DEPARTMENT OF THE NAVY
INDIAN HEAD DIVISION
NAVAL SURFACE WARFARE CENTER
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Ser 0951/228
20 Jul 95

Ms. Helene Drago
EPA Region III
841 Chestnut Building
Philadelphia, PA 19107

Dear Ms. Drago:

As discussed in our July 7, 1995 meeting, we are providing additional information on the corrective action plan for lead violations at industrial wastewater outfall (IW) 87.

These violations were caused by lead contamination in the outfall drainage system near Building 790 in our Nitration Plant. This building is used for storing spent nitric and sulfuric acid containing small amounts of nitrate esters. Since nitrate esters, such as nitrogylcerin, are very sensitive liquid explosives, the building was constructed with a lead floor. The lead provides a conductive surface for preventing electrostatic discharge and also prevents absorption of any spilled or leaked nitrate esters. Interior and exterior photos of the building are shown in enclosure (1).

The acid vapors create a weak acid environment which can enhance lead solubility in water. From 1953, when the plant was first built, until 1992, Building 790 was periodically washed down, providing a pathway for a gradual lead contamination of the drainage area leading to IW87. The building floor drains were sealed in October, 1992 to prevent any further discharge of wastewater containing lead. However, cooling water, steam condensate, and stormwater still continue to run through the contaminated drainage area.

After the initial NPDES permit violation, we began an extensive sampling program to determine the source and extent of the problem. Over 40 soil and water samples were collected and analyzed. The results showed lead had settled in the sediment of the wastewater discharge pit outside of Building 790, and in a 700 foot long, 24-inch terra cotta pipe which runs from that pit to IW87. Lead has also settled in the 30 feet of stream bed between the end of the pipe and the NPDES sampling point. A summary of sampling results and a map showing the sampling locations are provided in enclosure (2). Photographs of the pipe and the outfall sampling site are shown in enclosure (3).

A video inspection was done of the interior of the terra cotta drain pipe. The inspection showed cracks throughout the pipe which allowed for the introduction of groundwater and sediments. The inspection also showed the outfall end of the pipe is at least half full with sediment. The large amount of sediment in the pipe, coupled with stream bed contamination where the pipe discharges, provided us no alternative other than a large-scale clean up of the entire drainage system.

Since the contamination was the result of past operations, the clean up is being conducted as a Removal Action under the National Contingency Plan. As indicated in our June 19, 1995 letter, work is being coordinated with MDE's CERCLA Response Division and EPA Region III's Superfund Division. The schedule for this work is provided as enclosure (4).

To accelerate corrective actions at this outfall, the Engineering Evaluation and Cost Analysis (EECA) was done by personnel from our staff and the Navy's Engineering Field Activity, Chesapeake. (Normally, this task is done by an environmental firm, which can involve considerable delays due to the contracting process.)

Ten remedial action alternatives were evaluated during the EECA. An excerpt from the EECA analyzing these alternatives is provided as enclosure (5). The final decision was to clean the terra cotta pipe, remove the contaminated sediments inside and at the outlet of the pipe, and reline it with an in-situ form liner. The sediments in the streambed will be removed to a depth where lead levels are less than 35 parts per million.

In addition to completing the EECA, a contract delivery order was awarded to OHM Inc., the Navy's Remedial Action Contractor. Phase I of this effort, which was to develop a work plan for the clean up, has been completed at a cost of $11,000. As we discussed in our meeting, we are awaiting funding from the Defense Environmental Restoration Account to award Phase II, the actual clean up. The estimated Phase II cost, including disposal of the contaminated soil, is $625,000.

This project is Indian Division's top priority in its Installation Restoration program. We are continuing to lobby for release of the funding to our Activity, but are competing for limited DERA funds with other Navy Activities in the region, many of which are already on the National Priorities List (NPL). We are, however, optimistic that the funding will be provided before the end of this fiscal year (September 30, 1995), or first quarter of next fiscal year.

To avoid schedule delays, we are working to complete the interim requirements. Since the work will be performed near an explosives operating area, a site approval from the Department of Defense's Explosive Safety Board was necessary and has been obtained.

To meet the requirements of the National Historic Preservation Act, an archaeological investigation must be done because of the proximity of the outfall site to other known archaeological sites. An $11,400 contract was recently awarded to Lewis Berger & Associates to conduct the archaeological survey at this site. The contract kickoff meeting was held July 18th, and the survey is expected to be completed by the end of August.

We are also developing the plan and drawings for the soil and sediment erosion control measures which will be employed during the clean up. This information will be forwarded to the Maryland Department of the Environment for their review and approval, so that once the funding is available and the clean up phase is awarded, OHM can proceed as quickly as possible.

If you have any questions on this corrective action plan for IW87, please contact Mike Dunn at (301) 743-4320.

