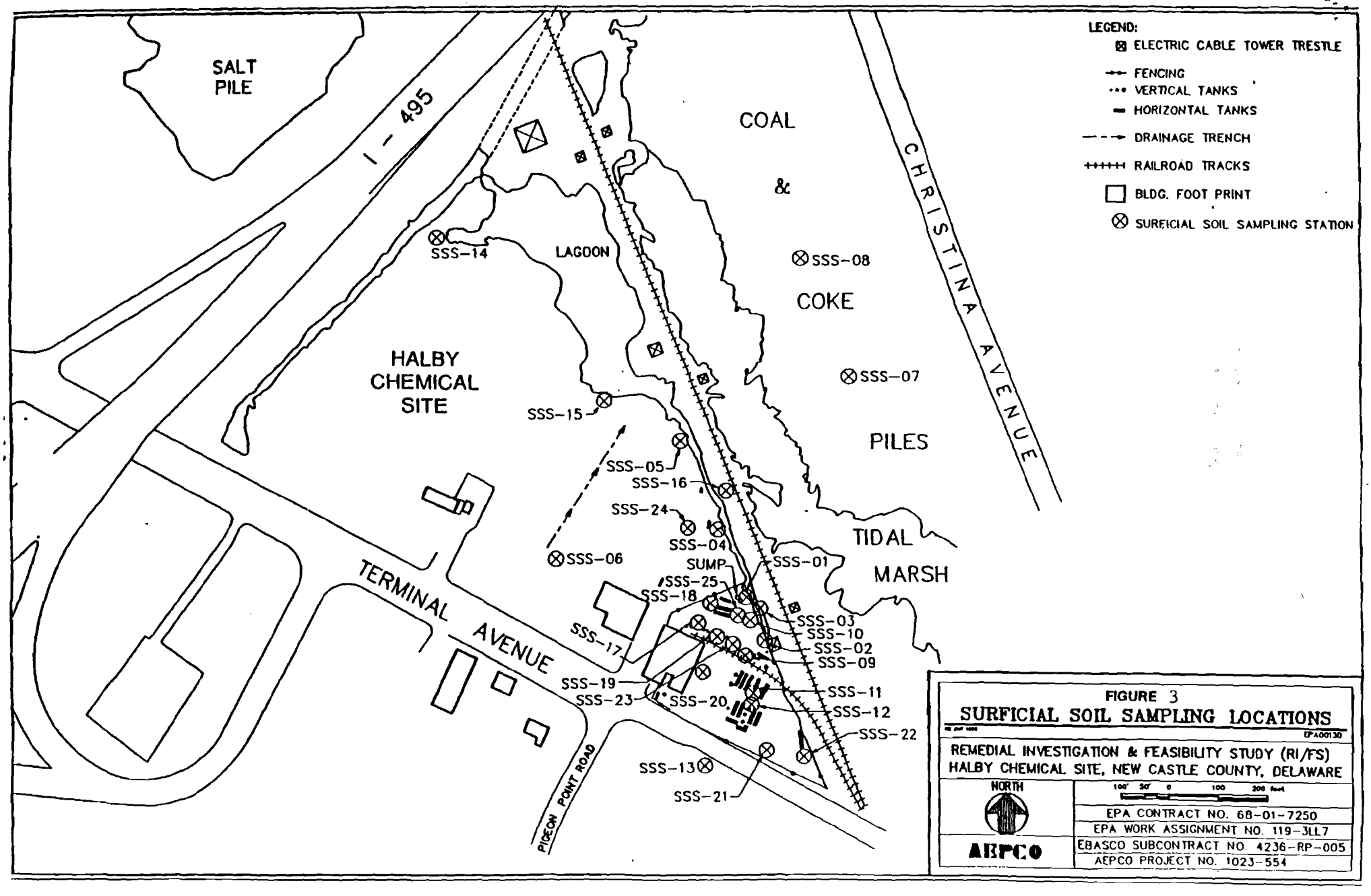

FIGURE 3
SURFICIAL SOIL SAMPLING LOCATIONS
REMEDIAL INVESTIGATION & FEASIBILITY STUDY (RI/FS)
HALBY CHEMICAL SITE, NEW CASTLE COUNTY, DELAWARE

TABLE 1
METAL CONCENTRATIONS - PROCESS PLANT AREA
HALBY CHEMICAL SITE

	PARAMETERS	UNIT	SSS-06* 2'0"	SSS-06* 2'0"	SSS-01 3'0"	SSS-09 0'3"	SSS-10 0'3"	SSS-11 0'2"	SSS-12 0'3"	SSS-17 0'3"	SSS-18 0'3"	SSS-19 0'0"	SSS-20 0'0"	SSS-21A 4'0"	SSS-21B 6'0"	SSS-21C 8'0"	SSS-21D 10'0"
**	ARSENIC	mg/kg	4.4	4.4		1130	74.1	36	58.7	23.4	57.7	107	36.4				50
	BARIUM	mg/kg	63.4	63.4		143	150				199	393					
***	BERYLLIUM	mg/kg	1.4	1.4				7.1									
***	CADMIUM	mg/kg	0.89	0.89		7.1	1.9				3.8	3.1	9.5				
	CALCIUM	mg/kg	469	469		7860	1240	1090		1760	5590		3310				
***	CHROMIUM	mg/kg	28.3	28.3		343					98.7	86	228				
	COBALT	mg/kg	16.3	16.3									50				
	COPPER	mg/kg	37.3	37.3	315	217	151		76.8	1780	1470	3870	372				
	IRON	mg/kg	27500	27500		107000					65200		487000				
	LEAD	mg/kg	16.5	16.5	120	400	225	249	255	133	260	222	443				
	MANGANESE	mg/kg	359	359									2680				
	MERCURY	mg/kg	0.11	0.11	0.65	9	0.6	2	0.5	2	5.5	43	7.6				
***	NICKEL	mg/kg	13.7	13.7		42.3					51.9	43.3	174				
	SELENIUM	mg/kg	0.83	0.83			3.6	3									
	SILVER	mg/kg	0.86	0.86								2.3					
	SODIUM	mg/kg	42.5	42.5		559	447	707			647						
	ZINC	mg/kg	81.6	81.6		1250	272	314		275	910	475	3270				

*Background sample.

** Carcinogen by both the ingestion and inhalation routes.

*** Carcinogen by inhalation route.

TABLE 1 (cont)
METAL CONCENTRATIONS - PROCESS PLANT AREA
HALBY CHEMICAL SITE

	PARAMETERS	UNIT	SSS-06* 2'0"	SSS-22A 4'0"	SSS-22B 6'0"	SSS-22C 8'0"	SSS-22D 10'0"	SSS-23A 4'0"	SSS-23B 5'0"	SSS-23C 6'0"	SSS-23D 8'0"	SSS-23E 10'0"	SSS-25A 4'0"	SSS-25B 6'0"	SSS-25C 8'0"	SSS-25D 10'0"	SSS-25E 12'0"
**	ARSENIC	mg/kg	4.4					130	50	60		60	1700	540	1300	490	140
	BARIUM	mg/kg	63.4														
***	BERYLLIUM	mg/kg	1.4														
***	CADMIUM	mg/kg	0.89														
	CALCIUM	mg/kg	469														
***	CHROMIUM	mg/kg	28.3														
	COBALT	mg/kg	16.3														
	COPPER	mg/kg	37.3														
	IRON	mg/kg	27500														
	LEAD	mg/kg	16.5					200							200	100	
	MANGANESE	mg/kg	359														
	MERCURY	mg/kg	0.11														
***	NICKEL	mg/kg	13.7														
	SELENIUM	mg/kg	0.83														
	SILVER	mg/kg	0.86														
	SODIUM	mg/kg	42.5														
	ZINC	mg/kg	81.6					260					2000	570	1200	470	220

*Background sample.

** Carcinogen by both the ingestion and inhalation routes.

*** Carcinogen by inhalation route.

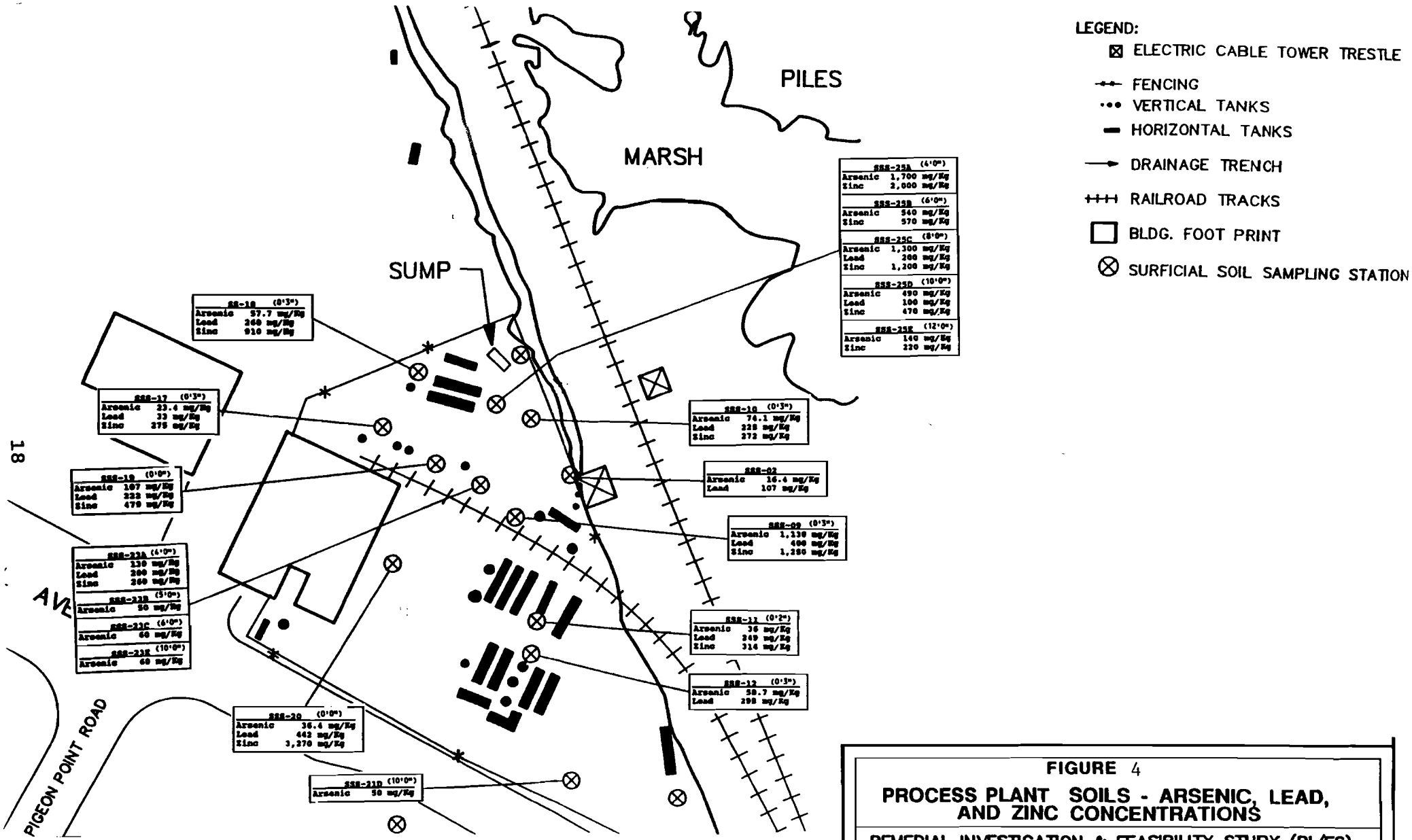

FIGURE 4

PROCESS PLANT SOILS - ARSENIC, LEAD, AND ZINC CONCENTRATIONS

REMEDIAL INVESTIGATION & FEASIBILITY STUDY (RI/FS)
HALBY CHEMICAL SITE, NEW CASTLE COUNTY, DELAWARE

NORTH

AEPCO

EPA CONTRACT NO. 68-01-7250
EPA WORK ASSIGNMENT NO. 119-3LL7
EBASCO SUBCONTRACT NO. 4236-RP-005
AEPCO PROJECT NO. 1023-554

Within the vertical profile at SSS-25 (samples A-E), arsenic was identified at an elevated concentration of 1,700 mg/kg at the 4-foot level but declined with depth (see Table 1). SSS-25 shows the attenuation of arsenic to be one order of magnitude in 8 feet of vertical depth (1,700 to 140 mg/kg). SSS-09 contamination (1,130 mg/kg) is reported at a depth of 3 inches.

Copper concentrations were less than 400 mg/kg at all sampling locations except SSS-17 (1,780 mg/kg), SSS-18 (1,470 mg/kg), and SSS-19 (3,870 mg/kg). These sample locations are in the western part of the process plant near its west gate (SSS-17), near the plant sump adjacent to storage tanks (SSS-18), and the covered drain adjacent to the railroad spur (SSS-19); and may be indicative of a spill during the filling of a storage tank. Copper was not analyzed for during the Phase II sampling.

Lead concentrations appear homogenous, ranging from 120-443 mg/kg. This element appears in 11 of the 13 process plant sampling locations, and in all the near-surface Phase I samples. The highest concentration is found at SSS-20, the lowest at SSS-01.

SSS-25 was the only sampling location at which significant concentrations of lead were identified at more than one contiguous depth. At a depth of 8 feet, lead was detected at a concentration of 200 mg/kg and at 10 feet at 100 mg/kg.

Zinc contamination closely parallels that of arsenic. It was reported at significant levels in 9 of the 13 sampling locations in the process plant area. Like arsenic, elevated concentrations of zinc were identified at SSS-09 (1,250 mg/kg) and SSS-25 (2,000 mg/kg). Elevated concentrations of zinc were also identified at SSS-18 (910 mg/kg) and SSS-20 (3,270 mg/kg). Zinc levels identified at other locations within the process plant area are commonly in the 275-475 mg/kg range.

Vertical profiling at sample station SSS-25 using Phase II data shows the highest zinc concentration of 2,000 mg/kg at the 4-foot level and a decrease with depth to a low of 220 mg/kg at 12 feet.

b. <u>Volatile Organic Compounds (VOCs)</u> - The VOC contaminants found to be present within the process plant are shown in Table 2 and in Figure 5. Of the 14 VOCs identified within the process plant, carbon disulfide and methylene chloride were the only two found throughout the process plant area. These two VOCs were detected at nine of the process plant sampling locations in concentrations of 12-66,900 and 21-6,600 ug/kg, respectively.

The highest concentration of carbon disulfide was identified at SSS-25 (66,900 ug/kg) at a depth of 4 feet. Stations SSS-18 (58,000 ug/kg), SSS-17 (9,000 ug/kg), and SSS-10 (680 ug/kg), which are all in the same area as SSS-25 in the northwestern section of the process plant, also revealed elevated concentrations. This area represents

TABLE 2
VOC CONCENTRATIONS - PROCESS PLANT AREA
HALBY CHEMICAL SITE

PARAMETERS	UNIT	SSS-06* 2'0"	SSS-01 3'0"	SSS-09 0'3"	SSS-10 0'3"	SSS-11 0'2"	SSS-12 0'3"	SSS-17 0'3"	SSS-18 0'3"	SSS-19 0'0"	SSS-20 0'0"	SSS-21A 4'0"	SSS-21B 6'0"	SSS-21C 8'0"	SSS-21D 10'0"
** METHYLENE CHLORIDE	ug/kg	ND	46	120	130	24		190	6600	25	21				
ACETONE	ug/kg	230			3000				6500						
CARBON DISULFIDE	ug/kg	ND	18	120	680			9000	58000	23	140				
2-BUTANONE	ug/kg	27	170	300											
TRICHLORO-ETHENE	ug/kg	ND												712	507
** BENZENE	ug/kg	ND						190							
4-METHYL-2-PENTANONE	ug/kg	ND		120	700			500							
2-HEXANONE	ug/kg	ND			550			1200							
** TETRACHLORO ETHENE	ug/kg	ND		690					3300					24.3	38.2
1,1,2,2-TETRA CHLOROETHANE	ug/kg	ND		28											
TOLUENE	ug/kg	2	480					160							
ETHYL BENZENE	ug/kg	ND	56												
STYRENE	ug/kg	ND									15				
TOTAL XYLENES	ug/kg	ND	490							12	18				

*Background Sample.

** Carcinogen by both the ingestion and inhalation routes.

TABLE 2 (cont)
VOC CONCENTRATIONS - PROCESS PLANT AREA
HALBY CHEMICAL SITE

	PARAMETERS	UNIT	SSS-06* 2'0"	SSS-22A 4'0"	SSS-22B 6'0"	SSS-22C 8'0"	SSS-22D 10'0"	SSS-23A 4'0"	SSS-23B 5'0"	SSS-23C 6'0"	SSS-23D 8'0"	SSS-23E 10'0"	SSS-25A 4'0"	SSS-25B 6'0"	SSS-25C 8'0"	SSS-25D 10'0"	SSS-25E 12'0"
**	METHYLENE CHLORIDE	ug/kg	ND								33.5					28.7	
	ACETONE	ug/kg	230								814	1520					
	CARBON DISULFIDE	ug/kg	ND								29.7	12.1	66900	130	12	212	36.0
	2-BUTANONE	ug/kg	27								370	180				182	
	TRICHLORO-ETHENE	ug/kg	ND														
**	BENZENE	ug/kg	ND										142		24.2		
	4-METHYL-2-PENTANONE	ug/kg	ND									33.4					
	2-HEXANONE	ug/kg	ND														
**	TETRACHLORO ETHENE	ug/kg	ND														
	1,1,2,2-TETRA CHLOROETHANE	ug/kg	ND														
	TOLUENE	ug/kg	2										87.2		23.3	10.5	
	ETHYL BENZENE	ug/kg	ND														
	STYRENE	ug/kg	ND														
	TOTAL XYLENES	ug/kg	ND										145.3		28.1	12.0	

*Background Sample.

** Carcinogen by both the ingestion and inhalation routes.

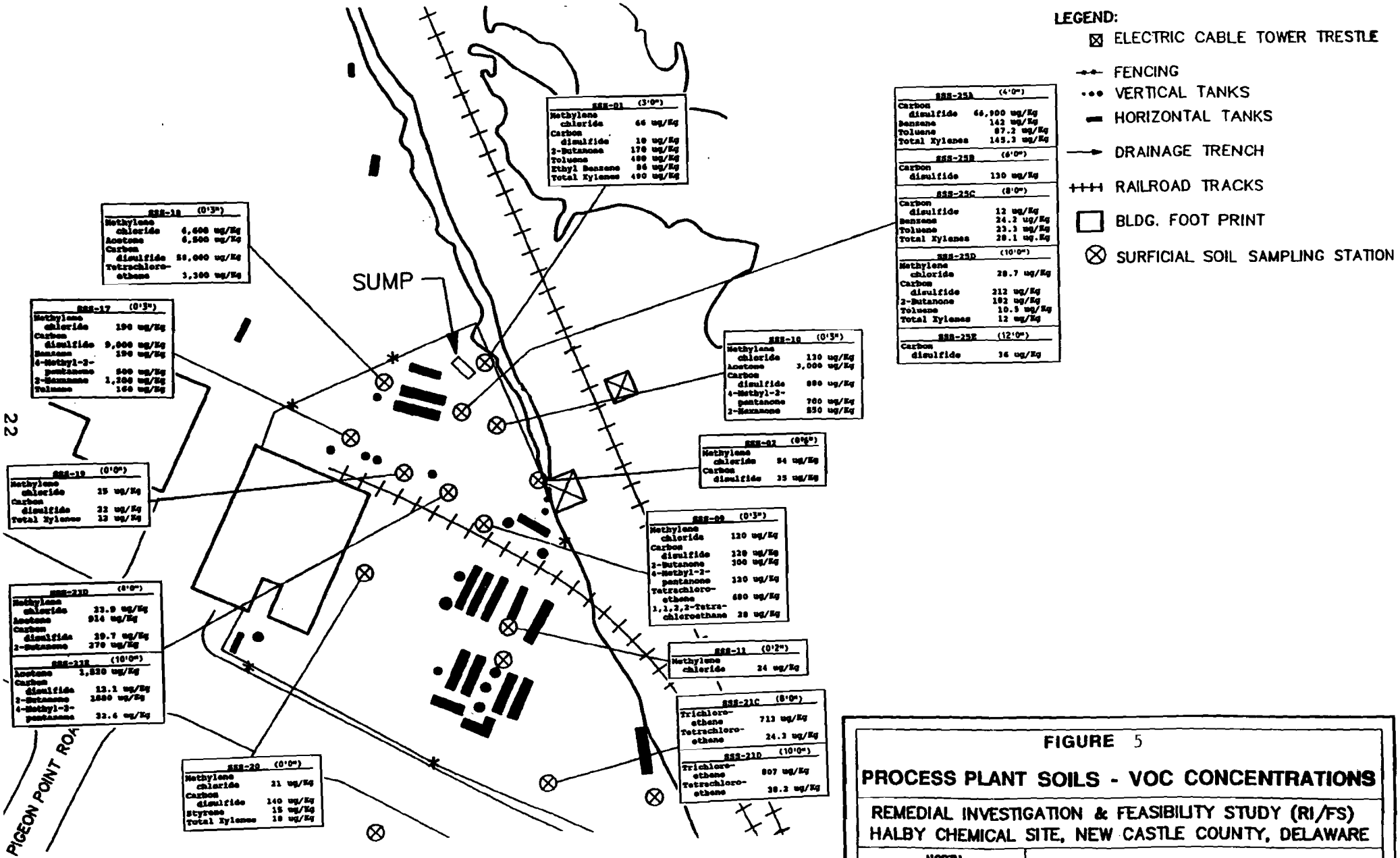

FIGURE 5

PROCESS PLANT SOILS - VOC CONCENTRATIONS

REMEDIAL INVESTIGATION & FEASIBILITY STUDY (RI/FS)
HALBY CHEMICAL SITE, NEW CASTLE COUNTY, DELAWARE

NORTH

AEPCO

EPA CONTRACT NO. 68-01-7250
EPA WORK ASSIGNMENT NO. 119-3LL7
EBASCO SUBCONTRACT NO. 4236-RP-005
AEPCO PROJECT NO. 1023-554

the topographic low area within the process plant area. Vertical profiling of station SSS-25 demonstrates a sharp decline in carbon disulfide concentration with depth. The concentration dropped from 66,900 to 130 ug/kg from the 4-foot to the 6-foot depth interval.

The maximum concentration of methylene chloride (6,600 ug/kg) was detected within the topographical low area, at SSS-18. Methylene chloride was also detected at slightly elevated concentrations at SSS-09 (120 ug/kg), SSS-10 (130 ug/kg), and SSS-17 (190 ug/kg). Methylene chloride is a common laboratory contaminant and was detected in the QC blank samples (26 ug/kg); thus, it cannot be concluded that methylene chloride is a contaminant at a sampling station if its concentration is less than 260 ug/kg. Phase II samples show no data to suggest high levels at depth. Trichloroethene (712 ug/kg), 1,1,2,2-tetrachloroethane (28 ug/kg), ethyl benzene (56 ug/kg), and styrene (15 ug/kg) were identified at only one of the 13 sampling locations. Acetone (1,520-6,500 ug/kg), 2-butanone (170-370 ug/kg), benzene (142-190 ug/kg), 4-methyl-2-pentanone (33.4-700 ug/kg), 2-hexanone (550-1200 ug/kg), tetrachloroethene (24.3-3,300 ug/kg), toluene (87.2-480 ug/kg), and total xylenes (12-490 ug/kg) were identified at four or less sampling locations.

These VOCs were generally detected at the same sample locations at which the elevated concentrations of carbon disulfide were detected or at isolated sample locations along the railroad spur. Acetone was detected in concentrations of 6,500 and 3,000 ug/kg, respectively, at SSS-18 and SSS-10. It was not identified in any other process plant sample, except at depth at station SSS-23. It was detected in a concentration of 814 ug/kg in the 8-foot level and 1,520 ug/kg in the 10 foot level samples at this location. However, acetone contamination cannot be confirmed at this location because the detected concentration is less than 2,000 ug/kg (ten times the QC blank concentration). Sample SSS-01 collected near the plant sump indicated toluene and total xylenes contamination of approximately 500 ug/kg. The maximum concentration of tetrachloroethene (3,300 ug/kg) was also detected as SSS-18.

c. **Semivolatile Organic Compounds (SVOCs)** - SVOCs were evaluated as potential site contaminants in the same manner as VOCs. The resulting SVOC contaminants considered to be present within the process plant are listed in Table 3. Combined carcinogenic polycyclic aromatic hydrocarbon (CPAH) concentrations are shown in Figure 6.

