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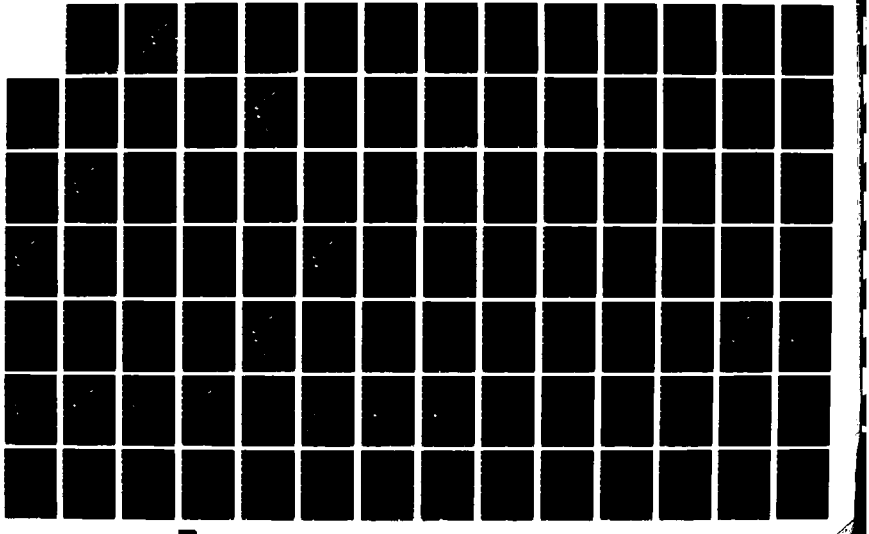

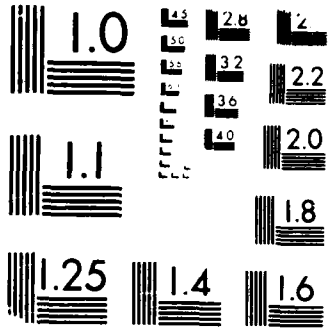

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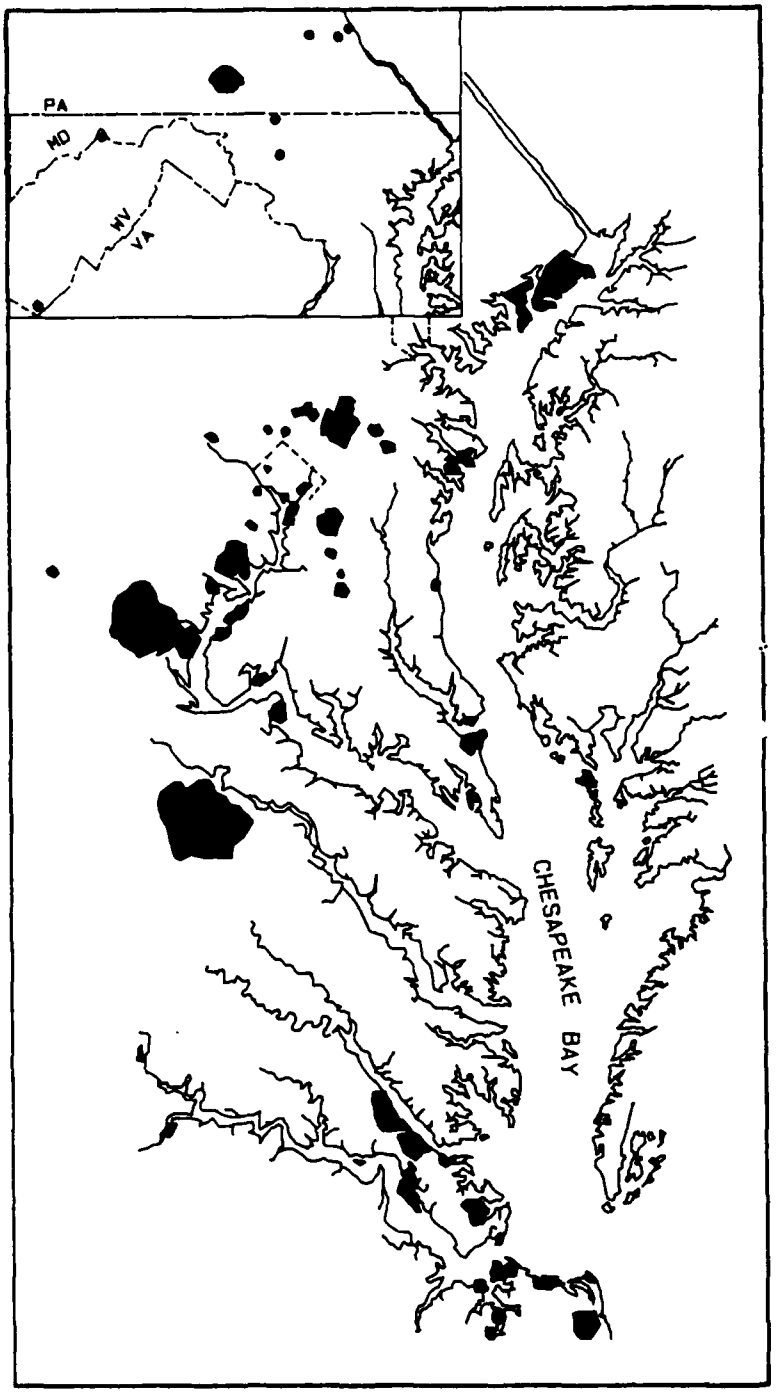
WATER QUALITY ASSESSMENT OF DOD INSTALLATIONS/ FACILITIES IN THE CHESAPEAKE BAY REGION

PHASE III REPORT

VOLUME 1 - SUMMARY



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This report represents the culmination of a two-year, three-phase effort to determine the relative impact of DoD activities on the water quality and living resources of the Chesapeake Bay.

Phase I defined the recent historical and present pollution potential of all 66 DoD installations in the Bay's drainage basin, and developed a preliminary screening procedure to categorize these installations according to existing or potential impacts on the Bay and its tributaries. Phase II developed and tested a detailed assessment methodology on six installations to define the character and extent of their impact on the Bay. Phase III applied this tested methodology to the remaining 31 installations identified in Phase I as needing more detailed assessment, and summarizes impacts and program recommendations from an installation, regional, and Bay-wide perspective. Volume 1 presents summary information from this analysis.

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WATER QUALITY ASSESSMENT OF DOD INSTALLATIONS/FACILITIES IN THE CHESAPEAKE BAY REGION

PHASE III REPORT

VOLUME 1

SUMMARY

Prepared for:
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and
U.S. Army Corps of Engineers
Baltimore District
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WATER QUALITY ASSESSMENT OF DoD INSTALLATIONS/ FACILITIES IN THE CHESAPEAKE BAY REGION

EXECUTIVE SUMMARY

The Department of Defense (DoD), recognizing its role as a major Federal user of the land and waters in the Chesapeake Bay drainage area, has undertaken a study to determine the relative impact of DoD activities on the water quality and living resources of this important estuary. This just completed two-year, three-phase study is part of DoD's contribution to the September 1984 Joint Resolution on Pollution Abatement in the Chesapeake Bay. The Joint Resolution outlines a cooperative program with the U.S. Environmental Protection Agency (EPA), other Federal agencies, the States of Maryland, Pennsylvania, and Virginia, and the District of Columbia. Of particular interest to DoD is the development of basin strategies aimed at specific problems and needs.

A total of 66 DoD installations are included in this study: 37 Navy, 22 Army, 6 Air Force, and 1 Defense Logistics Agency installations. The 66 installations were selected by DoD to include all those that have the potential for impacting Bay water quality and living resources (either adversely or beneficially) by virtue of their size, proximity to the Bay, or by the type of activities which are performed at the installations. The study area encompasses the entire Chesapeake Bay drainage basin, and includes installations draining to fresh water tributaries as well as to estuarine waters.

The study was divided into three phases over a 24 month schedule, beginning 1 October 1985. Phase I of the study, which ended in July, 1986, defined the recent historical and present pollution potential of all 66 installations, and developed a preliminary screening procedure to categorize the installations according to existing (if known) or potential impacts on the Bay and its tributaries (Tetra Tech, 1986). **Of the initial 66 installations, the preliminary screening procedure identified 37 installations with a significant impact potential. These 37 installations have been the subject of more detailed analysis in Phases II and III of the study.** Phase II, completed in February, 1987, developed and tested a detailed assessment methodology on six installations to define the character and extent of an installation's impact on water quality and living resources of the Bay or its tributaries. Phase III, completed in October, 1987, applies the tested methodology to the remaining 31 installations identified in Phase I for more detailed assessment, and summarizes impacts and program recommendations from an installation, regional, and Bay-wide perspective. As an aid towards developing an implementation plan, general and installation-specific cost estimates have been developed for each program recommendation, as well as a general qualitative description of the water quality benefits that would likely result from each suggested improvement.

Prior to presenting the major findings of this study, a number of issues related to the scope and focus of the study effort are emphasized. First, this study was intended as a **water quality oriented study**. It is not a regulatory compliance audit, nor is it an environmental assessment of all DoD activities (i.e., air quality, groundwater quality, noise, etc.). In addressing water quality concerns, however, a wide range of activities was examined, affording DoD the opportunity to identify beneficial programs that have enhanced water quality, as well as enhancements needed in areas that have the potential to impact surface water quality. Such areas include point and nonpoint sources, storage and disposal of hazardous/toxic materials, munitions production and testing, and maintenance operations.

Second, the study has been totally dependent upon available information and data. No field data have been collected as part of this study. Despite a thorough search of both DoD and non-DoD historical water quality data, it is relatively rare that the existing data base includes appropriate chemical and biological constituents and the spatial and temporal coverage to rigorously define or verify a suspected cause and effect relationship between an installation pollutant source and local water quality concerns. This is especially the case for sediment quality and benthic biological species data, which are valuable for representing the cumulative impacts of low concentration toxic discharges. The lack of meaningful data in the near vicinity of most DoD installations has led to the frequently made recommendation for developing surface water monitoring programs at installations where areas of concern have been identified.

Third, and most important, the term "**significant**", as used in this study to describe a potential impact, is a relative term primarily intended to compare the 66 DoD installations, in order to identify and prioritize common areas of concern. This term is not intended to denote presence of a statistically significant or quantifiable impact, as adequate data to establish this are generally not available.

The major strength of this study is in providing a structured, orderly process in which a large amount of information was processed and compared. The 66 DoD installations were evaluated on a common basis, allowing a comparison of areas of concern, beneficial effects, and recommendations. The study has also provided a "new" perspective of DoD installation activities relative to the surrounding activities and environment of the Chesapeake Bay region.

With the above in mind, the major findings of this study are summarized in the following.

DoD installations, singly or in aggregate, do not appear to be implicitly involved in the far-field, long-term trends of declining environmental integrity of the Bay system. In fact, although the EPA-Chesapeake Bay Program study indicated that the estuary has sustained substantial population growth over the past several decades, with attendant land use changes and increased waste disposal consequences,

and that agricultural practices have greatly increased nonpoint source nutrient and sediment loadings throughout the estuary, there were few significant changes in the number or types of DoD installations and/or activities on the Bay during this period. Nevertheless, information to date indicates that more careful management of **all** lands adjacent to the estuary will be required to reverse these Bay-wide trends. Restoration and protection plans have been instituted by Federal and State agencies, and DoD facility management should be in accord with these initiatives.

With several exceptions, the region of influence of the military activities appears to be limited to the immediate vicinity of each installation. The Naval Surface Weapons Center at Dahlgren, Harry Diamond Labs-Blossom Point, and Aberdeen Proving Ground, however, are unique because of ordnance testing over large test ranges in the adjacent open waters and/or on-site wetland areas (the effects of unexploded ordnance on aquatic resources is not well understood). **In terms of conventional pollutants (BOD, nutrients, sediments) on a regional scale, it appears that military installations contribute a relatively insignificant loading of both point and nonpoint source pollutants to the Chesapeake Bay and its tributaries. Significant reductions in DoD pollutant sources have been achieved over the past several years, largely in response to Federal and State regulations** (i.e., National Pollutant Discharge Elimination System (NPDES) Permits and Spill Prevention Control and Countermeasures (SPCC) Plans under the Clean Water Act, hazardous waste storage and disposal under the Resource Conservation and Recovery Act (RCRA), and toxics substances storage and handling under the Toxics Substances Control Act (TSCA)).

Areas that represent ongoing concerns at the military installations relate primarily to activities that are difficult to control or regulate. They include: stormwater runoff; dispersed, intermittent sources of industrial (toxic) pollutants to sewage treatment systems and/or to storm drains (which are typically permitted and tested only for conventional pollutants); and abandoned or inactive hazardous waste disposal sites.

The discharge of toxics from poorly defined point and nonpoint sources (including abandoned waste disposal sites) is potentially the most important issue related to preservation of water quality on or near military installations in the Bay area. Certain toxic constituents are of special concern due to their tendency to adsorb to sediment and to accumulate in the estuarine sediment bed, where benthic organisms are exposed over long periods of time. **Although limited, preliminary data on toxic contamination has become available at many installations as part of the Installation Restoration Program, the results are generally inconclusive with respect to assessing the need, if any, for specific controls or cleanup of toxic pollutant sources.** Despite the compilation of an extensive data base for this study, few suitable data sets exist to determine whether a cause and effect relationship exists between installation contaminant sources and local water quality impacts. This becomes even more apparent in the frequent situations where vicinity non-DoD contaminant sources overlap and/or obscure contaminant sources

from the military installation. These data limitations notwithstanding, several installations, including Aberdeen Proving Ground, NOS-Indian Head, Naval Shipyard-Norfolk, Naval Supply Center-Yorktown, Naval Weapons Station-Yorktown, and Vint Hill Farms Station, have exhibited a certain degree of toxic contamination (above chronic or acute levels for the protection of aquatic life) of local (primarily on-site) receiving waters. The contamination is believed to be largely confined to the immediate installation vicinity, based on the limited data currently available.

Recommendations

Monitoring Needs - There is a lack of sufficient information to adequately characterize local water quality conditions at over 30 installations where areas of concern have been identified. For these installations, a monitoring program has been recommended for one or all of the following: 1) toxics in sewage or industrial waste treatment plant effluent; 2) toxics in intermittent stormwater drainage; and 3) field monitoring for conventionals and toxics in the receiving water and sediments in the immediate vicinity of the installation. Each monitoring program should be designed according to the specific activities at each installation. Although these activities are not currently required, recent experience suggests that NPDES permit requirements will be upgraded by the EPA to include monitoring for toxic pollutants for certain cases. At Fort Eustis, for example, a Toxics Monitoring Program was recently instituted to determine the need for pretreatment and/or elimination of several minor industrial waste processes discharging to the on-post sewage treatment system. At NOS Indian Head, a major feasibility study is underway to design a series of industrial waste treatment systems to consolidate and treat approximately 48 intermittent industrial discharges in anticipation of a revised NPDES permit to control and monitor industrial pollutants. **As a way of anticipating changes to the regulatory requirements regarding toxics, it may be in the best interest of DoD to conduct a certain level of "self-monitoring" in order to plan appropriately, as well as to isolate the effects of military activities from upstream (riverine) or nearby (estuarine) pollutant sources.**

Nonpoint Source Runoff Control - In recent years water quality managers have become increasingly aware of the impacts associated with nonpoint source runoff. The EPA Chesapeake Bay Program has identified nonpoint source runoff as the major cause of water quality and resource habitat degradation in the Chesapeake Bay and its tributaries.

This study has found evidence of nonpoint source contributions from the majority of the military installations such as erosion, sediment runoff, and stormwater discharges. While a number of installations have begun actions to address these problems, their effectiveness in controlling nonpoint source runoff is uncertain. A systematic examination of nonpoint sources, on an installation-by-installation basis, would provide the necessary information to develop comprehensive action plans to reduce nonpoint source problems.

Hazardous/Toxic Materials - The accidental release of hazardous waste into the Chesapeake Bay or its tributaries could have a significant impact on the water quality and biological productivity of the receiving water. Implementation of, and strict adherence to, the management requirements of RCRA are necessary to insure minimal degradation of ecological resources of the Chesap ake Bay.

At the time of the site visits, the hazardous material storage facilities were in compliance at most installations. Nonconforming storage facilities were identified at a few installations, however, construction projects are planned to bring these into compliance by FY89. Part B permits for two of these installations have been submitted and are under review. At one installation the conforming storage facility is full, resulting in storage of hazardous materials in other nonconforming areas. At another installation, a conforming storage area has recently been built and is awaiting final approval by the State agency. High priority should be given to bringing these and any other nonconforming storage facilities into compliance.

Several installations have experienced delays in the pickup of hazardous materials by the DLA disposal contractors. These include, but are not limited to, DTNSRDC-Carderock, HDL-Adelphi, Andrews AFB, Fort Meade, and Walter Reed Army Medical Center. The procedures for enforcing contract provisions should be improved to include contract authority at the point of material pick up. Flexibility and authority at the lowest level of DLA contract implementation will provide the appropriate level of support needed by the Services.

In some cases, hazardous materials are stored in nonconforming areas because the capacity of the installation's existing storage area is being used to store waste materials which are to be sold by DLA. DLA has experienced difficulty finding buyers for certain types of waste materials, and these materials can take up needed storage space for the ongoing activities on the installation. The economic resale value of waste materials needs to be balanced against maintaining an adequate and safe storage capacity for ongoing installation activities.

Other Recommendations - Additional areas of concern related to surface water quality include activities that have been brought largely under control by the installation's environmental management and are in the process of being resolved. These include improved implementation of SPCC plans, testing of underground storage tanks, improvement of soil conservation/land management plans, and in-house education of environmental managers and personnel on the installations.

It is worth noting that most environmental problems at DoD installations are not unique. Private industry, agricultural activities, and municipalities experience many of the same types of problems and are among the dominant contributors of pollutants to the Bay. **In fact, DoD has performed remarkably well in responding to environmental regulations, especially regarding the direct discharge of effluent from sewage treatment plants.** However, regulations are being constantly upgraded,

and some areas of environmental concern are not adequately addressed by current regulations (e.g., nonpoint sources). It is believed that the regulatory agencies need to work more effectively with the military, especially in providing guidance on new developments in the regulations and in areas identified as concerns for the Chesapeake Bay Restoration and Protection Plan, i.e., nonpoint source control, elimination of industrial discharges into storm drains, control of toxics in sewage effluent, and wetlands restoration and protection.

An advantage that the military has that is unique compared to private industry, agriculture, and municipalities throughout the Chesapeake Bay region is the ability to develop, direct and control a program uniformly throughout the DoD Services when initiated from the top down. This capability can be utilized efficiently by DoD to implement new directives and regulations concerning the control of point and nonpoint pollutant sources.

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CHAPTER 1: INTRODUCTION

THE CHESAPEAKE BAY

Chesapeake Bay, located on the east coast of the United States (Figure 1), is one of the largest and most productive estuaries in the world. The mainstem of the Bay extends approximately 190 miles from Cape Henry, Virginia, to the mouth of the Susquehanna River. The Chesapeake Bay is a submerged river valley, a remnant of the Susquehanna River Valley which was inundated with rising sea level after the most recent glacial period. The estuary is fed by more than 50 tributaries comprising the 64,000 square mile drainage area, however, 90% of the freshwater contributed to the bay originates in five major tributaries; the Susquehanna, Potomac, James, York, and Rappahannock Rivers. The Susquehanna, draining from Pennsylvania and New York provides approximately half of the Bay's freshwater.

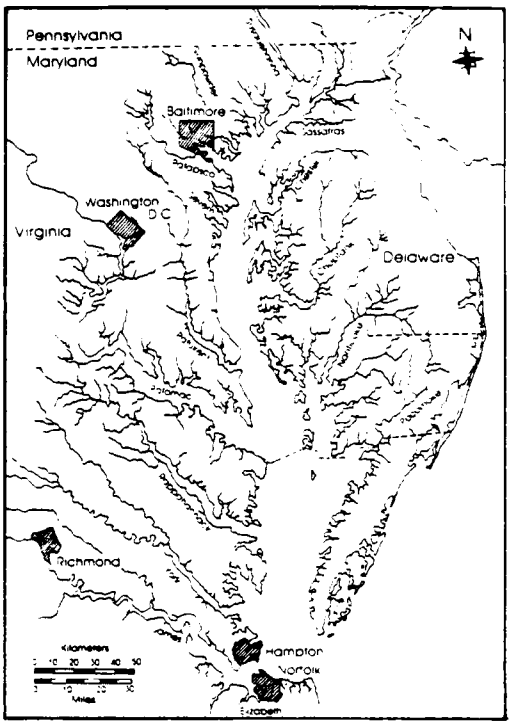

Figure 1. Chesapeake Bay

As with most estuaries, the Chesapeake Bay supports a highly productive biological community which supports a large commercial and sport fishery quite important to the regional economy. The recreational importance of the Bay to the region's nearly 15 million residents is also great and the resulting tourist industry thrives. It has also served for centuries as a commercial shipping center with two major port complexes connected by interstate highway, air, and rail systems to important inland points.

In recent decades, however, as attention has been focused on the Nation's water resources, it has become apparent that water quality in the Chesapeake Bay is, and has been for some time, in decline. The decline in water quality has been most telling on the biological communities. Harvests of most of the traditional commercial species have declined over the years until recently there have been restrictions on the taking of some anadromous (freshwater spawning) finfish (shad and striped bass) in Maryland and Virginia. Oyster harvests have also dramatically declined in the last 100 years. The population of some species such as the blue crab and menhaden have increased in recent years, but these are either marine spawners or spawn in the marine portions of the estuary.

Populations of submerged aquatic vegetation (SAV) have declined dramatically in the last 20 years in the upper estuary, decreasing the protective habitat for many species during their critical nursery lifestages.

The causes of the estuary's decline are many. Some reductions in population are due to naturally recurring cycles in the life histories of organisms and to the natural geomorphological decline of the estuary, however, **the acceleration of this decline is viewed by many to be the direct result of anthropogenic (man induced) influences on the Bay.**

Because of these concerns, the United States Environmental Protection Agency (EPA), in cooperation with many State and Federal agencies and academic institutions, commissioned surveys and studies of unprecedented scope, through the Chesapeake Bay Program (CBP), to evaluate the system. In this seven year study, information on the above mentioned environmental phenomena as well as data on nutrient and toxic loadings were compiled and evaluated, and long-term trends of water quality data and observations were examined. Research was also conducted on SAV, nutrients, and toxics. Data analyses led to conclusions that there were significant increases in the turbidity of the Bay (especially in the upper Bay), a significant increase in phosphorous and nitrogen, an increase in the extent and severity of oxygen depleted bottom waters in the trenches of the Bay, significant changes in development and population pressures on adjacent lands, and significant changes in adjacent agricultural practices. Also in this decade, analytical technology has made possible large scale observations on the distribution of heavy metals and anthropogenic (human originated) organic chemicals in the entire system. Areas characterized by high concentrations of such toxicants (i.e., urban centers) have been directly correlated to low biological species diversity and domination by a few pollutant tolerant species.

The EPA has concluded that there have been significant deleterious trends in water quality in the Chesapeake Bay, and that changes in management practices are necessary to remedy the problems. These management practices include a wide array of both point (sewage and industrial outfalls) and nonpoint (urban runoff, agricultural runoff) controls currently being implemented under the Chesapeake Bay Restoration and Protection Plan.

PROJECT BACKGROUND

Federal agencies, including EPA, the Fish and Wildlife Service (FWS), the National Oceanic and Atmospheric Administration (NOAA) and the Department of Defense (DoD), in cooperation with the States of Maryland, Pennsylvania, and Virginia, and the District of Columbia, have planned extensive activities under a cooperative approach towards improving and restoring the environmental quality of the Chesapeake Bay. President Reagan in his State of the Union address in January 1984 stated, "Though this is a time of budget restraints....we will begin the long, necessary effort to clean up....the Chesapeake Bay."

DoD has actively participated in pollution abatement efforts in the Chesapeake Bay area, and has achieved significant progress at military installations, including major sewage treatment plant (STP) upgrades, environmental self auditing, and implementation of a training program for STP operators. **The participation of DoD in the Chesapeake Bay Restoration and Protection Plan was made official on 13 September, 1984 when the EPA and DoD signed a Joint Resolution on Pollution Abatement in the Chesapeake Bay.** The Joint Resolution outlined a number of objectives for pollution abatement by DoD, including participation on the Implementation Committee of the Chesapeake Bay Program, upgrading of natural resources and land management plans to include control of nonpoint source discharges, continued provision of data and information on all wastewater discharge permits under the National Pollutant Discharge Elimination System (NPDES), priority funding of pollution abatement projects in the Chesapeake Bay area, and conducting the study described herein.

Of particular interest to DoD in conducting this study is to determine the relative impact of DoD actions (beneficial or adverse) on the water quality and living resources of the Bay. This information, coupled with the State and EPA programs, will afford DoD components a framework to develop appropriate improvement plans. These plans will include studies, practices or projects that can be implemented at specific locations, where necessary, to restore and protect water quality and living resources of the Bay.

PROJECT OVERVIEW

The study area encompasses the entire Chesapeake Bay drainage basin, and includes installations draining to fresh water tributaries as well as to estuarine waters (See Figure 2). **There are a total of 66 DoD installations included in this study.** They consist of 37 Navy, 22 Army, 6 Air Force, and 1 Defense Logistics Agency. A list of DoD installations under evaluation and their approximate locations are given in Figure 3. The 66 installations selected by DoD include all those that have the potential for impacting Bay water quality by virtue of their size, proximity to the Bay, or by the types of activities which exist at the installations. **The major objectives of the study were to:**

- Summarize DoD impacts by installation, tributary (regional), and Bay-wide;

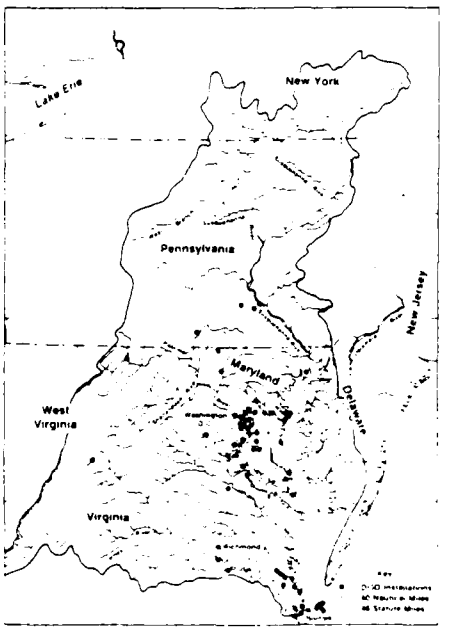

Figure 2. Location of DoD Installations Under Evaluation in the Chesapeake Bay Drainage Basin.

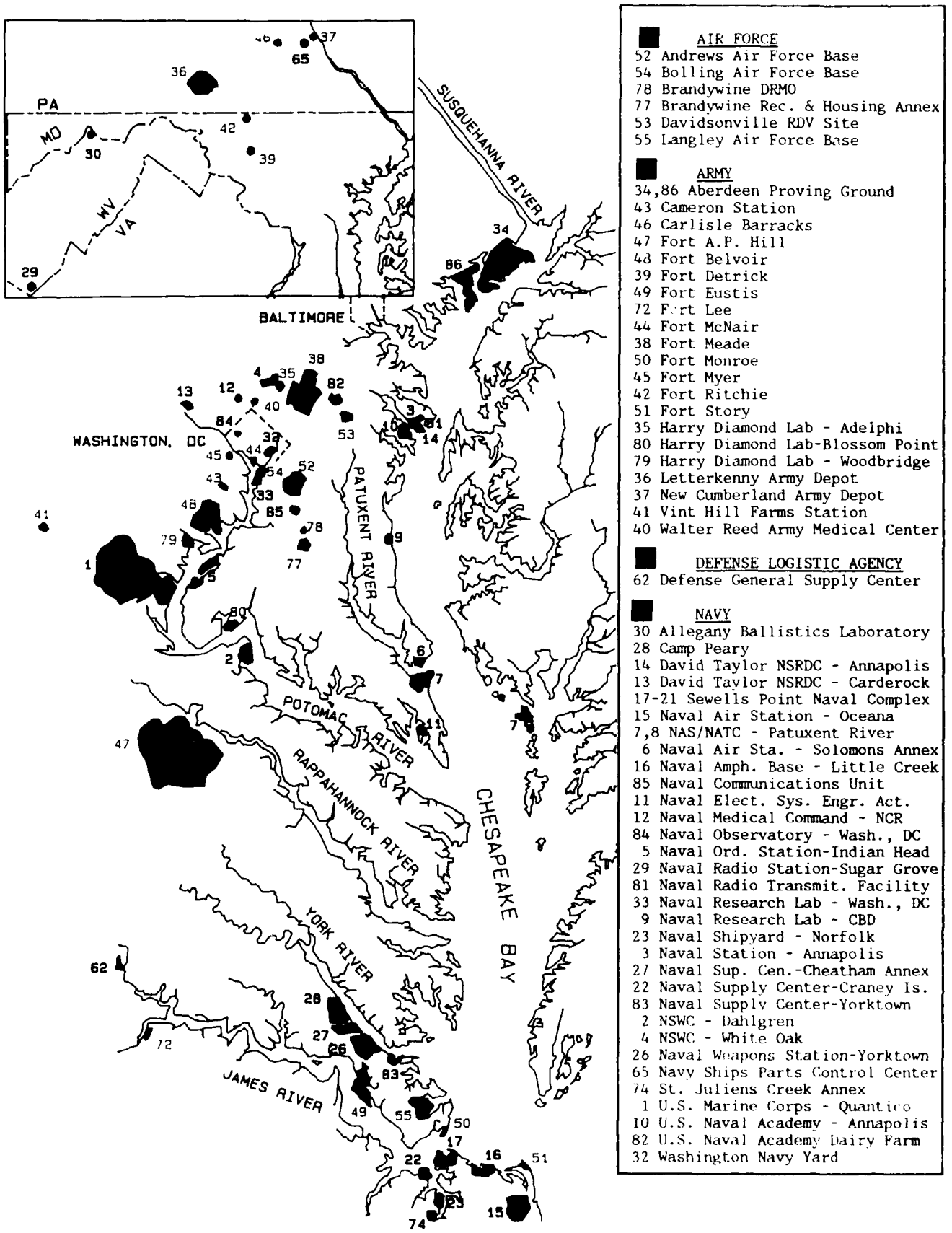

Figure 3 Location of the 66 DoD Installations Under Evaluation. [Note: numbers 7, 17, and 34 represent complexes consisting of two or more installations.]

- o Identify the most effective DoD projects and programs that have either protected Bay resources or reduced adverse impacts on the Chesapeake Bay; and

- o Provide recommendations as to additional detailed studies, practices or projects that could be implemented at specific locations to restore and protect water quality conditions and living resources of the Chesapeake Bay.

The study has required extensive coordination with DoD, the military Services, Commands, and installations. In addition, the study has required data collection from the EPA and agencies in the States of Maryland, Pennsylvania, and Virginia.

The study was divided into three phases over a twenty-four month schedule, beginning 1 October 1985 (see Figure 4). Phase I of the study, which ended in July, 1986, defined the recent historical and present pollution potential of all 66 installations, and developed a preliminary screening procedure to categorize the installations according to existing or potential impacts on the Bay and its tributaries (Tetra Tech, 1986). **Out of the initial 66, the preliminary screening procedure identified 37 installations that could adversely impact the Bay or its tributaries. These have been the subject of more detailed analysis in Phases II and III of the study.** Phase II, completed in February 1987, developed and tested on six installations a detailed assessment methodology to define the character and extent of an installation's impact on the water quality and living resources of the Bay or tributaries. Phase III, completed in October, 1987, applies the tested methodology to all remaining installations (31) identified in Phase I for more detailed assessment, and summarizes impacts and program recommendations from an installation, regional, and Bay-wide perspective. As an aid towards developing pollution abatement plans, general

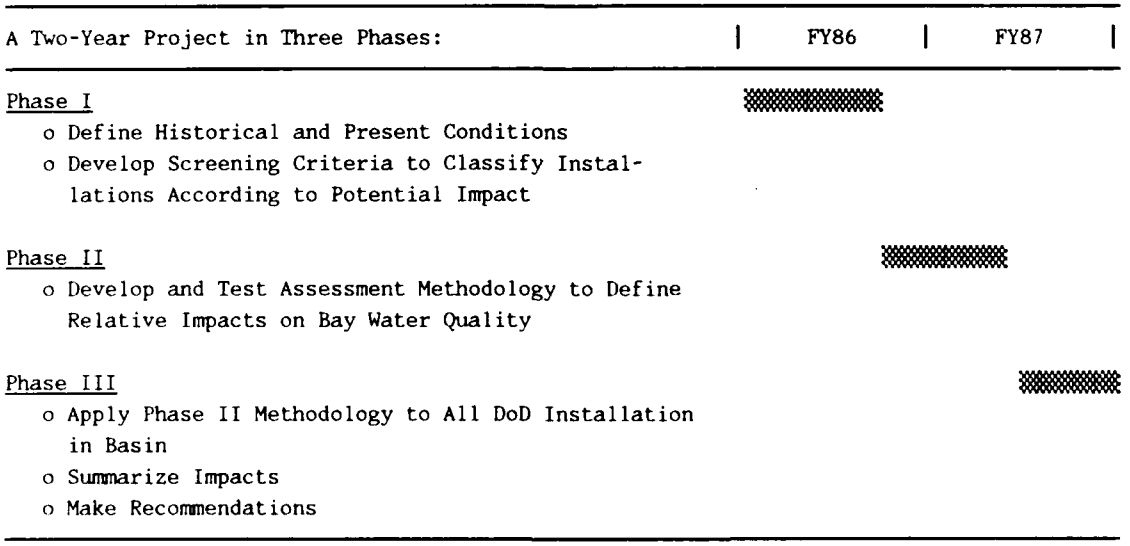

Figure 4. Project Schedule

and installation-specific cost estimates have been developed for each program recommendation. Also, a qualitative description of the expected water quality benefits that would result from any improvement plans have been outlined.

