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NAPL INTERIM REMOVAL FIELD EVALUATION REPORT (NIRFER) FOR THE REMEDIATION OF THE RAYMARK INDUSTRIES FACILITY SITE

SUBTASK 12.05
NAPL EXTRACTION

VOLUME 1: TEXT

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LIST OF ACRONYMS

1,1-DCE	1,1-dichloroethene
1,1,1-TCA	1,1,1-trichloroethane
APR	Air Purifying Respirator
ASTM	American Society of Testing of Materials
CCV	Continuing Calibration Verification
CDAP	Chemical Data Acquisition Plan
CQCP	Construction Quality Control Plan
CTDEP	Connecticut Department of Environmental Protection
cy	cubic yard
DNAPL	Dense Non-Aqueous Phase Liquid
D.O. 11	Delivery Order 11
ESGC	Enhanced Soil Gas Collection
FCR	Field Change Request
FID	Flame Ionization Detector
FS	Feasibility Study
GC/FID	Gas Chromatograph/Flame Ionization Detector
HEPA	High Efficiency Particulate Air
IDW	Investigation Derived Waste
LCS	Laboratory Control Spike
LNAPL	Light Non-Aqueous Phase Liquid
mg/kg	milligrams per kilogram
ml/min	milliliters per minute
MS/MSD	matrix spike/matrix spike duplicate
NAPL	Non-Aqueous Phase Liquid
NED	New England Division
NIRFE	Non-Aqueous Phase Liquids (NAPL) Interim Removal Field Evaluation
NIRFER	Non-Aqueous Phase Liquids (NAPL) Interim Removal Field Evaluation Report
NTU	Nephelometric Turbidity Unit
O_2/LEL	Oxygen/Lower Explosive Limit
OVA	Organic Vapor Analyzer
PCB	Poly-Chlorinated Biphenyl
PCE	Perchloroethene (tetrachloroethene)
PGC	Portable Gas Chromatograph
ppm	parts per million
ppb	parts per billion

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LIST OF ACRONYMS *(cont.)*

PPE	Personal Protective Equipment
ppm	parts per million
ppmv	parts per million by volume
PVC	polyvinylchloride
QA	Quality Assurance
QC	Quality Control
RCRA	Resource Conservation & Recovery Act
RFI	RCRA Facility Investigation
RI	Remedial Investigation
ROD	Record of Decision
SAR	Supplied Air Respirator
SCBA	Self-Contained Breathing Apparatus
SGC	Soil Gas Collection
SSHP	Site Safety and Health Plan
SVOC	Semi-Volatile Organic Compound
TCE	trichloroethene
tic	tentatively identified compound
toc	top of casing
TTS/WMP	Transportation and Temporary Storage/Waste Management Plan
μg/kg	micrograms per kilogram
μg/l	micrograms per liter
USEPA	United States. Environmental Protection Agency
USACE	United States Army Corps of Engineers
USCS	Unified Soil Classification System
VOC	Volatile Organic Compound

1.0 INTRODUCTION

Foster Wheeler Environmental Corporation (Foster Wheeler Environmental) prepared this Non-Aqueous Phase Liquid (NAPL) Interim Removal Field Evaluation Report (NIRFER) to present the results obtained during completion of the NAPL Interim Removal Field Evaluation (NIRFE) described in the Amendment to the Work Plan (DO11-WP-NAPL-03) for the remediation of the Raymark Industries, Inc. facility site (the facility), Task 12.0, NAPL Extraction. NIRFE activities were conducted to evaluate NAPL distribution and removal at the facility in Stratford, Connecticut under Delivery Order 11 (D.O. 11) of USACE Contract No. DACW33-94-D-0002.

The Task 12.0 Work Plan Amendment is based on the Task 12.0 Scope of Work contained in the D.O. 11 Work Plan for the Remediation of the Raymark Industries Facility Site, prepared by Foster Wheeler Environmental, dated July 1995. The Task 12.0 Work Plan Amendment also reflects changes due to field conditions detected and planning meetings attended by representatives of Foster Wheeler Environmental, Groundwater Technology, Inc. (a Foster Wheeler Environmental Team Subcontractor), the U.S. Environmental Protection Agency (USEPA), the U.S. Army Corps of Engineers (USACE), and the Connecticut Department of Environmental Protection (CTDEP) during D.O. 11 Work Plan implementation (from July 1995 through December 1995). The NIRFE activities included the following tasks and subtasks:

Task	Work Plan Activity	NIRFER Section
Subtask 12.01	NAPL Extraction Conceptual Planning/Coordination	2.0
Subtask 12.02	Groundwater Monitoring	2.1
Subtask 12.03	Existing 2-Inch Monitoring Well NAPL Recovery	2.2
Subtask 12.03	Enhanced Soil Gas Collection Pilot Testing	2.2
Subtask 12.04	NAPL Delineation Investigation	2.3
Subtask 12.05	NAPL Interim Removal Field Evaluation Report (NIRFER)	entire

Subtask 12.05 also includes development of two additional deliverables not included here: a conceptual approach package and a draft subgrade extraction design. To develop the conceptual approach package, NAPL extraction approaches will be screened, evaluated for consistency with other site remediation activities, and reviewed with project stakeholders. The recommended conceptual approach will be proposed in writing to reviewers and will be further developed following acceptance or authorization to proceed. The conceptual approach will form the basis of a draft subgrade extraction design. That design package will be submitted to USACE as part of the Resource Conservation and Recovery Act (RCRA) Cap 90% design submittal. Reviewer comments will be addressed and the design will be revised once.

1.1 Purpose

The NIRFER has been prepared to briefly summarize activities conducted during execution of the Task 12.0 Work Plan, to present the results of the investigation, and to interpret NAPL distribution in two geographic areas of the site: the vicinity of monitoring well cluster J and Building 43 where acid neutralization pits were formerly operated (Well cluster J and Building 43 Area); and the vicinity of monitoring well clusters V, O, and N and Building 6 (Northeast Area). The general objectives of Task 12.0 were to:

1) Chemically characterize groundwater in selected monitoring wells before the wells are destroyed by demolition or redevelopment activities;

2) Remove NAPL from existing monitoring wells in the areas of well clusters J, V, and N in order to evaluate the feasibility of long-term NAPL recovery in the western and northeastern portions of the site;
3) Delineate the horizontal and vertical extent (if possible) of NAPL distribution at well cluster J and in the northeast portion of the site; and
4) Conceptualize a long-term NAPL extraction approach and prepare a draft subgrade NAPL extraction design.

Considering the uncertainty associated with NAPL presence and extractability, a phased approach was followed in order to use the results of earlier efforts as guides for planning and executing subsequent subtasks. The phased approach provided opportunities for scope revision, addition, or deletion. Communication among USEPA, USACE, CTDEP, Groundwater Technology, Inc., and Foster Wheeler Environmental occurred before, during, and after each proposed phase.

