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SITE CLOSURE PLAN
SITE 6
AT NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI

Prepared for:

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February 2006

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EXECUTIVE SUMMARY

Source removal is being conducted at Site 6, a former fire fighting training area located at the Naval Construction Battalion Center Gulfport, under a Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) non-time critical removal action as part of the Navy's Installation Restoration program. The goal of the source removal action is to remove the light nonaqueous phase liquid (LNAPL) present in the subsurface, which serves as a source of contamination to the groundwater, to the maximum extent practicable.

The LNAPL initially was recovered using an interceptor trench and recovery system. This system reduced the thickness of LNAPL in site wells by about half; however, in 1999 after about four years of operation, continued recovery of LNAPL became impractical using this technology. The Navy contracted Battelle to install and operate a more aggressive multiphase extraction (MPE) system to facilitate the removal of the remaining LNAPL. The system was in operation from November 1, 2001, through October 26, 2004, during which an additional 2,330 gallons of LNAPL was recovered. The system was shut down because the rate of recovery of LNAPL decreased to only a couple of gallons per day, making the system cost prohibitive to operate.

Groundwater monitoring, being performed semiannually, was initiated March 2004 to collect data necessary to demonstrate that the contaminants of concern in the groundwater comply with Applicable or Relevant and Appropriate Requirements (ARARs) as required by CERCLA. Monitoring data were compared to the Federal maximum contaminant levels (MCLs) to evaluate compliance with Federal regulations. In addition, the State of Mississippi cleanup standards for underground storage tank (UST) sites were used to evaluate compliance with relevant State regulations. The State of Mississippi cleanup standards for UST sites are believed to be appropriate because many of the potential COCs at Site 6 are similar to those that would be found at a typical UST site, the present land use at the site is restricted, and land use will continue to be restricted in the foreseeable future. The more stringent of these two ARARs were used to determine compliance.

The groundwater plume at Site 6 is limited in size and there is no evidence of significant migration beyond the source along the predominant groundwater flow direction. Monitoring well GPT-6-4, which is located in the source area, was the only monitoring well having contaminant concentrations exceeding regulatory limits for any COC during the four monitoring events. In 2004, 1,1-dichloroethene, vinyl chloride, and *bis*(2-ethylhexyl)phthalate were detected above their respective Federal MCLs. However, groundwater monitoring data collected during the subsequent monitoring events (February 2005 and August 2005) shows no contaminants above either the Federal MCLs or the UST program cleanup standards at any monitoring well located at Site 6. Recent monitoring data also indicates that concentrations along the plume axis are decreasing and thus there is no evidence for ongoing plume expansion/migration, which would have been evidenced by increasing concentrations. The low chemical concentrations indicate that the LNAPL has been largely depleted, and is no longer acting as a significant source of contamination to the groundwater.

A comparison of natural attenuation data collected from wells located within the area of contamination to perimeter and background wells was made to evaluate whether monitored natural attenuation (MNA) is viable at the site. A correlation of MNA parameters with total petroleum hydrocarbon contamination support that natural attenuation is occurring. One line of evidence is that dissolved oxygen (DO) levels are depleted within the plume indicating biodegradation of dissolved petroleum compounds. There also is a strong correlation between levels of iron and manganese and total petroleum hydrocarbons (TPH) quantified as diesel range organics (DRO), which suggests that iron and manganese reduction are occurring. Correlations of other MNA parameters observed with respect to variations in concentrations

between contaminated and noncontaminated areas further substantiate that natural attenuation is occurring and limiting plume migration.

Based on these results, the Navy proposes to implement appropriate institutional controls at Site 6 (i.e., land use restriction and an agreed order with the Mississippi Department of Environmental Quality [MDEQ]) to address the remaining hydrocarbon contamination. No further remedial action is warranted for the following reasons:

1) LNAPL thickness monitoring data indicate that the LNAPL plume will not migrate off-site. Water table fluctuations are smearing a few inches of LNAPL over 5 feet, thus allowing slight amounts of LNAPL to appear and disappear. Under these conditions, horizontal movement of LNAPL will not occur, and recovery of LNAPL will be negligible.

2) The LNAPL has been present at the site for over 40 years. Sufficient time has elapsed to allow the LNAPL and groundwater to reach a pseudo steady-state condition. It is not expected that the groundwater plume would expand in the future, which is substantiated by the groundwater monitoring data collected thus far indicating that the dissolved-phase plume exhibits no migration.

3) Groundwater contaminant concentrations are below regulatory standards (i.e., Federal MCLs and the MDEQ cleanup goals for UST sites). MNA, which has been demonstrated to be occurring at the site, appears to have limited contaminant migration.

The Navy also proposes to develop a long-term monitoring plan for postremediation monitoring. Groundwater monitoring should be continued on a semiannual basis for volatile organic compound (VOC) and semivolatile organic compound (SVOC) analyses until two consecutive monitoring events show that contaminant concentrations continue to be less than the ARARs. Once groundwater monitoring is complete, the site wells will be abandoned in accordance with local regulations.

CONTENTS

EXECUTIVE SUMMARY iii
FIGURES vi
TABLES vi
ACRONYMS AND ABBREVIATIONS vii

1.0: INTRODUCTION 1

2.0: EVALUATION OF HYDROCARBON RECOVERY 4
- 2.1 Hydrocarbon Recovery 4
- 2.2 Recovery Cost 5
- 2.3 LNAPL Thickness Monitoring 7

3.0: GROUNDWATER MONITORING 12
- 3.1 Hydrogeologic Data 12
- 3.2 Sampling Methods 17
- 3.3 Chemicals of Concern in Groundwater 18
- 3.4 Natural Attenuation Assessment 23
- 3.5 Data Validation 27

4.0: CONCLUSIONS AND RECOMMENDATIONS 28

5.0: REFERENCES 29

ATTACHMENTS

ATTACHMENT 1: Graphs Showing LNAPL Thickness and Groundwater Elevation Measured in Extraction Wells EW-1 Through EW-23 and Monitoring Wells GPT-6-1 Through GPT-6-8 Over Time
ATTACHMENT 2: Graphs Showing Contaminant Concentrations for Contaminants Over Time
ATTACHMENT 3: Site Maps Showing Natural Attenuation Indicator Data in Conjunction with the TPH-Dissolved-Phase Plume for February 2005
ATTACHMENT 4: Site Maps Showing Natural Attenuation Indicator Data in Conjunction with the TPH-Dissolved-Phase Plume for August 2005
ATTACHMENT 5: Graphs Showing TPH Concentrations vs Natural Attenuation Indicator Concentrations, February 2005
ATTACHMENT 6: Graphs Showing TPH Concentrations vs Natural Attenuation Indicator Concentrations, August 2005

APPENDICES

APPENDIX A: Analytical Results for February 2005
APPENDIX B: Analytical Results for August 2005
APPENDIX C: Data Validation Reports for February 2005
APPENDIX D: Data Validation Reports for August 2005

FIGURES

Figure 1-1. Location of Site 6 2
Figure 1-2. Site Layout 3
Figure 2-1. Cumulative Mass of Hydrocarbons Removed During Multi-Phase Extraction 5
Figure 2-2. Cost per Gallon of LNAPL Recovered Vs. Operating Time 6
Figure 2-3. Cost per Gallon LNAPL Recovered Vs. Recovery Rate 6
Figure 2-4. LNAPL Plume Maps Generated From Time Series Data Part 1 9
Figure 2-5. LNAPL Plume Maps Generated From Time Series Data Part 2 10
Figure 2-6. LNAPL Plume Maps Generated From Time Series Data Part 3 11
Figure 3-1. Groundwater Potentiometric Surface Map, February 2005 15
Figure 3-2. Groundwater Potentiometric Surface Map, August 2005 16
Figure 3-3. Historical and Recent Groundwater Sampling Results (μg/L) 22

TABLES

Table 2-1. Average LNAPL Thickness Measured In Each Well During The Past Two Months (August and September 2005) of Postoperation Monitoring 8
Table 3-1. Groundwater Elevations and LNAPL Thicknesses in Site 6 Monitoring Wells Measured on February 08, 2005 13
Table 3-2. Groundwater Elevations and LNAPL Thicknesses in Site 6 Monitoring Wells Measured on August 23, 2005 14
Table 3-3. Summary of Chemical Analyses and Laboratory Methods 17
Table 3-4. Chemical Data for Groundwater, February 2005 19
Table 3-5. Chemical Data for Groundwater, August 2005 20
Table 3-6. Analytical Results for LNAPL Samples Collected at Site 6 21
Table 3-7. Field Parameter Measurements During Groundwater Sampling, February 2005 24
Table 3-8. Field Parameter Measurements During Groundwater Sampling, August 2005 24
Table 3-9. Natural Attenuation Parameters Detected in Samples from Groundwater Monitoring Wells, February 2005 25
Table 3-10. Natural Attenuation Parameters Detected in Samples from Groundwater Monitoring Wells, August 2005 26

ACRONYMS AND ABBREVIATIONS

ARAR	Applicable or Relevant and Appropriate Requirement
bgs	below ground surface
BTEX	benzene, ethylbenzene, toluene, xylene
btoc	below top of casing
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act
COC	contaminant of concern
CPT	cone penetrometer testing
DCA	dichloroethane
DCE	dichloroethene
DO	dissolved oxygen
DTP	depth to product
DTW	depth to water
LNAPL	light, nonaqueous-phase liquid
MCL	maximum contamination level
MDEQ	Mississippi Department of Environmental Quality
MDL	method detection limit
MNA	monitored natural attenuation
MPE	multi-phase extraction
mS/cm	millisiemens per centimeter
msl	mean sea level
MS/MSD	matrix spike/matrix spike duplicate
mV	millivolt(s)
N/A	not analyzed
NA	not applicable
NAD	North American Datum
NCBC	Naval Construction Battalion Center
ND	not detected
NTU	nephelometric turbidity units
ORP	oxidation-reduction potential
OWS	oil/water separator
PAH	polycyclic aromatic hydrocarbon
PCE	tetrachloroethene
ppm	parts per million
PVC	polyvinyl chloride
RL	reporting limit
RPD	relative percent difference
RSD	relative standard deviation
SVOC	semivolatile organic compound

TCA	trichloroethane
TCE	trichloroethene
TPH	total petroleum hydrocarbons
TPH-DRO	total petroleum hydrocarbons quantified as diesel range organics
TRG	target remediation goal
U.S. EPA	United States Environmental Protection Agency
UST	underground storage tank
VOA	volatile organic analysis
VOC	volatile organic compound

Report

1.0: INTRODUCTION

The Naval Construction Battalion Center (NCBC) Gulfport is located in the City of Gulfport, in Harrison County, in the southeast corner of the State of Mississippi (Figure 1-1). The location of Site 6 within the NCBC is shown in Figure 1-1. The site layout is shown in Figure 1-2. The site is bounded by Building 383 and Fifth Street to the north, Colby Avenue to the west, Simms Avenue to the east, and Building 391 to the south. Drainage ditches are located along the western and northern boundaries, and the site is grass-covered with the exception of a small parking lot located south of Building 383.

Site 6 is a former fire-fighting training area that was operational from 1966 to 1975. Various flammable liquids were used in two burn pits at the site. Up to 500,000 gallons of waste oils, solvents, paint thinners, and cleaning compounds are suspected to have been burned in the pits. The pits were backfilled with sand and gravel when fire-fighting training activities were concluded in 1975.

A light non-aqueous phase liquid (LNAPL) plume was discovered in 1991. Removal of this LNAPL was initiated as part of the Navy's Installation Restoration Program under a CERCLA non-time critical removal action. The goal of this source removal action was to reduce the LNAPL, which served as a source of contamination to the groundwater, to the maximum extent practicable. The LNAPL was initially treated using an interceptor trench and recovery system. This system reduced the thickness of LNAPL in site wells by about half; however, after about 4 years of operation, continued recovery of LNAPL became impractical using this technology. The Navy contracted Battelle to install and operate an aggressive multiphase extraction (MPE) to facilitate the removal of the remaining LNAPL. The MPE system was in operation from November 1, 2001, through October 26, 2004, during which 2,330 gallons of LNAPL were recovered.

The MPE system was shut down in October because the rate of recovery of LNAPL decreased to only a couple of gallons per day. Groundwater monitoring, performed semiannually, was initiated March 2004 to collect data necessary to demonstrate that the contaminants of concern (COCs) in the groundwater comply with Applicable or Relevant and Appropriate Requirements (ARARs) as required by CERCLA. Monitoring data were compared to the Federal maximum contaminant levels (MCLs) to evaluate compliance with Federal regulations. In addition, the State of Mississippi cleanup standard for UST sites was used to determine compliance with relevant State regulations. The State of Mississippi cleanup standards for UST sites are believed to be appropriate because many of the potential COCs at Site 6 are similar to those that would be found at a typical UST site, present land use at the site is restricted, and land use will continue to be restricted in the foreseeable future. The more stringent of the two ARARs were used to determine compliance.

Results of these activities are presented in this report. The specific objectives of this report are (1) *to document that source removal is complete and (2) to demonstrate that no further active groundwater remediation is necessary.* Product recovery results using the MPE system are presented in Section 2. This section documents that the LNAPL recovery has been achieved to the maximum extent practicable and describes the nature and extent of the LNAPL that is remaining at the site. Section 3 describes the results of the groundwater monitoring that have been performed and documents that the dissolved-phase plume has been significantly reduced, exhibits limited plume migration, and that the COCs are in compliance with site ARARs. Section 4 provides conclusions and recommendations for future activities and the recommended path forward for site closure.

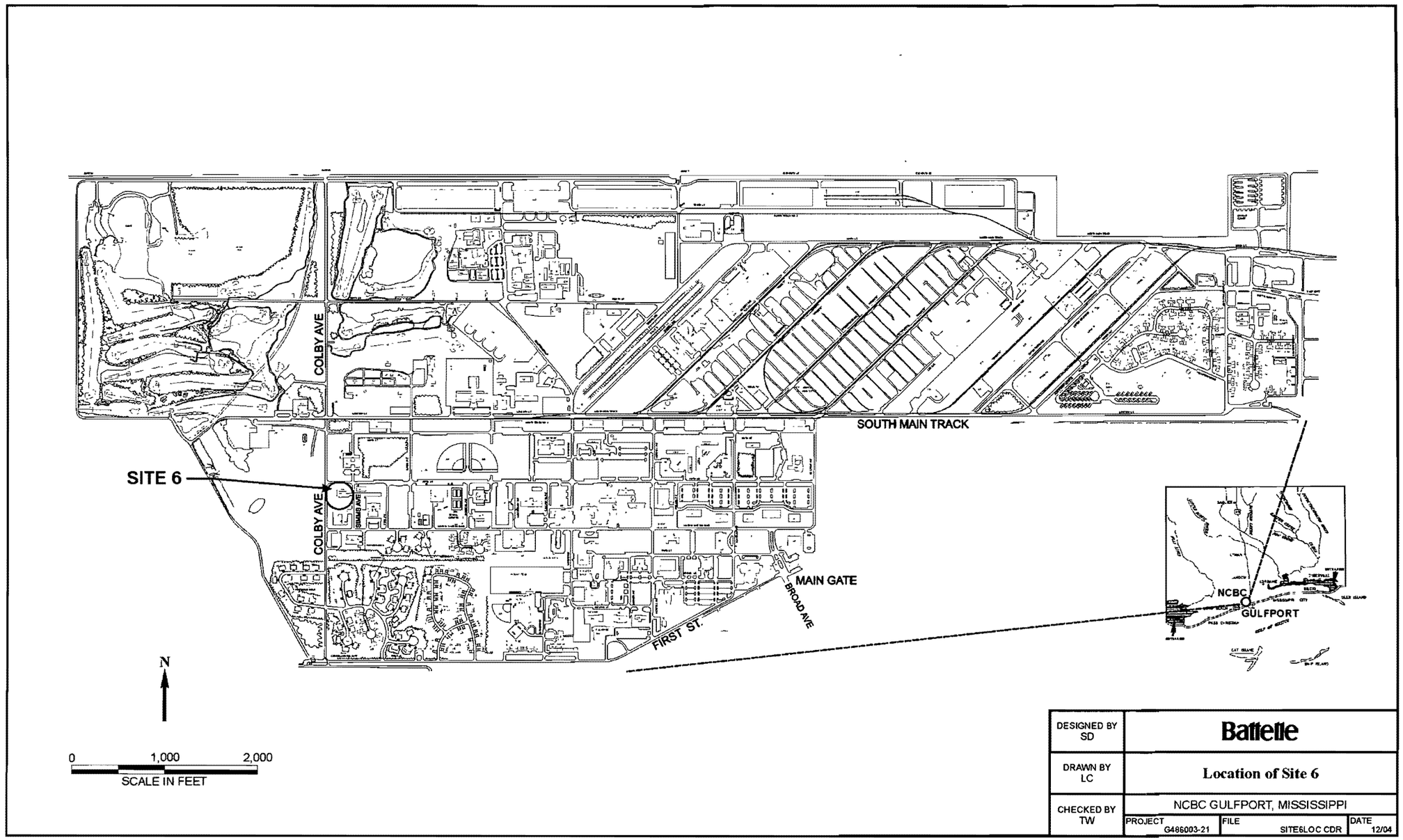


Figure 1-1. Location of Site 6

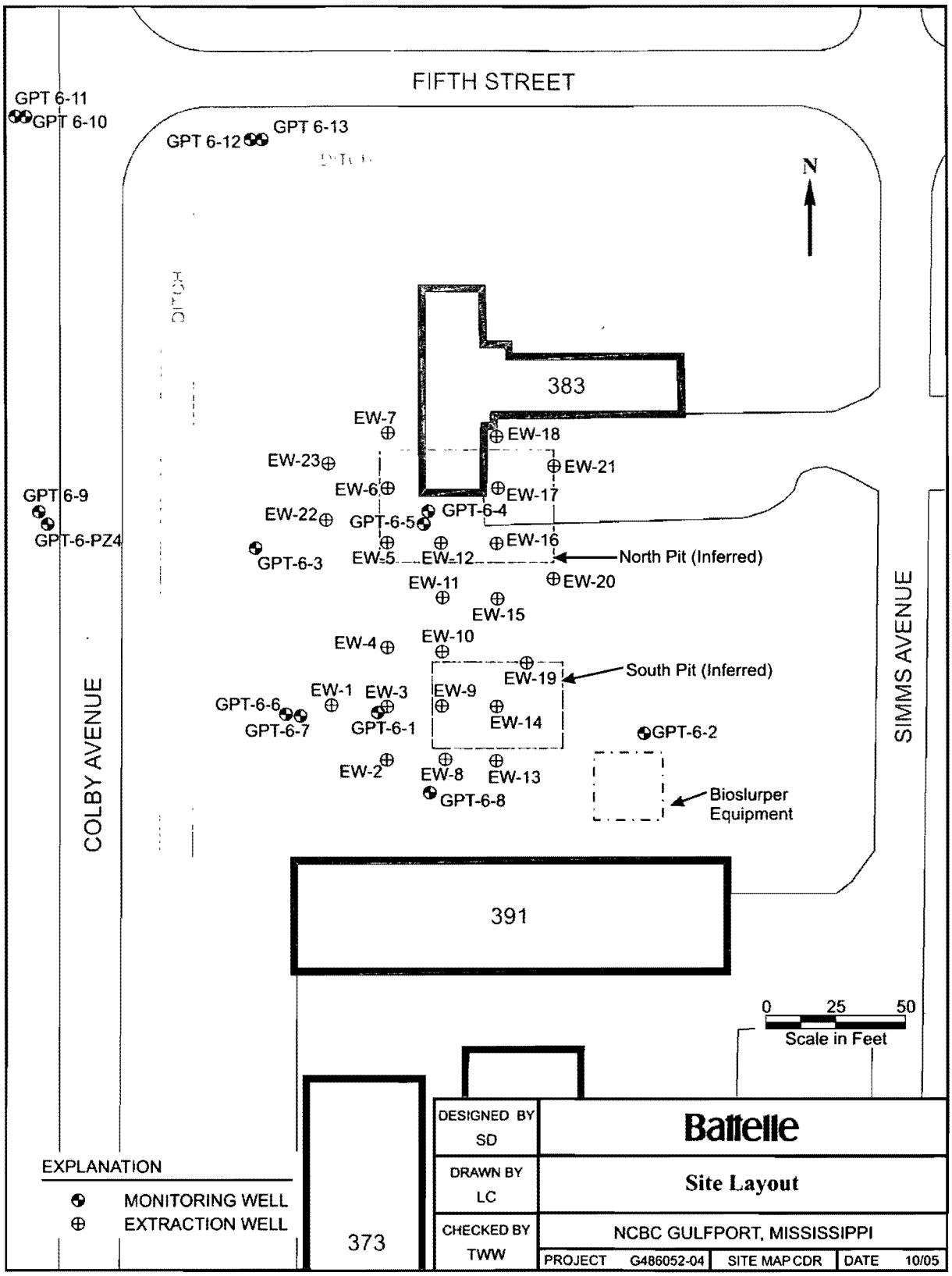


Figure 1-2. Site Layout

2.0: EVALUATION OF HYDROCARBON RECOVERY

The recovery of LNAPL at Site 6 has been performed to the "maximum extent practicable" in accordance with Mississippi Department of Environmental Quality (MDEQ) regulations (MDEQ, 1989). Two remedial actions have been performed at the site. The first was the installation and operation of an interceptor recovery system, which was installed in 1995. The system included a recovery trench located east of the drainage ditch on the east side of Colby Avenue, with three recovery wells and associated pumps. The aboveground treatment system included an oil/water separator (OWS), an oil storage tank, an air stripper, and associated pumps, blowers, and controls. The system was operated for approximately four years, until 1999. At this time, it was decided that the system was no longer an efficient or cost-effective method to recover the remaining LNAPL, and operation was discontinued. The average LNAPL thickness in the extraction wells decreased by 50% during the period of operation.

The second remedial action was to install and operate an MPE system for the purpose of recovering the remaining LNAPL to the "maximum extent practicable" in accordance with MDEQ regulations. MPE systems are designed to aggressively recover hydrocarbons in the form of LNAPL, remove TPH dissolved and/or emulsified in the groundwater, and remove it via a portion in the vadose zone through soil vapor extraction.

The installation and startup of the MPE system were completed at the end of October 2001. The system operated from November 1, 2001, through October 26, 2004, during which the system operated 14,900 hours and recovered 2,330 gallons of LNAPL. During the first three months of operation, recovery of LNAPL averaged about 300 gal/month. However a significant decrease in recovery was observed over time. In order to improve recovery, six additional extraction wells were installed during April 2002. Also, because it was observed that the recovery of LNAPL was greatest during periods of low water table elevation, beginning November 2002, the system has only been operated about nine months each year, corresponding to the drier season. Although these activities did result in the improved recovery of LNAPL, the rate of recovery continued to decrease to only a few gallons per day during the subsequent months of operation. Therefore, a decision was made to discontinue operation of the system. The system has remained off since October 26, 2004.

This section demonstrates that the LNAPL has been recovered to the maximum extent practicable by presenting the hydrocarbon recovery results, combined with an analysis of the LNAPL that remains at the site, along with the cost incurred to recover these hydrocarbons.

2.1 Hydrocarbon Recovery

The mass of hydrocarbons removed as LNAPL as well as in the aqueous and vapor streams are regularly monitored and are presented in Figure 2-1. During the three years of operation of the MPE system, 2,330 gallons of LNAPL were removed. As shown on the figure, the LNAPL recovery decreased significantly after the first few months of operation as the majority of recoverable LNAPL was removed from the site. The system was shut down for periods during times of high groundwater table elevation, which tends to inhibit LNAPL recovery and determines if recharge of LNAPL into site wells occurs during extended periods of shutdown. As can be seen from Figure 2-1, there was an initial spike in recovery immediately after each time the system was restarted; however, within a couple of weeks of startup, recovery returned to a level at which it was no longer cost-effective to continue operation.

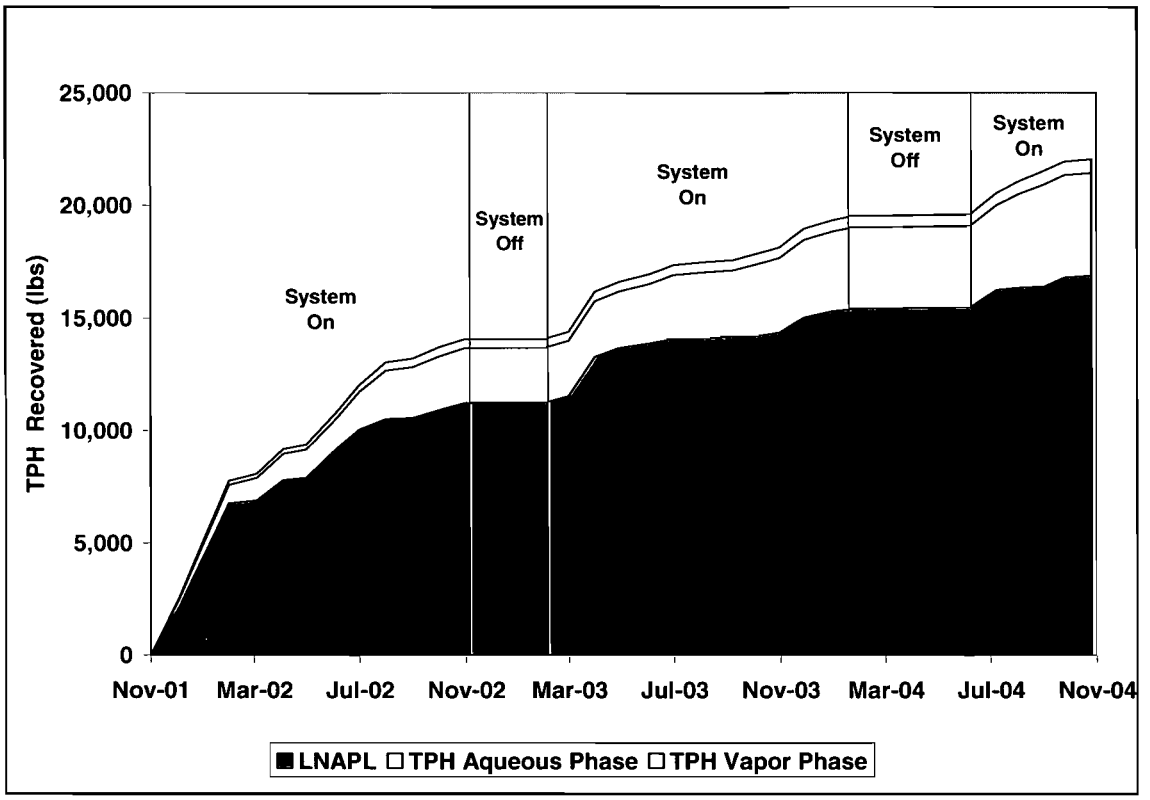


Figure 2-1. Cumulative Mass of Hydrocarbons Removed During Multi-Phase Extraction

In addition to the volume of free-phase LNAPL, the mass of dissolved/emulsified petroleum hydrocarbons in the aqueous stream and the mass of petroleum hydrocarbons recovered in the off-gas were calculated and are presented in Figure 2-1, as these components also are key elements of the total mass removal. An additional 707 gallons (5,130 lbs) of hydrocarbons, representing about 23% of the total hydrocarbons recovered, were removed in the vapor and aqueous phases.

2.2 Recovery Cost

Cost is a factor in technical practicability. Although it is possible that low amounts of LNAPL would be recovered if operation of the system was continued, it would not be cost-effective. An average cost per gallon of LNAPL was calculated on a semiannual basis (excluding times during which the system was shut down) and plotted in Figure 2-2. The cumulative volume of LNAPL recovered on a quarterly basis also is included on this graph, which shows the correlation between LNAPL recovery and unit cost. The costs shown in Figure 2-2 ranged from $58 to $254 per gallon of LNAPL recovered, exhibiting an exponentially increasing trend as the recovery of LNAPL decreases. This graph predicts that if operation were to continue, a significant increase in unit cost would occur as less and less LNAPL is recovered. The cost per gallon of LNAPL recovered was correlated with the monthly LNAPL recovery rate (gallons per day) and is plotted in Figure 2-3. Again, an exponentially increasing trend is observed as the LNAPL recovery rate decreases to zero. When the LNAPL recovery rate is less than two gallons per day, the unit cost quickly increases from a little less than $200 per gallon to over $1,000 per gallon of LNAPL recovered.

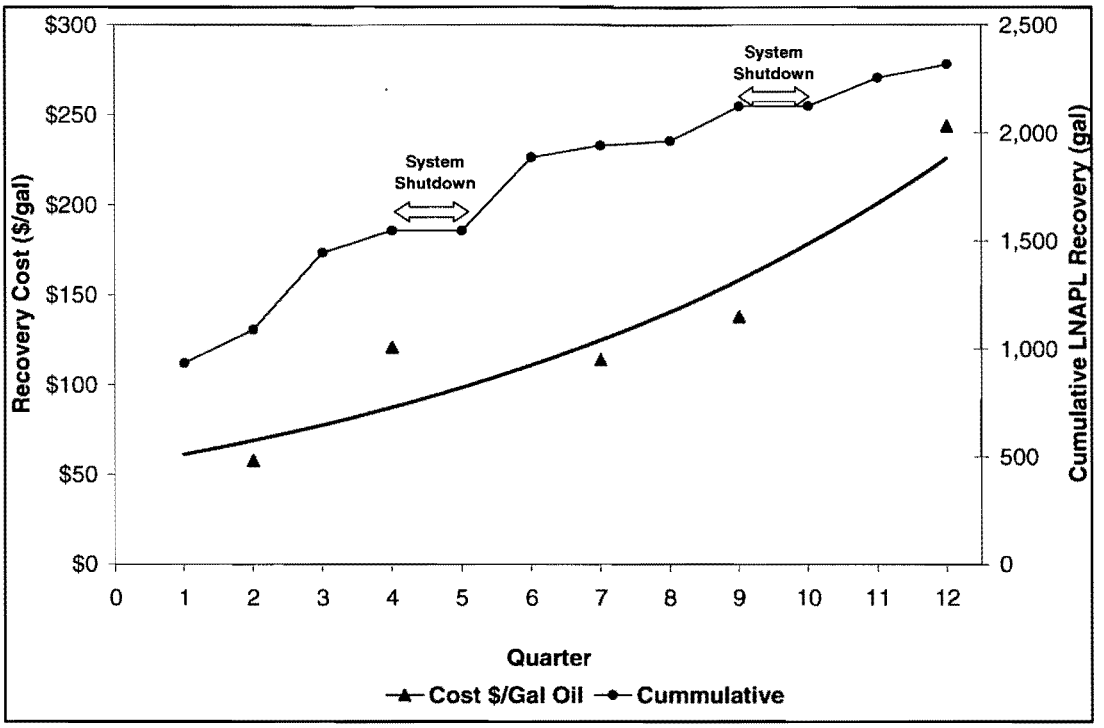


Figure 2-2. Cost per Gallon of LNAPL Recovered Vs. Operating Time

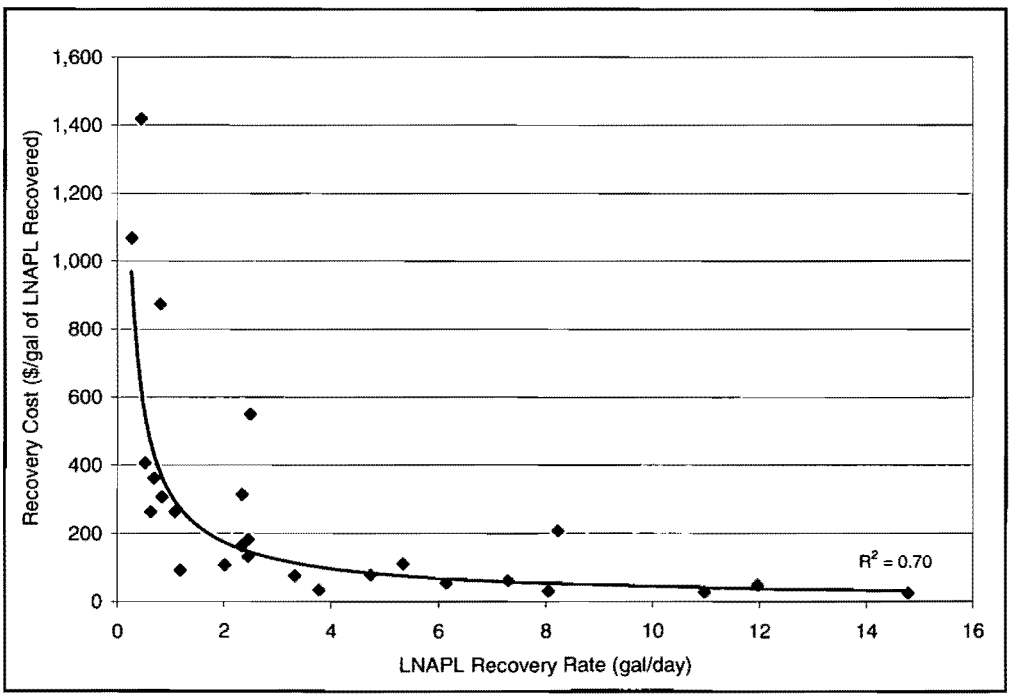


Figure 2-3. Cost per Gallon LNAPL Recovered Vs. Recovery Rate

2.3 LNAPL Thickness Monitoring

Groundwater level and product thickness were measured frequently from the extraction wells throughout MPE and subsequent long-term groundwater monitoring. The thickness of LNAPL in wells was monitored to track the effectiveness of removal activities and monitor changes in groundwater elevation.

