RI051301F

TECHNICAL MEMORANDUM

NON-TIME-CRITICAL REMOVAL ACTION

BEEDE WASTE OIL SITE
PLAISTOW, NEW HAMPSHIRE

RESPONSE ACTION CONTRACT (RAC), REGION I

For
U.S. Environmental Protection Agency

By
Tetra Tech NUS, Inc.

EPA Contract No. 68-W6-0045
EPA Work Assignment No. 105-NARV-011T
TtNUS Project No. GN4103

December 2005

TETRA TECH NUS, INC.

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APPENDICES

1.0 INTRODUCTION

This Technical Memorandum presents the results of three evaluations of the ongoing Non-Time-Critical Removal Action (NTCRA) and remaining LNAPL plumes at the Beede Waste Oil Site (the site). Tetra Tech NUS (TtNUS) conducted the evaluations and prepared this memorandum at the request of the U.S. Environmental Protection Agency (EPA) under Contract No. 68-W6-0045, Work Assignment No. 105-NARV-011T.

The NTCRA treatment system, comprised of a vacuum enhanced oil extraction system and a passive oil interceptor trench, has been in operation at the site since February 2000 and has recovered over 90,000 gallons of oil from the subsurface during that time. EPA has tentatively determined that the operation of the oil extraction system shall be terminated after the summer of 2005 because the objectives of the system have been met. EPA has also tentatively determined that the oil interceptor trench should continue to be monitored, maintained, and skimmed of oil until the planned remedial action can be implemented.

EPA requested that TtNUS perform three evaluations in preparation for shutdown of the vacuum extraction system: (1) evaluate the requirements for shutting down and "mothballing" the vacuum extraction system, (2) evaluate the requirements for maintenance and monitoring of the oil interceptor trench, and (3) evaluate the source of an apparent oil outbreak in the wetlands northeast of the interceptor trench and identify any recommended steps to address the outbreak. TtNUS has performed these evaluations and summarized the results in this draft Technical Memorandum.

This Technical Memorandum contains four sections: Section 1.0 is this introduction; Section 2.0 presents the vacuum extraction system shutdown evaluation; Section 3.0 presents the interceptor trench maintenance and monitoring evaluation; and Section 4.0 presents the oil outbreak evaluation.

2.0 NTCRA VACUUM EXTRACTION SYSTEM SHUTDOWN EVALUATION

TtNUS conducted an evaluation to identify the activities and costs required to shut down and "mothball" the NTCRA vacuum extraction system in a manner that would leave it available to be restarted within 2 to 4 weeks if necessary. Two shutdown options were identified. Sections 2.1 and 2.2 describe the two options, the activities and costs associated with each, and the pros and cons of each option.

TtNUS has also prepared a set of instructions that could be followed and the materials and equipment needed to restart the "mothballed" vacuum extraction system if required. The start-up procedures and materials are included as Appendix A to this technical memorandum.

TtNUS has also prepared an addendum to the NTCRA operations manual (developed at the start of the NTCRA) to provide instructions for operating the system once it has been re-started. The addendum reflects the current operating procedures, identifies common problems encountered, and includes a summary of common troubleshooting and repair activities. The addendum to the operations plan also includes a section describing procedures for monitoring and maintaining the oil interceptor trench using the vacuum extraction system. The addendum to the operations manual is included as Appendix B to this technical memorandum.

2.1 <u>Shutdown Option A – Partial System Shutdown</u>

Shutdown Option A is the equipment shutdown scenario recommended by the manufacturer (SCG Industries, Inc.) to ensure that the vacuum extraction equipment does not sustain damage due to inoperation and freezing temperatures. This option assumes that the extraction equipment would remain lubricated and housed in a heated environment during the winter to prevent freezing of the fluids in the pumps. Although the equipment would remain in operational condition, operation of the vacuum extraction systems would be terminated, all extraction wells would be disconnected from the transmission piping, valves plugged, and the extraction wells capped. Periodic maintenance of the extraction equipment would be required to help prevent damage and ensure that the systems could be restarted in the future if necessary. The maintenance would involve bi-weekly start up of the liquid ring pumps and compressors to prevent rusting and seizing; the systems would be run until they reached normal operating temperature (15 to 30 minutes) and then be shut off. These measures are recommended by the manufacturer to keep the systems in working condition (SCG, 2005).

Option A provides a high degree of certainty that the extraction equipment will not sustain damage due to rusting, freezing, or seizing because the equipment will remain lubricated, will not be exposed to freezing conditions, and will periodically be turned on and brought up to operating temperature. This option also provides the capability of continuing to use one of the extraction systems for maintenance of the oil interceptor trench. See Section 3.3.4 for details of how the extraction system could be used for trench maintenance.

The major tasks associated with a partial shutdown and mothballing of the oil extraction systems include: cleaning the extraction equipment and waste storage tanks; removing, decontaminating and storing the tank heaters; and disconnecting and capping all the extraction wells. Specific tasks required for partial shutdown of the extraction system are described in detail in Section 2.1.1. The associated costs are discussed in Section 2.1.2.

2.1.1 Shutdown Option A – Partial Shutdown Elements

The following table describes the tasks required for shutdown and long-term maintenance of the NTCRA vacuum extraction system under Shutdown Option A – partial system shutdown.

NO.	ACTIVITY	DETAILS
1	Evacuate fluids from piping system	• Raise all drop tubes and pull air through transmission piping for extended duration (est. 2 days) to evacuate as much residual oil as possible from lines. • Flush limited amount of water through system after air evacuation to further clean piping and separators.
2	Remove all waste fluids from oil extraction equipment	• Remove all extracted oil and water from the high vacuum liquid separator (HVLS), isolation tank, and oil/water separator in both buildings, transfer fluids to storage tanks for ultimate disposal.
3*	Clean extraction equipment	• Clean the oil/water separators and other components of the extraction systems (i.e. switches and floats) to remove oil residue.
4	Drain operation fluids (i.e. Lubricating oil) from oil extraction equipment	• NOT NEEDED FOR PARTIAL SHUTDOWN
5	Disconnect and drain transfer lines between extraction systems and storage tanks	• Disconnect, remove, and drain transfer lines that run through conduit under access road to prevent release of residual oil if line cracks during shutdown period.

NO.	ACTIVITY	DETAILS
6	Remove and clean waste storage tank heaters	• Remove heaters from water and oil storage tanks. • Decontaminate heaters. • Store heaters (unheated storage OK).
7	Empty, seal, and clean oil storage tank (cleaning optional)	• Remove oil and dispose off site. • Seal hole (heater port) in tank cover. • Decontaminate oil storage tank (optional). • Leave tank on site (it is owned by EPA).
8	Empty and clean water storage tank	• Remove water and dispose off site. • Decontaminate water storage tank. • Return tank (it is rented).
9	Remove transfer pumps from extraction systems	• NOT NEEDED FOR PARTIAL SHUTDOWN
10*	Regenerate carbon units	• Send the vapor-phase activated carbon treatment units for both buildings off site for regeneration. • Replace Units upon return and seal inlets and outlets to prevent damage due to weather or wildlife.
11	Seal extraction system buildings	• Plug and seal holes/cracks/gaps in both buildings to prevent damage due to weather or wildlife intrusion.
12	Disconnect and plug all extraction wells	• Remove drop tubes from all wells. • Cap wells. • Plug valves that connect drop tube to piping system. • Protect heat trace line associated with drop tube at each well. (Enclose heat trace line and rubber reducer from each well in lidded bucket secured to each well.)
13	Dispose of generated waste	• Dispose contaminated materials including drop tubes (approximately 5000 feet), discharge tubing, PPE, absorbents, etc. Dispose of tubing • Dispose non-contaminated materials including drop tube insulation, miscellaneous trash
14	Demobilize from site	• Return rented equipment (PID, interface probe, etc.); discontinue site services (phone, toilet, dumpster, etc.); demobilize from site.
15	Bi-weekly maintenance	• Turn on the vacuum extraction systems and run until vacuum pumps reach normal operating temperature (15 to 30 minutes) to prevent rusting and seizing.
16	Periodic site monitoring and maintenance	• Inspect transmission piping and site facilities (treatment buildings, trailer, soil piles) to identify damage from weather, wildlife, or trespassers. • Maintain piping and facilities as needed to prevent or repair damage. Periodic maintenance may include clearing brush that is encroaching on piping and securing tarps on soil piles.

* If one extraction system is to be used for maintenance of the oil interceptor trench, the activities identified with an asterisk would be performed only for the system that would not be used for trench maintenance. See Section 3.3.4 for details of how the vacuum extraction system could be used in trench maintenance.

2.1.2 Shutdown Option A – Partial Shutdown Costs

The estimated costs to shut down the NTCRA system under Shutdown Option A are summarized below and presented in detail in Appendix D. Cost estimates are provided for a

1-year period based on the remaining period in TtNUS' contract with EPA; and for a 3-year period because it is estimated that the system may be shut down for 3 years before the final remedial action commences at the site. Present worth costs were calculated using a 3-year discount rate of 3.7 percent (OMB, 2005).

Shutdown Costs – Option A	
Total Initial Costs	$43,951
Monthly Energy Costs (4 winter months)	$819
Monthly Energy Costs (non-winter months)	$19
Total Annual Energy Costs	$3,425
Total 1-Year Present Worth Cost	47,253
Total 3-Year Present Worth Cost	53,509

The estimated costs for inspection and maintenance of the NTCRA extraction equipment (as required for Shutdown Option A), piping system, and other site facilities as well as the labor costs for inspection and maintenance of the interceptor trench during the shutdown period are summarized below and presented in detail in Appendix D. Because the inspection and maintenance of the NTCRA system, the site, and the interceptor trench would be conducted during the same site visit, the labor costs for all inspection and maintenance tasks were estimated together. The required time for this site visit is expected to be approximately the same for all shutdown and trench maintenance options. The non-labor costs for the trench maintenance options are presented separately in Section 3.3.

NTCRA and Trench Inspection and Maintenance Costs	
Averaged Monthly Costs	$1,819
Total Annual Costs	$21,822
Total 1-Year Present Worth Cost	21,043
Total 3-Year Present Worth Cost	60,904

2.2 Shutdown Option B – Complete System Shutdown

Shutdown Option B assumes that the oil extraction systems would be completely shut down and mothballed and that the buildings that house the vacuum extraction equipment would not be heated during the winter months. As a result, all operation/lubrication fluids would have to be drained from the vacuum pumps and other equipment in order to prevent freezing and the mechanical components of the systems would have to be manually rotated on a regular basis to help prevent rusting and seizing. These measures are the minimum maintenance requirements recommended by the manufacturer of the extraction systems. However, the manufacturer does not guarantee that these measures will be adequate to prevent damage to the pumps and compressors (SCG, 2005).

As with Option A, all extraction wells would be disconnected from the transmission piping, the valves plugged, and the wells capped. The major tasks associated with a complete shutdown and mothballing of the oil extraction systems include: draining all fluids and cleaning the extraction equipment and waste storage tanks; removing, decontaminating and storing the tank heaters; returning the rented water storage tank; removing the oil and water transfer pumps from the extraction systems and placing them in heated storage to prevent damage from freezing; and sealing the pump houses to prevent damage from weather and wildlife. Specific tasks required to mothball the extraction system are described in detail in Section 2.2.1. The associated costs are discussed in Section 2.2.2.

2.2.1 Shutdown Option B – Complete Shutdown Elements

The following table describes the tasks required for shutdown and long-term maintenance of the NTCRA vacuum extraction system under Shutdown Option B – complete system shutdown.

NO.	ACTIVITY	DETAILS
1	Evacuate fluids from piping system	• Raise all drop tubes and pull air through transmission piping for extended duration (est. 2 days) to evacuate as much residual oil as possible from lines. • Flush limited volume of water through system after air evacuation to further clean piping and separators.
2	Remove all waste fluids from oil extraction equipment	• Remove all extracted oil and water from the high vacuum liquid separator (HVLS), isolation tank, and oil/water separator in both buildings, transfer fluids to storage tanks for ultimate disposal.
3	Clean extraction equipment	• Clean the oil/water separators and other components of the extraction systems (i.e. switches and floats) to remove oil residue.
4	Drain operation fluids (i.e. Lubricating oil) from oil extraction equipment	• Drain operation/lubrication fluids from liquid ring pumps, reclaimers, radiators, and compressors to prevent damage from freezing.
5	Disconnect and drain transfer lines between extraction systems and storage tanks	• Disconnect, remove, and drain transfer lines that run through conduit under access road to prevent release of residual oil if line cracks during shutdown period.
6	Remove and clean waste storage tank heaters	• Remove heaters from water and oil storage tanks. • Decontaminate heaters. • Store heaters (unheated storage OK).
7	Empty, seal, and clean oil storage tank (cleaning optional)	• Remove oil and dispose off site. • Seal hole (heater port) in tank cover. • Decontaminate oil storage tank (optional).

NO.	ACTIVITY	DETAILS
7	Empty, seal, and clean oil storage tank (cleaning optional)	• Remove oil and dispose off site. • Seal hole (heater port) in tank cover. • Decontaminate oil storage tank (optional). • Leave tank on site (it is owned by EPA).
8	Empty and clean water storage tank	• Remove water and dispose off site. • Decontaminate water storage tank. • Return tank (it is rented).
9	Remove transfer pumps from extraction systems	• Remove oil transfer pump and water transfer pumps from both buildings. • Store pumps in heated storage to prevent degradation of pump diaphragms.
10	Regenerate carbon units	• Send the vapor-phase activated carbon treatment units for both buildings off site for regeneration. • Replace Units upon return and seal inlets and outlets to prevent damage due to weather or wildlife.
11	Seal extraction system buildings	• Plug and seal holes/cracks/gaps in both buildings to prevent damage due to weather or wildlife intrusion.
12	Disconnect and plug all extraction wells	• Remove drop tubes from all wells. • Cap wells. • Plug valves that connect drop tube to piping system. • Protect heat trace line associated with drop tube at each well. (Enclose heat trace line and rubber reducer from each well in lidded bucket secured to each well.)
13	Dispose of generated waste	• Dispose contaminated materials including drop tubes, (approximately 5000 feet), discharge tubing, PPE, absorbents, etc. • Dispose non-contaminated materials including drop tube insulation, miscellaneous trash
14	Demobilize from site	• Return rented equipment (PID, interface probe, etc.); discontinue site services (electricity, phone, toilet, dumpster, etc.); demobilize from site.
15	Bi-weekly vacuum extraction system maintenance	• Manually turn the mechanical components of the liquid ring pumps and compressors to help prevent rusting and seizing.
16	Periodic site monitoring and maintenance	• Inspect transmission piping and site facilities (treatment buildings, trailer, soil piles) to identify damage from weather, wildlife, or trespassers. • Maintain piping and facilities as needed to prevent or repair damage. Periodic maintenance may include clearing brush that is encroaching on piping and securing tarps on soil piles.

2.2.2 Shutdown Option B – Complete Shutdown Costs

The estimated costs to shut down the NTCRA system under Shutdown Option B are summarized below and presented in detail in Appendix D. Cost estimates are provided for a 1-year period based on the remaining period in TtNUS' contract with EPA; and for a 3-year period because it is estimated that the system may be shut down for 3 years before the final remedial action commences at the site. Present worth costs were calculated using a 3-year discount rate of 3.7 percent (OMB, 2005).

Shutdown Costs – Option B	
Total Initial Costs	$46,426
Monthly Energy Costs	$0
Total Annual Energy Costs	$0
Total 1-Year Present Worth Cost	$46,426
Total 3-Year Present Worth Cost	$46,426

The estimated costs for inspection and maintenance of the NTCRA extraction equipment (as required for Shutdown Option B), piping system, and other site facilities as well as the labor costs for inspection and maintenance of the interceptor trench during the shutdown period are summarized below and presented in detail in Appendix D. Because the inspection and maintenance of the NTCRA system, the site, and the interceptor trench would be conducted during the same site visit, the labor costs for all inspection and maintenance tasks were estimated together. The required time for this site visit is expected to be approximately the same for all shutdown and trench maintenance options. The non-labor costs for the four trench maintenance options are presented separately in Section 3.3.

NTCRA and Trench Inspection and Maintenance Costs	
Averaged Monthly Costs	$1,799
Total Annual Costs	$21,582
Total 1-Year Present Worth Cost	20,812
Total 3-Year Present Worth Cost	60,235

2.3 Shutdown Evaluation Conclusions

Shutdown Option A provides a greater degree of certainty than Option B that the extraction equipment will not sustain damage due to rusting, freezing, or seizing because the equipment will remain lubricated, will not be exposed to freezing conditions, and will periodically be turned on and brought up to operating temperature. Because of the high cost of the extraction equipment and the high potential for its re-use at this or another site, partial shutdown Option A is recommended over complete shutdown Option B. Additionally, this option also provides the capability of continuing to use one of the extraction systems for maintenance of the oil interceptor trench (see Section 3.3.4).

A comparison of the total cost of the two shutdown options (including NTCRA and trench inspection and maintenance) is shown below and presented in detail in Appendix D. Cost estimates are provided for a 1-year period based on the remaining period in TtNUS' contract with EPA; and for a 3-year period because it is estimated that the system may be shut down for 3 years before the final remedial action commences at the site. Present worth costs were calculated using a 3-year discount rate of 3.7 percent (OMB, 2005).

Cost Item	Option A Partial Shutdown	Option B Complete Shutdown
Total Initial Costs	$43,951	$46,130
Averaged Monthly Costs	$2,104	$1,799
Total Annual Costs	$25,247	$21,582
Total 1-Year Present Worth Cost	68,297	67,238
Total 3-Year Present Worth Cost	114,414	106,661

3.0 OIL INTERCEPTOR TRENCH MONITORING AND MAINTENANCE EVALUATION

EPA has tentatively determined that the oil interceptor trench at the site should continue to be monitored and maintained until the planned remedial action can be implemented. The trench is located along the northern edge of the site, immediately upgradient of the Kelley Brook wetlands. The trench was installed in October 1997 and extended in November 1999 to stop the continuing oil seepage into the wetlands. The trench has been monitored and maintained by TtNUS (formerly Brown & Root) since August 1998. This section presents the evaluation of requirements for monitoring and maintaining the trench after the oil vacuum extraction system is shut down.

3.1 Historical Monitoring and Maintenance of Interceptor Trench

Before the vacuum extraction system was installed, the trench was inspected and maintained one to two times per week. Oil was collected from the trench using three passive skimmers deployed in the western end of the original 100 foot-long trench. Oil accumulation was significant only in the western third to half of the trench. On average, approximately 7 gallons of oil per month were collected from the trench during the year prior to installation of the NTCRA vacuum extraction system.

The passive skimmers were used to collect oil from the trench until a few months after start-up of the NTCRA vacuum extraction system, when it was concluded that the oil could be more efficiently evacuated using the vacuum system. The passive skimmers had been fairly effective in collecting the oil from the trench when the oil layer was relatively thick, but after the vacuum extraction system was in operation for a few months extracting oil from the subsurface upgradient from the trench, the amount of oil reaching the trench significantly decreased and the skimmers did not efficiently capture the thin sheen. Instead, the skimmers routinely filled with water before a significant volume of oil was collected.

Since the spring of 2000, the oil interceptor trench has been monitored and maintained as a component of the regular operation of the NTCRA. The trench is inspected on a weekly basis and maintained (skimmed of oil) as needed. In recent months, maintenance has been conducted every 2 to 3 weeks – when a significant oil layer develops within the trench (pools of oil up to approximately 0.1 inch thick in the western third of the trench). Maintenance of the trench involves evacuating the accumulated oil using the vacuum extraction system. A drop tube from an extraction well near the interceptor trench is lowered into the trench and held in place just above the oil/water interface (using a clamp system) and allowed to vacuum the oil from the water surface, slowly drawing the oil toward the tube. The tube is left there until all the oil has been skimmed from the trench, typically about 2 hours.

It is anticipated that once the vacuum extraction system is shut down, more oil may enter the trench and more frequent monitoring and maintenance may be required. Monitoring requirements are described in the following section.

3.2 Interceptor Trench Monitoring Requirements

As discussed in the previous section, the required frequency of trench maintenance has ranged from once or twice per week before the NTCRA vacuum extraction system was in place to once every 2 to 3 weeks after the vacuum extraction system had been in operation for some time. It is anticipated that after shutdown of the vacuum extraction systems, the required maintenance frequency will be between these extremes because the volume and thickness of oil in the subsurface in the vicinity of the trench has been significantly reduced over the duration of the NTCRA operation. The observed oil thickness in the two extraction wells closest to the western half of the trench (wells 105 and 106) was generally greater than 1.5 feet during quarterly monitoring events from January 2000 through October 2003, but has been 0.1 foot or less in the monitoring periods since November 2004. The two extraction wells closest to the eastern half of the trench (wells 114 and 121) have generally had no measurable thickness of oil. It is hypothesized that the subsurface materials in this area (mainly landfill material/debris) are less permeable than the surrounding soils and have thereby obstructed the flow of LNAPL. A figure showing the interceptor trench and the oil thickness observed in the extraction wells in May/June 2005 is presented for reference in Appendix C.

