N62604.AR.000723
NCBC GULFPORT
5090.3a

FEASIBILITY STUDY SITE 5 HEAVY EQUIPMENT TRAINING AREA NCBC GULFPORT MS
8/1/2008
TETRA TECH NUS

Comprehensive Long-term Environmental Action Navy

CONTRACT NUMBER N62467-94-D-0888

Rev. 1
08/04/08

Feasibility Study
for
Site 5 - Heavy Equipment Training Area

Naval Construction Battalion Center Gulfport
Gulfport, Mississippi

Contract Task Order 0292

August 2008

NAVFAC
Naval Facilities Engineering Command
NAVFAC SOUTHEAST

NAS Jacksonville
Jacksonville, Florida 32212-0030

TETRA TECH NUS, Inc.

Rev. 1
08/04/08

FEASIBILITY STUDY
FOR
SITE 5 - HEAVY EQUIPMENT TRAINING AREA

NAVAL CONSTRUCTION BATTALION CENTER GULFPORT
GULFPORT, MISSISSIPPI

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

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Naval Facilities Engineering Command
Southeast
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Jacksonville, Florida 32212-0030

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CONTRACT NO. N62467-94-D-0888
CONTRACT TASK ORDER 0292

AUGUST 2008

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TABLE OF CONTENTS

SECTION **PAGE**

LIST OF ACRONYMS v

EXECUTIVE SUMMARY ES-1

1.0 INTRODUCTION 1-1
1.1 PRESUMPTIVE REMEDY APPROACH 1-1
1.2 THE CERCLA FS PROCESS 1-1
1.3 SITE BACKGROUND 1-3
1.3.1 Site Description 1-4
1.3.2 Site History 1-4
1.3.3 Site-Specific Geology and Surface Features 1-4
1.3.4 Site-Specific Aquifer Characteristics 1-5
1.3.5 Investigation History 1-6
1.4 ENVIRONMENTAL CONDITIONS 1-8
1.4.1 Nature and Extent of Contamination 1-8
1.4.2 Human Health Risk Assessment Results 1-10
1.4.3 Ecological Screening Results 1-10
1.4.4 Geotechnical/Landfill Gas Investigation 1-11
1.5 DOCUMENT ORGANIZATION 1-11

2.0 REMEDIAL ACTION OBJECTIVES AND GENERAL RESPONSE ACTIONS 2-1
2.1 REMEDIAL ACTION OBJECTIVES 2-1
2.1.1 ARARs and TBC Criteria 2-1
2.1.2 Chemicals and Media of Concern 2-2
2.1.3 Preliminary Remedial Goals 2-4
2.1.4 Statement of Remedial Action Objectives 2-4
2.2 GENERAL RESPONSE ACTIONS 2-5
2.3 ESTIMATED VOLUME OF CONTAMINATED MEDIA 2-5

3.0 SCREENING OF TECHNOLOGIES AND DEVELOPMENT OF ALTERNATIVES 3-1
3.1 PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS 3-2
3.2 DETAILED SCREENING OF REMEDIATION TECHNOLOGIES AND PROCESS OPTIONS 3-3
3.2.1 No Action 3-3
3.2.2 Limited Action 3-4
3.2.3 Containment 3-5
3.2.4 Excavation 3-7
3.3 SELECTION OF REMEDIATION TECHNOLOGIES AND PROCESS OPTIONS 3-9
3.4 DEVELOPMENT OF ALTERNATIVES 3-9

4.0 ASSEMBLY AND DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES 4-1
4.1 INTRODUCTION 4-1
4.1.1 Evaluation Criteria 4-1
4.1.2 Relative Importance of Criteria 4-4
4.1.3 Selection of Remedy 4-5
4.2 ASSEMBLY OF REMEDIAL ALTERNATIVES 4-6
4.3 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES 4-6
4.3.1 Alternative 1: No Action 4-6
4.3.2 Alternative 2: Cap, Ditch Lining, LUCs, and Monitoring 4-7

TABLE OF CONTENTS (Continued)

SECTION **PAGE**

5.0 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES.....5-1
5.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT.....5-1
5.2 COMPLIANCE WITH ARARS AND TBCS 5-1
5.3 LONG-TERM EFFECTIVENESS AND PERMANENCE.....5-1
5.4 REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT...5-1
5.5 SHORT-TERM EFFECTIVENESS 5-1
5.6 IMPLEMENTABILITY.....5-2
5.7 COST 5-2
5.8 SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES.....5-2

REFERENCES..... R-1

APPENDICES

A LABORATORY DATA
B CALCULATIONS
C COST ESTIMATES

TABLES

NUMBER

2-1 ARARs and TBC Criteria
3-1 Preliminary Screening of Remediation Technologies
5-1 Summary of Comparative Analysis of Remedial Alternatives

FIGURES

NUMBER

1-1 Vicinity Map
1-2 Site Map
1-3 North-South Geologic Cross-Section
1-4 East-West Geologic Cross-Section
1-5 Monitoring Well Location Map
1-6 Potentiometric Surface Map – October 17, 2002
1-7 Location of Previously Identified Electromagnetic Anomalies
1-8 Surface Soil Exceedances At/Above MDEQ Tier 1 Unrestricted TRGs
1-9 Subsurface Soil Exceedances of Restricted and Unresticted Tier 1 Standards
1-10 Comparison of Groundwater Positive Detections and Tier 1 Standards
1-11 Surface Water and Sediment Restricted and Unrestriced Tier I TRGs
4-1 Alternative 2 Plan

LIST OF ACRONYMS AND ABBREVIATIONS

ABB-ES	ABB Environmental Services, Inc.
ARAR	Applicable or Relevant and Appropriate Requirement
BaA	Benzo(a)anthracene
bgs	Below ground surface
BTU/scf	British Thermal Units per standard cubic feet
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfm	cubic feet per minute
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-Term Environmental Action Navy
cm/sec	Centimeter per second
COC	Chemical of concern
COPC	Chemical of potential concern
CTO	Contract Task Order
DPT	Direct push technology
ESV	Ecological Screening Value
FS	Feasibility Study
ft^2	square foot/feet
ft^3	cubic foot/feet
ft/day	feet per day
GCL	Geosynthetic clay liner
GPR	Ground penetrating radar
GRA	General Response Action
HHRA	Human health risk assessment
HI	Hazard index
HLA	Harding Lawson Associates
HO	Herbicide Orange
HpCDD	Heptachlorodibenzo-p-dioxin
ILCR	Incremental lifetime cancer risk
K	Hydraulic conductivity
kW	Kilowatt
LLDPE	Linear low density polyethylene
LUC	Land use control
µg/kg	microgram(s) per kilogram
µg/L	microgram(s) per liter

MCL	Maximum Contaminant Level
MDEQ	Mississippi Department of Environmental Quality
msl	mean sea level
NA	not available
NAVFAC SE	Naval Facilities Engineering Command, Southeast
Navy	U.S. Department of the Navy
NCBC	Naval Construction Battalion Center
NCP	National Oil and Hazardous Substance Pollution Contingency Plan
NEESA	Naval Energy and Environmental Support Activity
ng/kg	nanogram(s) per kilogram
NPW	net present worth
OCDD	Octachloro-p-dibenzodioxin
O&M	operation and maintenance
OSHA	Occupational Safety and Health Act
PAH	polynuclear aromatic hydrocarbon
PCB	polychlorinated biphenyl
pg/L	Picogram per liter
ppb	parts per billion
PPE	personal protection equipment
ppq	parts per quadrillion
PRG	Preliminary Remedial Goal
PVC	polyvinyl chloride
RAO	Remedial Action Objective
RBCV	Risk-based concentration value
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RI	Remedial Investigation
ROD	Record of Decision
SARA	Superfund Amendments Reauthorization Act
SVOC	semivolatile organic compound
TBC	To Be Considered
TCDD	Tetrachlorodibenzo-p-dioxin
TEQ	Toxicity Equivalency Quotient
TRG	Target Remediation Goals
TtNUS	Tetra Tech NUS, Inc.
USEPA	United States Environmental Protection Agency
VOC	Volatile organic compound
yd^3	cubic yard(s)

EXECUTIVE SUMMARY

PURPOSE OF THE REPORT

The purpose of this Feasibility Study (FS) is to develop and evaluate alternatives for the mitigation of waste and groundwater contamination at the Heavy Equipment Training Area (Site 5) at the Naval Construction Battalion Center (NCBC) in Gulfport, Mississippi. Based on the activities at the site, the presumptive remedy for Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) municipal landfills was applied to the site. This approach narrows the evaluation of options and technologies to those that have been historically used for landfills.

SITE DESCRIPTION AND HISTORY

Site 5 is a 6.2-acre landfill located approximately 200 feet west of the intersection of 4th Street and Colby Avenue, in an area used for heavy equipment training until 2005. The site is flat with the exception of a large earthen mound near the middle of the site. This mound was used in conjunction with the heavy equipment training at the site. There is an open drainage ditch located along the southern and western edges of the site with flow to the west and north, respectively. The site itself is predominantly free of vegetation but is bounded by trees and/or various other types of vegetation on all but the northern edge. Just beyond the drainage ditch, approximately 50 feet to the south, is a family housing area. Located approximately 40 feet to the west and running northwest-southeast is the base boundary.

The landfill operated from 1972 to 1976 and was the only operating landfill on the base during this time. However, during this same time period, a private contractor was disposing of most solid waste being generated at the base at an off-base landfill.

Reports indicate that drums of the insecticide DDT and other liquid wastes were disposed in this landfill. An estimated 6,000 cubic yards (yd^3) of solid waste and an unknown quantity of liquid wastes were disposed by a trench and fill operation, typically accompanied by burning prior to backfilling. Solid wastes disposed in this landfill included solid dumpster waste and approximately 12 pounds of powder DDT. Liquid wastes reportedly included 50 to 100 55-gallon drums of liquid DDT, fuels, oils, solvents, paints, and paint thinners. Following cessation of landfilling, the site was covered with 4 to 6 feet of fine to medium-grained sand and was used as a heavy equipment training area, hosting bulldozer and dump truck operation schools until 2005.

SUMMARY OF THE INVESTIGATIONS FINDINGS

Investigations conducted prior to the Remedial Investigation (RI) identified the presence of volatile organic compound (VOCs), semivolatile organic compound (SVOCs), dioxins, furans, and arsenic in various media at Site 5. The RI confirmed the presence of these constituents, but mostly at levels below the Mississippi Department of Environmental Quality (MDEQ) Tier 1 restricted and unrestricted Target Remediation Goals (TRGs). Constituents detected above the unrestricted TRGs included arsenic and the dioxin Toxicity Equivalency Quotient (TEQ) calculated for a surface soil sample located near the earthen mound. Arsenic concentrations detected on and off site, as well as, on and off base, suggest that the presence of arsenic may be due to naturally occurring concentrations.

An early geophysical survey identified electromagnetic anomalies at the site. It was believed that these anomalies may represent buried drums of Herbicide Orange (HO) reportedly disposed at the site during its operation as a landfill. A more recent geophysical survey did not identify any anomalies representative of a relatively large numbers of drums (50 to 100) buried in close proximity. Only one anomaly, located approximately 5 feet from the southeast corner of the earthen mound, was assigned a high probability of representing a single buried drum, and the location was sampled, but no significantly elevated concentrations of contaminants were detected.

A human health risk assessment (HHRA) performed as part of recent investigations showed that potential adverse health effects may be associated with future residential use of off-site groundwater, particularly with regard to dioxin and arsenic. However, there is considerable uncertainty in the risks calculated for groundwater exposure and the numerical risk results are likely overestimated. Uncertainties include the fact that no drinking water wells are currently located downgradient of Site 5, groundwater concentrations or arsenic and dioxins/furans are less then their Maximum Contaminant Levels (MCLs), and no chemicals in soil, groundwater, surface water, or sediment were eliminated as chemicals of potential concern (COPCs) on the basis of background because neither facility nor site-specific background data are available. However, dioxin and arsenic were still retained as chemicals of concern (COCs).

Media not evaluated during the RI but considered to be of concern is the waste that was disposed at Site 5 during its operation. Exposure to the waste could pose significant threat to human health. Therefore, the actual waste of Site 5 is retained as a media of concern.

Comprehensive ecological investigations did not detect any chemical at concentrations high enough to be considered of potential concern.

REMEDIAL ACTION OBJECTIVES, PRELIMINARY REMEDIAL ACTION GOALS, AND VOLUME OF CONTAMINATED GROUNDWATER

The Remedial Action Objectives (RAOs) identified for the waste present at Site 5 and two COCs retained in groundwater (dioxin and arsenic) are as follows:

RAO 1: Prevent direct exposure to contaminated soil and waste disposed at Site 5

RAO 2: Reduce the migration of contaminants to groundwater

RAO 3: Prevent residential exposure and consumption of groundwater

RAO 4: Comply with federal and state Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (TBC) guidance criteria

The Preliminary Remedial Action Goals (PRGs) for dioxin and arsenic in the Site 5 groundwater are 30 picograms per liter (pg/L) and 10 micrograms per liter (µg/L). As mentioned in the RI (TtNUS, 2007), dioxin results will be discussed in terms of TEQ, the value that relates the toxicity of the different dioxin congeners to the most toxin dioxin congener –TCDD.

It is estimated that approximately 6,000 yd^3 of solid waste and an unknown quantity of liquid waste were disposed at Site 5 by a trench and fill operation, typically accompanied by burning prior to backfill. The waste is presumed to be present below 4 to 6 feet of sand cover.

SCREENING OF GENERAL RESPONSE ACTIONS, REMEDIATION TECHNOLOGIES, AND PROCESS OPTIONS

General Response Actions (GRAs) and associated technologies and processes were screened in conjunction with the presumptive remedy for effectiveness, implementability, and cost. Technologies that were determined to be ineffective or too difficult to implement were eliminated from further consideration. The following GRAs, remediation technologies, and process options were retained to develop remedial alternatives for Site 5:

General Response Action	Remediation Technology	Process Option
No Action	None	Not Applicable
Limited Action	Land Use Controls	Active and Passive Controls
	Monitoring	Sampling and Analysis

General Response Action	Remediation Technology	Process Option
Containment	Waste Protection	Cap
	Surface Water Controls	Vertical Barriers
Removal	Excavation	Excavation*
Ex-Situ Treatment	Thermal	Incineration
	Physical/Chemical	Dewatering*
Disposal	Landfill	Off-Site Disposal
		On-Site Disposal*

* These options are also applicable to the incidental removal of sediment as part of the lining of the ditch.

DEVELOPMENT OF REMEDIAL ALTERNATIVES

The following remedial alternatives were developed for Site 5:

- **Alternative 1: No Action**. No action would be taken. Retained as a baseline for comparison with other alternatives.

- **Alternative 2: Cap, Ditch Lining, Institutional Controls, and Monitoring**. Under Alternative 2, a cap would be installed over the waste area to minimize the infiltration of rainwater into the landfill. The cap would include of a geosynthetic clay liner (GCL). Perforated piping will be installed beneath the cap to collect landfill gas. The piping will be routed to vents on the periphery of the site for passive removal of the gas and to allow for maximum utilization of space. Overlying the GCL will be a layer of sand to create the final grade of the area. A layer of soil will be placed over the sand to support grass and for use a playing field. Sediment would be excavated from the bottom of the ditches on the western and southern sides of the site so that the ditch can be lined with grouted riprap. Land use controls (LUCs) would be implemented to maintain the site for recreational use for field sports and to prevent residential development, intrusive activities, and the use of site groundwater as a drinking source. Periodic groundwater monitoring would be conducted. Monitoring would consist of collecting groundwater samples from selected wells and analyzing these samples for arsenic, dioxins/furans, and/or benzo(a)anthracene (BaA).

DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

The remedial alternatives were analyzed in detail using seven of the nine criteria provided in the United States Environmental Protection Agency's (USEPA) National Oil and Hazardous Substance Pollution Contingency Plan (NCP) and CERCLA. These seven criteria are as follows:

- Overall Protection of Human Health and the Environment,
- Compliance with ARARs and TBCs guidance criteria,
- Long-term Effectiveness and Permanence,
- Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment,
- Short-term Effectiveness,
- Implementability, and
- Cost

Two other criteria, State and Community Acceptance were not evaluated in this FS. They will be evaluated after regulatory and public comments are available.

COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

The remedial alternatives were compared to each other using the same criteria that were used for detailed analysis. The following is a summary of these comparisons:

- **Overall Protection of Human Health and the Environment**

  Alternative 1 would not be protective. Alternative 2 would be protective.

- **Compliance with ARARs and TBCs**

  Alternative 1 would not comply with chemical-specific or location-specific ARARs. Action-specific ARARs do not apply to Alternative 1. Alternative 2 would comply with chemical-, location-, and action-specific ARARs.

- **Long-term Effectiveness and Permanence**

  Alternative 1 would not be effective in the long term and offers no permanent solution. Alternative 2 offers long-term effectiveness and permanence although it depends on LUCs.

- **Reduction of Toxicity, Mobility, or Volume through Treatment**

  Alternatives 1 and 2 do not employ any treatment. However, treatment is not a component of the presumptive remedy.

- **Short-term Effectiveness**

Alternative 1 has no relevant issues to address. Alternative 2 would be effective in the short term in terms of short-term risks to workers, the community, and the environment. Short-term risks would be properly mitigated by application of engineering controls and adherence to Occupational Safety and Health Act (OSHA) requirements.

Alternative 1 would not achieve the RAOs. The approximate time frames for implementation and attainment of RAOs would be 1 year for Alternative 2.

- **Implementability**

Alternative 1 would be readily implementable because there is no action to implement. Alternative 2 would be relatively easy to implement, but would require maintenance of LUCs as well as maintenance of the cap.

- **Cost**

The capital costs, net present worth (NPW) of operation and maintenance (O&M) costs, and NPW costs of the alternatives are as follows. Costs have been rounded to the nearest $1,000 to reflect the preliminary nature of the estimates.

Alternative	Capital ($)	30-Year NPW of O&M ($)	30-Year NPW ($)
1	0	0	0
2	3,722,000	765,000	4,487,000

1.0 INTRODUCTION

Under contract to the United States Department of the Navy, Naval Facilities Engineering Command, Southeast (NAVFAC SE), Tetra Tech NUS, Inc. (TtNUS) prepared this Feasibility Study (FS) for Site 5 – Heavy Equipment Training Area on the Naval Construction Battalion Center (NCBC) in Gulfport, Mississippi. This FS was prepared under the Comprehensive Long-Term Environmental Action Navy (CLEAN) III Program, Contract Number N62467-94-D-0888, Contract Task Order (CTO) 0292.

1.1 PRESUMPTIVE REMEDY APPROACH

Based on historical patterns of remedy selection for common categories of sites – of which landfills are one, the United States Environmental Protection Agency (USEPA) encourages the selection of Presumptive Remedies (USEPA, 1993a) to increase the consistency in remedy selection and to streamline the investigative process. Following the Groundwater Monitoring Evaluation Study (HLA, 1998), it was determined that a presumptive remedy for Site 5 was the best course of action based on the characteristics of the materials in the landfill and low concentrations of the contaminants reported in the surficial aquifer. A containment remedy incorporating a low permeability cover was considered to be the overall site strategy most consistent with USEPA Guidance (USEPA, 1993b) and *Presumptive Remedy for CERCLA Municipal Landfill Sites,* (USEPA, 1993c); amended by the *Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills*, (USEPA, 1996), as well as Mississippi Department of Environmental Quality (MDEQ) policy requiring a final cover (containment) for this category of landfill.

The general components of the presumptive remedy include containment, source area groundwater control, leachate collection and treatment, landfill gas collection and treatment and/or land use controls (LUCs).

This FS is based on the presumptive remedy approach. The presumptive remedy for Site 5 is containment of the existing disposal cells. The actions taken to implement containment of Site 5 will include a final cover of the disposal cells coupled with a lining of the adjacent ditch. The sediment from the ditch will be removed prior to the placement of the lining to provide a geotechnically stable base for the lining and, incidentally, to remove known residual contamination in the sediment.

1.2 THE CERCLA FS PROCESS

The presumptive remedy for military landfills with municipal-landfill type wastes, which are being addressed under CERCLA as given in the USEPA directives, will be followed. Using the presumptive

remedy eliminates the need for the initial identification and screening of alternatives during the FS since this is accomplished by the guidance mentioned above. The presumptive remedy for landfills such as Site 5, is containment based on the historical review of completed remedial actions at similar sites by the USEPA.

The development of remedial alternatives for CERCLA sites consists of developing Preliminary Remediation Goals (PRGs) and areas and volumes of contamination and then identifying applicable technologies and developing those technologies into remedial alternatives to meet the PRGs.

Therefore, the first step in this FS process is to develop Remedial Action Objectives (RAOs) specifying the contaminants, media of interest, and exposure pathways leading to development of the PRGs. The PRGs are developed based on chemical-specific applicable or relevant and appropriate requirement (ARARs), when available; site-specific risk-based factors; or other available information. Chemicals of Concern (COCs,) as identified in the RI, are those chemicals with average concentrations exceeding the PRGs and background. Once the PRGs and COCs have been determined, the areas and volumes of contamination requiring remedial action are determined.

Once RAOs/PRGs are identified, general response actions (GRAs) for each medium of interest are developed. GRAs typically fall into the following categories: No Action (NA), containment, excavation, extraction, treatment, disposal, or other actions, singular or in combination, taken to satisfy the RAOs for the site.

The next step in the FS process is to develop remedial action alternatives based on the presumptive remedy components for landfills and site-specific criteria. Those technologies that satisfy the site specific criteria are then described and analyzed in detail using the CERCLA evaluation criteria (see Table 1-1) described in the NCP, including the nine (9) criteria listed below:

<u>Threshold Criteria</u>

1) Overall protection of human health and the environment
2) Compliance with ARARs

<u>Balancing Criteria</u>

3) Long-term effectiveness and permanence
4) Reduction of toxicity, mobility, or volume of contaminants through treatment
5) Short-term effectiveness
6) Implementability
7) Cost

Alternatives are evaluated against two additional factors (Modifying Criteria) after state participation:

Modifying Criteria

8) State acceptance
9) Community acceptance

The results of the detailed analyses are summarized and compared in a comparative analysis. The alternatives are compared against each other using the CERCLA evaluation criteria.

These criteria are used because SARA requires them to be considered during remedy selection. Modifying criteria, including state and community acceptance, are also evaluated. State acceptance is evaluated when the state reviews and comments on the FS report, and a proposed plan is then prepared in consideration of the State's comments. Community acceptance is evaluated based on comments received on the proposed plan during a public comment period. This evaluation is described in a responsiveness summary and will be included in the Record of Decision (ROD).

Upon completion of the FS, the Proposed Plan will be developed. The Proposed Plan will identify the preferred remedial alternative for Site 5. This document will be written in community-friendly language and will be made available for public comment. Following receipt of all public comments, responses to these comments will be developed in a responsiveness summary within the ROD. The ROD will document the chosen alternative for the site and will include the responsiveness summary as an appendix. Once the ROD is signed, the chosen remedial alternative will be implemented.

The entire FS process provides the technical information and analyses forming the basis for a proposed remedial action plan (proposed plan), and the subsequent ROD documents the identification and selection of the remedy.

1.3 SITE BACKGROUND

As shown on Figure 1-1, NCBC Gulfport is located in the western part of Gulfport, in Harrison County, in the southeastern corner of the State of Mississippi, approximately 2 miles north of the Gulf of Mexico. The base occupies approximately 1,100 acres and has an elevation averaging 30 feet above mean sea level (msl).

1.3.1 Site Description

Site 5 is a 6.2-acre landfill located approximately 200 feet west of the intersection of 4th Street and Colby Avenue, in an area used for heavy equipment (bulldozers and forklifts) training until 2005 (Figure 1-2). The site is flat with the exception of a large earthen mound near the middle of the site. This mound was used in conjunction with the heavy equipment training at the site. An asphalt road on the site is used for truck driver training. There is a drainage ditch located along the southern and western edges of the site with flow to the west and north, respectively. The site itself is predominantly free of vegetation but is bounded by trees and/or various other types of vegetation on all but the northern edge. Just beyond the drainage ditch, approximately 50 feet to the south, is a family housing area. Located approximately 40 feet to the west and running northwest-southeast is the base boundary.

1.3.2 Site History

The landfill operated from 1972 to 1976 and was the only operating landfill on the base during this time. However, during this same time period, a private contractor was disposing of most solid waste being generated at the base at an off-base landfill (NEESA, 1985).

Reports indicate that drums of the insecticide DDT and other liquid wastes were disposed in this landfill. An estimated 6,000 cubic yards (yd^3) of solid waste and an unknown quantity of liquid wastes were disposed by a trench and fill operation, typically accompanied by incineration prior to backfilling. Solid wastes disposed in this landfill included solid dumpster waste and approximately 12 pounds of powder DDT. Liquid wastes included 50 to 100 55-gallon drums of liquid DDT, fuels, oils, solvents, paints, and paint thinners. Following closure of the landfill, the site was covered with 4 to 6 feet of fine to medium-grained sand and was used as a heavy equipment training area, hosting bulldozer and dump truck operation schools until 2005.

1.3.3 Site-Specific Geology and Surface Features

Based on site-specific data collected during subsurface investigations, the geology at the site consists of 4 to 6 feet of undifferentiated fine- to medium-grained silty sand at the surface, the fill material mentioned above. This fill material was regularly used by the dump truck and bulldozer driving schools until heavy equipment training was stopped in the waste disposal area in 2005. The site is maintained nearly flat with no vegetation.

