1162635 - R8 SDMS

Golder Associates

TECHNICAL MEMORANDUM

Date: August 5, 2010 **Project No.:** 073-81526

To: Fran Costanzi, Remedial Project Manager **Company:** U.S. EPA

From: Walter Weinig and Sarah Doyle **Email:** WWeinig@golder.com

cc: D. White-KMI, J. Francis-DEQ, R. Gill-DEQ, C. Hanify-DEQ,

RE: REVISED SUMMARY OF VAPOR INTRUSION MODELING FOR THE KINDER MORGAN PORTION OF THE MYSTERY BRIDGE SUPERFUND SITE

1.0 INTRODUCTION

This revised technical memorandum presents a summary of vapor intrusion modeling for BTEX compounds (benzene, toluene, ethylbenzene, and xylenes) in groundwater at the Kinder Morgan, Inc. (KMI) Casper Compressor Station (Site). The KMI Site is part of the Mystery Bridge Superfund Site located in Evansville, Wyoming.

As described in a technical memorandum to Fran Costanzi of the United States Environmental Protection Agency (EPA) dated February 12, 2010 (Golder 2010a), groundwater associated with the KMI Site met the compliance criteria established in the post remedial action groundwater monitoring plan (Adrian Brown Consultants (ABC) 1993) after the November 2009 monitoring event. Quarterly groundwater monitoring for benzene, toluene, ethylbenzene, and xylenes (BTEX) has continued in 2010 at monitoring wells ABC-2, ABC-5, EPA-1-9, EPA-1-10, and EPA-2-11 although KMI has requested to suspend groundwater monitoring based on meeting the compliance criteria.

The vapor intrusion modeling was originally conducted by Golder Associates Inc. (Golder) as requested by the EPA during an April 29, 2010 meeting with KMI and other parties involved at Mystery Bridge, at which the steps remaining for eventual delisting of the Mystery Bridge site were discussed. Results of the initial vapor intrusion modeling were described in a technical memorandum to Fran Costanzi dated June 8, 2010 (Golder, 2010b).

EPA provided comments on the initial vapor intrusion model in correspondence from Fran Costanzi to Walter Weinig of Golder dated June 23, 2010 (EPA, 2010a). Further clarification regarding the EPA comments was provided in e-mail correspondence from Andrew Schmidt to Walter Weinig dated July 14, 2010 (EPA 2010b). While KMI and Golder do not agree with the technical rationale underlying some of EPA's comments, the revised modeling described below incorporates the changes suggested by EPA in these communications.

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Section 2 contains background information on the Site and a summary of the comments received from EPA. The methods and results of the vapor intrusion modeling are summarized in sections 3 and 4, respectively.

2.0 BACKGROUND

2.1 Site Description

The Site is located in Natrona County, northeast of Casper, Wyoming. Since 1965, KN Energy and later KMI and its affiliates have operated a natural gas compression station at the Site.

In 1987, groundwater under and immediately north of the Site was found to contain trace amounts of dissolved hydrocarbons that were suspected at the time to have originated, in part, from the KN Energy Site. Remedial actions were conducted at the Site from 1989 through 1996 and consisted of groundwater pump-and treat, air sparging, soil-vapor extraction, and free product removal. Following remedial actions, post remedial action (PRA) groundwater monitoring has been conducted in accordance with the Groundwater Monitoring Plan (ABC 1993), the 1997 U.S. Environmental Protection Agency (EPA) letter which moves the site into a post-remedial action status (EPA 1997), and a work plan approved by EPA on June 29, 2005 (EPA 2005).

2.2 Summary of EPA Comments

In correspondence dated June 23, 2010 (EPA 2010a) and July 14, 2010 (EPA 2010b) EPA provided the following comments on the initial vapor intrusion modeling memo (Golder 2010b). The text of the EPA comments is provided in italics. Responses are provided following each comment.

1. *The analytical input data for the model should be a 95% UCL of the mean for each BTEX analyte. The size of the dataset should be from the conclusion of active remediation at the site to the present. The 95% UCL should be calculated using data from wells that are within the dissolved phase plume of BTEX constituents. If there is no longer a definable plume, then only wells that continue to have detections or sporadic detections of BTEX should be used for the calculation of the 95% UCL.*

   Golder did not agree that the time period from the end of active remediation to the present is a suitable representation of current groundwater conditions. Golder and EPA discussed this comment during a telephone call on July 1, 2010. After further consideration EPA provided a revised comment regarding the period of record to be included in the analysis (EPA, 2010b):

   After looking at historical benzene data and talking to one of our toxicologists and statistical gurus, we would like you to calculate the 95% UCL using the data set from 2002 to present using all wells that had detectable concentrations during that period. The rationale behind using the dataset from 2002-present is that the DOW facility discontinued groundwater pumping in April

2001, and following the shut down of DOW's groundwater extraction system the groundwater regime presumably returned to a more natural state. Please use the ProUCL program to calculate the 95% UCL and to estimate the value of ND's. We do not want you to use the ½ detection limit substitution for non detects. Recognizing that concentrations at the site have been variable and some concentrations appear to have decreased since 2002, you may also present Johnson and Ettinger modeling results using a 95% UCL calculated from the last twelve quarters of data in addition to the data from 2002-present. In your calculations of the 95% UCL using the last twelve quarters of data, please use only monitoring wells ABC-5, EPA-1-9, EPA-1-10, and EPA-2-11.

Golder and KMI do not agree with the rationale that the data set used for modeling vapor intrusion for the BTEX plume should be tied to remediation activities for the chlorinated solvent plume at the adjacent DOW facility. The two groundwater plumes are distinct and have been the subject of separate remediation efforts. However, Golder and KMI have used the data set from 2002 to the present as requested by EPA in the July 14, 2010 email correspondence (EPA, 2010b). The revised modeling presented in Sections 3 and 4 below incorporates the requested data input.

Sections 3 and 4 also present results using input based on the past 12 quarters of analytical data for monitoring wells ABC-5, EPA-1-9, EPA-1-10, and EPA-2-11. Golder and KMI do not agree with the exclusion of data from monitoring well ABC-2 in this analysis, but the likely difference in output that would result from the inclusion of data from ABC-2 is minimal.

Analytical data for BTEX constituents used in the revised vapor intrusion modeling are provided in Attachment C.

2. *The groundwater temperature input used for the model should be the maximum groundwater temperature detected over the period extending from the conclusion of active remediation at the site to present. Wells used to determine the maximum temperature should be the same wells used to determine the analytical data input as specified in comment #1.*

   Groundwater temperatures are not routinely monitored at the KMI site. This comment was discussed during the telephone call on July 1, 2010. As agreed with EPA during that call and described in Section 3 below, the revised vapor intrusion modeling uses the default groundwater temperature shown on a map in the vapor-intrusion modeling guidance document (EPA, 2004).

3. *The depth to groundwater input should be the minimum depth to groundwater observed over the period extending from the conclusion of active remediation at the site to present. Wells used to determine the minimum depth to groundwater should be the same wells used to determine the analytical data input as specified in comments #1 and #2.*

The depth to groundwater used in the revised vapor intrusion modeling is the minimum depth to groundwater for the period of record and wells used to develop the analytical input data. The depth to groundwater data for the wells considered in the analysis are presented in Attachment B.

4. *Please provide a discussion of the screened interval of the wells used to calculate the analytical and temperature input data relative to the water table. Ideally, for vapor intrusion analysis, wells would be screened across the water table. If wells used for analytical and temperature input data are not screened across the water table, please provide a discussion as to why these wells are acceptable to use for vapor intrusion analysis.*

   The wells used to calculate the input data are screened across the water table. Available well logs for the wells used in the analysis are provided in Attachment A. Graphs of depth to water and screened intervals for the wells used in the analysis are provided in Attachment B.

5. *Please provide a site figure, and ideally a plume map with the memorandum.*

   Figure 1 is a site map showing monitoring well locations. Current groundwater concentrations are below the compliance criteria for the site. There is no definable plume to represent on the site map.

6. *Please provide all modeling sheets used during the modeling process (e.g., Input, Intercalc, and Results sheets for all analytes simulated).*

   Modeling sheets are provided in Attachment E.

7. *Please provide a cumulative risk value for carcinogenic and non-carcinogenic risk.*

   The calculation of cumulative risk was discussed during the telephone call on July 1, 2010. As agreed by Golder and EPA, the non-carcinogenic cumulative risk calculations are arithmetic sums of the revised vapor intrusion modeling results for the BTEX constituents. Potential synergistic effects of multiple constituents are not considered in the calculation. The cumulative carcinogenic risk is equal to the incremental carcinogenic risk due to benzene because toluene, ethylbenzene, and xylenes do not have calculated carcinogenic risks in the vapor intrusion model (EPA, 2004).

3.0 VAPOR INTRUSION MODELING METHODS

The Johnson and Ettinger (1991) model for subsurface vapor intrusion into buildings was used to assess the potential for BTEX groundwater contamination to adversely impact indoor air quality. The model is a one-dimensional analytical solution to convective and diffusive vapor transport into indoor space. It provides an estimated attenuation coefficient that relates the vapor concentration in the indoor space to the vapor concentration at the source of contamination (EPA 2004). Inputs to the model include chemical

properties of the contaminant, saturated- and unsaturated-zone soil properties, and structural properties of the building (EPA 2004).

The EPA constructed the Johnson and Ettinger vapor intrusion model in a Microsoft® Excel spreadsheet. The spreadsheet GW-SCREEN, Version 3.1, was used to calculate the incremental risk from vapor intrusion to indoor air (EPA 2004). This model uses default building properties for parameters such as building dimensions and size and area of cracks in the foundation. Model inputs for GW-SCREEN that were constant for all model runs for the Site are presented in Table 1 and are summarized below.

- *Soil Parameters:* The soil was considered to be sand, based on information provided in borehole logs and the U.S. Department of Agriculture (USDA) Web Soil Survey for the Site (USDA 2010). According to the USDA soil survey, on-site soils are typically a loam from 0 to 25 inches depth, and stratified sand to loam from 25 to 60 inches depth. Soil borehole logs indicate that the soil from approximately 20 to 30 feet below ground surface (typically the depth of the top of the screen) to approximately 5 to 10 feet below ground surface is typically a sand. From ground surface to approximately 5 to 10 feet below ground surface, the soil is finer grained, such as a silt or clay. As a conservative estimate, the entire soil profile was assumed to be sand. Remaining soil parameters needed for model input, such as bulk density and porosity, were estimated based on typical values for a sand. Typical values for various soil types are provided in the model, as compiled from several data sources (EPA 2004). Available borehole logs for wells used for modeling are provided in Attachment A.
- *Groundwater Temperature:* Average groundwater temperature was estimated to be 11 degrees Celsius, based on Figure 8 of the User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings (EPA 2004).
- *Depth to Groundwater:* For the depth below grade to the water table, the shallowest groundwater observed from wells with BTEX detections from 2002 through May 2010 was selected as a conservative value for the Site. From 2002 through May of 2010, fifteen wells were monitored with detectable BTEX concentrations: ABC-2, ABC-5, ABC-12, ABC-17, ABC-27, ABC-91, GW-2, MW-5, MW-6, MW-7, EPA-1-9, EPA-1-10, EPA-2-11, EPA-1-11, and ABC-19. Of those wells, a minimum depth to water of 27.34 feet (833 cm) occurred at well EPA-1-9 on August 22, 2008. Attachment B presents graphs of depths to water over time for wells with BTEX detections between 2002 through May 2010. Water level data were not available for well EPA-1-11 and monitoring at this well was discontinued in mid-2002. As shown in Attachment B, the wells are screened across the water table.
- *Depth below Grade to Bottom of Enclosed Space:* As a conservative estimate, buildings were assumed to have basements. The default model value for basement construction is 6.5 feet (200 cm).
- *Exposure Duration and Frequency:* Default model values were selected for exposure duration and frequency, 30 years and 350 days, respectively.
- *Averaging Time for Carcinogens and Noncarcinogens:* Default model values were selected for the carcinogen and noncarcinogen averaging time, 70 years and 30 years, respectively.

Two chemical datasets were modeled for vapor intrusion. The first dataset consists of BTEX concentrations for wells with detections from 2002 through May 2010. Fifteen wells had detectable BTEX concentrations during this time period: ABC-2, ABC-5, ABC-12, ABC-17, ABC-27, ABC-91, GW-2, MW-5, MW-6, MW-7, EPA-1-9, EPA-1-10, EPA-2-11, EPA-1-11, and ABC-19. The locations of these wells are

shown on Figure 1. BTEX concentrations from 2002 through May 2010 are presented in Attachment C and benzene concentrations from 2002 through May 2010 are presented on Figure 2.

As shown in Figure 2, benzene has been detected less frequently and at lower concentrations since 2005, compared to 2002 through 2005. Therefore, the use of data extending back to 2002 is not representative of current risks from vapor intrusion. The dataset from 2002 through May 2010 was used for vapor intrusion modeling because it was specifically requested by EPA (EPA 2010b). The second dataset is more representative of current risks and consists of BTEX concentrations for the past 12 quarters of monitoring at four wells: ABC-5, EPA-1-9, EPA-1-10, and EPA-2-11.

For both datasets, the 95% upper confidence limit (UCL) of each BTEX compound was selected for model input. UCLs were calculated using the EPA software ProUCL Version 4.00.05. The software uses several methods for calculating the UCL and treatment of non-detects. For the first dataset (detections from 2002 through May 2010), the UCL selected was based upon Kaplan-Meier estimates using bias-corrected accelerated bootstrap methods. For the second dataset (data from the past 12 quarters), the UCL selected was based upon Kaplan-Meier estimates using the Student's t-distribution cutoff value.

The methods used for calculating the UCL and the selected UCL values were recommended by the ProUCL software based on characteristics of the datasets. ProUCL results are provided in Attachment D.

UCLs were calculated separately for m,p-xylenes and o-xylene. Since November 2002, the analytical laboratory has reported m,p-xylenes and o-xylene separately. However, for the first three quarterly events of 2002, the laboratory reported only total xylenes. For calculating the UCLs, the total xylenes concentration was used as a conservative estimate of individual concentrations of m,p-xylene and o-xylene for the first three quarterly events of 2002. For modeling vapor intrusion of xylenes, the Johnson and Ettinger (1991) model calculates risk from o-, m-, and p-xylene individually. Therefore, the UCL calculated for m,p-xylenes was used for modeling both m- and p-xylene. Of m- and p-xylene, the isomer with the higher hazard quotient was used to calculate the cumulative non-carcinogenic risk.

4.0 RESULTS OF MODELING

Results of the vapor intrusion modeling are presented in Table 2 for each compound. Model inputs and results are also provided in Attachment E.

4.1 Carcinogenic Risk Calculations

For the first dataset (2002 through May 2010), the incremental carcinogenic risk from vapor intrusion of benzene in groundwater to indoor air is 1.6×10^{-6}, which is above the lower screening level for carcinogens (1×10^{-6}). However, this dataset includes benzene detections from 2002 through May 2010, which is not representative of current conditions. For the second dataset, the incremental carcinogenic risk is 4.5×10^{-7}, which is below the target risk for carcinogens. This second dataset includes the past 12 quarters of data for wells ABC-5, EPA-1-9, EPA-1-10, and EPA-2-11. For toluene, ethylbenzene, and

xylenes, incremental carcinogenic risk was not calculated because these compounds are not Group 1 carcinogens.

Benzene is the only carcinogen monitored at the site, therefore the cumulative carcinogenic risk is equal to the incremental carcinogenic risk from benzene.

4.2 Non-carcinogenic Risk Calculations

Non-carcinogenic hazard quotients were calculated for all of the BTEX constituents. For the first dataset, the non-carcinogenic hazard quotients range from 2.4×10^{-4} for toluene to 1.6×10^{-2} for benzene, which are orders of magnitude below the screening-level target of 1 for non-carcinogens.

Results for the second dataset are lower, with hazard quotients ranging from 6.5×10^{-5} for toluene to 4.5×10^{-3} for benzene. Cumulative risks for both datasets are also below 1, with values of 2.2×10^{-2} for the first dataset, and 6.6×10^{-3} for the second dataset.

4.3 Summary of Model Results

The cumulative carcinogenic risk for the first data set is only slightly above the lower screening level of 1×10^{-6}. The cumulative carcinogenic risk for the second, more representative dataset is below this screening level. The cumulative non-carcinogenic hazard quotients for both datasets are well below the target level of 1.0. Based on these results vapor intrusion of BTEX compounds into occupied buildings at the Site does not pose a significant risk to human health.

5.0 REFERENCES

Adrian Brown Consultants, Inc., 1993, Remedial Action Groundwater Monitoring Plan for the KN Energy Gas Compressor Station, Casper, Wyoming, Report 1125A/930901, September 1.

Golder, 2010a, Technical Memorandum from Walter Weinig and Sarah Doyle to Fran Costanzi (Remedial Project Manager, U.S. Environmental Protection Agency) regarding: Summary of the previous eight quarters of post remedial action groundwater monitoring at the Casper Compressor Station, February 12.

Golder, 2010b, Technical Memorandum from Walter Weinig and Sarah Doyle to Fran Costanzi (Remedial Project Manager, U.S. Environmental Protection Agency) regarding: Summary of vapor intrusion modeling for the Kinder Morgan portion of the Mystery Bridge Superfund site, June 8.

Johnson, P. C, and R. A. Ettinger. 1991. Heuristic model for predicting the intrusion rate of contaminant vapors in buildings. Environ. Sci. Technol. 25: 1445-1452.

U.S. Department of Agriculture, 2010, Natural Resources Conservation Services, Web Soil Survey for Natrona County Area, Wyoming. <http://websoilsurvey.nrcs.usda.gov/app/WebSoilSurvey.aspx> (accessed May 17, 2010).

U.S. Environmental Protection Agency, 1997. Letter from Lisa Reed Lloyd (Project Manager, U.S. Environmental Protection Agency) to Mr. Hayden Truscott (Environmental Manager, KN Energy, Inc.) regarding: Mystery Bridge Superfund Site – Remedial Action Completion, August 20, 1997.

U.S. Environmental Protection Agency, 2004, Environmental Quality Management, Inc., User's Guide for the Johnson and Ettinger (1991) Model for Subsurface Vapor Intrusion into Buildings. Prepared for U.S. EPA Office of Emergency and Remedial Response. Washington, DC. U.S. EPA, 2000, revised February 22, 2004.

U.S. Environmental Protection Agency, 2005. Letter from Rebecca J. Thomas (Project Manager, U.S. Environmental Protection Agency) to Mr. Hayden Truscott (Kinder Morgan, Inc.) regarding: Mystery Bridge Superfund Site, Long-term Groundwater Monitoring and Well Abandonment Proposal, June 29, 2005.

U.S. Environmental Protection Agency, 2010a, Letter from Fran Costanzi, P.E. (Hydrogeologist, Superfund Program Support U.S. EPA Region 8) to Mr. Walter Weinig (Golder Associates Inc.) regarding: Mystery Bridge NPL Site vapor intrusion analysis, Kinder Morgan Portion, June 23.

U.S. Environmental Protection Agency, 2010b, Email from Andrew Schmidt, P.G. (Hydrogeologist, Superfund Program Support U.S. EPA Region 8) to Mr. Walter Weinig (Golder Associates Inc.) regarding: KMI Casper Compressor Station VI Modeling, July 14.

Attachments:

Table 1 – Vapor Intrusion Model Inputs for KMI Casper Compressor Station
Table 2 – Chemical Model Inputs and Results of Vapor Intrusion Modeling
Figure 1 – Locations of Monitoring Wells
Figure 2 – Benzene Concentrations from 2002 through May 2010
Attachment A: Soil Boring Logs
Attachment B: Depth-to-Water Graphs
Attachment C: BTEX Concentrations from 2002 through May 2010
Attachment D: ProUCL Results
Attachment E: Model Inputs and Results

TABLES

TABLE 1
VAPOR INTRUSION MODEL INPUTS FOR KMI CASPER COMPRESSOR STATION

Parameter	Model Input	Source of Model Input
Average Groundwater Temperature (°C)	11	Estimated from Figure 8 of User's Guide for Evaluating Subsurface Vapor Intrusion into Buildings (EPA 2004)
Depth below Grade to Bottom of Enclosed Space (cm)	200	Default for basement construction
Depth below Grade to Water Table (cm)	833*	Depth selected is for shallowest groundwater observed from the well listed on Table 1
SCS Soil Type Directly above Water Table	Sand	Soil type selected based on borehole logs and USDA Web Soil Survey data
Vadose Zone SCS Soil Type	Sand	Soil type selected based on borehole logs and USDA Web Soil Survey data
Vadose Zone Soil Dry Bulk Density (g/cm^3)	1.66	Provided in lookup table for soil type
Vadose Zone Soil Total Porosity (unitless)	0.375	Provided in lookup table for soil type
Vadose Zone Soil Water-filled Porosity (unitless)	0.054	Provided in lookup table for soil type
Averaging Time for Carcinogens (years)	70	Default value
Averaging Time for Noncarcinogens (years)	30	Default value
Exposure Duration (years)	30	Default value
Exposure Frequency (days/yr)	350	Default value

*Minimum depth to water is approximately 27.34 feet below ground surface, as observed at well EPA-1-9 on August 22, 2008. This is the minimum for both datasets (BTEX detections from 2002 through May 2010 and the last 12 quarters from ABC-5, EPA-1-9, EPA-1-10, and EPA-2-11.)

TABLE 2
CHEMICAL MODEL INPUTS AND RESULTS OF VAPOR INTRUSION MODELING

Chemical Inputs				Results	
Dataset	Chemical	Type of Concentration[1]	Concentration (μg/L)	Incremental Risk[2], carcinogen (unitless)	Hazard Quotient[2], noncarcinogen (unitless)
Wells with BTEX detections from 2002 through May 2010	Benzene	95% UCL -KM(BCA)	5.66	1.6E-06	1.6E-02
	Toluene	95% UCL -KM(BCA)	1.09	NA	2.4E-04
	Ethylbenzene	95% UCL -KM(BCA)	2.96	NA	2.6E-04
	o-xylene[3]	95% UCL -KM(BCA)	2.56	NA	1.6E-03
	p-xylene[3]	95% UCL -KM(BCA)	4.34	NA	3.7E-03
	m-xylene[3]	95% UCL -KM(BCA)	4.34	NA	3.3E-03
			Cumulative Risk[4]	1.6E-06	2.2E-02
Last 12 Quarters of monitoring (August 2007 through May 2010) at wells ABC-5, EPA-1-9, EPA-1-10, and EPA-2-11	Benzene	95% UCL - KM (t)	1.62	4.5E-07	4.5E-03
	Toluene	95% UCL - KM (t)	0.29	NA	6.5E-05
	Ethylbenzene	95% UCL - KM (t)	1.71	NA	1.5E-04
	o-xylene[3]	95% UCL - KM (t)	1.69	NA	1.1E-03
	p-xylene[3]	95% UCL - KM (t)	0.88	NA	7.6E-04
	m-xylene[3]	95% UCL - KM (t)	0.88	NA	6.8E-04
			Cumulative Risk[4]	4.5E-07	6.6E-03

1) 95% UCL - KM(BCA): UCL based upon Kaplan-Meier estimates using bias-corrected accelerated bootstrap methods

95% UCL - KM (t): UCL based upon Kaplan-Meier estimates using the Student's t-distribution cutoff value

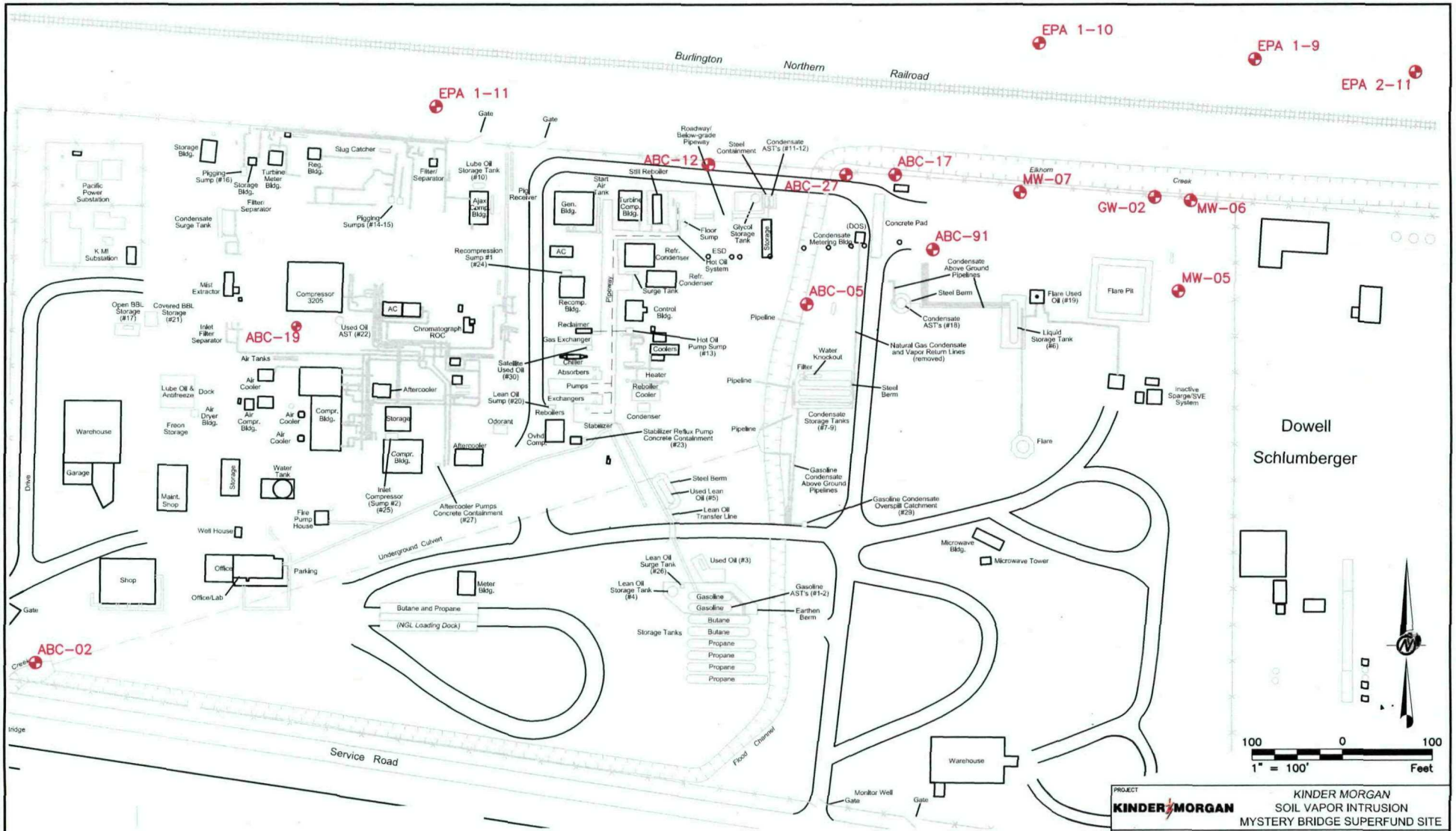
2) Incremental risk and hazard quotient for vapor intrusion to indoor air

3) Xylene was typically reported by the laboratory as m,p-xylenes and o-xylenes. The UCL for m,p-xylenes was used to model m- and p-xylene individually. For three monitoring events in 2002, only total xylenes were reported by the lab. In these cases, total xylene concentrations were used in calculating the m,p-xylene UCL and the o-xylene UCL.

