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ENGINEERING EVALUATION AND COST ANALYSIS (EE/CA) REPORT

for

Installation Restoration (IR) Site 56
Lead Contamination at
National Pollutant Discharge Elimination System (NPDES)
Industrial Wastewater Outfall (IW) 87

Indian Head Division
Naval Surface Warfare Center
101 Strauss Avenue
Indian Head, Maryland
20640-5035

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Naval Surface Warfare Center
INDIAN HEAD DIVISION

FOREWORD

The purpose of this Engineering Evaluation and Cost Analysis (EECA) is to support the need for an Interim Removal Action of the lead contaminated sediment at Installation Restoration (IR) Site 56, National Pollutant Discharge Elimination System (NPDES) Industrial Wastewater Outfall 87 (IW87).

This EECA provides cleanup alternatives and evaluates each alternative for the following:

1) protection of human health and the environment,
2) implementability,
3) cost efficiency, and
4) consistency with final remedial goals and applicable or relevant and appropriate requirements (ARARs).

A cleanup alternative for the Interim Removal Action will be chosen based on the results of the above evaluations. This action will be undertaken under the authority of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 and the Superfund Amendments and Reauthorization Act (SARA) of 1986.

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EXECUTIVE SUMMARY

This Engineering Evaluation and Cost Analysis (EECA) was prepared for the Indian Head Division, Naval Surface Warfare Center (IHDIVNAVSURFWARCEN) Installation Restoration (IR) Site 56 to determine the most appropriate cleanup method for a Removal Action at this site. In order to be considered, an interim remedial alternative must be:

1) protective of human health and the environment,
2) consistent with final remedial goals and applicable or relevant and appropriate requirements,
3) easy to implement,
and 4) cost efficient.

These items, which a removal action must address, are consistent with the CERCLA.

IR Site 56 consists of the sediments in three areas of the Biazzi Nitration Plant:

a) the pit outside of Building 790,
b) 700 foot length of cracked underground pipe,
and c) an open channel area six feet wide, 30 feet long, and 2 feet deep at the end of the pipe.

These three areas discharge to Industrial Wastewater Outfall 87 (IW87). A limit of 82 micrograms per liter for lead in wastewater at IW87 was established in June 1992 by the Maryland Department of the Environment, since the outfall is part of the National Pollutant Discharge Elimination System (NPDES). Since the limit became effective, it has been exceeded 8 times. In addition, the sediments in the areas described above are contaminated with lead and have failed the Toxicity Characteristic Leaching Procedure (TCLP) test for lead. Because the water was found to exceed the Federal and State Ambient Water Quality Criteria, this EECA was prepared to determine whether or not a Removal Action to remove the source of the contamination was necessary and if so, what was the most likely removal alternative.

The resulting alternatives, including a "No Action" alternative, were compared to determine compliance with the criteria listed above. As a result, two alternatives were found to satisfy all of the criteria. These Removal Action alternatives include:

a) Alternative 4, Removal of Sediment in the Pit, Pipe, and Outfall with Relining of the Pipe;
b) Alternative 5, Removal of the Sediment in the Pit, Pipe, and Outfall with Abandonment of the Pipe.

These alternatives were then evaluated for cost efficiency. The cost to implement Alternative 4 is $255,000 and Alternative 5 is $207,000-$232,000. Because the costs are relatively the same, the recommendation from the EECA is that either alternative is acceptable. The final determination of what shall be done with the system, after the system is cleaned of all contaminated sediment, shall be evaluated by the Navy at a future date. The approach will be to let the remedial construction contractor propose a means to complete the removal with either pipe abandonment or relining. This

proposal, which will be based on the contractor's experience and technical approach, shall be evaluated by the Navy and the removal will follow after final Navy approval.

AUTHORITY AND PURPOSE

This EECA is being performed by the Navy under the authority granted the Navy as the lead agency in the National Contingency Plan, Title 40 of the Code of Federal Regulations (CFR) Section 300 Subpart B (40 CFR 300 Subpart B). The lead agency is given the authority to conduct removal actions in 40 CFR 300.130. This EECA is part of a non-time critical removal action as specified in 40 CFR 300.415. The pattern of the report follows the Guidance on Conducting Non-Time Critical Removal Actions Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), EPA Publication Number PB93-963402 of August 1993. State and local participation are in accordance with 40 CFR 300 Subpart F, State Involvement in Hazardous Substance Response, and the Maryland Superfund Memorandum of Agreement.

An administrative record has been established at the Indian Head Division, Naval Surface Warfare Center (IHDIVNAVSURFWARCEN or IHD-NSWC) and the Engineering Field Activity Chesapeake, per 40 CFR 300 Subpart I. In addition, Information Repositories containing all pertinent documentation from the Administrative Record have been established at the IHDIVNAVSURFWARCEN General Library, Building D-40, and the Charles County Public Library in La Plata, Maryland.

1.0 ACTIVITY DESCRIPTION

This section contains a description of the Indian Head Division, Naval Surface Warfare Center (IHDIVNAVSURFWARCEN), including information on topographic setting, history, climate, geology, hydrology, and additional features.

1.1 Topographic Setting

The IHDIVNAVSURFWARCEN is located in Indian Head, Maryland, approximately 25 miles south of Washington, DC, at the southern terminus of Maryland Route 210. The mainside of the IHDIVNAVSURFWARCEN occupies approximately 2,400 acres of land and is situated on a peninsula formed at the confluence of the Potomac River to the northwest, and the Mattawoman Creek to the south-southeast, in the west-central portion of Charles County, Maryland (Figure 1-1).

1.2 History and Background

The principal mission of the IHDIVNAVSURFWARCEN is research, development, and production of propellants and explosives for the United States Navy. The scope of operations ranges from laboratory research to full-scale production and testing. The IHDIVNAVSURFWARCEN is the largest employer in Charles County, Maryland, and, since operations began in 1892, has consistently proven to be a vital economic force in Southern Maryland.

1.3 Climate

IHDIVNAVSURFWARCEN is located in the Atlantic Coastal Plain on the east bank of the Potomac River, lying midway between the rigorous climate of the north and the mild climate of the south. Since IHDIVNAVSURFWARCEN is located in the middle latitudes where the general atmospheric flow is from west to east across North America, it has a continental-type climate with four well-defined seasons. However, the proximity of the Potomac Ricer and its tributaries have a considerable modifying effect on the climate, especially in moderating extreme temperatures.

Generally, the coldest period of the year is late January and early February when the early morning temperature averages 21°F. The warmest period is late July when the afternoon maximum temperature averages 89°F. The highest temperature on record in the county is 108F, recorded at Newburg in July 1930, while the lowest was -12°F at La Plata in January 1913. Precipitation is evenly distributed through the year with either July or August being the wettest month, and February or October the driest. The heaviest precipitation during the colder half of the year is generally the result of low pressure systems moving northeastward along the Atlantic coast; in summer it occurs as thunderstorms. The highest official one day precipitation on record is 6.45 inches, which occurred at Waldorf in August 1955. Thunderstorms occur on an average of 35 days per year, mostly from May through August.

Prevailing surface winds are from the west-northwest to northwest except during the warm months of the year when they become more southerly. The most windy period is late winter and early spring. The growing season is approximately 187 days long.

1.4 Geology[1]

The surficial geology comprises Cretaceous fluviodeltic, Tertiary marine, and Quaternary fluvial deposits, which include the Cretaceous Upper Patapsco Formation, the Tertiary Aquia Formation, and the Quaternary deposits of the Potomac River System.

The upland is an erosional remnant of the Upper Patapsco Formation capped by a thin layer of Tertiary Aquia Formation. The Quaternary sediments make up the majority of the surficial exposures and are generally thickest in the lower relief area.

The USGS reports that the early Potomac River cut paleochannels across the Indian Head Peninsula during the Quaternary (Hiortdahl, 1990). A paleochannel is evident where Quaternary deposits form a belt along the northeast end and the southeastern part of the facility. The southern section of the paleochannel extends across the entire southern region of the facility. Portions of these units subsequently have been eroded by the current Potomac River and Mattawoman Creek systems.

1.5 Hydrology[1]

The shallow, water-bearing zones (water table aquifer) of IHDIVNAVSURFWARCEN are controlled by the shallow soil deposits. In general, the water table appears to be between 7 and 10 feet below the ground surface within the Quaternary sediment belt. Lithologies of the water-bearing zones were usually restricted to silty and sandy clay zones.

A thin layer of the Tertiary deposits overlay the Upper Patapsco confining unit along the upland in the northwest. Soils in this area are very stiff, with lithologies ranging from silt to silty clays. A marker bed on top of the Upper Patapsco Formation, an iron-cemented reddish sand unit was encountered during the Site Inspection in the upland area at depths ranging from 30 to 40 feet. The upper-most aquifer is the Patapsco aquifer, which is estimated to be more than 100 feet below ground surface in the upland area.

Data collected during the Site Inspection generally indicate that the inorganic quality of the water table aquifer is poor. Analytical results of groundwater samples indicate elevated concentrations of total dissolved solids in the water table aquifer suggesting that water from the surficial zones is not suitable as a potable water source. This unit is not used as a potable water source on the peninsula (Hiortdahl, oral communication 1993).

Potable water wells at IHDIVNAVSURFWARCEN are screened in one or more sand zones in either the Patapsco or Patuxent Formations (Hiortdahl, oral communication 1993) to a average depth of 200-300 feet. These potable water wells serve an approximate population of 3,350 people, including civilian and enlisted Navy employees, as well as contractor employees. None of these wells supply reserves or residences beyond the facility boundaries.

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[1] The information in this section was obtained from the Final Site Inspection Report Phase II of March 4, 1994

1.6 Additional Features

IHDIVNAVSURFWARCEN contains archeological sites which contain Indian artifacts dating back 12,000 years. In addition, the Mattawoman Creek is a popular fishing location and is frequently used for national bass fishing tournaments. Numerous bird species, including the bald eagle, great blue heron, a variety of waterfowl, and several neotropical migratory species feed in the approximately 300 acres of tidal and nontidal wetlands present.

FIGURE 1-1
Physical Setting of IHDIVNAVSURFWARCEN

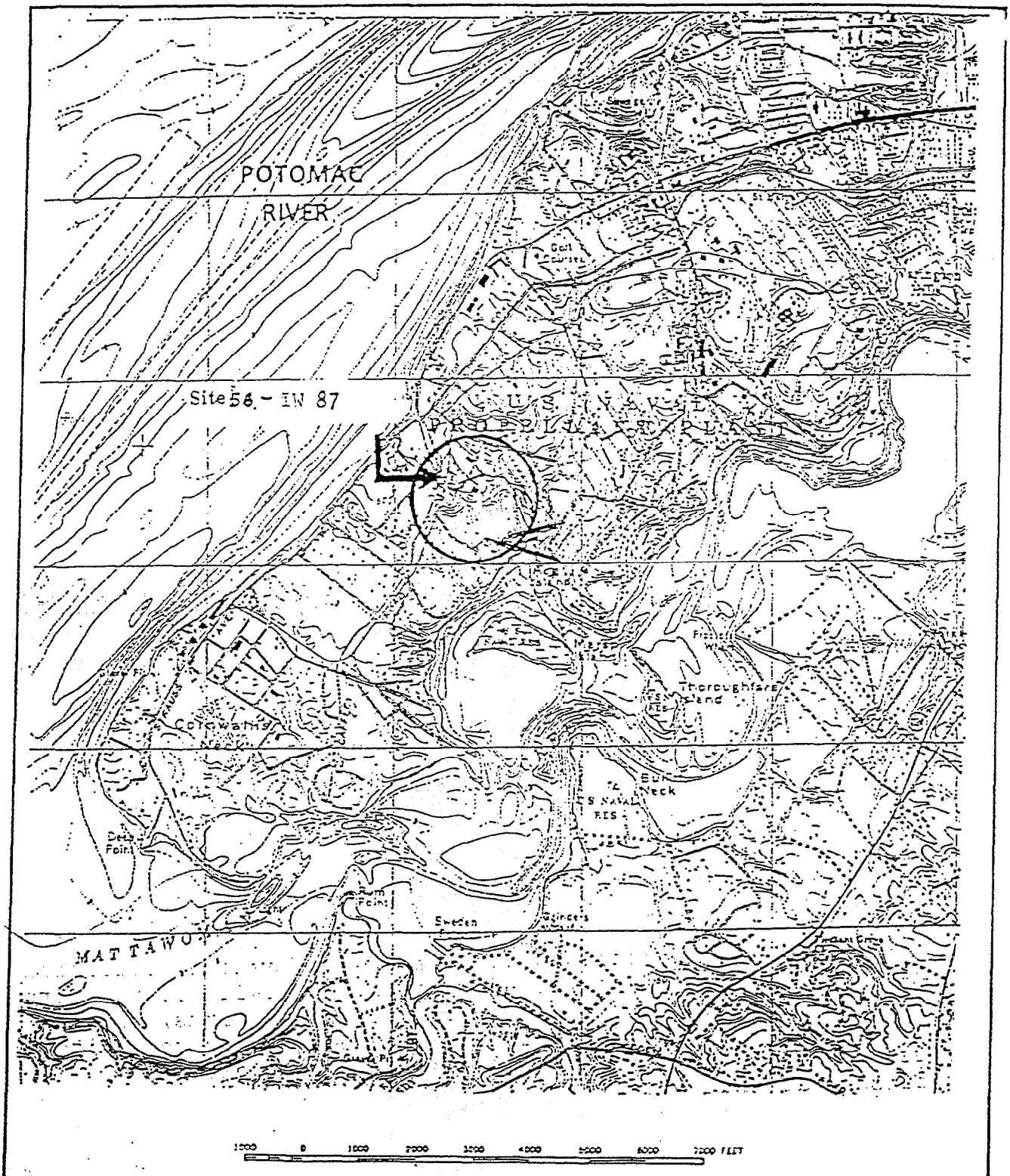


FIGURE 1-1 SITE LOCATION MAP INSTALLATION RESTORATION PROGRAM	SITE 56 - Industrial Outfall (IW) 87, Lead Sediment

Source: 7.5 Minute USGS Quad Indian Head, MD-VA 1966 Photo Revised 1978

2.0 IR SITE 56 DESCRIPTION

This section contains a brief background and description of Installation Restoration Site 56 (site 56). The site consists mainly of National Pollutant Discharge Elimination System (NPDES) Outfall 87 (IW87).

2.1 Background

2.1.1 Biazzi Nitration Plant

The Biazzi Nitration Plant was constructed in 1953 to provide a continuous process for the manufacture of Nitroglycerin (NG). In 1963, the facility was expanded to include the production of Otto Fuel, which contains Propylene Glycol Dinitrate, a nitrate ester similar to NG. Additional nitrate esters can be and are produced at the Biazzi Nitration Plant.

2.1.2 Building 790

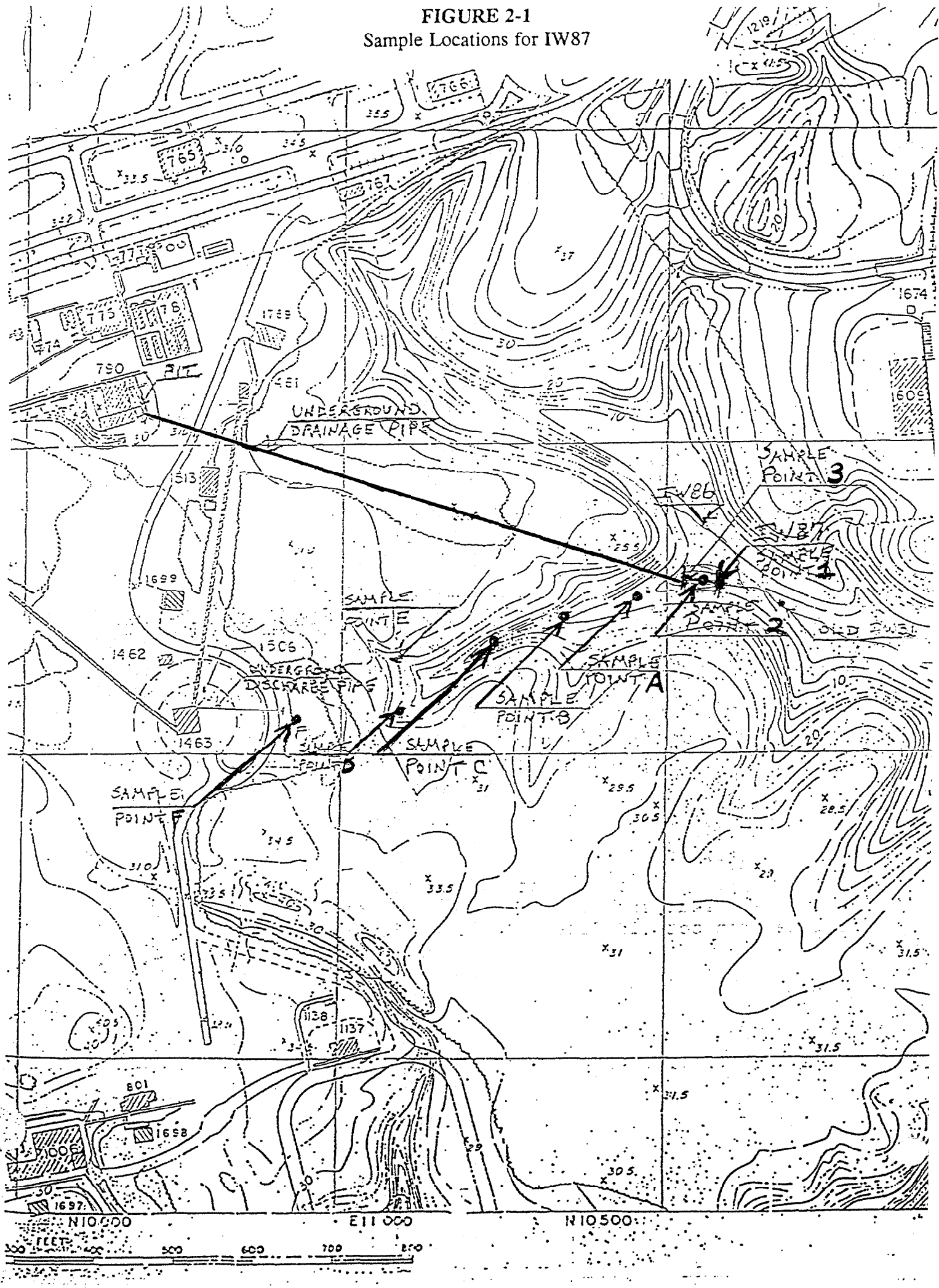
Building 790 is located in the Biazzi Nitration Plant and is used for the storage of spent nitric and sulfuric acid from the production of nitrate esters. The building is part of the original nitration facility and was constructed in 1953.

All explosives operating buildings, including Building 790, are constructed following the Navy Explosive Safety instruction, OP-5. OP-5 requires these buildings be equipped with conductive floors to eliminate the possibility of static electricity discharges which may cause an explosion. In the past, the floors in these buildings were lined with lead to provide a conductive surface. Today, lead is no longer used for this purpose.

2.1.3 IW87

Industrial wastewater (IW) outfall monitoring limits were established at IHDIVNAVSURFWARCEN in 1985, as a result of the National Pollutant Discharge Elimination System (NPDES) regulations, 40 CFR 122. IW87 is part of the original IW31, which is no longer in existence and is shown on Figure 2-1. The original sampling parameters were established based on operations at the time the permit was issued. Therefore, IW31 was monitored for flow, total suspended solids, nitrogen, phosphorus, nitrate esters, mercury, and lead. Although the requirement to monitor for lead became effective in 1988, no limit for lead was established at that time.

FIGURE 2-1
Sample Locations for IW87



In 1990, IW31 was split into two distinct sample locations, IW31A and IW31B, which are upgradient of IW31. Since then, these sample locations were relabeled as IW86 and IW87, respectively. Both IW86 and IW87 are monitored for the same parameters as the original IW31, as required by NPDES regulations. The requirement to monitor for mercury at IW31 was based on Installation Restoration (IR) Site 8. IR Site 8 is upgradient of the new IW86 and does not affect the discharge at IW87. In fact, mercury has never been detected in the discharge at IW87. More information on IR Site 8 can be found in the Administrative Record and IR Repositories.

The majority of the water entering IW87 is from storm water runoff. However, some sources are from plant operations, such as equipment cooling water and maintenance washwater. Appendix A contains a list of permitted discharges, effluent limitations, and monitoring requirements for IW87, as provided in the NPDES permit number MD0003158A (MDE permit 88-DP-2515A) modification of March 1, 1994. A majority of these sources enter a pit outside Building 790, which discharges through an underground pipe to IW87. Figures 2-2 and 2-3 show the pipes that enter the pit and provides a brief description of their sources.

