US Army Corps of Engineers
Baltimore District

PHASE II OF ELKTON FIREHOLE SITE NON-TIME CRITICAL MEC REMOVAL ACTION

EXPLOSIVE SAFETY SUBMISSION

FINAL DOCUMENT
MARCH 2006

FINAL

Explosives Safety Submission

MUNITIONS AND EXPLOSIVES OF CONCERN
NON-TIME CRITICAL REMOVAL ACTION

PHASE II OF ELKTON FIREHOLE SITE

ELKTON FIREHOLE SITE
ELKTON, MARYLAND

March 21, 2006

Prepared by

US ARMY CORPS OF ENGINEERS

Military Munitions Design Center, Baltimore District

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1.0 INTRODUCTION

The Elkton Fireholes Project (EFP) was funded by the U.S Environmental Protection Agency (USEPA) Region III, under CERCLA (Superfund). The U.S. Army Corps of Engineers, Baltimore District, per a Memorandum of Agreement with USEPA III contracted with InfoPro Corporation to conduct a Munitions and Explosives of Concern (MEC) Removal Action. USEPA III issued a Time Critical Removal Action (TCRA) Action Memorandum, dated 28 September, 2005, stating USEPA III intent to fund this action using CERCLA funding.

Due to safety concerns, the EFP is being addressed in two separate phases. Phase I addresses the immediate concerns of surface and near surface MEC over the entire 55 acres. The Phase I TCRA is being completed under a TCRA ESS approved by Army and DDESB in February 2006 with amendment 1 dated 14 March 2006. The purpose of this Explosive Safety Submission (ESS) is to address the Phase II High Density Anomaly (HDA) area within the project boundaries. The HDA encompasses the four suspect burn pits and surrounding area and is estimated to be approximately 14 acres in size.

1.1 SITE BACKGROUND

1.1.1 Site Location

The EFP Site is located at 183 Zeitler Rd. approximately two miles northwest of the city of Elkton, Cecil County, Maryland. The project site occupies approximately 55 acres of an approximate 400-acre farm property presently owned by the MARVA, Ltd. Partnership. (Figure 1). The EFP parcel is located on the USGS Bayview/Newark West quadrangles at approximately 39°38' north latitude and 75°53' west longitude and has a Maryland grid coordinate of 655,000 N and 1,117,500 E. The site is bounded on the west by Laurel Run, to the north by Zeitler Road, and to the East by Little Elk Creek. A gravel access road bisects the western quadrant of the site. Land use surrounding the site is primarily agricultural/residential, with an area of medium to heavy industry property to the southeast across Little Elk Creek.

1.2 Site Description

1.2.1 Terrain and Vegetation

The site topography is characterized by relatively flat terrain of open farmland bounded by woodland and streams. The most common and current use for the property is agriculture. Over the past 30 years the EFP Site has been farmed by one farmer under a lease agreement with the property's owner.