4) Cumulative Risk for non-carcinogens was calculated using the larger of the hazard quotients for m-xylene and p-xylene. Both hazard quotients were calculated with the 95% UCL for m,p-xylenes combined.

NA: Not Applicable, not a carcinogen

FIGURES



LEGEND

MONITORING WELL

PROJECT: KINDER MORGAN

KINDER MORGAN
SOIL VAPOR INTRUSION
MYSTERY BRIDGE SUPERFUND SITE

TITLE: LOCATIONS OF MONITORING WELLS

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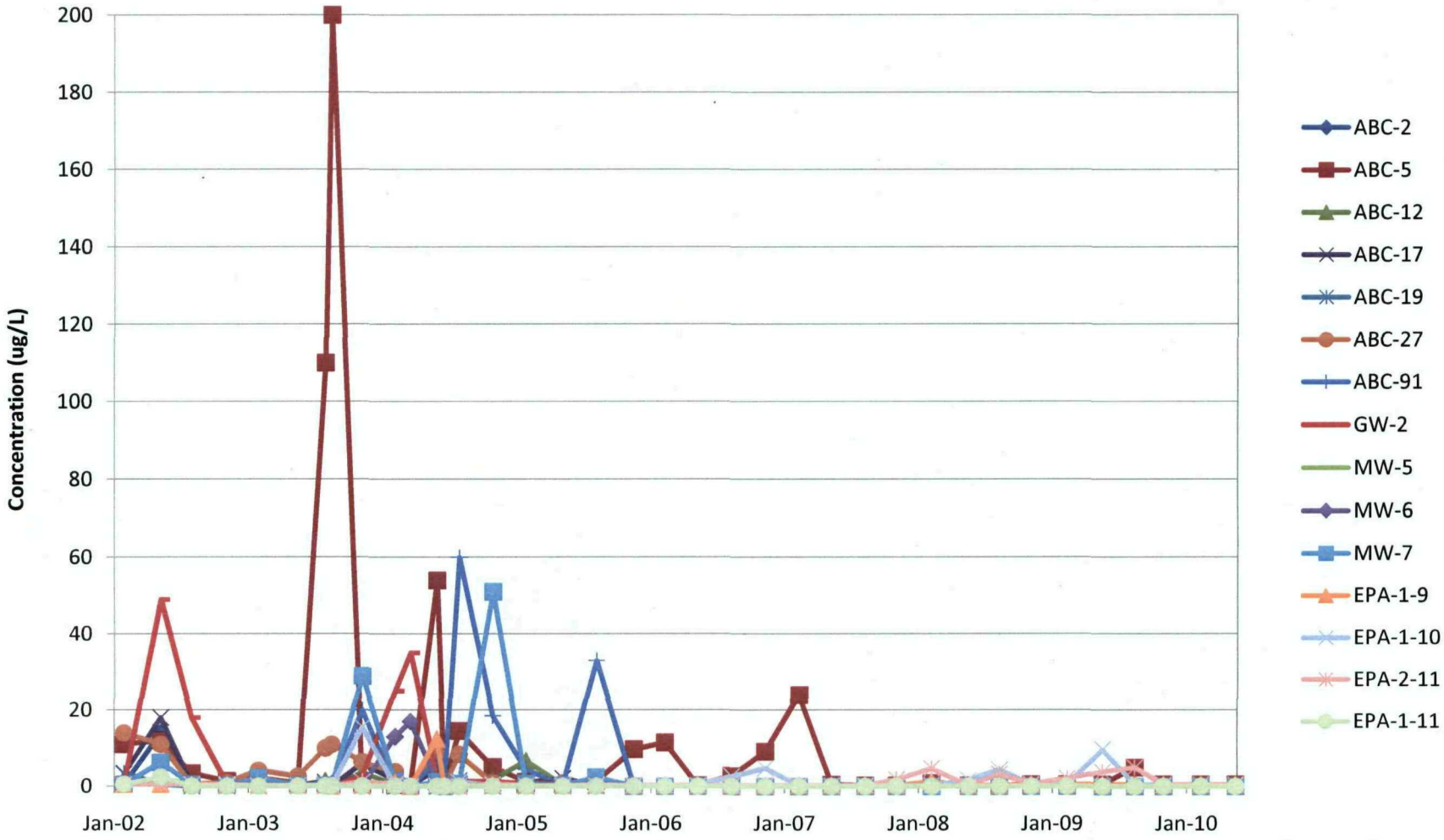
PROJECT No.		073-81526	FILE No.	07381526A001
DESIGN	SD	07/26/10	SCALE AS SHOWN	REV. A
CADD	MTM	07/29/10		
CHECK	SD	07/29/10		
REVIEW				

FIGURE 1

Drawing File: N:\07\073-81526_A SOIL VAPOR\ 07381526A001.dwg | Layout: 11x17 Landscape | Modified: Jul 29, 2010 12:20 MTanks | Plotted: 08/02/10 1:04pm MTanks



Note: Non-detects are plotted as one-half the detection limit

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DENVER, COLORADO USA

Benzene Concentrations from 2002 through May 2010

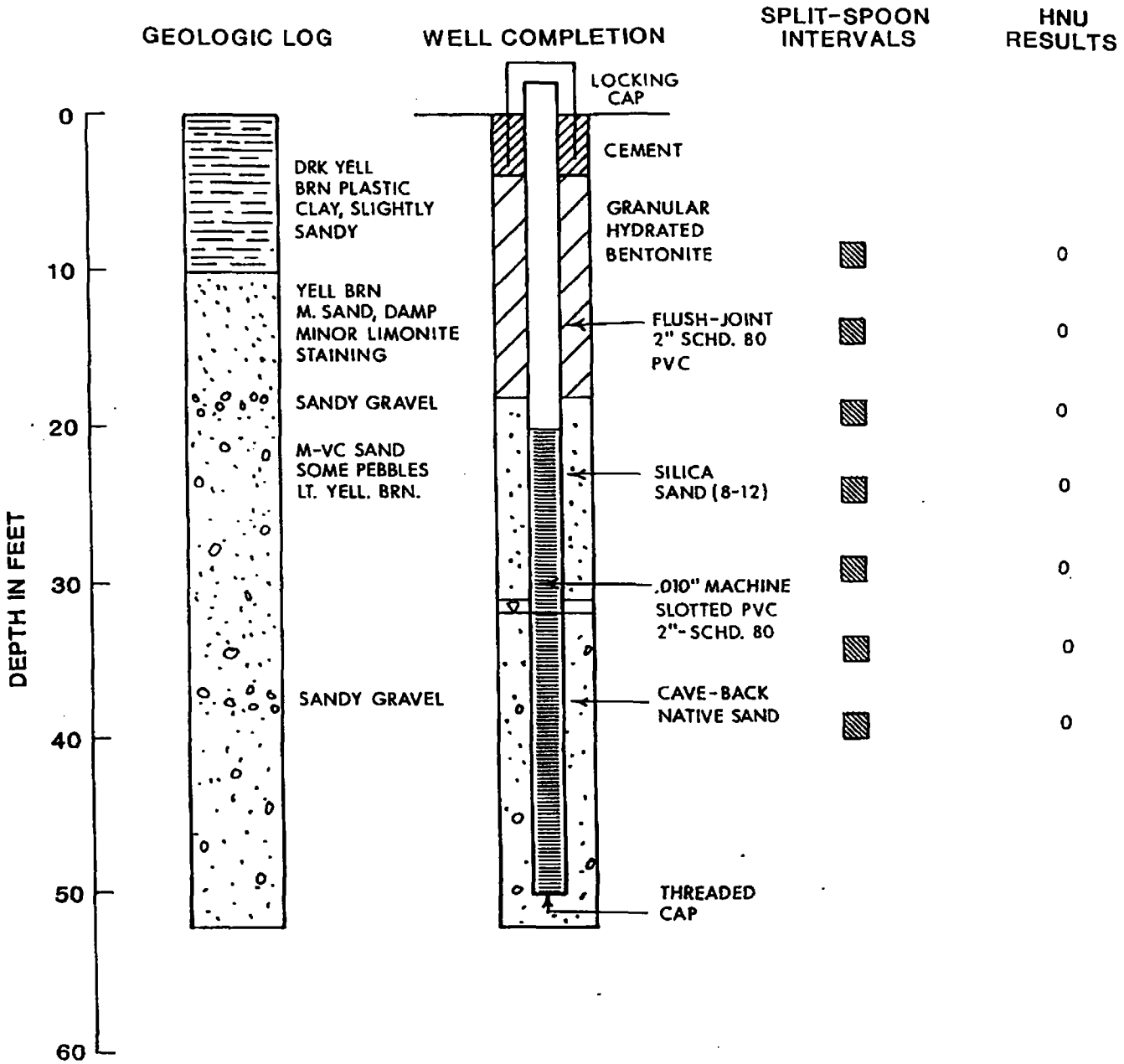
CLIENT/PROJECT	Date	Job No.
Kinder Morgan Inc.	Aug-10	7381526
	File name: *Figure 2.xls*	FIGURE 2

ATTACHMENT A
SOIL BORING LOGS

KNABC- 2

COORDINATES : 10,016.9 9,241.5 MP. ELEVATION: 5,120.89

ELEV. (L.S.): 5,118.41 TOTAL DEPTH: 52 FEET



Date: 9/88

wn: JCG

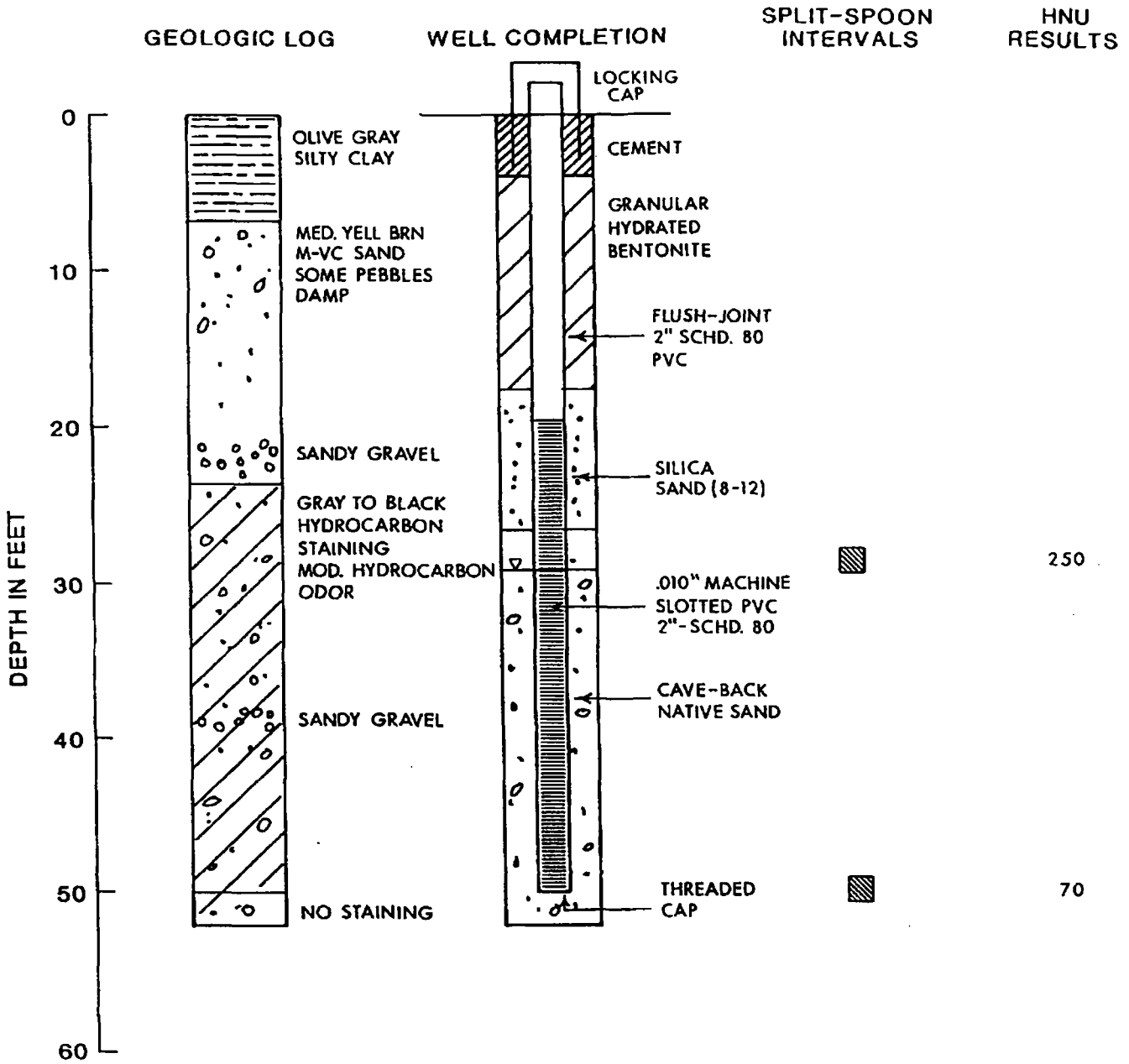
ADRIAN BROWN CONSULTANTS, INC.

Client: KN Energy, Inc.

KNABC-5

COORDINATES : 10,869.8 9,638.2 MP. ELEVATION: 5,116.57

ELEV. (L.S.): 5,114.76 TOTAL DEPTH: 52 FEET



Date: 9/88

Drawn: JCG

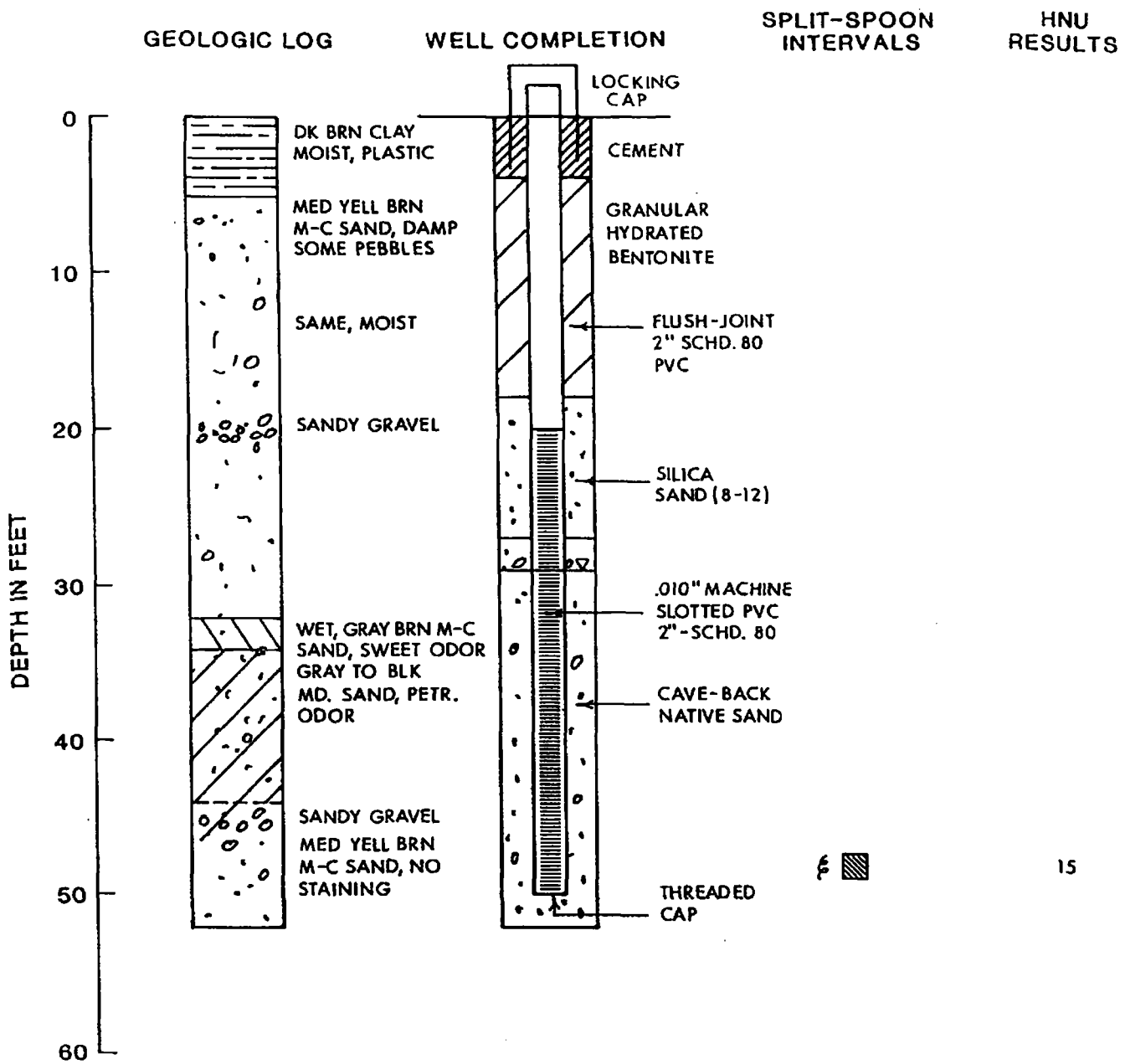
ADRIAN BROWN CONSULTANTS, INC.

Client: KN Energy, Inc.

KNABC- 12

COORDINATES : 10,760.6 9,792.0 MP. ELEVATION: 5,114.49

ELEV. (L.S.): 5,113.23 TOTAL DEPTH: 52 FEET



= AUGER SAMPLE

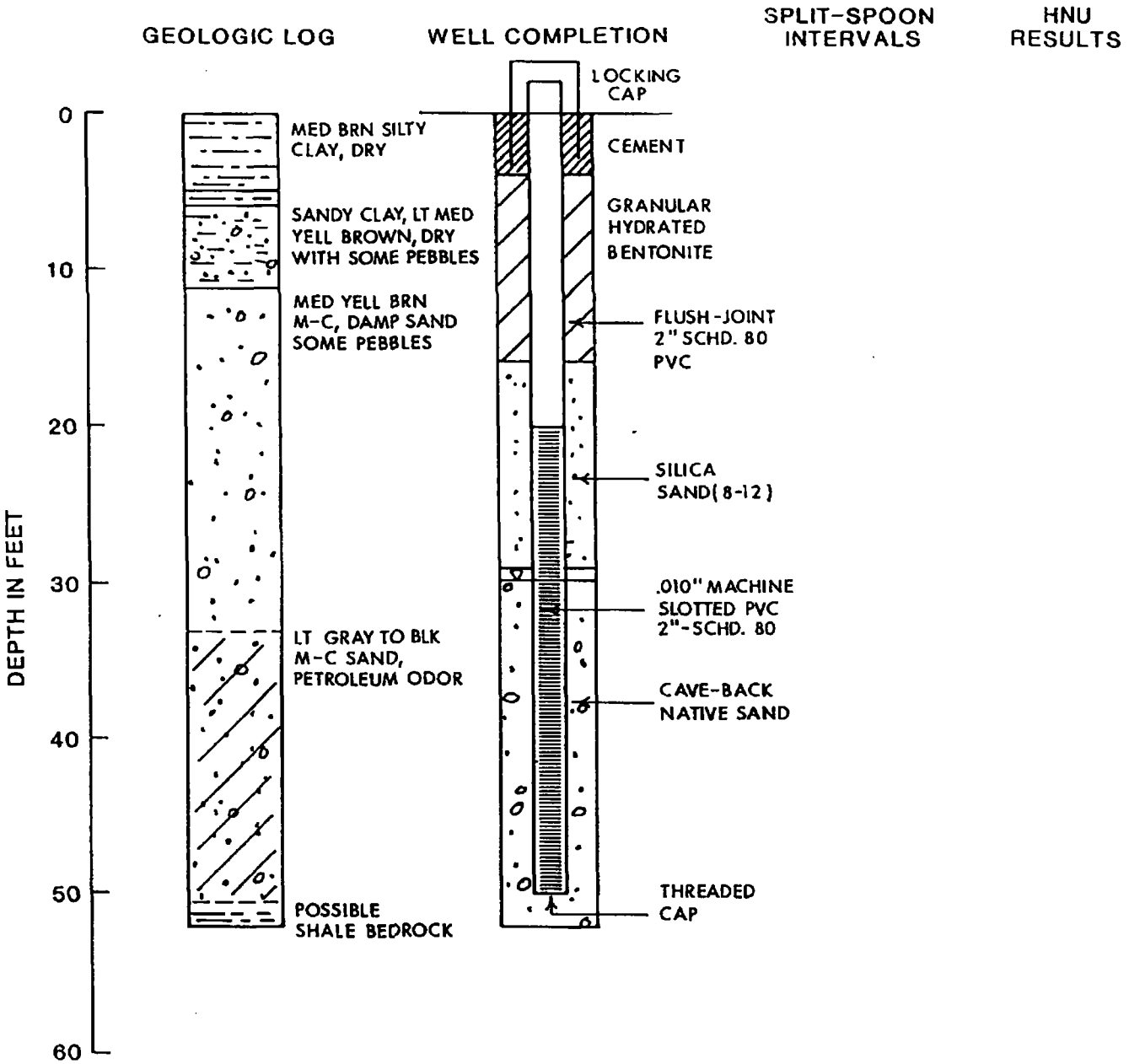
ADRIAN BROWN CONSULTANTS, INC.		
Client: KN Energy, Inc.		

Drawn: JCG Date: 9/88

KNABC-17

COORDINATES : 10,967.7 9,780.8 MP. ELEVATION: 5,116.55

ELEV. (L.S.): 5,113.79 TOTAL DEPTH: 52'



Drawn: JCG Date: 9/88

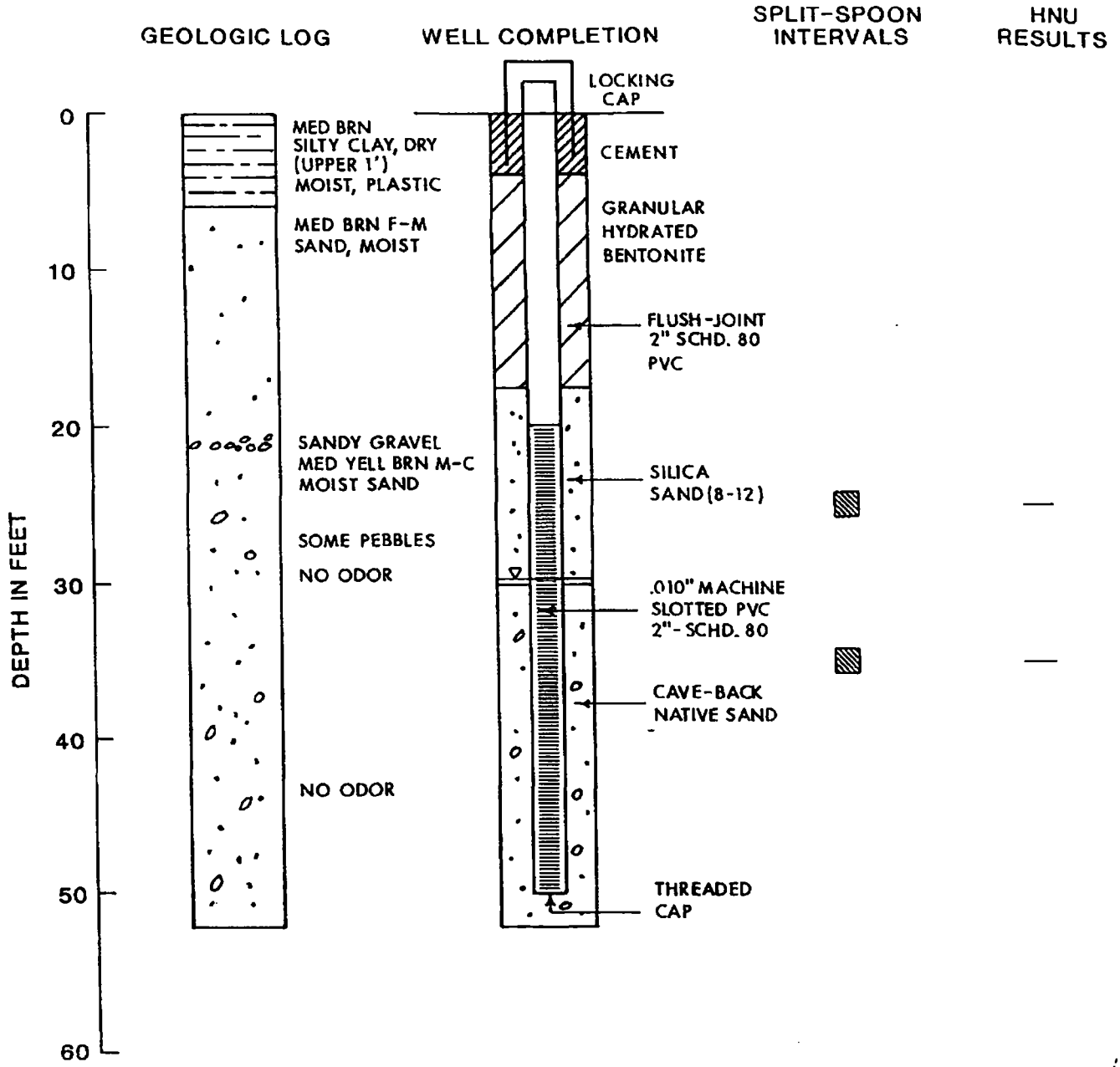
ADRIAN BROWN CONSULTANTS, INC.