The native soil type for Site 5 is the Harleston fine sandy loam. These Harleston soils are no longer at the surface since the sandy cover material was placed over Site 5. The disposal cells were excavated into the Harleston soil. The Harleston soils consist of moderately well drained soils that form in loamy

materials on uplands. Representative soils have a dark gray fine sandy loam at the surface grading to a brown-yellow fine sand mottled with a red sandy clay to a thickness of 4 feet. Below that the soil consists of a fine sandy loam for an additional 4 feet. It is in this zone where the water table is regularly encountered.

The remaining surficial alluvial deposits consist of fine to medium grained silty sand to a depth of approximately 30 feet.

Below that, a much more plastic green and gray silty/sandy clay layer was encountered. The clay-bearing strata are shown on the geologic cross sections (Figure 1-3 and Figure 1-4). Twelve borings, widely spaced throughout the base, have encountered the clay-rich zone at depths of approximately 50 feet below ground surface (bgs). The deepest boring during this study, GPT-05-13, was sampled continuously to 256 feet bgs. Over 150 feet of stiff, green clay and silty clay with minor lenses of sand and silt was encountered. The borings were discontinued prior to encountering the coarser Miocene sediments.

1.3.4 Site-Specific Aquifer Characteristics

The groundwater investigated at Site 5 was encountered in the shallow subsurface, typically within 5 to 10 feet of ground surface. Monitoring well locations are shown on Figure 1-5. The surficial aquifer consists of fine-grained silty sand and is unconfined. The surficial aquifer extends to approximately 45 feet bgs at Site 5 and is separated from the primary drinking water aquifer (Miocene) by a much more plastic gray silty/sandy clay layer. Water levels in monitoring wells screened at a similar depth were used to construct a potentiometric surface map, (Figure 1-6), which indicates that shallow groundwater flows toward the drainage ditch that runs along the southern and western perimeter of Site 5.

The groundwater seepage velocity at Site 5 using Darcy's Law and site-specific estimates of hydraulic gradient and hydraulic conductivity (K) values were only calculated for the shallow portion of the aquifer where sufficient data were available to plot the potentiometric surface using a representative groundwater gradient. The potentiometric contours and groundwater elevations shown in Figure 1-6 were used to estimate a representative gradient of 0.006 north of the drainage ditch and 0.014 south of the drainage ditch. The K of the aquifer at Site 5 was estimated based on the results of slug tests conducted in site wells during the RI. The results of rising-head tests conducted in shallow wells GPT-05-11 and GPT-05-13 showed a range of K for the aquifer of 5.4 to 28.4 feet per day (ft/day); with an average value of 16.9 ft/day representing the shallow aquifer. The results of both falling- and rising-head slug tests at deep well GPT-05-10 were used to estimate a K value of 71.1 ft/day for the deep portion of the aquifer. These data suggest that the deeper portion of the aquifer is more conductive for groundwater flow than the shallow portion of the aquifer and is consistent with the observed downward gradient based on

groundwater elevations in the wells. At the same time, the significant difference in potentiometric head between the shallow and deep wells indicates that flow between the two is restricted by the anisotropic nature of the aquifer material.

The aquifer effective porosity was required to calculate an estimate for the groundwater seepage velocity at Site 5. The effective porosity represents that portion of the total pore space through which saturated groundwater flow occurs. A fine-grained, nonuniform aquifer such as the material encountered at Site 5 may include dead-end pore spaces and a percentage of stagnant groundwater that does not contribute to groundwater flow. Based on the type of aquifer material, a total porosity of approximately 40 percent was deemed representative of the site conditions and, based on the previous discussion, an effective porosity of 20 percent was selected (Driscoll, 1989).

Based on the aquifer properties presented above, the groundwater seepage velocity for the shallow portion of the aquifer at Site 5 was estimated to be 0.51 ft/day, or 185 feet per year (ft/year) north of the drainage ditch, and 1.18 ft/day, or 432 ft/year south of the drainage ditch. The variation in the two estimates is a result of the higher hydraulic gradient observed south of the ditch (see Figure 1-6). Because of the range in K values from the slug tests performed in the two shallow wells, the seepage velocity estimates could range downward by a factor of approximately 3 or upward by a factor of approximately 1.7 depending on the value of K used to represent the aquifer. Additionally, the Gulfport area received approximately 15 inches of rainfall in late September and early October 2002 prior to the October 17, 2002, groundwater measurements that were used to plot the potentiometric surfaces and determine the hydraulic gradients used in the calculations. This suggests that average groundwater flow conditions might demonstrate lower gradients than those used in the calculations which would, in turn, result in lower groundwater seepage velocities.

1.3.5 Investigation History

The following is a description of the investigations that have taken place at Site 5.

1985 Naval Energy and Environmental Support Activity (NEESA) - *Initial Assessment Study of NCBC Gulfport* - This report identified and assessed NCBC sites posing a potential threat to human health and the environment. The Initial Assessment included:

1. A records search
2. On-site survey, including geophysics to define site boundaries
3. Site ranking
4. Outline for Confirmation Study

1987 Harding Lawson Associates (HLA) Confirmation Study - This study included the collection of surface water, groundwater, and soil samples at locations on the south and west sides of Site 5, under the assumption that surface water and groundwater flowed south. This assumption was incorrect, resulting in up- or cross-gradient groundwater samples that yielded no contaminants above action levels at that time.

1997 Morrison-Knudsen - Direct push technology (DPT) sampling of soil and groundwater was conducted near magnetic anomalies identified during a geophysical investigation. The study found levels of arsenic above Tier 1 Risk Screening Levels for soil, and low levels of dioxins and furans but no tetrachlorodibenzo-dioxin (TCDD), a byproduct contaminant of Herbicide Orange (HO).

1997 ABB Environmental Services, Inc. (ABB-ES) - *Surface Water and Sediment Dioxin Delineation Report* - Surface water, sediment, seep, and groundwater samples were collected from the ditches in and around the site. Dioxins were detected at concentrations ranging from 39.1 parts per quadrillion (ppq) up to 42 ppq in water samples. In addition, several volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) were detected at levels below Maximum Contaminant Levels (MCLs) or risk based concentration values (RBCVs). Groundwater potentiometric surface maps indicated that groundwater generally flowed to the northwest, and not to the south as had been previously assumed.

1999 HLA - *Groundwater Monitoring Report* - This report was a more in-depth study of groundwater conditions at Site 5, with a focus on the potential for dioxins and furans. Dioxin levels at the southern end of the site were as high as 80 ppq, well above the MCL of 30 ppq. Dioxin levels in several other wells in the area were also greater than the dioxin MCL, and it was recommended that a complete delineation of the dioxin plume be completed. Additionally, in one sample, benzene [6 parts per billion (ppb)] was detected at a concentration above the MCL and two other chemicals, 1,4 dichlorobenzene (1 ppb) and total naphthalene (20 ppb), were detected above the USEPA Region 3 RBCVs (USEPA, 1999).

2007 TtNUS – Draft Remedial Investigation Report - A Remedial Investigation (RI) was performed from 2001 through 2007 to further delineate the nature and extent of contamination at Site 5 and to characterize risks to human health and the environment. The results of the RI are summarized in Section 1.3.

1.4 ENVIRONMENTAL CONDITIONS

In this section, the environmental conditions of Site 5, including the nature and extent of contamination and risk assessment results, are summarized.

1.4.1 Nature and Extent of Contamination

Investigations conducted prior to the RI identified the presence of VOCs, SVOCs, dioxins, furans, and arsenic in various media at Site 5. In order to fully define the nature and extent of contamination at the site, an RI was conducted in 2001 and 2002 with a followup surface soil study in March 2006. The RI consisted of a geophysical survey as well as surface soil, subsurface soil, groundwater, surface water, and sediment sampling. Refer to the RI report for a more detailed discussion (TtNUS, 2007).

The purpose of the geophysical survey was to further investigate electromagnetic anomalies identified in a previous geophysical survey (see Figure1-7). It was believed that these anomalies may represent buried drums of HO reportedly disposed at the site during its operation as a landfill. No ground penetrating radar (GPR) anomalies appeared to represent relatively large numbers of drums (50 to 100) buried in close proximity. One anomaly, located approximately 75 feet north of the earthen mound and approximately 100 feet west of the northeast corner of the mound, was assigned a medium probability of representing a single buried drum. Another anomaly, located approximately 5 feet from the southeast corner of the earthen mound, was assigned a high probability of representing a single buried drum. Subsurface samples were later collected at these anomalies.

Surface Soil

Figure 1-8 shows the surface soil exceedances. No VOCs, SVOCs, polychlorinated biphenyls (PCBs), or herbicides were detected in the surface soil samples. All detected pesticide concentrations in surface soil were below the applicable Mississippi Tier 1 restricted and unrestricted Target Remediation Goals (TRGs). One inorganic, arsenic, was detected in all samples at concentrations greater than the unrestricted TRG but less than the restricted TRG.

Dioxins and furans were reported at very low levels in each surface soil sample. TCDD concentrations ranged from 0.89 nanograms per kilogram (ng/kg) to 3.6 ng/kg. The reported TEQs for the samples ranged from 1.2 ng/kg to 8.69 ng/kg. The average for the positive concentrations was 5.04 ng/kg, greater than the unrestricted TRG value of 4.26 ng/kg, but much less than the restricted TRG of 38 ng/kg. There was no discernable pattern to the distribution of the total TEQ or the congener types in the surface soil samples.

Subsurface Soil

Figure 1-9 shows the subsurface soil exceedances. All detected VOC, SVOC, and pesticide/PCB concentrations in subsurface soil were below the applicable TRGs. Arsenic exceedances of the unrestricted TRG were the most widespread, occurring both on and off site and in all three sample depths (10-12, 18-20, and 28-30 feet bgs). All were less than the restricted TRG. Arsenic concentrations detected on and off site, as well as, on and off base, suggest that the presence of arsenic in subsurface soils may be due to naturally occurring concentrations. Dioxins were detected site-wide, but exceedances of unrestricted TRGs were limited to three locations, all on-site and north of the access road. TCDD concentrations ranged from 0.199 ng/kg to 13.52 ng/kg. The reported TEQs ranged from 0.0356 ng/kg to 18.57 ng/kg. All exceedances were less than the restricted TRGs.

Groundwater

Figure 1-10 shows the subsurface soil detections and exceedances. Chloroform was the only VOC with a concentration greater than its TRG in groundwater. This compound was found the deeper portion of the aquifer. Bis(2-ethylhexyl)phthalate was detected at a concentration greater than its TRG in one sample. Benzo(a)anthracene (BaA) was detected at a concentration greater than its TRG in three monitoring well samples, one on-site and two off-site south of the training area. No pesticides were found at concentrations exceeding TRGs. Several inorganic chemicals were detected at concentrations exceeding TRGs. However, only iron and lead detected at concentrations greater than TRGs in monitoring well samples and the one exceedance of iron was just slightly greater than the TRG. Lead was detected at a concentration greater than its TRG in one monitoring well sample and its duplicate. Lead was not detected at a concentration greater than its TRG in any on-site monitoring wells. The TRG for dioxin TEQ was exceeded in one off-site groundwater sample. Three individual congeners were detected at concentrations greater than their TRGs in monitoring well samples, but the TEQ TRG was not exceeded in any monitoring well samples collected during the RI. Prior to the RI, one groundwater sample had a dioxin TEQ concentration greater than the TRG.

No groundwater plume that extended from the site was identified; all contaminants on site were beneath the footprint of the disposal area.

Surface Water

Figure 1-11 shows surface water exceedances. Detected SVOC, inorganic, and dioxin concentrations in surface water were less than their TRGs. Chloroethane was detected at a concentration greater than the TRG in a sample located at the upstreammost surface water location, just east of the wooden bridge in

the southwest corner of Site 5. Concentrations of VOCs and SVOCs generally decreased in the downstream direction, while there is no clear trend for inorganics or dioxins.

Sediment

Figure 1-11 also shows sediment exceedances. VOC, SVOC, and pesticide/PCB concentrations in sediment were less than applicable TRGs. Arsenic was detected most frequently and is likely attributable to naturally occurring concentrations. It was found in all sediment samples at levels greater than the unrestricted TRG but exceeded the restricted TRG in one sample. Dioxin congeners were detected in all sediment samples, with the resulting TEQs exceeding the applicable TRGs in only one sample.

1.4.2 Human Health Risk Assessment Results

A human health risk assessment (HHRA) was performed to evaluate exposure to chemicals of potential concern (COPCs) in soil, groundwater, surface water, and sediment at Site 5. Estimated risks for workers and trespassers assumed to be exposed to soil, surface water, and sediment were less than or within USEPA benchmarks. The quantitative risk evaluation indicated that potential adverse health effects may be associated with the future residential use of off-site groundwater, and therefore, arsenic, dioxins/furans, and iron are considered COCs. However, there is considerable uncertainty in the risks calculated for groundwater exposure and the numerical risk results are likely overestimated. Uncertainties include the fact that no drinking water wells are currently located downgradient of Site 5, groundwater concentrations of arsenic and dioxins/furans are less than their MCLs, and no constituents in soil, groundwater, surface water, or sediment were eliminated as COPCs on the basis of background because neither facility nor site-specific background data are available. In addition, the residential groundwater scenarios are evaluated to be conservative, although the site is not expected to be used for residential development in the future and groundwater is not used as a source of drinking water. Risks estimated for other site media were within USEPA and MDEQ benchmarks.

1.4.3 Ecological Screening Results

Suitable habitat for terrestrial receptors does not exist at Site 5 due to the site's former use as an active heavy equipment training area. The soil lacks vegetation and was constantly moved and reworked by earth-moving equipment. On-site drainage ditches contain minnow-sized fish and benthic organisms and is undoubtedly used to some extent by piscivorous birds and mammals like the kingfisher and raccoon.

SVOCs, pesticides or PCB concentrations in soil did not exceed Ecological Screening Values (ESVs). Maximum concentrations of four metals exceeded ESVs, but exposure of terrestrial receptors to soil is precluded by the current land use.

Only aluminum and iron exceeded surface water ESVs. Sediment ESVs are exceeded by several organic compounds. Potential risk from these analytes, however, are mitigated by factors such as low screening HQs relative to conservative ESVs, and comparisons to alternate guidelines. Overall, potential direct impacts to aquatic and benthic organisms appear to be minimal.

Food-chain modeling indicates negligible potential risk to piscivorous birds and mammals that forage in the nearby drainage ditch. There is uncertainty associated with potential direct toxicity from iron, and to a lesser extent, aluminum.

1.4.4 Geotechnical/Landfill Gas Investigation

A geotechnical investigation was conducted in 2007 to determine if the current surface soil can be integrated into a final cover. Three soil samples were collected over a depth of 0 to 2 feet using Shelby tubes to determine the hydraulic conductivity of the surface soil cover and for grain size analysis. The hydraulic conductivities ranged from 7.1×10^{-5} to 4.1×10^{-4} centimeter per second (cm/sec), which are greater than the MDEQ regulations for a final cover, of 1×10^{-5} cm/sec.

In addition to the geotechnical samples, one landfill gas sample was collected in 2007 to evaluate the need for a landfill gas venting system. The sampling result showed a methane concentration of 46.7 percent, which is typical of landfill gas.

The results of the geotechnical samples and landfill gas sample are included in Appendix A.

1.5 DOCUMENT ORGANIZATION

This FS has been organized with the intent of meeting the general format requirements specified in the RI/FS Guidance Document (USEPA, 1988) with considerations given to the presumptive remedy guidance. This report consists of the following five sections:

- Section 1.0, Introduction - summarizes the purpose of the report, provides site background information, summarizes findings of the previous investigations, and provides the report outline.

- Section 2.0, Remedial Action Objectives (RAOs) and General Response Actions (GRAs) - presents the RAOs, identifies Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered (TBC) criteria, develops Preliminary Remedial Action Goals (PRGs) and associated GRAs, and provides an estimate of the volume of contaminated media.

- Section 3.0, Screening of Remediation Technologies and Process Options - provides a two-tiered screening of potentially applicable remediation technologies and identifies the technologies that will be assembled into remedial alternatives.

- Section 4.0, Assembly and Detailed Analysis of Remedial Alternatives - assembles the remedial technologies retained from the Section 3.0 screening process into multiple remedial alternatives, describes these alternatives, and performs a detailed analysis of these alternatives in accordance to the seven Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) criteria.

- Section 5.0, Comparative Analysis of Remedial Alternatives - compares the remedial alternatives on a criterion-by-criterion basis, for each of the CERCLA analysis criteria used in Section 4.0.

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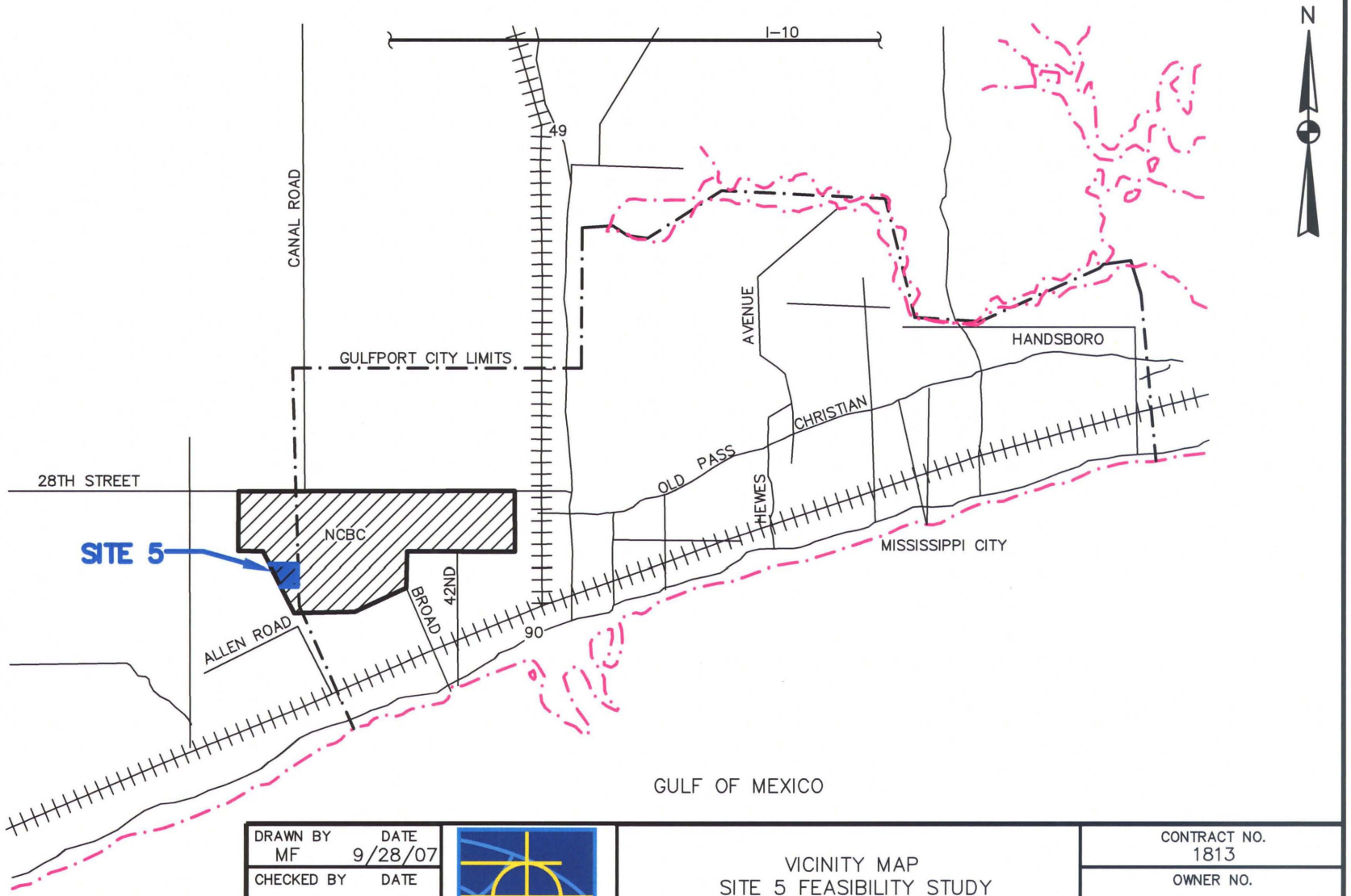

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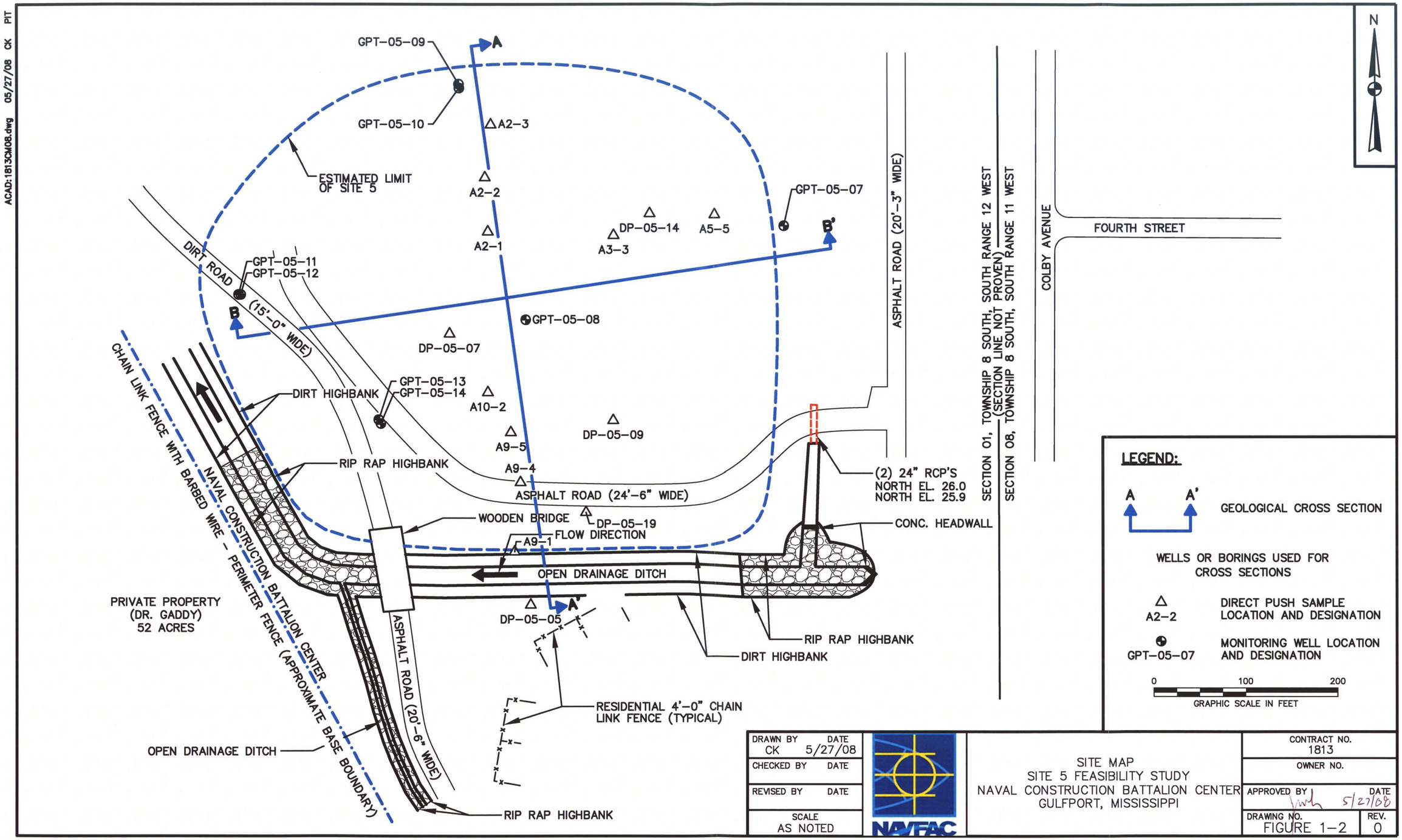