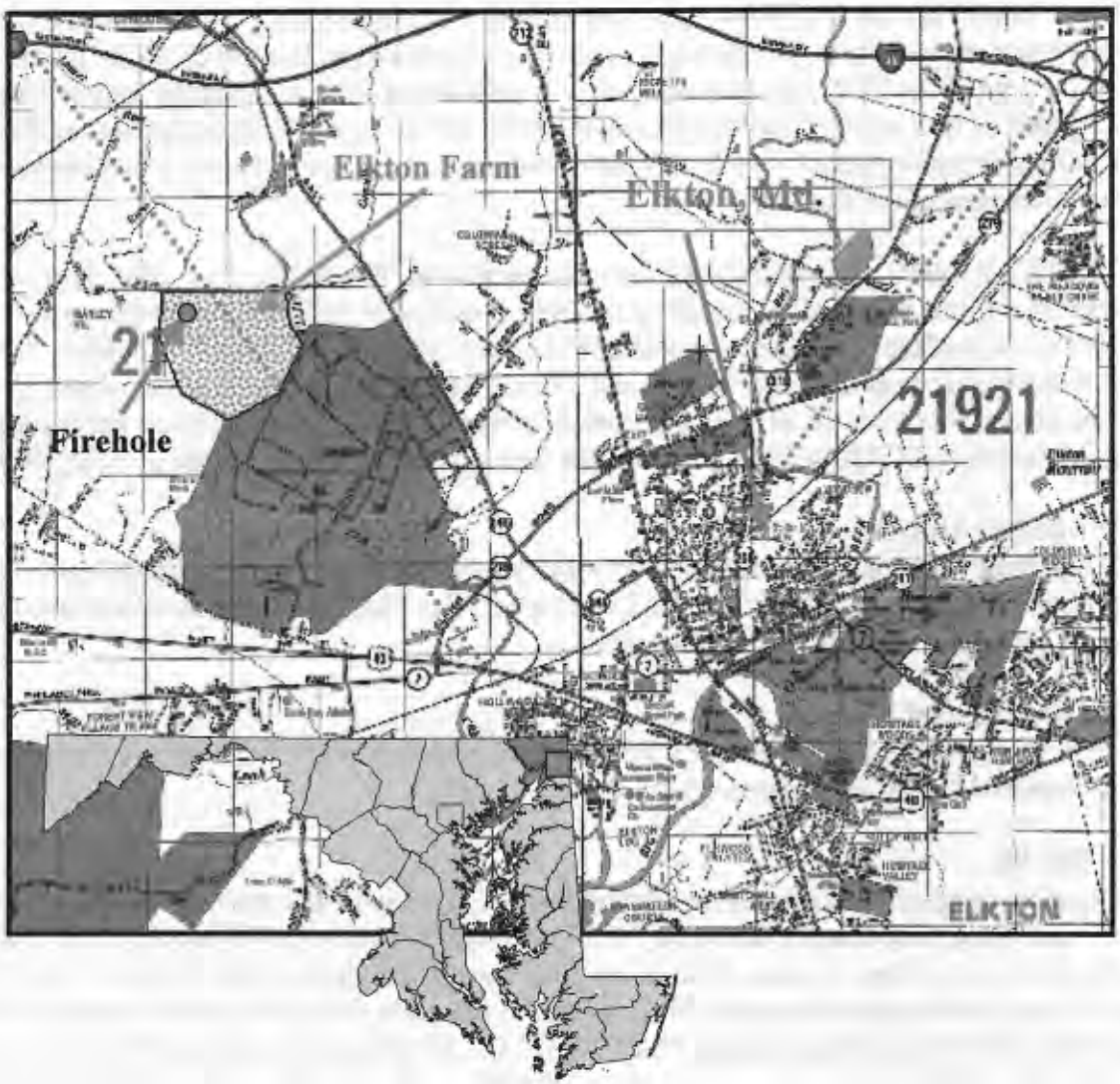
1.2.2 Soil Conditions

The site is gently sloping, moderately well drained, sandy loam soils with a subsoil of firm clay. The estimated frost penetration for the general area is 30 inches.

1.3 Site History

During the majority of its history, the EFP site was used as a farm, with much of the surrounding fields (including the location of the fireholes) under cultivation. The MEC, classified as discarded military munitions, addressed in this ESS was incompletely disposed of during World War II as part of the operations of Triumph Explosives, Inc., which occupied property adjacent to the EFP.

Figure 1



The EFP lies north of, and adjacent to, the Triumph Industrial Park, a site whose environmental implications are currently being addressed in a collaborative effort involving EPA and the Maryland Department of the Environment ("MDE") as the Little Elk Creek Area-Wide One Cleanup Program Pilot Project. The property now occupied by the Triumph Industrial Park was originally owned and operated by the Triumph Fuse and Fireworks Company, which was formed in 1933 by the merger of two fireworks companies. Its principal products were fireworks and fusees (flares). Beginning as early as 1935 the company had contracts with the U.S. Navy and others to produce fusees "floatlights" (naval markers), and a variety of other pyrotechnic devices. In 1938 the company changed its name to Triumph Explosives, Inc. ("TEI") and during the next few years, through a series of property acquisitions, expanded its manufacturing operations to include production of other explosive and additional pyrotechnic devices, which it sold to the U.S. Army and Navy as well as international government (non-U.S.) customers. During a four month period bridging 1942 and 1943 the United States Government assumed direct control of ordnance manufacturing operations at the TEI plant

pursuant to a Presidential executive order. After replacing the original management (two of whom were convicted of bribing acquisition officials) with new personnel, the U.S. Government returned control of the plant to TEI.

Ordnance waste disposal activities on the EFP appear to have first taken place in late 1942, when manufacturing operations at TEI were expanded to accommodate a new 40 mm antiaircraft ordnance production facility for the U.S. Navy. The new facility was built on the location of an existing TEI ordnance waste disposal area, and thereafter ordnance wastes were disposed of on the adjacent Elkton Farm in the area of the EFP... Various ordnance manufacturing wastes, including munitions residue, were disposed of in a series of shallow pits on the EFP. There were several explosions at the Firehole Site (resulting in some deaths), which may have resulted in unburned ordnance being blown away from the immediate area of the fireholes.

In 2004 CENAB OESS personnel conducted a site visit to the Elkton Fire Hole Site. During this visit numerous Munitions Potentially Presenting an Explosive Hazard (MPPEH) were discovered over a large part of the surface of the property visited (55 acres). MPPEH which were identified included projectile nose and tracer elements (40mm and 37mm), and parts and pieces of pistol and "pop" flares. Of all the items identified, the M74 37mm nose fuze was deemed most hazardous. Items recovered during the on-going TCRA validate that the M74 fuze should be utilized for the MGFD calculations.

1.3.1 Physical Setting

The EFP property occupies approximately 55 acres on the Elkton Farm and is located just south of Zeitler Road between Little Elk Creek and Laurel Run. The Phase II area to be investigated under this ESS is estimated to be approximately 14 acres.

