GSI ENVIRONMENTAL

CERTIFICATION OF GEOSCIENCE

Evaluation of Vapor Intrusion to Indoor Air from Groundwater

Charlie Burch Site, Spring, Texas
Rohm and Haas Texas, Inc., Deer Park, Texas
VCP Site No. 421

I, James A. Kearley, a licensed geologist in the State of Texas, certify that I have reviewed the geosciences portions of the "Evaluation of Vapor Intrusion to Indoor Air from Groundwater," issued 6 December 2006.

James A. Kearley, P.G.
State of Texas
Registration No. 4375

STATE OF TEXAS
JAMES A. KEARLEY
GEOLOGY
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REPLY TO:
ENGINEERING DIVISION
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ROHM AND HAAS

December 11, 2006

Mr. Joe Bell
Project Manager, Voluntary Cleanup Section
Remediation Division
Texas Commission on Environmental Quality
PO Box 13087
Austin, Texas 78711-3087

RE: Evaluation of Potential for Soil Vapor Intrusion, Charlie Burch Site, Montgomery County, Texas. VCP. Site No. 421

Dear Mr. Bell,

Enclosed with this letter is a report that evaluated whether soil vapor intrusion should be a concern caused by 1,2 dichloroethane (1,2 –DCA) found in the groundwater downgradient from the Charlie Burch site[1]. The Texas Commission on Environmental Quality (TCEQ) requested that Rohm and Haas conduct this study. As discussed with you, we commissioned Groundwater Services Inc. (GSI) to perform the work.

The evaluation shows that soil vapor intrusion is <u>not</u> a concern associated with the 1,2-DCA groundwater plume. Specifically, the report shows that:

1. 1,2-DCA vapors would <u>not</u> move into buildings because of the low concentrations of 1,2-DCA in groundwater, the distance between the groundwater and the surface, the clean soil between the groundwater and the surface, the type of geology, and the type of building construction.
2. Even if an assumption was made that, despite the factors listed in Item 1 above, 1,2-DCA vapors somehow would move to the surface, the amount calculated is within the acceptable range that TCEQ uses for ambient air.
3. 1,2-DCA concentrations in groundwater are much lower than those that would cause a vapor intrusion concern. The levels required to cause a concern have never been measured in the downgradient plume. Because of the treatment systems in place, the expectation is that the groundwater concentrations will decline in the future. Therefore, vapor intrusion should not be a concern in the future.

[1] The study focused on the area south of Richard Road including Forestry Drive and Forestburg Drive. The conclusions are expected to be similar for other areas of the downgradient plume.

GSI conducted this evaluation using standard United States Environmental Protection Agency guidance and procedures. GSI also used several methods of evaluation and reached the same conclusion:

> *Therefore, in accordance with USEPA guidance, no further evaluation of vapor intrusion is warranted at this time.*

Rohm and Haas remains committed to completing our obligations associated with the Charlie Burch site. We continue to operate the two treatment systems, we have identified the maximum extent of the plume and expect to shortly complete the detailed plume delineation activities, and we are working on a variety of methods to attempt to accelerate cleanup of the entire plume.

We hope that this report meets your needs. If you have any questions regarding this letter, please contact me at 215-785-7244.

Edward F. Tokarski
Corporate Remediation Projects Manager

Cc: Ellen Friedell
Chris Miller
Rick Wenzel

December 6, 2006
GSI Job No. G-3040

GROUNDWATER
SERVICES, INC.

Mr. Ed Tokarski
Rohm and Haas
3100 State Road
Croydon, PA 19021

Re: Evaluation of Vapor Intrusion to Indoor Air from Groundwater, Charlie Burch Site, Spring, Texas. VCP Site No. 421.

Dear Mr. Tokarski:

At the request of Rohm and Haas, Groundwater Services, Inc. (GSI), has evaluated the potential for 1,2-dichloroethane (1,2-DCA) in groundwater to impact the indoor air of buildings located in the vicinity of Forestry and Forestburg Drives south of the Charlie Burch site in Spring, Texas. The evaluation has been completed in accordance with guidance published by the United States Environmental Protection Agency (USEPA, 2002). The study area encompasses the area overlying the affected groundwater plume associated with the Charlie Burch site and is bounded by Richard Road on the north, a gas pipeline right-of-way on the south, and extends to the east and west 100 ft from the plume. The study area has been defined in accordance with USEPA guidelines as the area immediately above the plume and extending 100 ft out from the edge of the plume (USEPA, 2002); the potential for vapor intrusion does not need to be evaluated outside that area.

