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EPA Superfund
Record of Decision:

ABERDEEN PROVING GROUND (EDGEWOOD AREA)
EPA ID: MD2210020036
OU 06
EDGEWOOD, MD
09/23/1997

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<IMG SRC 97091A>

DECLARATION FOR THE RECORD OF DECISION
DECISION SUMMARY

SITE NAME AND LOCATION

Watson Creek, O-Field Area, Edgewood Area, U.S. Army Aberdeen Proving Ground, Maryland.

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected action for the Watson Creek sediment, which is Operable Unit 3 (OU3) of the O-Field Study Area at Aberdeen Proving Ground, MD. The selected action was chosen in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) 300.430. This decision document explains the factual basis for selecting the remedy for OU3 and the rationale for the final decision. The information supporting this remedial action decision is contained in the Administrative Record for this site.

The State of Maryland Department of the Environment (MDE) concurs with the selected remedy.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from the site, if not addressed by implementing the response actions selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE REMEDY

This operable unit (OU) is the third of four that are planned for the site. The first operable unit (OU1) addresses the contaminated groundwater emanating from Old O-Field. The remedy for OU1, the O-Field Groundwater Treatment Facility (GWTF), is in the operational stage. The second operable unit (OU2) addresses the Old O-Field Source Area. The remedy for OU2, the Permeable Infiltration Unit (PIU), is currently under construction. The fourth operable unit (OU4) consists of the source area and groundwater at New O-Field. Studies are presently underway to evaluate the risks associated with OU4.

This ROD has been developed for OU3 of the O-Field area. The levels of contamination in the Watson Creek sediment are not a threat to human health. However, localized areas may exist where the levels of contaminants could potentially adversely affect benthic communities. This remedy addresses the reduction in adverse effects to benthic communities by limiting disturbance of the sediment which could occur through future use and development of the affected area.

The major components of the selected remedy include:

- Institutional restrictions and maintenance of existing physical security measures;
- Prevention of development and disturbance of the site;
- Provision of information for workers and the public concerning the risks present at the site; and
- Long-term monitoring of site conditions.

The remedy specified herein will be one component of the overall remedy for the O-Field area. This action will be consistent with any current or planned future remedial actions for the site to the extent practicable.

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with Federal and State requirements that are legally applicable or relevant and appropriate for this action, and is cost-effective. This action utilizes permanent solutions and alternative treatment technologies, to the maximum extent practicable for this site. However, because treatment of the principal threats of the site was not found to be practicable, this remedy does not satisfy the statutory preference for treatment as a principal element.

Because this remedy will result in hazardous substances remaining on site, a review will be conducted within five years after commencement of the long-term monitoring plan to ensure that the remedy continues to provide adequate protection of human health and the environment.

<IMG SRC 97091B>

TABLE OF CONTENTS

Section Page

LIST OF APPENDICES

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS AND ABBREVIATIONS

2,4,6-TNT 2,4,6-trinitrotoluene
4,4-DDE 4,4-dichlorodiphenyldichloroethylene

APG .... Aberdeen Proving Ground
ARAR .... Applicable or Relevant and Appropriate Requirement
AVS .... Acid Volatile Sulfide
AWQC .... Ambient Water Quality Criteria
BTAG .... Biological Technical Advisory Group
BZ .... 3-quinuclidinyl benzilate
CERCLA .... Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR .... Code of Federal Regulations
CG .... phosgene
CN .... chloroacetophenone
CNS .... chloroacetophenone in chloroform
CS .... ortho-chlorobenzylidenemalonitrile
CWM .... chemical warfare materiel
DANC .... Decontaminating Agent Non-Corrosive
DM .... adamsite
DSHE .... Directorate of Safety, Health and Environment
EEQ .... Environmental Effects Quotient
ERA .... Ecological Risk Assessment
ER-L .... Effects Range Low
ER-M .... Effects Range Median
FFS .... Focused Feasibility Study
GAC .... granular-activated carbon
GB .... Sarin
GIS .... Geographical Information System
GWTF .... Groundwater Treatment Facility
H. azteca .... Hyalella azteca
ICF KE .... ICF Kaiser Engineers, Inc.
L .... Lewisite
LTC .... Lieutenant Colonel
MDE .... Maryland Department of the Environment
MEP .... Maximum Extent Practicable
Ig/L .... micrograms per liter
NCP .... National Oil and Hazardous Substances Pollution Contingency Plan
NPL .... National Priorities List
O&M .... Operation & Maintenance
OU .... Operable Unit
PCB .... polychlorinated biphenyl
PIU .... permeable infiltration unit
RA .... Risk Assessment
RI/FS .... Remedial Investigation/Feasibility Study
ROD .... Record of Decision
SARA .... Superfund Amendments and Reauthorization Act of 1986
SVOC .... semivolatile organic compound
TAL .... Target Analyte List
TCL .... Target Compound List
TCLP .... Toxicity Characteristic Leaching Procedure
TEU .... Technical Escort Unit
USAEC .... U.S. Army Environmental Center
USAEHA .... U.S. Army Environmental Hygiene Agency
USATHAMA .... U.S. Army Toxic and Hazardous Materials Agency
USCS .... Unified Soil Classification System
USEPA .... U.S. Environmental Protection Agency
USGS .... U.S. Geological Survey
UV/OX .... ultraviolet light catalyzed oxidation
UXO .... unexploded ordnance
VOC .... volatile organic compound
VX .... ethyl s-dimethyl amino ethyl methyl-phosphonothiolate
WP .... white phosphorus

1.0 SITE NAME, LOCATION, AND DESCRIPTION

The U.S. Army Aberdeen Proving Ground (APG) is a 72,516-acre (39,882-acre land area) installation located in southern Harford County and northeastern Baltimore County, Maryland, on the western shore of the upper Chesapeake Bay (Figure 1-1). The installation is bordered to the east and south by the Chesapeake Bay; to the west by Gunpowder Falls State Park, the Crane Power Plant and residential areas; and to the north by the City of Aberdeen and the towns of Edgewood, Joppatowne, Magnolia, and Perryman. APG is divided into two areas by the Bush River: the Edgewood Area of APG lies to the west and the Aberdeen Area lies to the east.

Watson Creek is a 60-acre estuarine water body, located in the O-Field Study Area on the Gunpowder Neck peninsula in the Edgewood Area of APG. It is bordered on the south and west by O-Field, on the north and east by M-Field, and discharges to the northwest into the Gunpowder River. The location of Watson Creek is shown on Figure 1-1. Watson Creek receives both surface water runoff and groundwater discharge from O-Field. The Watson Creek watershed drains into the Gunpowder River, which in turn drains into the Chesapeake Bay. Surface water exchange between Watson Creek and the Gunpowder River is restricted to a narrow culvert under Watson Creek Road. This culvert restricts tidal flushing of the creek (U.S. Army Environmental Hygiene Agency [USAEHA], 1977).

Watson Creek provides an aquatic habitat for a variety of freshwater and estuarine aquatic life. Freshwater and estuarine fish that have been caught in Watson Creek include largemouth bass (Micropterus salmoides), black crappie (Pomoxis nigromaculatus), carp (Cyprinus carpio), white perch (Morone americana), striped bass (Morone saxatilis), catfish (Ictalurus spp.), yellow perch (Perca flavenscens), eels (Anguila rostrata), and Atlantic silverside (Menidia menidia) (ICF KE, 1995). Other fish species that may be present year round or seasonally in Watson Creek include various species of herring (Alosa spp., Anchoa mitchilli, Brevoortia tyrannus), black drum (Pogonias cromis), bluefish (Pomatomus saltatrix), croaker (Micropogonias undulatus), and mummichog (Fundulus heteroclitis). Invertebrates identified in Watson Creek sediments include polychaetes, isopods, amphipods, and chironomids. Sediment-dwelling organisms in Watson Creek are representative of typical tidal fresh water to low mesohaline (Holland et al. 1989), including worms, amphipods, and isopods. Various factors such as seasonal temperature fluctuations, restricted tidal flushing, high organic loading, and salinity (ranging from 0.5 to 10 parts per trillion) may have an impact on the abundance of organisms in Watson Creek. In addition, the dams at Watson Creek which were constructed to enlarge the water surface area for wildlife have "altered the natural habitat, greatly reducing the innate ability of the creek-estuary systems to maintain conditions favorable for a balanced and health ecosystem ..." (USAEHA, 1977).

The topography of the area surrounding Watson Creek is generally flat, with land-surface elevations ranging from sea level to approximately 19 feet above mean sea level. Marshy areas surround Watson Creek on all sides and are especially prevalent in the area immediately south of Watson Creek. Marshes within this area are characteristically dense and are largely covered by Phragmites, a reed-like plant which produces a very dense root mat.

The O-Field area contains two (2) identified disposal areas and one (1) suspected disposal area (Figure 1-2). The northern disposal area, designated as Old O-Field, is a strictly controlled, contaminated area. Contamination at Old O-Field is currently being remediated by the Groundwater Treatment Facility (GWTF) and Permeable Infiltration Unit (PIU) interim actions. Further restrictions to on-site access are currently being implemented. Old O-Feld is located adjacent to Watson Creek and east of Watson Creek Road. The second identified disposal area, New O-Field, is located south of Old O-Field and east of Watson Creek Road. New O-Field was used from 1950 to the late 1970s as a destruction, disposal, and training area. The suspected disposal area, known as the "Pit Site," is on the west side of Watson Creek Road near the Gunpowder River. Old O-Field and the Pit Site were reportedly used from the late 1930s to mid-1950s as disposal areas.

The residential areas closest to Old O-Field lie approximately 2.7 miles north (on-post military housing within the Edgewood Area of APG), 3 miles to the west (Graces Quarters, Maryland), and 4.5 miles to the north-northwest (Edgewood, Maryland, and Joppatowne, Maryland). In addition, Kent County, Maryland, lies 6 miles east of Old O-Field.

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2.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

APG was established in 1917 as the Ordnance Proving Ground and was designated a formal military Post in 1919. Testing of ammunition and other equipment and operation of training schools began at APG in 1918. Between this time and the onset of World War II, activities at APG included research and development and large-scale testing of a wide variety of munitions, weapons, and other equipment. Immediately prior to and during World War II, the pace of testing increased greatly. During the war, personnel strength at APG exceeded 30,000. Similar but smaller-scale increases in development and testing activities were experienced during the Korean and Vietnam conflicts.

APG's primary mission continues to be the testing and development of weapons, munitions, vehicles, and a wide variety of support equipment. Chemical warfare research, development, and related activities have occurred within the Edgewood Area. Specific activities at Edgewood have included laboratory research, field testing of chemical munitions, pilot-scale manufacturing, and production-scale chemical agent manufacturing.

Many areas of the Gunpowder Neck of the Edgewood Area have been used as impact areas for the testing of ordnance; as such, there is the potential for encountering unexploded ordnance (UXO) and/or intact or leaking liquid-filled rounds which remain from testing. Disposal and testing activities have also taken place in areas along the Gunpowder Neck. O-Field and J-Field were the major disposal areas (the disposal history of O-Field is discussed in more detail below). Currently, testing of combat tracked vehicles occurs at H-Field (to the south of O-Field) and testing of obscurants (e.g., smoke screens) takes place at M-Field (immediately northeast of Watson Creek).

2.1 HISTORY OF OLD O-FIELD

Periodic disposal of waste materials at the O-Field area began before World War II; the first documented use of Old O-Field occurred in May 1941 (Yon et al., 1978), although other records suggest that disposal activities occurred as early as the late 1930s. Disposal consisted of placing materials in excavated trenches and then covering the trenches with soil. Records indicate that some of the burial trenches were 100 yards long, 10 feet deep, and 10 feet wide; however, most known trenches are much shorter. The existence of 35 trenches is documented in historical records (Yon et al., 1978). However, inspection of survey notes and historical aerial photographs reveals that the trenches and pits are not distinct. As disposal activities continued, trenches were created which appear to overlay and intersect other trenches. Because of this, the total number of trenches and their locations are not known. The last pit used for disposal of materials within Old O-Field was closed in June 1953.