It is recommended that after shutdown of the vacuum extraction systems, the trench should initially be monitored on a weekly basis and maintained as needed. The monitoring frequency can then be altered as needed based on observations. Based on historical observations, the rate of oil accumulation in the trench is likely to change seasonally, primarily due to fluctuations in the water table elevation. Therefore, the required frequency of monitoring and maintenance may also vary.

Recommended monitoring and maintenance tasks are identified below. Section 3.3 presents the evaluation of several different options for evacuating oil from the interceptor trench.

Monitoring of the trench and wetlands would include:

- Visual inspection of the condition of the trench structure (i.e. manhole covers and masonry, vegetation, etc.)
- Visual inspection of oil accumulation within the trench
- Visual inspection of wetland adjacent to trench for evidence of oil.

Maintenance of the trench and wetland would include:

- Evacuation of accumulated oil from trench (frequency determined based on observations during monitoring, evacuation methods evaluated below in Section 3.3)
- Clearing of excessive vegetation from trench area (periodically during growing season)
- Repair of masonry seals (as needed – expected to be infrequent)
- Installing and changing oil-absorbent booms in wetland as needed.

Trench Monitoring and Maintenance Costs

The estimated labor costs for monitoring and maintaining the interceptor trench are presented in Sections 2.1.2 and 2.2.2 along with the costs for maintenance of the NTCRA extraction equipment, piping system, and other site facilities. These costs are also presented in detail in Appendix D. Because the inspection and maintenance of the NTCRA system, the site, and the interceptor trench would be conducted during the same site visit, the labor costs for all inspection and maintenance tasks were estimated together. The required time for this site visit is expected to be approximately the same for all shutdown and trench maintenance options. The non-labor costs for the four trench maintenance options are presented separately in Section 3.3.

3.3 Trench Maintenance Alternatives Evaluation and Recommendations

This section presents the evaluation of several options available for removing accumulated oil from the oil interceptor trench.

3.3.1 Option 1 – Absorbents

Various types of absorbent materials are available that are capable of collecting oil. The type most applicable for collecting oil floating on the water surface in an interceptor trench are oil-only absorbents, formulated to absorb oil but repel water. The absorbents are available in several forms (i.e. pads, booms, socks, pillows) and in various sizes and absorbent capacities. Absorbents have been used historically at the Beede site to assist in collecting oil from the trench and from the adjacent wetlands. However, they have not been used alone to collect oil from the trench. Absorbent pads were used in the trench, in conjunction with skimmers, to collect the small amounts of oil not effectively captured by the skimmers.

Effectiveness

Absorbents are theoretically effective for collecting oil of virtually any thickness. However, each absorbent has a limited capacity and a limited area of influence and its overall effectiveness is limited by the required replacement frequency. The pads that have been used historically at the Beede site are approximately 3 square feet in size and have a maximum oil capacity of 0.375 gallons of oil. Because they don't create a gradient to draw the oil toward them except within a continuous oil pool, multiple absorbent pads would be required throughout length of trench to effectively capture the accumulated oil. The pads have to be removed from the trench and replaced periodically as they reached their saturation capacity. The effectiveness and efficiency of the absorbents is dependent on the amount of oil present, the placement of the absorbents, and the frequency of monitoring and maintenance (moving or replacement) of the absorbents. The effectiveness and efficiency are reduced if the rate of oil accumulation between monitoring/maintenance events exceeds the capacity of the absorbents or the absorbents are not situated properly to capture the oil.

Absorbents would be expected to be effective and efficient for collecting oil from the interceptor trench at the site only if the oil accumulation rate was relatively low and the pads could be situated appropriately to capture the oil seep. As the accumulation rate increases, the absorbents must be changed more frequently. Because personnel will not be on site to inspect the trench daily, the absorbents may reach saturation and be ineffective between inspection intervals. In this case, oil would accumulate beyond the capacity of the absorbents. Additionally, the configuration of the trench openings may result in decreasing the efficiency of the absorbents: because the small size of the openings into the trench makes monitoring and retrieving the absorbents difficult, they are likely to remain in the trench after they have reached saturation.

Implementability

Absorbents are simple to use and require no electricity or specialized equipment or training. They are simply placed in the trench and removed using long-handled tools (i.e. hooks) when they appear to have reached their absorbent capacity. However, because of the small size of the openings into the trench and the depth of the trench below the ground surface, the absorbents can be difficult to monitor and retrieve, especially from remote corners of the trench boxes. Absorbent materials and tools could be stored inside the vacuum extraction equipment buildings. Used absorbents could be placed in 55 gallon drums stored in the covered drum storage area.

Costs

The cost for using absorbents to maintain the trench is the sum of the capital cost for materials and supplies (absorbents + tools + drums for storage), the cost to dispose of the oil-saturated absorbents, and the labor involved in deploying and replacing the pads. Because the volume of oil to be collected from the trench is not known, costs were estimated for three hypothetical oil accumulation rates which encompass the rates likely to occur: 1 gallon per month, 3 gallons per month, and 6 gallons per month (slightly less than the average rate before installation of the vacuum extraction system).

The labor costs are not included in the cost estimates for maintenance because it is assumed that the labor for monitoring and maintenance will be approximately the same for each option. The labor costs for monitoring and maintaining the trench are estimated separately and presented in Sections 2.1.2 and 2.2.2. The estimated costs for trench maintenance option 1 are presented below. Cost estimates are provided for a 1-year period based on the remaining period in TtNUS' contract with EPA; and for a 3-year period because it is estimated that the system may be shut down for 3 years before the final remedial action commences at the site. Present worth costs were calculated using a 3-year discount rate of 3.7 percent (OMB, 2005). The assumptions and details of costing are presented in Appendix D.

Cost Type	Potential Oil Accumulation Rate Gallons per Month (Gallons per Year)		
	1 (12)	3 (36)	6 (72)
Initial Capital Costs	$25	$25	$25
Averaged Monthly Costs	$21	$56	$107
Annual Costs	$256	$667	$1,284
Total 1-Year Present Worth Cost	272	668	1,263
Total 3-Year Present Worth Cost	739	1,887	3,609

3.3.2 Option 2 – Passive Skimmers (Filter Buckets)

Passive skimmers are used to recover free-floating hydrocarbons in extraction wells or recovery trenches. The passive skimmer consists of a floating intake head with a hydrophobic-oleophilic filter, an integral product collection canister, and a flexible product transfer tube. The skimmer is placed in the trench with a tether to hold the skimmer in place and allow for its retrieval. The oil intake cartridge floats at the product-water interface. LNAPL enters the cartridge through the oleophilic-hydrophobic filter, and flows down through the flexible tube and into the collection canister. As liquid accumulates in the canister, it rides lower in the water, while the filter cartridge remains at the product-water interface. To empty the collection canister, it is pulled to the surface and the canister is drained into a storage drum.

The filter on the floating intake head is designed to allow product with a specific gravity of less than 1.0 to pass, but to repel water. Two types of filter cartridges are available: 100 mesh for lighter oils (viscosity up to 20 centiStockes) and 60 mesh for heavier oils (viscosity up to 60 centiStockes).

As discussed in Section 3.1 above, passive skimmers (Filter Bucket™ manufactured by ORS Environmental Systems) have been used for collecting oil from the Beede interceptor trench. Four of the skimmers remain in storage at the site. The canisters are still in working condition, but they would need new intake/filter cartridges if they were to be used again.

<u>Effectiveness</u>:

The manufacturer's literature states that the passive skimmers are designed to repel water and are capable of collecting LNAPL of any thickness down to a sheen (<0.01 inches). However, in practice at the Beede site, when little oil was present (less than approximately 0.1 inches), water eventually seeped through the screen and filled or partially filled the collection canister, rendering the skimmer ineffective until emptied. A potential factor in decreased effectiveness and efficiency of the skimmers for thin oil layers is that the viscosity of oil in the trench was higher than the rated viscosity range of the filters. Oil samples from the trench have had viscosities of up to 100 centiStokes, whereas the filters used were rated for 20 and 60 centi-Stokes. The filters effectively and efficiently collected the more viscous oil when it was present in a thick layer, but were less effective as the thickness decreased, perhaps because a larger pressure gradient (i.e. thickness) is required for the more viscous oils to pass through the filter. When the oil layer was relatively thick (greater than 0.1 inches), the skimmers generally worked well and collected mostly oil. However, problems with clogging and bio-fouling of the screen sometimes reduced the effectiveness and efficiency of the skimmers, even when the oil layer was thick.

Product recovery rates for passive skimmers are relatively low and are directly related to the product viscosity and the product thickness in the trench. Recovery rates decrease with increased viscosity and decreased oil thickness. Because of their low recovery rates, passive skimmers generally have a small radius of influence. Before the operation of the NTCRA vacuum extraction system began, three passive skimmers were deployed to collect oil accumulating in approximately 50 feet of the trench. The three skimmers effectively collected oil from the trench when it was steadily entering in the trench at a rate of approximately 7 gallons per month. However, after start up of the vacuum extraction system, which significantly reduced the volume of oil entering the trench, the skimmers were less effective and efficient and required frequent inspection and emptying to remove accumulated water.

Implementability

Passive skimmer units could easily be implemented to maintain the interceptor trench after shutdown of the NTCRA vacuum extraction system. Passive skimmers (Filter Bucket™ manufactured by ORS Environmental Systems) have been used in the past to collect oil from the trench and four skimmers remain in storage at the site. The skimmers units are in working condition, but would need new intake/filter cartridges if they were to be used again. The cartridges are readily available from the manufacturer.

The passive skimmers are simple to use, with no specialized training and no power required. The cartridges are easily replaced and TtNUS staff are familiar with their use and maintenance requirements The skimmers are manually emptied and maintained. Regular maintenance and cleaning is required to keep the filters free of oil and scum build-up. Skimmer maintenance supplies could be stored inside the vacuum extraction equipment buildings. Recovered oil and water could be emptied from the skimmers into a lidded bucket and transferred into 55 gallon drums stored in the covered drum storage area.

Cost:

The cost for using passive skimmers to maintain the trench is the sum of the capital cost for materials and supplies (replacement filter cartridges + cleaning supplies + drums for storage), the cost to dispose of the collected oil and any collected water, and the labor involved in deploying, emptying, and maintaining the skimmers.

Because the volume of oil to be collected from the trench is not known, costs were estimated for three hypothetical oil accumulation rates which encompass the rates likely to occur: 1 gallon per month, 3 gallons per month, and 6 gallons per month (slightly less than the average rate before installation of the vacuum extraction system). The volume of water that would be collected and disposed was estimated based on estimated water/oil collection ratios for each oil accumulation rate. It was assumed that the oil collection efficiency of the skimmers would increase (and water/oil ratios would decrease) with increased oil accumulation rates because the skimmers would be deployed in the trench continuously and would collect less water when more oil was present. Water/oil ratios of 10:1; 1:1; and 1:4 were assumed for oil collection rates of 1, 3, and 6 gallons per month, based on historical observations at the site.

The labor costs are not included in the cost estimates for maintenance because it is assumed that the labor for monitoring and maintenance will be approximately the same for each option. The labor costs for monitoring and maintaining the trench are estimated separately and presented in Sections 2.1.2 and 2.2.2. The estimated costs for trench maintenance option 2 are presented below. Cost estimates are provided for a 1-year period based on the remaining period in TtNUS' contract with EPA; and for a 3-year period because it is estimated that the system may be shut down for 3 years before the final remedial action commences at the site. Present worth costs were calculated using a 3-year discount rate of 3.7 percent (OMB, 2005). The assumptions and details of costing are presented in Appendix D.

Cost Type	Potential Oil Accumulation Rate Gallons per Month (Gal per Year)		
	1 (12)	3 (36)	6 (72)
Initial Capital Costs	$2,200	$2,200	$2,200
Averaged Monthly Costs	$84	$56	$75
Annual Costs	$1,005	$676	$896
Total 1-Year Present Worth Cost	3,169	2,852	3,064
Total 3-Year Present Worth Cost	5,004	4,087	4,700

3.3.3 Option 3 – Industrial Wet Vacuum

Wet vacuums are used to collect spilled or accumulated fluids. The industrial wet vacuum consists of an electric or pneumatic vacuum that either has an integrated collection vessel or sits on top of a 55-gallon drum. The fluid is collected via a vacuum hose and transferred directly into the collection vessel through the vacuum. A wet vacuum could be used to recover accumulated oil from the interceptor trench using the same method that has been used to recover oil with the NTCRA vacuum extraction system. The vacuum tube would be lowered into the trench and held in place just above the oil/water interface (using a clamp system) and allowed to vacuum the oil from the water surface, slowly drawing the oil toward the tube. The tube would be left there until all the oil has been skimmed from the trench. Some water would be collected along with the oil.

Effectiveness:

Industrial wet vacuums are commercially available that are capable of evacuating the oil from the interceptor trench at the Beede site and transferring it into a collection drum. An estimated vacuum flow rate of 35 to 50 cubic feet per minute (CFM) is needed to lift fluid from the trench into a collection vessel. Commercially available wet vacuums have flow rates beginning at 105 CFM.

A wet vacuum would effectively collect any thickness of oil; however the efficiency of collection would be greater for a thicker layer (a higher water/oil ratio would be expected as oil thickness decreases to a sheen). For maximum efficiency, the oil would be allowed to accumulate into a layer approximately 1/8th inch thick before skimming. It is anticipated that the skimming effectiveness of the wet vacuum would be similar to that of the NTCRA vacuum extraction system. Like the NTCRA system, the wet vacuum creates a pressure gradient that draws oil toward the collection point, making it possible to skim oil from one point in the trench (or multiple points). The only anticipated difference in effectiveness between skimming with a wet vacuum and the NTCRA vacuum system is that skimming may be somewhat slower with the wet vacuum than with the NTCRA system due to the lower vacuum flow rate and resulting smaller radius of influence of the wet vacuum.

Implementability

Industrial wet vacuums could easily be used to maintain the interceptor trench after shutdown of the NTCRA vacuum extraction system. Wet vacuums of adequate size and vacuum flow rate are readily available from many sources. Electric and pneumatic vacuums that would be capable of skimming the Beede trench are readily available. Pneumatic vacuums require the use of a compressor, which would be available at the site if the NTCRA systems were left in operational condition (partial shutdown option A). Electric vacuums require standard 110 volt electrical service, which is available at the utility pole near the NTCRA equipment buildings.

Wet vacuums are simple to use, with no specialized training required. A small storage shed would be needed near the trench to store the vacuum and supplies. To eliminate the difficulties associated with moving a full drum of fluid from the trench area, the oil and water collected in the vacuum collection vessel would be regularly transferred into 55-gallon drums stored in the covered drum storage area near the former operations building. A lidded bucket would be used to transfer the fluid to prevent spills. It is assumed that the oil and water collected by the vacuum would be allowed to settle in the vacuum vessel or separate container before being transferred to storage containers.

Cost:

The cost for using an industrial wet vacuum to maintain the trench is the sum of the costs for equipment and supplies (vacuum + storage shed + cleaning supplies + drums for storage), electricity to operate the vacuum, disposal of the collected oil and water, and the labor involved in operating and emptying the vacuum.

Because the volume of oil to be collected from the trench is not known, costs were estimated for three hypothetical oil accumulation rates which encompass the rates likely to occur: 1 gallon per month, 3 gallons per month, and 6 gallons per month (slightly less than the average rate before installation of the vacuum extraction system).

The volume of water that would be collected and disposed was estimated based on an estimated water/oil collection ratio for each oil accumulation rate. Because it is assumed that the oil would be allowed to accumulate into a layer approximately 1/8th inch thick before skimming, the collection efficiency and water/oil ratio is assumed to be the same for the three oil collection rates. For costing purposes, a water/oil ratio of 6:1 was assumed based on the estimated ratios for historical skimming the trench using the vacuum extraction system.

The labor costs are not included in the cost estimates for maintenance because it is assumed that the labor for monitoring and maintenance will be approximately the same for each option. The labor costs for monitoring and maintaining the trench are estimated separately and presented in Sections 2.1.2 and 2.2.2. The estimated costs for trench maintenance option 3 are presented below. Cost estimates are provided for a 1-year period based on the remaining period in TtNUS' contract with EPA; and a 3-year period because it is estimated that the system may be shut down for 3 years before the final remedial action commences at the site. Present worth costs were calculated using a 3-year discount rate of 3.7 percent (OMB, 2005). The assumptions and details of costing are presented in Appendix D.

Cost Type	**Potential Oil Accumulation Rate Gallons per Month (Gallons per Year)**		
	1 (12)	**3 (36)**	**6 (72)**
Initial Capital Costs	$1,180	$1,180	$1,180
Averaged Monthly Costs	$54	$152	$299
Annual Costs	$650	$1,826	$3,590
Total 1-Year Present Worth Cost	1,807	2,941	4,642
Total 3-Year Present Worth Cost	2,994	6,276	11,200

3.3.4 Option 4 – NTCRA Vacuum Extraction Unit

One of the NTCRA vacuum extraction units could be used to maintain the oil interceptor trench after shutdown of the NTCRA system if Shutdown Option A (partial shutdown) is selected. In that case, the vacuum extraction equipment would remain operational and the equipment buildings would be heated during the winter to prevent equipment damage.

As discussed above in Section 3.2, the NTCRA vacuum extraction system has been used since the spring of 2000 to maintain the interceptor trench. Maintenance has been conducted using an extraction system drop tube from a well near the interceptor trench. The drop tube is lowered into the trench and held in place just above the oil/water interface (using a clamp system) and allowed to vacuum the oil from the water surface, slowly drawing the oil toward the tube. The tube is left there until all the oil has been skimmed from the trench, typically about two hours. Using this method, the fluid (a mix of oil and water) skimmed from the trench is transferred through the extraction system transmission piping, through the vacuum extraction and separation equipment, and into separate oil and water storage tanks.

If the vacuum extraction system were to be used to maintain the interceptor trench after shutdown of the NTCRA, the skimming would be conducted in a similar manner. However, because partial shutdown would involve returning the rented water storage tank and disconnecting and cleaning waste transfer lines to the oil storage tank, and not operating the heat-trace tape on most of the transmission piping, minor changes to the process would be required. Instead of discharging to the storage tanks, the collected fluids would remain in and be stored within the extraction system(s) (in the oil/water separators and equalization tanks). The stored fluids would then be collected for disposal as a bulk fluid (mixed oil and water). Because the expected volume of fluids to be collected monthly (less than 50 gallons) is much smaller than the total storage capacity of the extraction systems (approximately 375 gallons each system), the systems can adequately handle the anticipated volume. The trench would be evacuated using a drop tube from an extraction well near the trench. It may be necessary to modify drop tubes or run tubes from alternate transmission pipelines to reduce the potential for freezing of the tubes. To prevent problems due to freezing lines, the section of the existing heat trace network on the transmission piping to be used for trench skimming could be isolated from the rest of the heat trace system and operated as needed, or an alternate piping method could be used, such as running a drop tube directly from the vacuum extraction unit to trench (bypassing the transmission piping). The tube could be heated separately or taken into the heated equipment building when not in use.

Effectiveness:

The NTCRA vacuum extraction system has been effectively used to maintain the interceptor trench at the Beede site for the past 5 years. The system would be expected to perform similarly even with the minor system changes that would be required due to the partial shutdown of the NTCRA. The vacuum extraction system would effectively collect any thickness of oil; however the efficiency of collection would be greater for a thicker layer (a higher water/oil ratio would be expected as oil thickness decreases to a sheen). For maximum efficiency, the oil would be allowed to accumulate into a layer approximately 1/8th inch thick before skimming. The vacuum system creates a pressure gradient that draws oil toward the collection point, making it possible to skim oil from one point in the trench (or multiple points). Using this method, the oil typically can be skimmed from the trench in about two hours.

Implementability

The NTCRA vacuum extraction system could easily be used to maintain the interceptor trench after a partial shutdown of the NTCRA. Minor modifications to the drop tubes and heat-trace system may be required to facilitate its use for trench maintenance. These changes would be easily accomplished by TtNUS staff using readily available equipment and materials.

This option is implementable ONLY if Shutdown Option A (partial shutdown) is selected and the extraction equipment remains operational and the equipment buildings are heated in the winter.

Cost:

The cost for using one of the NTCRA vacuum extraction units to maintain the trench is the sum of the costs for equipment to modify the extraction system (drop tubes and heat trace), operation and maintenance supplies (fuses, cleaning supplies), electricity to operate the extraction system, disposal of the collected oil and water, and the labor involved in operating and emptying the vacuum extraction system.

Because the volume of oil to be collected from the trench is not known, costs were estimated for three hypothetical oil accumulation rates which encompass the rates likely to occur: 1 gallon per month, 3 gallons per month, and 6 gallons per month (slightly less than the average rate before installation of the vacuum extraction system).

The volume of water that would be collected and disposed was estimated based on an estimated water/oil collection ratio for each oil accumulation rate. Because it is assumed that the oil would be allowed to accumulate into a layer approximately 1/8th inch thick before skimming, the collection efficiency and water/oil ratio is assumed to be the same for the three oil collection rates. For costing purposes, a water/oil ratio of 6:1 was assumed based on the estimated ratios for historical skimming the trench using the vacuum extraction system.