In addition, a large volume of water flows overland to IW87 from a sump pump at Building 1463. The sump pump runs almost continuously in wet months and pumps groundwater away from the building, which is located partially underground, similar to Building 790. In drier months, the pump runs less frequently, but is still required to keep water out of the building.

2.1.4. Pond

A tidal pond is located approximately 100 yards downstream from the IW87 open channel confluence with the stream. This pond discharges into the Mattawoman Creek, a tributary of the Potomac River. A weir was installed at the culvert under Noble Road at the lower end of the pond in June 1993. The weir was installed as a sediment containment measure for Installation Restoration (IR) Site 8. The pond created from the installation of the weir serves as a sediment trap for the soils/sediments that may migrate from both IR Site 8 and the IW87 site.

FIGURE 2-2
Building 790 Water Discharge Collection Pit

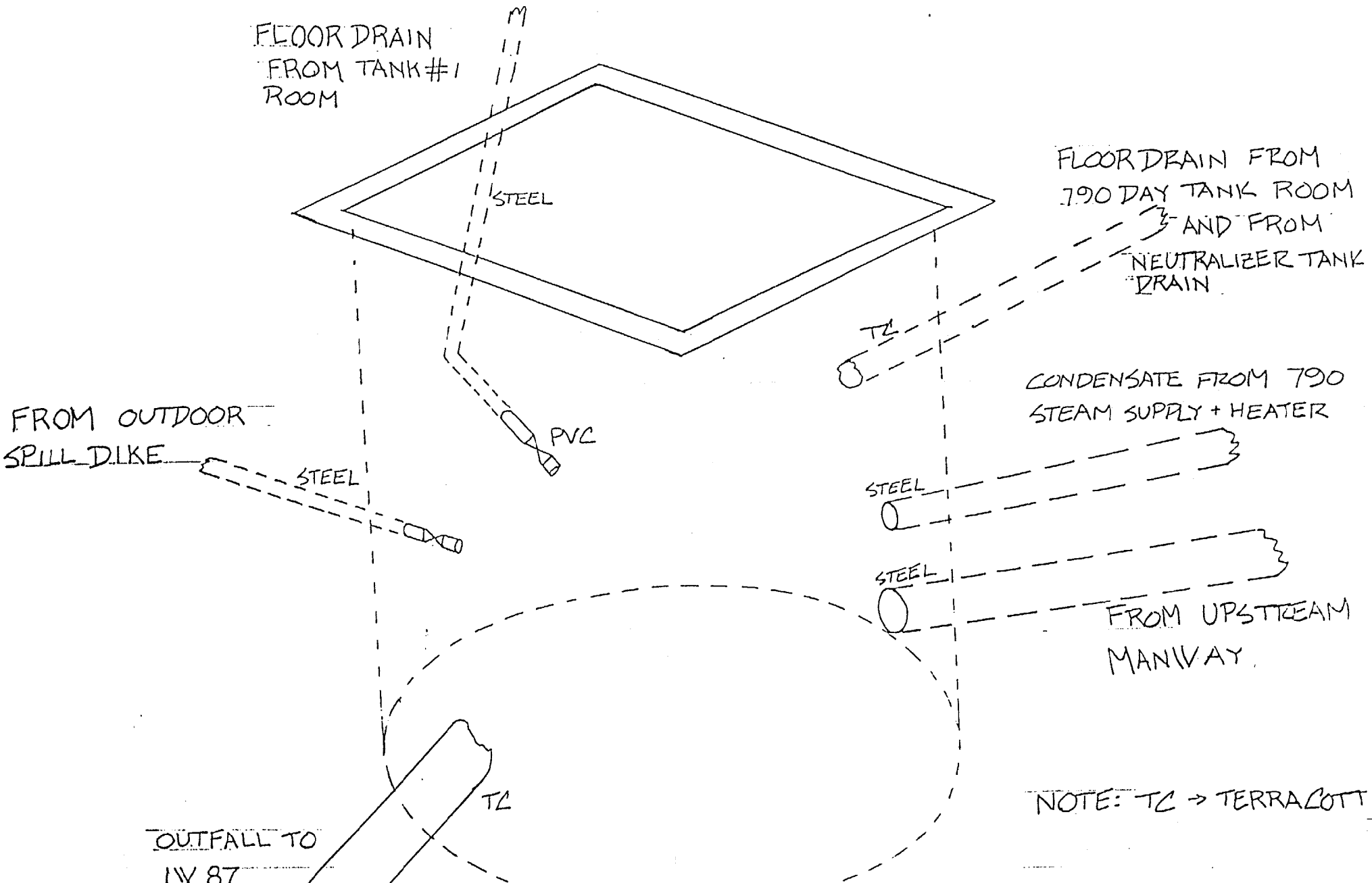
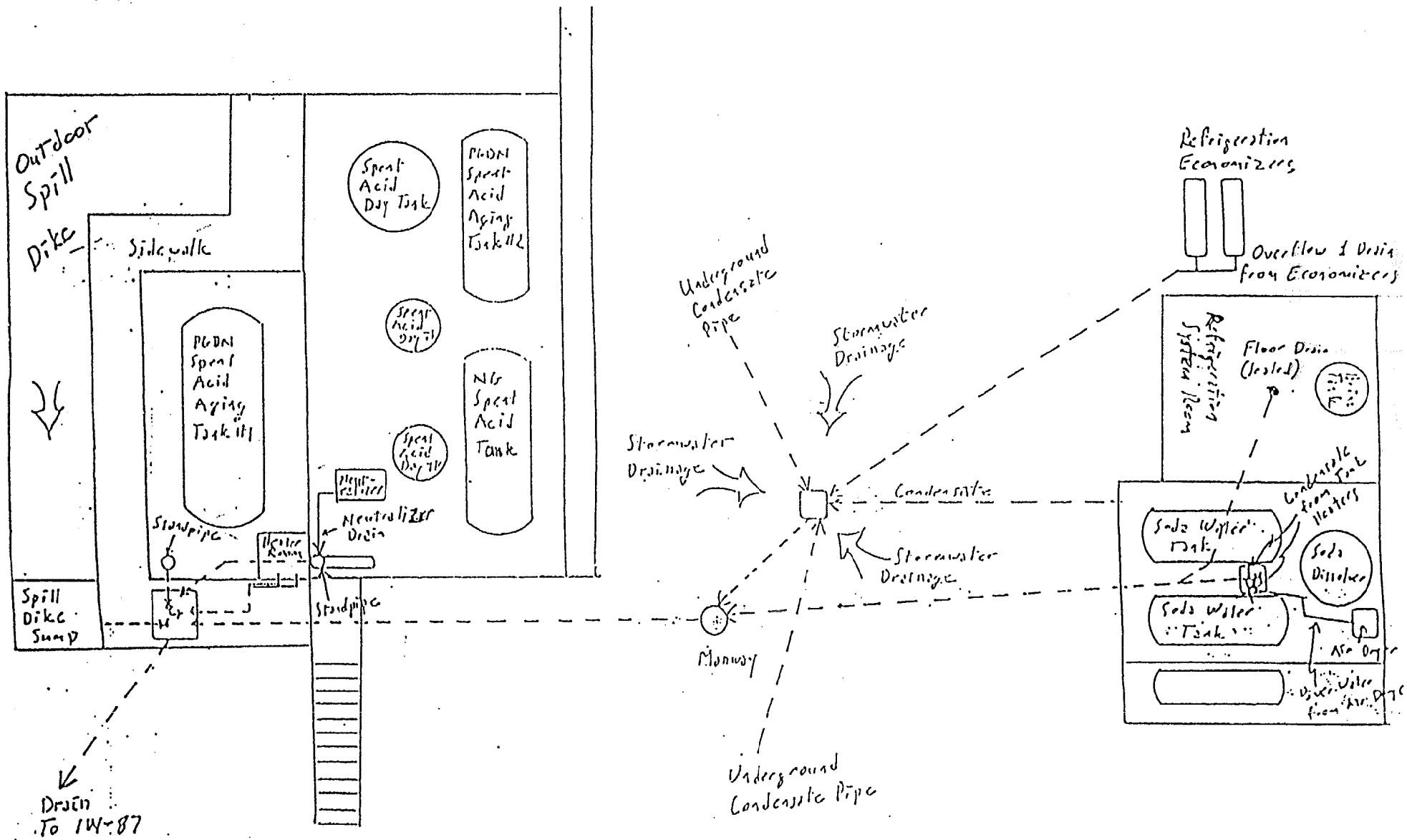


FIGURE 2-3

Drainage to IW87 Via Building 790 Collection Di[illegible]



2.2 Source, Nature, and Extent of Contamination

The site is contaminated as a result of previous industrial activities. The original source of contamination was the washdown of Building 790, which contains a lead-lined floor. Sulfuric and nitric acids, which are used in the building, are very strong acids and have a tendency to generate fumes. The acidic fumes, in combination with periodic washdown of the walls and floor, caused lead to go into solution in the washdown water and be transported through the floor drain to IW 87. It is also possible that particulate lead was washed to IW 87 via the floor drain. The level of 82 micrograms of lead per liter (μg/l) has been exceeded in 16 monthly monitoring rounds since May, 1990. More recently, the limit, 82 μg/l of lead, has been exceeded in 8 monthly monitoring rounds since the limit was made effective on June 4, 1992. The drain leading to the pit from inside the building was sealed in October 1992, because of these exceedances.

Beginning June 1993, the lead limit of 82μg/l at IW87 was exceeded almost every month. These increased NPDES exceptions revealed a problem with the drainage area from the pit outside the building, since all sources of lead to the outfall from current operations and buildings had been eliminated.

This problem was further delineated, based on the sediment lead results from the IHDIVNAVSURFWARCEN sampling. This additional sediment sampling revealed the lead has settled in the sediment in the pit outside of Building 790. The lead-contaminated sediment has also settled in the 700 foot long, 24-inch terra cotta pipe which flows to IW87. This settling is due to the pipe being an old bell and joint type providing settling areas and the very low slope at which the pipe is laid. The pipe is cracked at certain points, as shown in a video survey performed on the pipe on January 31, 1994, which is allowing groundwater to enter the pipe. The depth of sediment in the pipe gradually increased from hardly any at the beginning of the pipe pit to several inches at 378 feet from the pit, which is where the video survey ended. In addition, the outfall end of the pipe is at least half full of sediment. Sediment lead results from IHDIVNAVSURFWARCEN sampling also show that the lead has settled in the area between the end of the pipe and the actual IW87 sampling point.

2.3 Analytical Data

Since the activity became aware of the problem from the NPDES sampling, numerous water and sediment samples have been taken to help characterize this site, as discussed in Section 2.2. The analytical results from samples taken by IHD-NSWC personnel and Halliburton NUS are summarized in Table 1a and Table 1b and a map showing these sample locations is provided in Figure 2-1.

Samples TCLP-A, TCLP-B, and TCLP-C are composite samples taken from three sample points (1, 2, and 3), which are staked at the site, and shown on Figure 2-1.

Sample point 1 is located at the actual IW87 sample location, which is approximately 35 feet from the end of the Building 790 discharge pipe. Sample point 2 is located at the midpoint between the IW87 sample location and the end of the discharge pipe. Sample point 3 is located at the end of the discharge pipe.

Samples TCLP-A, TCLP-B, and TCLP-C were obtained by compositing sediment from sample points 1, 2, and 3 at different depths. The results for these samples are 7.04 milligrams per liter (mg/L), 13.2 mg/L, and 30.3 mg/L, respectively. These concentrations are all above the TCLP regulatory limit of 5 mg/L for lead.

Additional sediment and water samples were taken to better characterize this site. These results are also summarized in Tables 1a and 1b. For example, sediment samples were taken at various locations along the storm water drainage ditch to IW87. These results, which are negative for lead, are also provided in Table 1a. The storm water drainage ditch lies above the IW87 underground drainage system. These sample locations, A through F, have also been staked by IHD-NSWC sampling personnel and are shown in Figure 2-1.

Water samples taken from the pipe flow were taken to determine if the high lead content was a result of current operations. These samples were sent to Chesapeake Analytical Laboratory in Waldorf, Maryland, where the samples were filtered using a 0.45 micron filter. The resulting filtrate was analyzed for total lead. The analytical results, which are also summarized in Table 1b, show that the discharges from current operations to this outfall do not contain lead.

TABLE 1a
Analytical Results of Sediment Samples for Lead

DATE	SAMPLE	SAMPLER	SAMPLING POINT	TYPE	RESULT OF ANALYSIS
07/28/93		IHD-NSWC	Point 3	Sediment	2060 mg/kg
07/28/93		IHD-NSWC	Point 1 (IW87)	Sediment	291 mg/kg
07/29/93		IHD-NSWC	Point 3	Sediment	568 mg/kg
07/29/93		IHD-NSWC	Point 1 (IW87)	Sediment	1530 mg/kg
08/03/93		IHD-NSWC	Point 3	Sediment	684 mg/kg
08/03/93		IHD-NSWC	Point 1 (IW87)	Sediment	1110 mg/kg
08/04/93		IHD-NSWC	Point 3	Sediment	2690 mg/kg
08/04/93		IHD-NSWC	Point 1 (IW87)	Sediment	878 mg/kg
08/04/93		IHD-NSWC	IW86	Sediment	<5.00 mg/kg
08/13/93		IHD-NSWC	Bldg. 790 Pit	Sediment	18,200 mg/kg
08/16/93		IHD-NSWC	Bldg. 1463 Pit	Sediment	14 mg/k
10/29/93	TCLP-A	IHD-NSWC	Points 1, 2, and 3 (4 to 6 inch depth)	Composite (Sediment)	7.04 mg/L
10/29/93	TCLP-B	IHD-NSWC	Points 1, 2, and 3 (6 to 10 inch depth)	Composite (Sediment)	13.2 mg/L
10/29/93	TCLP-C	IHD-NSWC	Points 1, 2, and 3 (10 to 15 inch depth)	Composite (Sediment)	30.3 mg/L
10/29/93	A	IHD-NSWC	Point A	Sediment	<17.8 mg/kg
10/29/93	B	IHD-NSWC	Point B	Sediment	<17.8 mg/kg
10/29/93	C	IHD-NSWC	Point C	Sediment	<17.3 mg/kg
10/29/93	D	IHD-NSWC	Point D	Sediment	<15.1 mg/kg
10/29/93	E	IHD-NSWC	Point E	Sediment	<17.0 mg/kg
10/29/93	F	IHD-NSWC	Point F	Sediment	<15.2 mg/kg

TABLE 1b

Analytical Results of Water Samples Taken for Lead

DATE	SAMPLING POINT	TYPE	RESULT OF ANALYSIS
06/02/93	IW87	Composite (NPDES)	0.0851 mg/L
07/21/93	IW87	Composite (NPDES)	0.401 mg/L
07/27/93	Bldg. 790 Pit	Grab	4.430 mg/L
07/27/93	IW87	Grab	0.985 mg/L
07/28/93	IW87	Composite	0.142 mg/L
07/29/93	IW87	Composite	0.165 mg/L
08/03/93	IW87	Composite	0.0924 mg/L
08/04/93	Bldg. 790 Pit	Grab	0.822 mg/L
08/04/93	Pipe from Bldg. 775 in Pit at Bldg. 790	Grab	<0.100 mg/L
08/04/93	IW87	Composite	<0.100 mg/L
08/16/93	Bldg. 1463 Sump Discharge	Grab	<0.100 mg/L
10/06/93	IW87	Grab (Water)	<0.020 mg/L
10/19/93	IW87	Composite (Water)	<0.020 mg/L
10/20/93	IW87	Composite (Water)	0.0308 mg/L
10/27/93	IW87	Grab (Water, Acidified)	0.0797 mg/L
10/27/93	IW87	Grab (Water, 0.45 Filter/Acidified)	<0.020 mg/L
10/29/93	IW87	Grab (Water, Acidified)	0.878 mg/L
10/29/93	IW87	Grab (Water, 0.45 Filter/Acidified)	0.0316 mg/L
11/03/93	IW87	Composite (Water, Acidified)	0.360 mg/L
11/03/93	IW87	Composite (Water, 0.45 Filter/Acidified)	0.0259 mg/L
11/04/93	IW87	Composite (Water, Acidified)	0.180 mg/L
11/04/93	IW87	Composite (Water, 0.45 Filter/Acidified)	<0.020 mg/L
11/17/93	IW87	Composite (Water)	0.194 mg/L
11/18/93	IW87	Composite (Water, Acidified)	0.168 mg/L

3.0 Identification Of Removal Action Objectives

3.1 Streamlined Risk Evaluation

The Navy, as the lead agency, must evaluate the need for a removal action per the criteria listed in 40 CFR 300.415(b)(1) and (2). Of the criteria listed, the ones of particular interest at this site include: actual or potential exposure to humans, animals, or the food chain; actual or potential contamination of the drinking water supply or sensitive ecosystems; high levels of contaminants in soils largely at or near the surface that may migrate; and weather conditions that may cause the contaminants to migrate.

Due to the risks posed by the contamination at this site, four exposure pathways must be evaluated, in accordance with 40 CFR 300, Appendix D (b). These pathways, herein after referred to as media, are soils and sediments, ground water, surface water, and air.

SOILS AND SEDIMENTS

The surficial sediments at the outfall end of the pipe are unconfined and the media is exposed to continuous erosion due to the pipe flow. The immediate site is located in an industrial portion of the facility, the Restricted Area, which, for the most part, is fenced in, except at locations where high cliffs act as a barrier. In addition, due to the restricted access and strict rules on eating, drinking, and smoking in the Restricted Area, no one has ever been observed resting or picnicking at the site. Direct human exposure is not regarded as a significant threat.

The continuous washing of the sediment media by pipe and storm water flow also causes concern with migration of the sediment to the pond. A potential exists for lead contaminated sediment particles to impact benthic organisms and fish. This impact is almost negligible as demonstrated by a round of biomonitoring fish sampling for lead in April 1994. Lead was detected in two of the species whole fish analysis (carp and bullhead catfish), but was below a quanifiable amount (<0.2 ppm fish). The lead concentrations in the other species, Pumkinseed, was below the detection limit. Lead concentrations in the liver tissue of two painted turtles averaged 0.5 ppm. As a reference for comparision, a Maryland Department of the Environment Study (MDE, Basic Water Monitoring Program Fish Tisue Analysis, 1985) reports a range of average lead concentrations in fish tissues from 0.6 ppm in Blue Crab up to 4.3 ppm in Redbreast Sunfish. While many different species were sampled, this is the reported range from that study. All the fish sampled in the study were whole fish analysis.

It must be noted that the subsurface soil surrounding the pipe has a potential, via entering the pipe, to contribute to surface sediment contamination. Due to the uncontrolled nature of the contaminants in this media coupled with the constant washing by surface water, regardless of the unlikelihood of direct human contact, the Navy feels this pathway warrants mitigation measures. See also the surface water pathway for how this source has been demonstrated to impact the surface water.

GROUNDWATER

The most direct ground water at the site is in the form of a shallow, unconfined water table aquifer. The site is bounded to the south by the Mattawoman Creek and more directly by the stream at the outfall and the pond downstream from the outfall. Due to the presence of wet, seep areas, it is likely that the shallow ground water discharges to the surface water system (stream, pond and Mattawoman creek). In this respect, the Mattawoman Creek acts as a hydrogeologic barrier that isolates the shallow water table aquifer system on the Indian Head peninsula from similar upland areas, such as the southern shore of the Mattawoman Creek (Hiortdahl, 1990). The nearest potable water wells (PW) to this site are PW 17 and 18, which are located approximately 3200 feet from the site. PW 17 and 18 are screened at about 300-400 feet below ground surface. Because the shallow groundwater probably discharges directly to the surface water and no potable wells are likely targets, this pathway is not viewed by the Navy as warranting a mitigating measure at this time.

SURFACE WATER

The area surrounding the site is rich in surface water bodies and natural resources. The site is a contributing source of water for a stream originating with a storm sewer outfall below Building 766 and ending in the tidal pond 100 yards downstream from the site. This pond drains directly into the Mattawoman Creek about 1300 feet downstream from where the stream enters the pond. The Mattawoman Creek is used for recreational fishing and boating. In addition, it has been the subject of the Navy funded Mattawoman Creek/Surface Warfare Center Mercury Monitoring Study (U.S. Fish and Wildlife Service, 1992) due to IR Site 8, which is currently undergoing a removal action.

Potential for impacts of the downstream aquatic life has been demonstrated by the exceedance of Federal and State Ambient Water Quality Criteria as provided in the NDPES permit. Possible impacts could be to wildlife, sensitive wetlands, and possibly recreational fishers. While no impacts to the fish have been detected in sampling to date, the Navy concludes that surface water is a valid pathway of concern which warrants mitigation measures.

AIR

The air pathway is only of concern when either fugitive dust emissions or volatile compounds are an issue. Due to the non-volatile nature of lead and the fact that the continually wet sediment is not a source of dust, the Navy does not consider the air pathway to be a concern which warrants any mitigating measures.

