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October 15, 2002

Commander
Atlantic Division
Naval Facilities Engineering Command
1510 Gilbert Street (Bldg. N-26)
Norfolk, VA 23511-2699

Attn: Mr. Kirk Stevens, P.E.
Navy Technical Representative
Code EV23-KAS

Re: Contract N62470-95-D-6007
Navy CLEAN, District III
Contract Task Order (CTO) 0219
Site 35 Hot Spot Characterization Sample Strategy Letter – Final
Marine Corps Base, Camp Lejeune

Dear Mr. Stevens:

This document provides the final sample strategy plan (SSP) for Site 35 "hot spot" delineation and characterization. Comment responses on the draft SSP were provided by USEPA Region IV and NC DENR. No significant comments were provided and, therefore, minimal changes were made in this final.

As discussed during the August 2002 Partnering Team meeting, "hot spot" delineation and characterization is warranted prior to the proposed pilot-scale treatability studies so that the studies can effectively focus on "hot spots". Site 35 is relatively large, and as such the spacing between existing data points (monitoring wells) is relatively large. Also, two points have been used to define the vertical dimension of the plume above the semi-confining layer (i.e., clusters containing one shallow and one intermediate monitoring well). This resolution was adequate for overall groundwater contamination delineation during the remedial investigation; however, it is evident from previous "hot spot" delineation at Camp Lejeune that "hot spots" can be smaller than originally conceptualized and a finer resolution is desirable for more efficient treatability studies and remediation.

Rationale and Scope

The investigations conducted to date have revealed general "hot spot" areas (refer to the Site 35 Summary Report (July 2001) for a summary of those investigations). To better understand the configuration of these known "hot spots", an arbitrary concentration was considered to define a "hot spot". A "hot spot" is defined herein as an area of the groundwater contaminant plume(s) where a given compound has been observed at a concentration of at least 100 times the North Carolina 2L Standard (e.g., the 2L Standard for TCE is 2.8 µg/L, so a "hot spot" would be 280 µg/L or greater). Using that definition, there are three compounds that would define "hot spot" areas, including benzene, trichloroethene (TCE), and vinyl chloride (VC).

Figure 1 shows the benzene, TCE, and VC "hot spots" in both the surficial and upper Castle Hayne aquifers. The size and shape of the "hot spots" is based on the current spatial distribution of the site monitoring wells. The benzene "hot spot" in the surficial aquifer is centered on well 35-MW67A, just northwest of the IAS trench. It should be noted that a thin layer of light, non-aqueous phase liquid (LNAPL) has been observed in this well. This investigation will include further definition of the extent of LNAPL as well as the dissolved-phase "hot spot". It should be noted that an Implementation Plan (IP) was prepared by Baker in October 1998 for an LNAPL investigation in the vicinity of well 35-MW67A. The IP was never implemented due to funding limitations. A TCE "hot spot" is also adjacent to the benzene "hot spot", and is in the vicinity of well 35-MW14A. It should be noted that the TCE concentration at this well (240 µg/L) is currently less than the above "hot spot" definition; however, TCE concentrations have historically exceeded 280 µg/L and for that reason has been included as a "hot spot". VC is also present in the surficial aquifer at 100 times the 2L Standard (or 1.5 µg/L). One area is coincident with TCE at well 35-MW14A. The other area is under the Highway 17 Bypass and in the wetlands. This later location will not be included in the "hot spot" investigation because of the scattered locations and low concentrations (i.e., below the Federal Maximum Concentration Limit [MCL] of 5 µg/L). A TCE "hot spot" is present in the upper portion of the Castle Hayne aquifer in the vicinity of the newly installed wells on the Highway 17 Bypass median and in the wetlands. A relatively broad VC "hot spot" is also present in the upper portion of the Castle Hayne aquifer, with the highest levels generally coincident with the TCE "hot spot". Like the surficial aquifer, much of the VC "hot spot" is at low levels (below the Federal MCL) and will not be included in the "hot spot" investigation. Only that area coincident with the TCE "hot spot" will be included in this investigation.

To summarize, this investigation will include two "hot spot" areas:

1. The Benzene/TCE "hot spots" in the surficial aquifer just northwest of the IAS trench, and;
2. The TCE/VC "hot spot" in the upper portion of the Castle Hayne aquifer under the Highway 17 Bypass.

The wetland area will not be included in this investigation since active remediation in this area is not likely given the sensitive nature of the environment and that natural attenuation will likely be employed to mitigate migration of contaminants in the wetland area to Brinson Creek.