Results of the evaluation indicate that, considering site specific conditions, it is unlikely that 1,2-DCA would migrate from the subsurface and get into buildings in the study area. Further, even if it were assumed that 1,2-DCA could move to the surface and enter a building, the maximum concentration in groundwater in the study area is less than the USEPA semi-site specific screening value and less than the screening value developed using the USEPA J&E spreadsheet model. Therefore, in accordance with USEPA guidance, no further evaluation of vapor intrusion is warranted at this time.

TECHNICAL BACKGROUND

Rohm and Haas has been conducting investigations and response actions to address affected soil and groundwater associated with the Charlie Burch site in Spring, Texas, in accordance with the requirements of the Texas Commission on Environmental Quality (TCEQ) Voluntary Cleanup Program (VCP; see Figure 1). The source of the affected groundwater plume is the former disposal area located north of Richard Road approximately one-quarter mile to the northwest of the study area (see Figure 1). Affected soils and waste residual materials on the Charlie Burch site north of Richard Road have been removed, and groundwater remediation systems have been installed both in the source area north of Richard Road and in the downgradient portion of the plume. As a part of the response effort, groundwater conditions have been investigated

beneath the study area in the vicinity of Forestry and Forestburg Drives (see Figure 2). Collection and analysis of groundwater samples have identified small, but measurable concentrations of 1,2-DCA in the groundwater beneath the study area.

A two-step analysis has been conducted to evaluate whether 1,2-DCA in groundwater could produce indoor air concentrations in excess of applicable risk-based limits. This letter provides a brief summary of site conditions applicable to the evaluation followed by a discussion of the evaluation. The analysis involved i) completing a qualitative analysis of the potential for 1,2-DCA to migrate from the underlying groundwater, through the overlying soil, and into indoor air; and ii) running a USEPA screening model to estimate potential impacts to indoor air, assuming the potential exists for 1,2-DCA to enter buildings.

SITE CONDITIONS

Subsurface Geology

Based on previous monitoring well installations, shallow subsurface geology in the study area consists of the following stratigraphic units, in order of increasing depth (see Figure 3):

1) *Surface Clay:* An orange to brown clay and silty clay unit extending from the surface to an average of 12 ft below ground surface (bgs) in the vicinity of the affected groundwater plume. This surface clay generally increases in thickness from east to west beneath the study area. A 1-ft thick layer of fill and concrete roadway is present at most of the well locations.

2) *Sand:* The surface clay is underlain by a mixed stratum of brown clayey silt, clayey sand, silty sand, sand, and gravelly sand. The sand was not fully penetrated at a depth of 70 ft at the location of well MW-CB-11AS/11AD; however, in the eastern portion of the study area, the sand averaged approximately 20 ft in thickness in the borings to the east.

3) *Clay:* A clay stratum encountered at a depth of 31 ft bgs and extending to a depth of at least 40 feet below this area of the site.

The sand interval (Unit 2, above), encountered at an average depth of 12 ft bgs, represents the uppermost groundwater bearing unit beneath this site. Static water levels were encountered at approximately 22 ft below ground surface and below the top of the sand, indicating a hydraulically unconfined condition. Groundwater within the uppermost groundwater-bearing unit is moving in a south-southeast direction beneath the study area.

Current Soil Conditions

The source of the affected groundwater plume is the former disposal area located north of Richard Road approximately one-quarter mile to the northwest of the study area (see

Figure 1). Waste disposal operations were confined to a limited area north of Richard Road; therefore, no soil source areas associated with the Charlie Burch site are present in the study area.

Current Groundwater Conditions

Within the uppermost groundwater bearing unit, recent concentrations of 1,2-DCA, the only chemical of concern in groundwater within the study area, ranged from 0.00303 mg/L to 0.0813 mg/L (see Table 1). For samples collected in October 2006 from the 13 monitoring wells in the study area, only two values were greater than 0.050 mg/L and six were less than 0.050 mg/L. In the remaining five samples, 1,2-DCA was not detected. These results are consistent with historical groundwater monitoring results obtained since 1998 (see Table 2).

