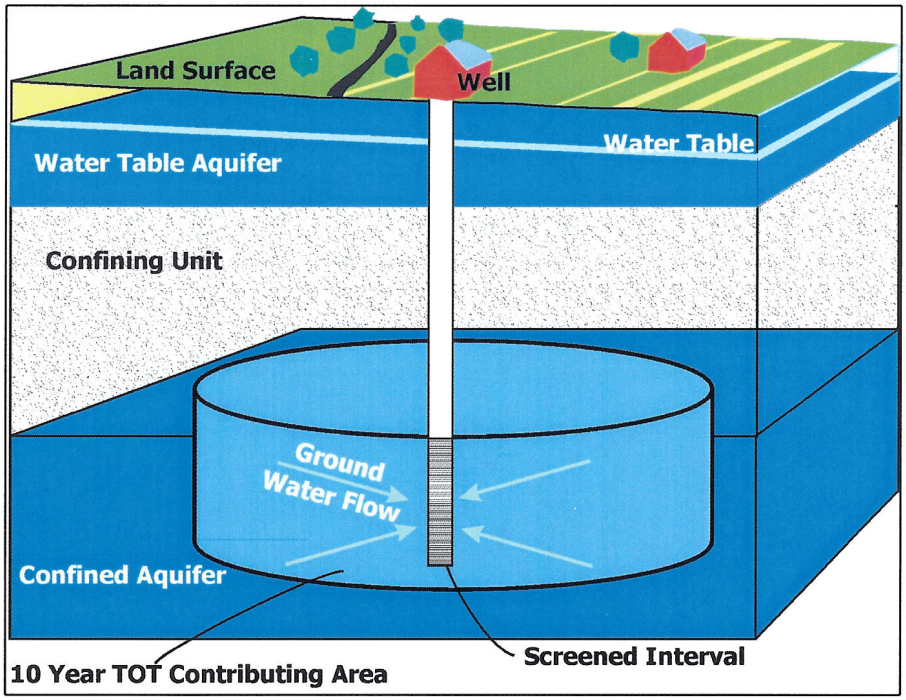
SOURCE WATER ASSESSMENT

FOR WEBSTER FIELD ANNEX – ST. INIGOES

NON-TRANSIENT NON-COMMUNITY WATER SYSTEM

IN ST. MARY'S COUNTY, MD



Prepared By
Water Management Administration
Water Supply Program
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MDE

Robert L. Ehrlich, Jr.
Governor

Kendl P. Philbrick
Secretary

Michael S. Steele
Lt. Governor

Jonas A. Jacobson
Deputy Secretary

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SUMMARY

The Maryland Department of the Environment's (MDE) Water Supply Program (WSP) has conducted a Source Water Assessment for the Webster Field Annex St. Inigoes Water System. The system is owned and operated by the Navy, Naval Air Station. The major components of this report as described in Maryland's Source Water Assessment Plan (SWAP) are: 1) delineation of an area that contributes water to the source, 2) identification of potential sources of contamination, and 3) determination of the susceptibility of the water supply to contamination. Recommendations for management of the assessment area conclude this report.

The source of Webster Field's water supply is a Coastal Plain confined aquifer- the Aquia. Three wells are currently being used to supply the water from this aquifer. The source water assessment area was delineated by the Water Supply Program using methods approved by the U. S. EPA.

Potential sources of contamination within the assessment area were identified based on MDE site visits, and a review of MDE's databases. Well information and water quality data were also reviewed. A map showing the source water assessment area and potential contaminant sources is enclosed.

The susceptibility analysis for the water supply system is based on a review of the water quality data, potential sources of contamination, aquifer characteristics, and well integrity. Webster Field's water supply is not susceptible to contaminants originating at the land surface due to the protected nature of confined aquifer. Due to the natural occurrence of arsenic in Aquia aquifer, Webster Field's water supply may be susceptible to arsenic. However, it is not susceptible to other contaminants originating at the land surface due to the protected nature of confined aquifer.

