October 30, 2003

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United States General Services Administration
1500 East Bannister Road
Kansas City, Missouri 64131-3088

Attn: Mr. Dave L. Hartshorn (6 PEC-F)

PUBLIC BUILDINGS SERVICE
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Re: Remedial Alternatives Evaluation
Hardesty Federal Complex
601-607 Hardesty Avenue
Kansas City, Jackson County, Missouri 64116
EPA Region 7
EPA ID No. MON000703320
Terracon Project No. 02037021 (Revision No. 1)

Dear Mr. Hartshorn:

Terracon is pleased to submit the following remedial alternatives evaluation for the Hardesty Federal Complex, located at 601-607 Hardest Avenue in Kansas City, Kansas. The evaluation was completed in general accordance with our proposal (Proposal No. E0203109) dated April 21, 2003. The proposed remedial alternatives address the area of chlorinated solvent impacted groundwater identified during the course of several investigations conducted at the subject site. Per the client's request, this report does not address remedial alternative scenarios for off-site chlorinated solvent impact.

Site Description

The total area of the Hardesty Federal Complex is approximately 18 acres, and is irregular in shape. The Hardesty Federal Complex property is located on relatively flat terrain that slopes gently toward the east\southeast property boundary. The U.S. Government Services Administration (GSA) currently owns the subject site.

Site History/Previous Assessment Activities

Several studies have been performed at the subject site to assess the presence and extent of chlorinated solvents associated with historical operations. The paragraphs below summarize Terracon's prior site investigation activities at the site. These investigations include: Terracon's Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) Preliminary Assessment (PA) report dated November 4, 2002; Terracon's Expanded CERCLA Site Inspection (SI) report dated November 4, 2002; and Terracon's On-Site Groundwater Investigation Report, dated August 20, 2003. Terracon also performed an "Off-site Groundwater Investigation

Report, dated September 9, 2003. However, because the remedial alternatives address on-site impact, this report is not elaborated further here.

Terracon's PA was based on a visual survey of the subject site, a reconnaissance of adjoining properties, interviews with individuals knowledgeable about the subject site, a regulatory records review, project-specific research, review of subsequent documents provided by GSA in 2002 and a review of site use history. The SI was conducted on the basis of PA findings.

Terracon's SI involved the collection of on-site groundwater samples during three sampling events, February 2002, June/July 2002, and October 2002. Terracon's SI report concluded the following:

- The highest area of groundwater concentration of chlorinated solvents appeared to be in the grass-covered area between Buildings 6 and 9, and toward the northeast, east, and southeast of the grass-covered area. Since Chlorinated solvents were also detected in borings advanced within approximately 25 feet of the north and east property boundaries of the subject site, it appeared that VOC contaminants had reached the boundary of the subject site, and may have extended beyond the boundaries of the Hardesty Federal Complex to the north and east. Chlorinated solvents above the MDNR GTARC CALM were not detected west of the grass-covered area between Buildings 6 and 9.

Based on information obtained from Terracon's Phase I ESA report dated August 19, 1999, and Terracon's PA report dated November 4, 2002, it is possible that the source of the VOC contaminants may be associated with historical clothing chemical pretreatment activities that occurred at the site (i.e., in the vicinity of Building 6, the former clothing chemical pretreatment building) during World War II. VOC contaminants such as 1,1,2,2-perchloroethane (PCA), perchloroethene (PCE), 1,1,2-trichloroethane (TCA), trichloroethene (TCE), and cis-1,2-dichloroethene (cis-1, 2-DCE) can typically be associated with the use of dry-cleaning agents. The use of dry-cleaning agents was one of the functions of the Hardesty Federal Complex during its use as a Quartermaster Depot. Processes located in Building 6 included the treatment/renovation of new Army uniforms with "Impregnate I" to make them gas-resistant against chemicals such as "mustard gas," and the laundering of old uniforms, may have involved the use of dry-cleaning agents. Above ground storage tanks used for the storage of virgin processed dry-cleaning type solvents were historically located outside the west end of Building 6, between Building 6 and Building 9.

Based on these studies, Terracon performed additional environmental site investigation (ESI) activities at the Hardesty Federal Complex in 2003. Terracon evaluated the lateral and vertical extent of chlorinated solvents impact to groundwater, present within the

property boundaries, and the results are presented in the On-Site Groundwater Investigation Report, dated August 20, 2003. The investigation activities included:

- Installation and sampling of five permanent groundwater monitoring well clusters (one shallow and one deep) in the vicinity of Building 6, and along the northern site boundary; and,

- Sampling two of the existing monitoring wells, west of Building 6, which were installed at the site by Cape Environmental Management, Inc. (originally installed for the purpose of monitoring and characterizing of petroleum-hydrocarbon contamination associated with former underground storage tanks (USTs) previously located at the site).