Table 2-1 presents LNAPL thickness measurements taken between July and September 2005, after discontinuing operation of the MPE system. Graphs showing LNAPL thickness and groundwater elevation measured in extraction wells EW-1 through EW-23 and monitoring wells GPT-6-1 through GPT-6-8 over time are included as Attachment 1. During operation of the MPE system, the appearance of LNAPL appears to be sporadic; for example, LNAPL observed in a particular well during one month would not be observed in the well during the next monthly measurement. Also, during times of high water table elevations, the LNAPL thickness decreases in the wells. Fluctuations of the water table are smearing a few inches of LNAPL over 5 feet, thus allowing slight amounts of LNAPL to appear and disappear. Under these conditions, horizontal movement of LNAPL will not occur, and recovery of LNAPL will be negligible.

Figures 2-4 through 2-6 present a series of LNAPL plume maps before and after MPE. During operation, the LNAPL thickness has decreased in many of the wells located at the site; however, some rebound has been observed since shutting the system down. A visual analysis of these plume maps indicates that size and shape of the LNAPL plume has not changed significantly in recent monitoring events, which indicates that LNAPL does not appear to be migrating off site. After almost one year following shutdown of the system, LNAPL has not appeared in either GPT-6-6 or GPT-6-3, the two wells located closest to the ditch, and in 14 other extraction wells located around the LNAPL plume.

Table 2-1. Average LNAPL Thickness Measured In Each Well During The Past Two Months (August and September 2005) of Postoperation Monitoring

Well ID	8/16/2005	8/23/2005	9/16/2005	9/30/2005	Average Thickness in Well (ft)
EW-1	0.14	0.15	0.17	0.15	**0.15**
EW-2	0.00	0.00	0.00	0.00	**0.00**
EW-3	0.00	0.00	0.00	0.00	**0.00**
EW-4	0.00	0.00	0.00	0.00	**0.00**
EW-5	0.00	0.01	0.00	0.00	**0.00**
EW-6	0.00	0.00	0.00	0.00	**0.00**
EW-7	0.84	0.37	0.48	0.52	**0.55**
EW-8	0.17	0.16	0.26	0.07	**0.17**
EW-9	0.00	0.00	0.00	0.00	**0.00**
EW-10	0.02	0.17	0.11	0.05	**0.09**
EW-11	0.00	0.00	0.00	0.00	**0.00**
EW-12	0.88	0.23	0.24	0.31	**0.42**
EW-13	0.24	0.15	0.03	0.03	**0.11**
EW-14	0.00	0.01	0.00	0.00	**0.00**
EW-15	1.27	0.17	0.17	0.20	**0.45**
EW-16	0.00	0.01	0.00	0.00	**0.00**
EW-17	0.02	0.01	0.02	0.03	**0.02**
EW-18	0.00	0.00	0.00	0.02	**0.01**
EW-19	0.49	0.29	0.14	0.15	**0.27**
EW-20	0.00	0.00	0.00	0.00	**0.00**
EW-21	0.00	0.00	0.00	0.00	**0.00**
EW-22	0.00	0.02	0.20	0.20	**0.11**
EW-23	0.55	0.46	0.08	0.19	**0.32**
GPT-6-1	0.00	0.00	0.00	0.00	**0.00**
GPT-6-2	0.00	0.00	0.00	0.00	**0.00**
GPT-6-3	0.00	0.00	0.00	0.00	**0.00**
GPT-6-4	0.00	0.00	0.00	0.00	**0.00**
GPT-6-5	0.00	0.00	0.00	0.00	**0.00**
GPT-6-6	0.00	0.00	0.00	0.00	**0.00**
GPT-6-7	0.00	0.00	0.00	0.00	**0.00**
GPT-6-8	0.12	0.14	0.05	0.07	**0.10**
Site Average	**0.15**	**0.08**	**0.06**	**0.06**	**0.09**

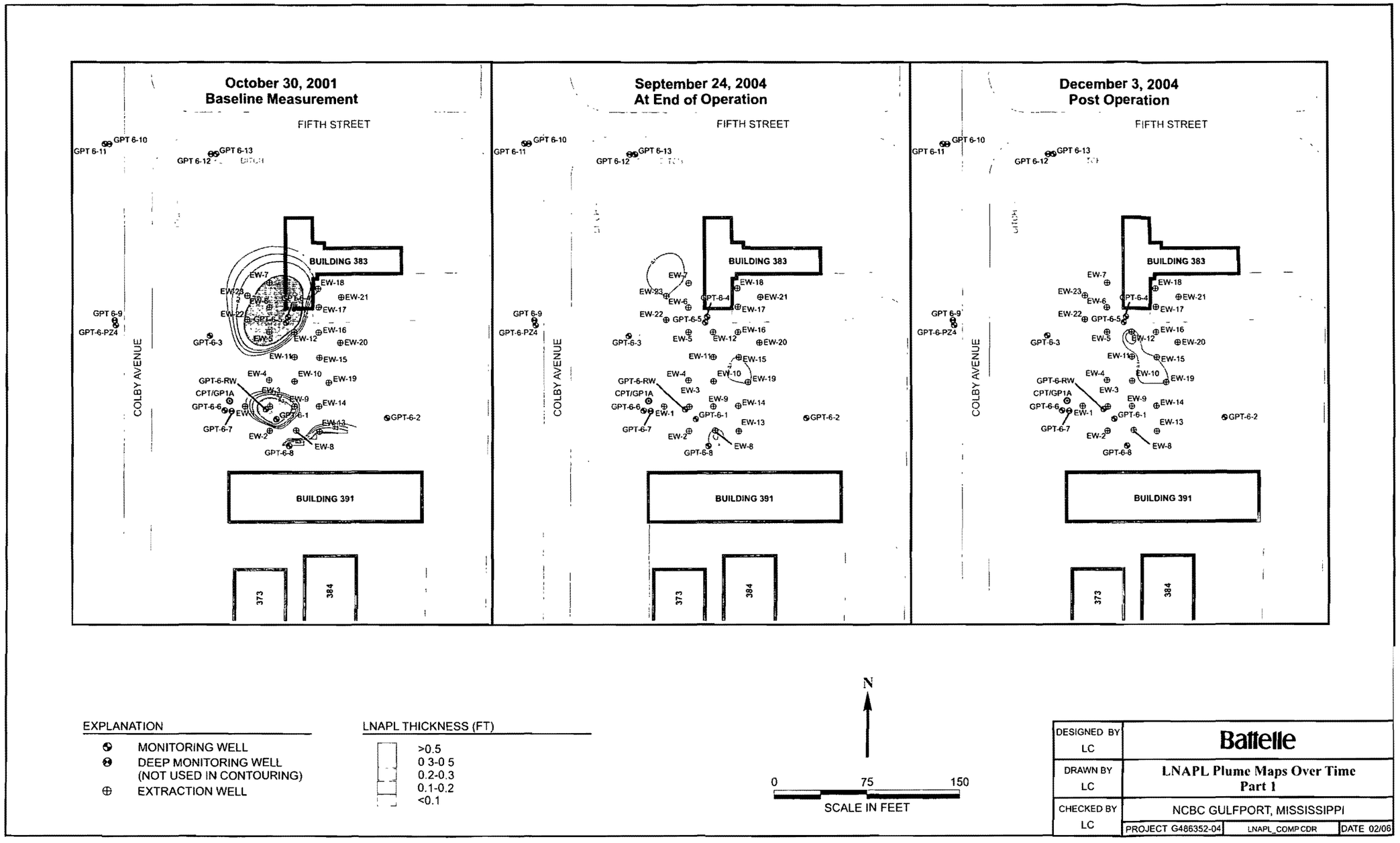


Figure 2-4. LNAPL Plume Maps Generated From Time Series Data Part 1

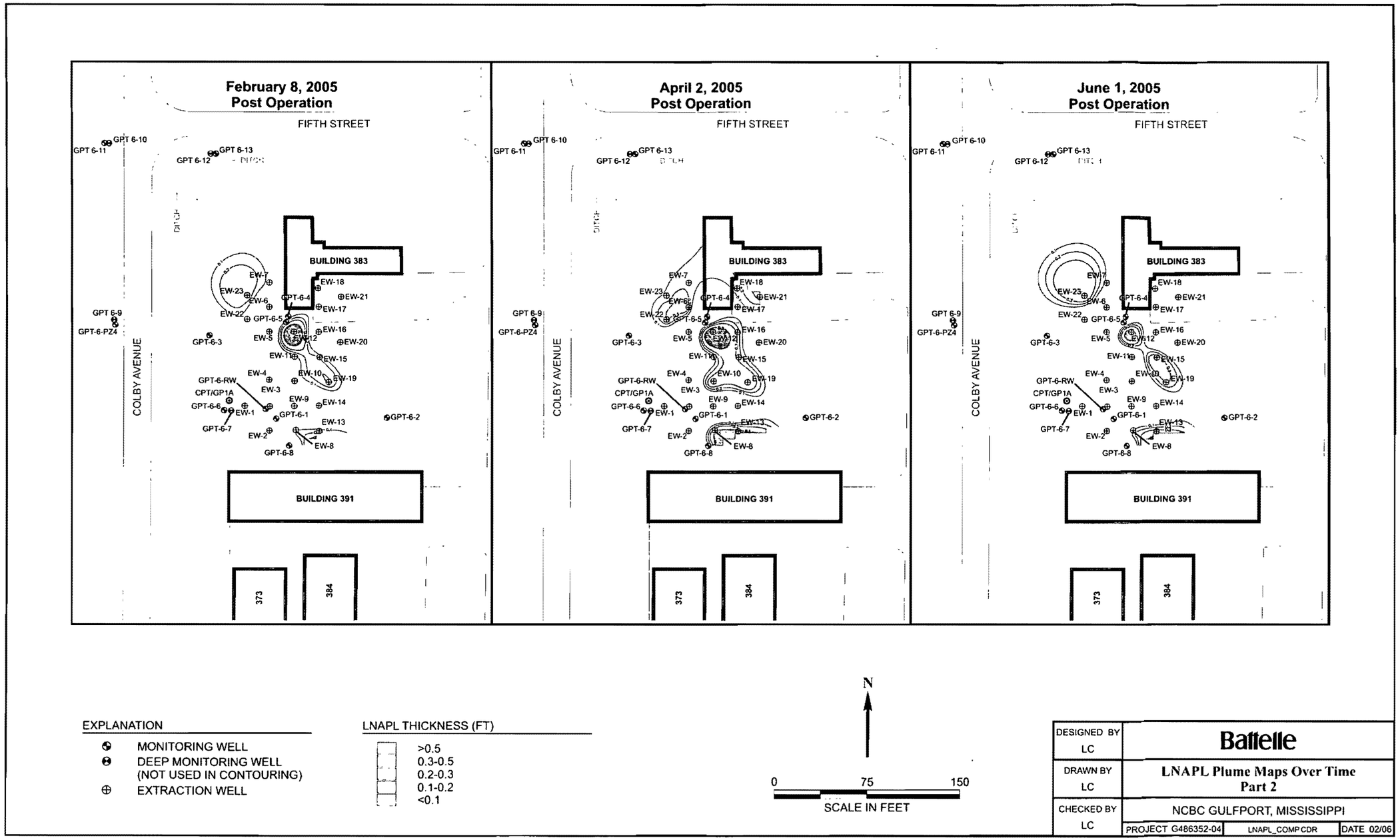
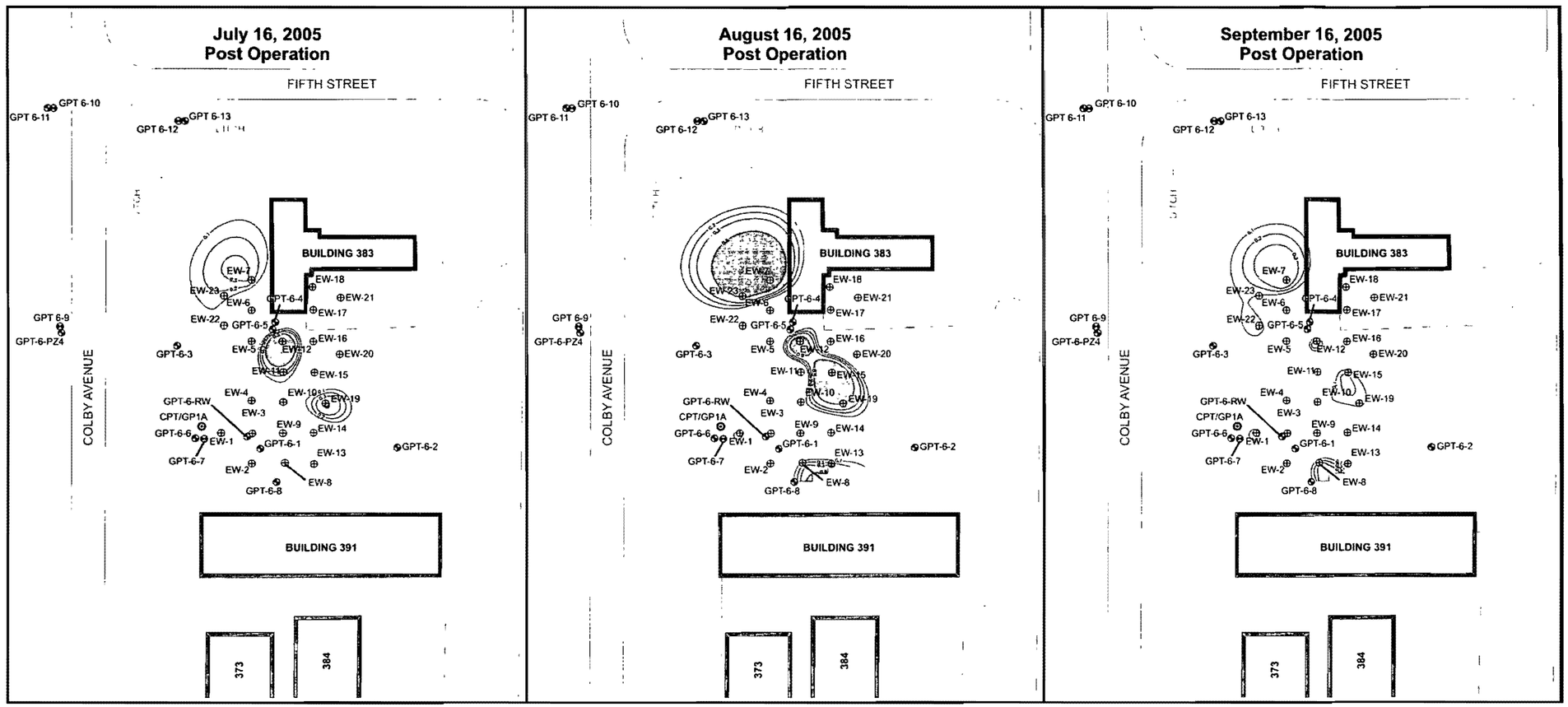


Figure 2-5. LNAPL Plume Maps Generated From Time Series Data Part 2



EXPLANATION

- MONITORING WELL
- DEEP MONITORING WELL (NOT USED IN CONTOURING)
- EXTRACTION WELL

LNAPL THICKNESS (FT)

- >0.5
- 0 3-0.5
- 0.2-0.3
- 0.1-0.2
- <0.1

N

0 75 150

SCALE IN FEET

DESIGNED BY LC	Battelle
DRAWN BY LC	LNAPL Plume Maps Over Time Part 3
CHECKED BY LC	NCBC GULFPORT, MISSISSIPPI
	PROJECT G486352-04 · LNAPL_COMP.CDR · DATE 02/06

Figure 2-6. LNAPL Plume Maps Generated From Time Series Data Part 3

3.0: GROUNDWATER MONITORING

Groundwater monitoring was performed to characterize the nature and extent of dissolved-phase contamination and to evaluate the feasibility of natural attenuation to address the remaining dissolved-phase contamination. An initial investigation was performed in March 2004, during which the dissolved-phase plume was delineated. The results of the investigation have been presented in detail in the dissolved-phase plume delineation report for Site 6 (Battelle, 2004a). During this field investigation, contaminants of concern in the source area were identified by collecting groundwater samples from the site monitoring wells and from groundwater samples collected from temporary direct-push locations both upgradient and downgradient of the LNAPL plume for volatile organic compounds (VOCs) analysis following U.S. EPA Method 8260. Cone penetrometer testing (CPT) and soil sample collection using a Geoprobe® also was performed to collect in situ lithologic information across the site and determine the depth to the silty-clay unit and verify its presence.

The results of the March 2004 investigation indicated that the silt-clay layer is continuous across the site and occurs approximately 26 to 29 ft bgs. The analytical results were compared to the Federal MCLs and the Mississippi cleanup standards for UST sites. 1,1-DCE and vinyl chloride were the only contaminants present at levels above their respective Federal MCLs (U.S. EPA, 2002). No contaminant concentrations were observed above the Mississippi cleanup goals for UST sites. Elevated concentrations of 1,1-DCE were detected in one Geoprobe sampling location downgradient of the free-phase LNAPL and in monitoring well GPT-6-4, which is located in the source area. Vinyl chloride occurred at levels above its Federal MCL only in monitoring well GPT-6-4. The investigation concluded that the dissolved-phase contamination was limited in size and recommended locations for additional monitoring wells downgradient from the site to confirm that dissolved-phase contaminants were not migrating off-site (Battelle, 2004a). The locations of the new wells (GPT-6-9, GPT-6-10, GPT-6-11, GPT-6-12, and GPT-6-13) are shown on Figure 3-1.

Three groundwater sampling events have taken place since the March 2004 investigation. The first occurred in October 2004, shortly before the operation of the MPE system ended. The second took place in February 2005, approximately three months following shutdown of the MPE system. The most recent event took place six months later in August 2005. Groundwater samples were collected from all Site 6 groundwater monitoring wells and analyzed for VOCs by U.S. EPA Method 8260, semivolatile organic compounds (SVOCs) by U.S. EPA Method 8270, and TPH by U.S. EPA Method 8015. Groundwater samples also were analyzed for natural attenuation indicator parameters, including alkalinity, ethene, ethane, methane, nitrate, sulfate, ferrous iron, manganese, and sulfide.

The results of the October 2004 event were presented in the groundwater monitoring report prepared for the October 2004 event (Battelle, 2004b). GPT-6-4 was the only well with contaminants exceeding the Federal MCLs or Mississippi cleanup goals for UST sites. This section describes in detail the results of the groundwater sampling that took place in February and August 2005. Results of the previous investigations are presented for comparison to evaluate changes in contaminant concentrations over time.

3.1 Hydrogeologic Data

The groundwater elevations and LNAPL thicknesses measured in the groundwater monitoring wells on February 8, 2005 and August 23, 2005 are presented in Tables 3-1 and 3-2. These data were used to create potentiometric surface maps (Figures 3-1 and 3-2). As shown in these figures, the groundwater flow is generally to the west/northwest and the average hydraulic gradient is 0.003 ft/ft, which are similar to previous monitoring events.

Table 3-1. Groundwater Elevations and LNAPL Thicknesses in Site 6 Monitoring Wells Measured on February 08, 2005

Well ID	Top of Casing Elevation (ft msl)	Screen Interval (ft bgs)	DTP (ft btoc)	DTW (ft btoc)	Groundwater Elevation (ft msl)	Groundwater Elevation [a] (ft msl)	LNAPL Thickness (ft)
EW-1	29.60	5-15	5.93	5.93	23.67	23.67	0.00
EW-2	29.36	5-15	5.38	5.38	23.98	23.98	0.00
EW-3	29.68	5-15	5.67	5.67	24.01	24.01	0.00
EW-4	29.96	5-15	5.95	5.95	24.01	24.01	0.00
EW-5	29.72	5-15	5.75	5.75	23.97	23.97	0.00
EW-6	29.95	5-15	5.97	5.97	23.98	23.98	0.00
EW-7	30.15	5-15	6.18	6.22	23.97	23.96	0.04
EW-8	29.51	5-15	5.38	5.45	24.13	24.12	0.07
EW-9	29.73	5-15	5.57	5.57	24.16	24.16	0.00
EW-10	29.91	5-15	5.82	5.84	24.09	24.09	0.02
EW-11	29.81	5-15	5.78	5.8	24.03	24.03	0.02
EW-12	30.09	5-15	5.93	6.89	24.16	23.98	0.96
EW-13	29.79	5-15	5.58	5.73	24.21	24.18	0.15
EW-14	29.52	5-15	5.34	5.34	24.18	24.18	0.00
EW-15	29.72	5-15	5.63	5.81	24.09	24.06	0.18
EW-16	29.84	5-15	5.73	5.73	24.11	24.11	0.00
EW-17	28.66	5-15	5.04	5.05	23.62	23.62	0.01
EW-18	28.82	5-15	4.79	4.79	24.03	24.03	0.00
EW-19	29.54	5-15	5.38	5.69	24.16	24.10	0.31
EW-20	29.79	5-15	5.65	5.65	24.14	24.14	0.00
EW-21	28.81	5-15	4.77	4.78	24.04	24.04	0.01
EW-22	29.05	5-15	5.06	5.07	23.99	23.99	0.01
EW-23	28.97	5-15	5.02	5.31	23.95	23.89	0.29
GPT-6-1	30.67	3-27.5	6.70	6.70	23.97	23.97	0.00
GPT-6-2	30.83	3-22	6.63	6.63	24.20	24.20	0.00
GPT-6-3	27.26	3-22	3.33	3.33	23.93	23.93	0.00
GPT-6-4	31.55	2.5-12.5	7.53	7.54	24.02	24.02	0.01
GPT-6-5	31.39	26.5-31.5	7.40	7.40	23.99	23.99	0.00
GPT-6-6	29.24	2.5-12.5	5.53	5.53	23.71	23.71	0.00
GPT-6-7	30.51	39.5 - 44.5	10.97	10.97	19.54	19.54	0.00
GPT-6-8	30.57	12.5-12.5	6.52	6.52	24.05	24.05	0.00
GPT-6-9	28.75	20-30	4.75	4.75	24.00	24.00	0.00
GPT-6-10	27.87	20-30	3.96	3.96	23.91	23.91	0.00
GPT-6-11	27.94	5-15	3.98	3.98	23.96	23.96	0.00
GPT-6-12	28.38	20-30	4.53	4.53	23.85	23.85	0.00
GPT-6-13	28.06	5-15	4.22	4.22	23.84	23.84	0.00
GPT-6-PZ4	28.59	5-15	4.93	4.93	23.66	23.66	0.00

(a) Corrected groundwater elevation = TOC Elevation – ((1 - 0.81)*DTW + (0.81*DTP))
DTP = depth to product.
DTW = depth to water.
btoc = below top of casing.

Table 3-2. Groundwater Elevations and LNAPL Thicknesses in Site 6 Monitoring Wells Measured on August 23, 2005

Well ID	Top of Casing Elevation (ft msl)	Screen Interval (ft bgs)	DTP (ft btoc)	DTW (ft btoc)	Groundwater Elevation (ft msl)	Groundwater Elevation [(a)] (ft msl)	LNAPL Thickness (ft)
EW-1	29.60	5-15	6.10	6.25	23.41	23.41	0.15
EW-2	29.36	5-15	--	5.85	28.19	28.19	0.00
EW-3	29.68	5-15	--	6.15	28.45	28.45	0.00
EW-4	29.96	5-15	--	6.45	28.67	28.67	0.00
EW-5	29.72	5-15	6.22	6.23	23.44	23.44	0.01
EW-6	29.95	5-15	--	6.45	28.66	28.66	0.00
EW-7	30.15	5-15	6.63	7.00	23.38	23.38	0.37
EW-8	29.51	5-15	5.86	6.02	23.56	23.56	0.16
EW-9	29.73	5-15	--	6.09	28.51	28.51	0.00
EW-10	29.91	5-15	6.25	6.42	23.56	23.56	0.17
EW-11	29.81	5-15	6.27	6.27	23.48	23.48	0.00
EW-12	30.09	5-15	6.50	6.73	23.48	23.48	0.23
EW-13	29.79	5-15	6.07	6.22	23.63	23.63	0.15
EW-14	29.52	5-15	5.82	5.83	23.64	23.64	0.01
EW-15	29.72	5-15	6.11	6.28	23.51	23.51	0.17
EW-16	29.84	5-15	6.27	6.28	23.51	23.51	0.01
EW-17	28.66	5-15	5.55	5.56	23.05	23.05	0.01
EW-18	28.82	5-15	--	5.31	27.76	27.76	0.00
EW-19	29.54	5-15	5.90	6.19	23.52	23.52	0.29
EW-20	29.79	5-15	--	6.14	28.56	28.56	0.00
EW-21	28.81	5-15	5.42	5.42	23.34	23.34	0.00
EW-22	29.05	5-15	5.52	5.54	23.47	23.47	0.02
EW-23	28.97	5-15	5.45	5.91	23.37	23.37	0.46
GPT-6-1	30.67	3-27.5	--	7.16	29.24	23.51	0.00
GPT-6-2	30.83	3-22	--	7.09	29.41	23.74	0.00
GPT-6-3	27.26	3-22	--	3.82	26.50	23.44	0.00
GPT-6-4	31.55	2.5-12.5	8.04	8.04	23.42	23.51	0.00
GPT-6-5	31.39	26.5-31.5	--	7.90	31.39	23.49	0.00
GPT-6-6	29.24	2.5-12.5	--	5.82	28.08	23.42	0.00
GPT-6-7	30.51	39.5 - 44.5	--	10.81	28.35	19.70	0.00
GPT-6-8	30.57	12.5-12.5	6.95	7.09	23.62	23.59	0.14
GPT-6-9	28.75	20-30	--	5.38	27.67	23.37	0.00
GPT-6-10	27.87	20-30	--	4.66	26.94	23.21	0.00
GPT-6-11	27.94	5-15	--	4.69	27.00	23.25	0.00
GPT-6-12	28.38	20-30	--	5.10	27.36	23.28	0.00
GPT-6-13	28.06	5-15	--	4.76	27.11	23.30	0.00
GPT-6-PZ4	28.59	5-15	--	8.56	26.88	20.03	0.00

(a) Corrected groundwater elevation = TOC Elevation – ((1 - 0.81)*DTW + (0.81*DTP))
DTP = depth to product.
DTW = depth to water.
btoc = below top of casing.

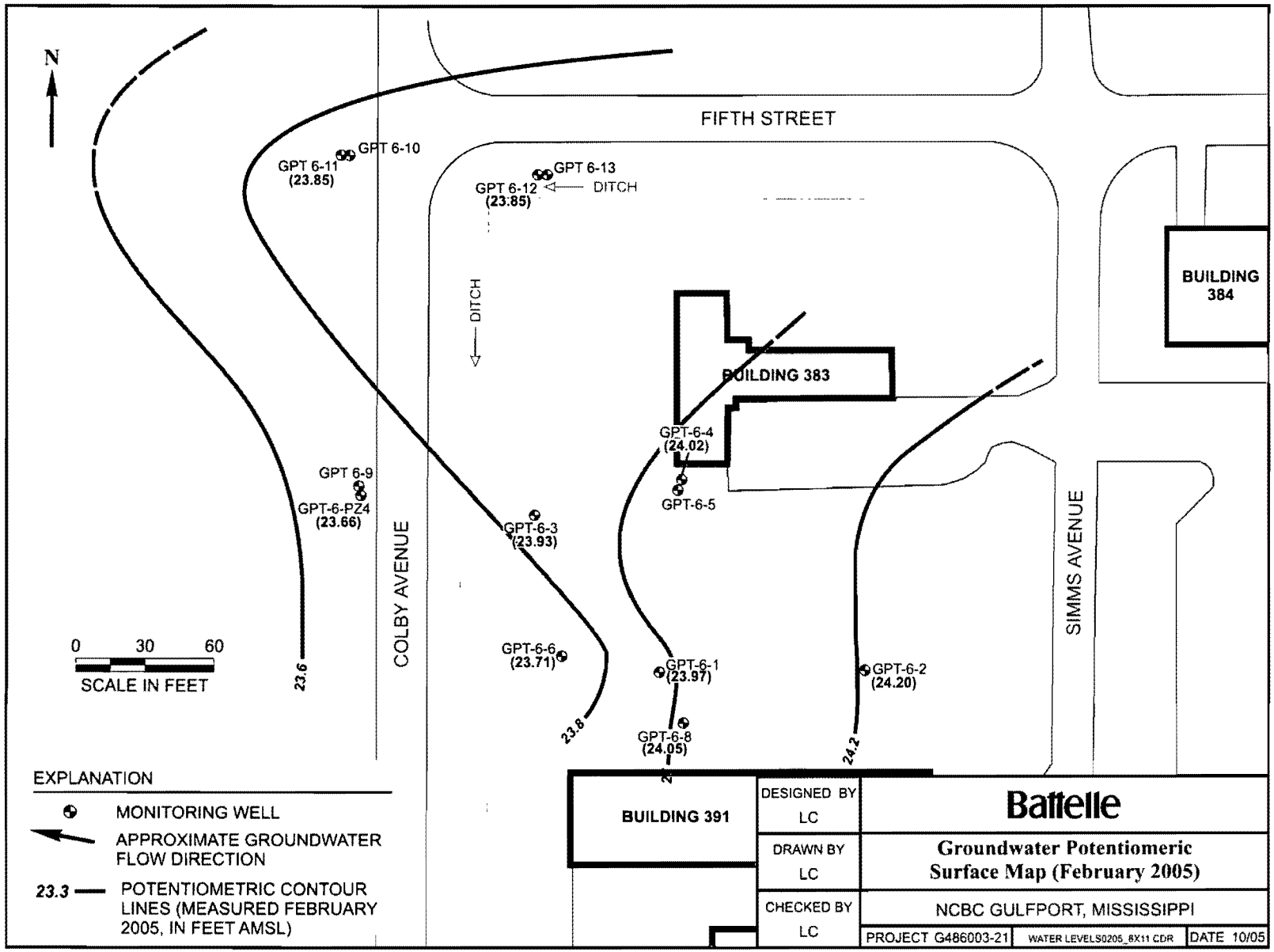


Figure 3-1. Groundwater Potentiometric Surface Map, February 2005

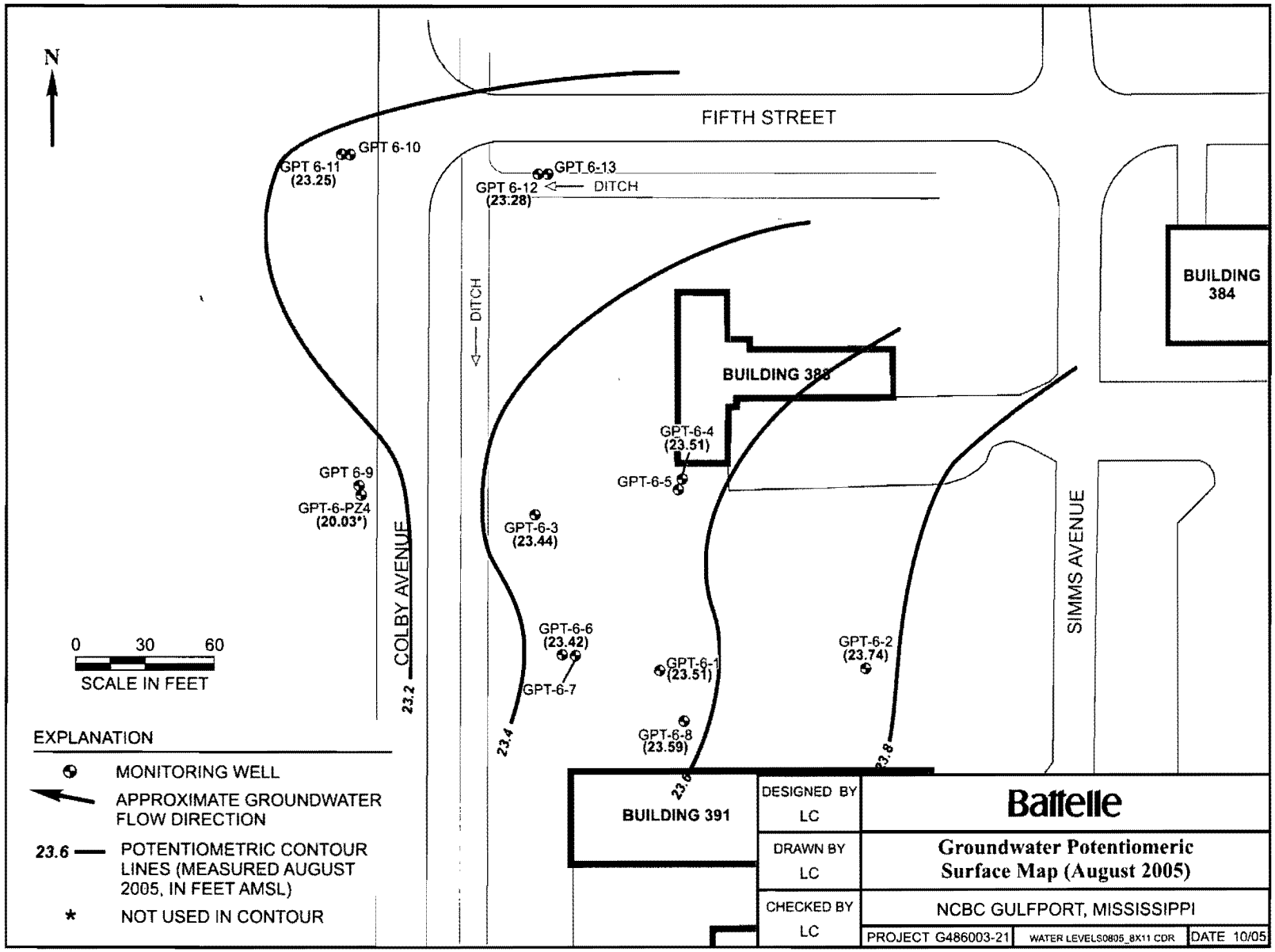


Figure 3-2. Groundwater Potentiometric Surface Map, August 2005

During the February 2005 event, elevations of the bottom slope of the ditch that borders the site were surveyed in State Plane coordinates North American Datum (NAD) of 1983 (1993 adjustment) by a Mississippi licensed surveyor. The purpose of the survey was to determine whether the water table could intersect the ditch during periods of high groundwater elevation. Groundwater levels measured in the monitoring well closest to the ditch located west of the site (i.e., GPT-6-3) show that occasionally the water table is higher than the toe of the ditch slope. However, LNAPL never has been observed to be present in the ditch during remedial activities.

