FINAL

Focused Corrective Measures Study for Groundwater at Site SS-45

Volume II - Appendices



England Air Force Base
Alexandria, Louisiana

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Prepared For

Air Force Center for Environmental Excellence
Technology Transfer Division
Brooks Air Force Base
San Antonio, Texas

and

England Air Force Base Conversion Agency
Alexandria, Louisiana

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Walton, Norman

From: Hansen, Jerry E, Mr, HQAFCEE [Jerry.Hansen@HQAFCEE.brooks.af.mil]
Sent: Tuesday, August 08, 2000 10:16 AM
To: 'nwalton@dtic.mil'
Subject: Distribution statement for AFCEE/ERT reports

Norman, This is a followup to our phone call. The eight boxes of reports you received from us are all for unlimited distribution. If you have any questions, you can contact me at DSN 240-4353.

FINAL

FOCUSED CORRECTIVE MEASURES STUDY FOR GROUNDWATER AT SITE SS-45

ENGLAND AIR FORCE BASE
ALEXANDRIA, LOUISIANA

VOLUME II - APPENDICES

FEBRUARY 2000

Prepared For:

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San Antonio, Texas

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England Air Force Base Conversion Agency
Alexandria, Louisiana

Prepared By:

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Denver, Colorado

APPENDIX A

SELECTED TABLES FROM THE SS-45 RCRA FACILITY INVESTIGATION REPORT (LAW, 1998a)

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L001DP	A39L001DP	A39L001DP	A39L001DP	A39L001DP	A39L002BH
	Sample Depth (ft):	16 - 18	24 - 26	44 - 47	64 - 67	71 - 74	26 - 28
	Sample Date:	3/15/96	3/15/96	3/15/96	3/16/96	3/16/96	3/5/96
	Geologic Unit:	Shallow Silt/Clay	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<1.0	<1.0	<0.5	<1.0	<0.5	<1.0
1,1-Dichloroethene		NA	NA	<0.5	NA	<0.5	NA
Benzene		<1.0	<1.0	<0.5	<1.0	<0.5	<1.0
cis-1,2-Dichloroethene		<1.0	<1.0	0.713	<1.0	<0.5	<1.0
Ethylbenzene		<1.0	<1.0	<0.5	<1.0	<0.5	<1.0
Toluene		<1.0	<1.0	<0.5	<1.0	<0.5	<1.0
Total 1,2-Dichloroethene		<1.0	<1.0	0.713	<1.0	<0.5	<1.0
trans-1,2-Dichloroethene		<1.0	<1.0	<0.5	<1.0	<0.5	<1.0
Trichloroethene		<1.0	<1.0	3.61	<1.0	<0.5	<1.0
Vinyl Chloride		<1.0	<1.0	0.92	<1.0	<2.0	<1.0
Xylenes (total)		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

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SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L002BH	A39L002BH	A39L002BH	A39L002DP	A39L002DP	A39L002DP
	Sample Depth (ft):	33 - 35	64 - 66	71 - 73	20 - 22	43 - 45	62 - 64
	Sample Date:	3/5/96	3/6/96	3/6/96	3/17/96	3/17/96	3/17/96
	Geologic Unit:	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<1.0	<1.0	<0.5	<1.0	<10	<10
1,1-Dichloroethene		NA	NA	<0.5	NA	<10	NA
Benzene		<1.0	<1.0	<0.5	<1.0	<10	<10
cis-1,2-Dichloroethene		<1.0	<1.0	8.86	1.98	3.82 JQ	<10
Ethylbenzene		<1.0	<1.0	<0.5	<1.0	<10	<10
Toluene		<1.0	<1.0	<0.5	<1.0	<10	<10
Total 1,2-Dichloroethene		<1.0	<1.0	9.19	1.98	3.82	<10
trans-1,2-Dichloroethene		<1.0	<1.0	0.33 JQ	<1.0	<10	<10
Trichloroethene		<1.0	<1.0	<0.5	<1.0	458	218
Vinyl Chloride		<1.0	<1.0	<2.0	<1.0	<40	<10
Xylenes (total)		<1.0	<1.0	<1.0	<1.0	<20	<10

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Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L002DP	A39L002DP	A39L003BII	A39L003BII	A39L003BII	A39L003BII
	Sample Depth (ft):	71 - 73	88 - 90	21 - 22	71 - 73	93 - 95.5	105 - 107
	Sample Date:	3/17/96	3/18/96	3/15/96	3/15/96	3/16/96	3/16/96
	Geologic Unit:	Intermediate Sand	Deep Sand	Shallow Silt/Clay	Intermediate Sand	Deep Sand	Deep Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<2.0	<1.0	<1.0	<1.0	<1.0	<2.0
Benzene		<2.0	<1.0	<1.0	<1.0	<1.0	<2.0
cis-1,2-Dichloroethene		27.3	8.5	<1.0	9.49	<1.0	<2.0
Ethylbenzene		<2.0	<1.0	<1.0	<1.0	<1.0	<2.0
Toluene		<2.0	<1.0	<1.0	<1.0	<1.0	<2.0
Total 1,2-Dichloroethene		27.3	15.1	<1.0	9.49	<1.0	<2.0
trans-1,2-Dichloroethene		<2.0	6.6	<1.0	<1.0	<1.0	<2.0
Trichloroethene		15.3	<1.0	<1.0	<1.0	<1.0	<2.0
Vinyl Chloride		<2.0	<5.0	<1.0	<1.0	<1.0	<2.0
Xylenes (total)		<2.0	<2.0	<1.0	<1.0	<1.0	<2.0

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Group/Analyte	Boring Number:	A39L003BH	A39L003DP	A39L003DP	A39L003DP	A39L003DP	A39L003DP
	Sample Depth (ft):	118 - 120	20 - 22	42 - 44	55 - 57	71 - 73	96 - 98
	Sample Date:	3/16/96	3/17/96	3/17/96	3/18/96	3/18/96	3/18/96
	Geologic Unit:	Deep Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Intermediate Sand	Deep Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<0.5	<1.0	<1.0	<10	<1.0	<1.0
1,1-Dichloroethene		<0.5	NA	NA	NA	NA	NA
Benzene		<0.5	<1.0	<1.0	<10	<1.0	<1.0
cis-1,2-Dichloroethene		1.68	<1.0	1.28	<10	14.8	<1.0
Ethylbenzene		<0.5	<1.0	<1.0	<10	<1.0	<1.0
Toluene		<0.5	<1.0	<1.0	<1.0	<1.0	<1.0
Total 1,2-Dichloroethene		1.68	<1.0	1.28	<10	14.8	<1.0
trans-1,2-Dichloroethene		<0.5	<1.0	<1.0	<10	<5.0	<1.0
Trichloroethene		<0.5	<1.0	53.9	171	<1.0	<1.0
Vinyl Chloride		<2.0	<1.0	<1.0	<10	<5.0	<1.0
Xylenes (total)		<1.0	<1.0	<1.0	<10	<2.0	<1.0

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SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L003DP	A39L004DP	A39L004DP	A39L004DP	A39L004DP	A39L005DP
	Sample Depth (ft):	116 - 118	20 - 22	38 - 40	58 - 60	71 - 73	20 - 22
	Sample Date:	3/19/96	3/21/96	3/21/96	3/21/96	3/21/96	3/20/96
	Geologic Unit:	Deep Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<0.5	<1.0	<1.0	<4.0	<1.0	<1.0
1,1-Dichloroethene		<0.5	NA	NA	<4.0	NA	NA
Benzene		<0.5	<1.0	<1.0	<4.0	<1.0	<1.0
cis-1,2-Dichloroethene		<0.5	<5.0	16	10.9	<5.0	<5.0
Ethylbenzene		<0.5	<1.0	<1.0	<4.0	<1.0	<1.0
Toluene		<0.5	<1.0	<1.0	<4.0	<1.0	<1.0
Total 1,2-Dichloroethene		<0.5	<5.0	16	10.9	<5.0	<5.0
trans-1,2-Dichloroethene		<0.5	<5.0	<5.0	<4.0	<5.0	<5.0
Trichloroethene		<0.5	<1.0	21.5	507	1.6	<1.0
Vinyl Chloride		<2.0	<5.0	<5.0	<16	<5.0	<5.0
Xylenes (total)		<1.0	<2.0	<2.0	<8.0	<2.0	<1.0

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England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L005DP	A39L005DP	A39L005DP	A39L006DP	A39L006DP	A39L006DP
	Sample Depth (ft):	40 - 42	55 - 57	71 - 73	20 - 22	53 - 55	63 - 65
	Sample Date:	3/20/96	3/20/96	3/20/96	3/19/96	3/20/96	3/20/96
	Geologic Unit:	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<1.0	<1.0	<0.5	<1.0	<1.0	<2.0
1,1-Dichloroethene		NA	NA	<0.5	NA	NA	NA
Benzene		<1.0	<1.0	<0.5	<1.0	<1.0	<2.0
cis-1,2-Dichloroethene		<5.0	<5.0	<0.5	<5.0	<5.0	<2.0
Ethylbenzene		<1.0	<1.0	<0.5	<1.0	<1.0	<2.0
Toluene		<1.0	<1.0	<0.5	<1.0	<1.0	<2.0
Total 1,2-Dichloroethene		<5.0	<5.0	<0.5	<5.0	<5.0	<2.0
trans-1,2-Dichloroethene		<5.0	<5.0	<0.5	<5.0	<5.0	<2.0
Trichloroethene		2.3	4.9	<0.5	<1.0	3.4	<2.0
Vinyl Chloride		<5.0	<5.0	<2.0	<5.0	<5.0	<2.0
Xylenes (total)		<2.0	<2.0	<1.0	<2.0	<2.0	<2.0

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SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L006DP	A39L007DP	A39L007DP	A39L007DP	A39L007DP	A39L008DP
	Sample Depth (ft):	71 - 73	20 - 22	41 - 43	58 - 60	70 - 72	20 - 23
	Sample Date:	3/20/96	3/22/96	3/22/96	3/22/96	3/22/96	3/29/96
	Geologic Unit:	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<0.5	<1.0	<1.0	<1.0	<0.5	<1.0
1,1-Dichloroethene		<0.5	NA	NA	NA	<0.5	NA
Benzene		<0.5	<1.0	<1.0	<1.0	<0.5	<1.0
cis-1,2-Dichloroethene		0.641	<5.0	<5.0	<5.0	<0.5	<1.0
Ethylbenzene		<0.5	<1.0	<1.0	<1.0	<0.5	<1.0
Toluene		<0.5	<1.0	<1.0	<1.0	<0.5	<1.0
Total 1,2-Dichloroethene		0.641	<5.0	<5.0	<5.0	<0.5	<1.0
trans-1,2-Dichloroethene		<0.5	<5.0	<5.0	<5.0	<0.5	<1.0
Trichloroethene		3.44	<1.0	<1.0	2.0	<0.5	<1.0
Vinyl Chloride		<2.0	<5.0	<5.0	<5.0	<2.0	<1.0
Xylenes (total)		<1.0	<2.0	<2.0	<2.0	<1.0	<1.0

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Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L008DP	A39L008DP	A39L008DP	A39L009DP	A39L009DP	A39L009DP
	Sample Depth (ft):	40 - 42	56 - 58	71 - 73	24 - 26	44 - 46	57 - 59
	Sample Date:	3/29/96	3/29/96	3/29/96	3/31/96	3/31/96	3/31/96
	Geologic Unit:	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<0.5	<1.0	<2.0	<1.0	<1.0	<2.0
1,1-Dichloroethene		<0.5	NA	NA	NA	NA	NA
Benzene		<0.5	<1.0	<2.0	<1.0	<1.0	<2.0
cis-1,2-Dichloroethene		<0.5	2.87	<2.0	<1.0	<1.0	<2.0
Ethylbenzene		<0.5	<1.0	<2.0	<1.0	<1.0	<2.0
Toluene		<0.5	<1.0	<2.0	<1.0	<1.0	<2.0
Total 1,2-Dichloroethene		<0.5	2.87	<2.0	<1.0	<1.0	<2.0
trans-1,2-Dichloroethene		<0.5	<1.0	<2.0	<1.0	<1.0	<2.0
Trichloroethene		<0.5	14.13	<2.0	<1.0	<1.0	<2.0
Vinyl Chloride		<2.0	<1.0	<2.0	<1.0	<1.0	<2.0
Xylenes (total)		<1.0	<1.0	<2.0	<1.0	<1.0	<2.0

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England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L009DP	A39L010DP	A39L010DP	A39L010DP	A39L010DP	A39L011DP
	Sample Depth (ft):	71 - 73	20 - 22	43 - 45	60 - 62	70 - 71	20 - 22
	Sample Date:	3/31/96	3/21/96	3/21/96	3/21/96	3/21/96	3/22/96
	Geologic Unit:	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<2.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzene		<2.0	<1.0	<1.0	<1.0	<1.0	<1.0
cis-1,2-Dichloroethene		<2.0	<5.0	<5.0	22	15	<5.0
Ethylbenzene		<2.0	<1.0	<1.0	<1.0	<1.0	<1.0
Toluene		<2.0	<1.0	<1.0	<1.0	<1.0	<1.0
Total 1,2-Dichloroethene		<2.0	<5.0	<5.0	22	15	<5.0
trans-1,2-Dichloroethene		<2.0	<5.0	<5.0	<5.0	<5.0	<5.0
Trichloroethene		<2.0	<1.0	12	213	147	<1.0
Vinyl Chloride		<2.0	<5.0	<5.0	<5.0	<5.0	<5.0
Xylenes (total)		<2.0	<2.0	<2.0	<2.0	<2.0	<2.0

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SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L011DP	A39L011DP	A39L011DP	A39L012DP	A39L012DP	A39L012DP
	Sample Depth (ft):	40 - 43	60 - 62	71 - 73	24 - 26	42 - 44	54 - 56
	Sample Date:	3/22/96	3/22/96	3/22/96	4/1/96	4/1/96	4/1/96
	Geologic Unit:	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<1.0	<1.0	<1.0	<0.5	<2.0	<1.0
1,1-Dichloroethene		NA	NA	<5.0	<0.5	NA	NA
Benzene		<1.0	<1.0	<1.0	<0.5	<2.0	<1.0
cis-1,2-Dichloroethene		<5.0	<5.0	46.7	<0.5	<2.0	<1.0
Ethylbenzene		<1.0	<1.0	<1.0	<0.5	<2.0	<1.0
Toluene		<1.0	<1.0	<1.0	0.269 JQ	<2.0	<1.0
Total 1,2-Dichloroethene		<5.0	<5.0	46.7	<0.5	<2.0	<1.0
trans-1,2-Dichloroethene		<5.0	<5.0	<5.0	<0.5	<2.0	<1.0
Trichloroethene		<1.0	10.8	544 J	<0.5	<2.0	<1.0
Vinyl Chloride		<5.0	<5.0	5.1	<2.0	<2.0	<1.0
Xylenes (total)		<2.0	<2.0	<2.0	<1.0	<2.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L012DP	A39L013DP	A39L013DP	A39L013DP	A39L013DP	A39L01 DP
	Sample Depth (ft):	71 - 73	20 - 22	42 - 44	58 - 60	70 - 72	20 - 22
	Sample Date:	4/1/96	3/29/96	3/29/96	3/29/96	3/29/96	3/30/96
	Geologic Unit:	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<1.0	<1.0	<1.0	<1.0	<0.5	<1.0
1,1-Dichloroethene		NA	NA	NA	NA	<0.5	NA
Benzene		<1.0	<1.0	<1.0	<1.0	<0.5	<1.0
cis-1,2-Dichloroethene		<1.0	<1.0	2.12	<1.0	0.963	<1.0
Ethylbenzene		<1.0	<1.0	<1.0	<1.0	<0.5	<1.0
Toluene		<1.0	<1.0	<1.0	<1.0	<0.5	<1.0
Total 1,2-Dichloroethene		<1.0	<1.0	2.12	<1.0	0.963	<1.0
trans-1,2-Dichloroethene		<1.0	<1.0	<1.0	<1.0	<0.5	<1.0
Trichloroethene		<1.0	<1.0	<1.0	<1.0	9.77	<1.0
Vinyl Chloride		<1.0	<1.0	<1.0	<1.0	<2.0	<1.0
Xylenes (total)		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L014DP	A39L014DP	A39L014DP	A39L015DP	A39L015DP	A39L015DP
	Sample Depth (ft):	40 - 42	58 - 60	70 - 72	20 - 22	43 - 45	58 - 60
	Sample Date:	3/30/96	3/31/96	3/31/96	4/1/96	4/1/96	4/1/96
	Geologic Unit:	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<1.0	<0.5	<1.0	<1.0	<1.0	<0.5
1,1-Dichloroethene		NA	<0.5	NA	NA	NA	<0.5
Benzene		<1.0	<0.5	<1.0	<1.0	<1.0	0.251 JQ
cis-1,2-Dichloroethene		<1.0	<0.5	<1.0	<1.0	<1.0	<0.5
Ethylbenzene		<1.0	<0.5	<1.0	<1.0	<1.0	<0.5
Toluene		<1.0	<0.5	<1.0	<1.0	<1.0	<0.5
Total 1,2-Dichloroethene		<1.0	<0.5	<1.0	<1.0	<1.0	<0.5
trans-1,2-Dichloroethene		<1.0	<0.5	<1.0	<1.0	<1.0	<0.5
Trichloroethene		<1.0	<0.5	<1.0	<1.0	<1.0	<0.5
Vinyl Chloride		<1.0	<2.0	<1.0	<1.0	<1.0	<2.0
Xylenes (total)		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L015DP	A39L016DP	A39L016DP	A39L016DP	A39L016DP	A39L017DP
	Sample Depth (ft):	70 - 72	24 - 26	42 - 44	54 - 56	71 - 73	24 - 26
	Sample Date:	4/1/96	4/2/96	4/2/96	4/2/96	4/2/96	4/16/96
	Geologic Unit:	Intermediate Sand	Intermediate Sand	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<1.0	<1.0	<0.5	<1.0	<2.0	<1.0
1,1-Dichloroethene		NA	NA	<0.5	NA	NA	NA
Benzene		<1.0	<1.0	<0.5	<1.0	<2.0	<1.0
cis-1,2-Dichloroethene		<1.0	10.72	11.2 J	3.45	<2.0	<1.0
Ethylbenzene		<1.0	<1.0	<0.5	<1.0	<2.0	<1.0
Toluene		<1.0	<1.0	<0.5	<1.0	<2.0	<1.0
Total 1,2-Dichloroethene		<1.0	12.25	12.23	3.45	<2.0	<1.0
trans-1,2-Dichloroethene		<1.0	1.53	1.03	<1.0	<2.0	<1.0
Trichloroethene		<1.0	1.76	3.47	<1.0	<2.0	<1.0
Vinyl Chloride		<1.0	<1.0	<2.0	10.73	<2.0	<1.0
Xylenes (total)		<1.0	<1.0	<1.0	<1.0	<2.0	<1.0

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JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L017DP	A39L017DP	A39L017DP	A39L018DP	A39L018DP	A39L018DP
	Sample Depth (ft):	44 - 46	58 - 60	71 - 73	20 - 22	48 - 50	58 - 60
	Sample Date:	4/16/96	4/16/96	4/16/96	4/2/96	4/2/96	4/2/96
	Geologic Unit:	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<1.0	<1.0	<0.5	<2.0	<0.5	<2.0
1,1-Dichloroethene		NA	NA	<0.5	NA	<0.5	NA
Benzene		<1.0	<1.0	<0.5	<2.0	<0.5	<2.0
cis-1,2-Dichloroethene		<1.0	<1.0	<0.5	<2.0	<0.5	<2.0
Ethylbenzene		<1.0	<1.0	<0.5	<2.0	<0.5	<2.0
Toluene		<1.0	<1.0	<0.5	<2.0	<0.5	<2.0
Total 1,2-Dichloroethene		<1.0	<1.0	<0.5	<2.0	<0.5	<2.0
trans-1,2-Dichloroethene		<1.0	<1.0	<0.5	<2.0	<0.5	<2.0
Trichloroethene		<1.0	<1.0	<0.5	<2.0	<0.5	<2.0
Vinyl Chloride		<1.0	<1.0	<2.0	<2.0	<2.0	<2.0
Xylenes (total)		<1.0	<1.0	<1.0	<2.0	<1.0	<2.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
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JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L018DP	A39L019DP	A39L019DP	A39L019DP	A39L019DP	A39L020DP
	Sample Depth (ft):	70 - 72	20 - 23	42 - 44	54 - 57	71 - 73	24 - 26
	Sample Date:	4/3/96	4/2/96	4/3/96	4/3/96	4/3/96	4/17/96
	Geologic Unit:	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<1.0	<2.0	<1.0	<2.0	<1.0	<2.0
Benzene		<1.0	<2.0	<1.0	<2.0	<1.0	<2.0
cis-1,2-Dichloroethene		<1.0	<2.0	<1.0	<2.0	<1.0	<2.0
Ethylbenzene		<1.0	<2.0	<1.0	<2.0	<1.0	<2.0
Toluene		<1.0	<2.0	<1.0	<2.0	<1.0	<2.0
Total 1,2-Dichloroethene		<1.0	<2.0	<1.0	<2.0	<1.0	<2.0
trans-1,2-Dichloroethene		<1.0	<2.0	<1.0	<2.0	<1.0	<2.0
Trichloroethene		<1.0	<2.0	<1.0	<2.0	<1.0	<2.0
Vinyl Chloride		<1.0	<2.0	<1.0	<2.0	<1.0	<2.0
Xylenes (total)		<1.0	<2.0	<1.0	<2.0	<1.0	<2.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L020DP	A39L020DP	A39L020DP	A39L021DP	A39L021DP	A39L021DP
	Sample Depth (ft):	43 - 45	58 - 60	71 - 73	20 - 22	40 - 42	58 - 60
	Sample Date:	4/17/96	4/17/96	4/18/96	4/4/96	4/4/96	4/4/96
	Geologic Unit:	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<2.0	<2.0	<2.0	<1.0	<0.5	<1.0
1,1-Dichloroethene		NA	NA	NA	NA	0.234 JQ	NA
Benzene		<2.0	<2.0	<2.0	<1.0	<0.5	<1.0
cis-1,2-Dichloroethene		<2.0	<2.0	<2.0	<1.0	4.17	<1.0
Ethylbenzene		<2.0	<2.0	<2.0	<1.0	<0.5	<1.0
Toluene		<2.0	<2.0	<2.0	<1.0	<0.5	<1.0
Total 1,2-Dichloroethene		<2.0	<2.0	<2.0	<1.0	4.409	<1.0
trans-1,2-Dichloroethene		<2.0	<2.0	<2.0	<1.0	0.239 JQ	<1.0
Trichloroethene		<2.0	<2.0	<2.0	<1.0	15.2	<1.0
Vinyl Chloride		<2.0	<2.0	<2.0	<1.0	<2.0	<1.0
Xylenes (total)		<2.0	<2.0	<2.0	<1.0	<1.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L021DP	A39L022DP	A39L022DP	A39L022DP	A39L022DP	A39L023DP
	Sample Depth (ft):	70 - 72	20 - 22	38 - 40	58 - 60	70 - 72	20 - 23
	Sample Date:	4/4/96	4/3/96	4/3/96	4/3/96	4/3/96	4/3/96
	Geologic Unit:	Intermediate Sand	Shallow Silt/Clay	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<1.0	<1.0	<1.0	<0.5	<2.0	<1.0
1,1-Dichloroethene		NA	NA	NA	<0.5	NA	NA
Benzene		<1.0	<1.0	<1.0	<0.5	<2.0	<1.0
cis-1,2-Dichloroethene		<1.0	<1.0	<1.0	0.842	<2.0	<1.0
Ethylbenzene		<1.0	<1.0	<1.0	<0.5	<2.0	<1.0
Toluene		<1.0	<1.0	<1.0	<0.5	<2.0	<1.0
Total 1,2-Dichloroethene		<1.0	<1.0	<1.0	0.842	<2.0	<1.0
trans-1,2-Dichloroethene		<1.0	<1.0	<1.0	<0.5	<2.0	<1.0
Trichloroethene		<1.0	<1.0	<1.0	7.16	<2.0	<1.0
Vinyl Chloride		<1.0	<1.0	<1.0	<2.0	<2.0	<1.0
Xylenes (total)		<1.0	<1.0	<1.0	<1.0	<2.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L023DP	A39L023DP	A39L023DP	A39L024DP	A39L024DP	A39L024DP
	Sample Depth (ft):	40 - 42	54 - 56	71 - 73	20 - 23	42 - 44	54 - 56
	Sample Date:	4/4/96	4/4/96	4/4/96	4/4/96	4/4/96	4/4/96
	Geologic Unit:	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<1.0	<2.0	<2.0	<1.0	<2.0	1.02
1,1-Dichloroethene		NA	NA	NA	NA	NA	<0.5
Benzene		<1.0	<2.0	<2.0	<1.0	<2.0	0.573
cis-1,2-Dichloroethene		<1.0	<2.0	<2.0	10.06	<2.0	1.83
Ethylbenzene		<1.0	<2.0	<2.0	<1.0	<2.0	<0.5
Toluene		<1.0	<2.0	<2.0	<1.0	<2.0	<0.5
Total 1,2-Dichloroethene		<1.0	<2.0	<2.0	10.06	<2.0	1.83
trans-1,2-Dichloroethene		<1.0	<2.0	<2.0	<1.0	<2.0	<0.5
Trichloroethene		<1.0	<2.0	<2.0	<1.0	<2.0	8.54
Vinyl Chloride		<1.0	<2.0	<2.0	<1.0	<2.0	<2.0
Xylenes (total)		<1.0	<2.0	<2.0	<1.0	<2.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L024DP	A39L025DP	A39L025DP	A39L025DP	A39L025DP	A39L026DP
	Sample Depth (ft):	71 - 73	20 - 22	40 - 42	58 - 60	70 - 72	20 - 22
	Sample Date:	4/5/96	4/4/96	4/4/96	4/5/96	4/5/96	4/17/96
	Geologic Unit:	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<1.0	<1.0	<1.0	<0.5	<1.0	<1.0
1,1-Dichloroethene		NA	NA	NA	<0.5	NA	NA
Benzene		<1.0	<1.0	<1.0	<0.5	<1.0	<1.0
cis-1,2-Dichloroethene		29	<1.0	<1.0	<0.5	<1.0	<1.0
Ethylbenzene		<1.0	<1.0	<1.0	<0.5	<1.0	<1.0
Toluene		<1.0	<1.0	<1.0	<0.5	<1.0	<1.0
Total 1,2-Dichloroethene		36.74	<1.0	<1.0	<0.5	<1.0	<1.0
trans-1,2-Dichloroethene		7.74	<1.0	<1.0	<0.5	<1.0	<1.0
Trichloroethene		84.6	<1.0	<1.0	3.1	5.16	<1.0
Vinyl Chloride		<1.0	<1.0	<1.0	<2.0	<1.0	<1.0
Xylenes (total)		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L026DP	A39L026DP	A39L026DP	A39L026DP	A39L026DP	A39L026DP
	Sample Depth (ft):	43 - 45	58 - 60	71 - 73	88 - 90	102 - 104	118 - 120
	Sample Date:	4/17/96	4/17/96	4/17/96	4/19/96	4/19/96	4/19/96
	Geologic Unit:	Intermediate Sand	Intermediate Sand	Intermediate Sand	Deep Sand	Deep Sand	Deep Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<0.5	<0.5	<1.0	<10	<1.0	<1.0
1,1-Dichloroethene		0.356 JQ	0.431 JQ	NA	NA	NA	NA
Benzene		<0.5	<0.5	<1.0	<10	<1.0	<1.0
cis-1,2-Dichloroethene		5.31	6.54 J	11.6	234	40	<1.0
Ethylbenzene		<0.5	<0.5	<1.0	<10	<1.0	<1.0
Toluene		<0.5	<0.5	<1.0	<10	<1.0	<1.0
Total 1,2-Dichloroethene		5.769	6.869	11.6	234	42.89	<1.0
trans-1,2-Dichloroethene		0.459 JQ	0.329 JQ	<5.0	<10	2.89	<1.0
Trichloroethene		85.4 J	175	<1.0	<10	<1.0	<1.0
Vinyl Chloride		<2.0	0.96 JQ	<5.0	<10	<1.0	<1.0
Xylenes (total)		<1.0	<1.0	<1.0	<10	<1.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L027DP	A39L027DP	A39L027DP	A39L027DP	A39L027DP	A39L027DP
	Sample Depth (ft):	20 - 22	43 - 45	58 - 60	70 - 72	92 - 94	108 - 110
	Sample Date:	4/20/96	4/20/96	4/20/96	4/20/96	4/22/96	4/23/96
	Geologic Unit:	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Intermediate Sand	Deep Sand	Deep Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<1.0	<0.5	<2.0	<2.0	<2.0	<1.0
1,1-Dichloroethene		NA	<0.5	NA	NA	NA	NA
Benzene		<1.0	<0.5	<2.0	<2.0	<2.0	<1.0
cis-1,2-Dichloroethene		<1.0	0.868	3.22	106	<2.0	<1.0
Ethylbenzene		<1.0	<0.5	<2.0	<2.0	<2.0	<1.0
Toluene		<1.0	<0.5	<2.0	<2.0	<2.0	<1.0
Total 1,2-Dichloroethene		<1.0	0.868	3.22	127.62	<2.0	<1.0
trans-1,2-Dichloroethene		<1.0	<0.5	<2.0	21.62	<2.0	<1.0
Trichloroethene		<1.0	14	34.8	<2.0	<2.0	<1.0
Vinyl Chloride		<1.0	<2.0	<2.0	<2.0	<2.0	<1.0
Xylenes (total)		<1.0	<1.0	<2.0	<2.0	<2.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L027DP	A39L028DP	A39L028DP	A39L029DP	A39L029DP	A39L029DP
	Sample Depth (ft):	118 - 120	102 - 104	118 - 120	20 - 22	43 - 45	62 - 64
	Sample Date:	4/23/96	4/23/96	4/23/96	4/18/96	4/18/96	4/19/96
	Geologic Unit:	Deep Sand	Deep Sand	Deep Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<1.0	<2.0	<1.0	<1.0	<1.0	<0.5
1,1-Dichloroethene		NA	NA	NA	NA	NA	<0.5
Benzene		<1.0	<2.0	<1.0	<1.0	<1.0	<0.5
cis-1,2-Dichloroethene		<1.0	<2.0	<1.0	<5.0	<1.0	6.29
Ethylbenzene		<1.0	<2.0	<1.0	<1.0	<1.0	<0.5
Toluene		<1.0	<2.0	<1.0	<1.0	<1.0	<0.5
Total 1,2-Dichloroethene		<1.0	<2.0	<1.0	<5.0	<1.0	7.058
trans-1,2-Dichloroethene		<1.0	<2.0	<1.0	<5.0	<1.0	0.768
Trichloroethene		<1.0	<2.0	<1.0	<1.0	<1.0	<0.5
Vinyl Chloride		<1.0	<2.0	<1.0	<5.0	<1.0	49.2
Xylenes (total)		<1.0	<2.0	<1.0	<1.0	<1.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
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JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L029DP	A39L030DP		'39L027DP	A39L027DP	A39L027DP
	Sample Depth (ft):	71 - 73	20 - 22			92 - 94	108 - 110
	Sample Date:	4/19/96	4/19/96			4/22/96	4/23/96
	Geologic Unit:	Intermediate Sand	Shallow Silt/Clay			Deep Sand	Deep Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<2.0	<1.0				<1.0
Benzene		<2.0	<1.0				NA
cis-1,2-Dichloroethene		<2.0	<1.0	<2			<1.0
Ethylbenzene		<2.0	<1.0	<2.0			
Toluene		<2.0	<1.0	<2.0			
Total 1,2-Dichloroethene		<2.0	<1.0	<2.0			
trans-1,2-Dichloroethene		<2.0	<1.0	<2.0			
Trichloroethene		<2.0	<1.0	<2.0			
Vinyl Chloride		36.6	<1.0	<2.0			
Xylenes (total)		<2.0	<1.0	<2.0			

Page 22 of 64

Data Qualification Flag Notes:
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NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L031DP	A39L031DP	A39L031DP	A39L032DP	A39L032DP	A39L032DP
	Sample Depth (ft):	43 - 45	58 - 60	71 - 73	20 - 22	41 - 43	56 - 58
	Sample Date:	4/20/96	4/21/96	4/21/96	4/21/96	4/21/96	4/22/96
	Geologic Unit:	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<1.0	<2.0	<1.0	<1.0	<2.0	<0.5
1,1-Dichloroethene		NA	NA	NA	NA	NA	<0.5
Benzene		<1.0	<2.0	<1.0	<1.0	<2.0	0.289 JQ
cis-1,2-Dichloroethene		<1.0	<2.0	<1.0	<1.0	<2.0	<0.5
Ethylbenzene		<1.0	<2.0	<1.0	<1.0	<2.0	<0.5
Toluene		<1.0	<2.0	<1.0	<1.0	<2.0	0.43 JQ
Total 1,2-Dichloroethene		<1.0	<2.0	<1.0	<1.0	<2.0	<0.5
trans-1,2-Dichloroethene		<1.0	<2.0	<1.0	<1.0	<2.0	<0.5
Trichloroethene		<1.0	<2.0	<1.0	<1.0	<2.0	<0.5
Vinyl Chloride		<1.0	<2.0	<1.0	<1.0	<2.0	<2.0
Xylenes (total)		<1.0	<2.0	<1.0	<1.0	<2.0	<1.0

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J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L032DP	A39L033DP	A39L033DP	A39L033DP	A39L033DP	A39L034DP
	Sample Depth (ft):	71 - 73	20 - 22	43 - 45	60 - 62	70 - 72	20 - 22
	Sample Date:	4/22/96	5/7/96	5/7/96	5/7/96	5/7/96	5/8/96
	Geologic Unit:	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<2.0	<1.0	<1.0	<1.0	<1.0	<1.0
Benzene		<2.0	<1.0	<1.0	<1.0	<1.0	<1.0
cis-1,2-Dichloroethene		<2.0	<1.0	<1.0	<1.0	<1.0	<1.0
Ethylbenzene		<2.0	<1.0	<1.0	<1.0	<1.0	<1.0
Toluene		<2.0	<1.0	<1.0	<1.0	<1.0	<1.0
Total 1,2-Dichloroethene		<2.0	<1.0	<1.0	<1.0	<1.0	<1.0
trans-1,2-Dichloroethene		<2.0	<1.0	<1.0	<1.0	<1.0	<1.0
Trichloroethene		<2.0	<1.0	<1.0	<1.0	<1.0	<1.0
Vinyl Chloride		<2.0	<1.0	<1.0	<1.0	<1.0	<1.0
Xylenes (total)		<2.0	<1.0	<1.0	<1.0	<1.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
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VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L034DP	A39L034DP	A39L034DP	A39L035DP	A39L035DP	A39L035DP
	Sample Depth (ft):	45 - 47	58 - 60	70 - 72	20 - 22	43 - 45	58 - 60
	Sample Date:	5/8/96	5/9/96	5/9/96	5/7/96	5/7/96	5/7/96
	Geologic Unit:	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<1.0	<1.0	<1.0	<2.0	<1.0	<0.5
1,1-Dichloroethene		NA	NA	NA	NA	NA	<0.5
Benzene		<1.0	<1.0	<1.0	<2.0	<1.0	<0.5
cis-1,2-Dichloroethene		<1.0	<1.0	<1.0	<2.0	<1.0	16.8
Ethylbenzene		<1.0	<1.0	<1.0	<2.0	<1.0	<0.5
Toluene		<1.0	<1.0	<1.0	<2.0	<1.0	0.208 JQ
Total 1,2-Dichloroethene		<1.0	<1.0	<1.0	<2.0	<1.0	18.18
trans-1,2-Dichloroethene		<1.0	<1.0	<1.0	<2.0	<1.0	1.38
Trichloroethene		<1.0	<1.0	<1.0	<2.0	8.36	5.07
Vinyl Chloride		<1.0	<1.0	<1.0	<2.0	<1.0	<2.0
Xylenes (total)		<1.0	<1.0	<1.0	<2.0	<1.0	<1.0

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J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
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VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L035DP	A39L036DP	A39L036DP	A39L036DP	A39L036DP	A39L037DP
	Sample Depth (ft):	71 - 73	20 - 22	41 - 43	58 - 60	71 - 73	20 - 22
	Sample Date:	5/7/96	5/8/96	5/8/96	5/9/96	5/9/96	5/9/96
	Geologic Unit:	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<2.0	<1.0	<1.0	<0.5	<0.5	<1.0
1,1-Dichloroethene		NA	NA	NA	<0.5	<0.5	NA
Benzene		<2 0	<1.0	<1.0	<0.5	<0.5	<1.0
cis-1,2-Dichloroethene		4.28	<1.0	<1.0	4.01	1.09	<1.0
Ethylbenzene		<2.0	<1.0	<1.0	<0.5	<0.5	<1.0
Toluene		<2.0	<1.0	<1.0	<0.5	<0.5	<1.0
Total 1,2-Dichloroethene		4.28	<1.0	<1.0	4.714	1.09	<1.0
trans-1,2-Dichloroethene		<2.0	<1.0	<1.0	0.704	<0.5	<1.0
Trichloroethene		<2.0	<1.0	<1.0	27.4	1.49	<1.0
Vinyl Chloride		<2.0	<1.0	<1.0	<2.0	<2.0	<1.0
Xylenes (total)		<2.0	<1.0	<1.0	<1.0	<1.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
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(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L037DP	A39L037DP	A39L037DP	A39L038DP	A39L038DP	A39L038DP
	Sample Depth (ft):	45 - 47	58 - 60	71 - 73	20 - 22	45 - 47	58 - 60
	Sample Date:	5/9/96	5/9/96	5/10/96	5/13/96	5/13/96	5/13/96
	Geologic Unit:	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<2.0	<2.0	<1.0	<1.0	<0.5	<0.5
1,1-Dichloroethene		NA	NA	NA	NA	<0.5	<0.5
Benzene		<2.0	<2.0	<1.0	<1.0	<0.5	<0.5
cis-1,2-Dichloroethene		<2.0	<2.0	<1.0	<1.0	<0.5	<0.5
Ethylbenzene		<2.0	<2.0	<1.0	<1.0	<0.5	<0.5
Toluene		<2.0	<2.0	<1.0	<1.0	<0.5	0.213 JQ
Total 1,2-Dichloroethene		<2.0	<2.0	<1.0	<1.0	<0.5	<0.5
trans-1,2-Dichloroethene		<2.0	<2.0	<1.0	<1.0	<0.5	<0.5
Trichloroethene		<2.0	<2.0	<1.0	<1.0	<0.5	<0.5
Vinyl Chloride		<2.0	<2.0	<1.0	<1.0	<2.0	<2.0
Xylenes (total)		<2.0	<2.0	<1.0	<1.0	<1.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L038DP	A39L039DP	A39L039DP	A39L039DP	A39L039DP	A39L040DP
	Sample Depth (ft):	71 - 73	20 - 22	45 - 47	58 - 60	71 - 73	20 - 22
	Sample Date:	5/14/96	5/14/96	5/14/96	5/14/96	5/14/96	5/14/96
	Geologic Unit:	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<1.0	<2.0	<1.0	<1.0	<2.0	<1.0
Benzene		<1.0	<2.0	<1.0	<1.0	<2.0	<1.0
cis-1,2-Dichloroethene		<1.0	<2.0	<1.0	<1.0	<2.0	<1.0
Ethylbenzene		<1.0	<2.0	<1.0	<1.0	<2.0	<1.0
Toluene		<1.0	<2.0	<1.0	<1.0	<2.0	<1.0
Total 1,2-Dichloroethene		<1.0	<2.0	<1.0	<1.0	<2.0	<1.0
trans-1,2-Dichloroethene		<1.0	<2.0	<1.0	<1.0	<2.0	<1.0
Trichloroethene		<1.0	<2.0	<1.0	<1.0	<2.0	<1.0
Vinyl Chloride		<1.0	<2.0	<1.0	<1.0	<2.0	<1.0
Xylenes (total)		<1.0	<2.0	<1.0	<1.0	<2.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L040DP	A39L040DP	A39L040DP	A39L041DP	A39L041DP	A39L041DP
	Sample Depth (ft):	43 - 45	58 - 60	70 - 72	20 - 22	46 - 48	58 - 60
	Sample Date:	5/14/96	5/15/96	5/15/96	5/15/96	5/15/96	5/15/96
	Geologic Unit:	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<0.5	<1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethene		<0.5	NA	NA	NA	NA	NA
Benzene		<0.5	<1.0	<1.0	<1.0	<1.0	<1.0
cis-1,2-Dichloroethene		<0.5	<1.0	<1.0	<1.0	<1.0	<1.0
Ethylbenzene		<0.5	<1.0	<1.0	<1.0	<1.0	<1.0
Toluene		<0.5	<1.0	<1.0	<1.0	<1.0	<1.0
Total 1,2-Dichloroethene		<0.5	<1.0	<1.0	<1.0	<1.0	<1.0
trans-1,2-Dichloroethene		<0.5	<1.0	<1.0	<1.0	<1.0	<1.0
Trichloroethene		<0.5	<1.0	<1.0	<1.0	<1.0	<1.0
Vinyl Chloride		<2.0	<1.0	<1.0	<1.0	<1.0	<1.0
Xylenes (total)		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L041DP	A39L041DP	A39L041DP	A39L041DP	A39L042DP	A39L042DP
	Sample Depth (ft):	71 - 73	86 - 88	100 - 102	118 - 120	88 - 90	108 - 110
	Sample Date:	5/16/96	5/16/96	5/16/96	5/16/96	5/14/96	5/14/96
	Geologic Unit:	Intermediate Sand	Deep Sand	Deep Sand	Deep Sand	Deep Sand	Deep Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<1.0	<1.0	<1.0	<2.0	<0.5	<0.5
1,1-Dichloroethene		NA	NA	NA	NA	<0.5	<0.5
Benzene		<1.0	<1.0	<1.0	<2.0	<0.5	<0.5
cis-1,2-Dichloroethene		<1.0	<1.0	<1.0	<2.0	0.705	<0.5
Ethylbenzene		<1.0	<1.0	<1.0	<2.0	<0.5	<0.5
Toluene		<1.0	<1.0	<1.0	<2.0	<0.5	<0.5
Total 1,2-Dichloroethene		<1.0	<1.0	<1.0	<2.0	0.705	<0.5
trans-1,2-Dichloroethene		<1.0	<1.0	<1.0	<2.0	<0.5	<0.5
Trichloroethene		<1.0	<1.0	<1.0	<2.0	2.17	1.2
Vinyl Chloride		<1.0	<1.0	<1.0	<2.0	<2.0	<2.0
Xylenes (total)		<1.0	<1.0	<1.0	<2.0	<1.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L042DP	A39L043DP	A39L043DP	A39L044DP	A39L044DP	A39L044DP
	Sample Depth (ft):	118 - 120	98 - 100	118 - 120	20 - 22	45 - 47	58 - 60
	Sample Date:	5/14/96	5/13/96	5/13/96	5/9/96	5/9/96	5/10/96
	Geologic Unit:	Deep Sand	Deep Sand	Deep Sand	Shallow Silt/Clay	Shallow Silt/Clay	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<1.0	<0.5	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethene		NA	<0.5	NA	NA	NA	NA
Benzene		<1.0	<0.5	<1.0	<1.0	<1.0	<1.0
cis-1,2-Dichloroethene		<1.0	<0.5	<1.0	<1.0	<1.0	<1.0
Ethylbenzene		<1.0	<0.5	<1.0	<1.0	<1.0	<1.0
Toluene		<1.0	0.223 JQ	<1.0	<1.0	<1.0	<1.0
Total 1,2-Dichloroethene		<1.0	<0.5	<1.0	<1.0	<1.0	<1.0
trans-1,2-Dichloroethene		<1.0	<0.5	<1.0	<1.0	<1.0	<1.0
Trichloroethene		<1.0	<0.5	<1.0	<1.0	<1.0	<1.0
Vinyl Chloride		<1.0	<2.0	<1.0	<1.0	<1.0	<1.0
Xylenes (total)		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L044DP	A39L045DP	A39L045DP	A39L045DP	A39L045DP	A39L046DP
	Sample Depth (ft):	70 - 72	20 - 22	38 - 40	53 - 55	71 - 73	20 - 22
	Sample Date:	5/10/96	5/10/96	5/10/96	5/10/96	5/10/96	5/10/96
	Geologic Unit:	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<1.0	<1.0	<2.0	<2.0	<2.0	<1.0
Benzene		<1.0	<1.0	<2.0	<2.0	<2.0	<1.0
cis-1,2-Dichloroethene		<1.0	<1.0	<2.0	<2.0	<2.0	<1.0
Ethylbenzene		<1.0	<1.0	<2.0	<2.0	<2.0	<1.0
Toluene		<1.0	<1.0	<2.0	<2.0	<2.0	<1.0
Total 1,2-Dichloroethene		<1.0	<1.0	<2.0	<2.0	<2.0	<1.0
trans-1,2-Dichloroethene		<1.0	<1.0	<2.0	<2.0	<2.0	<1.0
Trichloroethene		<1.0	<1.0	<2.0	<2.0	<2.0	<1.0
Vinyl Chloride		<1.0	<1.0	<2.0	<2.0	<2.0	<1.0
Xylenes (total)		<1.0	<1.0	<2.0	<2.0	<2.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L046DP	A39L046DP	A39L046DP	A39L047DP	A39L047DP	A39L047DP
	Sample Depth (ft):	45 - 47	60 - 62	71 - 73	22 - 24	43 - 45	58 - 60
	Sample Date:	5/10/96	5/10/96	5/10/96	5/12/96	5/12/96	5/12/96
	Geologic Unit:	Shallow Silt/Clay	Shallow Silt/Clay	Intermediate Sand	Shallow Silt/Clay	Shallow Silt/Clay	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<1.0	<10	<5.0	<0.5	<2.0	<2.0
1,1-Dichloroethene		NA	NA	NA	0.281 JQ	NA	NA
Benzene		<1.0	<10	<5.0	<0.5	<2.0	<2.0
cis-1,2-Dichloroethene		<1.0	145	78	4.85	<2.0	<2.0
Ethylbenzene		<1.0	<10	<5.0	<0.5	<2.0	<2.0
Toluene		<1.0	<10	<5.0	<0.5	<2.0	<2.0
Total 1,2-Dichloroethene		<1.0	145	78	6.26	<2.0	<2.0
trans-1,2-Dichloroethene		<1.0	<10	<5.0	1.41	<2.0	<2.0
Trichloroethene		<1.0	<10	<5.0	2.78	<2.0	<2.0
Vinyl Chloride		<1.0	<10	<5.0	<2.0	<2.0	<2.0
Xylenes (total)		<1.0	<10	<5.0	<1.0	<2.0	<2.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L047DP	A39L048DP	A39L048DP	A39L048DP	A39L049DP	A39L049DP
	Sample Depth (ft):	70 - 72	86 - 88	100 - 102	116 - 118	20 - 22	47 - 49
	Sample Date:	5/12/96	5/15/96	5/15/96	5/15/96	5/12/96	5/12/96
	Geologic Unit:	Intermediate Sand	Deep Sand	Deep Sand	Deep Sand	Shallow Silt/Clay	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<2.0	<1.0	<2.0	<2.0	<1.0	<0.5
1,1-Dichloroethene		NA	NA	NA	NA	NA	<0.5
Benzene		<2.0	<1.0	<2.0	<2.0	<1.0	<0.5
cis-1,2-Dichloroethene		<2.0	<1.0	<2.0	<2.0	<1.0	3.8
Ethylbenzene		<2.0	<1.0	<2.0	<2.0	<1.0	<0.5
Toluene		<2.0	<1.0	<2.0	<2.0	<1.0	0.235 JQ
Total 1,2-Dichloroethene		<2.0	<1.0	<2.0	<2.0	<1.0	3.8
trans-1,2-Dichloroethene		<2.0	<1.0	<2.0	<2.0	<1.0	<0.5
Trichloroethene		<2.0	<1.0	<2.0	<2.0	<1.0	0.474 JQ
Vinyl Chloride		<2.0	<1.0	<2.0	<2.0	<1.0	<2.0
Xylenes (total)		<2.0	<1.0	<2.0	<2.0	<1.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L049DP	A39L049DP	A39L050DP	A39L050DP	A39L050DP	A39L050DP
	Sample Depth (ft):	58 - 60	71 - 73	25 - 27	40 - 42	58 - 60	70 - 72
	Sample Date:	5/12/96	5/12/96	5/16/96	5/16/96	5/16/96	5/17/96
	Geologic Unit:	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<1.0	<2.0	<2.0	<1.0	<1.0	<2.0
Benzene		<1.0	<2.0	<2.0	<1.0	<1.0	<2.0
cis-1,2-Dichloroethene		2.82	<2.0	<2.0	<1.0	<1.0	<2.0
Ethylbenzene		<1.0	<2.0	<2.0	<1.0	<1.0	<2.0
Toluene		<1.0	<2.0	<2.0	<1.0	<1.0	<2.0
Total 1,2-Dichloroethene		2.82	<2.0	<2.0	<1.0	<1.0	<2.0
trans-1,2-Dichloroethene		<1.0	<2.0	<2.0	<1.0	<1.0	<2.0
Trichloroethene		<1.0	<2.0	<2.0	<1.0	<1.0	<2.0
Vinyl Chloride		<1.0	<2.0	<2.0	<1.0	<1.0	<2.0
Xylenes (total)		<1.0	<2.0	<2.0	<1.0	<1.0	<2.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L051DP	A39L051DP	A39L051DP	A39L051DP	A39L052DP	A39L052DP
	Sample Depth (ft):	21 - 23	45 - 47	60 - 62	70 - 72	20 - 22	45 - 47
	Sample Date:	5/23/96	5/23/96	5/23/96	5/23/96	5/16/96	5/16/96
	Geologic Unit:	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<2.0	<0.5	<1.0	<2.0	<1.0	<1.0
1,1-Dichloroethene		NA	<0.5	NA	NA	NA	NA
Benzene		<2.0	<0.5	<1.0	<2.0	<1.0	<1.0
cis-1,2-Dichloroethene		<2.0	<0.5	<1.0	<2.0	<1.0	<1.0
Ethylbenzene		<2.0	<0.5	<1.0	<2.0	<1.0	<1.0
Toluene		<2.0	<0.5	<1.0	<2.0	<1.0	<1.0
Total 1,2-Dichloroethene		<2.0	<0.5	<1.0	<2.0	<1.0	<1.0
trans-1,2-Dichloroethene		<2.0	<0.5	<1.0	<2.0	<1.0	<1.0
Trichloroethene		<2.0	<0.5	<1.0	<2.0	<1.0	<1.0
Vinyl Chloride		<2.0	<2.0	<1.0	<2.0	<1.0	<1.0
Xylenes (total)		<2.0	<1.0	<1.0	<2.0	<1.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L052DP	A39L052DP	A39L053DP	A39L053DP	A39L053DP	A39L053DP
	Sample Depth (ft):	58 - 60	70 - 72	20 - 23	44 - 46	58 - 60	70 - 72
	Sample Date:	5/16/96	5/16/96	5/23/96	5/23/96	5/23/96	5/23/96
	Geologic Unit:	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5
1,1-Dichloroethene		NA	<1.0	NA	NA	NA	<0.5
Benzene		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5
cis-1,2-Dichloroethene		<1.0	<1.0	7.62	<1.0	39	2.72
Ethylbenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5
Toluene		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5
Total 1,2-Dichloroethene		<1.0	<1.0	7.62	<1.0	39	2.72
trans-1,2-Dichloroethene		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5
Trichloroethene		<1.0	<1.0	<1.0	<1.0	<1.0	<0.5
Vinyl Chloride		<1.0	14.9	<1.0	<1.0	<1.0	<2.0
Xylenes (total)		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L054DP	A39L054DP	A39L054DP	A39L054DP	A39L056DP	A39L056DP
	Sample Depth (ft):	20 - 22	43 - 45	58 - 60	70 - 72	20 - 22	45 - 47
	Sample Date:	5/23/96	5/23/96	5/23/96	5/23/96	5/29/96	5/29/96
	Geologic Unit:	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<2.0	<2.0	<2.0	<2.0	<0.5	<0.5
1,1-Dichloroethene		NA	NA	NA	NA	<0.5	<0.5
Benzene		<2.0	<2.0	<2.0	<2.0	<0.5	0.421 JQ
cis-1,2-Dichloroethene		<2.0	<2.0	<2.0	<2.0	4.17	36.2
Ethylbenzene		<2.0	<2.0	<2.0	<2.0	<0.5	<0.5
Toluene		<2.0	<2.0	<2.0	<2.0	<0.5	<0.5
Total 1,2-Dichloroethene		<2.0	<2.0	<2.0	<2.0	4.794	0.242
trans-1,2-Dichloroethene		<2.0	<2.0	<2.0	<2.0	0.624	0.242 JQ
Trichloroethene		<2.0	<2.0	<2.0	<2.0	<0.5	<0.5
Vinyl Chloride		<2.0	<2.0	<2.0	<2.0	11.3	2.66
Xylenes (total)		<2.0	<2.0	<2.0	<2.0	<1.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L056DP	A39L056DP	A39L057DP	A39L057DP	A39L057DP	A39L057DP
	Sample Depth (ft):	56 - 58	71 - 73	20 - 22	44 - 46	56 - 58	71 - 73
	Sample Date:	5/29/96	5/30/96	5/30/96	5/30/96	5/30/96	5/30/96
	Geologic Unit:	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzene		0.492 JQ	<0.5	<0.5	<0.5	<0.5	<0.5
cis-1,2-Dichloroethene		4.34	1.87	<0.5	<0.5	<0.5	<0.5
Ethylbenzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene		<0.5	<0.5	<0.5	<0.5	0.329 JQ	<0.5
Total 1,2-Dichloroethene		4.719	2.167	<0.5	<0.5	<0.5	0.736
trans-1,2-Dichloroethene		0.379 JQ	0.297 JQ	<0.5	<0.5	<0.5	0.736
Trichloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Vinyl Chloride		4.85	5.54	<2.0	<2.0	<2.0	1.14 JQ
Xylenes (total)		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L058DP	A39L058DP	A39L058DP	A39L058DP	A39L059DP	A39L059DP
	Sample Depth (ft):	20 - 22	43 - 45	58 - 60	70 - 72	20 - 22	43 - 45
	Sample Date:	6/18/96	6/18/96	6/18/96	6/18/96	6/15/96	6/15/96
	Geologic Unit:	Shallow Silt/Clay	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzene		<0.5	<0.5	<0.5	0.212 JQ	0.342 JQ	<0.5
cis-1,2-Dichloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	0.349 JQ
Ethylbenzene		0.304 JQ	<0.5	<0.5	0.34 JQ	1.22	<0.5
Toluene		<0.5	<0.5	<0.5	0.299 JQ	0.248 JQ	<0.5
Total 1,2-Dichloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	0.349
trans-1,2-Dichloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trichloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Vinyl Chloride		<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Xylenes (total)		0.822 JQ	<1.0	<1.0	0.937 JQ	4.43	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L059DP	A39L059DP	A39L060DP	A39L060DP	A39L060DP	A39L060DP
	Sample Depth (ft):	58 - 60	68 - 70	20 - 22	43 - 45	58 - 60	68 - 70
	Sample Date:	6/15/96	6/15/96	6/13/96	6/13/96	6/16/96	6/16/96
	Geologic Unit:	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzene		0.271 JQ	<0.5	1.01 JB	1.4	<0.5	0.246 JQ
cis-1,2-Dichloroethene		<0.5	<0.5	<0.5	3.08	1.7	14.4
Ethylbenzene		<0.5	<0.5	5.12	7.05	0.349 JQ	0.27 JQ
Toluene		<0.5	<0.5	0.904	1.33	<0.5	<0.5
Total 1,2-Dichloroethene		4.9	<0.5	<0.5	3.08	1.7	17.69
trans-1,2-Dichloroethene		4.9	<0.5	<0.5	<0.5	<0.5	3.29
Trichloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Vinyl Chloride		<2.0	<2.0	<2.0	1.23 JQ	2.33	3.72
Xylenes (total)		<1.0	<1.0	19	26.8	1.06	0.782 JQ

Data Qualification Flags/Notes:
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JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Group/Analyte	Boring Number:	A39L061DP	A39L061DP	A39L061DP	A39L061DP	A39L062DP	A39L062DP
	Sample Depth (ft):	20 - 22	44 - 46	58 - 60	20 - 22	22 - 24	43 - 45
	Sample Date:	6/17/96	6/17/96	6/17/96	6/17/96	6/19/96	6/19/96
	Geologic Unit:	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Shallow Silt/Clay
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzene		<0.5	<0.5	0.236 JQ	<0.5	<0.5	<0.5
cis-1,2-Dichloroethene		<0.5	<0.5	30.6	<0.5	<0.5	<0.5
Ethylbenzene		0.657	0.734	0.329 JQ	0.734	<0.5	<0.5
Toluene		<0.5	<0.5	0.317 JQ	<0.5	<0.5	<0.5
Total 1,2-Dichloroethene		<0.5	<0.5	170.6	4.65	<0.5	<0.5
trans-1,2-Dichloroethene		<0.5	<0.5	140	4.65	<0.5	<0.5
Trichloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Vinyl Chloride		<2.0	<2.0	1260	206	<2.0	<2.0
Xylenes (total)		2.36	2.65	1.11	2.65	<1.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L062DP	A39L062DP	A39L063DP	A39L063DP	A39L063DP	A39L063DP
	Sample Depth (ft):	58 - 60	70 - 72	20 - 22	43 - 45	58 - 60	70 - 72
	Sample Date:	6/19/96	6/19/96	8/21/96	8/21/96	8/21/96	8/21/96
	Geologic Unit:	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<0.5	<0.5	<1.0	<1.0	<1.0	<0.5
1,1-Dichloroethene		<0.5	<0.5	NA	NA	NA	<0.5
Benzene		<0.5	<0.5	<1.0	<1.0	<1.0	<0.5
cis-1,2-Dichloroethene		<0.5	<0.5	<1.0	<1.0	<1.0	<0.5
Ethylbenzene		<0.5	<0.5	<1.0	<1.0	<1.0	<0.5
Toluene		<0.5	<0.5	<1.0	<1.0	<1.0	<0.5
Total 1,2-Dichloroethene		<0.5	<0.5	<1.0	<1.0	<1.0	0.31 JQ
trans-1,2-Dichloroethene		<0.5	<0.5	<1.0	<1.0	<1.0	<0.5
Trichloroethene		<0.5	<0.5	<1.0	<1.0	<1.0	<0.5
Vinyl Chloride		<2.0	<2.0	<1.0	<1.0	<1.0	14.8
Xylenes (total)		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