Client: KN Energy, Inc.

KNABC-19

COORDINATES: 10,305.0 9,613.5 MP. ELEVATION: 5,116.58

ELEV. (L.S.): 5,115.74 TOTAL DEPTH: 52'



Date: 9/88

Dwn: JCG

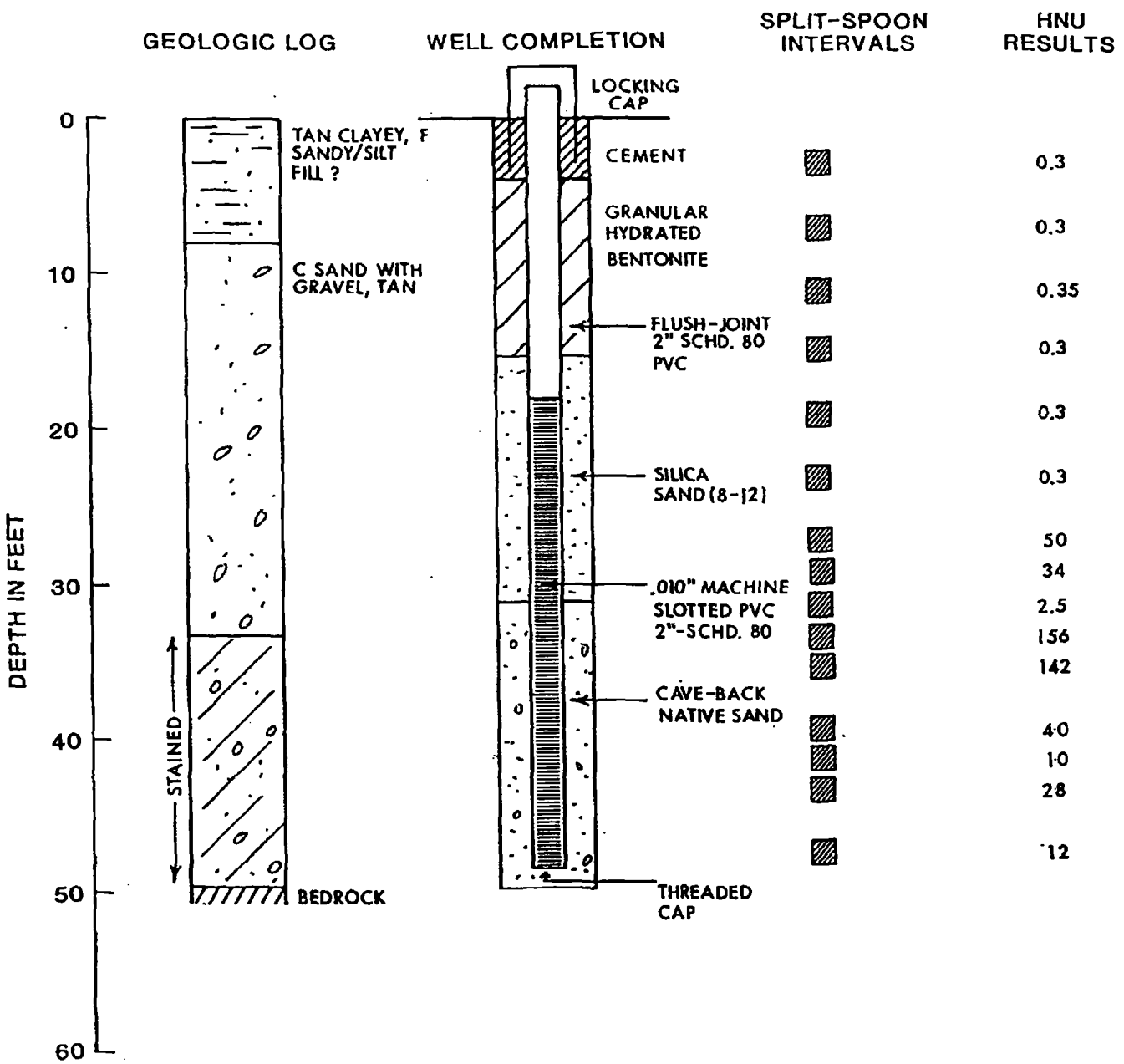
ADRIAN BROWN CONSULTANTS, INC.

Client: KN Energy, Inc.

KNABC-27

COORDINATES: 10,913.1 9780.6 MP. ELEVATION: 5115.03

ELEV. (L.S.): 5113.90 TOTAL DEPTH: 49 FEET



Drawn: JCG Date: 9/88

ADRIAN BROWN CONSULTANTS, INC.

Client: KN Energy, Inc.

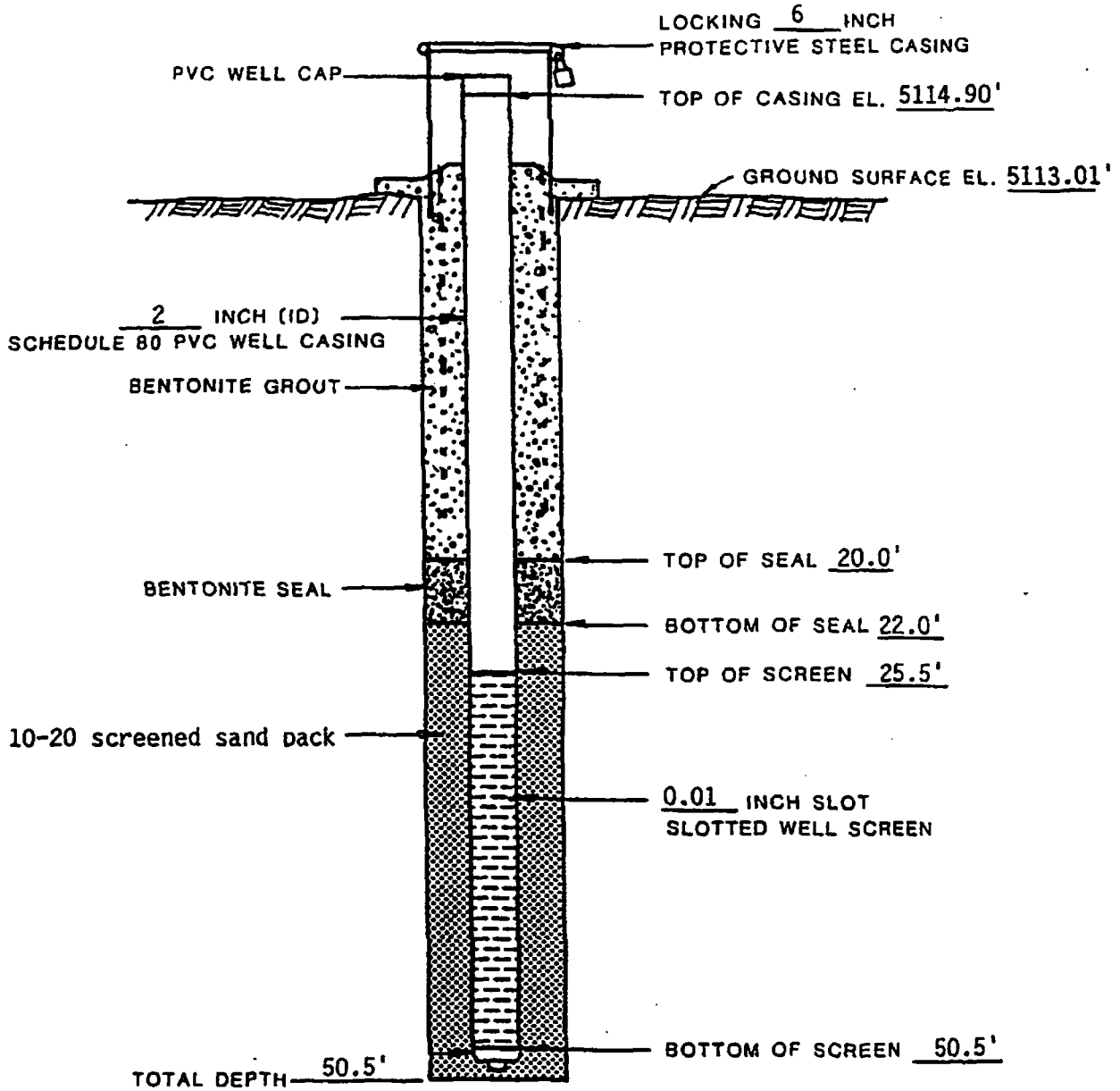
PROJECT NAME: KN Energy-Casper

BORING NUMBER: KNMW-5

PROJECT NUMBER: E392

DATE INSTALLED: 01/28/88

WATER LEVEL MEASUREMENT: _____



ERT®
A RESOURCE ENGINEERING COMPANY

DETAILS OF MONITOR WELL CONSTRUCTION

KNMW-5

DRAWN BY:	DATE: 3/22/88	PROJECT NO. E392

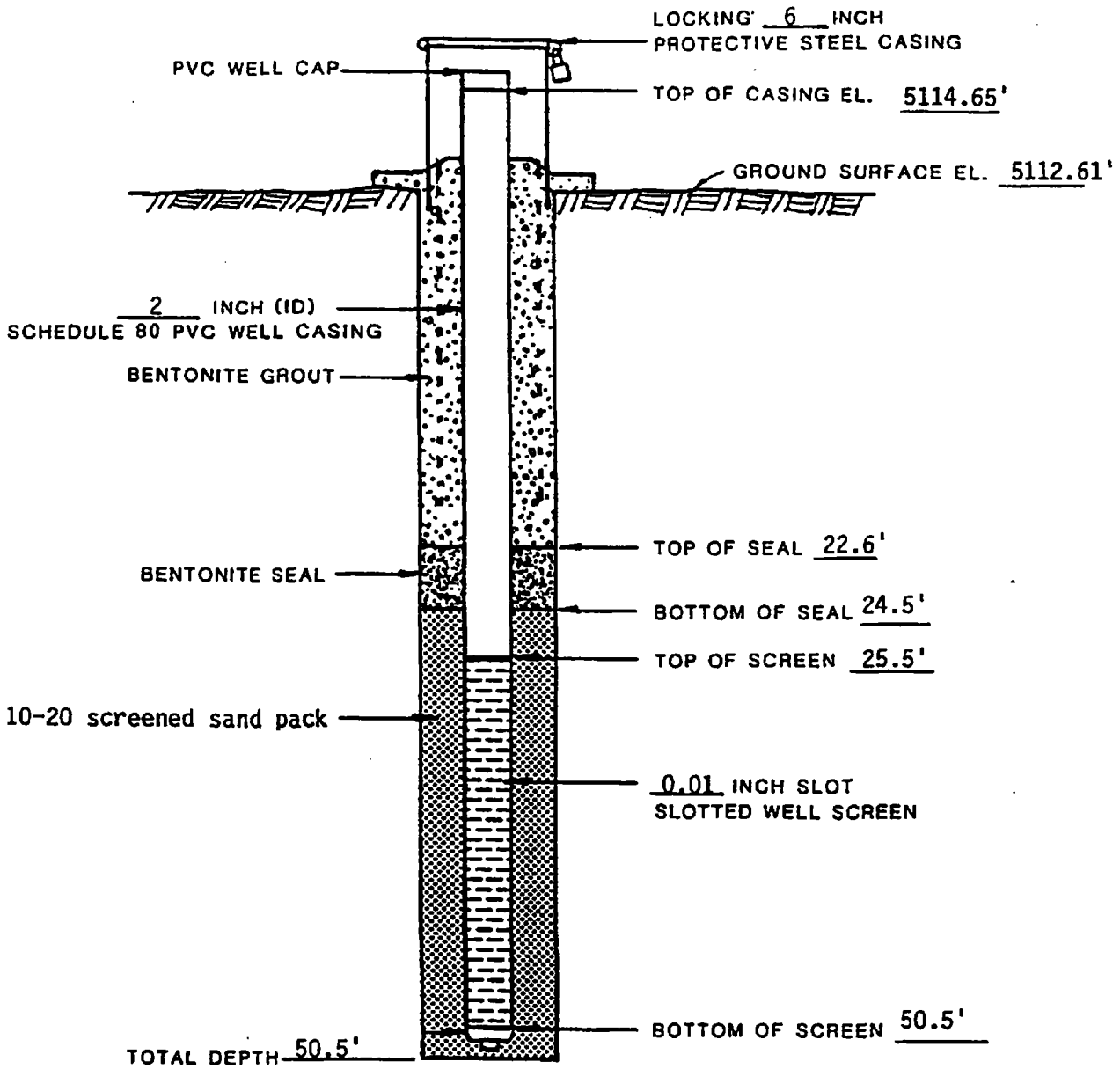
PROJECT NAME: KN Energy-Casper

BORING NUMBER: KNMW-6

PROJECT NUMBER: E392

DATE INSTALLED: 01/28/88

WATER LEVEL MEASUREMENT: _____



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DETAILS OF MONITOR WELL CONSTRUCTION

KNMW-6

DRAWN BY:	DATE: 3/22/88	PROJECT NO. E392

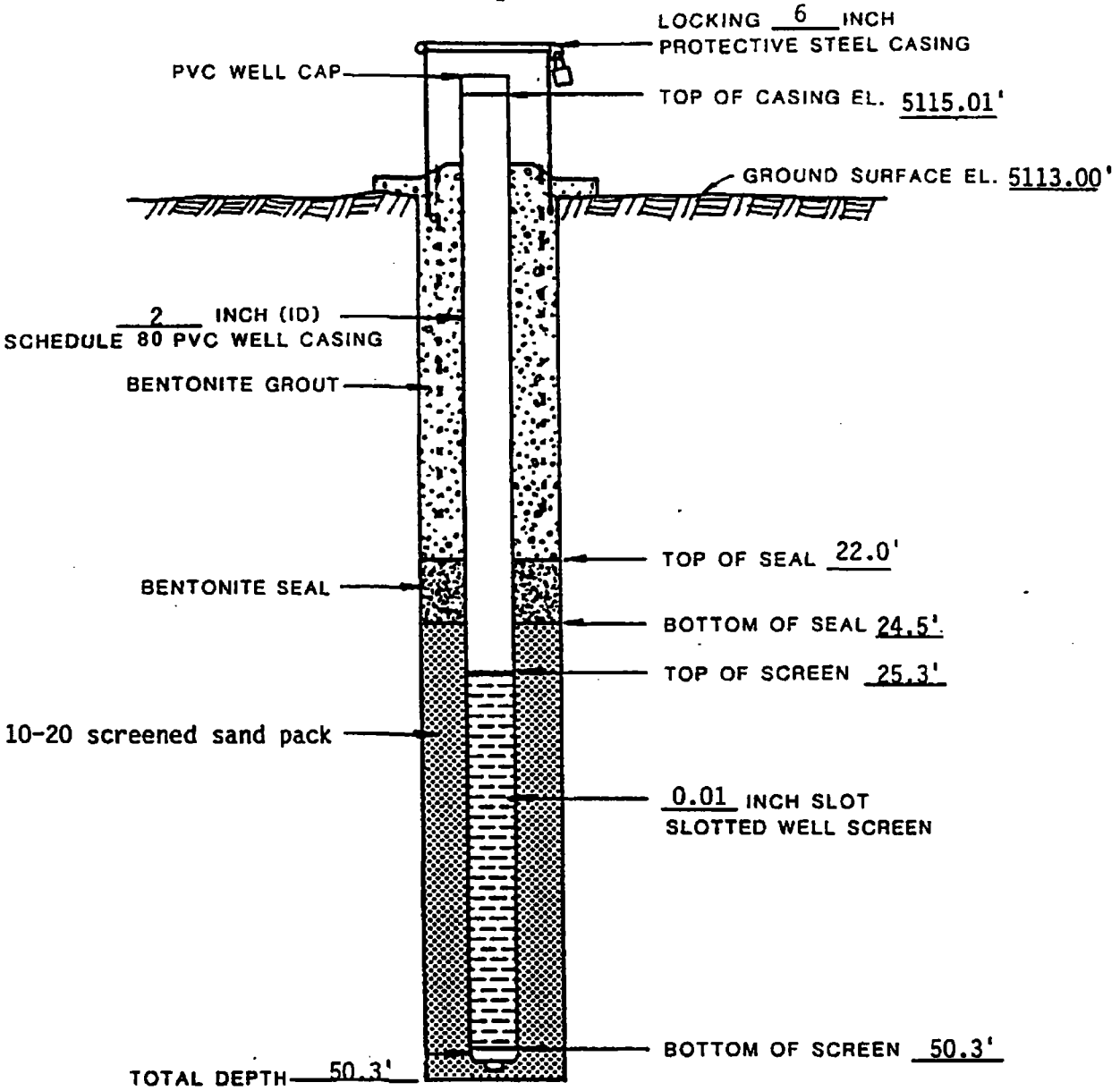
PROJECT NAME: KN Energy-Casper

BORING NUMBER: KNMW-7

PROJECT NUMBER:

DATE INSTALLED: 01/29/88

WATER LEVEL MEASUREMENT:



ERT®
A RESOURCE ENGINEERING COMPANY

DETAILS OF MONITOR WELL CONSTRUCTION

KNMW-7

DRAWN BY:	DATE: 3/22/88	PROJECT NO. E392

OBSERVATION WELL INSTALLATION REPORT

Observation Well No. EPA2-11.

Project BROOKHURST SUBDIVISION Location South of Burl. Nor. RR & East of Elkhorn Creek

Type of Rig Mobile B-52 Installed By Watson Well Service Laramie, WY Date 3-3-87 Time 14:20

Method of Installation 3 1/4" ID, 8" O.D. Hollow Stem Auger. Used 15 gallons distilled water from 27 ft. to 52 ft.

Total Depth = 52 ft. Screened interval = 52 ft to 22 ft. or 30 ft. 25 ft. Blank PVC

Water Table = 30.83 3/3/87 15:45 Total PVC Footage = 55 ft.

LOG OF BORING AND OBSERVATION WELL

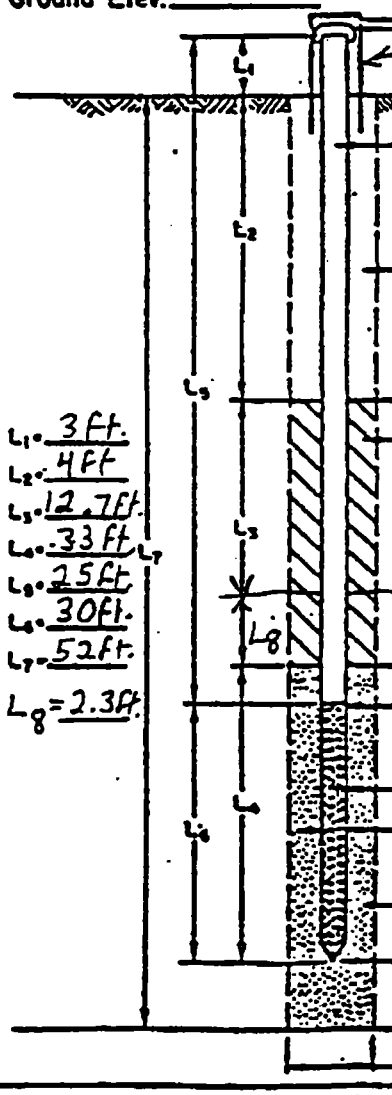
BORING

Depth Drilled	Cored Interval	Description
0		0 to 3 ft. Brown sandy loam topsoil
1		3 to 10 ft. Tan to red brown sandy gravel of well rounded quartzite cobbles & pebbles.
2		
10		
3		10 to ft. Tan brown - small pebble to coarse sand, well sorted with few fines and only occasional quartzite cobbles, sand is angular to subangular quartz arenite, and pebbles are small well rounded quartzites.
4		
20		
5		
6		▽ W.T. = 30.83 ft.
30		
7		= 32 ft. Sand & pebbles above stained gray tw/ rotten product odor - diesel or gasoline ??
8		
40		37 to 40 ft. Sand & pebbles above stained black & have slight product odor.
9		
10		
50		50 to 52 ft. Blue Green Shale
11		T.D. = 52 ft.

OBSERVATION WELL

Type of Observation Well Groundwater - Chlorinated Hydrocarbons & Hydrocarbons

Ground Elev. _____ Top of Riser Elev. _____



L_1 = 3 ft.
L_2 = 4 ft
L_3 = 12.7 ft.
L_4 = 33 ft
L_5 = 25 ft
L_6 = 30 ft.
L_7 = 52 ft.
L_8 = 2.3 ft.

(Protective Casing) Vented Cap 6" x 5 ft. Steel w/Lock

I.D. of Riser Pipe 2 inch

Type of Pipe Flush Threaded Schedule 40, PVC.

Type of Backfill Around Riser SAKRETE CONCRETE Two 90 lb sacks

Top of Seal Elev. 4 ft.

Type of Seal Material 50 lbs VOLCLAY GROUT SEAL - 2 bags & 48 gals water

16.7 ft. 1/4" Bentonite Pellets One 50 lb. Tub

Top of Filter Elev. 19 ft.

Elev. of Perforations 22 ft. Flush Threaded PVC.

Size of Openings 0.020"

Diameter of Casing Tip 2 3/8" O.D. Thr. End cap

Type of Filter Material #12/20 Frac Badger Sand

Bottom of Csg. Elev. 52 ft.

Bottom of Boring Elev. 52 ft.

Diameter of Boring 8 inch

Remarks Descriptions based on cuttings only.

W.T. = 30.83 ft.

Inspected By Dale E. Conover

OBSERVATION WELL INSTALLATION REPORT

Observation Well No. EPA 1-10.

Project BROOKHURST SUBDIVISION EPA, ERCS Location Burlington Northern, RR

Type of Rig Mobile B-52 Installed By Watson Well Service Date 1/21/87 Time 1

Method of Installation 3 1/4" I.D. & 8" O.D. Hollow Stem Auger, Trapdoor w/hand installation of screen, pipe, sand pack, bentonite, pumped grout seal, & hand concreted in place cover (Steel 6" locking). Used 17 1/2 gallons dist. well water 27 ft to 5 ft. Used 5 ft. mfd. screen on this hole plus two 10 ft. screens.

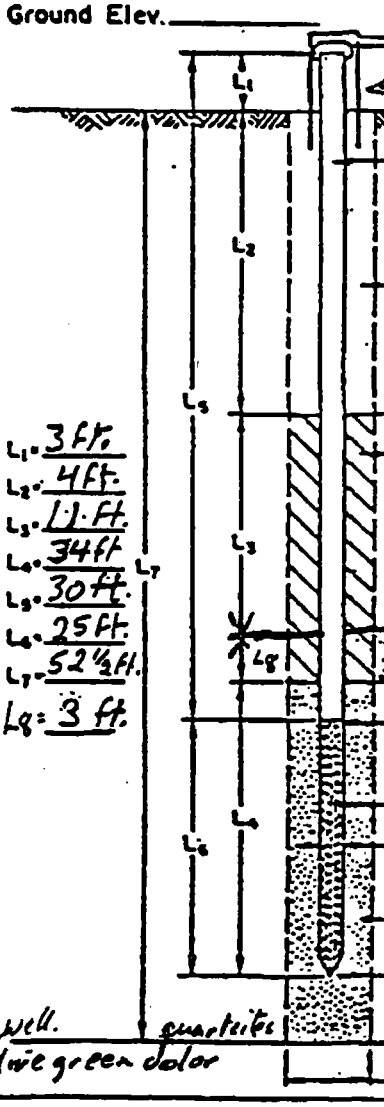
LOG OF BORING AND OBSERVATION WELL

BORING

Depth in Ft.	Cored*	Interval	Description
0			0 to 6 ft. Dark to Light Brown, Sandy 2 ft. frozen Loamy Soil.
#1			
#2			6 to 49 ft. Light tan Brown Very Coarse to Coarse Sand, slight fine-silt content, well sorted subangular quartz arenite, occasional well rounded pebbles to cobbles of quartzite.
10			
#3			
#4			
20			
#5			
#6			
30			W.T. = 31.5 ft. 1/27/87 OCC.
#7			
#8			Change from around 38 ft. to 40 ft. 38 to 50 ft Old product smelling sands as above dark gray green color - Rotten oil or diesel smell. Continues to shale.
40			
#9			
#10			49 ft. to 50 ft. Gravels - Cobbles & pebbles
50			50 ft. Shale weathering to very sandy silty clay, olive green color T.D. = 52 1/2 ft.

OBSERVATION WELL

Type of Observation Well Groundwater



L_1 = 3 ft.
L_2 = 4 ft.
L_3 = 11 ft.
L_4 = 34 ft
L_5 = 30 ft.
L_6 = 25 ft.
L_7 = 52 1/2 ft.
L_8 = 3 ft.

Ground Elev. _____

Top of Riser Elev. _____ (Protective Casing)

Vented Cap ← Steel 6" Locking Cap 5' Length

I.D. of Riser Pipe 2"

Type of Pipe PVC Sched 40 Threaded Blank 10 ft sections

Type of Backfill Around Riser SAKRETE Concrete 90 lb bag - 3 bags & 5 gall water

Top of Seal Elev. 4 ft.

Type of Seal Material Grout (VOLCLAY) Seal TWO bags @ 50 lbs/bag & 50 gallons water. One Pail &

L_8 15 ft. VOLCLAY 50 lb pail 3 ft of 1/2" Bentonite Pellets

Top of Filter Elev. 18 ft.

