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LETTER REPORT REGARDING TREATABILITY STUDY WORK PLAN ADDENDUM SITE 4

NCBC GULFPORT MS

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Project Number 9666

Commander, Southeast
Naval Facilities Engineering Command
ATTN: Art Conrad (Code OPGEVR)
Remedial Project Manager
2155 Eagle Drive
North Charleston, SC 29419-9010

Reference: Clean Contract No. N62467-94-D0888
Contract Task Order No. 9666

Subject: Treatability Study (TS) Work Plan Addendum for Site 4
Naval Construction Battalion Center, Gulfport, Mississippi

Dear Mr. Art Conrad:

Introduction

Tetra Tech NUS (TtNUS), under contract to the U. S. Department of the Navy, Southern Division, Naval Facilities Engineering Command Southeast (NAVFAC SE), has prepared this Treatability Study (TS) Work Plan Addendum for Site 4 at the Naval Construction Battalion Center (NCBC) in Gulfport, Mississippi. This work plan was prepared under the Comprehensive Long-term Environmental Action Navy (CLEAN) III, Contract No. N62467-94-D-0888.

The primary objective of the TS at Site 4 is to provide information for the selection of a remedial option that is protective of human health and the environment. In order to achieve this primary objective, substrate and microbial inoculum will be injected in to the subsurface in a small area of the site. Analytical data will be collected prior to and following the injection to determine the success of the injection in reducing volatile organic compound (VOC) concentrations at the site. This document describes the field activities, laboratory analyses, and data management that will be performed as part of the Site 4 TS.

Initial information on the TS was provided in the Remedial Investigation (RI) and Treatability Study Work Plan Addendum submitted in November 2005. This Work Plan updates and expands on the information provided in that plan utilizing data collected since that time.

Site Background and History

Initial RI activities at Site 4 focused on a plume of VOC-contaminated groundwater detected in 1997. During these activities, groundwater samples were collected using direct push technology (DPT) from 25 locations for VOC analysis and groundwater samples were collected for full suite analysis from 13 monitoring wells (Figure 1). The following is a brief summary of preliminary RI results (1997):

- VOCs were detected in groundwater samples at concentrations exceeding risk-based screening criteria.
- The VOC plume at Site 4 remains at concentrations similar to those detected in 1997 and 1999.
- The area of greatest dissolved VOC concentration appears to have migrated downgradient over time.
- The horizontal extent of the plume had not been fully delineated in the southwest corner of the site near Seventh Street or on the northwest side of Canal 1 (Figure 1). Activities completed in 2006 have addressed this data gap.
- The lithology of the site includes discontinuous clay and sandy clay horizons that may influence vertical distribution of contaminants.
- Analysis of natural biodegradation indicator parameters (e.g. dissolved oxygen, reduction/oxidation potential, etc.) indicates that reducing conditions are present in site groundwater.

To fill data gaps from the initial RI, additional field sampling activities were conducted in March and April 2006. The activities included:

- Advancement of 20 soil borings (04GP25 through 04GP44) via DPT and collection of 63 groundwater samples at varying depths in those borings. Samples were analyzed in a mobile laboratory.
- Installation of three temporary monitoring wells (MP-01, MP-02, and MP-03) in the area of highest detected VOC concentrations; these wells will be sampled as part of the TS

that is described in this document. Soil and groundwater samples were collected from each of these locations.

- Installation of a total of 10 permanent monitoring wells (04MW21 through 04MW30) to
- varying depths. Three of these wells (04MW21, 04MW22, and 04MW23) were installed in the TS area to depths of 16 feet, 24 feet, and 45 feet, respectively. Groundwater samples were collected from each of these locations as well as seven existing monitoring wells and analyzed in a fixed-base laboratory.