The purposes of the additional investigation can be summarized as follows:

- To further delineate and characterize "hot spot" locations;
- To identify and delineate any continuing sources associated with these "hot spots" (i.e., NAPL), and;
- To assist in the evaluation of remedial alternatives (i.e., active remediation of "hot spots")

Also, additional permanent monitoring wells may be installed if "hot spot" locations are found to be significantly different from the current conceptual model.

The proposed scope of the additional characterization is based on the following assumptions:

- Contamination is not present below the first semi-confining layer, which is within the Castle Hayne aquifer (approximately 45 feet below ground surface [bgs]). Historical data supports this assumption;
- The surficial aquifer "hot spots" extend to a depth of approximately 25 feet bgs (the approximate depth of the top of screen of well 35-MW14D);
- Groundwater is present at a depth beginning at approximately 10 feet bgs, and;
- Baker will be able to obtain access to Building G480, which is an Armory.

Sampling Locations and Depths

It is proposed that the field investigation will consist of the installation of approximately 30 Geoprobe® groundwater sample borings (Figure 2). The overall approach and methodology of this field program will be similar to those recently employed at Sites 78, 86, and 93. Six borings will be located in the median of Highway 17 Bypass to delineate the lateral extent of that "hot spot". Five borings will be located in southern shoulder of the southbound lanes of the Highway 17 Bypass to characterize that "hot spot" between the highway median and the Base. Four groundwater grab samples will be collected at each of the 12 locations as follows:

- 10 to 14 feet bgs
- 20 to 24 feet bgs
- 30 to 34 feet bgs
- 40 to 44 feet bgs

Nineteen borings will be located in the surficial aquifer on a grid in the vicinity of Building G480 (Figure 2). Three borings will be located downgradient of the "hot spots", which places them on the southern shoulder of the southbound lanes of the Highway 17 Bypass. Three groundwater grab samples will be collected at each of the 19 locations as follows:

- 10 to 12 feet bgs
- 15 to 17 feet bgs
- 20 to 22 feet bgs

The number and depths of sampling intervals will be evaluated as the field program progresses, and will be adjusted as necessary to provide vertical delineation. Also, boring spacings may be adjusted and locations may be added or subtracted to provide horizontal delineation.

One or two permanent wells may be installed in the "hot spot" areas if the above sampling effort shows a significantly different configuration. These wells will be installed using Geoprobe Pre-pack screens (10-foot long) and direct push methods. These wells will be developed prior to sampling.

Groundwater Analysis and Other Information

Chemical analysis performed on groundwater samples collected from Site 35 will include the following VOCs:

- 1,1,2,2-Tetrachloroethane
- Tetrachloroethene
- Trichloroethene
- cis-1,2-Dichloroethene
- trans-1,2-Dichloroethene
- Vinyl chloride
- Benzene
- Ethylbenzene
- Toluene
- M&P Xylenes
- O Xylene

The above analyses will be performed using an on-site mobile laboratory (via gas chromatography methods). The goal for detection limits will be 1 µg/L. The detection limit may vary due to matrix interferences or elevated contaminant concentrations.

The presence of LNAPL will be evaluated in the vicinity of well 35-MW67A. This investigation is different than the one proposed in 1998. The 1998 IP considered only free-phase NAPL through the use of temporary wells. Now both free-phase and residual-phase NAPL will be evaluated. Soil samples will be collected from nine borings surrounding the well with detected LNAPL (the dots with diamonds on Figure 2). Additional borings may be required to delineate the extent of LNAPL. Soil samples will be collected from ground surface to approximately 4 feet below the water table. Each soil sample interval will be split three ways:

1. For lithologic characterization and field screening using photo and flame ionization detectors (PID and FID);
2. For dye shake tests, and;
3. For laboratory analysis.

PID and FID profiles will be generated at each boring location. Up to three select intervals exhibiting elevated PID and FID readings will be screened via a dye shake test to confirm the presence or absence of free-phase NAPL and samples sent to a fixed-base laboratory. An LNAPL sample from monitoring well 35-MW67A will be collected for high temperature simulated distillation (ASTM-D2887) to determine components and relative percentages. That information will be used to direct the fixed-base lab regarding parameters to analyze. The split sample from that interval will be analyzed by the fixed-base laboratory and is expected to be in VOC/SVOC range. Partitioning calculations may be performed using that data to determine if residual-phase NAPL is present.