3.2 Sampling Methods

On February 8 through 10, 2005 and August 23 through 25, 2005, groundwater samples were collected from all Site 6 groundwater monitoring wells and analyzed for VOCs by U.S. EPA Method 8260, SVOCs by U.S. EPA Method 8270, and TPH by U.S. EPA Method 8015. Groundwater samples also were analyzed for natural attenuation parameters, including alkalinity, ethene, ethane, methane, nitrate, sulfate, ferrous iron, manganese, and sulfide. In addition, samples also were collected for analysis of TPH quantified as gasoline range organics (GRO) (U.S. EPA Method 8015) and dissolved hydrogen (AM 19GA) during the February sampling event. For informational purposes, two LNAPL samples were collected at the site for analysis of VOCs (U.S.EPA Method 8260), SVOCs (U.S.EPA Method 8270), density (M2710F), viscosity (ASTM D445), and interfacial tension (ASTM 971). Laboratory analytical methods performed on groundwater and LNAPL samples are summarized in Table 3-3.

Table 3-3. Summary of Chemical Analyses and Laboratory Methods

Analyte	Laboratory Method	Sampling Bottles	Preservative	Special Instructions
VOC	8260B	40 mL VOA	HCl	No headspace
SVOC	8270C	1-Liter Amber	None	None
TPH-DRO	8015B	1-Liter Amber	None	None
TPH-GRO	8015B	40 mL VOA	HCl	No headspace
Ethene, Ethane, Methane	RSK-175	40 mL VOA	HCl	No headspace
Dissolved Hydrogen	AM 19GA	Vacuumed vial	None	20 mL of gas
Nitrate/Sulfate	9056	125-mL plastic	None	None
Ferrous Iron	3500	125-mL plastic	HNO_3	Filter sample
Manganese	6010B	125-mL plastic	HNO_3	Filter sample
Alkalinity	310.1	125-mL plastic	None	None
Sulfide	376.1	125-mL plastic	Zinc Acetate	None
LNAPL interfacial tension	ASTM D971	250-mL Amber	None	None
Kinematic Viscosity at 40°C	ASTM D445	250-mL Amber	None	None
Density	M2710F	250-mL Amber	None	None

VOA = volatile organic analysis.

An oil-water interface probe was used to monitor depth to groundwater to the nearest 0.01 ft and to check for the presence of free product. Water-level and free product measurements were taken from the top of casing.

Monitoring wells were sampled following water quality parameter stabilization. A peristaltic pump equipped with fresh polyethylene tubing was used to purge each well. If LNAPL was present in a monitoring well, a piece of new 1-inch-diameter polyvinyl chloride (PVC) pipe was placed down the well with the bottom end covered in plastic wrap. The sample was collected by placing the polyethylene tubing down the PVC pipe and punching through the plastic wrap. During purging, in-line water quality parameters were monitored continuously in a flowthrough cell using a Horiba™ U-22. The water quality

indicator parameters measured included temperature, pH, turbidity, conductivity, dissolved oxygen (DO), and oxidation-reduction potential (ORP). Measurements were taken every three to five minutes.

Upon parameter stabilization, sampling was initiated by disconnecting or bypassing the in-line water quality parameter monitoring device. Simultaneously, the sample flowrate was adjusted to minimize aeration, bubble formation, turbulent filling of sample bottles or loss of volatiles due to extended residence time in tubing. A disposable capsule-type groundwater filter was used to filter samples for ferrous iron and manganese analysis.

Laboratory samples were properly preserved, labeled, recorded on a chain-of-custody, and placed in a cooler with ice for shipment. Samples were shipped to an off-site laboratory via overnight courier.

3.3 Chemicals of Concern in Groundwater

The groundwater analytical results for TPH and petroleum-related compounds for the two most recent events (February and August 2005) are summarized in Tables 3-4 and 3-5. Only chemicals that have been detected in at least one well has been included on the tables. The complete set of analytical data can be found in the analytical laboratory reports, which are included in Appendices A and B. The highest chemical concentrations appear in shallow wells GPT-6-1, GPT-6-4, GPT-6-6, and GPT-6-8, which have contained LNAPL in the past or are located immediately downgradient of wells that have historically contained LNAPL.

The analytical results were compared with the Federal MCLs. In addition, the analytical results were compared to the State of Mississippi cleanup standards for UST sites, based on the fact that the COCs at Site 6 are similar to those that would be found at a typical UST site and because the land use at the site will continue to be restricted in the foreseeable future. Under the UST program, if the substance in the storage tank was gasoline, the COC of primary concern would be benzene, toluene, ethylbenzene and xylenes (BTEX), having a cleanup standard of 18 parts per million (ppm). If the substance stored in the tank was diesel, waste oil, or kerosene, the cleanup level applies to polycyclic aromatic hydrocarbons (PAHs), which varies based on the particular PAH (see Table 3-4) and the distance (0, 50, and 100 feet) to a sensitive receptor. Since Site 6 may have been exposed to both heavy oils and gasoline, the resulting data were compared to both BTEX and PAH cleanup levels. Concentrations of PAHs were compared to the most conservative cleanup levels for the sample point, which is 0 ft to a sensitive receptor. For COCs for which both Federal and State standards are available, the more stringent of the two ARARs were used to determine compliance.

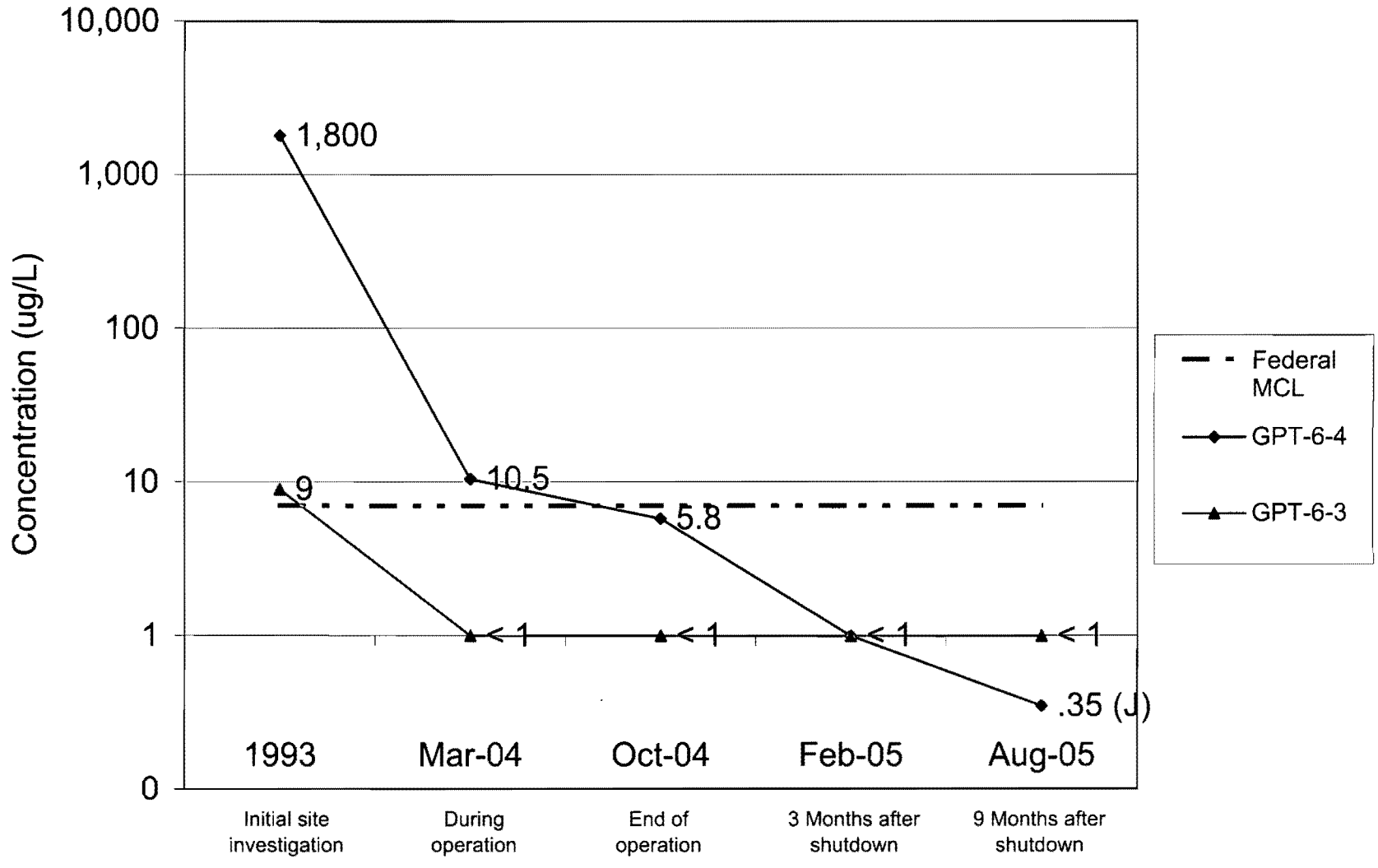
Contaminants that were detected in the February and August 2005 sampling events include the following: VOCs (i.e., benzene; 2-butanone; tert-butylbenzene; chloroethane; 1,1-DCA; *cis*-1,1-DCE; 1,1-DCE; ethylbenzene; p-isopropyltoluene; isopropylbenzene; 4-methyl-2-pentanone; naphthalene; toluene; 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, trichloroethene [TCE]; vinyl chloride; *o*-xylene; and *m,p*-xylene), SVOCs (i.e., 2-methylnaphthalene; 2-methylphenol, 4-methylphenol, fluorene, phenanthrene, and phenol), TPH-GRO, and TPH-DRO. As expected, many of the VOCs and SVOCs that were observed in the groundwater samples also were observed in the LNAPL samples collected from extraction wells EW-12 and EW-19 (see Table 3-6 for the analytical results for LNAPL samples).

The contaminant concentrations measured during the February and August 2005 events were compared with historical data to evaluate changes over time. No groundwater contaminant concentrations measured during the historical and recent monitoring events exceed the State of Mississippi cleanup standards for UST sites. The following COCs have been detected above the Federal MCLs at least once during the past four monitoring events (i.e., March 2004, October 2004, February 2005, and August 2005): 1,1-DCE;

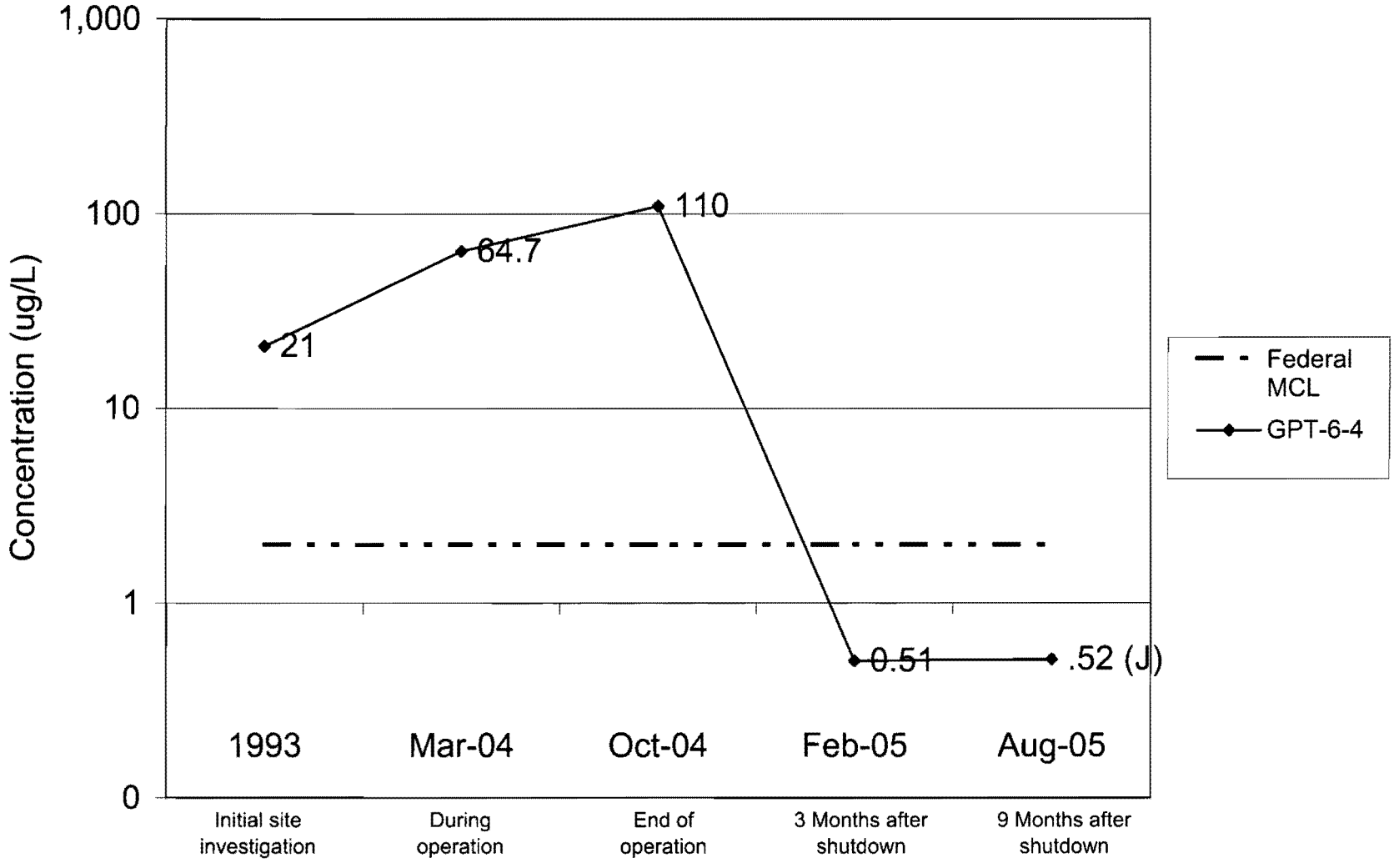
ATTACHMENT 2:

Graphs Showing Contaminant Concentrations for Contaminants Over Time with Historical Levels Exceeding Federal MCLs

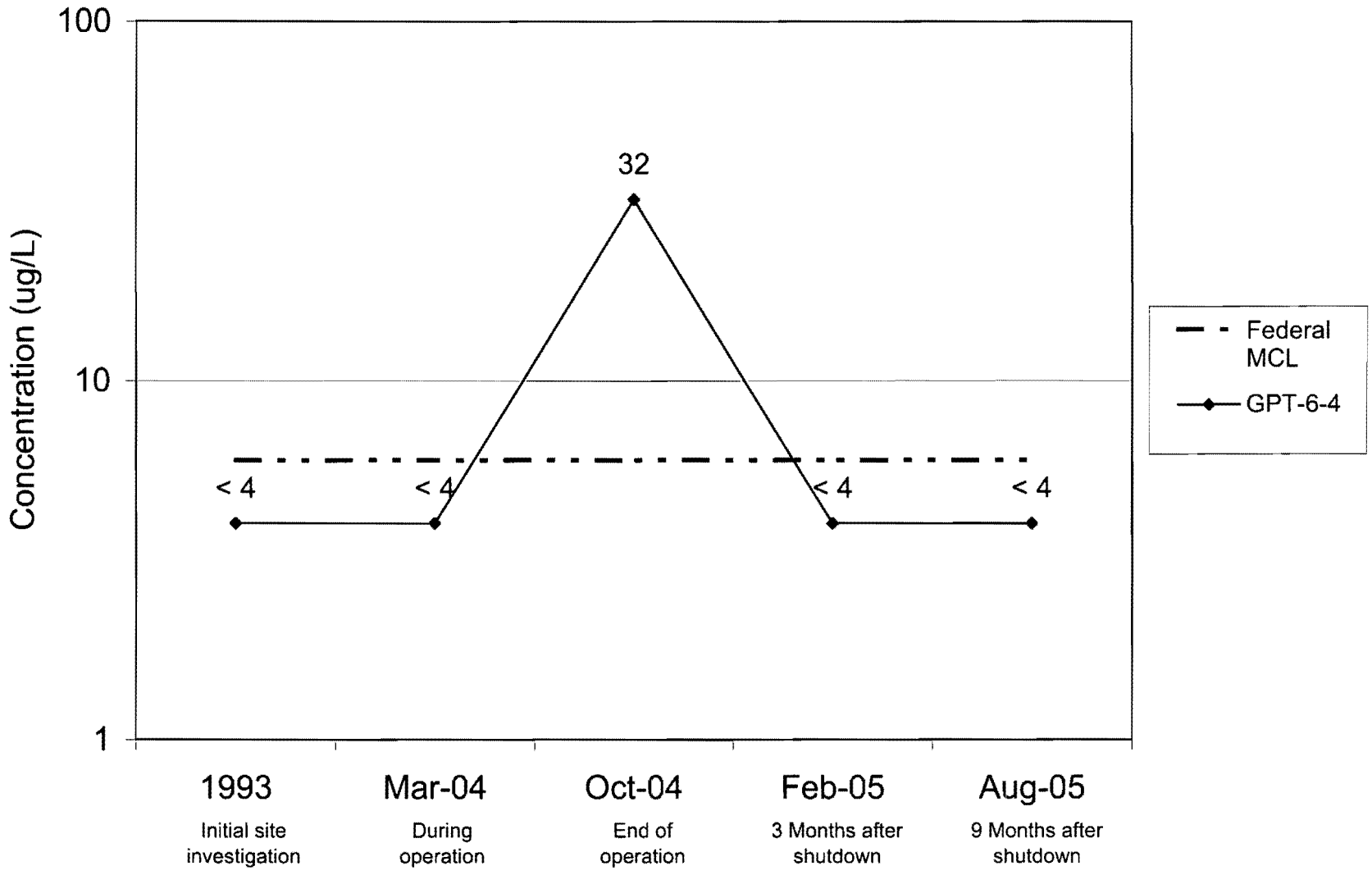
1,1-Dichloroethene concentrations for wells with historical levels above the Federal MCLs



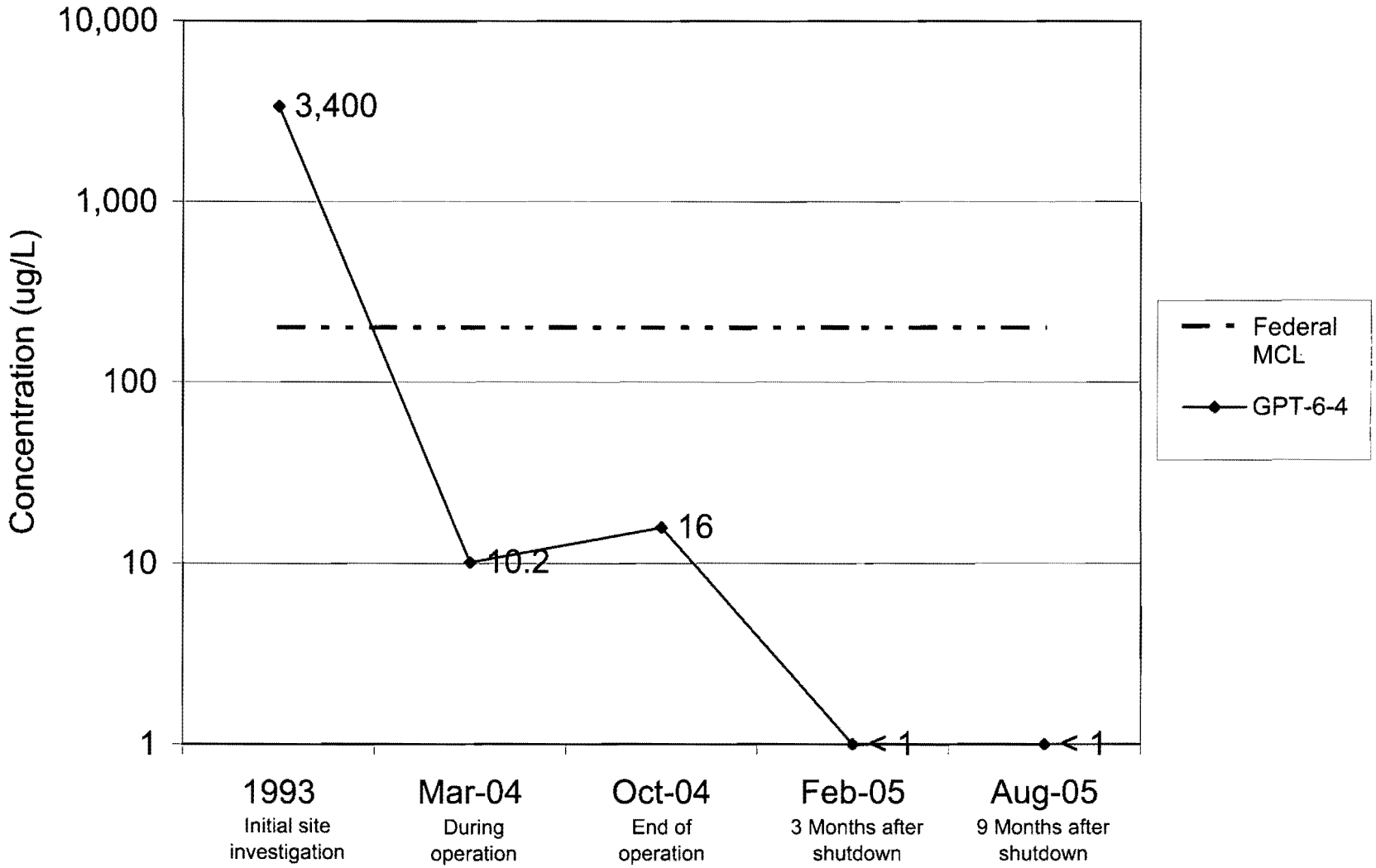
Vinyl Chloride concentrations for wells with historical levels above the Federal MCLs



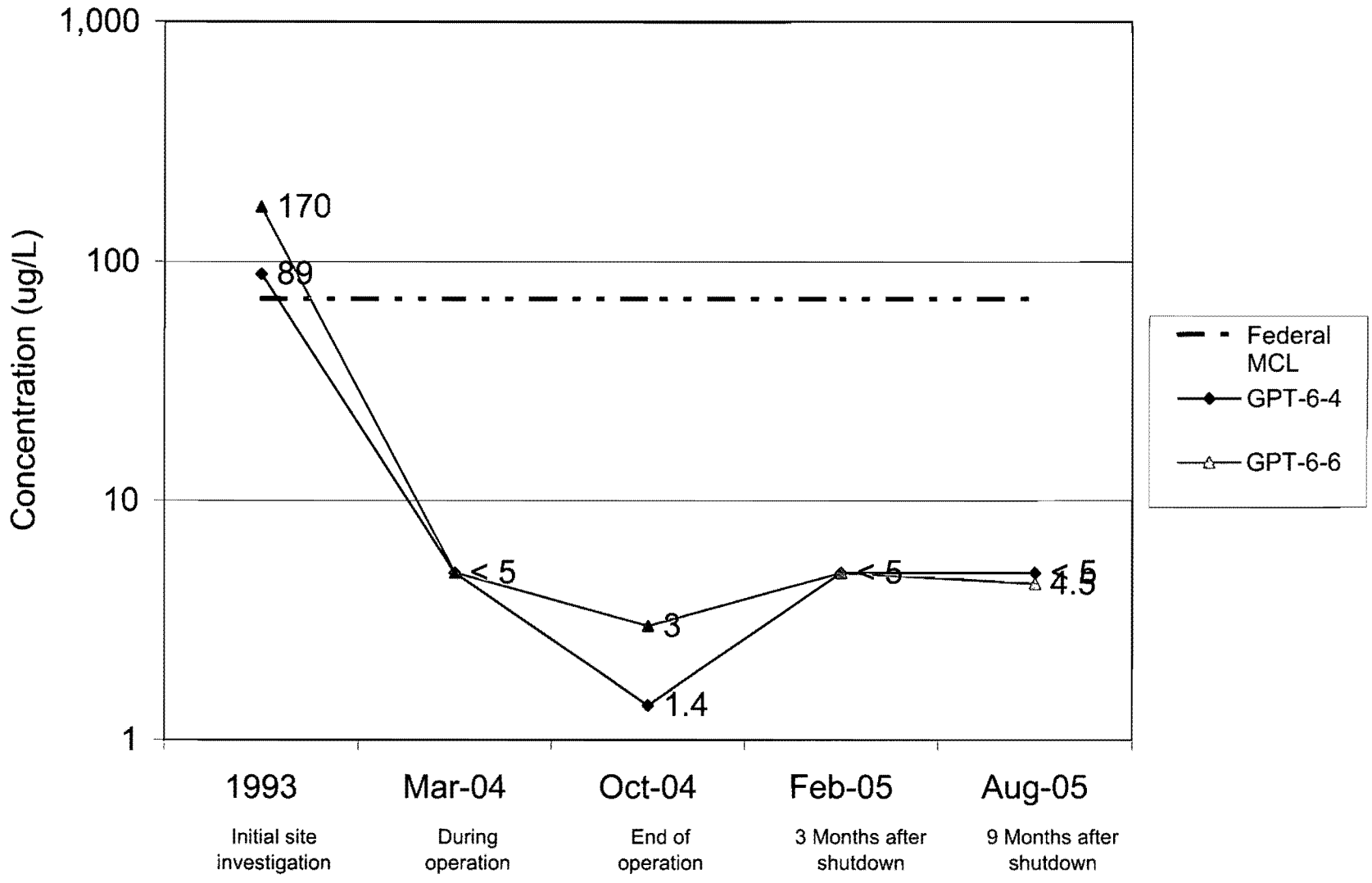
Bis(2-ethylhexyl-phthalate) concentrations for wells with historical levels above the Federal MCLs



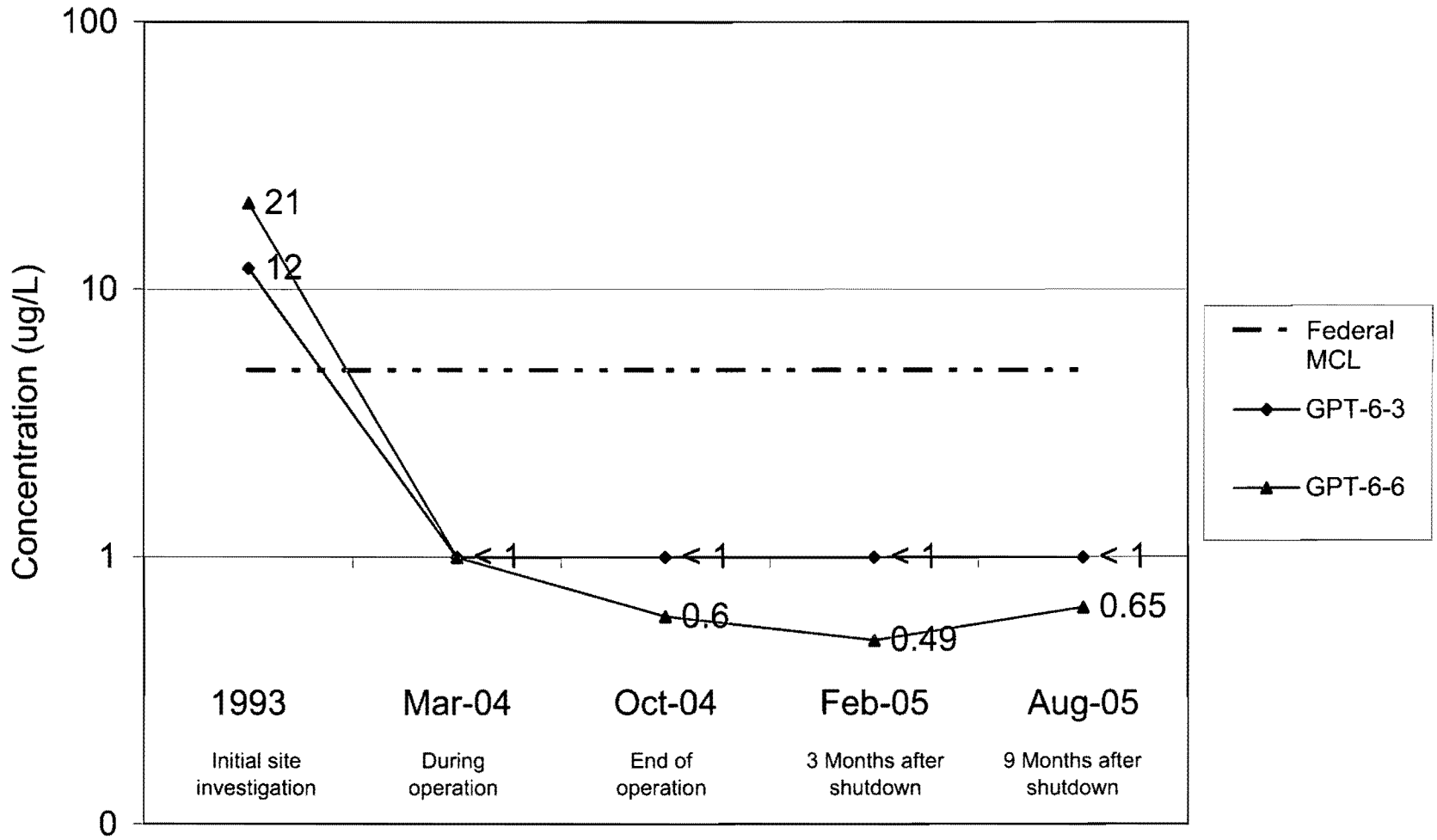
1,1,1-Trichloroethane concentrations for wells with historical levels above the Federal MCLs



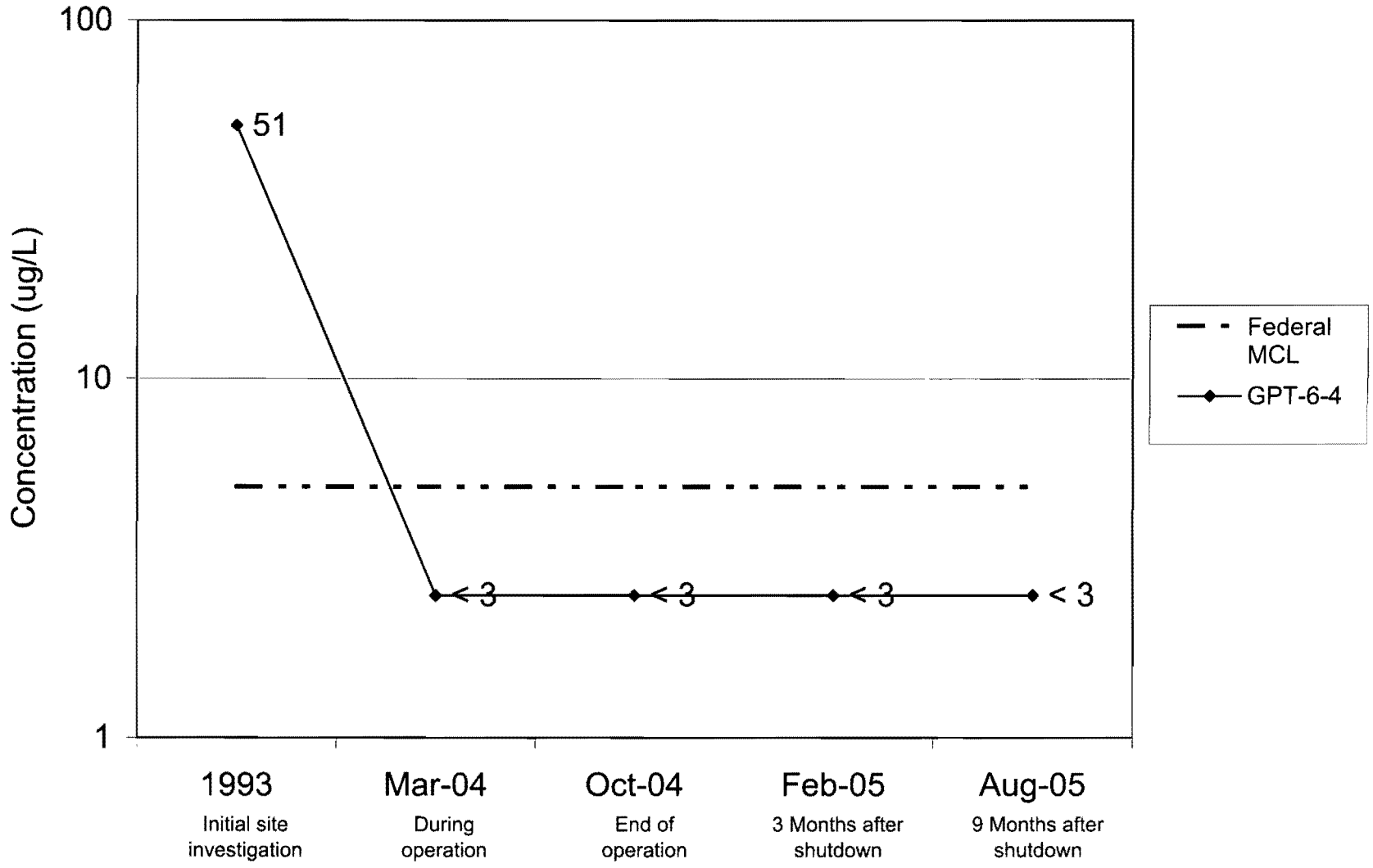
1,2-Dichloroethene (tot) concentrations for wells with historical levels above the Federal MCLs