During the period of 1941 to 1949, tons of chemical-filled/explosive-loaded munitions, contaminated plant equipment, pipes, and tanks were buried or placed on the ground surface in the area of Old O-Field. Interviewed personnel stated that the area contained 55-gallon drums of mustard and lewisite (L); items filled with chloroacetophenone (CN), chloroacetophenone in chloroform (CNS), and adamsite (DM); munitions containing explosive charge; and munitions filled with white phosphorus (WP) and other chemical warfare materiel (CWM).

During August 1946, the unloading and decontamination operations of the SS Francis L. Lee, a Liberty ship containing mustard-filled German munitions captured during World War II, were conducted at Edgewood Arsenal. The ship was anchored in the eastern channel of the Chesapeake Bay between Worton Point and Stoops Point. The material was then loaded onto barges and towed up the Bush River to the Edgewood dock. Contaminated empty German bombs (formerly mustard-filled), contaminated wood, and dunnage were placed at Old O-Field for disposal.

In June 1949, a spontaneous ignition occurred in one of the disposal pits at Old O-Field where a large variety of chemical-filled/explosive-loaded munitions had been buried. As a result of this explosion, a broad area was contaminated with CWM, and unexploded ordnance was dispersed around the area. Immediately after this incident, an inspection was conducted by the Armed Services Explosive Safety Board. A directive was issued calling for a thorough cleanup of the contaminated area. In November 1949, the responsibility for the disposal and cleanup operations at Old O-Field was given to the Command of the Technical Escort Detachment at Edgewood Arsenal.

2.2 CLEANUP ACTIVITIES AT OLD O-FIELD

2.2.1 LTC Dean Dickey's Affidavit

The main source of information concerning early cleanup activities at Old O-Field is a testimonial prepared by Lieutenant Colonel (LTC) Dean Dickey (Yon et al., 1978), who was Officer-in-Charge of cleanup at Old O-Field, and who later returned to the Edgewood Area as Commander of the U.S. Army Technical Escort Unit (TEU).

Between September 1949, and the early 1950s, LTC Dickey's team performed a surface sweep and clearance of Old O-Field. The following activities were performed:

- Fuses, bursters, and boosters were gathered, placed in drums, and detonated. The handling of items and drums in Old O-Field was slowed down by the quantity of WP in the ground, which ignites and burn when exposed to air.

- Several hundred drums, mustard-filled rounds (including German mustard-filled 250-kg and 500-kg rounds), and tear gas-filled rounds were recovered from the surface of Old O-Field. The mustard-filled rounds and WP rounds were destroyed by placing them in a pit with lumber and napalm and burning.

- Old O-Field was also used for the destruction of leaking mustard and lewisite one-ton containers. The agent was destroyed by pouring it into flat steel pans and igniting it in the presence of lime.

- During the recovery activities, the surface of Old O-Field was decontaminated by pouring Decontaminating Agent Non-Corrosive (DANC, which contains approximately 95% 1,1,2,2-tetrachloroethane) and lime (calcium hydroxide) on the field. Approximately 1,000 barrels of DANC were used. Contaminated soil was then scooped up and put on top of Old O-Field. The trees were decontaminated by placing 2,4,6-trinitrotoluene (2,4,6-TNT) under cans of lime and detonating the cans to spread the lime. The reaction of lime with the agent in the trees caused the leaves and trees to ignite and burn.

- The Old O-Field pits and their contents were then burned. Hundreds of gallons of fuel oil were pumped into the pits. The entire field was then sprayed with fuel oil. Time fuses were placed in the pits. The pits and the entire area burned for two days, and numerous explosions occurred. The date for this phase of the cleanup is not given, but is presumed to have occurred during the early 1950s.

- During these cleanup activities, a number of unplanned detonations occurred. These explosions resulted in the release of mustard to the surface of Old O-Field and the surrounding trees and surface water bodies.

Other portions of LTC Dickey's affidavit indicate that, although a large quantity of disposed materials have been recovered from the surface of Old O-Field and some of the pits, a much larger quantity of munitions, bulk containers, and other items remain buried at the site.

2.2.2 U.S. Army TEU Surface Sweeps of Old O-Field

From the late 1960s to the early 1970s, the U.S. Army TEU performed surface sweeps of the area. A number of suspect CWM-filled rounds were recovered from Old O-Field, temporarily stored in Conex containers at Old O-Field, and then transported and stored in the storage bunkers at N-Field.

2.3 HISTORY OF NEW O-FIELD

Records indicate that in December 1950, the survey and layout of the second disposal area within the boundary of the-O-Field area was accomplished. This area is south of Old O-Field and east of Watson Creek Road, and is defined as the New O-Field disposal area. Yon and others (1978) reported that 9 pits at New O-Field were used for disposal operations from 1950 to 1961. The disposed material is reported to have included explosives; acids; animal carcasses; research laboratory samples of ethyl s-dimethyl amino ethyl methyl-phophonothiolate (VX), Sarin (GB), and impregnate; mustard and WP-filled shells; ortho-chlorobenzylidenemalonitrile (CS), DM, and CN. The pits were 20 feet wide and ranged in length from 40 to 100 feet. The depth of the pits is not known, but is probably similar to the depth of pits at Old O-Field (maximum depth of at least 12 feet)(U.S. Geological Survey [USGS], 1991). In later years, until disposal ended in the late 1970s, the primary activity at New O-Field was destruction of materials by burning (USGS, 1991). This most likely included burning of wastes containing chlorinated solvents (Nemeth, 1989).

An accidental ignition of one disposal pit was reported in New O-Field in August 1961. The report describing this incident states that the pit contained 55-gallon drums of acid on dunnage; one 300-gallon tank contaminated with mustard; laboratory samples and waste material consisting of VX, GB, phosgene (CG), and numerous bottles of miscellaneous laboratory chemicals, GB-contaminated pipe; and 3-quinuclidinyl benzilate (BZ) contaminated rags. The ignition of the pit was reported as being caused by an unknown laboratory chemical after a brief but heavy rain shower.

2.4 PREVIOUS INVESTIGATIONS

This section summarizes the results of past environmental studies focusing on Watson Creek.

2.4.1 Environmental Survey

An Environmental Survey of the Edgewood Area of APG was conducted in 1977 and 1978 by the U.S. Army Toxic and Hazardous Materials Agency (USATHAMA), now known as the U.S. Army Environmental Center (USAEC) (Nemeth et al., 1983), to determine if chemical contamination from past operations was presenting a hazard to the off-post environment. The survey indicated that groundwater flowed from Old O-Field to Watson Creek, although some component flowed toward the Gunpowder River. Results of the study also indicated that the groundwater at Old O-Field contained metals, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), and CWM degradation products at concentrations above 1,000 Ig/L (micrograms per liter). Surface water in Watson Creek was found to contain low levels of VOCs and arsenic; however, none of the compounds were detected above their respective surface water criteria. Finally, the report concluded that because VOCs volatilize from surface water after discharge to Watson Creek, and because Watson Creek is diluted upon entry into the Gunpowder River, significant degradation of surface water quality within the Gunpowder River was not occurring.

2.4.2 Surface Water Quality Survey

USAEHA conducted a surface water quality and biological study of Watson Creek and nearby creeks (USAEHA, 1977). Due to poor tidal flushing in Watson Creek, unusually high loading of metals was detected in the sediment. The report indicated elevated concentrations of cadmium (0.73 to 1.01 mg/kg), copper (20 to 41.4 mg/kg), and zinc (29 to 167 mg/kg); and low concentrations of arsenic (9.5 mg/kg) in the sediment. Silver concentrations (0.023 to 0.042 mg/l) in the surface water at Watson Creek exceeded the recommended safe limit of 0.02 mg/l, outlined in Water Quality Criteria (National Academy of Sciences, 1972). Bioassays that were conducted using sediment samples determined that the contamination in the sediment was at levels non-lethal to aquatic inhabitants.

2.4.3 Hydrogeologic Investigation

In 1984, the USGS began a study to investigate the source, extent, and possible migration of contaminants from the Old O-Field site. The final report by Vroblesky et al. (USGS, 1991) presents a preliminary characterization of the contamination of the groundwater, surface water, and bottom sediment in the O-Field area of APG, and describes the probable hydrologic and chemical effects of relevant remedial actions on the groundwater at the site. Sampling in August 1985 revealed maximum detected concentrations of the following metals in surface water: arsenic (1.26 mg/L); cadmium (0.019 mg/L); copper (2.5×10^{-3} mg/L); and mercury (3.8×10^{-4} mg/L). Sediment sampling in November 1984 and August 1985 also identified the following maximum detected concentrations: arsenic (30.6 mg/kg); chromium (39.4 mg/kg); copper (66.7 mg/kg); lead (47.9 mg/kg); mercury (0.99 mg/kg); zinc (394 mg/kg); phenanthrene (65.1 Ig/kg); 1,2-dichloroethene (0.2 Ig/kg); and trichlorofluoromethane (98 Ig/kg)(USGS, 1991).

2.4.4 Groundwater and Surface Water Sampling, Fall 1991

In November 1991, the Army collected groundwater samples from all existing monitoring wells. Surface water samples were also collected from Watson Creek and the Gunpowder River. The results concluded that VOCs, SVOCs, polychlorinated biphenyls (PCBs), herbicides, pesticides, and explosive compounds were not detected in surface water samples collected from Watson Creek and Gunpowder River adjacent to O-Field; however, oxathiane (a CWM degradation product) was detected and one sample collected from Watson Creek east of Old O-Field (at 7.8 Ig/L).

2.4.5 Old O-Fleld Groundwater Treatment Remedy

A Focused Feasibility Study (FFS) was performed to evaluate remedial alternatives for the groundwater, OU1, at Old O-Field (ICF Kaiser Engineers, Inc. [ICF KE], 1990). As part of this study, aquifer tests were performed to aid in designing a groundwater extraction system (ICF KE, 1991a). Treatability tests were conducted to evaluate the implementability of various groundwater treatment technologies. A number of promising technologies were tested at both the bench- and pilot-scale.

The data obtained from the treatability tests were used to select a preferred remedial technology. Groundwater extraction and treatment using chemical precipitation for removal of the inorganic analytes followed by ultraviolet light catalyzed oxidation (UV/OX) for removal of the organic contaminants was selected as the proposed remedial treatment technology (ICF KE, 1991b). Discharge of treated groundwater to the Gunpowder River was also proposed. Based on the results of the FFS, the aquifer tests, and the treatability studies, a Proposed Plan was developed which addressed groundwater extraction and treatment for the Old O-Field Area (U.S. Department of the Army, 1991a). A ROD which documented the remedy selection was signed by the Army and the U.S. Environmental Protection Agency (USEPA) Region III in September 1991 (U.S. Department of the Army, 1991b).

ICF KE then developed this conceptual design for the groundwater extraction, treatment, and discharge system (ICF KE, 1991c). The system was designed to intercept and treat the contaminated groundwater emanating from Old O-Field and to prevent loading of contaminants into Watson Creek. Under a separate contract, Roy F. Weston, Inc. completed this engineering design and construction of the GWTF. In addition to the core processes of chemical precipitation and UV-OX specified in the ROD, air stripping and granular-activated carbon (GAC) adsorption were added to the final design. The GWTF began operation in April 1995.