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J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L064DP	A39L064DP	A39L064DP	A39L064DP	A39L065DP	A39L065DP
	Sample Depth (ft):	20 - 22	43 - 45	58 - 60	70 - 72	20 - 22	45 - 47
	Sample Date:	8/20/96	8/20/96	8/20/96	8/20/96	8/20/96	8/20/96
	Geologic Unit:	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<1.0	<1.0	<2.0	<2.0	<1.0	<1.0
Benzene		<1.0	<1.0	<2.0	<2.0	<1.0	<1.0
cis-1,2-Dichloroethene		<1.0	<1.0	<2.0	<2.0	<1.0	<1.0
Ethylbenzene		<1.0	<1.0	<2.0	<2.0	<1.0	<1.0
Toluene		1.18	1.19	<2.0	<2.0	<1.0	<1.0
Total 1,2-Dichloroethene		<1.0	<1.0	<2.0	<2.0	<1.0	<1.0
trans-1,2-Dichloroethene		<1.0	<1.0	<2.0	<2.0	<1.0	<1.0
Trichloroethene		<1.0	<1.0	<2.0	<2.0	<1.0	<1.0
Vinyl Chloride		<1.0	<1.0	<2.0	<2.0	<1.0	<1.0
Xylenes (total)		<1.0	<1.0	<2.0	<2.0	<1.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L065DP	A39L065DP	A39L067DP	A39L067DP	A39L067DP	A39L067DP
	Sample Depth (ft):	58 - 60	68 - 70	20 - 22	43 - 45	58 - 60	70 - 72
	Sample Date:	8/20/96	8/20/96	8/22/96	8/22/96	8/22/96	8/22/96
	Geologic Unit:	Intermediate Sand	Intermediate Sand	Intermediate Sand	Intermediate Sand	Intermediate Sand	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<1.0	<0.5	<1.0	7.34	<2.0	<1.0
1,1-Dichloroethene		NA	<0.5	<1.0	<0.5	NA	NA
Benzene		<1.0	<0.5	<1.0	0.365 JQ	<2.0	<1.0
cis-1,2-Dichloroethene		<1.0	<0.5	<1.0	4.16	<2.0	<1.0
Ethylbenzene		<1.0	<0.5	<1.0	<0.5	<2.0	<1.0
Toluene		<1.0	<0.5	<1.0	<0.5	<2.0	<1.0
Total 1,2-Dichloroethene		<1.0	<0.5	<1.0	4.16	<2.0	<1.0
trans-1,2-Dichloroethene		<1.0	<0.5	<1.0	<0.5	<2.0	<1.0
Trichloroethene		<1.0	<0.5	6.45	2.0	<2.0	<1.0
Vinyl Chloride		<1.0	<2.0	1.39 JQ	13.2 J	8.24	3.0
Xylenes (total)		<1.0	<1.0	<1.0	<1.0	<2.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L068DP	A39L068DP	A39L068DP	A39L068DP	A39L069DP	A39L069DP
	Sample Depth (ft):	20 - 22	38 - 40	58 - 60	70 - 72	28 - 30	45 - 47
	Sample Date:	8/22/96	8/22/96	8/22/96	8/22/96	8/21/96	8/21/96
	Geologic Unit:	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
1,1-Dichloroethene		NA	NA	NA	NA	NA	0.784 JQ
Benzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
cis-1,2-Dichloroethene		<1.0	<1.0	<1.0	<1.0	<1.0	479
Ethylbenzene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Toluene		<1.0	<1.0	<1.0	<1.0	<1.0	1.92
Total 1,2-Dichloroethene		<1.0	<1.0	<1.0	<1.0	4.75	479
trans-1,2-Dichloroethene		<1.0	<1.0	<1.0	<1.0	4.75	<1.0
Trichloroethene		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Vinyl Chloride		<1.0	<1.0	<1.0	<1.0	56.8	7.36
Xylenes (total)		<1.0	<1.0	<1.0	<1.0	<1.0	<2.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L069DP	A39L069DP	A39L070DP	A39L070DP	A39L070DP	A39L070DP
	Sample Depth (ft):	58 - 60	70 - 72	20 - 22	38 - 40	58 - 60	70 - 72
	Sample Date:	8/21/96	8/21/96	8/23/96	8/23/96	8/23/96	8/23/96
	Geologic Unit:	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<0.5	<0.5	<1.0	<1.0	<2.0	<1.0
1,1-Dichloroethene		<0.5	<0.5	NA	NA	NA	NA
Benzene		0.259 JQ	<0.5	<1.0	<1.0	<2.0	<1.0
cis-1,2-Dichloroethene		2.61	1.54	<1.0	<1.0	<2.0	<1.0
Ethylbenzene		<0.5	<0.5	<1.0	<1.0	<2.0	<1.0
Toluene		<0.5	<0.5	<1.0	<1.0	<2.0	<1.0
Total 1,2-Dichloroethene		2.61	1.54	<1.0	<1.0	<2.0	<1.0
trans-1,2-Dichloroethene		<0.5	<0.5	<1.0	<1.0	<2.0	<1.0
Trichloroethene		<0.5	<0.5	<1.0	<1.0	<2.0	<1.0
Vinyl Chloride		3.95	1.59 JQ	<1.0	<1.0	<2.0	<1.0
Xylenes (total)		<1.0	<1.0	<1.0	<1.0	<2.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L072DP	A39L072DP	A39L072DP	A39L073DP	A39L073DP	A39L073DP
	Sample Depth (ft):	43 - 45	58 - 60	70 - 72	20 - 22	38 - 40	58 - 60
	Sample Date:	9/5/96	9/5/96	9/5/96	9/6/96	9/6/96	9/6/96
	Geologic Unit:	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<2.0	<2.0	<2.0	<2.0	<1.0	<0.5
1,1-Dichloroethene		NA	NA	NA	NA	NA	<0.5
Benzene		<2.0	<2.0	<2.0	<2.0	<1.0	<0.5
cis-1,2-Dichloroethene		<2.0	<2.0	<2.0	<2.0	<1.0	<0.5
Ethylbenzene		<2.0	<2.0	<2.0	<2.0	<1.0	<0.5
Toluene		<2.0	<2.0	<2.0	<2.0	<1.0	<0.5
Total 1,2-Dichloroethene		<2.0	<2.0	<2.0	<2.0	<1.0	<0.5
trans-1,2-Dichloroethene		<2.0	<2.0	<2.0	<2.0	<1.0	<0.5
Trichloroethene		<2.0	<2.0	<2.0	<2.0	<1.0	<0.5
Vinyl Chloride		<2.0	<2.0	<2.0	<2.0	<1.0	<2.0
Xylenes (total)		<2.0	<2.0	<2.0	<2.0	<1.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L073DP	A39L074DP	A39L074DP	A39L074DP	A39L074DP	A39L075DP
	Sample Depth (ft):	70 - 72	20 - 22	38 - 40	58 - 60	70 - 72	20 - 22
	Sample Date:	9/6/96	9/8/96	9/9/96	9/9/96	9/9/96	9/5/96
	Geologic Unit:	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Intermediate Sand	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<0.5	<0.5	<0.5	<1.0	<1.0	<1.0
1,1-Dichloroethene		<0.5	<0.5	<0.5	NA	NA	NA
Benzene		0.215 JQ	<0.5	<0.5	<1.0	<1.0	<1.0
cis-1,2-Dichloroethene		<0.5	3.0	<0.5	<1.0	<1.0	<1.0
Ethylbenzene		<0.5	<0.5	<0.5	<1.0	<1.0	<1.0
Toluene		<0.5	<0.5	<0.5	<1.0	<1.0	<1.0
Total 1,2-Dichloroethene		<0.5	3.0	<0.5	<1.0	<1.0	<1.0
trans-1,2-Dichloroethene		<0.5	<0.5	<0.5	<1.0	<1.0	<1.0
Trichloroethene		<0.5	<0.5	<0.5	<1.0	<1.0	<1.0
Vinyl Chloride		<2.0	<2.0	<2.0	<1.0	<1.0	<1.0
Xylenes (total)		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L075DP	A39L075DP	A39L075DP	A39L076DP	A39L076DP	A39L076DP
	Sample Depth (ft):	38 - 40	58 - 60	70 - 72	38 - 40	58 - 60	70 - 72
	Sample Date:	9/5/96	9/5/96	9/5/96	8/26/96	8/26/96	8/26/96
	Geologic Unit:	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<0.5	<1.0	<1.0	<1.0	<2.0	<1.0
1,1-Dichloroethene		<0.5	NA	NA	NA	NA	NA
Benzene		<0.5	<1.0	<1.0	<1.0	<2.0	<1.0
cis-1,2-Dichloroethene		<0.5	<1.0	<1.0	<1.0	<2.0	<1.0
Ethylbenzene		<0.5	<1.0	<1.0	<1.0	<2.0	<1.0
Toluene		<0.5	<1.0	<1.0	<1.0	<2.0	<1.0
Total 1,2-Dichloroethene		<0.5	<1.0	<1.0	<1.0	<2.0	<1.0
trans-1,2-Dichloroethene		<0.5	<1.0	<1.0	<1.0	<2.0	<1.0
Trichloroethene		<0.5	<1.0	<1.0	<1.0	<2.0	<1.0
Vinyl Chloride		<2.0	<1.0	<1.0	<1.0	<2.0	<1.0
Xylenes (total)		<1.0	<1.0	<1.0	<1.0	<2.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L077DP	A39L077DP	A39L077DP	A39L077DP	A39L078DP	A39L078DP
	Sample Depth (ft):	20 - 22	43 - 45	58 - 60	70 - 72	20 - 22	43 - 45
	Sample Date:	8/26/96	8/26/96	8/26/96	8/26/96	8/24/96	8/24/96
	Geologic Unit:	Shallow Silt/Clay	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Shallow Silt/Clay
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<2.0	<0.5	<1.0	<1.0	<2.0	<2.0
1,1-Dichloroethene		NA	<0.5	NA	NA	NA	NA
Benzene		<2.0	0.235 JQ	<1.0	<1.0	<2.0	<2.0
cis-1,2-Dichloroethene		<2.0	<0.5	<1.0	<1.0	<2.0	<2.0
Ethylbenzene		<2.0	0.269 JQ	<1.0	<1.0	<2.0	<2.0
Toluene		<2.0	<0.5	<1.0	<1.0	<2.0	<2.0
Total 1,2-Dichloroethene		<2.0	<0.5	<1.0	<1.0	<2.0	<2.0
trans-1,2-Dichloroethene		<2.0	<0.5	<1.0	<1.0	<2.0	<2.0
Trichloroethene		<2.0	<0.5	<1.0	<1.0	<2.0	<2.0
Vinyl Chloride		<2.0	<2.0	<1.0	<1.0	<2.0	<2.0
Xylenes (total)		<2.0	<1.0	<1.0	<1.0	<2.0	<2.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L078DP	A39L078DP	A39L079DP	A39L079DP	A39L079DP	A39L079DP
	Sample Depth (ft):	58 - 60	70 - 72	20 - 22	38 - 40	58 - 60	70 - 72
	Sample Date:	8/24/96	8/25/96	8/24/96	8/25/96	8/25/96	8/25/96
	Geologic Unit:	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<2.0	<1.0	<1.0	<1.0	<2.0	<2.0
Benzene		<2.0	<1.0	<1.0	<1.0	<2.0	<2.0
cis-1,2-Dichloroethene		<2.0	<1.0	<1.0	<1.0	<2.0	<2.0
Ethylbenzene		<2.0	<1.0	<1.0	<1.0	<2.0	<2.0
Toluene		<2.0	<1.0	<1.0	<1.0	<2.0	<2.0
Total 1,2-Dichloroethene		<2.0	<1.0	<1.0	<1.0	<2.0	<2.0
trans-1,2-Dichloroethene		<2.0	<1.0	<1.0	<1.0	<2.0	<2.0
Trichloroethene		<2.0	<1.0	<1.0	<1.0	<2.0	<2.0
Vinyl Chloride		<2.0	<1.0	<1.0	<1.0	<2.0	<2.0
Xylenes (total)		<2.0	<1.0	<1.0	<1.0	<2.0	<2.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L080DP	A39L080DP	A39L080DP	A39L080DP	A39L081DP	A39L081DP
	Sample Depth (ft):	20 - 22	43 - 45	58 - 60	70 - 72	20 - 22	38 - 40
	Sample Date:	9/10/96	9/10/96	9/10/96	9/10/96	9/10/96	9/10/96
	Geologic Unit:	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Shallow Silt/Clay
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<1.0	<1.0	<1.0	<1.0	<2.0	<1.0
Benzene		<1.0	<1.0	<1.0	<1.0	<2.0	<1.0
cis-1,2-Dichloroethene		<1.0	<1.0	<1.0	<1.0	<2.0	<1.0
Ethylbenzene		<1.0	<1.0	<1.0	<1.0	<2.0	<1.0
Toluene		<1.0	<1.0	<1.0	<1.0	<2.0	<1.0
Total 1,2-Dichloroethene		<1.0	<1.0	<1.0	<1.0	<2.0	<1.0
trans-1,2-Dichloroethene		<1.0	<1.0	<1.0	<1.0	<2.0	<1.0
Trichloroethene		<1.0	<1.0	<1.0	<1.0	<2.0	<1.0
Vinyl Chloride		<1.0	<1.0	<1.0	<1.0	<2.0	<1.0
Xylenes (total)		<1.0	<1.0	<1.0	<1.0	<2.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L081DP	A39L081DP	A39L082DP	A39L082DP	A39L082DP	A39L084DP
	Sample Depth (ft):	58 - 60	70 - 72	83 - 85	98 - 100	118 - 120	21 - 23
	Sample Date:	9/10/96	9/10/96	8/25/96	8/25/96	8/25/96	9/7/96
	Geologic Unit:	Intermediate Sand	Intermediate Sand	Deep Sand	Deep Sand	Deep Sand	Shallow Silt/Clay
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<1.0	<1.0	<0.5	<2.0	<1.0	<2.0
1,1-Dichloroethene		NA	NA	<0.5	NA	NA	NA
Benzene		<1.0	<1.0	<0.5	<2.0	<1.0	<2.0
cis-1,2-Dichloroethene		<1.0	<1.0	<0.5	<2.0	<1.0	<2.0
Ethylbenzene		<1.0	<1.0	<0.5	<2.0	<1.0	<2.0
Toluene		<1.0	<1.0	<0.5	<2.0	<1.0	<2.0
Total 1,2-Dichloroethene		<1.0	<1.0	<0.5	<2.0	<1.0	<2.0
trans-1,2-Dichloroethene		<1.0	<1.0	<0.5	<2.0	<1.0	<2.0
Trichloroethene		<1.0	<1.0	<0.5	<2.0	<1.0	<2.0
Vinyl Chloride		<1.0	<1.0	<2.0	<2.0	<1.0	<2.0
Xylenes (total)		<1.0	<1.0	<1.0	<2.0	<1.0	<2.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L084DP	A39L084DP	A39L084DP	A39L085DP	A39L085DP	A39L085DP
	Sample Depth (ft):	43 - 45	58 - 60	70 - 72	20 - 22	43 - 45	58 - 60
	Sample Date:	9/7/96	9/8/96	9/8/96	9/4/96	9/4/96	9/4/96
	Geologic Unit:	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<2.0	<0.5	<0.5	<1.0	<1.0	<2.0
1,1-Dichloroethene		NA	<0.5	<0.5	NA	NA	NA
Benzene		<2.0	<0.5	<0.5	<1.0	<1.0	<2.0
cis-1,2-Dichloroethene		<2.0	1.27	11.6	<1.0	<1.0	<2.0
Ethylbenzene		<2.0	<0.5	<0.5	<1.0	<1.0	<2.0
Toluene		<2.0	<0.5	<0.5	<1.0	<1.0	<2.0
Total 1,2-Dichloroethene		<2.0	<0.5	16.42	<1.0	<1.0	<2.0
trans-1,2-Dichloroethene		<2.0	<0.5	4.82	<1.0	<1.0	<2.0
Trichloroethene		<2.0	<0.5	<0.5	<1.0	<1.0	<2.0
Vinyl Chloride		<2.0	<2.0	<2.0	<1.0	<1.0	<2.0
Xylenes (total)		<2.0	<1.0	<1.0	<1.0	<1.0	<2.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L085DP	A39L086DP	A39L086DP	A39L086DP	A39L086DP	A39L087DP
	Sample Depth (ft):	70 - 72	20 - 22	43 - 45	58 - 60	70 - 72	20 - 22
	Sample Date:	9/4/96	9/6/96	9/6/96	9/6/96	9/6/96	8/21/96
	Geologic Unit:	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<2.0	<2.0	<1.0	<0.5	<2.0	<0.5
1,1-Dichloroethene		NA	NA	NA	<0.5	NA	<0.5
Benzene		<2.0	<2.0	<1.0	<0.5	<2.0	<0.5
cis-1,2-Dichloroethene		<2.0	<2.0	<1.0	<0.5	<2.0	<0.5
Ethylbenzene		<2.0	<2.0	<1.0	<0.5	<2.0	<0.5
Toluene		<2.0	<2.0	<1.0	<0.5	<2.0	<0.5
Total 1,2-Dichloroethene		<2.0	<2.0	<1.0	<0.5	<2.0	<0.5
trans-1,2-Dichloroethene		<2.0	<2.0	<1.0	<0.5	<2.0	<0.5
Trichloroethene		<2.0	<2.0	<1.0	<0.5	<2.0	<0.5
Vinyl Chloride		<2.0	<2.0	<1.0	<2.0	<2.0	<2.0
Xylenes (total)		<2.0	<2.0	<1.0	<1.0	<2.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L087DP	A39L087DP	A39L087DP	A39L088DP	A39L088DP	A39L088DP
	Sample Depth (ft):	43 - 45	58 - 60	70 - 72	20 - 22	43 - 45	58 - 60
	Sample Date:	8/21/96	8/21/96	8/21/96	8/22/96	8/22/96	8/22/96
	Geologic Unit:	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<1.0	<1.0	<1.0	<2.0	<2.0	<2.0
Benzene		<1.0	<1.0	<1.0	<2.0	<2.0	<2.0
cis-1,2-Dichloroethene		2.16	<1.0	<1.0	<2.0	<2.0	<2.0
Ethylbenzene		<1.0	<1.0	<1.0	<2.0	<2.0	<2.0
Toluene		<1.0	<1.0	<1.0	<2.0	<2.0	<2.0
Total 1,2-Dichloroethene		2.16	<1.0	<1.0	<2.0	<2.0	<2.0
trans-1,2-Dichloroethene		<1.0	<1.0	<1.0	<2.0	<2.0	<2.0
Trichloroethene		<1.0	<1.0	<1.0	<2.0	<2.0	<2.0
Vinyl Chloride		<1.0	<1.0	<1.0	<2.0	<2.0	<2.0
Xylenes (total)		<1.0	<1.0	<1.0	<2.0	<2.0	<2.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L088DP	A39L089DP	A39L089DP	A39L089DP	A39L089DP	A39L090DP
	Sample Depth (ft):	71 - 73	20 - 22	43 - 45	58 - 60	70 - 72	20 - 22
	Sample Date:	8/22/96	8/23/96	8/23/96	8/23/96	8/23/96	9/4/96
	Geologic Unit:	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<1.0	<1.0	<1.0	<0.5	<2.0	<1.0
1,1-Dichloroethene		NA	<1.0	NA	<0.5	NA	NA
Benzene		<1.0	326	32	4.94	6.42	<1.0
cis-1,2-Dichloroethene		<1.0	<1.0	<1.0	<0.5	<2.0	<1.0
Ethylbenzene		<1.0	605	40.6	10.6	7.92	<1.0
Toluene		<1.0	20.2	<1.0	0.325 JQ	<2.0	<1.0
Total 1,2-Dichloroethene		<1.0	<1.0	<1.0	<0.5	<2.0	<1.0
trans-1,2-Dichloroethene		<1.0	<1.0	<1.0	<0.5	<2.0	<1.0
Trichloroethene		<1.0	<1.0	<1.0	<0.5	<2.0	<1.0
Vinyl Chloride		<1.0	<1.0	<1.0	<2.0	<2.0	<1.0
Xylenes (total)		<1.0	24	7.07	<1.0	<2.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L090DP	A39L090DP	A39L090DP	A39L091DP	A39L091DP	A39L091DP
	Sample Depth (ft):	43 - 45	58 - 60	70 - 72	20 - 22	43 - 45	58 - 60
	Sample Date:	9/4/96	9/4/96	9/4/96	9/5/96	9/5/96	9/5/96
	Geologic Unit:	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<2.0	<2.0	<2.0	<2.0	<0.5	<2.0
1,1-Dichloroethene		NA	NA	NA	NA	<0.5	NA
Benzene		<2.0	<2.0	<2.0	<2.0	0.254 JQ	<2.0
cis-1,2-Dichloroethene		<2.0	<2.0	<2.0	<2.0	<0.5	<2.0
Ethylbenzene		<2.0	<2.0	<2.0	<2.0	<0.5	<2.0
Toluene		<2.0	<2.0	<2.0	<2.0	0.468 JQ	<2.0
Total 1,2-Dichloroethene		<2.0	<2.0	<2.0	<2.0	<0.5	<2.0
trans-1,2-Dichloroethene		<2.0	<2.0	<2.0	<2.0	<0.5	<2.0
Trichloroethene		<2.0	<2.0	<2.0	<2.0	<0.5	<2.0
Vinyl Chloride		<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Xylenes (total)		<2.0	<2.0	<2.0	<2.0	<1.0	<2.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENI.'s fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L091DP	A39L092DP	A39L093DP	A39L093DP	A39L093DP	A39L093DP
	Sample Depth (ft):	70 - 72	116 - 118	19 - 20.5	34 - 35.5	54 - 55.5	70 - 71.5
	Sample Date:	9/5/96	9/8/96	6/11/97	6/11/97	6/11/97	6/12/97
	Geologic Unit:	Intermediate Sand	Deep Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<1.0	<1.0	<0.5	<0.5	<0.5	4.86
1,1-Dichloroethene		NA	NA	<0.5	<0.5	<0.5	<0.5
Benzene		<1.0	<1.0	<0.5	<0.5	<0.5	2.56 JB
cis-1,2-Dichloroethene		<1.0	<1.0	<0.5	2.27	1.14	<0.5
Ethylbenzene		<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
Toluene		<1.0	<1.0	<0.5	<0.5	<0.5	<0.5
Total 1,2-Dichloroethene		<1.0	<1.0	<0.5	2.657	1.749	<0.5
trans-1,2-Dichloroethene		<1.0	<1.0	<0.5	0.387 JQ	0.609	<0.5
Trichloroethene		<1.0	<1.0	<0.5	<0.5	14.8	<0.5
Vinyl Chloride		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Xylenes (total)		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L094DP	A39L094DP	A39L094DP	A39L094DP	A39L095DP	A39L095DP
	Sample Depth (ft):	18 - 20	33 - 35	53 - 55	69 - 71	23 - 24.5	34 - 35.5
	Sample Date:	6/10/97	6/10/97	6/10/97	6/10/97	6/13/97	6/13/97
	Geologic Unit:	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzene		<0 5	<0.5	<0.5	<0.5	<0.5	<0.5
cis-1,2-Dichloroethene		<0.5	<0.5	4.69	0.625	<0.5	<0.5
Ethylbenzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total 1,2-Dichloroethene		<0.5	<0.5	6.08	0.625	<0.5	<0.5
trans-1,2-Dichloroethene		<0.5	<0.5	1.39	<0.5	<0.5	<0.5
Trichloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Vinyl Chloride		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0
Xylenes (total)		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOC's are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L095DP	A39L095DP	A39L096DP	A39L096DP	A39L096DP	A39L096DP
	Sample Depth (ft):	54 - 55.5	70 - 71.5	20 - 21.5	34 - 35.5	54 - 55.5	70 - 71.5
	Sample Date:	6/13/97	6/13/97	6/14/97	6/14/97	6/14/97	6/14/97
	Geologic Unit:	Intermediate Sand	Intermediate Sand	Shallow Silt/Clay	Intermediate Sand	Intermediate Sand	Intermediate Sand
Volatile Organic Compounds (ug/L)							
1,1-Dichloroethane		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
1,1-Dichloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Benzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
cis-1,2-Dichloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	81.4
Ethylbenzene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Toluene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Total 1,2-Dichloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	81.4
trans-1,2-Dichloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Trichloroethene		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Vinyl Chloride		<1.0	<1.0	<1.0	<1.0	<1.0	7.59
Xylenes (total)		<1.0	<1.0	<1.0	<1.0	<1.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Table 4-9
Summary of HydroPunch Groundwater Sample Results
SS-45 RFI Report
England Air Force Base, Louisiana

Group/Analyte	Boring Number:	A39L097DP	A39L097DP	A39L097DP
	Sample Depth (ft):	89 - 90	99 - 100	118 - 119
	Sample Date:	6/15/97	6/15/97	6/15/97
	Geologic Unit:	Deep Sand	Deep Sand	Deep Sand
Volatile Organic Compounds (ug/L)				
1,1-Dichloroethane		<0.5	<0.5	<0.5
1,1-Dichloroethene		<0.5	<0.5	<0.5
Benzene		<0.5	<0.5	<0.5
cis-1,2-Dichloroethene		<0.5	<0.5	<0.5
Ethylbenzene		<0.5	<0.5	<0.5
Toluene		<0.5	<0.5	<0.5
Total 1,2-Dichloroethene		<0.5	<0.5	<0.5
trans-1,2-Dichloroethene		<0.5	<0.5	<0.5
Trichloroethene		<0.5	<0.5	<0.5
Vinyl Chloride		<1.0	<1.0	<1.0
Xylenes (total)		<1.0	<1.0	<1.0

Data Qualification Flags/Notes:
J = Estimated quantitation based on QC data.
JB = Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgement.
JQ = Estimated quantitation: detected below sample quantitation limit.
NA = Not analyzed for this analyte.
VOCs = Volatile organic compounds.
(1) Some analyses were performed by Hydrologic's mobile laboratory using Methods SW8010/SW8020 for VOCs. Other analyses were performed by Hydrologic's or LENL's fixed-based laboratories using Method SW8260 for VOCs. For confirmation analyses, results from the fixed-based laboratory are generally reported on this table. If a field duplicate sample was analyzed, the greater of the two results is reported.
(2) Only the six primary chlorinated VOCs and fuel hydrocarbons VOCs are reported on this table.
(3) Sample quantitation limits may vary due to sample volume, dilutions and the method of analysis utilized.
(4) Surrogate recoveries are not shown.

Prepared by/Date: 1-29-98
Checked by/Date: 1/29/98

January 27, 1998

TABLE 3-3

Summary of Physical Laboratory Results
SS-45 RFI Report
England AFB, Louisiana

Moisture Retention Tests

Location	Sample Interval	Total Porosity (%)	Effective Porosity (%)	Bulk Density (g/cm^3)
Intermediate Sand Unit				
A39L097DP	79.5-81 ft	46.6*	0.7*	1.41*
SS45L001MW	59-60.5 ft	34.4	27.4	1.63
SS45L002MW	54-55.5 ft	37.0	27.7	1.64
Deep Sand Unit				
A39L022PZ	113-115 ft	34.8	28.3	1.73
A39L097DP	107-108.5 ft	35.6	7.4	1.77
SS45L002MW	95-95.5 ft	37.6	15.2	1.72

Falling-Head Permeability Tests

Location	Sample Interval	Vertical Hydraulic Conductivity (cm/s)
Shallow Silt/Clay Unit		
A39L004PZ	14-16 ft	4.3×10^{-8}
SS45L002MW	24-26 ft	4.4×10^{-8}
SS45L005MW	19-21 ft	2.0×10^{-6}
Intermediate Clay Unit		
A39L022PZ	90-92 ft	1.2×10^{-7}
A39L039DP	80.5-82 ft	4.4×10^{-8}
A39L097DP	68.5-70.5 ft	3.8×10^{-8}

* Results are suspect, sample may be silt or clay.

PREPARED/DATE: J. Chulick 11/07/9
CHECKED/DATE: [illegible] 1-25-95

TABLE 3-4

WATER L[illegible]L MEASUREMENTS
SS-45 RFI Report
England AFB, Louisiana

Location	Top of Casing Elevation	Date Measured											
		4/5/96	6/2/96	6/19/96	7/30/96	8/6/96	8/21/96	8/26/96	8/27/96	9/4/96	9/7/96	9/11/96	10/5/96
Staff Gauges													
Le Tig Bayou	--	--	--	--	--	--	--	--	--	--	--	--	--
Drainage Canal	--	--	--	--	--	--	--	--	--	--	--	--	--
Shallow Silt/Clay Unit													
A39L001BH	82.40	77.90	77.33	77.22	76.85	--	76.82	76.68	76.64	76.38	76.23	76.16	75.84
Intermediate Sand Unit													
A39L005PZ	84.76	--	--	--	76.32	76.22	76.08	76.05	76.04	76.02	75.98	75.94	75.96
A39L006PZ	83.98	--	--	--	75.62	75.55	75.20	75.05	75.02	74.92	74.86	74.76	74.60
A39L008DP	82.68	--	75.94	75.86	75.65	--	75.65	--	75.29	75.04	74.90	--	74.10
A39L009PZ	83.38	--	--	--	--	--	75.38	75.12	75.00	74.88	74.78	74.58	74.58
A39L010PZ	86.11	--	--	--	--	--	--	--	--	--	--	--	--
A39L011PZ	87.52	--	--	--	--	--	--	--	--	--	--	--	74.29
A39L012PZ	84.37	--	--	--	--	--	--	--	--	--	--	--	74.14
A39L013DP	84.07	--	76.19	76.13	75.95	75.68	75.48	75.20	75.03	74.85	74.71	74.57	74.39
A39L013PZ	85.43	--	--	--	--	--	--	--	--	--	--	--	--
A39L014DP	84.42	--	--	--	--	--	--	--	--	--	--	--	--
A39L014PZ	85.43	--	--	--	--	--	--	--	--	--	--	--	--
A39L015PZ	83.15	--	--	--	--	--	--	--	--	--	--	--	73.86
A39L016PZ	83.83	--	--	--	--	--	--	--	--	--	--	--	--
A39L017PZ	84.66	--	--	--	--	--	--	--	--	--	--	--	--
A39L018PZ	78.02	--	--	--	--	--	--	--	--	--	--	--	74.89
A39L019PZ	87.03	--	--	--	--	--	--	--	--	--	--	--	73.44
A39L021PZ	87.65	--	--	--	--	--	--	--	--	--	--	--	--
A39L036DP	82.68	--	--	--	--	--	--	--	--	--	--	--	--
A39L039DP	81.58	--	--	--	--	--	--	--	--	--	--	--	74.96
A39L073DP	83.73	--	--	--	--	--	--	--	--	--	--	--	--
BKGL039MW	83.35	77.60	76.60	77.19	75.93	--	75.65	75.47	75.39	75.21	75.09	74.93	--
SS45L001MW	82.42	--	--	--	--	--	--	--	--	--	--	--	--
SS45L005MW	84.75	--	--	--	--	--	--	--	--	--	--	--	--

NOTES:

-- Not measured or unreliable data. Not measured as some measurements preceed installation at some wells or wells were not accessible due to base activities. Unreliable data were discarded if well contained silt in screen interval or data were otherwise erratic.

* Troll Data

All units in feet.

Elevations are referenced to NGVD.

TABLE 3-4

WATER LEVEL MEASUREMENTS
SS-45 RFI Report
England AFB, Louisiana

Location	Top of Casing Elevation	Date Measured											
		4/5/96	6/2/96	6/19/96	7/30/96	8/6/96	8/21/96	8/26/96	8/27/96	9/4/96	9/7/96	9/11/96	10/5/96
Deep Sand Unit													
A39L001PZ	82.41	--	75.37	75.36	75.28	--	75.28	--	74.97	74.55	74.39	--	74.11
A39L002PZ	81.32	--	75.54	--	74.85	--	74.85	--	74.30	74.12	73.98	--	73.96
A39L003PZ	82.73	--	--	75.11	74.88	74.62	74.19	74.05	73.95	73.85	73.65	73.57	73.71
A39L004PZR	84.54	--	--	--	--	--	--	--	--	--	--	--	--
A39L007PZ	84.03	--	--	--	--	--	--	--	--	--	--	--	74.13
A39L008PZ	84.42	--	--	--	--	--	--	--	--	--	--	--	--
A39L020PZ	87.18	--	--	--	--	--	--	--	--	--	--	--	--
A39L022PZ	85.55	--	--	--		--	--	--	--	--	--	--	--
A39L026DP	82.55	--		--	75.12	--	74.77	74.59	74.53	74.33	74.21	74.03	74.15
A39L027DP	82.90	--	75.54	75.84	75.27	75.08	74.68	74.46	74.38	74.28	74.16	73.98	74.08
A39L028DP	84.29	--	75.19	75.73	75.61	75.24	75.07	74.80	74.71	74.59	74.49	74.19	74.19
A39L082DP	86.35	--	--	--	--	--	--	--	--	--	--	--	73.80
A39L092DP	87.40	--	--	--	--	--	--	--	--	--	--	--	--
SS45L002MW	82.60	--	--	--	--	--	--	--	--	--	--	--	--

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* Troll Data

All units are in feet.

Elevations are referenced to NGVD.

WATER [redacted] MEASUREMENTS
SS-45 RFI Report
England AFB, Louisiana

Location	Top of Casing Elevation	Date Measured											
		10/9/96	10/16/96	10/17/96	11/12/96	1/21/97	2/18/97	3/25/97	3/26/97	4/19/97	5/27/97	7/1/97	9/20/97
Staff Gauges													
Le Tig Bayou Drainage Canal	--	--	--	--	72.77	72.64	72.68	--	72.12	--	72.95	72.45	72.73
	--	--	--	--	74.24	74.07	74.02	--	73.71	--	73.85	73.88	74.12
Shallow Silt/Clay Unit													
A39L001BH	82.40	--	--	--	75.01	78.07	80.62	79.96	--	--	78.88	77.79	75.68
Intermediate Sand Unit													
A39L005PZ	84.76	75.76	--	--	76.74	79.13	79.57	--	79.96	79.43	79.48	--	75.49
A39L006PZ	83.98	--	74.14	74.11	75.47*	77.75*	79.21*	--	--	78.32	78.52	76.38	74.03
A39L008DP	82.68	--	--	--	75.14	76.74	79.15	78.47	--	--	78.28	75.86	73.35
A39L009PZ	83.38	74.48	--	--	75.68	77.88	79.10	--	78.77	78.29	78.56	76.32	73.91
A39L010PZ	86.11	--	--	--	75.11*	77.03*	78.80*	--	--	78.01	78.08	76.37	73.97
A39L011PZ	87.52	74.27	74.13	--	74.97*	76.93*	78.59*	--	--	77.90	77.93	76.63	74.43
A39L012PZ	84.37	74.03	--	--	74.62	76.62	78.37	--	78.33	77.83	77.77	76.41	74.16
A39L013DP	84.07	74.25	--	--	75.39	77.68	78.95	--	78.73	78.28	--	76.21	73.78
A39L013PZ	85.43	--	--	--	--	--	--	--	78.09	77.44	77.92	76.11	74.21
A39L014DP	84.42	--	--	--	75.01*	77.3*	78.77*	--	--	--	--	75.99	73.49
A39L014PZ	85.43	--	--	--	--	--	--	--	--	--	79.39	77.81	75.48
A39L015PZ	83.15	73.76	--	--	74.07	77.01	78.82	--	78.55	78.13	78.29	76.13	73.55
A39L016PZ	83.83	--	--	--	--	--	--	--	--	--	--	78.00	75.51
A39L017PZ	84.66	--	--	--	--	--	--	--	--	--	--	76.66	74.27
A39L018PZ	78.02	74.53	--	--	74.74	77.48	--	--	--	--	--	77.00	74.68
A39L019PZ	87.03	74.11	--	--	74.88	77.11	78.83	--	78.79	78.26	78.32	76.57	74.12
A39L021PZ	87.65	74.74	--	--	75.51	77.52	79.06	--	78.95	78.44	78.45	77.09	74.81
A39L036DP	82.68	75.02	74.62	74.62	76.21*	78.16*	79.26*	--	--	78.49	78.86	76.69	74.34
A39L039DP	81.58	--	--	--	76.14	78.15	79.22	78.62	--	78.33	78.58	76.39	73.99
A39L073DP	83.73	--	--	--	74.77	77.13	79.05	--	78.91	78.40	78.56	76.60	74.05
BKGL039MW	83.35	--	--	--	76.13	--	79.69	79.30	--	--	79.17	76.82	74.38
SS45L001MW	82.42	--	--	--	--	--	--	--	--	--	--	76.10	73.64
SS45L005MW	84.75	--	--	--	--	--	--	--	--	--	--	77.01	74.60

NOTES:

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* Troll Data

All units are in feet.

Elevations are referenced to NGVD.

TABLE 3-4

WATER LEVEL MEASURMENTS
SS-45 RFI Report
England AFB, Louisiana

Location	Top of Casing Elevation	Date Measured											
		10/9/96	10/16/96	10/17/96	11/12/96	1/21/97	2/18/97	3/25/97	3/26/97	4/19/97	5/27/97	7/1/97	9/20/97
Deep Sand Unit													
A39L001PZ	82.41	--	--	--	75.15	77.19	78.58	--	--	--	78.28	75.88	73.38
A39L002PZ	81.32	--	--	--	75.06	77.48	78.85	78.48	--	78.09	78.24	75.74	73.20
A39L003PZ	82.73	73.85	73.61	73.61	75.12*	77.40*	78.95*	--	--	78.47	78.27	75.87	73.34
A39L004PZR	84.54	--	--	--	--	--	--	--	--	--	--	76.00	73.47
A39L007PZ	84.03	73.93	73.71	73.69	74.88*	77.73*	79.33*	--	--	78.23	78.39	76.15	73.61
A39L008PZ	84.42	73.92	73.68	73.66	74.77*	77.37*	78.81*	--	--	--	--	76.00	73.51
A39L020PZ	87.18	73.82	--	--	74.63	76.99	78.76	--	78.58	78.12	78.26	76.21	73.64
A39L022PZ	85.55	--	--	--	--	--	--	--	--	--	--	76.18	73.57
A39L026DP	82.55	--	--	--	--	77.57	78.94	--	78.65	--	78.39	76.03	73.54
A39L027DP	82.90	73.88	--	--	75.08	77.42	78.82	--	78.56	78.15	78.30	75.91	73.40
A39L028DP	84.29	74.03	--	--	75.23	77.82	78.92	--	78.65	78.21	78.39	76.05	73.56
A39L082DP	86.35	73.65	73.96	--	74.40*	76.74*	78.63*	--	--	77.95	78.11	76.08	73.50
A39L092DP	87.40	73.59	73.38	73.37	74.34*	76.69*	78.61*	--	--	77.92	78.04	76.02	73.38
SS45L002MW	82.60	--	--	--	--	--	--	--	--	--	--	76.17	73.69

NOTES:
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* Troll Data
All units are in feet.
Elevations are referenced to NGVD.

PREPARED/DATE: [illegible]
CHECKED/DATE: [illegible]

Table 4-10
First Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L001MW-001WG 13 June 97	Sample SS45L005MW-001WG 17 June 97	Sample SS45L009MW-001WG 16 June 97	Sample SS45L010MW-001WG 16 June 97
Volatile Organic Compounds -SW8260A/SW5030A (ug/L)						
1,1-Dichloroethene	0.500	--	.517	<.500	<.500	<.500
cis-1,2-Dichloroethene	0.500	--	4.31	.472 JQ	2.53	80.3
trans-1,2-Dichloroethene	0.500	--	.284 JQ	<.500	.473 JQ	4.63
Trichloroethene	0.500	--	451	<.500	11.0	35.8
Vinyl chloride	1.00	--	.548 JQ	<1.00	<1.00	<1.00
Specific Conductance -E120.1/NONE (umhos/cm)						
Specific Conductance	--	715	859	405	443	707
pH -E150.1/NONE (pH units)						
pH	--	6.86	6.73	7.04	6.63	6.8
Total Dissolved Solids -E160.1/NONE (mg/L)						
Total Dissolved Solids	10.0	386	591	404	430	446
Total Suspended Solids -E160.2/NONE (mg/L)						
Total Suspended Solids	10.0	27	<10.0	67.0	53.0	92.0
Temperature -E170.1/NONE (Celsius)						
Temperature	--	17.7	22.1	22.6	22.7	23.3
Turbidity -E180.1/NONE (NTUs)						
Turbidity	--	45.6	3.6	37.9	38.0	48.7

Data Qualification Flags/Notes:
NA=Not Analyzed
J=Estimated quantitation based upon QC data
JB=Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgment
JH=Estimated quantitation: possibly biased high or false positive based upon QC data
JL=Estimated quantitation: possibly biased low or false negative based upon QC data
JQ=Estimated quantitation: detected below the Sample Quantitation Limit
ND=No Positive Results detected for the Analytical Method
JT=This sample has GC/FID characteristics for which reliable identification of a product could not be achieved
R=Datum rejected based upon QC data: do not use

(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions

(b) The site-specific background concentration is derived from the upradient monitoring well results. The intermediate upgradient monitoring well is SS45L017MW.

[ ] Positive result exceeds background concentration or no background value has been determined

Prepared By/Date: MG/1-29-98
Checked By/Date: [illegible] 1-29-98

Table 4-10
First Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

	Sample ID:			Sample	Sample	Sample		Sample	
	Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	SS45L001MW-001WG 13 June 97	SS45L005MW-001WG 17 June 97	SS45L009MW-001WG 16 June 97		SS45L010MW-001WG 16 June 97	
Anions -SW9056/NONE (mg/L)									
Chloride		0.200	3.05	14.3	5.15	2.49		13.0	
Nitrogen as Nitrate		0.100	< 0.1	<.100	<.100	.0823	JQ	.0137	JB
Sulfate as SO4		0.200	21.8	59.9	.454	17.8		13.6	
Total Kjeldahl Nitrogen -E351.2/NONE (mg/L)									
Total Kjeldahl Nitrogen		0.500	< 0.5	<0.50	1.1	0.41	JQ	0.62	
Dissolved Oxygen -E360.1/NONE (mg/L)									
Dissolved Oxygen		--	< 0	5.6	3.8	2.7		2.7	
Total Phosphorous -E365.3/NONE (mg/L)									
Phosphorus, Total as P		0.0500	0.16	0.12	1.1	0.14		0.24	
Biochemical Oxygen Demand -E405.1/NONE (mg/L)									
Biochemical Oxygen Demand		2.00	< 2	<2.00	2.93	<2.00		2.07	
Chemical Oxygen Demand -E410.4/NONE (mg/L)									
Chemical Oxygen Demand (Regular)		5.00	6.09	10.4	19.3	8.99		5.98	
Ferrous Iron -HACH 8146/NONE (mg/l)									
Iron		--	3.61	0.52	2.66	2.96		2.95	
Alkalinity -HACH ALAP/NONE (mg/l)									
Alkalinity		1.0	460	580	460	499		NA	

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[ ] Positive result exceeds background concentration or no background value has been determined.

Table 4-xx

First Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L001MW-001WG 13 June 97	Sample SS45L005MW-001WG 17 June 97	Sample SS45L009MW-001WG 16 June 97	Sample SS45L010MW-001WG 16 June 97
Methane, Ethane, Ethene -Kampbell, et al./METHOD (ug/L)						
Methane	47.0	< 47	<47	620	<47	460
Redox Potential -SM 2580/NONE (mv)						
Redox Potential	--	-48	88	0.0	0.0	57
ICP Metals (Dissolved) -SW6010A/SW3005A (mg/L)						
Aluminum	0.200	< 0.2	<0.20	<0.20 J	0.046 JB	0.023 JB
Barium	0.00500	0.22	0.24	0.20	0.22	0.28
Calcium	1.00	84.1	81.5	62 2	98.5	107
Iron	0.200	4	0.48	2.1	2.7	4.3
Potassium	5.00	0.71	1.2 JQ	0.85 JQ	1.1 JQ	1.5 JQ
Magnesium	0.200	47.3	69.7	23.8	44.1	50.3
Manganese	0.0100	0.62	0.64	1.2	0.89	1.6
Sodium	5.00	15.9	55.3	85.8	13.5	19.9
Nickel	0.0400	< 0.04	0.026 JQ	0.0098 JQ	<0.040	0.0070 JQ
Vanadium	0.0100	< 0.01	<0.010	<0.010	0.0024 JQ	0.0032 JQ
Zinc	0.0200	< 0.02	<0.020	<0.020	0.0090 JQ	<0.020
ICP Metals (Total) -SW6010A/SW3005A (mg/L)						
Aluminum	0.200	1.1	0.052 JB	1.5 J	1.1	2 6
Barium	0.00500	0 23	0.23	0.22	0.20	0 28
Calcium	1.00	84.4	79.7	63 6	90.3	101
Copper	0.0100	< 0.01	<0.010	<0.010	0.0040 JQ	0.0052 JQ

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(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

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[ ] Positive result exceeds background concentration or no background value has been determined.

Table 4-10
First Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

	Sample ID:			Sample		Sample		Sample		Sample	
	Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	SS45L001MW-001WG 13 June 97		SS45L005MW-001WG 17 June 97		SS45L009MW-001WG 16 June 97		SS45L010MW-001WG 16 June 97	
Iron		0.200	4.8	0.55		3.9		3.7		7.1	
Potassium		5.00	1.1	0.99	JQ	1.7	JQ	1.3	JQ	1.7	JQ
Magnesium		0.200	48	68.2		24.8		40.0		48.0	
Manganese		0.0100	0.62	0.63		1.3		0.83		1.6	
Sodium		5.00	16	52.8		85.1		12.1		18.3	
Nickel		0.0400	< 0.04	0.021	JQ	0.0099	JQ	0.0089	JQ	0.013	JQ
Vanadium		0.0100	0.0031	0.0031	JQ	0.0050	JQ	0.0064	JQ	0.0079	JQ
Zinc		0.0200	< 0.02	<0.020		<0.020		0.013	JQ	0.014	JB
Trace ICP Metals- (Dissolved) -SW6010AT/SW3005 (mg/L)											
Arsenic		0.0100	< 0.01	<0.010		<0.010	J	0.0072	JQ	0.0094	JQ
Selenium		0.00500	< 0.005	<0.0050	J	<0.0050		<0.0050		0.0037	JQ
Trace ICP Metals- (Total) -SW6010A/SW3005A (mg/L)											
Arsenic		0.0100	< 0.01	0.0044	JQ	0.0087	J	0.010		0.012	
Lead		0.00300	0.0098	0.0028	JQ	<0.0030		<0.0030		<0.0030	
ICP/MS Metals (Dissolved) -SW6020/SW3020A (mg/L)											
Antimony		0.00100	< 0.001	<0.0010		0.0013		0.0007	JQ	0.00081	JQ
ICP/MS Metals (Total) -SW6020/SW3020A (mg/L)											
Cadmium		0.00100	< 0.001	<0.0010	JL	<0.001	JL	<0.00100	JL	0.00025	JL
Mercury (Dissolved) -SW7470A/METHOD (mg/L)											
				ND		ND		ND		ND	

Data Qualification Flags/Notes:

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JH=Estimated quantitation: possibly biased high or false positive based upon QC data
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(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

(b) The site-specific background concentration is derived from the upradient monitoring well results. The intermediate upgradient monitoring well is SS45L017MW.

[ ] Positive result exceeds background concentration or no background value has been determined

Table 4-10
First Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L001MW-001WG 13 June 97	Sample SS45L005MW-001WG 17 June 97	Sample SS45L009MW-001WG 16 June 97	Sample SS45L010MW-001WG 16 June 97
Mercury (Total) -SW7470A/METHOD (mg/L)						
			ND	ND	ND	ND
Semivolatile Organic Compounds -SW8270B/SW3520B (ug/L)						
bis(2-Ethylhexyl)phthalate	10.0	--	<10.6	<10.8	5.28 JB	<10.8
Polynuclear Aromatic Hydrocarbons -SW8310/SW3520B (ug/L)						
			ND	ND	ND	ND
Total Organic Carbon -SW9060M/NONE (mg/L)						
Total Organic Carbon	1.00	14.7	18.1	17.4	19.7	15.2

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JH=Estimated quantitation: possibly biased high or false positive based upon QC data
JL=Estimated quantitation: possibly biased low or false negative based upon QC data
JQ=Estimated quantitation: detected below the Sample Quantitation Limit
ND=No Positive Results detected for the Analytical Method
JT=This sample has GC/FID characteristics for which reliable identification of a product could not be achieved
R=Datum rejected based upon QC data: do not use

(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

(b) The site-specific background concentration is derived from the upradient monitoring well results. The intermediate upgradient monitoring well is SS45L017MW.

[ ] Positive result exceeds background concentration or no background value has been determined

Table 4-10
First Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L011MW-001WG 16 June 97	Duplicate SS45L011MW-002WG 16 June 97	Sample SS45L011MW-001WGRS 24 June 97	Duplicate SS45L011MW-002WGRS 24 June 97
Volatile Organic Compounds -SW8260A/SW5030A (ug/L)						
Toluene	0.500	--	.531	.493 JQ	NA	NA
cis-1,2-Dichloroethene	0.500	--	9.46	9.43	NA	NA
trans-1,2-Dichloroethene	0.500	--	31.4	30.1	NA	NA
Vinyl chloride	1.00	--	549	540	NA	NA
Specific Conductance -E120.1/NONE (umhos/cm)						
Specific Conductance	--	715	477	477	539	539
pH -E150.1/NONE (pH units)						
pH	--	6.86	6.94	6.94	6.91	6.91
Total Dissolved Solids -E160.1/NONE (mg/L)						
Total Dissolved Solids	10.0	386	491	578	NA	NA
Total Suspended Solids -E160.2/NONE (mg/L)						
Total Suspended Solids	10.0	27	90.0	97.0	NA	NA
Temperature -E170.1/NONE (Celsius)						
Temperature	--	17.7	20.8	20.8	22.5	22.5
Turbidity -E180.1/NONE (NTUs)						
Turbidity	--	45.6	60	60	3.6	3.6
Anions -SW9056/NONE (mg/L)						

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(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

(b) The site-specific background concentration is derived from the upradient monitoring well results. The intermediate upgradient monitoring well is SS45L017MW

[ ] Positive result exceeds background concentration or no background value has been determined

First Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L011MW-001WG 16 June 97	Duplicate SS45L011MW-002WG 16 June 97	Sample SS45L011MW-001WGRS 24 June 97	Duplicate SS45L011MW-002WGRS 24 June 97
Chloride	0.200	3.05	10.8	11.2	NA	NA
Nitrogen as Nitrate	0.100	< 0.1	.0331 JB	.0440 JB	NA	NA
Sulfate as SO4	0.200	21.8	.405 JB	.463 JB	NA	NA
Total Kjeldahl Nitrogen -E351.2/NONE (mg/L)						
Total Kjeldahl Nitrogen	0.500	< 0.5	0.90	0.92	NA	NA
Dissolved Oxygen -E360.1/NONE (mg/L)						
Dissolved Oxygen	--	< 0	1.2	1.2	6.6	6.6
Total Phosphorous -E365.3/NONE (mg/L)						
Phosphorus, Total as P	0.0500	0.16	0.90	0.92	NA	NA
Biochemical Oxygen Demand -E405.1/NONE (mg/L)						
			ND	ND	NA	NA
Chemical Oxygen Demand -E410.4/NONE (mg/L)						
Chemical Oxygen Demand (Regular)	5.00	6.09	16.3	21.4	NA	NA
Ferrous Iron -HACH 8146/NONE (mg/l)						
Iron	--	3.61	5.1	5.1	NA	NA
Alkalinity -HACH ALAP/NONE (mg/l)						
Alkalinity	1.0	460	600	600	NA	NA
Methane, Ethane, Ethene -Kampbell, et al./METHOD (ug/L)						

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[ ] Positive result exceeds background concentration or no background value has been determined

Table 4-10
First Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID:			Sample	Duplicate	Sample	Duplicate
Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	SS45L011MW-001WG 16 June 97	SS45L011MW-002WG 16 June 97	SS45L011MW-001WGRS 24 June 97	SS45L011MW-002WGRS 24 June 97
Ethene	82.0	< 82	400 J	720 J	NA	NA
Methane	47.0	< 47	4700	7100	NA	NA
Redox Potential -SM 2580/NONE (mv)						
Redox Potential	--	-48	-129	-129	0.0	0.0
ICP Metals (Dissolved) -SW6010A/SW3005A (mg/L)						
Aluminum	0.200	< 0.2	<0.20	0.028 JB	NA	NA
Barium	0.00500	0.22	0.52	0.53	NA	NA
Calcium	1.00	84.1	143	139	NA	NA
Cobalt	0.0100	< 0.01	<0.010	0.0044 JQ	NA	NA
Iron	0.200	4	19.8	19.6	NA	NA
Potassium	5.00	0.71	1.7 JQ	2.1 JQ	NA	NA
Magnesium	0.200	47.3	52.1	52.4	NA	NA
Manganese	0.0100	0.62	2.2	2.2	NA	NA
Sodium	5.00	15.9	11.4	11.9	NA	NA
Vanadium	0.0100	< 0.01	0.0028 JQ	0.0061 JQ	NA	NA
Zinc	0.0200	< 0.02	<0.020	0.014 JB	NA	NA
ICP Metals (Total) -SW6010A/SW3005A (mg/L)						
Aluminum	0.200	1.1	0.83	0.57	NA	NA
Barium	0.00500	0.23	0.51	0.48	NA	NA
Calcium	1.00	84.4	141	132	NA	NA
Iron	0.200	4.8	20.2	18.9	NA	NA

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[ ] Positive result exceeds background concentration or no background value has been determined

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First Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID:			Sample	Duplicate	Sample	Duplicate
Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	SS45L011MW-001WG 16 June 97	SS45L011MW-002WG 16 June 97	SS45L011MW-001WGRS 24 June 97	SS45L011MW-002WGRS 24 June 97
Potassium	5.00	1.1	1.9 JQ	1.5 JQ	NA	NA
Magnesium	0.200	48	51.5	48.3	NA	NA
Manganese	0.0100	0.62	2.2	2.1	NA	NA
Sodium	5.00	16	10.4	10.1	NA	NA
Vanadium	0.0100	0.0031	0.0042 JQ	0.0031 JQ	NA	NA
Trace ICP Metals- (Dissolved) -SW6010AT/SW3005 (mg/L)						
Arsenic	0.0100	< 0.01	0.016	0.018	NA	NA
Selenium	0.00500	< 0.005	<0.0050	0.0062	NA	NA
Trace ICP Metals- (Total) -SW6010A/SW3005A (mg/L)						
Arsenic	0.0100	< 0.01	0.017	0.017	NA	NA
ICP/MS Metals (Dissolved) -SW6020/SW3020A (mg/L)						
Antimony	0.00100	< 0.001	0.0013 J	0.00045 JQ	NA	NA
ICP/MS Metals (Total) -SW6020/SW3020A (mg/L)						
			ND	ND	NA	NA
Mercury (Dissolved) -SW7470A/METHOD (mg/L)						
			ND	ND	NA	NA
Mercury (Total) -SW7470A/METHOD (mg/L)						
			ND	ND	NA	NA
Semivolatile Organic Compounds -SW8270B/SW3520B (ug/L)						

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Table 4-10
First Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L011MW-001WG 16 June 97	Duplicate SS45L011MW-002WG 16 June 97	Sample SS45L011MW-001WGRS 24 June 97	Duplicate SS45L011MW-002WGRS 24 June 97
bis(2-Ethylhexyl)phthalate	10.0	--	<10.8	NA	7.36 JQ	3.73 JQ
Polynuclear Aromatic Hydrocarbons -SW8310/SW3520B (ug/L)						
			ND	NA	ND	ND
Total Organic Carbon -SW9060M/NONE (mg/L)						
Total Organic Carbon	1.00	14.7	33.5	27.6	NA	NA

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First Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L012MW-001WG 16 June 97	Sample SS45L013MW-001WG 16 June 97	Sample SS45L015MW-001WG 13 June 97	Sample SS45L017MW-001WG 12 June 97
Volatile Organic Compounds -SW8260A/SW5030A (ug/L)						
Benzene	0.500	--	.474 JQ	<.500	<.500	<.500
1,1-Dichloroethane	0.500	--	.819	<.500	<.500	<.500
cis-1,2-Dichloroethene	0.500	--	77.2	26.6	<.500	<.500
trans-1,2-Dichloroethene	0.500	--	6.39	<.500	<.500	<.500
Vinyl chloride	1.00	--	85.3	4.13	<1.00	<1.00
Specific Conductance -E120.1/NONE (umhos/cm)						
Specific Conductance	--	715	406	488	1186	715
pH -E150.1/NONE (pH units)						
pH	--	6.86	6.8	6.81	6.75	6.86
Total Dissolved Solids -E160.1/NONE (mg/L)						
Total Dissolved Solids	10.0	386	626	494	809	386
Total Suspended Solids -E160.2/NONE (mg/L)						
Total Suspended Solids	10.0	27	49.0	51.0	35.0	27.0
Temperature -E170.1/NONE (Celsius)						
Temperature	--	17.7	23.0	24.0	24.6	17.7
Turbidity -E180.1/NONE (NTUs)						
Turbidity	--	45.6	6.4	27.1	40.3	45.6

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Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

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Anions -SW9056/NONE (mg/L)								
Chloride	0.200	3.05	6.19		11.9		12.4	3.05
Nitrogen as Nitrate	0.100	< 0.1	.0313	JB	.0340	JB	<.100	< 100
Sulfate as SO4	0.200	21.8	.356	JB	.157	JB	60.0	21.8
Total Kjeldahl Nitrogen -E351.2/NONE (mg/L)								
Total Kjeldahl Nitrogen	0.500	< 0.5	1.8		5.3		<0.50	<0.50
Dissolved Oxygen -E360.1/NONE (mg/L)								
Dissolved Oxygen	--	< 0	0.1		2.2		3.4	0.0
Total Phosphorous -E365.3/NONE (mg/L)								
Phosphorus, Total as P	0.0500	0.16	1.2		1.3		0.099	0.16
Biochemical Oxygen Demand -E405.1/NONE (mg/L)								
Biochemical Oxygen Demand	2.00	< 2	5.07		7.00		<2.00	<2.00
Chemical Oxygen Demand -E410.4/NONE (mg/L)								
Chemical Oxygen Demand (Regular)	5.00	6.09	11.1		19.3		12.2	6.09
Ferrous Iron -HACH 8146/NONE (mg/l)								
Iron	--	3.61	5.1		5.1		1.52	3.61
Alkalinity -HACH ALAP/NONE (mg/l)								
Alkalinity	1.0	460	740		460		800	460

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Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID:			Sample	Sample	Sample	Sample
Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	SS45L012MW-001WG 16 June 97	SS45L013MW-001WG 16 June 97	SS45L015MW-001WG 13 June 97	SS45L017MW-001WG 12 June 97
Methane, Ethane, Ethene -Kampbell, et al./METHOD (ug/L)						
Methane	47.0	< 47	3900	9000	<47	<47
Redox Potential -SM 2580/NONE (mv)						
Redox Potential	--	-48	495	0.0	-1	-48
ICP Metals (Dissolved) -SW6010A/SW3005A (mg/L)						
Aluminum	0.200	< 0.2	<0.20	0.025 JB	<0.20	<0.20
Barium	0.00500	0.22	0.47	0.44	0.32	0.22
Calcium	1.00	84.1	177	118	122	84.1
Iron	0.200	4	21.9	14.1	1.4	4.0
Potassium	5.00	0.71	2.1 JQ	3.5 JQ	0.85 JQ	0.71 JQ
Magnesium	0.200	47.3	46.1	32.3	94.2	47.3
Manganese	0.0100	0.62	3.4	1.7	1.1	0.62
Sodium	5.00	15.9	11.2	28.9	62.9	15.9
Vanadium	0.0100	< 0.01	0.0037 JQ	0.0021 JQ	<0.010	<0.010
Zinc	0.0200	< 0.02	<0.020	0.0087 JB	<0.020	<0.020
ICP Metals (Total) -SW6010A/SW3005A (mg/L)						
Aluminum	0.200	1.1	0.065 JB	0.15 JB	1.1	1.1
Barium	0.00500	0.23	0.47	0.42	0.32	0.23
Calcium	1.00	84.4	178	114	117	84.4
Cobalt	0.0100	< 0.01	<0.010	<0.010	0.0054 JQ	<0.010
Iron	0.200	4.8	22.6	14.5	2.3	4.8

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Table 4-10
First Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L012MW-001WG 16 June 97		Sample SS45L013MW-001WG 16 June 97		Sample SS45L015MW-001WG 13 June 97		Sample SS45L017MW-001WG 12 June 97	
Potassium	5.00	1.1	2.0	JQ	3.5	JQ	1.3	JQ	1.1	JQ
Magnesium	0.200	48	45.6		31.3		90.7		48 0	
Manganese	0.0100	0 62	3.2		1.6		1.1		0 62	
Sodium	5.00	16	11.4		28.3		61.3		16 0	
Vanadium	0.0100	0.0031	0.0033	JQ	0.0028	JQ	0.0044	JQ	0.0031	JQ
Zinc	0.0200	< 0.02	<0.020		<0.020		0.012	JQ	<0 020	
Trace ICP Metals- (Dissolved) -SW6010AT/SW3005 (mg/L)										
Arsenic	0.0100	< 0 01	0 046		NA		<0 010		<0 010	
Trace ICP Metals- (Total) -SW6010A/SW3005A (mg/L)										
Arsenic	0.0100	< 0.01	0.043		0.018		<0.010		<0 010	
Lead	0.00300	0 0098	<0 0030		<0 0030		0.0030		0 0098	
ICP/MS Metals (Dissolved) -SW6020/SW3020A (mg/L)										
Antimony	0.00100	< 0 001	0.0011	J	0 00088	JQ	0 00066	JQ	<0 0010	
ICP/MS Metals (Total) -SW6020/SW3020A (mg/L)										
			ND		ND		ND		ND	
Mercury (Dissolved) -SW7470A/METHOD (mg/L)										
			ND		ND		ND		ND	
Mercury (Total) -SW7470A/METHOD (mg/L)										
			ND		ND		ND		ND	

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First Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L012MW-001WG 16 June 97	Sample SS45L013MW-001WG 16 June 97	Sample SS45L015MW-001WG 13 June 97	Sample SS45L017MW-001WG 12 June 97
Semivolatile Organic Compounds -SW8270B/SW3520B (ug/L)						
			ND	ND	ND	ND
Polynuclear Aromatic Hydrocarbons -SW8310/SW3520B (ug/L)						
			ND	ND	ND	ND
Total Organic Carbon -SW9060M/NONE (mg/L)						
Total Organic Carbon	1.00	14.7	20.4	17.3	14.9	14.7

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Table 4-10
First Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

	Sample ID:			Sample
	Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	SS45L019MW-001WG 15 June 97
Volatile Organic Compounds -SW8260A/SW5030A (ug/L)				
Chlorobenzene		0.500	--	.640
1,1-Dichloroethane		0.500	--	1.98
trans-1,2-Dichloroethene		0.500	--	1.10
Vinyl chloride		1.00	--	2.00
Specific Conductance -E120.1/NONE (umhos/cm)				
Specific Conductance		--	715	425
pH -E150.1/NONE (pH units)				
pH		--	6.86	7.0
Total Dissolved Solids -E160.1/NONE (mg/L)				
Total Dissolved Solids		10.0	386	282
Total Suspended Solids -E160.2/NONE (mg/L)				
Total Suspended Solids		10.0	27	35.0
Temperature -E170.1/NONE (Celsius)				
Temperature		--	17.7	22.6
Turbidity -E180.1/NONE (NTUs)				
Turbidity		--	45.6	13.8
Anions -SW9056/NONE (mg/L)				

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[.] Positive result exceeds background concentration or no background value has been determined

Table 4.10
First Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID:			Sample SS45L019MW-001WG	
Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	15 June 97	
Chloride	0.200	3.05	6.10	
Nitrogen as Nitrate	0.100	< 0.1	.0407	JQ
Sulfate as SO4	0.200	21.8	.230	
Total Kjeldahl Nitrogen -E351.2/NONE (mg/L)				
Total Kjeldahl Nitrogen	0.500	< 0.5	1.5	
Dissolved Oxygen -E360.1/NONE (mg/L)				
Dissolved Oxygen	--	< 0	0.3	
Total Phosphorous -E365.3/NONE (mg/L)				
Phosphorus, Total as P	0.0500	0 16	1.5	
Biochemical Oxygen Demand -E405.1/NONE (mg/L)				
Biochemical Oxygen Demand	2.00	< 2	3.44	
Chemical Oxygen Demand -E410.4/NONE (mg/L)				
Chemical Oxygen Demand (Regular)	5.00	6.09	17.3	
Ferrous Iron -HACH 8146/NONE (mg/l)				
Iron	--	3.61	5.1	
Alkalinity -HACH ALAP/NONE (mg/l)				
Alkalinity	1.0	460	400	
Methane, Ethane, Ethene -Kampbell, et al./METHOD (ug/L)				

Data Qualification Flags/Notes:
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J=Estimated quantitation based upon QC data
JB=Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgment
JH=Estimated quantitation: possibly biased high or false positive based upon QC data
JL=Estimated quantitation: possibly biased low or false negative based upon QC data
JQ=Estimated quantitation: detected below the Sample Quantitation Limit
ND=No Positive Results detected for the Analytical Method
JT=This sample has GC/FID characteristics for which reliable identification of a product could not be achieved
R=Datum rejected based upon QC data: do not use

(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

(b) The site-specific background concentration is derived from the upradient monitoring well results. The intermediate upgradient monitoring well is SS45L017MW.

[ ] Positive result exceeds background concentration or no background value has been determined

Table 4-10
First Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L019MW-001WG 15 June 97	
Methane	47.0	< 47	1100	
Redox Potential -SM 2580/NONE (mv)				
Redox Potential	--	-48	995	
ICP Metals (Dissolved) -SW6010A/SW3005A (mg/L)				
Aluminum	0.200	< 0.2	0.020	JB
Barium	0.00500	0.22	0.29	
Calcium	1.00	84.1	79.3	
Iron	0.200	4	9.0	
Potassium	5.00	0.71	1.8	JQ
Magnesium	0.200	47.3	30.9	
Manganese	0.0100	0.62	0.85	
Sodium	5.00	15.9	16.8	
Vanadium	0.0100	< 0.01	0.0054	JQ
Zinc	0.0200	< 0.02	0.011	JQ
ICP Metals (Total) -SW6010A/SW3005A (mg/L)				
Aluminum	0.200	1.1	0.098	JB
Barium	0.00500	0.23	0.29	
Calcium	1.00	84.4	81.7	
Iron	0.200	4.8	9.2	
Potassium	5.00	1.1	2.0	JQ
Magnesium	0.200	48	30.9	

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☐ Positive result exceeds background concentration or no background value has been determined

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First Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

	Sample ID:			Sample	
	Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	SS45L019MW-001WG 15 June 97	
Manganese		0.0100	0.62	0.86	
Sodium		5.00	16	16.9	
Vanadium		0.0100	0.0031	0.0046	JQ
Zinc		0.0200	< 0.02	0.017	JQ
Trace ICP Metals- (Dissolved) -SW6010AT/SW3005 (mg/L)					
				ND	
Trace ICP Metals- (Total) -SW6010A/SW3005A (mg/L)					
				ND	
ICP/MS Metals (Dissolved) -SW6020/SW3020A (mg/L)					
Antimony		0.00100	< 0.001	0.00037	JQ
ICP/MS Metals (Total) -SW6020/SW3020A (mg/L)					
				ND	
Mercury (Dissolved) -SW7470A/METHOD (mg/L)					
				ND	
Mercury (Total) -SW7470A/METHOD (mg/L)					
				ND	
Semivolatile Organic Compounds -SW8270B/SW3520B (ug/L)					
				ND	

Data Qualification Flags/Notes:

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☐ Positive result exceeds background concentration or no background value has been determined.