1.3.2 Current Land Use

The site is primarily used for agricultural purposes. A crop of winter wheat was growing on the site but was removed during preparation for the Phase I TCRA.

1.4 CLIMATE

The Atlantic coastal climate is moderate throughout the year, and there are four distinct seasons. Summer can bring temperatures above 90 F/32 C and high humidity (55-85%), although most coastal areas do get some cooling breezes. Winters are cold enough for snow to fall at times (23 to 43 F/-5 to 6 C), and it can be as much as 4 degrees F/2 C colder in the north than in the south. Spring and fall are changeable, with temperatures ranging 42-67 F/6-19 C. Air temperatures along the Atlantic coast are about 10 degrees F/5 C warmer in winter and cooler in summer than they are in the inland areas.

2.0 MAPS

The regional map is located above (Figure 1). The following additional maps are located at Appendix A:

Figure 2	Site Map
Figure 3	Explosive Safety Quantity Distance (ESQD) Map

3.0 REASONS FOR MUNITIONS AND EXPLOSIVES OF CONCERN (MEC)

The main reason for MEC on the property is identified by the historical evidence presented in Section 1.3. Historical evidence suggests that MEC will be found in the fireholes and immediate surrounding area (blow out zone) to the depth of the plow zone (12- 18 inches).

3.1 Types of MEC

During peak war time production, TEI was the sole source of the navy's 40 mm antiaircraft munitions. Table 1 lists the munitions and explosive materials that were produced at TEI during the 1940s:

TABLE 1

1. TRIUMPH (TEI) EXPLOSIVE PRODUCED

- **22,059,000 40-MM SHELLS**
- **65,000 RIFLE GRENADES**
- **1,345,000 FLOAT LIGHTS**
- **3,097,000 FUZES**
- **12,000,000 AIRCRAFT SIGNALS**
- **100,000,000 DETONATERS**
- **121,000,000 PRIMER CAPS**
- **647,000 LBS of PENTOLITE**
- **2,383,000 INCENDIARY BOMBS**
- **355,000 HAND GRENADES**

4.0 EXPLOSIVE SAFETY QUANTITY-DISTANCE

4.1 Munition with the Greatest Fragmentation Distance (MGFD)

During a site visit by CENAB in 2004 the M74 nose fuze for the 37mm was identified to be the MGFD for the site. On-going TCRA operations have subsequently verified that the MGFD is the M74 nose fuze for the 37mm projectile. This is a non-fragmenting item with an NEW of .00014 lb (see calculation sheet, Appendix C) If, during the course of operations, a munition with a greater minimum separation distance (MSD) is encountered, then Q-D arcs will be adjusted IAW DDESB TP 16, and an amendment to the Explosive Safety Submission (ESS) will be promptly submitted.

4.2 Explosive Storage Magazines

The contractor co-located two (2) ATF Type II magazines on this site as described in the TCRA ESS approved for Phase I. Inhabited dwellings and public use roadways are in excess of 700 feet away. These magazines will be used to store MEC items that are deemed acceptable to move, for later disposal (net explosive weight not to exceed 100 lbs, HC 1.1). Security for the magazines will be provided 24/7 by a private security firm. Magazines were installed and grounded in full compliance with the requirements set forth in EM 1110-1-4009.

4.3 Planned or Established Demolition Areas.

There are no planned or established demolition areas for this project. MEC items deemed acceptable to move will be consolidated. Items which are unacceptable to move will be blown in place (BIP).

4.4 UNINTENTIONAL DETONATIONS - Minimum Separation Distance for Non Essential Personnel.

Minimum Separation Distance (MSD) for unintentional shall be 200 (feet), based on the calculation sheet (appendix C) for the nose fuze for the 37mm Projectile.

4.5 INTENTIONAL DETONATIONS

4.5.1 Consolidated Demolition Shots

Per amendment 1, TCRA ESS Elkton Farms Firehole Site, the minimum separation distance (MSD) for intentional detonations will be 277 feet (K328). In accordance with DOD 6055.9-STD, the MSD for intentional detonations is the maximum fragment distance or K328, whichever is greater. Because the only energetic material these items contain is a small primer which will not cause the fuze to fragment, K328 will be used for calculating the MSD for intentional detonations. Consolidated shots will use sandbags to contain M74 nose fuzes to the vicinity of the shot. Maximum NEW for consolidated shots will be less than 1 pound

4.5.2 Blow-in-Place Operations (BIP).

Blast effects resulting from blow-in-place operations will be mitigated when necessary using sandbag techniques delineated in HNC-ED-CS-S-98-7. The MSD will be 277 feet unless sandbags are used. If sandbags are used the MSD will be 200 feet.

4.6 Maximum Credible Event (MCE) for Explosive Soil

Explosive soil is not expected to be encountered at this site. In the event that soil sampling analysis indicates that explosives are present in the soil at explosive levels (10% by weight), a Maximum Credible Event (MCE) for explosive soils will be calculated and an amendment to this ESS will be submitted.

