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NSWC CRANE
5090.3a

DEPARTMENT OF THE NAVY
CRANE DIVISION
NAVAL SURFACE WARFARE CENTER
300 HIGHWAY 361
CRANE, INDIANA 47522-5000

IN REPLY REFER TO:

5090
Ser 095/1076

06 MAR 2001

U.S. Environmental Protection Agency, Region V
Waste, Pesticides, & Toxics Division
Waste Management Branch
Illinois, Indiana, and Michigan Section
ATTN: Mr. Peter Ramanauskas (DW-8J)
77 West Jackson Blvd.
Chicago, IL 60604

Dear Mr. Ramanauskas:

Crane Division, Naval Surface Warfare Center (NSWC Crane) submits the Scope of Work (SOW) for Demonstration of Natural Attenuation (NA) at the Ammunition Burning Ground (ABG). Although NSWC Crane was unable to find records documenting such, this SOW was reportedly submitted to Ms. Carol Witt-Smith of the U.S. EPA. In addition, please note that the approved Ground Water Monitoring Plan also contains a discussion of NA monitoring at the ABG, as well as identifying the key NA analytical parameters. The permit required Certification Statement is provided as enclosure (2).

NAVSURFWARCENDIV Crane point of contact is Mr. Thomas J. Brent, Code 09510, telephone 812-854-6160.

Sincerely,

James M. Hunsicker
Director, Environmental
Protection Department
By direction of the Commander

Encl:
(1) NA SOW for the ABG
(2) Certification Statement

Copy to:
ADMINISTRATIVE RECORD
SOUTHNAVFACENGCOM (Code 1864) (w/o encl)
USACEWES (GG) (w/o encl)
IDEM (Doug Griffin)
TTNUS (Ralph Basinski) (w/o encl)

SCOPE OF WORK FOR DEMONSTRATION OF NATURAL ATTENUATION AT THE AMMUNITION BURNING GROUND AT CRANE NAVAL SURFACE WARFARE CENTER, CRANE, INDIANA

Preliminary Evaluation of Existing Site Data

A preliminary evaluation of existing data for the ABG indicates that this site is a candidate for natural and /or enhanced attenuation. Data used for this purpose included groundwater hydrology, subsurface geology, surface soil, surface water, and contamination data. Contaminants included explosives, and degradation /transformation products of explosives. The review included WES Final Report, RCRA Facility Investigation, Phase III, Groundwater Release Characterization, SWMU 03/10, Ammunition Burning Ground, WES Dye Tracer Report and ongoing research by Indiana University.

The available data indicates that the Ammunition Burning Grounds site is a good candidate for remediation by natural and/or enhanced attenuation. A review of the hydrogeology at the site shows that the primary groundwater flow path from the ABG is down the valley of Little Sulfur Creek. The contaminated groundwater is moving through the alluvium of Little Sulfur Creek, the fractured sandstone of the Big Clifty, fractures and solution cavities of the Beech Creek limestone and emerging as surface water in springs and seeps down gradient of the ABG. An area of solution cavities in the Beech Creek limestone acts as a groundwater drain to focus contaminated groundwater down the valley of Little Sulfur Creek. Extensive drilling shows that the solution cavities are found primarily in the valley of Little Sulfur Creek and were not found in the groundwater divides along the valley. Therefore, unlike mature karst areas where the ground water flow through solution cavities would not be predictable , the flow at the ABG seems to be controlled laterally and vertically. The dense Elren shale underlying the Beech Creek limestone helps to restrict downward flow of groundwater in the ABG area and focus the flow of groundwater down the Little Sulfur Creek valley (Figure 1). Dye tracer tests conducted by WES and Indiana University provide data indicating that the majority of the groundwater exiting the ABG emerges as surface flow from Spring C. Groundwater also enters Little Sulfur Creek through seeps in the alluvium. The contaminated groundwater is attenuated as it moves through the Big Clifty, Beech Creek and alluvial materials. As the groundwater enters the area of the solution cavities dilution occurs as clean groundwater flows in from the sides of the valley. As the groundwater and surface water moves toward the installation boundary the contaminants have been reduced to very low concentrations insuring that natural and/ enhanced attenuation

is a viable remedial alternative.

Part 1: Groundwater Monitoring.

The springs in the Little Sulfur Creek Valley will be monitored in addition to the observation wells. Spring A and spring C will be especially useful in determining the fate of contaminants moving down the valley.

