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INITIAL ASSESSMENT STUDY OF NAVAL ORDNANCE STATION INDIAN HEAD, MARYLAND

NEESA 13-021

NAVAL ENERGY AND ENVIRONMENTAL
SUPPORT ACTIVITY
Port Hueneme, California 93043

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INITIAL ASSESSMENT STUDY

NAVAL ORDNANCE STATION, INDIAN HEAD, MARYLAND

UIC: N00174

Prepared By:

Fred C. Hart Associates, Inc.
530 Fifth Avenue
New York, New York 10036

Contract No. N62474-81-C-A526

Initial Assessment Study Team Members:

Mr. Wayne Tusa, Project Director
Mr. Charles E. Sell, Team Leader
Mr. Mark Jewett, Hydrogeologist
Mr. Richard Dorrler, Hydrogeologist
Mr. Brian Gillen, P.E., Environmental Engineer
Ms. Mary Manto, Public Health Specialist
Ms. Cathy Bobenhausen, Biologist
Dr. Donna Toeroek, Radiologist
Dr. Barry North, Technical Reviewer
Mr. James E. Dodgen, Consultant for Ordnance Operations

Prepared for:

NAVY ASSESSMENT AND CONTROL OF INSTALLATION
POLLUTANTS (NACIP) DEPARTMENT

Naval Energy and Environmental Support Activity (NEESA)
Port Hueneme, California 93043

Project Coordinators

Mr. Wallace Eakes
Mr. Jefferey C. Heath, P.E.

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EXECUTIVE SUMMARY

This report presents the results of an Initial Assessment Study (IAS) conducted at the Naval Ordnance Station, Indian Head, Maryland (NOS Indian Head). The purpose of an IAS is to identify and assess sites in order to determine any potential threats to human health or the environment due to contamination from past hazardous materials operations. This report reflects the conditions as of the on-site survey conducted during June 1982.

Based on information from historical records, aerial photographs, field inspections, and personnel interviews, a total of five potentially contaminated sites were identified at NOS Indian Head. Each of the sites was evaluated with regard to contamination characteristics, migration pathways, and pollutant receptors.

The sites do not appear to pose an immediate threat to human health or the environment, however further investigation should be made under the Navy Assessment and Control of Installation Pollutants (NACIP) Program, to assess potential long-term impacts. A Confirmation Study, involving actual sampling and monitoring of the five sites, is recommended to confirm or deny the existence of the suspected contamination and to quantify the extent of any problems which may exist. The five sites recommended for confirmation are listed below in order of priority:

(1) X-ray Building, Building 731 (SITE NO. 5)
(2) Town Gut Landfill (SITE NO. 12)
(3) Mercury Deposits, Building 766 (SITE NO. 8)
(4) Radiographic Facility, Building 1349 (SITE NO. 6)
(5) Hypo Discharges from X-ray Building No. 2, Building 588 (SITE NO. 25)

The results of the Confirmation Study will be used to evaluate the necessity of conducting mitigating actions or clean-up operations.

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FOREWORD

The Navy initiated the Navy Assessment and Control of Installation Pollutants (NACIP) Program in OPNAVNOTE 6240 ser 45/733503 of 11 September 1980. The purpose of the program is to systematically identify, assess, and control contamination of the environment resulting from past hazardous materials management operations.

An Initial Assessment Study (IAS) was performed at the Naval Ordnance Station, Indian Head, Maryland, by a team of specialists from the Fred C. Hart Associates, Inc. New York, New York. Further confirmation studies under the NACIP program were recommended at several areas at the activity. Sections dealing with significant findings, conclusions, and recommendations are presented in the earlier section of the report. The later technical sections provide more in-depth discussion on important aspects of the study.

Questions regarding the NACIP Program or this report should be referred to the Commanding Officer, NEESA (Code 112N), Port Hueneme, CA 93043, AUTOVON 360-3351, FTS 799-3351, or commercial (805) 982-3351.

Daniel L. Spiegelberg, LCDR, CEC, USN
Environmental Officer
Naval Energy and Environmental Support Activity

ACKNOWLEDGEMENTS

The Initial Assessment Study team commends the support, assistance, and cooperation provided by personnel at Chesapeake Division, Naval Facilities Engineering Command; Naval Energy and Environmental Support Activity; Ordnance Environmental Support Office; and Naval Ordnance Station, Indian Head. In particular, the team gratefully acknowledges the outstanding effort provided by the following people, who participated in the successful completion of the study:

T. H. Woo, Environmental Coordinator, NOS Indian Head

H. A. Dodohara, Ordnance Environmental Support Office

Larry Sparks, Environmental Engineer, Chesapeake Division, Naval Facilities Engineering Command

Scott Markert, Manager, Environmental Engineering Branch, Chesapeake Division, Naval Facilities Engineering Command

Wallace Eakes, Project Coordinator, Naval Energy and Environmental Support Activity.

Jeff Heath, Project Coordinator, Naval Energy and Environmental Support Activity.

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

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Initial Assessment Study
of
Naval Ordnance Station, Indian Head, 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 pose a potential threat to human health or the environment either 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 was 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), Indian Head was designated for an IAS by CNO letter ser 451/397464 of 3 August 1981.

2. The Commanding Officer of NOS Indian Head 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 Indian Head and CHESDIV personnel were briefed by NEESA Environmental Engineer Jeff Heath, P.E., and Wayne Tusa of Fred C. Hart Associates, Inc., 5 May 1982.

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

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. Northern Division (NORTHDIV) Applied Biology Section.

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

g. National Archives, Science and Technological Archives Division, Alexandria, VA. Aerial photographs from EPA Environmental Photographic Interpretation Center (EPIC). Photographs taken in 1957, 1963, and 1972.

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, Washington, D.C.

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

m. U.S. Navy Ordnance Environmental Support Office, Indian Head, MD.

Prior to this study, NOS Indian Head and CHESDIV personnel conducted several surveys to identify sources of pollution and to plan corrective action. Recent reports date from the early 1970s and include air and water pollution surveys, Pollution Source and Environmental Resource Reconnaissance Survey, Environmental Engineering Surveys, Hazardous Waste Management Plan, and the Disposal Site Fact form. The NACIP Team used these reports to supplement extensive interviews and on-site investigations.

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 NACIP team:

Mr. Wallace Eakes, Contract Coordinator
Mr. Wayne Tusa, Project Director, 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, FCHA
Mr. James E. Dodgen, Consultant for ordnance operations.

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 report identifies information received in interviews, unpublished reports, or 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, are based on the findings of the Initial Assessment Study.

During Confirmation Studies, extensive sampling and monitoring are conducted to confirm or refute the existence of migrating contamination at sites identified during an IAS. If significant impacts are found to be present, the Confirmation Study recommends the types of remedial actions to be taken. A Confirmation Study is recommended only if the following circumstances exist:

1. Sufficient evidence exists to suspect that the activity is contaminated; <u>and</u>

2. The potential contamination presents a danger to:

   a. The health of civilians in nearby communities or personnel within the activity 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

2.1 GENERAL

Significant findings relevant to hazardous waste sites at NOS Indian Head have been grouped as follows: (1) background conditions; (2) past operations, and (3) waste sites.

2.2 BACKGROUND

The important background conditions with respect to hazardous waste management at NOS Indian Head are summarized below in discussions of the following:

1) soils and geology
2) water resources
3) ecology
4) population and land use.

More detailed information can be found in Section 5 of this report.

2.2.1 Soils and Geology

Soils at NOS Indian Head are typically loams, however some sandy soils prevail at lower surface elevations. The soils in the northern part of the Indian Head peninsula area have a hard dense frangipan in the lower part of the subsoil (three to four feet) which minimizes the downward movement of water. Generally the loamy soils have a low permeability.

Foundation soil borings from 10 to over 100 feet deep show the presence of extensive zones of fine-grained sediment such as clay, silt, and sandy or silty clay. Where interbedded lenses of sand were found, extensive layers of fine-grained clays were encountered below the interbedded coarse-grained materials.

At depths generally greater than 40 to 60 feet, sand deposits are typically encountered beneath the extensive zones of clay discussed above. These sands are most likely the top of the upper Raritan and Patapsco Formation. Stump Neck soils are generally similar.

2.2.2 Water Resources

Indian Head peninsula is formed by the Potomac River and its tributary Mattawoman Creek. Stump Neck peninsula is formed by the Potomac and the tributary Chicamuxen Creek. All surface water drainage is directly

to either the Potomac on the west or to the tributary creeks to the east of the peninsulas. Marsh and lowland areas of NOS Indian Head are subject to flooding, and portions are within 100-year flood plains. The Potomac River and its tributaries at NOS is an estuary and is subject to tidal action and salt water intrusion from Chesapeake Bay. Surface water is used for fire fighting. It is not used for drinking water.

Migration potential of contaminants into surface waters is directly related to hydraulic connection between the shallow groundwater zones and the surface drainages at NOS Indian Head. Should contaminants enter the shallow groundwater system, it is highly probable that they would discharge to Mattawoman Creek, Chicamuxen Creek, or the Potomac River. (See Section 5.3.8 for further details.)

Groundwater which may occur above sea level drains to either the Potomac River or the tributary creeks. This ground water is not used for any purpose on NOS Indian Head.

Drinking water and industrial process water are drawn by Navy wells from the Raritan and Patapsco Formation at a depth of 200 to 300 feet. Some of these wells extend deeper into the Patuxent and Arundel Formation at 300 to 400 feet deep.

Due to the geology of 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.

From a hydraulic perspective, it appears that Mattawoman Creek and the Potomac River would be the discharge points for any contamination migration from potential disposal sites to the shallow groundwater on the main peninsula. Both of these waterways (as well as Chicamuxen Creek) are very close to sea level and are therefore the lowest hydraulic points in the area.

There is only a remote possibility of contaminants migrating vertically at NOS to the aquifer sands on the Raritan and Patapsco Formation. For a more extensive groundwater discussion see Section 5.3.7.1.

2.2.3 Ecology

NOS property, 3,423 acres, is approximately 50 percent open field and shrub, 40 percent forest and 10 percent wetland, including Marsh Island, a 25-acre tidal swamp and waterfowl sanctuary.

The significant mammal on NOS is the white-tailed deer which has overpopulated and is in a poor state of health. See Appendix B for other terrestrial fauna in the area.

The waters of the Potomac in the NOS Indian Head area are a spawning and nursery area for several species of fresh water fish and are also the upstream limit of the nursery area for estuarine-dependent species which spawn in the Atlantic Ocean.

NOS Indian Head is not a habitat for any federally listed threatened or endangered species. The Station could harbor the Rainbow Snake, a Maryland listed species, identified at Stump Neck in 1937. No federally listed plant species has been identified at NOS.

2.2.4 Population and Land Use

The total population of Charles County is approximately 70,000. The county is 40 percent agricultural, 50 percent wooded, and contains widely dispersed residential sub-divisions. Land use in the immediate vicinity of NOS is under the jurisdiction of the Incorporated Town of Indian Head, population approximately 2000. The Town boundary adjoins the northeast border of the Station. The immediate land use surrounding Stump Neck is primarily rural residential and public use, which includes General Smallwood State Park.

2.3 SITE OPERATIONS

Past and present site operations generate materials classified as hazardous. The principal mission of NOS Indian Head is the research, development, and production of propellants used in rocket motors and torpedoes. The scope of industrial operations ranges from laboratory research to full scale production and testing of complex chemical propellants. Attendant base support functions include public works shop operations. Disposal of scrap propellants and other chemical wastes requires special facilities and precautions. Major tenant operations that may have generated potentially hazardous wastes include the Naval Explosive Ordnance Disposal Technology Center and the Naval School, Explosive Ordnance Disposal.

This Initial Assessment Study began as a study of all operations past and present. Subsequently the study was revised to include an evaluation of past operations only. In general, an operation which has not changed in the years since it began at NOS is thus a current operation, and any wastes associated with that operation are not evaluated in this study. More detailed information on site operations can be found in Section 6.

2.4 WASTE TYPES AND DISPOSAL SITES

2.4.1 Waste Types

Wastes from ordnance operations have included waste propellants, explosives, acids, paints, solvents, asbestos, and metals as well as trash such as packing material, rags, and dunnage.

Wastes from non-ordnance operations have included a broad range of waste types including oils, pesticides, low level radioactive materials, oil and lead-based paints, asbestos, solvents, degreasers, acids, polychlorinated biphenyls, scrap metals, and dunnage.

2.4.2 Disposal Sites

A total of 38 sites have been identified at NOS Indian Head which are of potential concern. These sites include waste disposal sites previously identified by NOS Indian Head personnel as well as sites identified by the NACIP Team during the course of this study. The histories of site use, the types of waste disposed, the magnitude of spill incidents, and other characteristics related to these sites were investigated in detail. A description of waste disposal activities at each site and an analysis of potential human health or environmental effects from contaminant migration are presented in Section 6.

SECTION 3 CONCLUSIONS

3.1 GENERAL

The principal conclusion reached after the record search, interviews, and site visit is that 5 of the 38 disposal sites at NOS Indian Head may pose a potential hazard to human health or the environment. Of the 5 sites, 3 were recommended for current confirmation studies under the NACIP Program. These sites are discussed in Section 3.3. Two of the 5 sites are expected to present less of a hazard to health and the environment. Evaluation of these sites can be withheld until results of the recommended confirmation studies are known. These two sites are discussed in Section 3.4.

3.2 INITIAL SITE SCREENING

Hazardous waste sites identified by the IAS team were evaluated using a Confirmation Study Ranking System (CSRS) developed by NEESA for the NACIP Program. The system is a 2-step procedure for systematically evaluating a site's potential hazard to human health and the environment based on evidence collected during the IAS.

Step one of the system is a flow chart which eliminates innocuous sites from further consideration. Step two is a ranking model which assigns a numerical score, within a range of 0 to 100, to indicate the potential severity of a site. Scores are a reflection of the characteristics of the wastes disposed of at a site, contaminant migration pathways, and potential contaminant receptors on and off the installation. CSRS scores and engineering judgment are then used to evaluate the need for a confirmation study based on the criteria stipulated in Section 1.3. CSRS scores assigned to sites recommended for confirmation studies also assist Navy managers to establish priorities for accomplishing the recommended actions. A more detailed description of the Confirmation Study Ranking System is contained in NEESA Report 20.2-042.

3.3 SITES RECOMMENDED FOR CONFIRMATION STUDIES

Evaluation of the data has led to the conclusion that sufficient evidence exists to suspect contamination and that further studies are required to determine whether or not the sites discussed in this section pose a threat to human health or the environment. This conclusion is based on the review of records, interviews, site inspections, and the NACIP Confirmation Study Ranking System.

3.3.1 X-ray Building, Building 731 (SITE NO. 5)

From 1953 to 1965, the wastewater from the development of X-ray film was discharged directly into an open ditch. The wastes have consisted

of the fixing solution (hypo) and the developer. Between 1953 and 1965, untreated wastes including fixer and developer were discharged into a 1200-foot open drainage ditch, resulting in a calculated discharge of 720 pounds of silver over the 12-year period. Therefore, silver compounds, which are toxic to marine life, may have deposited along the sidewalls of the ditch or in the Mattawoman Creek sediments. Since about 1965, the hypo solutions have been collected for silver recovery. (See Section 6.6.5 for further details.)

3.3.2 Town Gut Landfill (SITE NO. 12)

Visual evidence of hazardous waste disposal exists in this 3-acre landfill Northwest and across the roadway from Building 704, built almost entirely on marsh and creek bed over the period from about 1968 to 1980. 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 to Mattawoman Creek into which it feeds. (See Section 6.6.12 for further details.)

3.3.3 Mercury Deposits, Building 766 (SITE NO. 8)

Mercury used in laboratory tests in Building 766 has been discharged for over twenty years directly into a manhole outside the building, and from there by open ditch to the Mattawoman Creek. Dangerous mercuric compounds may have formed in the creek sediments. The presence of these hazardous compounds produces a potential environmental danger to aquatic life in the creek. (See Section 6.6.8 for further details.)

3.4 SITES WHICH MAY REQUIRE FUTURE CONFIRMATION STUDIES

3.4.1 Hypo Spill, Radiographic Facility Accelerator Control Building, and Open Drain, Building 1349 (SITE NO. 6)

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. This site is similar to SITE NO. 5 in regard to soil conditions and waste types, however the total waste quantities differ. The amount of waste generated at SITE NO. 6 is based on estimated use of 2,000 X-ray film sheets per month as opposed to 4,000 sheets per month at SITE NO. 5. Another factor is the shorter time of operation, i.e., beginning in 1965 at SITE NO. 6 versus beginning in 1953 at SITE NO. 5.

A confirmation study at SITE NO. 6 should await the outcome of the study at SITE NO. 5. Only if a hazardous condition is confirmed at SITE NO. 5 should funds be expended at SITE NO. 6 on confirmation. (See Section 6.6.6 for further details.)

3.4.2 Hypo Discharges from X-ray Building No. 2, Building 588 (SITE NO. 25)

As is the case with SITE NO. 5, this facility generated wastes consisting of sodium thiosulfate fixer, hydroquinone developer, and silver in a silver thiosulfate complex. During its 20-year operating period (1944-1964), SITE NO. 25 generated an estimated 112,800 lbs. of sodium thiosulfate; 112,800 lbs. of hydroquinone, and 860 lbs. of silver. Silver compounds, which are toxic to aquatic life, may have deposited along the drainage path of IW45 or in the Mattawoman Creek sediments. SITE NO. 5, which has operated since 1953, has discharged an estimated 180,000 lbs. of sodium thiosulfate fixer and hydroquinone, and 720 lbs. of silver. Due to its longer operating period a confirmation study of SITE NO. 5 should precede a study of SITE NO. 25. (See Section 6.6.25 for further details.)

3.5 SITES OF POSSIBLE LIMITED FUTURE USE

Several disposal sites have potential health, environment, or safety conditions which may limit their future use. The hazard associated with each site is generally static, not migrating, and it may be best to leave the sites covered and/or undisturbed. The sites are briefly summarized below and in Table 3.2-1.

3.5.1 Thorium Spill (SITE NO. 1)

This site is the location of the Special Weapons Disposal Building (Building 900). There has been some radioactive surface soil contamination, caused by an ordnance training session, near Building 900. There are no records to document the current status of this area. Therefore, since there are no records available to indicate the success or extent of cleanup of thorium-contaminated soil, a thorough survey must be made prior to any excavation or change in land use. (See Section 6.6.1 for further details.)

3.5.2 HMX Spill, Slurry Mix Building, Building 682 (SITE NO. 7)

This site is the location of the Slurry Mix Building (Building 682). Wastewater was discharged into the floor drain and from there to an open storm ditch (IW10). A mixture of alcohol and water contaminated with HMX was periodically spilled onto the concrete platform floor of Building 682 and periodically washed out onto nearby ground surfaces.

Contaminants known to be in the wastewater included HMX. The major hazard associated with HMX is its explosive characteristics. It is not possible to determine whether HMX was deposited in the ditch or the Mattawoman Creek sediments. Since HMX is extremely dense, it is likely that certain quantities of material remain within the vicinity of Building 682. This potential safety hazard should be considered in any future development plans in the vicinity of Building 682. Therefore, the site should be included on the Station's General Development Map. (See Section 6.6.7 for further details.)

TABLE 3.2-1

SITES OF POSSIBLE LIMITED FUTURE USE

Site No.	Site Name	Incident
1	Thorium Spill	Reported thorium spills
7	HMX Spill, Slurry Mix Building	HMX deposits near Building 682 and in Ditch IW 10
22	NG Slums Burning Site	NG slums reportedly were burned on a ½-acre strip of land off Greenslade Road
24	Abandoned Drain Lines	Reported NC deposits in drain lines
35	Buried Torpedoes	Reported buried explosive-filled torpedoes

3.5.3 NG Slums Burning Site (SITE NO. 22)

This site at the east end of Hussey Road along Mattawoman Creek was reportedly used as a burning area for the disposal of NG slums generated by the nitrating facilities.

While team site reconnaissance indicated the presence of waste disposal, there was no evidence of the old slum burning 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.

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 considered with any future NOS development plans. Therefore the site should be included on the Station's General Development Map. A Confirmation Study has not been recommended at this time. (See Section 6.6.22 for further details.)

3.5.4 Abandoned Drain Lines (SITE NO. 24)

This site, in the vicinity of Carpenter Road, is the location of the abandoned nitrocellulose (NC) production facilities. Nitrocellulose, 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. (See Section 6.6.24 for further details.)

3.5.5. Buried Torpedoes (SITE NO. 35)

Although evidence of buried torpedoes could not be confirmed in records at NOS, allegations were from reliable persons. The material is said to be from the Torpedo Station near Blue Plains in Washington, D.C. (possibly the old Naval Torpedo Station in Alexandria, Virginia which is across the Potomac River from the Blue Plains area of 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 fuzes and parts which are not rendered safe. No other details are available. The hazard from buried explosive-filled torpedoes is more likely to come from inadvertent disturbance than from the potential contamination due to deterioration of the metal case and explosive contents. It is therefore recommended that this site not be disturbed and that NOS maps be suitably marked to warn of the potential safety hazard. (See Section 6.6.35 for further details.)

SECTION 4 RECOMMENDATIONS

Based on the preceding discussion of significant findings and conclusions, there are 5 sites at NOS Indian Head for which evidence exists to suspect contamination which may present a threat to the environment, principally to the aquatic environment, on and off the station. However, additional information is needed to validate the location, the concentration, and the potential for migration of suspect contaminants at these sites. Such validation is necessary before corrective action, if necessary, is initiated. Therefore, it is recommended that a Confirmation Study, Phase II of the NACIP Program, be conducted at NOS Indian Head, MD.

4.1 CONFIRMATION STUDY

Three sites which warrant further investigation by a Confirmation Study are: X-ray Building (SITE NO. 5), Town Gut Landfill (SITE NO. 12) and Mercury Deposits (SITE NO. 8). Based on the results of the Confirmation Study Ranking System (CSRS) these sites are listed in descending order:

WASTE SITE	SITE NUMBER	CSRS SCORE
X-ray Building	5	29
Town Gut Landfill	12	26
Mercury Deposits	8	19

Two sites, similar to SITE NO. 5, which meet the criteria for a Confirmation Study will be studied depending on the SITE NO. 5 results. The sites are: Radiographic Facility (SITE NO. 6) and Hypo discharges from X-ray Building (SITE NO. 25). These two sites are very much like SITE NO. 5. Both are sites where photographic developing wastes have been discharged to open ditches. They do not rank as high on CSRS scores. On completion of the Confirmation Study of SITE NO. 5, a decision can be made to add or drop SITE NOS. 6 and 25. If the study confirms no hazard to the environment at SITE NO. 5, there should be no reason to study SITE NOS. 6 and 25.

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 (40 CFR 401), 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 the Ordnance Environmental Support Office (OESO) be consulted regarding the location of contaminant sources prior to the selection of sampling points.

Table 4.1-1
Recommended Confirmation Studies

Site	Site No.	CSRS Score	Type & No. of Samples Water	Sediment	Soil	Laboratory Analytical Procedures
X-ray Building	5	29	-	6	-	silver
Radiographic Facility	6	-	(Withhold until SITE NO. 5 results are known)			
Mercury Deposits	8	19	3	8	-	mercury
Town Gut Landfill	12	26	3	4	-	pH, specific conductance, total organic carbon, total organic halogen, silver, cadmium, chromium, lead, mercury, and arsenic
Hypo Discharges X-ray Bldg. No. 2	25	-	(Withhold until SITE NO. 5 results are known)			

4.1.1 X-ray Building (SITE NO. 5)

Type of sample: Sediment

Number of samples: Two sediment samples in wetlands at end of ditch; one within one foot of and on the creek side of the Low Low (LL) water line and one within 10 feet of and on the creek side of the LL water line. Four samples in ditch; three within 150 feet of point of discharge, and one 300 feet from point of discharge.

Frequency: Initial sampling only

Testing parameters: Silver

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

Comments: The present drainage ditch may not have existed in 1975. Consult NOS and OESO personnel prior to selection of sampling points.

4.1.2 Radiographic Facility (SITE NO. 6)

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. 5. In the event that the study of SITE NO. 5 confirms a danger to aquatic life, then the following study is recommended for SITE NO. 6:

Type of sample: Sediment

Number of samples: Four samples in surface drainage ditch leading to Mattawoman Creek. Three of these samples within 50 feet of Building 1349 and one taken 200 feet from Building 1349. No samples are required at the wetlands end of the ditch. Use the samples from SITE NO. 5 which are taken from the same wetlands.

Frequency: Initial sample only.

Testing parameters: Silver.

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

4.1.3 Mercury Deposits (SITE NO. 8)

Type of samples: Sediment and Water

Number of samples: Eight sediment samples in the creek; two along the storm ditch leading to the marshland, two in the lowlands leading to the marshes, one in the LL water line of the marshes, one within ten feet of the LL water line in the marshes, one in the LL water line of the Mattawoman Creek, and one within ten feet of the LL water line of the Mattawoman.

Three water samples; one from the marshes, one in the storm ditch, and one from the discharge of the marshes into Mattawoman Creek.

Frequency: Initial sampling only

Testing parameters: Mercury

Potential danger: Mercury compounds have been documented as severe threats to aquatic organisms. 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 Town Gut Landfill (SITE NO. 12)

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. Samples should be taken during out-going tidal flow. 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: pH, specific conductance, total organic carbon, total organic halogen, silver, cadmium, chromium, lead, mercury, and arsenic.

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.

Comment: During the Confirmation Study, consideration should be given to opportunistic sampling of any visible leachate from the Landfill, especially from the older portion of the Landfill, upstream of Atkins Road Extension.

4.1.5 Hypo Discharges, X-ray Building No.2 (SITE NO.25)

This site is not recommended for a Confirmation Study at this time. In the event that the study of SITE NO. 5 confirms a danger to aquatic life then a study should commence at SITE NO. 25 to confirm the concentration of contaminants and their effect on the environment.

Type of sample: Sediment

Number of samples: Two sediment samples to be taken in wetlands at end of ditch IW 46; one within one foot of and on the creek side of the LL water line and one within 10 feet of and on the creek side of the LL water line. Four samples in ditch IW 46: three of these to be taken within 50 feet and one within 200 feet of Building 588 discharge point.

Frequency: Initial sampling only

Testing parameters: Silver

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

4.2 OTHER RECOMMENDED ACTIONS

The review of the water supply wells at the NOS revealed that a number of abandoned wells have not been cemented or filled and 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. All wells should be cemented properly and wells which are standing open should be properly sealed.

SECTION 5 BACKGROUND

5.1 GENERAL

Naval Ordnance Station (NOS) Indian Head covers approximately 3,423 acres and is bounded by the Potomac River, Mattawoman Creek, Chicamuxen Creek, the Town of Indian Head, and private property. It is situated in the Northwestern 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-actuated and propellant-actuated devices, and chemicals. Disciplines represented at NOS include expertise in weapons systems propulsion, explosives development, and propellant and explosives 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. It 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 the Naval Surface Weapons Center. Stump Neck has 98 buildings and other facilities. Within Stump Neck, 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. Only a few rail lines remain active -- the rest have been abandoned. 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 is bounded by Chicamuxen Creek to the east and the Potomac River to the west. Indian Head has 8.6 miles of shoreline, while Stump Neck has 4.2 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 encompass 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 was used several times weekly for receiving materials, trans-shipping finished products and receiving 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 fuzes, 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 formed 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 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 Proving Ground (NPG) 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 years.

As technology advanced, the safety limits of shot and shrapnel in tests exceeded the size of the Station. In addition, the presence of the 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 on 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 1920s. By 1932, the Naval Proving Ground was officially established at Dahlgren, and the Indian Head site was redesignated as the Naval Powder Factory (NPF).

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 of new and 4,000 lbs of reworked Explosive D were 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.

A new Explosive D plant was completed in 1942. The production rate of Explosive D was 4 million pounds a 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 propellant 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 1943, 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 grain 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, Sidewinder, 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 torpedoes 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 1960s, the Station started producing Navy Cool (NACO) gun propellant 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 Technology Center 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 Devices/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.

In 1976, NOS was also assigned the task of producing 1,000 Standard ARM Rocket Motors. 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 Naval Ordnance Station (NOS) Indian Head 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.

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 Naval School, Explosive Ordnance Disposal, 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. 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 NOS experience a continental type of climate, with well defined seasons. However, the Chesapeake Bay and Potomac River have a modifying influence on the climate of the area, particularly with respect to temperature. Locations which are situated very near the shore characteristically experience a small diurnal range in temperature.

