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A Member of The IT Group

the IT group SM

November 09, 1999

Ms. Kate Landman, Code 18232
Naval Facilities Engineering Command
1510 Gilbert Street
Norfolk, VA 23511-2699

RE: Draft Work Plan for Camp Geiger Air Sparge Trench
Contract N62470-93-D-3032 Delivery Order 0083
MCB, Camp Lejeune, North Carolina

Dear Ms. Landman:

Enclosed herewith please find a copy of our draft Work Plan for a dye trace study to investigate groundwater flow regimes under the influence of air sparging at the subject site. Please provide review comments by November 23rd to allow commencement of field activities during December 1999.

Sincerely,
OHM Remediation Services Corp.

Thomas A McCoy for

James A. Dunn, Jr., PE
Senior Project Manager

Enclosure

PC: Rick Raines -IRA/EMD
Dave Lown - NCDENR
Gena Townsend - EPA Reg. IV
Katy Chavara – Baker Environ.
Diane Rossi – NCDENR
Project 917536

MCB CAMP LEJEUNE
OPERABLE UNIT 10, SITE 35, CAMP GEIGER
AIR SPARGE TRENCH
GROUNDWATER FLOW REGIME INVESTIGATION
UTILIZING A DYE TRACE STUDY
NOVEMBER 8, 1999

1.0 Introduction

A plume of dissolved phase chlorinated hydrocarbons 2,500 feet long by 1,000 feet wide has impacted the lower portion of the shallow aquifer at Camp Lejeune Marine Corps Base (MCB), Camp Geiger, Site 35. An air sparge trench 100 feet long by 40 feet deep was installed within the boundaries of the plume to perform a pilot test. The system has been in operation since March 1998. As indicated in the progress report dated October 1999, air sparging appears to be very effective in removing most of the dissolved phase chlorinated hydrocarbons.

It has been proposed that the trench be extended laterally to remediate the entire plume. However, concern has been raised that the operation of the trench may cause an "air dam" to form. This might tend to prevent some of the upgradient groundwater containing chlorinated hydrocarbons from migrating through the trench. Instead, this groundwater might be forced around the ends of trench, preventing remediation from occurring.

Air sparging causes the water table in the vicinity of the trench to fluctuate rapidly and unpredictably. In some cases, artesian flow has been observed from piezometers located in the trench. For this reason, potentiometric surface isoelevation maps cannot be used to infer groundwater and contaminant migration pathways.

2.0 Purpose

An alternative method of evaluating this concern is a dye trace study. The objectives of the study are:

- Determine if the pilot air sparge trench is capturing the chlorinated hydrocarbon plume.
- Determine the direction(s) of groundwater flow in the vicinity of the trench.
- Establish point-to-point hydrologic connections.
- Obtain order of magnitude estimates of the time of travel (and thus flow velocity).

The study is performed by injecting a non-toxic tracer into lower portion of the shallow aquifer and then monitoring for its appearance in strategically located observation wells. Detection of the tracer is accomplished by collecting water samples from the observation wells and analyzing them at a qualified laboratory.

3.0 Dye Trace Methodology

The investigation involves four activities:

! Background Survey and Tracer Selection
! Injection
! Monitoring
! Report

4.0 Background Survey and Tracer Selection

The most common fluorescent tracers used for groundwater dye studies include

! Fluorescein (CI acid yellow 73)
! Rhodamine WT (CI acid red 388)
! Eosine (CI acid yellow 87)
! Sulphorhodamine B

Each of these dyes has a characteristic energy absorbency peak at a specific wavelength and a characteristic energy re-emission peak at a longer wavelength. This characteristic makes it possible to detect these dyes in concentrations as low as 10 parts per trillion.

The purpose of the background survey is to determine the ambient concentration (if any) of the four prospective dyes. One water sample will be collected from each of the four permanent observation wells that are downgradient from the proposed injection point under natural conditions (OP-1S, OP-1D, MP-3S, and MP-3D). The samples will be analyzed for these four tracers. Depending upon the results of the background survey and the site lithology (some of the dyes are susceptible to absorption by clays), one or two of these four dyes will be selected for use in the study.

The potential toxicity of these tracers has been extensively studied. In 1984, Smart reviewed the available information concerning the toxicity of 12 commonly used dyes. He found that the four tracers listed above presented minimal toxicity in mammals and "...there is no evidence of either short or long term toxicity to dye users and those drinking water containing tracer dyes." (It should be noted that the shallow aquifer is not currently used for drinking water, and the dissolved chlorinated hydrocarbons would preclude its use as a potable water source long after the dye has completely dissipated).

5.0 Observation Well and Injection Well Installation

IT will install one injection well (IP-1) and three observation wells (OB-1, OB-2, OB-3) in the vicinity of the air sparge trench using direct push equipment (see Figure 1). The direct push rig should be capable of both auger and hydraulic-powered probing. During hydraulically powered probing, the rig utilizes the static force and percussion to advance small diameter sampling tools into the subsurface for sample collection.