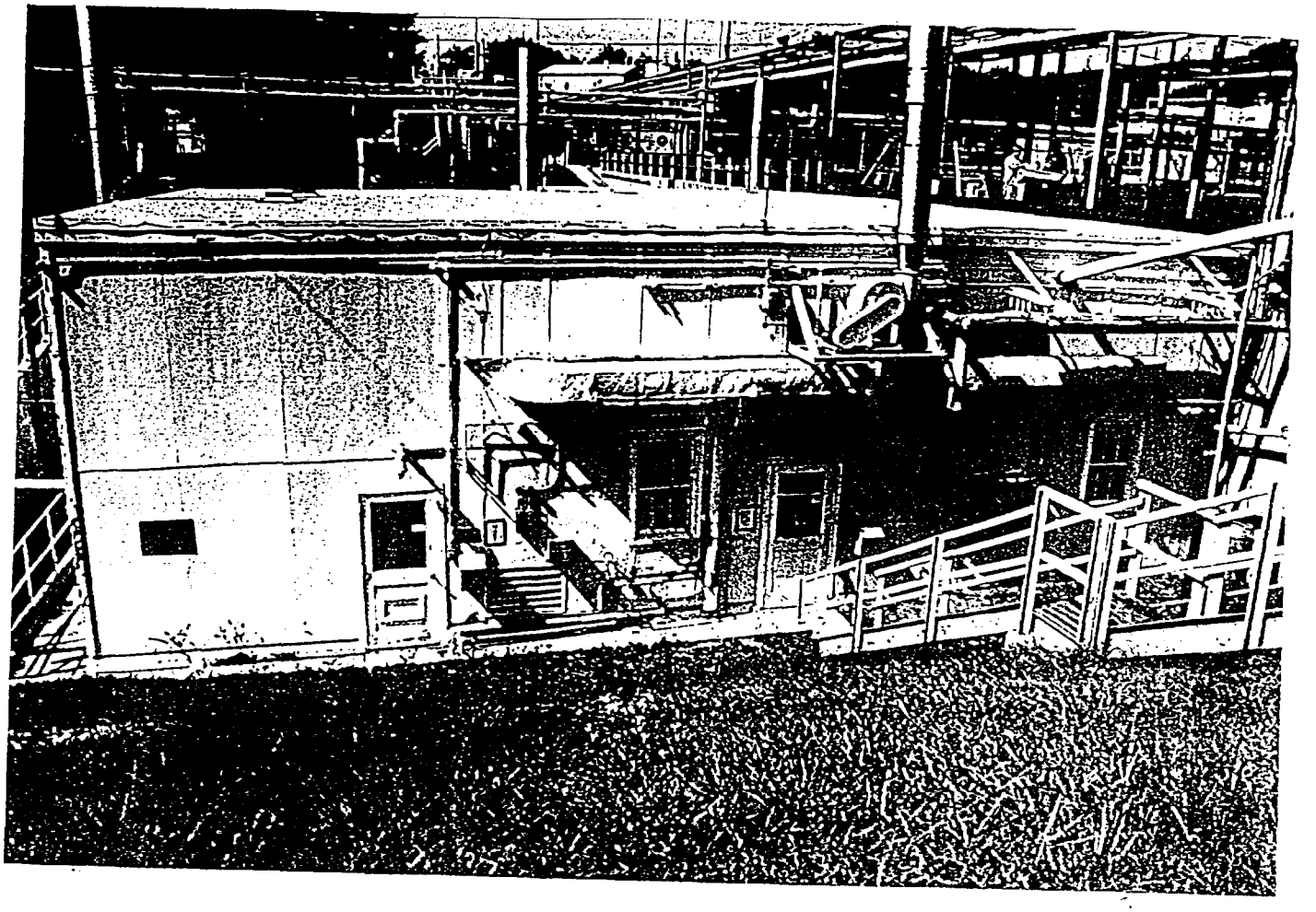
Sincerely,

Cheryl D. Deskins

CHERYL D. DESKINS
Acting Director
Environmental Division
By direction of the Commander

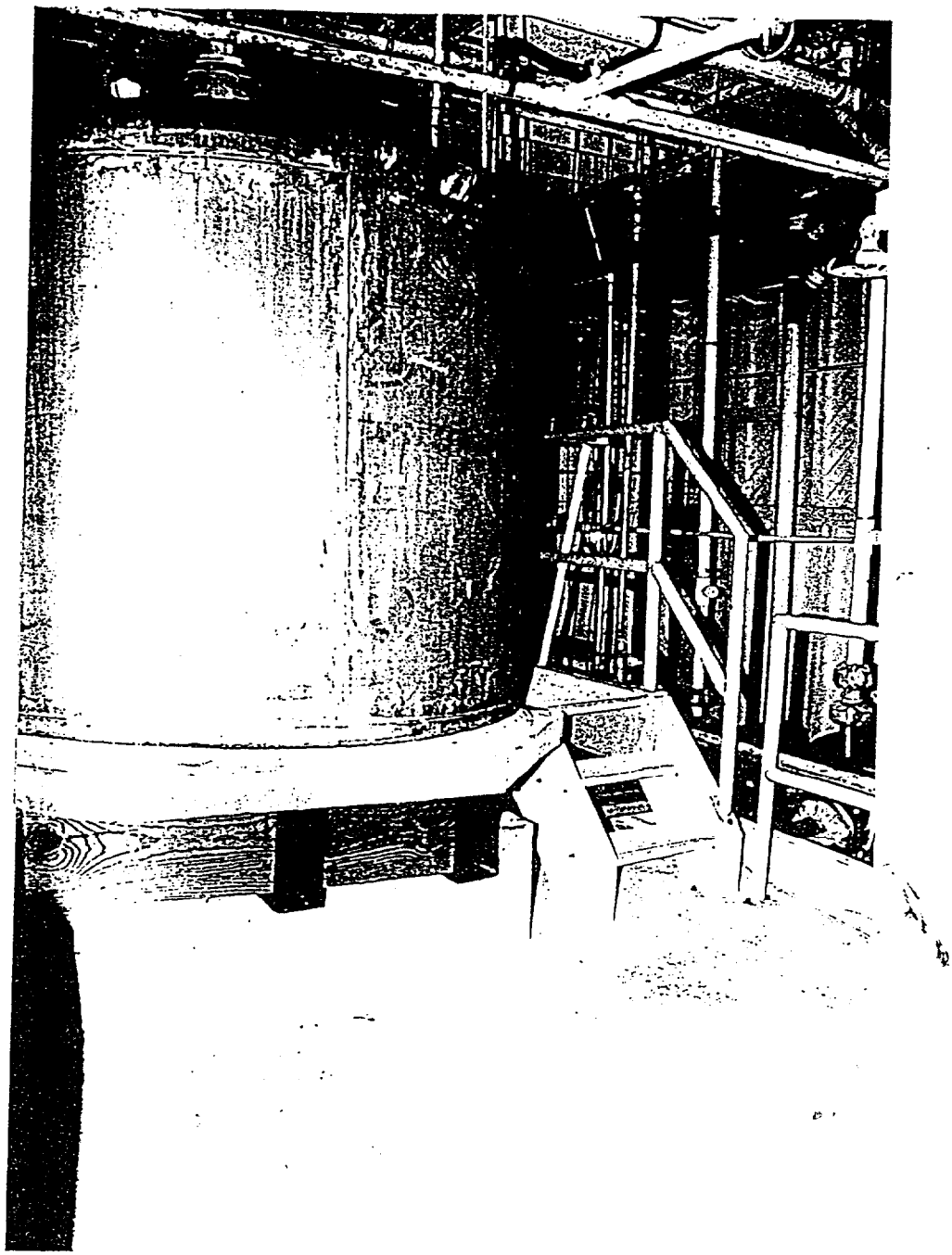
Encl:
(1) Photos of Bldg. 790
(2) Summary of Sampling Results
(3) Photos of Pipe and Outfall Sampling Site
(4) Schedule
(5) Excerpt from EECA

Copy to:
EPA Region III (P. Yeany)
MDE (C. Coates)
EFACHES (P. Gilbertson)
EFACHES (S. Phillips)
NAVSEASYSCOM (SEA07E)
COMNAVBASE Norfolk (N9E3)
NSWC (NSWC 04E)



Exterior of Spent Acid Storage
Building 790

ENCLOSURE(1)