2.4.6 Old O-Field Source Area Treatment Remedy

A FFS was performed by ICF KE to evaluate remedial alternatives for the source area at Old O-Field, OU2 (ICF KE, 1994). As part of this study, a hazard assessment was performed to evaluate the hazards associated with explosions and dispersion of chemical agents within Old O-Field. Based on the results of the hazard assessment and the FFS, a Proposed Plan was developed by ICF KE which addressed the source area at Old O-Field (U.S. Department of the Army, 1994a). Under this plan, a PIU, consisting of a layer of sand and other granular materials, was proposed for the surface of Old O-Field. The PIU was designed to: 1) reduce the threat of a release of chemical agents by covering the site with non-flammable materials, which will serve to cut off the air flow to the surface of Old O-Field, stop erosion, and stabilize the soil; 2) provide a blast resistant layer on top of the ordnance within Old O-Field; and 3) provide a vapor barrier to reduce the emission of chemical agents from an underground release. Additionally, covering the surface of Old O-Field will stop surface runoff from migrating off site to nearby surface water bodies (e.g., Watson Creek and the Gunpowder River).

Once the PIU is constructed and operating, treatability studies will be performed to evaluate the feasibility of applying solutions through the PIU to enhance leaching of contaminants from the soil. The ability of the groundwater extraction and treatment system to capture and treat the contaminated groundwater emanating from Old O-Field and solutions applied to Old O-Field will be verified.

An interim ROD, which documents the remedy selection, was signed by the Army and USEPA Region III in October 1994 (U.S. Department of the Army, 1994b). ICF KE then developed the design for the PIU (U.S. Department of the Army, 1995). Under a separate contract, Roy F. Weston, Inc. has initiated construction of the PIU. Completion is anticipated by early 1998.

2.4.7 O-Field Area Remedial Investigation/Feasibility Study

The Army performed a Remedial Investigation/Feasibility Study (RI/FS) of the entire O-Field study area. The RI consisted of the installation of monitoring wells and the collection and analysis of samples from surface water, sediment, groundwater, air, and soil. Extensive soil gas surveys and geophysical surveys were also performed.

Because the toxicity of the military-specific compounds is not well known, toxicity tests were conducted to evaluate potential impacts to aquatic life. Macroinvertebrates were collected in sediments from Watson Creek and the Gunpowder River and analyzed to evaluate the potential for bioaccumulation of contaminants. Further hydrogeologic investigation of the area has been performed through aquifer testing and groundwater flow modeling. Results of this investigation are presented in the RI Report (ICF KE, 1995).

2.4.8 Watson Creek Sampling

Watson Creek sediment sampling events were conducted in September 1993 (Phase I), March 1995 (Phase II), and June 1996 (Phase III). Phases I and II were conducted during the RI, and the results are presented in the RI Report (ICF KE, 1995). Data from the three phases of sampling indicate that humans and aquatic life would not be adversely impacted by chemicals in the surface water in Watson Creek; however, benthic-dwelling species may be impacted by the metals concentrations in sediment in Watson Creek. Results from Phases I, II, and III are discussed in the FFS for Watson Creek (ICF KE, 1997a).

2.4.9 Focused Feasibility Study for Watson Creek

The FFS for Watson Crook evaluated the risks posed by the sediment in Watson Creek and the potentially applicable remedial technologies for mitigating these risks (ICF KE, 1997a). The Proposed Plan for Watson Creek (ICF KE, 1997b) and this ROD are based on the results of the FFS report.

3.0 HIGHLIGHTS OF COMMUNITY PARTICIPATION

The FFS Report and Proposed Plan for OU3 were released to the public in July 1997. Both of these documents are available in the Administrative Record and the information repositories maintained at the Harford County Library - Aberdeen Branch, Aberdeen, MD; Harford County Library - Edgewood Branch, Edgewood, MD; and Washington College - Miller Library, Chestertown, MD. The notice of availability of these documents was published in the Aegis (Harford County), the Baltimore Sun, the Avenue (Baltimore County), and the Kent County News on July 2,1997.

The 45-day comment period was held from July 2, 1997 through August 15, 1997. In addition, a public meeting was held on July 28, 1997. At this meeting, representatives from APG, USEPA, and MDE presented a summary of the site conditions and remedial alternatives under consideration. A response to the comments received during this period is included in the Responsiveness Summary, which is part of this ROD.

This decision document presents the selected remedial action for Watson Creek, OU3 of the Old O-Field Study Area, APG, Maryland. The remedy has been chosen in accordance with CERCLA, as amended by SARA, and, to the extent practicable, the NCP. In addition, this decision incorporates the findings of the FFS, which evaluated the remedial alternatives for OU3. The decision for this OU is based on data contained in documents found in the Administrative Record.

4.0 SCOPE AND ROLE OF OPERABLE UNIT OR RESPONSE ACTION

Past disposal operations at the O-Field area have led to contaminated soil and groundwater at and near O-Field. The Army has decided to manage the environmental contamination in the different media at the O-Field area in a phased approach. This separation of environmental media into OUs allows the Army to begin remediation prior to full assessment of the O-Field Area. The NCP provides that CERCLA National Priorities List (NPL) sites "should generally be remediated in OUs when early actions are necessary or appropriate to achieve significant risk reduction quickly, when phased analysis or response is necessary or appropriate given the site or complexity of the site, or to expedite the completion of a total cleanup" (40 CFR 300.430(a)(1)(ii)(A)). The Army's phased approach to O-Field is consistent with these objectives.

An OU is defined by the NCP as a discrete action which is an incremental step toward comprehensively mitigating site problems. The OUs for the O-Field area at APG have been defined as follows:

- OU1: Contaminated groundwater beneath and immediately downgradient of the Old O-Field disposal trenches which has been contaminated from past disposal practices;
- OU2: Contaminant source area within the disposal trenches at Old O-Field;
- OU3: Contaminated sediment and surface water within Watson Creek; and
- OU4: Contaminated soil and groundwater at New O-Field.

The Army has already selected remedies for OU1 and OU2, as discussed in Sections 2.4.5 and 2.4.6. respectively, of this ROD. OU4 requires additional investigation and will be handled in a separate action.

As mentioned in Section 1.0, Watson Creek (OU3) receives both surface water runoff and groundwater from O-Field (which includes OU1, OU2, and OU4). This remedy for OU3 addresses the potential adverse effects to benthic communities due to elevated concentrations of inorganics and 4,4-dichlorodiphenyldichloroethylene (4,4-DDE) in the Watson Creek sediment. This action will be consistent with planned future activities, to the maximum extent practicable. In addition, the remedy for OU3 will be taken into consideration during remedy selection for OU4.

5.0 SUMMARY OF SITE CHARACTERISTICS

This section provides a summary of the nature and extent of contamination in Watson Creek.

5.1 CONTAMINANTS IN WATSON CREEK

Watson Creek sediments were sampled in 1984 and 1985 by the USGS (USGS, 1991). Sample analyses revealed detectable, and in some cases elevated (as compared to sediment screening values), levels of heavy metals, including arsenic, lead, and mercury (Section 2.4.3). Detectable levels of some organic compounds were also found. The data indicated that additional sampling of sediment was needed to evaluate temporal changes and to complete the data set to allow an Ecological Risk Assessment (ERA) to be performed.

The Phase I sediment sampling locations were based on sample locations used during the 1984/1985 Watson Creek sediment sampling (USGS, 1991). Based on the Phase I bioassay results, Phase II sampling locations were chosen to further characterize the impact of metals on the benthic communities in Watson Creek. Phase III sample locations were selected to delineate areas which might be considered "hot spots" within Watson Creek. Sediment bioassays were collected throughout Watson Creek to determine if benthic communities were being impacted. Samples were collected and analyzed for VOCS, SVOCs, pesticides/ polychlorinated biphenyls (PCBs), and CWM degradation products to evaluate the presence of these chemicals in sediment in Watson Creek. A summary of the chemicals detected in the Watson Creek sediment is presented in Table 5-1.

5.1.1 Phase I Sediment Sampling

Phase I sampling activities occurred in October 1992 and September 1993. Background sediment samples (DCB-1, PCB-1, and SCB-1) were collected from Dundee Creek and Saltpeter Creek in October 1992. Phase I sediment samples (WC-1 through WC-12) were collected from Watson Creek in September 1993 (Figure 5-1). All of the

Phase I sediment samples were analyzed for metals, total phosphorus, Target Compound List (TCL) VOCs, CWM degradation products and explosives compounds, ammonia, acid volatile sulfide (AVS), grain-size distribution, and Unified Soil Classification System (USCS) classification. Three sediment samples (WC-1, WC-4, WC-6) were also analyzed for SVOCs, dioxins, and furans. In addition to the chemical and physical analyses, bioassays were collected at each sampling location to determine the impact of sediment contamination on benthic communities in Watson Creek.

Results from the Phase I sediment sampling event indicated that contaminants of potential concern (those analytes which were detected above background levels) are metals. These metals include aluminum, arsenic, barium, cadmium, calcium, chromium, cobalt, copper, iron, lead, magnesium, manganese, mercury, silver, sodium, and zinc. TCL VOCs, SVOCs, CWM degradation products, and explosives compounds were not detected in sediment or background samples. Bioassay results indicate that the survival of Hyalella azteca (H. azteca) in sediment collected from WC-3 was significantly lower than in the remaining samples and the controls. Additionally, growth of H. azteca in sediment collected from WC-9 was inhibited when compared to the remaining sediment samples and the controls.

5.1.2 Phase II Sediment Sampling

The results of sediment bioassays and chemical analyses from the Phase I sediment sampling event indicated the potential for limited impacts to benthic-dwelling aquatic species in Watson Creek due to the elevated concentrations of metals in the sediments. Based on the Phase I bioassay results, impacts to benthic communities were most likely to occur at Phase I sample locations WC-3 and WC-9. Therefore, a total of 23 locations (WC-13 through WC-35) were sampled within Watson Creek in March 1995, to provide additional data regarding metals concentrations (Figure 5-1). Additionally, bioassay tests similar to those performed during Phase I were also performed on the Phase II samples.

Table 5-1
Summary of Chemicals Detected in
Watson Crook Sediment, O-Field Area
1993 - 1996 (a)

Chemical	Frequency of Detection	Range of Detected On-Site Concentrations (b)	Range of Detected Background Concentrations (c)
Inorganics (mg/kg):			
Aluminum	85/85	281 - 22,000	10,100 - 16,300
Arsenic	85/85	0.467 - 82.5	4.8 - 7.1
Barium	85/85	1.05 - 111	50.8 - 74.3
Beryllium	33/85	0.451 - 3.35	2.4
Cadmium	29/85	1.36 - 4.62	ND
Calcium	85/85	179 - 4,510	1,590 - 3,070
Chromium	85/85	1.22 - 132	29.2 - 35.2
Cobalt	84/85	4.3 - 31.3	21.8 - 28.4
Copper	80/85	0.737 - 305	67.8 - 80.2
Iron	85/85	771 - 41,200	28,000 - 32,000
Lead	85/85	1.05 - 109	59.8 - 91.4
Magnesium	85/85	132 - 5,970	3,780 - 5,480
Manganese	85/85	10.3 - 637	231 - 367
Mercury	72/85	0.23 - 5.91	ND
Nickel	85/85	1.49 - 42.7	42.3 - 49.1
Potassium	85/85	79 - 2,190	1,730 - 2,230
Selenium	42/85	0.97 - 3.66	1.2 - 3.2
Silver	13/85	0.14 - 7.34	ND
Sodium	85/85	573 - 11,110	4,210 - 8,190
Vanadium	85/85	0.908 - 43.5	41.7 - 58.8
Zinc	80/85	16.2 - 1,130	283 - 410
Organics (Ig/kg);			
Acetone	5/27	140 - 1,500	ND
Bis(2-ethylhexyl)phthalateb	5/18	770 - 4,100	ND
2-Butanone	3/27	17 - 57	ND
Diethyl phthalate	5/27	71 - 180	ND
Methylene chloride	2/27	31 - 100	ND
4,4-DDE	4/18	20.7 - 34.5	ND
CWM Degradation Products (mg/kg):			
1,4-Dithiane	1/17	21,000	ND

Notes:
ND = Not Detected
(a) Chemicals not detected substantially above the levels reported in laboratory or field blanks (validated as "B") were excluded from this summary.
(b) Summary of all three sediment sampling events at Watson Creek Phase I - September 1993; Phase II - March 1995; and Phase III - June 1996.
(c) Background samples were collected from Dundee Creek and Saltpeter Creek in October 1992.