Table 4-10
First Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

	Sample ID:			Sample
	Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	SS45L019MW-001WG 15 June 97
Polynuclear Aromatic Hydrocarbons -SW8310/SW3520B (ug/L)				
				ND
Total Organic Carbon -SW9060M/NONE (mg/L)				
Total Organic Carbon		1.00	14.7	11.7

Data Qualification Flags/Notes:

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ND=No Positive Results detected for the Analytical Method
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R=Datum rejected based upon QC data: do not use

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[ ] Positive result exceeds background concentration or no background value has been determined

Table 4-12
First Quarter Groundwater - Positive Result Summary
Deep Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L002MW-001WG 15 June 97	Duplicate SS45L002MW-002WG 15 June 97	Sample SS45L014MW-001WG 17 June 97	Sample SS45L016MW-001WG 12 June 97
Volatile Organic Compounds -SW8260A/SW5030A (ug/L)						
Toluene	0.500	--	<.500	.995	<.500	<.500
cis-1,2-Dichloroethene	0.500	--	128	111	<.500	1.06
trans-1,2-Dichloroethene	0.500	--	6.15	5.30	<.500	<.500
Methylene chloride	3.00	--	<3.00	.942 JQ	<3.00	<3.00
Trichloroethene	0.500	--	<.500	<.500	<.500	4.78
Vinyl chloride	1.00	--	2.50	2.92	<1.00	<1.00
Specific Conductance -E120.1/NONE (umhos/cm)						
Specific Conductance	--	710	845	845	671	602
pH -E150.1/NONE (pH units)						
pH	--	6.92	6.82	6.82	6.87	6.82
Total Dissolved Solids -E160.1/NONE (mg/L)						
Total Dissolved Solids	10.0	483	560	571	465	579
Total Suspended Solids -E160.2/NONE (mg/L)						
Total Suspended Solids	10.0	11	99.0	143	21.0	17.0
Temperature -E170.1/NONE (Celsius)						
Temperature	--	20.6	21.8	21.8	19.8	23.6
Turbidity -E180.1/NONE (NTUs)						
Turbidity	--	3	45	45	8.5	3.35

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☐ Positive result exceeds background concentration or no background value has been determined

Prepared By/Date: MG/1-29-98
Checked By/Date: [illegible] 1-29-98

Table 4-12
First Quarter Groundwater - Positive Result Summary
Deep Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID:			Sample	Duplicate		Sample	Sample
Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	SS45L002MW-001WG 15 June 97	SS45L002MW-002WG 15 June 97		SS45L014MW-001WG 17 June 97	SS45L016MW-001WG 12 June 97
Anions -SW9056/NONE (mg/L)							
Chloride	0.200	29.1	29.0	28.7		14.1	15.4
Nitrogen as Nitrate	0.100	< 0.1	<.100	.0379	JQ	<.100	<.100
Sulfate as SO4	0.200	27.5	11.2	11.2		1.39	46.1
Total Kjeldahl Nitrogen -E351.2/NONE (mg/L)							
Total Kjeldahl Nitrogen	0.500	0.54	1.0	0.99		0.78	<0.50
Dissolved Oxygen -E360.1/NONE (mg/L)							
Dissolved Oxygen	--	7.4	0.4	0.4		6.2	12.3
Total Phosphorous -E365.3/NONE (mg/L)							
Phosphorus, Total as P	0.0500	0.39	0.25	0.26		0.51	0.21
Biochemical Oxygen Demand -E405.1/NONE (mg/L)							
Biochemical Oxygen Demand	2.00	< 2	2.07	<2.00		5.22	<2.00
Chemical Oxygen Demand -E410.4/NONE (mg/L)							
Chemical Oxygen Demand (Regular)	5.00	16.9	19.5	21.7		22.7	6.52
Ferrous Iron -HACH 8146/NONE (mg/l)							
Iron	--	4.32	1.64	1.64		4.46	3.68
Alkalinity -HACH ALAP/NONE (mg/l)							
Alkalinity	1.0	481	540	540		600	485

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[ ] Positive result exceeds background concentration or no background value has been determined

Table 4-12
First Quarter Groundwater - Positive Result Summary
Deep Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L002MW-001WG 15 June 97		Duplicate SS45L002MW-002WG 15 June 97		Sample SS45L014MW-001WG 17 June 97		Sample SS45L016MW-001WG 12 June 97	
Methane, Ethane, Ethene -Kamphell, et al./METHOD (ug/L)										
Methane	47.0	< 47	680		600		3600		<47	
Redox Potential -SM 2580/NONE (mv)										
Redox Potential	--	-20	-45		-45		1067		2037	
ICP Metals (Dissolved) -SW6010A/SW3005A (mg/L)										
Barium	0 00500	0.58	0.52		0.53		0.64		0.27	
Calcium	1 00	96 2	107		109		122		95.2	
Iron	0 200	5.1	2.1		2.1		4 6		3.8	
Potassium	5.00	3.1	2 3	JQ	2.1	JQ	2.3	JQ	0 85	JQ
Magnesium	0 200	32.9	44 9		45.8		41.6		70.9	
Manganese	0.0100	0.53	0.68		0.69		0 38		0 62	
Molybdenum	0 0400	< 0.04	0 0082	JQ	<0.040		<0 040		<0 040	
Sodium	5 00	41.5	41 4		42.0		43.4		33 2	
Vanadium	0 0100	0 004	0 0036	JQ	0.0040	JQ	<0 010		0 0038	JQ
ICP Metals (Total) -SW6010A/SW3005A (mg/L)										
Aluminum	0 200	0 049	1 2		1.1		0 070	J	1 1	
Barium	0 00500	0 59	0.51		0.51		0 65		0 30	
Calcium	1.00	98 6	101		102		123		94 7	
Cobalt	0 0100	< 0 01	0 0065	JQ	0 0050	JQ	<0 010		<0 010	
Copper	0 0100	< 0.01	0 0053	JQ	0 0046	JQ	<0 010		<0 010	
Iron	0.200	5.4	3.5		3.3		5 0		5 0	

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[ ] Positive result exceeds background concentration or no background value has been determined

Table 4-12
First Quarter Groundwater - Positive Result Summary
Deep Wells
SS-45 RFI Report
England AFB, Louisiana

	Sample ID:			Sample		Duplicate		Sample		Sample	
	Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	SS45L002MW-001WG 15 June 97		SS45L002MW-002WG 15 June 97		SS45L014MW-001WG 17 June 97		SS45L016MW-001WG 12 June 97	
Potassium		5.00	2.6	2.8	JQ	2.5	JQ	2.0	JQ	1.6	JQ
Magnesium		0.200	33.8	43.1		43.5		42.2		71.0	
Manganese		0.0100	0.54	0.67		0.66		0.40		0.67	
Molybdenum		0.0400	< 0.04	<0.040		0.018	JQ	<0.040		<0.040	
Sodium		5.00	42.6	40.1		39.6		44.0		34.0	
Nickel		0.0400	< 0.04	0.0083	JQ	0.0073	JQ	<0.040		0.012	JQ
Vanadium		0.0100	0.0033	0.0090	JQ	0.0077	JQ	<0.010		0.0067	JQ
Zinc		0.0200	< 0.02	0.011	JQ	0.010	JQ	<0.020		<0.020	
Trace ICP Metals- (Dissolved) -SW6010AT/SW3005 (mg/L)											
Arsenic		0.0100	0.015	0.0045	JQ	<0.010		<0.010	J	0.0042	JQ
Trace ICP Metals- (Total) -SW6010A/SW3005A (mg/L)											
Arsenic		0.0100	0.015	0.0057	JQ	0.0038	JQ	<0.010	J	0.0039	JQ
ICP/MS Metals (Dissolved) -SW6020/SW3020A (mg/L)											
Antimony		0.00100	0.9	0.001	J	<0.00100		<0.001		<0.0010	
ICP/MS Metals (Total) -SW6020/SW3020A (mg/L)											
Thallium		0.000100	< 0.0001	0.000049	JQ	0.000054	JQ	<0.0001		<0.00010	
Mercury (Dissolved) -SW7470A/METHOD (mg/L)											
				ND		ND		ND		ND	
Mercury (Total) -SW7470A/METHOD (mg/L)											

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☐ Positive result exceeds background concentration or no background value has been determined.

Table 4-12
First Quarter Groundwater - Positive Result Summary
Deep Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L002MW-001WG 15 June 97	Duplicate SS45L002MW-002WG 15 June 97	Sample SS45L014MW-001WG 17 June 97	Sample SS45L016MW-001WG 12 June 97
Semivolatile Organic Compounds -SW8270B/SW3520B (ug/L)			ND	ND	ND	ND
Polynuclear Aromatic Hydrocarbons -SW8310/SW3520B (ug/L)			ND	ND	ND	ND
Total Organic Carbon -SW9060M/NONE (mg/L)			ND	ND	ND	ND
Total Organic Carbon	1.00	20.1	16.3	21.6	18.7	12.8

Data Qualification Flags/Notes:

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Table 4-12
First Quarter Groundwater - Positive Result Summary
Deep Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L018MW-001WG 12 June 97
Volatile Organic Compounds -SW8260A/SW5030A (ug/L)			
			ND
Specific Conductance -E120.1/NONE (umhos/cm)			
Specific Conductance	--	710	710
pH -E150.1/NONE (pH units)			
pH	--	6.92	6.92
Total Dissolved Solids -E160.1/NONE (mg/L)			
Total Dissolved Solids	10.0	483	483
Total Suspended Solids -E160.2/NONE (mg/L)			
Total Suspended Solids	10.0	11	11.0
Temperature -E170.1/NONE (Celsius)			
Temperature	--	20.6	20.6
Turbidity -E180.1/NONE (NTUs)			
Turbidity	--	3	3.0
Anions -SW9056/NONE (mg/L)			
Chloride	0.200	29.1	29.1
Sulfate as SO4	0.200	27.5	27.5
Total Kjeldahl Nitrogen -E351.2/NONE (mg/L)			

Data Qualification Flags/Notes:
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J=Estimated quantitation based upon QC data
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Table 4-12
First Quarter Groundwater - Positive Result Summary
Deep Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L018MW-001WG 12 June 97
Total Kjeldahl Nitrogen	0.500	0.54	0.54
Dissolved Oxygen -E360.1/NONE (mg/L)			
Dissolved Oxygen	--	7.4	7.4
Total Phosphorous -E365.3/NONE (mg/L)			
Phosphorus, Total as P	0.0500	0.39	0.39
Biochemical Oxygen Demand -E405.1/NONE (mg/L)			
			ND
Chemical Oxygen Demand -E410.4/NONE (mg/L)			
Chemical Oxygen Demand (Regular)	5.00	16.9	16.9
Ferrous Iron -HACH 8146/NONE (mg/l)			
Iron	--	4.32	4.32
Alkalinity -HACH ALAP/NONE (mg/l)			
Alkalinity	1.0	481	481
Methane, Ethane, Ethene -Kampbell, et al./METHOD (ug/L)			
			ND
Redox Potential -SM 2580/NONE (mv)			
Redox Potential	--	-20	-20
ICP Metals (Dissolved) -SW6010A/SW3005A (mg/L)			

Data Qualification Flags/Notes:

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12

First Quarter Groundwater - Positive Result Summary
Deep Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID:			Sample	
Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	SS45L018MW-001WG 12 June 97	
Aluminum	0.200	0.031	0.031	JB
Barium	0.00500	0.58	0.58	
Calcium	1.00	96.2	96.2	
Iron	0.200	5.1	5.1	
Potassium	5.00	3.1	3.1	JQ
Magnesium	0.200	32.9	32.9	
Manganese	0.0100	0.53	0.53	
Sodium	5.00	41.5	41.5	
Vanadium	0.0100	0.004	0.0040	JQ
Zinc	0.0200	0.0091	0.0091	JQ
ICP Metals (Total) -SW6010A/SW3005A (mg/L)				
Aluminum	0.200	0.049	0.049	JB
Barium	0.00500	0.59	0.59	
Calcium	1.00	98.6	98.6	
Iron	0.200	5.4	5.4	
Potassium	5.00	2.6	2.6	JQ
Magnesium	0.200	33.8	33.8	
Manganese	0.0100	0.54	0.54	
Sodium	5.00	42.6	42.6	
Vanadium	0.0100	0.0033	0.0033	JQ
Trace ICP Metals- (Dissolved) -SW6010AT/SW3005 (mg/L)				
Arsenic	0.0100	0.015	0.015	

Data Qualification Flags/Notes:

NA=Not Analyzed
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JB=Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgment
JH=Estimated quantitation: possibly biased high or false positive based upon QC data
JL=Estimated quantitation: possibly biased low or false negative based upon QC data
JQ=Estimated quantitation: detected below the Sample Quantitation Limit
ND=No Positive Results detected for the Analytical Method
JT=This sample has GC/FID characteristics for which reliable identification of a product could not be achieved
R=Datum rejected based upon QC data: do not use

(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

(b) The site-specific background concentration is derived from the upradient monitoring well results. The deep upgradient monitoring well is SS45L018MW.

Positive result exceeds background concentration or no background value has been determined

Table 4-12
First Quarter Groundwater - Positive Result Summary
Deep Wells
SS-45 RFI Report
England AFB, Louisiana

	Sample ID:			Sample SS45L018MW-001WG	
	Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	12 June 97	
Selenium		0.00500	0.0033	0.0033	J
Trace ICP Metals- (Total) -SW6010A/SW3005A (mg/L)					
Arsenic		0.0100	0.015	0.015	
ICP/MS Metals (Dissolved) -SW6020/SW3020A (mg/L)					
Antimony		0.00100	0.9	0.90	JQ
ICP/MS Metals (Total) -SW6020/SW3020A (mg/L)					
				ND	
Mercury (Dissolved) -SW7470A/METHOD (mg/L)					
				ND	
Mercury (Total) -SW7470A/METHOD (mg/L)					
				ND	
Semivolatile Organic Compounds -SW8270D/SW3520B (ug/L)					
				ND	
Polynuclear Aromatic Hydrocarbons -SW8310/SW3520B (ug/L)					
				ND	
Total Organic Carbon -SW9060M/NONE (mg/L)					
Total Organic Carbon		1.00	20.1	20.1	

Data Qualification Flags/Notes:
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J=Estimated quantitation based upon QC data
JB=Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgment
JH=Estimated quantitation: possibly biased high or false positive based upon QC data
JL=Estimated quantitation: possibly biased low or false negative based upon QC data
JQ=Estimated quantitation: detected below the Sample Quantitation Limit
ND=No Positive Results detected for the Analytical Method
JT=This sample has GC/FID characteristics for which reliable identification of a product could not be achieved
R=Datum rejected based upon QC data: do not use

(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions

(b) The site-specific background concentration is derived from the upradient monitoring well results. The deep upgradient monitoring well is SS45L018MW.

☐ Positive result exceeds background concentration or no background value has been determined

Table 4-13
Second Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L001MW-001WG 16 September 97	Sample SS45L001MW-001WGRS 19 September 97	Sample SS45L005MW-001WG 18 September 97	Sample SS45L009MW-001WG 21 September 97
Anions -SW9056/NONE (mg/L)						
Chloride	0.200	3.75	NA	33.7 JH	6.35 JH	8.39 JH
Nitrogen as Nitrate	0.100	0.111	NA	<.100	.122	<.100
Sulfate as SO4	0.200	23.4	NA	34.8	1.46	20.1
Total Kjeldahl Nitrogen -E351.2/NONE (mg/L)						
Total Kjeldahl Nitrogen	0.500	0.39	<0.50	NA	1.1	<0.50
Dissolved Oxygen -E360.1/NONE (mg/L)						
Dissolved Oxygen	--	1	2.1	0.9	1.4	0.7
Total Phosphorous -E365.3/NONE (mg/L)						
Phosphorus, Total as P	0.0500	0.19	0.20	NA	1.5	0.14
Biochemical Oxygen Demand -E405.1/NONE (mg/L)						
Biochemical Oxygen Demand	2.00	< 2	<2.00	NA	2.36	<2.00
Chemical Oxygen Demand -E410.4/NONE (mg/L)						
Chemical Oxygen Demand (Regular)	5.00	6.29	6.57	NA	14.8	10.2
Ferrous Iron -HACH 8146/NONE (mg/l)						
Iron	--	3.28	0.60	0.60	1.46	2.76
Alkalinity -HACH ALAP/NONE (mg/l)						
Alkalinity	1.0	500	520	520	460	460

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(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

(b) The site-specific background concentration is derived from the upradient monitoring well results. The intermediate upgradient monitoring well is SS45L017MW.

[ ] Positive result exceeds background concentration or no background value has been determined.

Table 4-13
Second Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L001MW-001WG 16 September 97	Sample SS45L001MW-001WGRS 19 September 97	Sample SS45L005MW-001WG 18 September 97	Sample SS45L009MW-001WG 21 September 97
Volatile Organic Compounds -SW8260A/SW5030A (ug/L)						
1,1-Dichloroethene	0.500	--	.674	NA	<.500	<.500
cis-1,2-Dichloroethene	0.500	--	14.7	NA	.602	2.95
trans-1,2-Dichloroethene	0.500	--	1.90	NA	<.500	.624
Methylene chloride	3.00	--	<3.00	NA	1.36 JQ	<3.00
Trichloroethene	0.500	--	697	NA	<.500	12.9
Specific Conductance -E120.1/NONE (umhos/cm)						
Specific Conductance	--	616	808	619	628	521
pH -E150.1/NONE (pH units)						
pH	--	6.86	6.73	6.89	7.03	6.73
Total Dissolved Solids -E160.1/NONE (mg/L)						
Total Dissolved Solids	10.0	430	518	NA	447	441
Total Suspended Solids -E160.2/NONE (mg/L)						
Total Suspended Solids	10.0	98	<10.0	NA	12.0	13.0
Temperature -E170.1/NONE (Celsius)						
Temperature	--	22.9	22.8	22.4	21.5	18.4
Turbidity -E180.1/NONE (NTUs)						
Turbidity	--	36.5	6.64	4.52	17.4	9.4

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☐ Positive result exceeds background concentration or no background value has been determined.

Prepared By/Date: MS / 1-29-98
Checked By/Date: QH 1-29-98

...id Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L001MW-001WG 16 September 97	Sample SS45L001MW-001WGRS 19 September 97	Sample SS45L005MW-001WG 18 September 97	Sample SS45L009MW-001WG 21 September 97
Methane, Ethane, Ethene -Kampbell, et al./METHOD (ug/L)						
Methane	47.0	< 47	120 JH	76 JH	530 JH	<47 J
Redox Potential -SM 2580/NONE (mv)						
Redox Potential	--	68	76	17	13	3.0
ICP Metals (Dissolved) -SW6010A/SW3005A (mg/L)						
Barium	0.00500	0.21	0.15	NA	0.23	0.21
Calcium	1.00	83.7	77.9	NA	64.2	98.1
Iron	0.200	3.3	0.60	NA	2.2	2.7
Potassium	5.00	< 5	0.80 JQ	NA	1.2 JQ	0.87 JQ
Magnesium	0.200	48.4	67.9	NA	23.5	44.6
Manganese	0.0100	0.54	0.65	NA	1.3	0.85
Sodium	5.00	14.5	27.0	NA	68.8	12.7
Vanadium	0.0100	< 0.01	<0.010	NA	<0.010	0.0021 JQ
ICP Metals (Total) -SW6010A/SW3005A (mg/L)						
Aluminum	0.200	0.57	0.043 JQ	NA	0.031 JQ	0.082 JQ
Barium	0.00500	0.25	0.16	NA	0.26	0.23
Calcium	1.00	91.9	83.9	NA	69.4	103
Iron	0.200	4.3	0.97	NA	2.5	3.0
Potassium	5.00	0.83	0.79 JQ	NA	1.2 JQ	0.78 JQ
Magnesium	0.200	51.1	72.4	NA	25.3	46.7
Manganese	0.0100	0.61	0.70	NA	1.4	0.91

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R=Datum rejected based upon QC data: do not use

(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

(b) The site-specific background concentration is derived from the upradient monitoring well results. The intermediate upgradient monitoring well is SS45L017MW.

[ ] Positive result exceeds background concentration or no background value has been determined.

Table 4-13
Second Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L001MW-001WG 16 September 97		Sample SS45L001MW-001WGRS 19 September 97	Sample SS45L005MW-001WG 18 September 97		Sample SS45L009MW-001WG 21 September 97	
Sodium	5.00	15.6	29.2		NA	75.5		13.5	
Nickel	0.0400	< 0.04	<0.040		NA	0.015	JQ	<0.040	
Zinc	0.0200	< 0.02	0.020		NA	0.0090	JQ	<0.020	J
ICP/MS Metals (Dissolved) -SW6020/SW3020A (mg/L)									
Arsenic	0 0100	0.0022	0.0061	JQ	NA	0.0092	JQ	0.004	JQ
Lead	0.00300	0.0001	0.00021	JB	NA	<0.003		0.00011	JB
Antimony	0.00100	0.0016	<0.001		NA	<0.0021	JB	0.0015	JB
ICP/MS Metals (Total) -SW6020/SW3020A (mg/L)									
Arsenic	0.0100	0.0023	0.0062	JQ	NA	0.0091	JQ	0.0041	JQ
Lead	0.00300	0.0016	0.00075	JB	NA	0.00015	JB	0.00019	JB
Thallium	0.000100	< 0.0001	<0.001		NA	<0.001		0.000070	JQ
Mercury (Dissolved) -SW7470A/METHOD (mg/L)			ND		NA	ND		ND	
Mercury (Total) -SW7470A/METHOD (mg/L)			ND		NA	ND		ND	
Selenium (Dissolved) -SW7740/METHOD (mg/L)			ND		NA	ND		ND	
Selenium (Total) -SW7740/METHOD (mg/L)			ND		NA	ND		ND	

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Table 4-13
Second Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID:			Sample	Sample	Sample	Sample
Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	SS45L001MW-001WG 16 September 97	SS45L001MW-001WGRS 19 September 97	SS45L005MW-001WG 18 September 97	SS45L009MW-001WG 21 September 97
Semivolatile Organic Compounds -SW8270B/SW3520B (ug/L)						
Polynuclear Aromatic Hydrocarbons -SW8310/SW3520B (ug/L)			ND	NA	ND	ND
Total Organic Carbon -SW9060M/NONE (mg/L)			ND	NA	ND	ND
Total Organic Carbon	1.00	15.9	22.6 JL	NA	11.4 JL	15.2 JL

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Table 4-13
Second Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L010MW-001WG 19 September 97	Sample SS45L011MW-001WG 22 September 97	Duplicate SS45L011MW-002WG 22 September 97	Sample SS45L012MW-001WG 22 September 97
Volatile Organic Compounds -SW8260A/SW5030A (ug/L)						
Benzene	0.500	--	<.500	.251 JQ	.235 JQ	.510
Toluene	0.500	--	<.500	.578	.501	<.500
1,1-Dichloroethane	0.500	--	<.500	<.500	<.500	1.09
cis-1,2-Dichloroethene	0.500	--	95.7	4.52 J	8.54 J	189
trans-1,2-Dichloroethene	0.500	--	1.28	18.4 J	32.8 J	8.00
4-Methyl-2-pentanone (MIBK)	5.00	--	<5.00	<5.00	.290 JQ	<5.00
Methylene chloride	3.00	--	1.46 JB	2.10 JB	<3.00	<3.00
Trichloroethene	0.500	--	9.00	<.500	<.500	<.500
Vinyl chloride	1.00	--	<1.00	605	655	59.2
Specific Conductance -E120.1/NONE (umhos/cm)						
Specific Conductance	--	616	552	620	620	651
pH -E150.1/NONE (pH units)						
pH	--	6.86	6.86	6.8	6.8	6.8
Total Dissolved Solids -E160.1/NONE (mg/L)						
Total Dissolved Solids	10.0	430	495	569	563	647
Total Suspended Solids -E160.2/NONE (mg/L)						
Total Suspended Solids	10.0	98	33.0	156 J	72.0 J	56.0
Temperature -E170.1/NONE (Celsius)						

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JL=Estimated quantitation: possibly biased low or false negative based upon QC data
JQ=Estimated quantitation: detected below the Sample Quantitation Limit
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JT=This sample has GC/FID characteristics for which reliable identification of a product could not be achieved
R=Datum rejected based upon QC data: do not use

(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

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[ ] Positive result exceeds background concentration or no background value has been determined.

Table 4-13
Second Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID:			Sample	Sample	Duplicate	Sample
Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	SS45L010MW-001WG 19 September 97	SS45L011MW-001WG 22 September 97	SS45L011MW-002WG 22 September 97	SS45L012MW-001WG 22 September 97
Temperature	--	22.9	25.9	20.3	20.3	21.3
Turbidity -E180.1/NONE (NTUs)						
Turbidity	--	36.5	7.54	38.29	38.29	9.7
Anions -SW9056/NONE (mg/L)						
Chloride	0.200	3.75	34.8 JH	18.1 JH	20.9 JH	13.7 JH
Nitrogen as Nitrate	0.100	0.111	<.100	.816 J	.0900 J	<.100
Sulfate as SO4	0.200	23.4	11.2	.291 JB	.281 JB	.223 JB
Total Kjeldahl Nitrogen -E351.2/NONE (mg/L)						
Total Kjeldahl Nitrogen	0.500	0.39	0.65	0.93	0.89	1.5
Dissolved Oxygen -E360.1/NONE (mg/L)						
Dissolved Oxygen	--	1	1.0	1.0	1.0	1.2
Total Phosphorous -E365.3/NONE (mg/L)						
Phosphorus, Total as P	0.0500	0.19	0.25	0.99	1.0	1.3
Biochemical Oxygen Demand -E405.1/NONE (mg/L)						
Biochemical Oxygen Demand	2.00	< 2	<2.00	4.18	4.57	3.24
Chemical Oxygen Demand -E410.4/NONE (mg/L)						
Chemical Oxygen Demand (Regular)	5.00	6.29	7.43	18.6 J	29.5 J	15.0
Ferrous Iron -HACH 8146/NONE (mg/l)						

Data Qualification Flags/Notes:

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[ ] Positive result exceeds background concentration or no background value has been determined

Table 4-13
Second Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID:			Sample SS45L010MW-001WG		Sample SS45L011MW-001WG		Duplicate SS45L011MW-002WG		Sample SS45L012MW-001WG	
Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	19 September 97		22 September 97		22 September 97		22 September 97	
Iron	--	3.28	4.37		5.10		5.10		5.10	
Alkalinity -HACH ALAP/NONE (mg/l)										
Alkalinity	1.0	500	520		640		640		740	
Methane, Ethane, Ethene -Kamphell, et al./METHOD (ug/L)										
Ethene	82.0	< 82	<82	R	680		630		<82	
Methane	47.0	< 47	370	JH	4300	JH	4300	JH	2800	JH
Redox Potential -SM 2580/NONE (mv)										
Redox Potential	--	68	-25		92		92		102	
ICP Metals (Dissolved) -SW6010A/SW3005A (mg/L)										
Barium	0.00500	0.21	0.28		0.50		0.51		0.46	
Calcium	1.00	83.7	103		141		144		174	
Iron	0.200	3.3	5.0		19.3		19.6		21.6	
Potassium	5.00	< 5	1.3	JQ	1.5	JQ	1.3	JQ	1.5	JQ
Magnesium	0.200	48.4	48.7		52.6		53.6		46.1	
Manganese	0.0100	0.54	1.4		2.2		2.3		3.1	
Sodium	5.00	14.5	17.5		9.9		9.2		9.9	
Nickel	0.0400	< 0.04	0.0070	JQ	<0.040		<0.040		<0.040	
Vanadium	0.0100	< 0.01	<0.010		0.0025	JQ	<0.010		<0.010	
ICP Metals (Total) -SW6010A/SW3005A (mg/L)										
Aluminum	0.200	0.57	0.060	JQ	1.6		1.8		0.033	JB

Data Qualification Flags/Notes:

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JL=Estimated quantitation: possibly biased low or false negative based upon QC data
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[ ] Positive result exceeds background concentration or no background value has been determined

Table 4-13
Second Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L010MW-001WG	Sample SS45L011MW-001WG	Duplicate SS45L011MW-002WG	Sample SS45L012MW-001WG
Sample Date:			19 September 97	22 September 97	22 September 97	22 September 97
Barium	0.00500	0.25	0.29	0.55	0.54	0.50
Calcium	1.00	91.9	112	146	149	186
Copper	0.0100	< 0.01	<0.010	0.0086 JQ	<0.010	<0.010
Iron	0.200	4.3	5.5	21.7	21.8	23.3
Potassium	5.00	0.83	1.2 JQ	1.8 JQ	1.6 JQ	1.5 JQ
Magnesium	0.200	51.1	51.3	55.2	55.1	49.1
Manganese	0.0100	0.61	1.5	2.4	2.4	3.3
Sodium	5.00	15.6	19.0	9.9	9.5	10.8
Vanadium	0.0100	0.0037	<0.010	0.0051 JQ	0.0034 JQ	<0.010
Zinc	0.0200	< 0.02	<0.020	0.015 J	0.0034 J	<0.020 J
ICP/MS Metals (Dissolved) -SW6020/SW3020A (mg/L)						
Arsenic	0.0100	0.0022	0.0072 JQ	0.0191	0.0195	0.047
Lead	0.00300	0.0001	0.00022 JB	0.00022 JB	0.00026 JB	0.00013 JB
Antimony	0.00100	0.0016	0.0029 JB	0.0019 JB	<0.001	0.00059 JQ
Thallium	0.000100	< 0.0001	<0.001	<0.001	0.000025	<0.001
ICP/MS Metals (Total) -SW6020/SW3020A (mg/L)						
Arsenic	0.0100	0.0023	0.0071 JQ	0.0179	0.0182	0.0467
Cadmium	0.00100	< 0.001	0.00022 JQ	0.000046 JQ	<0.001	<0.001
Lead	0.00300	0.0016	0.00022 JB	0.001 JB	0.00061 JB	0.00025 JB
Mercury (Dissolved) -SW7470A/METHOD (mg/L)			ND	ND	ND	ND

Data Qualification Flags/Notes:

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JL=Estimated quantitation: possibly biased low or false negative based upon QC data
JQ=Estimated quantitation: detected below the Sample Quantitation Limit
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JT=This sample has GC/FID characteristics for which reliable identification of a product could not be achieved
R=Datum rejected based upon QC data: do not use

(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

(b) The site-specific background concentration is derived from the upradient monitoring well results. The intermediate upgradient monitoring well is SS45L017MW.

[ ] Positive result exceeds background concentration or no background value has been determined.

Table 4-13
Second Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L010MW-001WG 19 September 97		Sample SS45L011MW-001WG 22 September 97		Duplicate SS45L011MW-002WG 22 September 97		Sample SS45L012MW-001WG 22 September 97	
Mercury (Total) -SW7470A/METHOD (mg/L)										
			ND		ND		ND		ND	
Selenium (Dissolved) -SW7740/METHOD (mg/L)										
			ND		ND		ND		ND	
Selenium (Total) -SW7740/METHOD (mg/L)										
			ND		ND		ND		ND	
Semivolatile Organic Compounds -SW8270B/SW3520B (ug/L)										
			ND		ND		ND		ND	
Polynuclear Aromatic Hydrocarbons -SW8310/SW3520B (ug/L)										
			ND		ND		ND		ND	
Total Organic Carbon -SW9060M/NONE (mg/L)										
Total Organic Carbon	1.00	15.9	9.6	JL	6.3	JL	10.1	JL	5.83	JL

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Second Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L013MW-001WG 23 September 97	Sample SS45L015MW-001WG 16 September 97	Sample SS45L015MW-001WGRS 19 September 97	Sample SS45L017MW-001WG 18 September 97
Volatile Organic Compounds -SW8260A/SW5030A (ug/L)						
cis-1,2-Dichloroethene	0.500	--	29.8	<.500	NA	<.500
Vinyl chloride	1.00	--	6.01	<1.00	NA	<1.00
Specific Conductance -E120.1/NONE (umhos/cm)						
Specific Conductance	--	616	570	1007	885	616
pH -E150.1/NONE (pH units)						
pH	--	6.86	6.95	6.69	6.82	6.86
Total Dissolved Solids -E160.1/NONE (mg/L)						
Total Dissolved Solids	10.0	430	509	799	NA	430
Total Suspended Solids -E160.2/NONE (mg/L)						
Total Suspended Solids	10.0	98	219	18.0	NA	98.0
Temperature -E170.1/NONE (Celsius)						
Temperature	--	22.9	15.9	21.8	25.9	22.9
Turbidity -E180.1/NONE (NTUs)						
Turbidity	--	36.5	780	26	48	36.5
Anions -SW9056/NONE (mg/L)						
Chloride	0.200	3.75	22.6 JH	NA	35.6 JH	3.75 JH
Nitrogen as Nitrate	0.100	0.111	<.100	NA	.0120 JQ	.111

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[ ] Positive result exceeds background concentration or no background value has been determined.

Table 4-13
Second Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID:			Sample	Sample	Sample	Sample
Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	SS45L013MW-001WG 23 September 97	SS45L015MW-001WG 16 September 97	SS45L015MW-001WGRS 19 September 97	SS45L017MW-001WG 18 September 97
Sulfate as SO4	0.200	23.4	.120 JB	NA	58.4	23.4
Total Kjeldahl Nitrogen -E351.2/NONE (mg/L)						
Total Kjeldahl Nitrogen	0.500	0.39	4.9	<0.50	NA	0 39 JQ
Dissolved Oxygen -E360.1/NONE (mg/L)						
Dissolved Oxygen	--	1	0.5	0.6	2.0	1.0
Total Phosphorous -E365.3/NONE (mg/L)						
Phosphorus, Total as P	0.0500	0.19	1.6	0.11	NA	0.19
Biochemical Oxygen Demand -E405.1/NONE (mg/L)						
Biochemical Oxygen Demand	2.00	< 2	3.98	<2.00	NA	<2.00
Chemical Oxygen Demand -E410.4/NONE (mg/L)						
Chemical Oxygen Demand (Regular)	5.00	6.29	18.6	8.85	NA	6.29
Ferrous Iron -HACH 8146/NONE (mg/l)						
Iron	--	3.28	4.61	0.67	0.67	3.28
Alkalinity -HACH ALAP/NONE (mg/l)						
Alkalinity	1.0	500	620	840	840	500
Methane, Ethane, Ethene -Kampbell, et al./METHOD (ug/L)						
Methane	47.0	< 47	2400	<47 J	<47 J	<47 J
Redox Potential -SM 2580/NONE (mv)						

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Second Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID:			Sample	Sample	Sample	Sample
Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	SS45L013MW-001WG 23 September 97	SS45L015MW-001WG 16 September 97	SS45L015MW-001WGRS 19 September 97	SS45L017MW-001WG 18 September 97
Redox Potential	--	68	26	39	91	68
ICP Metals (Dissolved) -SW6010A/SW3005A (mg/L)						
Barium	0.00500	0.21	0.44	0.33	NA	0.21
Calcium	1.00	83.7	112	117	NA	83.7
Iron	0.200	3.3	14.2	0.52	NA	3.3
Potassium	5.00	< 5	2.9 JQ	0.82 JQ	NA	<5.0
Magnesium	0.200	48.4	32.0	94.4	NA	48.4
Manganese	0.0100	0.54	1.7	0.96	NA	0.54
Sodium	5.00	14.5	28.3	59.3	NA	14.5
ICP Metals (Total) -SW6010A/SW3005A (mg/L)						
Aluminum	0.200	0.57	1.5	0.12 JQ	NA	0.57
Barium	0.00500	0.25	0.51	0.35	NA	0.25
Calcium	1.00	91.9	128	125	NA	91.9
Iron	0.200	4.3	17.0	0.67	NA	4.3
Potassium	5.00	0.83	3.4 JQ	0.83 JQ	NA	0.83 JQ
Magnesium	0.200	51.1	36.7	98.9	NA	51.1
Manganese	0.0100	0.61	1.9	1.0	NA	0.61
Sodium	5.00	15.6	31.2	64.1	NA	15.6
Nickel	0.0400	< 0.04	<0.040	0.0087 JQ	NA	<0.040
Vanadium	0.0100	0.0037	0.0051 JQ	<0.010	NA	0.0037 JQ
ICP/MS Metals (Dissolved) -SW6020/SW3020A (mg/L)						

Data Qualification Flags/Notes:

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JH=Estimated quantitation: possibly biased high or false positive based upon QC data
JL=Estimated quantitation: possibly biased low or false negative based upon QC data
JQ=Estimated quantitation: detected below the Sample Quantitation Limit
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R=Datum rejected based upon QC data: do not use

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(b) The site-specific background concentration is derived from the upradient monitoring well results. The intermediate upgradient monitoring well is SS45L017MW.

[ ] Positive result exceeds background concentration or no background value has been determined.

Table 4-13
Second Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

	Sample ID:			Sample		Sample		Sample	Sample	
	Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	SS45L013MW-001WG 23 September 97		SS45L015MW-001WG 16 September 97		SS45L015MW-001WGRS 19 September 97	SS45L017MW-001WG 18 September 97	
Arsenic		0.0100	0.0022	0.0175		0.0014	JQ	NA	0.0022	JQ
Lead		0.00300	0.0001	0.00016	JB	0.00016	JB	NA	0.0001	JB
Antimony		0.00100	0.0016	.0011	JB	0.00046	JB	NA	0.0016	JB
Thallium		0.000100	< 0.0001	<0.001		0.00013		NA	<0.001	
ICP/MS Metals (Total) -SW6020/SW3020A (mg/L)										
Arsenic		0.0100	0.0023	0.0178		0.0014	JQ	NA	0.0023	JQ
Cadmium		0.00100	< 0.001	0.00066	JQ	<0.001		NA	<0.001	
Lead		0.00300	0.0016	0.0011	JQ	0.00066	JB	NA	0.0016	JB
Antimony		0.00100	0.00037	0.00025	JB	0.00025	JB	NA	0.00037	JB
Mercury (Dissolved) -SW7470A/METHOD (mg/L)										
				ND		ND		NA	ND	
Mercury (Total) -SW7470A/METHOD (mg/L)										
				ND		ND		NA	ND	
Selenium (Dissolved) -SW7740/METHOD (mg/L)										
				ND		ND		NA	ND	
Selenium (Total) -SW7740/METHOD (mg/L)										
				ND		ND		NA	ND	
Semivolatile Organic Compounds -SW8270B/SW3520B (ug/L)										
bis(2-Ethylhexyl)phthalate		10.0	--	<12.7	J	3.63	R	NA	<11 0	J

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(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

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Table 4-13
Second Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L013MW-001WG 23 September 97		Sample SS45L015MW-001WG 16 September 97		Sample SS45L015MW-001WGRS 19 September 97		Sample SS45L017MW-001WG 18 September 97	
Polynuclear Aromatic Hydrocarbons -SW8310/SW3520B (ug/L)										
			ND		ND		NA		ND	
Total Organic Carbon -SW9060M/NONE (mg/L)										
Total Organic Carbon	1.00	15.9	22.6	JL	21.3	JL	NA		15.9	JL

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Table 4-13
Second Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

	Sample ID:			Sample
	Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	SS45L019MW-001WG 22 September 97
Volatile Organic Compounds -SW8260A/SW5030A (ug/L)				
Chlorobenzene		0.500	--	.765
1,1-Dichloroethane		0.500	--	1.54
trans-1,2-Dichloroethene		0.500	--	1.19
Vinyl chloride		1.00	--	1.13
Specific Conductance -E120.1/NONE (umhos/cm)				
Specific Conductance		--	616	406
pH -E150.1/NONE (pH units)				
pH		--	6.86	7.02
Total Dissolved Solids -E160.1/NONE (mg/L)				
Total Dissolved Solids		10.0	430	340
Total Suspended Solids -E160.2/NONE (mg/L)				
Total Suspended Solids		10.0	98	30.0
Temperature -E170.1/NONE (Celsius)				
Temperature		--	22.9	20.8
Turbidity -E180.1/NONE (NTUs)				
Turbidity		--	36.5	13.5
Anions -SW9056/NONE (mg/L)				

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Table 4-13
Second Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L019MW-001WG 22 September 97	
Chloride	0.200	3.75	6.83	JH
Sulfate as SO4	0.200	23.4	.861	JB
Total Kjeldahl Nitrogen -E351.2/NONE (mg/L)				
Total Kjeldahl Nitrogen	0.500	0.39	1.0	
Dissolved Oxygen -E360.1/NONE (mg/L)				
Dissolved Oxygen	--	1	1.0	
Total Phosphorous -E365.3/NONE (mg/L)				
Phosphorus, Total as P	0.0500	0.19	1.5	
Biochemical Oxygen Demand -E405.1/NONE (mg/L)				
			ND	
Chemical Oxygen Demand -E410.4/NONE (mg/L)				
Chemical Oxygen Demand (Regular)	5.00	6.29	16.1	
Ferrous Iron -HACH 8146/NONE (mg/l)				
Iron	--	3.28	3.97	
Alkalinity -HACH ALAP/NONE (mg/l)				
Alkalinity	1.0	500	440	
Methane, Ethane, Ethene -Kampbell, et al./METHOD (ug/L)				
Methane	47.0	< 47	500	JH

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Table 4-13
Second Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

	Sample ID:			Sample
	Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	SS45L019MW-001WG 22 September 97
Redox Potential -SM 2580/NONE (mv)				
Redox Potential		--	68	-68
ICP Metals (Dissolved) -SW6010A/SW3005A (mg/L)				
Barium		0.00500	0.21	0.24
Calcium		1.00	83.7	72.5
Iron		0.200	3.3	7.9
Potassium		5.00	< 5	1.3 JQ
Magnesium		0.200	48.4	27.7
Manganese		0.0100	0.54	0.77
Sodium		5.00	14.5	14.5
ICP Metals (Total) -SW6010A/SW3005A (mg/L)				
Aluminum		0.200	0.57	0.15 JB
Barium		0.00500	0.25	0.27
Calcium		1.00	91.9	82.3
Iron		0.200	4.3	9.2
Potassium		5.00	0.83	1.5 JQ
Magnesium		0.200	51.1	31.7
Manganese		0.0100	0.61	0.88
Sodium		5.00	15.6	16.6
Zinc		0.0200	< 0.02	0.015 J
ICP/MS Metals (Dissolved) -SW6020/SW3020A (mg/L)				

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JH=Estimated quantitation: possibly biased high or false positive based upon QC data
JL=Estimated quantitation: possibly biased low or false negative based upon QC data
JQ=Estimated quantitation: detected below the Sample Quantitation Limit
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(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

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[ ] Positive result exceeds background concentration or no background value has been determined

Table 4-13
Second Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

	Sample ID:			Sample	
	Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	SS45L019MW-001WG 22 September 97	
Arsenic		0.0100	0.0022	0.00084	JQ
Lead		0.00300	0.0001	0.00015	JB
Thallium		0.000100	< 0.0001	0.00015	
ICP/MS Metals (Total) -SW6020/SW3020A (mg/L)					
Arsenic		0.0100	0.0023	0.00068	JQ
Cadmium		0.00100	< 0.001	0.00014	JQ
Lead		0.00300	0.0016	0.00024	JB
Antimony		0.00100	0.00037	0.00031	JQ
Mercury (Dissolved) -SW7470A/METHOD (mg/L)					
				ND	
Mercury (Total) -SW7470A/METHOD (mg/L)					
				ND	
Selenium (Dissolved) -SW7740/METHOD (mg/L)					
				ND	
Selenium (Total) -SW7740/METHOD (mg/L)					
				ND	
Semivolatile Organic Compounds -SW8270B/SW3520B (ug/L)					
				ND	
Polynuclear Aromatic Hydrocarbons -SW8310/SW3520B (ug/L)					

Data Qualification Flags/Notes:

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J=Estimated quantitation based upon QC data
JB=Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgment
JH=Estimated quantitation: possibly biased high or false positive based upon QC data
JL=Estimated quantitation: possibly biased low or false negative based upon QC data
JQ=Estimated quantitation: detected below the Sample Quantitation Limit
ND=No Positive Results detected for the Analytical Method
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Table 4-13
Second Quarter Groundwater - Positive Result Summary
Intermediate Wells
SS-45 RFI Report
England AFB, Louisiana

	Sample ID.			Sample	
	Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	SS45L019MW-001WG 22 September 97	
				ND	
Total Organic Carbon -SW9060M/NONE (mg/L)					
Total Organic Carbon		1.00	15.9	4.89	JL

Data Qualification Flags/Notes:
NA=Not Analyzed
J=Estimated quantitation based upon QC data
JB=Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgment
JH=Estimated quantitation: possibly biased high or false positive based upon QC data
JL=Estimated quantitation: possibly biased low or false negative based upon QC data
JQ=Estimated quantitation: detected below the Sample Quantitation Limit
ND=No Positive Results detected for the Analytical Method
JT=This sample has GC/FID characteristics for which reliable identification of a product could not be achieved
R=Datum rejected based upon QC data: do not use

(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

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[ ] Positive result exceeds background concentration or no background value has been determined.

Table 4-15
Second Quarter Groundwater - Positive Result Summary
Deep Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L002MW-001WG 17 September 97		Duplicate SS45L002MW-002WG 17 September 97		Sample SS45L014MW-001WG 22 September 97	Sample SS45L016MW-001WG 17 September 97
Volatile Organic Compounds -SW8260A/SW5030A (ug/L)								
cis-1,2-Dichloroethene	0.500	--	186		183		<.500	1.79
trans-1,2-Dichloroethene	0.500	--	6.33	J	2.63	J	<.500	<.500
Methylene chloride	3.00	--	.634	JQ	.535	JQ	<3.00	<3.00
Trichloroethene	0.500	--	.370	JQ	.421	JQ	<.500	6.25
Vinyl chloride	1.00	--	3.35		<1.00		<1.00	<1.00
Specific Conductance -E120.1/NONE (umhos/cm)								
Specific Conductance	--	605	734		734		603	790
pH -E150.1/NONE (pH units)								
pH	--	6.84	6.77		6.77		6.92	6.81
Total Dissolved Solids -E160.1/NONE (mg/L)								
Total Dissolved Solids	10.0	503	574		568		567	597
Total Suspended Solids -E160.2/NONE (mg/L)								
Total Suspended Solids	10.0	82	<10.0		11.0		31.0	17.0
Temperature -E170.1/NONE (Celsius)								
Temperature	--	21.7	18.7		18.7		21.4	22.1
Turbidity -E180.1/NONE (NTUs)								
Turbidity	--	43.6	5.17		5.17		9.40	18.3

Data Qualification Flags/Notes:
NA=Not Analyzed
J=Estimated quantitation based upon QC data
JB=Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgment
JH=Estimated quantitation: possibly biased high or false positive based upon QC data
JL=Estimated quantitation: possibly biased low or false negative based upon QC data
JQ=Estimated quantitation: detected below the Sample Quantitation Limit
ND=No Positive Results detected for the Analytical Method
JT=This sample has GC/FID characteristics for which reliable identification of a product could not be achieved
R=Datum rejected based upon QC data: do not use

(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

(b) The site-specific background concentration is derived from the upradient monitoring well results. The deep upgradient monitoring well is SS45L018MW.

☐ Positive result exceeds background concentration or no background value has been determined

Prepared By/Date: MG/1-29-98
Checked By/Date: QH 1-29-98

Table 4-15
Second Quarter Groundwater - Positive Result Summary
Deep Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L002MW-001WG 17 September 97		Duplicate SS45L002MW-002WG 17 September 97		Sample SS45L014MW-001WG 22 September 97		Sample SS45L016MW-001WG 17 September 97	
Anions -SW9056/NONE (mg/L)										
Chloride	0.200	49.3	12.7	JL	6.94	JL	20.9	JH	9.10	JL
Nitrogen as Nitrate	0.100	< 0.1	.0840	JQ	.103		<.100		.153	
Sulfate as SO4	0.200	37.4	9.27		9.18		.869	JB	34.6	
Total Kjeldahl Nitrogen -E351.2/NONE (mg/L)										
Total Kjeldahl Nitrogen	0.500	0.72	0.67		0.67		1.0		<0.50	
Dissolved Oxygen -E360.1/NONE (mg/L)										
Dissolved Oxygen	--	0.6	0.8		0.8		0.5		0.8	
Total Phosphorous -E365.3/NONE (mg/L)										
Phosphorus, Total as P	0.0500	0.63	0.28		0.28		0.47		0.14	
Biochemical Oxygen Demand -E405.1/NONE (mg/L)										
Biochemical Oxygen Demand	2.00	< 2	<2.00		<2.00		6.48		<2.00	
Chemical Oxygen Demand -E410.4/NONE (mg/L)										
Chemical Oxygen Demand (Regular)	5.00	10.3	8.28		8.85		15.0		9.41	
Ferrous Iron -HACH 8146/NONE (mg/l)										
Iron	--	4.65	3.24		3.24		4.37		2.36	
Alkalinity -HACH ALAP/NONE (mg/l)										
Alkalinity	1.0	460	560		560		600		700	

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(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

(b) The site-specific background concentration is derived from the upradient monitoring well results. The deep upgradient monitoring well is SS45L018MW.

[ ] Positive result exceeds background concentration or no background value has been determined.

Table 4-15
Second Quarter Groundwater - Positive Result Summary
Deep Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L002MW-001WG 17 September 97		Duplicate SS45L002MW-002WG 17 September 97		Sample SS45L014MW-001WG 22 September 97		Sample SS45L016MW-001WG 17 September 97	
Methane, Ethane, Ethene -Kampbell, et al./METHOD (ug/L)										
Methane	47.0	< 47	460	JH	<47	J	880	JH	210	JH
Redox Potential -SM 2580/NONE (mv)										
Redox Potential	--	61	9.0		9.0		-40		83	
ICP Metals (Dissolved) -SW6010A/SW3005A (mg/L)										
Barium	0.00500	0.64	0.49		0.50		0.63		0.28	
Calcium	1.00	101	112		114		119		93.6	
Iron	0.200	8.8	3.0		3.0		6.7		2.8	
Potassium	5.00	2.2	1.7	JQ	1.8	JQ	2.0	JQ	0.68	JQ
Magnesium	0.200	31.7	50.9		51.8		41.1		72.5	
Manganese	0.0100	0.59	0.98		1.0		0.49		0.70	
Sodium	5.00	41.8	28.8		29.7		38.7		33.7	
Nickel	0.0400	<0.04	<0.040		<0.040		<0.040		0.017	JQ
Vanadium	0.0100	<0.01	<0.010		0.0021	JQ	<0.010		<0.010	
Zinc	0.0200	<0.02	0.0092	JQ	<0.020		<0.020		<0.020	
ICP Metals (Total) -SW6010A/SW3005A (mg/L)										
Aluminum	0.200	0.61	<0.20		<0.20		0.069	JB	0.25	
Barium	0.00500	0.62	0.54		0.55		0.70		0.31	
Calcium	1.00	105	125		126		130		101	
Iron	0.200	10.1	3.4		3.5		7.4		3.7	
Potassium	5.00	2.1	1.8	JQ	1.6	JQ	2.2	JQ	0.90	JQ

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JL=Estimated quantitation: possibly biased low or false negative based upon QC data
JQ=Estimated quantitation: detected below the Sample Quantitation Limit
ND=No Positive Results detected for the Analytical Method
JT=This sample has GC/FID characteristics for which reliable identification of a product could not be achieved
R=Datum rejected based upon QC data: do not use

(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

(b) The site-specific background concentration is derived from the upradient monitoring well results. The deep upgradient monitoring well is SS45L018MW.

☐ Positive result exceeds background concentration or no background value has been determined

Table 4-15
Second Quarter Groundwater - Positive Result Summary
Deep Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID:			Sample	Duplicate	Sample	Sample
Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	SS45L002MW-001WG 17 September 97	SS45L002MW-002WG 17 September 97	SS45L014MW-001WG 22 September 97	SS45L016MW-001WG 17 September 97
Magnesium	0.200	29.4	55.4	56.0	44.9	76.2
Manganese	0.0100	0.62	1.1	1.1	0.55	0.76
Sodium	5.00	41.2	32.1	32.7	43.5	36.6
Nickel	0.0400	< 0.04	<0.040	<0.040	<0.040	0.017 JQ
ICP/MS Metals (Dissolved) -SW6020/SW3020A (mg/L)						
Arsenic	0.0100	0.0054	0.0032 JQ	0.0033 JQ	0.00042 JQ	0.0055 JQ
Cadmium	0.00100	< 0.001	<0.001	0.000041 JQ	<0.001	<0.001
Lead	0.00300	0.00024	0.00017 JB	0.00026 JB	0.00033 JB	0.00015 JB
Antimony	0.00100	0.00066	0.0027 JB	0.0002 JB	0.0024 JB	0.0024 JB
Thallium	0.000100	< 0.0001	<0.001	<0.001	0.000040 JQ	<0.001
ICP/MS Metals (Total) -SW6020/SW3020A (mg/L)						
Arsenic	0.0100	0.0057	0.0035 JQ	0.0034 JQ	0.00039 JQ	0.0061 JQ
Lead	0.00300	0.00076	0.00048 JB	0.00027 JB	0.00037 JB	0.00052 JB
Mercury (Dissolved) -SW7470A/METHOD (mg/L)			ND	ND	ND	ND
Mercury (Total) -SW7470A/METHOD (mg/L)			ND	ND	ND	ND
Selenium (Dissolved) -SW7740/METHOD (mg/L)			ND	ND	ND	ND
Selenium (Total) -SW7740/METHOD (mg/L)						

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(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

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[ ] Positive result exceeds background concentration or no background value has been determined

Table 4-15
Second Quarter Groundwater - Positive Result Summary
Deep Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L002MW-001WG 17 September 97		Duplicate SS45L002MW-002WG 17 September 97		Sample SS45L014MW-001WG 22 September 97		Sample SS45L016MW-001WG 17 September 97	
Semivolatile Organic Compounds -SW8270B/SW3520B (ug/L)			ND		ND		ND		ND	
Polynuclear Aromatic Hydrocarbons -SW8310/SW3520B (ug/L)			ND		ND		ND		ND	
Total Organic Carbon -SW9060M/NONE (mg/L)			ND		ND		ND		ND	
Total Organic Carbon	1.00	14	14.8	JL	6.8	JL	7.56	JL	16.0	JL

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[ ] Positive result exceeds background concentration or no background value has been determined

Table 4-15
Second Quarter Groundwater - Positive Result Summary
Deep Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID:			Sample	
Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	SS45L018MW-001WG 19 September 97	
Volatile Organic Compounds -SW8260A/SW5030A (ug/L)				
Methylene chloride	3.00	--	1.27	JB
Specific Conductance -E120.1/NONE (umhos/cm)				
Specific Conductance	--	605	605	
pH -E150.1/NONE (pH units)				
pH	--	6.84	6.84	
Total Dissolved Solids -E160.1/NONE (mg/L)				
Total Dissolved Solids	10.0	503	503	
Total Suspended Solids -E160.2/NONE (mg/L)				
Total Suspended Solids	10.0	82	82.0	
Temperature -E170.1/NONE (Celsius)				
Temperature	--	21.7	21.7	
Turbidity -E180.1/NONE (NTUs)				
Turbidity	--	43.6	43.6	
Anions -SW9056/NONE (mg/L)				
Chloride	0.200	49.3	49.3	JH
Sulfate as SO4	0.200	37.4	37.4	
Total Kjeldahl Nitrogen -E351.2/NONE (mg/L)				

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Table 4-15
Second Quarter Groundwater - Positive Result Summary
Deep Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID:			Sample
Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	SS45L018MW-001WG 19 September 97
Total Kjeldahl Nitrogen	0.500	0.72	0.72
Dissolved Oxygen -E360.1/NONE (mg/L)			
Dissolved Oxygen	--	0.6	0.6
Total Phosphorous -E365.3/NONE (mg/L)			
Phosphorus, Total as P	0.0500	0.63	0.63
Biochemical Oxygen Demand -E405.1/NONE (mg/L)			
			ND
Chemical Oxygen Demand -E410.4/NONE (mg/L)			
Chemical Oxygen Demand (Regular)	5.00	10.3	10.3
Ferrous Iron -HACH 8146/NONE (mg/l)			
Iron	--	4.65	4.65
Alkalinity -HACH ALAP/NONE (mg/l)			
Alkalinity	10	460	460
Methane, Ethane, Ethene -Kamphell, et al./METHOD (ug/L)			
			ND
Redox Potential -SM 2580/NONE (mv)			
Redox Potential	--	61	61
ICP Metals (Dissolved) -SW6010A/SW3005A (mg/L)			

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Table 4-15
Second Quarter Groundwater - Positive Result Summary
Deep Wells
SS-45 RFI Report
England AFB, Louisiana

Sample ID:			Sample	
Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	SS45L018MW-001WG 19 September 97	
Barium	0.00500	0.64	0.64	
Calcium	1.00	101	101	
Iron	0.200	8.8	8.8	
Potassium	5.00	2.2	2.2	JQ
Magnesium	0.200	31.7	31.7	
Manganese	0.0100	0.59	0.59	
Sodium	5.00	41.8	41.8	
ICP Metals (Total) -SW6010A/SW3005A (mg/L)				
Aluminum	0.200	0.61	0.61	
Barium	0.00500	0.62	0.62	
Calcium	1.00	105	105	
Chromium	0.0200	0.0054	0.0054	JQ
Copper	0.0100	0.0042	0.0042	JQ
Iron	0.200	10.1	10.1	
Potassium	5.00	2.1	2.1	JQ
Magnesium	0.200	29.4	29.4	
Manganese	0.0100	0.62	0.62	
Molybdenum	0.0400	0.0057	0.0057	J
Sodium	5.00	41.2	41.2	
Zinc	0.0200	0.021	0.021	
ICP/MS Metals (Dissolved) -SW6020/SW3020A (mg/L)				
Arsenic	0.0100	0.0054	0.0054	JQ

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☐ Positive result exceeds background concentration or no background value has been determined

Table 4-15
Second Quarter Groundwater - Positive Result Summary
Deep Wells
SS-45 RFI Report
England AFB, Louisiana

	Sample ID:			Sample	
	Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	SS45L018MW-001WG 19 September 97	
Lead		0.00300	0.00024	0.00024	JB
Antimony		0.00100	0.00066	0.00066	JB
ICP/MS Metals (Total) -SW6020/SW3020A (mg/L)					
Arsenic		0.0100	0.0057	0.0057	JQ
Cadmium		0.00100	0.00064	0.00064	JQ
Lead		0.00300	0.00076	0.00076	JB
Mercury (Dissolved) -SW7470A/METHOD (mg/L)					
				ND	
Mercury (Total) -SW7470A/METHOD (mg/L)					
				ND	
Selenium (Dissolved) -SW7740/METHOD (mg/L)					
				ND	
Selenium (Total) -SW7740/METHOD (mg/L)					
				ND	
Semivolatile Organic Compounds -SW8270B/SW3520B (ug/L)					
				ND	
Polynuclear Aromatic Hydrocarbons -SW8310/SW3520B (ug/L)					
				ND	

Data Qualification Flags/Notes:
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R=Datum rejected based upon QC data: do not use

(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

(b) The site-specific background concentration is derived from the upradient monitoring well results. The deep upgradient monitoring well is SS45L018MW.

☐ Positive result exceeds background concentration or no background value has been determined.

Table [illegible]
Second Quarter Groundwater - Positive Result Summary
Deep Wells
SS-45 RFI Report
England AFB, Louisiana

	Sample ID:			Sample SS45L018MW-001WG	
	Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	19 September 97	
Total Organic Carbon -SW9060M/NONE (mg/L)					
Total Organic Carbon		1.00	14	14.0	JL

Data Qualification Flags/Notes:
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(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

(b) The site-specific background concentration is derived from the upradient monitoring well results. The deep upgradient monitoring well is SS45L018MW

[ ] Positive result exceeds background concentration or no background value has been determined

TABLE 5-1

Third Quarter Groundwater - Positive Results Summary
Intermediate Wells
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L001MW-001WG 11 December 97	Sample SS45L005MW-001WG 12 December 97	Sample SS45L009MW-001WG 10 December 97	Sample SS45L010MW-001WG 10 December 97
Volatile Organic Compounds -SW8260A/SW5030A (ug/L)						
1,1-Dichloroethane	0.500	--	<.500	.337 JQ	<.500	<.500
1,1-Dichloroethene	0.500	--	.936	<.500	<.500	.499 JQ
cis-1,2-Dichloroethene	0.500	--	16.8	.698	2.87	79.8
trans-1,2-Dichloroethene	0.500	--	2.36	<.500	.642	2.70
Trichloroethene	0.500	--	598	<.500	15.8	6.93
Vinyl chloride	1.00	--	<1.00	<1.00	<1.00	1.05
Specific Conductance -E120.1/NONE (umhos/cm)						
Specific Conductance	--	664	655	506	552	584
pH -E150.1/NONE (pH units)						
pH	--	7.023	7.47	7.36	6.82	6.81
Total Dissolved Solids -E160.1/NONE (mg/L)						
		< 0	NA	NA	NA	NA
Total Suspended Solids -E160.2/NONE (mg/L)						
		< 0	NA	NA	NA	NA
Temperature -E170.1/NONE (Celsius)						
Temperature	--	21.167	21.2	16.5	16.5	16.1
Turbidity -E180.1/NONE (NTUs)						
Turbidity	--	33.267	1.82	4.3	1.89	2.46

Data Qualification Flags/Notes:

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JB=Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgment
JH=Estimated quantitation: possibly biased high or false positive based upon QC data
JL=Estimated quantitation: possibly biased low or false negative based upon QC data
JQ=Estimated quantitation: detected below the Sample Quantitation Limit
ND=No Positive Results detected for the Analytical Method
JT=This sample has GC/FID characteristics for which reliable identification of a product could not be achieved
R=Datum rejected based upon QC data: do not use

(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

(b) The site-specific background concentration is derived from the upgradient monitoring well results. The intermediate upgradient monitoring well is SS45L017MW.

☐ Positive result exceeds background concentration or no background value has been determined.

Prepared By/Date: MG for GHT 6/15/98
Checked By/Date: MMB 6/15/98

TABLE

Third Quarter Groundwater - Positive Results Summary
Intermediate Wells
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L001MW-001WG 11 December 97	Sample SS45L005MW-001WG 12 December 97	Sample SS45L009MW-001WG 10 December 97	Sample SS45L010MW-001WG 10 December 97
Anions -SW9056/NONE (mg/L)						
Chloride	0.200	4.17	22.4	11.2	5.31	41.3
Nitrogen as Nitrate	0.100	0.048	<.100	.0180 JQ	.0420 JQ	<.100
Sulfate as SO4	0.200	23.8	32.3	.595	28.6	160
Total Kjeldahl Nitrogen -E351.2/NONE (mg/L)						
		< 0	NA	NA	NA	NA
Dissolved Oxygen -E360.1/NONE (mg/L)						
Dissolved Oxygen	--	0.4	0.00	0.3	0.4	0.3
Total Phosphorous -E365.3/NONE (mg/L)						
		< 0	NA	NA	NA	NA
Biological Oxygen Demand -E405.1/NONE (mg/L)						
		< 0	NA	NA	NA	NA
Chemical Oxygen Demand -E410.4/NONE (mg/L)						
		< 0	NA	NA	NA	NA
Ferrous Iron -HACH 8146/NONE (mg/L)						
Iron	0.01	2.96	0.43	1.74	1.46	4.74
Alkalinity -HACH ALAP/NONE (mg/L)						
Alkalinity	1.0	438.333	540	420	440	580

Data Qualification Flags/Notes:
NA=Not Analyzed
J=Estimated quantitation based upon QC data
JB=Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgment
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JQ=Estimated quantitation: detected below the Sample Quantitation Limit
ND=No Positive Results detected for the Analytical Method
JT=This sample has GC/FID characteristics for which reliable identification of a product could not be achieved
R=Datum rejected based upon QC data: do not use

(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

(b) The site-specific background concentration is derived from the upgradient monitoring well results. The intermediate upgradient monitoring well is SS45L017MW.