Acid Storage Tank and Lead Floor
Building 790

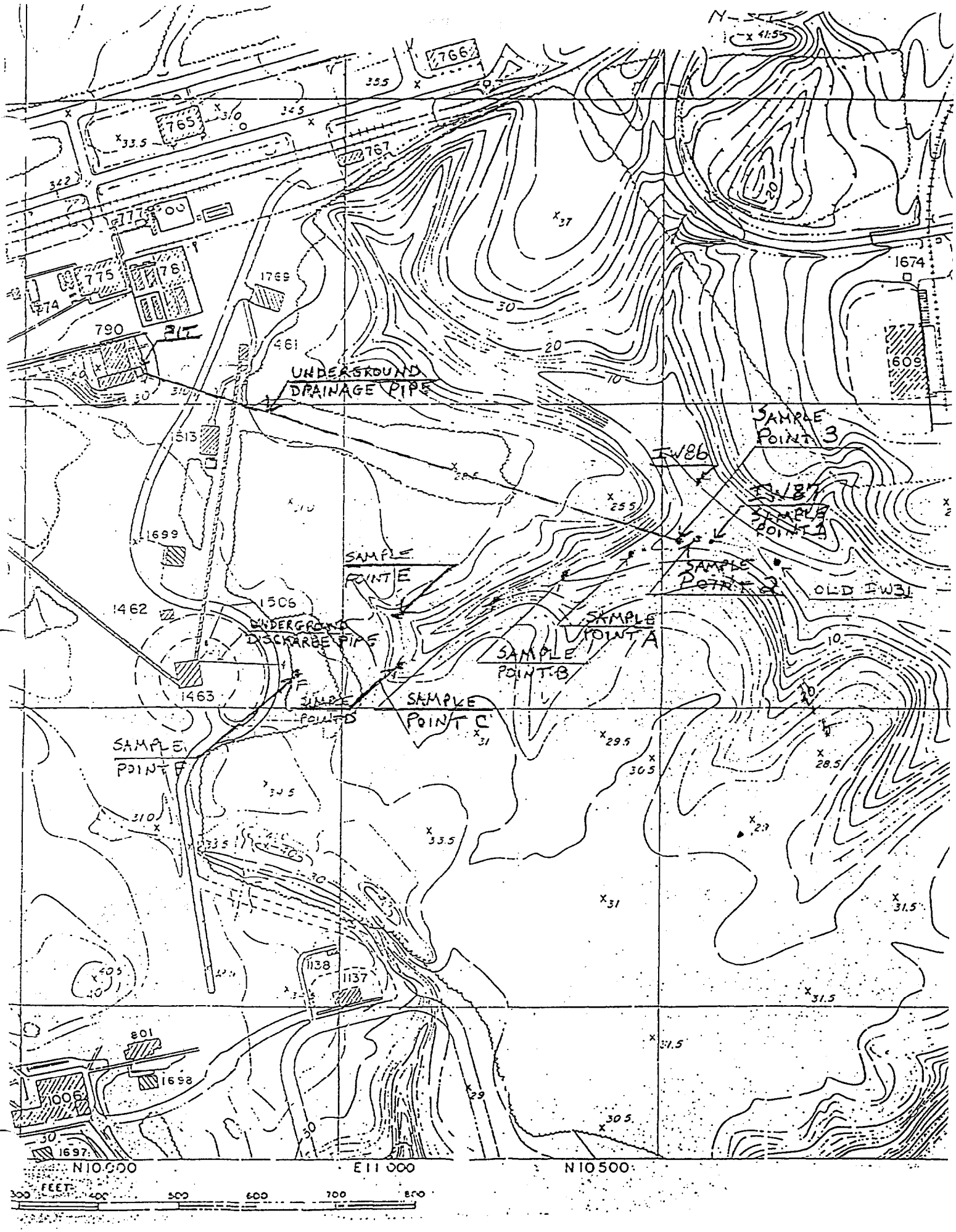
TABLE 1b
Analytical Results of Water Samples Taken for Lead

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

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

ENCLOSURE(2

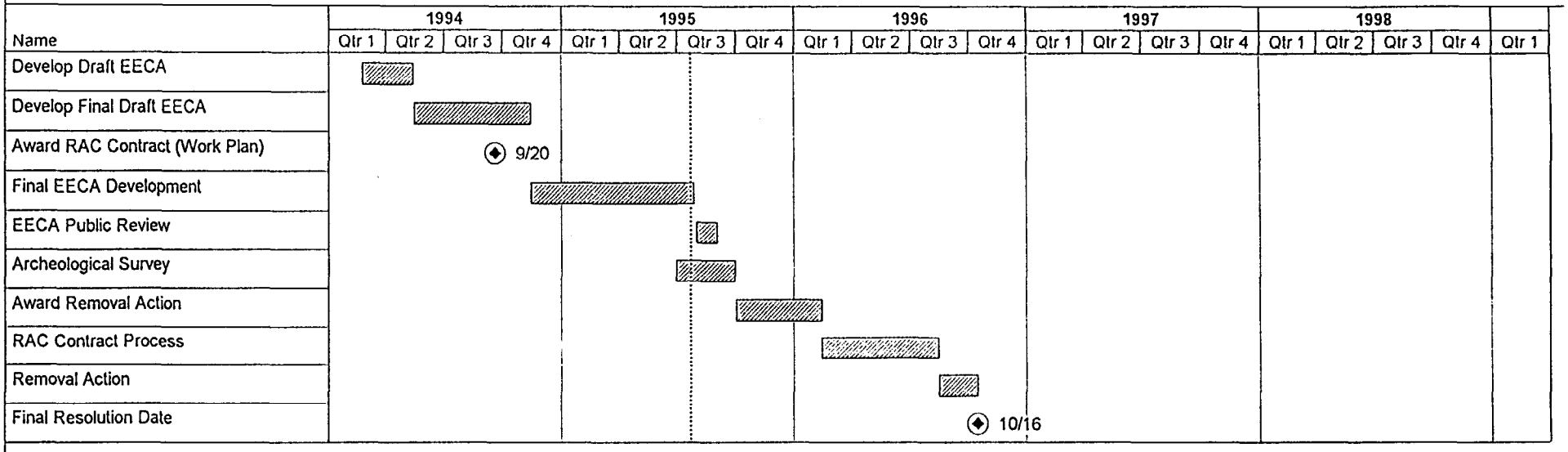

N
766
765
767
775
776
790
PIT
1769
461
UNDERGROUND
DRAINAGE PIPE
1674
1609
1513
SAMPLE
POINT 3
IW86
IW87
SAMPLE
POINT 1
SAMPLE
POINT 2
OLD IW31
1699
SAMPLE
POINT E
1462
1506
UNDERGROUND
DISCHARGE PIPE
SAMPLE
POINT A
SAMPLE
POINT B
1463
SAMPLE
POINT D
SAMPLE
POINT C
SAMPLE
POINT F
1138
1137
801
1698
1006
1697
N10,000
E11,000
N10,500
FEET
300
400
500
600
700
800

Stream and Sampling Site
IW 87

ENCLOSURE(3)

Terra Cotta Pipe From Building 790
Emptying into IW 87 Stream

Plan for Cleanup of Lead Contamination @ NPDES Industrial Wastewater Outfall IW 87



Project:
Date: 7/20/95

Critical — Noncritical — Progress — Milestone — Summary — Rolled Up

ENCLOSURE (4)

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.