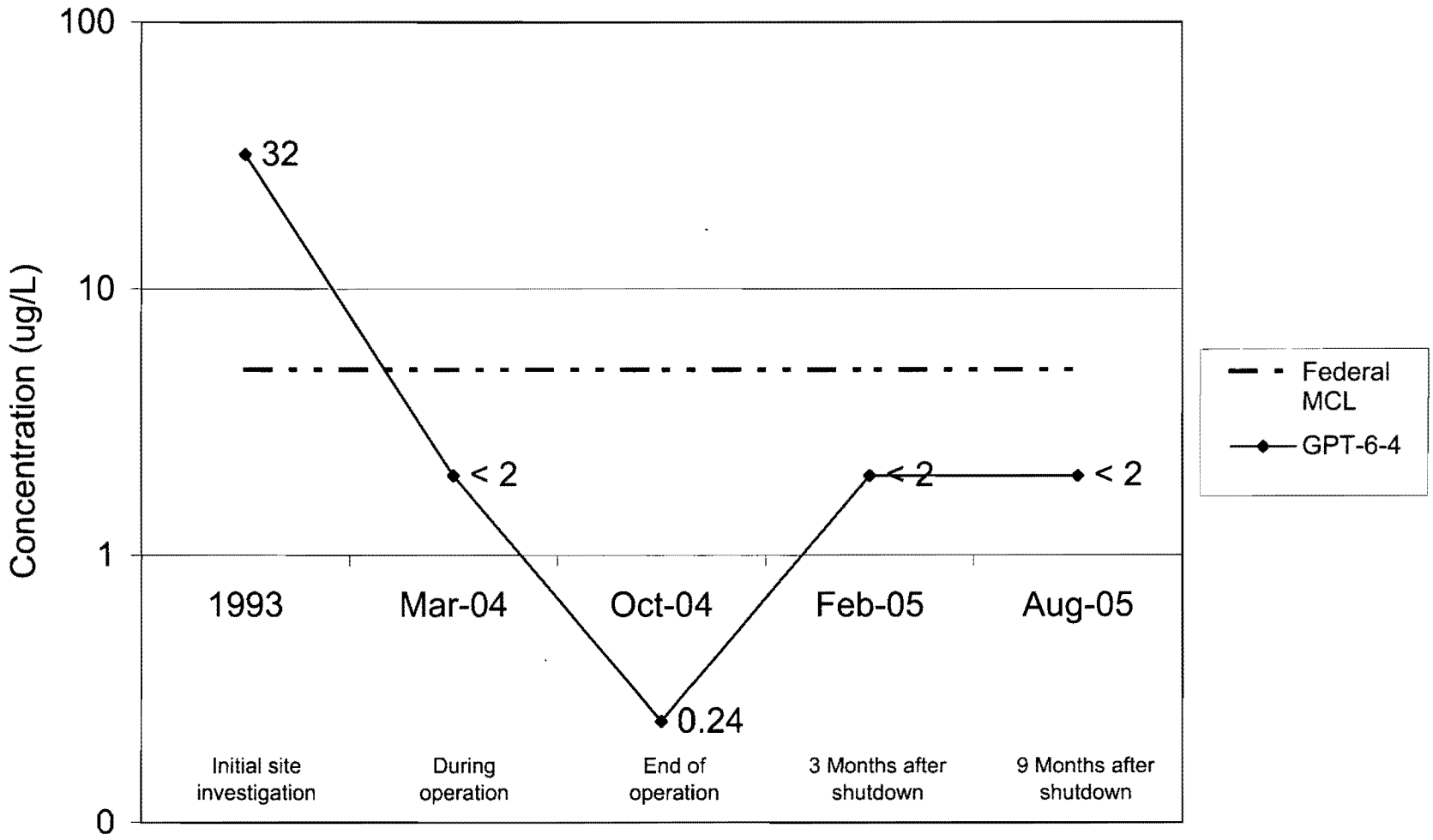
Benzene concentrations for wells with historical levels above the Federal MCLs



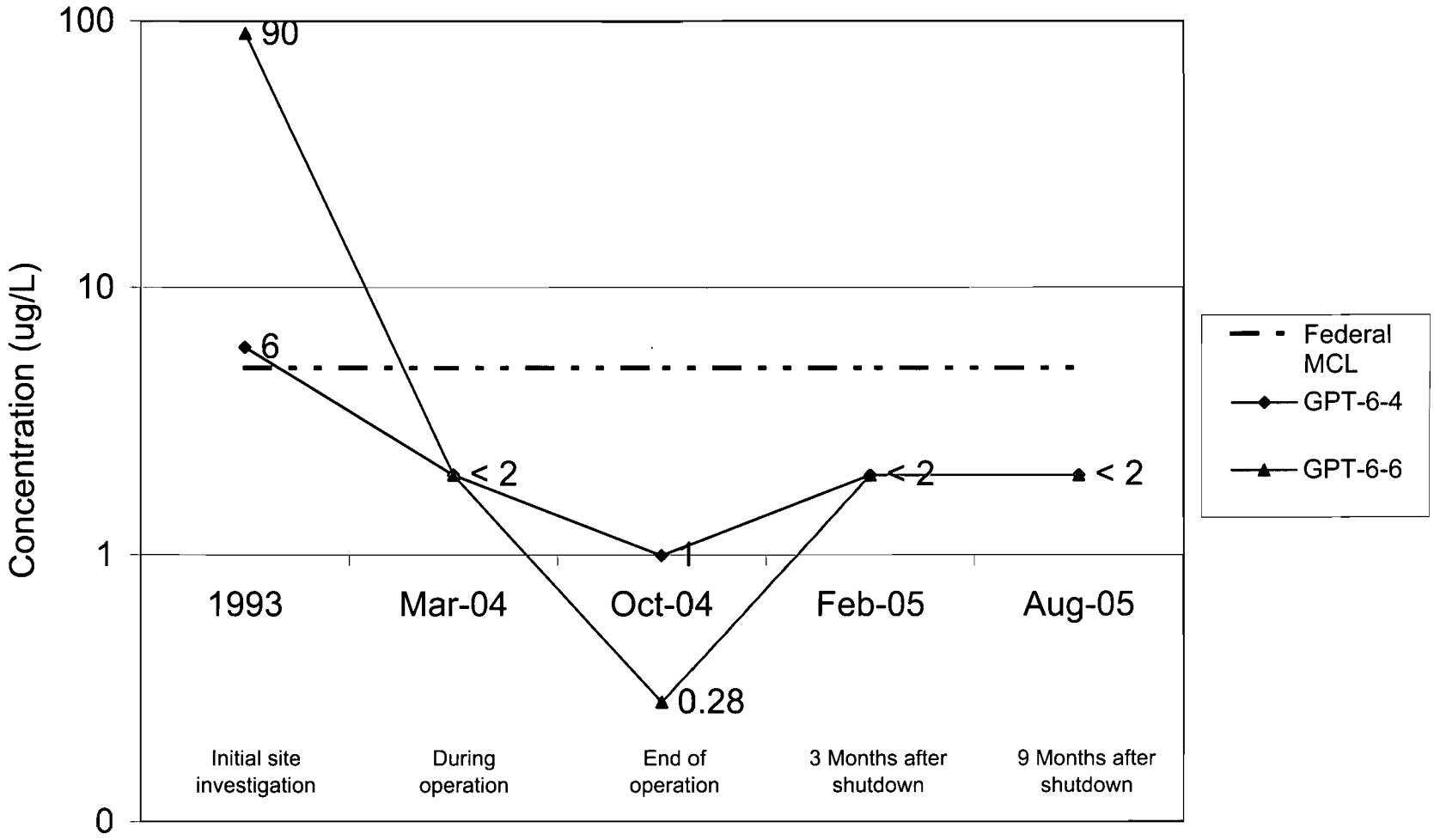
Methylene Chloride concentrations for wells with historical levels above the Federal MCLs



Tetrachloroethene concentrations for wells with historical levels above the Federal MCLs

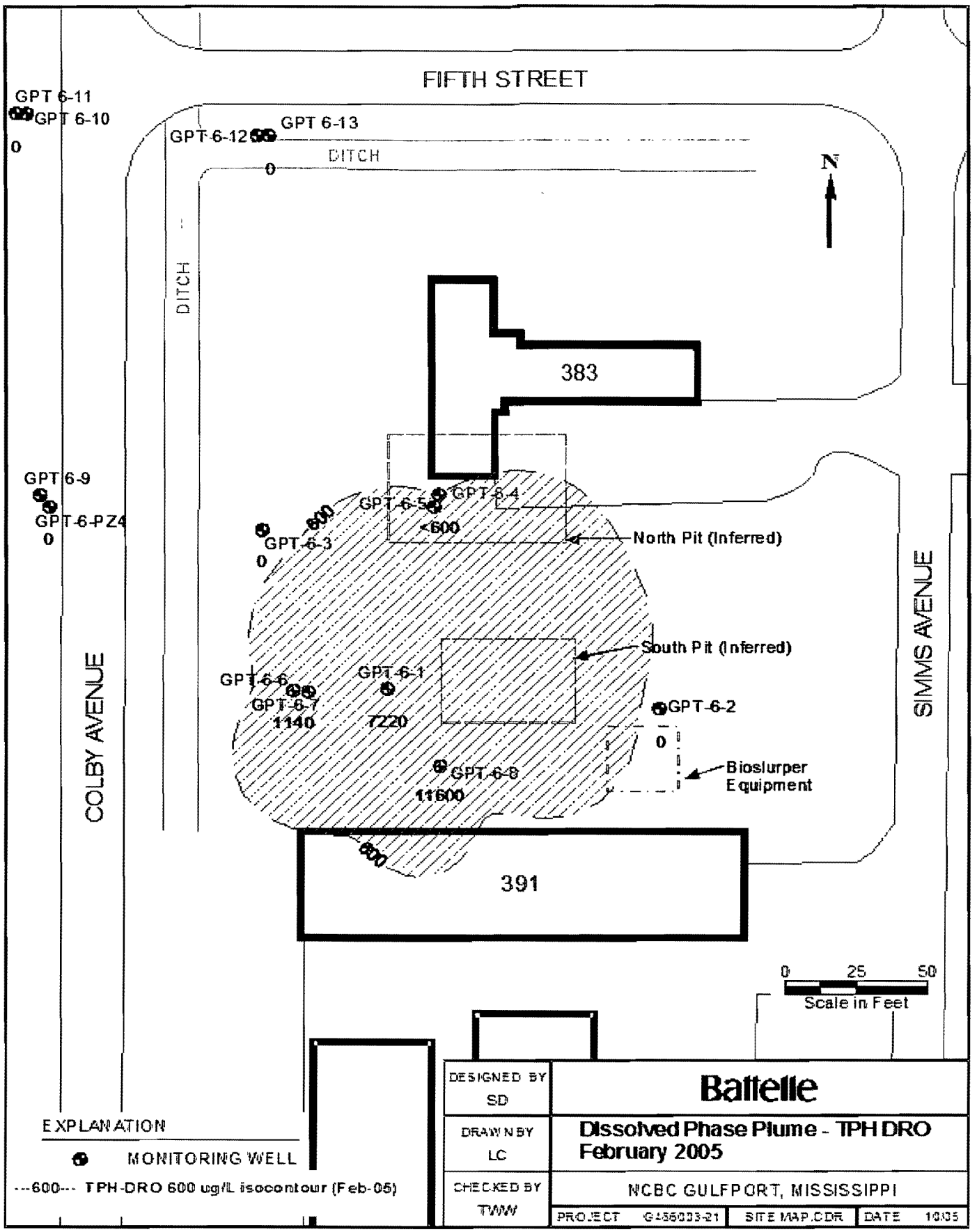


Trichloroethene concentrations for wells with historical levels above the Federal MCLs



ATTACHMENT 3:

Site Maps Showing Natural Attenuation Indicator Data in Conjunction with the TPH Dissolved-Phase Plume for February 2005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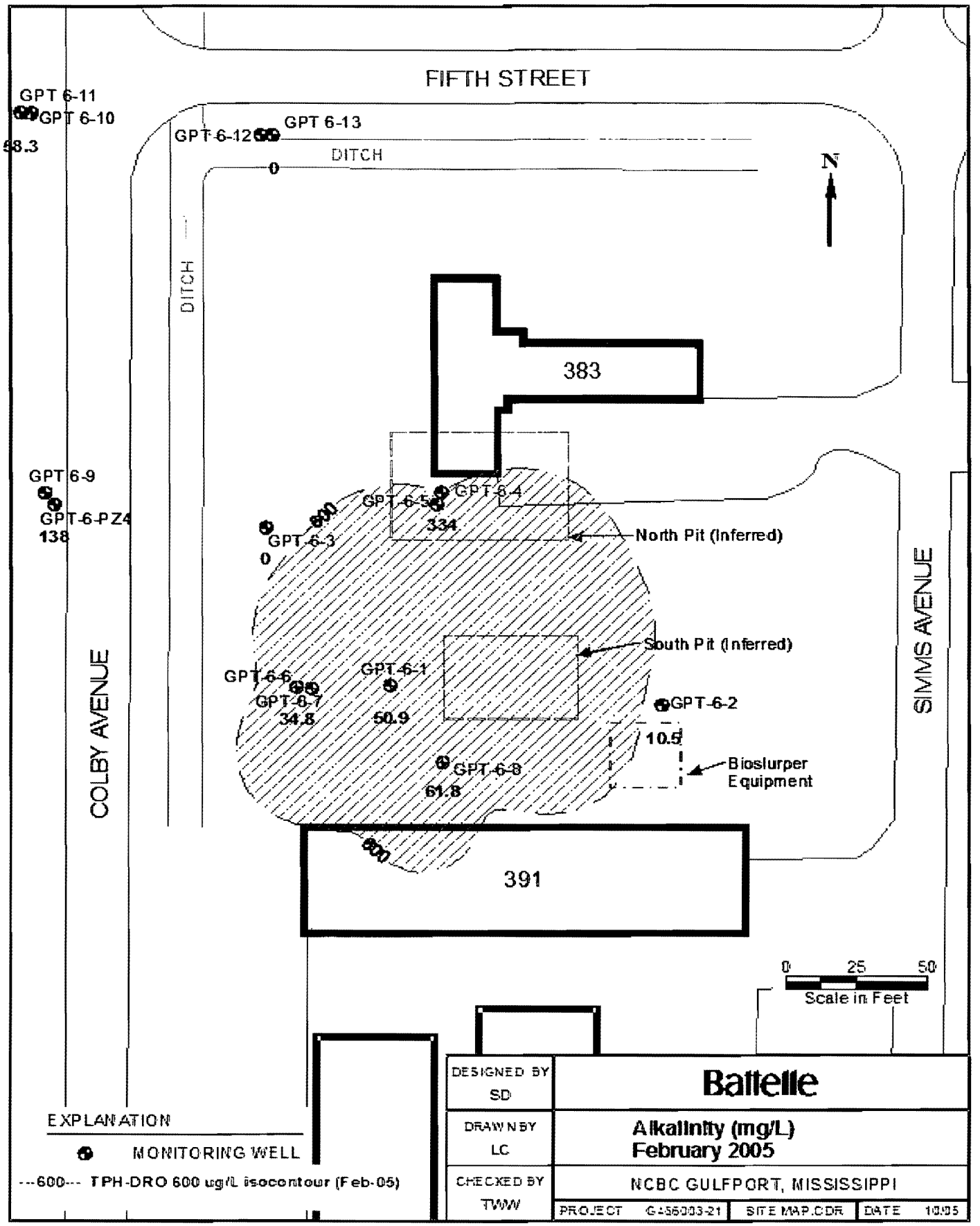
GPT 6-10
0
GPT 6-12
GPT 6-13
DITCH
0
N
DITCH
383
GPT 6-9
GPT-6-PZ4
0
GPT 6-5
GPT 6-4
<600
600
GPT-6-3
0
North Pit (Inferred)
South Pit (Inferred)
GPT 6-6
GPT 6-7
1140
GPT 6-1
7220
GPT-6-2
0
GPT 6-8
11600
Bioslurper Equipment
600
391
COLBY AVENUE
SIMMS AVENUE
0 25 50
Scale in Feet
EXPLANATION
MONITORING WELL
---600--- TPH-DRO 600 ug/L isocontour (Feb-05)
DESIGNED BY SD
DRAWN BY LC
CHECKED BY TWW
Battelle
Dissolved Phase Plume - TPH DRO
February 2005
NCBC GULFPORT, MISSISSIPPI
PROJECT G455033-21
SITE MAP.DDR
DATE 10/05


FIFTH STREET
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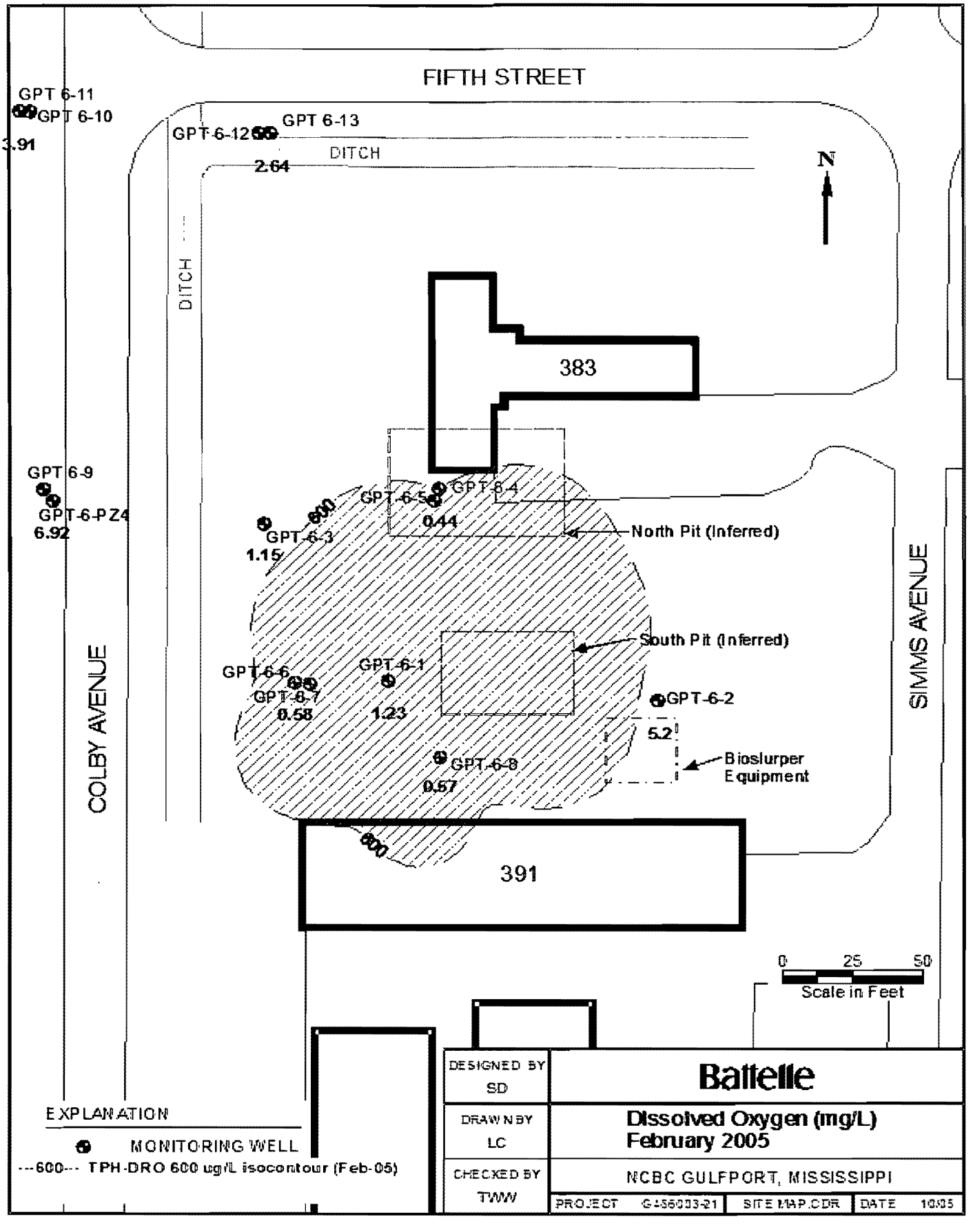
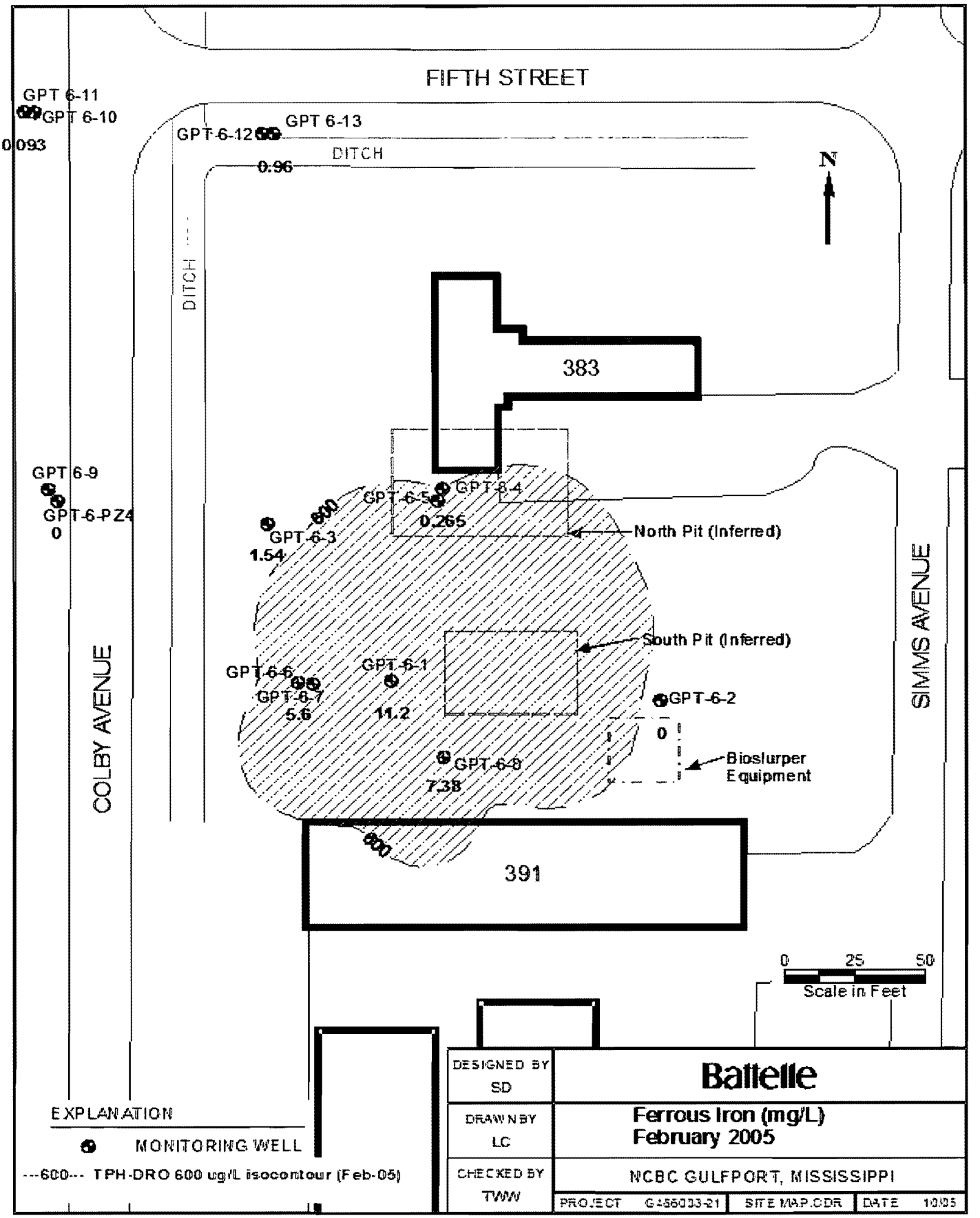
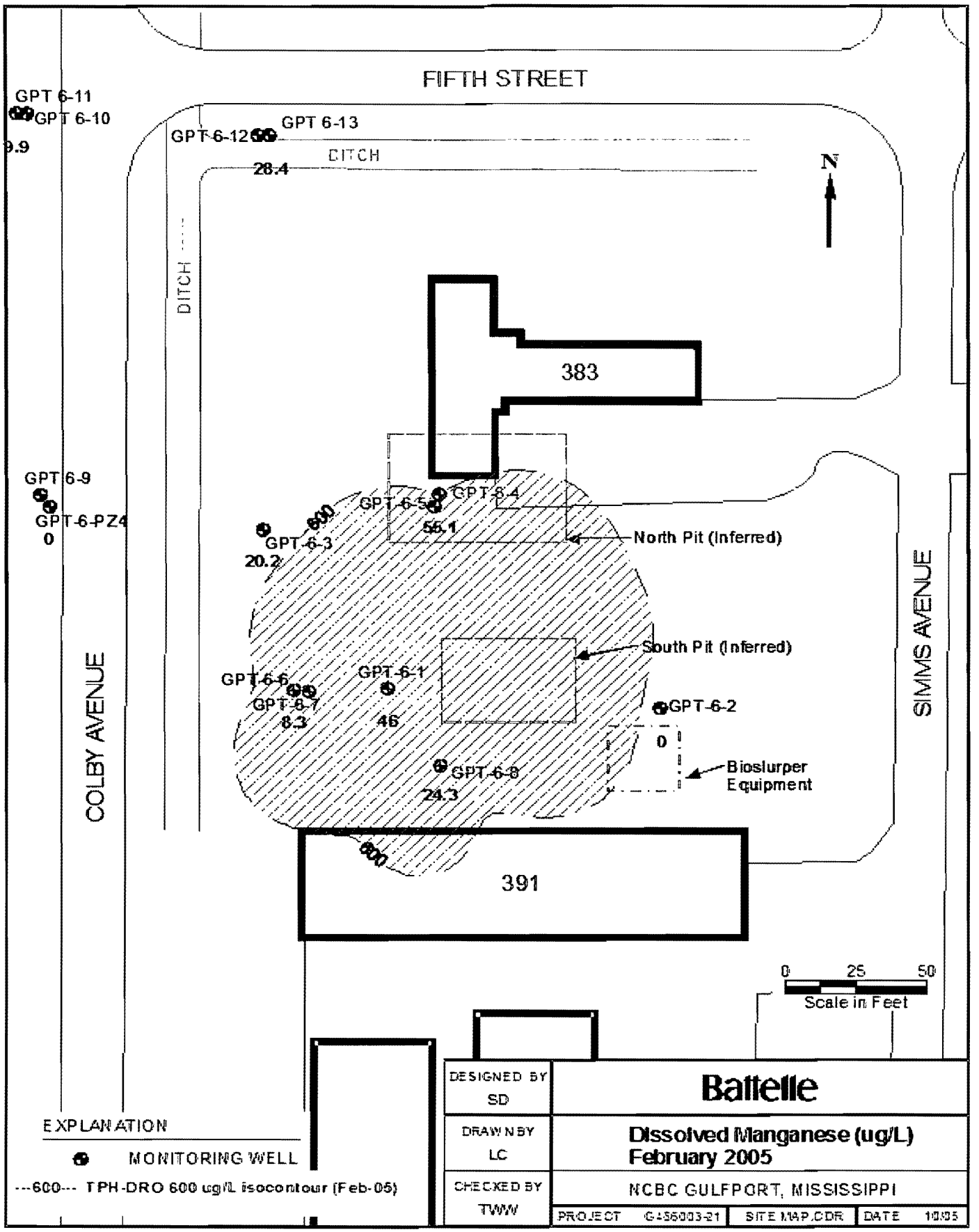
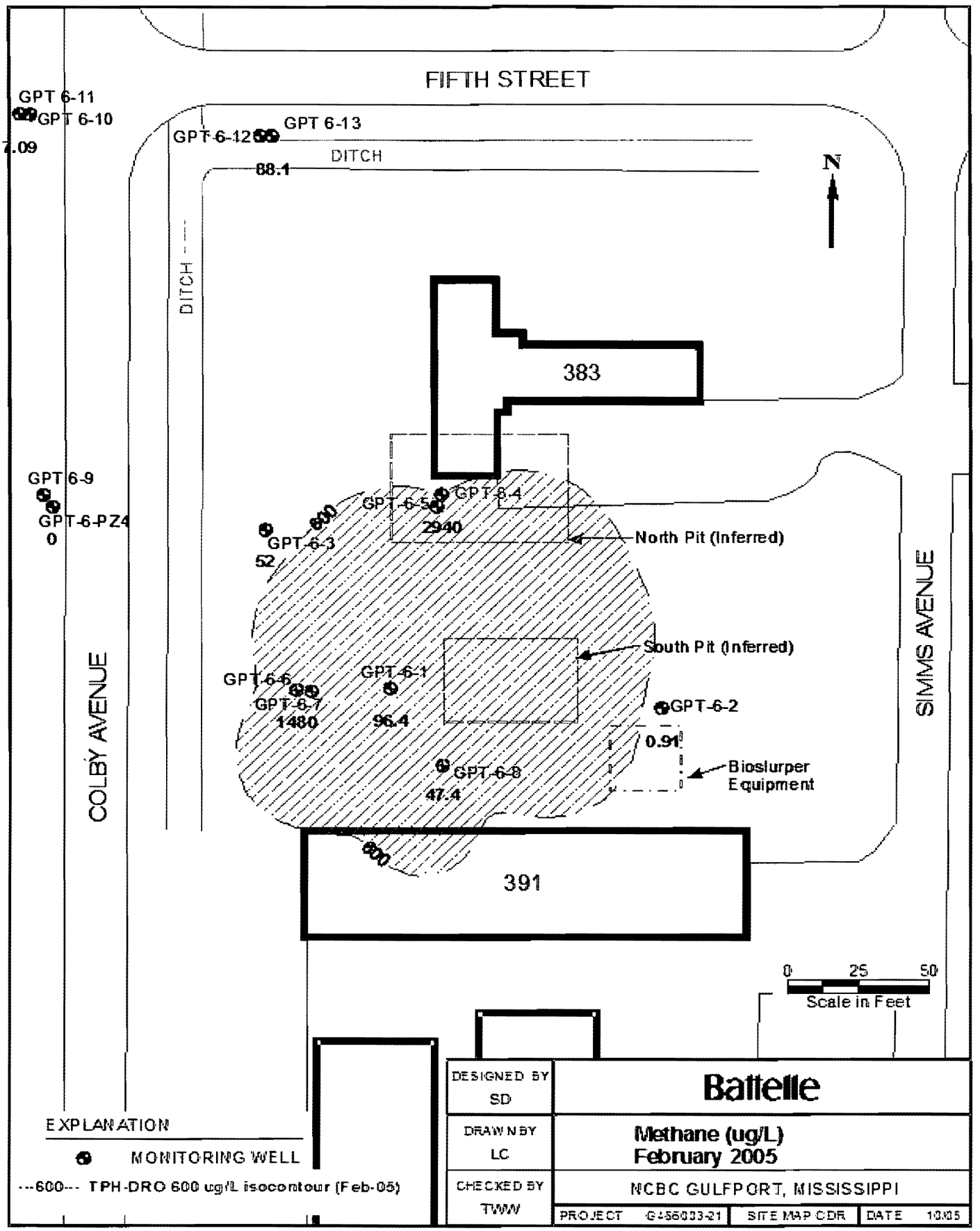
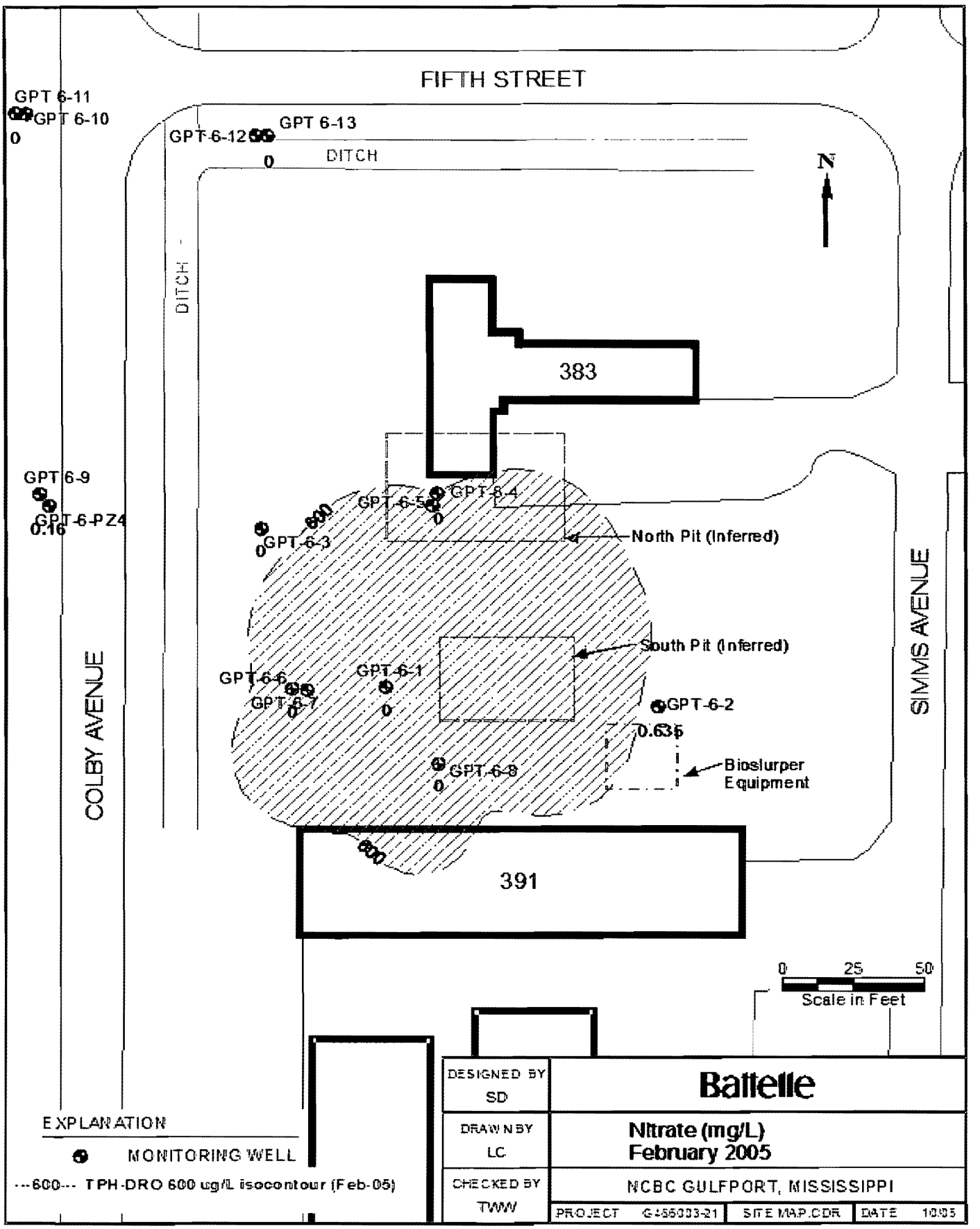
GPT 6-10
58.3
GPT 6-12
GPT 6-13
DITCH
0
N
DITCH
383
GPT 6-9
GPT-6-PZ4
138
GPT 6-5
GPT 6-4
334
600
GPT-6-3
0
North Pit (Inferred)
South Pit (Inferred)
GPT-6-6
GPT-6-7
34.8
GPT-6-1
50.9
GPT-6-2
10.5
GPT-6-8
61.8
Bioslurper Equipment
COLBY AVENUE
SIMMS AVENUE
600
391
0 25 50
Scale in Feet
EXPLANATION
MONITORING WELL
---600--- TPH-DRO 600 ug/L isocontour (Feb-05)
DESIGNED BY SD
DRAWN BY LC
CHECKED BY TWW
Battelle
Alkalinity (mg/L)
February 2005
NCBC GULFPORT, MISSISSIPPI
PROJECT G456003-21
SITE MAP.CDR
DATE 10/05