☐ Positive result exceeds background concentration or no background value has been determined.

TABLE 5-1

Third Quarter Groundwater - Positive Results Summary
Intermediate Wells
England AFB, Louisiana

Sample ID:			Sample	Sample	Sample	Sample
Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	SS45L001MW-001WG 11 December 97	SS45L005MW-001WG 12 December 97	SS45L009MW-001WG 10 December 97	SS45L010MW-001WG 10 December 97
Methane, Ethane, Ethene -Kampbell, et al./METHOD (ug/L)						
Methane	47.0	< 47	130	1300	<47	500
Redox Potential -SM 2580/NONE (mv)						
Redox Potential	--	22.333	2.0	63	74	69
ICP Metals (Dissolved) -SW6010A/SW3005A (mg/L)						
Barium	0.00500	0.213	0.15	0.24	0.21	0.31
Calcium	1.00	84.633	80.2	67.5	96.7	104
Copper	0.0100	< 0.01	<0.010	0.010	0.0090 JQ	0.019
Iron	0.200	3.433	1.0	3.1	2.4	5.3
Potassium	5.00	0.237	<5.0	1.0 J	<5.0	1.2 JQ
Magnesium	0.200	48.767	68.5	25.9	46.0	50.8
Manganese	0.0100	0.563	0.66	1.4	0.69	1.5
Sodium	5.00	15.433	25.9	76.7	12.0	18.8
ICP Metals (Total) -SW6010A/SW3005A (mg/L)						
Aluminum	0.200	0.687	<0.20	0.060 JH	0.046 JH	<0.20
Barium	0.00500	0.227	0.16	0.24	0.21	0.31
Calcium	1.00	85.033	81.5	67.5	97.9	107
Iron	0.200	4.1	1.1	3.3	2.5	5.5
Potassium	5.00	0.643	<5.0	1.1 JQ	5.0	1.3 JQ
Magnesium	0.200	48.7	69.6	25.9	46.4	52.4
Manganese	0.0100	0.573	0.67	1.3	0.69	1.5

Data Qualification Flags/Notes:

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R=Datum rejected based upon QC data: do not use

(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

(b) The site-specific background concentration is derived from the upgradient monitoring well results. The intermediate upgradient monitoring well is SS45L017MW.

Positive result exceeds background concentration or no background value has been determined.

TABLE

Third Quarter Groundwater - Positive Results Summary
Intermediate Wells
England AFB, Louisiana

Sample ID:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L001MW-001WG	Sample SS45L005MW-001WG	Sample SS45L009MW-001WG	Sample SS45L010MW-001WG
Sample Date:			11 December 97	12 December 97	10 December 97	10 December 97
Sodium	5.00	15.467	26.1	76.2	13.2	19.5
ICP/MS Metals (Dissolved) -SW6020/SW3020A (mg/L)						
Arsenic	0.0100	< 0.01	0.0094 JQ	0.0127	0.0028 JQ	0.0285
Lead	0.00300	< 0.003	0.00025 JQ	0.00034 JQ	<0.0030	<0.0030
Thallium	0.00100	0.001	0.0015	0.00046 JQ	0.00074 JQ	0.00082 JQ
	0.000100	< 0.0001	0.000026 JQ	<0.00010	<0.0001	0.000036 JQ
ICP/MS Metals (Total) -SW6020/SW3020A (mg/L)						
Arsenic	0.0100	< 0.01	0.0094 JQ	0.0129	0.0028 JQ	0.0312
Cadmium	0.00100	< 0.001	0.00014 JQ	0.0000042 JQ	<0.001	0.00026 JQ
Lead	0.00300	< 0.003	0.00061 JQ	0.00031 JQ	<0.0030	<0.0030
Thallium	0.000100	< 0.0001	0.000044 JQ	<0.00010	<0.0001	0.000036 JQ
Mercury (Dissolved) -SW7470A/METHOD (mg/L)			ND	ND	ND	ND
Mercury (Total) -SW7470A/METHOD (mg/L)			ND	ND	ND	ND
Selenium (Dissolved) -SW7740/METHOD (mg/L)			ND	ND	ND	ND
Selenium (Total) -SW7740/METHOD (mg/L)			ND	ND	ND	ND

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Positive result exceeds background concentration or no background value has been determined.

TABLE 5-1

Third Quarter Groundwater - Positive Results Summary
Intermediate Wells
England AFB, Louisiana

Sample ID:			Sample	Sample	Sample	Sample
Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	SS45L001MW-001WG 11 December 97	SS45L005MW-001WG 12 December 97	SS45L009MW-001WG 10 December 97	SS45L010MW-001WG 10 December 97
Semivolatile Organic Compounds -SW8270D/SW3520B (ug/L)						
		--	NA	NA	NA	NA
Polynuclear Aromatic Hydrocarbons -SW8310/SW3520B (ug/L)						
		--	NA	NA	NA	NA
Sulfide -SW9030/NONE (mg/L)						
	1.0	< 1	0.00	0.009	0.00	0.00
Total Organic Carbon -SW9060M/NONE (mg/L)						
Total Organic Carbon	1.00	11.617	5.2	15.7	16.8	10.1

Data Qualification Flags/Notes:

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JB=Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgment
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R=Datum rejected based upon QC data: do not use

(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

(b) The site-specific background concentration is derived from the upgradient monitoring well results. The intermediate upgradient monitoring well is SS45L017MW.

☐ Positive result exceeds background concentration or no background value has been determined.

TABLE

Third Quarter Groundwater - Positive Results Summary
Intermediate Wells
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L011IMW-001WG 09 December 97	Duplicate SS45L011IMW-002WG 09 December 97	Sample SS45L012IMW-001WG 10 December 97	Sample SS45L013IMW-001WG 10 December 97
Volatile Organic Compounds -SW8260A/SW5030A (ug/L)						
Benzene	0.500	--	.354 JQ	.351 JQ	.618	<.500
Toluene	0.500	--	.661	.681	<.500	<.500
1,1-Dichloroethane	0.500	--	.599	.579	1.08	<.500
1,1-Dichloroethene	0.500	--	<.500	<.500	.754	<.500
cis-1,2-Dichloroethene	0.500	--	6.70	6.44	186	28.8
trans-1,2-Dichloroethene	0.500	--	21.5	21.7	7.41	<.500
Vinyl chloride	1.00	--	619	695	22.7	7.17
Specific Conductance -E120.1/NONE (umhos/cm)						
Specific Conductance	--	664	776	776	606	581
pH -E150.1/NONE (pH units)						
pH	--	7.023	6.88	6.88	6.85	6.98
Total Dissolved Solids -E160.1/NONE (mg/L)						
		<0	NA	NA	NA	NA
Total Suspended Solids -E160.2/NONE (mg/L)						
		<0	NA	NA	NA	NA
Temperature -E170.1/NONE (Celsius)						
Temperature	--	21.167	17.3	17.3	21.0	17.8
Turbidity -E180.1/NONE (NTUs)						

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[ ] Positive result exceeds background concentration or no background value has been determined.

TABLE 5-1

Third Quarter Groundwater - Positive Results Summary
Intermediate Wells
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L011MW-001WG 09 December 97	Duplicate SS45L011MW-002WG 09 December 97	Sample SS45L012MW-001WG 10 December 97	Sample SS45L013MW-001WG 10 December 97
Turbidity	--	33.267	7.3	7.3	4.0	30
Anions -SW9056/NONE (mg/L)						
Chloride	0.200	4.17	18.6	23.6	11.7	18.7
Nitrogen as Nitrate	0.100	0.048	<.100	.0850 JQ	.0306 JQ	.0350 JQ
Sulfate as SO4	0.200	23.8	3.10 J	.203 J	.309	<.200
Total Kjeldahl Nitrogen -E351.2/NONE (mg/L)						
		< 0	NA	NA	NA	NA
Dissolved Oxygen -E360.1/NONE (mg/L)						
Dissolved Oxygen	--	0.4	0.00	0.00	13.2	11.1
Total Phosphorous -E365.3/NONE (mg/L)						
		< 0	NA	NA	NA	NA
Biological Oxygen Demand -E405.1/NONE (mg/L)						
		< 0	NA	NA	NA	NA
Chemical Oxygen Demand -E410.4/NONE (mg/L)						
		< 0	NA	NA	NA	NA
Ferrous Iron -HACH 8146/NONE (mg/L)						
Iron	0.01	2.96	5.10	5.10	12.7	5.10
Alkalinity -HACH ALAP/NONE (mg/L)						

Data Qualification Flags/Notes:

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TABLE

Third Quarter Groundwater - Positive Results Summary
Intermediate Wells
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L011KMW-001WG 09 December 97		Duplicate SS45L011KMW-002WG 09 December 97		Sample SS45L012KMW-001WG 10 December 97		Sample SS45L013KMW-001WG 10 December 97	
Alkalinity	1.0	438.333	620		620		760		500	
Methane, Ethane, Ethene -Kampbell, et al./METHOD (ug/L)										
Ethene	82.0	< 82	340		380		<82		<82	
Methane	47.0	< 47	3000		3100		2000		2300	
Redox Potential -SM 2580/NONE (mv)										
Redox Potential	--	22.333	55		55		51		732	
ICP Metals (Dissolved) -SW6010A/SW3005A (mg/L)										
Barium	0.00500	0.213	0.54		0.54		0.49		0.46	
Calcium	1.00	84.633	141		143		180		118	
Iron	0.200	3.433	20.6		20.4		21.5		14.5	
Potassium	5.00	0.237	1.3	JQ	1.4	JQ	1.3	JQ	2.9	JQ
Magnesium	0.200	48.767	55.3		54.8		51.2		34.1	
Manganese	0.0100	0.563	2.1		2.1		3.7		1.8	
Sodium	5.00	15.433	9.2		9.1		9.8		29.7	J
ICP Metals (Total) -SW6010A/SW3005A (mg/L)										
Aluminum	0.200	0.687	0.39	JH	0.66	JH	0.20		0.54	JH
Barium	0.00500	0.227	0.50		0.51		0.47		0.42	
Calcium	1.00	85.033	133		138		183		108	
Iron	0.200	4.1	19.5		20.2		21.3		13.8	
Potassium	5.00	0.643	1.3	JQ	1.3	J	1.4	JQ	2.8	JQ

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JL=Estimated quantitation: possibly biased low or false negative based upon QC data
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TABLE 5-1

Third Quarter Groundwater - Positive Results Summary
Intermediate Wells
England AFB, Louisiana

Sample ID:			Sample		Duplicate		Sample		Sample	
Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	SS45L011MW-001WG 09 December 97		SS45L011MW-002WG 09 December 97		SS45L012MW-001WG 10 December 97		SS45L013MW-001WG 10 December 97	
Magnesium	0.200	48.7	51.3		53.1		51.8		31.6	
Manganese	0.0100	0.573	2.0		2.1		3.7		1.6	
Sodium	5.00	15.467	8.5		8.7		9.5		26.6	J
Zinc	0.0200	0.017	0.013	JQ	<0.020		<0.020		<0.020	
ICP/MS Metals (Dissolved) -SW6020/SW3020A (mg/L)										
Arsenic	0.0100	< 0.01	0.0155		0.0147		0.0505		0.0150	
Antimony	0.00100	0.001	<0.001		<0.001		0.00070	JQ	0.00053	JQ
Thallium	0.000100	< 0.0001	0.000034	JQ	0.000026	JQ	0.000028	JQ	<0.0001	
ICP/MS Metals (Total) -SW6020/SW3020A (mg/L)										
Arsenic	0.0100	< 0.01	0.0164		0.0167		0.0518		0.0152	
Cadmium	0.00100	< 0.001	0.000040	JQ	<0.001		<0.001		<0.001	
Lead	0.00300	< 0.003	0.00082	JQ	0.0008	JQ	<0.0030		<0.0030	
Thallium	0.000100	< 0.0001	0.000039	JQ	0.000037	JQ	0.000027	JQ	0.000023	JQ
Mercury (Dissolved) -SW7470A/METHOD (mg/L)			ND		ND		ND		ND	
Mercury (Total) -SW7470A/METHOD (mg/L)			ND		ND		ND		ND	
Selenium (Dissolved) -SW7740/METHOD (mg/L)			ND		ND		ND		ND	
Selenium (Total) -SW7740/METHOD (mg/L)										

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JL=Estimated quantitation: possibly biased low or false negative based upon QC data
JQ=Estimated quantitation: detected below the Sample Quantitation Limit
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(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

(b) The site-specific background concentration is derived from the upgradient monitoring well results. The intermediate upgradient monitoring well is SS45L017MW.

☐ Positive result exceeds background concentration or no background value has been determined

TABLE 5-1

Third Quarter Groundwater - Positive Results Summary
Intermediate Wells
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L011MW-001WG 09 December 97	Duplicate SS45L011MW-002WG 09 December 97	Sample SS45L012MW-001WG 10 December 97	Sample SS45L013MW-001WG 10 December 97
			ND	ND	ND	ND
Semivolatile Organic Compounds -SW8270B/SW3520B (ug/L)						
		--	NA	NA	NA	NA
Polynuclear Aromatic Hydrocarbons -SW8310/SW3520B (ug/L)						
		--	NA	NA	NA	NA
Sulfide -SW9030/NONE (mg/L)						
	1.0	< 1	0.00	0.00	0.00	0.00
Total Organic Carbon -SW9060M/NONE (mg/L)						
Total Organic Carbon	1.00	11.617	7.6	9.5	16.2	17.8

Data Qualification Flags/Notes.

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(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

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[ ] Positive result exceeds background concentration or no background value has been determined.

TABLE 5-1

Third Quarter Groundwater - Positive Results Summary
Intermediate Wells
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L015MW-001WG 10 December 97	Sample SS45L017MW-001WG 09 December 97	Sample SS45L019MW-001WG 12 December 97	Sample SS45L020MW-001WG 11 December 97
Volatile Organic Compounds -SW8260A/SW5030A (ug/L)						
Chlorobenzene	0.500	--	<.500	<.500	.916	<.500
1,1-Dichloroethane	0.500	--	<.500	<.500	1.27	<.500
trans-1,2-Dichloroethene	0.500	--	<.500	<.500	1.19	<.500
Specific Conductance -E120.1/NONE (umhos/cm)						
Specific Conductance	--	664	890	661	447	1014
pH -E150.1/NONE (pH units)						
pH	--	7.023	7.28	7.35	6.85	7.02
Total Dissolved Solids -E160.1/NONE (mg/L)						
Total Dissolved Solids	10.0	272	NA	NA	NA	481
Total Suspended Solids -E160.2/NONE (mg/L)						
Total Suspended Solids	10.0	41.667	NA	NA	NA	20.0
Temperature -E170.1/NONE (Celsius)						
Temperature	--	21.167	22.7	22.9	18.6	19.1
Turbidity -E180.1/NONE (NTUs)						
Turbidity	--	33.267	26.6	17.7	6.74	10
Anions -SW9056/NONE (mg/L)						
Chloride	0.200	4.17	16.4	5.71	10.3	8.00

Data Qualification Flags/Notes:

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JQ=Estimated quantitation: detected below the Sample Quantitation Limit
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R=Datum rejected based upon QC data: do not use

(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

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☐ Positive result exceeds background concentration or no background value has been determined.

TABLE 3

Third Quarter Groundwater - Positive Results Summary
Intermediate Wells
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L015MW-001WG 10 December 97		Sample SS45L017MW-001WG 09 December 97		Sample SS45L019MW-001WG 12 December 97		Sample SS45L020MW-001WG 11 December 97	
Nitrogen as Nitrate	0.100	0.048	.0290	JQ	.0340	JQ	.0170	JQ	<.100	
Sulfate as SO4	0.200	23.8	60.0		26.2		<.200		.183	JQ
Total Kjeldahl Nitrogen -E351.2/NONE (mg/L)										
Total Kjeldahl Nitrogen	0.500	0.13	NA		NA		NA		0.11	JL
Dissolved Oxygen -E360.1/NONE (mg/L)										
Dissolved Oxygen	--	0.4	0.00		0.2		0.00		9.0	
Total Phosphorous -E365.3/NONE (mg/L)										
Phosphorus, Total as P	0.0500	0.117	NA		NA		NA		0.29	
Biological Oxygen Demand -E405.1/NONE (mg/L)			NA		NA		NA		ND	
Chemical Oxygen Demand -E410.4/NONE (mg/L)			NA		NA		NA		ND	
Ferrous Iron -HACH 8146/NONE (mg/L)										
Iron	0.01	2.96	0.69		1.99		4.35		4.94	
Alkalinity -HACH ALAP/NONE (mg/L)										
Alkalinity	10	438.333	840		355		400		560	
Methane, Ethane, Ethene -Kampbell, et al./METHOD (ug/L)										
Methane	47.0	<47	<47		<47		1400	J	580	

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[ ] Positive result exceeds background concentration or no background value has been determined.

TABLE 5-1

Third Quarter Groundwater - Positive Results Summary
Intermediate Wells
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L015MW-001WG 10 December 97		Sample SS45L017MW-001WG 09 December 97		Sample SS45L019MW-001WG 12 December 97		Sample SS45L020MW-001WG 11 December 97	
Redox Potential -SM 2580/NONE (mv)										
Redox Potential	--	22.333	25		-47		-72		1334	
ICP Metals (Dissolved) -SW6010A/SW3005A (mg/L)										
Barium	0.00500	0.213	0.35		0.21		0.25		0.34	
Calcium	1.00	84.633	122		86.1		73.4		91.1	
Iron	0.200	3.433	0.35		3.0		8.1		9.0	
Potassium	5.00	0.237	<5.0		<5.0		1.1	JQ	<5.0	
Magnesium	0.200	48.767	99.2	J	50.6		29.2		60.9	
Manganese	0.0100	0.563	0.95		0.53		0.77		1.7	
Sodium	5.00	15.433	65.3	J	15.9		15.2		21.6	
ICP Metals (Total) -SW6010A/SW3005A (mg/L)										
Aluminum	0.200	0.687	0.40	JH	0.39	JH	0.053	JH	0.083	JQ
Barium	0.00500	0.227	0.32		0.20		0.25		0.34	
Calcium	1.00	85.033	111		78.8		72.8		91.4	
Iron	0.200	4.1	0.68		3.2		8.2		9.1	
Potassium	5.00	0.643	<5.0		5.0		1.3	JQ	5.0	
Magnesium	0.200	48.7	90.1	J	47.0		29.2		61.0	
Manganese	0.0100	0.573	0.88		0.49		0.76		1.7	
Sodium	5.00	15.467	59.0	J	14.8		15.3		21.8	
Zinc	0.0200	0.017	0.0097	JQ	0.051		0.020		0.020	
ICP/MS Metals (Dissolved) -SW6020/SW3020A (mg/L)										

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[ ] Positive result exceeds background concentration or no background value has been determined.

TABLE

Third Quarter Groundwater - Positive Results Summary
Intermediate Wells
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L015MW-001WG 10 December 97		Sample SS45L017MW-001WG 09 December 97		Sample SS45L019MW-001WG 12 December 97		Sample SS45L020MW-001WG 11 December 97	
Arsenic	0.0100	< 0.01	0.0025	JQ	0.0024	JQ	0.00070	JQ	0.0081	JQ
Lead	0.00300	< 0.003	<0.0030		<0.0030		0.00024	JQ	0.00012	JQ
Antimony	0.00100	0.001	0.00069	JQ	0.00025	JQ	<0.0010		0.00091	JQ
Thallium	0.000100	< 0.0001	0.000031	JQ	<0.0001		<0.00010		<0.00010	
ICP/MS Metals (Total) -SW6020/SW3020A (mg/L)										
Arsenic	0.0100	< 0.01	0.0028	JQ	0.0028	JQ	0.00066	JQ	0.0082	JQ
Cadmium	0.00100	< 0.001	0.000052	JQ	<0.001		0.000069	JQ	0.00019	JQ
Lead	0.00300	< 0.003	0.00015	JQ	0.00087	JQ	0.00045	JQ	0.00025	JQ
Antimony	0.00100	< 0.001	<0.001		0.00024	JQ	<0.0010		<0.0010	
Thallium	0.000100	< 0.0001	0.000033	JQ	0.000028	JQ	<0.00010		<0.00010	
Mercury (Dissolved) -SW7470A/METHOD (mg/L)			ND		ND		ND		ND	
Mercury (Total) -SW7470A/METHOD (mg/L)			ND		ND		ND		ND	
Selenium (Dissolved) -SW7740/METHOD (mg/L)			ND		ND		ND		ND	
Selenium (Total) -SW7740/METHOD (mg/L)			ND		ND		ND		ND	
Semivolatile Organic Compounds -SW8270B/SW3520B (ug/L)										

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TABLE 5-1

Third Quarter Groundwater - Positive Results Summary
Intermediate Wells
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L015MW-001WG 10 December 97	Sample SS45L017MW-001WG 09 December 97	Sample SS45L019MW-001WG 12 December 97	Sample SS45L020MW-001WG 11 December 97
Polynuclear Aromatic Hydrocarbons -SW8310/SW3520B (ug/L)			NA	NA	NA	ND
Sulfide -SW9030/NONE (mg/L)			NA	NA	NA	ND
Total Organic Carbon -SW9060M/NONE (mg/L)	1.0	< 1	0.10	0.00	0.018	0.034
Total Organic Carbon	1.00	11.617	14.7	4.25	3.85	11.9

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TAB

Third Quarter Groundwater - Positive Results Summary
Intermediate Wells
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L021MW-001WG 11 December 97	Sample SS45L022MW-001WG 11 December 97	Sample SS45L024MW-001WG 16 December 97	Sample SS45L025MW-001WG 16 December 97
Volatile Organic Compounds -SW8260A/SW5030A (ug/L)						
1,1-Dichloroethane	0.500	--	<.500	<.500	<.500	.655
cis-1,2-Dichloroethene	0.500	--	<.500	2.01	<.500	.772
trans-1,2-Dichloroethene	0.500	--	<.500	.291 JQ	<.500	<.500
Vinyl chloride	1.00	--	<1.00	<1.00	<1.00	2.58
Specific Conductance -E120.1/NONE (umhos/cm)						
Specific Conductance	--	664	944	692	777	567
pH -E150.1/NONE (pH units)						
pH	--	7.023	7.0	6.79	6.9	6.91
Total Dissolved Solids -E160.1/NONE (mg/L)						
Total Dissolved Solids	10.0	272	377	727	910	518
Total Suspended Solids -E160.2/NONE (mg/L)						
Total Suspended Solids	10.0	41.667	67.0	32.0	95.0	500
Temperature -E170.1/NONE (Celsius)						
Temperature	--	21.167	19.1	16.1	22.2	17.3
Turbidity -E180.1/NONE (NTUs)						
Turbidity	--	33.267	17	2.4	41.2	7.5
Anions -SW9056/NONE (mg/L)						

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TABL

Third Quarter Groundwater - Positive Results Summary
Intermediate Wells
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L021MW-001WG 11 December 97		Sample SS45L022MW-001WG 11 December 97		Sample SS45L024MW-001WG 16 December 97		Sample SS45L025MW-001WG 16 December 97	
Chloride	0.200	4.17	8.02		26.2		7.88		20.5	
Sulfate as SO4	0.200	23.8	<.200		180		205		<.200	
Total Kjeldahl Nitrogen -E351.2/NONE (mg/L)										
Total Kjeldahl Nitrogen	0.500	0.13	0.52	JL	<0.50	JL	1.5	JL	3.0	JL
Dissolved Oxygen -E360.1/NONE (mg/L)										
Dissolved Oxygen	--	0.4	7.5		0.1		0.00		0.6	
Total Phosphorous -E365.3/NONE (mg/L)										
Phosphorus, Total as P	0.0500	0.117	0.99		0.079		1.3		1.2	
Biological Oxygen Demand -E405.1/NONE (mg/L)										
Biochemical Oxygen Demand	2.00	< 2	4.54		<2.00		<2.00		6.41	
Chemical Oxygen Demand -E410.4/NONE (mg/L)										
Chemical Oxygen Demand (Regular)	5.00	4.127	<5.00		<5.00		7.42		9.97	
Ferrous Iron -HACH 8146/NONE (mg/L)										
Iron	0.01	2.96	8.72		0.06		8.94		4.78	
Alkalinity -HACH ALAP/NONE (mg/L)										
Alkalinity	1.0	438.333	540		480		680		500	
Methane, Ethane, Ethene -Kampbell, et al./METHOD (ug/L)										
Methane	47.0	< 47	8300		< 47		420		4800	

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Intermediate Wells
England AFB, Louisiana

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Redox Potential -SM 2580/NONE (mv)										
Redox Potential	--	22.333	3860		74		-89		-203	
ICP Metals (Dissolved) -SW6010A/SW3005A (mg/L)										
Aluminum	0.200	< 0.2	<0.20		<0.20		0.023	JQ	<0.20	
Barium	0.00500	0.213	0.41		0.24		0.74		0.43	
Calcium	1.00	84.633	101		100		179		109	
Copper	0.0100	< 0.01	0.0079	JQ	0.023		0.0037	JQ	0.017	
Iron	0.200	3.433	16.7		0.11	JQ	14.1		9.8	
Potassium	5.00	0.237	0.96	JQ	<5.0		1.4	JQ	1.5	JQ
Magnesium	0.200	48.767	49.8		77.0		68.3		33.8	
Manganese	0.0100	0.563	2.5		0.61		2.4		1.9	
Sodium	5.00	15.433	10.5		52.5	J	18.2		18.3	
Nickel	0.0400	< 0.04	<0.040		<0.040		<0.040		0.010	JQ
Zinc	0.0200	< 0.02	<0.020		0.0084	JQ	<0.020		<0.020	
ICP Metals (Total) -SW6010A/SW3005A (mg/L)										
Aluminum	0.200	0.687	0.82		0.94		1.8		0.48	
Barium	0.00500	0.227	0.38		0.23		0.77		0.44	
Calcium	1.00	85.033	92.4		92.3		182		108	
Copper	0.0100	< 0.01	0.0034	JQ	0.0039	JQ	0.0056	JQ	0.0040	JQ
Iron	0.200	4.1	16.1		1.0		16.8		10.6	
Potassium	5.00	0.643	1.0	JQ	0.63	JQ	1.8	JQ	1.7	JQ

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TABLE

Third Quarter Groundwater - Positive Results Summary
Intermediate Wells
England AFB, Louisiana

Sample ID:			Sample SS45L021MW-001WG		Sample SS45L022MW-001WG		Sample SS45L024MW-001WG		Sample SS45L025MW-001WG	
Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	11 December 97		11 December 97		16 December 97		16 December 97	
Magnesium	0.200	48.7	45.2		70.1		70.0		33.8	
Manganese	0.0100	0.573	2.3		0.57		2.5		1.9	
Sodium	5.00	15.467	9.6		47.0	J	18.2		18.4	
Nickel	0.0400	< 0.04	0.011	JQ	<0.040		<0.040		0.012	JQ
Vanadium	0.0100	0.002	0.0030	JQ	0.0031	JQ	0.0051	JQ	0.0031	JQ
Zinc	0.0200	0.017	0.014	JQ	0.011	JQ	0.0084	JQ	<0.020	
ICP/MS Metals (Dissolved) -SW6020/SW3020A (mg/L)										
Arsenic	0.0100	< 0.01	0.0068	JQ	0.00090	JQ	0.0016	JQ	0.0127	
Lead	0.00300	< 0.003	0.00010	JQ	0.00040	JQ	0.00025	JQ	0.00061	JQ
Antimony	0.00100	0.001	0.00045	JQ	0.00054	JQ	0.0012		0.00078	JQ
Thallium	0.000100	< 0.0001	<0.00010		0.000032	JQ	<0.00010		<0.00010	
ICP/MS Metals (Total) -SW6020/SW3020A (mg/L)										
Arsenic	0.0100	< 0.01	0.0072	JQ	0.0011	JQ	0.002	JQ	0.0134	
Cadmium	0.00100	< 0.001	<0.0010		0.000063	JQ	<0.0010		0.0010	
Lead	0.00300	< 0.003	0.00066	JQ	0.00071	JQ	0.0015	JQ	0.00065	JQ
Thallium	0.000100	< 0.0001	0.000024	JQ	0.000041	JQ	<0.00010		0.000029	JQ
Mercury (Dissolved) -SW7470A/METHOD (mg/L)			ND		ND		ND		ND	
Mercury (Total) -SW7470A/METHOD (mg/L)			ND		ND		ND		ND	

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TABLE

Third Quarter Groundwater - Positive Results Summary
Intermediate Wells
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L021MW-001WG 11 December 97	Sample SS45L022MW-001WG 11 December 97	Sample SS45L024MW-001WG 16 December 97	Sample SS45L025MW-001WG 16 December 97
Selenium (Dissolved) -SW7740/METHOD (mg/L)						
			ND	ND	ND	ND
Selenium (Total) -SW7740/METHOD (mg/L)						
			ND	ND	ND	ND
Semivolatile Organic Compounds -SW8270B/SW3520B (ug/L)						
			ND	ND	ND	ND
Polynuclear Aromatic Hydrocarbons -SW8310/SW3520B (ug/L)						
			ND	ND	ND	ND
Sulfide -SW9030/NONE (mg/L)						
	1.0	< 1	0.034	0.00	1.6	0.1
Total Organic Carbon -SW9060M/NONE (mg/L)						
Total Organic Carbon	1.00	11.617	13.2	11.2	13.2	23.9

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TABLE 5-1

Third Quarter Groundwater - Positive Results Summary
Intermediate Wells
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L026MW-001WG 16 December 97
Volatile Organic Compounds -SW8260A/SW5030A (ug/L)			
			ND
Specific Conductance -E120.1/NONE (umhos/cm)			
Specific Conductance	--	664	768
pH -E150.1/NONE (pH units)			
pH	--	7.023	6.85
Total Dissolved Solids -E160.1/NONE (mg/L)			
Total Dissolved Solids	10.0	272	744
Total Suspended Solids -E160.2/NONE (mg/L)			
Total Suspended Solids	10.0	41.667	112
Temperature -E170.1/NONE (Celsius)			
Temperature	--	21.167	22.2
Turbidity -E180.1/NONE (NTUs)			
Turbidity	--	33.267	38.7
Anions -SW9056/NONE (mg/L)			
Chloride	0.200	4.17	12.6
Sulfate as SO4	0.200	23.8	5.05
Total Kjeldahl Nitrogen -E351.2/NONE (mg/L)			

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TABLE

Third Quarter Groundwater - Positive Results Summary
Intermediate Wells
England AFB, Louisiana

	Sample ID:			Sample SS45L026MW-001WG	
	Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	16 December 97	
Total Kjeldahl Nitrogen		0.500	0.13	6.8	JL
Dissolved Oxygen -E360.1/NONE (mg/L)					
Dissolved Oxygen		--	0.4	2.5	
Total Phosphorous -E365.3/NONE (mg/L)					
Phosphorus, Total as P		0.0500	0.117	0.51	
Biological Oxygen Demand -E405.1/NONE (mg/L)					
Biochemical Oxygen Demand		2.00	< 2	19.9	
Chemical Oxygen Demand -E410.4/NONE (mg/L)					
Chemical Oxygen Demand (Regular)		5.00	4.127	23.1	
Ferrous Iron -HACH 8146/NONE (mg/L)					
Iron		0.01	2.96	11.67	
Alkalinity -HACH ALAP/NONE (mg/L)					
Alkalinity		1.0	438.333	820	
Methane, Ethane, Ethene -Kumpbell, et al./METHOD (ug/L)					
Methane		47.0	47	58000	
Redox Potential -SM 2580/NONE (mv)					
Redox Potential		--	22.333	428	
ICP Metals (Dissolved) -SW6010A/SW3005A (mg/L)					

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JH=Estimated quantitation: possibly biased high or false positive based upon QC data
JL=Estimated quantitation: possibly biased low or false negative based upon QC data
JQ=Estimated quantitation: detected below the Sample Quantitation Limit
ND=No Positive Results detected for the Analytical Method
JT=This sample has GC/FID characteristics for which reliable identification of a product could not be achieved
R=Datum rejected based upon QC data: do not use

(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions

(b) The site-specific background concentration is derived from the upgradient monitoring well results. The intermediate upgradient monitoring well is SS45L017MW.

☐ Positive result exceeds background concentration or no background value has been determined.

Third Quarter Groundwater - Positive Results Summary
Intermediate Wells
England AFB, Louisiana

(a)	Sample ID:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L026MW-001WG
	Sample Date:			16 December 97
Barium		0.00500	0.213	0.76
Calcium		1.00	84.633	134
Iron		0.200	3.433	14.7
Potassium		5.00	0.237	3.7 JQ
Magnesium		0.200	48.767	44.6
Manganese		0.0100	0.563	1.0
Sodium		5.00	15.433	85.1
ICP Metals (Total) -SW6010A/SW3005A (mg/L)				
Aluminum		0.200	0.687	0.70
Barium		0.00500	0.227	0.80
Calcium		1.00	85.033	139
Copper		0.0100	< 0.01	0.0037 JQ
Iron		0.200	4.1	16.0
Potassium		5.00	0.643	3.8 JQ
Magnesium		0.200	48.7	45.9
Manganese		0.0100	0.573	1.0
Sodium		5.00	15.467	80.5
ICP/MS Metals (Dissolved) -SW6020/SW3020A (mg/L)				
Arsenic		0.00100	< 0.01	0.00529
Lead		0.000300	0.003	0.000021 JQ
Antimony		0.00100	0.001	0.0019

Data Qualification Flags/Notes:

NA=Not Analyzed
J=Estimated quantitation based upon QC data
JB=Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgment
JH=Estimated quantitation: possibly biased high or false positive based upon QC data
JL=Estimated quantitation: possibly biased low or false negative based upon QC data
JQ=Estimated quantitation: detected below the Sample Quantitation Limit
ND=No Positive Results detected for the Analytical Method
JT=This sample has GC/FID characteristics for which reliable identification of a product could not be achieved
R=Datum rejected based upon QC data: do not use

(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

(b) The site-specific background concentration is derived from the upgradient monitoring well results. The intermediate upgradient monitoring well is SS45L017MW.

☐ Positive result exceeds background concentration or no background value has been determined.

TABL

Third Quarter Groundwater - Positive Results Summary
Intermediate Wells
England AFB, Louisiana

	Sample ID:	Practical	Site-Specific	Sample	
	Sample Date:	Quantitation Limit(a)	Background Concentration (b)	SS45L026MW-001WG 16 December 97	
ICP/MS Metals (Total) -SW6020/SW3020A (mg/L)					
Arsenic		0.0100	< 0.01	0.057	
Lead		0.00300	< 0.003	0.00096	JQ
Thallium		0.000100	< 0.0001	0.000026	JQ
Mercury (Dissolved) -SW7470A/METHOD (mg/L)					
				ND	
Mercury (Total) -SW7470A/METHOD (mg/L)					
				ND	
Selenium (Dissolved) -SW7740/METHOD (mg/L)					
				ND	
Selenium (Total) -SW7740/METHOD (mg/L)					
				ND	
Semivolatile Organic Compounds -SW8270B/SW3520B (ug/L)					
				ND	
Polynuclear Aromatic Hydrocarbons -SW8310/SW3520B (ug/L)					
				ND	
Sulfide -SW9030/NONE (mg/L)					
		1.0	< 1	1.4	

Data Qualification Flags/Notes:
NA=Not Analyzed
J=Estimated quantitation based upon QC data
JB=Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgment
JH=Estimated quantitation: possibly biased high or false positive based upon QC data
JL=Estimated quantitation: possibly biased low or false negative based upon QC data
JQ=Estimated quantitation: detected below the Sample Quantitation Limit
ND=No Positive Results detected for the Analytical Method
JT=This sample has GC/FID characteristics for which reliable identification of a product could not be achieved
R=Datum rejected based upon QC data: do not use

(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions

(b) The site-specific background concentration is derived from the upgradient monitoring well results. The intermediate upgradient monitoring well is SS45L017MW.

[ ] Positive result exceeds background concentration or no background value has been determined.

TABLE 3-1

Third Quarter Groundwater - Positive Results Summary
Intermediate Wells
England AFB, Louisiana

	Sample ID:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L026MW-001WG
	Sample Date:			16 December 97
Total Organic Carbon -SW9060M/NONE (mg/L)				
Total Organic Carbon		1.00	11.617	29.7

Data Qualification Flags/Notes:

NA=Not Analyzed
J=Estimated quantitation based upon QC data
JB=Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgment
JH=Estimated quantitation: possibly biased high or false positive based upon QC data
JL=Estimated quantitation: possibly biased low or false negative based upon QC data
JQ=Estimated quantitation: detected below the Sample Quantitation Limit
ND=No Positive Results detected for the Analytical Method
JT=This sample has GC/FID characteristics for which reliable identification of a product could not be achieved
R=Datum rejected based upon QC data: do not use

(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

(b) The site-specific background concentration is derived from the upgradient monitoring well results. The intermediate upgradient monitoring well is SS45L017MW.

[ ] Positive result exceeds background concentration or no background value has been determined.

TABLE 5-2

Third Quarter Groundwater - Positive Results Summary
Deep Wells
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L002MW-001WG 11 December 97	Sample SS45L016MW-001WG 10 December 97	Sample SS45L018MW-001WG 10 December 97	Sample SS45L023MW-001WG 11 December 97
Volatile Organic Compounds -SW8260A/SW5030A (ug/L)						
cis-1,2-Dichloroethene	0.500	--	180	1.72	<.500	1.08
trans-1,2-Dichloroethene	0.500	--	4.66	< 500	<.500	< 500
Trichloroethene	0.500	--	<.500	6.29	<.500	<.500
Vinyl chloride	1.00	--	3.58	<1.00	<1.00	<1.00
Specific Conductance -E120.1/NONE (umhos/cm)						
Specific Conductance	--	636.667	704	825	595	604
pH -E150.1/NONE (pH units)						
pH	--	7.037	7.45	7.39	7.35	7.13
Total Dissolved Solids -E160.1/NONE (mg/L)						
Total Dissolved Solids	10.0	328.667	NA	NA	NA	469
Total Suspended Solids -E160.2/NONE (mg/L)						
Total Suspended Solids	10.0	31	NA	NA	NA	21.0
Temperature -E170.1/NONE (Celsius)						
Temperature	--	21.333	20.6	21.5	21.7	16.9
Turbidity -E180.1/NONE (NTUs)						
Turbidity	--	17.287	40.2	10.25	5.26	3.3
Anions -SW9056/NONE (mg/L)						

Data Qualification Flags/Notes:

NA=Not Analyzed
J=Estimated quantitation based upon QC data
JB=Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgment
JH=Estimated quantitation: possibly biased high or false positive based upon QC data
JL=Estimated quantitation: possibly biased low or false negative based upon QC data
JQ=Estimated quantitation: detected below the Sample Quantitation Limit
ND=No Positive Results detected for the Analytical Method
JT=This sample has GC/FID characteristics for which reliable identification of a product could not be achieved
R=Datum rejected based upon QC data: do not use

(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions

(b) The site-specific background concentration is derived from the upgradient monitoring well results. The deep upgradient monitoring well is SS45L018MW.

[ ] Positive result exceeds background concentration or no background value has been determined.

Prepared By/Date: MG by gpH 6/15/98
Checked By/Date: MGB 6/15/98

06/03/98 04:29:44 PM

TABLE 5

Third Quarter Groundwater - Positive Results Summary
Deep Wells
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L002MW-001WG 11 December 97	Sample SS45L016MW-001WG 10 December 97	Sample SS45L018MW-001WG 10 December 97	Sample SS45L023MW-001WG 11 December 97
Chloride	0.200	41.467	31.6	23.1	46.0	12.8
Nitrogen as Nitrate	0.100	0.009	<.100	.0280 JQ	.0280 JQ	<.100
Sulfate as SO4	0.200	34.933	6.18	56.6	39.9	2.13
Total Kjeldahl Nitrogen -E351.2/NONE (mg/L)						
Total Kjeldahl Nitrogen	0.500	0.42	NA	NA	NA	0.14 JL
Dissolved Oxygen -E360.1/NONE (mg/L)						
Dissolved Oxygen	--	2.667	0.00	0.00	0.00	0.3
Total Phosphorous -E365.3/NONE (mg/L)						
Phosphorus, Total as P	0.0500	0.34	NA	NA	NA	0.38
Biological Oxygen Demand -E405.1/NONE (mg/L)						
			NA	NA	NA	ND
Chemical Oxygen Demand -E410.4/NONE (mg/L)						
			NA	NA	NA	ND
Ferrous Iron -HACH 8146/NONE (mg/L)						
Iron	0.01	4.763	3.67	3.94	5.32	5.72
Alkalinity -HACH ALAP/NONE (mg/L)						
Alkalinity	1.0	447	600	620	480	580
Methane, Ethane, Ethene -Kampbell, et al./METHOD (ug/L)						

Data Qualification Flags/Notes:

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(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

(b) The site-specific background concentration is derived from the upgradient monitoring well results. The deep upgradient monitoring well is SS45L018MW.

☐ Positive result exceeds background concentration or no background value has been determined.

TABLE 5-2

Third Quarter Groundwater - Positive Results Summary
Deep Wells
England AFB, Louisiana

Sample ID:			Sample SS45L002MW-001WG	Sample SS45L016MW-001WG	Sample SS45L018MW-001WG	Sample SS45L023MW-001WG
Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	11 December 97	10 December 97	10 December 97	11 December 97
Methane	47.0	< 47	660	<47	<47	320
Redox Potential -SM 2580/NONE (mv)						
Redox Potential	--	8.667	-16	12	-15	61
ICP Metals (Dissolved) -SW6010A/SW3005A (mg/L)						
Barium	0.00500	0.613	0.56	0.30	0.62	0.32
Calcium	1.00	97.767	120	96.2	96.1	98.1
Copper	0.0100	< 0.01	<0.010	0.019	<0.010	<0.010
Iron	0.200	7.6	3.7	4.3	8.9	10.1
Potassium	5.00	2.467	1.5 JQ	<5.0	2.1 JQ	0.80 JQ
Magnesium	0.200	31.233	54.0	75.9	29.1	64.0
Manganese	0.0100	0.557	1.1	0.68	0.55	1.2
Sodium	5.00	43.167	23.7	34.5	46.2	19.9
Nickel	0.0400	< 0.04	0.011 JQ	<0.040	<0.040	<0.040
Zinc	0.0200	0.003	<0.020	0.0085 JQ	<0.020	<0.020
ICP Metals (Total) -SW6010A/SW3005A (mg/L)						
Aluminum	0.200	0.227	0.88 JH	0.11 JH	0.023 JH	0.20
Barium	0.00500	0.62	0.51	0.31	0.65	0.33
Calcium	1.00	100.9	112	98.2	99.1	96.9
Iron	0.200	8.3	4.5	4.8	9.4	10.4
Potassium	5.00	2.333	1.4 JQ	<5.0	2.3 JQ	0.78 JQ
Magnesium	0.200	31.067	49.9	77.5	30.0	63.8

Data Qualification Flags/Notes:

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R=Datum rejected based upon QC data: do not use

(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

(b) The site-specific background concentration is derived from the upgradient monitoring well results. The deep upgradient monitoring well is SS45L018MW.

Positive result exceeds background concentration or no background value has been determined.

TABLE 5-2

Third Quarter Groundwater - Positive Results Summary
Deep Wells
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L002MW-001WG 11 December 97		Sample SS45L016MW-001WG 10 December 97		Sample SS45L018MW-001WG 10 December 97		Sample SS45L023MW-001WG 11 December 97	
Manganese	0.0100	0.577	1.0		0.71		0.57		1.2	
Sodium	5.00	44.1	22.0		34.8		48.5		20.6	
Nickel	0.0400	< 0.04	0.011	JQ	<0.040		<0.040		<0.040	
Vanadium	0.0100	0.001	0.0025	JQ	<0.010		<0.010		<0.010	
Zinc	0.0200	0.007	0.018	JQ	<0.020		<0.020		<0.020	
ICP/MS Metals (Dissolved) -SW6020/SW3020A (mg/L)										
Arsenic	0.0100	< 0.01	0.0343		0.0066	JQ	0.0053	JQ	0.0022	JQ
Lead	0.00300	< 0.003	0.00022	JQ	<0.0030		<0.0030		0.000095	JQ
Antimony	0.00100	0.301	0.00022	JQ	0.00077	JQ	0.0015		<0.0010	
Thallium	0.000100	< 0.0001	0.000038	JQ	0.000026	JQ	0.000029	JQ	<0.00010	
ICP/MS Metals (Total) -SW6020/SW3020A (mg/L)										
Arsenic	0.0100	< 0.01	0.0343		0.0070	JQ	0.0052	JQ	0.0026	JQ
Cadmium	0.00100	< 0.001	0.000043	JQ	0.000060	JQ	<0.001		0.000071	JQ
Lead	0.00300	< 0.003	0.0012	JQ	0.00140	JQ	0.00031	JQ	0.00045	JQ
Thallium	0.000100	< 0.0001	0.000044	JQ	0.000032	JQ	0.000026	JQ	0.000024	JQ
Mercury (Dissolved) -SW7470A/METHOD (mg/L)			ND		ND		ND		ND	
Mercury (Total) -SW7470A/METHOD (mg/L)			ND		ND		ND		ND	
Selenium (Dissolved) -SW7740/METHOD (mg/L)										

Data Qualification Flags/Notes.

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JB=Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgment
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JL=Estimated quantitation: possibly biased low or false negative based upon QC data
JQ=Estimated quantitation: detected below the Sample Quantitation Limit
ND=No Positive Results detected for the Analytical Method
JT=This sample has GC/FID characteristics for which reliable identification of a product could not be achieved
R=Datum rejected based upon QC data: do not use

(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

(b) The site-specific background concentration is derived from the upgradient monitoring well results. The deep upgradient monitoring well is SS45L018MW.

☐ Positive result exceeds background concentration or no background value has been determined.

TABLE 5-2

Third Quarter Groundwater - Positive Results Summary
Deep Wells
England AFB, Louisiana

Sample ID: / Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	Sample SS45L002KMW-001WG 11 December 97	Sample SS45L016KMW-001WG 10 December 97	Sample SS45L018KMW-001WG 10 December 97	Sample SS45L023KMW-001WG 11 December 97
			ND	ND	ND	ND
Selenium (Total) -SW7740/METHOD (mg/L)						
			ND	ND	ND	ND
Semivolatile Organic Compounds -SW8270B/SW3520B (ug/L)						
			NA	NA	NA	ND
Polynuclear Aromatic Hydrocarbons -SW8310/SW3520B (ug/L)						
			NA	NA	NA	ND
Sulfide -SW9030/NONE (mg/L)						
	1.0	< 1	0.119	0.014	0.01	0.00
Total Organic Carbon -SW9060M/NONE (mg/L)						
Total Organic Carbon	1.00	13.58	6.6	7.48	6.64	11.7

Data Qualification Flags/Notes:

NA=Not Analyzed
J=Estimated quantitation based upon QC data
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JH=Estimated quantitation: possibly biased high or false positive based upon QC data
JL=Estimated quantitation: possibly biased low or false negative based upon QC data
JQ=Estimated quantitation: detected below the Sample Quantitation Limit
ND=No Positive Results detected for the Analytical Method
JT=This sample has GC/FID characteristics for which reliable identification of a product could not be achieved
R=Datum rejected based upon QC data: do not use

(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions

(b) The site-specific background concentration is derived from the upgradient monitoring well results. The deep upgradient monitoring well is SS45L018KMW.

[ ] Positive result exceeds background concentration or no background value has been determined

TABLE 5-2

Third Quarter Groundwater - Positive Results Summary
Deep Wells
England AFB, Louisiana

	Sample ID:	Practical	Site-Specific	Duplicate
	Sample Date:	Quantitation Limit(a)	Background Concentration (b)	SS45L023MW-002WG 11 December 97
Volatile Organic Compounds -SW8260A/SW5030A (ug/L)				
cis-1,2-Dichloroethene		0.500	--	1.18
Specific Conductance -E120.1/NONE (umhos/cm)				
Specific Conductance		--	636.667	604
pH -E150.1/NONE (pH units)				
pH		--	7.037	7.13
Total Dissolved Solids -E160.1/NONE (mg/L)				
Total Dissolved Solids		10.0	328.667	524
Total Suspended Solids -E160.2/NONE (mg/L)				
Total Suspended Solids		10.0	31	18.0
Temperature -E170.1/NONE (Celsius)				
Temperature		--	21.333	16.9
Turbidity -E180.1/NONE (NTUs)				
Turbidity		--	17.287	3.3
Anions -SW9056/NONE (mg/L)				
Chloride		0.200	41.467	13.1
Sulfate as SO4		0.200	34.933	1.39
Total Kjeldahl Nitrogen -E351.2/NONE (mg/L)				

Data Qualification Flags/Notes:
NA=Not Analyzed
J=Estimated quantitation based upon QC data
JB=Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgment
JH=Estimated quantitation: possibly biased high or false positive based upon QC data
JL=Estimated quantitation: possibly biased low or false negative based upon QC data
JQ=Estimated quantitation: detected below the Sample Quantitation Limit
ND=No Positive Results detected for the Analytical Method
JT=This sample has GC/FID characteristics for which reliable identification of a product could not be achieved
R=Datum rejected based upon QC data: do not use

(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

(b) The site-specific background concentration is derived from the upgradient monitoring well results. The deep upgradient monitoring well is SS45L018MW.

☐ Positive result exceeds background concentration or no background value has been determined.

TABLE 5-2

Third Quarter Groundwater - Positive Results Summary
Deep Wells
England AFB, Louisiana

	Sample ID:			Duplicate
	Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	SS45L023MW-002WG 11 December 97
Total Kjeldahl Nitrogen		0.500	0.42	0.090 JL
Dissolved Oxygen -E360.1/NONE (mg/L)				
Dissolved Oxygen		--	2.667	0.3
Total Phosphorous -E365.3/NONE (mg/L)				
Phosphorus, Total as P		0.0500	0.34	0.41
Biological Oxygen Demand -E405.1/NONE (mg/L)				ND
Chemical Oxygen Demand -E410.4/NONE (mg/L)				ND
Ferrous Iron -HACH 8146/NONE (mg/L)				
Iron		0.01	4.763	5.28
Alkalinity -HACH ALAP/NONE (mg/L)				
Alkalinity		1.0	447	580
Methane, Ethane, Ethene -Kamphell, et al./METHOD (ug/L)				
Methane		47.0	< 47	290
Redox Potential -SM 2580/NONE (mv)				
Redox Potential		--	8.667	61
ICP Metals (Dissolved) -SW6010A/SW3005A (mg/L)				

Data Qualification Flags/Notes:

NA=Not Analyzed
J=Estimated quantitation based upon QC data
JB=Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgment
JH=Estimated quantitation: possibly biased high or false positive based upon QC data
JL=Estimated quantitation: possibly biased low or false negative based upon QC data
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(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions

(b) The site-specific background concentration is derived from the upgradient monitoring well results. The deep upgradient monitoring well is SS45L018MW.

☐ Positive result exceeds background concentration or no background value has been determined.

TABLE 5

Third Quarter Groundwater - Positive Results Summary
Deep Wells
England AFB, Louisiana

	Sample ID:			Duplicate	
	Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	SS45L023MW-002WG 11 December 97	
Barium		0.00500	0.613	0.32	
Calcium		1.00	97.767	97.2	
Copper		0.0100	< 0.01	0.024	
Iron		0.200	7.6	10.0	
Potassium		5.00	2.467	0.77	JQ
Magnesium		0.200	31.233	63.5	
Manganese		0.0100	0.557	1.2	
Sodium		5.00	43.167	19.3	
ICP Metals (Total) -SW6010A/SW3005A (mg/L)					
Barium		0.00500	0.62	0.32	
Calcium		1.00	100.9	97.3	
Iron		0.200	8.3	10.1	
Potassium		5.00	2.333	0.77	JQ
Magnesium		0.200	31.067	63.3	
Manganese		0.0100	0.577	1.2	
Sodium		5.00	44.1	19.6	
ICP/MS Metals (Dissolved) -SW6020/SW3020A (mg/L)					
Arsenic		0.00100	0.01	0.00122	JQ
Cadmium		0.00100	< 0.001	0.000043	JQ
Lead		0.00300	< 0.003	0.00031	JQ
Antimony		0.00100	0.301	0.0012	

Data Qualification Flags/Notes:

NA=Not Analyzed
J=Estimated quantitation based upon QC data
JB=Estimated quantitation: possibly biased high or false positive based upon blank data or professional judgment
JH=Estimated quantitation: possibly biased high or false positive based upon QC data
JL=Estimated quantitation: possibly biased low or false negative based upon QC data
JQ=Estimated quantitation: detected below the Sample Quantitation Limit
ND=No Positive Results detected for the Analytical Method
JT=This sample has GC/FID characteristics for which reliable identification of a product could not be achieved
R=Datum rejected based upon QC data: do not use

(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

(b) The site-specific background concentration is derived from the upgradient monitoring well results. The deep upgradient monitoring well is SS45L018MW.

☐ Positive result exceeds background concentration or no background value has been determined

TABLE 5-2

Third Quarter Groundwater - Positive Results Summary
Deep Wells
England AFB, Louisiana

	Sample ID:	Practical	Site-Specific	Duplicate SS45L023MW-002WG	
	Sample Date:	Quantitation Limit(a)	Background Concentration (b)	11 December 97	
ICP/MS Metals (Total) -SW6020/SW3020A (mg/L)					
Arsenic		0.0100	< 0.01	0.0023	JQ
Cadmium		0.00100	< 0.001	0.000058	JQ
Lead		0.00300	< 0.003	0.00028	JQ
Mercury (Dissolved) -SW7470A/METHOD (mg/L)				ND	
Mercury (Total) -SW7470A/METHOD (mg/L)				ND	
Selenium (Dissolved) -SW7740/METHOD (mg/L)				ND	
Selenium (Total) -SW7740/METHOD (mg/L)				ND	
Semivolatile Organic Compounds -SW8270B/SW3520B (ug/L)				ND	
Polynuclear Aromatic Hydrocarbons -SW8310/SW3520B (ug/L)				ND	
Sulfide -SW9030/NONE (mg/L)		10	< 1	0.011	

Data Qualification Flags/Notes:

NA=Not Analyzed
J=Estimated quantitation based upon QC data
JB=Estimated quantitation. possibly biased high or false positive based upon blank data or professional judgment
JH=Estimated quantitation: possibly biased high or false positive based upon QC data
JL=Estimated quantitation: possibly biased low or false negative based upon QC data
JQ=Estimated quantitation: detected below the Sample Quantitation Limit
ND=No Positive Results detected for the Analytical Method
JT=This sample has GC/FID characteristics for which reliable identification of a product could not be achieved
R=Datum rejected based upon QC data: do not use

(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions

(b) The site-specific background concentration is derived from the upgradient (ies) monitoring well results. The deep upgradient monitoring well is SS45L018MW

☐ Positive result exceeds background concentration or no background value has been determined

Third Quarter Groundwater - Positive Results Summary
Deep Wells
England AFB, Louisiana

	Sample ID:			Duplicate
	Sample Date:	Practical Quantitation Limit(a)	Site-Specific Background Concentration (b)	SS45L023MW-002WG 11 December 97
Total Organic Carbon -SW9060M/NONE (mg/L)				
Total Organic Carbon		1.00	13.58	10.9

Data Qualification Flags/Notes.

NA=Not Analyzed
J=Estimated quantitation based upon QC data
JB=Estimated quantitation. possibly biased high or false positive based upon blank data or professional judgment
JH=Estimated quantitation: possibly biased high or false positive based upon QC data
JL=Estimated quantitation. possibly biased low or false negative based upon QC data
JQ=Estimated quantitation: detected below the Sample Quantitation Limit
ND=No Positive Results detected for the Analytical Method
JT=This sample has GC/FID characteristics for which reliable identification of a product could not be achieved
R=Datum rejected based upon QC data: do not use

(a) Quantitation Limits presented are ideal. Sample quantitation limits may vary due to sample weight and dilutions.

(b) The site-specific background concentration is derived from the upgradient monitoring well results. The deep upgradient monitoring well is SS45L018MW

[ ] Positive result exceeds background concentration or no background value has been determined.

APPENDIX B

GEOLOGIC LOGS, GEOPHYSICAL LOGS, AMBIENT FLOW AND INDUCED-FLOW TESTING RECORDS AND RESULTS, WELL CONSTRUCTION DIAGRAMS, MONITORING WELL DEVELOPMENT AND SAMPLING FORMS, SURVEY DATA, WELL PERMITS, WASTES MANIFESTS, AND WELL ABANDONMENT RECORDS

GEOTECHNICAL LOGGING REPORT

Well #1

CLIENT *AFCEE*
PROJECT *England AFB*
LOCATION *Alexandria, La*
DRILL CONTRACTOR *Layne Western*
DRILL METHOD *Percussion Hammer*
SAMPLE METHOD *Cuttings*

PROJECT NUMBER *730486*
DATE DRILLED *8/21/98*
BOREHOLE DIAMETER *9 in.*
SURFACE ELEVATION *ft. MSL*
WATER LEVEL *10.62 ft.*
LOGGED BY *David White*

DEPTH (feet)	(meters)	WELL TEST LOGS: Borehole Flowmeter Log (1.2 to -0.2)	WELL TEST LOGS: Gamma Log (10 to 100)	Sample Number	cis-DCE (ppb)	VC (ppb)	GRAPHIC LOG	USCS	SOIL DESCRIPTION	CONTACT ELEVATION
0								ML	0'–4' – SILT: brown, non-plastic, loose, moist, 25–30% sand and clay.	
5								CL	4'–7' – CLAY: brown, medium stiff, plastic, 25% sand, moist.	-4
10								ML	7'–12' – SILT: brown, semi-plastic, 30% sand, saturated.	-7
15	5							CH	12'–31' – CLAY: brown, stiff to very stiff, plastic, moist, <10% sand.	-12
20										
25										
30										-31
35	10			30–40	84	ND		SP	31'–76' – SAND: light brown to light gray, very fine to fine, unconsolidated, heeving, saturated.	
40										
45				40–50	94	ND				
50	15									
55										
60										
65	20			60–70	92	ND				
70										
75										-76
80	25							CH	76'–79' – CLAY: gray to olive green mottled, very stiff, plastic, moist, 25% sand.	-79
									Bottom of boring at 79 feet.	

WELL CONSTRUCTION LOG

PROJECT	PROJECT NUMBER	WELL NUMBER
England AFB	730486	Well#1

SITE	COORDINATES	GROUND SURFACE ELEVATION	CASING STICKUP
Alexandria, LA	237157.4225 / 1990831.0492		-1.5

Soil Boring Cross-Reference Well#1
Town and City Alexandria
County and State Rapides, LA

Installation Date (s) 8/21-23/98

Drilling Method AP-1000 Percussion Hammer
Drilling Contractor
Drilling Fluid Water used to assist heaving sand.

Development Technique (s) / Dates
Completed prior to initial ground water sampling.

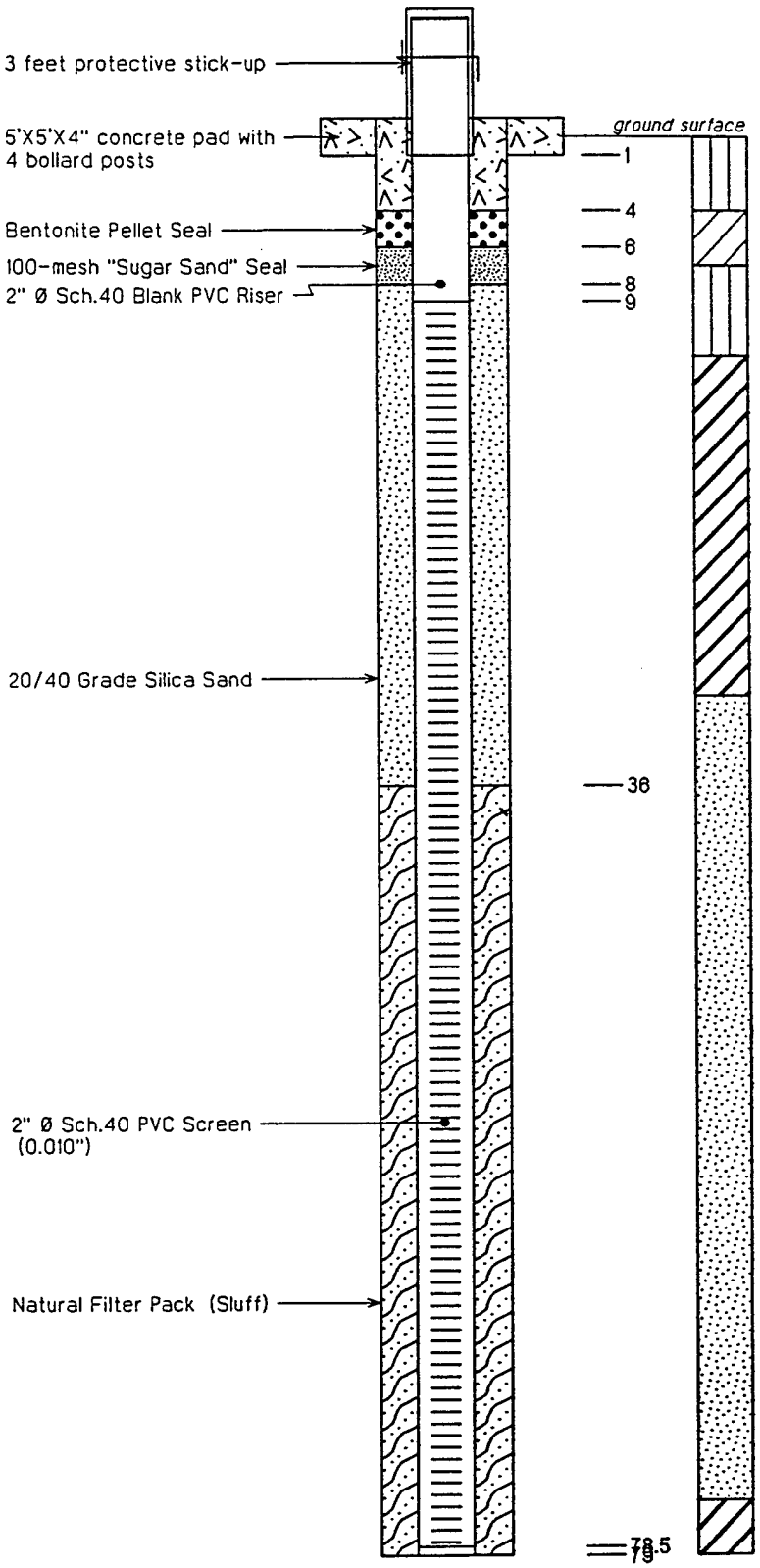
Fluid Loss During Drilling (gals)
Water Removed During Development (gals)
230 - 8/25/98

Static Depth to Water Date 9/1/98
Static Depth to Water (feet) 10.55

Well Purpose Monitoring ground water.

