INITIAL ASSESSMENT STUDY
OF NAVAL ORDNANCE STATION, INDIAN HEAD, MARYLAND

CONTENTS

		Page
Section 1.	INTRODUCTION	1-1
	1.1 Purpose of Initial Assessment Study	1-1
	1.2 Sequence of Events	1-1
	1.3 Subsequent NACIP STudies	1-5
Section 2.	SIGNIFICANT FINDINGS	2-1
	2.1 Sites Requiring Confirmation Studies	2-2
	2.2 Status of Remaining Sites	2-8
	2.3 Groundwater Aquifers	2-8
	2.4 Surface Water	2-9
	2.5 Biology	2-9
Section 3.	CONCLUSIONS	3-1
	3.1 General	3-1
	3.2 Initial Site Screening	3-1
	3.3 Sites Recommended for Confirmation Studies	3-4
Section 4.	RECOMMENDATIONS	4-1
	4.1 Confirmation Study	4-1
	4.2 Other Recommended Actions	4-9
Section 5.	BACKGROUND	5-1
	5.1 General	5-1
	5.2 History	5-4
	5.3 Physical Features	5-9
	5.4 Biological Features	5-78
	5.5 Legal Actions	5-88
Section 6.	ACTIVITY FINDINGS	6-1
	6.1 General	6-1
	6.2 Ordnance Operations	6-2
	6.3 Non-Ordnance Operations	6-20
	6.4 Radiological Operations	6-39
	6.5 Materials Storage	6-40
	6.6 Waste Disposal Operations	6-62
References		

Appendices	4.1-1	List of EPA Priority Pollutants
	5.3-1	Available Well Logs
	5.4-1	Inventory of Terrestrial Fauna
	6.5-1	Hazardous Materials Stored at NOS
	6.5-2	Hazardous Wastes Stored at NOS-1980

Initial Assessment Study

of

Naval Ordnance Station, Indianhead, MD

SECTION 1

INTRODUCTION

1.1 PURPOSE OF INITIAL ASSESSMENT STUDY

As directed by the Chief of Naval Operations (CNO), the Naval Energy and Environmental Support Activity (NEESA), in conjunction with the Ordnance Environmental Support Office (OESO), conducts Initial Assessment Studies (IASs) to collect and evaluate all evidence which indicates the existence of pollutants which may have contaminated a site or pose an imminent health hazard for people located on or off the installation. The IAS is the first phase of the Navy Assessment and Control of Installation Pollutants (NACIP) program, which has the objective of identifying, assessing, and controlling environmental contamination from past hazardous materials storage, transfer, processing, and disposal operations. The NACIP program has been initiated by OPNAVNOTE 6240 ser 45/733503 of 11 September 1980 and Marine Corps Order 6280.1 of 30 January 1981.

1.2 SEQUENCE OF EVENTS

1. Naval Ordnance Station (NOS), Indianhead was designated for an IAS by CNO letter ser 451/397464 of 3 August 1981.

2. The Commanding Officer of NOS was notified via Naval Facilities Engineering Command (NAVFAC), Chesapeake Division (CHESDIV) and by NEESA of the selection of NOS for an IAS. The NACIP Program Management Plan, (Appendix A to NEESA 20.2-035), and Activity Support Requirements for the IAS were forwarded to the installation to outline assessment scope, provide guidelines to personnel, and request advance information for review by the IAS team.

3. NOS IndianHead and CHESDIV personnel were briefed by NEESA Environmental Engineer Jeff Heath, 5 May 1982.

4. Various government agencies were contacted for documents pertinent to the IAS effort. Agencies contacted included:

a. NEESA Information Management Department

b. NEESA Information Services Department

c. NAVFAC Historian, Naval Construction Battalion Center (NCBC), Port Hueneme, CA.

d. CHESDIV Facilities Management Department and Planning Department; Maintenance/Utilities Division and Real Estate Division including the Environmental Engineering, Utilities Engineering, and Natural Resources Branches.

e. NORTHDIV applied Biology Section.

f. National Archives Military Archives Divison, Washington, D.C., Records Group 80 "General Records of the Navy Department, General Correspondnence 1897-1915."

g. National Archives Science and Technological Archives Division, Alexandria, VA. Aerial photograph by the Soil Conservation Service.

h. National Archives, General Archives Division, Suitland, MD.

i. Washington National Records Center, Suitland MD, Records Group 181, Records of the Naval Districts and Shore Establishments, Accession numbers 009059,60A2335, 71A7407, 73A1300, 760074, 77-0209, 77-210, 78-0156, 80-0061, and 81-0061.

j. Department of Defense, Explosive Safety Board, Alexandria, VA.

k. Naval Historical Center, including the Navy Library and the Operational Archives, Washington Navy Yard, District of Columbia.

l. U.S. Geological Survey, Reston, VA.

m. U.S. Navy Ordnance Environmental Support office, Indianhead, MD.

5. The on-site phase of the IAS was conducted from 14-18 June 1982. A separate radiological survey was conducted on 8 and 9 July 1982. The information presented in this report is current, as of the date of the on-site search. The following personnel were assigned to the IAS team:

Mr. Wallace Eakes, NEESA Advisor

Mr. Wayne Tusa, Project Director, Fred C. Hart Associates (FCHA)

Mr. Charles E. Sell, Team Leader, FCHA

Mr. Mark Jewett, Hydrogeologist, FCHA

Mr. Richard Dorrler, Hydrogeologist, FCHA

Mr. Brian Gillen, P.E., Environmental Engineer, FCHA

Ms. Mary Manto, Public Health Specialist, FCHA

Ms. Cathy Bobenhausen, Biologist, FCHA

Dr. Donna Toeroek, Radiologist, FCHA

Dr. Barry North, Technical Reviewer

Mr. Jim Dodgen, Consultant for ordnance operations.

6. In addition to records reviews, interviews were conducted with long-term and former employees. Ground and boat tours of the installation were made, and photographs were taken. The use of "Personal Communication" as a reference citation in this reports identifies information re-

ceived in interviews or through unpublished reports such as interoffice memoranda. Information received from an interview was generally verified by one or more additional interviews, or by comparison with documented data.

1.3 SUBSEQUENT NACIP STUDIES

The recommendations for the next phase of the NACIP program, the Confirmation Study, is based on the findings of the Initial Assessment Study. A Confirmation Study is conducted only if the IAS concludes that:

1. Sufficient evidence exists to suspect that an installation is contaminated, and
2. The contamination presents a definite danger to:

    a. The health of civilians in adjoining communities or personnel within the base fenceline, or
    b. The environment within or outside the installation.

If these criteria are not met, no further studies will be conducted under the NACIP program.

SECTION 2

SIGNIFICANT FINDINGS

Prior to this report, the NOS Indian Head conducted several environmental surveys to identify sources of pollution and plan corrective action. The recent reports date from the early 1970's and include: Air and Water Pollution Survey, Pollution-Source and Environmental Resource Reconnaissance Survey, Environmental Engineering Survey, Hazardous Waste Management Plan, and the Disposal Site Fact Form. The IAS Team used these available reports to supplement its extensive interviews and on-site investigations in identifying some 67 hazardous waste disposal sites at NOS Indian Head. Of the 67 sites identified, the IAS Team finds that only 14 sites satisfy the criteria of:

1) evidence to suspect contamination, and
2) possibility that the contamination presents a "definite danger" to health and the environment on or off the installation.

The significant findings with regard to each of the 14 sites are discussed in this section. For a complete discussion of all 67 sites refer to Sections 6.6 (Waste Disposal Operations) and 6.2 (Ordnance Operations) of this report.

NOS MAIN STATION SITES REQUIRING CONFIRMATION STUDIES OR FURTHER ACTION

Team Site reconnaissance surveys, file searches and NOS personnel interviews indicated the presence of 50 potential hazardous waste sites at NOS Indian Head and 17 sites at NOS Stump Neck. Of these 67 sites, 9 were recommended for confirmation studies. These sites are summarized in the following section, along with 5 sites which NOS may want to consider for further action. These are further discussed in Section 4.

2.1.1 Large Motor Test Facility (SITE NO. 1)

From 1953 to date large rocket motors have been test fired at this site. The rocket exhaust fumes contain heavy concentrations of carbon dioxide and monoxide, nitric and hydrochloric acids, nitrous oxides and metal oxides. The plume has visibly eroded the launch pads and has caused severe vegetative stress between the facility and the Potomac River. Severe soil erosion has already taken place and the accumulation of hazardous particulates in the ground and river sediments are probable. A total quantity of 720 pounds of particulates per week were estimated to have been emitted into the air over the thirty year operating period of the facility, resulting in a total discharge of approximately 91 tons of total metals (aluminum, iron, lead and copper) discharged over the life of the facility.

2.1.2 Drainage Ditch At Motor Preparation Building (SITE NO. 2)

Wastewater from the building flows in an open ditch to the Potomac River. The wastewater contains an asbestos insulating material, paints, paint solvents, oil and grease, and suspended solids. A combined volume of

4600 gallons per week were estimated to have been discharged into the ditch over the thirty year operating period of both facilities, resulting in a total discharge of approximately 800 pounds of asbestos, 500 pounds of total metals, and 800 pounds of methylene chloride.

2.1.3 X-ray Building (SITE NO. 9)

Since 1953 the wastewater from the development of X-ray film has discharged directly into an open ditch. The wastes have consisted of the fixing solution (hypo) and the developer. Between 1953 and 1965 all wastes including fixer developer were discharged into an 1200 foot open drainage ditch (IW2), resulting in a calculated discharge of 1800 pounds of silver over the 12 year period in which untreated wastewater was discharged from the X-ray facility. Therefore, silver precipitates which are toxic to marine life may have deposited along the sidewalls of the ditch or Mattawoman Creek sediments. Since about 1965, the hypo solutions have been collected for silver recovery. The other wastes continue to be discharged in the ditch.

2.1.4 Pyrotechnics Burn Point (SITE NO. 10)

Extensive open burning of propellants has taken place at this site since the early 1940's. The site was the principal burning point for all waste propellants until about 1954, when the operation was shifted to Site 22, the current Main Burn Point. Since 1954 Cartridge Actuated Devices, Propellant Actuated Devices (CAD/PAD), igniters, squibs, caps, etc. have been burned here at a rate of 25,000 pounds per year. Sources of potential

lead contamination included the previous propellant disposal operations (circa 1942-1954), chrome and nickel contamination from open burning of CAD's (circa 1954-present) and various other metals from the fill material (fly ash and rocket motor casings) used to build the Pyrotechnics Burning Point (circa 1954). The site is a man made point of land surrounded on three sides by the Potomac River. Unknown quantities of metals have been deposited in the river sediments and lead contamination is the principal concern.

2.1.5 Radiographic Facility (SITE NO. 11)

This site is similar to the X-ray Building at Site 9. Various quantities of hypo may have been discharged into an open ditch from 1965 to about 1977. The amount of hypo and period of discharge, 12 years, is less than that from Site 9, however the distance to the outfall in Mattawoman Creek is less (900 feet to the Mattawoman as opposed to 1200 feet).

2.1.6 Mercury Deposits In Manhole (SITE NO. 14)

Since 1958 the nitroglycerin plant laboratory has been the source of mercury discharge to a manhole and from there to an open ditch. An estimated 23 pounds of mercury was discharged during this period. Discharge may have reached Mattawoman Creek sediments.

2.1.7 Main Burning Area (SITE NO. 22)

Up to 600,000 pounds per year of ordnance propellants are burned at this site which lies in a flood plain at the edge of the Potomac River on Mattawoman Creek. Open burning of these materials has been taking place since the mid 1950s. Some of the propellants are transported to the site wet. The propellant slums are dewatered at the site and the effluent water, an estimated 7,800 gallons per year, resulted in a calculated discharge of 16 pounds of lead over the 28 year operating period of the facility. Metal oxides from the burning process and lead from the water discharges, as well as nitroglycerin may have contaminated the sediments in the creek and the river.

2.1.8 Town Gut Landfill (SITE NO. 24)

This landfill, placed in a marsh, totals some 3 acres. The landfill was active from about 1968 to 1980. Although intended for rubble and landscaping wastes, interviews and site visits indicate that hazardous wastes (e.g. paints and varnish) may have been deposited here. A NOS water sample detected arsenic at 30 parts per million.

STUMP NECK SITES REQUIRING CONFIRMATION STUDIES OR FURTHER ACTION

2.1.9 Small Motor Test Area (SITE NO. 39)

This site is similar to the large motor test area at Site No. 1. Rocket exhaust fumes contain heavy concentrations of carbon dioxide, nitric acid and hydrochloric acids, nitrous oxides and metal oxides. A total

quantity of 100 pounds per week of particulates were estimated to have been emitted into the air over the 30 year operating period of the facility, resulting in a calculated discharge of 10-15 tons of total metals (aluminum, iron, lead and copper). A small area of tree kills and vegetation stress was observed on the site slope between the test facility and the Mattawoman Creek. Accumulation of hazardous particles on the ground and river sediments are possible.

2.1.10 Hypo Discharges, X-Ray Building No. 2 (SITE NO. 43)

This site is similar to the X-ray Building at Site No. 9. Between 1944 and 1965 all wastes including fixer and developer were discharged into a 400' open ditch (IW45), resulting in a calculated discharge of almost 940 pounds of silver over the 21 year period in which untreated wastewater was discharged from the X-ray facility. Therefore, silver precipitates which are toxic to marine life, may have deposited along the sidewalls of IW45 or the Mattawoman Creek sediments.

2.1.11 Range 6 (SITE NO. 54)

Range 6 is an explosive ordnance disposal training range. Thirty to forty pounds of explosives are consumed per day over about 165 training days per year. Water filled craters are visibly contaminated with the explosive demolition products such as picric acid and ammonium picrate.

2.1.12 Range 3 (SITE NO. 53)

Range 3 is another explosive ordnance disposal range. It is operated by the EOD Technical Center for research and development purposes rather than for training, as done at Range 6. However, the use of explosives on Range 3 may have contaminated the adjacent waters and sediments of Chicamuxen Creek.

2.1.13 Porter Road Range (SITE NO. 55)

At the end of Porter Road is an old demolition range believed to have been in operation from the late 1940s to the mid 1960s. The range was operated for training purposes, using high explosives such as TNT. It has been closed and is the present location of Building 2107. Operations at this range may have contaminated the sediments at Chicamuxen Creek in a manner similar to the other active ranges, Range 6 and Range 3.

2.1.14 Torpedoes (SITE NO. 63)

Trash from the Torpedo Station near Blue Plains in Washington D.C. was brought to Stump Neck and buried at this site in the late 1940s or early 1950s. There was a Naval Torpedo Station in Alexandria, Virginia across the Potomac River from Blue Plains. It is presumed that the Virginia site is the origin of the wastes. The wastes are described as torpedo parts and fuses which may not be rendered safe. The quantity is unknown but other allegations from the interviewees raise suspicions that large quantities of explosives were buried in landfills at unspecified site/s at Stump Neck.

2.2 STATUS OF REMAINING SITES

While the 53 remaining sites did not meet the NACIP program criteria as outlined in Section 1.3, team site reconnaissance surveys, file searches, and NOS personnel interviews indicated that certain of these sites merit the attention of NOS. These include sites which NOS may want to consider for one or more of the following actions:

- further site investigation.
- minor cleanup or remedial work.
- restrictions on future earthwork activity or land use.
- review of current operating procedures (in the case of certain active sites)

Section 4 summarizes specific recommendations, and Section 6.6 (Figure 6.6.-1) identifies each site with a recommended action codes for any actions NOS may want to consider.

2.3 GROUNDWATER AQUIFERS

At NOS, water supply wells are located in deep aquifers. Although the upper portions of the surficial deposits do contain water, this water is not used as a source of supply at the NOS.

Due to the geology of the NOS area, potential contaminants would have to migrate through a number of zones of low permeability materials several tens of feet thick before entering the water supply zones present beneath the site.

2.4 SURFACE WATER

Migration potential of contaminants into surface waters is directly related to hydraulic connection between the shallow groundwater zones and the surface drainages adjacent to NOS. Should contaminants enter the shallow groundwater system, it is highly probable that they would discharge to Mattawoman Creek, Chicamuxen Creek, or the Potomac River.

2.5 BIOLOGY

The only endangered or threatened species identified at NOS Indian Head is the Rainbow Snake, which is identified on Maryland's list of threatened or endangered species.

There are signs of vegetative stress at several of the sites identified at the activity. These are discussed in Section 6.6 and 6.9.

SECTION 3
CONCLUSIONS

3.1 GENERAL

The principal conclusion reached after the record search, interviews, and site visit is that 14 of the 67 sites at NOS Indian Head may pose a potential hazard to human health or the environment. Of these 14, 9 were recommended for current confirmation studies under the NACIP program. These areas are discussed in Section 3.3.

3.2 INITIAL SITE SCREENING

The NACIP Confirmation Study Ranking Model was used as an aid in determining the degree of hazard (potential threat to human health and the environment) posed by each of the 67 disposal/spill sites at NOS Indian Head. Fifty-three (53) sites were eliminated from detailed consideration based on the IAS findings and the flow chart portion of the model. These sites, along with explanations for elimination, are listed in Table 3.2-1.

Confirmation Study Rankings were performed for the 9 remaining 14 sites. The results of these models are presented in Table 3.2-2.

The areas for which confirmation studies are recommended are discussed in the following section.

TABLE 3.2-1

TABLE 3.2-2

RESULTS OF CONFIRMATION STUDY RANKING MODEL

SITE No.	DESCRIPTION	RECEPTOR SUBSCORE	PATHWAYS SUBSCORE SURFACE WATER	FLOODING	GROUND WATER	CHARACTER-TERISTICS SUBSCORE	WASTE MGMT FACTOR	OVERALL SCORE
1	Large Motor Test Area	.78	.81	1	.25	.54	1	42.1
2	Drainage Ditch - Bldg. 763	.78	.59	0	.25	.54	1	24.8
9	Grain Manufacture - X-Ray Bldg.	.74	.72	0	.25	.36	1	19.18
10	Pyrotechnics Burn Point	.76	.67	1	.25	.36	1	27.36
14	Mercury Depositis in Manhole	.77	.67	0	.25	.37	1	19.09
22	Main Burning Point	.76	.67	1	.25	.36	1	27.36
24	Town Gut Landfill	.72	.67	1	.25	.39	1	28.08
54	Stump Neck - Range 6	.64	.67	1	.25	.21	1	13.44
53	Stump Neck - Range 3	.64	.67	1	.25	.21	1	13.44

Note: The highest pathways subscore is used to calculate the overall score.

3.3 SITES RECOMMENDED FOR CONFIRMATION STUDIES

3.3.1 Large Motor Test Facility (SITE NO. 1)

Rocket exhaust fumes containing carbon dioxide, carbon monoxide, nitric and hydorchloric acids, nitrous oxides and other metal oxides have severely stressed the vegetation at this site. Hazardous particulate matter may have accumulated on the Potomac River bank and in the sediments. The presence of these hazardous materials presents a potential environmental danger to aquatic life in the river.

3.3.2 Drainage Ditch Outfall From Motor Preparation Building (SITE NO. 2)

Wastewater containing asbestos insulation material, paints, paint solvents, oil and grease and suspended solids have been discharging to the Potomac River for over 20 years. The presence of these hazardous materials presents a potential environmental danger to aquatic life in the river.

3.3.3 X-Ray Building (SITE NO. 9)

Waste photographic developing and fixing waters have discharged into an open ditch and to Mattawoman Creek. Silver salts and other metal compounds produce a potential environmental danger to aquatic life in the creek.

3.3.4 Pyrotechnic Burn Point (SITE NO. 10)

The residual waste from burned pyrotechnics and propellents have accumulated for forrty years at the rivers edge at this site. Lead contaminants are the principal concern and present a definite danger to aquatic life in the Potomac River.

3.3.5 Mercury Deposits In Manhole (SITE NO. 14)

Mercury used in laboratory tests have been discharged directly into a manhole, thence by open ditch to the Mattawoman Creek for over twenty years. Dangerous mercuric compounds have formed in the creek sediments. The presence of these hazardous compounds produce a potential environmental danger to aquatic life in the creek.

3.3.6 Main Burning Area (SITE NO. 22)

The residual waste from burned waste propellents have accumulated for over twenty five years at this site on the edge of the Potomac River. The site is in a flood plain and the hazardous waste products of the combustion have migrated to the river sediment. Lead compounds are of principal concern. The presence of these compounds produce a potential environmental danger to aquatic life in the river.

3.3.7 Town Gut Landfill (SITE NO. 24)

Visual evidence of hazrdous waste exists in this 3 acre landfill built almost entirely on marsh and creek bed over the period from about 1968

to 1980. In addition,, a water sample taken from the stream/landfill boundary measured 30 ppm arsenic. Due to the free flow between the landfill leachate and the stream the entire drainage basin may be contaminated. The presence of the contaminated surface water presents a potential environmental danger to aquatic life in this stream and Mattawoman Creek which it feeds.

II. STUMP NECK SITES

3.3.8 Range 6 (SITE NO. 54)

The use of explosive charges at Range 6 has caused a build up of the hazardous products of complete and partial explosive combustion. These products leak into the Chicamuxen Creek. The presence of the contaminated surface water presents a potential environmental danger to aquatic life in the creek.

3.3.9 Range 3 (SITE NO. 53)

The use of explosives at Range 3 has caused a buildup of the hazardous products of complete and partial explosive combustion. These products can leak directly into Chicamuxen Creek. The presence of the contaminated sediments and surface water presents a potential environmental danger to aquatic life in Chicamuxen Creek.

SECTION 4

RECOMMENDATIONS

Based on the preceeding discussion of significant findings and conclusions, there are 12 sites at NOS Indian Head for which evidence exists to suspect contamination which presents a threat to the environment, principally to the aquatic environment, on and off the station. However, additional information regarding the location or extent of contamination and the potential for contaminant migration is needed before corrective action is initiated. Therefore, it is recommended that a Confirmation Study, Phase II of the NACIP Program, be performed under contract at NOS Indian Head, MD.

4.1 CONFIRMATION STUDY

The main site areas which warrant further investigation under Confirmation Study include: large motor test facility (SITE NO. 1), drainage ditch outfall from motor preparation building (SITE NO. 2), X-ray building (SITE NO. 9), pyrotechnic burn point (SITE NO. 10), mercury deposits (SITE NO. 14), main burning area (SITE NO. 22), Town Gut landfill (SITE NO. 24). At Stump Neck areas included Range 6 (SITE NO. 54) and Range 3 (SITE NO. 53).

Sites at which potential dangers to the health or environment exist but which are not now recommended for confirmation study are: radiographic facility (SITE NO. 11); small motor test area (SITE NO. 39); Hypo discharges from x-ray building (SITE NO. 43) Stump Neck sites: Porter Road

Range (SITE NO.55), and torpedoes (SITE NO.63). See discussion in this section for the rationale for not presently performing confirmation studies on these sites.

The recommendations presented in this section are intended to be used as a guide in the development and implementation of the Confirmation Study. Whenever possible, the recommendations include the approximate number of groundwater monitoring wells or sampling sites; type of samples to be taken, such as soil, water, or sediment; and testing parameters. Unless otherwise indicated, it is recommended that samples be placed through a screening procedure, prior to the determination of the final sampling analysis parameters. It is recommended that the screening procedure include analysis for the four general categories of groundwater contamination established by EPA in the Hazardous Waste Regulations (40 CFR 265), analysis for the EPA priority pollutants (45 CFR 231, see Appendix 4.1-1 for listing), and previously identified suspected contaminants.

Table 4.1-1 summarizes the recommended environmental monitoring program for the areas included in the Confirmation Study. The detailed approach for each area is described below. It is recommended that personnel from OESO be consulted regarding the location of contaminant sources prior to the selection of sampling points.

4.1.1 Large Motor Test Facility, SITE NO. 1

Type of samples: Soil and sediment

Number of samples: Six soil samples; three soil samples along bank of river above high water mark and three soil samples in the vicinity of the rocket

Table 4.1.1
Recommended Confirmation Studies

Site	Site No.	Sample Water	Sample Sediment	Sample Soil	Laboratory Analytical Procedure
Large Motor Test Facility	1	-	6	6	aluminum, copper, iron, lead, EP toxicity
Motor Preparation Bldg.	2	-	10	-	ABS, organics, zinc, chromium, selenium, VHO's, EP toxicity
X-Ray Building	9	-	6	-	silver, EP toxicity
Pyro Burn Point	10	-	12	-	lead, aluminum, iron, copper, EP toxicity
Radiographic Facility	11		(Postponed until Site 9 results are known)		
Mercury in Manhole	14	-	2	-	mercury, EP toxicity
Main Burn Point	22	-	12	-	lead, aluminum, iron, copper, EP toxicity
Town Gut LF	24	3	4	-	arsenic, metals, VHO, VNHO, pesticides
Stump Neck Sites					
Torpedos	63		(Post warnings only - no sampling recommended)		
Range 6	54		6	-	
Range 3	53		6	-	
Porter Road Range	55		(Postponed until Range 6 & 3 results are known)		

launch pad. Six sediment samples in river; three within one foot of the low low water mark and three at ten feet from low low water line. One Extraction Procedure Test (EP test) should be run on the most contaminated sample to test for toxicity.

Frequency: Initial sampling only

Testing parameters: Aluminum, iron, copper, lead

Potential danger: Sampling and analysis should determine if contaminants are present and migrating into the river and whether they are a threat to aquatic life.

4.1.2 Drainage Ditch Outfall from Motor Preparation Building (SITE NO. 2)

Type of samples: Sediment

Number of samples: Two sediment samples in river; one within one foot of the low low (LL) water line and one within ten feet of the LL water line. Eight sediment samples; four samples in ditch IW 10, three within 50 feet of point of discharge, one 200 feet from point of discharge; four samples in ditch IW 25, three within 50 feet of point of discharge, one 200 feet from point of discharge, one Extraction Procedure Test (EP test) should be run on the most contaminated sample to test for toxicity.

Frequency: Initial sampling only

Testing parameters: Asbestos, organics, zinc, chromium, selenium, volatile halogenated logenated organics.

Potential danger: Sampling and analysis should determine if contaminants are present and migrating into the river and whether they are a threat to aquatic life.

4.1.3 X-Ray Building (SITE NO. 9)

Type of sample: Sediment

Number of samples: Two sediment samples in creek; one within one foot of the LL water line and one within 10 feet of the LL water line. Four samples in ditch IW2; three within 50 feet of point of discharge, and one 200 feet from point of discharge, one Extraction Procedure Test (EP

test) should be run on the most contaminated sample to test for toxicity.

Frequency: Initial sampling only

Testing parameters: Silver

Potential danger: Sampling and analysis should determine if contaminants are present and migrating into the river and whether they are a threat to aquatic life.

4.1.4 Pyrotechnic Burn Point (SITE NO. 10)

Type of sample: Sediment

Number of samples: Twelve samples in the river, two each within one foot of the LL water line at stations selected upstream, at midpoint and downstream of the burn point; two each within 10 feet of the LL water line at the same stations (e.g. upstream, midpoint and downstream). Care should be taken to select an upstream station which is free of tidal movement upstream. One Extraction Procedure Test (EP test) should be run on the most contaminated sample to test for toxicity.

Frequency: Initial sampling only

Testing parameters: Lead, aluminum, iron, chromium, nickel, copper

Potential danger: Sampling and analysis should determine if contaminants are present and migrating into the river and whether they are a threat to aquatic life.

4.1.5 Radiographic Facility (SITE NO. 11)

This site is not recommended for a confirmation study at this time. Contamination at this site is suspected to be less serious than that at Site No. 9. In the event that the study of Site No. 9 confirms a danger to aquatic life, then a study at Site 11 is recommended to establish the concentration of contaminants and potential effect on the environment.

4.1.6 Mercury Deposits (SITE NO. 14)

Type of samples: Sediment

Number of samples: Two sediment samples in river; one within one foot of the low low (LL) water line and one within ten feet of the LL water line. One Extraction Procedure Test (EP test) should be run on the most contaminated sample to test for toxicity.

Frequency: Initial sampling only

Testing parameters: Mercury

Potential danger: Sampling and analysis should determine if contaminants are present and migrating into the river and whether they are a threat to aquatic life.

4.1.7 Main Burning Area (SITE NO. 22)

Type of sample: Sediment

Number of samples: Twelve samples in the river, two each within one foot of the LL water line at stations selected upstream, at midpoint and downstream of the burn point; two each within 10 feet of the LL water line at the same stations (e.g. upstream, midpoint and downstream). Care should be taken to select an upstream station which is free of tidal movement. One Extraction Procedure Test (EP test) should be run on the most contaminated sample to test for toxicity.

Frequency: Initial sampling only

Testing parameters: Lead aluminum, iron, copper

Potential danger: Sampling and analysis should determine if contaminants are present and migrating into the river and whether they are a threat to aquatic life.

4.1.8 Town Gut Landfill (SITE NO. 24)

Type of sample: Surface water and sediment

Number of samples: Three surface water samples taken at the upstream entry point in grid I22; upstream entry point in grid J24; and downstream exit

point L21; Four sediment samples taken at: 400 feet upstream from the Atkins Road causeway, immediately upstream of the causeway, approximately 200 feet downstream of the causeway, and immediately upstream at the Noble Road crossing.

Frequency: Sample quarterly the first year, annually thereafter for at least 5 years.

Testing parameters: arsenic, heavy metals, volatile halogenated organics, volatile non-halogenated organics, pesticides.

Potential danger: Samples should be tested for the presence of the above parameters, the trend of concentrations to increase or decrease, any evidence of movement downstream. Danger to aquatic and terrestrial life should be determined.

4.1.9 Small Motor Test Area (SITE NO.39)

This site is not recommended for confirmation at this time. In the event that the study of SITE NO. 1 confirms a danger to aquatic life, then a study should commence at SITE NO. 39 to confirm this lesser concentration of contaminants and its effect in the environment.

4.1.10 Hypo Discharges, X-ray Building No.2 (SITE NO.43)

This site is not recommended for confirmation at this time. In the event that the study of SITE NO. 11 confirms a danger to aquatic life then a study should commence at SITE NO. 43 to confirm this lesser concentration of contaminants and its effect on the environment.

4.1.11 Torpedoes (SITE NO. 63)

The contamination is not critical to current operations at Stump Neck and poses little likelihood of migration off-site. The site should be posted with signs warning of possible ordnance contamination. Base maps of the area should be marked to indicate a possibly contaminated site. Prior to any construction, excavation, personnel training, or similar activity, an EOD team should be called to survey the site in question and to clear it as required.

4.1.12 Range 6 (SITE NO. 54)

Type of samples: Sediment

Number of samples: Six, located in 3 pairs:
- one pair in Grid YY-38 at one foot and ten feet from shore (LLW)
- one pair in Grid YY-37 at one foot and ten feet from shore
- one pair in Grid YY-36 at one foot and ten feet from shore

Frequency: Initial sampling only

Testing parameters: pH, organics, lead

Potential danger: Samples should be tested for the presence of parameters and pattern of movement. The concentrations should be compared against those thought to cause threshold damage to aquatic life.

4.1.13 Range 3 (SITE NO. 53)

Type of sample: Sediment

Number of samples: Six located in 3 pairs
- one pair in Grid YY-31 at 1 foot and 10 feet from shore (LLW)
- one pair in Grid YY-30 at 1 foot and 10 feet from shore (LLW)

- one pair in Grid YY-29 at 1 foot and 10 feet from shore (LLW)

Frequency: Initial sampling only

Testing parameters: pH, organics, lead

Potential danger: Samples should be tested for the presence of parameters and pattern of movement. The concentrations should be compared to threshold damage to aquatic life.

4.1.14 Porter Road (Old Demolition) Range (SITE NO. 55)

This range is older and not as great a threat to the environment as newer Ranges 3 and 6. The results of study of the newer ranges should be used to determine whether to conduct a confirmation study at this site.

4.2 REMAINING SITES

The remaining sites of identified waste disposal at NOS Indian Head require no further action. These sites are discussed in Section 6.6.

4.2 OTHER RECOMMENDED ACTIONS

The team site reconnaissance, NOS personnel interviews, and file searches have identified several sites at Indian Head that NOS may want to consider for various remedial activities, prior to the implementation of Phase II (Confirmation Study) of the NACIP program. Table 4.2.-1 identifes nine sites with indicated ongoing incidents ranging from unauthorized dumping, uncontrolled site seepage, and contaminated surface soils which, if unaddressed, could present NOS with future environmental difficulties. The site identified and suggested remedial actions are listed on Table 4.2.-1.

TABLE 4.2-1

SITES NOS MAY CONSIDER FOR REMEDIAL ACTIONS

Site No.	Map Grid	Site Name	Suggested Remedial Action
8	D37	Lloyd Road Oil Spill Sites	Remove contaminated soil, cease discharge of vehicle steam cleaning operation.
23	K6,L6	Decontamination Burning Point	Remove contaminated soil, unauthorized wastes and secure site from unauthorized dumping.
24	K22	Town Gut Landfill	Sample drain contents, clean up drummed wastes.
25	K31	Paint Solvents dumping ground	Remove contaminated soil, Up over area
30	M6, 7, L5	Dumped metal parts along shoreline	Clean up dumped materials
36	N21	Bronson Road landfill	Cover deposited waste, control site seepage
37	N31	Goddard Power Plant	Remove contaminated soil, cease addition of TCE to fuel stocks
38	031	Coal storage pile	Secure site from unauthorized dumping
47	P33	TCE, phenolic waste storage	Sample contents of drums and dispose of appropriately

Table 4.2.-2 identifies seven sites which require additional site surveys and soil analyses prior to any earthwork or change in NOS land use. For sites contaminated with ordnance materials, explosive decontamination of the site may be required prior to any earthwork activities. Those same restrictions should be applied to all current burning points (SITES 10, 20, 22, 23) and landfills (SITES 21, 31, 36).

All recommended activities are keyed into site action codes and displayed along with the site on Figure 6.2-1 and 6.6.-1.

TABLE 4.2.-2

SITES NOS SHOULD RESTRICT FROM EARTHWORK
ACTIVITY AND/OR CHANGES IN LAND USE

Site No.	Map Grid	Site Name	Incident
3	C27	Thorium Spill	Reported thorium spills
12	G18	HMX Spill, slurry building	HMX deposits near Building 682 and in Ditch IW 10
19	I, J, K, L, M, N, O, 37, 38, 39	Single base propellant grains spill area	Small propellant grains spread over 14 acre area
25	K31	Paint solvents dumping ground	Various quantities of paints and solvents dumped in a 2000 sq.ft. area behind Bldg 870
38	O12	NG slums disposal site	NG slums reportedly deposited in a ½ acre strip of land off Greenslade Road
42	O35, 37, 38	Abandoned drain lines	Reported NC deposits in drain lines
49	S36, 37	Original burning ground	Former facility for burning smokeless powder

SECTION 5

BACKGROUND

5.1 GENERAL

Indian Head Naval Ordnance Station (NOS) covers approximately 3,423 acres and is bounded by the Potomac River, the Mattawoman Creek, Chicamuxen Creek, the Town of Indian Head, and private property. It is situated in the eastern section of Charles County, Maryland, approximately 25 miles southwest of Washington, D.C.

The mission of the Station is to provide material and technical support for assigned weapons systems, weapons or components and to perform additional tasks as directed by the Naval Sea Systems Command. These tasks may include research, development, engineering, production and quality surveillance in the fields of weapons systems, propulsion, unconventional explosives, cartridge and propellent actuated devices, and chemicals. Disciplines represented at NOS include expertise in weapons systems propulsion, explosives development and propellant and explosive chemistry.

NOS also hosts two major tenants on Stump Neck: the Naval Explosive Ordnance Disposal Technology Center and the Naval School, Explosive Ordnance Disposal. The Naval Explosive Ordnance Disposal Technology Center was established to render safe procedures for conventional and special weapons, guided missiles, biological and chemical munitions, tools, equipment and techniques. The mission of the Naval School, Explosive Ordnance Disposal is to train officers and enlisted personnel in the best methods and

procedures for recovery, evaluation, rendering safe, and disposal of surface and underwater, conventional and nuclear, explosive ordnance.

The Indian Head area of the station is primarily dedicated to ordnance research, manufacture and test activities and is supported by administrative, shop and military housing facilities. It contains 1,043 of the total of 1,141 buildings. Explosive production and storage occupies 1,494 acres; 60 acres are utilized for Explosive Ordnance Disposal classroom and field training; 280 acres for administrative functions and 200 acres for military housing and personnel support facilities.

Stump Neck is devoted primarily to ordnance disposal research and training, with some administrative and military housing facilities. The Naval Explosive Ordnance Disposal Technology Center and the Naval School, Explosive Ordnance Disposal. occupy most of the land area on Stump Neck with the remainder used by NOS research facilities and several additional tenants, i.e., the Naval Ordnance Laboratory, the Naval Research Laboratory and Naval Oceanographic Office. Stump Neck has 98 buildings and other facilities; 635 acres are devoted to explosive operations; 486 acres are utilized as a military training area and 41 acres are occupied by housing and personnel support facilities.

The station consists of Indian Head itself (2,010 acres), Stump Neck (1,170 acres), Bullet's Neck (47 acres), the railroad right-of-way linking Indian Head to White Plains, Maryland (163 acres), Marsh Island (25 acres) and Thoroughfare Island (10 acres). There are rail connections to all parts of the station from the main spur. The station has 42 miles of

railroad, and a total of 109 miles of roadway. It has over 29 miles of steam distribution lines, its own powerplant, and its own water and sewage treatment plants.

Stump Neck is separated from Indian Head by Mattawoman Creek and bounded by Chicamuxen Creek to the east and the Potomac River to the west. Indian Head has 9 miles of shoreline while Stump Neck has 7.5 miles. Both Indian Head and Stump Neck are at a low elevation, crisscrossed by numerous streams and drainage swales. The Potomac River shorelines are steep while the Mattawoman and Chicamuxen Creek shorelines are buffered by swamps, wetlands and floodplains. Together, Indian Head and Stump Neck encompass 314 acres of wetlands and tidal flats. Stump Neck has 191 acres of coastal marshland while Indian Head has 123 acres of wetlands. The expanse of water between the two areas comprises much of the area required as safety radius distances surrounding the station's hazardous activities. These safety arcs encumber about 1,350 acres or 66 percent of the total land area at Indian Head and about 451 acres or 51 percent of Stump Neck.

Bullet's Neck, originally named Bullocks Neck, a promontory to the east of Stump Neck jutting out into the Mattawoman Creek, is located within the explosive danger zone of the Station's high explosives magazines on Greenslade Road. It is a protected wildlife refuge, wetland and floodplain forest area. Marsh and Thoroughfare Islands are situated in the marsh area of the Mattawoman Creek. Marsh Island is a 25-acre tidal swamp and waterfowl sanctuary lying entirely within the explosive danger zone of Buildings 804 (Magazine 10XC4) and 1410 (Altitude Simulation Chamber). Thoroughfare Island lies partially inside Indian Head's explosive danger zone and contains a swamp and floodplain forest.

Transport to the main station is by truck via Maryland Route 210 and via Maryland Route 224 to Stump Neck. The White Plains Railroad is used several times weekly for receiving materials, trans-shipping finished products and receipt of bulk coal deliveries. Although air service is available nearby , it is used primarily to expedite shipments. The station can also be served by occasional, shallow draft vessels through use of docking facilities on the Potomac River; depth of water at the New Dock area is 13.0 feet below Mean Sea Level. No high volume load handling facilities are available at the waterfront, and the only mode of egress from that area is by a narrow, steep and winding road or by an unimproved security road.

5.2 HISTORY

The Naval Ordnance Station was established in 1890 as the Naval Proving Ground on a 659 acre peninsula known locally as Cornwallis Neck. One year later, an adjacent 223 acre parcel (Mt. Pleasant Farm) was acquired. The station was responsible for proof and acceptance testing of samples from every lot of powder, projectile fuses and cartridge cases purchased by the Navy Department and every naval gun manufactured at the Washington Navy Yard. Besides engaging in quality assurance and control, the station also occasionally field-tested projectiles. The proving ground itself was situated in a long funnel-shaped valley found by the Potomac River running between two high bluffs. In 1897, Congress appropriated $94,000 for the construction of a smokeless powder factory at the site with sufficient capacity to supply the entire U.S. naval fleet. The facility was built in 1900 on the Mattawoman Creek side of the site. All raw materials, provisions and finished products were shipped to and from the Indian Head wharf on the Potomac River.

In 1901, a 1,084 acre parcel known as Mason's Enlargement (most of the site which is now referred to as "Stump Neck") was purchased by the Navy. During gun testing, this peninsula, which is located across the Mattawoman Creek from the main station, was often inadvertently shelled. Between 1904 and 1907, the powder factory was expanded and a powder reworking facility constructed. As a result of the escalating cost of commercial acid, new sulfuric and nitric acid plants were added in 1915. An Explosive D (ammonium picrate) production plant was built in the same year and was operational for the next five years. Explosive D was valued for its insensitivity to shock and friction and was used by the Navy mainly with black powder in projectiles. During World War I, an additional 1,365 acres adjacent to the main site were acquired, as well as three acres on Stump Neck. A 13.8 mile railroad spur was also laid linking Indian Head to the Pennsylvania Railroad Junction at White Plains, Maryland. The Naval Powder Factory (NPF) produced a total of 10 million lbs. of new smokeless powder and reworked 800,000 lbs. of smokeless powder over the course of the war.

As technology advanced, the safety limits of shot and shrapnel testing exceeded the size of the station. In addition, the presence of the naval powder factory complicated site layout. As a result, all proving ground facilities were moved to Dahlgren, Virginia (the "Lower Station"). In 1920, Robert Hutchings Goddard occupied one of the powder magazines vacated in the move to Dahlgren and began early research and development of rocket propellant for a depth charge. Testing was conducted in a closed-pressure chamber apparatus. Initial formulation of flashless powder was attempted at the station in the 1920's. By 1932, the Dahlgren Naval Proving

Ground was officially established and the Indian Head site was redesignated as the Naval Powder Factory.

In 1933 the Explosive D recrystallization plant was reopened and operated at a production rate of approximately 34,000 lbs./month. Production increased until, between 1939 and 1940, 17,000 lbs. new and 4,000 lbs. reworked Explosive D was manufactured daily. Nitric acid production was increased to 40 tons/day in 1941; during World War II the plant averaged 48 tons/day for a total wartime production of 70,262 tons.

Many smokeless powder plants were erected to supplement the NPF's production capability in WWII. However, the burden of solving new production problems confronted the Bureau of Ordnance. One of these production problems was related to flashless powder. Early naval battles in the Pacific in World War II created a substantial demand for flashless powder. The NPF had worked unsuccessfully on this problem in the 1920s but did succeed by 1942 in developing a chemical pellet which when added to existing inventories of smokeless powder effected a flashless charge. The pellet was made of a mixture of potassium nitrate and potassium sulphate with a small amount of graphite. The pellets were limited to use in 3", 4", 5" and 6" guns. Development work continued on a true flashless powder and by the end of the war these grains were in production at NPF. The new material consisted of potassium sulfate mixed with nitrocellulose, colloided as a normal smokeless powder, and extruded in the form of a powder grain. Meanwhile, through the war, the pellets continued to serve the need for a flash suppressor.

A new Explosive D plant was completed in 1942. The production rate of Explosive D was 4 million pounds per month during the war years. A new Extrusion Plant for the manufacture of double-base propellents came on-line in 1943. In 1945 an ammonia oxidation plant began operations to improve nitric acid production.

The war also generated research into new defense strategies; specifically in rocketry and rocket propellent grains for bombardment rockets; the bazooka; and air-to-ground anti-tank weapons. As the war ended, the station's mission was expanded to include propellant research and development. In 1949, the Patterson Pilot Plant was constructed for scaled-up experimental production. The Army's commercial-scale production program for rocket propellants was initiated at the Naval Powder Factory and the California Institute of Technology. The Naval Powder Factory itself was capable of processing 1 million lbs./month of finished rocket powder; hardly a mass production effort, yet its contribution of engineering data and product information proved invaluable in laying the groundwork for Army production.

Beginning in 1950, the Korean War brought the Naval Powder Factory back to major production. Production emphasis shifted to double base and high energy casting powders. Nitroglycerin, cast products, cordite and nitroguandine plants were built. "Mighty Mouse" grains were extruded for use by both the Navy and the Army in air-to-ground rockets. Other extruded rocket motors such as the Sidewinder, Zuni and Asroc came on-line. In November 1953, the first Terrier grain was cast. The cast process was also used in the development of Talos, Bullpup, 1C and Tartar.

The station's shift to production of rocket and missile propellants led to redesignation of the station as the Naval Propellant Plant in 1958. In support of the Polaris Program, twenty-three new buildings for Polaris base grain manufacturing were constructed in 1960. The following year, a computer facility for ballistic evaluation was completed and nitroplasticizers were first produced for the Polaris Program. In 1962, capability for manufacture of the X-248 Scout, a space-oriented program, was added and Otto Fuel II, a new liquid monopropellent for use in the Mark 46 Mod 1 and Mark 48 torpedos was developed. Inert diluent and pneumatic mixing processes were also developed.

In 1966, the station was redesignated the Naval Ordnance Station (NOS) and subsequently approached maximum production capability during the Vietnam War. Land on Bullet's Neck (47 acres) and Rum Point (83 acres) was acquired during 1965 and 1966 because of increased Quantity Distance Arc requirements. In the late 1960's, the station started producing Navy Cool (NACO) gun propellent and high-energy casting powder for the second stage of the C-3 Poseidon Missile. In addition, the Inert Diluent Process Pilot Plant for production of energetic propellants was dedicated.

In November 1971, the Department of the Navy was designated as the single manager for explosive ordnance disposal, which is conducted at the Naval Explosive Ordnance Disposal Facility at NOS. After the Vietnam War, emphasis at the station shifted from primarily production to highly technical and engineering support operations. The station provides backup capability to the Navy and Army, largely by filling small-scale production orders.

Since its inception, the station has supplied the Navy with most of its propellant powder during peacetime. Recently, the station was designated as the engineering/production center for the Tri-Service Cartridge Actuated Services/Propellant Actuated Devices Program. Two inactive plants were re-opened at NOS to produce unsymmetrical dimethylhydrazine (UDMH), a storable liquid propellant, for the Department of Defense when the last commercial producer ceased operations.

NOS was also assigned the task of producing 1,000 Standard ARM Rocket Motors in 1976. The following year, NOS was designated the design agent for Standard Missile Rocket Motors. Modernization of the Moser Nitrating Plant was completed in 1978. Recently, NOS was designated as the Department of Defense's pilot production source for Low Vulnerability Ammunition (LOVA) propellant, and the Polaris Plant facilities are being modified to accomplish this task.

5.3 PHYSICAL FEATURES

5.3.1 General

The Indian Head Naval Ordnance Station (NOS) is geographically located in the Atlantic Coastal Plain physiographic province. The station is situated in Charles County, one of five counties which comprise the geographic region known as the Southern Maryland area. The Southern Maryland area is an irregularly shaped peninsula of 1,944 square miles, bounded on the south and west by the Potomac River, on the northwest by the District of Columbia, on the north by the Patapsco River, and on the east by Chesapeake Bay. The area is one of low relief, with gently rolling to

undulating topography. Swampy areas are common adjacent to major waterways, and flat upland plains exist in most interstream areas. The streams are characterized by low gradients and few, if any, waterfalls and rapids. The numerous estuaries and river valleys of southern Maryland are the most prominent physiographic features. The estuaries are characterized by irregular shorelines, wide mouths, and tidal marshes; water depths of 10 feet or less are common. The closest estuary to NOS is the Potomac estuary, which includes that portion of the Potomac River from Washington, D.C. to the Chesapeake Bay.

As described in Section 5.1, the principal facilities of NOS are located on the Indian Head peninsula, occupying approximately 3,400 acres of land. The penninsula is bounded on the west by the Potomac River, on the East by Mattawoman Creek, and on the north by the town of Indian Head. Ancillary facilities, including the Explosive Ordnance Disposal School, are located on a parcel of land adjacent to the main peninsula known as Stump Neck. Stump Neck is bounded by Mattawoman and Chicamuxen Creeks. Figure 5.3-1 shows the location of Indian Head and Stump Neck from a regional perspective, while Figures 5.3-2 and 5.3-3 portray plan views of the Main Site and Stump Neck. The NOS has, within its jurisdiction, 314 acres of marsh lands and tidal flats. These marshlands and tidal flats are included in the 100 year flood plain of the Potomac River system. The Potomac River and the two tributaries adjacent to the station experience tidal actions.

5.3.2 Climatology

Charles County and the NOS experience a continental type of climate, with well defined seasons. However, the Chesapeake Bay and Potomac

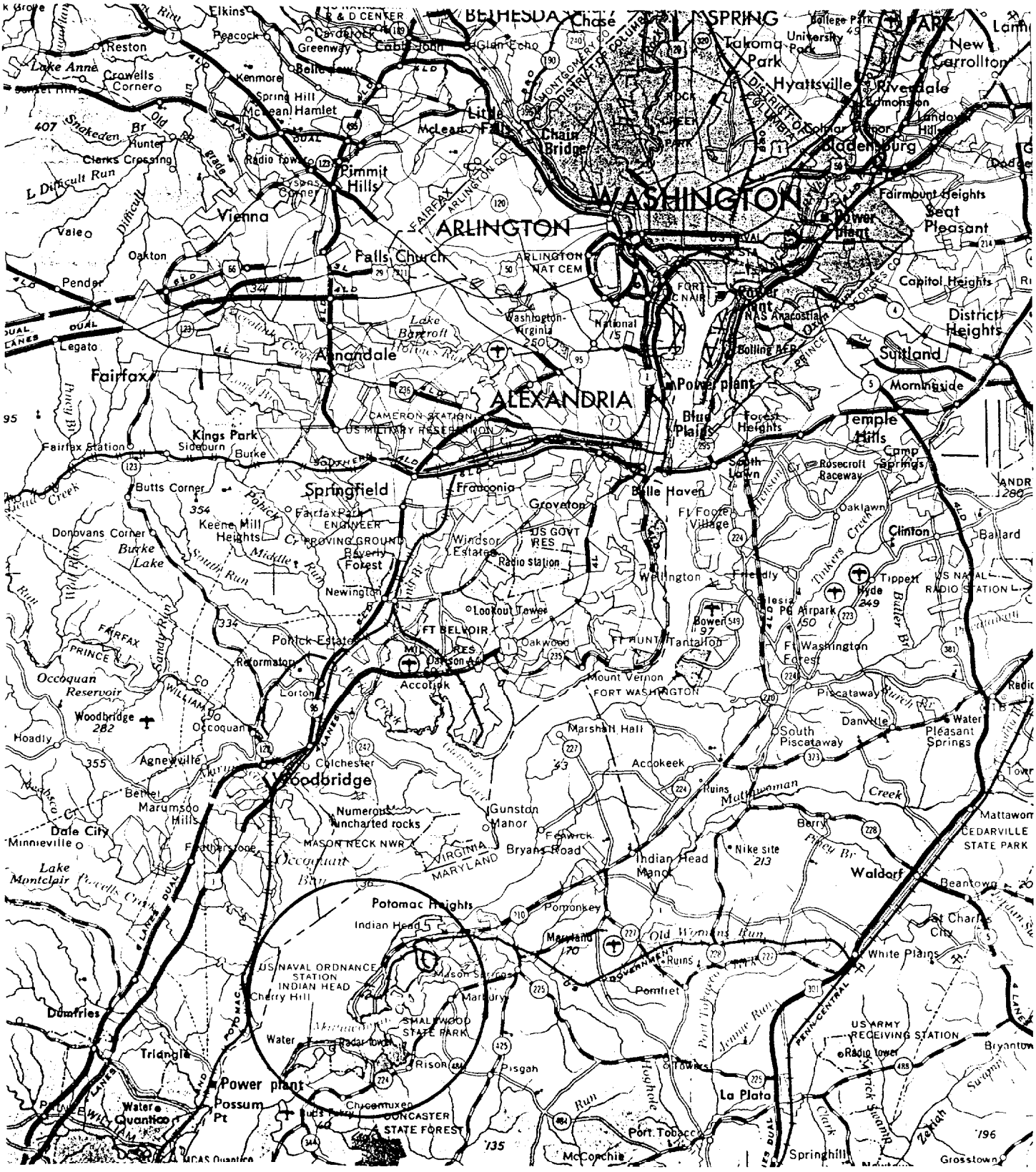


Figure 5.3-1
Location Map of the Indian Head NOS

Figure 5.3-2
Plan View of the Indian Head Main Peninsula

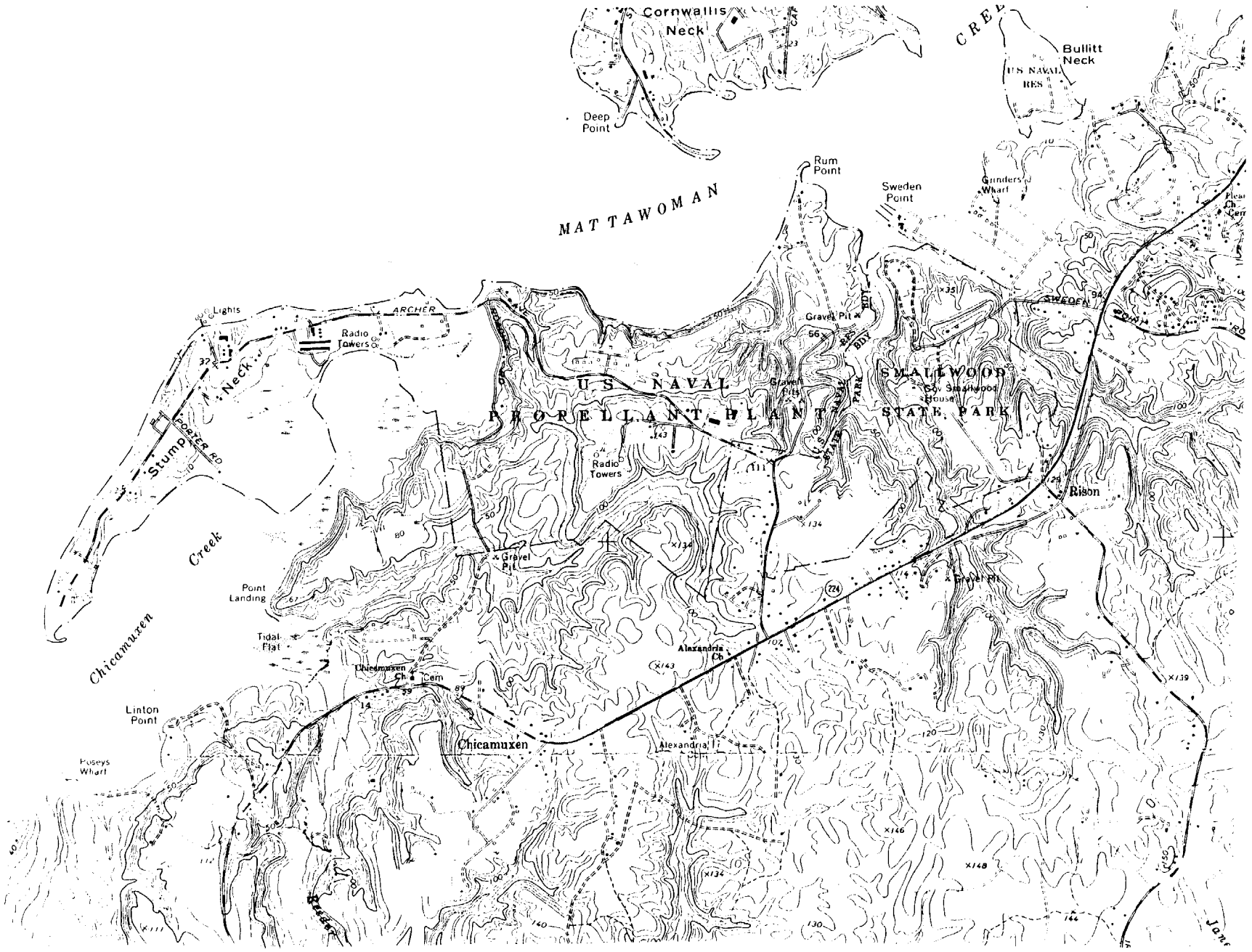


Figure 5.3-3
Plan View of the Stump Neck Area

River have a modifying influence on the climate of the area, particularly in regards to temperature. Locations which are situated very near the shore characteristically experience a small diurnal range in temperature.