ENCLOSURE(5)

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 $= \pi r^2 l$, 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.

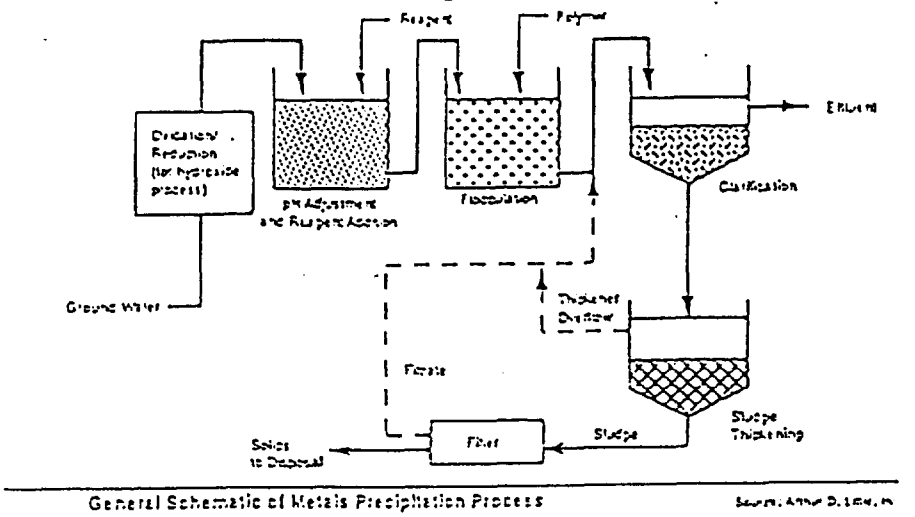
3.3.2 Contaminant Specific Goals

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.

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

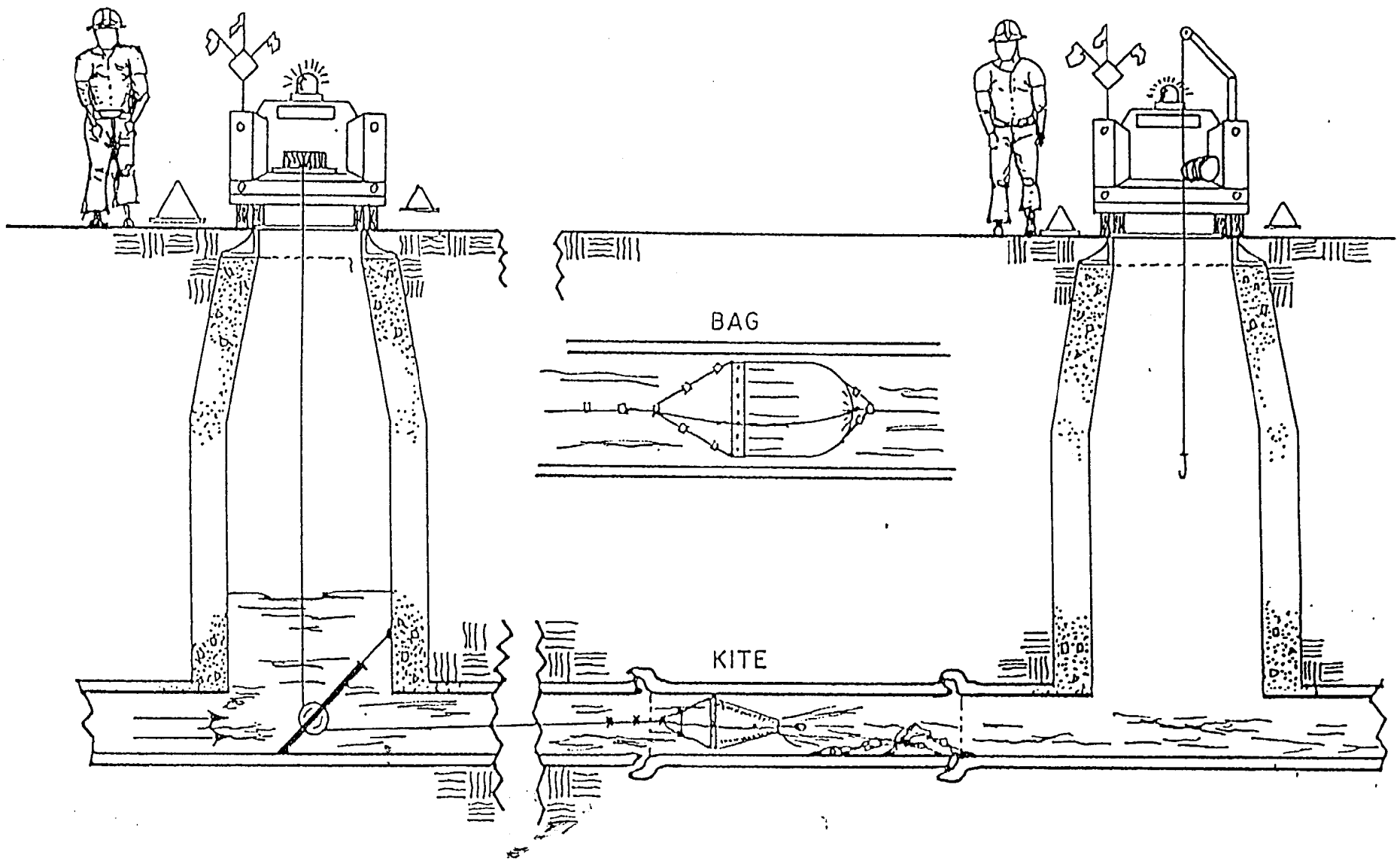
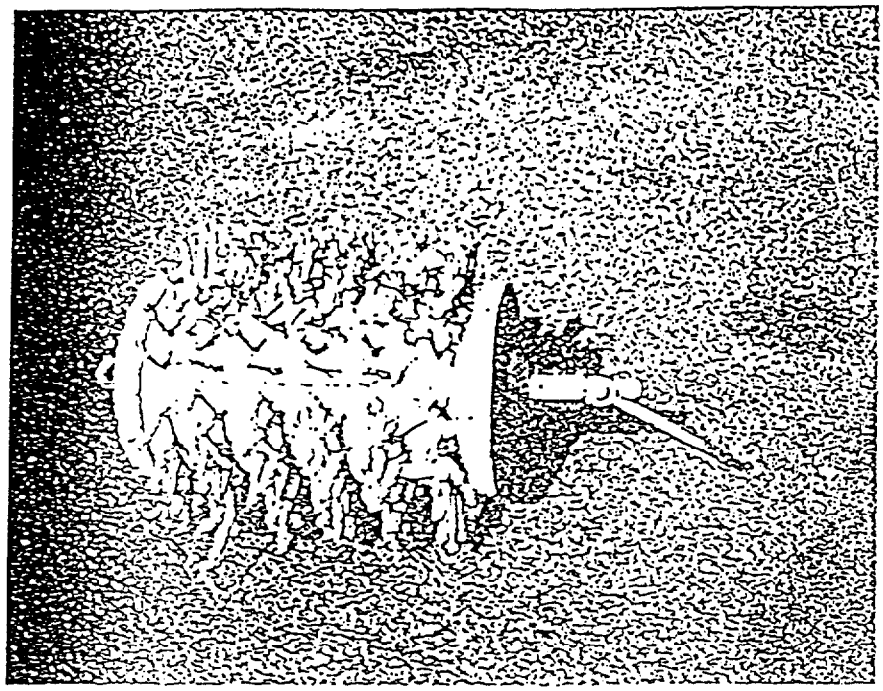
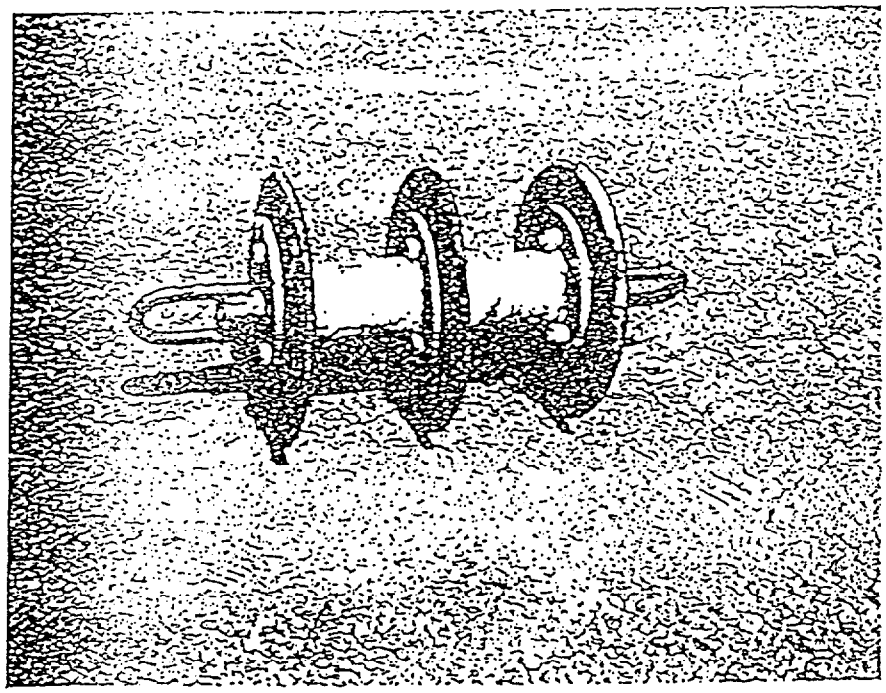


