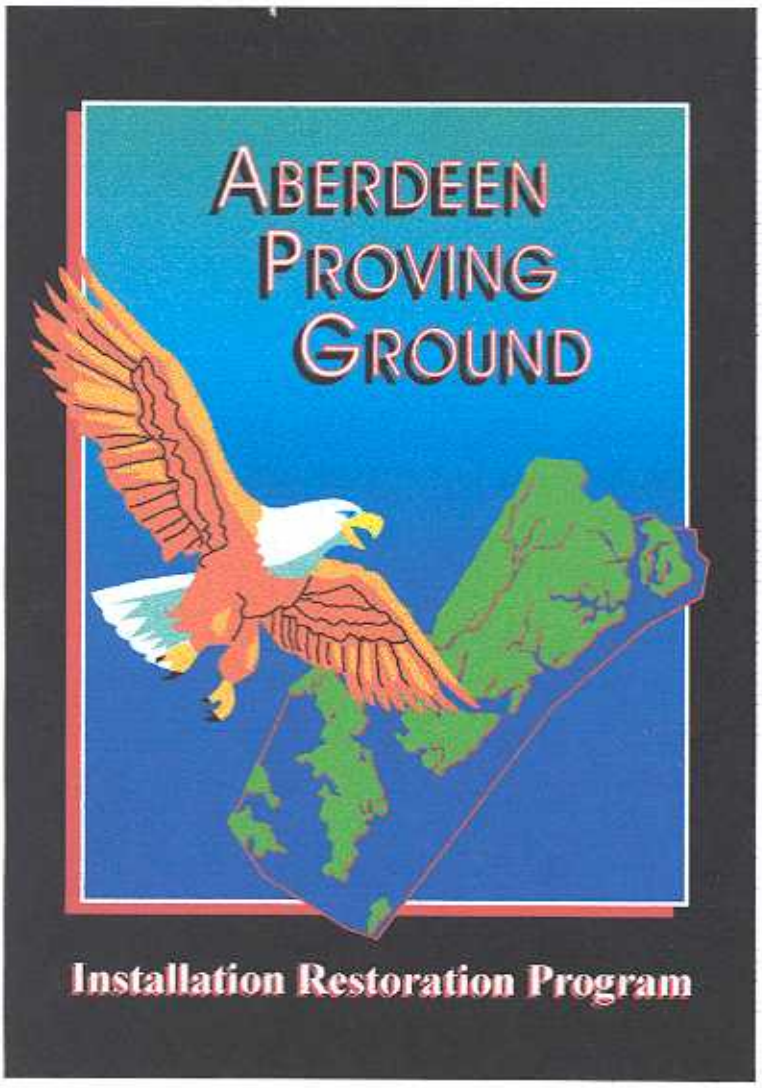

WORK PLAN FOR FALL SAMPLING PERIOD
J-FIELD PHYTOREMEDIATION STUDY

ABERDEEN PROVING GROUND, MARYLAND

OCTOBER 1998

Rec'd 10-05-98
CF: John Fairbank
Via Fax 10-05-98

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1.0 OBJECTIVE

The Response Engineering and Analytical Contract (REAC) under the United States Environmental Protection Agency's Environmental Response Team Center (U.S. EPA/ERTC) will provide the requested sampling, monitoring and analytical analyses to evaluate pilot-scale phytoremediation at the J-Field Toxic Pits Site, Aberdeen Proving Ground (APG), Maryland.

The current objectives of this project are to:

1) monitor water levels in all wells and lysimeters within the study area.

2) monitor contaminant concentrations in JFP wells and lysimeters within the study area.

3) perform air sampling/monitoring to capture volatile compounds in transpiration gas and condensate samples.

4) monitor tree transpiration rates by measuring sap flow and correlate findings with meteorological data.

5) monitor soil flux emissions from established sampling locations for diurnal and seasonal changes.

6) maintain the phytoremediation study area by pruning, adding fertilizer / soil amendments, and clearing the drainage system.

7) replant trees in areas where current trees have died or are unhealthy

8) use a geoprobe to install semi-permanent wells at various screening depths and collect groundwater samples. Water samples will then be analyzed for volatile organic compounds.

9) examine a tree's root system by digging a trench next to the tree in an attempt to observe root depth / location and take soil samples to examine microorganisms associated with the roots.