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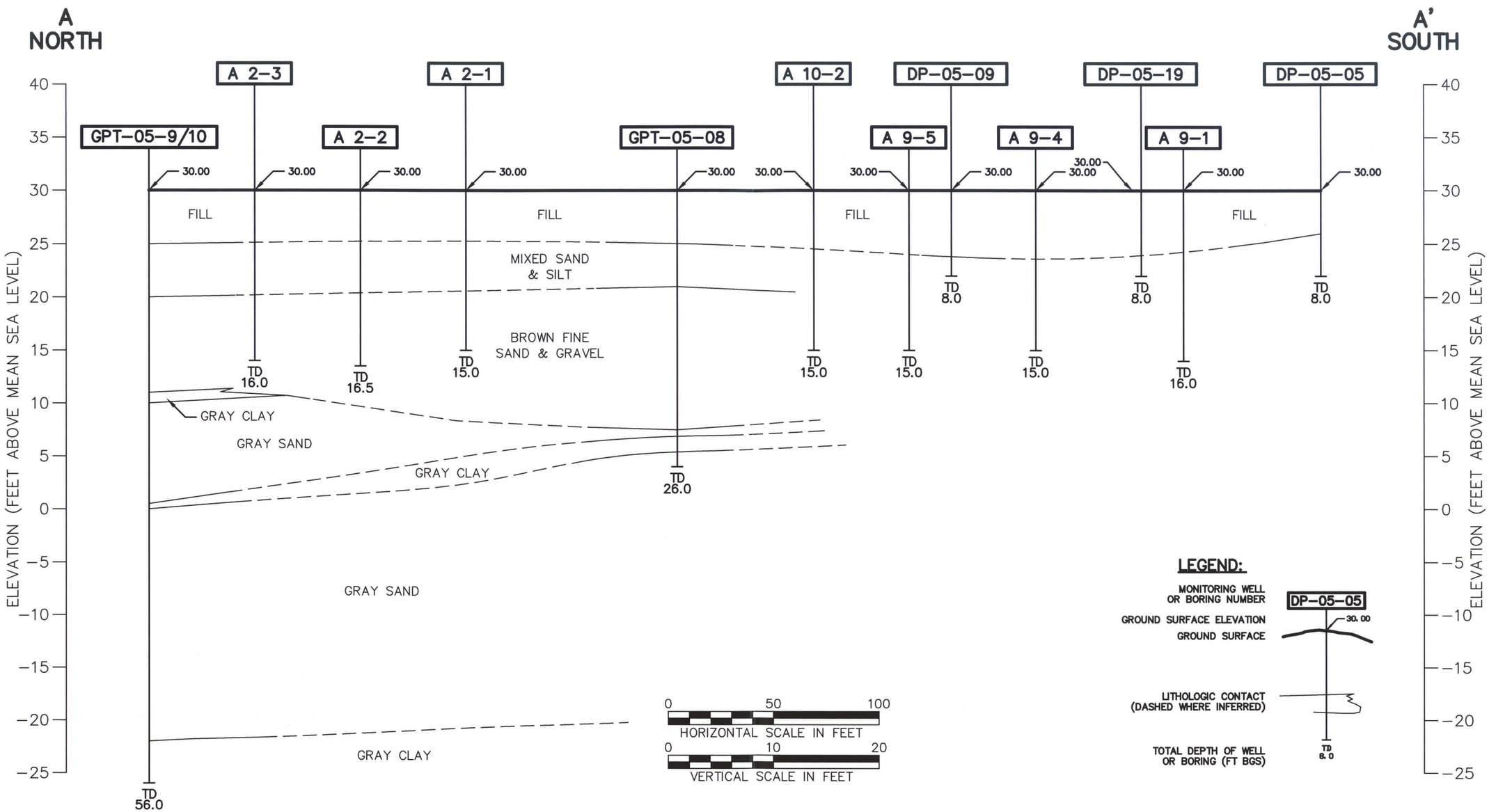

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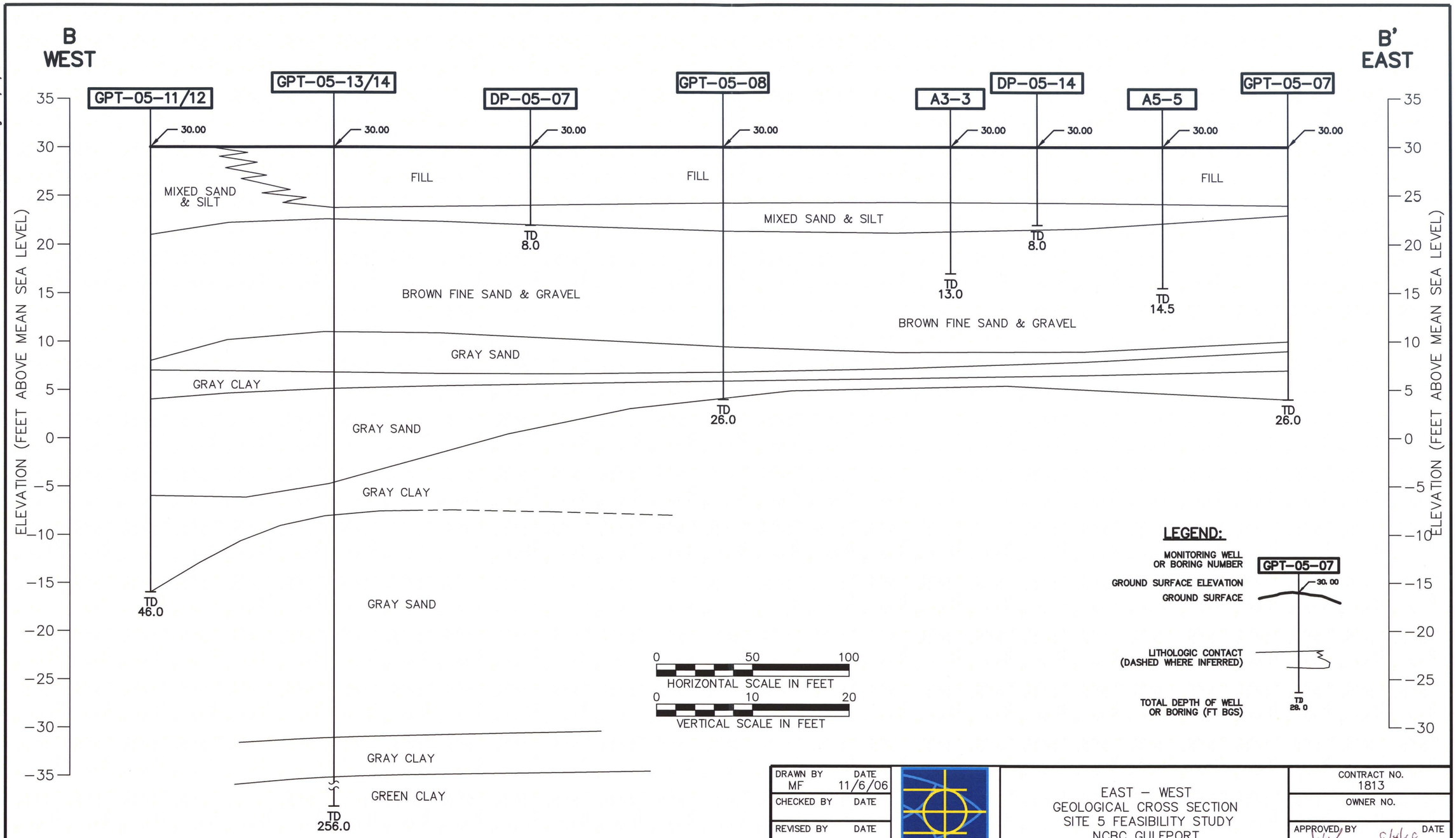

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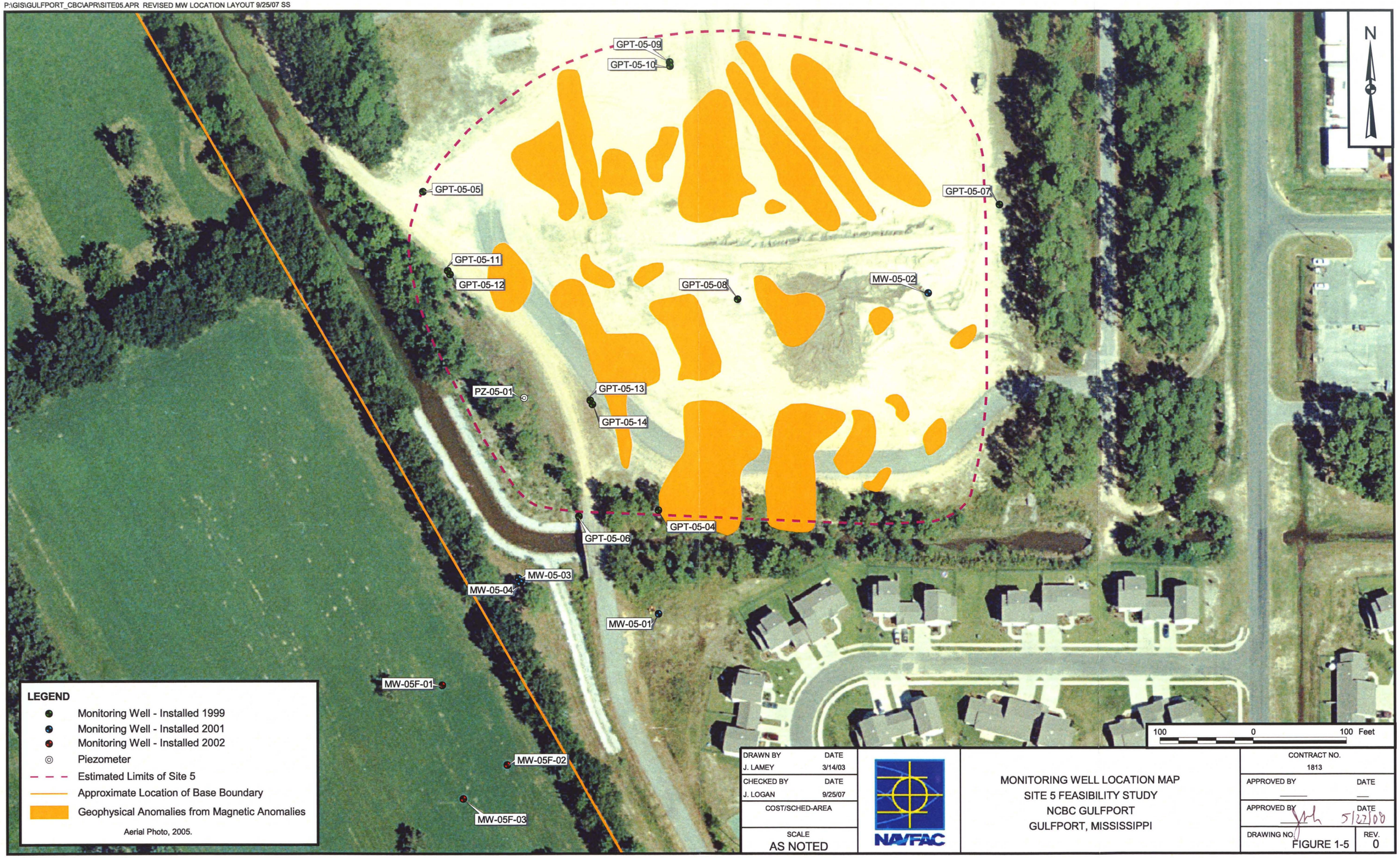

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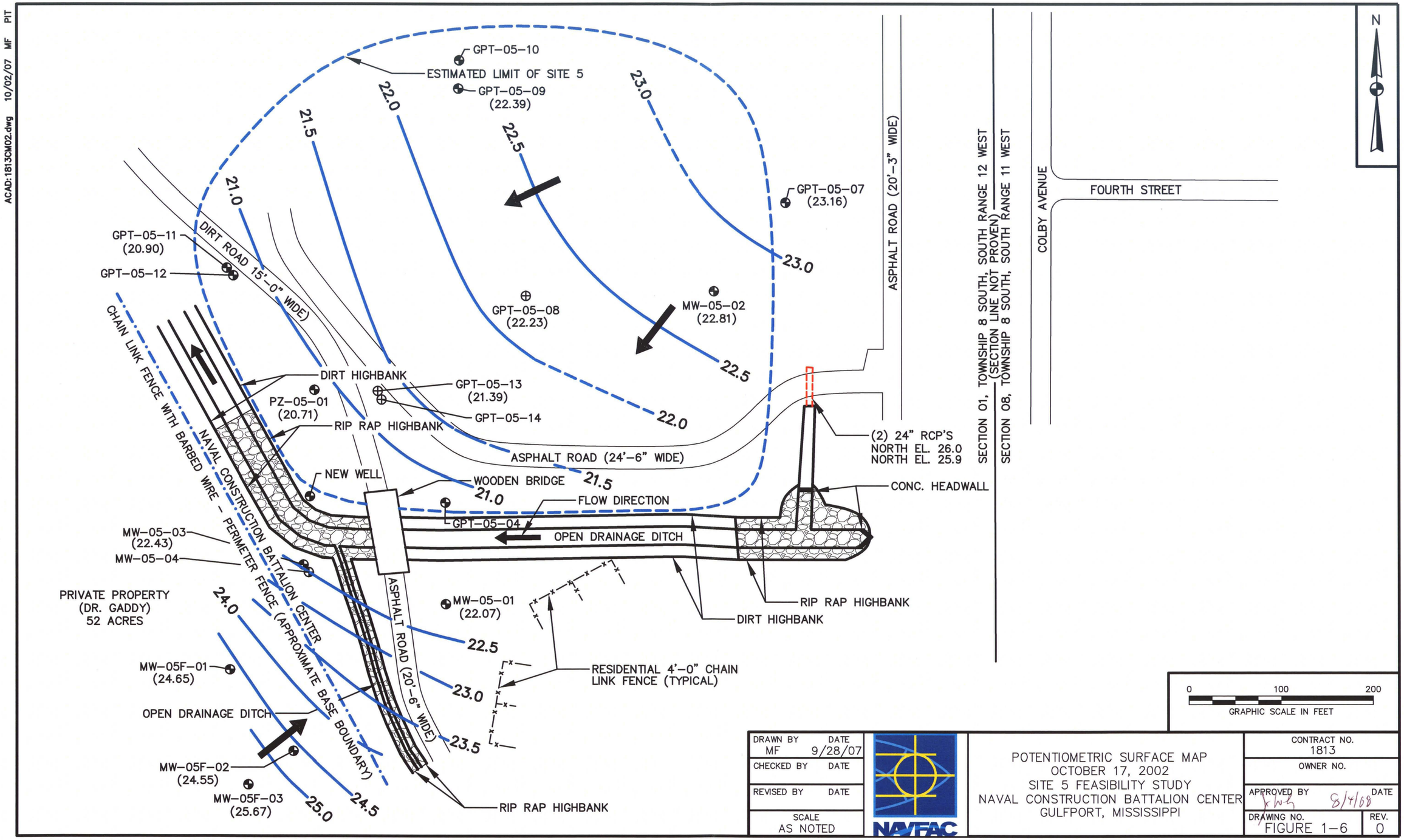

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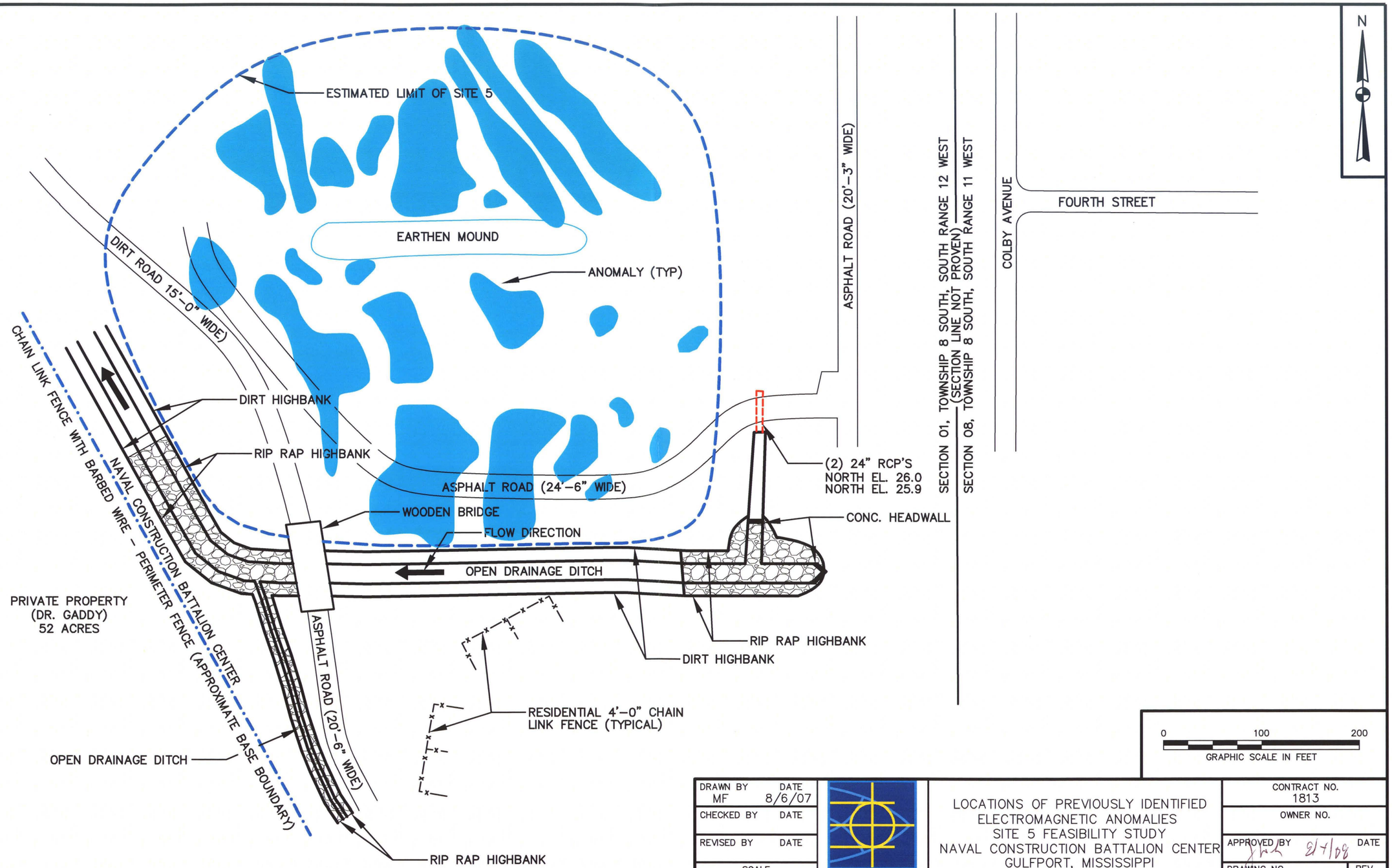

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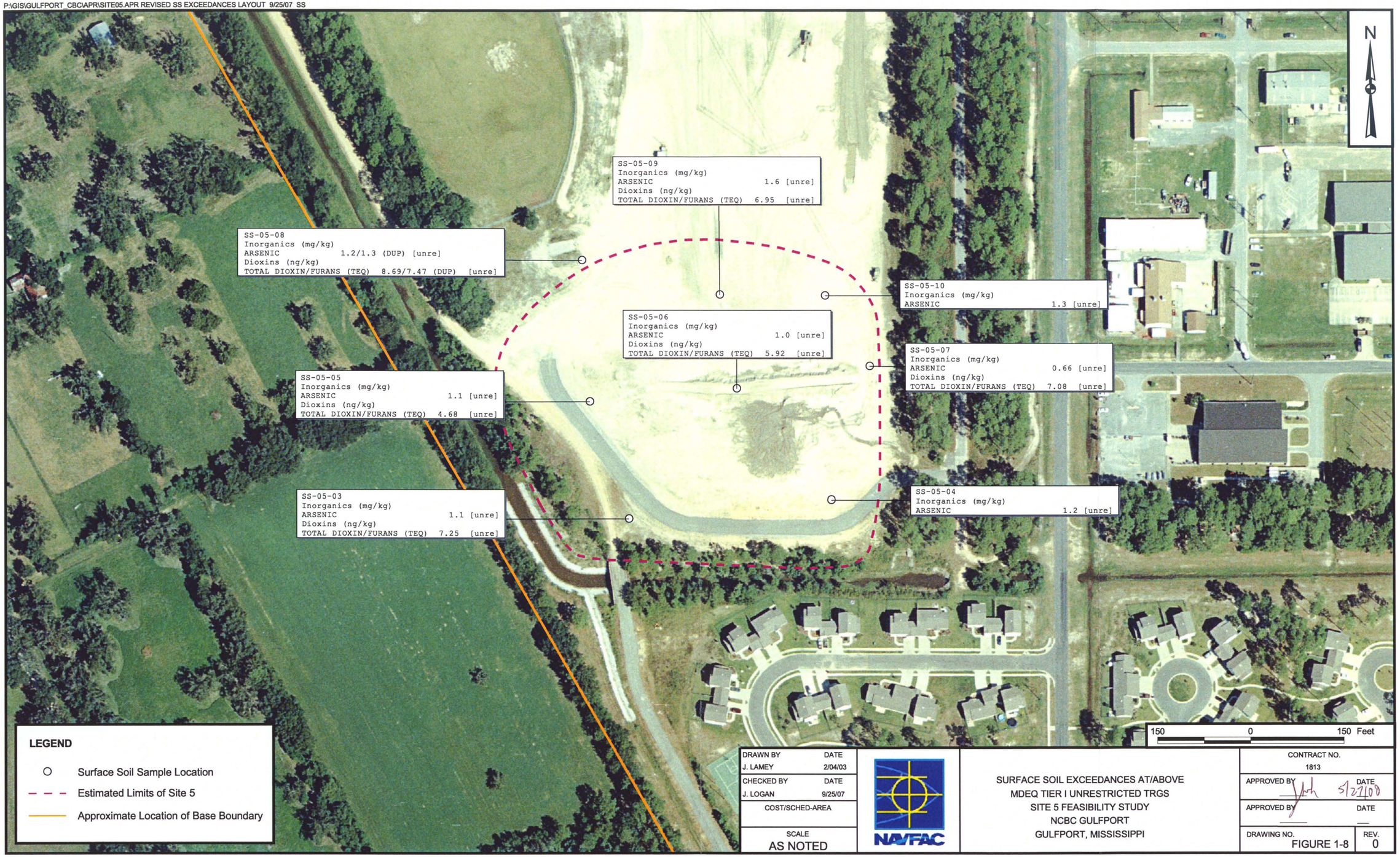

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LEGEND

- Sample Location, Phase 1 - 1997
- Sample Location, Phase 2 - 1999
- Sample Location, Phase 3 - 2001
- RES [3.82] Restricted Tier I Value
- UNRES [0.43] Unrestricted Tier I Value
- Estimated Limits of Site 5
- Approximate Location of Base Boundary
- Geophysical Anomalies from Magnetic Anomalies

An * indicates that the detected concentration exceeded Tier I TRG.

Aerial Photo, 2005.