Site-Specific Conceptual Model

In order to present a concern to indoor air, three elements must be present: one, a source zone, such as affected groundwater; two, a way for a chemical to migrate from groundwater, through the overlying soil, and into a building (the transport mechanism); and three, a person who could potentially be exposed to the chemical in air (the receptor). These three elements make up what is called an exposure pathway. If all three elements are present, then the pathway is considered "complete". If one of the elements is absent, then the exposure pathway is considered incomplete, and no exposure can occur.

For this evaluation, the study area has been defined in accordance with USEPA guidelines as the area immediately above the plume between Richard Road and the gas pipeline right-of-way and extending 100 ft out from the edge of the plume (USEPA, 2002); the potential for vapor intrusion does not need to be evaluated outside that area. In order for exposure to 1,2-DCA from groundwater to occur in the study area, 1,2-DCA that volatilizes from groundwater would be required to migrate upward through the overlying soils, then enter a building, and then be breathed by a person in the building. As mentioned above, 1,2-DCA has been identified in groundwater beneath the study area. However, as demonstrated below, the potential is low for 1,2-DCA to move from groundwater to indoor air. Therefore, in accordance with USEPA guidance, no further evaluation of the vapor intrusion is warranted at this time.

EVALUATION OF POTENTIAL FOR INDOOR AIR IMPACTS

Evaluation Strategy

The strategy for evaluating the potential for 1,2-DCA vapors to migrate from groundwater to indoor air involved a two-part analysis. First, a qualitative review was conducted using site-specific factors to evaluate the potential for vapor intrusion. Second, a screening model was employed to further evaluate the potential for vapor intrusion. USEPA guidance on the indoor air exposure pathway provided the general approach for the evaluation (USEPA, 2002).

Factors Influencing Vapor Intrusion

Site-specific factors controlling whether a volatile organic compound such as 1,2-DCA would migrate from groundwater to indoor air are summarized below:

- *Absence of Soil Source Areas:* No soil source areas are present in the study area; therefore, no additional 1,2-DCA will be contributed to vapors moving upward through the soil. In addition, 1,2-DCA will decrease in concentration due to attenuation as vapors move upward through the soil.

  Finding: The potential for vapor intrusion is lessened by the absence of soil source areas within the study area.

- *Depth to Groundwater:* The deeper that groundwater is encountered the less likely vapor intrusion will be a concern, especially when groundwater is deeper than 15 ft bgs, according to USEPA guidance. In the study area, groundwater is encountered at depths ranging from 21 bgs to 24 ft bgs, corresponding to an average depth of 22 ft bgs.

  Finding: The potential for vapor intrusion is lessened by the depth to groundwater in the study area.

- *Soil Type:* Clay and silt are less permeable to air flow, due to the smaller pore size and lack of interconnected porosity.

  Finding: The potential for vapor intrusion is lessened by clayey and silty soils in the study area.

In summary, the qualitative review of site specific factors pertinent to vapor intrusion indicates that site characteristics would limit 1,2-DCA vapors from migrating from the affected groundwater plume and into buildings in the study area.

Results from Screening Model

Even though the qualitative evaluation presented above for factors influencing vapor intrusion indicates a very low potential for vapor intrusion, an additional quantitative screening has been completed. Although 1,2-DCA is not expected to volatilize from groundwater, migrate to the surface, and enter buildings in the study area, an evaluation has been conducted assuming such a situation could develop. Two screening models were completed: i) a preliminary semi-site-specific screening model, and ii) a more detailed site-specific screening model.

Preliminary Semi-Site-Specific Screening Results

USEPA guidance provides a means of quickly evaluating the vapor intrusion pathway using tables of generally recommended target media-specific concentrations that

incorporate limited site-specific information (USEPA, 2002). This preliminary site-specific screening includes multiple levels of conservatism. A conservative screening procedure such as the one used here is most protective of potential receptors.

For the preliminary semi-site-specific screening, the soil texture was approximated as a loamy sand to represent the clay, silt, and sand mixture overlying the groundwater plume (see Figure 3). Based on a soil texture classification of loamy sand and a depth to groundwater of 22 ft bgs, USEPA guidance specifies a preliminary vapor attenuation factor of 2.0E04. The guidance also correlates a preliminary vapor attenuation factor of 2.0E04 to a semi-site-specific screening concentration of 1,2-DCA in groundwater of 0.120 mg/L. This indicates that a concentration of 0.120 mg/L 1,2-DCA in groundwater would be expected to be protective of a potential receptor. The value of 0.120 mg/L is greater than any of the groundwater concentrations measured at wells in the study area at any time since monitoring began (see Table 2).