5.0 START DATE

Phase I of this project began on 6 February 2006. Pending approval of this ESS, it is anticipated for Phase II to start during the week of 8 May 2006. As discussed in paragraph 7.2 of this ESS, the use of the Range Master is planned for the saturated blow-out area. Due to the limited availability of this equipment it was recommended that mobilization occur in mid April. A start date later than 17 April would result in equipment and personnel down time and could impact the available funding. It is further anticipated that both phases of the project will be ongoing concurrently.

6.0 MEC MIGRATION (Frost Line)

The average frost penetration for the site is 30 inches. Fireholes will be excavated until all MEC, MPPEH, and munitions debris is cleared. Given the nature of operations conducted at the site, it is anticipated that MEC, MPPEH and munitions debris will be located on the surface/near surface to a maximum depth of the plow zone (12-18 inches). Clearance depth identified in Phase I TCRA is eighteen inches subsequently there is no concern about migration due to frost heave in the project area.

7.0 DETECTION EQUIPMENT AND RESPONSE TECHNIQUES

7.1 Removal Depth

7.1.1 The High Density Area

The high density area will be cleared of MEC, MPPEH, and munitions debris to an approximate depth of 8 feet using mechanical equipment. See 7.2 for procedural details.

7.1.2 Low Density Areas

The Low Density Areas will be cleared to a depth of 18 inches. See 7.3 for procedural details.

7.2 HIGH DENSITY AREAS - Mechanical Excavation Equipment

The project team anticipates the utilization of two types of mechanical excavation equipment, the Timberline Environmental Services (TES) TAZ® Series II armored excavator and the RangeMaster® UXO Excavation System. The Range Master can be either manned or remotely operated. Both systems are armored with operator shielding in compliance with the specifications outlined in DDESB Technical Paper 16 (TP-16). Equipment specifications and shielding information is provided at Appendix B.

Figure 2 – Range Master at Phase I Demonstration

Although there is no fragmentation hazard to operators for this project, the Range Master comes fitted with protection against an unintentional detonation from UXO up to a 105mm projectile. The cab is also armored. The system is designed to excavate a 12-foot wide swath to a depth of 12-inches. The excavator paddles lift site soil/debris to an integrated power-screen. The adjustable screens sift objects of interest into a hopper, letting the soil return to the site. The operator can dump the hopper contents at any time (typically at the end of a line or at a designated dump location) for inspection by UXO personnel.

The Range Master will be used in shielded operator mode to excavate the high density areas . Current plan is for the Range Master to excavate at a 12" depth for each pass until the exact footprint of the high density area is identified. Once identified, the high density area will be excavated utilizing the

TAZ® Series II armored excavator. The distance between the operator's cab and scraping/screening area is 18 feet. Specifications are provided at Appendix B.

TAZ will be utilized to excavate the identified high-density areas for MEC screening. The distance from the the TAZ' **Trommex** rotary screen to the operator's cab is 15 feet. Armor/window shielding/protection specifications for operator's cab are provided at Appendix B.

UXO Technicians will proof the spoils from both the Range Master and the TAZ screening processes to ensure all MEC is removed. The spoils remaining in the equipment screens will be spread across a designated area that has previously been cleared of MEC and scrap metals, and then be cleared of MEC/metallic objects. There is a potential for MEC to become lodged in the mechanized equipment. To address this scenario, the Range Master and TAZ will be inspected at a minimum of twice each working day. (mid-day and at the end of the work day or anytime the equipment is to be returned to a cleared location) for any lodged MEC/MPPEH/MD. These routine inspections for lodged material will be performed by UXO Qualified Personnel. In the event that lodged MEC/MPPEH items are identified, items will be removed and placed in respective authorized holding area for disposal.

7.3 Low Density Areas

7.3.1 Sweep Procedures

Low density areas are suitable for "mag and flag/mag and dig" operations. The detection equipment listed in 7.3.2 will be utilized. Project site will be sub-divided into 200' x 200' grids for navigational and reporting purposes. Each grid will be further sub-divided into 5' sweep lanes. Each lane will then be swept with the instrument. Subsurface anomalies identified during this sweep will be marked (mag and flag) for later excavation and/or be immediately excavated (mag and dig). Grid sheets shall be completed on each grid and will record the appropriate grid numeric identification number corresponding to the numeric identification number of the area.

.4 7.3.2 Detection Equipment

Approved detection equipment for this phase of the project include the Schonstedt 52/72-CX Magnetometer, and Whites and Fisher all metals detectors.

The Schonstedt magnetometers are the primary detectors to be used for sweep operations in areas deemed suitable for "mag and flag/mag and dig" operations and for a check of spoils resulting from mechanical excavations. These instruments are magnetometer-type metal locators, which only detect ferrous or magnetic material and will be used to ensure each excavation is 100% free of any other ferrous material.

If non ferrous MEC/material is encountered, the Whites/Fisher all metals detectors will be utilized.

