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NCBC GULFPORT
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TECHNICAL MEMORANDUM NUMBER 6 AT SITE 8A GROUNDWATER SAMPLING TO DETERMINE EXTENT OF CONTAMINATION FROM ASH STORAGE IN GROUNDWATER

NCBC GULFPORT MS

8/1/1997

ABB ENVIRONMENTAL

TECHNICAL MEMORANDUM NO. 6
AREA A, FORMER HERBICIDE ORANGE STORAGE AREA, GROUNDWATER SAMPLING EVENT NO. 6

NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI

UNIT IDENTIFICATION CODE: N62604
CONTRACT NO. N62467-89-D-0317/092

AUGUST 1997

SOUTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
NORTH CHARLESTON, SOUTH CAROLINA
29419-9010

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CERTIFICATION OF TECHNICAL
DATA CONFORMITY (MAY 1987)

The Contractor, ABB Environmental Services, Inc., hereby certifies that, to the best of its knowledge and belief, the technical data delivered herewith under Contract No. N62467-89-D-0317/092 is complete, accurate, and complies with all requirements of this contract.

DATE: August 15, 1997

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(DFAR 252.227-7036)

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TECHNICAL MEMORANDUM NO. 6
AREA A, FORMER HERBICIDE ORANGE STORAGE AREA, GROUNDWATER SAMPLING EVENT NO. 6

NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI

Unit Identification No. N62604

Contract No. N62467-89-D-0317/092

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August 1997

FOREWORD

To meet its mission objectives, the U.S. Navy performs a variety of operations, some requiring the use, handling, storage, or disposal of hazardous materials. Through accidental spills and leaks and conventional methods of past disposal, hazardous materials may have entered the environment in ways unacceptable by today's standards. With growing knowledge of the long-term effects of hazardous materials on the environment, the Department of Defense initiated various programs to investigate and remediate conditions related to suspected past releases of hazardous materials at its facilities.

One of these programs is the installation restoration program. This program complies with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA). The acts, passed by Congress in 1980 and 1986, respectively, established the means to assess and cleanup hazardous waste sites for both private-sector and Federal facilities. These acts are the basis for what is commonly known as the Superfund program.

A second program to address present hazardous material management is the Resource Conservation and Recovery Act (RCRA) corrective action program. This program is designed to identify and cleanup releases of hazardous substances at RCRA-permitted facilities. RCRA is the law that ensures that solid and hazardous wastes are managed in an environmentally sound manner. The law applies primarily to facilities that generate or handle hazardous waste.

Investigations at this site focus on characterizing groundwater quality and are in support of a petition to delist the ash located at the site under the RCRA program. This report discusses the findings of the fourth round of groundwater sampling at Area A, Former Herbicide Orange Storage Area, Naval Construction Battalion Center, Gulfport, Mississippi.

Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM), has the responsibility for implementation of the Navy and Marine Corps RCRA program in the southeastern and midwestern United States. Questions regarding this report should be addressed to the SOUTHNAVFACENGCOM Remedial Project Manager, Mr. Dan Owens, at (803) 820-7331.

EXECUTIVE SUMMARY

ABB Environmental Services, Inc., under contract to Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM), conducted site investigative activities at Area A, Former Herbicide Orange Storage Area, located at Naval Construction Battalion Center (NCBC), Gulfport, Mississippi. This technical memorandum was prepared under the Comprehensive Long-Term Environmental Action, Navy (CLEAN) Contract No. N62467-89-D-0317 as Contract Task Order No. 092.

Groundwater sampling event No. 6 at Area A included a collection of four groundwater samples, including one duplicate sample. Groundwater samples were analyzed and validated for dioxin and furans (U.S. Environmental Protection Agency Method 8290). This sampling event was conducted as part of a series of quarterly sampling events which are part of the ongoing delisting process for the ash located at Area A. Originally, only four quarterly events were planned, but the dioxin and furan results from the first two rounds were rejected by a data validator; as a result, two additional quarterly rounds were required to analyze samples for dioxin only.

Before the ash on Area A can be considered for delisting, determination of whether or not it is a source of groundwater contamination is necessary. Analytical results indicated little organic contamination. Results from each sample were considerably lower than the previous three rounds. This may be attributed to unusually low groundwater levels. The results ranged from a low level at monitoring well GPT-A-1 (sample G6W001) of 0.11 picograms per liter (pg/ℓ) (toxicity equivalency factors [TEQ]) to a high level of 8.61 pg/ℓ (TEQ) at monitoring well GPT-A-3 (sample G6W003). Very low levels of dioxin were detected in the ash while soils remaining at the site may contain 2,3,7,8 tetrachlorodibenzo-p-dioxin at concentrations of up to 1 part per billion. Soil, and not the ash, is thought to be the source of dioxin in the groundwater. The correlation between groundwater sample results (TEQ) and the elevation of groundwater at the time of collection is another strong indication that the source of groundwater contamination continues to be from the soil, and not from the ash.

This was the final scheduled sampling event, but the low results may require an additional round.

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Area A, Former Herbicide Orange Storage Area
Groundwater Sampling Event No. 6
Naval Construction Battalion Center
Gulfport, Mississippi

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GLOSSARY

ABB-ES	ABB Environmental Services, Inc.
CLEAN	Comprehensive Long-Term Environmental Action, Navy
FID	flame ionization detector
HO	Herbicide Orange
1,2,3,4,6,7,8-HpCDD	1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin
MCL	maximum concentration limit
MS/MSD	matrix spike and matrix spike duplicate
MSDEQ	Mississippi State Department of Environmental Quality
NCBC	Naval Construction Battalion Center
NEESA	Naval Energy and Environmental Support Activity
OCDD	octachlorodibenzodioxin
PARCC	precision, accuracy, representativeness, comparability, and completeness
PCDD/PCDF	polychlorinated dibenzodioxin and polychlorinated dibenzofuran
pg/ℓ	picograms per liter
ppb	part per billion
QC	quality control
RCRA	Resource Conservation and Recovery Act
SOUTHNAVFAC-ENGCOM	Southern Division, Naval Facilities Engineering Command
2,3,7,8-TCDD	2,3,7,8-tetrachlorodibenzo-p-dioxin
TEF	toxicity equivalency factor
TEQ	toxicity equivalency quotient
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound

1.0 INTRODUCTION

ABB Environmental Services, Inc. (ABB-ES), under contract to Southern Division, Naval Facilities Engineering Command (SOUTHNAVFACENGCOM), conducted site investigative activities at Area A, Former Herbicide Orange (HO) Storage Area, at the Naval Construction Battalion Center (NCBC) in Gulfport, Mississippi. This technical memorandum is the sixth technical memoranda (ABB-ES, 1994, 1995a, and 1995b) associated with the groundwater investigation to supplement the ongoing Resource Conservation and Recovery Act (RCRA) delisting process. The field program and preparation of this report were completed under the Comprehensive Long-Term Environmental Action, Navy (CLEAN) contract (Contract Number N62467-89-D-0317, Contract Task Order Number 092) between SOUTHNAVFACENGCOM and ABB-ES.

Site 8 covers approximately 12 acres of nearly flat land and comprises Areas A, B, and C where approximately 850,000 gallons of HO were stored from 1965 to 1977. Between 1986 and 1988, soil contaminated with 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD) at concentrations greater than 1 part per billion (ppb) were incinerated and returned to selected areas within Area A. The contaminated soil was classified as RCRA-listed waste F027; however, following incineration, it is now classified as F028.