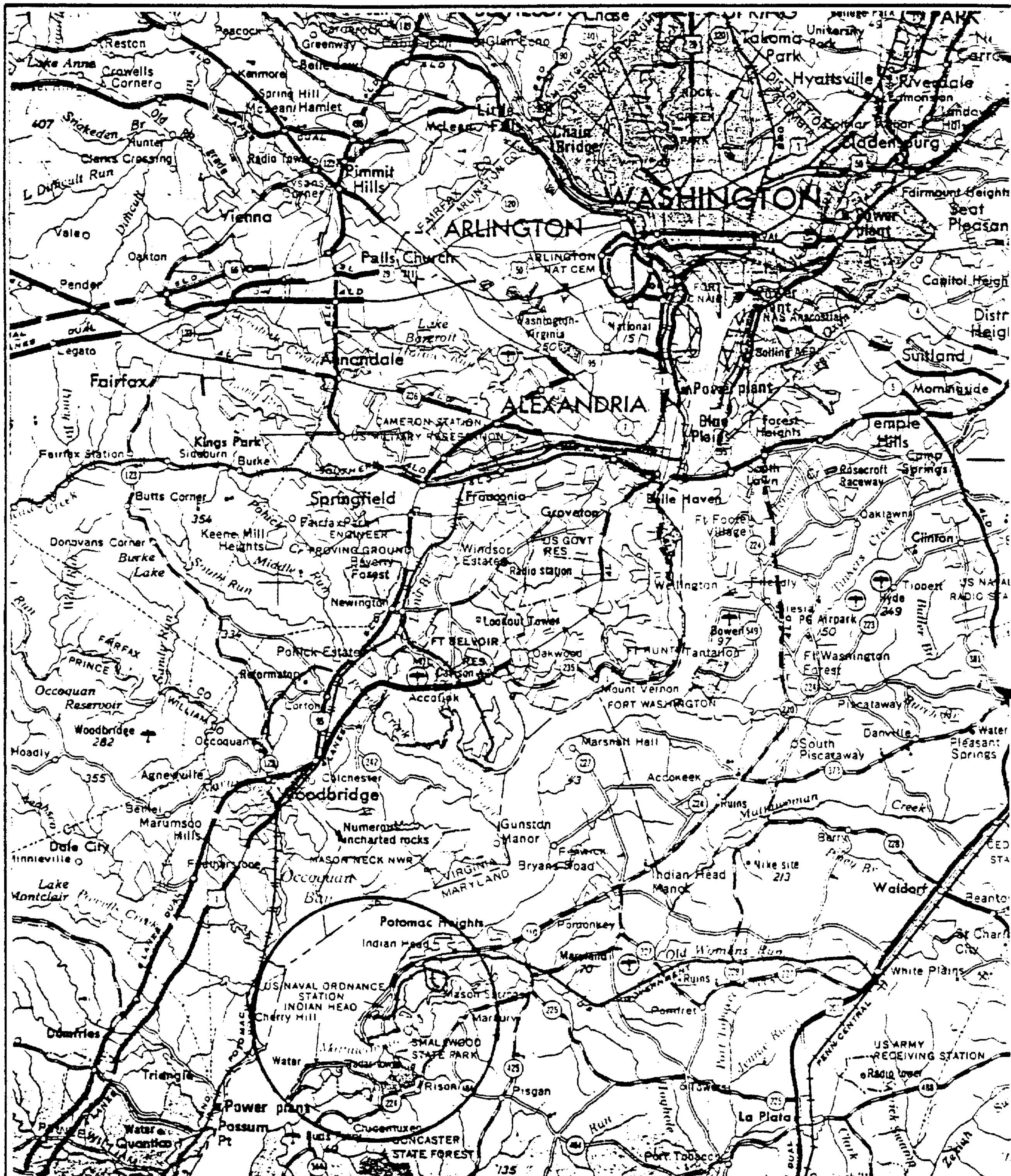


FIGURE 5.3-1 LOCATION MAP OF THE INDIAN HEAD NOS

FCHA

INITIAL ASSESSMENT STUDY
NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND

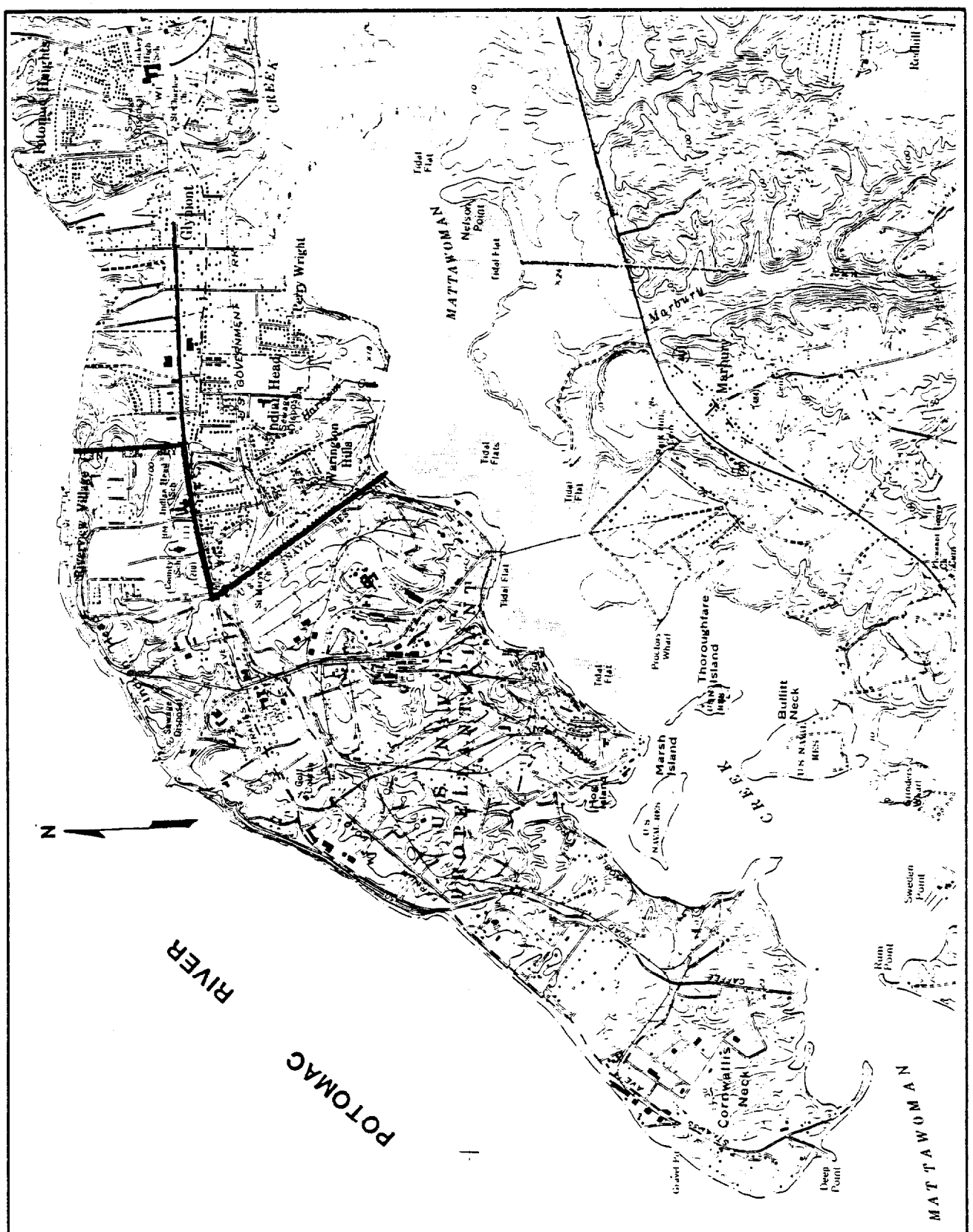


FIGURE 5.3-2 PLAN VIEW OF THE INDIAN HEAD MAIN PENINSULA

FCHA INITIAL ASSESSMENT STUDY
NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND

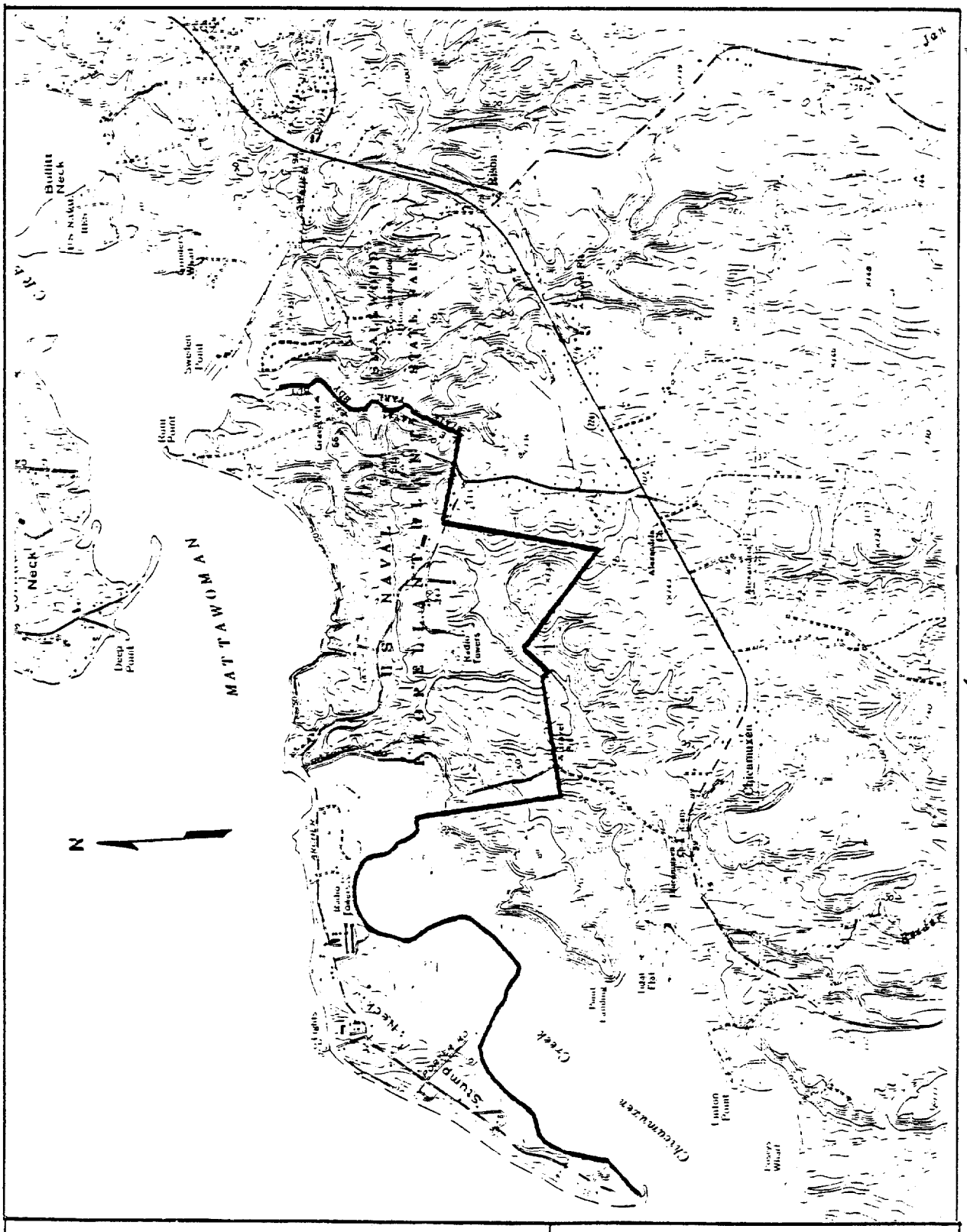


FIGURE 5.3-3 PLAN VIEW OF THE STUMP NECK AREA

FCHA INITIAL ASSESSMENT STUDY
NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND

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 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

NOS Indian Head 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. 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 southeast, 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 southeast 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 suggests 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 NOS Indian Head 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 which places the age of the sediments and bedrock in perspective. The crystalline bedrock near Indian Head is approximately 600 feet below sea level, so the unconsolidated deposits at NOS Indian Head are on the order of 600-700 feet thick.

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 Patapsco and Raritan Formations of Upper Cretaceous age, and the surficial Columbia Formation of Quaternary 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 is a generalized geologic map of the project area and Figure 5.3-6 is a cross section of the sub-surface geology from the Virginia outcrop area through Indian Head and into Charles County.

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 in Figure 5.3-6. In this area, the Aquia Greensand would be anywhere from 0 to 20 feet thick.

The principal physical characteristics of the major geologic formations in the Indian Head area and Charles County are described below (Otton, 1955; Slaughter and Otton, 1968).

- Columbian Formation

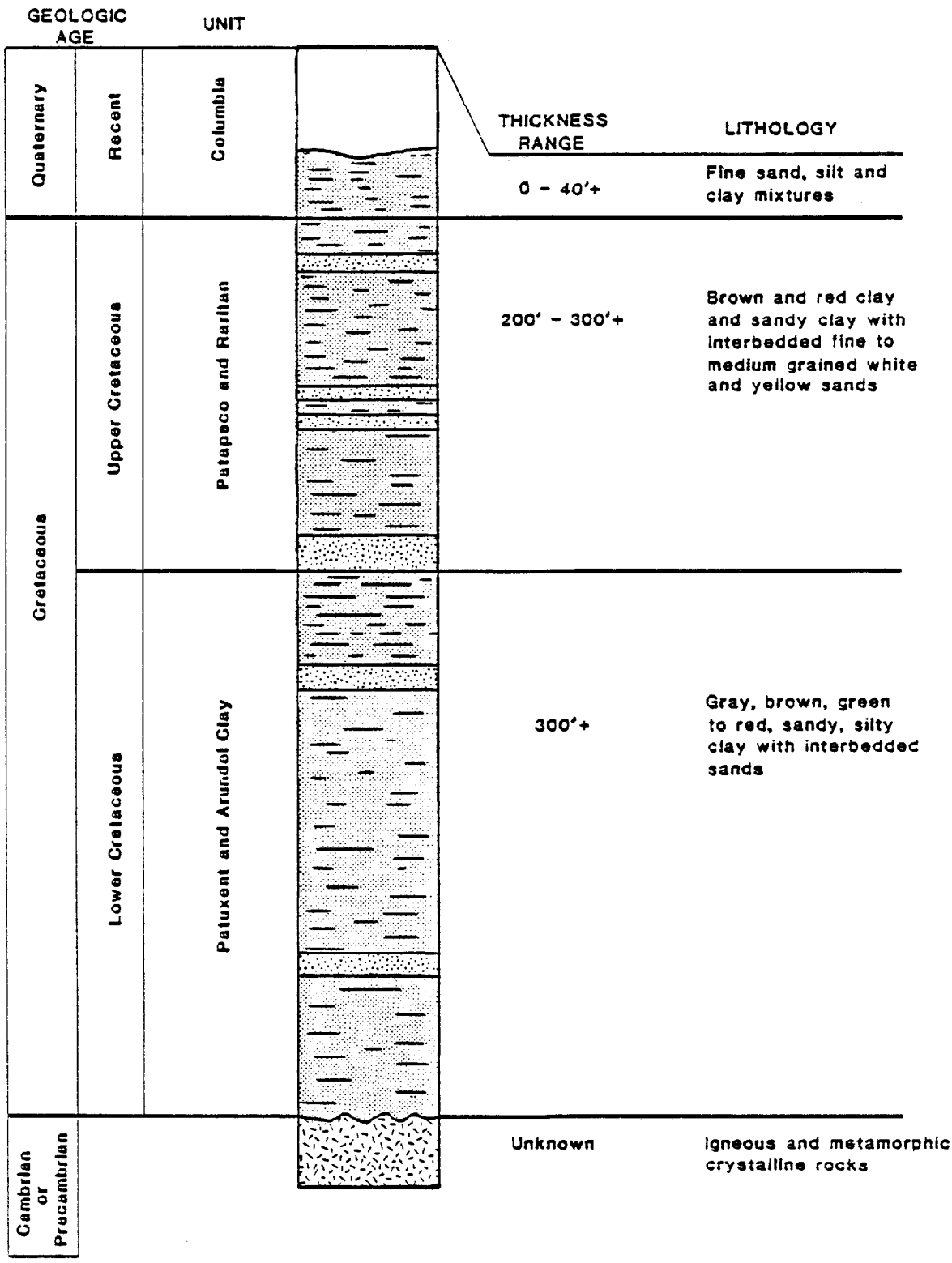
The Quaternary Columbia Formation consists of Pleistocene and recent deposits ranging in thickness from 0-60+ feet in Charles County. At Indian Head, the deposits are thought not to exceed 40 feet in thickness

Table 5.3-1

AGE OF GEOLOGIC FORMATIONS

Era	Period	Epoch	Age Range*
Cenozoic	Quaternary	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?

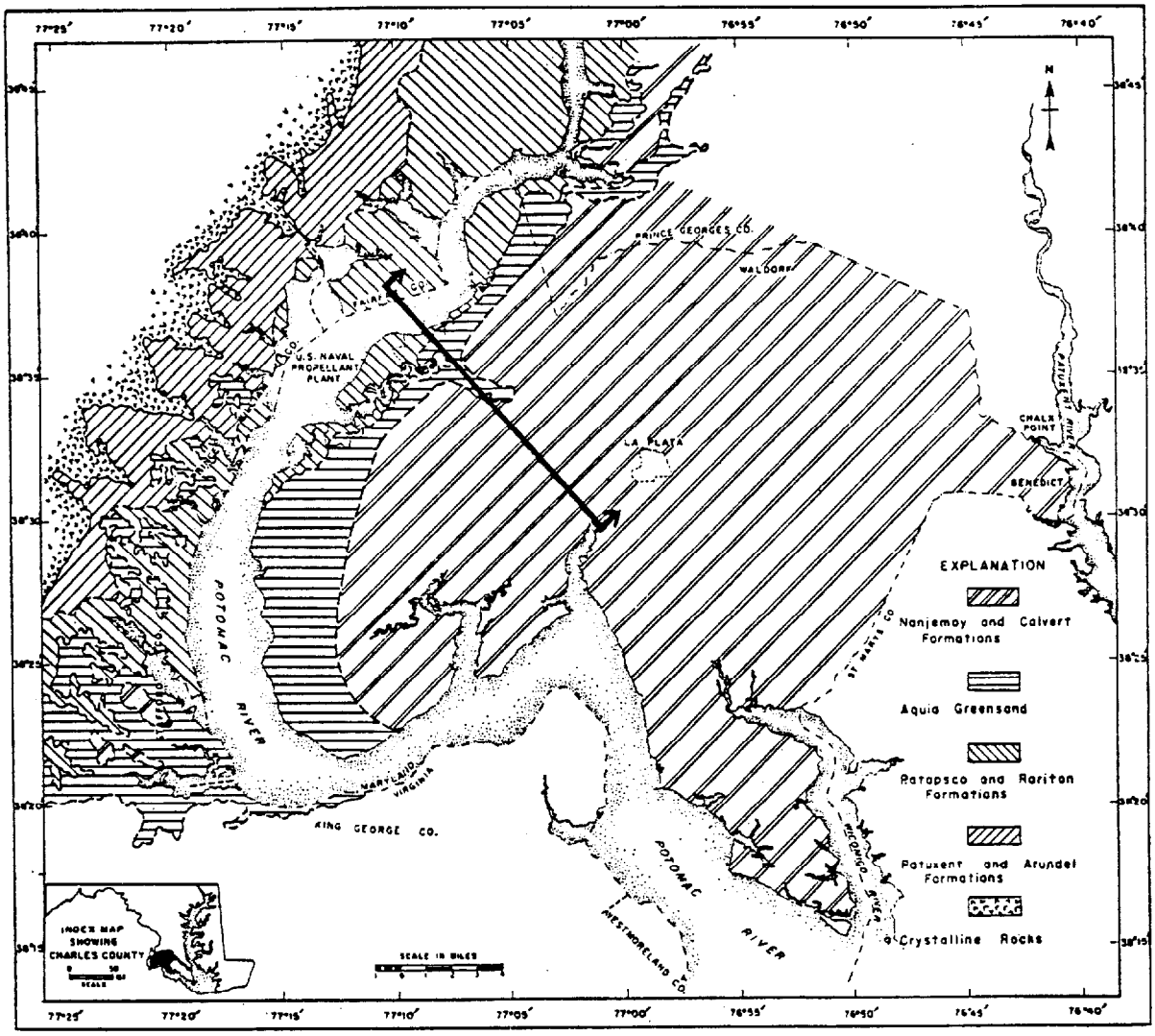
Source: Sowers (1979)



Source: AWARE, Inc. (1982)

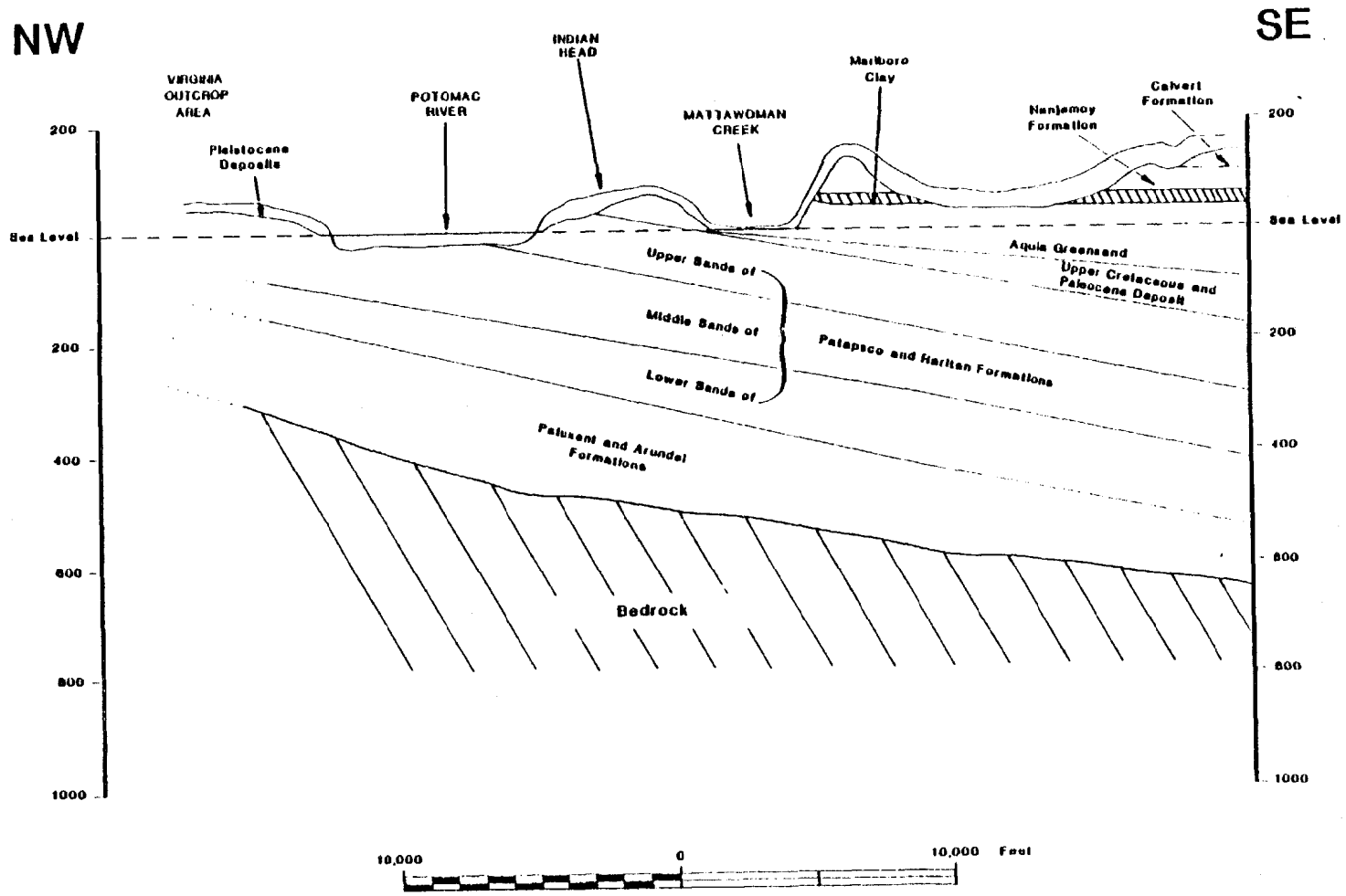
FIGURE 5.3-4 GENERALIZED LITHOLOGIC COLUMN FOR THE INDIAN HEAD AREA

FCHA INITIAL ASSESSMENT STUDY NAVAL ORDNANCE STATION INDIAN HEAD, MARYLAND



Source: Slaughter and Otton (1968).

FIGURE 5.3-5 GENERALIZED GEOLOGIC MAP OF THE PROJECT AREA	FCHA	INITIAL ASSESSMENT STUDY NAVAL ORDNANCE STATION INDIAN HEAD, MARYLAND



Source: AWARE, Inc. (1982)

FIGURE 5.3-6 GENERALIZED CROSS-SECTION SHOWING STRATIGRAPHY OF INDIAN HEAD AREA

FCHA

INITIAL ASSESSMENT STUDY
NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND

(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 Aquia Greensand.

- Patapsco and Raritan 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, well logs for the county generally indicate the existence of a regular sequence of position and thickness of the sands. On this basis, the sands within the Patapsco and Raritan 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 General

The U.S. Department of Agriculture Soil Conservation Service (USDA SCS) 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. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil and is named for the major soils. The soils in one association may occur in another, but in a different proportion. The associations identified by the SCS are:

1) Beltsville - Gravelly land - Bourne association - These are level to moderately-sloping, moderately-well-drained loamy soils that are only moderately-deep to a dense root-inhibiting fragipan.

2) Beltsville - Exum - Wickham association - These are level to moderately-sloping, moderately-well-drained and well-drained loamy soils, some of which are only moderately-deep to a hard dense fragipan.

3) Evesboro - Keyport - Elkton association - These are level to moderately-sloping excessively-drained sandy soils and moderately-well-drained and poorly-drained level to gently-sloping loamy soils that have a clayey subsoil.

4) Bibb - Tidal Marsh - Swamp association - These are level to nearly-level, poorly-drained soils on flood plains and miscellaneous unclassified wetlands.

5.3.5.2 Soils Series on the Indian Head Main Peninsula

The surface soil series on the Main Peninsula are shown in Figure 5.3-7. The key to the numbers identifying the soil series on the map is in Table 5.3-2. Engineering properties of these various soil series are contained in Table 5.3-3. The Unified Soil Classification System, shown in Table 5.3-4, provides further information on the engineering properties of these soils.

The dominant inland soils on the Main Peninsula are the Beltsville, Keyport, and Elkton silt loams. The Beltsville series consists of nearly-level to moderately-sloping, moderately-deep, moderately-well-drained soils, that are strongly acid and slowly permeable. These soils have developed a hard, dense fragipan layer that prevents the downward movement of water. The Keyport and Elkton series are nearly-level, poorly- to-moderately well-drained soils that occur along major rivers and on higher upland flats. The Elkton series is less permeable than the Keyport, but neither soils have developed fragipans.