3.2. Applicable or Relevant and Appropriate Requirements (ARARs)

The ARARs for the pathways of concern are those cleanup standards, limitations, criteria, and substantive requirements promulgated under federal environmental or state environmental or facility siting laws, that either specifically address a contaminant, remedial action, location, or other circumstance found at a CERCLA site (applicable), or while not "applicable" to a contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at a CERCLA site so that their use is well suited to the site (relevant and appropriate)(40 CFR 300.5 Definitions).

The Maryland Department of the Environment (MDE) was contacted (Lemaster, oral communication, March 29, 1994) and requested to provide guidance as to all ARARs for surface water and soil media with lead contamination. The ARARs discussed are provided in this section. Further research is being conducted by the MDE and will be provided to the Navy as information becomes available.

In addition to ARARs, other guidance and regulations may be classified as guidance "To Be Considered" (TBC). TBCs are also identified in this section to aid in the development of removal actions and in establishing the cleanup levels of contamination.

The ARARs and TBCs are presented in Table 2. Reference materials for the NPDES ARAR is included in Appendix A while some of the other cited ARARs are provided in Appendix B.

TABLE 2
ARARs and TBCs

ARAR/TBC	REQUIREMENT	SYNOPSIS	COMMENTS
Federal Safe Drinking Water Act, MCL	15µg/l water	This action level is if over 10% of potable samples are exceeded.	From 40 CFR 141. Is not appropriate at this site due to no potable concerns.
Federal Ambient Water Quality Criteria	82µg/l for maximum concentration fresh water	AWQC, developed under CWA, are designed for the protection of marine life and human food chain.	From 40 CFR 131.36 More appropriate than MCLs when surface water impacts are the concern.
MDE NPDES Permit	82µg/l water	The actual permitted limit for this site.	From MDE NPDES Permit #MD0003158 88-DP-2515. This is applicable to the site.
Resource Conservation and Recovery Act	5 mg/l in leachate	This is the Lead hazardous waste criteria as established in 40 CFR 261 as an D008 waste.	This regulatory value is commonly refered to as TCLP analysis and values.
Guidance Risk-based Level for Lead	200 mg/kg soil	Under this level, soil lead is judged to be non-bioavailable to humans.	From the Phase II S.I. (Ensafe, March 4, 1994). The level was provided by USEPA Environmental Criteria and Assessment Office via oral communication.
Soil Lead Cleanup Guidance	500-1000 mg/kg soil	USEPA recommends an interim cleanup level for residential CERCLA sites. This is from the Uptake Biokenetic Model the EPA uses.	The Uptake model uses the scenario of bioavailability of lead to human blood serum levels from a risk viewpoint.
NOAA Screening Values for Lead	35 mg/kg (effects range low)	This concentration is used by EPA Region 4 to screen if lead levels in sediment warrant further investigation. The ER-L value, which is a NOAA generated concentration limit, is the level to which aquatic life have been subjected to without any adverse effects.	The concentrations are acknowledged by Region IV to be "dynamic" in nature. The Region uses sediment values compiled by the National Oceanic and Atmospheric Administration (NOAA) during the interim until the Federal sediment quality criteria for the protection of aquatic life are developed.
Soil Background	To Be Determined	The estimated range in the Eastern US is 10-50 mg/kg with a mean of 22 mg/kg.	These levels will be determined by the Navy.

3.3 Identification Of The Removal Action Scope

As mentioned in Section 3.1, the Navy, as the lead agency, must evaluate the need for a removal action per the criteria listed in 40 CFR 300.415(b)(1) and (2). Appropriate removal actions, as stated in 40 CFR 300.415(d) and 300.415(d).6, include "Excavation, consolidation, or removal of highly contaminated soil from drainage or other areas-where such actions will reduce the spread of, or direct contact with, the contamination."

The scope of this removal action is to address the source of the known impacts caused by on-site contamination. This known impact is the exceedance of the NPDES permit level at the IW 87 outfall pipe. A removal action by definition is a short-term, immediate action taken to address releases of hazardous substances that require an expedited response (OPNAVINST 5090.1A). Addressing the source of contamination will eliminate the imminent threat posed through the surface sediment and surface water pathways, including the NPDES violations for lead at this outfall.

At this site, the source of contamination affecting the two media of concern include all sediment contaminated with high levels of lead. This sediment includes that which is at the NPDES sampling location and everything contributing sediment through transport to that location. This means the sediment within the pipe and pit and along the thirty foot open drainage channel.

In addition, the open channel is subjected to swift moving water, up to 77,556 gallons per day as measured by IHDIVNAVSURFWARCEN personnel, which aids in the migration of the contamination. As stated in section 3.1.4., this flow comes from the pit at Building 790, Building 1463, and area stormwater runoff. The pipe is approximately 700 feet long and runs from a brick lined pit beside building 790 to the outfall invert. A video survey performed on the pipe on January 31, 1994, revealed that the pipe contained some sediment throughout the entire length of the pipe. However, the sediment was significant from a volume perspective along the bottom 300 feet, since the camera was unable to travel more than 378 feet down the pipe due to the large sediment deposits. The survey also revealed that groundwater was infiltrating into the pipe at joints along the length.

The sediment downstream from IW 87 is also contaminated by lead as demonstrated by recent sampling by Halliburton NUS in the Report on April 1994 Biomonitoring. While this will be examined in future study, such as further biomonitoring for lead, the downstream sediment is considered out of the scope of this removal action.

3.3.1 Estimated Extent Of Contamination

All sediment inside the pit at the corner of Building 790 and in the open channel is considered to be contaminated with lead. The sediment inside of the pipe may also be contaminated with lead, although that sediment has not been sampled. However, the stream beyond the confluence of the outfall is not considered to be part of the source but a receptor and is out of the scope of the Removal Action.

The Navy anticipates that the majority of the sediments in the pipe, pit, and at the outfall will meet the 40 CFR 261 definition of a hazardous waste by being "leachable" when subjected to TCLP analyses after the sediment is removed and is being managed. Therefore, for estimation purposes pertaining to disposal options, all of the sediments to be removed will be considered hazardous waste. However, samples will be taken during the removal action to determine what quantities are actually hazardous waste. The exact method of hazardous waste determination, both in type of analysis and frequency of sampling, will be made during the removal action per MDE requirements.

The generation of a volume estimate of contaminated sediment is as follows:

PIPE

Pipe Volume$=\pi r2l$, where r=pipe radius (feet),
and l=pipe length (feet)
= (3.14)x(1 foot)2x(700 feet)
= 2,200 cubic feet
= 82 cubic yards

Assuming the pipe is 1/3 full of sediment,
Volume to be Removed = ~30 cubic yards sediment

OUTFALL

Assuming Length = 30 feet
Width = 6 feet
and Depth = 3 feet

Volume to be Removed = length x width x depth
= 30 feet x 6 feet x 3 feet
= 540 cubic feet
= 20 cubic yards sediment

PIT

Assume $<$1 cubic yard of sediment

TOTAL

51 cubic yards sediment
Assuming all waste will be disposed
of as Hazardous Waste.
Note a density estimate is provided in section 5.1,
Disposal of non-hazardous soil.

WATER

An unknown amount of water may need to be containerized during the removal. For estimation purposes, assume we will generate 25,000 gallons of contaminated water.

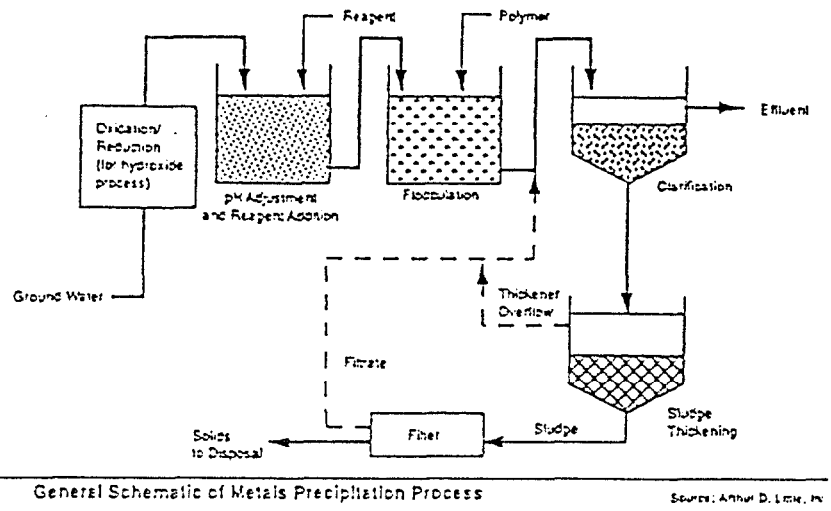
3.3.2 Contaminant Specific Goals

While the scope of the removal action is defined as being from the pit to the end of the open channel, the goals for this removal action will be based on the soil bioavailability concern with downstream water life and with the Clean Water Act which also concerns the downstream life. These are the concerns the Navy feels are most applicable and relevant to this site.

The sediment from the outfall end of the pipe to the confluence of the stream has demonstrated a leaching characteristic by failing the TCLP analysis for lead. This sediment shall be removed. The sediment inside the pipe and in the pit shall also be removed as that sediment should exhibit the same leaching characteristics as the outfall sediment. Within the boundaries of sediment requiring removal, the sediment will be removed until such a time as that area poses no potential threat to aquatic life. The most appropriate standard without performing a detailed bio-toxicity study is the NOAA screening guidance of 35 mg/kg. The level may be more conservative than what is required, but the imminent nature of the contamination at the site does not allow for the time necessary to perform a site specific bio-toxcity test. Using the NOAA guidance will ensure that the site is cleaned to a level that has no detrimental effects to aquatic life.

Any water generated by this action shall be cleaned to a concentration of less than 82 μg/l before being released. The potential for water to be generated would come from dewatering the soil before disposal and the pit/pipe cleaning operation. The water inflow to the pit at Building 790 and the water from the sump pump at Building 1463 shall be diverted during the removal so no storm water should be encountered. No water generated is anticipated to be characterized as hazardous waste and treatment may consist of settling the suspended solids out of the water and removing the water from the settled particulate matter. In the case that any water generated is characterized as a hazardous waste, IHDIVNAVSURFWARCEN has the capability to treat this water in a tank on-site at Building 497, as approved by the MDE, by flocculating the lead out of solution (Figure 3-1).

Figure 3.1



General Schematic of Metals Precipitation Process

3.4 Removal Action Schedule

The removal action was initiated during the federal fiscal year ending on September 30, 1994, but only to the point of retaining the services of an environmental construction firm to develop the detailed workplan, which will include a construction schedule. The actual construction will be done in the winter and spring of 1995. This could possibly be delayed until the summer to take advantage of drier conditions. Once the construction schedule is availanble from the contractor, it will be made available to any interested parties.

4.0 Identification And Analysis Of Removal Alternatives

There are several alternatives for the cleanup of this pipe and outfall system which may be feasible. The identified alternatives are as follows:

1. No Action
2. Abandonment of the pipe with removal of sediments in the Pit and at the Outfall
3. Removal of sediment from pit, pipe, and outfall.
4. Removal of sediment as above with pipe relining.
5. Removal of sediment as above with pipe abandonment.
6. Removal of sediment as above with removal of the pipe.
7. Stabilize sediment in place.
8. Other methods of containment of sediment in place.
9. In situ soil flushing.
10. Soil washing.

Each alternative will be discussed in the following section. The discussion will include a technology description with reference, an estimate on the implementability and the effectiveness of the technology for the site, and a generalized cost estimate.

Alternative 1 - No Action.

The no action alternative is not deemed appropriate at the site. The regulatory implications of not addressing the NPDES outfall non-compliances and also the knowledge of the sediments having failed a TCLP analysis leads the Navy to disregard this alternative without any further analysis.

Alternative 2 - Abandonment of the Pipe with Removal of Sediments in the Pit and at the Outfall

The items of work associated with this alternative is grouting the pipe with cement or a cement/bentonite slurry mixture which would cure, effectively abandoning the pipe in place, installing a new outfall system, and excavating the soil at the pipe end.

This alternative could also be easily implemented. The effectiveness of this alternative is questionable. This is because the alternative leaves a suspected hazardous waste in place inside the pipe. This does not accomplish the strict goal of removing a source of contamination. The alternative is viewed as being unacceptable by regulatory agencies.

The cost of this alternative would include installing a new outfall for the pit at the beginning of the pipeline. The pit would serve as the sump for the new system and would therefore require cleaning. After preliminary review of the sites topographic relief, there appears to be two alternative points much closer to the pit and Building 790. This undoubtedly would require some lift as the elevation of the pit is considerably lower than the surrounding area but this is not anticipated as posing any technical problems. The general cost for this new system is from $75,000 to $100,000 (Memorandum, Review Comments, Frank Tiscione, 29 April 1994). Seventy five thousand dollars will be used in this EE/CA for estimation purposes.

The Navy intends on excavating the bottom 50 feet of pipe. Therefore, the volume estimate of cement needed for the inside of the pipe is based on using a two foot inside diameter and 650 foot length for the pipeline that would be left in place. This volume corresponds to approximately 76 cubic yards of cement. After discussion with engineering estimators (Allen Wilson, Code 04, Personal Communication, March 31, 1994) the current cost associated with cement in Charles County runs about $50/yard with some additional costs for delivery bringing the total cement cost to $5,000.

In summary, the costs associated with this alternative are the costs of the alternative outfall, the end of pipe excavation, and raw material; cement, clay, wood forms, etc., and the delivery cost. These costs are estimated as follows:

Excavation and fill of the outfall end sediment	~$ 5,000
Grouting the Pipe*	~$ 5,000
Construct a sediment trap	~$ 2,000
Clean pit	~$ 5,000
Containment/treatment of water	~$15,000
Containment and Hazard Classification of Soils	~$ 4,000
Installation of a new Outfall	~$75,000
Other associated cost**	~$10,000
Mobilization/Demobilization	~$15,000
TOTAL	**$136,000****

* Other associated costs include building an access to the outfall end, any testing required by the contractor, site management costs, etc.

** This cost does not include disposal. Disposal costs are discussed in Section 5.0

Alternative 3 - Removal of Sediment from the Pit, Pipe, and the Outfall End of the Pipe.

The outfall sediments would be removed using traditional excavation techniques while the pit would be manually cleaned of sediments. There are several methods to remove the sediments from the pipe. The methods that will be addressed here are mechanical and washing methods (EPA, Operations and Maintenance of Wastewater Collection Systems, 1987). The 24" pipe has sediment in it from little to none at the beginning to almost totally full (4"-6" freeboard) at the outfall end. The pipe has a manhole access approximately 350 feet along the 700 feet of pipe. While most of the length of pipe is from 20 to 25 feet below grade, approximately the last 50 feet at the outfall end is very shallow below grade. The sediments at the end of the pipe may be removed along with this 50 foot portion of pipe. This would allow for the construction of a sediment trap to collect additional sediments removed from the rest of the pipe.

The sediments from the majority of the pipe may be removed using mechanical means. Different methods of mechanical means include power rodders, power buckets, and hand push rods. Power rodders use a steel rod to push or pull various cleaning instruments through the pipe. It is unknown to the Navy if any devices are available to clean pipes in excess of 12" diameter. Power bucketing uses tools such as clamshell buckets and "porcupines" (Figure 4-1 and 4-2), which are pulled through the pipe and collect debris. Porcupines are very effective in removing debris like roots but

are also hard on the pipe. Hand rodding is similar to power rodding and in fact, is typically available to power rod crews as a backup in the field. These methods are very effective but in general should not be used for routine cleaning as they are all hard on pipelines.

Another means to remove sediments from the pipe is using hydraulic methods. Traditional sewer cleaning techniques using water involve devices such as scooters, balls, high velocity cleaning machines, and flushing. Balling involves pulling a device (Figure 4-3), through the pipe which may be inflated to fit the inside diameter of the pipe. Flush water is also used in this approach. This method may not be adequate by itself if roots and other obstacles are too numerous. High velocity cleaners use a self-propelled nozzle and high pressure water to scour the pipe (Figure 4-4). This method may remove some of the root material that may be in the pipe. Flushing generally only does a good job of cleaning sewers when only floatables are encountered, not grit or other heavy solids. A scooter operates similar to balling except the device is a frame on small wheels with a metal shield and rubber flange at the front of the frame. Flush water is also used in conjunction with scooters. Scooters are particularly effective at removing root debris.

In general, hydraulic methods are to be considered first with routine pipeline cleaning but will not remove heavier root mass from pipe lines.

Figure 4-1 Kite or Bag Cleaning Operation

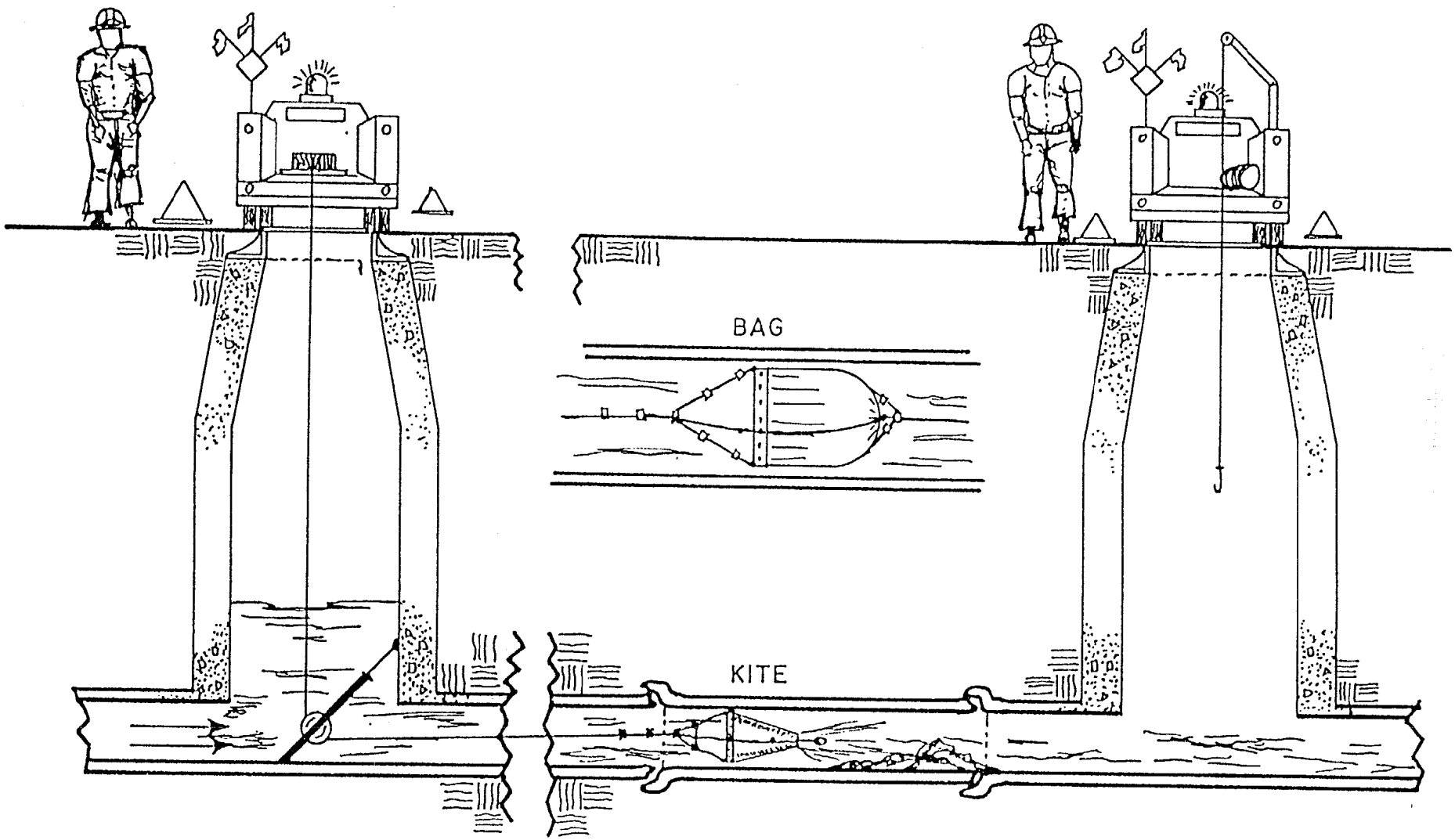
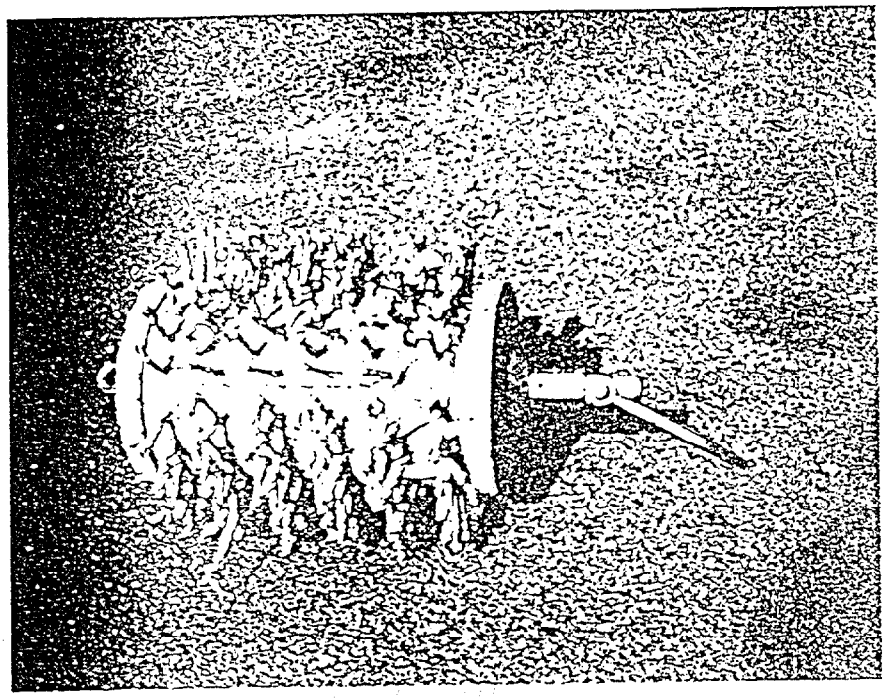
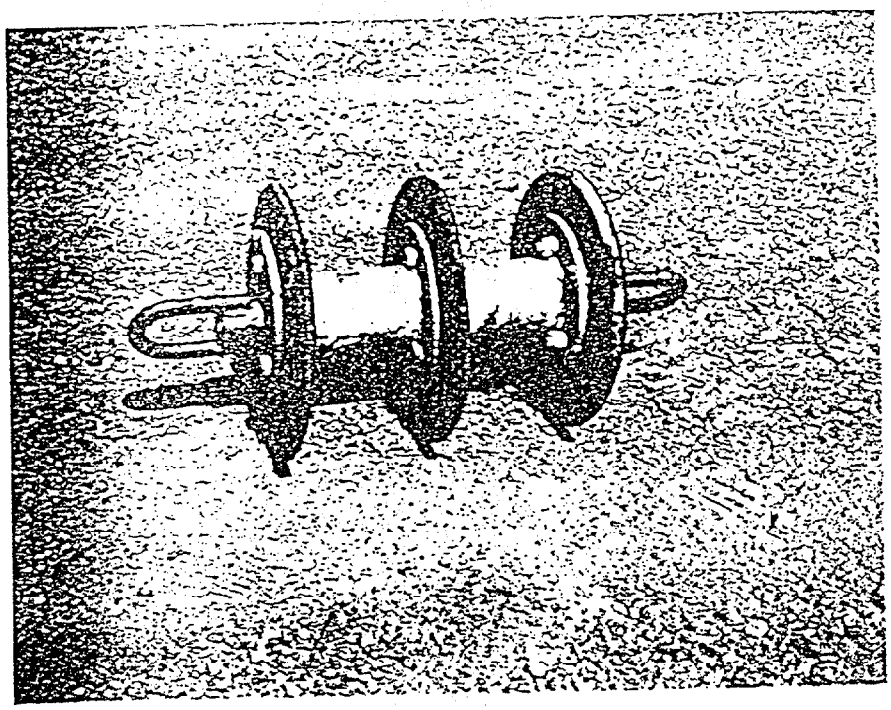