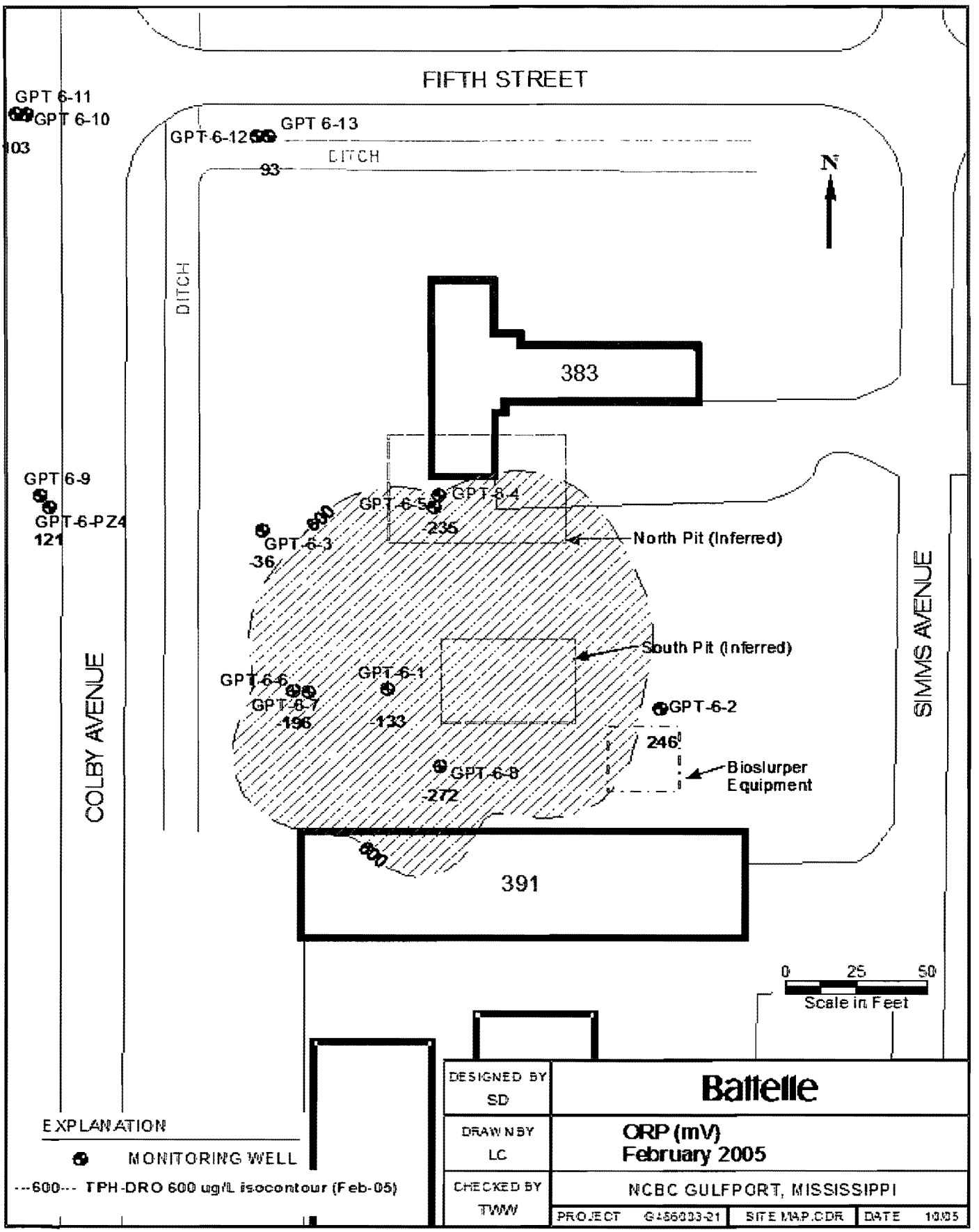

FIFTH STREET
GPT 6-11
GPT 6-10
3.91
GPT 6-12
GPT 6-13
2.64
DITCH
N
DITCH
383
GPT 6-9
GPT-6-PZ4
6.92
600
GPT-6-5
GPT 6-4
0.44
GPT-6-3
1.15
North Pit (Inferred)
South Pit (Inferred)
GPT-6-6
GPT-6-7
0.58
GPT-6-1
1.23
GPT-6-2
5.2
Bioslurper Equipment
GPT-6-8
0.57
600
391
COLBY AVENUE
SIMMS AVENUE
0 25 50
Scale in Feet
EXPLANATION
MONITORING WELL
---600--- TPH-DRO 600 ug/L isocontour (Feb-05)
DESIGNED BY SD
DRAWN BY LC
CHECKED BY TWW
Battelle
Dissolved Oxygen (mg/L)
February 2005
NCBC GULFPORT, MISSISSIPPI
PROJECT G-436003-21
SITE MAP.CDR
DATE 10/05

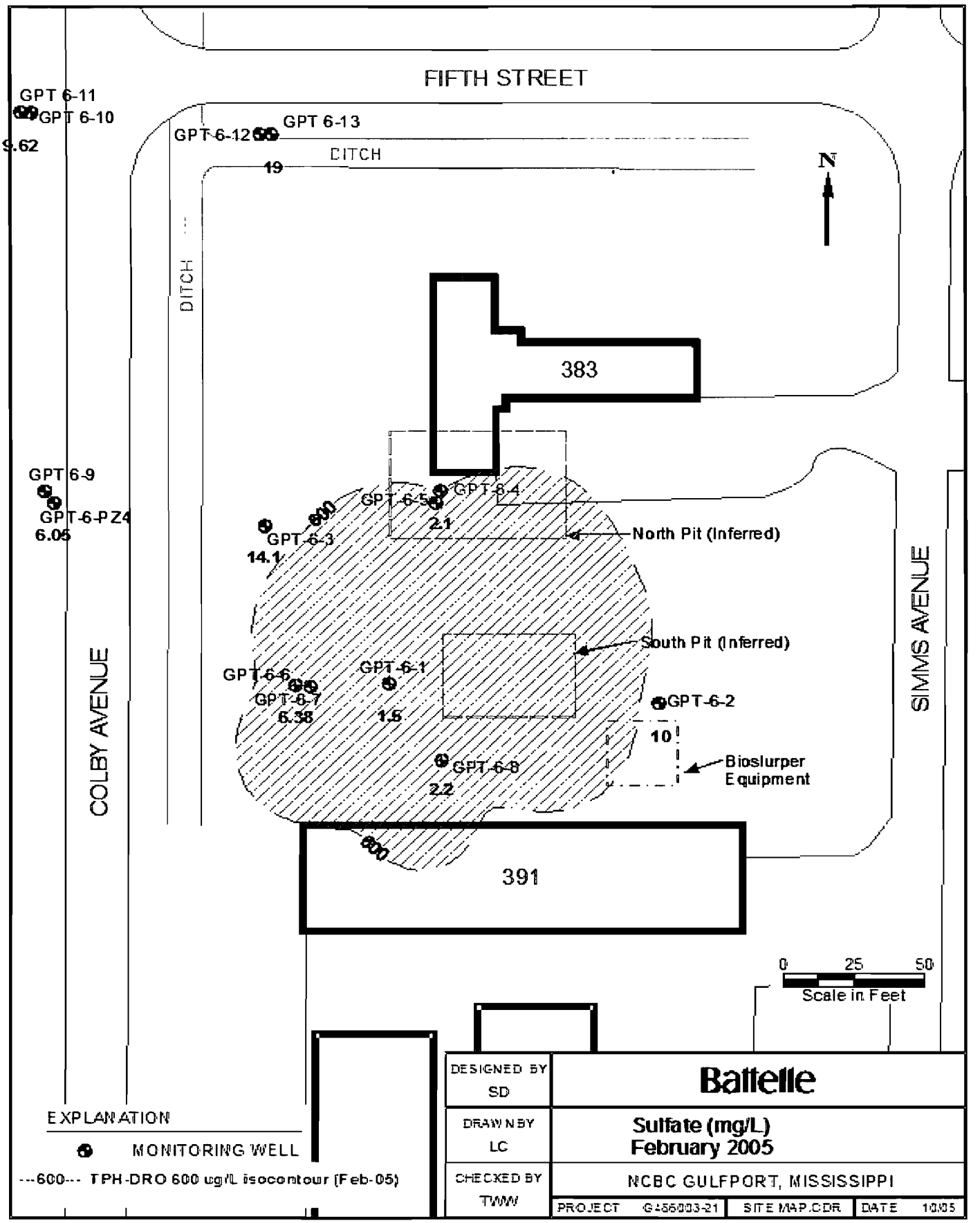

FIFTH STREET
GPT 6-11
GPT 6-10
0.093
GPT 6-12
GPT 6-13
0.96
DITCH
DITCH
N
383
GPT 6-9
GPT 6-PZ4
0
600
GPT 6-3
1.54
GPT 6-5
GPT 6-4
0.265
North Pit (Inferred)
South Pit (Inferred)
GPT 6-6
GPT 6-7
5.6
GPT 6-1
11.2
GPT 6-2
0
Bioslurper Equipment
GPT 6-8
7.38
600
391
COLBY AVENUE
SIMMS AVENUE
0 25 50
Scale in Feet
EXPLANATION
MONITORING WELL
---600--- TPH-DRO 600 ug/L isocontour (Feb-05)
DESIGNED BY SD
DRAWN BY LC
CHECKED BY TWW
Battelle
Ferrous Iron (mg/L)
February 2005
NCBC GULFPORT, MISSISSIPPI
PROJECT G456033-21
SITE MAP.CDR
DATE 10/05

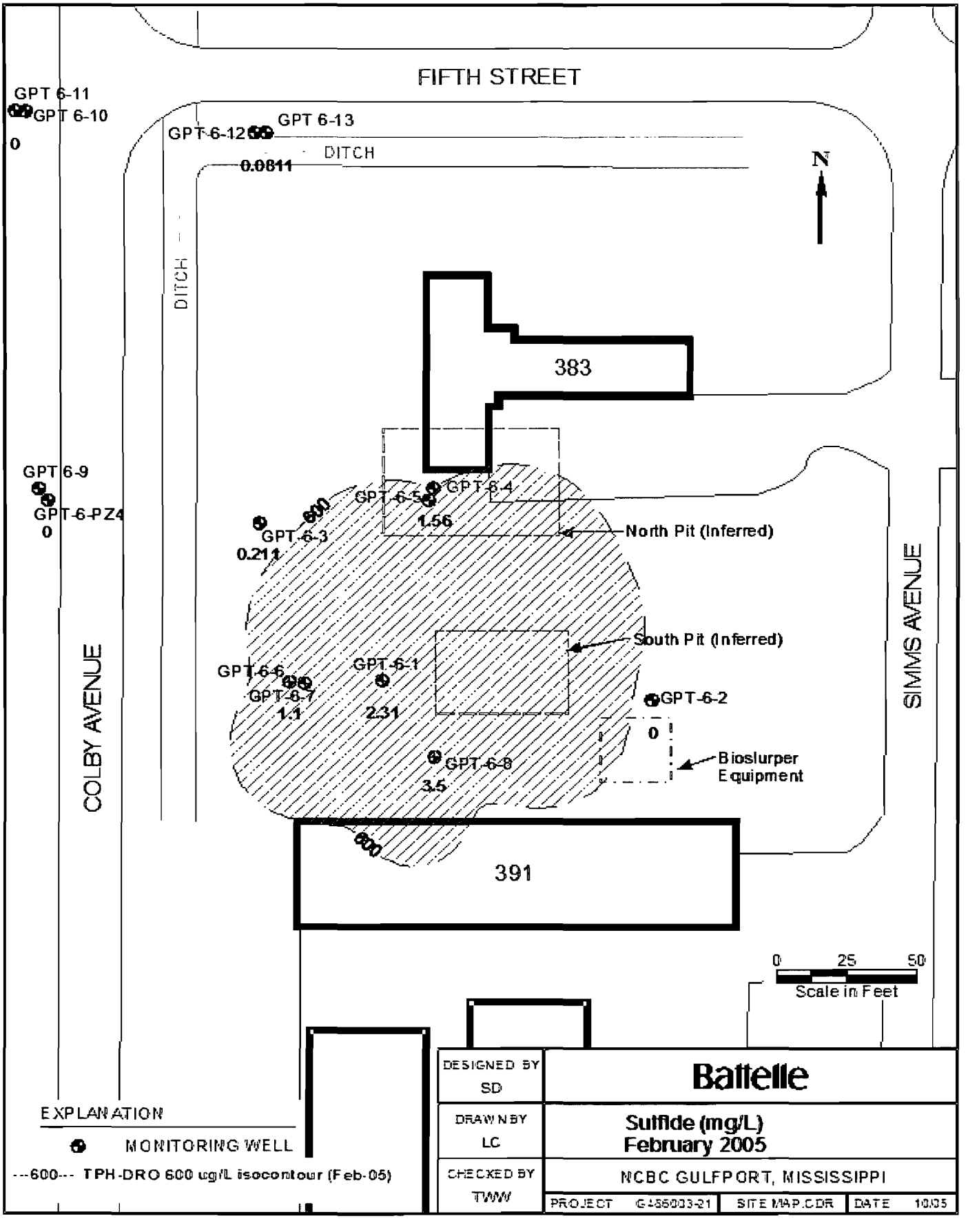

FIFTH STREET
GPT 6-11
GPT 6-10
9.9
GPT 6-12
GPT 6-13
DITCH
28.4
N
DITCH
383
GPT 6-9
GPT-6-PZ4
0
GPT-6-5
GPT 6-4
55.1
600
GPT-6-3
20.2
North Pit (Inferred)
South Pit (Inferred)
GPT-6-6
GPT-6-1
GPT-6-7
8.3
46
GPT-6-2
0
GPT-6-8
24.3
Bioslurper Equipment
600
391
COLBY AVENUE
SIMMS AVENUE
0 25 50
Scale in Feet
EXPLANATION
MONITORING WELL
---600--- TPH-DRO 600 ug/L isocontour (Feb-05)
DESIGNED BY SD
DRAWN BY LC
CHECKED BY TWW
Battelle
Dissolved Manganese (ug/L)
February 2005
NCBC GULFPORT, MISSISSIPPI
PROJECT G-A5603-21
SITE MAP.CDR
DATE 10/05


FIFTH STREET
GPT 6-11
GPT 6-10
7.09
GPT 6-12
GPT 6-13
DITCH
88.1
N
DITCH
383
GPT 6-9
GPT-6-PZ4
0
GPT-6-5
GPT-6-4
2940
600
GPT-6-3
52
North Pit (Inferred)
South Pit (Inferred)
GPT-6-6
GPT-6-7
1480
GPT-6-1
96.4
GPT-6-2
0.91
GPT-6-8
47.4
Bioslurper Equipment
600
391
COLBY AVENUE
SIMMS AVENUE
0 25 50
Scale in Feet
EXPLANATION
MONITORING WELL
---600--- TPH-DRO 600 ug/L isocontour (Feb-05)
DESIGNED BY SD
DRAWN BY LC
CHECKED BY TWW
Battelle
Methane (ug/L)
February 2005
NCBC GULFPORT, MISSISSIPPI
PROJECT G456033-21
SITE MAP CDR
DATE 10/05


FIFTH STREET
GPT 6-11
GPT 6-10
0
GPT 6-12
GPT 6-13
0
DITCH
N
DITCH
383
GPT 6-9
GPT 6-PZ4
0.16
GPT 6-5
GPT 6-4
0
600
GPT 6-3
0
North Pit (Inferred)
South Pit (Inferred)
GPT 6-6
GPT 6-7
0
GPT 6-1
0
GPT 6-2
0.635
Bioslurper Equipment
GPT 6-8
0
600
391
COLBY AVENUE
SIMMS AVENUE
0 25 50
Scale in Feet
EXPLANATION
MONITORING WELL
---600--- TPH-DRO 600 ug/L isocontour (Feb-05)
DESIGNED BY SD
DRAWN BY LC
CHECKED BY TWW
Battelle
Nitrate (mg/L)
February 2005
NCBC GULFPORT, MISSISSIPPI
PROJECT G-55033-21
SITE MAP.CDR
DATE 10/05

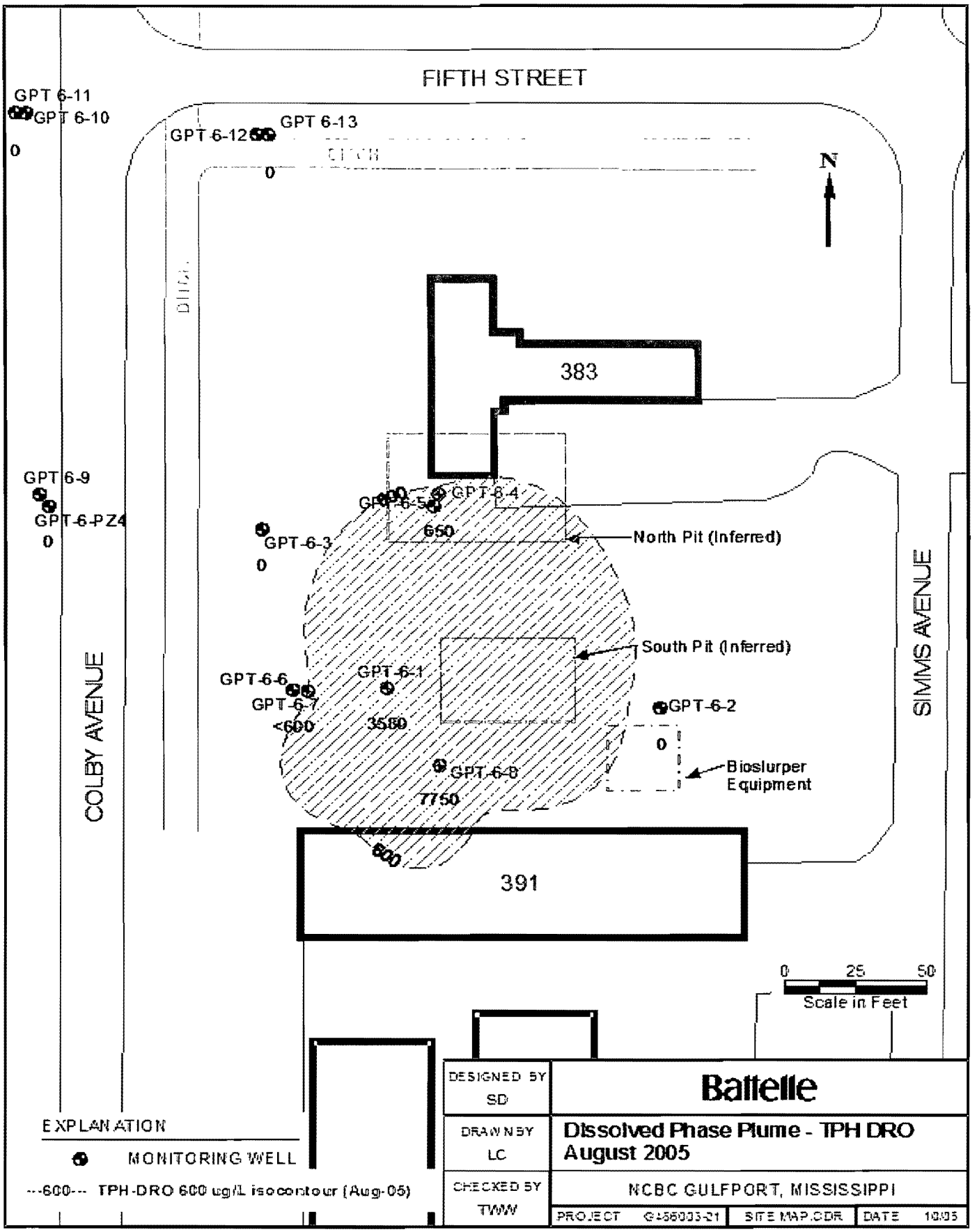

FIFTH STREET
GPT 6-11
GPT 6-10
103
GPT 6-12
GPT 6-13
DITCH
93
N
DITCH
383
GPT 6-9
GPT 6-PZ4
121
600
GPT 6-5
GPT 6-4
235
GPT 6-3
36
North Pit (Inferred)
South Pit (Inferred)
GPT 6-6
GPT 6-7
196
GPT 6-1
133
GPT 6-2
246
Bioslurper Equipment
GPT 6-8
272
600
391
COLBY AVENUE
SIMMS AVENUE
0 25 50
Scale in Feet
EXPLANATION
MONITORING WELL
---600--- TPH-DRO 600 ug/L isocontour (Feb-05)
DESIGNED BY SD
Battelle
DRAWN BY LC
ORP (mV)
February 2005
CHECKED BY TWW
NCBC GULFPORT, MISSISSIPPI
PROJECT G456033-21
SITE MAP.CDR
DATE 10/05

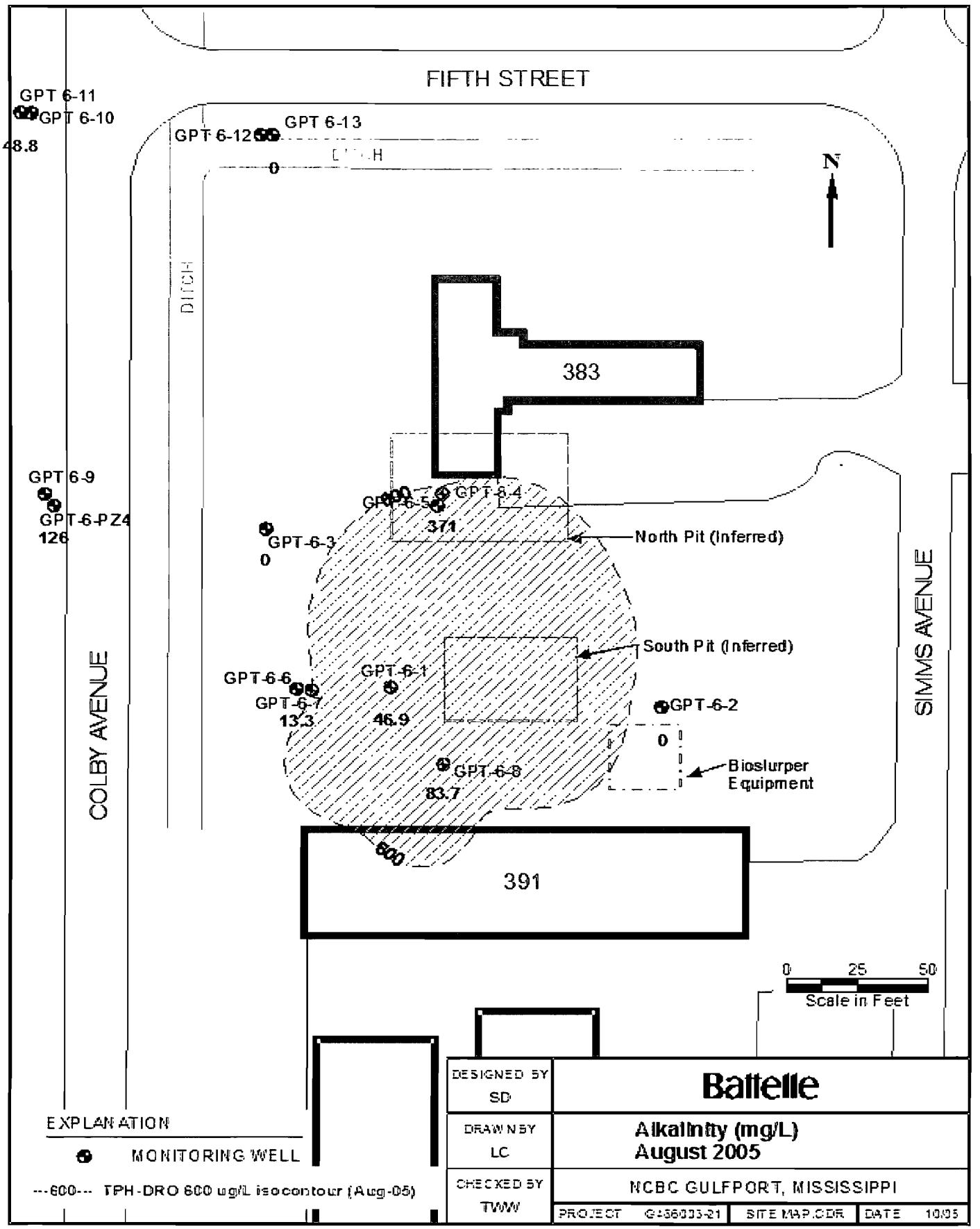

FIFTH STREET
GPT 6-11
GPT 6-10
9.62
GPT 6-12
GPT 6-13
DITCH
19
N
DITCH
383
GPT 6-9
GPT-6-PZ4
6.05
GPT-6-5
GPT-6-4
21
600
GPT-6-3
14.1
North Pit (Inferred)
South Pit (Inferred)
GPT-6-6
GPT-6-1
GPT-6-7
6.38
1.5
GPT-6-2
10
GPT-6-8
2.2
Bioslurper Equipment
600
391
COLBY AVENUE
SIMMS AVENUE
0 25 50
Scale in Feet
EXPLANATION
MONITORING WELL
---600--- TPH-DRO 600 ug/L isocontour (Feb-05)
DESIGNED BY SD
DRAWN BY LC
CHECKED BY TWW
Battelle
Sulfate (mg/L)
February 2005
NCBC GULFPORT, MISSISSIPPI
PROJECT G-55003-21
SITE MAP.CDR
DATE 10/05

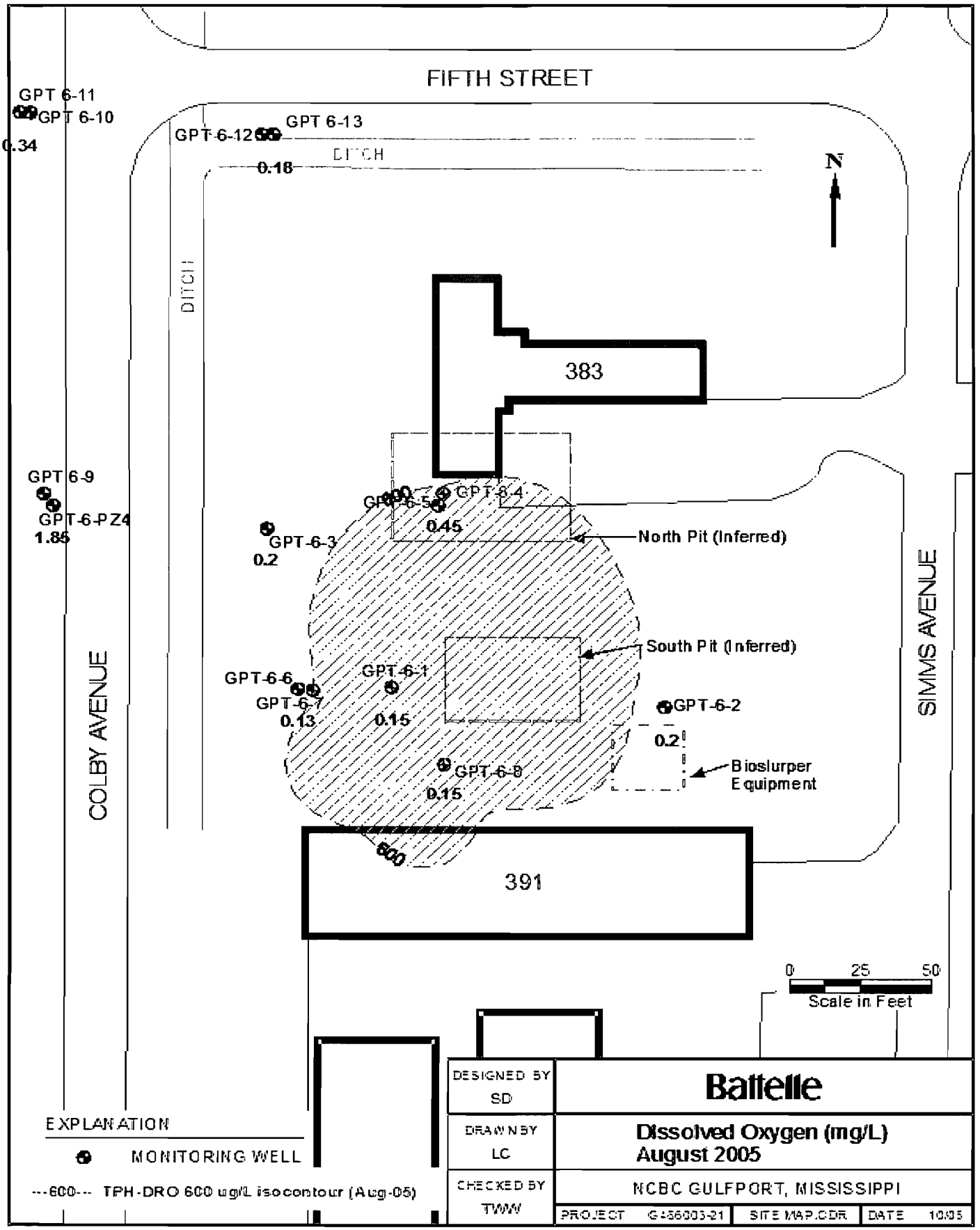

FIFTH STREET
GPT 6-11
GPT 6-10
0
GPT 6-12
GPT 6-13
0.0811
DITCH
DITCH
N
383
GPT 6-9
GPT 6-PZ4
0
GPT 6-5
GPT 6-4
1.56
600
GPT 6-3
0.211
North Pit (Inferred)
South Pit (Inferred)
GPT 6-6
GPT 6-7
1.1
GPT 6-1
2.31
GPT 6-2
0
Bioslurper Equipment
GPT 6-8
3.5
600
391
COLBY AVENUE
SIMMS AVENUE
0 25 50
Scale in Feet
EXPLANATION
MONITORING WELL
---600--- TPH-DRO 600 ug/L isocontour (Feb-05)
DESIGNED BY SD
DRAWN BY LC
CHECKED BY TWW
Battelle
Sulfide (mg/L)
February 2005
NCBC GULFPORT, MISSISSIPPI
PROJECT G-A6003-21
SITE MAP.CDR
DATE 10/05

