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CLOSURE PLAN SITE 6 NCBC GULFPORT MS
11/1/2003
TETRA TECH NUS

Closure Plan
for
Site 6

NCBC Gulfport
Gulfport, Mississippi

Southern Division
Naval Facilities Engineering Command
Contract Number N62467-94-D-0888
Contract Task Order 0125

November 2000

CLOSURE PLAN
FOR
SITE 6

NCBC GULFPORT
GULFPORT, MISSISSIPPI

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
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Naval Facilities Engineering Command
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CONTRACT NUMBER N62467-94-D-0888
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CERTIFICATION PAGE

I certify that the information contained in this report and on any attachments is true, accurate, and complete to the best of my knowledge, information, and belief.

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EXECUTIVE SUMMARY

This Site Closure Plan was developed by Tetra Tech NUS (TtNUS) for the Site 6 free-product extraction system located at the Naval Construction Battalion Center, Gulfport, MS. The Site Closure Plan includes the following:

- A brief review of the site and system history.
- The screening and evaluation of additional removal technologies.
- A review of system operation and recommendations for future operational performance standards.
- Interpretation and analysis of current operational performance of the treatment system.

The evaluation of additional technologies to improve the removal of free-phase product was performed by screening existing, full scale, technologies from the DODs Remediation Technologies Screening Matrix and the USEPAs Characterization Innovative Technologies Database. Three technologies passed this screening for further evaluation; periodic dual phase extraction, installation of depression pumps, and electrokinetic aided extraction.

The operational performance standard modifications include monthly product thickness measurement and the generation of product thickness maps, depth to fluid level measurements during active (pumping) and static (pumps off) conditions, and additional analytical data collection for volatiles and semivolatiles to monitor the changes in the dissolved phase plume.

This removal action is being taken as a Non-Time Critical Removal Action under the guidance of CERCLA and the NCP. The goal of this Removal Action at Site 6 is the removal and treatment of the free-phase product that is considered the primary source for groundwater contamination. This Site Closure Plan is only intended to address the free-phase product, and following the removal of the product, it must be determined if any further threats to human health, welfare, or the environment remain.

1.0 INTRODUCTION

1.1 SITE DESCRIPTION

The Fire-Fighting Training Area, hereinafter referred to as Site 6, occupies 2 acres immediately southeast of the intersection of Fifth Street and Colby Avenue at NCBC Gulfport (Figure 1). Site 6 consists of two burn pits operated between 1966 and 1975.

Based on the presence of the free-phase product plume and the elevated levels of volatile organic compounds (VOCs) and semivolatile organic compounds (SVOCs) in the soil and groundwater, a trench interceptor recovery system was installed in 1995 by Morrison Knudsen (MK). The primary objective for the design and installation of the treatment system was the removal and treatment of the free-phase product. The system was designed to remove and treat 15,000 to 30,000 gallons per day – depending on hydraulic conditions. The original extraction component of the system included a trench (130-foot long by 18-inch wide and approximately 20 feet deep) backfilled with a fine to medium gravel; three six-inch recovery wells installed within the trench; and top-loading pneumatic pumps to minimize emulsification of the product during removal.

Above ground treatment equipment included an oil-water separator [25 gallons per minute (gpm) maximum], a product holding tank, and a multi-tray air stripper. Control systems included digital flow meters and SCADA package to allow for remote monitoring, initiation, and shutdown. The system was operated from November 1995 until November 1999, when the system was shut down due to a lack of proper operation and maintenance.

1.2 CONTAMINATION ASSESSMENT AND PRODUCT REMOVAL

The observations included in the Letter Report of Findings (TtNUS, 2000) indicated that the existing system operation was rarely in compliance with the O&M Manual (MK, 1995). This non-compliance was responsible, in a large part, for the underperformance of the product removal by the system. Other observations included,

- Average product thickness at the site has been reduced by 50% from 1995.
- Changes in plume thickness at the site have not been uniform. The northern half of the plume has shown significantly greater reduction than the southern half of the plume. Whether this is due to site hydrogeologic conditions or due to operational inefficiencies is unclear.