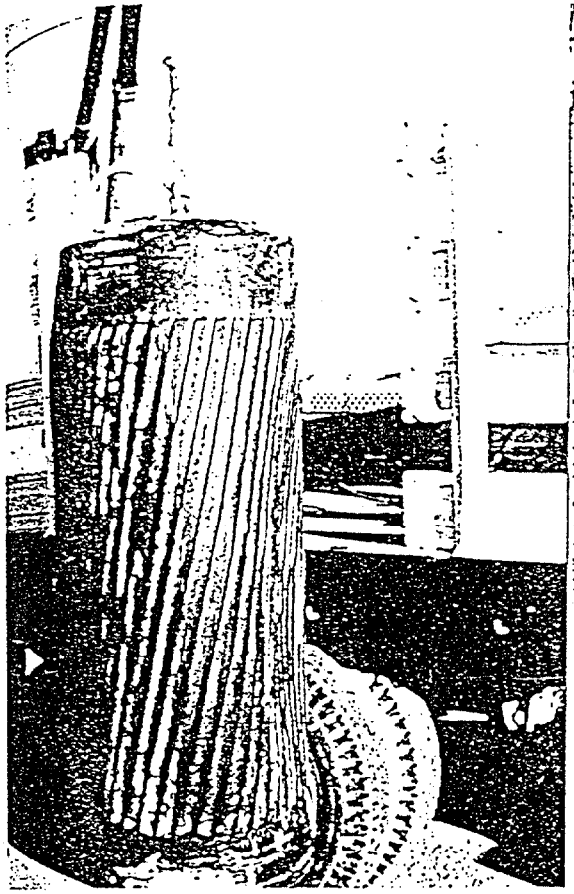
Figure 4-2 Porcupine and Swab



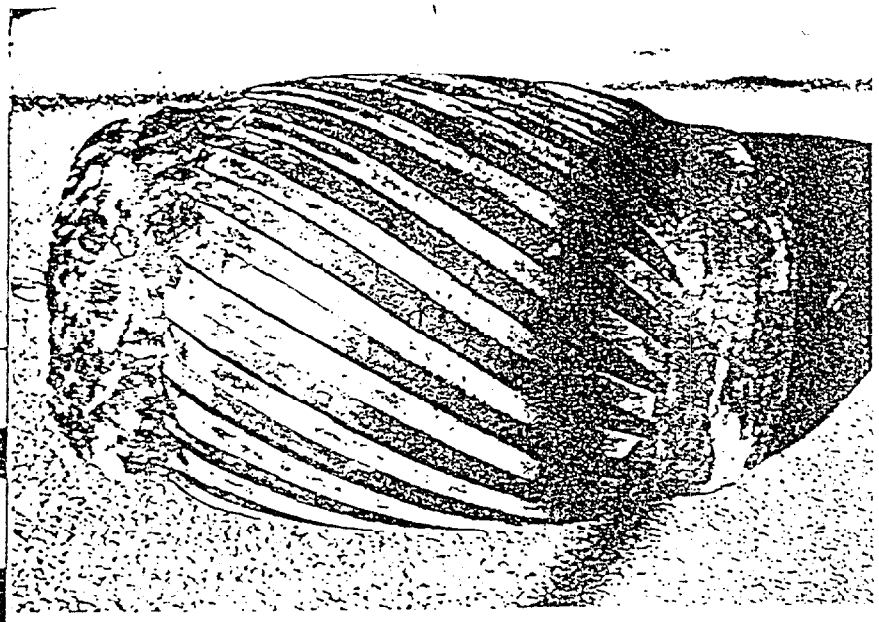


Pull-type swab used to follow the cleaning of a line with a porcupine

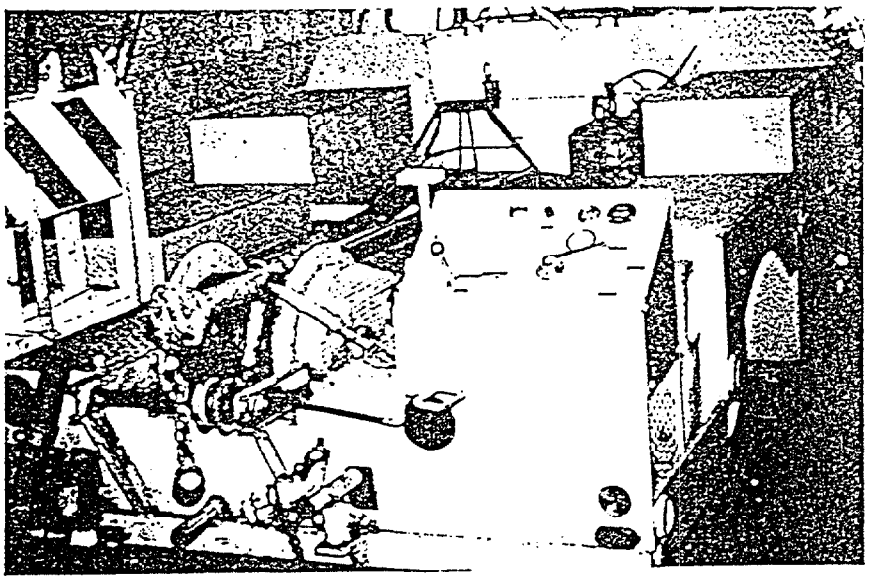
Figure 4-3 Sewer Balls and Truck with Power Winch



Multi-sized "ball," will fit through 24-inch manhole frame. Inflate and deflate to fit size of line. Will clean larger lines up to 48 inches.

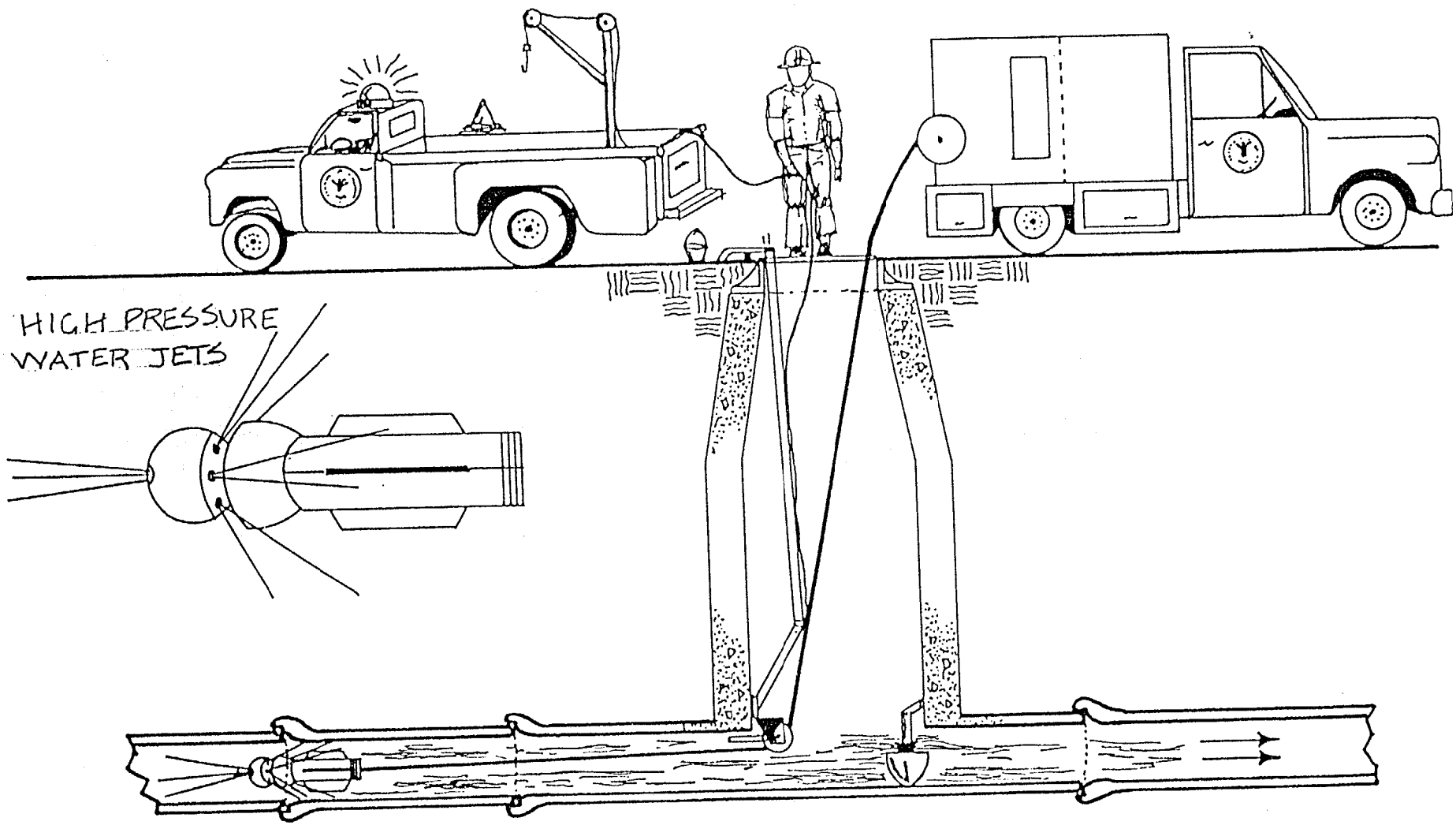


Multi-sized cleaning "ball" for lines 15 through 24 inches.



Hydraulic "balling" powered winch on truck. Used for balls and tires. Winch drum holds 2000 feet of cable.

Figure 4-4 High Velocity Cleaning Operation



The actual method would be left to the removal contractor but some combination of these methods would provide for removal of the contaminated sediments. Also several iterations of cleaning would likely be necessary.

Table 3 shows the relative effectiveness of the possible solutions to different problems. The larger the size of the box in the square, the more effective the solution is for a particular problem. One problem may have several effective solutions and another problem may have only one possible solution.

TABLE 3
Effectiveness of Solutions

SOLUTION TO PROBLEM	Emergency Stoppages	Grease	Roots	Sand, Grit, Debris	Odors
Balling[1]		☒		☒	☒
High Velocity Cleaning	☒	☒		☒	☒
Flushing					☒
Sewer Scooters		☒		☒	
Bucket Machines, Scrapers				☒	
Power Rodders	☒	☒	☒		
Hand Rods	☒	☒	☒		

1 Kites, tires, bags, parachutes, scooters, and cones are commonly used instead of balls in large sewers (greater than 24 inches in diameter) with similar results.

2 Power rodders and high velocity cleaners may be faster (if available) under certain conditions.

These methods are very applicable to the site. In fact, if there was not any concern with the lead contamination, the Navy would not even evaluate any other alternatives to removing the sediments from the IW87 pipeline. With two pipeline access points, at the pit and the single manhole, the entire pipeline may be accessed by most types of equipment available. There are two concerns that must be addressed with this alternative: generation of significant quantities of water; and access to the outfall end of the pipe. All wash water would require initial containment and sampling pending either treatment and release or off-site disposal. Collection of sediments at the outfall end of the pipe and actual removal of the bottom 50 foot section of pipe line will require some vehicle access to the outfall. All other removal alternatives likely will also include these concerns.

This alternative will treat the pit and surface sediments from the pipe to the confluence of the streams very effectively. The inside of the pipe will be sufficiently addressed in terms of loose sediments, but it may be impossible to ascertain if the inside surface of the pipe has been adequately decontaminated. The pipe will also be subject to future sediment buildup. It is not clear what level of lead contamination that remained on the interior of the pipe is acceptable in terms of risk to the biota downstream. The last concern is that subsurface soils surrounding the pipeline, if contaminated, will be left with a significant migration pathway by entering the pipe and migrating downstream. While these risks are not quantifiable, they are definitely undesirable.

The construction of an adequate sampling point for the NPDES outfall would increase the costs for a sediment trap from alternative 2. This sediment trap would most likely be left in place permanently and serve as the sampling point.

The costs are estimated as follows:

Excavation and fill of the outfall end sediment	~$ 5,000
Excavation and fill of 50 feet of pipe and sediment	~$15,000
Construct a sediment trap	~$ 5,000
Clean pit	~$ 5,000
Clean Pipe @ $5.50/foot*	~$25,000
Containment/treatment of water	~$15,000
Containment and Hazard Classification of Soils	~$20,000
Other associated cost**	~$25,000
Mobilization/Demobilization.	~$15,000
TOTAL	**$130,000*** **

* Cleaning the pipe unit cost is for one pass. The Navy assumes six passes would be necessary to adequately clean the pipe.

** Other associated costs include building an access to the outfall end, any testing required by the contractor, site management costs, etc.

*** This cost does not include disposal. Disposal costs are discussed in Section 5.0

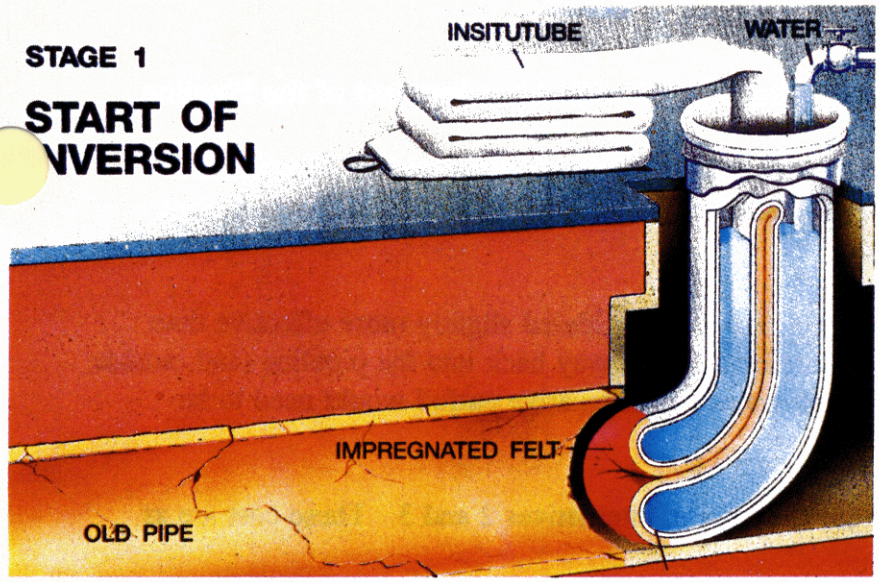
Alternative 4 - Cleaning Pipe as above with Pipe Relining.

The only additional item of work associated with this alternative as compared to Alternative 2 is the insertion of a pipe liner. While there are several methods to reline utility pipes, the "in situ form" technique will be discussed (Figure 4-5). This technique entails running a flexible "sock" of the lining material through a cleaned pipeline. The sock is then filled with water that is greater than 160°F. This heat causes the flexible sock to form into the final product, a rigid polyester/fiberglass liner that conforms to the inside surface of the original pipeline. The end of the sock is then cut and trimmed to align with the pipeline end and the water is drained out of the relined pipeline.

This technique seems to be implementable at the site. The sock would be inserted from the pit end of the pipe and go all the way to the outfall end. The manhole in the middle of the pipeline would be accessed at a later time by cutting and inserting a tap, if necessary. This would certainly improve flow through the pipe line and help to insure that soils from around the original pipe would not enter the pipeline and migrate downstream, probably eliminating all future risk posed by this scenario.

The cost of this technology varies depending on size of pipe and length to be relined. From a manufacturers pamphlet, an average unit cost of approximately $104/foot was determined but this was using 1989 data. The calculated total with this site, 650 feet of pipe after the end fifty feet are removed, is $68,000. There would also undoubtedly be some expense in mobilization, time value, and economies of scale (or lack of scale). Therefore, a more realistic estimate would be $100,000-$125,000. This would cost, in addition to the $130,000 from alternative 3, a total of about $255,000.