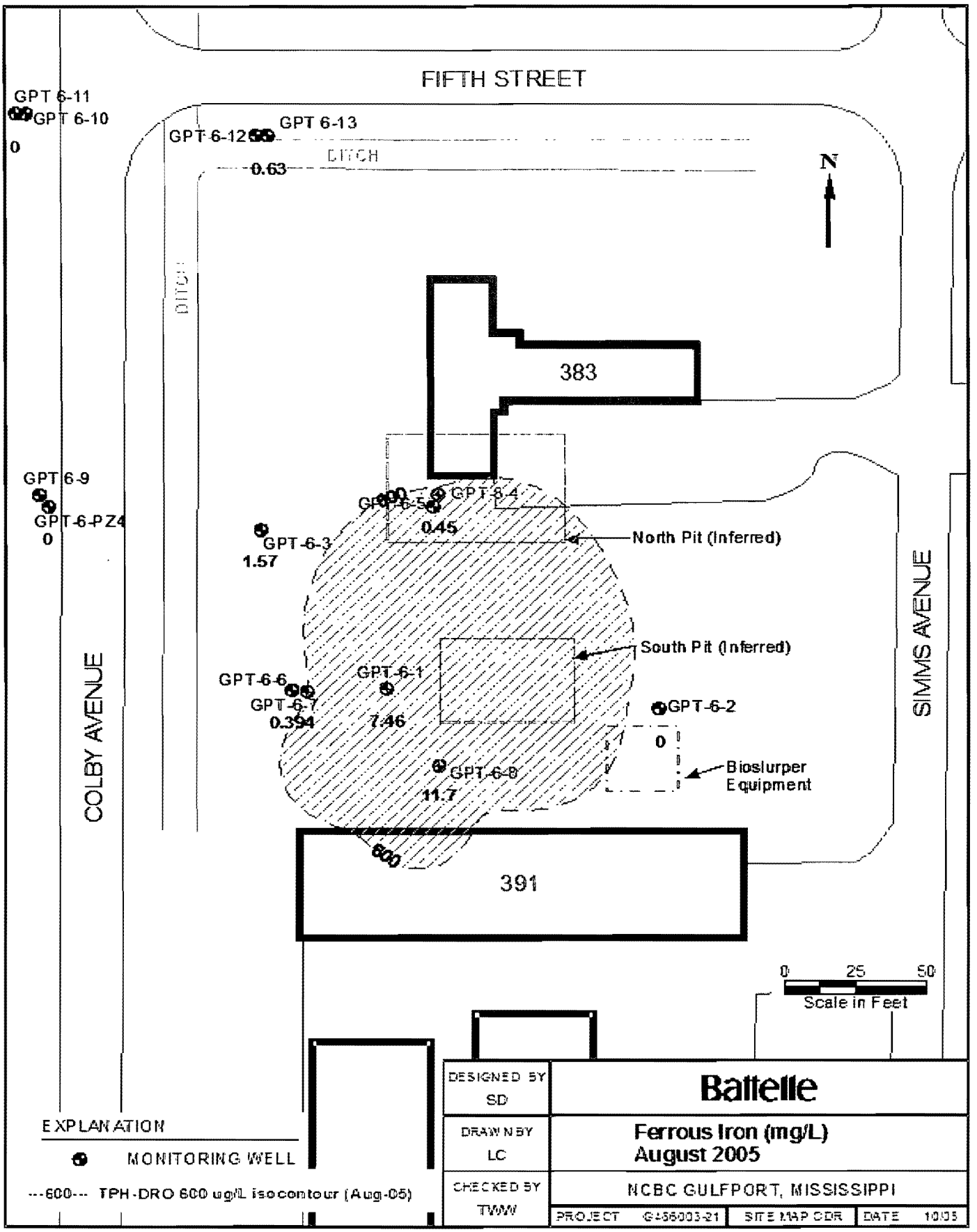
ATTACHMENT 4:

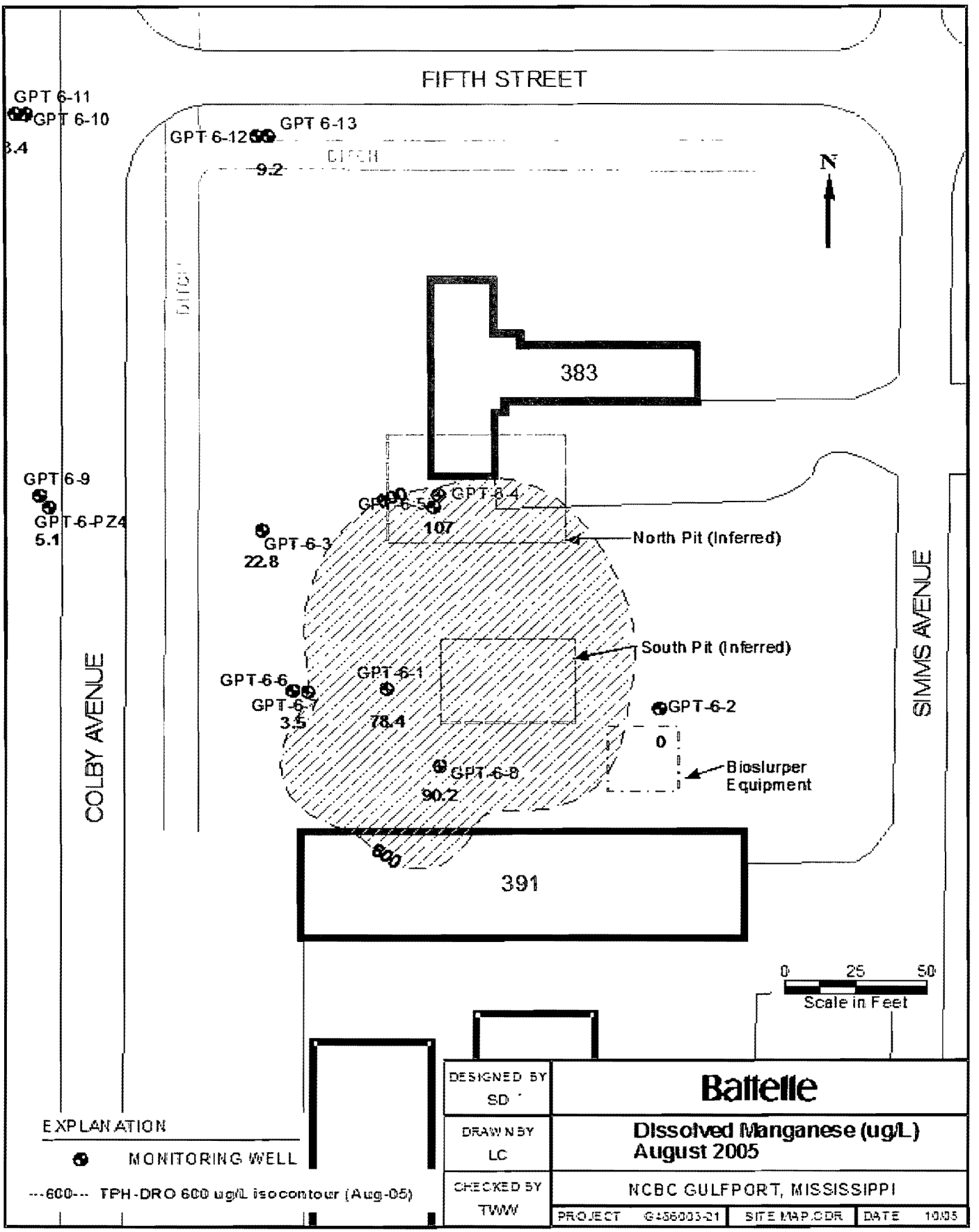
Site Maps Showing Natural Attenuation Indicator Data in Conjunction with the TPH Dissolved-Phase Plume for August 2005

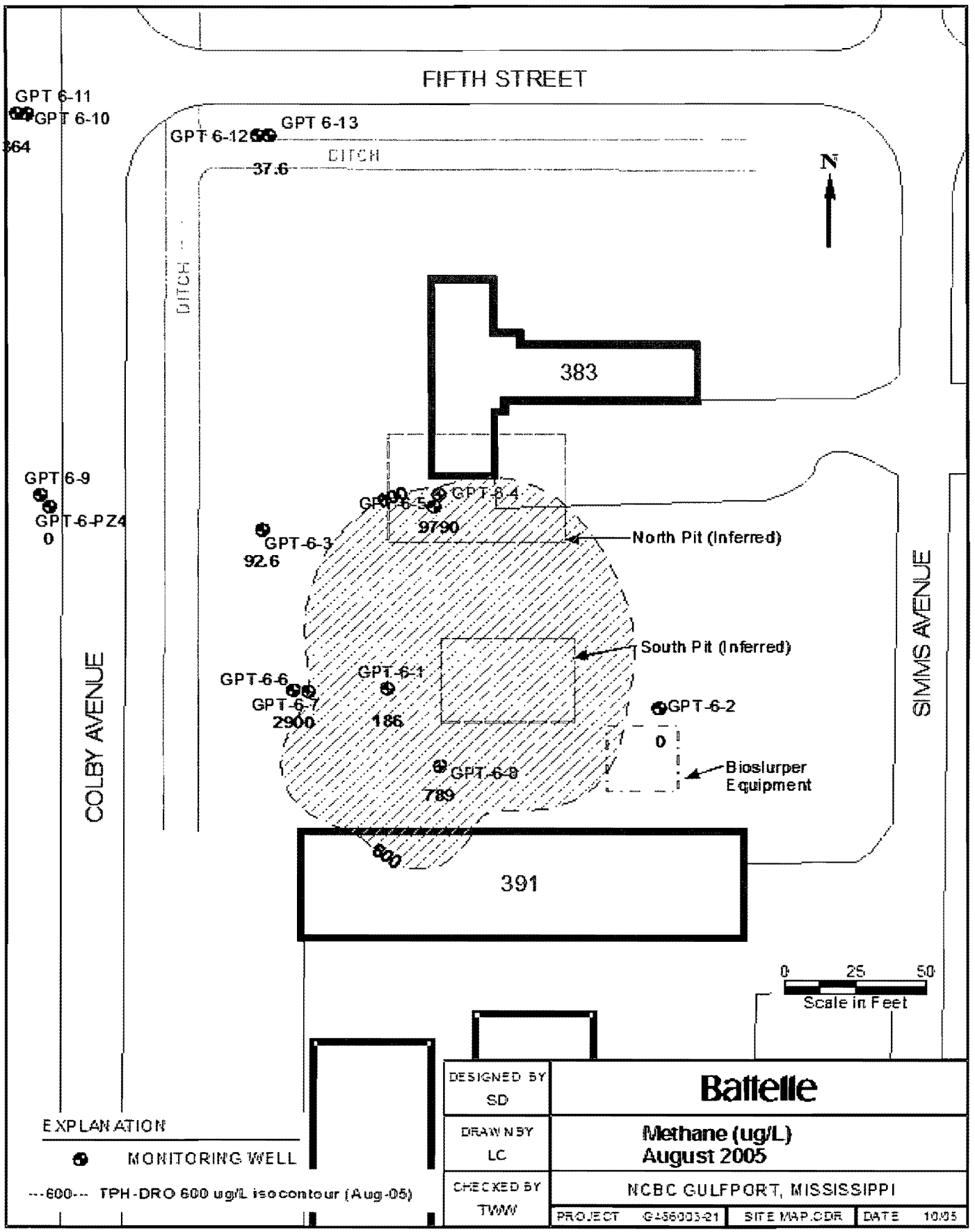

FIFTH STREET
GPT 6-11
GPT 6-10
0
GPT 6-12
GPT 6-13
0
N
383
GPT 6-9
GPT 6-PZ4
0
GPT 6-5
GPT 6-4
650
GPT 6-3
0
North Pit (Inferred)
South Pit (Inferred)
GPT 6-6
GPT 6-7
<600
GPT 6-1
3580
GPT 6-2
0
Bioslurper Equipment
GPT 6-8
7750
600
391
COLBY AVENUE
SIMMS AVENUE
0 25 50
Scale in Feet
EXPLANATION
MONITORING WELL
---600--- TPH-DRO 600 ug/L isocontour (Aug-05)
DESIGNED BY SD
DRAWN BY LC
CHECKED BY TWW
Battelle
Dissolved Phase Plume - TPH DRO
August 2005
NCBC GULFPORT, MISSISSIPPI
PROJECT G-56003-21
SITE MAP.CDR
DATE 10/05

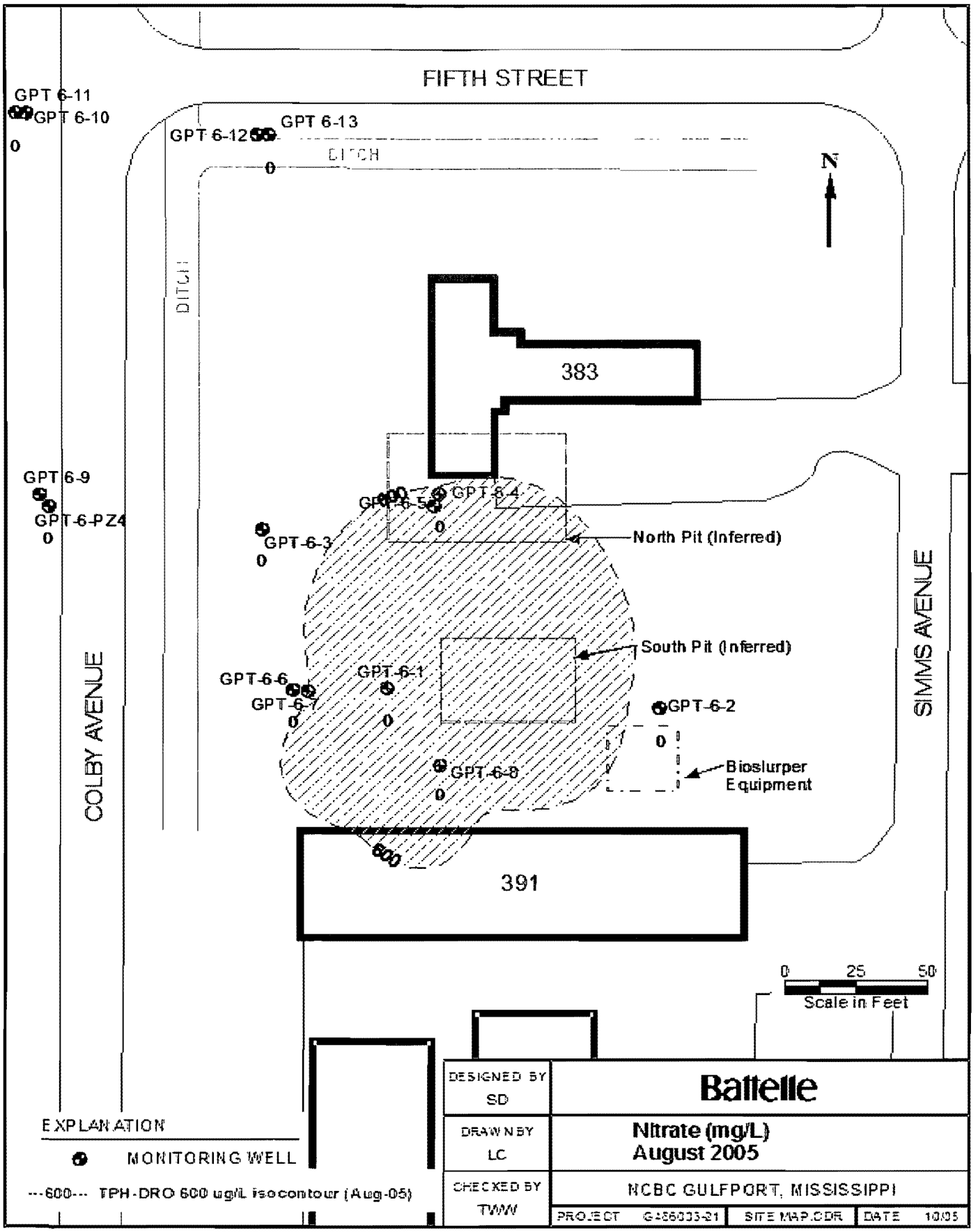

FIFTH STREET
GPT 6-11
GPT 6-10
48.8
GPT 6-12
GPT 6-13
0
DITCH
N
DITCH
383
GPT 6-9
GPT-6-PZ4
126
GPT-6-5
GPT 6-4
371
GPT-6-3
0
North Pit (Inferred)
South Pit (Inferred)
COLBY AVENUE
SIMMS AVENUE
GPT-6-6
GPT-6-7
13.3
GPT-6-1
46.9
GPT-6-2
0
Bioslurper Equipment
GPT-6-8
83.7
600
391
0 25 50
Scale in Feet
EXPLANATION
MONITORING WELL
---600--- TPH-DRO 600 ug/L isocontour (Aug-05)
DESIGNED BY SD
DRAWN BY LC
CHECKED BY TWW
Battelle
Alkalinity (mg/L)
August 2005
NCBC GULFPORT, MISSISSIPPI
PROJECT G-36033-21
SITE MAP.CDR
DATE 10/05

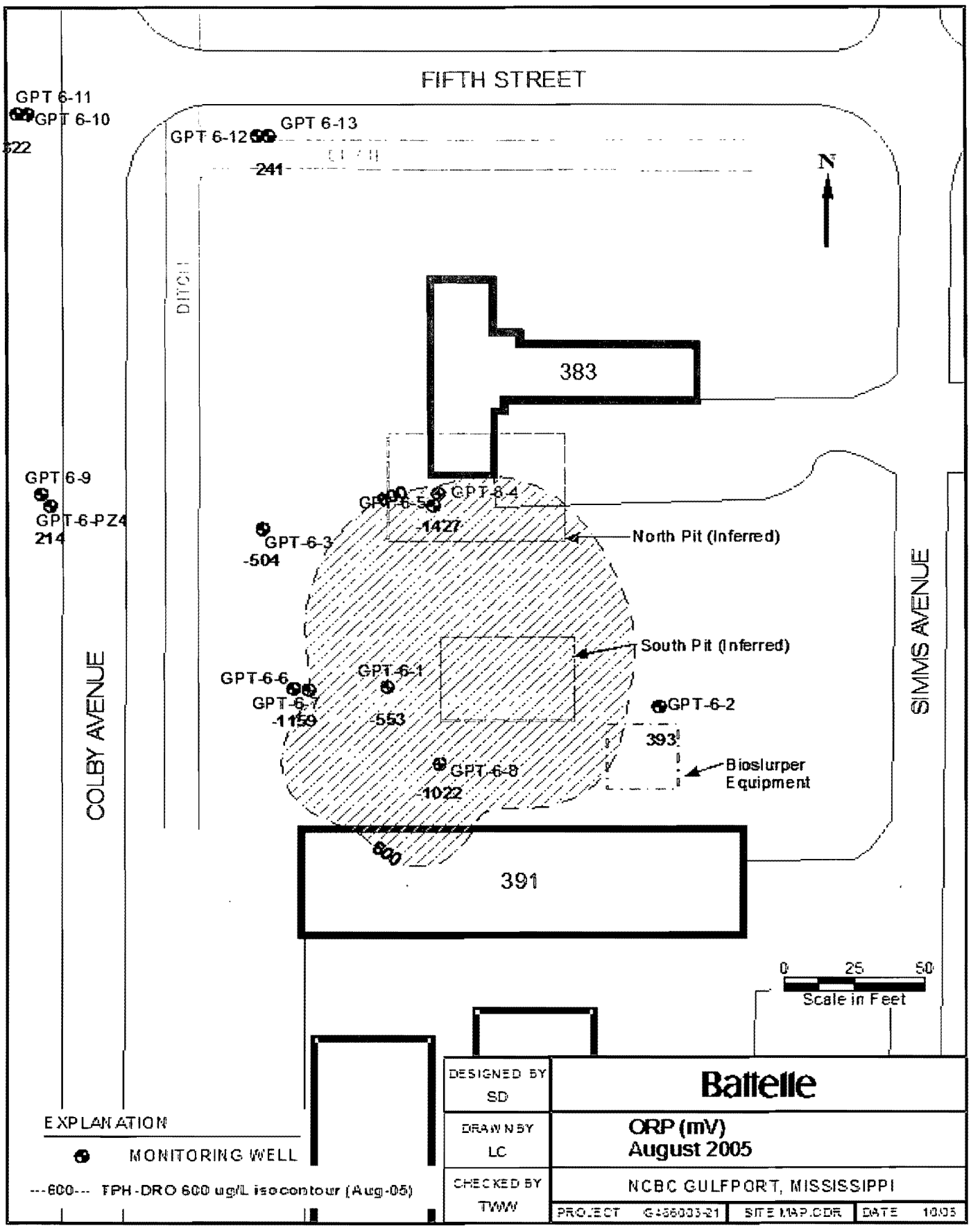

FIFTH STREET
GPT 6-11
GPT 6-10
0.34
GPT 6-12
GPT 6-13
0.18
DITCH
N
DITCH
383
GPT 6-9
GPT-6-PZ4
1.85
GPT-6-3
0.2
GPT-6-5
GPT-6-4
0.45
North Pit (Inferred)
South Pit (Inferred)
GPT-6-6
GPT-6-7
0.13
GPT-6-1
0.15
GPT-6-2
0.2
Bioslurper Equipment
GPT-6-8
0.15
600
391
COLBY AVENUE
SIMMS AVENUE
0 25 50
Scale in Feet
EXPLANATION
MONITORING WELL
---600--- TPH-DRO 600 ug/L isocontour (Aug-05)
DESIGNED BY SD
DRAWN BY LC
CHECKED BY TWW
Battelle
Dissolved Oxygen (mg/L)
August 2005
NCBC GULFPORT, MISSISSIPPI
PROJECT G-36003-21
SITE MAP.CDR
DATE 10/05

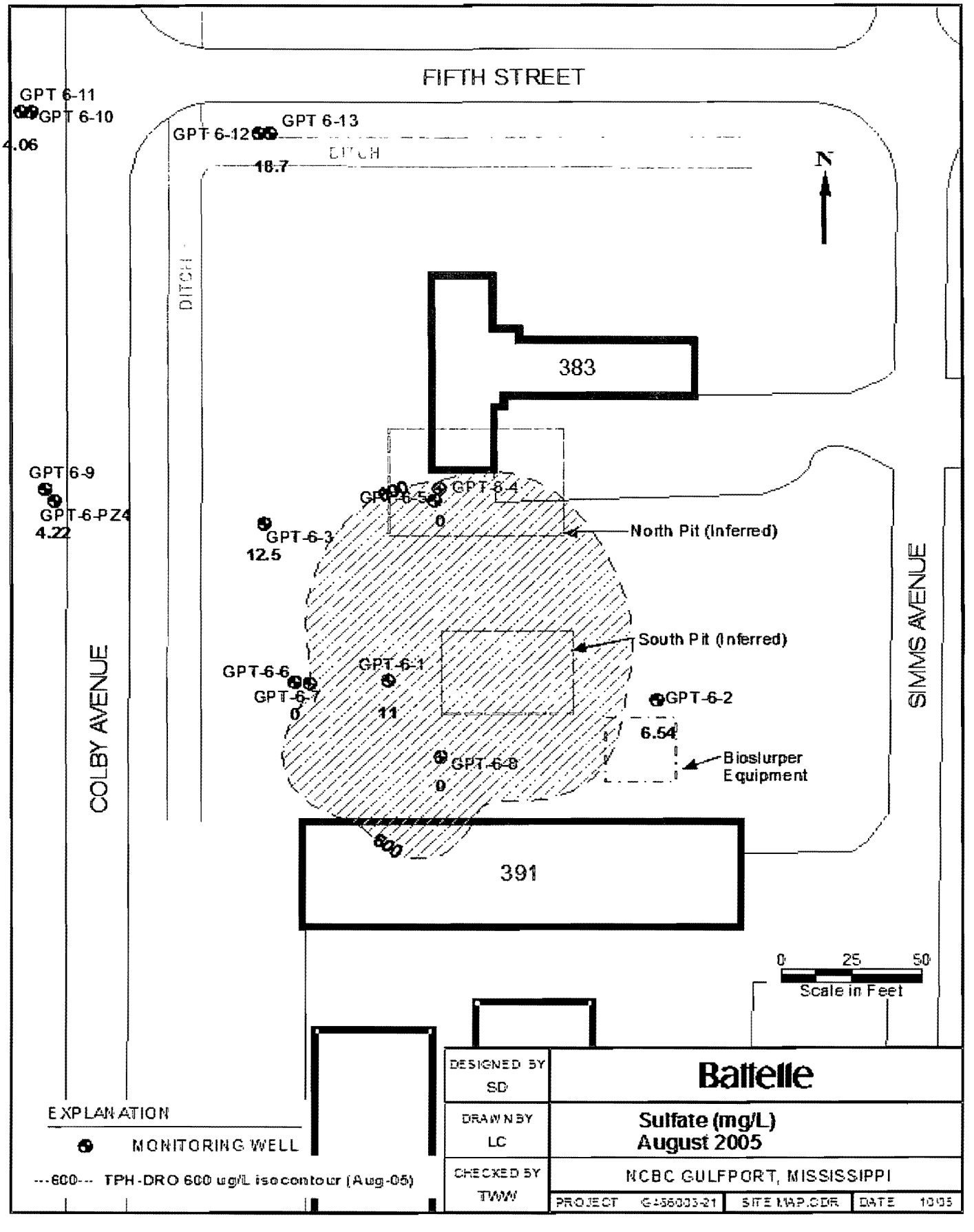

FIFTH STREET
GPT 6-11
GPT 6-10
0
GPT 6-12
GPT 6-13
0.63
DITCH
N
DITCH
383
GPT 6-9
GPT-6-PZ4
0
GPT-6-3
1.57
GPT 6-5
0.45
GPT 6-4
North Pit (Inferred)
South Pit (Inferred)
GPT-6-6
GPT-6-7
0.394
GPT-6-1
7.46
GPT-6-2
0
GPT-6-8
11.7
Bioslurper Equipment
600
391
COLBY AVENUE
SIMMS AVENUE
0 25 50
Scale in Feet
EXPLANATION
MONITORING WELL
---600--- TPH-DRO 600 ug/L isocontour (Aug-05)
DESIGNED BY SD
DRAWN BY LC
CHECKED BY TWW
Battelle
Ferrous Iron (mg/L)
August 2005
NCBC GULFPORT, MISSISSIPPI
PROJECT G-436003-21
SITE MAP CDR
DATE 10/05

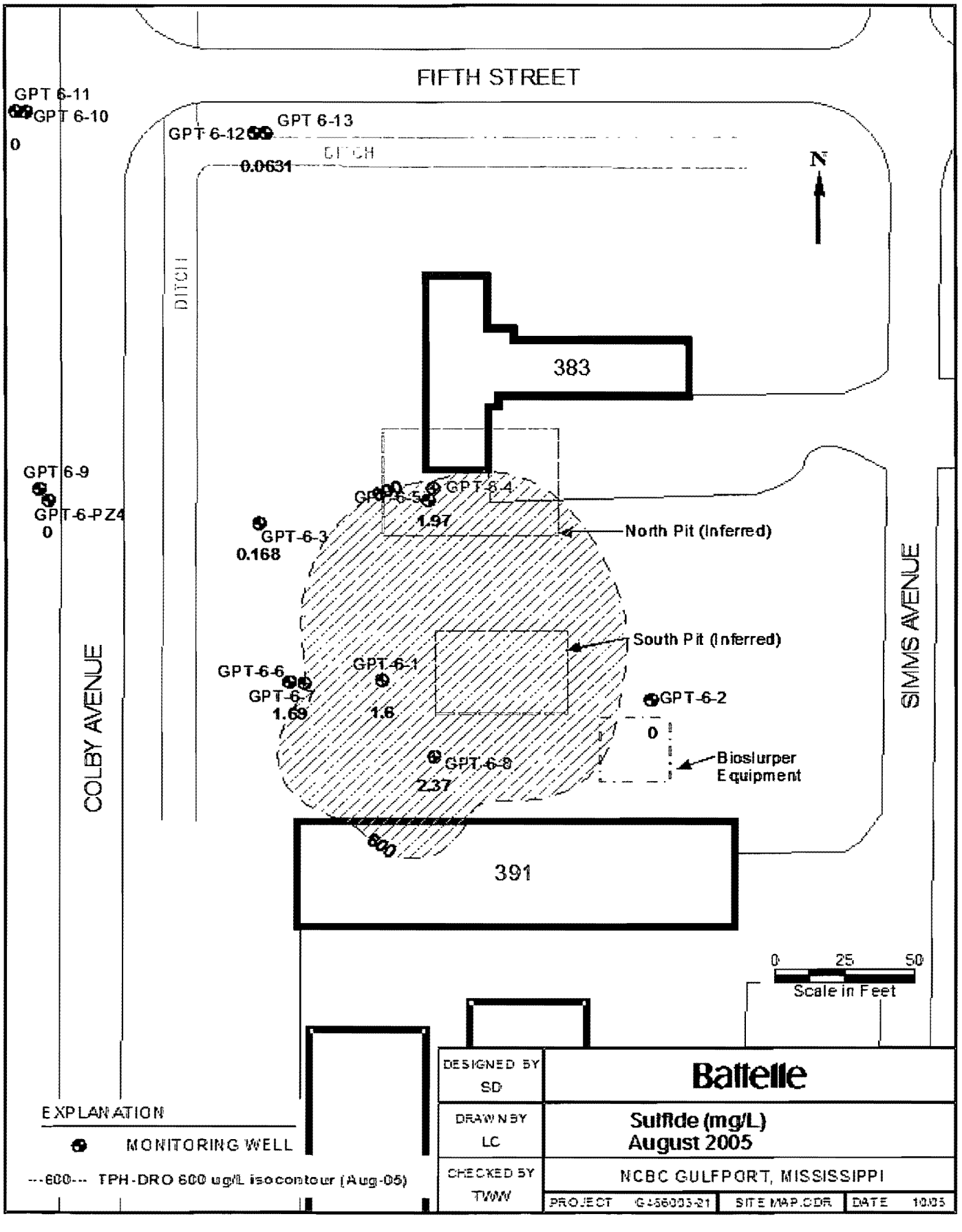

FIFTH STREET
GPT 6-11
GPT 6-10
3.4
GPT 6-12
GPT 6-13
9.2
DITCH
N
383
GPT 6-9
GPT-6-PZ4
5.1
GPT-6-3
22.8
GPT-6-5
GPT-6-4
107
North Pit (Inferred)
South Pit (Inferred)
GPT-6-6
GPT-6-7
3.5
GPT-6-1
78.4
GPT-6-2
0
Bioslurper Equipment
GPT-6-8
90.2
600
391
COLBY AVENUE
SIMMS AVENUE
0 25 50
Scale in Feet
EXPLANATION
MONITORING WELL
---600--- TPH-DRO 600 ug/L isocontour (Aug-05)
DESIGNED BY SD
DRAWN BY LC
CHECKED BY TWW
Battelle
Dissolved Manganese (ug/L)
August 2005
NCBC GULFPORT, MISSISSIPPI
PROJECT G-86003-21
SITE MAP.CDR
DATE 10/05


FIFTH STREET
GPT 6-11
GPT 6-10
364
GPT 6-12
GPT 6-13
DITCH
37.6
N
DITCH
383
GPT 6-9
GPT-6-PZ4
0
GPT-6-5
GPT-6-4
9790
GPT-6-3
92.6
North Pit (Inferred)
South Pit (Inferred)
GPT-6-6
GPT-6-1
GPT-6-7
2900
186
GPT-6-2
0
GPT-6-8
789
Bioslurper Equipment
600
391
COLBY AVENUE
SIMMS AVENUE
0 25 50
Scale in Feet
EXPLANATION
MONITORING WELL
---600--- TPH-DRO 600 ug/L isocontour (Aug-05)
DESIGNED BY SD
DRAWN BY LC
CHECKED BY TWW
Battelle
Methane (ug/L)
August 2005
NCBC GULFPORT, MISSISSIPPI
PROJECT G-36003-21
SITE MAP.CDR
DATE 10/05