10) collect soil and leaves from the planting area to be used in a degradation study.

11) collect branches and leaves to be burned in a study designed to analyze compounds released in the burning process.

2.0 PROJECT SCOPE

J-Field is located at the tip of Gunpowder Neck, Edgewood Area of APG in Harford County, Maryland. The Toxic Pits area of J-Field was once the disposal site for chemical warfare agents, munitions, and industrial chemicals. The Toxic Pits area consists of two parallel disposal pits that are approximately 10 feet deep by 15 feet wide by 200 feet long. Remnants of other pits extend into the marsh area to the southeast. The pits were used for open-pit burning and detonation from 1940 through 1980.

During open burning, wood was first placed in the pit and the agents, munitions, and chemicals were placed on top. The pit was then flooded with fuel oil and ignited. After the first burn, a reburn of the material was performed in the adjacent pit. Any remaining debris was pushed into the marsh. The pits and surrounding land have been disturbed by the activities that took place on J-Field. The area to the northeast of the pits appears to be the main push out area for the pits.

The types of materials handled at these pits included:

High explosives
Nerve agents
Mustard agents
Smoke materials
Solvents

The contaminants of concern are:

1,1,2,2-tetrachloroethane (1122)
1,1,2-trichloroethane (TCA)
trans-1,2-dichloroethene (DCE)
trichloroethene (TCE)
tetrachloroethene (PCE)
lead (Pb)

The ecosystem of concern is the Chesapeake Bay and surrounding waterways. Additional information/data may be found in: *Hydrology and Soil Gas at J-Field, Aberdeen Proving Ground, Maryland, U.S. Geological Survey, Water-Resources Investigations Report 92-4087, 1993.*

2.1 J-Field Phytoremediation

The J-Field Phytoremediation Sampling & Monitoring Pilot Study is being performed as an interim measure to prevent the migration of contaminants into the marsh area located to the east of the toxic pits. The feasibility of this type of process will be studied and evaluated for future full-scale use in remediating the site. Contaminant migration will be reduced either by depletion of the concentration of contaminants in the groundwater by means of transpiration and microbial degradation, by interception of the flow of groundwater by means of water uptake, or by reduction of the concentration of contaminants in the soil by means of microbial degradation and natural soil flushing.

The pilot-scale TreeMediation system was installed in March and April 1996 by ERTC as assisted by REAC and Applied Natural Sciences, Inc. (ANS) personnel. Since the time of the installation, site visits were made to monitor the progress of the trees, install a drainage system on the site, and collect samples.

Monitoring of the pilot system will involve the collection and analysis of leaves, stems, roots, soil, and groundwater over a five-year period. Sap flow rates and transpiration gases will also be measured.

Data from various agencies, companies, and APG will be compiled. Modeling of contaminant and water levels will be performed in order to establish a base for all subsequent sampling events. These data will be utilized to determine the effect the trees have on the groundwater system.

3.0 TECHNICAL APPROACH

3.1 Monitor Well/Lysimeter Sampling

Monitoring of the wells and lysimeters will include obtaining one round of samples per year to determine groundwater contaminant concentrations. Groundwater sampling for Volatile Organic Compounds (VOCs) will be conducted on wells JFP 1 through 5 and the lysimeters. Water levels will be recorded from all other wells. This data will be used to assess the effectiveness of the remediation

project. Permanent water elevation monitors located at well JF-53, JF-63, JF-73 and JF-83 will record changes in groundwater levels.

Groundwater sampling of monitor wells will be performed in accordance with APG protocols (Appendix A) and any measurements will be recorded on Well Purge Forms along with the time of the reading and the cumulative volume extracted. Prior to purging, water depth will be recorded for each individual well. Each well will be purged prior to sampling using disposable bailers in accordance with the acceptable purge/sampling devices listed in the APG Standard Operating Procedure (SOP). Initially, after removing three Liters of water from the well while purging, a sample will be collected for pH, temperature, turbidity, conductivity and dissolved oxygen. These stabilization measurements will be collected using a Horiba water quality monitoring instrument, where an individual water sample will be poured from the bailer into a designated sampling cup. These measurements will be used to determine if conditions in the well have stabilized. Stabilization is achieved when three successive readings are within ± 0.1 for pH, $\pm 3\%$ for conductivity and $\pm 10\%$ for turbidity and dissolved oxygen (DO). Turbidity and DO are typically the last parameters to stabilize. If turbidity samples do not approach the range of natural groundwater (10 nephlometric turbidity units (NTU)), both filtered and unfiltered samples will be collected for metals analysis. A sample will be collected when the total volume of water purged exceeds the water volume in the screened interval and the surrounding filter pack (the minimum purge volume for each well will be listed on the sampling form), and parameters stabilize over three consecutive readings. Lysimeters will be sampled in accordance with the TIMCO lysimeter manual (Appendix B).