INTRODUCTION

The Maryland Department of the Environment's (MDE) Water Supply Program (WSP) has conducted a Source Water Assessment for the Webster Field Annex, St. Inigoes, Water System. The system is located in the southeastern part of St. Mary's County. Webster Field Annex is located approximately one mile west of Point Lookout Road (Maryland Route 5) and is bounded on the north by St. Inigoes Creek and on the west by the St. Mary's River, and pumps water from three wells. Two of these wells are located in the Aquia aquifer and the third well is located in the Patapsco formation. The system is owned and operated by the Navy and currently serves a population of approximately 25 persons. The Webster Field water system is identified as a non-transient non-community water system. The system uses chlorine as a disinfectant to provide a barrier for microbiological contamination that could occur due to breaks or cross connections in the storage and distribution systems. The focus of this report however is possible risks to the water supply sources and does not address treatment, distribution, or storage issues.

WELL INFORMATION

Well information was obtained from the Water Supply Program's database, site visits, well completion reports, sanitary survey inspection reports and published reports. A review of the well data and sanitary surveys of the systems indicates the wells serving Webster Field Annex were drilled after 1973, when the State's well construction regulations went into effect, and meet current well construction standards for grouting and casing. Table 1 contains a summary of the well construction data.

PLANT ID	SOURCE ID	SOURCE NAME	PERMIT NO	TOTAL DEPTH (ft)	CASING DEPTH (ft)	YEAR DRILLED	AQUIFER NAME
01	02	Coast Guard Bldg 8130	SM-73-1496	537	487	1975	AQUIA
02	04	Bldg 8195 Well 2	SM-94-1128	539	486	1998	AQUIA
	05	Bldg 8195 Well 3	SM-94-3700	884	635	2001	PATAPSCO

Table 1. Well Information.

HYDROGEOLOGY

Ground water flows through pores between gravel, sand and silt grains in unconsolidated sedimentary aquifers such as the aquifers used by Webster Field Annex water system. An aquifer is any formation that is capable of yielding a significant amount of water. The transmissivity is a measure of the amount of water an aquifer is capable of producing and is related to the hydraulic conductivity and the thickness of the aquifer. A confining layer is generally composed of fine material such as clay and silt, which transmits relatively very little water. Confined aquifers are those formations that are overlain by a confining unit. Confined aquifers are recharged from the water stored in the

confining unit above and from precipitation that infiltrates into the formation where it is exposed at the surface.

The St. Inigoes area lies within the Atlantic Coastal Plain physiographic province. This province, which in Maryland includes roughly the area east of Interstate 95, is underlain by unconsolidated clastic sediments of Lower Cretaceous to recent age, which thicken to the southeast so that they appear wedge-shaped. These sediments crop out in a concentric band that lies parallel to the Fall Line, which marks the western boundary of the Coastal Plain.

Two of Webster Field's wells pump water from the Aquia aquifer, which is confined and is composed of fine to coarse-grained, greenish-brown sand that contains layers of grayish-green silt and clay, indurated calcite-cemented sand and fossil beds composed of shell debris (DNR, 1987). The top of the Aquia aquifer in the St. Inigoes area is approximately 500 feet below sea level. The third well at Webster Field pumps water from the Patapsco formation, which is a multi-aquifer formation consisting of irregularly stratified interbedded, variegated (gray, brown, and red) silt and clay and argillaceous (clayey), subrounded, fine to medium-grained quartzrose sand with minor amounts of gravel (Hansen, 1972b). The top of the Patapsco formation in the St. Inigoes areas is approximately 725 feet below sea level.

SOURCE WATER ASSESSMENT AREA DELINEATION

For ground water systems, a Wellhead Protection Area (WMPA) is considered to be the Source Water Assessment Area (SWAA) for the system. Source Water Assessment Areas (SWAAs) were delineated for Webster Field Annex wells using the methodology described in Maryland's Source Water Assessment Plan (1999) for confined aquifers in the Coastal Plain often referred to as the "Florida Method". The area is a radial zone of transport within the aquifer and is based on a 10 year time of travel (TOT), pumping rate and the screened interval(s) of the well or wells included in the SWAA, and the porosity of the aquifer (see illustration below for conceptual model). The SWAA's were calculated using the following volumetric equation:

$$r = \sqrt{\frac{Qt}{\pi n H}}$$

where r = calculated fixed radius (ft)
Q = pumping rate of well (ft^3/yr)
n = aquifer porosity (dimensionless)
H = length of well screen (ft)
t = time of travel (yr.)