Since the area lies in the humid, temperate climatic belt of the Eastern U.S., it has warm summers and wet, but not extremely cold, winters. The warmest portion of the year is the last half of July, when temperatures average 89° F. Temperatures of 90°F or higher occur on an average of 34 days per year. The coldest period occurs at the end of January when minimum temperatures average 21°F. Temperatures below freezing occur approximately 100 days per year. The average annual daily temperature is 56°F; the highest recorded temperature for the area was 103°F, while the lowest was -12°F. The average growing season for the area is approximately 189 days.

The precipitation for the area is rather evenly distributed throughout the year. Mean annual precipitation for Charles County is 47 inches. During the driest month, November, the precipitation averages about 60 percent of that during the wettest month, July. The 10 year probable minimum and maximum annual precipitation values are 35 and 56 inches, respectively. Thunderstorms occur an average of 35 days per year, and precipitation in excess of 0.01 inch occurs on 81 days during a mean year. The mean annual precipitation as snow, sleet and hail is 19 inches.

Since the NOS is fairly level and almost totally surrounded by water, wind movement is generally good to excellent. Windspeeds for the area average 9 miles per hour, while gusts are known to reach 50 to 60 miles per hour. Prevailing winds are from the northwest except for the summer

months when they become more southerly. Easterly winds are the rarest, occurring only 5 percent of the time on an annual basis. The mean annual number of clear days is 164, and the number of cloudy days is 103.

The potential evapotranspiration for the area is about 31 inches, on a mean annual basis. The average rate of evaporation from open-water surfaces is about 37 inches on an annual basis.

5.3.3 Topography

The Indian Head NOS is located in the USGS Indian Head topographic quadrangle. Station elevations range from sea level to 111 feet on the main peninsula, and from sea level to 143 feet on Stump Neck. As shown on Figure 5.3-2, the highest elevations on the main peninsula occur in the northern section, near the station boundary. The highest elevations for the Stump Neck facility occur in the central portion of the facility, near the two radio towers sited on Figure 5.3-3. The major portion of Stump Neck, between Chicamuxen Creek and Mattawoman Creek, lies at elevations of 30 feet or less.

The portion of the Indian Head peninsula adjacent to the Potomac River is characterized by 40-50 foot bluffs, where the land area meets the shore. On the Mattawoman Creek side, the shoreline is more gradational, except in a few areas where several 10-40 foot bluffs are found. Most of the land surface of the main peninsula slopes to the east and southest, towards Mattawoman Creek. Slopes of 5 percent or less are common over most of the main area.

At Stump Neck, the land area adjacent to Mattawoman Creek and Chicamuxen Creek is very flat, much of it existing as a marsh area. Slopes of 3 percent or less are common, generally trending to the southest towards Chicamuxen Creek. The portion of the Stump Neck facility inland from the Neck is somewhat more hilly, with slopes exceeding 5 percent in many places. In this area, approximately half the land surface slopes to the west towards Mattawoman Creek, the remainder sloping east and southeast to surface drainages tributary to Chicamuxen Creek. Several 50-60 foot bluffs are found along Mattawoman Creek between Stump Neck and Rum Point, as depicted on Figure 5.3-3.

The land areas of the main peninsula and Stump Neck are quite characteristic of Coastal Plain sedimentation processes, where gravel, sand, silt, and clay materials were transported by streams from Appalachian and Piedmont regions west of the area and deposited in the form of alluvial fans, deltas, and as estuarine and marine mud and silt layers. The nature of these continental deposits suggest that they were carried by low gradient streams whose channel meandered back and forth across a land surface of gentle relief. The successive rise and fall of sea level in the geologic past, accompanied by successive stream valley erosion and filling cycles, sculpted the surface features visible today.

5.3.4 Geology

The geology of the region in which the Indian Head NOS is located is characterized by extensive layers of unconsolidated fluvial and marine deposits resting on dense, hard, crystalline metamorphic and igneous basement rocks. The deposits are chiefly of Cretaceous, Tertiary and Quaternary

age, while the bedrock is of Precambrian or Cambrian Age. Table 5.3-1 presents the geologic time scale to put the age of the sediments and bedrock into perspective. The crystalline bedrock near Indian Head is approximately 600 feet below sea level, so the unconsolidated deposits are on the order of 600-700 feet thick at the NOS.

Figure 5.3-4 illustrates the general lithologic column found in the Indian Head area. The major sedimentary units identified in the area are, in ascending order, the Patuxent and Arundel Clay Formations of Lower Cretaceous age, the Raritan and Patapsco Formations of Upper Cretaceous age, and the surficial Columbia Formation of Quarternary age. These major sedimentary units outcrop to the west of Indian Head, beneath the Potomac River or across the river in Virginia. The sediments strike to the northeast and dip to the southeast, thickening in a southeasterly direction so that they appear to be wedge shaped. Figure 5.3-5 illustrates a general cross-section of the subsurface geology from the Virginia outcrop area through Indian Head and on into Charles County. Figure 5.3-6 locates this cross section and also presents a plan view of the underlying geology of Charles County beneath the Quarternary deposits.

The geology of Stump Neck is similar to that of the main Indian Head peninsula, except that the easternmost portion of the Naval property borders on the subcrop of the Aquia Greensand, as shown on Figure 5.3-6. In this area, the Aquia Greensand would be anywhere from zero to 20 feet thick.

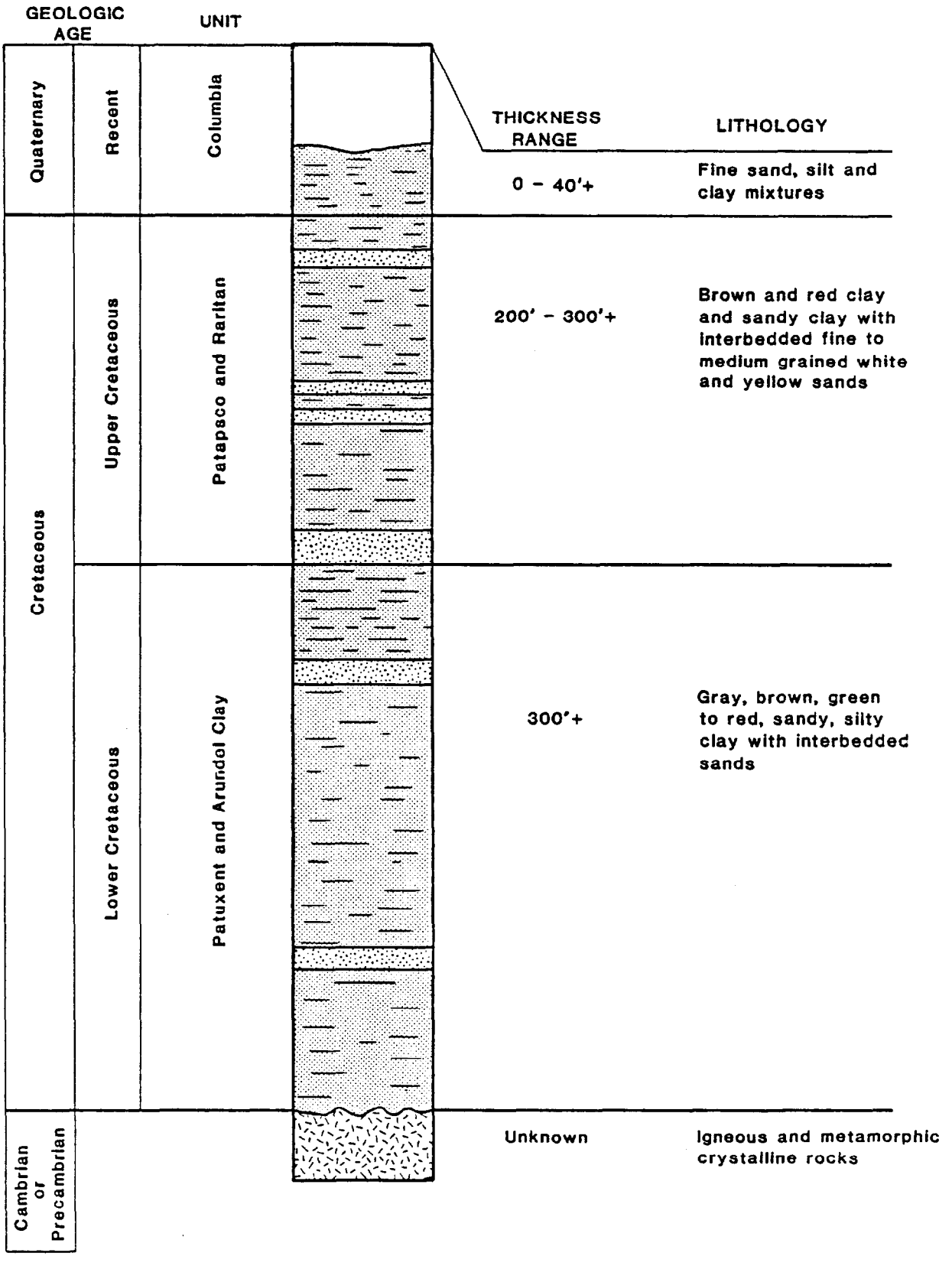
The principal physical characteristics of the major geologic formations in the Indian Head area and Charles County are described below.

Table 5.3-1

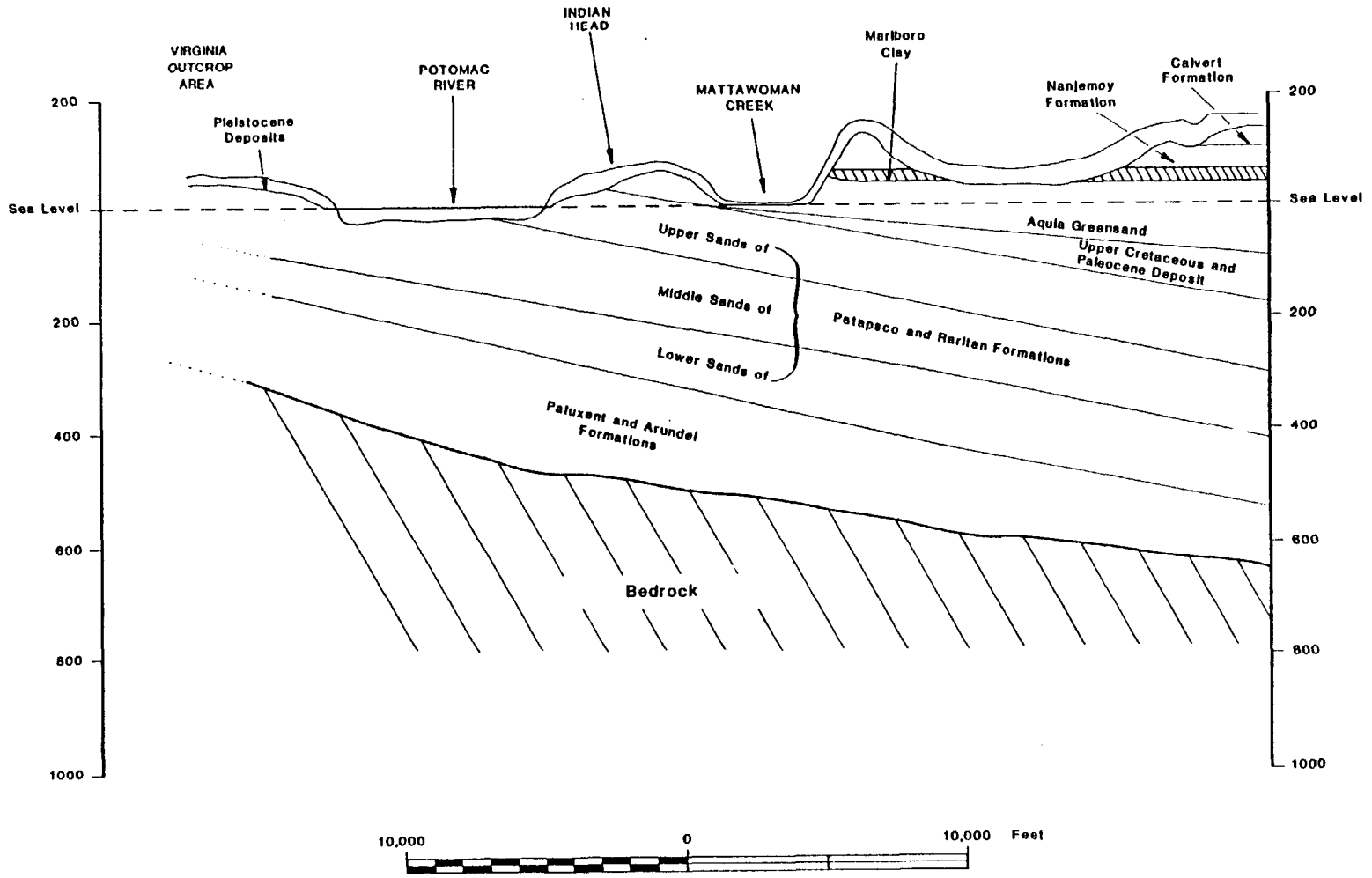
Age of Geologic Formations

Era	Period	Epoch	Age Range*
Cenozoic	Quarternary	Holocene (Recent)	0–11,000 years
		Pleistocene	11,000–2 million
	Tertiary	Pliocene	2–5 million years
		Miocene	5–25
		Oligocene	25-35
		Eocene	35–55
		Paleocene	55–65
Mesozoic	Cretaceous	Upper	65–90
		Lower	90–140
	Jurassic		140–190
	Triassic		190–230
Paleozoic	Permian		230–280
	Pennsylvanian	Carboniferous	280–320
	Mississippian	Carboniferous	320–350
	Devonian		350–400
	Silurian		400–430
	Ordovician		430–500
	Cambrian		500–600
Precambrian	Proterozoic		600+
	Archeozoic		from 4600?

Source: Sowers (1979)



GENERALIZED LITHOLOGIC COLUMN FOR THE INDIAN HEAD AREA



GENERALIZED CROSS - SECTION SHOWING STRATIGRAPHY OF INDIAN HEAD AREA

Figure 5.3-5

Source: Aware (1982).

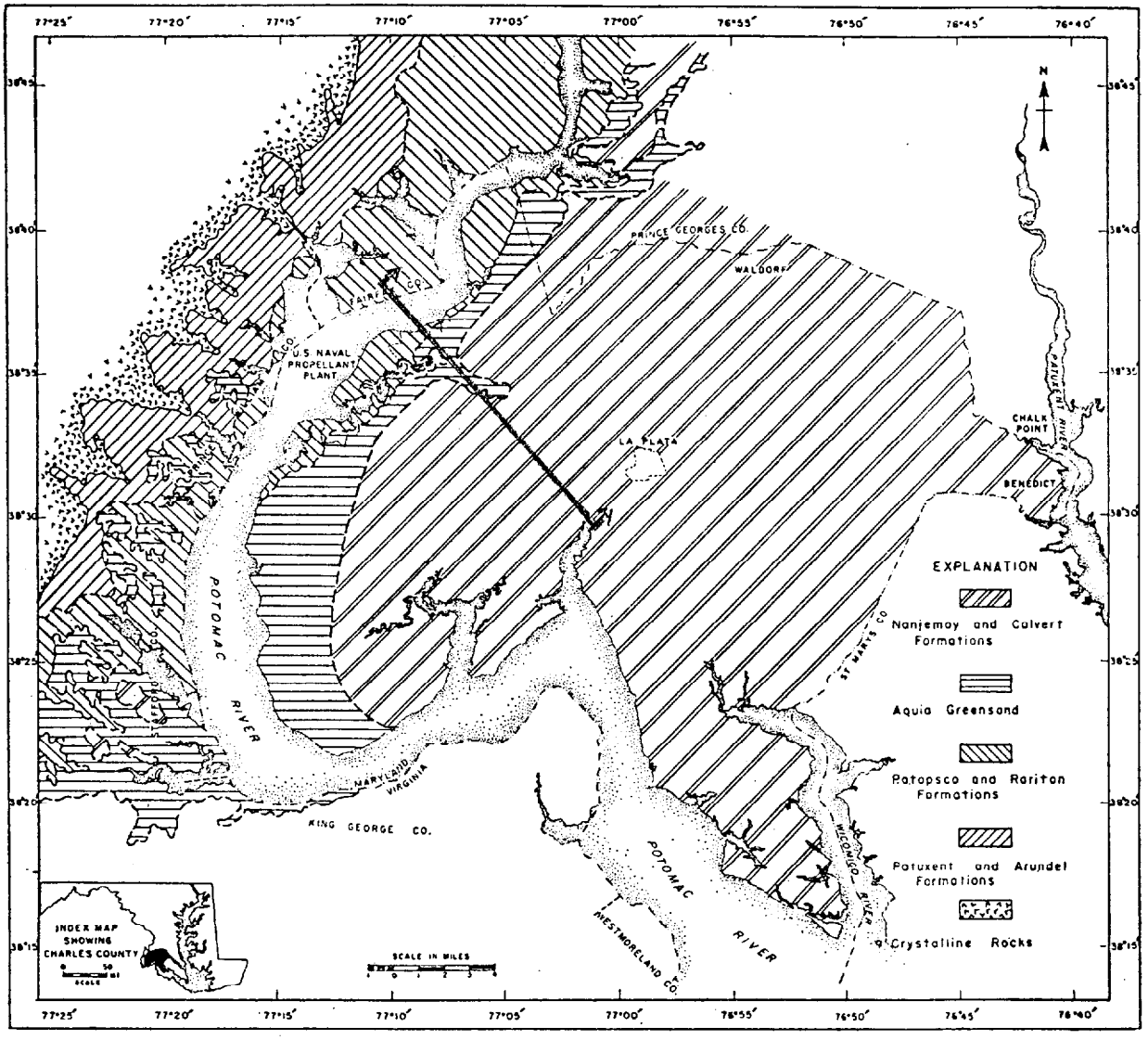


Figure 5.3-6
Generalized Geologic Map of the Project Area

Source: Slaughter and Otton (1968).

This information has been obtained from the work of Otton (1955) and Slaughter and Otton (1968) in the Charles County area.

- Columbian Formation

The Quarternary Columbia Formation consists of Pleistocene and Recent deposits ranging in thickness from 0-60+ feet in Charles County. At Indian Head, the deposits are not thought to exceed 40 feet in thickness (AWARE, Inc., 1982). The deposits are tan to orange, fine sand, silt and clay mixtures which are irregularly bedded. The deposits are broken down into lowland deposits (0-40 ft above sea level) and upland deposits (40+ ft above sea level). The upland deposits generally contain a larger proportion of coarser grained materials including gravel and cobble beds.

- Aquia Greensand

The Aquia Greensand of Tertiary Age averages 80-150 feet in thickness in Charles County. The formation consists of light to dark olive glauconite sand interbedded with very fine sand, silt and clay. The sands are salt and pepper in appearance. Only the easternmost portion of the Stump Neck naval facility property is located above the Aquia Greensand. In this area where the formation subcrops beneath the Pleistocene deposits, it will generally be less than 20 feet thick. The bulk of Stump Neck between Chicamuxen Creek and Mattawoman Creek is not underlain by the Aquian Greensand.

- Raritan and Patapsco Formation

In Charles County, the Upper Cretaceous age Patapsco and Raritan Formations are typically grouped together as one geohydrologic unit because of the difficulties in readily separating them on the basis of lithology. The formation consists chiefly of brown and red clay and sandy clay; much of the clay is tough and wax-like. The formation is interbedded with yellow and white sands which are fine-to-medium grained. The thickness of the formation ranges from about 200 feet in the western portion of the county to 700 feet in the central portion. Although in many places in the area the sands cannot be traced laterally for distances greater than a few miles, generally well logs for the county indicate that a regular sequence of position and thickness of the sands do exist. On this basis, the sands within the Raritan and Patapsco Formation are designated as the lower, middle, and upper sand units, generally from a hydrologic perspective. The Patapsco and Raritan Formations are believed to underlie all of Charles County, but only a small portion of their total thickness has been penetrated in the eastern half of the county. The general dip of the sands is on the order of 25 feet per mile.

- Patuxent and Arundel Clay Formations

While the Lower Cretaceous Age Patuxent and Arundel Clay Formations are differentiated in the Washington D.C. and Baltimore areas, no differentiation is typically made in the central and southern portions of the Southern Maryland geographic region. The entire sequence is generally considered the Patuxent Formation. The formation consists of gray, brown, light-green to deep-red sandy silty clays with interbedded sand zones. In

many areas the sand layers contain gravel. The Patuxent overlies the crystalline bedrock on an irregular erosional surface. The top of the Patuxent is not exactly known but has been arbitrarily designated as the bottom surface of the lowermost sand in the Patapsco and Raritan Formation. In the Indian Head area, the formation has an average thickness of 300 feet with the elevation of the top of the unit approximately 250 to 300 feet below mean sea level. In other portions of the county, the thickness of the unit ranges from 350 to 800 feet. The surface of the unit dips to the southeast at 30 to 50 feet per mile. In the Indian Head area, it has been reported that the formation consists of about 77 percent clay and related fine sediments, with the remainder comprised of sand and other coarse grained materials.

5.3.5 Soils

5.3.5.1 USDA Soils Classification

The U.S. Department of Agriculture Soil Conservation Service has mapped the soils in the Indian Head area and published the results in a 1974 report (USDA, 1974). The results indicate that four principal soil associations are found on the Indian Head peninsula and on Stump Neck. Figure 5.3-7 shows the location of the soil associations at the NOS, and provides a description of the general nature of the soils. Within the four principal soil associations found at the NOS, nine soil series are found. In Table 5.3-2, a number of engineering properties and grain size characteristics for these nine soil series are tabulated. Included in this Table are the equivalent Unified Soil Classification Symbols for these soils. In Table 5.3-3,

FIGURE 5.3- 7

SOIL TYPES IN VICINITY OF NOS

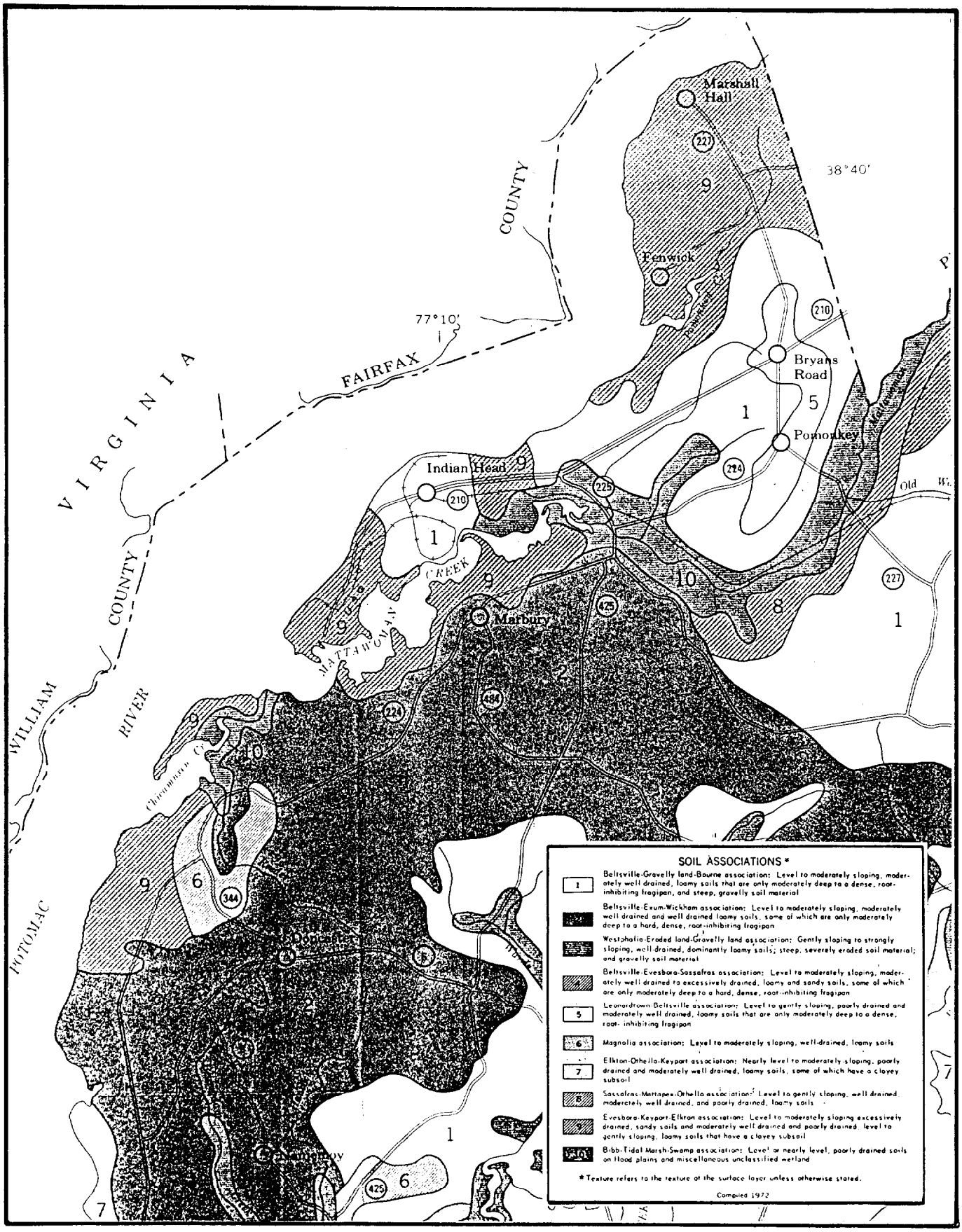


Table 5.3-2

Engineering Properties of the NOS Soils Series

Soil series and map symbol	Depth to high water table	Depth from surface [1]	Classification: USDA texture	Classification: Unified	Percentage passing sieve— No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Permeability [2]	Available water capacity	Reaction (unlimed)	Shrink-swell potential
	Feet	*Inches*							*Inches per hour*	*Inches per inch of soil*		
Belleville: BlA, BlB2, BlC2, BlC3	1½–2½	0–16	Silt loam	ML	95–100	90–100	75–100	60–90	0.63–2.0	0.18–0.24	4.0–5.0	Low.
		16–54	Loam, silt loam, silty clay loam (fragipan).	ML, CL	95–100	90–100	90–100	65–95	<0.20	0.10–0.18	4.0–5.0	Low.
		54–72	Loam, gravelly loam	SM, ML	75–100	65–100	55–100	25–80	0.20–6.3	0.08–0.16	4.0–5.0	Low.
Bibb: Bo	0–1	0–28	Silt loam, loam	ML	95–100	90–100	80–100	50–80	0.63–2.0	0.18–0.24	4.0–5.0	Low.
		28–60	Gravelly sandy loam to silty clay loam.	SM, ML, CL	50–100	45–100	40–90	25–80	0.63–2.0	0.10–0.20	4.0–5.0	Low.
Bourne: BrB2, BrC2, BuC3	1½–2½	0–13	Sandy loam, sandy clay loam	SM, SC, ML	75–100	55–100	50–100	25–75	0.63–2.0	0.10–0.18	4.0–5.0	Low.
		13–23	Loam, sandy clay loam	SC, CL	80–100	60–100	55–100	35–80	0.63–2.0	0.08–0.18	4.0–5.0	Low.
		23–60	Loam, fine sandy loam (fragipan).	SM, SC, ML	75–100	65–100	60–100	25–60	<0.20	0.08–0.18	4.0–5.0	Low.
Elkton: Ek	0–1	0–12	Silt loam	ML, CL	90–100	85–100	80–100	55–90	0.20–2.0	0.18–0.27	4.0–5.0	Low.
		12–40	Clay, silty clay, silty clay loam.	MH, CL, CH	95–100	80–100	80–100	70–100	<0.20	0.18–0.24	4.0–5.0	Moderate.
		40–70	Loamy sand to clay	SM, SC, ML, CL	90–100	85–100	65–100	30–100	0.20–6.3	0.08–0.24	4.0–6.0	Low to moderate.
Evesboro: EvB, EvC, EwB, EwC	>5	0–60	Loamy sand, gravelly loamy sand.	SM, SP-SM	75–100	60–100	40–95	5–15	>6.3	0.06–0.10	4.0–5.0	Low.
Exum: ExC2, ExD2, EyC3, EyD3, ExB2.	1½–2½	0–8	Silt loam, clay loam	ML, CL	95–100	90–100	90–100	65–95	0.20–2.0	0.12–0.24	4.0–5.5	Low to moderate.
		8–43	Clay loam, silty clay loam	CL	95–100	95–100	90–100	70–100	0.20–2.0	0.12–0.18	4.0–5.5	Low to moderate.
		43–96	Clay loam, loam	ML, CL	95–100	90–100	80–100	65–95	0.20–2.0	0.10–0.18	4.0–5.0	Low.
Gravelly land, steep: GvE	>5	0–60	Gravelly to very gravelly loam.	SM, GM, GC, GP-GM.	35–85	20–80	15–60	10–50	0.20–2.0	0.04–0.10	4.0–5.0	Low.
Keyport: KeA, KeB2, KpA, KpB2, KpC2, KrC3	1½–2½	0–16	Fine sandy loam, silt loam, silty clay loam.	SM, ML, CL	95–100	90–100	70–100	40–100	0.20–2.0	0.12–0.24	4.0–5.5	Low to moderate.
		16–39	Silty clay loam, silty clay, clay.	MH, CL, CH	85–100	75–100	70–100	65–100	<0.20	0.12–0.24	4.0–5.5	Moderate.
		39–66	Fine sandy loam, gravelly sandy loam.	SM, SC	90–100	70–100	60–90	25–50	0.63–2.0	0.10–0.18	4.0–5.0	Low.
Wickham: WkB2, WkC2, WkD2, WmC3, WmD3.	>6	0–9	Fine sandy loam, sandy clay loam.	SM, ML, CL	80–100	80–100	75–100	45–75	0.63–6.3	0.12–0.24	4.5–5.5	Low.
		9–36	Clay loam, sandy clay loam	SC, CL, MH	85–100	85–100	65–100	40–80	0.63–2.0	0.14–0.24	4.5–5.5	Low to moderate.
		36–64	Sandy loam to sandy clay loam.	SM, SC, CL	85–100	85–100	75–100	15–65	0.63–2.0	0.10–0.18	4.0–5.0	Low.

[1] Depths given are for the representative profile (see descriptions of the soils). For any given layer, the figures are estimates of the range of the series within the county.

[2] Classes of soil permeability in inches of water per hour are as follows: Rapid, more than 6.3; moderately rapid, 2.0–6.3; moderate, 0.63–2.0; moderately slow, 0.20–0.63; and slow or very slow, less than 0.20.

The land types Alluvial land (Ad), Coastal beaches (Ce), Cut and fill land (Cu), Eroded land, steep (ErE), Gravel and borrow pits (Gp), Swamp (Sa), and Tidal marsh (Tm) are too variable to be rated.

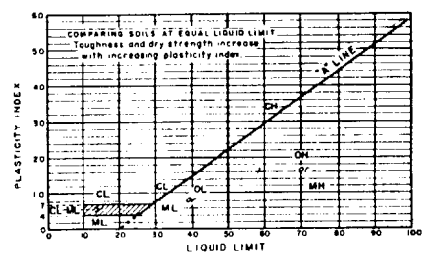
Source: USDA (1974).

Table 5.3-3
Unified Soil Classification System

UNIFIED SOIL CLASSIFICATION
INCLUDING IDENTIFICATION AND DESCRIPTION

FIELD IDENTIFICATION PROCEDURES (Excluding particles larger than 3 inches and basing fractions on estimated weights)				GROUP SYMBOLS [1]	TYPICAL NAMES	INFORMATION REQUIRED FOR DESCRIBING SOILS	LABORATORY CLASSIFICATION CRITERIA
COARSE GRAINED SOILS — More than half of material is larger than No. 200 sieve size [2] (The No. 200 sieve size is about the smallest particle visible to the naked eye)	GRAVELS — More than half of coarse fraction is larger than No. 4 sieve size (For visual classifications, the ¼" size may be used as equivalent to the No. 4 sieve size.)	CLEAN GRAVELS (Little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes	GW	Well graded gravels, gravel-sand mixtures, little or no fines	Give typical name; indicate approximate percentages of sand and gravel, max size, angularity, surface condition, and hardness of the coarse grains, local or geologic name and other pertinent descriptive information, and symbol in parentheses	Determine percentages of gravel and sand from grain size curve. Depending on percentage of fines (fraction smaller than No. 200 sieve size) coarse grained soils are classified as follows: Less than 5% GW, GP, SW, SP; More than 12% GM, GC, SM, SC; 5% to 12% Borderline cases requiring use of dual symbols. Use grain size curve in identifying the fractions as given under field identification. $C_u = \frac{D_{60}}{D_{10}}$ Greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between one and 3
			Predominantly one size or a range of sizes with some intermediate sizes missing	GP	Poorly graded gravels, gravel-sand mixtures, little or no fines		Not meeting all gradation requirements for GW
		GRAVELS WITH FINES (Appreciable amount of fines)	Non plastic fines (for identification procedures see ML below)	GM	Silty gravels, poorly graded gravel-sand-silt mixtures.	For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions and drainage characteristics.	Atterberg limits below "A" line, or PI less than 4 — Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols. Atterberg limits above "A" line with PI greater than 7
			Plastic fines (for identification procedures see CL below)	GC	Clayey gravels, poorly graded gravel-sand-clay mixtures.		
	SANDS — More than half of coarse fraction is smaller than No. 4 sieve size	CLEAN SANDS (Little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate particle sizes	SW	Well graded sands, gravelly sands, little or no fines	EXAMPLE:- Silty sand, gravelly; about 20% hard, angular gravel particles ½-in maximum size; rounded and subangular sand grains coarse to fine, about 15% non-plastic fines with low dry strength; well compacted and moist in place, alluvial sand; (SM)	$C_u = \frac{D_{60}}{D_{10}}$ Greater than 6; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between one and 3
			Predominantly one size or a range of sizes with some intermediate sizes missing	SP	Poorly graded sands, gravelly sands, little or no fines		Not meeting all gradation requirements for SW
		SANDS WITH FINES (Appreciable amount of fines)	Non-plastic fines (for identification procedures see ML below)	SM	Silty sands, poorly graded sand-silt mixtures.		Atterberg limits below "A" line or PI less than 4 — Above "A" line with PI between 4 and 7 are borderline cases requiring use of dual symbols.
			Plastic fines (for identification procedures see CL below)	SC	Clayey sands, poorly graded sand-clay mixtures.		Atterberg limits above "A" line with PI greater than 7

FINE GRAINED SOILS — More than half of material is smaller than No. 200 sieve size (The No. 200 sieve size is about the smallest particle visible to the naked eye)	IDENTIFICATION PROCEDURES ON FRACTION SMALLER THAN No. 40 SIEVE SIZE				GROUP SYMBOLS [1]	TYPICAL NAMES	INFORMATION REQUIRED FOR DESCRIBING SOILS
		DRY STRENGTH (CRUSHING CHARACTERISTICS)	DILATANCY (REACTION TO SHAKING)	TOUGHNESS (CONSISTENCY NEAR PLASTIC LIMIT)			
SILTS AND CLAYS — Liquid limit less than 50		None to slight	Quick to slow	None	ML	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity.	Give typical name; indicate degree and character of plasticity, amount and maximum size of coarse grains; color in wet condition, odor if any, local or geologic name, and other pertinent descriptive information, and symbol in parentheses.
		Medium to high	None to very slow	Medium	CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
		Slight to medium	Slow	Slight	OL	Organic silts and organic silt-clays of low plasticity.	For undisturbed soils add information on structure, stratification, consistency in undisturbed and remolded states, moisture and drainage conditions.
SILTS AND CLAYS — Liquid limit greater than 50		Slight to medium	Slow to none	Slight to medium	MH	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	EXAMPLE:- Clayey silt, brown; slightly plastic; small percentage of fine sand; numerous vertical root holes; firm and dry in place; loess; (ML)
		High to very high	None	High	CH	Inorganic clays of high plasticity, fat clays.	
		Medium to high	None to very slow	Slight to medium	OH	Organic clays of medium to high plasticity.	
HIGHLY ORGANIC SOILS		Readily identified by color, odor, spongy feel and frequently by fibrous texture			Pt	Peat and other highly organic soils.	



PLASTICITY CHART
FOR LABORATORY CLASSIFICATION OF FINE GRAINED SOILS

[1] Boundary classifications: Soils possessing characteristics of two groups are designated by combinations of group symbols. For example GW-GC, well graded gravel-sand mixture with clay binder.
[2] All sieve sizes on this chart are U.S. standard.

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the Unified Soil Classification system is presented so that the classification symbols may be interpreted.

The general features of each of the four soil associations found at the NOS are described below:

- Beltsville - Gravelly Land - Bourne Association

This association occupies approximately 28 percent of Charles County. Approximately half of the soils in this association are classified as severely eroded or subject to severe erosion. These soils have a hard, dense fragipan in the lower part of the subsoil, which minimizes the downward movement of water. Typically in late winter and early spring, the soil above the fragipan is saturated. Beltsville and Bourne soils are suited to most crops grown in the area, but Gravelly Land soils are not used for farming. All three soils have a severe limitation for the disposal of septic tank effluent.

- Beltsville - Exum - Wickham Association

This association makes up about 22 percent of Charles County, and occurs mainly on elevated areas that are moderately dissected by the major rivers and streams of the county. Many moderately sloping areas near drainageways are severely eroded. Neither the Exum soil nor the Wickham soil has a fragipan layer and are therefore moderately to well drained. Beltsville soils are severely limited for the disposal of septic tank waste; Exum soils are moderately to severely limited for this use. They have moderate

limitations for most other nonfarm uses. Wickham soils have few limitations for nonfarm uses.

- Evesboro - Keyport - Elkton Association

This association makes up about 4 percent of Charles County. It is generally found along the upper parts of the Potomac River. Elevations are commonly less than 40 feet above sea level. The Evesboro soils are excessively drained and are very sandy to a depth of five feet or more. The Keyport and Elkton soils are moderate to poorly drained and have subsoils of clay and silty clay. These two soils require drainage for the cultivation of crops. The Elkton soils are severely limited for the disposal of effluent from septic tanks and for building sites. The Keyport soils are also severely limited for septic tank effluent disposal, but only slightly to moderately limited for residential and industrial development.

- Bibb-Tidal Marsh-Swamp Association

This association makes up about 7 percent of Charles County. It is found along major floodplains and on nearby marshes and swamps. Bibb soils are poorly drained and subject to flooding. Tidal marsh consists of wet, unstable soil material that is subject to flooding by saline to brackish water. Swamp consists of wet, unclassified soil that has fresh water above the land surface for extended periods of time. Bibb soils can be cropped if protected from flooding; however, the association as a whole is severely limited for most nonfarm uses. These soils are used mainly for wildlife habitat.

- Subsurface Soil Conditions

In order to evaluate the subsurface soil conditions present at Indian Head NOS, a number of foundation soil borings were examined. These borings ranged in depth from 10 to 147 feet. In all, a total of 118 borings were obtained for review from the NOS: 92 of the borings were from the main peninsula area, and 16 of the borings were from Stump Neck. Table 5.3-4 presents a summary of the boring logs which were examined. Included in this table is a description of the general soil conditions encountered, the depth to groundwater, if found to be present, the depth range of the borings, and the location of the borings using the Indian Head NOS base map grid notation. In Table 5.3-5, each of the soil boring references cited in Table 5.3-4 are identified. Appendix 5.3-1 contains selected boring logs which are considered representative of the NOS area.

- Main Peninsula Subsurface Soils

As can be seen in Table 5.3-4, each of the boring logs examined showed the presence of extensive zones of fine grained sediments such as clay, silt, sandy clay, and silty clay. Interbedded with these fine grained sediments are lenses of coarse grained sediments including fine to medium sand, and in some instances, sand and gravel. In almost every instance the fine grained materials were the predominant material encountered in the boring. Typically, these extensive layers of fine grained clays and silty clays were encountered in the boring columns at depths just below the zones where the interbedded coarse grained materials were found. An additional general pattern can be seen in those borings which are fairly deep.

TABLE 5.3-4: NOS SOIL BORING DATA

Reference	Location	Date	Number of Borings	Depth Range	General Soil Type	Depth to Groundwater
A	T 33,34	1974	8	40-50'	Sand and silty sand, situated above clay and silty clay. Some sands and sandy gravels observed below the clays, at depths of 40 feet or more.	4 feet or less; 7 of 8 borings showed groundwater
B	D 11	1964	3	30'	Clay and sandy clay; some layers of silty sand.	6 to 10 feet; 2 of 3 borings showed groundwater
C	F1,G1,H2	1959	6	50-85'	Sand and silty sand, situated above clay and silty clay. Sand and gravel found below the clays, at depths of 60 feet or more. The clay layer is typically 20 feet or more in thickness.	6 feet or less; found within the sands above the clay.
D	G6,H6,I6,J6	1954	9	65-95'	Sandy clay situated above several discontinuous layers of fine sand. Silts, sandy silts, and sandy clays lie below the fine sand. Sand and gravel found below the lowermost silts and clays, at depths exceeding 70 feet.	5-15 feet; 8 of 9 borings showed groundwater
E	D6,E6,F6,C6	1959	8	50-60'	Predominantly clay, underlain by silt, sandy silt, and sandy clay. At depths of 50 feet or more, sands and gravels were encountered.	0-20 feet

TABLE 5.3-4: NOS SOIL BORING DATA (CONT)

Reference	Location	Date	Number of Borings	Depth Range	General Soil Type	Depth to Groundwater
F	G4,H4,I4,F3	1960's	8	20-50'	Sandy clay above a thin (5 feet or less) fine sand layer. Beneath the thin sand, thick (20 feet or more) silt deposits are found.	10-20 feet; three of eight borings showed groundwater
G	I14,I15,J14	1961	4	50-52'	Mixture of sand, gravel, and silt above an 8 to 20 foot thick clay. The clay is the predominant material observed in the borings.	13-17 feet; found in the coarse grained materials above the clay.
H	J26,J27, I26,I27	1959	8	65'-100'	Alternating silts, clays, and sandy silts situated above a zone of hard, compact sandy clay. The compact sandy clay is generally 50-60 feet below the land surface, and is the predominant material observed in the borings.	0-20 feet
I	I12,I25,I26, I27,J25	1959	9	40-80'	Variable composition, but generally a layer of surficial sand underlain by thick zones of silt, clay, and sandy clay. Two borings showed predominantly thicker sand zones and correspondingly thinner zones of clay. These two borings were located away from the others in I12.	0-5 feet; 7 of 9 borings showed the presence of groundwater
J	B3,C3	1969	4	15-21'	Fine sand and silty sand; in one boring, the predominant material was a fine sandy clay.	5-18 feet

TABLE 5.3-4: NOS SOIL BORING DATA (CONT)

Reference	Location	Date	Number of Borings	Depth Range	General Soil Type	Depth to Groundwater
K	I25,H25	Unknown	4	10-45'	Fine to medium sand, silty sand, and clayey sand underlain by clay and silty clay. In the deepest boring, a zone of fine to medium sand was detected at a depth of 33 feet, below the clay and silty clay material.	Not stated.
L	H26,H27,I27	Unknown	6	30-56'	Predominant material is clay and silty clay; some zones of fine to medium sand and gravel alternate between the clay zones, generally above the 30 foot depth.	Not stated.
M	L17,L18,K18	Unknown	4	75-95'	Predominant material above 40 feet is clay and silty clay; below 40 feet, lenses of fine to coarse sand, and some sand and gravel are encountered, alternating with zones of clay and sandy clay.	Not stated.
N	H19,I19,J18	1968	4	10-30'	5 foot zone of sand, and sand and gravel, underlain by clay, silty clay, and silt throughout the remainder of the boring. Clay is the predominant material.	Five feet or less; groundwater documented in only one of the borings.

TABLE 5.3-4: NOS SOIL BORING DATA (CONT)

Reference	Location	Date	Number of Borings	Depth Range	General Soil Type	Depth to Groundwater
O	E39,R31,P24	Unknown	15	15-55'	Predominant material is clay, which grades from soft, to stiff, to hard with depth. Some of the shallower borings showed zones of fine to medium sand, and some sand and gravel lenses, generally above 30 feet.	5-25 feet; 7 of 15 borings showed the presence of groundwater.
P	J5	Unknown	6	90'	Predominant material is silty clay, underlain by fine to coarse silty sand and some gravel. Transition from the silty clay to the coarser grained materials occurs generally below 60 feet. Below 80 feet, sandy clays are encountered.	14-23 feet
Q	A-18 Stump Neck	1964	8	15-25'	Fine sand, silty sand, and clayey sand underlain by clay, silt, and sandy clayey silt. Variable proportions between boreholes.	6-10 feet; 5 of 8 boreholes showed the presence of groundwater.
R	WW-24 Stump Neck	1969	6	25'	Fine sandy clay, underlain by a ten foot zone of sand and gravel. Beneath the zone of sand and gravel, fine silty clay or sandy clay is encountered for the remainder of the boring.	12-16 feet
S	F-12 Stump Neck	1945	1	123'	Sequence of sandy clay (10'), gravel (10'), clay (40'), Marl (9'), sand (4') and clay (50').	not available

TABLE 5.3-4: NOS SOIL BORING DATA (CONT)

Reference	Location	Date	Number of Borings	Depth Range	General Soil Type	Depth to Groundwater
T	G-11 Stump Neck	1944	1	147'	Sequence of sandy clay (35'), clay (15'), sand (10'), sandy clay (50'), and clay (37').	not available

TABLE 5.3-5: IDENTIFICATION OF NOS SOIL BORINGS

Reference	Source
A	Department of the Navy, NAVFAC, NOS, Indian Head, MD. Boring Logs, Relocate and Construct UDMH Distillation Facility, NAVFAC # 3,103,583, Public Works SI-UDMH.
B	Department of the Navy, NAVFAC, NOS, Indian Head, MD. Boring Logs, Central Air Compressor Station, NAVFAC #1029393; Public Works SI-#110-112.
C	Department of the Navy, Bureau of Yards and Docks, Potomac River Naval Command, Y&D # 870162; Public Works SI-#2-7.
D	Department of the Navy, Bureau of Yards and Docks, Potomac River Naval Command, Y&D # 870158; Public Works SI#16-24.
E	Department of the Navy, Bureau of Yards and Docks, Potomac River Naval Command, Y&D #870157; Public Works SI# 8-15.
F	Department of the Navy, Bureau of Yards and Docks, Area Public Works Office, Chesapeake. Y&D drawing #981280; Public Works SI#34-41.
G	Department of the Navy, Bureau of Yards and Docks, Area Public Works Office, Chesapeake. Y&D # 94189; Public Works SI # 124-127.
H	Department of the Navy, Bureau of Yards and Docks, Potomac River Naval Command, Y&D # 880728; Public Works ST # 64-71.
I	Department of the Navy, Bureau of Yards and Docks, Potomac River Naval Command, Y&D # 870169; Public Works SI # 25-33.
J	Soil Consultants, Inc. Soil Investigations near Building 750; NOS, Indian Head, MD. Public Works SI # 200-203.
K	Public Works SI # 128-131; Handwritten Report; NOS, Indian Head, MD.

TABLE 5.3-5: IDENTIFICATION OF NOS SOIL BORINGS (CONT)

Reference	Source
L	Public Works SI # 132-137; Handwritten Report. NOS, Indian Head, MD.
M	Public Works SI # 140-143; Handwritten Report. NOS, Indian Head, MD.
N	Public Works SI # 204-208; logs prepared by Soil Consultants, Inc., NOS, Indian Head, MD.
O	Public Works SI # 209-211; NOS, Indian Head, MD.
P	Public Works SI # 212, NOS, Indian Head, MD.
Q	Public Works SI # 313. NOS, Indian Head, MD.
R	Public Works SI # 306-311. Test Boring Report by Foundation Test Service, Inc., Wash. DC, for NAV.
S	Public Works SI # 300; Log of Well 43SN at Stump Neck; upper 123' described.
T	Public Works SI # 301; Log of Well 66SN at Stump Neck; upper 147' described.

At depths generally greater than 40 to 60 feet, sands and sand and gravel deposits are typically encountered beneath the extensive zones of clay and silty clay discussed above. These deposits of coarse grained sediments are most likely the top of the upper sands found in the Raritan and Patapsco Formation. Where the soil borings are deep enough, these coarse grained materials are encountered in most every instance, and as a general rule they are found beneath extensive deposits of fine grained clay and silty clay.

The upper portions (15 feet or less) of the subsoils encountered in the soil borings are generally of medium density as evidenced from blow counts obtained during soil sampling. In some instances, zones rated "dense" are encountered in this interval. Table 5.3-6 presents the general soil density and stiffness values used for soils, as tabulated by Powers (1982). Generally, the clays in this interval range from medium stiff to very stiff. Below 15 feet, the subsoils are generally dense to very dense as evidenced by blow counts, and the clays are generally stiff to very stiff. In several instances soils of lower density (i.e. "loose" to "medium dense") are encountered in this interval, as are soft to medium stiff clays.

5.3.5.2 Stump Neck Subsoils

At Stump Neck, similar soil conditions are encountered as occur on the main peninsula, although this statement is made on the basis of fewer available soil borings. Generally, sandy clays are interbedded with sand and gravel layers in the upper portions of soil borings. With depth, extensive clay deposits are encountered, interbedded with several sequences of sand or sand and gravel. The granular soils in the upper portion of the

TABLE 5.3-6
SOIL DENSITY FROM STANDARD PENETRATION TEST
(ASTMA D1586) 1

Granular Soils	Cohesive Soils
0-10 Loose	0-4 Soft
10-30 Medium Dense	4-8 Medium Stiff
30-50 Dense	8-15 Stiff
Over 50 Very Dense	15-30 Very Stiff

[1] Blows per foot of a 140-lb. hammer falling 30 in. on a standard split spoon sampler (6).

Source: Powers (1982).

area are of medium density, while the clays range from soft to stiff. Blow counts were not available for the deeper borings and density ratings are therefore not assigned. For the most part, however, it is anticipated that soil conditions with depth at Stump Neck would be very similar to those encountered on the Indian Head peninsula.

5.3.5.3 Soil Permeability Values

One of the most critical soil properties for the purposes of this report is the anticipated soil permeability. Since actual in-place or laboratory permeability tests are not available for the soils encountered in the boring logs, permeability values must be estimated on the basis of the physical soil descriptions which are available.

Freeze and Cherry (1979) present a compilation of permeability values which can be expected for various geologic materials which may be encountered in the subsurface. Similarly, Todd (1980) and Powers (1982) have tabulated permeability values for various subsurface materials. Shown below are the ranges which might be expected for the materials identified at the NOS, on the basis of these references:

Material	Permeability (cm/sec)
Unweathered marine clay	10^{-6} to 10^{-8}
Silty clay	10^{-5} to 10^{-7}
Silt	10^{-4} to 10^{-5}
Clayey Sand	10^{-3} to 10^{-4}
Silty Sand	10^{-2} to 10^{-4}

Material	Permeability (cm/sec)
fine sand	10^{-2} to 10^{-3}
medium sand	10^{-1} to 10^{-2}
wellgraded sand	10^{-1} to 10^{-3}
sand and gravel	10 to 10^{-1}

Generally, the two most important considerations in addition to grain-size for determining the permeability of earthen materials are in-situ density and grain uniformity. All else being equal, the greater the in-place density, and the less uniform the grain-size distribution, the lesser the permeability. Most of the subsurface materials encountered at the site which were ranked as "dense" to "very dense" or stiff" to "very stiff" would be expected to have permeabilities at the lower end of the ranges reported above.