Results from Phase II sediment sampling confirmed that contaminants of potential concern (those analytes which were detected up to nine times the background levels) are metals. These metals included aluminum, arsenic, cadmium, chromium, cobalt, copper, iron, manganese, mercury, selenium, and zinc. Although arsenic and mercury were detected above background levels throughout Watson Creek, the remaining metals were detected in localized areas. Bioassay results from Phase II sampling indicate that the survival of H. azteca in sediment collected from two samples were significantly lower than in the remaining samples and the controls. However, there did not appear to be any correlation between the bioassay and chemical results from either the Phase I or Phase II Watson Creek sediment samples.

5.1.3 Phase III Sediment Sampling

Phase III sampling was conducted in June 1996 to further characterize the extent of contamination in Watson Creek sediment and to evaluate the potential impact of contaminated sediment on benthic organisms in the creek from the presence of metals or other compounds (e.g., organics) which were not identified in previous investigations. The first objective was met by collecting additional sediment, subsurface soil, and groundwater samples in and along the border of Watson Creek. The second objective was met by performing sediment bioassays to evaluate sediment toxicity. Results of the Phase III sediment sampling event were used to revise the Watson Creek sediment ERA.

The sediment sampling locations were chosen to delineate "hot spots," which were defined by: 1) locations where elevated chemical concentrations in sediment; 2) toxicity based on the results of sediment bioassay tests; and 3) a combination of both elevated chemical concentrations in sediment and toxicity based on the results of the sediment bioassays. Four sample areas were chosen for the Phase III sampling event: Area 1 (grid sampling at G-1 through G-37 and WC-3); Area 2 (WC-9, WC-27, WC-28, and WC-44); Area 3 (WC-36 through WC-40); and Area 4 (WC-41 through WC-43). The sediment sampling locations are shown on Figure 5-1.

All 50 of the Phase III sediment samples were analyzed for Target Analyte List (TAL) metals and physical analysis. Fifteen samples were analyzed for TCL VOCs, SVOCs, pesticides/PCBs; and five samples were analyzed for CWM degradation products. In addition to collecting sediment samples for chemical analysis during Phase III, 13 samples were collected for H. azteca bioassays.

Results from the Phase III sediment sampling event confirmed the presence of elevated metals in Watson Creek. These metals included aluminum, arsenic, barium, beryllium, cadmium, calcium, chromium, copper, iron, lead, manganese, mercury, silver, and zinc. Arsenic, copper, mercury, and zinc were detected above background in all areas of Watson Creek. The remaining metals were detected above background in localized areas of Watson Creek.

In addition to the elevated metals, a few VOCs and SVOCs were detected in Watson Creek sediment. Acetone, 2-butanone, and methylene chloride were detected in localized regions of Areas 1 and 3 sediment. Bis(2-ethylhexyl) phthalate and diethyl phthalate were detected in scattered locations throughout Watson Creek. Many of the detected VOCs and SVOCs are used as common laboratory solvents; therefore, it is highly probable that the detections are the result of contamination during analysis. The pesticide degradation product 4,4-DDE was detected in localized areas of the southern region of Watson Creek (WC-39, WC-41, and WC-43). Based on the locations where 4,4-DDE was detected, the concentrations are most likely due to contamination from New O-Field. Pesticides have been detected in New O-Field marsh samples collected in the vicinity of Watson Creek. 1,4-Dithiane was detected in WC-3 downgradient of Old O-Field, but not in the duplicate sample for that location. Bioassay results from Phase III sampling indicated there were no statistically significant differences in the survival and growth of H. azteca between the sediment samples collected from Watson Creek and the control sample.

5.2 POTENTIAL ROUTES OF CONTAMINANT MIGRATION AND ROUTES OF EXPOSURE

The Risk Assessment (RA) prepared as part of the RI for the O-Field Area indicated that no complete pathways exist by which humans could be exposed to chemicals in the surface water or sediment of Watson Creek under current or future land-use scenarios. Furthermore, the results of surface water analysis indicated that aquatic life would not be adversely affected by chemicals in surface water. Based on discussions with the USEPA Region III Biological Technical Advisory Group (BTAG), the evaluation of potential adverse effects to aquatic life from the presence of chemicals in sediment was identified as the most viable potential exposure pathway and was selected for evaluation in the ERA. Results of the ERA are discussed in Section 6.0 of this ROD.

5.3 SITE-SPECIFIC FACTORS THAT MAY AFFECT REMEDIAL ACTIONS AT THE SITE

Although there is no risk of human exposure to chemicals in the sediment at Watson Creek, there is potential risk to human health due to the possible presence of ordnance in Watson Creek. Many areas within the Gunpowder Neck peninsula were at one time used as impact areas for the testing of ordnance. In addition, there is the likelihood that ordnance was ejected into Watson Creek from Old O-Field during explosions in the late 1940s. For these reasons, the Army believes it is likely that ordnance is buried within the Watson Creek sediment. The presence of ordnance may limit the activities that are considered safe to perform at Watson Creek.

6.0 SUMMARY OF SITE RISKS

The Remedial Investigation for the O-Field area evaluated the full range of potential human and ecological receptors in Watson Creek. The results of this assessment indicated that there was no risk of human exposure to chemicals in the surface water or sediment of Watson Creek under current or future land-use scenarios. Furthermore, the results of surface water analysis indicated that aquatic life would not be adversely affected by chemicals in surface water. Based on discussions with the USEPA Region III BTAG, the potential adverse effects from the presence of chemicals in the Watson Creek sediment was identified as the most likely potential exposure pathway to aquatic life and was selected for evaluation in the FFS ERA.

Risk estimates were developed using the results of the three phases of chemical and biological analysis. The chemical analysis results for the sediment samples indicated that certain metals (specifically arsenic, copper, mercury, silver, and zinc) and one pesticide degradation product (4,4-DDE) are present at concentrations high enough to have the potential to cause limited adverse effects to sediment-dwelling organisms (such as clams, crabs, tubeworms, etc.). However, the chemical data indicate that the concentrations are just above the levels of concern, thus, any impacts that may occur are expected to be small and would not threaten the overall health of the sediment-dwelling community (Table 6-1).

Sediment samples were also collected during the three phases for toxicity testing, which consisted of the introduction of test aquatic species into the sample for a period of time. The aquatic species used in these toxicity tests are known to be sensitive to chemicals. During the tests, measurements of survival and growth of the test aquatic species were made to assess the effect of chemicals within the sample on the organism.

The results of the Phase III toxicity tests performed with Watson Creek sediment samples indicated that adverse effects to sediment-dwelling organisms are unlikely at the sampled locations. The results of Phase I and II toxicity tests were not taken into consideration, because low survival in the laboratory controls invalidated the results. Although toxicity tests were only performed for 13 of the 50 Phase III sediment sampling locations, samples which were tested were taken from locations where survival was lowest during the Phase I and II toxicity tests (e.g., WC-3, WC-27, and WC-28) and where the greatest chemical concentrations were detected in the Phase III chemical analyses (e.g., WC-3). Because no reduction in survival or growth of the test aquatic species occurred for these sample locations where adverse effects were considered most likely, it is unlikely that a reduction in survival or growth would have occurred for the sample locations which were not tested in Phase III. Thus, adverse effects to the overall health of the sediment-dwelling community in Watson Creek are unlikely.

The risk assessment concludes that Watson Creek surface water does not pose a threat to human health, terrestrial species, or aquatic species; therefore remediation of surface water is not needed. In addition, the results of the sediment sampling indicate that there maybe a small threat posed to sensitive sediment-dwelling organisms by the metals detected in the sediment; however, the overall health of the sediment-dwelling community does not appear to be threatened based on the Phase III toxicity test results.

The principal contaminant migration pathways from Old O-Field to Watson Creek have been partially mitigated by the OU1 action (interception of contaminated groundwater, treatment, and discharge into the Gunpowder River which is already in the operational phase) and the OU2 action (construction of the PIU on the Old O-Field source area which is in the construction phase). Furthermore, gradual redistribution of the fine-grained sediment particles is expected to occur naturally over time throughout the creek bed (due to changes in water elevation, movement of fish and other organisms, etc.). In addition, other chemical and physical processes, such as reduction, complexation, and ion exchange, may naturally lower the bioavailable metals concentrations in the sediment. It is therefore reasonable to expect that the concentratioris of metals within Watson Creek sediment will decrease over time, even in the absence of active romediation.

Although the toxicity tests from Phase III sampling indicate that metals in Watson Creek sediment have no observed adverse effects on the health of the sediment-dwelling organisms, previous toxicity results from Phase I & II sampling (since voided due to poor control group performance) prompted the Army to examine the remedial alternatives that could be performed to reduce the concentrations of metals in Watson Creek sediment. The purpose of such a remedial action would be to lower the overall concentrations to a level that is not expected to result in adverse impacts to sediment-dwelling organisms, or to remove the shallow sediment and replace it with clean material.

Table 6-1
Chemicals of Potential Concern

Chemical	Max. Detected Concentration (mg/kg)	ER-L (mg/kg)	EEQ (L)	ER-M (mg/kg)	EEQ (M)
Arsenic	82.5	8.2	10.1	70	1.2
Copper	305	34	9.0	270	1.1
Mercury	5.91	0.15	39.3	0.71	8.3
Silver	7.34	1.0	7.3	3.7	2.0
Zinc	1,130	150	7.5	410	2.8
4,4-DDE	0.0345	0.0022	15.7	0.027	1.3

Effects Range Low (ER-L): Approximate concentration of a given compound at which effects are likely to occur in sensitive life stages and/or species.

Effects Range-Median (ER-M): Approximate concentration of a given compound at which effects are likely to occur in most species.

Environmental Effects Quotient (EEQ): Ratio of contaminant concentration to ER-L/ER-M values.

EEQ<=1	Adverse effects considered unlikely
EEQ>1	Potential for adverse effects to occur
EEQ>10	Moderately high potential risk
EEQ>100	Extreme risk

The remediation of sediment is often a difficult problem and can result in greater harm to the aquatic and sediment-dwelling species than the risk originally posed by contaminants. Removal (dredging) of creek sediments will invariably cause a substantial resuspension of fine-grain sediments into the water column. Many metals are preferentially adsorbed to the finer-grained sediment components. As such, resuspending the fine-grained sediment component during a remedial action may effectively remobilize the metals contamination increasing the likelihood that aquatic species, and possibly terrestrial species, would be exposed to the metals.

7.0 DESCRIPTION OF ALTERNATIVES

During the technology screening conducted as part of the FFS (ICF KE, 1997a), applicable remedial technologies were identified, evaluated, and assembled into remedial alternatives as follows:

- No Action;
- Limited Action;
- Full-Scale Dredging/Solidification/Landfill;
- "Hot Spot" Removal/Solidification/Landfill; and
- Aquatic Phytoremediation.

This section describes the alternatives that were considered for remediating OU3.