Site-Specific Screening Results

Although additional screening is not required, a more site-specific screening model was completed to further evaluate conditions in the study area. The Johnson and Ettinger (J&E; 1991) model was used to estimate the risk associated with potential subsurface vapor intrusion into a typical building in the study area, owing to 1,2-DCA in the groundwater beneath the site. The USEPA has published a user's guide for the model (USEPA, 2004), and offers the model for download as an Excel spreadsheet from the USEPA website. A review of the limitations and assumptions in the user's guide for the model indicates that the model is compatible with site conditions as currently understood.

The J&E spreadsheet offers two options for evaluating potential impacts to indoor air from affected groundwater: one for screening purposes, in which many of the parameters are assigned a conservative (i.e., protective of receptors) default value; and an advanced version, in which the user is required to enter values for many more of the parameters, based on site-specific conditions. For this analysis of the study area the screening version was employed using the following site specific input values:

Parameter	Description	Value Used in Model
1. Depth below grade to bottom of enclosed floor space	The concrete foundation thickness was estimated as 6 in (15 cm) as recommended by the user's guide.	15 cm
2. Depth below grade to water table	The distance between the ground surface and the water table was based on measurements taken 10/23/06. Distances ranged from 21.23 ft at MW-CB-24AS to 24.37 ft at MW-CB-8AD, and averaged 22 ft (670 cm, see Table 3).	670 cm
3. Soil type as defined by Soil Conservation Service	Stratigraphic logs (see Figure 3) indicate that layers of clay, silt, and sand are present between the water table and the ground surface. These various layers were represented by the SCS soil texture classification of loamy sand.	LS

Parameter	Description	Value Used in Model
4. Average soil/ groundwater temperature	As measured on 10/23/06, groundwater temperatures ranged from 21.7°C to 26.5°C and averaged 25.3°C (see Table 4). Per user's guide the groundwater temperature was taken to represent soil temperature.	25.3°C
5. Target Risk	For excess cancer risk, use value specified by TCEQ of 1E-05.	1E-05

Default values were used for other input data, which included such parameters as soil total porosity and bulk density; soil water-filled porosity; soil vapor permeability; soil-building pressure differential; floor-wall seam gap; indoor air exchange rate; and building volume. These default values are appropriate for the site and considered to be conservative (i.e., protective of a potential receptor), thereby providing an upper bound estimate of risk associated with potential indoor air concentrations.

The model was run to obtain a groundwater screening concentration for evaluation of the vapor intrusion pathway. Based on the input data described above, a screening value was calculated indicating that a concentration of 0.417 mg/L 1,2-DCA in groundwater would be protective of a potential receptor in a building in the study area. The maximum groundwater concentration in the study area was 0.085 mg/L during monitoring conducted over the last eight years (well MW-CB-12AS in October 2000) which is only 20% of the screening value.

CONCLUSION

An evaluation of the potential for 1,2-DCA in groundwater to impact the indoor air of buildings in the study area indicates that, considering site-specific conditions, it is unlikely that 1,2-DCA would migrate from the subsurface and get into buildings in the study area. Further, even if it were assumed that 1,2-DCA could move to the surface and enter a building, the maximum concentration in groundwater in the study area is less than the USEPA semi-site-specific screening value and less than the screening value developed using the USEPA J&E spreadsheet model. Therefore, in accordance with USEPA guidance, no further evaluation of vapor intrusion is warranted at this time.

Should you have any questions concerning this letter, please contact us at 713-522-6300. We look forward to continuing our work together on this project.

Sincerely,

Elaine A. Higgins, P.E.
Environmental Engineer

Thomas E. McHugh, Ph.D., DBAT
Vice-President

GROUNDWATER
SERVICES, INC.

December 6, 2006

EAH/hs
Attachments.

References:

Johnson, P.C. and R.A. Ettinger, 1991. "Heuristic Model for Predicting the Intrusion Rate of Contaminant Vapors in Buildings," *Environmental Science and Technology*, vol 25, pp. 1445-1452.

USEPA, 2002. *OSWER Draft Guidance for Evaluating the Vapor Intrusion to Indoor Air Pathway from Groundwater and Soils (Subsurface Vapor Intrusion Guidance)*, U.S. Environmental Protection Agency, EPA530-D-02-004, November 2002.