Data from the field and laboratory analysis of the samples collected is summarized in Tables 1 through 3. More detailed information on the activities completed during this stage of the RI will be included in the site RI Report. In general, the data provided the following information for designing the TS:

- The highest VOC concentrations were observed 04GP28. The maximum concentrations of trichloroethene (TCE), cis-1,2-dichlorethene (cis-1,2-DCE), trans-1,2-dichloroethene (trans-1,2-DCE) and vinyl chloride (VC) at this location were 120 micrograms per liter (µg/L), 970 µg/L, 800 µg/L, and 1,600 µg/L, respectively. Similar concentrations were present from a depth of approximately 10 feet to the bottom of the boring (24 feet).
- Based upon the results at 04GP28, it was determined that the TS would be conducted in the vicinity of that boring. Therefore, additional samples were collected in that area. This included the installation and sampling of three temporary wells installed to a depth of 18 feet, and three permanent monitoring wells installed to depths of 16 feet (screened from 6 to 16 feet), 24 feet (screened from 19 to 24 feet), and 45 feet (screened from 40 to 45 feet). None of the samples collected from these wells contained elevated VOC concentrations except those collected from 04MW22 (screened from 19 to 24 feet); this sample exhibited TCE, cis-1,2-DCE, trans-1,2-DCE, and VC concentrations of 110 µg/L, 470 µg/L, 310 µg/L, and 190 µg/L, respectively. The soil samples collected from the locations of the three temporary wells were non-detect for all VOCs.
- It was confirmed that the conditions in the aquifer at the site are slightly reducing to strongly reducing. In all but one well sampled, the oxidation reduction potential (ORP) was negative, ranging from -19 to -489.5 millivolts (mV), with an average reading of -145 mV. Additionally, the majority of the dissolved oxygen readings were below 1 milligram per liter (mg/L), with 40 percent of the readings below 0.5 mg/L. pH readings ranged from 5.45 to 6.87; the lowest reading was observed at 04MW28, located in the TS area.

- Although present, very low quantities of microbes responsible for degradation of DCE and VC were present in the groundwater at MP-01 and MP-03. Dhc concentrations at
- those wells were 13.4 and 5.48 cells per milliliter, respectively. The functional genes believed to be responsible for reduction of DCE and VC (BAV1 VC R-Dase and VC R-Dase) were present at only very low concentrations, less than 1 cell per milliliter.
- Soil samples from the temporary wells indicate that chlorinated VOCs are not present in the soil in the TS area.
- This and previous data collected suggest that the phenomena known as "DCE/VC stall" is occurring in the dissolved VOC plume at Site 4. A site is considered to be in DCE/VC stall if these compounds are accumulating as concentrations of TCE are reduced. DCE/VC stall occurs when insufficient electron donors, insufficient microbes, and/or adverse environmental conditions prevent complete biological anaerobic reductive dechlorination (ARD) of VOCs to non-toxic components such as ethene, ethane, carbon dioxide, and water.
- Despite the fact that DCE/VC stall is occurring at the site, the lack of VOCs in some wells and the relatively high ethane concentrations in the wells sampled provide evidence that complete ARD is also occurring.

Work Plan Rationale

This document is an Addendum to the "Work Plan for Remedial Investigation at Site 4 – Golf Course Landfill" (TtNUS, 2004). The overall goals of the TS are to determine if the proposed technology will effectively reduce VOC concentrations at the site and to provide data to allow design of full-scale site remediation.

Several remedial options were considered for this TS, including chemical oxidation, enhanced aerobic biodegradation, enhanced ARD via biostimulation, enhanced ARD via biostimulation and bioaugmentation, and cometabolic biodegradation. The process utilized to determine the technology utilized in this TS is detailed below.

As stated above, it is apparent that DCE/VC stall is occurring in the site groundwater, but there is also evidence that complete ARD is also occurring in the reducing conditions present at the site.

Chemical oxidation and cometabolic biodegradation both rely on the presence of an oxidizing environment in the site aquifer. At Site 4, the present conditions are naturally reducing. Additionally, there is a significant amount of organic carbon present in the soil and groundwater at

the site which would deplete the oxidizer or other aerobic amendment as it was added, limiting the degradation of VOCs. Therefore, before either of these technologies could be effective, these natural conditions would have to be overcome, requiring a significant quantity of oxidizer or other aerobic amendment be injected, potentially over a series of injection events.

Therefore, it was determined that the naturally occurring reducing conditions would be exploited. The optimal manner in which this would be accomplished is through enhancing the natural ARD occurring at the site. Based on the data, it appears that natural reduction of TCE is occurring, with the reactions in some portions of the site stalling at DCE and VC. This is a common occurrence at sites where either insufficiently reducing conditions, lack of the proper microbial community, and/or some other condition inhibiting biodegradation (e.g., pH outside of the optimal range, elevated sulfate concentrations, etc.) are present.