- The review of operating practices has revealed that the system has rarely been operated within design specifications.
- The most significant deviations from the intended operation are the flow rates which have been less than half those needed to establish the intended capture zone.
- There has been a lack of record keeping and product thickness monitoring since November 1996.
- Significant periods of system down-time have resulted from improper maintenance of all system components.

As shown in the findings of the Letter Report of Findings (TtNUS, 2000), the lack of proper system operation and maintenance is the major cause for the current system's underperformance. However, significant reduction in product thickness at Site 6 was documented.

Contamination Assessment Findings

A contamination assessment was conducted in 1994 and 1995 included the sampling of free-phase product, soil, and groundwater media, to delineate the extent of free-phase and dissolved-phase contamination. The free-phase product samples were analyzed for a fingerprint, while the soil and groundwater media were analyzed for VOC, SVOC, inorganics, pesticides, polychlorinated biphenols (PCBs), herbicides, dioxins/furans, total petroleum hydrocarbons (TPH), and total organic carbon (TOC). The natural physical and chemical parameters for soil and groundwater media were also evaluated to assist in the design of a recovery system in order to maximize system efficiency.

The free-phase product plume, delineated using Hydropunch II, was determined to be 140 feet long (north-south) by 100 feet wide (east-west). Based on the thickness observed, and assuming an effective porosity of 20 to 30 percent (Driscoll, 1986), the recoverable product ranges from approximately 10,000 to 15,000 gallons.

Review of Historical Operational Data

The TtNUS review of historical data included the monthly operation and maintenance reports from Morrison Knudsen (MK) from September 1995 through November 1996, and the discharge monitoring reports (DMRs) by A & S Environmental from January 1997 through October 1999.

Unfortunately, this discussion of historical operational data – including flow rates, product thickness, and product removal – will be limited to the 14 months that MK performed the operation and maintenance due to the lack of records available from A & S Environmental.

Based on the data in the Operations and Maintenance Summary Report – Site 6 (MK, 1996), the system was operated nearly continuously for fourteen months from September 1995 to November 1996. The only significant modifications to the system were to change the types of flow-meters used in the control system. Figure 2 contains a schematic diagram of the system.

The system operated within the parameters of the discharge permit with the exception of low pH. The low pH values (<3.8) were the result of natural reducing conditions in the surficial aquifer; the current permit has been modified to account for these conditions.

The efficiency of the STAT 30, 6 tray strippers to remove BTEX contaminants from the groundwater, was calculated at approximately 61% during this period of operation, which is below the 85% to 90% efficiency specified by the manufacturer. Several issues may cause lower efficiency of these types of strippers including; lack of regular cleaning, high levels of emulsified product passing through the oil water separator, or erratic or consistently low pressure within the stripping trays.

The operating permit only required influent and effluent samples be analyzed for BTEX and pH. However, one TPH sample was collected to determine the amount of emulsified product passing from the oil water separator into the stripping trays. The level of this sample (1,660 parts per million [PPM]) was an indication that adjustments to the oil water separator were necessary. No follow-up sampling was conducted to confirm that adjustments to the oil water separator were effective. The effluent sample verified that the strippers were removing the majority of the TPH contamination prior to discharge.

Nearly 3.3 million gallons were removed and treated from September 1995 until November 1996. The average daily quantity of groundwater processed was 7,500 gallons per day, which was well below the designed rate of 15,000 gallons per day. It is unlikely that these low flow rates were sufficient to maintain a sufficient capture zone.

Recent Sampling and Analysis

A round of sampling was conducted at the Site on 01 Sep 00 in support of the discharge permit for the local POTW. The system was energized on 31 Aug 00 and allowed to operate to ensure that effluent samples would be representative of current operational capabilities. Influent samples were collected immediately downstream of the three-way junction from the extraction wells at the sampling port leading to the oil-water separator/equalization tank. Effluent samples were collected at the final sampling port before the discharge to the POTW. The samples were analyzed for the following organic constituents VOC, SVOC, TPH (DRO), and Oil and Grease (O&G). The inorganic analyses included metals, sulfide, sulfate, sulfite, phosphate, ammonia, and COD.