1.2 Background Information

Raymark Industries, Inc. and its predecessor Raybestos-Manhattan, Inc., operated at the Stratford, Connecticut location from 1919 to 1989. During this period, the facility manufactured automotive parts, including brakes, clutch linings, and other heat-resistant parts. The manufacturing process resulted in generation of waste containing lead, asbestos, polychlorinated biphenyls (PCBs), and other contaminants including chlorinated solvents. This waste was stored in lagoons on the Raymark property. As the Raymark facility expanded, new buildings and parking areas were constructed over former lagoons and waste disposal areas.

Wastes from the lagoons were periodically dredged and disposed of as fill at sites around the Town of Stratford, including residential properties. Under its Emergency Removal programs, USEPA and its contractor, OHM, initiated the cleanup of residential properties in the town of Stratford, which was completed by Foster Wheeler Environmental under contract to USACE. Raymark waste contaminated soil was excavated from various residential properties and placed in the southern parking lot areas of the facility. The contaminated soil was placed in two large, covered stockpiles and at several of the site buildings, in a freestanding pile and in approximately 8,300 1.25-cubic yard (cy) soil bags. An additional 30,000 cy of contaminated soil has been transported from Wooster Middle School to the site. A total of approximately 53,000 to 58,000 cy of contaminated soil from the residential properties is estimated to be stored on-site.

USEPA contracted Halliburton NUS to complete a Remedial Investigation (RI) and a Source Control Feasibility Study (FS) for the Raymark facility. USEPA issued a Proposed Plan and signed a Record of Decision (ROD) on July 3, 1995. The cleanup for the site proposed in the ROD includes demolition of facility buildings and structures, removal of NAPL, and capping of the site.

NAPL was detected in monitoring well clusters J and V at depths between 24 and 48 feet and between 24 and 58 feet, respectively, during a RCRA Facility Investigation (RFI) completed in February 1995 by ELI, Inc. for Raymark Industries, Inc. Monitoring well cluster J is located in the southwest corner of the facility and monitoring well cluster V is located in the northeast corner of the facility. In prior investigations, the NAPL was interpreted to be primarily composed of trichloroethylene, 1,1,1-trichloroethane, and toluene. The ROD requires that NAPL contamination be measured and removed from these previously specified areas to limit migration into groundwater. The NIRFER describes the steps taken to achieve this objective.

2.0 NAPL INTERIM REMOVAL FIELD EVALUATION (NIRFE)

Field tasks performed under the Work Plan included:

- Site-wide measurement of groundwater and NAPL levels (liquid level gauging) in 58 site monitoring wells, including 4 monitoring wells installed under subtask 3.03 during the September 1995 geotechnical boring program;
- Site-wide groundwater sampling and laboratory analysis for volatile organic compounds (VOCs) and PCBs from 58 monitoring wells;
- Groundwater sampling and laboratory analysis for semi-volatile organic compounds (SVOCs) from eight site monitoring wells;
- NAPL sampling and laboratory analysis for VOCs, SVOCs, disposal characterization, and engineering parameters from well clusters J and O;
- Installation of 11 direct-push soil borings to depths of up to 20 feet below grade in the areas of well clusters V, O, and N, and the former Building 6 slab (Northeast Area);
- Installation of 11 direct-push soil borings to depths of approximately 50 feet below grade, and three deep drive and wash soil borings to bedrock from 50 to 109 feet below grade in the well cluster J and Building 43 area;
- On-site portable gas chromatography screening of soil samples for trichloroethene (TCE), tetrachloroethene (PCE), 1,1 dichloroethene (1,1-DCE), 1,1,1 trichloroethane (1,1,1-TCA), toluene, ortho-meta xylenes, and approximate total VOCs;
- Interim NAPL recovery pilot testing from existing 2-inch-diameter monitoring wells at well clusters J, V, and O; and
- Enhanced Soil Gas Collection (ESGC) testing in the northeast area of the site.

All NIRFE tasks were performed in accordance with the relevant project planning documents and their respective amendments including the Work Plan, Chemical Data Acquisition Plan (CDAP), Construction Quality Control Plan (CQCP), Transportation and Temporary Storage/Waste Management Plan (TTS/WMP), and Site Safety and Health Plan (SSHP).

Summaries of methodologies employed during each phase of the Work Plan are presented in **Appendix A**.

2.1 NIRFE Rationale

The NIRFE emphasized two geographic portions of the facility: the well cluster J area, where former waste handling/acid neutralization activities took place (monitoring well clusters J, E and K), and the northeastern portion of the facility where historic chemical releases are known to have occurred (monitoring well clusters Q, O, N, V, FW1, FW2, FW3, FW4). Additional areas of the facility were evaluated during groundwater monitoring activities that took place during Subtask 12.02.

2.1.1 <u>Liquid Level Gauging</u>

Liquid level gauging was conducted to: (1) determine which site monitoring wells contained NAPL in detectable thicknesses, and (2) to establish groundwater elevations at each well cluster to aid in interpretation of groundwater flow regimes and potential NAPL migration directions. Liquid level gauging methodologies are presented in **Appendix A**.

2.1.2 NAPL Sampling

NAPL sampling and analysis were initiated to determine the chemical composition of the NAPL observed in well clusters J and O and to quantify physical and chemical characteristics to assist in further delineation investigations and recovery system design. NAPL sampling methodologies are presented in **Appendix A**.

2.1.3 Groundwater Sampling

Groundwater sampling and analysis were conducted to characterize the site-wide distribution of dissolved-phase VOCs and PCBs identified during previous investigations. Groundwater samples from eight select wells were also analyzed for SVOCs. All groundwater samples were submitted to an off-site laboratory for analysis. QA samples were collected at 5% frequency and submitted to the USACE Environmental Laboratory in Hubbardston, Massachusetts. Groundwater sampling methodologies are presented in **Appendix A**.

2.1.4 NAPL Delineation Investigation

A NAPL delineation investigation was conducted to determine the horizontal and vertical extent of dense non-aqueous phase liquids (DNAPL) adjacent to well cluster J, and light non-aqueous phase liquids (LNAPL) adjacent to well clusters O, V, N and below the former Building 6 slab, as well as to investigate potential VOC sources in the vicinity of former acid neutralization pits, identified by USEPA Region I, beneath Building 43. Delineation investigation methodologies are presented in **Appendix A**.