5.1 Observation Well Installation

Temporary observation wells OB-1, OB-2, and OB-3 will be installed by using large diameter (approximately 2 1/8-inch outside diameter [OD], 1 1/2 inch inside diameter [ID]) probe rods and a disposable aluminum or carbon steel drive point. After the rods are driven to the base of the aquifer, a one inch ID PVC temporary well consisting of five feet of well screen and sufficient riser to reach the ground surface will be installed through the inside of the rods. The disposable steel point will be detached from the rods allowing the PVC well string to remain in place as the rods are retracted. In the event that geological conditions prevent the direct push rig from reaching the required depth, the unit will be converted to an auger rig and conventional observation wells will be installed.

Observation well OB-1 will be installed upgradient of the injection point to determine if the sparging trench has caused a reversal of the localized groundwater gradient around the trench. Observation wells OB-2 and OB-3 will be installed on the north west end of the trench to determine if sparging is causing the chlorinated hydrocarbon plume to migrate around the end of the trench.

5.2 Injection Point Installation and Tracer Injection

The target zone for the dye injection is the lowest portion of the shallow aquifer, which has historically contained the highest level of chlorinated solvents. Injection point IP-1 will be installed as follows. A 1 1/4-inch OD probe rod with an expendable point and post-run tubing (PRT) holder will be advanced to the base of the aquifer (approximately 40 feet). If necessary, the direct push rig will first collect soil samples to determine the exact depth to the bottom of the aquifer.

A 3/8-inch OD vinyl tubing with a PRT adapter will be inserted down the rod and threaded into the PRT holder. The expendable point will be retracted from the end of the rod and approximately five gallons of dye solution will be pumped into the lowest portion of the aquifer at a rate of approximately 250 milliliters per minute. As the dye is pumped into the aquifer, the probe rods will be raised at a rate of 0.5 feet per gallon of dye. When the dye injection is finished, the tubing will be flushed with 2 gallons of potable water and the probe rods and PRT sampler will be extracted. As the rods are extracted, the probe hole will be filled with bentonite slurry.

6.0 Monitoring and Analysis

6.1 Monitoring

After dye has been injected into the aquifer system, one water sample will be collected from each of the observation wells. These include existing wells OP-1S, OP-1D, MP-3S, and MP-3D, and new observation wells OB-1 (shallow and deep), OB-2 (shallow and deep), and OB-3 (shallow and deep). Prior to sampling, each well will be purged a minimum of three well volumes to remove stagnant water. Following purging, one 40-ml water sample will be collected from each observation well.

The samples will be collected at the indicated times following the completion of injection:

12 hours	3 days	6 days	9 days	20 days	50 days
24 hours	4 days	7 days	10 days	30 days	
2 days	5 days	8 days	15 days	40 days	

Once the dye is unambiguously detected in an observation well and its concentration is no longer increasing, that well will be deleted from the list for further sampling.

Each groundwater sample will be labeled with the unique sample location name, sampler name, and time and date of collection. Each sample will be sealed in its own Ziplock bag and safely packaged for shipment. To document the sampling process, Chain of Custody and Request for Analysis forms will be completed as the samples are collected. The background water samples will be sent to a qualified laboratory by courier for analysis on a spectrofluorophotometer.

6.1 Water Sample Analysis

A Shimadzu SpectrofluorophotometerModel RF 5301U will be used for analyzing both the excitation and emission maxima of fluorescent dyes. This instrument can detect the prospective dyes in concentrations as low as 10 parts per trillion. It provides a scaled graph of the fluorescence intensity versus excitation and/or emission wavelengths. By analyzing a sample in the synchronous scanning mode where a broad band of the spectrum is analyzed, the sensitivity and selectivity of the analysis is greater than single emission or excitation scan (Duley, 1986). Analysis of the water samples will take approximately two days from receipt of the samples.

The background survey samples will be analyzed for the ambient concentrations of Fluorescein (CI acid yellow 73), Rhodamine WT (CI acid red 388), Eosine (CI acid yellow 87), and SulphorhodamineB. The lab will also evaluate if other compounds are present in the groundwater that might cause interference with a specific dye. Once the specific tracers are selected for the study, the laboratory will only analyze for those tracers in the groundwater samples that are collected following injection.