DRAWN BY S.STROZ	DATE 12/18/06	SUBSURFACE SOIL EXCEEDANCES OF RESTRICTED AND UNRESTRICTED TIER I TRGs SITE 5 FEASIBILITY STUDY NCBC GULFPORT GULFPORT, MISSISSIPPI	CONTRACT NO. 1813
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COST/SCHED-AREA			APPROVED BY DATE
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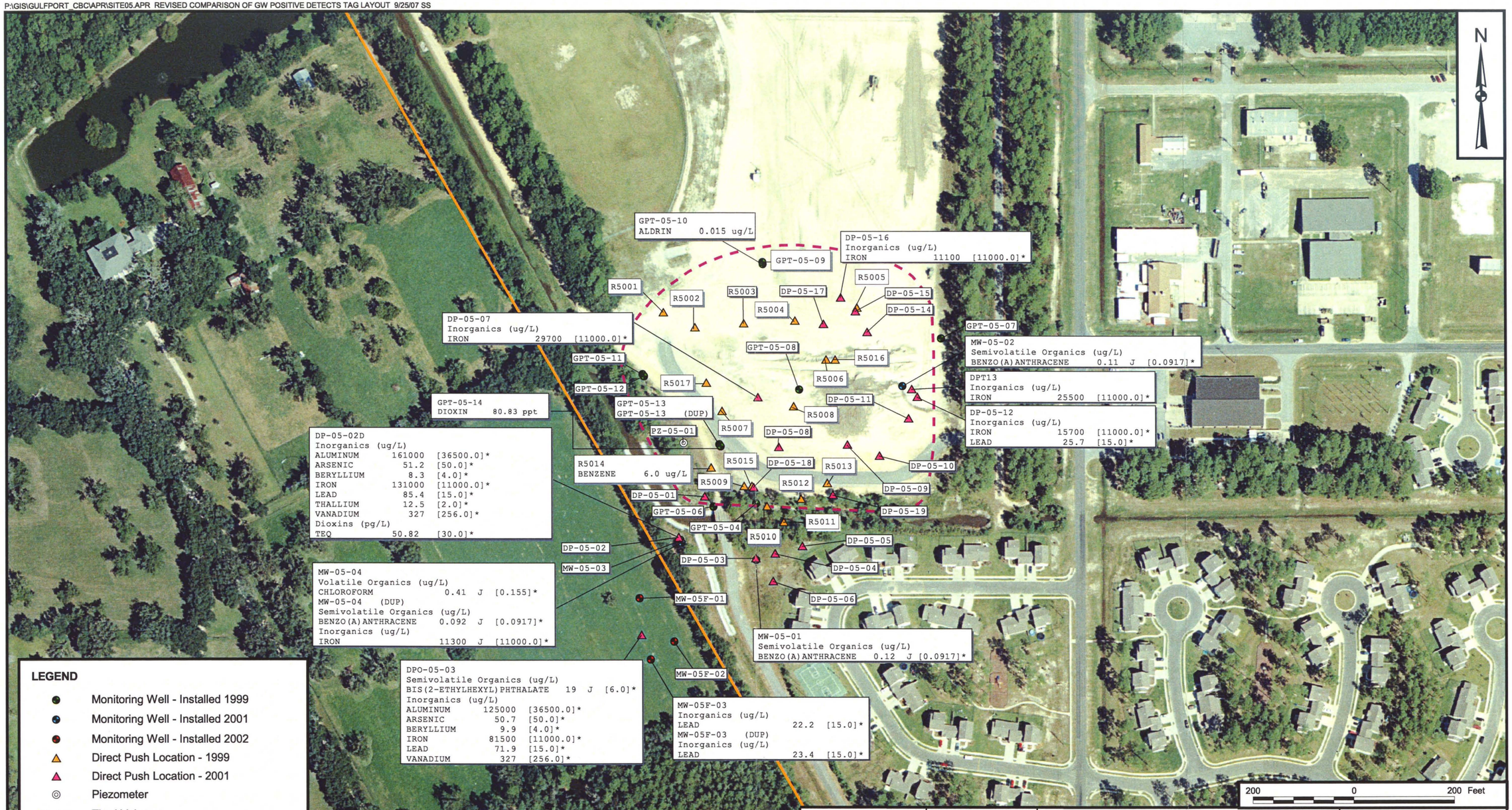

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COMPARISON OF GROUNDWATER POSITIVE DETECTIONS VS.
TIER I STANDARDS
SITE 5 FEASIBILITY STUDY
NCBC GULFPORT
GULFPORT, MISSISSIPPI

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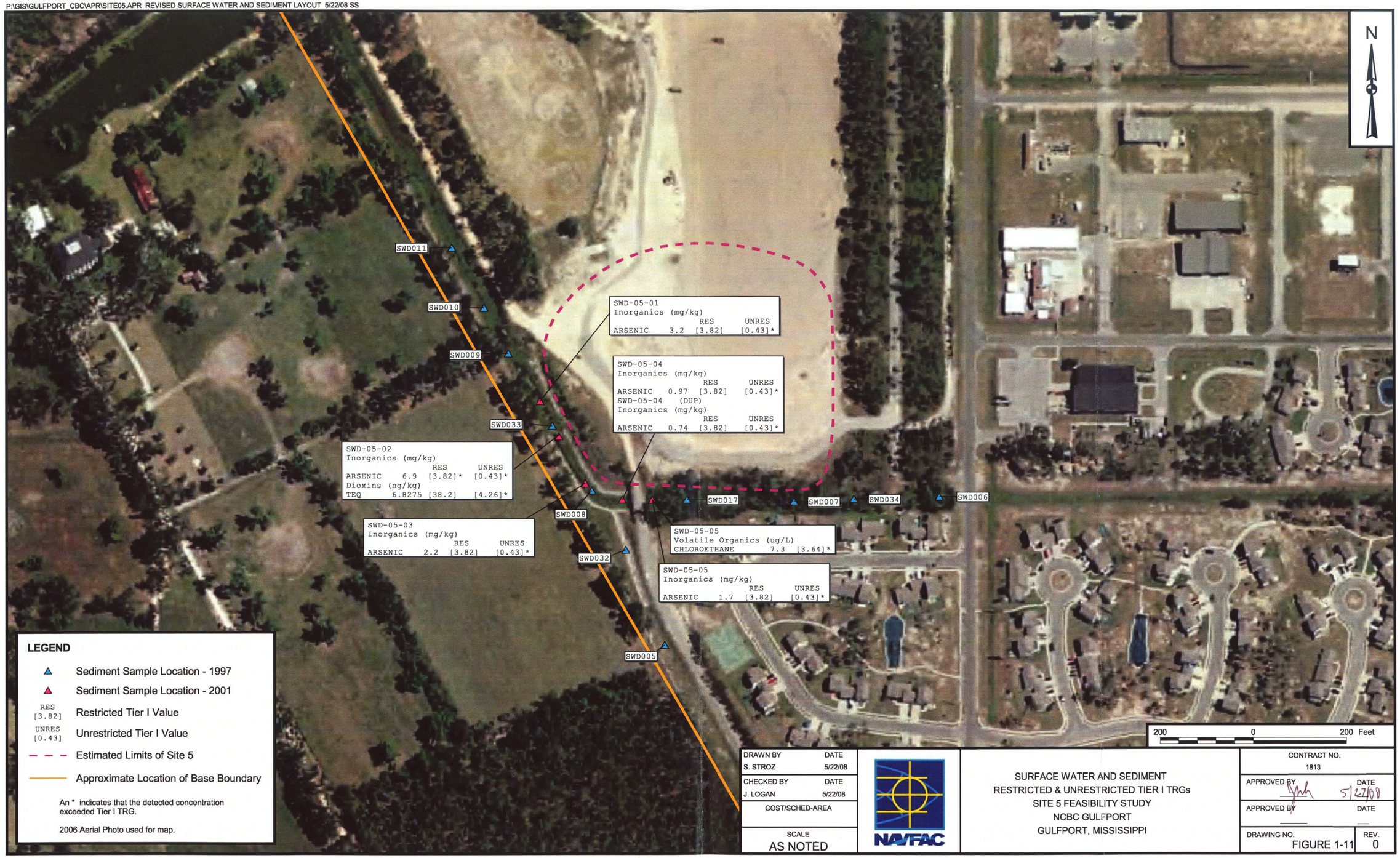

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SCALE	AS NOTED

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SURFACE WATER AND SEDIMENT
RESTRICTED & UNRESTRICTED TIER I TRGs
SITE 5 FEASIBILITY STUDY
NCBC GULFPORT
GULFPORT, MISSISSIPPI

CONTRACT NO.	
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2.0 REMEDIAL ACTION OBJECTIVES AND GENERAL RESPONSE ACTIONS

The objectives and goals for a remedial action at Site 5 provide the basis for selecting RAOs and identifying remedial technologies to address unacceptable exposure scenarios that may be encountered with Site 5 contaminated media. The guidance for the presumptive remedy is also considered.

This section presents the development of RAOs. As part of this development, regulatory requirements or ARARs and TBCs, are identified. Next, media of concern are identified based on the several COPCs identified for Site 5. Preliminary action levels, or PRGs, for each medium of concern are then identified. Taking into consideration this information, RAOs are then defined.

This section also presents GRAs for Site 5 contaminated media. GRAs are categories of actions that could be implemented to satisfy or address a component of the RAOs for the site. Lastly, this section provides an estimate of the volumes of contaminated media to be addressed at Site 5.

2.1 REMEDIAL ACTION OBJECTIVES

2.1.1 ARARs and TBC Criteria

ARARs for this FS are the federal and State environmental requirements used to define the appropriate extent of site clean up, to identity sensitive land areas or land uses, to develop remedial alternatives, and to direct site remediation. The CERCLA and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) require remedial actions to comply with state ARARs when they are more stringent than federal ARARs.

The NCP defines two ARAR components: (1) applicable requirements and (2) relevant and appropriate requirements. Applicable requirements are those clean-up standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal or State environmental or facility siting laws specifically addressing a hazardous substance, pollutant, contaminant, remedial action, or other circumstance found at a CERCLA site. Applicable state standards are only those (1) identified by the state in a timely manner, (2) consistently enforced, and (3) more stringent than federal requirements.

Relevant and appropriate requirements are those clean-up standards, standards of control, and other substantive requirements under federal and state environmental and facility siting laws that, while not “applicable” to a hazardous substance, pollutant, contaminant, or remedial action, address situations sufficiently similar to those encountered at the CERCLA site so their use is well suited to the particular

site. Only those state standards (1) identified in a timely manner and (2) more stringent than federal requirements may be relevant and appropriate.

"Applicability" is a legal determination of jurisdiction of existing statutes and regulations, whereas "relevant and appropriate" is a site-specific determination of the appropriateness of existing statutes and regulations. Therefore, relevant and appropriate requirements allow flexibility not provided by applicable requirements in the final determination of clean-up levels. After a requirement is identified as an ARAR, the selected remedy must comply with or be waived from compliance with the ARAR, even if the ARAR is not required to assure protectiveness. Applicable requirements apply to both on- and off-site remedial actions.

TBC guidance criteria are federal and state non-promulgated advisories or guidance that are not legally binding and do not have the status of ARARs. However, if there are no specific ARARs for a chemical or site condition, or if ARARs are not deemed sufficiently protective, then guidance or advisory criteria should be identified and used to ensure the protection of human health and the environment.

Under the description of ARARs set forth in the NCP and the Superfund Amendments Reauthorization Act (SARA), state and federal ARARs are categorized as follows:

- Chemical-specific: Controlling the extent of site remediation with regard to specific contaminants and pollutants.

- Location-specific: Governing site features such as wetlands, floodplains, and sensitive ecosystems (including features of historical significance).

- Action-specific: Pertaining to the proposed site remedies and governing the implementation of the selected site remedy.

During the detailed analysis of remedial alternatives performed in Section 4.0, each alternative will be analyzed to determine its compliance with ARARs. Chemical-, location-, and action-specific ARARs for Site 5 are presented in Table 2-1.

2.1.2 Chemicals and Media of Concern

The Site 5 RI characterized media where waste disposal occurred. The RI took the presumptive remedy strategy into consideration. Media that were investigated during the RI consisted of soil, groundwater, surface water, and sediment located on site and downgradient from Site 5. The following paragraphs

discuss the media of concern (waste and groundwater) that will be retained in this FS and explain why surface and subsurface soil, surface water, and sediment will not be retained as media of concern.

COPCs were identified throughout surface soil, subsurface soil, surface water and sediment samples during the RI. However, the HHRA concluded that estimated risks for workers and trespassers assumed to be exposed to surface and subsurface soil, surface water, and sediment were less than or within USEPA benchmarks. This outcome was not unforeseen given that no waste was encountered during the installation of soil borings during the RI (a total of 19 soil borings were advanced with the boundaries of Site 5 to depths of 8 feet bgs). Given the depth of waste present at the site, contaminants would not be expected to migrate to surface water and sediment. The area was most recently used as a heavy equipment training area and is expected to be used for recreational purposes in the future. However, the presumptive remedy for a landfill is containment that eliminates exposure to waste material in the landfill. As a result of these circumstances, surface soil, subsurface soil, surface water and sediment will not be retained as media of concern.

Media not evaluated during the RI but considered to be of concern is the waste that was disposed at Site 5 during its operation. Exposure to the waste could pose significant threat to human health, but under the presumptive remedy, potential exposure to human receptors is eliminated by the cover.

COPCs were also identified in groundwater samples during the RI. The COPCs included VOCs, SVOCs, dioxins/furans, and inorganics. The HHRA concluded that potential health effects under current land uses are within USEPA's acceptable risk range. However, potential health risks may be associated with future residential use of off-site groundwater, particularly with regard to dioxin/furan and arsenic exposure via direct contact and ingestion of groundwater. Therefore, groundwater will be addressed under the presumptive remedy with LUCs to prevent the installation of wells at the site and prevent exposure to groundwater.

No constituents were specifically identified as COCs in the RI. However, because contaminants will remain on site, several contaminants will continue to be retained as COPCs and included in groundwater monitoring programs. The chemicals include the following:

- Arsenic
- Dioxins/Furans
- BaA

Arsenic and dioxins/furans are retained because they were generally detected in surface and subsurface soil samples. BaA is retained because it was detected in at least one on-site well at concentrations greater than its TRG.

2.1.3 Preliminary Remedial Goals

Based on discussions between the Navy, MDEQ, and USEPA, it was agreed that the State of Mississippi would be the regulatory lead agency at Site 5 and that PRGs for the project would be based on the State of Mississippi TRGs. As a result, TRGs will serve as the basis for remedial action.

Per Mississippi Code Section 49-35-21, TRGs are based on either (1) a $1x10^{-6}$ target incremental lifetime cancer risk level (ILCR) for each carcinogenic chemical, (2) a hazard index (HI) not to exceed 1.0 for each systemic toxicant, or (3) constituent TRG concentrations established through federal/state programs (e.g., the Safe Drinking Water Act). The State of Mississippi lists TRGs for both restricted (industrial) and unrestricted (residential) land use. Site 5 is located approximately 200 feet west of the intersection of 4th Street and Colby Avenue. There is a drainage ditch located along the southern and western edges of the site. Just beyond the drainage ditch, approximately 50 feet to the south, is a family housing area. Because of Site 5's proximity to these public locations, unrestricted (residential) TRGs are deemed appropriate for remedial consideration. The State of Mississippi unrestricted TRG for arsenic in groundwater is 10 µg/L. As mentioned in the RI (TtNUS, 2007), dioxin and furan results will be discussed in terms of TEQ, the value that relates the toxicity of the different dioxin and furan congeners to the most toxic dioxin congener – TCDD. Therefore, the TEQ for dioxin in groundwater is 30 picograms per liter (pg/L). The MDEQ TRG for BaA is 0.0917 µg/L.

As part of the CERCLA process, PRGs are periodically revised because of new guidance requirements and promulgated or updated ARARs. Final remediation goals will not be formally established until the approval of the Record of Decision (ROD).

2.1.4 Statement of Remedial Action Objectives

RAOs are the medium-specific goals established to protect human health and the environment (USEPA, 1988). The RAOs identified in this section are based on the waste present at Site 5 and two COPCs retained in groundwater and consist of the following.

RAO 1: Prevent direct exposure to contaminated soil and waste disposed at Site 5

RAO 2: Reduce the migration of contaminants to groundwater

RAO 3: Prevent residential exposure and consumption of groundwater

RAO 4: Comply with federal and state ARARs and TBC guidance criteria

2.2 GENERAL RESPONSE ACTIONS

GRAs describe categories of actions that could be implemented to satisfy or address a component of the RAOs for the site. Remedial alternatives will be developed using one or more GRAs to meet the RAOs. These remedial alternatives will be capable of achieving the RAOs for each contaminated medium at the site.

The Presumptive Remedy for CERCLA Municipal Landfill Sites (USEPA, 1993) establishes containment as the presumptive remedy for municipal landfills because the volume and heterogeneity of the waste in municipal landfills generally make treatment impracticable. Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills (USEPA, 1996) provides guidance on applying the containment presumptive remedy to military landfills. In accordance with the Presumptive Remedy, the following GRAs will be considered at Site 5:

- No Action
- Limited Action (e.g., Institutional Controls, Monitoring)
- Containment

2.3 ESTIMATED VOLUME OF CONTAMINATED MEDIA

Based on historical records and information, it is estimated that approximately 6,000 cubic yards (yd^3) of solid waste and an unknown quantity of liquid waste were disposed by a trench and fill operation, typically accompanied by incineration prior to backfill. The waste is presumed to be present below more than 4 feet of soil cover.

As mentioned in Section 2.1.4, there is considerable uncertainty in the risks calculated for the groundwater exposures and the numerical risk results are likely overestimated. In addition, the residential groundwater scenarios are evaluated to be conservative, because the site is not expected to be used for residential development in the future and off-site groundwater is not used as a source of drinking water. By addressing the waste at Site 5, the issue of groundwater as a media of concern will be indirectly addressed. Therefore, the volume of contaminated groundwater will not be estimated.

TABLE 2-1

ARARs AND TBC CRITERIA
SITE 5 FEASIBILITY STUDY
NCBC GULFPORT, MISSISSIPPI

Name and Regulatory Citation	Description	Consideration in the Remedial Action Process	Type
Federal			
USEPA Region 3 RBC Table	Provides risk-based concentrations for screening of soil and groundwater.	Relevant and Appropriate. These guidelines aid in the screening of chemicals in soil and groundwater.	Chemical-specific
Safe Drinking Water Act MCLs (40 CFR 140-143)	Protective levels for groundwater that is for current or potential drinking water sources.	Applicable if on-base and off-base groundwater were to be used for potable purposes in the future.	Chemical specific
CERCLA and the NCP Regulations (40 CFR, Section 300.430)	Discusses the types of post-removal site controls to be established at CERCLA sites.	Applicable. These requirements may be used as guidance in establishing appropriate post-removal site controls at Site 5.	Action-specific
Hazardous Materials Transportation Act Regulations (49 CFR 171-179)	Provides requirements for packaging, labeling, manifesting and transporting hazardous materials.	Applicable. If sediment is excavated and transported and is found to be hazardous, the soil would need to be handled, manifested, and transported as a hazardous waste.	Action-specific
National Emissions Standards for Hazardous Air Pollutant (40 CFR Part 61)	Standards promulgated under the Clean Air Act for significant sources of hazardous air pollutants.	Relevant and Appropriate. Remedial Action (e.g., soil excavation) may result in release of hazardous air pollutants.	Action-specific
RCRA Treatment Storage, and Disposal of Hazardous Waste (40 CFR 262-266)	Regulates the treatment, storage, and disposal of hazardous waste.	Relevant and Appropriate. Hazardous waste generated by site remediation must meet RCRA generator and treatment, storage, or disposal requirements.	Action-specific
Land Disposal Restrictions (40 CFR Part 268)	Restricts certain listed or characteristic hazardous waste from placement or disposal on land without treatment.	Relevant and Appropriate. Excavated sediment or treatment residuals (such as spent granular activated carbon) may require disposal in a landfill.	Action-specific
Presumptive Remedy for CERCLA Municipal Landfill Sites	Through this directive, the USEPA has identified containment as the presumptive remedy to military landfill.	TBC. Municipal trash and solid waste from the base was disposed at Site 5.	Action-specific

TABLE 2-1

ARARs AND TBC CRITERIA
SITE 5 FEASIBILITY STUDY
NCBC GULFPORT, MISSISSIPPI

Name and Regulatory Citation	Description	Consideration in the Remedial Action Process	Type
State			
MDEQ TRGs MDEQ Regulation HW-2: Brownfields Voluntary Cleanup and Redevelopment	Default Screening Levels. Human Health risk-based cleanup goals for soil and groundwater.	Applicable. These regulations apply to all remedial actions in the State of Mississippi.	Chemical Specific
MDEQ Regulation SW-2: Nonhazardous Solid Waste Management regulations and Criteria	Provides minimum criteria for all solid waste management facilities.	Relevant and Appropriate. These regulations describe the requirements for closing landfills.	Action Specific
MDEQ Risk Evaluation Procedures for Voluntary Cleanup and Redevelopment	Risk-based procedures and rationale for site evaluation and remediation.	TBC. These regulations apply to all Voluntary Cleanup and Brownfield actions in the State of Mississippi.	Guidance
MDEQ Office of Pollution Control Hazardous Waste Management Regulations	Adopts by reference, specific sections of the Federal Hazardous Waste regulations.	Relevant and Appropriate. These regulations may apply if material is removed from the Base.	Action Specific

CERCLA Comprehensive Environmental Response, Compensation, and Liability Act.
CFR Code of Federal Regulations.
MCL Maximum Contaminant Level.
MDEQ Mississippi Department of Environmental Quality.
NCP National Oil and Hazardous Substances Pollution Contingency Plan.
RBC Risk-Based Concentration.
RCRA Resource Conservation and Recovery Act.
TBC To be considered.
TRG Target Remediation Goal.
USEPA United States Environmental Protection Agency.

3.0 SCREENING OF TECHNOLOGIES AND DEVELOPMENT OF ALTERNATIVES

This section identifies, screens, and evaluates the potential technologies and process options that may be applicable to assemble remedial alternatives for Site 5. The primary objective of this phase of the FS is to develop an appropriate range of remedial technologies and process options that will be used for developing remedial alternatives. The application of the presumptive remedy effectively screens many technologies and process options. Technologies for addressing wastes at Site 5 are discussed in Sections 3.1, 3.2, and 3.3. Remedial alternatives are assembled in Section 3.4 using the technologies and process options that were retained following detailed evaluation.

The basis for remediation technology identification and screening began in Section 2.0 with a series of discussions that included the following:

- Identification of ARARs
- Development of RAOs
- Identification of volumes or areas of media of concern
- Identification of GRAs

Remediation technology screening is performed in this section with the completion of the following analytical steps:

- Identification and screening of remediation technologies and process options
- Evaluation and selection of representative process options

In this section, remediation technologies for addressing wastes and process options are first identified for each of the GRAs listed in Section 2.2 and then screened. The selection of remediation technologies and process options for initial screening is based on “Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA” (USEPA, 1988) and “Presumptive Remedy for CERCLA Municipal Landfill Sites” (USEPA, 1993). The screening is first conducted at a preliminary level to focus on relevant remediation technologies and process options. Then the screening is conducted at a more detailed level based on certain evaluation criteria. Finally, process options are selected to represent the remediation technologies that have passed the detailed evaluation and screening.

The evaluation criteria for detailed screening of remediation technologies and process options that have been retained after the preliminary screening are effectiveness, implementability, and cost. The following are descriptions of these evaluation criteria:

- Effectiveness
  - Protection of human health and the environment; reduction in toxicity, mobility, or volume; and permanence of solution.
  - Ability of the technology to address the estimated areas or volumes of contaminated medium.
  - Ability of the technology to attain the PRGs required to meet the RAOs.
  - Technical reliability (innovative versus well-proven) with respect to contaminants and site conditions.

- Implementability
  - Overall technical feasibility at the site.
  - Availability of vendors, mobile units, storage and disposal services, etc.
  - Administrative feasibility.
  - Special long-term considerations (e.g., maintenance and operation requirements).

- Cost (Qualitative)
  - Capital cost.
  - Operation and maintenance (O&M) costs.

Another criterion that was considered in the screening was the future use of the site as a recreational area for field sports. Technologies and processes that interfere with the future use of the site were also eliminated.

3.1 PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS

This section identifies and screens remediation technologies and process options at a preliminary stage based on implementation with respect to site conditions and COCs. Based on the presumptive remedy for landfills, the primary components of the remedy are containment and LUCs. In addition, two other process options, excavation with off-site disposal and excavation with on-site treatment and disposal, will be evaluated at this stage. The groundwater plume does not extend beyond the site, so groundwater treatment is not required. A grouted riprap lining of the ditch will serve to prevent erosion of the waste into the ditch and to reduce migration of groundwater into the ditch. There is no leachate, so there is no leachate control component. Landfill gas will be addressed according to requirements of the landfill regulations.

Table 3-1 summarizes the preliminary screening of technologies and process options. It presents the GRAs, identifies the technologies and process options, and provides a brief description of each process option followed by the screening comments. The following are the technologies and process options retained for detailed screening:

General Response Action	Remediation Technology	Process Option
No Action	None	Not Applicable
Limited Action	Land Use Controls	Active and Passive Controls
	Monitoring	Sampling and Analysis
Containment	Waste Protection	Cap
	Surface Water Controls	Vertical Barriers
Removal	Excavation	Excavation*
Ex-Situ Treatment	Thermal	Incineration
	Physical/Chemical	Dewatering*
Disposal	Landfill	Off-Site Disposal
		On-Site Disposal*

* These options are also applicable to the incidental removal of sediment as part of the lining of the ditch.

3.2 DETAILED SCREENING OF REMEDIATION TECHNOLOGIES AND PROCESS OPTIONS

3.2.1 No Action

No action consists of maintaining status quo at the site. As required under CERCLA regulations, the No Action alternative is carried through the FS to provide a baseline for comparison of alternatives and their effectiveness in mitigating risks posed by site contaminants. Because no remedial actions are conducted under this alternative, there are no costs associated with “walking away from” the site. Neither is there a reduction in risk through exposure control or treatment.

Effectiveness

No action would not be effective in meeting the RAOs for the site. No action would not be effective in evaluating either potential contaminant reduction through natural attenuation or potential contaminant migration off site since no monitoring would be performed.

Implementability

There would be no implementability concerns since no actions would be implemented.

Cost

There would be no costs associated with no action.

Conclusion

No action is retained for comparison to other options.

3.2.2 Limited Action

3.2.2.1 Land Use Controls

LUCs would consist of access restrictions. Access restrictions would consist of installing and maintaining a fence at the site to limit access to trespassers and posting warning signs around the perimeter of the landfill to warn against unauthorized digging activities. Site controls would consist of preparing and implementing a LUC plan, which would prohibit current site users from being exposed to the contaminants and deed restrictions to prevent the site from being used in the future for residential purposes and prevent the installation of potable water wells.

Effectiveness

Restricting site access and future uses of the site would prevent direct exposure of human receptors with waste and groundwater.

Implementability

LUCs would be readily implementable. Legal requirements for property transfer would need to be met in the event of base closure. Additionally, fencing would be installed and maintained to minimize unauthorized entry. Site controls would be easy to formulate and implement. Resources are readily available for the implementation of LUCs.

Cost

Costs of LUCs would be low compared to active remedial measures.

Conclusion

LUCs are retained in combination with other process options for the development of remedial alternatives.

3.2.2.2 Monitoring

Monitoring would consist of regularly collecting and analyzing samples of media (e.g., groundwater) from the site to evaluate the trends in concentrations. Monitoring may be considered when contaminated media are left in place without treatment.

Effectiveness

Monitoring would not of itself remediate dioxin and arsenic concentrations in groundwater. However, monitoring would be an effective tool to evaluate potential migration of contaminants and to determine the direction of future actions

Implementability

A sampling and analysis program could be readily implemented. Sampling is a routine activity that can be performed by qualified and trained personnel. Environmental consulting firms that offer sampling and laboratory services are readily available.

Cost

Capital and O&M costs of monitoring would be low compared to active remedial measures.

Conclusion

Monitoring is retained in combination with other process options for the development of remedial alternatives.

3.2.3 Containment

The technologies considered under containment are waste protection and surface water controls. These remedial alternatives serve different purposes in containment and are not mutually exclusive. The implementation of containment technologies would be consistent with the application of the landfill presumptive remedy.

3.2.3.1 Waste Protection

Materials used in the construction of such covers and caps include clay or synthetic, low-permeability material such as linear low-density polyethylene (LLDPE) or polyvinyl chloride (PVC). Low-permeability caps composed of synthetic material or clay are also suited for reducing contaminant migration to groundwater due to rainfall infiltration and surface runoff. The purposes of a cap at Site 5 would be to minimize the potential for human and ecological contact with the soil, to minimize infiltration and vertical containment migration, and to support the future use of the site for recreational activities.