The investigation used select compound-specific concentrations in soil as described in **Section 2.2.4,** and the concentration of select NAPL-compounds greater than 1% of solubility as the indicators of potential NAPL presence in the subsurface at investigation locations. Soil samples were analyzed on-site by PGC. QC samples were collected at 10% frequency and submitted to a USACE-validated laboratory, E^3I, for confirmatory analysis of VOCs in accordance with EPA Method 8260. QA analysis was performed by USACE Laboratory on 5% of the split sample population.

2.1.5 Interim NAPL Recovery Pilot Testing

Interim NAPL recovery testing was performed to evaluate recovery potential at locations where NAPL was detected during monitoring well gauging (well clusters J and O) or where NAPL had been observed during previous investigations (well clusters J and V). Interim NAPL recovery pilot testing methodologies are presented in **Appendix A**.

2.1.6 Enhanced Soil Gas Collection Testing

ESGC was evaluated as a recovery technology for the northeast area of the site as an alternative to the NAPL pumping originally outlined in the ROD and the Task 12.0 Work Plan. During Task 12.0 activities, it became apparent that NAPL pumping in the northeast area would not be the most effective technology for contaminant source reduction for several reasons: the lack of consistent NAPL presence; poor results from the interim NAPL recovery pilot testing at well clusters V and O; and the consistent presence of contaminant mass primarily in shallow soil near the water table. ESGC was evaluated as a recovery approach because it is generally effective at removal of shallow VOC contamination at or above the water table and because it could be easily integrated with the passive soil gas collection system planned for the facility cap. ESGC is especially effective when used in areas of relatively permeable sandy soils, such as those found in the northeast area of the site.

2.2 Site-wide Activities and Results

2.2.1 Liquid Level Gauging

Site-wide groundwater and NAPL gauging was conducted between August 24, 1995 and August 30, 1995 at 54 monitoring wells in well clusters A, B, C, E, F, I, J, K, L, M, N, O, Q, and V, and subtask 3.03 wells FW1 through FW4, as shown on **Figure 2-1.**

Ten monitoring wells, located in clusters J, K, O, and V, and wells FW1, FW2, and FW3, produced headspace concentrations of vapor-phase VOCs that exceeded 1,000 ppm when tested with a hand-held FID. High headspace concentrations are general indicators that contaminant mass exists in the liquid-phase, dissolved-phase, or adsorbed-phase in sufficient volume to volatilize to vapor-phase. Headspace screening results are presented in **Table 2-1**.

Depths to groundwater ranged from less than 2 feet below top of casing at well cluster M to more than 16 feet below top of casing at well clusters J, C, and E. Liquid level gauging data are presented in **Table 2-1**.

2.2.2 NAPL Sampling

NAPL samples were analyzed in accordance with EPA Method 8260 for purgeable VOCs, EPA Method 8270 for SVOCs, and EPA Method 8080 for PCBs. NAPL samples were analyzed for disposal characterization parameters including pH, reactive sulfide, reactive cyanide, flash point, and gross heat of combustion. NAPL samples were also analyzed for engineering parameters including: viscosity, specific gravity, density, electrical conductivity, and vapor pressure. NAPL analytical results are presented in **Table 2-2.** A comparison of analytical results and engineering parameter results is presented in **Table 2-3** and discussed in **Sections 2.3.2 and 2.4.2**. NAPL analytical reports are included in **Appendix B**.

2.2.3 Groundwater Sampling

Groundwater samples were collected following completion of liquid level gauging and NAPL sampling. Monitoring wells were purged and sampled in accordance with "USEPA Region I Low-Flow (minimal stress) Purging and Sampling Procedure for the Collection of Groundwater Samples from Monitoring Wells, 8/11/95 Final Draft, SOP #GW0001." The temperature, specific conductivity, pH, turbidity, salinity, and dissolved oxygen of the purge water were measured in the field. A summary of field data is included in **Table 2-4**. Groundwater sampling methodologies are presented in **Appendix A**.

Groundwater samples were analyzed in accordance with EPA Method 8260 for purgeable VOCs and EPA Method 608 for PCBs. Groundwater samples from monitoring wells J1-1, J5, N3, and V1, that exhibited a sheen on discharge water during well purging and monitoring wells K2, K3, K4, K5 that exhibited a yellowish-green coloration, were analyzed for SVOCs in accordance with EPA Method 8270. Groundwater samples were also collected from wells J5 and J1-1 for waste characterization parameters. Groundwater analytical data is provided in **Table 2-5** and **Table 2-6**, groundwater laboratory data is included in **Appendix C,** and the three QA/QC memoranda related to Task 12.0 field sampling activities are included as **Appendix D**. Groundwater sampling results are discussed in detail in **Section 2.3.3** and **Section 2.4.3**.

Groundwater analytical results were compared with published solubility information for EPA Method 8260 target compounds to determine if dissolved-phase concentrations of any particular compound exceeded 1% of the compound's solubility limit in water. Under direction of USEPA Region I, the dissolved concentrations that were greater than 1% of the water solubility limit of each respective compound was used as an investigation standard to indicate the possibility of NAPL presence.

The results of site-wide groundwater sampling indicate:

- 18 dissolved phase VOCs were identified during groundwater sampling. Detectable VOC concentrations were measured in 40 of the 58 monitoring wells sampled for VOC compounds.

- Dissolved phase concentrations of SVOCs were identified in all eight groundwater samples collected from selected wells in clusters J, K, N, and V. The SVOC that was present at those locations at the highest concentration (3,900 μg/l) was 2, 4-Dinitrophenol, that was present in bedrock well K4.

- Dissolved phase PCB (Aroclor 1268) was detected in four of the 58 monitoring wells sampled. Site-wide dissolved phase PCB concentrations in groundwater were less than the maximum observed concentration, 43 μg/l, which was measured in monitoring well J5.

- Up to 20 dissolved phase semi-volatile organic TICs and up to 9 dissolved phase volatile organic TICs were found in well clusters I, J, K, M, N, O, V and FW1, FW2, FW3 and FW4.

- The dissolved-phase concentrations of toluene and xylene, exceeded the 1% solubility level in a shallow well in each cluster N, O, V, and in well FW2, respectively.

- The dissolved-phase concentration of chlorobenzene exceeded the 1% solubility level in shallow monitoring well FW2 and bedrock well O4-1, both of which are located in the northeast portion of the site.

- The dissolved-phase concentrations of denser-than-water compounds exceeded the 1% solubility level in two intermediate depth monitoring wells at well clusters B (1,2-DCE) and J (1,1,1-TCA and TCE).

- The dissolved-phase concentrations of denser-than-water compounds exceeded the 1% solubility level in three bedrock monitoring wells at well clusters E (1,1-DCE and 1,1,1-TCA), K (TCE), and O (chlorobenzene).

- Site-wide, the pH of the groundwater ranged from 2.5 to 11. Low pH values (less than 4) were identified at well clusters J, K, M, and E. High pH values (greater than 10) were identified at well clusters V and L.