Remarks Monitor well was screened across entire saturated zone.
Tests run on well:
Sample for VOC 8260B
Electromagnetic Borehole Floweter
Gamma Log with Resistivity

Prepared By D. White
Date Prepared 10/9/98



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GEOTECHNICAL LOGGING REPORT

Well #2

CLIENT *AFCEE*
PROJECT *England AFB*
LOCATION *Alexandria, La*
DRILL CONTRACTOR *Layne Western*
DRILL METHOD *Percussion Hammer*
SAMPLE METHOD *Cuttings*

PROJECT NUMBER *730486*
DATE DRILLED *8/21/98*
BOREHOLE DIAMETER *9 in.*
SURFACE ELEVATION *ft. MSL*
WATER LEVEL *17.06 ft.*
LOGGED BY *David White*

DEPTH (feet)	(meters)	WELL TEST LOGS: Borehole Flowmeter Log (0.8 to -0.20)	WELL TEST LOGS: Gamma Log (160)	Sample Number	cis-DCE (ppb)	VC (ppb)	GRAPHIC LOG	USCS	SOIL DESCRIPTION	CONTACT ELEVATION
0								ML	0'-6' – SILT: brown, non-plastic, moist, 30% sand and clay.	
5										-6
10								CL	6'-13' – CLAY: brown, stiff, plastic, 30% sand, moist.	
15	5									-13
								ML	13'-16' – SILT: brown, semi-plastic, 30% sand, wet.	-16
20								CH	16'-31' – CLAY: brown, stiff to very stiff, plastic, moist, <10% sand.	
25										
30	10								31'-49' – CLAY: brown/gray mottled, stiff, plastic, moist, 20% sand and increasing with depth.	
35										
40										
45										
50	15			48-58	2.9	0.24J		SP	49'-76' – SAND: light brown to light gray, very fine to fine, unconsolidated, heeving, saturated.	-49
55										
60										
65	20			60-70	2.8	ND				
70										
75				70-80	3.0	0.24J				-76
								CL	76'-80' – CLAY: dark brown, very stiff, plastic, moist, 30% sand.	-80
80	25							SP	80'-88' – SAND: light brown to light gray, very fine to fine, unconsolidated, heeving, saturated.	
85										-88
90								CH	88'-89' – CLAY: dark brown to dark gray, very stiff, plastic, moist, <10% sand.	-89
95									*Bottom of boring at 89 feet.*	

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WELL CONSTRUCTION LOG

PROJECT	PROJECT NUMBER	WELL NUMBER
England AFB	730486	Well#2

SITE	COORDINATES	GROUND SURFACE ELEVATION	CASING STICKUP
Alexandria, LA	238394.2266 / 1991247.9997		-1.5

Soil Boring Cross-Reference Well#2
Town and City Alexandria
County and State Rapides, LA

Installation Date (s) 8/21/98

Drilling Method AP-1000 Percussion Hammer
Drilling Contractor
Drilling Fluid Water used to assist heaving sand.

Development Technique (s) / Dates
Completed prior to initial ground water sampling.

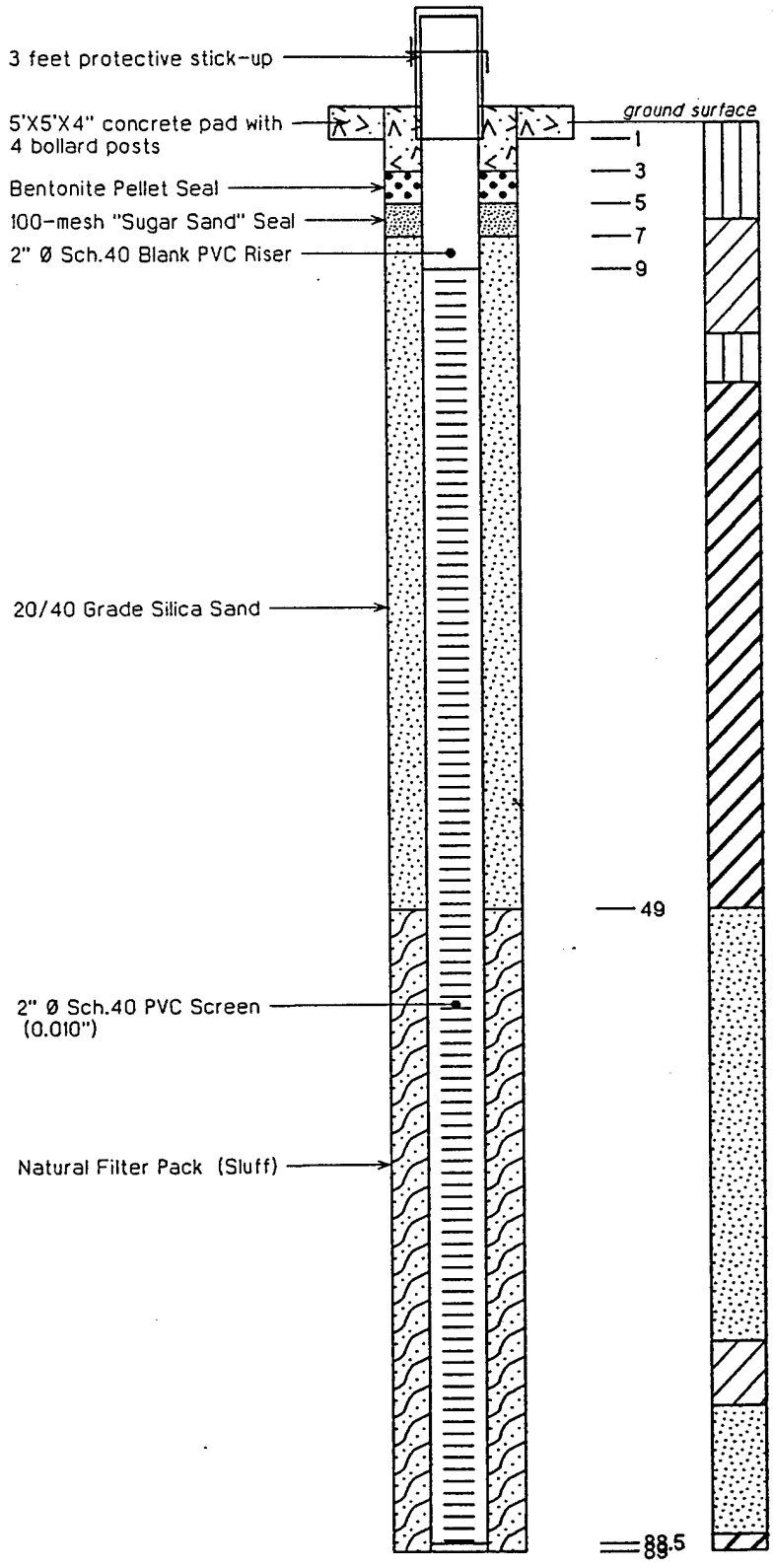
Fluid Loss During Drilling (gals)
Water Removed During Development (gals)
285 - 8/25/98

Static Depth to Water Date 9/1/98
Static Depth to Water (feet) 17.06

Well Purpose Monitoring ground water.

Remarks Monitor well was screened across entire saturated zone.
Tests run on well:
Sample for VOC 8260B
Electromagnetic Borehole Floweter
Gamma Log with Resistivity

Prepared By D. White
Date Prepared 10/9/98



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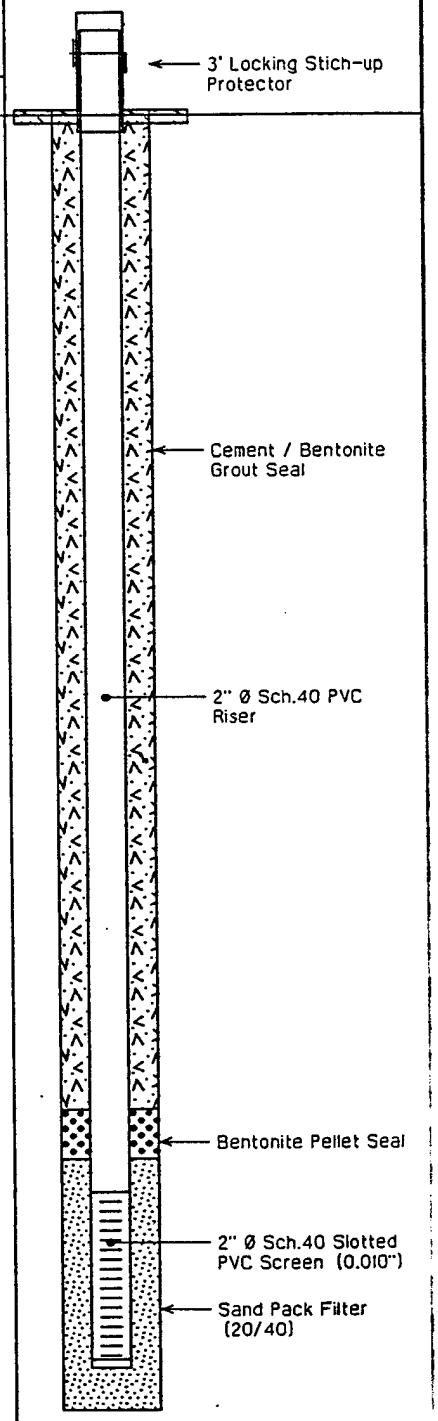
Monitoring Well No. Well #3

PROJECT: England AFB Phase II Drilling
LOGGED BY: David White
DRILLING COMPANY: Geo Engineering/Warren Drilling

DATE: 2/2/99
NORTHING: 238988.9657
EASTING: 1990815.3458

WELL HOLE DIA: 8" OD
DRILLING METHOD: Wet Rotary
HOLE ELEV.: 88.55 ft. MSL

DESCRIPTION	USCS CLASS	GRAPHIC LOG	DEPTH	SAMPLE	FID
0'-5' - SILT: brown, moist, non-plastic, rootlets present, 25%-30% clay and sand.	ML		0		
5'-8' - CLAY: brown, medium stiff, plastic, 25% sand, slightly moist.	CL		5		
8'-16' - SILT: brown, semi-plastic, 30% clay and sand, wet.	ML		10		0
16'-42' - CLAY: brown to reddish brown, stiff to very stiff, plastic, moist, 10% sand.	CL		15		
			20		0
			25		
			30		0
			35		
			40		0
42'-78' - SAND: light brown to light gray, very fine to fine, unconsolidated, saturated.	SP		45		
			50		0
			55		
			60		0
66'-68' small amount of gravle present in cuttings, larger sand grain size.			65		
			70		
			75		
Bottom of boring at 78 feet.			80		



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Notes:
Monitor well #3 is on the golf course just west of bayou and south of golf course pro shop in "2500 Area".

Project No.
722450

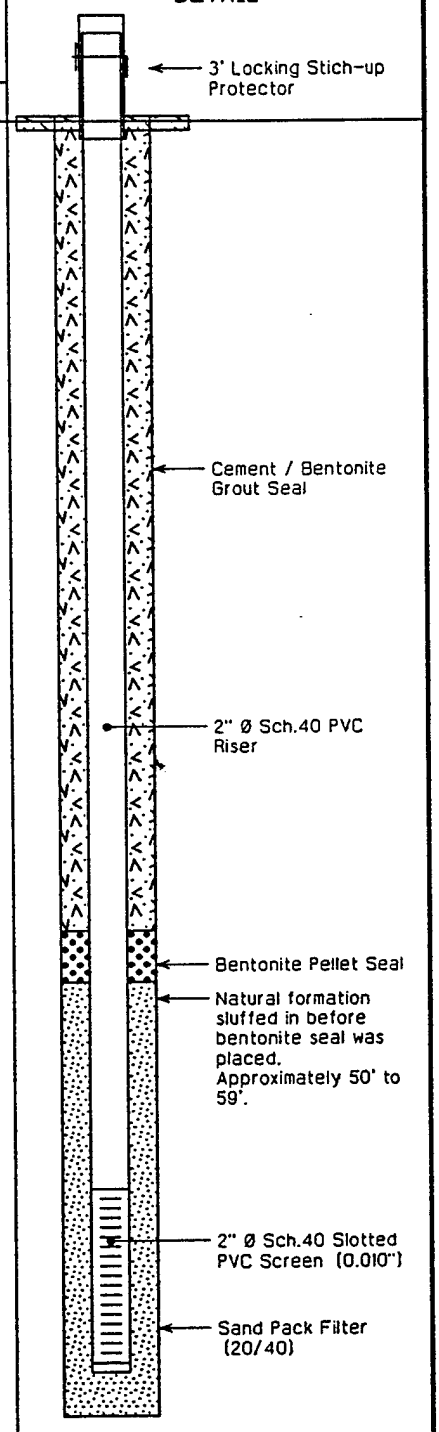
Monitoring Well No. Well #4

PROJECT: England AFB Phase II Drilling
LOGGED BY: David White
DRILLING COMPANY: Geo Engineering/Warren Drilling

DATE: 2/4/99
NORTHING: 238523.7110
EASTING: 1991064.8907

WELL HOLE DIA: 8" OD
DRILLING METHOD: Wet Rotary
HOLE ELEV.: 88.97 ft. MSL

DESCRIPTION	USCS CLASS	GRAPHIC LOG	DEPTH	SAMPLE	FID
0'-6' - SILT: brown, moist, non-plastic, rootlets present, 25%-30% clay and sand.	ML		0		
6'-13' - CLAY: brown, medium stiff, plastic, 25% sand, slightly moist.	CL		5		
13'-16' - SILT: brown, semi-plastic, 30% clay and sand, wet.	ML		10		0
16'-49' - CLAY: brown to reddish brown, stiff to very stiff, plastic, moist, 10% sand.	CL		15		
			20		0
			25		
			30		0
			35		
			40		0
			45		
49'-75' - SAND: light brown to light gray, very fine to fine, unconsolidated, saturated.	SP		50		0
			55		
			60		0
			65		
68'-71' small amount of gravle present in cuttings, larger sand grain size.			70		0
			75		
Bottom of boring at 75 feet.					



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Notes:
Monitor well #4 is on the golf course just west of bayou and south of golf course pro shop in "2500 Area".

Project No.
722450

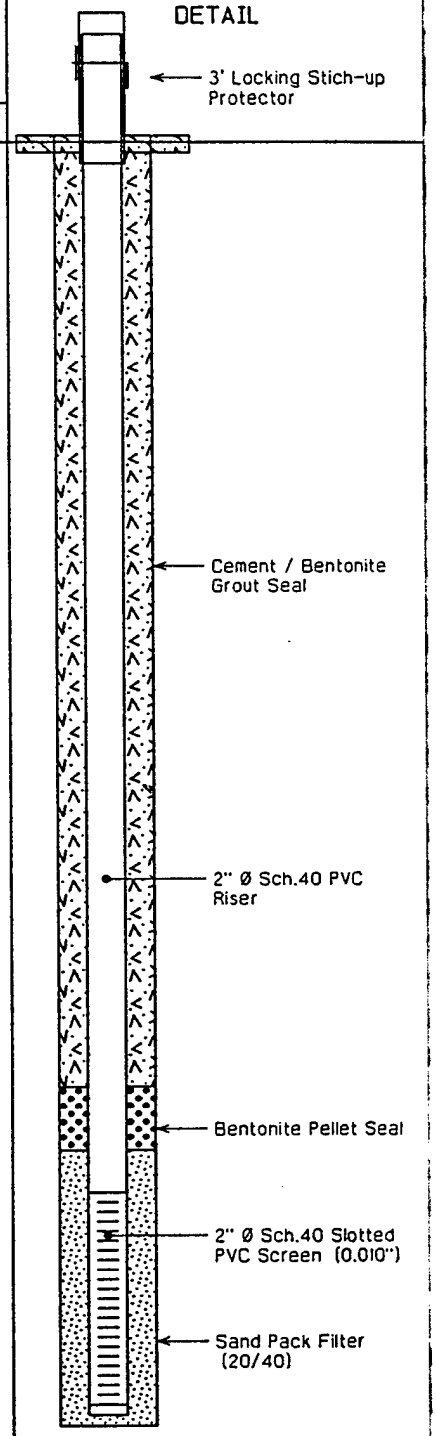
Monitoring Well No. Well #5

PROJECT: England AFB Phase II Drilling
LOGGED BY: David White
DRILLING COMPANY: Geo Engineering/Warren Drilling

DATE: 2/4/99
NORTHING: 237820.9884
EASTING: 1990733.8525

WELL HOLE DIA: 8" OD
DRILLING METHOD: Wet Rotary
HOLE ELEV.: 85.50 ft. MSL

DESCRIPTION	USCS CLASS	GRAPHIC LOG	DEPTH	SAMPLE	FID
0'-4' - SILT: brown, moist, non-plastic, rootlets present, 25%-30% clay and sand.	ML		0		
4'-7' - CLAY: brown, medium stiff, plastic, 25% sand, slightly moist.	CL		5		
7'-13' - SILT: brown, semi-plastic, 30% clay and sand, wet.	ML		10		0
13'-24' - CLAY: brown to reddish brown, stiff to very stiff, plastic, moist, 10% sand.	CL		15		
18'-18.5' Wood layer	CL		20		0
24'-61' - SAND: light brown to light gray, very fine to fine, unconsolidated, saturated.	SP		25		
			30		0
			35		
42'-44' Thin CLAY layer			40		0
			45		
			50		0
56'-60' small amount of gravel present in cuttings, larger sand grain size.			55		
			60		0
Bottom of boring at 61 feet.					



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Notes:
Monitor well #5 is located west of Billy Mitchell Blvd. on the golf course across from building 2505 in the "2500 Area"

Project No.
722450

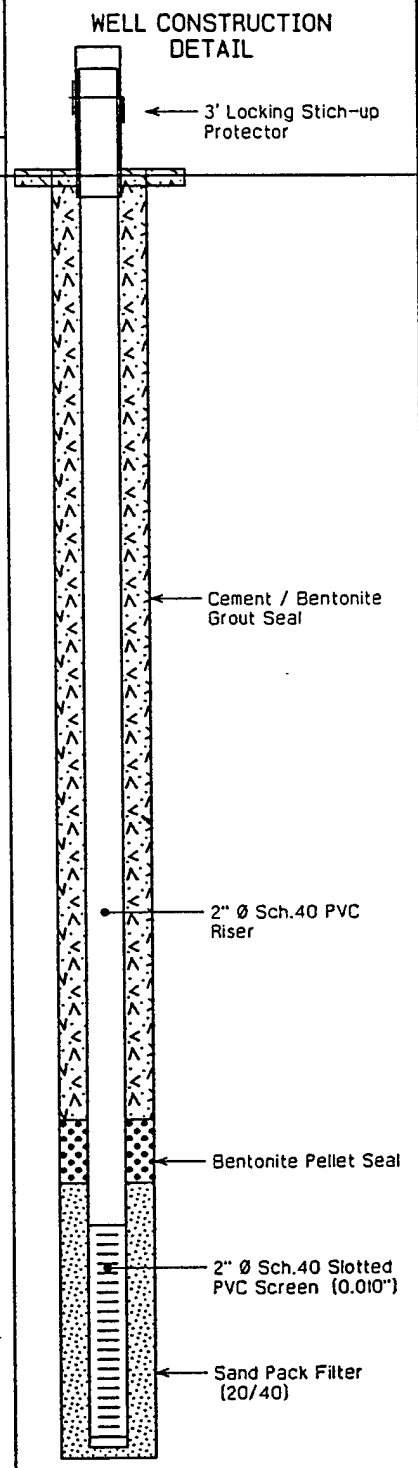
Monitoring Well No. Well #6

PROJECT: England AFB Phase II Drilling
LOGGED BY: David White
DRILLING COMPANY: Geo Engineering/Warren Drilling

DATE: 2/2/99
NORTHING: 236910.9112
EASTING: 1990843.9439

WELL HOLE DIA: 8" OD
DRILLING METHOD: Wet Rotary
HOLE ELEV.: 83.42 ft. MSL

DESCRIPTION	USCS CLASS	GRAPHIC LOG	DEPTH	SAMPLE	FID
0'-5' - SILT: brown, moist, non-plastic, rootlets present, 25%-30% clay and sand.	ML		0		
5'-7' - CLAY: brown, medium stiff, plastic, 25% sand, slightly moist.	CL		5		
6'-6.5' - Wood layer.	CL				
7'-13' - SILT: brown, semi-plastic, 30% clay and sand, wet.	ML		10		0
13'-28' - CLAY: brown to reddish brown, stiff to very stiff, plastic, moist, 10% sand.	CL		15		
			20		0
			25		
28'-61' - SAND: light brown to light gray, very fine to fine, unconsolidated, saturated.	SP		30		0
			35		
			40		0
			45		
			50		0
			55		
Bottom of boring at 61 feet.			60		0



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Notes:
Monitor well #6 is located south of Chanault Ave and southeast of building 2503 just west of golf course in "2500 Area".

Project No.
722450

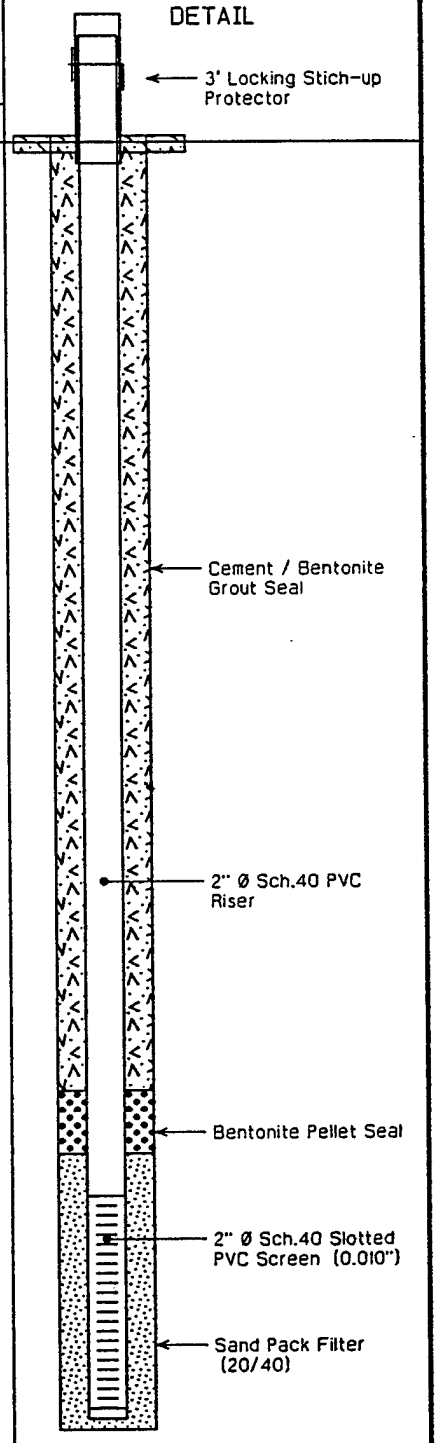
Monitoring Well No. Well #7

PROJECT: England AFB Phase II Drilling
LOGGED BY: David White
DRILLING COMPANY: Geo Engineering/Warren Drilling

DATE: 2/4/99
NORTHING: 236924.2460
EASTING: 1990282.6706

WELL HOLE DIA: 8" OD
DRILLING METHOD: Wet Rotary
HOLE ELEV.: 91.16 ft. MSL

DESCRIPTION	USCS CLASS	GRAPHIC LOG	DEPTH	SAMPLE	FID
0'-7' - SILT: brown, moist, non-plastic, rootlets present, 25%-30% clay and sand.	ML		0		
7'-9' - CLAY: brown, medium stiff, plastic, 25% sand, slightly moist.	CL		5		
7.5'-8' - Wood layer.	CL		10		0
9'-16' - SILT: brown, semi-plastic, 30% clay and sand, wet.	ML		15		
16'-44' - CLAY: brown to reddish brown, stiff to very stiff, plastic, moist, 10% sand.	CL		20		0
			25		
			30		0
			35		
			40		0
44'-61' - SAND: light brown to light gray, very fine to fine, unconsolidated, saturated.	SP		45		
			50		0
			55		
Bottom of boring at 61 feet.			60		0



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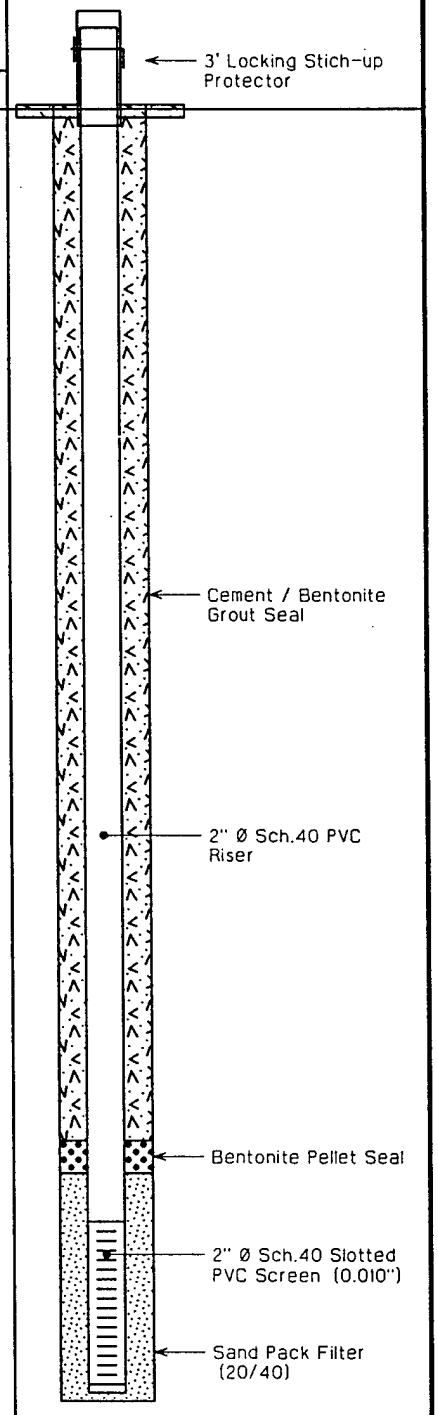
Notes:
Monitor well #7 is located southwest of the corner Chanault Ave. and Billy Mitchell Blvd in the "2500 Area".

Project No.
722450

Monitoring Well No. Well #8

PROJECT: England AFB Phase II Drilling
DATE: 7/12-13/99
WELL HOLE DIA: 8" OD
LOGGED BY: David White
NORTHING: in.
DRILLING METHOD: Wet Rotary
DRILLING COMPANY: Geo Engineering/Warren Drilling ft.
EASTING: ft.
HOLE ELEV.: ft. MSL

DESCRIPTION	USCS CLASS	DEPTH	FID
0'-8.9' - SILT: brown to reddish brown, non-plastic, rootlets present in upper 1 foot, dry.	ML	0	
8.9'-9.2' - SAND: reddish brown, moist, very fine grain, 30% silt.	SM	10	0
9.2'-10' - CLAY: dark brown, stiff, plastic, moist, 20% sand.	CL		
10'-11.3' - SILT: tan to reddish brown, non-plastic, moist, 20- 25% very fine grained sand.	ML	15	
11.3'-13' - SAND: reddish brown, very fine to fine grained, wet, 20% silt.	SM		
13'-14' - CLAY: dark brown, stiff, plastic, moist.	CL	20	0
14'-15.2' - SAND: dark reddish brown, very fine grained, wet, 30% silt.	SM		
15.2'-15.9' - SILT: red to reddish brown, non-plastic, moist, soft, 30% very fine grained sand.	ML	25	
15.9'-18' - SAND: dark reddish brown, very fine grained, wet, 30% silt.	SM		
18'-48.6' - CLAY: brown to reddish brown, stiff to very stiff, plastic, moist.	CL	30	0
little light gray mottling from 26 to 34			
color change to light gray at 34 feet		35	
color change back to brown to reddish brown at 38 feet			
color change to light gray, clay very stiff at 40.7 feet		40	0
48.6'-78' - SAND: tan to light gray, very fine to fine, unconsolidated, saturated.	SP	45	
		50	0
		55	
		60	0
		65	
wood fragments found in sample from 76-78 feet		70	0
		75	
78'-80'- CLAY: light gray, stiff, plastic, moist, 25% very fine sand.	CL	80	0
Bottom of boring at 80 feet.			



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Notes:
Monitor well #8 is located on the southwest corner of the hospital south parking lot in grassy field in the "2500 Area".

Project No.
722450

GEOTECHNICAL LOGGING REPORT

Well #10

CLIENT *AFCEE*
PROJECT *England AFB*
LOCATION *Alexandria, La*
DRILL CONTRACTOR *Layne Western*
DRILL METHOD *Percussion Hammer*
SAMPLE METHOD *Cuttings*

PROJECT NUMBER *730486*
DATE DRILLED *8/23/98*
BOREHOLE DIAMETER *8 in.*
SURFACE ELEVATION *ft. MSL*
WATER LEVEL *15.05 ft.*
LOGGED BY *David White*

DEPTH (feet)	(meters)	WELL TEST LOGS: Borehole Flowmeter Log (1.0 to -0.20)	WELL TEST LOGS: Gamma Log (100)	Sample Number	cis-DCE (ppb)	VC (ppb)	GRAPHIC LOG	USCS	SOIL DESCRIPTION	CONTACT ELEVATION
0								ML	0'-4' - SILT: light brown, dry, non-plastic, rootlets present, 30% clay.	
5										-4
10								CL	4'-16' - CLAY: dark brown, stiff, plastic, 25% sand, moist.	
15	5								few semi-consolidated silt nodules present from 13-18 feet.	
20										-18
								ML	16'-21' - SILT: brown, semi-plastic, 30% sand, wet.	
25										-21
30	10							CH	21'-41' - CLAY: brown, stiff to very stiff, plastic, moist, <10% sand.	
35										
40									color change to light gray/brown mottled.	
										-41
45								SP	41'-100' - SAND: light brown to light gray, very fine to fine, unconsolidated, heeving, saturated.	
50	15									
55										
60				55-65	1.8	ND				
65	20									
70										
75				68-78	1.7	ND				
80										
85	25									
90										
95										
100	30									-100
								CH	100'-102' - CLAY: dark brown/olive green mottled, very stiff, plastic, moist, 20% sand.	-102
105									*Bottom of boring at 102 feet.*	

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WELL CONSTRUCTION LOG

PROJECT	PROJECT NUMBER	WELL NUMBER
England AFB	730486	Well#10

SITE	COORDINATES	GROUND SURFACE ELEVATION	CASING STICKUP
Alexandria, LA	239932.2042 / 1988550.181		-1.5

Soil Boring Cross-Reference Well#10
Town and City Alexandria
County and State Rapides, LA

Installation Date (s) 8/23/98

Drilling Method AP-1000 Percussion Hammer
Drilling Contractor
Drilling Fluid Water used to assist heaving sand.

Development Technique (s) / Dates
Completed prior to initial ground water sampling.

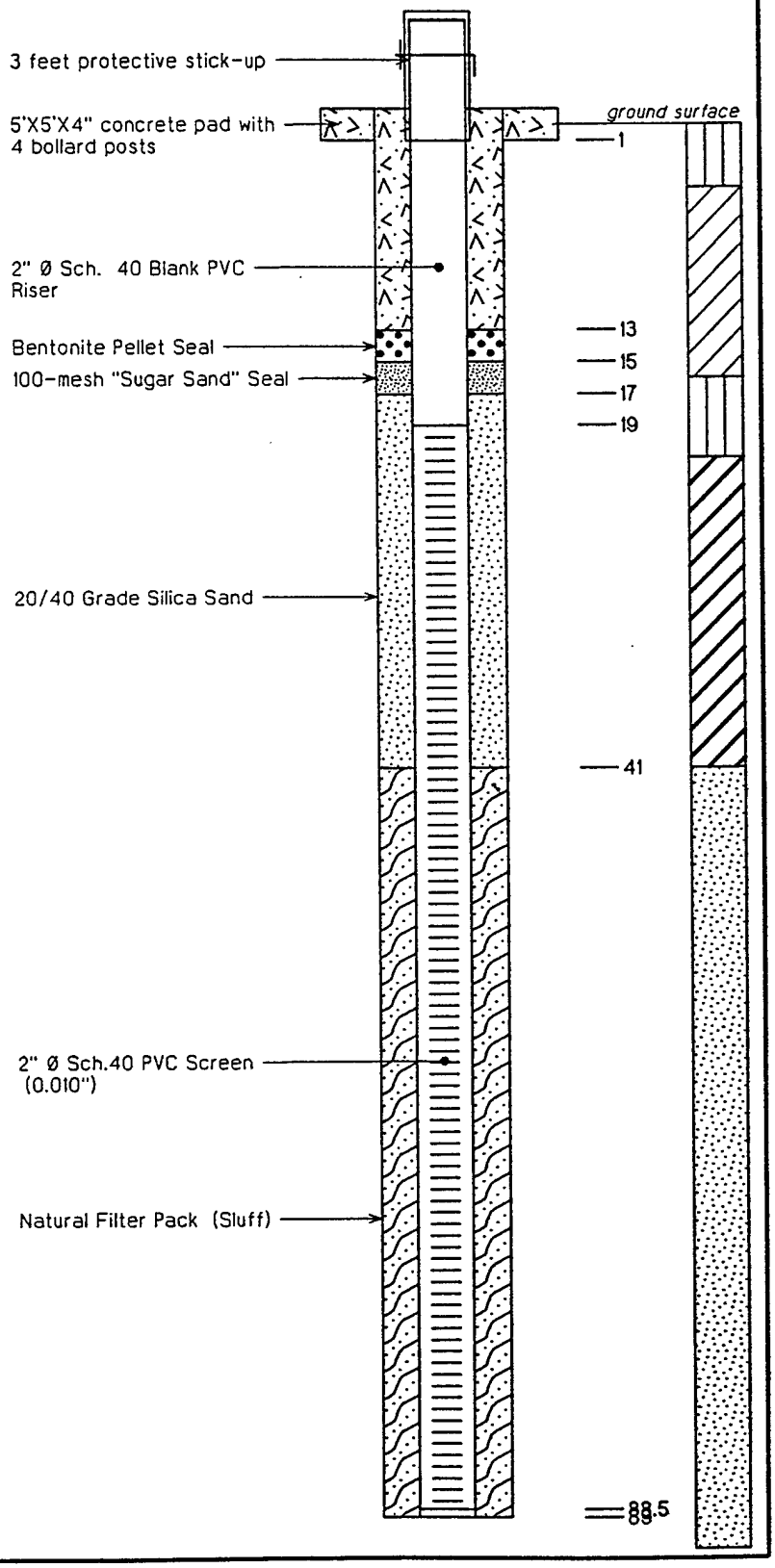
Fluid Loss During Drilling (gals)
Water Removed During Development (gals)
270 - 8/25/98

Static Depth to Water Date 9/1/98
Static Depth to Water (feet) 15.05

Well Purpose Monitoring ground water.

Remarks Monitor well was screened across entire saturated zone.
Tests run on well:
Sample for VOC 8260B
Electromagnetic Borehole Floweter
Gamma Log with Resistivity

Prepared By D. White
Date Prepared 10/9/98



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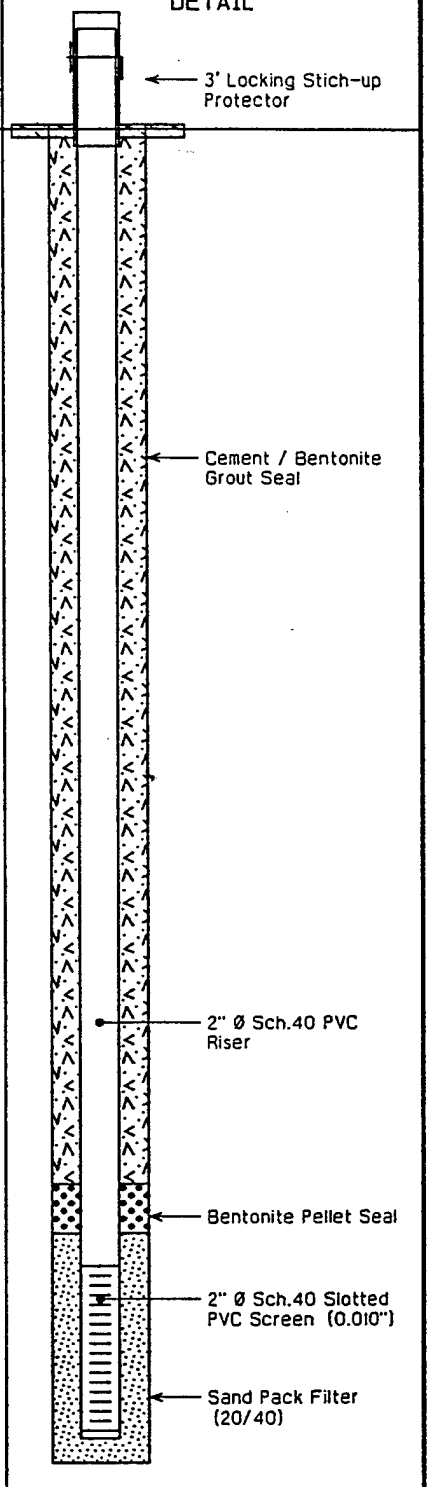
Monitoring Well No. Well #11

PROJECT: England AFB Phase II Drilling
LOGGED BY: David White
DRILLING COMPANY: Geo Engineering/Warren Drilling

DATE: 1/23/99
NORTHING: 240021.4188
EASTING: 1988070.1551

WELL HOLE DIA: 8" OD
DRILLING METHOD: Wet Rotary
HOLE ELEV.: 86.88 ft. MSL

DESCRIPTION	USCS CLASS
0'-5' - SILT: light brown to red, dry non-plastic, rootlets present, 30% clay.	ML
5'-15' - CLAY: dark brown to red, stiff, plastic, 25% sand, slightly moist.	CL
15'-18' - SILT: brown, semi-plastic, 30% clay and sand, wet.	ML
18'-38' - CLAY: brown to reddish brown, stiff to very stiff, plastic, moist, 10% sand.	CL
38'-80' - SAND: light brown to light gray, very fine to fine, unconsolidated, saturated.	SP
67'-69' small amount of gravel present in cutting, larger sand grain size.	
70'-71' 1 foot layer of wood.	SP
Bottom of boring at 80 feet.	



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Houston, Texas

Notes:
Monitor well #11 is located north of building 804 and just south of the drainage ditch in the "800 Area".

Project No.
722450

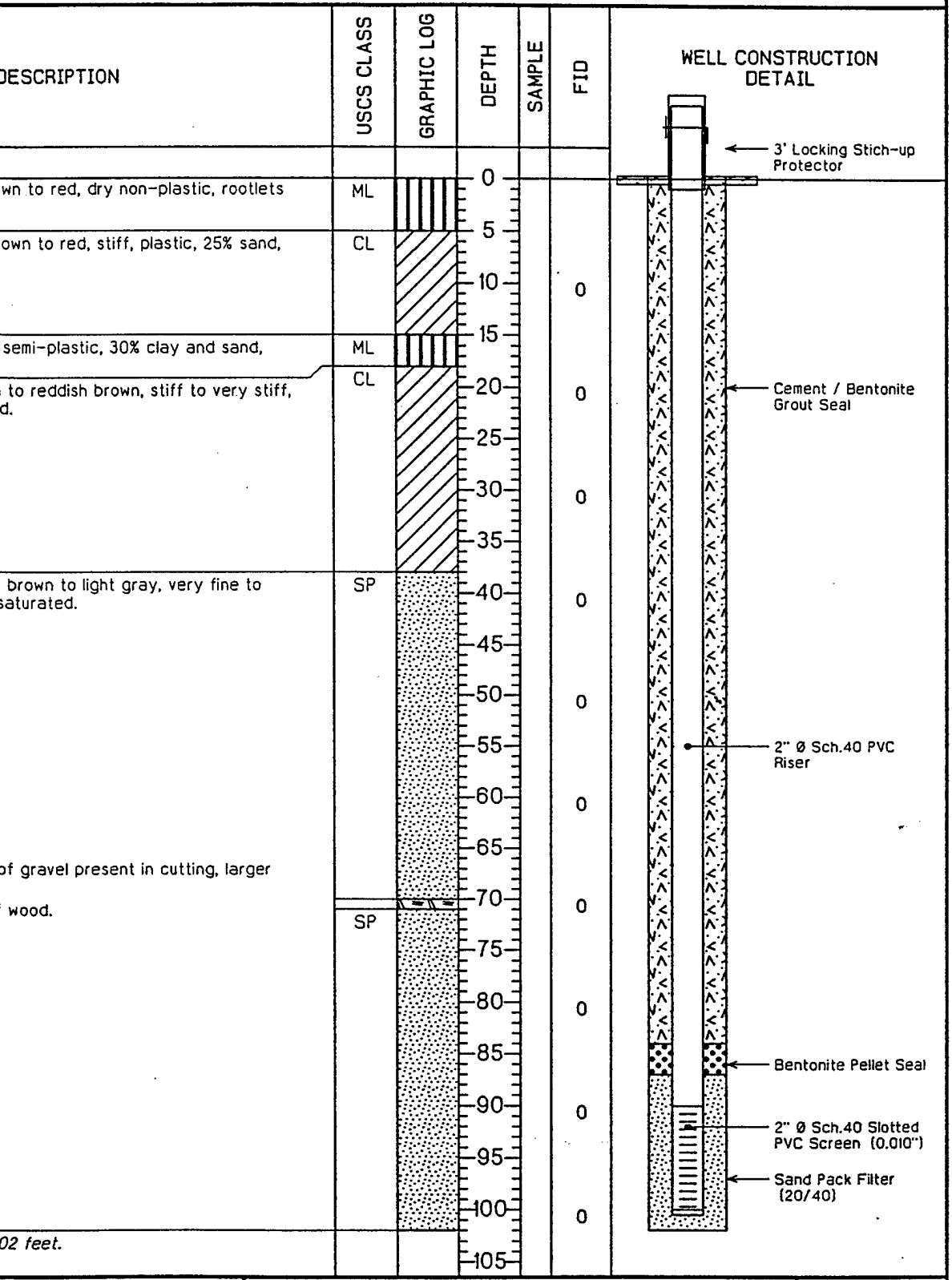
Monitoring Well No. Well #12

PROJECT: England AFB Phase II Drilling
LOGGED BY: David White
DRILLING COMPANY: Geo Engineering/Warren Drilling

DATE: 1/23/99
NORTHING: 240028.6456
EASTING: 1988082.9627

WELL HOLE DIA: 8" OD
DRILLING METHOD: Wet Rotary
HOLE ELEV.: 87.35 ft. MSL

DESCRIPTION	USCS CLASS
0'–5' – SILT: light brown to red, dry non-plastic, rootlets present, 30% clay.	ML
5'–15' – CLAY: dark brown to red, stiff, plastic, 25% sand, slightly moist.	CL
15'–18' – SILT: brown, semi-plastic, 30% clay and sand, wet.	ML
18'–38' – CLAY: brown to reddish brown, stiff to very stiff, plastic, moist, 10% sand.	CL
38'–102' – SAND: light brown to light gray, very fine to fine, unconsolidated, saturated.	SP
67'–69' small amount of gravel present in cutting, larger sand grain size.	
70'–71' 1 foot layer of wood.	SP
Bottom of boring at 102 feet.	



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Notes:
Monitor well #12 is located north of building 804 and just south of the drainage ditch in the "800 Area".

Project No.
722450

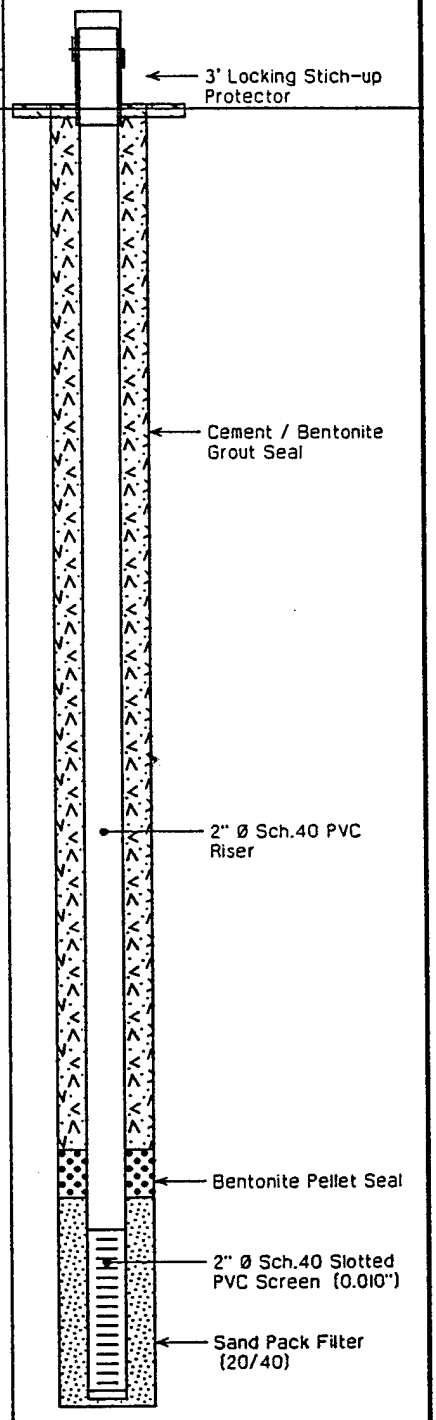
Monitoring Well No. Well #13

PROJECT: England AFB Phase II Drilling
LOGGED BY: David White
DRILLING COMPANY: Geo Engineering/Warren Drilling

DATE: 1/21/99
NORTHING: 240491.5534
EASTING: 1988661.2809

WELL HOLE DIA: 8" OD
DRILLING METHOD: Wet Rotary
HOLE ELEV.: 87.38 ft. MSL

DESCRIPTION	USCS CLASS	GRAPHIC LOG	DEPTH	SAMPLE	FID
0'-5' - SILT: light brown to red, dry non-plastic, rootlets present, 30% clay.	ML		0		
5'-14' - CLAY: dark brown to red, stiff, plastic, 25% sand, slightly moist.	CL		5		0
14'-20' - SILT: brown, semi-plastic, 30% clay and sand, wet.	ML		10		0
20'-41' - CLAY: brown to reddish brown, stiff to very stiff, plastic, moist, 10% sand.	CL		15		0
clay color change to light gray/brown mottled.			20		0
41'-81' - SAND: light brown to light gray, very fine to fine, unconsolidated, saturated.	SP		25		0
68'-72' small amount of gravel present in cuttings, larger sand grain size.			30		0
Bottom of boring at 81 feet.			35		0
			40		0
			45		0
			50		0
			55		0
			60		0
			65		0
			70		0
			75		0
			80		0



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Houston, Texas

Notes:
Monitor well #13 is located due west of building 1221 and east of building 806 within the "800 Area".

Project No.
722450

Monitoring Well No. Well #14

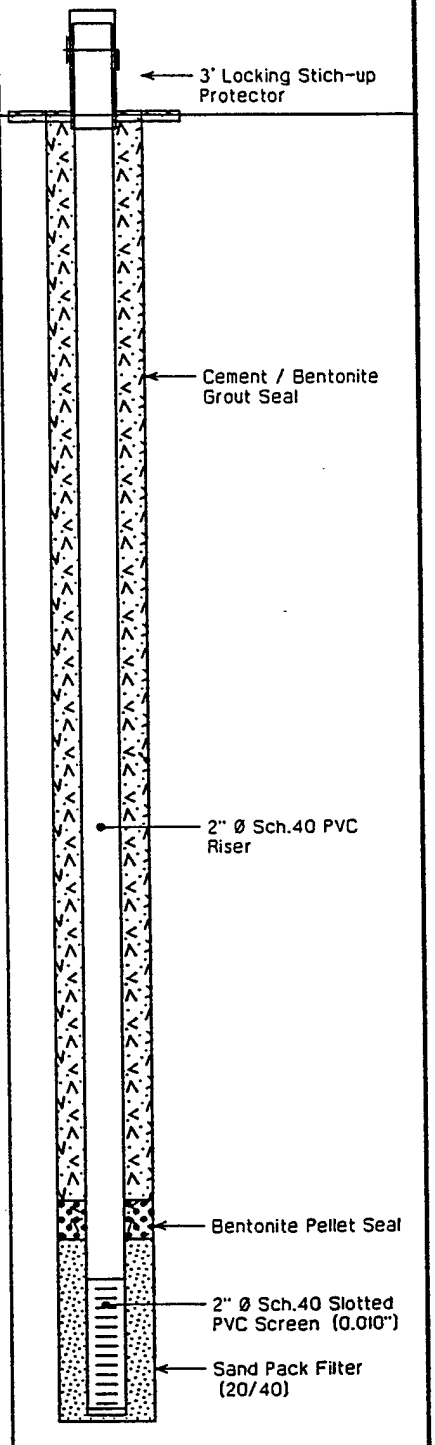
PROJECT: England AFB Phase II Drilling
LOGGED BY: David White
DRILLING COMPANY: Geo Engineering/Warren Drilling

DATE: 1/24/99
NORTHING: 240393.7464
EASTING: 1988274.3133

WELL HOLE DIA: 8" OD
DRILLING METHOD: Wet Rotary
HOLE ELEV.: 86.31 ft. MSL

DESCRIPTION	USCS CLASS
0'-4' - SILT: light brown to red, dry non-plastic, rootlets present, 30% clay.	ML
4'-14' - CLAY: dark brown to red, stiff, plastic, 25% sand, slightly moist.	CL
14'-18' - SILT: brown, semi-plastic, 30% clay and sand, wet.	ML
18'-32' - CLAY: brown to reddish brown, stiff to very stiff, plastic, moist, 10% sand.	CL
32'-101' - SAND: light brown to light gray, very fine to fine, unconsolidated, saturated.	SP
Bottom of boring at 101 feet.	

GRAPHIC LOG | DEPTH | SAMPLE | FID



PARSONS
Engineering Science
Houston, Texas

Notes:
Monitor well #14 is located on the southwest corner of building 814 in the "800 Area".

Project No.
722450

Monitoring Well No. Well #15

PROJECT: England AFB Phase II Drilling
LOGGED BY: David White
DRILLING COMPANY: Geo Engineering/Warren Drilling

DATE: 1/24/99
NORTHING: 240384.1721
EASTING: 1988258.4773

WELL HOLE DIA: 8" OD
DRILLING METHOD: Wet Rotary
HOLE ELEV.: 86.77 ft. MSL

DESCRIPTION	USCS CLASS
0'-4' - SILT: light brown to red, dry non-plastic, rootlets present, 30% clay.	ML
4'-14' - CLAY: dark brown to red, stiff, plastic, 25% sand, slightly moist.	CL
14'-18' - SILT: brown, semi-plastic, 30% clay and sand, wet.	ML
18'-32' - CLAY: brown to reddish brown, stiff to very stiff, plastic, moist, 10% sand.	CL
32'-71' - SAND: light brown to light gray, very fine to fine, unconsolidated, saturated.	SP
Bottom of boring at 71 feet.	

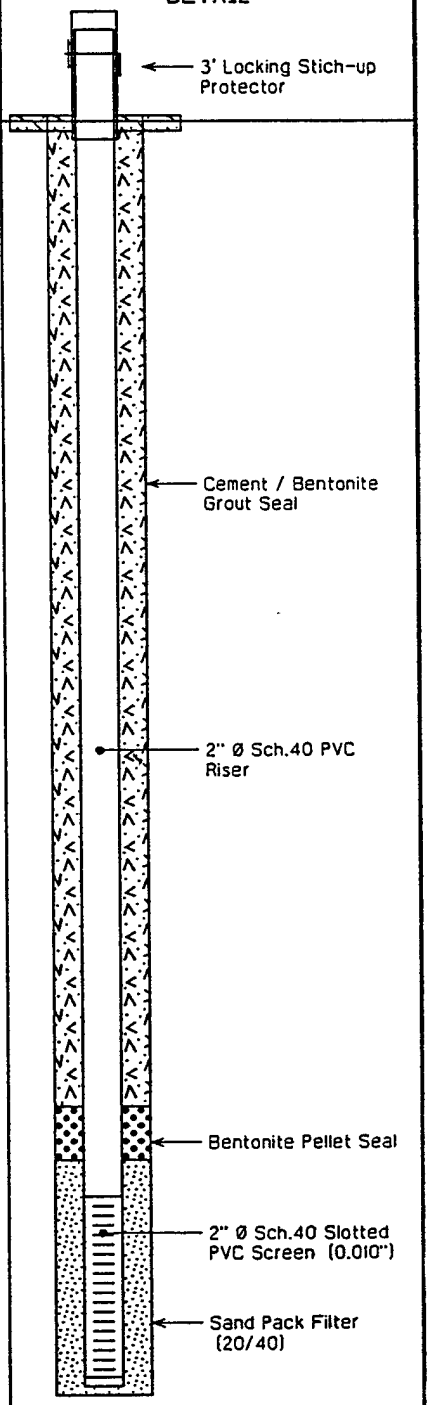
GRAPHIC LOG

DEPTH: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75

SAMPLE

FID: 0, 0, 0, 0, 0, 0, 0

WELL CONSTRUCTION DETAIL



PARSONS
Engineering Science
Houston, Texas

Notes:
Monitor well #15 is located on the southwest corner of building 814 in the "800 Area".

Project No.
722450

Monitoring Well No. Well #16

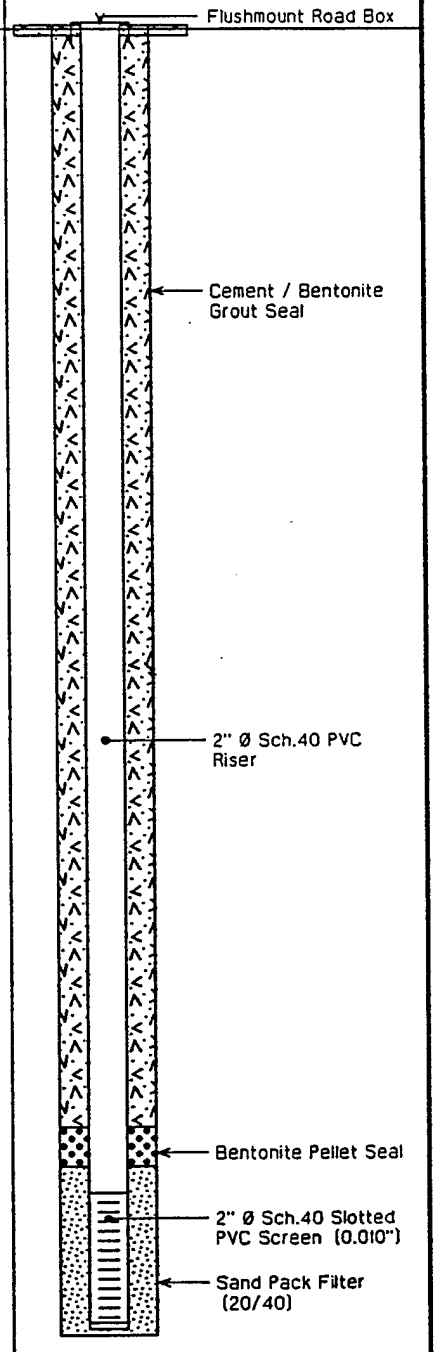
PROJECT: England AFB Phase II Drilling
LOGGED BY: David White
DRILLING COMPANY: Geo Engineering/Warren Drilling

DATE: 1/22/99
NORTHING: 241095.7838
EASTING: 1988156.4034

WELL HOLE DIA: 8" OD
DRILLING METHOD: Wet Rotary
HOLE ELEV.: 81.56 ft. MSL

DESCRIPTION	USCS CLASS	GRAPHIC LOG	DEPTH	SAMPLE	FID
0'-5' - SILT: light brown to red, dry non-plastic, rootlets present, 30% clay.	ML		0		
5'-14' - CLAY: dark brown to red, stiff, plastic, 25% sand, slightly moist.	CL		5		0
14'-18' - SILT: brown, semi-plastic, 30% clay and sand, wet.	ML		10		0
18'-43' - CLAY: brown to reddish brown, stiff to very stiff, plastic, moist, 10% sand.	CL		15		0
43'-101' - SAND: light brown to light gray, very fine to fine, unconsolidated, saturated.	SP		20		0
55'-56' 1 foot layer of wood.	SP		25		0
70'-80' small amount of gravel present in cuttings, larger sand grain size.			30		0
			35		0
			40		0
			45		0
			50		0
			55		0
			60		0
			65		0
			70		0
			75		0
			80		0
			85		0
			90		0
			95		0
Bottom of boring at 101 feet.			100		0

WELL CONSTRUCTION DETAIL



PARSONS
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Notes:
Monitor well #16 is located between the north cargo ramp and the the North Ramp in the "800 Area".

Project No.
722450

Page 1 of 1

Monitoring Well No. Well #17

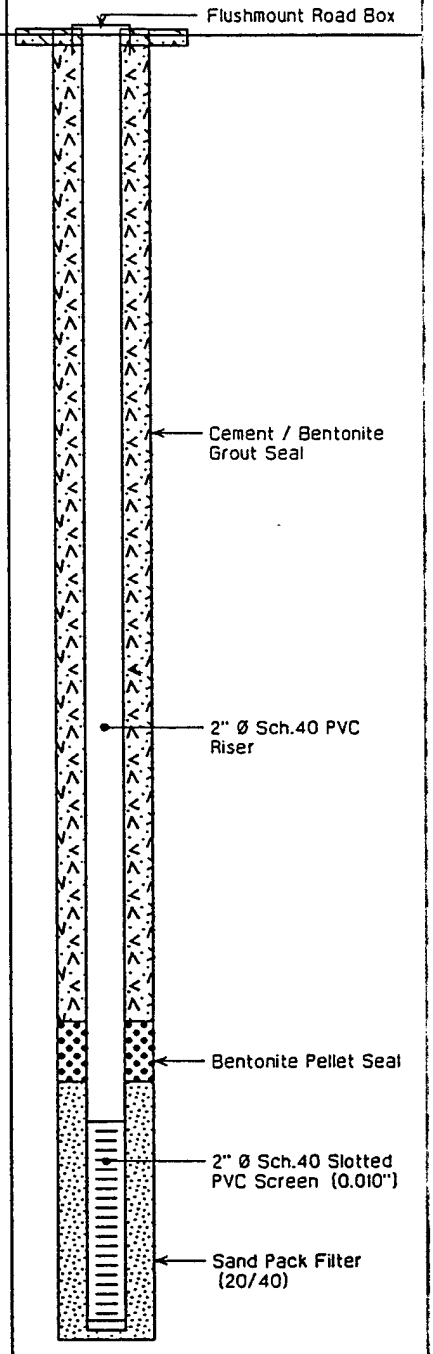
PROJECT: England AFB Phase II Drilling
LOGGED BY: David White
DRILLING COMPANY: Geo Engineering/Warren Drilling

DATE: 1/24/99
NORTHING: 241118.2153
EASTING: 1988517.5491

WELL HOLE DIA: 8" OD
DRILLING METHOD: Wet Rotary
HOLE ELEV.: 83.93 ft. MSL

DESCRIPTION	USCS CLASS	GRAPHIC LOG	DEPTH	SAMPLE	FID
0'-5' - SILT: light brown to red, dry non-plastic, rootlets present, 30% clay.	ML		0		
5'-15' - CLAY: dark brown to red, stiff, plastic, 25% sand, slightly moist.	CL		5		
			10		0
15'-19' - SILT: brown, semi-plastic, 30% clay and sand, wet.	ML		15		
19'-31' - CLAY: brown to reddish brown, stiff to very stiff, plastic, moist, 10% sand.	CL		20		0
			25		
31'-66' - SAND: light brown to light gray, very fine to fine, unconsolidated, saturated.	SP		30		0
			35		
			40		0
			45		
			50		0
56'-57' 1 foot layer of wood.			55		
	SP		60		0
63'-66' small amount of gravel present in cuttings, larger sand grain size.			65		
Bottom of boring at 66 feet.					

WELL CONSTRUCTION DETAIL



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Engineering Science
Houston, Texas

Notes:
Monitor well #17 is located between the north cargo ramp and the the North Ramp in the "800 Area".

Project No.
722450

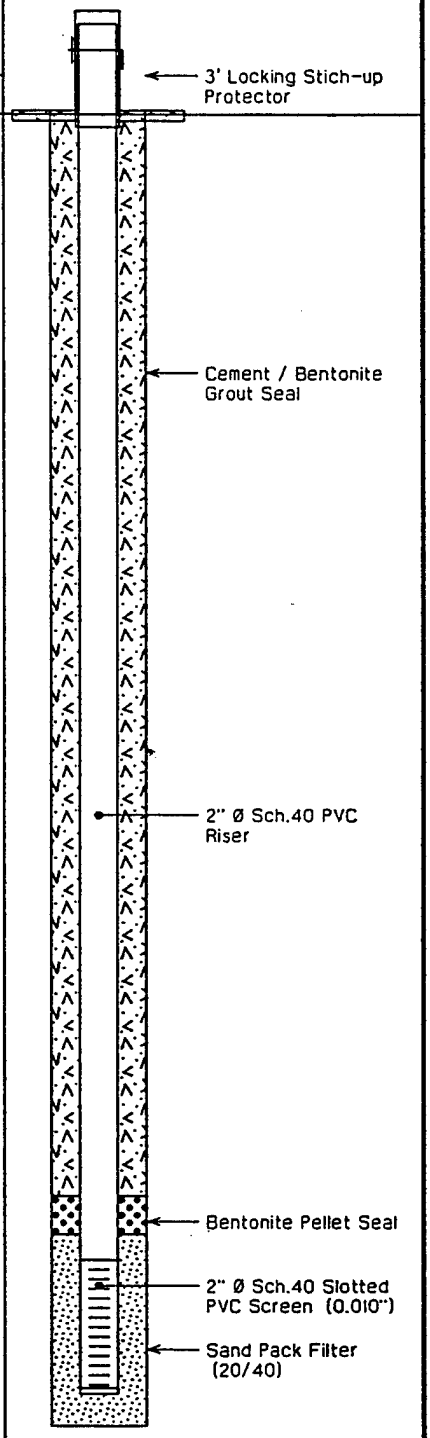
Monitoring Well No. Well #18

PROJECT: England AFB Phase II Drilling
LOGGED BY: David White
DRILLING COMPANY: Geo Engineering/Warren Drilling

DATE: 1/22/99
NORTHING: 241239.7776
EASTING: 1987610.9854

WELL HOLE DIA: 8" OD
DRILLING METHOD: Wet Rotary
HOLE ELEV.: 85.05 ft. MSL

DESCRIPTION	USCS CLASS	GRAPHIC LOG	DEPTH	SAMPLE	FID
0'–5' – SILT: light brown to red, dry non-plastic, rootlets present, 30% clay.	ML		0		
5'–13' – CLAY: dark brown to red, stiff, plastic, 25% sand, slightly moist.	CL		5		0
13'–16' – SILT: brown, semi-plastic, 30% clay and sand, wet.	ML		10		
16'–31' – CLAY: brown to reddish brown, stiff to very stiff, plastic, moist, 10% sand.	CL		15		0
31'–103' – SAND: light brown to light gray, very fine to fine, unconsolidated, saturated.	SP		20		
57'–58' 1 foot layer of wood.	SP		25		0
73'–85' small amount of gravel present in cuttings, larger sand grain size.			30		
Bottom of boring at 103 feet.			35		0
			40		
			45		0
			50		
			55		0
			60		
			65		0
			70		
			75		0
			80		
			85		0
			90		
			95		0
			100		
			105		0



PARSONS
Engineering Science
Houston, Texas

Notes:
Monitor well #18 is located between buildings 2403 and 2404 along the north cargo ramp in the "800 Area".