Effectiveness

Multilayer caps as a physical barrier can be effective in reducing risk associated with human and ecological exposure to contaminated waste beneath the cap. Multilayer caps can also be effective in reducing the infiltration of rainfall/surface water runoff into the wastes beneath the cover, which in turn reduces vertical contaminant migration.

Implementability

Covering and capping are common remedial alternatives and would be fully implementable. Synthetic materials are readily available from several vendors and the materials are commonly used. It is anticipated that borrow sources can be identified relatively close to the base. The main concern with the implementation of the cap would be its maintenance under the influence of natural (e.g., storms and burrowing animals) and human interferences (e.g., development). Proper engineering and continued O&M would minimize the impacts of natural interferences. Because the site is under federal control, human interferences could also be minimized.

Cost

Costs of covers and caps are moderate to high, depending on the materials and labor involved in placement. O&M costs for covers and caps are typically low to moderate.

Conclusion

Multilayer covers and capping is retained for development as an alternative. This technology meets the requirements of the presumptive remedy for landfills.

3.2.3.2 Surface Water Controls

Surface water controls would consist of using vertical barriers to contain or divert surface or storm water in order to minimize the potential for infiltration and/or migration of contaminated waste.

Vertical barriers would consist of lining the ditch wall and bottom with grouted riprap. Lining the ditches with grouted riprap would prevent the erosion of the wastes and surface soil into the ditch and reduce migration of groundwater into the surface water.

Effectiveness

Surface water controls would not reduce contaminant concentrations, but they would generally be effective in minimizing migration of waste and contaminated soil entrained in surface runoff.

Lining the ditch would be effective in diverting water around specific sections of the Site 5 drainage ditch and prevent erosion of the ditch walls and prevent contaminated soil from entering the surface water.

Implementability

Surface water controls would be easy to implement, and the resources, materials, and services required to implement this technology are readily available.

Cost

Capital and O&M costs for surface water controls would be moderate.

Conclusion

Surface water controls is retained in combination with other process options for the development of remedial alternatives.

3.2.4 Excavation

Waste material and contaminated soil can be remediated by excavation followed by on-site treatment or off-site disposal. The presumptive remedy notes that these process options are typically eliminated because of high costs. Based on an area of 6.2 acres and a thickness of 8 feet, the estimated volume of material that would be excavated is estimated to be 80,000 cubic yards.

3.2.4.1 Excavation and Off-site Disposal

In this option, soil and waste are excavated using conventional excavation equipment. Soil and waste would be sampled and analyzed for disposal characterization prior to excavation. The excavated material would be loaded onto trucks for off-site disposal. Based on the existing analyses, it is assumed that the material could be disposed of as a non-hazardous waste.

Effectiveness

This method would be very effective in removing hazardous substances and meeting RAOs. The technology is commonly applied to sites with contaminated soil.

Implementability

The depth of soil to be removed is shallow and the sandy soil is easy to handle. Standard excavating equipment could be used.

Cost

The cost for excavation and off-site disposal of the quantity of soil would be very high and is estimated to be $12,000,000 (See Appendix B). Because the waste would be removed, there would be no annual O&M costs.

Conclusion

Because of the very high capital costs, this process option is eliminated.

3.2.4.2 Excavation, On-site Treatment, and On-site Disposal

In this option, soil and waste are excavated using conventional excavation equipment. Soil and waste would be sampled and analyzed prior to and following treatment. Because the primary contaminants are dioxins and furans, the process option for treatment is assumed to be incineration. Based on the assumed effectiveness of the treatment, it is assumed that the treated soil can be placed back onto the site.

Effectiveness

This method would be very effective in removing hazardous substances and meeting RAOs. The technology has been applied to sites with contaminated soil.

Implementability

The depth of soil to be removed is shallow and the sandy soil is easy to handle. Standard excavating equipment could be used. However, obtaining a permit for on-site incineration will be difficult. Obtaining permits of incineration projects, particularly dioxin projects, is a time-consuming process.

Cost

The cost for excavation, on-site treatment, and on-site disposal of the quantity of soil would be very high and is estimated to be $24,000,000 (See Appendix B). Because the contaminants would be removed, there would be no annual O&M costs.

Conclusion

Because of the very high capital costs and permitting issues, this process option is eliminated.

3.3 SELECTION OF REMEDIATION TECHNOLOGIES AND PROCESS OPTIONS

The following technologies and process options are retained to develop remedial alternatives:

- No Action
- LUCs
- Monitoring
- Containment

3.4 DEVELOPMENT OF ALTERNATIVES

Alternatives have been developed based on an assembly of the technologies selected under each of the GRAs. Because the presumptive remedy is being applied, only two alternatives are being considered.

Alternative 1: No Action

The no action alternative maintains the site as is. This alternative does not address site contamination and is only retained to provide a baseline for comparison to other alternatives. There would be no reduction in toxicity, mobility, or volume of wastes and site contaminants other than what might result from natural dispersion, dilution and other attenuating factors. Existing monitoring programs and LUCs would be discontinued, and the site would be available for unrestricted use.

Alternative 2: Cap, Ditch Lining, Institutional Controls, and Monitoring

Under Alternative 2, a cap that meets the MDEQ solid waste landfill final cover regulations would be installed over the waste area to minimize the infiltration of rainwater into the landfill. The cap design would be consistent with MDEQ regulations for nonhazardous solid waste and would consist of a geosynthetic clay liner (GCL). The GCL would direct infiltrated rainwater away from the landfill and minimize the amount of rainwater that would come into contact with the underlying waste. This action would result in a reduced flow of groundwater/rain infiltration through the waste which in turn would reduce the transport of contaminants from the waste.

Prior to installation of the cap, the existing cover would be regarded to create a slope to divert precipitation away from the fill. Then, perforated piping placed in gravel bedding will be installed to collect

landfill gas. The piping will be routed to a vent on the periphery of the site for passive removal of the gas and to allow for maximum utilization of space. The GCL is then placed over the gas collection layer. Overlying the GCL will be a layer of sand to protect the GCL and to create the final grade of the area. A layer of soil will be placed over the sand to support grass and for use a playing field.

Sediment would be excavated from the bottom and landfill-side of the ditches on the western and southern sides of the site so that the ditch can be lined with grouted riprap. (Residual contamination in the sediment will be incidentally removed.) The excavated sediment and soil will be disposed on-site at Site 5during initial regarding and prior to GCL installation. The sides and bottom of the ditch will be lined with grouted riprap extending to the top of the bank to prevent erosion of the soil and waste and to reduce the flow of groundwater from the site into the surface water.

LUCs would be implemented to maintain the site for recreational use for field sports. LUCs would be developed and implemented to prevent residential development, intrusive activities, and the use of site groundwater as a drinking source. Signs would be posted around the perimeter of the landfill to warn against unauthorized digging activities. Fencing and gates would be installed to limit the access of heavy vehicles that could damage the cap system. Periodic inspections would be required over time to ensure that the integrity of the cap and erosion control measures.

Periodic groundwater monitoring would be conducted. Monitoring would consist of collecting groundwater samples from selected wells and analyzing these samples for arsenic, dioxins/furans, and BaA. Groundwater samples would be collected from existing monitoring wells and new monitoring wells. Initially, groundwater sampling would be performed quarterly to verify the previous sampling results and to monitor concentrations over time. Sampling results obtained after the first 2 years would be used to make recommendations regarding the frequency and extent of the sampling program. For costing purposes, sampling and analysis of eight wells would occur over a 30-year period consisting of quarterly sampling for the first 2 years and annual sampling for the next 25 years. Every 5 years, the status of the site would be formally reviewed and evaluated to determine the continued effectiveness of this alternative. Soil gas monitoring wells installed on the perimeter of the site would be sampled quarterly for methane.

TABLE 3-1

PRELIMINARY SCREENING OF REMEDIATION TECHNOLOGIES
SITE 5 FEASIBILITY STUDY
NCBC GULFPORT, MISSISSIPPI
PAGE 1 OF 2

TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS	OPTION RETAINED
GENERAL RESPONSE ACTION: NO ACTION				
No Action	No Action	No activities conducted at the site to address contamination.	Required by NCP. Retain for baseline comparison to other technologies.	Yes
GENERAL RESPONSE ACTION: LIMITED ACTION				
Institutional Controls (Land Use Controls)	Active Controls: Physical Barriers/ Security Guards	Fencing and warning signs restrict site access other than for intended use.	Retain to minimize risk of exposure to contaminated soil and groundwater. Fencing already exists around parts of Site 5.	Yes
	Passive Controls: Deed or Land Use Restrictions	Administrative action using property deeds or other land use prohibitions to restrict future site activities.	Retain to prevent future residential development and groundwater use.	Yes
Monitoring	Sampling and Analysis	Sampling and analysis of site media to evaluate migration of chemical constituents in the environment.	Retain to assess migration of chemical constituents from Site 5.	Yes
GENERAL RESPONSE ACTION: CONTAINMENT				
Waste Protection	Cap	Use of low permeability or synthetic materials constructed over the site to provide a barrier to water infiltration and also reduce direct contact with and ingestion of waste.	Would provide a barrier for potential human exposure pathways and reduce transport of COCs in waste to groundwater. Cap system would be designed for use of site for recreation.	Yes
	Soil Cover	Use of soil cover over site to reduce direct contact with and ingestion of waste.	Would provide a barrier for potential human exposure pathways but would not reduce transport of COCs in waste to groundwater.	No
Surface Water Controls	Vertical Barriers	Installation of a vertical barrier to prevent water form entering into the work area and to prevent erosion of contaminated materials from work areas.	Ditch would be lined with grouted riprap to prevent erosion of waste and contaminated soil and to reduce flow of groundwater into surface water.	Yes

TABLE 3-1

PRELIMINARY SCREENING OF REMEDIATION TECHNOLOGIES
SITE 5 FEASIBILITY STUDY
NCBC GULFPORT, MISSISSIPPI

TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENTS	OPTION RETAINED
GENERAL RESPONSE ACTION: REMOVAL				
Excavation	Excavation	Use of construction equipment such as backhoe, front-end loader, gradall, etc. to move cover material.	Retain. Retained only for removal of sediment from ditch. Eliminated for application to the entire landfill contents because of high disposal costs.	Yes
GENERAL RESPONSE ACTION: IN-SITU AND EX-SITU TREATMENT				
In-Situ and Ex-Situ Treatment	Physical, Chemical, and Biological Treatment Processes	Physical, chemical, and biological treatment processes are employed to reduce the toxicity, mobility, and/or volume of contaminates.	Generally not evaluated if the presumptive remedy for landfills is applied. On-site treatment by incineration was eliminated because of high costs and permitting issues.	No
GENERAL RESPONSE ACTION: DISPOSAL				
Disposal	0n-site	Sediment is excavated and characterized as required and disposed at Site 5.	Retained only for removal of sediment from ditch. Eliminated for application to entire landfill contents because of high costs.	Yes

4.0 ASSEMBLY AND DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

In this section, the remedial technologies retained from the technology screening process conducted in Section 3.0 are assembled into multiple remedial alternatives. The following sections contain descriptions of these alternatives and provide a detailed analysis of these alternatives in accordance with the CERCLA evaluation criteria.

4.1 INTRODUCTION

This section presents an evaluation of each remedial alternative with respect to the criteria of the NCP of 40 Code of Federal Regulations (CFR) Part 300, as revised in 1990. The criteria as required by the NCP and the relative importance of these criteria are described in the following subsections.

4.1.1 Evaluation Criteria

In accordance with the NCP (40 CFR 300.430), the following nine criteria are used for the evaluation of remedial alternatives:

- Overall Protection of Human Health and the Environment
- Compliance with ARARs
- Long-Term Effectiveness and Permanence
- Reduction of Toxicity, Mobility, and Volume through Treatment
- Short-Term Effectiveness
- Implementability
- Cost
- State Acceptance
- Community Acceptance

4.1.1.1 Overall Protection of Human Health and the Environment

Alternatives must be assessed for adequate protection of human health and the environment, in both the short and long term, from unacceptable risks posed by hazardous substances or contaminants present at the site. For this purpose, alternatives should eliminate, reduce, or control exposure to levels of contaminants exceeding remediation goals. Overall protection draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

4.1.1.2 Compliance with ARARs

Alternatives must be assessed to determine whether they attain ARARs under federal environmental laws and state environmental or facility siting laws. CERCLA Section 121(d) specifies in part that remedial actions for cleanup of hazardous substances must comply with requirements and standards under federal or more stringent state environmental laws and regulations that are applicable or relevant and appropriate (ARARs) to the hazardous substances or particular circumstances at a site or a waiver must be obtained [see also 40 CFR 300.430(f)(1)(ii)(B)]. ARARs include only federal and state environmental or facility siting laws/regulations and do not include occupational safety or worker protection requirements. In addition, per 40 CFR 300.405(g)(3), other advisories, criteria, or guidance may be considered in determining remedies (TBC guidance category).

4.1.1.3 Long-Term Effectiveness and Permanence

Alternatives must be assessed for the long-term effectiveness and permanence they offer, along with the degree of certainty that the alternative will prove successful. Factors that shall be considered as appropriate include the following:

- Magnitude of Residual Risk - Residual risk is posed by untreated waste or treatment residuals at the conclusion of remedial activities. The characteristics of residuals should be considered to the degree that they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bioaccumulate.

- Adequacy and Reliability of Controls - Controls such as containment systems and LUCs that are necessary to manage treatment residuals and untreated waste must be shown to be reliable. In particular, the following should be addressed: the uncertainties associated with land disposal for providing long-term protection from residuals; the potential need to replace technical components of an alternative such as a cap, slurry wall, or treatment system; and the potential exposure pathways and risks posed should the remedial action need replacement.

4.1.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

The degree to which the alternative employs recycling or treatment that reduces the toxicity, mobility, or volume shall be assessed, including how treatment is used to address the principal threats posed by the site. Factors that shall be considered, as appropriate, include the following:

- The treatment or recycling processes the alternative employs and the materials that they will treat.

- The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled.

- The degree of expected reduction in toxicity, mobility, or volume of waste due to treatment or recycling and the specification of which reductions are occurring.

- The degree to which the treatment is irreversible.

- The type and quantity of residuals that will remain following treatment considering the persistence, toxicity, mobility, and propensity to bioaccumulate of hazardous substances and their constituents.

- The degree to which treatment reduces the inherent hazards posed by principal threats at the site.

4.1.1.5 Short-Term Effectiveness

The short-term impacts of the alternative shall be assessed considering the following:

- Short-term risks that might be posed to the community during implementation.

- Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures.

- Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation.

- Time until protection is achieved.

4.1.1.6 Implementability

The ease or difficulty of implementing the alternatives shall be assessed by considering the following types of factors, as appropriate:

- Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy.

- Administrative feasibility, including activities needed to coordinate with other offices and agencies, and the ability and time required to obtain any necessary approvals and permits from other agencies.

- Availability of services and materials, including the availability of adequate off-site treatment, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists and provisions to ensure necessary additional resources; the availability of services and materials; and the availability of prospective technologies.

4.1.1.7 Cost

Capital costs shall include both direct and indirect costs. Annual O&M costs shall be provided. A net present value (NPW) of the capital and O&M costs shall also be provided. Typically, the cost estimate accuracy range is plus 50 percent to minus 30 percent.

4.1.1.8 State Acceptance

The state's concerns that must be assessed include the following:

- The state's position and key concerns related to the preferred alternative and other alternatives.
- State comments on ARARs or the proposed use of waivers.

These concerns cannot be evaluated at this time in the FS until the state has reviewed and commented on this FS. These concerns will be discussed, to the extent possible, in the Proposed Plan to be issued for public comment.

4.1.1.9 Community Acceptance

This assessment consists of responses of the community to the Proposed Plan. This assessment includes determining which components of the alternative interested persons in the community support, have reservations about, or oppose. This assessment can be done after comments on the Proposed Plan are received from the public.

4.1.2 Relative Importance of Criteria

Among the nine criteria, the threshold criteria are considered to be the following:

- Overall Protection of Human Health and the Environment
- Compliance with ARARs (excluding those that may be waived)

The threshold criteria must be satisfied for an alternative to be eligible for selection.

Among the remaining criteria, the following five criteria are considered to be the primary balancing criteria:

- Long-Term Effectiveness and Permanence
- Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment
- Short-Term Effectiveness
- Implementability
- Cost

The balancing criteria are used to weigh the relative merits of alternatives.

The remaining two of the nine criteria, State Acceptance and Community Acceptance, are considered to be modifying criteria that must be considered during remedy selection. These last two criteria can be evaluated after the FS has been reviewed by MDEQ and the Proposed Plan has been discussed in a public meeting. Therefore, this document addresses only seven of the nine criteria.

4.1.3 Selection of Remedy

The selection of a remedy is a two-step process. The first step consists of identification of a preferred alternative and presentation of the alternative in a Proposed Plan to the community for review and comment. The preferred alternative must meet the following criteria:

- Protection of human health and the environment.
- Compliance with ARARs unless a waiver is justified.
- Cost effectiveness in protecting human health and the environment and in complying with ARARs.
- Utilization of permanent solutions and alternate treatment technologies or resource recovery technologies to the maximum extent practicable.

The second step consists of the review of the public comments and the determination, in consultation with MDEQ, as to whether or not the preferred alternative continues to be the most appropriate remedial action for the site.

4.2 ASSEMBLY OF REMEDIAL ALTERNATIVES

Based on the technology screening presented in Section 3.0, the following two remedial alternatives were developed.

- Alternative 1: No Action
- Alternative 2: Cap, Ditch Lining, LUCs, and Monitoring

Alternative 1 was developed and analyzed to serve as a baseline for other alternatives, as required by CERCLA and the NCP. Alternative 2 was formulated and analyzed to evaluate the presumptive remedy. Descriptions and detailed analyses of these alternatives are presented in the following sections.

4.3 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

4.3.1 Alternative 1: No Action

4.3.1.1 Description

The no action alternative maintains the site as is. This alternative does not address site contamination and is only retained to provide a baseline for comparison to other alternatives. There would be no reduction in toxicity, mobility, or volume of waste. Existing monitoring programs and institutional controls would be discontinued, and the site would be available for unrestricted use.

4.3.1.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative 1 would not provide protection of human health and the environment. Under the current land-use scenario (industrial/military), the potential for human contact with waste would remain. This alternative would not be protective of potential future residents who would consume or come into contact with Site 5 groundwater in the future.

Compliance with ARARs and TBCs

Alternative 1 would not comply with chemical-specific ARARs or TBCs because no action would be taken to reduce contaminant concentrations. There are no location-specific ARARs identified for Site 5. Action-specific ARARs or TBCs are not applicable because no action would be taken.

Long-Term Effectiveness and Permanence

Alternative 1 would have no long-term effectiveness and permanence because waste would remain on site. Since there would be no institutional controls to control land use, the potential would exist for human exposure to waste. Because there would be no monitoring, potential dioxin and metal migration would not be detected.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 1 would not reduce toxicity, mobility, or volume of waste through treatment because no treatment would occur. Some reduction of dioxin or metal toxicity and volume might occur through natural dispersion, dilution, or other attenuation process in the very long term, but no monitoring would be performed to verify this condition.

Short-Term Effectiveness

Because no action would occur, implementation of Alternative 1 would not pose any risks to on-site workers or result in short-term adverse impact to the local community and the environment. Alternative 1 would never achieve the RAOs and, although the PRGs might eventually be achieved through natural attenuation in the very long term, monitoring would not be in place to verify this condition.

Implementability

Because no action would occur, Alternative 1 would be readily implementable. The technical feasibility criteria, including constructability, operability, and reliability, are not applicable. Implementability of administrative measures is not applicable because no such measures would be taken.

Cost

There would be no costs associated with the no action alternative.

4.3.2 Alternative 2: Cap, Ditch Lining, LUCs, and Monitoring

4.3.2.1 Description

Alternative 2 would consist of four major components: (1) a cap system to meet recreational RAOs and future land use, (2) lining the bottom and side of the ditch adjacent to the site with grouted riprap, (3) LUCs, and (4) monitoring.

Component 1: Cap System

Under this alternative, the landfill will be contained by a cap system and the ditch will be lined with grouted riprap to complete the containment system. Because the site will be re-used as a recreational area for field sports, the cap design must take this into account. Figure 4-1 illustrates the areal extent where the cap would be installed. Existing monitoring wells within the boundary of the landfill would be abandoned. The area to be disturbed would also be cleared and grubbed, although existing site conditions are such that minimal clearing and grubbing would be expected. The existing cover would be regraded to provide a slope to allow for drainage and reuse of the site.

Based on the results of the soil gas sample, landfill gas continues to be generated. Because the site will be reused for recreation, a landfill gas collection system will be installed rather than multiple individual vents. Perforated piping in a low permeability gas collection layer will be installed over the existing fill and the gas will be collected in a common header, which is described further below.

A cap (equivalent to 18 inches of 1×10^{-5} cm/sec soil, per MDEQ regulations) would then be installed to minimize the infiltration of rainwater into the landfill. The cap would consist of a GCL. The GCL would channel infiltrated rainwater away from the landfill and minimize the amount of rainwater that would come into contact with the underlying waste. This action would result in a reduced flow of groundwater/rain infiltration through the waste which in turn would reduce the transport of contaminants from the waste.

Overlying the GCL would be a sand layer covered by a top soil erosion layer. A 6-inch layer of topsoil would be placed over the drainage layer to provide a 1 percent slope for the playing surface. After placing the topsoil, turf grass would be planted with suitable mulch and fertilizer to promote growth. After the grass has been established, the site would be lined as needed for field sports. The grass would be irrigated and mowed routinely to maintain its use.

Landfill gas is collected and piped to a common header. The estimated gas generation rate (see Appendix B) of 1,600 cubic feet per minute (cfm) with a higher heating value of 500 British thermal units per standard cubic foot (BTU/scf). The estimated electrical energy that this stream could provide is less than 5 kilowatts (kW), which is much less than the output of the smallest electric microturbines. Therefore, the gas will be not be used for power generation. Because of the small amount of gas, the gas can be vented directly rather than flared.

Existing slope stabilization and erosion control measures, such as riprap, disturbed during the installation of the cap would be replaced as needed. This area would primarily consist of the western and southern edges of the site that border the drainage ditch and may include replacement of riprap that lines the sides of the drainage ditch and disturbed vegetation.

Component 2: Ditch Lining

To prevent erosion of waste and contaminated soil and to reduce the flow of groundwater into the surface water, the existing ditch on the southern and western sides of the site will be lined with grouted riprap. The existing grouted riprap at the southwest corner of the site will be left in place. Prior to lining, the bottom sediment will be dredged and disposed on-site. The ditch wall along the landfill will be graded to provide an even surface and to maintain the existing channel cross-section after the placement of the riprap. The top of the grouted riprap will be brought over the top of the bank to minimize erosion. The linear extent of the ditch to be lined with grouted riprap is shown on Figure 4-1.

Component 3: LUCs

LUCs would be developed to prevent the site from being used in the future for any purposes other than as an athletic field or for similar non-intrusive activities. Physical restrictions to the site may include signage and fencing. LUC performance objectives and restrictions would be as follows:

- Prohibit residential, industrial, commercial, and agricultural (specifically growing crops for human consumption) unless prior written approval is obtained from the Navy, USEPA, and MDEQ. Prohibited residential uses shall include, but are not limited to, any form of housing, child-care facilities, pre-schools, elementary schools, secondary schools, playgrounds, convalescent, or nursing care facilities.

- Prohibit the excavation of soils from the site unless prior written approval is obtained from the Navy, USEPA, and MDEQ.

- Maintain the integrity of any existing or future monitoring or remediation system(s) unless prior written approval is obtained from the Navy, USEPA, and MDEQ.

Annual inspections of the site would be conducted to confirm compliance with LUC objectives. Prior to any property conveyance, USEPA, and MDEQ would be notified.

The LUCs would be implemented through a LUC Remedial Design (RD) that would be prepared as a component of the overall RD. The LUCs would be maintained for as long as they are required to prevent unacceptable exposure to contaminated soil and groundwater and/or to preserve the integrity of the selected remedy.

The LUC RD would also include procedures for regular inspections of the soil cover and maintenance and repair of the cap as required. LUCs would be developed in accordance with the Principles and Procedures for Specifying, Monitoring, and Enforcement of Land Use Controls and Other Post-ROD Actions (DoD, 2003). Implementation of this alternative would therefore require a survey of the site, annual visual inspections, and five-year review report preparation.

Component 4: Monitoring

Overall, monitoring would consist of collecting groundwater samples from 8 new monitoring wells and analyzing them for COCs. Samples from all wells will be analyzed for the most significant COCs, dioxins and arsenic. All samples will also be analyzed for contaminants detected at concentrations greater than TRGs during the RI: BaA in monitoring well MW-05-02. New wells will be located along the downgradient perimeter of the site to replace wells that will be abandoned because of the remediation and site use. Sampling frequency would be quarterly for the first year, semi-annual for the next 2 years, and annual thereafter.

Monitoring of the methane concentration in the landfill gas in perimeter soil gas monitoring wells will be performed quarterly as part of the landfill cap O&M program.