- Dissolved-phase concentrations of denser-than-water compounds increase with depth at several locations across the site, as described in **Section 2.3.3** and **Section 2.4.3**. However, concentrations of denser-than-water compounds at clusters L and M were greatest in the shallow well at each cluster.

- At well cluster B, dissolved-phase 1,2-dichloroethene was detected at 7,000 μg/l, or 1.2% of the compound's water solubility.

Plate 6 illustrates the distribution of VOCs in groundwater. Further discussion of the groundwater analytical results by geographic area (i.e. Well cluster J/Building 43 area and Northeast Area) is presented in **Sections 2.3.3** and **Section 2.4.3**.

Results of the site-wide gauging, NAPL sampling, and groundwater sampling indicated that DNAPL was present in the well cluster J area and that LNAPL was present in the northeast portion of the site. These results are generally consistent with previous investigation data. Subsequent delineation activity focussed on these contaminant types and distributions.

2.2.4 NAPL Delineation Investigation

A NAPL delineation investigation was conducted to:

- Determine the horizontal and vertical distribution of NAPL in known source areas;
- Investigate additional suspected source areas;
- Predict if NAPL was present in recoverable quantities in previously indicated areas; and
- Identify appropriate locations for recovery system installation.

Investigation activities included completion of shallow soil borings in areas of suspected LNAPL occurrence and deep soil borings in areas of possible DNAPL occurrence. Also, USEPA Region I identified two areas beneath Building 43 suspected to contain abandoned acid neutralization pits. These areas were evaluated in the delineation investigation. Final boring locations are presented in **Figure 2-1.** Summaries of delineation investigation methodologies are presented in **Appendix A**.

Direct-push hydraulic drill rigs (Geoprobe™) were used to collect soil samples from depths up to 50 feet below grade. A drive and wash drill rig was also used to collect soil samples from surface grade to the top of bedrock at three locations in the well cluster J and Building 43 areas.

Continuous sampling from surface grade was conducted in areas of suspected LNAPL occurrence and in areas of possible former acid pits so that the entire vertical section of unsaturated zone soil could be evaluated. In areas of suspected DNAPL presence outside of former acid pit locations, soil sampling was initiated at 12 to 16 feet below surface grade to investigate native soils and to avoid process and imported fill materials. Sampling intervals for all borings are presented in **Table 2-7** and **Table 2-8** and boring logs are included as **Appendix E**.

Soil samples were screened on-site using a Photovac portable gas chromatograph (PGC) in accordance with modified EPA Method 3810 for analysis of VOCs by GC/PID. PGC analysis was used as a screening method which allowed a large number of samples to be processed over a short period of time. On-site PGC analytical methodology is presented in **Appendix A**.

On-site PGC concentration greater than 1,000 mg/kg of any target analyte was selected by the USEPA as the threshold level indicative of potential NAPL presence. On-site PGC analytical detection limits were established as close to 1,000 mg/kg as possible for each target analyte in order to accommodate the threshold levels. Detection limits for the target VOC analytes were: 1,1-DCE (1,500 mg/kg; 1,1,1-TCA (10,000 mg/kg); TCE (1,000 mg/kg); PCE (1,000 mg/kg); total ortho-meta xylenes (1,000 mg/kg) and toluene (1,000 mg/kg). Each of the six analytes was identified in previous groundwater or soil sampling events. In addition, the approximate concentrations of total target VOCs and unidentified compounds (calculated based on the response of TCE) were reported in the PGC results. The combined threshold levels and detection limits defined an investigation standard that was used to characterize source area identification throughout delineation efforts. The results of on-site

PGC analysis are presented in **Table 2-7** and **Table 2-8** and the PGC Reports are included in **Appendix F**. Identification by PGC of non-target analytes was not accomplished by any means within this investigation.

A random population of split QC soil samples, representing approximately 10% of the total number of samples analyzed on-site by PGC methods, was submitted to a USACE-validated off-site laboratory, E^{3}I, for analysis of VOCs in accordance with EPA Method 8260. Laboratory reports, including the results of the TIC library search, are included in **Appendix G.** QA analysis was performed by USACE on 5% of the QC split population. Comparisons of on-site to off-site results are presented in **Appendix D**. Split sample comparison indicates that on-site analysis was effective in semi-quantitatively measuring relative concentrations of target analytes and augmented visual observation. Soil concentrations determined by on-site analysis should not be considered absolute, accurate levels.

Additional soil samples were collected from representative borings in both investigation areas for off-site laboratory analysis of grain size in accordance with American Society of Testing of Materials (ASTM) Standard D422-63, Total Organic Carbon, and Bulk Density. These analyses were completed to provide additional information for use in extraction system modeling and design. Bulk density and total organic carbon analytical results are presented in **Table 2-9**. A soil grade size reference is presented in **Table 2-10**, and a summary of soil grade distribution is presented in **Table 2-11** and in sieve analysis graphs presented in **Appendix H**.

2.2.5 NAPL Interim Removal Pilot Testing

Interim NAPL recovery systems designed to facilitate the removal of NAPL from existing 2-inch diameter monitoring wells at well clusters J, V, and O, were installed following well gauging and sampling activities. Summaries of interim NAPL recovery pilot testing methodologies are presented in **Appendix A**, and results from each area are discussed in **Section 2.3.5** and **Section 2.4.5**.

2.3 Well Cluster J and Building 43 Area Activities and Results

2.3.1 Liquid Level Gauging

DNAPL was identified at the base of monitoring well J2-1 during August 1995 in apparent thicknesses ranging from 2.34 feet to 2.69 feet at approximate depths ranging from 33 to 36 feet below toc. The DNAPL was described as a dark brown, oily-appearing substance. Liquid level gauging data is presented in **Table 2-1** .

2.3.2 NAPL Sampling

Laboratory analysis indicated that DNAPL obtained from well J2-1 in August 1995 was composed primarily of 1,1,1-TCA (310,000,000 μg/kg), 1,1-DCE (64,000,000 μg/kg), acetone (58,000,000 μg/kg), and TCE (5,000,000 μg/kg), with several additional volatile and semi-volatile compounds present in lower concentrations. PCB Aroclor 1268 was detected in the NAPL sample collected from J2-1 at a concentration of 190,000 μg/kg. One volatile organic TIC and eighteen semi-volatile TICs were found in the J2-1 NAPL sample. Although the DNAPL was observed only in the base of well J2-1, the sample partitioned within the sample container following collection. The partitioned sample was comprised of two distinct phases, an upper and a lower phase. The balance of the sample mass is likely to have been composed of water.