Mr. Kirk Stevens, P.E.
October 15, 2002
Page 5

The dye shake test involves mixing equal parts distilled water and soil in a clear glass jar with a small amount of Sudan IV (a hydrophobic dye). The contents are then vigorously shaken for about one minute and observed. The dye will stain any free phase organic liquid that is present red.

It is envisioned that additional data will be required to support the technology evaluation for the proposed pilot-scale treatability study. A list of potential additional data include:

- Groundwater and aquifer chemical composition, including primary contaminants, secondary chemical composition, and total organic carbon (TOC) content, and;
- Water quality and natural attenuation field data, including pH, specific conductance, temperature, oxidation-reduction potential, ferrous iron, alkalinity, and dissolved oxygen.

VOCs are the primary contaminant and will be analyzed by mobile laboratory and fixed-base laboratory. Additionally, historical VOC trends are also available from the LTM data. Secondary groundwater chemical composition will be assessed through the collection of one target analyte list (TAL) metals and anion sample in each "hot spot". These samples will be collected from permanent monitoring wells during the first LTM event after demobilization (October 2002). Samples for TAL metals will be analyzed in a fixed-base laboratory.

Soil samples for TOC will be collected from one location at each "hot spot". These analyses will be performed by a fixed-base laboratory.

The water quality and natural attenuation parameters will be measured in the field from the Geoprobe[®] groundwater samples and the first LTM event after completion of any new permanent monitoring wells.

Other useful data may include site lithology and hydraulic conductivity. The site lithology has been sufficiently characterized in the RI and in subsequent investigations at the site. Other than lithology characterization for the LNAPL delineation, additional site lithology data will not be collected during this investigation. Sufficient hydraulic conductivity data exists from the RI and subsequent investigations and will not be collected during this investigation.

A quality assurance/quality control (QA/QC) program will also be implemented and will include the following elements:

- Daily equipment rinsates (analysis for VOCs in the on-site mobile laboratory).
- 10% of the groundwater samples collected will be split for mobile laboratory confirmation by fixed-base laboratory. These splits will be selected from samples over a broad range of contaminant concentrations.

All boring locations will be cleared for utilities prior to installation, and will be surveyed after installation. One Baker representative will oversee all field activities including utility clearance, drilling, groundwater sampling, and surveying. One additional Baker representative will be one site to support the LNAPL delineation.

All drilling and sampling activities will conform to USEPA Region IV Standard Operating Procedures (SOPs), which are commonly in use at MCB, Camp Lejeune. Health and safety procedures will be in accordance with the original RI project plans. In addition, based on the new procedures provided by the Base Environmental Quality Branch (EQB), investigation-derived waste (IDW) will be managed by Shaw Environmental.

Mr. Kirk Stevens, P.E.

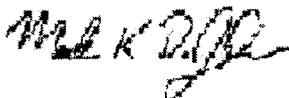
October 15, 2002

Page 6

Please do not hesitate to call me if you have any questions or desire further clarification of the investigation described. Baker anticipates starting the field investigation on October 7, 2002 followed by the LTM sampling event in late October. Accordingly, we would like to have comments from the Partnering Team by September 27, 2002. A final work plan will be submitted before start of the field program.