Influent and effluent organic sample results are compared in the following table. The inorganic analyses are not presented on this table because there are no current systems to treat any of these constituents.

Table 1

Comparison of Influent and Effluent Organic Samples

Parameter	Influent Result (mg/L)	Effluent Result (mg/L)	% Reduction
TPH	277,780	29,535	90
Oil and Grease	244	38	84
Napthalene	21.5	BDL	100
Toluene	5.5	BDL	100
2-Methylnapthalene	52.5	BDL	100
Anthracene	51.2	BDL	100
1,2,4-Trimethylbenzene	7.7	BDL	100
1,3,5 Trimethylbenzene	5.6	BDL	100
o-Xylene	5.2	BDL	100

Notes: BDL = below detection limit

This data shows that the treatment system was very efficient at removing the volatile and semivolatile constituents. The TPH and O&G reductions are significant, however these lower efficiencies likely reflect the need to clean and adjust the oil/water separator and air strippers.

These efficiencies were significantly better than the 61% observed during previous system operations; this may be due to the lower influent levels or the additional attention given to the system during this shorter period of operation.

The inorganic analyses were at acceptable levels for maintaining the permit.

Product Removal

Product removal up to November 1996 totaled only 130 gallons, however the TPH samples indicate much more product was being treated by the air strippers or was being passed to the POTW. Morrison Knudsen (1996) estimated that approximately 5,000 gallons of product were removed and treated by multiplying the TPH results by the total effluent to determine total product removed. Recalling the earlier estimate of 10,000 to 15,000 gallons of recoverable product would indicate approximately 33% to 50% of the recoverable product was removed by November 1996. The new analytical data – discussed above – supports the observation that significant amounts of TPH are being treated within the system. However, this estimate of 5,000 gallons of product removed in the emulsified phase does not consider the amount of dissolved phase TPH that is in the groundwater at the site as well. While the truest measure of free product removal will be observed in the monitoring wells at the site and in the product tank, this method of estimation serves as a valuable monitoring tool.

Based on this information, the technology review and recommendations will focus on methodologies that will enhance the effectiveness of the current system without incurring significant capital costs. Given these parameters, the results of the technology screening to improve the effectiveness of product removal at Site 6 are presented in the next section.

2.0 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

ARARs are Federal and State human health and environmental requirements used to define the appropriate extent of site cleanup, identify sensitive land areas or land uses, develop remedial alternatives, and direct site remediation. The NCP (National Oil and Hazardous Substances Pollution Contingency Plan) defines three ARAR components; (1) action specific ARARs, (2) chemical specific ARARs, and (3) location specific ARARs. Product removal at Site 6 was initiated as part of the Installation Restoration Program under a CERCLA Non-time Critical Removal (NTC) Action. The purpose of the NTC removal at Site 6 was to control the source of contamination – the free-phase product. At the completion (Closeout) of this NTC Action, a Remedial Action may be initiated to address dissolved phase contaminants. The ARARs for this NTC Removal Action are listed in the following paragraphs.

2.1 ACTION SPECIFIC ARARS

The action specific ARARs are:

1. Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and the National Hazardous Substance and Contingency Plan Regulations (40 CFR 300.430).
2. CERCLA Removal Action Guidance [40 CFR 300.415(b)].
3. Occupational Safety and Health Act (OSHA) – 29 CFR Part 1910.
4. Hazardous Materials Transportation Act – 49 CFR Parts 171-179.

2.2 CHEMICAL SPECIFIC ARARS

The chemical specific ARARs include the following:

1. Safe Drinking Water Act (SDWA) – 40 CFR Parts 141 and 143. Via established maximum concentration levels (MCLs) in groundwater.
2. Region III Risk-Based Concentrations (USEPA, 1999).

2.3 LOCATION SPECIFIC ARARS

As stated in the Action Memorandum (ABB-ES, 1996) no State or Federally listed rare, threatened, or endangered species or species of concern are known to inhabit Site 6. Therefore, location-specific ARARs do not apply and there are no additional restrictions placed on this Removal Action based solely on the characteristics or location of this site. Additionally, it was determined that the presence of the product and hydrogeologic conditions posed a greater risk to nearby surface water bodies than to the drinking water aquifer which is separated from the surficial aquifer by a significant aquitard.