7.5 Exclusion Zone Control

Prior to intrusive activities on any potential MEC areas, all nonessential personnel will move to a location outside of the established exclusion zone (EZ). Positive control of the EZ will be maintained at all times during MEC/intrusive operations. Project personnel and security guards will prevent non-essential personnel from entering the EZ. In the event that non-essential personnel enter the EZ, all intrusive/demolition activities will halt immediately until the non-essential personnel exit the EZ.

7.6 Intrusive Investigations

UXO-qualified personnel will perform manual excavation and investigation of suspect anomalies and screening of excavated spoils. Equipment operators are deemed essential personnel and will remain in shielded equipment during mechanical excavations. All other excavations will be by hand using suitable hand tools. A detailed accounting of all MEC located/recovered will be maintained by the site Senior UXO Supervisor (SUXOS).

8.0 DISPOSITION TECHNIQUES

8.1 Demolition Operations

Demolition operations will be conducted/scheduled on an as needed basis. All MEC items which are deemed acceptable to move will be consolidated in the site MEC storage magazine. MEC items deemed unacceptable to move will be marked, pending BIP. All unacceptable to move MEC will be secured until destruction, normally the following day. Consolidated items will either be scheduled for disposal concurrently with BIP operations or separately as the situation dictates. All explosive operations will be supervised by the SUXOS and coordinated with the US Army Corps of Engineers (USACE) on-site OE Safety Specialist. Demolition operations will follow the procedures outlined in TM 60A-1-1-31 and the EP 385-1-95a, "Basic Safety Concepts and Considerations for OE Operations", dated 27 August 2004.

8.2 Explosive Storage, Accountability, and Transportation

Two ATF Type II magazines will be co-located on the site. These magazines will be used for storage of recovered MEC deemed acceptable to move. For BIP and for scheduled demolition operations, demolition materials will be delivered to the job site on an as-needed basis. Transportation of explosives by site personnel will only occur after receipt from the vender on the project site. Project personnel will not transport explosives via public transportation routes. All vehicles transporting explosives on site will be properly inspected, equipped, and placarded prior to the loading of explosives onto the vehicle, and DD Form 626 "Motor Vehicle Inspection" completed

8.3 Engineering Controls

8.3.1 Demolition

In the event that more than one MEC item is placed on a particular demolition shot, the DDESB-approved sandbag method will be used ("Use of Sand Bags for Mitigation of Fragmentation and Blast Effects due to Intentional Detonation of Munitions", HNC-ED-CS-S 98-7, dated August 1998.) the sandbag method will be used to confine M74 fuzes to the vicinity of the shot to allow ease of recovery of the M74 fuzes after the shot.. A copy of HNC-ED-CSS-98-7 will be available on site, if these engineering controls are to be used.

8.3.2 Disposal Shots

While preparing MEC for disposal, the UXO Safety Officer (UXOSO) will ensure the number of personnel on site is kept to the minimum required to safely accomplish the disposal mission. Authority to initiate demolition operations will rest solely with the SUXOS. The UXOSO will be responsible for ensuring all personnel are outside the exclusion zone and have been accounted for and that the area is secure prior to authorizing the detonation of explosive charges. The contractor will utilize non-electrically initiated means of detonation on all demolition operations. Demolition operations will be coordinated with the on-site OE Safety Specialist.

8.4 Scrap Procedures

8.4.1 Inspection and Certification

All material potentially presenting an explosive hazard (MPPEH) and other metallic debris will be twice-inspected and certified as presenting no explosive hazards by UXO qualified personnel prior to being removed from the grid. Once inspected and certified as presenting no explosive hazard, MPPEH will be reclassified as Munitions Debris (MD) and will be containerized in an on site storage container and safeguarded until proper disposition can be arranged. The storage container will be locked at all times when not in use. MD will be segregated from other metallic debris. All MD shall be disposed of at a foundry and/or recycler where it will be processed through a smelter, shredder or furnace prior to resale or release in accordance with all governing regulations. It is the intent that MD is disposed of permanently. The Contractor shall document the transport of the MD and the transfer of the debris to the next responsible party.

8.4.2 DD Form 1348-1A

All MPPEH/MD will be inspected, certified, and disposed of in accordance with DOD Instruction 4140.62, *Management and Disposition of MPPEH.* This inspection will be certified on DD Form 1348-1 as follows: "This certifies and verifies that the Munitions Debris (MD) listed has been 100 percent properly inspected and to the best of our knowledge and belief, is free of explosive hazards". This certification requires dual signatures. Both the SUXOS and the UXOSO/UXOQCS will sign as certifiers, and the on-site CENAB OE Safety Specialist will sign as verifier. The inspected, and certified to be inert, MD will be containerized, maintained and then safeguarded until proper disposal can be arranged.

8.5 Alternate Disposal Techniques

No off-site destruction of recovered MEC is anticipated for this removal action. All destruction by disposal actions will occur on-site. Primary means of disposal is countercharge with explosives. No other disposal techniques are anticipated for this MEC removal action.