USEPA, 2004. *User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings*, Office of Emergency and Remedial Response, U.S. Environmental Protection Agency, February 2004.

GROUNDWATER SERVICES, INC.

TABLE 1
RESULTS OF GROUNDWATER TESTING:
1,2-DICHLOROETHANE

Sampling Period: October 3-4, 2006

Study Area for Vapor Intrusion Evaluation

Charlie Burch Site, Spring, Texas
Rohm and Haas Texas, Inc.
Voluntary Cleanup Program No. 421

Sample Location	Date Sampled	Date Analyzed	Screen Depth (ft bgs)	1,2-Dichloroethane mg/L
MW-CB-8AD	10/3/06	10/6/06	40-50	**0.0081**
MW-CB-9AS	10/3/06	10/6/06	20-40	<0.00047
MW-CB-9AD	10/3/06	10/6/06	40-60	<0.00047
MW-CB-10AD	10/3/06	10/6/06	40-60	<0.00047
MW-CB-11AS	10/3/06	10/5/06	25-45	**0.0172**
MW-CB-11AD	10/3/06	10/5/06	45-65	**0.00303**
MW-CB-12AS	10/3/06	10/6/06	19.5-39.5	**0.0509**
MW-CB-12AD	10/3/06	10/6/06	38-58	**0.0250**
MW-CB-13AS	10/4/06	10/9/06	17.7-37.8	**0.0130**
MW-CB-16AS	10/3/06	10/9/06	19.3-39.3	**0.0813**
MW-CB-17AS	10/3/06	10/5/06	15-35	<0.00047
MW-CB-24AS	10/3/06	10/5/06	19.5-29.5	<0.00047
TP-21	10/3/06	10/6/06	39.7-49.2	**0.0207**
			Minimum	**0.00303**
			Maximum	**0.0813**

Notes:
1. Groundwater samples collected at the locations shown on Figure 1.
2. Samples analyzed by Severn Trent Laboratories, Houston, Texas, in accordance with U.S. EPA Method 8260.
3. Bold type indicates a measurement exceeding the sample quantitation limit.
4. Well number subscripts refer to screen depths as follows:
   A and AS: Zone A wells with screen < 40 ft depth
   AD: Zone A wells with screen > 40 ft depth
5. < = Not detected at the quantitation limit indicated.

GROUNDWATER SERVICES, INC.

TABLE 2
RESULTS OF HISTORICAL GROUNDWATER TESTING:
1,2-DICHLOROETHANE

Sampling Period: 1998-2006

Study Area for Vapor Intrusion Evaluation

Charlie Burch Site, Spring, Texas
Rohm and Haas Texas, Inc.
Voluntary Cleanup Program No. 421

		1,2-Dichloroethane								
Sampling Date / **Sample Location**	**Screen Depth (ft bgs)**	9/98-3/99 mg/L	10/00 mg/L	8/01 mg/L	8-9/02 mg/L	11/03 mg/L	10/04 mg/L	9/05 mg/L	10/06 mg/L	Maximum mg/L
MW-CB-8AD	40-50	**0.011**	<0.005	<0.005	**0.005**	**0.0043**	0.00264J	<0.005	**0.0081**	**0.011**
MW-CB-9AS	20-40	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.00047	ND
MW-CB-9AD	40-60	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.00047	ND
MW-CB-10AD	40-60	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.00047	ND
MW-CB-11AS	25-45	**0.044**	**0.042**	**0.033**	**0.033**	**0.0264**	**0.0209**	**0.0158**	**0.0172**	**0.044**
MW-CB-11AD	45-65	<0.005	<0.005	<0.005	<0.005	0.0029J	0.0022J	0.00387J	**0.00303**	**0.00303**
MW-CB-12AS	19.5-39.5	**0.078**	**0.085**	**0.077**	**0.076**	**0.0672**	**0.0508**	**0.0551**	**0.0509**	**0.085**
MW-CB-12AD	38-58	<0.005	**0.016**	**0.013**	**0.017**	**0.0189**	**0.0164**	**0.0218**	**0.0250**	**0.025**
MW-CB-13AS	17.7-37.8	**0.017**	**0.026**	**0.025**	**0.015**	**0.018**	**0.0168**	**0.0151**	**0.0130**	**0.026**
MW-CB-16AS	19.3-39.3	**0.048**	**0.036**	**0.02**	**0.016**	**0.0133**	**0.033**	**0.0749**	**0.0813**	**0.0813**
MW-CB-17AS	15-35	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.00047	ND
MW-CB-24AS	19.5-29.5	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.00047	ND
TP-21	39.7-49.2	**0.021**	**0.037**	**0.025**	**0.03**	**0.021**	**0.021**	**0.0228**	**0.0207**	**0.037**
									Minimum	**0.00303**
									Maximum	**0.0850**