Of the 19 SVOCs detected, fluoranthene (85,000 ug/kg), indeno (1,2,3-cd) pyrene (4,200 ug/kg), and benzo (g,h,i) perylene (5,000 ug/kg) were only identified at SSS-09, near the on-site railroad spur line. Naphthalene (1,200 and 1,300 ug/kg), 2-methylnaphthalene (2,200 and 2,800 ug/kg), acenaphthylene (27,000 and 1,900 ug/kg), dibenzofuran (14,000 and 1,300 ug/kg), fluorene (20,000 and 700 ug/kg), phenanthrene (110,000 and 8,000 ug/kg), anthracene (19,000

TABLE 3
SVOC CONCENTRATIONS - PROCESS PLANT AREA
HALBY CHEMICAL SITE

PARAMETERS	UNIT	SSS-06* 2'0"	SSS-01 3'0"	SSS-09 0'3"	SSS-10 0'3"	SSS-11 0'2"	SSS-12 0'3"	SSS-17 0'3"	SSS-18 0'3"	SSS-19 0'0"	SSS-20 0'0"
NAPHTHALENE	ug/kg	ND		1200				1300			
2-METHYL NAPHTHALENE	ug/kg	ND		2200				2800		1200	
ACENAPHTHYLENE	ug/kg	ND		27000				1900			
DIBENZOFURAN	ug/kg	ND		14000				1300			
FLUORENE	ug/kg	ND		20000				700			
PHENANTHRENE	ug/kg	ND		110000				8000		2100	
ANTHRACENE	ug/kg	ND		19000				1200			
** DI-N-BUTYL PHTHALATE	ug/kg	40	460		500				2000		2300
FLUORANTHENE	ug/kg	ND		85000							
PYRENE	ug/kg	ND		66000				9000		2200	
** BUTYLBENZYL PHTHALATE	ug/kg	ND							900		
** BENZO(a) ANTHRACENE	ug/kg	ND		19000				4000			
** CHRYSENE	ug/kg	ND		22000				3800			
** BIS(2-ETHYLHEXYL) PHTHALATE	ug/kg	260			1700	1200		1800	14000	24000	11000
** BENZO(b) FLUORANTHENE	ug/kg	ND		12000				3900			
** BENZO(k) FLUORANTHENE	ug/kg	ND		11000				2500			
** BENZO(a)PYRENE	ug/kg	ND		7900				2100			
** INDENO(1,2,3-cd)PYRENE	ug/kg	ND		4200							
BENZO(g,h,i) PERYLENE	ug/kg	ND		5000							

*Background sample.

** Carcinogenic PAHs

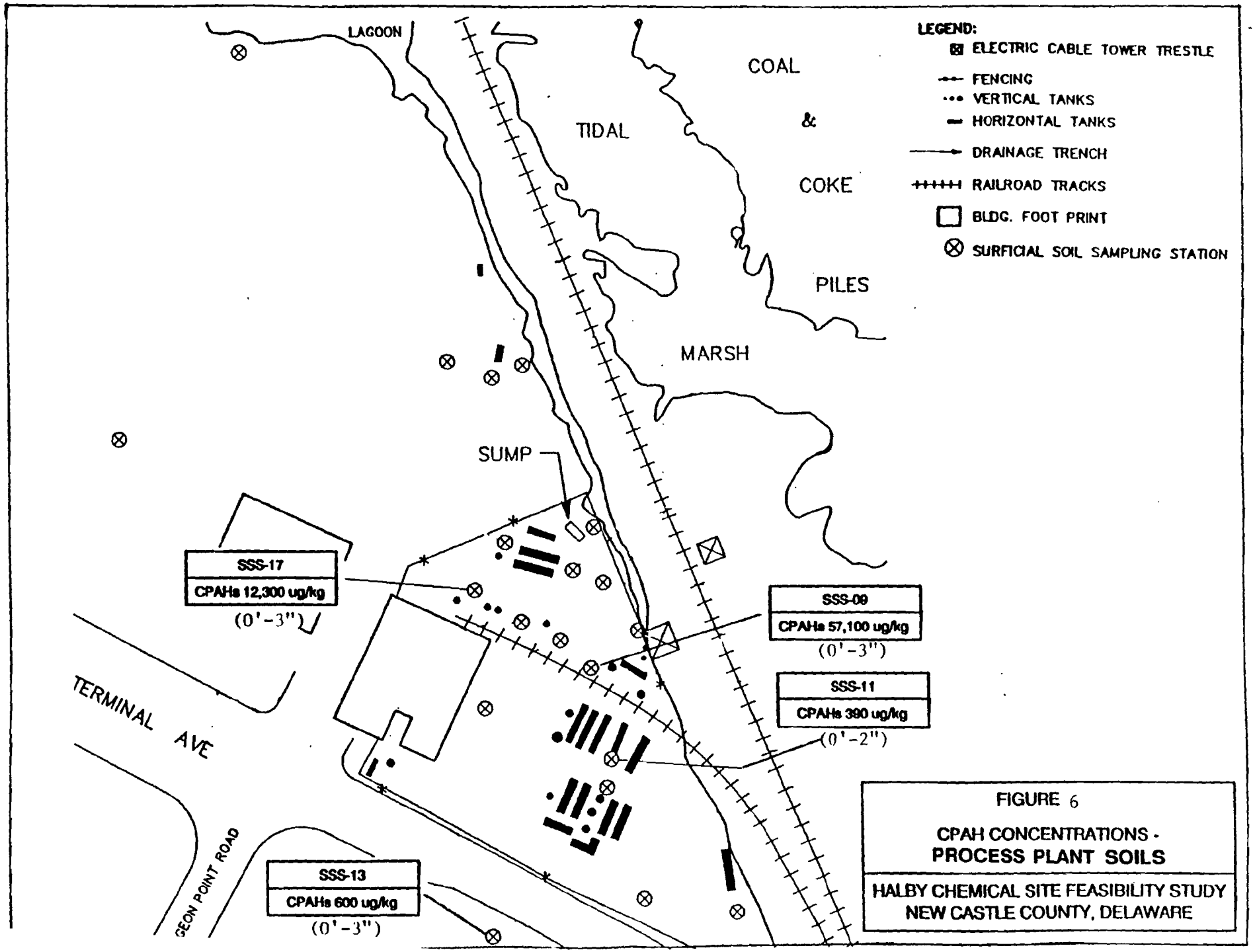

FIGURE 6

CPAH CONCENTRATIONS - PROCESS PLANT SOILS

HALBY CHEMICAL SITE FEASIBILITY STUDY
NEW CASTLE COUNTY, DELAWARE

and 1,200 ug/kg), pyrene (66,000 and 9,000 ug/kg), benzo(a)anthracene (19,000 and 4,000 ug/kg), chrysene (22,000 and 3,800 ug/kg), benzo(b)fluoranthene (12,000 and 3,900 ug/kg), benzo(k)flouranthene (11,000 and 2,500 ug/kg), and benzo(a)pyrene (7,900 and 2,100 ug/kg) were also detected at SSS-09 and near the gate at SSS-17, respectively. Benzo(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(a)pyrene, and indeno(1,2,3-cd)pyrene are carcinogenic.

2-Methyl-naphthalene (1,200 ug/kg), phenanthrene (2,100 ug/kg), and pyrene (2,200 ug/kg) were also detected as SSS-19. Bis(2-ethylhexyl) phthalate was detected as SSS-19 as well, at a concentration of 24,000 ug/kg. Di-n-butylphthalate (460 ug/kg) was the only SVOC detected at SSS-01. At SSS-11, bis(2-ethylhexyl)phthalate (1,200 ug/kg) was the only SVOC detected. These two compounds were also detected at SSS-10, in concentrations of 500 and 1,700 ug/kg and at SSS-20 in concentrations of 2,300 and 11,000 ug/kg, respectively.

The SVOCs identified within the process plant area are not considered to be wide-spread site contaminants because of their isolated locations. Sixteen of the identified SVOCs (including six carcinogenic compounds) were, however, identified at SSS-09; while fourteen were identified at SSS-17. These areas may have experienced localized spills.

d. Additional Parameters - Total cyanide, free cyanide, and thiocyanate, were analyzed for during Phase I sampling. Phase II samples were analyzed for thiocyanate only. Total cyanide was found in the process plant area at stations SSS-09, SSS-11, and SSS-12 in concentrations of 40, 15, and 35.1 mg/kg, respectively. These stations are located adjacent to one another within the southern tank area of the Plant. No associated in-plant free cyanide or thiocyanate contamination was detected in Phase I samples.

6. SUMMARY OF SITE RISKS

A Risk Assessment was prepared by the Environmental Protection Agency (EPA) to assess the potential health effects that may result from exposure to contaminants within the process plant area of the Halby Chemical Site (Operable Unit 1). The environmental risks associated with exposure to the wastes found at the site are fully evaluated in the Biological Assessment in the RI Report, Appendix E of the FS, and in the Analytical Chemistry and Solid Phase Toxicity Bioassay Report of April 1991. There are no risks to the environment within the process plant area of the site. Areas where environmental risks exist will be addressed in Operable Unit 2 for the site. All of the referenced reports can be found in the Administrative Record for the Halby Chemical Site. Based on the EPA risk assessment it has been concluded that actual or threatened releases from Operable Unit 1, if not addressed by implementing the response action selected in

this ROD, may present an imminent and substantial endangerment to public health and welfare.

a. Contaminant Identification Information - The media of concern in Operable Unit 1 is soil contamination within the process plant area. The concentration of the chemicals of concern on which the risk assessment was based is the reasonably most exposed (RME) concentration. The RME is a calculated level of contamination which is the upper 95th percent of confidence level. The contaminants of concern and their respective RME concentrations are presented in Table 4. Mercury, nickel, zinc and carbon disulfide were initially considered to be contaminants of concern, however, results of the calculations for noncarcinogenic health threats support the decision that they should not be considered further as shown in Table 7. They were therefore eliminated from the list of contaminants of concern.

b. Exposure Assessment - As the primary current use of the site is for industrial purposes, and the potential for site access by casual trespassers is quite limited, the most likely potential route of exposure under current conditions is exposure to the workers in the course of their day-to-day activities. Current and future-use exposure pathways for Operable Unit 1 are summarized as follows:

Exposure Pathway	Exposed Population(s)
1. Current Site Land Use	
• Ingestion of dusts and soils containing arsenic and CPAHs	Workers at Halby Site
• Inhalation of dusts and soils containing arsenic, chromium and CPAHs	Workers at Halby Site
• Dermal absorption of CPAHs from soils that adhere to the skin	Workers at Halby SIte
2. Future Site Land Use (Construction Excavation)	
• Ingestion of dusts and soils containing arsenic	Workers at Halby Site
• Inhalation of dusts and soils containing arsenic	Workers at Halby Site

It is expected that onsite workers may experience direct contact with surface and shallow subsurface soil as part of their normal duties. Activities which would involve such exposures could include grading, maintenance and normal housekeeping activities. Exposures could be both through direct dermal contact and incidental ingestion

Table 4

CONTAMINANTS OF CONCERN IN PROCESS PLANT AREA (OU1)

HALBY CHEMICAL SITE

INORGANICS	RME (mg/kg)
Arsenic	412
@ 4 ft	872
@ 6 ft	282
@ 10 ft	265
Chromium	170
ORGANICS	
Pyrene	17,861
Benzo(a)anthracene	5,334
Chrysene	6,051
Benzo(b)fluoranthene	3,597
Benzo(k)fluoranthene	3,155
Benzo(a)pyrene	2,337

occurring due to such activities as smoking or eating at the site without washing soiled hands.

Since the majority of the site is not vegetated, it is to be expected that airborne particulates will be generated due to the action of wind, excavation and construction activities (future use scenario), and surface disturbance by vehicles. Inhalation of airborne particulates by onsite workers is therefore likely to occur. Inhalation of site-associated particulates is less likely to be significant for off-site receptors (residents) because of the distances to the nearest residences, and obstacles between the site and the residences (the cement works and the I-495 embankment) that would increase the rate of particle deposition.

To calculate the risks to on-site workers at the Halby Chemical Site certain exposure assumptions were made based on human activity patterns. Assumptions common to all evaluated scenarios are the human lifetime set at 70 years, body weight set at 70 kg, exposure frequency set at 250 events/year and the averaging time set at 25,550 days in 70 years. Other assumptions for each exposure scenario are as follows.

INGESTION
- Amount of Soil Ingested per day = 50 mg
- Exposure Duration
  = 25 years under the current use scenario
  = 1 year under the future use scenario

INHALATION
- Inhalation Rate = 0.83 m^3/hr
- Exposure Time = 8 hrs/day
- Exposure Duration
  = 25 years under the current use scenario
  = 1 year under the future use scenario

DERMAL CONTACT
- Skin Surface Area in Contact = 3,120 cm^2/event
- Soil to Skin Adherence Factor = 1.45 mg/cm^2
- Exposure Duration = 25 years

The Cowherd Model was used in calculating risks present in the inhalation pathway of exposure. A brief summary of assumptions used in this model are as follows:

- Models the transport of respirable particles;
- Assumes that the contamination is distributed uniformly over the facility;
- Employs dispersion modeling that accounts for concentrations at the breathing height;
- Makes steady state assumptions indicating that the contaminant source is never depleted; and

- Concentration of contaminants in the respirable particles is the same as that of the bulk phase soils.

c. **Toxicity Assessment** - Cancer potency factors (CPFs) have been developed by EPA's Carcinogenic Assessment Group for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals (Table 5). CPFs, which are expressed in units of $(mg/kg\text{-}day)^{-1}$, are multiplied by the estimated intake of a potential carcinogen, in mg/kg-day, to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upper bound" reflects the conservative estimate of the risks calculated from the CPF. Use of this approach makes underestimation of the actual cancer risk highly unlikely. Cancer potency factors are derived from the results of human epidemiological studies or chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied.

Reference doses (RfDs) have been developed by EPA for indicating the potential for adverse health effects from exposure to chemicals exhibiting noncarcinogenic effects (Table 5). RfDs, which are expressed in units of mg/kg-day, are estimates of lifetime daily exposure levels for humans, including sensitive individuals, that is not likely to be without an appreciable risk of adverse health effects. Estimated intakes of chemicals from environmental media (e.g., the amount of a chemical ingested from contaminated drinking water) can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans). These uncertainty factors help ensure that the RfDs will not underestimate the potential for adverse noncarcinogenic effects to occur.

d. **Risk Characterization Summary**

Cancer Risks - Excess lifetime cancer risks are determined by multiplying the intake level with the cancer potency factor. These risks are probabilities that are generally expressed in scientific notation (e.g., $1x10^{-6}$ or 1E-6). An excess lifetime cancer risk of $1x10^{-6}$ indicates that, as a plausible upper bound, an individual has a one in one million chance of developing cancer as a result of site-related exposure to a carcinogen over a 70 year lifetime under the specific exposure conditions at a site.

The results of the risk assessment for the site indicated that chemical exposures through the aforementioned exposure pathways may be associated with cancer risks which achieve or exceed EPA's target risk range of 10^{-6} to 10^{-4}. The primary contaminant of concern at the Halby Chemical Site is arsenic although the broad spectrum of CPAHs also elicit some notable cancer risk. The carcinogenic risks for each contaminant of concern for each exposure pathway are presented in Table 6.

Table 5

TOXICITY PARAMETERS FOR CONTAMINANTS OF CONCERN
IN PROCESS PLANT AREA (OU1)

HALBY CHEMICAL SITE

Compound	CPF^0 $(mg/kg/day)^{-1}$	CPF^i $(mg/kg/day)^{-1}$	RfD^0 (mg/kg/day)
Arsenic	1.75	5×10^1	1×10^{-3}
Chromium*	4.1		5×10^{-3}
Carbon Disulfide			1×10^{-1}
Pyrene	9.32×10^{-1}	4.94×10^{-1}	
Benzo(a)anthracene	1.67	8.84×10^{-1}	
Chrysene	5.06×10^{-2}	6.77	
Benzo(b)fluoranthene	1.61	8.54×10^{-1}	
Benzo(k)fluoranthene	7.59×10^{-1}	4.03×10^{-1}	
Benzo(a)pyrene	1.15×10^{-1}	6.10	

CPF^0 - Cancer Potency Factor for oral exposure.

CPF^i - Cancer Potency Factor for inhalation exposure.

RfD^0 - Reference Dose for oral exposure, noncarcinogenic effects.

* Chrome VI potency factor used although most soil chromium is the noncarcinogenic chrome III (conservative approach).

Table 6

INCREMENTAL CANCER RISKS BY EXPOSURE PATHWAYS

PROCESS PLANT AREA (OU1)
HALBY CHEMICAL SITE

I. CURRENT USE SCENARIO

A. The Incidental Oral (Ingestion) Exposure Route

CONTAMINANT	RME CONC. ug/kg	CDI mg/kg/day	CANCER POT.FACT.	INCRE. CANC.RISK
ORGANICS (PAHs):				
Pyrene	17861	3.1E-06	9.32E-01	3E-06
Benzo(a) anthracene	5334	9.3E-07	1.67E+00	2E-06
Chrysene	6051	1.1E-06	5.06E-02	6E-08
Benzo(b) fluoranthene	3597	6.3E-07	1.61E+00	1E-06
Benzo(k) fluoranthene	3155	5.5E-07	7.59E-01	4E-07
Benzo(a)pyrene	2337	4.1E-07	1.15E+01	5E-06
PAH Total Incre. Cancer Risk ...1E-05				
INORGANICS:				
Arsenic	4.12E+05	7.2E-05	1.75E+00	1.3E-04

Table 6 (cont)

B. The Inhalation of Airborne Particulates Exposure Route

CONTAMINANT	RME CONC. ug/kg	CDI mg/kg/day	CANCER POT.FACT*	INCRE. CANC.RISK
Carbon Disulfide**				
Pyrene	17861	6.3E-07	4.94E-01	3E-07
Benzo(a) anthracene	5334	1.8E-07	8.84E-01	2E-07
Chrysene	6051	2.1E-07	6.77E+00	1E-06
Benzo(b) fluoranthene	3597	1.3E-07	8.54E-01	1E-07
Benzo(k) fluoranthene	3155	1.1E-07	4.03E-01	4E-08
Benzo(a)pyrene	2337	8.3E-08	6.10E+00	5E-07
		Total Incre. Cancer Risk =		2E-06
Arsenic	4.12E+05	1.46E-05	5.00E+01	7.3E-04
Chromium	1.70E+05	6.03E-06	4.10E+01	2.5E-04

* Inhalation potency factors in mg/kg/day

** Carbon Disulfide is not considered to be a carcinogen by the Agency

Table 6 (cont)

C. The Dermal Absorption Exposure Route

CONTAMINANT	RME CONC. ug/kg	CDI mg/kg/day	CANCER POT.FACT.	INCRE. CANC.RISK
PYRENE	17861	2.8E-05	9.32E-01	3E-05
Benzo(a) anthracene	5334	8.4E-06	1.67E+00	1E-05
Chrysene	6051	9.6E-06	5.06E-02	5E-07
Benzo(b) fluoranthene	3597	5.7E-06	1.61E+00	9E-06
Benzo(k) fluoranthene	3155	5.0E-06	7.59E-01	4E-06
Benzo(a)pyrene	2337	3.7E-06	1.15E+01	4E-05
			TOTAL	9E-05

Table 6 (cont)

II. FUTURE USE SCENARIO

A. The Incidential Oral (Ingestion) Exposure Route

ARSENIC

DEPTH	RME	CDI(mg/kg/d)	CAN. POT. FACT.	INCRE.RISK
4'0"	874	6.1E-06	1.75E+00	1E-05
6'0"	282	1.9E-06	1.75E+00	3E-06
10'0"	265	1.8E-06	1.75E+00	3E-06

B. The Inhalation of Airborne Particulates Exposure Route

ARSENIC

DEPTH	RME	CDI(mg/kg/d)	CAN. POT. FACT.	INCRE.RISK
4'0"	872 -	1.2E-06	5.0E+01	6E-05
6'0"	282	3.9E-07	5.0E+01	2E-05
10'0"	265	3.7E-07	5.0E+01	2E-05

The risk assessment for various exposure scenarios indicated that the soil at the Halby Chemical Site poses a potential risk to human health (expected value of cancer risk $>10^{-6}$). The current use pathway poses excess cancer risks greater than 10^{-4}. Remedial action is generally warranted at a site when the cancer risk is determined to be above the upper bound of the risk range identified in the National Contingency Plan (10^{-6} to 10^{-4}).

The exposure pathways and expected excess cancer risks are presented below:

Exposure Pathway	Expected Excess Cancer Risk
1. Current Site Land Use:	
• Ingestion of dusts and soils containing:	
arsenic.....	1.3×10^{-4}
CPAHs.....	1×10^{-5}
Total.....	1.4×10^{-4}
• Inhalation of dusts and soils containing:	
arsenic.....	7.3×10^{-4}
chromium.....	2.5×10^{-4}
CPAHs.....	2×10^{-6}
Total.....	9.82×10^{-4}
• Dermal Absorption of CPAHs from Soils that adhere to skin.....	9×10^{-5}
TOTAL CANCER RISKS.....	1.2×10^{-3}
2. Future Site Land Use:	
• Ingestion of dusts and soils containing arsenic.....	1×10^{-5} @ 4 feet
• Inhalation of dusts and soils containing arsenic.....	6×10^{-5} @ 4 feet
TOTAL CANCER RISKS.....	7×10^{-5} @ 4 feet

Arsenic elicits an incremental cancer risk of a calculated 1.3×10^{-4} over a lifetime by the incidental ingestion route and an incremental risk of 7.3×10^{-4} by the inhalation route for a combined incremental risk of about 8.6×10^{-4} to the workers at the process plant area. This rounds off to a 1.0×10^{-3} incremental cancer risk

from arsenic located in surface soils. Any future health threats are from arsenic exposure during operations that involve the digging into buried contamination. The incidental ingestion pathway could cause an incremental exposure of as much as 1×10^{-5} while the inhalation pathway could cause an additional 6×10^{-5} cancer risk.

The cleanup goal for arsenic will be set at its background level, however, the background value of 10 ppm for arsenic is based on a limited number of samples at the Halby Chemical Site. Existing EPA guidance suggests that additional samples are necessary in order to determine a statistically representative background value for arsenic. This additional sampling will be used to determine the value which will be used as the cleanup criteria for arsenic. Setting the cleanup goal for arsenic in soils at background would be practicable and the excess cancer risk will be sufficiently reduced for protection of human health.

If the RME soil levels of chromium are assumed to be the hexavalent form (which is highly unlikely) there is an incremental cancer risk of 2.5×10^{-4} by the inhalation pathway. The soil chromium is very likely to be in the relatively harmless and noncarcinogenic trivalent form, however, this should be confirmed in the field.

The wide spectrum of CPAHs elicits about a 1×10^{-5} incremental cancer risk to the workers over a lifetime by the incidental ingestion pathway, but a 9×10^{-5} incremental cancer risk by the dermal absorption pathway (close to a 10^{-4} risk). The inhalation of airborne particles contaminated with CPAHs only elicits a risk of 2×10^{-6} additional cancers. When all exposure pathways are added, CPAHs contribute about a 1×10^{-4} incremental cancer risk to the workers.

A cleanup goal for CPAHs in soils will be set at background. This cleanup standard would be practicable and would result in residual cancer risks of less than 10^{-4}, however, the background value of 1.2 ppm is based on a limited number of samples. EPA guidance suggests that additional samples are necessary in order to determine a statistically representative background value for CPAHs at the Halby Chemical Site. This additional sampling will be used to determine the value which will be used as the cleanup criteria for CPAHs.

Noncarcinogenic Effects - Potential concern for noncarcinogenic effects of a single contaminant in a single medium is expressed as the hazard quotient (HQ) which is the ratio of the estimated intake derived from the contaminant concentration in a given medium to the contaminant's reference dose. By adding the HQs for all contaminants within a medium or across all media to which a given population may reasonably be exposed, the Hazard Index (HI) can be generated. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or across media.

Noncancerous threats as demonstrated in Table 7 by the hazard quotients for arsenic and chromium were not particularly notable and summed to a hazard index of 0.13 suggesting that the combined concentrations of these elements is about 13% of that necessary to constitute a threat to the workers. The widespread carbon disulfide does not present any notable risk to the workers at this facility.

Table 8 presents the future noncancerous toxic hazard calculation results for exposure to buried arsenic. The depths assessed, RMEs utilized, and calculated daily intakes (CDI) are the same as those used for the ingestion pathway under the future use scenario in Table 6. It should be noted that arsenic is both a carcinogen and a noncancerous threat. All other future risks and noncarcinogenic hazards would be trivial.

Environmental Risks - There are no critical habitats, endangered species or habitats of endangered species affected by site contaminants within the process plant area. Areas where environmental risks exist will be addressed in Operable Unit 2 for the site.

7. DESCRIPTION OF ALTERNATIVES

Prior to discussing the alternatives for Operable Unit 1 it should be stated that there are no Federal or State of Delaware chemical-specific ARARs which establish a cleanup action level for contaminated soil at the Halby Chemical Site. The cleanup levels for Operable Unit 1 will therefore be established based on the aforementioned current and future risk values taking into account the background levels of contaminants found in the area of the site. Based on a limited number of samples at the Halby Chemical Site background levels were established as follows:

- Arsenic - background is approximately 10 ppm on average
- CPAHs - background is approximately 1.2 ppm on average

Existing EPA guidance suggests that additional samples are necessary in order to determine a statistically representative background value for both arsenic and CPAHs. This additional sampling will be used to determine the value which will be used as the cleanup criteria for arsenic and CPAHs.