Based on the results of this on-site groundwater investigation, the following conclusions were made:

- 1,1 Dichloroethene, PCA, PCE, TCA, TCE, and vinyl chloride were detected above the Missouri Department of Natural Resources (MDNR) Cleanup Levels for Missouri (CALM) Groundwater Target Concentrations (GTARC) levels. PCA and TCE appear to be the two constituents detected most frequently in the groundwater samples collected.

- The groundwater at the site appears to principally flow toward the east and northeast. Based on laboratory analytical results, it appears likely that Chlorinated solvents have migrated off-site to the northeast.

- Soil samples collected above the groundwater table do not appear to be impacted above the MDNR CALM Soil Target Concentrations (STARC) and Leaching to Groundwater Values.

- Bedrock was not encountered within 90 feet of ground surface north of Building 6.

- The water levels (and associated groundwater elevations) in the deeper wells were slightly higher than the adjacent shallow wells, which may be indicative of differences in transmissivities within the aquifer, since a confining unit was not observed.

The chlorinated solvents detected at the site are dense nonaqueous phase liquids (DNAPLs). These DNAPLs have a higher density than water and will tend to sink through the aquifer over time as well as spread horizontally. In analyzing the concentrations detected across the site, it is apparent that the Chlorinated solvents detected in groundwater are following a known breakdown pathway for the Chlorinated

solvents present [PCA (and possibly PCE) → TCE/TCA → cis/trans 1, 2-DCE → vinyl chloride].

Additionally, it appears that the Chlorinated solvents are dropping in elevation across the site to the northeast as evidenced by the increase in TCE concentrations in the deeper wells present at well clusters 2 and 3.

Limits of On-Site Contamination

The general lateral extent of groundwater impact from chlorinated solvents is shown in Figure 1, attached. As shown in the figure, the chlorinated solvent plume generally extends from northwest of Existing Building 6 south to the northern portion of Existing Building 9. From there, the plume extends eastward toward the railroad tracks that border the eastern/southeastern property line, and along the northern property boundary line, paralleling Independence Avenue. The depths of the chlorinated solvent plume were found to be at depths in the aquifer ranging from approximately 12.91 feet to 83.6 feet below ground surface. As noted above, soil samples collected above the groundwater table do not appear to be impacted above the MDNR CALM Soil Target Concentrations (STARC) and Leaching to Groundwater Values.

Remedial Alternatives

Based on the findings from Terracon's investigations, three remedial alternatives were evaluated to address the chlorinated solvent impacted groundwater at the site. The remedial objective is not intended to remove all chlorinated constituents to non-detect levels, but to provide cleanup of releases that are protective of human health and environment, and are considerate of cost. The following are summaries of the three proposed alternatives. A more detailed description of the proposed alternatives is provided below.

Alternative One – Enhanced Natural Attenuation and Monitoring

- Injection of approximately 1,000 pounds of a hydrogen donor compound (e.g., HRC-X®) using Geoprobe® equipment at approximately 270 locations to enhance the natural attenuation of the chlorinated solvent detected in the groundwater; and

- Initiation of a routine groundwater monitoring program monthly for the first three months (following hydrogen donor compound injection) followed by a quarterly, groundwater monitoring program at the site for a minimum of one to five years. The installation of five additional 2-inch groundwater monitoring wells and utilization of previously installed monitoring wells would be required for monitoring purposes.

Alternative Two – In-Situ Biosparging System Installation and Monitoring

- Installation and maintenance of a system to promote microbial activity to enhance the microbial degradation of the previously identified chlorinated solvent impacted groundwater. Installation of 4- to 6-inch diameter groundwater monitoring wells throughout the groundwater impact area would be part of the system installation.

- Initiation of a routine groundwater monitoring program at the site for a minimum of one to five years. The installation of five additional 2-inch groundwater monitoring wells and utilization of previously installed monitoring wells would be required for monitoring purposes.

Alternative Three – Groundwater Pump and Treat System Installation and Monitoring

- Installation of a groundwater pump and treat system with activated carbon units to remove chlorinated solvents from the subsurface groundwater. Installation of 4- to 6-inch diameter groundwater monitoring wells throughout the groundwater impact area would be part of the system installation.

- Initiation of a routine groundwater monitoring program at the site for a minimum of one to five years. The installation of five additional 2-inch groundwater monitoring wells and utilization of previously installed monitoring wells would be required for monitoring purposes.