It is emphasized that this is a water quality oriented study, and is not an environmental assessment of all DoD activities in the Chesapeake Bay region. In addressing water quality concerns, however, a wide range of activities has been examined which affords DoD the opportunity to identify beneficial programs that have enhanced water quality, as well as needed enhancements in areas that have the potential to impact water quality. Such areas include point and nonpoint sources, storage and disposal of hazardous/toxic materials, munitions production and testing, and maintenance operations.

CHAPTER 2: SUMMARY OF PHASE I

(Data Gathering and Installation Screening)

PHASE I OVERVIEW

Figure 5 represents the activity flow chart for Phase I - Data Gathering and Installation Screening.

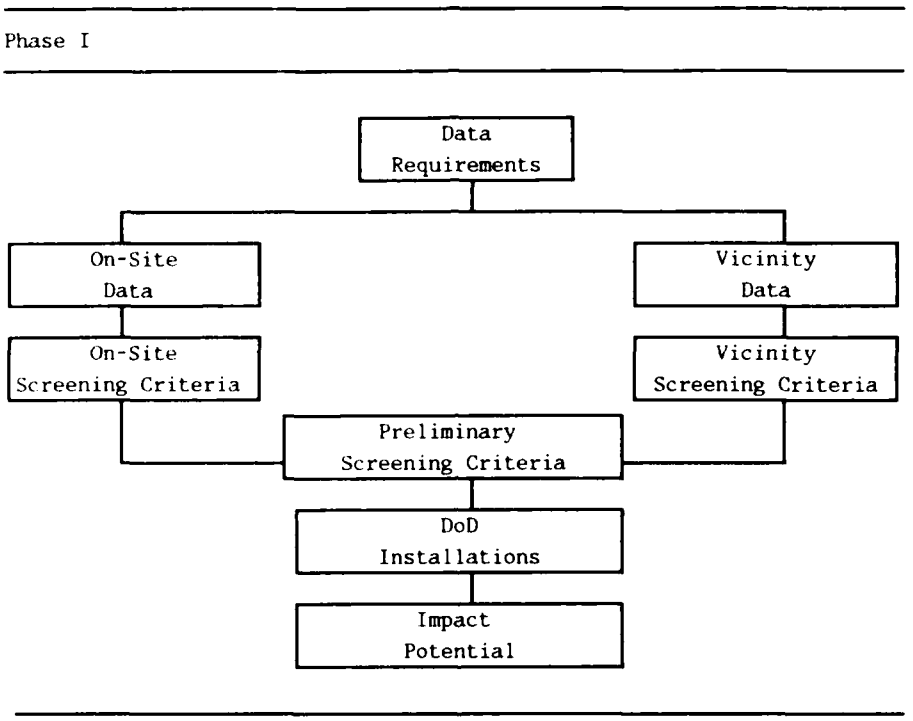

Figure 5. Phase I Flow Chart

There were three (3) primary objectives of Phase I:

- Develop a preliminary screening procedure using on-site and off-site data to identify existing and potential water quality impacts (adverse and beneficial) at DoD installations;
- Screen the 66 installations under evaluation and select those which would receive additional focus in Phases II and III of the study; and
- Inventory in a standardized computer data base format, existing water quality and environmental information for all 66 DoD installations in the Chesapeake Bay drainage basin.

In accomplishing the first objective of Phase I, a tremendous amount of on-site and off-site data were collected from both DoD and non-DoD sources. The on-site data were used to develop a set of on-site screening criteria which were used to evaluate the impact potential of each installation. This allows for a relative comparison of installation activities and pollution impact potential on an installation by installation basis. The off-site data were used to develop a set of vicinity screening criteria which evaluate an installation relative to its surrounding environment, i.e., its proximity to significant ecological resources and its relative impact on local receiving waters.

DATA COLLECTION AND INVENTORY

A major goal of Phase I of the study was the establishment of data collection procedures and the compilation of the available information in a usable data base. The scope of the study was limited to gathering readily available information in either raw or summarized form. Since no field work was performed to supplement the available information, it was necessary to gather the information from as many known sources as possible.

DoD Installation Data

The data inventory process included the collection of both DoD and non-DoD generated environmental information describing known or potential pollutant sources and receiving water quality characteristics on and around each installation. Visits were made to each installation to interview environmental management staff and to retrieve key documents such as master plans, drainage maps, land use maps, environmental audits/impact assessments, treatment plant discharge permit compliance reports, water quality monitoring results, and studies of past on-site waste disposal practices. A central document library was established which has been used in later phases of this study.

Non-DoD Vicinity Data

The goal of the non-DoD data base development was to identify and acquire readily available data which describes the health of the Bay in the vicinity of the DoD installations. The data base was developed in two phases. In Phase I, 27 government agencies and research institutions were contacted for the purpose of identifying relevant data sets. This data set search was limited to completed, well documented studies. In Phase II, the data sets were acquired, converted into the standardized format (SAS) being used by the EPA CBP, and archived. Twenty data sets were identified and acquired. The data base information includes physical, chemical, and biological parameters with the station coverage varying between data sets. Temporal coverage of the data sets is from 1976 to the present, with physical coverage including portions of Pennsylvania, Maryland, Virginia, and the District of Columbia. The data sets are accessible through the Chesapeake Bay Program's VAX 11/780 computer (medium sized data sets), the National Computer Center's IBM

3090 computer (large data sets), and on microcomputer floppy diskettes (small data sets).

A document describing the data base has been produced (SCI, 1986). This document describes the data inventory process, the contacts, the sources of information, and access information, and presents a description of the major data sets on water quality and biota.

Study reports and other data set documentation were acquired and stored in the project library. A bibliographic data base was created to catalogue and update the library. Included in this data base is information on the data collected, the methodology, and the spatial and temporal coverage of the data. The bibliographic data base was programmed in DBASE III-Plus and is available on floppy diskette for use on any IBM-compatible microcomputer.

PHASE I - INSTALLATION SCREENING

A second major objective of Phase I was to provide an initial overview of all DoD activities in the Chesapeake Bay drainage basin. This overview allowed a preliminary understanding of the relative impact of DoD installations on the Bay and its tributaries, as well as provided an identification of areas of concern.

In accomplishing this objective, a screening system was developed and applied to all 66 DoD installations under evaluation, which assigned each installation to one of four Study Groups:

Study Group 1. Significant* Existing or Potential Water Quality Impacts;

Study Group 2. Impact Potential Poorly Defined but Likely Significant;

Study Group 3. Impact Potential Poorly Defined but Likely Insignificant; and

Study Group 4. Insignificant Impact Potential.

Installations screened under Study Groups 1 and 2 received additional focus under Phases II and III of this study. Installations screened under Study Groups 3 and 4 did not receive additional focus; however,

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* Note: The term, "significant", as used in this study, is a relative expression used to compare potential levels of impact on water quality between the 66 DoD installations. The term is not intended to signify the presence of a "statistically significant" impact, as data to show this are generally not available.

they were carried through and included in the final Phase III overview and set of study recommendations.

Installation Screening Procedure

The Phase I installation screening methodology was performed in a logical sequence of four major Steps:

Step 1: Develop Installation Screening Criteria, selected to represent key installation activities/conditions which most likely determine environmental impact potential;

Step 2: Develop Installation Screening Data, which are based on the screening criteria and consist of a summary of the key environmental information for each installation;

Step 3: Develop Screening Criteria Guidelines, based on Steps 1 and 2, which are used to assign relative "scores" for each criterion in a matrix format; and

Step 4: Develop Preliminary Installation Study Groups, which serve as a first cut summary of the impact potential level for each installation and prioritize installations according to further assessment needs under Phases II and III.

Since the ultimate goal of this study is to determine the relative impact of DoD activities on the Chesapeake Bay, the method of installation evaluation should reflect the major areas of concern identified in the EPA Chesapeake Bay Program (CBP). The CBP developed a number of Bay management recommendations based on extensive research correlating degradation of the Bay's aquatic resources to respective pollutant sources (EPA, 1983). A brief summary of the CBP's major findings is given below.

Nutrients - the increase in nutrient levels in the Bay and the corresponding decrease in dissolved oxygen through undesirable algal production has had detrimental effects on submerged aquatic vegetation (SAV), fisheries, and shellfish resources throughout the Bay. Both point and nonpoint sources contribute to nutrient loadings. Management recommendations made by the CBP to control nutrient loadings from point sources include upgrading treatment plants for nutrient removal, improving treatment plant maintenance and efficiency, improving monitoring and enforcement of National Pollutant Discharge Elimination System (NPDES) permit limitations, and implementation of pretreatment programs. Nonpoint source recommendations for controlling nutrient loadings include best management practices (BMPs) for agricultural uses (e.g., soil conservation, runoff control, animal waste management, improved fertilizer application, creation of buffer strips), urban runoff control BMPs (also needed to control sediment, heavy metals, bacteria, and other

pollutants), and protection of tidal and non-tidal wetlands which act as nutrient buffers.

Toxics - toxic compounds include metals such as cadmium, copper, and lead; organic chemicals such as polychlorinated biphenyls (PCBs), Kepone, and DDT; and other chemicals like chlorine. These and other toxicants are affecting the Bay's resources especially in urbanized areas. High levels of toxicants can reduce egg production, juvenile survival, and maturation rate and can result in histopathologies such as disease, lesions, and genotypic variation in fish and invertebrates. High levels of toxicants have also been correlated with low species diversity where sensitive species are eliminated leaving communities dominated by a few pollution-tolerant forms.

As with nutrients, sources of toxic materials include both point and nonpoint sources. Management recommendations made by the CBP to control toxicant loadings from point sources include biomonitoring and chemical analysis of industrial and municipal effluents to identify presence and levels of toxicants, revision of water quality criteria and standards for toxicants, updating of NPDES permits to include toxicant limitations, enforcement and strengthening of pre-treatment control programs, and reduction or elimination of chlorination, especially in fresh or brackish water, fish spawning and nursery areas and shellfish spawning areas. Recommendations for controlling nonpoint source toxicant loadings include upgrading permit conditions for dredge-and-fill (404 permits), use of integrated pest management (IPM) and soil conservation practices to control runoff of pesticides and herbicides, improvement/implementation of urban runoff controls, and improving knowledge of the levels and effects of other toxicant sources such as atmospheric deposition, contaminated groundwater, hazardous waste disposal and storage sites, accidental spills, and anti-fouling paints.

In light of the CBP findings and recommendations, a set of on-site screening criteria were selected for evaluation of the potential point and nonpoint source loadings from DoD installations. Management programs to control pollutant sources are also of interest. **The on-site screening criteria are listed in Table 1. It is believed that they adequately consider all major potential sources of pollutants from DoD installations to surface waters.**

The on-site screening criteria address the impact potential of each installation based upon on-site activities. This allows for a relative comparison of installation activities and pollution impact potential on an installation by installation basis. Also of interest, however, is each installation's relationship to its surrounding environs, i.e., its proximity to significant ecological resources and its relative impact on the tributaries or subregion. A set of vicinity screening criteria were therefore selected to address these concerns. The vicinity screening criteria are listed in Table 2.

Table 1. Phase I On-Site Screening Criteria

Nonpoint Sources	1.	Erosion/Siltation
	2.	Impervious Area Runoff
	3.	Combined Storm Drains
	4.	Shoreline Erosion
Point Sources	5.	Sewage Treatment
	6.	Industrial Waste Treatment
	7.	Intermittent Sewage Treatment
Hazardous/Toxic Materials	8.	Refueling Operations
	9.	Munitions Operations
	10.	Chemical Operations
	11.	Pesticides Use
	12.	Vehicle Maintenance (vehicle wash racks)
	13.	Ship Maintenance
	14.	Solid Waste Disposal
	15.	Hazardous Waste Handling/Storage
	16.	Spill Prevention, Countermeasures and Control (SPCC) Plans
	17.	Abandoned Hazardous Waste Dumpsites
	18.	Leaking Underground Storage Tanks (UST)
Environmental Programs	19.	Forestry Management Plans
	20.	Wildlife/Habitat Management Plans
	21.	Soil Conservation Programs
	22.	Stormwater Management Plans
	23.	Wetlands Management Plans (including SAV)
	24.	Shoreline Erosion Plans

Table 2. Phase I Vicinity Screening Criteria

Receiving Waters Sensitivity	25.	Shellfish Areas
	26.	Submerged Aquatic Vegetation (SAV) Beds
	27.	Fish Spawning/Nursery Areas
	28.	Wetland Areas
	29.	Waterfowl Nesting/Wintering Areas
	30.	Endangered Species
	31.	Relative Impacts on Tributary

The intent of the Phase I screening was to be as direct and objective as possible in evaluating the impact of each installation. For this reason, ranking models based on numerical scoring systems were avoided in favor of a relatively straightforward set of screening criteria guidelines. The criteria guidelines (presented in Volume 2) were based on key DoD installation activities that best reflect potential environmental impacts on surface waters. Figure 6 presents an example of the preliminary screening system as applied in this study.

	ON-SITE SCREENING CRITERIA (ON-SITE IMPACT POTENTIAL)																								VICINITY SCREENING CRITERIA					STUDY GROUP			
	NON-POINT SOURCES					POINT SOURCES		HAZARDOUS/TOXIC MATERIALS										ENVIRONMENTAL PROGRAMS							RELATIONSHIP TO LOCAL ENVIRONMENT					IMPACT POTENTIAL			
	1. Erosion/Sediment ation	2. Impervious Area Runoff	3. Combined Storm Drains	4. Shoreline Erosion	5. Sewage Treatment	6. Industrial Waste Trear	7. Intermitt Sewage Treat	8. Refueling Operations	9. Munitions Operations	10. Chemical Operations	11. Pesticides	12. Vehicle Maintenance	13. Ship Maintenance	14. Solid Waste Disposal	15. Hazardous Waste	16. SPCC Status	17. Abandoned Sites	18. LUST Status	19. Forestry Mgmt. Plan	20. Wildlife Mgmt. Plan	21. Soil Conservation Plan	22. Stormwater Mgmt. Plan	23. Wetlands Mgmt. Plan	24. Shoreline Erosion Plan	25. Shellfish Areas	26. SAV Areas	27. Fish Spawning Areas	28. Wetlands Areas	29. Waterfowl Nesting	30. Endangered Species	31. Relative Local Impact	1. Significant	2. Poorly Defined, Sig.	3. Poorly Defined, Insig.	4. Insignificant
Installation A	-	Θ	-	·	·	-	·	-	-	·	·	-	·	+	Θ	-	Θ	-	·	-	-	Θ	-	-	·	-	-	-	-	Θ	X			
Installation B	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·	·	+	+	·	·	·	·	·	·	·	·				X
Installation C	·	·	·	·	·	·	·	-	·	·	·	·	-	Θ	-	·	Θ	·	+	+	·	·	·	·	Θ	·	·	⊕	⊕	·	·		X		
Installation D	·	·	·	·	·	·	+	-	·	·	⊕	·	·	+	·	+	·	·	+	·	+	+	·	·	·	·	·	+	·	·	+				X
Installation E	·	·	-	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	+	+	·	·	·	·	·	·	·					X
Installation F	-	·	-	-	·	·	·	-	·	·	·	-	·	·	·	·	·	-	·	·	·	·	+	-	-	·	+	+	·	·			X		

KEY:
- Impact Category 1:
  - Θ Significant Impact Potential (Adverse)
  - ⊕ Significant Impact Potential (Beneficial)
- Impact Category 2:
  - \- Unknown or Poorly Defined Impacts (Adverse)
  - \+ Unknown or Poorly Defined Impacts (Beneficial)
- Impact Category 3:
  - · Insignificant Impact Potential (Adverse or Beneficial)

Figure 6. Installation Screening Matrix

Preliminary Screening Results

The screening procedure was applied to all 66 installations with the results summarized in Figure 7. Twelve installations were rated in Study Group 1, and twenty-five in Study Group 2. These 37 installations were addressed in more detail in Phases II and III. Figure 8 lists these installations along with their locations in the Bay region. The remaining 29 installations were rated as having a "likely insignificant" impact potential and were carried through to the final Phase III

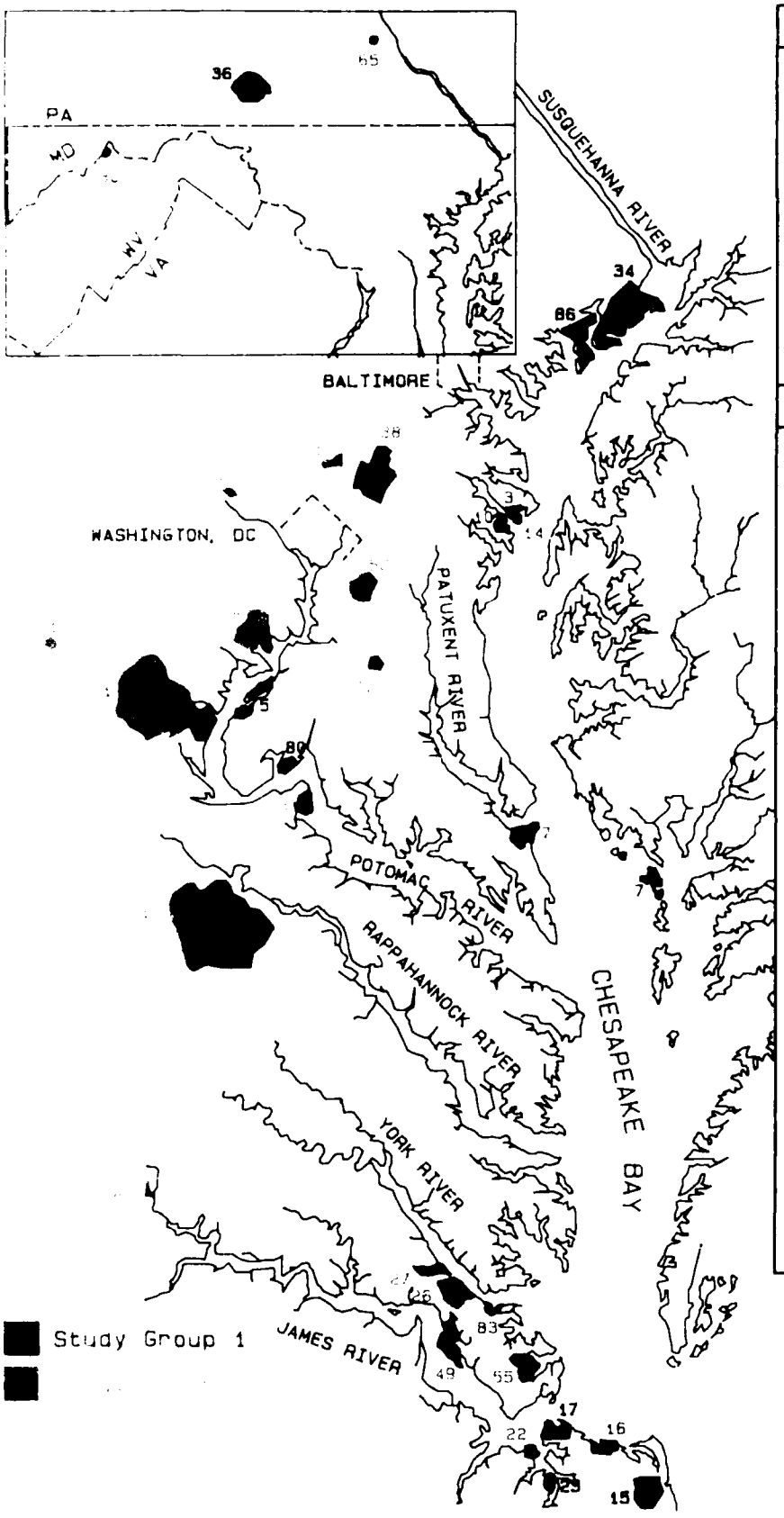
overview without any additional detailed analysis. In addition, they were included, where appropriate, in the final Phase III study recommendations.

Phase I Screening Results

Study Group	Impact Potential	Number Screened All	NAVY	ARMY	USAF	DLA
1	Significant	12	9	3	0	0
2	Poorly Defined, Significant	25	15	6	3	1
3	Poorly Defined, Insignificant	17	9	6	2	0
4	Insignificant	12	4	7	1	0
	Total	66	37	22	6	1

Figure 7. Results of Phase I Screening

A number of general findings and recommendations were summarized based on the preliminary screening results (Tetra Tech, 1986). **For example, the most frequently occurring activities which create the potential for significant adverse water quality impacts from installations fall under the nonpoint source categories of impervious area runoff, combined storm drains, erosion/sedimentation, and abandoned hazardous waste disposal sites, and under the point source category of industrial waste treatment. On the other hand, the activities which show significant beneficial impact potential include natural resources management (soil conservation, wildlife and wetlands management), pesticides management, Spill Prevention Control and Countermeasures (SPCC) implementation, and sewage treatment upgrades or elimination.**



Phase I Preliminary Study Group 1

ARMY

34,86 Aberdeen Proving Ground
80 Harry Diamond Lab-Blossom Point
36 Letterkenny Army Depot

NAVY

17-21 Sewells Point Naval Complex
15 Naval Air Station - Oceana
5 Naval Ordnance Sta.-Indian Head
23 Naval Shipyard - Norfolk

Phase I Preliminary Study Group 2

AIR FORCE

52 Andrews Air Force Base
77 Brandywine Rec. & Housing Annex
55 Langley Air Force Base

ARMY

47 Fort A.P. Hill
48 Fort Belvoir
49 Fort Eustis
38 Fort Meade
41 Vint Hill Farms Station

DEFENSE LOGISTIC AGENCY

62 Defense General Supply Center

NAVY

30 Allegany Ballistics Laboratory
14 David Taylor NSRDC - Annapolis
13 David Taylor NSRDC - Carderock
7,8 NAS/NATC - Patuxent River
16 Naval Amph. Base - Little Creek
3 Naval Station - Annapolis
27 Naval Sup. Cen.-Cheatham Annex
22 Naval Supply Center-Craney Is.
83 Naval Supply Center-Yorktown
2 NSWC - Dahlgren
4 NSWC - White Oak
26 Naval Weapons Station-Yorktown
65 Navy Ships Parts Control Center
1 U.S. Marine Corps - Quantico
10 U.S. Naval Academy - Annapolis

Figure 8 Locations of the 37 DoD Installations Addressed in Phases II and III.

CHAPTER 3: SUMMARY OF PHASE II

(Development and Testing of Installation Assessment Methodology)

PHASE II OVERVIEW

The Phase I preliminary screening system served as an initial assessment of the impact potential of the 66 DoD installations on water quality and living resources of Chesapeake Bay and its tributaries. **In Phase I, most of the analysis was qualitative and was based on the "potential" for environmental impacts, as opposed to known or measured "actual" impacts.** This approach proved useful in identifying 29 installations which clearly do not have a significant impact potential on surface water quality, and thus could be eliminated from further analysis in Phases II and III of this study. **For the remaining 37 installations estimated to have a significant impact potential, a more quantitative assessment was required to verify suspected or known pollutant impacts** and to identify and recommend specific practices or programs that could be used to restore and/or protect water quality and living resources of the Bay.

Figure 9 presents the activity flow chart for Phase II - Development and Testing of Installation Assessment Methodology.

Phase II

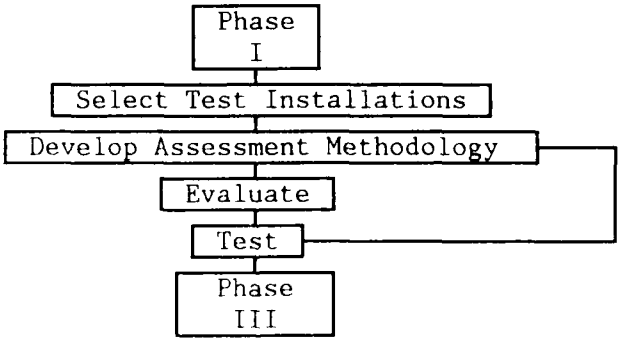


Figure 9. Phase II Flow Chart

There were three primary objectives of Phase II:

- Develop a detailed assessment methodology to quantify, where possible, water quality impacts from installation pollutant loadings, and to identify and recommend specific practices or programs that have been, or, if necessary, could be used to restore and/or protect the living resources of the Bay;

- Apply the detailed assessment methodology to six installations as a test. Results from the test applications were incorporated into the methodology, which was then applied to the remaining thirty-one installations during Phase III; and

- Finalize the data base compilation of existing water quality and environmental information for 66 DoD installations in the Chesapeake Bay drainage basin. This data base was developed to allow subsequent analysis of water quality and biological trends at DoD installations.

A description of the data inventory process and data base systems was presented in Chapter 2. The remainder of Chapter 3 describes the development and testing of the installation assessment methodology.

INSTALLATION ASSESSMENT METHODOLOGY

In Phase II, a detailed assessment methodology was developed to define the likely character and extent of an installation's impact on water quality and living resources in the immediate vicinity of the installation as well as on the Chesapeake Bay and its tributaries. The methodology was applied to six installations during Phase II as a test.

The methodology utilizes available data and information to quantify, where possible, the impacts of an installation on water quality in terms of: 1) conventional pollutants (nutrients, coliform, and BOD loadings), 2) output of toxic and hazardous substances, 3) contribution of sediment and turbidity, 4) effects on benthic sediment quality, and 5) effects on benthic biota and on planktonic populations. Where quantification of water quality impacts was not possible, potential impacts were qualitatively addressed through an updating of the Phase I screening exercise.

The installation assessment methodology consists of six major steps. These are:

STEP 1. Calculate Installation Pollutant Loadings. Quantify, where possible, point and nonpoint source loadings of conventional (BOD, nutrients, coliforms, suspended solids) and toxic pollutants from the installation.

STEP 2. Calculate Relative Pollutant Loadings. Quantify, where possible, point and nonpoint source loadings of conventional and toxic pollutants in the installation's surrounding region of influence for the purpose of comparison.

STEP 3. Evaluate Theoretical Effects of Installation Pollutants. Quantify, where possible, theoretical effects of installation pollutant loadings on local water and sediment quality and biological resources, using established water quality criteria and bioassay acute and chronic toxicity levels.

STEP 4. Perform Vicinity Verification of Theoretical Effects. Verify, where possible, theoretical effects using historical data and studies on local water/sediment quality, benthic and water column biota, and habitat trends in the vicinity of the installation.

STEP 5. Summarize Installation Assessment. Summarize the findings of Steps 1-4. Also, summarize known beneficial effects of installation activities and other potential environmental impacts (i.e., poorly defined or nonquantifiable) and summarize recommended actions.

STEP 6. Update Installation Screening. Based on the findings and data generated in Steps 1-5, update the installation screening evaluation of Phase I.

The methodology combines both quantitative (where possible) and qualitative analysis procedures to identify the relative significance of a wide variety of contaminant sources on the environmental health of an installation's receiving waters. **It should be noted that, the assessment methodology is highly dependent on the availability of data on contaminant source characteristics and receiving water quality conditions in the vicinity of the installation.** Where information is lacking and a potential impact is probable, recommendations are made to fill information gaps. **A qualitative review of other potential impacts that do not necessarily have a direct impact on surface waters is also performed to identify problem areas on a basin-wide scale.**

RESULTS OF TEST APPLICATIONS

The assessment methodology was tested on six DoD installations. The six installations include Letterkenny Army Depot in Pennsylvania, Andrews Air Force Base and Naval Ordnance Station-Indian Head in Maryland, and Marine Corps Development and Education Command-Quantico, Naval Surface Weapons Center-Dahlgren, and Fort Eustis in Virginia. Although there were some changes in the scoring of the screening criteria guidelines for the six test installations, only one, LEAD, was assigned to a different Study Group (i.e., changed from Study Group 1 to Study Group 2). This change reflects the finding that LEAD's operations, although not well defined or quantifiable, are apparently not creating significant impacts on surface water quality, as was originally believed. Recommendations have been made to verify these findings through the establishment of a monitoring program for LEAD's surface waters.

A major finding of the Phase II test was that the region of influence of each of the six test installations is generally limited to the installation's immediate vicinity. The six installations were found to contribute a relatively insignificant loading of point and nonpoint source pollutants to regional surface waters. Despite these findings, there are several potential pollutant sources that remain relatively obscure and therefore, difficult to quantify and/or regulate, i.e., stormwater runoff; dispersed, intermittent sources of industrial (toxic) pollutants to sewage treatment systems and/or to storm drains; and abandoned hazardous waste disposal sites.

EVALUATION AND MODIFICATION OF ASSESSMENT METHODOLOGY

The test applications of the assessment methodology in Phase II were useful in defining the strengths and weaknesses in the methodology, and allowing modification, if necessary, to be made before application to the remaining 31 installations in Phase III.

The major strength of the methodology is in providing a structured, orderly process in which a large amount of information can be processed in a relatively short time. Due to its structure, the methodology evaluates all installations on a common basis, allowing a comparison of common areas of concern, beneficial effects, and study recommendations. The methodology has also provided a "new" perspective of an installation's activities relative to the surrounding activities and environment. The application of the assessment methodology provides a check of the data and information used to screen the six test installations in Phase I. The updated screening results are considered a more accurate representation of each installation's impact potential.

The major limitation of the assessment methodology is its total dependence upon available information and data. No field data were collected as part of this study. It is relatively rare that the existing historical data base includes appropriate constituents and the spatial and temporal coverage to adequately define or verify a suspected cause and effect relationship between an installation pollutant source and local water quality concerns. This is especially the case for sediment quality and benthic biological species data, which are most valuable for representation of the cumulative impacts of low concentration toxic discharges. The lack of meaningful data in the near vicinity of most DoD installations has led to the frequently made recommendation for developing surface water monitoring programs at installations where areas of concern have been identified.

No major modifications were made to the assessment methodology prior to its use for Phase III. Instead, since the methodology is so strongly dependent on available data and information, additional effort was expended to ensure that the key information from the remaining 31 installations to be evaluated during Phase III was obtained.

CHAPTER 4: SUMMARY OF PHASE III

(Installation Assessments)

PHASE III OVERVIEW

In Phase III the methodology developed and refined in Phase II has been applied to the remaining 31 installations which were under expanded evaluation. A report summarizing DoD impacts by installation, branch of Service, geographic region and/or tributaries, and Bay-wide was produced. Figure 10 presents the activity flow chart for Phase III-Installation Assessments.

Phase III

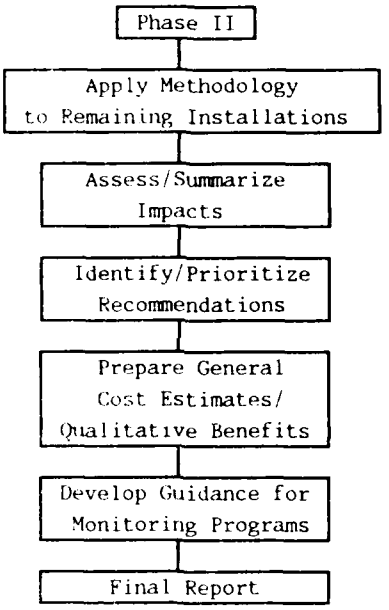


Figure 10. Phase III Flow Chart

The Phase III report also includes recommendations for the 66 installations which identify practices or projects that could be implemented, if necessary, at specific locations to improve the water quality and living resources of the Bay. To aid DoD in developing an implementation strategy for the recommendations, general cost estimates have been prepared for each major program recommendation. The general cost estimates are based on available information from both DoD and non-DoD sources for projects similar in scope to those presented here. In addition, a qualitative description of the potential benefits to water quality for

each recommendation has been prepared for DoD's use in evaluating beneficial effects of program implementation, and prioritizing of specific actions.

Other activities in Phase III have involved the preparation of a generic guidance model for point source, nonpoint source, and groundwater monitoring programs at a typical installation (presented in Appendix E of Volume 2). Implementation of these monitoring programs, where necessary, would provide DoD with useful information in evaluating the impact potential of an installation on local receiving waters.