The following alternatives for Operable Unit 1 were evaluated in detail in the Feasibility Study to determine which would be most effective in achieving the goals of CERCLA, and in particular, achieving the remedial action objectives for the site. The detailed analysis of remedial alternatives for Operable Unit 1 are described

Table 7

NONCARCINOGENIC TOXIC HEALTH THREATS
HAZARD QUOTIENT AND HAZARD INDEX CALCULATIONS

CURRENT USE SCENARIO

PROCESS PLANT AREA (OU1)
HALBY CHEMICAL SITE

	RME (mg/kg of soil)	CDI(mg/kg/day)	RfD(mg/kg/d)	HQ
Arsenic	412	7.2E-05	1.0E-03	0.07
Chromium	170	2.9E-05	5.0E-03	0.06
Lead	309**			
Mercury	14	2.5E-06	2.0E-03	0.001*
Nickel	62	1.0E-05	2.0E-02	5E-04*
Zinc	1461	2.5E-04	2.0E-01	0.001*
Carbon Disulfide	16	2.5E-05	1.0E-01	3E-04*

Hazard Index (HI) = 0.13

(Note: noncarcinogenic toxic impacts from PAH compounds are too minuscule to warrant consideration in this table)

Note:
This Hazard Index indicates that these contaminants elicit a non-carcinogenic chronic toxic threat that is about 13 percent of the magnitude that could be a concern.

* These contaminants were determined to be present at concentrations that provoked a hazard quotient that is less than 0.01. Therefor they are not contaminants of concern, but since they were commonly detected these results are provided to support the decision that they should not be considered further.

** Since there is no RfD for lead this element is assessed by comparing both its arithmetic average (273 ppm) and RME (309) with the CDC recommendation of a 500 to 1000 ppm criterion for industrial areas. This would suggest that lead does not constitute a health threat to the workers at this facility.

Table 8

NONCARCINOGENIC THREATS FROM
EXPOSURES TO ARSENIC-CONTAMINATED SOILS

FUTURE USE SCENARIO

PROCESS PLANT AREA (OU1)
HALBY CHEMICAL SITE

DEPTH	RME	CDI(mg/kg/d)	RfD	Hazard Quotient
4'0"	872	6.1E-06	1.0E-03	6E-03
6'0"	282	1.9E-06	1.0E-03	2E-03
10'0'	265	1.8E-06	1.0E-03	2E-03

below. The alternatives are numbered to correspond with the numbers in the RI/FS Report. The cost and implementation times presented with each alternative are estimates and should be used for comparative purposes only. The implementation times are for construction of the alternative and do not include any time for pre-design or design activities.

a. **Alternative S-1: No Action**

Capital Costs:	$40,000
Annual O&M	38,000
Present Worth:	655,000
Months to Implement:	1

The no action alternative for the contaminated soil is the baseline alternative for comparison with the other alternatives. Under this alternative, no action would be taken to remediate the contaminated soil at the site. The no action alternative provides for long-term monitoring and site reviews every five years. Long-term monitoring of the site would examine the soils, sediment and surface water contaminants. The program would identify any changes in the site conditions which could pose an increase in the risk from the site. This monitoring program would include annual visual site inspections with sampling and analysis of areas that are suspect. Because this alternative does not entail contaminant removal, the site would have to be reviewed every five years as called for in the Superfund Amendments and Reauthorization Act (SARA).

The long-term monitoring program is designed to monitor the process plant and the lagoon and would include the following:

1. Surface water samples would be collected from locations, as indicated in Figure 7. The samples would be analyzed for volatile organics, Target Analyte List (TAL) compounds, ammonia, nitrate, cyanide, and thiocyanate.
2. Sediment samples would be collected from locations, as indicated in Figure 8. The sediment samples would be analyzed for full TCL and TAL, ammonia, nitrate, cyanide, and thiocyanate.
3. A visual site inspection would be performed to note any changes from the previous inspection.
4. The analytical and inspection results would be tabulated in a report for review by the State of Delaware and EPA.

This long-term monitoring program would be performed annually for up to 30 years. Remediation of groundwater would be addressed under Operable Unit No. 2 for the Halby Chemical Site. Groundwater samples are therefore not included in the long-term monitoring program described here.

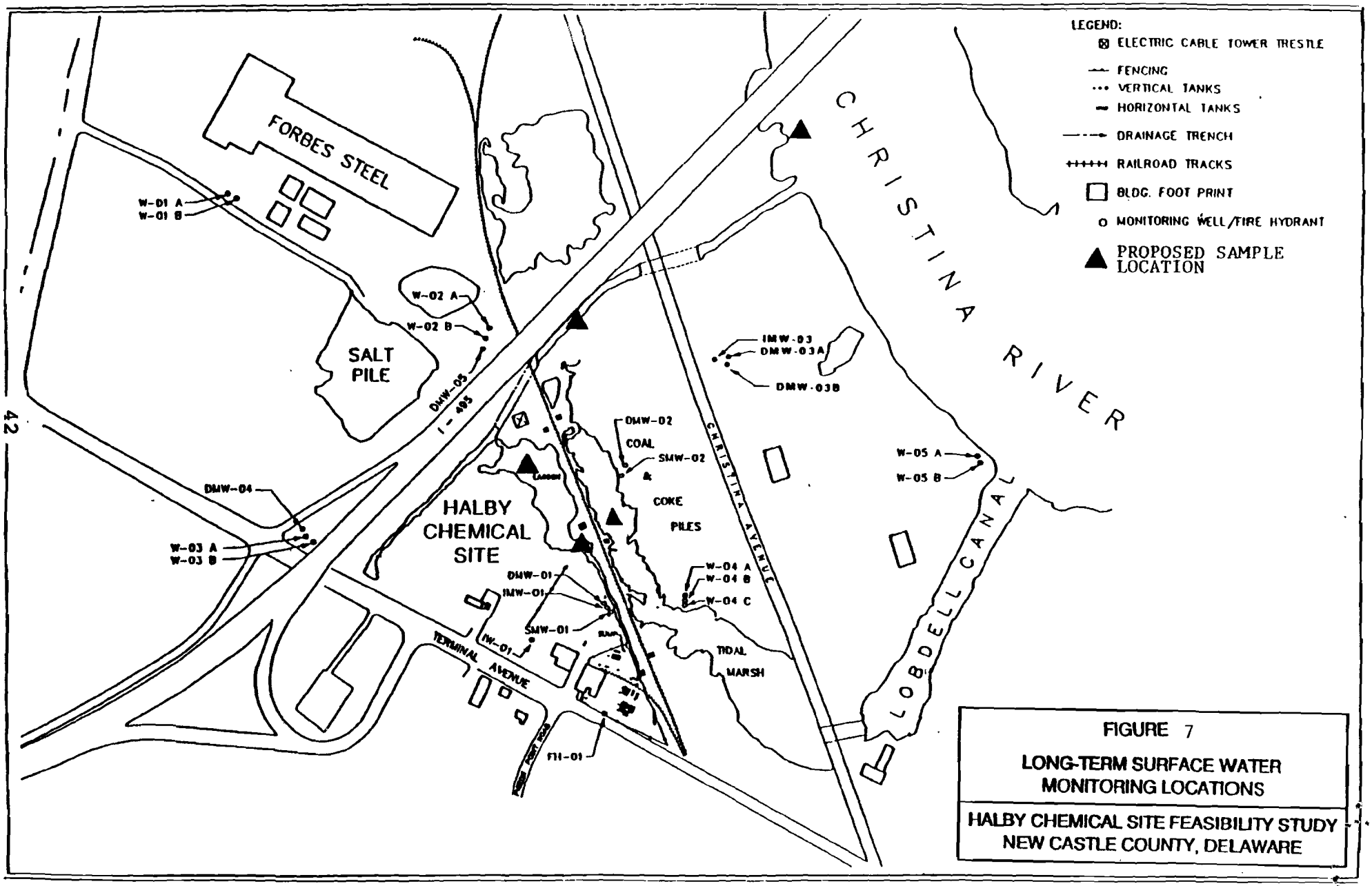

FIGURE 7

LONG-TERM SURFACE WATER MONITORING LOCATIONS

HALBY CHEMICAL SITE FEASIBILITY STUDY
NEW CASTLE COUNTY, DELAWARE

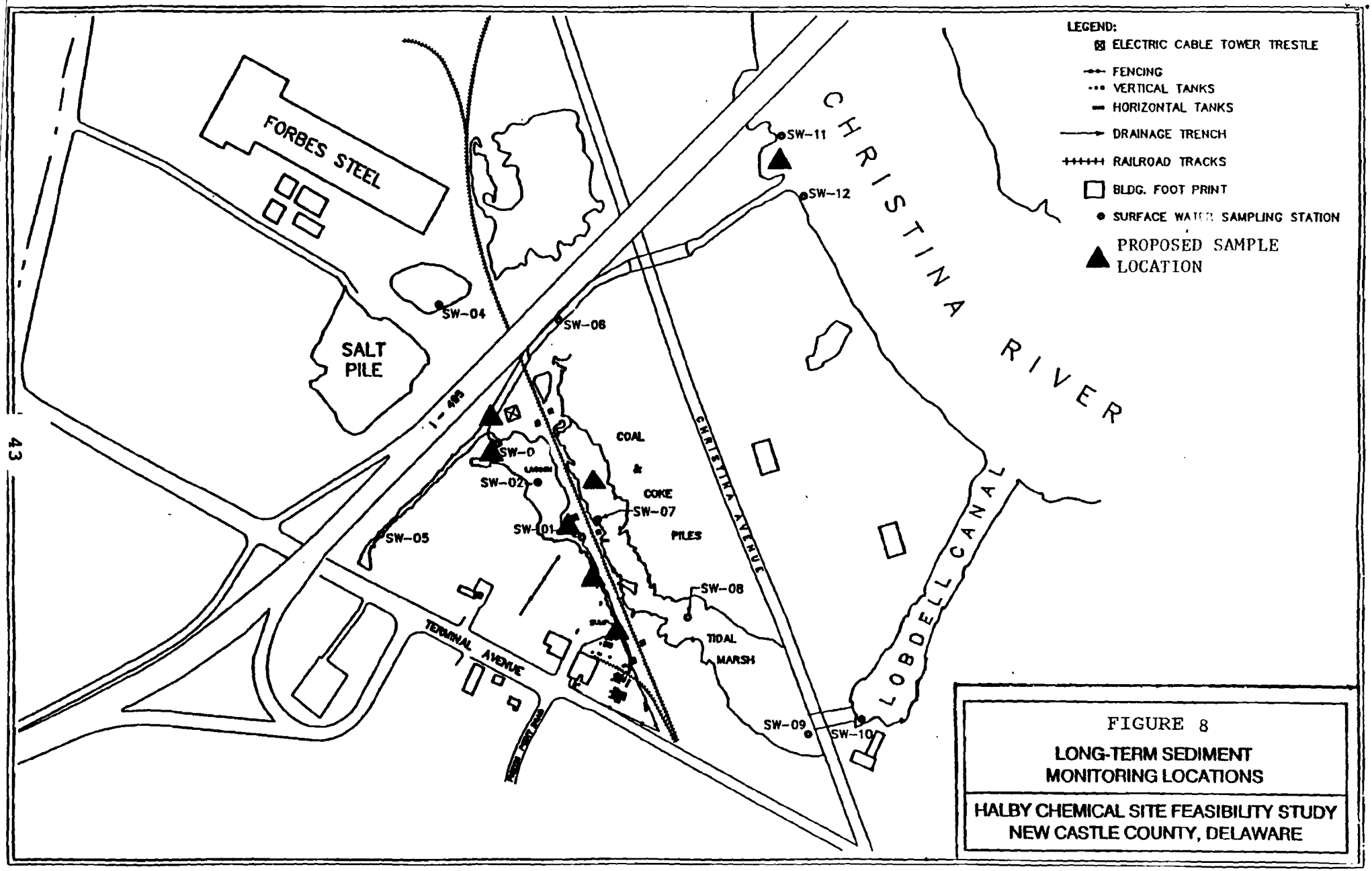

FIGURE 8

LONG-TERM SEDIMENT MONITORING LOCATIONS

HALBY CHEMICAL SITE FEASIBILITY STUDY
NEW CASTLE COUNTY, DELAWARE

Although the NCP requires EPA to consider the no-action alternative, it would not be protective of human health since it does not meet the aforementioned health-based cleanup goals. The process plant area is not located in the 100-year floodplain and is not a wetland. There are no known endangered species living inside the plant area. There are no data to indicate that the process plant area contains any sites which may be considered to be of historic or archeological significance. Thus, there are no location-specific ARARs associated with this portion of the site. Monitoring would be conducted according to OSHA Health and Safety Standards. There are no other action-specific ARARs applicable to Alternative S-1. All action-specific ARARs for Operable Unit 1 are listed in Table 9.

b. **Alternative S-2: Limited Action**

Capital Costs:	$70,000
Annual O&M:	39,000
Present Worth:	696,000
Months to Implement:	1

The major work items associated with this alternative are as follows:

- Upgrade the existing perimeter fence and install warning signs;
- Establish institutional controls to limit the use of contaminated areas and groundwater;
- Monitor with site inspections and long-term monitoring program to determine changes in site conditions and their effects on the risks associated with the area;
- Conduct public education programs by means of meetings, presentations, or workshops to increase public awareness of the site conditions; and
- Perform site reviews every five years.

The limited action alternative for the contaminated soil at the process plant area would not include any containment or treatment to remediate the site soil. For this alternative, deed restrictions, public education, fencing and long-term monitoring are used to reduce the potential hazards at the Halby Chemical site. The deed restrictions would be imposed for the entire site to limit or restrict groundwater uses, excavation in areas of subsurface soil contamination, and cross contamination of the lower Potomac aquifer by improper installation of deep wells in the area. Public education programs would be established to inform all interested parties of the conditions existing at the site. Site access would be restricted by improvement of the existing fence and placement of warning signs around the area. Long-term monitoring of the site (as described in

Table 9

ACTION-SPECIFIC ARARS FOR SOIL
OPERABLE UNIT 1
HALBY CHEMICAL SITE

ARARS	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARS
A. Common to all alternatives:			
OSHA-General Industry Standards (29 CFR 1910)	Applicable	These regulations specify the 8-hour time-weighted average concentration for worker exposure to various organic compounds. Training requirements for workers at hazardous waste operations are specified in 29 CFR 1910.120.	Proper respiratory equipment will be worn if it is not possible to maintain the work atmosphere below these concentrations.
OSHA-Safety and Health Standards (29 CFR 1926)	Applicable	This regulation specifies the type of safety equipment and procedures to be followed during site remediation.	All appropriate safety equipment will be on-site and appropriate procedures will be followed during treatment activities.
OSHA-Record Keeping, Reporting and Related Regulations (29 CFR 1904)	Applicable	This regulation outlines the record keeping and reporting requirements for an employer under OSHA.	These regulations apply to the company(s) contracted to install, operate, and maintain the remedy.
RCRA-Standards for Owners/Operators of Permitted Hazardous Waste Facilities (40 CFR 264.10-264.18)	Relevant And Appropriate	General facility requirements outline general waste analysis, security measures, inspections, and training requirements.	Facility will be designed, constructed, and operated in accordance with this requirement. All workers will be properly trained.
RCRA-Preparedness and Prevention (40 CFR 264.30-264.31)	Relevant And Appropriate	This regulation outlines the requirements for safety equipment and spill control.	Safety and communication equipment will be installed at the site. Local authorities will be familiarized with the site.
RCRA-Contingency Plan and Emergency Procedures (40 CFR 254.50-264.56)	Relevant And Appropriate	This regulation outlines the requirements for emergency procedures to be used following explosions, fires, etc.	Plans will be developed and implemented during remedial design. Copies of the plans will be kept on-site.
DNREC Regulations Covering Hazardous Substances Cleanups (Part IX, Ch.91 Sec 9101-9120)	Relevant And Appropriate	Requires prompt containment and removal of hazardous substances to eliminate or minimize the risk to public health or welfare or the environment.	Hazardous substances will be contained or removed promptly.

Table 9 (cont)

ARARS	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARS
B. Off-Site Disposal:			
Waste Transportation:			
DOT Rules for Transportation of Hazardous Material (49 CFR Parts 107, 171.1-172.558)	Applicable	This regulation outlines procedures for the packaging, labeling, manifesting, and transporting of hazardous materials.	This regulation will be applicable to any company contracted to transport hazardous material from the site.
Standards Applicable to Transporters of Hazardous Waste - RCRA Section 3003, 40 CFR 262 and 263, 40 CFR 170 to 179	Applicable	Establishes the responsibility of off-site transporters of hazardous waste in the handling, transportation, and management of the waste. Requires a manifest, recordkeeping, and immediate action in the event of a discharge of hazardous waste.	This regulation will be applicable to any company contracted to transport hazardous material from the the site.
DHWR - Part 263, Standards Applicable Transporters of Hazardous Waste	Applicable	The Delaware Department of Natural Resources and Environmental Control (DNREC) has adopted certain DOT regulations governing the transport of hazardous materials.	This regulation will be applicable to any company contracted to transport hazardous material from the site.
Disposal:			
RCRA Land Disposal Restrictions (40 CFR 268, Subpart D)	Applicable	After November 8, 1988, movement of of excavated materials to new location and placement in or on land would trigger land disposal restrictions (for non-CERCLA actions). CERCLA actions became regulated under this requirement on November 8, 1990.	If soil and sediment are RCRA wastes, the excavated material will be properly disposed or treated as required by the regulations.
EPA Administered Permit Program: The Hazardous Waste Permit Program RCRA Section 3005, 40 CFR 270, 124	Applicable	Covers the basic permitting, application, monitoring and reporting requirements for off-site hazardous waste management facilities.	Any off-site facility accepting hazardous waste from the site must be properly permitted. Implementation of the alternative will include consideration of requirements.
Delaware Regulations Governing Solid Waste (DNREC)	To Be Considered	Delaware program to properly manage solid waste storage, collection, transfer, and disposal by obtaining a permit.	This regulation may be applied to the disposal of debris on-site.

Table 9 (cont)

ARARS	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARS
C. Excavation and/or Stabilization:			
CAA- NAAQS for Total Suspended Particulates (40 CFR 129.105, 750)	Relevant And Appropriate	This regulation specifies maximum and secondary 24-hour concentrations for particulate matter. Fugitive dust emissions from site excavation activities must be maintained below 260 ug/m^3 (primary standards).	Proper dust suppression methods such as water spray would be specified when implementing excavation and/or stabilization actions.
40 CFR 262: RCRA	Applicable	Establishes standards for generators of hazardous wastes including waste determination, manifests, and pre-transport requirements.	This regulation will be applicable upon excavation and on-site storage of site wastes.
40 CFR 261: RCRA	Applicable	Hazardous Waste determination.	Wastes will be compared to Federal Register listing to determine if they are listed or characteristic wastes.
40 CFR 264: Subpart L	Applicable	Provides requirements to design and operate waste piles.	Performance standards would be specified for compliance.
40 CFR 264: RCRA	Relevant And Appropriate	Requires owner/operator to control wind disposal of particulate matter.	Fugitive dust emissions will be controlled during implementation to maintain concentrations below these levels.
40 CFR 50: NAAQS	Applicable	Provides air quality standards for particulate matter and lead.	Same as below.
DNREC-Regulations Governing the control of Air Pollution (Regulation Nos. 2, 3, 6 and 21)	Relevant And Appropriate	Details the required permits, ambient air quality, allowable dust control during excavation activities and emission standards.	Proper dust suppression methods and monitoring will be required when implementing excavation and/or stabilization actions.
DNREC-Environmental Control (Part VII, Ch. 60, Sec. 6003)	Relevant And Appropriate	Requires a permit if any contaminants are discharged to the air, surface water or groundwater.	Practices will be followed to reduce potential emissions. If discharges are anticipated, an application for a permit will be submitted.
DHWR-Chemical, Physical and Biological Treatment (Subpart Q, Section 265.400-404)	Relevant And Appropriate	Outlines operating requirements, analysis and trail tests, inspections and closures for hazardous waste treatment processes.	Required waste analysis, trail tests, inspections, closures and operation procedures will be used during stabilization treatment.

Table 9 (cont)

ARARS	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARS
DNREC - Delaware Erosion and Sediment Control Handbook for Development (1989) and Delaware's Erosion and Sediment Control Law (Chapter 40, Title 7, Delaware Code)	Relevant And Appropriate	Outlines Delaware Erosion and Sediment Control Law Regulations and practices to minimize erosion.	Recommended practices will be followed during excavation. An erosion and sediment control plan will be submitted for review and approval to comply with state erosion and sediment control requirements for land-disturbing activities.
D. Closure: (For Alternative S-5 only)			
Clean Closure:			
RCRA-General Standards (40 CFR 264.111)	Relevant And Appropriate	General performance standard requires minimization of need for further maintenance and control; minimization or elimination of post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products. Also requires disposal or decontamination of equipment, structures, and soils.	Proper design considerations will be implemented to minimize the need for future maintenance.
RCRA-Manifesting, Recordkeeping and Applicable Reporting (40 CFR 264.70-264.77)	Applicable	This regulation specifies the recordkeeping and reporting requirements for RCRA facilities.	Requirement will be followed during closure.
DHWR-Closure and Post-Closure (Subpart G, Sections 264.110-264.120)	Relevant And Appropriate	This regulation details state closure requirements including performance standards, closure plans, disposal or decontamination of equipment and post-closure plans and uses.	State requirements will be followed to ensure compliance.
E. Capping (Waste In Place):			
RCRA-Landfills (40 CFR 264.310(a))	Relevant And Appropriate	Placement of a cap over waste requires a cover designed and constructed to: - Provide long-term minimization of migration of liquids through the capped area; - Function with minimum maintenance; - Promote drainage and minimize erosion or abrasion of the cover;	Design considerations will include all requirements.

Table 9 (cont)

ARARS	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARS
		- Accommodate settling and subsidence so that the cover's interity is maintained; - Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoil present.	
RCRA-General Standards (40 CFR 264.117(c))	Relevant And Appropriate	Restricts post-closure use of property as necessary to prevent damage to the cover.	Post-Closure uses will be limited to those that will not damage the cover.
CAA-NAAQS for Particulate Matter Less than 10 Microns in Diameter (40 CFR Part 60, Appendix J)	Relevant And Appropriate	This regulation specifies annual arithmatic mean and maximum 24-hour concentrations for particulate matter.	Proper dust suppression methods will be employed to keep concentrations below regulations.
CAA-NAAQS for Total Suspended Particulates (40 CFR 2129.105,750)	Relevant And Appropriate	This regulation specifies maximum primary and secondary 24-hour concentrations for particulate matter. Fugitive dust emissions from site excavation activities must be maintained below 260 ug/m^3 (primary standard).	Proper dust suppression methods will be employed to keep concentrations below regulations.

Alternative S-1) would be conducted to identify any changes in the site conditions. Samples would be taken annually for 30 years to identify major changes in arsenic and PAH contamination on-site. Because this alternative leaves contamination on-site, the site would be reviewed every five years as required by SARA. The review would include comparing the monitoring data to the RI results to determine whether or not the remedial measures have been effective.

The process plant area is not located in a 100-year flood plain and is not a wetland. There are no known endangered species living inside the plant area. There are no data to indicate that the process plant area contains any sites which may be considered to be of historic or archeological significance. Thus, there are no location-specific ARARs associated with this portion of the site.

Monitoring and, fence and sign installation would be conducted according to OSHA Health and Safety Standards. This alternative would not achieve the soil cleanup goals, and thus is not considered to be protective of human health.

c. **Alternative S-3: Capping**

Capital Costs:	$493,000
Annual O&M:	43,000
Present Worth:	1,188,000
Months to Implement	2

The capping alternative is a partial containment remedial action. The primary purpose of the cap is to prevent direct contact with the contaminated soil and fugitive dust migration. This alternative also includes deed restrictions, public education, fencing, monitoring programs, and five-year reviews specified in the limited action alternative (S-2). The area to be capped (area within perimeter fence) is shown in Figure 9.

Debris, including steel plates, lumber, and miscellaneous material, have been observed on-site. These would be consolidated or disposed of so that they would not interfere with the capping operations. Some areas of the plant are also covered with vegetation. This vegetation would be removed and disposed off-site prior to capping.