4.3.2.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative 2 would be protective of human health and the environment. A cap over the area of contamination would ensure that the most likely future potential site users would be protected from exposure to unacceptable levels of contaminants. The use of LUCs would prevent potential residential and commercial/industrial receptors from being exposed to unacceptable levels of contaminants in the soil and groundwater that would remain under the capped areas. The site would be suitable for revegetation and future use as athletic fields. All of the RAOs would be met.

Compliance with ARARs

Alternative 2 would comply with chemical-specific ARARs, because exposure to soil with contaminant concentrations greater than TRGs would be prevented by the cap and LUCs. The following location-specific and action-specific ARARs would be complied with in substance:

- Mississippi Brownfields Voluntary Cleanup and Redevelopment Regulations.
- Mississippi Air Pollution Rules (grading and landfill gas discharge).
- Mississippi Solid Waste Management Facility Regulations (SW-2)

Long-Term Effectiveness and Permanence

Alternative 2 would be effective in the long term because the cap would provide a barrier that would prevent recreational and ecological receptors from unacceptable exposure to COCs in soil. The ditch lining would prevent erosion of the waste and contaminated soil and would reduce groundwater from entering the surface water. The grouted riprap ditch is durable and will provide long-term protection.

Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative 2 would not reduce the toxicity, mobility or volume through treatment. However, the soil COCs present at the site are not currently migrating to groundwater and are not expected to do so in the future because of their relative low mobility.

Short-Term Effectiveness

Alternative 2 would be effective in the short term. Dust suppression and control measures would be implemented to minimize the emission of contaminated soil particulates during on-site remedial activities such as initial regrading of the site. Erosion control measures would minimize the potential migration of COCs into the nearby drainage ditch. Workers performing work during construction and collecting samples from monitoring wells would be adequately protected if suitable health and safety procedures are followed. Transportation of contaminated soil to an off-site disposal facility would be conducted in suitable containers and by reputable transporters. The time frame for implementation of this alternative is estimated to be approximately 1 year, after which it would be protective assuming LUCs have been implemented.

Implementability

Alternative 2 is implementable. Excavation and earthmoving equipment considered under this alternative is typical in the construction industry and readily available from several local sources. Off-site borrow locations for clean soil can be identified. Establishment of LUCs would require negotiation and agreement on the specifics of the procedures between the Navy, USEPA, and MDEQ.

Cost

Estimated costs for Alternative 2 are as follows:

- Capital: $3,722,000
- 30-Year NPW of O&M: $765,000
- 30-Year NPW: $4,487,000

The above figures have been rounded to the nearest $1,000 to reflect the preliminary nature of the estimates. A more detailed breakdown of these cost estimates is provided in Appendix C.

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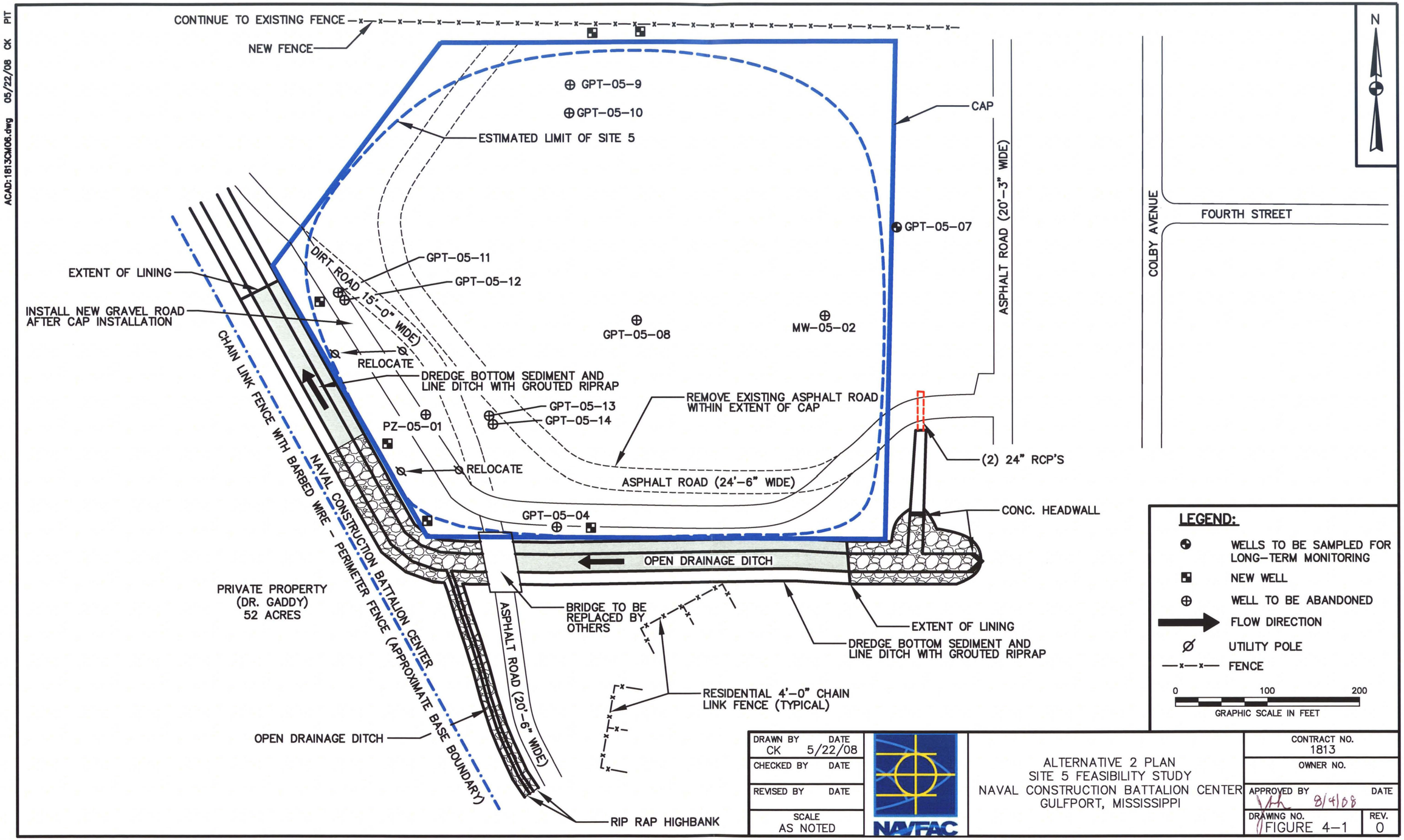

DRAWN BY CK	DATE 5/22/08	ALTERNATIVE 2 PLAN SITE 5 FEASIBILITY STUDY NAVAL CONSTRUCTION BATTALION CENTER GULFPORT, MISSISSIPPI	CONTRACT NO. 1813
CHECKED BY	DATE		OWNER NO.
REVISED BY	DATE		APPROVED BY 8/4/08 DATE
SCALE AS NOTED			DRAWING NO. FIGURE 4-1 REV. 0

NAVFAC

FORM CADD NO. SDIV-BH.DWG – REV 1 – 9/10/98

5.0 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

This section compares the analyses presented for each of the remedial alternatives in Section 4.0 of this FS. The criteria for comparison are identical to those used for the detailed analysis of individual alternatives.

The following remedial alternatives for soil are being compared in this section:

- Alternative 1: No Action
- Alternative 2: Cap, Ditch Lining, LUCs, and Monitoring

5.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Alternative 1 would not be protective. Alternative 2 would be protective

5.2 COMPLIANCE WITH ARARS AND TBCS

Alternative 1 would not comply with chemical-specific or location-specific ARARs. Action-specific ARARs do not apply to Alternative 1. Alternative 2 would comply with chemical-, location-, and action-specific ARARs.

5.3 LONG-TERM EFFECTIVENESS AND PERMANENCE

Alternative 1 would not be effective in the long term and offers no permanent solution. Alternative 2 offers long-term effectiveness and permanence although it depends on LUCs and may be somewhat less effective in the long term.

5.4 REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT

Alternatives 1 and 2 do not employ any treatment. However, treatment is not a component of the presumptive remedy.

5.5 SHORT-TERM EFFECTIVENESS

Alternative 1 has no relevant issues to address. Alternative 2 would be effective in the short term in terms of short-term risks to workers, the community, and the environment. Short-term risks would be properly mitigated by application of engineering controls and adherence to Occupational Safety and Health Act (OSHA) requirements.

Alternative 1 would not achieve the RAOs. The approximate time frames for implementation and attainment of RAOs would be 1 year for Alternative 2.

5.6 IMPLEMENTABILITY

Alternative 1 would be readily implementable because there is no action to implement. Alternative 2 would be relatively easy to implement, but would require maintenance of LUCs as well as maintenance of the cap.

5.7 COST

The capital costs, NPW of O&M costs, and NPW costs of the alternatives are as follows. Costs have been rounded to the nearest $1,000 to reflect the preliminary nature of the estimates. Detailed cost estimates are provided in Appendix G.

Alternative	Capital ($)	30-Year NPW of O&M ($)	30-Year NPW ($)
1	0	0	0
2	3,722,000	765,000	4,487,000

5.8 SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

Table 5-1 summarizes the comparative analysis of the remedial alternatives.

TABLE 5-1

SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES
SITE 5 FEASIBILITY STUDY
NCBC GULFPORT
GULFPORT, MISSISSIPPI

Evaluation Criteria	Alternative 1: No Action	Alternative 2: Cap, Ditch Lining, LUCs, and Monitoring
Overall Protection of Human Health and Environment	Not protective	Protective
Compliance with ARARs and TBCs Chemical-Specific Location-Specific Action-Specific	 Would not comply Would not comply Not applicable	 Would comply Would comply Would comply
Long-Term Effectiveness and Permanence	Not effective	Effective
Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment	None	None
Short-Term Effectiveness	No relevant issues to address	Would be effective. Potential for short-term risks. One year to attain RAOs.
Implementability	Nothing to implement	More difficult to implement than Alternative 1.
Costs: Capital NPW of O&M NPW	 $0 $0 $0	 $3,722,000 $765,000 $4,487,000

ARARs Applicable or Relevant and Appropriate Requirements
LUCs Land use controls
NPW Net present worth
RAOs Remedial Action Objectives
TBCs To Be Considered
O&M Operation and maintenance

REFERENCES

ABB-ES (ABB Environmental Services, Inc), 1999. Surface Water and Sediment Dioxin Delineation Report, NCBC, Gulfport, Mississippi. June.

DoD (Department of Defense), 2003. Principles and Procedures for Specifying, Monitoring, and Enforcement of Land Use Controls and Other Post-ROD Actions. October.

Driscoll, F.G., 1989. Groundwater and Wells, 2nd Edition.

HLA (Harding Lawson Associates), 1998. Groundwater Monitoring Report, NCBC, Gulfport, Mississippi. Prepared for SOUTHDIVNAVFACENGCOM, Charleston, South Carolina. December.

MK (Morrison Knudsen), 1997. Sampling and Analysis Report Sites 1 and 5 at the Naval Construction Battalion Center (NCBC), Gulfport, Mississippi. 1995.

NEESA (Naval Energy and Environmental Support Activity), 1985. Initial Assessment Study, Naval Construction Battalion Center, Gulfport, Mississippi. July.

TtNUS (Tetra Tech NUS, Inc.), 2007. (Draft) Remedial Investigation Report for Site 5 - Heavy Equipment Training Area, Naval Construction Battalion Center Gulfport, Gulfport, Mississippi. August.

USEPA (United States Environmental Protection Agency), 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA. EPA/540/G-89/004. Office of Solid Waste and Emergency Response. Washington, D.C. October.

USEPA, 1993a. Presumptive Remedies: Policies and Procedures, OSWER Directive No. 9355.0-47FS. September

USEPA, 1993b. Presumptive Remedy for CERCLA Municipal Landfill Sites. EPA 540-F-93-035, Office of Solid Waste and Emergency Response, Washington D.C.

USEPA, 1996. Application of the CERCLA Municipal Landfill Presumptive Remedy to Military Landfills (Interim Guidance). EPA-540-5-96-007, Office of Solid Waste and Emergency Response, Washington, D.C.

USEPA, 1999. Risk-Based Concentration Table. USEPA Region III, Philadelphia, PA. April.

APPENDIX A

LABORATORY DATA

Geotechnical Analyses

BEAVER ENGINEERING, INC.
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615-350-8124
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DETERMINATION OF PHYSICAL PROPERTIES OF SOILS

PROJECT: **TERRA TECH** DATE: **MAY 31, 2007**

PROJECT #: **07-5492**

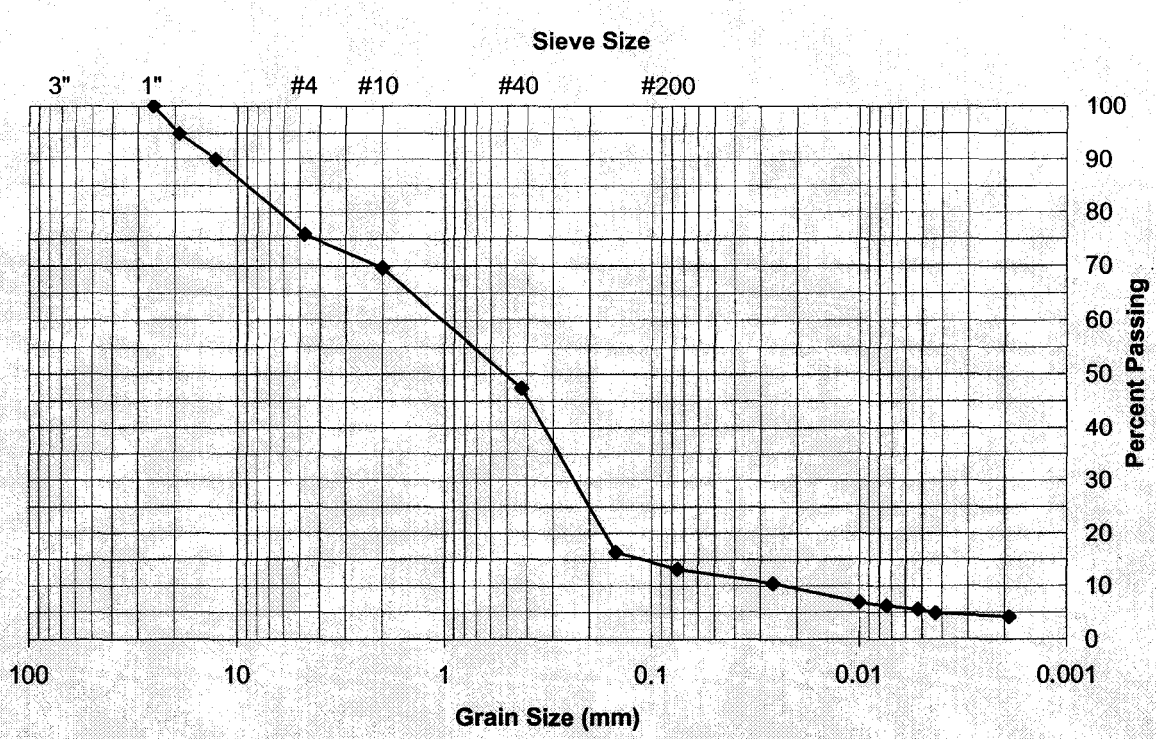
DETERMINATION OF SOIL MOISTURE

ASTM D2216

SAMPLE IDENTIFICATION AND TEST RESULTS

LOCATION	LAB ID	MOISTURE AS % OF OVEN DRIED MASS
04GT0101	J 1844	**12.4** %
04GT0201	J 1845	**8.0** %
04GT0301	J 1846	**13.4** %
04GT0401	J 1847	**8.0** %
04GT0501	J 1848	**8.5** %
04GT0601	J 1849	**7.3** %
05GT0101	J 1856	**7.1** %
05GT0201	J 1857	**8.0** %
05GT0301	J 1858	**7.1** %

GRAIN SIZE DISTRIBUTION REPORT
ASTM D 422



PERCENT PASSING

SAMPLE ID	Seive Sizes for Mechanical Analysis								Diameters for Hydrometer Analysis (mm)					
	1.0(in)	0.75(in)	0.50(in)	#4	#10	#40	#100	#200	0.026	0.01	0.0074	0.0052	0.0043	0.0019
05GT0101	100	95	90	76	70	47	16	13	10	7	6	6	5	4
	24%			63%				8%				6%		
LAB ID J 1856	GRAVEL			SAND				SILT				CLAY		

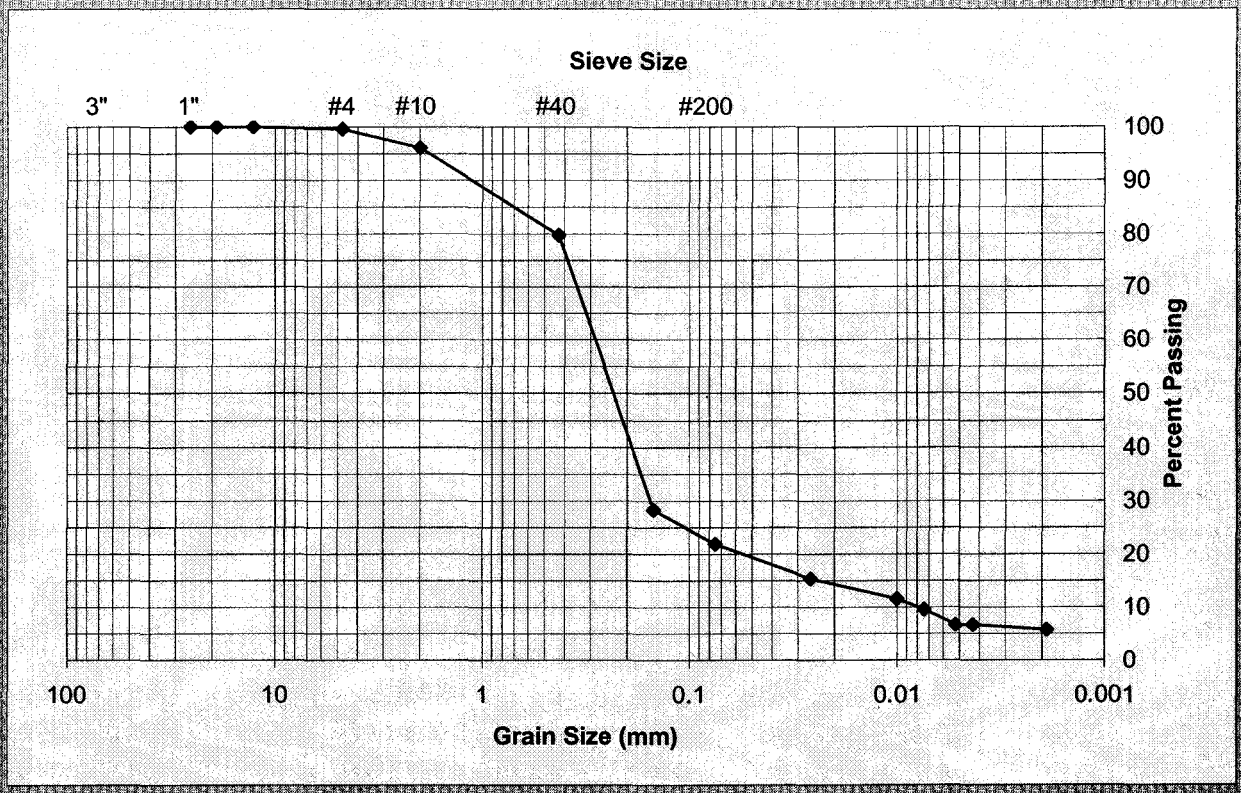
BEAVER ENGINEERING

PROJECT: TERRA TECH

PROJECT NUMBER: 07-5492

DATE: MAY 31, 2007

GRAIN SIZE DISTRIBUTION REPORT
ASTM D 422



PERCENT PASSING

SAMPLE ID	Seive Sizes for Mechanical Analysis								Diameters for Hydrometer Analysis (mm)					
	1.0(in)	0.75(in)	0.50(in)	#4	#10	#40	#100	#200	0.026	0.01	0.0074	0.0052	0.0043	0.0019
05GT0201	100	100	100	100	96	80	28	22	15	12	10	7	7	6
	0%			78%					15%			7%		
LAB ID J 1857	GRAVEL			SAND					SILT			CLAY		

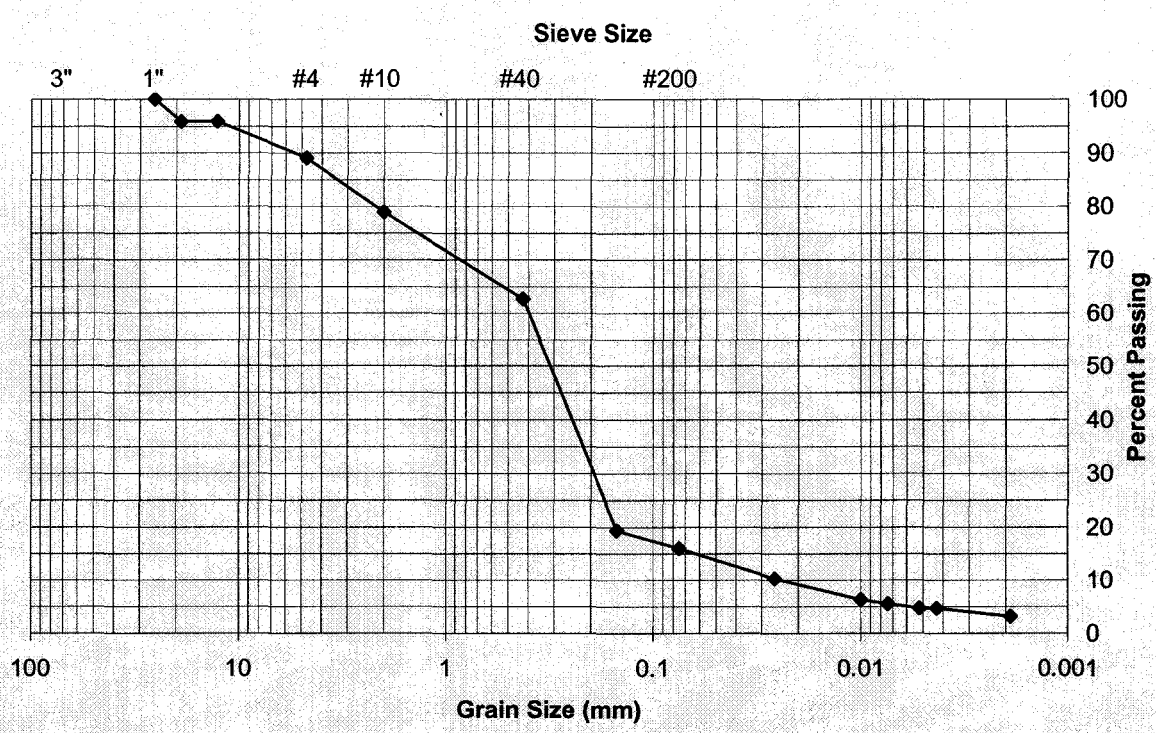
BEAVER ENGINEERING

PROJECT: TERRA TECH

PROJECT NUMBER: 07-5492

DATE: MAY 31, 2007

GRAIN SIZE DISTRIBUTION REPORT
ASTM D 422



PERCENT PASSING

SAMPLE ID	Seive Sizes for Mechanical Analysis								Diameters for Hydrometer Analysis (mm)					
	1.0(in)	0.75(in)	0.50(in)	#4	#10	#40	#100	#200	0.026	0.01	0.0074	0.0052	0.0043	0.0019
05GT0301	100	96	96	89	79	63	19	16	10	6	6	5	5	3
	11%			73%				11%				5%		
LAB ID J 1858	GRAVEL			SAND				SILT				CLAY		

BEAVER ENGINEERING

PROJECT: TERRA TECH

PROJECT NUMBER: 07-5492

DATE: MAY 31, 2007

BEAVER ENGINEERING, INC.
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615-350-8124

CLIENT **ELAB**

PROJECT **TERRA TECH** PROJ. NO. **07-5492**

SATURATED HYDRAULIC CONDUCTIVITY

TEST DESCRIPTION:
EPA 9100, SECTION 2.8, TRIAXIAL CELL METHOD WITH BACKPRESSURE
ASTM D5084 - 90, MEASUREMENT OF HYDRAULIC CONDUCTIVITY

LOCATION	**05ST0101**		
DESCRIPTION	**SAND, DARK YELLOWISH BROWN**		
LAB ID	**ST 1859**		
TYPE SAMPLE	**SHELBY TUBE**		
SAMPLE INFORMATION:		TEST INFORMATION:	
LENGTH	6.6 cm	TEST DATE	5/31/2007
WEIGHT	540.4 grams	TOTAL BACKPRESSURE	80 psi
CROSS SECTIONAL AREA	42.68 cmsq	CELL PRESSURE	85 psi
MOISTURE OF SAMPLE	7.1%	HEAD PRESSURE	83 psi
DENSITY	112.2 pcf	CONSOLIDATION STRESS:	
	1.80 g/cu cm	MAXIMUM	5 psi
PERMEANT:	WATER	MINIMUM	2 psi