5.3.6 Hydrology

5.3.6.1 Groundwater

As presented earlier in Section 5.3.4, three major sedimentary formations are present at the Indian Head NOS: the Patuxent and Arundel Clay ("Patuxent") Formation, the Raritan and Patapsco Formation, and the surfical Quarternary deposits known as the Columbia Formation. A fourth and lesser formation, the Aquia Greensand, underlies a small portion of the eastern edge of the Stump Neck facility. In the regional context, subsurface water is found in all four geologic formations, and in various locations in Charles County, each formation is being utilized as a source of groundwater.

However, in the Indian Head area, only two of the formations are regarded as viable aquifers capable of supplying useable quantities of groundwater (Otton, 1955; Slaughter and Otton, 1968; AWARE, Inc., 1982). These formations are the Patuxent Formation, and the Raritan and Patapsco Formation. At Indian Head NOS, the sand aquifers developed for use are found in the lower section of the Patapsco and Raritan Formation and the upper section of the Patuxent Formation. Table 5.3-7 summarizes the principal water bearing characteristics of the four geologic formations found at NOS. The crystalline bedrock found beneath the sedimentary formations at Indian Head is not known to be water bearing at any location in Charles County. The hydrogeologic characteristics of each of the formations are discussed below:

- Columbia Deposits

The surficial alluvial deposits found at Indian Head are not considered to be a viable aquifer in the area. Groundwater does occur in surficial lenses which are generally discontinuous in nature. A study by Raney Collector Well Company (as cited by AWARE, Inc., 1982) was performed years ago to determine the feasibility of using the surficial deposits for water supply production at NOS. The conclusion was reached that, due to the mixed lithology of the deposits, dependable water producing zones would be too sporadic. Furthermore, the water bearing zones which were located yielded water of poor quality due to iron and suspended solids content.

TABLE 5.3-7: Waterbearing Properties of the Geologic Formations Found at the NOS

Formation	Thickness at Indian Head	Elevation (MSL) of formation top	Summary of Water-bearing properties
Columbia deposits	0-40'	Land surface elevation	Not considered a viable aquifer at Indian Head. Water is found in the deposits in thin surficial lenses at the NOS; most water bearing zones would be discontinuous and occur as the result of infiltration of local precipitation. In some parts of Charles County, the deposits yield limited quantities of water to large diameter dug or bored wells.
Aquia Greensand	20 ft or less	+80	Small portion of the formation outcrop occurs on the easternmost edge of Stump Neck. Does not yield water to wells west of La Plata and Waldorf. In south-eastern Charles County, the formation thickens and serves as a viable aquifer.
Raritan and Patapsco Formation	200-300 ft.	0 (upper sands) -50 (middle sands) -150 (lower sands)	The principal water bearing formation in western Charles County. Three distinct zones in the formation serve as aquifers - upper sands, middle sands, lower sands. Wells in the area are commonly screened in more than one sand. The lower sands are generally the most productive; they serve as the principal source of groundwater at Indian Head. Wells in the formation as a unit may yield up to 560 gpm.

TABLE 5.3-7: Waterbearing Properties of the Geologic Formations Found at the NOS (CONT)

Formation	Thickness at Indian Head	Elevation (MSL) of formation top	Summary of Water-bearing properties
Patuxent	300 ft.	-250	Major aquifer in western Charles County; wells yield as much as 385 gpm. Sand zones within the formation are laterally discontinuous and at most are only one to two miles in length.

Shallow unconfined groundwater has been encountered in the deposits during subsurface exploration studies at the NOS. In Table 5.3-4 presented in Section 5.3.5 of this report, the foundation boring logs which encountered groundwater are listed. Generally, the depths to groundwater are shallow, ranging from near surface to approximately 20 feet. Typically, this shallow groundwater is found in coarser grained sediments (sands, silty sands, etc.) situated above relatively impervious sediments such as clays, silty clays, silts, etc. Hence, this local groundwater is "perched" above the fine grained sediments found below. This shallow unconfined groundwater originates and is replenished by the infiltration of direct precipitation falling on the area (Slaughter and Otton, 1968).

In lieu of detailed on-site information regarding flow directions of unconfined groundwater, it can generally be assumed to follow the surface topography of the land. Figures 5.3-8 and 5.3-9 depict the topographic divides present on the main peninsula and at the Stump Neck facility. The divide on the main peninsula separates drainage to the Potomac River from that flowing to Mattawoman Creek. Similarly, the divide at the Stump Neck facility separates flow to Mattawoman Creek from that to Chicamuxen Creek. Groundwater present in the surficial deposits would generally be under similar topographic control. In those instances where the coarser grained sediments containing shallow groundwater are sufficiently continuous to permit significant lateral groundwater flow, it can be expected that the shallow groundwater would migrate in the direction dictated by the topographic divides. Hence, on the main peninsula, it is apparent from Figure 5.3-8 that the majority of the NOS drains to Mattawoman Creek, and most shallow groundwater present would have the potential to do likewise. On

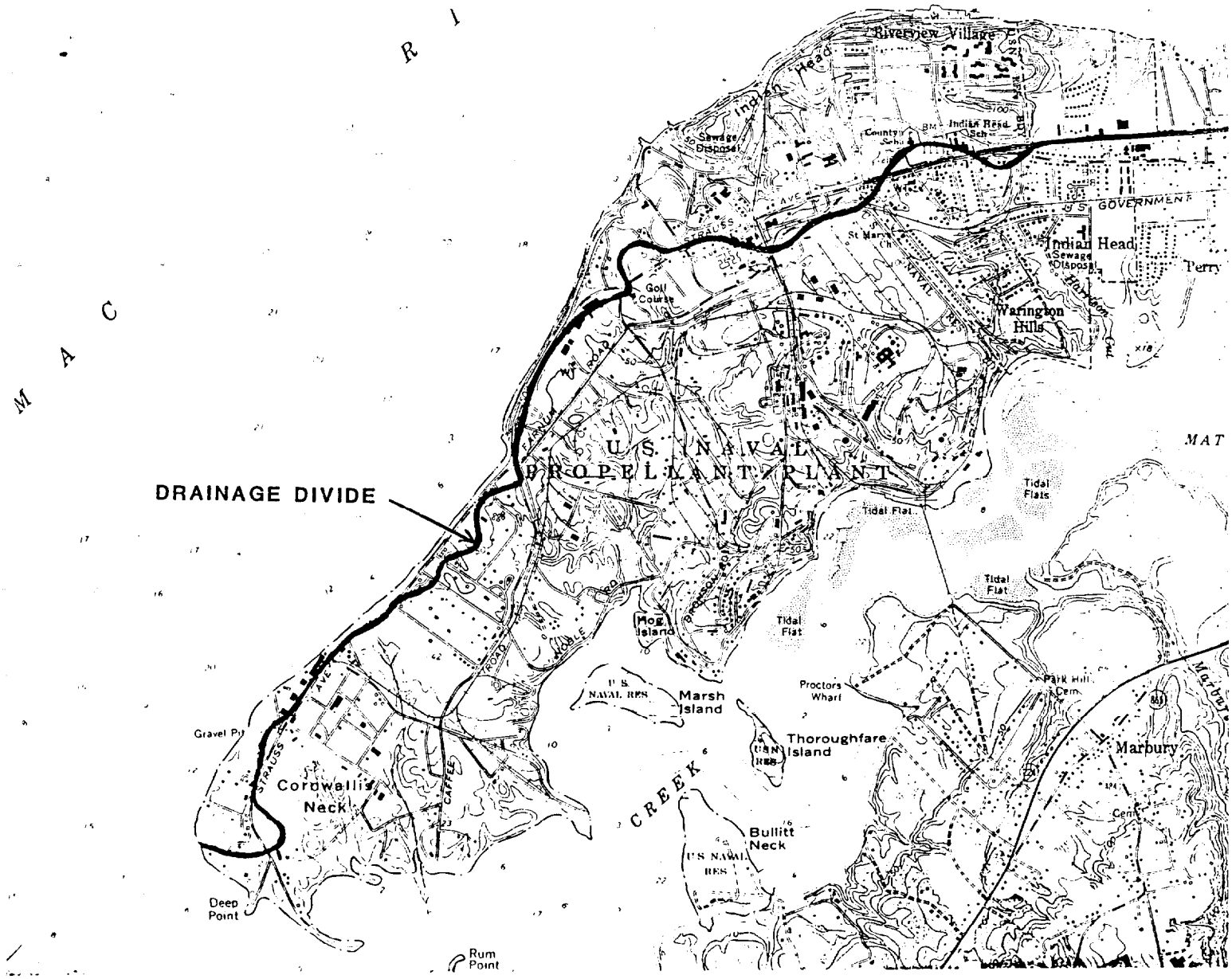

DRAINAGE DIVIDE
U.S. NAVAL PROPELLANT PLANT
Riverview Village
Indian Head
Sewage Disposal
Indian Head Sch
GOVERNMENT
Indian Head
Sewage Disposal
Perry
Warrington Hills
Golf Course
Tidal Flats
Tidal Flat
Tidal Flat
Tidal Flat
Mog Island
Proctors Wharf
Park Hill Cem
Marsh Island
U.S. NAVAL RES
Thoroughfare Island
U.S.N. RES
Marbury
Cem
Bullitt Neck
U.S. NAVAL RES
CREEK
Cornwallis Neck
Gravel Pit
STRAUSS AVE
CAFFEE
Deep Point
Rum Point
MAT

Figure 5.3-8

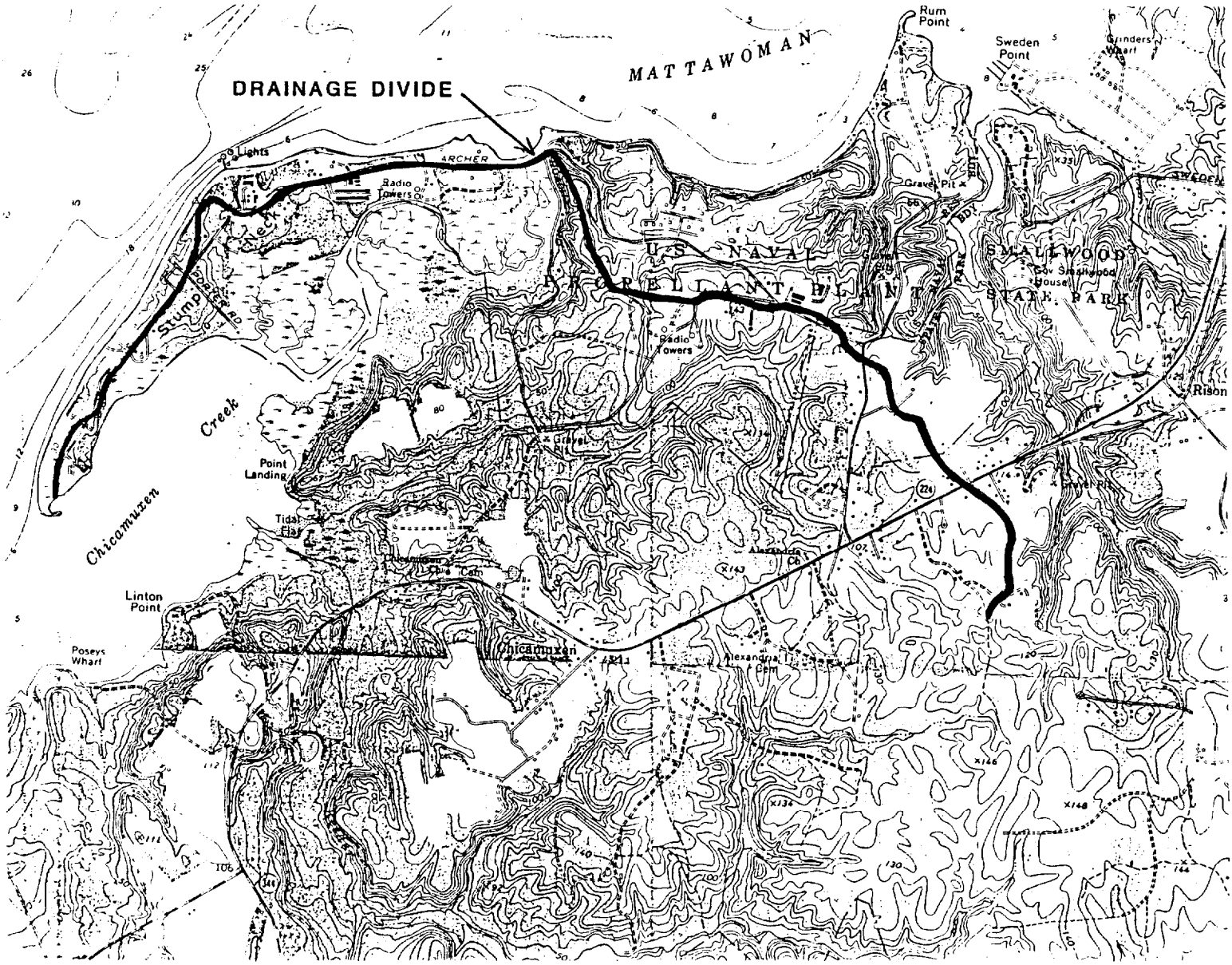


Figure 5.3-9
Drainage Divide on Stump Neck

Stump Neck, as shown on Figure 5.3-9, most of the drainage is to Chicamuxen Creek, except on the northern portion of the naval property where it is approximately evenly divided between Chicamuxen Creek and Mattawoman Creek.

Although the shallow groundwater in the surficial deposits is not considered a viable aquifer (e.g., important from a water use perspective) the potential direction of groundwater flow in the deposits is important from a contaminant migration perspective. The concept of migration potential is discussed in section 5.3.7 of this report.

- Aquia Greensand

The Aquia Greensand Formation outcrops and/or subcrops over a small portion of the eastern margin of the Stump Neck facility. In this area, it is characteristically indistinguishable from the surficial Columbia deposits located directly above or immediately adjacent to the Formation. The portion of the Aquia Greensand Formation which occurs or borders on the Stump Neck naval property would be expected to behave similarly from a hydrogeologic standpoint as do the Columbian alluvial deposits discussed earlier. The Formation generally does not yield useable quantities of groundwater to wells anywhere west of La Plata and Waldorf, MD (Slaugher and Otton, 1968) and in this area, is generally not regarded as an aquifer. The formation thickens to the east, and the medium to fine-grained sands characteristic of this formation become more extensive. These sands are generally scarce in the western portion of the County, and where present, are not very thick. In southeastern Charles County, the Aquia Greensand is regarded as a

favorable aquifer, and yields as much as 250 gpm may be achieved. In the area of concern of this report, however, the outcrop/subcrop deposits of the Aquia Greensand are generally undifferentiated from the Columbian surficial deposits, and may be regarded as one unit where they occur at the Stump Neck facility.

- Raritan and Patapsco Formation

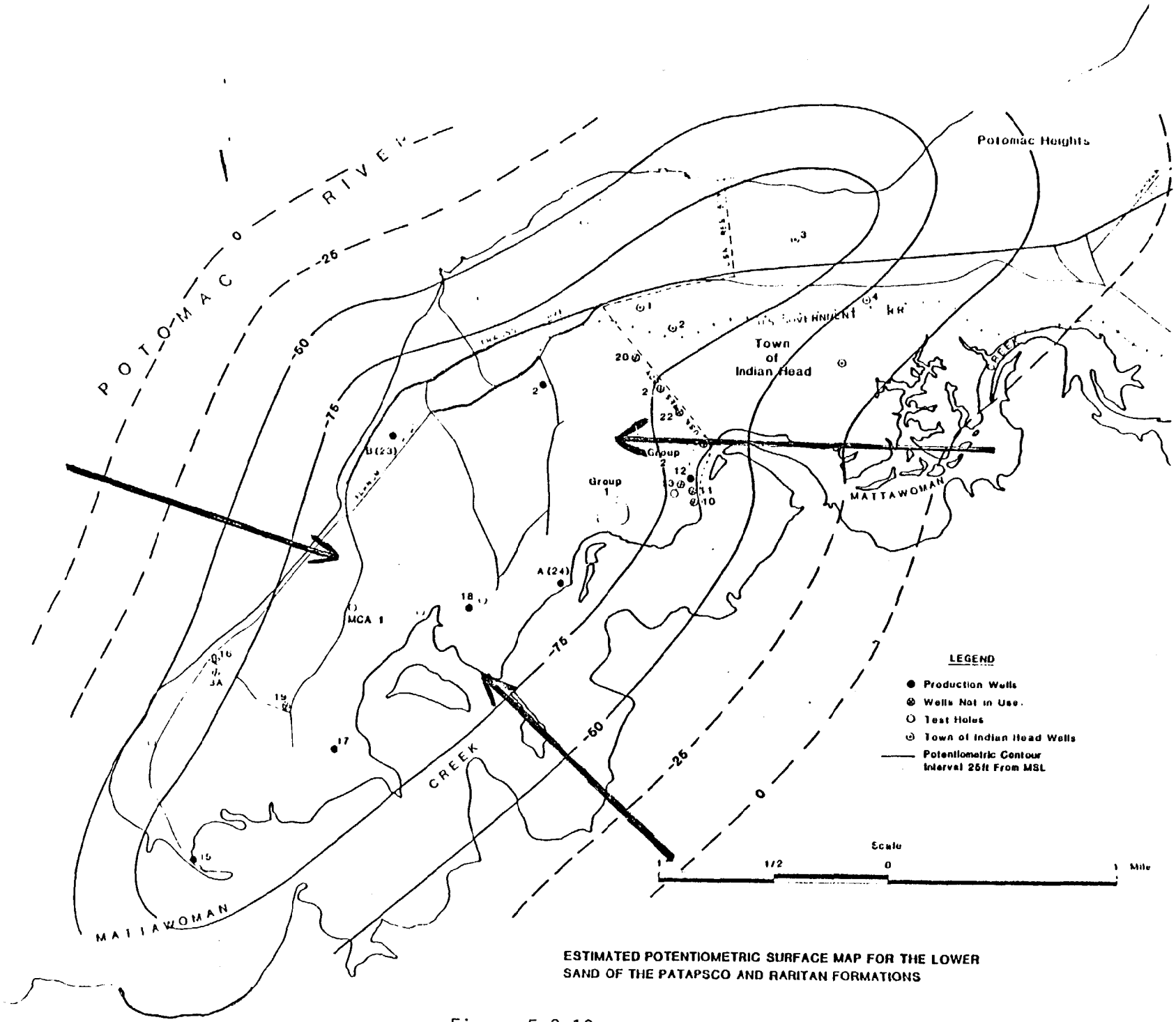
The Raritan and Patapsco Formation is the principal waterbearing formation in Charles County. The Formation contains three principal water-bearing zones, designated the Upper, Middle, and Lower Sands. The Lower Sands are considered the greatest single source of groundwater in the county. Figure 5.3-5 shows the relationship of the Raritan and Patapsco Sands beneath the site. The Upper Sands subcrop and outcrop in the Indian Head area and beneath the Potomac River. The Middle Sands outcrop beneath the Potomac River and across the river in Virgina. The Lower Sands outcrop totally in Virgina. This area is shown in Figure 5.3-5 as the Virginia outcrop area. Water in the Raritan and Patapsco Formation occurs in the area under confined (artesian) conditions, with recharge to the Formation occuring in the areas of outcrop. Water would be expected to rise in wells above the aquifer zones to levels several tens (or even hundreds, in some instances) of feet above the top of the Formation. However, many of the wells in the Indian Head area and in Charles County are screened opposite two or more sands in the Raritan and Patapsco Formation, and in some instances, are also screened in sands of the Patuxent Formation below. Water levels observed in these wells are therefore "composite" levels reflective of artesian pressures over several aquifer zones. It is therefore difficult to construct a potentiometric surface map for the aquifers in the area,

which would delineate the expected artesian pressures for any individual aquifer. There are, however, several wells in the region which are screened only in the Lower Sand Units, as this is the principal aquifer in the area. Six of these wells occur at the NOS. Based on water levels observed for the Lower Sands wells in the area, a potentiometric map has been prepared and reported by AWARE, Inc. (1982). This is shown as Figure 5.3-10. The potentiometric contours show an area of lowered water levels, forming a cone of depression at NOS. The area of influence has been estimated to extend for six miles in a NE-SW direction, and for three miles in a NW-SE direction. The direction of groundwater flow at NOS is also shown on Figure 5.3-10. Because of the cone of depression, flow direction and gradients are "reversed" in the area, with flow from all directions in the area of influence heading towards NOS, as delineated on Figure 5.3-10. Under natural conditions, without the influence of pumping, flow into the area would tend to move south and east, generally down-dip.

Aquifer coefficients for the Patapsco & Raritan Formation have been determined by the USGS. The results indicate a transmissivity value ranging from 270 to 535 ft^2/day, for individual sand units; a transmissivity of 1,070 ft^2/day for the formation as a unit; well yields ranging from 200 to 560 gpm; and specific capacities from 2.2 to 7.1 gpm/ft of drawdown.

- Patuxent Formation

The Patuxent Formation, located below the Patapsco & Raritan Formation, is another principal aquifer in western Charles County. Sand



ESTIMATED POTENTIOMETRIC SURFACE MAP FOR THE LOWER SAND OF THE PATAPSCO AND RARITAN FORMATIONS

Figure 5.3-10

Source: Aware (1982)

zones in the formation are laterally discontinuous, and most are only one to two miles in length. The individual sand units of the Patuxent range from irregularly bounded sheets to isolated ribbons; consequently, aquifer boundaries are complex and generally must be defined locally. (Hansen, 1972). The Formation outcrops in Virginia, as shown on Figure 5.3-5. Recharge to the Formation would occur in the Virginia outcrop.

There are no wells at Indian Head NOS screened solely in the Patapsco Formation (AWARE, Inc. 1982). Where the formation is utilized at NOS, the wells screened in the Patuxent are also screened in the overlying Patapsco and Raritan Formation. In other areas of western Charles County, the Patuxent is utilized without augmentation from the overlying Patapsco and Raritan Formation. Based on these wells in the county, the USGS reports well yields ranging from less than 100 gpm to 385 gpm, and specific capacities ranging from 1.0 to 6.0 gpm/ft. of drawdown (Slaughter and Otton, 1968). Regional transmissivity for the Patuxent is about 405 ft^2/day (Hansen, 1972).

- Groundwater Use

- NOS Wells

The Indian Head NOS is the largest user of grounwater in Charles County. A total of 28 wells have been drilled and completed on the main peninsula of the NOS, while 11 wells have been installed at the Stump Neck facility. Currently, 8 wells are in use on the main peninsula, with 5 additional wells deemed available for use if necessary (AWARE, 1982). At

Stump Neck, 1 well is in use, with 1 additional well kept ready as a back up. The remaining wells at both locations have either been cemented and abandoned, or else are abandoned and left open. Tables 5.3-8 and 5.3-9 summarize the information made available on the wells at the main facility an Stump Neck, while Appendix 5.3-1 contains a compilation of available well logs.

Most heavy well water use occurs on the main peninsula, where the NOS is engaged in manufacturing and process activities. It has been projected that the main peninsula may suffer well water shortages in the near future, and a recent study was commissioned to evaluate alternative water supply measures and water conservation techniques on the main peninsula. The study was recently completed and submitted by the contractor, AWARE, INC. (1982). During this study, the wells on the main peninsula were inventoried and inspected, and those wells which could be made available for use were identified. Figures 5.3-11 and 5.3-12 identify the locations of all wells on the main peninsula. Currently, water supplies on Stump Neck are adequate, and the water supply study did not address concerns at that location.

As noted, all the wells at the NOS are deep wells, completed in the Patapsco and Raritan Sands, or in both the Patapsco and Raritan sands and the underlying Patuxent Formation. Tables 5.3-8 and 5.3-9 identify the well depths and screened intervals (where known) for all wells in use or which can be made available for use. It can be seen from these tables that the wells are screened in relatively deep water bearing formations at the site. No wells are completed in the shallow water bearing zones found in the Quarternary surficial deposits at the site.

Table 5.3-8

Wells Located on the Indian Head NOS

Well	Status	Depth	Screen Interval	Location (grid)	Date Installed	Remarks
1A	abandoned	437	-	-	1952	NCU
1	abandoned	388	-	-	1900(est)	NCU
2	abandoned	-	-	-	1900(est)	NCU
3	abandoned; cemented	-	-	-	1900(est)	Could not be located by AWARE
4	abandoned	-	-	-	1900(est)	NCU
5	abandoned	395	-	-	1910(est)	NCU
6	in use	398	252-259; 301-311; 377-397	P-31	1915	
7	in use	419	255-265; 305-314; 375-396	P-31	1915	
8	abandoned	319	-	-	1900(est)	NCU
9	available for use	390	185-195; 235-245; 284-294; 355-376	P-30	1918	
15A	abandoned; cemented	-	-	-	1900(est)	Could not be located by AWARE
10	abandoned	396	-	-	1930s	NCU
11	abandoned; cemented	409	-	-	1930s	NCU
12	available for use	390	unknown	T-35	1930s	
13	abandoned; cemented	-	-	-	1930s	Could not be located by AWARE
14	available for use	480	unknown	S-36	1930s	Being considered for use
15	in use	280	191-206; 230-234; 240-244; 268-280	H-1	1953	Borehole drilled to 623'
16	available for use	242	85-93; 123-133; 144-152; 221-229; 234-242	C-11	1952	
17	in use	295	259-295	L-11	1954	Borehole drilled to 452'
18	in use	302	208-220; 274-302	N-22	1954	Borehole drilled to 605'
19	"test well*"	400	154-167	H-11	Unknown	Insufficient yield NCU
20	"test well"	542	-	-	1952	Insufficient yield NCU
21	"test well"	450	-	-	1952	Insufficient yield NCU
22	"test well"	258	-	-	1952	Insufficient yield NCU
23(B)	in use	294	240-294	D-27	1957	

Table 5.3-8 (Continued)

Wells Located on the Indian Head NOS

Well	Status	Depth	Screen Interval	Location (grid)	Date Installed	Remarks
24(A)	in use	290	228-239; 269-286	Q-26	1957	
2A (2 new)	in use	380	270-380	I-34	1970	
3A	available for use	232	217-232	D-11	1970	

Notes:

NCU = not considered usable (by AWARE study)

* = USGS uses well 19 as a water level monitoring station

est = estimated

Table 5.3-9

Wells Located at the Stump Neck Area
(as identified by MD Geological Survey)
Data Report #2

Well	Status	Depth	Screen Interval	Location (grid)	Geologic Log	Date Installed	Remarks
b10	not used	610	NA	see map	NA	1945	Naval well 13SN
b11	in use?	414	NA	see map	NA	1945	Naval well 43SN
b12	in use?	441	NA	see map	NA	1944	Naval well 66SN
b13	not used; cemented	443	NA	see map	NA	1944	Naval well 51SN
b14	not used	200+	NA	see map	NA	NA	Naval well 11SN
b24	in use?	580	NA	see map	NA	1958	"Naval Research Lab Well"
b25	not used; cemented	603	NA	see map	NA	1958	Drilled as test hole
b26	not used	600	185-190; 203-208; 225-230, 275-285	see map	NA	1958	
b27	not used; cemented	331	NA	see map	NA	1960	Drilled as test hole
b28	in use?	290	190-200; 230-240; 280-290	see map	NA	1961	
b30	not used	167	NA	see map	NA	"old"	

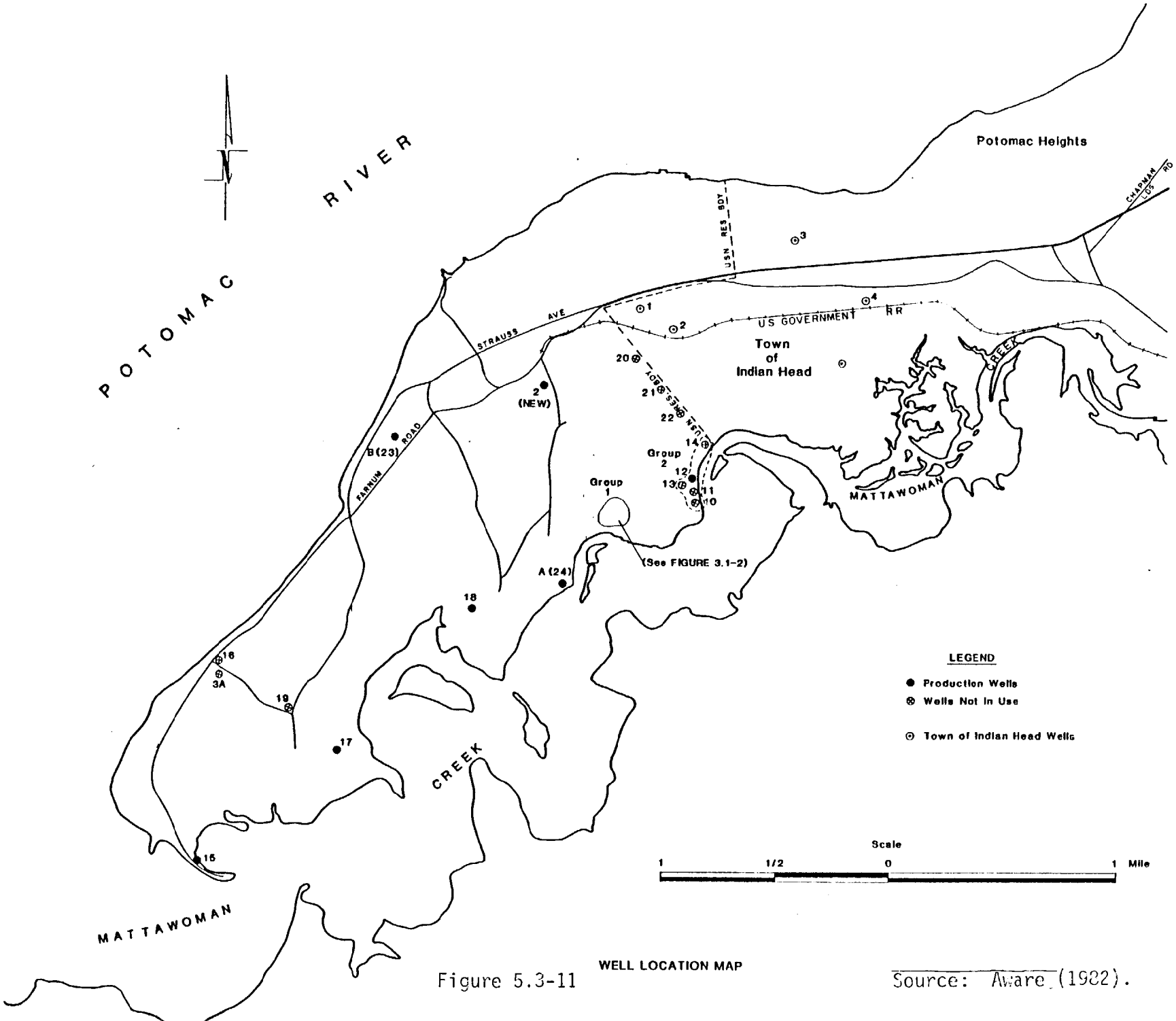
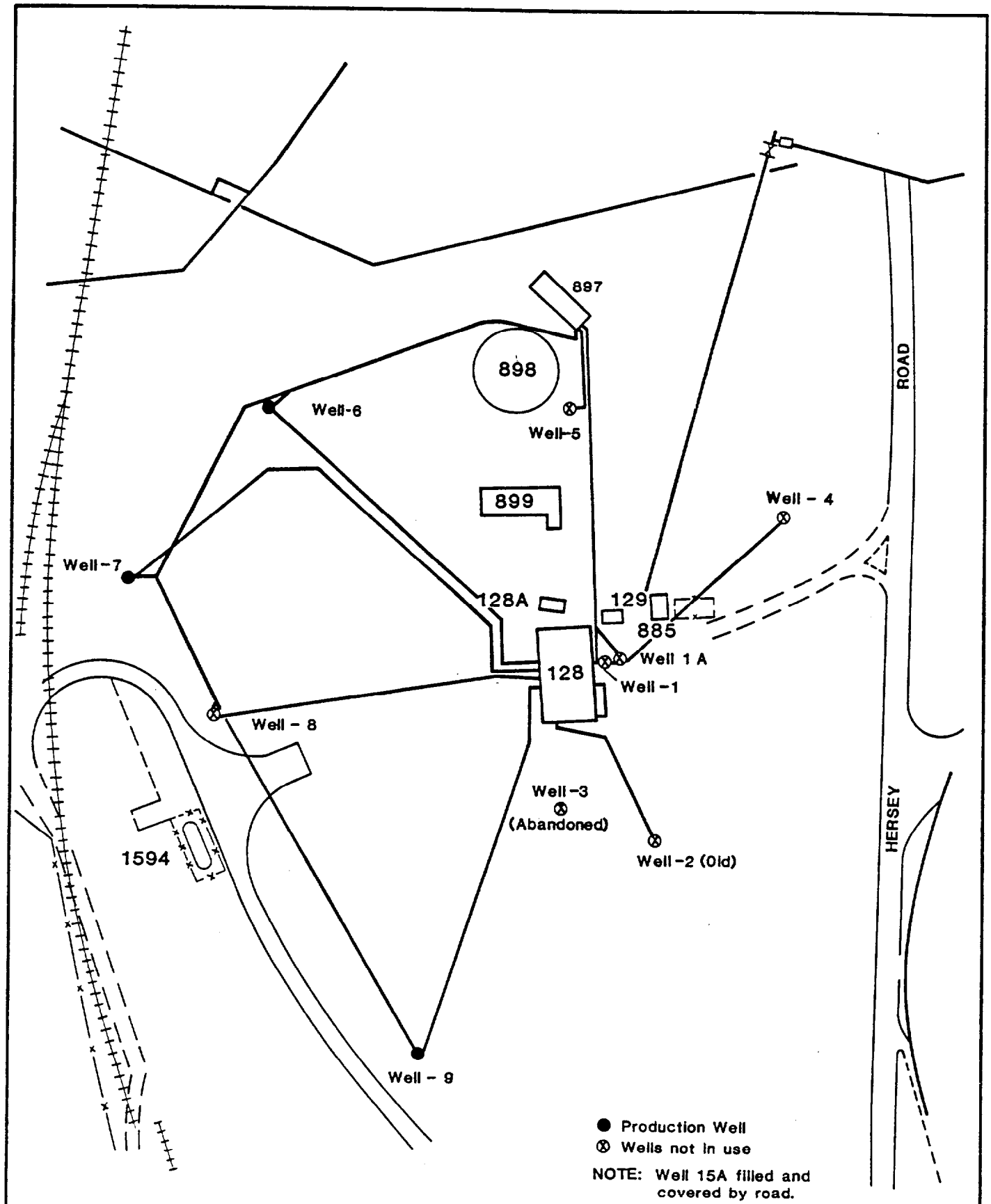


Figure 5.3-11 WELL LOCATION MAP

Source: Aware (1982).



GROUP 1 WELLS

Figure 5.3-12

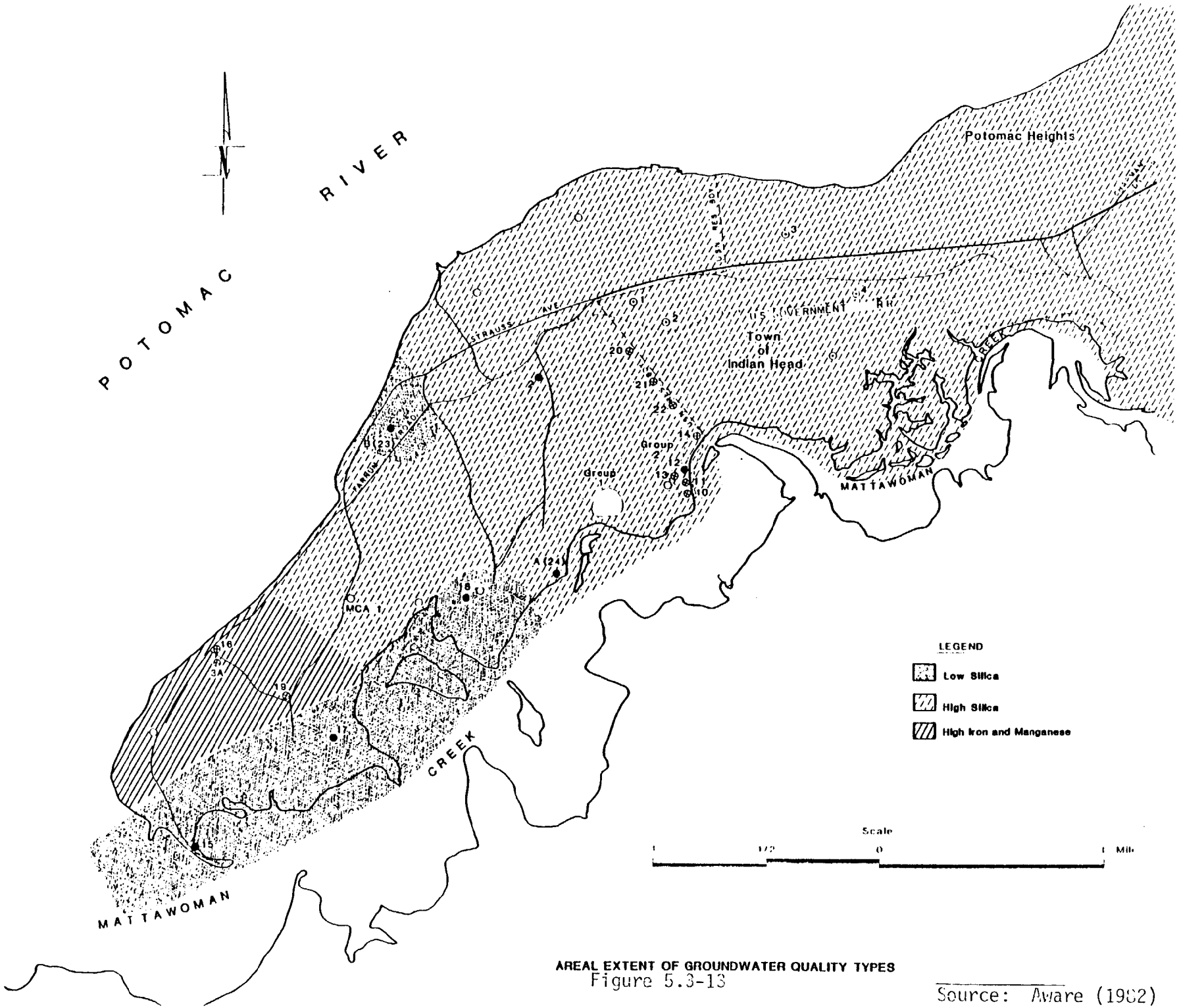
- Water Quality

The wells present on the main peninsula supply two types of well water: high silica and low silica. The low silica water at the site contains approximately 15 mg/l silica, and the high silica contains approximately 30 mg/l silica. Low silica water is obtained from a limited zone in the lower sand unit of the Patapsco/Raritan Formation , and is supplied by wells 23, 15, 17, and 18. High silica water is supplied by the remaining wells at the main peninsula. The low silica water is used to supply the power plant for steam and to backwash resin columns in the production areas. High silica water is used for sanitary purposes and in some production areas. Figure 5.3-13 shows the general areas on the base where high and low silica water supplies are found, and also where wells high in iron and manganese content are found.

As a general indication of groundwater quality at the site, AWARE, INC. (1982) performed an analysis of well 3A for 12 selected parameters. The results for this analysis, and for past chemical analyses for well 3A and 16 are shown in Table 5.3-10. Generally, the water is characterized by high Total Dissolved Solids (TDS) content, and generally high iron and manganese content.

- Off-Site Wells

A records search of domestic wells located in the surrounding area of the NOS was performed at the Charles County Health Department in La Plata, Maryland. The well records are tabulated by computer for the



AREAL EXTENT OF GROUNDWATER QUALITY TYPES
Figure 5.3-13

Source: Aware (1982)

Table 5.3-10

RESULTS OF CHEMICAL ANALYSES OF GROUNDWATER FROM WELLS 3A AND 16

Parameter	Well Number and Sample Date						U.S. EPA Drinking Water Standards
	3A 11/81	3A 1973	3A 1/71	16 5/71	16 1971	16 8/53	
	(Results in mg/l, unless otherwise indicated)						
Fe	4.7	12.9	2.0	23.0	16.0	2.1	0.3
Mn	0.57	-	0.11	0.46	0.36	0.54	0.05
Mg	12	44	8	56	7.8	19	d
Ca	5.8	16	-	62	30	23	d
Na	53	-	-	-	29	47	d
SiO_2	33	30.4	39.9	35	34	32	d
SO_4	10	-	0.5	-	1.8	0.8	250
Bicarbonates	110	-	-	-	-	137	d
Cl	20	146	95	137	61.0	101	250
TDS	430	-	399	410	244	339	500
TSS	3.4	-	18	-	-	-	d
pH[a]	6.7	7.1	7.3	6.9	6.9	6.9	-
Specific Conductance[b]	-	950	-	-	385	536	d
Total Hardness (as $CaCO_3$)	-	60	17	118	120	114	d
Alkalinity	-	218	5	93	200	-	d
Al	-	-	-	-	1.0	0.3	d
K	-	-	-	-	2.4	2.7	d
NO_3	-	-	0.5	-	1.1	0.8	10
PO_4	-	-	-	-	0	0.2	d
F	-	-	0.00	-	0	-	1.4-2.4
Source of Analyses	AWARE	MCA[c]	MCA	MCA	MCA	USGS	

[a]Standard pH units
[b]Micromhos/cm at 25°C
[c]Matz, Childs and Associates
[d]No Standard

Source: Aware (1982)

county by the State Water Resources Administration in Annapolis, Maryland. The computer tabulations maintained by the County include records for all well permits issued up to year 1980. The records are tabulated alphabetically by well owner, and numerically by well permit number. The location of the wells are tabulated according to the closed township to the well. In the surrounding area of the NOS, wells are tabulated for the following nearby townships: Indian Head, Glymont/Potomac Heights, Rison, and Chicamuxen. The total number of wells on file for these townships are as follows:

Indian Head	117 (27 Navy Permits)
Glymont/Potomac Heights	38
Chicamuxen	8
Rison	37
Total	200

It can be seen from this tabulation that 200 registered wells lie within the surrounding area of the NOS. The wells in closest proximity to the NOS operations are those in the Indian Head township, and those in the Chicamuxen and Rison townships.

The majority of wells in the area of interest are deep wells which are artesian. These wells are probably located in the sand units of the Patapsco/Raritan Formation, or in some cases, also within the Patuxent Formation below. However, several shallow wells also found in the area are completed in the sporadically occurring near-surface waterbearing zones. Five shallow wells were identified in the Indian Head township, and two

shallow wells were identified in Rison township. The remaining 193 wells in the area are expected to be deep artesian wells.

The Charles County Health Department has decided to issue no additional permits in the county for shallow wells, as insufficient water yield and marginal water quality are characteristic of the shallow wells in the area. All new wells which are permitted must be completed as deep wells in the aquifers present at depth.

To illustrate the general characteristics of wells in close proximity to the NOS, several tables have bee prepared. In Table 5.3-11, information on selected wells in the Indian Head township is presented. The wells listed included the six municipal wells registered to the Town of Indian Head, and the 5 shallow wells identified in the township.

In Table 5.3-12, information on 6 Chicamuxen area wells for which completion details were available is presented. All these wells are deep artesian wells. In Table 5.3-13, information on 29 select Rison area wells is presented. 26 of these wells are registered to Smallwood State Park, located immediately adjacent to the Stump Neck Naval Facility. These wells are all deep wells. Two shallow wells were identified in the Rison area, and these wells are also included in Table 5.3-13.

The information assembled from the records search of the Charles County Health Department indicates that groundwater use in the Indian Head Study area is extensive. Although the preponderance of groundwater use is limited to the deep artesian aquifers found with depth in the area, there is some use of the shallow, sporadic, water bearing zones found in the

TABLE 5.3-11

Selected Wells in Indian Head Township

Owner	Permit No.	Well Depth	Depth to Water at time of completion	Uppermost Screen Depth From	To
Town of Indian Head	CH700076	527	98	490	500
Indian Head	CH720053	522	102	488	498
Indian Head	CH732329	442	80	372	392
Indian Head	CH732415	410	82	400	410
Indian Head	CH013284	515	149	NA	NA
Indian Head	CH030288	352	141	NA	NA
Shallow Wells					
Balder's Real Estate	CH731109	39	13	38	39
Balder's Real Estate	CH731013	48	22	47	48
Balder's Real Estate	CH731021	41	21	40	41
Brawner	CH710019	30	6	25	30
Stamper	CH730462	52	40	51	52

TABLE 5.3-12

Selected Wells in Chicamuxen Township

Owner	Permit No.	Well Depth	Depth to Water at time of completion	Uppermost Screen Depth From	To
Gilroy	CH732274	180	20	165	180
Groff	CH732217	220	70	215	220
Langley	CH730920	400	60	390	400
Langley	CH732196	398	60	388	398
Millstead	CH731429	320	90	300	320
Millstead	CH731979	180	25	160	180

Source: Charles County Health Department

TABLE 5.3-13

Selected Wells in Rison Township

Owner	Permit No.	Well Depth	Depth to Water at time of completion	Uppermost Screen Depth From	To
Shallow Wells					
Cooksey	CH730436	31	14	30	31
Johnson	CH730335	40	21	39	40
Deep Wells					
Smallwood State Park	CH660045	310	115	NA	NA
Rison Acres Housing Development	26 Wells Registered to Rison Acres	282-482	NA	NA	NA

Source: Charles County Health Department

surficial alluvial deposits covering the area. Seven of the 200 wells identified in townships near the NOS are completed in the upper surficial deposits, and are generally less than 50 feet deep. For ranking purposes, off-site use of groundwater (both shallow and deep) occurs at distances less than 3,000 feet from the NOS.

5.3.6.2 Surface Water

Three principal waterways are located in the immediate vicinity of the Indian Head NOS: the Potomac River, Mattawoman Creek, and Chicamuxen Creek. Mattawoman Creek and the Potomac River border along the main peninsula area of the NOS, while the Stump Neck area is bordered by Mattawoman Creek and Chicamuxen Creek. Both Mattawoman and Chicamuxen Creeks are tributary to the Potomac River. Figures 5.3-8 and 5.3-9 depict the locations of principal waterways in relation to the main peninsula and the Stump Neck area of the NOS. Also shown on these figures are the drainage divides which occur on the main peninsula and at Stump Neck. On the main peninsula, as shown on Figure 5.3-8, the majority of the area drains to Mattawoman Creek, with the remainder draining to the Potomac River. The drainage to the Potomac generally occurs along the western edge of the site. At Stump Neck, most of the drainage is to Chicamuxen Creek, except on the northern portion of the Naval property where the site drainage is approximately evenly divided between Chicamuxen Creek and Mattawoman Creek.

The physical characteristics of the principal waterways adjacent to the NOS are discussed below.

- The Potomac River

The Potomac River is the largest of the waterways in the area. The river originates in the Allegheny Plateau division of the Appalachian Province, and crosses both the Piedmont Province and the Coastal Plain Province before it enters the Chesapeake Bay. The Potomac River drains an area of about 14,680 square miles, and ranks fourth in watershed area of all East Coast rivers (Lippson, et. al. 1979). The portion of the Potomac from Washington, D.C. to Chesapeake Bay is under the influence of tides and salt water intrusion from the bay, and is therefore considered an estuary. The watershed of the estuarine portion of the Potomac River encompasses an area of 2500 square miles.

The US Geological Survey maintains a stream quality station on the Potomac River at the Indian Head NOS. This station is located at river mile 84.5, which is 3.5 miles above the mouth of Mattawoman Creek. The drainage area for this station is 12,160 square miles, and the period of record for the station extends from October 1977 to September 1981. Daily records are maintained for pH, specific conductance, temperature, and dissolved oxygen. For water year 1981, the average values for these parameters are as follows: specific conductance, 958 micromhos/cm; pH 7.7; temperature, 14.7°C; and dissolved oxygen, 10 mg/l. The extremes for these parameters over the period of record are: specific conductance, 116-3,490 micromhos/cm; pH, 6.6-9.4; Temperature, 0.0-33.5°C; and dissolved oxygen, 3.4-15.5 mg/l. These values lend an indication of the variablity which might be expected in the quality of the Potomac River system, and also indicate the brackish nature of the estuary.

Mean yearly discharges of the Potomac River to the Chesapeake Bay are on the order of 14,3000 cfs (10.3 million acre feet per year). This is approximately 21 percent of the total freshwater contribution to the Bay, and the Potomac River is second only to the Susquehanna River, which supplies 52 percent (Lippson, et al, 1979). Upstream flows entering the estuary portion of the Potomac River at Washington, D.C. average 11,180 cfs on a mean annual basis. Therefore, tributary runoff to the Potomac between Washington, D.C. and the Chesapeake Bay accounts for approximately 3,100 cfs of the total discharge (Lippson, et al., 1979).

The state of Maryland has prepared receiving water quality standards for the waters of the state, based upon designated uses of the waters involved. The water use classes recognized by the state are as follows (in increasing levels of stringency):

Class I:	Water Contact Recreation and Aquatic Life
Class II:	Shellfish Harvesting Waters
Class III:	Natural Trout Waters
Class IV:	Recreational Trout Waters.

The Potomac River is classified as both a Class I and a Class II Water. The Class I designation is for all portions of the river upstream from Smith Point (MD) and Simms Point (VA). Below the Simms Point-Smith Point transect, the Potomac River is designated a Class II water. The Simms Point-Smith Point transect is approximately eight river miles downstream from the Indian Head NOS, so therefore the Potomac River is a Class I water adjacent to the NOS. The criteria for Class I Waters are summarized below:

Bacteriological: Mean fecal coliform count of 200 or less per 100 ml, over a 30 day period. Ten percent of the samples in a 30 day period may not exceed 400 per 100 ml.

Dissolved Oxyen: May not be less than 5.0 mg/l

Temperature: Temperatures outside the mixing zone of heat discharges may not exceed 90°F.

pH: The acceptable pH range is 6.5 to 8.5.

Turbidity: Turbidity may not exceed 150 NTU Units at any time, or 50 NTU Units on a monthly average.

Toxic Materials:	PCB's	0.001 micrograms/liter
	Endrin	0.004 micrograms/liter
	Toxaphene	0.005 micrograms/liter
	DDT	0.001 micrograms/liter
	Benzidine	0.1 micrograms/liter
	Aldrin-Dieldrin	0.003 micrograms/liter

The Maryland State Health Department performs monthly sampling of both the Potomac River and Mattawoman Creek in the vicinity of Indian Head. Samples are analyzed for nutrients (phosphorus and nitrogen compounds) coliform bacteria, chlorophyll "A", turbidity, dissolved oxygen, conductivity, pH and temperature. The program has been on-going for several years,

and computer printouts of data assembled to date can be obtained from the Divison of Water Quality with the State Department of Health.

Water from the Potomac River is used at the NOS to charge the fire protection system at the base. River water is also used for some minor infrequent cooling and washdown processes. A recent engineering study evaluated the option of converting existing cooling and washdown processes from well water to Potomac River water, in an effort to conserve process water. The study found such an option to be feasible, and recommendations were made to the NOS regarding such an investment (AWARE, 1982). Currently, the NOS discharges up to 3 million gallons per day of river water from the fire protection lines back to the Potomac River.

- Mattawoman and Chicamuxen Creeks

Both Mattawoman and Chicamuxen Creeks are tributary to the Potomac River. Chicamuxen Creek originates on Stump Neck, and drains a major portion of the NOS property at that location. Much of Chicamuxen Creek, however, is actually an extension or inlet of the Potomac River, and the actual drainage area of the creek is quite small relative to Mattawoman Creek. The total length of the creek is on the order of a mile, and the drainage area is several hundred acres.

Mattawoman Creek is one of the principal drainages in Charles County. The creek contributes approximately 54 cfs of flow to the Potomac River on a mean annual basis (Lippson, et al, 1979). The USGS operates a crest stage gauge on Mattawoman Creek, upstream of the tidal portion of the

Creek. This station is approximately 12.6 miles upstream of the mouth of the creek. The drainage area for the station is 55 square miles, and the total length of stream from the headwaters to the station is about 20 miles. In water year 1981, a peak discharge of 316 cfs was recorded (USGS, 1982).

Both Mattawoman Creek and Chicamuxen Creek are rated as Class I waters by the State of Maryland. The lower reaches of both creeks are subject to tidal action, and are components of the Potomac River estuary system.

- Site Drainage

The majority of natural site drainage on the main peninsula of the NOS is to Mattawoman Creek, with the remainder flowing to the Potomac River. At Stump Neck, the natural drainage is to both Chicamuxen and Mattawoman Creeks. A survey of industrial waste waters at the NOS by base personnel indicates that waste water is discharged to the Potomac River and the two tributaries through 49 identified outfalls. The total flow averages 4,600,000 gallons per day, and the water discharged is from process water, cooling systems, steam generation, building clean-up, fire protection, and office use (NOS, July 1981). An earlier field survey identified 190 discharges on the main peninsula, and 36 discharges at Stump Neck (NOS 1976). These discharges consisted of industrial, sanitary, and storm effluents, or combinations thereof. Table 5.3-14 summarizes the discharges uncovered during that study:

TABLE 5.3-14
SUMMARY OF DISCHARGES

Category	NOS	Stump Neck
Total industrial	84	8
Total sanitary	30	12
Total storm	106	25
Dead/unlocated-dead	32	2
Industrial only	42	3
Sanitary only	7	6
Storm only	59	16
Industrial and sanitary	3	--
Industrial and storm	27	3
Sanitary and storm	8	4
Industrial, sanitary and storm	12	2
Total discharges	190	36

Source: NOS, 1976.