Elev. of Perforations 27 ft Sched 40, PVC Thr. Screen

Size of Openings 0.020"

Diameter of Casing Tip Threaded End Cap

Type of Filter Material #12/20 Badger Sand; 4 - 100 lb bags

Bottom of Csg. Elev. 52 ft.

Bottom of Boring Elev. 52 1/2 ft

Diameter of Boring 8"

Remarks *Descriptions based on cuttings only.
55 1/2 ft. pump as 56 ft. drilled.

Inspected By Dale E. Grover

ıent	: E.P.A. Region VIII	Project Number	: 8432
oject Name	: Brookhurst Subdivision	File Number	: 110
oject Location	: Evansville, Wyoming	Well Number	: EPA 1-10
ologist	: Dale E. Conover	Date Drilled	: 1-21-87
ll Dimensions	: 2" x 52.5'	Length of Riser	: 3 ft.

ıp ILCLAY	Top of Pellets	Top of Filter	Top of Screen	Length of Screen	Feet	Visual Classification
					1	[CL] Brown sandy loea soil.
					2	
					3	
4 ft.					4	
					5	
					6	[SW] Tan-brown very coarse to coarse well-sorted quartz
					7	arenite sand, with occasional well-rounded quartzite
					8	cobbles and pebbles.
					9	
					10	
					11	
					12	
					13	
					14	
	15 ft.				15	
					16	
					17	
		18 ft.			18	
					19	
					20	
					21	
					22	
					23	
					24	
					25	
					26	
			27 ft.		27	
					28	
					29	
					30	
					31	
					32	Water table 31.5 ft.
					33	
					34	
					35	
					36	
					37	
					38	[SW] Dark gray-green sand as described above with hydro-
					39	carbon product odor. Odor similar to old gasoline or
				25 ft.	40	diesel fuel.
					41	
					42	
					43	
					44	
					45	Dale E. Conover

Log Continued on Next Page

ient : E.P.A. Region VIII
oject Name : Brookhurst Subdivision
oject Location : Evansville, Wyoming
Geologist : Dale E. Conover
Well Dimensions : 2" x 52.5'

Project Number : 8432
File Number : 110
Well Number : EPA 1-10
Date Drilled : 1-21-87
Length of Riser : 3 ft.

Top of CLAY	Top of Pellets	Top of Filter	Top of Screen	Length of Screen	Feet	Visual Classification
					46	
					47	
					48	
					49	[GP] Cobbles and pebbles of well-rounded quartzites.
					50	[CH] Olive-green weathered shale.
					51	
					52	
					53	Total depth 52.5 ft.

Dale E. Conover

OBSERVATION WELL INSTALLATION REPORT

Observation Well No. EPA 1-9

Project BROOKHURST SUBDIV. EPA-ERCS Location Burlington North RR

Type of Rig Mobile B-52 Installed By Watson Well Service Date 1/21/87 Time 07:45

Method of Installation 3 1/4" I.D., 8" O.D. Laramie, WY Hollow Stem Auger. Tube w/ teflon between flights, used 17½ gallons distilled water down inside of augers to counter act W. flow into well bringing in sands. Runs take 30 secs to 1 minute to drill depending on gravels.

LOG OF BORING AND OBSERVATION WELL

BORING

Depth in Ft.	Sample #	Cored	Interval	Description
0	#1			1½ ft. depth frozen ground. 0 to 6 ft. Brown, loamy type soil sandy.
	#2			6 to 6½ ft. Thin gravel layer " Coarse pebbles to Cobbles well rounded quartzites, very sandy (sub-base).
10	#3			6" to 50 ft Light tan-brownish tan very Coarse to Coarse Sands with little fines, well sorted, subrounded to subangular, occasional rounded cobbles and/or pebbles.
	#4			
20	#5			
	#6			
30	#7			W.T. = 31.00 ft. 1/27/87
40	#8			
50	#9			44 to 47 ft. Dark gray-green sand as above, no odor discernible
60				50 ft Shale - gray green, weathered to a stiff, swelling clay.
				T.D. = 53 ft. (52'10")

OBSERVATION WELL

Type of Observation Well Chlorinated Hydrocarbons & Hydrocarbons in Groundwater.

Ground Elev. _____ Top of Riser Elev. _____ (Protective Casing)

Vented Cap

6" PVC Breakaway Protective Cover

I.D. of Riser Pipe 2 inches

Type of Pipe PVC Threaded Schedule 40, 10 ft. Blanks

Type of Backfill Around Riser SAKRETE Concrete 90 lbs/bag, TWO bags

Top of Seal Elev. 4 ft

Type of Seal Material VOLCLAY GROUT SEAL - 50 lb. bags TWO bags + 50 gals H_2O

Cover 18 8" L_8 = 20 ft. ** VOLCLAY "

3 ft. Bentonite Pellets

Top of Filter Elev. 23 ft.

Elev. of Perforations 28 ft.

Slotted PVC, Sched. 40 Threaded

Size of Openings 0.020"

Diameter of Casing Tip 2" Slip-End Cap

Type of Filter Material 100 lb Bags of Badger #12/20 Sand

Bottom of Csg. Elev. 53 ft.

Bottom of Boring Elev. 53 ft.

Diameter of Boring 8 inches

L_1 = 3 ft.
L_2 = 4 ft.
L_3 = 16 ft. = 14 3/4 ft. + 1 1/4 ft.
L_4 = 30 ft.
L_5 = 31 ft.
L_6 = 25 ft.
L_7 = 53 ft.
L_8 = 3 ft.

Remarks * Descriptions based on cuttings alone.
** VOLCLAY Pellets come in 50 lb Tubs.

Inspected By Dale E. Conover

ent	: E.P.A. Region VIII	Project Number	: 8432
ject Name	: Brookhurst Subdivision	File Number	: 19
roject Location	: Evansville, Wyoming	Well Number	: EPA 1-9
eologist	: Dale E. Conover	Date Drilled	: 1-21-87
l Dimensions	: 2" x 53'	Length of Riser	: 3 ft.

cp CLAY	Top of Pellets	Top of Filter	Top of Screen	Length of Screen	Feet	Visual Classification
					1	[CL] Brown sandy loam soil.
					2	
					3	
4 ft.					4	
					5	
					6	[GM] Sandy gravel layer of quartzite cobbles and pebbles.
					7	[SW] Tan-brown very coarse to coarse well-sorted quartz
					8	arenite sand, with occasional well-rounded quartzite
					9	cobbles and pebbles.
					10	
					11	
					12	
					13	
					14	
					15	
					16	
					17	
					18	
					19	
	20 ft.				20	
					21	
					22	
		23 ft.			23	
					24	
					25	
					26	
					27	
			28 ft.		28	
					29	
					30	
					31	Water table 31.0 ft.
					32	
					33	
					34	
					35	
					36	
					37	
					38	
					39	
					40	
				25 ft.	41	
					42	
					43	
					44	[SW] Dark gray-green sand as described above with no
					45	noticeable odor.

Dale E. Conover

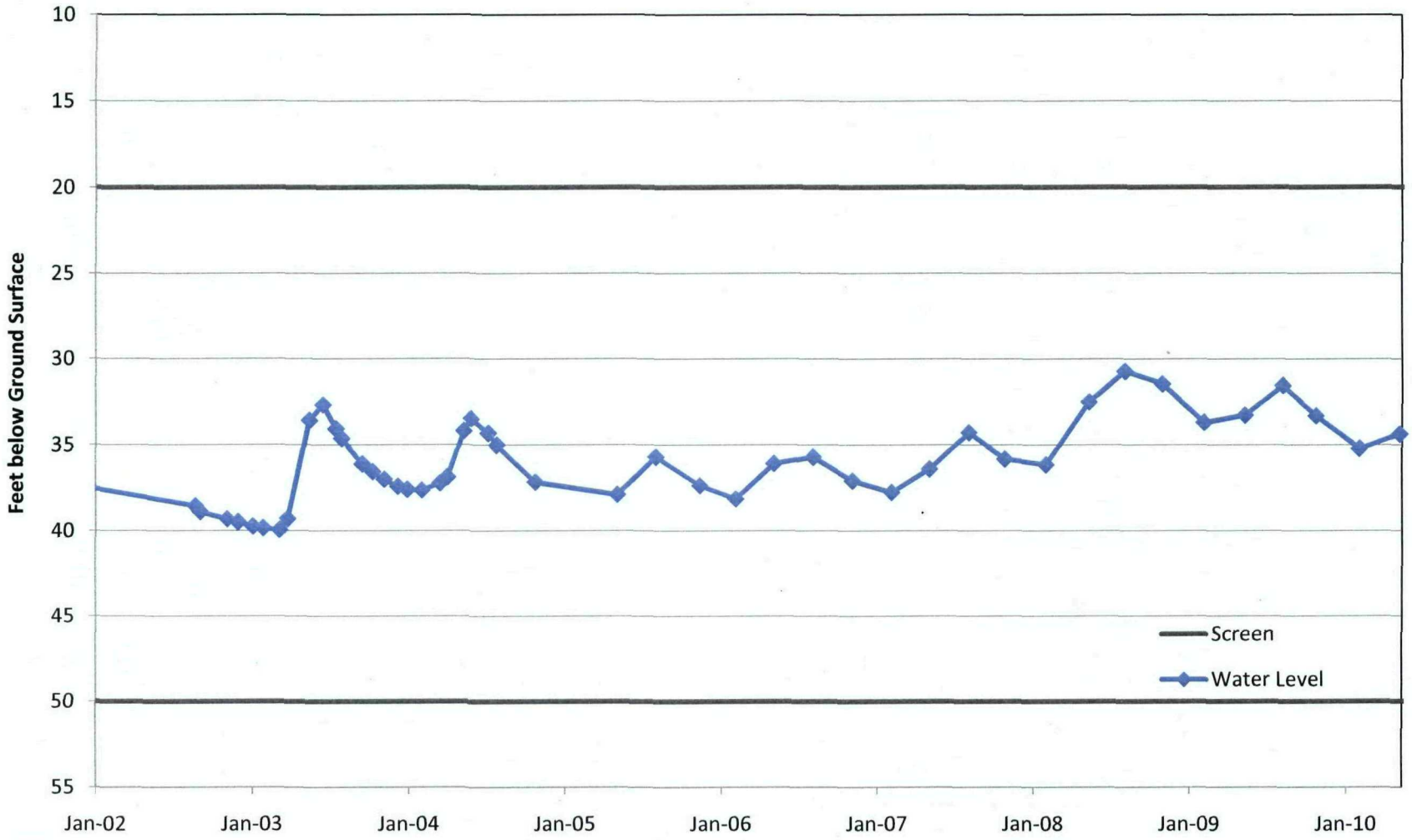
Log Continued on Next Page

.ent	: E.P.A. Region VIII	Project Number	: 8432
Project Name	: Brookhurst Subdivision	File Number	: 19
Project Location	: Evansville, Wyoming	Well Number	: EPA 1-9
Geologist	: Dale E. Conover	Date Drilled	: 1-21-87
Well Dimensions	: 2" x 53'	Length of Riser	: 3 ft.

Top of BOLCLAY	Top of Pellets	Top of Filter	Top of Screen	Length of Screen	Feet	Visual Classification
					46	
					47	
					48	
					49	
					50	(CH) Gray-green weathered shale.
					51	
					52	
					53	Total depth.

Dale E. Conover

ATTACHMENT B
DEPTH-TO-WATER GRAPHS

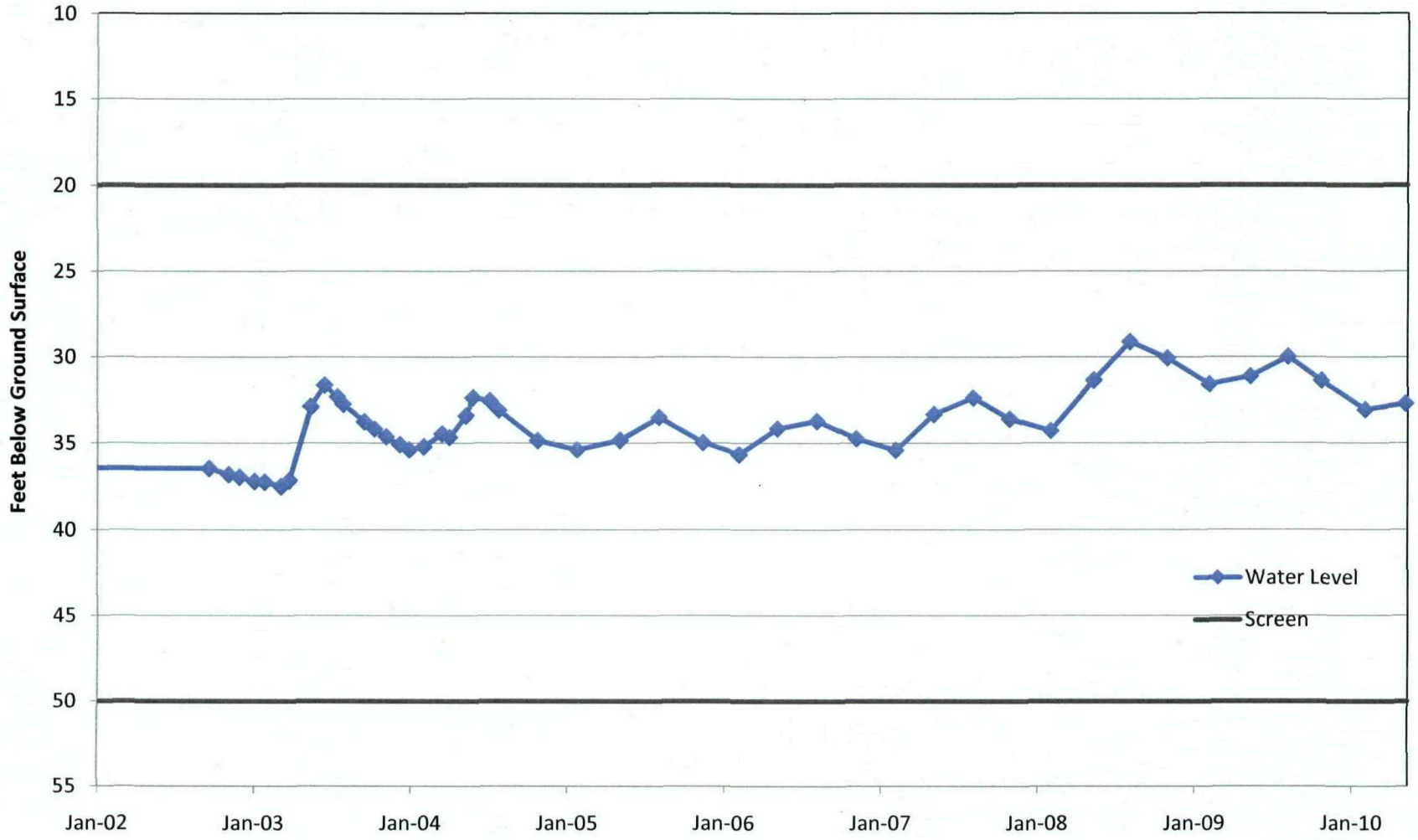


Golder Associates

DENVER, COLORADO USA

Water Levels at ABC-2

CLIENT/PROJECT	Date	Job No.
Kinder Morgan Inc.	Aug-10	7381526
	File name: *Data for modeling.xls*	FIGURE B-1

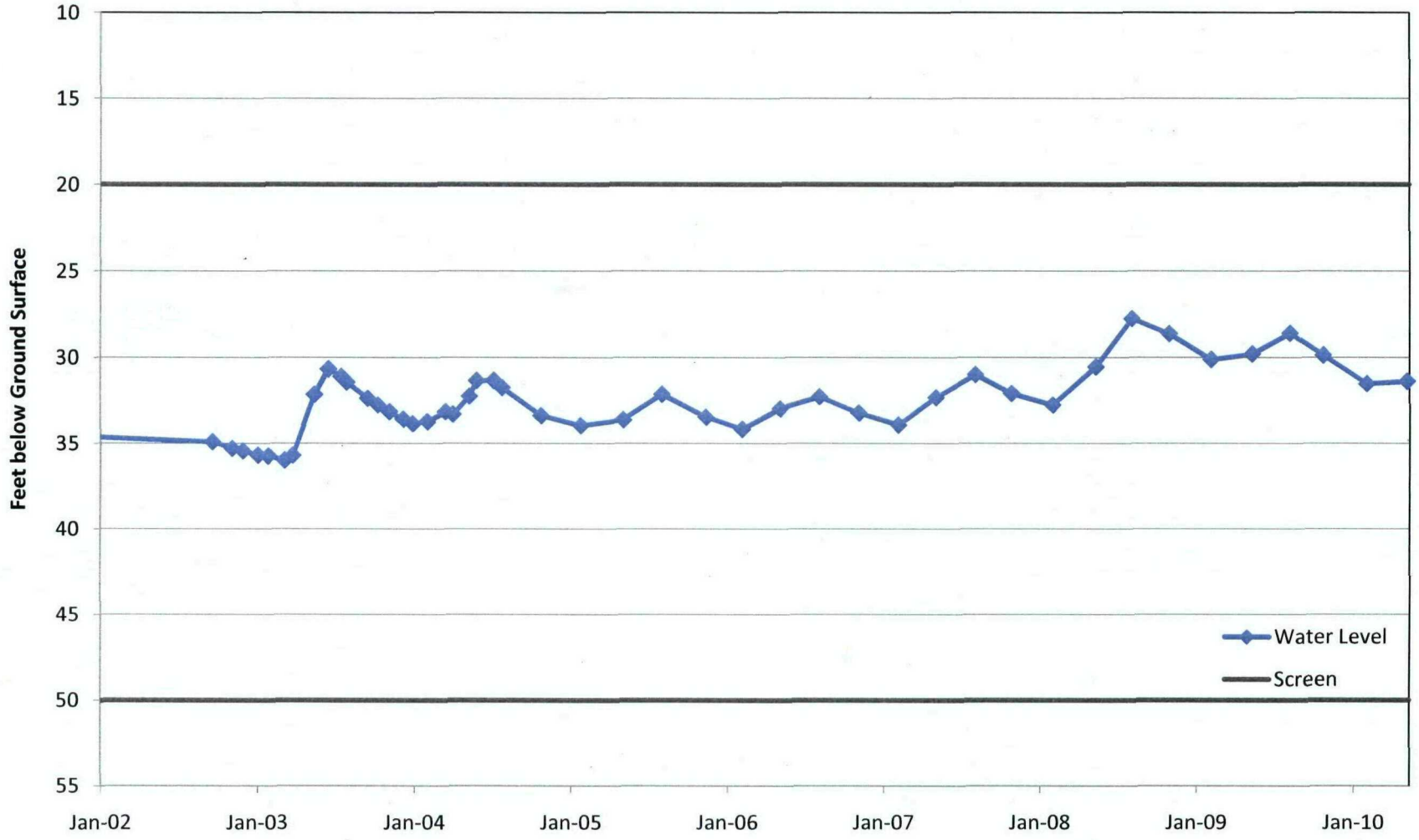


Golder Associates

DENVER, COLORADO USA

Water Levels at ABC-5

CLIENT/PROJECT	Date	Job No.
Kinder Morgan Inc.	Aug-10	7381526
	File name: *Data for modeling.xls*	FIGURE B-2

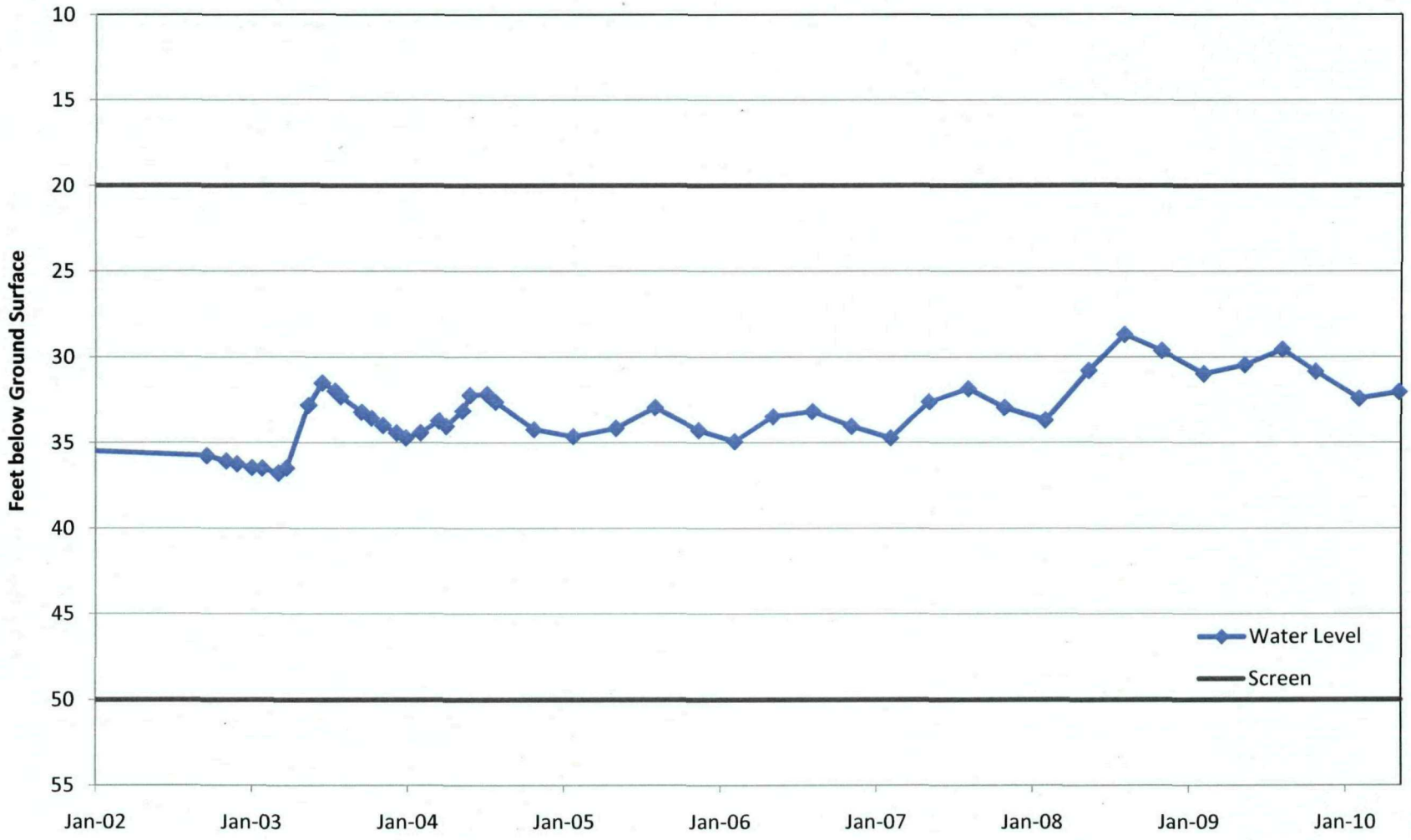


Golder Associates

DENVER, COLORADO USA

Water Levels at ABC-12

CLIENT/PROJECT	Date	Job No.
Kinder Morgan Inc.	Aug-10	7381526
	File name: *Data for modeling.xls*	FIGURE B-3

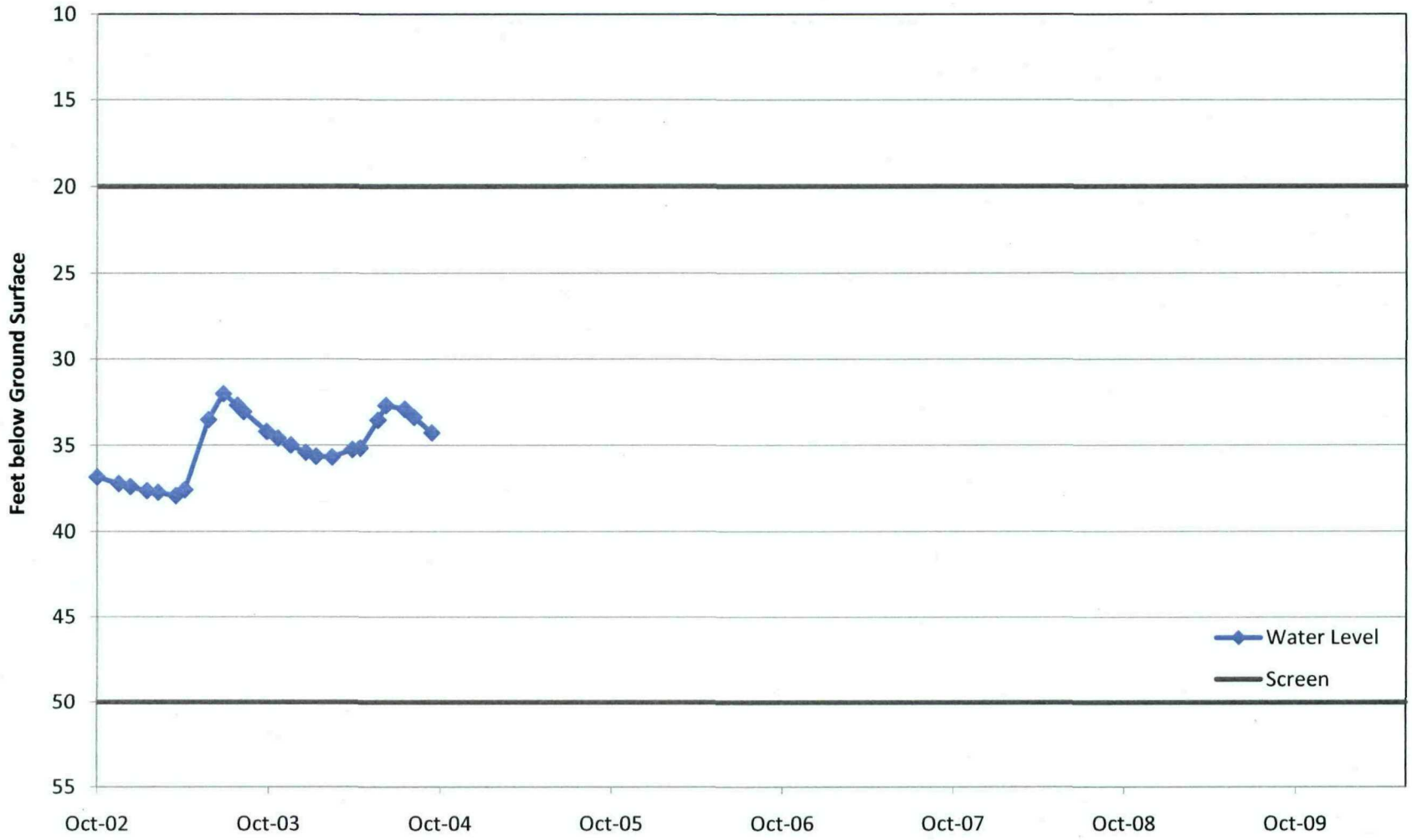


Golder Associates

DENVER, COLORADO USA

Water Levels at ABC-17

CLIENT/PROJECT	Date	Job No.
Kinder Morgan Inc.	Aug-10	7381526
	File name: *Data for modeling.xls*	FIGURE B-4