Project No.
722450

Monitoring Well No. Well #19

PROJECT: England AFB Phase II Drilling
LOGGED BY: David White
DRILLING COMPANY: Geo Engineering/Warren Drilling

DATE: 1/22/99
NORTHING: 241223.8343
EASTING: 1987589.5080

WELL HOLE DIA: 8" OD
DRILLING METHOD: Wet Rotary
HOLE ELEV.: 85.26 ft. MSL

DESCRIPTION	USCS CLASS
0'-5' - SILT: light brown to red, dry non-plastic, rootlets present, 30% clay.	ML
5'-13' - CLAY: dark brown to red, stiff, plastic, 25% sand, slightly moist.	CL
13'-16' - SILT: brown, semi-plastic, 30% clay and sand, wet.	ML
16'-31' - CLAY: brown to reddish brown, stiff to very stiff, plastic, moist, 10% sand.	CL
31'-81' - SAND: light brown to light gray, very fine to fine, unconsolidated, saturated.	SP
57'-58' 1 foot layer of wood.	SP
73'-85' small amount of gravel present in cuttings, larger sand grain size.	
Bottom of boring at 81 feet.	

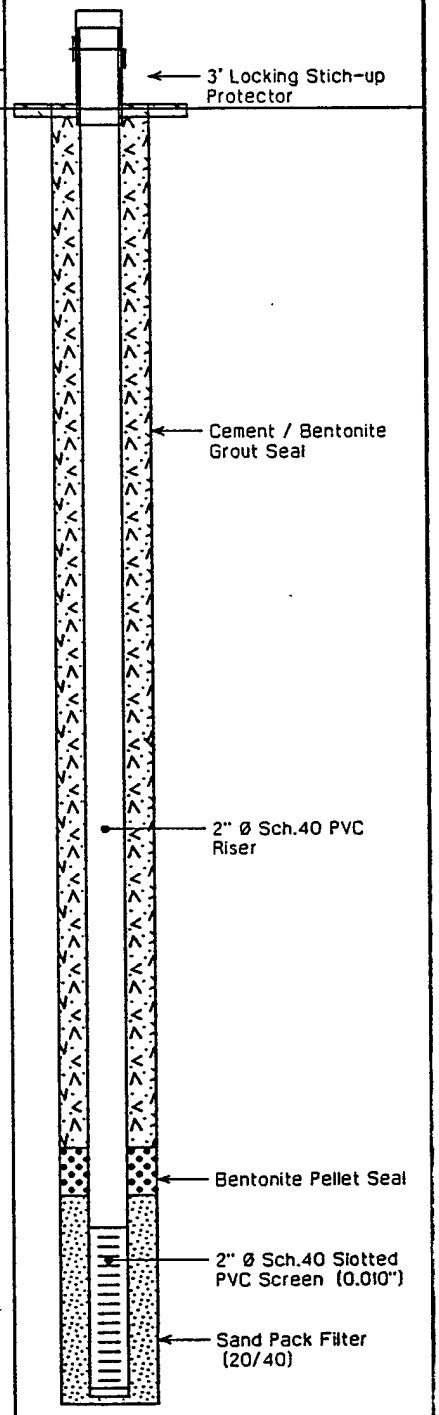
GRAPHIC LOG

DEPTH: 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80

SAMPLE

FID: 0, 0, 0, 0, 0, 0, 0

WELL CONSTRUCTION DETAIL



PARSONS
Engineering Science
Houston, Texas

Notes:
Monitor well #19 is located between buildings 2403 and 2404 along the north cargo ramp in the "800 Area".

Project No.
722450

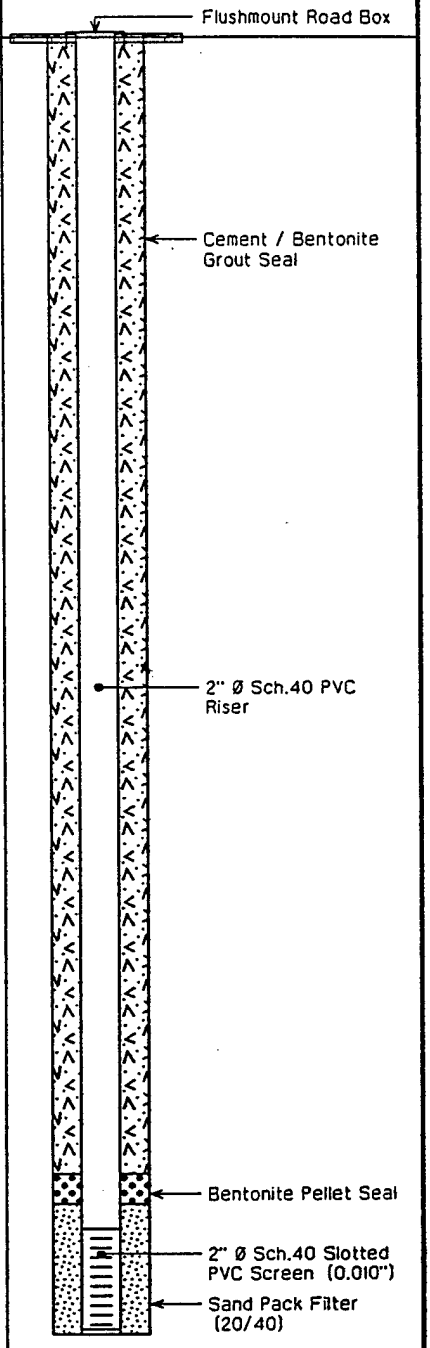
Monitoring Well No. Well #20

PROJECT: England AFB Phase II Drilling
LOGGED BY: David White
DRILLING COMPANY: Geo Engineering/Warren Drilling

DATE: 1/22/99
NORTHING: 241030.4841
EASTING: 1988244.3258

WELL HOLE DIA: 8" OD
DRILLING METHOD: Wet Rotary
HOLE ELEV.: 82.17 ft. MSL

DESCRIPTION	USCS CLASS	GRAPHIC LOG	DEPTH	SAMPLE	FID
0'–5' – SILT: light brown to red, dry non-plastic, rootlets present, 30% clay.	ML		0		
5'–14' – CLAY: dark brown to red, stiff, plastic, 25% sand, slightly moist.	CL		5		0
14'–18' – SILT: brown, semi-plastic, 30% clay and sand, wet.	ML		10		
18'–31' – CLAY: brown to reddish brown, stiff to very stiff, plastic, moist, 10% sand.	CL		15		0
31'–128' – SAND: light brown to light gray, very fine to fine, unconsolidated, saturated.	SP		20		
56'–57' 1 foot layer of wood.			25		0
	SP		30		
75'–86' small amount of gravel present in cuttings, larger sand grain size.			35		0
			40		
			45		0
			50		
			55		0
			60		
			65		0
			70		
			75		0
			80		
			85		0
			90		
			95		0
			100		
			105		0
			110		
			115		0
			120		
			125		0
128'–130' – CLAY: blue/gray, stiff, plastic, moist "Miocene Clay"	CL		130		
Bottom of boring at 130 feet.			135		0



WELL CONSTRUCTION DETAIL

PARSONS
Engineering Science
Houston, Texas

Notes:
Monitor well #20 is located between the north cargo ramp and the the North Ramp in the "800 Area".

Project No.
722450

Monitoring Well No. Well #21

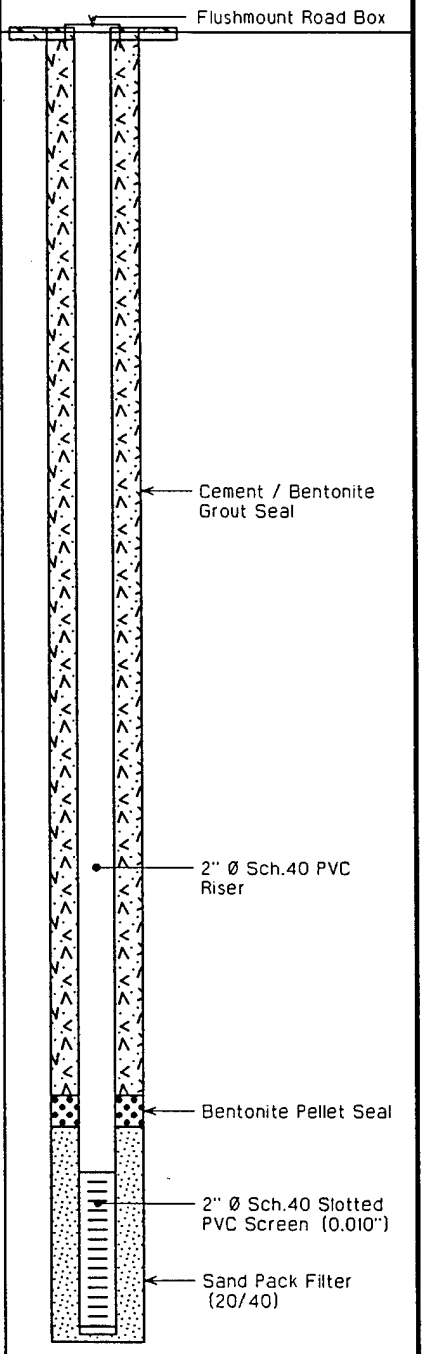
PROJECT: England AFB Phase II Drilling | **DATE:** 7/12/99 | **WELL HOLE DIA:** 8" OD

LOGGED BY: David White | **NORTHING:** in. | **DRILLING METHOD:** Wet Rotary

DRILLING COMPANY: Geo Engineering/Warren Drilling ft. | **EASTING:** ft. | **HOLE ELEV.:** ft. MSL

DESCRIPTION	USCS CLASS	GRAPHIC LOG	DEPTH	SAMPLE	FID
0'-2.4' - SILT: reddish brown, semi-plastic, moist, rootlets present in upper 1 foot, 30% clay.	ML		0		
2.4'-9.3' - CLAY: reddish brown, stiff, plastic, moist.	CL		5		
9.3'-13.2' - SILT: brown to reddish brown, semi-plastic, wet, 30% sand and clay. (First Water Bearing Zone)	ML		10		0
13.2'-35.9' - CLAY: brown to reddish brown, stiff to very stiff, plastic, moist, 10% sand.	CL		15		
			20		0
			25		
			30		0
32.8'-35.9' sand increasing with depth	CL		35		
35.9'-79.2' - SAND: light brown to light gray, very fine to fine, unconsolidated, saturated.	SP		40		0
			45		
			50		0
			55		
			60		0
			65		
70'-79.2 sand grain size increaing (coarse to fine)			70		0
			75		
79.2'-79.8' - CLAY: light gray, plastic, soft, 20-25% sand, moist.	CL		80		0
79.8'-85' - SAND: light brown to light gray, very fine to fine, unconsolidated, saturated.	SP		85		
Bottom of boring at 85 feet.					

WELL CONSTRUCTION DETAIL



PARSONS

Engineering Science
Houston, Texas

Notes:

Monitor well #21 is located east of the north cargo ramp and the the North Ramp in the "800 Area".

Project No.
722450

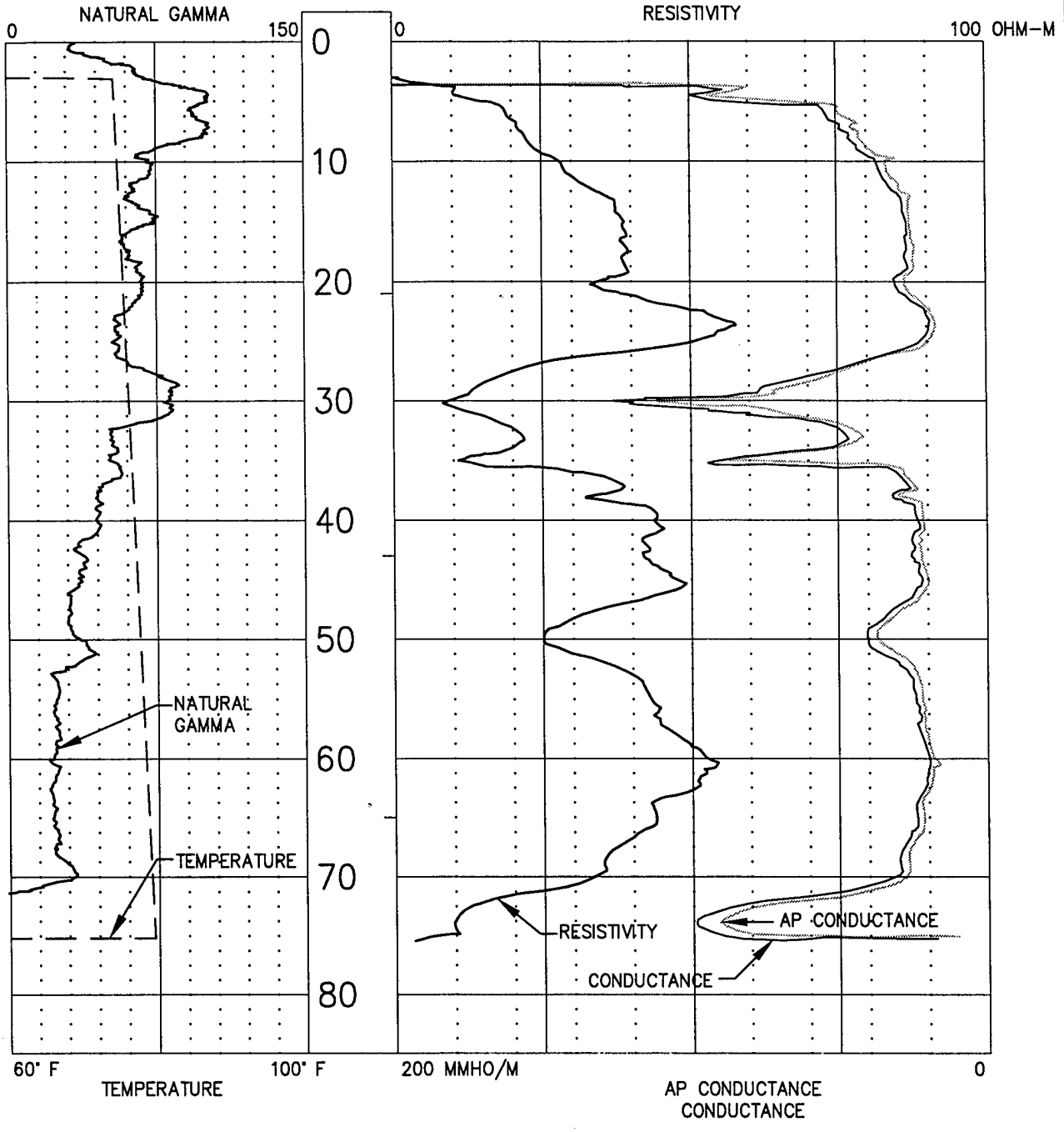


FIGURE X

GEOPHYSICAL LOGS OF WELL #1

Site SS-45
England AFB
Alexandria, Louisiana

PARSONS
PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

S:\ES\cad\AFCEE\730486\ENGLAND\99DN0567.dwg, 07/27/99 at 12:12

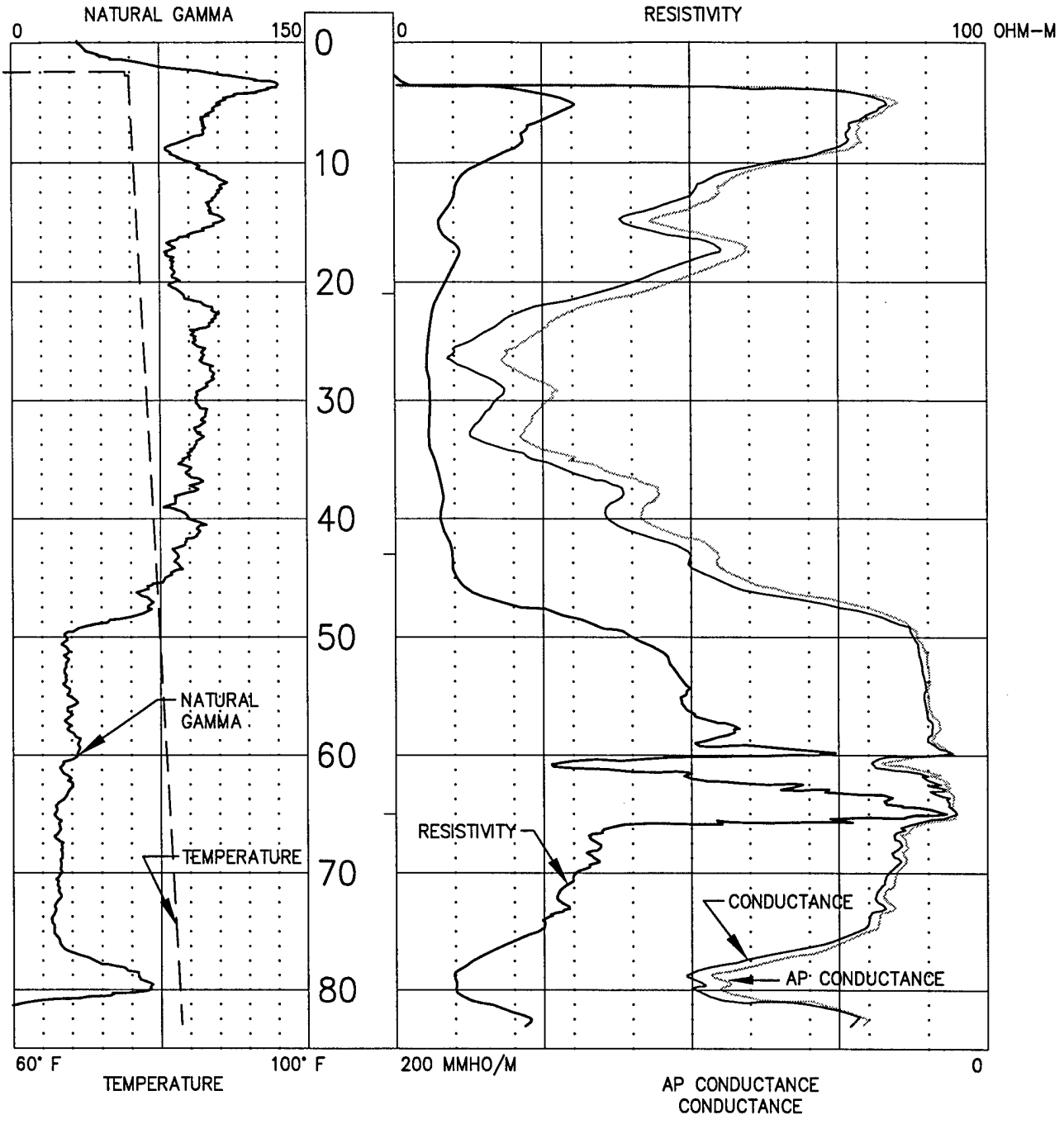


FIGURE X

GEOPHYSICAL LOGS OF WELL #2

Site SS-45
England AFB
Alexandria, Louisiana

PARSONS
PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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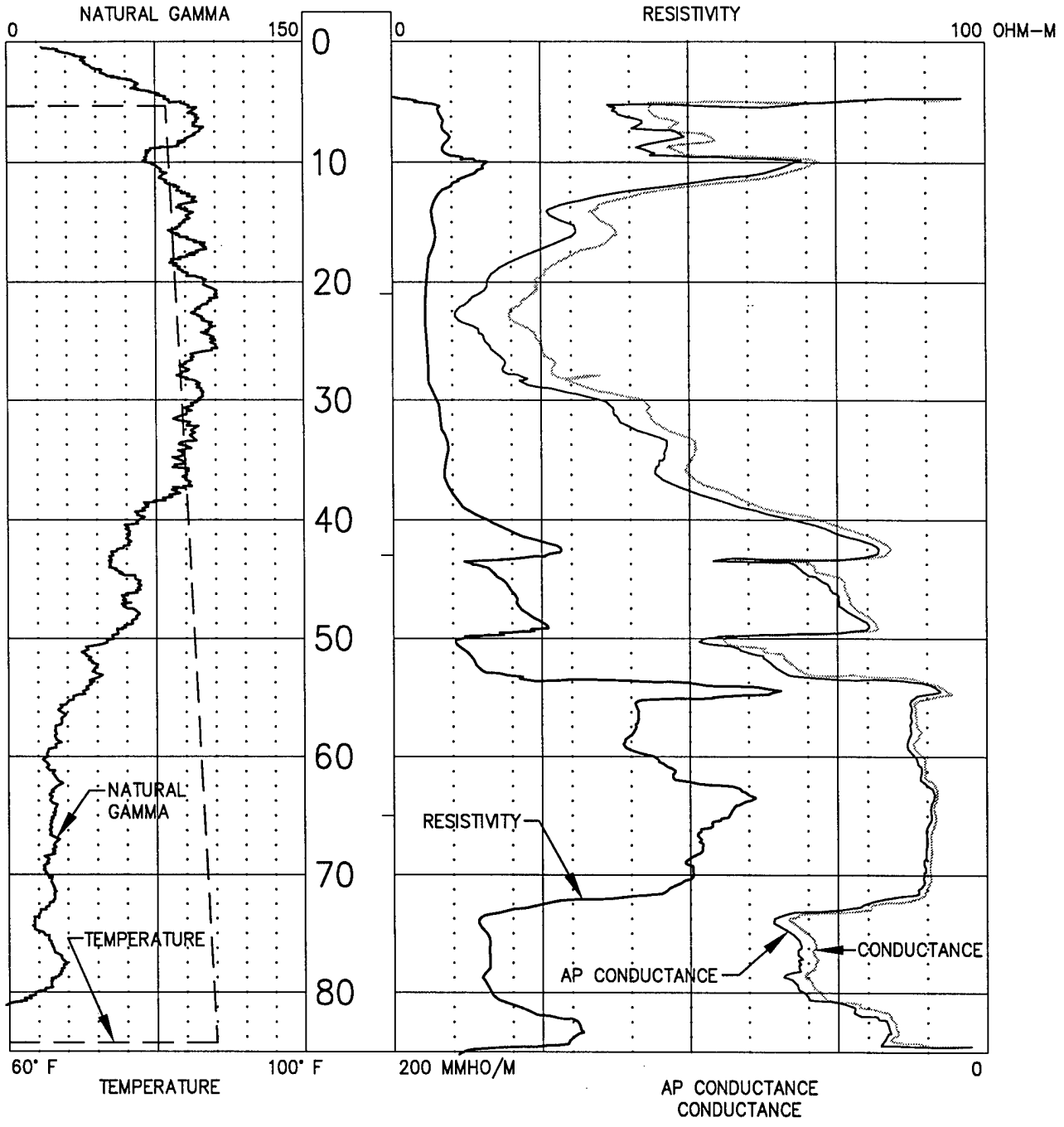


FIGURE X

GEOPHYSICAL LOGS OF WELL #10

Site SS-45
England AFB
Alexandria, Louisiana

PARSONS
PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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QEC

QEC - T - 125

Results of Field Tests with the Electromagnetic Borehole Flowmeter at the Former England Air Force Base Site Alexandria, LA

by

William R. Waldrop
and
Hubert S. Pearson

September 1998

Quantum Engineering Corporation
112 Tigitsi Lane, Tellico Village
Loudon, Tennessee 37774
Phone (423) 458-0506 FAX (423) 458-0504

Introduction

Quantum Engineering Corporation (QEC) conducted flowmeter tests at the former England Air Force Base (AFB) in Alexandria, Louisiana, to assist Parsons Engineering Science, Inc. in developing a groundwater remediation strategy. QEC specializes in flowmeter tests of the type conducted at this site.

The instrument system used, the Electromagnetic Borehole Flowmeter (EBF), is designed expressly for such tests as performed at the former England AFB site. The EBF was a spin-off of a groundwater research program previously conducted by QEC staff as employees of the Tennessee Valley Authority (TVA). The development team for the EBF built upon extensive experience of testing with an impeller meter used for flowmeter testing in the TVA research program. The research team recognized the potential of the borehole flowmeter method as a cost-effective and accurate way of measuring relative hydraulic conductivity to a resolution required for environmental analyses if a flowmeter with sufficient accuracy and reliability were available. This led to the development of the EBF designed to avoid deficiencies of other downhole flow measuring devices (Young and Waldrop, 1989). The QEC team that performs EBF tests are inventors of the instrument system. They have conducted similar tests for a wide range of geohydrology throughout the United States.

Field data were collected at 3 wells at the site on 1 and 2 September 1998. The tests were conducted according to a scope of work developed jointly by staff of QEC and staff of Parsons Engineering Science, Inc. This report presents results from the field tests as well as describes the test protocol and the EBF system used.

The Borehole Flowmeter Method

The flowmeter method represents a reasonably simple approach for assessing the relative hydraulic conductivity in porous media or flow through fractured rock at discrete positions in a screened well or uncased borehole. This method is equally effective for evaluating the direction of ambient vertical hydrostatic pressure gradients throughout the depth of a borehole. The technique involves measuring at arbitrarily selected intervals as water is transmitted through a well under ambient and induced pumping conditions. These data serve as the basis for computing the relative hydraulic conductivity at each interval.

In principal, the flowmeter method is very straightforward. Consider the test setup for the well shown in Figure 1. When water is pumped into or from the well at a constant rate for an extended time (i.e. an hour or less), then the water surface level inside the well will adjust until it reaches equilibrium. At that time water is being induced into (or from) the well at the same rate as that being pumped near the surface. Water is flowing into the well horizontally throughout the screened or open interval of the well and flowing vertically within the well. The objective is to measure the vertical distribution of the horizontal flow into the well. The horizontal flow rate at each stratum is indicative of the hydraulic conductivity of those strata as discussed by Molz, et. al. (1990).

Under ideal conditions, the probe is sealed to the wall such that any vertical flow must pass through the recording zone of the meter. Then the flow into or from the well below the meter is recorded as it flows vertically in the well. For some applications, it is not possible to effect a complete seal with the wall and prevent bypass flow. For such cases, it is often desirable but not essential to determine the percentage of flow rate bypassing the recording section of the probe and correct the probe readings accordingly.

A flowmeter test for a well is initiated by measuring for ambient flow throughout the screened section of the well. This is typically initiated with the flowmeter at the bottom of the screen where flows should be zero. The probe is then raised one increment. After any flow disturbance caused by the probe movement has subsided, the vertical flow at

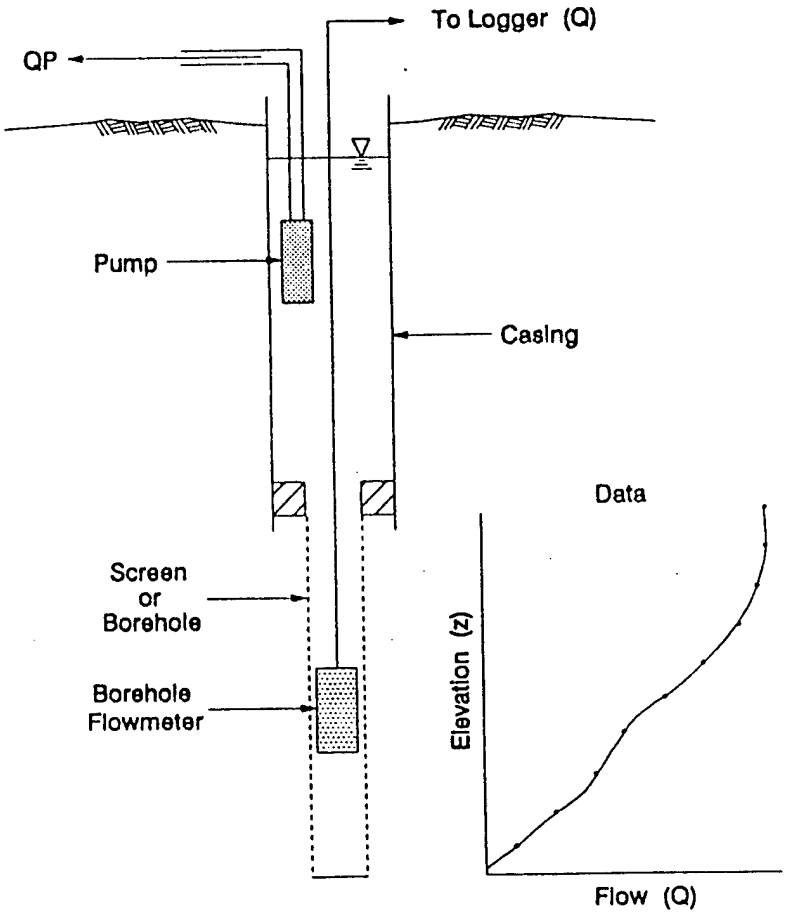


Figure 1. Apparatus and Geometry of a Borehole Flowmeter Test

that station is recorded. This process is repeated throughout the entire screened region. These ambient flows reveal the presence of vertical pressure gradients, positive or negative, between strata, and provide a baseline for analyzing induced flow into the well during pumping.

Once the ambient flow pattern has been recorded, the induced flow test is initiated by pumping from the well at a constant rate. The water surface is monitored to determine when equilibrium conditions have been achieved. At that time, the probe is systematically moved vertically with flow rates recorded at predetermined intervals throughout the well screen. Data at each depth are displayed on a digital readout and stored in a data file of a portable computer. A typical graph of flow as derived from the borehole flowmeter is shown in Figure 2. These tests can be performed with equal accuracy by injecting flow into the well at a constant rate instead of pumping.

Data analysis is also relatively simple. The lateral inflow from each stratum is calculated by successively subtracting the cumulative flow measured at those strata from the cumulative flow recorded at the level immediately below. Hydraulic conductivity can be calculated for those strata by using the Cooper-Jacob formula for horizontal flow to a well. The ratio of local hydraulic conductivity K_i to average K_{ave} for each well was computed using Equation 7 from Molz and Young (1993),

$$K_i / K_{ave} = ((\text{Delta } Q_i - \text{Delta } q_i) / \text{Delta } z) / (Q_{pump} / b) \; ; \; i = 1,2, \ldots n$$

where

Delta Q_i = Flow from the ith layer in the well;

Delta q_i = Ambient flow from the ith layer of the well;

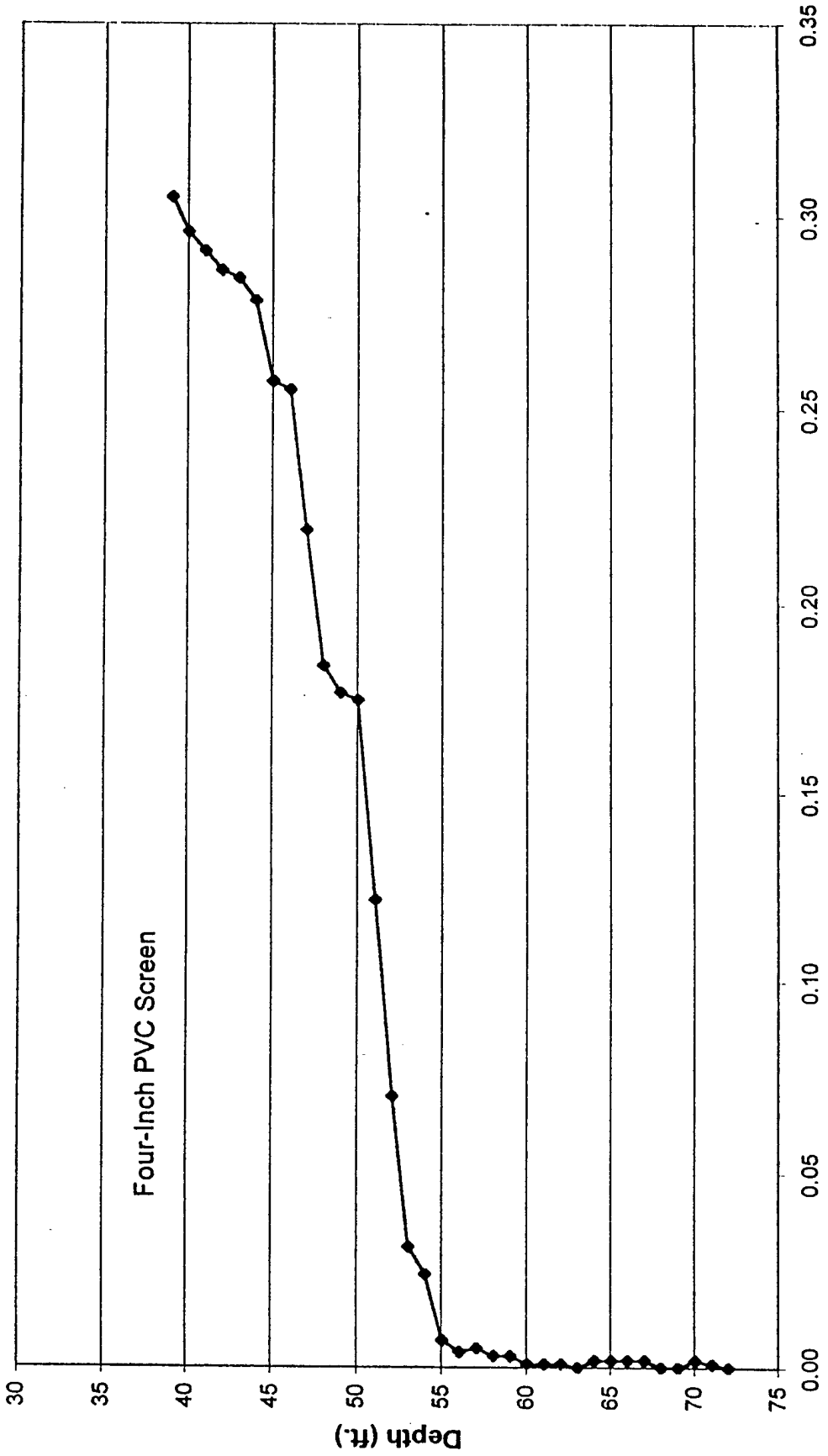
Delta z = ith layer thickness;

Q_{pump} = Flow rate pumped from the well during the induced flow test; and

b = Aquifer thickness.

Details are presented in Molz, et. al., (1994).

Figure 2: Typical Flow Pattern from an EBF Induced Flow Test



The Electromagnetic Borehole Flowmeter

The EBF was designed to provide accurate flow data over a wider range of flow velocities than measurable using impeller-type or other available flowmeters. A schematic of the EBF is shown in Figure 3. The flowmeter consists of an electromagnet and two electrodes located 180 degrees apart and 90 degrees to the magnetic field inside of a hollow cylinder. The flowmeter operates according to Faraday's Law of Induction, which states that the voltage induced by a conductor moving at right angles through a magnetic field is directly proportional to the velocity of the conductor through the field. The flowing water is the conductor, the electromagnet generates the magnetic field, and the electrodes measure the induced voltage. The electronics attached to the electrodes transmit a voltage directly proportional to the velocity of the water. All electronics in the probe are encased in watertight epoxy making the probe very durable and not subject to calibration drift.

Two probe sizes are available for use - one with a one-inch inside diameter (i.d.) and one with a half-inch i.d. The smaller probe has demonstrated a threshold signal of about 5 milliliters per minute (0.0013 GPM) and produces a linear output from about 10 milliliters per minute (0.0026 GPM) to 10 liters per minute (2.64 GPM) which is a factor of 1000. Although the instrument is capable of measuring flows at the lower limit, measurements of such extremely low flows (i.e. 10 ml/min.) are sometimes difficult to achieve accurately in the field because of ground currents. The one-inch probe spans a flow range of about 40 milliliters per minute (0.010 GPM) to 40 liters per minute (10 GPM). Accuracy in the lower flow range for either probe permits pumping at a far lower rate than conventional meters. It also permits testing the well to measure ambient flow conditions with no pumping from the surface. Both probes measure positive or negative flow rates with equal accuracy.

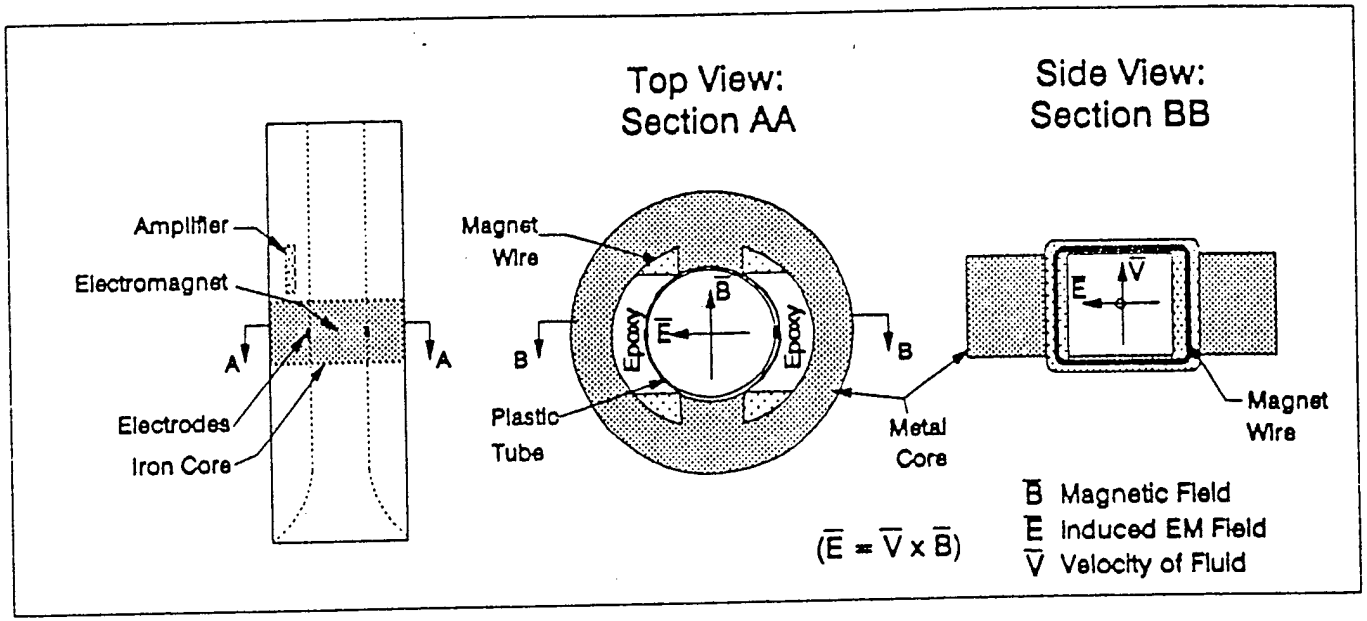


Figure 3: Schematic of the Electromagnetic Borehole Flowmeter

The probe is designed to fit snugly inside a Schedule 40 two-inch PVC pipe. However, to accommodate testing in larger diameter wells, the probe can be fit with an inflatable packer assembly that allows applications in cased and uncased wells of up to 10 inches in diameter. The probe can also be sealed with a collar that fits the inside diameter of the well. For many type wells, this collar provides an adequate seal and is much easier to use. Tests at the former England Air Force Base site did not require using either a collar or packer because they were constructed of Schedule 40 PVC pipe two inches in diameter.

Test Results

Hubert Pearson of QEC, a member of the invention team and experienced in conducting EBF tests, served as test engineer for these tests. Bill Waldrop of QEC and David White of Parsons Engineering Science, Inc assisted him. Mr. White also provided guidance for test objectives to assure that test data would be consistent with their needs for developing an effective groundwater remediation strategy.

The flowmeter tests were performed with the QEC EBF system using the half-inch i.d. probe. The one-inch i.d., probe was available, but not used because the pumping flow rates produced flows well within range of the smaller i.d. probe. The QEC EBF system was calibrated prior to this test. Experience with the EBF system has shown that the system is not subject to calibration drift. This is attributable to the design features of the electronics and the fabrication method by which the electronics of the probe are encased in watertight epoxy. No anomalies in the EBF system were noted during the field tests.

The EBF system produced a linear signal throughout the range of flows tested. The half-inch i.d. probe is considered accurate between flows of 10 milliliters per minute (0.0026 GPM) and 10 liters per minute (2.64 GPM). This translates to a velocity in the throat of the probe ranging between a minimum velocity of 0.13 cm/sec (0.0043 ft/sec) to a maximum of 131 cm/sec (4.3 ft/sec). Upward flows were designated as positive as the sign convention used throughout all testing.

QEC furnished the EBF system, a water level measuring device, pumps, hoses and a portable generator. Field data were recorded using the QEC notebook computer, developed in spreadsheet format, and plotted later for detailed analysis.

Both ambient and induced flow tests were performed on three wells at this site. In addition, the change in water surface was recorded in each well after steady state conditions were achieved when pumping at a higher flow rate than required for the induced flow tests.

Two of the wells tested had screens 70 feet in length and the screen of the other well was 80 feet long. The physical description of the wells is presented in Figures 4. All depths shown in this report are referenced to the top of the casing that is approximately 2.5 feet above ground surface. A summary of the hydraulic parameters of the tests, ambient and induced, is shown in Table 1. Results of the pump tests at higher pump rates are also included in Table 1.

Ambient Flow Tests - Ambient flow rates were recorded in each well prior to pumping. Ambient flows normally represent a second order correction to flow rates measured during induced flow tests. This was generally true for these tests, but significant ambient of the order of 0.1 GPM flow was recorded in all three wells. The largest upward flow, 0.151 GPM, in any of the wells was recorded at a depth of 32 feet in Well 1. The largest downward flow, -0.116 GPM, was recorded at depths of 74 and 76 feet in Well 2.

Induced Flow Tests - Flow data recorded from both ambient and induced flow tests were combined to compute the vertical distribution of hydraulic conductivity of each of the monitoring wells. The ratio of local hydraulic conductivity K_i to average K_{ave} for each well was computed using Equation 7 from Molz and Young (1993) discussed in a previous section of this report. The length of the well screen was used as the aquifer thickness b. This parameter, as is the pump rate used in this equation, however is relatively unimportant since it will affect the absolute values, but have no effect upon the distribution of hydraulic conductivity in each well. Nevertheless, using the well screen length is appropriate because horizontal flow entering the screen from the surrounding medium is a basic assumption of the analysis method.

Flow rates measured in the three wells are presented in Appendix A; whereas, computed values of the profiles of relative hydraulic conductivity are presented in Appendix B.

Figure 4: Physical Parameters of the Wells

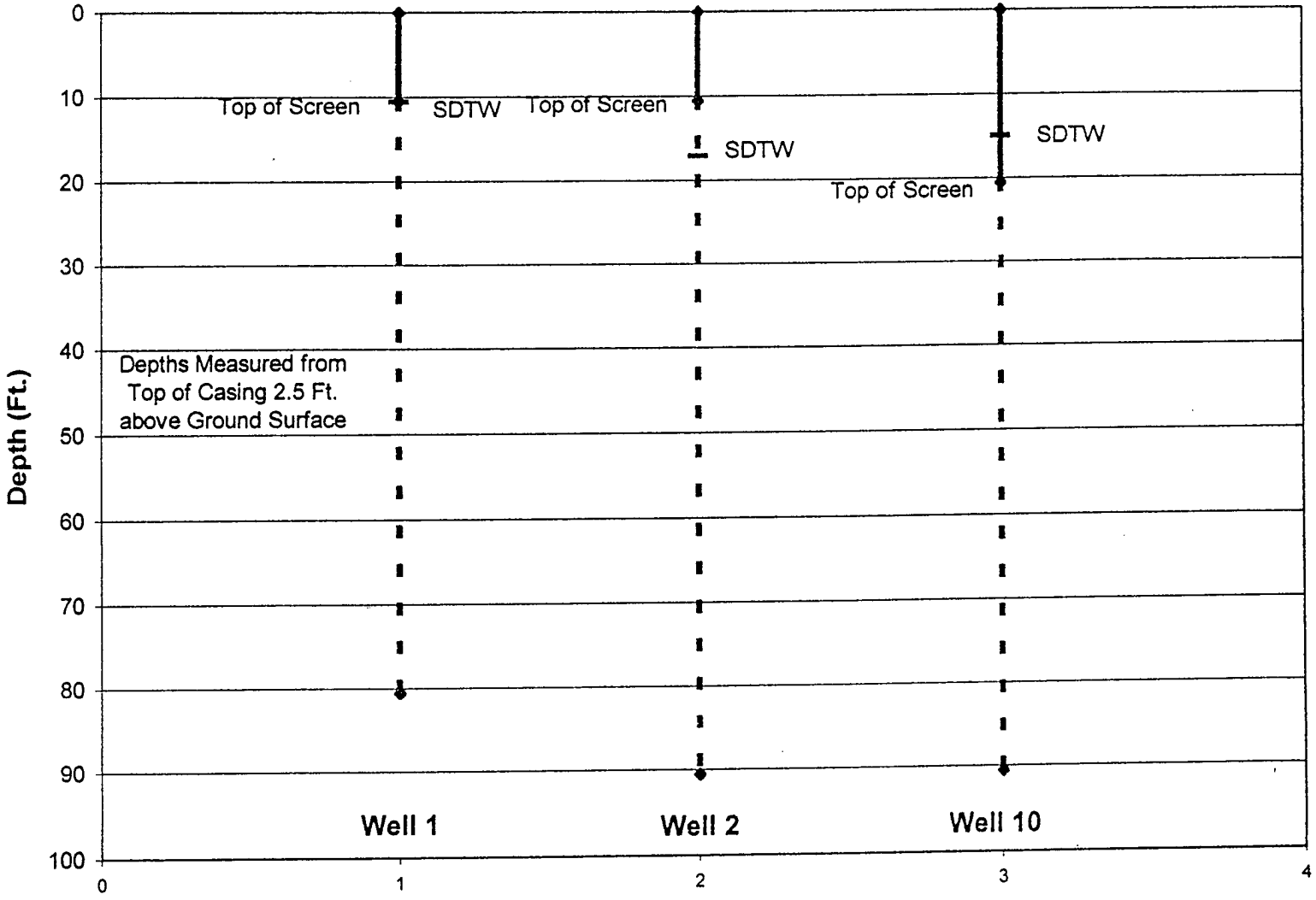


Table 1: Hydraulic Parameters for the EBF Field Test

Well No.	Top of Screen	Ambient Flow Direction	SDTW	Pump Rate	PDTW	Net Change in Water Depth
	(Ft.)		(Ft.)	(GPM)	(Ft.)	(Ft.)
1	10.5	Up	10.55	0.99	10.67	0.12
			10.55	6.5	11.26	0.71
2	10.5	Down	17.14	0.76	17.21	0.07
			17.06	7.12	17.76	0.70
10	20.5	Down	15.05	0.81	15.10	0.05
			15.05	11.0	15.16	0.11

Specific Capacity Test Calculations (based on FBF data set)

$\frac{Q}{S} \times 2000 = T$ and $\frac{T}{(10700)h} = K$

Q = induced flow (gal/min)
S = drawdown at well (ft)
T = Transmissivity (gal/day ft)
h = screened interval (ft)
K = hydraulic conductivity (ft/min)

Well	Q	S	T	h	K
1	6.5	.71	18300	45	3.8×10^{-2} ft/min
2	7.12	.70	20343	39	4.9×10^{-2} ft/min
10	11.0	.11	200,000	59	3.2×10^{-1} ft/min

Several graphs in Appendix B show localized values of negative hydraulic conductivity. These computed negative values are a result of localized decreases in measured flow rate between ascending data points. Clearly a negative hydraulic conductivity is not a physical reality, but only an artifact of a localized flow phenomenon. There is no clear explanation for this localized decrease in flow, but examination of the flows indicate this was likely caused by the scatter of flow data recorded between neighboring data points. This effect is compounded by the fact that the computed values of Ki are based upon the net induced flow that is calculated from the difference between the flow rates measured during pumping and those measured during the ambient test; thus effects of any scatter in the data is compounded. Nevertheless, it is felt that a computed negative value was indicative of a region of low relative hydraulic conductivity because if flow were entering at that zone, the flow rate would not have decreased.

The field test and resulting data analysis did produce a good picture of the vertical structure of relative hydraulic conductivity at the England Air Force Base site. A brief general description of the flow patterns presented in Appendix A, and the computed relative hydraulic conductivity presented in Appendix B follows for each well.

Well 1 - The static depth to water (SDTW) for this well approximately coincides with the top of the screen. Ambient flow, shown in Figure A-1, enters the well at a depth of 60 feet and moves both up and down the well. Water flowing downward from this point leaves the well at depths between 70 and 75 feet. Flow up the well from a depth of 60 feet continues upward and begins exiting the well at about a depth of 30 feet. There is no ambient flow above a depth of 16 feet.

Data from the pumped flow test are very consistent with that from the ambient test. There is essentially no flow below a depth of 76 feet. Essentially all flow entering the

well during the pump test had done so below a depth of 30 feet. The flow data recorded during the pump test actually tracked the ambient flow pattern above a depth of 30 feet.

Figure B-1 presents a graph of the profile of relative hydraulic conductivity based on the net induced flow for each stratum. This graph reveals vary tight material in the bottom four feet of the well overlain by very coarse material extending up to of about 46 feet. A very thin stratum of higher conductivity was noted between depths of 30 and 34 feet. Otherwise, material above a depth of 38 feet showed relatively low hydraulic conductivity.

Well 2 - The top of the screen for this well extended above the water surface making it impossible to test over the complete length of the screen. However, this was a zone of relatively tight material so essentially nothing valuable was lost.

Ambient flows presented in Figure A-2 showed a clear trend. Very little water entered the well above a depth of 46 feet. Below that depth, water entered the well and flowed downward until a depth of 72 feet. Water began exiting the well at a depth of 76 feet and flowed outward between that depth and the bottom.

The profile of relative hydraulic conductivity, Figure B-2, computed from the net induced flow showed some variation in hydraulic conductivity between depths of 52 feet and the well bottom, but generally the values were relatively high. Above a depth of 52 feet, the hydraulic conductivity was significantly less than that in the lower zones with one exception. A narrow layer of high conductivity was detected at a depth of 46 feet. Variations above that zone likely only reflect a scatter in the flow data.

Well 10 - Flow patterns recorded at Well 10 are remarkably similar to those recorded at Well 2. The solid casing extended about five feet below the SDTW; therefore it was possible to record flows throughout the entire length of the screen. Ambient flows presented in Figure A-3 were negligible from the top of the screen to a depth of 42 feet.

At that depth, groundwater began entering the well, and flowing downward to a depth of 72 feet. Water exited the well between this depth and the bottom at a depth of 90 feet.

The graph of flows measured during pumping in Figure A-3 reveals that essentially all water entered the well below a depth of 52 feet. The resulting graph of relative hydraulic conductivity, Figure A-3A, computed from the net induced flow shows that the hydraulic conductivity is greatest in a narrow zone between depths of 74 and 78 feet. Values of Ki steadily decrease with both increasing and decreasing depth from that zone.

Computed values of relative hydraulic conductivity in the zone of tighter deposits above a depth of 50 feet reflect the compounded scatter in flow measurements from both the ambient and pumped tests. Values computed at depth intervals of four feet presented in Figure B-3B have the effect of smoothing the data to show a clearer trend over the entire profile. This figure clearly shows that the highest value of hydraulic conductivity is located at a depth of between 74 and 78 feet. Additionally, it reveals a likely zone of slightly higher hydraulic conductivity at a depth of between 22 and 26 feet. The presence of this zone was not evident in the analysis of data at intervals of two feet because of the data scatter at this higher resolution. This demonstrates the value of analyzing data using various ways to glean as much information as possible from a test.

Results from this EBF test provide a good picture of the heterogeneity of the hydraulic conductivity at the former England Air Force Base site. The structure and magnitude of ambient flows recorded at this site should be especially useful. Generally, this was a quite successful test and should be valuable in developing a groundwater remediation strategy for this site.

References

Molz F.J., Oktay Guven, and J.G. Melville, (1990), Measurement of Hydraulic Conductivity Distributions - A Manual of Practice, U.S. Environmental Protection Agency Technical Report, EPA/600/8-90/046.

Molz, F.J., G.K. Boman, S.C. Young, and W.R. Waldrop, (1994), Borehole Flowmeters: Field Application and Data Analysis, Journal of Hydrology No. 163, pp. 347-371.

Molz, F.J. and S.C. Young, (1993), Development and Application of Borehole Flowmeters for Environmental Assessment, The Log Analyst, pp. 13-23, January-February 1993.

Young, S.C. and W.R. Waldrop, (1989), An Electromagnetic Borehole Flowmeter for Measuring Hydraulic Conductivity Variability, Proceedings of the Conference on New Techniques in Groundwater, National Water Well Association, Dallas, Texas.

Appendix A

Graphs of Flow Profiles for Ambient and Induced Flows

Figure A-1: Profile of Flow Rate in Well 1

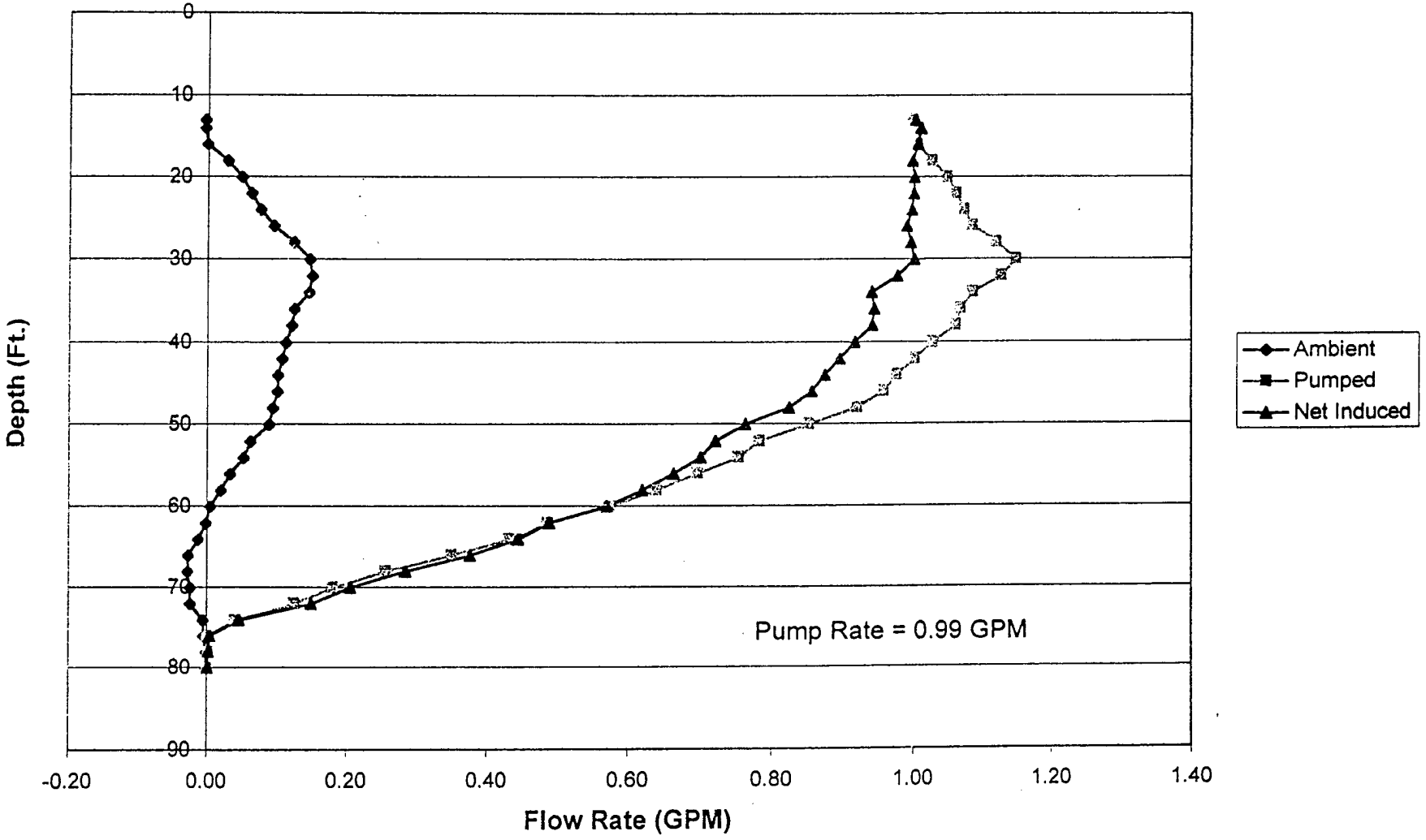


Figure A-2: Profile of Flow Rate in Well 2

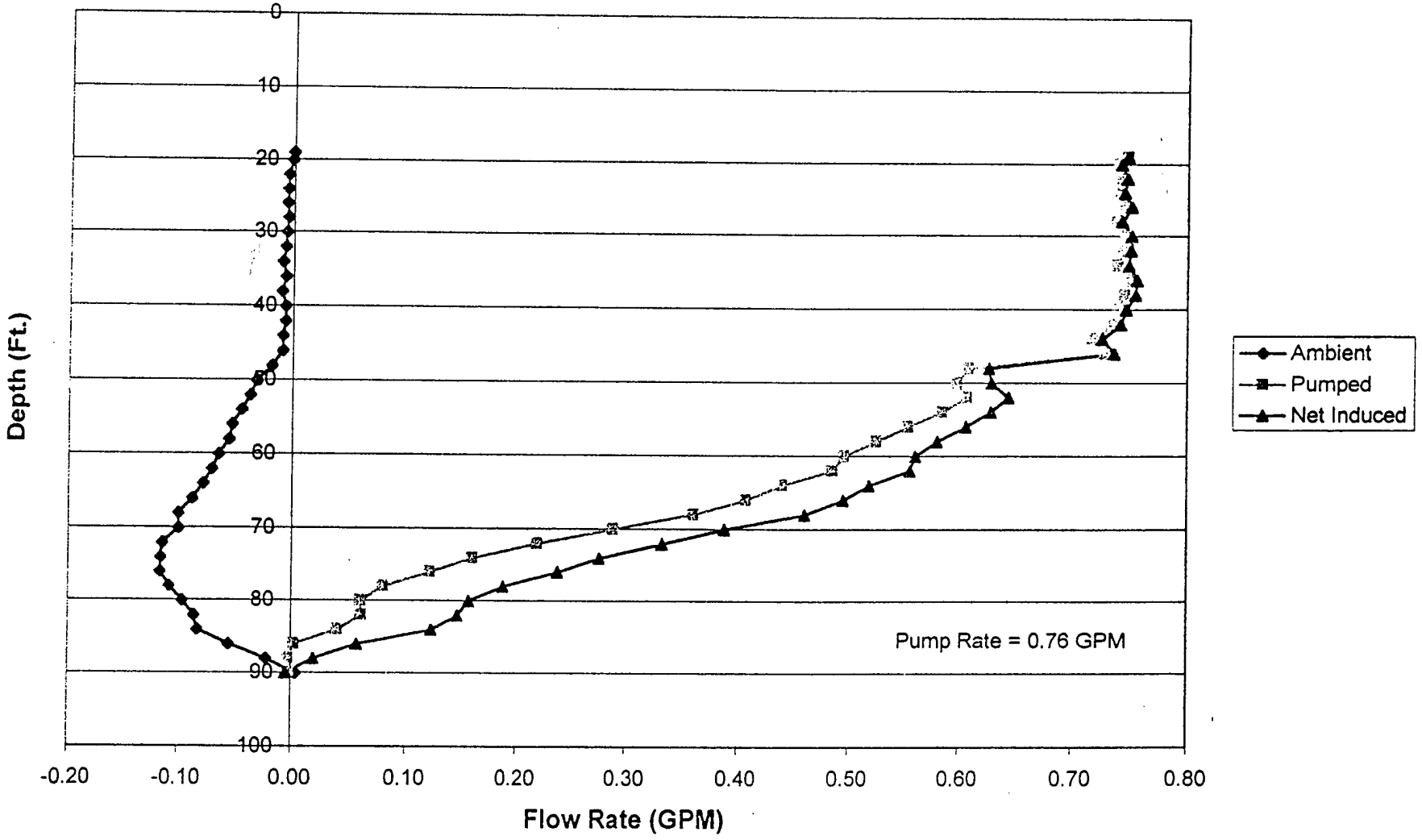
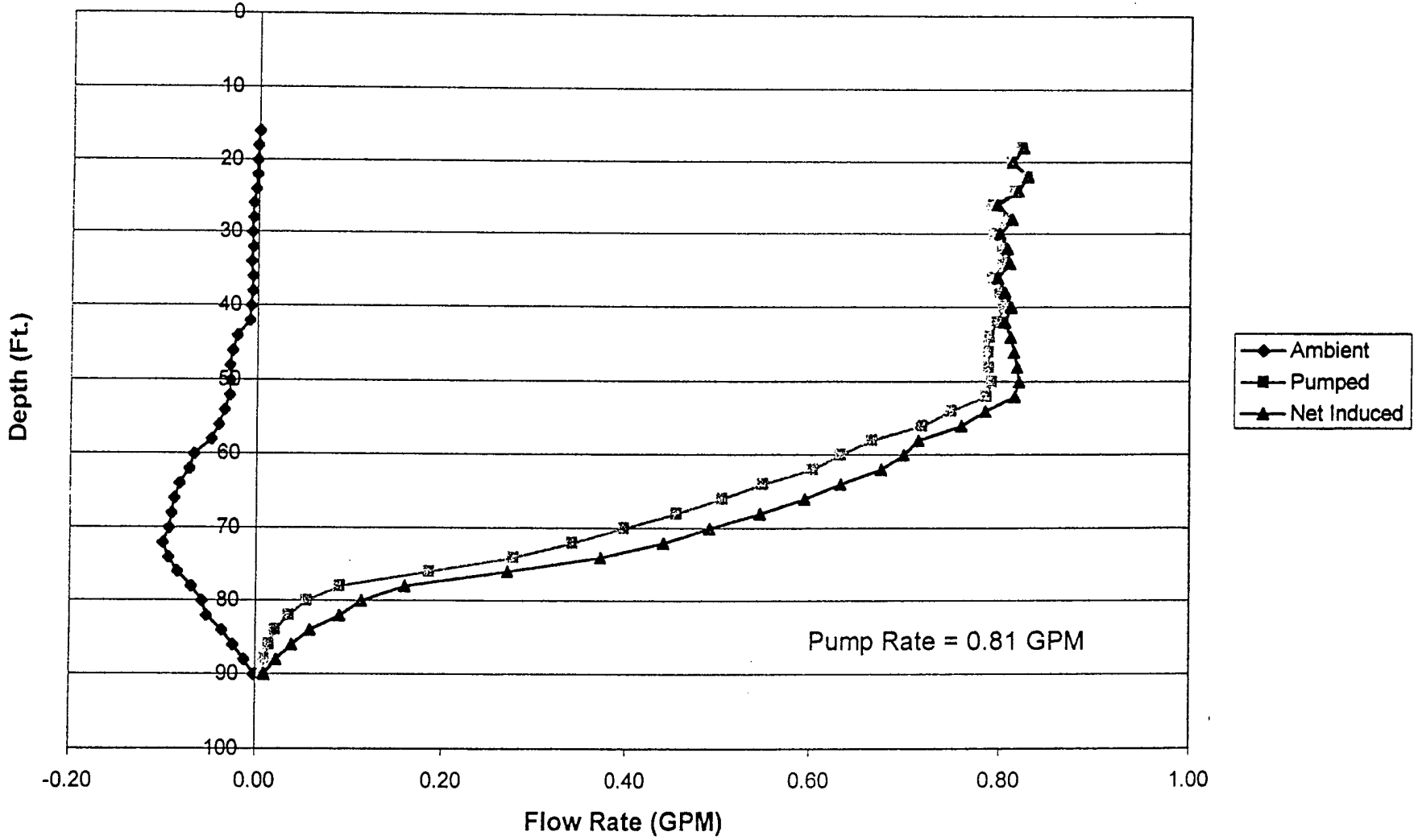