Prior to disposition, the ash must be approved for delisting by the Mississippi State Department of Environmental Quality (MSDEQ). A petition for final exclusion of the incinerated residue was submitted in November 1988. Additional information was requested by the regulators to sufficiently characterize the groundwater. The objective of the quarterly groundwater sampling is to determine whether the groundwater is contaminated with dioxins or other inorganic contaminants at levels higher than background. Results from six groundwater sampling events and from the ash sampling will be incorporated into an addendum report for submittal to U.S. Environmental Protection Agency (USEPA) Region IV and the MSDEQ to support delisting the ash at Site 8.

This technical memorandum summarizes the findings and results based on information and data collected from Site 8 as a result of groundwater sampling event No. 6, which was performed on August 14 and August 15, 1995.

2.0 GROUNDWATER SAMPLING FIELD PROGRAM

Groundwater sampling was performed on August 14 and 15, 1995. Groundwater samples were collected from the four wells installed at Area A during the April 1994 field effort. The samples were analyzed for dioxins and furans following protocol (USEPA Method 8290). Laboratory services were provided by QAL/Canviro Analytical Laboratories in London, Ontario. Naval Energy and Environmental Support Activity (NEESA) Level D data quality objectives and deliverables were specified for the analytical program (NEESA, 1988). Results of groundwater sample analyses are discussed in Chapters 3.0 and 4.0.

Upon opening each monitoring well, the headspace was screened for volatile organic compounds (VOCs) using a flame ionization detector (FID). Prior to sample collection, each well was purged of at least three well volumes. Samples were collected within 24 hours following purging. Decontaminated Teflon™ bailers were used to purge the monitoring wells and to collect samples. ABB-ES personnel placed the filled containers on ice in ice chests immediately after collection. Chain of custody procedures were initiated in the field at the time of sample collection. Samples were shipped via overnight courier service to the laboratory on the date of collection.

Field parameter measurements for groundwater samples included pH, conductivity, and temperature.

3.0 ANALYTICAL PROGRAM

This chapter summarizes the analytical program for groundwater samples collected from monitoring wells at Area A during groundwater sampling event No. 6 at NCBC Gulfport. In addition, it presents an assessment of data quality and useability.

3.1 CHEMICAL ANALYSES. Sampling activities during the sixth groundwater sampling event at NCBC Gulfport included collection of five groundwater samples, including one duplicate sample. All samples were collected in accordance with procedures outlined in the addendum to the Versar sampling and analysis plan (ABB-ES, 1993). Samples were submitted to QAL/Canviro for chemical analyses. Samples were analyzed in accordance with USEPA SW-846 methods (USEPA, 1986) and NEESA Level D documentation (NEESA, 1988) for dioxin and furans (Method 8290). Table 3-1 is a list of dioxin and furan congeners with associated toxicity equivalency factors (TEFs).

3.2 DATA QUALITY ASSESSMENT. Immediately after collection, all groundwater samples were properly preserved, placed in coolers, and packed with bagged ice immediately after collection. All samples remained in the custody of the field operations leader until delivery to the courier service responsible for providing overnight shipment to the laboratory. All samples were shipped, complete with chain-of-custody forms, to QAL/Canviro within 24 hours for analyses. Upon arrival, QAL/Canviro personnel checked the chain-of-custody forms and of the samples with the contents of each cooler, signed the chain-of-custody form, and accepted the samples for analysis.

Review of the field notebook and chain-of-custody forms did not indicate any non-conformance relative to field instrument calibration or sample handling. All required field quality control (QC) samples were collected in conformance with the requirements of the USEPA and ABB-ES' quality assurance plans and the June 1988 NEESA *Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Restoration Program* (NEESA, 1988) (Document 20.2-047B). These field QC samples included field duplicates, equipment rinsate blanks, and source water blanks.

The analytical results for environmental samples collected during groundwater sampling event No. 6 were evaluated and validated according to NEESA Level D QC criteria to determine data quality and useability. The data tables included in Appendix A reflect validation according to Level D criteria. These criteria are described in NEESA Document 20.2-047B (NEESA, 1988). The following subsections discuss analytical performance and the evaluation of field and laboratory QC samples.

3.2.1 Analytical Performance The data review and validation were performed under subcontract to Heartland Environmental Services, Inc., St. Peters, Missouri. Review of analytical data indicated that the laboratory generally met applicable analytical QC criteria for all chemical analyses. Extraction and holding times for all sample lots were met.

Table 3-1
U.S. Environmental Protection Agency Dioxin and Furan Toxic Equivalency Factors

Technical Memorandum No. 6
Area A, Former Herbicide Orange Storage Area
Groundwater Sampling Event No. 6
Naval Construction Battalion Center
Gulfport, Mississippi

Congener	Toxic Equivalency Factor (TEF[1])
Dioxins	
2,3,7,8-Tetrachlorodibenzo-p-dioxin (TCDD)	1
1,2,3,7,8-Pentachlorodibenzo-p-dioxin (PeCDD)	0.5
1,2,3,4,7,8-Hexachlorodibenzo-p-dioxin (HxCDD)	0.1
1,2,3,6,7,8-HxCDD	0.1
1,2,3,7,8,9-HxCDD	0.1
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin (HpCDD)	0.01
Octachlorodibenzo-p-dioxin (OCDD)	0.001
Furans	
2,3,7,8-Tetrachlorodibenzo-p-furan (TCDF)	0.1
1,2,3,7,8-Pentachlorodibenzo-p-furan (PeCDF)	0.05
2,3,4,7,8,-PeCDF	0.5
1,2,3,6,7,8-Hexachlorodibenzo-p-furan (HxCDF)	0.1
1,2,3,7,8,9-HxCDF	0.1
1,2,3,4,7,8-HxCDF	0.1
2,3,4,6,7,8-HxCDF	0.1
1,2,3,4,6,7,8-Heptachlorodibenzo-p-furan (HpCDF)	0.01
1,2,3,4,7,8,9-HpCDF	0.01
Octachlorodibenzo-p-furan (OCDF)	0.001

[1] Reference is U.S. Environmental Protection Agency (USEPA), 1989, Interim Procedures for Estimating Risks Associated with Exposures to Mixtures of Chlorinated Dibenzo-p-dioxins and Dibenzofurans.

3.2.2 Precision Precision of the water matrix data was acceptable based on the assessment of duplicate precision criteria.

Relative percent differences for the matrix spike and matrix spike duplicates (MS/MSDs) fell within acceptable ranges for all compounds evaluated. No qualifications were required.

3.2.3 Accuracy Accuracy criteria were met for all data. The MS/MSD from sample G6W001 exhibited acceptable percent recoveries. All of the internal standard recoveries were within the acceptable range (40 to 135 percent). No qualifications were required.

3.2.4 Representativeness Representativeness of the analytical data was assessed and no method blank contamination for the 2,3,7,8-substituted congeners were detected.

3.2.5 Comparability Comparability is the qualitative measure designed to express the confidence with which one data set may be compared to another. The analytical samples were collected and transported to the chemical analytical laboratory in accordance with standard procedures and were analyzed in conformance with acceptable USEPA procedures. This should assure comparability of the analytical data.

3.2.6 Completeness Overall, the analytical data met the completeness goal of 85 percent for every fraction. Appendix B contains the complete precision, accuracy, representativeness, comparability, and completeness (PARCC) report.

3.2.7 System Performance and Overall Assessment Overall performance was very good. The mass resolution checks, which are required to be analyzed at the beginning and end of each analytical sequence (every 12 hours), were acceptable. The column performance check that was analyzed met the window criteria and the initial calibration that was analyzed by the laboratory for these samples were acceptable for all native and internal standards. In addition, all ion ratios were acceptable.