A more detailed explanation of the proposed activities is included in the following paragraphs.

Alternative One - Enhanced Natural Attenuation and Monitoring

Enhanced Natural Attenuation

Natural attenuation is a passive remedial alternative that relies upon natural processes to degrade and dissipate contaminants in the groundwater. Chlorinated solvent constituents, as present at the subject site, are generally biodegradable, as long as indigenous microbes have an adequate supply of hydrogen. The hydrogen is usually present in the subsurface environment, but the anaerobic biodegradation consumes hydrogen, which needs to be replenished to enhance further biodegradation. Based on the low permeabilities of the subsurface soils (as observed during site investigation activities), the rate of hydrogen replenishment at this site is reduced. Therefore, hydrogen donors would be introduced into the subsurface to promote biodegradation. To promote natural attenuation at the site, approximately 50,000 pounds (approximately 185 pounds per injection location) of a hydrogen donor compound (e.g., HRC-X®) would be injected using Geoprobe® equipment at approximately 270 locations (150 points to 60-foot depths within the source area on 10-foot centers, and 120 points to 60-foot depths in a downgradient direction on 20-foot centers) to enhance the natural

attenuation of the chlorinated solvent present in groundwater. This assumes an area of approximately 250,000 square feet (from Buildings 6 and 9, north and east to the property boundary) to be treated. It is assumed that installation of the 270 points would take approximately 50 working days. Depending on the effectiveness of the injection, based on groundwater monitoring activities, a second application of hydrogen into the subsurface may be necessary at a later date.

Groundwater Monitoring

A routine groundwater monitoring program would be initiated on a monthly basis for the first three months following completion of injection activities. A quarterly groundwater monitoring program would be initiated following completion of the initial monitoring activities. A total of 6, 2-inch monitoring wells (in addition to the 10 existing monitoring wells) would be installed in up-gradient, cross-gradient, and down-gradient positions for the purpose of identifying plume stability and degradation of the chlorinated solvents. Additionally, prior to initiating hydrogen donor compound injection activities, the monitoring wells would be sampled to provide baseline data of the current impact to groundwater.

Alternative Two – In-Situ Biosparging System Installation and Monitoring

In-Situ Biosparging System Installation

In-situ biosparging involves the injection of hydrogen gas into subsurface soils to promote microbial activity and the natural tendency for microbes to degrade chlorinated solvents under anaerobic conditions. The hydrogen gas is injected into the groundwater through injection points (monitoring wells) placed throughout the zone of contamination. The increase in hydrogen concentrations around each injection point would subsequently increase the anaerobic microbial activity within this area and their natural ability to degrade chlorinated solvents.

The installation of approximately 350, 2-inch diameter monitoring wells, to depths of 60 feet each throughout the groundwater impact area (estimated to be approximately 250,000 square feet) would be part of the system installation. Additionally, the air sparging system design would include 11 air sparge systems, including manifold piping, compressed air equipment, and monitoring and controls. Vapor recovery and treatment may also be required prior to discharge to the atmosphere.

Groundwater Monitoring

A routine monitoring program would be initiated during the first three months following completion of system installation. A quarterly groundwater monitoring program would be initiated following completion of the initial monitoring activities. A total of 6, 2-inch monitoring wells (in addition to the 10 existing monitoring wells) would be installed in

up-gradient, cross-gradient, and down-gradient positions for the purpose of identifying plume stability and degradation of the chlorinated solvent impacted groundwater. Additionally, prior to initiating biosparging activities, the monitoring wells would be sampled to provide baseline data of the current impact to groundwater.

Alternative Three – Groundwater Pump and Treat System Installation and Monitoring

Groundwater Pump and Treat System Installation

The groundwater pump and treat remediation alternative involves pumping contaminated groundwater from the saturated zone to the surface, where it is treated via activated carbon units. and discharged. The number of wells necessary for this remediation process are determined primarily by the extent of groundwater contamination, and the permeability of the saturated soils, which affects the recharge rate of groundwater into the well. Due to the low permeability of the saturated soils encountered during site investigation activities, well recovery was low during the sampling of the wells. Therefore, the number of wells needed to remediate the site is increased. As part of the system design, it is estimated that approximately 171, 6-inch diameter monitoring wells would be necessary throughout the groundwater impact area (estimated to be approximately 250,000 square feet in area). The water pumped from the recovery wells is then discharged into activated carbon drums, where the chlorinated solvents adsorb to the carbon, while allowing the water to pass through.