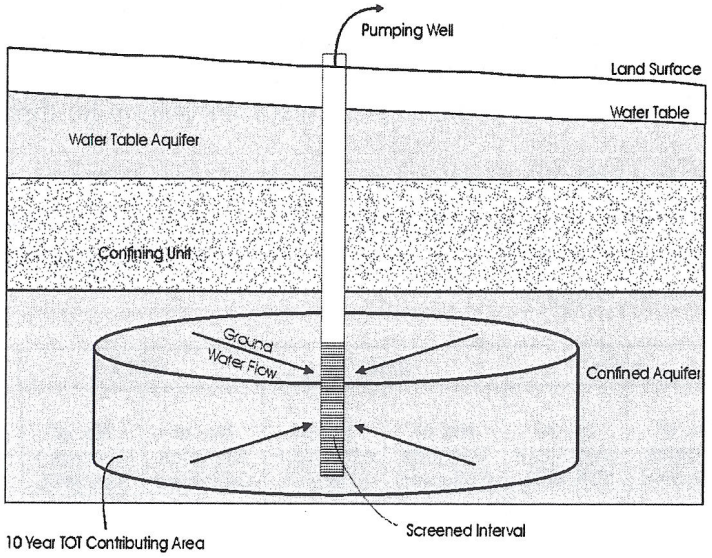
Webster Field Annex has two water appropriation permits. One permit is for the two wells drilled to the Aquia aquifer. Withdrawals from the Aquia are limited to an annual average of 60,000 gpd. The second permit allows for the withdrawal of 30,000 gpd from one well in the Patapsco formation. The two wells drilled to the Aquia aquifer,

SM-73-1496 and SM-94-1128 each have 50 feet of well screen. The well drilled to the Patapsco formation, SM-94-3700, has multiple well screen lengths for a combined well screen length of 49 feet.

A conservative estimate of porosity (n) of 25% was used for the aquifer based on published reports. Using these parameters and current water usage the radius was calculated with the above equation for the WHPA delineation (Table 2A). A WHPA delineation was also calculated using these parameters and the requested water allocation (Table 2B). The circle shown in Figure 1 and Figure 2 represent the aquifer zone of transport in the subsurface as illustrated below.

System Name	Source ID	Well pumpage (Q) in gpd	Well pumpage (Q) in ft3/yr	Screened interval in feet (H)	Aquifer	Calculated radius for WHPA in feet (r)	Acreage of WHPA
WEBSTER FIELD ANNEX	02	30,000*	1,463,796	50	AQUIA	611	27
	04	30,000*	1,463,796	50		611	27
	05	30,000	1,463,796	49	PATAPSCO	617	27

Table 2. Parameters used for the Wellhead Protection Area Delineations



Conceptual illustration of a zone of transport for a confined aquifer

POTENTIAL SOURCES OF CONTAMINATION

In confined aquifer settings, sources of contamination at the land surface are generally not a threat unless there is a pathway for direct injection into the deeper aquifer such as unused wells or along well casing that are not intact or have no grout seal. Wells that are not being used or maintained will eventually corrode and provide a pathway for contaminants present in the shallow aquifers at higher-pressure heads to migrate to the deeper aquifers.

Potential sources of contamination identified at the land surface have the potential to impact the shallow water table aquifer. Past disposal practices of wastes at the facility has resulted in its being listed on the state's master list of sites with possible ground water contamination. A summary of the site status as of the end of 2002 was obtained from MDE's website. Buried drums and unexploded ordnance have been found at the site. The summary is in Appendix A. Unless there is direct injection of contaminants into the deeper confined aquifer, Webster Field Annex's water supply should not be threatened by contamination of the shallow ground water.

WATER QUALITY DATA

Water Quality data was reviewed from the Water Supply Program's database and system files for Safe Drinking Water Act contaminants. The State's SWAP defines a threshold for reporting water quality data as 50% of the Maximum Contaminant Level (MCL). If a monitoring result is at or greater than 50% of a MCL, this assessment will describe the sources of such a contaminant and, if possible, locate the specific sources which are the cause of the elevated contaminant level. All data reported is from the finished (treated) water unless otherwise noted. The treatment currently used at both Webster Field Annex water plants is post-hypochlorination for disinfection.

A review of the monitoring data since September 1995 for Webster Field Annex's water supply indicates that it meets the current drinking water standards for inorganic, microbiological, radiological, and organic compounds. The water quality sampling results are summarized in Table 3.