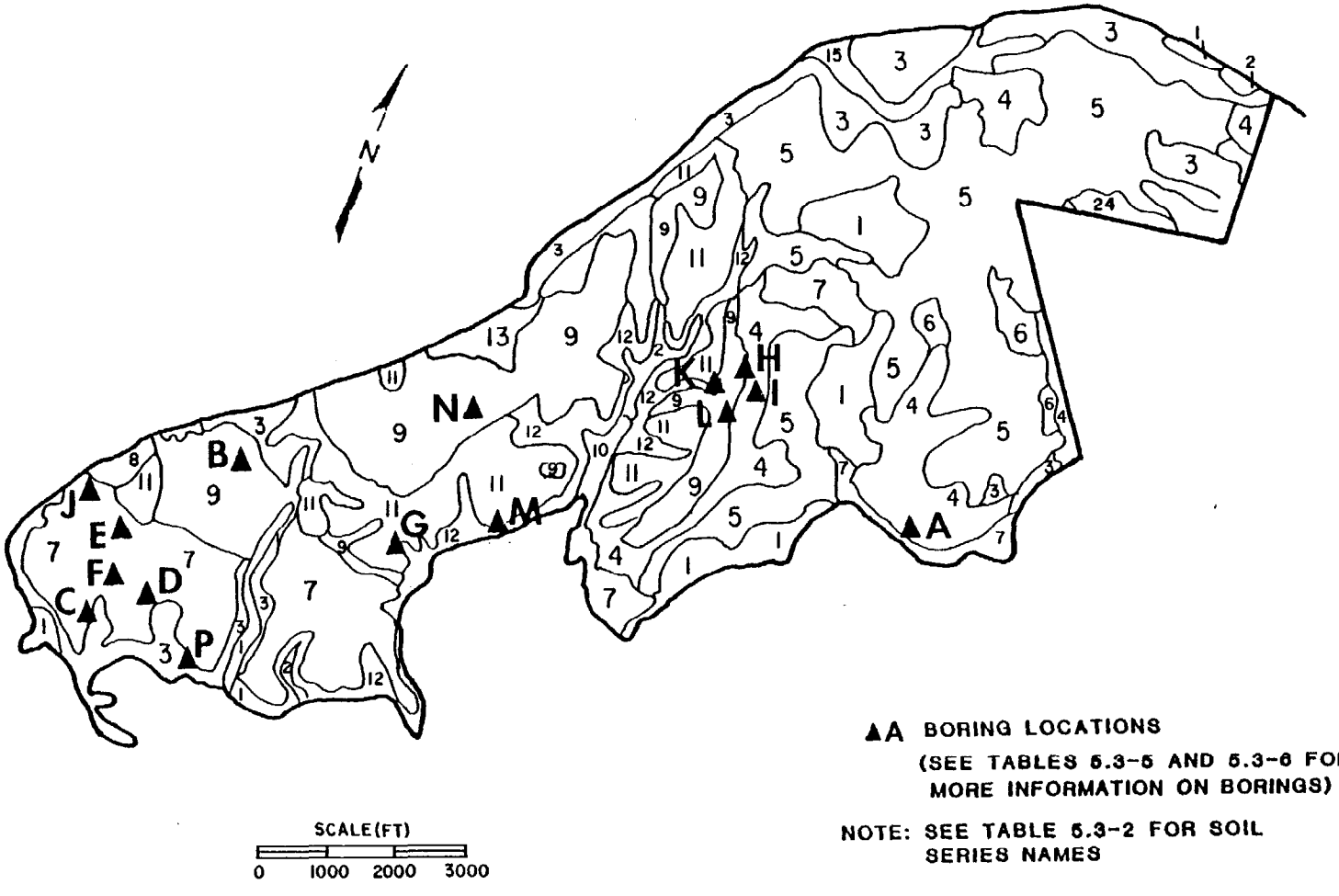


FIGURE 5.3-7 SOIL SERIES ON THE MAIN PENINSULA

FCHA INITIAL ASSESSMENT STUDY
NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND

TABLE 5.3-2

KEY TO SOILS MAPS

Map Number	Symbol	Soil Series Name
1	Cu	Cut-and-Fill Land
2	Bo	Bibb Silt Loam
3	GvE	Gravelly Land; Steep
4	Au	Aura Gravelly Sandy Loam
5	Bl	Beltsville Silt Loam
7	Kp	Keyport Silt Loam
8	Gp	Gravell and Borrow Pits
9	Ek	Elkton Silt Loam
10	Tm	Tidal Marsh
11	Ms	Matawan Loamy Sand
12	Sa	Sandy Land; Steep
13	Rd	Rumford Loamy Sand
15	Sh	Sassafias Sandy Loam
17	Ga	Galestorun Loamy Sand
18	Ot	Otbelto Silt Loam
19	Wo	Woodstown Sandy Loam
20	Ex	Exum Silt Loam
21	Mn	Matapeake Silt Loam
22	Mu	Mattapex Silt Loam

Table 5.3-3

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*		
Bellsville: 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.
		16-34	Loam, silt loam, silty clay loam (fragipan).	ML, CL	95-100	90-100	80-100	65-85	<0.20	0.10-0.18	4.0-5.0	Low.
		34-72	Loam, gravelly loam	SM, ML	75-100	65-100	55-100	25-80	0.20-0.3	0.04-0.16	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	80-100	45-100	40-80	25-80	0.63-2.0	0.10-0.20	4.0-5.0	Low.
Bourne: BrB2, BrC2, BrC3	1½-2½	0-13	Sandy loam, sandy clay loam	SM, SC, ML	75-100	45-100	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	0.06-0.18	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	0.06-0.18	4.0-5.0	Low.
Elkton: Ek	0-1	0-12	Silt loam	ML, CL	90-100	85-100	80-100	65-90	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	90-100	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	0.20-0.3	0.06-0.24	4.0-5.0	Low to moderate.
Evesboro: EsB, EsC, EsB, EsC	>3	0-60	Loamy sand, gravelly loamy sand.	SM, SP-SM	75-100	60-100	40-95	5-15	>0.3	0.06-0.10	4.0-5.0	Low.
Equm: EqC2, EqD2, EyC3, EyD3, EzB2.	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.
		43-60	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: GrE	>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: KaA, KaB2, 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.
		16-30	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.
		30-60	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, WkC3, WkD2, WmC3, WmD3.	>6	0-8	Fine sandy loam, sandy clay loam.	SM, ML, CL	80-100	50-100	75-100	45-75	0.63-0.3	0.12-0.24	4.5-5.5	Low.
		8-36	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	65-100	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 (Co), Cut and fill land (Cu), Eroded land, steep (ErE), Gravel and borrow pits (Gp), Swamp (Sw), and Tidal marsh (Tm) are too variable to be rated.

Source: USDA (1974).

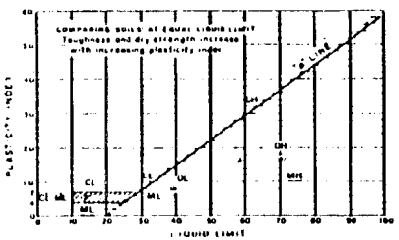
Table 5.3-4

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 [a]	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 [b] — (For visual classifications, the 2 mm size may be used as equivalent to the No. 4 sieve size)	GRAVELS — More than half of coarse fraction is larger than 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	$C_u = \frac{D_{60}}{D_{10}}$ Greater than 4; $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between one and 3; Not meeting all gradation requirements for GW
			Predominantly one size or a range of sizes with some intermediate sizes missing	GP	Poorly graded gravels, gravel sand mixtures, little or no fines		
		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
			Plastic fines (for identification procedures see CL below)	GC	Clayey gravels, poorly graded gravel sand clay mixtures		Atterberg limits above "A" line with PI greater than 7
	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 1/2 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; Not meeting all gradation requirements for SW
			Predominantly one size or a range of sizes with some intermediate sizes missing	SP	Poorly graded sands, gravelly sands, little or no fines		
		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						
		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	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		
		Slight to medium	Slow	Slight	OL	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	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		
		Medium to high	None to very slow	Slight to medium	OH		
HIGHLY ORGANIC SOILS		Readily identified by color, odor, spongy feel and frequently by fibrous texture			PT	Peat and other highly organic soils	

[a] 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.
[b] All sieve sizes on this chart are U.S. standard.



PLASTICITY CHART
FOR LABORATORY CLASSIFICATION OF FINE GRAINED SOILS

ADOPTED BY CORPS OF ENGINEERS AND BUREAU OF RECLAMATION JANUARY 1952

The coastal areas are dominated by cut-and-fill land, gravelly land, and tidal marshes. Cut-and-fill land is defined as an area where the natural soil has been removed. Gravelly land are gravelly deposits that may once have been distinct soil types but cannot be identified because of severe erosion. Tidal marshes consist of material that ranges from sand to clay, but in places it is peat or muck. These soils are generally located along the lower sides of major streams and in low areas that border major rivers.

5.3.5.3 Soils Series on Stump Neck

The surface soil series on Stump Neck are shown in Figure 5.3-8. The legend for this map is in Table 5.3-2. Engineering properties are in Table 5.3-3.

The eastern portion of the Naval property on Stump Neck is dominated by the Beltsville silt loam, a moderately-well-drained soil that has a fragipan generally at a depth of less than 30 inches. Also included is a large area of gravelly land.

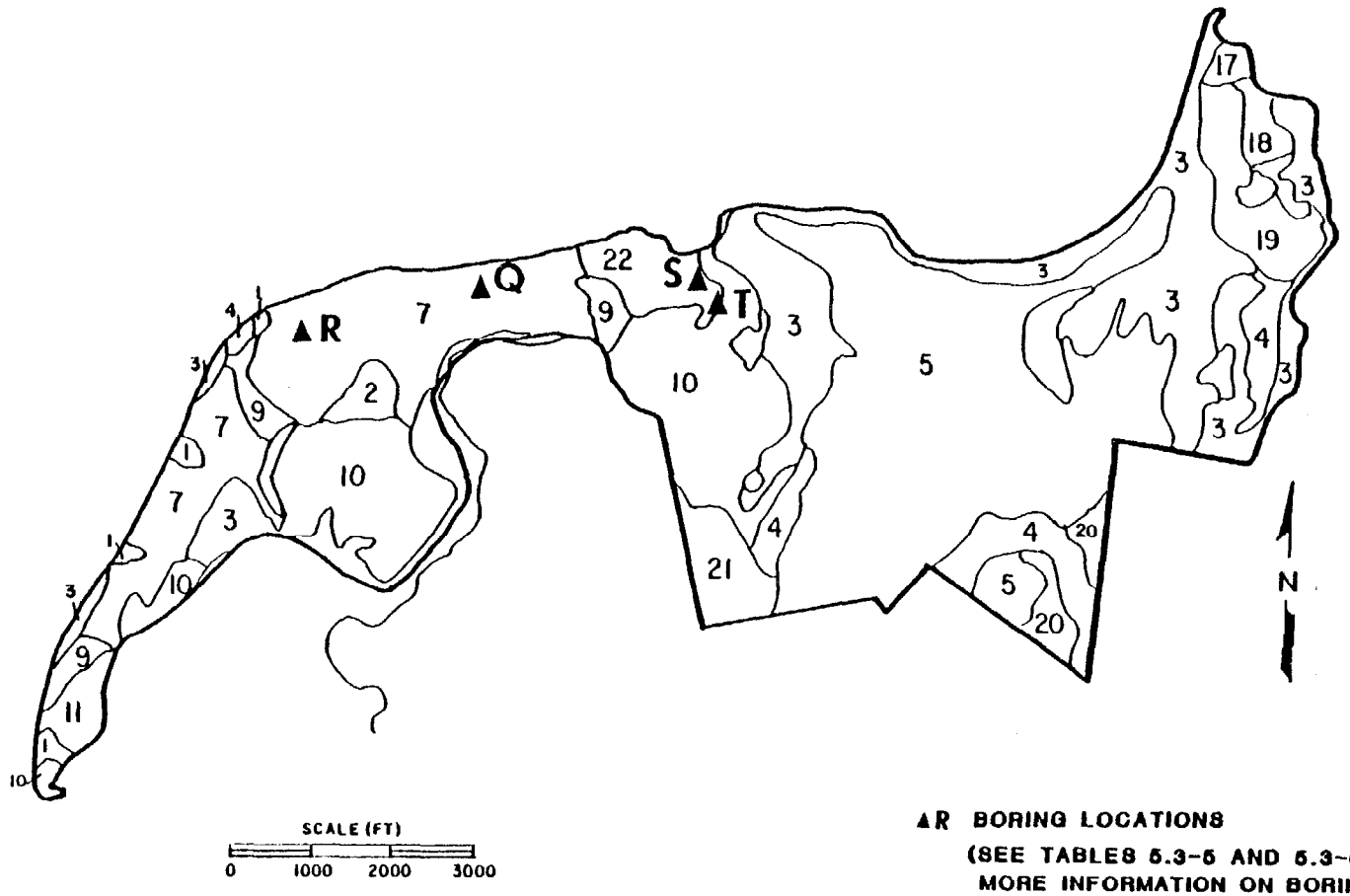
The central and western portions of the Stump Neck Naval Property are dominated by tidal marsh and Keyport silt loam. Towards the end of the neck, there is an area of Matawan loamy sand.

5.3.6 Shallow Subsurface Conditions

5.3.6.1 General

The previous section discussed the surface soils identified by the SCS as occurring on both the Main Peninsula and Stump Neck. For the purpose of the SCS study, an agricultural definition of soil was used to establish the limits of the soil profile. The agricultural definition of "soil" refers to the weathered uppermost layers of unconsolidated deposits, the layers in which plants anchor their roots and from which they derive the water necessary for growth. However, engineers have a different usage of the term. In engineering, "soil" refers to ground that can be excavated by earth moving equipment, without blasting. Thus, to an engineer, any unconsolidated material can be considered soil and not just the upper five feet or so of the earth surface. Therefore, in the following discussion, "soil" will refer to any unconsolidated materials that occur below the surface at NOS Indian Head.

To evaluate the subsurface soil conditions at NOS Indian Head, a number of foundation soil borings were examined. These borings ranged in depth from 10 to 147 feet. In all, a total of 122 borings were obtained for review from NOS: 106 of the borings were from the main peninsula area, and 16 of the borings were from Stump Neck. Figures 5.3-7 and 5.3-8 locate these borings, and Table 5.3-5 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 an estimate of the range in permeabilities of the earth materials encountered. In Table 5.3-6, each of the soil boring references cited in Table 5.3-5 are identified. Appendix A contains selected boring logs which are considered representative of the NOS area.



▲R BORING LOCATIONS
(SEE TABLES 5.3-5 AND 5.3-6 FOR MORE INFORMATION ON BORINGS)

NOTE: SEE TABLE 5.3-2 FOR SOIL SERIES NAMES

FIGURE 5.3-8 SOIL SERIES ON STUMP NECK

FCHA INITIAL ASSESSMENT STUDY
NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND

TABLE 5.3-5: NOS SOIL BORING DATA

Reference	Location[1]	Date	Number of Borings	Depth Range	Subsurface Soil Conditions	Depth to Groundwater	Surface Soil Series Symbol[2]	Estimated[3] Range of Permeabilities cm/sec
A	T33,34	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	Au	10^{-6} to 10^{-1}
B	D11	1964	3	30'	Clay and sandy clay; some layers of silty sand	6 to 10 feet; 2 of 3 borings showed groundwater	Ek	10^{-7} to 10^{-3}
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.	Kp	10^{-6} to 10^{-1}
D	G6,H6, I16,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 lower-most silts and clays, at depths exceeding 70 feet.	5-15 feet; 8 of 9 borings showed groundwater	Kp	10^{-6} to 10^{-1}
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	Kp	10^{-7} to 10^{-3}

TABLE 5.3-5: NOS SOIL BORING DATA (CONT)

Reference	Location[1]	Date	Number of Borings	Depth Range	Subsurface Soil Conditions	Depth to Groundwater	Surface Soil Series Symbol[2]	Estimated[3] Range of Permeabilities cm/sec
F	G4,H4, I4,F3	1960s	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	Kp	10^{-5} to 10^{-3}
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.	Ms	10^{-7} to 10^{-2}
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	Ek	10^{-7} to 10^{-4}
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	Au	10^{-7} to 10^{-5}

TABLE 5.3-5: NOS SOIL BORING DATA (CONT)

Reference	Location[1]	Date	Number of Borings	Depth Range	Subsurface Soil Conditions	Depth to Groundwater	Surface Soil Series Symbol[2]	Estimated[3] Range of Permeabilities cm/sec
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	Kp	10^{-5} to 10^{-3}
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.	Ek	10^{-7} to 10^{-1}
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.	Ek	10^{-7} to 10^{-5}
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.	Sa	10^{-7} to 10^{-5}
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.	Ek	10^{-7} to 10^{-1}

TABLE 5.3-5: NOS SOIL BORING DATA (CONT)

Reference	Location[1]	Date	Number of Borings	Depth Range	Subsurface Soil Conditions	Depth to Groundwater	Surface Soil Series Symbol[2]	Estimated[3] Range of Permeabilities cm/sec
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.	BI	10^{-7} to 10^{-5}
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	GvE	10^{-6} to 10^{-3}
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.	Kp	10^{-6} to 10^{-2}
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	Kp	10^{-6} to 10^{-1}

TABLE 5.3-5: NOS SOIL BORING DATA (CONT)

Reference	Location[1]	Date	Number of Borings	Depth Range	Subsurface Soil Conditions	Depth to Groundwater	Surface Soil Series Symbol[2]	Estimated[3] Range of Permeabilities cm/sec
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	Mu	10^{-7} to 10^{-1}
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	Mu	10^{-7} to 10^{-3}

Notes:
1. See Figure 6.6-1 and 6.6-2 for grid location.
2. USDA, 1974.
3. Permeability estimates based on information provided in Figure 2.9 in Seepage, Drainage, and Flow Nets, by Harry R. Cedergren, 1977.

TABLE 5.3-6: 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 SI # 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 5.3-6: 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.

5.3.6.2 Main Peninsula Subsurface Soils

As can be seen in Table 5.3-5, 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. 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 5.3-7 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.

5.3.6.3 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 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.

5.3.6.4 Estimated Permeability Values for Subsurface Materials Encountered in the Soil Borings

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.

TABLE 5.3-7
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).

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 NOS.

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}
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. An estimate of the range of permeabilities for materials encountered in the borings is contained in Table 5.3-5.

5.3.7 Hydrology

5.3.7.1 Groundwater

As presented earlier in Section 5.3.4, three major sedimentary formations are present at NOS Indian Head: the Patuxent and Arundel Clay ("Patuxent") Formation, the Patapsco and Raritan Formation, and the surfical Quaternary 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 Patapsco and Raritan Formation. At NOS Indian Head, 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 5.3-8 summarizes the principal water-bearing

TABLE 5.3-8: Water-Bearing Properties of the Geologic Formations Found at NOS

Formation	Thickness at Indian Head	Elevation (MSL) of formation top	Summary of Water-bearing properties
Columbia deposits	0-40 ft	Land surface elevation	Not considered a viable aquifer at Indian Head. Water is found in the deposits in thin surficial lenses at 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.
Patapsco and Raritan 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 5.3-8: Water-Bearing Properties of the Geologic Formations Found at 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.

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.

Shallow unconfined groundwater has been encountered in the deposits during subsurface exploration studies at NOS. In Table 5.3-5 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 5.3-9 and 5.3-10 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 NOS drains to Mattawoman Creek, and most shallow groundwater present would have the potential to do likewise. On 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 (i.e., 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.

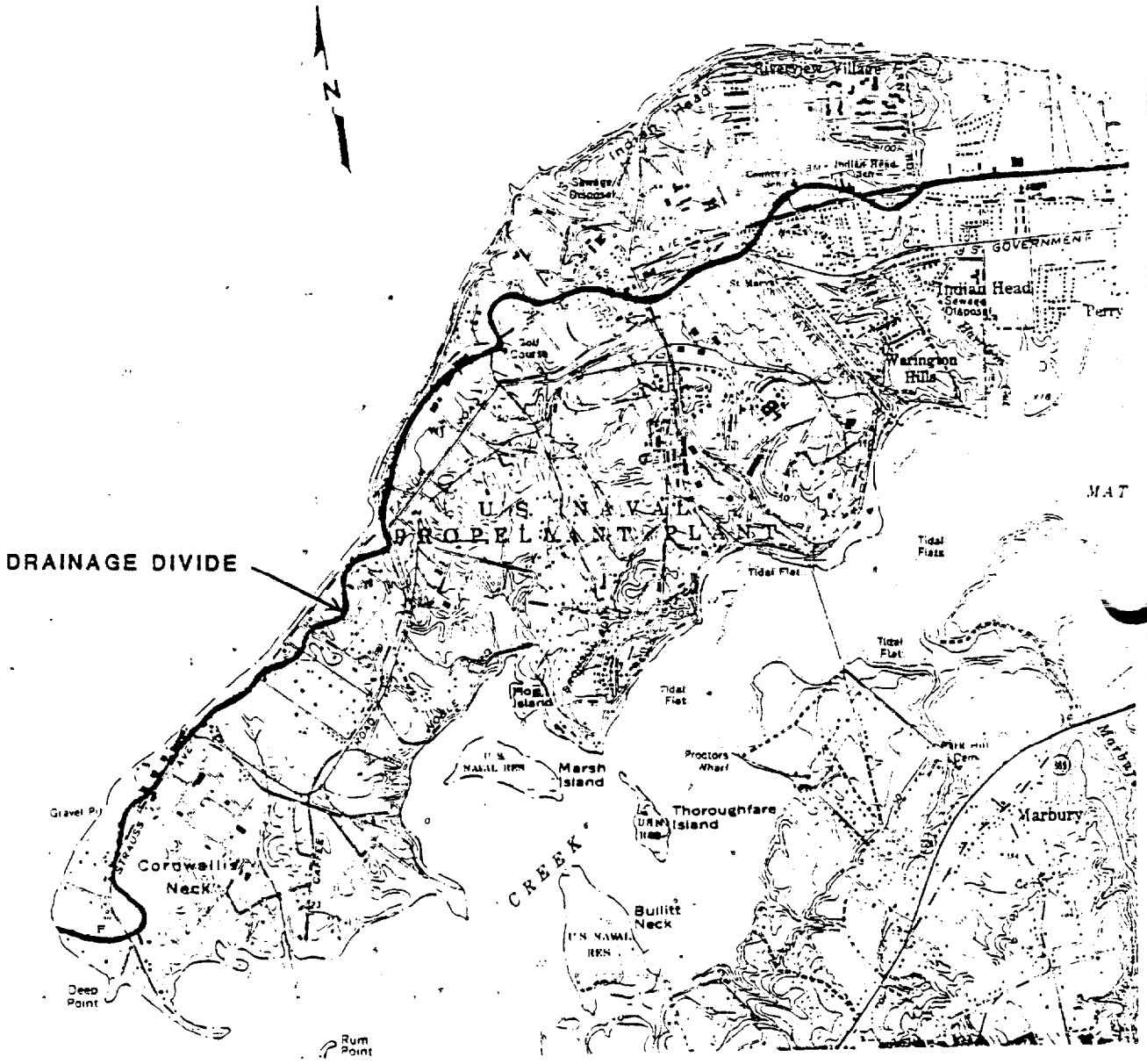


FIGURE 5.3-9 DRAINAGE DIVIDE ON THE MAIN PENINSULA

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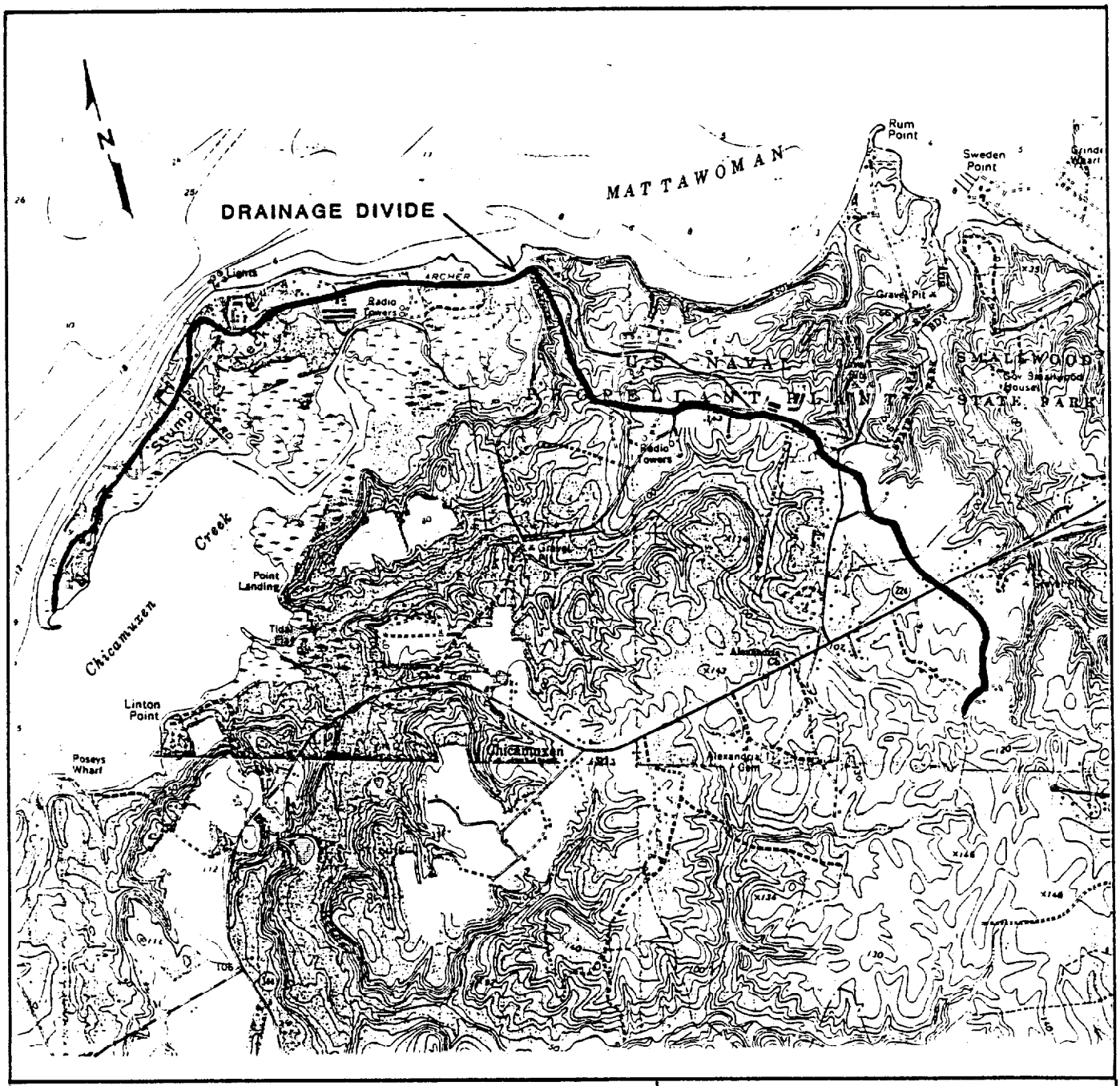

FIGURE 5.3-10 DRAINAGE DIVIDE ON STUMP NECK

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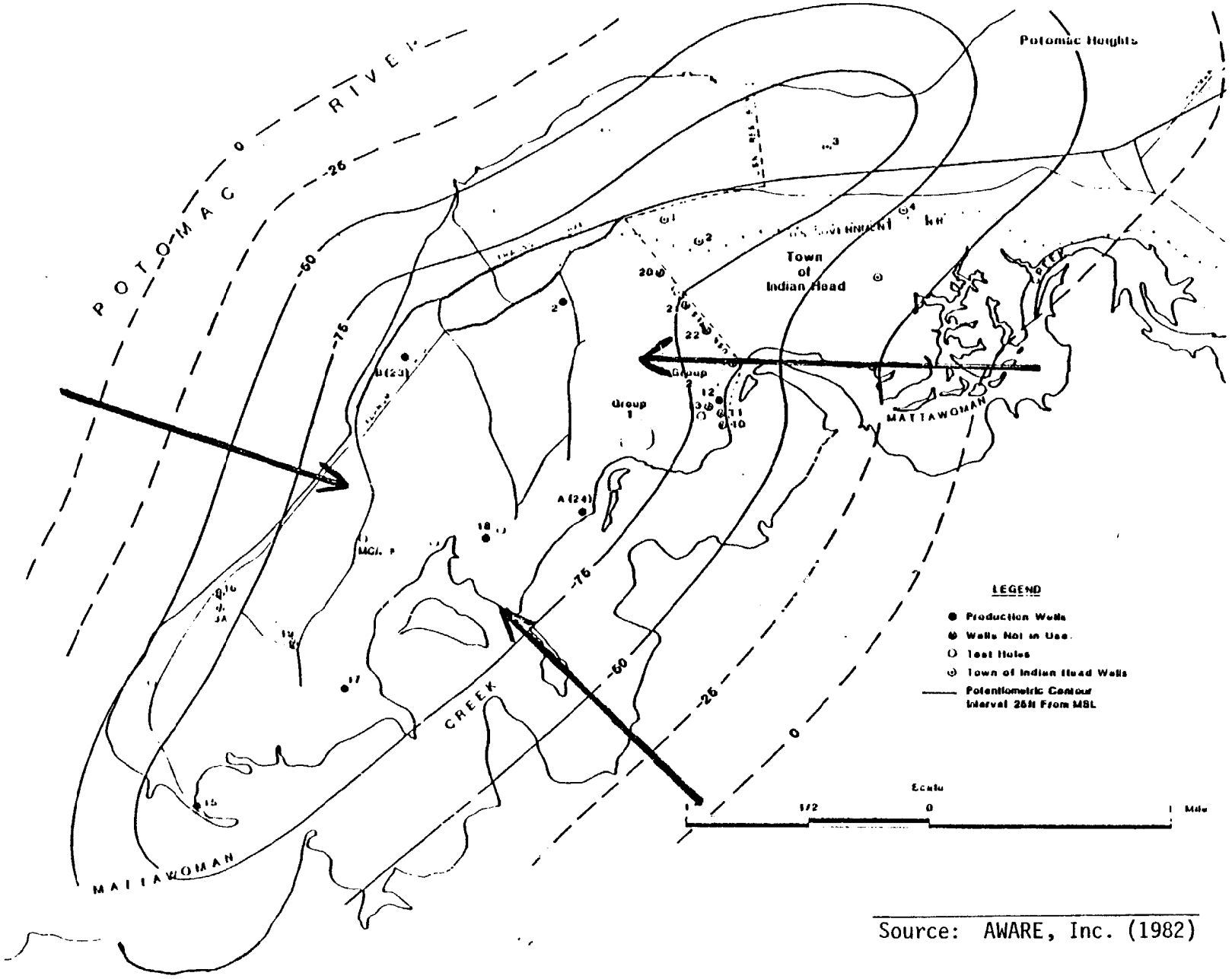
INDIAN HEAD, MARYLAND

- 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 (Slaughter 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 high 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.

- Patapsco and Raritan Formation

The Patapsco and Raritan Formation is the principal waterbearing formation in Charles County. The Formation contains three principal waterbearing zones, designated the Upper, Middle, and Lower Sands. The Lower Sands are considered the greatest single source of groundwater in the county. Figure 5.3-6 shows the relationship of the Patapsco and Raritan 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 5.3-6 as the Virginia outcrop area. Water in the Patapsco and Raritan 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 in two or more sands of the Patapsco and Raritan 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 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 5.3-11. 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 5.3-11. Because of the



Source: AWARE, Inc. (1982)

FIGURE 5.3-11 ESTIMATED POTENTIOMETRIC SURFACE MAP FOR THE LOWER SAND OF THE PAPSCO AND RARITAN FORMATIONS

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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 5.3-11. 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 and Raritan Formation have been determined by the USGS. The results indicate permeability values ranging from 80 to 800 gal/day/ft^2 (0.0038 to 0.038 cm/sec). These values are representative of fine to medium sand. The near surface soils contain a wide range of earth materials and as such range in permeability from 10^{-7} to 10^{-1} cm/sec.