A number of natural drainage channels traverse the main peninsula and Stump Neck Naval land parcels. These drainages flow intermittently, and receive contributions from both industrial and storm water discharges. Some of the larger natural drainage channels which traverse the site may also receive intermittent contributions of shallow groundwater flow from the waterbearing surficial deposits covering the site. This process, however, most likely occurs sporadically, and is topographically controlled.

5.3.7 Summary of Migration Potential

5.3.7.1 Groundwater

At the Indian Head NOS, the water supply wells are completed in deep aquifers which are separated from the land surface by extensive deposits of low permeability fine-grained materials such as clays and silty clays. Although the upper portions of the surficial deposits do contain water, this water is not used as a source of supply at the NOS.

If contaminants were present in any potential waste disposal sites identified at the NOS, the greatest risk of migration to groundwater resources would be to the upper water bearing zones present in the surficial deposits. Since the surficial deposits are not used for water supply at the NOS, the base water supply is not directly jeopardized. The potential contaminants would have to migrate through a number of zones of low-permeability materials several tens of feet thick before entering the water supply zones present beneath the site.

If contaminants were to enter the shallow waterbearing zones present in the surficial deposits, they might be expected to laterally move, under topographic controls towards the nearest downgradient surface water body. In general, the permeability of the water bearing zones in the surficial deposits might be expected to be on the order of 10^{-2} to 10^{-5} cm/sec. On the main peninsula, any potential contaminants which enter the shallow water bearing zones would be expected to migrate (in the majority of instances) towards Mattawoman Creek, in accordance with the topographic divide

present on Figure 5.3-8. West of the divide, contaminants could migrate laterally towards the Potomac River. The total land area on the main peninsula draining towards the Potomac is much smaller than the area draining towards Mattawomen Creek. From a hydraulic perspective, it is strongly supported that Mattawoman Creek and the Potomac River would be the discharge points for any contamination migrating from potential disposal sites to the shallow groundwater on the main peninsula. Both of these water ways (as well as Chicamuxen Creek) are very close to sea level, and therefore are the lowest hydraulic points in the area.

On Stump Neck, the water supply wells are again completed in deep aquifer zones, protected from the downward migration of potential contaminants by thick layers of low-permeability clay and silty clay. Contaminants which might enter the shallow waterbearing zones in the surficial desposits would be expected to move laterally under topographic constraints (as on te main peninsual) towards Chicamuxen and Mattawoman Creeks, in accordance with the topographic divide delineated on Figure 5.3-9. Chicamuxen and Mattawoman Creeks should be the ultimate discharge points for any shallow groundwater flow occurring on Navy Property at Stump Neck.

The potential for contamination of off-site wells is considered to be signficantly less than the potential for contamination of the NOS wells, due to the greater distance of the off-site wells from any potential sources of contamination present on the Naval property. The deep artesian wells located in Chicamuxen and Rison townships are, however, located downgradient of the NOS facility, so, in the remote possiblity of contaminants migrating vertically at the NOS to the aquifer sands of the Raritan and Patapsco

Formation below, it would be hydraulically possible for them to migrate within the formation under the natural hydraulic gradient towards these deep wells. It should be realized further, however, that the pumping of the Naval wells has "reversed" the natural direction of flow in the deeper aquifer creating a core of depression around the base. This has been presented earlier in Figure 5.3-10. Contaminant migration in the deep aquifer under the pumping gradient would therefore not be in the down dip direction, but rather would be towards the NOS wells creating the depression cone. Under this pumping gradient, any potential contamination within the deep aquifer would not be expected to leave the site.

The seven shallow wells located in the off-site area most likely would also not be subject to possible contaminant migration from the NOS, as the hydraulic gradients controlling flow in the shallow waterbearing zones at the NOS should direct this flow towards the three areas of probable discharge, the Potoamc River, Mattawoman Creek, and Chicamuxen Creek. The five shallow wells in Indian Head township, and the two shallow wells in Rison, therefore are most likely located in under different topographic (and assumed hydraulic) control. The influence of each pumping gradients in these wells could negate this contention; however, drawdown in these wells is not expected to be large.

The review of the water supply wells at the NOS revealed that a number of the abandoned wells have not been cemented or filled, and are therefore standing open. A recommendation was made by Aware, Inc. (1982) in their study that all the wells which they identified as nonusable be properly cemented and capped. A concurrence is reached in this IAS that the

nonusable wells be cemented and capped as quickly as possible. Improperly sealed or open wells and boreholes are a common conduit to groundwater contamination, as potential contaminants have a direct and easy access to deeper waterbearing zones. Open boreholes and wells also encourage accidental or purposeful introduction of foreign substances and liquids. It is recommended that NOS personnel inspect all the nonusable wells at the main peninsula and at Stump Neck to ensure that all wells which are thought to be cemented are actually cemented properly, and that all wells which are standing open are properly sealed as quickly as possible.

5.3.7.2 Surface Water

The potential for migration of contaminants to surface waters in the area is directly related to hydraulic connection between the shallow groundwater zones and the surface drainages adjacent to the NOS. Mattawoman Creek, Chicamuxen Creek, and the Potomac River are all approximately at sea level in the area, and are therefore also probable hydraulic discharge points for unconfined groundwater present in the surficial deposits. If contaminants were to enter the shallow groundwater system encountered at the site, it is highly suspect that they would discharge to these waterways.

Contaminants can also enter the surface drainages as a result of overland flow occurring on the property, and any substances present on impermeable surfaces such as parking areas, storage pads, aprons, etc. could be washed directly to the receiving waterways. Mean annual runoff in the area is as high as 16 inches (USGS, 1976) and sufficient water would be available to transport these potential contaminants via open drainage channels and storm drains.

5.4 BIOLOGICAL FEATURES

5.4.1 Regional Ecosystem

Indian Head is located within the Eastern Deciduous Forest Biome in which oak-hickory hardwood is the climax forest type. There are 314 acres of marshland and tidal flats at the installation, providing productive ecological habitat.

Indian Head is also located approximately 75 nautical miles from the mouth of the Potomac River at which point the Potomac flows into Chesapeake Bay. The Potomac River estuary is the longest and broadest of the estuaries flowing into the Chesapeake Bay, extending 113 statute miles from Little Falls, Maryland to its confluence with the Bay. It has basically three salinity zones: tidal fresh (with salinity ranging from 0-0.5 ppt), oligohaline (0.5-5.0 ppt) and mesohaline (5.0-18.0 ppt). The zone upriver of Indian Head is characterized as tidal fresh. The region from Indian Head to Colonial Beach, Virginia varies seasonally with salinity levels generally rising during the period of low flow in the fall. At this time the waters can be described as transitional between tidal fresh and oligohaline.

5.4.2 Flora

The terrain at the station spans a range of moisture regimes, from wet bottomlands to dry uplands, supporting a series of distinctive vegetative communities. The dry upland areas are characterized by old growth

Virginia (or scrub) pine and upland oaks; almost pure stands of chestnut oak have been identified in some areas. Dense thickets of mountain laurel and shrubs form the ground cover. In the mesic areas of the installation, yellow poplar and white oak predominate, as well as, in some instances, sweetgum. Dogwood, blackgum, red maple and holly comprise the understory. In the moist bottomlands, American sycamore, green ash, American elm and sweetgum are present, with a shrub layer of spicebush, mayapple, viburnum and ferns.

Open field and shrub communities cover an estimated 1,756 acres at NOS, or 53 percent of the total land area. Loblolly pine, Virgina pine, sweetgum, red cedar and black locust are typical of shrub communities, along with Japanese honeysuckle, persimmon, brambles, poison ivy, trumpet creeper, Virginia creeper, sumac, grapes, asters, goldenrod, wild onion, strawberries and blackberries.

The station's coastline is steep along the Potomac River, with clear evidence of erosion exacerbated by certain base activities, subsurface seepage, wave action, and bank sloughing. In addition, some drainage pipes outlet directly onto the slopes. There are infrequent narrow beaches around the periphery of Indian Head and Stump Neck vegetated with black locust, persimmon, false indigo, poison ivy, sea myrtle, grape and Virginia creeper; also present may be phlox, gama grass, panic grass, bermuda grass or finger grass.

In contrast to the Potomac River shoreline, the Mattawoman Creek coasts are buffered by marshes and characterized by jewelweed, alder, marsh

elder, bottombush, sea myrtle and sumac. Tidal wetland plants may include cattail, weedgrass, sedge, three square bulrush, wild rice, saltmarsh cordgrass, smartweed, and marsh mallow.

5.4.2.1 Forest Resources

A forest inventory conducted in 1981 by CHESDIV Natural Resources personnel identified 1106 acres of hardwood forest, 76 acres of pine forest and 25 acres of pine-hardwood forest. The canopy, which represents the climax forest type for this area, consists of white and red oak and hickory. The understory typically includes sweetgum, American holly and flowering dogwood. Shrub and groundcover may include oak, Virgina creeper, strawberry brush, highbush blueberry, partridge berry and ground pine.

The pine forest is a transitional forest type, indicative of past disturbance. Loblolly and Virginia pine form the canopy; older pine stands may also have an understory of white and red oaks, hickory, blackgum and sweetgum. Ground vegetation typically includes Japanese honeysuckle, trumpet creeper, poison ivy, Virginia creeper, highbush blueberry, flowering spurge and spotted wintergreen.

The pine-hardwood forest type contains loblolly and Virginia pine, yellow poplar (tuliptree) and white oak in its upper layer, with white oak, black gum, sweetgum, red maple and American holly below.

In summary, of the 1207 forested acres at the station, 92 percent are characterized as hardwood, 6 percent as pine and 2 percent as pine-

hardwood. The majority of forest stands (96 percent) contained predominantly older stock (having a diameter breast height (dbh) of 11 inches and greater). All of the forest acreage classified as poletimber (with a majority of trees having a dbh of 6 to 10 inches) was identified as pine, and occupied approximately 53 acres. The area of concern which was highlighted by the survey is: absence of significant seedling/sapling populations in any of the forest types. This is attributed to overgrazing by the large deer population.

5.4.2.2 Forest Management

An even-aged stand of loblolly pine (aged 15 to 17 years) is located south of Farnum Road and west of Benson Road which aligns the property boundary. A Timber Stand Improvement Program was initiated here to enhance growth. Currently, a station-wide Forest Management Plan is being drafted. Its purpose will be the development of sound forestry practices to maintain a vigorous forest and eventually to establish sustained yield timber management on the station.

5.4.2.3 Food Plots

There are eight food plots on the Main Station and four on Stump Neck. Browse consists of millet, grain sorghum, and winter wheat. At four of the locations on the main site (B7, I15-I16, J-K22, and J23-J24), sewage sludge from the secondary treatment plant is applied and disked into the soil from late fall through early spring. No land application of sewage sludge takes place on Stump Neck.

5.4.3 Terrestrial Fauna

5.4.3.1 Mammals

The white-tailed deer population at the Station has increased to excessive levels over the past decade. It has been estimated that there are currently 100 (±25) fawns and 250 (±25) adult deer on the main site. Deer were reintroduced to this area from Edgewood Arsenal at the end of World War II, and were first observed on the Station in 1953. Their numbers have increased dramatically over the past several years, due both to the absence of natural predators (wolf, bobcat, black bear) and to the protected status of deer at NOS, given that the Station's mission, which involves production and storage of explosive ordnance, precludes hunting in all but one small area of the Station. Hunting by military and civilian personnel based at the station is permitted in a 400 acre area on Rum Point.

In 1980, NOS, U.S. Fish and Wildlife Service and Maryland Wildlife Administration personnel signed a cooperative agreement to initiate a controlled hunting program at NOS with disposition as follows: contribution to needy families, institutions, zoological parks or disposal by burying at an approved facility. This controlled hunting program was inactivated in November 1981 after it was determined that further analysis of the problem was warranted.

In light of this decision, the Southeastern Cooperative Wildlife Disease Study division of the Department of Parasitology, College of Veterinary Medicine, University of Georgia, conducted a herd health check on the

NOS deer population on April 21, 1982 based on necropsies of five adult deer. A major discovery was lungworm pneumonia which was detected in 100 percent of the deer, due to the large lungworm, Dictyocaulus viviparus. This lungworm was present at moderately high levels in all of the deer and was associated with lung damage (bronchitis, peribronchitis, pulmonary consolidation) in three of the five deer. According to the center, losses to lungworm pneumonia usually are of a sustained covert nature and may go unnoticed until the problem becomes very severe. Fawns and yearlings are most vulnerable and mortality may be highest in winter and early spring. The center suggested that the lungworm count would be much higher in late summer/early fall, and recommended retesting at that time.

The center also indicated that the herd is vulnerable to hemorrhagic disease and that at least one of the causative viruses (epizootic hemorrhagic disease) was previously active in the herd. In addition, tick infestations were relatively severe and associated with chronic skin lesions in three deer. Based on these and other test findings, the center concluded that there is a good likelihood that the deer population exceeds the habitat carrying capacity; the herd is experiencing parasitism problems with verminous pneumonia due to Dictyocaulus viviparus and heavy tick infestations; and evidence suggests that the majority of the animals are apparently fully susceptible to infection by EHD virus. To avoid excessive malnutrition and heavy parasitism in the near future, the center recommended that herd growth be stopped and consideration be given to herd reduction.

In addition, an on-site field survey conducted in March 1982 by the Regional Forester (Maryland Forest and Park Services), with the Project

Forester for Charles County and the Base Forester revealed significant deer browsing, which was severe in some areas. The Regional Forester concluded that any attempts at afforestation or reforestation with softwoods would be wasted unless intensive management of the deer herd is initiated. Trees would be stunted, deformed or killed under present circumstances. It was also observed that, since older plantations do not exhibit high mortality rates, it is likely that the substantial population increase occurred over the last ten years. The 1980 NOS Wildlife Management Plan predicts that, unless some population control measures are initiated, a rapid decline in the deer population is imminent, with the survivors remaining in poor physical condition.

Other mammals known to be commonly present in the vicinity of the station are listed in Appendix 5.4-1.

5.4.3.2 Birds

A significant variety of birds have been identified in Charles County. See Appendix 5.4-2 for a listing of the bird species recorded in this area.

5.4.3.3 Reptiles and Amphibians

Common species of reptiles and amphibians in the Charles County area are listed in Appendix 5.4-3.

5.4.4 Aquatic Ecosystem

5.4.4.1 Fish

The portion of the Potomac River which is adjacent to NOS is part of a spawning and nursery area for striped bass, white perch, herrings and shad. It is also within a major spawning and nursery area for forage species--bay anchovies and three species of silversides. It is the upstream limit of the nursery area for estuarine-dependent species (Atlantic menhaden, Spot, Atlantic croaker) which spawn in the Atlantic Ocean. Mattawoman Creek and Chicamuxen Creek adjacent to NOS are spawning areas for alewife, blueback herring, white and yellow perch and gizzard shad.

In 1914, a pollution report was issued by W.W. Welsh, Scientific Assistant, Bureau of Fisheries on an alleged fish kill in June of that year during a period of low flow in the Mattawoman Creek. During a site inspection, Mr. Welsh observed two sources of discharge from the now inactive acid plant: a large concrete drain pipe and a dissolving pile of salt cake near the shoreline. The salt pile looked "like dirty melting snow" and stood "in a row of irregular piles, about 100 yards in length, slowly disintegrating under the influence of rain and weather. Several sprinklers are used to assist in the disintegration. From under these piles come little rivulets, strongly acid." The scientist described the salt cake as a mixture of sodium sulphate and sulfuric acid. No vegetation or evidence of aquatic life was observed along the drainage path to the channel.

The scientist ran a series of toxicity experiments on live fish using surface water samples collected from the vicinity of the salt pile and varying concentrations of the sample. It was concluded that the drainage from the outlet and salt pile proved highly injurious to fish; water samples collected from points 1.5 miles downstream and .75 mile upstream of the point of pollution proved fatal to fish within 24 hours. Mr. Welsh concluded that the June fish kill was probably attributable to the low water level, which stranded numbers of fish, subjecting some to the highly acidic concentrations of water in the channel.

The sodium sulphate "salt cake" piles resulted from the manufacture of nitric acid by the retort process, which was in operation from 1912 to 1957. Evidently, the salt cake had commercial value as a substitute for sulfuric acid in pickling metal and as an insecticide for mosquito control, and there is proof that attempts were made to sell the material (the report stated that "a large amount of salt cake had recently been allowed to accumulate with the idea of selling it, but the sale fell through," and several requests for the material were discovered in the station files at the Federal Records Center and National Archives); however, no solid evidence was found to substantiate that any major transaction was actually finalized.

Correspondence from the Commander of the U.S. Navy to a potential buyer (International Nickel Company of Copper Cliff, Ontario, Canada) indicated that, in 1931, the Naval Powder Factory was producing excess nitre cake at a rate of 1,100 tons per year. The product was in large lumps, containing an average of 30.38 percent free sulfuric acid. No record of a sale at this time was documented. From January 1st through July 1, 1932, it was recorded

that 600 tons of nitre cake was put "up for sale to civilians." Again, no record of sale was made. In 1935, correspondence from the Inspector of Ordnance in Charge to the Bureau of the Ordnance reported a monthly generation rate of 100 tons of nitre cake during production of smokeless powder. This nitre cake was flushed directly into Mattawoman Creek. In 1936, it was reported that nitre cake was being produced at a rate of 240 tons per month and that some small sales were transacted with the Washington Navy Yard but almost all of the material was dumped. Further discussion of this source of potential contamination is contained in Section 6.6.

5.4.5 Endangered and Threatened Species

The Endangered Species Act of 1973 required Federal agencies to carry out programs for the conservation of nationally listed endangered and threatened species and to ensure that actions do not jeopardize the existence of such species.

The only species identified on NOS that is designated as endangered or threatened by federal or state authorities is the Rainbow Snake (Farancia erytrogramma erytrogramma). According to the Maryland Department of Natural Resources Natural Heritage Program, one male and two female Rainbow Snakes were collected in July 1937 during road building operations on Stump Neck. The females were discovered at the head of Chicamuxen Creek and the male was found 200 yards from the tip of Stump Neck. The Rainbow Snake is identified on Maryland's list of threatened and endangered species. The federally listed endangered Southern Bald Eagle (Haliaeetus leucocephalus leucocephalus) is indigenous to Charles County and may be an infrequent

visitor to NOS. In addition, the Potomac River is potential habitat for the Shortnose Sturgeon (Acepenser brevirostris) and a number of sea turtles, all of which are federally listed. No endangered or threatened plant species have actually been identified at NOS; however, the lotus, Nelumbo lutea, is found at its only Maryland location approximately 1.5 miles upstream at Mattawoman Creek.

5.5 LEGAL ACTIONS

On August 24, 1978, the Chesapeake Bay Foundation, Inc. (CBF) petitioned USEPA Region III to convene an adjudicatory hearing on the application of the NOS for a NPDES permit (EPA: MD0003158), pursuant to 40 CFR Part 125.34. The purpose of the hearing was to acquire additional information concerning the pollutants discharged at NOS, concentration effects on receiving waters, designated mixing zones, the rationale for and expected effects of changes made in the proposed permit, and commitment to a monitoring schedule as had been proposed as a condition to the NOS permit.

On September 15, 1978, USEPA issued NPDES Permit MD0003158 for NOS and the State of Maryland tentatively certified the NPDES permit on November 24, 1978.

On February 2, 1979, USEPA's Administrative Law Judge notified all parties of a prehearing conference scheduled for April 4, 1979, at which time all unresolved issues would be discussed. In addition to procedural questions, e.g., State responsibility in administering NPDES permitting; public disclosure of required information (preparation of Fact Sheets for

dissemination); and appropriate application of treatment guidelines, there were several issues raised that were of a technical nature. Evidently, determination of pollutants in the industrial discharges was based on limited grab samples collected in October and November 1977. Analysis of these samples had indicated the presence of phenol, cyanide, arsenic, cadmium, chromium, copper, lead and mercury at some of the outfalls. CBF maintained that all identified pollutants should be limited by the permit and that a compliance schedule for industrial wastewater treatment to meet applicable BPT standards should be instituted. The toxics listed above had not been mentioned in the study which was required for the NPDES permit and the State certification. It was also established that there are no applicable federal effluent guidelines for NOS' industrial processes; effluent limitations in the NPDES permit must be based solely on best engineering judgment.

CBF alleged that toxics contained in the industrial discharges were not covered by the permit. The presiding officer conceded that while analyses did indicate the presence of toxics, the sampling methodology was considered inadequate. Part I-B.1.a. of the permit required that an analytical study for toxic substances be designed and conducted by the facility on all undiluted waste streams; the results of the study were to be made available to EPA by the permit expiration date.

CBF questioned whether monitoring requirements contained in the permit would be adequate to identify and quantify substances known to have been in the discharge. The presiding officer responded that the purpose of monitoring requirements was to determine compliance with effluent limitations, not to characterize the waste stream.

CBF also questioned whether Federal and industrial facilities are treated similarly in enforcement of NPDES regulations. It was reported that the NOS compliance process was progressing slower than comparable industrial compliance processes; no action toward planning, design and construction of required treatment facilities at NOS would be initiated until completion of a pollution abatement study, whose completion date was to be six months prior to permit expiration, or June 30, 1981. (NOS subsequently corrected this report, stating that treatment alternatives were already being evaluated and progress was being made toward revising and finalizing the monitoring program.)

In addition, CBF alleged that NOS had at least three discharges which violated thermal limits established by Maryland water quality standards (Outfalls 001, 010 and 053). Outfall 053 discharged 2,966 gallons daily at a temperature of 191°F (88.5°C). This discharge was steam condensate. It was determined that a finding of violation would depend upon flow rates/mixing zones, to be addressed in the study required by the permit and State certification.

Fact Sheets were to have been prepared for any outfall discharging in exceedence of 500,000 gallons per day (i.e., Outfalls 006 and 030) and made available to the public prior to permit issuance. The USEPA Region III submitted these Fact Sheets at the prehearing conference and recommended that CBF be permitted adequate time for comment.

Subsequent to the prehearing conference, on May 4, 1979, CBF submitted an analysis of the Fact Sheets for Outfalls 006 and 030. In the

submission, it made a Motion to Raise Additional Issues Arising Therefrom, contending that the Fact Sheets were legally insufficient according to 40 CFR 125.33 and requesting that all apparent inadequacies be discussed fully at the hearing.

On May 16, 1979, the Department of the Navy Chesapeake Division Naval Facilities Engineering Command (CHESDIV NAVFACENGCOM) submitted to CBF the finalized monitoring plan which included additional parameters recommended by CBF. CHESDIV NAVFACENGCOM also enclosed a list of parameters to be applied at specific outfalls including rationale for exclusion of some of the parameters at some of the outfalls.

NOS and CBF were able to resolve issues raised at the prehearing conference and CBF subsequently withdrew its Motion to Raise Additional Issues. On June 28, 1979, CBF verified that all issues with respect to the administrative hearing had been resolved. The adjudicatory hearing was dismissed by Order of the Administrative Law Judge on July 24, 1979.

SECTION 6

ACTIVITY FINDINGS

6.1 GENERAL

This section provides a description of operations at Naval Ordnance Station, Indian Head which utilize hazardous materials and/or generate hazardous waste products. The following will be discussed: ordnance operations including the organic chemical plant, nitroglycerin plants, double-base propellant manufacture, multibase plant, Polaris plant, ballistic test areas, cast plant, single-base manufacture, nitrocellulose production, sulfuric and nitric acid production, pilot plant operations, ranges and impact zones, and ordnance disposal; non-ordnance operations encompassing the public works department; and, radiological operations including a thorium spill and the EOD technology center. Materials storage and waste disposal sites are also discussed. Information included in this chapter provides the background and documentation to support sections 2, 3, and 4.

In addition to describing the various operations, wastes generated by each operation are identified. Periods of operation and quantities of materials disposed of are described in as great a detail as was possible to identify. Where a lack of historical information regarding past generation rates existed, best engineering judgement was applied where possible to provide a rough estimate of generation rates. Generally, it can be inferred that the order of magnitude of past generation rates approximates current rates.

6.2 ORDNANCE OPERATIONS

The present ordnance mission of NOS, Indian Head is as follows:

"To provide material and technical support for assigned weapons systems, weapons or components, and perform additional tasks as directed by the Commander, Navy Ordnance Systems Command."

Since its inception, NOS has participated in the production of a variety of ordnance materials including the following:

nitric acid	research and development
sulfuric acid	of propellants, chemicals,
nitrocellulose	and explosives
nitroglycerine	Explosive D
single base propellant	Composition D2
double-base propellant	nitroguanidine
triple-base propellant	DNPOH
cast propellants	BDNPA/F
extruded propellant	mercury fulminate
UDMH	KI test paper
DMAN	caustic recovery
TMETN	Sodium nitrate
nitroform and derivatives	shock-gel powder

Past and current ordnance operations with the potential to generate toxic wastes are discussed in the following sections.

6.2.1 Current Operations

At present, types of ordnance items on the station include:

- propellants (single, double and triple based; composite; and high energy)

- explosives (HMX, TNT, RDX, HNS, TATB)

- pyrotechnics

6.2.1.1 Magazines

As of January 1976, total square footage of the 142 magazines at NOS was approximately 207,823 square feet. Total combined storage capacity in the magazines is approximately 3,373,936 cubic feet. The Public Works Department is responsible for maintaining the magazines.

The last major incident involving magazine storage occurred in 1961. During that year 3 magazine explosions occurred, leading to subsequent major changes in storage practices.

6.2.1.2 Organic Chemical Plant

The organic chemical plant (Building 497) is utilized for the large-scale manufacture of chemicals and explosives for use in weapons. Established originally to produce Explosive "D" (ammonium picrate), this facility was also used to manufacture a number of other materials. These included: nitroguanidine, composition D-2, dinitropropanol, dinitropropal, acetyl/formal, plasisol nitrocellulose, dimethyl ammonium nitrate, dimethyl nitramine, unsymmetrical dimethylhydrazine, and high bulk nitroguanidine.

Wash waters containing quantities of liquid and solid raw materials, products, and by-products, were typically neutralized and then passed through a catch tank. The catch tank was emptied periodically and the contents taken to the current burning ground. The Caffee Road landfill was also used in the early 1950's. The waste streams may possibly have contained trace quantities of nitrates, sulfates, nitric esters, nitrocellulose, nitromethane, phenol, picric acid, wax, silver salts, nitropropane, acetyl, formal, dimethylamine, dimethyl ammonium nitrate, palladium catalyst, acetic acid, caustic, ammonia, UDMH, or nitroguanidine.

Currently, the sole operation is high bulk nitroguanidine recrystallization. Nitroguanidine is dissolved in a methylcellulose/water solution and recrystallized to form high bulk nitroguanidine. These crystals are washed, centrifuged, and sent to building 498 for pulverizing.

6.2.1.3 Nitroglycerin Plant Operations

There have been 4 nitroglycerin plants at Indian Head. The original batch plant was installed in the Pilot Plant around 1950. This plant was destroyed in 1971 and replaced with a Moser plant (Building 1543). A Nitro Nobel Plant, built in 1969, was never used. The current Biazzi Plant (Building 786 area) (SITES 17, 18, 21) was completed in 1953.

The Biazzi nitroglycerin plant, provides NG for the multi-base, Polaris, and cast plants. NG is made by the nitration of glycerin and a mixed acid of sulfuric and nitric. Airborne NG is toxic through skin absorption and is continuously monitored by safety and health personnel. The

spent waste stream, which contains about 1400 ppm NG, is neutralized and dispersed in the streams through an open ditch. There have been several spills and explosions resulting in spills over the last 30 years. In all cases the spills were treated and neutralized with caustic. In some instances the suspect area was shocked with explosives to render the area safe.

6.2.1.4 Production of Solventless Double-base Propellant

Solventless double-base propellant has been produced at NOS since 1943 by extruding carpet roll. This operation, carried out in Building 526, produces up to a maximum of 100,000 lbs/month. This propellant contains nitrocellulose, nitroglycerine, plasticizers and ballistic modifiers. After extrusion, the resulting rocket grains were annealed and finished. The finishing process includes machining the grains to the desired diameter and application of inhibitors on the external surfaces. Materials involved in these processes are nitroglycerin, aromatic plasticizers, and metallic ballistic modifiers including lead. Process equipment is washed down and solids are collected via catch tanks or other means. The solid waste is typically taken to the burn area and incinerated. Lead residue from these materials has been detected in soils at the burn area.

6.2.1.5 Polaris High Energy Plant

This facility (Building 1024) was established for the manufacture of high energy casting powder for Polaris rocket motors. Present production capacity is approximately 350,000 lbs/month. Waste water streams from washdown operations contains acetone, alcohol, ammonium picrate, nitrogly-

cerin and HMX in limited quantities. Process operations also generate approximately 5000 lbs./yr of scrap which is sent to the burn area.

6.2.1.6 Multibase Plant

The multibase plant (Building 704) was originally built in 1953 to produce cordite "N" triple base powder. The manufacturing procedure is a solvent process, the same as that for single base propellant. Triple base powder ingredients include nitrocellulose, nitroglycerin, nitroguanidine, and various additives.

Since its inception, this facility has been expanded to produce double-base and multibase casting powders. Maximum capacity is approximately 500,000 lbs/month. Some of the casting powders contain small amounts (2-4%) of ballistic modifiers, including organic lead compounds. A waste stream consisting of acetone, alcohol and nitroglycerin vapors is emitted during these processes. Washdown water containing alcohol, ether, acetone and nitroglycerin is discharged. Solid wastes include floor sweepings, scrap powder, and industrial waste. This solid waste is accumulated and burned in the burning ground at a rate of approximately 5,000 lbs/year.

6.2.1.7 Ballistic Test Areas

As of 1940, ballistic test areas have been provided for the test and evaluation of the products of Indian Head and other Navy suppliers. The effluent of these test bays includes the gaseous exhaust from combustion and the wash-down of the firing bays to prevent a build-up of ashes. The ashes

are packed for landfill. Wash-down water may contain small amounts of chlorides, nitrates, and oxides in solution which are released in the streams. The accumulation of lead salts in the firing area is monitored.

6.2.1.8 Cast Plant

The cast plant (Building 720) was established in 1953 to produce solid propellant charges (grains for missiles such as Tartar, Terrier, and Talos). The production technique is based on the following two-step process using nitrocellulose as the polymeric binder and nitroglycerin or other high energy liquids as plasticizers.

- manufacture of casting powder. A product containing all the nitrocellulose and solid ingredients and a portion of the plasticizer is made in the form of a right circular cylinder approximately 1 mm. in diameter and length.

- casting and curing. Casting powder is loaded into a mold and the small spaces between the granules filled with a casting solvent consisting of the remainder of the plasticizer. When heated to moderate temperatures, interdiffusion of polymer and plasticizer occurs and knits the two component system into a single grain.

Production capacity at this facility is approximately 200,000 lbs/month. Waste or scrap powder, floor sweepings, and contaminated industrial waste are accumulated and burned. Washdown water is passed through catch tanks and discharged to streams. Contaminants present in minor quantities include alcohol, acetone, ammonium picrate, HMX, and IPA.

6.2.2 Past Ordnance Operations

6.2.2.1 Single-Base Propellant Manufacture

In 1897, Congress appropriated $94,000 for the construction of the powder factory at Indian Head. Work started almost immediately and the first powder was manufactured in 1900. From that time until 1970, most of the propellant powder used by the Navy during peacetime was produced by the Naval Powder Factory.

NOS Indian Head is the only naval activity qualified to produce single base smokeless powder. The single base line consists of 17 buildings as well as 25 air dry houses. These structures, along with their explosive quantity distance arcs, occupy approximately 90 acres.

Single-base smokeless powder was produced from nitrocellulose and diphenylamine stabilizer, using ether and alcohol as solvents. The nitrocellulose was purified by boiling and washing in water. Large quantities of water were also necessary to transfer the nitrocellulose safely from building to building. Long hours of boiling and poaching are required to purify

and stabilize the nitrocellulose. These steps are required prior to dehydrating and use in smokeless powder. The bulk of the water was removed by centrifuge with the remainder eliminated by alcohol. Upon the addition of ether, the nitrocellulose became a colloidal mass which was then extruded into appropriate cords. These were cut into either small or large cylindrical grains, depending on the gun size.

Although the service life of smokeless powder is approximately 20 years, the propellant may be reworked after this period to bring it up to service standards. Overage or obsolete smokeless powder granulations were ground up to produce reworked nitrocellulose, a process carried out from 1920 to 1968. As a result of the grinding operation, some smokeless powder decomposition products were released into the waste water effluent which was discharged into Mattawoman Creek. These decomposition products mainly consisted of water-soluble derivatives of diphenylamine. For purposes of test and issue, the powder was manufactured in lots varying from 25,000 to 125,000 pounds. During World War I, Indian Head produced over 10,000,000 pounds of new powder and reworked approximately 800,000 pounds of older powder.

All solid scrap from this operation was typically collected and burned. Most of the ether or alcohol solvent was lost to the atmosphere. Small quantities were contained in the process waste waters which were discharged to Mattawoman Creek.

6.2.2.2 Nitrocellulose Production

Nitrocellulose (NC) a component of smokeless powder for naval cannon, was produced at NOS during the years 1900 to 1957. Production levels varied up to a maximum of approximately 1,000,000 pounds per month during peak production. Raw materials included cotton linters as well as nitric and sulfuric acids. The cotton linters were immersed in a solution containing the two acids. The resulting waste products were acid water and nitrocellulose "white water". The acid water contained approximately 1 pound of mixed nitric and sulfuric acids per pound of nitrocellulose. Approximately 50,000 gallons of water were used per ton of nitrocellulose. The acid water was neutralized and the resulting discharge, which contained salts of sulfuric and nitric acids, was discharged into Mattawoman Creek. The fine nitrocellulose particles contained in the "white water" eventually settled into the silt in the creek.

6.2.2.3 Manufacture of Sulfuric Acid (Oleum)

Until 1955, sulfuric acid (30% oleum) was produced at Indian Head via a contact process whereby sulfur was burned in air to produce sulfur dioxide. The sulfur dioxides further oxidized to sulfur trioxide which was then dissolved in water to produce oleum. Waste streams from this process consisted of weak acid solutions which were neutralized with soda ash or lime and the resulting water-soluble salts. Small quantities of residual solid sulfur, coal, coke and cinders were observed in the area of Building 135.

6.2.2.4 Manufacture of Nitric Acid

In this process, carried out from 1900 to 1957, chile saltpeter (sodium nitrate) was acidified in a retort prior to distilling and condensing the strong nitric acid. The resulting sodium bisulfate was neutralized with soda ash and discharged into Mattawoman Creek.

The retort system was replaced in 1941 by an air oxidation plant. In this process ammonia is catalytically converted with platinum gauze to nitrogen oxide and then absorbed in water. The resulting weak nitric acid is concentrated with high pressure/temperature steam to strong nitric. Waste streams would have consisted of weak acid solution neutralized with soda ash or lime which would have been discharged into the Mattawoman.

6.2.2.5 Pilot Plant Operations

The pilot plant (Building 863) was established in 1947 to provide a small scale independent unit to perform research and development, process variable, or product variable studies. Characteristically, short runs are made to produce small quantities of materials without interfering or hazarding a production operation.

The plant was equipped to manufacture nitric esters, solvent powders, solventless powders, composite propellants, and a variety of specialty chemicals and explosives.

Residue from these processes are either taken to the burning ground for disposal or drummed and disposed of by sale or authorized dumping.

Washdown from the pilot plant area passes through catch tanks and into open ditches. The latter are monitored for accumulation of material.

6.2.3 Ranges, Impact Zones

Indian Head was originally established as a proving ground. Guns were test fired here to "prove" their condition; powder was likewise tested; and shells were fired into steel plate to "prove" the quality of the steel. In addition to the ranges at Indian Head main base, there is some reason to believe that Stump Neck was also an impact area. Explosive ordnance disposal ranges are also located on Stump Neck.

6.2.3.1 The Valley (Site No. 51)

The naturally occurring valley along Torrense Road from grid location A37 to D41 was the site of test firing of naval guns. Magazines, firing points and a railroad were all built along this valley for about one-half mile beginning at the Potomac River. Firing of guns lasted from 1891 to 1921 by which time proving ground activities had been shifted down river to Dahlgren, Virginia. References to the firing indicate that shells were fired into butts in the valley walls as well as down river over the Stump Neck area. Occasionally shells were inadvertently fired across the river into Virginia. References tell of accidental damage from shrapnel and

bursting shells on the proving ground. The records search did not reveal specific impact areas.

6.2.3.2 Stump Neck Impact Area (Site No. 52)

There was alleged to have been naval gun firing at Stump Neck into the marsh at grid location F-16 and G-16 during pre-World War II years. This firing was said to be observed from a concrete bunker. The bunker does exist and is located on the bluff at grid location H-13. The concrete appears to be old enough to have been in place prior to World War II. Other details are not available.

6.2.3.3 Range #3 (Site No. 53)

Range #3 is an explosive ordnance disposal test range. The range is operationally under the control of the Naval Explosive Ordnance Disposal Technology Center. The range is located at grid XX-30 and is about 1.5 acres in size. The gravelly clay surface lacks vegetation. Activity on the range is characterized by explosive destruction of a variety of shells, mines and other explosive devices for research purposes. Range #3 and Range #6 are similar in appearance except there were no visible craters at Range #3 during the site investigation.

6.2.3.4 Range #6 (Site No. 54)

Range #6 is an explosive ordnance disposal training range. The range is operationally under the control of the Naval School, Explosive

Ordnance Disposal. The range is located at the farthest end of Stump Neck at grid XX-37. The range is approximately 3 acres large with sparse to no vegetation. Students practice explosive demilitarization of projectiles and mines. Live explosive charges are limited to a maximum of 20 pounds of TNT or composition (CA) per charge. The usual size charge is 6 to 8 pounds. The frequency of training is 5 demolitions per day, 165 total days per year. The site is lined with sedimentation control hay bales at the water's edge on Chicamuxen Creek. The site investigation showed a number of craters, approximately 10, in which water stood. The craters varied in size with the average about 6' diameter and 3' deep. The standing water was amber to reddish orange in color. These colors suggest the presence of ammonium picrate and picric acid byproducts. According to NOS files, the State of Maryland Department of Natural Resources has approved and certified that the training area is in compliance with the State's Coastal Zone Management program.

6.2.3.5 Old Demolition Range (Site No. 55)

There is said to be an old demolition training ground about 1 acre at grid location ZZ-26 at the end of Porter Road. It was in use in 1962 and for "many years" prior to 1962. The closure date is not known; however, Building 2107, built in the late 1970s, is also located in the immediate area. Training activities at this site are believed to be similar to those now practiced at Range #6.

6.2.3.6 Underwater Training Area (Site No. 56)

In conjunction with underwater demolition training, the Naval School utilizes a pond at grid location K-16. Explosive charges are set off in the woods nearby in grid location J-15 as part of training procedure. These charges are small quarter-pound to half-pound charges.

6.2.4 Ordnance Disposal

6.2.4.1 Burn Pit (Site No. 57)

On Range #6 in grid location XX-36, one person described the existence of an old burn pit. The pit was used only during 1955 to destroy detonators, squibs, and other small explosive initiating devices. The burning was done in a pit 3 to 4 feet deep and about 2 feet x 3 feet in size. Burning was done about once a week using black powder. The quantity of devices burned at each occurrence was the volume of about one-half of a two pound coffee can. Some of the devices were foreign made. The debris was left in place in the pit. The site investigation revealed no sign of the old pit.

6.2.4.2 Arsenic Pit (Site No. 58)

During onsite interviews, it was alleged that 300 pounds of arsenic powder was buried in a deep hole near Range #6 on Stump Neck. The hole is reputed to be 40 feet deep and 6 feet in diameter, dug by heavy well drilling equipment in 1956 or 1957. The location is grid XX-35 west of

Archer Avenue. The arsenic was in individual plastic bags of undetermined size and was said to have come from the District of Columbia. On-site investigation failed to reveal any visual evidence of the hole. At least one other person, a surveyor on Stump Neck at the time, believes he would have known of the existence of such an excavation and is not aware of it.

6.2.4.3 Range #3 Holding Tank (Site No. 59)

A steam cleanout facility on Range #3 removes TNT from explosive devices such as shells. The wash water is held in an open, concrete lined tank about 10'W x 20'L and about 3' deep. The tank is located immediately beside Building 2057, Explosive Steaming Complex, built in 1952, in grid XX-29. The tank acts to biodegrade the wash water. The effluent from the tank is approved under an NPDES permit.

6.2.4.4 Suspected Tool Burial (Site No. 60)

One person interviewed believed that special beryllium-copper alloy hand tools used in explosive ordnance disposal work were buried in the vicinity of Building 31SN, at grid ZZ-18. The area around the building is paved with asphalt. No other clues are available to confirm this suspicion; however, another confirmed site is reported near Building D-21C in grid E-15.

6.2.4.5 Scrap Metal Pit (Site No. 61)

An excavation, 10' x 10' x 30'L, is reported to contain scrap metal in grid O-16. The metal is said to be parts of mines, torpedoes and other explosive inert items. The location is approximate. No other details are available.

6.2.4.6 Tool Burial (Site No. 62)

Beryllium-copper alloy hand tools are reported to be buried near Building D-21C in grid location E-15. There are two burial holes, each about 5' x 15' x 12' deep. The volume of tools in each pit is said to be about 5' x 8' x 2'. The tools are hand tools such as hammers, wrenches, screwdrivers, pliers, scrapers and knives. These tools are used in EOD work because they are nonmagnetic and nonsparking. According to the interviewees, these particular tools had failed a magnetometer test and were considered unserviceable. The burial was said to take place in 1972 or 1973. It is noted that the magnetometer test took place in Building D-21C which was added in 1973. A memorandum dated 28 May 1975, Ser 113-45-75, contains a sketch showing the two pits at 60 feet and 70 feet southeast of the building. On-site investigation confirms subsidence of soil at these locations.

6.2.4.7 Buried Torpedoes (Site No. 63)

In grid locations E-15 and E-14, between Buildings D-21C and 2075, are believed to be buried torpedoes and associated hardware. The parts are said to be from the Torpedo Station near Blue Plains in Washington, D.C.

The items were brought to Stump Neck and buried in the late 1940s and early 1950s in unknown quantities. The items allegedly may contain fuses and parts which are not rendered safe. No other details are available.

6.2.4.8 Closed Landfill (Site No. 64)

There is a landfill at grid H-15 to H-14. The filled area is in what was a marsh. The ground has been levelled and the area is approximately one to two acres. Grass and other low vegetative growth covers most of the site. The fill is believed to contain metal casings such as mines, bombs, and torpedoes. The contents are claimed to be certified inert and did not contain any explosives or chemicals when buried. The time of the landfill use was 1972 to 1974. Site inspection revealed evidence of small metal parts in the surface soil which is a gravelly clay texture.

6.2.4.9 Causeway (Site No. 65)

The access road to the ranges at Stump Neck crosses a narrow neck of land which has been built up with fill material. The location is grid E-13. An allegation was made that the causeway fill perhaps contains hazardous materials in addition to rubble. On-site inspection shows generous use of large concrete slabs to protect the Potomac River side of the roadway from erosion for a distance of 300-400 feet. There is no visual evidence of hazardous materials on site.

6.2.4.10 New Disposal Pit (Site No. 66)

A new pit is being excavated at location G-12 near the well pump house building 43SN. This pit is intended to contain buried inert metal ordnance parts. No disposal had occurred at the time of site inspection.

6.2.4.11 Rum Point Landfill (Site No. 67)

This landfill is located in grid U-7 west of Rum Point Road. The landfill is intended for biodegradable wastes and is currently in use. The landfill encroaches on the natural drainage of the topography and is not an enclosed fill. Materials have been pushed to the edge of the fill which is 10 to 12 feet above ground level. On-site investigation shows that metal parts have been discarded on the fill in addition to degradable material such as wood and brush. Metal objects included garbage cans, 55-gallon drums, a hot water heater tank, a metal office chair, a rusted land mine and a partially exposed projectile. All metal parts appeared to be empty. The projectile was light blue in color, about 6 inches in diameter and thought to be an inert round. The date of the first use of the site as a fill was not available.

6.2.5 NBC Agents

The initial assessment did not indicate the presence of any nuclear, biological or chemical warfare agents at NOS.

6.3 OPERATIONS, NON-ORDNANCE

6.3.1 Public Works Department (Code 09)

The NAEC Organizational Manual describes the Public Works mission as:

> "Responsible for the acquisition, design, construction and maintenance, repair, and operation of Public Work Utilities, Test Facilities, and for the installation of production and Fleet Support equipment. Operates, assigns, maintains, and repairs construction, transportation, weight handling and material handling equipment. Provides rigging and motor vehicle operators in support of test programs. Administers the Family Housing and Forest Management Program".

Construction, equipment maintenance, transportation, utilities and related support activities are implemented by the Maintenance Division (Code 094), the Transportation Division (Code 095) and the Utilities Division (Code 096). The various branches of these divisions perform specialized activities in shops located throughout the station. Relevant division activities are discussed in Sections 6.3.1.1, 6.3.1.2 and 6.3.1.3 respectively.

6.3.1.1 Maintenance Division (Code 094)

The Maintenance Division consists of four principal branches, the Metal Trades Branch (Code 0941), the Building Trades Branch (Code 0942), the Electric Branch (Code 0943) and the Tool and Facilities Branch (Code 0944). Relevant branch activities are discussed in the following sections.

6.3.1.1.1 Metal Trades Branch (0941)

The pipe working, and electric shop (Section 6.3.1.3) activities are performed in Building 111. Pipe working activities include cutting, threading and testing steel, iron and galvanized pipe. This shop contains a coil pressure test area which has a large floor sink used to drain cleaned pipes. Wastewater from shop activities discharges into an open drainage ditch (IW06). Flow rates reportedly vary from 16-33 GPD and are characterized in the Point Source Pollution Abatement Study (PSPAS) NOS. Indian Head Md., July 1981 as containing oil and grease and trace concentrations of zinc and copper.

Cutting oil was used by this shop from the time of its establishment until the present. As cutting oil is recycled through the cutting machine, approximately 15 gallons is wasted annually via contaminated rags used in cleaning machined parts, metal shavings and shop floor drains. Between 2 and 5 gallons of this oil may enter floor drains along with 2-3 gallons per year of "Mule Kick", a granular petroleum distillate type sewer cleansing agent. Other liquid wastes include degreasers (less than 1/2 gallon per year) and penetrating oil (1 gallon per year), produced primarily as residual liquids contained in discarded 16 ounce aerosol cans. Contaminated rags and 175 aerosol cans are mixed in with shop trash which is generated at a rate of 150 cubic yards annually. This waste is collected weekly by a private contractor from a 5 cubic yard dumpster located behind Building 111 for off-station disposal.

Oil-contaminated metal shavings are captured on a screened catch tray in the cutting machine which generates 4 cubic yards of this material annually. Metal shavings are transported by shop personnel to the Scrap Metal Storage Area, where it is stored and periodically sold to private contractors via normal bidding procedures.

Sheet metal and related machine work activities are performed in Building 113. Acetic acid is used for cleaning and etching metal surfaces prior to soldering. The acid is taken from reusable glass bottles and applied using swab brushes along metal seams to be soldered. Acids are primarily consumed during usage. Shop practices also included degreasing metal parts using Varsol which is purchased in quantities of up to five gallons per year. Larger parts may be soaked in a 250 gallon tank recently installed in this shop. This tank contains a water soluble degreasing agent. Plans to empty the tank contents in order to replenish the degreaser and clean the tank are now being developed by NOS.

Liquid wastes include degreasers (less than 1/2 gallon per year) and penetrating oil (1 gallon per year), produced as residual liquids contained in discarded emptied 16 ounce aerosol cans. Five empty 5-gallon freon cans, 175 aerosol cans and various quantities of oil degreaser contaminated rags are mixed in with shop trash which is generated at a rate of 150 cubic yards annually. This waste is collected weekly for off-station disposal by a private contractor from a 5 cubic yard dumpster serving this shop and the Goddard Power Plant.

Sheet metal and machining activities produce steel (carbon and galvanized), aluminum and lead scrap. These materials are stored in bins and periodically transported by shop personnel to the Scrap Metal Storage Area. Small quantities of scrap solder (1-2 pounds annually) may get mixed in with floor sweepings which are mixed in with the shop trash. Scrap metal is sold to private contractors via normal bidding procedures.

6.3.1.1.2 Building Trades Branch (0942)

Carpentry activities are performed in Building 314. Shop personnel perform carpentry, cabinetry, upholstery and locksmith services. Waste products produced by the carpentry activities include scrap lumber, ceiling tiles, sawdust, sheetrock, asbestos cement board, fiberglass insulation, creosoted lumber and occasionally cans formerly containing wood stain and finishing products. These materials are mixed in with shop trash which is collected weekly by a private contractor from one of two nearby dumpsters for off-station disposal. The 5 cubic yard dumpster behind Building 6 is used exclusively by that shop. The 5 cubic yard dumpster in front of Building 314 is shared with the electronic shop (Building 521) (Ref. Sec. 6.3.1.3).

Painting activities are performed by Branch 0942 in Building 870. Shop personnel perform painting, masonry, glazing, signwork and provide labor services to other trades.

Shop practices also include degreasing metal parts and paint equipment using Varsol, a mineral spirit, and kerosene. Varsol is purchased in one gallon cans in quantities of up to 55 gallons per year. Kerosene is

Other liquid wastes include oil paint (12 gallons per year), and latex paint, (28 gallons per year) produced as residual liquids, and paint sludges in either discarded aerosol or used paint cans. Approximately 2,300 paint cans, 144 aerosol cans, 5 special epoxy solvent cans, various paint degreaser contaminated rags and resin paper are mixed in with shop trash which is generated at a rate of 260 cubic yards annually. This waste is collected weekly or bi-weekly by a private contractor from a 5 cubic yard dumpster located behind Building 870 for off-station disposal.

Prior to 1972, the paints used by this shop were almost exclusively oil paints. Products used during these years included paint thinners, lacquer thinner, turpentine, kerosene, mineral spirits, and all types of oil paints including lead paint. Although oil paints are still in use, in 1975 the paint shop switched over to an increased usage of latex water-based paints which have been used up to the present time. In 1981 the paint shop purchased 2,325 gallons of latex paint, 1,055 gallons of oil paint and approximately 12 cases containing twelve-16 fluid ounce containers of lacquer paints.

Prior to 1979, various quantities of waste solvents may have been deposited in a 400 foot area behind Building 898. It is estimated that 110 gallons per year of kerosene, Varsol and other mineral spirits may have been deposited on an annual basis in this area. Previous disposal practices and current cleaning procedures may have contributed to the contamination and vegetation stress adjacent to the cleaning area. (Ref. Section 6.6-25)

6.3.1.1.3 Electric Branch (0943)

Branch 0943 consists of three sections:

- Electric,
- Refrigeration and Air Conditioning,
- Emergency Service, and
- Housing Maintenance

The Electric Section Activities take place in Building 111. Besides pipeworking (Section 6.3.1.1.1), shop personnel perform installation, maintenance, repairs and alterations to all types of electrical equipment and systems, lighting and power systems (from the pole down), and motors controls and appliances. Other shop activities include repairs and alterations to electrical facilities and underground (low voltage) distribution systems, including repairs to fire protection alarm systems and related equipment installations.

Shop practices include degreasing motor parts using "Safety Solvent" which is purchased in quantities of up to 110 gallons per year. Bearings, bearing casings and gear boxes are lubricated with lubricating oil purchased in quantities of up to 5 gallons per year.

Liquid wastes include lubricating oil in discarded emptied oil cans, and sulfuric acid (30 gallons per year) discharged periodically into an open drainage ditch (IW 06) during battery cleaning operations. Five empty one-gallon lubricating oil cans and 20 batteries are mixed in with

small quantities (1-2 gallons); are wasted annually via contaminated rags and metal shavings.

Other liquid wastes included trace quantities of degreasers which are contained in discarded emptied aerosol cans and 40 gallons per year of shop soap solutions which are discharged into shop floor drains.

Approximately 10-15 disabled freon cylinders, 2-5 pounds of sulfuric acid powder residue contained in 10-20 emptied bags, variable quantities of oil contaminated rags, and 15-25 emptied degreaser aerosol cans are generated annually. This material is mixed in with shop trash which is deposited in the Building 111 dumpster (Ref Sec 6.3.1.1.1).

Scrap metal is also produced by this shop. Oil contaminated metal shavings are produced in small quantities, are mixed in with scrap metal and transported by shop personnel to the Scrap Metal Storage Area, where it is stored and periodically sold to private contractors, via normal bidding procedures.

Trichloroethylene solvents were used by this shop in the 1960's, but were typically collected and disposed by private contractors for off-station disposal during that period.

shop trash which is generated at a rate of 100 cubic yards annually and deposited in the Building 111 dumpster (Ref. 6.3.1.1.1).

Annually one-half gallon of residual safety solvent contained in two discarded 55 gallon drums are sent to the Caffee Road disposal area where the drum and drum contents are flashed.

The refrigeration and air conditioning activities are performed in Building 193. Shop personnel perform installation, maintenance, and repair on air conditioning and refrigeration equipment. Shop practices include degreasing and cleaning condensers in air conditioning equipment with degreasers and sulfuric acid solutions. Degreasers are purchased in quantities ranging from 15 to 25 sixteen-fluid ounce aerosol cans, while acid is purchased in quantities ranging from 10 to 20 50-pound bags. Air conditioner coils are cleaned with a concentrated soap solution, "Cal Clean", which is purchased in quantities of up to 40 gallons per year.

Freon (dichlorodifluoromethane) is supplied in 35 pound cylinders (containing 30 pounds of various refrigerants, i.e. R-12, R-22, R-500 and R-502), purchased in quantities ranging from 400 to 450 pounds per year. After usage, these cylinders are disabled by opening cylinder valves and removing caps. Other freon refrigerants are supplied in returnable 20 pound cylinders (containing 9 pounds of either refrigerants R-13 or R-503) and are purchased in quantities ranging from 120 to 160 pounds per year.