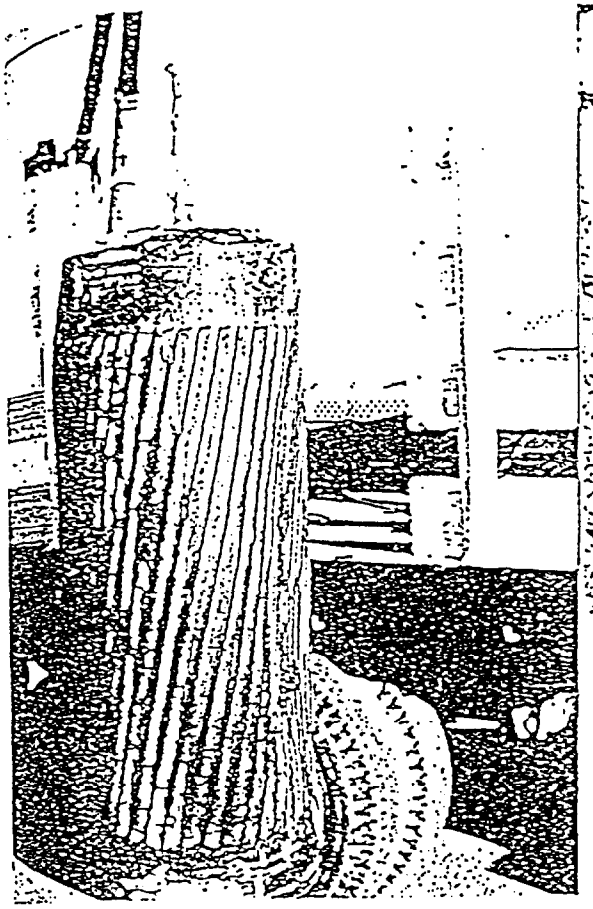
Figure 4-2 Porcupine and Swab



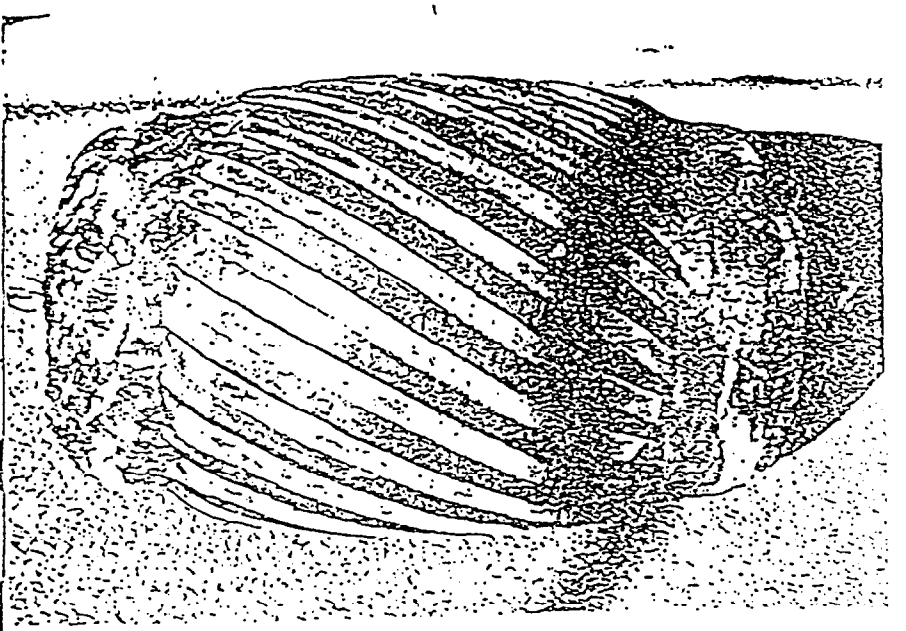


Pull-type swab used to follow the cleaning of a line with a porcupine

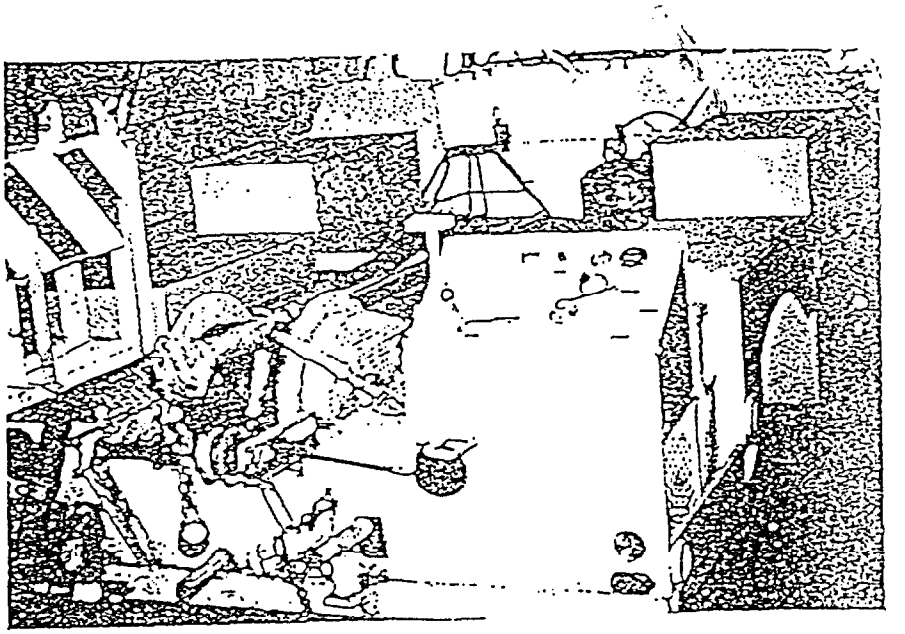