The large number of observation wells in the vicinity of the ABG should be adequate to conduct the groundwater monitoring needed to confirm that natural attenuation is occurring. The groundwater monitoring needed to confirm that natural attenuation is occurring has been included in the overall groundwater monitoring program being conducted by Morrison and Knudson (MK) Before sampling is initiated, the historical chemical data will be further analyzed to establish existing trends. Time versus concentration data will be plotted to evaluate trends in concentration for specific wells. Figure 1 shows a typical historical plot for a well at the Louisiana Ammunition Plant.

The wells will be monitored quarterly for two years following closely a WES protocol which uses a low flow, submersible pump placed in the center of the screened interval to purge wells before sampling. The pumping rate will be keyed to the recharge rate of the individual well by measuring the groundwater elevation during pumping and adjusting the flow rate until recharge rate balances removal rate. This procedure clears the well head of oxygenated water resulting from diffusion from the atmosphere and results in a minimum of turbulence in the sample. The pumped water is passed through a continuous monitor which measures dissolved oxygen, specific conductance, and pH. As the well is pumped, the dissolved oxygen declines as oxygenated water is removed and formation water enters the well. Samples are collected when the key parameters stabilize. Other parameters that will be monitored include: total iron , nitrate/nitrite, nitrogen, total organic carbon, manganese, sulfate, calcium, magnesium, chloride, and methane. To determine attenuation of TCE redox potential and total dissolved oxygen will be measured. All the wells will be monitored quarterly for the following contaminants:

TCE
TNT (2,4,6-trinitrotoluene)
RDX (1,3,5-hexahydro-1,3,5-trinitrontriazine)
HMX (octahydroo-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)
Tetryl
2ADNT (2-amino-4,6-dinitrotoluene)
4ADNT (4-amino-2,6-dinitrotoluene)
24DNT (2,4-dinitrotoluene)
26DNT (2,6-dinitrotoluene)
24DANT(2,4-diamino-6-dinitrotoluene)
26DANT(2,6-diamino-4-nitrotoluene)
TNB (1,3,5-trinitrobenzene)
44AZOXY (2,2'6,6-tetranitro-4,4'azoxytoluene)
DNA (3,5-dinitroaniline)
TNX (1,3,5-trinitroso-1,3,5-hexahydrotriazine)