FIFTH STREET
GPT 6-11
GPT 6-10
GPT 6-12
GPT 6-13
DITCH
DITCH
N
383
GPT 6-9
GPT-6-PZ4
GPT-6-3
GPT-6-4
GPT-6-5
North Pit (Inferred)
South Pit (Inferred)
GPT-6-6
GPT-6-7
GPT-6-1
GPT-6-2
GPT-6-8
Bioslurper Equipment
600
391
COLBY AVENUE
SIMMS AVENUE
0 25 50
Scale in Feet
EXPLANATION
MONITORING WELL
---600--- TPH-DRO 600 ug/L isocontour (Aug-05)
DESIGNED BY SD
DRAWN BY LC
CHECKED BY TWW
Battelle
Nitrate (mg/L)
August 2005
NCBC GULFPORT, MISSISSIPPI
PROJECT G486033-21
SITE MAP.CDR
DATE 10/05

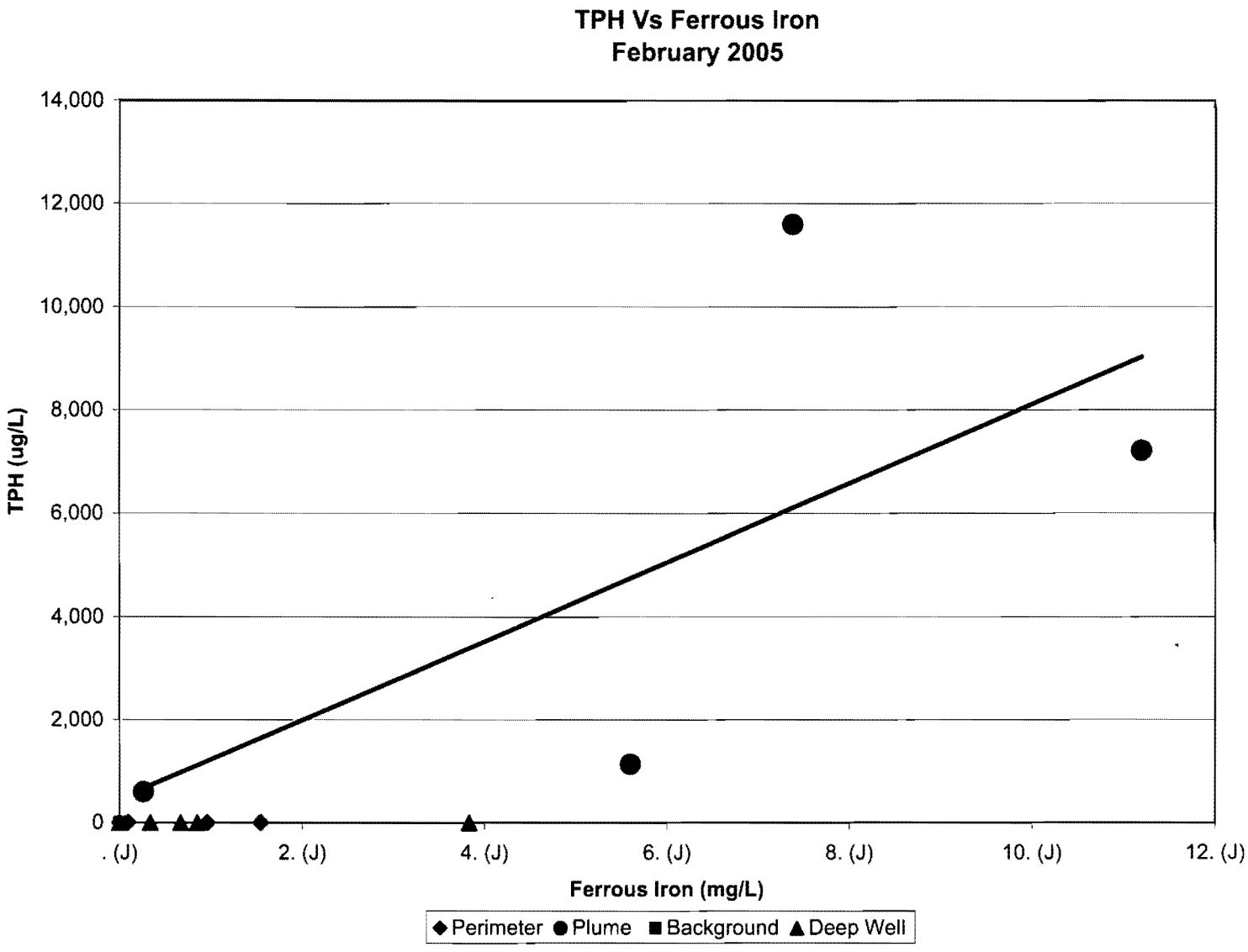

FIFTH STREET
GPT 6-11
GPT 6-10
522
GPT 6-12
GPT 6-13
-241
N
DITCH
383
GPT 6-9
GPT-6-PZ4
214
GPT-6-3
-504
GPT-6-5
GPT-6-4
-1427
North Pit (Inferred)
South Pit (Inferred)
GPT-6-6
GPT-6-7
-1159
GPT-6-1
-553
GPT-6-2
393
GPT-6-8
-1022
Bioslurper Equipment
600
391
COLBY AVENUE
SIMMS AVENUE
0 25 50
Scale in Feet
EXPLANATION
MONITORING WELL
---600--- TPH-DRO 600 ug/L isocontour (Aug-05)
DESIGNED BY SD
DRAWN BY LC
CHECKED BY TWW
Battelle
ORP (mV)
August 2005
NCBC GULFPORT, MISSISSIPPI
PROJECT G-36003-21
SITE MAP.CDR
DATE 10/05

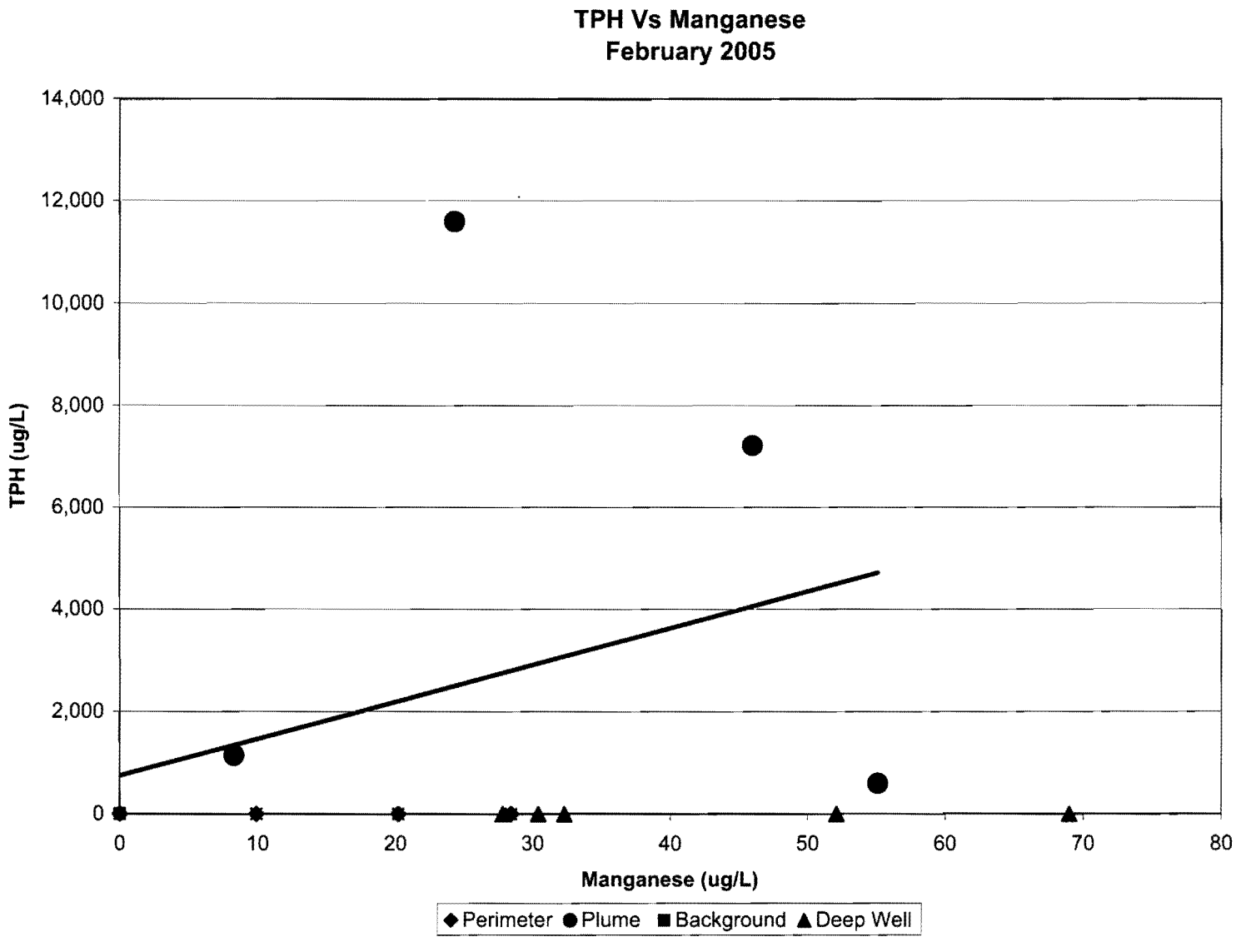

FIFTH STREET
GPT 6-11
GPT 6-10
4.06
GPT 6-12
GPT 6-13
18.7
DITCH
N
DITCH
383
GPT 6-9
GPT-6-PZ4
4.22
GPT-6-5
GPT 6-4
0
GPT-6-3
12.5
North Pit (Inferred)
South Pit (Inferred)
COLBY AVENUE
SIMMS AVENUE
GPT-6-6
GPT-6-7
0
GPT-6-1
11
GPT-6-2
6.54
Bioslurper Equipment
GPT-6-8
0
600
391
0 25 50
Scale in Feet
EXPLANATION
MONITORING WELL
---600--- TPH-DRO 600 ug/L isocontour (Aug-05)
DESIGNED BY SD
DRAWN BY LC
CHECKED BY TWW
Battelle
Sulfate (mg/L)
August 2005
NCBC GULFPORT, MISSISSIPPI
PROJECT G-56003-21
SITE MAP.CDR
DATE 10/05

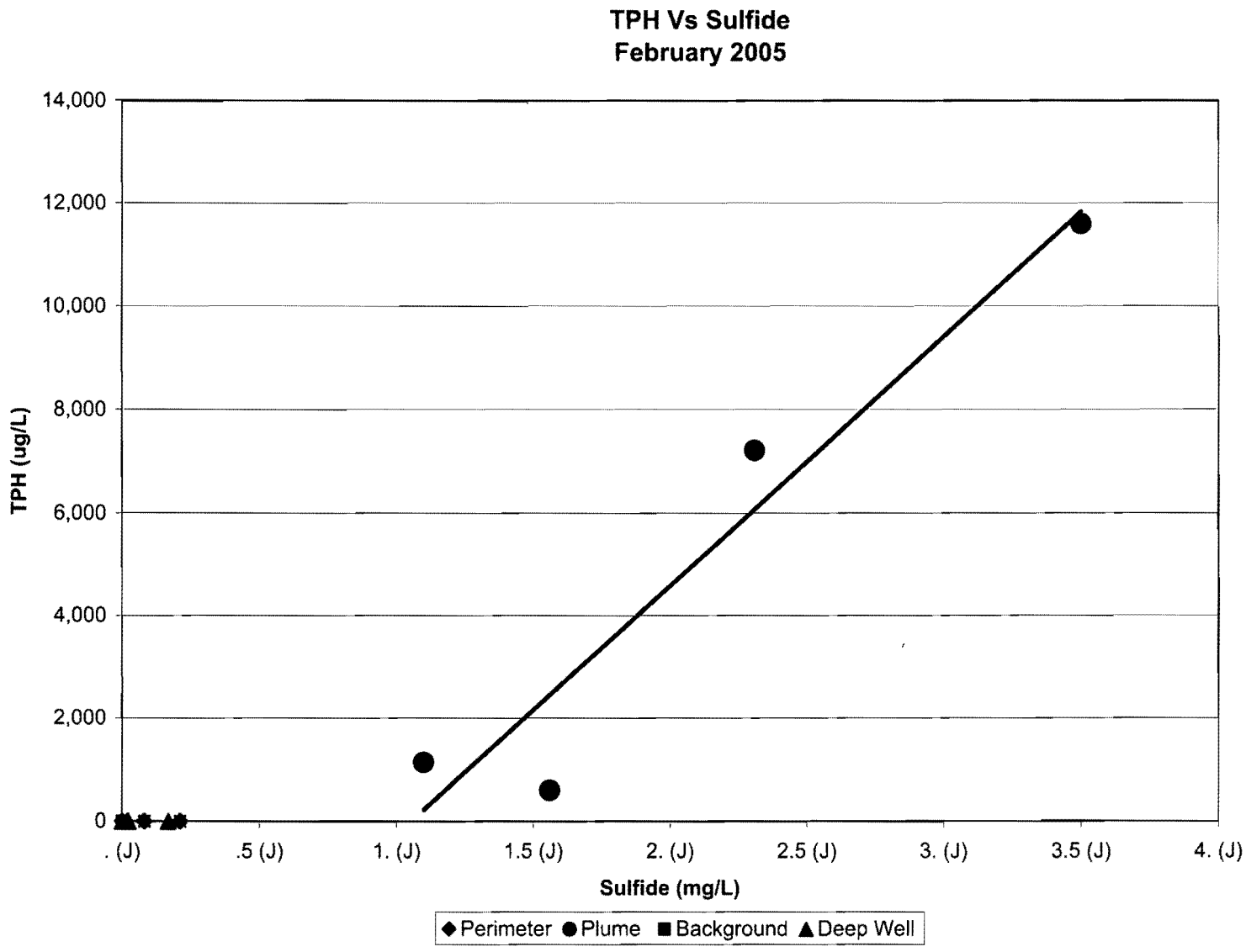

FIFTH STREET
GPT 6-11
GPT 6-10
0
GPT 6-12
GPT 6-13
0.0631
DITCH
DITCH
N
383
GPT 6-9
GPT-6-PZ4
0
GPT-6-3
0.168
GPT-6-5
1.97
GPT-6-4
North Pit (Inferred)
South Pit (Inferred)
GPT-6-6
GPT-6-7
1.69
GPT-6-1
1.6
GPT-6-2
0
Bioslurper Equipment
GPT-6-8
2.37
600
391
COLBY AVENUE
SIMMS AVENUE
0 25 50
Scale in Feet
EXPLANATION
MONITORING WELL
---600--- TPH-DRO 600 ug/L isocontour (Aug-05)
DESIGNED BY SD
DRAWN BY LC
CHECKED BY TWW
Battelle
Sulfide (mg/L)
August 2005
NCBC GULFPORT, MISSISSIPPI
PROJECT G456003-21
SITE MAP.CDR
DATE 10/05

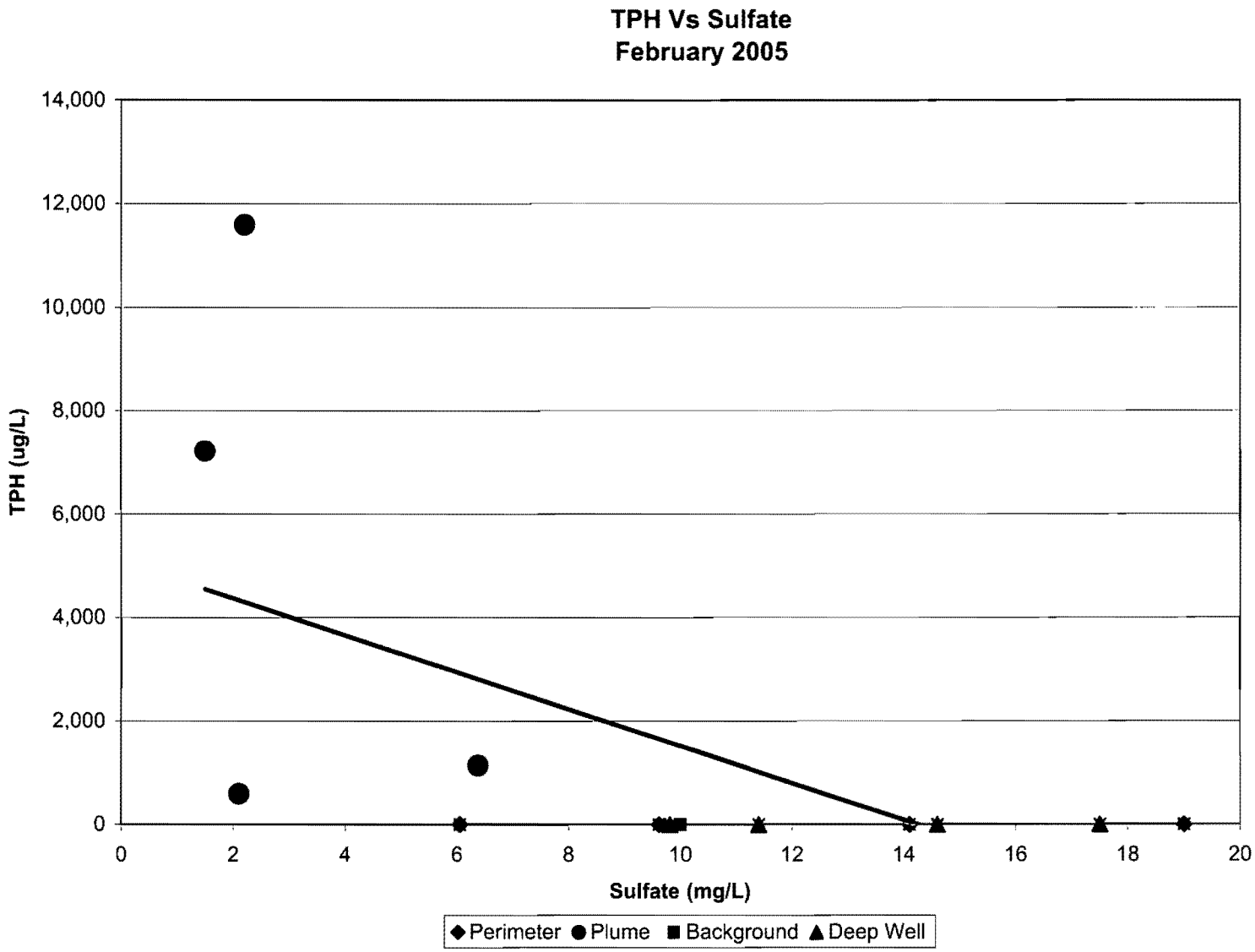
ATTACHMENT 5:

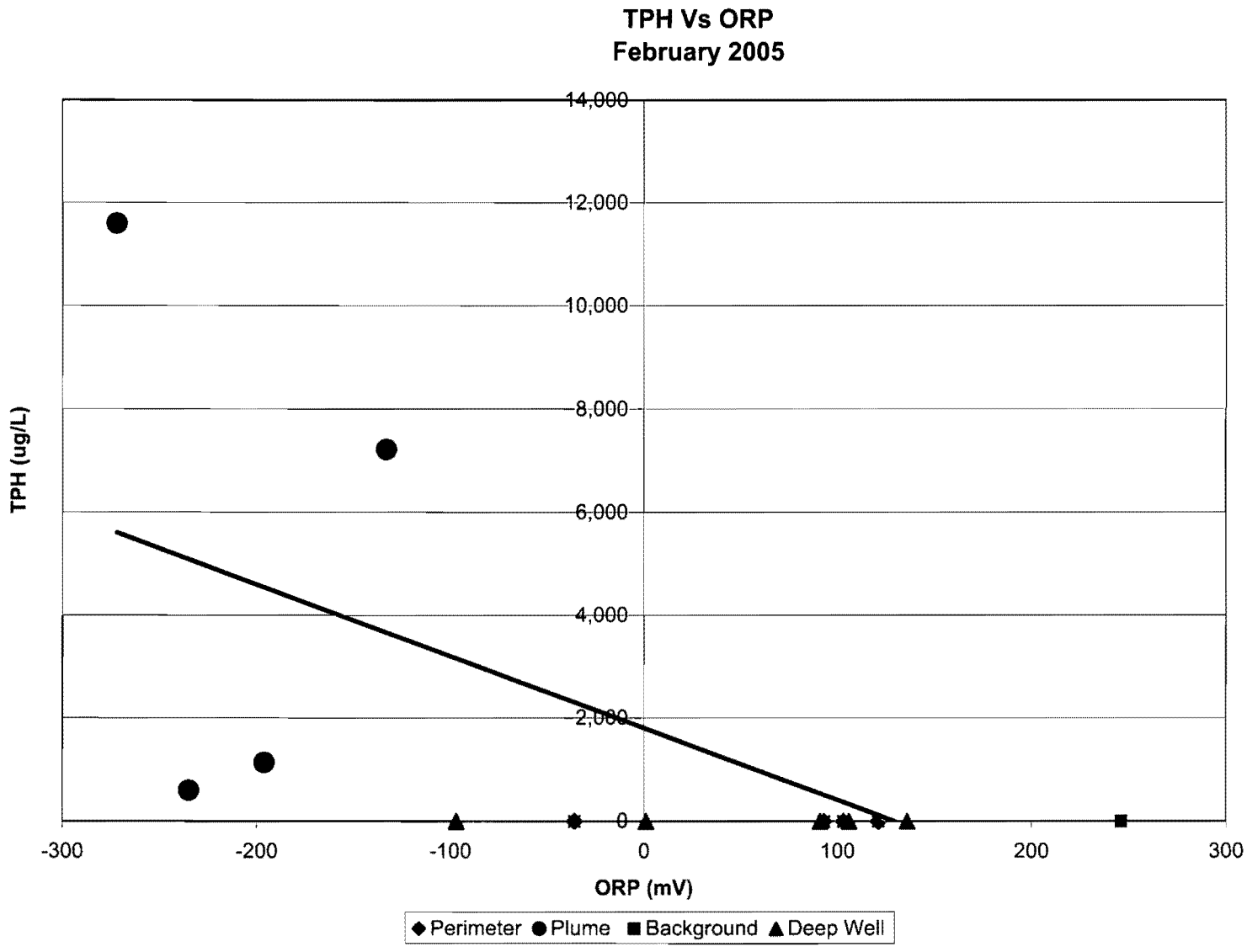
Graphs Showing TPH Concentrations vs. Natural Attenuation Indicator Concentrations
February 2005

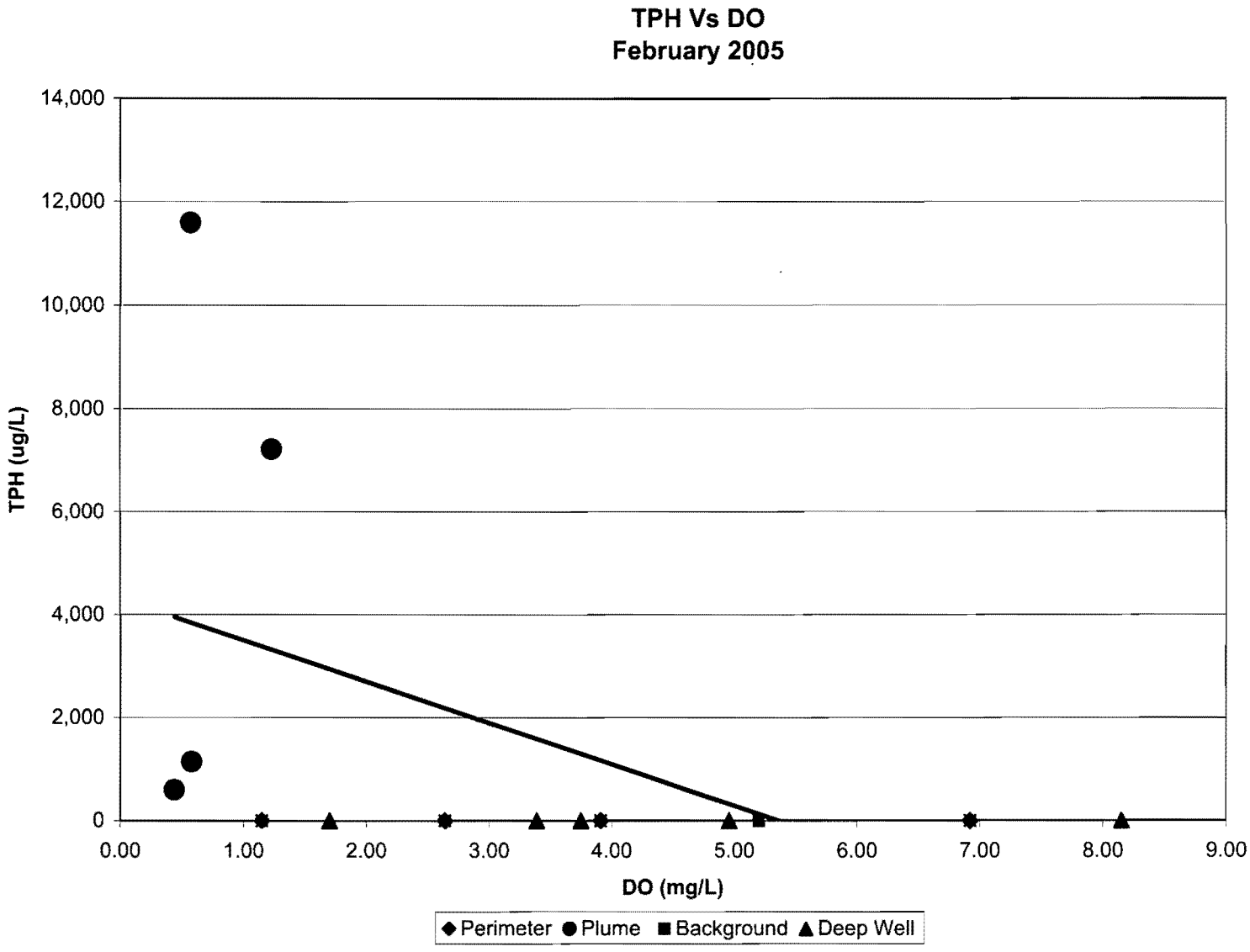

TPH Vs Ferrous Iron
February 2005
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
TPH (ug/L)
. (J)
2. (J)
4. (J)
6. (J)
8. (J)
10. (J)
12. (J)
Ferrous Iron (mg/L)
Perimeter
Plume
Background
Deep Well

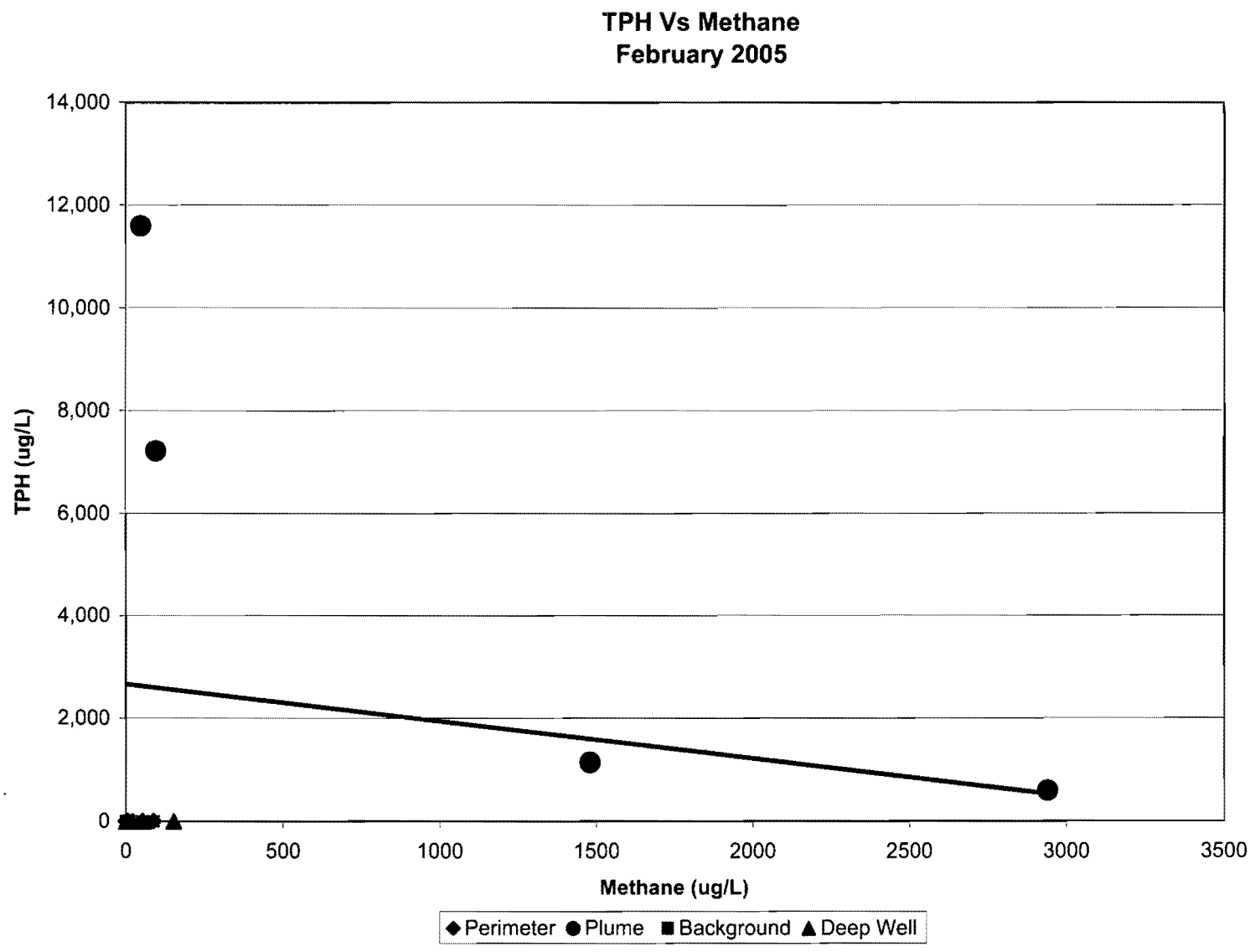

TPH Vs Manganese
February 2005
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
TPH (ug/L)
0
10
20
30
40
50
60
70
80
Manganese (ug/L)
Perimeter
Plume
Background
Deep Well

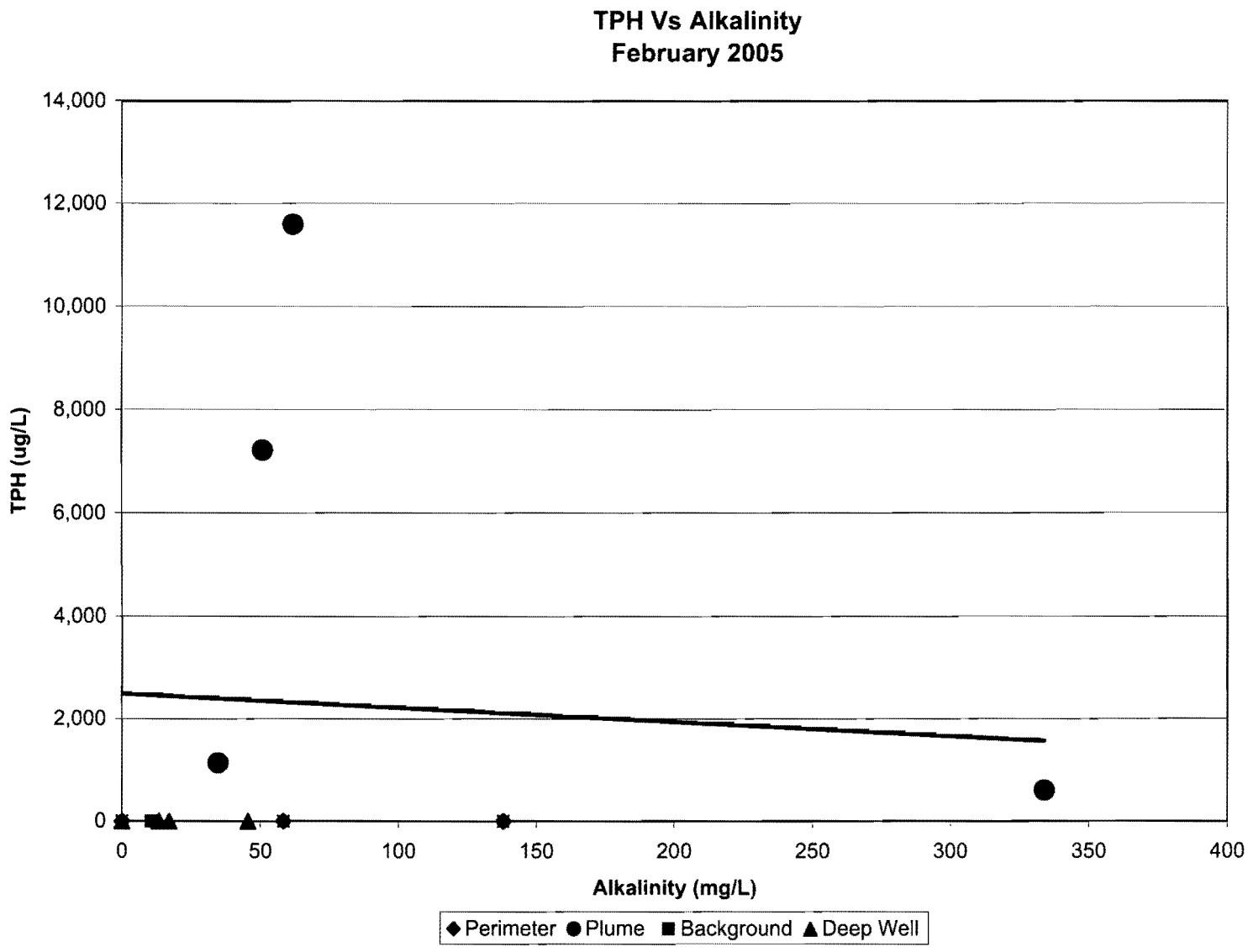

TPH Vs Sulfide
February 2005
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
TPH (ug/L)
. (J)
.5 (J)
1. (J)
1.5 (J)
2. (J)
2.5 (J)
3. (J)
3.5 (J)
4. (J)
Sulfide (mg/L)
Perimeter
Plume
Background
Deep Well