Figure 4-3 Sewer Balls and Truck with Power Winch



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.

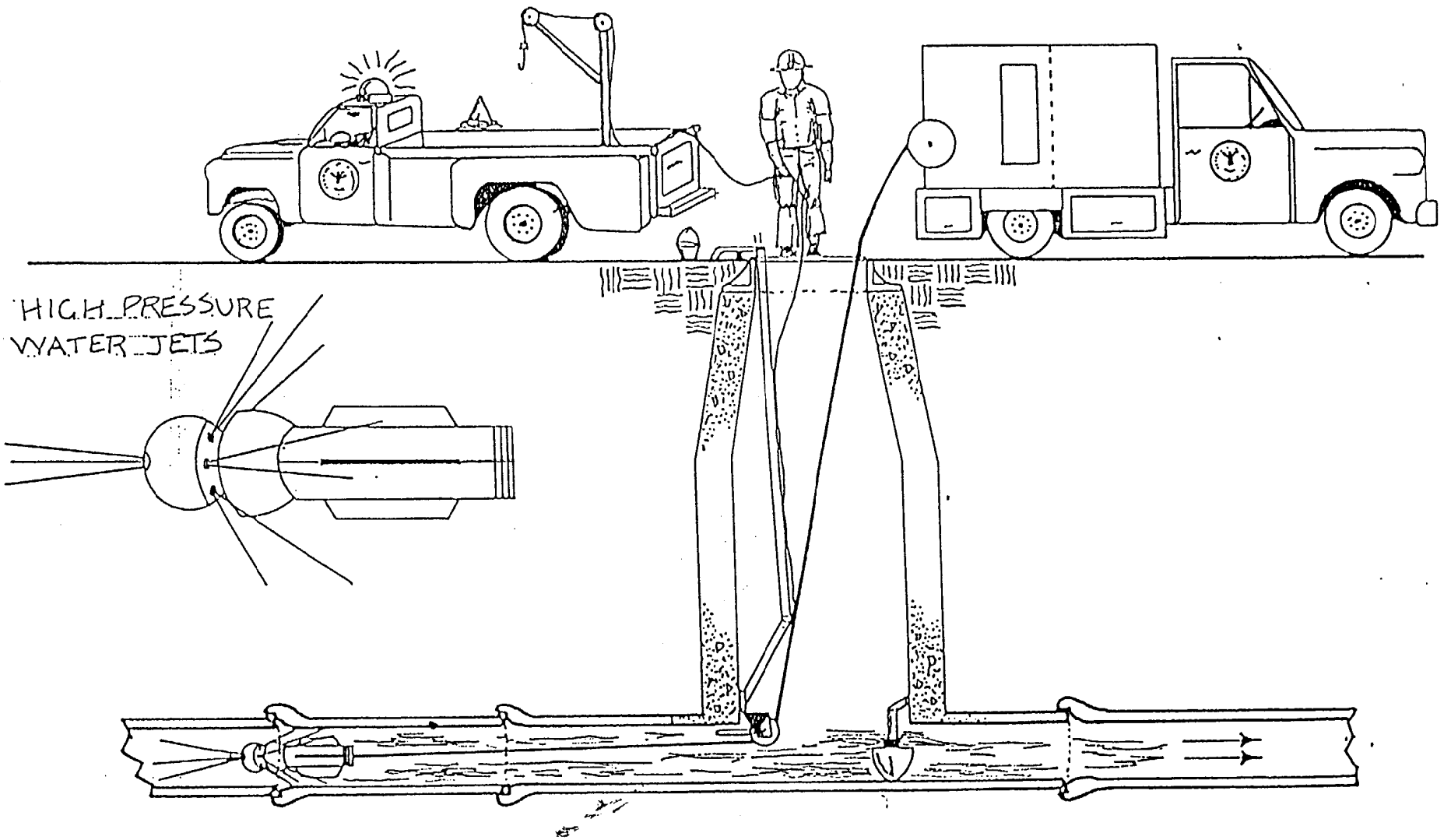


Multi-sized cleaning "ball" for lines 15 through 24 inches.