2.4 COMPLETION OF NON-TIME CRITICAL ACTION

It is proposed at this time that this non-time critical removal action be discontinued when the average product thickness at the site has been reduced to a thickness of 0.25-foot and the following threats to the environment have been addressed or confirmed removed.

- Demonstrate that the remaining product plume no longer threatens local surface water bodies.
- Confirm that the elevated levels of chlorinated volatile compounds have been removed; vinyl chloride has not been observed in influent samples for over two years.
- Demonstrate that remaining dissolved phase constituents have very low likelihood of migrating from current position.

Documenting the removal or reduction of these threats to human health and the environment in the Non-time Critical Closeout Report will demonstrate that this action has been successful.

3.0 TECHNOLOGY REVIEW

A review of available and full-scale technologies was performed using the Remediation Technologies Screening Matrix (DOD, 1996) and the USEPA Remediation and Characterization Innovative Technologies (USEPA, 2000). The technology options reviewed in this document focus on complementing the existing remedial system rather than opting for another remedial option, such as excavation or bioremediation, which were evaluated during the analysis of alternatives in the Interim Action Study (ABB-ES, 1994a). The current extraction trench was selected in the Performance Specification Site 6 (ABB-ES, 1994b). The parameters used to evaluate and screen these complimentary technologies include:

- The remedial objectives presented in the Site 6 Interim Action Remedial Workplan (ABB-ES, 1994a).
- Site hydrology and land use.
- Ability to work in conjunction with or enhance the existing extraction system.
- Capital costs to implement.
- Shortening the overall operations and maintenance period.
- Requirement to significantly modify the existing extraction or treatment systems.

Given these parameters, the following technologies passed the screen.

1. Periodic Dual-phase Vacuum Extraction (Mobile Unit).
2. Installation of depression pumps (hydraulic control) in conjunction with the existing top-loading pneumatic pumps.
3. Electrokinetic (Direct Thermal) aided extraction.

All three of these options listed above are full-scale technologies that meet the screening requirements for this site. The technologies are listed in order of increasing capital costs. However, operation and maintenance costs should be considered in the total cost estimate over the selected period. To facilitate the evaluation of removal technologies, a brief description and comparison of each is included in Table 2.

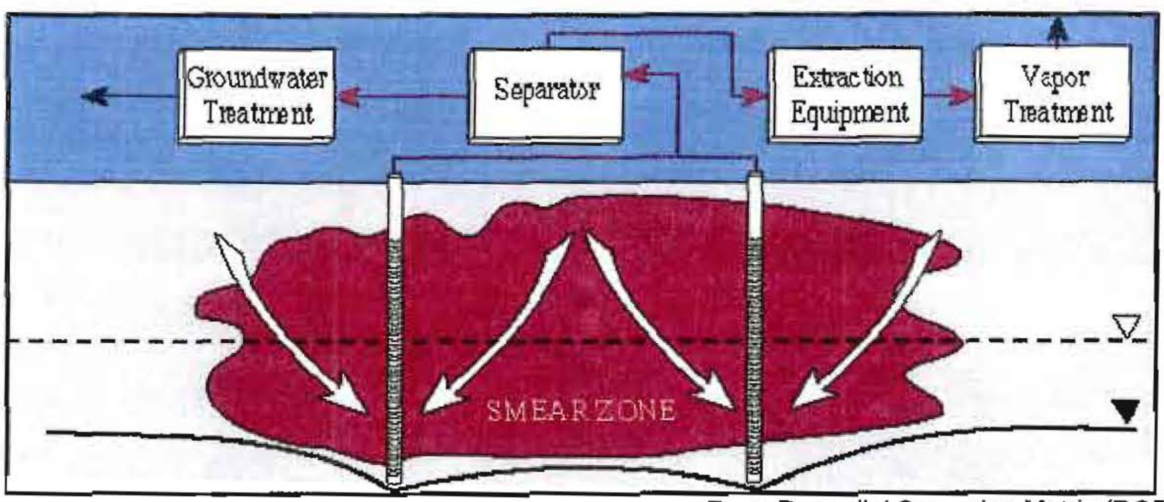
Table 2 **Comparison of Technologies**			
Treatment Technology	**Methodology**	**Advantages**	**Disadvantages**
Periodic dual phase vacuum extraction	Monthly dual phase extraction utilizing mobile vacuum extraction truck.	• No capital costs. • No modifications to existing system. • Treats soil and groundwater.	• May require vapor treatment. • Increased O&M costs. • Labor intensive
Installation of groundwater depression and hydraulic control pumps	Installation of groundwater depression pumps in the recovery well to facilitate product recovery.	• Allows greater hydraulic control while continuously removing product. • Extraction rates can be adapted to varying site conditions.	• May require system modifications to accommodate higher extraction rate. • Capital costs.
Electro-kinetic (direct-thermal) Aided Extraction	Thermally enhanced extraction by installing current feeding electrodes into the formation in the vicinity of the product plume.	• Increases mobility of "heavy" fuel oils found at site. • Aids desorption of the long-chain hydrocarbons from the soil. • Does not result in increased flow rates.	• Least developed of the technologies. • Capital costs may vary based on aquifer conditions