- Patuxent Formation

The Patuxent Formation, located below the Patapsco and Raritan Formation, is another principal aquifer in western Charles County. Sand zones in the formation are laterally discontinuous, and most are only one to two miles in length. The individual sand units of the Patuxent Formation 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 NOS Indian Head 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).

5.3.7.2 Groundwater Use

- NOS Wells

NOS Indian Head is the largest user of groundwater in Charles County. A total of 28 wells have been drilled and completed on the main peninsula of 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, Inc., 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 either have been cemented and abandoned, or are abandoned and left open. Tables 5.3-9 and 5.3-10 summarize the information made available on the wells at the main facility and Stump Neck, while Appendix A contains a compilation of available well logs.

Most heavy well-water use occurs on the main peninsula, where NOS is engaged in manufacturing and processing activities. It has been projected that the main peninsula may suffer well-water shortages in the near future. A recent study was commissioned to evaluate alternative water supply measures and water conservation techniques on the main peninsula and was recently completed and submitted by the contractor, AWARE, Inc. (1982). During this study, the wells on the main peninsula were inventoried and

Table 5.3-9

Wells Located on NOS Indian Head

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	P31	1915	
7	in use	419	255-265; 305-314; 375-396	P31	1915	
8	abandoned	319	-	-	1900(est)	NCU
9	available for use	390	185-195; 235-245; 284-294; 355-376	P30	1918	
10	abandoned	396	-	-	1930s	NCU
11	abandoned; cemented	409	-	-	1930s	NCU
12	available for use	390	unknown	T35	1930s	
13	abandoned; cemented	-	-	-	1930s	Could not be located by AWARE
14	available for use	480	unknown	S36	1930s	Being considered for use
15A	abandoned; cemented	-	-	-	1900(est)	Could not be located by AWARE
15	in use	280	191-206; 230-234; 240-244; 268-280	H1	1953	Borehole drilled to 623'
16	available for use	242	85-93; 123-133; 144-152; 221-229; 234-242	C11	1952	
17	in use	295	259-295	L11	1954	Borehole drilled to 452'
18	in use	302	208-220; 274-302	N22	1954	Borehole drilled to 605'
19	"test well"*	400	154-167	H11	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	D27	1957	

Table 5.3-9 (Continued)

Wells Located on NOS Indian Head

Well	Status	Depth	Screen Interval	Location (grid)	Date Installed	Remarks
24(A)	in use	290	228-239; 269-286	Q26	1957	
2A (2 new)	in use	380	270-380	I34	1970	
3A	available for use	232	217-232	D11	1970	

Notes:

NCU = not considered usable (by AWARE, Inc. study)

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

est = estimated

Table 5.3-10

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
Cb10	not used	610	NA	see map	NA	1945	Naval well 13SN
Cb11	in use?	414	NA	see map	NA	1945	Naval well 43SN
Cb12	in use?	441	NA	see map	NA	1944	Naval well 66SN
Cb13	not used; cemented	443	NA	see map	NA	1944	Naval well 51SN
Cb14	not used	200+	NA	see map	NA	NA	Naval well 11SN
Cb24	in use?	580	NA	see map	NA	1958	"Naval Research Lab Well"
Cb25	not used; cemented	603	NA	see map	NA	1958	Drilled as test hole
Cb26	not used	600	185-190; 203-208; 225-230, 275-285	see map	NA	1958	
Cb27	not used; cemented	331	NA	see map	NA	1960	Drilled as test hole
Cb28	in use?	290	190-200; 230-240; 280-290	see map	NA	1961	
Cb30	not used	167	NA	see map	NA	"old"	

inspected, and those wells which could be made available for use were identified. Figures 5.3-12 and 5.3-13 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 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 5.3-9 and 5.3-10 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 Quaternary surficial deposits at the site.

- Water Quality

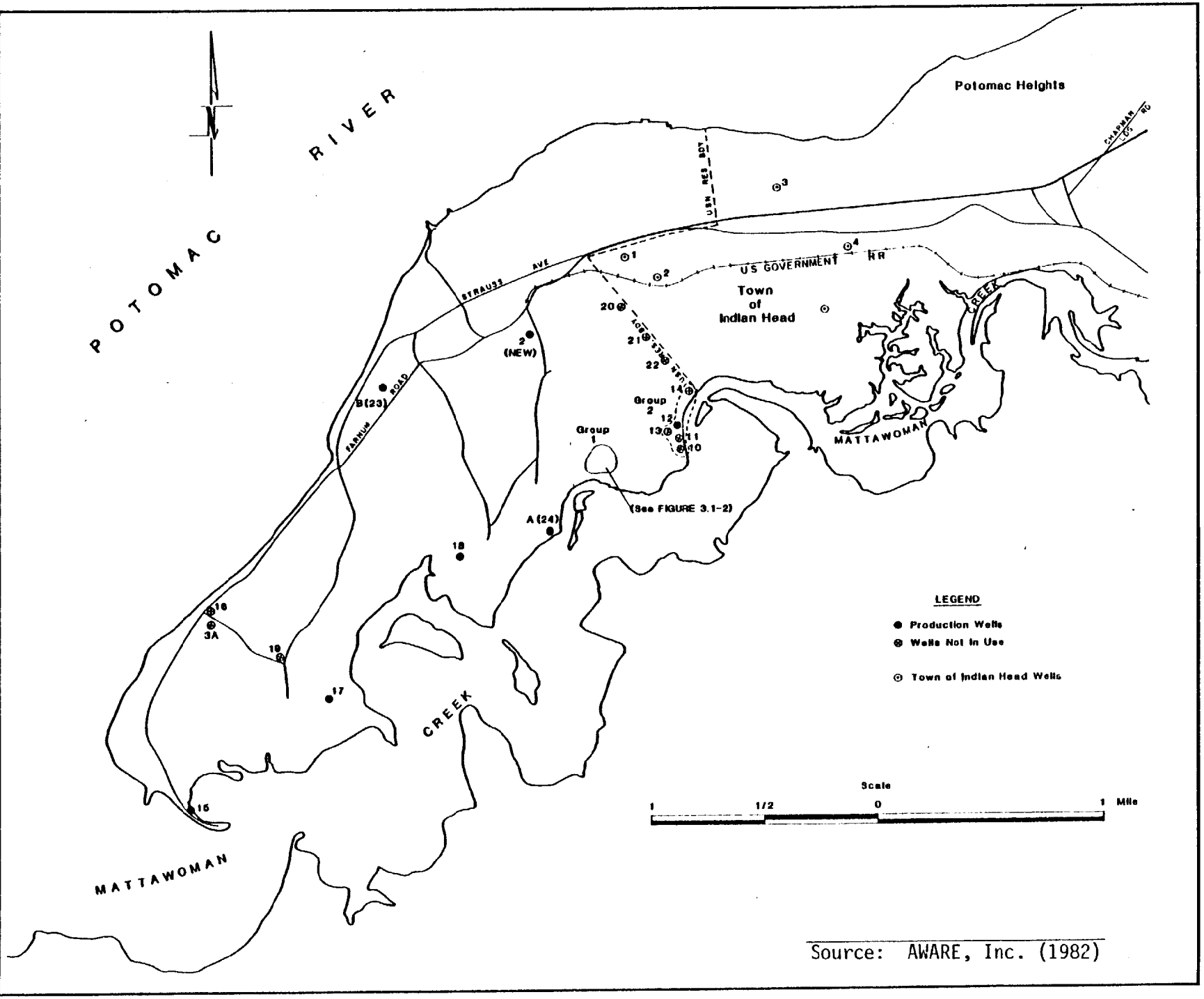
The wells present on the main peninsula supply two types of well water: high silica and low silica. The low silica water at the site contains approximately 15 mg/l silica, and the high silica contains approximately 30 mg/l silica. Low silica water is obtained from a limited zone in the lower sand unit of the Patapsco and Raritan Formation, and is supplied by wells 15, 17, 18, and 23. 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 5.3-14 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 wells 3A and 16 are shown in Table 5.3-11. Generally, the water is characterized by high Total Dissolved Solids (TDS) content and generally high iron and manganese content.

- Off-Station Wells

A records search of domestic wells located in the surrounding area of NOS was performed at the Charles County Health Department in La Plata, Maryland. The well records are tabulated by computer for the 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 locations of the wells are tabulated according to the township closest to the well. In the area surrounding NOS, wells are tabulated for the following nearby townships: Indian Head, Glymont/Potomac Heights, Rison, and Chicamuxen. The total numbers of wells on file for these townships are as follows:

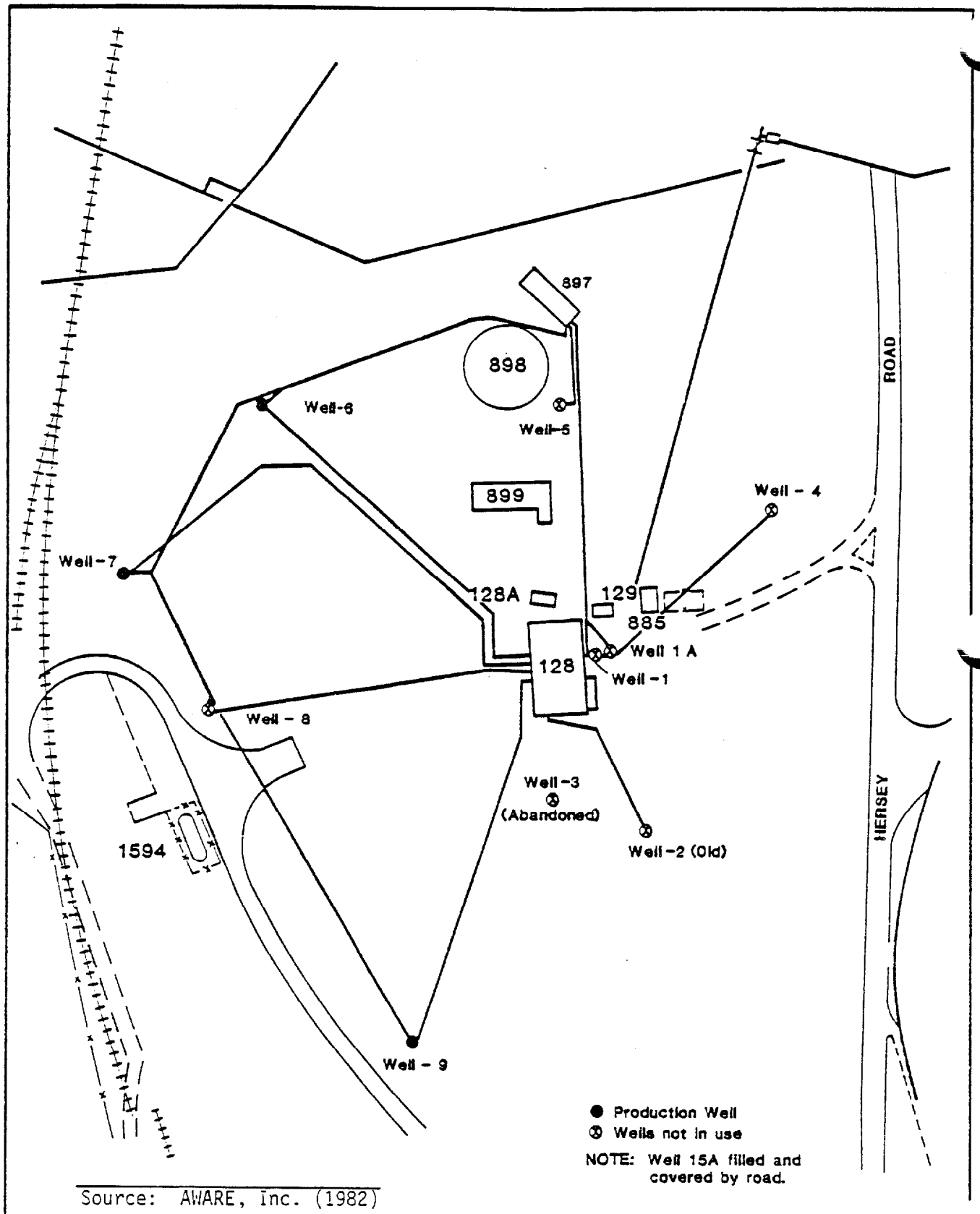
Indian Head	117 (27 Navy Permits)
Glymont/Potomac Heights	38
Rison	37
Chicamuxen	8
Total	200



Source: AWARE, Inc. (1982)

FIGURE 5.3-12 WELL LOCATION MAP

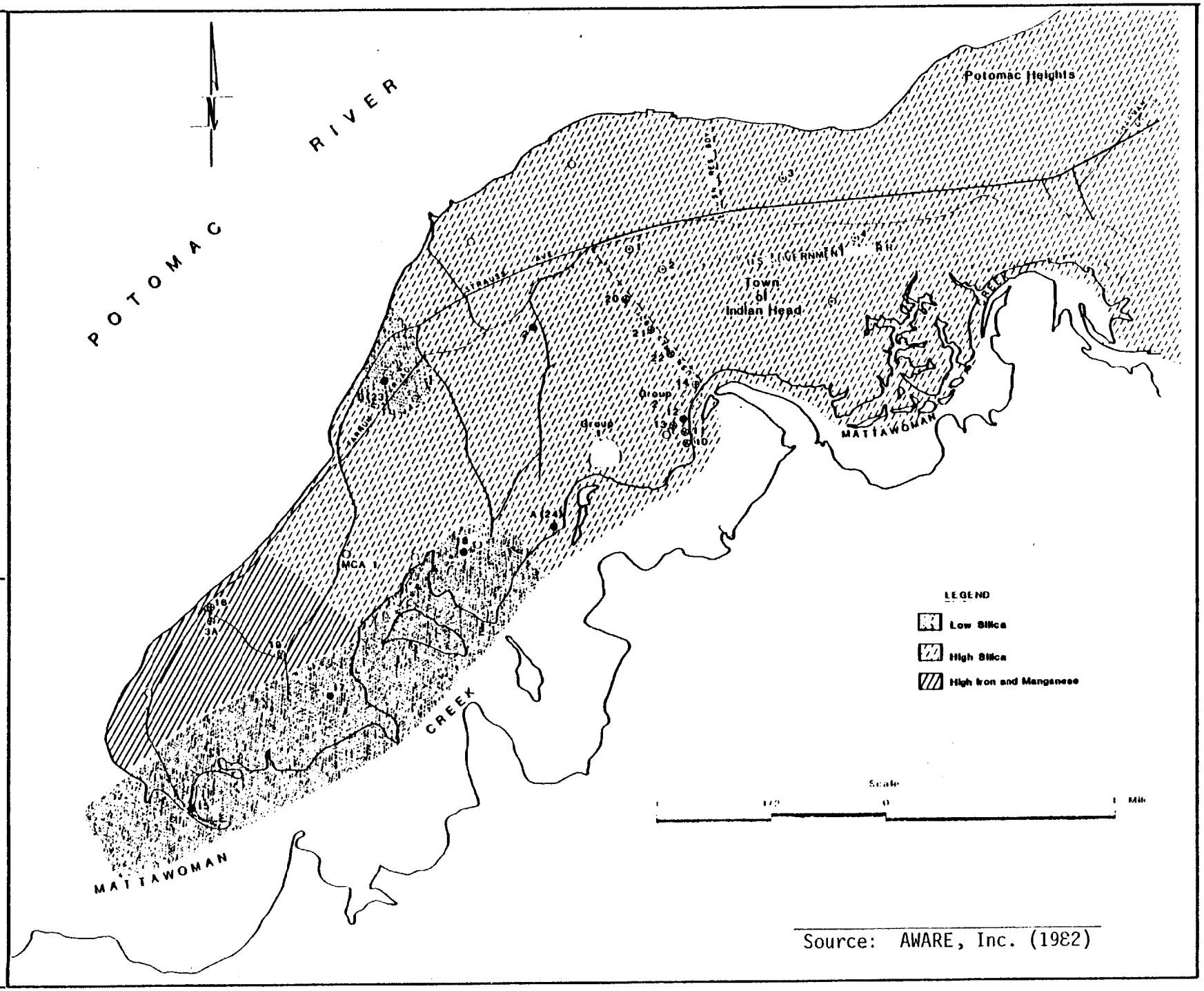
FCHA INITIAL ASSESSMENT STUDY
NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND



Source: AWARE, Inc. (1982)

FIGURE 5.3-13 GROUP WELLS

FCHA INITIAL ASSESSMENT STUDY
NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND



Source: AWARE, Inc. (1982)

FIGURE 5.3-14 AREAL EXTENT OF GROUND WATER WATER QUALITY TYPES

FCHA INITIAL ASSESSMENT STUDY
NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND

Table 5.3- 11

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	-	210	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	HCA[c]	HCA	HCA	HCA	USGS	

[a]Standard pH units

[b]Micromhos/cm at 25°C

[c]Hatz, Childs and Associates

Standard

Source: AWARE, Inc. (1982)

It can be seen from this tabulation that 200 registered wells lie within the surrounding area of NOS. The wells in closest proximity to 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 and 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 water-bearing 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 NOS, several tables have been prepared. In Table 5.3-12, 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 5.3-13, information on 6 Chicamuxen-area wells for which completion details were available is presented. All these wells are deep artesian wells. In Table 5.3-14, information on 29 selected Rison-area wells is presented. Twenty-six (26) of these wells are registered to a Rison Acres housing development 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 5.3-14.

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

5.3.7.3 Surface Water

Three principal waterways are located in the immediate vicinity of NOS Indian Head: the Potomac River, Mattawoman Creek, and Chicamuxen Creek. Mattawoman Creek and the Potomac River border along the main peninsula area of NOS, while the Stump Neck area is bordered by Mattawoman Creek and Chicamuxen Creek. Both Mattawoman and Chicamuxen Creeks are tributary to

TABLE 5.3-12

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 5.3-13

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
Milstead	CH731429	320	90	300	320
Milstead	CH731979	180	25	160	180

Source: Charles County Health Department

TABLE 5.3-14

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

the Potomac River. Figures 5.3-9 and 5.3-10 depict the locations of principal waterways in relation to the main peninsula and the Stump Neck area of 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 5.3-9, 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 Navy property where the site drainage is approximately evenly divided between Chicamuxen Creek and Mattawoman Creek.

The physical characteristics of the principal waterways adjacent to 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 the 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 formerly maintained a stream quality station on the Potomac River at NOS Indian Head. This station was located at river mile 84.5, which is 3.5 miles above the mouth of Mattawoman Creek. The drainage area for this station was 12,160 square miles, and the period of record for the station extended from October 1977 to September 1981. Daily records were maintained for pH, specific conductance, temperature, and dissolved oxygen. For water year 1981 (1 October 1980 - 30 September 1981), the average values for these parameters were 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 indicate 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 14,300 cfs (10.4 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 NOS Indian Head, so therefore the Potomac River adjacent to NOS is a Class I water. 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:		
	PCBs	0.001 microgram/liter
	Endrin	0.004 microgram/liter
	Toxaphene	0.005 microgram/liter
	DDT	0.001 microgram/liter
	Benzidine	0.1 microgram/liter
	Aldrin-Dieldrin	0.003 microgram/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 going on for several years, and computer printouts of data assembled to date can be obtained from the Divison of Water Quality, Maryland State Department of Health and Mental Hygiene.

Water from the Potomac River is used at NOS Indian Head 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 NOS regarding such an investment (AWARE, Inc. 1982). Currently, NOS pumps up to 3 million gallons per day of river water to maintain the fire protection system.

- 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 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 (1 October 1980 - 30 September 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 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 NOS by base personnel indicates that wastewater 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 5.3-15 summarizes the discharges uncovered during that study.

A number of natural drainage channels traverse the main peninsula and Stump Neck Navy 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.

5.3.8 Summary of Migration Potential

5.3.8.1 Groundwater

At NOS Indian Head, the water supply wells are completed in deep aquifers which are separated from the land surface by extensive deposits of

TABLE 5.3-15

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.

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 NOS.

If contaminants were present in any potential waste disposal sites identified at 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 water-bearing zones present in the surficial deposits, they might be expected to move laterally, under topographic controls, towards the nearest downgradient surface water body. In general, the permeability of the water-bearing zones in the near surficial deposits might be expected to be on the order of 10^{-2} to 10^{-5} cm/sec. Permeabilities for the water-bearing zones in the Patapsco and Raritan Formations average in the 10^{-2} cm/sec range. While permeabilities in this range are conducive to contaminant migration, these water-bearing zones are protected from surface contaminants by several clay layers. 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 presented in Figure 5.3-9. 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 Mattawoman 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 waterways (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 water-bearing zones in the surficial deposits would be expected to move laterally under topographic constraints (as on the main peninsula) towards Chicamuxen and Mattawoman Creeks in accordance with the topographic divide delineated in Figure 5.3-10. 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 NOS wells, due to the greater distance of the off-site wells from any potential sources of contamination present on the Navy property. The deep, artesian wells located in Chicamuxen and Rison townships are, however, located downgradient of the NOS facility. In the remote possiblity of contaminants migrating vertically at NOS to the aquifer sands of the Patapsco and Raritan Formation below, it would be possible for them to migrate hydraulically within the formation under the natural hydraulic gradient towards these deep wells. It

should be realized further, however, that the pumping of the Navy 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 5.3-11. Contaminant migration in the deep aquifer under the pumping gradient would therefore not be in the down dip direction, but rather would be towards 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 NOS, as the hydraulic gradients controlling flow in the shallow, water-bearing zones at NOS should direct this flow towards the three areas of probable discharge: the Potomac 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 and are under different topographic (and assumed hydraulic) control. The influence of each pumping gradient 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 NOS revealed that a number of the abandoned wells have not been cemented or filled in 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.

5.3.8.2 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 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. 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 providing productive ecological habitat, at the installation.

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, sweet gum. Dogwood, black gum, red maple, and holly comprise the understory. In the moist bottomlands, American sycamore, green ash, American elm, and sweet gum 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, sweet gum, 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. The infrequent narrow beaches around the periphery of Indian Head and Stump Neck are 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 sweet gum, 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, black gum, and sweet gum. 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, sweet gum, 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) were 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 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 to I16, J22 to K22, and J23 to

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 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. 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. 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 Department of Parasitology suggested that the lungworm count would be much higher in late summer/early fall and recommended retesting at that time.

The Department 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 Department 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, it was 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 B.

5.4.3.2 Birds

A significant variety of birds has been identified in Charles County. See Appendix B 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 B.

5.4.4 Aquatic Ecosystem

5.4.4.1 Fish

The portion of the Potomac River 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, U.S. 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 mills at Indian Head": a large concrete drain pipe and a dissolving pile of "saltcake" 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 sulfate 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 0.75 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 sulfate "salt cake" piles resulted from the manufacture of nitric acid by the retort process, which was in operation from 1900 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 completed.

Correspondence from a U.S. Navy Commander to a potential buyer (International Nickel Company of Copper Cliff, Ontario, Canada) indicated that, in 1931, the Naval Proving Ground (later the Naval Powder Factory) was producing excess niter cake (sodium bisulfate) 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 that time was documented. From January 1 through July 1, 1932, it was recorded that 600 tons of niter cake was put "up for sale to civilians." Again, no record of sale was found. In 1935, correspondence from the Inspector of Ordnance in Charge to the Bureau of Ordnance reported a monthly generation rate of 100 tons of niter cake during production of smokeless powder. This niter cake was flushed directly into Mattawoman Creek. In 1936, it was reported that niter 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 6.2.

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 at 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 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 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. Analyses 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 Best Practicable Control Technology Currently Available (BPT) standards should be instituted. The toxic substances 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, and effluent limitations in the NPDES permit must be based solely on best engineering judgment.

CBF alleged that toxic substances contained in the industrial discharges were not covered by the permit. The presiding officer conceded that while analyses did indicate the presence of toxic substances, 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 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 completing 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 excess 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 completed 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.

Locations of sites are described in this study by the use of Station map grid locations. Grid locations are identified by a combination of letters and numbers. Numbers are positive numbers on the Main Station and negative numbers on Stump Neck. An example of a Main Station location is F16. An example of a Stump Neck location is F-16.

6.2 ORDNANCE OPERATIONS

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

nitric acid	Otto Fuel II
sulfuric acid	Explosive D
nitrocellulose	Composition D-2
nitroglycerin	nitroguanidine
single-base propellants	DNPOH
double-base propellants	BDNPA/F
triple-base propellants	mercury fulminate
cast propellants	KI test paper
extruded propellants	caustic for recovery
UDMH	sodium nitrate
DMAN	shock-gel powder
TMETN	PBXs
nitroform and derivatives	casting powder
composite propellants	wax

6.2.1 Current Operations

Current ordnance operations are mentioned briefly in the following sections. The current waste disposal practices of these operations are not included in the study. Ongoing operations are mentioned only to lend perspective to the complexity of activities at Indian Head and to provide background for estimates of past operations.

6.2.1.1 Organic Chemical Plant

The organic chemical plant (Building 497) has been 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, bis-dinitropropyl acetal/formal, plastisol nitrocellulose, dimethyl ammonium nitrate, dimethyl nitramine, unsymmetrical dimethylhydrazine, and high-bulk-density nitroguanidine.

6.2.1.2. 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) was completed in 1953.

6.2.1.3. Production of Solventless Double-base Propellant Grains

Solventless double-base propellant grains have been produced at NOS since 1943 by extruding carpet roll. This operation is carried out in the Extrusion Plant. The propellant contains nitrocellulose, nitroglycerin, plasticizers, and ballistic modifiers.

6.2.1.4. Polaris High-energy Plant

This facility was established for the manufacture of high-energy casting powder for Polaris rocket motors. Waste water streams from wash-down operations contained acetone, alcohol, ammonium perchlorate, nitroglycerin, and HMX in limited quantities. Process operations also generated approximately 5000 lbs/yr of scrap. The plant was inactive during the survey.

6.2.1.5. Multibase Plant

The multibase plant 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. Wash-down water containing alcohol, ether, acetone, and nitroglycerin is discharged. Solid wastes include floor sweepings, scrap powder, and industrial waste.

6.2.1.6. Ballistic Test Areas

Since 1940, ballistic test areas have been provided for the test and evaluation of the products of Indian Head and other Navy suppliers. Tests in static test bays generate gaseous and solid wastes from the combustion of rocket motors.

6.2.1.7. Cast Plant

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

Waste or scrap powder, floor sweepings, and contaminated industrial waste are generated. Contaminants present in minor quantities include alcohol, acetone, ammonium perchlorate, HMX, and isopropyl alcohol.

6.2.1.8 Pilot Plant Operations

The Pilot Plant was established in 1947 to provide a small scale independent unit to perform research and development and to conduct process variable or product variable studies. Characteristically, short runs are made to produce small quantities of materials without interfering in 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. Wash-down from the Pilot Plant area passes through catch tanks and into open ditches.

6.2.2 Past Ordnance Operations

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

6.2.2.1 Single-base Propellant Manufacture

In 1897, Congress appropriated $94,000 for the construction of a 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 peace time was produced at Indian Head.

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 safety 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 were required to purify and stabilize the nitrocellulose. These steps were required prior to dehydration and conversion into smokeless powder. The bulk of the water was removed by centrifuge with the remainder displaced by alcohol. Upon the addition of ether, the nitrocellulose became a colloidal mass which was then extruded into appropriate strands. These were cut into 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 grains 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 consisted mainly 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 mixture containing the two acids. The resulting waste products were acid water and nitrocellulose "white water". The acid water contained approximately one pound of mixed nitric acid and sulfuric acid per pound of nitrocellulose. Approximately 50,000 gallons of water were used per ton of nitrocellulose. The acid water was neutralized and the resulting solution, which contained salts of nitric and sulfuric acids, was discharged into Mattawoman Creek. The fine nitrocellulose particles contained in the "white water" eventually settled into the silt in the creek. In about 1956, the creek was dredged to clean up the nitrocellulose accumulation.

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 dioxide was 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 the nitric acid manufacturing 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 residue of niter cake (sodium bisulfate) was neutralized with soda ash to form sodium sulfate. The water-soluble sodium sulfate was then 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, which is then absorbed in water. The resulting weak nitric acid is concentrated with high pressure/temperature steam to strong nitric acid. Waste streams would have consisted of weak acid solutions. These acid solutions, neutralized with soda ash or lime, would have been discharged into Mattawoman creek.

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.

6.2.3.1 The Valley

The valley along Torrense Road from grid locations A37 to D41 (SITE NO. 29) 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. Test firing of guns occured from 1891 to 1921, at which time proving ground activities were shifted down-river to Dahlgren, Virginia. This valley area is also known as the Old Navy Proving Ground.

6.2.3.2 Stump Neck Impact Area

There was alleged to have been naval gun firing at Stump Neck into the marsh at grid locations F-16 and G-16 (SITE NO. 30) during pre-World War II years. This firing was said to have been observed from an existing concrete bunker located on the bluff at grid location H-13.