The labor costs are not included in the cost estimates for maintenance because it is assumed that the labor for monitoring and maintenance will be approximately the same for each option. The labor costs for monitoring and maintaining the trench are estimated separately and presented in Sections 2.1.2 and 2.2.2. The estimated costs for trench maintenance option 3 are presented below. Cost estimates are provided for a 1-year period based on the remaining period in TtNUS' contract with EPA; and a 3-year period because it is estimated that the system may be shut down for 3 years before the final remedial action commences at the site. Present worth costs were calculated using a 3-year discount rate of 3.7 percent (OMB, 2005). The assumptions and details of costing are presented in Appendix D.

Cost Type	**Potential Oil Accumulation Rate Gallons per Month (Gallons per Year)**		
	1 (12)	**3 (36)**	**6 (72)**
Initial Capital Costs	$480	$480	$480
Averaged Monthly Costs	$60	$88	$130
Annual Costs	$717	$1,053	$1,557
Total 1-Year Present Worth Cost	1,172	1,496	1,982
Total 3-Year Present Worth Cost	2,482	3,419	4,826

3.3.5 Trench Maintenance Alternatives, Conclusions, and Recommendations

This section presents the summary and recommendations of the evaluation of trench maintenance alternatives.

Evaluation Summary and Conclusions

Trench maintenance option 3 (industrial wet vacuum) and option 4 (using the NTCRA vacuum system) are expected to be the most effective options for collection of oil from the interceptor trench. Both methods are effective for any accumulation of oil and create a gradient in the trench to draw oil from all areas within the trench to the collection point. Use of the NTCRA vacuum system for trench maintenance has been proven effective during the past 5 years of NTCRA operation. A wet vacuum operates on the same principle and would be expected to perform similarly. Option 3 would require that electrical service (110 volt) be continued at the pole near the extraction equipment buildings. Option 4 would only be possible if NTCRA system Shutdown Option A is selected and one extraction unit remains in operational condition. The costs of these two options are in the middle of the range of the options evaluated.

Trench maintenance option 1 (absorbents) is expected to be effective and efficient for collecting oil from the interceptor trench if the oil accumulation rate is low. As the accumulation rate increases, the absorbents must be changed more frequently and may reach saturation and be ineffective between inspection intervals. In this case, oil would accumulate beyond the capacity of the absorbents. However, Option 1 is the easiest and the lowest cost of the maintenance alternative to implement.

Trench maintenance option 2 (passive skimmers) is expected to be effective only for high oil accumulation rates and thick accumulations of oil. Past experience with the skimmers at the site has shown that their effectiveness declines significantly when the oil layer decreases to less than approximately 1/8 of an inch.

Cost Comparison Summary

A comparison of the costs of the four evaluated trench maintenance options is presented below. Cost estimates are provided for a 1-year period based on the remaining period in TtNUS' contract with EPA; and a 3 year period because it is estimated that the system may be shut down for 3 years before the final remedial action commences at the site. Present worth costs were calculated using a 3-year discount rate of 3.7 percent (OMB, 2005). See Appendix D for the detailed cost estimate.

OIL ACCUMULATION RATE/ COST TYPE	OPTION 1 Oil-Only Absorbents	OPTION 2 Passive Skimmers	OPTION 3 Industrial Wet Vacuum	OPTION 4 NTCRA Vacuum System
1 GALLON/MONTH (12 GAL/YEAR)				
INITIAL CAPITAL COSTS	$25	$2,200	$1,180	$480
AVERAGED MONTHLY COSTS	$21	$84	$54	60
ANNUAL COSTS	$256	$1,005	$650	717
Total 1-Year Present Worth Cost	**272**	**3,169**	**1,807**	**1,172**
Total 3-Year Present Worth Cost	**739**	**5,004**	**2,994**	**2,482**
3 GALLONS/MONTH (36 GAL/YEAR)				
INITIAL CAPITAL COSTS	$25	$2,200	$1,180	$480
AVERAGED MONTHLY COSTS	$56	$56	$152	88
ANNUAL COSTS	$667	$676	$1,826	1,053
Total 1-Year Present Worth Cost	**668**	**2,852**	**2,941**	**1,496**
Total 3-Year Present Worth Cost	**1,887**	**4,087**	**6,276**	**3,419**
6 GALLONS/MONTH (72 GAL/YEAR)				
INITIAL CAPITAL COSTS	$25	$2,200	$1,180	$480
AVERAGED MONTHLY COSTS	$107	$75	$299	130
ANNUAL COSTS	$1,284	$896	$3,590	1,557
Total 1-Year Present Worth Cost	**1,263**	**3,064**	**4,642**	**1,982**
Total 3-Year Present Worth Cost	**3,609**	**4,700**	**11,200**	**4,826**

Recommendations

Two trench maintenance options are recommended for further evaluation. Oil-only absorbents (option 1) were identified as the lowest cost method, but may not be effective or efficient for all oil accumulation rates. Use of the NTCRA vacuum system (option 4) is the second lowest cost alternative, but is expected to be the most effective and efficient for any oil accumulation rate. Because the rate that oil will accumulate in the trench after shut down of the NTCRA vacuum extraction system is not known, it is recommended that EPA delay final selection of a trench maintenance method until the trench is inspected for approximately 2 months after shutdown. The 2-month evaluation period is recommended to allow the subsurface to reach equilibrium after the vacuum extraction system is shut down and to allow adequate time to observe oil accumulation rates and test and evaluate the two maintenance methods. Initially, and if the accumulation rate is determined to be low, it is recommended that oil-only absorbents (option 1) be used to maintain the trench. If the accumulation rate is determined to be too high for effective and efficient use of absorbents, it is recommended that the NTCRA extraction system (option 4) be used to maintain the trench. This option could be easily and quickly implemented if selected, provided that Shutdown Option A (partial shutdown) was selected. This shutdown option would provide the highest degree of certainty that the NTCRA extraction system would remain in working condition and be available quickly for start-up if needed, and it would allow maximum flexibility for any potential future use of the NTCRA extraction system.

4.0 OIL OUTBREAK EVALUATION

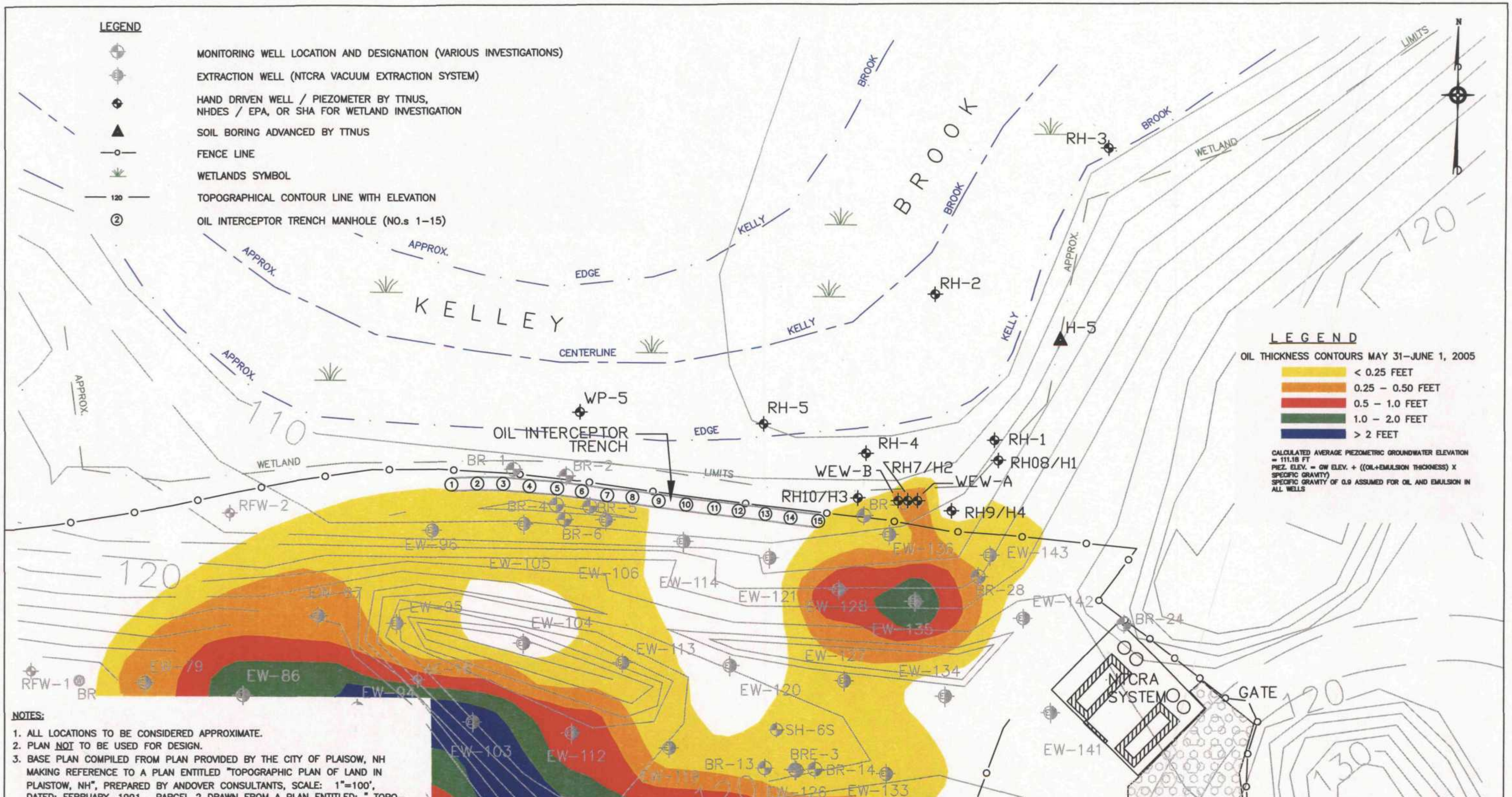
During the late winter and early spring of 2005, Tetra Tech NUS, Inc. (TtNUS) personnel observed an orange/brown colored stain and sheen within the wetland area beyond the perimeter fence north/northeast of NTCRA system extraction wells EW-136 and EW-143 (Figure 1). On closer inspection it was confirmed that there was a petroleum odor and a sheen on standing water within the wetlands in the apparent outbreak area. There also appears to be an inorganic and/or biological component to the sheen consisting of an orange/brown film that breaks up readily when disturbed. TtNUS personnel continued to visually monitor and report their observations during the spring as water level variations modified the surface water and groundwater flow patterns. TtNUS installed 2-inch diameter oil absorbent booms at nine locations in small channels within the Kelley Brook wetland/floodplain where the orange-brown petroleum sheen was observed. The booms are anchored on both sides of each channel to allow the booms to rise and fall with water level variations. Photographs 1, 2, and 3 in Appendix E shows the observed staining in the late winter and spring of 2005.

Following an inspection by EPA personnel, TtNUS was directed to conduct a field investigation within the wetland area to investigate the apparent outbreak to determine whether the LNAPL is residual product from previously noted site contamination or part of ongoing LNAPL migration.

4.1 Wetland Oil Outbreak Investigation History

Oil was observed in the Kelley Brook wetland adjacent to the northern side of the site as early as 1992. The outbreak area was situated approximately 80 to 120 feet west of the location of the current area of investigation. The New Hampshire Department of Environmental Services (NHDES) installed and maintained oil-absorbent booms in this western area of the wetland for several years beginning in 1992.

In March of 1997 a series of six shallow piezometers (RH1-RH6) were installed in the Kelley Brook wetland adjacent to the site by EPA and NHDES personnel to investigate a possible oil breakout east of the historical outbreak, in the approximate area of the current investigation. The piezometer locations are shown on Figure 1. These hand driven wellpoints were monitored and sampled on March 19, 1997 and April 9, 1997. No free oil was noted during either monitoring event. The presence of an additional oil outbreak was not confirmed.



NOTES:

1. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.
2. PLAN NOT TO BE USED FOR DESIGN.
3. BASE PLAN COMPILED FROM PLAN PROVIDED BY THE CITY OF PLAISOW, NH MAKING REFERENCE TO A PLAN ENTITLED "TOPOGRAPHIC PLAN OF LAND IN PLAISTOW, NH", PREPARED BY ANDOVER CONSULTANTS, SCALE: 1"=100', DATED: FEBRUARY, 1991, PARCEL 2 DRAWN FROM A PLAN ENTITLED: " TOPOGRAPHIC WORKSHEET OF A PARCEL IN PLAISTOW, NH" PREPARED BY EASTERN TOPOGRAPHICS, SCALE: 1"=40', DATED: JANUARY, 1990 AND A PLAN LABELLED: "U.S. ARMY CORPS OF ENGINEERS, U.S. ENVIRONMENTAL PROTECTION AGENCY, SITE NAME: BEEDE WASTE OIL, CITY NAME: PLAISTOW, NH, ... PROJECT NO. 1NH4251030710612, DATE OF PHOTOGRAPHY: MAY 07, 1996, DATE OF PREPARATION: FEBRUARY 1997, SCALE: 1"=300', CONTOUR INTERVAL: 2'.
4. LOCATIONS INDICATED BY ⊕ OR ▲ WERE SURVEYED BY TTNUS ON JUNE 3, 2005 USING GPS (SUB-METER ACCURACY).

OIL OUTBREAK EVALUATION FEATURES				FIGURE 1
BEEDE WASTE OIL SITE				TETRA TECH NUS, INC.
PLAISTOW, NEW HANPSHIRE				55 Jonspin Road Wilmington, MA 01887 (978)658-7899
DRAWN BY:	D.W. MACDOUGALL	REV.:	0	
CHECKED BY:	T. DORGAN	DATE:	SEPTEMBER 26, 2005	
SCALE:	AS NOTED	FILE NO.:	I:\DWG\4103\1020\JUNE_2005_2.DWG	

Additional shallow well points were installed in the Kelly Brook wetland by Sanborn, Head & Associates as part of the remedial investigation (RI) activities for the site in September 1997. These drive points are labeled WP-3 through WP-18 and cover a much larger study area of Kelly Brook than the immediate area where the petroleum outbreak has historically been noted.

In October 1997 an oil interceptor trench was installed at the edge of the wetlands, beginning approximately 25 feet west of the location of the current potential outbreak and extending 100-feet west (see trench manholes 15 to 4 on Figure 1). The trench was installed to address an active oil outbreak in that area and was used in a treatability study evaluation of various oil collection technologies. The trench effectively stopped migration of additional oil into the wetland, but did not address the oil that had already migrated beyond the trench and remained in wetland soils. TtNUS installed and maintained oil-absorbent booms in the wetland for about 1 year after installation of the trench. The wetlands were inspected regularly thereafter, but no discernable oil (other than sheen) was noted downgradient from trench or in the area of the current investigation. The trench was extended 24 feet to the west in November 1999 to prevent an additional outbreak from an area where oil had been observed in soils adjacent to the wetland during construction of the initial trench.

Measurements of LNAPL thicknesses in the extraction well network made prior to start up of the NTCRA vacuum extraction system (January 2000) indicate that the oil plume extended beyond the site perimeter fence at that time, but it is not known how far the plume extended into the wetland. One of the two extraction wells closest to the current area of investigation (EW-143) contained 1.95 feet of oil in January 2000. This well has contained a significant thickness of oil during most monitoring events (typically greater than 0.3 feet) and has consistently produced recoverable quantities of oil throughout the period of NTCRA operation. The other nearby well (EW-136) did not contain a measurable thickness of oil in January 2000, but has contained measurable oil (0.01 to 0.7 feet) during most of the subsequent monitoring events. Well EW-136 has been much less consistent in its oil production, often yielding little oil before turning over to water. The findings from oil thickness measurement rounds conducted as part of the NTCRA operations have consistently indicated a divergent plume of oil in the area of the Kelley Brook wetland, with the western portion of the plume being intercepted by the trench and the eastern finger of the plume being addressed by NTCRA extraction wells EW-128, EW-135, EW-136, and EW-143, located east of the interceptor trench. It is believed that the plume divergence in this area is caused by the presence of less permeable landfill materials in the subsurface that have obstructed the flow of oil. The plume geometry is illustrated on Figure 1.

4.2 Field Investigation

Field investigation activities were initiated by TtNUS on May 19th, 2005 in the area of the apparent oil seep. Initial activities included clearing brush and vegetation sufficiently to allow physical access and to ease locating previously installed piezometers. In addition to the six well points installed in 1997 (RH1 through RH6), two of the Sanborn, Head & Associates well points (WP-5 & WP-6) are in the vicinity of the apparent oil outbreak. Of these eight existing piezometers only seven were located. Only RH6 was not relocated and checked. This piezometer is located well upstream (west) of the observed petroleum breakout so no further efforts were made to find it. The WP-6 piezometer is not in a useable condition due to polyethylene tubing which is stuck inside the 1 inch inside diameter galvanized pipe. Multiple attempts were made to remove the obstruction without success. Piezometers RH-1 and RH-2 were both found to be nearly filled in with sediment and were removed and cleaned using a pressure washer at the decontamination pad. Upon removal, the well point screens were inspected and found to be very heavily corroded in addition to being nearly completely fouled in the interval between the ground surface and approximately 1 foot below ground (see photos 4 and 5 in Appendix E). The material fouling the well screens had a petroleum odor but may also be caused by biofouling in the area where the water table fluctuates. After cleaning, the piezometers were re-inserted in their original locations. Although the well screens were heavily corroded, they were open to flow, but probably not functioning optimally.

A series of hand excavations were advanced into the overburden materials using shovels and hand-augers in an attempt to cross the water table and get a sense of the soil stratigraphy and presence of oil in the subsurface within the study area. Depths of these excavations ranged from 0.5 to 4.0 feet below ground surface (bgs). The water table was encountered at five of these locations identified as H-1 through H-5 (shown on Figure 1). Soil descriptions were logged at these five locations. Boring logs for the excavations are provided in Appendix F.

In general the soil stratigraphy consists of a pattern of brown sandy fill overlying the former wetland soils. This is consistent with the site history in this area where landfilling was documented. Man-made debris including metal fragments and wire were found during excavation of this material. The fill unit changes to a coarser grained sand and gravel unit approximately 0.25 to 0.5 feet thick directly overlying the wetland deposits. Typically the first evidence of petroleum contamination, usually an odor and dark stained soils, was noted within the coarse grained sand and gravel, although this unit was not saturated at the time of excavation.

The wetlands soils encountered below this coarse grained unit were very soft, loose, and easily penetrated. The wetland soils typically consisted of organic rich silt and sand, but peat was noted at H1 at 3.25 feet bgs and at H4 at 0.9 feet bgs. The heaviest petroleum contamination and saturated conditions were noted within this wetland soil unit at most of the locations. Evidence of petroleum contamination was encountered at each excavation except H5. The heaviest petroleum contamination was encountered at H2 and H4. At both of these locations, pools of LNAPL formed within minutes on the water that filled the excavations.