PHASE I INSTALLATION SCREENING UPDATE

The updated Phase III screening results for the 66 installations are presented in Table 3. The names of the installations are listed on the left side of the table along with their corresponding study identification number and Service affiliation. Across the top of the table are the 31 screening criteria, which have been grouped into five categories (i.e., nonpoint sources, point sources, hazardous/toxic materials, environmental programs, and relationship to the local environment). Each criterion was reevaluated during the Phase III analysis. Under each criterion, a symbol score (i.e., Θ, ⊕, -, +, ·) was assigned to indicate the relative impact potential of the installation for that criterion. These symbol scores were obtained according to the guidelines presented in Table 3.4 of Volume 2 of this report. It should be noted that the symbol scores do not necessarily represent an installation's full level of impact potential. Rather, the level of impact potential and assignment of an installation to a particular Study Group are the result of a review of available on-site and off-site data. For more specific information on a particular installation, the reader is referred to Chapter 4.0 of Volume 2 of this report.

A primary goal of applying the installation assessment methodology was to move the installations from a "poorly defined" impact category (Study Groups 2 and 3) to either a known "significant" (Study Group 1) or "insignificant" (Study Group 4) impact category, based on the comprehensive assessment process described in Chapter 3. Figure 11 presents the installation assessment flowpath for the three phase study effort. As shown, the number of installations in Study Group 2 (Poorly Defined, Significant) decreased from 25 in Phase I to 16 in Phase III. Three of these installations were reassigned to Study Group 1, five to Study Group 3, and one to Study Group 4.

The relatively large number of installations remaining in Study Groups 2 and 3 (38 of 66) reflects the general lack of water quality data in the immediate vicinity of the installations needed to establish the existence or nonexistence of potential contamination from known pollutant source(s) on those installations.

Table 3
Potomac Screening Criteria Matrix
Installation Type
Chesapeake Drainage Area[1]

			ON SITE SCREENING CRITERIA (ON-SITE IMPACT POTENTIAL)																							VICINITY SCREENING CRITERIA							STUDY GROUP			
			NON-POINT SOURCES			POINT SOURCES		HAZARDOUS/TOXIC MATERIALS												ENVIRONMENTAL PROGRAMS						RELATIONSHIP TO LOCAL ENVIRONMENT							IMPACT POTENTIAL*			
			1. Erosion/Sediment Loss	2. Impervious Area Runoff	3. Combined Storm Drains	4. Shoreline Erosion	5. Sewage Treatment	6. Industrial Waste Treat	7. Intermittent Sewage Treat	8. Refueling Operations	9. Munitions Operations	10. Chemical Operations	11. Pesticides	12. Vehicle Maintenance	13. Ship Maintenance	14. Solid Waste Disposal	15. Hazardous Waste	16. SPCC Status	17. Abandoned Sites	18. UST Status	19. Forestry Mgmt. Plan	20. Wildlife Mgmt. Plan	21. Soil Conservation Plan	22. Stormwater Mgmt. Plan	23. Wetlands Mgmt. Plan	24. Shoreline Erosion Plan	25. Shellfish Areas	26. SAV Areas	27. Fish Spawning Areas	28. Wetlands Areas	29. Waterfowl Nesting	30. Endangered Species	31. Relative Local Impact	1. Significant	2. Poorly Defined, Sig.	3. Poorly Defined, Insig.	4. Insignificant
[illegible]	[illegible]	Aberdeen Proving Grd	+	·		-	-	+	·	-	Θ	Θ	+	-	·	·	-	+	Θ	-	+	⊕	+	-	+	-	·	⊕	-	-	⊕	⊕	Θ	X			
2	NAVY	Allegany Ballist. Lab		·	·	·	-	·	·	·	-	-	·	·	·	·	-	+	Θ	-	+	·	Θ	·	·	·	·	·	·	·	·	·	-		X		
3	USAF	Andrews AFB	-	-	+	·	-	·	·	-	·	·	+	-	·	·	-	-	-	-	·	·	-	+	·	·	·	·	-	·	·	-		X		
4a	USAF	Bolling AFB	·	-	·	·	·	·	·	-	·	·	+	·	·	·	·	-	-	-	·	·	·	-	·	+	·	·	·	·	·	-			X	
5a	USAF	Brandywine DRMO	·	·	·	·	·	·	Θ	·	·	·	·	·	·	·	-	Θ	-	·	·	·	·	·	·	·	·	·	·	·	·	·	·			X	
5b	USAF	Brandywine RHA	·	·	·	·	·	·	+	·	·	·	·	·	·	·	·	-	Θ	·	·	·	·	·	·	·	·	·	·	·	·	·	+			X	
6a	ARMY	Cameron Station	·	·	·	·	·	·	·	·	·	·	+	·	·	·	-	+	·	-	·	+	+	+	·	·	·	·	·	·	+	·	+			X	
7a	NAVY	Camp Peary	-	·	·	-	+	·	·	·	·	·	·	·	·	·	·	+	·	·	+	·	+	+	+	+	-	·	-	·	-	-	+			X	
8b	ARMY	Carlisle Barracks	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·	·	+	+	·	·	·	·	·	·	·	·	·				X
9a	NAVY	David Taylor-Annap.	+	-	-	·	·	·	·	-	·	·	·	·	·	·	·	+	·	·	·	·	·	·	·	·	-	·	-	·	·	·	+			X	
13	NAVY	David Taylor-Carder.	·	·	·	·	·	·	·	·	·	·	·	·	·	·	-	+	·	-	·	·	·	-	·	·	·	·	·	·	·	·	·				X
5c	USAF	Davidsonville RDV	·	·	·	·	·	·	·	·	·	·	·	·	-	·	·	·	+	·	·	·	·	·	-	·	·	·	+	+	·	·	+				X
62	DLA	Defense Gen Sup Ctr.	·	-	·	·	·	·	·	-	·	-	·	-	·	·	-	·	Θ	+	·	·	·	-	·	·	·	·	·	·	·	·	-		X		
47	ARMY	Fort A.P. Hill	Θ	·	·	·	-	·	-	-	-	·	+	·	·	+	-	-	Θ	-	Θ	⊕	Θ	·	+	·	·	·	-	-	⊕	-	·			X	
48	ARMY	Fort Belvoir	+	-	-	·	·	-	·	-	·	+	+	+	·	+	Θ	-	Θ	-	+	+	+	Θ	+	-	·	-	·	-	⊕	-	-		X		

NOTES: 1. Refer to Screening Criteria Guidelines in Volume 2 for definition of scores.
2. Installations listed alphabetically.
3. Scores are narrative reviews.

KEY: Impact Category 1: { Θ Significant Impact Potential (Adverse); ⊕ Significant Impact Potential (Beneficial)
Impact Category 2: { - Unknown or Poorly Defined Impacts (Adverse); + Unknown or Poorly Defined Impacts (Beneficial)
Impact Category 3: · Insignificant Impact Potential (Adverse or Beneficial)

Table 5 (continued)
Level Screening of the 60 DoD Installations in the Chesapeake Drainage Area[1]

			ON-SITE SCREENING CRITERIA — ON-SITE IMPACT POTENTIAL																							VICINITY SCREENING CRITERIA						STUDY GROUP			
			NON-POINT SOURCES				POINT SOURCES			HAZARDOUS/TOXIC MATERIALS													ENVIRON MENTAL PROGRAMS				RELATIONSHIP TO LOCAL ENVIRONMENT						IMPACT POTENTIAL*			
			1. Erosion/Sedimentation	2. Impervious Area Runoff	3. Combined Storm Drains	4. Shoreline Erosion	5. Sewage Treatment	6. Industrial Waste Treat	7. Intermitt Sewage Treat	8. Refueling Operations	9. Munitions Operations	10. Chemical Operations	11. Pesticides	12. Vehicle Maintenance	13. Ship Maintenance	14. Solid Waste Disposal	15. Hazardous Waste	16. SPCC Status	17. Abandoned Sites	18. LUST Status	19. Forestry Mgmt. Plan	20. Wildlife Mgmt. Plan	21. Soil Conservation Plan	22. Stormwater Mgmt. Plan	23. Wetlands Mgmt. Plan	24. Shoreline Erosion Plan	25. Shellfish Areas	26. SAV Areas	27. Fish Spawning Areas	28. Wetlands Areas	29. Waterfowl Nesting	30. Endangered Species	31. Relative Local Impact	1. Significant	2. Poorly Defined, Sig.	3. Poorly Defined, Insig.	4. Insignificant
ID	Branch	Installation Name																																	
39	ARMY	Fort Detrick	-	·	·	·	⊕	·	+	·	·	⊕	+	·	·	+	·	-	-	·	+	+	+	+	·	·	·	·	·	·	·	+			X	
49	ARMY	Fort Eustis	·	·	·	·	-	-	·	-	·	·	·	-	-	Θ	-	·	Θ	-	+	+	·	·	+	·	Θ	·	·	⊕	⊕	·	-		X		
72	ARMY	Fort Lee	·	·	·	·	·	·	+	-	·	·	⊕	·	·	+	·	+	·	·	+	·	+	+	·	·	·	·	·	·	·	+				X
44	ARMY	Fort McNair	·	·	·	·	·	·	·	-	·	·	+	·	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·	·	·	+				X
38	ARMY	Fort Meade	Θ	+	·	·	⊕	-	·	+	+	+	⊕	+	·	+	-	+	Θ	-	⊕	⊕	+	+	⊕	·	·	·	·	⊕	⊕	+	-		X		
50	ARMY	Fort Monroe	·	·	-	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·	+	·	·	·				X
45	ARMY	Fort Myer	·	+	-	·	·	·	·	·	·	·	·	·	·	·	·	+	·	·	·	·	+	+	·	·	·	·	·	·	·	·				X
42	ARMY	Fort Ritchie	⊕	·	·	·	⊕	·	·	·	·	·	⊕	·	·	·	+	+	·	·	+	+	⊕	⊕	·	·	·	·	·	·	⊕	·	·				X
51	ARMY	Fort Story	-	·	-	-	·	·	-	-	·	·	·	-	·	·	·	·	·	-	·	·	·	·	+	-	-	·	-	+	+	·	·			X	
35	ARMY	HDL - Adelphi	+	·	·	·	·	+	·	·	·	·	·	·	·	·	+	+	·	-	·	·	+	-	·	·	·	·	·	·	·	+				X	
80	ARMY	HDL - Blossom Point	Θ	·	·	Θ	·	·	Θ	·	Θ	·	-	·	·	·	·	+	Θ	-	-	Θ	Θ	·	Θ	Θ	Θ	-	Θ	Θ	-	Θ	X				
79	ARMY	HDL - Woodbridge	+	·	·	+	·	·	+	·	·	·	·	·	·	·	·	+	⊕	+	+	⊕	⊕	+	⊕	+	+	·	⊕	⊕	⊕	⊕	+				X
55	USAF	Langley AFB	+	-	·	+	·	·	-	-	·	·	⊕	-	·	·	·	+	-	-	+	·	+	-	+	·	-	·	·	+	+	·	-		X		
36	ARMY	Letterkenny Army Dep.	Θ	-	·	·	-	-	-	-	-	-	-	-	·	·	-	-	Θ	-	+	+	-	+	·	·	·	·	·	·	·	-		X			
15	NAVY	Naval Air Sta-Oceana	Θ	-	-	·	·	-	·	Θ	·	·	+	Θ	·	-	-	-	Θ	Θ	+	+	-	Θ	-	·	-	-	·	-	·	·	Θ	X			

NOTES: 1. Refer to Screening Criteria Guidelines in Volume 2 for definition of scores
2. Installations listed alphabetically
* See also narrative reviews

KEY: Impact Category 1: { Θ Significant Impact Potential (Adverse); ⊕ Significant Impact Potential (Beneficial)
Impact Category 2: { - Unknown or Poorly Defined Impacts (Adverse); + Unknown or Poorly Defined Impacts (Beneficial)
Impact Category 3: · Insignificant Impact Potential (Adverse or Beneficial)

Table 5 (continued)
Final Screening of the 80 DoD Installations in the Chesapeake Drainage Area[1]

ID	Branch	Installation Name[2]	ON SITE SCREENING CRITERIA (ON-SITE IMPACT POTENTIAL): NON-POINT SOURCES: 1. Erosion/Sediment	2. Impervious Area Runoff	POINT SOURCES: 3. Combined Storm Drains	4. Shoreline Erosion	5. Sewage Treatment	6. Industrial Waste Treat	7. Intermitt Sewage Treat	HAZARDOUS/TOXIC MATERIALS: 8. Refueling Operations	9. Munitions Operations	10. Chemical Operations	11. Pesticides	12. Vehicle Maintenance	13. Ship Maintenance	14. Solid Waste Disposal	15. Hazardous Waste	16. SPCC Status	17. Abandoned Sites	18. LUST Status	ENVIRONMENTAL PROGRAMS: 19. Forestry Mgmt. Plan	20. Wildlife Mgmt. Plan	21. Soil Conservation Plan	22. Stormwater Mgmt. Plan	23. Wetlands Mgmt. Plan	24. Shoreline Erosion Plan	VICINITY SCREENING CRITERIA: RELATIONSHIP TO LOCAL ENVIRONMENT: 25. Shellfish Areas	26. SAV Areas	27. Fish Spawning Areas	28. Wetlands Areas	29. Waterfowl Nesting	30. Endangered Species	31. Relative Local Impact	STUDY GROUP: IMPACT POTENTIAL[3]: 1. Significant	2. Poorly Defined, Sig.	3. Poorly Defined, Insig.	4. Insignificant
6	NAVY	Naval Air Sta-Sol Anx	+	·	·	+	·	·	·	·	·	·	·	·	+	·	·	+	·	·	+	+	+	+	+	+	-	-	-	-	-	-	·			X	
7	NAVY	Naval Air Sta-Pax Riv	-	-	·	-	·	-	·	Θ	-	·	+	-	·	-	-	-	Θ	-	+	⊕	+	-	+	+	-	-	-	-	+	+	Θ	X			
16	NAVY	Naval Amphibious Base	·	-	-	·	·	·	·	-	·	·	+	·	Θ	·	+	-	Θ	-	+	+	·	-	-	-	Θ	·	·	⊖	·	·	-		X		
85	NAVY	Naval Com. Unit	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	·	+	·	·	-	·	·	·	·	·	·	·	⊕	·	·	·				X
11	NAVY	Naval Elect. Sys Eng	+	·	·	+	+	·	·	·	·	·	·	·	·	·	·	·	·	·	+	+	+	+	+	+	+	-	-	+	+	+	·			X	
12	NAVY	Naval Med. Com-NCR	⊕	·	-	·	·	-	·	-	·	·	·	·	·	·	-	-	·	·	·	·	·	-	·	·	·	·	·	·	·	-	·			X	
84	NAVY	Naval Observatory	·	·	·	·	·	·	·	·	·	·	+	·	·	·	·	·	·	·	+	⊕	·	·	·	·	·	·	·	·	·	·	·				X
5	NAVY	Naval Ordnance Sta.	·	·	⊖	Θ	+	-	·	·	Θ	·	·	·	·	·	+	+	Θ	·	+	+	·	·	+	-	·	·	·	·	·	Θ	X				
29	NAVY	NAVRADSTA-Sugar Grove	-	-	·	·	-	·	-	·	·	·	·	·	·	-	·	+	·	·	·	+	+	·	·	·	·	·	+	·	·	·	·			X	
33	NAVY	Naval Research Lab	·	-	·	+	·	-	·	·	·	·	+	·	·	·	+	+	·	·	·	·	+	+	·	+	·	·	-	·	·	·	·			X	
9	NAVY	Naval Res Lab-CB Det.	·	-	·	-	⊕	·	·	·	·	·	·	·	·	·	·	+	-	·	+	+	+	+	+	+	·	·	·	·	·	+	·			X	
23	NAVY	Naval Shipyard-Norflk	·	-	·	·	·	Θ	·	·	·	Θ	·	·	Θ	Θ	Θ	-	Θ	-	·	·	·	-	-	-	·	·	⊖	·	·	Θ	X				
3	NAVY	Naval Station-Annap.	+	·	·	+	+	·	·	·	·	·	·	·	-	·	·	·	·	·	+	⊕	+	·	+	-	·	·	·	+	·	·	+			X	
27	NAVY	Naval Sup Ctr-Cht Anx	-	-	·	-	+	·	+	-	·	·	·	·	·	·	·	·	-	Θ	·	+	+	+	+	+	-	-	-	-	-	-	-		X		
22	NAVY	Naval Sup Ctr-Craney	·	·	·	+	·	⊕	·	-	·	·	·	·	·	·	·	-	-	Θ	Θ	+	-	·	Θ	-	+	Θ	·	-	·	·	-		X		

NOTES: 1. Refer to Screening Criteria Guidelines in Volume I for definition of scores
2. Installations listed alphabetically
* See also narrative reviews

KEY: Impact Category 1: { Θ Significant Impact Potential (Adverse); ⊕ Significant Impact Potential (Beneficial)
Impact Category 2: { - Unknown or Poorly Defined Impacts (Adverse); + Unknown or Poorly Defined Impacts (Beneficial)
Impact Category 3: · Insignificant Impact Potential (Adverse or Beneficial)

[illegible] Study
[illegible] Screening Criteria Matrix
[illegible] Installations in the
Chesapeake [illegible] Drainage Area[1]

			ON SITE SCREENING CRITERIA (ON-SITE IMPACT POTENTIAL)																							VICINITY SCREENING CRITERIA							STUDY GROUP			
			NON-POINT SOURCES			POINT SOURCES		HAZARDOUS/TOXIC MATERIALS												ENVIRONMENTAL PROGRAMS						RELATIONSHIP TO LOCAL ENVIRONMENT							IMPACT POTENTIAL*			
			1. Erosion/Sedimentation	2. Impervious Area Runoff	3. Combined Storm Drains	4. Shoreline Erosion	5. Sewage Treatment	6. Industrial Waste Treat	7. Intermitt Sewage Treat	8. Refueling Operations	9. Munitions Operations	10. Chemical Operations	11. Pesticides	12. Vehicle Maintenance	13. Ship Maintenance	14. Solid Waste Disposal	15. Hazardous Waste	16. SPCC Status	17. Abandoned Sites	18. LUST Status	19. Forestry Mgmt. Plan	20. Wildlife Mgmt. Plan	21. Soil Conservation Plan	22. Stormwater Mgmt. Plan	23. Wetlands Mgmt. Plan	24. Shoreline Erosion Plan	25. Shellfish Areas	26. SAV Areas	27. Fish Spawning Areas	28. Wetlands Areas	29. Waterfowl Nesting	30. Endangered Species	31. Relative Local Impact	1. Significant	2. Poorly Defined, Sig.	3. Poorly Defined, Insig.	4. Insignificant
ID	Branch	Installation Name[2]																																	
83	NAVY	Naval Sup Ctr-Yorktwn	•	•	•	•	•	•	-	-	•	•	•	•	•	•	•	+	Θ	Θ	•	•	•	Θ	Θ	•	-	-	-	Θ	-	•	Θ	X			
2	NAVY	Nav Sur Wea Ctr-Dahl.	+	-	-	+	+	-	•	-	Θ	-	+	•	•	•	+	+	Θ	•	+	+	+	+	+	+	-	-	-	-	-	-	-		X		
4	NAVY	Nav Sur Wea Ctr-W Oak	-	-	•	•	+	-	-	•	•	•	+	•	•	•	+	+	-	•	+	+	+	-	•	•	•	•	-	•	•	•	-		X		
26	NAVY	Naval Weapons Station	•	•	•	•	•	+	•	+	+	+	•	+	•	-	-	-	Θ	-	+	+	+	•	-	•	-	-	-	-	•	•	Θ	X			
6	NAVY	Navy SPCC	•	-	•	•	•	•	-	-	•	•	•	•	•	•	•	+	-	-	•	•	•	-	•	•	•	•	•	•	•	•	-		X		
37	ARMY	New Cumberland Depot	•	+	•	•	+	⊕	•	+	•	⊕	•	•	•	•	+	+	+	•	•	+	+	+	⊕	•	•	•	•	⊕	⊕	•	+			X	
81	NAVY	Nav Rad Trn Fac-Annap	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	+	•	-	•	-	+	•	•	+				X
17	NAVY	Sewells Pt Navy Compx	•	Θ	Θ	•	•	+	•	Θ	•	-	•	-	Θ	•	-	-	-	-	•	•	•	-	•	•	-	•	-	•	•	•	-	X			
28	NAVY	St. Juliens Cr. Annex	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	-	•	•	•	•	•	+	•	•	•	-	-	•	•	•			X	
1	NAVY	USMC - Quantico	-	-	Θ	•	+	•	•	⊕	•	•	•	+	•	⊕	-	⊕	Θ	-	⊕	+	-	-	-	•	•	-	-	⊕	⊕	+		X		
10	NAVY	US Naval Academy	•	-	+	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	+	+	+	-	+	•	-	•	-	•	•	•	•				X
82	NAVY	US Naval Academy Farm	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	-	⊕	+	•	•	•	•	•	•	•	•	•				X
41	ARMY	Vint Hill Farms Sta.	•	•	•	•	Θ	-	•	•	•	•	⊕	•	Θ	+	-	Θ	-	+	•	•	+	+	•	•	•	•	•	•	•	•	-		X		
40	ARMY	Walter Reed Med Ctr.	-	+	•	•	•	•	•	•	•	•	•	•	•	•	•	-	•	•	•	•	+	+	•	•	•	•	•	•	•	•	•			X	
32	NAVY	Washington Navy Yard	•	-	•	•	•	•	•	-	•	•	-	•	•	•	•	-	•	-	•	•	-	+	•	•	•	-	•	•	•	•	•			X	

NOTES: 1. Refer to Screening Criteria Guidelines in Volume 2 for definition of scores
2. Installations listed alphabetically
3. See also narrative reviews

KEY: Impact Category 1: { Θ Significant Impact Potential (Adverse); ⊕ Significant Impact Potential (Beneficial)
Impact Category 2: { - Unknown or Poorly Defined Impacts (Adverse); + Unknown or Poorly Defined Impacts (Beneficial)
Impact Category 3: • Insignificant Impact Potential (Adverse or Beneficial)

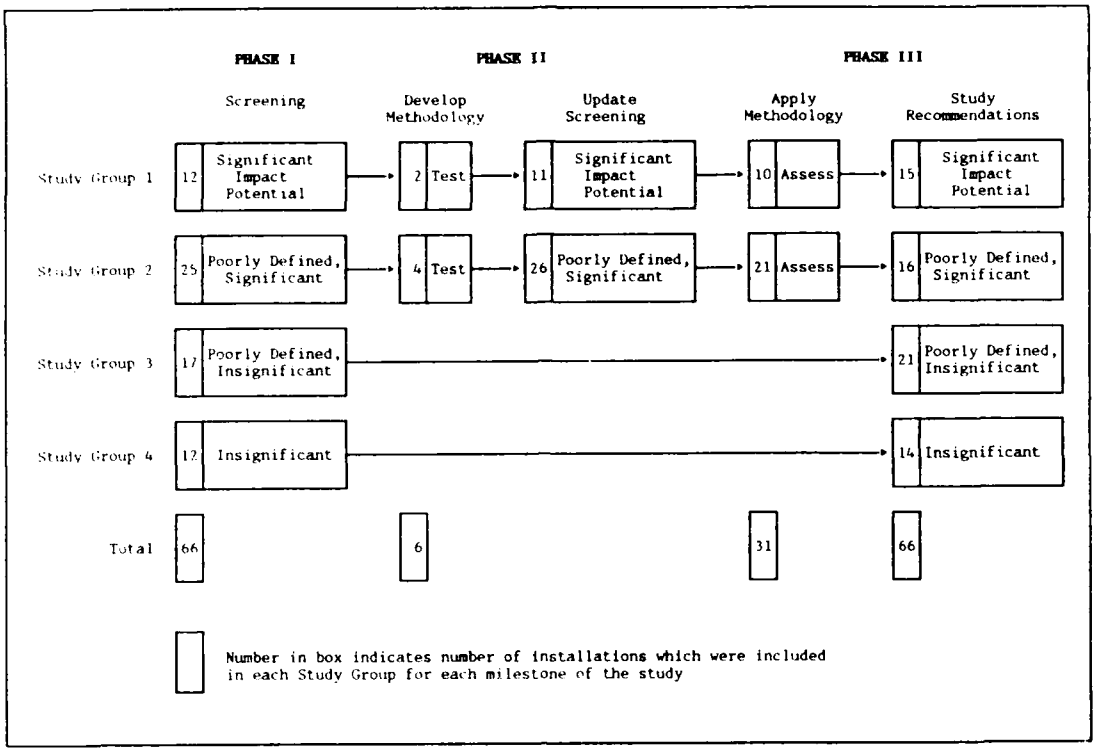


Figure 11. Installation Assessment Flowpath

Figure 12 summarizes the final Phase III screening results by branch of Service and by Study Group. Figure 12 can be directly compared to Figure 7 for the Phase I screening results. As shown, the number of installations in Study Group 1 increased by three for Navy installations and remained unchanged for Army, Air Force, and Defense Logistics Agency installations. Likewise, the number of installations in Study Group 4 increased by two for Navy installations and remained unchanged for Army, Air Force, and DLA.

Phase III Screening Results

Study Group	Impact Potential	Number Screened All	NAVY	ARMY	USAF	DLA
1	Significant	15	12	3	0	0
2	Poorly Defined, Significant	16	8	5	2	1
3	Poorly Defined, Insignificant	21	11	7	3	0
4	Insignificant	14	6	7	1	0
	Total	66	37	22	6	1

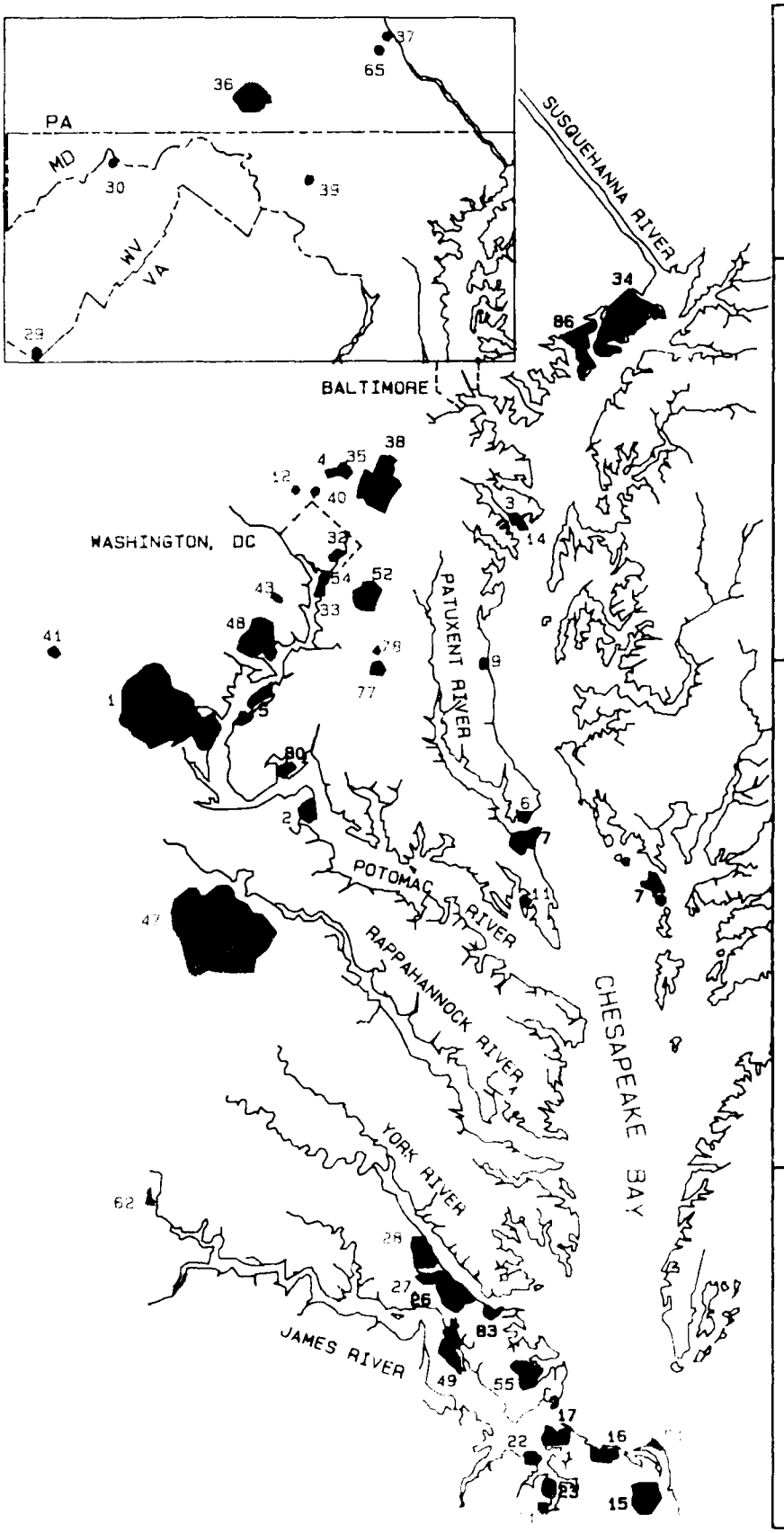
Figure 12. Phase III Updated Screening Results

Figure 13 shows the locations of the installations by Study Group in the Bay region. This figure can be used as a visual aid to locate installations according to their relative level of impact potential on surface water quality. **In general, the assignment of an installation to Study Group 1 (Significant Impact Potential) resulted from a review of limited data observations which indicated contamination of surface waters immediately adjacent to the installation in excess of Federal and/or State water quality criteria or guidelines (primarily for toxics). In most cases, data showing these conditions have been collected through DoD studies (e.g., NACIP, IRP, etc.). Because they usually represent one-time sampling events and are preliminary results, the study findings cannot be used to develop a statistically significant cause and effect relationship between installation pollutant source(s) and receiving water contamination levels. Thus the use of the term "significant" to describe impacts in this study must be used with caution, and as a relative expression to compare the impact potential of the various DoD installations.**

The assignment of an installation to Study Group 2 (Poorly Defined, Likely Significant) generally resulted from the finding of potential pollutant sources that have characteristics similar to those pollutant sources found to be contaminating local surface waters in the Study Group 1 installations. There is a lack of appropriate data, however, to verify the existence of contaminants, if any, in the receiving waters adjacent to these installations.

The assignment of an installation to Study Group 3 (Poorly Defined, Likely Insignificant) or to Study Group 4 (Insignificant Impact Potential) generally reflects the likely absence of any significant pollutant sources on these installations, or that these installations have significantly reduced or eliminated practices that at one time created water quality concerns.

To help interpret the final Phase III screening results and to aid in prioritizing the recommended actions to improve DoD practices and programs in the Chesapeake Bay drainage basin, an approximate ranking of the screening criteria has been prepared. This ranking is based on the frequency of "adverse" symbol scores (i.e., Θ or -) for all installations, multiplied by an impact "priority level" of one or two, with two representing an activity involving the direct discharge of pollutants to receiving waters. Table 4 presents the scoring procedure for rank determination. Columns one through five in Table 4 present, for criteria 1 through 24, the distribution of criterion symbol scores for the 57 installations evaluated in this study. The number in column six results from the addition of the two adverse symbol scores "Θ" and "-" in columns three and five. In column seven, a priority level is assigned to each criterion in the following manner. Each criterion is set equal to one, but if the criterion involves the direct discharge of pollutant(s) to **surface waters**, the priority level is doubled. The "Ranking Score" in column eight results from the multiplication of columns six and seven. The highest ranked criteria (i.e., abandoned sites, impervious area runoff, erosion/siltation, combined storm drains,



STUDY GROUP 1
34,66 Aberdeen Proving Ground
80 Harry Diamond Lab-Blossom Point
15 Naval Air Station - Oceana
7,8 NAS/NATC - Patuxent River
5 Naval Ordnance Sta.-Indian Head
23 Naval Shipyard - Norfolk
83 Naval Supply Center - Yorktown
26 Naval Weapons Station-Yorktown
17-21 Sewells Point Naval Complex

STUDY GROUP 2
30 Allegany Ballistics Lab
52 Andrews Air Force Base
62 Defense General Supply Center
48 Fort Belvoir
49 Fort Eustis
38 Fort Meade
55 Langley Air Force Base
36 Letterkenny Army Depot
16 Naval Amph. Base - Little Creek
27 Naval Sup. Cen.-Cheatham Annex
22 Naval Sup. Cen. - Craney Island
2 NSWC - Dahlgren
4 NSWC - White Oak
65 Navy Ships Parts Control Center
1 USMC/MCDEC - Quantico
41 Vint Hill Farms Station

STUDY GROUP 3
54 Bolling Air Force Base
78 Brandywine DRMO
77 Brandywine Rec. & Housing Annex
43 Cameron Station
28 Camp Peary
14 David Taylor NSRDC - Annapolis
47 Fort A.P. Hill
39 Fort Detrick
51 Fort Story
35 Harry Diamond Lab - Adelphi
6 Naval Air Sta. - Solomons Annex
11 Naval Elect. Sys. Engr. Act.
12 Naval Medical Command - NCR
29 Naval Radio Station-Sugar Grove
33 Naval Research Lab - Wash., DC
9 Naval Research Lab - CBD
3 Naval Station - Annapolis
37 New Cumberland Army Depot
74 St. Juliens Creek Annex
40 Walter Reed Army Medical Center
32 Washington Navy Yard

STUDY GROUP 4
46 Carlisle Barracks
13 David Taylor NSRDC - Carderock
53 Davidsonville RDV
72 Fort Lee
44 Fort McNair
50 Fort Monroe
45 Fort Myer
42 Fort Ritchie
79 Harry Diamond Lab - Woodbridge
85 Naval Communications Unit
84 Naval Observatory - Wash., DC
81 Naval Radio Transmit. Facility
10 U.S. Naval Academy
82 U.S. Naval Academy Dairy Farm

Figure 13 Final Screening of all 66 DoD Installations by Study Group and Location.