Notes:
1. Groundwater samples collected at the locations shown on Figure 1.
2. Samples analyzed in accordance with U.S. EPA Method 8260. Samples collected in 2001 and 2002 analyzed by Environmental Chemistry, Inc., Houston, Texas. Samples collected in 2003 and after analyzed by Severn Trent Laboratories, Houston Texas.
3. Bold type indicates a measurement exceeding the sample quantitation limit.
4. Well number subscripts refer to screen depths as follows:
   A and AS: Zone A wells with screen < 40 ft depth
   AD: Zone A wells with screen > 40 ft depth
5. J = Estimated result. Analyte positively identified but detected at a concentration less than the lowest calibration standard.
   ND = 1,2-DCA not detected during any sampling event.
   < = Not detected at the quantitation limit indicated.

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TABLE 3
MONITORING WELL AND TEMPORARY PIEZOMETER CONSTRUCTION SPECIFICATIONS AND WATER ELEVATION CALCULATIONS: 10/23/06

Study Area for Vapor Intrusion Evaluation

Charlie Burch Site, Spring, Texas
Rohm and Haas Texas, Inc., Deer Park
Voluntary Cleanup Program No. 421

Well ID	Date Installed	Total Boring Depth (ft bgs)	Screened Depth Interval (ft bs)	Ground Surface Elevation (ft msl)	Top of Casing Elevation (ft msl)	Depth to Water (ft toc)	Water Elevation (ft msl)	Water Depth (ft bgs)
MW-CB-8AD	11/17/94	50.0	40-50	118.6	118.28	24.05	94.23	24.4
MW-CB-9AS	12/15/94	40.0	20-40	117.5	117.21	21.54	95.67	21.8
MW-CB-9AD	11/11/94	60.0	40-60	117.4	117.05	21.41	95.64	21.8
MW-CB-10AD	11/16/94	60.0	40-60	117.1	116.75	21.87	94.88	22.2
MW-CB-11AS	11/9/94	45.0	25-45	117.5	117.15	21.76	95.39	22.1
MW-CB-11AD	11/10/94	70.0	45-65	117.5	117.18	22.21	94.97	22.5
MW-CB-12AS	12/15/94	40.0	19.5-39.5	116.9	116.55	21.27	95.28	21.6
MW-CB-12AD	11/16/94	60.0	38-58	116.9	116.64	21.71	94.93	22.0
MW-CB-13AS	12/22/94	40.0	17.7-37.8	118.9	118.63	23.21	95.42	23.5
MW-CB-16AS	12/16/94	40.0	19.3-39.3	118.3	117.95	22.38	95.57	22.7
MW-CB-17AS	2/8/95	40.0	15-35	116.6	116.30	21.06	95.24	21.4
MW-CB-24AS	3/4/95	32.0	19.5-29.5	116.5	116.16	20.89	95.27	21.2
TP-21	8/18/94	50.0	39.7-49.2	NA	118	22.88	95.12	NA
							Minimum	**21**
							Maximum	**24**
							Average	***22***

Notes:
1. Monitoring well and temporary piezometer locations shown on Figure 1.
2. bgs = Below ground surface.
   msl = Mean Sea Level;
   NM = Not measured.
3. A and AS = Zone A <40 ft depth; AD = Zone A > 40 ft depth.

GROUNDWATER SERVICES, INC.