Cutting oil was used by this shop from the time of its establishment to the present. As cutting oil is recycled through a cutting machine,

6.3.1.1.4 Tool and Facilities Branch (0944)

Branch 0944 consists of the following three section:

- the Tool, gauge and die section,
- the Equipment maintenance section, and
- the Facilities maintenance section.

All Section activities take place in Building 268. This shop performs maintenance and repair of station machinery and manufactures new parts for station ordnance materials. Shop machinery includes jig bores, belt sanders, lathes, electric discharge machines, drill presses, bench grinders and milling machines.

Shop practices include degreasing metal pieces, application of layout fluid to metal parts prior to machining, and cutting metal in milling machines. Cutting oil, water soluble oil, Varsol thinner, lube oil and layout fluid are used during shop activities.

Cutting oil was used by this shop from the time of its establishment until the present. As cutting oil is recycled through the cutting machine, small quantities are wasted annually via contaminated rags used in cleaning machine parts and metal shavings. Current practices include storage of waste oils in 55 gallon drums where they are collected periodically by a private contractor for off-station disposal. These wastes are generated at a rate of 110 gallons annually.

Other liquid wastes produced included semi-cool water soluble oil layout fluid thinner, and lube oil, produced as residuals in discarded cans.

Five empty oil cans, discarded aerosol cans, and various quantities of oil contaminated rags are mixed in with shop trash which is collected weekly by a private contractor from a 5 cubic yard dumpster serving this shop.

Other wastes include "oil soak", a sorbent material used to clean up oil spills and oil filters. Filters are placed in plastic bags, mixed with oil soak and deposited in 55 gallon drums. Annually, 4 drums are transported to the Caffee Road disposal areas where the drums and drum contents are flashed.

Tooling and machining activities produce steel (carbon and galvanized), aluminum, brass, copper and lead scrap. Scrap metal and metal chips are stored in bins, racks or dumpsters and are periodically transported by riggers to the Scrap Metal Storage Area. This shop generates approximately 520 cubic yards of scrap metal annually. Oil-contaminated metal shavings are captured on a screened catch tray in the shop cutting machine. Ten to twenty pounds of this material are generated annually. Metal shavings are transported by shop personnel to the Scrap Metal Storage Area, where it is stored along with scrap and periodically sold to private contractors via normal bidding procedures.

6.3.1.2 Transportation Division (Code 095)

The Transportation Division consists of two principal branches, the Operations Branch (Code 0951) and the Transportation Equipment Maintenance Branch (Code 0952). This division operates, repairs and maintains more than 500 pieces of automotive and heavy equipment machinery pieces for the Indian Head and Stump Neck facilities. Relevant branch activities are discussed in Section 6.3.1.2.1 and 6.3.1.2.2, respectively.

6.3.1.2.1 Operations Branch (0951)

The base of operations for branch heavy equipment operators and maintenance crews and limited equipment maintenance is located in Building 510. This building houses maintenance, servicing and repair of locomotive equipment. This shop contains track facilities, grease pits, and bridge cranes for maintainance of locomotives. Shop activities include rebuilding locomotive engines, a dispatch and staging area for heavy equipment (bulldozers, front end loaders, etc.) and a mobilization area for snow removal operations.

Liquid wastes include waste fuel oil, motor oil, and kerosene which is discharged during servicing operations and collected in a 500 gallon capacity underground storage tank. (Ref Sec 6.5). Waste oils are generated at a rate of 500 gallons annually and are collected semi-annually by a private contractor for recycling.

Shop trash consists of rubbish, floor sweepings and rags, which are generated at a rate of 260 cubic yards annually. This waste is collected weekly by a private contractor from a 5 cubic yard dumpster located in front of Building 510 for off station disposal.

6.3.1.2.2 Transportation Equipment Maintenance Branch

Branch activities relating to automotive and heavy equipment take place in Buildings 290 and 525 respectively. Shop personnel perform the maintenance, servicing, and repair of automobiles and light equipment (bicycles, snowblowers, etc.) in Building 290. This shop contains 3 lifts and 10 service bays. Liquid wastes include crank case, differential, transmission and hydraulic oils. Wastes are discharged during servicing operations and collected in an underground 550 gallon storage tank. (Ref Section 6.5). Waste oils are generated at a rate of 2,200 gallons annually and are either collected quarterly by a private contractor for recycle or mixed in with power plant fuel oils for disposal. Previously (circa 1965) waste oils were applied to unpaved roads in the Bldg 290 vicinity for dust control. (Ref. Section 6.6.5)

Shop trash consists of rubbish, oil filters, paper boxes and trash (from the shop store) which is generated at a rate of 520 cubic yards annually and deposited in one of the two Building 290 dumpsters. Shop practices previously included a small painting and degreasing operation which was discontinued 2 years ago. Varsol was the degreasing agent used in this operation. At that time paint wastes were discharged into the Building 290 dumpster and (four or five years ago) solvents were emptied into waste oil.

Shop personnel perform maintenance, servicing and repair of heavy equipment, (bulldozers, front end loaders, etc.) in Building 525. This shop contains ten service bays. Shop practices included periodic detergent wash-down of vehicles using steam jennies on a wash pad located behind the shop and degreasing vehicle parts with the solvent "Safety Clean". Safety Clean is used at a rate of 250 gallons per year and is collected periodically by a contractor for recycle. This procedure was started in 1976. Prior to that time solvents may have been added to waste oils and empty solvent cans may have been mixed in with shop trash.

Liquid wastes included waste oils similar to those generated in Building 290 and are collected in a 1,000 gallon capacity underground storage tank, (Ref. Section 6.5). Waste oils are generated at a rate of 3,000-4000 gallons annually and are collected once every three months by a private contractor for recycle.

Shop trash consists of rubbish, oil filters, rags and floor sweepings which are generated at a rate of 130 cubic yards annually and deposited in the Building 525 dumpster. Other wastes are generated from both Buildings 290 and 525, and include scrap batteries which are generated at a rate of 100-200 per month (3000 pounds per year). These wastes are turned over to the DPDO for disposal.

6.3.1.3 Utilities Division (Code 096)

The Utilities Division consists of three principal branches, the Water and Sewage Distribution Branch, (Code 0961) the Utilities Maintenance Branch (Code 0962) and the Power Generation Branch (Code 0963). Relevant branch activities are discussed in the following sections.

Water and Sewage Distribution Branch

Activities relating to the collection, treatment, distribution of water and sewage and/or disposal of sewage and sewage sludge are performed by this branch.

The source of potable water and power plant cooling water at Indian Head is groundwater. Three 6" diameter wells (capacities ranging from 130,000 to 250,000 gallons per day) and one 4" diameter well (35,000 gallons per day) tap a low silica water source for the cooling water required by the Goddard Power Plant. Cooling water is collected and chlorinated in one of two Buildings, (143 or 128). Seven 4" diameter wells (each at a 175,000 gpd capacity) tap a higher silica water source to supply base drinking water requirements. All eleven wells were installed at depths ranging from 300 - 400 feet below grade.

The Building 143 sump (capacity 75,400 gallons) and Building 128 sump (capacity 65,250 gallons) are periodically cleaned of sand and the sump

walls are washed down with chlorine (HTH). Sand from the sump cleaning operation is washed into nearby creeks.

Water quality is generally good, although recently (January 1982) one well supplying make up water to the steam B plant was closed because of elevated iron concentrations. This well water had been previously treated with soda ash (for pH control) and potassium permanganate (for odor control). Backwash water was periodically discharged into the sanitary sewer system.

The source of water for fire fighting and various other potable iron cooling water applications is river water. This water is supplied by either Old River Pump House or the New River Pump House. These facilities, each equipped with a 300 hp-2,000 gpm pump, were built in the early 1930's and 50's respectively and are designed to supply chlorinated river water, on an as-needed basis.

Indian Head has two sanitary sewage treatment plants. Wastewater treatment at both facilities consists of primary and secondary clarification, anaerobic digestion and activated sludge. Sludge from the digestor and settling tanks, and oil, grease, and grit from the grit chambers is treated with a polymer (NALCO #7135) and dried in sludge drying beds. Dried sludge is periodically removed and deposited in dumpsters for disposal at on site landfills. The sewage treatment plant No. 1 is located near the Old Navy Proving Ground and operates under NPDES permit No. MD 0020805 (Building

1469) STP #1 discharges approximately .35 MGD of sewage sludge into the Potomac River and generates approximately 1000 cubic yards per year. Sewage Treatment Plant No. 2 (Building 1472) is located west of the UDMH Distillation Plant and operates under NPDES permit No. MD 002893. STP#2 discharges approximately 0.15 MGD into Mattawoman Creek and generates approximately 15 cubic yards of sewage sludge per year.

Utilities Maintenance Branch

Maintenance of water, sewage and power plant equipment is performed by this branch. Other branch activities include electric linemen work. Repairs and alterations to above ground power facilities and inspection of transformers is performed by this shop. (Bldg 115). Trash is generated by this shop and is deposited in the dumpster serving Building 111 and the Goddard Power Plant. PCB wastes are collected and stored in the PCB storage shed (Ref. Section 6.5).

Power Generation Branch

The Goddard Power Plant (Building 873) was built in 1957. This plant has three boilers, each of which rated at 150,000 pounds per hour. In addition, two steam operated 5,000 kw steam generators produce electricity for emergency use. Prior to the construction of the Goddard Plant there was a steam and electric plant run exclusively on coal in Building 111. This facility has supplied energy to the base since the 1920's.

Coal was used as fuel for the Goddard power plant until the early 70's when the plant was converted to burn both No. 2 and No. 6 fuel oil. Coal was shipped by both train and truck to the power plant. Coal ash was used to build roads and as a subbase throughout the base. The Goddard Power Plant is currently being reconverted to burn coal. The facility is equipped with a fly ash vacuum system which transports ash to a 100 ton silo. This material is hauled off station by a private contractor to a facility which converts ash into cinder block. It is anticipated that the plant will generate between 200-300 tons of ash per month when the conversion to coal is completed.

The facility currently contains a 16,500 cubic yard, one-acre coal pile. Interviews indicated that various quantities of waste oil were deposited on the coal pile, when the facility burned coal. These interviews also indicated that additional quantities of waste oil may have been deposited recently. Additional detail is not available.

Internal boiler water chemical treatment includes addition of sodium sulfite, sulfuric acid, phosphate, caustic soda and hydrazine. Boiler blowdown is discharged into the sanitary sewer. The power plant also has a demineralizer facility which requires regeneration once every 360,000 gallons in the plant cooling cycle. Demineralized regeneration water is treated in an 80,000 gallon capacity neutralization tank and discharged at a rate of 60,000 gallons per regeneration cycle into the storm sewer system. This procedure is repeated 15 times each month.

Two aboveground fuel tanks, with a capacity of 50,000 gallons each, are located near the power plant. Although there have been no major spills recorded from those tanks, there has been occasionally minor spillage resulting in a 75 square foot patch of discolored soil within the bermed area of the tank facilities. (See Section 6.6-37) Both facilities are surrounded by a four foot high earthen berm to contain leakage.

A 275-gallon underground waste oil storage tank is located to the east side of the Goddard Power Plant. This facility stores waste oil generated at a rate of 100 to 150 gallons per year. This oil is treated in a oil water separator and combined wth No. 6 fuel oil for burning. The underground facility has not been monitored for leakage. Other materials used at the steam plant consist of about 20 gallons of degreaser (trichloroethylene) annually. Waste TCE is emptied into the boiler for combustion.

The Steam "B" (Moser) Power Plant was built in the early 1950's and is located in the southwestern part of the base, in Building 712. This facility supplies steam to the base for winter usage. The two boilers in this facility have recently been replaced with "one" Johnston steam fired tube boiler rated at 30,000 pounds per hour. Construction of an additional Cleaver Brooks water tube boiler is on-going at this facility.

Boiler blowdown overflows from a blowdown tank and is discharged into the storm drain system. Internal boiler water chemical treatment consists of phosphate, hydrazine and sodium sulfite. Make-up water is developed from 30 gpm well tapping a low silica water source. Boilers use either No. 6 or No. 2 fuel oil supplied from two above-ground 200,000 gallon

fuel tanks. The fuel tanks are bermed with a 4 foot concrete wall to contain any leakage. Interviews with base personnel did not indicate any problem with leakage from these tanks.

6.4 RADIOLOGICAL OPERATIONS

6.4.1 General

Interviews were conducted with appropriate personnel in order to understand the history, present status, and potential impacts of nonordnance radiological materials at this activity.

By virtue of the base's mission, radiological materials are present on-site in various forms. At the Naval Ordnance Station, most radiological operations are associated with x-ray units.

There are also sealed sources, most of which are handled under NRC license conditions. Those not under licenses are old sources, formerly used for research experiments. These are stored on-site.

6.4.2 Thorium Spill (Near Building 900)

From personnel interviews, it was learned that there had been some surface soil contamination, caused by an ordnance training session, near Building 900 (map grid C-27). Unfortunately, there were no records available on the history of this contamination event, or to document the current status of this area by contamination surveys. Interviews indicated that some cleanup took place, generating an unknown quantity of thorium-contaminated soil reportedly drummed and stored on base in Building 901.

6.4.3 EOD Technology Center (Building 2083)

At the Naval Explosive Ordnance Disposal Technology Center, radiological materials are present. There are x-ray units at this facility. Also, Building 2083 and its vicinity contain radioactive materials used for training purposes. Personnel decontamination procedures after training sessions consist of hand-washing. It is not known how this waste water is disposed. Contamination surveys are routinely taken in Building 2083, as part of training sessions and the readings are reportedly near background levels. It is not known, nor are records available, to indicate if radiological contamination is present in soils below ground level or at what concentrations. There are no records of radiation surveys outside the building. The fact that it is open in the center may facilitate deposition of windblown contaminants outside.

Interviews indicated that contaminated wastes were shipped to this facility in the past and are still stored on the base. No further information was available.

6.5 MATERIALS STORAGE

The Supply Department (Code 11) orders and stores most of the materials awaiting usage at NOS Indian Head. There have been various POL and hazardous waste contamination incidents and accidents caused by spills or leaks from station facilities. Storage facilities, related practices, and relevant spill events are discussed in the following sections.

6.5.1 Waste Ordnance Storage

All waste ordnance-related materials, i.e., propellents, pyrotechnics, contaminated containers, related ingredients and fleet-returned obsolete propellents are destroyed by open burning (at the three station burn points described in Section 6.6) with no previous treatment. Prior to this, these wastes are stored near the processing buildings in specially designated dumpsters on open-air concrete pads or in plastic-lined color-coded steel cans in nearby sheds. The color codes were adopted in October 1980: nitrate ester propellents are stored in yellow cans; blue containers store composite propellents and plastic-bonded explosives (PBX); orange cans contain oxidizers; and silver or aluminum containers store powdered metals. Types and volumes of waste ordnance vary depending on production activity. Currently, propellants and explosive wastes are disposed of roughly three times a week, pyrotechnic waste weekly, and contaminated materials, biweekly. Building supervisors are responsible for removal of all stored wastes which are removed by specially designated trucks.

6.5.2 POL Storage

Storage capacity for petroleum, oil and lubricants on NOS consists of a total combined capacity of over 1.5 million gallons. This includes potential storage for 1 million gallons of #6 fuel oil, 300,000 gallons of #2 fuel oil and 17,000 gallons of #1 fuel oil. Gasoline is stored in tanks located both underground and aboveground with a total capacity of approximately 200,000 gallons. Tanks containing waste oil have a total capacity of 1,175 gallons and lube oil can be contained on-site in the 121 available

tanks, having a total combined capacity of roughly 6,500 gallons. See Table 6.5-1 for a complete listing of POL storage capacities.

6.5.2.1 Spill Prevention

EPA requires the preparation and implementation of a Spill Prevention Control and Countermeasure (SPCC) Plan pursuant to Section 112.7 of 40 CFR 112, "Oil Pollution Prevention, Non-Transportation Related Onshore and Offshore Facilities". The SPCC Plan is required for any facility having underground oil storage capacity in excess of 42,000 gallons or storage capacity, not buried, of more than 1,320 gallons or any above ground tank in excess of 660 gallons. At the time of formulation of NOS' SPCC Plan, it was reported that underground oil storage capability on the site was approximately 77,000 gallons. An SPCC Plan was drafted in November 1979 and approved in January 1980 by CHESDIV. The Plan identifies and evaluates potential spill sources and appropriate measures to be taken to minimize risk of oil spills. The deficiencies which were identified as well as the recommendations which were proposed in the SPCC Plan were fairly consistent for each of the underground storage tanks. Generally, there was a need for high-level alarms or oil level indicators; there was no means of containing minor spills at fill pipe connections or vents, and there was no written procedure for fueling operations/tank inspections. At Buildings 771 and 776, the containment areas surrounding two 500,000 gallon #6 fuel oil tanks for the

Table 6.5-1

POL Storage Facilities

Fuel Type	Location*	Number of Tanks	Total Combined Capacity (Gallons)
#1 Fuel Oil	AG	9	17,200
#2 Fuel Oil	AG	45	254,050
	UG	33	46,475
#6 Fuel Oil	AG	4	1,035,000
	UG	2	30,000
Waste Oil	AG	2	675
	UG	1	500
Lube Oil	AG	121	6,655
Diesel	AG	5	53,375
	UG	5	16,250
Gasoline	AG	10	146,800
	UG	9	61,500

*AG = Aboveground
UG = Underground

Reference: Oil Spill Prevention, Control and Countermeasure Plan (Oil SPCC Plan) for Naval Ordnance Station, Indian Head, Maryland, Nov. 30, 1979.

Goddard Power Plant were earthen and needed liners to prevent absorption of spilled oil into the ground. At Building 59SN, the Emergency Power Unit, the spill box covers on the underground tanks (a 1,000 gallon diesel tank and a 2,000 gallon #2 fuel oil tank) did not provide sufficient cover and allowed rainwater to accumulate. See Section 6.5.6 for documentation of past spill events associated with containment deficiencies. Dikes have been constructed to contain oil spills around aboveground bulk storage tanks exceeding storage capacity of 660 gallons. These dikes have adequate volume to contain the contents of the largest single tank plus sufficient freeboard for stormwater.

6.5.2.2 Waste Oil

The Public Works Department collects waste oil from shops and the garage and stores it in steel tanks in Buildings 290, 510 and 525. The tank near Building 290, the Transportation Office and Maintenance Garage, is aboveground and may store approximately 400 gallons. Building 510 is the Railroad and Heavy Equipment Building. The adjacent tank is underground and may hold 500-550 gallons. Building 525, the Transportation Maintenance Shop, has a 200-gallon underground tank for waste oil storage. Approximately 1,200 gallons of waste oil is collected at the station per year. The waste oil is characterized as used crankcase oil from NOS vehicles, tool and machine lubricant oil, cutting oil, and hyraulic oil. Samples of this waste oil are analyzed periodically for heavy metals and polychlorinated biphenyls (PCBs) and recertified for use as fuel. The storage tanks are emptied by the DPW and the waste oil is transferred to the Goddard Powerplant (Building 873) where it is burned as a supplement to #6 fuel oil.

6.5.2.3 Abandoned POL Tanks

Abandoned POL storage tanks were identified in the SPCC Plan and are listed in Table 6.5-2. These tanks are located adjacent to the Emergency River Pump House, the Photo and Radiography Classroom, the Waterfront Operations Building, the Fuse Stripping Building, the Ski Storage Equipment Building, and the old Post Office.

Table 6.5-2

Abandoned POL Storage Tanks

Location	Building	Type/Placement*	Tank Capacity (Gallons)
B38	#254	Gasoline/AG	100
XX-25	#7SN	#2 Fuel Oil/AG	550
H49	#1444	#2 Fuel Oil/AG	275
K16	#2010	#2 Fuel Oil/AG	275
I49	#1529	#2 Fuel Oil/UG	550
I42	#293	#2 Fuel Oil/UG	550

*AG = Aboveground
UG = Underground

6.5.3 Hazardous Materials Storage

The following table provides a listing of hazardous substances (as designated in 40 CFR 116) which were stored in quantities exceeding 1,000 gallons (or 20,000 pounds) for use at NOS in 1980. A complete listing of hazardous materials at the station is presented in its entirety in Appendix 6.5-1.

Table 6.5-3

Storage of Selected[1] Hazardous Materials at NOS

Material	Storage Site Building	Type of Storage	Quantity Procured/ Generated Annually	Average Storage Time	Responsible Organization (Code)
Acetone	777	Drums inside adequate shelter	10,000 gals.	6-12 months	20
Aluminum (powdered)	325, 505, 455, 858	Steel drums in adequate shelter	50,000 lbs.	6+ years	20
Ammonium perchlorate	454,473, 505, 508 & 509	Steel drums	297,976 lbs.	1 year	11
Butyl acetate		Railroad tank car	69,110 lbs.		11
Butyl acetate	183, 875, 808	Railroad tank car	22,000 lbs.	2 years	20
Dibutyl sebacate	1461	Tank	6,000 gals.	Used continuously	2014
Diethylene glycol dinitrate	676	Steel containers	20,000 lbs.	Used continuously	2014
Ethyl alcohol	164, 165, 1012 & 1013	Tanks in concrete bldg.	10,000 gals.	All year	2013
Ethyl ether	164, 1012 & 1013	Tanks in concrete bldg.	50,000 gals.	All year	2013
Methyl alcohol	263	55 gal. drums	4,235 gals.	1 year	11

Notes:

(1) Hazardous materials stored in excess of 1,000 gallons (or 20,000 pounds) as reported by NOS LIST OF HAZARDOUS MATERIALS.

Table 6.5-3 (continued)

Storage of Selected[1] Hazardous Materials at NOS

Material	Storage Site Building	Type of Storage	Quantity Procured/ Generated Annually	Average Storage Time	Responsible Organization (Code)
Mixed acid	781	Tanks	60,000 gals.	Used continuously	2014
Nitrocellulose	471	Drums	38,109 lbs.	Indefinite	2042
Nitrodiphenylamine (2NDPA)	524	Drums	38,109 lbs.	Indefinite	11
Nitroglycerin	709, 804, 1137	Diluted with solvent; 1,500 lb. capacity stainless desiccators	110,000 lbs. mfgd/ year (approx. 8,000 lbs. stored)	1 year	2014
Propylene glycol	772	Tanks; diked	25,000 gals.	Used continuously	2014
Propylene glycol dinitrate	1463	Tanks	156,000 gals.	Used continuously	2014
Sodium hydroxide	1107	Drums	8,000 gals.	30-50 days	096
Sodium hydroxide	497	Tanks	5,000 gals.	1 year	203
Sulfuric acid	1107	Tank	8,000 gals.	30-50 days	096
Teracol	453	55-gal. drums	165,150 lbs.	1 year	526
Trichloroethylene	263	55-gal. drums	356,100 lbs.	Indefinite	11
Trichloroethylene	859	55-gal. drums on pallets	2,750 gals.	1 year	20

As indicated above, numerous locations around the site store hazardous materials. Many of these storage sites are equipped with containment berms. At the unsymmetrical dimethyl hydrazine (UDMH) facility, the bermed storage areas are drained to sumps which discharge to storage tanks for processing through a thermal destructor. UDMH storage ended prior to 1980.

6.5.4 Hazardous Waste Storage

Most of the hazardous waste at NOS is explosive or explosive-contaminated waste produced by the Ordnance Department (Code 20), and the Cartridge Actuated Devices/Propellent Actuated Devices (CAD/PAD) Dept. (Code 51). Most of the nonexplosive hazardous waste is generated by the Public Works Dept. (Code 09). Hazardous nonexplosive waste products of concern are generated by such operations as paint spraying, paint stripping, rocket motor insulating, solvent evaporation and static firing testing. Major waste generators are the nitration operations (Biazzi and Moser processes). At the Biazzi Plant the spent acid is collected for reprocessing off-station and reuse. At the Moser Plant, the acid is settled and neutralized in tanks prior to discharge via IW02.

Hazardous wastes stored in quantities exceeding ten gallons (or 100 pounds) per year are listed in Table 6.5-4). A complete listing of hazardous wastes stored at NOS was prepared for the facility in 1980 and is presented in its entirety in Appendix 6.5-2. This appendix provides a description of waste characteristics, location, storage time and ultimate disposal. See Figure 6.5-1 which presents an overview of current practice concerning hazardous waste storage.

Table 6.5-4

Storage of Selected[1] Hazardous Wastes at NOS

Material	Storage Site Building	Type of Storage	Quantity Procured/ Generated Annually	Average Storage Time	Responsible Organization (Code)
Ammonium nitrate	704	Sealed cans	100 lbs.	One month	526
Delay compositions (containing B, $BaCrO_4$, $KClO_4$, SiO_2, W, etc.)	7XC40	Metal cans in magazine	1,200 lbs.	90 days	511
Ignition mixes (containing B, $BaCrO_4$, Fe_2O_3, $KClO_4$, SiO_2, Ti, Zr, etc.)	7XC40	Alcohol-wet, in plastic bottles in magazine	118 lbs.	90 days	511
Mixed acid (spent)	781 & 790	Tank	80,000 lbs.	1 week	2014
Mixed acid (dilute)	674	Tank	20,000 lbs.	2 hours	2014
Double base propellent	1298	Covered container	160 lbs.	1 week	2013
	1300	Covered container	330 lbs.	1 week	2013
	1295	Covered container	170 lbs.	1 week	2013

Notes:

(1) Waste chemicals stored in excess of 10 gallons (or 100 pounds) as reported by NOS HAZARDOUS WASTE INVENTORY, June 1980.

Table 6.5-4 (continued)

Storage of Selected[1] Hazardous Wastes at NOS

Material	Storage Site Building	Type of Storage	Quantity Procured/ Generated Annually	Average Storage Time	Responsible Organization (Code)
Double base and composite propellents	Outside bldg. on dumpster pad	Covered container in "explosive" dumpster	250 lbs.	2 weeks	202
Composite propellent	1197 & 1259	Covered containers	200 lbs.	3 days	201
	1376	Covered containers	100 lbs.	3 days	201
	Outside bldg. on dumpster pad	Covered container in "explosive" dumpster	250 lbs.	2 weeks	202
Cured propellent scrap	905	PE-lined cans	100 lbs.	4 days	526
Uncured propellent and PBX	1277	PE-lined cans	100 lbs.	1 week	526
Rubber, Polyurethane	903	Drums	100 lbs.	90 days	526
Spent fixer	266	Tank	100 lbs.	8 hours	30
Trichloroethylene (dirty degreaser solvent)	Outside bldg. 859	55-gal. drums	40 gallons	2 months	201

The Stump Neck area of NOS does not generate hazardous wastes in significant quantities. In its Hazardous Waste Management Plan (August 1981), The Naval Ordnance Disposal Technology Center identified the following waste products with volume generated annually: preservatives (8 gallons), oils and grease (12 gallons), beryllium, copper (1 lb.), epoxy (1 quart), "research chemicals" (5 lbs.), "chemicals" (4 gallons), cleaning fluids (15 gallons) and paints (8 gallons). The Naval Explosive Ordnance Disposal Technology Center has one waste storage tank located next to Building 2057, the Explosive Steaming Complex. This tank holds wastewater from processing of explosives, and pink/red water from trinitrotoluene (TNT) demilitarization operations and acts as a biodegradable treatment facility. The effluent discharges to Mattawoman Creek.

6.5.4.1 Solvents

Hydrocarbon solvents are currently slummed with sawdust and burned at the main burn point. Prior to this, they are stored at various production facilities around NOS (see Appendix 6.5-2). Chlorinated solvents, such as trichloroethylene (TCE), once contaminated, are drained from vapor degreasers and containerized in 55-gallon drums, which are stored on open-air sites surrounded by containment dikes awaiting final disposal through DPDO.

6.5.4.2 Photographic Work

Spent fixer and other photographic wastes are generated at the X-ray facilities of the Weapons Quality Engineering Center (Code 30) and the photographic laboratory in the Visual Information Branch (Code 5245). These

Figure 6.5.1

NOS Main Site

Hazardous Waste Storage, Treatment, and Disposal

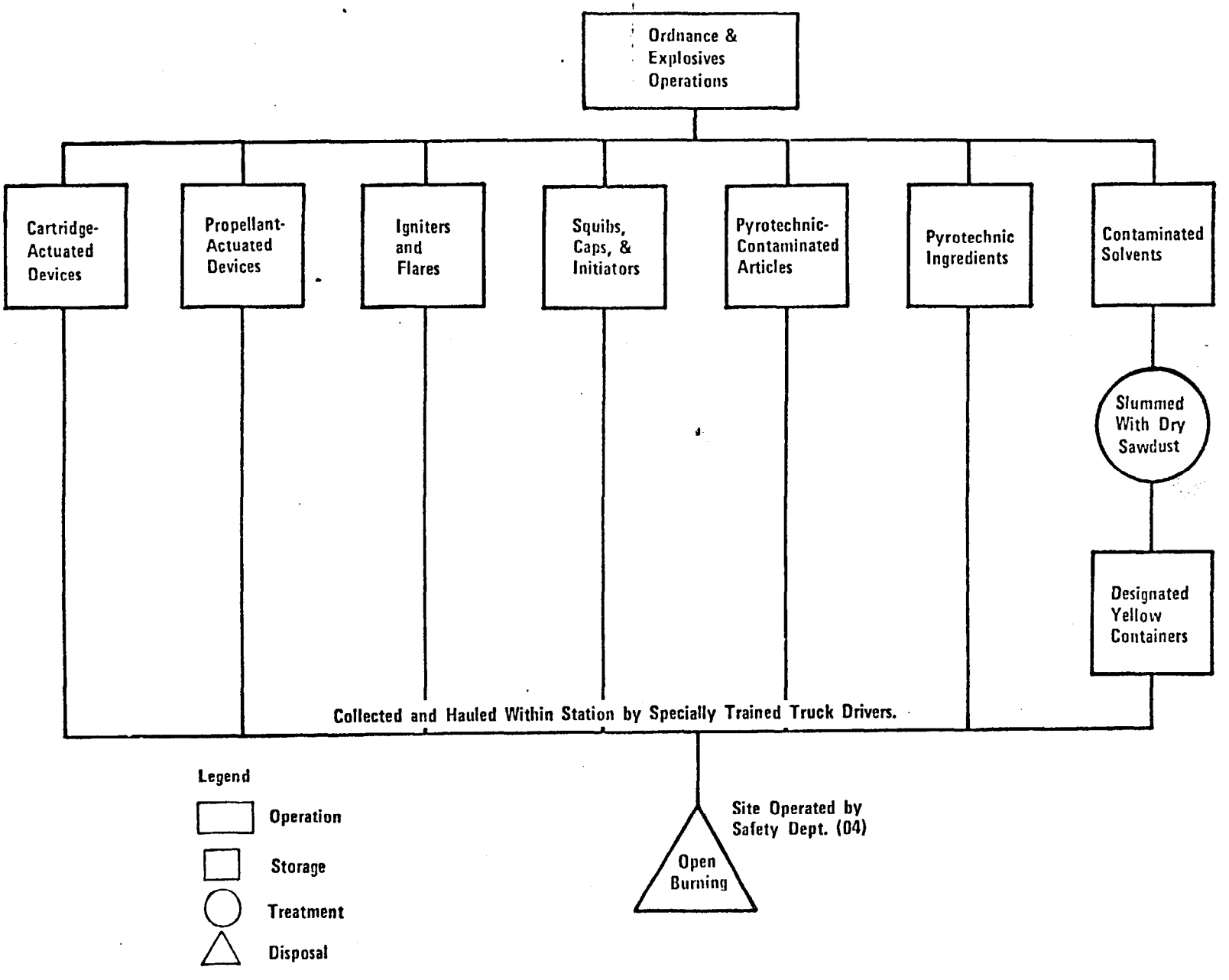


Figure 6.5.1 cont'd.

NOS Main Site

Hazardous Waste Storage, Treatment, and Disposal

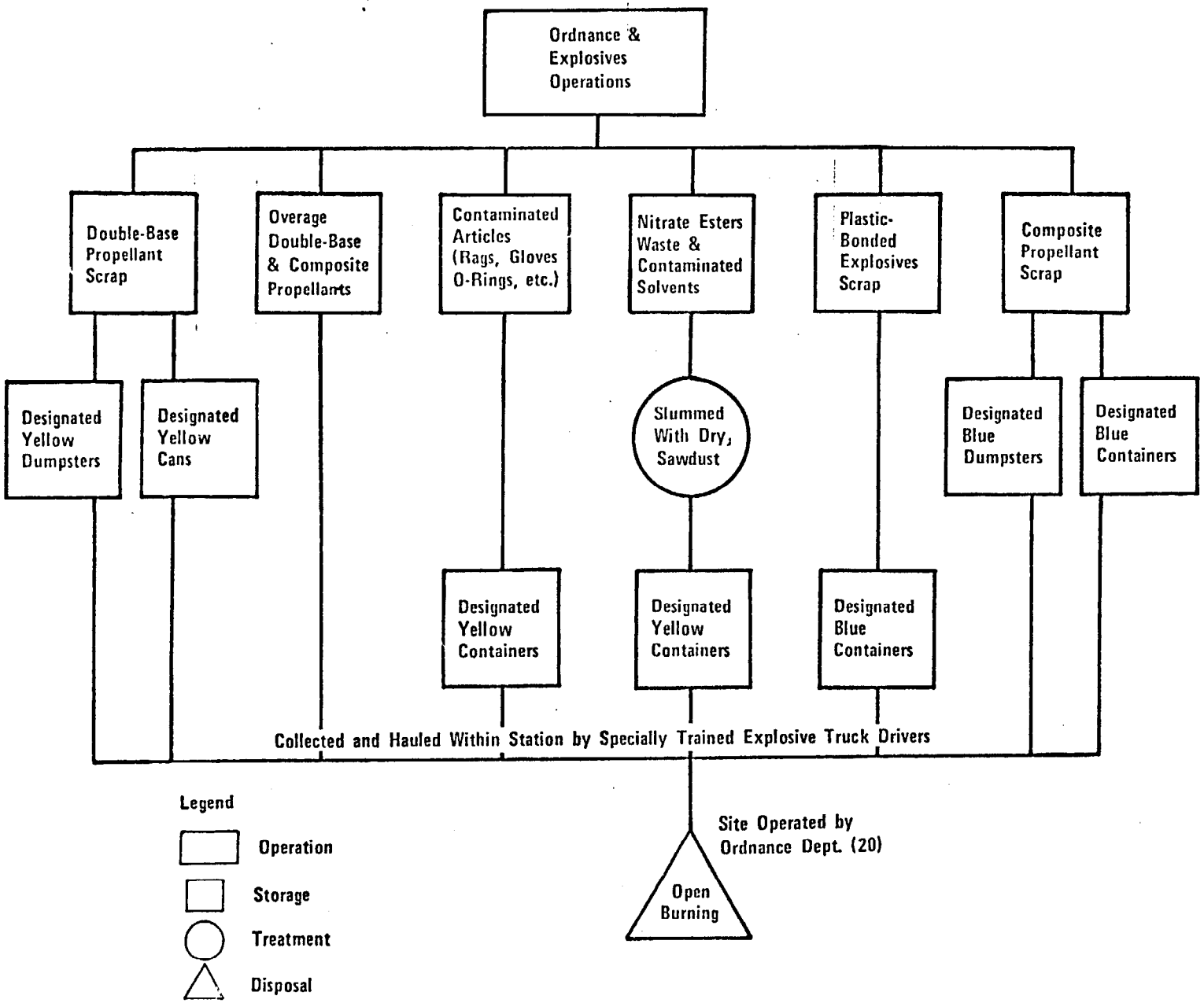


Figure 6.5.1 cont'd.

NOS Main Site

Hazardous Waste Storage, Treatment, and Disposal

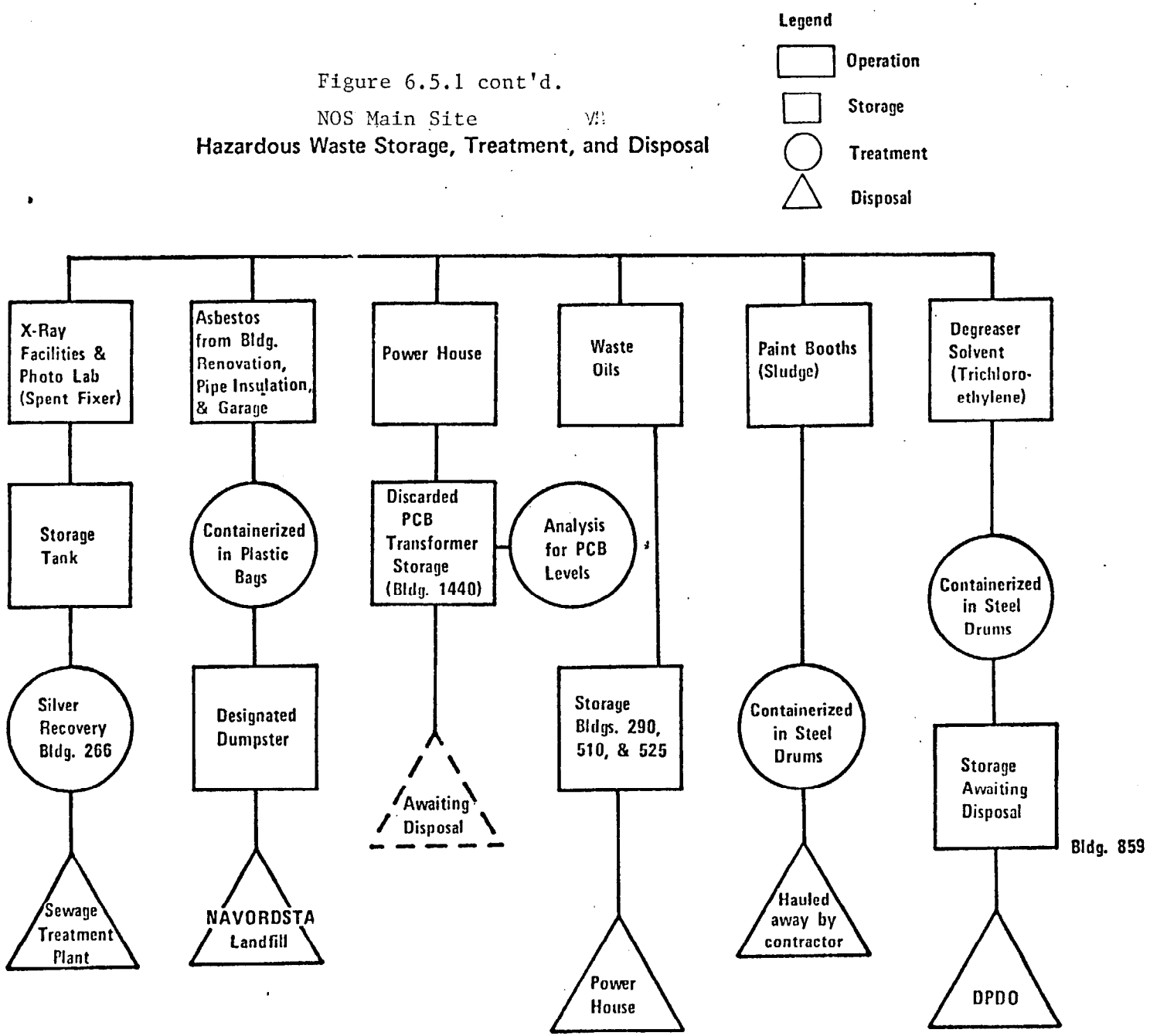


Figure 6.5.1 cont'd.

NOS Main Site

Hazardous Waste Storage, Treatment, and Disposal

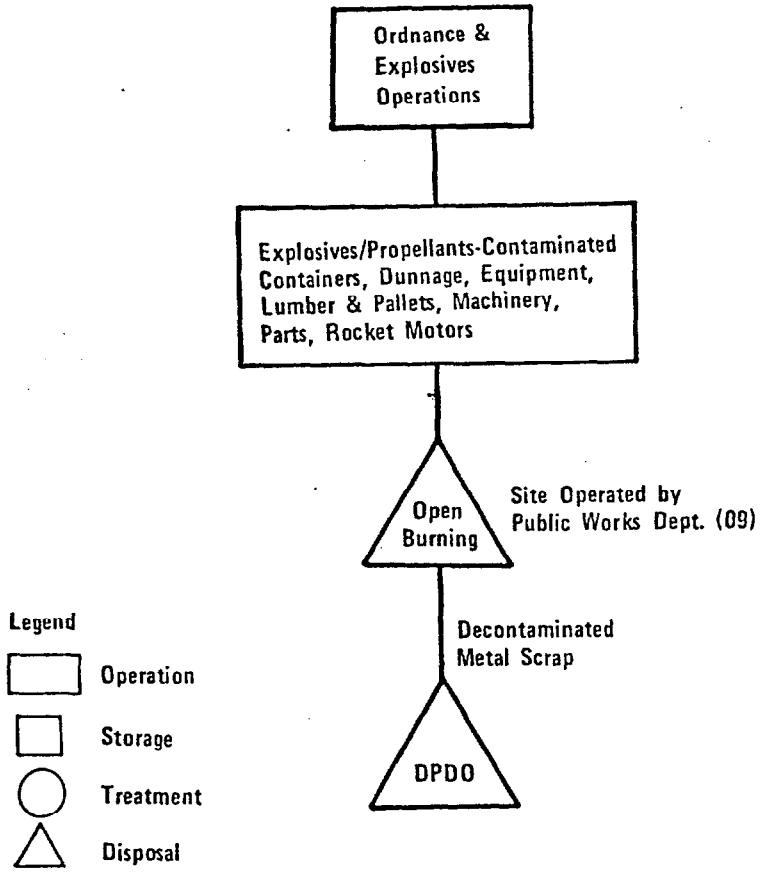
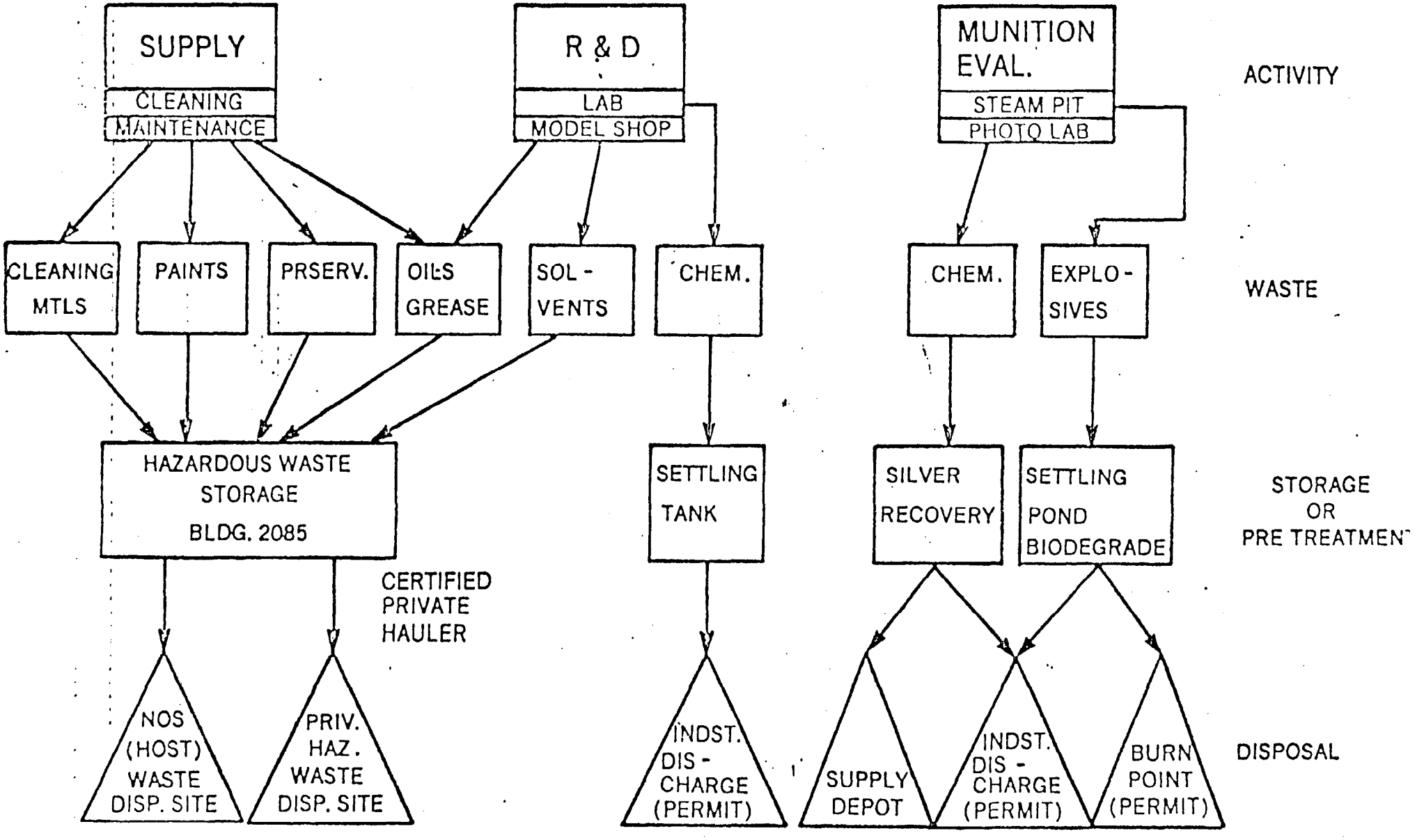


Figure 6.5.1

NOS Stump Neck
Hazardous Waste Storage, Treatment and Disposal



wastes are temporarily stored in a plastic tank in Building 266 (Property Disposal Office). It is estimated that approximately 4,500 lbs. of this material is generated yearly and average storage time is one day. The Supply Department operates an electrolytic silver recovery process which removes approximately 90 percent of the silver from the processing solution. The remaining solution is discharged to the sewage treatment plant. The spent fixer is analyzed periodically by the Naval Surface Weapons Center/ Indian Head Detachment Lab.

The fixer, developer, and wash waters were all discharged directly to the ground at Buildings 588, 731 and 1140 until approximately five years ago. At that time, NOS started collecting the processing solution for silver recovery, as described above.

6.5.4.3 Polychlorinated Biphenyls (PCBs)

Approximately 90 transformers in use or recently replaced on the station are suspected of containing polychlorinated biphenyl (PCB) dielectric coolant. Discarded PCB-suspected transformers were previously held at the Scrap Yard (R31). This portion of the Scrap Yard is no longer in use and transformers are now being stored at Building 1440 (GRID J8). The station's "Waste Analysis Plan" (October 1981) reported that of 27 discarded transformers awaiting disposal, nine contained PCBs, eight were PCB-contaminated and ten contained no detectable PCBs. It also stated that as transformers become unserviceable, the Department of Public Works will remove and store them, and the Naval Surface Weapons Center/Indian Head Detachment (NSWC/IH Detachment) will conduct analyses to determine PCB content. Dikes

have been installed at Building 1440 to contain any spilled PCBs from transformers stored there. Currently, a 5-gallon can and 20 1-gallon cans known to contain PCB-contaminated oil are also stored in Building 1440. It is estimated that there are approximately 8,200 lbs. of PCB-contaminated fluid at NOS which will be stored indefinitely until a proper EPA disposal method is approved. A list of facilities known to be locations of PCB-contaminated transformers is provided in Figure 6.5.2. Pyranol, Askarel and Inerteen are the brand names of the PCB products contained in the transformers. It should be noted that approved procedures relating to the marking and interim storage of PCB-contaminated material (pursuant to 40 CFR Part 761) are currently being instituted at NOS.

6.5.4.5 Paint Spray Booth Sludge

Sludge is formed at the paint spray booths in Buildings 730 and 717 during cleaning operations when a strong commercial alkali solution combines with the paint residue. This sludge is collected at the buildings in 55-gallon drums which are eventually transported to a landfill off-site. Approximately 1,000 lbs. of this material is generated annually.

6.5.4.6 Asbestos

Friable asbestos is contained in insulation on above-ground steam pipes which run throughout the installation (there are over 29 miles of this piping on the station). When the insulation is removed during repair of the steam distribution system or during building renovation, it is packaged in

Figure 6.5.2

TRANSFORMERS CONTAINING POLYCHLORINATED BIPHENYL (PCB) INSULATING OIL

Building	Kilovolt Amperes	Voltage	Material
D327	200	2.3-120-208	Pyranol
1556	300	13.2-120-208	Askarel
900	300	13.2-120-208	Askarek
901	750	13.2-120-208	Askarel
899	500	2.3-480-277	Pyranol
128	200	2.3-480-277	Pyranol
292-A	200	2.3-480-277	Pyranol
1035	300	2400-480	Askarel
1022	500	2400-480	Askarel
613	500	13.2-480-277	Pyranol
600	300	2400-208	Pyranol
D323	225	2.3-120-208	Askarel
2076SN	225	277-480	Askarel
2072SN	100	120-240	Askarel
BEQ	225	13.2-120-208	Askarel
BEQ	225	13.2-120-208	Askarel
675	225	13.2-480-277	Inerteen
465	45	13.2-120-208	Pyranol
783	75	13.2-480	Pyranol

Reference: U. S. Navy, Chesapeake Division Naval Facilities Engineering Command, Environmental Engineering Branch. Environmental Engineering Survey: Naval Ordnance Station (NAVORDSTA), Indian Head, Maryland. UIC N00.174. June 1980.

plastic bags and collected in a dumpster located next to Building 873. Once the dumpster is full, the bagged asbestos is disposed in the Bronson Road landfill.

Asbestos is an ingredient in the production of Pyroloc, an insulating material which is used to line rocket casings. The Pyroloc is removed by abrasive tumbling at Building 763. Waste Pyroloc is stored in 55-gallon drums in an uncovered area for final disposal. It is estimated that 600 gallons of this waste material is generated annually.

6.5.5 Storage Piles

Coal and road salt are stored in open areas on the station. Coal serves as an emergency fuel supply at the Goddard Powerplant (#6 fuel oil is normally used) and is stockpiled next to Building 768. Stormwater runoff from this area is consistently acidic, with pH recorded as low as 2.5. Metals may also be leaching from the pile. In 1967, a limestone filter bed was constructed to raise the pH, but without proper erosion control, the unit was destroyed. A proposal has been made to construct a new limestone filter bed in the stormwater drainage ditch near Building 128 ("Pollution Abatement Project C19-79, Coal Storage Effluent Neutralizing Facility," July 31, 1980). It has also been reported that, if coal conversion of the powerplant occurs, a berm will be constructed around the storage area and runoff will be pumped to an ion exchange effluent neutralizer tank located at Building 947. Coal was also observed along the shore near the old acid plant (T-35, U-35).

Road salt (calcium chloride) is also being stored in an open area near Lloyd Road identified as Building 408. High concentrations of chloride runoff from the road salt in stormwater which drains to the Potomac River.

6.5.6 Spill Events

There have been several spill incidents involving storage/production tanks. These are summarized in Table 6.6-12. On December 14, 1967, approximately 3,400 lbs. of nitroglycerin in two tanks detonated and an unknown quantity of Otto Fuel II from a storage tank and nitroglycerin in process lines and tanks escaped to a drainage ditch by the Biazzi Plant. Some of the spillage was collected and the area was decontaminated by explosive charges to render the site free from residual NG.

On March 1, 1975, an oil spill occurred at the Goddard Powerplant. It was attributed to an internally leaking fuel oil heater tube which permitted oil to vent into a condensate drain, eventually discharging via a storm sewer to Mattawoman Creek. It was estimated that approximately 3,000 gallons of #6 fuel oil was lost, spreading along four miles of the Creek's western shoreline. Wind and tide carried the oil upstream. A contractor was engaged and floatable booms were used to contain the spill. Clean-up operations were initiated, using wire nets and absorbent chemical under supervision of the U.S. Coast Guard and Maryland Department of Natural Resources. A Final Consolidated Oil Spill Report, dated March 20, 1975, indicated that evidence of oil slick or accumulation was no longer present with the exception of slight discoloration of the shoreline. Clean-up was

Table 6.6-12

SPILL EVENTS ASSOCIATED WITH STORAGE FACILITIES

Contaminant	Source of Contaminant	Quantity Spilled (lbs)	Quantity of Contaminant Recovered (lbs)	Remaining[2] (lbs)
Propylene Gylcol Dinotrate (PGDN)	Bldg. 1463	2325	--	2325
Di-butyl Sebacate (DBS)	Bldg. 1463	744	--	744
2-Nitro-diphenylamine (2NDPA)	Bldg. 1463	31	--	31
Otto Fuel II[1]	Bldg. 1463	3100	--	3100

Notes:

(1) Estimates of quantities developed from NOS safety reports and approximate Otto Fuel II formulations. Otto Fuel II estimated to contain 75 percent PGDN, 2 percent DBS, 1-2 percent (2NDPA).

(2) Team NOS personnel interviews indicated that spill was neutralized.

accomplished to the satisfaction of the State of Maryland Water Resources Administration and the U.S. Coast Guard. Monitoring was planned over the summer of 1975 to detect surfacing of sunk oil due to rising water temperatures; any oil was then to be removed.

On June 15, 1978, approximately 5,150 lbs. of dibutyl sebacate (DBS) was spilled from the storage tank at Building 1462 when a tractor trailer backed into the tank. DBS is a desensitizing and diluent agent of Otto Fuel, is insoluble in water, combustible and exhibits moderate to high toxicity.

6.6 WASTE DISPOSAL OPERATIONS

The environmental staff and subcontractors identified potential contamination sites during a one week site reconnaissance survey during the period 6/14-6/18/82, at NOS, Indian Head. Those pertaining to ordnance operations are discussed in section 6.2 of this report.

The following sections discuss the available information gathered about each site. Figures 6.6-1 and 6.2-1 show their locations at NOS.