Table 4 Criteria Ranking System

On-Site Screening Criteria	Symbol Scores* ·	+	-	⊕	⊖	Columns (3) + (5)	Priority** Level	Adverse: Ranking Score Columns (6) x (7)	Adverse: Rank	Beneficial: Ranking Score Columns (7) x (2+4)	Beneficial: Rank
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
1. Erosion/Siltation	32	10	11	2	5	16	2	32	3	24	3
2. Impervious Area Runoff	36	4	20	0	1	21	2	42	2	8	9
3. Combined Storm Drains	45	2	10	0	3	13	2	26	5	4	14
4. Shoreline Erosion	44	8	6	0	2	8	2	16	11	16	5
5. Sewage Treatment	40	9	6	4	1	7	2	14	12	26	2
6. Industrial Waste Treatment	41	4	12	2	1	13	2	26	6	12	6
7. Intermittent Sewage Treatment	45	5	8	0	2	10	2	20	9	10	7
8. Refueling Operations	33	3	20	1	3	23	1	23	7	4	15
9. Munitions Operations	49	2	5	0	4	9	1	9	16	2	17
10. Chemicals Operations	48	3	5	2	2	7	1	7	17	5	12
11. Pesticides	38	15	3	4	0	3	1	3	18	19	4
12. Vehicle Maintenance	45	4	9	1	1	10	1	10	15	5	13
13. Ship Maintenance	54	1	2	0	3	5	2	10	14	2	18
14. Solid Waste Disposal	43	5	8	1	3	11	1	11	13	6	10
15. Hazardous Waste	31	9	18	0	2	20	1	20	8	9	8
16. SPCC Status	15	25	18	1	1	19	1	19	10	26	1
17. Abandoned Sites	24	2	11	1	22	33	2	66	1	6	11
18. UST Status	30	3	24	0	3	27	1	27	4	3	16
19. Forestry Management Plan	29	27	1	2	1	2	1	2	6	29	5
20. Wildlife/Habitat Management Plan	30	20	2	7	1	3	1	3	5	27	6
21. Soil Conservation Program	23	26	5	3	3	8	2	16	3	58	1
22. Stormwater Management Plan	20	21	14	1	4	18	2	36	1	44	2
23. Wetlands Management Plan	30	18	7	3	2	9	2	18	2	42	3
24. Shoreline Erosion Plan	38	16	5	0	1	6	2	12	4	32	4

*Key: ⊖ Significant Impact Potential (Adverse)
⊕ Significant Impact Potential (Beneficial)
- Unknown or Poorly Defined Impacts (Likely Adverse)
+ Unknown or Poorly Defined Impacts (Likely Beneficial)
· Insignificant Impact Potential

**Priority Levels - start at "1"
- add 1 if involves direct discharge of pollutants to surface waters

industrial waste treatment) reflect the most frequently occurring areas of concern and involve the direct discharge of pollutants to surface waters*.

All of the six top ranked areas of concern at military installations relate primarily to nonpoint or intermittent pollutant sources that are difficult to control or regulate. They include: stormwater runoff; surface erosion; dispersed, intermittent sources of toxic industrial pollutants to sewage treatment systems and/or to storm drains (which are tested only for conventional pollutants); leaking underground storage tanks; and abandoned or inactive hazardous waste disposal sites that have the potential for leachate migration to surface waters.

It is noted that the environmental programs represented by criteria 19 through 24 are ranked separately in Table 4. These activities reflect environmental management policies and procedures rather than the potential discharge of pollutants associated with criteria 1 through 18.

Also shown in Table 4 are the same screening criteria ranked on the basis of the frequency of "beneficial" symbol scores (i.e., ⊕ or +) for all installations. The number in column ten represents the product of column seven (priority level) multiplied by the sum of the two beneficial symbol scores "⊕ and "+" from columns two and four. In column eleven, a ranking level is assigned to each criterion based on the "beneficial" score in column 10. As shown in Table 4, **the highest ranked criteria (i.e., SPCC status, erosion/siltation, sewage treatment, pesticides, shoreline erosion, industrial waste treatment, intermittent sewage treatment, hazardous waste) reflect areas where military installations have controlled potential pollutant sources.** Such areas include: upgrading of sewage treatment plant or elimination by pumping to municipal treatment systems; upgrading of pesticides and hazardous waste storage/handling facilities and procedures; implementation of SPCC plans and containment of fuel spills; and development of land management and natural resources management plans.

SUMMARY OF DOD IMPACTS BY TRIBUTARY/REGION, SERVICE, AND BAY-WIDE

Summary by Region and Bay-wide

An important finding of this study is that, with the exception of a few installations, the region of influence of the military activities appears to be limited to the immediate vicinity of each respective installation. The exceptions (Aberdeen Proving Ground, NSWC Dahlgren, HDL-Blossom Point) are unique because of the impacts of ordnance over large areas of wetlands and/or open water areas. This study has, because of the nature of most installation activities, focussed on the immediate vicinity of each installation. The regional, or far-field

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* Note: Criterion 18 - UST Status - was ranked 4th overall but it does not represent a direct impact on surface waters.

effects of individual or groups of installations must also be viewed in terms of (1) the Bay-wide changes in environmental quality noted over the past decade and (2) the critical ecological functions historically attributed to the particular regions. Some of these far-field trends on Chesapeake Bay are presented in Chapter 4.0 of Volume 2 of this report (Sec. 4.1), as are brief descriptions of the 13 CBP regions into which the DoD installations have been grouped.

The EPA-CBP study of the late 1970's examined many facets, but concentrated on three aspects.

1. The distribution of toxic materials (i.e., inorganic (metals) and synthetic organic compounds) throughout the Bay. Areas of significantly elevated concentrations of these materials and compounds were found at the head of the Bay, Baltimore harbor, and the Hampton Roads-Elizabeth River system.

2. The Bay-wide loss of submerged aquatic vegetation (SAV). This decline was found to have started in the early 1970's at the head of the Bay, and has progressed down the Bay with a near depletion of SAV in most areas. Some areas of the lower Eastern Shore of Virginia were apparently little affected. Adjacent emergent grasses (wetlands) do not seem to have been affected except by local development pressures.

3. Large scale trends in water quality conditions were determined, especially as they relate to cultural eutrophication. Increases in the concentration of phosphorous and nitrogen were established, and decreases in light penetration and dissolved oxygen in some areas were found.

During and since the EPA-CBP study, certain estuarine dependent species of finfish and shellfish of commercial and recreational significance have continued to decline. The reproductive potential of these species, especially those that spawn in fresh or oligohaline waters, seems to be impaired. Marine species utilizing the estuary as nursery grounds do not seem to be affected, and appear to be increasing in numbers in the Bay filling the ecological niche (e.g., bluefish and menhaden).

Generally the findings of the EPA-CBP study indicate that the Bay region has sustained substantial population growth over the past several decades, with accompanying land use changes and increased waste disposal consequences. In addition, agricultural practices have greatly increased nonpoint source nutrient and sediment loadings throughout the estuary. It is worth noting that there were probably little or no significant changes in the number or types of DoD installations and/or activities affecting the Bay during this period.

Alleviation of these problems will involve large scale changes in social, economic, and technological practices on adjacent Bay land uses, some of which have been implemented at the State level. The various management schemes to reduce and control pollutant sources to the Bay

from point and nonpoint sources are summarized in Chapter 2 of this report.

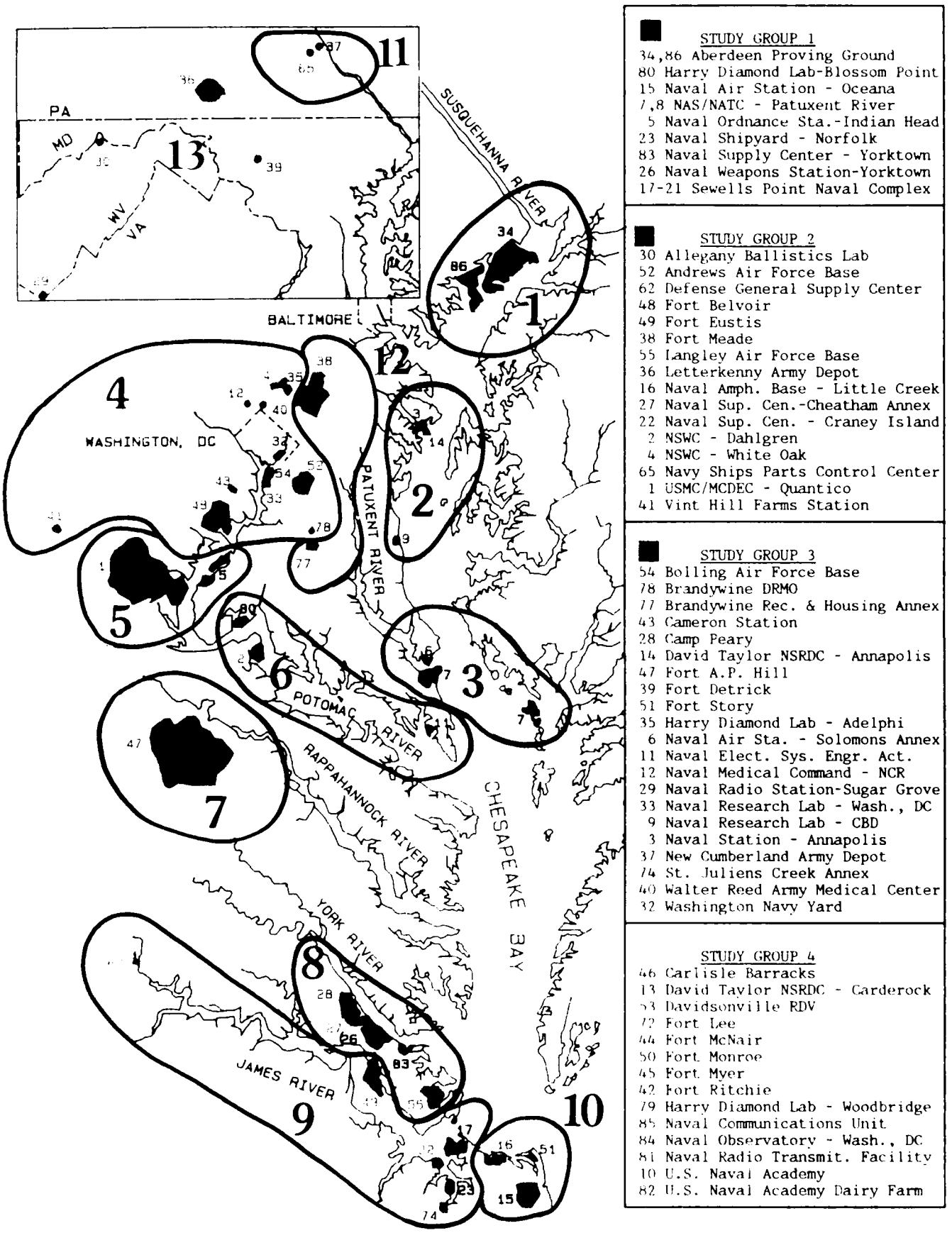
The EPA-CBP organized environmental information on the Chesapeake Bay into relatively distinct segments, definable by hydrographic and biological characteristics. Some areas of the Chesapeake estuary are intrinsically more fragile and vulnerable to environmental stress than others. The tidal fresh waters at the head of the Bay, in the vicinity of Aberdeen Proving Ground and ancillary facilities, are ecologically more critical and vulnerable than, for example, the region at the mouth of the Patuxent River where Naval installations are located. This implies that different management strategies will be necessary to meet the needs of various regions. Figure 14 summarizes the impact potential of DoD installations by Study Group and by regional location. This figure is intended as a visual aid that identifies the regional locations of installations representing a relatively significant impact potential on local water quality and biological resources of the Bay. As shown in Figure 14, installations in Study Groups 1 (Significant Impact Potential) and 2 (Poorly Defined but Likely Significant Impact Potential) are distributed throughout the Bay in 11 of the 13 regions. A discussion of DoD impacts by region is briefly presented in the following sections.

Region 1: Upper Chesapeake Bay. This region of tidal fresh waters near Aberdeen Proving Ground is probably the most vulnerable of the Bay segments and is an area considered critical for:

1. Spawning of estuarine dependent fishes, such as striped bass and white perch;
2. Spawning of anadromous finfish such as shad and some clupeids;
3. Nesting and rearing for some estuarine dependent raptors, such as bald eagle and osprey;
4. Major overwintering grounds for waterfowl, especially canvasback and redhead ducks; and
5. Significant wetlands habitat, now considered an integral part of the estuarine ecosystem.

This region has large scale environmental stresses on it from:

1. Major silt loads, primarily from the Susquehanna River;
2. Abnormally elevated nutrient concentrations, notably nitrogen and phosphorous, primarily from the Susquehanna River;
3. Abnormally elevated metal and anthropogenic organic compounds, probably from the Susquehanna watershed;
4. The nearly complete loss of SAV in the entire region, but especially in the Susquehanna Flats; and
5. Acid rain. (These fresh water regions are more susceptible to environmental damage from acid rain than the more saline reaches with greater buffering capacity. Some recent studies indicate large scale changes in pH in the region attributed to acid rain.)



STUDY GROUP 1
34,86 Aberdeen Proving Ground
80 Harry Diamond Lab-Blossom Point
15 Naval Air Station - Oceana
7,8 NAS/NATC - Patuxent River
5 Naval Ordnance Sta.-Indian Head
23 Naval Shipyard - Norfolk
83 Naval Supply Center - Yorktown
26 Naval Weapons Station-Yorktown
17-21 Sewells Point Naval Complex

STUDY GROUP 2
30 Allegany Ballistics Lab
52 Andrews Air Force Base
62 Defense General Supply Center
48 Fort Belvoir
49 Fort Eustis
38 Fort Meade
55 Langley Air Force Base
36 Letterkenny Army Depot
16 Naval Amph. Base - Little Creek
27 Naval Sup. Cen.-Cheatham Annex
22 Naval Sup. Cen. - Craney Island
2 NSWC - Dahlgren
4 NSWC - White Oak
65 Navy Ships Parts Control Center
1 USMC/MCDEC - Quantico
41 Vint Hill Farms Station

STUDY GROUP 3
54 Bolling Air Force Base
78 Brandywine DRMO
77 Brandywine Rec. & Housing Annex
43 Cameron Station
28 Camp Peary
14 David Taylor NSRDC - Annapolis
47 Fort A.P. Hill
39 Fort Detrick
51 Fort Story
35 Harry Diamond Lab - Adelphi
6 Naval Air Sta. - Solomons Annex
11 Naval Elect. Sys. Engr. Act.
12 Naval Medical Command - NCR
29 Naval Radio Station-Sugar Grove
33 Naval Research Lab - Wash., DC
9 Naval Research Lab - CBD
3 Naval Station - Annapolis
37 New Cumberland Army Depot
74 St. Juliens Creek Annex
40 Walter Reed Army Medical Center
32 Washington Navy Yard

STUDY GROUP 4
46 Carlisle Barracks
13 David Taylor NSRDC - Carderock
53 Davidsonville RDV
72 Fort Lee
44 Fort McNair
50 Fort Monroe
45 Fort Myer
42 Fort Ritchie
79 Harry Diamond Lab - Woodbridge
85 Naval Communications Unit
84 Naval Observatory - Wash., DC
81 Naval Radio Transmit. Facility
10 U.S. Naval Academy
82 U.S. Naval Academy Dairy Farm

Figure 14. Summary of DoD Installation Impact Potential by Study Group and Regional Location.

Land management and general environmental controls must be more stringently applied in this region than in other regions. Point sources and nonpoint sources of nutrients, which may lead to increased concentrations of phytoplankton and subsequent loss of light penetration, need to be controlled, especially in this region.

Aberdeen Proving Ground (APG) is the only DoD installation operating in the Upper Chesapeake Bay region (see Figure 14). APG (included in Study Group 1) is a complex installation, and it is difficult to determine with any confidence the level of environmental impact on surface waters based on existing information. Overall, however, APG does not appear to impact significantly the Upper Chesapeake Bay region. Rather, conditions in this region are dominated by pollutant and sediment loads entering from the Susquehanna River. APG's influence, other than the contamination of open water areas by ordnance testing, appears to be confined to the creeks and waters directly on or adjacent to the installation. The primary area of concern at APG involves the existence of several past sources of toxic contaminants from munitions and chemical research and testing activities that once discharged into the local tidal creeks and wetlands throughout the installation. Available data collection efforts designed to investigate the presence of toxics are very limited but, where available, have indicated the presence of toxic materials above chronic toxicity threshold levels set by the EPA for the protection of aquatic life. Key recommended actions for this installation therefore include the expansion of monitoring activities specifically designed to detect the presence of chemical agents used or produced by the activities that have occurred at APG. Beneficial activities at APG include a progressive natural resources program (which includes SAV planting), elimination of numerous industrial waste discharges by connection to centralized treatment facilities, and preservation of large undeveloped areas which act as buffer zones for surface water habitat protection.

Region 2: Mouth of Severn River (Upper Central Bay). The Severn River is steadily losing its oystering ground resources, due to past fishing pressures, general lack of reproductive success, and increasing closures due to urban and suburban development in the vicinity. This area has lost nearly all of its SAV. Water quality degradation, especially bacterial contamination and low dissolved oxygen in some bottom waters, has become more widespread. None of these changes can be directly attributed to the five DoD installations in this region (see Figure 14), but reflect the general trends noted in the Bay which have been attributed to the increasing local urbanization.

None of the five DoD installations in this region are likely to have a significant potential to adversely impact water quality. There are no major industrial activities or point sources at these facilities. Existing areas of concern are relatively minor in nature and include: the release of pollutants in storm drains (DTNSRDC, U.S. Naval Academy); shoreline erosion at the Naval Station and NRL-CBD; and management of hazardous materials (Naval Station, U.S. Naval Academy). No information

exists, however, to indicate that these installations have created any significant adverse impact on water quality. Compared to the surrounding point and nonpoint sources, these installations probably contribute an insignificant loading of pollutants to the Upper Central Bay region. Beneficial activities of these installations have included upgrading sewage treatment systems (Naval Station, NRL-CBD), and developing land management and natural resources programs (all installations).

Region 3: Mouth of Patuxent River (Central Bay). The reaches of the lower Patuxent estuary and adjacent Bay waters have experienced the decline of SAV and estuarine dependent fishes observed elsewhere in the Bay. Oyster and soft-shell clam fisheries have declined, partially due to fishing pressure and partially due to the lack of reproductive success noted in recent years. Generally, water quality in this area is considered good. The three Naval installations (see Figure 14) have apparently no significant far-field effects on the region.

Of the three installations operating in this region, NAS and NATC Patuxent were screened in Study Group 1. Areas of local concern at these installations include: the lack of a stormwater management plan and/or monitoring program for the extensive storm drainage system; lack of secondary containment facilities around POL storage areas; detection of contaminants (fuels) leaking into local on-site surface waters from fuel storage areas; and the continuing evaluation of several NACIP confirmation study sites including past spill sites and inactive waste disposal sites which have the potential to leach contaminants into ground and surface waters. All of the above concerns relate primarily to activities that are difficult to control or regulate. In general, NAS/NATC's impacts on regional water quality are believed to be minor. The surrounding agricultural activities and upstream pollutant loadings are primarily responsible for the eutrophic conditions observed in this area. NAS/NATC's impacts are more likely confined to receiving waters located adjacent to the installation, however, there is a general lack of appropriate data on areas local to the installation to quantify NAS/NATC's impact. Beneficial activities at NAS/NATC include a progressive natural resources program which promotes waterfowl nesting areas and presents educational programs for the public.

Region 4: Tidal Fresh Potomac River. The tidal Potomac River from urban Washington, D.C. to approximately 60 miles downstream has been seriously degraded for decades. Extensive efforts, especially in improving sewage treatment, have somewhat alleviated these degraded conditions in the past decade. This reach of the estuary and the small creeks which feed into it in the urban area will probably continue to be ecologically substandard due to the urban surroundings. Water quality in this reach of the tidal fresh waters is impaired by low dissolved oxygen, turbidity, nutrients, and elevated bacterial concentrations. The eighteen DoD facilities (see Figure 14) are generally served by the regional sewage treatment facilities and programs, and can be considered

as an integral part of the urban setting, in the context of regional efforts.

Four of the eighteen installations (NSWC-White Oak, Vint Hill Farms, Fort Belvoir, and Andrews AFB) were estimated to represent a poorly defined but likely significant adverse impact potential for local water quality and biological resources. Areas of concern for these four installations include: stormwater runoff and poorly characterized minor industrial discharges to storm drains; possible toxic materials in sewage treatment effluent (Vint Hill Farms); unknown integrity of underground storage tanks and/or fuel spill containment protection (Fort Belvoir and Andrews AFB); erosion and sedimentation (Fort Belvoir and Andrews AFB); and potential contaminants leaching to surface waters from inactive waste disposal sites. In general, little data exists to adequately quantify pollutant sources and potential impact levels from these activities.

The most beneficial programs at DoD installations in this region for pollution control and environmental enhancement have included: the elimination of sewage treatment systems (Fort Belvoir, Andrews AFB); implementation of erosion controls; provision of tight pesticides management; implementation and updating of effective SPCC programs; preservation of large undeveloped areas which act as buffer zones for surface water habitat protection (Fort Belvoir, HDL-Woodbridge, Naval Communications Unit); and development and implementation of progressive natural resource and land management programs.

Ongoing areas of concern at many of the DoD installations in this region relate primarily to nonpoint source pollutants that are difficult to control. They include: overland runoff and erosion; potential contaminant migration from inactive waste disposal sites; and intermittent and poorly defined industrial discharges into storm drainage.

Region 5: Potomac River Transition Zone. The transition zone of the Potomac estuary and its tributary creeks is significant as a spawning area for the Potomac populations of striped bass, white perch, shad, and clupeids. This reach has historically been impacted by excessive plant and phytoplankton populations which is probably due to overenrichment from upstream sources. Since the recent partial alleviation of upstream degradation in the urban area, the water quality and ecological health in this reach appears to have improved. This area did suffer a decline of SAV as did the Bay in general, but the SAV losses can be at least partially attributed to urban inputs. This reach is critical as a finfish spawning area, and is also a major population center for estuarine dependent raptors, notably the osprey and bald eagle. The State of Maryland, which has jurisdiction over the environmental aspects of these waters, discouraged the construction of a power plant in this region because of possible ecological consequences.

Two DoD installations (NOS-Indian Head, and MCDEC-Quantico) are located in the region (see Figure 14). NOS Indian Head was screened in Study

Group 1 (significant impact potential) primarily due to: industrial pollutants, high suspended solids and BOD/nutrient levels found in the industrial discharges; as well as metals deposits in wetlands adjacent to Mattawoman Creek. MCDEC was screened in Study Group 2 (poorly defined, likely significant impact potential) due to the possible existence of toxicants in the storm drainage system, high erosion and sedimentation rates on the installation, and limited field observations indicating, on a preliminary basis, the migration of leachate into nearby surface waters from inactive landfills. In general, there is a lack of adequate data to characterize the level(s) of impact and source(s) of contamination from these installations.

Despite these concerns, the region(s) impacted by these installations in the Potomac River Transition Zone is probably limited to the immediate vicinity of each installation, due partially to the dilution capacity of the Potomac River. Environmentally beneficial activities at MCDEC have included: upgrading the sewage treatment plant to AWT with nitrification; construction of a modern fuel storage system and elimination of old spill-prone fuel storage areas; construction of a new hazardous waste storage facility and a modern sanitary landfill with a leachate collection/treatment/monitoring system; and implementation of a comprehensive natural resources and land management plan. Similarly at NOS, beneficial programs have included: significant sanitary sewage system upgrades; construction of a conforming hazardous waste storage facility; improvement of oil and chemical containment and spill control; and implementation of a natural resources management plan which includes soil conservation practices, forestry management, and wildlife habitat development.

Region 6: Potomac River Estuary. The Potomac estuarine salinity gradient becomes evident just upstream of the Blossom Point facility. The traditional estuarine species such as oysters, soft-shell clam, and blue crabs are found generally from the Navy Dahlgren facility downstream (see Figure 14). The shellfisheries and the finfisheries in the area are in general decline, as they are in the rest of the Bay. Submerged aquatic vegetation has disappeared from these reaches. Except for an increase in phytoplankton blooms, water quality is generally good. This is a nursery area for estuarine and marine spawning fishes. The two DoD facilities probably have little involvement in the far-field trends in this reach.

The confluence of the Potomac and the Bay, near the Naval Electronic Systems Engineering Activity (NESEA) facility (see Figure 14), marks one of the few remaining areas where oysters experience extraordinary reproductive success. These areas are commonly referred to as oyster "seed beds", and while diminished in extent over the past few decades, represent one of the few remaining in Maryland waters.

A relatively deep trench runs up the length of this reach, and this configuration often leads to stratification during the summer, with oxygen poor bottom waters. The potential exists for increased environ-

mental impact from increased phytoplankton production loading in the bottom waters, with further depletion of oxygen. NESEA is a relatively small Navy facility, and probably has no significant effect on these phenomena.

HDL-Blossom Point was screened in Study Group 1. Areas of concern at Blossom Point include: widespread ordnance testing, exposure of a landfill and possible exposure of additional landfills and/or septic systems by shoreline and bluff erosion; and unknown status of contaminant migration from several inactive landfills and burn/detonation pits. NSWC-Dahlgren, screened in Study Group 2, also exhibits concern related to the widespread impact from ordnance testing, as well as stormwater runoff, and potential contaminant migration into local wetlands from past discharges from industrial operations (gun barrel decoppering and degreasing). In general, there is a lack of data sufficient to characterize the levels of impact and sources of contamination from these two installations.

Other than the widespread testing of ordnance at Blossom Point and over a large area of the Potomac River near Dahlgren, the region(s) these installations impact in the Potomac River estuary is probably limited to the immediate vicinity of each installation. The lack of development at Blossom Point has proven environmentally beneficial by maintaining a rich diversity of habitat utilized by wildlife, waterfowl, and fish. Positive activities at Dahlgren have included several upgrades to the sewage treatment systems, construction of a new hazardous waste storage facility, and development of an active natural resources program, including soil conservation and habitat enhancement and protection.

Region 7: Rappahannock River. The Rappahannock River watershed is primarily an agricultural and forested area with little development. The river serves as spawning and nursery grounds for a number of anadromous and marine species and the non-tidal freshwater portion supports a high diversity of freshwater fish. Specific water quality problems observed in the Rappahannock River include elevated fecal coliform counts, seasonally low dissolved oxygen levels, and nutrient enrichment. The CBP concluded that phosphorous and total nitrogen enrichment in this area were due primarily to nonpoint source loadings from agricultural and forestry-related activities.

Fort A.P. Hill is the only DoD installation in the Rappahannock River Basin (see Figure 14). Pollutant loading contributions to the Rappahannock and York Rivers from A.P. Hill are believed insignificant, with the possible exception of sedimentation. The erosion of disturbed areas on A.P. Hill is mitigated to a large degree by the trapping of the sediment in natural retention basins formed by the ponds and lakes on the installation. Erosion is still a potential problem that needs to be adequately addressed to prevent future adverse impacts on water quality in the vicinity. The environmental management staff at A.P. Hill have made considerable progress in cleaning up past pollutant sources and

spills, and have maintained a very active natural resources program to limit erosion and to enhance local wildlife habitats.

Region 8: York River Estuary. The four DoD installations on the lower York estuary (see Figure 14) front on commercial and recreational finfishing and shellfishing grounds. This area has lost most of its SAV. There have been indications of dissolved oxygen deficiencies in bottom waters due partially to geomorphology, with the existence of natural basins or trenches which impede circulation. Increased phytoplankton production contributes organic matter, increasing oxygen demand in bottom waters. While the DoD facilities are not directly involved, the management concepts most applicable here to prevent far-field impacts are those of controlling nutrient input from nonpoint sources as well as point sources.

Back River, abutting the Langley facility (see Figure 14), has experienced many of the environmental declines noted elsewhere in the Bay, particularly the loss of SAV. The presence of the Air Force facility does not, however, seem to conflict with the positive environmental qualities of this embayment.

NSC-Yorktown and NWS-Yorktown were screened in Study Group 1 (significant impact potential). Areas of concern for these installations include: limited evidence of the migration of toxic contaminants from inactive waste disposal or spill sites into local surface waters, where preliminary observations indicate contaminant levels exceeding Federal and State criteria; poorly defined quality of discharges from storm drainage and miscellaneous industrial activities; leaking underground fuel storage tanks; and deficiencies in hazardous waste storage and handling (NWS-Yorktown). Two installations (NSC-Cheatham Annex and Langley AFB) were assigned to Study Group 2 (poorly defined, likely significant adverse impact potential). At NSC-Cheatham Annex, unresolved areas of concern include NACIP inactive waste sites, and severe shoreline erosion. At Langley AFB, concerns relate primarily to poorly defined storm water runoff quality/quantity, existence of occasional fuel spills reaching drainage areas, and lack of a stormwater management plan.

The impact of the DoD installations appears to be limited to the immediate vicinity of each installation. Compared to the surrounding point and nonpoint pollutant sources, these installations contribute an insignificant loading of conventional pollutants (BOD, nutrients, sediments) to the Chesapeake Bay. The most beneficial activities or programs sponsored by these installations for pollution control and environmental enhancement have included natural resources management (NSC Cheatham Annex and Langley AFB), pesticides/herbicides management (Langley AFB), and deactivation of sewage treatment systems (NWS Yorktown, NSC Cheatham Annex in FY88, Camp Peary in FY89). Ongoing areas of concern at these installations relate primarily to nonpoint sources that are difficult to control (i.e., shoreline erosion, stormwater runoff, inactive hazardous waste disposal, and past spill sites).

Region 9: James River Estuary. The upper James River Estuary is impacted by the urbanized Richmond area and surrounding agricultural activities. General water quality conditions are improving in this area, but are still relatively poor. Downstream from Richmond about 22 miles, at the confluence with the Appomattox River, the Hopewell area also impacts the tidal fresh waters with discharges from paper, fertilizer, chemical, and tobacco processing plants. The Hopewell area was the site of the illegal Kepone (a toxic pesticide) discharges of a decade ago, which have resulted in the James River estuary being closed to commercial finfishing to this day.

The James River estuary just below Ft. Eustis is the largest "seed oyster" area remaining in Chesapeake Bay and is a treasured resource in Virginia. Although oysters will grow in most areas of suitable salinity and substrate, areas of significant natural reproduction are declining. As a result, the "seed oyster" industry, in which blank shells are placed overboard in late spring to catch oyster spat then later removed to growing areas, assumes increasing significance. This area has also lost most of its SAV, but does not seem to be seriously affected by accelerated eutrophication.

The Hampton Roads area, downstream from the oyster seed beds, has a significant hard clam fishery and finfishery, and although bottom sediments have elevated levels of heavy metals, they have not yet impacted on the fisheries. The urban and industrial development at Hampton-Newport News, including the Naval facilities at Sewells Point, apparently have little effect on these open waters. Generally, the substantial tidal exchange of this area contributes to the ability of these waters to maintain good water quality.

Water quality and benthic conditions in the Elizabeth river, especially the south branch, are generally degraded due to the intense commercial, industrial and urban use of adjacent lands. Surprisingly, the upper reaches of these subtributaries are still utilized by certain finfishes as viable spawning and nursery areas. These reaches are also utilized by the estuarine dependent raptors, notably the osprey. The environmental management programs in this area are targeted to spillage prevention, point source controls, waste pretreatment, dredging and spoiling, etc., in contrast to eutrophication control in the upper reaches of the Bay system.