9.0 ENVIRONMENTAL, ECOLOGICAL OR CULTURAL CONSIDERATIONS

Per guidance from the USEPA and documented prior use of the project site, there are no significant resources or identified endangered, threatened or protected species associated with the project site.

10.0 TECHNICAL SUPPORT

10.1 Environmental Protection Agency

The On-Scene Coordinator for the U.S Environmental Protection Agency (USEPA) Region III will coordinate required soil sampling and will be the primary point of contact for all public inquiries on this project. .

10.2 Contractor

The contractor for both phases of this project is InfoPro Corporation. All on-site personnel will meet the training and minimum experience delineated in DDESB Technical Paper 18.

11.0 STAKEHOLDER INVOLVEMENT

Both the USEPA and Maryland Department of the Environment (MDE) are in full support of the execution of this project.

12 CONTINGENCES

None have been identified at this time.

APPENDIX A

MAPS

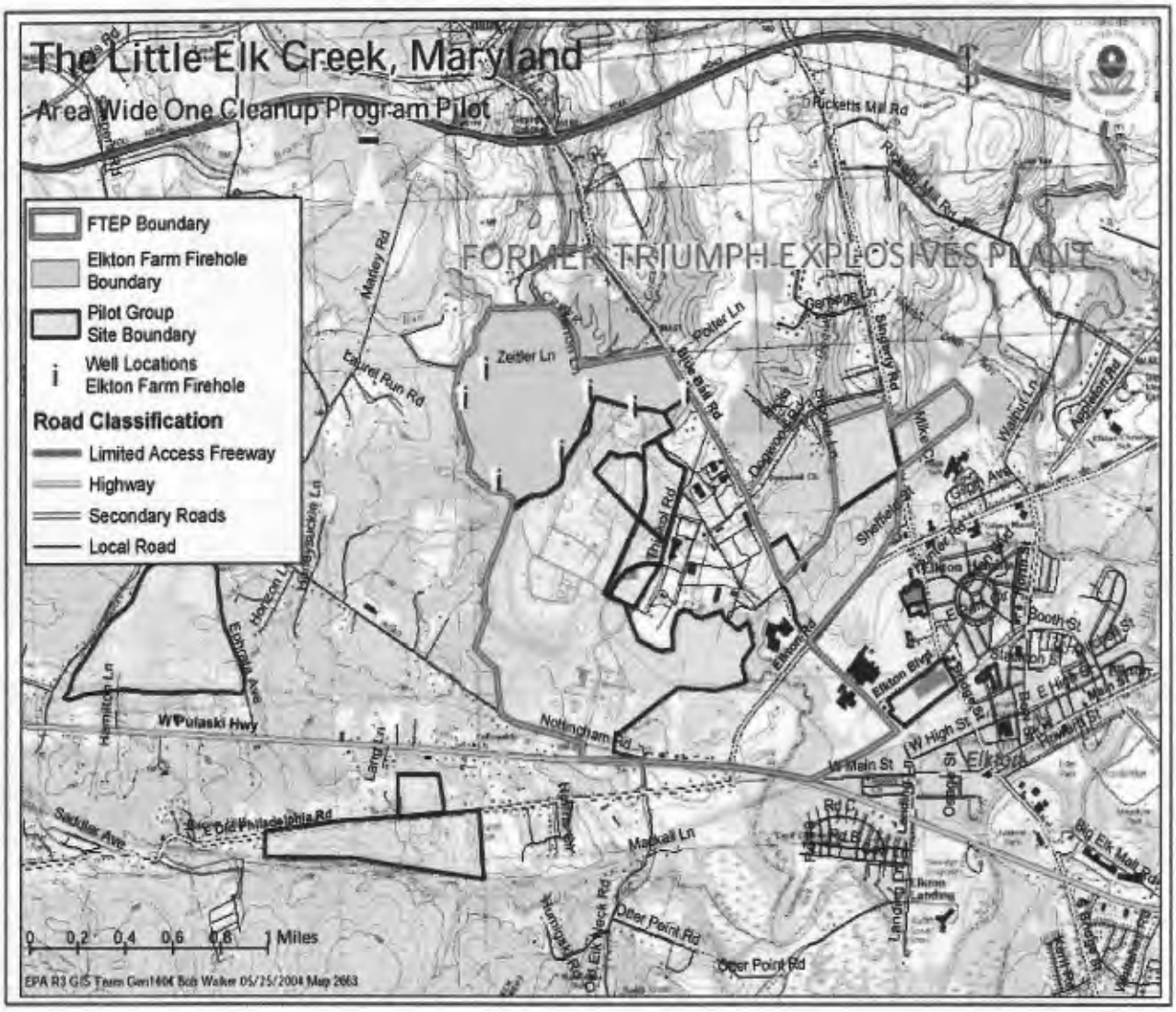

The Little Elk Creek, Maryland
Area Wide One Cleanup Program Pilot
FTEP Boundary
Elkton Farm Firehole Boundary
Pilot Group Site Boundary
Well Locations Elkton Farm Firehole
Road Classification
Limited Access Freeway
Highway