Data from the site indicate that while reducing conditions sufficient for ARD of DCE and VC are present in some portions of the site, they may not be present in the area where the highest contaminant concentrations have been observed (the TS area). Therefore, biostimulation, through the addition of a carbon source (substrate) to the subsurface, will be implemented. In this case, a fast acting substrate (lactate) has been chosen over a slow release substrate such as vegetable oil; lactate was chosen to quickly achieve strongly reducing conditions in the TS area and to provide timely information on the success of enhanced ARD.

As stated above, another cause of DCE/VC stall can be the lack of the proper microbial community in the subsurface. While several bacterial groups are involved in partial reductive dechlorination (e.g., *Dehalobacter, Desulfuromonas, etc*), *Dehalococcoides* (Dhc) is the key consortia involved in complete reductive dechlorination to ethene. However, the Dhc organism is not ubiquitous and, if present, may be at insufficient quantities for complete ARD. Laboratory data from Site 4 shows that Dhc concentrations in the TS area are orders of magnitude below levels believed to sustain ARD. Further, the Dhc functional genes believed to be responsible for ARD of DCE and VC are not present at sufficient levels. Bioaugmentation is the process of supplementing the existing microbial population with an inoculum of Dhc. In this case, biostimulation will be implemented with bioaugmention to create favorable conditions and continue to provide a food source for the bacteria for complete, efficient, and rapid ARD, while providing more of the microbes responsible for complete ARD.

Other condition that may be contributing to the DCE/VC stall the site include pH and competing electron acceptors. The optimal pH for ARD is between 6 and 9. The pH observed at 04MW22, located in the TS area, was 5.75. Therefore, as part of the TS, sodium bicarbonate will be added with the substrate and inoculum in an attempt to raise the pH to more optimal conditions. Relatively high sulfate levels provide a competing electron donor; this will be overcome by the injection of additional donor, which will overcome these effects.

In order to obtain the best possible data regarding chlorinated VOC concentration reductions, the TS will be conducted in the area where the highest concentrations have been detected, near 04GP28.

To summarize, the TS will include injection of lactate, microbial inoculum, and sodium bicarbonate in the area of 04GP28. Details on the quantities of material and injection process are provided below.

Field Activities

Field activities conducted for the TS include:

- Installation of temporary and permanent monitoring wells in the TS area. Three temporary and three permanent monitoring wells have been installed; three additional temporary wells (MP-04/05/06) will be installed.
- Groundwater sampling
- Injection of substrate and microbial inoculum
- Sample management
- IDW management

Field activities will be conducted in accordance with the site specific Health and Safety Plan (HASP) and the RI Work Plan (TtNUS, 2004). Detailed descriptions of field procedures are located in the RI Work Plan (TtNUS, 2004).

Well Installation/Baseline Sampling

As stated above, three permanent and three temporary monitoring wells were installed in the TS area. Prior to initiation of the TS, three additional temporary wells (MP-04/05/06) will be installed. These wells will be installed as pairs with the existing temporary wells (MP-01/02/03). The well will be screened from approximately 19 feet to 24 feet below ground surface to provide data from the base of the shallow aquifer unit.

Baseline sampling for the TS was conducted during investigation activities at the site. The sampling consisted of the following:

- Sampling of the groundwater at the three temporary wells and three permanent monitoring wells in the TS area for chlorinated VOCs and field parameters (including pH, DO, and ORP).
- Sampling of the three temporary wells for volatile fatty acids, dissolved gases, and other bio-indicator parameters (including nitrate, nitrite, total and dissolved iron, orthophosphate, sulfate, sulfide, chloride, and total organic carbon).
- Sampling of two of the temporary wells in the TS area for microbial community data.
- Soil samples were collected from each of the temporary well locations and analyzed for chlorinated VOCs and total organic carbon.
- Following the installation of the deep temporary wells, groundwater samples will be collected for chlorinated VOCs and the field parameters listed above. Samples from MP-04 will also be analyzed for volatile fatty acids, dissolved gases, microbial community data, and the bio-indicator parameters listed above.

The results of this sampling, in general, are presented above. A detailed analysis of the data will be provided in the Treatability Study Report, to be submitted following the completion of TS performance monitoring.