7.1 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

As required by the NCP, the selected alternative must be in compliance with all "applicable or relevant and appropriate requirements" (ARARs). ARARs are the cleanup standards, standards of control, and other substantive environmental requirements, criteria, or limitations promulgated under Federal or State law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance of a Superfund site.

Chemical-specific ARARs are not available for sediment; however, State surface water quality standards and Federal Ambient Water Quality Criteria (AWQC) apply for surface water at Watson Creek. Location-specific ARARs include Federal and State regulations protecting endangered or threatened species; migratory birds; and bald and golden eagles. Action-specific ARARs relevant to Watson Creek include Federal and State regulations regarding hazardous wastes; environmental quality, floodplain management, wetland protection; and storm water, erosion, and sediment control.

7.2 ALTERNATIVE A: NO ACTION

Under this alternative, no action would be taken to address the contaminated sediment at Watson Creek. The No Action alternative is intended to serve as a baseline with which to compare the risk reduction effectiveness Of the other alternatives that are under consideration. Based on its location in the Edgewood Area, access would remain restricted; however, no additional land-use restrictions would be imposed at Watson Creek. Risks to benthic communities due to contaminants in the sediment would not be reduced or controlled under the No Action alternative.

The No Action alternative would not involve active treatment or containment. Therefore, there would be no significant reduction in toxicity, mobility, or volume of contaminants in Watson Creek. There would be no implementation time or cost associated with the No Action alternative because no remedial activities would be implemented at the site.

7.3 ALTERNATIVE B: LIMITED ACTION

The Limited Action alternative would include implementation of the following actions, which are detailed further in Section 9.0:

- Institutional controls;
- Physical security measures;
- Public education programs;
- Long-term monitoring of site conditions; and
- Five-year reviews.

The purpose of this alternative is to continue limiting access to the site, inform the public of site hazards, provide a database of site conditions, and evaluate changes over time. Long-term environmental monitoring of site conditions would consist of periodic sediment sampling and tissue sampling (if possible) of fish and/or invertebrates within Watson Creek. Site conditions would be reviewed at least every five years, as required by the NCP for all sites where contaminants remain at or above levels that allow for unlimited use and unrestricted exposure. This alternative does not use any technology that reduces the toxicity, mobility, or volume of contaminants. Land use restrictions would be inputted into APG's Geographical Information System (GIS) which is utilized in the development of APG's Real Property Master Plan.

All components of Alternative B would be feasible and easily implemented. All necessary equipment and materials required for implementation of this alternative are readily available. Administrative implementation of this alternative would require coordination between APG, the State of Maryland, and the USEPA to ensure continuity of the long-term management and monitoring of the site. Implementation would not affect additional future actions at the site. In fact, all components of Alternative B are also components of each of the active remedial alternatives evaluated for Watson Creek.

Capital costs are estimated to be $38,000, and annual operation and maintenance (O&M) costs are $46,000. Total present worth costs for this alternative based on a 30 year (5% discount rate) implementation period are $615,000. Contingencies associated with the alternative would be minimal because the alternative does not include any treatment or design components.

7.4 ALTERNATIVE C: FULL-SCALE DREDGING/SOLIDIFICATION/LANDFILL

Under this alternative, sediment covering the entire area of Watson Creek (approximately 60 acres) would be dredged due to the widely dispersed inorganic contamination. Approximately 100,000 yd 3 (a one-foot layer of sediment) would be removed. Prior to conducting any remedial activities at Watson Creek, areas which contain UXO would need to be identified, and the UXO would be removed by qualified personnel.

The removal activities would be performed using a cutterhead dredge hydraulic technique. This technique was chosen because it is a widely used and economical method for removing large quantities of sediment, which also minimizes sediment suspension. Once removed, the dredged sediment would be replaced with a one-foot layer of sand. Replacement of the dredged sediment would provide a layer of clean material for the benthic organisms to burrow while providing a barrier from any residual contamination remaining in the Watson Creek sediment.

The removed sediment would then be dewatered to reduce the water content to an acceptable level. This dewatered sediment would then be mixed with a cementitious material in order to encapsulate the contaminants within the sediment, isolating the contaminants from the environment. Although the volume of the contaminants in the dredged sediment would not be reduced, contaminant mobility would be significantly reduced because inorganic contaminants would be bound in the solidified sediment/cement monolith through treatment. The cured cement/sediment monolith would be sent to an off-site solid waste landfill for final disposal.

Dredging normally is a simple construction process, and all equipment required for dredging is available near the site. However, dredging at Watson Creek would be complicated by the unique hazards associated with the site. Normal dredging methods may not be applicable to Watson Creek due to UXO hazards. Techniques which minimize the suspension and migration of contaminated fines will be utilized during UXO and dredging operations to reduce short-term effects to the aquatic environment and to protect surface water quality in Watson Creek.

In addition to the dredging activities, Alternative C also includes all components of Alternative B (i.e., institutional controls, maintenance of existing physical security measures, public education programs, long-term monitoring of site conditions, and five-year reviews).

The chemical-specific ARARs that apply to this remedial action are surface water criteria. The quality of surface water in Watson Creek and the Gunpowder River would be protected during UXO clearance and planting operations by utilizing techniques which would minimize the suspension and migration of contaminated fines. All components of this alternative would be in compliance with action- and location-specific ARARs. Solidification, if properly implemented and performed within the established operating parameters, would allow the treated sediment to pass TCLP and Paint Filter Liquid Tests. Disposal of the treated sediment in an off-site landfill would be conducted in accordance with the appropriate regulations.

Implementation of this option would take approximately 12 to 18 months for the design phase, approximately 12 months for the surface clearance work, and approximately 12 to 18 months for the dredging and treatment phase. These time estimates include regulatory review of the design, but do not take potential delays due to weather and eagle nesting season into account.

The total capital costs to implement Alternative C are estimated at $156,000,000 and the total annual O&M costs are estimated at $46,000. The total present worth of these costs, calculated with a 5% discount rate over a lifetime of 30 years, is $157,000,000.

7.5 ALTERNATIVE D: "HOT SPOT" REMOVAL/SOLIDIFICATION/LANDFILL

Under this alternative, "hot spots" or areas of elevated concentration would be dredged from Watson Creek. This alternative will help remove the highest concentrations of inorganics in the sediment, while providing a significant cost savings compared to full-scale removal. The primary difference between Alternative D and Alternative C is the volume of sediment to be removed. Under this alternative, only "hot spots" will be removed. Based on the identification of "hot spots," a volume of approximately 20,000 yd 3 would be removed from Watson Creek. As discussed in Section 7.4, a one-foot layer of sediment would be removed and replaced with sand, to ensure protection of benthic communities in these areas.

The same procedures used for full-scale dredging would be followed during "hot spot" removal including: UXO clearance; sediment dredging; sand placement; and sediment dewatering, solidification, and final disposition. In addition to the dredging activities, Alternative D also includes all components of Alternative B (i.e., institutional controls, maintenance of existing physical security measures, public education programs, long-term monitoring of site conditions, and five-year reviews).

The dredging, treatment, and off-site disposal proposed in this alternative would remove the contaminated sediment which could adversely affect benthic communities. The dredged sediment would be treated using solidification to reduce the mobility of contaminants which could leach from the sediment, and would be disposed in an off-site landfill. Although the volume of the contaminants in the dredged sediment would not be reduced, contaminant mobility would be significantly reduced because inorganic contaminants would be bound in the solidified sediment/cement monolith through treatment.

Dredging normally is a simple construction process, and all equipment required for dredging is available near the site. However, dredging at Watson Creek would be complicated by the unique hazards associated with the site. Normal dredging methods may not be applicable to Watson Creek due to UXO hazards. Techniques which minimize the suspension and migration of contaminated fines will be utilized during UXO and dredging operations to reduce short-term effects to the aquatic environment and to protect surface water quality in Watson Creek.

The chemical-specific ARARs that apply to this remedial action are surface water criteria. The quality of surface water in Watson Creek and the Gunpowder River would be protected during UXO clearance and planting operations by utilizing techniques which would minimize the suspension and migration of contaminated fines. All components of this Alternative would be in compliance with action and location-specific ARARs. Solidification, if properly implemented and performed within the established operating parameters, would allow the treated sediment to pass TCLP and Paint Filter Liquid Tests. Disposal of the treated sediment in an off-site landfill would be conducted in accordance with the appropriate regulations.

Implementation of this option would take approximately 10 to 16 months for the design phase, approximately 8 months for the surface clearance work, and approximately 6 to 9 months for the dredging and treatment phase. These time estimates include regulatory review of the design, but do not take potential delays due to weather and eagle nesting season into account.

The total capital costs to implement Alternative D are estimated at $36,000,000 and the total annual O&M costs are estimated at $46,000. The total present worth of these costs, calculated with a 5% discount rate over a lifetime of 30 years, is $37,000,000.

7.6 ALTERNATIVE E: AQUATIC PHYTOREMEDIATION

Uptake of metals by emergent and aquatic plants is a passive approach to removing the metals from the Watson Creek sediment. Under this alternative, emergent and aquatic plants capable of removing metals from submerged sediment would be planted in the sediment. The plants would take up the metals in their root systems; and deposit the metals in their roots, stems, and leaves. Eventually the plants would die, and the low levels of metals within these plants would be dispersed within Watson Creek and the Gunpowder River. Although plants used for aquatic phytoremediation are not generally preferred by terrestrial or aquatic organisms as food sources, there is a possibility that these organisms could become exposed to the metals in the plants. This alternative would not address the potential pesticide contamination (an estimated 0.5% of the total volume), but it is anticipated that the pesticide concentrations will diminish over time due to natural processes occurring in the sediment. The basic procedures used under this alternative would be to clear Watson Creek of UXO, plant the emergent and aquatic plants within the sediment, and monitor the sediment for reductions in metals.

In addition to the planting activities, Alternative, E also included all components of Alternative B (i.e., institutional controls, maintenance of existing physical security measures, public education programs, long-term monitoring of site conditions, and five-year reviews).

The chemical-specific ARARs that apply to this remedial action are surface water criteria. The quality of surface water in Watson Creek and the Gunpowder River would be protected during UXO clearance and planting operations by utilizing techniques which would minimize the suspension and migration of contaminated fines. All components of this alternative would be in compliance with action and location-specific ARARs.

Implementation of this option would take approximately 12 to 18 months for the design phase, approximately 12 months for the surface clearance work, and approximately 6 months for the planting phase. These time estimates include regulatory review of the design, but do not take potential delays due to weather and eagle nesting season into account.

The total capital costs to implement Alternative E are estimated at $5,070,000 and the total annual O&M costs are estimated at $46,000. The total present worth of these costs, calculated with a 5% discount rate over a lifetime of 30 years, is $5,780,000.

8.0 SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

This section evaluates and compares each of the alternatives described in Section 7.0 with respect to nine criteria used to assess remedial alternatives as outlined in Section 300.430(e) of the NCP. Each of the nine criteria are briefly described below. To aid in identifying and assessing relative strengths and weaknesses of the remedial alternatives, this section provides a comparative analysis of alternatives. As previously discussed, the alternatives are as follows:

- No Action;
- Limited Action;
- Full-Scale Dredging/Solidification/Landfill;
- "Hot Spot" Removal/Solidification/Landfill; and
- Aquatic Phytoremediation.

These five alternatives are compared to highlight the differences between the alternatives and to identify trade-offs in meeting the criteria.

8.1 NINE EVALUATION CRITERIA

Section 300.430(e) of the NCP lists nine criteria by which each remedial alternative must be assessed. The acceptability or performance of each alternative against the criteria is evaluated individually so that relative strengths and weaknesses may be identified.