Engineering analyses indicate that the lower phase of the sample had specific gravity and density greater than water. If present in sufficient quantities, denser than-water compounds could be expected to accumulate as a discrete measurable layer at the top of a lower permeable unit, i.e. at the top of bedrock, above a confining lithologic unit, or above a finer layer of soil. The upper phase had a specific density and gravity nearly equal to that of water. NAPL sample comparison results are presented in **Table 2-3** and NAPL analytical results are presented in **Table 2-2** . NAPL analytical laboratory reports are included in **Appendix B**.

2.3.3 Groundwater Sampling

The groundwater analytical results from the western portion of the site (Well Clusters J, K, and E) indicate:

- 15 dissolved phase VOCs were identified in groundwater samples collected from well clusters J, K, and E.
- Five dissolved phase SVOCs were identified in groundwater samples from well clusters J and K. The highest dissolved phase SVOC concentration was measured in the bedrock well at well cluster E.
- Dissolved phase concentrations of PCBs (Aroclor 1268) concentrations were detected in well cluster J (43 μg/l at 48 feet below grade) and well cluster K (1.6 μg/l at 17 feet below grade).
- Up to 20 semi-volatile organic TICs and one volatile organic TIC were found in well cluster J and well cluster K.
- Low pH values (less than 4) were identified at well clusters J, K, and E. Site-wide, the pH of the groundwater ranged from 2.5 to 11.

Within each of the following well clusters, the following VOCs were present at concentrations greater than 1% of their respective solubilities in water:

- Well cluster E - 1,1,1-TCA was present at 74,000 μg/l or 1.7% of the compound's water solubility and 1,1-DCE was present at 8,400 μg/l, or 2.1% of the compound's water solubility,
- Well cluster J - TCE present at 790,000 μg/l or 72% of the compound's water solubility; toluene was present at 8,800 μg/l or 1.7% of the compound's water solubility, and 1,1,1-TCA was present at 190,000 μg/l or 4.3% of the compound's water solubility.
- Well cluster K - TCE was present at 11,000 μg/l or 1% of the compound's water solubility,

Review of the groundwater concentration data **(Table 2-5)** and the depth from which the groundwater samples were collected indicates that:

- The highest concentrations of TCE (790,000μg/l) were identified in well cluster J at intermediate depths of 38 to 48 feet below grade, adjacent to observed DNAPL accumulations.
- Dissolved-phase TCE concentrations ranged from 72% of the solubility limit at well cluster J to 1% of the solubility limit at the bedrock well in well cluster K. The well cluster J concentration suggests that TCE is highly soluble in site groundwater and might be expected to occur in high dissolved-phase concentrations adjacent to accumulated NAPL. Using the 1%

solubility threshold of TCE as an indicator of NAPL occurrence may be an overly conservative investigation standard.

- Concentrations of 1,1,1-TCA and 1,1-DCE increased with depth at well cluster E. The highest concentrations were identified at well cluster J at an intermediate depth of 38 to 48 feet below grade, adjacent to the successful interim DNAPL recovery system. The second highest concentration of 1,1,1-TCA was identified in a bedrock well at well cluster E at 1.7% of the water solubility. The highest concentration of 1,1-DCE (8,400 μg/l or 2.1% water solubility) was identified at well cluster E.

- The well cluster E, J, and K areas are contaminated primarily with dissolved-phase 1,1,1 TCA, TCE, and 1, 1-DCE, each of which if present at sufficient concentrations, would accumulate as a measurable layer of DNAPL.

- The observed DNAPL contamination does not consist of single compounds, but rather as a mixture of several compounds that each contribute to the density, viscosity, and vertical distribution of the NAPL.

Off-site groundwater QC results are presented in **Appendix D**. The QC review determined the data to be acceptable for use considering project objectives.

2.3.4 NAPL Delineation Investigation

Three soil borings were advanced by drive and wash drilling methods from surface grade to bedrock (50 to 109 feet below grade) at locations in the well cluster J and Building 43 area, as shown on **Figure 2-1**. Approximately 11 Geoprobe borings were also advanced in this area to an average depth of 50 feet below grade. The results of soil sampling in well cluster J and Building 43 areas indicate that:

- DNAPL appears to be located within 50 feet of surface grade in the area of well cluster J, at locations extending from monitoring well J2-1 toward the northwest, as indicated by the analytical results of soil samples collected from borings GP7 and NB1.

- DNAPL was visible on soil samples collected from GP7 at approximately 24 feet below grade. These samples are at the same elevation as the interim DNAPL extraction system that was used at well cluster J, where a higher silt content than that of the overlying strata is present.

- DNAPL was visible on soil samples from NB1 at approximately 72 feet below grade. Staining was also visible on soil samples collected from NB1 at approximately 30 and 66 feet below grade.

- TCE concentrations above the PGC investigation reporting limit were observed in soils collected from NB1 at depths from 30 to 70 feet, 86 to 88 feet, and 96 to 98 feet below grade, coincident with increased silt content within the soil column.

- TCE was detected above the PGC investigation reporting limit in soil samples collected from GP3 between 22 and 26 feet below grade.

- DNAPL does not appear to be located within 50 feet of surface grade in borings GP1, GP2, GP4, GP5, and GP6, based on non-detectable levels of target analytes.

- Based on non-detectable levels, DNAPL does not appear to be located in deep soil boring NB2, indicating that the well cluster J area DNAPL plume may not extend toward the east and may not be contiguous with VOC impact observed beneath Building 43.

- The vertical distribution of DNAPL within the western portion of the site appears to be related to the percentage of silt present within the soil column. Increased silt content correlates with areas of visible DNAPL accumulations, or high concentrations of DNAPL constituents in soil.

- Based on proximity, TCE concentrations observed in GP8 may be related to nearby groundwater concentrations of TCE in excess of 1% of solubility that were measured at well cluster K during August 1995.

- DNAPL does not appear to be present in deep soil boring NB3, indicating that the TCE impact observed in boring GP8 does not extend southeasterly above investigation reporting limits.

- DNAPL does not appear to be visibly present in borings GP9 or GP10. TCE concentrations above the investigation reporting limit were observed in boring GP10 in process fill material and in the native soils up to 30 feet below grade and in GP9 between 30 to 50 feet below grade, suggesting that both GP9 and GP10 may be in the vicinity of a source (a possible former acid neutralization pit) of continuing VOC impact.

- Visual verification of DNAPL occurrence in well J2-1 and borings GP7 and NB1 suggests that an extensive portion of the well cluster J investigation area contains recoverable DNAPL.

- Split sample comparison indicates that on-site analysis was effective in semi-quantitatively measuring relative concentrations of target analytes and augmented visual observation. Soil concentration determined by on-site analysis should not be considered absolute, accurate levels.