Groundwater Monitoring

A routine monitoring program would be initiated during the first three months following completion of the remedial system installation. A quarterly groundwater monitoring program would be initiated following completion of the initial monitoring activities. A total of 6, 2-inch monitoring wells (in addition to the 10 existing monitoring wells) would be installed in up-gradient, cross-gradient, and down-gradient positions for the purpose of identifying plume stability and degradation of the petroleum hydrocarbon impacted groundwater. Additionally, prior to initiating pump and treat activities, the monitoring wells would be sampled to provide baseline data of the current impact to groundwater.

Remedial Alternative Cost Estimates

The range of costs associated with the performance of the above referenced remedial alternatives were generated utilizing the Remedial Action Cost Engineering System (RACER™) software. The ranges of cost are summarized below.

REMEDIAL ALTERNATIVE COST ESTIMATES			
ALTERNATIVE ONE – ENHANCED NATURAL ATTENUATION			
Hydrogen Donor Compound Injection (estimate includes one application only)	$700,000	to	$800,000
Monitoring Well Installation (for monitoring) *Assumes 6 additional monitoring wells	$35,000	to	$45,000
First Year Monitoring *Assumes monitoring once/month for first three months and quarterly thereafter	$100,000	to	$125,000
Four Years Monitoring *Assumes quarterly monitoring	$250,000	to	$275,000
Total for Option One	**$1,085,000**	to	**$1,245,000**
ALTERNATIVE TWO – IN-SITU BIOSPARGING			
Biosparging System Installation	$2,500,000	to	$2,750,000
Operation and Maintenance (five years)	$1,200,000	to	1,300,000
Monitoring Well Installation (for monitoring) *Assumes 6 additional monitoring wells	$35,000	to	$45,000
First Year Monitoring *Assumes monitoring once/month for first three months and quarterly thereafter	$100,000	to	$125,000
Four Years Monitoring *Assumes quarterly monitoring	$250,000	to	$275,000

REMEDIAL ALTERNATIVE COST ESTIMATES			
Total for Option Two	**$4,085,000**	to	**$4,495,000**
ALTERNATIVE THREE – GROUNDWATER PUMP AND TREAT (carbon adsorption)			
Pump and Treat System Installation	$2,500,000	to	$2,750,000
Operation and Maintenance (five years)	$2,500,000	to	$2,750,000
Monitoring Well Installation (for monitoring) *Assumes 6 additional monitoring wells	$35,000	to	$45,000
First Year Monitoring *Assumes monitoring once/month for first three months and quarterly thereafter	$100,000	to	$125,000
Four Years Monitoring *Assumes quarterly monitoring	$250,000	to	$275,000
Total for Option Three	**$5,385,000**	to	**$5,945,000**

Recommendations

The enhanced natural attenuation remedial alternative is recommended for the site. Natural attenuation is one-quarter to one-fifth as much cost as the other two remedial alternatives, does not require operation and maintenance of on-site remedial equipment, and will not require the treatment and disposal of contaminated groundwater. Furthermore, additional injection events can be completed in the future to address "hot spots" allowing flexibility in the remediation efforts.

Limitations

Terracon's services were performed in a manner consistent with generally accepted practices of the profession undertaken in similar studies in the same geographical area during the same time period. Terracon makes no warranties, either express or implied, regarding the findings, conclusions or recommendations.

Findings, conclusions and recommendations resulting from these services are based upon information derived from the most recent on-site activities and other services performed under this scope of work; such information is subject to change over time. Certain indicators of the presence of hazardous substances, petroleum products, or other constituents may have been latent, inaccessible, unobservable, non-detectable or

not present during these services, and we cannot represent that the site contains no hazardous substances, toxic materials, petroleum products, or other latent conditions beyond those identified in these assessments. Subsurface conditions may vary from those encountered at specific sampling locations or wells or during other surveys, tests, assessments, investigations or exploratory services; the data, interpretations, and our recommendations are based solely upon data obtained at the time and within the scope of these services.

This report has been prepared for the exclusive use and reliance of the GSA. Use or reliance by any other party is prohibited without the written authorization of the GSA, and Terracon. The limitation of liability defined in the Agreement for Services is the aggregate limit of Terracon's liability to the client and all relying parties.

Terracon appreciates the opportunity to provide environmental services to GSA. If you have any comments or questions regarding this report/evaluation, please contact our office at (913) 492-7777.