Two of the installations in this region (Sewells Point Navy Complex, Norfolk Naval Shipyard) were estimated to represent a significant adverse impact potential (Study Group 1) for local water quality. Areas of concern include:

- Preliminary evidence of the migration of toxic contaminants from inactive waste disposal or past spill sites into local surface waters, with contaminant levels exceeding Federal and State criteria;

- Poorly defined quality of discharges from storm drainage and miscellaneous industrial activities;
- Introduction of pollutants from ship maintenance activities; and
- The existence of leaking underground fuel storage tanks.

Three of the installations (Defense General Supply Center, Fort Eustis, and Naval Supply Center-Craney Island) were estimated to represent a poorly defined but likely significant impact potential (Study Group 2). Areas of concern for these three installations are similar to the previously listed concerns (contaminant migration, storm water runoff, and fuel leakage/spills). In general, there is a lack of data adequate to quantify pollutant sources and the potential impact levels from these activities. The remaining three installations (Fort Lee, Fort Monroe, St. Julien's Creek Annex) were estimated to represent an insignificant potential for water quality impacts, based on the available information.

The region impacted by the DoD installations appears to be limited to the immediate vicinity of each installation, since there are no major point sources at any of these facilities. The most beneficial programs for pollution control and environmental enhancement at DoD installations in this region have included: elimination of industrial discharges by connection to regional sewer systems (Sewells Point) with similar plans at NSC Craney Island and Norfolk Naval Shipyard; implementation of effluent toxics monitoring programs (Sewells Point, Fort Eustis); and upgrading sanitary and industrial waste water treatment systems (Fort Eustis, Craney Island, Norfolk Naval Shipyard).

Ongoing areas of concern at DoD installations in this region relate primarily to nonpoint or intermittent pollutant sources that are difficult to control. They include: stormwater runoff; dispersed intermittent sources of industrial (toxic) pollutants to sewage treatment systems and/or to storm drains; and inactive hazardous waste disposal or past spill sites.

Region 10: Mouth of Bay. This region contains three DoD installations (see Figure 14), two of which (NAB-Little Creek, NAS-Oceana) support major industrial activities. The Naval Amphibious Base dominates the small tributary, Little Creek, located near the mouth of the Bay. Other smaller industrial activities are also located on the embayment. The harbor is dredged for large vessels and is largely bulkheaded. Consequently, it is susceptible to stratification and stagnation. In spite of the nature and intensity of development in this area, water quality remains generally good.

NAS-Oceana bounds on the east side of "Canal #2", which feeds into Linkhorn Bay, to Broad Bay, and through the "narrows" to Lynnhaven Bay. Although the area is increasingly urban, the subestuary is widely used for sport boating and fishing. Water quality is generally fair, despite flushing times in the headwaters which are relatively slow.

Of the three installations in this region, two (NAS-Oceana, and NAB-Little Creek) were estimated to represent a likely significant potential for adverse water quality impacts. Fort Story was estimated to have a likely insignificant impact potential. NAS-Oceana was screened in Study Group 1 (significant impact potential, adverse), and NAB Little Creek in Study Group 2 (poorly defined but likely significant impact potential, adverse). Areas of concern for these two installations are similar, and include potential contaminant migration from several hazardous waste disposal and past spill sites adjacent to surface waters, questionable adequacy of stormwater runoff and fuel spill containment controls, and for NAB Little Creek, the need to control contaminants from ship sand blasting activities. Currently available data are generally insufficient to determine the degree of impact from these activities. As is the case at most of the DoD installations, the above activities relate primarily to nonpoint pollutant sources that are difficult to control. Beneficial activities at DoD installations in this region include control of surface erosion, and updating land management and natural resources plans.

Region 11: Susquehanna River. The Susquehanna River and its tributaries account for about 50% of the freshwater inflow to the Chesapeake Bay. Along its length, the Susquehanna flows through undeveloped mountain habitats, agricultural land, coal mining areas, urban and suburban settings, and heavy industry. Water quality in the mainstem Susquehanna, because of the relatively large volume, is generally good.

There are three DoD installations located in this region (see Figure 14), including Carlisle Barracks, New Cumberland Army Depot (NCAD), and Navy Ship Parts Control Center. The former two installations were estimated to represent a likely insignificant impact potential for surface water quality. NSPCC was found to represent a poorly defined but likely significant impact potential (Study Group 2), based on a number of concerns including stormwater runoff from ore piles and from impervious surfaces, potential for migration of trace organics to local surface drainage from past spill areas, and potential contamination from remote septic systems. Little data exist, however, to verify the level of impact of NSPCC on the quality of local receiving waters. Beneficial activities have included the decommissioning of a major helicopter maintenance activity (NCAD), and effective stormwater management (NCAD and Carlisle Barricks).

Based on the findings of this study, the overall effect of DoD activities on the Susquehanna River is believed to be insignificant.

Region 12: Non-Tidal Patuxent River. The non-tidal Patuxent River originates in the Piedmont nearly at the Fall Line and flows southeastward, parallel to the mainstem Chesapeake Bay. Extensive development in this region exists in the Baltimore-Washington corridor upriver from Ft. Meade, and the river receives treated sewage both upstream and downstream of this installation. It has been estimated that at summer low

flow conditions, half the freshwater input to the estuary is treated sewage. EPA characterizes water quality in the lower river as fair, with enrichment of nutrients, toxics, high turbidity, and accelerated siltation. Other DoD installations in this region which drain to the Patuxent River (see Figure 14) include the U.S. Naval Academy Dairy Farm, Davidsonville RDV, and Brandywine Receiving and Housing Annex. These facilities are on a riverine system nearly loaded to its carrying capacity for treated wastes. Allocation of the assimilative capacity of this system must therefore be carefully managed.

Three of the four DoD installations in this region were judged to represent a likely insignificant impact potential for surface water quality. The fourth installation, Fort Meade, was screened in Study Group 2 (poorly defined but likely significant impact potential). Areas of concern at Fort Meade include: leachate migration from the active sanitary landfill; control of erosion and sedimentation and subsequent effects on local sensitive habitat; and non-conforming hazardous waste disposal practices. In comparison to the Patuxent River basin-wide practices, the DoD installations in this region have only a minor effect on surface water quality based on currently available information. Beneficial practices at DoD installations in this region include: the implementation of progressive land management and natural resources plans (Fort Meade); the upgrading of sewage treatment systems (Fort Meade, Brandywine Receiver and Housing Annex); and the clean-up of POL and pesticide storage areas (Fort Meade, Davidsonville RDV). In addition, a lagoon has been constructed at the Naval Academy Dairy Farm to manage the runoff from its barns to eliminate potential coliform contamination. The lagoon, in turn, is used for irrigation purposes.

Region 13: Non-Tidal Potomac River. The non-tidal Potomac River and its tributaries and branches originate in the Blue Ridge and Appalachian Mountain regions, and flow generally southeasterly through the Piedmont region to the Fall Line at Washington, D.C. The land is primarily forested or agricultural, with only a few sizeable urban areas. In general, water quality is good, except for localized problems of acid mine drainage (low pH), sewage (bacterial) contamination, and agricultural runoff (nutrients, sediments, and organic material).

Five DoD installations operate in the non-tidal Potomac Region (see Figure 14). Three of these installations (NAVRADSTA-Sugar Grove, Fort Ritchie, and Fort Detrick), were judged to represent a likely insignificant impact potential (Study Groups 3 and 4) for local surface water quality. These installations appear to be well managed and are sources of minimal pollution. Letterkenny Army Depot, located at the drainage divide between the Potomac and Susquehanna Rivers, was judged to represent a poorly defined but likely significant impact potential (Study Group 2), due to contaminant sources known to exist at LEAD. Areas of concern at LEAD include: possible existence of toxics in the storm drainage system; erosion from disturbed areas; runoff of nutrients and pesticides from agricultural out-lease areas; and significant on and off-post groundwater contamination from several inactive waste disposal

sites. The preservation of large areas of the installation as natural (forested) habitat is an obvious beneficial aspect of LEAD's operational program, as this tends to reduce runoff of sediments, nutrients and pesticides in a region of concentrated agricultural activity.

Allegany Ballistics Lab (ABL) was also assigned to Study Group 2. Areas of concern at ABL include: erosion from a solid propellant test area; lack of an active NPDES permit and recurring violations for TSS and fecal coliforms at the sewage treatment plant; and the potential migration of priority pollutants and metals from several inactive waste disposal sites adjacent to the Potomac River. Although no data exist for areas downstream of ABL, the large dilution capacity of the river is believed to be adequate to minimize any pollutant loadings from ABL.

Overview. The DoD installations on the Chesapeake Bay, singly or in aggregate, do not appear to be involved in the far-field, long term trends of declining environmental integrity of the Bay ecosystem. However, information to date indicates more careful management of all lands adjacent to the estuary is necessary to reverse these trends. Restoration and protection plans have been instituted by Federal and State agencies, and DoD facility management is in accord with these initiatives.

Three areas have been identified where special diligence should be exercised: (1) the finfish spawning grounds at the Head of the Bay; (2) a similar environment in the Potomac estuary from Indian Head to Dahlgren; and (3) in the reaches of the Elizabeth River with seriously degraded environmental conditions.

In general, the DoD facilities have active environmental management programs that are based on an awareness of the environmental status of the Chesapeake Bay. Some of the larger installations, i.e., Aberdeen Proving Ground, MCDEC-Quantico, and Fort Eustis, probably benefit the Bay environmental by precluding intense waterfront development. Certain installations have particularly aggressive natural resources and land management plans. For example, Aberdeen Proving Ground performs extensive SAV planting. Fort Meade provides a major outdoor recreational area (hunting, fishing, hiking) for the public in the crowded Baltimore-Washington corridor. Fort Belvoir has established a major wildlife habitat (Accotink Wildlife Sanctuary), as has Quantico (Chopawamsic Creek).

Summary by Service

Figure 15 summarizes the relative impact potential of DoD installations by branch of Service and by Study Group. Of the fifteen installations in Study Group 1 (significant impact potential), twelve are Navy and three are Army. Of the sixteen installations in Study Group 2 (poorly defined, likely significant impact potential), eight are Navy, five are Army, two are Air Force, and one is DLA. The higher frequency of Navy

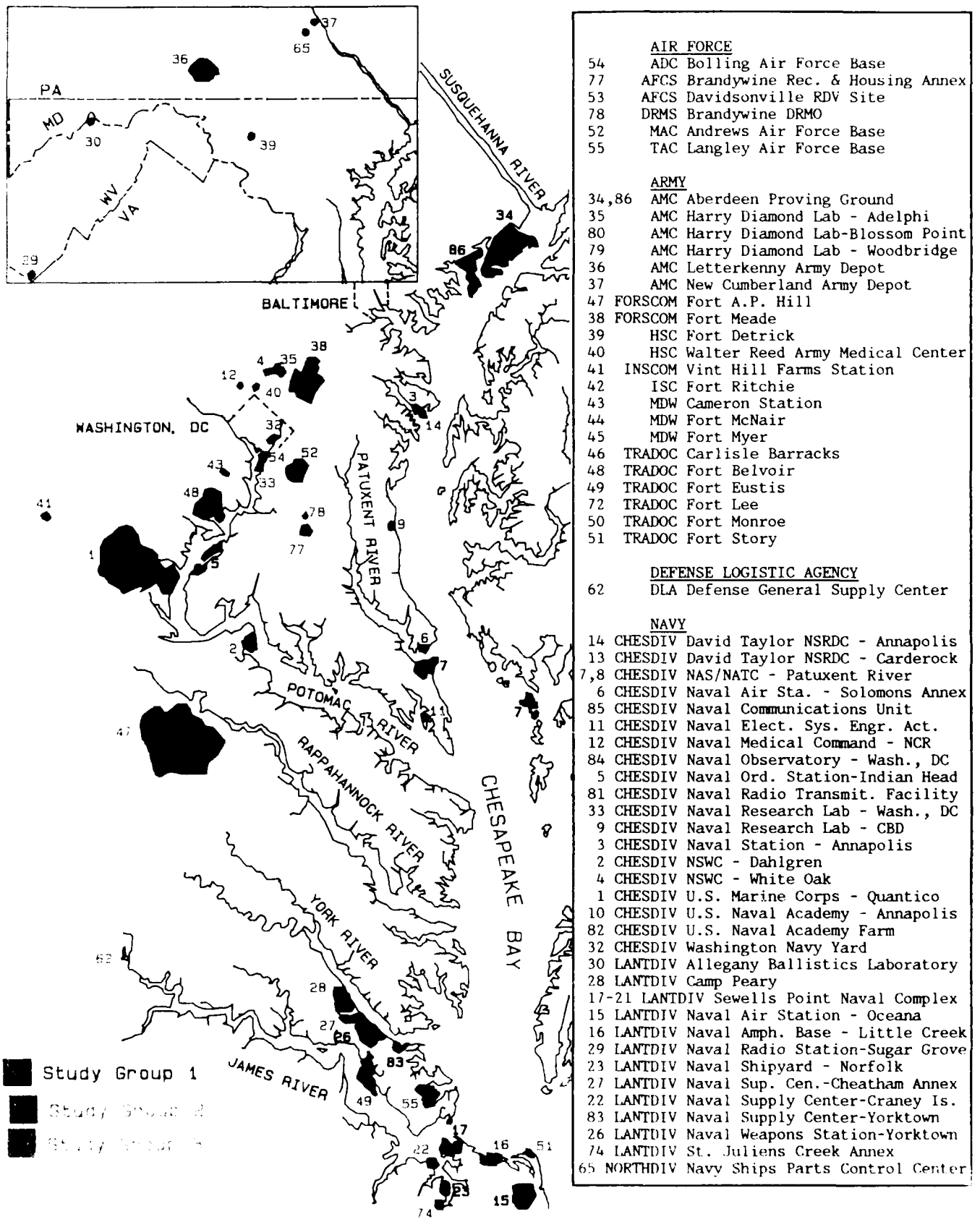
installations in these two Study Groups partially reflects the fact that there are more Navy installations operating in the Bay than all other Services combined (37 vs. 29). The Navy installations also tend to be more shoreline oriented, and many of the installations are heavily industrialized to support major naval vessel operations.

Navy installations. Of the 37 Navy installations included in this study, 16 operate under CHESDIV, 16 under LANTDIV, and one under NORTHDIV engineering field divisions. The CHESDIV installations represent the largest group (30%) of DoD installations operating in the study area, and include several large, industrialized activities along the Bay shoreline. Of these, 14 were judged to represent a likely insignificant impact potential for surface water quality. The remaining six installations were found to represent a likely significant impact potential, due primarily to: 1) the existence of inactive waste disposal or past spill sites which have the potential for contaminant migration to local surface waters; and 2) poorly characterized waste effluent from industrial activities. Programs which have contributed significantly to pollution abatement at CHESDIV facilities include: control of shoreline erosion; sewage treatment upgrades; control of pesticides; hazardous waste storage facility upgrades; implementation of spill prevention and control measures; and the development and implementation of natural resources and land management plans. With few exceptions, the environmental management programs at CHESDIV installations appear to be tightly managed with considerable support and guidance given by the Engineering Field Division of NAVFAC CHESDIV.

LANTDIV installations, primarily located in the Norfolk-Newport News area, are probably the most heavily industrialized of all the DoD installations in the Chesapeake Bay region, with major ship maintenance and support functions occurring along the Bay shoreline.

Three LANTDIV installations were judged to represent a likely insignificant impact potential for water quality (Study Groups 3 and 4). Nine of the 16 LANTDIV installations were judged to represent a significant adverse impact potential for local water quality and biological resources (Study Group 1). Areas of concern for these installations include: preliminary indication of migration of toxic contaminants from inactive waste disposal or past spill sites into local surface waters; poorly defined quality of discharges from storm drainage and industrial activities; introduction of pollutants from ship maintenance activities; and the existence of leaking underground fuel storage tanks.

Four of the LANTDIV installations were judged to represent a poorly defined but likely significant adverse impact potential (Study Group 2). The most frequently occurring area of concern for these installations is the potential, based on preliminary information, for release of toxic materials to surface waters from inactive waste disposal or past spill sites. Other areas of concern include: contaminants in stormwater runoff; periodic fuel leakage and uncertain status of underground storage tanks; occasional violations of NPDES permit limits;



AIR FORCE
54 ADC Bolling Air Force Base
77 AFCS Brandywine Rec. & Housing Annex
53 AFCS Davidsonville RDV Site
78 DRMS Brandywine DRMO
52 MAC Andrews Air Force Base
55 TAC Langley Air Force Base

ARMY
34,86 AMC Aberdeen Proving Ground
35 AMC Harry Diamond Lab - Adelphi
80 AMC Harry Diamond Lab-Blossom Point
79 AMC Harry Diamond Lab - Woodbridge
36 AMC Letterkenny Army Depot
37 AMC New Cumberland Army Depot
47 FORSCOM Fort A.P. Hill
38 FORSCOM Fort Meade
39 HSC Fort Detrick
40 HSC Walter Reed Army Medical Center
41 INSCOM Vint Hill Farms Station
42 ISC Fort Ritchie
43 MDW Cameron Station
44 MDW Fort McNair
45 MDW Fort Myer
46 TRADOC Carlisle Barracks
48 TRADOC Fort Belvoir
49 TRADOC Fort Eustis
72 TRADOC Fort Lee
50 TRADOC Fort Monroe
51 TRADOC Fort Story

DEFENSE LOGISTIC AGENCY
62 DLA Defense General Supply Center

NAVY
14 CHESDIV David Taylor NSRDC - Annapolis
13 CHESDIV David Taylor NSRDC - Carderock
7,8 CHESDIV NAS/NATC - Patuxent River
6 CHESDIV Naval Air Sta. - Solomons Annex
85 CHESDIV Naval Communications Unit
11 CHESDIV Naval Elect. Sys. Engr. Act.
12 CHESDIV Naval Medical Command - NCR
84 CHESDIV Naval Observatory - Wash., DC
5 CHESDIV Naval Ord. Station-Indian Head
81 CHESDIV Naval Radio Transmit. Facility
33 CHESDIV Naval Research Lab - Wash., DC
9 CHESDIV Naval Research Lab - CBD
3 CHESDIV Naval Station - Annapolis
2 CHESDIV NSWC - Dahlgren
4 CHESDIV NSWC - White Oak
1 CHESDIV U.S. Marine Corps - Quantico
10 CHESDIV U.S. Naval Academy - Annapolis
82 CHESDIV U.S. Naval Academy Farm
32 CHESDIV Washington Navy Yard
30 LANTDIV Allegany Ballistics Laboratory
28 LANTDIV Camp Peary
17-21 LANTDIV Sewells Point Naval Complex
15 LANTDIV Naval Air Station - Oceana
16 LANTDIV Naval Amph. Base - Little Creek
29 LANTDIV Naval Radio Station-Sugar Grove
23 LANTDIV Naval Shipyard - Norfolk
27 LANTDIV Naval Sup. Cen.-Cheatham Annex
22 LANTDIV Naval Supply Center-Craney Is.
83 LANTDIV Naval Supply Center-Yorktown
26 LANTDIV Naval Weapons Station-Yorktown
74 LANTDIV St. Juliens Creek Annex
65 NORTHDIV Navy Ships Parts Control Center

Figure 15 Summary of DoD Installation Impact Potential by Service (Command) and Study Group.

and deficiencies in the storage and handling of hazardous waste. Lack of appropriate data exist to quantify or verify the offsite impact level, if any, from these installations.

Beneficial activities or programs at LANTDIV installations for pollution control and environmental enhancement include: the elimination of major sewage discharges and connection to the regional sewerage system; industrial waste pretreatment and upgrades; upgrades in hazardous waste storage and handling procedures; implementation of spill prevention and control measures; and the development and implementation of natural resources and land management plans. The environmental management programs at most LANTDIV installations appear to be aggressively pursuing solutions to the environmental problems on these complex facilities, with considerable and effective support and guidance by the Engineering Field Division of NAVFAC LANTDIV.

The one NORTHDIV installation included in this study, Navy Ships Parts Control Center (NSPCC), was screened in Study Group 2 (poorly defined but likely significant impact potential). Areas of concern at NSPCC include: contamination of local surface waters by stormwater runoff from ore piles and impervious surfaces; potential groundwater contamination from remote septic tanks; and potential contamination of ground and surface waters from waste solvent/sludge disposal areas. There exist inadequate data in the vicinity of NSPCC to verify the extent and/or presence of contaminants in local surface waters. Beneficial activities at NSPCC have included connection of the base to the regional sewerage system and upgrading of sewage lines to eliminate extensive infiltration problems.

Army Installations. Of the 22 Army installations included in this study, seven are under Army Materiel Command (AMC), six are under Training and Doctrine Command (TRADOC), three are under Military District, Washington, D.C. (MDW), two are under Health Services Command (HSC), one is under Intelligence and Security Command (INSCOM), two under Forces Command (FORSCOM) and one under Information Systems Command (ISC). Except for three installations under AMC and two under TRADOC, most Army installations in the Chesapeake Bay region are oriented towards administrative and personnel training functions, and are not heavily industrialized. In Phase III, 14 Army installations were found to represent a likely insignificant impact potential on surface water quality (Study Groups 3 and 4). Three installations were screened in Study Group 1 (significant impact potential) and five installations were screened in Study Group 2 (poorly defined, likely significant).

Areas of concern for the Study Group 1 installations (both under AMC) include: widespread contamination of wetlands and open water areas with UXO (unexploded ordnance); potential contaminant migration into adjacent surface waters from inactive landfills or waste disposal sites and from the open burning of chemicals; shoreline erosion and exposure of a landfill; and tentative status of NPDES discharge compliance.

Letterkenny Army Depot (LEAD), originally placed in Study Group 1 during the Phase I initial screening, was reevaluated during Phase II and assigned to the Study Group 2 (poorly defined but likely significant impact potential). Available data from studies performed at LEAD indicate that, despite known groundwater contamination extending offpost and across surface drainage courses, impacts on surface water quality are probably minor due to rapid volatilization of the contaminants when exposed to air. Surface erosion and runoff of pesticides and nutrients from agricultural outlease areas were also identified as potential areas of concern at LEAD. The remaining two AMC installations were judged to represent a likely insignificant impact potential for water quality. The most beneficial programs at AMC installations for pollution control and environmental enhancement have included: upgrades to domestic and industrial waste treatment systems; implementation of spill prevention and control measures; improvements in hazardous waste storage and handling; development and implementation of natural resources and land management plans; and preservation of large undeveloped areas which act as buffer zones for surface water habitat protection. The environmental management programs at all AMC installations are progressive and well managed, with considerable support and guidance by AMC headquarters and by the Army Environmental Hygiene Agency (AEHA).

Of the six TRADOC installations, four were judged in Phase III to represent a likely insignificant potential for impacts on surface water quality (Study Groups 3 and 4). Areas of concern for the remaining two installations (Fort Belvoir and Fort Eustis) include: leachate migration from inactive landfills into local surface waters; surface erosion and stormwater runoff; and possible toxics in the sewage treatment system (Fort Eustis). Little data exist to adequately quantify pollutant sources and potential impact levels from these activities. The most beneficial programs at TRADOC installations for pollution control and environmental enhancement have included: the upgrading and/or elimination of sewage treatment systems (Fort Belvoir and Fort Eustis); cleanup of past POL and chemical spills and implementation of preventative controls; preservation of large undeveloped areas which act as buffer zones for surface water habitat protection; and development and implementation of progressive natural resources and land management programs. The environmental management staffs at these TRADOC installations have coordinated with AEHA on a variety of investigations to resolve environmental problems.

Of the remaining Army installations, all but two were judged to represent a likely insignificant impact potential. Vint Hill Farms Station (VHFS), was screened in Study Group 2 (poorly defined but likely significant impact potential). Areas of concern at VHFS include: cyanide and metals contamination of South Run downstream of the VHFS STP discharge; elevated cyanide contamination in South Run off post and downstream of the former EPA/EPIC photographic laboratory discharge/lagoon; and lack of a permit for land disposal of sludge from the STP. Beneficial activities at VHFS include: suspension of a large sandblasting and painting operation; implementation of a pretreatment system at the EPA/EPIC photographic laboratory; and planned installation

of an ultraviolet (UV) system in the STP to eliminate residual chlorine in the effluent.

Fort George G. Meade (FGGM), a FORSCOM installation, was also screened in Study Group 2. Areas of concern include: continued problems with pretreatment of NSA's industrial wastewater and its subsequent effects on STP operations; the potential leachate migration from the existing sanitary landfill; the need for erosion and sedimentation controls; and questionable hazardous waste disposal practices. Beneficial practices at FGGM include: the implementation of progressive land management and natural resources plans; the upgrading of the sewage treatment system; and the recycling of waste POL.

Fort A. P. Hill (also FORSCOM), originally placed in Study Group 2 during the initial Phase I screening, was reevaluated during Phase III and assigned to Study Group 3 (poorly defined but likely insignificant impact potential). Available information for Fort A. P. Hill indicates that the problems with sewage treatment, surface erosion, and past chemical/toxics spills have been largely confined to the base or, in the latter case, have been adequately cleaned up and controlled.

Air Force Installations. There are six USAF installations included in this study. None of the six USAF installations were screened in the category of significant adverse impacts (Study Group 1). Two of the six installations, Andrews AFB and Langley AFB, were judged to represent a poorly defined but likely significant impact potential to local water quality and biological resources. These installations involve the operation of substantial air fields with attendant large impervious surfaces and refueling and fuel storage/transfer operations. Primary concerns include: stormwater runoff carrying contaminants from large impervious surfaces (runways); unknown effectiveness and/or need for oil/water separation in storm drainage systems; and potential for contaminant migration to surface waters from poorly characterized inactive waste disposal sites. The most beneficial programs at the USAF installations for pollution control and environmental enhancement have included: the preservation of land in an undeveloped state; tightly controlled pesticides management; and the self-monitoring of water quality in the drainage pathways to determine the need for upgrade(s) or additions to oil/water separators (Langley and Andrews AFBs).

Defense Logistics Agency Installations. There is one DLA installation included in this study, Defense General Supply Center (DGSC), located near Richmond, Virginia. In Phase III, DGSC was screened in Study Group 2 (poorly defined, likely significant impact potential). Areas of concern include: the potential migration of contaminants to receiving waters from the former Fire Training Area, the former Area 50 landfill, and the Open Storage Area; as well as unknown quality of stormwater runoff from large impervious surfaces.

SUMMARY OF DOD ENVIRONMENTAL ENHANCEMENT PROGRAMS

In general, the environmental ennancement programs at the military installations in the Chesapeake Bay region are very progressive. In recent years, DoD has taken steps to eliminate and/or reduce the direct discharge of pollutants to local receiving waters. Ways in which DoD operations have been particularly beneficial to water quality conditions include:

1. **Preservation of undeveloped land** - This stabilizes the soil, reduces surface runoff of pollutants, and slows erosion rates;

2. **Maintenance and implementation of natural resources programs, soil conservation plans, wetlands management programs, forestry management plans** - These programs provide a mechanism to implement proper BMPs to preserve and enhance the environmental resources on the installation;

3. **Sewage treatment** - In recent years, a significant effort has been made to upgrade sewage treatment systems on the installations (several to AWT or tertiary systems) to conform to regulatory requirements. Another active program has involved the tie-in of sewage lines directly to the local municipal system for treatment.

4. **Hazardous waste storage and handling** - Despite ongoing problems with the removal of hazardous waste from military installations, great progress has been made in upgrading HW storage and handling facilities and in reducing the incidence of spills.

5. **IRP/NACIP** - A systematic program to identify and clean up abandoned toxic and hazardous waste sites has been established for all DoD services. The Army has tasked USATHAMA to deal with these sites where they exist on their installations and on DLA installations. The Navy has accomplished most of this through the NAVFAC EFDs with aid from NEESA, and the Air Force program is sponsored by OEHL. All three programs are aggressive and are having a beneficial effect, as manifested by the reduction and/or elimination of toxics or hazardous waste migration in groundwater.

6. **Defense Environmental Restoration Account Program (DERA)** - The IRP/NACIP activities are directed under the DERA program, through which DoD implements the Superfund Amendments and Reauthorization Act (SARA) of 1986. The major goals of DERA include: (1) the identification, investigation, and cleanup of contamination from hazardous substances; (2) the correction of other environmental damage which imminently and substantially endangers the environment and/or the public health or welfare; and (3) the demolition and removal of unsafe buildings and structures. The DERA is focused on the cleanup of past hazardous waste disposal sites located on DoD installations.

7. **Environmental Assistance Programs** - DoD services provide additional environmental engineering assistance to installations, as needed, through a number of programs designed to deal with specific health-related problems. The Army's AEHA at Aberdeen Proving Ground, the Engineering Field Divisions of NAVFAC (CHESDIV and LANTDIV) in the Navy, and OEHL in the Air Force all respond to requests by the installations for tasks ranging from laboratory analyses of suspected toxic materials to full scale environmental audits and environmental impact statements. These programs greatly enhance the ability of the installation environmental coordinator to assess and deal with water quality problems.

8. **Defense Environmental Status Reports (DESR)** - The input that the branches of military service provide to the DESR is an aid to the DoD environmental programs, and provides an up-to-date assessment of how the individual installations and services are progressing with environmental programs. It can prioritize areas needing attention and it can aid in the funding of necessary projects.

9. **DoD Environmental Audit Program** - Environmental audits performed on a three-year cycle is one of the best examples of an ongoing program to assess an installation's water quality needs. This program can also help to prioritize the needs of an installation.

10. **Advanced Wastewater Treatment (AWT) Upgrades** - A number of installations have upgraded their sewage treatment plants by incorporating AWT practices. Denitrification, phosphorous removal, UV disinfection, and multi-media sand filters are examples of AWT procedures which have been implemented at DoD installations in the Chesapeake Bay Region.

11. **OMTAP Program** - DoD's Operation, Maintenance and Training Assistance Program (OMTAP) is a pilot program designed to enhance sewage treatment plant operations at selected facilities through site-specific evaluation, analysis, and assistance. OMTAP uses a detailed on-site evaluation of each management, support, and operating function of a STP to identify both short- and long-term problems, and to recommend changes to improve the operations and effectiveness of the plant.

Activities at DoD installations which can affect the environment are extremely varied and complex (e.g., munitions production and testing, troop training activities). These activities have existed at most installations for several decades. As with private industry during this time, manufacturing processes and disposal procedures were established with little consideration of the consequences to water quality and to the environment. The current generation of the military has the difficult task of dealing with these past practices and establishing new procedures which can accomplish the military mission while maintaining a

healthier environment. DoD has made significant progress in dealing with this problem and in promoting actions and attitudes necessary to accomplish this goal.

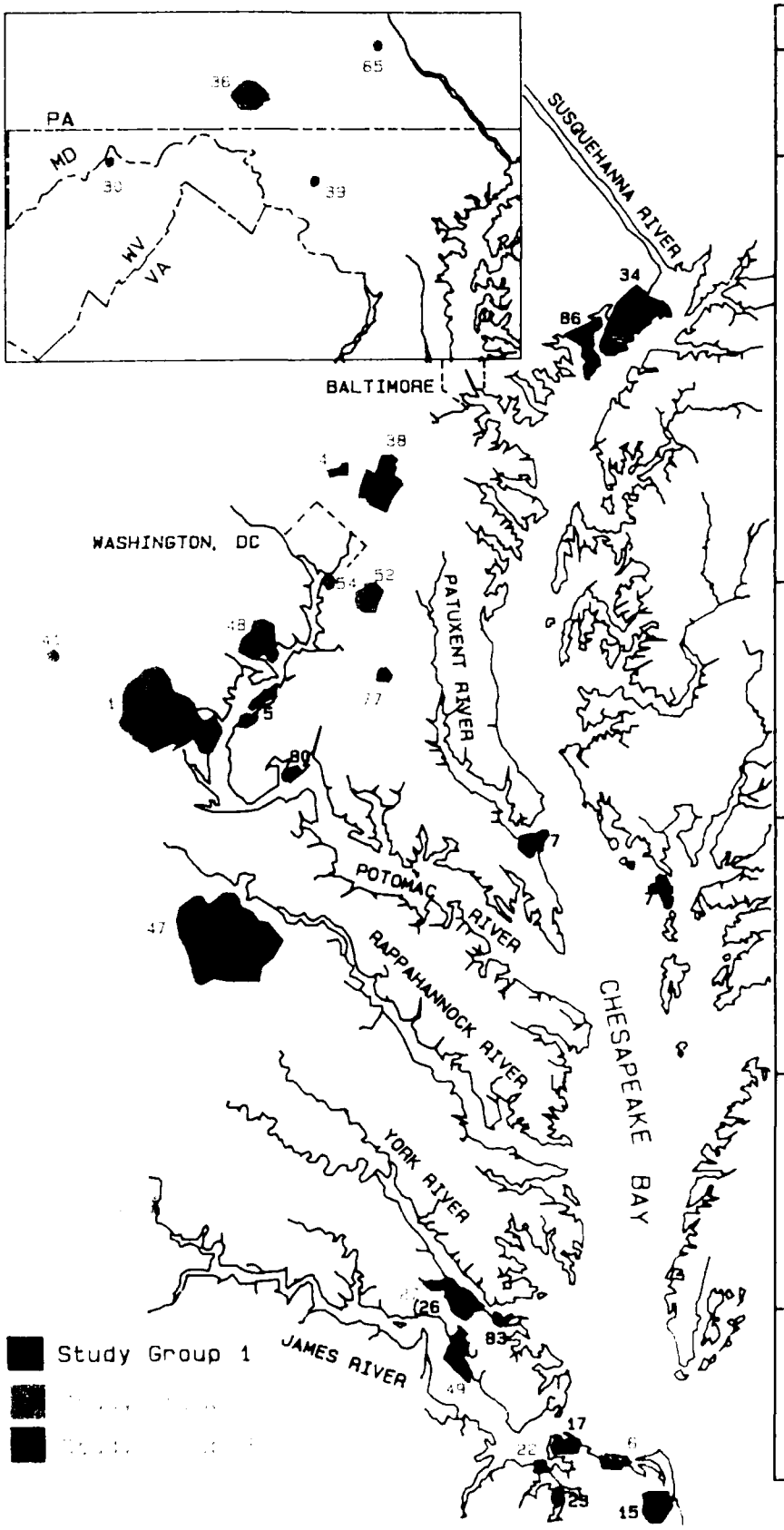
SUMMARY OF RECOMMENDED DOD STUDIES/PRACTICES OR PROJECTS

An important goal of this project is to develop recommendations for additional studies, practices or projects that could be implemented at specific DoD installations, where necessary, to restore and protect water quality and living resources of the Chesapeake Bay. These recommended actions are presented for each installation in Chapter 4.0 of Volume 2 of this report. Also, a summary of these recommended actions is presented in Table A of Appendix A, Volume 1. Table A summarizes the generic recommended actions by screening criteria. The installation-specific recommendations presented in Chapter 4.0, Volume 2 are combined under the more generic areas presented in Table A. It is recalled from Table 4 that the screening criteria were ranked according to the type of impact and frequency of occurrence of concerns under each criterion. This ranking level, also indicated in Table A, can be used to help prioritize the recommendations according to greatest frequency and relative importance for protection of the Bay's aquatic resources.