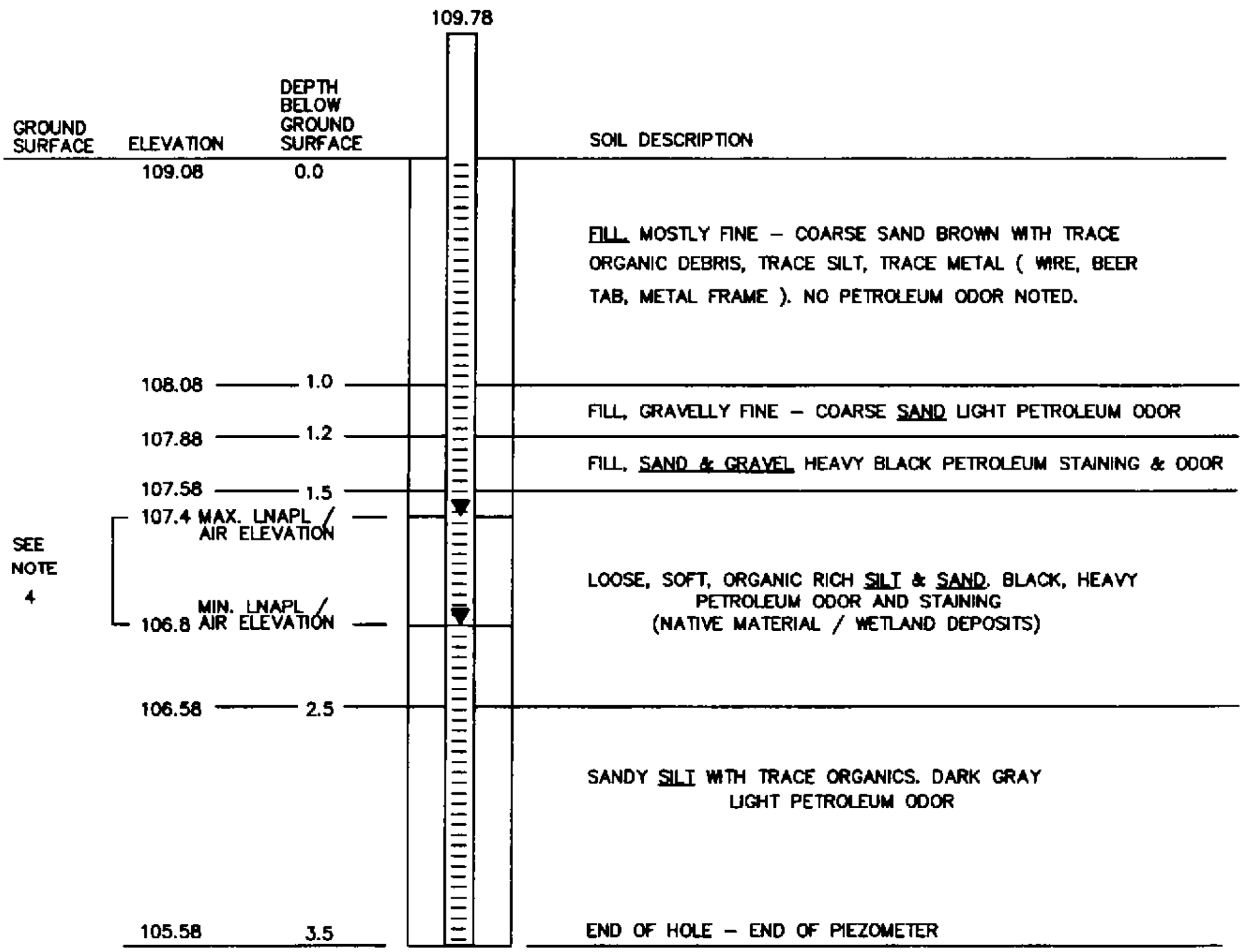
In addition to the petroleum odor noted at H1, a more pungent odor was also noted from the dark stained sand and gravel observed at 2.8 feet bgs. This same location and interval had the highest VOC concentration noted from any of the soils (10.0 ppm in open air, measured using a photo ionization detector). Oxidation staining was noted at many of the excavations directly above the most significant contamination, indicating occasional periods of upward movement of the water table.

A detailed description and cross section of the H2 excavation is provided as the clearest example of the findings (Figure 2). This location was also selected because it has consistently had a significant amount of LNAPL accumulation.

At the four hand excavation locations where evidence of oil contamination was observed (H-1 through H-4), 1.25 inch inside diameter, 0.010 inch slotted PVC well screen was installed to serve as a temporary piezometer or observation well. These observation wells are identified as RH-7 through RH-10 to continue the identification system initiated by the NHDES/EPA personnel during the initial investigation of this possible outbreak area (see Figure 1).

Following the installation of the PVC piezometers within the excavations, each hole was backfilled with either soil cuttings or uniform fine-coarse grained sand to act as a filter pack. An

BORING H2 / PIEZOMETER RH7



NOTES:

1. SOIL DESCRIPTIONS FROM HAND EXCAVATED BORING CONDUCTED ON 5/19/05.
2. ELEVATION DATUM IS NGVD 29 (FEET). BM USED INVERT OF MANHOLE 15 (ELEV.= 111.61)
3. PIEZOMETER INSTALLED IN OPEN HOLE 05/19/05. 1-INCH INSIDE DIAMETER, 0.010-INCH SLOTTED PVC, 4-FEET LONG AND WELL ID = RH-7.
4. TRIANGULAR SYMBOL (▼) INDICATES MAXIMUM AND MINIMUM LNAPL / AIR INTERFACE ELEVATIONS OBSERVED DURING INVESTIGATION ON 5/27/05 & 5/20/05 RESPECTIVELY.

SOIL BORING/PIEZOMETER CONSTRUCTION LOG (H2/RH-7)				FIGURE 2
BEEDE WASTE OIL SITE				TETRA TECH NUS, INC.
PLAISTOW, NEW HAMPSHIRE				
DRAWN BY:	D.W. MACDOUGALL	REV.:	1	
CHECKED BY:	D. BAXTER	DATE:	SEPTEMBER 28, 2005	55 Jonspin Road Wilmington, MA 01887
SCALE:	NONE	ACAD NAME:	I:\DWG\4103\1020\H2-RH7_SOILS.DWG	(978)658-7899

oil/water interface probe was used to monitor the elevations of the contents of each existing and new piezometer multiple times over a 1-month period from May 19 to June 21, 2005. Although free oil was noted in the open excavations at H2 and H4, only the RH-7 piezometer installed in H2 has contained a significant quantity of LNAPL. Approximately 0.01 feet (1/8 inch) of oil and approximately 0.1 feet (1.2 inches) of emulsion were detected in RH-9 (installed in H4) within 3 hours of its installation, but only a sheen has been detected in it since that time. A petroleum sheen and possible metals flocculent has been noted in all of the other piezometers, including the original RH 1-6 piezometers installed by NHDES and EPA, but none other than RH-7 has contained a measurable thickness of oil.

On June 3, 2005 all piezometers in the study area wetland were surveyed by TtNUS using GPS to determine their horizontal locations to sub meter accuracy. On June 10, 2005 selected locations were surveyed by TtNUS for the elevations of ground surface and top of piezometer. The elevation survey was conducted using a transit/stadia rod, using the invert elevation of manhole 15 as the control point.

On June 14 and 15, 2005 TtNUS personnel installed two larger diameter wells (WEW-A and WEW-B) adjacent to RH-7 to use as extraction wells in attempt to recover additional oil. Well installation involved excavating two holes, approximately 3 feet east and west of RH-7. Each hole was approximately 1.5 to 2 feet in diameter and extended below the water table. A small quantity of free oil was observed entering both open excavations. A 4-inch inside diameter PVC pipe with 1/8 inch vertical hand cut slots was installed in each excavation and backfilled with clean fine-coarse sand. Both of these hand dug extraction wells have been monitored and evacuated multiple times with very little petroleum being noted, yet RH-7 continues to indicate multiple tenths of a foot of free product. A summary timeline of activities and measurements at RH-7 is provided below:

INVESTIGATION TIMELINE AT EXCAVATION H2 / PIEZOMETER RH-7

DATE	OIL THICKNESS	EMULSION THICKNESS	COMMENTS
5/19/05	NM	NM	Excavate H2 & Install RH-7
5/20/05	0.03 ft 0.05 ft	ND	0900 hrs 1415 hrs
5/23/05 - 5/26/05	NM	NM	Multiple heavy precipitation events cause groundwater and surface water rise.
5/27/05	0.16 ft	1.0 ft	

DATE	OIL THICKNESS	EMULSION THICKNESS	COMMENTS
6/2/05	0.36 ft	0.12 ft	Evacuated oil and emulsion using a drop-tube from EW-136 – ran for about 10 minutes.
6/3/05	0.15 ft	0.15 ft	
6/7/05	0.51 ft	ND	Evacuated oil using drop tube from EW-136 – ran for about 50 minutes.
6/8/05	0.22 ft	ND	
6/14/05	0.3 ft	ND	Evacuated oil using drop tube from EW-136 – ran for 5 to 10 minutes. Installed WEW-A and WEW-B three feet to the east and west of RH-7 to attempt to recover additional product.
6/16/05	0.2 ft 0.01 ft sheen	0.12 ft 0.04 ft ND	– Measured in RH7 – Measured in WEW-A – Noted in WEW-B Evacuated oil from RH-7, WEW-A and WEW-B using drop tube from EW-136 – ran for 5 to 10 minutes.
6/17/05	NM	NM	Evacuated oil from RH-7, WEW-A and WEW-B using drop tube from EW-136 – ran for 5 to 10 minutes.
6/21/05	0.44 ft	0.05 ft	Measured at RH-7

NM = not measured
ND = not detected

4.3 Oil Outbreak Evaluation Conclusions

Based on observations made during the investigation of the apparent outbreak, it appears that the orange/brown staining and oil sheen observed in the wetland channels downgradient from extraction wells EW-136 and EW-143 during the winter and spring of 2005 is derived largely from residual oil within wetland soils and, to a lesser extent from seepage from the edge of the oil plume in the northeast corner of the Beede site.

The consistent observation of multiple tenths of a foot of oil in piezometer RH7, even following the repeated evacuation of oil using the vacuum extraction system, indicates that mobile NAPL is present at this location. RH7 is located immediately upland from the delineated edge of the wetland, in an area that becomes submerged when the water levels in the Brook are very high during the spring. RH7 is located approximately 12 feet northeast of extraction well EW-136 and 30 feet northwest of well EW-143, which have both consistently contained measurable, mobile oil. Based on these observations, the fact that measurable oil was not observed in any of the other piezometers evaluated, and the fact that no active oil seeps were observed in the wetland stream channels, it appears that the mobile oil plume extends to the edge of the wetland area east of the interceptor trench, but does not appear to continue a significant distance into the wetland.

It is believed that most of the oil that is released to the surface water is residual (not mobile) oil on wetland soils that were contaminated by the oil plume prior to construction of the interceptor trench and NTCRA extraction system, and remained in place after construction of trench and the NTCRA system. The amount of oil seeping into the surface water channels has not been quantified, but appears to be relatively small and appears to be occurring only during periods of high surface water and groundwater levels. The oil occurs as a sheen on the water surface, mixed with what appears to be a biological/inorganic sheen or film. No distinct oil layer or oil seep location has been observed. TtNUS personnel have observed numerous cycles of precipitation events that cause the surface water to rise up and disperse the observed sheen. Subsequently, as water levels retreat, the surface water stagnates inside small braided channels within the already-contaminated wetland. It is during this lower, more stagnant flow period that the orange/brown sheen are observed in the small channels. Once the surface water level in the channels drops below the ground surface, the petroleum then adheres to the surface material. The next time the water level rises some of this residual petroleum is again released to the water to form a sheen. This repeated cycle is believed to explain much of the observed sheen and staining noted in the wetland.

In addition to residual oil being released to the surface water from the previously-contaminated wetland soils, it also appears that a small amount of mobile oil may be seeping into the surface water from the edge of the oil plume when surface water levels in the wetland are high (filling the stream channels or flooding the wetland). This active oil seep into the surface water is likely most significant at times of high groundwater elevation when the water table and mobile oil layer lie within the course grained sand and gravel unit. The seepage rate is likely to be much lower when the groundwater level is lower and the oil layer lies within the lower permeability wetland soils.

It can not be determined conclusively whether the oil plume migrated to the current investigation area before or after startup of the NTCRA. However, based on the fact that oil was observed seeping into the wetlands approximately 100 feet to the west as early as 1992, it is likely that the plume had reached the current outbreak area before construction of the NTCRA in 1999.

Based on the fact that a continuous oil seep into the wetland channels has not been observed, the mobile plume has likely not migrated much beyond piezometer RH7.

The NTCRA extraction well network was designed to capture the estimated extent of the oil plumes. The basis of the design and placement of the extraction wells in this area was to minimize or prevent further migration of LNAPL into the wetlands beyond the extraction well network. The edge of the wetland and piezometer RH7 are located within the theoretical (design) radius of influence of extraction well EW-136, which has been operated consistently throughout the duration of the NTCRA operation. As a result, operation of the NTCRA vacuum extraction system has likely been effective in minimizing further migration of the plume into the wetlands. The continuing presence of mobile oil at piezometer RH7 may result in part from heterogeneities in the subsurface materials in this area, especially the presence of landfill debris, which may decrease the effectiveness and capture radius of the vacuum extraction system in this area.

4.4 Oil Outbreak Evaluation Recommendations

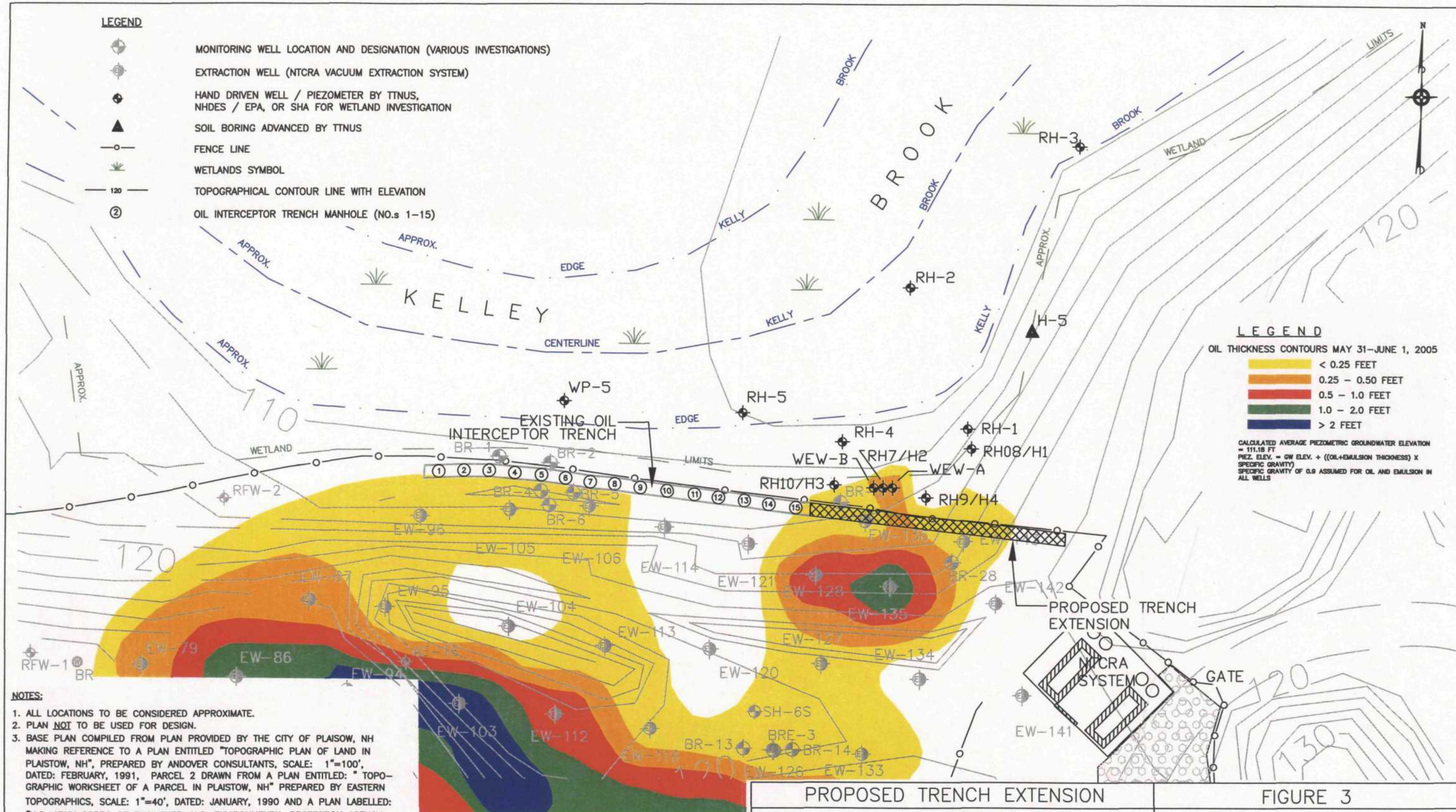
Based on the conclusions described in Section 4.3, the following recommendations are made to minimize oil seepage into the wetland in the event that the NTCRA extraction system is shut down and the extraction wells upgradient of the wetland are no longer available to prevent further migration of the plume.

1. Extend the oil interceptor trench approximately 80 feet to the east – If the NTCRA extraction system is to be shut down, it is recommended that the oil interceptor trench be extended to cut off the LNAPL plume extending into the wetland near extraction wells EW-136 and EW-143. This action would not remove any oil that has already migrated into the wetland, but it would prevent additional oil from reaching the area. This proposed location of the trench extension is shown on (Figure 3).

   The estimated cost to construct the trench extension is $59,165. The detailed cost estimate and assumptions are presented in Appendix G.

2. Maintain oil-absorbent boom in wetland – Oil-absorbent booms were installed in the wetland in the seep area during the spring of 2005. These booms should be inspected and maintained as needed to capture any observed oil seepage.

3. Operate vacuum extraction system upgradient from seep area until trench is installed – It is recommended that one of the NTCRA vacuum extraction units (system B), continue to operate to attempt to control any breakout into the wetland until an interceptor trench can be installed. The system could be operated at reduced frequency and possibly at less than maximum capacity. The primary requirement would be to run the extraction wells in the immediate area of the plume east of the interceptor trench (EW-135, EW-136, and EW-143).



NOTES:

1. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.
2. PLAN NOT TO BE USED FOR DESIGN.
3. BASE PLAN COMPILED FROM PLAN PROVIDED BY THE CITY OF PLAISOW, NH MAKING REFERENCE TO A PLAN ENTITLED "TOPOGRAPHIC PLAN OF LAND IN PLAISTOW, NH", PREPARED BY ANDOVER CONSULTANTS, SCALE: 1"=100', DATED: FEBRUARY, 1991. PARCEL 2 DRAWN FROM A PLAN ENTITLED: " TOPOGRAPHIC WORKSHEET OF A PARCEL IN PLAISTOW, NH" PREPARED BY EASTERN TOPOGRAPHICS, SCALE: 1"=40', DATED: JANUARY, 1990 AND A PLAN LABELLED: "U.S. ARMY CORPS OF ENGINEERS, U.S. ENVIRONMENTAL PROTECTION AGENCY, SITE NAME: BEEDE WASTE OIL, CITY NAME: PLAISTOW, NH, ... PROJECT NO. 1NH4251030710612, DATE OF PHOTOGRAPHY: MAY 07, 1996, DATE OF PREPARATION: FEBRUARY 1997, SCALE: 1"=300', CONTOUR INTERVAL: 2'.
4. LOCATIONS INDICATED BY ⊕ OR ▲ WERE SURVEYED BY TTNUS ON JUNE 3, 2005 USING GPS (SUB-METER ACCURACY).

PROPOSED TRENCH EXTENSION			
BEEDE WASTE OIL SITE			
PLAISTOW, NEW HANPSHIRE			
DRAWN BY:	D.W. MACDOUGALL	REV.:	0
CHECKED BY:	D. BAXTER	DATE:	SEPTEMBER 28, 2005
SCALE:	AS NOTED	FILE NO.:	I:\DWG\4103\1020\PROP_TR_EXT.DWG

FIGURE 3

TETRA TECH NUS, INC.

55 Jonspin Road Wilmington, MA 01887
(978)658-7899

REFERENCES

REFERENCES

OMB, 2005. Discount Rates for Cost Effectiveness, Lease Purchase, and Related Analyses. OMB Circular No. A-94 Appendix C, White House Office of Management and Budget. January 2005.

SCG Industries, 2005. Personal communication between TtNUS and SCG Industries Limited, June 16 and July 14, 2005.

APPENDIX A

NTCRA RESTART PROCEDURES

PROCEDURES FOR RESTARTING THE NTCRA VACUUM EXTRACTION SYSTEM AFTER SHUTDOWN PERIOD UNDER SHUTDOWN OPTION A – PARTIAL SHUTDOWN

1. Measure the elevation and thickness of oil and water in all extraction wells to evaluate baseline conditions.
2. Inspect and repair transmission piping system as needed. Piping system consists of polypropylene pipes (1.5-inch to 8-inch diameter), valves, heat tracing, insluation, and weather-proof insulation covering.
3. Install drop tubes in extraction wells (1" ID HDPE tubing). Each well requires tubing sufficient to reach bottom of well to connection valve at transmission piping (average length of 35 to 40 feet per well). It may not be necessary to install tubing in wells that do not contain measurable oil, particularly those that have not contained measurable oil for a prolonged period.
4. Re-attach heat trace line to drop tubes and secure foam pipe insulation over tubes and heat trace.
5. Bring water storage tank on site. (Previous tank was a rented 20,000 gallon fractionation tank.)
6. Connect transfer lines between extraction systems and storage tanks. Wrap the lines in heat-trace and pipe insulation and run through the conduit under the access road between the equipment buildings and tanks. Oil transfer lines consist of a short length of 1" ID HDPE tubing, stepped up to 2" ID HDPE tubing outside each building (the separate 2" ID lines go through conduit to oil storage tank. Water transfer lines are 1" ID HDPE tubing from each unit, connected into one 1" ID HDPE tube prior to the conduit.
7. Install tank heaters in water and oil storage tanks.
8. Move vapor-phase activated carbon treatment units from covered storage area to equipment pads and connect to air discharge points at each building.
9. Inspect multi-phase vacuum extraction equipment. Perform maintenance as needed.
10. Follow the start-up procedures described in the *Operations Manual for Multi-Phase Extraction and Separation at the Beede Oil Site* (SCG Industries Limited, May 2000).