Treatability Study

Following the completion of the installation of the deep temporary monitoring wells and the baseline sampling, the TS will begin. Based on the reducing conditions already present at the site, and the low levels of microbes present capable of reducing VC and DCE, ARD via biostimulation and bioaugmentation has been chosen as the technology most likely to be successful at this site. Specifically, this will include injection of fast acting organic substrate (lactate) and microorganisms known to degrade less chlorinated VOCs (e.g., Dhc) into the subsurface. This section describes the activities in detail.

One thousand one hundred (1,110) pounds of lactate (in 20 5-gallon buckets) and up to 10 liters of microbial inoculum will be delivered to the site. Groundwater from a non-impacted well will be added to a tank with the lactate to create a lactate solution of approximately 15 percent (by weight). Site groundwater will be utilized for diluting the lactate to prevent exposure of the lactate to oxygenated water; if it is found to be impractical to use site groundwater, city water may be used. A total of approximately 750 gallons of water will be required to properly dilute the lactate.

The solution will be mixed in approximately 170-gallon batches. Each batch will contain 20 gallons of lactate and 150 gallons of water, Because of the low pH in the TS area, approximately 6 pounds of sodium bicarbonate will also be added to the solution, to raise the pH of the aquifer.

The solution will then be injected into the aquifer via DPT borings. The locations of the five borings are shown in Figure 2. Approximately 170 gallons of solution will be injected evenly through the DPT rods from a depth of approximately 24 feet to a depth of approximately 10 feet. A high pressure grout pump will be utilized.

The inoculum will be added to the aquifer only after it has been determined that the aquifer has sufficiently reducing conditions to allow the microbes to propagate. This will be determined based on field readings (primarily DO and ORP) and may occur up to one month after addition of the lactate. When conducted, the injection of the inoculum (in locations at or near the locations of the lactate addition) will be done in strict accordance with the manufacturer's instructions.

Performance Monitoring

To evaluate the efficacy of the technology chosen for the treatability study, two rounds of performance monitoring sampling will be conducted. The first event will be scheduled approximately three months following injection activities; the second event will take place three months after the initial event.

The first performance monitoring event will consist of groundwater sample collection and the following analyses:

- Samples from 04MW21, 04MW22, MP-05, and MP-06 – chlorinated VOCs and field parameters
- Samples from MP-01 and MP-04 – chlorinated VOCs, volatile fatty acids, dissolved gases, bio-indicator parameters, microbial community data, and field parameters
- Samples from MP-03 - chlorinated VOCs, dissolved gases, bio-indicator parameters, and field parameters

At this time, it is expected that the same analyses will be conducted during the second performance monitoring event; however, this may be subject to change based on the results of the first event. Parameters may be added or deleted to develop the most efficient data collection protocol to provide the required data.

Data Quality

The Data Quality Objectives (DQOs) for an TS are project specific and are based on the intended use of the data in the decision process. DQO selection is the main factor in identifying:

- The types of samples to be collected
- The sample collection locations
- The types of equipment to be used
- The analytical requirements

The DQOs for Site 4 are presented in Section 4.0 of the Quality Assurance Project Plan (QAPP) which is located in Appendix B of the RI Work Plan (TtNUS, 2004).

Data Management

The Data Management Plan (DMP) is included in Appendix A of the RI Work Plan (TtNUS, 2004) and outlines the project-specific procedures that will be used to manage the environmental information pertaining to Site 4. The methods to be used to manage the data generated during the field investigation include the tracking of data in the field and subsequent data validation.
Onsite data management involves the day-to-day recording of sampling and field activities in the field. The project database will be initiated in the field to promote the proper collection and storage of field data and documentation of field activities. Onsite data management requirements are presented in Appendix C of the QAPP, located in Appendix B of the RI Work Plan (TtNUS, 2004). The FOL and/or sample coordinator will be responsible for entering the data into the database in the field. The following data will be entered into the project database:

- Sample information (i.e. identification, matrix, sample depth, collection time, analyses)
- Location information
- Chain of custody information
- Shipping data
- Field descriptions
- Photographic logs

The laboratory, field and natural attenuation data will be subjected to full validation. The data will be assessed using precision, accuracy, representativeness, completeness and comparability (PARCC) parameters using the National Validation Functional Guidelines for Organic Data

Review (June 1991), the Laboratory Data Validation Functional Guidelines for Evaluation of Inorganic Analysis (June 1988), and the TtNUS SOPs in Appendix C of the QAPP (TtNUS, 2004).