6.2.3.3. Old Demolition Range

There is said to be an old demolition training ground of about one acre at grid location ZZ-26 at the end of Porter Road (SITE NO. 31). 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 have included the use of TNT and composition explosives (C-4) to destroy projectiles, shells, and mines. Based on current training, the amount of explosive charges may have totalled 30-40 pounds per day over 165 training days per year.

6.2.4 NBC Agents

There is no indication of any biological or chemical warfare agents at NOS. (See Section 6.4 for a discussion of radiological operations.)

6.3 NON-ORDNANCE OPERATIONS

6.3.1 Public Works Department (Code 09)

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 following Sections.

6.3.1.1 Maintenance Division (Code 094)

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

Shop practices also include degreasing metal parts and paint equipment using Varsol and kerosene. Varsol is purchased in one-gallon cans in quantities of up to 55 gallons per year. Kerosene is purchased in quantities of up to 200 gallons annually and is stored in the rear of the paint shop. The kerosene storage tank is an above-ground facility with a capacity of 175 gallons, supported on railroad ties. Shop practices included cleaning metal parts and paint equipment in this area, which is a 2,500 square foot open, bare-soil, site with evidence of spillage.

Cleaned metals and other materials are painted in paint spray booths located in the rear of Building 870 and in the paint spray barn (Building 379). Three spent spray booth filters, each one-third cubic foot in size (from the Paint Spray Barn), and four spent spray booth filters, each 0.18 cubic foot in size (from Building 870), are removed periodically and mixed in with shop trash. Annual production of filters varies with work load. In 1981, when the facility operated for approximately 3 months, 13 tons (44 cubic feet) were produced. When the facilities are in use, three waste filters from the paint spray barn are generated three times per week, and four waste filters from Building 870, once every two weeks. Until 1979, when the facilities operated on an annual basis, waste filters were generated in larger quantities, 40 tons annually.

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, the paint shop, in 1975, switched over to an increased usage of latex water-based paints which are being used 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 annually in this area. Previous disposal practices and current cleaning procedures may have contributed to the contamination and vegetation stress adjacent to the cleaning area (SITE NO. 13).

6.3.1.2 Transportation Division (Code 095)

The Transportation Division consists of two 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 for the Indian Head and Stump Neck facilities.

- Transportation Equipment Maintenance Branch (0952)

Branch activities relating to automotive and heavy mobile 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 crankcase, differential, transmission, and hydraulic oils. Wastes are discharged during servicing operations and collected in an underground 550-gallon storage tank. Waste oils are generated at a rate of 2,200 gallons annually. This rate is similar to past generation rates. In past years waste oil was burned in the power plant. Previously (circa 1965) waste oils were applied to unpaved roads in the vicinity of Building 290 for dust control. (Ref. Section 6.6.2).

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. Shop practices included periodic detergent wash-down of vehicles using steam jennies on a wash pad located behind the shop. Vehicle parts were degreased with the solvent "Safety Clean", used at a rate of 250 gallons per year. Solvents may have been added to waste oils, and empty solvent cans may have been mixed in with shop trash. This procedure was ended in 1976.

Liquid wastes, including waste oils similar to those generated in Building 290, are collected in a 1,000-gallon-capacity underground storage tank. Waste oils are generated at a rate of 3,000-4,000 gallons annually and are collected once every three months for recycling by a private contractor.

6.3.1.3 Utilities Division (Code 096)

The Utilities Division consists of three branches, the Distribution, Water, and Sewage 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.

- Distribution, Water, and Sewage Branch (0961)

Activities relating to the collection, treatment, and 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 boiler feed required by the Goddard Power Plant. Cooling water is collected in one of two Buildings (143 or 128). Seven 4"-diameter wells (each with 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 source of water for fire fighting and various other cooling water applications is river water. This water is supplied by either the 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 1930s and 1950s respectively and are designed to supply river water on an as-needed basis.

Indian Head has two sanitary sewage treatment plants and four packaged treatment plants. Wastewater treatment at Sewage Treatment Plant No. 1 (STP #1) consists of primary and secondary clarification, anaerobic digestion, and activated sludge. Sludge from the digester and settling tanks, and oil, grease, and grit from the grit chambers are treated with a polymer (NALCO #7135) and dried in sludge-drying beds. Dried sludge is periodically removed and deposited in dumpsters for disposal in on-site landfills. The STP #1 (Building 1469) is located near the Old Navy Proving Ground and operates under NPDES permit No. MD 0020885. STP #1 discharges approximately 0.35 MGD of sanitary waste water into the Potomac River and generates approximately 1000 cubic yards per year of sludge. Sewage Treatment Plant No. 2 (STP #2) (Building 1472) is located west of the UDMH Distillation Plant and operates under NPDES permit No. MD 0020893. STP #2, an extended aeration plant, discharges approximately 0.15 MGD into Mattawoman Creek and generates approximately 50 cubic yards of sewage sludge per year.

- Utilities Maintenance Branch (0962)

Maintenance of water, sewage, and power plant equipment is performed by this branch. Other branch activities include electrical distribution 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 (0963)

The Goddard Power Plant (Building 873) was built in 1957. This plant has three boilers, each of which is rated at 150,000 pounds per hour. In addition, two steam-operated 5,000-kw generators produce electricity, one on a continuous basis. 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 1920s.

Coal was used as fuel for the Goddard Power Plant until the early 1970s when the plant was converted to burn both No. 2 and No. 6 fuel oil. Coal was shipped to the power plant by both train and truck. Coal ash was used as a road surface and as a subbase throughout the Station. The facility is equipped with a fly ash vacuum system which transports ash to a 100-ton silo. This material is hauled off of the Station by a private contractor to a facility which manufactures cinder blocks.

The Steam "B" Power Plant was built in the early 1950s and is located in the southwestern part of the Station, in Building 712. This facility supplies steam to the Station 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.

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 non-ordnance radiological materials at this activity.

By virtue of the Station'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 license 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 C27). Unfortunately, there were no records available on the history of this contamination event, or documentation of 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-Station in Building 901.

6.4.3 Naval 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.

Building 2083 and its vicinity also 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 the building 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 Petroleum, Oil, and Lubricants (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., propellants, pyrotechnics, contaminated containers, related ingredients, and fleet-returned obsolete propellants are destroyed by open-burning.

6.5.2 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 Ordnance Devices Department (Code 51). Other hazardous (non-explosive) waste products of concern were generated by such operations as paint spraying, paint stripping, rocket motor insulating, solvent evaporation, and photographic developing. Major waste generators are the nitration operations (Biazzi and Moser processes).

Hazardous wastes stored in quantities exceeding ten gallons (or 100 pounds) per year are listed in Table 6.5-1. Since 1982, non-explosive hazardous waste is being removed and disposed of by a State-permitted contractor.

6.5.2.1 Solvents

Hydrocarbon solvents are currently slummed with sawdust and burned at the main burning point. Prior to this, they were stored at various production facilities around NOS. Chlorinated solvents, such as trichloroethylene (TCE), once contaminated, are drained from vapor degreasers and

Table 6.5-1

Storage of Selected Hazardous Wastes at NOS[1]

Material	Storage Site Building	Type of Storage	Quantity 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 propellant	1298	Covered container	160 lbs	1 week	2013
	1300	Covered container	330 lbs	1 week	2013
	1295	Covered container	170 lbs	1 week	2013
Double-base and composite propellants	Outside bldg. on dumpster pad	Covered container in "explosive" dumpster	250 lbs	2 weeks	202

Table 6.5-1 (continued)

Storage of Selected Hazardous Wastes at NOS[1]

Material	Storage Site Building	Type of Storage	Quantity Generated Annually	Average Storage Time	Responsible Organization (Code)
Composite propellant	1197 & 1259 containers	Covered	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 propellant scrap	905	PE-lined cans	100 lbs	4 days	526
Uncured propellant 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

Notes:

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

containerized in 55-gallon drums, which are stored on open-air sites surrounded by containment dikes awaiting final disposal through the Defense Property Disposal Office (DPDO).

6.5.2.2 Photographic Wastes

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 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 are 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 Laboratory.

During past years, fixer, developer, and wash waters were all discharged directly to the ground at Buildings 588, 731, and 1349. Approximately five years ago NOS started collecting the processing solution for silver recovery, as described above.

6.5.2.3 Polychlorinated Biphenyls (PCBs)

Approximately 90 transformers, in use or recently replaced on Station, are suspected of containing polychlorinated biphenyl (PCB) dielectric coolant. Discarded PCB-suspected transformers were previously held at the Scrap Yard (grid 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 Public Works Department will remove and store them, and the Naval Surface Weapons Center/Indian Head Detachment (NSWC/IH Detachment) Laboratory 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 Table 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.

6.5.2.4 Asbestos

Friable asbestos is contained in insulation on the 29 miles of above-ground steam pipes which run throughout the installation. When the insulation is removed, during repair of the steam distribution system or during building renovation, it is packaged in plastic bags and collected in

TABLE 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	Askarel
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, Naval Facilities Engineering Command, Chesapeake Division, Environmental Engineering Branch. Environmental Engineering Survey: Naval Ordnance Station (NAVORDSTA), Indian Head, Maryland. UIC N00174. June 1980.

a dumpster located next to Building 873. Once the dumpster is full, the bagged asbestos is disposed of in the Bronson Road Landfill.

Asbestos is an ingredient in the production of Pyrolock, an insulating material which is used to line rocket casings. The Pyrolock is removed by abrasive tumbling at Building 763. Waste Pyrolock is stored in 55-gallon drums in an uncovered area for final disposal. It is estimated that 600 gallons of this waste material are generated annually. Until June 1982, the final disposal site for this material was the Bronson Road Landfill. Asbestos is currently hauled off-Station for disposal.

6.6 WASTE DISPOSAL OPERATIONS

The environmental staff and subcontractors identified potential contamination sites during a one-week site reconnaissance survey from June 14 to June 18, 1982, at NOS Indian Head. Those findings 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 6.6-2 show their locations at the main peninsula and at the Stump Neck area respectively.

6.6.1 Thorium Spill (MAP GRID C27) (SITE NO. 1)

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

From interviews of NOS personnel, 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 near Building 900, a thorough survey must be made prior to any excavation or change in land use. A Confirmation Study is not recommended due to insufficient evidence of unauthorized disposal. However, potential safety and environmental hazards associated with any thorium spillage should be factored into future development plans. A Confirmation Study would be recommended prior to implementing any earthwork in the vicinity of Building 900.

6.6.2 Waste Crank Case Oil Applied to Torrense Road (MAP GRID D37) (SITE NO. 2) (FIGURE 6.6-3)

This is the location of Torrense Road, a 20-foot-wide gravel road bisecting the Old Navy Proving Ground. Waste oil from NOS Transportation Branch Buildings was reportedly applied to unpaved roads behind Building 290 (Public Works Department Maintenance Garage) for dust control prior to 1965. Waste oils from these facilities were generated at a rate of 7700 gallons annually and consisted of crankcase, hydraulic, transmission, and motor oils.

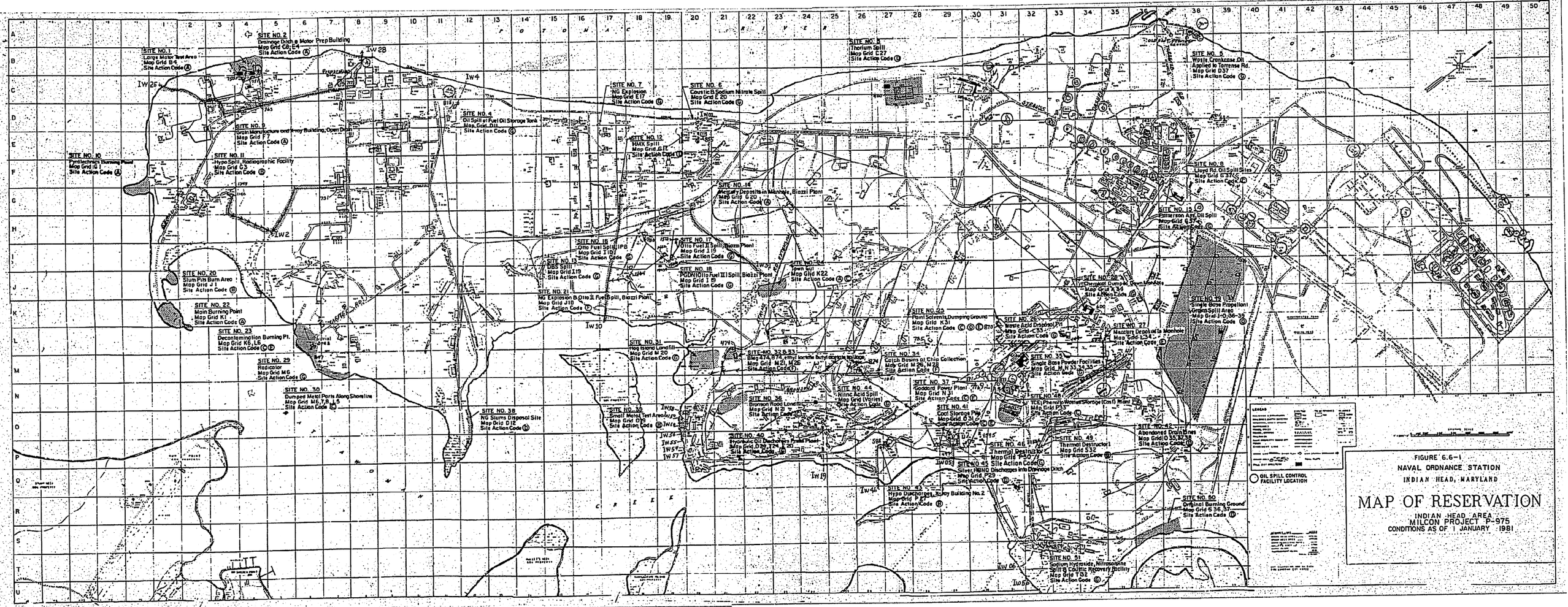


FIGURE 6.6-1
NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND

MAP OF RESERVATION

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

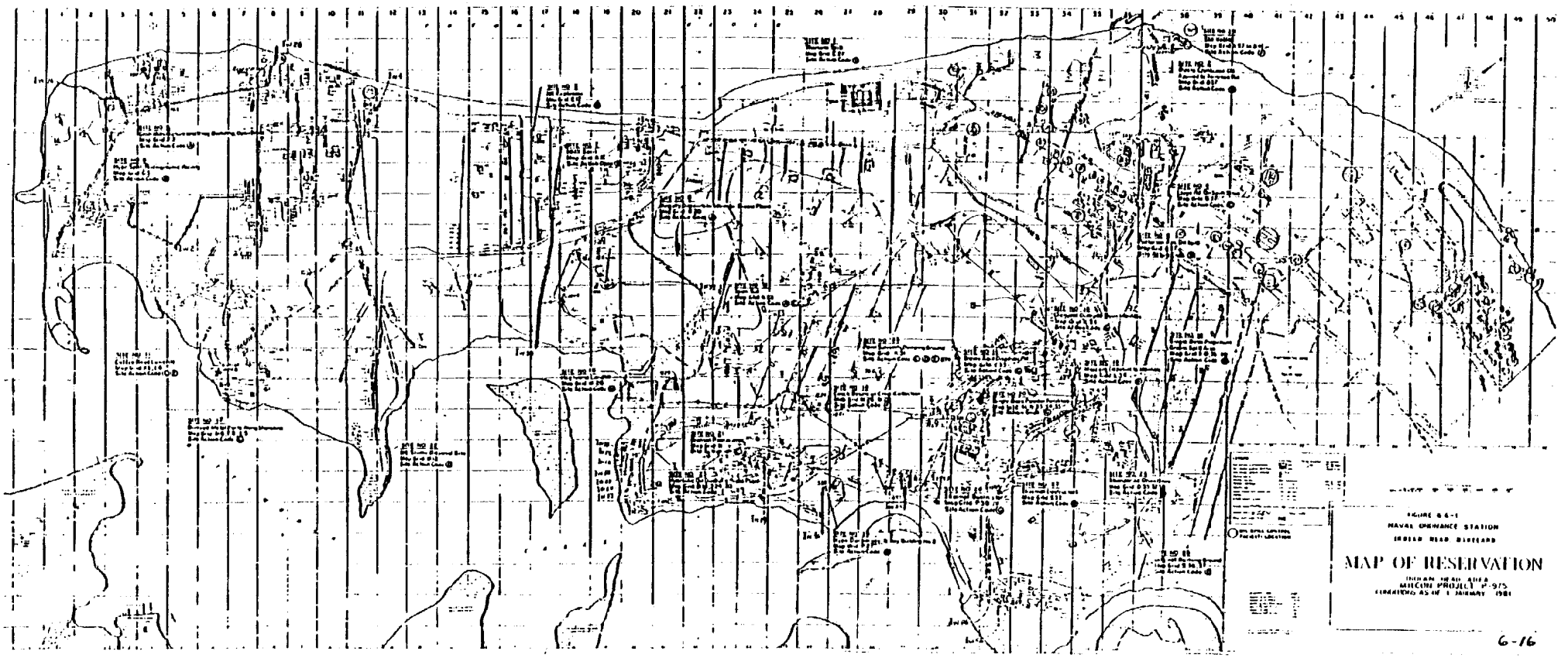
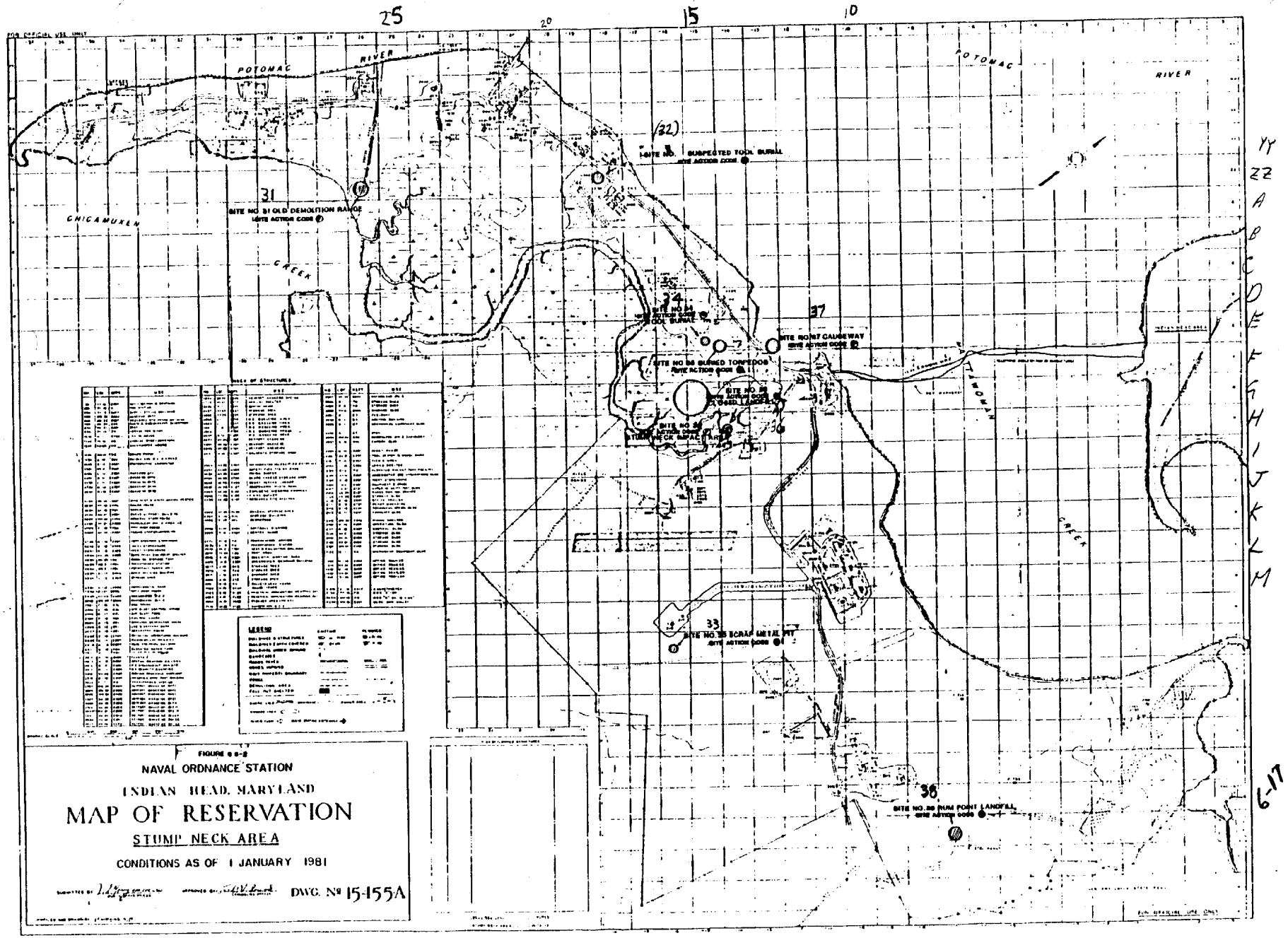


FIGURE 6.6-1
NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND
MAP OF RESERVATION
INDIAN HEAD AREA
MALCOM PROJECT P-975
CONDITIONS AS OF 1 JANUARY 1981


POTOMAC RIVER
CHICAMUXEN CREEK
SITE NO. 31 OLD DEMOLITION RANGE
SITE ACTION CODE
SITE NO. SUSPECTED TOOL BURIAL
SITE ACTION CODE
SITE NO. 34
SITE ACTION CODE
TOOL BURIAL
SITE NO. 37 CAUSEWAY
SITE ACTION CODE
SITE NO. 36 BURNED TORPEDOES
SITE ACTION CODE
SITE NO. 35
SITE ACTION CODE
SITE NO. 34
SITE ACTION CODE
STUMP NECK DISPOSAL AREA
SITE NO. 33 SCRAP METAL PIT
SITE ACTION CODE
SITE NO. 38 RUM POINT LANDFILL
SITE ACTION CODE
LEGEND
FOR OFFICIAL USE ONLY
FIGURE 6-2
NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND
MAP OF RESERVATION
STUMP NECK AREA
CONDITIONS AS OF 1 JANUARY 1981
DWG. № 15-155A

6-17

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

Site requires confirmation study.

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

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

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

Site may be receiving unauthorized wastes.

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

Site indicates no apparent environmental or human health damage potential.

Figure 6.6-3 TORRENSE ROAD, Small quantities of oil found in standing water at a low point in roadway drainage ditch on the corner of Dashiell and Torrense Road.

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 hydrogeology of the area is not conducive to contaminant migration to groundwater, no Confirmation Study is recommended.

6.6.3 Nitroglycerin Explosion, Nitration Building Area (MAP GRID E17) (SITE NO. 3)

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

6.6.4 Lloyd Road Oil Spill Sites (MAP GRID G37) (SITE NO. 4)

This site consists of a series of oil spills primarily occurring near Lloyd Road in the vicinity of the Public Works Department (PW) maintenance garage areas.

Until early 1981, waste oil from the PW 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 at 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.

No Confirmation Study has been recommended. The site is steeply sloped enhancing rapid run-off. There is low potential for migration into the groundwater.

6.6.5 Grain Manufacture and X-ray Building, Open Drain (MAP GRID F7) (SITE NO. 5) (FIGURE 6.6-4)

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.

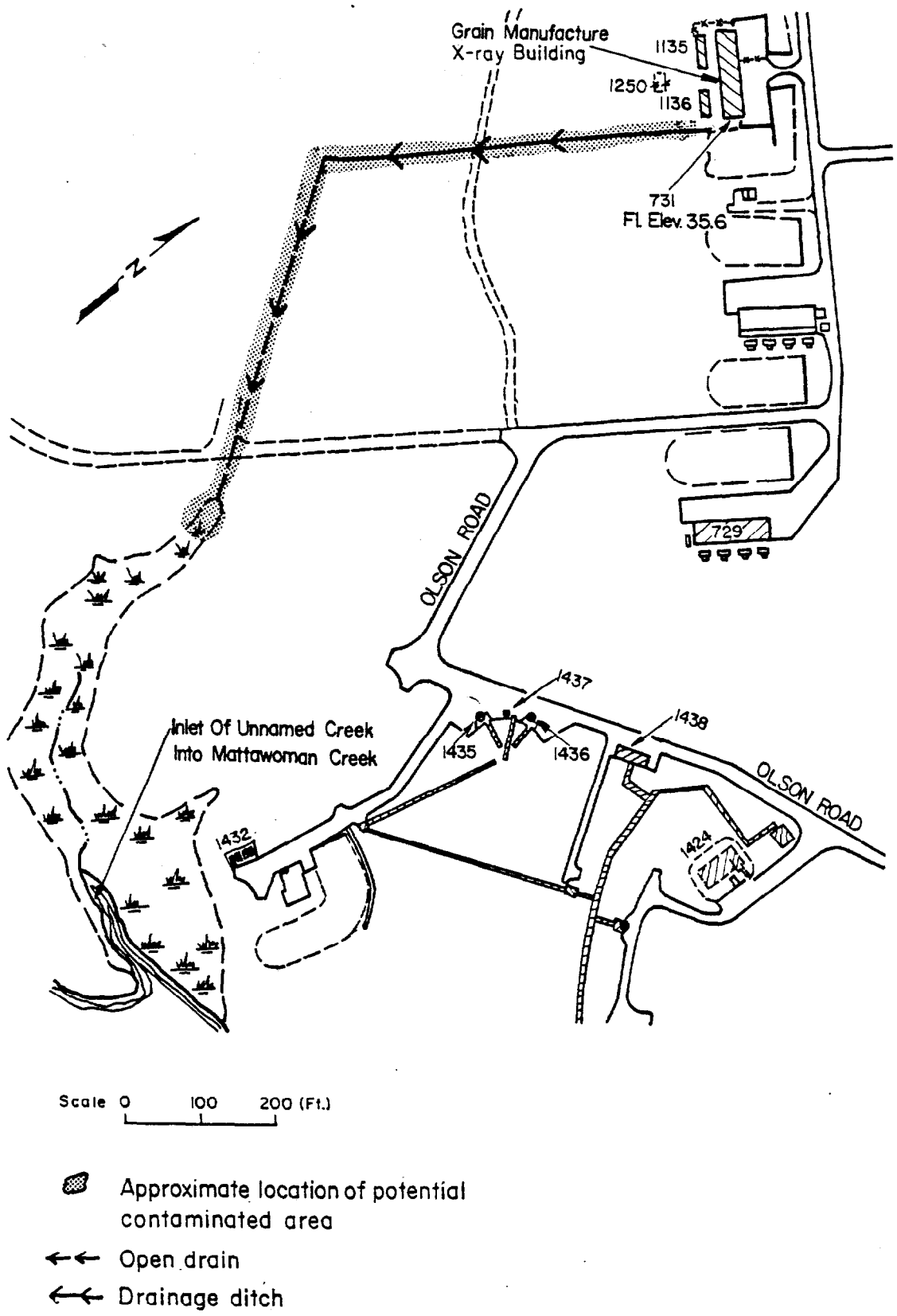


Figure 6.6-4 LOCATION OF SITE 9, GRAIN MANUFACTURE & X-RAY BUILDING

FCHA INITIAL ASSESSMENT STUDY
NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND

Prior to 1965, all wastes, including fixer and developer, were discharged into an open ditch. (Other sources suggest that fixer and developer were discharged into open ditches prior to 1977.) Table 6.6-1 develops estimates for the quantities of contaminants discharged into the open ditch. A combined quantity of approximately 180,000 pounds of sodium thiosulfate (fixer) and hydroquinone (developer) containing 720 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 to quinone shortly after discharge, and after further oxidation, the decomposition products include basic acids which are generally considered non-toxic. Both hydroquinone and sodium thiosulfate are extremely soluble in water, and sodium thiosulfate decomposes rapidly under natural conditions. The most significant potential environmental hazard associated with this site is silver, which even at low levels, is toxic 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.

These factors suggest that silver compounds may have deposited along open ditch sidewalls and bottoms within the first two hundred feet of the Building 731 outfall. At the team site reconnaissance no vegetation stress was noted within the 500 feet of open drain area surveyed.

A Confirmation Study has been recommended to determine the potential for past contamination to migrate to surface water.

6.6.6 Hypo Spill, Radiographic Facility Accelerator Control Building, and Open Drain (MAP GRID G3) (SITE NO. 6) (FIGURE 6.6-5, 6.6-6, 6.6-7)

This site (Building 1349) is the location of the control building for the Radiographic Facility Accelerator (Building 1140). These buildings were built in 1965. Past operations included the development of X-ray photographs. Approximately 2000 X-ray sheets were developed per month using the chemical development process described for SITE NO. 5. One interviewer stated that, prior to 1977, all photographic process liquid wastes including fixer and developer were discharged into the nearby open ditch, but this could not be confirmed.

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 periodically behind Building 1349. At this time no Confirmation Study is recommended. If, however, a study of SITE NO. 5 confirms a danger to aquatic life, a study of SITE NO. 6 should be performed to establish contaminant concentrations and potential environmental effects.