TPH Vs Sulfate
February 2005
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
TPH (ug/L)
0
2
4
6
8
10
12
14
16
18
20
Sulfate (mg/L)
Perimeter
Plume
Background
Deep Well


TPH Vs ORP
February 2005
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
TPH (ug/L)
-300
-200
-100
0
100
200
300
ORP (mV)
Perimeter
Plume
Background
Deep Well

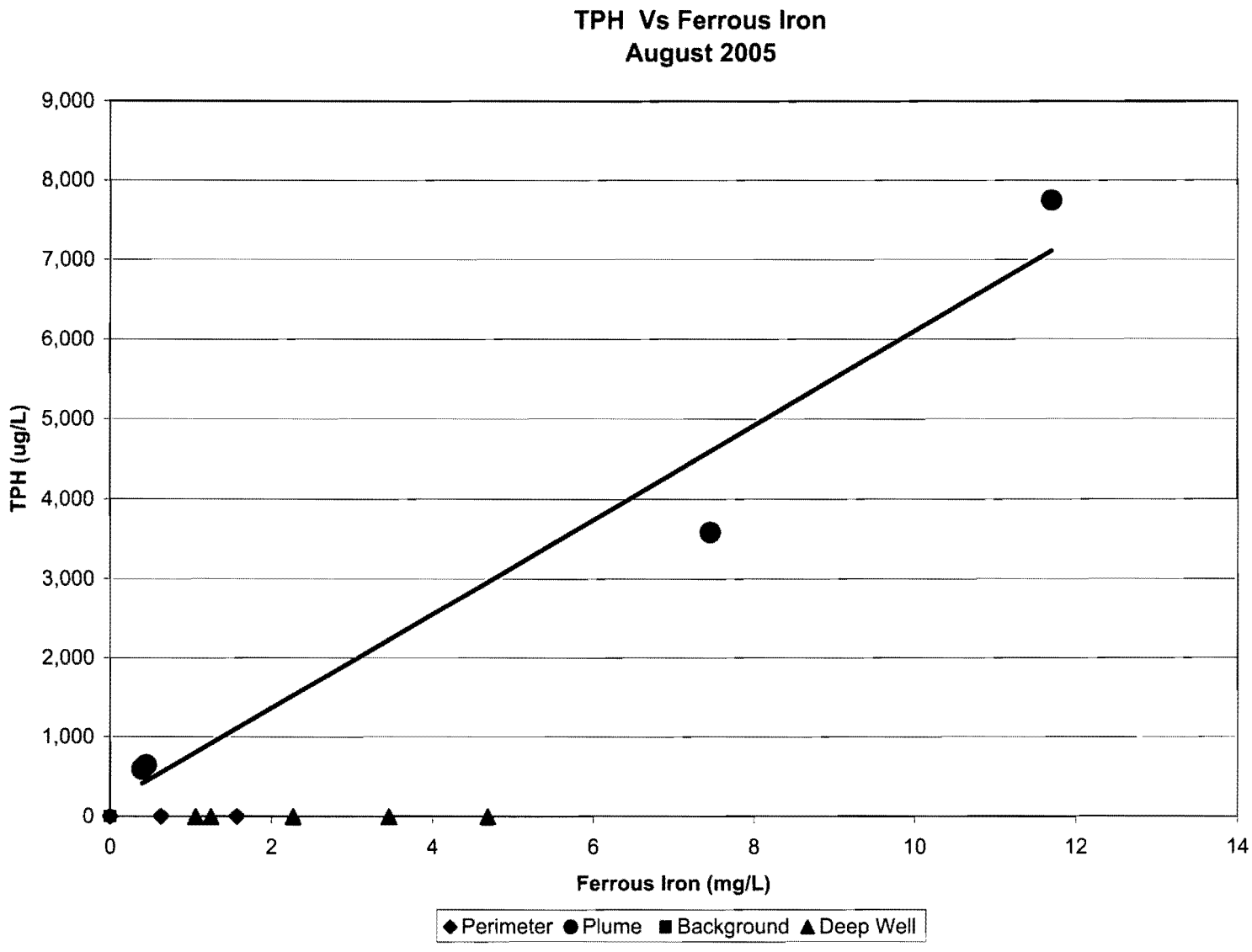

TPH Vs DO
February 2005
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
TPH (ug/L)
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
8.00
9.00
DO (mg/L)
Perimeter
Plume
Background
Deep Well

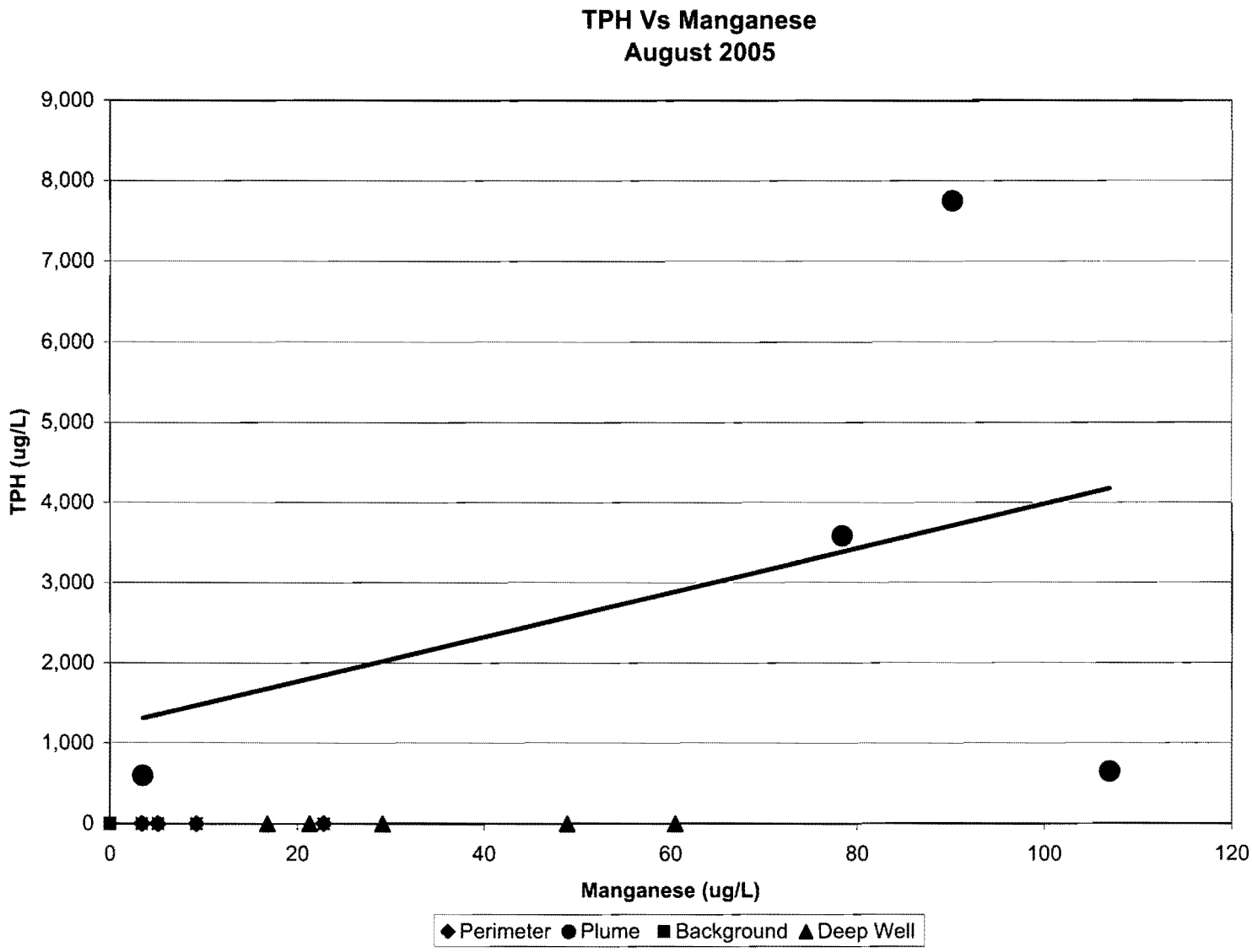

TPH Vs Methane
February 2005
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
TPH (ug/L)
0
500
1000
1500
2000
2500
3000
3500
Methane (ug/L)
Perimeter
Plume
Background
Deep Well

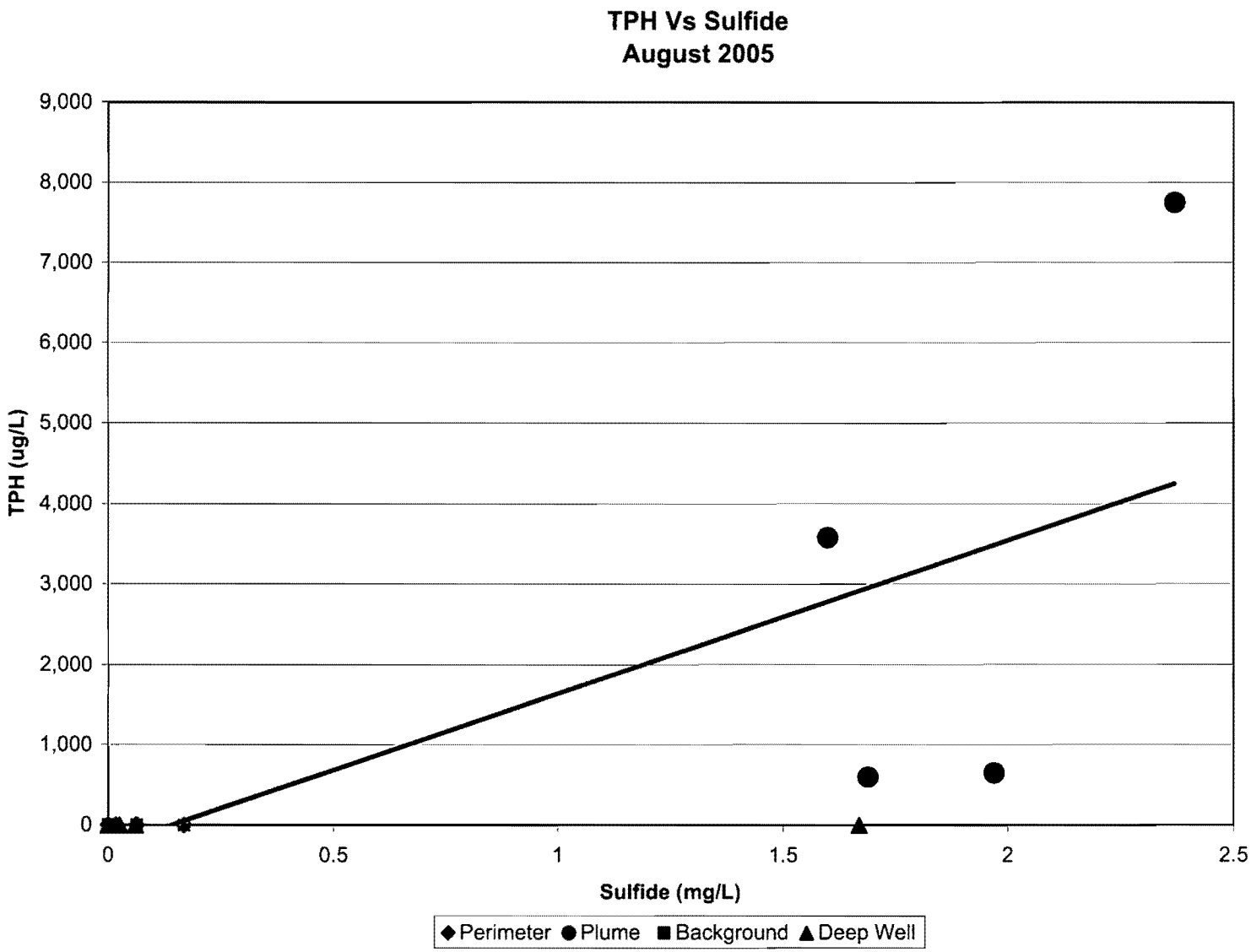

TPH Vs Alkalinity
February 2005
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
TPH (ug/L)
0
50
100
150
200
250
300
350
400
Alkalinity (mg/L)
Perimeter
Plume
Background
Deep Well

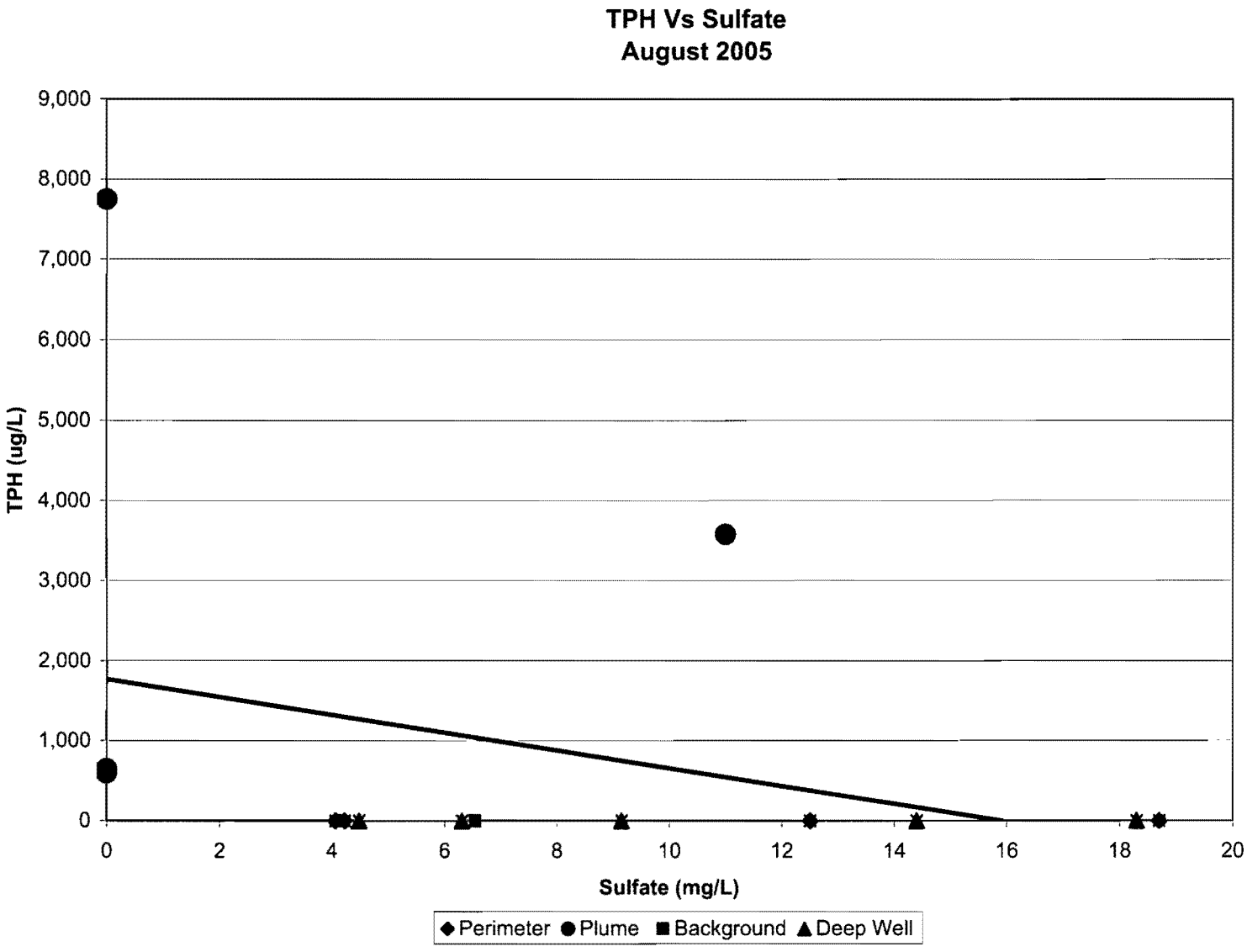
ATTACHMENT 6:

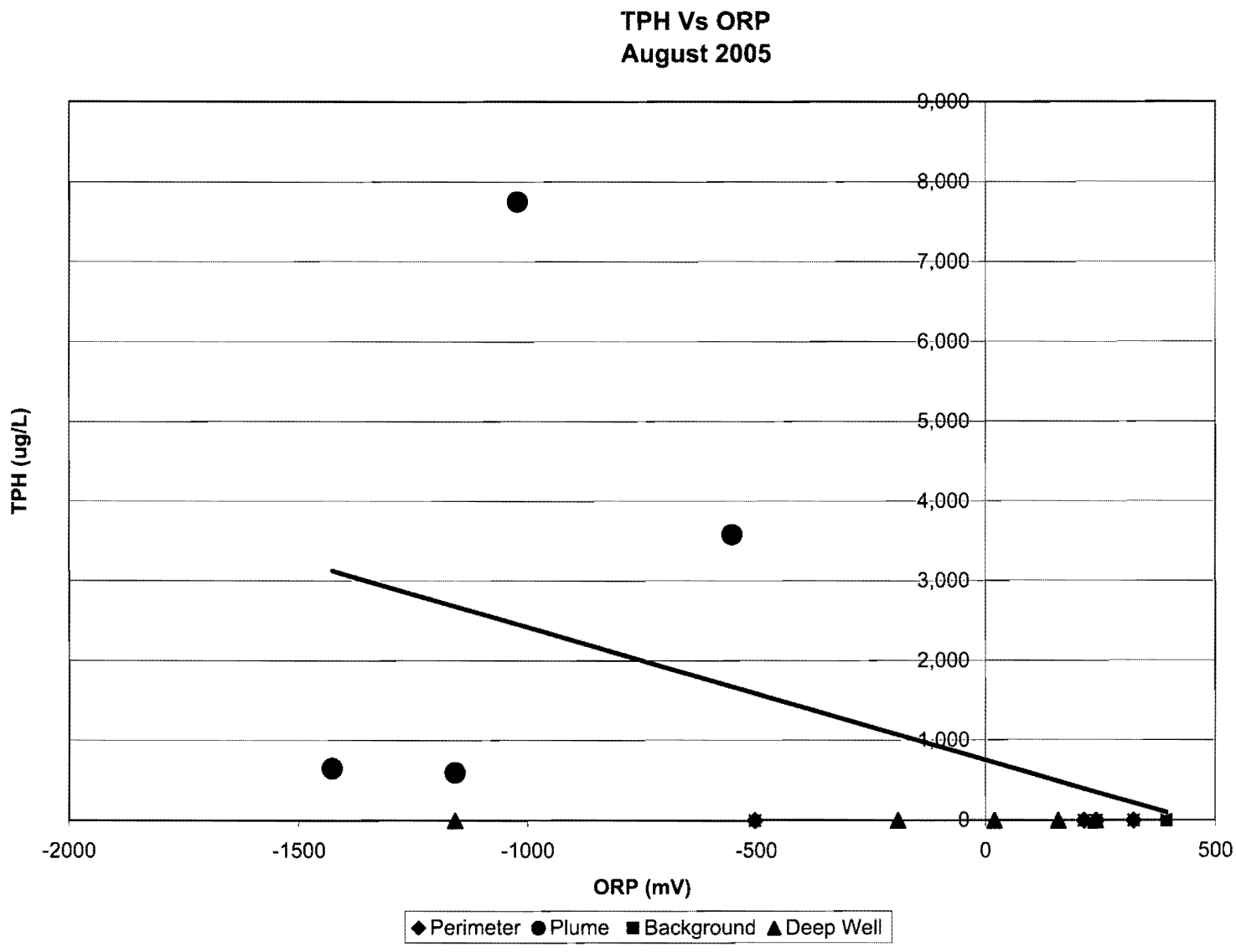
Graphs Showing TPH Concentrations vs. Natural Attenuation Indicator Concentrations
August 2005

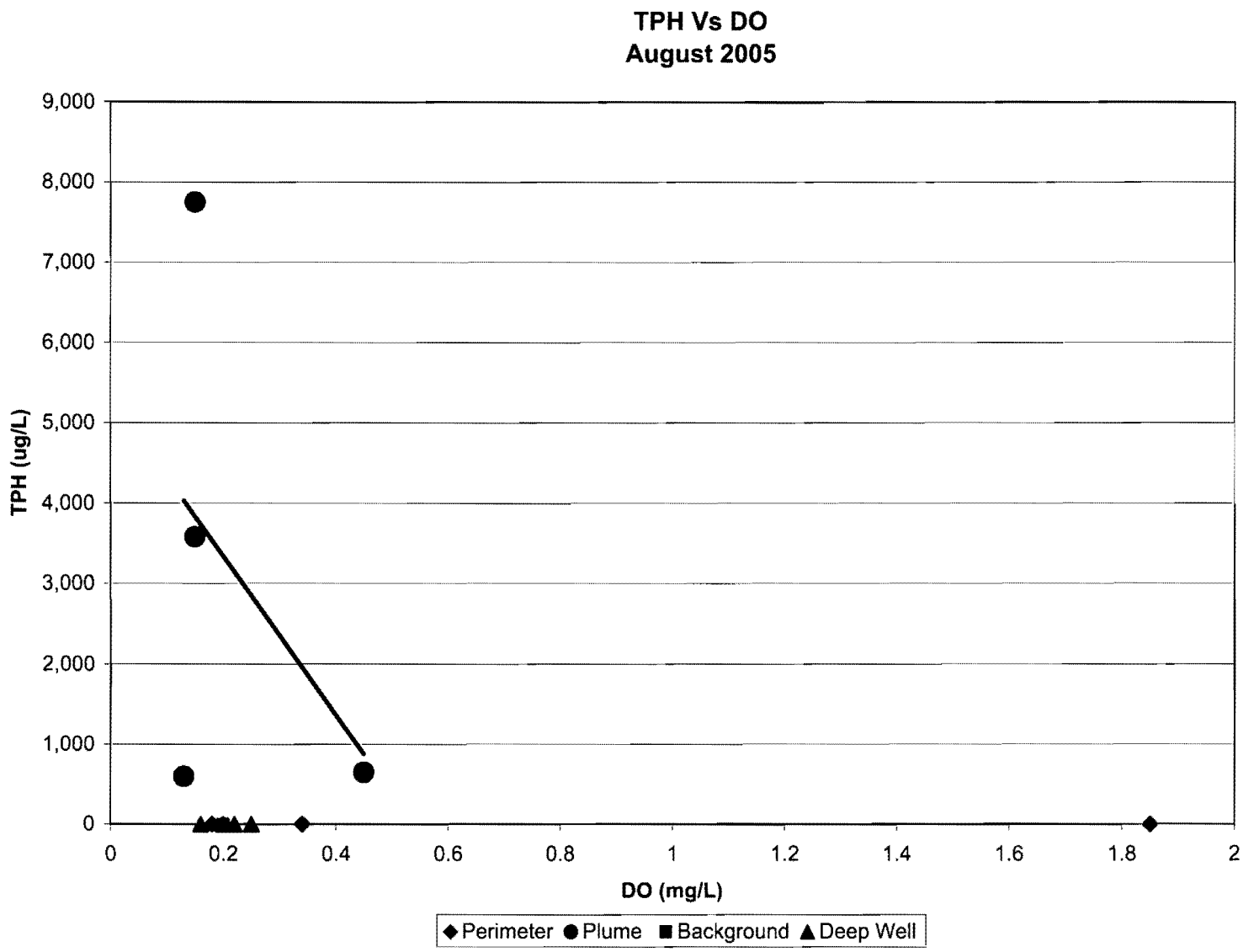

TPH Vs Ferrous Iron
August 2005
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
TPH (ug/L)
0
2
4
6
8
10
12
14
Ferrous Iron (mg/L)
Perimeter
Plume
Background
Deep Well

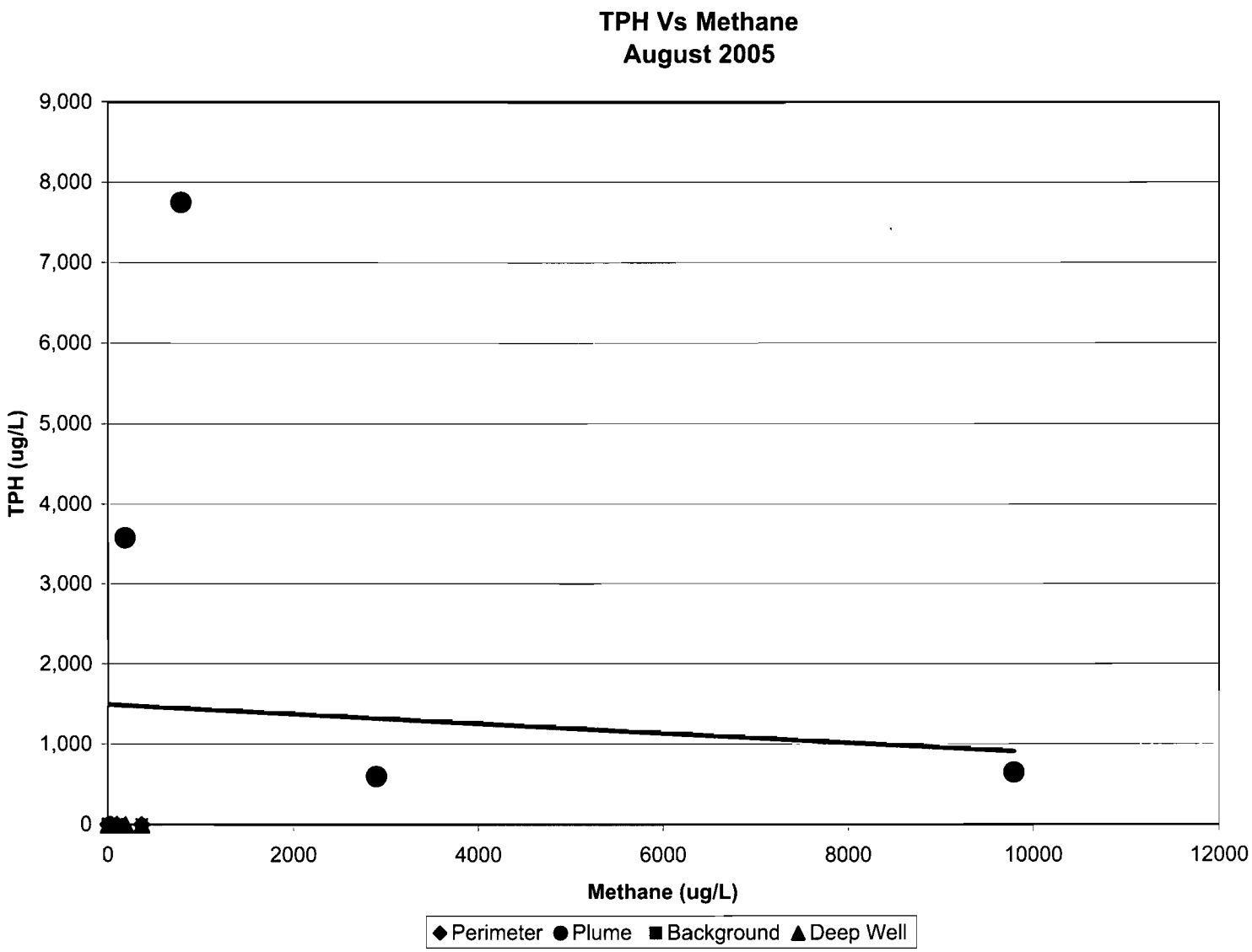

TPH Vs Manganese
August 2005
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
TPH (ug/L)
0
20
40
60
80
100
120
Manganese (ug/L)
Perimeter
Plume
Background
Deep Well

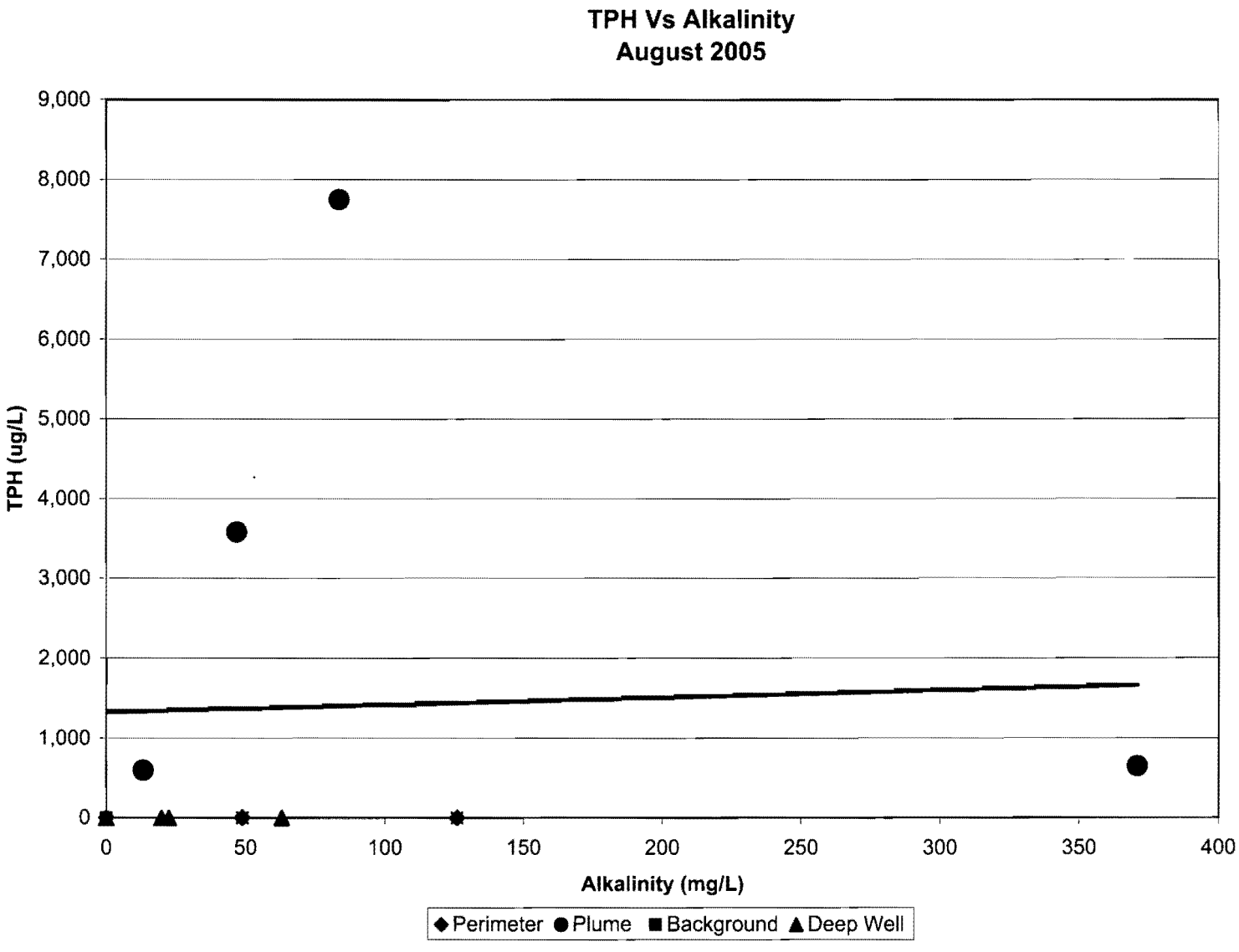

TPH Vs Sulfide
August 2005
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
TPH (ug/L)
0
0.5
1
1.5
2
2.5
Sulfide (mg/L)
Perimeter
Plume
Background
Deep Well


TPH Vs Sulfate
August 2005
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
TPH (ug/L)
0
2
4
6
8
10
12
14
16
18
20
Sulfate (mg/L)
Perimeter
Plume
Background
Deep Well


TPH Vs ORP
August 2005
TPH (ug/L)
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
-2000
-1500
-1000
-500
0
500
ORP (mV)
Perimeter
Plume
Background
Deep Well


TPH Vs DO
August 2005
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
TPH (ug/L)
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
DO (mg/L)
Perimeter
Plume
Background
Deep Well


TPH Vs Methane
August 2005
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
TPH (ug/L)
0
2000
4000
6000
8000
10000
12000
Methane (ug/L)
Perimeter
Plume
Background
Deep Well


TPH Vs Alkalinity
August 2005
TPH (ug/L)
9,000
8,000
7,000
6,000
5,000
4,000
3,000
2,000
1,000
0
0
50
100
150
200
250
300
350
400
Alkalinity (mg/L)
Perimeter
Plume
Background
Deep Well

APPENDIX A:

Analytical Results for February 2005

(available on CD)

APPENDIX B:

Analytical Results for August 2005

(available on CD)

APPENDIX C:

Data Validation Reports for February 2005

(available on CD)

APPENDIX D:

Data Validation Reports for August 2005

(available on CD)