EQUIPMENT AND MATERIAL NEEDED FOR RESTARTING
THE NTCRA VACUUM EXTRACTION SYSTEM
AFTER SHUTDOWN PERIOD UNDER SHUTDOWN OPTION A – PARTIAL SHUTDOWN

1. HDPE Tubing
   a. 1" ID tube for drop tube and waste transfer lines (est. 3000 - 6500 ft - quantity based on number of wells completed with drop tube)
   b. 2" ID tube for oil transfer lines (est. 250 feet)
2. Foam pipe insulation (approximately 10 to 15 feet per well depending on length of exposed drop tube)
3. Tie wraps to secure pipe insulation
4. Tape to secure heat trace
5. Hose clamps to connect drop tubing to valve fitting (1 per well)
6. Extraction equipment operation fluids and replacement parts as needed

PROCEDURES FOR RESTARTING THE NTCRA VACUUM EXTRACTION SYSTEM AFTER SHUTDOWN PERIOD UNDER SHUTDOWN OPTION B – COMPLETE SHUTDOWN

1. Measure the elevation and thickness of oil and water in all extraction wells to evaluate baseline conditions.
2. Inspect and repair transmission piping system as needed. Piping system consists of polypropylene pipes (1.5-inch to 8-inch diameter), valves, heat tracing, insluation, and weather-proof insulation covering.
3. Install drop tubes in extraction wells (1" ID HDPE tubing). Each well requires tubing sufficient to reach bottom of well to connection valve at transmission piping (average length of 35 to 40 feet per well). It may not be necessary to install tubing in wells that do not contain measurable oil, particularly those that have not contained measurable oil for a prolonged period.
4. Re-attach heat trace line to drop tubes and secure foam pipe insulation over tubes and heat trace.
5. Bring water storage tank on site. (Previous tank was a rented 20,000 gallon frac tank.)
6. Connect transfer lines between extraction systems and storage tanks. Wrap the lines in heat-trace and pipe insulation and run through the conduit under the access road between the equipment buildings and tanks. Oil transfer lines consist of a short length of 1" ID HDPE tubing, stepped up to 2" IDHDPE tubing outside each building (the separate 2" ID lines go through conduit to oil storage tank. Water transfer lines are 1" ID HDPE tubing from each unit, connected into one 1" ID HDPE tube prior to the conduit.
7. Install tank heaters in water and oil storage tanks.
8. Move vapor-phase activated carbon treatment units from storage area to equipment pads and connect to air discharge points at each building.
9. Remove covers/seals used to protect equipment buildings during shutdown period.
10. Inspect stored transfer pumps and repair as needed. Install the transfer pumps (one for water + one for oil) in each extraction unit.
11. Replace operation fluids in vacuum extraction equipment:
    a. liquid ring pumps – 30 gallons of vacuum pump oil (T-32) for each unit
    b. compressors – 32 ounces of compressor oil (ingersol synthetic) for each unit
12. Inspect multi-phase vacuum extraction equipment. Perform maintenance as needed.
13. Follow the start-up procedures described in the *Operations Manual for Multi-Phase Extraction and Separation at the Beede Oil Site* (SCG Industries Limited, May 2000).

EQUIPMENT AND MATERIALS NEEDED FOR RESTARTING THE NTCRA VACUUM EXTRACTION SYSTEM AFTER SHUTDOWN PERIOD UNDER SHUTDOWN OPTION B – COMPLETE SHUTDOWN

1. HDPE Tubing
   a. 1" ID tube for drop tube and waste transfer lines (est. 3000 - 6500 ft - quantity based on number of wells completed with drop tube)
   b. 2" ID tube for oil transfer lines (est. 250 feet)
2. Foam pipe insulation (approximately 10 to 15 feet per well depending on length of exposed drop tube)
3. Tie wraps to secure pipe insulation
4. Tape to secure heat trace
5. Hose clamps to connect drop tubing to valve fitting (1 per well)
6. Extraction equipment operation fluids:
   a. vacuum pump oil (T-32) – approximately 30 gallons for each pump
   b. compressor oil (ingersol synthetic) – 32 ounces for each compressor
7. Extraction equipment replacement parts as needed

APPENDIX B

ADDENDUM TO OPERATIONS MANUAL FOR NTCRA EXTRACTION SYSTEM

ADDENDUM TO THE OPERATIONS MANUAL
FOR MULTI-PHASE EXTRACTION AND SEPARATION
AT THE BEEDE WASTE OIL SITE, PLAISTOW, NEW HAMPSHIRE

The Operations Manual (SCG Industries Limited, May 2000) includes descriptions and drawings of the equipment and components, initial start-up and general maintenance procedures, and a list of spare parts. This addendum provides additional information for daily operation of the vacuum extraction systems.

Daily Start-up Procedure

1. Turn on the air compressor.
2. Drain vacuum pump to center line. pour drained off vacuum oil into reclaimer.
3. Check that both fresh air dilution valves are open! Starting the system with the valves closed will cause a hammering effect and potentially damage equipment.
4. Check that the heat exchanger valves are in the bypass position.
5. Start liquid ring pump.
6. Slowly close fresh air dilution valve under sight glass. closing this valve rapidly will cause a hammering effect and potentially damage equipment.
7. Slowly close fresh air dilution valve(intake behind pump) until approx 10-12 inches of Hg is maintained.
8. Open heat exchanger valves when oil temperature reaches **75** °F.
9. Check sight glass on isolation tank: oil should be visually splashing in sight glass.

Daily Shut Down Procedure

1. Open both fresh air dilution valves.
2. Turn off liquid ring pump.
3. Place heat exchanger valves to bypass position
4. Turn off air compressor.

Maintenance

1. Grease pump bearings monthly.
2. Visually inspect all belts, couplers and gages daily.
3. Drain water trap on compressor as needed.

4. Annual service should include: pump and compressor oil change, belts, gages, switches replaced as needed, replace demisters elements, clean oil/water separator and replace coalescing material if needed.

Common Problems

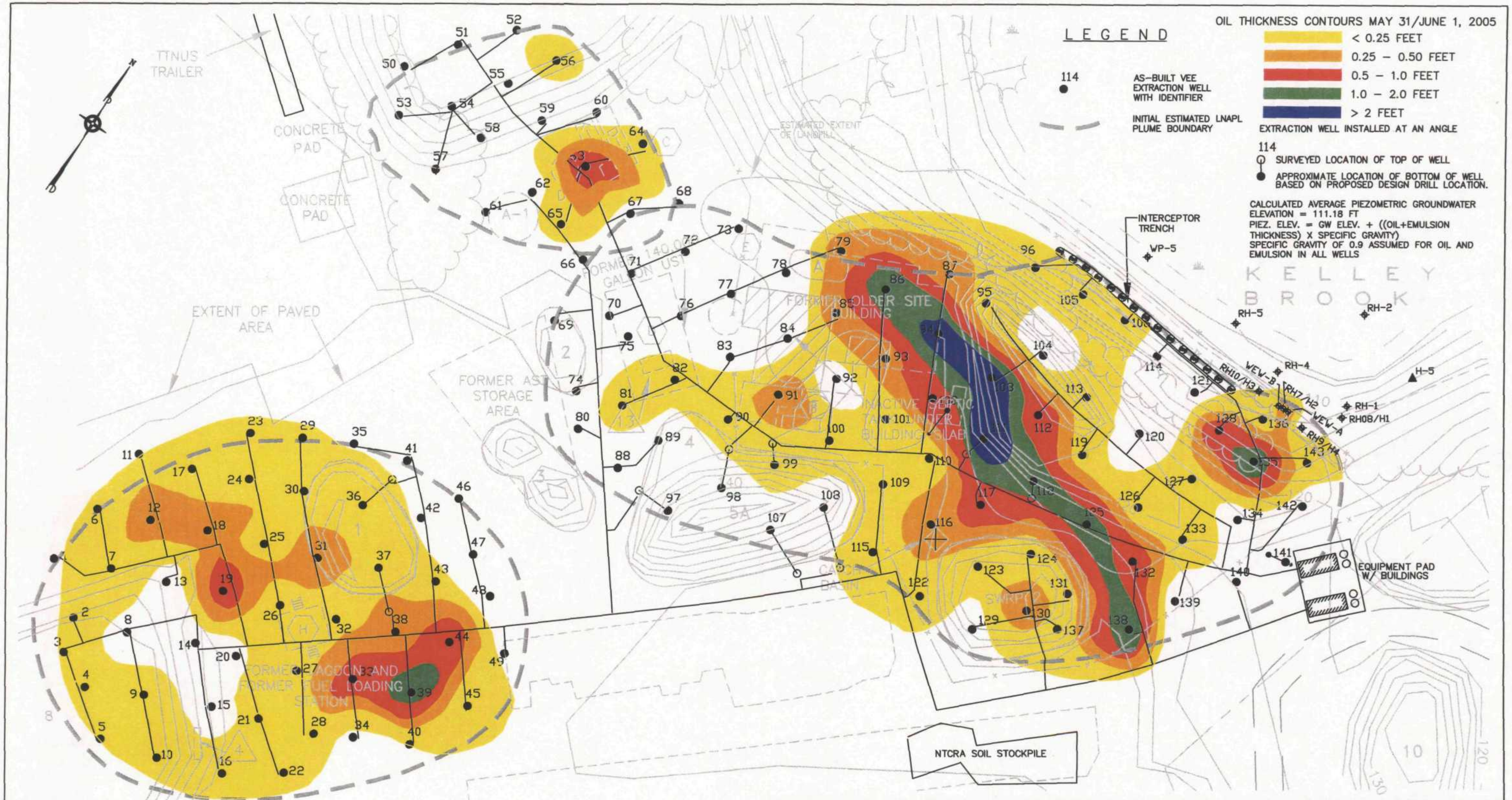
1. Blown Fuses. It is very common after an electrical storm that a fuse or fuses may have blown. A multi-meter should be on site to easily determine which fuses need replacement.
2. Heaters and Heat Trace. In the event of a winter power failure and heaters and heat trace function is lost, everything from the oil/water separator to the external lines and storage tanks may freeze. When power is restored, do not run system until the transfer lines are thawed and transfer pumps are capable of transferring liquids to the external tanks.

Maintaining The Oil Interceptor Trench Using The Multi-Phase Extraction System

1. Inspect the trench regularly – open all manholes to evaluate presence of oil throughout the trench. Evacuation of oil from the trench using the vacuum extraction system is most efficient when a significant oil layer is present within the trench (discontinuous pools of oil up to about 1/8th of an inch thick in the western third of the trench).
2. Remove the drop tube from an extraction well near the interceptor trench (EW-105 and EW-106 have been most commonly used in the past).
3. Lower the drop tube into the trench and hold it in place just above the oil. (TtNUS has used a clamp system made from a board and one of the rubber rings used to hold the drop tubes in place at the extraction wells.)
4. Open the valve to the drop tube and adjust the intake elevation of the tube so that it slowly evacuates the oil, while collecting little water and not changing the water level in the trench.
5. Leave the tube in place to vacuum the oil from the water surface, slowly drawing the oil toward the tube until all the oil has been skimmed from the trench.

APPENDIX C

OIL THICKNESS CONTOURS – MAY-JUNE 2005



NOTES:

1. ALL LOCATIONS TO BE CONSIDERED APPROXIMATE.
2. PLAN NOT TO BE USED FOR DESIGN.

GRAPHIC SCALE

0' 50' 100'

ESTIMATED OIL THICKNESS CONTOURS – MAY/JUNE 2005

NON-TIME CRITICAL REMOVAL ACTION

BEEDE WASTE OIL SITE – PLAISTOW, NEW HAMPSHIRE

DRAWN BY:	R.G. DEWSNAP	REV.:	0
CHECKED BY:	D. BAXTER	DATE:	SEPTEMBER 28, 2005
SCALE:	AS NOTED	FILE NO.:	I:\4103\1020\JUNE_2005.DWG

APPENDIX C

TETRA TECH NUS, INC.

55 Jonspin Road Wilmington, MA 01887
(978)658-7899

APPENDIX D

COST ESTIMATES

APPENDIX D1

NTCRA EXTRACTION SYSTEM SHUTDOWN OPTIONS

COST COMPARISON
NTCRA SHUTDOWN AND
NTCRA AND TRENCH INSPECTION, AND MAINTENANCE COSTS
BEEDE WASTE OIL SITE
PLAISTOW, NEW HAMPSHIRE

COST ITEM	OPTION A - PARTIAL SHUTDOWN	OPTION B - COMPLETE SHUTDOWN
NTCRA SYSTEM SHUTDOWN COSTS		
TOTAL INITIAL COSTS	$43,951	$46,426
MONTHLY ENERGY COSTS (4 Winter Months)	$819	$0
MONTHLY ENERGY COSTS (Non-Winter Months)	$19	$0
TOTAL ANNUAL ENERGY COSTS	$3,425	$0
NTCRA AND TRENCH INSPECTION AND MAINTENANCE[1]		
AVERAGED MONTHLY COSTS	$1,819	$1,799
TOTAL ANNUAL COSTS	$21,822	$21,582
TOTAL INITIAL COSTS (shutdown)	$43,951	$46,426
MONTHLY COSTS (shutdown, insp. & maint.)	$2,104	$1,799
TOTAL ANNUAL COSTS (shutdown, insp. & maint.)	$25,247	$21,582
TOTAL 1ST YEAR PRESENT WORTH[2]	**$68,297**	**$67,238**
TOTAL 3-YEAR PRESENT WORTH[2]	**$114,414**	**$106,661**

1. Monthly labor, materials & subcontract costs for NTCRA/site inspection and maintenance (different for each shutdown option) + monthly labor costs for trench inspection and maintenance (all maintenance options assumed to require the same amount of labor). Non-labor costs for the four trench maintenance options are presented separately for ease of comparison.

2. Present worth costs calculated using a 3-year discount rate of 3.7 percent (White House Office of Management and Budget, 1/05)

COST ESTIMATE
NTCRA EXTRACTION SYSTEM SHUTDOWN OPTION A - PARTIAL SHUTDOWN
BEEDE WASTE OIL SITE
PLAISTOW, NEW HAMPSHIRE

INITIAL COSTS			TtNUS Labor			Materials/Rental		Subcontract (or P.O.)	
NO.	**ACTIVITY**	**DETAILS**	**Comments**	**LOE hrs**	**LOE $**	**$$**	**Comments**	**$$**	**Comments**
1	Evacuate fluids from piping system	• Air Flush - Raise all drop tubes and run system for extented duration (est. 2 days) to evacuate as much residual oil as possible from lines. • Minimal Water Flush - After air flush, run system with selected wells at the ends of pipelines drawing only water to flush any residual oil from pipes.	2 people X 1 day to raise and lower tubes for air and water flush. Air flush while performing other tasks.	16	$1,200	$0 $0		$0 $0	none none
2	Remove all waste fluids from oil extraction equiment	• Remove all extracted oil and water from the high vacuum liquid separator (HVLS), isolation tank, and oil/water separator in both buildings, transfer fluids to storage tanks for ultimate disposal. Estimated 300 - 400 gallons for each extraction unit.						$512	MCE - Vac truck. Schedule same time as oil tank pick up, so don't include additional transportation cost. Assume oil disposal = 800 gal at $0.64/gal (existing sucontract price)
3	Clean extraction equipment, perform annual maintenance to prep. for shutdown	• Clean equipment that will not be used. Change fluids and perform annual maintenance tasks as required to prepare for extended (partial) shutdown. If one unit will be used for trench maintenance, it would not be cleaned and maintenance would be adjusted accordingly.						$4,568	SCG - shut down prep -- Estimate 2 days for all tasks (Historical subcontract cost)
4	Drain operation fluids	• NOT PERFORMED FOR PARTIAL SHUTDOWN							
5	Disconnect and drain transfer lines between extraction systems and storage tanks	• Remove and drain lines that run through below ground conduit.	2 people x 4 hrs	8	$600			$0	none
6	Remove and clean waste storage tank heaters	• Remove heaters from water and oil storage tanks. • Decontaminate heaters. • Store heaters (unheated storage OK).	3 people X 8 hrs	24	$1,800	$0	assume on site storage	$0	none
7	Empty oil storage tank and dispose of contents	• *Remove oil and dispose off site.* • Leave tank on site (it is owned by EPA).						*$0**	MCE - existing sucontract price ($965/load + $0.64/gal)
8	Empty and clean water storage tank and dispose of contents	• *Remove water and dispose off site.* • Decon. water storage tank + collect wipe samples • Return rented tank (demob charge + analysis) PCB analysis of 5 wipe samples from tank						*$0** $2,500 $150 $350	MCE - existing sucontract price ($965/load + $0.64/gal) MCE - subcontractor quote 7/05 Rain for rent - demob charge Laboratory quote 7/05
9	Remove transfer pumps from extraction systems	• NOT PERFORMED FOR PARTIAL SHUTDOWN							
10	Regenerate Carbon Units	• Send the vapor-phase activated carbon treatment units for both buildings off site for regeneration. • Upon return place in covered drum storage area prevent damage exposure.	2 people x 4 hrs each event x 2 events (load and off-load truck)	16	$1,200	$900	fork truck - 2 rentals	$12,000	Envirotrol - historical cost (Assumes regen of 4 cannisters.)
11	Seal extraction system buildings	• Plug and seal holes/cracks/gaps in both buildings to prevent damage due to weather or wildlife intrusion.	1 person x 1 hr	1	$75	$50	foam insulation for disharge pipe holes.		

COST ESTIMATE
NTCRA EXTRACTION SYSTEM SHUTDOWN OPTION A - PARTIAL SHUTDOWN
BEEDE WASTE OIL SITE
PLAISTOW, NEW HAMPSHIRE

INITIAL COSTS			TtNUS Labor			Materials/Rental		Subcontract (or P.O.)	
NO.	ACTIVITY	DETAILS	Comments	LOE hrs	LOE $	$$	Comments	$$	Comments
12	Plug and Label all extraction wells	• Remove drop tubes from all wells. • Cap wells. • Plug valves that connect drop tube to piping system. • Protect heat trace line associated with drop tube at each well. (Enclose heat trace line and rubber reducer from each well in lidded bucket secured to each well.)	3 people X 5 days	120	$9,000	$1,850	plugs, well caps, buckets & misc. mat.		
13	Dispose of all generated waste	• Trans & dispose misc. non-contaminated solid waste including tank insulation, pallets, trash - assume non-regulated solid waste						$2,723	MCE - subcontractor quote 7/05
		• Transport & disposal of tubing (estimated 5000 feet) along with other oil-contaminated residual materials. (Assume managed as hazardous waste solid, D008, <25ppm PCBs)						$3,873	MCE - subcontractor quote 7/05 (Cost ~$2723 if managed as non-regulated material.)
14	Return Rental Items/Demob.		1 person x 1 day	8	$600				
	TOTAL INITIAL COSTS				**$14,475**	**$2,800**		**$26,676**	

* Costs not included in shutdown costs because they are associated with operation and are already covered in existing operation budget.