Secondary Roads
Local Road
FORMER TRIUMPH EXPLOSIVES PLANT
Ruckens Mill Rd
Markey Rd
Laurel Run Rd
Zeitler Ln
Potter Ln
Blue Bell Rd
Garriage Ln
Singerly Rd
Appleton Rd
Walnut Ln
Mike Dr
Deerwood Dr
Dogwood Dr
Dilseal Rd
Sheffield Dr
Glen Ave
Booth St
Elkton Ctr
Elkton
W High St
W Main St
Main St
Bridge St
Railroad Ave
Bow Tie Ln
Big Elk Mall Rd
Kent Rd
Hamilton Ln
Horton Ln
Shadyside Ln
Estonia Ave
W Pulaski Hwy
Land Ln
Nottingham Rd
Saddler Ave
Old Philadelphia Rd
Malkall Ln
Meadow Dr
Elk Neck Rd
Deer Point Rd
Landing Dr
Iron Landing
0 0.2 0.4 0.6 0.8 1 Miles
EPA R3 GIS Team Gen1404 Bob Walker 05/25/2004 Map 2663

Figure 2

Figure 3

(See Attached PDF File)

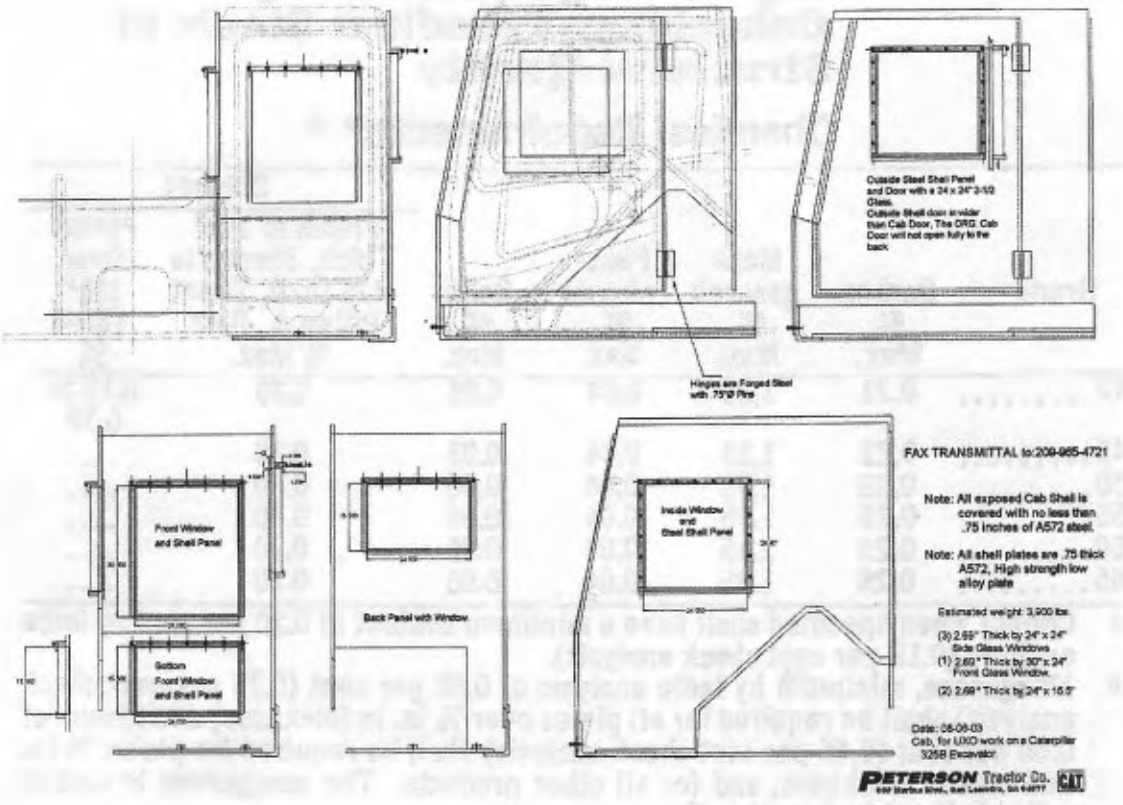
APPENDIX B

MECHANICAL EQUIPMENT SPECIFICATIONS

TAZ WITH TROMMEX HEAD

TAZ Series II

- **Built to survive unintentional detonation of a 75mm HE**
- **Zero Tail Swing for operation in tight quarters**
- **Can operate on slopes up to 65 percent**
- **Articulated arm with a 30' reach**
  from center line Ground pressure is 6.3 PSI
- **.75 A572 steel armor protection from direct detonations**



TES TAZ® Series II armored excavator

A572-70a—High Strength, Low Alloy Columbium-Vanadium Steels of Structural Quality