4.0 RESULTS OF INVESTIGATIONS

Chapter 4.0 presents the analytical results of groundwater samples collected during the fourth groundwater sampling event at Area A, Former HO Storage Area, in August 1994. Technical Memorandum No. 1 (ABB-ES, 1994) presented discussion of the field program, including well installation, soil samples, and groundwater sampling event No. 1. Technical Memoranda Nos. 2 through 5 (ABB-ES, 1994 and 1995) presented the results from groundwater sampling events No. 2 through No. 5, respectively.

The following sections discuss analytical data results from this event and compares these results with data associated with previous sampling events at Site 8. Appendix A contains tables of validated analytical data for samples collected in August 1995 at Site 8. Analyses were performed by Canviro under subcontract to QAL which was contracted by ABB-ES.

4.1 SITE 8, FORMER HERBICIDE ORANGE STORAGE AREA. On August 14, 1995, groundwater level measurements were taken from four monitoring wells and seven well points at Area A. Figure 4-1 is a groundwater potentiometric surface map developed from these measurements. The configuration of the potentiometric surface and the groundwater flow direction is generally towards the west, which is nearly unchanged from previous sampling events.

The headspace of monitoring wells at Site 8 was measured for VOCs using an FID; only low levels of VOCs were detected. Field measurements of pH, specific conductance, and temperature were collected during purging of monitoring wells. Table 4-1 summarizes field measurements collected during purging of monitoring wells at Site 8. Purging continued until at least three well volumes were removed and field parameters stabilized to within 10 percent. The final measurements of pH, specific conductance, and temperature are considered the measurements of record for the monitoring wells (USEPA, 1991).

4.1.1 Dioxin and Furan Compounds in Groundwater Samples Octachlorodibenzodioxin (OCDD) was detected in all four groundwater samples collected. Sample G6W003 collected from the downgradient well GPT-A-3 resulted in the highest concentration of OCDD, at 783 picograms per liter (pg/ℓ). Also, sample G6W003 was the only sample that had a positive detection (185 pg/ℓ) for 1,2,3,4,6,7,8-heptachlorodibenzo-p-dioxin (1,2,3,4,6,7,8-HpCDD). Table 4-2 summarizes the results from all samples and presents the toxicity equivalency quotients (TEQs). A groundwater quality map is provided as Figure 4-2, which displays the graphic results from each monitoring well.

2,3,7,8-TCDD is considered to be the most potent carcinogen in the dioxin and furan families. Toxicologists believe that polychlorinated dibenzodioxins and polychlorinated dibenzofurans (PCDDs/PCDFs) with chlorine atoms at the 2, 3, 7, and 8 positions (2,3,7,8 substituted compounds) in their molecules can mimic the toxic properties of 2,3,7,8-TCDD. The USEPA developed TEFs to quantify the carcinogenicity of these compounds relative to 2,3,7,8-TCDD. Concentrations of PCDDs/PCDFs in a sample are multiplied by TEFs to determine a 2,3,7,8-TCDD equivalent (TEQ) concentration. The maximum TEQ, 8.61 pg/ℓ in sample G6W003, is well below the maximum concentration limit (MCL) of 30 pg/ℓ. The TEQ for each sample is also shown in Table 4-2.

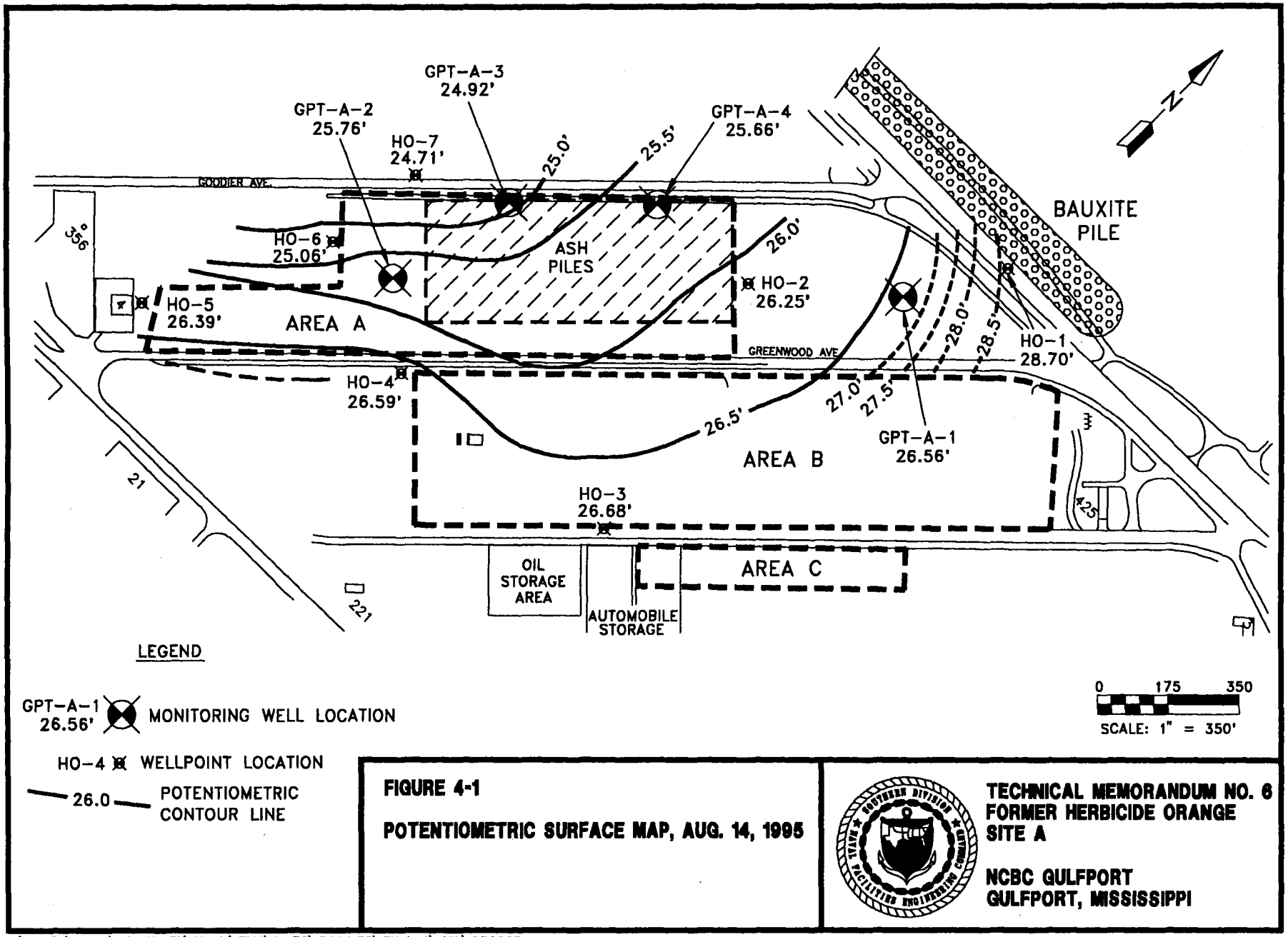

FIGURE 4-1

POTENTIOMETRIC SURFACE MAP, AUG. 14, 1995

TECHNICAL MEMORANDUM NO. 6
FORMER HERBICIDE ORANGE
SITE A

NCBC GULFPORT
GULFPORT, MISSISSIPPI

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Table 4-1
Summary of Field Measurements for Monitoring Wells at Area A

Technical Memorandum No. 6
Area A, Former Herbicide Orange Storage Area
Groundwater Sampling Event No. 6
Naval Construction Battalion Center
Gulfport, Mississippi

Monitoring Well No.	FID Headspace Data (ppm)	Field Data	Well Volume No. 1	Well Volume No. 2	Well Volume No. 3	Total Purge Volume (gallons)
GPT-A-1	0	pH	5.61	5.50	5.32	8
		Conductivity	80	80	70	
		Temperature	24.3	22.1	22.3	
GPT-A-2	0	pH	5.93	5.87	5.87	8
		Conductivity	140	135	130	
		Temperature	23.3	22.1	22.0	
GPT-A-3	25	pH	5.40	5.37	5.40	8
		Conductivity	150	130	130	
		Temperature	23.8	23.1	23.1	
GPT-A-4	10	pH	5.66	5.12	5.10	8
		Conductivity	110	100	100	
		Temperature	25.1	23.5	23.0	

Notes: Units are standard units (su) for pH, micromhos per centimeter (μmhos/cm) for specific conductance, and degrees Celsius (°C) for temperature.