Sincerely,

Terracon

for:

Wil W. King
Project Geologist

for:

Eric Gorman, CHMM, P.G.
Environmental Due Diligence Manager

Jon C. McDaniel, C.P.G. (AIPG)
Senior Project Manager

Attachment: Figure 1

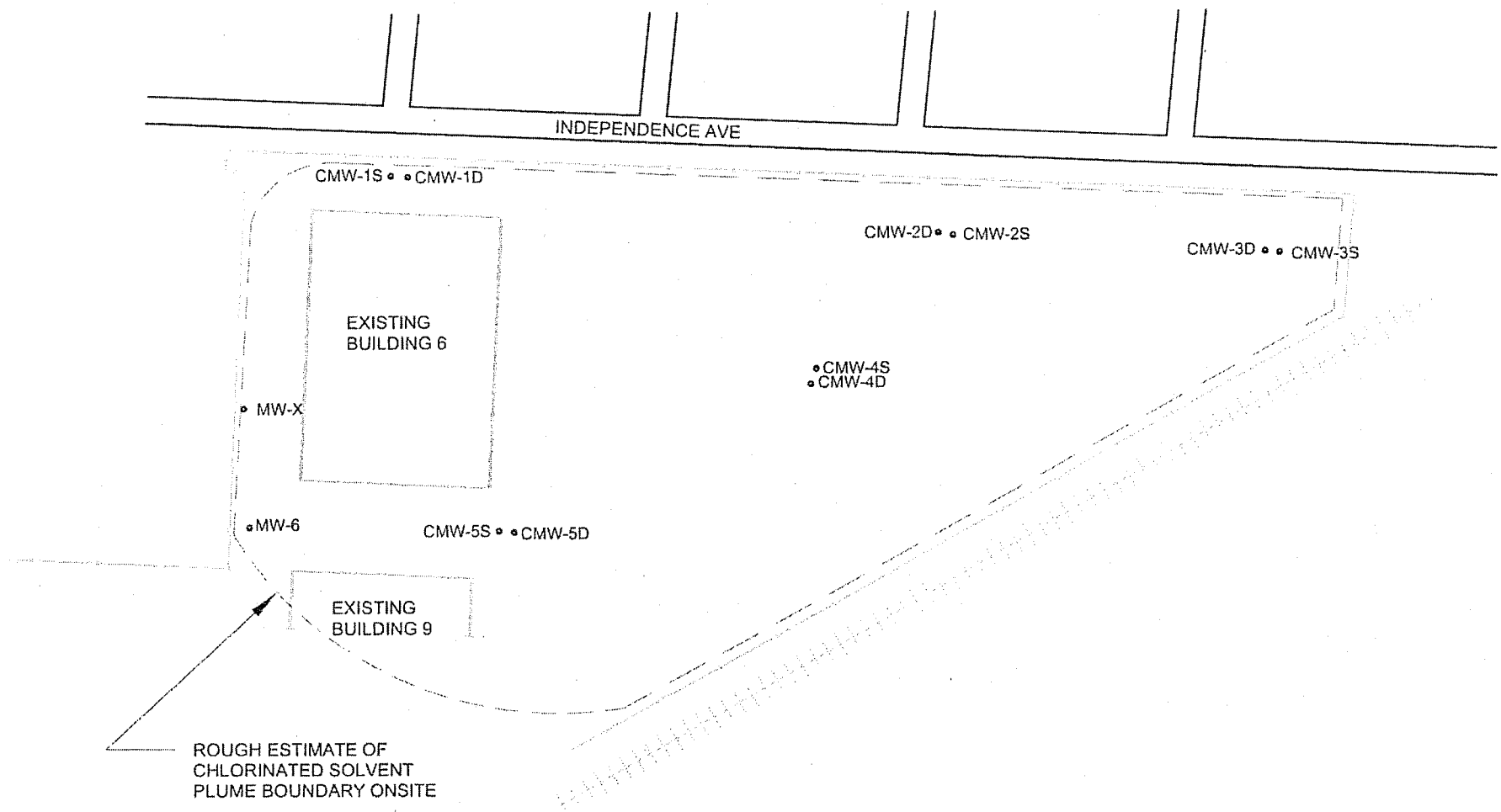

DIAGRAM IS FOR GENERAL LOCATION ONLY, AND IS NOT INTENDED FOR CONSTRUCTION PURPOSES

FIGURE 1
MONITORING WELL LOCATION MAP
HARDESTY FEDERAL COMPLEX
KANSAS CITY, MISSOURI

Project Mngr: EJG	Terracon	Project No.	02037021
Designed By: TAR		Scale:	1" = 120'
Checked By: CAS	13910 WEST 96th TERRACE LENEXA, KANSAS 66215	Date:	10/31/03
Approved By: EJG		Drawn By:	SAG
File Name: FIGURE 1.DWG		Figure No.	1