MONTHLY ELECTRICITY COSTS									
NO.	COST ITEM	DETAILS	Monthly $$	No. Mos	Annual $$		Comments	$$	Comments
	Monthly utility costs	Electricity to heat 2 extraction equipment buildings during winter - assume 24 hour operation for 4 months	$800	4	$3,200				2 existing heaters - 5 kW each @ $ 0.11/kWhr
	Monthly utility costs	Electricity to turn on and run systems to operating temperature twice per month for duration of shutdown. Assume 1 hour/month each system.	$19	12	$225				Calculated from historical operation costs
	TOTAL MONTLY COSTS		**$819 (month)**		**$3,425 (year)**				

COST SUMMARY: NTCRA SHUTDOWN OPTION A - PARTIAL SHUTDOWN	
TOTAL INITIAL COSTS:	$43,951
MONTHLY ENERGY COSTS (4 Winter Months)	$819
MONTHLY ENERGY COSTS (Non-Winter Months)	$19
TOTAL ANNUAL ENERGY COSTS	$3,425

YEAR	PRESENT WORTH FACTOR[1]	CAPITAL COSTS	O & M COSTS	PRESENT WORTH
0	1.000	$43,951		$43,951
1	0.964		$3,425	$3,302
2	0.930		$3,425	$3,185
3	0.897		$3,425	$3,071
	TOTAL 3-Year Present Worth Cost =			$53,509

1 3-year real discount rate = 3.7% (Office of Management and Budget, 1/05)

DETAILED COST ESTIMATE
NTCRA EXTRACTION SYSTEM SHUTDOWN OPTION B - COMPLETE SHUTDOWN
BEEDE WASTE OIL SITE
PLAISTOW, NEW HAMPSHIRE

INITIAL COSTS			TtNUS Labor			Materials/Rental		Subcontract (or P.O.)	
NO.	**ACTIVITY**	**DETAILS**	**Comments**	**LOE hrs**	**LOE $**	**$$**	**Comments**	**$$**	**Comments**
1	Evacuate fluids from piping system	• Air Flush - Raise all drop tubes and run system for extented duration (est. 2 days) to evacuate as much residual oil as possible from lines.	2 people X 1 day to raise and lower tubes for air and water flush. Air flush while performing other tasks.	16	$1,200	$0		$0	none
		• Minimal Water Flush - After air flush, run system with selected wells at the ends of pipelines drawing only water to flush any residual oil from pipes.				$0		$0	none
2	Remove all waste fluids from oil extraction equirment	• Remove all extracted oil and water from the high vacuum liquid separator (HVLS), isolation tank, and oil/water separator in both buildings, transfer fluids to storage tanks for ultimate disposal. Estimated 300 - 400 gallons for each extraction unit.						$512	MCE - Vac truck. Schedule same time as oil tank pick up, so don't include additional transportation cost. Assume oil disposal = 800 gal at $0.64/gal (existing sucontract price)
3	Clean extraction equipment	• Clean High vacuum liquid separator (HVLS), isolation tank, and oil water separator in both systems, to remove oil residue from equipment.						$4,568	SCG - shut down prep -- Estimate 2 days for all tasks. (Historical subcontract cost)
4	Drain operation fluids (i.e. lubricating oil) from oil extraction equipment	• Drain operation fluids from liquid ring pump, reclaimer, radiator, and compressor in both systems to prevent damage from freezing.							SCG - included in above cost item
5	Disconnect and drain transfer lines between extraction systems and storage tanks	• Remove and drain transfer lines that run through below ground conduit.	2 people x 4 hrs	8	$600			$0	none
6	Remove and clean waste storage tank heaters	• Remove heaters from water and oil storage tanks. • Decontaminate heaters. • Store heaters (unheated storage OK).	3 people X 8 hrs	24	$1,800	$0	assume on site storage	$0	none
7	Empty oil storage tank and dispose of contents	• *Remove oil and dispose off site.* • Leave tank on site (it is owned by EPA).						*$0**	MCE - existing sucontract price ($965/load + $0.64/gal)
8	Empty and clean water storage tank and dispose of contents	• *Remove water and dispose off site.*						*$0**	MCE - existing sucontract price ($965/load + $0.64/gal)
		• Decon. water storage tank + collect wipe samples						$2,500	MCE - subcontractor quote 7/05
		• Return rented tank (demob charge + analysis)						$150	Rain for rent - demob charge
		PCB analysis of 5 wipe samples from tank						$350	Laboratory quote 7/05
9	Remove transfer pumps from extraction systems	• Remove oil tranfer pump and water transfer pumps from both buildings.	1 person	4	$300			$0	
		• Store pumps in heated storage to prevent degradation of pump diaphrams.				$0	assume heated storage in site trailer	$0	
10	Regenerate Carbon Units	• Send the vapor-phase activated carbon treatment units for both buildings off site for regeneration. • Upon return place in covered drum storage area prevent damage exposure.	2 people x 4 hrs each event x 2 events (load and off-load truck)	16	$1,200	$900	fork truck - 2 rentals	$12,000	Envirotrol - historical cost (Assumes regen of 4 cannisters. Dep. on shutdown date, may only need to regen 2 cannisters)

INITIAL COSTS			TtNUS Labor			Materials/Rental		Subcontract (or P.O.)	
NO.	ACTIVITY	DETAILS	Comments	LOE hrs	LOE $	$$	Comments	$$	Comments
11	Seal extraction system buildings	• Plug and seal holes/cracks/gaps in both buildings to prevent damage due to weather or wildlife intrusion.	2 people x 12 hrs	24	$1,800	$500	plastic covers for vents, foam insulation, outlet caps, etc.		
12	Plug and Label all extraction wells	• Remove drop tubes from all wells. • Cap wells. • Plug valves that connect drop tube to piping system. • Protect heat trace line associated with drop tube at each well. (Enclose heat trace line and rubber reducer from each well in lidded bucket secured to each well.)	3 people X 5 days	120	$9,000	$1,850	plugs, well caps, buckets & misc. matl.		
13	Dispose of all generated waste	• Transport & dispose misc. non-contaminated solid waste including tank insulation, pallets, trash - assume non-regulated solid waste						$2,723	MCE - subcontractor quote 7/05
		• Transport & disposal of tubing (estimated 5000 feet) along with other oil-contaminated residual materials. (Assume managed as hazardous waste solid, D008, <25ppm PCBs)						$3,873	MCE - subcontractor quote 7/05 (Cost ~$2723 if managed as non-regulated material.)
14	Return Rental Items/Demob.		1 person x 1 day	8	$600				
	TOTAL INITIAL COSTS				**$16,500**	**$3,250**		**$26,676**	

* Costs not included in shutdown costs because they are associated with operation and are already covered in existing operation budget.

MONTHLY ELECTRICITY COSTS									
NO.	COST ITEM	DETAILS	Monthly $$	No. Mos	Annual $$		Comments	$$	Comments
	Monthly utility costs	None for complete shutdown/mothballing	$0						
	TOTAL MONTLY ELECTRICITY COSTS		**$0**						

COST SUMMARY: NTCRA SHUTDOWN OPTION B - COMPLETE SHUTDOWN	
TOTAL INITIAL COSTS:	$46,426
MONTHLY ENERGY COSTS	$0
ANNUAL ENERGY COSTS	$0

YEAR	PRESENT WORTH FACTOR[1]	CAPITAL COSTS	O & M COSTS	PRESENT WORTH
0	1.000	$46,426		$46,426
1	0.964		$0	$0
2	0.930		$0	$0
3	0.897		$0	$0
	TOTAL 3-Year Present Worth Cost =			$46,426

1. 3-year real discount rate = 3.7% (Office of Management and Budget, 1/05)

NTCRA AND SITE INSPECTION AND MAINTENANCE COSTS – SHUTDOWN OPTION A - PARTIAL SHUTDOWN

TRENCH INSPECTION AND MAINTENANCE LABOR COSTS -- ALL TRENCH MAINTENANCE OPTIONS

BEEDE WASTE OIL SITE

PLAISTOW, NEW HAMPSHIRE

MONTHLY TRENCH AND NTCRA INSPECTION AND MAINTENANCE COSTS*			TtNUS Labor			Materials/Rental		Subcontract (or P.O.)	
NO.	COST ITEM	DETAILS	Comments	LOE hrs	LOE $	$$	Comments	$$	Comments
1	Site Inspection, vacuum extraction system maintenance, and trench maintenance - for all trench maintenance options. (Trench maintenance assumed to require approximately same time regardless of method.)	**Extraction system maintenance** (bi-weekly) - Turn on vacuum extraction system, run until normal operating temperature is reached (15 to 30 minutes). Maintain systems as needed.	bi-weekly - during trench inspection site visit (cost included in trench inspection item below)	--	--	$20	miscellaneous monthly costs (fuses, light bulbs, & contingency repair)		
		Site/NTCRA piping system inspection and maintenance Inspect transmission piping and site facilities (treatment buildings, trailer, soil piles) for damage due to weather, wildlife, or trespassers. Maintain as needed to prevent or repair damage.	bi-weekly - during trench inspection site visit (cost included in trench inspection item below)	--	--	$10	Estimated monthly cost for minor repairs. Contingency costs not included for major repairs.	$589	Averaged monthly costs for 1 year snowplowing, sanding, brush cutting. ($4,500 - plow/sand 10 events + $2,562 brush cutting 3 events) source: historical costs
		Trench inspection and maintenance - Inspect condition of trench and oil accumulation in trench and wetland. *Evacuate accumulated oil from trench and maintain oil-absorbent booms in wetland as needed.*	initially assume a 4 hr visit/weekly (4 vis/month), change freqency based on observations/needs	16	$1,200		See individual trench maintenance options for materials costs.		
	TOTAL MONTLY COSTS				**$1,200**	**$30**		**$589**	

* Monthly labor costs for trench inspection and maintenance (all maintenance options) + monthly labor, materials & subcontract costs for NTCRA/site inspection and maintenance (shutdown option A)

COST SUMMARY: TRENCH AND NTCRA INSPECTION AND MAINTENANCE*	
AVERAGED MONTHLY COSTS	$1,819
TOTAL ANNUAL COSTS	$21,822

YEAR	PRESENT WORTH FACTOR[1]	CAPITAL COSTS	O & M COSTS	PRESENT WORTH
0	1.000	$0		$0
1	0.964		$21,822	$21,043
2	0.930		$21,822	$20,293
3	0.897		$21,822	$19,569
	TOTAL 3-Year Present Worth Cost =			**$60,904**

1. 3-year real discount rate = 3 7% (Office of Management and Budget, 1/05)

COST ESTIMATE

NTCRA AND SITE INSPECTION AND MAINTENANCE COSTS -- SHUTDOWN OPTION B - COMPLETE SHUTDOWN

TRENCH INSPECTION AND MAINTENANCE LABOR COSTS -- ALL TRENCH MAINTENANCE OPTIONS

BEEDE WASTE OIL SITE

PLAISTOW, NEW HAMPSHIRE

MONTHLY TRENCH AND NTCRA INSPECTION AND MAINTENANCE COSTS*			TtNUS Labor			Materials/Rental		Subcontract (or P.O.)	
NO.	COST ITEM	DETAILS	Comments	LOE hrs	LOE $	$$	Comments	$$	Comments
1	Site Inspection, vacuum extraction system maintenance, and trench maintenance - for all trench maintenance options. (Trench maintenance assumed to require approximately same time regardless of method.)	**Extraction system maintenance** (bi-weekly) - Manually turn pumps, compressors in both systems	bi-weekly - during trench inspection site visit (cost included	--	--	$0			
		Site/NTCRA piping system inspection and maintenance - Inspect transmission piping and site facilities (treatment buildings, trailer, soil piles) for damage due to weather, wildlife, or trespassers. Maintain as needed to prevent or repair damage.	bi-weekly - during trench inspection site visit (cost included in trench inspection item below)	--	--	$10	Estimated monthly cost for minor repairs. Contingency costs not included for major repairs	$589	Averaged monthly costs for 1 year snowplowing, sanding, brush cutting. ($4 500 - plow/sand 10 events + $2.562 brush cutting 3 events) source: historical costs
		Trench inspection and maintenance - Inspect condition of trench and oil accumulation in trench and wetland. Evacuate accumulated oil from trench and maintain oil-absorbent booms in wetland as needed.	initially assume a 4 hr visit/weekly (4 vis/month), change freqency based on observations/needs	16	$1,200		See individual trench maintenance options for materials costs		
	TOTAL MONTLY COSTS				**$1,200**	**$10**		**$589**	

* Monthly labor costs for trench inspection and maintenance (all maintenance options) + monthly labor, materials & subcontract costs for NTCRA/site inspection and maintenance (shutdown option B)

COST SUMMARY: TRENCH AND NTCRA INSPECTION AND MAINTENANCE*	
AVERAGED MONTHLY COSTS	$1,799
TOTAL ANNUAL COSTS	$21,582

YEAR	PRESENT WORTH FACTOR[1]	CAPITAL COSTS	O & M COSTS	PRESENT WORTH
0	1.000	$0		$0
1	0.964		$21,582	$20,812
2	0.930		$21,582	$20,069
3	0.897		$21,582	$19,353
	TOTAL 3-Year Present Worth Cost =			$60,235

1. 3-year real discount rate = 3.7% (Office of Management and Budget, 1/05)

APPENDIX D2

INTERCEPTOR TRENCH MAINTENANCE OPTIONS

COST COMPARISON
INTERCEPTOR TRENCH MAINTENANCE OPTIONS
ESTIMATED COSTS FOR RANGE OF POTENTIAL OIL ACCUMULATION RATES
BEEDE WASTE OIL SITE
PLAISTOW, NH

OIL ACCUMULATION RATE/ COST TYPE	OPTION 1 Oil-Only Absorbents	OPTION 2 Passive Skimmers	OPTION 3 Industrial Wet Vacuum	OPTION 4 NTCRA Vacuum System
1 GALLON/MONTH (12 GAL/YEAR)				
INITIAL CAPITAL COSTS	$25	$2,200	$1,180	$480
AVERAGED MONTHLY COSTS	$21	$84	$54	$60
ANNUAL COSTS	$256	$1,005	$650	$717
TOTAL 1-YEAR PRES. WORTH COSTS[1]	**$272**	**$3,169**	**$1,807**	**$1,172**
TOTAL 3-YEAR PRES. WORTH COSTS[1]	**$739**	**$5,004**	**$2,994**	**$2,482**
3 GALLONS/MONTH (36 GAL/YEAR)				
INITIAL CAPITAL COSTS	$25	$2,200	$1,180	$480
AVERAGED MONTHLY COSTS	$56	$56	$152	$88
ANNUAL COSTS	$667	$676	$1,826	$1,053
TOTAL 1-YEAR PRES. WORTH COSTS[1]	**$668**	**$2,852**	**$2,941**	**$1,496**
TOTAL 3-YEAR PRES. WORTH COSTS[1]	**$1,887**	**$4,087**	**$6,276**	**$3,419**
6 GALLONS/MONTH (72 GAL/YEAR)				
INITIAL CAPITAL COSTS	$25	$2,200	$1,180	$480
AVERAGED MONTHLY COSTS	$107	$75	$299	$130
ANNUAL COSTS	$1,284	$896	$3,590	$1,557
TOTAL 1-YEAR PRES. WORTH COSTS[1]	**$1,263**	**$3,064**	**$4,642**	**$1,982**
TOTAL 3-YEAR PRES. WORTH COSTS[1]	**$3,609**	**$4,700**	**$11,200**	**$4,826**

1. Present worth costs calculated using a 3-year discount rate of 3.7 percent (White House Office of Management and Budget, 1/05)

COST ESTIMATE
TRENCH MAINTENANCE OPTION 1 - OIL-ONLY ABSORBENTS
BEEDE WASTE OIL SITE,
PLAISTOW, NH

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST	GALLONS/UNIT	COST/GALLON	SOURCE/NOTE
	Capital Equipment and Materials							
1	Tools (long handled hook/rake)	1	ea	$25	$25	NA		historical cost
	Operations Supplies							
2	Oil Absorbent Pads (100 pads/case, 37.5 gal capacity) assume efficiency = 75% of max capacity, so ~28 gal/case	1	case	$100	$100	28	$3.57	vendor cost
3	55-gallon drums for storage of used absorbents	1	ea	$30	$30	28	$1.07	historical cost
4	Miscellaneous maintenance supplies (spill pads, rope, etc.)	1	LS/year	$50	$50	NA		historical cost
	Waste Transportation and Disposal							
5	Disposal of drummed solid waste (oil saturated pads) - assume one 55 gallon drum/100 pads, managed as haz. D008 solid	1	drum	$175	$175	28	$6.25	vendor quote (MCE, 7/05)
6	Transport of drummed solid waste	1	trip	$175	$175	28	$6.25	vendor quote (MCE, 7/05)
	Labor -- See Separate Estimate for Trench/Site Monitoring and Maintenance							

COST SUMMARY	TOTAL COST	UNIT	COST/GALLON
INITIAL CAPITAL COSTS (1)	$25	--	
OIL VOLUME-DEPENDENT OPERATIONS, TRANSPORT & DISPOSAL COSTS (2,3,5,6)	$480	28 gallons	$17.14
MONTHLY OPERATIONS SUPPLIES COSTS (not volume-dependent)(4)	$4.17	month	

COST FOR RANGE OF POTENTIAL OIL ACCUMULATION RATES			
COST TYPE	**GALLONS PER MONTH (YEAR)**		
	1 (12)	**3 (36)**	**6 (72)**
INITIAL CAPITAL COSTS	$25	$25	$25
AVERAGED MONTHLY COSTS	$21	$56	$107
ANNUAL COSTS	$256	$667	$1,284

YEAR	PRESENT WORTH FACTOR[1]	PRESENT WORTH OF ANNUAL COSTS		
1	0.964	$247	$643	$1,238
2	0.930	$238	$620	$1,194
3	0.897	$229	$598	$1,152

TOTAL 1-YEAR PW COST	**$272**	**$668**	**$1,263**
TOTAL 3-YEAR PW COST	**$739**	**$1,887**	**$3,609**

1. 3-year real discount rate = 3.7% (White House Office of Management and Budget, 1/05)

COST ESTIMATE
TRENCH MAINTENANCE OPTION 2 - PASSIVE SKIMMERS
BEEDE WASTE OIL SITE,
PLAISTOW, NH

DESCRIPTION		QUANTITY	UNIT	UNIT COST	TOTAL COST	GALLONS/UNIT	COST/GALLON	SOURCE/NOTE
	Capital Equipment and Materials							
1	Filter cartridges for skimmers	4	ea	$550	$2,200		NA	vendor cost
	Operations Supplies							
2	55-gallon drums for oil storage and disposal	1	ea	$30	$30	50	$0 60	historical cost
3	55-gallon drums for water storage and disposal	1	ea	$30	$30	50	$0.60	historical cost
4	Miscellaneous maintenance supplies (spill pads, rope, etc.)	1	LS/year	$100	$100	NA	NA	historical cost
	Waste Transportation and Disposal							
5	Disposal of drummed liquid waste (oil) - assume 50 gallons oil per 55 gal drum, manage as haz. D0008 oil, < 25 ppm PCBs	1	drum	$165	$165	50	$3 30	vendor quote (MCE, 7/05)
6	Disposal of drummed water - assume 50 gallons water	1	drum	$150	$150	50	$3.00	historical cost est
7	Transport of drummed oil	1	trip	$275	$275	50	$5 50	vendor quote (MCE, 7/05)
8	Transport of drummed water	1	trip	$150	$150	50	$3 00	vendor quote (MCE, 7/05)
	Labor -- See Separate Estimate for Trench/Site Monitoring and Maintenance							

COST SUMMARY	TOTAL COST	UNIT	COST/GALLON
INITIAL CAPITAL COSTS (1)	$2,200	--	
MONTHLY OPERATIONS SUPPLIES COSTS (not volume-dependent) (4)	$8 33	month	
OIL VOLUME-DEPENDENT OPERATIONS, TRANPORT & DISPOSAL COSTS (2,5,7)	$470	50 gallons	$9.40
WATER VOLUME-DEPENDENT TRANSPORT & DISPOSAL COSTS (3,6,8)	$330	50 gallons	$6 60

COST FOR RANGE OF POTENTIAL OIL ACCUMULATION RATES[1]			
COST TYPE	GALLONS PER MONTH (YEAR)		
	1 (12)	3 (36)	6 (72)
INITIAL CAPITAL COSTS	$2,200	$2,200	$2,200
AVERAGED MONTHLY COSTS	$84	$56	$75
ANNUAL COSTS	$1,005	$676	$896

YEAR	PRESENT WORTH FACTOR[2]	PRESENT WORTH OF ANNUAL COSTS		
1	0 964	$969	$652	$864
2	0.930	$934	$629	$833
3	0 897	$901	$606	$803

TOTAL 1-YEAR PW COST	**$3,169**	**$2,852**	**$3,064**
TOTAL 3-YEAR PW COST	**$5,004**	**$4,087**	**$4,700**

1 Monthly costs calculated from the unit costs presented above, using assumed oil and water collection rates discussed in text Section 3 3.