The contaminated soil within the Halby Chemical process plant area would be covered with an asphalt aggregate mix. Any structures and outdoor equipment would be left intact. The area used for truck access and parking would require some road bed improvement. The asphalt cover would include a four-inch asphalt aggregate mix layer and a three-inch gravel layer and would cover approximately 5,800 square yards. The asphalt cover would not cover the railroad track, and the area adjacent to the track would be covered with stone and gravel. In order to minimize impacts to existing plant operations, capping would proceed in stages (i.e., only one portion of the site

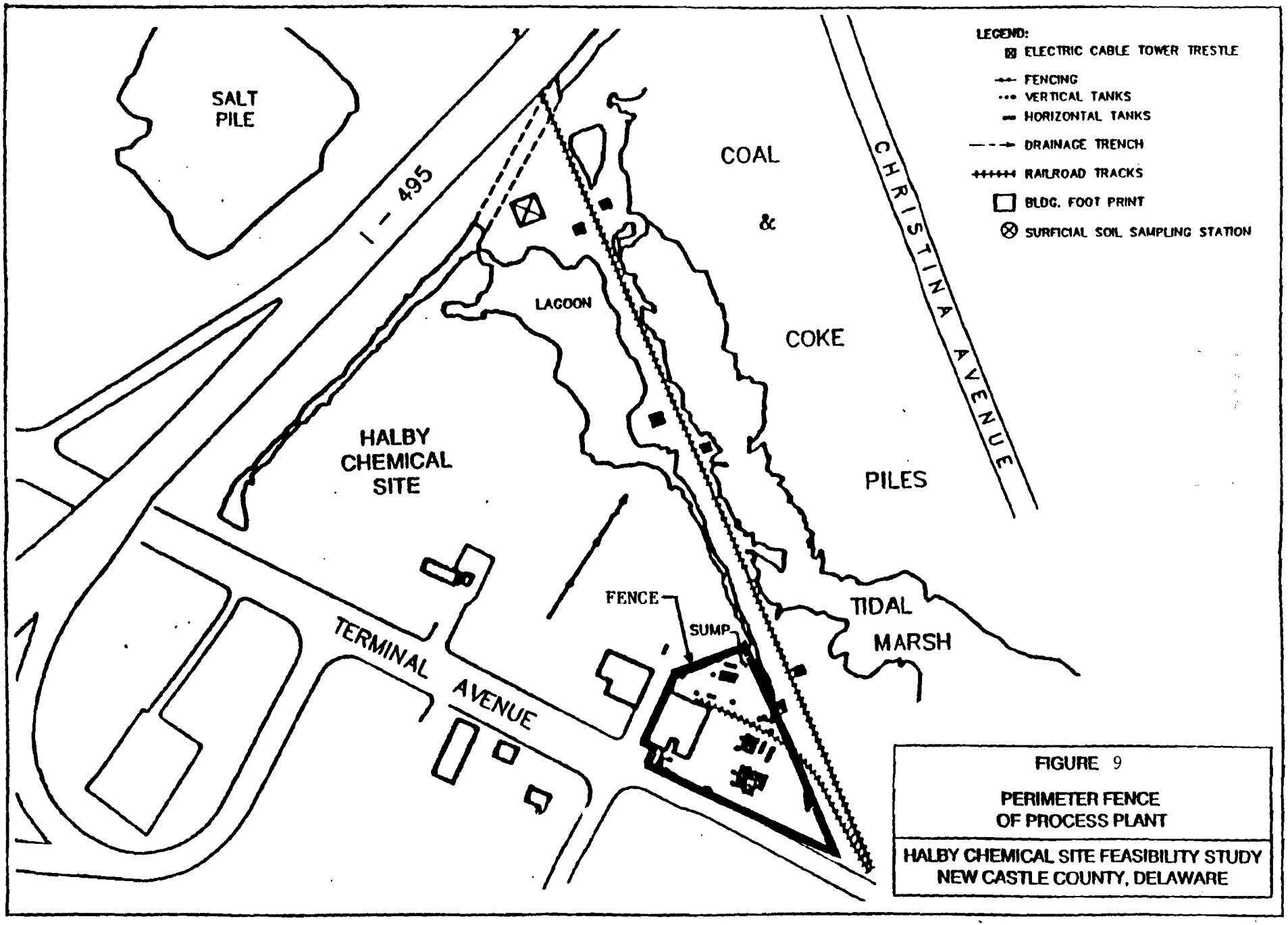

FIGURE 9

PERIMETER FENCE OF PROCESS PLANT

HALBY CHEMICAL SITE FEASIBILITY STUDY
NEW CASTLE COUNTY, DELAWARE

would be capped at any time).

The cap would be designed and constructed to meet the following objectives:

- Function with minimum maintenance;
- Promote drainage;
- Prevent runoff from damaging (eroding) the area around the cap; and
- Accommodate settling and subsidence, such that the cap's integrity would be maintained.

The surface runoff from the capped plant area could either discharge to the lagoon or the sewer. The runoff would not be contaminated, as contact with contaminants is eliminated by the cap.

This alternative provides containment of contaminated soil above the cleanup goals, thus preventing exposure to soils, thereby achieving the remedial action objectives. The process plant area is not located in a 100-year flood plain and is not a wetland. There are no known endangered species living inside the plant area. There are no data to indicate that the process plant area contains any sites which may be considered to be of historic or archeological significance. Thus, there are no location-specific ARARs associated with this portion of the site.

During site work, Clean Air Act and State of Delaware air requirements must be considered. If regulatory limits are exceeded, dust suppression would be employed. Requirements for these activities include OSHA Health and Safety Standards as shown in Table 9.

Post-closure use of the property must be restricted, as necessary, to prevent damage to the cover. Cap construction would follow OSHA requirements. Long-term monitoring and site security measures would have to be executed in accordance with Federal and State RCRA hazardous waste facility standards.

Section 121(c) of CERCLA, as amended, 42 U.S.C. §9621(c), requires a periodic review of remedial actions at least every five years for as long as hazardous substances remain on-site. Therefore, Alternative S-3 would satisfy action-specific ARARs identified for this alternative.

d. <u>Alternative S-4: Surface Soils Stabilization/Asphalt Cap</u>

Capital Costs:	$891,000
Annual O&M:	43,000
Present Worth:	1,586,000
Months to Implement	3

The major components of this alternative include the following:

1. Consolidate all debris on-site into one area, or dispose of debris off-site;

2. Perform a treatability study to identify a proper stabilization formula;

3. Excavate top 6 inches of contaminated surface soil;

4. Stabilize excavated soil;

5. Backfill stabilized soil;

6. Cover the stabilized soil with an asphalt cap;

7. Implement deed restrictions and public education programs;

8. Perform long-term monitoring and maintenance.

Debris including steel plates, piping, lumber, and miscellaneous materials was observed scattered throughout the site. In order to facilitate excavation, this debris must be consolidated into one area or disposed off-site.

This alternative involves the excavation of the top six inches of contaminated surface soil in the process plant area, followed by stabilization of the soil and replacement back into the excavated area. The contaminated soil would be mixed with stabilization agents to immobilize the contaminants of concern and would be placed back over the excavated area. The backfilled soil would be compacted to provide a stable sub-base for the asphalt cap. Any structures and outdoor equipment would be left intact.

The asphalt cap would be constructed within the area indicated in Figure 9 and would be placed approximately seven inches thick. The cap would include a 3 inch gravel layer, and a 4 inch asphalt aggregate mix. The area used for truck access and parking would require some roadbed improvement. The asphalt cover would not cover the railroad track. The area adjacent to the track would be covered with stone and gravel. In order to minimize impacts to existing plant operations, the excavation, stabilization, and capping processes could proceed in stages (i.e., only one portion of the site would be remediated at any one time).

The cap would be constructed to meet the following objectives:

- Function with minimum maintenance;
- Promote drainage and minimize erosion of the cap;
- Prevent runoff damage around the cap; and
- Accommodate settling and subsidence, such that the cover's integrity is maintained.

Prior to implementing this alternative, a treatability study would be performed to identify a proper stabilization formula. It is understood that arsenic is relatively difficult to immobilize. The treatability study (TS) performed during the Remedial Investigation indicated that more metals were leached out after treatment using cement as the binder, even though the leachates from the treated and untreated soil were both below the TCLP criteria. The asphalt binder tested in the same TS reduced the leachability of arsenic. Many commercial vendors have claimed to have successfully immobilized arsenic. Treatability studies performed for the Whitmoyer Laboratory Superfund site, which contained high concentrations of arsenic in soil and sediment, have successfully reduced the leachability of arsenic by 90% using ferric sulfate as a stabilizing agent.

Because of the congested nature within the process plant area, some areas might not be accessible for excavation. If this should occur, the inaccessible area would be covered with clean soil, stone/gravel, or asphalt aggregate mix. At the completion of the capping operation, the chemical plant could be returned to its normal operation. Because the asphalt cap would have a relatively low permeability, rain water will not infiltrate into the stabilized material or the soil. Surface runoff would be channeled to the lagoon or the storm sewer on-site. The runoff would not be contaminated, as contact with contaminants is eliminated by the cap. Because a significant amount of contaminants would still remain on-site, this alternative would include the deed restrictions, public education, and long-term monitoring programs as described under Alternative S-2.

This alternative would immobilize surface soil contaminated above the cleanup goals, thus achieving the remedial objectives. The process plant area is not located in a 100-year floodplain and is not a wetland. There are no known endangered species living inside the plant area. There are no data to indicate that the plant site contains any areas which may be considered to be of historic or archeological significance. Thus, there are no location-specific ARARs associated with this portion of the site.

During site work, Clean Air Act and State of Delaware air requirements must be considered. If regulatory limits on air and particulate emissions are exceeded, dust suppressants would be

utilized. Requirements for these activities also include OSHA Health and Safety Standards as shown in Table 9.

Post-closure use of the property must be restricted, as necessary, to prevent damage to the cover. Site remediation, long-term monitoring and site security measures would have to be executed in accordance with Federal and State RCRA hazardous waste facility standards and pertinent State flood plain area construction standards.

Since this alternative would result in hazardous substances remaining on the site a periodic review would be conducted at the facility, at least every five years, as required by Section 121(c) of CERCLA, as amended, 42 U.S.C. §9621(c). Alternative S-4 would satisfy all action-specific ARARs identified for this alternative.

e. **Alternative S-4a: Modified Soils Stabilization/Asphalt Cap**

Capital Costs:	$1,850,000
Annual O&M:	43,000
Present Worth:	2,700,000
Months to Implement:	3

This alternative is a modification of Alternative S-4. The only difference between S-4 and S-4a is that S-4a addresses soil stabilization with depth. A soil grid sampling program would be required as a predesign activity to locate contaminants with depth that exceed the aforementioned cleanup levels. Since it is not practicable to stabilize soils which are below the water table, this alternative would only provide treatment for soils which are above the water table, and which exceed the cleanup goals established for arsenic and CPAHs. Actual results of the soil grid sampling will be used to define exact depths to which soil would be stabilized throughout the process plant area. The estimated costs were calculated based on stabilizing soil at a depth of two feet throughout the process plant area. The same ARARs as discussed in Alternative S-4 apply to this alternative.

f. **Alternative S-5: Excavation/Off-Site Disposal**

Capital Costs:	$4,995,000
Annual O&M:	38,000
Present Worth:	5,610,000
Months to Implement	6

The major components of Alternative S-5 include the following:

1. Collect and remove debris from the site;

2. Decontaminate and dismantle tanks, piping, pumps, and other equipment;

3. Decontaminate and dismantle tank foundations and railroad tracks;

4. Excavate contaminated soil;

5. Transport and dispose of contaminated soil at an off-site facility;

6. Backfill excavated area with clean soil;

7. Revegetate backfilled area;

8. Implement deed restrictions and public education programs;

9. Perform long-term monitoring and maintenance.

This alternative involves excavation of contaminated soil and disposal at an off-site RCRA landfill. The chemical plant would be shut down permanently under this alternative.

Prior to excavation, scattered debris on-site would need to be collected from the site and disposed of in a sanitary landfill. The debris includes steel plates, piping, lumber, and miscellaneous materials. It is not expected that this debris would be contaminated. Decontamination, if necessary, would consist of brushing off dust or washing with water.

This alternative would not remove the two structures or the equipment housed inside. All existing tanks, piping, pumps, and other equipment outside of the structures would be decontaminated by solvent washing, detergent washing, or other methods as required. The equipment would be dismantled and salvaged if possible, or disposed of in an industrial landfill off-site. A total of 37 tanks were observed on-site. There are no known underground storage tanks on-site. Little information is available regarding the size, condition, or contents of the tanks. Inspection and sampling would be required during remedial design to determine the decontamination requirements. Any products stored in these tanks should be removed prior to the shutdown of the plant. Residual wastes in the tanks would be packaged and transported to a TSD facility for treatment and disposal. Spent solvents from decontamination activities would be treated off-site in a TSD facility. The railroad tracks inside the plant fence and the tank foundations would also be removed.

After the process plant area is clear of obstacles, contaminated soil would be excavated using construction equipment and disposed of off-site in a RCRA hazardous waste landfill. During the excavation, sampling and analysis would be performed to ensure that all soil exceeding the cleanup goals established for arsenic and PAHs is removed. Excavation would proceed to the groundwater table, or to a depth of five feet, whichever is shallower. The total volume of soil that would be removed is estimated to be 10,300 cubic yards from an

area of 5,800 square yards. Based on the analytical results from the TCLP tests performed on the untreated soil for the treatability study, the contaminated soil from the Halby Chemical site would not need treatment prior to landfilling under the Land Disposal Restrictions.

RCRA hazardous waste disposal facilities with sufficient capacity for disposal of contaminated soil are located in Ohio, Indiana, and South Carolina. Industrial landfills and sanitary landfills are available in nearby States (Pennsylvania, New Jersey, and Delaware) for debris and miscellaneous waste.

Since the excavation would most likely proceed below the footings of the building structures, engineering measures such as shoring and sheet piling would be required to protect the buildings from collapsing. Surface run-off during remediation would be treated by a temporary treatment facility prior to disposal.

At the completion of the excavation, the excavated area would be backfilled with clean soil from an off-site source. The area would be covered with a layer of topsoil and revegetated. Surface runoff would be discharged to the lagoon or the on-site storm water sewer. Treatment of surface runoff following remediation would not be required as contaminated surface soil will have been removed. A fence would be built around the building to minimize physical hazards to trespassers.

This alternative also includes deed restrictions, public education, and the long-term monitoring programs specified under the limited action alternative (S-2). A long-term monitoring program would be required for the site since contaminated material in the saturated zone would remain on-site. The site conditions would be reviewed every five years for 30 years to assess the effectiveness of the remedy.

This alternative would remove contaminated surface soil above the cleanup goals, thus achieving the remedial action objectives. The process plant area is not located in a 100-year flood plain and is not a wetland. There are no data to indicate that the plant area contains any sites which may be considered to be of historic or archeological significance. Thus, there are no location-specific ARARs associated with this alternative.

Excavation/disposal, long-term monitoring and site security measures would have to be executed in accordance with Federal and State RCRA hazardous waste facility standards, OSHA Health and Safety Standards, and pertinent Delaware flood plain area construction standards. During site work, Clean Air Act and State of Delaware air requirements would be complied with. If regulatory limits are exceeded, dust suppressants would be utilized.

Movement of excavated materials to a new location and placement in or on land may mean that the land disposal restrictions of 40 CFR 268, Subpart D apply to the excavated material. For the development of this alternative, the land disposal restrictions would not be invoked for the contaminated soil at the Halby Chemical site since TCLP tests performed on site samples indicated that the soil would pass the criteria for land disposal without treatment. However, this assumption is based on a limited number of tests and must be confirmed during remedial design.

General performance standards for clean closure (removal) require elimination of the need for further maintenance and control. Since contaminated soil will remain in the saturated zone, this removal alternative would not meet the clean closure standards and long-term monitoring would be required. Post-closure care and groundwater monitoring for 30 years would be provided as required by RCRA 40 CFR 264.310.

Although the soil removed from the Halby Chemical site may not be classified as hazardous wastes under RCRA, the facility receiving the soil should be one which is in compliance with State and Federal regulations for RCRA hazardous waste disposal. EPA's off-site disposal policy would be followed in determining acceptable receiving facilities.

Section 121(c) of CERCLA, as amended, requires a periodic review of remedial actions at least every five years for as long as contaminants that may pose a threat to human health or the environment remain on-site.

8. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

The five remedial action alternatives described above were evaluated using the nine evaluation criteria as set forth in the NCP 40 C.F.R. § 300.430(e)(9). These nine criteria can be categorized into three groups as shown below. A brief description of each of the nine evaluation criteria is provided in Appendix I.

THRESHOLD CRITERIA

* Overall protection of human health and the environment
* Compliance with applicable or relevant and appropriate requirements (ARARs)

PRIMARY BALANCING CRITERIA

* Long-term effectiveness
* Reduction of toxicity, mobility, or volume through treatment
* Short-term effectiveness
* Implementability
* Cost

MODIFYING CRITERIA

* Community acceptance
* State acceptance

These evaluation criteria relate directly to requirements in Section 121 of CERCLA, 42 U.S.C. Section 9621, which determine the overall feasibility and acceptability of the remedy. Threshold criteria must be satisfied in order for a remedy to be eligible for selection. Primary balancing criteria are used to weigh major trade-offs between remedies. State and community acceptance are modifying criteria formally taken into account after public comment is received on the Proposed Plan. The evaluation of the five remedial alternatives which were developed for Operable Unit 1 follows.

a. **Overall Protection of Human Health and the Environment** - A primary requirement of CERCLA is that the selected remedy be protective of human health and the environment. A remedy is protective if it reduces current and potential risks to acceptable levels under the established risk range posed by each exposure pathway at the site. Alternative S-5 (Excavation/Off-Site Disposal) provides protection for human health and the environment as most contaminants would be removed from the site. Exposures through direct contact, ingestion, and inhalation of contaminated soil would be eliminated.

Alternatives S-3 (Capping), S-4 (Surface Soils Stabilization/Asphalt Cap) and S-4a (Modified Surface Soils Stabilization/Asphalt Cap) would afford similar protection from contaminated soil. The asphalt cap in all three alternatives and the stabilized soil in Alternatives S-4 and S-4a would prevent direct contact, ingestion, and inhalation of contaminated soil. However, these processes are reversible (cap failure) and are not as permanent as the removal action in Alternative S-5. However, Alternatives S-4, and S-4a are superior to Alternative S-3 in minimizing risk subsequent to a cap failure as Alternatives S-4 and S-4a provide for stabilization of surface soil. Alternative S-2 (Limited Action) does not provide protection from contaminated soil for the workers, but provides some protection by limiting site access and implementing institutional controls.

Exposure to contaminated groundwater is eliminated by deed restrictions. Protection from exposure to contaminated groundwater would be similar for all alternatives (except the no action alternative) since they all use identical remedial measures (i.e., institutional controls, via deed restrictions). The need for remediating groundwater will be further investigated under Operable Unit 2 for the site.

Alternative S-1 (No Action) does not provide any remedial measures to protect human health except for monitoring the migration

of contaminants. Since this alternative is not protective of human health and the environment, it is dropped from further consideration.

b. **Compliance with ARARs** - This criterion addresses whether or not a remedy will meet all of the applicable or relevant and appropriate requirements of other environmental statutes and/or provide grounds for invoking a waiver. There are no chemical-specific ARARs for contaminated soil. However, Alternatives S-3 (Capping), S-4 (Surface Soils Stabilization/Asphalt Cap), S-4a (Modified Surface Soils Stabilization/Asphalt Cap) and S-5 (Excavation/Off-Site Disposal) comply with health-based cleanup goals and achieve the remedial action objectives. Alternative S-2 (Limited Action) does not comply with the soil cleanup goals and does not achieve the remedial objectives.

Since the process plant is not located in a wetland, within the 100-year flood plain, in an area that is a critical habitat for endangered species, or in an area that is of historic or archeological value, there are no location-specific ARARs that must be complied with for Operable Unit 1.

All alternatives would be implemented in a fashion that complies with action-specific ARARs as listed in Table 9.

c. **Long-Term Effectiveness and Permanence** - Long-term effectiveness and permanence addresses the long-term protection of human health and the environment once remedial action cleanup goals have been achieved, and focuses on residual risks that will remain after completion of the remedial action. Alternative S-5 (Excavation/Off-Site Disposal) would be the most effective in the long-term as the soil and disposal removal process is not reversible and is permanent. Since most contaminated soil would be removed from the site to a regulated landfill, it has the least residual risk at the site.

Alternatives S-3 (Capping), S-4 (Surface Soils Stabilization/Asphalt Cap), and S-4a (Modified Surface Soils Stabilization/Asphalt Cap) would provide less protection than Alternative S-5 since all contaminants would remain on-site. Capping and stabilization of surface soil are both reversible. The asphalt cap has a finite lifetime. If the failed asphalt cap was not replaced, the potential risks would be similar to existing conditions for Alternative S-3; the potential risks would be less for Alternatives S-4 and S-4a as the surface soil would be stabilized, thus providing an extra level of protection. Repair of the asphalt cap will be provided as part of the Operation and Maintenance (O&M) of the cap. Alternative S-2 (Limited Action) would provide limited protection by restricting access.

Alternatives S-2, S-3, S-4, S-4a and S-5 would provide identical protection of human health from contaminated groundwater, while Alternative S-1 does not provide any protection. Alternatives S-3, S-4, S-4a and S-5 would also reduce leaching into groundwater.

Alternative S-5 would require the least maintenance while Alternatives S-3, S-4 and S-4a would require some maintenance of the caps. Alternative S-2 would require periodic maintenance of the fence. The no action alternative does not require any maintenance activities.

All alternatives would provide for identical long-term monitoring. Deed restrictions are included for all alternatives except the no action alternative.

Alternative S-2 has the highest possibility of requiring future actions. The caps in Alternatives S-3, S-4 and S-4a would require replacement some time in the future. Alternative S-5 has the least possibility of requiring future actions.

d. **Reduction of Toxicity, Mobility, or Volume** - This evaluation criterion addresses the degree to which a technology or remedial alternative reduces the toxicity, mobility, or volume of a hazardous substance. Section 121(b) of CERCLA, 42 U.S.C. Section 9621(b), establishes a preference for remedial actions that permanently and significantly reduce the toxicity, mobility, or volume of hazardous substances over remedial actions which will not result in such reduction. Alternative S-5 (Excavation/Off-Site Disposal) reduces toxicity and volume of contaminants on-site but not via treatment. Off-site disposal without treatment in a landfill does not meet the statutory preference for treatment under SARA. The mobility of contaminants in soil would also be reduced by placement in a properly designed and operated landfill. Alternative S-4 (Surface Soils Stabilization/Asphalt Cap) reduces contaminant mobility by a stabilization process. However, the treatment only extends to 6 inches below the ground surface. Subsurface soils are not treated. Alternative S-4a (Modified Surface Soils Stabilization/Asphalt Cap) also reduces contaminant mobility by a stabilization process. Due to contaminants being identified through a pre-design grid sampling event, soils would be stabilized with depth. Alternatives S-3, S-4 and S-4a reduce infiltration of rain water and surface run-on by capping. Alternative S-2 (Limited Action) does not reduce toxicity, mobility, or volume of contaminants.

e. **Short-Term Effectiveness** - Short-term effectiveness addresses the period of time needed to achieve protection of human health and the environment, and any adverse impacts that may be posed during the construction and operation period until cleanup goals are achieved. Alternative S-2 (Limited Action) provides for upgrading the existing fence and the installation of warning signs. Alternative S-3 (Capping) involves capping of the site and has a greater chance of releasing contaminants during implementation than Alternative S-2. Alternatives S-4 (Surface Soils Stabilization/Asphalt Cap), S-4a (Modified Surface Soils Stabilization/Asphalt Cap) and S-5 (Excavation/Off-Site Disposal) involve excavating contaminated soil and have the greatest chance of air emissions. Alternative S-5 involves more soil handling and will take the longest time to

implement. It also involves shipping waste off-site. It therefore presents the highest short-term risks.

Once on-site actions begin, Alternative S-2 would take approximately one month to implement. It would take approximately two months to complete the asphalt cap required for Alternative 3. Alternatives S-4 and S-4a would take approximately three months to complete. It would take six months to excavate and dispose of contaminated soil under Alternative S-5. Implementation times are for construction activities only, no predesign or design time is included.

f. **Implementability** - This criterion addresses the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement the chosen solution. Alternative S-2 (Limited Action) involves the least construction and would be the simplest to implement. However, the alternative does not achieve the remedial action objectives.

Construction requirements for Alternative S-3 (Capping) are fairly simple. Alternative S-3 has more construction activities than Alternative S-2 because of the asphalt cap. Capping is a reliable technology for prevention of direct contact, ingestion, and inhalation of soil particles. However, the cap must be maintained in order for it to be effective.

Alternatives S-4 (Surface Soils Stabilization/Asphalt Cap) and S-4a (Modified Surface Soils Stabilization/Asphalt Cap) involve more construction activities than Alternative S-3. They include excavation, stabilization, replacement of treated soil, and capping.

Alternative S-5 (Excavation/Off-Site Disposal) has the most construction activities and involves the largest volume of contaminated soil. It also includes decontamination and dismantling of tanks and equipment. It would be the most difficult to implement.

All alternatives except Alternative S-5 have similar administrative feasibility. All alternatives except the no action alternative require deed restrictions, public awareness programs, and long-term monitoring. However, Alternative S-5 would require shutdown of the plant permanently, which would require consent from the current plant owner. Alternative S-1 involves only long-term monitoring.

All alternatives utilize proven technologies. Services and materials are readily available. However, Alternatives S-4 and S-4a may utilize a proprietary stabilization formula which may limit competition to perform the remedial action.

g. **Cost** - CERCLA requires selection of a cost-effective remedy (not merely the lowest cost) that protects human health and the environment and meets the other requirements of the statute. Project

costs include all construction and operation and maintenance costs incurred over the life of the project. An analysis of the present worth value of these costs has been completed for each alternative described in this Record of Decision, and is summarized in Table 10. Capital costs include those expenditures necessary to implement a remedial action.

The capital costs of the six alternatives range from $40,000 to $4,995,000. The degree of protection provided by the alternatives also varies. Comparison of different levels of costs for different levels of protectiveness and permanence of treatment is a primary decision criterion in the cost-effectiveness evaluation.

The no action alternative (S-1) has the least cost while Alternative S-5 (Excavation/Off-site Disposal) has the highest cost. It should be noted that monitoring costs contribute a major portion of the cost of all alternatives except for Alternative S-5.

The three capping alternatives, Alternatives S-3 (Capping), S-4 (Surface Soils Stabilization/Asphalt Cap) and S-4a (Modified Surface Soils Stabilization/Asphalt Cap), would reduce the risks to levels which are generally considered acceptable for the corresponding increase in cost. The excavation and off-site disposal alternative would virtually eliminate the risk from the plant area, but at a significant increase in cost over the other alternatives.

h. State Acceptance - The State of Delaware accepts the selected remedy as presented in this document.

i. Community Acceptance - A Public Meeting on the Proposed Plan was held on May 2, 1991. The Community concurs with the selected remedy as presented in this document. Several of the PRPs submitted comments during the public comment period which express concern regarding the selected remedy. The PRPs comments, as well as all other comments received during the public comment period, have been summarized in the Responsiveness Summary.