Sincerely,

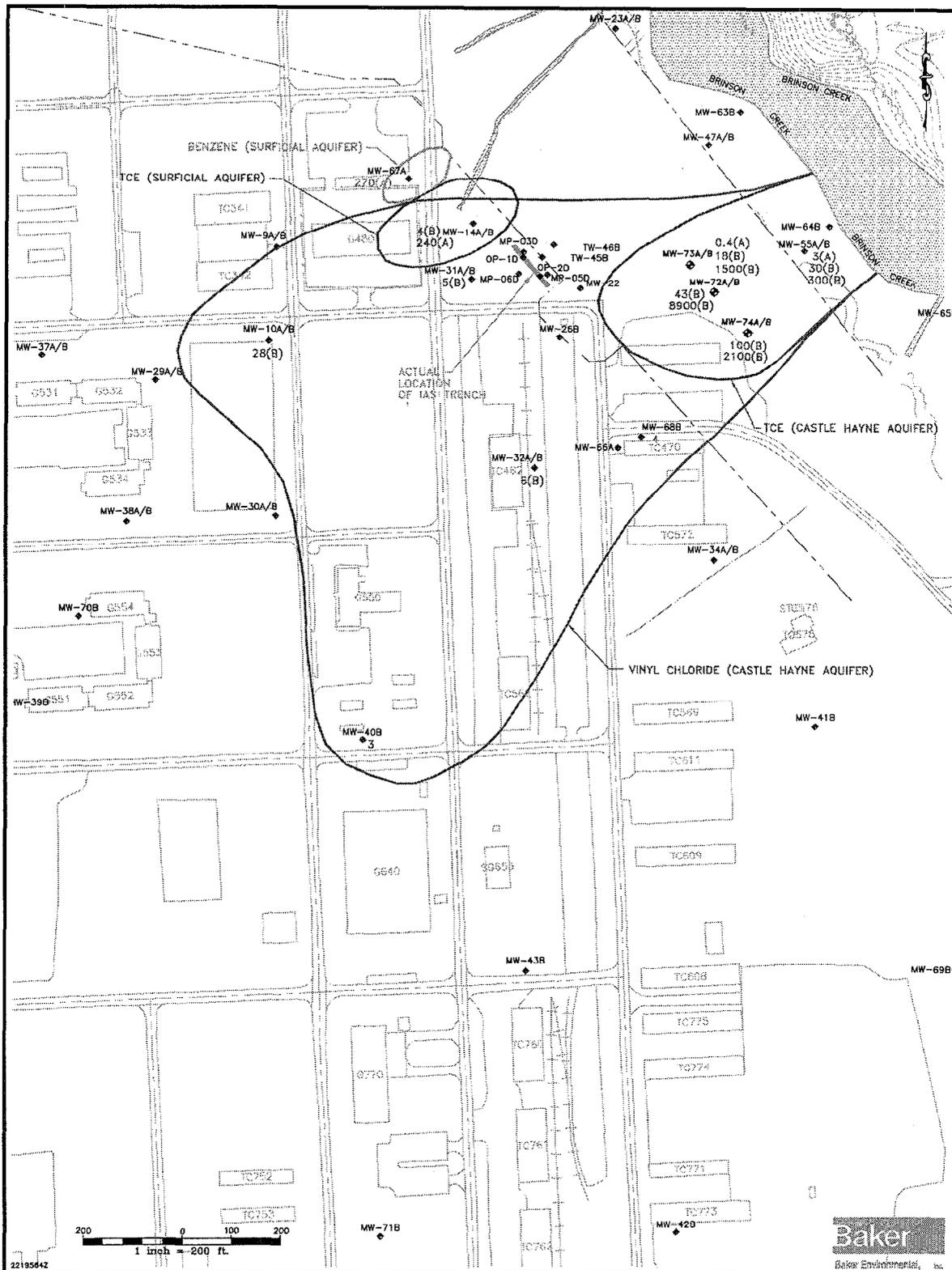
BAKER ENVIRONMENTAL, INC.



Mark K. DeJohn, P.G.
Project Geologist

MKD/lp
Attachment

- cc: Mr. Scott Bailey, CH2M Hill (w/attachment)
Mr. Christopher Bozzini, CH2M Hill (w/attachment)
Mr. Thomas Burton, EQD (w/attachment)
Mr. Rick Raines, EQD (w/attachment)
Mr. Dave Lown, NC DENR- Superfund Section (w/attachment)
Ms. Gena Townsend, USEPA (w/attachment)
Ms. Diane Rossi, NC DENR – WRO (letter only)
Dr. Charlie Stehman, NC DENR – WRO (w/attachment)
Mr. Ron Kenyon, Shaw Environmental (w/attachment)