The distribution of NAPL soil contamination is concentrated in the deeper portions of the saturated zone in the well cluster J area with minimal lateral continuity of NAPL occurrence within specific layers, consistent with the geology detected during drilling. From this, the major mode of contaminant distribution is likely to have been vertical migration from source areas, such as the former lagoons/acid pits that had been located in those areas. DNAPL in the well cluster J area appears to have migrated vertically within small lithologic zones. Based on soil sampling, these zones are very thin and not laterally or vertically continuous. **Plate 1, Plate 3** and **Plate 7** illustrate VOC soil contamination greater than 1,000 ppm as determined by PGC and **Plate 2** illustrates VOC soil contamination greater than 30,000 ppm as determined by PGC in the well cluster J area. Interpretation of vertical contaminant distribution in the well cluster J/Building 43 area is shown on cross-section A-A', cross-section B-B' and cross-section C-C', included as **Figure 2-3, Figure 2-4** and **Figure 2-5**, respectively. The cross-section index map is included as **Figure 2-2**.

2.3.5 NAPL Interim Removal Pilot Testing

Interim removal of NAPL was undertaken at well cluster J in order to determine whether sustainable DNAPL extraction could occur.

Small diameter recovery system pumps were installed in monitoring wells J2-1 and J5 between August 29, 1995 and September 18, 1995. The system was activated for 24-hours-per-day operation on September 18, 1995. A layout sketch of the interim NAPL removal system at the well cluster J is included in **Figure 2-6.** A piping configuration sketch is included in **Figure 2-7**.

Initially, pumps installed in monitoring wells J2-1 and J5 were deployed at the bottom of the wells at depths of approximately 34 and 48 feet below grade, respectively. DNAPL was extracted from monitoring well J2-1 immediately during initial system startup, while no NAPL was recovered from well J5. After five days of continuous operation without DNAPL recovery from well J5, the pump was raised to approximately 38 feet below grade to coincide with the approximate top of the well's screened interval, approximately 4 feet below the depth at which DNAPL was extracted from well J2-1.

Through December 6, 1995, the NAPL recovery system at well cluster J recovered approximately 17 gallons of separate phase DNAPL and approximately 6,089 gallons of a water/NAPL emulsion. During well cluster J pumping activities, measurable DNAPL remained present at well J-2-1, and DNAPL accumulation began in well J5. In August 1995, DNAPL was detected at a thickness of 2.34 feet in well J2-1, while no DNAPL was detected in well J5. On December 6, 1995, the DNAPL thickness in well J2-1 was 0.70 feet, while the DNAPL thickness in well J5 was 0.79 feet. The well cluster J NAPL recovery system was deactivated on December 8, 1995. Operational data for the well cluster J interim NAPL recovery system is summarized in **Table 2-12**.

Based on the results of interim NAPL recovery testing, DNAPL recovery appears viable at well cluster J.

2.4 Northeast Area Activities and Results

2.4.1 Liquid Level Gauging

LNAPL was identified in monitoring well T3 (well cluster O) on September 7, 1995, at an apparent thickness of 0.11 feet at a depth approximately 12 feet below toc . The LNAPL was described as amber in color. Liquid level gauging data is presented in **Table 2-1**.

2.4.2 NAPL Sampling

Laboratory analysis of the LNAPL from well T3 indicated that the LNAPL was composed primarily of toluene (1,600,000 μg/l) and xylene (75,000 μg/l). The balance of the sample mass was likely composed of water.

Engineering analyses indicate that the sample had specific gravity (0.9996) and density (0.9986) less than water. Lighter-than-water compounds typically accumulate on the top of the water table as a floating discrete layer, if present in sufficient quantities. NAPL sample comparison results are presented in **Table 2-3** and NAPL analytical results are presented in **Table 2-2** . NAPL analytical laboratory reports are included in **Appendix B**.

2.4.3 Groundwater Sampling

The results of groundwater sampling in the northeast portion of the site indicate:

- High pH values (greater than 10) were identified at well cluster V. Site-wide, the pH of the groundwater ranged from 2.5 to 11

Within each of the following well clusters, dissolved phase VOCs were present at the following concentrations at levels above 1% of their respective solubility in water:

- Well cluster N - toluene was present at 64,000 μg/l, or 12.5% of the compound's water solubility, and xylenes were present at 6,800 μg/l, or 3.4% of the compound's water solubility.
- Well cluster O - toluene was present at 6,300 μg/l, or 1.2% of the compound's water solubility, and chlorobenzene was present at 5,500 μg/l, or 1.1% of the compound's water solubility,
- Well FW2 - toluene was present at 13,000 μg/l, or 2.5% of the compound's water solubility, and chlorobenzene was present at 28,000 μg/l, or 5.6% of the compound's water solubility,
- Well cluster V - toluene was present at 180,000 μg/l, or 35.3% of the compound's water solubility, and xylenes were present at 9,500 μg/l, or 4.8% of the compound's water solubility.

Review of the groundwater concentration data (**Table 2-4**) and the depth from which the groundwater samples were collected indicates that:

- Dissolved-phase toluene was detected at concentrations greater than the 1% solubility limit in shallow monitoring wells N-1, O-1, V-1, and FW2.
- Dissolved -phase concentrations of denser than water compounds, such as chlorinated volatile organic compounds, increase with depth at most locations across the site, except at well clusters L and M where concentrations are greatest at shallow depths.
- Concentrations of 1,1,1-TCA increased with depth at well cluster V from concentrations below the reporting limit in shallow well V1 (13 feet below grade) to 4,500 μg/l at well V4, a bedrock well screened 79 feet below grade.
- Concentrations of chlorobenzene at approximately 5.6% of the solubility limit were identified in monitoring well FW2, located in the northeast corner of the site. Chlorobenzene concentrations at approximately 1.1% of solubility limit were observed in well O4-1, a bedrock well at well cluster O. In general, chlorobenzene concentrations increased with depth in a southeasterly direction from the former mono-chlorobenzene underground storage tanks, located north of building 6, toward well cluster O.
- Discrete DNAPL was not observed in well clusters O, N, V, Q, nor in monitoring wells FW1, FW2, FW3 or FW4. Based on this data, dissolved chlorobenzene impact appears to be restricted to the dissolved-phase in a limited portion of the area, most likely the area directly south of the two former chlorobenzene tanks located north of Building 6.

Off-site groundwater QC results are presented in **Appendix D**. The limited review considered the off-site data acceptable for project objectives.

2.4.4 NAPL Delineation Investigation

Thirteen Geoprobe borings were advanced in the northeast portion of the site in the vicinity of well clusters O, N, and V and around former Building 6, as shown on **Figure 2-1**. Delineation methodologies are summarized in **Appendix A**.