Estimated Water/Oil Ratio	10 1	1 1	1 4
Estimated Volume Water (gal/month (year))	10 (120)	3 (36)	1 5 (18)

2 3-year real discount rate = 3 7% (White House Office of Management and Budget, 1/05)

COST ESTIMATE
TRENCH MAINTENENCE OPTION 3 - INDUSTRIAL WET VACUUM
BEEDE WASTE OIL SITE,
PLAISTOW, NH

DESCRIPTION		QUANTITY	UNIT	UNIT COST	TOTAL COST	GALLONS/UNIT	COST/GALLON	SOURCE/NOTE
	Capital Equipment and Materials							
1	Industrial Wet Vacuum (electric drum vacuum)	1	ea	$400	$400			vendor cost
2	55-gallon drum for fluid collection	1	ea	$30	$30			historical cost
3	Storage Shed (8 ft x 10 ft built on site)	1	LS	$750	$750			vendor cost/TtNUS
	Assume $600/shed kit + 2 hrs labor @ 75/hr							
	Operations Supplies							
4	Miscellaneous maintenance supplies (spill pads, rope, etc.)	1	LS/year	$50	$50	NA		historical cost
5	55-gallon drums for oil storage and disposal	1	ea	$30	$30	50	$0.60	historical cost
6	55-gallon drums for water storage and disposal	1	ea	$30	$30	50	$0.60	historical cost
7	Electricity to operate wet vacuum	12	mo	$1	$12	NA		
	assume (16 Amp @ 110 volt)(5 hours/month) (0.11$/kWhr)							
	Waste Transportation and Disposal							
8	Disposal of drummed liquid waste (oil) - assume 50 gallons oil per 55 gal drum, manage as haz. D0008 oil, < 25 ppm PCBs	1	drum	$165	$165	50	$3.30	vendor quote (MCE, 7/05)
9	Disposal of drummed water - assume 50 gallons water	1	drum	$150	$150	50	$3.00	historical cost est
10	Transport of drummed oil	1	trip	$275	$275	50	$5.50	vendor quote (MCE, 7/05)
11	Transport of drummed water	1	trip	$150	$150	50	$3.00	vendor quote (MCE, 7/05)
	Labor -- See Separate Estimate for Trench/Site Monitoring and Maintenance							

COST SUMMARY	TOTAL COST	UNIT	COST/GALLON
INITIAL CAPITAL COSTS (1,2,3)	$1,180	--	
MONTHLY OPERATIONS SUPPLIES COSTS (not volume-dependent) (4,7)	$5.17	month	
OIL VOLUME-DEPENDENT OPERATIONS, TRANPORT & DISPOSAL COSTS (5,8,10)	$470	50 gallons	$9.40
WATER VOLUME-DEPENDENT TRANSPORT & DISPOSAL COSTS (6,9,11)	$330	50 gallons	$6.60

COST FOR RANGE OF POTENTIAL OIL ACCUMULATION RATES[1]			
COST TYPE	GALLONS PER MONTH (YEAR)		
	1 (12)	3 (36)	6 (72)
INITIAL CAPITAL COSTS	$1,180	$1,180	$1,180
AVERAGED MONTHLY COSTS	$54	$152	$299
ANNUAL COSTS	$650	$1,826	$3,590

YEAR	PRESENT WORTH FACTOR[2]	PRESENT WORTH OF ANNUAL COSTS		
1	0.964	$627	$1,761	$3,462
2	0.930	$604	$1,698	$3,338
3	0.897	$583	$1,637	$3,219

TOTAL 1-YEAR PW COST	**$1,807**	**$2,941**	**$4,642**
TOTAL 3-YEAR PW COST	**$2,994**	**$6,276**	**$11,200**

1 Monthly costs calculated from the unit costs presented above, using assumed oil and water collection rates discussed in text Section 3.3
Estimated Water/Oil Ratio = 6:1 for all oil accumulation rates. Assume oil is evacuated only after significant (>1/8 inch thick) layer accumulates

Estimated Water (gal/month (year))	6 (72)	18 (216)	36 (432)

2 3-year real discount rate = 3.7% (White House Office of Management and Budget 1/05)

COST ESTIMATE
TRENCH MAINTENENCE OPTION 4 - NTCRA VACUUM EXTRACTION SYSTEM
BEEDE WASTE OIL SITE,
PLAISTOW, NH

DESCRIPTION		QUANTITY	UNIT	UNIT COST	TOTAL COST	GALLONS/UNIT	COST/GALLON	SOURCE/NOTE
	Capital Equipment and Materials							
1	Tubing (for waste discharge to drums)	20	ft	$1	$20	NA		vendor cost
2	55-gallon drums to replace oil and water storage tanks	2	ea	$30	$60	NA		historical cost
3	Supplies to extend and heat drop tube from transmission piping to trench (tubing, elbows, insulation)	1	LS	$400	$400			vendor cost
	Operations Supplies							
4	Miscellaneous maintenance supplies (spill pads, fuses, etc.)	1	LS/year	$100	$100	NA		historical cost
5	Electricity to operate NTCRA vacuum extraction system assume 4 hours/month	12	mo	$37	$449	NA		est. based on hist. cost
	Waste Transportation and Disposal							
8	Bulk fluids transport and disposal - mixed oil and water (vac truck	1	gal	$2	$2	1	$2.00	vendor quote (MCE, 11/05)
	Labor -- See Separate Estimate for Trench/Site Monitoring and Maintenence							

Note: The cost of heating the equipment building is not included in this option. Heating costs are included in shutdown Option A.

COST SUMMARY	TOTAL COST	UNIT	COST/GALLON
INITIAL CAPITAL COSTS (1,2,3)	$480	--	
MONTHLY OPERATIONS SUPPLIES COSTS (not volume-dependent) (4,5)	$45.76	month	
OIL AND WATER TRANSPORT & DISPOSAL COSTS (volume dependent) (8)	$2	1 gallon	$2.00

COST FOR RANGE OF POTENTIAL OIL ACCUMULATION RATES[1]			
COST TYPE	GALLONS PER MONTH (YEAR)		
	1 (12)	3 (36)	6 (72)
INITIAL CAPITAL COSTS	$480	$480	$480
AVERAGED MONTHLY COSTS	$60	$88	$130
ANNUAL COSTS	$717	$1,053	$1,557

YEAR	PRESENT WORTH FACTOR[2]	PRESENT WORTH OF ANNUAL COSTS		
1	0.964	$692	$1,016	$1,502
2	0.930	$667	$979	$1,448
3	0.897	$643	$944	$1,396

TOTAL 1-YEAR PW COST	**$1,172**	**$1,496**	**$1,982**
TOTAL 3-YEAR PW COST	**$2,482**	**$3,419**	**$4,826**

1 Monthly costs calculated from the unit costs presented above using assumed oil and water collection rates discussed in text Section 3.3

Estimated Water/Oil Ratio = 6:1 for all oil accumulation rates. Assume oil is evacuated only after significant (>1/8 inch thick) layer accumulates.

Estimated Water (gal/month (year))	6 (72)	18 (216)	36 (432)

2 3-year real discount rate = 3.7% (White House Office of Management and Budget, 1/05)

APPENDIX E

OIL OUTBREAK EVALUATION PHOTOGRAPHS

PHOTOGRAPHS
OIL OUTBREAK EVALUATION
BEEDE WASTE OIL SITE PLAISTOW, NEW HAMPSHIRE
WINTER/SPRING 2005

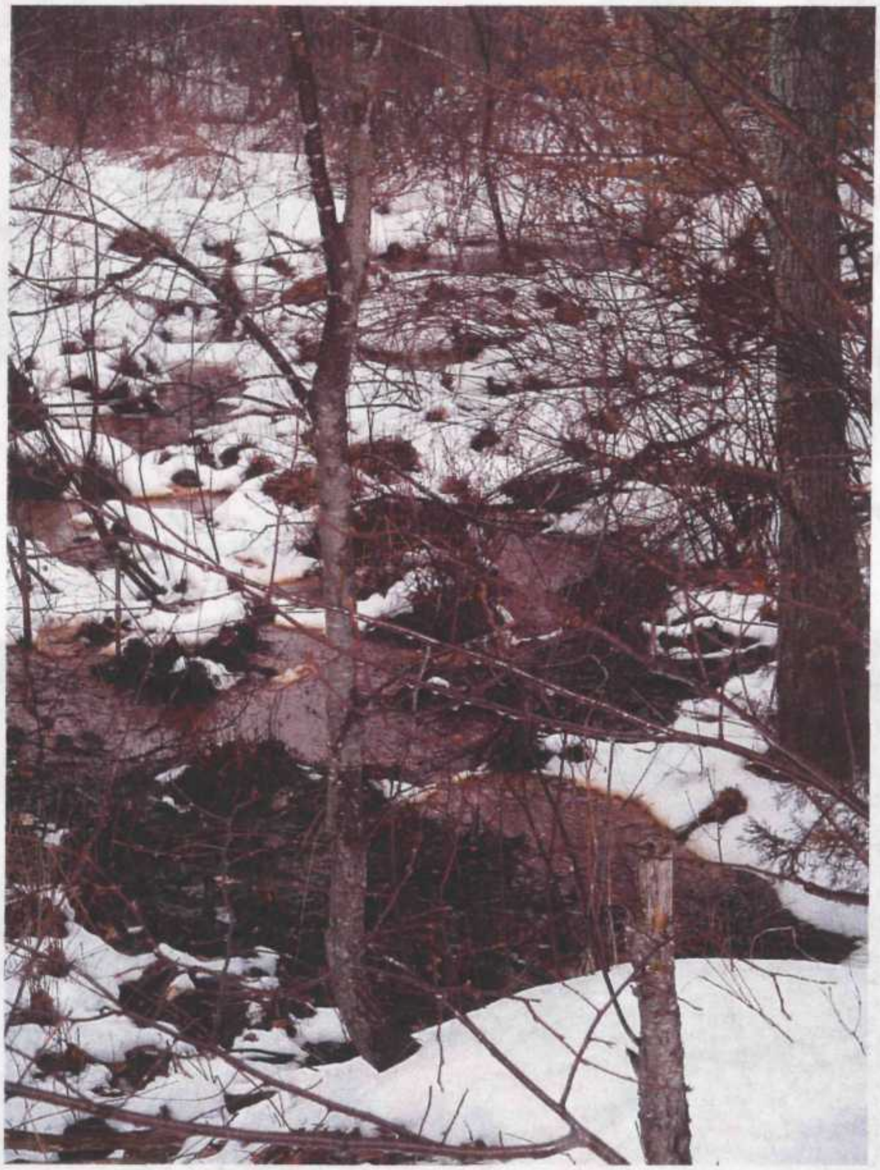


PHOTO 1
SHEEN/STAINING IN WETLANDS NORTH/NORTHEAST OF WELLS EW-136 AND EW-143
BEEDE WASTE OIL SITE, PLAISTOW, NEW HAMPSHIRE
LATE WINTER 2005

PHOTO 2
SHEEN IN WETLANDS NORTH/NORTHEAST OF WELLS EW-136 AND EW-143
BEEDE WASTE OIL SITE, PLAISTOW, NEW HAMPSHIRE
LATE WINTER 2005

PHOTO 3
SHEEN IN WETLANDS NORTH/NORTHEAST OF WELLS EW-136 AND EW-143
BEEDE WASTE OIL SITE, PLAISTOW, NEW HAMPSHIRE
SPRING 2005

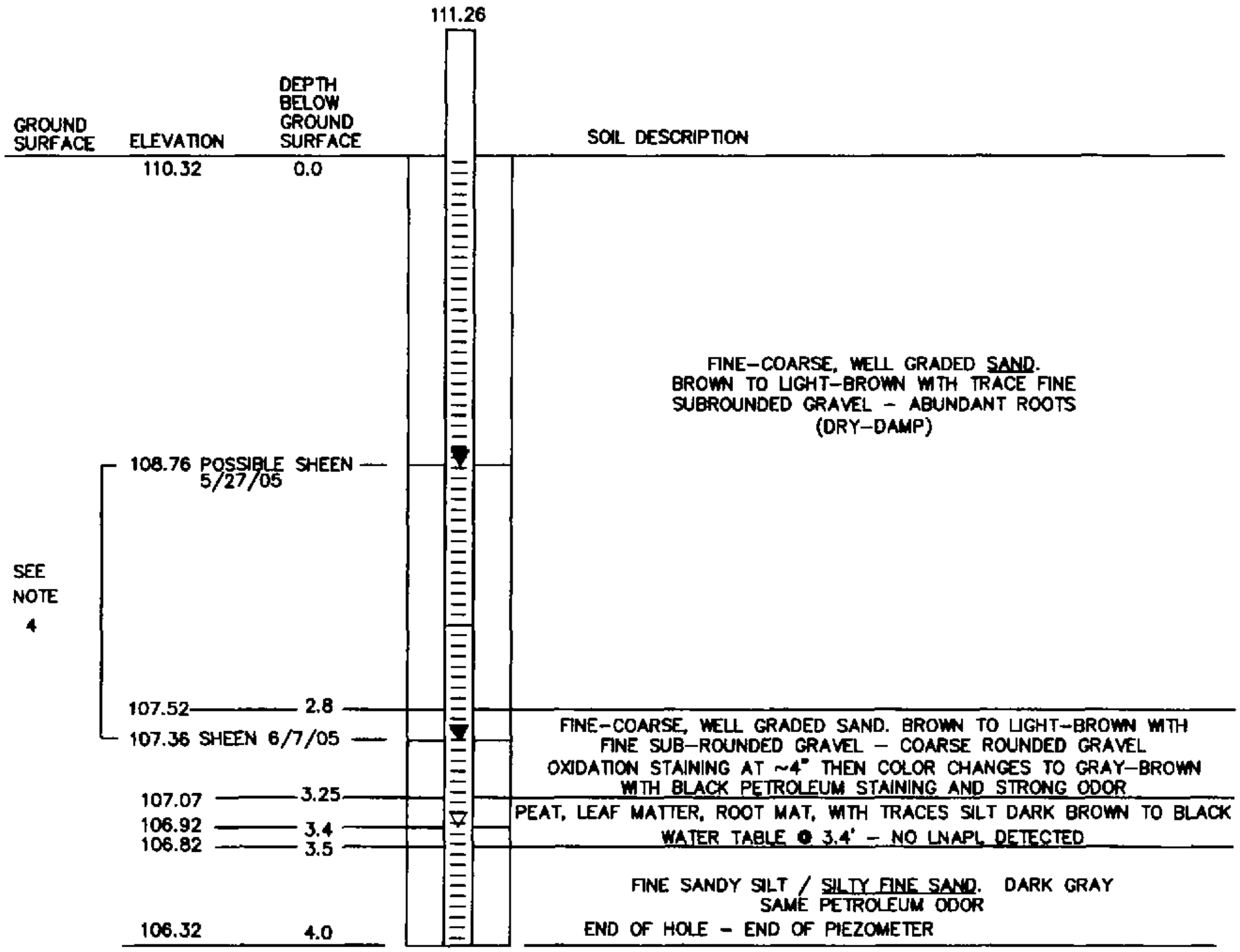
PHOTO 4
CORROSION AND FOULING OF PIEZOMETER RH-1
BEEDE WASTE OIL SITE, PLAISTOW, NEW HAMPSHIRE
SPRING 2005

PHOTO 5
CORROSION AND FOULING OF PIEZOMETER RH-1
BEEDE WASTE OIL SITE, PLAISTOW, NEW HAMPSHIRE
SPRING 2005

APPENDIX F

SOIL EXCAVATION LOGS

BORING H1 / PIEZOMETER RH8

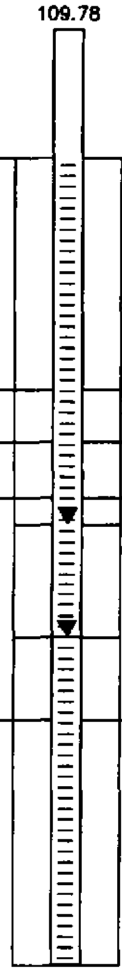


NOTES:

1. SOIL DESCRIPTIONS FROM HAND EXCAVATED BORING CONDUCTED ON 5/19/05.
2. ELEVATION DATUM IS NGVD 29 (FEET). BM USED INVERT OF MANHOLE 15 (ELEV.= 111.61)
3. PIEZOMETER INSTALLED IN OPEN HOLE 05/19/05. 1-INCH INSIDE DIAMETER, 0.010-INCH SLOTTED PVC, AND WELL ID = RH-8.
4. TRIANGULAR SYMBOL (▼) INDICATES MAXIMUM AND MINIMUM PETROLEUM SHEEN ELEVATIONS OBSERVED DURING INVESTIGATION ON 5/27/05 & 6/7/05 RESPECTIVELY. ONLY SHEEN OBSERVED; NO MEASURABLE LEVEL.
5. TRIANGULAR SYMBOL (▽) INDICATES LOCATION OF WATER TABLE IN OPEN HOLE AT TIME OF EXCAVATION.

SOIL BORING/PIEZOMETER CONSTRUCTION LOG (H1/RH-8)				FIGURE F-1
BEEDE WASTE OIL SITE				TETRA TECH NUS, INC.
PLAISTOW, NEW HAMPSHIRE				
DRAWN BY:	D.W. MACDOUGALL	REV.:	0	
CHECKED BY:	D. BAXTER	DATE:	SEPTEMBER 28, 2005	55 Jonspin Road Wilmington, MA 01887 (978)658-7899
SCALE:	NONE	ACAD NAME:	I:\DWG\4103\1020\H1-RH8_SOILS.DWG	

BORING H2 / PIEZOMETER RH7



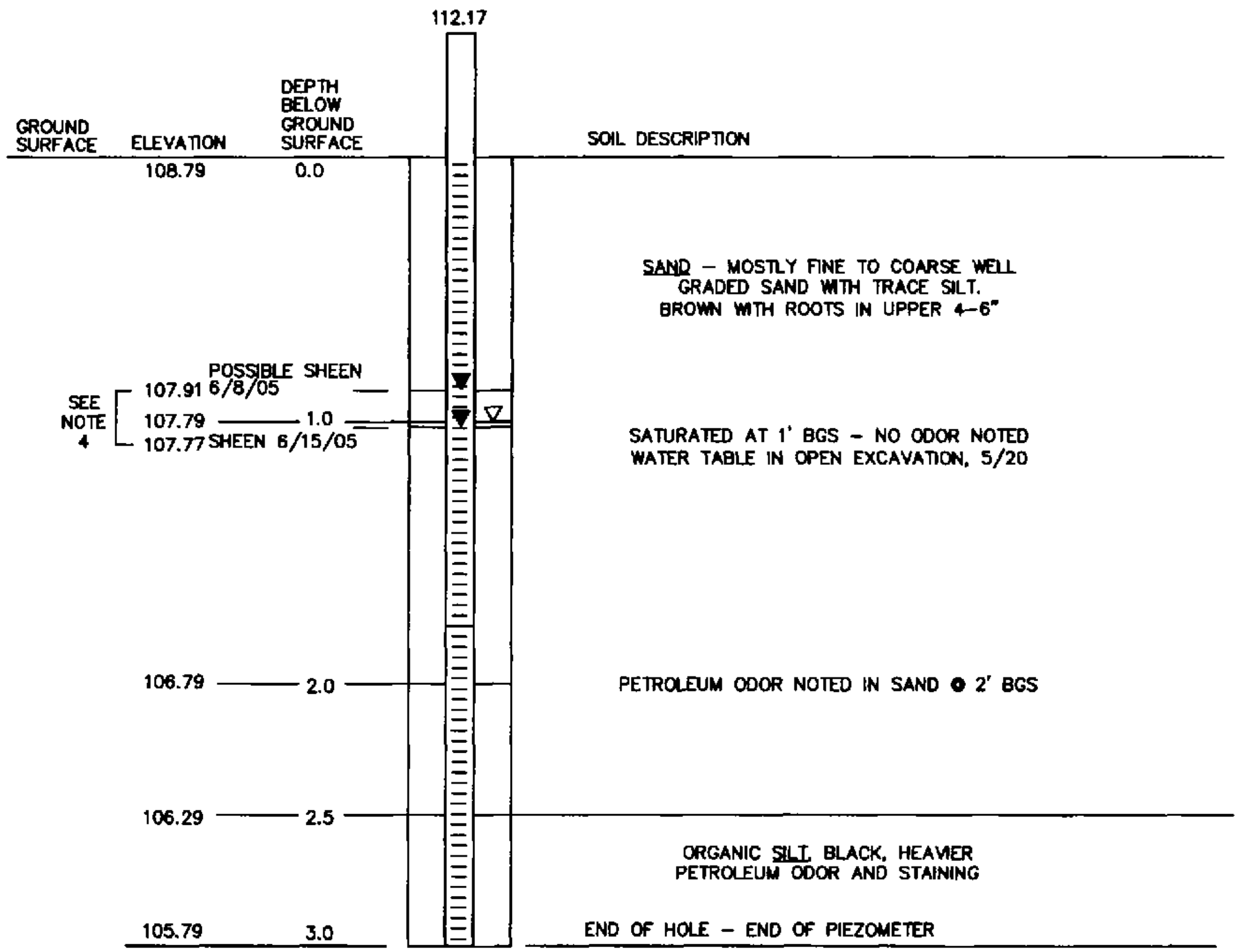
GROUND SURFACE ELEVATION	DEPTH BELOW GROUND SURFACE	SOIL DESCRIPTION
109.08	0.0	FILL, MOSTLY FINE – COARSE SAND BROWN WITH TRACE ORGANIC DEBRIS, TRACE SILT, TRACE METAL (WIRE, BEER TAB, METAL FRAME). NO PETROLEUM ODOR NOTED.
108.08	1.0	FILL, GRAVELLY FINE – COARSE SAND LIGHT PETROLEUM ODOR
107.88	1.2	FILL, SAND & GRAVEL HEAVY BLACK PETROLEUM STAINING & ODOR
107.58	1.5	LOOSE, SOFT, ORGANIC RICH SILT & SAND, BLACK, HEAVY PETROLEUM ODOR AND STAINING (NATIVE MATERIAL / WETLAND DEPOSITS)
107.4 MAX. LNAPL / AIR ELEVATION (SEE NOTE 4)		
106.8 MIN. LNAPL / AIR ELEVATION (SEE NOTE 4)		
106.58	2.5	SANDY SILT WITH TRACE ORGANICS. DARK GRAY LIGHT PETROLEUM ODOR
105.58	3.5	END OF HOLE – END OF PIEZOMETER

NOTES:

1. SOIL DESCRIPTIONS FROM HAND EXCAVATED BORING CONDUCTED ON 5/19/05.
2. ELEVATION DATUM IS NGVD 29 (FEET). BM USED INVERT OF MANHOLE 15 (ELEV.= 111.61)
3. PIEZOMETER INSTALLED IN OPEN HOLE 05/19/05. 1-INCH INSIDE DIAMETER, 0.010-INCH SLOTTED PVC, 4-FEET LONG AND WELL ID = RH-7.
4. TRIANGULAR SYMBOL (▼) INDICATES MAXIMUM AND MINIMUM LNAPL / AIR INTERFACE ELEVATIONS OBSERVED DURING INVESTIGATION ON 5/27/05 & 5/20/05 RESPECTIVELY.