The detailed criteria are briefly defined as follows:

- Overall Protection of Human Health and the Environment is used to denote whether a remedy provides adequate protection against harmful effects and describes how human health or environmental risks are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

- Compliance with ARARs addresses whether a remedy will meet all of the applicable or relevant and appropriate requirements of Federal and State environmental statutes or provides a basis for invoking a waiver.

- Long-term Effectiveness and Permanence refers to the magnitude of residual risk and the ability of a remedy to maintain reliable protection of human health and the environment, over time, once clean-up goals have been met.

- Reduction of Toxicity, Mobility, or Volume through Treatment is the anticipated performance of the remedial actions as employed for each alternative.

- Short-term Effectiveness refers to the speed with which the remedy achieves protection, as well as the remedy's potential to create adverse impacts on human health and the environment during the construction and implementation period.

- Implementability is the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement the chosen solution.

- Cost includes both capital and O&M costs.

- State Acceptance indicates whether, based on its review of the FFS Report and Proposed Plan, the State concurs with, opposes, or has no comment on the preferred alternative.

- Community Acceptance assesses the public comments received on the FFS Report and the Proposed Plan.

The NCP (Section 300.430(f) states that the first two criteria, protection of human health and the environment and compliance with ARARs, are the "threshold criteria" which must be met by the selected remedial action. The next five criteria are the "primary balancing criteria", and the trade-offs within this group must be weighed. The preferred alternative is that alternative which is protective of human health and the environment, is ARAR-compliant, and provides the best combination of primary balancing criteria attributes. The final two criteria, state and community acceptance, are "modifying criteria" which are evaluated following comments on the FFS report and the Proposed Plan.

8.2 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The land-use condition assumed under Alternative A, No Action, would allow for unrestricted residential, industrial, or recreational use. The levels of contamination in the Watson Creek sediment are not a threat to human health. However, localized areas may exist where the levels of contaminants could potentially adversely affect benthic communities. No controls would be implemented to prevent the disturbance of the sediment; therefore, aquatic and terrestrial species could become exposed to the contaminants within the fine-grained particles. The threshold criterion of protection of human health and the environment would not be achieved by Alternative A.

Alternative B, Limited Action, would provide reduction in adverse effects to benthic communities by limiting future use and development of the affected area. Limited Action would include no further actions to reduce or eliminate the contaminant source, or to reduce contaminant migration. However, the principal contaminant migration pathway between Old O-Field and Watson Creek has been mitigated by the construction of the GWTF. Additionally, unlike active treatment alternatives, the Limited Action alternative would limit any activities which would disturb the sediment; thereby releasing contaminants within the sediment into the surface water and negatively affecting aquatic communities within Watson Creek. The long-term monitoring and review components of Alternative B would ensure that the action provides an adequate protection of human health and the environment.

Alternatives C and D both involve dredging the contaminated sediment and then immobilizing the contaminants in the dredged sediment by ex-situ solidification techniques. They differ only by the total volume of sediment removed. In each case, the solidified sediment would be disposed in an off-site landfill. Benthic communities would be protected from residual contamination by replacing the dredged sediment with a layer of sand. However, by removing the sediment, the benthic communities presently living in Watson Creek would also be removed and would not be protected.

Under Alternative E, the metals in the Watson Creek sediment would be removed by plant uptake. However, as the plants die, they would distribute the metals back into the environment. This would result in further mixing of the metals but, most likely, no net loss in the mass of metals. Additionally, the emergent and aquatic plants added to Watson Creek could completely fill the entire area of free standing water within Watson Creek, adversely affecting both aquatic and terrestrial communities dependent on the current state of Watson Creek. This alternative would not address the pesticide contamination in the southwestern tip of Watson Creek, except by the long-term decrease in concentrations due to naturally occurring processes in the sediment.

Although implementation of Alternatives C, D, and E would remove contaminants from Watson Creek sediment, active removal of the sediment or planting operations could have adverse impacts on both human health and the environment. Watson Creek is located adjacent to Old O-Field, an area known for the presence of UXO. During dredging (Alternatives C and D) or planting operations (Alternative E), there would be the potential for encountering UXO not only adjacent to Old O-Field, but throughout Watson Creek. In the event that UXO was encountered, there would be potential for an explosion and/or CWM release, resulting in detrimental effects to human health and the environment. Additionally, the disruptive nature of UXO clearance, dredging (Alternatives C and D), and planting operations (Alternative E) could cause a portion of the fine sediment particles to become suspended in the surface water in Watson Creek. Disturbing these fine materials could mobilize the contaminants and adversely affect aquatic organisms within Watson Creek. However, by temporarily closing the gate on the culvert between Watson Creek and the Gunpowder River during the field operations, the migration pathway for suspended solids into the Gunpowder River would be eliminated.

8.3 COMPLIANCE WITH ARARS

Compliance with ARARs is a threshold criterion which must be met by the selected remedial action. Chemical-specific ARARs for sediment, aside from surface water criteria, do not exist.

Alternatives B, C, D, and E would all be capable of meeting location-specific ARARs (including Federal and State endangered species and migratory bird acts; water management and wetlands regulations; and erosion and sediment control regulations). Surface water criteria and location-specific ARARs will be considered during all sampling to minimize disturbance of the environment at Watson Creek. In addition, during the more active alternatives, the quality of nearby surface water would be protected by proper sediment control measures (chemical- and location-specific ARARs). The quality of surface water in Watson Creek would be protected during UXO clearance, dredging (Alternatives C and D), or planting operations (Alternative E) by utilizing techniques which would minimize the suspension of contaminated fines (chemical- and location-specific ARARs). The quality of the surface water in the Gunpowder River would be protected by closing the gate on the culvert between Watson Creek and the Gunpowder River (chemical- and location-specific ARARs).

All components of Alternatives C, D, and E would be in compliance with action-specific ARARs. Solidification, if properly implemented and performed within the established operating parameters, would allow the treated sediment to pass TCLP and Paint Filter Liquid Tests. Disposal of the treated sediment in an off-site landfill would be conducted in accordance with appropriate regulations. Selection of emergent and aquatic plants and planting techniques would be performed in compliance with State and Federal regulations. There are no action-specific ARARs for Alternatives A and B.

8.4 LONG-TERM EFFECTIVENESS AND PERMANENCE

Alternative A, No Action, would not meet this criterion because the risk would not be reduced beyond current risks posed by the site. The principal contaminant migration pathway between Old O-Field and Watson Creek has been mitigated by the construction of the GWTF. However, because activities which could disturb the sediment and expose aquatic communities to the contaminants within the suspended sediment would not be prevented under this alternative, the effectiveness of the No Action alternative would be uncertain over the long term.

Alternative B, Limited Action, would provide long-term protection of human health and the environment. Institutional restrictions currently in place at APG (i.e., access restrictions and security measures) along with additional land-use restrictions (i.e., prohibiting any activities at Watson Creek other than future monitoring) would prevent activities which could disturb the sediment; thereby preventing aquatic communities from being exposed to contaminants within the suspended sediment.

Alternatives C, D, and E would provide effective long-term and permanent protection by treating the contaminated sediment within Watson Creek. The ecological receptor exposure pathway defined in the RA would be eliminated using these alternatives.

Dredging combined with solidification as the treatment method under Alternatives C and D would provide the greatest degree of long-term effectiveness and permanence by removing the top layer of sediment and replacing it with a layer of sand. Once treated, the solidified sediment would be disposed in an off-site landfill. Therefore, adverse impacts on benthic communities due to direct contact with the contaminated sediment would be eliminated under these alternatives. However, the use of dredging would remove existing benthic communities and aquatic plants. Although the benthic communities and aquatic plants are expected to recover, it is not known if the removal of natural sediment and replacement with sand would have long-term ecological effects on benthic communities within Watson Creek.

Alternative E would provide long-term reduction of contaminant concentrations by removing metals in the sediment using aquatic plant uptake. Adverse effects to benthic communities via direct contact with the contaminants in the sediment would eventually be eliminated over a period of time under Alternative E. The long-term effectiveness of phytoremediation depends on the ability of the introduced emergent and aquatic plants to survive within Watson Creek, remove the metals from the sediment, and evenly distribute the metals around Watson Creek once the plants die. Additionally, it is not known it the plants introduced into Watson Creek would out-compete indigenous aquatic plants, benthic organisms, and aquatic organisms. Therefore, the overall long-term effectiveness of Alternative E depends on the survival of the introduced aquatic and emergent plants and their ability to co-exist with existing communities within Watson Creek.

8.5 REDUCTION OF TOXICITY, MOBILITY OR VOLUME THROUGH TREATMENT

Alternatives A and B would not provide any reduction of toxicity, mobility, or volume of the contaminants because removal or treatment of the contaminated sediment would not be components of these alternatives. However, unlike active treatment alternatives, these alternatives would not include any activities which would disturb the sediment, thereby releasing contaminants within the sediment into the surface water and adversely affecting aquatic ecosystems within Watson Creek.

The dredging, treatment, and off-site disposal of contaminated sediment proposed under Alternatives C and D would reduce the mobility of contaminants within the Watson Creek bottom sediment. However, solidification processes will increase the total volume of sediment for disposal. Aquatic plant uptake under Alternative E would passively remove the contaminants within the Watson Creek sediment. The volume of the contaminants would not be reduced under Alternative E; however, inorganic contaminants would be temporarily bound in the aquatic plants. The mobility of the inorganics could increase as the plants die and disperse throughout Watson Creek.

8.6 SHORT-TERM EFFECTIVENESS

The length of time which would be required to implement the remediation alternatives follows in increasing order: Alternative B; Alternative D; Alternative C; and Alternative E. Alternative B, the Limited Action, could be implemented in 1 year. Alternative D would require approximately 10 to 16 months to design and procure materials for dredging and solidification treatment: approximately 8 months to perform surface clearance work; and approximately 6 to 9 months to treat and dispose of the dredged sediment. Alternative C would require approximately 12 to 18 months to design and procure materials for dredging and solidification treatment; approximately 12 months to perform surface clearance work; and approximately 12 to 18 months to treat and dispose of the dredged sediment. Alternative E would require approximately 12 to 18 months to design and procure all necessary equipment for planting the aquatic plants, approximately 12 months to perform surface clearance work; approximately 6 months for planting; and over 30 years to reduce the levels of contaminants in the Watson Creek sediment to prevent adverse effects to benthic communities. These time estimates include regulatory review of the design, but do not take potential delays due to weather and eagle nesting season (Mid-December through Mid-April) into account.

There would be no short-term adverse effects on the public, workers, or environment from Alternatives A and B, because no active remedial actions would be implemented at Watson Creek.

Alternatives C, D, and E would require that extensive UXO surveys be performed to ensure that the equipment used in the actual remediation does not accidentally encounter UXO. Underwater UXO surveys are difficult and expensive to implement, and are not likely to be 100% affective. However, Alternatives C, D, and E would each be designed to provide for short-term protection of the public, workers, and the environment during implementation. In addition, proper personal protective equipment would be required for all site workers.

Secondly, elements of Alternatives C, D, and E each require that the sediment be disturbed. This would likely result in the mixing and suspension of fine-grained particles through the water column, which could expose aquatic and terrestrial species to the metals adsorbed onto these particles. However, proper measures would be used to minimize the suspension of contaminated fines in the surface water during intrusive activities to protect the aquatic ecosystems within Watson Creek.

8.7 IMPLEMENTABILITY

Alternatives A and B would be the most easily implemented. Alternative A would require no change in existing controls, and nearly all of the institutional control components of Alternative B are already in place. Administrative implementation of Alternative B would require continued coordination between APG, the State of Maryland, and the USEPA to ensure continuity of the long-term management and monitoring of the site.