TABLE 4
RESULTS OF GROUNDWATER TESTING: FIELD PARAMETERS
October 2006

Study Area for Vapor Intrusion Evaluation

Charlie Burch Site, Spring, Texas
Rohm and Haas Texas, Inc.
Voluntary Cleanup Program No. 421

Well ID	Date Measured	Temp. (°F)
MW-CB-9AS	10/3/06	25.8
MW-CB-9AD	10/3/06	24.9
MW-CB-10AD	10/3/06	23.9
MW-CB-11AS	10/3/06	26.0
MW-CB-11AD	10/3/06	25.6
MW-CB-12AS	10/3/06	26.2
MW-CB-12AD	10/3/06	25.8
MW-CB-13AS	10/4/06	21.7
MW-CB-16AS	10/3/06	25.0
MW-CB-17AS	10/3/06	26.5
MW-CB-24AS	10/3/06	26.3
TP-21	10/3/06	25.8
	Minimum	**21.7**
	Maximum	**26.5**
	Average	***25.3***

Notes:
1. Well and piezometer locations shown on Figure 1.
2. Field measurements were made using a YSI portable meter and a turbidity meter.

LEGEND

- Monitoring well location (Zone A)
- Monitoring well location (Zone B)
- Recovery well location
- Temporary sampling point location
- Temporary groundwater sampling location 10/30-11/2/06, groundwater sample only
- Temporary groundwater sampling location 10/30-11/2/06, with stratigraphic logging

Note: Photo by Aerial's Express, Houston, TX, April 2006.

GROUNDWATER SERVICES, INC.

GSI Job No.	G-3040	Drawn By:	DLB
Issued:	12/06/06	Chk'd By:	DMB
Revised:	———	Aprv'd By:	RSL
Scale:	As Shown		FIGURE 1

GROUNDWATER SAMPLING AND MONITORING WELL LOCATIONS

Charlie Burch Site, Spring, Texas
Rohm and Haas, Texas, Inc.

LEGEND

- Monitoring well location (Zone A)
- Recovery well location
- Temporary sampling point location

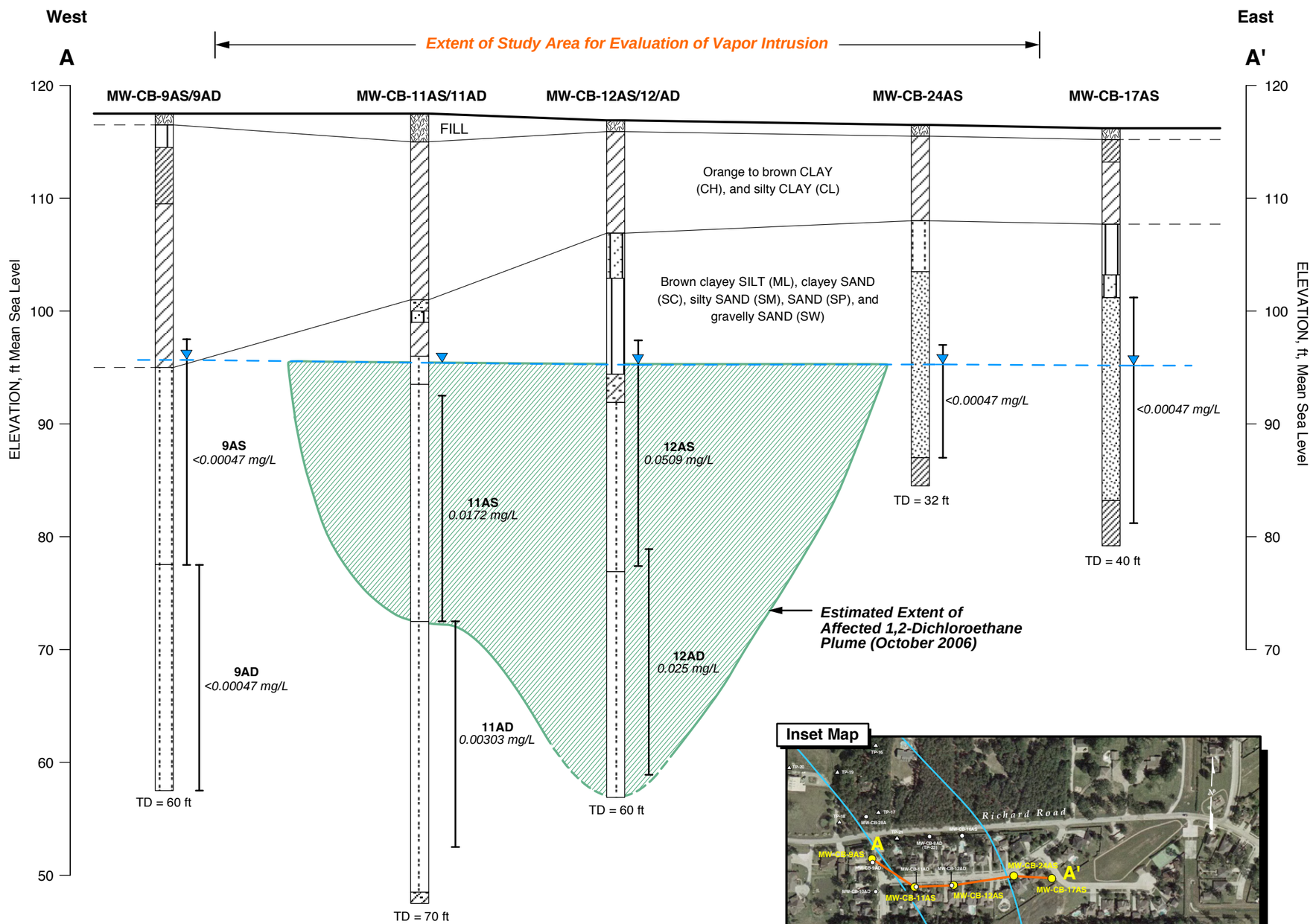
Note: Photo by Aerial's Express, Houston, TX, April 2006.