SOIL BORING/PIEZOMETER CONSTRUCTION LOG (H2/RH-7)				FIGURE F-2
BEEDE WASTE OIL SITE				TETRA TECH NUS, INC.
PLAISTOW, NEW HAMPSHIRE				
DRAWN BY:	D.W. MACDOUGALL	REV.:	1	
CHECKED BY:	D. BAXTER	DATE:	SEPTEMBER 28, 2005	55 Jonspin Road Wilmington, MA 01887
SCALE:	NONE	ACAD NAME:	t:\DWG\4103\1020\H2-RH7_SOILS.DWG	(978)658-7899

BORING H3 / PIEZOMETER RH10



NOTES:

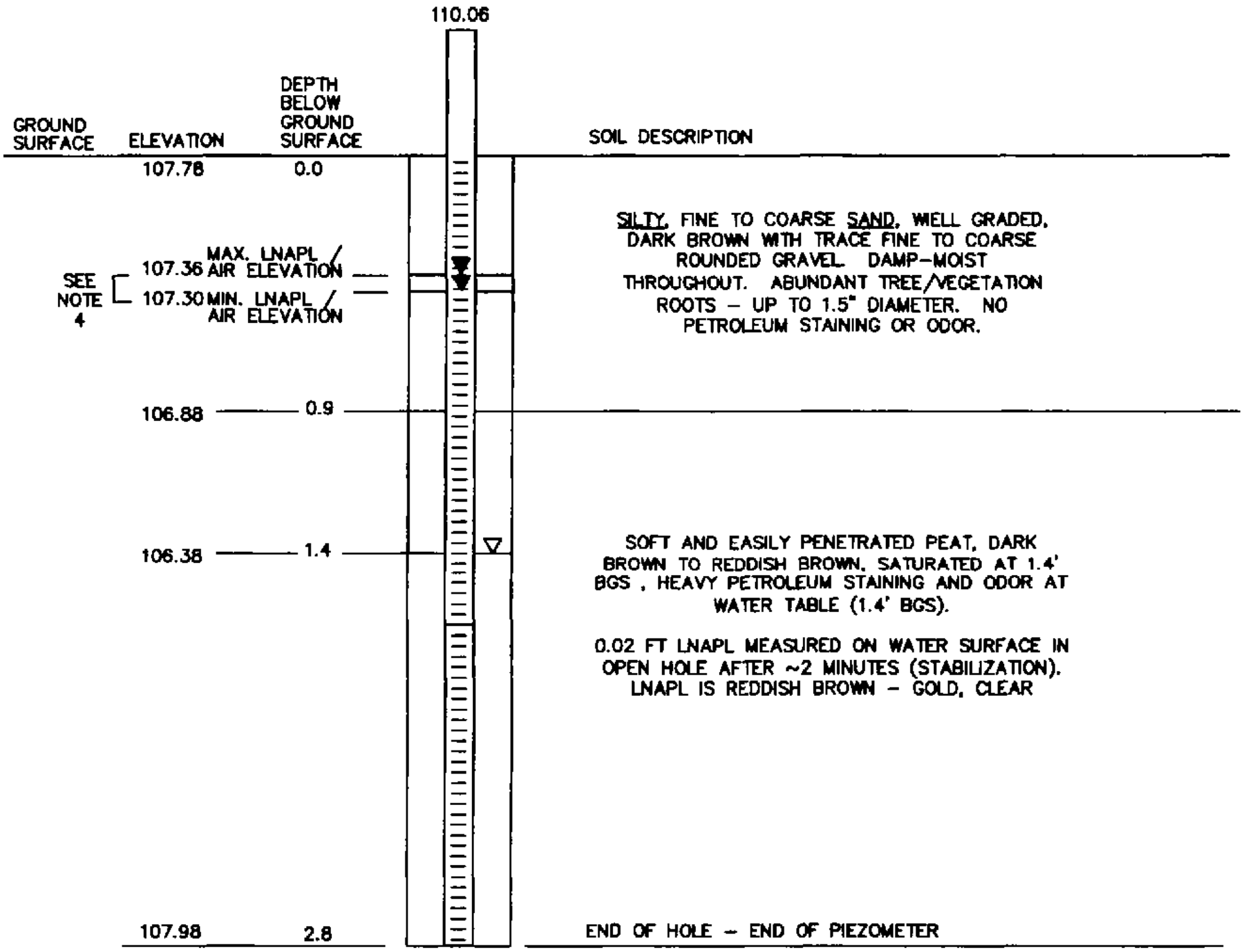
1. SOIL DESCRIPTIONS FROM HAND EXCAVATED BORING CONDUCTED ON 5/20/05.
2. 1.15" ID PVC WELL INSTALLED IN RE-EXCAVATED HOLE ON 6/7/05.
3. ELEVATION DATUM IS NGVD 29 (FEET). BM USED INVERT OF MANHOLE 15 (ELEV.= 111.61)
4. TRIANGULAR SYMBOL (▼) INDICATES MAXIMUM AND MINIMUM PETROLEUM SHEEN ELEVATIONS OBSERVED DURING INVESTIGATION ON 6/8/05 & 6/15/05 RESPECTIVELY. ONLY A SHEEN OBSERVED; NO MEASURABLE LEVEL.
5. TRIANGULAR SYMBOL (▽) INDICATES LOCATION OF WATER TABLE IN OPEN HOLE AT TIME OF EXCAVATION.

SOIL BORING/PIEZOMETER CONSTRUCTION LOG (H3/RH-10)			
BEEDE WASTE OIL SITE			
PLAISTOW, NEW HAMPSHIRE			
DRAWN BY:	D.W. MACDOUGALL	REV.:	0
CHECKED BY:	D. BAXTER	DATE:	SEPTEMBER 28, 2005
SCALE:	NONE	ACAD NAME:	I:\DWG\4103\1020\H3-RH10_SOILS.DWG

FIGURE F-3

TETRA TECH NUS, INC.
55 Jonspin Road Wilmington, MA 01887
(978)658-7899

BORING H4 / PIEZOMETER RH9



NOTES:

1. SOIL DESCRIPTIONS FROM HAND EXCAVATED BORING CONDUCTED ON 6/3/05.
2. ELEVATION DATUM IS NGVD 29 (FEET). BM USED INVERT OF MANHOLE 15 (ELEV.= 111.61)
3. PIEZOMETER INSTALLED IN OPEN HOLE 6/3/05. 1.25–INCH INSIDE DIAMETER, 0.010–INCH SLOTTED PVC, 4–FEET LONG. WELL ID = RH9.
4. TRIANGULAR SYMBOL (▼) INDICATES MAXIMUM AND MINIMUM LNAPL/AIR INTERFACE ELEVATIONS OBSERVED IN WELL DURING INVESTIGATION ON 6/3/05 & 6/15/05 RESPECTIVELY.
5. TRIANGULAR SYMBOL (▽) INDICATES LOCATION OF WATER TABLE IN OPEN HOLE AT TIME OF EXCAVATION.

SOIL BORING/PIEZOMETER CONSTRUCTION LOG (H4/RH–9)			
BEEDE WASTE OIL SITE			
PLAISTOW, NEW HAMPSHIRE			
DRAWN BY:	D.W. MACDOUGALL	REV.:	0
CHECKED BY:	D. BAXTER	DATE:	SEPTEMBER 28, 2005
SCALE:	NONE	ACAD NAME:	I:\DWG\4103\1020\H4–RH9_SOILS.DWG

FIGURE F–4

TETRA TECH NUS, INC.
55 Jonspin Road Wilmington, MA 01887
(978)658–7899

BORING H5

GROUND SURFACE	ELEVATION	DEPTH BELOW GROUND SURFACE	SOIL DESCRIPTION
			WETLAND SOILS: ORGANIC SILT & SAND / PEAT. ABUNDANT TREE./VEGETATION ROOTS, LEAF MATTER, MIXED WITH FINE-COARSE SAND AND TRACE FINE ROUNDED GRAVEL. VERY SOFT, SATURATED AT 0.5' BGS.
		0.5 ▽	HOLE FILLS QUICKLY WITH WATER. NO SIGN OF PETROLEUM SHEEN, STAINING, OR ODOR.
		1.0	END OF HOLE – NO PIEZOMETER INSTALLED

NOTES:

1. SOIL DESCRIPTIONS FROM HAND EXCAVATED BORING CONDUCTED ON 6/3/05.
2. HOLE LEFT OPEN FOR OBSERVATION.
3. TRIANGULAR SYMBOL (▽) INDICATES LOCATION OF WATER TABLE IN OPEN HOLE AT TIME OF EXCAVATION.

SOIL BORING/PIEZOMETER CONSTRUCTION LOG (H5)				FIGURE F-5
BEEDE WASTE OIL SITE				TETRA TECH NUS, INC.
PLAISTOW, NEW HAMPSHIRE				
DRAWN BY:	D.W. MACDOUGALL	REV.:	0	
CHECKED BY:	D. BAXTER	DATE:	SEPTEMBER 28, 2005	55 Jonspin Road Wilmington, MA 01887 (978)658-7899
SCALE:	NONE	ACAD NAME:	I:\4103\1020\H5_SOILS.DWG	

APPENDIX G

COST ESTIMATE – INTERCEPTOR TRENCH EXTENSION

80 FOOT EXTENSION OF EXISTING RECOVERY TRENCH
BEEDE WASTE OIL
PLAISTOW, NH

COST SUMMARY TABLE

DIRECT COSTS		
1.0	Mobilization/Demobilization	$3,900
2.0	Site Preparation	$8,296
3.0	Excavation and Soil Management	$9,620
4.0	*Installation of Concrete Structures*	$17,458
5.0	Backfill and Site Restoration	$6,237
	Total Direct Costs	$45,511
OTHER COSTS (Includes 5% for Engineering and Design, and 15% Contingency)		
	Cost for Engineering (5%)	$2,276
	Construction Management (10%)	$4,551
	Contingency (15%)	$6,827
	Total Other Costs	$13,653
Total Cost		**$59,165**

Notes:

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DETAILED COST ESTIMATE
80 FOOT EXTENSION OF EXISITING RECOVERY TRENCH
BEEDE WASTE OIL SITE,
PLAISTOW, NH

	DESCRIPTION	QUANTITY	UNIT	UNIT COST	TOTAL COST	SOURCE/NOTE
1.0 Mobilization/Demobilization						
1.1	Equipment Mobilization	1	LS	$1,200	$1,200	historical cost
1.2	*Monthly Costs associated with Field Support*	1	*MONTH*	*$2,700*	*$2,700*	*historical cost*
	Subtotal				**$3,900**	
2.0 Site Preparation						
2.1	Site Access Road Construction	40	SY	$12.55	$502	Means 2004 HC, 02720 200 0300
2.2	Site survey	1	EA	$5,000	$5,000	TtNUS. 2005
2.3	Construct Soil Stockpiling/Staging Areas					
2.3.1	*6 mil polyethylene cover tarps (60 x 60)*	10	EA	$150.00	$1,500	TtNUS, 2005
2.4	Install Erosion and Sedimentation Controls					
2.4.1	*Hay bails, staked*	300	LF	$2.72	$816	Means 2004 HC, 02370-700-1250
2.4.2	*Silt fence*	300	LF	$1.01	$303	Means 2004 HC, 02370-700-1100
2.5	Fence removal	1	LS	$174.00	$175	Means 2004 ER, crew rates
	Subtotal				**$8,296**	
3.0 Excavation and Soil Management						
3.1	*Excavation*	800	CY	$2.29	$1,832	*Means 2004 ER, 17 03 0277*
3.2	Haul Waste to Stockpile/Staging Area	800	CY	$5.50	$4,400	Means 2004 HC, 02315 490 1245
3.3	Perimeter Air Monitoring	1	MONTH	$750.00	$750	U.S. Environmental 2002
3.4	Equipment Decontamination	40	HR	$39.56	$1,582	Means 2004 ER, 33 17 0823
3.5	Stockpile Management	800	CY	$1.32	$1,056	Means 2004 HC, 02230 500 0100
	Subtotal				**$9,620**	
4.0 Installation of Concrete Structures						
4.1	Precast Concrete Galley	10	EA	$475.00	$4,750	United Concrete Products Inc., CT
4.1.1	Galley installation	20	HR	$113.65	$2,273	Means 2004 ER, crew data
4.2	18" Precast Concrete Cones	10	EA	$88.00	$880	Shea Concrete Products Inc., 2005
4.3	30" Pipe Connection to Concrete Cone	20	LF	$87.09	$1,742	Means ER 2004, 19 02 0119
4.4	Cast Iron Frame and Cover	10	EA	$100.00	$1,000	Shea Concrete Products Inc., 2005
4.5	Delivery	2	LS	$122.99	$246	Shea Concrete Products Inc.
4.6	*Brick and Mortar*	1	LS	$245.97	$246	*Shea Concrete Products Inc.*
4.7	12" gravel Backfill	150	CY	$24.51	$3,677	Means 2004 ER, 18 01 0102
4.8	Install non-permeable geotextile	1,000	SF	$2.03	$2,030	Means ER 2004, 33 08 0572
4.9	Miscellaneous tools and supplies	1	LS	$614.94	$615	Shea Concrete Products Inc.
	Subtotal				**$17,458**	
5.0 Backfill and Site Restoration						
5.1	Site Cleanup	8	hours	$293.70	$2,350	Means 2004, 17 04 0101
5.2	Fence Replacement	100	LF	$38.87	$3,887	Means 2004 ER, 18 04 0102
	Subtotal				**$6,237**	
TOTAL DIRECT COSTS					**$45,511**	
7.0 Other Costs						
6.1	*Engineering and Design (5% of total direct costs)*				$2,276	
6.2	Construction Management (10% of total direct costs)				$4,551	
6.3	Contingency (15% of total direct costs)				$6,827	
TOTAL OTHER COSTS					**$13,653**	
TOTAL COST					**$59,165**	

References:

Means 2004 HC: RS Means Heavy Construction Cost Data, 18th Annual Edition, 2004.

Means 2004 ER: RS Means Environmental Cost Data, 10th Annual Edition, 2004.

TtNUS, 2005: Tetra Tech NUS Internal Supplier Quote, 2005.

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CHECKED BY ______

COSTING ASSUMPTIONS
80 FOOT EXTENSION OF EXISTING RECOVERY TRENCH
BEESE WASTE OIL SITE,
PLAISTOW, NH

DESCRIPTION		RATIONALE
1.0 Mobilization/Demobilization		
1.1	Equipment mobilization	Assume less than 25 mile haul distance for all equipment.
		Equipment would be mobilized and demobilized to and from the site once each for this project.
		Assume $200 for mob, $200 for demob per piece of equipment
		The following pieces of heavy equipment would be mobilized to the site at various points of the project: *1 excavator, 1 backhoe, 1 roller*
		Unit costs include labor cost for equipment mob/demob.
1.2	Field Support Facilities	Field support facilities will be mobilized and demobilized to and from the central field support area once during the course of the project.
		The following items are included in this cost line item: storage trailer @ $500, dumpster @ $100, sanitary facilities @ $100, soil sampling equip @ $2000.
2.0 Site Preparation		
Site preparation was assumed to be required. There is little clearing and access road construction required at this site however a fence behind the treatment systems may need to be removed and later replaced to allow the heavy machinery to access the trench extension area.		
2.1	Site Access Road Construction	Assume 50 feet, 20 feet wide, and one-foot thick layer of gravel, of access road total for the site. There exists an access road to the treatment systems, will take half a day or less upon delivery of aggregate base course.
		Aggregate base course, 12" deep, daily output 5,000 S.Y.
		Crew B-36B: 1 labor foreman, 1 laborer, 2 equip operators, 1 backhoe, 1 roller.
2.2	Site survey	Assume $5,000 for site survey.
		Site survey would serve to identify the extension trench footprint prior to excavation.
2.3	Construct Soil Stockpiling/Staging Areas	Assume one soil stockpiling/staging area to be constructed at one of the existing soil piles on the site that will be removed at a later date in the future.
		The stockpile will be covered with 6 mil, or heavier, poly tarps daily to prevent excessive erosion due to stormwater runoff. Assume 10 tarps will be adequate for covering the stockpile and lining the bottom of the stickpile for collection of runoff water.
		Silt fence and hay bales would be installed at the perimeter of each stockpiling/staging area to prevent sedimentation that might enable contaminant transport from the stockpiles (see section 2.4 below).
2.4	Install Erosion and Sedimentation Controls	Erosion and sedimentation controls will consist of hay/straw bales and silt fence installed at the perimeter of each soil bales and silt fence installed at the perimeter the stockpile area and at the perimeter of the excavation area.
		100 hay bales, assume a hay bale measure approximately 3 feet in length.
		Silt fence for 300 feet of erosion control.
2.5	Fence removal	Assume 100 feet of the existing fence will need removing to allow the equipment to work effectively and efficiently. Assume 2 laborers at $26.00/hour and one backhoe with operator at $35.00/hour working for two hours to remove the fence.
3.0 Excavation and Soil Management		
Excavation and loading of soil is assumed to occur using a hydraulic excavator (2 CY capacity). The excavation rate was assumed to be 75 CY/HR. Therefore, for excavation of 800 CY (see calculations) approximately 11 HR is assumed. Excavated material and soil will be loaded directly into 20 CY dump trailers and transported to the staging/soil stockpiling areas , which will be at one of the existing soil piles on site..		
3.1	Excavation and Load Excavated Material	Excavate and Load, 2 CY Hydraulic Excavator, Medium Material, 75 CY/Hour. Crew CODET: 1 laborer (semi-skilled), 1 hydraulic excavator, crawler, 2.00 CY bucket, 1 equipment operator. Labor costs included in unit cost. Excavation will be approximately 6 feet wide, 80 feet long and between 5 to 15 feet deep.
3.2	Haul Waste to Stockpile/Staging Area	20 CY dump trailers, 0.25 mile round trip, 5 loads/hour, 800 CY/ truck/day assumed. Assume one truck transporting soil accross the Beede property to one of the existing soil stockpiles to provide capacity for 75 CY/HR excavation rate. Crew B-34D: 1 truck driver, 1 dump trailer 20 CY.
3.3	Perimeter Air Monitoring	Monitoring of VOCs for site workers and residents. Use a photoionization device, assume a PhotoVAC 2020.
3.4	Equipment Decontamination	Assume decontamination of heavy vehicles as they leave the site at the end of the job. Operate 1,800 PSI pressure washer at $39.56/HR. Includes water, soap, electricity, and labor. Assume operation during entire duration of excavation activities.
3.5	Stockpile Management	Stockpile management assumed to include an equipment operator grading the excavated soil onto an existing soil pile at the Beede waste oil site.

PREPARED BY DH

CHECKED BY [illegible]

COSTING ASSUMPTIONS
80 FOOT EXTENSION OF EXISTING RECOVERY TRENCH
BEESE WASTE OIL SITE,
PLAISTOW, NH

	DESCRIPTION	RATIONALE
4.0 Installation of Concrete Structures		
4.1	Precast Concrete Galley	Pre-cast concrete galleys of dimensions 4' by 4' by 8' long were used in the existing recovery trench at the site, these will be used to tie in to the existing recovery trench. Available, delivery included, from United Concrete Products Inc.
	Galley Installation	Labor to install pre-cast concrete galleys is assumed to be: 1 excavator operator at $33.65/hr, 2 skilled workers at $26.00/hr, and 1 forman/oversight at $28.00/hr. Assume 2 hours to install one conrete galley.
4.2	18" Precast Concrete Cones	Will be installed on the galley at the 20" cleanout hole.
4.3	30" Pipe Connection to Concrete Cone	Extension of the galley opening may be necessary for some of the galleys due to the rise in grade to the east of the site (see sketch - recovery trench extension).
4.4	Cast Iron Frame and Cover	Manhole cover for 18" cone, will be mounted slightly higher than the final surrounding grade.
4.5	Delivery	Pre-cast concrete structures, not including the galleys, and supplies from local dealer to the recovery trench work site.
4.6	Brick and Mortar	Will be delivered by a local dealer or subcontractor.
4.7	12" Gravel Backfill	Will be delivered by a local supplier. The subcontractor will apply the gravel to form a base in the excavated trench for the pre-cast concrete galleys to rest on. Gravel will also be used to fill the upgradient side of the trench.
4.8	Install non-permeable geotextile	Install non-permeable geotextile on the downgradient side of the trench to prevent any possible migration of waste oil.
4.9	Miscellaneous tools and supplies	Any specialized equipment or supplies needed to properly install the galley's and the geotextiles surrounding the collection trench structures.
5.0 Backfill and Site Restoration		
5.1	Site Cleanup	Crew B-36B: 1 labor foreman, 1 laborer, 2 equip operators, 1 backhoe.
		Assume clean excavated material will be used as backfill after the galleys are installed.
5.2	Fence Replacement	Security fence wth 1' by 1' grade beam, 10' Galvanized with 3 Strands barbed wire. Pour grade beam, regular, direct chute, place 3,000 PSI concrete foundations.

References:

Means 2004: RS Means Heavy Construction Cost Data, 18th
Means ECHOS 2004: RS Means Environmental Cost Data, '
TtNUS, 2005: Tetra Tech NUS Internal Quote, 2005.

PREPARED BY ______

CHECKED BY ______