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

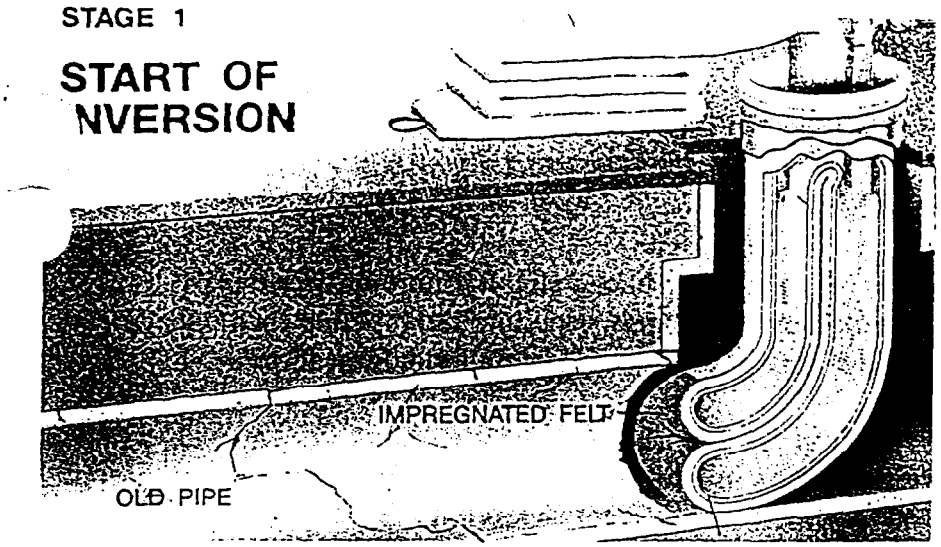
Alternative 4 - Cleaning Pipe as above with Pipe Relining.

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 an 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.

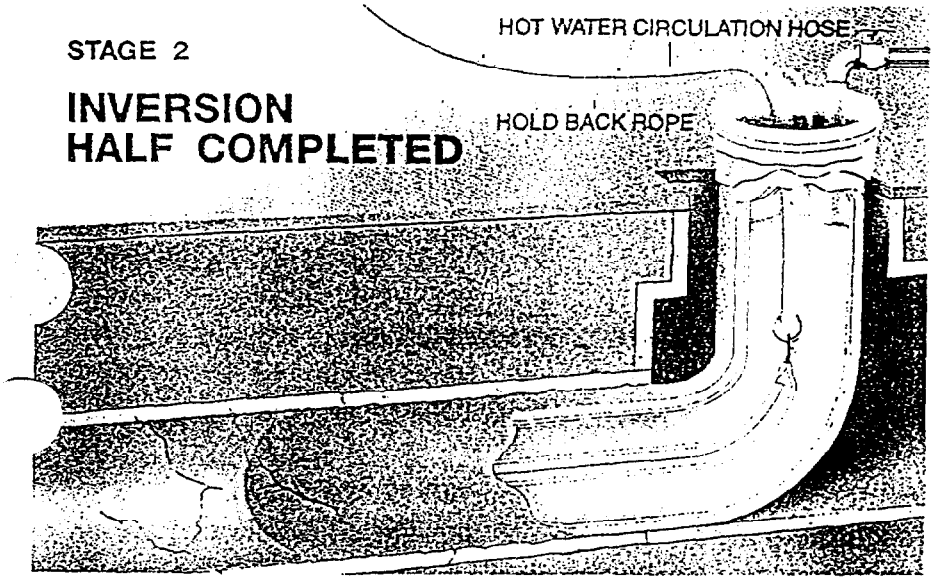
The cost of this technology varies depending on size of pipe and length to be relined. From a manufacturers pamphlet, an average unit cost of approximately $104/foot was determined but this was using 1989 data. The calculated total with this site, 650 feet of pipe after the end fifty feet are removed, 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.

Is Installed



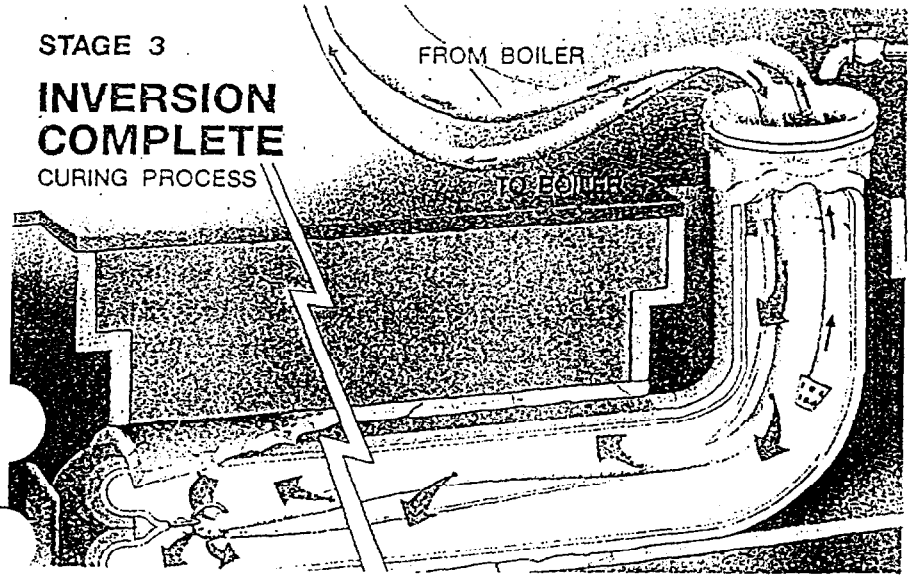
Stage 1

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.

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 5 to minimize the spread of contamination. However, 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

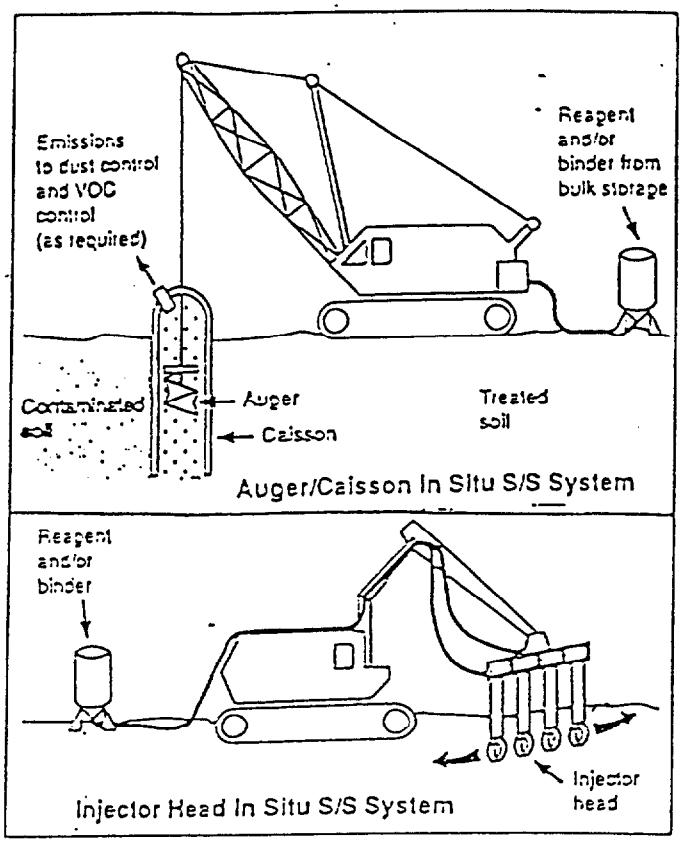
This alternative was reviewed for technical feasibility from a Remedial Action Tech Data Sheet (NEESA Doc. # 20.2-051.2, 22 February 1992). Stabilization and solidification waste treatment processes involve the mixing of specialized additives or reagents with waste materials to reduce physically or chemically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

wetdry 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.