As observed in Table A for point sources, nonpoint sources and hazardous/toxic materials (criteria 1-18) the most frequently occurring recommendations relate to abandoned waste disposal sites, impervious area runoff, erosion/siltation, underground storage tank (UST) status, combined storm drains, and industrial waste treatment. For environmental programs (criteria 19-24), the most frequently occurring recommendations include development of stormwater management plans, soil conservation plans, and wetlands management plans.

Included in Table A, for each generic recommendation, are an approximate cost range, a qualitative description of the water quality benefits associated with implementing the recommended action, and a list of installations for which the generic recommendation was identified. It is emphasized that the cost estimates are only very approximate (order of magnitude). In some cases the estimated range may be quite large due to the wide variety and scope of activities at the installations. These costs are based on available information from both DoD and non-DoD sources for projects similar in scope to those presented here. Also, the description of benefits to water quality are highly generalized, since the quantification of benefits in terms of the increased value of biological resources or recreational use is difficult and arbitrary. More detailed information on each installation-specific recommendation can be obtained by reviewing the appropriate section in Chapter 4.0 of Volume 2 of this report.

Finally, as a visual aid in interpreting these generic recommendations, Figures 16 through 25 have been prepared. These figures present the locations of installations which received recommendations under the top ten ranked criteria for point sources, nonpoint sources, and hazardous/toxic materials. These figures can be used in conjunction with Table A to locate installations listed under each generic recommendation for these criteria.



CRITERION 17 - ABANDONED SITES

General Concern - Migration of toxic contaminants to local surface waters from abandoned hazardous waste disposal or spill sites.

Recommendation 17a - Proceed with next round of Confirmation Study sampling and testing.

26 Naval Weapons Station-Yorktown
27 NSC - Cheatham Annex
83 NSC - Yorktown
22 NSC - Craney Island
23 Naval Shipyard - Norfolk
16 NAB - Little Creek
30 Allegany Ballistics Lab
34,86 Aberdeen Proving Ground
52 Andrews AFB
54 Bolling AFB
62 Defense General Supply Center
5 Naval Ordnance Sta.-Indian Head
17-21 Sewells Point Naval Complex
36 Letterkenny Army Depot
38 Fort Meade

Recommendation 17b - Eliminate/control/treat leachate from landfills.

7,8 NAS/NATC - Patuxent River
1 USMC/MCDEC - Quantico
49 Fort Eustis
41 Vint Hill Farms Station
62 Defense General Supply Center
39 Fort Detrick

Recommendation 17c - Implement containment control measures as outlined in Confirmation Study.

4 NSWC - White Oak
23 Naval Shipyard - Norfolk
15 NAS - Oceana
65 NSPCC - Mechanicsburg, PA
34,86 Aberdeen Proving Ground
7,8 NAS/NATC Patuxent River
5 Naval Ordnance Sta.-Indian Head

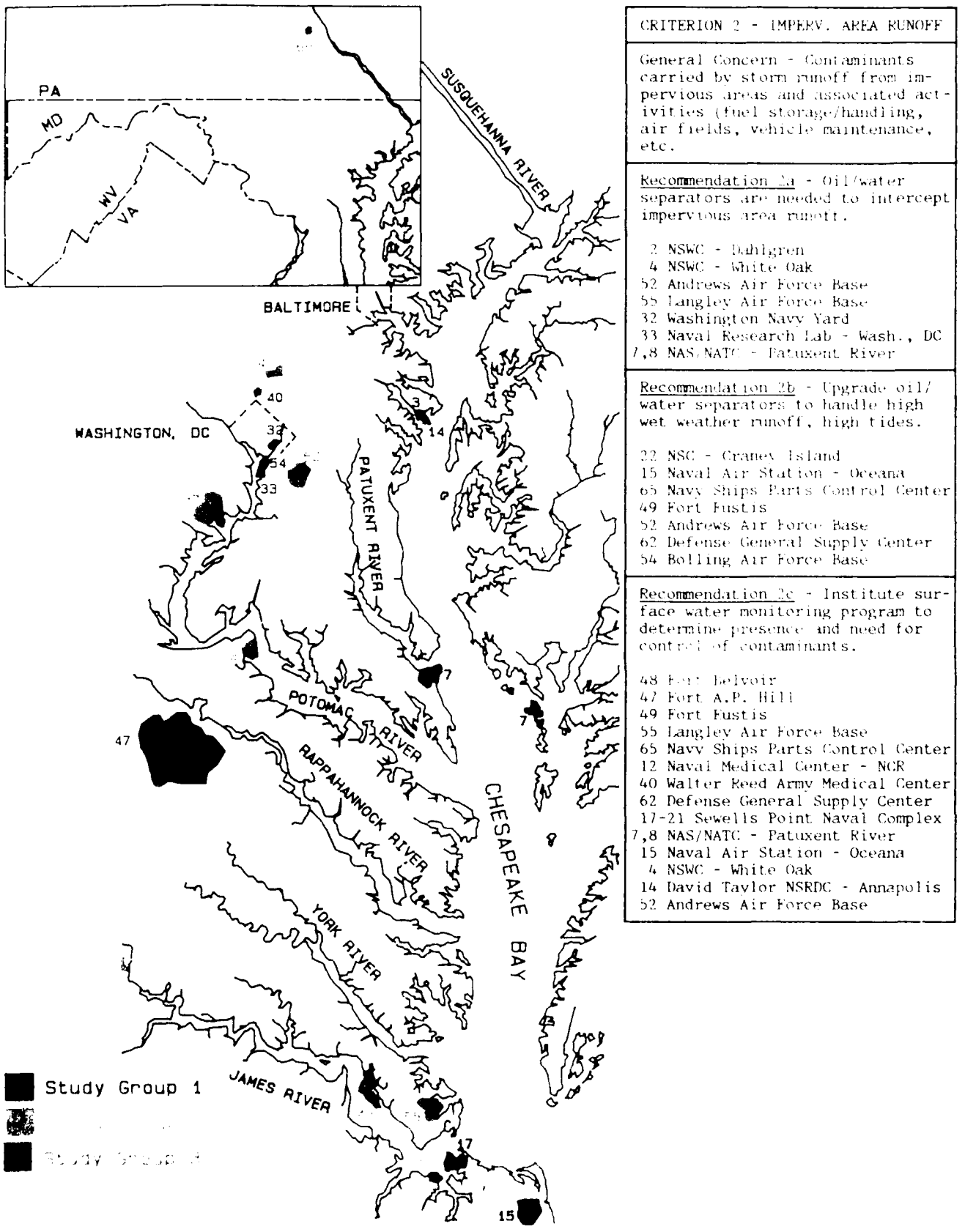
Recommendation 17d - Confirm containment/migration of POL floating on ground water or in soil near tanks.

22 NSC - Craney Island
23 Naval Shipyard - Norfolk
77 Brandywine RDV
62 Defense General Supply Center
47 Fort A.P. Hill

Recommendation 17e - Implement Confirmation Study at site(s) identified in IAS.

80 HDL - Blossom Point
48 Fort Belvoir
62 Defense General Supply Center

Figure 16 Summary of Recommended Actions and Installation Locations for Criterion 17 - Abandoned Waste Sites (Rank 1 of 18).



CRITERION 2 - IMPERV. AREA RUNOFF

General Concern - Contaminants carried by storm runoff from impervious areas and associated activities (fuel storage/handling, air fields, vehicle maintenance, etc.

Recommendation 2a - Oil/water separators are needed to intercept impervious area runoff.

2 NSWC - Dahlgren
4 NSWC - White Oak
52 Andrews Air Force Base
55 Langley Air Force Base
32 Washington Navy Yard
33 Naval Research Lab - Wash., DC
7,8 NAS/NATC - Patuxent River

Recommendation 2b - Upgrade oil/water separators to handle high wet weather runoff, high tides.

22 NSC - Craney Island
15 Naval Air Station - Oceana
65 Navy Ships Parts Control Center
49 Fort Eustis
52 Andrews Air Force Base
62 Defense General Supply Center
54 Bolling Air Force Base

Recommendation 2c - Institute surface water monitoring program to determine presence and need for control of contaminants.

48 Fort Belvoir
47 Fort A.P. Hill
49 Fort Eustis
55 Langley Air Force Base
65 Navy Ships Parts Control Center
12 Naval Medical Center - NCR
40 Walter Reed Army Medical Center
62 Defense General Supply Center
17-21 Sewells Point Naval Complex
7,8 NAS/NATC - Patuxent River
15 Naval Air Station - Oceana
4 NSWC - White Oak
14 David Taylor NSRDC - Annapolis
52 Andrews Air Force Base

Figure 17 Summary of Recommended Actions and Installation Locations for Criterion 2 - Impervious Area Runoff (Rank 2 of 15).

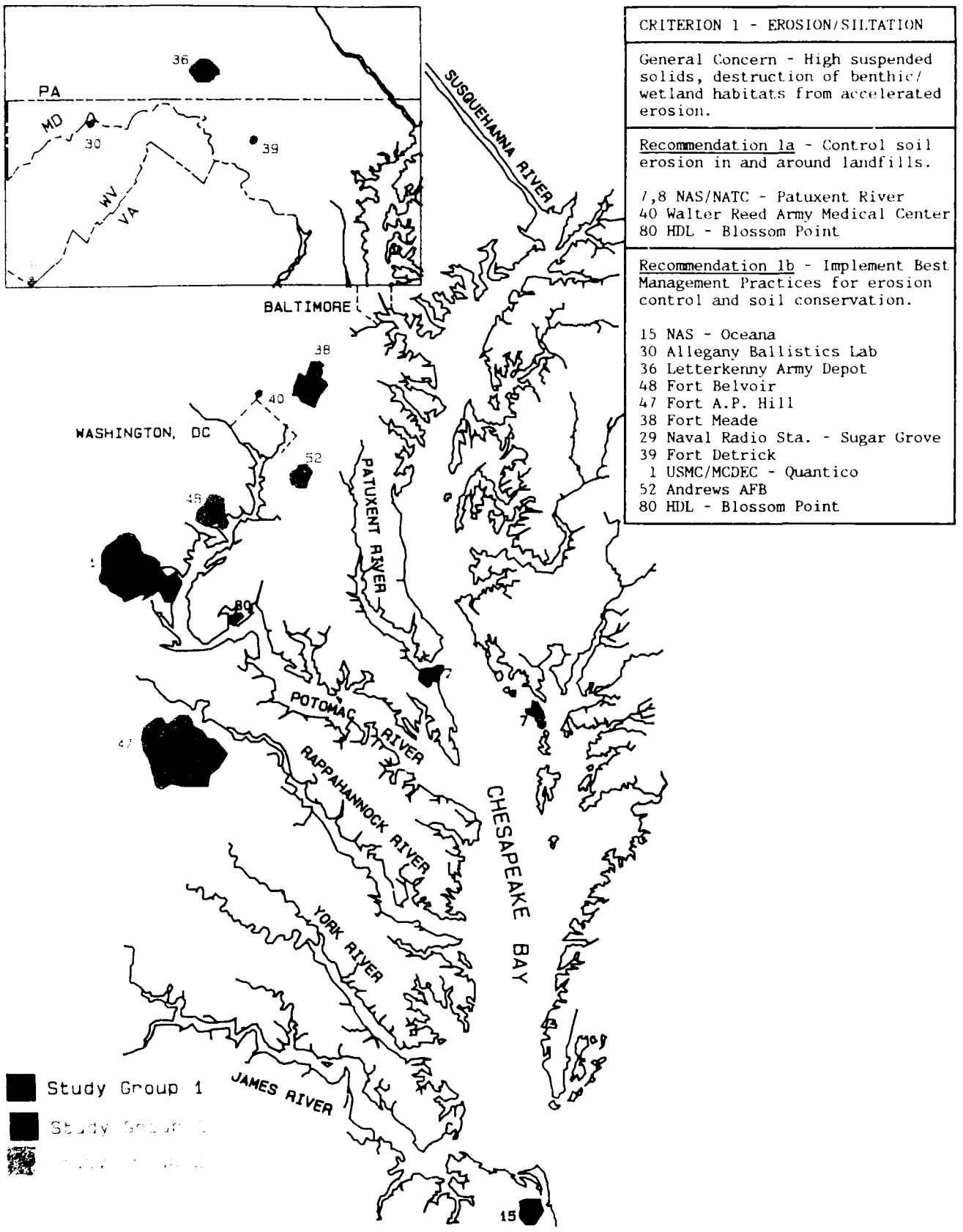


Figure 18 Summary of Recommended Actions and Installation Locations for Criterion 1 - Erosion/Siltation (Rank 3 of 18).

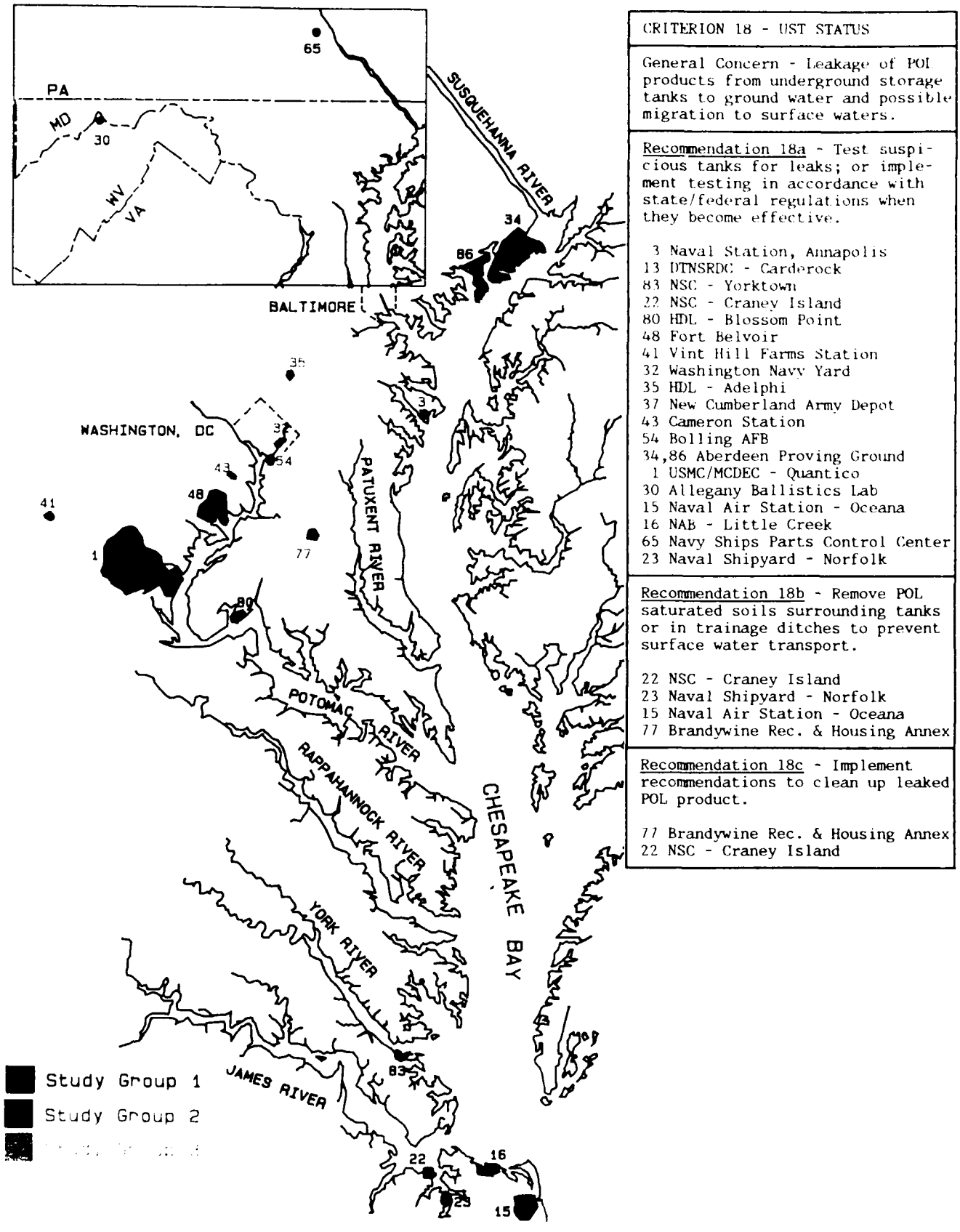


Figure 19 Summary of Recommended Actions and Installation Locations for Criterion 18 - UST Status (Rank 4 of 18).

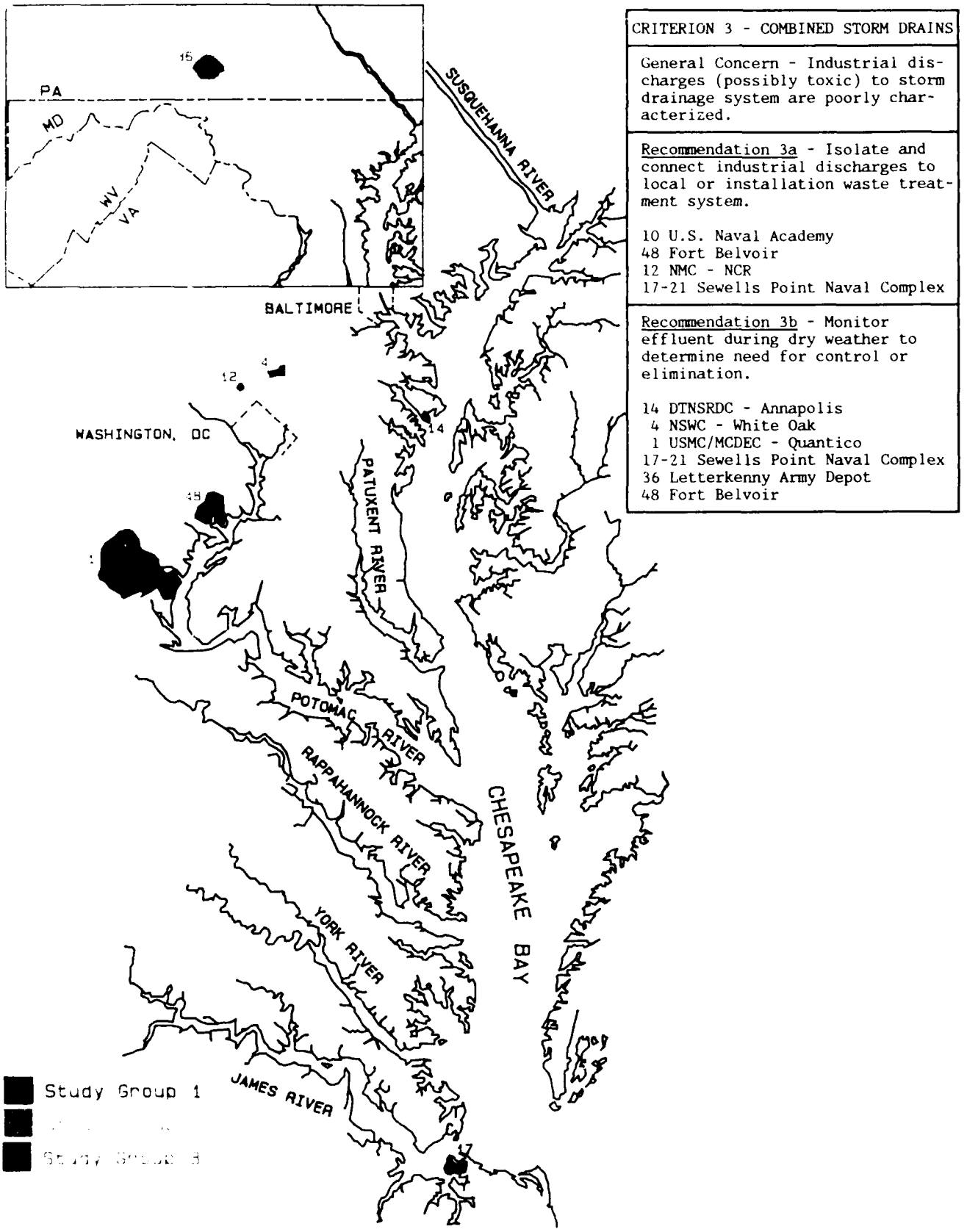
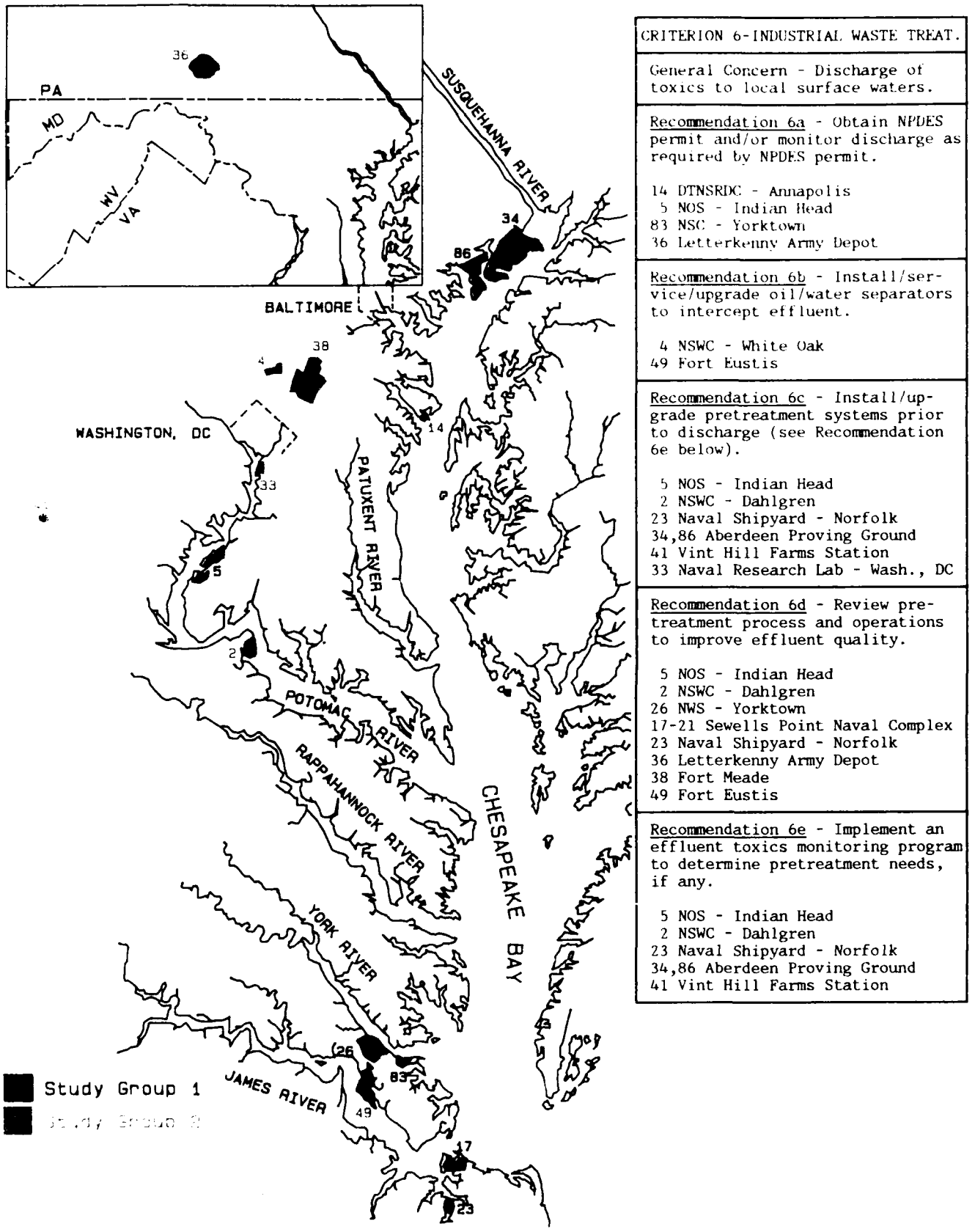
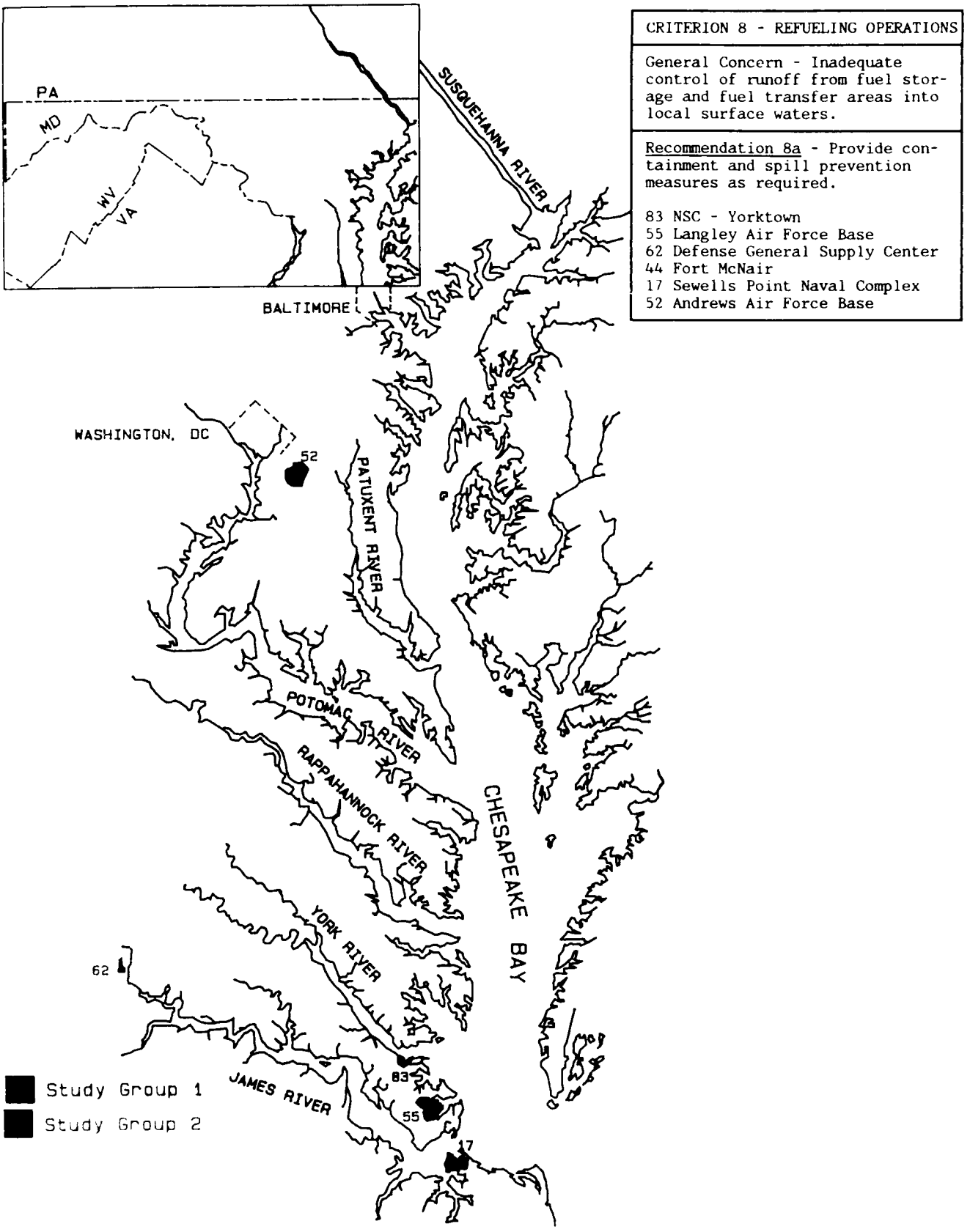


Figure 20 Summary of Recommended Actions and Installation Locations for Criterion 3 - Combined Industrial/Storm Drains (Rank 5 of 18).



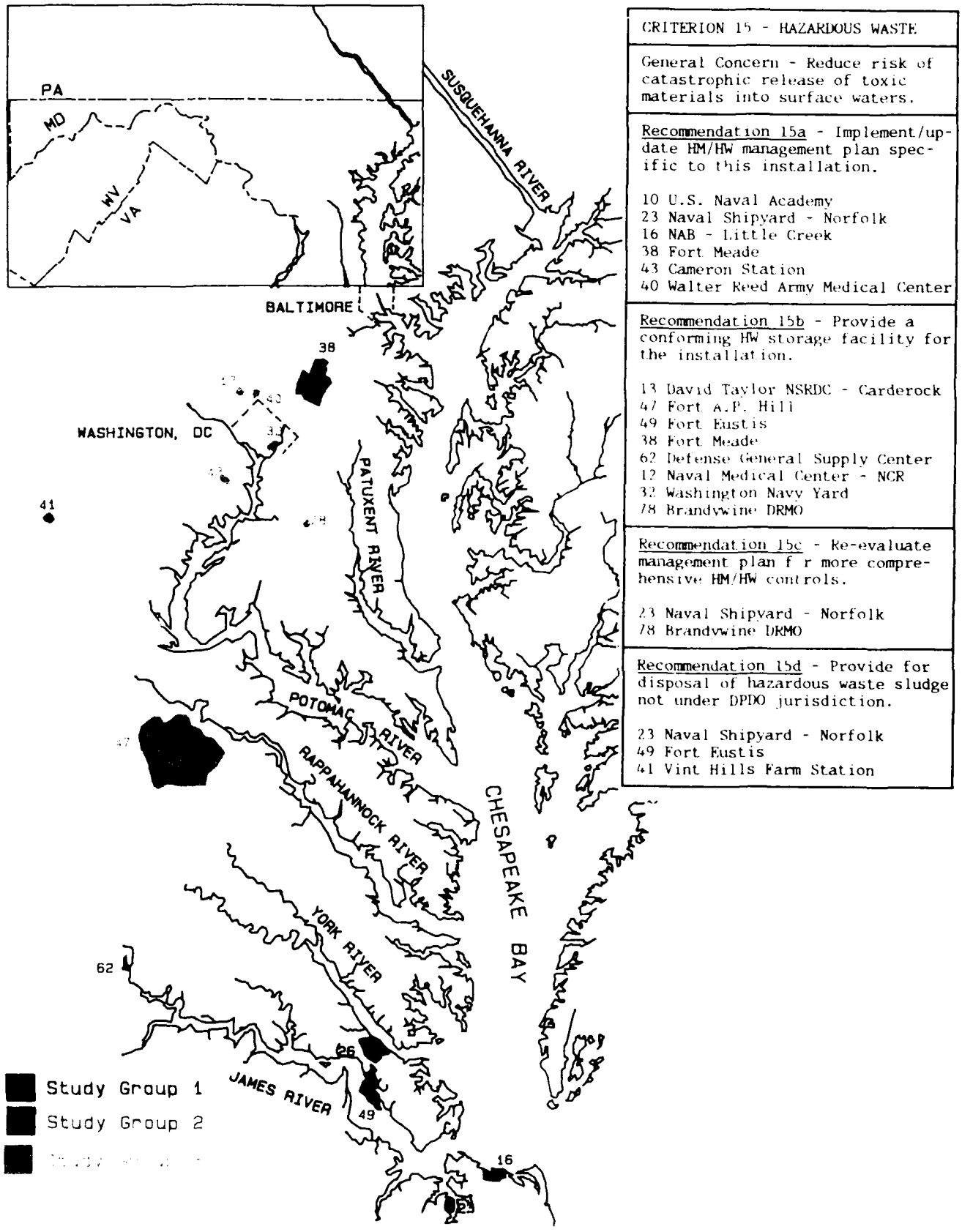
CRITERION 6-INDUSTRIAL WASTE TREAT.
General Concern - Discharge of toxics to local surface waters.
Recommendation 6a - Obtain NPDES permit and/or monitor discharge as required by NPDES permit. 14 DTNSRDC - Annapolis 5 NOS - Indian Head 83 NSC - Yorktown 36 Letterkenny Army Depot
Recommendation 6b - Install/service/upgrade oil/water separators to intercept effluent. 4 NSWC - White Oak 49 Fort Eustis
Recommendation 6c - Install/upgrade pretreatment systems prior to discharge (see Recommendation 6e below). 5 NOS - Indian Head 2 NSWC - Dahlgren 23 Naval Shipyard - Norfolk 34,86 Aberdeen Proving Ground 41 Vint Hill Farms Station 33 Naval Research Lab - Wash., DC
Recommendation 6d - Review pretreatment process and operations to improve effluent quality. 5 NOS - Indian Head 2 NSWC - Dahlgren 26 NWS - Yorktown 17-21 Sewells Point Naval Complex 23 Naval Shipyard - Norfolk 36 Letterkenny Army Depot 38 Fort Meade 49 Fort Eustis
Recommendation 6e - Implement an effluent toxics monitoring program to determine pretreatment needs, if any. 5 NOS - Indian Head 2 NSWC - Dahlgren 23 Naval Shipyard - Norfolk 34,86 Aberdeen Proving Ground 41 Vint Hill Farms Station

Figure 21 Summary of Recommended Actions and Installation Locations for Criterion 6 - Industrial Waste Treatment (Rank 6 of 18).