	IOCs		SOCs		VOCs	
Plant No.	No. of Samples Collected	No. of samples > 50% MCL	No. of Samples Collected	No. of samples > 50% MCL	No. of Samples Collected	No. of samples > 50% MCL
01	15	1	-	-	5	-
02	14	2	-	-	5	-

Table 3. Summary of Water Quality Samples for Webster Field Annex's Water Supply

Inorganic Compounds (IOCs)

IOCs above 50% of the MCL have been detected in the Webster Field Annex water system. At plant 1, at the Coast Guard building, the only parameter detected at 50% or more of the MCL was arsenic in October 2001 at 0.008 parts per million (ppm). Other IOCs detected at plant 1 include arsenic, sodium, fluoride, barium, chromium, nitrate, nitrite, and sulfate. Arsenic was detected in December and October 2004 at 0.002 ppm both times. The MCL for arsenic is 0.010 ppm. Fluoride was detected in October 2004, October 2001, December 1998, and November 1995 at 1.2 ppm, 0.9 ppm, 1.7 ppm, and 1.21 ppm, respectively. The MCL for fluoride is 4 ppm. Nitrate was detected in October 2000, November 1999, December 1998, and December 1996 at 1.1 ppm, 1.5 ppm, 1.7 ppm, and 0.129 ppm, respectively. The MCL for nitrate is 10 ppm. In November 1995, barium, chromium, nitrite, and sulfate were detected at 0.002 ppm, 0.011 ppm, 0.15 ppm, and 10.4 ppm, respectively. The MCL for barium is 2 ppm, for chromium 0.1 ppm, for nitrite is 1 ppm, and there is not MCL for sulfate. The secondary standard for sulfate is 250 ppm. Chromium and barium have not been detected in any other sample collected after this date. Sodium was detected in December 2004, October 2004, and October 2001 at 121 ppm, 140 ppm, and 72 ppm, respectively. There is no MCL for sodium. EPA's advisory for persons on severely sodium-restricted diets is to limit the concentration in drinking water to 20 ppm.

At plant 2, building 8195, both arsenic and chromium was detected at levels greater than 50% of the MCL. Arsenic was detected in October 2001 at 0.008 ppm and in December 1998 chromium was detected at 0.10 ppm. Other IOCs detected at plant 2 include sodium, fluoride, barium, nitrate, and sulfate. Barium was detected in October 2004 and November 1995 at 0.18 ppm and 0.011 ppm, respectively. Fluoride was detected in October 2004, October 2001, December 1998, and November 1995 at 1.3 ppm, 0.9 ppm, 2.2ppm, and 1.88 ppm, respectively. Sulfate was detected in November 1995 at 10.7 ppm. Sodium was detected in December 2004, October 2004, and October 2001 at 127 ppm, 148 ppm, and 70 ppm, respectively.

Volatile Organic Compounds (VOCs)

No VOCs above 50% of the MCL have been detected in Webster Field Annex's water supply. Only one other VOC has been detected at plant 1, chloroform in December 2004 at 1.5 parts per billion (ppb) and in May 1998 at 4.3 ppb. The later sample included a note that there was trace chlorine in the sample. At plant 2, in December 2004 bromodichloromethane, chloroform, and dibromochloromethane were detected at 2.7 ppb, 3.6 ppb, and 1.7 ppb, respectively. And, in May 1998 bromodichloromethane and chloroform were detected at 7.5 ppb and 3 ppb, respectively. These parameters are formed as a result of chlorine reacting with natural organic compounds in the water during disinfection and are part of a group of VOCs known as trihalomethanes. The maximum contaminate level for total trihalomethanes is 80 ppb.

Synthetic Organic Compounds (SOCs)

No samples for SOC have been take at this water system.

Microbiological Contaminants

Routine bacteriological monitoring is conducted in the finished water for each community water system on a monthly basis and measures total coliform bacteria. Total coliform bacteria are not pathogenic, but are used as an indicator organism for other disease-causing microorganisms. A major breach of the system or the aquifers would likely cause a positive total coliform result despite disinfection and would require follow-up total and fecal coliform analysis.

Since January 1997 Webster Field Annex has conducted routine bacteriological sampling. On five different occasions between June 1997 and February 2001 a positive result was obtained. Repeat sampling did not indicate any confirmations. There have been no positive results since February 2001.