Table 6.6-1

SITE NO. 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 12-Year Period (Months)	Total Quantity of Contaminant Discharged During 12-Year Period (lbs)
Sodium thiosulfate (fixer)	Building 731 X-ray facility	630	144	90,720
Hydroquinone (developer)	Building 731 X-ray facility	630	144	90,720
Silver	Building 731 X-ray facility	5(1)	144	720

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 quantities = (0.0158 gal/sheet) (4000 sheets/mo) = 63 gallons/month; silver quantities = (35 grams/gal fixer) (63 gallons) fixer ÷ 454 grams/lb = 4.86 = 5 pounds (approx.)

(2) Open discharge occurred for a 12-year period beginning 1953 and ending in 1965.

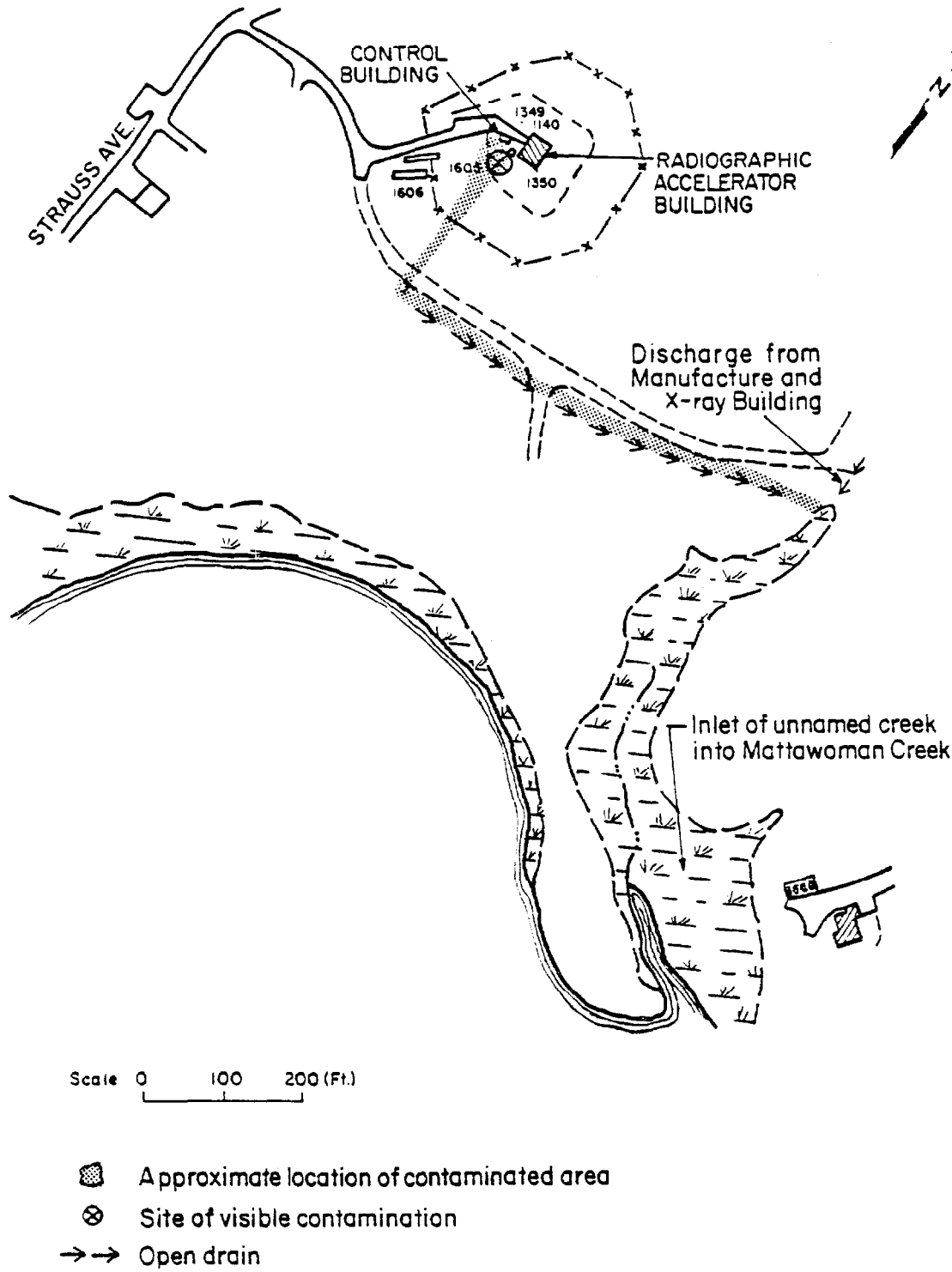


Figure 6.6-5 LOCATION OF SITE NO. 11, RADIOGRAPHIC FACILITY

FCHA INITIAL ASSESSMENT STUDY NAVAL ORDNANCE STATION INDIAN HEAD, MARYLAND

Figure 6.6-6 CONTROL BUILDING (1349) AND RADIOGRAPHIC FACILITY ACCELERATOR (BUILDING 1140)

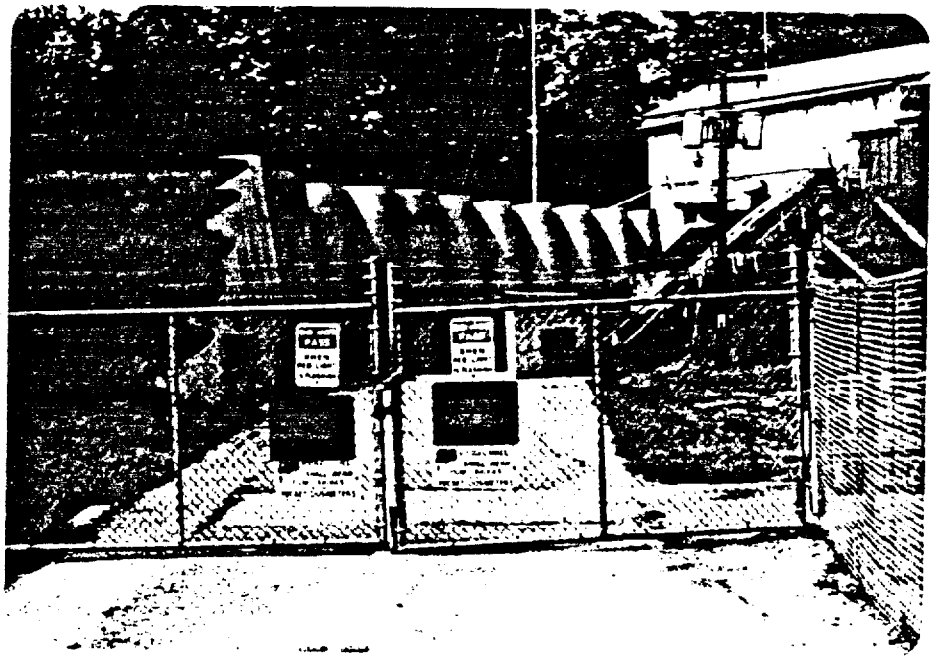
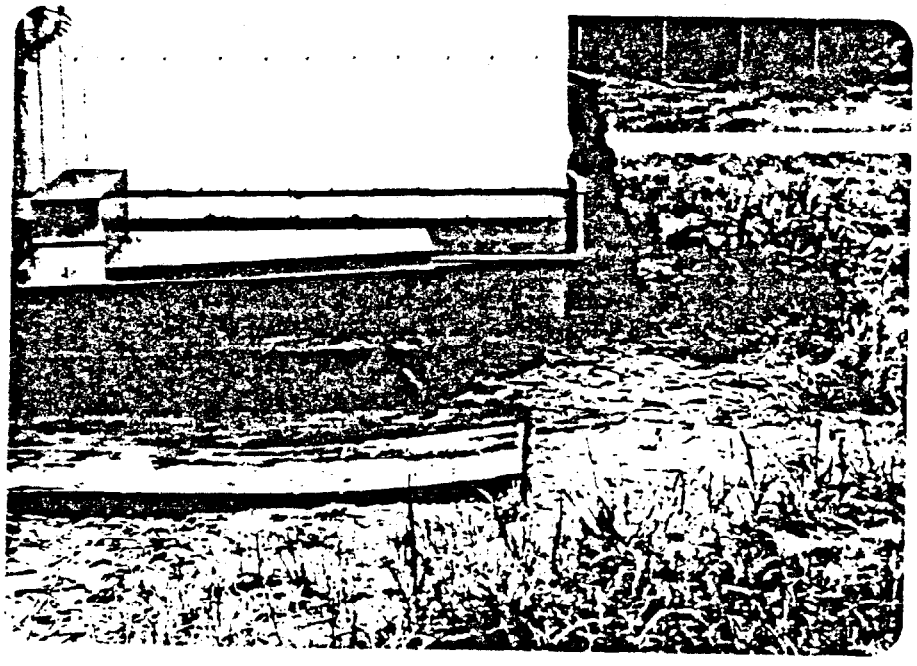


Figure 6.6-7 Stressed vegetation in vicinity of Building 1349 Hypo Storage Tank.



6.6.7 HMX Spill, Slurry Mix Building (MAP GRID G18) (SITE NO. 7) (FIGURE 6.6-8)

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 dewatered in an eductor vacuum filter. 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. A mixture of alcohol contaminated with HMX was periodically spilled onto the concrete platform floor of Building 682 and periodically washed out onto nearby ground surfaces. The HMX dewatering operation at Building 682 was terminated when the Polaris line was shut down circa 1968.

Contaminants known to be in the eductor wastewater included phthalate esters, nitrate esters, amines, lead, oil, and grease as well as HMX. HMX ($C_4H_8N_8O_8$) is similar to cyclonite (RDX) in chemical and physical properties. 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 wash-downs. Table 6.6-2 summarizes wastewater quantity, quality, and discharge operations from these facilities. Table 6.6-3 factors this information into the development of estimates for the total quantities of contaminants discharging into SITE NO. 7. A combined volume (slurry water/eductor water) of 14,000 gallons per week was 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 an estimated discharge of 8 pounds of HMX (in the area around the building), 160 pounds of HMX (in ditch), and 5 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 phthalate esters may represent greater safety and environmental hazards due to the insolubility and density of these contaminants. Since HMX is dense, it is likely certain quantities of material remain within the vicinity of Building 682. This potential contamination should be considered in any future development plans, in the vicinity of Building 682. Therefore, the site should be included on the Station's General Development Map.

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 groundwater migration, no Confirmation Study is recommended at this time. Precautions regarding future earthwork activities, as noted above, should be taken.

Figure 6.6-8 SLURRY MIX BUILDING (Building 682), Looking west, the Solvent Storage Building (Building 1004) is in view.

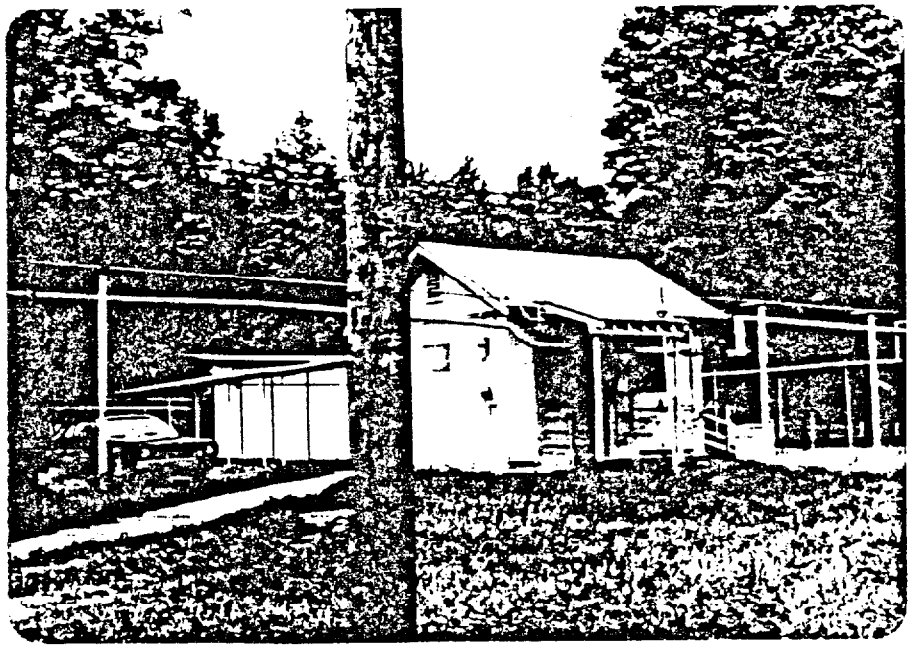


Table 6.6-2

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
Phthalate Esters (PEs)	(3)
(O/G) 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 683 discharge points consist of periodic wastewater from eductor and occasional washdown of concrete platform. Combined wastewater flow consists of 2680 gpd eductor water (river water) plus 192 gpd of slurry water.

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

Table 6.6-3

SITE NO. 7
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	0.16	1,000[2]	160
HMX	platform washdown	0.008	1,000[3]	8
Lead	eductor discharge	0.0048	1,000	4.8

Notes

(1) Estimate of quantities (lbs) developed from average flow rates and average contaminant concentrations - (Ref. Table 6.6-2). 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) Facility was washed down one time per week. Figures here expressed as an average day (1/5 wk).

6.6.8 Mercury Deposits in Manhole, Biazzi Plant (MAP GRID G20) (SITE NO. 8) (Figure 6.6-9)

This is the location of the Biazzi Plant, NG Plant Office (Building 766), constructed in 1953. Industrial effluents originated from two sinks in the building laboratory. Laboratory procedures included cleaning mercury from glassware. Mercury was used in nitrate-ester analysis accompanying production of NG and PGDN at neighboring Biazzi Plant Buildings.

Wastewater contaminated with mercury and possibly nitrate esters (RNO_3) was discharged into a 3,200-foot ditch (IW31) which flows southeasterly into the Mattawoman Creek. Between circa 1958 and 1981, this ditch received wastewater discharges four days per week.

Contaminants known to be in the wastewater included mercury, suspended solids, and oil/grease. During NG and PGDN production activities, average wastewater discharges were 225 gallons per day. Table 6.6-4 summarizes wastewater quantity and characteristics from these facilities. Table 6.6-5 factors this information into the development of estimates for the total quantities of contaminants discharged into SITE NO. 8. A combined volume of 900 gallons per week was 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. (Ten pounds were later recovered.) Since the wastewater discharges were intermittent, and the ditch also carried storm-water runoff, it is not possible to determine whether this material was deposited in the manholes, ditch, or downstream Mattawoman Creek sediments. 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 in either the manhole or ditch, or any signs of stressed vegetation in the vicinity of the Biazzi Plant. A Confirmation Study is recommended to verify the presence of contaminants and to determine whether they pose a threat to aquatic life.

6.6.9 Patterson Avenue, Oil Spill (MAP GRID G37) (SITE NO. 9)

This site was reportedly the location of an oil spill from an oil tanker truck. Approximately 10,000 gallons of an unspecified fuel oil were spilled when the vehicle overturned 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 groundwater migration, and no signs of contamination are present in surface water, no Confirmation Study has been recommended.

6.6.10 Single-base Propellant Grains Spill Area (MAP GRID I to O 37 to 39) (SITE NO. 10)

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 nitrocellulose (NC) propellant grain contamination probably originating from spillage during transportation of

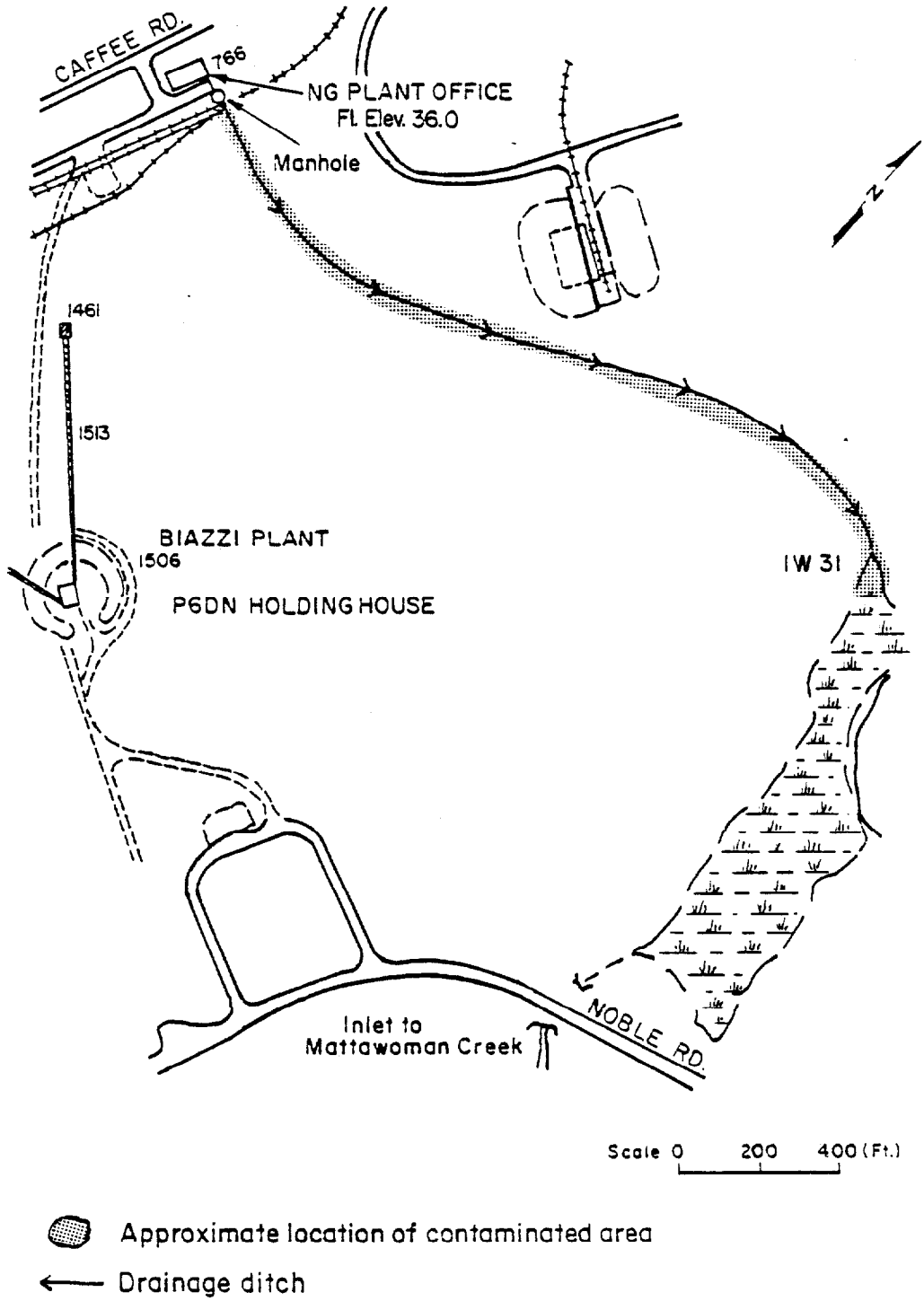


Figure 6.6-9 LOCATION OF SITE NO. 8, MERCURY DEPOSITS IN MANHOLE, BIAZZI PLANT

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Table 6.6-4

Biazzi Plant
Nitroglycerin Plant Office Wastewater Characterization[1]

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

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 on samples taken during mercury analysis procedures accompanying NG and PGDN production.

Table 6.6-5

SITE NO. 8
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	"	0.005	4,600	23

Notes:

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

the finished product. These pellets, which are present only in small quantities, do not endanger water supply, biological receptors, or humans, as NC is insoluble in water and non-toxic. Since there is no evidence of migration, they do not represent an environmental hazard, and no Confirmation Study has been recommended.

6.6.11 Caffee Road Landfill (MAP GRID K6, L6) (SITE NO. 11) (FIGURES 6.6-10, 6.6-11, 6.6-12)

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.

The site was never used as an authorized landfill, although occasionally certain bulk items and trash were buried there. Reportedly, on repeated occasions, M-1 rifles were buried there and bulldozed over with cover material. Other bulk metal items (e.g., rocket motor casings) and exploded building debris (Ref. SITE NO. 3) were deposited along the shoreline east of Caffee Road (SITE NO. 17) for an undetermined period of time. Reportedly, other undetermined materials were deposited in the lowland areas near Building 1440. This could not be substantiated by team site reconnaissance surveys. Interviews and team site reconnaissance indicated that certain unauthorized trash and dunnage disposal may also have taken place. In late 1980, NOS spent $30,000 to remove 5000-6000 cubic yards of deposited material. This material was primarily 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 6.6-6 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 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.

No Confirmation Study is recommended.

6.6.12 Town Gut (MAP GRID K22) (SITE NO. 12) (FIGURES 6.6.-13, 6.6-14)

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. The total fill area is 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 the fill now stands 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 discarding of trash may have

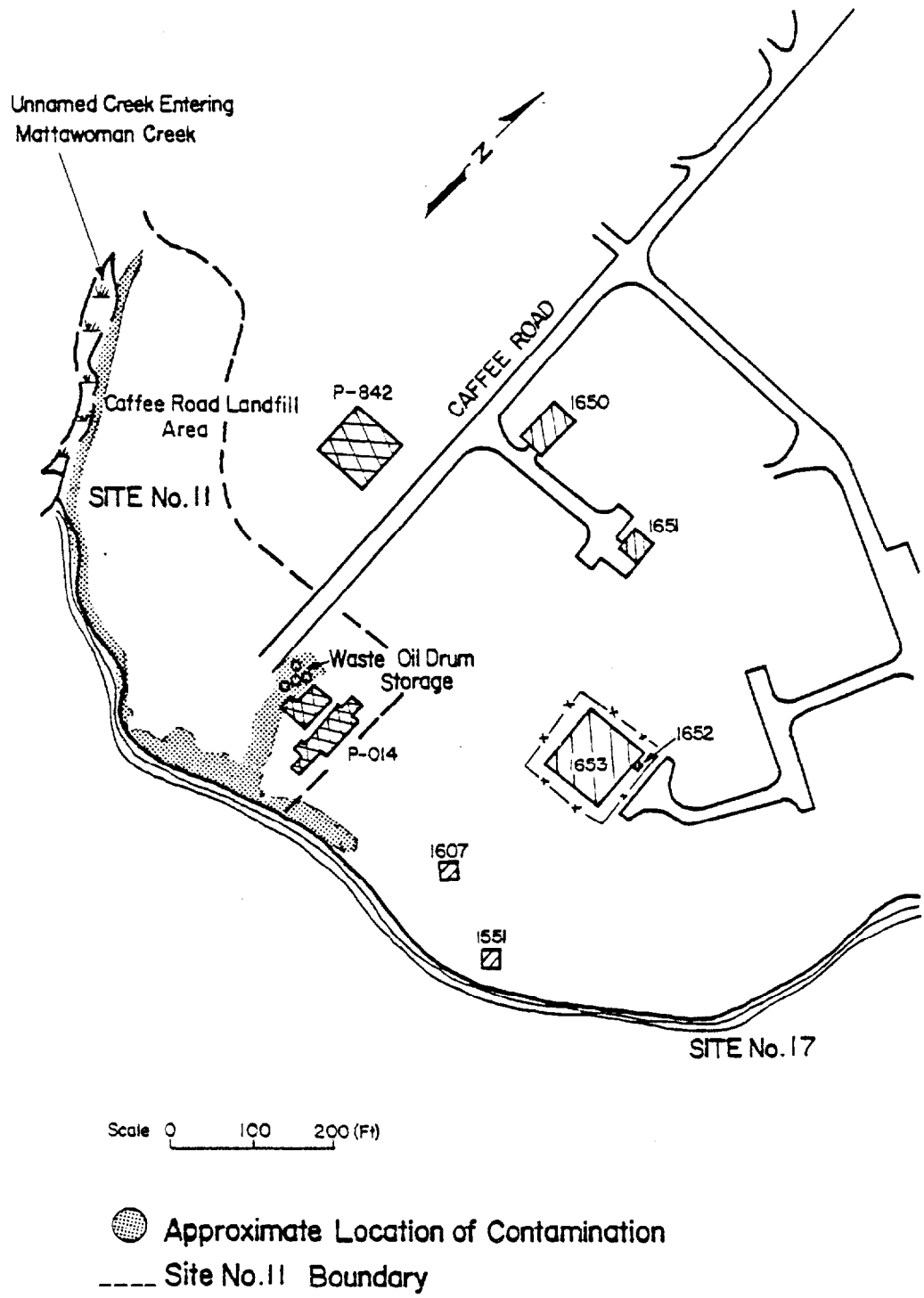

Figure 6.6-10 LOCATION OF SITE NO. 11
CAFFEE ROAD LANDFILL

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Figure 6.6-11 CAFFEE ROAD LANDFILL, Looking north towards Caffee Road. Oil storage drums and leakage (entering Mattawoman Creek) in view.

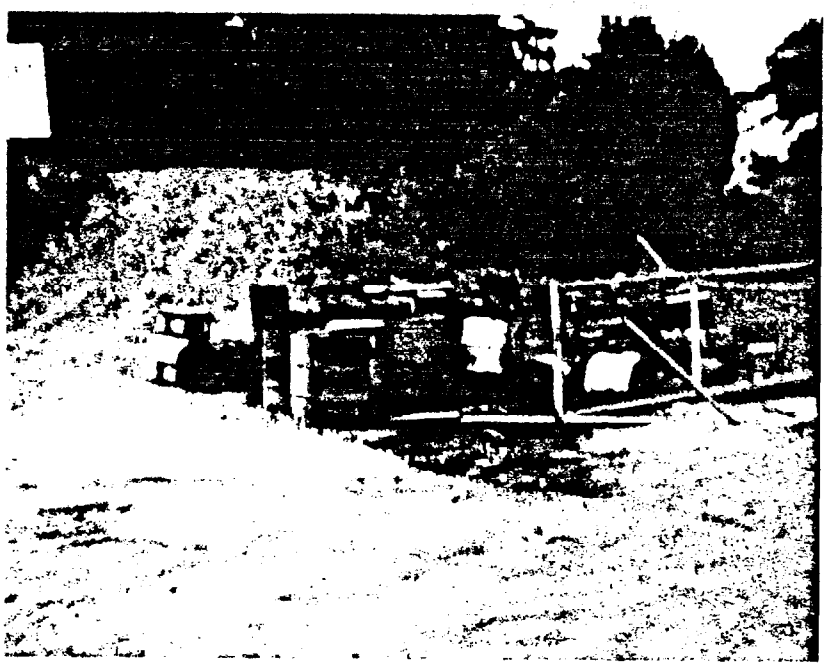

Figure 6.6-12 CAFFEE ROAD LANDFILL, 100 feet south of Caffee Road entrance, Pyrolock spillage from drums in view.

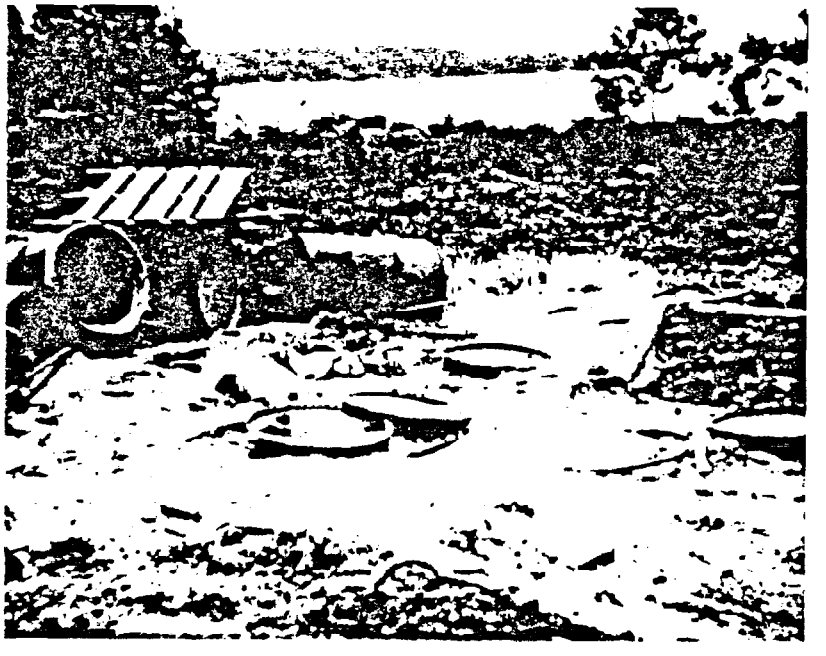

Table 6.6-6

Material Deposited at Caffee Road Landfill

Material Description	Quantity	Origin of Material
Flashed bulk waste	5-6,000 cubic yards(1)	Ordnance Activities
Demilitarized ordnance material, propellant grains residue	5,000 pounds/yr(2)	Pyrotechnics Burning Point
Open-burning residues	26,000 pounds/yr(3)	Decontamination Burning Point
Trash dunnage	2,000 cubic yards(4)	Unknown
Pyrolock slurry	6 drums(5)	Unknown
Rifles Model M-1	Unknown	Unknown

Notes:

(1) Material excavated 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

$$Q = 517{,}000\ (.25)\ (.20) = 25{,}850 \cong 26{,}000 \text{ pounds/year}$$

(4) Material observed during team site reconnaisance survey June 17, 1982.