The results of soil sampling in the northeast portion of the facility indicate that:

- LNAPL constituents were detected at boring GP15.
- Toluene was detected in soil samples collected from GP13, GP14, GP15, GP16, and GP23 in the vicinity of Building 6 and in GP20 near well cluster N.
- Toluene concentrations in soil appear to be limited to the vadose zone and the capillary fringe (smear zone) in the northeastern portion of the site.
- Unidentified VOCs at concentrations calculated to be greater than or equal to those of identified compounds (based on the response factor for TCE) were observed to be present within the area of Building 6. **Appendix D** further discusses unidentified VOCs.

A documented toluene release occurred at the facility in 1984 in the northeast portion of the site, around former Building 6. Additional historical leaks or releases of toluene in this area are also suspected to have occurred. The concentrations detected in the shallow soil are consistent with a history of leaks and spills suspected in this area and limited vertical migration, typical in an LNAPL. Approximately 90% of the contaminant mass in this area is located in the upper sandy soils from grade to a depth of approximately 8 feet. **Plate 4** and **Plate 5** illustrate soil contamination greater than 1,000 ppm in the northeast area. Selected contaminant distribution in the northeast area is shown on cross-section A-A' and cross-section B-B', included as **Figure 2-9** and **Figure 2-10,** respectively. The cross-section index map is included as **Figure 2-8**.

The primary distribution of soil contamination appears to be concentrated in the shallow unsaturated zone in the well cluster N, O and V areas with a fairly continuous distribution of soils contaminated with toluene and xylene across the area bounded by these three well clusters. Contaminant distribution in the northeast area appears to be the result of multiple surface releases.

2.4.5 NAPL Interim Removal Pilot Testing

Interim removal of NAPL was undertaken in the northeast portion of the site to determine whether substantial NAPL extraction could occur.

Small-diameter pumps were installed in wells V2 and V3 at well cluster V between August 30, and September 18, 1995. The system was activated for 24-hours-per-day-operation on September 18, 1995. The NAPL recovery system was initially configured to pump DNAPL from recovery wells V-2 and V-3. A layout sketch of the interim NAPL removal system at the well cluster V is included in **Figure 2-11.** A piping configuration sketch is included in **Figure 2-12**.

Subsequent pumping activities at well cluster V did not induce flow of DNAPL into wells V2 or V3. DNAPL was not detected in either well during preliminary well gauging or during the first nine days of system operation of the NAPL recovery system. Groundwater analyses indicated that the primary contaminants in well cluster V were: toluene, xylenes, and lighter-than-water compounds, which, if present in sufficient quantity, would be expected to accumulate as an LNAPL on top of the water table. Based on the groundwater sampling results, and the lack of observable DNAPL during the first nine days of operation, the focus of system operation was modified to test the recoverability of LNAPL.

The submersible pump was removed from well V2 and redeployed into well V1, which is screened across the water table, on September 27, 1995. During V1 pump installation, the water table was located approximately 6.18 feet below grade. The flow rate and run cycles were set to depress the water table at the well to encourage migration of LNAPL into well V1, if present within the zone of influence of the well. Water table drawdown ranged from 0.5 to 1.8 feet. During operation of the system, no LNAPL was collected. The system was deactivated on October 18, 1995. Prior to system deactivation, the system pumped approximately 6,600 gallons of water and recovered no LNAPL.

The data collected during the operation of the well cluster V interim NAPL recovery system is summarized on **Table 2-12.**

The system was moved to well cluster O, at USEPA's request, to evaluate NAPL recoverability at that location. Since the primary contaminant of concern at well cluster O is toluene, the goal of the NAPL recovery system was to recover water from well T3 to create a cone of depression around T3 and encourage the migration of LNAPL into the well. Well T3 is screened across the water table (from 6 to 16 feet below grade). Initial well gauging conducted on August 24, 1995 detected 0.10 feet of LNAPL in well T3. Subsequent gauging events detected up to 0.12 feet of LNAPL in the well (**see Table 2-13**). During T3 system installation, the water table was located approximately 11.43 feet below grade. A layout sketch of the interim NAPL removal system at the well cluster V is included in **Figure 2-13.** A piping configuration sketch is included in **Figure 2-14**.

The system components were transferred from well cluster V to well cluster O between October 31, 1995 and November 15, 1995. The system was activated for 24-hours-per-day operation on November 15, 1995 and operated until December 18, 1995. No LNAPL was detected in the well during the system operation (**see Table 2-13**). The maximum observed drawdown in well T3 was approximately 0.5 feet during system operation. The system was deactivated on December 9, 1995. Prior to system deactivation, the system pumped approximately 4,700 gallons of water and recovered no LNAPL.

2.4.6 Enhanced Soil Gas Collection Testing (ESGC)

Review of groundwater gauging and sampling data, delineation investigation results, and interim NAPL recovery system performance suggests that the majority of VOC mass in the northeast area of the site resides as soil contamination in the unsaturated zone and capillary fringe (smear zone), and as localized LNAPL in the vicinity of well cluster O.

One technology for removal of LNAPL from soil in order to limit VOC migration into groundwater is ESGC. The ESGC process utilizes a vacuum pump to extract vapor from unsaturated zone soils. Vacuum applied to unsaturated zone soils causes a pressure gradient to develop, inducing air flow. The pressure gradient and air flow cause volatilization of LNAPL and adsorbed-phase VOCs and movement of the vapor-phase contamination through soil toward the extraction points. ESGC volatilizes VOCs and enhances aerobic degradation of contaminated vades zone soil, thereby reducing VOC migration.

Foster Wheeler Environmental conducted an ESGC radius of influence pilot test in the northern portion of the Raymark site on November 17, 1995. The purpose of the ESGC pilot test was to characterize air-flow conditions in the unsaturated zone and to determine the concentration of VOCs in the extracted soil vapor effluent stream. The pilot test system layout is included in **Figure 2-15.**

The results of the ESGC testing indicate:

- Extraction vacuum was detected at a monitoring point located over 25 feet distant from the extraction pressure applied to vapor probe B-27 (**Table 2-14**)

- Extraction vacuum was detected at a monitoring point located over 25 feet distant from extraction pressure applied to vapor probe B-29 (**Table 2-15**)

The data collected during the pilot test activities was used to produce a conceptual approach for an enhanced system design in the northeastern portion of the site. The conceptual approach and design are presented as separate contract documents.

3.0 SUMMARY/CONCLUSIONS

Results of the site-wide gauging, NAPL sampling, and groundwater sampling NIRFE activities indicate that DNAPL is present in the well cluster J area and LNAPL is present in the northeast portion of the site. These results are generally consistent with previous investigation data; therefore, the subsequent delineation and recoverability testing activities focused on these contaminant types and distribution, as described above.