CRITERION 8 - REFUELING OPERATIONS
General Concern - Inadequate control of runoff from fuel storage and fuel transfer areas into local surface waters.
Recommendation 8a - Provide containment and spill prevention measures as required. 83 NSC - Yorktown 55 Langley Air Force Base 62 Defense General Supply Center 44 Fort McNair 17 Sewells Point Naval Complex 52 Andrews Air Force Base

Figure 22 Summary of Recommended Actions and Installation Locations for Criterion 8 - Refueling Operations (Rank 7 of 18).



CRITERION 15 - HAZARDOUS WASTE

General Concern - Reduce risk of catastrophic release of toxic materials into surface waters.

Recommendation 15a - Implement/update HM/HW management plan specific to this installation.

10 U.S. Naval Academy
23 Naval Shipyard - Norfolk
16 NAB - Little Creek
38 Fort Meade
43 Cameron Station
40 Walter Reed Army Medical Center

Recommendation 15b - Provide a conforming HW storage facility for the installation.

13 David Taylor NSRDC - Carderock
47 Fort A.P. Hill
49 Fort Eustis
38 Fort Meade
62 Defense General Supply Center
12 Naval Medical Center - NCR
32 Washington Navy Yard
78 Brandywine DRMO

Recommendation 15c - Re-evaluate management plan f r more comprehensive HM/HW controls.

23 Naval Shipyard - Norfolk
78 Brandywine DRMO

Recommendation 15d - Provide for disposal of hazardous waste sludge not under DPDO jurisdiction.

23 Naval Shipyard - Norfolk
49 Fort Eustis
41 Vint Hills Farm Station

Figure 23 Summary of Recommended Actions and Installation Locations for Criterion 15 - Hazardous Waste (Rank 8 of 18).

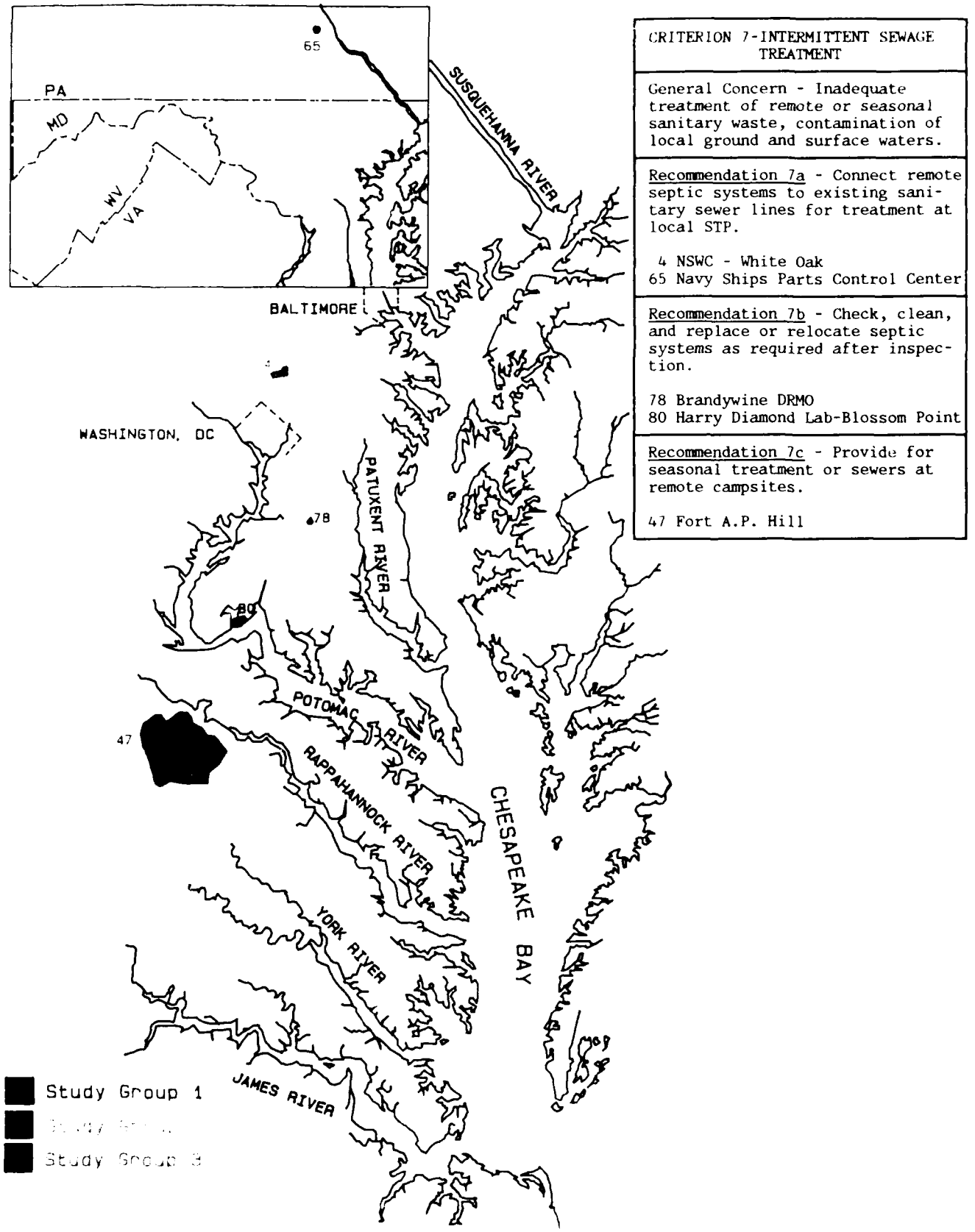


Figure 24 Summary of Recommended Actions and Installation Locations for Criterion 7 - Intermittent Sewage Treatment (Rank 9 of 18).

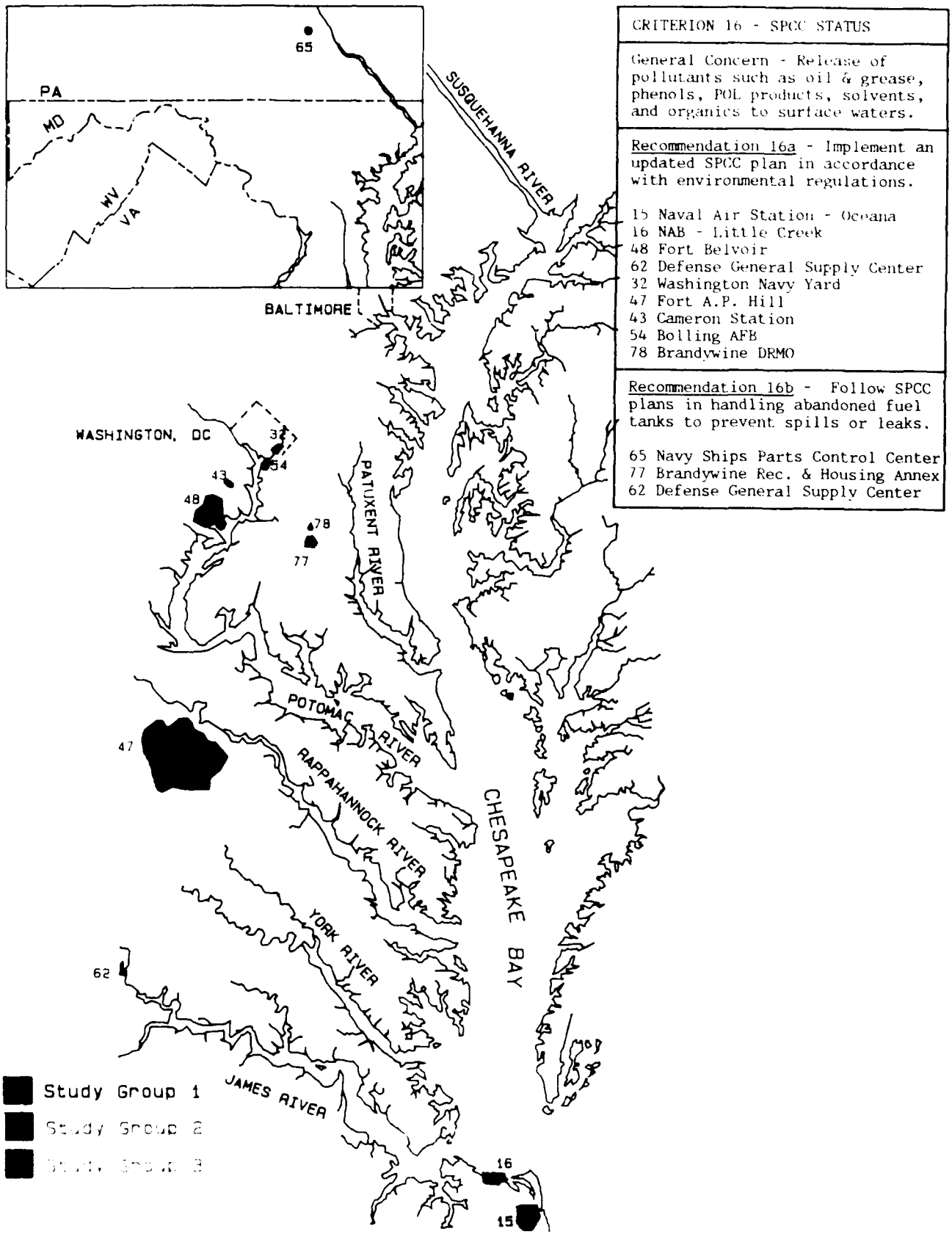


Figure 25 Summary of Recommended Actions and Installation Locations for Criterion 16 - SPCC Status (Rank 10 of 18).

CHAPTER 5: PROJECT SUMMARY

GENERAL FINDINGS AND CONCLUSIONS

An assessment of the relative impact of 66 DoD installations on water quality conditions in the Chesapeake Bay area has been performed. The focus of the study has been on surface water quality, and is not intended as an "audit" or an environmental assessment of all DoD activities in the Bay region. In addressing water quality concerns, however, a wide range of activities has been examined which affords DoD the opportunity to identify needed enhancements in areas that have the potential to impact water quality.

The installation assessment methodology, developed specifically for this study, considered all of the major areas of concern identified in the EPA Chesapeake Bay Program. The major strength of the methodology has been to provide a structured, orderly process in which a large amount of information was processed in a relatively short time, as well as to evaluate all installations on a common basis. The methodology has also provided a "new" perspective of an installation's activities relative to the surrounding activities and environment.

The major limitation of the assessment methodology has been in the total dependence upon available information and data. No field data were collected as part of this study. It is relatively rare that the historical data base includes appropriate constituents and the spatial and temporal coverage to adequately define or verify a suspected cause and effect relationship between an installation pollutant source and local water quality contamination. Despite this limitation, areas of concern for potential water quality impacts have been identified based on the similarity of characteristics of pollutant sources known to have created impacts at other locations and activities. Recommendations to address these concerns have been identified, where needed, for each installation.

General findings and conclusions of this study are summarized in the following:

- With the exception of the Naval Surface Weapons Center at Dahlgren, Harry Diamond Labs - Blossom Point, and Aberdeen Proving Ground, the military activities appear to play a minor role in the regional or far-field water quality conditions of Chesapeake Bay. Dahlgren, Blossom Point, and Aberdeen Proving Ground, however, are unique because of the impacts of ordnance shelling over large test ranges in the adjacent open waters and/or on-site wetland areas. In terms of conventional pollutants (BOD, nutrients, sediments), the military installations appear to contribute a relatively insignificant loading of pollutants to the Chesapeake Bay and tributaries, compared to surrounding point and nonpoint sources.

- The most beneficial programs at the military installations are related to: sewage treatment upgrades or connection to a municipal system; hazardous waste storage/handling; SPCC plan implementation and containment of fuel spills; and implementation of natural resource management plans.

- Areas that represent ongoing problems at the military installations relate primarily to nonpoint or intermittent pollutant sources that are difficult to control. They include: stormwater runoff; dispersed, intermittent sources of industrial (toxic) pollutants to sewage treatment systems and/or to storm drains (which are permitted and tested only for conventional pollutants); and abandoned hazardous waste disposal sites.

- The discharge of toxics from poorly defined point and nonpoint sources (including abandoned waste disposal sites) is potentially the most important issue related to the preservation of water quality on or near the military installations. Certain toxic constituents (e.g., hydrophobic organic compounds such as pesticides, polynuclear aromatic hydrocarbons, and halogenated hydrocarbons and inorganic compounds such as heavy metals) are of special concern due to the tendency to adsorb to sediments and to accumulate in the estuarine sediment bed, where benthic organisms are exposed over long periods of time. There is insufficient quantitative data and information at most installations, however, to accurately assess the need for specific controls or cleanup of toxic pollutant sources. Despite the compilation of an extensive data base for this study, few suitable data sets exist to determine whether a cause and effect relationship exists between installation contaminant sources and water quality impacts. This becomes even more apparent in situations where vicinity contaminant sources overlap and/or obscure contaminant sources from the military installation (e.g., Skiffes Creek at Fort Eustis). Installations which have exhibited toxic contamination of local surface waters, based on preliminary limited data, include Aberdeen Proving Ground, NOS-Indian Head, Naval Shipyard-Norfolk, Naval Supply Center-Yorktown, Naval Weapons Station-Yorktown, and Vint Hill Farms Station.

- DoD has performed especially well in areas that have required direct response to Federal and State regulatory procedures. Examples include sewage treatment (NPDES -Clean Water Act), hazardous waste storage and disposal (RCRA), SPCC programs (Clean Water Act), and investigation of abandoned hazardous substances disposal sites (CERCLA). On the other hand, improved performance is needed in areas that are relatively ineffectively regulated by Federal and State laws. These include control of toxic substances in sewage and industrial waste treatment systems, control of miscellaneous industrial discharges in storm drains (combined storm drains), and control of pollutants in stormwater runoff. It is important to note that many NPDES

permits are likely to be upgraded by EPA to include monitoring for priority pollutants and other toxic substances. The fact of good compliance with a permit, based only on conventional constituents, may obscure contaminant contributions from the installation in non-monitored areas.

GENERAL RECOMMENDATIONS

The following paragraphs address specific water quality related problem areas common to many of the DoD installations in the Chesapeake Bay study area, along with suggested recommendations to improve performance.

1. **Long-term Monitoring Needs** - It is believed that the control of toxics (and nutrients) from poorly defined point and nonpoint sources is the most important issue related to the preservation of local receiving water quality near military installations. Unfortunately, there is a lack of data to adequately quantify discharge characteristics, levels of impacts (if any) and required controls on such discharges. Because of this lack of information, a long-term monitoring program is recommended for: 1) toxics in sewage or industrial waste treatment plant effluent; 2) toxics in intermittent storm water drainage; and 3) field monitoring for conventionals and toxics in the receiving water and sediments in the immediate vicinity of an installation. Although these activities are not currently required, it is believed that NPDES permit requirements will be upgraded by the EPA to include monitoring for toxic pollutants. At Fort Eustis, for example, an Effluent Toxics Monitoring Program has been recently instituted to determine the need for pretreatment and/or elimination of several minor industrial waste processes discharging to the on-post sewage treatment system. At NOS Indian Head, a major feasibility study is underway to design a series of industrial waste treatment systems to consolidate and treat approximately 48 intermittent industrial discharges/storm drains in conjunction with a revised NPDES permit to control and monitor industrial pollutants. As a way of anticipating changes to the regulatory requirements regarding toxics, it may be in the best interest of DoD to conduct a certain level of "self-monitoring" in order to plan appropriately, as well as to isolate the effects of military activities from upstream or possibly overlapping pollutant sources.

2. **Nonpoint Source Runoff Control** - In recent years water quality managers have become increasingly aware of the impacts associated with nonpoint source runoff. The EPA Chesapeake Bay Program has identified nonpoint source runoff as a major cause of water quality and resource habitat degradation in the Chesapeake Bay and its tributaries.

   This study has found evidence of nonpoint source contributions such as erosion, sediment runoff, and stormwater discharges from military installations. While a number of installations have begun actions

to address these problems, their effectiveness in controlling nonpoint source runoff is uncertain. A systematic examination of sources of water quality impacts, on an installation-by-installation basis, would provide the necessary information to develop comprehensive action plans to reduce nonpoint source problems. Considerable expertise exists within the services and agencies such as the Soil Conservation Service (SCS) to assist with nonpoint source evaluation and planning.

3. **Hazardous/Toxic Materials** - The accidental release of hazardous waste into the Chesapeake Bay and its tributaries can have a significant impact on water quality and biological productivity of the receiving water. Implementation of and strict adherence to the management requirements of the RCRA regulations is necessary to insure minimal degradation of the ecological resources of Chesapeake Bay.

   Provision of adequate storage space for hazardous wastes in approved storage facilities helps to lessen the probability that the wastes will accidentally enter receiving waters. Installations having approved Part A and Part B permits, conforming hazardous waste storage facilities (where required), as well as timely and efficient removal of the hazardous wastes have a significantly lower potential for the accidental release of hazardous waste into receiving waters.

   At the time of the installation visits, the hazardous material storage facilities were in compliance at most of the installations. Nonconforming storage facilities included those at NAS/NATC-Patuxent, DTNSRDC-Carderock, Andrews AFB, Norfolk Naval Shipyard and Fort Meade. Construction projects are planned to bring Fort Meade into compliance by FY89. Part B permits for DTNSRDC-Carderock and Andrews AFB have been submitted and are under review. Norfolk Naval Shipyard has a conforming storage facility, but it is full, resulting in storage of hazardous materials in other nonconforming areas. At NAS/NATC-Patuxent, a conforming storage area has recently been built and is awaiting final approval by the State of Maryland. Deficiencies in the temporary hazardous materials storage areas at Patuxent have been identified and require action. High priority should be given to bringing these and any other nonconforming storage facilities into compliance.

   Several installations have experienced delays in the pick up of hazardous materials by the DLA disposal contractors. These include, but are not limited to, DTNSRDC-Carderock, HDL-Adelphi, Andrews AFB, Fort Meade, and Walter Reed Army Medical Center. The procedures for enforcing contract provisions should be improved to include contract authority at the point of material pick up. Flexibility and authority at the lowest level of DLA contract implementation will provide the appropriate level of support needed by the Services.

In some cases, hazardous materials are stored in nonconforming areas because the capacity of the installation's existing storage area is being used to store waste materials which are to be sold by DLA. DLA has experienced difficulty finding buyers for certain types of waste materials, and these materials can take up needed storage space for the ongoing activities on the installation. The economic resale value of waste materials needs to be balanced against maintaining an adequate and safe storage capacity for ongoing installation activities.

4. **Sewage Treatment Systems** - Considerable progress has been made by DoD over the last several years in upgrading its sewage treatment plants and/or directing sewage to regional municipal systems for treatment. Continued improvements in NPDES permit compliance for existing wastewater treatment systems at DoD installations has been and continues to be aided by the provision of technical assistance, training seminars (refresher courses), and diagnostic evaluations to determine sources of system operational deficiencies. It is believed that operation and maintenance (O & M) training and operating assistance has the potential for improving discharge permit compliance, especially at small treatment plants. Official recognition and awards for exemplary and sustained compliance can also be used as an incentive to improve compliance.

5. **Installation Environmental Programs and Retention of Personnel** - At some installations, the effective implementation and continuity of environmental programs is hampered by the high turnover rate of installation environmental personnel. A number of the installations visited had environmental coordinators who had been on the job for less than two years. The reasons for the turnover are probably numerous but most often are related to promotion considerations or requested transfers. In some cases, a gap has existed between assignments of environmental coordinators, where ideally an overlap should occur to allow for proper transfer of information and training.

   Enhancement of continuity could be achieved in a number of ways. The turnover rate could be reduced by creating more opportunities for career and salary advancement in the environmental coordinator staff positions. If a high turnover is inevitable, continuity could be provided by the environmental engineering staff at the command level (e.g., NAVFAC divisions, AMC, TRADOC, etc.). To some extent this support is currently provided, but the regular demands on existing command level staff may prevent the day-to-day type of support and attention that is required at an installation.

   It is recommended that the Services and DoD continue to implement educational programs for installation administrative personnel (i.e., commanders and section chiefs and supervisors), where necessary, to clarify the relationship between sound environmental planning and the defense mission. Also, enhancement of the status and priority of environmental programs as well as continuation of

appropriate staff training will probably contribute to staff satisfaction and continuity.

6. **Tenant Organizations and Security Considerations** - The relationship of the tenant organizations with the installation's environmental programs may require change. In certain instances the tenant organizations on an installation create water quality problems which are the responsibility of the host installation's environmental officer, but not under his or her direct control. Because avenues of approach often cross command, or even Service levels, these problems can be difficult to reconcile. In other cases, the environmental officer may not be fully aware of all activities taking place on the installation. One recommendation is to establish an environmental oversight committee which would consist of representatives from the tenant organizations. The committee would meet on a regular basis, review planned activities, and anticipate and reconcile any problems. This type of program has been implemented at Andrews AFB, for example, and has facilitated the environmental officer's task.

   It is strongly recommended that personnel in secure activities on an installation participate in establishing the above-mentioned oversight group, and cooperate, consistent with security concerns, in providing the environmental officer with information necessary to develop an effective water quality program. Secure tenants should also work within their own framework to insure their discharges and waste management activities are controlled. This can be facilitated by the activity training in-house environmental personnel, who have appropriate security access, to develop in-house programs consistent with the installation's overall environmental objectives.

7. **DoD's Role in the Chesapeake Bay Restoration and Protection Plan** - The foundation of this study has been the Joint Resolution signed by DoD and EPA in 1984 which officially involved DoD in the Chesapeake Bay Restoration and Protection Plan. The installation evaluations and recommendations developed under this study are fashioned after the goals and objectives identified by the EPA and the States of Maryland and Virginia (EPA, 1983). There is a continuing need for DoD, EPA and the states to cooperate in developing and implementing specific programs to meet the objectives of the Plan. The following lists a number of suggested recommendations for consideration:

   - DoD's data collection/monitoring programs should be coordinated with EPA/State data collection programs to maximize continuity and efficiency. A coordinated monitoring plan would offer significant benefits to each program in terms of reduced expenditures, amount of time required to complete the task, and the creation of a more usable data base. It would be advantageous for all monitoring data collected by DoD to be incorporated into a data base format compatible with the EPA Chesapeake Bay data base, as described by SCI (1986).

- The action plan developed by the Chesapeake Bay Restoration and Protection Plan should be used as a guide to develop DoD's environmental programs in the Chesapeake Bay region. The installation - specific recommendations developed during this study and presented in Volume 2 are based on all relevant aspects of these action plans.

- It is recommended that DoD consider offering certain installation environmental projects as demonstration or pilot projects for the EPA and State programs. Such projects could involve testing of stormwater runoff control devices/plans, shoreline erosion control devices, agricultural practices on outlease areas, and/or effluent toxics monitoring programs. Benefits from such cooperative efforts would include an improvement in DoD's environmental management capability while simultaneously fostering an improvement in public and interagency relations.

8. **Recommendations Directed at the EPA/State Agency Levels** - Most environmental problems at DoD installations are not unique to DoD. Private industry, agricultural activities, and the municipal infrastructure experience the same type of problems and are the main contributors of pollutants to the Bay. In fact, DoD has responded remarkably well to environmental regulations, especially regarding the direct discharge of effluent from sewage treatment plants. However, regulations are being constantly upgraded, and many areas of environmental concern are not adequately addressed by current regulations (e.g., nonpoint source loadings). Regulatory agencies and the military would probably benefit from more coordinated efforts especially with regard to new developments in the regulations and with regard to areas identified as concerns for the Chesapeake Bay Restoration and Protection Plan, i.e., nonpoint source control, elimination of industrial discharges to storm sewers, control of toxics in sewage effluent, and wetlands restoration and protection. This could be accomplished in part by establishing training programs conducted by EPA or other agencies to improve technology and information transfer to the military's environmental managers.

   An advantage that the military has over private industry, agriculture, and the municipal infrastructure throughout the Chesapeake Bay region is its ability to develop, direct and control a program uniformly throughout the DoD services when initiated from the top down. This capability can be utilized efficiently by DoD to implement new directives in the regulations.

9. **Recommendations For Ongoing Study Efforts** - Presented below are a list of recommendations aimed at improving the study effort:

   a. Prepare "guidance models" for the recommended actions or programs/practices at DoD installations. Examples include plans to monitor effluent for toxicants, stormwater management plans, soil conservation plans, wetlands management plans, and point

and nonpoint source field monitoring programs. Also it is recommended that cost guidelines be prepared for estimating the implementation cost of various environmental programs. Where possible, the guidance models would be based on examples taken directly from DoD installations in the study region, e.g., the Fort Eustis Effluent Toxics Monitoring Program.

2. Update the installation screening procedure as new projects, practices, and data develop at DoD installations. This update can be used as a measure of progress for DoD's role in the Chesapeake Bay Restoration and Protection Plan, and to help redefine priorities, if necessary, for focusing resources in key problem areas.

3. Consider selecting one or more "control" installations for more detailed evaluation. This would primarily include, but not be limited to, collecting field data to better quantify pollutant loadings and receiving water conditions. The control installation(s) would serve as a benchmark to judge the validity and accuracy of the installation assessments performed as part of this study.

4. Consider adding risk assessment to the methodology to evaluate potential water quality and living resources impacts from hazardous waste spills/accidents, oil spills, catastrophic events, and general single event occurrences. Associated with this assessment would be: an in-depth review of SPCC plans, hazardous waste management plans, biocides application guidelines, etc.; an evaluation of past spill/accident history at each installation; and a ranking of the "criticality" of the applicable Bay regions in terms of the environmental risk.

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Tetra Tech, Inc., 1986. Water Quality Assessment of DoD Installations/Facilities in the Chesapeake Bay Region, Phase I Report - Data Gathering and Installation Screening. U.S. Army Corps of Engineers, Baltimore District Contract DACA 31-85-C-0168, October, 1986.

Tetra Tech Inc., 1987. Water Quality Assessment of DoD Installations/Facilities in the Chesapeake Bay Region, Phase II Report-Development and Testing of Installation Assessment Methodology. U.S. Army Corps of Engineers, Baltimore District Contract DACA 31-85-C-0168, June, 1987.

APPENDIX A

SUMMARY OF GENERIC RECOMMENDED ACTIONS, ESTIMATED COSTS, AND QUALITATIVE BENEFITS

Table A Summary of Generic Recommendations and Their Estimated Costs and Potential Benefits to Surface Water Quality

SCREENING CRITERIA	GENERIC RECOMMENDATIONS	ESTIMATED COST	INSTALLATIONS INVOLVED	POTENTIAL BENEFITS TO SURFACE WATER QUALITY
1. Erosion/ Sedimentation Pollutant of concern: Total Suspended Solids (TSS)	a. Control soil erosion in and around landfill sites	For 10 acre site: $40,000 (erosion control only) to $400,000 (clay cap, cover, erosion and leachate control)	7,8 NAS/NATC Patuxent 40 Walter Reed Med. Ctr. 80 HDL - Blossom Point	Reduction in suspended solids increases light penetration, reduce clogging of gills, enhance spawning habitats, reduces smothering of benthic organisms/plants, and reduces transport of heavy metals/organics sorbed to sediment.
	b. Implement erosion controls for stormwater runoff using BMPs	Sediment basins: < 50 acres $5,000 > 50 acres $10,000 + Stormwater Conveyance Channel: riprap lined $50/yd^2 concrete $80/yd^2 Check dams (rock): $30/yd^3 Drop Structure: $120/yd^3 Streambank Protection: nongrouted riprap $45/yd^2 grouted riprap $60/yd^2 gabions $90/yd^3 log cribbing $90/yd^3	15 Naval Air Sta-Oceana 30 Allegany Ballis. Lab 36 Letterkenny Army Dep. 48 Fort Belvoir 47 Fort A. P. Hill 38 Fort Meade 29 NAVRADSTA - Sugar Grove 39 Fort Detrick 1 USMC - Quantico 52 Andrews AFB 80 HDL - Blossom Point	Same as above (see also Appendix C) Volume 2

Table A Summary of Generic Recommendations and Their Estimated Costs and Potential Benefits to Surface Water Quality (Continued)

SCREENING CRITERIA	GENERIC RECOMMENDATIONS	ESTIMATED COST	INSTALLATIONS INVOLVED	POTENTIAL BENEFITS TO SURFACE WATER QUALITY
2. Impervious Area Runoff Pollutants of Concern: Oil and Grease, heavy metals, hydrocarbons, TSS	a. Oil/water separators are needed to intercept impervious area runoff prior to reaching surface waters	<u>To construct one separator</u>: $5,000 to $20,000	4 NSWC - White Oak 52 Andrews AFB 55 Langley AFB 32 Wash. Naval Yard 33 Naval Research Lab 7,8 NAS/NATC Patuxent	Reduction of oil and grease and hydrocarbons reduces long-term sublethal effects on cellular and physiological processes such as feeding and reproduction. Reduction of toxic organics or heavy metals residuals reduces risk of histopathological abnormalities, metabolic and fecundity suppression, simplification of trophic levels, increase in pollutant tolerant species, and unsuitable spawning and living conditions. (see also Appendix C)
	b. Upgrade oil/water separators to handle high flow (wet) conditions, high tide conditions	<u>To upgrade one separator</u>: $5,000 to $20,000	22 Naval Sup. Ctr. - Craney 15 Naval Air Sta. - Oceana 65 Navy SPCC 49 Fort Eustis 52 Andrews AFB 62 Defense Gen. Sup. Ctr. 54 Bolling AFB	
	c. Institute surface water monitoring program to determine if contaminants are present and whether there is a need for controls	<u>To design program</u> (See Appendix A Volume 2): $20,000 <u>To monitor seasonally</u>: $25,000/yr - "small" installation (approx. 5 stations, conventionals, metals) $100,000/yr - "large" installation (approx. 20 stations conventionals, metals) NOTE: Double or triple above costs to include priority pollutants	65 Navy SPCC 48 Fort Belvoir 47 Fort A. P. Hill 49 Fort Eustis 55 Langley AFB 62 Defense Gen. Sup. Ctr. 12 Naval Med. Com. - NCR 40 Walter Reed Med. Ctr. 7,8 NAS/NATC Patuxent 4 NSWC - White Oak 14 David Taylor - Annapolis 17 Sewells Pt. Naval Cmpx. 52 Andrews AFB	

Table A Summary of Generic Recommendations and Their Estimated Costs and Potential Benefits to Surface Water Quality (Continued)

SCREENING CRITERIA	GENERIC RECOMMENDATIONS	ESTIMATED COST	INSTALLATIONS INVOLVED	POTENTIAL BENEFITS TO SURFACE WATER QUALITY
3. Combined Storm Drains Pollutants of Concern: Toxics (primary); BOD/nutrients/TSS/ low pH/Oil & Grease (secondary)	a. Connect combined storm drain discharge into local or installation sanitary sewer system for treatment by STP	<u>For one drain</u>: $30,000 to $150,000 (depending on gravity or pumped system)	10 U.S. Naval Academy 48 Fort Belvoir 12 Naval Med. Com. - NCR 17 Sewells Pt. Naval Cmpx.	Reduction of toxic organics or heavy metals residuals reduces risk of histopathological abnormalities, metabolic and fecundity suppression, simplification of trophic levels, increase in pollutant tolerant species, and unsuitable spawning and living conditions. Reduction in nutrients decreases likelihood of eutrophication conditions (biological nuisances). Reduction in BOD reduces deoxygenation by decaying organic material, resulting in higher dissolved oxygen levels for aquatic biota. Avoidance of low pH reduces toxicity levels of certain compounds in solution, and reduce direct physiological stress to aquatic biota.
	b. Monitor effluent during dry and wet weather to determine need for separators, or other controls	<u>Per station per year</u>: $5,000 - conventionals only $25,000 -conventionals, metals, priority pollutants NOTE: Typical monitoring program would include from 4 to 20 station	14 David Taylor - Annapolis 4 NSWC - White Oak 1 USMC - Quantico 17 Sewells Pt. Naval Cmpx. 36 Letterkenny Army Dep. 48 Fort Belvoir	

Table A Summary of Generic Recommendations and Their Estimated Costs and Potential Benefits to Surface Water Quality (Continued)

SCREENING CRITERIA	GENERIC RECOMMENDATIONS	ESTIMATED COST	INSTALLATIONS INVOLVED	POTENTIAL BENEFITS TO SURFACE WATER QUALITY
4. Shoreline Erosion Pollutants of Concern: TSS, heavy metals	a. Implement bluff/shoreline erosion control measures where on-site facilities are threatened	Low energy zone: (vol. loss < $1yd^3/ft/yr$) $25/ft bank treatment $125/ft revetment or $100/ft vegetative planting Moderate energy zone: (1 < vol. loss < 2) $yd^3/ft/yr$ $25/ft bank treatment $125/ft revetment or $175/ft gabion breakwater High energy zone: (vol. loss > $2yd^3/ft/yr$) $25/ft bank treatment $375/ft revetment or $350/ft offshore breakwater or $300/ft bulkhead timber Notes: 1) Other shore protection alternatives exist 2) Selection of type and cost is highly dependent on local conditions, wave exposure, access, geotechnical conditions and degree of protection needed. 3) Bank treatment includes removal of exposed trees and reduction of slope grade.	3 Naval Station - Annap. 7,8 NAS/NATC - Patuxent 5 NOS - Indian Head 27 Naval Sup. Ctr.-Cht.Anx. 80 HDL - Blossom Point 9 Naval Res. Lab. - CBD 6 Naval Air Sta. - Sol Anx 11 Naval Elect. Sys. Eng. 28 Camp Peary 51 Fort Story	Reduction in suspended solids increases light penetration, reduces clogging of gills, enhances spawning habitats, reduces smothering of benthic organisms/plants, and reduces transport of heavy metals/organics sorbed to sediment.