SUSCEPTIBILITY ANALYSIS

All three wells serving Webster Field Annex's water system obtain water from a confined aquifer. Confined aquifers are naturally well protected from activity on the land surface due to low permeability sediments that provide a barrier for water movement from the surficial aquifers into the deeper aquifer. A properly constructed well with the casing extended to the confining layer above the aquifer and with sufficient grout should be well protected from contamination at the land surface. Wells that are not being used or maintained will eventually corrode and can provide a pathway for contaminants present in the shallow aquifers at higher-pressure heads to migrate to the deeper aquifers. The information that was used to conduct the susceptibility analysis is as follows: (1) available water quality data (2) presence of potential contaminant sources in the WHPA (3) aquifer characteristics (4) well integrity and (5) the likelihood of change to the natural conditions.

The susceptibility of Webster Field Annex's water supply to the various contaminant groups is shown in Table 4 at the end of this section.

Inorganic Compound (IOCs)

IOCs above 50% of the MCL have been detected in the Webster Field Annex's water supply. Some chemical elements (e.g. arsenic) are naturally occurring in the aquifer and in some instances can reach concentrations that pose a risk to water supply. In the case of confined aquifers, this is generally more problematic than contaminants at the land surface.

Based on the natural occurrence of arsenic in the aquifer and its presence in the water samples, Webster Field Annex's water supply **maybe susceptible** to arsenic. Due to the naturally protected characteristics of the confined aquifers, the water quality data, and the lack of potential sources of contamination, Webster Field Annex's water supply **is not susceptible** to the other inorganic compounds.

Volatile Organic Compounds (VOCs)

No VOCs above 50% of the MCL have been detected in Webster Field Annex's water supply.

Due to the naturally protected characteristics of the confined aquifers, the water quality data, and the lack of potential sources of contamination in the aquifers, Webster Field Annex's water supply **is not susceptible** to volatile organic compounds.

Synthetic Organic Compounds (SOCs)

No sample for SOCs have bee obtained at this water system.

Due to the naturally protected characteristics of the confined aquifers, the water quality data, and the lack of potential sources of contamination, Webster Field Annex's water supply **is not susceptible** to synthetic organic compounds.

Microbiological Contaminants

Raw water monitoring for microbiological contaminants is not required of water systems in confined aquifers because they are considered naturally protected from sources of pathogens at the land surface. Routine bacteriological testing at Webster Field Annex's has shown no positives for total coliform or fecal coliform. Therefore, Webster Field Annex's water supply **is not susceptible** to microbiological contaminants.

CONTAMINANT TYPE	Are Contaminant Sources present in the WHPA?	Are Contaminants detected in WQ samples at 50% of the MCL	Is Well Integrity a Factor?	Is the Aquifer* Vulnerable?	Is the System Susceptible to the Contaminant
Arsenic	NO	YES	NO	YES	MAYBE
Inorganic Compounds	NO	NO	NO	NO	NO
Volatile Organic Compounds	NO	NO	NO	NO	NO
Synthetic Organic Compounds	NO	NO	NO	NO	NO
Radionuclides	NO	NO	NO	NO	NO
Microbiological Contaminants	NO	NO	NO	NO	NO

Table 4. Susceptibility Chart for Webster Field Annex's Water Supply

MANAGEMENT OF THE WELLHEAD PROTECTION AREA

Specific management recommendations for consideration are listed below:

Monitoring

Continue to monitor for all required Safe Drinking Water Act contaminants.

Contaminant Source Inventory Updates

Conduct a survey of the WHPA and inventory any potential sources of contamination, including unused wells that may not have been included in this report. Keep records of new development within the WHPA and new potential sources of contamination that may be associated with the new use.

Develop and employ good housekeeping practices to protect the shallow aquifer.

Well Inspection/Maintenance

Water operation personnel should have a program for periodic inspections and maintenance of the supply wells to ensure their integrity and protect the aquifer from contamination.

Changes in Use

The system is required to notify the MDE Water Supply Program if new wells are to be added or an increase in water usage is proposed. An increase in use or the addition of new wells may require revisions to the WHPA.

References

Maryland Association of Counties, Directory of County Officials - 2005/2006, 53 pp.

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Maryland Department of Natural Resources (DNR), 1987, The Quantity and Natural Quality of Ground Water in Maryland: DNR Water Resources Administration.

Maryland Geological Survey, A User's Guide for the Artesian Aquifers of the Maryland Coastal Plain, Part II, Aquifer Characteristics, 1972b, by H. J. Hansen, 122 pp.

Maryland Geological Survey Report of Investigations No. 38, 1983, by Chapelle, F.H. and D.D. Drummond, Hydrogeology, Digital Simulation, and Geochemistry of the Aquia and Piney Point-Nanjemoy Aquifer System in Southern Maryland, 100 pp.