FID = flame ionization detector.
ppm = parts per million.

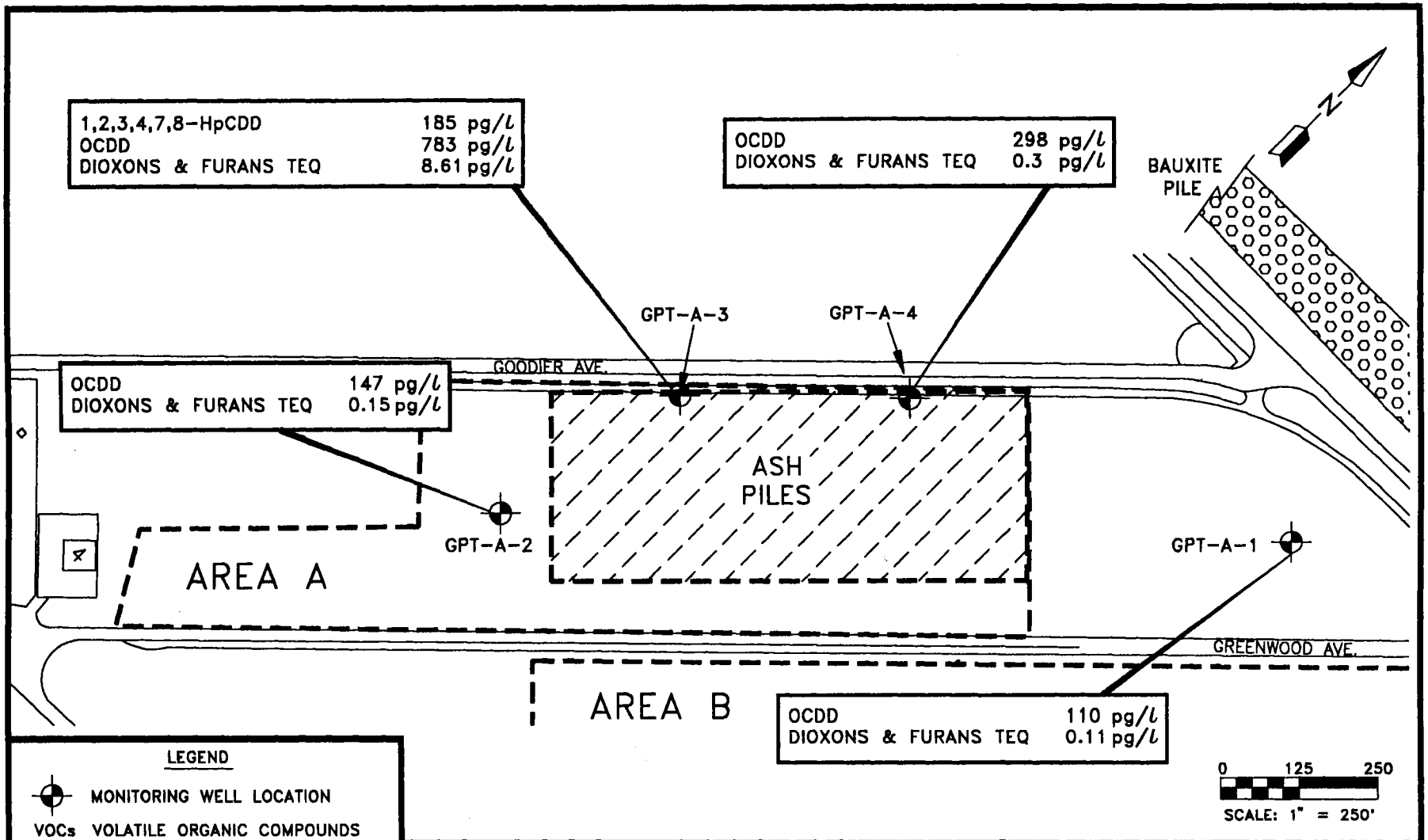
Table 4-2
Dioxins and Furans Detected in Groundwater Samples

Technical Memorandum No. 6
Area A, Former Herbicide Orange Storage Area
Groundwater Sampling Event No. 6
Naval Construction Battalion Center
Gulfport, Mississippi

Analyte	GPTH04-1	GPTH04-2	GPTH04-2D	GPTH04-3	GPTH04-4
1,2,3,4,6,7,8-Heptachlorodibenzo-p-dioxin	ND	ND	ND	185	ND
Octachlorodibenzo-p-dioxin	110	147	112	783	298
TEQ	0.11	0.15	0.11	8.61	0.3

Notes: All concentrations are reported in picograms per liter.

ND = not detected.
TEQ = toxicity equivalent quotient.



LEGEND

- MONITORING WELL LOCATION
- VOCs VOLATILE ORGANIC COMPOUNDS
- SVOCs SEMIVOLATILE ORGANIC COMPOUNDS
- ND NOT DETECTED
- mg/l MILLIGRAMS PER LITER
- µg/l MICROGRAMS PER LITER
- pg/l PICOGRAMS PER LITER