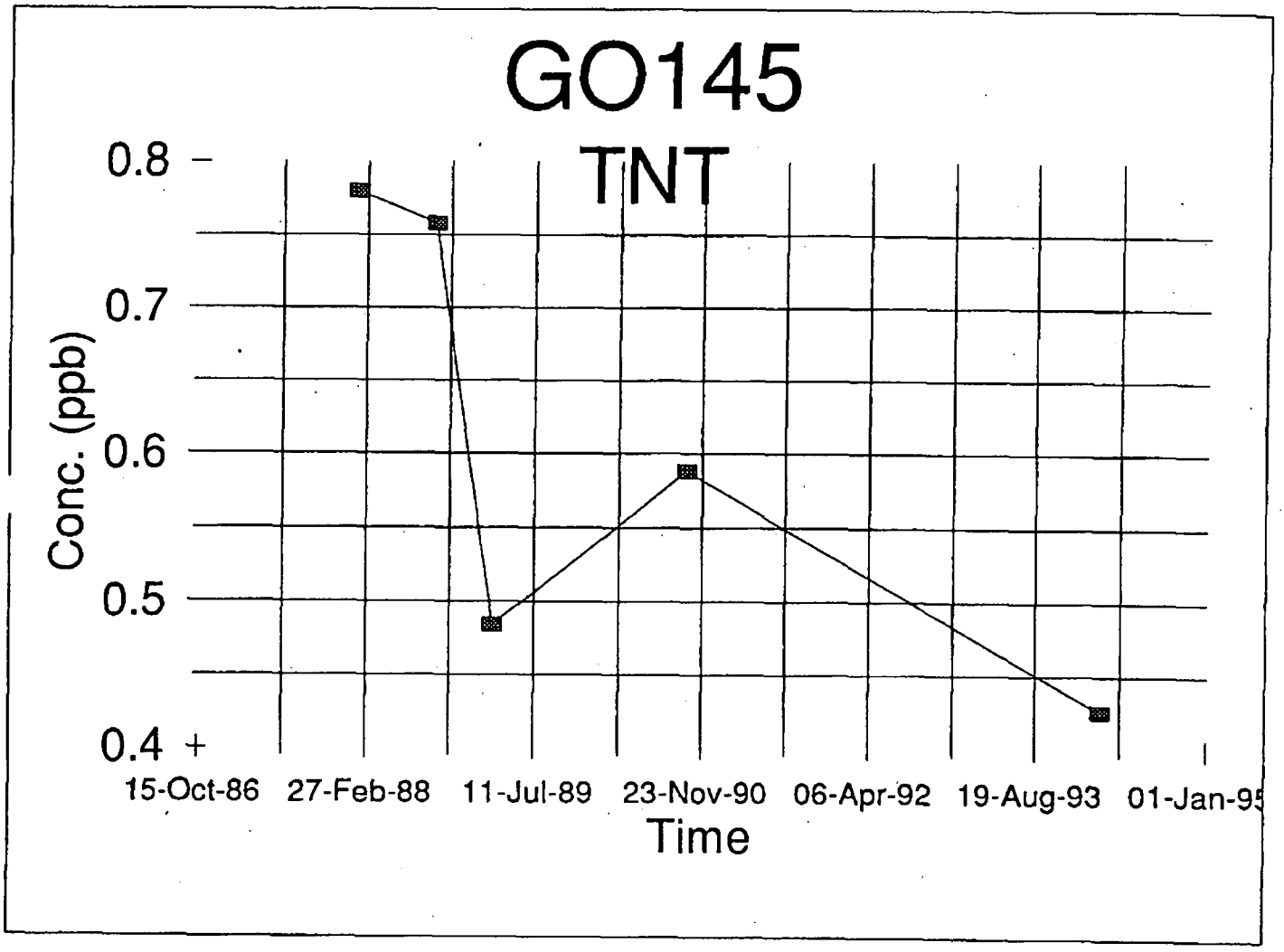

FIGURE 1. Time versus concentration plot for a well at the Louisiana Ammunition Plant

MNX (1-nitroso-3,5-dinitro-1,3,5-hexahydrotriazine)
NB (nitrobenzene)
DNB (1,3-dinitrobenzene)

TABLE 1. SUMMARY OF GROUNDWATER MONITORING TASKS

FY	Groundwater Monitoring Tasks
FY98	Task 1 - Evaluate site historical data Task2- Initiate well monitoring protocol Task 3 -Modify sampling protocol if needed Task 4 -Complete well monitoring protocol
FY99	Task 5-Complete data analysis and interpretation Task 6-Produce report and provide recommendations

The tasks associated with part 1 will be performed by WES. The sampling activities and data will be coordinated with NERL and MK..

PART 2. PHYTOREMEDIATION

If the data indicates that the contaminants in the groundwater or surface water have not been completely attenuated before they reach the boundary of ABG phytoremediation will be initiated.

Monitoring studies at ABG indicate that TCE, TNT and RDX are degraded as they migrate down the valley of Little Sulfur Creek. Plant/plant enzyme medited degradation of munitions contaminated soils, sediments and surface waters has been shown to reduce the concentration of these contaminants to environmentally acceptable levels. Previous studies have been carreid out in laboratory, bench, proof of concept and field demonstration. Enzyme linked immunosorbant assays (ELISA) have shown that nitroreductase/laccase systems that can degrade TNT, RDX, and HMX are stable in sediments and soils. If contaminants are present in groundwater or surface water near the installation boundary phytoremediation should be considered.

TABLE 2. Summary of Phytoremediation Tasks.

FY	Phytoremediation Tasks
FY98	Task 1. -Concur with WES to develop a monitoring plan for the groundwater plume that will provide the data for modeling and evaluation of phytoprocesses and that will provide samples for enzyme activity assays.

Task 2. -Determine pseudo-first-order degradation rate constants for munitions for aquifer materials, sediments, surface waters, and other nitroreductase/laccase sources.

Task 3. -Use the ELISA to determine the enzyme activity associated with the samples (i.e. system nitroreductase activities).

Task 4. -Use ELISA testing to identify local terrestrial plants for nitroreductase/ laccase activity to determine sources of nitroreductase/laccase activities.

Task 5. -Use the measured first-order rate constants for TNT, RDX AND HMX with measured nitroreductase/laccase activities to deveoop second-order or higher order rate expressions. Relate measured enzyme activities to system parpmeters such as organic carbon.

Task 6. -Develop kinetic tranformation models (including sorption) for plant/plant enzyme processes for TNT,RDX and HMX.

Task 7. -Develop protocol for integrating phytoprocesses into multimedia exposure models.

FY99 Task 8.- Develop protocol for integrating phytoprocesses into multimedia exposure models.

Task 9. -Final report.

The tasks associated with Part 2 will be performed by NERL if deemed necessary. Results will be coordinated and integrated with modeling conducted by WES.