6.6.1 Large Motor Test Area (MAP GRID B-4) (SITE NO.1) (FIGURE 6.6-2)

This site is the location of the large (Building 750) and small (Building 751) test areas constructed in 1953. This facility contains two contiguous firing bays for test firing large rocket motors. Terrier boosters, Talos and Bullpup missiles were fired from those test bays on a periodic basis since the facility was built. Each firing bay consists of a rocket launcher assembly and tracks mounted on 150 foot long concrete pads. Building 751 operations included electrolytic machining and periodic rocket motor wash downs after test firing and electrolytic machining. Test firing frequencies varied since both facilities opened in 1953, but usually occurred on a biweekly basis.

Small quantities of lead, cadmium and mercury were found in wastewater discharges into industrial waste effluent outfall number 23 (IW23). The total metals are estimated at less than 1 pound per year, based on average flow rates and metal concentrations. However, team site reconnais-

LEGEND

open drainage ditch

natural drainage course

storm drain or sewer

spill site

explosion site

IW	Industrial Waste Outfall Number
(715)	NOS Facility Number

Site Action Code

(A) Site requires confirmation study.

(B) Site requires confirmation study pending evaluation of "Action Code A" site results.

(C) NOS should consider minor remedial actions, investigations or review of operating procedures at site.

(D) Site requires additional survey/soil evaluation prior to any earthwork or change in land use. For sites contaminated with ordinance materials, explosive decontamination of site may be required prior to any earthwork activities.

(E) Site may be receiving unauthorized wastes.

(F) Site reconnaissance surveys, NOS personnel interviews and file searches were insufficient to determine the presence or extent of potential site hazards.

(G) Site indicates no apparent environmental or human health damage potential.

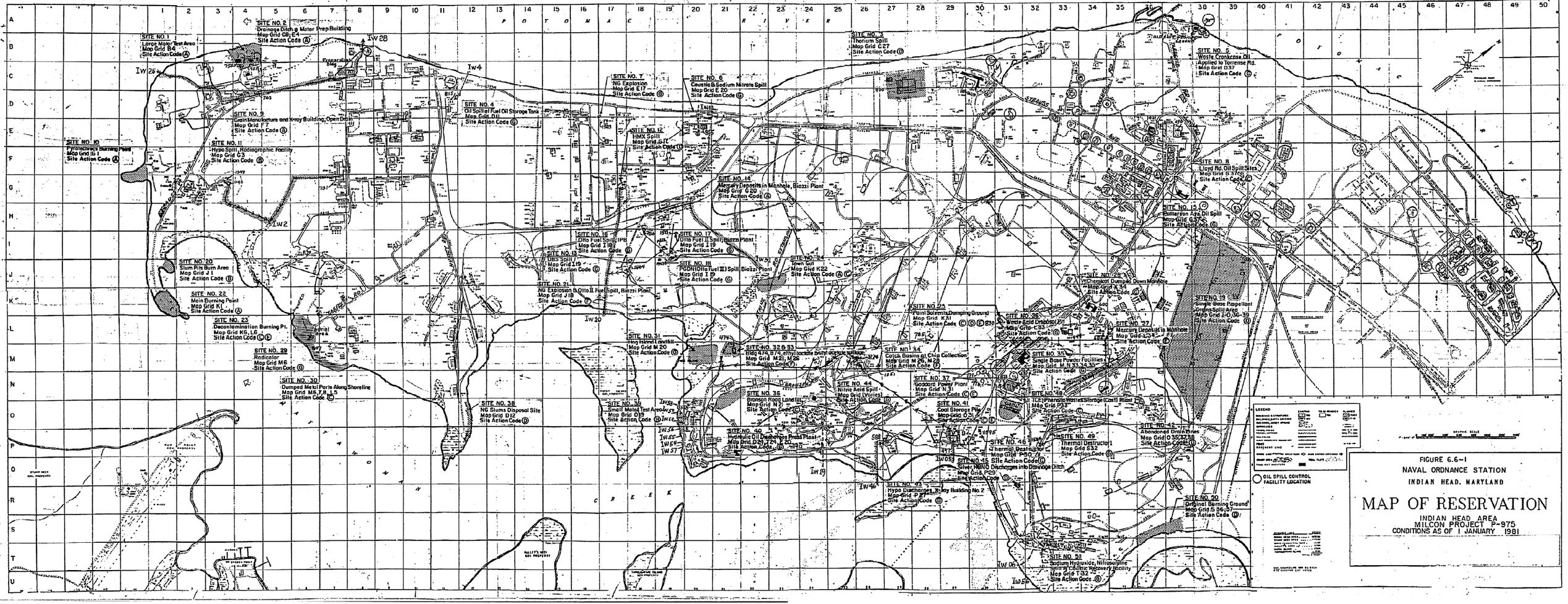


FIGURE 6.6-1
NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND

MAP OF RESERVATION

INDIAN HEAD AREA
MILCON PROJECT P-975
CONDITIONS AS OF 1 JANUARY 1981

6.6-2 SITE NO 1, LARGE MOTOR TEST AREA, severe vegetation stress and erosion in view, demolition debris put on slope for soil stabilization.

sance indicated that the rocket gas plumes emitted during test firings represented the most significant environmental hazard at this site. These plumes consist of carbon monoxide, carbon dioxide, nitric and hydrochloric acid, nitrous oxides, and various metal oxides (iron, aluminum, lead and copper). Table 6.6-1 summarizes the total quantity of particulate contaminants emmitted during test firing operations. Table 6.6-2 factors this information into the development of estimates for total quantities of particulate contaminants discharged at Site No. 1. Since these contaminants were emmitted as particulates in air plumes, it is not possible to determine whether this material was deposited at Site No. 1, Potomac River sediments, or was carried away by air currents. However, the plume has visibly eroded both concrete pads and resulted in severe vegetation stress to the foliage and grasses on the one-half acre side slope area situated between the end of the test pad and the Potomac River. Severe slope erosion has also taken place at this site and demolition wastes were put on the side slopes for erosion control. Rocket motor parts, metal salts and acidity may have contributed to contamination of both the side slope area and, to a lesser degree, the Potomac River. A confirmation study has been recommended to determine the extent of the contamination.

6.6.2 Drainage Ditch at Motor Preparations Building (MAP GRID C8,E4,) (SITE NO. 2) (FIGURES 6.6-3, 6.6-4, 6.6-5, 6.6.-6)

Wastewater contaminated with "Pyroloc" (an asbestos insulating material sprayed onto rocket casings), paint, and solvents was discharged at

Table 6.6-1

Large Motor Test Area Propellants Fired and Plume[2] Particulates Generated

Propellant Type	Quantity Burned During Test Firing (pounds per wk)	Quantity of Particulate Contaminants in Plume				
		Total Particulates	Aluminum	Iron	Lead	Copper
			(pounds per week)			
composite	3600	360	36	11	9	9
double base	3600	360	36	11	0	9
total	7200[1]	720	72	22	9	18

NOTES:

1) 360,000 pounds (7200 lbs x 50 wks/yr) of composite and double base propellant burned per year as reported by air and water pollution survey, ORD 048c/CMS/SWP-6240, NOS, Inidan Head, M.D., 18 January 1971.

2) composite propellants used in firing Tartar and Chaparral missles. Average plume solids concentrations assumed to be 10 percent particulates 3 percent iron, 2½ percent copper and 2½ percent lead. Double base propellants used in firing Terrier and Talos missles. Average plume solids concentrations assumed to be 10 percent particulates, 3 percent iron, and 2½ percent copper.

Table 6.6-2
Estimate[1] of Total Quantity of Contaminants Emitted into the Air

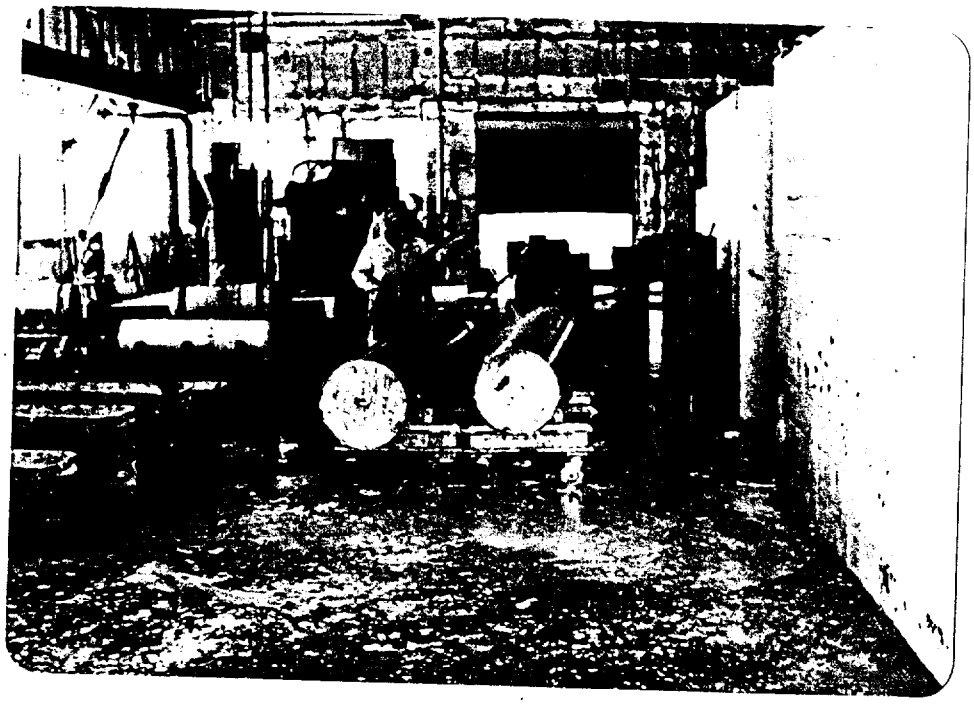
Contaminant	Source of Contaminant (propellant type)	Total Quantity of contaminants emitted During Test Firing (lbs)	Total Number of test firing operations During 20 yr. Period	Total Quantity of contaminants emitted During 20 yr. Period (lbs)
lead	composite	9	1500[2]	13,500
aluminum	composite	36	1500	54,000
	double base	36	1500	54,000
iron	composite	11	1500	16,500
	double base	11	1500	16,500
copper	composite	9	1500	13,500
	double base	9	1500	13,500
total metals	composites	121	1500	181,500

NOTES:

1) estimates of quantities (pounds) developed from average quantities of propellants burned during test firings annually, using estimated average solids content of exhaust sttream (Ref. Table 6.6-1)

2) 1 firing per week x 50 wks/yr x 30 yrs.

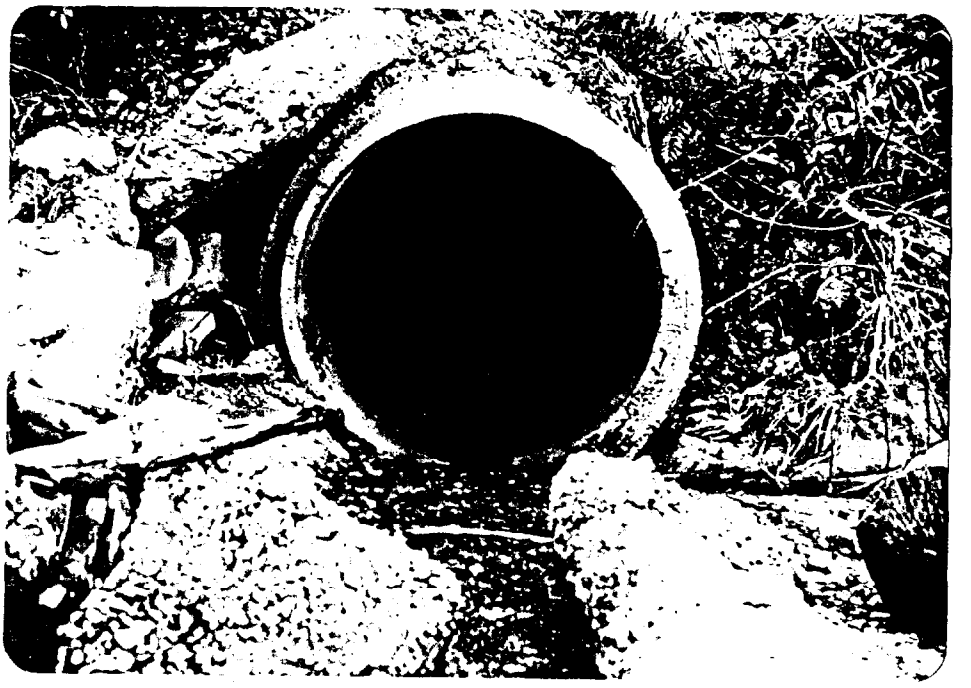
6.6-3 MOTOR WASHING OPERATION BUILDING 763



6.6-4 MOTOR WASHING OPERATION, Wastewater discharge into open ditch (IW25)

6.6-5 Milky green, asbestos, paint contaminated 1,500 foot, stretch of ditch (IW25), running southwesterly from Building 763 toward the Potomac River.

6.6-6 MOTOR PREPARATIONS BUILDING (717) OUTFALL (IW28) DISCHARGING INTO POTOMAC, Paint deposits in view.



IW25, into a 3,000 foot drainage ditch which flows southwesterly along Strauss Avenue before verging westerly into the Potomac River. Building 717 also has an open ditch discharge (IW28) which flows northwesterly 200 feet before entering the Potomac River. Between 1953 and 1982 the ditches received periodic wash downs and discharges from paint spray booth operations originating in both Motor Preparation Buildings (Building 717 and 763).

Contaminants known to be in the wastewater included "Pyroloc" paints and paint related contaminants such as solvents, (e.g., methylene chloride) and various metals (e.g., zinc, selenium and chrome), oil and grease, and suspended solids. During motor facility rework operations average wastewater discharges were 2,300 gallons per day. Table 6.6-3 summarizes wastewater quantity, characterization and discharge operations from these facilities. Table 6.6-4 factors this information into the development of estimates for the total quantities of contaminants discharging into Site No. 2. A combined volume of 4600 gallons per week were estimated to have been discharged into these ditches over the thirty year operating period of both facilities, resulting in a total discharge of approximately 800 pounds of asbestos, 500 pounds of total metals, and 800 pounds of methylene chloride. Since the wastewater discharges are intermittent and the ditch also carries stormwater runoff, it is not possible to determine whether this material was deposited in the ditch or in downstream Potomac River sediments. However, team site reconnaisance indicated a 1500 foot stretch of ditch containing a milky green discharge, and paint deposits at the Building 717 outfall. The discharges are currently regulated by NPDES Permit MD 003158.

Table 6.6-3

Motor Preparation Buildings
Wastewater Characterization[1]

Building	763	717
Wastewater Discharge[4] Flow Rates (range gpd)	1618	750
Contaminant Concentration (range mg/l)		
Total Suspended Solids (TSS)	56.0 - 9000.0	2.14 -66.0
Asbestos (ABS)	48.0 - 68.0	61.0 - 65.0
Total Metals	0.5 - 0.8	0.1 - 4.7
Methylene Chloride	5.0 -130.0	5.0 -420.0
Oil & Grease (O/G)	0.3 - 5.6	3.2 - 23.4

Notes:

(1) Characterization developed from analysis of twelve samples taken from building wastewater discharges as reported by Point Source Pollution Abatement Study (PSPAS), Naval Ordnance Station (NOS) Indian Head MD, July 1981.

(2) Discharges from both facilities were estimated to be 5 gpm during team site reconnaissance survey.

Table 6.6-4

Site No. 2
Estimate of Total Quantity of Contaminants
Discharged into Ditch

Contaminant	Source Of Contaminant	Total[1] Quantity Discharged During Daily Rework Operation (lbs)		Total Number[2] Days Rework Facility Operational During 20 Yr Period		Total Quantity Discharged During 20 Yr Period (lbs)
ABS	BLDG 763	0.03	X	2080	=	73
	BLDG 717	0.35	X	2080	=	728
Total Metals	BLDG 763[3]	0.06	X	2080	=	124
	BLDG 717[4]	0.02	X	2080	=	360
Methylene Chloride	BLDG 763	0.27	X	2080	=	561
	BLDG 717	0.17	X	2080		360
Total Suspended Solids	BLDG 763	26.0	X	2080	=	27 tons
	BLDG 717	2.0	X	2080	=	2.2 tons
						29.2 tons

Notes:

(1) estimates of quantities (pounds) developed from average flow rates and concentrations (Ref. Table 6.2-3)
(2) 2080 = two rework days/wk X 52 wks/yr X 20 yrs
(3) consisted of selenium, chromium and zinc
(4) consisted primarily of zinc

Various reports have been issued which set forth corrective actions for industrial wastewater discharges from these facilities. These reports include:

- Pollution Control Report (PCR) (PCR WK, 077K, L, M)
- Military Construction, MILCON P-963

A confirmation study has been recommended to determine the nature and extent of potential contamination and possible effects on aquatic life.

6.6.3 Thorium Spill (MAP GRID C27) (SITE NO. 3)

This site is the location of the special Weapons Disposal Building (Building 900).

From team NOS personnel interviews, it was learned that there had been some surface soil contamination, caused by an ordnance training session, near Building 900. Unfortunately, there were no records available on the history of this contamination event, or to document the current status of this area by contamination surveys. Interviews indicated that some cleanup took place, generating an unknown quantity of thorium-contaminated soil reportedly drummed and stored on base in Building 901. Therefore, since there are no records available to indicate the success or extent of cleanup of thorium-contaminated soil at Building 900, a thorough survey must be made before any excavation is done in the area or if any change in land use is made. A confirmation study is not presently recommended due to the absence of other hazardous materials in the vicinity.

6.6.4 Oil Spill at Fuel Oil Storage Tank (MAP GRID D11) (SITE NO. 4)

This site was the location of an oil spill resulting from the accidental discharge of an oil/rainwater mixture from a 15 x 25 square foot bermed area surrounding a 20,000 gallon aboveground oil storage tank. The incident occurred at the Fuel Oil Storage Tank (Building 815) circa June 1978. Approximately 5,000-6,000 gallons of the mixture (containing 1,000-2,000 gallons of #6 fuel oil) was pumped into a drainage swale resulting in discoloration of approximately 60 square feet of soil. The mixture entered an underground storm drain system (IW4) which discharges into the Potomac River. The drainage swale was covered over with sand to absorb the spilled oil.

Team file searches did not indicate any instances of adverse environmental impacts attributable to this incident and team site reconnaissance did not indicate the presence of any soil discoloration or stressed vegetation in the vicinity of the spill. Therefore, a Confirmation study is not recommended.

6.6.5 Waste Crank Case Oil Applied to Torrense Road (MAP GRID D37) (SITE NO. 5) (FIGURE 6.6-7)

This is the location of Torrense Road, a 20 foot wide gravel road bisecting the Old Navy Proving Ground. Waste oil from the NOS Transportation Branch Buildings was reportedly applied to unpaved roads behind Building 290 (Department of Public Works Maintenance Garage), for dust control prior to 1965. Waste oils from these facilities were generated at a

6.6-7 OLD NAVY PROVING GROUND, Small quantities of oil found in standing water of low point in roadway drainage ditch on the corner of Dashiell and Torrense Road.

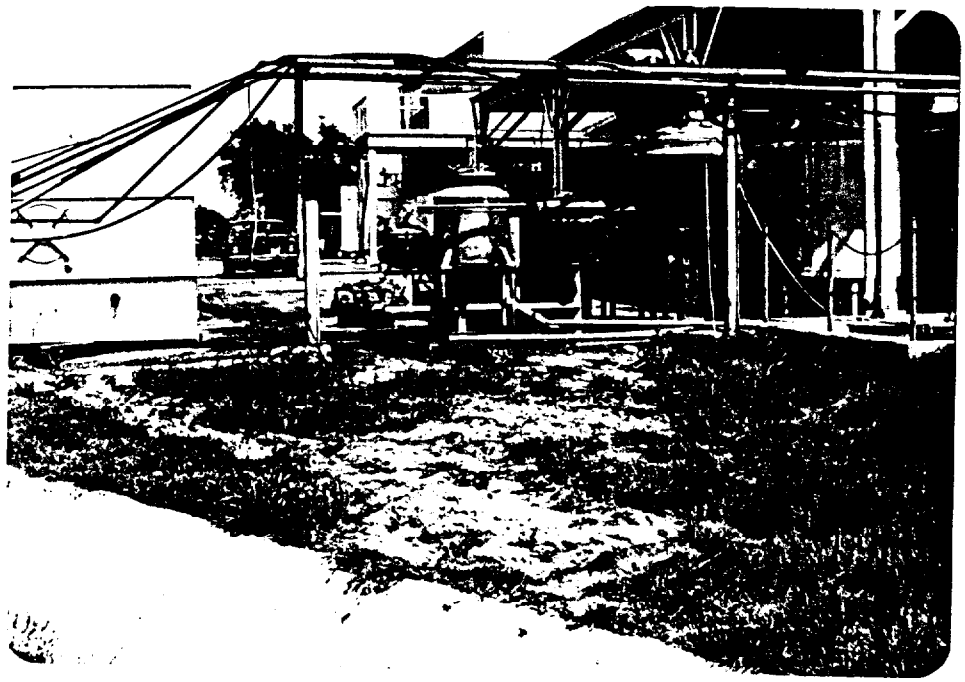
rate of 7700 gallons annually and consist of crank case, hydraulic, transmission, and motor oils. Current NOS waste oil disposal practices include mixing in with power plant fuels, and collection by private contractor for recycle.

Record searches could not identify the quantity of waste oils used as a dust palliative, but site reconnaissance indicated no signs of vegetation stress or oil stains on the road, or surfaces in the vicinity of the alleged oil application areas. However, small quantities of oil were found in standing water at a low point in a roadway drainage ditch on the corner of Dashiell and Torrense Road. Since the hydeogeology of the area is not conducive to contaminant migration, no Confirmation Study is recommended.

6.6.6 Caustic/Sodium Nitrate Spill (MAP GRID E20) (SITE NO. 6) (FIGURES 6.6-8, 6.6-9)

This site is the location of the Intermediate Process Building (Building 855). Approximately 50 pounds of sodium hydroxide and an undetermined amount of sodium nitrate were spilled during routine processing operations circa 1974-1975. The material spilled over a 6-inch dike and either contaminated adjacent soils and/or was discharged through the existing sewer system into the Potomac River (IW01). Procedures were reportedly implemented to neutralize the spill prior to entry into the river. The team site reconnaissance did not indicate any signs of spillage or stressed vegetation in this area. However, a 50-foot section of the High Explosives Bunker (Building 1090) drainage trough contained highly discolored water (reddish orange with an oily sheen). A steam condensate blow-off valve located over

6.6-8 PICTURE TAKEN BEHIND INTERMEDIATE PROCESS BUILDING (855) LOOKING NORTH TOWARD POTOMAC RIVER, Six-inch bermed area hidden from view by storage tanks.



6.6-9 Reddish orange water with oily sheen seen in drainage trough surrounding High Explosive Bunker (1090).

the trough periodically emitted condensate which collected in the trough. Although these troughs may have collected surface runoff from Site No. 6, the probable origin of the discolored water was the blow-off valve. (Similar situations correlating discolored water with blow-off valves were observed throughout the site). At this site, the hydrogeology is not conducive to migration into the aquifec. Therefore, a Confirmation Study is not recommended.

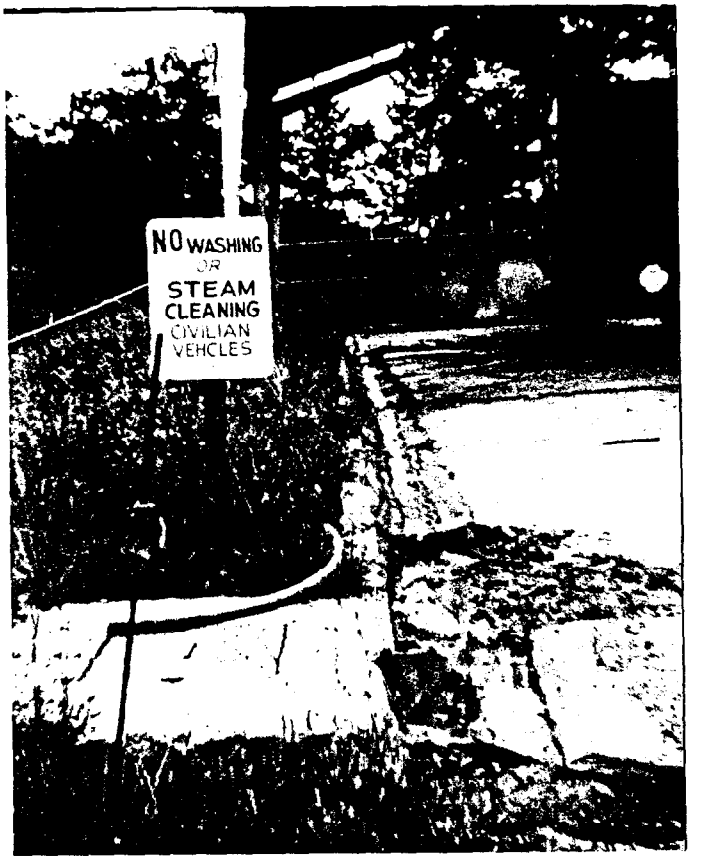
6.6.7 Nitroglycerin Explosion, Nitration Building Area (MAP GRID E17) (SITE NO. 7)

This is the location of the former Nitration Building (Building 675) which was demolished in a nitroglycerin (NG) explosion during NG production which occurred in September 1971. A Safety Department report indicated that "no material escaped from the building," and that the "...site was decontaminated explosively." Residual materials and demolition debris were buried at the end of the Caffee Road Landfill site (SITE NO. 23). Building 1543 (Nitration Building) was constructed to replace the destroyed facility. Since this site hydrogeology is not conducive to migration, this area was not recommended for a Confirmation Study.

6.6.8 Lloyd Road Oil Spill Sites, DPW Maintenance Garage Area (MAP GRID G37) (SITE NO. 8) (FIGURE 6.6-10, 6.6-11, 6.6.-12)

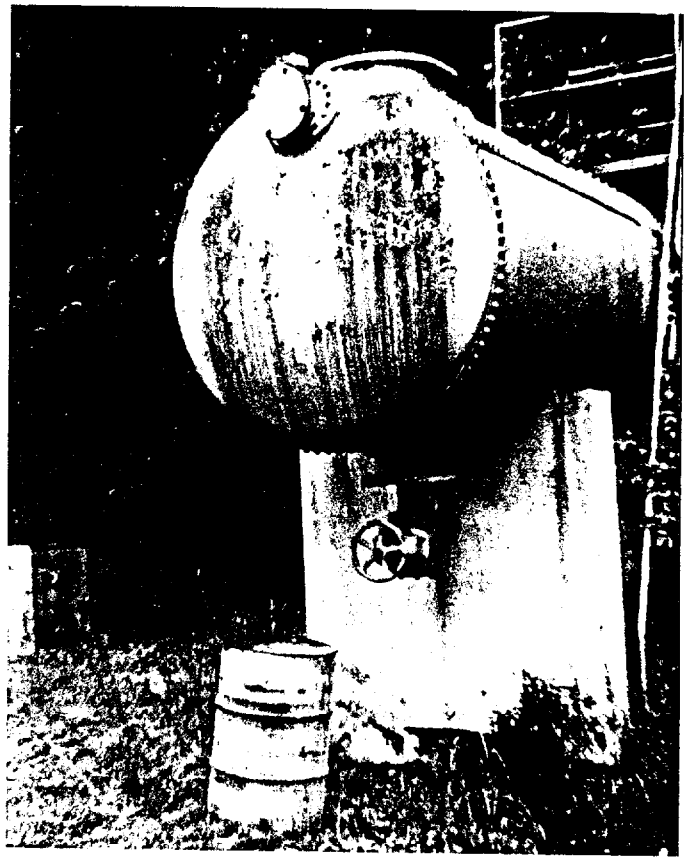
This site consists of a series of oil spills primarily occurring near Lloyd Road in the vicinity of the Department of Public Works (DPW) Maintenance Garage areas.

6.6-10 BUILDING 1421 TRUCK BAY, Steam cleaning operation in progress. 2 gpm oil water discharge in view.



6.6-11 400 square foot oil stain located 200 feet northwest of Building 290, above 1,000 gallon tank

6.6-12 550 gallon tank behind Building 290. Oil spillage lower right corner of picture.



Up until early 1981, waste oil from the DPW maintenance operations was deposited in a dumpster. Waste oil consisted of fuel oil, motor oil, and kerosene. These wastes overflowed the dumpster on two or three occasions, and the total amount of spillage is estimated between 50 and 100 gallons. Approximately one and one half years ago, a 500-gallon underground waste storage tank was installed to replace this dumpster. The team site reconnaissance did not indicate any signs of spillage attributable to the abandoned dumpster storage operation.

However, various sources of contamination were noted in this area. These included:

- a two gallon per minute oil/water wastewater discharge entering a drainage ditch which flows into the Potomac River. The discharge originates from the Building 1421 truck bay, where periodic vehicle steam cleaning operations take place.
- a 400-square foot area of contaminated soil located approximately 200 feet northwest of Building 290, above the 1,000-gallon underground storage tank in the vicinity of the aboveground tank piping, and
- a 100-foot stretch of oil contamination in standing water contained in a drainage ditch. Leakage may have originated from the spigot of the 550-gallon cylindrical aboveground storage tank behind Building 290.

No Confirmation Study has been recommended due to the low potential for migration into the groundwater.

6.6.9 Grain Manufacture and X-Ray Building, Open Drain (MAP GRID F7) (SITE NO. 9) (FIGURE 6.6-13, 6.6-14)

This is the site of the Grain Manufacture and X-Ray Building (Building 731) constructed in 1953. The x-ray section of this building houses an x-ray machine that uses water to cool the x-ray tube and to rinse the x-ray photos in the developing process. Approximately 4000 x-ray sheets per month are processed in this manner. The fix solutions are collected and transferred to Defense Property Disposal Office (DPDO) for silver recovery. The spent fixer from x-ray buildings and the photography laboratory is

6.6-13 GRAIN MANUFACTURE AND X-RAY BUILDING (731) OUTFALL IW2.

6.6-14 Blackish green colored wastewater discharge within 50 feet of IW2.

stored in a plastic tank in Building 266 (G35) where an electrolytic silver recovery process is operated. After the silver is recovered, the remaining solution is disposed through the NOS extended aeration sewage treatment plant.

Small quantities of silver, oil and grease (O/G) were found in wastewater discharges to an open ditch, (IW2). These quantities were estimated as 1-2 pounds per year (silver) and 3-6 pounds per year (O/G), based on average flow rates and effluent contaminant concentrations. Prior to 1965 all wastes, including fixer and developer, were dumped into IW2. (Other sources suggest that fixer and developer were dumped into open ditches prior to 1977) Table 6.6-5 develops estimate for the quantities of contaminants discharged into IW2. A combined quantity of approximately 450,000 pounds of sodium thiosulfate (fixer) and hydroquinone (developer) and 1800 pounds of silver was estimated to have been discharged over the 12 year period in which untreated wastewater was discharged from the x-ray facility. Hydroquinone is toxic, but reportedly begins to decompose shortly after discharge (as quinone) and, after further oxidation, the decomposition products include basic acids which are generally considered not toxic. Both hydroquinone and sodium thiosulfate are extremely soluble in water and sodium thiosultate decomposes rapidly under natural conditions. The most significant potential environmental hazard associated with this site is silver which is toxic at low levels to marine life. The silver thiosulfate complex in the presence of sunlight is reduced to a silver sulfide precipitate. Furthermore, stagnant pools and eddies commonly associated with open ditch discharges, would form anaerobic reducing environments favorable to the formation of silver precipitates.

Table 6.6-5

Estimate of Total Quantity of Contaminants
Discharged into Ditch

Contaminant	Source of Contaminant	Total Quantity of Contaminant Discharged Monthly (lbs)	Total Number of Months Facility was Operated During 20-Year Period (Months)	Total Quantity of Contaminant Discharged During 20-Year Period (lbs)
Sodium thiosulfate (fixer)	Building 731 x-ray facility	630	144	226,800
hydroquinone (developer)	Building 731 x-ray facility	630	144	226,800
silver	Building 731 x-ray facility	5(1)	144	1,800

NOTES:

1. estimates of quantities developed from manufacturers recommended solution application rates for fixer and developer, average monthly quantities of sheets developed at facility and average silver concentrations of in fixer baths as follows: Fixer and developer quantitites = (.0158 gal/sheet) (4000 sheets/mo) 4= 63 gallons; silver quantities = (35 grams/gal fixer) (63 gallons) fixer ÷ 454 grams/lb = 4.85 = 5 pounds (approx.)

These factors suggest that silver may have deposited along open ditch sidewalls and bottoms within the first two hundred feet of the Building 731 outfall and other NOS photolab outfalls as well.

Team site reconnaissance indicated a blackish green-colored wastewater with flow rates estimated as 10 gallons per minute. However, no vegetation stress was noted within the 500 feet of open drain area surveyed. This discharge is currently regulated by NPDES Permit MDC03158 and appropriate facility corrective actions (MILCON P-963) have been implemented by the Navy.

A confirmation Study has been recommended in order to determine the potential for contaminant migration to surface water.

6.6.10 Pyrotechnics Burning Point (MAP GRID G-1) (SITE NO. 10)
(FIGURE 6.6-15, 6.6-16, 6.6-17, 6.6-18)

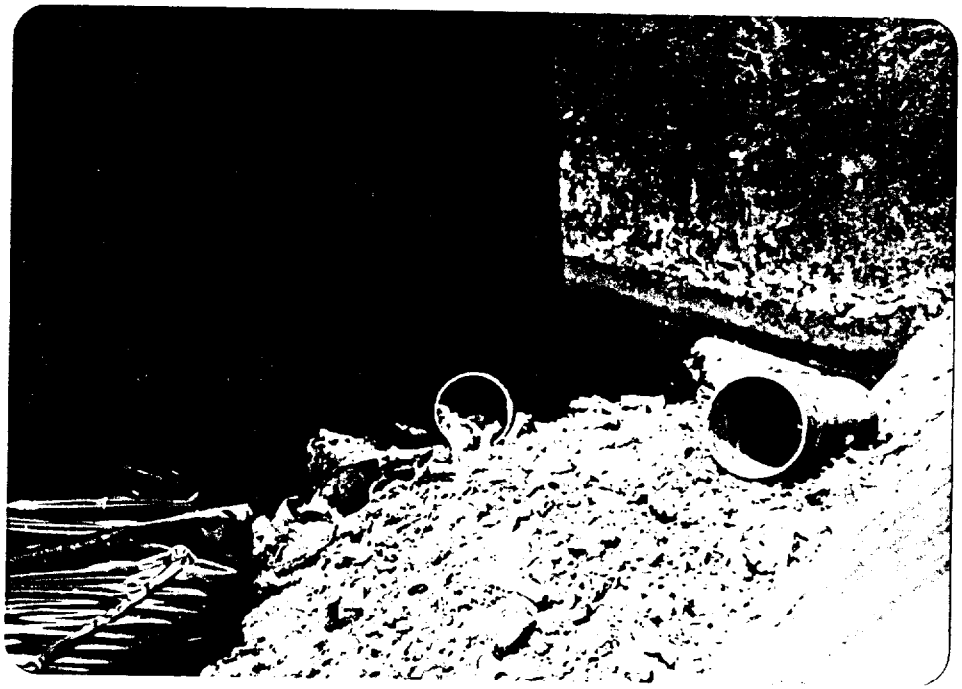
This is the location of a 1.4 acre site situated on a man-made peninsula midway between the Potomac River and Mattawoman Creek. This facility is also identified in the completed Navy Shore Activity Disposal Site Fact Form (NSADFF) as Site No. 2. Reportedly this site was built circa 1942-43 following the abandonment of the original burning ground (SITE NO. 50). Other sources place this date at approximately 1960. Materials used to construct the facility included sand, fill, rocket motor casings, empty cartridges and fly-ash from the Goddard Power Plant, which burned coal up until the late 50's. It is estimated that 8,000 - 10,000 cubic yards of fly ash may have been deposited at this site as fill material.

6.6-15 PYROTECHNICS BURNING POINT AS SEEN FROM THE MAIN BURNING POINT.

6.6-16 PYROTECHNICS BURNING POINT, Facility used to burn 25,000 pounds per year of pyrotechnics.

6.6-17 PYROTECHNICS BURNING POINT, Drums used to burn special solvent wet or water wet wastes. CAD items held in view.

6.6-18 PYROTECHNICS BURNING POINT DUMPSTER.



NOS waste pyrotechnics, single, double-base, and composite propellants were burned at this site until circa 1954 when the operation was transferred to the Main Burning Point (SITE NO. 22). The Pyrotechnics Burning Point (a/k/a Special Burning Area) is currently operated by the Safety Department and is used as a facility for incinerating 25,000 pounds per year of pyrotechnics, squibs, caps, initiators, cartridges, igniters and difficult to burn ordnance materials such as propellants contaminated with glass, water solutions contaminated with pyridine and pthalic anhydride, and small quantities of laboratory solvents.

Open burning of these materials and propellants began on a weekly basis circa 1942 and continued until circa 1954 when the propellant burning operations were transferred to SITE NO. 22. Open burning of pyrotechnics has been taking place on a weekly basis since circa 1954 governed by Standard Job Procedure (SJP) 001003. On an annual basis CAD items are burned (40-50 pounds per week) on a screened catch tray, and water or solvent wet wastes (10-20 gallons per week) are burned with oil in 55 gallon drums the tip of Site NO. 10. Residues from burned CAS items are stored on site in dumpsters (See Figure 6.6-18) and are periodically transported to Decontamination Burning Point (Site No. 22) for disposal.

Team site reconnaissance indicated no evidence of spillage or leakage of contaminants stored at this site. However, any spillage would have a high potential for entering the surrounding surface waters, since the burning facilities are located in an unbermed area. Reportedly, in the recent past, 5 gallons of an undetermined amount of waste solvents were spilled on site and may have entered the water as surface runoff. Further-

more, site interviews indicate that various quantities of metal items may fly out into the river during open burning. A strong solvent odor was noticed within 25 feet of the solvent drum burning facility.

The principal environmental concern associated with this site is the quantity of metals deposited in nearby river sediment as noted in previous NOS reports. Sources of lead contamination included the previous propellant disposal operations (circa 1942-1954), chrome and nickel contamination from open burning of CAD's (circa 1954-present) and various other metals from the fill material (fly ash and rocket motor casings) used to build the Pyrotechnics Burning Point (circa 1954). PCR W0778 was issued by NOS to address the issue of containing contaminants at the burning points.

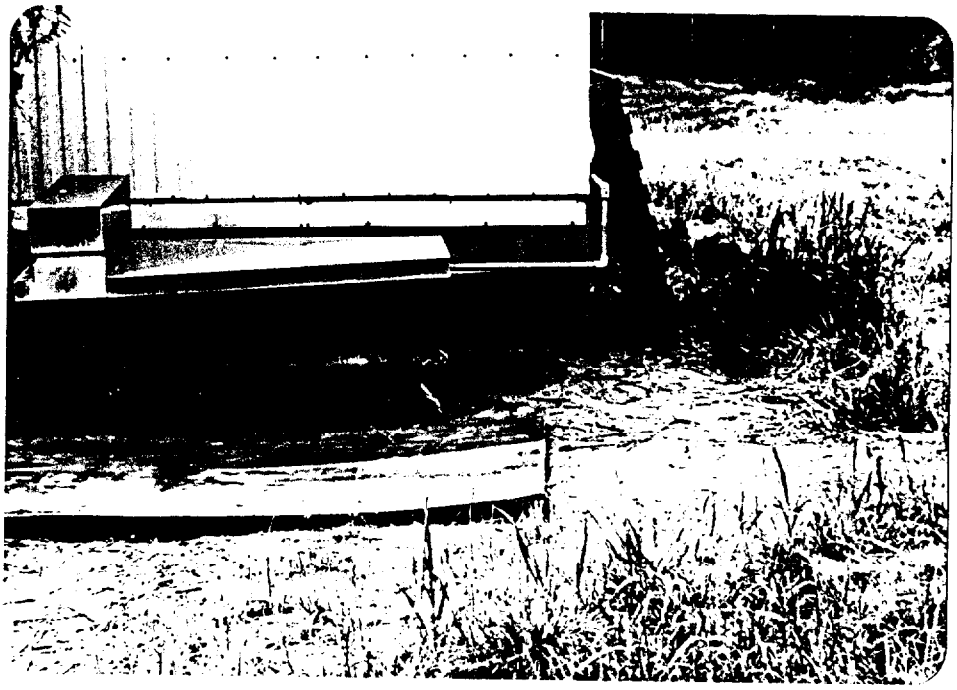
A Confirmation Study has been recommended to assess the presence and migration of contaminants to nearby surface water.

6.6.11 Hypo Spill, Radiographic Facility Accelerator Control Building, and Open Drain (MAP GRID G3) (SITE NO. 11) (FIGURE 6.6-19, 6.6-20)

This site is the location of the control building (Building 1349) for the Radiographic Facility Accelerator (Building 1140). These buildings were built in 1965. This building uses x-ray photos in the developing process. Approximately 2000 x-ray sheets are developed per month. The fix solutions are collected and transferred to the DPDO for silver recovery as described elsewhere (Ref. Site No. 9). Small quantities of silver and oil and grease (O/G) were found in the wastewater discharge. Approximately 5-6

6.6-19 CONTROL BUILDINGS (1349) AND RADIOGRAPHIC FACILITY ACCELERATOR (BUILDING 1140)

6.6-20 Stressed vegetation in vicinity of Building 1349 Hypo Storage Tank.



gallons of developer are discharged into an open ditch weekly. One interviewer stated that, prior to 1977, all wastes including fixer and developer were dumped into this open ditch, but this could not be confirmed at the present time. This waste is mixed in the plant rinsewater which is discharged continuously at a rate of 3 gallons per minute. This discharge is currently regulated by NPDES Permit MD003158, and appropriate facility corrective actions under (MILCON P-963) have been implemented by the Navy.

Reportedly, 10 gallons of fixer spilled to the ground behind Building 1349 ten years ago when the contents of an old tank were transferred to a newer storage facility. Team site reconnaissance indicated approximately 200 square feet of bare soil and stressed vegetation in the immediate vicinity of the spill. Subsequent spills may have occurred behind Building 1349 periodically. At this time no Confirmation Study is recommended. If however, a study of Site No. 9 confirms a danger to aquatic life, a study of Site No. 11 should be performed to establish contaminant concentrations and potential environmental effects.

6.6.12 HMX Spill, Slurry Mix Building (MAP GRID G18) (SITE NO. 12) (FIGURE 6.6-21)

This site is the location of the Slurry Mix Building (Building 682) constructed in 1948. Facility processing procedures included dewatering HMX, which was purchased in a slurry form and dehydrated in a vacuum press eductor. Wastewater was discharged into the floor drain and from there to an open storm ditch (IW10). Between 1964 and 1968, this ditch received periodic discharges from the eductor. Furthermore, some of this

6.6-21 SLURRY MIX BUILDING (682), Looking west, the Solvent Storage Building (1004) is in view.

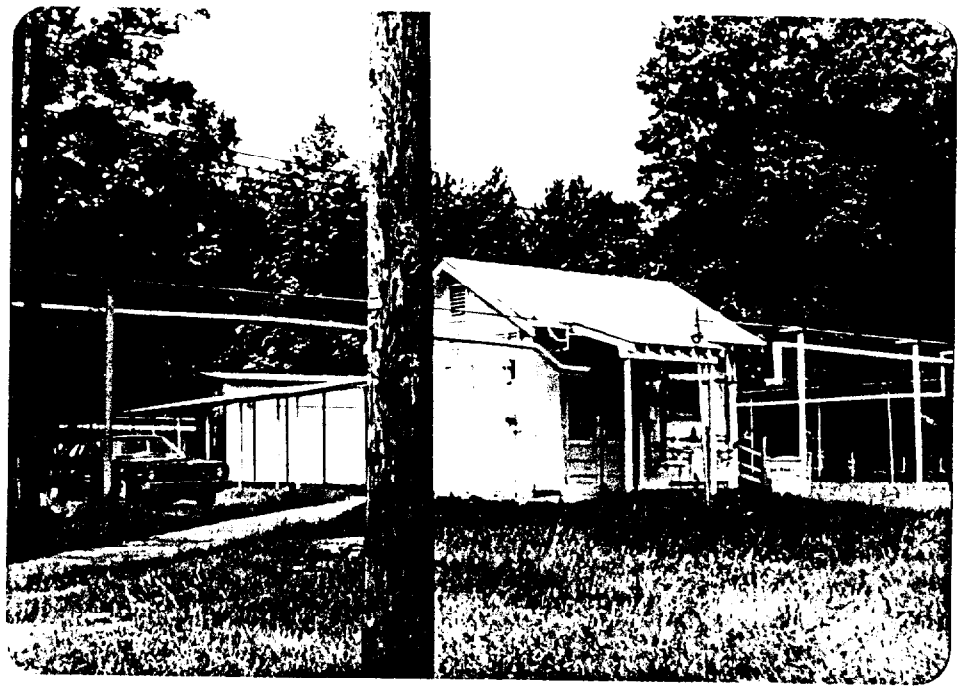


Table 6.6-6

Slurry Mix Building
Wastewater Characterization(1)

Building	682
Wastewater Discharge Flow Rates(2) (range gpd)	2,870
Contaminant Concentrations (range mg/l)	
Total Suspended Solids (TSS)	42.8 - 148.0
Lead (Pb)	0.3 - 7.5
Nitrate Esters (RNO_3)	630.0 - 1,000.0
Amines (RNH_2)	1.0 - 2.2
Pthalate Esters (PEs)	(3)
(OG) Oil and Grease	343.0 - 797.0

Notes

(1) Characterization developed from analysis of three samples taken from building wastewater discharges as reported by PSPAS, NOS, Indian Head, MD., July 1981.

(2) Building 682 discharge points consist of periodic wastewater from eductor and occasional washdown of concrete platform.

(3) Since pthalate esters (PEs) were insoluble, only 1 sample was taken for dibutyl pthalate less than (LT) 0.5 mg/l and dioctyl pthalate LT 0.5 mg/l.

Table 6.6-7

Site No. 12
Estimate of Total Quantity of Contaminants
Discharged into Ditch and Soil

Contaminant	Source of Contaminant	Total Quantity[1] Discharged During Facility Daily Operation (lbs)	Total Number Days Slurry Mix Facility Operational During 4 Yr Period (days)	Total Quantity Discharged During 4 Yr Period (lbs)
HMX	eductor discharge	1.7	1,000[2]	1,734
HMX	platform washdown	0.008	200[3]	8
Lead	eductor discharge	0.05	1,000	52

Notes

(1) Estimate of quantities (lbs) developed from average flow rates and average contaminant concentrations. Ref. Table 6.6-6. Average contaminant concentrations used in calculations:

HMX	100 mg/l
Lead	3 mg/l

(2) 1,000 = five operating days/wk x 50 wks/yr x 4 yrs
(3) 200 = one operating day/wk x 50 wks/yr x 4 yrs

material was periodically spilled onto the concrete platform floor of Building 682 and periodically washed out onto nearby ground surfaces. The slurry mix operation at Building 682 was terminated when the Polaris line was shut down circa 1968.

Contaminants known to be in the eductor wastewater included pthalate esters, nitrate esters, amines, lead, oil and grease as well as HMX. HMX ($C_4H_8N_8O_8$) is similar to cyclonite (RDX) in composition and physical characteristics. Both are major components of plastic explosives. HMX has a high thermal stability in the solid state and is denser than water (1.89 g/cc). The major hazard associated with HMX is its explosive characteristics, i.e., detonation velocity (9.1 km/sec) and available energy (2.46 kcal/mole).

During facility operations, average wastewater discharges were 2,870 gallons per day into the ditch. Operations also included periodic platform washdowns. Table 6.6-6 summarizes wastewater quantity, quality and discharge operations from these facilities. Table 6.6-7 factors this information into the development of estimates for the total quantities of contaminants discharging into Site No. 12. A combined volume of 14,000 gallons per week were estimated to have been discharged into the ditch (IW10) and 50 gallons per week to surface areas surrounding Building 682 over the four-year period during which HMX was worked at this facility. This resulted in a total discharge of 5-10 pounds of HMX (in area around building), 1,700 pounds of HMX (in ditch) and 50 pounds of lead (in ditch). Since the wastewater discharges were intermittent and IW10 also carries stormwater runoff, it is not possible to determine whether these contaminants were deposited in

the ditch or the Mattawoman Creek sediments. The soluble contaminants, nitrate esters (RNO_3) and amines (RNH_3), were probably washed away. However, HMX and pthalate esters may represent greater safety and environmental hazards due to the insolubility and density of these contaminants. Since HMX is extremely dense, it is likely certain quantities of material remain within the vicinity of Building 682. This potential safety hazard should be considered in any future development plans, especially regarding earthwork activities, in the vicinity of Building 682.

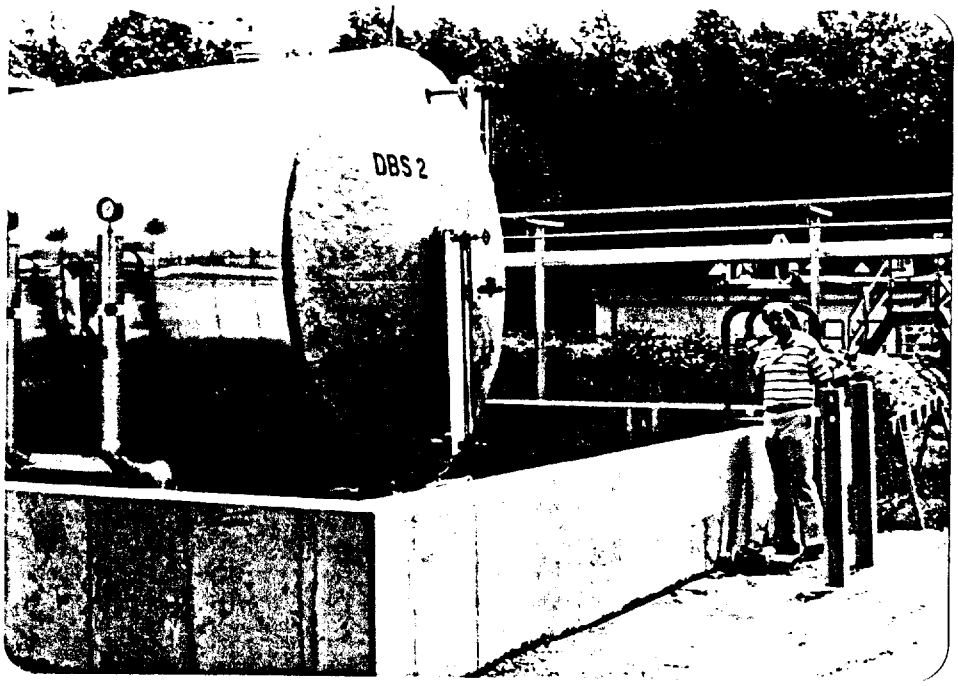
A team site reconnaissance did not indicate the presence of any stressed vegetation. However, waxy substances were found deposited in IW10.

As the hydrogeology is not conducive to migration, no cinfirmation Study is recommended at this time.

6.6.13 DBS Spill (MAP GRID I19) (SITE NO. 13) (FIGURE 6.6-22)

This is the area west of the Pre-mix Building (Building 1462), a facility which premixes dibutyl sebacate (DBS), a desensitizing and diluting agent into Otto Fuel II. Approximately 5,150 pounds of DBS were spilled onto the ground when a tractor trailer operator backed the equipment into the sight glass and valve of an above-ground storage tank on June 15, 1978. The spill covered an approximate 4,000 square foot area and subsequent soil sample analyses indicated DBS concentrations ranging from 3.2 to 6.6 percent by wet weight.

6.6-22 Site of the 1978 DBS Spill



DBS is insoluble, has a specific gravity of 0.936, and is a component used in the manufacture of cosmetics and food flavoring. Various sources indicate that the material is biodegradable especially in the acidic (pH 5.4) soil environment of the spill site. The team site reconnaissance did not indicate any signs of spillage or vegetation stress in this area. The hydrogeology is not conducive to migration and no Confirmation Study is recommended.

6.6.14 Mercury Deposits in Manhole, Biazzi Plant (MAP GRID G-20) (SITE NO. 14)

This is the location of the Biazzi Plant, NG Plant Office (Building 766), constructed in 1953. Industrial effluents originate from

Table 6.6-3

Motor Preparation Buildings
Wastewater Characterization[1]

Building	763	717
Wastewater Discharge[4] Flow Rates (range gpd)	1618	750
Contaminant Concentration (range mg/l)		
Total Suspended Solids (TSS)	56.0 - 9000.0	2.14 -66.0
Asbestos (ABS)	48.0 - 68.0	61.0 - 65.0
Total Metals	0.5 - 0.8	0.1 - 4.7
Methylene Chloride	5.0 -130.0	5.0 -420.0
Oil & Grease (O/G)	0.3 - 5.6	3.2 - 23.4

Notes:

(1) Characterization developed from analysis of twelve samples taken from building wastewater discharges as reported by Point Source Pollution Abatement Study (PSPAS), Naval Ordnance Station (NOS) Indian Head MD, July 1981.

(2) Discharges from both facilities were estimated to be 5 gpm during team site reconnaissance survey.