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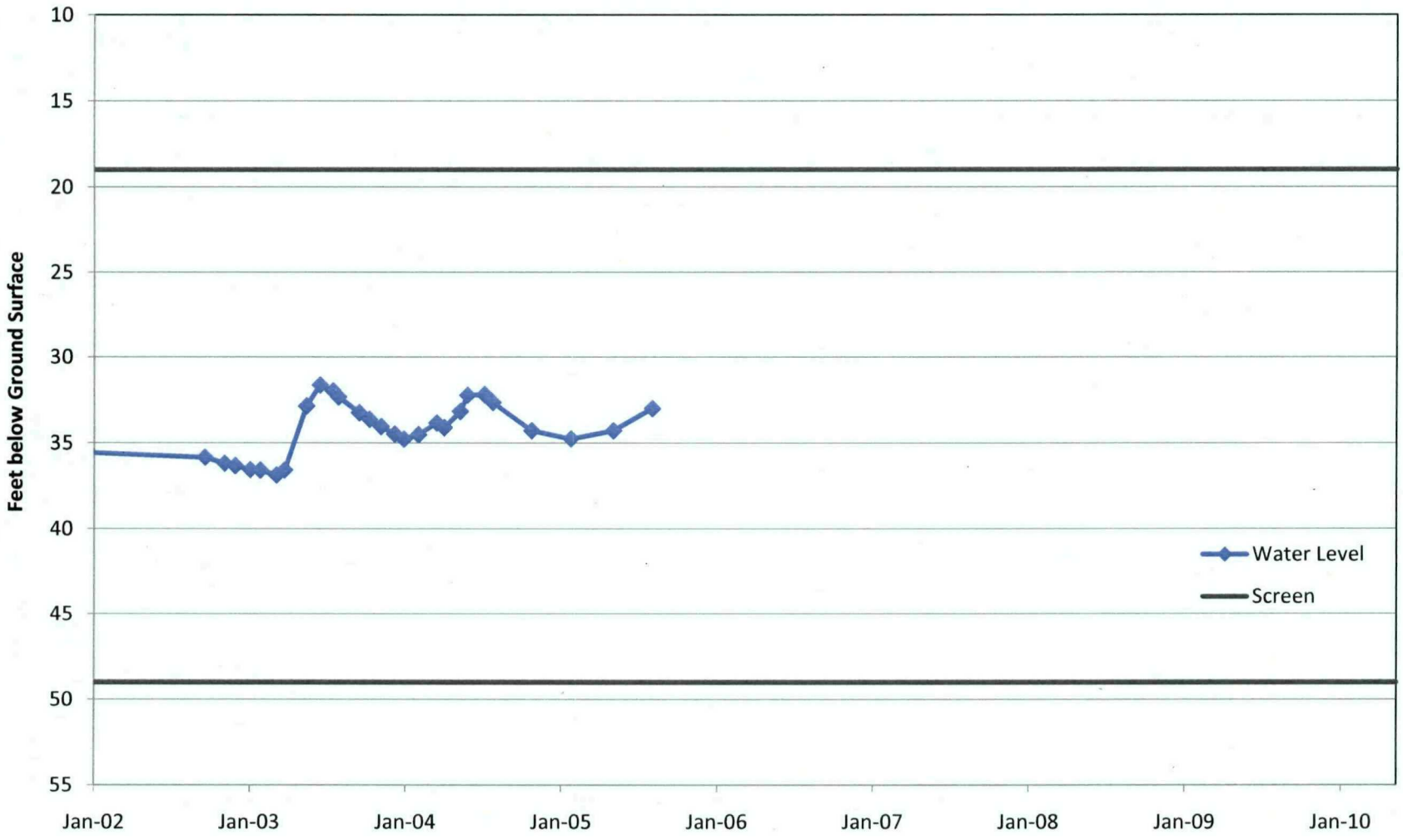
DENVER, COLORADO USA

Water Levels at EPA-ABC-19

CLIENT/PROJECT	Date	Job No.
Kinder Morgan Inc.	Aug-10	7381526
	File name: *Data for modeling.xls*	FIGURE B-5

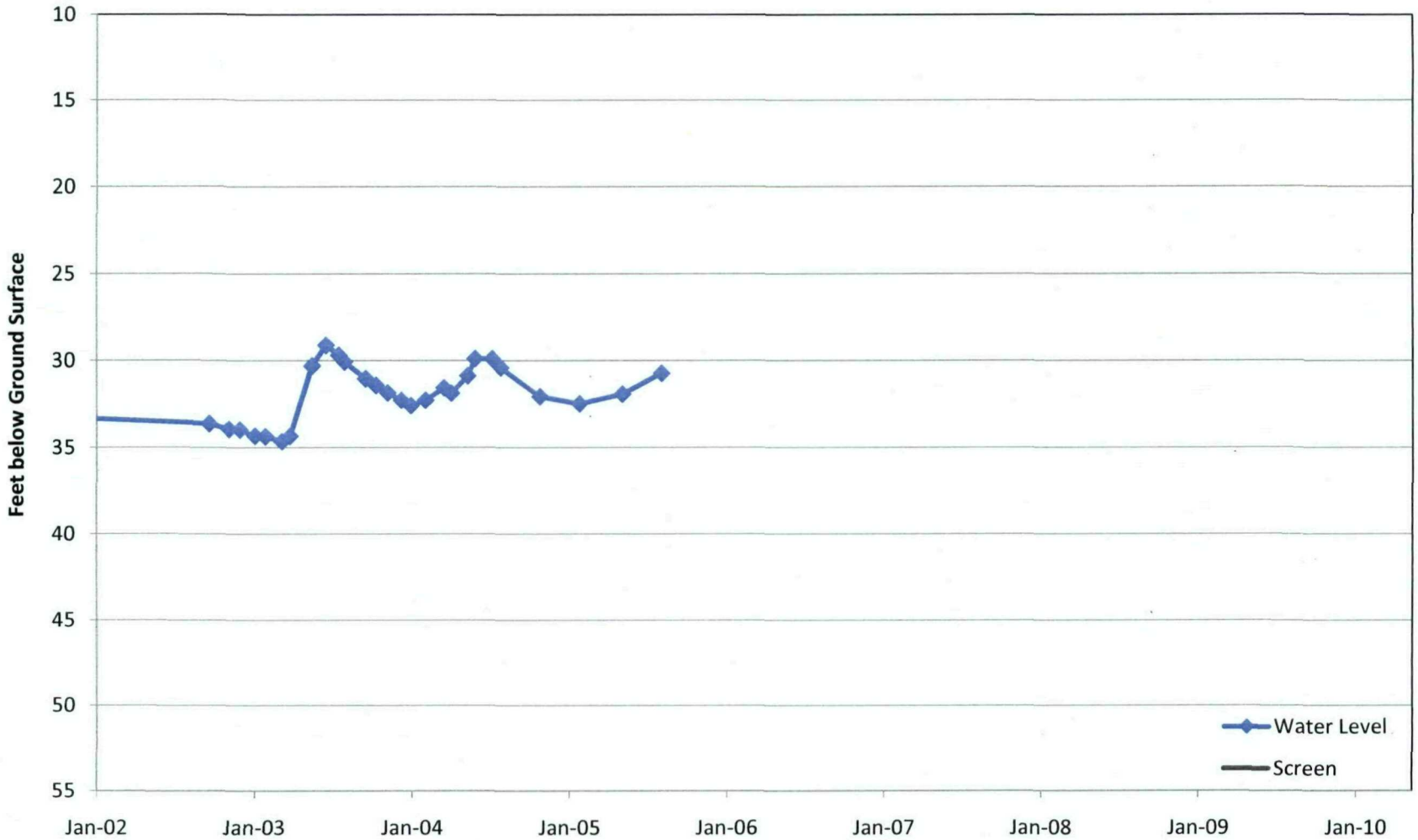


Golder Associates

DENVER, COLORADO USA

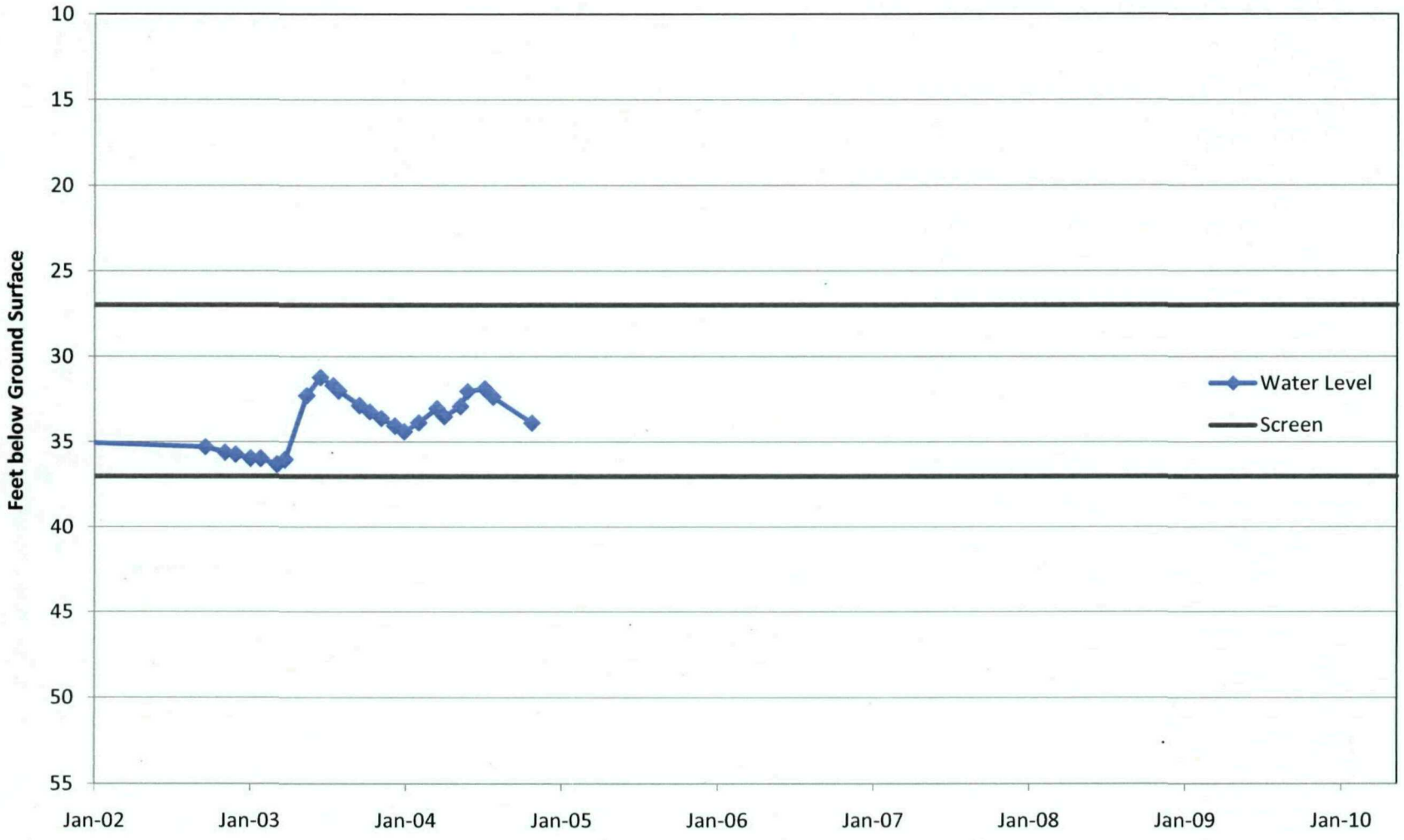
Water Levels at ABC-27

CLIENT/PROJECT	Date	Job No.
Kinder Morgan Inc.	Aug-10	7381526
	File name: *Data for modeling.xls*	FIGURE B-6



Note: Information regarding the screened interval is not available for well ABC-91

Golder Associates DENVER, COLORADO USA	**Water Levels at ABC-91**	
CLIENT/PROJECT Kinder Morgan Inc.	Date **Aug-10**	Job No. **7381526**
	File name *Data for modeling.xls*	**FIGURE B-7**

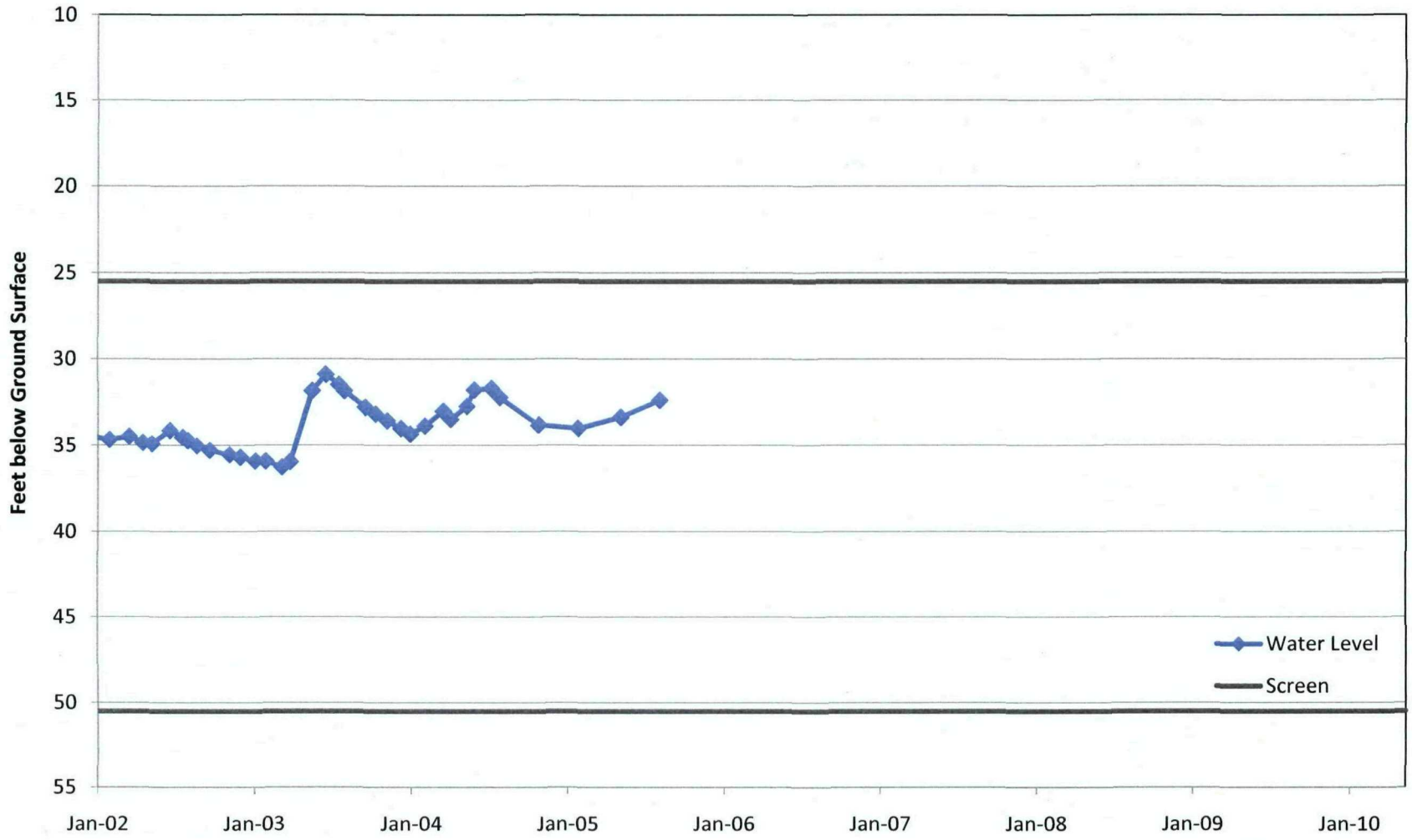


Golder Associates

DENVER, COLORADO USA

Water Levels at GW-2

CLIENT/PROJECT	Date	Job No.
Kinder Morgan Inc.	Aug-10	7381526
	File name: *Data for modeling.xls*	FIGURE B-8

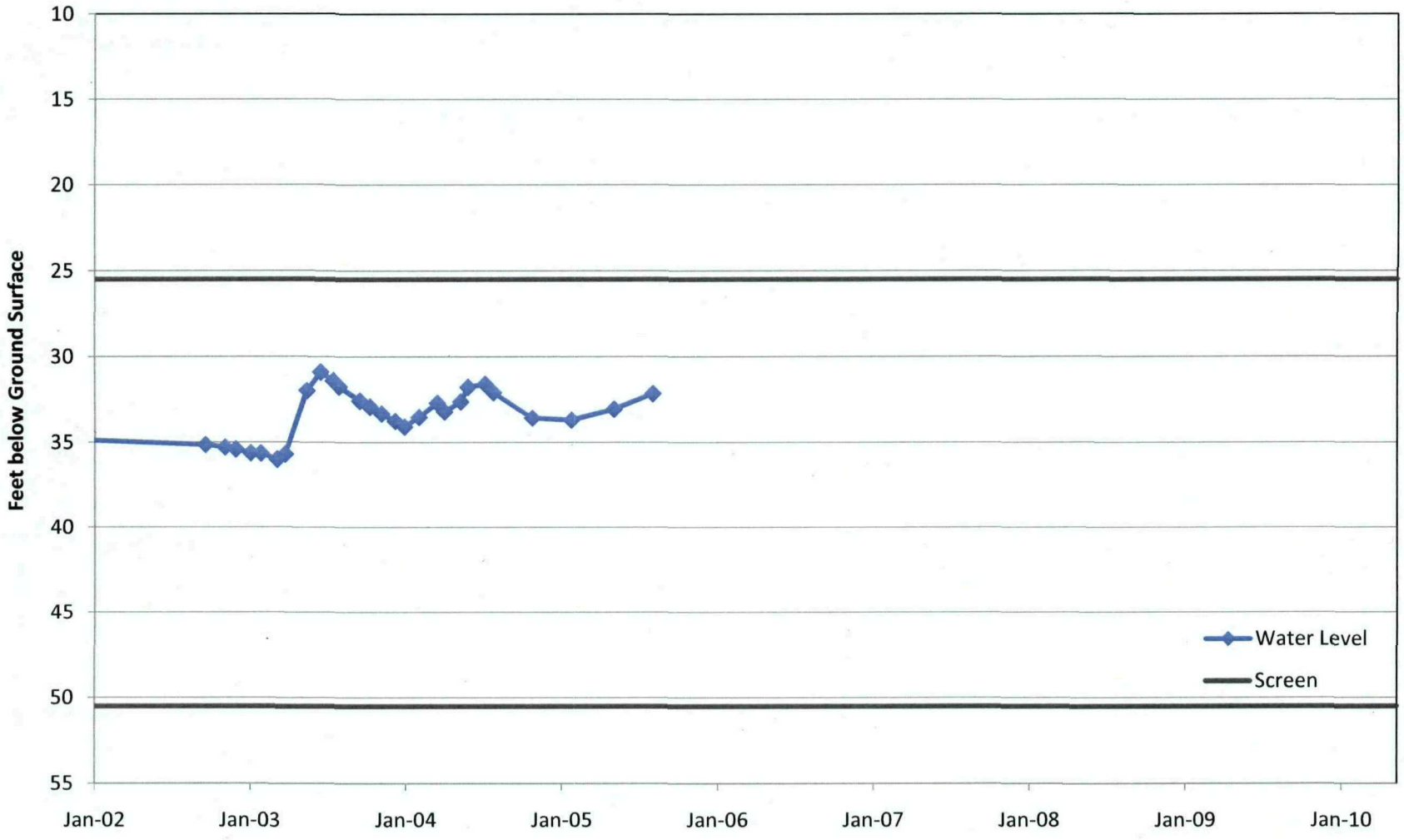


Golder Associates

DENVER, COLORADO USA

Water Levels at MW-5

CLIENT/PROJECT	Date	Job No.
Kinder Morgan Inc.	Aug-10	7381526
	File name: *Data for modeling.xls*	FIGURE B-9



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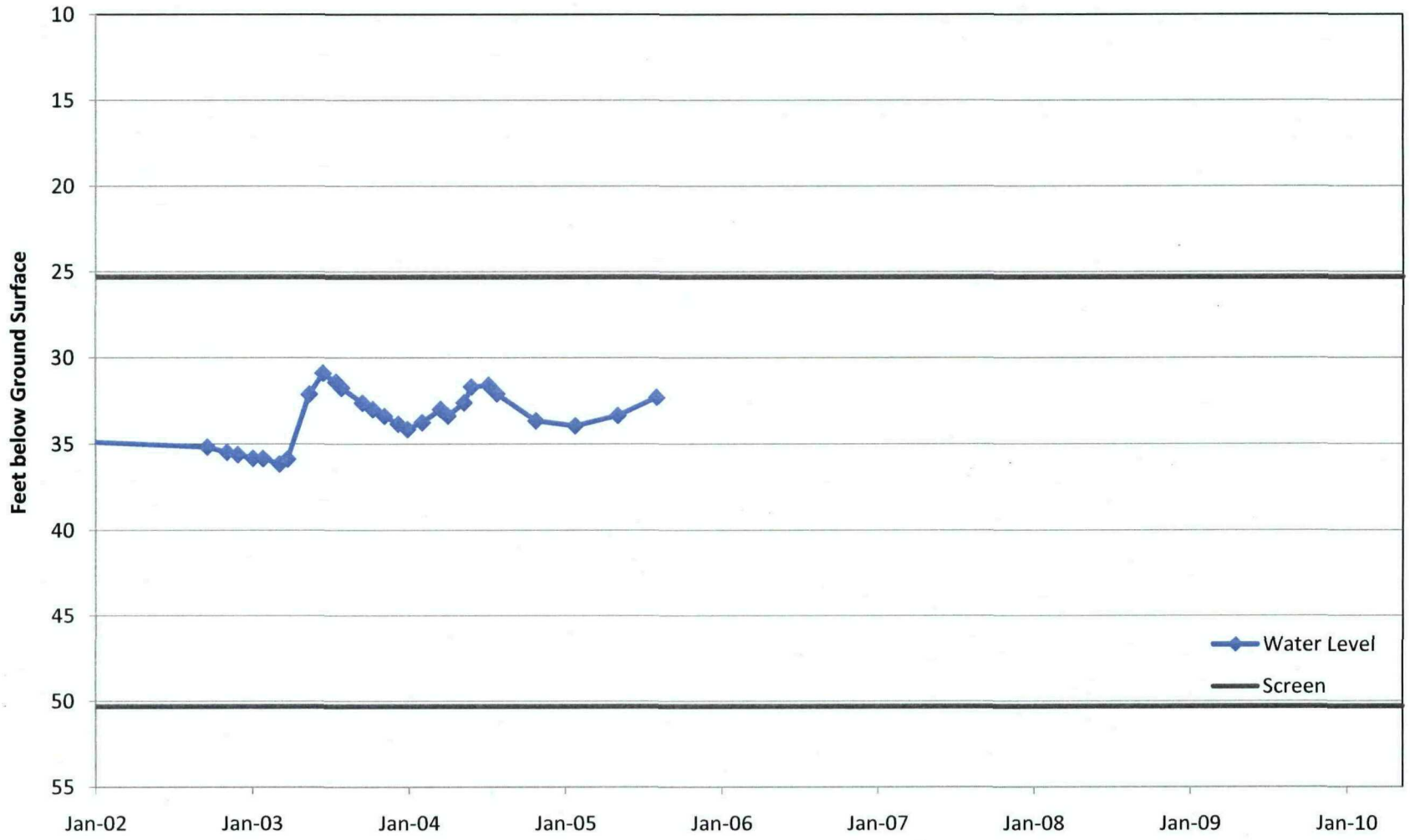
DENVER, COLORADO USA

Water Levels at MW-6

CLIENT/PROJECT	Date	Job No.
Kinder Morgan Inc.	Aug-10	7381526
	File name: *Data for modeling.xls*	FIGURE B-10