FIGURE 4-2

GROUNDWATER QUALITY MAP

TECHNICAL MEMORANDUM NO. 6
FORMER HERBICIDE ORANGE SITE A

NCBC GULFPORT
GULFPORT, MISSISSIPPI

C:\DWGS\NAVY\GULFPORT\HOTM\TM6\NCBC\8504.50\FIG4-2\JSL\951229

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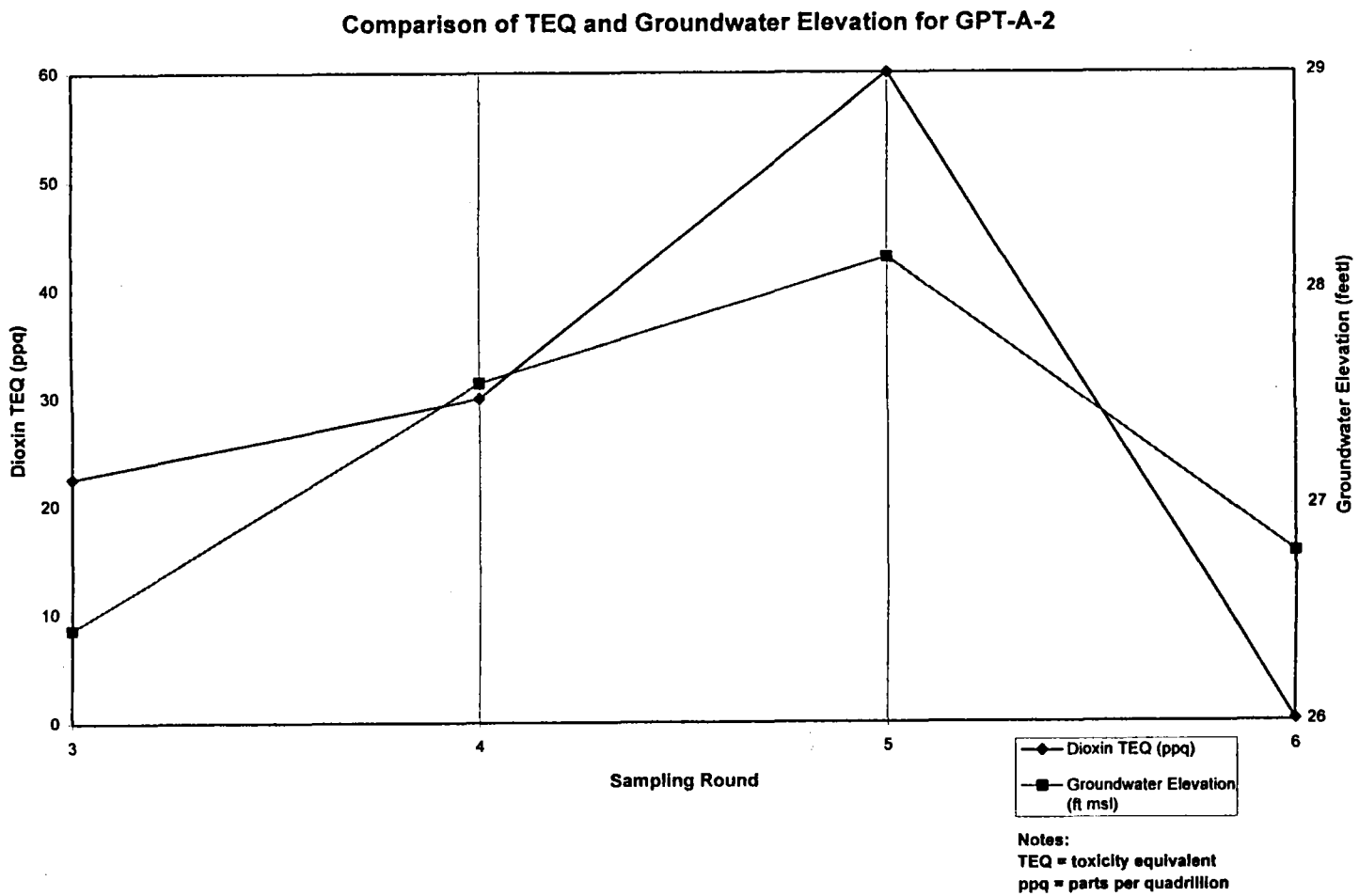
4.2 CONCLUSIONS. While 2,3,7,8-TCDD was not detected in any of the samples collected during this event, it was detected during the previous three events. The absence of 2,3,7,8-TCDD and the generally much lower TEQs is possibly the result of lower than usual groundwater levels. For example, the groundwater was observed to be 1.5 to 2 feet lower than in previous rounds. Conceptually, dioxin molecules have a high affinity for organic carbon and are easily affixed to most soils. Due to this natural property of dioxin, it is not likely that particles of dioxin would be mobile in the soil. Therefore, when water levels drop significantly, as they prior to this sampling event, it would be expected that dioxin levels would decrease. This correlation between water level and dioxin TEQ is clarified in Figure 4-3 where dioxin TEQs from well GPT-A-2 are plotted against the water level at the time the sample was collected. Figure 4-3 clearly shows that highest (shallow) groundwater conditions resulted in the highest dioxin TEQs, while the lowest TEQs were observed when the groundwater levels were at their lowest, which was typical for each of the other wells also.

Detections of dioxins and furans in the groundwater may be attributed to contamination within the soil instead of the ash. Only soils that exceeded concentrations of 1 ppb for 2,3,7,8-TCDD were excavated and incinerated. The analytical results of the sampled ash (ABB-ES, 1995) indicate that 2,3,7,8-TCDD levels are much below 1 ppb. Additionally, the soil would be the primary source for groundwater contamination since dioxin contaminated soil is in direct contact with groundwater when water levels are high. Therefore, it is believed that the soil is the source of the 2,3,7,8-TCDD detected in the groundwater rather than the ash.



Notes:
TEQ = toxicity equivalent
ppq = parts per quadrillion

FIGURE 4-3

COMPARISON OF DIOXIN TEQ VERSUS GROUNDWATER LEVEL

D:\ABB\9042-01\FIG 4-3\MLV\01-03-96

TECHNICAL MEMORANDUM NO. 6, FORMER HERBICIDE ORANGE, SITE A

NAVAL CONSTRUCTION BATTALION CENTER GULFPORT, MISSISSIPPI

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5.0 SUMMARY

This chapter summarizes results from the sixth groundwater sampling event at Site 8. The sampling event is part of an ongoing delisting process of the ash at this site.

Groundwater samples were collected in August 1995 and were analyzed for dioxins and furans using USEPA Method 8290. The samples were analyzed and validated according to NEESA Level D data quality objectives (NEESA, 1988). Data quality and useability were good, and met the 85 percent completeness goal.

Groundwater samples from the upgradient and downgradient wells exhibited positive OCDD results. 1,2,3,4,6,7,8-HpCDD was detected in sample G6W003 from monitoring well GPT-A-3. All resulting TEQs were below the MCL established for these compounds. The soil is believed to be the source of dioxin and furan contamination in the groundwater.

It is likely that dioxins detected in the groundwater are the result of soil contamination and not from the ash. First, dioxin levels in the soil are as high as 1 ppb, whereas ash concentrations were in the low parts per trillion range. Secondly, it was observed that dioxin levels in the groundwater have varied relative to the level of groundwater in the soil. Specifically, when groundwater levels rise to the upper 6 to 7 feet below land surface, dioxin levels increase. When groundwater levels drop significantly, dioxin levels have decreased as well. The combination of these observations indicates dioxin contamination in groundwater samples is the direct result of groundwater contact with contaminated soil and not from the ash.

REFERENCES

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APPENDIX A

ANALYTICAL DATA VALIDATION TABLES

Validation Groundwater Results

PROJECT: NCBC GULFPORT, MISSISSIPPI	DIOXIN/FURANS AQUEOUS ANALYSES: (pg/l)				
SAMPLE LOCATION:	G6W001	G6W002	G6W002D	G6W003	G6W004
LAB NUMBER:	K1009-0013	K1009-0016	K1009-0017	K1009-0018	K1009-0019
DATE SAMPLED:	08/15/95	08/15/95	08/15/95	08/15/95	08/15/95
DATE ANALYZED:	09/11/95	09/11/95	09/11/95	09/11/95	09/11/95
2,3,7,8-TCDD	3.74U	3.62U	3.00U	3.09U	3.13U
2,3,7,8-TCDF	3.15U	3.36U	2.60U	3.01U	2.21U
1,2,3,7,8-PeCDD	4.38U	4.78U	3.96U	4.27U	3.85U
1,2,3,7,8-PeCDF	2.59U	2.80U	2.71U	2.58U	1.88U
2,3,4,7,8-PeCDF	2.81U	3.03U	2.94U	2.80U	2.04U
1,2,3,4,7,8-HxCDD	3.13U	3.20U	3.67U	3.55U	3.15U
1,2,3,6,7,8-HxCDD	2.73U	2.79U	3.19U	3.09U	2.75U
1,2,3,7,8,9-HxCDD	2.99U	3.01U	3.49U	3.38U	3.00U
1,2,3,4,7,8-HxCDF	1.37U	1.34U	1.83U	1.56U	1.10U
1,2,3,6,7,8-HxCDF	1.21U	1.19U	1.62U	1.38U	0.97U
2,3,4,6,7,8-HxCDF	1.46U	1.43U	1.96U	1.66U	1.17U
1,2,3,7,8,9-HxCDF	1.76U	1.73U	2.36U	2.01U	1.42U
1,2,3,4,6,7,8-HpCDD	2.95U	0.54U	0.89U	185	0.55U
1,2,3,4,6,7,8-HpCDF	1.36U	1.37U	1.62U	1.58U	1.60U
1,2,3,4,7,8,9-HpCDF	1.85U	1.86U	2.20U	2.15U	2.18U
OCDD	110	147	112	783	298
OCDF	4.79U	6.45U	6.07U	1.52U	6.36U