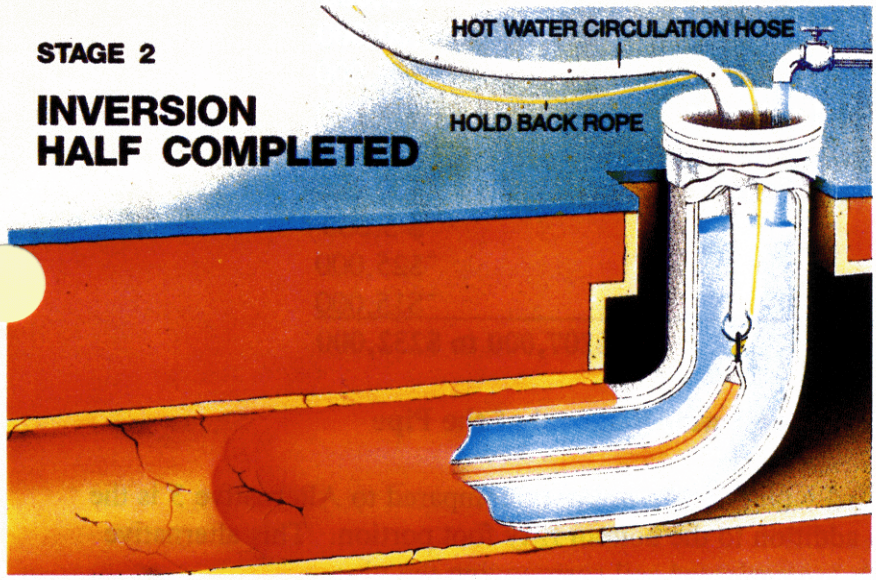
Figure 4-5 Installing Insituform®



How Insituform® Is Installed

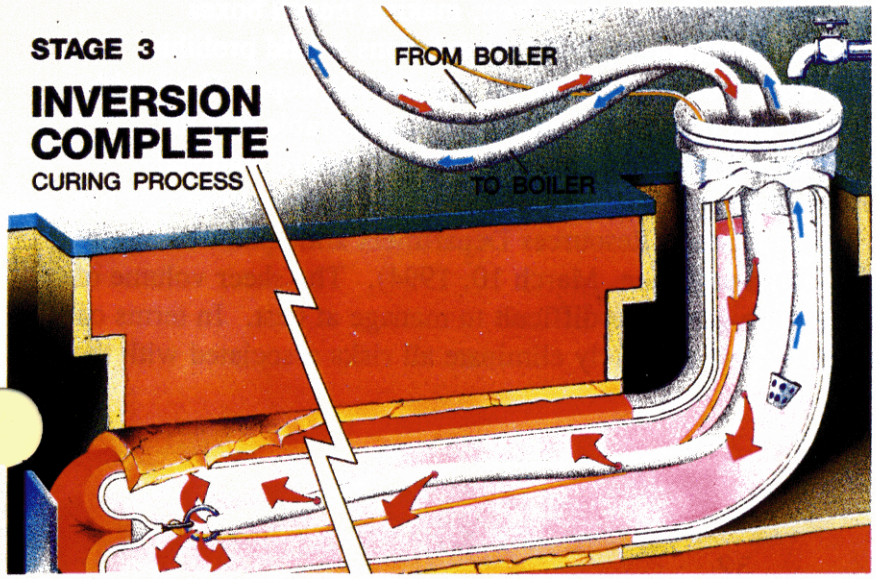
Stage 1

A special needled felt reconstruction tube, Insitutube®, with a plastic coating on the outside is custom engineered and manufactured to fit the damaged pipe. The Insitutube is positioned at the opening of the old pipe through an existing manhole. Water pressure is used to push the Insitutube through the damaged pipe. The special felt material, which is saturated with thermosetting resin, is pressed firmly against the walls of the old pipe.



Stage 2

The weight of the water inverts the Insitutube into the damaged pipe, turning it inside out as it makes its way through the length of the old pipe. Because the Insitutube is flexible, it can negotiate bends, offset joints, changes in size, diameter and elevation, and span missing sections. The water pressure keeps the Insitutube pressed tightly against the walls of the old pipe, eliminating annular space and pushing any remaining water forward and out of the pipe.



Stage 3

When the Insitutube is inverted to its specified length, the water in the line is recirculated through a heat source. The hot water cures the thermosetting resin, causing it to harden into a structurally sound, jointless Insitupipe™. The ends of the Insitupipe are then cut off and lateral service is restored to the line by a remote controlled Insitucutter™. All this is accomplished without excavation.

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Alternative 5 - Cleaning the Pipeline as in Alternative 3 with Abandonment of the Pipeline

The only additional item of work associated with this alternative as compared to Alternative 3 includes grouting the pipe with cement or a cement/bentonite slurry mixture which would cure, allowing the pipe to be abandoned in place.

This alternative could also be easily implemented and is considered slightly more effective than relining the pipe because there would be no preferential pathway back into the pipeline (and outside the liner) by the surrounding groundwater. However, an alternative outfall would need to be installed as in alternative 2.

The costs associated with this alternative are the costs of alternatives 2 and 3. These cost are as follows:

Excavation and fill of the outfall end sediment	~$ 5,000
Construct a sediment trap	~$ 2,000
Clean pit	~$ 5,000
Installation of a new Outfall	~$75,000 to $100,000
Containment/treatment of water	~$15,000
Excavation and fill of 50 feet of pipe and sediment	~$15,000
Clean Pipe @ $5.50/foot	~$25,000
Containment and Hazard Classification of Soils	~$20,000
Grouting the Pipe	~$ 5,000
Other associated cost	~$25,000
Mobilization/Demobilization.	~$15,000
TOTAL	**$207,000 to $232,000**

Alternative 6 - Cleaning Pipe as in Alternative 3 with Removal of the Pipe

The only additional item of work associated with this alternative as compared to Alternative 3 is the removal of the entire existing pipeline in addition to the bottom fifty foot portion. This alternative would allow for removal of all potentially contaminated soil surrounding the pipe.

The alternative has questionable implementability. There are several factors that would possibly affect using this alternative. The majority of the pipeline is very deep, making trench boxes necessary. Occupational Safety and Health Administration (OSHA) regulations would prohibit shoring and sheeting at this depth unless the sides were cut back to an impractical slope. Even with all the side slopes secured as much as possible, this operation would pose considerable risk to workers. Another factor affecting this alternative is the presence of a potential future National Historical Register Site located in the vicinity of the pipeline. The Indian site has been proposed for listing on the Historical Registry and the facility Natural Resources Department anticipates listing in the very near future (Jeff Bossart, Personal Communication, March 10, 1994). The sheer volume of excavation on the slope at the site would make the quantities difficult to manage at best. In terms of effectiveness in cleaning the site, this alternative will definitely eliminate all risks associated with the sediment/surface water risk pathways.

The pipe would still be cleaned as in Alternative 3 to minimize the spread of contamination because the Navy anticipates that the sediments inside the pipe will be the most contaminated. The additional costs will be with the excavation of 650 feet of pipe line and the surrounding soil. The costs associated with this action are difficult to ascertain from reference material included in Appendix C (Richard Engineering Services, 1992) because the depths involved are beyond typical industry excavations for utility lines. The costs presented here are an extrapolation. The equipment cited is a CAT 235 Back hoe with 3660mm/12' stick with two piece boom. This is the only equipment with a depth capacity greater than twenty feet. Note that by using this type of equipment, trench boxes cannot be used and the side slopes must be much more shallow to allow for stability.

Volume calculations and information regarding this task are provided in Appendix C. For calculation purposes, the Navy will assume the following:

PIT, PIPE, AND OUTFALL CLEANING
= $130,000 (from alternative 3)
PIPE REMOVAL
A 1-1/2:1 Angle of Repose is required,
650 feet at an average depth of 20 feet must be excavated,
One foot diameter of contaminated soil around the pipe must be removed, and the pipe must be cleaned before disposal.
Total Unit Cost for excavation is $8/cubic yard
Total Volume = 16,850 cubic yards
Total Contaminated Amount = 230 yards.

Cost for Excavating to Pipeline
= 16,850 cubic yards X $8/cubic yard
= $134,800

NEW OUTFALL INSTALLATION
=$75,000-100,000(from alternative 2)
SUBTOTAL = $339,800-$364,800

Note that there are additional costs associated with the pipe removal portion of this option. The cost will arise from having to clean (steam clean) the removed pipe, disposal of the pipe and cleaning residues, and the 230 cubic yards of assumed contaminated soil. The Navy believes this could increase the cost of pipe removal significantly, possibly up to $500,000

Alternative 7 - Stabilize the Sediments in Place

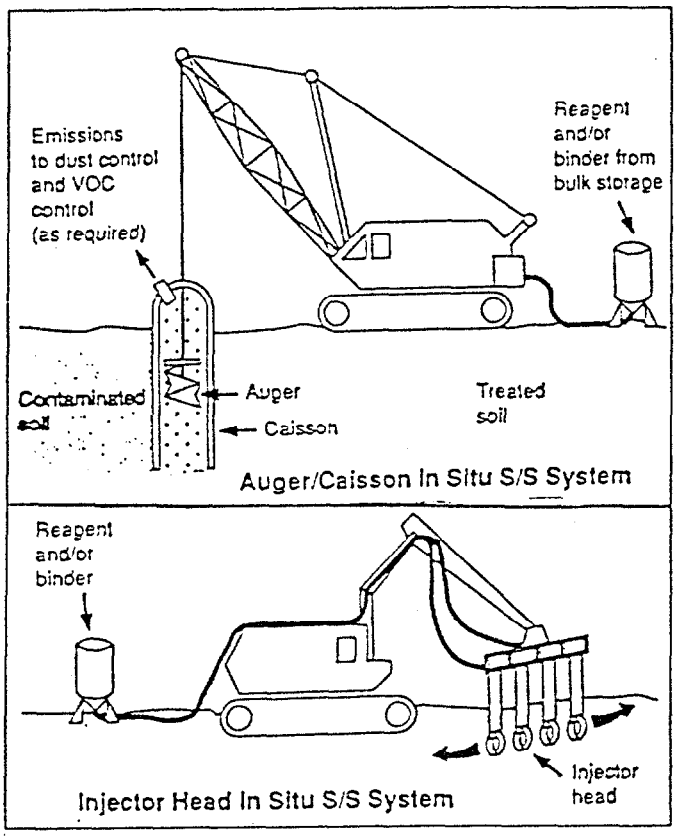
This alternative was reviewed for technical feasibility from a Remedial Action Tech Data Sheet (NEESA Doc. # 20.2-051.2, 22 February 1992). Stabilization and solidification waste treatment processes involve the mixing of specialized additives or reagents with waste materials to reduce physically or chemically the solubility or mobility of contaminants in the environmental matrix.

While stabilizing metal contamination is a very successful technology, the handling of small quantities of surface soils is still best done through removal and off-site disposal. The fact sheet included several potential limitations such as in homogeneities in the contaminated media and future

wet/dry and freeze/thaw conditions for the stabilized media. These potential limitations are present at the site. The additional physical condition of surface erosion also contributes to the uncertainty of using this technology. There would be at a minimum a long term monitoring program required to ensure the migration of lead contaminated particles was not occurring.

The sediments in the pit and the pipeline would still require physical removal from their current locations to allow for stabilization. The pipeline would then have to be cleaned, relined, and/or abandoned just like in the previously mentioned alternatives. Stabilization may be appropriate for the disposal of contaminated sediments but the technology is not viewed as very applicable in situ.

FIGURE 4.6

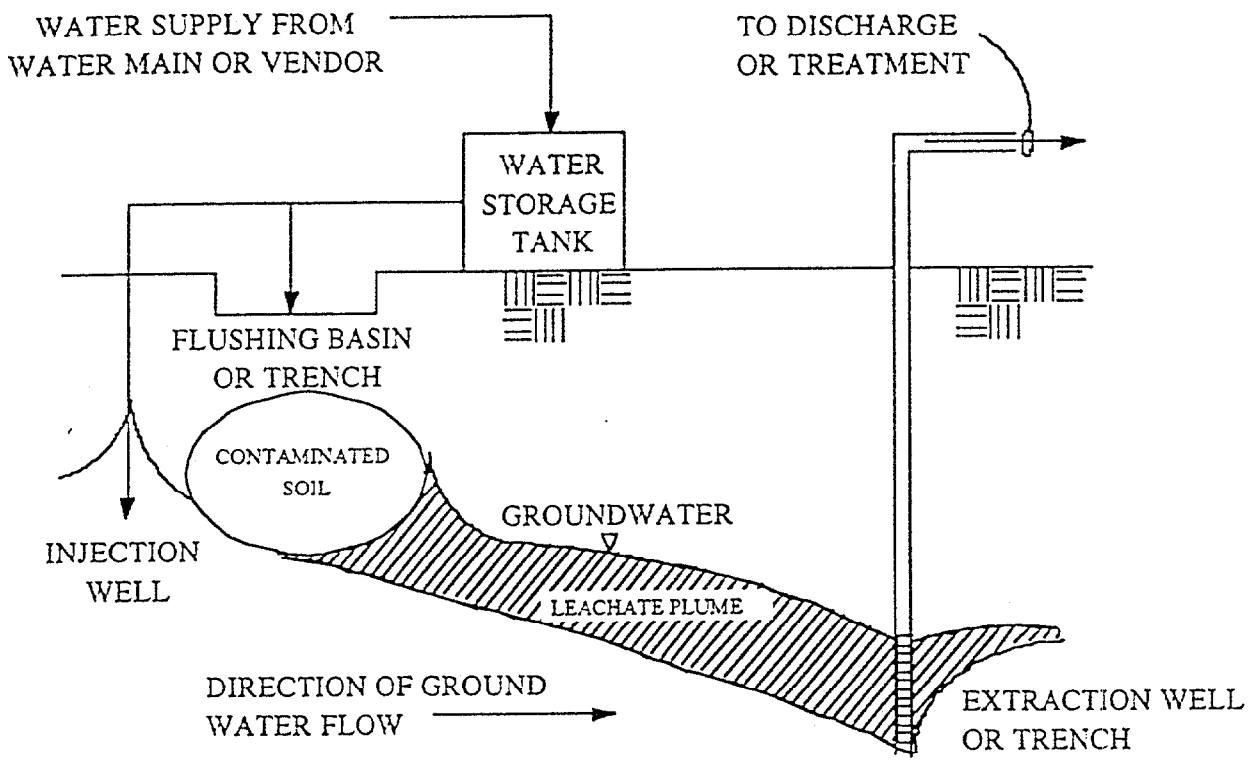


Alternative 8 - Containment in Place

This alternative would consist of some form of capping or lining and is only applicable to large surface areas or subsurface volumes of contaminated soils, such as a landfill. The site cannot be built up in terms of elevation and still function as a storm water outfall. The unusual shape and small surface extent of the contaminated area does not allow for covering the contaminated zone. It is reasonable to assume that some or all of the sediment within the pipe fails the TCLP hazardous waste criteria as previous samples have indicated. Therefore, any alternative considered must address removal and proper disposal of the pipe sediment. To contain sediments in the pipe fails the intent of this removal action. This alternative will not be evaluated further due to these inadequacies.

Alternative 9 - In Situ Soil Flushing

FIGURE 4-7 In Situ Soil Flushing



This alternative was reviewed for technical feasibility from an Engineering Bulletin (EPA/540/2-91/021, In Situ Soil Flushing, October 1991). In situ soil flushing is the extraction of contaminants from the soil with water or other suitable aqueous solutions. Soil flushing is accomplished by passing the extraction media through in-place soils using an injection or infiltration process.

This alternative is applicable to subsurface contamination and is not particularly useful for surface contamination. Since this technology is not appropriate for this site, it will not be considered further.

Alternative 10 - Soil Washing

This technology is a water-based process for mechanically scrubbing soils ex-situ to remove undesirable contaminants. The process removes contaminants from soil in one of two ways: by dissolving or suspending them in the wash solution (which is later treated by traditional waste water treatment methods) or by concentrating them into a smaller volume soil through simple particle size separation techniques (similar to those used in sand and gravel operations). This technology is very applicable to metal contamination.

This technology can be readily implemented at the site. The basic process of getting the soils out of the site for the washing is the same as for all of the other alternatives. Because this technology is

more applicable as a disposal means, it will be evaluated in Chapter 5, Identification and Analysis of Disposal Alternatives.

5.0 Identification and Analysis of Disposal Alternatives

The generation of waste is unavoidable when conducting a cleanup of a contaminated site. At the IW87 site, regardless of the removal action method chosen from Section 4.0, waste will be generated. As estimated in Section 3.3.1, the following approximations of waste will be generated from this removal action:

51 cubic yards of hazardous waste, and
25,000 gallons of contaminated water.

5.1 Disposal of Non-Hazardous Waste Soil

Nonhazardous, solid waste can be disposed of by placing the contaminated solid in a contained location, in such a way as no lead would able to leach out of the solid. Based on previous work performed at IHDIVNAVSURFWARCEN that is similar to this in nature, a location must be found, a placement plan (with engineered drawings) for the construction work must be written, and the actual job of removal and placement must be performed. The assumption that all soil/sediment removed from inside the pit, pipe, and outfall is hazardous waste will be evaluated for predetermined volumes of the removed waste as the waste is excavated. It is anticipated that these volumes will be in the form of either 55 gallon drums or some cubic yardage per hauling truck (every five yards, for example). The cost of this type of disposal, if the disposal can occur concurrently with other actions at IHDIVNAVSURFWARCEN is not anticipated to exceed $10,000.

Another option for the disposal of nonhazardous, solid waste is disposal through the Department of Defense's Defense Reutilization and Marketing Office (DRMO). As discussed with Mr. Robert Steves of the IHDIVNAVSURFWARCEN Property Disposal Office (Personal Communication, April 8, 1994), nonhazardous, solid waste will cost $0.24/pound to dispose of in bulk form, i.e., by the truck load. If the solid waste is in 55-gallon drums, the cost to dispose of the contaminated, nonhazardous soil through DRMO will be $0.49/pound. For estimation purposes, the bulk method will be used. Assuming that there are 1.5 tons per cubic yard, disposal will cost $720 per cubic yard.

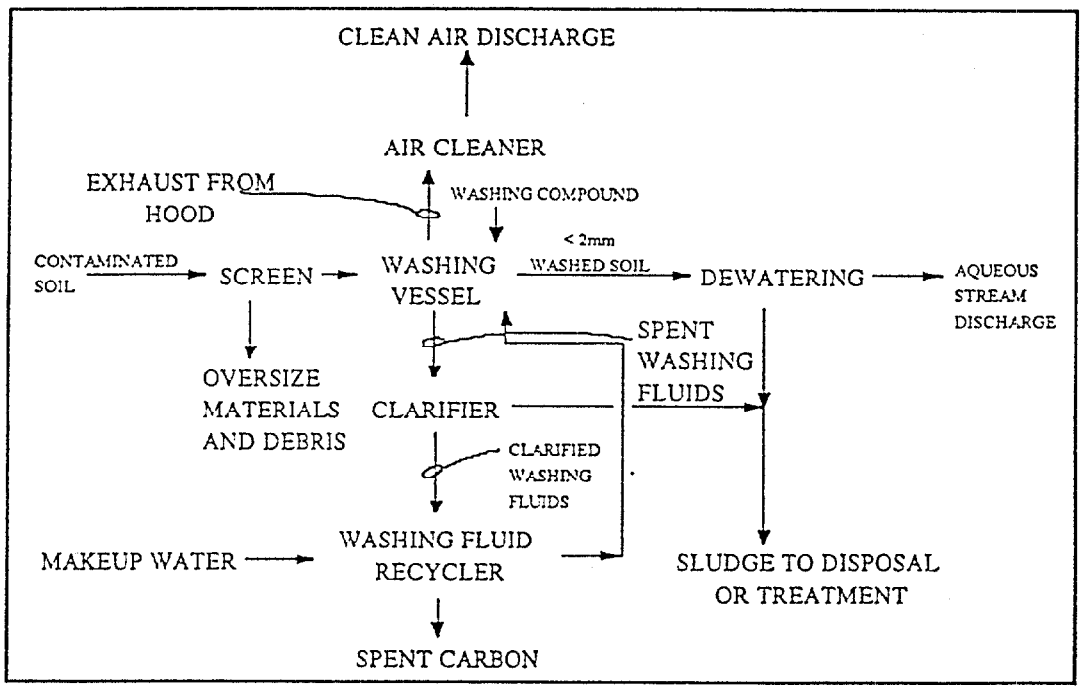
5.2 Disposal of Hazardous Waste Soil

To dispose of hazardous waste through DRMO, it must be contained in 55-gallon drums. The cost to dispose of this waste is $0.47/pound, or $1,410 per cubic yard. Therefore, disposal of 51 cubic yards of drummed lead contaminated hazardous waste will be $71,910.

There are two on-site treatment techniques for the type of waste that will be generated by the removal action, soil washing and soil stabilization. Soil washing, as mentioned in alternative 10 of Chapter 4, is judged to be very applicable to this waste. The technique will be evaluated for effectiveness, ability to meet ARARs, and cost.

The method has been very successful in treating metal-contaminated soil. The EPA judges the technique to be especially good in sandy soil conditions. The vendors equipment cited in the reference material (EPA/540/2-90/017, Engineering Bulletin-Soil Washing Treatment, September 1990) can handle flow through rates of up to 20 tons/hour but at that rate up to 4 acres is required. The reference material is not clear as to what the smallest, tractor trailer mounted units might take up in acreage but this is not anticipated to be a problem.

Figure 5-1 Aqueous Soil Washing Process



The main concern surrounding this or any on-site treatment technique for hazardous waste soil is the ARAR of 35 mg/kg or background from section 3.3.2. From the reference material, treatment efficiencies ranged from 70-90%. With the concentrations (from Table 1.A) ranging from <5 mg/kg to 2690 mg/kg and a mean of 1090 mg/kg, the corresponding post treatment concentrations would range from 0.5 to 807 mg/kg with a mean of 218 mg/kg. This would not allow for replacement of the treated soil back onto the site. The soil would still require off-site disposal.

The cost of this alternative was stated to range from $50 to $205 per ton by the reference material. This cost is assumed to be for large scale operations that would take advantage of economy of scale. The alternative cost for this site's estimated 51 cubic yards of contaminated soil is anticipated to be cost prohibited for the removal action.