9. SELECTED REMEDY

Section 121 of CERCLA, as amended, 42 U.S.C. § 9621, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) establish a variety of requirements relating to the selection of remedial actions under CERCLA. Having applied the evaluation criteria to the six remedial alternatives, EPA has selected Alternative S-4 (Surface Soils Stabilization/Asphalt Cap) as the best alternative for dealing with risks to workers in the process plant area (Operable Unit 1).

A description of the selected remedy can be found in Section 7 of this ROD. The methodology which will be used to determine the extent of the area to be stabilized and capped is described below. A pre-

Table 10

Cost-Comparative Analysis
Halby Chemical

	CAPITAL COST	ANNUAL O&M COST	PRESENT WORTH COST
ALTERNATIVE S-1	$40,000	$38,000	$655,000
ALTERNATIVE S-2	70,000	39,000	696,000
ALTERNATIVE S-3	493,000	43,000	1,188,000
ALTERNATIVE S-4	891,000	43,000	1,586,000
ALTERNATIVE S-4a	1,850,000	43,000	2,700,000
ALTERNATIVE S-5	4,995,000	38,000	5,610,000

A discount factor of 5 percent per year was assumed with Annual Costs incurred for 30 years.

design soil sampling study will be performed within the boundary of the process plant area, as designated in Figure 9. The purpose of the soil grid sampling is to more fully define the extent of soil contamination in the process plant area. The soil grid sampling system shall be surveyed and clearly marked by a licensed land surveyor. Grid lines shall be established on no less than 50-foot centers and run approximately north-south/east-west. Composite samples shall be taken to a depth of 3 inches at each grid nodal point. A total of 30 samples is estimated for one round of sampling based on a 50-foot grid pattern. Samples shall be analyzed for arsenic and CPAHs. Sample results will be used to determine the extent of soil stabilization and asphalt capping for soil contaminants that exceed cleanup standards set for soil at this site (background for arsenic and CPAHs).

The background levels that have been identified at the Halby Chemical Site for arsenic is 10 ppm and for CPAHs is 1.2 ppm, however, these values were based on a limited number of samples. Existing EPA guidance suggests that additional samples are necessary in order to determine a statistically representative background value for arsenic and CPAHs. A sufficient number of samples must be taken to determine the value which will be used as the cleanup criteria for both arsenic and CPAHs at the Halby Chemical Site.

The top six inches of contaminated surface soil will be excavated from the areas found to contain contaminants at concentrations exceeding the cleanup standards. The contaminated soil would be mixed with stabilization agents to immobilize the contaminants of concern and would be placed back into the process plant area. The backfilled stabilized soil would be compacted to provide a firm sub-base for the asphalt cap. The asphalt cap would cover all areas that have been stabilized.

If it is determined (based on the sample results) that several non-contiguous areas of the site need to be capped, efforts would be made to consolidate the contaminated soil in the area north of the railroad tracks which pass through the process plant area. The reason for consolidating small areas of contaminated soil into this area is the near certainty that this portion of the site would require stabilizing and capping. The areas from which contaminated soil was removed and relocated, would be backfilled to grade with clean fill.

The asphalt cap would include a 3" gravel layer, and a 4" asphalt aggregate mix. If the area used for truck access and parking is further determined to require soil stabilization, the area would also require some roadbed improvement. The maximum area that the asphalt cap would cover is approximately 5,800 SY. Any structures and outdoor equipment would be left intact. Prior to implementing this alternative, a treatability study would be performed to identify a proper stabilization formula.

As discussed in Section 6 of this ROD, the risk assessment assumed that the reasonably most exposed (RME) concentration of chromium in soil is in the hexavalent form (which is highly unlikely). An incremental cancer risk of 2.5×10^{-4} was calculated for chromium in the inhalation pathway. The chromium is very likely to be in the relatively harmless and noncarcinogenic trivalent form, however, this must be confirmed in the field.

The alternative would also include deed restrictions, an air sampling program, fencing, long-term monitoring, and five-year site reviews. Some changes may be made to the selected remedy as a result of the remedial design and construction processes.

a. **Cost Breakdown**

• Capital Costs	$ 891,000
• Maximum Volume of Material to Stabilize	980 CY
• Unit Costs for Stabilization of Material	$ 87.31
• Annual Operation & Maintenance Cost	$ 43,400
• 5-Year Review Costs	$ 10,000
• Total Present Value Costs	$ 1,586,000

b. **Remediation Goals and Performance Standards** - The purpose of this response action is to reduce the human health risks associated with direct contact, ingestion and inhalation of particulates within the process plant area (Operable Unit 1). Since no Federal or State chemical-specific ARARs exist for contaminated soils at the Halby Chemical Site, the cleanup levels for Operable Unit 1 will be established based on the aforementioned current and future risk values taking into account the background levels of contaminants found in the area of the site.

The cleanup standards set for soil at the Halby Chemical Site are background for arsenic and CPAHs. The background values that have been identified through a limited number of samples are as follows:

- Arsenic - background is approximately 10 ppm
- CPAHs - background is approximately 1.2 ppm

Existing EPA guidance suggests that additional samples are necessary in order to determine a statistically representative background value for arsenic and CPAHs. Additional samples will be taken under the selected remedy to allow EPA to determine the value which will be

used as the cleanup criteria for both arsenic and CPAHs at the Halby Chemical Site.

The selected remedy would immobilize surface soil contaminated above the cleanup goals, thus achieving the remediation goals. The selected remedy would prevent direct contact with and ingestion and inhalation of soil from the process plant area by stabilizing the top six inches of contaminated surface soil and capping the treated soil with an asphalt cap. This action would effectively eliminate the risks associated with those pathways from the process plant area for both the workers and residents. The selected remedy would also provide risk reduction through institutional controls, public education, fencing, and long-term monitoring. Additional future risk to workers through direct contact and ingestion of exposed contaminated subsurface soil would be eliminated by placing deed restrictions on excavations in the plant area. The long-term effectiveness of this remedy in minimizing human health risks through the potential exposure pathways would depend on the integrity of the cap. The useful life of the cap and fence is normally 30 years. The level of effectiveness of this remedy would remain virtually the same over this period. The cap would have to be maintained to prevent degradation, and the fence and warning signs would have to be maintained or replaced if damaged or stolen.

10. STATUTORY DETERMINATIONS

Under its legal authorities, EPA's primary responsibility at Superfund sites is to undertake remedial actions that achieve adequate protection of human health and the environment. In addition, Section 121 of CERCLA, 42 U.S.C. § 9621, establishes several other statutory requirements and preferences. These specify that when complete, the selected remedial action for this site must comply with applicable or relevant and appropriate environmental standards established under Federal and State environmental laws unless a statutory waiver is justified. The selected remedy also must be cost-effective and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Finally, the statute includes a preference for remedies that employ treatment that permanently and significantly reduce the volume, toxicity, or mobility of hazardous wastes as their principal element. The following sections discuss how the selected remedy meets these statutory requirements.

a. Protection of Human Health and the Environment - The selected remedy reduces the human health risks associated with direct contact, ingestion and inhalation of particulates by immobilizing the contaminated soil and containing the treated soil beneath an asphalt cap. The selected remedy does not require that the process plant be shut down yet it eliminates existing health risks to workers at the Halby Chemical Site. The selected alternative reduces exposure levels to within the 10^{-4} to 10^{-6} risk range and the Hazard Indices

for non-carcinogens to less than one. Deed restrictions and fencing of the contaminated areas to limit site access would ensure that the cap is not excavated or damaged.

Subsurface contaminants becoming mobile through groundwater movement does not appear to be a problem based on information that suggests that the groundwater moves directly into the Christina River. Groundwater will be studied further in Operable Unit 2 for this site.

There are no short-term threats associated with the selected remedy that cannot be readily controlled. In addition, no adverse cross-media impacts are expected from the remedy.

b. **Attainment of the Applicable or Relevant and Appropriate Requirements** - The selected remedy will comply with all Federal and State applicable or relevant and appropriate chemical-, location-, and action-specific requirements (ARARs). Each of these categories of ARARs is discussed below.

Chemical-Specific ARARs - There are no chemical-specific ARARs for soil at the Halby Chemical site. The cleanup goals are derived based on protection of human health. The selected remedy will immobilize surface soil contaminated above the cleanup goals, thus achieving the remedial objectives.

Location-Specific ARARs - The process plant area is not located in a 100-year floodplain and is not a wetland. There are no known endangered species living inside the plant area. There are no data to indicate that the plant area contains any sites which may be considered to be of historic or archeological significance. The selected remedy therefore complies with all identified location-specific ARARs.

Action-Specific ARARs - The action-specific ARARs for the selected remedy are summarized in Table 11 as well as some of the design considerations necessary to meet these requirements. The selected remedy will satisfy action-specific ARARs.

Other Criteria, Advisories or Guidance To Be Considered for This Remedial Action (TBCs) - Local deed restrictions will be in place to prohibit excavation and groundwater use for as long as concentrations of hazardous constituents exceed health based levels. An ARAR to be considered is the DNREC-Coastal Zone Act (ch.70, Sec 7001-1013). This ARAR controls location, extent, and type of industrial development in Delaware's Coastal areas to protect the natural environment. Although there is no intention to develop any new industries at the Halby Chemical Site, the requirements of this ARAR were considered when the selected remedy was chosen.

c. **Cost-Effectiveness** - The selected remedy is cost effective because it has been determined to provide overall protectiveness

Table 11

ACTION-SPECIFIC ARARS FOR SELECTED REMEDY
OPERABLE UNIT 1
HALBY CHEMICAL SITE

ARARS	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARS
OSHA-General Industry Standards (29 CFR 1910)	Applicable	These regulations specify the 8-hour time-weighted average concentration for worker exposure to various organic compounds. Training requirements for workers at hazardous waste operations are specified in 29 CFR 1910.120.	Proper respiratory equipment will be worn if it is not possible to maintain the work atmosphere below these concentrations.
OSHA-Safety and Health Standards (29 CFR 1926)	Applicable	This regulation specifies the type of safety equipment and procedures to be followed during site remediation.	All appropriate safety equipment will be on-site and appropriate procedures will be followed during treatment activities.
OSHA-Record Keeping, Reporting and Related Regulations (29 CFR 1904)	Applicable	This regulation outlines the record keeping and reporting requirements for an employer under OSHA.	These regulations apply to the company(s) contracted to install, operate, and maintain the remedy.
RCRA-Standards for Owners/Operators of Permitted Hazardous Waste Facilities (40 CFR 264.10-264.18)	Relevant And Appropriate	General facility requirements outline general waste analysis, security measures, inspections, and training requirements.	Facility will be designed, constructed, and operated in accordance with this requirement. All workers will be properly trained.
RCRA-Preparedness and Prevention (40 CFR 264.30-264.31)	Relevant And Appropriate	This regulation outlines the requirements for safety equipment and spill control.	Safety and communication equipment will be installed at the site. Local authorities will be familiarized with the site.
RCRA-Contingency Plan and Emergency Procedures (40 CFR 254.50-264.56)	Relevant And Appropriate	This regulation outlines the requirements for emergency procedures to be used following explosions, fires, etc.	Plans will be developed and implemented during remedial design. Copies of the plans will be kept on-site.
DNREC Regulations Covering Hazardous Substances Cleanups (Part IX, Ch.91 Sec 9101-9120)	Relevant And Appropriate	Requires prompt containment and removal of hazardous substances to eliminate or minimize the risk to public health or welfare or the environment.	Hazardous substances will be contained or removed promptly.

Table 11 (cont)

ARARS	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARS
CAA- NAAQS for Total Suspended Particulates (40 CFR 129.105, 750)	Relevant And Appropriate	This regulation specifies maximum and secondary 24-hour concentrations for particulate matter. Fugitive dust emissions from site excavation activities must be maintained below 260 ug/m^3 (primary standards).	Proper dust suppression methods such as water spray would be specified when implementing excavation and/or stabilization actions.
40 CFR 262: RCRA	Applicable	Establishes standards for generators of hazardous wastes including waste determination, manifests, and pre-transport requirements.	This regulation will be applicable upon excavation and on-site storage of site wastes.
40 CFR 261: RCRA	Applicable	Hazardous Waste determination.	Wastes will be compared to Federal Register listing to determine if they are listed or characteristic wastes.
40 CFR 264: Subpart L	Applicable	Provides requirements to design and operate waste piles.	Performance standards would be specified for compliance.
40 CFR 264: RCRA	Relevant And Appropriate	Requires owner/operator to control wind disposal of particulate matter.	Fugitive dust emissions will be controlled during implementation to maintain concentrations below these levels.
40 CFR 50: NAAQS	Applicable	Provides air quality standards for particulate matter and lead.	Same as below.
DNREC-Regulations Governing the control of Air Pollution (Regulation Nos. 2, 3, 6 and 21)	Relevant And Appropriate	Details the required permits, ambient air quality, allowable dust control during excavation activities and emission standards.	Proper dust suppression methods and monitoring will be required when implementing excavation and/or stabilization actions.
DNREC-Environmental Control (Part VII, Ch. 60, Sec. 6003)	Relevant And Appropriate	Requires a permit if any contaminants are discharged to the air, surface water or groundwater.	Practices will be followed to reduce potential emissions. If discharges are anticipated, an application for a permit will be submitted.
DHWR-Chemical, Physical and Biological Treatment (Subpart Q, Section 265.400-404)	Relevant And Appropriate	Outlines operating requirements, analysis and trail tests, inspections and closures for hazardous waste treatment processes.	Required waste analysis, trail tests, inspections, closures and operation procedures will be used during stabilization treatment.

Table 11 (cont)

ARARS	STATUS	REQUIREMENT SYNOPSIS	ACTION TO BE TAKEN TO ATTAIN ARARS
DNREC - Delaware Erosion and Sediment Control Handbook for Development (1989) and Delaware's Erosion and Sediment Control Law (Chapter 40, Title 7, Delaware Code)	Relevant And Appropriate	Outlines Delaware Erosion and Sediment Control Law Regulations and practices to minimize erosion.	Recommended practices will be followed during excavation. An erosion and sediment control plan will be submitted for review and approval to comply with state erosion and sediment control requirements for land-disturbing activities.
RCRA-Landfills (40 CFR 264.310(a))	Relevant And Appropriate	Placement of a cap over waste requires a cover designed and constructed to: - Provide long-term minimization of migration of liquids through the capped area; - Function with minimum maintenance; - Promote drainage and minimize erosion or abrasion of the cover; - Accommodate settling and subsidence so that the cover's interity is maintained; - Have a permeability less than or equal to the permeability of any bottom liner system or natural subsoil present.	Design considerations will include all requirements.
RCRA-General Standards (40 CFR 264.117(c))	Relevant And Appropriate	Restricts post-closure use of property as necessary to prevent damage to the cover.	Post-Closure uses will be limited to those that will not damage the cover.
CAA-NAAQS for Particulate Matter Less than 10 Microns in Diameter (40 CFR Part 60, Appendix J)	Relevant And Appropriate	This regulation specifies annual arithmatic mean and maximum 24-hour concentrations for particulate matter.	Proper dust suppression methods will be employed to keep concentrations below regulations.
CAA-NAAQS for Total Suspended Particulates (40 CFR 2129.105,750)	Relevant And Appropriate	This regulation specifies maximum primary and secondary 24-hour concentratrations for particulate matter. Fugitive dust emissions from site excavation activities must be maintained below 260 ug/m^3 (primary standard).	Proper dust suppression methods will be employed to keep concentrations below regulations.

proportional to its cost. The present worth, calculated at a discount rate of five percent, is $1,586,000. The estimated cost of the selected remedy is approximately 28 percent of the cost ($5,610,000) associated with excavating the contaminated soils with off-site disposal, yet the selected remedy through immobilization of surface soil contamination meets the cleanup goals, thus achieving the remedial objectives. The estimated cost of the selected remedy is approximately one half the cost associated with stabilizing the soils with depth (costs of $2,700,000 are based on 2 foot depth throughout area), yet both alternatives meet the cleanup goals but leave contaminated subsurface soils on-site.

d. **Utilization of Permanent Solutions and Alternative Treatment Technologies (or Resource Recovery Technologies) to the Maximum Extent Practicable** - EPA and the State of Delaware have determined that the selected remedy represents that maximum extent to which permanent solutions and treatment technologies can be utilized in a cost effective manner for this operable unit. Of those alternatives that are protective of human health and the environment and comply with ARARs, EPA and the State of Delaware have determined that the selected remedy provides the best balance of trade-offs in terms of long-term effectiveness and permanence, reduction in toxicity, mobility, or volume achieved through treatment, short-term effectiveness, implementability, cost, also considering the statutory preference for treatment as a principal element and considering State and community acceptance.

The selected remedy will eliminate current risks to workers at the site through stabilization of surface soil contamination and offers a high degree of long-term effectiveness. The selection of a treatment option is consistent with program expectations which indicate that priority consideration for treatment of high concentrations of toxic compounds is often necessary to ensure the long-term effectiveness of a remedy. The selected remedy has therefore been determined to be the most appropriate solution for the Halby Chemical Site.

e. **Preference for Treatment as a Principal Element** - By stabilizing the contaminated surface soil within the process plant area, the selected remedy addresses a principal threat posed by the site through the use of a treatment technology. Therefore, the statutory preference for remedies that employ treatment as a principal element is satisfied. The selected remedy meets the statutory requirement to utilize permanent solutions and treatment technologies to the maximum extent practicable.

11. DOCUMENTATION OF SIGNIFICANT CHANGES

The following changes have taken place since the Proposed Remedial Action Plan was released on April 19, 1991:

a. The Proposed Remedial Action Plan for Operable Unit 1 included remediation of the contamination in sediments and surface water within the lagoon and drainage ditch next to the process plant. EPA has decided that in order to gain more information regarding tidal and groundwater movement in and out of the lagoon, tidal marsh and drainage ditch areas, any actions with respect to the lagoon and drainage ditch should be deferred to Operable Unit 2. As stated in the Proposed Remedial Action Plan, Operable Unit 2 will also continue to investigate contamination in the tidal marsh area, outfall area, groundwater and air.

b. A soil grid sampling event was added as a requirement to the selected remedy (Alternative S-4). This added requirement does not change the objective of Alternative S-4, yet it provides a system by which the extent of surface soil contamination within the process plant area will be based.

EPA does not consider these changes to be significant since they do not effect EPA's choice of a selected remedy for Operable Unit 1 which now only addresses the process plant area.

RESPONSIVE SUMMARY FOR

OPERABLE UNIT 1

HALBY CHEMICAL SITE

RESPONSIVENESS SUMMARY

HALBY CHEMICAL SITE
OPERABLE UNIT NO. 1
NEW CASTLE COUNTY, DELAWARE

A public comment period was held from April 19, 1991 through June 3, 1991 to receive comments from the public on the Remedial Investigation and Feasibility Study Reports, the Proposed Remedial Action Plan, and EPA's preferred remedial alternative for Operable Unit No. 1 of the Halby Chemical Site. Operable Unit No. 1 has been redefined to include the process plant only. The lagoon, plant drainage ditch, plant outfall area, and marsh area have been deferred to Operable Unit No. 2. A public meeting for the Halby Chemical Site was conducted on May 2, 1991 at 7:00 p.m. at the De La Warr Community Service Center, New Castle, Delaware. The public meeting was attended by EPA staff, members of EPA's contractor staff, state regulatory representatives, PRP representatives, local consultants, university students, area residents, and property and business owners. The public meeting was preceded by a public officials briefing held at 3:00 P.M. at the same location. The briefing was attended by EPA staff, member's of EPA's contractor staff, representatives of federal, state and local public officials, and by state and local regulatory representatives.

The purpose of the public meeting was to present and discuss the findings of the RI/FS and to apprise meeting participants of the EPA's preferred remedial alternative for Operable Unit No. 1 of the Halby Chemical Site. Comments received during the public meeting are summarized in Part 1 of this Responsiveness Summary and categorized into the following topics:

A. Remedial Investigation
B. Risk Assessment
C. Remedial Alternatives Development and Selection
D. PRP and Financial Responsibilities
E. Other Concerns

In addition to comments made at the public meeting, written comments were received from the Potentially Responsible Parties (PRPs) and the State of Delaware. Part 2 of this Responsiveness Summary includes a brief summary of these written comments and EPA's response. The written comments are categorized into the following topics:

A. Remedial Investigation
B. Risk Assessment
C. Remedial Alternatives Development and Selection

PART 1

VERBAL COMMENTS RECEIVED DURING THE PUBLIC MEETING

A. REMEDIAL INVESTIGATION

A.1 Comment: A local consultant asked if both on- and off-site investigations were undertaken during the RI/FS.

EPA Response: EPA stated that the RI/FS involved sampling soil, surface water, groundwater, and sediment on and near the site. The studies revealed that the contamination problem is complex and that additional studies would be necessary to plan remedial actions for the affected areas. EPA concluded that two operable units would be necessary at the Halby Chemical Site to address the contamination issues. Only the remedial alternatives for Operable Unit No. 1 have been developed at this time. A separate Proposed Plan will be issued when the studies associated with Operable Unit No. 2 are completed. (Note: The definition of Operable Unit No. 1 has been revised after the public comment period. Only the process plant is included in Operable Unit No. 1. The lagoon, plant drainage ditch, and plant outfall area are deferred into Operable Unit No. 2.)

A.2 Comment: A university geology student asked if groundwater monitoring wells were installed in the area as part of the RI/FS, and/or if there are plans to install wells for Operable Units No. 1 or 2.

EPA Response: Groundwater monitoring wells were installed as part of the RI/FS to determine the nature and extent of the contamination on or near the site, and to study the geology and hydrogeology of the site. The locations of these wells are shown in the RI/FS report which is available for review at the information repositories. Some of the monitoring wells used were installed by the State of Delaware and the City of Wilmington from previous investigations. EPA is considering installing additional wells as part of Operable Unit No. 2.

A.3 Comment: A university geology student inquired about the locations of the maximum concentrations of the contaminants of concern in the tidal marsh area (located in Operable Unit No. 2) and the depths of the maximum concentrations.

EPA Response: In the tidal marsh area, the depth of the maximum concentration levels vary by the contaminant. During the RI/FS, a range of sediment samples were taken: 0 to 20 inches; 0 to 30 inches; 0 to 60 inches; and 0 to 72 inches. In general, the greatest concentrations of metals were found in the deeper samples. This was particularly true for arsenic, zinc, copper and lead. Detailed information is found in the RI/FS report.

A.4 Comment: A local consultant inquired why the highest concentrations of zinc in sediments in the lagoon area are found at the surface, whereas they are found in the deeper sediment samples in the tidal marsh area.

EPA Response: Sediment sampling in the lagoon area, the tidal marsh area and the drainage ditch revealed increased concentrations of zinc with depth in the tidal marsh and drainage ditch areas, but in the lagoon area the highest concentrations are at the surface. Factors that may explain the phenomenon include the tidal movement in and out of the study area, possible deposition and movement of the upper sediments in the area, and/or groundwater or some type of sub-surface drainage remnant from historical facility operations. The data is inconclusive and therefore, additional analysis will be required as EPA proceeds with the studies for Operable Unit No. 2.

A.5 Comment: A local consultant posed a possible explanation to the variation found between the lagoon and tidal marsh area for zinc concentrations: that the particles in the tidal marsh were deposited with erosion from the surrounding landscape and there were higher concentrations of these contaminants historically, and they have decreased with time, which is why there is a decrease at the surface samples. Whereas, in the lagoon there would be less soil layering from erosion, so the contaminants would not be layered by more recent sediments and remain in the surface sediments.

EPA Response: EPA will continue to analyze the data and the geologic and hydrogeologic conditions on- and off-site as needed to identify the sources and movement of contamination in areas included in Operable Unit No. 2.

A.6 Comment: A local consultant inquired if sediment samples greater than 72 inches in depth had been taken in the tidal marsh area.

EPA Response: Sediment samples deeper than 72 inches were not taken in the tidal marsh area. Only one of the sediment samples taken in the tidal marsh area was 72 inches deep. EPA is considering the need for additional sediment samples that are 72 inches or deeper for Operable Unit No. 2.

B. RISK ASSESSMENT

B.1 Comment: An area resident, representing a non-profit social service/housing program, inquired about the health of the employees who worked at the process plant when chemicals were being processed.

EPA Response: The health risks to employees working at the Halby Chemical Site between 1946 and 1977 when chemicals were being processed is not known, nor will it be assessed as part of this study. The risk assessment conducted for the site does indicate that currently there are unacceptable human health risks due to direct contact, ingestion or inhalation of contaminated soil.

C. REMEDIAL ALTERNATIVES DEVELOPMENT AND SELECTION

C.1 Comment: A local area resident asked if the preferred alternative for Operable Unit No. 1 - surface soil stabilization and asphalt cap - is a permanent solution, given that the asphalt may crack at some point in time.

EPA Response: The cost of the preferred alternative includes the cost for long-term maintenance and monitoring. The asphalt cap has an estimated useful life of approximately thirty years and may need to be replaced in the future. The stabilized soils will provide additional support for the asphalt cap to reduce cracking or buckling. The stabilized soil is expected to be effective for a period significantly longer than 30 years.