Investigation Derived Waste Management

For this field investigation, IDW management will include drum labeling, record keeping, and staging of materials. IDW generated during this investigation will include soil cuttings, development and purge water, and decontamination waste (water, solvents, and soap). The IDW drums will be labeled with the following information:

- Source of material (i.e. boring/well ID, decon pad, etc.)
- Matrix (i.e. soil, groundwater, decon water, etc.)
- Date generated (mmddyy)
- Contact name and contact phone number

The drums will remain on site until the results of the characterization are completed. A facility representative will sign waste manifests and bills of lading associated with the transport and off-site disposal of IDW.

Treatability Study Report

Following completion of the second round of performance monitoring, a TS Report will be submitted. The report will summarize the site data from the baseline and performance monitoring events and provide analysis of these results. The analysis will include:

- The degree to which the injections were successful in promoting ARD; this will be done primarily through analyzing reductions in chlorinated VOC concentrations, but will also include analysis of dissolved gas (ethene and ethane) concentrations and chloride concentrations.
- The degree to which the injections were successful in creating conditions in the subsurface suitable for ARD, including indicators of reductive conditions (such as DO and ORP), microbial concentrations, volatile fatty acids concentrations, pH, and concentrations of bio-indicator parameters such as nitrate, nitrite, total and dissolved iron, orthophosphate, sulfate, and sulfide.
- Parameters necessary to scale-up of the TS for full-scale site remediation, if successful. This will include determining whether the materials were added in the correct quantities, the area of influence of each injection location, and the effectiveness of the injection via DPT.

The results of these analyses will then be utilized to provide recommendations on future activities at the site, including, if applicable, a design basis for full-scale site remediation via enhanced ARD.

If you have any questions regarding the information presented in this document, please contact me by phone at (850) 385-9899 or via email at Robert.Fisher@ttnus.com.

Sincerely,

Robert Fisher
Task Order Manager

Enclosures: Gordon Crane, NCBC Gulfport
Bob Merrill, MDEQ
Debbie Humbert
Mark Perry/File

TABLE 1

GROUNDWATER POSITIVE DETECTIONS - ORGANICS
SITE 4 TREATABILITY STUDY-WORK PLAN ADDENDUM-4
NCBC
Gulfport, MS

LOCATION	04MP01	04MP02	04MP03	04MW12	04MW13	04MW14	04MW15	04MW16	04MW17	04MW20
SAMPLE ID	04MP0101-A	04MP0201-A	04MP0301-A	04MW1202	04MW1302	04MW1402	04MW1502	04MW1602	04MW1702	04MW2002
SAMPLE DATE	4/20/2006	4/20/2006	4/20/2006	4/11/2006	4/11/2006	0413-06	4/11/2006	3/30/2006	4/13/2006	4/11/2006
AQUIFER INTERVAL	Shallow	Shallow	Shallow	Shallow	Shallow	Deep	Shallow	Shallow	Deep	Deep
Volatile Organics (ug/L)										
1,1-DICHLOROETHENE	1U	1U	1U	1U	1U	1U	1U	2U	1U	1U
CIS-1,2-DICHLOROETHENE	**1.6**	**.37J**	1U	1U	1U	**47**	1U	**170**	1U	1U
TETRACHLOROETHENE	1U	1U	1U	1U	1U	1U	1U	2U	1U	1U
TRANS-1,2-DICHLOROETHENE	**1.8**	**.38J**	1U	1U	1U	**22**	1U	**89**	1U	1U
TRICHLOROETHENE	1U	1U	1U	1U	1U	**0.55**	1U	**4.1**	1U	1U
VINYL CHLORIDE	**.64J**	1U	1U	1U	1U	**14**	1U	**84**	1U	1U