The other on-site treatment alternative, soil stabilization, is also viewed as an applicable technique. This technique is similar to alternative 7. The stabilizing equipment necessary for ex-situ treatment are a mixer, grader, and pug mill. IHDIVNAVSURFWARCEN has experience on a previous removal action where silver contaminated soil was stabilized and placed back onto the site in a secure fashion. Because of this experience, the Navy anticipates that this treatment alternative will not be practically feasible for the small quantities that will be generated by this removal action.

5.3 Disposal of Contaminated Water

If the water generated from this activity contains less than 82 $\mu g/l$, the water will be released to the outfall as a permitted discharge per the outfall NPDES permit.

As previously mentioned, all lead contaminated waste water can be treated on-site. However, for comparative purposes, costs for off-site disposal were also calculated. The unit cost to dispose of wastewater containing less than 5 milligrams per liter (mg/L) of lead through DRMO is $1.14/pound. The unit cost for disposing of waste water containing more than 5 mg/l is $0.55/pound. The cost to dispose of the estimated 25,000 gallons that may be generated is $256,500 if it is less than 5 mg/l and $123,750 if the water contains more than 5 mg/l. In order to dispose of this water on-site will cost approximately $100,000 for the 25,000 gallon estimate (~$4/gallon).

6.0 Comparison of Alternatives

The removal action alternatives are evaluated in the following terms; constructability, effectiveness in eliminating risk to human health or the environment, consistency with the final remedial action, compliance with ARARs, and cost effectiveness. The comparative analysis is presented in Table 4.

TABLE 4
REMOVAL ALTERNATIVES

#	ALTERNATIVE	CONSTRUCT-ABILITY	EFFECTIVE-NESS	CONSISTENT WITH FINAL ACTION	COMPLIANCE WITH ARARS	DISPOSAL REQUIRED	COST
1	No Action	high	low	yes	no	no	$0
2	Abandon pipe with pit and outfall removal	high	moderate to high	no	no	yes	$136,000
3	Cleaning Pipe, Pit & Outfall	high	high	possibly	yes	yes	$130,000
4	Clean System & Reline	high	high	yes	yes	yes	$255,000
5	Clean System & Abandon Pipe	high	high	yes	yes	yes	$207,000-$232,000
6	Clean System & Remove Pipe	low to moderate	high	yes	yes	yes	$500,000
7	Stabilize Sediment In-Place	low	moderate	no	no	no	not evaluated
8	Containment In-Place	low	low to moderate	no	no	no	not evaluated
9	In-Situ Soil Flushing	low	moderate	possibly	possibly	no	not evaluated
10	Soil Washing	high	high	possibly	no	possibly	See disposal Table 5

The constructability of an alternative was based on how feasible the alternative will be to implement. The effectiveness of an alternative was judged by how the alternative would prevent future migration of contaminants to the stream and pond. The consistency with the final action and with ARARs is, in the Navy's opinion, the same issue. That is, will the alternative remove the source of contamination from the area included in the removal scope to the "clean-up" standard? And lastly, the costs of each realistic alternative is compared.

Since not all removal action alternatives require the same disposal, i.e., water, soil, or both, disposal costs for each type of disposal were calculated. However, based on the possible removal action alternatives provided in Table 4, the alternatives that meet all requirements do have the same type of disposal requirements, both soil and water. Therefore, Table 5 has been prepared for use as a future reference when planning the removal action.

TABLE 5 DISPOSAL ALTERNATIVES

MEDIA	CLASSIFICATION	ALTERNATIVE	COST
Soil	Non-Hazardous	On-Base Containment	< $10,000
Soil	Non-Hazardous	Off-site-DRMO	$720/cubic yard
Soil	Hazardous	On-site Treatment	Considered cost prohibitive
Soil	Hazardous	Off-site-DRMO	$72,000
Water	< 82 ug/l	On-site Release	No Cost
Water	> 82 μg/l and < 5 mg/l (nonhazardous)	Off-site DRMO	$257,000
Water	> 5 mg/l (hazardous)	Off-site DRMO	$124,000
Water	> 82 ug/l	On-site Treatment	$58,000

7.0 Recommended Alternative

Based on the information in Table 4 concerning constructability, effectiveness, consistency with final action, and ARARs, there are three acceptable alternatives. These are Alternatives 3, 4, and 5.

At first view, Alternative 3 appears to be the best alternative to choose. The concern with Alternative 3 is the possibility for sediment to collect in the future requiring additional cleaning. Although this should not pose a lead contamination problem, it can pose a total suspended solids (TSS) problem in the future. This possible TSS problem, which also can lead to an NPDES violation, is undesirable.

Of the remaining Alternatives, 4 and 5, Alternative 5 would be the most appropriate, based on cost alone, since both alternatives satisfy all of the requirements set forth from the beginning. The actual selection of an alternative will depend on the experience of the construction contractor who is retained by the Navy to complete the removal action. Therefore, the recommended alternative is to clean the pipe as in both alternatives 4 and 5, but leave the remainder of the action, i.e., pipe abandonment or relining, to the Navy's discretion at the recommendation of the construction contractor.

REFERENCES

1. 40 Code of Federal Regulations 261, 300.415, 300.5, Appendix D

2. Steve Hiortdahl, *Changes in Groundwater Quality Caused by River-Water Intrusion in the Potomac Group Aquifer System of Northwestern Charles County, Maryland,* Proceedings of the Forum C1990, Springfield Mass., 1990.

3. Robert Foley, *Mattawoman Creek/Surface Warfare Center Mercury Monitoring Study Progress Report for 1991 and Executive Summary for Five Year Study,* U.S. Fish and Wildlife Service, November 1992.

4. Kim Lemaster, Maryland Department of the Environment, Personnel Communication, Subject: Citing of Potential ARARs, 29 March 1994.

5. Chief of Naval Operations, *OPNAVINST 5090.1 Environmental and Natural Resources Program Manual,* Department of The Navy, 2 October, 1990.

6. Office of Water Programs, Environmental Protection Agency, *Operations and Maintenance of Wastewater Collection Systems Volume 1*, Hornet Foundation, Inc., 1987.

7. Allen Wilson, EFA Chesapeake Code 04, Personnel Communication, Subject: Costs Associated with Construction Items, 31 March 1994.

8. Jeff Bossart, NSWC Natural Resources Manager, Personnel Communication, Subject: Historic Site, 10 March 1994.

9. Richard Engineering Services, *Process Plant Construction Estimation Standards Volume 1,* 1992 Edition.

10. EPA/NAVY CERCLA Remedial Action Technology Guide (Containing many Bulletins and Tech Data Sheets), November 1993.

APPENDIX A

NPDES Permit MD0003158A
(excerpt for IW87)

MARYLAND DEPARTMENT OF THE ENVIRONMENT
2500 Broening Highway • Baltimore, Maryland 21224
(410) 631-3000

William Donald Schaefer
Governor

David A.C. Carroll
Secretary

STATE DISCHARGE PERMIT NUMBER	88-DP-2515A
NPDES PERMIT NUMBER	MD0003158A
EFFECTIVE DATE	May 4, 1990
EXPIRATION DATE	May 4, 1995

EFFECTIVE DATE OF MODIFICATION	March 1, 1994
UIC NUMBER	MDS0175W0013 MDS0175W0014 MDS0175W0015 MDS0175W0016 MDS0175W0017 MDS0175W0018 MDS0175W0019 MDS0175W0020

Pursuant to the provisions of Title 9 of the Environment Article, Annotated Code of Maryland and regulations promulgated thereunder and the provisions of the Clean Water Act, 33 U.S.C. § 1251 et seq. and implementing regulations 40 CFR Parts 122, 123, 124, and 125, the Department of the Environment, hereinafter referred to as the "Department," hereby authorizes

Indian Head Division
Naval Surface Warfare Center
Code 0964
101 Strauss Avenue
Indian Head, Maryland 20640-5035

TO DISCHARGE FROM

an explosives and propellant manufacturing, research, development, assembly, and testing facility

LOCATED AT

Indian Head, Charles County, Maryland

VIA OUTFALLS

001, 002, 003, 004, 005, 007, 009, 010, 018, 021, 023, 024, 025, 028, 033, 034, 035, 036, 037, 038, 040, 045, 046, 048, 049, 050, 053, 055, 056, 058, 060, 061, 062, 064, 065, 066, 068, and 075 through 101 as identified and described herein

TO

the Potomac River, Mattawoman Creek, and Chicamuxen Creek, which are protected for water contact recreation, fishing, aquatic life, and wildlife in accordance with the following special and general conditions and maps made a part hereof.

I. SPECIAL CONDITIONS

A.16. EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

Beginning on the effective date of the modification of the permit and lasting through the expiration date, the permittee is authorized to discharge from Outfall 086 maintenance washwater and noncontact cooling water from energetics mixing, lacquer premixes, and braiding, spent carbon canister drainage, and storm water runoff; Outfall 087 maintenance washwater and process wastewater from the Biazzi Nitration Facility, neutralized spent acid from the cleaning of holding tanks, neutralized spills, shower drainage, diked storm water, noncontact cooling water, discharge from carbon treatment processes, and storm water runoff.

As specified below, these discharges shall be limited and monitored by the permittee at the location described in Special Condition K.1.

EFFLUENT CHARACTERISTICS	EFFLUENT LIMITATIONS (lbs/day)		EFFLUENT LIMITATIONS Other Units (Specify)		MONITORING REQUIREMENTS	
	Quarterly Average	Daily Maximum	Quarterly Average	Daily Maximum	Measurement Frequency	Sample Type
Flow (gpd)	N/A	N/A	(1)	(1)	1/Month	Estimated
Total Suspended Solids	N/A	N/A	30 mg/l	60 mg/l	1/Month	8-hr. Composite
Temperature	N/A	N/A	N/A	90°F	1/Month	i-s
Nitrated Esters(2)	N/A	N/A	N/A	1.0 mg/l	1/Month	Grab
Lead(2)	N/A	N/A	(1)	0.082 mg/l	1/Month	8-hr. Composite
Mercury(2)	N/A	N/A	(1)	0.0024 mg/l	1/Month	8-hr. Composite
Chemical Oxygen Demand	N/A	N/A	(1)	(1)	1/Month	8-hr. Composite
Total Nitrogen	N/A	N/A	(1)	(1)	1/Month	8-hr. Composite
Total Phosphorus(3)	N/A	N/A	(1)	(1)	1/Month	8-hr. Composite

The pH shall not be less than 6.0 nor greater than 9.0 and shall be monitored once per month by grab sample.

There shall be no discharge of floating solids or persistent foam in other than trace amounts. Persistent foam is foam that does not dissipate within one half-hour of point of discharge.

I. SPECIAL CONDITIONS - continued

A.16.EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS

(1) Monitoring required without limits.

(2) Measured as total recoverable lead (EPA Method 239.2) and total mercury or both as acid soluble. Limit is contingent upon final promulgation of proposed COMAR 26.08.02. If a diffuser approved by the Department is installed, then the daily maximum limits shall be as follows: Lead - 0.3 mg/l; Mercury - 0.006 mg/l.

(3) Outfall 087 only.

APPENDIX B

ARAR Guidance

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

AUG 29 1991

OFFICE OF
SOLID WASTE AND EMERGENCY RESPONSE

MEMORANDUM

SUBJECT: Update on OSWER Soil Lead Cleanup Guidance

FROM: Don R. Clay
Assistant Administrator
Solid Waste and Emergency Response

TO: Addressees

PURPOSE

This memorandum addresses the progress of the Office of Solid Waste and Emergency Response (OSWER) in updating the directive #9355.4-02 entitled "Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites" (September 1989).

BACKGROUND

Currently, as set forth by OSWER directive #9355.4-02, EPA recommends an interim soil cleanup level of 500 - 1000 ppm total lead for CERCLA sites characterized as residential. This directive is being revised to:

1. Account for the contribution of various media to total lead exposure, and the variability of each medium's contribution with location and age of the exposed population, and

2. Provide a strong scientific basis for choosing a soil lead cleanup level for a specific CERCLA/RCRA site.

OSWER believes that the best available approach is to use the EPA Uptake Biokinetic (UBK) Model as a risk assessment tool to predict blood lead levels and aid the risk management decision on soil lead cleanup levels at CERCLA/RCRA sites which are characterized as residential.

OBJECTIVE

The EPA UBK Model, which was mentioned in OSWER directive #9355.4-02 as a tool for site-specific assessment of total lead exposure, will predict blood lead levels in the most sensitive

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populations (i.e., children 0-6 years old) exposed to lead in air, dust, drinking water, soil, and paint. The UBK Model:

1. Underwent Agency review in its use for the National Ambient Air Quality Standard (NAAQS);

2. Was used to support rulemaking for the Clean Air Act and the Safe Drinking Water Act;

3. Was adapted and reviewed for Superfund application;

4. Was validated at several Superfund sites; and

5. Has default parameters documented by the Office of Research and Development (ORD).

The UBK Model can be run with either site-specific data or its default parameters. Concern exists, however, over the use of the default parameters versus site-specific data for input to the model. OSWER has decided to address these concerns, as well as the appropriate method to use for collecting site specific data, before issuing a directive recommending the UBK model as the preferred method for setting lead cleanup levels at CERCLA/RCRA sites. To this end, the Science Advisory Board (SAB) has agreed to review the UBK model and its applicability for developing site-specific soil lead cleanup levels at CERCLA/RCRA sites. Also, a technical workgroup consisting of Regional, ORD, and OSWER scientists in consultation with outside experts is presently developing a "Site-specific Guidance Manual" which will provide guidance to site managers for determining why and when to collect site-specific data for the model. The guidance will include appropriate protocols and sampling strategies for collecting the site-specific data (e.g., soil, indoor/outdoor dust, paint, etc.) Once this guidance is complete, and the SAB issues have been resolved, EPA expects to release this guidance in conjunction with a revised OSWER directive recommending the UBK model as a risk assessment tool to develop soil lead cleanup levels at CERCLA/RCRA sites.

To assist in the implementation of this revised directive, once it is issued, the technical workgroup mentioned above will:

1. Review inputs and technical applications of the model, within 2-4 weeks of receipt, to aid site managers in the appropriate and consistent application of the model to individual site conditions;

2. Provide clarification and assistance to the Regions in the use and interpretation of the Site-specific Guidance Manual, such as the type of data to use in the Model;

3. Provide scientific support for those cases which the workgroup has reviewed and found the use of the model to

be both appropriate and justified; and

4. Collect data pertaining to the use of the model and Regional site-specific information which will be used to refine and further validate the model.

Once the revised directive is issued, Headquarters has recommended that, whenever the UBK model is used to help determine cleanup levels for a site, the Regions should consult the workgroup on the parameters utilized in the model and the reasons for their selection.

DISCUSSION

We are aware that a number of Regions are already using the UBK Model to develop soil lead cleanup levels at their sites and that the current directive allows for deviations from the 500 - 1000 ppm range due to site-specific conditions. We recommend a model projection benchmark of either 95% of the sensitive population having blood lead levels below 10 ug/dl or a 95% probability of an individual having a blood lead level below 10 ug/dl. This recommendation is consistent with EPA's Agency-Wide Lead Strategy.[1] When the model is run using this benchmark, as well as each of the model's default parameters (i.e. no site-specific data is input), an acceptable soil level of approximately 500 ppm is predicted for lead. For those Regions which have used or are planning on using the model prior to release of the revised directive, and who have developed soil lead cleanup levels which fall outside the 500 - 1000 ppm range, Headquarters has requested that the Assistant Administrator of OSWER be consulted prior to implementation of those cleanup levels. The use of the UBK model in these situations is considered precedent-setting and, as such, a formal consultation with Headquarters is recommended as set forth in OSWER directive #9012.10-1 entitled "Clarification of Delegation of Authority" (April 1990). Headquarters should also be consulted on removal actions which use soil lead cleanup levels derived by the UBK model and which fall outside the 500 - 1000 ppm range. For further information please contact Susan Griffin of the Toxics Integration Branch at FTS 475-9493.

DISCLAIMER

The recommendations in this document are intended solely as guidance. EPA decision makers may act at variance with any of the recommendations contained in this document. These recommendations are not intended and cannot be relied upon to create any rights, substantive or procedural, enforceable by any party in litigation with the United States. These

recommendations may change at any time without public notice.

REFERENCES

1. USEPA, 1990. Technical Support Document on Lead. Draft. Cincinnati, OH. Office of Health and Environmental Assessment, Office of Research and Development, U.S. Environmental Protection Agency. ECAO-CIN-757

2. USEPA, 1991. Strategy for Reducing Lead Exposure. Washington D.C., Office of Toxic Substances, U.S. Environmental Protection Agency. Available from the Toxic Substances Control Act Hotline (202) 554-1404.

Addressees:

Directors, Waste Management Division, Regions I, IV, V, VII, VIII
Director, Emergency and Remedial Response Division, Region II
Directors, Hazardous Waste Management Division, Regions III, VI, IX
Director, Hazardous Waste Division, Region X
Superfund Branch Chiefs, Regions I-X
Regional Counsels, Regions I-X

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

From Fred Ellen

202 433
6193

SEP 7, 1987

Shawn Phillips

OSWER Directive #9355.4-02

MEMORANDUM

SUBJECT: Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund Sites.

FROM: Henry L. Longest II, Director
Office of Emergency and Remedial Response

Bruce Diamond, Director
Office of Waste Programs Enforcement

TO: Directors, Waste Management Division, Regions I, II, IV, V, VII and VIII
Director, Emergency and Remedial Response Division, Region II
Directors, Hazardous Waste Management Division, Regions III and VI
Director, Toxic Waste Management Division, Region IX
Director, Hazardous Waste Division, Region X

PURPOSE

The purpose of this directive is to set forth an interim soil cleanup level for total lead, at 500 to 1000 ppm, which the Office of Emergency and Remedial Response and the Office of Waste Programs Enforcement consider protective for direct contact at residential settings. This range is to be used at both Fund-lead and Enforcement-lead CERCLA sites. Further guidance will be developed after the Agency has developed a verified Cancer Potency Factor and/or a Reference Dose for lead.

BACKGROUND

Lead is commonly found at hazardous waste sites and is a contaminant of concern at approximately one-third of the sites on the National Priorities List (NPL). Applicable or relevant and appropriate requirements (ARARs) are available to provide cleanup levels for lead in air and water but not in soil. The current

National Ambient Air Quality Standard for lead is 1.5 ug/m^3. While the existing Maximum Contaminant Level (MCL) for lead is 50 ppb, the Agency has proposed lowering the MCL for lead to 10 ppb at the tap and to 5 ppb at the treatment plant[1]. A Maximum Contaminant Level Goal (MCLG) for lead of zero was proposed in 1988[2]. At the present time, there are no Agency-verified toxicological values (Reference Dose and Cancer Potency Factor, ie., slope factor), that can be used to perform a risk assessment and to develop protective soil cleanup levels for lead.

Efforts are underway by the Agency to develop a Cancer Potency Factor (CPF) and Reference Dose (RfD), (or similar approach), for lead. Recently, the Science Advisory Board strongly suggested that the Human Health Assessment Group (HHAG) of the Office of Research and Development (ORD) develop a CPF for lead, which was designated by the Agency as a B2 carcinogen in 1988. The HHAG is in the process of selecting studies to derive such a level. The level and documentation package will then be sent to the Agency's Carcinogen Risk Assessment Verification Exercise (CRAVE) workgroup for verification. It is expected that the documentation package will be sent to CRAVE by the end of 1989. The Office of Emergency and Remedial Response, the Office of Waste Programs Enforcement and other Agency programs are working with ORD in conjunction with the Office of Air Quality Planning and Standards (OAQPS) to develop an RfD, (or similar approach), for lead. The Office of Research and Development and OAQPS will develop a level to protect the most sensitive populations, namely young children and pregnant women, and submit a documentation package to the Reference Dose workgroup for verification. It is anticipated that the documentation package will be available for review by the fall of 1989.

IMPLEMENTATION

The following guidance is to be implemented for remedial actions until further guidance can be developed based on an Agency verified Cancer Potency Factor and/or Reference Dose for lead.

Guidance

This guidance adopts the recommendation contained in the 1985 Centers for Disease Control (CDC) statement on childhood lead poisoning[3] and is to be followed when the current or predicted land use is residential. The CDC recommendation states that "...lead in soil and dust appears to be responsible for blood levels in children increasing above background levels when the concentration in the soil or dust exceeds 500 to 1000 ppm". Site-specific conditions may warrant the use of soil cleanup levels below the 500 ppm level or somewhat above the 1000 ppm level. The administrative record should include background documents on the toxicology of lead and information related to site-specific conditions.

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The range of 500 to 1000 ppm refers to levels for total lead, a asured by protocols developed by the Superfund Contract La ratory Program. Issues have been raised concerning the role that the bioavailability of lead in various chemical forms and particle sizes should play in assessing the health risks posed by exposure to lead in soil. At this time, the Agency has not developed a position regarding the bioavailability issue and believes that additional information is needed to develop a position. This guidance may be revised as additional information becomes available regarding the bioavailability of lead in soil.