Validated Quality Assurance and Quality Control Results

PROJECT: NCBC GULFPORT, MISSISSIPPI	DIOXIN/FURANS AQUEOUS ANALYSES: (pg/l)
SAMPLE LOCATION:	G6WRI
LAB NUMBER:	K1009-0012
DATE SAMPLED:	08/15/95
DATE ANALYZED:	09/11/95
2,3,7,8-TCDD	3.98U
2,3,7,8-TCDF	2.68U
1,2,3,7,8-PeCDD	4.57U
1,2,3,7,8-PeCDF	2.41U
2,3,4,7,8-PeCDF	2.62U
1,2,3,4,7,8-HxCDD	3.19U
1,2,3,6,7,8-HxCDD	2.78U
1,2,3,7,8,9-HxCDD	3.04U
1,2,3,4,7,8-HxCDF	1.16U
1,2,3,6,7,8-HxCDF	1.02U
2,3,4,6,7,8-HxCDF	1.23U
1,2,3,7,8,9-HxCDF	1.49U
1,2,3,4,6,7,8-HpCDD	1.85U
1,2,3,4,6,7,8-HpCDF	1.23U
1,2,3,4,7,8,9-HpCDF	1.67U
OCDD	3.52U
OCDF	5.24U

APPENDIX B

PRECISION, ACCURACY, REPRESENTATIVENESS, COMPARABILITY, AND COMPLETENESS REPORT

PRECISION, ACCURACY, REPRESENTATIVENESS, COMPARABILITY, AND COMPLETENESS FOR NCBC GULFPORT, SITE 8

NCBC GULFPORT
GULFPORT, MISSISSIPPI

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February 1996

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1.0 INTRODUCTION

Prior to evaluating the data for precision, accuracy, representativeness, comparability, and completeness (PARCC) criteria the laboratory reviewed the data package and the data also was independently reviewed and validated using the Naval Energy and Environmental and Support Activity (NEESA) guidance document 20.2-047B (1988) entitled, *Sampling and Chemical Analysis Quality Assurance Requirements for the Navy Installation Program*. Before the laboratory released the chemical analytical results, both the sample and laboratory QC data were carefully reviewed in order to verify sample identity, instrument calibration, detection limits, dilution factors, numerical computations, accuracy of transcriptions, and chemical interpretations. Additionally, the QC data were reduced and spike recoveries were included in control charts, and the resulting data were reviewed to ascertain whether they were within the laboratory defined limits for accuracy and precision. The data were compiled into a NEESA Level D data package and any nonconforming data were discussed in the data package cover letter and case narrative.

The Level D data package was then reviewed and validated by Heartland Environmental Services, Inc., Missouri (Heartland). Data validation is the technical review of a data package using criteria established in the data quality objectives, the quality assurance project plan and guidance documents prepared by the United States Environmental Protection Agency (USEPA) for the validation of organic and inorganic analytical data (USEPA 1990a and 1990b) as specified by NEESA document 20.2-047B. Samples that did not meet the acceptance limit criteria were qualified with a flag; single letter abbreviations that indicate a problem with the data. Data qualifiers used by the validators when amending the data include the following.

U — Undetected. The analyte was not detected above the contract required quantitation limit (CRQL) or the contract required detection limit (CRDL). The "U" designator also is used to qualify common laboratory contaminants. The "U" designator is applied to an environmental sample when the laboratory contaminant is detected in an environmental sample at a concentration less than 5 times (10 times for common laboratory contaminants) the value of the concentration detected in any corresponding field QC blank, method blank or preparation blanks.

J — Estimated. The analyte was present, but the reported value may not be accurate or precise. The "J" designator is used to qualify an analyte that was present at a concentration between the CRQL/CRDL and method detection limit (MDL) or the data "failed" some of the analytical validation criteria but not sufficient to reject the data and when combined with the U designator the quantitation limit is estimated.

R — Rejected. Data was rejected by the data validator during comparison of the NEESA Level C or D data package with the analytical functional guideline criteria. The "R" designator indicates a significant variance in acceptable laboratory performance. Either re-analysis or re-sampling and analysis would be necessary to determine the presence or absence of the target analyte(s).

Once the data were reviewed and validated according to the guidance presented in NEESA document 20.2-047B, the data were evaluated by Heartland using the PARCCs criteria included in the Data Quality Objectives (DQOs) of the Work Plan for NCBC Gulfport, Gulfport, Mississippi. The following sections present a brief description of PARCCs criteria.

Precision. Precision is a measure of the agreement or repeatability of a set of replicate results obtained from duplicate laboratory analyses of samples collected from the same location/depth interval. Precision was calculated from laboratory analytical data and cannot be measured directly. Precision is expressed as the Relative Percent Difference (RPD) between analytical values for two samples divided by the average of their analytical values. Precision is calculated using the expression:

$$RPD = (D1-D2) / (\tfrac{1}{2}(D1 + D2)) \times 100$$

D1 and D2 are the reported values for the duplicate sample pair. Precision was evaluated using field duplicate samples and laboratory split samples (for example, MS/MSD samples).

Precision for environmental samples and their duplicates was assessed using a maximum RPD of 20 Percent for the water matrix. Precision for MS/MSD/MD samples was assessed by using the target analyte specific RPD criteria for the spiked compounds and the sample duplicates.

Accuracy. Accuracy is a measure of the agreement between an experimental determination and the true value of the parameter being measured. Accuracy can be calculated from the analytical data and was not measured directly. Accuracy is used to identify the bias in a given measurement system (i.e. laboratory conditions, sample matrix, and sampling conditions). Accuracy is assessed by reviewing the Percent Recovery (%R) between the true value of the spike analyte and the actual analytical value. Accuracy is calculated using the equation:

$$\%R = ((A-B)/C) \times 100$$

A = Measured concentration of the spiked analyte.
B = Measured concentration of the spiked compound in the unspiked sample.
C = True concentration of the spiked analyte.

For the organic analyses, each of the samples was spiked with a surrogate compound and a designated field sample was spiked in duplicate (MS/MSD) with a known mixture of target compounds; and for inorganic analyses, each chosen matrix spike and matrix duplicate pair was spiked with a known reference material before digestion. Each of these approaches provides a measure of the matrix effects on the analytical accuracy.

Representativeness. Representativeness is a qualitative measure of the degree to which sample data accurately and precisely represent a characteristic environmental condition. Representativeness is a subjective parameter and is used to evaluate the efficacy of the sampling plan design. Representativeness was evaluated using the field and laboratory QC blank sample results. QC blank samples are equipment rinseate blanks, field blanks, trip blanks, laboratory method blanks for organic analysis and laboratory preparation blanks for inorganic analysis. Positive detection of target analytes in the QC blank samples identify contaminants that possibly were introduced to the associated environmental sample during sample collection, transport or laboratory analysis. Representativeness was also evaluated using the defined extraction and analytical holding time requirements set forth in the Work Plan for NCBC Gulfport or the analytical methodology.

Comparability. Comparability is qualitative measure designed to express the confidence with which one data set may be compared to another. Factors that affect comparability are: sample collection and handling techniques, sample matrix type, and analytical method. Comparability is limited by the other PARCC parameters because only when precision and accuracy are known can data sets be compared with confidence.