C.2 Comment: A property/business owner's representative inquired about the extent of the lagoon cleanup. Would the cleanup stop at the property line or would EPA clean up the tidal marsh area, the Lobdell Canal and where the contaminants have flowed.

EPA Response: Operable Unit No. 2 will encompass both on-site and off-site areas affected by contamination, including the tidal marsh area east of the Halby property.

C.3 Comment: A property/business owner's representative inquired about the potential for the contaminants in the groundwater in the lagoon and tidal marsh area leaching back and forth and potentially "undoing" EPA's clean up efforts in the lagoon, if only the lagoon is cleaned up at this time.

EPA Response: The Proposed Plan for Operable Unit No. 1 initially included the preferred remedial alternative for the lagoon and drainage ditch area. The levels of contaminants in the lagoon area surface sediments are very high as opposed to those found in the samples taken in the tidal marsh area. It is thought that the majority of the contamination in the lagoon is from historical surface deposition in the lagoon rather than contaminants leaching from the groundwater into the lagoon. Therefore, separate cleanup activities could proceed in the lagoon area while the tidal marsh area is being studied further. However, based on public comment, EPA has concluded that further hydrogeologic studies of the lagoon and adjacent off-site areas will be necessary to study the effects of groundwater movement both on- and off-site. These studies will be conducted as part of the remedial investigation for Operable Unit 2.

C.4 Comment: A property/business owner's representative inquired about whether the preferred alternative for the lagoon area (i.e., the soil barrier) would be sufficient to stop the groundwater contamination or would a liner also be required.

EPA Response: The soil barrier would not be sufficient to reduce leaching. The effects of groundwater contamination from the lagoon area will be further studied in Operable Unit No. 2, as described in EPA response to C.3 above.

C.5 Comment: A property/business owner's representative inquired about the timing for the Operable Unit No. 2 investigations.

EPA Response: The Operable Unit No. 2 investigations will be continuing this year as part of the Halby Chemical Superfund Site study process. The site was divided into two operable units so that cleanup activities for the process plant area could proceed while further studies of the lagoon and tidal marsh area are being undertaken.

C.6 Comment: A PRP inquired if the lagoon area becomes part of Operable Unit No. 2, will the Superfund site name change.

EPA Response: The site boundary of a Superfund site is not limited by the property lines, but rather is defined by the spreading limits of the contaminants. As such, the off-site tracking of contaminants from the Halby Chemical Site is considered part of the Halby Superfund Site investigations. It is not likely that Operable Unit No. 2 would be renamed.

C.7 Comment: A local consultant inquired about whether the plants in the re-established wetlands of the lagoon (following cleanup) would root into the contaminated soil and disturb the sediment; and whether frogs or turtles burrowing in the soil would disturb the contaminated soil; and/or the possibility of tidal action flushing away some of the clean sediment and exposing some of the contaminated soil.

EPA Response: The lagoon area and EPA's preferred cleanup alternative (i.e., soil barrier) will be studied further as part of Operable Unit No. 2. The potential effects of vegetation and tidal action on a soil barrier in the lagoon will also be assessed. It is known that most plants in the re-established wetland would be aerobic plants, with their roots at the surface, thus reducing the potential for sediment disruption. The effects of burrowing frogs and turtles, although considered insignificant, will also be reassessed. During the predesign and remedial design studies, the amount of clean soil fill that may be necessary to isolate the contaminated sediments will be further analyzed. Approximately one foot of clean soil fill would be sufficient, based on studies to date. However, the type of soil material and other considerations will be evaluated further in light of new data presented in Operable Unit No. 2. Mechanisms to control the drainage flow in and out of the lagoon to reduce sediment erosion will also be studied.

C.8 Comment: An area resident inquired about the length of time estimated for the cleanup efforts at the Halby Chemical Site.

EPA Response: The next phase for Operable Unit No. 1, following the Record of Decision, is the negotiations with the potentially responsible parties (PRP) for the implementation of the remedial design and remedial action called for in the Record of Decision. If these negotiations are successful, they will result in the entry of a Consent Decree between EPA and the PRPs which would provide for performance of the work. If no agreement is reached, EPA would consider other options to have the work completed. These would include performing the work with Fund monies, or ordering the PRPs to implement the remedy. It would be approximately two to three years before remedial actions would be completed. There is no estimated completion date for Operable Unit No. 2 remediation.

C.9 Comment: A PRP inquired if the extra $400,000 between Alternative S-3 (Capping Only) and Alternative S-4 (Soils Stabilization/Asphalt Cap) is justified if a crack in the asphalt is not going to be patched in a timely manner.

EPA Response: Alternative S-4, the preferred alternative for the process plant area, is considered cost effective because the stabilization will provide an additional layer of protectiveness and serve as a base for the asphalt cap. The firm base provided by soil stabilization would reduce the number of the potential cracks, thus reducing the overall operation and maintenance costs.

C.10 Comment: A PRP stated that if the soil in the process plant area has been in place since 1946, not much shifting should be expected.

EPA Response: There is likely to be differential settling once the entire process plant area is capped. The distribution trucks and vehicles entering and exiting the process plant area are likely to use more of the paved area, which has not been historically used and therefore is less compacted, for maneuvering. This is one of the reasons why it would be prudent to stabilize the entire site for the purpose of providing a firm base for the asphalt cap. Stabilization would also immobilize heavy metals and therefore would provide added protection to human health should the cap deteriorate.

C.11 Comment: A PRP inquired how the soil is stabilized. Is the stabilized soil clean soil or is it contaminated soil that is treated somehow and then compacted.

EPA Response: During the design phase, a treatability study would be undertaken to determine what components or materials, such as cement or asphalt or other mix of chemicals and materials, should be used to stabilize the contaminated soil.

C.12 Comment: A property/business owner's representative inquired about the remedial action objectives for the drainage ditch area. Is the goal to remove, treat or reduce the contamination level.

EPA Response: The drainage ditch will be studied further as part of Operable Unit No. 2. The remedial action objectives would be to prevent exposure to contaminated sediments which would result in adverse environmental impacts.

D. PRPs AND FINANCIAL RESPONSIBILITY

D.1 Comment: A PRP inquired about who would be responsible for the operation and maintenance cost of the asphalt cap, when the cap's useful life is complete and needs to be replaced.

EPA Response: A definitive answer to the question cannot be given, due to the present and future variables concerning financial responsibility for the cleanup. The search for potentially responsible parties will continue for the Halby Chemical Superfund Site, and negotiations with the PRPs may determine who is going to pay for the cleanup and the operation and maintenance cost. If negotiations with the PRPs fail, then the cleanup may be paid for by the Superfund Trust Fund, in whole or part. The State of Delaware may also fund the cleanup and/or the long term operation and maintenance cost. However, there is no statute that automatically requires the State of Delaware to be financially responsible for every Superfund site within the state.

D.2 Comment: A PRP inquired about whether the owners of the process plant would be responsible for replacing the asphalt cap in 30 years, or whenever it needs to be replaced, without the help of the other PRPs identified for the Halby Chemical Site.

EPA Response: Predicting who will be financially responsible for replacing the asphalt cap thirty or more years from now is not possible. It can be stated that long term maintenance and monitoring of the asphalt cap is necessary and repairs will be made as needed. It is unlikely that EPA would walk away from this site and the hundreds of other sites across the country.

D.3 Comment: A PRP inquired about who would be financially responsible for the on-site lagoon and drainage ditch area if it is included in Operable Unit No. 2 with other off-site areas that may have different PRPs. Does the Halby Chemical Site property owner have to pay twice?

EPA Response: When a remedial action is to be taken at a Superfund Site, EPA searches for the PRPs, which include present and former property owners, operators, transporters, etc., for each specific action. For Operable Unit No. 1, negotiations with the PRPs for the process plant area would be undertaken. For Operable Unit No. 2, negotiations with the PRPs associated with the drainage ditch, lagoon area and the tidal marsh area would commence, whether they are the same or different PRPs for Operable Unit No. 1.

D.4 Comment: An adjacent property/business owner stated that, given the historical usage of the Halby Chemical Site and the industrialized nature of the study area, it would be difficult to put a complete financial burden on the present and former owners of the Halby Chemical Site for the cleanup, given the potential contamination dumped into the water over the years. If the lagoon is cleaned up without addressing the potential contamination sources from adjacent areas, then EPA is opening a "Pandora's Box" of additional contamination.

EPA Response: It is known, based on the PRP investigations to date, that other drainage lines have drained into the lower tidal marsh area, from locations other than the Halby lagoon area. During the studies that will be undertaken for Operable Unit No. 2, the PRP search will continue to identify all possible contamination sources and those PRPs that may be legally responsible for the cleanup.

D.5 Comment: A PRP inquired whether the I-495 is considered to be a "PRP" in the sense that the runoff from the highway may include contaminants that contribute to the Halby site contamination.

EPA Response: Upgradient samples in the I-495 runoff ditch were taken to assess the potential contamination from the 1-495 runoff. The levels of some of the metals were lower than those found in the lagoon area. Nevertheless, on-site migration of contamination in the lagoon area will be studied in Operable Unit No. 2.

E. OTHER CONCERNS

E.1 Comment: A local consultant inquired about how the Halby Chemical Site was selected as a Superfund Site, given the contamination on other properties in the vicinity.

EPA Response: Potential Superfund sites are brought to EPA's attention all the time. If, after preliminary investigations, the site ranks high enough in the Hazard Ranking System, then the site is listed on the National Priorities List (NPL). The detailed RI/FS studies are initiated, and the process continues through to remediation, monitoring and maintenance, and deletion from the NPL. In the case of the Halby Chemical Site, it was necessary to extend the study area to adjacent off-site areas where contamination was found, to determine the extent of contamination associated with the site and other potential sources of contamination.

E.2 Comment: A PRP inquired about whether or not EPA was aware that the plans to widen Terminal Avenue have been roadblocked since 1987 due to the designation of the Halby Chemical Site as a Superfund Site.

EPA Response: EPA is initiating the consultation process with the State of Delaware, local transportation agencies, and with Conrail (who would like to construct railroad crossing gates on Terminal Avenue), regarding the design of these transportation improvements.

PART 2

WRITTEN COMMENTS RECEIVED DURING THE PUBLIC COMMENT PERIOD

(Note: The section and page numbers cited prior to the comment are for the Remedial Investigation Report.)

A. REMEDIAL INVESTIGATION

A.1 Comment: Section 2.1, pp. 1-2 -- Provide a review of the aerial photos used in the RI report.

EPA Response: A review of the aerial photographs is provided in the EPIC document.

A.2 Comment: Section 3.8.3 -- Provide more information on the time of day and tidal cycle for water level measurements.

EPA Response: Time and day of water level measurements are provided in Table 2-14, Note 1. Tidal cycle information was not recorded.

A.3 Comment: Section 4, pp. 4-11, 4-16, 4-44, 4-46, 4-47, 4-48, 4-67, 4-72, 4-100, 4-101, 4-106, 4-130, 4-132, and 4-151 -- The following contaminants were blank qualified. State the reason for including the contaminants in the assessment of site contaminants.

Methylene Chloride (SW, SED, SSS, GW)
Arsenic (SW, SED)
Acetone (SED, SSS, GW)
2-Butanone (SED, SSS)
bis(2-ethylhexyl)phthalate (SED, SSS)
Chloroform (GW)

EPA Response: Pg. 4-6 of the RI report discussed in detail the procedures used for selecting chemicals that were detected in the blank samples. In summary, if the contaminant identified is a common laboratory contaminant, the contaminant will be considered if the sample concentration exceeds ten times the blank sample concentration. This procedure is an accepted EPA protocol.

A.4 Comment: Section 4.3.4, p. 4-18; Section 7.3, p. 7-1 -- The surface water sample results do not concur with the conclusion that arsenic has contaminated the surface water of the I-495 drainage ditch and tidal marsh area.

EPA Response: The conclusion is based on the fact that arsenic concentrations exceed the Federal Water Quality Criteria, even though the arsenic concentrations are below MCLs. A MCL is a drinking water standard which is not the situation for the surface water.

A.5 Comment: Section 4.3.4, p. 4-19 -- The level of zinc in the surface water sample collected from the pond near the Forbes Steel Plant is not discussed.

EPA Response: The discussion of zinc contamination at SW-04 is presented in Section 4.3.3, p. 4-16. The bullet item on p. 4-19 serves to point out the dissimilarity between contaminants on-site and off-site.

A.6 Comment: Section 4.3.5, Transverse #2 Figures -- Sample location SW-04 is not provided on the plots for Transverse #2.

EPA Response: The inclusion of sampling station SW-04 into the plots will not change the conclusion. It will only add to the complexity of the plots. It is therefore not included in the plots.

A.7 Comment: Section 4.4.1, Table 4-5 -- Additional sediment samples should have been collected at the background station to provide the change in concentration with depth.

EPA Response: The existing background sample has provided reasonable background information for the remedial investigation. EPA agrees that additional samples at depth would provide greater details to background information. This recommendation will be considered during Operable Unit No. 2 or remedial design, if it is determined necessary.

A.8 Comment: Section 4.4.3, p. 4-50 -- Only ranges of data results were provided in the RI report. A table of metal concentrations for off-site samples is required.

EPA Response: A table of metal concentrations for off-site and on-site samples can be found in Appendix A of Volume II. These data were not repeated in the text.

A.9 Comment: Section 4.4.3, p. 4-51 -- The text states that two samples collected from the coal and coke piles contained negligible amounts of TCL metals and therefore should not contribute significantly to metals loading of marsh sediments. However, the samples collected from the coal and coke piles contained metals above background levels. The statement regarding the level of contamination affecting the Halby site is not supported by this data. Detailed results of these samples should be presented in a table.

EPA Response: The data for the coal and coke pile samples were summarized in Table 4-16 with detailed results presented in Appendix A. As the data indicated, the concentrations of metals in the coal and coke piles are significantly less than the metal concentrations in the marsh sediment. For example, the maximum arsenic concentration in the coal and coke piles was 12 mg/kg. The arsenic in marsh sediment ranges from 28 mg/kg to 1,400 mg/kg. The coal and coke piles are therefore not a likely source for the metal contamination for the marsh sediment.

A.10 Comment: Section 4.4.5, p. 4-61; Figure 4-16 -- The RI report states that arsenic concentrations increase at station SED-24 in the tidal marsh. This statement is misleading because the elevated concentration was from a depth of 6 feet and no other samples discussed were collected below 2 feet. It is not appropriate to compare sample data from different depths.

EPA Response: The purpose of the discussion is to identify areas that are above background and to provide an indication regarding the migration of contaminants, regardless of the depth of samples collected. The resulting figure clearly indicated that arsenic has migrated off-site into the marsh area. It may be warranted to collect additional sediment samples at depth in the marsh area to verify if other locations are contaminated by arsenic at depth. These studies are included in Operable Unit 2.

A.11 Comment: Section 4.4.5.1, p. 4-75 -- The report incorrectly states that 4.66 ug/kg of thiocyanate occurs at 6 inches when it really was detected at a depth of 6 feet.

EPA Response: The comment is correct. As a result of this correction, thiocyanate concentrations did not increase with depth.

A.12 Comment: Section 4.5.1, p. 4-90 -- Sample SSS-13, together with sample SSS-06, should be used as background samples for soil at the site.

EPA Response: Inclusion of SSS-13 as part of the background samples to compare the soil data would not change the conclusions of the RI. The overall results from SSS-06 and SSS-13 did not differ significantly. None of the contaminants in these two samples has any concentrations outside of the range of the normal background (natural) soil.

A.13 Comment: Section 4, Tables 4-8, 4-10, 4-11, 4-13, 4-15 -- Sample qualifiers are not included for volatile and semivolatile compounds.

EPA Response: The comment is correct. Data qualifiers "B" and "J" are mistakenly omitted.

A.14 Comment: Section 4.5.2.2, p. 4-108 -- Station SSS-04 is not located near the process plant outfall.

EPA Response: The process plant outfall is located near SED-03 through an underground pipe. SSS-04 is in the vicinity of this outfall.

A.15 Comment: Section 4.7, p. 4-121 -- Wells W-03A and W-03B are located too far northwest for use to characterize upgradient water quality of the Columbia and upper Potomac aquifers for the process plant.

EPA Response: The comment is correct. Wells W-03A and W-03B are not directly upgradient of the process plant based on the directions of the groundwater flows in the Columbia and upper Potomac aquifers. However, these wells did provide general background groundwater information for the site as a whole. Additional wells may be warranted during remedial design if remediation of groundwater is required.

A.16 Comment: Section 4.7.1.3, p. 4-132 -- The result of benzene was not listed on Table 4-20 but was discussed in the text.

EPA Response: Table 4-20 is a summary table for major contaminants only. Benzene was detected in only one sample at a very low concentration and is therefore not listed. The result of benzene at W-01A was listed in Appendix A.

A.17 Comment: Section 4.7.1.3, p. 4-132 -- Vinyl chloride was detected in one sample but absent from the duplicate sample. Additional testing is requested to verify the presence of vinyl chloride in well W-04C.

EPA Response: Additional samples will be collected during Operable Unit No. 2.

A.18 Comment: Section 4.7.1.4, p. 4-133; Section 7.4, p. 7-2 -- Tidal influence on groundwater movement should be discussed.

EPA Response: The tidal influences on groundwater flow direction are discussed in the USGS study included as Appendix M.

A.19 Comment: Table 4-25, p. 4-149 -- Well W-01B is listed on Page 2-34 as a well completed in the Columbia aquifer. In Table 4-25, this well is included with the upper Potomac wells.

EPA Response: Well W-01B is incorrectly listed on Page 2-35. This well is constructed in the upper Potomac aquifer.

A.20 Comment: Section 4.7.2.4.1, p. 4-154 -- The salt pile and the Forbes Steel pond, instead of the old settling lagoon, are the likely sources for contamination in well W-02B.

EPA Response: Since W-02B is located off-site, it is not the intention of this RI to identify the contamination source(s) for this well. The report did not indicate that the old settling lagoon is the source of the Well W-02B contamination.

A.21 Comment: Section 5.3.3, p. 5-13 -- In Section 4, the detection of contaminants at station SW-08/SED-14 located in the tidal marsh is explained as the result of hydraulic connection between the western edge of the tidal marsh and the on-site lagoon, while the USGS study indicated that there is no hydraulic connection. The coal and coke piles could be responsible for contamination in the marsh.

EPA Response: As discussed in the responses to comments A.9 and A.26, the coal and coke piles are most likely not the source of metals and other inorganic contamination for the marsh area. Even though the USGS study indicated that there is no interaction between the shallow groundwater and the surface water for the general site area, the possibility exists that there is an interaction between the surface water at the marsh and lagoon. As a result of this concern, further study is planned during Operable Unit No. 2 to investigate this interaction.

A.22 Comment: Section 7.1, p. 7-1 -- The summary and conclusions text should also acknowledge that certain contaminants detected are not site related and that neighboring activities are probably the source.

EPA Response: The purpose of the RI is to characterize the site with emphasis placed on site-related contaminants. All non-site-related contaminants are properly discussed in Section 4 and are therefore not repeated in the summary section.

A.23 Comment: Section 7.2, p. 7-1 -- The text should indicate that the semivolatile compounds identified at stations SSS-09 and SSS-17 were primarily PAHs and several phthalate esters. The PAHs are not considered widespread site contaminants and were detected in background sample SSS-13 and associated with the coal/coke pile. The majority of the phthalate ester concentrations are blank qualified.

EPA Response: The above concerns have been adequately addressed in Section 4.5.2.1 and are therefore not repeated in the summary section.

A.24 Comment: Section 7.3, p. 7-1 -- Manganese is not previously discussed in Chapter 4 as being elevated in surface water in the on-site lagoon.

EPA Response: Concentrations of manganese in the on-site lagoon exceed the background concentration by an order of magnitude. Discussion should have been included in Section 4.

A.25 Comment: Section 7.3, p. 7-1 -- No mention is made that carbon disulfide was detected on-site but that there was none detected at stations in the tidal marsh.

EPA Response: Extremely high concentrations of carbon disulfide were detected in a sediment sample (SED-24) in the marsh area.

A.26 Comment: Sections 7.3 and 7.4, p. 7-2 -- Runoff of water used to wet the adjacent coal and coke piles to control dust could be the source of the cyanide detected at station SW-08 in the tidal marsh. Also, PAH compounds were detected in the tidal marsh at levels above those detected on-site and the coal/coke piles should be acknowledged as the probable source.

EPA Response: Total cyanide and PAHs were not detected in the coal and coke pile samples. The coal and coke piles are therefore not the likely sources of contamination.

A.27 Comment: Section 7.5, p. 7-2 -- It should be stated that the Columbia and upper Potomac aquifers are naturally unsuitable for human consumption as a result of elevated iron and manganese levels.

EPA Response: The discussion of water quality is presented in Section 4 and is not repeated in the summary section.

A.28 Comment: Section 7.5, pp. 7-2 and 7-3 -- In Section 7, cadmium, chromium, and lead are discussed as site contaminants that have contributed contamination to the groundwater, but the RI report identifies these metals as non-site-related and lists possible sources as Forbes Steel, the salt pile, and the coal/coke piles. Also, the data indicates that background and off-site concentrations exceed those detected on-site.

EPA Response: The summary section did not state these metals are site-related contaminants.

A.29 Comment: Section 7.6, p. 7-3 -- More detail should be provided to explain that the two bioassay stations (BIO-03, 06) which demonstrated aquatic toxicity from surface water were in the tidal marsh and at the confluence of the I-495 drainage ditch and the Christina River, respectively.

EPA Response: Details of the bioassay tests were provided in Section 2.10, Section 4.8, and Appendix K. EPA concurs that the statement should indicate the two stations which showed aquatic toxicity were located off-site.

A.30 Comment: Section 7.6, p. 7-3 -- In the last sentence, it should be clarified that the inconsistencies were in the mini-chronic toxicity test findings. As the sentence reads now, the reader doesn't understand that the 48-hour acute survival tests were considered valid.

EPA Response: The testing protocols and results were presented in Sections 2.10, 3.9, 4.8, and Appendix K. EPA concurs that a clarification statement here will be helpful.

A.31 Comment: Section 7.7, p. 7-3 -- The hypothetical future use of groundwater from the shallow aquifer is unlikely considering the naturally poor water quality and that the City of Wilmington already supplies potable water to this area.

EPA Response: According to the federal regulations, the groundwater underneath the Halby Chemical Site would be classified as Class IIA or IIB. Accordingly, there is a potential that the groundwater could be used as a potable water source. An existing on-site well (IW-01) which is screened in the upper Potomac aquifer was used as a cooling water source. It is therefore feasible to use it for other purposes such as showering. The proposed future use scenario, while admittedly unlikely, is certainly not impossible.

A.32 Comment: Section 7.7, p. 7-3 -- Based on ERM's review of the results of the risk assessment, a strong case could be made for the no action alternative or limited no action alternative in the FS.

EPA Response: Issues relating to the development of alternatives will be addressed in the responses relating to the Feasibility Study. However, the Baseline Risk Assessment prepared by EPA documents unacceptable risks to workers in the process plant area, thereby justifying the need to implement remedial measures.

B. RISK ASSESSMENT

B.1 Comment: Review of the PHE was difficult because of the RI organization.

EPA Response: The RI Report was prepared in accordance with the standard organization for RI Reports contained in EPA guidance.

B.2 Comment: The quantitative uncertainty analysis does not add validity to the results, and adds another layer of confusion.

EPA Response: The quantitative uncertainty treatment was requested and participated in by the EPA Region III risk assessment staff. The uncertainty approach used is presented as an acceptable methodology in the Risk Assessment Guidance for Superfund (RAGS), and the EPA's contractor involved in the risk assessment are recognized proficient practitioners of uncertainty analysis.

Also, past attempts to deal with uncertainty in risk assessment by calculating so-called "worst-case" estimates have resulted in unreasonably high upper bound estimates by use of a combination of worst-case assumptions. This resulted in confusion in interpretation of the risk assessment results. The use of quantitative uncertainty analysis serves to produce more reasonable upper confidence level risk estimates.

B.3 Comment: Summary data tables were not provided showing valid versus invalid samples. Also, non-detects were included at one-half the analytical detection limit for all classes of compounds. ERM's experience in Region III is that the whole detection limit is used for inorganics and PCB/pesticides.

EPA Response: All data evaluation objectives, approaches, and results were discussed with and approved by EPA Region III risk assessment staff, and are within the guidelines presented in the RAGS.

B.4 Comment: Background levels are not presented in tabular form; this would have been helpful.

EPA Response: Background levels were used properly in the evaluation of the data, according to guidance provided by the RAGS and the EPA Region III staff. While including summary tables of background levels may be helpful, this data is provided elsewhere in the RI.

B.5 Comment: No indication is given in the text whether or not the concentration times toxicity screening tool was used to screen compounds of concern for the Halby Chemical Site.

EPA Response: The concentration times toxicity screening tool was not used in the final screening for chemicals of concern for the Halby Chemical Site. The RAGS suggests that this tool be considered for use in cases where there are an unmanageable number of chemicals remaining after standard evaluation criteria have been applied. This was not the case for this risk assessment.

B.6 Comment: The use of 5 percent frequency of detection as a screening criterion, rather than the more widely accepted 25 to 50 percent, allows compounds frequently detected as laboratory contaminants to be selected as compounds of concern.