Blood-lead testing should not be used as the sole criterion for evaluating the need for long-term remedial action at sites that do not already have an extensive, long-term blood-lead data base[1].

EFFECTIVE DATE OF THIS GUIDANCE

This interim guidance shall take effect immediately. The guidance does not require that cleanup levels already entered into Records of Decisions, prior to this date, be revised to conform with this guidance.

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[1] In one case, a biokinetic uptake model developed by the Office of Air Quality Planning and Standards was used for a site-specific risk assessment. This approach was reviewed and approved by Headquarters for use at the site, based on the adequacy of data (due to continuing CDC studies conducted over many years). These data included all children's blood-lead levels collected over a period of several years, as well as family socio-economic status, dietary conditions, conditions of homes and extensive environmental lead data, also collected over several years. This amount of data allowed the Agency to use the model without a need for extensive default values. Use of the model thus allowed a more precise calculation of the level of cleanup needed to reduce risk to children based on the amount of contamination from all other sources, and the effect of contamination levels on blood-lead levels of children.

REFERENCES

1. 53 FR 31516, August 18, 1988.
2. 53 FR 31521, August 18, 1988.
3. Preventing Lead Poisoning in Young Children, January U.S. Department of Health and Human Services, Center Disease Control, 99-2230.

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

345 COURTLAND STREET, N.E.
ATLANTA, GEORGIA 30365

REGION IV WASTE MANAGEMENT DIVISION SCREENING VALUES for HAZARDOUS WASTE SITES

The Region IV Waste Management Division Screening Values for Hazardous Waste Sites are intended to serve as preliminary screening tools for the review of chemical data associated with hazardous waste sites. These lists, currently there is one for surface water and one for sediments, are considered dynamic documents in that they will be updated as more information and other sources become available with the addition of media, parameters, screening levels, or changes in the screening levels.

Exceedences of the screening levels would indicate a need for more investigation, such as sito-specific toxicity tests, literature reviews, etc. It is possible that given the characteristics of a specific site, lower screening values may be used in evaluating preliminary data for that location.

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

REGION IV

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Federal sediment quality criteria for the protection of aquatic life are being developed. In the interim, the EPA Region IV Waste Management Division uses sediment values compiled by the National Oceanic and Atmospheric Administration (NOAA) as screening values for evaluating the potential for chemical constituents in sediments to cause adverse biological effects. NOAA developed this screening method through evaluation of biological effects data for aquatic (marine and freshwater) organisms, obtained through equilibrium partitioning calculations, spiked-sediment bioassays, and concurrent biological and chemical field surveys. For each constituent having sufficient data available, the concentrations causing adverse biological effects were arrayed, and the lower 10 percentile (called an Effects Range-Low, or ER-L) and the median (called an Effects Range-Median, or ER-M) were determined.

EPA Region IV's Waste Management Division compares sediment analytical data to these NOAA values. If sediment contaminant concentrations are above the ER-M, adverse effects on the biota are considered probable. If contaminant concentrations are between the ER-L and the ER-M, adverse effects are considered possible, and EPA recommends conducting sediment toxicity tests as a follow-up. If contaminant concentrations are below the ER-L, adverse effects are considered unlikely.

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REGION IV WASTE MANAGEMENT DIVISION SEDIMENT SCREENING VALUES[1]
for
HAZARDOUS WASTE SITES
(1/27/92 Version)

Chemical Analyte	NOAA ER-L Concentration	NOAA ER-M Concentration	Subjective Degree of Confidence ER-L/ER-M[2]
Trace Elements (ppm)			
Antimony	2	25	M/M
Arsenic	33	85	L/M
Cadmium	5	9	H/H
Chromium	80	145	M/M
Copper	70	390	H/H
Lead	35	110	M/H
Mercury	0.15	1.3	M/H
Nickel	30	50	M/M
Silver	1	2.2	M/M
Zinc	120	270	H/H
Polychlorinated Biphenyls (ppb)			
Total PCBs	50	400	M/M
DDT and Metabolites (ppb)			
DDT	1	7	L/L
DDD	2	20	M/L
DDE	2	15	L/L
Total DDT	3	350	M/M

Region IV WSMD Sediment Screening Values
January 27, 1992

Chemical Analyte	NOAA ER-L Concentration	NOAA ER-M Concentration	Subjective Degree of Confidence ER-L/ER-M[1]
Other Pesticides (ppb)			
Chlordane	0.5	6	L/L
Dieldrin	0.02	8	L/L
Endrin	0.02	45	L/L
Polynuclear Aromatic Hydrocarbons (ppb)			
Acenaphthene	150	650	L/L
Anthracene	85	960	L/M
Benzo(a)anthracene	230	1600	L/M
Benzo(a)pyrene	400	2500	M/M
Chrysene	400	2800	M/M
Dibenz(a,h)anthracene	60	260	M/M
Fluoranthene	600	3600	H/H
Fluorene	35	640	L/L
2-Methylnaphthalene	65	670	L/M
Naphthalene	340	2100	M/H
Phenanthrene	225	1380	M/M
Pyrene	350	2200	M/M
Total PAHs	4000	35000	L/L

Region IV WSMD Freshwater Water Quality Screening Values
November 16, 1992

Compound	Acute Screening Value (ug/L)	Chronic Screening Values (ug/L)
2-Chloroethylvinyl Ether	35400 (1s)	3540
Chloroform	2890 (3s)	289
1,2-Dichloroethane	11800 (3s)	2000 (1s)
1,1-Dichloroethylene	3030 (3s)	303
1,2-Dichloropropane	5250 (3s)	525
1,3-Dichloropropylene (cis and trans)	606 (2s)	24.4 (1s)
Ethylbenzene	4530 (5s)	453
Methyl Bromide	1100 (1s)	110
Methyl Chloride	55000 (1s)	5500
Methylene Chloride	19300 (3s)	1930
1,1,2,2-Tetrachloroethane	932 (3s)	240 (1s)
Tetrachloroethylene	528 (5s)	84 (1s)
Toluene	1750 (5s)	175
1,2-Trans-Dichloroethylene	13500 (1s)	1350
1,1,1-Trichloroethane	5280 (2s)	528
1,1,2-Trichloroethane	3600 (3s)	940 (1s)
2-Chlorophenol	438 (5s)	43.8
2,4-Dichlorophenol	202 (3s)	36.5 (1s)
2,4-Dimethylphenol	212 (3s)	21.2
2-Methyl-4,6-Dinitrophenol (4,6-Dinitro-O-Cresol)	23 (4s)	2.3
2,4-Dinitrophenol	62 (3s)	6.2
2-Nitrophenol	-	3500
4-Nitrophenol	828 (3s)	82.8
3-Methyl-4-Chlorophenol (P-Chloro-M-Cersol)	3 (1s)	0.3

Region IV WSMD Freshwater Water Quality Screening Values
November 16, 1992

Compound	Acute Screening Value (ug/L)	Chronic Screening Values (ug/L)
N-Nitrosodiphenylamine	585(2s)	58.5
1,2,4-Trichlorobenzene	150(4s)	44.9 (1s)
Aldrin	3*	0.3
a-BHC	-	500[5]
b-BHC	-	5000[5]
g-BHC (Lindane)	2*	0.08*
Chlordane	2.4*	0.0043*[3]
4,4'-DDT	1.1*	0.001*
4,4'-DDE	105(1s)	10.5
4,4'-DDD	0.064(8s)	0.0064
Dieldrin	2.5*	0.0019*[3]
a-Endosulfan	0.22*	0.056*
b-Endosulfan	0.22*	0.056*
Endrin	0.18*	0.0023*[3]
Heptachlor	0.52*	0.0038*[3]
Heptachlor Epoxide	0.52*	0.0038*[3]
PCB-1242	0.2(7s)	0.014*
PCB-1254	0.2(7s)	0.014*
PCB-1221	0.2(7s)	0.014*
PCB-1232	0.2(7s)	0.014*
PCB-1248	0.2(7s)	0.014*
PCB-1260	0.2(7s)	0.014*
PCB-1016	0.2(7s)	0.014*
Toxaphene	0.73*	0.0002*[3]

Region IV Waste Management Division
Freshwater Water Quality Screening Values
for
Hazardous Waste Sites[1]
(11/16/92 Version)

Compound	Acute Screening Value (ug/L)	Chronic Screening Values (ug/L)
Priority Pollutants		
Antimony	1300 (2s)	160 (2s)
Arsenic III	360*	190*
Beryllium	16 (6s)	0.53 (1s)
Cadmium[2]	1.79*	0.66*
Chromium (III)[2]	984.32*	117.32*
Chromium (VI)	16*	11*
Copper[2]	9.22*	6.54*
Lead[2]	33.78*	1.32*
Mercury	2.40*	0.012*[3]
Nickel[2]	789.00*	87.71*
Selenium	20.00*	5.00*
Silver[2]	1.23*	0.012(1s)
Thallium	140.00(3s)	4.00 (2s)
Zinc[2]	65.04*	58.91*
Cyanide	22*	5.2*
2,3,7,8-TCDD-Dioxin	0.1	0.00001[3]
Acrolein	6.8(3s)	2.1 (1s)
Acrylonitrile	755 (4s)	75.5
Benzene	530 (7s)	53
Bromoform	2930 (2s)	293
Carbon Tetrachloride	3520 (3s)	352
Chlorobenzene	1950 (5s)	195

Region IV WSMD Freshwater Water Quality Screening Values
November 16, 1992

Compound	Acute Screening Value (ug/L)	Chronic Screening Values (ug/L)
Pentachlorophenol[4]	3.32*	2.10*
Phenol	1020(16s)	256 (1s)
2,4,6-Trichlorophenol	32 (3s)	3.2
Acenaphthene	170 (2s)	17
Benzidine	250 (4s)	25
Bis(2-Chloroethyl) Ether	23800 (1s)	2380
Bis(2-Ethylhexyl) Phthalate	1110 (2s)	<0.3 (2s)
4-BromophenylPhenyl Phthalate	36(2s)	12.2 (1s)
Butylbenzyl Phthalate	330(4s)	22 (2s)
1,2-Dichlorobenzene	158(4s)	15.8 (3s)
1,3-Dichlorobenzene	502(3s)	50.2
1,4-Dichlorobenzene	112(5s)	11.2
Diethyl Phthalate	5210(2s)	521
Dimethyl Phthalate	3300(2s)	330
Di-n-Butyl Phthalate	94(6s)	9.4
2,4-Dinitrotoluene	3100(2s)	310
1,2-Diphenylhydrazine	27(2s)	2.7
Fluoranthene	398(2s)	39.8
Hexachlorobutadiene	9(5s)	0.93(1s)
Hexachlorocyclopentadiene	0.7(4s)	0.07
Hexachloroethane	98(5s)	9.8
Isophorone	11700(2s)	1170
Naphthalene	230(4s)	62(1s)
Nitrobenzene	2700(2s)	270

Region IV WSMD Freshwater Water Quality Screening Values
November 16, 1992

Compound	Acute Screening Value (ug/L)	Chronic Screening Values (ug/L)
Non-priority Pollutants		
Aluminum (pH 6.5 - 9.0)	750*	87*
Boron	-	750*[6]
Chloride	860000*	230000*
Chlorine (TRC)	19*	11*
Chloropyrifos	0.083*	0.041*
Demeton	-	0.1*
Guthion	-	0.01*
Iron	-	1000*
Malathion	-	0.1*
Methoxychlor	-	0.03*
Mirex	-	0.001*
Oil and Grease	-	0.01* Low LC_{50}
Parathion	0.065*	0.013*
Pentachlorobenzene	250	50
pH	-	6.5 - 9.0*
Sulfide (S_2-, HS-)	-	2*
1,2,4,5-Tetrachlorobenzene	250	50
Tributyltin	-	0.026

Region IV WSMD Freshwater Water Quality Screening Values
November 16, 1992

[1] Based on Region IV Water Management Division, Water Quality Standards Unit's Screening List.
Hardness (mg/L as $CaCO_3$): 50.0
pH: 6
*: Criteria
s: Number of Species

[2] Hardness Dependent
Based on the following equations:

Compound	Acute Screening Value	Chronic Screening Value
Cadmium	$e^{(1.128(\ln H)-3.828)}$	$e^{(0.7852(\ln H)-3.49)}$
Chromium III	$e^{(0.819(\ln H)+3.688)}$	$e^{(0.819(\ln H)+1.561)}$
Copper	$e^{(0.9422(\ln H)-1.464)}$	$e^{(0.8545(\ln H)-1.465)}$
Lead	$e^{(1.273(\ln H)-1.46)}$	$e^{(1.273(\ln H)-4.705)}$
Nickel	$e^{(0.846(\ln H)+3.3612}$	$e^{(0.846(\ln H)+1.1645)}$
Silver	$e^{(1.72(\ln H)-6.52)}$	
Zinc	$e^{(0.8473(\ln H)+0.8604)}$	$e^{(0.8473(\ln H)+0.7614)}$

[3] Based on the marketability of fish. The use of other values which may have greater ecological significance may be considered.

[4] pH Dependent.
Based on the following equation:

Compound	Acute Screening Value	Chronic Screening Value
Pentachlorophenol	$e^{(1.005pH-4.83)}$	$e^{(1.005pH-5.29)}$

[5] Lowest plant value reported

[6] For long term irrigation of sensitive crops (minimum standard)

Region IV Saltwater Water Quality Screening Values[1] for Hazardous Waste Sites (11/16/92 Version)

Compound	Acute Screening Value (ug/L)	Chronic Screening Values (ug/L)
Priority Pollutants		
Antimony	-	-
Arsenic III	69*	36*
Beryllium	-	-
Cadmium[2]	43*	9.3*
Chromium (III)[2]	1030 (2s)	103
Chromium (VI)	1100*	50*
Copper[2]	2.9*	2.9*
Lead[2]	140*	5.6*
Mercury	2.1*	0.025*[3]
Nickel[2]	75*	8.3*
Selenium	300*	71*
Silver[2]	2.3*	0.23 (1s)
Thallium	213 (3s)	21.3
Zinc[2]	95*	86*
Cyanide	1*	1*
2,3,7,8-TCDD-Dioxin	-	0.00001[3]
Acrolein	5.5 (1s)	0.55
Acrylonitrile	-	-
Benzene	1090 (6s)	109
Bromoform	1790 (2s)	640 (1s)
Carbon Tetrachloride	15000 (1s)	1500

Saltwater Water Quality Screening Values
November 16, 1992

Compound	Acute Screening Value (ug/L)	Chronic Screening Values (ug/L)
Chlorobenzene	1050 (2s)	105
2-Chloroethylvinyl Ether	-	-
Chloroform	8150 (1s)	815
1,2-Dichloroethane	11300 (1s)	1130
1,1-Dichloroethylene	22400 (3s)	2240
1,2-Dichloropropane	24000 (1s)	2400
1,3-Dichloropropylene (cis and trans)	79 (2s)	7.9
Ethylbenzene	43 (5s)	4.3
Methyl Bromide	1200 (1s)	120
Methyl Chloride	27000 (1s)	2700
Methylene Chloride	25600 (2s)	2560
1,1,2,2-Tetrachloroothane	902 (2s)	90.2
Tetrachloroethylene	1020 (1s)	45 (1s)
Toluene	370 (5s)	37
1,2-Trans-Dichloroethylene	-	-
1,1,1-Trichloroethane	3120 (2s)	312
1,1,2-Trichloroethane	-	-
2-Chlorophenol	-	-
2,4-Dichlorophenol	-	-
2,4-Dimethylphenol	-	-
2-Methyl-4,6-Dinitrophenol (4,6-Dinitro-O-Cresol)	-	-
2,4-Dinitrophenol	485 (3s)	48.5
2-Nitrophenol	-	-
4-Nitrophenol	717 (2s)	71.7

Saltwater Water Quality Screening Values
November 16, 1992

Compound	Acute Screening Value (ug/L)	Chronic Screening Values (ug/L)
3-Methyl-4-Chlorophenol (P-Chloro-M-Cresol)	-	-
Pentachlorophenol[4]	13[4]	7.9[4]
Phenol	580 (4s)	58
2,4,6-Trichlorophenol	-	-
Acenaphthene	97 (2s)	9.7
Benzidine	-	-
Bis(2-Chloroethyl) Ether	-	-
Bis(2-Ethylhexyl) Phthalate	-	-
4-BromophenylPhenyl Ether	-	-
Butylbenzyl Phthalate	294.4(2s)	29.4
1,2-Dichlorobenzene	197(3s)	19.7
1,3-Dichlorobenzene	285(2s)	28.5
1,4-Dichlorobenzene	199(2s)	19.9
Diethyl Phthalate	759(2s)	75.9
Dimethyl Phthalate	5800(2s)	580
Di-n-Butyl Phthalate	-	3.4[5]
2,4-Dinitrotoluene	-	-
1,2-Diphenylhydrazine	-	-
Fluoranthene	4(2s)	1.6 (1s)
Hexachlorobutadiene	3.2(4s)	0.32
Hexachlorocyclopentadiene	0.7(6s)	0.07
Hexachloroethane	94(2s)	9.4
Isophorone	1290(1s)	129

Saltwater Water Quality Screening Values
November 16, 1992

Compound	Acute Screening Value (ug/L)	Chronic Screening Values (ug/L)
Naphthalene	235(3s)	23.5
Nitrobenzene	668(2s)	66.8
N-Nitrosodiphenylamine	330000(1s)	33000
1,2,4-Trichlorobenzene	45(2s)	4.5
Aldrin	1.3*	0.13
a-BHC	-	1400[5]
b-BHC	-	-
g-BHC (Lindane)	0.16*	0.016
Chlordane	0.09*	0.004*[3]
4,4'-DDT	0.13*	0.001*
4,4'-DDE	1.4(1s)	0.14
4,4'-DDD	0.25(3s)	0.025
Dieldrin	0.71*	0.0019*[3]
a-Endosulfan	0.034*	0.0087*
b-Endosulfan	0.034*	0.0087*
Endrin	0.037*	0.0023*[3]
Heptachlor	0.053*	0.0036*[3]
Heptachlor Epoxide	0.053*	0.0036*[3]
PCB-1242	1.05(3s)	0.03*
PCB-1254	1.05(3s)	0.03*
PCB-1221	1.05(3s)	0.03*
PCB-1232	1.05(3s)	0.03*
PCB-1248	1.05(3s)	0.03*
PCB-1260	1.05(3s)	0.03*
PCB-1016	1.05(3s)	0.03*

Saltwater Water Quality Screening Values
November 16, 1992

Compound	Acute Screening Value (ug/L)	Chronic Screening Values (ug/L)
Toxaphene	0.21*	0.0002*[3]
Non-priority Pollutants		
Aluminum (pH 6.5 - 9.0)	-	-
Boron	-	-
Chloride	-	-
Chlorine (TRC)	13*	7.5*
Chloropyrifos	0.011*	0.0056*
Demeton	-	0.1*
Guthion	-	0.01*
Iron	-	-
Malathion	-	0.01*
Methoxychlor	-	0.03*
Mirex	-	0.001*
N-nitrosopyrrolidene	3300000	-
Oil and Grease	-	0.1* Low LC_{50}
Parathion	1.78(2s)	0.178
Pentachlorobenzene	160	129
Phosphorus (elemental)	-	0.1*
pH	-	6.5 - 8.5
Sulfide (S_2-, HS-)	-	2
1,2,4,5-Tetrachlorobenzene	160	129
Tributyltin (Advisory)	-	0.01

Saltwater Water Quality Screening Values
November 16, 1992

[1] Based on Region IV Water Management Division, Water Quality Standards Unit's Screening List.
* : Criteria
s : Number of Species

[2] Hardness Dependent
Based on the following equations:

Compound	Acute Screening Value	Chronic Screening Value
Cadmium	$e^{(1.128(\ln H)-3.828)}$	$e^{(0.7852(\ln H)-3.49)}$
Chromium III	$e^{(0.819(\ln H)+3.688)}$	$e^{(0.819(\ln H)+1.561)}$
Copper	$e^{(0.9422(\ln H)-1.464)}$	$e^{(0.8545(\ln H)-1.465)}$
Lead	$e^{(1.273(\ln H)-1.46)}$	$e^{(1.273(\ln H)-4.705)}$
Nickel	$e^{(0.846(\ln H)+3.3612}$	$e^{(0.846(\ln H)+1.1645)}$
Silver	$e^{(1.72(\ln H)-6.52)}$	
Zinc	$e^{(0.8473(\ln H)+0.8604)}$	$e^{(0.8473(\ln H)+0.7614)}$

[3] Based on the marketability of fish. The use of other values which may have greater ecological significance may be considered.