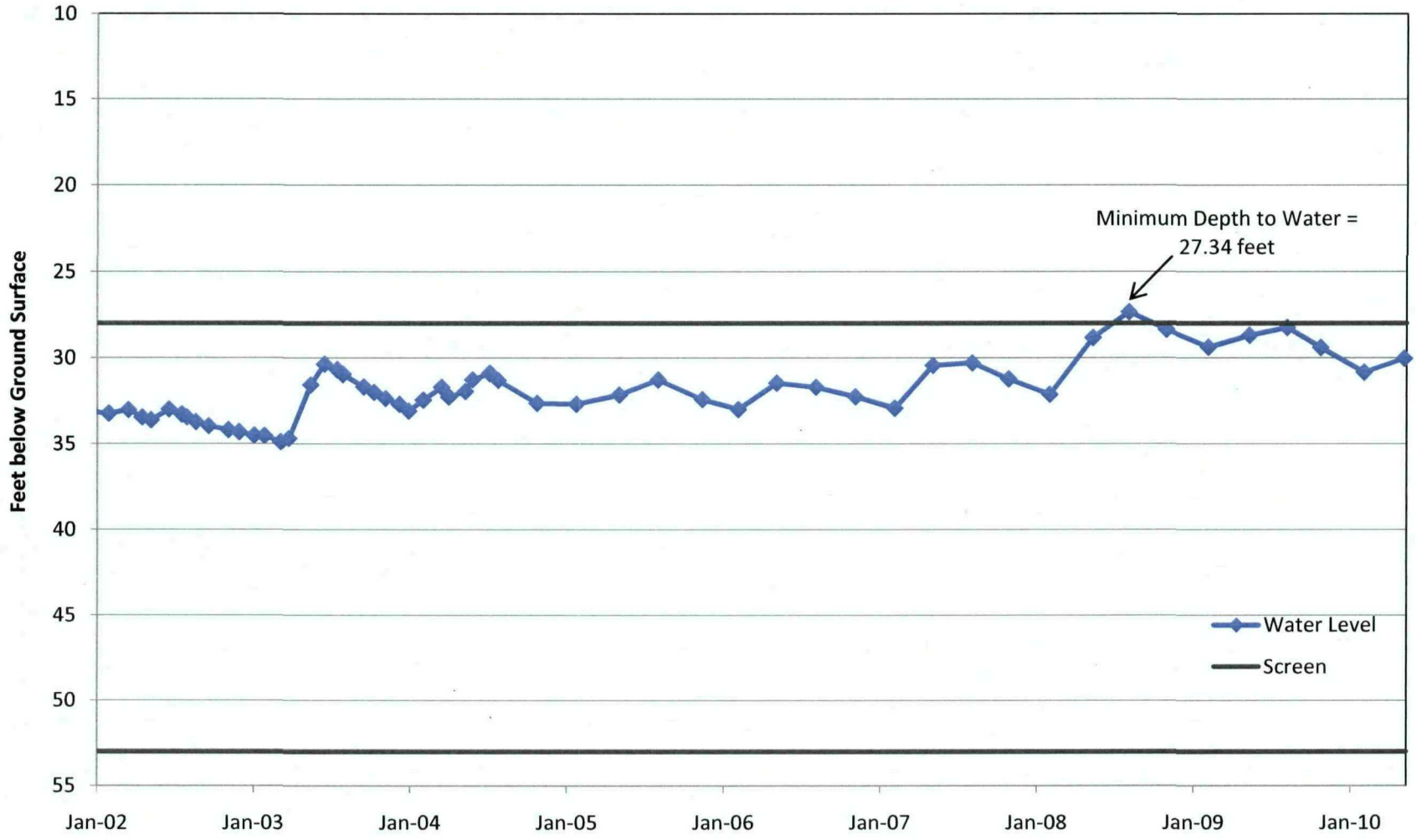


Golder Associates

DENVER, COLORADO USA

Water Levels at MW-7

CLIENT/PROJECT	Date	Job No.
Kinder Morgan Inc.	Aug-10	7381526
	File name: *Data for modeling.xls*	FIGURE B-11

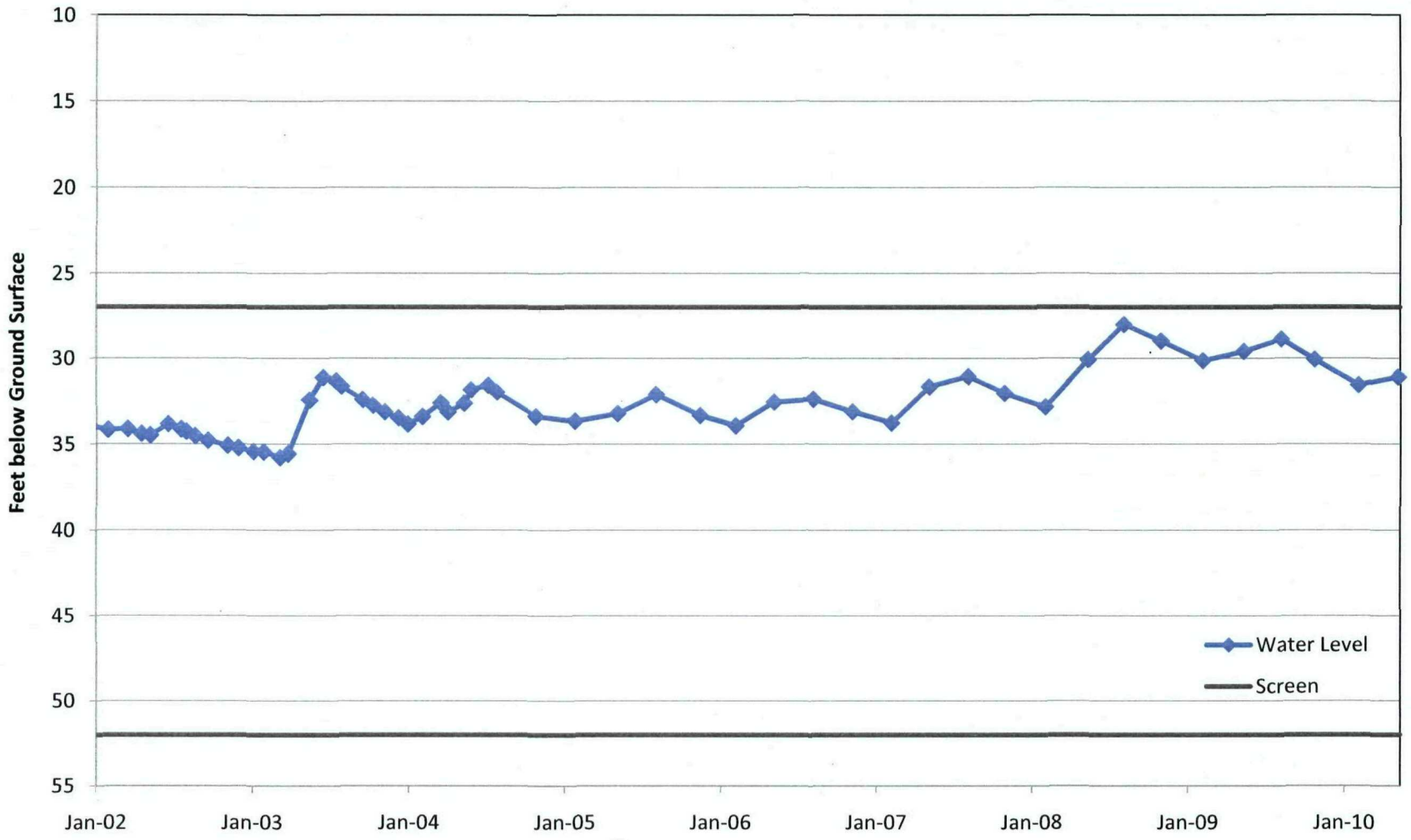


Golder Associates

DENVER, COLORADO USA

Water Levels at EPA-1-9

CLIENT/PROJECT	Date	Job No.
Kinder Morgan Inc.	Aug-10	7381526
	File name: *Data for modeling.xls*	FIGURE B-12



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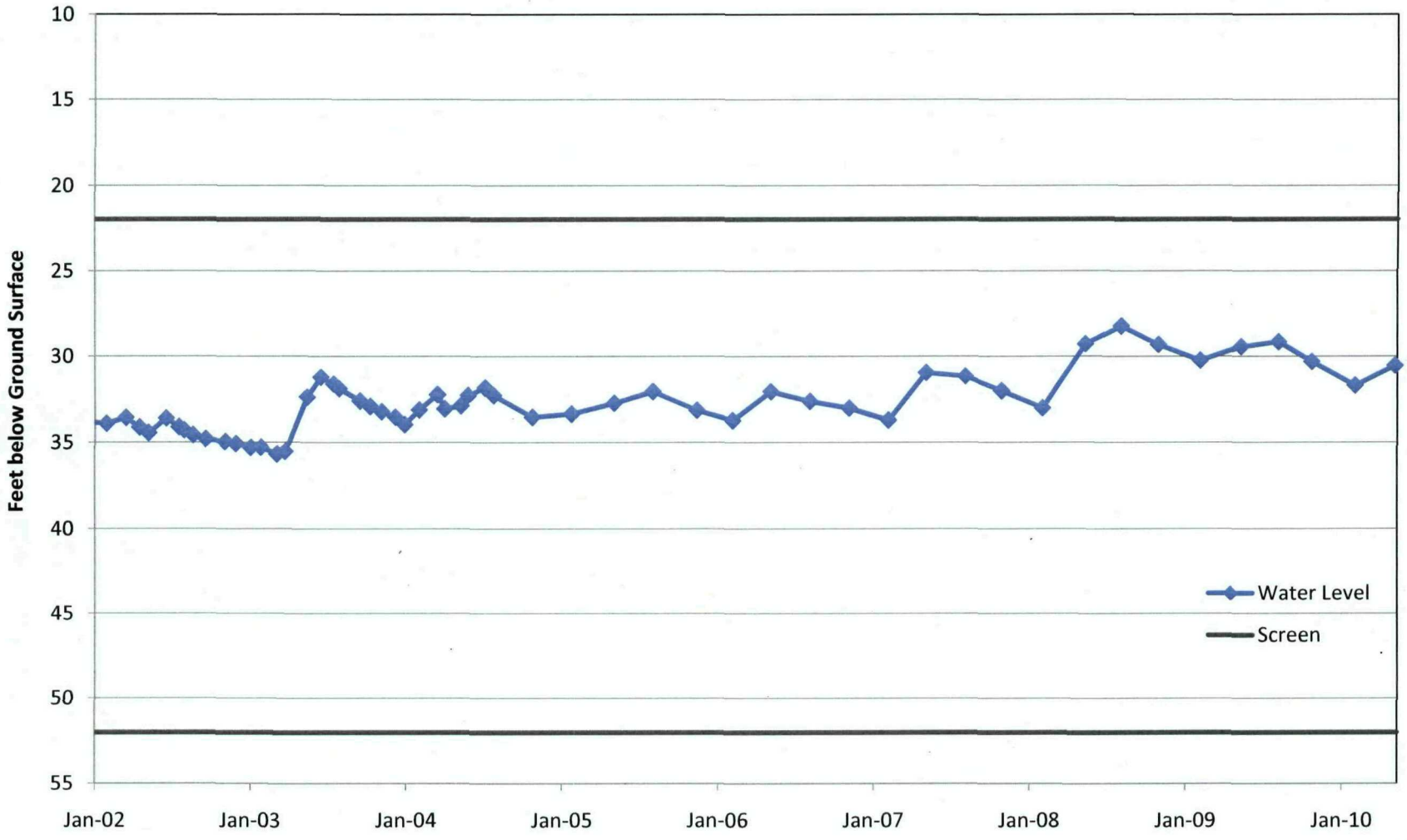
DENVER, COLORADO USA

Water Levels at EPA-1-10

CLIENT/PROJECT	Date	Job No.
Kinder Morgan Inc.	Aug-10	7381526
	File name: *Data for modeling.xls*	FIGURE B-13



Golder Associates

DENVER, COLORADO USA

Water Levels at EPA-2-11

CLIENT/PROJECT	Date	Job No.
Kinder Morgan Inc.	Aug-10	7381526
	File name: *Data for modeling.xls*	FIGURE B-14

ATTACHMENT C

BTEX CONCENTRATIONS FROM 2002 THROUGH MAY 2010

ATTACHMENT C
BTEX RESULTS USED FOR CALCULATING 95% UCLS

DATE	ABC-2						ABC-5					
	Benzene	Toluene	Ethylbenzene	m,p-Xylene	o-Xylene	Tot. Xylenes	Benzene	Toluene	Ethylbenzene	m,p-Xylene	o-Xylene	Tot. Xylenes
2/11/02	<1	<1	<1	NR	NR	<2	11	5.9	<1	NR	NR	12
5/22/02	14	<1	<1	NR	NR	<2	12	7.5	<1	NR	NR	13
8/14/02	<1	<1	<1	NR	NR	<2	3.4	<1	<1	NR	NR	2.1
11/18/02	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.4	<0.5	<0.5	<0.5	<0.5	<0.5
2/11/03	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	2.2	<0.5	<0.5	<0.5	1.2	1.45
5/29/03	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.73	<0.5	0.55	<0.5	1.015	1.265
8/13/03	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	110	<0.5	<0.5	<0.5	1.2	1.45
8/29/03	NS	NS	NS	NS	NS	NS	200	<0.5	<0.5	0.56	1.5	2.06
11/20/03	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	3.3	3.55
2/17/04	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.54	0.55	1.6	3.6	5.2
3/30/04	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
6/11/04	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	54	<0.5	<0.5	<0.5	1.2	1.45
6/30/04	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
8/9/04	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	14.5	<0.5	<0.5	<0.5	0.87	1.12
11/9/04	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	5.1	<0.5	<0.5	0.76	2.2	2.96
2/8/05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	<0.5	<0.5	1.6	3.7	5.3
5/19/05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.93	3.1	4.03
8/18/05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.3	<0.5	<0.5	0.375	1.35	1.725
11/29/05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9.7	<0.5	<0.5	0.715	2.75	3.465
2/21/06	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	11.5	<0.5	<0.5	0.725	2.45	3.175
5/22/06	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.5	2.1	2.6
8/22/06	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	2.7	<0.5	<0.5	0.38	1.75	2.13
11/22/06	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	9.1	<0.5	<0.5	0.545	1.7	2.245
2/22/07	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	24	<0.5	<0.5	<0.5	1.8	2.05
5/22/07	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.48	0.455	<0.5	0.975	2.35	3.325
8/22/07	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.4	2.1	3.5
11/15/07	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.59	<0.5	1.8	2.8	4.6
2/19/08	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.77	0.62	0.74	2.3	3.6	5.9
5/30/08	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.5	1.65	3.15
8/22/08	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.79	1.04
11/17/08	<1	<1	<1	<1	<1	<1	<1	0.2	<1	<1	1.2	1.7
2/23/09	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
5/30/09	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
8/26/09	<1	<1	<1	<1	<1	<1	<10	<1	<1	<1	<1	<1
11/12/09	<1	<1	<1	<1	<1	<1	<1	<1	<1	1.05	<1	1.55
2/22/10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	1.4	1.9
5/27/10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

NOTES:
All concentrations in ug/L
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NS: No sample; NR: Not reported

Golder Associates

ATTACHMENT C
BTEX RESULTS USED FOR CALCULATING 95% UCLS

DATE	ABC-12						ABC-17					
	Benzene	Toluene	Ethylbenzene	m,p-Xylene	o-Xylene	Tot. Xylenes	Benzene	Toluene	Ethylbenzene	m,p-Xylene	o-Xylene	Tot. Xylenes
2/11/02	<1	<1	<1	NR	NR	<2	3.3	1.1	1.1	NR	NR	2.8
5/22/02	<1	1.4	<1	NR	NR	5.3	18	<1	9.1	NR	NR	4.5
8/14/02	<1	<1	<1	NR	NR	<2	<1	<1	2.8	NR	NR	3.5
11/18/02	<2	<2	27	98	<2	99	<1	<1	7.9	8.4	<1	8.9
2/11/03	<0.5	<0.5	1.3	5.2	<0.5	5.45	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
5/29/03	<0.5	<0.5	0.99	1.5	<0.5	1.75	<0.5	<0.5	5.4	7.8	0.72	8.52
8/13/03	1.45	<0.5	8.55	14	<0.5	14.25	1	<0.5	16	25	1.2	26.2
8/29/03	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
11/20/03	3.6	<0.5	5.3	11	<0.5	11.25	6.05	<0.5	27	20.5	2.25	22.75
2/17/04	0.58	<0.5	2.1	3.1	<0.5	3.35	1.7	0.47	25	37	4.15	41.15
3/30/04	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
6/11/04	<0.5	<0.5	0.89	1.4	<0.5	1.65	4.6	<0.5	10	13	1.7	14.7
6/30/04	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
8/9/04	<0.5	<0.5	1.2	1.9	<0.5	2.15	1.5	<0.5	13	15	2.2	17.2
11/9/04	1.6	<0.5	<0.5	<0.5	<0.5	<0.5	0.84	<0.5	15	18	3.2	21.2
2/8/05	6.8	<0.5	<0.5	<0.5	<0.5	<0.5	0.98	<0.5	13	14	2.7	16.7
5/19/05	0.485	<0.5	1.08	2.75	0.97	3.72	2.1	<0.5	9.8	5.7	3.2	8.9
8/18/05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	3.1	0.88	0.93	1.81
11/29/05	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2/21/06	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
5/22/06	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
8/22/06	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
11/22/06	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2/22/07	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
5/22/07	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
8/22/07	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
11/15/07	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2/19/08	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
5/30/08	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
8/22/08	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
11/17/08	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2/23/09	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
5/30/09	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
8/26/09	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
11/12/09	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2/22/10	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
5/27/10	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

NOTES:
All concentrations in ug/L
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Golder Associates

ATTACHMENT C
BTEX RESULTS USED FOR CALCULATING 95% UCLS

DATE	ABC-27						ABC-91					
	Benzene	Toluene	Ethylbenzene	m,p-Xylene	o-Xylene	Tot. Xylenes	Benzene	Toluene	Ethylbenzene	m,p-Xylene	o-Xylene	Tot. Xylenes
2/11/02	14	22	9.9	NR	NR	40	<1	<1	<1	NR	NR	<2
5/22/02	11	18	12	NR	NR	38	<1	<1	<1	NR	NR	<2
8/14/02	<1	14	2.4	NR	NR	11	<1	<1	2	NR	NR	4.6
11/18/02	<2	<2	<2	20	<2	21	<1	<1	13	13	4.9	17.9
2/11/03	4.2	1.5	3.2	18	3.9	21.9	<0.5	<0.5	11.5	11	3.25	14.25
5/29/03	2.6	<0.5	7.7	9.4	1.1	10.5	<0.5	<0.5	1.3	1.3	0.98	2.28
8/13/03	10	1.1	1.7	24	2.8	26.8	0.71	<0.5	0.94	<0.5	<0.5	<0.5
8/29/03	11	<0.5	15	16	1.6	17.6	NS	NS	NS	NS	NS	NS
11/20/03	6.4	1.1	46	6.7	3.6	10.3	20	<0.5	1.5	<0.5	<0.5	<0.5
2/17/04	3.9	1.2	18	3.8	1.2	5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
3/30/04	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
6/11/04	9	0.64	17	3	2.2	5.2	6.6	<0.5	<0.5	<0.5	<0.5	<0.5
6/30/04	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
8/9/04	8.4	0.93	5.2	3.2	2.5	5.7	60	<0.5	1.3	<0.5	<0.5	<0.5
11/9/04	0.98	0.69	3.9	2.8	1.6	4.4	18.5	<0.5	0.635	<0.5	<0.5	<0.5
2/8/05	0.84	1.1	9.9	4.6	3.1	7.7	4.45	<0.5	<0.5	<0.5	0.81	1.06
5/19/05	0.89	0.8	15	4.1	3.2	7.3	<0.5	<0.5	<0.5	<0.5	1.2	1.45
8/18/05	<0.5	<0.5	3.5	0.71	0.83	1.54	33	<0.5	<0.5	<0.5	0.62	0.87
11/29/05	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2/21/06	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
5/22/06	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
8/22/06	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
11/22/06	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2/22/07	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
5/22/07	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
8/22/07	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
11/15/07	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2/19/08	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
5/30/08	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
8/22/08	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
11/17/08	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2/23/09	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
5/30/09	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
8/26/09	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
11/12/09	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2/22/10	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
5/27/10	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

NOTES:
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Golder Associates

ATTACHMENT C
BTEX RESULTS USED FOR CALCULATING 95% UCLS

DATE	GW-2						MW-5					
	Benzene	Toluene	Ethylbenzene	m,p-Xylene	o-Xylene	Tot. Xylenes	Benzene	Toluene	Ethylbenzene	m,p-Xylene	o-Xylene	Tot. Xylenes
2/11/02	<1	1	2.8	NR	NR	4.4	<1	1.2	<1	NR	NR	<2
5/22/02	49	20	2.4	NR	NR	67	2.2	<1	<1	NR	NR	<2
8/14/02	18	13	<1	NR	NR	24	<1	<1	<1	NR	NR	<2
11/18/02	<1	<1	11	21	<1	21.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2/11/03	1.4	<0.5	2.2	5.6	1.2	6.8	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
5/29/03	<0.5	<0.5	0.98	0.81	<0.5	1.06	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
8/13/03	<0.5	<0.5	3.8	4.9	1.4	6.3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
8/29/03	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
11/20/03	2.8	<0.5	7.3	12	3.8	15.8	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2/17/04	25	0.58	5.5	6.5	3.1	9.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
3/30/04	35	<0.5	1.6	1.7	1.2	2.9	NS	NS	NS	NS	NS	NS
6/11/04	2.5	<0.5	2.35	3.55	1.35	4.9	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
6/30/04	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
8/9/04	1.4	<0.5	3	4	1.5	5.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
11/9/04	1.2	<0.5	2.6	2.7	1.6	4.3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2/8/05	0.69	<0.5	1.6	2	1.1	3.1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
5/19/05	0.75	<0.5	2.3	3.2	1.6	4.8	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
8/18/05	0.86	<0.5	2.6	4.4	1.4	5.8	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
11/29/05	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2/21/06	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
5/22/06	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
8/22/06	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
11/22/06	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2/22/07	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
5/22/07	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
8/22/07	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
11/15/07	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2/19/08	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
5/30/08	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
8/22/08	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
11/17/08	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2/23/09	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
5/30/09	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
8/26/09	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
11/12/09	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2/22/10	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
5/27/10	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

NOTES:
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ATTACHMENT C
BTEX RESULTS USED FOR CALCULATING 95% UCLS

DATE	MW-6						MW-7					
	Benzene	Toluene	Ethylbenzene	m,p-Xylene	o-Xylene	Tot. Xylenes	Benzene	Toluene	Ethylbenzene	m,p-Xylene	o-Xylene	Tot. Xylenes
2/11/02	<1	2.6	<1	NR	NR	3.8	<1	<1	<1	NR	NR	<2
5/22/02	<1	<1	<1	NR	NR	<2	6.3	10	1.2	NR	NR	4
8/14/02	<1	<1	<1	NR	NR	<2	<1	5.9	<1	NR	NR	<2
11/18/02	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	5.65	6.1	0.775	6.875
2/11/03	1.2	<0.5	<0.5	<0.5	<0.5	<0.5	2.2	<0.5	20	2.9	<0.5	3.15
5/29/03	<0.5	<0.5	1.1	2.5	0.65	3.15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
8/13/03	<0.5	<0.5	0.57	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
8/29/03	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
11/20/03	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	29	<0.5	<0.5	<0.5	<0.5	<0.5
2/17/04	13	<0.5	<0.5	<0.5	0.55	0.8	1.4	<0.5	3.2	<0.5	0.82	1.07
3/30/04	17	1.2	<0.5	2.6	2.3	4.9	NS	NS	NS	NS	NS	NS
6/11/04	1.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	<0.5	<0.5	<0.5	<0.5	<0.5
6/30/04	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
8/9/04	0.72	<0.5	1.7	<0.5	<0.5	<0.5	0.72	<0.5	1	<0.5	<0.5	<0.5
11/9/04	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	51	<0.5	<0.5	<0.5	<0.5	<0.5
2/8/05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.72	0.5	0.5	0.5	0.5	1
5/19/05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.3	<0.5	<0.5	<0.5
8/18/05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	2.4	<0.5	<0.5	<0.5	<0.5	<0.5
11/29/05	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2/21/06	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
5/22/06	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
8/22/06	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
11/22/06	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2/22/07	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
5/22/07	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
8/22/07	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
11/15/07	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2/19/08	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
5/30/08	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
8/22/08	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
11/17/08	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2/23/09	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
5/30/09	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
8/26/09	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
11/12/09	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
2/22/10	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
5/27/10	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS

NOTES:
All concentrations in ug/L
Non-detects are shown as less than the detection limit
If a duplicate sample was collected, the average concentration was reported
NS: No sample; NR: Not reported

Golder Associates

ATTACHMENT C
BTEX RESULTS USED FOR CALCULATING 95% UCLS

DATE	EPA-1-9						EPA-1-10					
	Benzene	Toluene	Ethylbenzene	m,p-Xylene	o-Xylene	Tot. Xylenes	Benzene	Toluene	Ethylbenzene	m,p-Xylene	o-Xylene	Tot. Xylenes
2/11/02	<1	<1	<1	NR	NR	<2	<1	<1	<1	NR	NR	<2
5/22/02	<1	<1	<1	NR	NR	<2	<1	<1	<1	NR	NR	<2
8/14/02	<1	<1	<1	NR	NR	<2	<1	<1	<1	NR	NR	<2
11/18/02	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2/11/03	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
5/29/03	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.55	1.275	2.825	2.15
8/13/03	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
8/29/03	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
11/20/03	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	15.5	<0.5	9.1	<0.5	9.35	<0.5
2/17/04	1.3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.75	0.565	2.315	0.52
3/30/04	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
6/11/04	12.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	<0.5	1.45	<0.5
6/30/04	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NS	NS	NS	NS	NS	NS
8/9/04	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.2	<0.5	<0.5	<0.5	<0.5	<0.5
11/9/04	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2/8/05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1	<0.5	<0.5	<0.5	<0.5
5/19/05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
8/18/05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
11/29/05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2/21/06	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
5/22/06	<0.5	<0.5	<0.5	0.9	<0.5	1.15	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
8/22/06	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	2.6	<0.5	<0.5	<0.5	<0.5	<0.5
11/22/06	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	4.8	<0.5	<0.5	<0.5	<0.5	<0.5
2/22/07	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
5/22/07	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
8/22/07	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
11/15/07	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2/19/08	1.3	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
5/30/08	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.7	<0.5	<0.5	<0.5	<0.5	<0.5
8/22/08	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	4.4	<0.5	<0.5	<0.5	<0.5	<0.5
11/17/08	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
2/23/09	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
5/30/09	<1	<1	<1	<1	<1	<1	9.7	<1	<1	<1	<1	<1
8/26/09	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
11/12/09	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
2/22/10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
5/27/10	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