Table 6.6-4

Site No. 2
Estimate of Total Quantity of Contaminants
Discharged into Ditch

Contaminant	Source Of Contaminant	Total[1] Quantity Discharged During Daily Rework Operation (lbs)		Total Number[2] Days Rework Facility Operational During 20 Yr Period		Total Quantity Discharged During 20 Yr Period (lbs)
ABS	BLDG 763	0.03	X	2080	=	73
	BLDG 717	0.35	X	2080	=	728
Total Metals	BLDG 763[3]	0.06	X	2080	=	124
	BLDG 717[4]	0.02	X	2080	=	360
Methylene Chloride	BLDG 763	0.27	X	2080	=	561
	BLDG 717	0.17	X	2080		360
Total Suspended Solids	BLDG 763	26.0	X	2080	=	27 tons
	BLDG 717	2.0	X	2080	=	2.2 tons
						29.2 tons

Notes:

(1) estimates of quantities (pounds) developed from average flow rates and concentrations (Ref. Table 6.2-3)
(2) 2080 = two rework days/wk X 52 wks/yr X 20 yrs
(3) consisted of selenium, chromium and zinc
(4) consisted primarily of zinc

two sinks in the building laboratory. Laboratory procedures included cleaning mercury from glassware. Mercury is used in nitro-ester analysis accompanying production of NG and PGDN at neighboring Biazzi Plant Buildings.

Wastewater contaminated with mercury and possibly nitrate esters (RNO_3) is discharged into a 3,200-foot ditch (IW31) which flows southeasterly into the Mattawoman Creek. Between circa 1958 and the present time, this ditch received wastewater discharges four days per week.

Contaminants known to be in the wastewater included mercury, total suspended solids and oil/grease. During NG and PGDN production activities, average wastewater discharges were 225 gallons per day. Table 6.6-8 summaries wastewater quantity, and characteristics from these facilities. Table 6.6-9 factors this information into the development of estimates for the total quantities of contaminants discharging into Site No. 14. A combined volume of 900 gallons per week were estimated to have been discharged into either the manhole facilities or ditch over the 23-year period, during which mercury contaminated wastewater was discharged into IW 31. This resulted in a total discharge of 23 pounds of mercury. Since the wastewater discharges are intermittent and the ditch also carries stormwater runoff, it is not possible to determine whether this material was deposited in the manholes, ditch or downstream Mattawoman Creek sediments. However, in the summer of 1981, after NOS personnel removed 10 pounds of mercury from the manhole, an Erlenmeyer flask was hooked up to facility plumbing as a mercury sedimentation trap. This may have reduced mercury concentrations from the wastewater, since team site reconnaissance indicated no evidence of mercury precipitates in either the manhole or ditch, or any signs of stressed vegetation in the

Table 6.6-8

Biazzi Plant
Nitroglycerine Plant Office Wastewater Characterization(1)

Building Number	766
Wastewater Discharge Flow Rates (range gpd)	104-345
Contaminant Concentration(2) (range mg/l)	
Total Suspended Solids (TSS)	3.3- 39.0
Oil and Grease (O/G)	0.2- 5.5
Nitrate Esters (RNO_3)	5.0
Mercury (Hg)	2 ug/l- 5.0

Notes:

(1) Characterization developed from the analysis of three samples taken from building wastewater discharges as reported by PSPAS, NOS, Indian Head, MD. July, 1981.

(2) Analysis based samples taken during mercury analysis procedures accompanying NG and PGDN production.

Table 6.6-9

Site No. 14
Estimate of Total Quantity of Contaminant
Discharged into Manhole/Ditch

Contaminant	Source of Contaminants	Total Quantity[1] Discharged During Daily NG/PGDN Production (lbs)	Total[2] Number Production Days During 23-Year Period	Total Quantity Discharged During 23-Year Period (lbs)
Total Suspended Solids	Building 766 laboratory	0.03	4,600	140
Mercury	"	.005	4,600	23

Notes:

(1) Estimates of quantities developed from average flow rates (225 gallons per day) and concentrations (Ref. Table 6.6-8).
(2) 4,600 = 4 production days/wk x 50 wk/yr x 23 yrs.

vicinity of the Biazzi Plant. This discharge is currently regulated under a NPDES permit effective 1978 (Ref. Site No. 2). A Confirmation Study is recommended to determine if contaminants are present and if they pose a threat to aquatic life.

6.6.15 Patterson Avenue, Oil Spill (MAP GRID G37) (SITE NO. 15)

This site was reportedly the location of an oil spill from an oil tanker truck. Approximately 10,000 gallons of an unspecified fuel oil spilled as a result of the vehicle overturning in front of Building 320 circa 1958. NOS clean up efforts recovered an unknown amount of the spilled oil. The team site reconnaissance did not indicate any signs of spillage or vegetation stress in this area. Since the hydrogeology is not conducive to contaminant migration, no Confirmation Study has been recommended.

6.6.16 Otto Fuel II Spill, Intermediate Process Building (MAP GRID H18) SITE NO. 16)

This is the location of the Nitration House Building (Building 786), constructed in 1953. In 1977 approximately 5 gallons of Otto Fuel II was spilled onto the ground near Building 786. The spill was cleaned up and absorbed with sawdust, drummed and sent to the Radicator (ref. Site No.29) for disposal. Table 6.6-10 provides an estimate of the total quantity of Otto Fuel II spilled and recovered at Site No. 16. No confirmation Study has been recommended for this site.

6.6.17 Otto Fuel II Spill, Biazzi Plant (MAP GRID I19) (SITE NO. 17) (FIGURE 6.6-23)

This is the site of the Biazzi Plant's Otto Fuel Storage (Building 1513), the PGDN (poly glycol di-nitrate) Holding Houses (Building 1463) and the Pump House (Building 1506), facilities constructed in the late 60's. Otto fuel produced in the Nitration House is taken to the PGDN Holding House which is part of the Biazzi Nitration Plant. Facility manufacturing procedures included desensitizing Otto Fuel by adding DBS and 2-Nitrodiphenyl amine (2NDPA) to the fuel.

On May 31, 1979, there was an explosion of Otto Fuel caused by a malfunction of the filtering pump. This explosion triggered a secondary explosion in the pipe, line by Building 1513. The explosion took place in the vicinity of Buildings 1463 and 1506 and the Otto Fuel tanks leaked approximately 12,000 pounds of fuel which was primarily contained in Building 1463. The NOS Safety Department Report indicated that the material spilled "...was caught in the sump tank and was detected in the pump drain ditch. The building foundation was approximately 30 feet above ground water and has since been replaced by a new building. Approximately 95 percent of the fuel was recovered. Table 6.6-11 provides an estimate of the total quantity of Otto Fuel II spilled and recovered at Site No. 17. Recovered material was burned in the Pyrotechincs Burning Point (Ref. Site No. 10). A few pounds of material was spilled outside Building 1513 from the ruptured line and drums within that building were perforated by explosion fragments. Pipe leakage was decontaminated chemically and drum leakage was contained within the building. Reportedly, no leakage entered drainage Ditch IW31 due to the

Table 6.6-10

Site No. 16
Estimate of Total Quantity of Contaminants Spilled and Recovered

Contaminant	Source of Contaminant	Quantity Spilled (lbs)	Quantity of Contaminant Recovered[2] (lbs)	Remaining (lbs)
Propylene Gylcol Dinitrate (PGDN)	Bldg. 786	37.5	37.5	--
Di-butyl Sebacate (DBS)	Bldg. 786	12.0	12.0	--
2-Nitro-diphenylaomine (2NDPA)	Bldg. 786	0.5	0.5	--
Otto Fuel II[1]	Bldg. 786	1250	950	--

Notes:

(1) Estimates of quantities developed from NOS safety reports and approximate Otto Fuel II formulations. Otto Fuel II estimated to contain 75 percent PGDN, 2 percent DBS, 1-2 percent (2NDPA).

(2) Estimate of 100 percent of spilled Otto Fuel recovered based on team NOS personnel interviews.

Table 6.6-11

Site No. 17
Estimate of Total Quantity of Contaminants
Spill and Recovered

Contaminant	Source of Contaminant	Quantity Spilled (lbs)	Quantity of Contaminant Recovered[2] (lbs)	Remaining (lbs)
Propylene Gylcol Dinotrate (PGDN)	Bldg. 1163, 1506, 1513	9000	8550	450
Di-butyl Sebacate (DBS)	Bldg. 1163, 1506, 1513	2880	2736	144
2-Nitro-diphenylamine (2NDPA)	Bldg. 1163, 1506, 1513	120	114	6
Otto Fuel II[1]	Bldg. 1463 1506, 1513	12,000	8400	600

Notes:

(1) Estimates of quantities developed from NOS safety reports and approximate Otto Fuel II formulations. Otto Fuel II estimated to contain 75 percent PGDN, 2 percent DBS, 1-2 percent (2NDPA).

(2) Team NOS personnel interviews indicated that approximately 95 percent of spilled Otto Fuel II was recovered.

Table 6.6-12

Site No. 18
Estimate of Total Quantity of Contaminants Spilled and Recovered

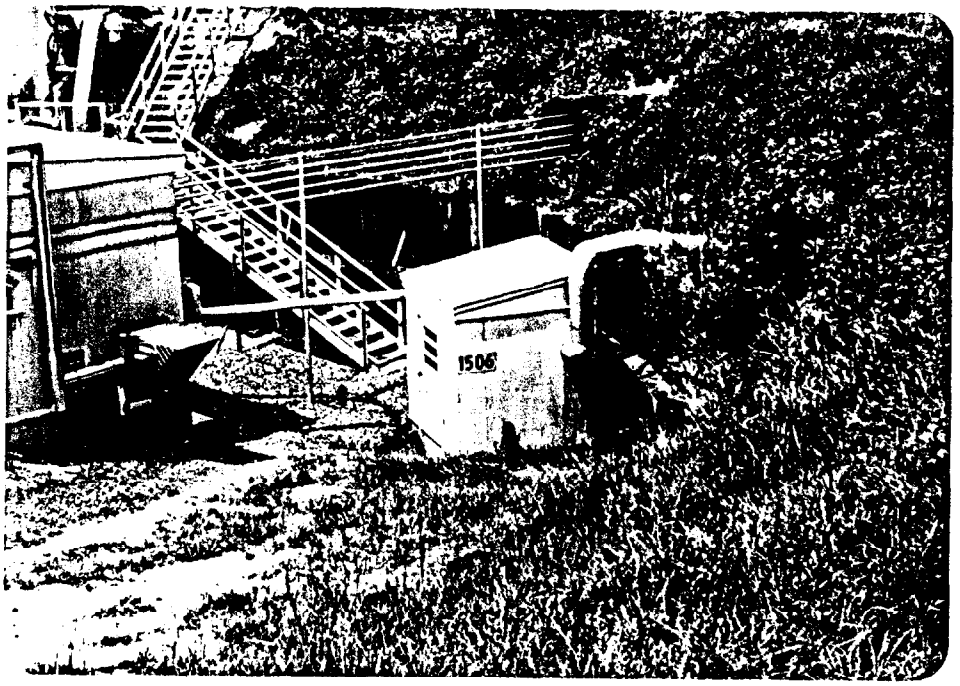
Contaminant	Source of Contaminant	Quantity Spilled (lbs)	Quantity of Contaminant Recovered (lbs)	Remaining[2] (lbs)
Propylene Gylcol Dinotrate (PGDN)	Bldg. 1463	2325	--	2325
Di-butyl Sebacate (DBS)	Bldg. 1463	744	--	744
2-Nitro-diphenylamine (2NDPA)	Bldg. 1463	31	--	31
Otto Fuel II[1]	Bldg. 1463	3100	--	3100

Notes:

(1) Estimates of quantities developed from NOS safety reports and approximate Otto Fuel II formulations. Otto Fuel II estimated to contain 75 percent PGDN, 2 percent DBS, 1-2 percent (2NDPA).

(2) Team NOS personnel interviews indicated that spill was neutralized.

6.6-23 BIAZZI PLANT'S PGDN HOLDING HOUSE (LEFT) (1463) AND PUMP HOUSE (RIGHT) (1506).



disabling of the pump in Building 1506 during the explosion. As the area hydiogrology is not conducive to migration to the main aquifer, no confirmation Study has been recommended.

6.6.18 PGDN (Otto Fuel II) Spill Biazzi Plant (MAP GRID I19) (SITE NO. 18)

This site is the site of the Biazzi Plant's PGDN Holding House (Building 1463) (Ref. Site No. 17).

This incident reportedly occurred as a result of a hose split during a PGDN transfer operation dated 2/22/79. Approximately 3,100 pounds of Otto Fuel II were discharged to the building sump drainage ditch. Although NOS safety reports indicate that this was a PGDN spill, various other NOS personnel indicated that, based on the color, the spilled material may have been Otto Fuel II. A catch tank system failure prevented the material from being retained as designed. barrier dams were constructed at two locations along the drainage path to prevent escape of material to off-station waters. The spill contaminated area along the drainage ditch was decontaminated with caustic and a final barrier was installed. Table 6.6-12 provides calculations of hazardous materials estimated to have been spilled at Site No. 18.

A Safety Department report indicated that some of the spill material was collected and ground areas were decontaminated by explosive charges. No Confirmation Study has been recommended due to the low potential for groundwater contamination.

6.6.19 Single Base Propellant Grains Spill Area. (MAP GRID I, J, K, L, M, N, 037 038, 039) (SITE NO. 19)

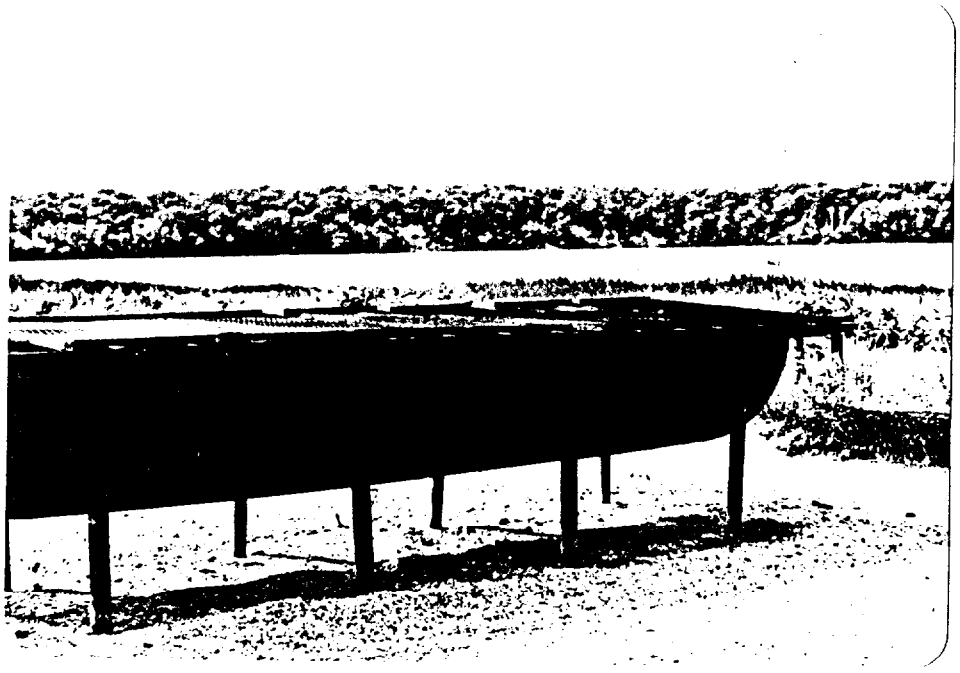
This is the location of a 14 acre area near the single base powder production area in the vicinity of the Powder Dry Houses. Team site reconnaissance indicated the presence of nitro cellulouse (NC) propellent grains contamination probably originating from spillage during the transportation of gunpowder. Since these grains are present in small quantities they do not represent a serious environmental hazard and no Confirmation Study has been recommended.

6.6.20 Slum Pits Burn Area (MAP GRID J1) (SITE NO. 20) (FIGURES 6.6-24, 6.6-25)

This is the location of a one-half acre site situated on Strauss Avenue, approximately 400 feet northwest of the Main Burning Point (Ref. Site No. 22). This site is currently operated by the Safety Department and is used as a facility for incinerating plastic bonded explosives (PBX's), nitrate ester slums, non-chlorinated casting solvents, igniters and flammable liquids, i.e., acetone, triethylene glycol dinitrate, diethyleneglycol, heptane, alcohols, ethers, and kerosene.

Open burning of these materials began circa 1968. PBX's, ignitors and pyrotechnics are burned in a fifteen foot cylindrical "sawed off" tub

6.6-24 SLUM PITS BURN AREA, Pyrotechnics Burn Tub, Mattawoman Creek in view.



6.6-25 SLUM PITS BURN AREA, Flammable liquids burn tub, Strauss Avenue, Potomac River in view.

supported above ground by welded steel angles. The slums, solvents and flammable liquids are burned in a 10,000 gallon "sawed off" above ground unsupported tank.

Table 6.6-13 lists the contaminated materials burned at this site on an annual basis. Team site reconnaisance indicated that the entire site situated on a penninsula in the Mattawoman Creek is devoid of vegetation although no surface spills were evident. However if only 1 percent of the solvents handled at this site were spilled or leaked from the solvents tank over the past 15 years, this would equal roughly 7,500 gallons of solvents in the soil. Since the containers are in good condition, no Confirmation Study is recommended. An impervious beam should be constructed around he tab area.

6.6.21 NG Explosion and Otto Fuel II Spill, Biazzi Plant (MAP GRID J18) (SITE NO. 21)

This is the site of the Biazzi Plant's NG Holding House (Building 1464) NG is transferred to this building using a water jet/aspirator where it is stored until tests are run and it is accepted.

On December 14, 1967, approximately 3400 pounds of NG in two tanks detonated. Ruptured pipelines, resulting from the explosion, caused leakage of approximately 7000 pounds of Otto Fuel II and some NG in process lines to spilled on to the ground and drained down through a natural drain area where it entered IW10. Table 6.6-14 provides an estimate of the total quantity of contaminants spilled at Site No. 21.

Table 6.6-13

Material Burned at Slum Pits Burn Area (1)

Quantity	Material	Description	Origin of Material
69,000 pounds per year	slums	nitrate esters(1)	Ordnance Activities
5,000 pounds per year	flammable liquids	non chlorinated casting solvent(3) & Otto Fuel	Ordnance Activities
1,100 pounds per year	PBXs	plastic bonded explosives	Ordnance Activities
25,000 pounds per year	pyrotechnics	(4)	Ordnance Activities

Notes:

(1) Source: Environmental Engineering Survey (EES), NAVORDSTA Indian Head Md. UICN00174, June 1978.

(2) nitrogylcerine, triethylene glycol dinitrate, triethylene glycol dinitrate

(3) acetone, heptane

(4) pyrotechnics, squibs, igniters, CADS/PAD's

Table 6.6-14

Site No. 21
Estimate of Total Quantity of Contaminants
Spilled at Site

Contaminant	Source of Contaminant	Quantity of Contaminant		
		Spilled (lbs)	Recovered (lbs)	Remaining (lbs)
Propylene Gylcol Di-notrate (PGDN)	Bldg. 1464	5250	--	5250
Di-butyl Sebacate (DBS)	Bldg. 1464	1680	--	1680
2-Nitro-diphenylamine (2NDPA)	Bldg. 1464	70	--	70
Otto Fuel II	Bldg. 1464	7000		7000

Notes:

(1) Estimates of quantities developed from NOS safety reports and approximate Otto Fuel II formulations. Otto Fuel II estimated to contain 75 percent PGDN, 2 percent DBS, 1-2 percent (2NDPA).

6.6.22 Main Burning Point (MAP GRID K1) (SITE NO. 22)

(FIGURE 6.6-26, 6.6.-27, 6.6-28)

This is the location of a 2-acre site situated on a man-made peninsula at the terminus of Strauss Avenue. This facility is also identified in the NSADFF as Site No. 1. The Main Burning Point (a/k/a conventional burning point) is currently operated by the Safety Department and is used as a facility for incinerating scrap single and double-base propellants fluorocarbon propellants, composite propellants and various propellant ingredients.

Open burning of these materials has been taking place on a weekly basis since circa 1954 when the Burning Point office (Building 880) was built. Other sources place this date at circa 1960. Prior to this, waste propellants were burned at the site now known as the Pyrotechnics Burning Point (Ref. Site No. 10). Table 6.6.-15 lists the materials burned at this site on an annual basis. During the summer months the scrap propellant is stored and transported in dumpsters filled with water for safety reasons. The scrap is put into a tank and the water is allowed to drain through a cheesecloth filter, into a drain pipe which flows directly into Mattawoman Creek. Table 6.6-16 summarizes wastewater quantity, characterization and discharge operations from the Main Burning Point, using this information to develop estimates of the total quantities of contaminants discharging from Site No. 22. A combined volume of 7800 gallons per year were estimated to have been discharged into the Mattawoman Creek over the 28 year (estimated) operating period of the facility, resulting in a calculated discharge of 16 pounds of lead, 9 pounds of amines, (RNH_3) and over 1 ton of nitrate esters

Table 6.6-14

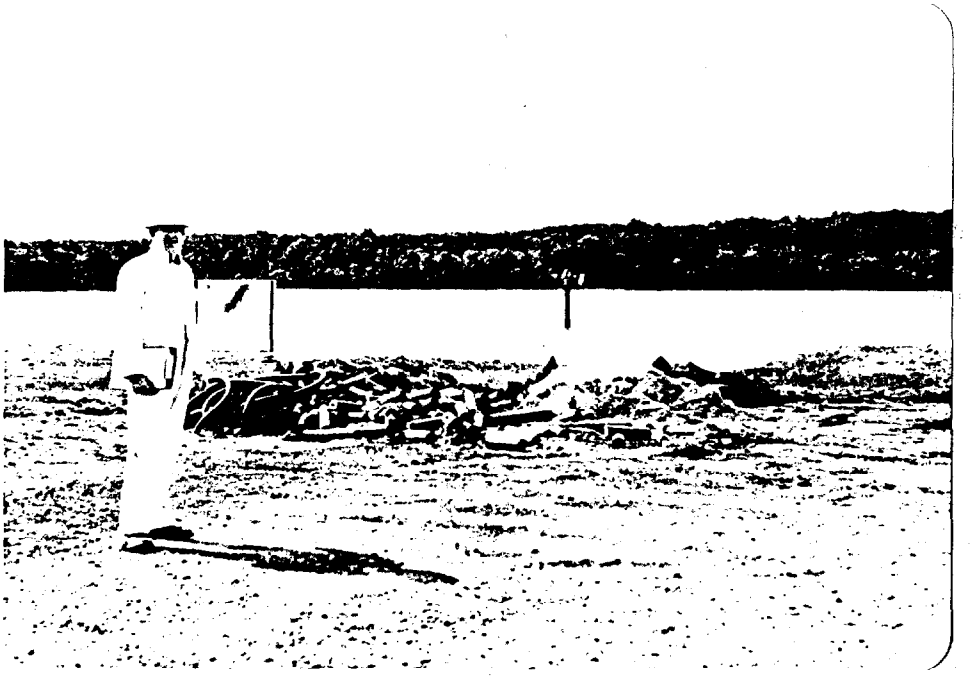
Site No. 21
Estimate of Total Quantity of Contaminants
Spilled at Site

Contaminant	Source of Contaminant	Quantity of Contaminant Spilled (lbs)	Recovered (lbs)	Remaining (lbs)
Propylene Gylcol Di-notrate (PGDN)	Bldg. 1464	5250	--	5250
Di-butyl Sebacate (DBS)	Bldg. 1464	1680	--	1680
2-Nitro-diphenylamine (2NDPA)	Bldg. 1464	70	--	70
Otto Fuel II	Bldg. 1464	7000		7000

Notes:

(1) Estimates of quantities developed from NOS safety reports and approximate Otto Fuel II formulations. Otto Fuel II estimated to contain 75 percent PGDN, 2 percent DBS, 1-2 percent (2NDPA).

6.6-26 MAIN BURNING POINT, Single base and composite propellent grains prior to open burning. Potomac River in view.



6.6-27 MAIN BURNING POINT, Open burning of scrap propellents shown in Figure 6.6-26.

Table 6.6-15

Material Burned at Main Burning Point[1]

Quantity	Material	Description	Origin of Material
634500 pounds per year	propellants	single & double base[2]	Ordnance Activities
119500 pounds per year	propellants	composite[3]	Ordnance Activities

Notes:

(1) Source: EES, NAVORDSTA, Indian Head, MD., UICN00174, June, 1980.

(2) Items burned include nitrocellulose, casting powder, grain end trims & slabs, shavings & chips from machining operations, carpet rolls, extrusion flashings, Terrier booster & sustainer grains, and PNC (plastisol nitrocellulose)

(3) Items burned include standard ARM sustainer & Booster scraps (cured), standard ARM propellant heels (uncured), standard ARM booster grains (rejects), JATO scrap & propellant grains (cured), JATO propellant heels (uncured), Ammonium perchlorate scrap, CTBN (carboxyl-terminated polybutadinene nitrile), HMX and RDX, HBNQ (high bulk nitroguanidine), hogged-out composite propellants, HTPB (hydroxyl-terminated polybutadiene), and powdered aluminum scrap.

Table 6.6-16

Main Burning Point

Propellant Scrap Cheesecloth Filter Wastewater Characterization[1]

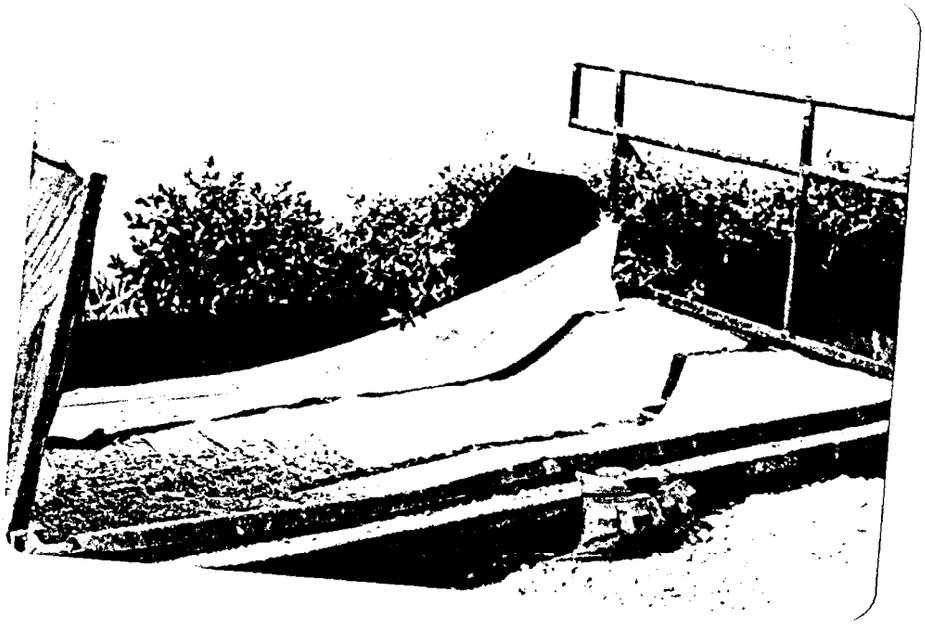
Outfall Number	IW31
Wastewater Discharge Flow Rates (gpd)	1800
Contaminant Concentration[2] (range mg/l)	
Total Suspended Solids (TSS)	183.0 - 8.0
Oil & Grease (O/G)	437.0 - 659.0
Nitrate Esters (RNO_3)	1000.0 - 1460.0
Amines (RNH_2)	1.5 - 10.0
Lead (Pb)	ND - 9.0

Notes:

(1) Characterization developed from analysis of two samples taken from filter wastewater discharges as reported by PSPAS, NOS, Indian Head, MD., July 1981.

(2) Discharges estimated to be 800 gallons per day during 13 burning days in summer season.

6.6-28 MAIN BURNING POINT, Dewatered scrap propellent or cheesecloth filter. Discharge Point IW51 and Mattawoman Creek in view.



(RNO_3). Since the amines and nitrate esters are soluble, it is most likely that these items were washed away over time. However, lead from this discharge combined with various metal oxide deposits resulting from open burning may have resulted in contamination of Mattawoman Creek sediments.

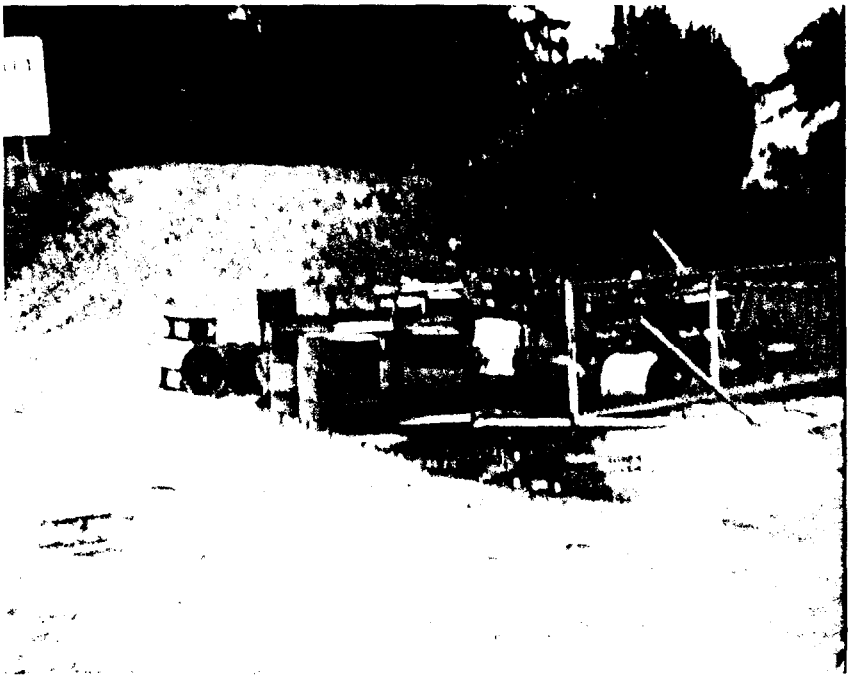
This discharge is currently regulated by NPDES permit MD03158. This site reconnaisance further indicated that surface runoff of contaminants (NG, double-based propellant grains containing lead salts) may also be a potential problem at the site. Furthermore, infiltration of NG into the sandy soil was documented by personnel familiar with the site. PCRW0778 was issued by NOS to address the issue of containing contaminants at the burning points. A Confirmation Study is recommended to determine levels of contamination and potential for migration into surface water.

6.6.23 Decontamination Burning Point/Caffee Road Landfill (MAP GRID K6, L6) (SITE NO. 23) (FIGURES 6.6-29, 6.6-30, 6.6-31)

This is the location of two contiguous one-acre sites situated at the terminus of Caffee Road approximately 200 feet southwest of the center line of the road. This facility is also identiifed in the NSADFF as Site No. 3. The Decontamination Burning Point (a/k/a/ Flashing Dump) site is currently operated by the DPW and is used as a facility for decontaminating bulk production items by open burning, and as a Scrap Metal Storage Area for decontaminated metal items. Scrap metal is sold periodically to outside contractors via normal bidding procedures by the DPDO. The Caffee Road Landfill is situated at the terminus of Caffee Road approximately 200 feet Southwest of the centerline of the road extending to the edge of the unnamed creek entering Mattawoman Creek.

6.6-29 DECONTAMINATION BURNING POINT, Looking south toward Mattawoman Creek. Flashed pile (foreground) unflashed pile (background).

6.6-30 DECONTAMINATION BURNING POINT, Looking north towards Caffee Road. Oil storage drums and leakage (entering Mattawoman Creek) in view.



Although the exact date open burning at this site began could not be established, this practice could be traced back as early as the late 1940's. Table 6.6-17 lists some of the materials flashed at the Caffee Road site. The site was never used as an authorized landfill, although occasionally certain bulk items and trash were buried here. Reportedly, on repeated occasions, M-1 rifles were buried here and bulldozed over with cover material. Other bulk metal and items (e.g. rocket motor casings), exploded building debris (Ref. Site No. 7), were deposited along the shoreline east of Caffee Road for an undetermined period of time. (Ref. Site No. 30) Reportedly, other undetermined materials were deposited in the lowland areas near Building 1440. This dumping could not be substantiated by team site reconnaissance surveys. Interviews and team site reconnaissance indicated that certain unregulated trash and dunnage dumping may have also taken place as well. In late 1980, NOS spent $30,000 to remove 5000-6000 cubic yards of deposited material. This material was primariliy flashed metal parts and dunnage which was removed by a private contractor for off-station disposal. The team site reconnaissance survey indicated that various materials were dumped or left uncovered for extended periods. Table 6.6-18 lists some of the items deposited at the Caffee Road site. Team site reconnaissance indicated that some of these items contributed to surface water contamination. Since this site is not operated as a landfill, there are no organized cover material application procedures to secure deposited or stored waste materials. Surface runoff, site leachate and air emissions present potential site hazards. The team site reconnaissance indicated the presence of uncontrolled spills over a 600 square foot area, uncovered and leaking drums, and dust (possibly asbestos) covering site vegetation. A solvent-like odor was noted on Caffee road approximately 50 feet north of the site and spillage and leaks were noted entering Mattawoman Creek.

6.6-31 DECONTAMINATION BURNING POINT, 100 feet south of Coffee Road entrance, pyroloc spillage from drums in view.

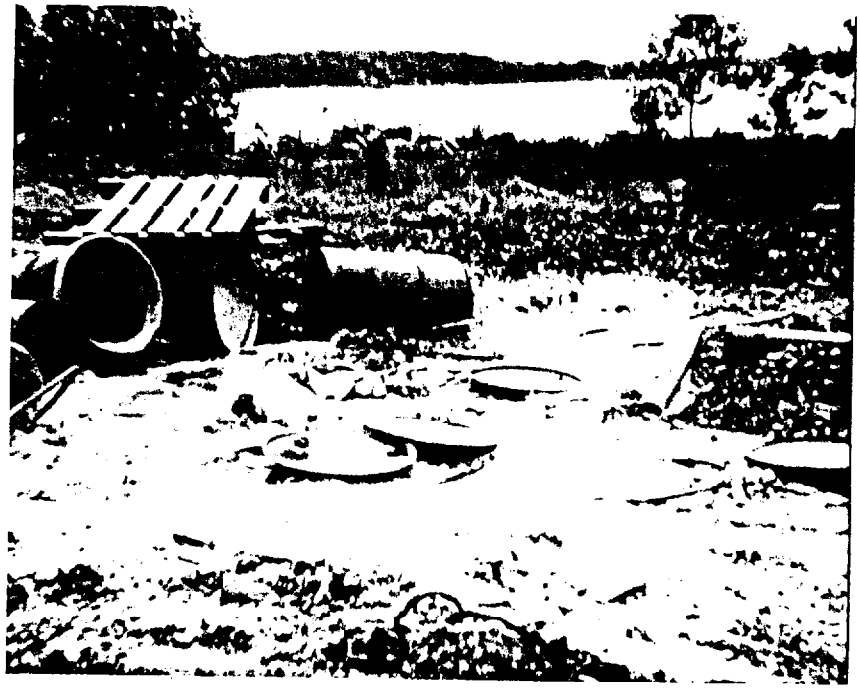


Table 6.6-17

Material Flashed in Caffee Road Site

Quantity	Material	Description	Original Material
17,000 pounds/yr(1)	Contaminated waste	gloves, rags, emptied contaminated waste in bags	Ordnance Activities
500,000 pounds/yr(1)	Contaminated waste	shipping containers dunnage fiber & steel drums, boxes, metal & plastic parts, smokeless powder bins	Ordnance Activities
100 pounds/yr(1)	Contaminated waste	extrusion wax out material	Ordnance Activities
Unknown(2)	M-1 Rifles		Unknown
330 gallons(2)(3) Yr 4 cubic yards/yr(2)	Waste oil, oil contaminated metal shavings	prime cutting oil, hydraulic oil, 10-40 motor oil, shavings contaminated with cutting oil	Bldg. 268 Bldg. 113 Bldg. 268
1/2 gallon/yr(2)	Safety solvent	residual in two 55-gallon drums	Bldg. 111
1 cubic yard/ur(2)	Oil contaminated material	four 55 gallon drums of bagged filters and oil soak	Bldg. 268

Notes:

(1) Source: EES, NAVORDSTA, Indian Head, Md. UIC N00174, June, 1980.
(2) Source: Team Interviews 6/14 - 15/82
(3) Source: Team site reconnaisance survey, 6/17/82 indicated spillage originating from drums.

Table 6.6-18

Material Deposited at Caffee Road Landfill

Quantity	Material	Description	Origin of Material
5-6,000 cubic yards(1)		flashed bulk waste	Ordnance Activities
5,000 pounds/yr(2)	residue	demilitarized ordnance material, propellant grains residue	Pyrotechnics Burning Point
26,000 pounds/yr(3)	residue	open burning residues	Caffee Road Landfill
2,000 cubic yards(4)	trash dunnage		Unknown
6 drums(5)	asbestos	pyroloc	Unknown

Notes:

(1) Material Excavated removed by NOS in 1980.

(2) Estimated Residue Generation 100 pounds/week.

(3) Q = Total Quantity of Material Flashed Annually x Estimated Combustible Fraction By Net Weight x Estimated Residue Fraction

Q = 517,000 (.25) (.20) = 25,050 say 26,000 pounds/year

(4) Material observed at site on surface during team site reconnaisance survey 6/17/82.

(5) Team site reconaissance survey 6/17/82 observed bags contaminated with phenolic compounds and pyroloc spillage from 2 drums.

6.6.24 Town-Gut (MAP GRID K22) (SITE NO. 24) (FIGURE 6.6.-32)

This site is the location of two plots 1.5 and 1.8 acres in size, which are separated by the new Atkins Road extension, with a fill area estimated to be approximately one acre. This facility was operated by NOS as a disposal site for landscaping waste, fill material and rubble beginning circa 1968 and terminating in June 1980. Reportedly, material was deposited at this site from off-station sources until 1972. The site is surrounded by a tidal wetland on two sides and it was filled from 10-15 feet above surrounding water surface elevations. The site is estimated to contain 80,000 cubic yards of material or 6,400 tons of mixed solid waste materials, primarily landscaping wastes, tree stumps and demolition debris. Team interviews indicated unauthorized dumping of trash may have occurred since operations at the site began, although estimates of quantities deposited were not available. Table 6.6-19 lists some of the items reportedly dumped at the Town Gut Landfill.

Table 6.6-20 provides calculations of hazardous materials deposited at the Town Gut Landfill based on the assumption that approximately 1000 gallons of paints and varnish were dumped at the site during the facility's operating years. These, items were included in the estimate because they were observed during the team site reconnaissance dated June 16, 1982 and were reported by various sources to have been deposited at the site (Ref. Table 6.6-19). Team site reconnaissance indicated that both sites were covered with grass and the site east of Atkins Road was capped over with clay. Empty paint and varnish cans, scrap metal, broken pieces of asphalt pavement and assorted trash was visible at the surface of both sites and waste material was observed strewn about the wetlands. A drum was found

6.6-32 TOWN GUT, Looking north into unnamed creek east of Atkins Road, drum spilling oily waste into creek in view.

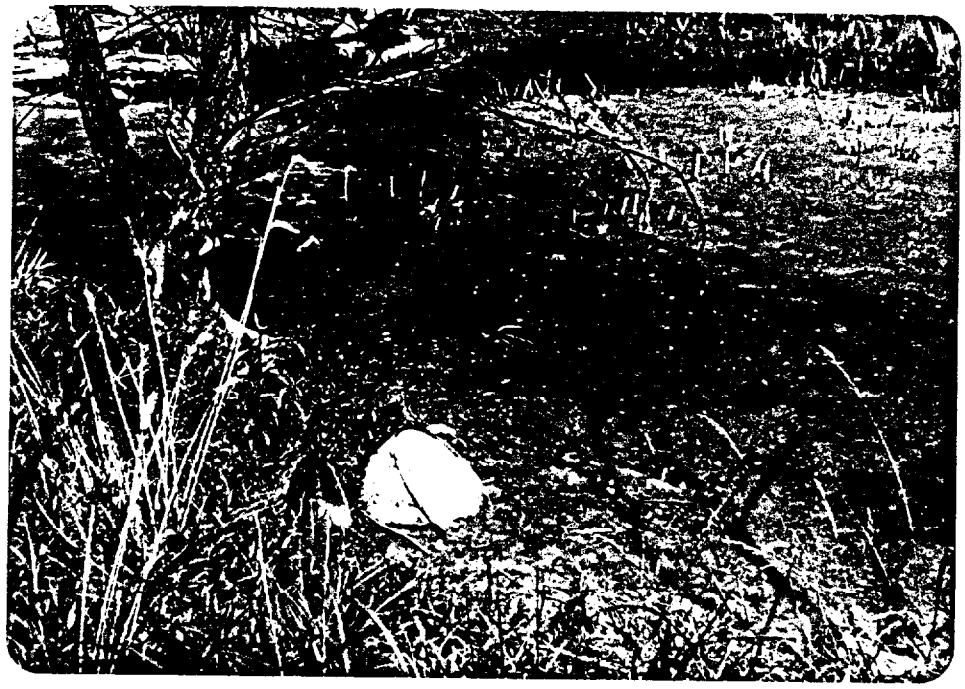


Table 6.6-19

Material Deposited at Town Gut Landfill

Quantity	Material	Description	Origin of Material
14 tons[1]	Solid Waste [2][3][4][5]	landscaping waste[2], bulk waste[2], tree stumps[2][4], trash, scrap metal[3], empty cans[5], drums[5], polyurethane containers[3], compressed gas cylinders[3]	NOS and Various Unknown Offstation Sources
Unknown	Paint[2][3][4] & Varnishes	paints & varnish left as residues in discarded empty cans	"
Unknown	Demolition[2][5] Wastes	broken up asphalt & concrete, rubble	"
Unknown	Chemical[5] Waste	spillage from drummed waste	"
Unknown	Arsenic Wastes	samples taken in creek adjacent to site indicated contaminant concentrations of 30 ppm	"

Notes:

(1) Total Estimated Quantity of Material Deposited (Tons) = Approximate Landfill Volume (Cubic Yards) X Estimated In Place Density of Deposited Materials

6,400 = (10 FT (DEPTH) X 43,500 SF(AREA)/27 CF/CY) (0.40 $\frac{\text{Tons}}{\text{CY}}$)

(2) Source: Team Interviews with NOS personel, Indian Head 7/14-15/82
(3) Source: Naval Ordnance System Command, Water Pollution Survey, ORD-04BC/6MB/SWP 6240, 18 January 1971
(4) Source: PSPAS, NOS, INDIAN HEAD, MD., July 1981.
(5) Source: Team site Reconnaissance Survey, 6/16/82

Table 6.6-20

Site No.
Estimate of Quantity of
Hazardous Materials Deposited
In
Town Gut Landfill

Contaminant	Quantity (range-pounds)
zinc, ethyl alcohol esters,	100-1000
arsenic, phenols benzene, toluene xylene, lead, titanium	10-100
ethyl acetate acetone, iron, chromium tetrachloroethane	1-10

Notes:

(1) Estimated Quantity of Material In Discarded Cans Discarded at Site

PAINT (13 lbs/gal)(0.1 gal/can)(1 can/wk)(52 wks/yr)(15 yrs) = 1014 lbs
VARNISH (10 lbs/gal) " " " " = 780 lbs

(2) Composition of Discarded Materials, Source: Industrial Chemistry, Kent

PAINT Zinc (15%), lead (5%), titanium (2%), chromium, iron, benzene, toluene, xylene, tetrachloroethane, ethyl acetate, acetone, ethy alcohol, ethylene glycol (each 1%)
VARNISH Phenols (10%) ethyl alcohol, ethyl acetate, acetones (each 15%)

to be leaking small quantities of a reddish oily waste into the wetland and vegetation stress in the vicinity of the site was noted. Results of NOS samples taken at the creek in the vicinity of the present spill reportedly indicated arsenic concentrations of 30 ppm. The recommended Confirmation Study should determine contamination trends, evidence of downstream movement and potential danger to aquatic and terestrial organisms.

6.6.25 Paint Solvents Dumping Ground (MAP GRID K31) (SITE NO. 25) (FIGURE 6.6-33)

This is the site of the Paint Shop (Building 870) which was constructed in 1953. Shop activities include painting various items by hand, aerosol sprays or in paint spray booths. Between 1953 and 1979, approximately 115 gallons per year of kerosene, mineral spirits, lacquer thinners and solvents may have been deposited in a 2000 square foot depressed area, approximately two feet below grade located 50 feet behind the Paint Spray Building. It is also estimated that approximately one percent of the 3380 gallons of paint used annually may have been washed off during paint equipment cleaning operations which takes place over uncontained bare soil areas behind Building 870. Table 6.6-21 summarizes the estimated quantity of hazardous materials dumped at Site No. 25 over a 26 year period, using assumed values for paint and lacquer thinner compositions annotated on the table.

Team site reconnaissance indicated severe vegetation and foliage stress over a 400 square foot area behind the shop and a strong solvent odor was noted up to 25 feet from the back of Building 870. The known waste mixtures

6.6-33 PAINT SOLVENTS DUMPING GROUND, Located 50 feet behind Paint Shop (870), stressed vegetation in view.

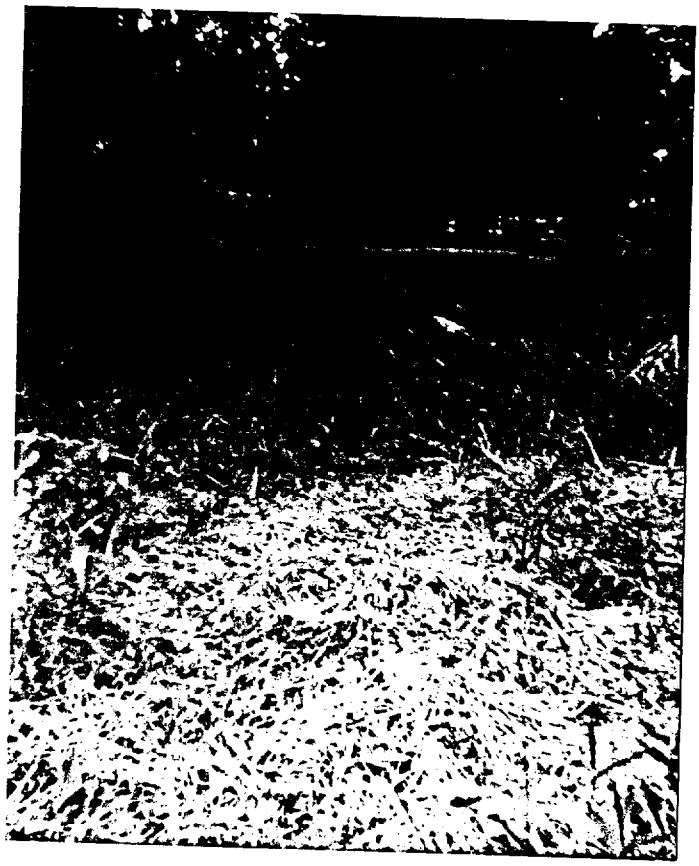


Table 6.6-21

Site No. 25
Estimate of Quantity of
Hazardous Materials Deposited

Contaminant	Quantity (range in pounds)
zinc (1), V-MEP naptha (2), kerosine (2)	1000-10,000
lead (1), titanium (1), toluene (2), 111trichloroethane (2) acetone (1)(2), ethyl alcohol (1)(2)	100-1000
ethyl acetate (1) chromium (1), iron (1), benzene ethyl alcohol, trichloroethane (1)	10-100

Notes:

(1) Estimated Quantity of Paint Washed From Rollers & Brushes Onto Site
(13 lbs/gal)(3380 gal/yr)(.01 gal/yr)(26 yrs) = 11,424 lbs
where: 3380 gal/yr/(Ref. Sec. 6.3.1.1.2)
.01 gal/yr - assume one percent of total quantity consumed (3,380 gal.) is washed out onto site
Composition of Paint Ref. Table 6.6-20

(2) Estimate of Quantity of Material Dumped on Site

Kerosene & v-m.e.p. naptha	(7 lbs/gal) X	(55 gal/yr)	(26 yrs) =	10,010 lbs ea
Toluene and 111trichloroethane	"	1 gal/yr	"	182 lbs ea
lacquer thinner	"	2 gal/yr	"	364 lbs ea

where: composition of thinner typically is assumed to be 1/3 acetone, 1/3 ethyl alcohol and 1/3 ether alcohol

(3) Quantity of each contaminant listed is estimated to fall within the range shown.

are not reactive or explosive and the hydruogology of the site is not conducive to migration. Therefore, no Cinfirmation Study is presently recommended.

6.6.26 Waste Acid Disposal Pit (MAP GRID L33) (SITE NO. 26)

This site is the location of a dump site 50 feet northeast of the Solvent Storehouse (Building 881), and 75 feet northwest of the Test Paper Manufacturing building (Building 444), facilities built in 1954 and 1941 respectively. Reportedly, undetermined quantities and types of waste acids and chemicals were collected from these buildings and various other NOS sources and dumped in a 15-20 foot-deep dry well. The dry well was filled in with chemicals and, in circa 1975, the material was dug up and removed and the dry well was filled in. Team site reconnaissance was not able to locate the site of the filled in dry well, nor did they discover any evidence of spillage, leaks or stressed vegetation in the vicinity of these facilities.

6.6.27 Mercury Deposits in Manhole, Fluorine Lab (MAP GRID L34) (SITE NO. 27)

This site is the location of the Fluorine Laboratory (Building 502) and the Surveillance/Sample Control Building (Building 103) facilities constructed in 1942 and 1902 respectively. Building 502 houses a laboratory to develop, provide and analyze bench scale quantities of experimental chemicals and fuels. The wide variety of products and processes developed here, require a wide variety of equipment such as water aspirators, and

condensers of different sizes and capacities, as well as jacketed reactors and vessels up to 50 gallons capacity.

Building 103 contains facilities to analyze raw materials and manufactured propellants for surveillance tests. The wastewater from this facility consists of water, acetone, and alcohol used to wash laboratory glassware.

The wastewater, from both buildings are discharged through underground pipes and combine in a manhole approximately 100 feet from Building 502. Wastewater then enters a 1200 foot ditch (IW06) which flows southeasterly into Mattawoman Creek. Between circa 1942 and the present time, this ditch received wastewater discharged four days per week.

Contaminants known to be in the wastewater included mercury, lead, total suspended solids and oil/grease. Average wastewater discharges were 1150 gallons per day. Table 6.6-22 summaries wastewater quantity, and characeristics from these facilities. Table 6.6-23 factors this information into the development of estimates for the total quantities of contaminants discharged into Site No. 27. A combined volume of 4600 gallons per week were estimated to have been discharged into either the manhole facilities or ditch over the 40-year period, in which contaminated wastewater was discharged into IW-06. This resulted in a total discharge of 64 pounds of lead and less than one pound of mercury. Since the wastewater discharges are intermittent and the ditch also carries stormwater runoff, it is not possible to determine whether this material was depositied in the manholes, ditch or downstream Mattawoman Creek sediments. However, in the summer of

Table 6.6-22

Fluorine Laboratory and Surveillance & Sample Control Building Wastewater Characterization[1]

Building Number	502, 103	
Wastewater Discharge Flow Rates (range gpd)	92-2160	
Contaminant Concentration[2] (range mg/l)		
Total Suspended Solids (TSS)	0-	8.0
Oil and Grease (O/G)	1.1-	9.9
Nitrate Esters (NO_3)	LT 5.0-	8.0
Mercury (Hg)	1.0-	2.3 ug/l
Lead (Pb)	0.5-	0.8

Notes:

1. Characteristics developed from the analysis of three samples taken from building wastewater discharges as reported by PSPAS, NOS Indian Head, MD., July 1981

2. Analysis of wastewater from this source for various other contaminants indicated that other constituents were either not present or present at concentrations below the level of detection; these included methylene chloride, zinc, copper, cadmium, silver and arsenic. Cyanide was found in one sample at a concentration of 3 mg/l.

Table 6.6-23

Site No. 27
Estimate of Total Quantity of Contaminants Discharged

Contaminant	Source of Contaminants	Total Quantity[1] Discharged (lbs)	Total[2] Number Production Days During 23-Year Period	Total Quantity Discharged During 40-Year Period (lbs)
Total Suspended Solids (TSS)	Bldg. 502, 103	0.05	8000	400
Mercury (Hg)	Bldg. 502, 103	1.7×10^{-5}	8000	0.14
Lead (pb)	Bldg. 502, 103	0.05	8000	64

Notes:

(1) Estimates of quantities developed from average flow rates (1150 gallons per day) and concentrations (Ref. Table 6.6-22).

(2) 8000 = 4 production days/wk x 50 wk/yr x 40 yrs.

1981, NOS personnel removed small quantities of mercury from building floor drains. Team site reconnaissance indicated no evidence of mercury or lead precipitates in either the manhole or ditch or any signs of stressed vegetation in the vicinity of the buildings. This discharge is currently regulated (Ref. Site No. 2). No Confirmation Study is recommended due to the low hydrogeologic potential for contaminant migration.

6.6.28 Chemicals Dumped Down Manhole (MAP GRID K34) (SITE NO. 28)

This is the location of the Research and Development building (Building 600), constructed in 1944. This building contains chemical research laboratories. Reportedly, waste chemicals were dumped into the plumbing system where it combines with sanitary sewage and flows to the NOS sewage treatment plant. Approximately 80 chemical compounds are generated or procured by this facility on an annual basis. Materials generated in quantities exceeding ten gallons per year (or 100 pounds per year) are listed in Table 6.6-24. These materials include acids, amines (RNH_3), cyanide compounds, and both chlorinated and nonchlorinated solvents. Other materials generated by Building 600 in smaller quantities and not listed in Table 6.6-24 include alkalies, alcohols, aldehydes, metals and metal compounds (including zinc, iron, cadmium, lead and mercury) and asbestos. (Ref NOS List of Hazardous Materials, June 1980).