Maryland Geological Survey Interim Report, 2003, Summary of Ground-Water Arsenic Concentrations in Major Aquifers of the Maryland Coastal Plain, 23 pp.

U.S. Environmental Protection Agency (EPA), 1991, Wellhead Protection Strategies for Confined – Aquifer Settings: Office of Ground Water and Drinking Water, EPA/570/9-91-008, p. 168.

United States Environmental Protection Agency, Office of Ground-Water Protection, 1987, Guidelines for Delineation of Wellhead Protection Areas.

Other Sources of Data

Water Appropriation and User Permit SM1932G001 and SM2001G009
MDE Water Supply Program (PDWIS) Database
MDE Waste Management Sites Database
Public Water Supply Inspection Reports
Monitoring Reports
Department of Natural Resources Digital Orthophoto Quarter Quadrangles
USGS Topographic 7.5-Minute Quadrangles
ADC Maps of St. Mary's County
SpecPrint Tax Maps of St. Mary's County
Maryland Department of Assessments and Taxation Real Property Database

APPENDIX

Naval Command Control Ocean Surveillance Center, In-service Engineering (NICE)
East Coast Division, St. Inigoes, MD.
(Federal Facility)

Site Location.

NICE East (St. Inigoes) currently referred to, as NAS Patuxent River Webster Field Annex is located in St. Mary's County, MD, approximately 10 miles to the southeast of Lexington Park. The 1,000-acre base is currently the home of unmanned aerial vehicle research for the Navy and Marine Corps. The Air Field consists of three paved 5,000-foot runways of which two are still active.

Site History.

The Navy acquired 773 acres of the northern part of the former St. Inigoes manor in 1942. The area was originally named NAS Beachville, and soon thereafter renamed Webster Field, in honor of Captain W.W. Webster, USN.

It was originally used as a dispersal field in the event of aerial attacks and also as an auxiliary landing field for NAS Patuxent River. It was also used for ordnance testing, dive-bomber rocket systems, aerial gunnery and glider control experiments.

There was a reduction in activity after World War II until 1947 when the Naval Reserve Training Unit reactivated Webster Field. In 1967 the base was renamed Naval Electronic Systems Test and Evaluation Facility and was removed from NAS Patuxent River's control. After subsequent name changes command was returned to NAS Patuxent River in 1994 and the base was named NAS Patuxent River Webster Field Annex, its current name today.

Environmental Investigations.

An Initial Assessment Study (IAS) was performed in March 1984 as part of the Naval Air Station Patuxent River's IAS. The Navy identified two Sites during the IAS, Site # 32 Disposal Site and Site # 33 Drum Disposal Area.

Site # 32 was the official disposal area for Webster Field from the early 1960's to 1967. Typical wastes included garbage from mess halls, scrap metal from electronic plating operations, organic (vegetative) matter, construction debris and waste oil. Material was placed in trenches 10-15 feet long and 5-10 feet wide. The material was then burned and covered. Numerous reports stated that no industrial wastes were generated at the Webster Field Annex while this disposal site was active. Presently the area is vegetated with a stand of pine trees. Some organic matter, large tree trunks and branches were visible at the time of the on-site survey.

Site # 33 is a forested area located in the southwest portion of the Webster Field Annex. In 1984 approximately 50 very corroded drums were identified during the on-site survey. Most of the drums were empty but some contained a dark tar-like material that was believed to be runway sealant. The small quantity of material was found to be almost insoluble. During a site visit undertaken by the MDE in October 2002 numerous drums were discovered, as well as the presence of inert ordnance.

Current Status.

Currently only two areas are known to have been disposal sites. The facility has recently received increased interest from the Navy and the MDE; and it had been selected to receive funds in the spring of 2002 for a Preliminary Assessment and Site Investigation (PA/SI), at the current time, these funds have been delayed indefinitely.

In October 2002, as a result of the site visit undertaken by the MDE, Munitions and Explosives of Concern (MEC) were discovered at Site 33, subsequently, one inert shell was removed in October 2002. MEC remains on site. A time critical removal action previously scheduled for February 2003 was delayed and is now planned for Fall 2003 in order to remove the remaining MEC.

Facility Contacts.

John Fairbank	Maryland Department of the Environment	(410) 537-3440
Steve Hurff, P.E.	EFACHES Project Manager	(202) 685-6293