4.0 SUMMARY OF ALTERNATIVE ADDITIONAL TECHNOLOGIES

This section discusses the alternatives for implementing additional technologies to improve the extraction of free-phase product and decrease the remaining period of operation and maintenance at Site 6. This discussion is included to provide the decision-makers with sufficient information to select a technology and proceed with a modification of the Interim Action Removal Plan.

4.1 PERIODIC DUAL-PHASE VACUUM EXTRACTION (MOBILE UNIT)

This technology applies a high vacuum system simultaneously to remove liquid and vapor from the screened sections of existing wells using a liquid ring vacuum truck. Once above ground, the vapors are vented and the emulsified product and groundwater would be stored in a tank and treated onsite. The system would be applied to wells in areas of greatest contamination. This technology will require optimization to determine the most effective duration and frequency. The only modification to the existing system will be an additional transfer pump to transfer the fluids stored during the vacuum extraction process to the submersible pump on the treatment pad.



From Remedial Screening Matrix (DOD, 1996)

This process would take advantage of the homogeneity and hydraulic conductivity of the fine and medium sands present at Site 6 to increase the removal of free-phase product and decrease the overall period of O&M. The disadvantages of this technology include the possible requirement for vapor treatment and that it will significantly increase the O&M costs.

Additionally, this option does not require remedial construction or significant modifications to the existing system and would be easily implemented.

4.2 INSTALLATION OF DEPRESSION PUMPS

This technology would require the installation of submersible groundwater pumps in each of the three existing recovery wells. The operations of these pumps would allow for greater head control in the aquifer and would allow the system operator to adjust the top loading pneumatic pumps for free-product removal only. Currently the pneumatic pumps must provide for free-product removal and head control.

This technology will make it easier to achieve the operational performance standards listed in the Remedial Design Workplan (MK, 1994) and as modified in later sections of this report. However, this modification would do little to change the mobility of the contaminant and therefore will not significantly shorten the O&M period following installation.

Achieving the performance standards of product removal that this option would provide is also in compliance with the objectives and ARARs included in the Site 6 Action Memorandum. With the current treatment system rated for 25 gallons per minute (GPM), upgrades to the oil water separator and air-stripping capacity may not be required. Modifications to the current extraction system may be required if the current 6-inch recovery wells do not support the diameters of the discharge piping of the submersible pumps and the existing pneumatic pumps. By improving the effectiveness of product removal this option is in compliance with the objectives and ARARs included in the Site 6 Action Memorandum.

4.3 ELECTROKINETIC (DIRECT THERMAL) AIDED EXTRACTION

This technology provides for direct heating of the ground/groundwater in selected zones of contamination by a process using electrical current. The increased temperature has several beneficial results.

1. Increased temperature of the soil and groundwater results in reduced viscosity of the groundwater and contamination; an increased effective porosity and hydraulic permeability; and ultimately an increased velocity of the contaminated groundwater to the extraction wells.