LOCATION	14MW21	04MW22	04MW24	04MW15	04MW26	04MW27	04MW28	04MW29	04MW29	04MW30
SAMPLE ID	04MW2101	04MW2201	04MW2401	04MW2501	04MW2601	04MW2701	04MW2801	04MW2901	04MW2901D	04MW3001
SAMPLE DATE	4/21/2006	4/21/2006	4/20/2006	4/21/2006	4/21/2006	4/21/2006	4/20/2006	4/20/2006	4/20/2006	4/20/2006
AQUIFER INTERVAL	Shallow	Intermediate	Shallow	Shallow	Deep	Shallow	Shallow	Deep	Deep	Shallow
Volatile Organics (ug/L)										
1,1-DICHLOROETHENE	1U	**1.2**	1U	1U	1U	1U	1U	1U	1U	1U
CIS-1,2-DICHLOROETHENE	**5.9**	**470D**	1U	**1.4**	1U	**25**	1U	1U	1U	**.98J**
TETRACHLOROETHENE	1U	**.72J**	1U	1U	1U	1U	1U	1U	1U	1U
TRANS-1,2-DICHLOROETHENE	**6.4**	**310D**	1U	**.77J**	1U	**11**	1U	1U	1U	**.36J**
TRICHLOROETHENE	**1**	**110**	1U	1U	1U	**1J**	1U	1U	1U	1U
VINYL CHLORIDE	**18**	**190D**	1U	**.67J**	1U	**11**	**.37J**	1U	1U	1U

TABLE 2

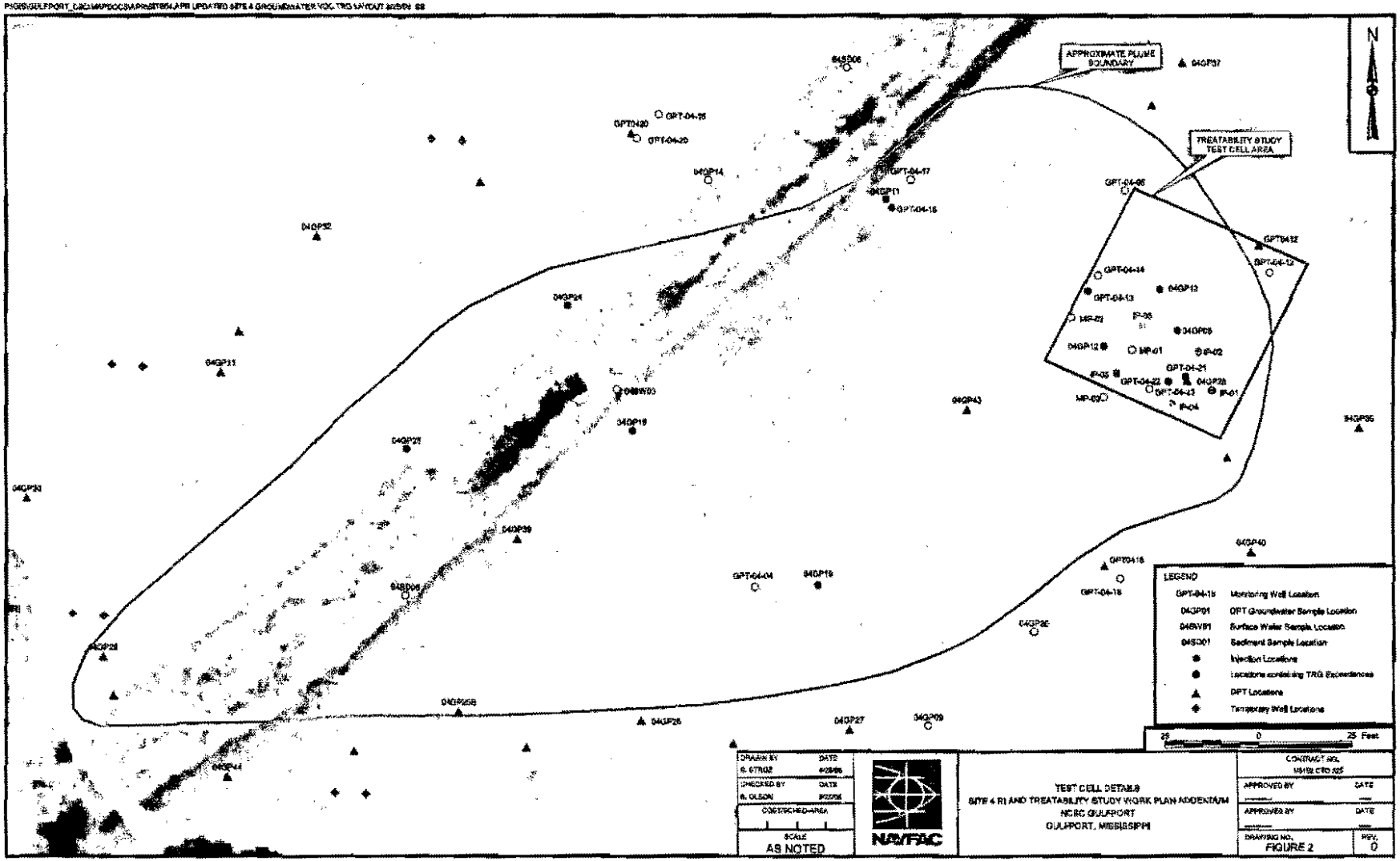
CVOC DELINEATION RESULTS
SITE 4 TREATABILITY STUDY-WORK PLAN ADDENDUM-4
NCBC
Gulfport, MS