3.2 Phytoremediation Monitoring

3.2.1 Transpiration Gas Sampling

Transpiration gas will be measured on trees using the following method. A Tedlar bag will be placed over a three foot section of the end of a branch. The bag will be sealed around the stem using clay and a mechanical fastener. A cold trap attached to the system will remove condensate from the Tedlar bag enclosure. Air will be circulated through the enclosure and cold trap so that transpiration rates will not be substantially reduced in the affected branch due to increased relative humidity within the enclosure.

Transpiration gases and condensate from the enclosure will be sampled and analyzed for VOCs. Mean transpiration rates and mean contaminant concentrations in transpired gases and condensate will be used to estimate the quantity of transpired water and contaminants for the entire planting area.

3.2.2 Plant Transpiration Measurements

Two methods of determining sap flow rates will be used. The heat balance technique, which has been used during previous monitoring events, uses the Dynamax Flow32™ Sap Flow System to measure the transpiration rate in grams water/hour/tree. This method is non-invasive and does not injure the tree. The second method, Thermal Dissipation Sap Velocity (TDSV), uses small probes inserted into holes drilled in the tree trunk to measure sap flow rates. Transpiration rates will be recorded on eight trees or more over a one week period using the two sampling methods. This information will be correlated with measures of VOCs in transpiration gas and with meteorological data in order to estimate the quantity of VOCs being emitted from the trees over the course of the season.

3.2.3 Weather Monitoring

Weather parameter data will be collected using a meteorological station. Parameters such as daily precipitation, wind speed/direction, solar radiation, and temperature will be recorded throughout the monitoring period. Weather and solar radiation data will be correlated with measures of transpiration.

3.2.4 Soil-Flux Sampling

Soil flux samples will be taken from previously monitored sampling locations during both day and nighttime periods to measure emissions from the site.

3.2.5 Site Maintenance

Where necessary, site maintenance will be performed and may include the following tasks: tree pruning, fertilizing, cleaning drainage system. etc.

3.2.6 Tree Re-Planting

Approximately 10 to 12 trees will be re-planted using one or several types of native cottonwood species. Trees will be re-planted in areas where previous trees have died or are doing poorly.

3.2.7 Surficial Aquifer Sampling

A geoprobe will be used to install semi-permanent micro-wells and discrete samples will then be collected from the upper portion of the surficial aquifer. These samples will be used to determine if a concentration gradient exists in the vicinity of the tree root zone. This will be done in several areas to be chosen by EPA / ERTC and approximately 3 water samples will be taken per tree.

3.2.8 Examination of Tree Root System

A trench will be dug tangent to the base of a tree (Tree #168) in an attempt to examine the root system of the tree. Soil will be removed from the trench and replaced in the hole after the examination is complete.

3.2.9 Degradation Study

Leaves and soil will be collected from several trees and from a reference area and used in a soil community / degradation study. Three trees will be selected along a contaminant concentration gradient. See attached sampling design for further detail.

3.2.10 Leaf Burning Study

If there are still leaves on the tree in October, several branches will be collected from 5 trees and one reference tree and submitted to a laboratory for a leaf and branch burning study. The purpose of such sampling is to determine whether or not any VOCs would be released from the tree in the event of a range fire.

3.3 Soil Sampling

Any soil sampling or boring (on trees not previously cleared) will require a magnetometer sweep for UXO (unexploded ordnance) avoidance. A contractor to REAC will provide this service. This will ensure that no unexploded ordnance or munitions are present where sampling and/or boring is being performed. Any samples to be taken off base will be cleared of chemical agents through the CTF lab and Scitech Services of APG if collected from areas not previously screened for chemical surety.