[4] pH Dependent.
Based on the following equation:

Compound	Acute Screening Value	Chronic Screening Value
Pentachlorophenol	$e^{(1.005pH-4.83)}$	$e^{(1.005pH-5.29)}$

[5] Lowest Plant Value Reported

APPENDIX C

Pipe Removal Volume
and Cost Estimate

RICHARDSON ENGINEERING SERVICES, INC.
1742 S. Fraser Drive, P.O. Box 9103 Mesa, Arizona 85214-9103
TELEPHONE (602) 497-2062 FAX # (602) 497-5529

THIS PACKAGE CONTAINS

VOLUME 1

OF A COMPLETE NEW SET OF THE

1992 EDITION:

PROCESS PLANT CONSTRUCTION ESTIMATING STANDARDS

REMOVE THE ENTIRE CONTENTS

OF YOUR VOLUME 1 BINDER

AND REPLACE SAME WITH THESE PAGES

DURING YOUR ANNUAL SUBSCRIPTION, YOU WILL RECEIVE THE RICHARDSON COST TREND REPORTER, INCLUDING REVISIONS AND/OR ADDITIONS TO THE STANDARDS (WHICH ARE PERFORATED FOR REMOVAL AND THREE-HOLE PUNCHED FOR PLACEMENT IN YOUR LOOSELEAF STANDARDS).

THE COST TREND REPORTER, WHICH IS UPDATED AND ISSUED QUARTERLY, GIVES CURRENT WAGE RATES IN 120 CITIES, CONSTRUCTION COSTS, PRICES AND PRODUCER PRICES OF MATERIALS USED IN CONSTRUCTION.

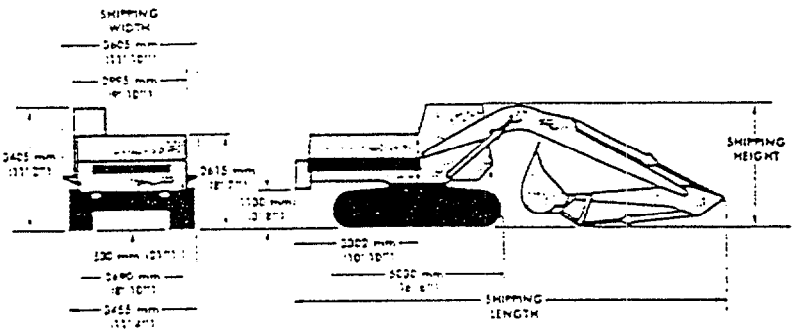
STRUCTURAL EXCAVATION USING A CATERPILLAR 235 BACKHOE ON A SUBCONTRACT BASIS.

	With 2440mm/ 8' Stick	With 2900mm/ 9'-6" Stick	With 3660mm/ 12' Stick
With one-piece boom:			
Shipping height	3404mm/11'-2"	3404mm/11'-2"	3480mm/11'-5"
Shipping length	11 400mm/37'-5"	11 400mm/37'-5"	11 460mm/37'-7"
With two-piece boom, foreboom extended:			
Shipping height	3555mm/11'-8"	3555mm/11'-8"	3580mm/11'-9"
Shipping length	11 400mm/37'-5"	11 400mm/37'-5"	11 460mm/37'-7"

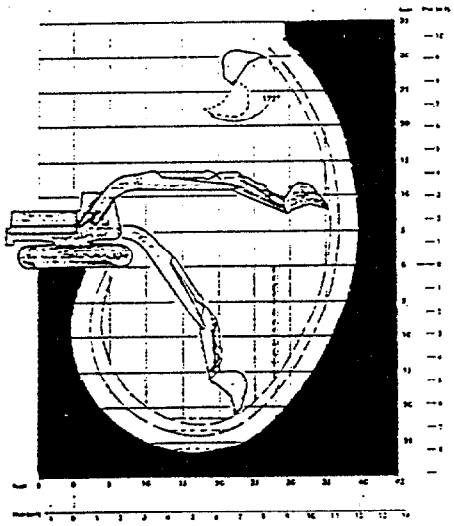
Shipping Weight (approximate)
With 760mm/30" triple grouser shoes, one-piece boom, lubricants, coolant, 10% fuel and without bucket (subtract 544 kg/1,200 lb. when equipped with std. 24" track on European machine.):

With 2400mm/8' stick . . . . . 36 800 kg/ 81,100 lb.
With 2900mm/9'-6" stick. . . . 36 900 kg/ 81,300 lb.
With 3600mm/12' stick . . . . 37 000 kg/ 81,600 lb.

(Add 454 kg/1,000 lb. for two-piece boom.)



Operating Weight
Add 1452 kg/3400 lb. for full fuel tank, operator and 1220mm/48" backhoe bucket.



Bucket specifications (includes tooth tip adapters):

Bite Width measured other outside of long (general purpose) tips	SAE Cubic Yards*		Liter		CECE** Liter	Weight With Tips	
	Struck	Heaped	Struck	Heaped	Heaped	kg	lb.
760mm/30"	1	1-1/8	760	880	930	880	1,940
910mm/36"	1-1/4	1-1/2	960	1150	1160	930	2,050
1070mm/42"	1-1/4	1-1/2	950	1170	1150	1040	2,285
1220mm/48"	1-3/8	1-7/8	1120	1400	1350	1225	2,700
1220mm/48" Rock	1-3/8	1-7/8	1120	1400	1350	1600	3,530
1370mm/54"	1-5/8	2-1/8	1240	1620	1510	1420	3,140
1800mm/71"	2	2-3/4	1660	2100	2000	1785	3,940

See Notes on Page 5.
(Continued on following page)

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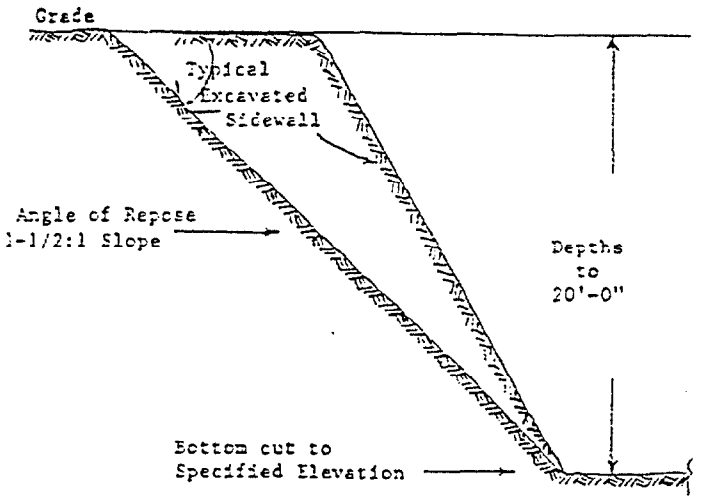

	STRUCTURAL EXCAVATION IN CLASS "A" MATERIAL Footings - Pits - Trenches					
Bucket Capacity, Cubic Yards	1.12 Cu. Yds.	1.25 Cu. Yds.	1.50 Cu. Yds.	1.88 Cu. Yds.	2.12 Cu. Yds.	2.75 Cu. Yds.
Output, Cubic Yards Per Hour (Bank Measure)	145	163	196	217	236	299
Equipment, 1 Hour						
Caterpillar 235 Backhoe $151.00						
Pickup Truck 9.50						
Total Equipment $160.50	$160.50	$160.50	$160.50	$160.50	$160.50	$160.50
Composite Field Crew, 1 Hour						
Foreman $24.60						
Operator 24.10						
Oiler 19.50						
Laborer 18.35						
Total Labor $86.55	86.55	86.55	86.55	86.55	86.55	86.55
Allow For General Conditions And Overhead 50% Of Labor	43.28	43.28	43.28	43.28	43.28	43.28
Total Cost	$290.33	$290.33	$290.33	$290.33	$290.33	$290.33
Profit 10%	29.03	29.03	29.03	29.03	29.03	29.03
TOTAL PER HOUR, SUBCONTRACT	$319.36	$319.36	$319.36	$319.36	$319.36	$319.36
Subcontract Standard Unit Price:*						
Per Cubic Yard	$2.20	$1.96	$1.63	$1.47	$1.35	$1.07
Per Cubic Yard (Total Labor Only)	$0.60	$0.53	$0.44	$0.40	$0.37	$0.29

Should Structural Excavation be performed by a General Contractor, use the Standard Unit Price (Total Labor Only) and carry the Equipment as an Overhead Item in Account 1-0.

*Use these data for comparison only. Four hour minimum crew charge and move-on cost must be considered in determining cost.

For excavation of Trenches, increase the Output Cubic Yards per Hour by 10%.

See Notes on Page 5.
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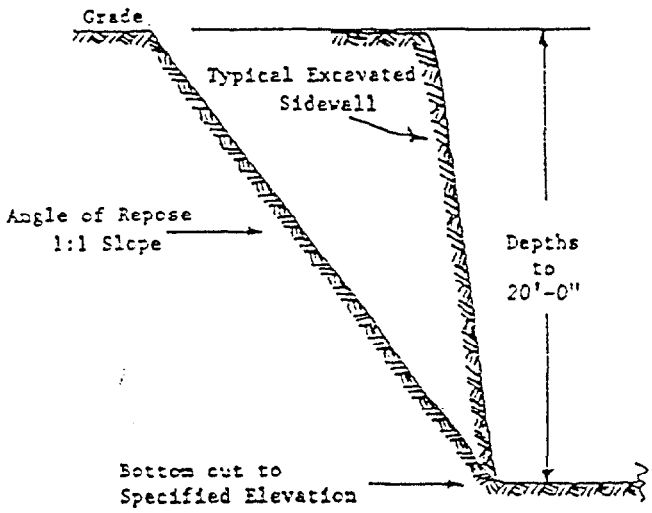

	STRUCTURAL EXCAVATION IN CLASS "B" MATERIAL Footings - Pits - Trenches					
Bucket Capacity, Cubic Yards	1.12 Cu. Yds.	1.25 Cu. Yds.	1.50 Cu. Yds.	1.88 Cu. Yds.	2.12 Cu. Yds.	2.75 Cu. Yds.
Output, Cubic Yards Per Hour (Bank Measure)	120	137	150	187	207	247
Equipment, 1 Hour						
Caterpillar 235 Backhoe $151.00						
Pickup Truck 9.50						
Total Equipment $160.50	$160.50	$160.50	$160.50	$160.50	$160.50	$160.50
Composite Field Crew, 1 Hour						
Foreman $24.60						
Operator 24.10						
Oiler 19.50						
Laborer 18.35						
Total Labor $86.55	86.55	86.55	86.55	86.55	86.55	86.55
Allow For General Conditions And Overhead 50% Of Labor	43.28	43.28	43.28	43.28	43.28	43.28
Total Cost	$290.33	$290.33	$290.33	$290.33	$290.33	$290.33
Profit 10%	29.03	29.03	29.03	29.03	29.03	29.03
TOTAL PER HOUR, SUBCONTRACT	$319.36	$319.36	$319.36	$319.36	$319.36	$319.36
Subcontract Standard Unit Price:* Per Cubic Yard	$2.66	$2.33	$2.13	$1.71	$1.54	$1.29
Per Cubic Yard (Total Labor Only)	$0.72	$0.63	$0.58	$0.46	$0.42	$0.35

Should Structural Excavation be performed by a General Contractor, use the Standard Unit Price (Total Labor Only) and carry the Equipment as an Overhead Item in Account 1-0.

*Use these data for comparison only. Four hour minimum crew charge and move-on cost must be considered in determining cost.

For excavation of Trenches, increase the Output Cubic Yards per Hour by 10%.

See Notes on Page 5.
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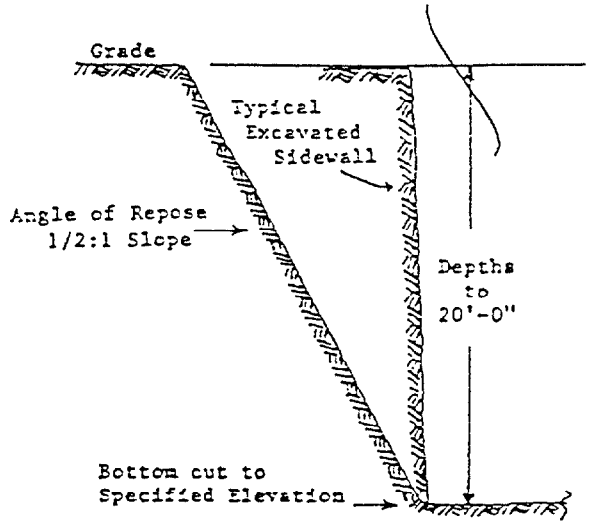

	STRUCTURAL EXCAVATION IN CLASS "C" MATERIAL Footings - Pits - Trenches					
Bucket Capacity, Cubic Yards	1.12 Cu. Yds.	1.25 Cu. Yds.	1.50 Cu. Yds.	1.88 Cu. Yds.	2.12 Cu. Yds.	2.75 Cu. Yds
Output, Cubic Yards Per Hour (Bank Measure)	102	115	123	136	157	203
Equipment, 1 Hour						
Caterpillar 235 Backhoe $151.00						
Pickup Truck 9.50						
Total Equipment $160.50	$160.50	$160.50	$160.50	$160.50	$160.50	$160.50
Composite Field Crew, 1 Hour						
Foreman $24.60						
Operator 24.10						
Oiler 19.50						
Laborer 18.35						
Total Labor $86.55	86.55	86.55	86.55	86.55	86.55	86.55
Allow For General Conditions And Overhead 50% Of Labor	43.28	43.28	43.28	43.28	43.28	43.28
Total Cost	$290.33	$290.33	$290.33	$290.33	$290.33	$290.33
Profit 10%	29.03	29.03	29.03	29.03	29.03	29.03
TOTAL PER HOUR, SUBCONTRACT	$319.36	$319.36	$319.36	$319.36	$319.36	$319.36
Subcontract Standard Unit Price:*						
Per Cubic Yard	$3.13	$2.78	$2.60	$2.35	$2.03	$1.57
Per Cubic Yard (Total Labor Only)	$0.85	$0.75	$0.70	$0.64	$0.55	$0.43

Should Structural Excavation be performed by a General Contractor, use the Standard Unit Price (Total Labor Only) and carry the Equipment as an Overhead Item in Account 1-0.

*Use these data for comparison only. Four hour minimum crew charge and move-on cost must be considered in determining cost.

For excavation of Trenches, increase the Output Cubic Yards per Hour by 10%.

See Notes on Page 5.
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PROCEDURE FOR ESTIMATING USING THE RICHARDSON RAPID SYSTEM

A. Determine the quantity of work to be performed and classify the type and condition of material to be excavated.

B. Using Pages 2 through 4, divide the cubic yardage quantity of work to be performed by the estimated output in Cubic Yards Per Hour. (Note: Adjust Output Cubic Yards if excavating for trenches.)

C. Round up the hours from B to the next 4 Hour increment; therefore, 2.6 Hours becomes 4 Hours; 5 Hours becomes 8 Hours; 35 Hours becomes 36 Hours, etc.

D. Multiply the hours determined in C by the subcontract hourly rate for the selected group. Round off extension of cost to next higher dollar.

E. For moving equipment to the Site, add the following allowance for the appropriate page:

For Pages 2 thru 4 equipment mix - $350.00

This covers the cost of loading and delivery to jobsite located within the local area using all weather roads. If equipment is also used in another Account, prorate these costs.

F. Add the total in dollars to determine the Total Subcontract Cost to perform the work.

G. Add Dump Truck Hauling from Account 2-23 if required.

EXAMPLE:

A. Excavate a trench 1000' in length, 6' in depth, with cut at the subgrade 4'-6" in width in Class A Material and trench sides to Angle of Repose.

From Account 2-12, Page 1, (4.5 x .2222) + 2.000 = 2.9999 x 1000' = 3000 Cubic Yards.

B. 3000 Cubic Yards ÷ (236 x 1.1) Cubic Yards Per Hour equals 11.56 Hours (Page 2).

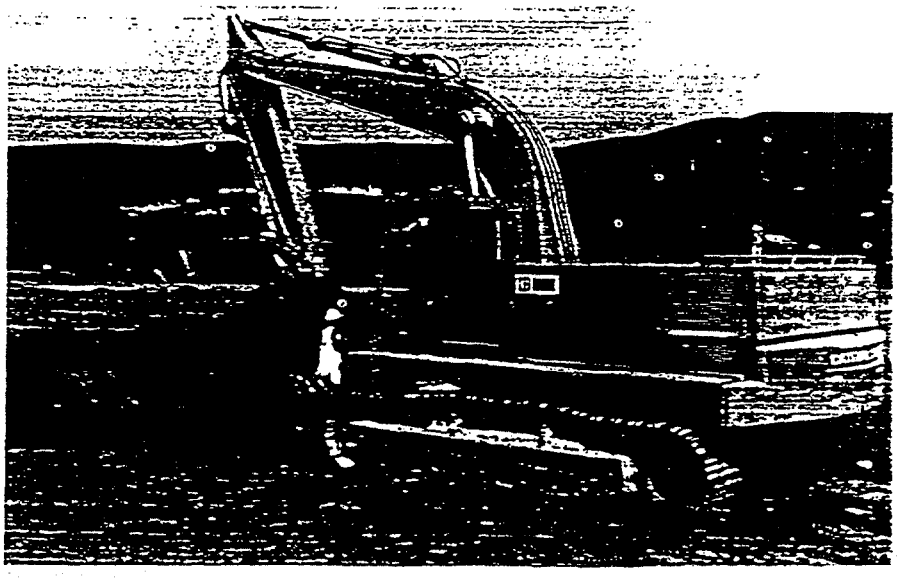
C. 11.56 Hours rounds up to 12 Hours.

D.	12.0 Hours @ $319.36	=	$3,832.32
E.	Transporting Equipment Allowance	=	350.00
F.	TOTAL, SUBCONTRACT	=	$4,182.32
	Cost Per Cubic Yard	=	$1.39

All data in this Account assumes a Dust and Noise Abatement Ordinance is in effect and enforced.

Refer to Account 2-12 to calculate structural excavation quantities and for description of Material Classes.

Refer to Account 2-23 for Dump Truck Hauling, should the project require excavated material be disposed.



Photograph shows Cat 235 being used to excavate for exterior utility piping.

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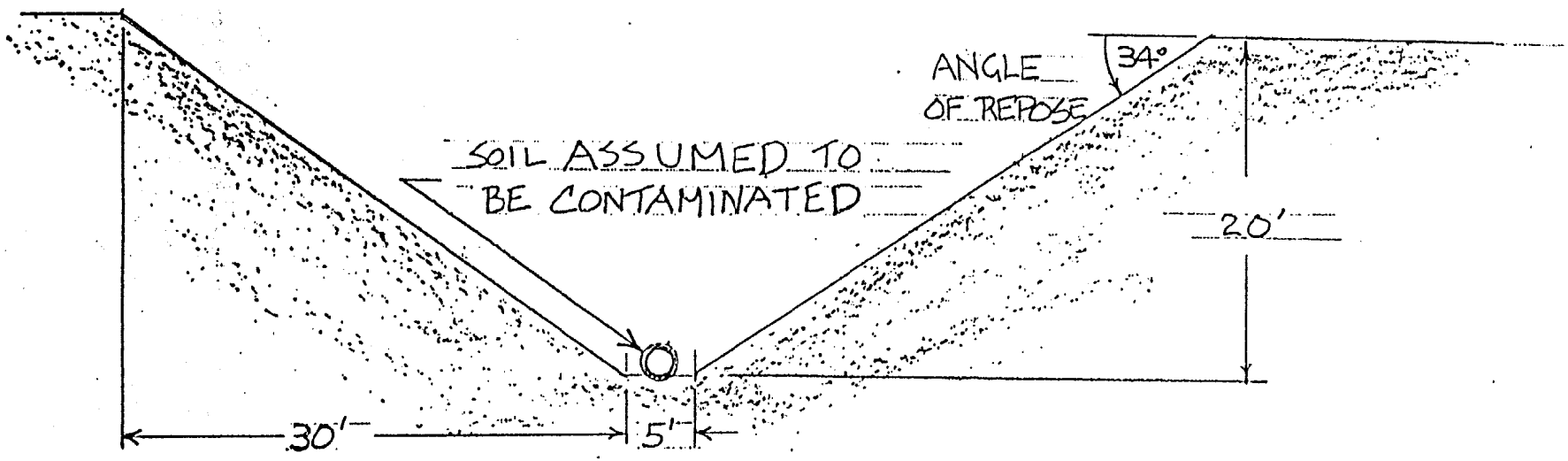
FIGURE C.1

PIPE REMOVAL EXCAVATION VOLUME



VOLUME CALCULATION

CENTER PORTION: 5' x 20' x 650' = 65,000 CUBIC FEET

SIDE SLOPES: 2 (SIDES) x ½ x 20' x 30' x 650 = 390,000 CUBIC FEET

TOTAL VOLUME: 455,000 ft.^{3} = 16,850 yd.^{3}

CONTAMINATED SOIL CALCULATION

VOLUME = $(\pi R^2 - \pi r^2)$ x LENGTH = $3.14(2^2 - 1^2) \times 650$