Chemical Requirements* a

Grade	Carbon % Max.	Manganese[b] % Max.	Phosphorus % Max.	Sulfur % Max.	Silicon[c] Plates to 1½" Thick, Shapes to 426 lb/ft, Sheet Piling & Bars % Max.	Silicon[c] Plates Over 1½" Thick %
42.....	0.21	1.35	0.04	0.05	0.30	0.15 to 0.30
45.....	0.22	1.35	0.04	0.05	0.30	....
50.....	0.23	1.35	0.04	0.05	0.30	....
55.....	0.25	1.35	0.04	0.05	0.30	....
60.....	0.26	1.35	0.04	0.05	0.30	....
65.....	0.26	1.35	0.04	0.05	0.30	....

a Copper when specified shall have a minimum content of 0.20 per cent by ladle analysis (0.18 per cent check analysis).

b Manganese, minimum by ladle analysis of 0.80 per cent (0.75 per cent check analysis) shall be required for all plates over ⅜ in. in thickness; a minimum of 0.50 per cent (0.45 per cent check analysis) shall be required for plates ⅜ in. and less in thickness, and for all other products. The manganese to carbon ratio shall not be less than 2:1.

c Silicon content in excess of 0.30 per cent by ladle analysis must be negotiated.

* Alloy content shall be in accordance with the following:	per cent
Columbium	0.005 to 0.05
Vanadium	0.01 to 0.10
Columbium (0.05 per cent max.) + vanadium	0.02 to 0.10
Nitrogen (with vanadium)	0.015 max.

Tensile Requirements

Grade	Yield Point, min psi	Tensile Strength, min psi	Minimum Elongation, in 8 in.	Minimum Elongation, in 2 in.
42.....	42,000	60,000	24	20
45.....	45,000	60,000	19	22[a]
50.....	50,000	65,000	18	21[a]
55.....	55,000	70,000	17	20[a]
60.....	60,000	75,000	16	18[a]
65.....	65,000	80,000	15	..

[a] Applies to bars only.

Bend Test Requirements—See ASTM Book of Standards (Part 4)

TP 16 Calculations Sheet

Minimum Thickness to Prevent Perforation Query								
Category	Munition	4000 psi Concrete (Prevent Spall)	Mild Steel	Hard Steel	Aluminum	LEXAN	Plexi-glass	Bullet Resist Glass
HE Rounds	40 mm MK2	2.17	0.40	0.33	0.86	3.41	2.08	1.63
HE Rounds	75 mm M48	3.76	0.70	0.58	1.45	4.82	3.27	2.69

Note: the above is for information only. Since the M74 fuze is a non-fragmenting item, the shielding already existing on the Range Master and TROMMEX is not actually necessary.

APPENDIX C

MSD CALCULATION SHEET

Minimum Separation Distances
Elkton Farms
M74 PD Fuze
24 February 2006

REQUESTED BY: Hank Hubbard
PREPARED BY: Michelle Crull, PhD, PE

This form shows calculated distances only. It does not constitute approval. Concurrence of CEHNC-OE-S is required to determine the applicable distance for a specific site.

In accordance with (IAW) EM 1110-1-4009, the minimum separation distance for unintentional detonations shall be the largest of the maximum fragment range, the K50 ($50W^{1/3}$ where W is the total net explosive weight for the detonation) overpressure distance or 200 ft. In accordance with (IAW) EM 1110-1-4009, use of the range to no more than 1 hazardous fragment/600 sq ft as the minimum separation distance for unintentional detonations requires written justification, a risk analysis, calculation of this distance by CEHNC-ED-CS-S, and concurrence of CEHNC-OE-S.

IAW EM 1110-1-4009, the minimum separation distance for intentional detonations shall be the largest of the maximum fragment range, the K328 ($328W^{1/3}$ where W is the total net explosive weight for the detonation) overpressure distance or 200 ft. The 200 ft is a default distance applied by USACE OE Safety and may be reduced by the appropriate approval authority (contact the MMRP-CX for instructions).

This calculation sheet is for a fuze with no attached booster (i.e., primer only). The primer will not cause the fuze to fragment. Therefore, MSD's will be the largest of the appropriate overpressure distance, soil ejecta distance and 200 ft.

FILLER INFORMATION
Weight = 1.0 grain = 0.00014 lbs
Type of filler = tetryl & lead azide

CALCULATED OVERPRESSURE DISTANCES BASED ON OE ITEM'S EXPLOSIVE WEIGHT ONLY (i.e. NO DONOR CHARGE)
Range to 0.9 psi Overpressure (K50) = 3 ft
K328 Overpressure Range = 18 ft (based on munition NEW only, no donor)

CALCULATED OVERPRESSURE DISTANCE FOR INTENTIONAL DETONATION USING ½ LB DONOR CHARGE
K328 Overpressure Range = 277 ft
Soil Ejecta Distance (IAW BEM, Ch 6, TP 16) = 61 ft

SIGNATURES:

Michelle Crull 2/24/06 — Subject Matter Expert / Date
Theresa Dawson 2/24/06 — QA Reviewer / Date

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