NOTES:
All concentrations in ug/L
Non-detects are shown as less than the detection limit
If a duplicate sample was collected, the average concentration was reported
NS: No sample; NR: Not reported

Golder Associates

ATTACHMENT C
BTEX RESULTS USED FOR CALCULATING 95% UCLS

DATE	EPA-2-11						EPA-1-11					
	Benzene	Toluene	Ethylbenzene	m,p-Xylene	o-Xylene	Tot. Xylenes	Benzene	Toluene	Ethylbenzene	m,p-Xylene	o-Xylene	Tot. Xylenes
2/11/02	<1	4.9	16	NR	NR	46	<1	<1	1.4	NR	NR	3.8
5/22/02	<1	<1	<1	NR	NR	3.6	2.4	<1	<1	NR	NR	<2
8/14/02	<1	<1	<1	NR	NR	<2	NS	NS	NS	NS	NS	NS
11/18/02	<1	<1	12	29	<1	29.5	NS	NS	NS	NS	NS	NS
2/11/03	<0.5	<0.5	3.65	7.5	<0.5	7.75	NS	NS	NS	NS	NS	NS
5/29/03	<0.5	<0.5	1.4	1.1	<0.5	1.35	NS	NS	NS	NS	NS	NS
8/13/03	<0.5	<0.5	8.5	4.2	1.2	5.4	NS	NS	NS	NS	NS	NS
8/29/03	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
11/20/03	1.2	<0.5	7.8	11	2.2	13.2	NS	NS	NS	NS	NS	NS
2/17/04	0.71	<0.5	4.8	6.8	2.1	8.9	NS	NS	NS	NS	NS	NS
3/30/04	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
6/11/04	<0.5	<0.5	2	1.6	1.2	2.8	NS	NS	NS	NS	NS	NS
6/30/04	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
8/9/04	<0.5	<0.5	2.3	1.8	1.2	3	NS	NS	NS	NS	NS	NS
11/9/04	0.58	<0.5	2.9	1.6	1.5	3.1	NS	NS	NS	NS	NS	NS
2/8/05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NS	NS	NS	NS	NS	NS
5/19/05	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NS	NS	NS	NS	NS	NS
8/18/05	0.42	<0.5	2.15	1	1.05	2.05	NS	NS	NS	NS	NS	NS
11/29/05	<0.5	<0.5	0.79	<0.5	0.52	0.77	NS	NS	NS	NS	NS	NS
2/21/06	<0.5	<0.5	0.98	<0.5	0.68	0.93	NS	NS	NS	NS	NS	NS
5/22/06	<0.5	<0.5	<0.5	0.55	2.3	2.85	NS	NS	NS	NS	NS	NS
8/22/06	<0.5	<0.5	2.2	0.52	1.6	2.12	NS	NS	NS	NS	NS	NS
11/22/06	<0.5	<0.5	0.78	<0.5	0.51	0.76	NS	NS	NS	NS	NS	NS
2/22/07	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	NS	NS	NS	NS	NS	NS
5/22/07	<0.5	<0.5	1.6	<0.5	1.8	2.05	NS	NS	NS	NS	NS	NS
8/22/07	<0.5	<0.5	2.2	<0.5	2.2	2.45	NS	NS	NS	NS	NS	NS
11/15/07	1.8	<0.5	1.3	<0.5	1.9	2.15	NS	NS	NS	NS	NS	NS
2/19/08	4.7	<0.5	2.9	0.705	4.3	5.005	NS	NS	NS	NS	NS	NS
5/30/08	<0.5	<0.5	0.94	<0.5	1.4	1.65	NS	NS	NS	NS	NS	NS
8/22/08	3.25	<0.5	8.6	<0.5	8.45	8.7	NS	NS	NS	NS	NS	NS
11/17/08	0.6	<1	5.3	<1	2.2	2.7	NS	NS	NS	NS	NS	NS
2/23/09	2.1	<1	2.4	<1	<1	<1	NS	NS	NS	NS	NS	NS
5/30/09	3.8	<1	4.2	<1	1.4	1.9	NS	NS	NS	NS	NS	NS
8/26/09	<10	<1	3.3	<1	1.4	1.9	NS	NS	NS	NS	NS	NS
11/12/09	<1	<1	3	<1	2.3	2.8	NS	NS	NS	NS	NS	NS
2/22/10	<1	<1	1.6	<1	1.4	1.9	NS	NS	NS	NS	NS	NS
5/27/10	<1	<1	2	<1	1.7	2.2	NS	NS	NS	NS	NS	NS

NOTES:
All concentrations in ug/L
Non-detects are shown as less than the detection limit
If a duplicate sample was collected, the average concentration was reported
NS: No sample; NR: Not reported

Golder Associates

ATTACHMENT C
BTEX RESULTS USED FOR CALCULATING 95% UCLS

DATE	ABC-19					
	Benzene	Toluene	Ethylbenzene	m,p-Xylene	o-Xylene	Tot. Xylenes
2/11/02	3.5	<1	1	NR	NR	2.2
5/22/02	<1	<1	<1	NR	NR	2.8
8/14/02	NS	NS	NS	NS	NS	NS
11/18/02	NS	NS	NS	NS	NS	NS
2/11/03	NS	NS	NS	NS	NS	NS
5/29/03	NS	NS	NS	NS	NS	NS
8/13/03	NS	NS	NS	NS	NS	NS
8/29/03	NS	NS	NS	NS	NS	NS
11/20/03	NS	NS	NS	NS	NS	NS
2/17/04	NS	NS	NS	NS	NS	NS
3/30/04	NS	NS	NS	NS	NS	NS
6/11/04	NS	NS	NS	NS	NS	NS
6/30/04	NS	NS	NS	NS	NS	NS
8/9/04	NS	NS	NS	NS	NS	NS
11/9/04	NS	NS	NS	NS	NS	NS
2/8/05	NS	NS	NS	NS	NS	NS
5/19/05	NS	NS	NS	NS	NS	NS
8/18/05	NS	NS	NS	NS	NS	NS
11/29/05	NS	NS	NS	NS	NS	NS
2/21/06	NS	NS	NS	NS	NS	NS
5/22/06	NS	NS	NS	NS	NS	NS
8/22/06	NS	NS	NS	NS	NS	NS
11/22/06	NS	NS	NS	NS	NS	NS
2/22/07	NS	NS	NS	NS	NS	NS
5/22/07	NS	NS	NS	NS	NS	NS
8/22/07	NS	NS	NS	NS	NS	NS
11/15/07	NS	NS	NS	NS	NS	NS
2/19/08	NS	NS	NS	NS	NS	NS
5/30/08	NS	NS	NS	NS	NS	NS
8/22/08	NS	NS	NS	NS	NS	NS
11/17/08	NS	NS	NS	NS	NS	NS
2/23/09	NS	NS	NS	NS	NS	NS
5/30/09	NS	NS	NS	NS	NS	NS
8/26/09	NS	NS	NS	NS	NS	NS
11/12/09	NS	NS	NS	NS	NS	NS
2/22/10	NS	NS	NS	NS	NS	NS
5/27/10	NS	NS	NS	NS	NS	NS

NOTES:
All concentrations in ug/L
Non-detects are shown as less than the detection limit
If a duplicate sample was collected, the average concentration was reported
NS: No sample; NR: Not reported

Golder Associates

ATTACHMENT D
PROUCL RESULTS

General UCL Statistics for Data Sets with Non-Detects

User Selected Options

From File	WorkSheet.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Bonzono

General Statistics

Number of Valid Data	299	Number of Detected Data	106
Number of Distinct Detected Data	78	Number of Non-Detect Data	193
Number of Missing Values	256	Percent Non-Detects	64.55%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.42	Minimum Detected	-0.868
Maximum Detected	200	Maximum Detected	5.298
Mean of Detected	10.56	Mean of Detected	1.291
SD of Detected	24.05	SD of Detected	1.369
Minimum Non-Detect	0.5	Minimum Non-Detect	-0.693
Maximum Non-Detect	10	Maximum Non-Detect	2.303

Note: Data have multiple DLs - Use of KM Method is recommended	Number treated as Non-Detect	271
For all methods (except KM, DL/2, and ROS Methods).	Number treated as Detected	28
Observations < Largest ND are treated as NDs	Single DL Non-Detect Percentage	90.64%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Lilliefors Test Statistic	0.337	Lilliefors Test Statistic	0.0997
5% Lilliefors Critical Value	0.0861	5% Lilliefors Critical Value	0.0861
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	3.994	Mean	-0.264
SD	15.09	SD	1.456
95% DL/2 (t) UCL	5.434	95% H-Stat (DL/2) UCL	2.748
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	-0.977
		SD in Log Scale	2.215
		Mean in Original Scale	3.894
		SD in Original Scale	15.11
		95% t UCL	5.336
		95% Percentile Bootstrap UCL	5.443
		95% BCA Bootstrap UCL	6.145

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	0.572	**Data do not follow a Discernable Distribution (0.05)**
Theta Star	18.46	
nu star	121.3	

A-D Test Statistic	5.002	**Nonparametric Statistics**	
5% A-D Critical Value	0.811	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.811	Mean	4.054
5% K-S Critical Value	0.0924	SD	15.05
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.874
		95% KM (t) UCL	5.497
Assuming Gamma Distribution		95% KM (z) UCL	5.492
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	5.493
Minimum	1.000E-12	95% KM (bootstrap t) UCL	6.555
Maximum	200	95% KM (BCA) UCL	5.656
Mean	17.73	95% KM (Percentile Bootstrap) UCL	5.586
Median	7.939	95% KM (Chebyshev) UCL	7.866
SD	23.16	97.5% KM (Chebyshev) UCL	9.515
k star	0.139	99% KM (Chebyshev) UCL	12.75
Theta star	127.2		
Nu star	83.31	**Potential UCLs to Use**	
AppChi2	63.28	95% KM (BCA) UCL	5.656
95% Gamma Approximate UCL	23.34		
95% Adjusted Gamma UCL	23.37		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). For additional insight, the user may want to consult a statistician.

Toluene

General Statistics

Number of Valid Data	299	Number of Detected Data	34
Number of Distinct Detected Data	27	Number of Non-Detect Data	265
Number of Missing Values	256	Percent Non-Detects	88.63%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.2	Minimum Detected	-1.609
Maximum Detected	22	Maximum Detected	3.091
Mean of Detected	4.227	Mean of Detected	0.563
SD of Detected	6.135	SD of Detected	1.291
Minimum Non-Detect	0.5	Minimum Non-Detect	-0.693
Maximum Non-Detect	2	Maximum Non-Detect	0.693

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	288
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	11
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	96.32%

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.658	Shapiro Wilk Test Statistic	0.884
5% Shapiro Wilk Critical Value	0.933	5% Shapiro Wilk Critical Value	0.933
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	

Mean	0.762	Mean	-1.002
SD	2.393	SD	0.768
95% DL/2 (t) UCL	0.991	95% H-Stat (DL/2) UCL	0.538
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	-1.891
		SD in Log Scale	1.569
		Mean in Original Scale	0.673
		SD in Original Scale	2.418
		95% t UCL	0.904
		95% Percentile Bootstrap UCL	0.92
		95% BCA Bootstrap UCL	0.999
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.648	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	6.522		
nu star	44.07		
A-D Test Statistic	2.777	**Nonparametric Statistics**	
5% A-D Critical Value	0.794	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.794	Mean	0.816
5% K-S Critical Value	0.158	SD	2.379
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.154
		95% KM (t) UCL	1.069
Assuming Gamma Distribution		95% KM (z) UCL	1.069
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	1.092
Minimum	0.2	95% KM (bootstrap t) UCL	1.178
Maximum	22	95% KM (BCA) UCL	1.089
Mean	3.592	95% KM (Percentile Bootstrap) UCL	1.099
Median	3.56	95% KM (Chebyshev) UCL	1.486
SD	2.138	97.5% KM (Chebyshev) UCL	1.775
k star	4.389	99% KM (Chebyshev) UCL	2.345
Theta star	0.819		
Nu star	2624	**Potential UCLs to Use**	
AppChi2	2506	95% KM (BCA) UCL	1.089
95% Gamma Approximate UCL	3.761		
95% Adjusted Gamma UCL	3.762		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). For additional insight, the user may want to consult a statistician.

Ethylbenzene

General Statistics

Number of Valid Data	299	Number of Detected Data	108
Number of Distinct Detected Data	70	Number of Non-Detect Data	191
Number of Missing Values	256	Percent Non-Detects	63.88%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.5	Minimum Detected	-0.693

Maximum Detected	46	Maximum Detected	3.829
Mean of Detected	5.767	Mean of Detected	1.178
SD of Detected	7.082	SD of Detected	1.062
Minimum Non-Detect	0.5	Minimum Non-Detect	-0.693
Maximum Non-Detect	2	Maximum Non-Detect	0.693

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	229
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	70
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	76.59%

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Lilliefors Test Statistic	0.234	Lilliefors Test Statistic	0.0938
5% Lilliefors Critical Value	0.0853	5% Lilliefors Critical Value	0.0853
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	2.294	Mean	-0.321
SD	4.986	SD	1.323
95% DL/2 (t) UCL	2.77	95% H-Stat (DL/2) UCL	2.095
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	-0.84
		SD in Log Scale	1.938
		Mean in Original Scale	2.242
		SD in Original Scale	5.009
		95% t UCL	2.72
		95% Percentile Bootstrap UCL	2.737
		95% BCA Bootstrap UCL	2.814
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.984	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	5.863		
nu star	212.5		
A-D Test Statistic	3.2	**Nonparametric Statistics**	
5% A-D Critical Value	0.783	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.783	Mean	2.408
5% K-S Critical Value	0.09	SD	4.933
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.287
		95% KM (t) UCL	2.881
Assuming Gamma Distribution		95% KM (z) UCL	2.879
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	2.852
Minimum	1.000E-12	95% KM (bootstrap t) UCL	2.975
Maximum	46	95% KM (BCA) UCL	2.962
Mean	7.588	95% KM (Percentile Bootstrap) UCL	2.921
Median	5.646	95% KM (Chebyshev) UCL	3.657
SD	6.923	97.5% KM (Chebyshev) UCL	4.198
k star	0.22	99% KM (Chebyshev) UCL	5.26
Theta star	34.44		
Nu star	131.8	**Potential UCLs to Use**	
AppChi2	106.3	95% KM (BCA) UCL	2.962

95% Gamma Approximate UCL	9.411
95% Adjusted Gamma UCL	9.42

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). For additional insight, the user may want to consult a statistician.

m,p-Xylene

General Statistics

Number of Valid Data	299	Number of Detected Data	108
Number of Distinct Detected Data	84	Number of Non-Detect Data	191
Number of Missing Values	256	Percent Non-Detects	63.88%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.375	Minimum Detected	-0.981
Maximum Detected	98	Maximum Detected	4.585
Mean of Detected	8.509	Mean of Detected	1.325
SD of Detected	13.84	SD of Detected	1.271
Minimum Non-Detect	0.5	Minimum Non-Detect	-0.693
Maximum Non-Detect	2	Maximum Non-Detect	0.693

Note: Data have multiple DLs - Use of KM Method is recommended	Number treated as Non-Detect	227
For all methods (except KM, DL/2, and ROS Methods).	Number treated as Detected	72
Observations < Largest ND are treated as NDs	Single DL Non-Detect Percentage	75.92%

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Lilliefors Test Statistic	0.278	Lilliefors Test Statistic	0.06
5% Lilliefors Critical Value	0.0853	5% Lilliefors Critical Value	0.0853
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	

Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	3.317	Mean	-0.226
SD	9.169	SD	1.446
95% DL/2 (t) UCL	4.192	95% H-Stat (DL/2) UCL	2.807
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	-0.863
		SD in Log Scale	2.14
		Mean in Original Scale	3.235
		SD in Original Scale	9.196
		95% t UCL	4.112
		95% Percentile Bootstrap UCL	4.121
		95% BCA Bootstrap UCL	4.3

Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**
k star (bias corrected)	0.721	**Data appear Lognormal at 5% Significance Level**
Theta Star	11.8	
nu star	155.8	

A-D Test Statistic	2.813	**Nonparametric Statistics**	
5% A-D Critical Value	0.796	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.796	Mean	3.328
5% K-S Critical Value	0.0909	SD	9.149
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.532
		95% KM (t) UCL	4.205
Assuming Gamma Distribution		95% KM (z) UCL	4.202
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	4.202
Minimum	1.000E-12	95% KM (bootstrap t) UCL	4.521
Maximum	98	95% KM (BCA) UCL	4.339
Mean	13.19	95% KM (Percentile Bootstrap) UCL	4.237
Median	7.5	95% KM (Chebyshev) UCL	5.645
SD	14.42	97.5% KM (Chebyshev) UCL	6.647
k star	0.173	99% KM (Chebyshev) UCL	8.617
Theta star	76.32		
Nu star	103.4	**Potential UCLs to Use**	
AppChi2	80.93	95% KM (BCA) UCL	4.339
95% Gamma Approximate UCL	16.86		
95% Adjusted Gamma UCL	16.88		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). For additional insight, the user may want to consult a statistician.

o-Xylene

General Statistics

Number of Valid Data	299	Number of Detected Data	121
Number of Distinct Detected Data	70	Number of Non-Detect Data	178
Number of Missing Values	256	Percent Non-Detects	59.53%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.5	Minimum Detected	-0.693
Maximum Detected	67	Maximum Detected	4.205
Mean of Detected	4.14	Mean of Detected	0.788
SD of Detected	8.837	SD of Detected	0.895
Minimum Non-Detect	0.5	Minimum Non-Detect	-0.693
Maximum Non-Detect	2	Maximum Non-Detect	0.693

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	237
For all methods (except KM, DL/2, and ROS Methods),		Number treated as Detected	62
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	79.26%

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Lilliefors Test Statistic	0.38	Lilliefors Test Statistic	0.114
5% Lilliefors Critical Value	0.0805	5% Lilliefors Critical Value	0.0805
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	

DL/2 Substitution Method	
Mean	1.91
SD	5.906
95% DL/2 (t) UCL	2.473
Maximum Likelihood Estimate(MLE) Method	N/A
MLE yields a negative mean	

DL/2 Substitution Method	
Mean	-0.325
SD	1.147
95% H-Stat (DL/2) UCL	1.621
Log ROS Method	
Mean in Log Scale	-0.646
SD in Log Scale	1.515
Mean in Original Scale	1.849
SD in Original Scale	5.921
95% t UCL	2.414
95% Percentile Bootstrap UCL	2.436
95% BCA Bootstrap UCL	2.627

Gamma Distribution Test with Detected Values Only

k star (bias corrected)	0.904
Theta Star	4.579
nu star	218.8
A-D Test Statistic	11.25
5% A-D Critical Value	0.787
K-S Test Statistic	0.787
5% K-S Critical Value	0.0868

Data not Gamma Distributed at 5% Significance Level

Assuming Gamma Distribution

Gamma ROS Statistics using Extrapolated Data	
Minimum	1.000E-12
Maximum	67
Mean	4.837
Median	2.8
SD	6.682
k star	0.185
Theta star	26.08
Nu star	110.9
AppChi2	87.59
95% Gamma Approximate UCL	6.124
95% Adjusted Gamma UCL	6.131

Data Distribution Test with Detected Values Only

Data do not follow a Discernable Distribution (0.05)

Nonparametric Statistics

Kaplan-Meier (KM) Method	
Mean	1.992
SD	5.873
SE of Mean	0.341
95% KM (t) UCL	2.555
95% KM (z) UCL	2.553
95% KM (jackknife) UCL	2.548
95% KM (bootstrap t) UCL	2.917
95% KM (BCA) UCL	2.643
95% KM (Percentile Bootstrap) UCL	2.555
95% KM (Chebyshev) UCL	3.479
97.5% KM (Chebyshev) UCL	4.123
99% KM (Chebyshev) UCL	5.386

Potential UCLs to Use

95% KM (t) UCL	2.555
95% KM (% Bootstrap) UCL	2.555

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). For additional insight, the user may want to consult a statistician.

Xylenes

General Statistics

Number of Valid Data	299	Number of Detected Data	137
Number of Distinct Detected Data	108	Number of Non-Detect Data	162
Number of Missing Values	256	Percent Non-Detects	54.18%

Raw Statistics **Log-transformed Statistics**

Minimum Detected	0.52	Minimum Detected	-0.654
Maximum Detected	99	Maximum Detected	4.595
Mean of Detected	8.195	Mean of Detected	1.475
SD of Detected	12.7	SD of Detected	1.048
Minimum Non-Detect	0.5	Minimum Non-Detect	-0.693
Maximum Non-Detect	2	Maximum Non-Detect	0.693

Note: Data have multiple DLs - Use of KM Method is recommended	Number treated as Non-Detect	193
For all methods (except KM, DL/2, and ROS Methods),	Number treated as Detected	106
Observations < Largest ND are treated as NDs	Single DL Non-Detect Percentage	64.55%

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Lilliefors Test Statistic	0.273	Lilliefors Test Statistic	0.0847
5% Lilliefors Critical Value	0.0757	5% Lilliefors Critical Value	0.0757
Data not Normal at 5% Significance Level		**Data not Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	3.967	Mean	0.087
SD	9.422	SD	1.507
95% DL/2 (t) UCL	4.866	95% H-Stat (DL/2) UCL	4.264
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	-0.0719
		SD in Log Scale	1.778
		Mean in Original Scale	3.966
		SD in Original Scale	9.424
		95% t UCL	4.865
		95% Percentile Bootstrap UCL	4.889
		95% BCA Bootstrap UCL	5.057
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	0.911	**Data do not follow a Discernable Distribution (0.05)**	
Theta Star	8.992		
nu star	249.7		
A-D Test Statistic	5.394	**Nonparametric Statistics**	
5% A-D Critical Value	0.787	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.787	Mean	4.049
5% K-S Critical Value	0.0825	SD	9.374
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.544
		95% KM (t) UCL	4.946
Assuming Gamma Distribution		95% KM (z) UCL	4.944
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	4.847
Minimum	0.52	95% KM (bootstrap t) UCL	5.122
Maximum	99	95% KM (BCA) UCL	5.15
Mean	8.261	95% KM (Percentile Bootstrap) UCL	4.983
Median	6.822	95% KM (Chebyshev) UCL	6.421
SD	8.753	97.5% KM (Chebyshev) UCL	7.447
k star	1.74	99% KM (Chebyshev) UCL	9.463
Theta star	4.747		
Nu star	1041	**Potential UCLs to Use**	

AppChi2	966.9	95% KM (BCA) UCL	5.15
95% Gamma Approximate UCL	8.893		
95% Adjusted Gamma UCL	8.896		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). For additional insight, the user may want to consult a statistician.

General UCL Statistics for Data Sets with Non-Detects

User Selected Options

From File	C:\last12Q.wst
Full Precision	OFF
Confidence Coefficient	95%
Number of Bootstrap Operations	2000

Benzene

General Statistics

Number of Valid Data	48	Number of Detected Data	11
Number of Distinct Detected Data	11	Number of Non-Detect Data	37
		Percent Non-Detects	77.08%

Raw Statistics		Log-transformed Statistics	
Minimum Detected	0.6	Minimum Detected	-0.511
Maximum Detected	9.7	Maximum Detected	2.272
Mean of Detected	3.102	Mean of Detected	0.833
SD of Detected	2.606	SD of Detected	0.828
Minimum Non-Detect	0.5	Minimum Non-Detect	-0.693
Maximum Non-Detect	10	Maximum Non-Detect	2.303

Note: Data have multiple DLs - Use of KM Method is recommended	Number treated as Non-Detect	48
For all methods (except KM, DL/2, and ROS Methods),	Number treated as Detected	0
Observations < Largest ND are treated as NDs	Single DL Non-Detect Percentage	100.00%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.829	Shapiro Wilk Test Statistic	0.977
5% Shapiro Wilk Critical Value	0.85	5% Shapiro Wilk Critical Value	0.85
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	

Assuming Normal Distribution		Assuming Lognormal Distribution	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	1.216	Mean	-0.435
SD	1.84	SD	0.991
95% DL/2 (t) UCL	1.662	95% H-Stat (DL/2) UCL	1.48
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE method failed to converge properly		Mean in Log Scale	-1.466
		SD in Log Scale	1.708
		Mean in Original Scale	0.874
		SD in Original Scale	1.728
		95% t UCL	1.293
		95% Percentile Bootstrap UCL	1.314
		95% BCA Bootstrap UCL	1.416

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only
k star (bias corrected)	1.386	**Data appear Gamma Distributed at 5% Significance Level**
Theta Star	2.238	
nu star	30.49	

A-D Test Statistic	0.216	**Nonparametric Statistics**	
5% A-D Critical Value	0.74	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.74	Mean	1.204
5% K-S Critical Value	0.259	SD	1.615
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	0.25
		95% KM (t) UCL	1.623
Assuming Gamma Distribution		95% KM (z) UCL	1.615
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	1.545
Minimum	1.000E-12	95% KM (bootstrap t) UCL	1.863
Maximum	9.7	95% KM (BCA) UCL	2.345
Mean	3.969	95% KM (Percentile Bootstrap) UCL	1.998
Median	3.85	95% KM (Chebyshev) UCL	2.293
SD	2.635	97.5% KM (Chebyshev) UCL	2.764
k star	0.332	99% KM (Chebyshev) UCL	3.69
Theta star	11.94		
Nu star	31.91	**Potential UCLs to Use**	
AppChi2	20	95% KM (t) UCL	1.623
95% Gamma Approximate UCL	6.333		
95% Adjusted Gamma UCL	6.427		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). For additional insight, the user may want to consult a statistician.