EPA Response: The use of 25 to 50 percent detection frequency as a selection criterion is not widely accepted. The RAGS present frequency of detection as an optional criterion, to be used when the number of chemicals involved is unmanageable. The RAGS further recommend that the limits on exclusion of infrequently detected chemicals be approved by the RPM. Additionally, a comparison to blank sample concentrations was made in this data evaluation to account for the possibility of common laboratory contamination.

B.7 Comment: Non-site related compounds such as lead, zinc, and PAHs were not considered separately in analyzing risks from exposure to compounds from the site. The compounds of concern included both non-site and site related compounds.

EPA Response: If a contaminant's measured concentration was elevated above it's background concentration level, then it was considered to be a compound of concern in the risk assessment. There is insufficient information available to exclude these compounds as non-site related compounds.

B.8 Comment: From the information given in the text, it is impossible to determine which compounds were eliminated from the list of contaminants of concern. If the toxicity times screening tool had been used, a majority of compounds would have been eliminated.

EPA Response: The general approach (per EPA guidance) used to evaluate the data is explained on pages 6-4 and 6-5 of the text.

B.9 Comment: In the PRP's consultant's judgment, the final compounds of concern for this site would have been limited to arsenic and carbon disulfide. Potential laboratory contaminants, such as acetone and methylene chloride, should not have been considered. Compounds representing off-site sources should be treated independent of those compounds related to site activities.

EPA Response: If compounds were included in the risk assessment that contribute little risk, then including them would demonstrate if this is the case. Analyzing all chemicals of concern to evaluate their contributions to risk is an objective of the risk assessment.

B.10 Comment: The inhalation of volatile contaminants through the use of groundwater in the Columbia and Upper Potomac aquifers in a (future) showering scenario is stretching the hypothetical case because the likelihood of use of these aquifers is extremely low.

EPA Response: The current EPA guidance for risk assessments (RAGS) specify that possible future land use scenarios be identified for analysis, in consultation with the RPM. The EPA Region III risk assessment staff and the RPM believe that the future use of contaminated groundwater from these aquifers by industrial workers for showering cannot be reasonably eliminated as a possibility. A quantitative evaluation of the likelihood of this scenario is not possible but a judgment that it has enough potential to merit inclusion in the analysis has been made by EPA.

B.11 Comment: MCLs should not be applied to concentrations detected at the site. It is more appropriate to apply MCLs to estimates of discharges from the aquifers to the Christina River.

EPA Response: The criteria shown in Tables 6-9 through 6-11 are properly labeled as "potential ARARs." The EPA is the final arbitrator of which ARARs will be applied in the establishment of cleanup levels.

B.12 Comment: The current MCL for lead is 50 ug/L. Add a table describing the groundwater and surface water concentrations at the Christina River. Add a strongly worded statement that indicates the concentrations detected in groundwater are "real concentrations only if someone is exposed".

EPA Response: The current MCL for lead is 15 ug/L. The impacts at the Christina River are beyond the scope of this PHE. An exposure pathway was considered complete, in accordance with the RAGS, if the following four elements were present: 1) a source and mechanism of chemical release to the environment from the site, 2) an environmental transport medium, 3) a point of potential human contact with the contaminated medium, and 4) an intake mechanism at the contact point. Table 6-11 should be changed to show the MCL for lead is 15 ug/L.

B.13 Comment: Anthracene is a Class C carcinogen, and should not be included in the risk assessment. The slope factors used for carcinogenic PAHs are higher than those documented in recent toxicological articles.

EPA Response: The basis for the toxicological criteria used for PAHs is discussed on page 6-66, and was specified by the EPA Region III risk assessment staff.

B.14 Comment: The highest uncertainty is in the toxicological evaluation. Uncertainty in the toxicological parameters were not included in the uncertainty analysis in Section 6.7.

EPA Response: This observation is correct, and is stated in the text.

B.15 Comment: Site-specific exposure assumptions were not defined because a range of assumptions were used.

EPA Response: The exposure assumptions ,as discussed in Section 6.6.2 of the Public Health Evaluation (Sept 1990), were precisely specified in the analysis as probability distributions.

B.16 Comment: Standard exposure assumptions from the Exposure Factors Handbook (EFH) were not used consistently. Some exposure assumptions were given as ranges from pre-guidance document articles.

EPA Response: Every exposure parameter distribution was developed taking into consideration all pertinent studies in the literature, including those that form the basis of values recommended in the Exposure Factors Handbook. Every exposure parameter distribution contains the EFH values within its range, but also accounts for the full range of information available on the parameter.

B.17 Comment: For residential exposure, the text does not discuss the risk posed by exposures for 6-12 year old children.

EPA Response: See Appendix 6-2 for Hazard Indices (HIs) for all groups. As a general rule, HIs were presented for the children's category showing the highest risk (2-6 year old children).

B.18 Comment: The generic equation for ingestion given on page 6-71 has a component called FI which is not defined in the text.

EPA Response: FI is the fraction of soil ingested from the contaminated source, and is presented in the generic equation for soil ingestion on page 6-73. The value of this parameter was assumed to be 1.0 throughout the analysis, and is discussed on page 6-78 at the end of the first paragraph.

B.19 Comment: The modeling used to calculate exposure concentrations for resuspended particulate matter and volatilized compounds from the soil did not employ the current USEPA Air/Superfund National Technical Guidance Study Series documents.

EPA Response: While the guidance in the National Technical Guidance Study Series was not used directly in this assessment, the models which were used have been reviewed and accepted by the EPA for risk assessments. The Cowherd model and the box dispersion model are recommended in the EPA Superfund Exposure Assessment Manual.

B.20 Comment: The sediment data used in the risk assessment appears to cover the full boring depth. The concentrations should have been limited to shallow sediments.

EPA Response: The distributions developed for exposure concentrations in sediment were based on shallow samples.

B.21 Comment: Justification was not given for using older draft guidance documents in calculating particulate emissions and volatile emissions from soils to air.

EPA Response: See EPA Response to Comment B.19.

B.22 Comment: More PAH compounds were used in the risk tables as compounds of concern than were identified as detected on-site in the Section 6.2 discussions.

EPA Response: As explained on page 6-66, the carcinogenicity of PAHs were estimated using an approach suggested by Thorslund (1988). Carcinogenic risks were assessed for all compounds which were addressed in that study. This resulted in the treatment of a number of PAHs as carcinogenic, which IRIS and the HEAST specify for non-carcinogenic treatment. The result is the discrepancy between Table 6-1 and the risk estimate tables for some PAHs. This approach provides a less conservative estimate of PAH-associated cancer risk than would be obtained by applying the cancer potency slope factor for BaP to all PAHs designated as "carcinogenic" in Table 6-1.

B.23 Comment: Justification for the selection of the Foster and Chrostowsi (1987) model for shower inhalation exposures was not provided. No sample calculations or input variables were given.

EPA Response: The Foster and Chrostowski model was selected because it is conservative, has been accepted by the EPA in numerous risk assessments, and has been validated by measurements. Sample calculations have not been provided; however, the spreadsheets are available from EPA and can be used to reproduce all calculations using LOTUS and @RISK.

B.24 Comment: Example calculations were not provided throughout the document. Because of the uncertainty analysis, verification of the calculations could not be made.

EPA Response: Standard procedures were employed to assure the quality of the calculations made in the risk assessment. Sample calculations have not been provided; however, all spreadsheets are available from the EPA and can be used to reproduce all calculations using LOTUS and @RISK.

B.25 Comment: Summary intake tables were not provided as recommended in the RAGS. Listed soil concentrations were not specified as maximum or mean. An effort was not made to lead the reader through these tables.

EPA Response: The tables in Appendix 6-2 are functionally equivalent to the tables recommended in the RAGS. Soil concentrations shown are expected values.

B.26 Comment: The concentrations of compounds used in this risk assessment may not accurately represent exposure levels. Invalid data were not specified and arithmetic means were not calculated. Risk tables do not specify whether a maximum or average concentration was used.

EPA Response: All valid data from the RI were used to develop cumulative frequency distributions for contaminant concentrations. In this manner, the concentrations are precisely represented as distributions which take into account all valid data. Tables in Section 6.6 were used to report expected values for contaminant concentrations. Tables 6-1 through 6-5 report the mean and maximum concentrations and the detection frequencies.

B.27 Comment: EPA had calculated the risk posed by surface sediments to trespassers as within the range of 10^{-6} to 10^{-7}. Ebasco calculated a cancer risk of $3x10^{-5}$ for adults occupationally exposed at the site. Explain why the children (trespassers) had less risk in the EPA calculations than adult workers did in the Ebasco calculations.

EPA Response: The reason for the difference in risk results is because of the exposure assumptions used in the two calculations. The EPA calculations assigned a very low exposure frequency for the trespassers as there are little attractions in the lagoon. The Ebasco calculations assumed that there will be work performed in the lagoon. As a result, the worker could be exposed to the sediment while performing work in the lagoon. The exposure frequency and duration would be much higher for a worker than a trespasser. Consequently, the risk would be higher.

B.28 Comment: The assumed use of the shallow aquifer is extremely hypothetical because ground water in the region is not used as potable water by residential or industrial areas. Therefore, the risk to someone using the groundwater at the site should be negligible.

EPA Response: The risk estimate for the future groundwater use scenario is <u>not</u> negligible. The assessment of hypothetical future land use scenarios is specified in the RAGS.

B.29 Comment: The risk calculations based on ambient air monitoring data are not considered applicable because the number of areal sources is varied. The compounds detected during the air monitoring study, in general, were not detected frequently or in all media at the site, which indicates other sources.

EPA Response: This issue is discussed in the first paragraph on page 6-23. The data may not provide a representative characterization of year-round air quality at the site, and cannot be used to identify which of the detected pollutants may be site-related.

B.30 Comment: The total hazard index for the groundwater exposure scenario is 110, and is a direct result of the carbon disulfide concentrations in the groundwater samples. Again, this scenario is highly unrealistic based on known groundwater use in the area. Therefore, the hazard from groundwater should be negligible.

EPA Response: See EPA Response to Comment B.28.

B.31 Comment: The quantitative uncertainty analysis is unwarranted. A better use of time and dollars would have been to calculate a reasonable or most probable case and a worst-case upper bound risk, as discussed in the guidance document.

EPA Response: The guidance document (RAGS) does <u>not</u> recommend estimating a worst-case upper bound risk. The RAGS discusses calculating a Reasonable Maximum Exposure (RME) with careful consideration given to characterization of uncertainties in the risk assessment. The quantitative uncertainty treatment was requested and participated in by the EPA Region III risk assessment staff. The uncertainty approach used is presented as an acceptable methodology in the <u>Risk Assessment Guidance for Superfund</u> (RAGS), and the EPA contractor's staff members involved in the risk assessment are recognized proficient practitioners of uncertainty analysis.

Past attempts to deal with uncertainty in risk assessment by calculating so-called "worst-case" estimates have resulted in unreasonably high upper bound estimates by use of a combination of worst-case assumptions. This resulted in confusion in interpretation of the risk assessment results. The use of quantitative uncertainty analysis in this PHE serves to produce more reasonable upper confidence level risk estimates.

B.32 Comment: It is the PRP's consultant's professional judgment that Section 6.7, Appendix 6.1, and Appendix 6.2 add little, if any, information to the overall conclusion of the risk assessment.

EPA Response: The quantitative treatment of uncertainty in this risk assessment provided assurance that "best-estimate" and upper and lower confidence level risk estimates are reasonable and well-founded.

B.33 Comment: The RI report indicated that the human health risk caused by the soil and sediment is within the acceptable risk range of $1x10^{-4}$ to $1x10^{-6}$. EPA recalculated the risk caused by soil and sediment exposure by using different and inappropriate exposure assumptions. The reason behind the change in the exposure assumptions is unclear.

EPA Response: The Ebasco risk assessment used geometric means of the contaminant concentrations of the entire site (process plant, lagoon and the other areas) for the risk calculation. The method is appropriate for the general population but was not adequate for the plant workers, whom are restricted to the process plant area most of the time. As a result, EPA recalculated the risk for on-site workers based on data from the process plant only, which is representative of exposure for on-site workers.

B.34 Comment: The extreme values employed by EPA in estimating frequency, duration, and amount of exposure are not reasonable maximum values, as required by EPA guidance.

EPA Response: The frequency, duration, and amount of exposure are discussed in detail in the risk assessment report. Per EPA guidance, the values range from low frequency, short duration, and small exposure to high frequency, long duration, and large exposure. A probability value was assigned to each value used to determine the likelihood of such occurrence.

B.35 Comment: EPA's cleanup target for arsenic in surface soils considered ingested arsenic as carcinogenic and ignored RCRA and other Agency policies that treat ingested arsenic as non-carcinogenic.

EPA Response: The risk assessment was prepared following the EPA guidance for risk assessment in general and for Superfund sites in particular. The cancer potency factors were obtained from EPA's Integrated Risk Information System (IRIS) database and the Health Effects Assessment Summary Tables. It is not the function of this document to resolve the discrepancy between various EPA programs.

B.36 Comment: The RI conducted by Ebasco indicated the carcinogenic and non-carcinogenic risk to fall within the acceptable EPA ranges. Based on these risk calculations, no further remediation or limited remediation is warranted at the Halby Chemical Site.

EPA Response: The risk calculations performed by Ebasco were for the whole site (including the areas occupied by the warehouses). EPA has recalculated the risks based on data within the process plant area. Both calculations indicated that carcinogenic risks exceeded the benchmark of $1x10^{-6}$ risk for on-site workers. EPA's calculations indicated that the plant area has cancer risks exceeding the EPA acceptable range. As a result, remediation of the process plant is warranted.

B.37 Comment: The risk calculations are a gross exaggeration of the more realistic risks posed by the site. The exposure assumptions are clearly ridiculous.

EPA Response: EPA established guidance and methodologies have been closely followed when performing these risk calculations. The assumptions used were either established by EPA, other agencies, or generally acceptable practices by the risk assessment profession. It is EPA's understanding that the calculations should be conservative and, in some cases, represent the worst case scenario.

B.38 Comment: The FS mentions that EPA recalculated dermal contact, particulate inhalation, and ingestion exposures to workers from compounds detected in surface soils. EPA used different exposure assumptions than Ebasco did in the 1990 risk assessment. Appendix A in the FS report did not provide the detailed assumptions used for these risk calculations. Justification for this new risk calculation and supporting documentation are requested from EPA.

EPA Response: Supporting documentation has been made available to the requester.

B.39 Comment: a) The modeled inhalation hazard index for residential exposures was inadvertently reported as 1.0. The calculated index from Ebasco's report was 0.33.

b) Although the Hazard Index for surface soil exposure is greater than 1, an effort was not made to recalculate the HI according to the same target organ effects, which is required whenever the worst-case summed hazard exceeds one.

EPA Response: a) This is a correct observation. The Hazard Index for residential exposures from volatile inhalation (modeled) has an expected value of 0.33, as shown in Table 6-43 or the RI. Table 1 of the PRAP should be corrected.

b) As shown in Table 6-43 of the RI, the expected HI for the total of onsite surface soil exposures for current land use scenarios is 1.5. In the USEPA Risk Assessment Guidance for Superfund (RAGS), guidance is provided that when the total hazard index exceeds unity and if combining exposure pathways has resulted in combining hazard indices based on different chemicals, one may need to consider segregating the contributions of the different chemicals according to major effect.

While this practice is recommended for the characterization of risk, in the context of a Feasibility Study to be protective of public health it is prudent to set cleanup goals based on keeping total hazard indices at less than 1.

C. REMEDIAL ALTERNATIVES DEVELOPMENT AND SELECTION

Soil Cleanup Levels:

C.1 Comment: In selecting the soil cleanup level, EPA did not add to the background arsenic concentration the 10 mg/kg level that causes (according to EPA) a $1x10^{-5}$ excess cancer risk.

EPA Response: EPA would like to clarify that the cleanup level for arsenic which will be established for the Halby Chemical Site will be based on background concentrations. Currently, the background concentration for arsenic, based on a limited number of samples, has been estimated at 10 ppm, which corresponds to a cancer risk of 1×10^{-5}. Additional samples will be taken during predesign to develop a more representative background value for arsenic. The NCP mandates cleanup levels in the range of $1x10^{-6}$ to $1x10^{-4}$, with $1x10^{-6}$ as the benchmark. Since it is not practical to reduce risk to below background, the background risk has been selected as the cleanup target. The commenter has suggested that the value corresponding to 10^{-5} excess cancer risk for arsenic be added to the background value to determine the soil cleanup level.

EPA would utilize the benchmark of $1x10^{-6}$ excess cancer risk to determine an acceptable level of incremental risk resulting from the site. This would result in a total cancer risk of $1.1x10^{-5}$ ($1x10^{-5} + 1x10^{-6}$) with a corresponding cleanup level of 11 ppm (assuming the background concentration for arsenic is confirmed to be 10 ppm). However, as pointed out above and discussed in the FS report (p. 2-28), the cleanup level should be the average background level, not the upper bound of background concentrations. The actual arsenic concentration range may be from non-detect to several times the background concentration. As a result, the 1 ppm addition for the excess cancer risk becomes meaningless as the cleanup level is based on sets of sample results, not on a single value.

C.2 Comment:

a) One commenter disagrees with the use of CPAHs as chemicals of concern at the site.

b) The commenter stated that 1.2 ppm could not be the background concentration for PAHs. Also, in deriving the 1.2 ppm cleanup level for PAHs, EPA did not consider the background sample taken near the asphalt plant (SSS-13).

EPA Response:

a) From Figure 1-10 of the FS report, there are two locations (SSS-09 and SSS-17) that have higher CPAH concentrations (by up to two orders of magnitude) than the remaining areas of the site and off-site, including the sample from the asphalt plant. The level is likely a result of manmade activities at these two areas. Because of the high potency factors

for the CPAHs, it is appropriate to include these chemicals in the risk assessment.

b) The background concentration of 1.2 ppm of CPAHs is derived by averaging four off-site samples, which include SSS-06, SSS-13, SB-3, and SB-4. As noted in the previous response, additional samples will be taken during pre-design to establish a more representative value for background concentrations of CPAHs.

C.3 Comment: If the Ebasco risk calculations were used in the derivation of arsenic soil cleanup levels, a clean-up level of 180 mg/kg for arsenic would have been derived. The commenter performed calculations based upon the use of appropriate reasonable maximum exposure assumptions and a risk goal of 10^{-5}. These calculations yielded a value of 207 mg/kg arsenic for the worker scenario assuming carcinogenic effects of arsenic through the soil ingestion route.

Levels set for arsenic in surface soils at other Superfund sites, the findings of ATSDR, the Washington State Cleanup Regulations, and the levels proposed for the RCRA corrective action rule all underscore the overly stringent nature of the surface soil arsenic cleanup target of 10 mg/kg for the Halby Chemical Site.

EPA Response: The risk assessment was performed using conservative assumptions and closely following the EPA guidelines. However, as discussed in the response to comment C.1 above, the Ebasco risk assessment used geometric means for the entire site. EPA recalculated the risk using data from the process plant, which is more closely related to the existing situation.

As previously discussed, EPA intends to establish the soil cleanup level for arsenic based on additional sampling to confirm a representative background value for arsenic. The arsenic cleanup level for surface soil at the Whitmoyer Site is set at background level, not at 2,836 mg/kg as cited in the comment. The arsenic cleanup level for contaminated soil at the Vineland Chemical Site was set at 20 ppm, also similar to the level tentatively identified for the Halby Chemical Site.

Sediment Cleanup Levels:

C.4 Comment: EPA states that the National Oceanographic and Atmospheric Administration (NOAA) has derived cleanup levels for heavy metals in the lagoon sediment. However, NOAA states that these values are not to be construed as NOAA standards or criteria. These values were used as informal guidelines to rank sites with regard to relative potential adverse effects at hazardous waste sites. NOAA further states that the degree of confidence at the low end of the range should be considered relatively poor.

EPA Response: As indicated in Appendix B, the cleanup levels were specifically developed by NOAA for the Halby Chemical Site based on toxic effects data gathered by NOAA. Even though these values should not be treated as standards or criteria, these values are nonetheless "guidelines to be considered." These values represent estimates of concentrations at or above which adverse effects were often detected. In the absence of established sediment criteria and/or standards, it was the best professional judgment by NOAA that the overall apparent effect's threshold could be recommended as target cleanup levels.

C.5 Comment: EPA used the same cleanup level for lagoon sediments as for soils. This means that EPA assumed that an individual would eat 100 mg of sediment, located beneath plant discharge water, for 165 days a year for a lifetime. This scenario is highly unlikely.

EPA Response: The cleanup levels for soil and sediment were developed independently. The soil cleanup level was developed for protection of human health from direct contact with contaminated soil. The sediment cleanup level was developed for protection of human health as well as the environment (biota). The evaluation process may look similar, but the remedial objectives were treated separately for the site soil and sediment.

Bioassay Investigations:

C.6 Comment: The following comments have been raised regarding the bioassay investigation:

a) The organisms used in the test do not appear to have been allowed sufficient time to acclimate.

b) Some mortality may have been due to factors other than toxic responses such as widely v ~ying organic carbon levels in the samples.

c) High survivorship in the control may be related to more favorable conditions and not the absence of toxicity. No chemical or physical data is provided to allow for this assessment

d) A comparison of on-site toxicity results to upstream and downstream locations does not reveal a contamination gradient. The Christina River and the tributary which discharges off-site drainage to the lower marsh are causing greater toxic effects than the site. This indicates that the other sources are more toxic than the site.

e) The aquatic community could potentially provide more information on the impact of the site than laboratory testing, especially considering the variability of the lab results.

EPA Response: Since remediation of the lagoon has been deferred to Operable Unit No. 2, these comments will be addressed during the feasibility study for Operable Unit No. 2.

Other Technical Issues:

C.7 Comment: Only seven criteria were used in the analysis of the alternatives instead of the stated nine criteria in the FS report.

EPA Response: Seven criteria were used in the evaluation of alternatives during the feasibility study. The two remaining criteria, namely state and community acceptance, were evaluated during the public comment period. All comments received during this period are considered prior to the issuance of the Record of Decision.

C.8 Comment: The treatability study results demonstrate that metals are relatively immobile and pose no significant risk to groundwater and surface water. The treated soil samples leached more arsenic and other metals than the untreated samples. This result indicates that the proposed treatment of soil might increase the mobility of arsenic and other metals.

EPA Response: The treatability study (TS) results did demonstrate that metals in soil were relatively resistant to TCLP leaching. However, the RI data also

indicated that the surface water and groundwater were contaminated by arsenic or other metals to some extent. The treatability study demonstrated that arsenic is relatively difficult to immobilize using cement alone. However, some other binding agents have been more successful in immobilizing arsenic, as demonstrated in TS at other Superfund sites. If stabilization is selected in the ROD, a treatability study will be performed during the remedial design phase to identify a proper formula for immobilizing arsenic. It should be noted that stabilization not only serves to immobilize heavy metals, more importantly, it also serves to reduce direct contact, ingestion, and inhalation of the contaminated soil.

C.9 Comment: Based on the EPA's remedial action objectives, only soil and sediment would require active remediation. Groundwater, air, and surface water would be remediated through source control or prevention of exposure.

EPA Response: The remediation of contaminated soil within the process plant will be addressed in Operable Unit No. 1. The remediation of contaminated sediment, groundwater, air, and surface water is deferred to Operable Unit No. 2. Whether management of migration for groundwater, air, and surface water is required or not will be determined during the Remedial Investigation/Feasibility Study for OU-2.

C.10 Comment: EPA considered a scenario to remove all contaminated soil by excavating down to the groundwater table or five feet, whichever is less. Existing tanks and equipment would be dismantled for disposal to allow excavation to five feet. This scenario is based on the potential future residential site usage. However, taking into account the current usage of the site as an industrial facility and the fact that the site is located in a heavily industrialized area, the EPA scenario is highly improbable.

EPA Response: It is EPA's belief that the scenario proposed is not highly improbable given the fact that there are currently residences (three trailer houses) located within the site boundary. Furthermore, residential communities are located in close proximity to the site.

C.11 Comment: The significant chemical reduction effect of the tidal event has been ignored by EPA in the evaluation of the remedial alternatives. It should be noted that the tide causes significant daily dilution of the groundwater and surface water. This effect, in combination with the fact that the discharge of chemicals from the plant has stopped, indicates that the concentrations of chemicals will be declining with time. Therefore, five-year reviews of the site in combination with institutional controls would be the more appropriate remedy for this site.

EPA Response: All site features, including the tidal event, have been considered in the development of remedial alternatives. As mandated by the NCP and CERCLA as amended by SARA, EPA must evaluate a wide range of remedial alternatives, including no action, containment, and treatment action. As a result, the five-year reviews in combination with institutional controls, was evaluated in the limited action alternative. The effect of tidal influence has been considered for the remediation of surface water. It is EPA's judgment that the limited action alternative would not achieve the remedial objectives.

C.12 Comment: On page 2-40 of the FS report, EPA makes a statement that "[b]ut extended contact with soil vapors or surface water would pose an unacceptable risk level." This contradicts an earlier statement made by EPA that "[A]ssessment of the risks posed by the surface water in the lagoon indicates that there is little cause for concern over adverse health effects occurring as a result of dermal exposure..."

EPA Response: The statement made on page 2-40 was referring to a hypothetical site that is most suitable for future use restrictions. It was not intended to describe the Halby Chemical Site.