Table A Summary of Generic Recommendations and Their Estimated Costs and Potential Benefits to Surface Water Quality (Continued)

SCREENING CRITERIA	GENERIC RECOMMENDATIONS	ESTIMATED COST	INSTALLATIONS INVOLVED	POTENTIAL BENEFITS TO SURFACE WATER QUALITY
5. Sewage Treatment Pollutants of Concern: BOD, TSS, Nutrients, Chlorine	a. Correct design and/or operation inadequacies to improve plant effluent quality	Flow equalization tank: $175,000 (small system) (controls BOD/TSS) Holding Ponds: $80,000 (small system) Develop Procedures Manual: $25,000 - $50,000 NOTE: Small system <20,000 GPD	3 Naval Station - Annap. 1 USMC - Quantico 2 NSWC - Dahlgren 30 Allegany Ballist. Lab 34 Aberdeen Proving Ground 47 Fort A. P. Hill 41 Vint Hill Farms Sta.	Reduction in BOD will reduce deoxygenation by decaying organic material, resulting in higher dissolved oxygen levels for aquatic biota. Reduction in nutrients decreases likelihood of eutrophication conditions (biological nuisances).
	b. Eliminate chlorine residual from STP discharge	Corrections to System: $25,000 (small system) $100,000 (large system) NOTE: Large system >100,000 GPD	5 NOS - Indian Head 2 NSWC - Dahlgren 34 Aberdeen Proving Ground	The State of Maryland has a zero chlorine discharge requirement. Reduction in residual chlorine reduces generation of chlorine complexes which are toxic to aquatic life and result in physiological stress and avoidance behavior.
	c. Upgrade deteriorated sewage collection system	Upgrade to new system: $25,000 to $2,000,000	85 Naval Com. Unit 50 Fort Monroe 45 Fort Myer	Deteriorated sewage collection system is susceptible to leaks which may contaminate ground water supply and/or reach surface waters.

Table A Summary of Generic Recommendations and Their Estimated Costs and Potential Benefits to Surface Water Quality (Continued)

SCREENING CRITERIA	GENERIC RECOMMENDATIONS	ESTIMATED COST	INSTALLATIONS INVOLVED	POTENTIAL BENEFITS TO SURFACE WATER QUALITY
6. Industrial Waste Treatment Pollutants of Concern: TSS, BOD, Nutrients, heavy metals, phenols, trace organics, H_2S, pH	a. Obtain NPDES permit and/or monitor discharge as required by NPDES permit (permit may require pre-treatment or plant process upgrades)	Monitoring Cost (per outfall): $5,000 to $20,000 per year $5,000 - quarterly for conventionals and metals $20,000 - monthly for conventionals and metals. Quarterly for priority pollutants	14 David Taylor - Annap. 5 NOS - Indian Head 83 Naval Sup Ctr - Yorktown 36 Letterkenny Army Dep.	Reduction of toxic organics or heavy metals residuals reduces risk of histopathological abnormalities, metabolic and fecundity suppression, simplification of trophic levels, increase in pollutant tolerant species, and unsuitable spawning and living conditions.
	b. Install/service/upgrade oil/water separator(s) to intercept effluent	$5,000 to $20,000	4 NSWC - White Oak 49 Fort Eustis	
	c. Install/upgrade (as necessary) pre-treatment system prior to discharge of effluent	Typical Examples: Sludge dewatering, metals removal- $65,000 Medical waste incinerator - $225,000 Pathological incinerator - $75,000 Plating shop - $125,000 Paint stripping-$15,000 PNC facility - $135,000 HBNQ - $55,000 Motor cleanout -$10,000 Paint booth - $10,000 Sulfate removal - $1,000,000	5 NOS - Indian Head 2 NSWC - Dahlgren 23 Naval Shipyard - Norfolk 34 Aberdeen Proving Ground 41 Vint Hill Farms Sta. 33 Naval Research Lab	reduces toxicity of certain compounds in solution, and reduce direct physiological stress to aquatic biota. Reduction in sulfates reduces risk of H_2S production in anaerobic waters, which would reduce stressful conditions to aquatic biota. Reduction in nutrients decreases likelihood of eutrophication conditions (biological nuisances). Reduction in BOD reduces deoxygenation by decaying organic material, resulting in higher dissolved oxygen levels for aquatic biota.

Table A Summary of Generic Recommendations and Their Estimated Costs and Potential Benefits to Surface Water Quality (Continued)

SCREENING CRITERIA	GENERIC RECOMMENDATIONS	ESTIMATED COST	INSTALLATIONS INVOLVED	POTENTIAL BENEFITS TO SURFACE WATER QUALITY
6. Industrial Waste Treatment (continued) Pollutants of Concern: TSS, BOD, Nutrients, heavy metals, phenols, trace organics, H_2S, pH	d. Review pretreatment process and operations to improve effluent quality	Process Review/ Assessment: $ 20,000 to $200,000 NOTE: Cost dependent on process type and size	2 NSWC - Dahlgren[1] 26 NWS - Yorktown[2] 17 Sewells Pt Navy Cmpx[3,5] 23 Naval Shipyard - Norfolk 36 Letterkenny Army Dep[6] 38 Fort Meade[3] 5 NOS Indian Head[1] 49 Fort Eustis[7]	Same as above.
	e. Implement Effluent Toxics Monitoring Program	Design Program: $20,000 - $50,000 Monitor: $10,000 - $30,000 per year per outfall	5 NOS Indian Head 2 NSWC Dahlgren 23 Naval Shipyard - Norfolk 34 Aberdeen Proving Ground 41 Vint Hill Farms Sta.	

[1] TSS, BOD, Nutrients
[2] Explosives
[3] Metals
[4] PAHs
[5] Phenols
[6] H_2S
[7] Trace Organics

Table A Summary of Generic Recommendations and Their Estimated Costs and Potential Benefits to Surface Water Quality (Continued)

SCREENING CRITERIA	GENERIC RECOMMENDATIONS	ESTIMATED COST	INSTALLATIONS INVOLVED	POTENTIAL BENEFITS TO SURFACE WATER QUALITY
7. Intermittent or Remote Sewage Treatment Pollutants of Concern: BOD, nutrients, coliforms	a. Connect septic systems to existing sanitary sewer lines for treatment at STP	Connection Costs: $50,000 to $100,000 (each system)	4 NSWC - White Oak 65 Navy SPCC 3 Naval Station - Annap.	Reduction in BOD reduces deoxygenation by decaying organic material resulting in higher dissolved oxygen levels for aquatic biota. Reduction in nutrients decreases likelihood of eutrophication conditions (biological nuisances). Reduction in coliform bacteria may be necessary to meet State/Federal water quality criteria.
	b. Check, clean and replace/ relocate septic systems as required after inspection.	$20,000 - $40,000	80 HDL - Blossom Point 78 Brandywine DRMO	
	c. Provide for seasonal treatment of "grey water" at remote campsites	Small Package STP: $500,000 - 0.5 MGD $40,000/year O & M	47 Fort A. P. Hill	

Table A Summary of Generic Recommendations and Their Estimated Costs and Potential Benefits to Surface Water Quality (Continued)

SCREENING CRITERIA	GENERIC RECOMMENDATIONS	ESTIMATED COST	INSTALLATIONS INVOLVED	POTENTIAL BENEFITS TO SURFACE WATER QUALITY
8. Refueling Operations Pollutants of Concern: petroleum hydrocarbons, fuels, oil and grease	a. Provide secondary containment and spill protection measures as required	$10,000 to $1,500,000 (depends on measures required and size of facility) examples: containment pad for sulvents, chemicals with drains and holding tanks - $200,000 Berm around fuel storage area - $10,000 Oil/water Separator- $5,000 - $20,000 Oil Spill Prevention facilities: wash racks, oil/water separator, treatment system for drainage - $1,500,000	83 NSC - Yorktown 55 Langley AFB 62 Defense Gen. Sup. Ctr. 44 Fort McNair 52 Andrews AFB	Reduction of oil and grease and hydrocarbons reduces long-term sublethal effects on cellular and physiological processes such as feeding and reproduction. Prevention of large oil spills prevents short-term acute lethal effects on aquatic life forms, and drowning of waterfowl.

Table A Summary of Generic Recommendations and Their Estimated Costs and Potential Benefits to Surface Water Quality (Continued)

SCREENING CRITERIA	GENERIC RECOMMENDATIONS	ESTIMATED COST	INSTALLATIONS INVOLVED	POTENTIAL BENEFITS TO SURFACE WATER QUALITY
9. Munitions Operations Pollutants of Concern: Ordnance, toxics, propellants, chemical agents	a. Cease ordnance impacts in wetlands or rivers/bay. Construct man-made water impact areas if necessary	Unknown	80 HDL - Blossom Point 34 Aberdeen Proving Ground 2 NSWC - Dahlgren	Reduce impact of physical stress from shock waves and chemical stress from ordnance chemicals (organics and heavy metals). Reduce destruction of valuable wetland habitat.
	b. Monitor stormwater runoff from munitions testing or detonation areas	Develop Program: $ 15,000 - $40,000 Monitoring Cost: $ 25,000 -"small" site 2-3 sampling stations $100,000 -"large" site 10-15 sampling stations (cost per site - one time event, seasonal sampling, metals and priority pollutants)	34 Aberdeen Proving Ground	Reduction of toxic organics or heavy metals residuals reduces risk of histopathological abnormalities, metabolic and fecundity suppression, implification of trophic levels, increase in pollutant tolerant species, and unsuitable spawning and living conditions.

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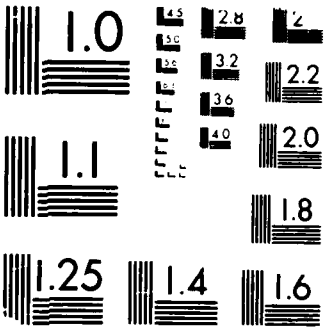

Table A Summary of Generic Recommendations and Their Estimated Costs and Potential Benefits to Surface Water Quality (Continued)

SCREENING CRITERIA	GENERIC RECOMMENDATIONS	ESTIMATED COST	INSTALLATIONS INVOLVED	POTENTIAL BENEFITS TO SURFACE WATER QUALITY
10. Chemical Operations Pollutants of Concern: Trace organics, exotic chemical agents, propellant chemicals, heavy metals	a. Establish monitoring program to confirm/deny migration of pollutants from laboratory and/or testing area	Develop Program: $25,000 Monitoring Cost: $25,000 -"small" site 2-3 sampling stations $100,000 -"large" site 10-15 sampling stations (cost per site - one time event, seasonal sampling metals, priority pollutants, chemical agents)	30 Allegany Ballist. Lab 34 Aberdeen Proving Ground	Reduction of toxic organics or heavy metals residuals reduces risk of histopathological abnormalities, metabolic and fecundity suppression, simplification of trophic levels, increase in pollutant tolerant species, and unsuitable spawning and living conditions.
	b. Add burnpad/detonation areas to confirmation sites list	Confirmation Monitoring: $25,000 to $50,000 (per site - one time event)	34 Aberdeen Proving Ground 80 HDL Blossom Point	

Table A Summary of Generic Recommendations and Their Estimated Costs and Potential Benefits to Surface Water Quality (Continued)

SCREENING CRITERIA	GENERIC RECOMMENDATIONS	ESTIMATED COST	INSTALLATIONS INVOLVED	POTENTIAL BENEFITS TO SURFACE WATER QUALITY
11. Pesticides Pollutants of Concern: Pesticides, biocides	a. Monitor use of pesticides in agricultural outleases especially in surface water drainage paths	Labor cost to properly manage/audit and ensure compliance with BMPs: $25,000 to $50,000/year (1/2 to 1 man year)	36 Letterkenny Army Dep.	Reduction in pesticides/ biocides levels in runoff reduces risk of mutagenicity for aquatic biota, destruction of aquatic plants.
	b. Practice strict management of biocide/herbicide applications on site	Labor cost for proper management of biocides applications: $25,000 to $50,000/year (1/2 to 1 man year)	47 Fort A. P. Hill	Same as above.

Table A Summary of Generic Recommendations and Their Estimated Costs and Potential Benefits to Surface Water Quality (Continued)

SCREENING CRITERIA	GENERIC RECOMMENDATIONS	ESTIMATED COST	INSTALLATIONS INVOLVED	POTENTIAL BENEFITS TO SURFACE WATER QUALITY
12. Vehicle Maintenance	No recommendations			
13. Ship Maintenance Pollutants of Concern: sandblast contaminants, heavy metals, oil and grease, fuels	a. Review operation of ship maintenance with respect to BMPs to control the release of: 1) oil/fuel, graywater, sewage 2) sandblast grit, lead, organotin	Assessment Study: $50,000 to $100,000 Example Corrective Measures: Sandblast grit reclamation unit - $350,000 Vacuum system - $75,000 Oil/water separator - $20,000	3 Naval Station - Annap. 17 Sewells Pt. Naval Cmpx 16 NAB - Little Creek 23 Naval Shipyard - Norfolk	Reduction of oil and grease and hydrocarbons reduces long-term sublethal effects on cellular and physiological processes such as feeding and reproduction. Reduction of toxic organics or heavy metals residuals reduces risk of histopathological abnormalities, metabolic and fecundity suppression, simplification of trophic levels, increase in pollutant tolerant species, and unsuitable spawning and living conditions.

Table A Summary of Generic Recommendations and Their Estimated Costs and Potential Benefits to Surface Water Quality (Continued)

SCREENING CRITERIA	GENERIC RECOMMENDATIONS	ESTIMATED COST	INSTALLATIONS INVOLVED	POTENTIAL BENEFITS TO SURFACE WATER QUALITY
14. Solid Waste Disposal Pollutants of Concern: Trace organics, heavy metals, BOD, low pH	a. Monitor leachate from active landfill	Monitoring Cost: $25,000 to $75,000/year Dependent on number of sampling stations and constituents sampled (see Appendix A, Volume 2)	48 Fort Belvoir 38 Fort Meade 49 Fort Eustis	Reduction of toxic organics or heavy metals residuals reduces risk of histopathological abnormalities, metabolic and fecundity suppression, simplification of trophic levels, increase in pollutant tolerant species, and unsuitable spawning and living conditions. Reduction in BOD reduces deoxygenation by decaying organic material resulting in higher dissolved oxygen levels for aquatic biota. Avoidance of low pH reduce toxicity of certain compounds in solution, and reduce direct physiological stress to aquatic biota.
	b. Install BMP's to stop migration of contaminants from active landfill	Cost to repair, reline, regrade active landfill $250,000 - average Cost to grade, cap, cover, vegetate, provide erosion/leachate control for 10 acre inactive landfill: $400,000 and up Cost for sludge lagoon liner: $150,000	38 Fort Meade 49 Fort Eustis	

Table A Summary of Generic Recommendations and Their Estimated Costs and Potential Benefits to Surface Water Quality (Continued)

SCREENING CRITERIA	GENERIC RECOMMENDATIONS	ESTIMATED COST	INSTALLATIONS INVOLVED	POTENTIAL BENEFITS TO SURFACE WATER QUALITY
15. Hazardous Waste Pollutants of Concern: Trace organics, heavy metals, chemical agents	a. Implement HM/HW management plan specific to this installation	Prepare RCRA Part B: $70,000 to $350,000 Develop HM/HW Tracking System: Start Up: $380,000-large facility $130,000-small facility Annual Cost: $30,000 -large facility $10,000 -small facility	10 U.S. Naval Academy 23 Naval Shipyard - Norfolk 16 NAB - Little Creek 38 Fort Meade 43 Cameron Station 40 Walter Reed Med. Ctr.	Reduction of toxic organics or heavy metals residuals reduces risk of histopathological abnormalities, metabolic and fecundity suppression, simplification of trophic levels, increase in pollutant tolerant species, and unsuitable spawning and living conditions.
	b. Provide a conforming hazardous waste storage facility	Cost to Construct: $100,000 to $550,000 (size and site dependent) (rough average cost - $\$125/ft^2$)	13 David Taylor - Carderock 47 Fort A. P. Hill 49 Fort Eustis 38 Fort Meade 62 Defense Gen. Sup. Ctr. 12 Naval Med. Com. - NCR 32 Washington Naval Yard 78 Brandywine DRMO	
	c. Re-evaluate management plan for more comprehensive HM/HW controls	Management, not cost related	26 NWS - Yorktown 78 Brandywine DRMO	
	d. Provide for disposal of hazardous waste sludges not under DRMO jurisdiction	Removal/Testing of drums: $200 - $500/drum Install sludge lagoon liners: $100,000 to $500,000 per lagoon	23 Naval Shipyard - Norfolk 49 Fort Eustis 41 Vint Hill Farms Sta.	

Table A Summary of Generic Recommendations and Their Estimated Costs and Potential Benefits to Surface Water Quality (Continued)

SCREENING CRITERIA	GENERIC RECOMMENDATIONS	ESTIMATED COST	INSTALLATIONS INVOLVED	POTENTIAL BENEFITS TO SURFACE WATER QUALITY
16. SPCC Status Pollutants of Concern: Oil and grease, phenols, POL products, solvents, organics	a. Implement an updated SPCC plan	Update Plan: $10,000 to $50,000 (dependent on need to prepare PPC plan) Construct New Facilities: $100,000-small facility $1,000,000 + - large facility	15 Naval Air Sta. - Oceana 16 NAB - Little Creek 48 Fort Belvoir 47 Fort A. P. Hill 62 Defense Gen. Sup. Ctr. 32 Washington Naval Yard 43 Cameron Station 54 Bolling AFB 78 Brandywine DRMO	Reduction of oil and grease and hydrocarbons reduces long-term sublethal effects on cellular and physiological processes such as feeding and reproduction. Reduction of toxic organics reduces risk of histopathological abnormalities, metabolic and fecundity suppression, simplification of trophic levels, increase in pollutant tolerant species, and unsuitable spawning and living conditions.
	b. Follow SPCC plans in handling abandoned fuel tanks to prevent spills or leaks	Clean up cost (average): $50,000 - one LUST NOTE: Cost range can be extreme	65 Navy SPCC 77 Brandywine RDV 62 Defense Gen. Sup. Ctr.	

Table A Summary of Generic Recommendations and Their Estimated Costs and Potential Benefits to Surface Water Quality (Continued)

SCREENING CRITERIA	GENERIC RECOMMENDATIONS	ESTIMATED COST	INSTALLATIONS INVOLVED	POTENTIAL BENEFITS TO SURFACE WATER QUALITY
17. Abandoned Sites Pollutants of Concern: Trace organics, heavy metals, hydrocarbons, chemical agents, pesticides, low pH	a. Proceed with next round of confirmation study sampling and testing	Monitoring Cost: $15,000 to $30,000 per site, one time event	26 NWS - Yorktown 27 NSC - Cht. Anx. 83 NSC - Yorktown 22 NSC - Craney Is. 23 Naval Shipyard - Norfolk 16 NAB - Little Creek 30 Allegany Ballist. Lab 34 Aberdoon Proving Ground 52 Andrews AFB 62 Defense Gen. Sup. Ctr. 54 Bolling AFB 5 NOS - Indian Head 17 Sewell's Pt. Navy Cmpx. 36 Letterkenny Army Dep. 38 Fort Meade	Reduction of toxic organics or heavy metals residuals reduces risk of histopathological abnormalities, metabolic and fecundity suppression, simplification of trophic levels, increase in pollution tolerant species, and unsuitable spawning and living conditions. Reduction of oil and grease and hydrocarbons reduces long-term sublethal effects on cellular and physiological processes such as feeding and reproduction. Reduction in pesticides/ biocides levels reduces risk of mutagenicity for aquatic biota, destruction of aquatic plants. Avoidance of low pH reduces toxicity of certain compounds in solution, and reduces direct physiological stress to aquatic biota.
	b. Eliminate/Control/Treat leachate observed from landfill(s) on this installation	Cost to grade, cap, cover, vegetate, provide erosion/leachate control for 10 acre inactive landfill: $400,000 and up Sludge Lagoon Liner: $100,000 - $500,000	7,8 NAS/NATC - Patuxent 1 USMC - Quantico 49 Fort Eustis 41 Vint Hill Farms Sta. 62 Defense Gen. Sup. Ctr. 39 Fort Detrick	
	c. Implement containment/ control measures as outlined in confirmation study recommendations	Clean-up per site: $150,000 to several million dollars	4 NSWC - White Oak 23 Naval Shipyard - Norfolk 15 NAS - Oceana 65 Navy SPCC 34 Aberdeen Proving Ground 7,8 NAS/NATC - Patuxent 5 NOS - Indian Head	

Table A Summary of Generic Recommendations and Their Estimated Costs and Potential Benefits to Surface Water Quality (Continued)

SCREENING CRITERIA	GENERIC RECOMMENDATIONS	ESTIMATED COST	INSTALLATIONS INVOLVED	POTENTIAL BENEFITS TO SURFACE WATER QUALITY
17. Abandoned Sites (continued) Pollutants of Concern: trace organics, heavy metals, hydrocarbons, chemical agents, pesticides, low pH	d. Confirm containment/ migration of POL floating on groundwater or soaking soils around tanks	Well Monitoring Program: $50,000 to $250,000 $50,000 - 5 to 10 wells $250,000 - 25 to 50 wells	22 NSC - Craney Is. 23 Naval Shipyard - Norfolk 77 Brandywine RDV 62 Defense Gen. Sup. Ctr. 47 Fort A. P. Hill	Same as above.
	e. Institute confirmation study at site(s) identified in IAS	Confirmation Study: $100,000 to $200,000 per installation $100,000 - 3 to 4 sites $200,000 - 6 to 10 sites	80 HDL - Blossom Pt. 62 Defense Gen. Sup. Ctr. 48 Fort Belvoir	

Table A Summary of Generic Recommendations and Their Estimated Costs and Potential Benefits to Surface Water Quality (Continued)

SCREENING CRITERIA	GENERIC RECOMMENDATIONS	ESTIMATED COST	INSTALLATIONS INVOLVED	POTENTIAL BENEFITS TO SURFACE WATER QUALITY
18. UST Status Pollutants of Concern: POL products, hydrocarbons, solvents, fuels	a. Test suspect tank(s) for leaks / implement testing in accordance with state and EPA regulations.	Tank Tesk: $400 - $700/tank (size dependent) $1,000 - $3,000/ 20,000 - 1,000,000 gal tank NOTE: Does not include coordination costs	3 Naval Station - Annap. 13 David Taylor - Carderock 83 Naval Sup. Ctr.-Yorktown 22 Naval Sup Ctr-Craney Is. 80 HDL - Blossom Pt. 48 Fort Belvoir 41 Vint Hill Farms Sta. 32 Washington Naval Yard 35 HDL - Adelphi 37 New Cumberland Army Dep. 43 Cameron Station 54 Bolling AFB 34 Aberdeen Proving Ground 1 USMC - Quantico 23 Naval Shipyard - Norfolk 30 Allegany Ballist. Lab 65 Navy SPCC 15 NAS - Oceana 16 NAB - Little Creek	Reduction of oil and grease and hydrocarbons reduces long-term sublethal effects on cellular and physiological processes such as feeding and reproduction. Reduction of toxic organics or heavy metals residuals reduces risk of histopathological abnormalities, metabolic and fecundity suppression, simplification of trophic levels, increase in pollutant tolerant species, and unsuitable spawning and living conditions.
	b. Removal of POL saturated soils surrounding tanks or in drainage ditches to prevent surface water transport	Clean up cost: $50,000 - small leak $350,000 - 2 acre spill site	22 Naval Sup Ctr-Craney Is. 23 Naval Shipyard - Norfolk 15 NAS - Oceana 77 Brandywine RDV	
	c. Implement recommendations to clean up leaked product	Examples: 1) Oil contaminated groundwater recovery system: $70,000 2) Soil clean up: $50,000 - small leak (one tank) $350,000 - large leak (two acres) 3) Fuel recovery from groundwater: $500,000 + (large leak)	77 Brandywine RDV 22 Naval Sup Ctr-Craney Is.	

Table A Summary of Generic Recommendations and Their Estimated Costs and Potential Benefits to Surface Water Quality (Continued)

SCREENING CRITERIA	GENERIC RECOMMENDATIONS	ESTIMATED COST	INSTALLATIONS INVOLVED	POTENTIAL BENEFITS TO SURFACE WATER QUALITY
19. Forestry Management Pollutants of Concern: TSS	a. Provide enforcement of BMP specifications in the timber sales contracts to ensure erosion and sedimentation does not result from timber sales activities on base.	$10,000 - $20,000	1 USMC - Quantico	Reduction in suspended solids increases light penetration, reduces clogging of gills, enhances spawning habitats, reduces smothering of benthic organisms/plants, and reduces transport of heavy metals/organics sorbed to sediment.
20. Wildlife Management	a. Continue/Enhance wildlife management program	$20,000/yr - average	7,8 NAS/NATC - Patuxent	Enhancement of terrestrial and aquatic habitats and wildlife quality/quantity.
	b. Institute wildlife management program where none now exists	$10,000/yr - average	85 Naval Com. Unit	
	c. Institute surface water quality monitoring program to insure viability of wildlife management	See recommendation 2c	7,8 NAS/NATC - Patuxent	

Table A Summary of Generic Recommendations and Their Estimated Costs and Potential Benefits to Surface Water Quality (Continued)

SCREENING CRITERIA	GENERIC RECOMMENDATIONS	ESTIMATED COST	INSTALLATIONS INVOLVED	POTENTIAL BENEFITS TO SURFACE WATER QUALITY
21. Soil Conservation Plan Pollutants of Concern: TSS, nutrients, pesticides	a. Institute soil conservation plan for agricultural outleases on site; i.e., planting cycles, plowing techniques, erosion controls, fertilizer application, pesticide application	Develop Plan: $5,000 to $25,000	7,8 NAS/NATC - Patuxent 16 NAB - Little Creek 36 Letterkenny Army Dep.	Reduction in nutrients decreases likelihood of eutrophication condition (biological nuisances) Reduction in pesticides in runoff decreases likelihood of histopathological abnormalities, metabolic and fecundity suppression, unsuitable spawning and living conditions for fish and benthic biota. Reduction in suspended solids, increases light penetration, reduces clogging of gills, enhances spawning habitats, reduces smothering of benthic organisms and plants, and reduces transport of heavy metals and organics sorbed to sediment.
	b. Review soil conservation plan to ensure BMPs for erosion control	Review sedimentation/ erosion control plan for installation and investigate alternatives $30,000 -small facility (<1,000 acres) $200,000 -large facility (>10,000 acres)	36 Letterkenny Army Dep. 1 USMC - Quantico 48 Fort Belvoir 52 Andrews AFB 7,8 NAS/NATC - Patuxent 47 Fort A. P. Hill	

Table A Summary of Generic Recommendations and Their Estimated Costs and Potential Benefits to Surface Water Quality (Continued)

SCREENING CRITERIA	GENERIC RECOMMENDATIONS	ESTIMATED COST	INSTALLATIONS INVOLVED	POTENTIAL BENEFITS TO SURFACE WATER QUALITY
22. Stormwater Mgmt. Plan Pollutants of Concern: Oil and grease, trace organics, heavy metals, TSS, BOD	a. Develop a stormwater management plan (i.e., drainage controls, detention systems, erosion controls, oil/water separators, containment systems, monitoring plan.	Develop Plan: $20,000 - $100,000 Dependent on installation size and complexity.	14 David Taylor - Annap. 13 David Taylor - Carderock 15 NAS - Oceana 16 NAB - Little Creek 34 Aberdeen Proving Ground 12 Naval Med. Com. - NCR 1 USMC - Quantico 55 Langley AFB 17 Sewells Pt. Naval Cmpx.	Reduction of oil and grease and hydrocarbons will reduce long-term sublethal effects on cellular and physiological processes such as feeding and reproduction. Reduction of toxic organics or heavy metals residuals reduces risk of histopathological abnormalities, metabolic and fecundity suppression, simplification of trophic levels, increase in pollutant tolerant species, and unsuitable spawning and living conditions. Reduction in BOD will reduce deoxygenation by decaying organic material resulting in higher dissolved oxygen levels for aquatic biota.
	b. Review/Update plan for adequate BMPs (detention basins, oil/water separators, treatment, etc.)	Review/Update Plan: $10,000 - $50,000	7,8 NAS/NATC - Patuxent 1 USMC - Quantico 2 NSWC - Dahlgren 83 NSC - Yorktown 15 NAS - Oceana 65 Navy SPCC 48 Fort Belvoir 52 Andrews AFB	

Table A Summary of Generic Recommendations and Their Estimated Costs and Potential Benefits to Surface Water Quality (Continued)

SCREENING CRITERIA	GENERIC RECOMMENDATIONS	ESTIMATED COST	INSTALLATIONS INVOLVED	POTENTIAL BENEFITS TO SURFACE WATER QUALITY
23. Wetlands Mgmt. Plan	a. Needs a wetlands management plan, i.e., determine need for control of stormwater runoff, erosion/sedimentation, and pollutant discharges in wetlands areas. Also measures for prevention of damage or destruction to wetlands from training activities, and revegetation of damaged areas.	Cost to Develop: $10,000 - small installation $60,000 - large installation	83 NSC - Yorktown 15 NAS - Oceana 16 NAB - Little Creek 55 Langley AFB 53 Davidsonville RDV 80 HDL - Blossom Pt.	Enhancement of wetland habitats and terrestrial and aquatic wildlife quality/quantity.
24. Shoreline Erosion Plan Pollutants of Concern: TSS, heavy metals	a. Upgrade/Implement erosion control plan Typical plan includes: problem identification; estimation of erosion rates; evaluation of erosion controls - structural vs. vegetative, or both; cost analysis; and implementation plan.	Develop/Upgrade Plan: $20,000 to $60,000	5 NOS - Indian Head 7,8 NAS/NATC - Patuxent 80 HDL - Blossom Point 27 Naval Sup Ctr - Cht. Anx	Reduction in suspended solids will increase light penetration, reduce clogging of gills, enhance spawning habitats, reduce smothering of benthic organisms/plants, and reduce transport of heavy metals/organics sorbed to sediment.

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