Toluene

General Statistics

Number of Valid Data	48	Number of Detected Data	3
Number of Distinct Detected Data	3	Number of Non-Detect Data	45
		Percent Non-Detects	93.75%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.2	Minimum Detected	-1.609
Maximum Detected	0.62	Maximum Detected	-0.478
Mean of Detected	0.47	Mean of Detected	-0.872
SD of Detected	0.234	SD of Detected	0.639
Minimum Non-Detect	0.5	Minimum Non-Detect	-0.693
Maximum Non-Detect	1	Maximum Non-Detect	0

Note: Data have multiple DLs - Use of KM Method is recommended	Number treated as Non-Detect	48
For all methods (except KM, DL/2, and ROS Methods),	Number treated as Detected	0
Observations < Largest ND are treated as NDs	Single DL Non-Detect Percentage	100.00%

Warning: There are only 3 Distinct Detected Values in this data set
The number of detected data may not be adequate enough to perform GOF tests, bootstrap, and ROS methods.
Those methods will return a 'N/A' value on your output display!

It is necessary to have 4 or more Distinct Values for bootstrap methods.
However, results obtained using 4 to 9 distinct values may not be reliable.
It is recommended to have 10 to 15 or more observations for accurate and meaningful results and estimates.

UCL Statistics

Normal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.803
5% Shapiro Wilk Critical Value	0.767
Data appear Normal at 5% Significance Level	

Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.783
5% Shapiro Wilk Critical Value	0.767
Data appear Lognormal at 5% Significance Level	

Assuming Normal Distribution	
DL/2 Substitution Method	
Mean	0.404
SD	0.13
95% DL/2 (t) UCL	0.436
Maximum Likelihood Estimate(MLE) Method	N/A
MLE method failed to converge properly	

Assuming Lognormal Distribution	
DL/2 Substitution Method	
Mean	-0.964
SD	0.358
95% H-Stat (DL/2) UCL	0.447
Log ROS Method	
Mean in Log Scale	-1.521
SD in Log Scale	0.539
Mean in Original Scale	0.252
SD in Original Scale	0.141
95% t UCL	0.286
95% Percentile Bootstrap UCL	0.287
95% BCA Bootstrap UCL	0.288

Gamma Distribution Test with Detected Values Only	
k star (bias corrected)	N/A
Theta Star	N/A
nu star	N/A
A-D Test Statistic	N/A
5% A-D Critical Value	N/A
K-S Test Statistic	N/A
5% K-S Critical Value	N/A
Data not Gamma Distributed at 5% Significance Level	

Assuming Gamma Distribution	
Gamma ROS Statistics using Extrapolated Data	
Minimum	N/A
Maximum	N/A
Mean	N/A
Median	N/A
SD	N/A
k star	N/A
Theta star	N/A
Nu star	N/A
AppChi2	N/A
95% Gamma Approximate UCL	N/A
95% Adjusted Gamma UCL	N/A

Note: DL/2 is not a recommended method.

Data Distribution Test with Detected Values Only
Data appear Normal at 5% Significance Level

Nonparametric Statistics	
Kaplan-Meier (KM) Method	
Mean	0.239
SD	0.119
SE of Mean	0.0318
95% KM (t) UCL	0.292
95% KM (z) UCL	0.291
95% KM (jackknife) UCL	0.477
95% KM (bootstrap t) UCL	0.266
95% KM (BCA) UCL	0.62
95% KM (Percentile Bootstrap) UCL	N/A
95% KM (Chebyshev) UCL	0.377
97.5% KM (Chebyshev) UCL	0.437
99% KM (Chebyshev) UCL	0.555

Potential UCLs to Use	
95% KM (t) UCL	0.292
95% KM (Percentile Bootstrap) UCL	N/A

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). For additional insight, the user may want to consult a statistician.

Ethylbenzene

General Statistics

Number of Valid Data	48	Number of Detected Data	13
Number of Distinct Detected Data	13	Number of Non-Detect Data	35
		Percent Non-Detects	72.92%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.74	Minimum Detected	-0.301
Maximum Detected	8.6	Maximum Detected	2.152
Mean of Detected	2.96	Mean of Detected	0.872
SD of Detected	2.129	SD of Detected	0.683
Minimum Non-Detect	0.5	Minimum Non-Detect	-0.693
Maximum Non-Detect	1	Maximum Non-Detect	0

Note: Data have multiple DLs - Use of KM Method is recommended	Number treated as Non-Detect	37
For all methods (except KM, DL/2, and ROS Methods),	Number treated as Detected	11
Observations < Largest ND are treated as NDs	Single DL Non-Detect Percentage	77.08%

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.85	Shapiro Wilk Test Statistic	0.991
5% Shapiro Wilk Critical Value	0.866	5% Shapiro Wilk Critical Value	0.866
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	

Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	1.093	Mean	-0.471
SD	1.578	SD	0.943
95% DL/2 (t) UCL	1.475	95% H-Stat (DL/2) UCL	1.332
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	-0.881
		SD in Log Scale	1.402
		Mean in Original Scale	1.034
		SD in Original Scale	1.617
		95% t UCL	1.425
		95% Percentile Bootstrap UCL	1.427
		95% BCA Bootstrap UCL	1.546

Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**
k star (bias corrected)	1.975	**Data appear Gamma Distributed at 5% Significance Level**
Theta Star	1.498	
nu star	51.36	
A-D Test Statistic	0.17	**Nonparametric Statistics**
5% A-D Critical Value	0.741	Kaplan-Meier (KM) Method
K-S Test Statistic	0.741	Mean 1.347
5% K-S Critical Value	0.239	SD 1.449
Data appear Gamma Distributed at 5% Significance Level		SE of Mean 0.218
		95% KM (t) UCL 1.712
Assuming Gamma Distribution		95% KM (z) UCL 1.705
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL 1.644

Minimum	1.000E-12	95% KM (bootstrap t) UCL	1.904
Maximum	8.6	95% KM (BCA) UCL	2.394
Mean	3.29	95% KM (Percentile Bootstrap) UCL	1.958
Median	3.201	95% KM (Chebyshev) UCL	2.296
SD	1.959	97.5% KM (Chebyshev) UCL	2.707
k star	0.455	99% KM (Chebyshev) UCL	3.514
Theta star	7.233		
Nu star	43.67	**Potential UCLs to Use**	
AppChi2	29.52	95% KM (t) UCL	1.712
95% Gamma Approximate UCL	4.868		
95% Adjusted Gamma UCL	4.929		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). For additional insight, the user may want to consult a statistician.

mpXylene

General Statistics

Number of Valid Data	48	Number of Detected Data	6
Number of Distinct Detected Data	6	Number of Non-Detect Data	42
		Percent Non-Detects	87.50%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.705	Minimum Detected	-0.35
Maximum Detected	2.3	Maximum Detected	0.833
Mean of Detected	1.459	Mean of Detected	0.31
SD of Detected	0.559	SD of Detected	0.416
Minimum Non-Detect	0.5	Minimum Non-Detect	-0.693
Maximum Non-Detect	1	Maximum Non-Detect	0

Note: Data have multiple DLs - Use of KM Method is recommended	Number treated as Non-Detect	43
For all methods (except KM, DL/2, and ROS Methods).	Number treated as Detected	5
Observations < Largest ND are treated as NDs	Single DL Non-Detect Percentage	89.58%

Warning: There are only 6 Detected Values in this data

Note: It should be noted that even though bootstrap may be performed on this data set the resulting calculations may not be reliable enough to draw conclusions

It is recommended to have 10-15 or more distinct observations for accurate and meaningful results.

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.991	Shapiro Wilk Test Statistic	0.975
5% Shapiro Wilk Critical Value	0.788	5% Shapiro Wilk Critical Value	0.788
Data appear Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	0.542	Mean	-0.784

SD	0.411	SD	0.54
95% DL/2 (t) UCL	0.641	95% H-Stat (DL/2) UCL	0.614
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		*Mean in Log Scale*	-1.506
		SD in Log Scale	1.074
		Mean in Original Scale	0.39
		SD in Original Scale	0.48
		95% t UCL	0.506
		95% Percentile Bootstrap UCL	0.501
		95% BCA Bootstrap UCL	0.518
Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**	
k star (bias corrected)	3.893	**Data appear Normal at 5% Significance Level**	
Theta Star	0.375		
nu star	46.72		
A-D Test Statistic	0.171	**Nonparametric Statistics**	
5% A-D Critical Value	0.698	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.698	Mean	0.799
5% K-S Critical Value	0.333	SD	0.308
Data appear Gamma Distributed at 5% Significance Level		SE of Mean	0.0487
		95% KM (t) UCL	0.881
Assuming Gamma Distribution		95% KM (z) UCL	0.879
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	1.013
Minimum	0.336	95% KM (bootstrap t) UCL	0.877
Maximum	3.394	95% KM (BCA) UCL	1.517
Mean	2.189	95% KM (Percentile Bootstrap) UCL	1.465
Median	2.301	95% KM (Chebyshev) UCL	1.011
SD	0.83	97.5% KM (Chebyshev) UCL	1.103
k star	4.818	99% KM (Chebyshev) UCL	1.284
Theta star	0.454		
Nu star	462.5	**Potential UCLs to Use**	
AppChi2	413.7	95% KM (t) UCL	0.881
95% Gamma Approximate UCL	2.448	95% KM (Percentile Bootstrap) UCL	1.465
95% Adjusted Gamma UCL	2.456		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). For additional insight, the user may want to consult a statistician.

oXylene

General Statistics

Number of Valid Data	48	Number of Detected Data	18
Number of Distinct Detected Data	13	Number of Non-Detect Data	30
		Percent Non-Detects	62.50%
Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	0.79	Minimum Detected	-0.236
Maximum Detected	8.45	Maximum Detected	2.134

Mean of Detected	2.344	Mean of Detected	0.687
SD of Detected	1.753	SD of Detected	0.542
Minimum Non-Detect	0.5	Minimum Non-Detect	-0.693
Maximum Non-Detect	1	Maximum Non-Detect	0

Note: Data have multiple DLs - Use of KM Method is recommended		Number treated as Non-Detect	31
For all methods (except KM, DL/2, and ROS Methods).		Number treated as Detected	17
Observations < Largest ND are treated as NDs		Single DL Non-Detect Percentage	64.58%

UCL Statistics

Normal Distribution Test with Detected Values Only		Lognormal Distribution Test with Detected Values Only	
Shapiro Wilk Test Statistic	0.672	Shapiro Wilk Test Statistic	0.918
5% Shapiro Wilk Critical Value	0.897	5% Shapiro Wilk Critical Value	0.897
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	
Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	1.139	Mean	-0.32
SD	1.418	SD	0.892
95% DL/2 (t) UCL	1.483	95% H-Stat (DL/2) UCL	1.443
Maximum Likelihood Estimate(MLE) Method	N/A	Log ROS Method	
MLE yields a negative mean		Mean in Log Scale	-0.364
		SD in Log Scale	1.012
		Mean in Original Scale	1.153
		SD in Original Scale	1.42
		95% t UCL	1.497
		95% Percentile Bootstrap UCL	1.495
		95% BCA Bootstrap UCL	1.632

Gamma Distribution Test with Detected Values Only		Data Distribution Test with Detected Values Only	
k star (bias corrected)	2.689	**Data appear Lognormal at 5% Significance Level**	
Theta Star	0.872		
nu star	96.79		
A-D Test Statistic	0.99	**Nonparametric Statistics**	
5% A-D Critical Value	0.745	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.745	Mean	1.373
5% K-S Critical Value	0.205	SD	1.286
Data not Gamma Distributed at 5% Significance Level		SE of Mean	0.191
		95% KM (t) UCL	1.693
Assuming Gamma Distribution		95% KM (z) UCL	1.687
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	1.666
Minimum	0.79	95% KM (bootstrap t) UCL	1.854
Maximum	8.45	95% KM (BCA) UCL	2.029
Mean	2.323	95% KM (Percentile Bootstrap) UCL	1.899
Median	2.268	95% KM (Chebyshev) UCL	2.206
SD	1.057	97.5% KM (Chebyshev) UCL	2.566
k star	7.681	99% KM (Chebyshev) UCL	3.274
Theta star	0.302		
Nu star	737.4	**Potential UCLs to Use**	
AppChi2	675.4	95% KM (t) UCL	1.693
95% Gamma Approximate UCL	2.536	95% KM (% Bootstrap) UCL	1.899

95% Adjusted Gamma UCL	2.543

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. *These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006).* For additional insight, the user may want to consult a statistician.

Xylenes

General Statistics

Number of Valid Data	48	Number of Detected Data	19
Number of Distinct Detected Data	16	Number of Non-Detect Data	29
		Percent Non-Detects	60.42%

Raw Statistics		**Log-transformed Statistics**	
Minimum Detected	1.04	Minimum Detected	0.0392
Maximum Detected	8.7	Maximum Detected	2.163
Mean of Detected	2.984	Mean of Detected	0.949
SD of Detected	1.883	SD of Detected	0.526
Minimum Non-Detect	0.5	Minimum Non-Detect	-0.693
Maximum Non-Detect	1	Maximum Non-Detect	0

Note: Data have multiple DLs - Use of KM Method is recommended	Number treated as Non-Detect	29
For all methods (except KM, DL/2, and ROS Methods).	Number treated as Detected	19
Observations < Largest ND are treated as NDs	Single DL Non-Detect Percentage	60.42%

UCL Statistics

Normal Distribution Test with Detected Values Only		**Lognormal Distribution Test with Detected Values Only**	
Shapiro Wilk Test Statistic	0.792	Shapiro Wilk Test Statistic	0.946
5% Shapiro Wilk Critical Value	0.901	5% Shapiro Wilk Critical Value	0.901
Data not Normal at 5% Significance Level		**Data appear Lognormal at 5% Significance Level**	

Assuming Normal Distribution		**Assuming Lognormal Distribution**	
DL/2 Substitution Method		DL/2 Substitution Method	
Mean	1.431	Mean	-0.188
SD	1.726	SD	1.018
95% DL/2 (t) UCL	1.849	95% H-Stat (DL/2) UCL	1.975
Maximum Likelihood Estimate(MLE) Method		Log ROS Method	
Mean	0.128	Mean in Log Scale	-0.0358
SD	3.004	SD in Log Scale	0.982
95% MLE (t) UCL	0.856	Mean in Original Scale	1.537
95% MLE (Tiku) UCL	1.167	SD in Original Scale	1.677
		95% t UCL	1.943
		95% Percentile Bootstrap UCL	1.959
		95% BCA Bootstrap UCL	2.092

Gamma Distribution Test with Detected Values Only		**Data Distribution Test with Detected Values Only**
k star (bias corrected)	3.08	**Data Follow Appr. Gamma Distribution at 5% Significance Level**
Theta Star	0.969	
nu star	117	

A-D Test Statistic	0.776	**Nonparametric Statistics**	
5% A-D Critical Value	0.746	Kaplan-Meier (KM) Method	
K-S Test Statistic	0.746	Mean	1.809
5% K-S Critical Value	0.2	SD	1.495
Data follow Appr. Gamma Distribution at 5% Significance Level		SE of Mean	0.222
		95% KM (t) UCL	2.181
Assuming Gamma Distribution		95% KM (z) UCL	2.174
Gamma ROS Statistics using Extrapolated Data		95% KM (jackknife) UCL	2.157
Minimum	1.04	95% KM (bootstrap t) UCL	2.287
Maximum	8.7	95% KM (BCA) UCL	2.517
Mean	3.014	95% KM (Percentile Bootstrap) UCL	2.438
Median	3.008	95% KM (Chebyshev) UCL	2.776
SD	1.169	97.5% KM (Chebyshev) UCL	3.194
k star	8.285	99% KM (Chebyshev) UCL	4.015
Theta star	0.364		
Nu star	795.4	**Potential UCLs to Use**	
AppChi2	731	95% KM (t) UCL	2.181
95% Gamma Approximate UCL	3.28		
95% Adjusted Gamma UCL	3.288		

Note: DL/2 is not a recommended method.

Note: Suggestions regarding the selection of a 95% UCL are provided to help the user to select the most appropriate 95% UCL. These recommendations are based upon the results of the simulation studies summarized in Singh, Maichle, and Lee (2006). For additional insight, the user may want to consult a statistician.

ATTACHMENT E
MODEL INPUTS AND RESULTS

GW-SCREEN
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
71432	5.66E+00	Benzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
200	833	S	11	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S			S	1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
		70	30	30	350

Used to calculate risk-based groundwater concentration.

END

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
633	0.321	0.003	9.94E-08	0.998	9.92E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
2.54E+04	1.80E+06	2.22E-04	200	8,112	2.82E-03	1.21E-01	1.76E-04	1.42E-02	5.70E-04	8.64E-03

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
633	200	6.85E+02	0.10	6.84E+01	1.42E-02	4.00E+02	1.74E+52	7.12E-04	4.87E-01	7.8E-06	3.0E-02

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.79E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
1.6E-06	1.6E-02

MESSAGE SUMMARY BELOW:

END

GW-SCREEN
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
100414	2.96E+00	Ethylbenzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
200	833	S	11	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S			S	1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
		70	30	30	350

Used to calculate risk-based groundwater concentration.

END

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
633	0.321	0.003	9.94E-08	0.998	9.92E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
2.54E+04	1.80E+06	2.22E-04	200	10,144	3.38E-03	1.45E-01	1.76E-04	1.21E-02	4.84E-04	7.36E-03

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
633	200	4.29E+02	0.10	6.84E+01	1.21E-02	4.00E+02	1.97E+61	6.31E-04	2.71E-01	NA	1.0E+00

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.69E+05	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	2.6E-04

MESSAGE SUMMARY BELOW:

END

GW-SCREEN
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
108383	4.34E+00	m-Xylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
200	833	S	11	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^v (g/cm^3)	ENTER Vadose zone soil total porosity, n^v (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^v (cm^3/cm^3)
S			S	1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
		70	30	30	350

Used to calculate risk-based groundwater concentration.

END

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^v (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
633	0.321	0.003	9.94E-08	0.998	9.92E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_v (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
2.54E+04	1.80E+06	2.22E-04	200	10,243	3.12E-03	1.34E-01	1.76E-04	1.13E-02	4.53E-04	6.87E-03

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
633	200	5.81E+02	0.10	6.84E+01	1.13E-02	4.00E+02	4.71E+65	5.98E-04	3.48E-01	NA	1.0E-01

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.61E+05	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	3.3E-03

MESSAGE SUMMARY BELOW:

END

]

GW-SCREEN
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
95476	2.56E+00	o-Xylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
200	833	S	11	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S			S	1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
		70	30	30	350

Used to calculate risk-based groundwater concentration.

END

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
633	0.321	0.003	9.94E-08	0.998	9.92E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
2.54E+04	1.80E+06	2.22E-04	200	10,393	2.18E-03	9.36E-02	1.76E-04	1.41E-02	5.65E-04	8.56E-03

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
633	200	2.39E+02	0.10	6.84E+01	1.41E-02	4.00E+02	6.92E+52	7.06E-04	1.69E-01	NA	1.0E-01

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
633	0.321	0.003	9.94E-08	0.998	9.92E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
2.54E+04	1.80E+06	2.22E-04	200	10,237	3.26E-03	1.40E-01	1.76E-04	1.24E-02	4.97E-04	7.55E-03

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe') (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
633	200	6.07E+02	0.10	6.84E+01	1.24E-02	4.00E+02	6.03E+59	6.43E-04	3.90E-01	NA	1.0E-01

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.85E+05	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	3.7E-03

MESSAGE SUMMARY BELOW:

END

GW-SCREEN
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
108883	1.09E+00	Toluene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
200	833	S	11	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S			S	1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
		70	30	30	350

Used to calculate risk-based groundwater concentration.

END

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
633	0.321	0.003	9.94E-08	0.998	9.92E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
2.54E+04	1.80E+06	2.22E-04	200	9,144	3.10E-03	1.33E-01	1.76E-04	1.41E-02	5.62E-04	8.54E-03

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
633	200	1.45E+02	0.10	6.84E+01	1.41E-02	4.00E+02	6.93E+52	7.05E-04	1.02E-01	NA	4.0E-01

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	5.26E+05	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	2.4E-04

MESSAGE SUMMARY BELOW:

END

GW-SCREEN
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
71432	1.62E+00	Benzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
200	833	S	11	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S			S	1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
		70	30	30	350

Used to calculate risk-based groundwater concentration.

END

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
633	0.321	0.003	9.94E-08	0.998	9.92E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
2.54E+04	1.80E+06	2.22E-04	200	8,112	2.82E-03	1.21E-01	1.76E-04	1.42E-02	5.70E-04	8.64E-03

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
633	200	1.96E+02	0.10	6.84E+01	1.42E-02	4.00E+02	1.74E+52	7.12E-04	1.39E-01	7.8E-06	3.0E-02

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.79E+06	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
4.5E-07	4.5E-03

MESSAGE SUMMARY BELOW:

END

GW-SCREEN
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
100414	1.71E+00	Ethylbenzene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
200	833	S	11	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S			S	1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
		70	30	30	350

Used to calculate risk-based groundwater concentration.

END

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^v (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
633	0.321	0.003	9.94E-08	0.998	9.92E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_v (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
2.54E+04	1.80E+06	2.22E-04	200	10,144	3.38E-03	1.45E-01	1.76E-04	1.21E-02	4.84E-04	7.36E-03

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
633	200	2.48E+02	0.10	6.84E+01	1.21E-02	4.00E+02	1.97E+61	6.31E-04	1.56E-01	NA	1.0E+00

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.69E+05	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, *carcinogen* (unitless)	Hazard quotient from vapor intrusion to indoor air, *noncarcinogen* (unitless)
NA	1.5E-04

MESSAGE SUMMARY BELOW:

END

GW-SCREEN
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
108383	8.80E-01	m-Xylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
200	833	S	11	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S			S	1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
		70	30	30	350

Used to calculate risk-based groundwater concentration.

END

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
633	0.321	0.003	9.94E-08	0.998	9.92E-08	17.05	0.375	0.122	0.253	4,000

Bldg. *ventilation* rate, $Q_{building}$ (cm^3/s)	Area of enclosed space *below* grade, A_B (cm^2)	Crack-to-total *area* ratio, η (unitless)	Crack depth *below* grade, Z_{crack} (cm)	Enthalpy of vaporization at *ave. groundwater* temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at *ave. groundwater* temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at *ave. groundwater* temperature, H'_{TS} (unitless)	Vapor viscosity at *ave. soil* temperature, μ_{TS} (g/cm-s)	Vadose zone effective *diffusion* coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective *diffusion* coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective *diffusion* coefficient, D^{eff}_T (cm^2/s)
2.54E+04	1.80E+06	2.22E-04	200	10,243	3.12E-03	1.34E-01	1.76E-04	1.13E-02	4.53E-04	6.87E-03

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
633	200	1.18E+02	0.10	6.84E+01	1.13E-02	4.00E+02	4.71E+65	5.98E-04	7.05E-02	NA	1.0E-01

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.61E+05	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	6.8E-04

MESSAGE SUMMARY BELOW:

END

GW-SCREEN
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
95476	1.69E+00	o-Xylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type *directly above* water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
200	833	S	11	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S			S	1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
		70	30	30	350

Used to calculate risk-based groundwater concentration.

END

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
633	0.321	0.003	9.94E-08	0.998	9.92E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
2.54E+04	1.80E+06	2.22E-04	200	10,393	2.18E-03	9.36E-02	1.76E-04	1.41E-02	5.65E-04	8.56E-03

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
633	200	1.58E+02	0.10	6.84E+01	1.41E-02	4.00E+02	6.92E+52	7.06E-04	1.12E-01	NA	1.0E-01

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.78E+05	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor *intrusion to* indoor air, carcinogen (unitless)	Hazard quotient from vapor *intrusion to* indoor air, noncarcinogen (unitless)
NA	1.1E-03

MESSAGE SUMMARY BELOW:

END

GW-SCREEN
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
106423	8.80E-01	p-Xylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
200	833	S	11	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S			S	1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
		70	30	30	350

Used to calculate risk-based groundwater concentration.

END

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
633	0.321	0.003	9.94E-08	0.998	9.92E-08	17.05	0.375	0.122	0.253	4.000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
2.54E+04	1.80E+06	2.22E-04	200	10,237	3.26E-03	1.40E-01	1.76E-04	1.24E-02	4.97E-04	7.55E-03

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, exp(Pe^f) (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
633	200	1.23E+02	0.10	6.84E+01	1.24E-02	4.00E+02	6.03E+59	6.43E-04	7.91E-02	NA	1.0E-01

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.85E+05	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	7.6E-04

MESSAGE SUMMARY BELOW:

END

GW-SCREEN
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
108883	2.90E-01	Toluene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
200	833	S	11	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S			S	1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
		70	30	30	350

Used to calculate risk-based groundwater concentration.

END

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
633	0.321	0.003	9.94E-08	0.998	9.92E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	*Henry's law* constant at ave. groundwater temperature, H_{TS} (atm-m^3/mol)	*Henry's law* constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
2.54E+04	1.80E+06	2.22E-04	200	9,144	3.10E-03	1.33E-01	1.76E-04	1.41E-02	5.62E-04	8.54E-03

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF $(\mu g/m^3)^{-1}$	Reference conc., RfC (mg/m^3)
633	200	3.85E+01	0.10	6.84E+01	1.41E-02	4.00E+02	6.93E+52	7.05E-04	2.72E-02	NA	4.0E-01

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	5.26E+05	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	6.5E-05

MESSAGE SUMMARY BELOW:

END

]

GW-SCREEN
Version 3.1; 02/04

Reset to Defaults

CALCULATE RISK-BASED GROUNDWATER CONCENTRATION (enter "X" in "YES" box)

YES [ ]

OR

CALCULATE INCREMENTAL RISKS FROM ACTUAL GROUNDWATER CONCENTRATION
(enter "X" in "YES" box and initial groundwater conc. below)

YES [X]

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
106423	4.34E+00	p-Xylene

MORE ↓

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
200	833	S	11	

MORE ↓

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm^2)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm^3)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm^3/cm^3)
S			S	1.66	0.375	0.054

MORE ↓

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
		70	30	30	350

Used to calculate risk-based groundwater concentration.

END

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
NA	NA	NA	1.78E+05	NA

INCREMENTAL RISK CALCULATIONS:

Incremental risk from vapor intrusion to indoor air, carcinogen (unitless)	Hazard quotient from vapor intrusion to indoor air, noncarcinogen (unitless)
NA	1.6E-03

MESSAGE SUMMARY BELOW:

END

]