3.1 Well Cluster J Area

The following summarizes the findings of the NAPL delineation and recoverability activities completed in the well cluster J area:

- DNAPL was visually identified at the base of monitoring well J2-1 with apparent thicknesses ranging from 2.34 feet to 2.69 feet at depths ranging from approximately 33 to 26 feet below toc;
- Laboratory analysis and physical observation of the DNAPL collected from J2-1 indicated that the DNAPL was composed primarily of 1,1,1-trichloroethane and had a density greater than that of water despite sample partitioning following collection;
- The highest concentrations of dissolved-phase VOCs in groundwater were identified in well cluster J at intermediate depths of 38 to 48 feet below grade, adjacent to observed DNAPL accumulations;
- The distribution of soil contamination appears to be located in the deeper saturated zone in the well cluster J area with minimal lateral continuity of specific stratigraphic layers, consistent with the geology detected during drilling. Based on this distribution, vertical migration from potential source areas, such as former acid pits, is suggested as the principal contaminant transport process; and
- Based on the results of interim NAPL recovery testing, DNAPL recovery by pumping appears viable in the well cluster J area.

3.2 Northeast Portion of the Site

The following summarizes the findings of the NAPL delineation and recoverability activities completed in the northeast portion of the site:

- LNAPL was observed in monitoring well T3 (well cluster O) at an apparent thickness of 0.11 feet at approximately 12 feet below toc;
- Laboratory analysis and physical observation of the LNAPL collected from well T3 indicated that the LNAPL was composed primarily of toluene and had a density less than that of water;
- Soil contamination appears to be located in the shallow unsaturated zone in well cluster N, O and V areas, with a fairly continuous distribution of soils contaminated with toluene and xylene

throughout the area bounded by these three well clusters. Contaminant distribution in the northeast area appears to be the result of multiple surface releases;

- Toluene was detected at concentrations greater than the 1% solubility limit in groundwater at shallow monitoring wells N1, O1, V1, and FW2, suggesting that the majority of the observed toluene is contained within the capillary fringe;

- Review of the NIRFE data indicates that the majority of VOC mass in the northeast area of the site resides as soil contamination in the unsaturated zone and capillary fringe (smear zone) and as localized LNAPL in the vicinity of well cluster O; and

- Based on the results of interim NAPL recovery testing, LNAPL recovery by pumping does not appear viable in the northeast area, but testing of ESGC technology indicates that this method will extract LNAPL and VOC soil contamination, thereby reducing potential VOC migration into groundwater.

4.0 REFERENCES

- American Society of Testing of Materials (ASTM), *Standard Practice for Description and Identification of Soils (Visual-Manual procedure)* methods, ASTM D 2488 - 93.

- ELI, Inc., RCRA Facility Investigation (RFI) for the Raymark Industries, Inc. site, dated February 1995.

- Halliburton NUS, Remedial Investigation (RI) and a Source Control Feasibility Study (FS) for the Raymark facility, dated April , 1995.

- Foster Wheeler Environmental Corporation, Amendment to the Work Plan (DO11-WP-NAPL-03) for the Remediation of the Raymark Industries, Inc. Facility Site, Task 12.0, NAPL Extraction, dated December 14, 1995.

- Foster Wheeler Environmental Corporation, Amendment (DO11-CDAP-NAPL-01) to the Chemical Data Acquisition Plan for the Remediation of the Raymark Industries, Inc. Facility Site, Task 12.0, NAPL Extraction, dated August, 1995.

- Foster Wheeler Environmental Corporation, Amendment (DO11-CDAP-NAPL-02) to the Chemical Data Acquisition Plan for the Remediation of the Raymark Industries, Inc. Facility Site, dated October 5, 1995.

- Foster Wheeler Environmental Corporation, Construction Quality Control Plan (CQCP) for the Raymark Industries, Inc. Facility Site, dated July, 1995.

- Foster Wheeler Environmental Corporation, Temporary Transportation and Storage Waste Management Plan (TTS/WMP) for the Raymark Industries, Inc. Facility Site, dated August, 1995.

- Foster Wheeler Environmental Corporation, Site Safety and Health Plan (SSHP) for the Raymark Industries, Inc. Facility Site, dated July, 1995.

- Montgomery, J.H, and L.M. Welkom, “Groundwater Chemicals Desk Reference”, Chelsea, Michigan, Lewis Publishers Inc., 1990.

- US Army Corps of Engineers, 1953, ”The Unified Soil Classification System (USCS),” Waterways Experiment Station, Vicksburg, Mississippi.

- USEPA, Proposed Plan and Record of Decision (ROD) for the Raymark Industries, Inc. Facility Site, dated July 3, 1995.

- USEPA Region I Low-Flow (minimum stress) Purging and Sampling Procedure For the Collection of Groundwater Samples from Monitoring Wells, 8/11/95 Final Draft, SOP #GW0001.

FOSTER WHEELER ENVIRONMENTAL CORPORATION

January 26, 1995
Response Requested
DO11-NIRFER-01
Reference: TD96-020

Mr. Raymond E. Goff
US Army Corps of Engineers
305 Boston Avenue, Suite 302
Stratford, CT 06497

Subject: USACE CONTRACT NO. DACW33-94-D-0002
TOTAL ENVIRONMENTAL RESTORATION CONTRACT (TERC)
DELIVERY ORDER 11--REMEDIATION OF THE RAYMARK INDUSTRIES FACILITY SITE
TASK 12.0 NAPL EXTRACTION
NAPL INTERIM REMOVAL FIELD EVALUATION REPORT (NIRFER)

Dear Mr. Goff:

Foster Wheeler Environmental Corporation (d.b.a Ebasco Contractors, Incorporated) is pleased to submit the attached NAPL Interim Removal Field Evaluation Report (NIRFER). This report was defined in subtask 12.05 of the Amendment (DO11-WP-NAPL-03) to the Work Plan for the Remediation of the Raymark Industries Facility Site. The report was prepared to support the information requirements of the RCRA Cap 90% Design.

The author and point of contact for the NIRFER is Paul Muniz, who may be contacted at Foster Wheeler Environmental offices in Boston at (617) 457-8200. Mr. Muniz is overseen by Jay Borkland of Foster Wheeler Environmental, who may be reached at (617) 457-8203. Mr. Borkland may be consulted as backup if Mr. Muniz is not available.

We request your review and consideration of the attached NIRFER. Your comments are requested by Monday, February 5. We are forwarding copies of this document directly to the reviewers indicated below. We request that you direct your comments to Mr. Paul Muniz, c/o Mr. Jay Borkland, at Foster Wheeler Environmental offices in Boston. Please do not hesitate to contact either person if the need arises. We look forward to your comments and anticipate discussion of the contents of the report.

Sincerely,

Paul F. Muniz
NAPL Extraction Task Leader
NIRFER Point of Contact

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