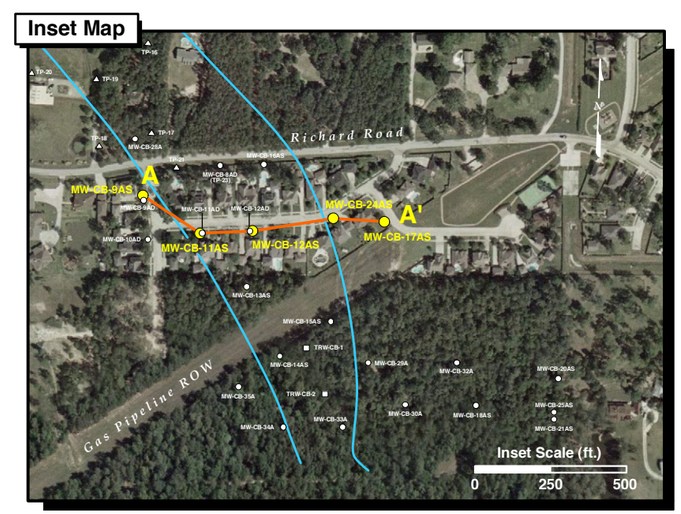
GROUNDWATER SERVICES, INC.

GSI Job No.	G-3040	Drawn By:	DLB
Issued:	12/06/06	Chk'd By:	EAH
Revised:	———	Aprv'd By:	EAH
Scale:	As Shown		FIGURE 2

STUDY AREA FOR EVALUATION OF VAPOR INTRUSION

Charlie Burch Site, Spring, Texas
Rohm and Haas, Texas, Inc.





Notes: 1) No soil samples were logged below 22.5 ft, 24 ft, and 25 ft at wells MW-CB-9AS, MW-CB-11AS, and MW-CB-12AS, respectively. SAND (SP) classification based on driller's report of sand (samples logged at MW-CB-4AD from 65-70').

2) Photo by Aerial's Express, Houston, Tx., April 2006.

LEGEND

- FILL
- Sand (SP)
- Gravelly SAND (SW)
- Silty SAND (SM)
- Clayey SAND (SC)
- SILT (ML)
- Sandy and Silty CLAY (CL)
- CLAY (CH)
- TD — Total depth of boring, ft below ground surface (BGS)
- Static water level (SWL), as measured on 10/23/06
- Screened interval
- *0.0172 mg/L* — 1,2-dichloroethane concentration, as measured in samples collected 10/3-5/06
- *<0.00047 mg/L* — 1,2-dichloroethane not detected at method detection limit indicated

HORIZONTAL SCALE, ft

0 50 100 150 200

VERTICAL SCALE: 1 INCH = 10 ft
VERTICAL EXAGGERATION: 10X

GROUNDWATER SERVICES, INC.

GEOLOGIC CROSS-SECTION: WEST-EAST ORIENTATION

Charlie Burch Site, Spring, Texas
Rohm and Haas, Texas, Inc.

GSI Job No:	G-3040	Drawn By:	EAH/DLB
Issued:	12/06/06	Chk'd By:	EAH
Revised:	———	Appv'd By:	
Scale:	As Shown		**FIGURE 3**