2. Increased solubility of some organic components (especially the heavier fuel oils and tars resulting from incineration) in water as the temperature is raised.

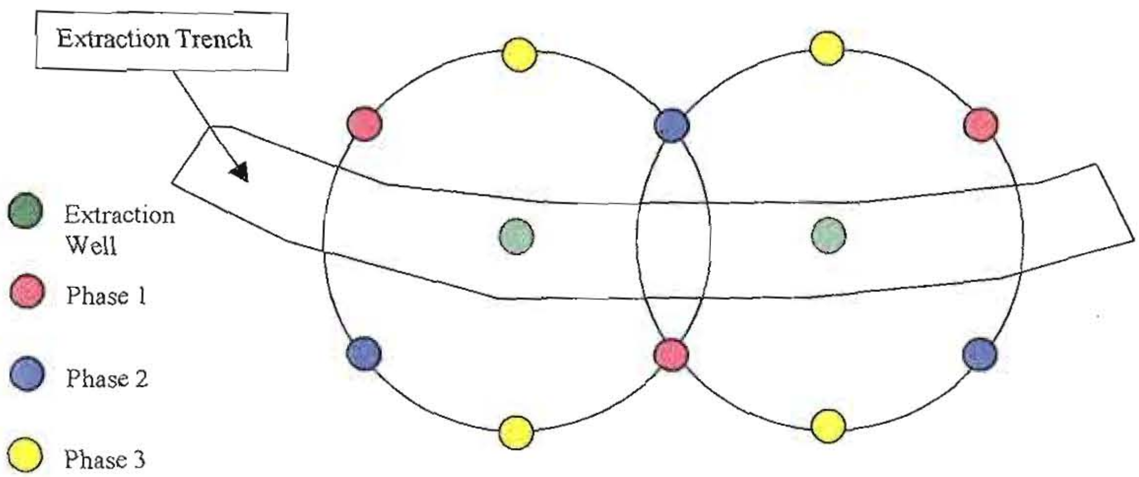
3. An inversion in the relative density of many heavy organic liquids (with respect to water) as temperature is raised to 80 - 85°C.

Each of these physical phenomena would directly result in enhanced effectiveness of the existing extraction system.

This technology operates by using AC resistance heating in which the ground/groundwater matrix forms the resistance heater and the electrodes simply supply current to the matrix. Current feeding electrodes are placed directly into the ground and the ground/groundwater becomes the heating element. Since it is a direct process, it is the most energy efficient. Conversion of electrical energy to heat energy occurs directly within the soil matrix. This avoids the two or three stages of energy conversion, which are required with steam injection and "hot rod" heaters.

The equipment and deployment is relatively simple and largely based on industrially proven components and is safe to use near or underneath existing structures.

Specifically, direct AC resistance heating uses current feeders (electrodes) which are placed directly into the ground. 3 Phase AC is used and each electrode is connected to a single phase of a delta supply in a series of interlocking triangles, which form a hexagonal pattern – the extraction well is in the middle of the array (see diagram below).



From GeoKinetics, Inc, 2000

Plan view of a typical Electro-kinetic array

Each corner of the triangle is then connected to one phase of the power supply. The ground/groundwater matrix then forms the connection between the phases and the resistance of the matrix forms the heating element.

The extraction well is located centrally between the electrodes. In general, electrode depth is such that the lowest point coincides with the deepest point from which contamination is to be removed.

This technology will have the highest capital costs of the three initially, but will also provide for lower O&M and may ultimately be the least costly if effective in significantly reducing the time required for site closure. Additionally, this technology will require a short period of optimization for electrode spacing if it is selected as a modification to the Interim Action Removal Plan.

As discussed above, this technology would improve the effectiveness of product removal and would therefore be in compliance with the objectives and ARARs included in the Site 6 Action Memorandum.

4.4 RECOMMENDATION FOR ALTERNATIVE ADDITIONAL TECHNOLOGIES

Additional technologies could be deployed at Site 6 to improve the effectiveness of free-phase product removal. While the system may not have been operated within the performance standards set in the Operations and Maintenance Manual (MK, 1995) in the past, technological improvements as well as operational improvements would decrease the overall period of operation and therefore the total project costs. It is recommended that a more detailed analysis of the costs of the three technologies reviewed in this document be conducted prior to final selection and implementation. When the additional remedial technology is selected, the existing Site 6 Remedial Workplan and Operations and Maintenance Manual should be modified to include the updated information.