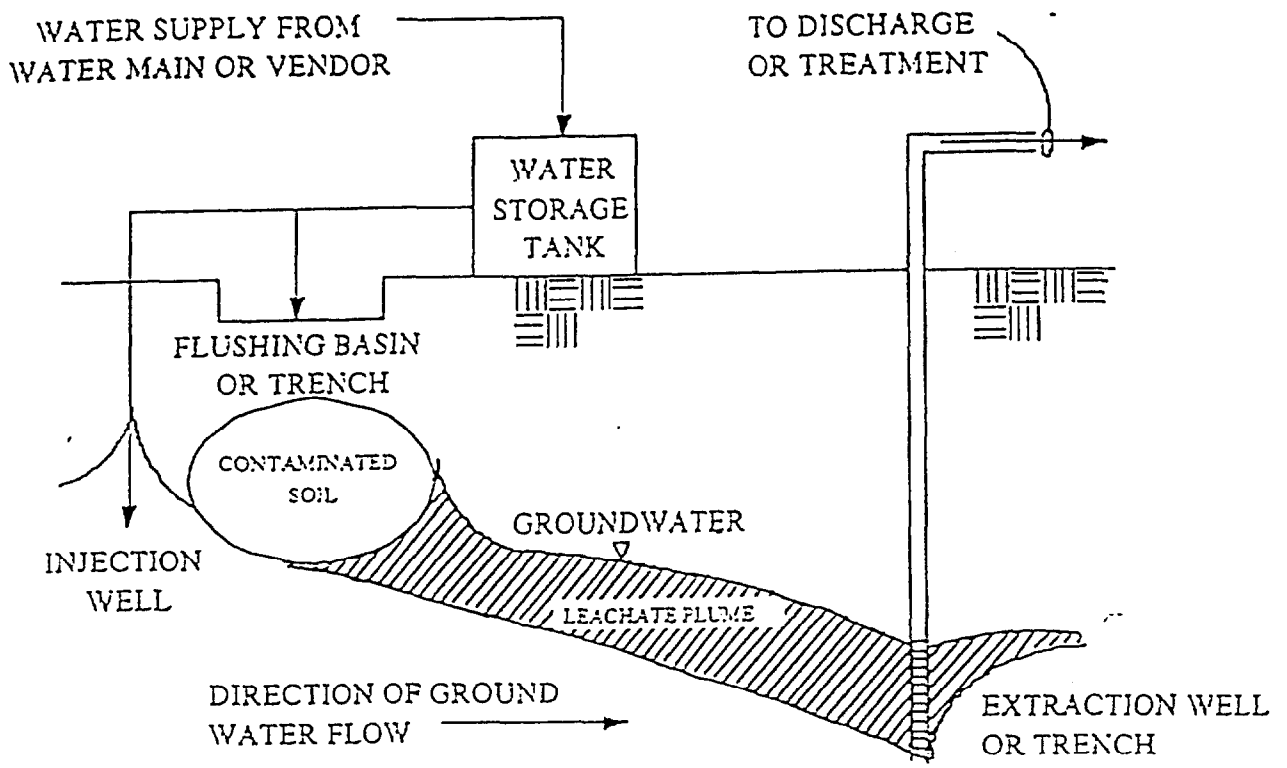
FIGURE 4.6



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.

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

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.

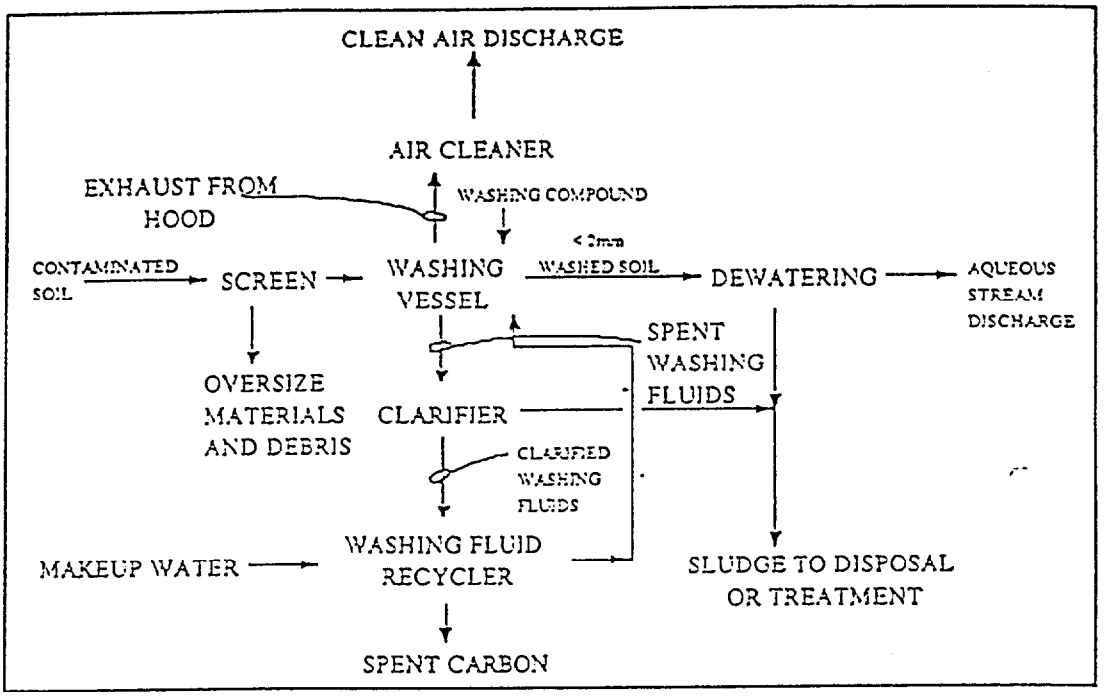
5.2 Disposal of Hazardous Waste Soil

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.

If the water generated from this activity contains less than 82 μg/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).

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.

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.

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.