The equipment and materials required for dredging and treating the sediment proposed for Alternatives C and D are commercially available. However, normal dredging methods may not be applicable to Watson Creek due to UXO hazards. UXO are inherently dangerous under any circumstances. UXO found in the creek will likely be in poor condition, making them even more unstable and dangerous to handle. This greatly increases the safety concerns and environmental effects associated with these alternatives. The logistics of successfully performing a UXO clearance over a large body of water also affects the implementability of Alternatives C and D. UXO clearance and dredging methods which would minimize the suspension of contaminated sediment particles into the surface water within Watson Creek would need to be implemented to prevent adverse effects on aquatic organisms. The solidification technology selected for Alternatives C and D has been demonstrated to be easily implementable for the remediation of contaminated sediment at other sites. However, the large volume of sediment to be removed and treated under Alternative C may cause logistical problems; therefore, Alternative D may be more feasible.

The equipment and materials required for planting aquatic plants proposed under Alternative E are commercially available. However, much like Alternatives C and D, UXO hazards at Watson Creek would complicate planting operations. Care would need to be taken during UXO clearance and planting operations to minimize the suspension of contaminated fines into the surface water within Watson Creek which could adversely affect aquatic organisms. Planting of aquatic plants has been demonstrated to be easily implementable at other sites; however, proliferation of emergent and aquatic plants in Watson Creek may cause problems in implementing Alternative E. It is also possible that the Watson Creek sediment may not sustain a viable population of aquatic plants capable of metals uptake.

8.8 COST

Table 8-1 provides a comparison of the costs of the five alternatives under consideration. Total capital costs, annual O&M costs, and present worth (30 years at a discount rate of 5%) for each alternative are presented. The progression of total present worth from least expensive to most expensive alternative is: Alternative A (no cost); Alternative B; Alternative E; Alternative D; and Alternative C. Alternatives C and D are the most expensive alternatives because of the large quantities of sediment that would require removal, treatment, and disposal.

8.9 STATE ACCEPTANCE

Based on a thorough review of the remedial alternatives and public comments, MDE concurs with the preferred alternative.

TABLE 8-1
COMPARISON OF COSTS FOR
WATSON CREEK REMEDIAL ALTERNATIVES

		Costs in 1996 Dollars		
Alternative	Description	Capital Cost	Annual O&M Cost	Present Worth (30 yr, 5% discount rate)
A	No Action	$0	$0	$0
B	Limited Action	$38,000	$46,000	$615,000
C	Full-Scale Dredging/ Solidification/ Landfill	$156,000,000	$46,000	$157,000,000
D	"Hot Spot" Removal/ Solidification/ Landfill	$36,000,000	$46,000	$37,000,000
E	Aquatic Phytoremediation	$5,070,000	$46,000	$5,780,000

8.10 COMMUNITY ACCEPTANCE

A full transcript of the public meeting, held on July 28, 1997, is available in the Administrative Record. In general, the community appears to be in support of the selected remedy. Responses to written comments received from the community are presented in the Responsiveness Summary (Appendix A).

8.11 SUMMARY OF DETAILED EVALUATION

The following is a brief summary of the evaluation of alternatives:

- Alternative A (No Action) would not prevent the disturbance of the sediment by trespassers or future development of the site. Therefore, Alternative A has been judged to be incapable of providing overall protection of human health and the environment.

- The implementation of Alternative B, Limited Action, would result in the establishment of institutional controls to restrict access to the site, prevent development and disturbance of the site, and inform workers and the public of the risks.

- The active remediation alternatives, Alternatives C, D, and E, would result in the remediation of the contaminated sediment. However, these alternatives pose relatively high risks during implementation due to the potential presence of UXO in the sediment. These alternatives would also result in the disturbance, and possible suspension, of the sediment in the water column. This suspension may cause the aquatic and terrestrial species who use Watson Creek to become exposed to the metals that are adsorbed onto the fine-grained sediment particles.

9.0 SELECTED REMEDY

Based upon consideration of the requirements of CERCLA, the detailed analysis of the alternatives, and public comments, the Army and USEPA, with the concurrence of MDE, have chosen Alternative B, Limited Action, as the most appropriate remedy for OU3 at Watson Creek in the O-Field Area of APG, MD. As mentioned in Section 7.3, the selected remedy shall involve implementation of the following actions at Watson Creek:

- Institutional Controls. Institutional controls such as access restrictions and land-use restrictions are currently in place at OU3. Watson Creek is located in a restricted area of APG; therefore, access to this area is strictly enforced by APG security. The restricted area is also subject to random patrols by armed security personnel. Additional access restrictions may be required at Watson Creek in the future if security practices are downgraded, however this is not anticipated considering the current activities at APG.

  Land-use restrictions will include: 1) the posting of signs prohibiting unauthorized entry into Watson Creek; 2) the prohibition of activities at Watson Creek other than future monitoring; 3) inputting these restrictions into APG's GIS, which is utilized in the development of APG's Real Property Master Plan; and 4) incorporation of these restrictions/prohibitions into any real property documents necessary for transferring ownership from the Army, in the unlikely event that the Army sells this property. The real property documents would also include a discussion of the NPL status of the site, as well as a description of the contamination at this site. The final wording, and the location and number of signs would be determined during the workplan development phase and through negotiations with USEPA and MDE. In addition, the Directorate of Safety; Health and Environment (DSHE) would certify to the USEPA on an annual basis that there have been no violations of these prohibitions. If a violation has occurred, a description of the violation and corrective actions to be taken would be provided.

- Physical Security Measures. In conjunction with institutional controls, existing physical security measures shall be maintained and additional security measures will be implemented, as needed. Physical security measures include the posting of signs and maintenance of fences within the restricted area.

- Public Education Programs. Educational programs shall be developed to inform workers and local residents of the potential hazards due to the presence of UXO in the sediment, and potential impacts to the aquatic environment caused by the disturbance of contaminated sediment in Watson Creek.

- Long-Term Monitoring of Site Conditions. Site conditions shall be monitored at least once every five years in conjunction with the reviews described below. Monitoring in Watson Creek will indicate whether any unforeseen changes would raise the human health or ecological risks associated with Watson Creek. A long-term sampling plan shall be developed for Watson Creek, by the Army, USEPA, and MDE, to monitor the levels of contaminants in the sediment and fish/invertebrate tissue. Because metals and 4,4-DDE are the contaminants of concern in Watson Creek, all samples shall be analyzed for metals, and samples collected in the vicinity of WC-39 shall also be analyzed for pesticides. Additional analytes may also be added, as needed, to future monitoring. Based on the results of chemical analysis, additional toxicity tests may also be warranted in the future.

- Five-Year Reviews. Although this remedy does not allow for unrestricted use and exposure, all available data shall be analyzed as part of the five-year review process to determine whether additional remedial actions or site controls are required.

Most components of Alternative B have been implemented and are being maintained at the site. Institutional controls and other provisions of this alternative are expected to minimize the risks posed to aquatic communities living within Watson Creek. Implementation of this alternative shall not create any adverse environmental impact.

9.1 BASIS FOR SELECTION

Alternative B will achieve risk reduction through institutional controls to prevent site access and future development, and public education and awareness of the potential hazards due to the presence of UXO in the sediment. Although Alternative B will not reduce the contaminant concentrations in the short term as the more active remedial alternatives (Alternatives C, D, and E), it will result in lower risks in the short term and better overall protection of the aquatic environment. Therefore, Alternative B is believed to provide the best balance of trade-offs among alternatives with respect to the evaluation criteria.

9.2 COST OF SELECTED REMEDY

The total capital cost for implementation of Limited Action (Alternative B) at Watson Creek is estimated at $38,000 and the total annual costs are estimated at $46,000. The total present worth of these costs, calculated with a 5% discount rate over a lifetime of 30 years, is $615,000. Contingencies associated with the alternative would be minimal because the alternative does not include any treatment or design components. The costs for implementation of Alternative B are outlined in Table 9-1.

TABLE 9-1
SUMMARY OF COSTS FOR THE SELECTED REMEDY
ALTERNATIVE B: LIMITED ACTION

ITEM	COST
Capital Costs	
Administrative Actions	$23,000
Contingencies (60% of Capital Subtotal)	$13,000
Permitting & Coordination	$2,000
Annual Operation and Maintenance Costs	
Program Oversight	$28,000
Long-Term Monitoring & Five-Year Reviews	$9,000
Contingencies (25% of Annual Subtotal)	$9.000
Present Worth of Annual O&M (30 years, 5% discount rate)	$577,000
Total Present Worth (Capital and Annual Costs, 30 years at 5% discount rate)	$615,000

10.0 STATUTORY DETERMINATIONS

The Army's primary responsibility at its NPL sites is to undertake remedial actions that achieve adequate protection of human health and the environment. When complete, the selected remedial action for this site must comply with applicable or relevant and appropriate environmental standards established under Federal and State environmental laws unless a statutory waiver is justified. The selected remedy also must be cost-effective and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Finally, the statutory preference for remedies that employ treatment that permanently and significantly reduce the volume, toxicity, or mobility of hazardous waste as their principal element should be satisfied, to the maximum extent practicable. The following sections discuss how the selected remedy meets these statutory requirements.

10.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The selected remedy protects human health and the environment by limiting disturbance of the sediment and potential UXO which could occur through future use and development of the affected area.

10.2 COMPLIANCE WITH APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Aside from surface water criteria, chemical-specific ARARs for sediment do not exist. In addition, there are no action-specific ARARs related to the components of the selected remedy. However, the selected remedy is in compliance with location-specific ARARs, therefore meeting this criterion (Table 10-1).

10.3 COST-EFFECTIVENESS

The selected remedy is cost-effective because it has been determined to provide overall effectiveness proportional to its costs, the net present worth being $615,000.

10.4 UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES (OR RESOURCE RECOVERY TECHNOLOGIES) TO THE MAXIMUM EXTENT PRACTICABLE (MEP)

The Army, USEPA, and MDE have determined that the selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost-effective manner for action at Watson Creek. Removal and treatment options were considered in the FFS for this site, but were eliminated because those alternatives posed a relatively high risk (due to the potential presence of UXO) and could result in the suspension of sedimet in the water column.

10.5 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

Based on the most accurate information available at this time, the Army, USEPA, and MDE believe the selected remedy is protective of human health and the environment complies with ARARs, is cost-effective, and utilizes permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. Although there is a statutory preference for remedies that involve treatment as a principal element, the Army believes that the preferred alternative represents the most effective means of risk reduction for the site, given the limited scope of the action.

TABLE 10-1
ARARS FOR THE SELECTED REMEDY

Authority	Requirement	Status	Requirement Synopsis
CHEMICAL-SPECIFIC ARARS AND TBCS:			
State Requirement	Maryland Water Pollution Control Regulations, Water Quality (COMAR) 26.08.02)	Relevant and Appropriate	The state of Maryland has promulgated surface water quality standards and use classifications for surface waters. Inorganic and organic contaminants in surface water are regulated for the protection of aquatic life and human health. These standards would also apply to any stormwater or applied water that flows from the regulated unit to the land surface.
Federal Criteria, Advisories, and Guidance	Clean Water Act (33 U.S.C. 1314). USEPA Office of Water, Federal Ambient Water Quality Criteria (AWQC)	Relevant and Appropriate	Federal AWQC are criteria for protection of human health and aquatic life which have been developed for 95 carcinogenic and noncarcinogenic compounds. Inorganic and organic contaminants in surface water are regulated for the protection of freshwater and marine aquatic life. These standards would also apply to any stormwater or applied water that flows from the regulated unit to the land surface.
LOCATION-SPECIFIC ARARS AND TBCS:			
Federal Requirement	Endangered Species Act of 1973 (16 USC 1531 et seq.)	Applicable, Relevant and Appropriate	This law requires that action be taken to conserve endangered or threatened species. In addition, actions must not destroy or adversely modify critical habitat. Consultation with the Department of the Interior is required to ascertain that proposed actions will not affect any listed species.
	Migratory Bird Treaty Act (16 USC 703 et seq.)	Applicable, Relevant and Appropriate	Any action taken or funded which results in the killing, hunting, taking, or capturing of any migratory bird, part, nest, or egg is unlawful.
	Bald and Golden Eagle Protection Act (16 USC 668 et seq.)	Applicable, Relevant, and Appropriate	This law requires that action be taken to conserve the endangered bald and golden eagles. In addition, actions must not destroy or adversely modify critical habitat.
State Requirement	COMAR 08.03.01 - .12	Applicable, Relevant, and Appropriate	These regulations define the threatened and endangered species within Maryland.