SAMPLE LOCATION	04MP01	04MP02	04MP03
SAMPLE ID	04MP0101	04MP0201	04MP0301
	4/13/2006	4/13/2006	4/13/2006
Volatile Organics (ug/kg)			
1,1-DICHLOROETHENE	5U	5.6U	6.6U
CIS-1,2-DICHLOROETHENE	5U	5.6U	6.6U
TETRACHLOROETHENE	5U	5.6U	6.6U
TRANS-1,2-DICHLOROETHENE	5U	5.6U	6.6U
TRICHLOROETHENE	5U	5.6U	6.6U
VINYL CHLORIDE	5U	5.6U	6.6U
TOTAL ORGANIC CARBONS (mg	2700	2600	5000

TABLE 3

MONITORING WELL FIELD PARAMETERS
SITE 4 TREATABILITY STUDY-WORK PLAN ADDENDUM-4
NCBC
Gulfport, MS

	pH	COND	TEMP	NTU	DO (mg/L)	ORP
MW-12	6.87	2.01	21.6	7.0	0.00	-200
MW-13	6.72	1.48	21.31	15.8	1.48	-116
MW-14	6.18	0.931	22.22	0.0	0.42	-84
MW-15	6.55	1.60	20.50	6.6	0.57	-89
MW-16	6.31	1.09	20.4	103.0	1.30	
MW-17	6.70	0.177	22.2	11.9	0.00	-137
MW-20	6.68	0.275	21.9	15	0.0	-147
MW-21	6.82	1.857	21.82	7.6	0.49	-110.3
MW-22	5.75	0.916	22.56	2.4	0.44	-19.1
MW-24	6.90	2.827	21.1	5.9	11.96	-280.9
MW-25	6.41	0.596	20.26	5.90	2.71	-75.5
MW-26	6.66	203	22.24	54.4	0.73	-346.1
MW-27	6.40	1.525	21.08	6.1	0.52	-72.6
MW-28	5.45	0.181	20.98	13.31	0.44	51.3
MW-29	6.36	0.263	22.38	40	0.58	-56.2
MW-30	5.18	0.173	20.92	60.0	2.03	-489.5
MP-01	6.56	1.911	21.65	20.5	0.57	-117.8
MP-02	6.83	2.025	21.48	11.3	0.94	-197.0
MP-03	6.85	2.195	22.22	6.16		-132.2


APPROXIMATE PLUME BOUNDARY
TREATABILITY STUDY TEST CELL AREA
N
LEGEND
GPT-04-15 Monitoring Well Location
04GP01 GPT Groundwater Sample Location
04SW01 Surface Water Sample Location
04SD01 Sediment Sample Location
Injection Locations
Locations containing TRG Exceedances
GPT Locations
Temporary Well Locations
25 0 25 Feet
DRAWN BY
DATE
CHECKED BY
DATE
SCALE
AS NOTED
NAVFAC
TEST CELL DETAILS
SITE 4 RI AND TREATABILITY STUDY WORK PLAN ADDENDUM
NCBC GULFPORT
GULFPORT, MISSISSIPPI
CONTRACT NO.
APPROVED BY
DATE
APPROVED BY
DATE
DRAWING NO.
FIGURE 2
REV.
0