3.4 Standard Operating Procedures

A magnetometer sweep for UXO avoidance will be performed according to procedures set forth in the Site Health and Safety Plan before any intrusive activities are performed. ERTC/REAC and APG SOPs will be utilized. The more stringent of the two SOPs will be utilized. Any discrepancies to these SOPs will be noted in a field logbook.

3.4.1 Sample Documentation

Sample documentation will be completed as per the following Standard Operating Procedures (SOPs):

- ERTC/REAC SOP #2002, *Sample Documentation*
- ERTC/REAC SOP #4005, *Chain of Custody Procedures*
- ERTC/REAC SOP #4021, *Preparation of Final Reports*

3.4.2 Sample Packaging and Shipment

Sample packaging and shipment will be conducted in accordance with the following SOP:

- ERTC/REAC SOP #2004, *Sample Packaging and Shipment*

3.4.3 Sampling Techniques

- ERTC/REAC SOP #2007, *Groundwater Well Sampling*
- ERTC/REAC SOP #2012, *Soil Sampling*
- ERTC/REAC SOP #2001, *General Field Sampling Guidelines*
- ERTC/REAC SOP #2003, *Sample Storage, Preservation, and Handling*
- ERTC/REAC SOP #2013, *Surface Water Sampling*
- ERTC/REAC SOP #2041, *Operation of the Hydrolab Surveyor II Water Quality Management System*
- ERTC/REAC SOP #2016, *Sediment Sampling*
- ERTC/REAC SOP #2043, *Water Level Measurement*
- APG SOP # 013, *Collection of Monitoring Well Samples*

Other ERTC/REAC SOPs will be followed where appropriate for the various phases of the project.

3.5 Equipment Decontamination

The following equipment decontamination procedure will be employed prior and subsequent to boring holes and/or for large equipment:

- physical removal
- high pressure nonphosphate detergent wash
- potable water rinse

The following sample equipment decontamination procedure will be employed prior to collection of environmental samples with nondedicated sampling equipment:

- physical removal
- nonphosphate detergent wash
- deionized water rinse
- 10% nitric acid wash
- deionized water rinse
- acetone wash
- deionized water rinse
- air dry

3.6 Waste/Sample Disposal

3.6.1 Investigation-Derived Waste (IDW) Disposal

RCRA Hazardous IDW:

- Any waste generated from the analytical procedures will be disposed through the appropriate hazardous waste disposal contractors in accordance with applicable regulations.

Other IDW:

- Waste generated on site will remain on site and be disposed through the appropriate hazardous waste disposal contractors in accordance with applicable regulations.

3.6.2 Sample Residuals Disposal

All of the treated and untreated samples will be maintained for 60 days after the issuance of the final report. If no additional testing is requested at the end of the 60 days, arrangements will be made for disposal.

Sampling Design / Requirements for Soil Degradation Studies

Number of Locations: 4 (3 tree locations, 1 reference)

Number of replicates per location: **9** = 3 with no leaves
3 with reference leaves
3 with contaminated leaves

Number of replicates at Reference location: **15** = **3** with no leaves
3 with reference leaves
3 with contaminated leaves from Tree A
3 with contaminated leaves from Tree B
3 with contaminated leaves from Tree C

Total number of samples: **42** (3 trees x 9 replicates each = **27** samples; 1 reference area x 15 replicates = **15** samples; **27** samples + **15** samples = **42 total samples)**

Note: approximately 2 g of leaves should placed on top of soil (Weston will provide a bag of leaves that Oregon will homogenize/crush)

Number of monitoring periods: 2 (Day 0 and Day 42)

Analyses to be performed during each monitoring period:

Note: Analytical methods will follow methods provided by Oregon State University Department of Crop and Soil Science

1) **Soil Nitrogen and Carbon analyses:**

a) Mineral N (NH_4-N and NO_3-N) and Dissolved organic N (DON) and Dissolved Organic Carbon (DOC)

b) Microbial biomass nitrogen and carbon (MBN and MBC)

c) Net Nitrogen and Carbon Mineralization During Lab Incubation with microbial respiration measured every seven (7) days

2) **Fungal Community Analyses using Fluorescein Diacetate Method**

fax transmittal

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From: John Fairbank	Phone #:
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Date: 10-05-98	Pages (including header): 9

Comments:

Attached is the workplan we will be conducting at the site this week w/ERT. Let me know if you have time to visit. Note tree extraction has been toned down to be just excavations and root examination.

John