A limited characterization of wastewater discharged from this building was reported in PSPAS, July, 1981. Amines (RNH_3), metals (cadmium, lead, zinc, copper, mercury, silver) cyanide, nitrate esters (RNO_3), trichlorethylene (TCE) and methylene chloride were among the contaminants analyzed. In six samples taken, analysis indicated that contaminant con-

Table 6.6-24

SITE NO. 28
Annual Generation of Selected[1] Chemicals by the
Research & Development Building

Material	Chemical	Annual Usage (gallons per year)
Acids	hydrochloric	31
"	sulfuric	25
Ammonia	ammonia	600 pounds
Amines	dimethylamine	450 pounds
Cyanide Compounds	di methylformamide	15
	acrylonitrile	110 pounds
Chlorine	chlorine	600 pounds
Chlorinated solvents	methyl chloride	44
	chloroform	19.5
	carbon tetrachloride	10
	p-dioxane	61
Non Chlorinated Solvents	cyclohexane	22
	toluene	20
	pyridene	10
Esters	n-butyl acetate	32

Notes:

(1) chemicals procured/generated in excess of 10 gallons (or 100 pounds) per year as reported by NOS LIST OF HAZARDOUS MATERIALS, June 1980.

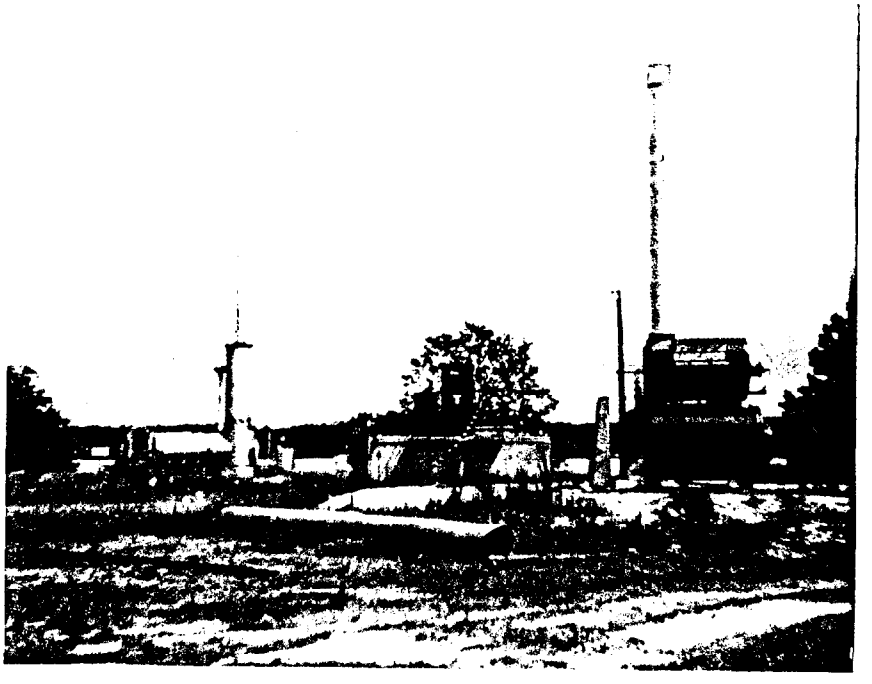
centrations were below detectable limits with certain minor exceptions. Mercury, zinc, and silver were found to be present in low concentrations. Mercury concentrations ranged from 0.5 ug/l to 2.2 ug/l, zinc concentrations ranged from 0.2 mg/l to 0.5 mg/l and silver from 0.01 mg/l to 0.4 mg/l.

Since this facility handles numerous other chemicals it is possible that other contaminants not analyzed in PSPAS, July, 1981 are present in Building 600 wastewater discharges. However, it discharges to the NOS STP are currently regulated by NPDES permit. Furthermore, team site reconnaissance, file searches and STP operator interviews did not indicate any incidents of plant malfunctions attributable to wastewater toxicity. Therefore, no Confirmation Study is recommended.

6.6.29 Radicator (MAP GRID M6) (SITE NO. 29) (FIGURE 6.6-34)

This site is the location of the NOS Radicator facility (Building 1607), constructed in 1976. This facility is also identified in NSADFF as Site No. 6. The Radicator is a propane fired, two chamber incinerator which burns 1000 pounds per year of Otto-fuel-contaminated solids, per SJP #P20870. This unit was constructed on a concrete pad resting on clay soil situated in flat terrain approximately 200 feet from the bank of the Mattawoman Creek.

The NSADFF report indicated no incidents or complaints associated with the operation of the Radicator and team site reconnaissance did not indicate the presence of any major spillage or stressed vegatation in the vicinity of the incinerator. A small area of reddish brown soil near the



6.6-34 SITE NO. 29, RADICATOR, Looking east toward Mattawoman Creek

6.6-35 SITE NO. 30, LOOKING AT MATTAWOMAN CREEK SHORELINE 400' EAST OF CAFFEE ROAD, Dumped metal parts in view

concrete platform may have indicated the presence of a minor Otto Fuel spill associated with the Radicator operation. A Confirmation Study has not been recommended at this site.

6.6.30 Dumped Metal Parts Along Shoreline (MAP GRID M6, 7, 8, L5) (SITE NO. 30) (FIGURE 6.6-35)

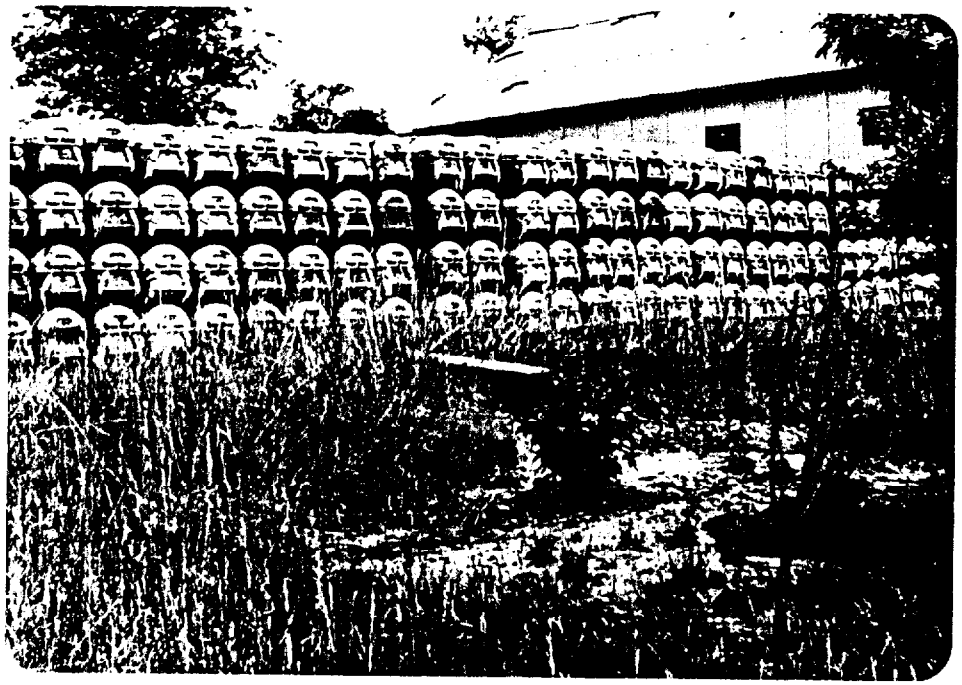
This site is the location of dumped metal parts along the Mattawoman Creek shoreline. Dumped materials included rocket motor casings, shipping containers, empty drums and various metal parts reportedly dumped along a 1000 foot stretch of shoreline east of the Decontamination Burning Point, beginning circa 1960 until recently.

Team site reconnaissance confirmed the presence of rusted large metal parts in the vicinity of the reported dump area, and, in sections, submerged dumped materials completely covered over the bottom sediments. Due to the inert nature of these materials, no Cinfirmation Study has been recommended.

6.6.31 Hog Island Landfill (MAP GRID M20) (SITE NO. 31) (FIGURE 6.6-36)

This is the location of a 1.8 acre site situated 600' southwest of Building 474, near Atkins Road. Clean fill material was reportedly deposited in this area over the years to elevations of approximately five feet above the marsh areas surrounding Hog Island. The deposited material now connects Hog Island with the Indian Head mainland.

6.6-36 SITE NO. 31 Hog Island LANDFILL, Looking northeast towards Atkins Road



6.6-37 SITE NO. 32, BUILDING 474, Stored rocket motor casings, evidence of site ponding in view (lower right)

Team site reconnaissance indicated spotted patches of grass amidst furrowed plowed up fields which are currently used as food plots for the deer herd on base. Deposits of a grit and sand material spotted with cigarette butts found at the site, possibly originated from grit/sludge generated form NOS sewage treatment plant grit chambers, primary tanks or sludge drying beds. However, there was no evidence of stressed vegetation, contamination or dumped material in the area. No Confirmation Study has been recommended due to the inert nature of the disposed wastes.

6.6.32 Building 474, Ethyl Lactate and Butyl Acetate Spillage (MAP GRID M21) (SITE NO.32) (FIGURE 6.6-37)

This is the location of the Retail Outlet No. 5 Building (Building 474), constructed in 1941. According to one interviewee, ethyl lactate and butyl acetate were stored in 55 gallon drums. Reportedly, leakage from rusted drums occurred, but could not be confirmed by any team site file searches or followup interviews. This material is no longer stored at Building 474 and team site reconnaissance indicated no evidence of spillage or stressed vegetation in the vicinity of the former building storage areas. This area is currently used to store rocket motor casings. Certain bare soil areas were noted and limited site erosion was observed. This may have been atttributed to inadequate site drainage facilities . The entire site was covered over with coal residues which pose potential problems (at this and various other NOS sites) from the standpoint of metal contaminant releases to the soil. Matted algae formations were also observed over gravel driveway areas signifying the frequent occurrence of site ponding. Due to inadequate verification of this area as a spill site, no Confirmation Study is currently being recommended.

6.6.33 Building 874, Ethyl Lactate and Butyl Acetate Spillage (MAP GRID M26) (SITE NO. 33)

This is the location of the Inhibition Building (Building 874), constructed in 1953. Ethyl lactate and butyl acetate, according to one interviewee, was stored in 55 gallon drums and reportedly leakage from rusted drums occurred. Leakage or spill events could not be confirmed by team file searches or follow up interviews. This material is no longer stored at this site and team site reconnaisance indicated no evidence of spillage or stressed vegetation in the vicinity of the former building storage areas. No Confirmation Study has been recommended at this site.

6.6.34 Catch Basins at Chip Collection Houses (MAP GRID M26 and M28) (SITE NO. 34)

Wastewater contaminated with lead and copper salts may have collected in the catch basins of the Chip Collection Houses (Building 1051 and 785). Wastewater was generated from these facilities for an undetermined period. There was no data on wastewater characterization or quantity available nor was there information available indicating that any environmental damage occurred as result of these discharges. However, team site reconnaissance indicated no evidence of sludge deposits in catch basins, spillage, or vegetation stress along the ditch receiving chip collection house discharges. Due to lack of verification of this site as a problem area, no Confirmation Study is recommended.

6.6.35 Single Base Powder Facilities (PCB's) (MAP GRID M,N-33, 34, 35) (SITE NO. 35)

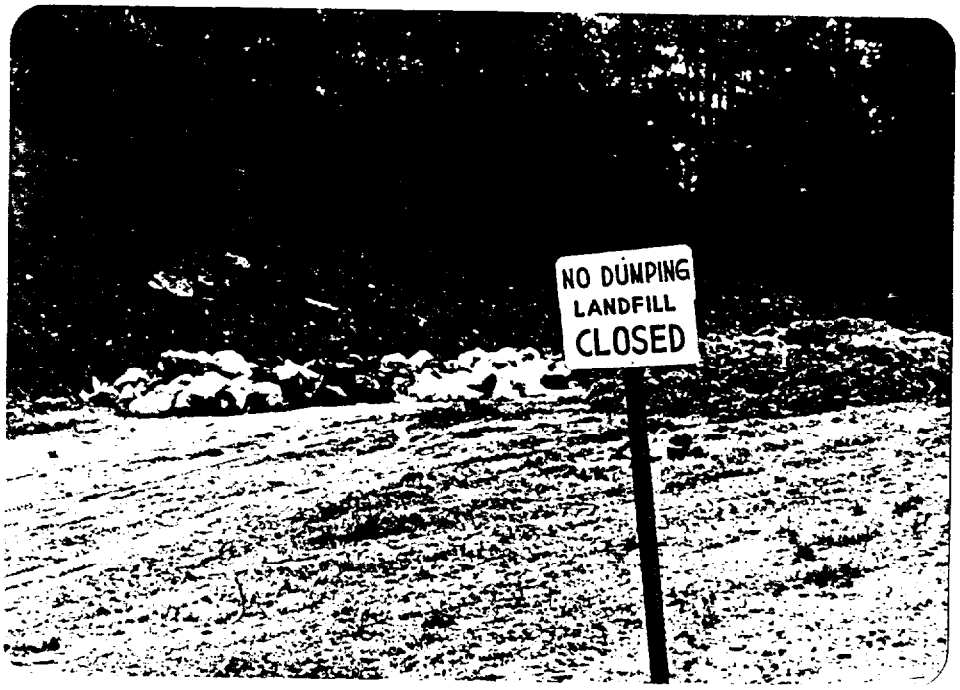
This is the location of the single base powder facilities (press, alcohol, dehydrating houses and various transformer stations). Reportedly, PCB's were suspected to have been used as coolant for transformer switches in the 40's. However, team interviews, file searches and site reconnaissance indicated nothing that would suggest that switches used contained PCB's. Therefore, no Confirmation Study is suggested.

Buildings with transformers containing PCB's, and NOS procedures used in collecting and storing PCB wastes are discussed in Section 6.5

6.6.36 Bronson Road Landfill (MAP GRID N 21) (SITE NO. 36) (FIGURES 6.6-38, 6.6-39, 6.6-40)

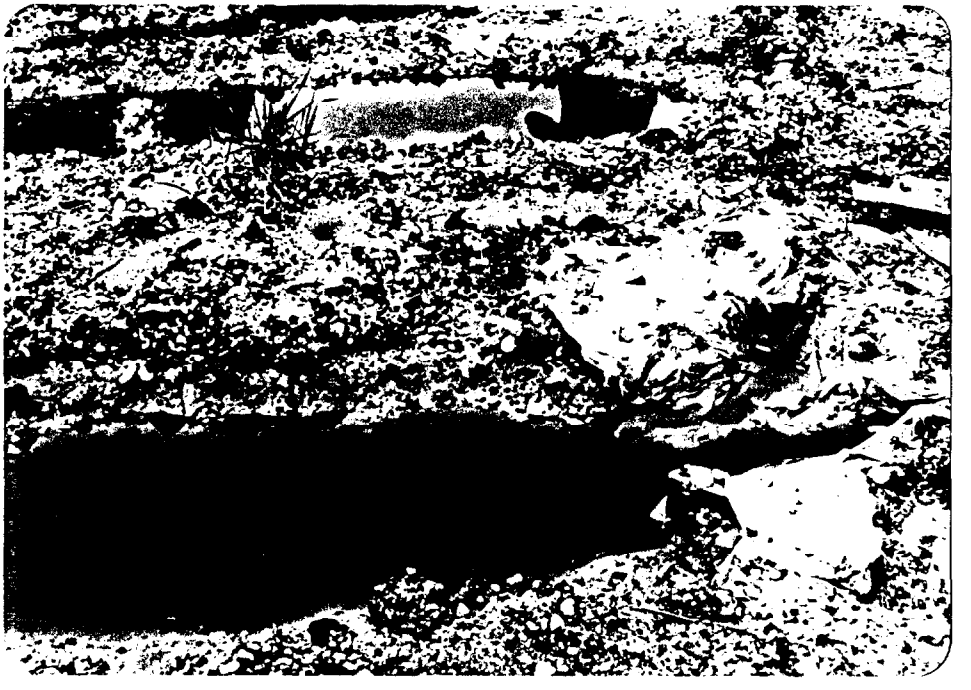
This site is the location of a two-acre abandoned gravel mining pit located near the terminus of Bronson Road directly across the street from Buildings 1384, approximately 200 feet from the Mattawoman Creek. This facility is also identifed in the NSADFF as Site No. 7. The Bronson Road Landfill was operated by the NOS DPW as a disposal site for trash generated by facilities in the explosives manufacturing area beginning circa 1975 and ending November 1981. At this time a 40 cubic yard dumpster was established as a transfer station. Trash wastes generated by the explosives area is collected by NOS personnel and collected weekly by a private contractor for off-station disposal. The site also accepted sludges from paint spray booths and bagged asbestos until circa June 1982. The site is surrounded by

20 foot cliffs on three sides and deposited materials are estimated to be 40-50 feet above underlying ground water elevations. This site was filled using trench excavation methods and is estimated to contain approximately 1500 tons of trash and various quantities of paint sludges, asbestos and barium sulfate. Team interviews indicated that unauthorized dumping of materials may have occurred and at least one interviewee mentioned that various undetermined quantities of liquids were dumped at this site. Table 6.6-25 lists some of the materials reportedly dumped at the Bronson Road Landfill. Table 6.6-26 provides calculations of hazardous materials deposited at the Bronson Road Landfill based on reported quantitites and the assumption that approximately 60 gallons of paint and varnish were dumped at the site during the facility's operating year. These items were included in the estimate since some of them were observed in a recently installed 40 cubic year dumpster near the landfill and were reported by various sources to have been deposited at the site. This analysis indicates that barium, asbestos, and various other metals (notably zinc and lead) and various non-halogenated solvents are the contaminants estimated to be present in the largest quantities. Since barium sulfate is an insoluble precipitate, it is unlikely that this contaminant would pose a serious environmental hazard. Team site reconnaissance indicated the facility had an intermediate cover over deposited material (6 inches to 1 foot in depth). Uncovered bags of asbestos were observed as well as several iodine colored perched water ponds which apparently originated as site seepage. Asbestos and paint sludges were accepted at the site until circa June 1982. No Confirmation Study has been recommended due to the nature of the sites hydiogedogy, which does not facilitate contaminant migration.



6.6-38 SITE NO. 36, BRONSON ROAD LANDFILL, Looking east, asbestos bags in view

6.6-39 SITE NO. 36, BRONSON ROAD LANDFILL, Looking west towards Bronson Road, water filled trench, asbestos bags and rubbish in view



6.6-40 SITE NO. 36, BRONSON ROAD LANDFILL, Leachate seeps

Table 6.6-25

Material Dumped at Bronson Road Landfill

Quantity[1] (tons)	Material	Description	Origin of Material
1500[2][3][4]	Solid Waste	shop trash, lumber, metal, empty boxes, empty cans, tires glassware, bottles pallets	NOS, explosives area
2.5[3]	Barium sludge	insoluble white powder delivered in 55 gallon drums	Building 856
3.3[5]	Asbestos	pyroloc delivered in colored plastic bags	Buildings 113, 193, 290, 855 856, 903
3.0[6]	Paint sludge	sludge from paint spray booths delivered in sealed 55 gallon drums	Buildings 717, 763, 868, 160 1134

(1) Total Estimated Quantity of Material Deposited (Tons) = Dumping Rate x Period of Facility Use

1500	= 1 ton per day x 5 days/wk. x 50 wks. x 6 yrs.
2.5	= .625 tons[4] per yr. x 4 yrs.
3.3	= 0.55 tons[5] per yr. x 6 yrs.
3.0	= 0.5 tons per yr. x 6 yrs.

(2) Team site reconnaissance survey 6/16/82.

(3) Source: EES, NAVORDSTA, Indian Head, MD., UICN00174, June, 1980.

(4) Source: Team NOS personnel interview 6/16/82.

(5) Source: NOS List of Hazardous Materials, June 1980.

(6) Source: NSADSFF, CHESDIV, NACIP, December 15, 1980.

Table 6.6-26

Estimate of Quantity of
Hazardous Materials Deposited
in
Bronson Road Landfill

Contaminant	Quantity (range-pounds)(4)
asbestos, barium	1,000-10,000
zinc, lead, titanium ethyl alcohol, acetone	100-1000
benzene, toluene xylene, ethyl acetate, ethylene glycol, iron, chromium, tetrachloro-ethane, phenols	10-100

Notes:

(1) - Estimated Quantity of Material In Discarded Cans discarded at Site

PAINT (13 lbs/gal)(0.1 gal/can)(1 can/wk)(52 wks/yr)(6 yrs) = 405 lbs

VARNISH (10 lbs/gal) " " " " = 312 lbs

(2) Estimated Quantity of Dumped Barium, Asbestos, and Paint Sludges 5000 lbs, 6600 lbs, and 6000 lbs respectively. (Ref. Table 6.6-25.

(3) Composition of Discarded Materials, Source Riegel is Hemdbook of Industrial Chemistry,

PAINT Zinc (15%), lead (5%), titanium (2%), chromium, iron, benzene, toluene, xylene, tetrachloroethane, ethyl acetate, acetone, ethyl alcohol (each 1%), ethylene glycol

VARNISH Phenols (10%) ethyl alcohol, ethyl acetate, acetones (each 15%)

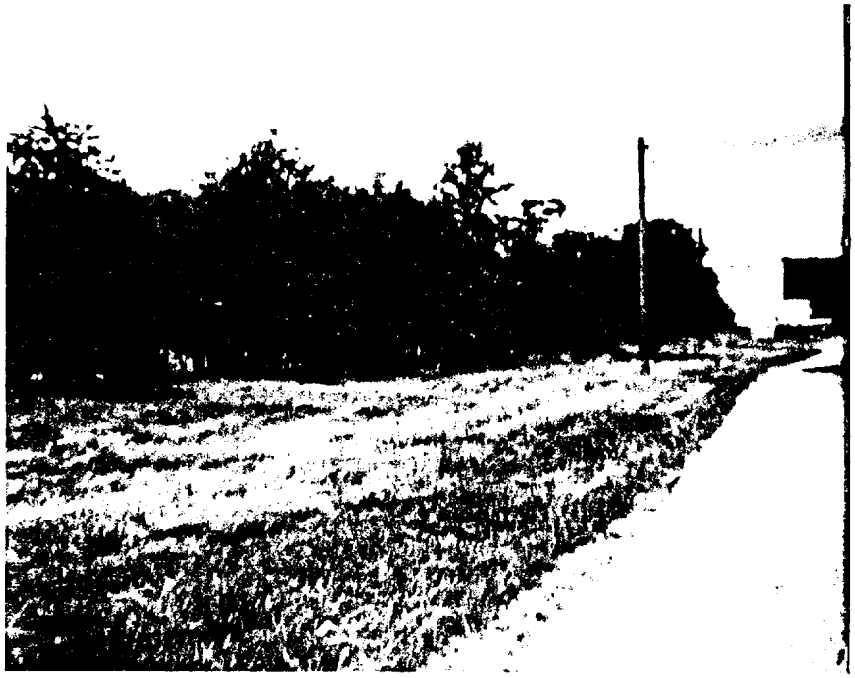
(4) Quantity of each contaminant listed is estimated to fall within range shown.

6.6.37 Goddard Power Plant (MAP GRID N31) (SITE NO. 37) (FIGURE 6.6-41)

This is the site of the Goddard Power Plant (Building 873), constructed in 1957. Coal was burned at this facility until the early 1970's when the plant was converted to burn both No. 2 and No. 6 fuel. In 1971 the facility burned approximately thirteen million gallons of low sulfur residual fuel oil in three boilers rated at 150,000 pounds each. This firing rate remained relatively stable for the next ten years.

The team file searches indicated three potential problem areas from the standpoint of past or continuing sources of environmental contamination originating from this building and its ancillary facilities. These include:

- a 2,600 gallon per day boiler blowdown which overflows from a blowdown tank where it discharges into a closed piping into IW06. Blowdown wastewater is an alkaline (pH ranging from 11-12) deionized water pretreated with sodium hydroxide, sulfate and sulfite compounds, phosphate and hydrazine,
- the addition of a waste degreaser, trichloroethylene (TCE) reportedly added at rates of 20 gallons per year into residual fuel oil stocks prior to combustion,
- the spillage of an undetermined amount of fuel oil from a storage tank, occurring in the early 70's, which reportedly was diverted into a storm drain and entered the Potomac River, and
- limited incidences of fuel spillage near storage facilities.

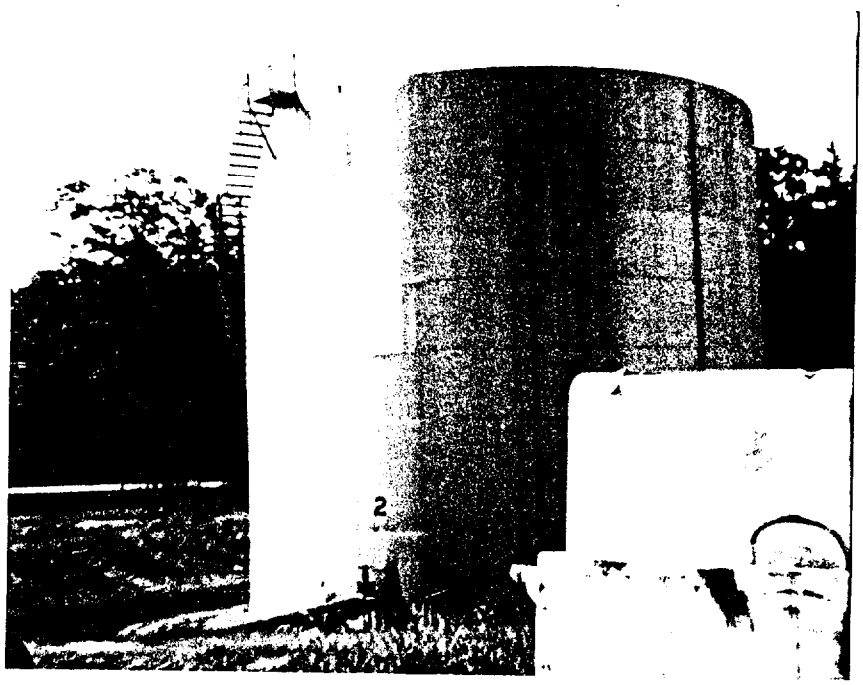


6.6-41 SITE NO. 38, NG DISPOSAL SITE, Looking northeast of Hussey Road

Team site reconnaissance indicated that the boiler water discharge enters the sewer system which is tied into the NPDES regulated NOS sewage treatment plant. No evidence of spillage or stressed vegetation associated with the reported spill could be found. However, field surveys conducted on 7/16/82 and 7/18/82 indicated the presence of 750 square feet of oil discolored soil within the bermed areas surrounding the two 500 gallon above ground storage tanks serving the Goddard Power Plant. The practice of adding TCE could not be ascertained in the field, but interviews suggested that the practice was continuing as part of current boiler firing procedures. Since the discharge flows into a system which is regulated by NPDES a Confirmation Study has not been recommended.

6.6.38 NG Slums Disposal Site (MAP GRID 012) (SITE NO. 38) (FIGURE 6.6-42)

This area was the location of the former NG Disposal Site, a 50 foot wide strip along the shoreline of the Greenslade Road Penninsula surrounded by Mattawoman Creek. This 1/2 acre, 400-foot strip of land was reportedly used as a depository for NG slums generated by the single base powder facilities. The time frame this site was in use is not known, but was probably operated from the date the NG production facilities were constructed (circa 1905) to the date the Main Burning Point (Site No. 27) was established (circa 1953) as a disposal site for these materials. The site probably contained drainings from the catch tanks labyrinth soaked in sawdust.



6.6-42 SITE NO. 37, GODDARD POWER PLANT, Looking south towards 500 gallon fuel oil tank #2, 750 square feet of discolored area in view (lower left)

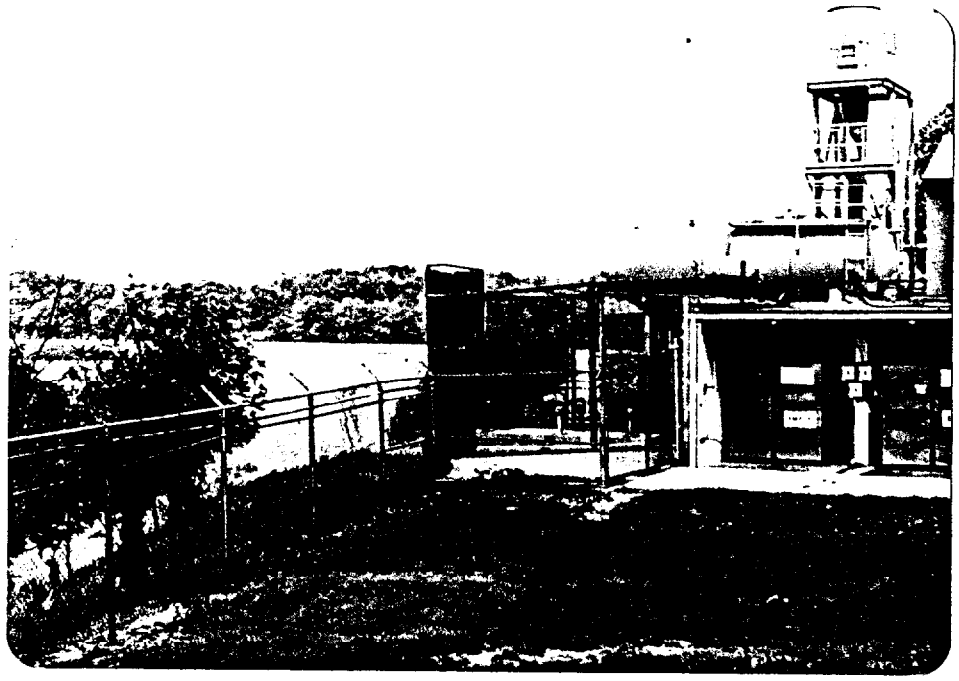
While team site reconnaissance indicated the presence of random dumping (cinders, gravel, plumbing fixtures), there was no evidence of the old slum disposal area or any NG slum deposits along the shoreline. Team observations also indicated a good growth of vegetation, even on steep side sloped areas of the peninsula.

However, since NG is soluble in water, leaching of NG from deposited sawdust slums is a possibility. Therefore, while NG does not represent a significant environmental hazard to the Mattawoman Creek, its explosive characteristics do pose potential safety hazards. These potential hazards should be factored into any future NOS development plans, specifically regarding earthwork activity, in the vicinity of the Site No. 38 shoreline areas. A Confirmation Study has not been recommended at this time.

6.6.39 Small Motor Test Area (MAP GRID 019) (SITE NO. 39) (FIGURE 6.6-43)

This site is the location of the Small Motor Test Area (a/k/a Ballistic Test Complex) which contains the Ballistic Test Building, (Building 558), constructed in 1944. This facility contains eight units or bays used for conditioning rocket motors for test firing, one bay used infrequently for washing metal parts and other bays which have been used infrequently for various activity support purposes or have been abandoned. Test firing frequencies vary since the facility opened in 1944, but usually occurred once or twice per week.

Wastewater discharged from the rocket bays discharge into seven 6 inch open terra cotta pipes (IW 54 through IW 60) and discharge into the



6.6-43 SITE NO. 39, SMALL MOTOR TEST AREA (BUILDING 558), Looking south towards Marsh Island. Screen to catch rocket motor particles in view, stressed cedar (lower left) in view.

Mattawoman Creek. Wastewater discharge vary from 420 (IW 59) to 10,100 gallons per day (IW 54), but the water consisted primarily of non-contaminated discharges from non-contact cooling and condensate overflow lines. Wastewater discharges from rocket motor wash downs are infrequent. As was reported in the large Motor Test Area (Ref. Site No. 1), gas plumes emitted during test firings represent the most significant environmental hazard at this site as well. These plumes consist of carbon monoxide, carbon dioxide, nitric and hydrochloric acid, nitrous oxides and various metal oxides (iron, aluminum, lead). A total quantity of 100 pounds per week of particulates were estimated to have been emitted into the air over the 30-year operating period of the facility, resulting in a total discharge of 10-15 tons of total metals (aluminum, iron, lead and copper) discharged over the life of the facility. (An approximate characterization of particulate metals emitted during test firing rockets is provided elsewhere (Ref. Site No. 1)). Since these contaminants were emitted as particulates in air plumes, it is not possible to determine whether the material was deposited at Site No. 39, or other NOS locations, the Mattawoman Creek sediments or was carried off station by air currents. However, team site reconnaissance indicated no visible erosion at the site. A small area of tree kills and vegetation stress was observed on the side slope between the test facility and the Mattawoman Creek. Rocket motor parts, metal salts and acidity may have resulted in the contamination of the side slope area and, to a lesser degree, the Mattawoman Creek.

However, team site reconnaissance suggests that there are greater potential environmental hazards associated with the Large Motor Test Area (Site No. 1) as compared to this site. Should the Confirmation Study at

Site No. 1 indicate danger to aquatic life, a Confirmation Study should be performed at Site No. 30.

6.6.40 Hydraulic Oil Discharges From Extrusion Plant (MAP GRID O24,T24, E20) (SITE NO. 40)

This site is the location of six buildings, referred to as Press Lines (Buildings 561 and 564), constructed in 1943. Water in these buildings is used primarily as coolant for pumps and press dies.

Water from these facilities is discharged into an underground pipe and into IW18 (Mattawoman Creek). Prior to 1981, discharges from these facilities reportedly were contaminated with hydraulic oil. However, team file searches did not indicate any environmental contamination incidents attributable to these facilities.

In 1981, an oil water separator was installed. Wastewater discharges were found to average 169 gallons per day and oil and grease concentrations in three samples ranged from 5.4 to 9.6 mg/l. Team site reconnaissance indicated that the oil water separators appeared to be working effectively and there was no evidence of oil spillage or stressed vegetation at the IW18 outfall. These factors, combined with hydrogeology unconducine to migration indicate that no confirmation Study should be performed at this site.

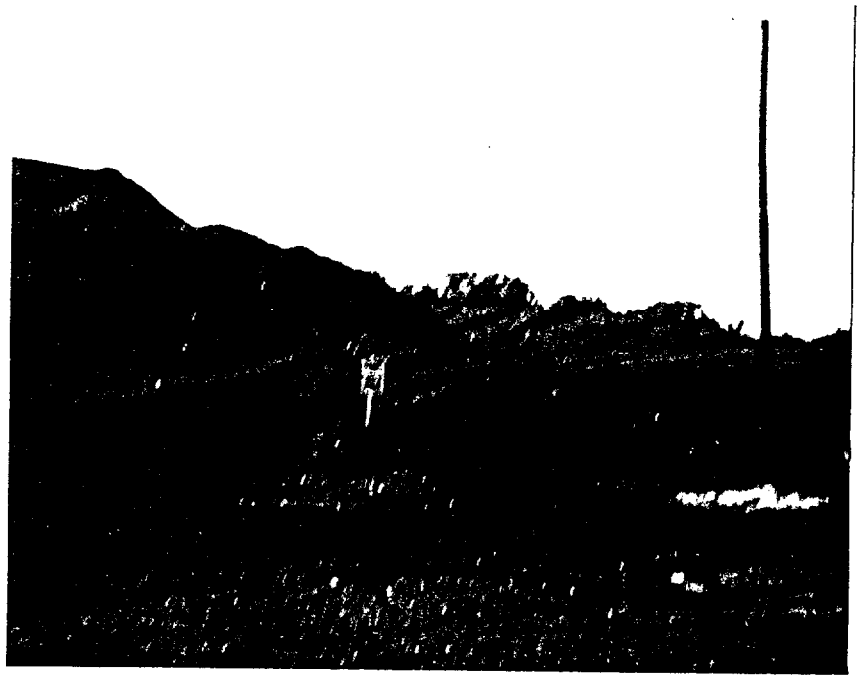
6.6.41 Coal Storage Pile (MAP GRID 031) (SITE NO. 41) (FIGURE 6.6-44)

This site is the location of the coal storage pile, situated 200 feet southeast of the Goddard Power Plant (Building 873) (Ref. Site No. 37). Coal was burned at this facility from 1957 until 1970. The Goddard Power plant is currently being reconverted to burn coal and contains an 11,000 ton, 16,500 cubic yard coal pile situated on a 1 acre plot behind Building 873. Interviews with NOS personnel indicated that previously, various quantities of waste oil originating from the DPW Maintenance Garage Area (Ref. Site No. 8) were dumped on the coal pile. The incidents reportedly included:

- dumping between 25-30 drums of #6 fuel oil with a large quantity (approximately 1,000 gallons) dumped on a Sunday, circa 1981, and
- dumping the contents of three waste oil filled dumpsters (containing 400-500 gallons), circa Spring 1982.

However, team site reconnaissance was not able to confirm any unauthorized dumping of waste oils at this site. Therefore, a Confirmation Study has not been recommended.

Another concern regarding the coal piles is uncontrolled acid coal pile runoff which may be entering the Mattawoman Creek tidal flats located 800 feet south of the site. NOS PCR Project 078G, which has been approved, calls for installation of a $7,400 limestone bed to neutralize coal pile runoff.



6.6-44 SITE NO. 41, LOOKING SOUTHEAST FROM GODDARD POWER PLANT TOWARDS COAL PILE

6.6.42 Abandoned Drain Lines (MAP GRID 035,37,38) (SITE NO. 42)

This site is the location of the abandoned nitrocellulose (NC) production facilities. The buildings were constructed in the late 19th century and early 1900's, and many of the original facilities have been removed. NC was produced for smokeless powder in naval cannon. Cotton linters, nitric acid, and sulfuric acid were the raw materials. The waste products included acid water and NC white water. The acid water was neutralized with lime or soda ash. The production capacity varied, but the maximum was about 1,000,000 pounds of NC per month. The acid wastewater contained about one pound of mixed acid (NA/SA) per pound of NC. The water use was about 50,000 gallons per ton NC. The neutralized acid water with salts of sulfuric and nitric acid were dispersed in the Mattawoman Creek. The white water, with finely divided NC, settled and became a part of the silt in the creek. There was some concern that NC, which is practically insoluble in water, may have deposited in abandoned drain lines located near the old NC plant site. Team site reconnaissance indicated no NC grains deposited in manholes. Due to its explosive characteristics, NC deposits may represent a greater safety than environmental hazard, should NC grains settle in abandoned drains. This potential safety hazard should be factored into any future development plans, especially any earthwork activities in the vicinity of the old NC plant or abandoned drain lines. A Confirmation Study is not suggested at this time.

6.6.43 Hypo Discharges, X-Ray Building No. 2 (MAP GRID P27) (SITE NO. 43)

This site is the location of the Rocket Motor Loading Building (Building 588), constructed in 1944, which contains facilities used for

motor loading, painting, and x-ray film developing. The x-ray section of this building is no longer in use.

Motor load operations do not use water and the small amounts of acetone used evaporates. Painting is done in water-spray paint booths. Floors are swept and cleaned with acetone as necessary.

The only effluent from this building is from the paint booth which is emptied every Friday afternoon. The water is discharged into a 1½ inch pipe that discharges from the side of the building into an open ditch (IW46) which flows into Mattawoman Creek.

Methyl chloride was found in concentrations of 65 mg/l in one out of three wastewater samples taken at the outfall, but contaminant concentrations in the remaining samples were below the level of detection. Analysis for lead, zinc, cadmium, selenium and chromium also indicated that contaminants if present, were below the level of detection. On weekly discharge days, flow rates averaged 436 gallons per day.

For the period beginning in 1944 and ending circa 1964, wastewater discharges from this facility included fixer (sodium thiosulfate), developer (hydroquinone) and silver, discharged in a silver thiosulfate complex. This silver represents the most significant contaminant from the standpoint of potential adverse environmental impacts. Table 6.6-27 provides an estimate of the total quantity of contaminants discharged into IW45 during the 20-year period the x-ray facilities discharged untreated wastewater into the ditch. The chemistry and probable fate of sodium thiosulfate, hydroquinone

Table 6.6-27

Site No. 43
Estimate of Total Quantity of Contaminants
Discharged into Ditch

Contaminant	Source of Contaminant	Total Quantity of Contaminant Discharged Monthly (lbs)	Total Number of Months Facility was Operated During 20-Year Period (Months)	Total Quantity of Contaminant Discharged During 20-Year Period (lbs)
Sodium thiosulfate (fixer)	Building 588 x-ray facility	470	240	112,800
hydroquinone (developer)	Building 588 x-ray facility	470	240	112,800
silver	Building 588 x-ray facility	3.6	240	869

NOTES:

1. estimates of quantities developed from manufacturers recommended solution application rates for fixer and developer, average monthly quantities of sheets developed at facility and average monthly quantities of sheets developed at the facility and average silver concentrations of fixer baths as follows: Fixer, developer quantitites = (.0158 gal/sheet) (3000 sheets/mo) = 47 gallons; silver quantities = (35 grams/gal fixer) (47 gallons) (454 grams/lb = 4.85 = 3.6

and silver would be similar to the fate of contaminants found in other x-ray photo lab discharges as discussed elsewhere (Ref. Site No. 9). For the period beginning in 1974 and ending circa 1978, the DPDO began collecting fixer solutions for recovery. During this period, negligible quantities of silver (less than ½ pound per year) are estimated to have been discharged into IW46. Team site reconnaissance indicated no vegetation stress or contamination immediately behind the building at the point of outfall discharge. However, there was evidence of dumping paint materials and accessories including paint brushes, empty solvent cans and trash. In the event that the Confirmation Study of Site No. 11 confirms a danger to aqutic life, a study will be performed at this site.

6.6.44 Nitric Acid Spill (MAP GRID P29) (SITE NO. 44)

This is the site of the Organic Chemicals Building (Building 497) constructed in 1942. Facility processing procedures included various manufacturing activities for chemical processes, including HBNQ (high bulk density nitroguanidine) recrystallization.

Reportedly, 1000 gallons of nitric acid spilled as a result of a storage tank inlet pump rupture circa 1962-1963. This spill occurred along a 400 foot ridge line (Ref. Figure 6.6-1) before discharging into the inlet facing Marsh Islands. Soda ash was placed along the spill path and no adverse reaction of the stream and surrounding environment was reported. Team site reconnaissance in the vicinity of the spill did not indicate any evidence of spillage or stressed vegetation. A confirmation Study is not indicated due to the nature of nitric acid (i.e., no tendency to form a precipitate or sediment in water).

6.6.45 Silver Nitrate Spill and HBNQ Discharges into Drainage Ditch (MAP GRID P29) (SITE NO. 45)

This site is the location of the Organic Chemicals Building (Building 497) discussed previously (Section Ref. 6.6-44). This is a multipurpose building for chemical processes. Currently, the only operation performed in the building is HBNQ High Bulk Density Nitroquanidine) recrystallization. NQ (nitroquanidine) is dissolved in a methyl cellulose (methocel) solution and recrystallized to form HBNQ. These crystals are then washed, centrifuged and sent to Building 498 for pulverizing. All floor drainage and process water spills enter a gutter running the length of the building where they flow directly into Mattawoman Creek. The principal environmental concerns associated with this site are HBNQ precipitates and a silver nitrate spill which may have contaminated the ditch and Mattawoman Creek sediments.

Contaminants known to be in the wastewater included MTC (which contains NQ), nitrate esters (RNO_3) and suspended solids (SS). During facility operations, average wastewater discharges were 2,900 gallons per day. Table 6.6-28 summarizes wastewater quantity, characterization and discharge operations from Building 497. A combined volume of 11,600 gallons per week was estimated to have been discharged into IW05 over the 40-year operating period of the facility, resulting in a total discharge of approximately 120 tons of methocel, 484 tons of RNO_3, and 240 tons of suspended solids. Since RNO_3 are soluble, this contaminant was probably washed away over time. However, methocel is relatively insoluble (solubility in water 4 percent). Since wastewater discharges are intermittent and the ditch also

Table 6.6-28

Organic Chemicals Building
HBNQ Wastewater Characterization[1]

Building	497
Wastewater Discharge Flow Rates[2] (range gpd)	70-388,000
Contaminant Concentrations (range mg/l)	
Total Suspended Solids (TSS)	521.0 - 4,022.0
Lead (Pb)	3.5 - 8.0
Nitrate Esters (RNO_3)	3,150.0 - 6,000.0
Methocel (MTC)[2]	1,110.0 - 2,000.0

Notes

(1) Characterization developed from the analysis of four samples taken from building wastewater discharges as reported by PSPAS, NOS, Indian Head, MD., July, 1981.

(2) MTC analysis was performed because MTC is used in the HBNQ process and is discharged into the Creek.

Table 6.6-29

Site No. 45
Estimate of Total Quantity of Contaminants
Discharged into Ditch and Soil

Contaminant	Source of Contaminant	Total Quantity[1] Discharged During HBNQ Daily Operation (lbs)	Total[2] Number of Production Days During 40-Year Period	Total Quantity Discharged During 40-Year Period (lbs)
Total Suspended Solids	Building 497	60	8,000	480,000
Methocel	Building 497	30	8,000	240,000
Nitrate Esters	Building 497	96	8,000	468,000

Notes

(1) Estimate of quantities lbs developed from average flow rates (2,900 gallons per day) and concentrations (Ref. Table 6.6-28).
(2) 4,000 = 4 production days/wk x 50 wks/yr x 40 yrs.

carries stormwater runoff, it is not possible to determine whether this material was deposited in the ditch or in downstream Mattawoman Creek sediments. However, methocel has a 4 percent solubility, indicating that over a period of time the material may have been dissolved in water and leached out into the Creek. Methocel deposits should not adversely affect the environment, but due to its explosive characteristics, a potential safety hazard exists. This potential safety hazard should be factored into any future NOS development plans, especially regarding earthwork activity in the vicinity of Building 497, IW05 or where IW05 enters the Mattawoman Creek. This discharge is currently regulated as discussed elsewhere (Ref. Site No. 2).

Building 497 was used in acetyl formal production circa 1966. Reportedly, 100-200 pounds per week of silver nitrate was accidently discharged into the Mattawoman Creek for a three-month period. This was caused by plant personnel leaving valves open for four or five hours at a time during the period in question. Team site reconnaissance, file searches and interviews did not indicate evidence of methocel deposits or any adverse environmental impacts attributable to either the spill event or the wastewater discharges. Due to these factors and the relatively low toxicity of methocel, no Confirmation Study is presently recommended.

6.6.46 Thermal Destructor 2 (MAP GRID P30) (SITE NO. 46)

This site is the locatin of the NOS Thermal Destructor 2 facility (a/k/a Princo unit) (Building 1595). This facility is also identified in NSADFF as Site No. 5. The Thermal Destructor is a propane fired incinerator, which burned 1.3 million pounds year of hydrazine-fuel-contaminated water, per SJP #360-036. This facility operated from 1976 until 1978.

Closure procedures included emptying storage tanks and closing all process piping valves. This unit was constructed on a concrete pad resting on clay soil situated on flat terrain approximately 500 feet from the bank of the Mattawoman Creek. The NASOFF report indicated no incidents or complaints associated with the operation of this unit, and team site reconnaissance did not indicate the presence of any spillage or stressed vegetation in the vicinity of the incinerator. However, reportedly during the operation of the facility, undetermined quantities of hydrazine and UDMH may have been spilled in the vicinity of the site. A Confirmation Study is not recommended at this time.

6.6.47 TCE, Phenolic Wastes Storage (Cast Plant) (MAP GRID P33) (SITE NO. 47) (FIGURE 6.6-45)

This site is the location of the Cast Plant (Building 292). Reportedly, drums of trichloroethylene and various other wastes were stored at this building. Team site reconnaissance indicated the presence of certain undetermined drummed materials at the site, but file searches indicated that drummed TCE wastes were removed by a private contractor for off-station disposal circa 1981. Site reconnaissance did not reveal any evidence of leakage or stressed vegetation in the vicinity of the Cast Plant. A Confirmation Study has not been suggested for this site.

6.6.48 Thermal Destructor 1 (MAP GRID S32) (SITE NO. 48)

This site is the location of the NOS Thermal Destructor 1 (Building 1584). This facility is similar to the Princo Unit (Ref. Site No. 47)

6.6-45 SITE NO. 47, DRUMMED WASTES OF UNDETERMINED MATERIAL IN VICINITY OF CAST PLANT

and is identified in NSADFF as Site No. 4. This unit is also a propane-fired incinerator which burned 1.3 million pounds per year of hydrazine-contaminated water from 1976 to 1979. This unit was constructed on a concrete pad resting on clay soil situated on a flat terrain approximately 400 feet from the banks of the Mattawoman Creek. The NSADFF report indicated no incidents or complaints associated with operation of this facility, and team site reconnaissance did not indicate the presence of spillage or stressed vegetation in the vicinity of the incinerator. As in the case of Unit #2, undetermined quantities of hydrazine and UDMH may have been spilled over the three-year operating period of this facility. However, other than statements describing spill events by NOS interviewees, contamination incidents associated with this facility could not be confirmed. No Confirmation Study has been recommended.

6.6.49 Original Burning Ground (MAP GRID S36, 37) (SITE NO. 49)

This site is the location of the 1.8 acre original NOS burning ground. Team file searches were not able to determine what materials were burned at this site. However, based on the materials manufactured when the site was operational (circa 1890s to 1942), presumably single-base, double-base, composite propellant scraps and smokeless powder were burned at this site. It is also possible that various other contaminated wastes (nitrate ester slums, flammable liquids, dunnage CADs, PADs and PBXs) were explosively decontaminated here. Although team site reconnaissance did not indicate any visible signs of these materials, this site should be considered a potential safety hazard, and should be factored into any future NOS development plans, especially any earthwork or construction activities

planned in the vicinity of this site. An actual Confirmation Study is not recommended at this time.

6.6.50 Sodium Hydroxide, Nitrosamine Spill at Caustic Recovery Facility (MAP GRID T32) (SITE NO. 50)

This site is the location of the Caustic Recovery Facility (a/k/a Pelletized Nitrocellulose Building) (Building 859), constructed in 1953.

Approximately 6,000-8,000 gallons of a waste caustic solution was spilled at the facility when a flexible vibration isolator ruptured on January 3, 1977. The isolator, attached to a 24-inch caustic evaporator recirculation pump, is a teflon lined, wire reinforced, neoprene bellows, installed with original plant process piping (circa 1958). Reportedly, equipment failure was due to loss of material strength and flexibility attributed to aging.

According to a Report of Spill, NQ5-30, filed by NOS with the State of Maryland on 26 January 77, four thousand gallons of the caustic solution was captured in the plant dike area surrounding Building 859; 1,000 gallons was captured in a remedial pond dike or absorbed in applied sand piles and the remaining 1,000 gallons were either discharged into the Mattawoman Creek via a nearby storm drain (IW56) or absorbed into nearby surface soils. Table 6.6-30 provides estimates of the total quantity of contaminants spilled and/or recovered at Site No. 50. This analysis indicates that approximately 1,000 gallons (10,000 pounds) of the caustic solution was discharged into the Mattawoman Creek or surrounding surface soils.

Table 6.6-30

Site No. 51
Estimate of Total Quantity of Contaminants
Spilled and Recovered

Contaminant	Source of Contaminant	Quantity[1] Spilled (lbs)	Quantity[2] of Contaminant Recovered	Remaining
Sodium Hydroxide (NaOH)	Bldg. 859	7,200	6,000	1,200
Sodium Nitrate ($NaNO_3$)	Caustic recovery facility	6,000	5,000	1,000
Sodium Nitrite ($NaNO_2$)	Caustic recovery facility	1,200	1,000	200
Water (H_2O)	Caustic recovery facility	45,600	38,000	7,600
Dimethylnitrosoamine ($(CH_3)_2NNHNO_2$	Caustic recovery facility	0.006	0.005	0.001
Caustic Solution		60,000	50,000	10,000

Notes:

(1) Estimates of quantities developed from NOS memorandum 2031c, 4 Jan. 77, caustic solution estimated to contain 12 percent NaOH, 10 percent $NaNO_3$, 2 percent $NaNO_2$, 76 percent H_2O and less than 100 ppb $(CH_3)_2NNHNO_2$. Solution density estimated at 10 pounds per gallon.

(2) Estimates of quantities captured in dike area or remedial sand dike developed from Report of Spill, State of MD, WP5-30, 26 Jan. 77.

In response to the spill event, on 17 January 1977, an NOS monitoring report, memorandum 2813E:HAD:11a(4668) was filed. This reported indicated that on two dates, 1/4/77 and 1/10/77, a point downstream of IW52 was sampled (Site B). Site B was located beyond the NOS fence line at the closest accessible point to the Mattawoman Creek, which was frozen during the sampling period. Flow rates from rain and snow ranged from 3 to 10 gallons per minute and pH readings on both dates were 11.5. Water samples were also taken from the Mattawoman Creek upstream (Site C) and downstream (Site A) of I52's point of entry into the creek. The pH value for Site C was 7.6 and the pH for site A was 7.7. No UDMH (unsymmetrical dimethyl hydrazin) related contamination was found in the creek.

A subsequent NOS report (ltr PM5B:RDB/6111-c:JGT524011-1a), dated 7 February 77, investigated the circumstances of the spill event. Report recommendations included ordering new equipment, developing new equipment inspection procedures, and increasing the capacity of the diked area to 6,600 gallons.

Prior to the 3 January 77 spill, NOS safety reports list another spill incident associated with Building 859. This incident included spillage of an undetermined quantity of caustic solution in the vicinity of the building, circa 1975. The spillage occurred during routine maintenance of plant piping and reportedly was limited to minor soil contamination. Although a few NOS maintenance workers reported to the infirmary after the incident, no one was seriously injured.

Building 859 currently houses a PNC process which recrystallizes nitrocellulose in a nitromethane solution. At the present time, the system is infrequently used. When in use, nearly all the nitro-methane is recovered, and there is only a small amount of water and dissolved product lost. The PSPAS reported that wastewater discharged from this facility averaged 3,312 gallons per day and analytical results from three effluent samples indicated relatively low nitrate ester (RNO_3) concentrations ranging from 15 to 40 mg/l. Nitrosoamines were by-products of the UDMH and caustic operations, processes which discontinued in the late 1970s.

Team file searches, NOS plant interviews and site reconnaissance did not indicate any evidence of severe environmental damage attributable to either the wastewater discharges at the plant or the reported spill events. Therefore, no Confirmation Study has been recommended.