(5) Team site reconnaissance survey June 17, 1982 observed bags contaminated with phenol-type organic chemical compounds and Pyrolock spillage from 2 drums.

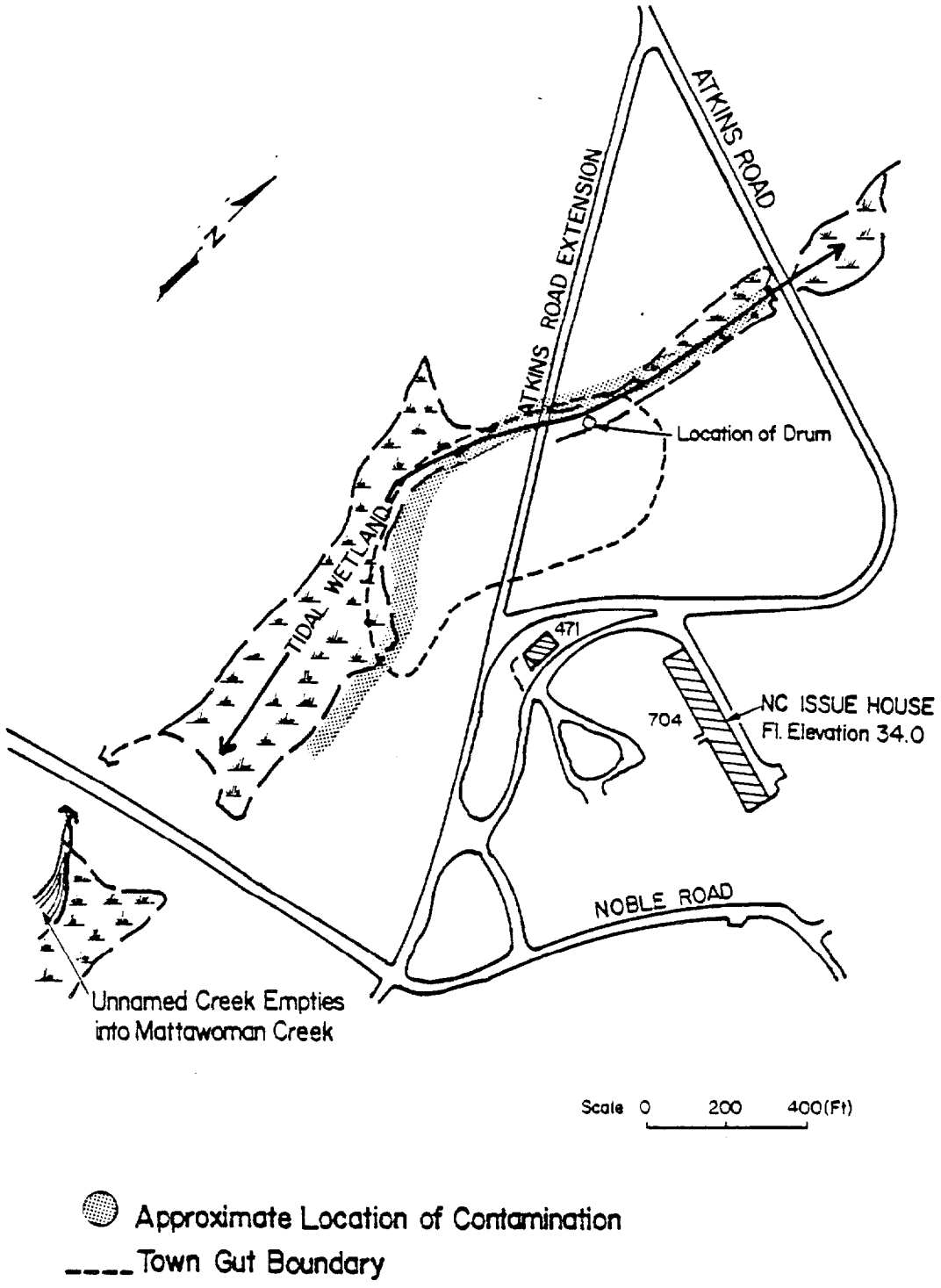

Figure 6.6-13 LOCATION OF SITE NO. 12 TOWN GUT.

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Figure 6.6-14 TOWN GUT, Looking north into unnamed creek east of Atkins Road Extension, drum in center of picture is located in Figure 6.6-13.

occurred since operations at the site began, although estimates of quantities deposited were not available. Table 6.6-7 lists some of the items reportedly discarded at the Town Gut Landfill.

Table 6.6-8 provides calculations of hazardous materials deposited at the Town Gut Landfill based on the assumption that approximately 1000 gallons of paints and varnish were discarded 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 on June 16, 1982 and were reported by various sources to have been deposited at the site (Ref. Table 6.6-7). 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 were visible at the surface of both sites, and waste material was observed strewn about the wetlands.

There is an open-topped drum about 2/3-embedded in the sediment at the edge of the marshy stream. Reddish-colored liquid can be seen along the side of the creek and inside the open end of the drum. There is some evidence of wildlife in the area. Some vegetation stress was noted in the vicinity of the site.

A water sample (leachate) taken from a small runoff originating from a point along the nearby bank in the vicinity of the drum was found to contain 30 mg/l of arsenic. The recommended Confirmation Study should determine contamination trends, evidence of downstream movement, and potential danger to aquatic and terrestrial organisms.

6.6.13 Paint Solvents Disposal Ground (MAP GRID K31) (SITE NO. 13) (FIGURE 6.6-15)

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 200-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 take place over uncontained bare soil areas behind Building 870. Table 6.6-9 summarizes the estimated quantity of hazardous materials deposited at SITE NO. 13 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 are not reactive or explosive, and the hydrogeology of the site is not conducive to migration. Therefore, no Confirmation Study is presently recommended.

6.6.14 Waste Acid Disposal Pit (MAP GRID L33) (SITE NO. 14)

This fenced-in site is the location of a former chemical disposal pit 50 feet northeast of the Solvent Storehouse (Building 881) and 75 feet

Table 6.6-7

Material Deposited at Town Gut Landfill

Material	Quantity	Description	Origin of Material
Solid Waste(2)(3)(4(5)	14 tons(1)	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 Off-Station Sources
Paint(2)(3)(4) & Varnishes	Unknown	Paints & varnish left as residues in discarded empty cans	"
Demolition(2)(5) Wastes	Unknown	Broken up asphalt & concrete, rubble	"
Chemical(5) Waste	Unknown	Spillage from drummed waste	"
Arsenic Wastes	Unknown	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 personnel, Indian Head June 14-15, 1982
(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, June 16, 1982

Table 6.6-8

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: Riegel's Handbook of Industrial Chemistry, J.A. Kent, ed., 7th ed., 1974.

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

VARNISH Phenols (10%); ethyl alcohol, ethyl acetate, acetone (each 15%)

Figure 6.6-15 PAINT SOLVENTS DISPOSAL GROUND, Located 50 feet behind Paint Shop (870), stressed vegetation in view.

Table 6.6-9

SITE NO. 13
Estimate of Quantity of
Hazardous Materials Deposited

Contaminant	Quantity (range in pounds)
Zinc (1), benzene(2), kerosene(2)	1000-10,000
Lead(1), titanium(1), toluene(2), 1,1,1-trichloroethane(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) (26 yrs) = 11,424 lbs
where: 3380 gal/yr(See Section 6.3.1.1)
0.01: assume one percent of total quantity consumed (3,380 gal.) is washed out onto site.
Composition of Paint, see Table 6.6-8

(2) Estimate of Quantity of Material Disposed of on Site

Kerosene & benzene (7 lbs/gal) X (55 gal/yr) (26 yrs) = 10,010 lbs

Toluene & 1,1,1-trichloroethane
(7 lbs/gal) X (1 gal/yr) (26 yrs) = 182 lbs

Lacquer thinner (7 lbs/gal) X (2 gals/yr (26 yrs) = 364 lbs

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.

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 discarded in a 15-20-foot-deep pit. The pit was filled in with chemicals and, circa 1975, the material was dug up and removed, and the pit was filled in. Team site reconnaissance was carried out in the vicinity of this site. Other than the fence, there are no visible signs of the former disposal area as the grounds were capped with concrete. Evidence of spills, leaks, or stressed vegetation in the area was not apparent.

6.6.15 Mercury Deposits in Manhole, Fluorine Lab (MAP GRID L34) (SITE NO. 15)

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 is discharged through underground pipes and combines in a manhole approximately 100 feet from Building 502. Wastewater then enters a 1200-foot ditch (IW06) which flows southeasterly into Mattawoman Creek. Between 1942 and the present time, this ditch received wastewater discharge 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 6.6-10 summaries wastewater quantity and characteristics from these facilities. Table 6.6-11 factors this information into the development of estimates for the total quantities of contaminants discharged into SITE NO. 15. A combined volume of 4600 gallons per week was estimated to have been discharged into the manhole facilities or ditch over the 40-year period during 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 deposited in the manholes, ditch, or downstream Mattawoman Creek sediments. However, in the summer of 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. No Confirmation Study is recommended due to the low hydrogeologic potential for contaminant migration.

Table 6.6-10

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]		
Total Suspended Solids (TSS)	0-	8.0 mg/l
Oil and Grease (O/G)	1.1-	9.9 mg/l
Nitrate Esters (RNO_3)	< 5.0-	8.0 mg/l
Mercury (Hg)	1.0-	2.3 ug/l
Lead (Pb)	0.5-	0.8 mg/l

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 6.6-11

SITE NO. 15
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.

6.6.16 Laboratory Chemical Disposal (MAP GRID K34) (SITE NO. 16)

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 disposed of into the plumbing system where they combined with sanitary sewage and flowed to the NOS sewage treatment plant. Approximately 80 chemical compounds are generated or procured by this facility on an annual basis. Chemicals used in quantities exceeding ten gallons per year (or 100 pounds per year) are listed in Table 6.6-12. These hazardous materials include acids, amines (RNH_3), cyanide compounds, and both chlorinated and nonchlorinated solvents. Other materials used in Building 600 in smaller quantities and not listed in Table 6.6-12 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), metal (cadmium, lead, zinc, copper, mercury, silver) cyanides, nitrate esters (RNO_3), trichlorethylene (TCE), and methylene chloride were among the contaminants determined. 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.

Discharges to 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.

6.6.17 Disposed Metal Parts Along Shoreline (MAP GRID M6, 7, 8, L5) (SITE NO. 17) (FIGURE 6.6-16)

This site is the location of discarded metal parts along the Mattawoman Creek shoreline. Disposed materials included rocket motor casings, shipping containers, empty drums, and various metal parts reportedly placed 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 disposal area. In some instances submerged materials were covered over with bottom sediments. Due to the inert nature of these materials, no Confirmation Study has been recommended.

6.6.18 Hog Island (MAP GRID M20) (SITE NO. 18) (FIGURE 6.6-17)

This is the location of a 1.8-acre site situated 600 feet 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.

Table 6.6-12

SITE NO. 16

Annual Use of Selected[1] Chemicals by the Research & Development Building

Material	Chemical	Annual Usage (gallons per year)
Acids	Hydrochloric	31
"	Sulfuric	25
Amines	Dimethylamine	450 pounds
Cyanide Compounds	Acrylonitrile	110 pounds
Chlorine	Chlorine	400 pounds
Chlorinated solvents	Methyl chloride	44
	Chloroform	19.5
	Carbon tetrachloride	10
Non-chlorinated Solvents	Acetaldehyde	320 pounds
	p-dioxane	61
	Cyclohexane	22
	Dimethyl formamide	15
	Toluene	20
	Pyridine	10
Esters	Butyl acetate	32

Notes:

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

Figure 6.6-16 SITE NO. 17, LOOKING AT MATTAWOMAN CREEK SHORELINE 400 FEET EAST OF CAFFEE ROAD, Disposed of metal parts in view

Figure 6.6-17 SITE NO. 18 Hog Island, Looking northeast towards Atkins Road

The Team observed spotted patches of grass amidst plowed fields which are currently used as food plots for the wildlife on base. Deposits of a grit and sand material spotted with cigarette butts found at the site, originated from grit/sludge generated from NOS sewage treatment plant grit chambers, primary tanks, or sludge drying beds. (The Station uses sewage plant sludge, with State approval, as a soil conditioner to grow crops for wildlife feed. Hog Island is one of the areas used for this purpose.) However, there was no evidence of stressed vegetation, contamination, or discarded material in the area. No Confirmation Study has been recommended due to the inert nature of the soil conditioner.

6.6.19 Catch Basins at Chip Collection Houses (MAP GRID M26 and M28) (SITE NO. 19)

Wastewater contaminated with lead and copper salts may have collected in the catch basins of the Chip Collection Houses (Building 1051 and 785). Wastewater has been generated from these facilities for an undetermined period. Team site reconnaissance indicated no evidence of sludge deposits in catch basins, spillage, or vegetation stress along the ditch receiving chip collection house discharges. This site is a current operation covered by an NPDES permit. The operation has not changed since its inception. No Confirmation Study is recommended.

6.6.20 Single-base Powder Facilities (MAP GRID M35 to N33 (SITE NO. 20)

This is the location of the single-base powder facilities (press, alcohol, dehydrating houses, and various transformer stations). Reportedly, PCBs were suspected to have been used as coolant for transformer switches in the 1940s. However, team interviews, file searches, and site reconnaissance indicated nothing that would suggest that the switches used contained PCBs. A sample collected from one of the switches showed no PCBs present. Therefore, no Confirmation Study is suggested.

Buildings with transformers containing PCBs and NOS procedures used in collecting and storing PCB-wastes are discussed in Section 6.5.

6.6.21 Bronson Road Landfill (MAP GRID N21) (SITE NO. 21)

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 Building 1384, approximately 500 feet from the Mattawoman Creek. Most of the gravel was located in surface deposits, and the underlying soils are relatively impermeable. This facility is also identifed in the NSADSFF as SITE NO. 7. The Bronson Road Landfill was operated by the NOS PW Department as a disposal site for trash generated by facilities in the explosives manufacturing area beginning around 1975 and ending November 1981. At this time a 40-cubic-yard dumpster was established as a transfer station. Trash generated by the explosives area is collected by NOS personnel and picked up 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. 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 disposal of materials may have occurred, and at least one interviewee mentioned that various undetermined quantities of liquids were disposed of at this site. Table 6.6-13 lists some of the materials reportedly disposed of at the Bronson Road Landfill. Table 6.6-14 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 disposed of at the site during the facility's total operating years. These items were included in the estimate since some of them were observed in a recently installed 40-cubic-yard dumpster near the landfill and were reported by various sources to have been deposited at the site. This analysis indicates that asbestos; barium and various other metals (notably zinc and lead); and non-halogenated solvents are the contaminants estimated to be present in the largest quantities. Since barium sulfate is an insoluble compound, it is unlikely that this contaminant would pose a serious environmental hazard. Team site reconnaissance indicated the facility had a partial cover over the deposited material (6 inches to 1 foot in depth). Uncovered bags of asbestos were observed, as well as several small dark-brown-colored pools of water which apparently originated as leachate. 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 hydrogeology, which does not facilitate contaminant migration. However, the portion of the landfill that is uncovered should be capped and properly closed to minimize any potential for subsurface or air-borne contamination migration.

6.6.22 NG Slums Burning Site (MAP GRID 012) (SITE NO. 22) (FIGURE 6.6-18)

This area is the location of the former NG Burning Site, a 50-foot-wide strip along the shoreline of the Greenslade Road Peninsula surrounded by Mattawoman Creek. This 1/2 acre, 400-foot strip of land was reportedly used as a burning ground for NG slums generated by the nitroglycerin plant. This site was probably operated from the date the NG production facilities were constructed (circa late 1940s) to the date the Main Burning Point was established (circa 1953) as a disposal site for these materials. The site probably contained drainings from the catch tanks labyrinth soaked in sawdust.

While team site reconnaissance indicated the presence of random disposal (cinders, gravel, plumbing fixtures), there was no evidence of the old slums burning area or any NG slums deposits along the shoreline. Team observations also indicated a good growth of vegetation, even on steep side sloped areas of the peninsula.

Since NG is slightly soluble in water, leaching of NG from disposed of sawdust slums is a possibility, despite the slums having been burned and the site shocked routinely due to NG's explosive properties. Therefore, while NG does not represent a significant environmental hazard to the Mattawoman Creek, its explosive characteristics could pose potential safety hazards. These potential hazards should be considered with any future NOS development plans. Therefore, the site should be included on the Station's General Development Map. A Confirmation Study has not been recommended at this time.

Table 6.6-13
Material Disposed of at Bronson Road Landfill

Material	Quantity[1] (tons)	Description	Origin of Material
Solid Waste	1500[2][3][4]	Shop trash, lumber, metal, empty boxes, empty cans, tires glassware, bottles, pallets	NOS explosives area
Barium sludge	2.5[3]	Insoluble white powder delivered in 55 gallon drums	Building 856
Asbestos	3.3[5]	Pyrolock delivered in colored plastic bags	Buildings 113, 193, 290, 855, 856, 903
Paint sludge	3.0[6]	Sludge from paint spray booths delivered in sealed 55 gallon drums	Buildings 717, 763, 868, 160, 1134

(1) Total Estimated Quantity of Material Deposited = Depositing Rate x Period of Facility Use

(Tons)	
1500	= 1 ton per day x 5 days/wk. x 50 wks. x 6 yrs.
2.5	= 0.625 ton[4] per yr. x 4 yrs.
3.3	= 0.55 ton[5] per yr. x 6 yrs.
3.0	= 0.5 ton per yr. x 6 yrs.

(2) Team site reconnaissance survey June 16, 1982.

(3) Source: EES, NAVORDSTA, Indian Head, MD, UIC N00174, June 1980.

(4) Source: Team NOS personnel interview June 16, 1982.

(5) Source: NOS List of Hazardous Materials, June 1980.

(6) Source: NSADSFF, CHESDIV, December 15, 1980.

Table 6.6-14

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, tetrachloroethane, 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 Discarded Barium, Asbestos, and Paint Sludges 5000 lbs, 6600 lbs, and 6000 lbs respectively. (Ref. Table 6.6-13).

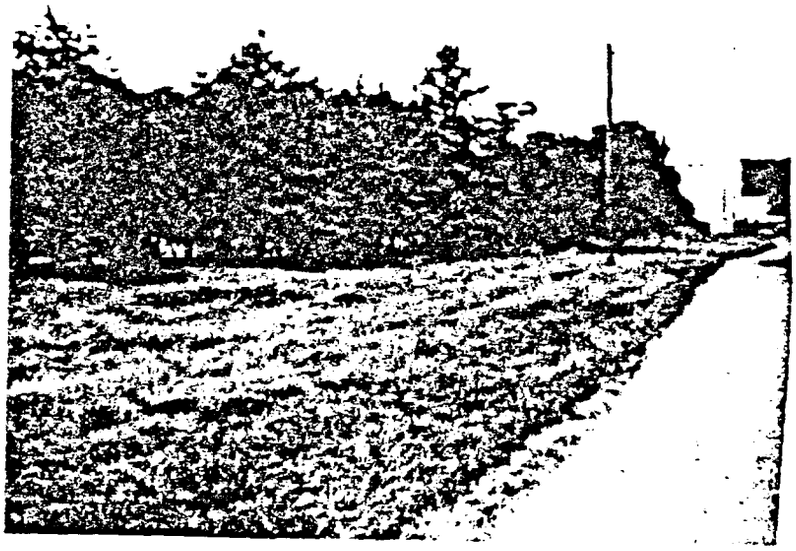
(3) Composition of Discarded Materials, Source: Riegel's Handbook of Industrial Chemistry, J.A. Kent, ed., 7th ed., 1974.

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

VARNISH Phenols (10%); ethyl alcohol, ethyl acetate, acetone (each 15%)

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

Figure 6.6-18 SITE NO. 22, NG BURNING SITE, Looking northeast of Hussey Road



6.6.23 Hydraulic Oil Discharges From Extrusion Plant (MAP GRID 024,T24, E20) (SITE NO. 23)

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 indicate that no Confirmation Study should be performed at this site.

6.6.24 Abandoned Drain Lines (MAP GRID 035,37,38) (SITE NO. 24)

This site is the location of the abandoned nitrocellulose (NC) production facilities. The buildings were constructed in the late 19th century and early 1900s, 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 nitric and sulfuric acids per pound of NC. The water use was about 50,000 gallons per ton of NC. The neutralized acid water with salts of sulfuric and nitric acid was 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 particles deposited in manholes. Due to its explosive characteristics, NC deposits may represent a greater safety than environmental hazard, should NC particles 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.

6.6.25 Hypo Discharges from X-ray Building No. 2 (MAP GRID P27) (SITE NO. 25) (Figure 6.6-19)

This site is the location of the Rocket Motor Loading Building (Building 588), constructed in 1944, which contains facilities used for X-ray film developing. The X-ray section of this building is no longer in use.

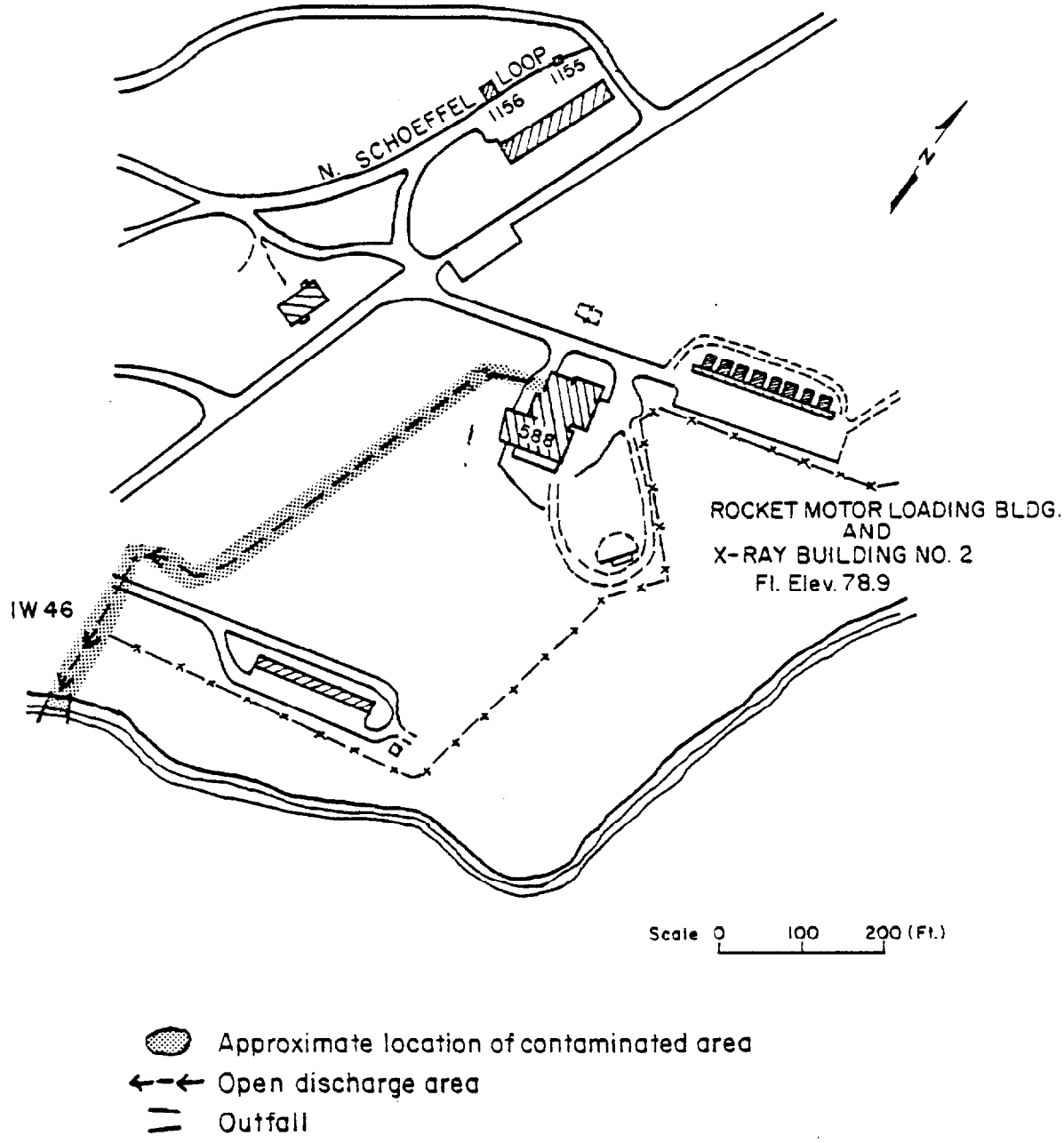


Figure 6.6-19 LOCATION OF SITE NO. 25, HYPO DISCHARGES, X-RAY BUILDING NO. 2

FCHA INITIAL ASSESSMENT STUDY
NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND

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 impact. Table 6.6-15 provides an estimate of the total quantity of contaminants discharged into IW46 during the 20-year period the X-ray facilities discharged untreated wastewater into the ditch. The chemistry and probable fate of sodium thiosulfate, hydroquinone, and silver would be similar to the fate of contaminants found in other X-ray photo lab discharges as discussed elsewhere (Ref. SITE NO. 5). Team site reconnaissance indicated no vegetation stress or contamination immediately behind the building at the point of outfall discharge. However, there was evidence of disposal of paint materials and accessories including paint brushes, empty solvent cans, and trash. In the event that the Confirmation Study of SITE NO. 5 confirms a danger to aquatic life, a study will be performed at this site.

6.6.26 Thermal Destructor 2 (MAP GRID P30) (SITE NO. 26)

This site is the location of NOS Thermal Destructor 2 facility (a/k/a Prenco unit) (Building 1595). This facility is also identified in NSADSFF as SITE NO. 5. The Thermal Destructor is a propane-fired incinerator, which burned 1.3 million pounds per 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 slab resting on clay soil situated on flat terrain approximately 500 feet from the bank of the Mattawoman Creek. The NSADSFF 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-contaminated wastewater may have been spilled in the vicinity of the site. A Confirmation Study is not recommended at this time.

6.6.27 Thermal Destructor 1 (MAP GRID S32) (SITE NO. 27)

This site is the location of NOS Thermal Destructor 1 (Building 1584). This facility is similar to the Prenco Unit (SITE NO. 26), and is identified in NSADSFF 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 slab resting on clay soil situated on a flat terrain approximately 400 feet from the banks of the Mattawoman Creek. The NSADSFF 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 by NOS interviewees describing spill events, contamination incidents associated with this facility could not be confirmed. No Confirmation Study is recommended.

Table 6.6-15

SITE NO. 25
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	864

NOTES:

1. Estimates of quantities developed from manufacturers recommended solution application rates for fixer and developer, average monthly quantities of sheets developed at the facility and average silver concentrations of fixer baths as follows: Fixer, developer quantitites = (0.0158 gal/sheet) (3000 sheets/mo) = 47 gallons/month; silver quantities = (35 grams/gal fixer) (47 gallons) ÷ (454 grams/lb) = 3.6 pounds.

6.6.28 Original Burning Ground (MAP GRID S36, 37) (SITE NO. 28)

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), only smokeless powder was burned at this site. It is also possible that various other contaminated wastes were open-burned here. Team site reconnaissance did not indicate any visible signs of these materials. There is not sufficient information to characterize the potential hazard at this site. A Confirmation Study is not recommended at this time.

6.6.29 The Valley (MAP GRID A37 to D41)(SITE NO. 29)

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.

6.6.30 Stump Neck Impact Area (MAP GRID F-16 and G-16)(SITE NO. 30)

There was alleged to have been naval gun firing at Stump Neck into the marsh at grid locations F-16 and G-16 during pre-World War II years. This firing was said to have been 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.

6.6.31 Old Demolition Range (MAP GRID ZZ-26)(SITE NO. 31)

There is said to be an old demolition training ground about 1 acre in area 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, an explosive ordnance disposal training range.

6.6.32 Suspected Tool Burial (MAP GRID ZZ-18)(SITE NO. 32)

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, at grid E-15.

6.6.33 Scrap Metal Pit (MAP GRID O-16)(SITE NO. 33)

An excavation, 10 feet x 10 feet x 30 feet long, is reported to contain scrap metal at 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.

6.6.34 Tool Burial (MAP GRID E-15)(SITE NO. 34)

Beryllium-copper alloy hand tools are reported to be buried near Building D-21C at grid location E-15. There are two burial holes, each about 5 feet x 15 feet x 12 feet deep. The volume of tools in each pit is said to be about 5 feet x 8 feet x 2 feet. 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 have taken place in 1972 or 1973. It is noted that the mangetometer 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.

6.6.35 Buried Torpedoes (MAP GRID E-15, E-14)(SITE NO. 35)

At grid locations E-15 and E-14, between Building D-21C and 2075, torpedoes and associated hardware are believed to be buried. 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 fuzes and parts which are not rendered safe. No other details are available.

6.6.36 Closed Landfill (MAP GRID H-15, H-14)(SITE NO. 36)

There is a landfill at grid H-15 to H-14. The filled area was a wetland or marsh. The filled, levelled ground occupies an area of approximately one to two acres. Grass and other low vegetation cover most of the site. The fill is believed to contain metal casings such as mines, bombs, and torpedoes. The contents are claimed to have been 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 fill material.