Further, it is recommended that the repairs to the existing system, detailed in the Letter of Findings (TtNUS, 2000), be completed prior to implementing any new technology at the site. In this way, any operational irregularities could be more easily investigated and repaired without the additional complication of bringing new systems on line.

5.0 OPERATIONAL PERFORMANCE STANDARDS MODIFICATIONS

Future operation of the extraction and treatment system at Site 6 should be operated following the performance specifications in The Operations and Maintenance Manual (MK, 1995). A checklist is provided in Appendix A for inclusion in the O & M Package that includes the following modifications:

1. Once-monthly collection and analysis of Total Petroleum Hydrocarbons (TPH) using the USEPA 8015 (Diesel Range Only) Method. Both influent and effluent samples should be collected in the proper containers and shipped on-ice to an USEPA certified laboratory. The results of these analyses will aid in determining the efficiency of product separation in the oil-water separator. Additionally, these data will provide a quantitative method for determining the amount of product that is being treated in the air stripping trays and the amount of emulsified and dissolved phase product passing through the system into the sanitary sewer. These data should be included in each monthly progress report.

2. Water level elevation and product thickness should be measured to help determine the effectiveness of the extraction system. These measurements should be conducted once a month and a product thickness and potentiometric surface map should be generated and included in each monthly report.

3. The following records should be kept and included in each monthly progress report:

   - Pneumatic pump levels and changes made during the monitoring period.
   - Observations of current flow and total flow rates for each recovery well during the monthly monitoring period.
   - Equipment maintenance, changes, and/or failure noted during the operational period.
   - Times and duration of system shut-down with an explanation of cause and description of repairs.

4. Extraction well-filter packs and the trench backfill material should be flushed to remove mineral scale and bio-fouling. Furthermore, this treatment should be performed annually after system restart to prevent plugging in the filter packs, which would then be difficult to remove.

5. The system was designed to maintain three feet of drawdown in the extraction wells. Given well capacities of approximately 1 to 1.3 gallons per foot of drawdown, the resulting system flow rates will be between 9 and 12 gallons per minute. Product thickness in each of the extraction wells should be observed during each visit to determine if pumping levels should

be adjusted due to seasonal fluctuations in water level or due to product thickness changes. Maintaining the capture zone should be the highest priority. If pumps must be lifted to capture product during the pumping cycle; it should only be done for two weeks (one maintenance cycle) at a time, which should be followed by a minimum of one month of capture zone maintenance.

Finally, the repairs and services to the system outlined earlier must be performed. The repairs should be phased in to allow time to order replacement parts should additional failed components be discovered. The frequency of site visits should remain bimonthly. It is not recommended that the telemetry system be reinstalled as part of the streamlining of the system due to the frequency of site visits during normal operations and maintenance.