Figure A-3: Profile of Flow Rate in Well 10



Appendix B

Computed Profiles of Relative Hydraulic Conductivity

Figure B-1: Profile of Relative Hydraulic Conductivity in Well 1

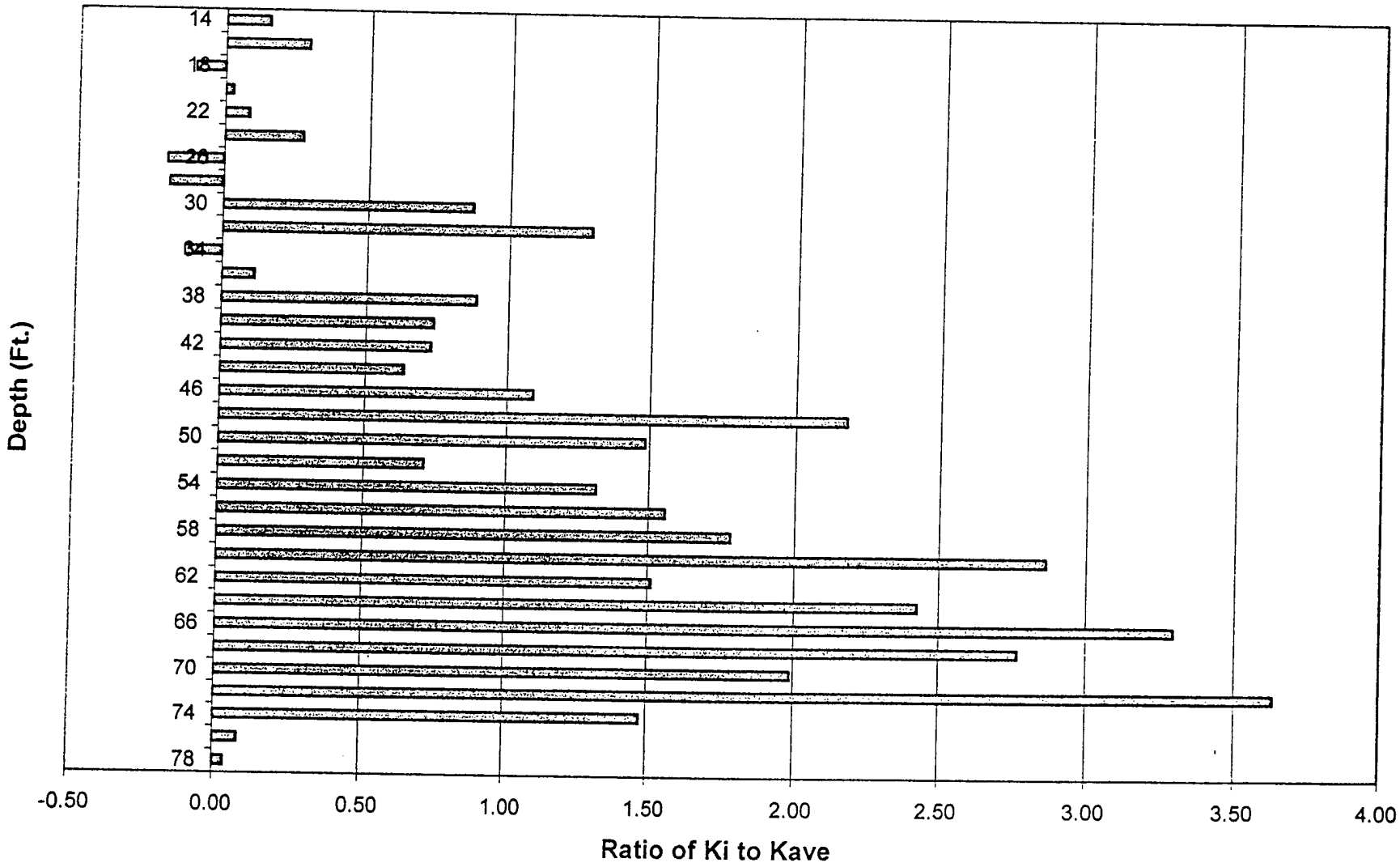


Figure B-2: Profile of Relative Hydraulic Conductivity in Well 2

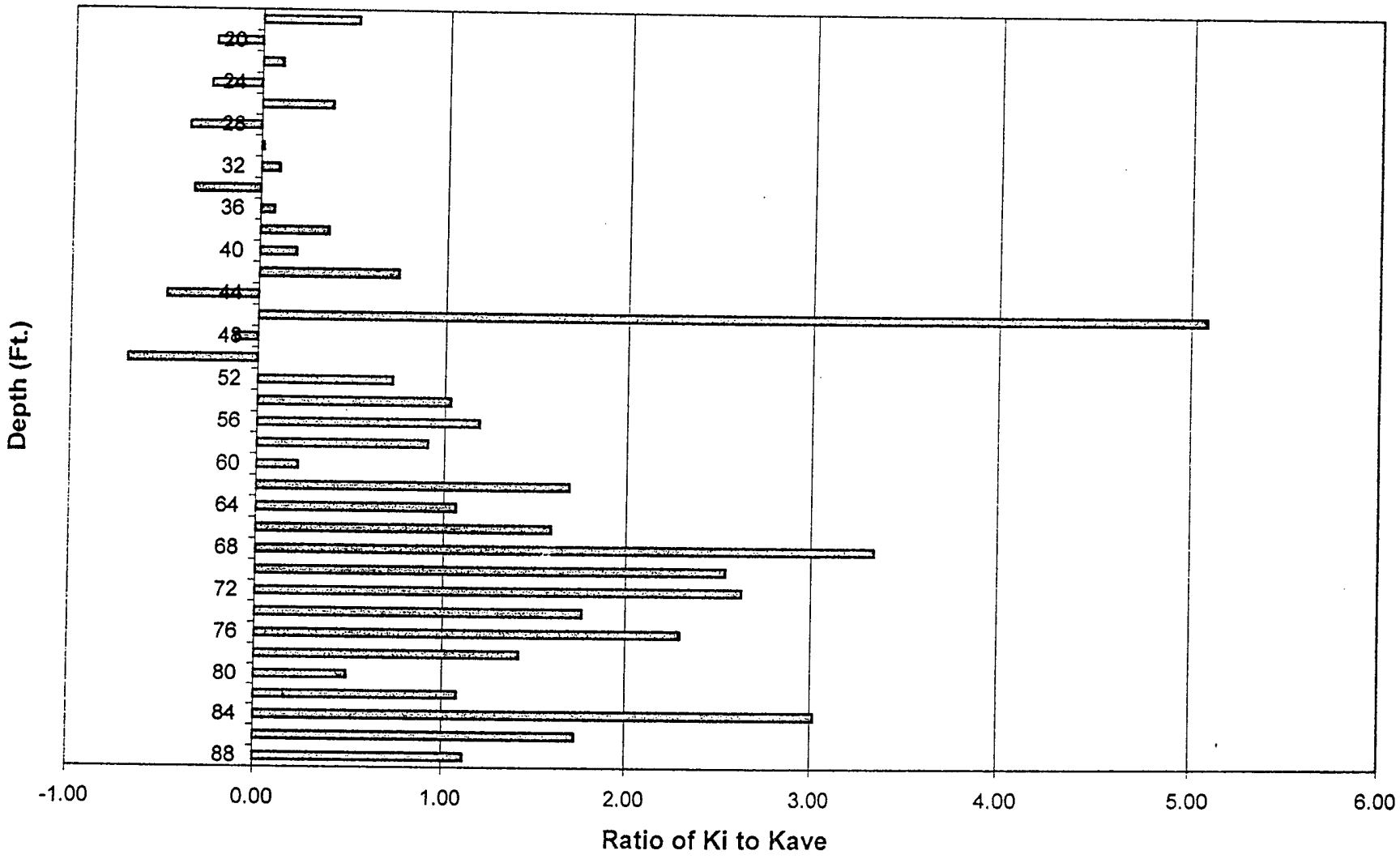


Figure B-3A: Profile of Relative Hydraulic Conductivity in Well 10
Intervals of Two Feet

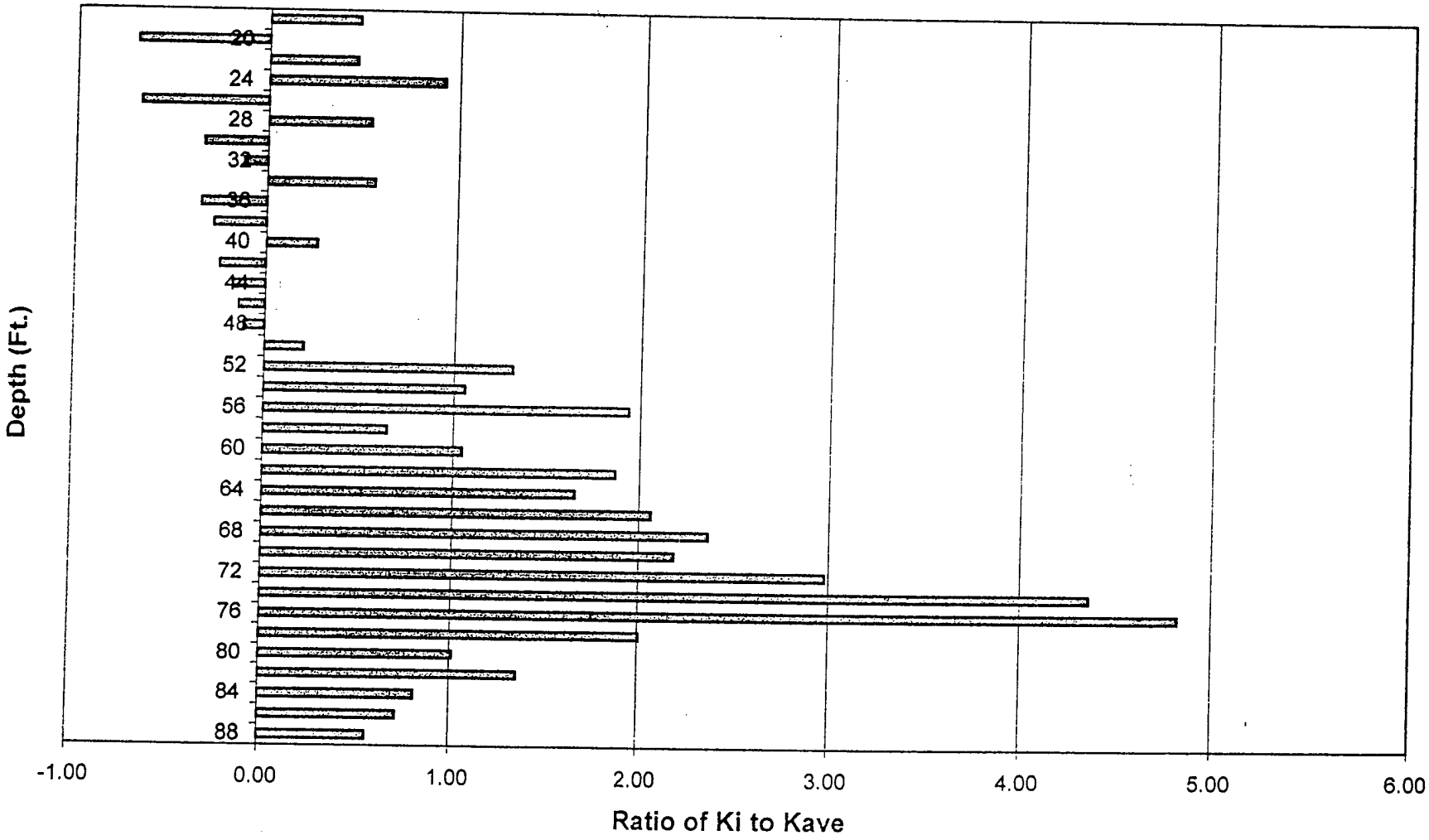
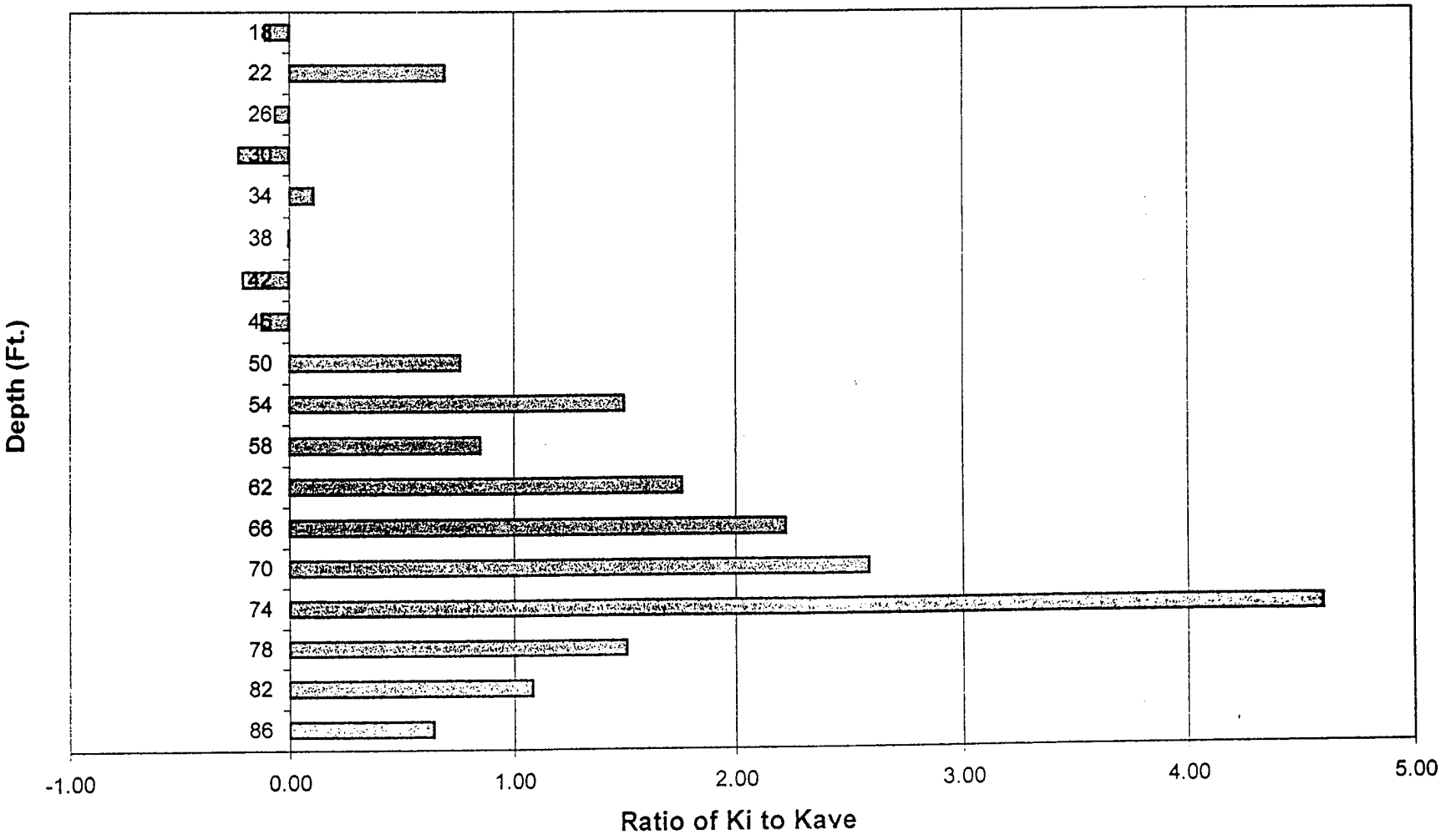


Figure B-3B: Profile of Relative Hydraulic Conductivity for Well 10
Intervals of Four Feet



GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [ ] 1800-Area; [X] 2500-Area MONITORING WELL: Well #1

DATE AND TIME OF SAMPLING: May 26, 1999 11:20 a.m./p.m.
SAMPLE COLLECTED BY: DW / TH of Parsons ES: Houston and Denver Offices.
WEATHER: Partly Sunny, Hot, Slight Breeze, Humid

MONITORING WELL CONDITION:
1 [ ] WELL NUMBER IS APPARENT
2 [X] WELL NUMBER IS NOT APPARENT. EXPLAIN: Wrote on well to add name
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:
5 [ ] PRODUCT OBSERVED AT DEPTH OF ____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:
7 [ ] WATER DEPTH MEASURED AT 8.00 FT. BELOW DATUM WITH Water Level Probe
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:
9 [X] PERISTALTIC PUMP AND DEDICATED TUBING dHz
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: Purge & Probe readings
Items Cleaned (List): _____

MONITORING WELL EVACUATION OBSERVATIONS:
Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments: _____
Other comments: _____

ON-SITE MEASUREMENTS:
12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:
14 [X] 1 MICROSEEPS Dissolved Hydrogen Vials (20 mL)

15 [ ] Notes/Comments/Other: _____

ON-SITE SAMPLE TREATMENT:
16 [X] NONE
17 [ ] [ ] FILTRATION: Method _____ Containers: _____
[ ] PRESERVATIVES Method _____ Containers: _____

CONTAINER HANDLING:
18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [ ] Containers Placed in Ice Chest

OTHER COMMENTS: TD = 79', water level is 8' ≈ 74' of H_2O
Need ≈ 37 gallons To Purge

PARSONS ENGINEERING SCIENCE, INC.

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 12500-Area MONITORING WELL: Well #1

DIRECT INSTRUMENT READINGS

Time	11:35	11:71	11:42	11:48			Measured With
Temp (°C)	21.45	20.31	20.32	20.28			
pH	6.74	6.70	6.74	6.74			
Cond (µS/cm)	1.060	1.062	1.058	1.059			
Do (mg/L)	2.54	0.32	0.34	0.33			
Redox (mv)	-138.5	-150.0	-147.9	-146.9			
Observations:	Clear.	Ten i turbid + Slight [illegible]			Turb = 30 NTU		
gallons purged	1	10	26.5	35.5			

Additional Comments:

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate			
(2) Sulfide			
(3) Manganese			
(4) Ferrous Iron			
(5) Alkalinity			
(6) Carbon Dioxide			
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [ ] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: #1

DATE AND TIME OF SAMPLING: March 12, 1999 1630 a.m./p.m.
SAMPLE COLLECTED BY: DW / TH / JB of Parsons ES: Houston and Denver Offices.
WEATHER: 53°F calm winds, overcast.

MONITORING WELL CONDITION:

1 [ ] WELL NUMBER IS APPARENT
2 [X] WELL NUMBER IS NOT APPARENT. EXPLAIN: No Identifying Markings on Well
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:

5 [ ] PRODUCT OBSERVED AT DEPTH OF _____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:

7 [ ] WATER DEPTH MEASURED AT 6.70 FT. BELOW DATUM WITH _____
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:

9 [ ] PERISTALTIC PUMP AND DEDICATED TUBING
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [ ] BLADDER PUMP OR OTHER: GRUNDFOS
Items Cleaned (List): _____

MONITORING WELL EVACUATION OBSERVATIONS:

Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations:
Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments: _____
Other comments: _____

ON-SITE MEASUREMENTS:

12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:

14 [X] 4 SW8260A (40 mL VOAs); 1 DOC by E415.1 (50c mL 6A Bottle); 3 NRMRL-147 (40 mL VOAs)
___ Sulfate/Chloride by Meth. N-601 (___ mL ___ Bottle); ___ Nitrate by E300/SW9056 (___ mL ___ Bottle)
15 [X] NONE/OTHER: T. IRON 2 / 1L Plastic 1 / 1L Plastic.

ON-SITE SAMPLE TREATMENT:

16 [X] NONE
17 [ ] [ ] FILTRATION: Method _____ Containers: _____
[ ] PRESERVATIVES Method _____ Containers: _____

CONTAINER HANDLING:

18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [ ] Containers Placed in Ice Chest

OTHER COMMENTS: _____

PARSONS ENGINEERING SCIENCE, INC.

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: ~~FT~~ 1

DIRECT INSTRUMENT READINGS

Time	1559	1604	1609	1619	1624	1629	Measured With
Temp (°C)	19.37	20.66	20.74	20.77	20.77	20.81	600XL-B-0 - YSI inc.
pH	6.85	6.86	6.86	6.86	6.86	6.86	
Cond (µS/cm)	0.909	0.953	0.955	0.956	0.957	0.957	
Do (mg/L)	8.25	0.39	0.30	0.31	0.31	0.32	
Redox (mv)	-52.5	-128.7	-139.8	-145.9	-147.7	-148.7	
Observations: spc	1.004	1.039	1.040	1.040	1.040	1.040	
gallons purged	1	10	20	40	50	60	

Additional Comments: 2 gpm purge RATE

Turbidity = 4.8

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate	No	0	No Turb, o Color.
(2) Sulfide	No	0.012	No Turb or Color except very, very slight Amber
(3) Manganese	No	1.1 mg/L	Mild light color
(4) Ferrous Iron	No	4.60 mg/L	Dark Rust
(5) Alkalinity	1:4; 12.5mL+37.5mL	7drops x 20 = 140/4 = 560 mg/L as CaCO3	
(6) Carbon Dioxide	No	48 ppm	—
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [X] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [ ] 1800-Area; [X] 2500-Area MONITORING WELL: Well #2

DATE AND TIME OF SAMPLING: May 25, 1999 14:58 a.m./p.m.
SAMPLE COLLECTED BY: DW / TH of Parsons ES: Houston and Denver Offices.
WEATHER: humid, partly sunny, Hot.

MONITORING WELL CONDITION:
1 [ ] WELL NUMBER IS APPARENT
2 [X] WELL NUMBER IS NOT APPARENT. EXPLAIN: No markings outside
3 [ ] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:
5 [ ] PRODUCT OBSERVED AT DEPTH OF ____ FT. BELOW DATUM WITH _____
6 [ ] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:
7 [ ] WATER DEPTH MEASURED AT 14.20 FT. BELOW DATUM WITH WL Meter
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:
9 [X] PERISTALTIC PUMP AND DEDICATED TUBING dH2
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: ~~BP~~ Purging; Direct Probe readings
Items Cleaned (List): _____

MONITORING WELL EVACUATION OBSERVATIONS:
Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments: _____
Other comments: _____

ON-SITE MEASUREMENTS:
12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:
14 [X] 1 MICROSEEPS Dissolved Hydrogen Vials (~~25~~ 20 mL)
15 [ ] Notes/Comments/Other: _____

ON-SITE SAMPLE TREATMENT:
16 [X] NONE
17 [ ] [ ] FILTRATION: Method _____ Containers: _____
[ ] PRESERVATIVES Method _____ Containers: _____

CONTAINER HANDLING:
18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [ ] Containers Placed in Ice Chest

OTHER COMMENTS: Well is 89' deep. ~75' of H_2O, ~38 gallons for 3 volumes.

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB. [ ] 800-Area; [X] 2500-Area MONITORING WELL: Well #2

DIRECT INSTRUMENT READINGS

Time	15:00	15:07	15:16	15:21	15:26		Measured With
Temp (°C)	20.74	20.12	20.09	20.08	20.06		
pH	6.92	6.81	6.81	6.80	6.81		
Sp. Cond (µS/cm)	0.945	0.938	0.922	0.924	0.925		
Do (mg/L)	3.04	2.06	1.91	1.78	1.77		
Redox (mv)	-67.1	-119.1	-119.3	-119.6	-123.3		
Observations:	clear.	Clear.	clear	clear	clear		
gallons purged	1	15gal	33gal.	43gal.	53gal.		

Do suspect. Erratic behavior of probe.

Additional Comments: Pumping at 2 gpm.

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate			
(2) Sulfide			
(3) Manganese			
(4) Ferrous Iron			
(5) Alkalinity			
(6) Carbon Dioxide			
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [ ] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: #2

DATE AND TIME OF SAMPLING: March 12, 1999 1139 (a.m.)/p.m.
SAMPLE COLLECTED BY: (DW) / TH / JB of Parsons ES: Houston and Denver Offices.
WEATHER: Overcast 50° breezy

MONITORING WELL CONDITION:

1 [ ] WELL NUMBER IS APPARENT
2 [X] WELL NUMBER IS NOT APPARENT. EXPLAIN: well not marked
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:

5 [ ] PRODUCT OBSERVED AT DEPTH OF _____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:

7 [X] WATER DEPTH MEASURED AT 12.74 FT. BELOW DATUM WITH _____
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:

9 [ ] PERISTALTIC PUMP AND DEDICATED TUBING
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: GRUNDFOS
Items Cleaned (List): _____

MONITORING WELL EVACUATION OBSERVATIONS:

Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (~~slightly~~ - very) cloudy
Water level (rose - fell - no change)
Water odors/comments: _____
Other comments: _____

ON-SITE MEASUREMENTS:

12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:

14 [ ] ___ SW8260A (40 mL VOAs); ___ DOC by E415.1 (___mL ___ Bottle); _____NRMRL-147 (40 mL VOAs)
___Sulfate/Chloride by Meth. N-601 (____mL ____Bottle); ____Nitrate by E300/SW9056 (___mL ___Bottle)
15 [ ] NONE/OTHER:

ON-SITE SAMPLE TREATMENT:

16 [X] NONE
17 [ ] [ ] FILTRATION: Method_____ Containers: _____
[ ] PRESERVATIVES Method_____ Containers: _____

CONTAINER HANDLING:

18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [X] Containers Placed in Ice Chest

OTHER COMMENTS: _____

PARSONS ENGINEERING SCIENCE, INC.

ON-SITE MEASUREMENT FORM

MPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: #2

DIRECT INSTRUMENT READINGS

Time	1107	1112	1117	1127	1137		Measured With
Temp (°C)	19.55	20.52	20.65	20.68	20.67		
pH	6.86	6.87	6.86	6.86	6.86		
Cond (µS/cm)	0.894	0.907	0.910	0.907	0.908		
Do (mg/L)	2.10	0.43	0.36	0.33	0.33		
Redox (mv)	-55.1	-146.2	-155.4	-159.4	-161.8		
Observations; sp.c	0.893	0.991	0.991	0.990	0.990		
gallons purged	1	10	20	40	60		

Additional Comments: measured Flow Rate ~ >2 gpm Turbidity = 8.6

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate	No	0	No Visible Color or Turb.
(2) Sulfide	No	0.022 mg/L	No Visible Color or Turb.
(3) Manganese	No	1.1 mg/L	Slight Violet Color.
(4) Ferrous Iron	No	4.70 mg/L	Deep Rust Color.
(5) Alkalinity	1:9; 12.5mL+325mL	7 drops x10 - 140 x4 = 560	mg/L as CaCO3.
(6) Carbon Dioxide	No	54 ppm	
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [X] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: #3

DATE AND TIME OF SAMPLING: March 12, 1999 ~~09:~~ 1000 (a.m.)/p.m.
SAMPLE COLLECTED BY: (DW) / TH / JB of Parsons ES: Houston and Denver Offices.
WEATHER: Rain ~50°F

MONITORING WELL CONDITION:

1 [X] WELL NUMBER IS APPARENT
2 [ ] WELL NUMBER IS NOT APPARENT. EXPLAIN: _____
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:

5 [ ] PRODUCT OBSERVED AT DEPTH OF _____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:

7 [ ] WATER DEPTH MEASURED AT 10.89 FT. BELOW DATUM WITH _____
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:

9 [ ] PERISTALTIC PUMP AND DEDICATED TUBING
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: GRUNDFOS
Items Cleaned (List): _____

MONITORING WELL EVACUATION OBSERVATIONS:

Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments: NA
Other comments: _____

ON-SITE MEASUREMENTS:

12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:

14 [ ] 4 SW8260A (40 mL VOAs); 1 DOC by E415.1 (___mL 6x Bottle); 3 NRMRL-147 (40 mL VOAs)
___Sulfate/Chloride by Meth. N-601 (____mL ____Bottle); ____Nitrate by E300/SW9056 (___mL ___Bottle)
15 [ ] NONE/OTHER:

ON-SITE SAMPLE TREATMENT:

16 [X] NONE
17 [ ] [ ] FILTRATION: Method _____ Containers: _____
[ ] PRESERVATIVES Method _____ Containers: _____

CONTAINER HANDLING:

18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [ ] Containers Placed in Ice Chest

OTHER COMMENTS: _____

PARSONS ENGINEERING SCIENCE, INC.

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: ~~#~~ 3

DIRECT INSTRUMENT READINGS

Time	0933	0938	0943	0953	1003		Measured With
Temp (°C)	18.24	20.50	20.90	20.83	21.07		
pH	6.94	6.86	6.87	6.88	6.88		
Cond (µS/cm)	0.818	0.853	0.860	0.866	0.867		
Do (mg/L)	7.90	1.13	0.57	0.42	0.43		
Redox (mv)	-63.0	-30.4	-134.5	-126.4	-137.8		
Observations; pc	.916	0.940	0936	0945	0938		
gallons purged	1.0	11	22	41	62		

Additional Comments:

Turbidity = 6.6

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate	No	0, 0	No Visible Turbidity or Color
(2) Sulfide	No	0.012, 0.016 mg/L	" "
(3) Manganese	No	1.7, 1.7	Violet
(4) Ferrous Iron	No	4.2, 4.4	Deep Rust.
(5) Alkalinity	No	46ppm, 55ppm.	← CO_2 Readings
(6) Carbon Dioxide	1:4; 12.5+37.5	7drops x 20 = 140 x 4 = 560 mg/L	← Alk Reading
(7) ~~Chloride~~	1:4; 12.5+37.5	6drops x 20 = 120 x 4 = 480 mg/L	← Alk Reading

Additional Comments: Duplicates

FIELD QA/QC PERFORMED AT THIS LOCATION? [X] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [ ] 800-Area: [X] 2500-Area MONITORING WELL: Well #3

DATE AND TIME OF SAMPLING: May 26, 1999 10:18 a.m./p.m.
SAMPLE COLLECTED BY: DW / TH of Parsons ES: Houston and Denver Offices.
WEATHER: Sunny, Hot

MONITORING WELL CONDITION:
1 [X] WELL NUMBER IS APPARENT
2 [ ] WELL NUMBER IS NOT APPARENT. EXPLAIN: _____
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:
5 [ ] PRODUCT OBSERVED AT DEPTH OF ____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:
7 [X] WATER DEPTH MEASURED AT 12.51 FT. BELOW DATUM WITH _____
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:
9 [X] PERISTALTIC PUMP AND DEDICATED TUBING dH_2 ; methane.
10 [ ] DEDICATED QED WELL WIZARD PUMP: , ,
11 [X] BLADDER PUMP OR OTHER: In purging; Probe readings
Items Cleaned (List): _____

MONITORING WELL EVACUATION OBSERVATIONS:
Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments: _____
Other comments: _____

ON-SITE MEASUREMENTS:
12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:
14 [X] 1 MICROSEEPS Dissolved Hydrogen Vials (20 mL) Collected @ 11:15
15 [X] Notes/Comments/Other: 3 methane 40 mL VOA bottles, collected @ 10:55, - well #; 3 methane 40 mL VOA bottles, collected @ 10:50, Field Blks

ON-SITE SAMPLE TREATMENT:
16 [X] NONE
17 [ ] [ ] FILTRATION: Method _____ Containers: _____
[ ] PRESERVATIVES Method _____ Containers: _____

CONTAINER HANDLING:
18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [ ] Containers Placed in Ice Chest

OTHER COMMENTS: 75' depth ~ 66' of H_2O - purge ≈ 33 gallons.

PARSONS ENGINEERING SCIENCE, INC.

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: Well #3

DIRECT INSTRUMENT READINGS

Time	10:30	10:38	10:43	[illegible]	10:58		Measured With
Temp (°C)	22.23	20.10	20.11	20.65	20.11		
pH	7.36	6.61	6.65		6.70		
Cond (µS/cm)	0.858	0.921	0.922		0.922		
Do (mg/L)	3.03	0.22	0.22		0.25		
Redox (mv)	-144.6	-163.7	-164.0		-151.8		
Observations:	Clear.	slightly turbid					
gallons purged	1	13	20.5		35		

Pump lowering, reset

Additional Comments: New DO probe. calibrated; drops to 0.02 mg/L

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate			
(2) Sulfide			
(3) Manganese			
(4) Ferrous Iron			
(5) Alkalinity			
(6) Carbon Dioxide			
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [ ] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [ ] 1800-Area; [X] 2500-Area MONITORING WELL: Well #4

DATE AND TIME OF SAMPLING: May 26, 1999 19:00 a.m./p.m.
SAMPLE COLLECTED BY: DW / TH of Parsons ES: Houston and Denver Offices.
WEATHER: Clear, Sunny, Warm, Muggy

MONITORING WELL CONDITION:
1 [X] WELL NUMBER IS APPARENT
2 [ ] WELL NUMBER IS NOT APPARENT. EXPLAIN:
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN:
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

PRODUCT INFORMATION:
5 [ ] PRODUCT OBSERVED AT DEPTH OF ~~[illegible]~~ FT. BELOW DATUM WITH
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:
7 [X] WATER DEPTH MEASURED AT 12.81 FT. BELOW DATUM WITH WL Meter
8 [ ] OTHER. EXPLAIN:

MONITORING WELL EVACUATION METHOD:
9 [X] PERISTALTIC PUMP AND DEDICATED TUBING dH_2, Methane / Ethane / Ethene / VOC
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER:
Items Cleaned (List):

MONITORING WELL EVACUATION OBSERVATIONS:
Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments:
Other comments:

ON-SITE MEASUREMENTS:
12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: collected @ 19:57

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:
14 [X] [ ] MICROSEEPS Dissolved Hydrogen Vials (20 mL) collect @ 19:40 collect @ 19:40
15 [X] Notes/Comments/Other: 2, 40 mL VOAs for VOC; 2, 40 mL VOAs for Methane/Eth/Ethene; 2 40 mL VOAs for Meth/Ethane/Ethene MS/MSD. ~ 19:40

ON-SITE SAMPLE TREATMENT:
16 [X] NONE
17 [X] [ ] FILTRATION: Method Containers:
[X] PRESERVATIVES Method HCL for VOCs in Containers Containers:

CONTAINER HANDLING:
18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [ ] Containers Placed in Ice Chest

OTHER COMMENTS: TD = 72' ; ~ 62' of water - need 31 gallons for purge

PARSONS ENGINEERING SCIENCE, INC.

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB. [ ] 300-Area [X] 2500-Area MONITORING WELL: well #4

DIRECT INSTRUMENT READINGS

Time	19:04	19:09	19:14	19:28 ~~19:29~~	~~19:31~~ 19:32	19:36	Measured With
Temp (°C)	21.97	20.38	20.29	20.32	20.24	20.23	
pH	7.666	6.78	6.75	6.78	6.79	6.80	
Cond (µS/cm)	0.803	0.929	0.939	0.942	0.945	0.945	
Do (mg/L)	6.19	1.20	0.12	0.17	0.10	0.10	
Redox (mv)	-77.4	-121.8	-131.3	-138.3	-143.3	-145.1	
Observations:	slightly turbid	Tan; turbid →		clearer →	slightly turbid →		Turb = 485
gallons purged	1	8.5	16 gallons ~~33.5~~	19	25 ~~35~~	31	

Additional Comments: ↳ Compressor out of gas. Refilled.

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate			
(2) Sulfide			
(3) Manganese			
(4) Ferrous Iron			
(5) Alkalinity			
(6) Carbon Dioxide			
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [ ] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [ ] 800-Area; [ ] 2500-Area MONITORING WELL: #4

DATE AND TIME OF SAMPLING: March 12, 1999 1450 a.m./p.m.
SAMPLE COLLECTED BY: DW / TH / JB of Parsons ES: Houston and Denver Offices.
WEATHER: ~50 °F, calm winds, slight Drizzle

MONITORING WELL CONDITION:

1 [X] WELL NUMBER IS APPARENT
2 [ ] WELL NUMBER IS NOT APPARENT. EXPLAIN: _____
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:

5 [ ] PRODUCT OBSERVED AT DEPTH OF _____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:

7 [X] WATER DEPTH MEASURED AT 11.24 FT. BELOW DATUM WITH _____
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:

9 [ ] PERISTALTIC PUMP AND DEDICATED TUBING
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: GRUNDFOS -
Items Cleaned (List): _____

MONITORING WELL EVACUATION OBSERVATIONS:

Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments: no
Other comments: _____

ON-SITE MEASUREMENTS:

12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:

14 [X] 8 SW8260A (40 mL VOAs); 1 DOC by E415.1 (250 mL 6A Bottle); 3 NRMRL-147 (40 mL VOAs)
X Sulfate/Chloride by Meth. N-601 (____mL ____Bottle); ____Nitrate by E300/SW9056 (___mL ___Bottle)
15 [X] NONE/OTHER: NITROW - 1L plastic 1 L Pl.

ON-SITE SAMPLE TREATMENT:

16 [X] NONE
17 [ ] [ ] FILTRATION: Method _____ Containers: _____
[ ] PRESERVATIVES Method _____ Containers: _____

CONTAINER HANDLING:

18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [X] Containers Placed in Ice Chest

OTHER COMMENTS: _____

PARSONS ENGINEERING SCIENCE, INC.

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: #4

DIRECT INSTRUMENT READINGS

Time	1417	1422	1427	1437	1447		Measured With
Temp (°C)	18.79	20.69	20.78	20.79	20.80		
pH	6.83	6.85	6.87	6.88	6.89		
Cond (µS/cm)	0.880	0.904	0.917	0.927	0.927		
Do (mg/L)	9.85	0.43	0.36	0.30	0.30		
Redox (mv)	-27	-108.1	-125.6	-141.9	-149.0		
Observations: scp	0.980	0.985	*1.001	1.007	1.009		
gallons purged	1	8	16	30	45		

Additional Comments: Turbidity = 5.2 NTU.
DO calibration zero at 0.20 mg/L
1.5 gpm purge rate

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate	No	0	No Vis. Color or Turb.
(2) Sulfide	No	0	No Vis. Color or Turb.
(3) Manganese	No	1.5	Violet Color
(4) Ferrous Iron	No	4.42	Deep Rust Color.
(5) Alkalinity	1:4; 12.5+37.5 mL	8 drops x 20 = 160 x 4 = 640 mg/L as CaCO3.	
(6) Carbon Dioxide	No	50 ppm	
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [X] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [ ] 1800-Area; [X] 2500-Area MONITORING WELL: Well #5

DATE AND TIME OF SAMPLING: May 26, 1999 17:38 a.m./p.m.
SAMPLE COLLECTED BY: DW / TH of Parsons ES: Houston and Denver Offices.
WEATHER: _____

MONITORING WELL CONDITION:
1 [X] WELL NUMBER IS APPARENT
2 [ ] WELL NUMBER IS NOT APPARENT. EXPLAIN: _____
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:
5 [ ] PRODUCT OBSERVED AT DEPTH OF ____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:
7 [X] WATER DEPTH MEASURED AT 9.12 FT. BELOW DATUM WITH _____
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:
9 [X] PERISTALTIC PUMP AND DEDICATED TUBING dH2
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: Purging & probe ready up
Items Cleaned (List): _____

MONITORING WELL EVACUATION OBSERVATIONS:
Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments: _____
Other comments: _____

ON-SITE MEASUREMENTS:
12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:
14 [X] 1 MICROSEEPS Dissolved Hydrogen Vials (20 mL) taken @ 18:18

15 [ ] Notes/Comments/Other: _____

ON-SITE SAMPLE TREATMENT:
16 [X] NONE
17 [ ] [ ] FILTRATION: Method _____ Containers: _____
[ ] PRESERVATIVES Method _____ Containers: _____

CONTAINER HANDLING:
18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [ ] Containers Placed in Ice Chest

OTHER COMMENTS: TD: 60' + ≥ 55 gallons of H2O. need ≈ 28 gallons for 3 purges.

PARSONS ENGINEERING SCIENCE, INC.

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: Well #5

DIRECT INSTRUMENT READINGS

Time	17:40	17:46	17:53	17:59			Measured With
Temp (°C)	25.66	21.85	21.81	21.79			
pH	9.56	6.46	6.48	6.53			
Cond (µS/cm)	0.793	1.089	1.069	1.061			
Do (mg/L)	6.41	0.19	0.14	0.12			
Redox (mv)	70.4	-153.5	-155.6	-156			
Observations:	Clear	slightly cloudy	~~~~~>		Turb =		45 NTU.
gallons purged	1	10	20.5	29.5			

Additional Comments: _____

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate			
(2) Sulfide			
(3) Manganese			
(4) Ferrous Iron			
(5) Alkalinity			
(6) Carbon Dioxide			
(7) Chloride			

Additional Comments: _____

FIELD QA/QC PERFORMED AT THIS LOCATION? [ ] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: #5

DATE AND TIME OF SAMPLING: March 13, 1999 1335 a.m./p.m.
SAMPLE COLLECTED BY: DW / TH / JB of Parsons ES: Houston and Denver Offices.
WEATHER: @ 55° cloudy, windy

MONITORING WELL CONDITION:

1 [X] WELL NUMBER IS APPARENT
2 [ ] WELL NUMBER IS NOT APPARENT. EXPLAIN: _____
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:

5 [ ] PRODUCT OBSERVED AT DEPTH OF ____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:

7 [X] WATER DEPTH MEASURED AT 7.66 FT. BELOW DATUM WITH _____
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:

9 [ ] PERISTALTIC PUMP AND DEDICATED TUBING
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: GRUNDFOS
Items Cleaned (List): Pump & tubing Decond Before use

MONITORING WELL EVACUATION OBSERVATIONS:

Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments: None
Other comments: _____

ON-SITE MEASUREMENTS:

12 [ ] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:

14 [X] 8 SW8260A (40 mL VOAs); 2 DOC by E415.1 (50 mL GA Bottle); 6 NRMRL-147 (40 mL VOAs)
___Sulfate/Chloride by Meth. N-601 (____mL ____Bottle); ____Nitrate by E300/SW9056 (___mL ___Bottle)
15 [X] NONE/OTHER: Total IRON 2 - 1 L plastic

ON-SITE SAMPLE TREATMENT:

16 [X] NONE
17 [ ] [ ] FILTRATION: Method_____ Containers:_____
[ ] PRESERVATIVES Method_____ Containers:_____

CONTAINER HANDLING:

18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [ ] Containers Placed in Ice Chest

OTHER COMMENTS: _____

PARSONS ENGINEERING SCIENCE, INC.

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: MW5

DIRECT INSTRUMENT READINGS

Time	1303	1308	1313	1323	1328	1332	Measured With
Temp (°C)	19.4	22.07	22.11	22.13			
pH	6.76	6.83	6.90	6.42			
Cond (µS/cm)	0.982	1.045	1.053	1.059			
Do (mg/L)	3.77	0.37	0.35	0.24			
Redox (mv)	48.	-112.4	-137	-123*			
Observations: Spc / Turbd	1.075	1.106	1.114	1.12	12.2	6.7	
gallons purged	1	11	21	40	50	58	

Additional Comments: 2 gpm purge Rate
DO calibration Zeroed at 0.19 mg/L
* Meter Battery Died
Final Turbidity 7.4

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate	NO	0.0	no color or turbidity
(2) Sulfide	NO	0.0 mg/L	NO color, NO Turbidity.
(3) Manganese	NO	3.0 mg/L	Light Violet color
(4) Ferrous Iron	NO	4.70 mg/L	Deep Rust color
(5) Alkalinity	YES: 1:4 12.5:50mL	8drops X 20 = 160 mg/L	High Range test.
(6) Carbon Dioxide	NO	65 ppm	—
(7) Chloride			

Additional Comments: Samples Filtered before Analysis.

FIELD QA/QC PERFORMED AT THIS LOCATION? [ ] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: #6

DATE AND TIME OF SAMPLING: March 11, 1999 _____ a.m./(p.m.)
SAMPLE COLLECTED BY: (DW) / TH / (TB) of Parsons ES: Houston and Denver Offices.
WEATHER: ~60 F, overcast steady Breeze

MONITORING WELL CONDITION:
1 [X] WELL NUMBER IS APPARENT
2 [ ] WELL NUMBER IS NOT APPARENT. EXPLAIN: _____
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:
5 [ ] PRODUCT OBSERVED AT DEPTH OF _____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:
7 [ ] WATER DEPTH MEASURED AT 6.06 FT. BELOW DATUM WITH _____
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:
9 [ ] PERISTALTIC PUMP AND DEDICATED TUBING
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: GRUNDFOS
Items Cleaned (List): _____

MONITORING WELL EVACUATION OBSERVATIONS:
Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments: n/a
Other comments: _____

ON-SITE MEASUREMENTS:
12 [ ] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:
14 [X] 4 SW8260A (40 mL VOAs); 1 DOC by E415.1 (50 mL 6A Bottle); 3 NRMRL-147 (40 mL VOAs)
___Sulfate/Chloride by Meth. N-601 (____mL ____Bottle); ____Nitrate by E300/SW9056 (___mL ___Bottle)
15 [ ] NONE/OTHER: L All ML, 1L Plastic bottle

ON-SITE SAMPLE TREATMENT:
16 [X] NONE
17 [ ] [ ] FILTRATION: Method _____ Containers: _____
[ ] PRESERVATIVES Method _____ Containers: _____

CONTAINER HANDLING:
18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [X] Containers Placed in Ice Chest

OTHER COMMENTS: _____

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: #6

DIRECT INSTRUMENT READINGS

Time	1638	1643	1648	1658	1709	1715	Measured With
Temp (°C)	20.84	21.16	21.37	21.63	21.54	21.59	
pH	7.06	7.06	7.00	6.99	6.99	6.99	
Cond (µS/cm)	0.849	0.854	0.858	0.849	0.852	0.857	
Do (mg/L)	0.49	0.38	0.31	0.18	0.22	0.27	
Redox (mv)	-98.6	-133.4	-126		-131.6	-136.3	
Observations: SpG	0.723	0.922	0.920		0.912	0.907	
gallons purged	2	10	20	46	60	80	

Additional Comments: Turbidity = 5.3

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate	No	0.0	No Color or Turb
(2) Sulfide	No	0.0	No Color or Turbs.
(3) Manganese	No	1.17 mg/L	Light Violet
(4) Ferrous Iron	No	4.64 0 mg/L	Dep Rust.
(5) Alkalinity	Yes, 1:4; 12.5+37.5	9 drops x 20 = 180 x 4 = 720 mg/L as CaCO3	
(6) Carbon Dioxide	No	55 ppm	
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [X] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: #7

DATE AND TIME OF SAMPLING: March 12, 1999 1545 a.m./p.m.
SAMPLE COLLECTED BY: DW / TH / JB of Parsons ES: Houston and Denver Offices.
WEATHER: 50° slight br

MONITORING WELL CONDITION:

1 [X] WELL NUMBER IS APPARENT
2 [ ] WELL NUMBER IS NOT APPARENT. EXPLAIN: _____
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:

5 [ ] PRODUCT OBSERVED AT DEPTH OF _____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:

7 [X] WATER DEPTH MEASURED AT 13.64 FT. BELOW DATUM WITH _____
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:

9 [ ] PERISTALTIC PUMP AND DEDICATED TUBING
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: GRUNDFOS
Items Cleaned (List): _____

MONITORING WELL EVACUATION OBSERVATIONS:

Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments: none
Other comments: _____

ON-SITE MEASUREMENTS:

12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:

14 [ ] 4 SW8260A (40 mL VOAs); 1 DOC by E415.1 (50 mL 6A Bottle); 3 NRMRL-147 (40 mL VOAs)
___Sulfate/Chloride by Meth. N-601 (___mL ___Bottle); ___Nitrate by E300/SW9056 (___mL ___Bottle)
15 [X] NONE/OTHER: TOTAL IRON 1 1L Plastic

ON-SITE SAMPLE TREATMENT:

16 [X] NONE
17 [ ] [ ] FILTRATION: Method _____ Containers: _____
[ ] PRESERVATIVES Method _____ Containers: _____

CONTAINER HANDLING:

18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [X] Containers Placed in Ice Chest

OTHER COMMENTS: _____

PARSONS ENGINEERING SCIENCE, INC.

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: #7

DIRECT INSTRUMENT READINGS

Time	1512	1517	1522	1532	1537	1542	Measured With
Temp (°C)	21.77	22.35	22.39	22.43	22.41	22.41	
pH	6.75	6.75	6.75	6.74	6.74	6.74	
Cond (µS/cm)	1.038	1.027	1.025	1.027	1.027	1.027	
Do (mg/L)	1.50	0.55	0.44	0.42	0.41	0.41	
Redox (mv)	-31.4	-57.8	-66.8	-74.1	-76.6	-79.4	
Observations: spc	1.088	1.080	1.078	1.079	1.081	1.081	
gallons purged	2	10	17	32	39	47	

Additional Comments: 1.5 gpm purge Rate ; DO calibration = Zero at 0.20 mg/L
Turbidity = 6.9

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate	No	0.0	No Vis color or turb -
(2) Sulfide	No	0.008	No Vis. color or turb. - very, very slight amber.
(3) Manganese	No	4.9 mg/L	Violet Color
(4) Ferrous Iron	No	3.43 mg/L	Rust colored.
(5) Alkalinity	1:4; 12.5+37.5	8 drops x 20 = 160 x 4 = 640 mg/L	as $CaCO_3$.
(6) Carbon Dioxide	No	70 mg/L	-
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [X] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: Well #10

DATE AND TIME OF SAMPLING: May 26, 1999 8:08 (a.m.)/p.m.
SAMPLE COLLECTED BY: DW / TH of Parsons ES: Houston and Denver Offices.
WEATHER: Clear, Warm, Slight Breeze

MONITORING WELL CONDITION:
1 [ ] WELL NUMBER IS APPARENT
2 [X] WELL NUMBER IS NOT APPARENT. EXPLAIN: No Markings. Added Marking with Pen.
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:
5 [ ] PRODUCT OBSERVED AT DEPTH OF ____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:
7 [X] WATER DEPTH MEASURED AT 12.18 FT. BELOW DATUM WITH WL Probe.
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:
9 [X] PERISTALTIC PUMP AND DEDICATED TUBING For dH2
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: For purging; probe washer
Items Cleaned (List): _____

MONITORING WELL EVACUATION OBSERVATIONS:
Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments: _____
Other comments: Pump set at about 50 just below Tox.

ON-SITE MEASUREMENTS:
12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:
14 [X] 1 MICROSEEPS Dissolved Hydrogen Vials (20 mL)

15 [ ] Notes/Comments/Other: _____

ON-SITE SAMPLE TREATMENT:
16 [X] NONE
17 [ ] [ ] FILTRATION: Method _____ Containers: _____
[ ] PRESERVATIVES Method _____ Containers: _____

CONTAINER HANDLING:
18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [ ] Containers Placed in Ice Chest

OTHER COMMENTS: Total Screen depth = 89', ≈ 69' of GW.
purge ≈ 35 gallons for 3 volumes

PARSONS ENGINEERING SCIENCE, INC.

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: Well #10

DIRECT INSTRUMENT READINGS

Time	08:12	18:20	18:26	18:31	18:36	18:41	Measured With
Temp (°C)	21.43	21.33	21.33	21.33	21.33	21.33	
pH	6.60	6.68	6.68	6.68	6.68	6.69	
Sp. Cond (µS/cm)	1.36	1.310	1.248	1.214	1.193	1.170	
Do (mg/L)	2.95	2.38	2.08	2.08	2.08	2.14	
Redox (mv)	-2.1	75.4	-8.4	-30.7	-40.3	-46.6	
Observations:	Brown GW.	~	Light Tan	Light Turb.	~	~	Turb = 144 NTU
gallons purged	2	14	23	30.5	38	45.5	

- Do stopped. Erratic Behavior of Probe.

Additional Comments: DO & charge has dropped below 75 on YSI meter, Do is within theoretical operation range.
DO = 66.5 @ 18:26.

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate			
(2) Sulfide			
(3) Manganese			
(4) Ferrous Iron			
(5) Alkalinity			
(6) Carbon Dioxide			
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [ ] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: #10

DATE AND TIME OF SAMPLING: March 15, 1999 0825 a.m./p.m.
SAMPLE COLLECTED BY: DW / TH / JB of Parsons ES: Houston and Denver Offices.
WEATHER: 40° F, clear, ~~&~~ winds calm

MONITORING WELL CONDITION:
1 [ ] WELL NUMBER IS APPARENT
2 [X] WELL NUMBER IS NOT APPARENT. EXPLAIN: No Lock/ Tag / ID marker
3 [ ] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:
5 [ ] PRODUCT OBSERVED AT DEPTH OF _____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:
7 [X] WATER DEPTH MEASURED AT 9.59 FT. BELOW DATUM WITH _____
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:
9 [ ] PERISTALTIC PUMP AND DEDICATED TUBING
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: GRUNDFOS
Items Cleaned (List): _____

MONITORING WELL EVACUATION OBSERVATIONS:
Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - (very) cloudy
Water level (rose - fell - no change)
Water odors/comments: _____
Other comments: _____

ON-SITE MEASUREMENTS:
12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:
14 [ ] 4 SW8260A (40 mL VOAs); 1 DOC by E415.1 (250 mL 6M Bottle); 3 NRMRL-147 (40 mL VOAs)
Sulfate/Chloride by Meth. N-601 (___mL ___Bottle); ___Nitrate by E300/SW9056 (___mL ___Bottle)
15 [X] NONE/OTHER: Total Iron 250 mL pl. 1 1L pl.

ON-SITE SAMPLE TREATMENT:
16 [X] NONE
17 [X] FILTRATION: Method In-line Filter Containers: Geochem: water only - turbidity = 16.2 after filt
[ ] PRESERVATIVES Method _____ Containers: _____

CONTAINER HANDLING:
18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [ ] Containers Placed in Ice Chest

OTHER COMMENTS: _____

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: # 10

DIRECT INSTRUMENT READINGS

Time	7:49	6754	0759	0809	08:14	08:19	Measured With	0824	0826
Temp (°C)	20.8	21.3	21.4	21.5	21.5	21.5	YSI 55	21.5	21.5
pH	7	7		7	7		Litmus		7
Cond (µS/cm)	—	—	-	-	—	—	—	—	
Do (mg/L)	.75	0.30	0.25	0.18	0.17	.15	YSI-55	0.15	0.15
Redox (mv)	+54.8	+32	+7.3	−23.5	−34.3	-41.8	ORION - 250A	-44.5	-46.3
Observations: Turbidity	>440	118	57.2	53.1	38.8		HACH		46.6
gallons purged	1	6	11	21	26	31		36	~~46.6~~ 38

Additional Comments: DO zeroed at 0.32 mg/L (YSI-55)
purge Rate ~ 1 gpm, Silt accumulation in Flowthrough cell

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate	YES - 1:2 20mL sample : 20 mL DI	57.8 x 2 =	115.6 mg/L, cloudy very turbid.
(2) Sulfide	NO	0.000	No color/Turbidity
(3) Manganese	NO	2.4 mg/L	Light violet
(4) Ferrous Iron	NO	1.73 mg/L	Rust color no turb.
(5) Alkalinity	YES - 1:4 12.5:50	7 drops x 20 mg/L x 4 =	560 mg/L - 8
(6) Carbon Dioxide	NO	21 drops x 5 mg/L = 105 mg/L	high Range method (
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [ ] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: Well #13

DATE AND TIME OF SAMPLING: March 15, 1999 0925 (a.m.)/p.m.
SAMPLE COLLECTED BY: (DW) / TH / JB of Parsons ES: Houston and Denver Offices.
WEATHER: clear, cool, breezy temp 45° F

MONITORING WELL CONDITION:

1 [X] WELL NUMBER IS APPARENT
2 [ ] WELL NUMBER IS NOT APPARENT. EXPLAIN: _____
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:

5 [ ] PRODUCT OBSERVED AT DEPTH OF _____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:

7 [X] WATER DEPTH MEASURED AT 9.97 FT. BELOW DATUM WITH _____
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:

9 [ ] PERISTALTIC PUMP AND DEDICATED TUBING
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: Grundfos
Items Cleaned (List): _____

MONITORING WELL EVACUATION OBSERVATIONS:

Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - (fell) - no change)
Water odors/comments: None
Other comments: _____

ON-SITE MEASUREMENTS:

12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:

14 [ ] ___ SW8260A (40 mL VOAs); ___ DOC by E415.1 (___mL ___ Bottle); _____NRMRL-147 (40 mL VOAs)
___Sulfate/Chloride by Meth. N-601 (____mL ____Bottle); ____Nitrate by E300/SW9056 (___mL ___Bottle)
15 [ ] NONE/OTHER:

ON-SITE SAMPLE TREATMENT:

16 [X] NONE
17 [ ] [ ] FILTRATION: Method _____ Containers: _____
[ ] PRESERVATIVES Method _____ Containers: _____

CONTAINER HANDLING:

18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [X] Containers Placed in Ice Chest

OTHER COMMENTS: _____

PARSONS ENGINEERING SCIENCE, INC.

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [X] 1800-Area; [ ] 2500-Area MONITORING WELL: Well # 13

DIRECT INSTRUMENT READINGS

Time	0850	0855	0900	0910	0915	0920	Measured With
Temp (°C)	21.5	21.3	21.8	21.9	21.8	21.8	~~Orit~~ YSI DO 55
pH	7.2	7.2	7.2	7	7	7	HTH Test Strips
Cond (µS/cm)	—	—	—	—	—	—	—
Do (mg/L)	0.19	0.17	0.16	0.13	0.12	0.11	YSI 55 DO
Redox (mv)	104.2	83.7	62.6	56.0	57.6	57.3	orion Model 250A
Observations:	59.6	30.6	7.2	4.9	2.8	1.1	Hach Turbidity meter
gallons purged	1	6	11	21	26	31	

Additional Comments: 1 gpm pumping

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate	NO	6.3 mg/L, 2.4 mg/L	Slight turbidity.
(2) Sulfide		0.010 mg/L, 0.000	NO Pink color, NO blue color / Turbidity.
(3) Manganese	NO	1.1 mg/L, 1.0 mg/L	Light violet color, no turbidity.
(4) Ferrous Iron	NO	2.84 mg/L, 2.77 mg/L	Rust color
(5) Alkalinity	1:4 - 12.5 - 37.5	6 drops x 20 x 4 = 480 mg/L, 480 mg/L	
(6) Carbon Dioxide	~~1:1~~ 1:2 20mL: 40 mL	16 drops x 5 mg/L/drop x 2 = 160 mg/L, 16 x 5 x 2 = 160 mg/L (Dup)	
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [ ] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB. [X] 1800-Area; [ ] 2500-Area MONITORING WELL: Well #13

DATE AND TIME OF SAMPLING: May 26, 1999 09:06 (a.m)/p.m.
SAMPLE COLLECTED BY: DW / TH of Parsons ES: Houston and Denver Offices.
WEATHER: Clear, Sunny, Warm, Slightly Breezy

MONITORING WELL CONDITION:
1 [X] WELL NUMBER IS APPARENT
2 [ ] WELL NUMBER IS NOT APPARENT. EXPLAIN:
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN:
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

PRODUCT INFORMATION:
5 [ ] PRODUCT OBSERVED AT DEPTH OF ____ FT. BELOW DATUM WITH
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:
7 [X] WATER DEPTH MEASURED AT 11.66 FT. BELOW DATUM WITH WL meter
8 [ ] OTHER. EXPLAIN:

MONITORING WELL EVACUATION METHOD:
9 [X] PERISTALTIC PUMP AND DEDICATED TUBING for dH2
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: To Purge ; take Probe readings
Items Cleaned (List):

MONITORING WELL EVACUATION OBSERVATIONS:
Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments:
Other comments:

ON-SITE MEASUREMENTS:
12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN:

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:
14 [X] 1 MICROSEEPS Dissolved Hydrogen Vials (20 mL)

15 [ ] Notes/Comments/Other:

ON-SITE SAMPLE TREATMENT:
16 [X] NONE
17 [ ] [ ] FILTRATION: Method Containers:
[ ] PRESERVATIVES Method Containers:

CONTAINER HANDLING:
18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [ ] Containers Placed in Ice Chest

OTHER COMMENTS: Total Screen Depth = 80', Water column ~ 71'
Purge ~ 36 gallons.

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: Wall #13

DIRECT INSTRUMENT READINGS

Time	09:10	09:15	09:21	~~09:27~~ 09:31	09:36		Measured With
Temp (°C)	22.83	21.72	21.67	21.67	21.67		
pH	7.49	6.91	6.86	6.85	6.84		
Sp. Cond (µS/cm)	0.930	0.951	0.942	0.938	0.934		
Do (mg/L)	6.55	1.98	2.14	2.09	2.03	~~~~	DO Jumped. Erratic Behavior of Probe.
Redox (mv)	-77.0	-111.9	-114.9	-116.2	-116.8		
Observations:	Clear	clear	clear	Clear	Clear.		
gallons purged	0.5	8	17	24.5	40		

Additional Comments:
Turbidity - 57 NTU

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate			
(2) Sulfide			
(3) Manganese			
(4) Ferrous Iron			
(5) Alkalinity			
(6) Carbon Dioxide			
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [ ] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: Well #14

DATE AND TIME OF SAMPLING: May 26, 1999 15:43 a.m./p.m.
SAMPLE COLLECTED BY: DW / TH of Parsons ES: Houston and Denver Offices.
WEATHER: Overcast, Warm, Muggy, Slight Breeze

MONITORING WELL CONDITION:
1 [X] WELL NUMBER IS APPARENT
2 [ ] WELL NUMBER IS NOT APPARENT. EXPLAIN: _____
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:
5 [ ] PRODUCT OBSERVED AT DEPTH OF ____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:
7 [X] WATER DEPTH MEASURED AT 10.57 FT. BELOW DATUM WITH WL Probe
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:
9 [X] PERISTALTIC PUMP AND DEDICATED TUBING dHg
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: Purge : hole readings
Items Cleaned (List): _____

MONITORING WELL EVACUATION OBSERVATIONS:
Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments: _____
Other comments: _____

ON-SITE MEASUREMENTS:
12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:
14 [X] X MICROSEEPS Dissolved Hydrogen Vials (20 mL) Taken @ 16:35
15 [ ] Notes/Comments/Other: _____

ON-SITE SAMPLE TREATMENT:
16 [X] NONE
17 [ ] [ ] FILTRATION: Method _____ Containers: _____
[ ] PRESERVATIVES Method _____ Containers: _____

CONTAINER HANDLING:
18 [X] Container Sides Labeled
19 [X] Container Lids Taped
20 [ ] Containers Placed in Ice Chest

OTHER COMMENTS: TD = 100', ~ 98'. Vol to purge ≈ 45 gallons.