Completeness. Completeness is defined as the percentage of measurements that are judged to be valid compared to the total number of measurements made. Valid usable data are values that were not qualified as rejected (R qualifier) during data validation. A goal of 85 percent usable data was established in the Work Plan for NCBC Gulfport. Completeness equals the total number of analytes for each matrix minus the total number of rejected analytes divided by the total number of analytes multiplied by 100.

2.0 PRECISION

The following section describes the evaluation of precision for volatile organic compounds, semivolatile organic compounds, pesticides and polychlorinated biphenyls (PCBs), metals/cyanide, and sulfide. Duplicate samples are evaluated for precision only when contaminants are detected in both the environmental sample and the sample's duplicate. A ND in the RPD column of the spreadsheet indicates that a RPD calculation was not required because one result was a non-detect and the other result was less than the compound/analyte CRQL/CRDL. Environmental samples and their respective duplicates may not exhibit positive results for all compounds found at or near the CRQL or CRDL. Duplicates with Relative Percent Differences (RPDs) within control limits indicate adequate sampling practices and/or good analytical precision. Duplicates with RPDs outside the control limits may result from inappropriate sampling procedures, matrix interferences, or non-homogeneity of the sample matrix. In addition, poor precision can be attributed to deviation(s) from the analytical methodology or to poor reproducibility of target analyte concentrations at or near the required CRQLs or CRDLs. The acceptance criteria for evaluating precision of field duplicate analytical results is a RPD of 35 for the groundwater matrix.

Field duplicates were submitted for validation for all analytical fractions. The percentage of duplicate samples collected for this project was greater than ten percent. The following Sections summarize the evaluation of analytical precision for the water field samples for the following analytical groups:

- 2,3,7,8-Substituted Dioxin/Furans (D/Fs)

Duplicate precision was assessed using both environmental sample and associated duplicates and matrix spike/matrix spike duplicates (MS/MSD).

Tabulation of the results of assessing duplicate precision and duplicate frequency is presented in Table 2-1. Tabulation of the results assessing precision based on the reproducibility between spike sample/duplicate sample pairs is presented in Table 2-2.

2.1 Groundwater Matrix

The assessment of groundwater matrix environmental samples and associated duplicates for precision is provided in Table 2-1. The dioxin/furan analysis of the field duplicate pair, G6W002/G6W002D exhibited a compliant RPD for the only congener detected, OCDD. The assessment of precision based on the reproducibility of results between matrix spike and matrix spike duplicate pairs is provided in Table 2-2. The MS/MSD pair, G6W001, were in compliance with RPD precision criteria.

Based on assessment of duplicate precision evaluation criteria, the soil boring sample matrix analytical data was acceptable for precision for each SDG.

TABLE 2 - 1
2,3,7,8-SUBSTITUTED DIOXIN/FURANS
GROUNDWATER DUPLICATE PRECISION
NCBC GULFPORT SITE 8

SDG	SAMPLE ID	MATRIX	NO. ASSC. SAMPLES	COMPOUND	SAMPLE CONC.	DUP CONC	MAX RPD	RPD
G8231	G6W002	WATER	3	OCDD	147	112	35%	27%
	TOTAL SAMPLES		3					

% OF DUPLICATES COLLECTED	RPD IN	RPD OUT	% WITHIN RPD LIMIT
33.3%	1	0	100.0%

TABLE 2 - 2
2,3,7,8-SUBSTITUTED DIOXIN/FURANS
GROUNDWATER MATRIX SPIKE/MATRIX SPIKE DUPLICATES
NCBC GULFPORT SITE 8

MS = MATRIX SPIKE *SAMPLE G6W001*		SDG G8231		
MSD = MATRIX SPIKE DUPLICATE		MS	MSD	
RPD = RELATIVE PERCENT DIFFERENCE		%R	%R	%RPD
DIOXIN/FURAN CONGENERS	UNITS			
2,3,7,8-TCDD	pg/L	96	93	3%
2,3,7,8-TCDF	pg/L	98	103	5%
1,2,3,7,8-PeCDD	pg/L	94	101	7%
1,2,3,7,8-PeCDF	pg/L	99	103	4%
2,3,4,7,8-PeCDF	pg/L	94	97	3%
1,2,3,4,7,8-HxCDD	pg/L	100	108	8%
1,2,3,6,7,8-HxCDD	pg/L	102	103	1%
1,2,3,7,8,9-HxCDD	pg/L	114	117	3%
1,2,3,4,7,8-HxCDF	pg/L	104	105	1%
1,2,3,6,7,8-HxCDF	pg/L	106	107	1%
2,3,4,6,7,8-HxCDF	pg/L	109	108	1%
1,2,3,7,8,9-HxCDF	pg/L	107	107	0%
1,2,3,4,6,7,8-HpCDD	pg/L	103	101	2%
1,2,3,4,6,7,8-HpCDF	pg/L	115	104	10%
1,2,3,4,7,8,9-HpCDF	pg/L	122	104	16%
OCDD	pg/L	101	92	9%
OCDF	pg/L	100	97	3%

* DENOTES VALUE NOT WITHIN QA/QC ADVISORY LIMITS

CORRESPONDING SDG'S AND ASSOCIATED SAMPLES

G8231: G6WRI, G6W001, G6W002, G6W002D, G6W003, G6W004

3.0 ACCURACY

The assessment of accuracy is evaluated by comparison of the percent recoveries (%R) computed from the known concentration of analyte spikes and their recovered concentration versus the analytical method acceptance criteria. Spike recoveries provide an indication of bias, where the reported data may either overestimate or underestimate the actual concentration of detected compounds and/or the detection limits. Recoveries outside acceptable criteria may be caused by factors such as matrix interference, poor analytical precision, or instrument calibration.

The following Sections summarize the evaluation of analytical accuracy for the field groundwater samples for the following analytical groups:

- 2,3,7,8-Substituted Dioxin/Furans (D/Fs)

Accuracy was assessed using MS and MSD samples for dioxin/furan analyses as well as internal standard recoveries. The results of the evaluation of accuracy for the MS/MSD sample is provided in Tables 2-2. The results of the evaluation of accuracy for the internal standard recoveries in the field samples is provided in Table 3-1.

3.1 Groundwater Matrix

The MS/MSD sample pair analyzed for dioxin/furans (Table 2-2) exhibited "in-control" recovery results. In addition, all internal standard recoveries for the dioxin/furans were acceptable (Table 3-1).

Based on an overall assessment of MS/MSD and internal standard sample accuracy evaluation criteria, the groundwater matrix analytical data was acceptable for each SDG.

TABLE 3-1
INTERNAL STANDARD RECOVERIES
DIOXIN/FURAN CONGENERS
NCBC GULFPORT SITE 8

SDG	SAMPLE IDs	ISTD1	ISTD2	ISTD3	ISTD4	ISTD5	ISTD6	ISTD7	ISTD8	ISTD9	TOTAL OUT
G8231	G6WRI	77.4%	63.4%	81.9%	98.6%	75.6%	89.1%	96.5%	96.4%	99.3%	0
	G6W001	76.9%	65.9%	73.0%	91.1%	80.0%	93.0%	99.5%	103.0%	105.0%	0
	G6W001MS	77.9%	91.6%	85.0%	84.6%	73.9%	76.5%	100.0%	86.7%	97.9%	0
	G6W001MSD	76.3%	78.0%	82.3%	79.5%	79.6%	85.1%	111.0%	105.0%	107.0%	0
	G6W002	91.1%	73.8%	90.4%	112.0%	88.9%	112.0%	104.0%	105.0%	99.8%	0
	G6W002D	85.4%	81.2%	88.6%	103.0%	86.6%	99.9%	102.0%	103.0%	93.4%	0
	G6W003	87.1%	74.6%	90.1%	110.0%	81.1%	102.0%	101.0%	107.0%	94.5%	0
	G6W004	86.3%	80.4%	82.4%	116.0%	94.8%	101.0%	98.4%	103.0%	95.1%	0