		READING 1	READING 2	READING 3	READING 4
LAPSED TIME(in seconds)	T=	5	5	5	5
INITIAL READING,influent liquid		12.8	15.8	18.8	21.7
INITIAL READING,effluent liquid		36.7	33.7	30.7	27.7
END READING, influent liquid		15.8	18.8	21.7	24.7
END READING, effluent liquid		33.7	30.7	27.7	24.7
TOTAL CUBIC CENTIMETERS	Q=	3.0	3.0	2.9	3.0
LENGTH OF SAMPLE	L=	6.6	6.6	6.6	6.6
LOSS OF HEAD	H=	231.8	225.8	219.8	213.9
CROSS SECTIONAL AREA	A=	42.68	42.68	42.68	42.68
EQUATION, K = QL/AHT	K=	**4.0E-04**	**4.1E-04**	**4.1E-04**	**4.3E-04**

4.1E-04 AVERAGE CENTIMETERS PER SECOND

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615-350-8124

CLIENT **ELAB**

PROJECT **TERRA TECH** PROJ. NO. **07-5492**

SATURATED HYDRAULIC CONDUCTIVITY

TEST DESCRIPTION:
EPA 9100, SECTION 2.8, TRIAXIAL CELL METHOD WITH BACKPRESSURE
ASTM D5084 - 90, MEASUREMENT OF HYDRAULIC CONDUCTIVITY

LOCATION **05ST0201**
DESCRIPTION **SAND, DARK GREYISH BROWN**
LAB ID **ST 1860**
TYPE SAMPLE **SHELBY TUBE**

SAMPLE INFORMATION:		TEST INFORMATION:	
LENGTH	7.4 cm	TEST DATE	5/31/2007
WEIGHT	570.0 grams	TOTAL BACKPRESSURE	80 psi
CROSS SECTIONAL AREA	40.74 cmsq	CELL PRESSURE	85 psi
MOISTURE OF SAMPLE	8.0%	HEAD PRESSURE	83 psi
DENSITY	108.6 pcf	CONSOLIDATION STRESS:	
	1.74 g/cu cm	MAXIMUM	5 psi
PERMEANT:	WATER	MINIMUM	2 psi

		READING 1	READING 2	READING 3	READING 4
LAPSED TIME(in seconds)	T=	10	10	10	10
INITIAL READING,influent liquid		18.0	22.1	26.2	30.2
INITIAL READING,effluent liquid		24.3	20.3	16.2	12.1
END READING, influent liquid		22.1	26.2	30.2	34.2
END READING, effluent liquid		20.3	16.2	12.1	8.1
TOTAL CUBIC CENTIMETERS	Q=	4.1	4.1	4.0	4.0
LENGTH OF SAMPLE	L=	7.4	7.4	7.4	7.4
LOSS OF HEAD	H=	213.2	205.0	196.8	188.8
CROSS SECTIONAL AREA	A=	40.74	40.74	40.74	40.74
EQUATION, K = QL/AHT	K=	**3.5E-04**	**3.7E-04**	**3.7E-04**	**3.9E-04**

3.7E-04 AVERAGE CENTIMETERS PER SECOND

BEAVER ENGINEERING, INC.
7378 COCKRILL BEND BLVD.
NASHVILLE, TENNESSEE 37209
615-350-8124

CLIENT **ELAB**

PROJECT **TERRA TECH** PROJ. NO. **07-5492**

SATURATED HYDRAULIC CONDUCTIVITY

TEST DESCRIPTION:
EPA 9100, SECTION 2.8, TRIAXIAL CELL METHOD WITH BACKPRESSURE
ASTM D5084 - 90, MEASUREMENT OF HYDRAULIC CONDUCTIVITY

LOCATION **05ST0301**
DESCRIPTION **SAND, DARK GREYISH BROWN**
LAB ID **ST 1861**
TYPE SAMPLE **SHELBY TUBE**

SAMPLE INFORMATION:		TEST INFORMATION:	
LENGTH	6.9 cm	TEST DATE	5/31/2007
WEIGHT	605.1 grams	TOTAL BACKPRESSURE	80 psi
CROSS SECTIONAL AREA	43.62 cmsq	CELL PRESSURE	85 psi
MOISTURE OF SAMPLE	7.1%	HEAD PRESSURE	83 psi
DENSITY	116.8 pcf	CONSOLIDATION STRESS:	
	1.87 g/cu cm	MAXIMUM	5 psi
PERMEANT:	WATER	MINIMUM	2 psi

		READING 1	READING 2	READING 3	READING 4
LAPSED TIME(in seconds)	T=	20	20	20	20
INITIAL READING,influent liquid		7.8	9.8	11.8	13.8
INITIAL READING,effluent liquid		25.6	23.6	21.6	19.6
END READING, influent liquid		9.8	11.8	13.8	15.8
END READING, effluent liquid		23.6	21.6	19.6	17.6
TOTAL CUBIC CENTIMETERS	Q=	2.0	2.0	2.0	2.0
LENGTH OF SAMPLE	L=	6.9	6.9	6.9	6.9
LOSS OF HEAD	H=	226.7	222.7	218.7	214.7
CROSS SECTIONAL AREA	A=	43.62	43.62	43.62	43.62
EQUATION, K = QL/AHT	K=	**7.0E-05**	**7.1E-05**	**7.3E-05**	**7.4E-05**

7.2E-05 AVERAGE CENTIMETERS PER SECOND

Landfill Gas Measurements

Site Information	
Site Name	NCBC Gulfport Site 5
Project	CTO 00068 - Landfill Evaluation
Project Number	112G00703
Date	5/18/2007
Personnel	W.D. Olson/J. Halfhill

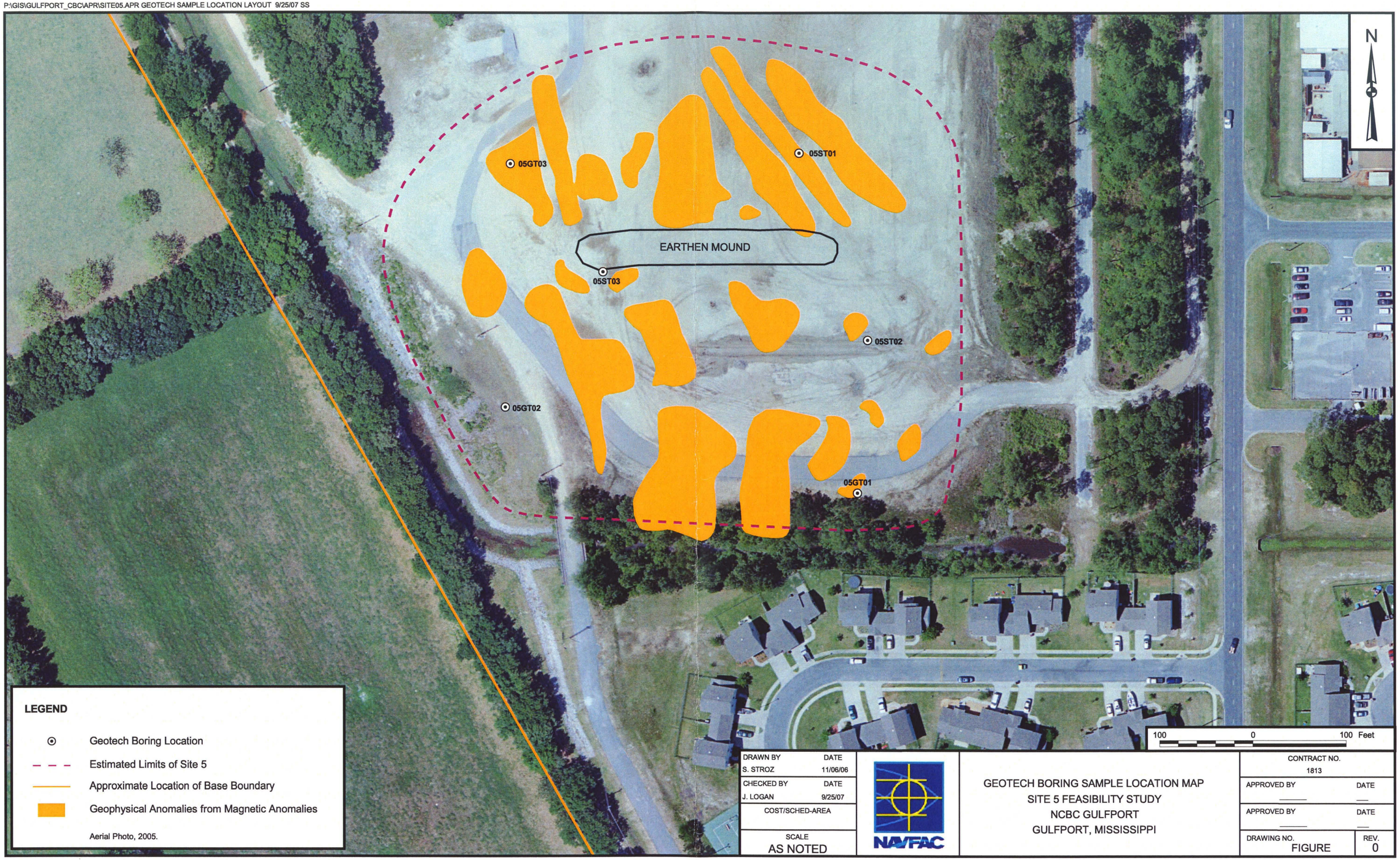
Well Information	
Name	GPT-05-12
Install Date	
Northing	317656.74
Easting	887813.97
GS_Elev	29.72
TOC_Elev	
Inside Diameter	2 inch
Total Depth	15.11 ft
Depth - Water	8.48 ft
Depth - top of screen	5 ft
Screen length	10 ft

Monitoring Instrument	
Model	GEM 2000
Serial Number	7757

Comments

Test Data	Time	Elapsed	CH_4 (%)	CH_4 LEL	CO_2 (%)	O_2 (%)
		BKG	0.0	0.0	0.0	21.5
		5 min.	37.1	>100	29.3	3.7
		10 min.	46.7	>100	37.6	<0.0

P:\GIS\GULFPORT_CBC\APR\SITE05.APR GEOTECH SAMPLE LOCATION LAYOUT 9/25/07 SS



DRAWN BY S. STROZ	DATE 11/06/06	GEOTECH BORING SAMPLE LOCATION MAP SITE 5 FEASIBILITY STUDY NCBC GULFPORT GULFPORT, MISSISSIPPI	CONTRACT NO. 1813
CHECKED BY J. LOGAN	DATE 9/25/07		APPROVED BY ____ DATE ____
COST/SCHED-AREA			APPROVED BY ____ DATE ____
SCALE AS NOTED			DRAWING NO. FIGURE / REV. 0

NAVFAC

APPENDIX B

CALCULATIONS

Landfill Dimensions

Tetra Tech NUS			*STANDARD CALCULATION SHEET*
CLIENT: NAVFAC SE	FILE No:	BY:	PAGE: 1 of 2
SUBJECT: NCBC Gulfport – Site 5 – Area and volume		CHECKED BY: 5/28/08	DATE: 9/24/07

Purpose: Calculate area and volumes related to Site 5.

1. AREA

Calculate area using planimeter and Figure 1-2 from RI (as provide on page 2 of 2).

Area = 26.7 in^2

At scale of 1 inch = 100 feet:

Area = 26.7 in^2 x 100^2 $feet^2$/1 in^2 = 267,000 ft^2

= 6.129 acres, say 6.2 acres

Using as estimated thickness of existing cover of 4 feet, the volume of cover is:

Vcover = 267,000 ft^2 x 4 feet = 1,068,000 ft^3 = 39,555 yd^3

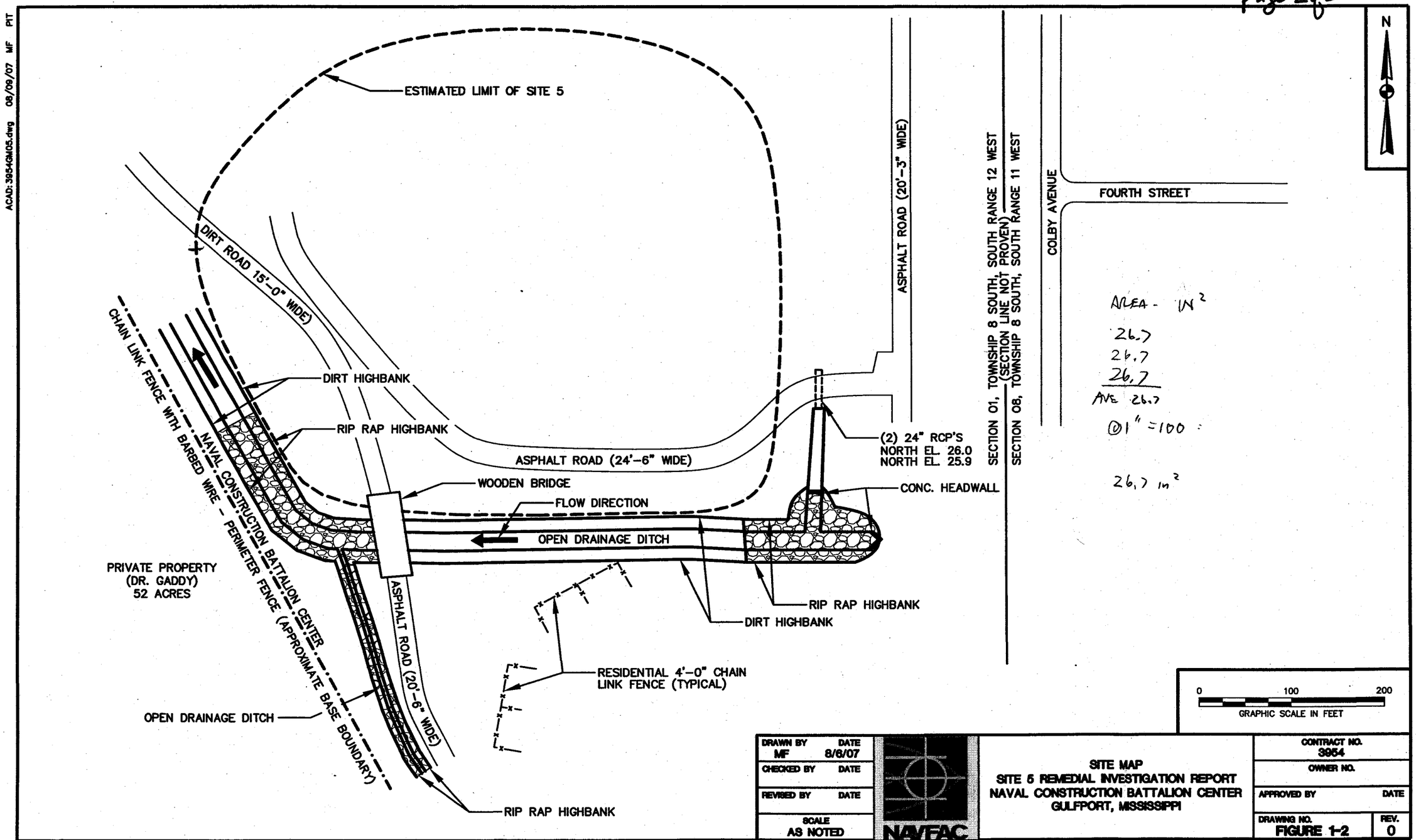
The bottom of the waste is uncertain and is assumed to be the groundwater table. The typical depth to groundwater is about 8 feet below ground surface, so the estimated waste volume (ignoring the space between cells) is:

Vwaste = 267,000 ft^2 x (8-4) feet = 1,068,000 ft^3 = 39,555 yd^3

Area Calculations

Page 2 of 2

ACAD:3954GM05.dwg 08/09/07 MF PIT



AREA - IN²
26.7
26.7
26.7
AVE 26.7
@1" = 100 :
26.7 in²

DRAWN BY MF	DATE 8/6/07	SITE MAP SITE 5 REMEDIAL INVESTIGATION REPORT NAVAL CONSTRUCTION BATTALION CENTER GULFPORT, MISSISSIPPI	CONTRACT NO. 3954
CHECKED BY	DATE		OWNER NO.
REVISED BY	DATE		APPROVED BY / DATE
SCALE AS NOTED		NAVFAC	DRAWING NO. FIGURE 1-2 / REV. 0

FORM CADD NO. SDIV-BH.DWG - REV 1 - 9/10/98

Excavation Cost Estimates

Tetra Tech NUS			STANDARD CALCULATION SHEET
CLIENT: SE DIV	FILE No:	BY:	PAGE: 1 of 2
SUBJECT: NCBC Gulfport – Site 5 – Order of magnitude cost estimate for excavation options		CHECKED BY: 5/28/08	DATE: 5/22/08

Purpose: Estimate order of magnitude cost for two excavation options for the Detailed Screening portion of the FS. The two options are Excavation and Off-Site Disposal, and Excavation, On-site Treatment, and Onsite Disposal.

1. Excavation and Off-Site Disposal

Estimate cost of excavation and disposal using typical unit costs.

Typical disposal cost of nonhazardous waste is 50 $/ton. At 1.3 ton/cubic yard (cy), the cost on a unit cost basis is:

50 $/ton x 1.3 ton/cy = 65 $/cy

Typical excavation cost is 20 $/cy.

Typical clean backfill cost is 20 $/cy.

Typical analytical costs are 5 $/cy.

In addition, a 30% is applied for design, planning, sampling, permitting and contingency.

The total unit cost is:

(65 + 20 + 20 + 5) x 1.3 = 143 $/cy, round to 150 $/cy.

The total volume is 6.2 acres and 8 feet deep

Cost = 6.2 acre x 43,560 ft^2/acre x 8 ft x cy/27 ft^3 x 150 $/cy = $12,000,000

2. Excavation, On-site Treatment, and Onsite Disposal

Estimate cost of excavation, treatment, and disposal using typical unit costs.

Because the COC is dioxin, the assumed treatment is incineration. Typical onsite treatment cost for incineration is waste is 200 $/cy. At 1.3 ton/cubic yard (cy), the cost on a unit cost basis is:

Typical excavation cost is 20 $/cy.

Typical backfilling cost is 10 $/cy.

Typical analytical costs are 5 $/cy.

In addition, a 30% is applied for design, planning, sampling, permitting and contingency.

The total unit cost is:

(200 + 20 + 10 + 5) x 1.3 = 305 $/cy.

Tetra Tech NUS			*STANDARD CALCULATION SHEET*
CLIENT: SE DIV	FILE No:	BY:	PAGE: 2 of 2
SUBJECT: NCBC Gulfport – Site 5 – Order of magnitude cost estimate for excavation options		CHECKED BY: TNA 5/28/08	DATE: 5/22/08

The total volume is 6.2 acres and 8 feet deep

Cost = 6.2 acre x 43,560 ft^2/acre x 8 ft x cy/27 ft^3 x 305 $/cy = $24,000,000

Landfill Gas Volume Estimate

GULFPORT
SITE 5
LANDFILL GAS ESTIMATE
9/14/07

Several methods were used to estimate the quantity of landfill gas and the electricity generation for the Site 5 landfill gas. According to online references, there is no good way to directly calculate the amount of gas, but there are several methods to make an estimate. EPA has a spreadsheet model for the calculation (LANDgem). The model requires a relatively large amount of data entry and was not used. Alternative ways of estimating the power and gas suggest that the model would be of limited value.

1. A University of Central Florida (UCF) website included a powerpoint presentation with several generalized factors for estimating landfill gas generation. According to this source, under average conditions:

Gas rate, cubic feet (cf)/ day = Tons of waste in place x 0.5

A waste density of 1,200 lb/cubic yard (cy) is assumed.

Existing information says that there is 6,000 cy waste disposed of at Site 5.

6,000 cy x 1,200 lb/cy x Ton/2,000 lb = 3,600 ton

Gas rate = 3,600 ton x 0.5 = 1,800 cf/day

Per UCF, even with a cap, a capture efficiency of 90% is assumed, so the available gas is:

Gas available = 1,800 x 0.9 = 1,600 cf/day

The heating value is uncertain, so a typical value of 500 BTU/CF higher heating value (HHV) is assumed. A typical lower heating value (LHV) of 90% of the HHV is also assumed. The heat that is potentially available for recovery (Q), then is:

Q = 1,600 cf/day x 500 BTU (HHV)/CF x 0.9 LHV/HHV = 720,000 BTU/day

Convert this to kilowatts (100% efficiency conversion to electricity)

720,000 BTU/day x 1 kw-hr/3,413 BTU x day/24 hour = 8.8 kw

Assuming that a microturbine efficiency is 30 % (per Capstone information)

0.3 x 8.8 = 2.6 kw

This is much less than the smallest Capstone microturbine (30 kw) or Ingersoll-Rand microturbine (70 kw).

2. In the Capstone case study literature, there is an example (RMT case study) of a landfill with 2,000,000 tons of waste providing 360 kw. Using this proportion:

360 kw/2,000,000 ton = X/3,600 ton

X = 0.6 kw

3. At an EPA website, there is a comprehensive database spreadsheet of landfills that generate electricity from landfill gas. The data base includes information, such as tons in place, power generated, and power technology-type. There were 14 landfills listed as using microturbines. The ratio of power to waste was calculated for each. The extremely high and extremely low ratios were ignored and an average of 120 kw/1,000,000 tons of waste was calculated.

Using this ratio, the estimated power that could be generated:

120 kw/1,000,000 ton x 3,600 ton = 0.4 kw

These three estimates are far below the smallest Capstone microturbine (30 kw) or Ingersoll-Rand microturbine (70 kw).

Finally, an EPA publication "Turning a Liability into an Asset: A Landfill Gas-to-Energy project Development Handbook" (EPA-430-B-96-004) (September 1996) includes a simplistic screening tool to determine if a landfill gas to electricity project is appropriate for a given site. The screening tool consists of a few questions about the mass of waste, depth of waste, and time since landfill closure. Points are assigned based on the response to each question. The points are summed and the total is compared to criteria in the screening tool. For Site 5, the score is -145 [negative 145]. If the score is less than 20, then the landfill "may not be a good candidate for conventional energy recovery options..."

This result, in conjunction with the estimates above, strongly suggests that microturbines are not applicable to this site.

(University of Central Florida)

MSW, CECS, UCF. EDU/Gas.ppt

Estimating Landfill Gas Production Rates - Gas Generation

- Minimum: Tons in place x 0.25= ft^3/d
- Average: Tons in place x 0.5 = ft^3/d
- Maximum: Tons in place x 1.0 = ft^3/d

Tons in place = Average Depth X Acres x 1000

(Assumes 1200 lb/yd^3)

MSW Learning Tool

Estimating Landfill Gas Production Rates - Collection

No Cap:

- Minimum: LFG x 0.25
- Average: LFG x 0.50
- Maximum: LFG x 0.75

Cap:

- LFG x (0.8 - 0.9)

MSW Learning Tool

From EPA "Turning a Liability into an Asset"
EPA 430-B-96-004

Box 2-1 Is a Project Right for Your Landfill?

A. Is your landfill a municipal solid waste landfill? Yes

If not, you may encounter some additional issues in project development due to the presence of hazardous or non-organic waste in the landfill. Stop and consult an energy recovery expert.

B. Add your score for the next 3 questions:

$6{,}000\ yd \times \frac{1200\ lb}{yd^3} \times \frac{t}{2000\ lb} = 3600T$

1. How much waste is in your landfill? **Score**

Tons	Score
≥ 3 million	40
1-3 million	30
0.75-1 million	20
< 0.75 million	10

10

2. Is your fill area at least 40 feet deep?
   Yes = 5
   No = 0

+ 0

3. Is your landfill currently open? If yes, answer 3(a). If no, answer 3(b).

   (a) How much waste will be received in the next 10 years?
   For each 500,000 ton, score 5 points. + –

   (b) If closed < 1 year, enter 0. 2007 − 1976 = 31
   If closed ≥ 1 year, multiply each year since closure by 5, and subtract that amount from the total. 31 × 5 = 155 − 155

Closed 1976

Total your answers to questions 1-3: = −145

C. If your score is:

≥ 30: Your landfill is a good candidate for energy recovery (go to section D).

20-30: Your landfill may be a good candidate for energy recovery, particularly if a factory or other energy user with constant fuel demand is located within a few miles of the landfill (go to Section D).

< 20: Your landfill may not be a good candidate for conventional energy recovery options. However, you may want to consider on-site or alternative uses for the landfill gas.

D. If your landfill is a good candidate, answer the following questions:

1. Are you now collecting gas at your landfill (other than from perimeter wells), or do you plan to do so soon for regulatory or other reasons? If yes, your landfill may be an excellent candidate for energy recovery.

2. (a) Is annual rainfall less than or equal to 25 inches per year?
   (b) Is construction and demolition waste mixed into the municipal waste or is it a large portion of total waste?

   If yes to questions D.2(a) or D.2(b), your annual landfill gas production may be lower than otherwise expected. Your landfill may still be a strong candidate, but you may want to lower your estimated gas volumes slightly during project design and evaluation.

Landfill Gas Concentration Estimate at Site Boundary

GULFPORT LANDFILL
SCREENING AIR DISPERSION MODEL STUDY
FOR METHANE GAS EMISSIONS

1.0 Introduction

A screening air dispersion modeling analysis was conducted to assess the impact of methane gas emissions from a closed municipal waste landfill located in Gulfport, Mississippi. Emissions of methane gas were assumed to be released through a passive vent stack located within the landfill boundary. The TSCREEN model was used to determine potential maximum ambient air concentrations at 100 feet and 300 from the vent stack. The gas released through the vent stack was assumed to contain 50 percent methane and 50 percent carbon dioxide by volume.