PART 3. GROUNDWATER MODELING

Numerical modeling is a cost effective means for the quantitative evaluation of mutiple, hydrogeological processes in support of natural attenuation. The processes are represented as a set of mathematical expressions, consistent with the site-specific conceptualizations. The complex and incompletely understood processes involved in the natural attenuation of explosives require the computational power and flexibility of a numerical model.

The main objective of the modeling is to compliment the field monitoring and data collection by providing a graphic representation of natural attenuation of exploxives. The modeling effort focuses on characterization of the site hydro geology and reduction of explosives by processes such as immobilization/degradation, and first order decay.

The primary contributions of numerical modeling to the demonstration project include visualization of contaminant transport, and feedback from the numerical models to identify requisite field measures. Hydrogeological realizations of the ABG based on current geological data will be provided in the form of numerical model input and 3-dimensional visualizations. The simulations will focus on flow and simple transport processes. Visualization of observational data and model predictions will be prepared. The existing and new ABG data will be used to develop a 3-dimensional conceptual and numerical model for the simulation oof selected explosives of the site. The Department of Defense Groundwater Modeling (GMS) will be used to model the site. Model results will be used to guide future monitoring strategies and to evaluate the potential transport and fate (attenuation) of explosives.

Table 3. Summary of Numerical Modeling Tasks.

FY	Numerical Modeling Task
FY98	Task 1. Analyze available geologic and chemical data.
	Task 2. Develop initial 3-dimensional conceptual and numerical model of ABG.
FY98	Task 3. Initate numerical simulation of flow and transport.
	Task 4. Provide guidance as to which field data are required for numerical modeling.
	Task 5. Integrate new data into coceptualization and its visualization.
FY99	Task 6. Refine and complete numerical simulations.
	Task 7. Interpret the numerical results, complete report and provide continuing guidance.

The tasks associated with Part 3 will be performed by WES. Results will be coordinated and integrated with modeling of phytoremediation conducted in Part 2 by NERL.

PART 4: WASTE DISPOSAL

The greatest source of waste from project activities will be investigation derived waste (IDW). The most common IDW will be purge water associated with well sampling, decontamination fluids, and disposable protective equipment. The disposal of IDW will comply with state and EPA regional requirements, which typically entail shipment off-site, or release to the site. Soil

and water samples taken for laboratory analysis will be disposed of according to standard laboratory procedures.

INNOVATIVE TECHNIQUES

Undet separate funding (SERDP), the USAE Waterways Experiment Station is investigating the use of stable isotopes and biomarkers as tools for monitoring natural attenuation of explosives in groundwater and soil. Data accumulated in the ABG effort will be integrated into this study at WES.

QUALITY CONTROL.

Standard Operating Procedures as described in the Natural Attenuation of Exploxives in Groundwater Technology Demonstration Plan (1996) will be followed. WES participates in several national quality control/ quality assurance programs and has special expertise in analysis of explosives and degradation/ tranformation products of explosives in groundwater and soil.

DATA ANALYSIS

The data will be intered in a QuattroPro file, reviewed and validated by cross-reference to spike, duplicates and confirmation samples, and distributed to various team members for use. Data will be subjected to standard statistical analyses as appropriate. Typically, duplicate and spike analyses are performed every tenth soil and groundwater sample.

SAFTY

Personnel working on the site will have the required HazMat training. All requirements of the site safety plan will be met. In the laboratory all tests will comply with applicable safety plan will be met. In the laboratory all tests will comply with applicable safety regulations and requirements pertaining to the handling of explosives and hazardous materials. These procedures are described in detail in the following document which is available upon request:
"Project Health and Safety Plan for Environmental Research Conducted with High Explosives: TNT, RDX and HMX, Environmental Laboratory, 15, April 1993.

PRODUCTS

A technical report will be prepared to present and synthesize the data and to summarize conclusions. All raw data, including quality control/quality assurance, will be available upon request.

SCHEDULE

	----FY98----	-- -FY99------
	O N D J F M A M J J A S	O D J F M A M J J A S
Part 1 Groundwater Monitoring	----------	----------
Part 2 Phytoremediation	---------	----------
Part 3 Groundwater Modeling	----------	----------
Draft Report		-------
Final Report		----

ESTIMATED FUNDS REQUIRED

	FY89	FY99	Total
Part 1: Groundwater Monitoring	210	150	360
Part 2: Phytoremediation	140	56	196
Part 3. Groundwater Modeling	65	50	115
Total	415	256	671

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

James M. Hyman

SIGNATURE

Environmental Protection Department Manager — 3/6/02

TITLE — DATE