ISTD1 = 13C-2,3,7,8-TCDD
ISTD2 = 13C-2,3,7,8-TCDF
ISTD3 = 13C-1,2,3,7,8-PeCDD
ISTD4 = 13C-1,2,3,7,8-PeCDF
ISTD5 = 13C-1,2,3,6,7,8-HxCDD
ISTD6 = 13C-1,2,3,4,7,8-HxCDF
ISTD7 = 13C-1,2,3,4,6,7,8-HpCDD
ISTD8 = 13C-1,2,3,4,6,7,8-HpCDF
ISTD9 = 13C-OCDD

WATERS:

QC LIMITS 40% - 135%

*** - INDICATES VALUE OUTSIDE QC LIMITS**

# SAMPLES		% REC IN	%REC OUT	% TOTAL IN
8		72	0	100.0%

4.0 REPRESENTATIVENESS

Representativeness of the environmental sample analytical data was assessed using method blanks and rinseate blanks and determining if holding time requirements were met. The environmental samples and associated blanks were analyzed for the following target analyte groups:

- 2,3,7,8-Substituted Dioxin/Furans (D/Fs)

Equipment rinseate blanks and laboratory method blanks were analyzed for dioxin/furans. The assessment of representativeness is summarized in tabular form for each type of blank, method blank results are summarized in Table 4-1 and equipment rinseate blank results are summarized in Table 4.2.

If contaminants were detected in a blank, corrective actions were made for the chemical analytical data during data validation by Heartland. The corrective action consisted of amending the laboratory reported results for organic and inorganic target analytes by the criteria. The following describes the Validation Qualifier code in the blank summary tables.

Organic Target Analytes

- CRQL Validation Qualifier. If a sample result for the blank contaminant was less than the CRQL and less than 10 times (for common contaminants) or 5X (for all other contaminants) the blank value, the sample result was rejected and amended as estimated non-detected at the CRQL for the target compound.

- U Validation Qualifier. If a sample result for the blank contaminant was greater than the sample CRQL and less than 10 times (for common contaminants) or 5X (for all other contaminants) the blank value, the sample result for the blank contaminant was amended as non detect at the concentration reported in the sample results.

- No Action (NA). If a sample result for the blank contaminant was greater than the CRQL and 10 times (for common contaminants) or 5X (for all other contaminants) the blank value, the result was not amended.

4.1 Method Blanks

The method blanks were a sample of deionized water that is prepared by the laboratory at the time of analysis. Method blanks undergo the same analytical process as the corresponding environmental samples and associated field blanks. The purpose of the method blank is to assess the potential for target analytes to "contaminate" the sample during analysis. Dioxin/furan target congeners were not detected in method blank samples (Table 4-1).

Based on the assessment of the trip blanks for representativeness, the analytical data was acceptable for each SDG.

4.2 Equipment Rinseate Blanks

The equipment rinseate blank was collected by rinsing a piece of sampling equipment with organic free deionized water. A sample of this water was collected and placed in sample containers similar to those used for the environmental samples. Dioxin/furans were not detected in equipment rinseate blank sample (Table 4-2).

Based on assessment of equipment rinseate blanks for representativeness, the analytical data was acceptable for each SDG.

TABLE 4 - 1
DIOXIN/FURAN CONGENERS DETECTED IN METHOD BLANKS
NCBC GULFPORT SITE 8

SDG NUMBER	BLANK ID	RELATED ENVIRONMENTAL SAMPLES	CONTAMINANT	MB CONC.	UNITS	VALIDATION QUALIFIER
G8231	WBLK09055	ALL SAMPLES	NO CONTAMINATION FOUND			

TABLE 4 - 2
DIOXIN/FURAN CONGENERS DETECTED IN RINSEATE BLANKS
NCBC GULFPORT SITE 8

SDG NUMBER	BLANK ID	RELATED ENVIRONMENTAL SAMPLES	CONTAMINANT	RB CONC.	UNITS	VALIDATION QUALIFIER
G8231	G6WRI	ALL SAMPLES	NO CONTAMINATION FOUND			

4.3 Holding Times

Holding times requirements are utilized in an effort to minimize the degradation or concentration of constituents in a particular matrix over time. The stability of the constituents is determined to the best extent by the regulatory agencies. A reasonable time limit is imposed under which the samples must be extracted or prepared and then analyzed. The holding times regulations assume that the samples have been properly preserved according to the guidelines, either at the laboratory or in the field. Analytical results from samples with holding time violations are qualified as estimated, J/UJ, because of the potential of compromising the sample. If the holding time is grossly violated (>15 days) the results are qualified/rejected, J/R.

All holding time requirements, both extraction and analytical, were met by the laboratory for all fractions.

5.0 COMPARABILITY

Comparability is a qualitative measure designed to express the confidence with which one data set may be compared to another. The analytical samples were collected and transported to the chemical analytical laboratory in accordance with standard procedures and were analyzed in conformance with acceptable USEPA procedures (Refer to Table 5-1 below). The analytical data are reported in standard units (micrograms per liter, micrograms per kilogram, etc.).

The methods used to collect the environmental samples and the methods used to analyze the samples should assure comparability of the analytical data.

TABLE 5-1
USEPA Procedures (SW-846 Methodologies)

U.S. EPA Method	Description
SW846 8290	High Resolution Dioxin/Furans

6.0 COMPLETENESS

Completeness is the quantitative measure of the amount of data obtained from a measurement process compared with the amount expected to be obtained under the conditions of measurement. The completeness goal for laboratory analysis for this project was 95 percent useable data. Unusable analytical data are those results reported by the laboratory but rejected during the data validation process. A summary of the completeness goal for NCBC Gulfport, Site 8 is provided in Table 6-1.

TABLE 6-1
COMPLETION GOAL (>85%)

	QC	GW	OVERALL
Dioxin/Furans	100.0	100.0	100.0

MATRIX KEY
QC = QC Samples
GW = Groundwater Samples

The completeness goal of 95% for each fraction of analytical data for each matrix was met.

7.0 PARCC SUMMARY

The purpose of evaluating the quality of the analytical data using the PARCC criteria was to address the qualification of the data in regards to evaluation of the presence, magnitude and characteristics of hazardous substances at NCBC Gulfport, Site 8. Overall, the chemical analytical data are acceptable and exceeded the completion goal of 95 percent for the Dioxin/Furan fraction. Tables 7-1 and 7-2 provides a tabulation of the assessment of PARCC criteria each SDG for the water samples and quality control samples, respectively.

7.1 QC Samples

No analytical data points were rejected. The completion goal was met.

7.2 Soil Boring Samples

No analytical data points were rejected. The completion goal was met.

TABLE 7 - 1
PARCC CRITERIA SUMMARY
GROUNDWATER SAMPLES
NCBC GULFPORT, SITE 8

SDGs	PRECISION	ACCURACY	REPRESENT-ATIVENESS	COMPARABILITY	COMPLETENESS
G8231	ACCEPTABLE	ACCEPTABLE	ACCEPTABLE	ACCEPTABLE	ACCEPTABLE

TABLE 7 - 2
PARCC CRITERIA SUMMARY
QUALITY CONTROL SAMPLES
NCBC GULFPORT, SITE 8

SDGs	PRECISION	ACCURACY	REPRESENT-ATIVENESS	COMPARABILITY	COMPLETENESS
G8231	ACCEPTABLE	ACCEPTABLE	ACCEPTABLE	ACCEPTABLE	ACCEPTABLE

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