6.0 REFERENCES

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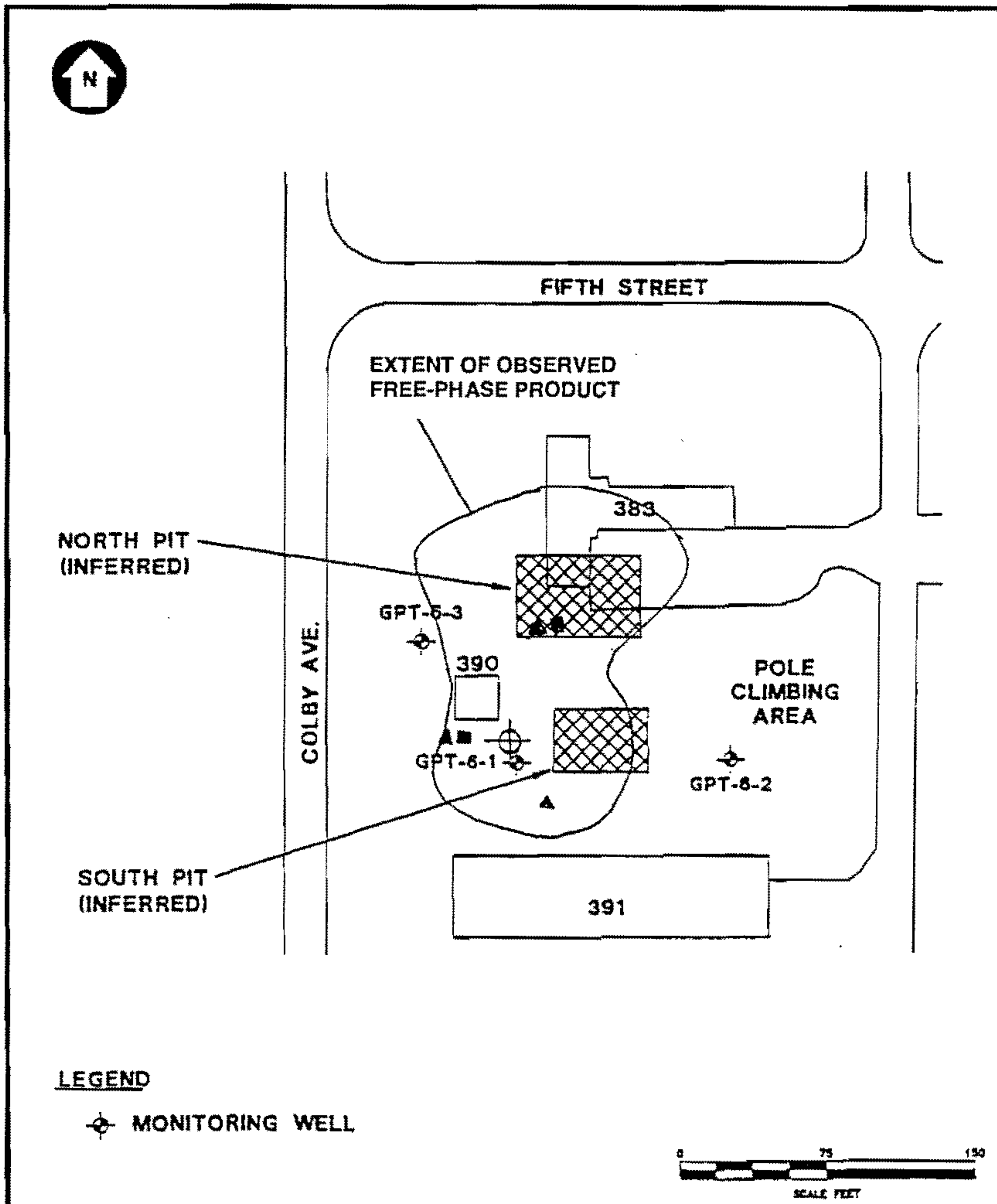

Figure 1
Site Map and Initial
Extent of Free-Phase Product

SITE 6 CLOSURE PLAN

NCBC Gulfport
Gulfport, Mississippi

SITE 6 O & M CHECKLIST
NCBC Gulfport - Gulfport, Mississippi

Date___________ Time_________ Name______________________________

1) Flow Rates:

Well	Flow Rate (gpm)	Total (Gal.)	Total Since Last Reading (Gal.)
RW-1			
RW-2			
RW-3			

2) Water Levels and Product Thickness MW

	Pumps On			Pumps Off		
Well	DTP	DTW	PT	DTP	DTW	PT
GPT 6-1						
GPT 6-2						
GPT 6-3						
GPT 6-4						
GPT 6-5						
GPT 6-6						
GPT 6-7						
GPT 6-8						
PZ 1						
PZ 2						
PZ 3						

3) Head Control

Well	Pumps On		Pumps Off		
	DTF Top of Cycle	DTF Bottom of Cycle	DTP	DTW	PT
RW-1					
RW-2					
RW-3					

Notes:

DTP - Depth to Product
DTW - Depth to Water
PT - Product Thickness
DTF - Depth to Fluid

Pumps must be off for a minimum of 4 hours when collecting static (Pump Off) Data