2.0 TSCREEN Model

TSCREEN (A Model of Screening Toxic Air Pollutant Concentrations) is designed to analyze toxic emissions and their subsequent dispersion from one of many different types of possible releases. Four different transport/dispersion models are included to account for a variety of release configurations including point and area sources, neutrally buoyant and heavier-than-air, instantaneous and continuous. TSCREEN can also account for building downwash. TSCREEN calculates maximum ambient air concentrations at user define receptor locations from the source on the basis of worst case meteorological conditions.

The model input parameters assumed in this analysis for the vent stack are shown in Table 1. Building downwash was considered due to the presence of a nearby storage building.

TABLE 1
LANDFILL VENT SOURCE PARAMETERS

Methane Emission Rate (grams/second)	235
Stack Height (meters)	2.44
Stack Inside Diameter (meters)	0.41
Stack Exit Velocity	6.6
Stack Gas Exit Temperature (°Kelvin)	293°
Ambient Air Temperature (°Kelvin)	293°
Receptor Distances from Vent Stack (meters)	31 and 100
Local Terrain Conditions	Flat
Local Environment	Urban
Nearby Building Dimensions (meters)	Height = 13; Length = 37; Width = 37

3.0 Modeling Results

Results of the TSCREEN modeling analysis are shown in Table 2 for receptor distances of 31 and 92 meters, as well as, the location of the maximum methane air concentration (40 meters). Ambient methane concentrations are given in parts per million. TSCREEN model output is presented in Attachment 1.

TABLE 2
TSCREEN MODELING RESULTS FOR
METHANE AIR CONCENTRATIONS (ppm)

Receptor Distance (meters)	15-minute Methane Concentration (ppm)	8-hour Methane Concentration (ppm)
40[b]	862	654
31	0[a]	0[a]
92	406	214

a - Plume has not yet reached ground level.
b - Location of maximum methane air concentration

ATTACHMENT 1

GULFPORT LANDFILL

TSCREEN MODEL OUTPUT

09/26/07
16:12:48

```
 ***  SCREEN3 MODEL RUN  ***
 *** VERSION DATED 95250 ***

Gulfport Landfill - Scenario 2 Urban

SIMPLE TERRAIN INPUTS:
   SOURCE TYPE            =        POINT
   EMISSION RATE (G/S)    =      235.350
   STACK HEIGHT (M)       =       2.4400
   STK INSIDE DIAM (M)    =        .4100
   STK EXIT VELOCITY (M/S)=       6.6000
   STK GAS EXIT TEMP (K)  =     293.0000
   AMBIENT AIR TEMP (K)   =     293.0000
   RECEPTOR HEIGHT (M)    =        .0000
   URBAN/RURAL OPTION     =        URBAN
   BUILDING HEIGHT (M)    =      13.0000
   MIN HORIZ BLDG DIM (M) =      37.0000
   MAX HORIZ BLDG DIM (M) =      37.0000


     ***************************************
     *** SUMMARY OF SCREEN MODEL RESULTS ***
     ***************************************

 CALCULATION         MAX CONC       MAX CONC     DIST TO   TERRAIN
  PROCEDURE         (UG/M**3)        (PPM)       MAX (M)    HT (M)
--------------    -----------    -----------    -------   -------
SIMPLE TERRAIN    .4268E+06        653.5375     40.       0.

BLDG. CAVITY-2    .3262E+06      38.       --  (DIST = CAVITY LENGTH)


***************************************************
** REMEMBER TO INCLUDE BACKGROUND CONCENTRATIONS **
***************************************************


BUOY. FLUX =      .000 M**4/S**3;  MOM. FLUX =    1.831 M**4/S**2.
```

*** FULL METEOROLOGY ***

****
*** SCREEN AUTOMATED DISTANCES ***
****

*** TERRAIN HEIGHT OF 0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

DIST (M)	CONC (UG/M**3)	STAB	U10M (M/S)	USTK (M/S)	MIX HT (M)	PLUME HT (M)	SIGMA Y (M)	SIGMA Z (M)	DWASH
31.	.0000	0	.0	.0	.0	.00	.00	.00	NA
100.	.2486E+06	5	1.0	1.0	10000.0	2.62	22.40	13.19	SS
200.	.1187E+06	5	1.0	1.0	10000.0	2.62	31.77	19.68	SS
300.	.7174E+05	5	1.0	1.0	10000.0	2.62	41.42	25.07	SS
400.	.4896E+05	5	1.0	1.0	10000.0	2.62	50.76	30.03	SS
500.	.3607E+05	5	1.0	1.0	10000.0	2.62	59.80	34.63	SS
600.	.2800E+05	5	1.0	1.0	10000.0	2.62	68.58	38.93	SS
700.	.2257E+05	5	1.0	1.0	10000.0	2.62	77.10	42.98	SS
800.	.1872E+05	5	1.0	1.0	10000.0	2.62	85.38	46.80	SS
900.	.1587E+05	5	1.0	1.0	10000.0	2.62	93.44	50.44	SS
1000.	.1370E+05	5	1.0	1.0	10000.0	2.62	101.30	53.91	SS
1100.	.1200E+05	5	1.0	1.0	10000.0	2.62	108.96	57.23	SS
1200.	.1064E+05	5	1.0	1.0	10000.0	2.62	116.43	60.41	SS
1300.	9530.	5	1.0	1.0	10000.0	2.62	123.73	63.48	SS
1400.	8610.	5	1.0	1.0	10000.0	2.62	130.87	66.44	SS
1500.	7837.	5	1.0	1.0	10000.0	2.62	137.85	69.29	SS
1600.	7181.	5	1.0	1.0	10000.0	2.62	144.68	72.06	SS
1700.	6617.	5	1.0	1.0	10000.0	2.62	151.37	74.75	SS
1800.	6129.	5	1.0	1.0	10000.0	2.62	157.93	77.35	SS
1900.	5702.	5	1.0	1.0	10000.0	2.62	164.36	79.89	SS
2000.	5327.	5	1.0	1.0	10000.0	2.62	170.67	82.36	SS
2100.	4994.	5	1.0	1.0	10000.0	2.62	176.86	84.77	SS
2200.	4698.	5	1.0	1.0	10000.0	2.62	182.95	87.12	SS
2300.	4432.	5	1.0	1.0	10000.0	2.62	188.93	89.42	SS
2400.	4193.	5	1.0	1.0	10000.0	2.62	194.80	91.67	SS
2500.	3977.	5	1.0	1.0	10000.0	2.62	200.58	93.87	SS
2600.	3781.	5	1.0	1.0	10000.0	2.62	206.27	96.02	SS
2700.	3602.	5	1.0	1.0	10000.0	2.62	211.87	98.14	SS
2800.	3438.	5	1.0	1.0	10000.0	2.62	217.38	100.21	SS
2900.	3287.	5	1.0	1.0	10000.0	2.62	222.81	102.25	SS
3000.	3149.	5	1.0	1.0	10000.0	2.62	228.16	104.25	SS
3500.	2594.	5	1.0	1.0	10000.0	2.62	253.81	113.76	SS
4000.	2199.	5	1.0	1.0	10000.0	2.62	277.85	122.59	SS
4500.	1905.	5	1.0	1.0	10000.0	2.62	300.52	130.86	SS
5000.	1678.	5	1.0	1.0	10000.0	2.62	322.01	138.66	SS
5500.	1497.	5	1.0	1.0	10000.0	2.62	342.46	146.06	SS
6000.	1351.	5	1.0	1.0	10000.0	2.62	362.01	153.11	SS
6500.	1231.	5	1.0	1.0	10000.0	2.62	380.75	159.87	SS
7000.	1129.	5	1.0	1.0	10000.0	2.62	398.76	166.36	SS
7500.	1043.	5	1.0	1.0	10000.0	2.62	416.13	172.61	SS
8000.	968.6	5	1.0	1.0	10000.0	2.62	432.91	178.64	SS
8500.	904.0	5	1.0	1.0	10000.0	2.62	449.14	184.49	SS
9000.	847.4	5	1.0	1.0	10000.0	2.62	464.89	190.15	SS
9500.	797.3	5	1.0	1.0	10000.0	2.62	480.18	195.66	SS
10000.	752.7	5	1.0	1.0	10000.0	2.62	495.05	201.01	SS
15000.	481.7	5	1.0	1.0	10000.0	2.62	626.15	248.36	SS
20000.	353.6	5	1.0	1.0	10000.0	2.62	735.49	288.08	SS
25000.	279.1	5	1.0	1.0	10000.0	2.62	831.07	322.96	SS
30000.	230.5	5	1.0	1.0	10000.0	2.62	916.99	354.44	SS
40000.	188.9	4	1.0	1.0	320.0	2.62	1552.84	1553.16	SS
50000.	168.0	4	1.0	1.0	320.0	2.62	1746.29	1750.00	SS

```
MAXIMUM 1-HR CONCENTRATION AT OR BEYOND    31. M:
     40.   .4268E+06    3     1.0    1.0   320.0    2.62   18.45    9.23    SS

  DIST    = DISTANCE FROM THE SOURCE
  CONC    = MAXIMUM GROUND LEVEL CONCENTRATION
  STAB    = ATMOSPHERIC STABILITY CLASS (1=A, 2=B, 3=C, 4=D, 5=E, 6=F)
  U10M    = WIND SPEED AT THE 10-M LEVEL
  USTK    = WIND SPEED AT STACK HEIGHT
  MIX HT  = MIXING HEIGHT
  PLUME HT= PLUME CENTERLINE HEIGHT
  SIGMA Y = LATERAL DISPERSION PARAMETER
  SIGMA Z = VERTICAL DISPERSION PARAMETER
  DWASH   = BUILDING DOWNWASH:
            DWASH=   MEANS NO CALC MADE (CONC = 0.0)
            DWASH=NO MEANS NO BUILDING DOWNWASH USED
            DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
            DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
            DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

 **********************************
 *** SCREEN DISCRETE DISTANCES ***
 **********************************

 *** TERRAIN HEIGHT OF    0. M ABOVE STACK BASE USED FOR FOLLOWING DISTANCES ***

   DIST     CONC              U10M   USTK  MIX HT   PLUME   SIGMA   SIGMA
    (M)   (UG/M**3)   STAB   (M/S)  (M/S)    (M)    HT (M)   Y (M)   Z (M)  DWASH
 -------  ----------  ----  -----  -----  ------  ------  ------  ------  -----
     31.   .0000        0      .0     .0      .0     .00     .00     .00    NA
     92.   .2651E+06    5     1.0    1.0 10000.0    2.62   21.87   12.65    SS

  DWASH=   MEANS NO CALC MADE (CONC = 0.0)
  DWASH=NO MEANS NO BUILDING DOWNWASH USED
  DWASH=HS MEANS HUBER-SNYDER DOWNWASH USED
  DWASH=SS MEANS SCHULMAN-SCIRE DOWNWASH USED
  DWASH=NA MEANS DOWNWASH NOT APPLICABLE, X<3*LB

  *** CAVITY CALCULATION - 1 ***       *** CAVITY CALCULATION - 2 ***
   CONC (UG/M**3)      =    .3262E+06    CONC (UG/M**3)      =    .3262E+06
   CRIT WS @10M (M/S)  =     1.00        CRIT WS @10M (M/S)  =     1.00
   CRIT WS @ HS (M/S)  =     1.00        CRIT WS @ HS (M/S)  =     1.00
   DILUTION WS (M/S)   =     1.00        DILUTION WS (M/S)   =     1.00
   CAVITY HT (M)       =    13.51        CAVITY HT (M)       =    13.51
   CAVITY LENGTH (M)   =    37.83        CAVITY LENGTH (M)   =    37.83
   ALONGWIND DIM (M)   =    37.00        ALONGWIND DIM (M)   =    37.00


****************************************
*** USER SPECIFIED AVERAGING TIMES ***
****************************************

ESTIMATED MAXIMUM CONCENTRATION FOR 15 MIN AVERAGING TIME:
563166 UG/M**3   862.3479 PPM

ESTIMATED MAXIMUM CONCENTRATION FOR 30 MIN AVERAGING TIME:
426800 UG/M**3   653.5375 PPM

ESTIMATED MAXIMUM CONCENTRATION FOR 3 HR AVERAGING TIME:
384120 (+/- 42680) UG/M**3   588.1838 (+/- 65.35375) PPM

ESTIMATED MAXIMUM CONCENTRATION FOR 8 HR AVERAGING TIME:
298760 (+/- 85360) UG/M**3   457.4763 (+/- 130.7075) PPM
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ESTIMATED MAXIMUM CONCENTRATION FOR 24 HR AVERAGING TIME:
170720 (+/- 85360) UG/M**3   261.415 (+/- 130.7075) PPM

ESTIMATED MAXIMUM CONCENTRATION FOR ANNUAL AVERAGING TIME:
34144 (+/- 8536) UG/M**3   52.283 (+/- 13.07075) PPM


***********************************
*** END OF SCREEN MODEL OUTPUT ***
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APPENDIX C

COST ESTIMATES

Alternative 2

NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI
Site 5
Alternative 2: Cap, Ditch Lining, LUCs and Monitoring
Capital Cost

	Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1	**PROJECT PLANNING**											
1.1	Prepare Construction/Work Plans	300	hr			$35.00		$0	$0	$10,500	$0	$10,500
2	**MOBILIZATION, DEMOBILIZATION AND FIELD SUPPORT**											
2.1	Office Trailer	9	mo				$375.00	$0	$0	$0	$3,375	$3,375
2.2	Field Office Support	9	mo		$150.00			$0	$1,350	$0	$0	$1,350
2.3	Storage Trailer (2)	18	mo				$101.00	$0	$0	$0	$1,818	$1,818
2.4	Utility Connection/Disconnection (phone/electric)	1	ls	$1,500.00				$1,500	$0	$0	$0	$1,500
2.5	Site Utilities	9	mo	$150.00				$1,350	$0	$0	$0	$1,350
2.6	Underground Utility Clearances	1	ls	$9,000.00				$9,000	$0	$0	$0	$9,000
2.7	Construction Survey Support	50	day	$935.00				$46,750	$0	$0	$0	$46,750
2.8	Equipment Mobilization/Demobilization	10	ea			$158.00	$384.00	$0	$0	$1,580	$3,840	$5,420
2.9	Site Superintendent	180	day			$355.00		$0	$0	$63,900	$0	$63,900
2.10	Site Health & Safety and QA/QC	180	day			$325.00		$0	$0	$58,500	$0	$58,500
3	**DECONTAMINATION**											
3.1	Decontamination Services	3	mo		$1,100.00	$2,025.00	$1,400.00	$0	$3,300	$6,075	$4,200	$13,575
3.2	Equipment Decon Pad	1	ls		$3,500.00	$3,000.00	$425.00	$0	$3,500	$3,000	$425	$6,925
3.3	Decon Water	3,000	gal		$0.20			$0	$600	$0	$0	$600
3.4	Decon Water Storage Tank, 6,000 gallon	3	mo				$704.00	$0	$0	$0	$2,112	$2,112
3.5	Clean Water Storage Tank, 4,000 gallon	3	mo				$633.00	$0	$0	$0	$1,899	$1,899
3.6	Disposal of Decon Waste (liquid & solid)	3	mo	$950.00				$2,850	$0	$0	$0	$2,850
4	**EXCAVATION AND COVER**											
4.1	Dozer, 140 hp	20	day			$318.40	$611.40	$0	$0	$6,368	$12,228	$18,596
4.2	Excavator, 2 cy	20	day			$318.40	$994.60	$0	$0	$6,368	$19,892	$26,260
4.3	Front End Loader, 3 to 4.5 cy	20	day			$318.40	$488.00	$0	$0	$6,368	$9,760	$16,128
4.4	Compactor, 125 h.p. (2 each)	40	day			$318.40	$565.60	$0	$0	$12,736	$22,624	$35,360
4.5	Site Labor, (3 laborers)	20	day			$690.00		$0	$0	$13,800	$0	$13,800
4.6	Ditch Dredging, Gradall	15	day			$318.40	$905.80	$0	$0	$4,776	$13,587	$18,363
4.7	Site Labor, (3 laborers)	15	day			$690.00		$0	$0	$10,350	$0	$10,350
4.8	Gas Vent Pipes, 4" dia. perforated PE	6,000	lf		$0.90			$0	$5,400	$0	$0	$5,400
4.9	Gas Vent Pipes, 6" dia. header PE	700	lf		$2.60			$0	$1,820	$0	$0	$1,820
4.10	Trench for Pipe	12	day				$51.00	$0	$0	$0	$612	$612
4.11	Site Labor, (3 laborers)	12	day			$690.00		$0	$0	$8,280	$0	$8,280
4.12	Geosynthetic Clay Liner, GCL	316,000	sf	$0.87				$274,920	$0	$0	$0	$274,920
5	**SITE RESTORATION**											
5.1	Upper Layer, sand/gravel	23,000	cy		$12.00			$0	$276,000	$0	$0	$276,000
5.2	Dozer, 140 hp (2 each)	60	day			$318.40	$611.40	$0	$0	$19,104	$36,684	$55,788
5.3	Compactor, 125 h.p. (2 each)	60	day			$318.40	$565.60	$0	$0	$19,104	$33,936	$53,040
5.4	Site Labor, (3 laborers)	30	day			$690.00		$0	$0	$20,700	$0	$20,700
5.5	Vent Layer, sand/gravel	7,000	cy		$12.00			$0	$84,000	$0	$0	$84,000
5.6	Dozer, 140 hp (2 each)	44	day			$318.40	$611.40	$0	$0	$14,010	$26,902	$40,911
5.7	Compactor, 125 h.p. (2 each)	44	day			$318.40	$565.60	$0	$0	$14,010	$24,886	$38,896
5.8	Site Labor, (3 laborers)	22	day			$690.00		$0	$0	$15,180	$0	$15,180
5.9	Drainage Pipe, 4" dia. perforated PE	6,000	lf		$2.19			$0	$13,140	$0	$0	$13,140
5.10	Trench for Pipe	10	day				$51.00	$0	$0	$0	$510	$510
5.11	Site Labor, (3 laborers)	10	day			$690.00		$0	$0	$6,900	$0	$6,900
5.12	Topsoil (loam)	5,900	cy		$24.93			$0	$147,087	$0	$0	$147,087
5.13	Dozer, 140 hp (2 each)	36	day			$318.40	$611.40	$0	$0	$11,462	$22,010	$33,473
5.14	Site Labor, (3 laborers)	18	day			$690.00		$0	$0	$12,420	$0	$12,420
5.15	Seeding Disturbed Areas	348	msf	$71.00				$24,708	$0	$0	$0	$24,708
5.16	Ditch Lining, riprap/concrete	2,900	sy		$60.50	$22.00	$9.25	$0	$175,450	$63,800	$26,825	$266,075
5.17	Water Supply Pipe, 2" PCV	800	lf		$1.17			$0	$936	$0	$0	$936
5.18	Trench for Pipe	2	day				$51.00	$0	$0	$0	$102	$102

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
5.19 Site Labor, (3 laborers)	2	day			$690.00		$0	$0	$1,380	$0	$1,380
5.20 Water Valves	3	ea		$425.00	$300.00	$200.00	$0	$1,275	$900	$600	$2,775
5.21 Backflow Preventer, 2"	1	ea		$283.00			$0	$283	$0	$0	$283
5.22 Irrigation System, 60' dia. coverage	27	ea	$200.00				$5,400	$0	$0	$0	$5,400
5.23 Fence, 8' high	2,000	lf	$44.00				$88,000	$0	$0	$0	$88,000
5.24 Fence Gates	4	ea	$2,350.00				$9,400	$0	$0	$0	$9,400
5.25 Relocate Power Poles	2	ea		$265.00	$432.80	$81.70	$0	$530	$866	$163	$1,559
5.26 Gravel Road, 6" gravel	1,200	sy		$8.90	$0.48	$0.63	$0	$10,680	$576	$756	$12,012
5.27 Vent Stack, 10' high	1	ea		$381.00	$690.00	$300.00	$0	$381	$690	$300	$1,371
6 MONITORING WELL INSTALLATION											
6.1 Well Installation & Development (5 wells, PVC)	125	lf	$80.00				$10,000	$0	$0	$0	$10,000
6.2 Gas Well Installation & Development (8 wells, PVC)	80	lf	$75.00				$6,000	$0	$0	$0	$6,000
6.3 Protective Well Casing & Apron	13	ea	$750.00				$9,750	$0	$0	$0	$9,750
6.4 Abandon PVC Wells (10 wells)	300	lf	$10.00				$3,000	$0	$0	$0	$3,000
6.5 IDW Transport & Disposal, solid non-haz	20	drum	$185.00				$3,700	$0	$0	$0	$3,700
6.6 IDW Transport & Disposal, liquid non-haz	20	drum	$175.00				$3,500	$0	$0	$0	$3,500
7 POST CONSTRUCTION COST											
7.1 Contractor Completion Report	150	hr			$35.00		$0	$0	$5,250	$0	$5,250
7.2 Remedial Action Closeout Report	200	hr			$35.00		$0	$0	$7,000	$0	$7,000
7.3 Prepare LUC Document	150	hr			$35.00		$0	$0	$5,250	$0	$5,250
7.4 LUC Survey Support	1	day	$935.00				$935	$0	$0	$0	$935
Subtotal							$500,763	$725,732	$431,202	$270,047	$1,927,744
Local Area Adjustments							100.0%	100.9%	86.3%	86.3%	
Subtotal							$500,763	$732,264	$372,127	$233,050	$1,838,204
Overhead on Labor Cost @ 30%									$111,638		$111,638
G & A on Labor Cost @ 10%									$37,213		$37,213
G & A on Material Cost @ 10%								$73,226			$73,226
G & A on Equipment Cost @ 10%										$23,305	$23,305
G & A on Subcontract Cost @ 10%							$50,076				$50,076
Tax on Materials and Equipment Cost @ 7%								$51,258		$16,314	$67,572
Total Direct Cost							$550,839	$856,748	$520,978	$272,669	$2,201,235
Indirects on Total Direct Cost @ 25%											$550,309
Profit on Total Direct Cost @ 10%											$220,124
Subtotal											$2,971,667
Health & Safety Monitoring @ 1%											$29,717
Total Field Cost											$3,001,384
Contingency on Total Field Costs @ 20%											$600,277
Engineering on Total Field Cost @ 4%											$120,055
TOTAL CAPITAL COST											**$3,721,716**

NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI
Site 5
Alternative 2: Cap, Ditch Lining, LUCs and Monitoring
Annual Cost

Item	Item Cost year 1	Item Cost year 2	Item Cost year 3	Item Cost years 4 to 30	Item Cost every 5 years	Notes
Site Inspection & Report	$13,400	$13,400	$13,400	$13,400		Visit to inspect cover four times a year
Cover Maintenance	$19,000	$19,000	$19,000	$19,000		Cut (mow) cover 20 times a year
Cover Repair	$4,100	$4,100	$4,100		$4;100	Irrigation system and cover repair in years 1, 2, 3, 5, 10,15, 20, 25, 30
Sampling	$23,760	$11,880	$11,880	$5,940		Labor and supplies to collect samples from wells using a crew of two.
Analysis/Water	$35,168	$17,584	$17,584	$8,792		Analyze groundwater samples from 8 wells for pesticides, PAHs, dioxins/furans, & arsenic in years 1 through 30. Collect samples 4 times a year in year 1, twice a year in years 2 & 3, and once a year for years 4 through 30.
Report	$6,000	$3,000	$3,000	$1,500		Document sampling & results
Subtotal	$101,428	$68,964	$68,964	$48,632	$4,100	
Contingency @ 10%	$10,143	$6,896	$6,896	$4,863	$410	
TOTAL	$111,571	$75,860	$75,860	$53,495	$4,510	

NAVAL CONSTRUCTION BATTALION CENTER
GULFPORT, MISSISSIPPI
Site 5
Alternative 2: Cap, Ditch Lining, LUCs and Monitoring
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate at 7%	Present Worth
0	$3,721,716		$3,721,716	1.000	$3,721,716
1		$111,571	$111,571	0.935	$104,319
2		$75,860	$75,860	0.873	$66,226
3		$75,860	$75,860	0.816	$61,902
4		$53,495	$53,495	0.763	$40,817
5		$58,005	$58,005	0.713	$41,358
6		$53,495	$53,495	0.666	$35,628
7		$53,495	$53,495	0.623	$33,328
8		$53,495	$53,495	0.582	$31,134
9		$53,495	$53,495	0.544	$29,101
10		$58,005	$58,005	0.508	$29,467
11		$53,495	$53,495	0.475	$25,410
12		$53,495	$53,495	0.444	$23,752
13		$53,495	$53,495	0.415	$22,201
14		$53,495	$53,495	0.388	$20,756
15		$58,005	$58,005	0.362	$20,998
16		$53,495	$53,495	0.339	$18,135
17		$53,495	$53,495	0.317	$16,958
18		$53,495	$53,495	0.296	$15,835
19		$53,495	$53,495	0.277	$14,818
20		$58,005	$58,005	0.258	$14,965
21		$53,495	$53,495	0.242	$12,946
22		$53,495	$53,495	0.226	$12,090
23		$53,495	$53,495	0.211	$11,287
24		$53,495	$53,495	0.197	$10,539
25		$58,005	$58,005	0.184	$10,673
26		$53,495	$53,495	0.172	$9,201
27		$53,495	$53,495	0.161	$8,613
28		$53,495	$53,495	0.15	$8,024
29		$53,495	$53,495	0.141	$7,543
30		$58,005	$58,005	0.131	$7,599
				TOTAL PRESENT WORTH	**$4,487,337**