6.6.37 Causeway (MAP GRID E-13)(SITE NO. 37)

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 at 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.

6.6.38 Rum Point Landfill (MAP GRID U-7)(SITE NO. 38)

This landfill is located at 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 and in the fill in addition to degradable material such as wood. 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 objects appeared to be empty. The projectile was light blue in color and about 6 inches in diameter. It is believed to be an inert round. The date of the first use of the site as a fill was not available.

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APPENDIX A

Available Well Logs

Well 15

Formation Log

0-84	Clay
84-95'6"	Water Sand
95'6"-187	Clay
187-205'6"	Water Sand
205'6-227	Clay
227-234'5"	Water Sand
234-238'5"	Clay
238'5"-244'6"	Water Sand
244'6"-264'5"	Clay
264'5"-279'6"	Water Sand
279-455	Clay
455-463	Water Sand
463-615	Clay
615-	Bedrock

Well 16

Formation Log

0-83	Clay
83-94	Water Sand
94-123	Sandy clay
123-125	Water sand
125-130	Sandy sand
130-132	Water sand
132-144	Sandy Clay
144-152	Water sand
152-219	Clays
219-229	Water sand
229-232	Clay
232-242	Water sand

Well 17

Formation Log

0-20	Brown Clay
20-35	Gray Clay
35-42	Sand & Wood
42-63	Mixed Clays
63-82	Sand & Gravel
82-142	Tough Clay
142-162	Clay with Sand
162-178	Coarse Sand
178-260	Clays
260-282	Coarse Sand
282-295'5"	Sand Streak
295'6"-452	Clays

Well 18

Formation Log

0-60	Clay
60-87	Sand & Gravel
87-206	Clays
206-220	Sand
220-272	Clay
272-286	Coarse Sand
286-287	Clay
287-302	Coarse Sand
302-605	Clays

Well A(24)

Formation Log

0-40	Red clay & sand
40-113	Gray & red clay
113-116	Sand & gravel
116-150	Gray sand, clay, gravel
150-154	Gray sand
154-170	Gray sand & clay
170-181	Sand & sand rock
181-191	Gray clay
191-216	Gray sand & clay
216-246	Gray sand
246-259	Gray sand & clay
259-306	Gray sand
306-319	Gray clay & sand
319-331	Gray sand
331-350	Mix clay & sand

Well B(23)

Formation Log

0-6	Brown Sand clay
6-21	White clay & gravel
21-54	Gray clay & fine gravel
54-79	Gray clay & Coarse gravel
79-159	Blue clay, sand & gravel
159-178	Gray sand, some gray clay
178-186	Blue clay, sand & gravel
186-214	Gray sand
214-218	Gray clay & sand
214-302	Gray sand & gravel
302-330	Gray sand, clay & gravel

Well 43SN

FORMATION

0' - 10'	-	Yellow sandy clay
10' - 20'	-	Large gravel
20' - 60'	-	Blue and brown clay
60' - 69'1	-	Sandy marl
69' - 73'	-	Gray muddy sand
73' - 123'	-	Brown clay
123' - 130'	-	Gray sand
130' - 176'	-	Alternate streaks of Brown and blue clay
176' - 186'	-	Gray muddy sand
186' - 205'	-	Fine sand
205' - 217'	-	Mud and sand
217' - 245'	-	Streaks of sand and blue clay
245' - 265'	-	Brown and blue clay
265' - 273'	-	Gray muddy sand
273' - 276'	-	Coarse gray sand
276' - 278'	-	Sticky brown clay
278' - 290'	-	Gray muddy sand
290' - 295'	-	Very sticky blue clay
295' - 320'	-	Very sticky red and brown clay
320' - 375'	-	Brown and blue clay
375' - 395'	-	Streaks of sand and clay
395' - 414'	-	Brown and blue sandy clay
414' - 420'	-	Very fine gray sand
420' - 425'	-	Brown clay
425' - 454'	-	Water-bearing sand

Well 66SN

FORMATION

0' - 35'	-	Yellow sandy clay
35' - 50'	-	Brown clay
50' - 60'	-	Gray sand
60' - 110'	-	Gray and brown sandy clay
110' - 147'	-	Brown clay
147' - 155'	-	Gray sand
155' - 295'	-	Blue and brown clay
295' - 312'	-	Gray sand - tested 45 G.P.M.
312' - 320'	-	Blue clay
320' - 395'	-	Blue and brown clay
395' - 409'	-	Fine gray sand
409' - 414'	-	Blue sandy clay
414' - 418'	-	Gray muddy sand
418' - 422'	-	Blue and brown sandy clay
422' - 443'	-	Gray water-bearing sand
443'		Blue clay

APPENDIX B

Inventory of Terrestrial Fauna

Inventory of Terrestrial Fauna

A. BIRDS

The following is a listing of birds which have been identified as common or abundant in the Charles County section of Maryland:

Horned Grebe
Great Blue Heron
Green Heron
Whistling Swan
Canada Goose
Mallard
Black Duck
American Wigeon
Wood Duck
Canvasback
Common Goldeneye
Bufflehead
Ruddy Duck
Common Merganser
Red-breasted Merganser
Turkey Vulture
Red-tailed Hawk
Red-shouldered Hawk
Osprey
American Kestrel
Bobwhite
Killdeer
Common Snipe
Herring Gull
Ring-billed Gull
American Robin
Wood Thrush
Eastern Bluebird
Blue-gray Gnatcatcher
Golden-crowned Kinglet
Ruby-crowned Kinglet
Cedar Waxwing
Starling
White-eyed Vireo
Red-eyed Vireo
Northern Parula
Yellow-rumped Warbler
Blackpoll Warbler
Prairie Warbler
Common Yellow-throat
House Sparrow
Laughing Gull
Mourning Dove
Yellow-billed Cuckoo
Barred Owl
Whip-poor-will
Chimney Swift
Common Flicker
Red-bellied Woodpecker
Downy Woodpecker
Eastern Kingbird
Eastern Phoebe
Acadian Flycatcher
Eastern Wood Pewee
Tree Swallow
Barn Swallow
Purple Martin
Blue Jay
Carolina Chickadee
Tuffled Titmouse
White-breasted Nuthatch
Brown Creeper
Carolina Wren
Mockingbird
Gray Catbird
Brown Thrasher
Rufous-sided Towee
Oark-eyed Junco
Chipping Sparrow
Field Sparrow
White-throated Sparrow
Song Sparrow
Eastern Meadowlark
Red-winged Blackbird
Common Grackle
Scarlet Tanager
Cardinal
Indigo Bunting
American Goldfinch
Ovenbird
American Redstart

B. MAMMALS

The following is a listing of mammals known to be common or abundant in Charles County:

Opossum	Least Shrew
Eastern Mole	Star-nosed Mole
Little Brown Myotis	Keen's Myotis
Silver-haired Bat	Eastern Pipistrelle
Red Bat	Woodchuck
Gray Squirrel	Southern Flying Squirrel
White-Footed Mouse	Meadow Vole
Pine Vole	Muskrat
Norway Rat	House Mouse
Meadow Jumping Mouse	Eastern Cottontail
Raccoon	White-tailed Deer

C. REPTILES

The following is a listing of reptiles identified as common or abundant in Charles County:

1. Lizards

   Northern Fence Lizard
   Six-lined Racerunner
   Five-lined Skink

2. Snakes

   Eastern Worm Snake
   Eastern Hognose Snake
   Rough Green Snake
   Black Rat Snake
   Eastern King Snake
   Northern Water Snake
   Northern Brown Snake
   Eastern Garter Snake

3. Turtles

   Eastern Mud Turtle
   Snapping Turtle
   Eastern Box Turtle

D. AMPHIBIANS

The following is a listing of amphibians found to be common or abundant in Charles County:

1. Salamanders

   Northern Two-lined Salamander
   Red-backed Salamander
   Northern Red Salamander
   Northern Dusky Salamander

2. Frogs and Toads

   American Toad
   Fowler's Toad
   Northern Cricket Frog
   Northern Spring Peeper
   Upland Chorus Frog
   Bullfrog
   Green Frog
   Southern Leopard Frog
   Pickerel Frog

Reference: U.S. Department of Agriculture Soil Conservation Service. Project Plan Supplement No. 1 - Southern Maryland Resource Conservation and Development Project. College Park, Maryland. July 1975.

APPENDIX C

Hazardous Wastes Stored at NOS - 1980

HAZARDOUS WASTE INVENTORY

Note: Asterisked (*) items are toxic wastes that do not appear on the EPA "Contaminants for Characteristic of EP Toxicity" list (40 CFR 261.24), but have been determined at NAVOROSTA to be potentially toxic. It is recommended that EP (Extraction Procedure) Toxicity tests be run on them.

HAZARDOUS WASTE INVENTORY

UIC #N00174

Activity: Naval Ordnance Station Indian Head, Maryland

Description of Hazardous Waste	Responsible Organization/ Code	Hazard	Quantity Generated Annually	Storage site: Location of Site (Building)	Storage site: Kind of Storage	Storage site: Quantity Stored	Storage site: Average Storage Time	Current Treatment, Disposal, Reclamation	Comments
Acetone (solvent)	526	Ignitable	4,000 lbs	855	Slum with sawdust	80 lbs	1 week	Open burning	
Acetone (contaminated)	526	Ignitable	2,000 lbs	905	Slum with sawdust	40 lbs	1 week	Open burning	
			60 lbs	1182	Slum with sawdust	5 lbs	1 month	Open burning	
			500 lbs	849	Slum with sawdust	10 lbs	1 week	Open burning	
			100 lbs	1267	Sealed cans	25 lbs	90 days	Open burning	
			250 lbs	1285	Steel drums	10 lbs	2 weeks	Open burning	
Acetone/Hexane	202	Ignitable	2,500 lbs	outside 859	55-gal drum in diked area	50 gals	2 mos.	Open burning or DPDO	
Aluminum (powdered)	526	Ignitable	100 lbs	905	Scrap can	2 lbs	1 week	Open burning	
			50 lbs	903	Sealed can	12.5 lbs	90 days	Open burning	

HAZARDOUS WASTE INVENTORY

UIC #N00174

Activity: Naval Ordnance Station Indian Head, Maryland

Description of Hazardous Waste	Responsible Organization/ Code	Hazard	Quantity Generated Annually	Storage site: Location of Site (Building)	Storage site: Kind of Storage	Storage site: Quantity Stored	Storage site: Average Storage Time	Current Treatment, Disposal Reclamation	Comments
Ammonium nitrate	526	Ignitable	1,000 lbs	704	Sealed cans	100 lbs	1 month	Open burning	
Ammonium nitrate propellant	526	Ignitable	12 lbs	855	Sealed can	0.25 lb	1 week	Open burning	
			300 lbs	704, 543	Sealed can	10 lbs	1 week	Open burning	
Ammonium perchlorate	526	Ignitable	1,000 lbs	905, 906	Scrap cans	20 lbs	1 week	Open burning	
			1,000 lbs	1277	PE-lined cans	20 lbs	1 week	Open burning	
			250 lbs	1267	PE-lined cans	5 lbs	1 week	Open burning	
			200 lbs	1265	Scrap cans	4 lbs	1 week	Open burning	
*Asbestos (friable)	09 20	Toxic	unknown	Near 873	Plastic bags in Dumpster		90 days	Landfill	
*Asbestos (Pyroloc)	201	Toxic	600 gals	Outside	55-gal drums	30 gals	1 month	Landfill	
Boron Potassium Nitrate	526	Ignitable	25 lbs	1263	Sealed can	0.5 lb	1 week	Open burning	

HAZARDOUS WASTE INVENTORY

UIC #N00174

Activity: Naval Ordnance Station
Indian Head, Maryland

Description of Hazardous Waste	Responsible Organization/ Code	Hazard	Quantity Generated Annually	Storage site: Location of Site (Building)	Storage site: Kind of Storage	Storage site: Quantity Stored	Storage site: Average Storage Time	Current Treatment, Disposal Reclamation	Comments
Boron Potassium Nitrate (powder)	526	Ignitable	10 lbs	849	Sealed can	1 lb	1 week	Open burning	
Contaminated solvent	526	Ignitable	2,500 lbs	1277	Slum with sawdust	50 lbs	1 week	Open burning	
*Copper Compounds	526	Toxic	4 lbs	1265	Slum with sawdust	1 lb	90 days	Open burning	
*Delay Compositions (containing B, $BaCrO_4$, $KClO_4$, SiO_2, W, etc.)	511	Ignitable Toxic	210 lbs	7XC40	Metal cans in magazine	1200 lbs	90 days	Excess/scrap: open burning at Decontamination Point	
Elba solvent	202	Ignitable	50 gals	Outside 874	55-gal drum	15 gals	2 mos.	Open burning	
*Epoxy, cured	526	Toxic	10 lbs	855	Trash can	0.5 lb	1 week	Open burning	
n-Heptane	526	Ignitable	500 lbs	905	Scrap can	10 lbs	1 week	Open burning	
Heptane (contaminated)	526	Ignitable	240 lbs	1182	Sealed cans	20 lbs	1 month	Open burning	
Hexane (contaminated)	526	Ignitable	120 lbs	1182	Sealed cans	10 lbs	1 month	Open burning	
HMX (cyclotetramethylenetetranitramine)	526	Ignitable	100 lbs	905 3	Water-wet	2 lbs	1 week	Open burning	

HAZARDOUS WASTE INVENTORY

UIC #N00174

Activity: Naval Ordnance Station
Indian Head, Maryland

Description of Hazardous Waste	Responsible Organization/ Code	Hazard	Quantity Generated Annually	Storage site: Location of Site (Building)	Storage site: Kind of Storage	Storage site: Quantity Stored	Storage site: Average Storage Time	Current Treatment, Disposal Reclamation	Comments
HMX/RDX	526	Ignitable	100 lbs	1265	Water-wet	2 lbs	1 week	Open burning	
Ignition mixes (containing B, $BaCrO_4$, Fe_2O_3, $KClO_4$, SiO_2, Ti, Zr, etc.)	511	Ignitable	46 lbs	7XC40	Alcohol-wet, in plastic bottles, in magazine	118 lbs	90 days	Excess/scrap: open burning at Decontamination Point	
Lead nitrate	526	Toxic	5 lbs	905	Sealed can	0.5 lb	1 week	Open burning	
Magnesium (metal, powder)	526	Ignitable	25 lbs	903	Sealed can	6 lbs	90 days	Open burning	
*Methyl aziridinyl phosphine oxide (MAPO)	526	Toxic	250 lbs	1285	Steel drums	10 lbs	2 weeks	Open burning	
Metriol trinitrate (MTN)	526	Ignitable	5 lbs	905	Slurry with sawdust	0.25 lb	4 days	Open burning	
Mixed acid (spent)	2014	Corrosive	3,000,000 lbs	781 790	Tank	80,000 lbs	1 week	Returned to vendor for rework	
Mixed acid (dilute)	2014	Corrosive	250,000 lbs	674	Tank	20,000 lbs	2 hours	Neutralized w/ alkali and discharged to drain	
Mixed solvent (MG/TA)	526	Ignitable	26 lbs	1267	Slurried	0.5 lb	1 week	Open burning	

HAZARDOUS WASTE INVENTORY

UIC #N00174

Activity: Naval Ordnance Station Indian Head, Maryland

Description of Hazardous Waste	Responsible Organization/ Code	Hazard	Quantity Generated Annually	Storage site: Location of Site (Building)	Storage site: Kind of Storage	Storage site: Quantity Stored	Storage site: Average Storage Time	Current Treatment, Disposal Reclamation	Comments
Nitrocellulose (NC)	526	Ignitable	100 lbs	1272	Water-wet	2 lbs	1 week	Open burning	
	2013	Ignitable	1,000 lbs	Outside 471	Water-wet in covered container	20 lbs	1 week	Open burning	
Nitroglycerin	2014	Ignitable Toxic	250 lbs	1109	Slumned w/sawdust in covered cans	5 lbs	1 week	Open burning	
Nitroguanidine, High bulk (HBNQ)	202	Ignitable	600 lbs	Outside of bldg on dumpster pad	Covered container or dumpster	25 lbs	2 weeks	Open burning	
*Otto fuel	2014	Toxic	250 lbs	1109	Slumned w/sawdust in covered cans	5 lbs	1 week	Open burning	
Paint thinner	526	Ignitable	500 lbs	855	Slum w/sawdust	10 lbs	1 week	Open burning	
PHC/NC (Plastisol Nitrocellulose/NC)	202	Ignitable	500 lbs	859	Covered container	10 lbs	1 week	Open burning	
Polybutadiene binder	202	Ignitable	520 lbs	905	Scrap can	10 lbs	1 week	Open burning	
			100 lbs	903	Sealed can	25 lbs	90 days	Open burning	

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HAZARDOUS WASTE INVENTORY

UIC N00174

Activity: Naval Ordnance Station Indian Head, Maryland

Description of Hazardous Waste	Responsible Organization/ Code	Hazard	Quantity Generated Annually	Storage site: Location of Site (Building)	Storage site: Kind of Storage	Storage site: Quantity Stored	Storage site: Average Storage Time	Current Treatment, Disposal Reclamation	Comments
*Polyurethane binder	202	Ignitable	520 lbs	905	Sealed can	10 lbs	1 week	Open burning	
			200 lbs	903	Drums	50 lbs	90 days	Open burning	
Primer mixes (with Sb_2S_3)	511	Ignitable	4 lbs	7XC40	Alcohol-wet in plastic bottles in magazine	2 lbs	60 days	Excess/scrap: open burning at Decontamination Point	
Propellant Scrap									
Double base propellant	201	Ignitable	500 lbs	Outside scrap pad	Dumpster	10 lbs	1 week	Open burning	
	2013	Ignitable	1,000 lbs	1228	Covered container	20 lbs	1 week	Open burning	
	2013	Ignitable	8,000 lbs	1298	Covered container	160 lbs	1 week	Open burning	
	2013	Ignitable	16,500 lbs	1300	Covered container	330 lbs	1 week	Open burning	
	2013	Ignitable	8,500 lbs	1295	Covered container	170 lbs	1 week	Open burning	
	526	Ignitable	500 lbs	849	PE-lined cans	10 lbs	1 week	Open burning	
	526	Ignitable	500 lbs	1267	PE-lined cans	10 lbs	1 week	Open burning	

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HAZARDOUS WASTE INVENTORY

UIC #N00174

Activity: Naval Ordnance Station Indian Head, Maryland

Description of Hazardous Waste	Responsible Organization/ Code	Hazard	Quantity Generated Annually	Storage site: Location of Site (Building)	Storage site: Kind of Storage	Storage site: Quantity Stored	Storage site: Average Storage Time	Current Treatment, Disposal Reclamation	Comments
* Double base & composite propellants	201	Ignitable	100,000 lbs	Outside scrap pad	Dumpster	Varies	3 days	Open burning	Downloading of overaged grains
	202	Ignitable	1,000 lbs	Outside 560 & 564 on Dumpster pad	Covered container in "Explosive" Dumpster	50 lbs	2 weeks	Open burning	
	202	Ignitable	5,000 lbs	Outside bldg. on Dumpster pad	Covered container in "Explosive" Dumpster	250 lbs	2 weeks	Open burning	
Composite propellant	201	Ignitable	25,000 lbs	1197, 1259	Covered containers	200 lbs	3 days	Open burning	
	201	Ignitable	15,000 lbs	1376	Covered containers	100 lbs	3 days	Open burning	
	201	Ignitable		Outside	Dumpster	[700 lbs]	3 days when operating	Hog-out facility; not operating at present	
Cured propellant scrap	526	Ignitable	2,600 lbs	1182	PE-lined cans	50 lbs	1 week	Open burning	
			5,200 lbs	905	PE-lined cans	100 lbs	4 days	Open burning	
Uncured propellant & PBX	526	Ignitable	5,000 lbs	1277	PE-lined cans	100 lbs	1 week	Open burning	

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HAZARDOUS WASTE INVENTORY

UIC #N00174

Activity: Naval Ordnance Station Indian Head, Maryland

Description of Hazardous Waste	Responsible Organization/ Code	Hazard	Quantity Generated Annually	Storage site: Location of Site (Building)	Storage site: Kind of Storage	Storage site: Quantity Stored	Storage site: Average Storage Time	Current Treatment, Disposal Reclamation	Comments
			1,200 lbs	905	PE-lined cans	10 lbs	4 days	Open burning	
			260 lbs	1182	PE-lined cans	5 lbs	1 week	Open burning	
Gun propellant scrap	526	Ignitable	250 lbs	1272	PE-lined cans	5 lbs	1 week	Open burning	
Propellant scrap	526	Ignitable	500 lbs	1263	PE-lined cans	10 lbs	1 week	Open burning	
Propylene glycol dinitrate (PGDN)	2014	Ignitable	250 lbs	1109	Slurried w/sawdust in covered cans	5 lbs	1 week	Open burning	
RDX (cyclotrimethylene-trinitramine)	526	Ignitable	100 lbs	905	Water-wet	2 lbs	1 week	Open burning	
RDX/TMX	526	Ignitable	100 lbs	1277	Water-wet in PE-lined cans	2 lbs	1 week	Open burning	
Rubber, Polybutadiene	526	Ignitable	200 lbs	903	Drums	50 lbs	90 days	Landfill	
Rubber, Polyurethane	526	Ignitable	400 lbs	903	Drums	100 lbs	90 days	Landfill	
*Rubber, Isocyanate, unreacted	526	Toxic	600 lbs	1053	Sealed trash cans	50 lbs	1 month	Open burning	
*Spent fixer	30	Toxic	2,000 lbs	266	Tank	100 lbs	8 hours	Electrolysis	

HAZARDOUS WASTE INVENTORY

UIC #N00174

Activity: Naval Ordnance Station
Indian Head, Maryland

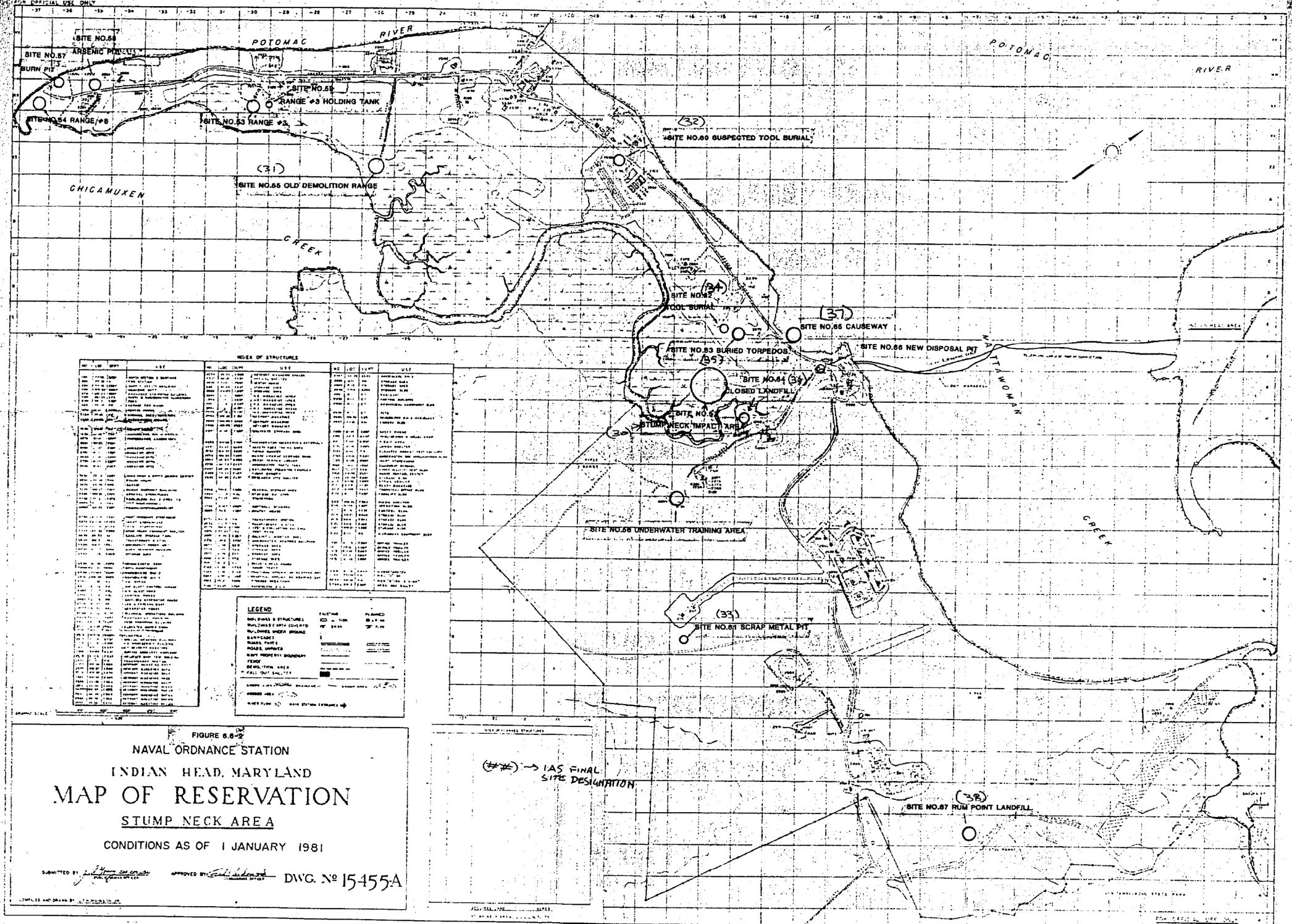
Description of Hazardous Waste	Responsible Organization/ Code	Hazard	Quantity Generated Annually	Storage site: Location of Site (Building)	Storage site: Kind of Storage	Storage site: Quantity Stored	Storage site: Average Storage Time	Current Treatment, Disposal Reclamation	Comments
Toluene (contaminated)	2014	Ignitable	1,300 lbs	1267	Sealed cans	25 lbs	1 week	Open burning	
			120 lbs	1182	Sealed cans	10 lbs	1 month	Open burning	
			2,000 lbs	905	Slum w/sawdust	40 lbs	1 week	Open burning	
*Toluene diisocyanate (Empty cans)	2014	Toxic	50 cans	855	Sealed	4 cans	1 week	Cans are washed with acetone, open-burned, then cans are discarded	
*Trichloroethylene (propellant-contaminated)	526	Toxic	2,400 lbs	855	Slum w/sawdust	50 lbs	1 week	Open burning	
*Trichloroethylene (dirty degreaser solvent)	201	Toxic	2,000 gals	Outside 859	55-gal drums	40 gals	2 mos.	DPDO	
MISCELLANEOUS									
Contaminated waste (containers, etc.)	Station-wide	Ignitable	700,000 lbs	Various	Open-air	14,000 lbs	2 weeks	Open burning	
*Film, Photographic/X-ray, Processing chemicals (spent fixer, etc.)	0115	Toxic	4,500 lbs	266	Plastic Tank		1 day	Silver recovered; spent fixer disposed of through sewage treatment plant	

HAZARDOUS WASTE INVENTORY

UIC JN00174

Activity: Naval Ordnance Station
Indian Head, Maryland

Description of Hazardous Waste	Responsible Organization/ Code	Hazard	Quantity Generated Annually	Storage site: Location of Site (Building)	Storage site: Kind of Storage	Storage site: Quantity Stored	Storage site: Average Storage Time	Current Treatment, Disposal Reclamation	Comments
*Paint booth sludges	20	Toxic	1,000 lbs	Paint booths	Steel drums		3 mos.	Hauled away by contractor	
*Polychlorinated biphenyls (PCB)	096	Toxic	8,200 lbs	1450	Transformers		Indefinite	Holding for proper disposal by EPA-approved method	
Waste oil	09	Ignitable	2,000 gals	290, 510, 525	Tanks		90 days	Burned as fuel by power house	


FOR OFFICIAL USE ONLY
POTOMAC RIVER
POTOMAC RIVER
SITE NO.57
BURN PIT
SITE NO.54 RANGE #5
SITE NO.53 RANGE #3
SITE NO.51
RANGE #3 HOLDING TANK
(31)
SITE NO.55 OLD DEMOLITION RANGE
CHICAMUXEN CREEK
(32)
SITE NO.60 SUSPECTED TOOL BURIAL
(34)
SITE NO.62
TOOL BURIAL
(37)
SITE NO.65 CAUSEWAY
SITE NO.66 NEW DISPOSAL PIT
SITE NO.63 BURIED TORPEDOS
(35)
SITE NO.64 (36)
CLOSED LANDFILL
SITE NO.59
STUMP NECK IMPACT AREA
MATTAWOMAN CREEK
SITE NO.58 UNDERWATER TRAINING AREA
(33)
SITE NO.61 SCRAP METAL PIT
(38)
SITE NO.67 RUM POINT LANDFILL
(**) → IAS FINAL SITE DESIGNATION
INDEX OF STRUCTURES
LEGEND
FIGURE 6.6-2
NAVAL ORDNANCE STATION
INDIAN HEAD, MARYLAND
MAP OF RESERVATION
STUMP NECK AREA
CONDITIONS AS OF 1 JANUARY 1981
SUBMITTED BY
APPROVED BY
DWG. № 15455A