7.0 Dye Trace Report

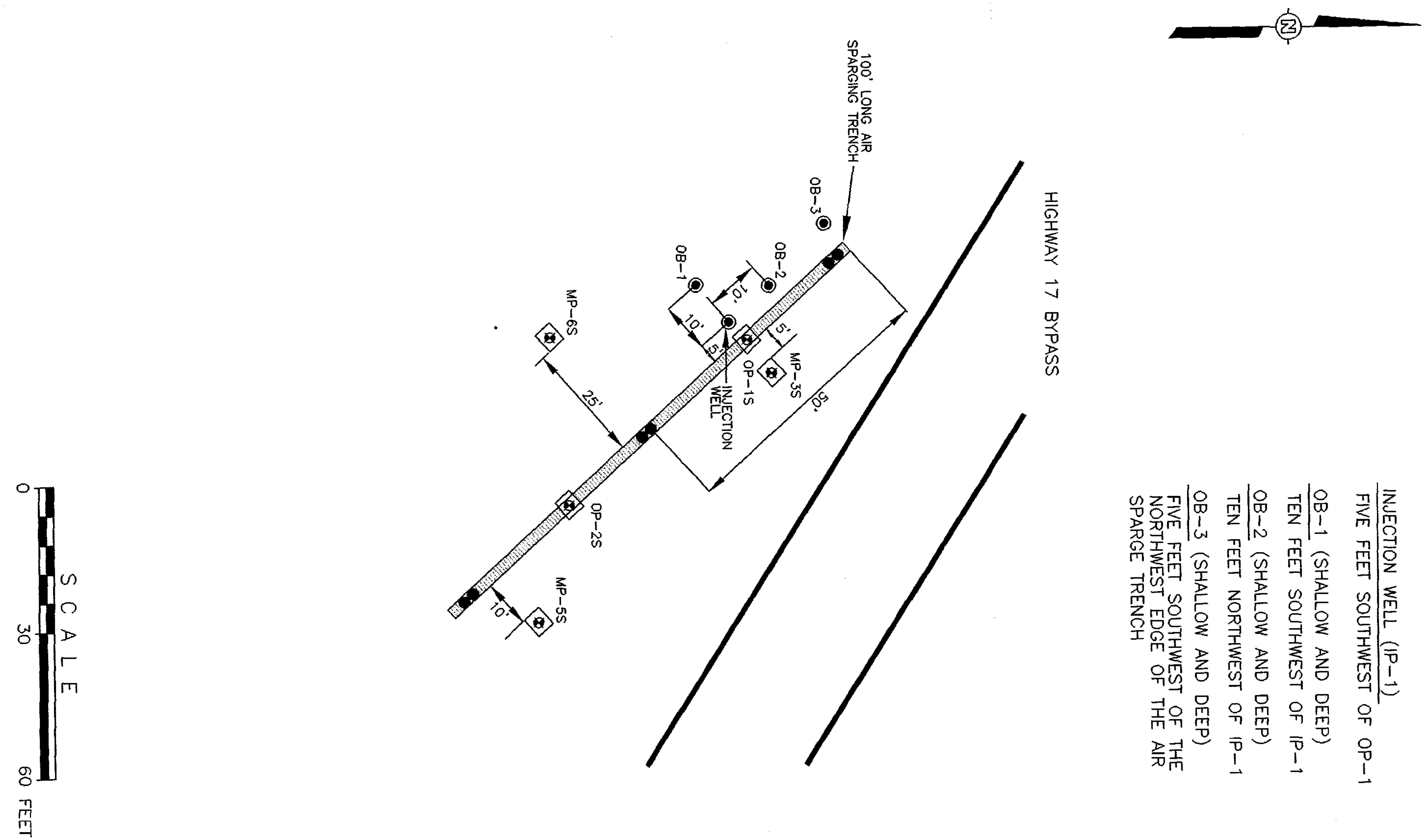
IT will prepare a dye trace report that summarizes the field activities and the results of the dye trace. IT will prepare a base map showing the injection point, observation wells and air sparge trench. A second map will be prepared showing the locations where dye was detected above background concentrations and the first dates when those detections occurred. Tables will be prepared comparing the background results to those results obtained after the dye was injected. Copies of the spectrofluorophotometer analysis will be included in an appendix. Based upon the results of the dye trace, IT will make recommendations for future remediation alternatives at the site.

8.0 Schedule

Assuming notice to proceed is received by November 24th, IT would make every effort to conduct the dye injection before the end of December 1999. If that takes place, the sampling period would be completed by the end of February and a draft report would be issued to LANTDIV by the end of March 2000.

PLOT DATE: 11/4/99
FORMAT REVISION 3/25/99

IMAGE	X-REF	OFFICE	DRAWING NUMBER
---	---	Atlanta, GA.	17536-D_T-FIG1



SHEET I.D. 1

NAVFAC DRAWING NO. ?

CONSTR. CONTRACT NO. N62470-93-D-3032

DELIVERY ORDER NO. 0083

SCALE: AS SHOWN

SIZE: A

DEPARTMENT OF THE NAVY — NAVAL FACILITIES ENGINEERING COMMAND

ATLANTIC DIVISION

NAVAL STATION — NORFOLK, VIRGINIA

NAVAL FLEET & INDUSTRIAL SUPPLY CENTER — YORKTOWN, VIRGINIA

CAMP LELEUNE MCB
CAMP GEIGER SITE 35 DYE TRACE TEST

INJECTION POINT AND TEMPORARY OBSERVATION POINT LOCATIONS

OHM Remediation Services Corp.
PROJECT NO. 775910

DESIGNED BY	T. McCRORY	CHECKED BY	
DRAWN BY	J. LANGE	APPROVED BY	

REV	DATE	BY	CHK'D	APPR'VD	DESCRIPTION/ISSUE

REVISIONS