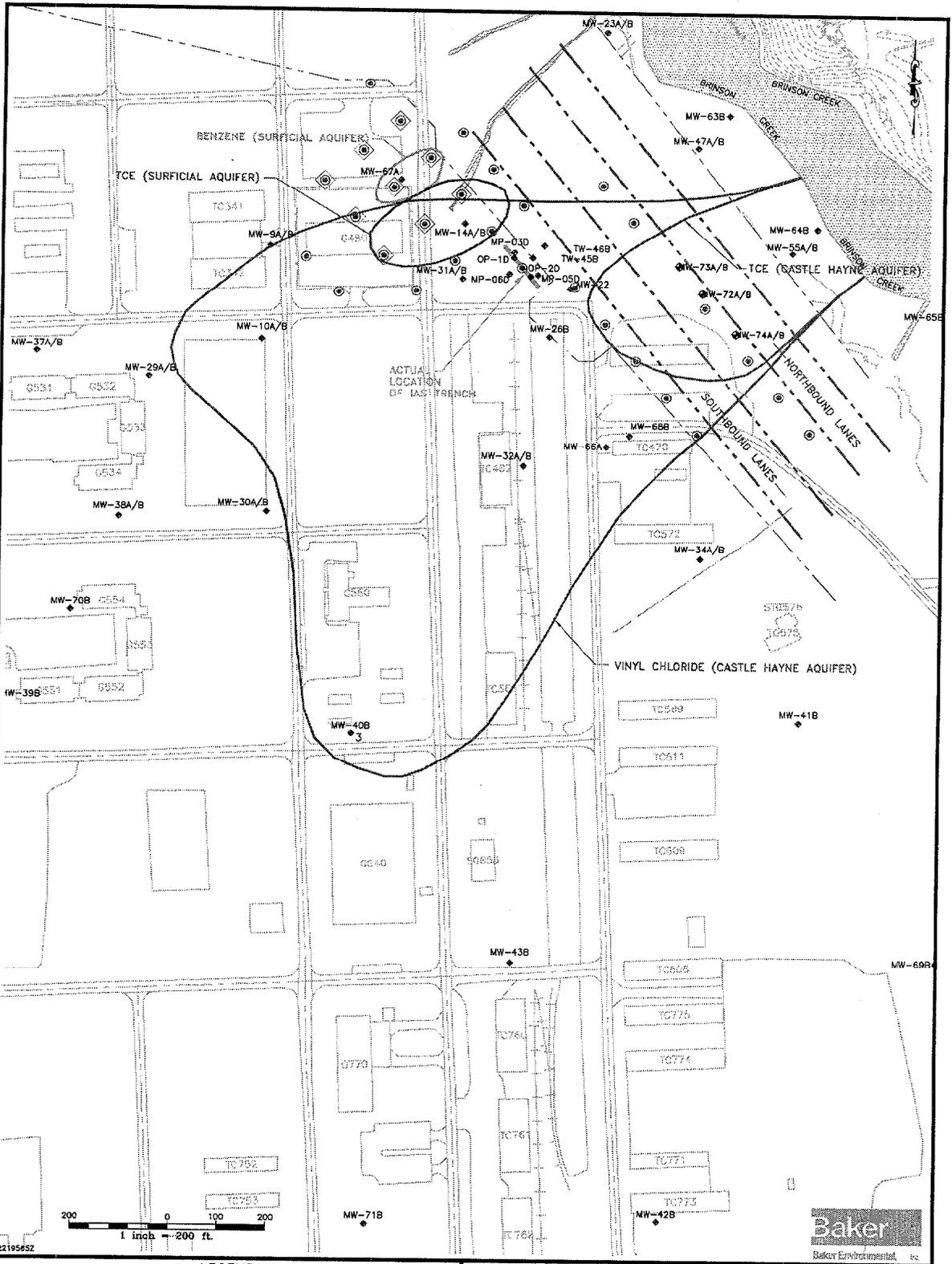


LEGEND

- US 17 JACKSONVILLE BYPASS RIGHT-OF-WAY LIMITS
- MW-14B MONITORING WELL WITH TOTAL CVOC CONCENTRATION
- 270 BENZENE CONCENTRATION (PPB)
- 2800 TCE CONCENTRATION (PPB)
- 3 VINYL CHLORIDE CONCENTRATION (PPB)
- 240(A) EXAMPLE OF TCE CONCENTRATION IN SHALLOW WELL (PPB)
- 8(B) EXAMPLE OF VINYL CHLORIDE CONCENTRATION IN INTERMEDIATE WELL (PPB)

SOURCE: MCB CAMP LEJEUNE, 2000.

FIGURE 1
HOT SPOT LOCATION MAP
SITE 35, FORMER CAMP GEIGER FUEL FARM
HOT SPOT CHARACTERIZATION WORK PLAN
CTO - 0219, SEPTEMBER 2002
MARINE CORPS BASE, CAMP LEJEUNE,
NORTH CAROLINA



LEGEND

- US 17 JACKSONVILLE BYPASS RIGHT-OF-WAY LIMITS
- US 17 JACKSONVILLE BYPASS EASEMENT LIMITS
- ◆ MONITORING WELL
- PROPOSED GEOPROBE BORING LOCATION
- ⊙ PROPOSED GEOPROBE BORING LOCATION ALSO USED FOR THE LNAPL EVALUATION

SOURCE: MCD CAMP LEJEUNE, 2000.

FIGURE 2
PROPOSED GEOPROBE BORING LOCATION MAP
SITE 35, FORMER CAMP GEIGER FUEL FARM
 HOT SPOT CHARACTERIZATION WORK PLAN
 CTO - 0219, SEPTEMBER 2002
 MARINE CORPS BASE, CAMP LEJEUNE,
 NORTH CAROLINA