C.13 Comment: Page 4-3: "Additional threats to humans and the environment may result from soil erosion which could result in the exposure of more highly contaminated soil. This exposure could result in increased risk to human health..." and page 4-10: "...[m]ay result from soil erosion which could result in increased risk to human health..." These statements are totally contradicted on page 1-41: "[I]f similar assumptions about the frequency and duration of exposures to subsurface soil were made as for exposures to surface soil, the resultant

cancer risks would be similar in magnitude, since the geometric mean concentration of arsenic in the subsurface soil (210 mg/kg) is very close to that found in surface soil (250 mg/kg)." EPA makes sweeping statements that have no technical basis to justify remediation of soils at the site.

EPA Response: The geometric means used for risk calculations are similar for surface soil and subsurface soil. However, there were subsurface areas (e.g., SSS-23 and SSS-25) with highly contaminated soil. Should these areas be exposed, the carcinogenic risks could increase.

C.14 Comment: EPA notes in Table 2-8 that the stabilization process could be reversed under adverse conditions. In other words, EPA has proposed a treatment method for soil/sediment that is both unnecessary and of questionable long-term effectiveness.

EPA Response: Since heavy metals are elements that cannot be destroyed using conventional methods, the only treatment technologies available are either containment or stabilization. Under the Resource Conservation and Recovery Act, the Best Demonstrated Available Technology for treatment of heavy metals is stabilization. Since stabilization involves physical and/or chemical bonding of heavy metals only, this bonding can be reversed under certain unfavorable conditions. A properly selected immobilization agent would be able to withstand most frequently encountered environmental conditions without degradation of the product.

C.15 Comment: The FS failed to consider in the Identification and Screening of Technologies section the capping of soils by a soil cover (without any "treatment") as a potentially applicable technology. This technology would reduce dermal contact and achieve the same results as paving.

EPA Response: A soil cover for the process plant has been evaluated in Section 2.4.2.3 (page 2-45). The soil cover has been incorporated into Alternatives S-3 and S-4 to supplement the asphalt cap for areas that have little plant activity, are inaccessible for equipment to place the asphalt cap, and areas that are not suitable for the asphalt cap.

C.16 Commer. EPA is concerned about the presence of PAHs found in only two soil samples at low concentrations; however, the asphalt-based alternative will introduce a significant amount of PAHs to the environment at levels that are probably much higher than what are already present at the site.

EPA Response: The asphalt cap is designed to protect against direct contact with arsenic and other heavy metals, as well as the two locations containing high concentrations of "carcinogenic" PAHs.

C.17 Comment: The FS and the Proposed Plan state that "[T]he asphalt cap would require maintenance and possible replacement in the future" (emphasis added) (page 12). Therefore, the cost for Preferred Alternative S-4 has been underestimated since the asphalt cap replacement cost has not been considered.

EPA Response: A properly maintained asphalt cap could last 20 to 30 years. As such, the asphalt cap replacement would be at the end of the 30 year period. The replacement cost would be approximately $25,000 (2" wear coat), $50,000 (4" asphalt cap), or $66,400 (cap and gravel base), depending on the condition of the cap at the time of replacement. The cost estimate for the FS is required to be accurate to within +50% and -30%. The maximum replacement cost of $66,400 is 4% of the $1.6 million cost estimate. It is therefore within the guidance requirements.

C.18 Comment: a) The average arsenic soil contamination level used for purposes of this risk assessment was approximately 334 parts per million. Nine of the eleven surface soil samples contained arsenic in concentrations substantially lower than 100 ppm. Sample point SSS-09, which had an extremely high concentration of arsenic, obviously contributed to the high average arsenic concentration. However, the laboratory data reported that SSS-09 had an arsenic concentration level of less than 1,130 ppm. The data did not reflect how much less the actual concentration was. Further study of the arsenic concentration in surface soil at the process plant area and recalculation of the risk using the new data are therefore requested.

b) Collect actual dust samples from inside and outside the plant to test the assumption that any dust ingested is generated solely from soils within the process plant area.

c) EPA should reconsider the need for any remedial action following recalculation of risk.

EPA Response:

a) During remedial design, additional soil samples will be collected to refine the locations within the process plant area which will be stabilized and capped. EPA does not plan to re-conduct the risk assessment unless there are major changes in the sample results.

b) The majority (90%) of the carcinogenic risk is from dermal contact and ingestion of the contaminated soil. Inhalation of dust particles accounts for less than 10% of the risk. It will be extremely difficult to make a conclusive statement regarding the origin of the dust particles, even with extensive sampling effort, due to the variability of weather and plant activities. EPA therefore has not planned to sample dust particles.

c) There are provisions in the NCP to reconsider the remedial action if there were major deviations from the RI results. EPA does not foresee this being the case for the Halby process plant area. Therefore, there is currently no plan to reconsider remedial action at the site.

C.19 Comment: DNREC (Department of Natural Resources and Environmental Control) of the State of Delaware recommended that the lagoon and plant outfall area be deferred to Operable Unit No. 2. The drainage ditch should be remediated together with the process plant in Operable Unit No. 1.

EPA Response: After discussion with the State of Delaware, EPA has decided to defer the remediation of the lagoon, plant outfall area, and plant drainage ditch to Operable Unit No. 2. Operable Unit No. 1 only includes the process plant. As a result of this decision, all concerns regarding the remediation of the lagoon, the plant outfall area, and the drainage ditch from the State of Delaware will be addressed during the execution of Operable Unit No. 2 and will not be included in this responsiveness summary.

C.20 Comment: DNREC commented that the remediation of the process plant needs to comply with certain state ARARs.

EPA Response: The State of Delaware will have opportunities to provide input to the remedial design. EPA will ensure that state ARARs will be complied with.

C.21 Comment: DNREC has concerns that the results of the treatability studies have been applied to new site conditions.

EPA Response: EPA will attempt to resolve DNREC's concerns in the treatability studies to be performed during the remedial design for the process plant.

C.22 Comment: DNREC is concerned that the asphalt cap in Alternative S-3 will not have sufficient load bearing capacity for the truck and forklift traffic.

EPA Response: If this alternative is selected, the asphalt cap will be properly designed to withstand the traffic load. A preliminary review of the load bearing capacity did not indicate this to be a problem.

C.23 Comment: DNREC is concerned that there may be hexavalent chromium in the plant soil to hinder the stabilization process.

EPA Response: The selected remedy in the Record of Decision calls for confirmation of whether the chromium is in the hexavalent form or the trivalent form. If it is confirmed that chromiun does exists in the hexavalent form, a proper stabilization formula will be selected.

C.24 Comment: DNREC is concerned that the clean fill proposed in Alternative S-5 may be recontaminated by site contaminants.

EPA Response: The process plant does not currently produce chemicals. It receives bulk chemicals at the site and distributes them to end users. Therefore, the source of arsenic no longer exists. Once the contaminated soil is removed from the site, there will not be a source of arsenic to re-contaminate the clean fill which is located in the unsaturated zone.

C.25 Comment: DNREC has various concerns regarding the remedy for the lagoon and drainage ditch.

EPA Response: Since the remediation of the lagoon and drainage ditch have been deferred to Operable Unit No. 2, the concerns from DNREC will be addressed during the execution of Operable Unit No. 2.

C.26 Comment: DNREC has recommended that EP toxicity tests be performed on stabilized soil if it fails TCLP testing. Such arrangement may avoid the need to re-process the failed batch of soil.

EPA Response: EPA will consider such an arrangement during remedial design.

APPENDIX I

DESCRIPTION OF EVALUATION CRITERIA

ALTERNATIVE EVALUATION CRITERIA

Overall Protection of Human Health and the Environment: Addresses whether the remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced or controlled through treatment, engineering controls, or institutional controls.

Compliance with ARARs: Refers to whether or not a remedy will meet all **Applicable or Relevant and Appropriate Requirements (ARARs)** of Federal and State environmental statutes and/or provides grounds for invoking a waiver. It also addresses whether or not the remedy complies with advisories, criteria and guidance that EPA and DNREC have agreed to follow.

Long-Term Effectiveness and Permanence: The ability of the remedy to maintain reliable protection of human health and the environment over time once the "clean-up" goals have been met.

Reduction of Toxicity, Mobility or Volume Through Treatment: Relates to the anticipated performance of the treatment technologies with respect to these criteria.

Short-Term Effectiveness: Refers to the period of time needed to achieve protection, and any adverse impacts on human health and the environment that may be posed during the construction and implementation, until "clean-up" goals are achieved.

Implementability: The technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement a particular option.

Cost: A comparison of the estimated capital, operation and maintenance, and net present worth.

State Acceptance: This indicates whether, based on its review of the FS, the Proposed Plan and public comments, the State concurs with, opposes, or has no comment regarding the preferred alternative.

Community Acceptance: Views expressed by the community during the Public Comment period are taken into account when identifying the selected remedy.

APPENDIX II

ADMINISTRATIVE RECORD INDEX

DRAFT

HALBY CHEMICAL SITE
ADMINISTRATIVE RECORD FILE *
INDEX OF DOCUMENTS

I. SITE IDENTIFICATION

1. Report: A Preliminary Assessment of Halby Chemical Company, prepared by Delaware Department of Natural Resources and Environmental Control (DNREC), 12/83. P. 100001-100027.

2. Report: Site Inspection of Halby Chemical Company, prepared by NUS Corporation, 1/10/85. P. 100028-100205.

3. Technical Services Section Sampling Report for Log Numbers 833, 834, 835, 836, 837, 838, 839 and 840, 3/21/85. P. 100206-100212. The following are attached:

    a) the laboratory analysis results for Sample Number 842;
    b) a map of Wilmington;
    c) the laboratory analysis results for Sample Number 841.

4. Report: Documentation Records for Hazard Ranking System, prepared by U.S. EPA, 4/25/85. P. 100213-100388.

5. Letter to Mr. Jay Murphy, Delaware Contracting Company, from Mr. Glenn K. Elliott, re: I-495 Salt Storage Area Hydrogeologic review, 6/18/85. P. 100389-100415. The following are attached:

    a) a Well Construction and Stratigraphy Table;
    b) a Groundwater Level Elevation Table;
    c) a Groundwater Quality Data Table;
    d) a Location Sketch Observation Well Map;
    e) a Location Plan;
    f) a Stratigraphic Profile Table;
    g) four Piezometric Level Maps;
    h) three Stratigraphic Logs;
    i) six boring logs.

* Administrative Record File available 7/21/89, updated 4/19/91.

6. Letter to Mr. John J. Casey, City of Wilmington, from Mr. James F. Duffield, Duffield Associates, re: Hydrogeologic Reconnaissance Bulk Storage Areas, Port of Wilmington, 1/8/86. P. 100416-100426. A Cost Estimate Summary, a General Contract Conditions Statement, and a Supplemental General Contract Conditions Statement are attached.

7. State of Delaware Application for a Permit to Drill a Well form, 1/22/86. P. 100427-100434. A Well Completion Report and a Site Map are attached.

8. Report: I-495 Bulk Storage Area Hydrogeologic Reconnaissance, prepared by Duffield Associates, Inc., 4/17/86. P. 100435-100452.

9. Letter to Mr. John J. Casey, Jr., City of Wilmington from Mr. James F. Duffield, Duffield Associates, re: I-495 Bulk Storage Area Groundwater Quality Analysis, 8/4/86. P. 100453-100457. Two Ground Water Quality Monitoring Tables are attached.

10. Letter to Mr. R. G. Shockley, Brandywine Chemical Company, from Mr. Garth Glenn, NUS Corporation, re: Receipt of letter, 9/3/86. P. 100458-100459. A letter regarding the series of samples taken at the Old Halby Chemical Plant is attached.

11. Letter to Mr. Christopher J. Corbett, U.S. EPA, from Mr. Joseph J. Hardman, DNREC, re: Transmittal of the Preliminary Hydrogeologic Investigation, 4/14/87. P. 100460-100492. The report is attached.

12. Letter to Mr. Leonard Nash, U.S.EPA, from Mr. Joseph J. Hardman, DNREC, re: Transmittal of the soil test results, 6/25/87. P. 100493-100507. A report entitled Department of Transportation Review Section of Terminal Avenue Project is attached.

II. REMEDIAL ENFORCEMENT PLANNING

1. Letter to Mr. Bob Shockley, Brandywine Chemical Company, from Mr. Stephen R. Wassersug, U.S. EPA, re: Responsible Parties conducting Remedial Investigation and Feasibilty Studies, 4/17/86. P. 200001-200004. A certified mail receipt is attached.

2. Letter to Mr. Nirmal Jala, Argus Chemical Corporation, from Mr. Stephen R. Wassersug, U.S. EPA, re: Responsible parties conducting Remedial Investigation and Feasibility Studies, 4/17/86. P. 200005-200008. A certified mail receipt is attached.

3. Letter to Mr. William Wishnick, Witco Chemical Company, from Mr. Stephen R. Wassersug, U.S. EPA, re: Responsible parties conducting Remedial Investigation and Feasibility Studies, 4/17/86. P. 200009-200012. A certified mail receipt is attached.

4. Letter to U.S. EPA, from Mr. R.G. Shockley, Brandywine Chemical Company, re: Possible clean up of the Halby Chemical Site, 5/12/86. P. 200013-200015. A letter regarding the confirmation of a meeting between U.S. EPA officials and representatives of Witco/Argus Corporation and an envelope are attached.

5. Letter to Mr. Steve Miano, U.S. EPA, from Mr. William C. Grabarek, Witco Corporation, re: Witco Corporation's decision not to accept Agency's invitation to conduct a company sponsored RI/FS at the site, 7/23/86. P. 200016-200017. An envelope is attached.

III. REMEDIAL RESPONSE PLANNING

1. Report: Work Plan and Field Operations Plan for Phase I Remedial Investigation at Halby Chemical Site, prepared by AEPCP, Inc., 10/3/88. P. 300001-300115.

2. Memorandum to Mr. Darius Ostrauskas, U.S. EPA, from Ms. Diane Baldi, U.S. EPA, re: Comments on the Workplan and Field Operations Plan for Halby Chemical Site, 11/30/88. P. 300116-300117. A memorandum regarding the Workplan and Field Operations Plan for Phase I Remedial Investigation of Halby Chemical Site is attached.

3. Report: Preliminary Health Assessment for Halby Chemical, prepared by Agency for Toxic Substances and Disease Registry (ATSDR), U.S. Public Health Services, 1/4/89. P. 300118-300122.

4. Letter to Mr. Christopher J. Corbett, U.S. EPA, from Mr. Joseph J. Hardman, PADER, re: The preliminary hydrogeological investigation report, 4/14/87. P. 300123-300155. The report is attached.

5. Report: Final Work Plan Remedial Investigation and Feasibility Study, Halby Chemical Site, prepared by EBASCO, 11/4/87. P. 300156-300289.

6. Letter to Mr. Darius Ostrauskas, U.S. EPA, from Mr. Bradley A. Hilton, Advanced Engineeringand Planning Corp. (AEPCO), re: Phase II surficial soil work plan, 7/20/89. P. 300290-300298. Table 1-stage II surficial soil samplingand table 2-second stage surficial soil sampling matrix and analytical parameters are included.

7. Memorandum to Mr. Darius Ostrauskas, U.S. EPA, from Mr. Richard L. Brunker, U.S. EPA, re: Review of sediment analytical results, 9/29/89. P. 300299-300300.

8. Letter to Ms. Paula Retzier [sic], U.S. EPA, from Mr. Bradley A. Hilton, AEPCO, Inc., re: Concern by DNREC regarding aquifer testing, 12/13/89. P. 300301-300310. A preliminary groundwater elevations table, three of the aquifers, and two test results are attached.

9. Letter to Ms. Paula L. Retzler, U.S. EPA, from Mr. Thomas S. Anderson, DNREC, re: Summarization of January 5, 1990 meeting, 1/11/90. P. 300311-300311.

10. Letter to Mr. Bradley A. Hilton, AEPCO, Inc., from Ms. Paula L. Retzler, U.S. EPA, re: Response to proposed pump test, 2/6/90. P. 300312-300312.

11. Report: Draft Quality Assurance Project Plan for Perforamnce of Treatability Studies on Environmental Samples, prepared by PEI Associates, Inc., 3/90. P. 300313-300460.

12. Letter to Ms. Paula Retzler, U.S. EPA, from Mr. Thomas S. Anderson, DNREC, re: DNREC's comments on the draft Remedial Investigation, 3/16/90. P. 300461-300467. The comments are attached.

13. Letter to Mr. Frank Tsang, EBASCO Environmental, from Ms. Paula Retzler, U.S. EPA, re: Transmission of partial review comments on the draft Remedial Investigation (RI) and Risk Assessment (RA) reports, 4/5/90. P. 300468-300487.

14. Letter to Ms. Paula Retzler and Ms. Roberta Riccio, U.S. EPA, from Ms. ALyce T. Fritz, National Oceanic and Atmospheric Adminstration (NOAA), re: Review and comments concerning the Draft Remedial Investigation report, 4/5/90. P. 300488-300493.

15. Letter to Ms. Paula Retzler, U.S. EPA, from Mr. Thomas S. Anderson, DNREC, re: Comments on the Draft Public Health Evaluation, 4/5/90. P. 300494-300495.

16. Memeorandum to Ms. Paula Retzler and Ms. Roberta Riccio, U.S. EPA, from Mr. Richard L. Brunker, U.S. EPA, re: Review of the risk characterization, 4/9/90. P. 300496-300497.

17. Report: Treatibility Study Trip Report, prepared by Weston, 4/26/90. P. 300498-300519.

18. Memorandum to Mr. Richard Brunker, U.S. EPA, from Mr. Peter Ludzia, U.S. EPA, re: Letter dated April 27, 1990 for Roberta Riccio to review, 5/1/90. P. 300520-300524. The letter is attached.

19. Report: Treatibility Study Samples Analytical Report, prepared by Roy F. Weston, Inc., 5/18/90. P. 300525-300538.

20. Letter to Ms. Roberta Riccio, U.S. EPA, from Ms. Jane F. Biggs, DNREC, re: List of the ARARs identified for the State of Delaware, 6/14/90. P. 300539-300540. The list is attached.

21. Letter to Ms. Roberta Riccio, U.S. EPA, from Mr. Frank Tsang, EBASCO, re: Analysis of ground water data, 7/13/90. P. 300541-300546. Table 1--contaminent Analysis and Appendix A, Calculation of Potential Surface Water Contaminent by Ground Water Flow are attached.

22. Letter to Ms. Roberta Riccio, U.S. EPA, from Mr. Tim Silar, EBASCO, re: Review of the findings of the U.S. Geological Survey's (USGS) investigation of tidal effects on shallow ground water movement, 7/31/90. P. 300547-300547.

23. Memorandum to Ms. Roberta Riccio, U.S. EPA, from Ms. Diane Wehner, Mr. Bob Davis, and Mr. Ron Preston, U.S. EPA, re: Recommendation of additional sampling, 8/9/90. P. 300548-300548.

24. Report: Final Public Health Evaluation, prepared by EBASCO, 9/90. P. 300549-300954.

25. Report: Appendices A through D Volume II Final RI Report, prepared by EBASCO, 9/12/90. P. 300955-301272.

26. Report: Appendices E through M Volume III Final RI Report, prepared by EBASCO, 9/12/90. P. 301273-301525.

27. Memorandum to Ms. Roberta Riccio, U.S. EPA, from Ms. Diane E. Wehner, re: Response to a request for assistance in establishing clean-up levels, 9/24/90. P. 301526-301526.

28. Report: Volume I Preliminary Final Remedial Investigation Report, prepared by EBASCO, 9/28/90. P. 301527-301848.

29. Report: Revised Quality Assurance Work Plan, prepared by Roy F. Weston, Inc., 12/90. P. 301849-301867.

30. Memorandum to Ms. Roberta Riccio, U.S. EPA, from Ms. Diane Whener, Mr. Bob Davis, and Mr. Ron Preston, U.S. EPA, re: Additional sediment sampling and toxicity testing recently completed at the site, 2/14/91. P. 301868-301868.

31. Memorandum to Ms. Roberta Riccio, U.S. EPA, from Mr. Richard L. Brunker, U.S. EPA, re: Results of calculated risks and hazards from exposures to individuals who work at the operating facility on the Halvy Chemical Facility, 2/15/91. P. 301869-301872. Table 1--Calculated Cancer Risks from Exposures to Arsenic and PAHs in the Industrial Work Place at the Halby NPL Facility is attached.

32. Memorandum to Ms. Roberta Riccio, U.S. EPA, from Ms. Diane Wehner, Mr. Bob Davis, and Mr. Ron Preston, U.S. EPA, re: Biological Technical Assistance Group (BTAG) providing recommendations regarding remediation of wetland sediments in the lagoon and further investigation and need for remediation of the lower marsh area, 3/7/91. P. 301873-301873.

33. Memorandum to Ms. Roberta Riccio, U.S. EPA, from Ms. Diane K. Wehner, NOAA, re: Summary of and comments on the preliminary results of additional chemical analysis and toxicity tests performed on lagoon and marsh sediments, 3/27/91. P. 301874-301876.

34. Memorandum to Ms. Roberta Riccio, U.S. EPA, from Ms. Bernice Pacquini, U.S. EPA, re: Review of the EBASCO letter dated July 13, 1990, 4/11/91. P. 301877-301877.

35. Memorandum to Ms. Paula Retzler and Ms. Roberta Riccio, U.S. EPA, from Mr. Ronald Preston, Ms. Alyce Fritz, and Mr. Robert Davis, U.S. EPA, re: Review of the pre-RI data package, (undated). P. 301878-301879.

36. Report: A Biological Assessment of the Halby Chemical Company, Superfund Site, prepared by U.S. Fish and Wildlife Service, (undated). P. 301880-301961.

37. Letter to Mr. Tom Anderson, DNREC, from Ms. Roberta Riccio, U.S. EPA, re: Highlights of a December 27, 1989 meeting, (undated). P. 301962-301964. The list of attendees is attached.

38. Report: Final Feasibility Study Report Operable Unit No . 1(OU-1), prepared by NUS Corp., 4/91. P. 301965-302234.

39. Report: Analytical Chemistry and Solid Phase Toxicity Bioassay on the Halby Chemical Company Superfund Site, prepared by U.S. Fish and Wildlife Service and U.S. EPA, 4/91. P. 302235-302528.

40. U.S. EPA Proposed Remedial Action Plan, Halby Chemical Site, 4/91. P. 302529-302553.

IV. REMOVAL RESPONSE PROJECTS

1. Memorandum to Mr. Robert Caron, U.S. EPA, from Mr. Greg Janiec, U.S. EPA, re: Halby Chemical Site, PCS #3292, 3/28/85. P. 400001-400027. The following are attached:

   a) a location map;
   b) six photographs of the site;
   c) a memorandum regarding the QA/QC Review of Halby Chemical Results;
   d) a Halby Chemical TAT Region III Summary Report;
   e) the Halby Chemical Analytical results;
   f) a memorandum regarding the Laboratory Charges - Halby Chemical Site TAT Region III Office;
   g) a Halby Chemical Site TAT Region III Summary Report;
   h) a memorandum regarding the additional Laboratory charges;
   i) the GC/MS Fraction Volatile Compounds Sample Data for RFW Numbers 8503-348-0010, 8503-348-0020, 8503-348-0030, 8503-348-0040, 8503-348-0050;
   j) a sample location map;
   k) six sample Data Summary sheets;
   l) a Record of Communication regarding information needed to document the HRS score;
   m) a site map.

2. Letter to Mr. Harold G. Byer, U.S. EPA, from Mr. Garth Glenn, NUS Corporation, re: Comments on Well Number 1, 9/3/86. P. 400028-400029.

3. Memorandum to Mr. Douglas Fox, U.S. EPA, from Mr. Michael Wilson, U.S. EPA, re: Halby Chemical Company Trip Report, 10/5/87. P. 400030-400065. The following are attached:

   a) a TAT Sample Locations Map;
   b) a Certificate of Laboratory Analysis for Sample Numbers W-01, S-01, S02 and S03;
   c) a Discussion of Findings;
   d) a Sample Data Package Cover Sheet;
   e) a Water Surrogate Recovery Summary for Case No. SAS 3364C;
   f) the Organic Analysis Data Sheet for Sample I.D. Numbers W01, S01, S02 and S03;
   g) a Method Blank Summary;

h) the Organic Analysis Data Sheets for Sample Numbers 1007D and 1007B;
i) the Organics Traffic Reports for Sample Numbers, CB158, CB161 and CB189.

4. Letter to Mr. Doug Fox, U.S. EPA, from Mr. Joseph J. Hardman, DNREC, re: Bore hole results, 10/5/87. P. 400066-400078. The following are attached:

a) two boring locations maps;
b) a memorandum regarding Halby Chemical Trip Report;
c) a TAT Sample Location Map;
d) a Certificate of Laboratory Analysis Sample, I.D. Numbers W-01, S-01, S-02 and S-03;
e) a Discussion of Findings;
f) the Organic Analysis Data Sheet for Sample Numbers W01.

V. COMMUNITY INVOLVEMENT/CONGRESSIONAL CORRESPONDENCE/IMAGERY

1. Report: Final Community Relations Plan for Halby Chemical Site, prepared by EBASCO, Inc., 8/30/88. P. 500001-500021.

2. Report; Draft Final Community relations Plan, Halby Chemical SIte, prepared by NUS, 4/91. P. 500022-500048.

SITE SPECIFIC GUIDANCE DOCUMENTS INCLUDED

Superfund Treatability Study Protocol: Solidification/Stabilization of Soils Containing Metals Phase II Review Draft, prepared by U.S. EPA, (undated).