11.0 DOCUMENTATION OF SIGNIFICANT CHANGES

The proposed plan for OU3, Watson Creek, O-Field Area, APG, Aberdeen, MD, was released for public comment on July 2, 1997. The Proposed Plan identified Alternative B, Limited Action, as the preferred alternative. The Army, USEPA, and MDE reviewed and considered all comments received during the public meeting and during the public comment period. Upon review of these comments, it was determined that no significant changes to the remedy, as originally identified in the Proposed Plan, are necessary.

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APPENDIX A. RESPONSIVENESS SUMMARY

The final component of the Record of Decision is the Responsiveness Summary. The purpose of the Responsiveness Summary is to provide a summary of the public's comments, concerns, and questions about Watson Creek and the Army's responses to these concerns.

During the public comment period, written comments were received by APG.

APG held a public meeting on July 28, 1997 to formally present the Focused Feasibility Study Report and Proposed Plan, to answer questions, and to receive comments. The transcript of this meeting is part of the administrative record for the site. All comments and concerns summarized below have been considered by the Army and USEPA in selecting the final cleanup methods for Watson Creek.

This responsiveness summary is divided into the following sections:

- A.1 Overview.
- A.2 Background on community involvement.
- A.3 Summary of comments received during the public comment period and APG's responses.
- A.4 Sample newspaper notice announcing the public comment period and the public meeting.

A.1 OVERVIEW

At the time of the public comment period, the Army and USEPA had endorsed a preferred alternative for the cleanup of Watson Creek. The preferred alternative consisted of long-term monitoring of site conditions, continuation of access controls, and administrative actions. The Maryland Department of the Environment (MDE) stated the proposed actions seemed appropriate based on the findings of the risk assessment; however, MDE would consider the public's comments before providing a final concurrence on the project.

The community generally seems to be in support of the preferred alternative, with a few residents preferring excavation.

A.2 BACKGROUND ON COMMUNITY INVOLVEMENT

Citizens' interest in the O-Field Study Area has been high, with the focus primarily on the groundwater and the Old O-Field landfill, the primary source of contamination. Specific interest in Watson Creek has been limited primarily to discussions at Restoration Advisory Board meetings and comments by the APG Superfund Citizens Coalition. However, area residents are heavy recreational users of the waterways surrounding APG and are concerned about any possible impacts to these waterways.

APG has maintained an active public involvement and information program regarding the O-Field Study Area. Highlights of APG's community relations activities for Watson Creek follows:

- APG began discussing possible cleanup methods for Watson Creek at Restoration Advisory Board meetings in January 1995. Other meetings where APG presented information on Watson Creek included July 1995, June 1996, and March 1997.

- APG released the Proposed Plan for Watson Creek tor public comment on July 2, 1997. Copies were available to the public at APG's information repositories at the Aberdeen and Edgewood Branches of Harford County Library and Miller Library at Washington College.

- APG issued a press release announcing the availability of the Proposed Plan, the dates of the public comment period, and the date and time of the public meeting to APG's media list.

- A 45-day public comment period on the Proposed Plan ran from July 2, 1997 to August 15, 1997.

- APG placed newspaper advertisements announcing the public comment period and meeting in The Aegis, the Cecil Whig, the Essex Times, The Avenue, and the Kent County News.

- APG prepared and published a fact sheet on the Proposed Plan. APG mailed copies of this fact sheet to over 2,590 citizens and elected officials on its Installation Restoration Program mailing list. The fact sheet included a form which citizens could use to send APG their comments.

- On July 28, 1997, APG hold a public meeting at the Edgewood Senior Center

Edgewood, Maryland, Representatives of the Army, USEPA, and the MDE presented information on the site and their respective positions on the proposed cleanup alternatives.

A.3 SUMMARY OF COMMENTS RECEIVED DURING THE PUBILIC COMMENT PERIOD AND AGENCY RESPONSES

Comments raised during the Watson Creek public comment period on the Focused Feasibility Study Report and the Proposed Plan are summarized below. The comments are categorized by source.

COMMENTS FROM QUESTIONNAIRE INCLUDED WITH FACT SHEET

As part of its fact sheet on the Proposed Plan, APG included a questionnaire that residents could return with their comments. APG received 2 completed returns. The following number of responses were in favor of:

0	No Action
7	Limited Action
1	Limited Action and Aquatic Phytoremediation
1	Full-Scale Dredging
1	Full-Scale Dredging and Aquatic Phytoremediation
2	Limited Removal
0	Aquatic Phytoremediation

Comments included on the forms were:

Comment 1: One resident expressed a preference for Limited Action combined with aquatic phytoremediation. He stated that if aquatic phytoremodiation is successful, the level of security and monitoring could be phased down over time. He also stated he believes the Army has a responsibility to neutralize and restore those areas.

APG Response: APG is studying phytoremediation and agrees it may be a valuable tool at certain sites. Analysis of its use at this site showed that while it may help decrease the limited impacts to sediment-dwelling organisms, the plants could completely fill the free-standing water within Watson Creek. This could adversely affect aquatic life, waterfowl, and terrestrial animals which depend on the present state of Watson Creek.

It is unlikely the level of security would be decreased as long as the Army continues to own the site. APG agrees that monitoring can be adjusted over time and phased down if appropriate. Also, the Army agrees it has a responsibility to restore areas wherever necessary or practicable and this is a goal of the cleanup program.

Comment 2: Thank you for your continued efforts to keep the community informed. This fact sheet does an excellent job of explaining the situation and possibilities. It is not easy to communicate these issues and your fact sheets always seem to be able to do it. I was at the Tollchester Fair last weekend with out of town guests and your staff graciously took the time to discuss with them your program. You are to be commended on your efforts. Keep it up!

APG Response: APG acknowledges and appreciates the comments.

Comment 3: One resident asked why the fact sheet did not contain the results on amphipod survival and growth. The person also asked for further explanation on the statement that a person's contact with sediment would be minimal since the water would wash it away. The commenter stated that a wader's feet and leg skin is exposed to sediment.

APG Response: APG will supply the commenter with the charts from the Focused Feasibility Study which summarize the survival and growth results. APG will also supply the commenter with the information repository locations which have copies of the full report for public review. The fact sheets present only a brief summary of all the voluminous data gathered during the studies.

APG agrees that a wader's skin is in contact with the sediment. However, the risk assessment assumed a person exposed to Watson Creek sediment would be trespassing and would not likely be standing in one place long enough to result in an exposure route. Also, the sediment samples from Watson Creek and the Gunpowder River were collected under at least two feet of water. This led to the conclusion the water would be washing away the sediment and the length of time the wader's skin would be in contact with the sediment would be minimal.

Comment 4: A resident commented that any unexploded ordnance should be located where possible and destroyed.

APG Response: APG is working on the issue of unexploded ordnance, particularly in areas near APG's boundaries and along shoreline areas. This work includes looking at technology that is on the cutting edge for locating the ordnance, determining what its contents are, and disposal methods. APG will continue to keep residents informed about these studies and actions.

Comment 5: A resident commented that her main concern is drinking water. She stated it is most important that APG constantly monitor the levels of impurities and be sure the water is safe at all times at any cost.

APG Response: APG agrees that ensuring any contamination found at APG does not impact drinking water supplies is a priority. The Installation Restoration Program has installed an extensive monitoring well network, with an emphasis along the APG boundaries, and is conducting comprehensive geologic studies to ensure any contamination is not moving off-post. Protection of public health and the environment is more highly weighted than cost in the remediation process.

Comment 6: A resident expressed a preference for Alternative C, full-scale dredging, with disposal in a concrete vault where it cannot leach out. She also stated toxins must be kept out of the environment, even diluted.

APG Response: Dredging followed by solidification was selected for detailed analysis because this process would immobilize the contaminants (primarily metals) in concrete blocks. Prior to disposal, the solidified blocks would be required to pass two tests, the Toxicity Characteristic Leaching Procedure (TCLP) and Paint Filter Tests, to ensure that the contaminants in the blocks would not readily migrate into the environment. However, APG's analysis found this alternative to be less favorable than Limited Action in terms of overall protection of human health and the environment and cost-effectiveness. Full-scale dredging could also have short-term impacts on human health and the environment, due to potential UXO and the suspension and migration of contaminated fines. Therefore, APG and USEPA selected Limited Action which will be more protective of human health and the environment than full-scale dredging. Under the Limited Action alternative, the contaminants in the sediment would be left undisturbed; thereby minimizing adverse impacts on the environment.

COMMENTS AT JULY 28, 1997 PUBLIC MEETING

No oral or written comments were presented at the July 28 public meeting on the Proposed Plan. A full transcript of the meeting is available at APG's information repositories.

COMMENTS FROM APG SUPERFUND CITIZENS COALITION

APGSCC is the recipient of two Technical Assistance Grants from the U.S. Environmental Protection Agency. The Coalition submitted comments prepared by their consultant the University of Maryland Program in Toxicology. APGSCC stated it supports the preferred alternative of Limited Action. They also had several specific comments which are summarized below:

Comment 7: The Toxicology Program noted it has raised previous concerns regarding the adequacy of using one bioassay to assess bioavailability, without other supporting science and logic.

APG Response: Hyalella azteca (H. azteca) was selected as the organism for further testing at Watson Creek after giving serious consideration to several test alternatives, one of which was to use two bioassays at each sample location. H. azteca was used in all sampling rounds to maintain a consistent test organism throughout all phases of testing, allowing the comparison of data from all sampling phases. The use of H. azteca was approved by the U.S. Environmental Protection Agency and Maryland Department of the Environment, as well as the multi-agency Biological Technical Assistance Group. Also, the scientific literature suggests that H. azteca is generally a sensitive indicator of sediment toxicity. As part of the long-term monitoring, APG will be again evaluating which organisms are appropriate.

Comment 8: The Toxicology Program questioned the accuracy of the costs presented for the other alternatives and suggested APG's current budget needed to be considered in selecting an alternative.

APG Response: APG believes the costs presented for the alternatives are reasonably accurate estimates. The Focused Feasibility Study report contains detailed cost information on the components that make up the total cost of each alternative. APG agrees that priorities need to be set in deciding which areas to address first. However, cost is not the primary factor considered in the selection of an appropriate remedy. Cost is considered only in relation to remedies that are equivalent in effect but vary in their cost. Protection of public health and the environment is the factor which receives the greatest weight in the evaluation of an appropriate cleanup plan.

Comment 9: The Toxicology Program questioned whether APG would be further investigating the marsh area south of Watson Creek. They stated it would not make sense to excavate the sediment it the marsh is a potential source.

APG Response: APG plans to conduct additional sampling in the New O-Field marsh area, located south of Watson Creek, in late 1997. Based on an analysis of historical information and the results of this investigation, APG will issue a proposed plan for any required actions to the public for review.

A.4 SAMPLE NEWSPAPER NOTICE ANNOUNCING THE PUBLIC COMMENT PERIOD AND THE PUBLIC MEETING

The following is a copy of the newspaper notice printed in the Cecil Whig on July 2, 1997.

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