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: well # 14

DIRECT INSTRUMENT READINGS

Time	1546	1556	1606	1616			Measured With
Temp (°C)	21.70	21.03	20.98	20.99			
pH	7.34	6.79	6.75	6.74			
Sp Cond (µS/cm)	0.804	0.867	0.877	0.879			
Do (mg/L)	2.80	0.53	0.26	0.24			
Redox (mv)	-119.4	-102.1	-100.4	-100.2			
Observations:	clear	cloudy	Clear	clear.	Turb =		15 NTU.
gallons purged	1	16	31	46			

Additional Comments: 1.5 gpm purging rate
purge 45 gallons ≈ 3 well volumes

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate			
(2) Sulfide			
(3) Manganese			
(4) Ferrous Iron			
(5) Alkalinity			
(6) Carbon Dioxide			
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [ ] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: well # 14

DATE AND TIME OF SAMPLING: March 16, 1999 1510 a.m./(p.m.)
SAMPLE COLLECTED BY: (DW) / TH / JB of Parsons ES: Houston and Denver Offices.
WEATHER: Clear cool Temp 65

MONITORING WELL CONDITION:

1 [X] WELL NUMBER IS APPARENT
2 [ ] WELL NUMBER IS NOT APPARENT. EXPLAIN: _____
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:

5 [ ] PRODUCT OBSERVED AT DEPTH OF ____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:

7 [X] WATER DEPTH MEASURED AT 7.79 FT. BELOW DATUM WITH _____
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:

9 [ ] PERISTALTIC PUMP AND DEDICATED TUBING
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: Grundfos
Items Cleaned (List): _____

MONITORING WELL EVACUATION OBSERVATIONS:

Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly / very) cloudy
Water level (rose / fell / no change)
Water odors/comments: No Odor
Other comments: _____

ON-SITE MEASUREMENTS:

12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:

14 [X] 4 SW8260A (40 mL VOAs); 1 DOC by E415.1 (___mL ___ Bottle); 3 NRMRL-147 (40 mL VOAs)
1 Sulfate/Chloride by Meth. N-601 (____mL ____Bottle); 1 Nitrate by E300/SW9056 (___mL ___Bottle)
15 [X] NONE/OTHER: Total Iron

ON-SITE SAMPLE TREATMENT:

16 [X] NONE
17 [ ] [ ] FILTRATION: Method _____ Containers: _____
[ ] PRESERVATIVES Method _____ Containers: _____

CONTAINER HANDLING:

18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [X] Containers Placed in Ice Chest

OTHER COMMENTS: _____

PARSONS ENGINEERING SCIENCE, INC.

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: Well #14

DIRECT INSTRUMENT READINGS

Time	1435	1440	1445	1455	1500	1505	Measured With
Temp (°C)	21.62	21.71	21.70	21.70	21.68	21.70	YSI 610-D
pH	6.90	6.84	6.83	6.81	6.80	6.80	"
Cond (µS/cm)	0.824	0.838	0.836	0.837	0.835	0.837	"
Do (mg/L)	0.44	0.43	0.44	0.45	0.45	0.45	"
Redox (mv)	-101.7	-143.0	-152.6	-159.7	-161.6	-163.3	"
Observations:	0.872 / 22.4	0.882 / 18.6	0.881 / 7.7	0.883 / 1.1	0.881 / 0.8	0.881 / 0.5	YSI 610-D / Hach Turbidity
gallons purged	1	11	21	41	51	61	

Additional Comments: 2 gpm pumping

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate	NO	0.0 mg/L	No Turbidity – Dup discolor – some rust
(2) Sulfide	NO	0.009 mg/L	no blue color.
(3) Manganese	NO	0.9 mg/L	Light Violet color.
(4) Ferrous Iron	NO	3.27 mg/L	Rust color.
(5) Alkalinity	1:4 12.5:37.5	6 drops × 20 mg/L/drop × 4 =	480 mg/L
(6) Carbon Dioxide	1:2 20:40	15 mg/L × 5 mg/L/drop × 2	= 150 mg/L high Rangetest
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [ ] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB. [X] 1800-Area; [ ] 2500-Area MONITORING WELL: Well #15

DATE AND TIME OF SAMPLING: May 26, 1999 15:20 a.m./p.m.
SAMPLE COLLECTED BY: DW / TH of Parsons ES: Houston and Denver Offices.
WEATHER: Overcast, warm, muggy, Light Breeze

MONITORING WELL CONDITION:
1 [X] WELL NUMBER IS APPARENT
2 [ ] WELL NUMBER IS NOT APPARENT. EXPLAIN:
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN:
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

PRODUCT INFORMATION:
5 [ ] PRODUCT OBSERVED AT DEPTH OF ____ FT. BELOW DATUM WITH
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:
7 [X] WATER DEPTH MEASURED AT 11.01 FT. BELOW DATUM WITH
8 [ ] OTHER. EXPLAIN:

MONITORING WELL EVACUATION METHOD:
9 [X] PERISTALTIC PUMP AND DEDICATED TUBING - dH2 Collected @ 15:58
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: Purging - Pump ready
Items Cleaned (List):

MONITORING WELL EVACUATION OBSERVATIONS:
Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments:
Other comments:

ON-SITE MEASUREMENTS:
12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN:

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:
14 [X] 1 MICROSEEPS Dissolved Hydrogen Vials (20 mL)

15 [ ] Notes/Comments/Other:

ON-SITE SAMPLE TREATMENT:
16 [X] NONE
17 [ ] [ ] FILTRATION: Method Containers:
[ ] PRESERVATIVES Method Containers:

CONTAINER HANDLING:
18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [ ] Containers Placed in Ice Chest

OTHER COMMENTS: Depth = 70', ~~depth~~ ≈ 62' gH2O, purge ≈ 31 gallons for 3 purges.

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: Well #15

DIRECT INSTRUMENT READINGS

Time	15:24	15:30	15:36	15:43			Measured With
Temp (°C)	22.27	21.15	21.12	21.11			
pH	7.26	6.76	6.74	6.76			
Sp Cond (mS/cm)	0.829	0.854	0.859	0.861			
Do (mg/L)	1.73	0.23	0.23	0.23			
Redox (mv)	-69.8	-70.0	-73.3	-78.1			
Observations:	Clear.	Iron, Turbid	Turbid. →		Turb = 38 NTU.		
gallons purged	2	11	20.	31			

Additional Comments:

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate			
(2) Sulfide			
(3) Manganese			
(4) Ferrous Iron			
(5) Alkalinity			
(6) Carbon Dioxide			
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [ ] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: Well #15

DATE AND TIME OF SAMPLING: March 16, 1999 1610 a.m. (p.m.)
SAMPLE COLLECTED BY: (DW) / TH / JB of Parsons ES: Houston and Denver Offices.
WEATHER: Clear cool hazy Temp 65°F

MONITORING WELL CONDITION:

1 [X] WELL NUMBER IS APPARENT
2 [ ] WELL NUMBER IS NOT APPARENT. EXPLAIN: _____
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:

5 [ ] PRODUCT OBSERVED AT DEPTH OF ____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:

7 [X] WATER DEPTH MEASURED AT 8.24 FT. BELOW DATUM WITH ART EIP
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:

9 [ ] PERISTALTIC PUMP AND DEDICATED TUBING
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: Grundfos
Items Cleaned (List): _____

MONITORING WELL EVACUATION OBSERVATIONS:

Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly) very) cloudy
Water level (rose (fell) no change)
Water odors/comments: No Odor
Other comments: _____

ON-SITE MEASUREMENTS:

12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:

14 [X] 4 SW8260A (40 mL VOAs); 1 DOC by E415.1 (___mL ___ Bottle); 3 NRMRL-147 (40 mL VOAs)
1 Sulfate/Chloride by Meth. N-601 (___mL ___Bottle); 1 Nitrate by E300/SW9056 (___mL ___Bottle)
15 [X] NONE/OTHER: Total Iron

ON-SITE SAMPLE TREATMENT:

16 [ ] NONE
17 [ ] [ ] FILTRATION: Method_____ Containers:_____
[ ] PRESERVATIVES Method_____ Containers:_____

CONTAINER HANDLING:

18 [ ] Container Sides Labeled
19 [ ] Container Lids Taped
20 [ ] Containers Placed in Ice Chest

OTHER COMMENTS: collected Duplicate (MW-15D) for all parameters in 14 + 15

PARSONS ENGINEERING SCIENCE, INC.

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: Well #16

DATE AND TIME OF SAMPLING: March 16, 1999 1055 (a.m.)/p.m.
SAMPLE COLLECTED BY: (DW) TH / JB of Parsons ES: Houston and Denver Offices.
WEATHER: clear, cool Temp 58°

MONITORING WELL CONDITION:

1 [ ] WELL NUMBER IS APPARENT
2 [X] WELL NUMBER IS NOT APPARENT. EXPLAIN: No tag or marker
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:

5 [ ] PRODUCT OBSERVED AT DEPTH OF ____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:

7 [X] WATER DEPTH MEASURED AT 3.11 FT. BELOW DATUM WITH Art EIP
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:

9 [ ] PERISTALTIC PUMP AND DEDICATED TUBING
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: Grundfos
Items Cleaned (List): _____

MONITORING WELL EVACUATION OBSERVATIONS:

Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose (fell) no change)
Water odors/comments: No odor
Other comments: _____

ON-SITE MEASUREMENTS:

12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:

14 [X] 4 SW8260A (40 mL VOAs); 1 DOC by E415.1 (___mL ___ Bottle); 3 NRMRL-147 (40 mL VOAs)
1 Sulfate/Chloride by Meth. N-601 (___mL ___Bottle); 1 Nitrate by E300/SW9056 (___mL ___Bottle)
15 [X] NONE/OTHER: Total Iron

ON-SITE SAMPLE TREATMENT:

16 [ ] NONE
17 [ ] [ ] FILTRATION: Method _____ Containers: _____
[ ] PRESERVATIVES Method _____ Containers: _____

CONTAINER HANDLING:

18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [X] Containers Placed in Ice Chest

OTHER COMMENTS: _____

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: Well # 16

DIRECT INSTRUMENT READINGS

Time	1020	1025	1030	1040	1045	1050	Measured With
Temp (°C)	21.2	21.4	21.4	21.4	21.5	21.5	DO YSI 55
pH	7.2	7.2	7	7	7	7	HTH Test Strips
Cond (µS/cm)	-	~	~	~	~	~	-
Do (mg/L)	1.48	0.41	0.28	0.23	0.28	0.26	DO YSI 55
Redox (mv)	-60.9	-77.0	-77.8	-78.6	-78.3	-78.4	Orion Model 250A
Observations:	38.7	12.7	6.2	4.9	1.3	1.4	Hach Turbidity
gallons purged	1	6	11	21	26	31	

Additional Comments: 1 gpm pumping

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate	NO	85.3 mg/L	Very Turbid.
(2) Sulfide	NO	0.009 mg/L	NO blue color
(3) Manganese	NO	0.5 mg/L	Light Violet color no turbidity
(4) Ferrous Iron	NO	3.07	Deep Rust color.
(5) Alkalinity	1:4 12.5 : 50	6 drops x 20 mg/L/drop x 4 =	480 mg/L
(6) Carbon Dioxide	NO	18 drops x 5 mg/L/drop =	90 mg/L High Range
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [ ] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: Well #15

DIRECT INSTRUMENT READINGS

Time	1535	1540	1545	1555	1600	1605	Measured With
Temp (°C)	21.56	21.79	21.81	21.82	21.82	21.82	YSI-610-D
pH	6.87	6.84	6.83	6.83	6.84	6.84	"
Cond (µS/cm)	0.804	0.813	0.815	0.816	0.816	0.816	"
Do (mg/L)	0.50	0.50	0.49	0.49	0.50	0.49	"
Redox (mv)	-145.8	-135.7	-143.0	-152.7	-155.8	-155.9	"
Observations:	0.881 >440	0.865 10.4	0.865 5.2	0.868 1.1	0.869 0.7	0.871 0.6	YSI-610-D / Hach Turbidity
gallons purged	1	11	21	41	51	61	

Additional Comments:

2 gpm pumping
collected Duplicate for all parameters -> MW-151D

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate	NO	8.9 mg/L	Slight Turbidity
(2) Sulfide	NO	0.012 mg/L	no blue color
(3) Manganese	NO	0.8 mg/L	Light violet
(4) Ferrous Iron	NO	2.50 mg/L	Deep. Purp. color
(5) Alkalinity	1:4 12.5:50 mL	6 drops x 20 mg/L/drop x 4 = 480 mg/L	high range test.
(6) Carbon Dioxide	1:2 20:40 mL	14 drops x 5 mg/L/drop x 2 = 140 mg/L	High range test
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [ ] No; [X] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: # 17

DATE AND TIME OF SAMPLING: March 16, 1999 _____ a.m./p.m.
SAMPLE COLLECTED BY: (DW) / TH / (JB) of Parsons ES: Houston and Denver Offices.
WEATHER: clear, calm winds, temp ~ 50° F pressure ~ 30.12 in.Hg

MONITORING WELL CONDITION:

1 [ ] WELL NUMBER IS APPARENT
2 [X] WELL NUMBER IS NOT APPARENT. EXPLAIN: No tag/markings
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:

5 [ ] PRODUCT OBSERVED AT DEPTH OF _____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:

7 [X] WATER DEPTH MEASURED AT 5.28 FT. BELOW DATUM WITH _____
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:

9 [ ] PERISTALTIC PUMP AND DEDICATED TUBING
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: GRUNDFOS
Items Cleaned (List): _____

MONITORING WELL EVACUATION OBSERVATIONS:

Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments: _____
Other comments: _____

ON-SITE MEASUREMENTS:

12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:

14 [ ] ___ SW8260A (40 mL VOAs); ___ DOC by E415.1 (___mL ___ Bottle); _____NRMRL-147 (40 mL VOAs)
___Sulfate/Chloride by Meth. N-601 (____mL ____Bottle); ____Nitrate by E300/SW9056 (___mL ___Bottle)
15 [ ] NONE/OTHER:

ON-SITE SAMPLE TREATMENT:

16 [ ] NONE
17 [ ] [ ] FILTRATION: Method_____ Containers: _____
[ ] PRESERVATIVES Method_____ Containers: _____

CONTAINER HANDLING:

18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [ ] Containers Placed in Ice Chest

OTHER COMMENTS: _____

PARSONS ENGINEERING SCIENCE, INC.

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: #17

DIRECT INSTRUMENT READINGS

Time	0820	0825	0830	0840	0845	0850	Measured With
Temp (°C)	21.7	22.3	22.3	22.4	22.4	22.4	DO YSI 55
pH	7	7	7	7	7	7	HTH STrips
Cond (µS/cm)	-	-	-	-	-	-	-
Do (mg/L)	2.54	0.58	0.23	0.19	0.21	0.21	DO YSI 55
Redox (mv)	163.1	139.5	119.6	98.6	92.1	87.5	Orion Model 250A
Observations:	23.0	6.0	1.9	0.8	0.9	0.5	Hach Turbidity
gallons purged	1	6	11	21	26	31	

Additional Comments: 1 gpm pumping

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate	NO	66.2, 64.6 mg/L	very turbid
(2) Sulfide	NO	0.009 mg/L, 0.016 mg/L	no color (Pink/blue)
(3) Manganese	NO	0.7 mg/L ; 0.4 mg/L	Light Violet color
(4) Ferrous Iron	NO	0.00, 0.00	No color/Turbidity
(5) Alkalinity	1:4 12.5:50 mL	16 drops for each test x20 mg/L x 4 = ~~320 mg/L~~ 1280 mg/L as $CaCO_3$	
(6) Carbon Dioxide	NO	19 drop x 5 mg/L/drop = 95 mg/L (High Range)	
(7) Chloride			

Additional Comments: Duplicates Completed For this well

FIELD QA/QC PERFORMED AT THIS LOCATION? [ ] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [X] 1800-Area; [ ] 12500-Area MONITORING WELL: Well #17

DATE AND TIME OF SAMPLING: May 26, 1999 13:29 a.m./p.m.
SAMPLE COLLECTED BY: DW / TH of Parsons ES: Houston and Denver Offices.
WEATHER: Light Showers, overcast, partly sunny.

MONITORING WELL CONDITION:
1 [ ] WELL NUMBER IS APPARENT
2 [X] WELL NUMBER IS NOT APPARENT. EXPLAIN:
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN:
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

PRODUCT INFORMATION:
5 [ ] PRODUCT OBSERVED AT DEPTH OF ____ FT. BELOW DATUM WITH
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:
7 [X] WATER DEPTH MEASURED AT 8.13 FT. BELOW DATUM WITH
8 [ ] OTHER. EXPLAIN:

MONITORING WELL EVACUATION METHOD:
9 [X] PERISTALTIC PUMP AND DEDICATED TUBING for dH2, VOC's & methane.
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER:
Items Cleaned (List):

MONITORING WELL EVACUATION OBSERVATIONS:
Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments:
Other comments:

ON-SITE MEASUREMENTS:
12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN:

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:
14 [X] 1 MICROSEEPS Dissolved Hydrogen Vials (20 mL) Taken @ 14:17
15 [X] Notes/Comments/Other: 3 VOAs for VOC, 3 VOAs for methane. Taken @ 14:00

ON-SITE SAMPLE TREATMENT:
16 [X] NONE
17 [ ] [ ] FILTRATION: Method Containers:
[ ] PRESERVATIVES Method Containers:

CONTAINER HANDLING:
18 [X] Container Sides Labeled
19 [X] Container Lids Taped
20 [ ] Containers Placed in Ice Chest

OTHER COMMENTS: Total Depth = 65', 8.13 feet Bgs, ≈ 57'
≈ 29 gallons for 3 purges

PARSONS ENGINEERING SCIENCE, INC.

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: Well #17

DIRECT INSTRUMENT READINGS

Time	13:32	13:37	13:43	13:49	13:55		Measured With
Temp (°C)	24.34	22.32	22.30	22.81	22.34		
pH	7.63	6.78	6.73	6.70	6.69		
SP Cond (µS/cm)	0.814	0.895	0.903	0.903	0.903		
Do (mg/L)	6.91	0.43	0.27	0.29	0.26		
Redox (mv)	78.9	+52.8	53.9	59.7	67.0		
Observations:	Clear	Brown; Turbid	~	~	Slightly Turbid.	Turb:	72 NTU.
gallons purged	1 gal.	8.5 gal	17.5 gal	26.5	35		

Additional Comments: _____

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate			
(2) Sulfide			
(3) Manganese			
(4) Ferrous Iron			
(5) Alkalinity			
(6) Carbon Dioxide			
(7) Chloride			

Additional Comments: _____

FIELD QA/QC PERFORMED AT THIS LOCATION? [ ] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: #18

DATE AND TIME OF SAMPLING: March 14, 1999 1720 a.m./(p.m.)
SAMPLE COLLECTED BY: (DW / TH / JB) of Parsons ES: Houston and Denver Offices.
WEATHER: ~~50~~ 42°F, cloudy, windy

MONITORING WELL CONDITION:
1 [X] WELL NUMBER IS APPARENT
2 [ ] WELL NUMBER IS NOT APPARENT. EXPLAIN: _____
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:
5 [ ] PRODUCT OBSERVED AT DEPTH OF _____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:
7 [X] WATER DEPTH MEASURED AT 6.65 FT. BELOW DATUM WITH _____
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:
9 [ ] PERISTALTIC PUMP AND DEDICATED TUBING
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: GRUNDFOS
Items Cleaned (List): _____

MONITORING WELL EVACUATION OBSERVATIONS:
Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments: _____
Other comments: _____

ON-SITE MEASUREMENTS:
12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:
14 [X] 4 SW8260A (40 mL VOAs); 1 DOC by E415.1 (500 mL GA Bottle); 3 NRMRL-147 (40 mL VOAs)
___ Sulfate/Chloride by Meth. N-601 (___ mL ___ Bottle); ___ Nitrate by E300/SW9056 (___ mL ___ Bottle)
15 [X] NONE/OTHER: Total IRON - 1 500 mL Pl. ½ 1 L Pl.

ON-SITE SAMPLE TREATMENT:
16 [X] NONE
17 [ ] [ ] FILTRATION: Method _____ Containers: _____
[ ] PRESERVATIVES Method _____ Containers: _____

CONTAINER HANDLING:
18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [ ] Containers Placed in Ice Chest

OTHER COMMENTS: _____

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: #18

DIRECT INSTRUMENT READINGS

Time	1641	1646	1651	1702	1707	1712	Measured With
Temp (°C)	21.2	21.6	21.6	21.6	21.6	21.6	YSI 55
pH	7	7		7		7	Litmus Paper
Cond (µS/cm)	—	—	—	—			N/A
Do (mg/L)	0.74	0.17	0.15	0.14	0.12	0.12	
Redox (mv)	-91.2	-91.2	-91.2	-96.5	-97.7	-97.3	ORION 250A
Observations: Turbidity	23.6	427	11.7	2.6	1.5	0.6	
gallons purged	2	7	12	23	28	33	

Additional Comments: 1gpm purge Rate
DO Exceeded 0.10 mg/L

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate		47.9 mg/L	Turbidity
(2) Sulfide		0.000	No color or Turb.
(3) Manganese		0.8 mg/L	Violet No turb.
(4) Ferrous Iron		2.79	Rust Color No Turb.
(5) Alkalinity	1:4, 12.5 mL + 37.5	6 drops x 20 = 120 mg/L x 4 = 480 mg/L as $CaCO_3$	
(6) Carbon Dioxide		13 drops x 5 mg/L/drop = 65 mg/L	CO_2 (High range of HACH method)
(7) Chloride			

Additional Comments:

Well #18
Ferrous - 2.79 - Rust Color - No Turb.
Sulfide - 0.000 No color or Turb
Sulfate - 47.9 mg/L Turbidity.
Manganese - 0.8 mg/L Violet - No Turb
CO_2 - 13 drops x 5 mg/L/drop = 65 mg/L CO_2 (High Range by CO_2 Hach kit)
Alk - 6 drops x 20 = 120 mg/L x 4 = 480 mg/L as $CaCO_3$
Diluted 1:4, 12.5 mL + 37.5 mL

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: #19

DATE AND TIME OF SAMPLING: March 14, 1999 1805 a.m./p.m.
SAMPLE COLLECTED BY (DW / TH / JB) of Parsons ES: Houston and Denver Offices.
WEATHER: 42°F cloudy windy

MONITORING WELL CONDITION:
1 [X] WELL NUMBER IS APPARENT
2 [ ] WELL NUMBER IS NOT APPARENT. EXPLAIN:
3 [ ] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN:
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

PRODUCT INFORMATION:
5 [ ] PRODUCT OBSERVED AT DEPTH OF ____ FT. BELOW DATUM WITH
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:
7 [X] WATER DEPTH MEASURED AT 6.86 FT. BELOW DATUM WITH
8 [ ] OTHER. EXPLAIN:

MONITORING WELL EVACUATION METHOD:
9 [ ] PERISTALTIC PUMP AND DEDICATED TUBING
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: Grundfos.
Items Cleaned (List):

MONITORING WELL EVACUATION OBSERVATIONS:
Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments:
Other comments:

ON-SITE MEASUREMENTS:
12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN:

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:
14 [X] 7 SW8260A (40 mL VOAs); 1 DOC by E415.1 (50 mL 4A Bottle); 3 NRMRL-147 (40 mL VOAs)
X Sulfate/Chloride by Meth. N-601 (1000 mL P Bottle); X Nitrate by E300/SW9056 (mL Bottle)
15 [ ] NONE/OTHER: MS/MSD (same sample time) SAMPLE TIME (1806) combined.

ON-SITE SAMPLE TREATMENT:
16 [X] NONE
17 [ ] [ ] FILTRATION: Method Containers:
[ ] PRESERVATIVES Method Containers:

CONTAINER HANDLING:
18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [ ] Containers Placed in Ice Chest

OTHER COMMENTS:

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: #19

DIRECT INSTRUMENT READINGS

Time	1727	1733	1738	1748	1753	1758	Measured With
Temp (°C)	21.3	21.5	21.6	21.7	21.7	21.8	YSI 55
pH	7		7.2	-	7.2	7	Litmus Paper
Cond (µS/cm)	-	-	-	-	-	-	N/A
Do (mg/L)	0.23	0.13	0.12	0.11	0.11	0.10	YSI 55
Redox (mv)	+252.8	+261.4	+264.9	+261.4	+266.9	+277.0	ORION 250A
Observations: Turbid, H	72.5	16.8	6.2	1.3	0.6	0.7	HACH
gallons purged	3	9	14	19	24	29	

Additional Comments: DO ZEROED AT 0.10 mg/L

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate	Yes, 1:2, 25+25 mL	58mg/L x 2 = 116 mg/L	- white Turbidity
(2) Sulfide	No	0.060	No color or Turb.
(3) Manganese	No	1.0 mg/L	Violet Color.
(4) Ferrous Iron	No	1.59 mg/L	Orange/Rust - ok ✓
(5) Alkalinity	1:4, 10mL + 30 mL	0 drops x 20 mg/L/drop = 140 x 4 =	560 mg/L as CaCO3.
(6) Carbon Dioxide	No	17 drops x 5 mg/L = 85 mg/L	Hach High Range
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [ ] No; [X] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes
Manganese	0 mg/L	1 mg/L	No Vis Turbidity. Violet color
	1	2.3 mg/L	
	2.5	3.6 mg/L	
	5	5.9 mg/L	
	10	10.9 mg/L	
CO_2 (No Dilute)	0 mg/L	17 drops x 5 = 85 mg/L	
No Dilute	10 mg/L	20 drops x 5 = 100 mg/L	
Dilute 1:2	50 mg/L	19 drops x 5 = 95 mg/L x 2 = 190 mg/L	
Dilute 1:2	25 mg/L	18 drops x 5 = 90 mg/L x 2 = 180 mg/L	
Dilute 1:2	100 mg/L	21 drops x 5 = 105 mg/L x 2 = 210 mg/L	
Sulfate	0, Dilute 1:2	58 mg/L x 2 = 116 mg/L	
	10 mg/L, Dilute 1:2	62.3 mg/L x 2 = 124.6 mg/L	
	20 mg/L	71.8 mg/L x 2 = 143.6 mg/L	
	40 mg/L	80.4 mg/L x 2 = 160.8 mg/L	
	80 mg/L	90.9 mg/L x 2 = 181.8 mg/L	- Bit out of Range - though looks good.
Alkalinity 1:4	0 mg/L	7 drops x 20 = 140 mg/L x 4 = 560 mg/L	
	50 mg/L	7 drops x 20 = 140 mg/L x 4 = 560 mg/L	
	100 mg/L	9 drops x 20 = 180 mg/L x 4 = 720 mg/L	↓ end
	200 mg/L	Not High Res.	END.
	300 mg/L	No sample left.	

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [X] 1800-Area; [ ] 2500-Area MONITORING WELL: Well #20

DATE AND TIME OF SAMPLING: May 26, 1999 14:22 a.m./p.m.
SAMPLE COLLECTED BY: DW / TH of Parsons ES: Houston and Denver Offices.
WEATHER: Breezy, Muggy, Partly Sunny

MONITORING WELL CONDITION:
1 [X] WELL NUMBER IS APPARENT
2 [ ] WELL NUMBER IS NOT APPARENT. EXPLAIN:
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN:
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

PRODUCT INFORMATION:
5 [ ] PRODUCT OBSERVED AT DEPTH OF ____ FT. BELOW DATUM WITH
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:
7 [ ] WATER DEPTH MEASURED AT 5.98 FT. BELOW DATUM WITH WL meter
8 [ ] OTHER. EXPLAIN:

MONITORING WELL EVACUATION METHOD:
9 [X] PERISTALTIC PUMP AND DEDICATED TUBING dH J
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: Purgy ; Probe readings
Items Cleaned (List):

MONITORING WELL EVACUATION OBSERVATIONS:
Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments:
Other comments:

ON-SITE MEASUREMENTS:
12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN:

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:
14 [X] 1 MICROSEEPS Dissolved Hydrogen Vials (20 mL)

15 [ ] Notes/Comments/Other:

ON-SITE SAMPLE TREATMENT:
16 [X] NONE
17 [ ] [ ] FILTRATION: Method Containers:
[ ] PRESERVATIVES Method Containers:

CONTAINER HANDLING:
18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [ ] Containers Placed in Ice Chest

OTHER COMMENTS: 130' bgs. , ≈ 124 Gal of H2O , ≈ 60 gallons for 3 purges

PARSONS ENGINEERING SCIENCE, INC.

ON-SITE MEASUREMENT FORM

MPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: Well #20

DIRECT INSTRUMENT READINGS

Time	14:24	14:29	14:39	14:49	14:59		Measured With
Temp (°C)	27.66	21.18	21.07	21.04	21.06		
pH	7.73	7.22	6.71	6.69	6.67		
Cond (mS/cm)	0.798	0.849	0.988	0.995	0.996		
Do (mg/L)	7.61	0.26	0.34	0.26	0.26		
Redox (mv)	158.9	-126.8	-100.0	-99.9	-99.3		
Observations:	clear	clear	slightly turbid	slightly turbid	→	Turbo @ 39 NTU.	
gallons purged	1 gall	8.5 gal	23.5	38.5	53.5		

Additional Comments:

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate			
(2) Sulfide			
(3) Manganese			
(4) Ferrous Iron			
(5) Alkalinity			
(6) Carbon Dioxide			
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [ ] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [X] 1800-Area; [ ] 2500-Area MONITORING WELL: Well # 20

DATE AND TIME OF SAMPLING: March 16, 1999 0950 (a.m)/p.m.
SAMPLE COLLECTED BY: (DW) / TH / JB of Parsons ES: Houston and Denver Offices.
WEATHER: clear cool Temp 50°

MONITORING WELL CONDITION:

1 [ ] WELL NUMBER IS APPARENT
2 [X] WELL NUMBER IS NOT APPARENT. EXPLAIN: No tag or markings
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:

5 [ ] PRODUCT OBSERVED AT DEPTH OF ____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:

7 [X] WATER DEPTH MEASURED AT 2.11 FT. BELOW DATUM WITH Act EIP
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:

9 [ ] PERISTALTIC PUMP AND DEDICATED TUBING
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: Grundfos
Items Cleaned (List): _____

MONITORING WELL EVACUATION OBSERVATIONS:

Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments: No odor
Other comments: _____

ON-SITE MEASUREMENTS:

12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:

14 [X] 4 SW8260A (40 mL VOAs); 1 DOC by E415.1 (___mL 1 Bottle); 3 NRMRL-147 (40 mL VOAs)
1 Sulfate/Chloride by Meth. N-601 (___mL ___Bottle); 1 Nitrate by E300/SW9056 (___mL ___Bottle)
15 [X] NONE/OTHER: Total Iron

ON-SITE SAMPLE TREATMENT:

16 [X] NONE
17 [ ] [ ] FILTRATION: Method _____ Containers: _____
[ ] PRESERVATIVES Method _____ Containers: _____

CONTAINER HANDLING:

18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [X] Containers Placed in Ice Chest

OTHER COMMENTS: _____

PARSONS ENGINEERING SCIENCE, INC.

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: Well #70

DIRECT INSTRUMENT READINGS

Time	0915	0920	0925	0935	0940	0945	Measured With
Temp (°C)	20.8	21.0	21.0	21.0	21.1	21.0	DO YSI 55
pH	7.2	7	7	7	7	7	HTH Test Strips
Cond (µS/cm)	—	—	—	—	—	—	—
Do (mg/L)	1.36	0.19	0.16	0.14	0.14	0.14	DO YST 55
Redox (mv)	-39.4	-38.2	-39.5	-39.4	-40.6	-40.5	Orion Model 250A
Observations:	35.2	28.2	19.7	18.2	14.2	16.3	Hach Turbidity
gallons purged	1	6	11	21	26	31	

Additional Comments: 1 gpm pumping

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate	NO	73.8 mg/L	Very Turbid.
(2) Sulfide	NO	0.017 mg/L	NO Blue color
(3) Manganese	NO	1.2 mg/L	Light violet color.
(4) Ferrous Iron	NO	0.85 mg/L	Light RUST color
(5) Alkalinity	1:4 12.5:50 mL	7 drops x 20mg/L/drop x 4 =	560 mg/L as $CaCO_3$
(6) Carbon Dioxide	NO	16 drops x 5 mg/L/drop = 80 mg/L	high range test.
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [ ] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: A39L008 DP

DATE AND TIME OF SAMPLING: March 16, 1999 1410 a.m./(p.m.)
SAMPLE COLLECTED BY (DW) / TH (JB) of Parsons ES: Houston and Denver Offices.
WEATHER: 65° F, clear, breezy

MONITORING WELL CONDITION:

1 [X] WELL NUMBER IS APPARENT
2 [ ] WELL NUMBER IS NOT APPARENT. EXPLAIN: _____
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:

5 [ ] PRODUCT OBSERVED AT DEPTH OF _____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:

7 [X] WATER DEPTH MEASURED AT 5.07 FT. BELOW DATUM WITH M.P.T. ZS 101 E
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:

9 [ ] PERISTALTIC PUMP AND DEDICATED TUBING
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: GRUNDFOS
Items Cleaned (List): _____

MONITORING WELL EVACUATION OBSERVATIONS:

Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments: _____
Other comments: _____

ON-SITE MEASUREMENTS:

12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:

14 [ ] 4 SW8260A (40 mL VOAs); 1 DOC by E415.1 (50 mL GA Bottle); 3 NRMRL-147 (40 mL VOAs)
1 Sulfate/Chloride by Meth. N-601 (____mL ____Bottle); ____Nitrate by E300/SW9056 (____mL ____Bottle)
15 [ ] NONE/OTHER: TOTAL IRON - 1 1L PL.

ON-SITE SAMPLE TREATMENT:

16 [X] NONE
17 [ ] [ ] FILTRATION: Method _____ Containers: _____
[ ] PRESERVATIVES Method _____ Containers: _____

CONTAINER HANDLING:

18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [X] Containers Placed in Ice Chest

OTHER COMMENTS: _____

ON-SITE MEASUREMENT FORM

LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: 08 DP

DIRECT INSTRUMENT READINGS

Time	1335	1340	1345	~~1350~~ 1358	1405	1405	Measured With
Temp (°C)	22.59	22.92	22.95	22.95	22.98	22.97	YSI-600XL-80
pH	6.64	6.65	6.65	6.65	6.65	6.65	"
Cond (µS/cm)	1.292	1.307	1.308	1.308	1.309	1.309	"
Do (mg/L)	2.10	1.10	0.92	0.77	0.74	0.74	"
Redox (mv)	86.4	33.6	-6.5	-23.0	-24.2	-26.4	"
Observations: SPC / Turb.	1.357 / 79.3	1.362 / 21.5	1.361 / 4.0	1.361 / 1.5	1.361 / 1.7	1.362 / 0.5	YSI-600XL-80 / HACH Turbidimeter
gallons purged	1	11	21	31	51	61	

Additional Comments:

2 gpm pumping

BATTERY Pack FOR YSI 600 ARRIVED TODAY, PREVIOUS MEASUREMENTS in 800 made with other meters.

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate	NO	73.5 mg/L, 73.8 mg/L	
(2) Sulfide	NO	0.008 mg/L, 0.000 mg/L	no blue color
(3) Manganese	NO	0.9 mg/L, 0.9 mg/L	
(4) Ferrous Iron	~~NO~~ NO	0.35 mg/L, 0.35 mg/L	Light Rust color.
(5) Alkalinity	1:4 ~~20:40 mL~~ 12.5	850 - 8 drops for each x 20 mg/L/drop x 4 = 640 mg/L	
(6) Carbon Dioxide	1:2 20:40 mL	18 drops x 5 mg/L/drop x 2 = 180 mg/L; 16 drops x 5 x 2 = 160 mg/L	
(7) Chloride			

Additional Comments:

Duplicates completed for this well

FIELD QA/QC PERFORMED AT THIS LOCATION? [ ] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [ ] 1800-Area; [X] 2500-Area MONITORING WELL: ~~MW10~~ A39L039DP

DATE AND TIME OF SAMPLING: May 5-25, 1999 17:10 a.m./p.m.
SAMPLE COLLECTED BY: DW / TH of Parsons ES: Houston and Denver Offices.
WEATHER: Cloudy, warm, Muggy.

MONITORING WELL CONDITION:
1 [ ] WELL NUMBER IS APPARENT
2 [X] WELL NUMBER IS NOT APPARENT. EXPLAIN: OLD PAD, No marker or lid.
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:
5 [ ] PRODUCT OBSERVED AT DEPTH OF ____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:
7 [ ] WATER DEPTH MEASURED AT 6.16 FT. BELOW DATUM WITH _____
8 [ ] OTHER. EXPLAIN: Pump was in Well - Airpod placed in.

MONITORING WELL EVACUATION METHOD:
9 [X] PERISTALTIC PUMP AND DEDICATED TUBING for dH2
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: Purge; Direct Probe readings
Items Cleaned (List): _____

MONITORING WELL EVACUATION OBSERVATIONS:
Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments: _____
Other comments: _____

ON-SITE MEASUREMENTS:
12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:
14 [X] 1 MICROSEEPS Dissolved Hydrogen Vials (20 mL)

15 [ ] Notes/Comments/Other: _____

ON-SITE SAMPLE TREATMENT:
16 [X] NONE
17 [ ] [ ] FILTRATION: Method _____ Containers: _____
[ ] PRESERVATIVES Method _____ Containers: _____

CONTAINER HANDLING:
18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [ ] Containers Placed in Ice Chest

OTHER COMMENTS: Total Depth of Well. 64', water Table = 58'
Purge Volume ~30 gallons.

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: A39L039DP

DIRECT INSTRUMENT READINGS

Time	17:14	17:18	17:24	17:29	17:35		Measured With
Temp (°C)	20.75	20.38	20.36	20.36	20.35		
pH	7.19	6.86	6.87	6.88	6.88		
Cond (µS/cm)	0.73	0.756	0.756	0.756	0.755		
Do (mg/L)	2.02	2.11	1.96	1.82	1.90		
Redox (mv)	-26.2	-77.5	-81.7	-83.2	-83.9		
Observations:	Clear.	Turbid				Turb = 187 NTU.	
gallons purged	3	9	18	24	33		

Sp. Cond

DO suspect. Erratic Behavior of Probe

Additional Comments:

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate			
(2) Sulfide			
(3) Manganese			
(4) Ferrous Iron			
(5) Alkalinity			
(6) Carbon Dioxide			
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [ ] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: A39L039DP

DATE AND TIME OF SAMPLING: March 15, 1999 1235 a.m/(p.m)
SAMPLE COLLECTED BY (DW) TH / JB of Parsons ES: Houston and Denver Offices.
WEATHER: clear cool Breezy Temp 50

MONITORING WELL CONDITION:

1 [ ] WELL NUMBER IS APPARENT
2 [X] WELL NUMBER IS NOT APPARENT. EXPLAIN: No tag or markings
3 [ ] PVC CONDITION IS UNDAMAGED
4 [X] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____
Needs New woodbox lid

PRODUCT INFORMATION:

5 [ ] PRODUCT OBSERVED AT DEPTH OF _____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:

7 [ ] WATER DEPTH MEASURED AT _____ FT. BELOW DATUM WITH _____
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:

9 [ ] PERISTALTIC PUMP AND DEDICATED TUBING
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [ ] BLADDER PUMP OR OTHER: _____
Items Cleaned (List): _____

MONITORING WELL EVACUATION OBSERVATIONS:

Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments: _____
Other comments: _____

ON-SITE MEASUREMENTS:

12 [ ] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:

14 [ ] ___ SW8260A (40 mL VOAs); ___ DOC by E415.1 (___mL ___ Bottle); _____NRMRL-147 (40 mL VOAs)
___Sulfate/Chloride by Meth. N-601 (____mL ____Bottle); ____Nitrate by E300/SW9056 (___mL ___Bottle)
15 [ ] NONE/OTHER:

ON-SITE SAMPLE TREATMENT:

16 [ ] NONE
17 [ ] [ ] FILTRATION: Method _____ Containers: _____
[ ] PRESERVATIVES Method _____ Containers: _____

CONTAINER HANDLING:

18 [ ] Container Sides Labeled
19 [ ] Container Lids Taped
20 [ ] Containers Placed in Ice Chest

OTHER COMMENTS: _____

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [ ] 800-Area; [ ] 2500-Area MONITORING WELL: A39LO39 OP

DIRECT INSTRUMENT READINGS

Time	1200	1205	1210	1220	1225	1230	Measured With
Temp (°C)	20.3	20.6	20.8	20.8	20.9	20.8	DO YSI 55
pH	7.2	7.2	7	7	7	7	HTH Test Strips
Cond (µS/cm)	—	—	—	—	—	—	—
Do (mg/L)	0.37	0.17	0.15	0.14	0.14	0.13	DO YSI 55
Redox (mv)	+20.7	-132.6	-142.6	-156.5	-161.1	-162.0	Orion Model 250A
Observations:	>440	134	86.2	56.3	44.8	40.2	Hach Turb: 1.4
gallons purged	1	6	11	21	26	31	

Additional Comments: 1 gpm purging

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate	no	22.5 mg/L	Slight turbidity
(2) Sulfide	no	0.012	NO color (Red or blue) sample clear
(3) Manganese	no	0.7 mg/L	Slight violet color.
(4) Ferrous Iron	no	2.16 mg/L	Rust color.
(5) Alkalinity	no	19 drops x 20 = 380 mg/L	~~HR~~ High Range test.
(6) Carbon Dioxide	1:2 ~~1:20~~ 20:40	12 drops x 5 mg/L/drop x 2 = 120 mg/L	
(7) Chloride			

Additional Comments: sample filtered - now clear.

Alkalinity ~~HR~~ test Repeated with 1:2 (20:40 mL) dilution - 9 drops x 20 mg/L/drop x 2 = 360 mg/L

FIELD QA/QC PERFORMED AT THIS LOCATION? [ ] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: BZ DP

DATE AND TIME OF SAMPLING: March 14, 1999 1050 (a.m.)/p.m.
SAMPLE COLLECTED BY: (DW / TH / JB) of Parsons ES: Houston and Denver Offices.
WEATHER: 45°F windy, overcast -

MONITORING WELL CONDITION:
1 [X] WELL NUMBER IS APPARENT
2 [ ] WELL NUMBER IS NOT APPARENT. EXPLAIN: _____
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:
5 [ ] PRODUCT OBSERVED AT DEPTH OF _____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:
7 [X] WATER DEPTH MEASURED AT 9.35 FT. BELOW DATUM WITH _____
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:
9 [ ] PERISTALTIC PUMP AND DEDICATED TUBING
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: GRUNDFOS
Items Cleaned (List): Pump & Tubing deconed prior to insertion

MONITORING WELL EVACUATION OBSERVATIONS:
Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments: _____
Other comments: _____

ON-SITE MEASUREMENTS:
12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:
14 [ ] 4 SW8260A (40 mL VOAs); 1 DOC by E415.1 (~~250~~ mL ~~6/4~~ Bottle); 3 NRMRL-147 (40 mL VOAs)
___Sulfate/Chloride by Meth. N-601 (___mL ___Bottle); ___Nitrate by E300/SW9056 (___mL ___Bottle)
15 [ ] NONE/OTHER: IRON 1-1LPl. 1 1L Plastic

ON-SITE SAMPLE TREATMENT:
16 [X] NONE
17 [ ] [ ] FILTRATION: Method _____ Containers: _____
[ ] PRESERVATIVES Method _____ Containers: _____

CONTAINER HANDLING:
18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [ ] Containers Placed in Ice Chest

OTHER COMMENTS: ~~Solinst~~ Now using ORION 250A meter and YSI 55 meter to measure parameters. YSI 600XL B-O Not working (Battery/Power problems) - BZDP - First well visited on 3-N-99

PARSONS ENGINEERING SCIENCE, INC.

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: ~~SB~~ 82 DP

DIRECT INSTRUMENT READINGS

Time	1015	1020	~~1025~~ 1030	1035	1040	1045	Measured With
Temp (°C)	17.9	19.9	20.0	20.0	20.0	2.0	YSI-55
pH	7.8	7.5	6.9	6.9	7	7	Litmus Paper
Cond (µS/cm)	—	—	—	—	—	—	N/A
Do (mg/L)	4.52	0.19	0.14	0.16	0.17	0.17	YSI-55
Redox (mv)	~~26~~ 294	-252	-202	-185.3	-181.9	177.8	ORION 250 A
Observations: Turbidity		3.4	3.4		3.2	~~4~~ 2.3	HACH
gallons purged	1	6	11	21	26	31	

Additional Comments: meters DO NOT Read conductivity
1 gpm ~~Flow~~ purge rate

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate	No	0.0	No Vis color or Turb.
(2) Sulfide		0.000	"
(3) Manganese	No	0.1 ± 0.0	Very, Very Slight trace of Violet. - Performed twice to double check.
(4) Ferrous Iron	No	3.95	Pink Colored
(5) Alkalinity	1:4; 12.5 + 37.5	7 drops x 20 = 140 x 4 = 560 mg/L	- Hach High Range.
(6) Carbon Dioxide	No	48 ppm	Chemetrics 10-100
(7) Chloride			

↓ 1st Location Encountered w/ No Mn.

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [X] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: 92 ~~BZ~~ DP

DATE AND TIME OF SAMPLING: March 14, 1999 1430 a.m. (p.m.)
SAMPLE COLLECTED BY (DW / TH / JB) of Parsons ES: Houston and Denver Offices.
WEATHER: 43°F Cloudy, Windy

MONITORING WELL CONDITION:

1 [ ] WELL NUMBER IS APPARENT
2 [X] WELL NUMBER IS NOT APPARENT. EXPLAIN: No ID TAG
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:

5 [ ] PRODUCT OBSERVED AT DEPTH OF ~~10.37~~ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:

7 [X] WATER DEPTH MEASURED AT 10.37 FT. BELOW DATUM WITH _____
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:

9 [ ] PERISTALTIC PUMP AND DEDICATED TUBING
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: GRUNDFOS.
Items Cleaned (List): _____

MONITORING WELL EVACUATION OBSERVATIONS:

Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water ~~(slightly - very)~~ ~~cloudy~~ - clear
Water level (rose - fell - no change)
Water odors/comments: Slight odor observed
Other comments: _____

ON-SITE MEASUREMENTS:

12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:

14 [ ] 4 SW8260A (40 mL VOAs); 1 DOC by E415.1 (500 mL GA Bottle); 3 NRMRL-147 (40 mL VOAs)
___Sulfate/Chloride by Meth. N-601 (____mL ____Bottle); ____Nitrate by E300/SW9056 (___mL ___Bottle)
15 [ ] NONE/OTHER: Total Dissolved - 1-500 mL P1 1 1L P. Bottle

ON-SITE SAMPLE TREATMENT:

16 [X] NONE
17 [ ] [ ] FILTRATION: Method _____ Containers: _____
[ ] PRESERVATIVES Method _____ Containers: _____

CONTAINER HANDLING:

18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [ ] Containers Placed in Ice Chest

OTHER COMMENTS: Stg

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [ ] 800-Area; [Y] 2500-Area MONITORING WELL: 92 DP

DIRECT INSTRUMENT READINGS

Time	1357	14.02	1407	1417	H2F	1432	Measured With
Temp (°C)	16.1	20.9	20.8	20.9	20.7	20.7	YSI - 55
pH	>8.4	>8.4	7.8	7.0	7.0	7.0	Litmus (HTH)
Cond (µS/cm)	—	—	—	—	—	—	—
Do (mg/L)	1.8	.13	0.10	0.12	0.15	0.14	YSI - 55
Redox (mv)	208	-130.7	-241.8	-198.7	-190.6	-186.9	ORION 250 A
Observations: turbidity	—	4.2	—	—	2.6	2.9	HACH
gallons purged	1	~~4~~ 6	11		31		

Additional Comments:

purge Rate ~ 1 gpm

DO ~~meter~~ meter Zeroed at 0.10 mg/L

FIELD CHEMISTRY RESULTS

Reported

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate	No	~~23 mg/L~~ 0.0 mg/L	No Vis. Color or Turb.
(2) Sulfide	No	0.000	No Detects - No Vis. Color or Turb.
(3) Manganese	No	0.2 mg/L	No visible Color or Turb.
(4) Ferrous Iron	No	4.10	Dark Red Color.
(5) Alkalinity	1:4 · 125+375	8 drops x 30 = 160 x 4 = 640 mg/L as CaCO3	Color ; Used High Range Titration.
(6) Carbon Dioxide	No	55 ppm	- Chlorides 10-100 ppm
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [X] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: A39L001PZ

DATE AND TIME OF SAMPLING: March 16, 1999 1155 a.m./p.m.
SAMPLE COLLECTED BY DW / TH / JB of Parsons ES: Houston and Denver Offices.
WEATHER: Clear cool Temp 65°

MONITORING WELL CONDITION:
1 [X] WELL NUMBER IS APPARENT
2 [ ] WELL NUMBER IS NOT APPARENT. EXPLAIN: _____
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:
5 [ ] PRODUCT OBSERVED AT DEPTH OF _____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:
7 [X] WATER DEPTH MEASURED AT 4.69 FT. BELOW DATUM WITH Ast GIP
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:
9 [ ] PERISTALTIC PUMP AND DEDICATED TUBING
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: Grundfos
Items Cleaned (List): _____

MONITORING WELL EVACUATION OBSERVATIONS:
Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly) - very) cloudy
Water level (rose - fell) no change)
Water odors/comments: No odor
Other comments: _____

ON-SITE MEASUREMENTS:
12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:
14 [X] 4 SW8260A (40 mL VOAs); 1 DOC by E415.1 (500 mL GA Bottle); 3 NRMRL-147 (40 mL VOAs)
1 Sulfate/Chloride by Meth. N-601 (___ mL ___ Bottle); 1 Nitrate by E300/SW9056 (___ mL ___ Bottle)
15 [X] NONE/OTHER: Total Iron, 1/2 L Pl. 1 1L Pl.

ON-SITE SAMPLE TREATMENT:
16 [ ] NONE
17 [ ] [ ] FILTRATION: Method _____ Containers: _____
[ ] PRESERVATIVES Method _____ Containers: _____

CONTAINER HANDLING:
18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [X] Containers Placed in Ice Chest

OTHER COMMENTS: _____

ON-SITE MEASUREMENT FORM

PLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: A39L001PZ

DIRECT INSTRUMENT READINGS

Time	1120	1125	1130	1140	1145	1150	Measured With
Temp (°C)	22.3	22.4	22.4	22.4	22.4	22.4	DO YSI 55
pH	7.5	7.2	7.2	7	7	7	HTH Test Strips
Cond (µS/cm)	—	—	—	—	—	—	—
Do (mg/L)	6.40	1.47	0.70	0.36	0.33	0.32	DO YSI 55
Redox (mv)	1.2	-63.9	-69.8	-76.8	-83.4	-84.9	Orion Model 250A
Observations:	21.2	6.3	4.2	4.4	2.6	1.3	Hach Turbidity
gallons purged	1	6	11	21	26	31	

Additional Comments: 1 gpm pumped

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate		66.3 mg/L	Very turbid.
(2) Sulfide	NO	0.000	no blue color
(3) Manganese	NO	0.4	very light violet color
(4) Ferrous Iron	ND	1.26 mg/L	Rust color
(5) Alkalinity	1:4 125 : 50 mL	5 drops × 20 mg/L/drop × 4 = 400 mg/L	
(6) Carbon Dioxide	NO	17 drops × 5 mg/L / drop = 85 mg/L	
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [ ] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: @A39L002PZ

DATE AND TIME OF SAMPLING: March 15, 1999 1145 a.m./p.m.
SAMPLE COLLECTED BY: DW / TH / JB of Parsons ES: Houston and Denver Offices.
WEATHER: clear cool breezy temp 50

MONITORING WELL CONDITION:

1 [ ] WELL NUMBER IS APPARENT
2 [X] WELL NUMBER IS NOT APPARENT. EXPLAIN: No number or tag
3 [ ] PVC CONDITION IS UNDAMAGED
4 [X] PVC CONDITION IS DAMAGED. EXPLAIN: Needs new pad
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

PRODUCT INFORMATION:

5 [ ] PRODUCT OBSERVED AT DEPTH OF ____ FT. BELOW DATUM WITH ____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:

7 [ ] WATER DEPTH MEASURED AT 3.76 FT. BELOW DATUM WITH ____
8 [ ] OTHER. EXPLAIN: ____

MONITORING WELL EVACUATION METHOD:

9 [ ] PERISTALTIC PUMP AND DEDICATED TUBING
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: Grundfos
Items Cleaned (List): ____

MONITORING WELL EVACUATION OBSERVATIONS:

Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments: ____
Other comments: ____

ON-SITE MEASUREMENTS:

12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: ____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:

14 [ ] ___ SW8260A (40 mL VOAs); ___ DOC by E415.1 (___mL ___ Bottle); _____NRMRL-147 (40 mL VOAs)
___Sulfate/Chloride by Meth. N-601 (____mL ____Bottle); ____Nitrate by E300/SW9056 (___mL ___Bottle)
15 [ ] NONE/OTHER:

ON-SITE SAMPLE TREATMENT:

16 [X] NONE
17 [ ] [ ] FILTRATION: Method____ Containers:____
[ ] PRESERVATIVES Method____ Containers:____

CONTAINER HANDLING:

18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [X] Containers Placed in Ice Chest

OTHER COMMENTS: ____

PARSONS ENGINEERING SCIENCE, INC.

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: A39L002PZ

DIRECT INSTRUMENT READINGS

Time	1108	1113	1123	1133	1138		Measured With
Temp (°C)	20.4	20.3	18.6	18.6	18.8		DO 55 YSI
pH	7.8	7.5	7.5	7.5	7.6		HTH Test Strips
Cond (µS/cm)	~	—	—	—	—		—
Do (mg/L)	5.23	2.82	0.19	0.10	0.10		DO YSI 55
Redox (mv)	88.4	0.8	-127.3	-126.3	-125.8		Orion Model 250A
Observations:	327	43.9	110	2.6	2.9		Hach Turbidity
gallons purged	1	6	16	26	31		

Additional Comments: 1 gpm pumping
Turbidity Low (<5), but; color apparent in samples (yellowish)

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate	NO	0.0 mg/L	NO turbidity
(2) Sulfide	NO	0.014	NO color (Pink or blue)
(3) Manganese	NO	0.0 mg/L	NO color
(4) Ferrous Iron	NO	0.00, 0.00	NO color
(5) Alkalinity	NO	5 drops x 20 mg/L = 100 mg/L	
(6) Carbon Dioxide	1:2 20:40 mL	10 drops x 5 mg/L/drop x 2 = 100 mg/L	
(7) Chloride			

Additional Comments: Filtering Does not Remove color.

FIELD QA/QC PERFORMED AT THIS LOCATION? [ ] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: A39L08PZ

DATE AND TIME OF SAMPLING: March 15, 1999 _____ a.m./p.m.
SAMPLE COLLECTED BY: (DW) / TH / JB of Parsons ES: Houston and Denver Offices.
WEATHER: Clear, cool, breezy Temp 50

MONITORING WELL CONDITION:

1 [X] WELL NUMBER IS APPARENT
2 [ ] WELL NUMBER IS NOT APPARENT. EXPLAIN: _____
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:

5 [ ] PRODUCT OBSERVED AT DEPTH OF _____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:

7 [X] WATER DEPTH MEASURED AT 6.83 FT. BELOW DATUM WITH ART EIP
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:

9 [ ] PERISTALTIC PUMP AND DEDICATED TUBING
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: Grundfos
Items Cleaned (List): _____

MONITORING WELL EVACUATION OBSERVATIONS:

Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments: _____
Other comments: _____

ON-SITE MEASUREMENTS:

12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:

14 [ ] ___ SW8260A (40 mL VOAs); ___ DOC by E415.1 (___mL ___ Bottle); ____NRMRL-147 (40 mL VOAs)
___Sulfate/Chloride by Meth. N-601 (____mL ____Bottle); ____Nitrate by E300/SW9056 (___mL ___Bottle)
15 [ ] NONE/OTHER:

ON-SITE SAMPLE TREATMENT:

16 [ ] NONE
17 [ ] [ ] FILTRATION: Method_____ Containers:_____
[ ] PRESERVATIVES Method_____ Containers:_____

CONTAINER HANDLING:

18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [X] Containers Placed in Ice Chest

OTHER COMMENTS: _____

PARSONS ENGINEERING SCIENCE, INC.

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: A39L008PZ

DIRECT INSTRUMENT READINGS

Time	0949	0954	1004	1009	1014	1019	Measured With
Temp (°C)	22.1	22.1	22.1	22.0	22.0	22.0	DO 55 (YSI)
pH	7.2	7	7	7	7	7	HTH Test Strips
Cond (µS/cm)	—	—	—	—	—	—	—
Do (mg/L)	0.79	0.18	0.13	0.12	0.12	0.11	YSI DO 55
Redox (mv)	-173.3	-200.6	-199.3	-199.4	-198.4	-198.2	Orion Model 250A
Observations:	22.7	1.5	0.4	0.9	0.8	0.6	Hach Turbidity
gallons purged	1	6	16	21	26	31	

Additional Comments: 1 gpm pumping

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate	~~ND~~ NA	0.0	no turbidity.
(2) Sulfide	ND	0.000	no color
(3) Manganese	ND	0.4 mg/L	slight violet color
(4) Ferrous Iron	ND	3.84 mg/L	Rust color.
(5) Alkalinity	1:4 12.5:50 mL	7 drops x 20 mg/L/drop x 4 =	560 mg/L
(6) Carbon Dioxide	1:2 20:40 mL	12 drops x 5 x 2 = 120 mg/L	
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [ ] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: 10PZ

DATE AND TIME OF SAMPLING: March 14, 1999 1140 (a.m)/p.m.
SAMPLE COLLECTED BY: DW / TH / JB of Parsons ES: Houston and Denver Offices.
WEATHER: 45°F, windy, cloudy

MONITORING WELL CONDITION:

1 [X] WELL NUMBER IS APPARENT
2 [ ] WELL NUMBER IS NOT APPARENT. EXPLAIN:
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN:
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

PRODUCT INFORMATION:

5 [ ] PRODUCT OBSERVED AT DEPTH OF 9.06 FT. BELOW DATUM WITH
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:

7 [X] WATER DEPTH MEASURED AT FT. BELOW DATUM WITH
8 [ ] OTHER. EXPLAIN:

MONITORING WELL EVACUATION METHOD:

9 [ ] PERISTALTIC PUMP AND DEDICATED TUBING
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [ ] BLADDER PUMP OR OTHER: GROUNDFOS
Items Cleaned (List): Pump & tubing cleaned prior to insertion and after sampling

MONITORING WELL EVACUATION OBSERVATIONS:

Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (~~slightly~~ - very) cloudy
Water level (rose - fell - no change)
Water odors/comments:
Other comments:

ON-SITE MEASUREMENTS:

12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN:

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:

14 [ ] 4 SW8260A (40 mL VOAs); ___ DOC by E415.1 (60 mL GA Bottle); 3 NRMRL-147 (40 mL VOAs)
___ Sulfate/Chloride by Meth. N-601 (___ mL ___ Bottle); ___ Nitrate by E300/SW9056 (___ mL ___ Bottle)
15 [ ] NONE/OTHER: Total IRON - 1 500 mL Pl. 1 L Pl.

ON-SITE SAMPLE TREATMENT:

16 [X] NONE
17 [ ] [ ] FILTRATION: Method Containers:
[ ] PRESERVATIVES Method Containers:

CONTAINER HANDLING:

18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [ ] Containers Placed in Ice Chest

OTHER COMMENTS:

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: 10PZ

DIRECT INSTRUMENT READINGS

Time	1104	1112	1117	1125	1129	1134	Measured With
Temp (°C)	18.9	19.6	19.8	19.9	19.8	19.8	YSI 55
pH	7.2	7.0	7.0	7.0		7.0	Litmus Paper
Cond (µS/cm)	—	—	—	—	—	—	N/A
Do (mg/L)	1.39	0.22	0.17	0.15	0.15	0.14	YSI 55
Redox (mv)	-139.6	-163.1	-167.6	-168.6	-168.2	-169.9	ORION 250A
Observations: Turb.	16.4	5.8	3.5	4.4	2.6		HACH
gallons purged	2	10	15	20	27	32	bucket & bottle

Additional Comments: 1 gpm purge Rate

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate	No	0.0	No Visible Color or Turb
(2) Sulfide	No	0.009	No Visible color or Turb.
(3) Manganese	No	4.1	Visible Color w/ brig Turb.
(4) Ferrous Iron	No	4.4 mg/L	Rust Color
(5) Alkalinity	1:4 1:2.5 1:32.5	8 drops 20 = 160 x 4 = 640 mg/L as CaCO3	Hach high Range.
(6) Carbon Dioxide	No	85 mg/L ppm	Chemetrics 10-100 ppm
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [X] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: 11 PZ

DATE AND TIME OF SAMPLING: March 14, 1999 1525 a.m./(p.m.)
SAMPLE COLLECTED BY: DW / TH / JB of Parsons ES: Houston and Denver Offices.
WEATHER: _____

MONITORING WELL CONDITION:

1 [X] WELL NUMBER IS APPARENT
2 [ ] WELL NUMBER IS NOT APPARENT. EXPLAIN: _____
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:

5 [ ] PRODUCT OBSERVED AT DEPTH OF ____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:

7 [ ] WATER DEPTH MEASURED AT 10.40 FT. BELOW DATUM WITH _____
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:

9 [ ] PERISTALTIC PUMP AND DEDICATED TUBING
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: Grundfos
Items Cleaned (List): _____

MONITORING WELL EVACUATION OBSERVATIONS:

Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - (very) cloudy – (pump hit bottom)
Water level (rose - fell - no change)
Water odors/comments: _____
Other comments: _____

ON-SITE MEASUREMENTS:

12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:

14 [ ] 43 SW8260A (40 mL VOAs); 1 DOC by E415.1 (500 mL GA Bottle); 3 NRMRL-147 (40 mL VOAs)
Sulfate/Chloride by Meth. N-601 (____mL ____Bottle); ____Nitrate by E300/SW9056 (____mL ____Bottle)
15 [ ] NONE/OTHER: Total Iron 1: 1L Al.

ON-SITE SAMPLE TREATMENT:

16 [X] NONE
17 [ ] [ ] FILTRATION: Method _____ Containers: _____
[ ] PRESERVATIVES Method _____ Containers: _____

CONTAINER HANDLING:

18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [X] Containers Placed in Ice Chest

OTHER COMMENTS: _____

PARSONS ENGINEERING SCIENCE, INC.

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: 11 PZ

DIRECT INSTRUMENT READINGS

Time	~~1447~~ ~~2345~~	1452	1457	1507	1512	1517	Measured With
Temp (°C)	18.4	20.4	20.7	20.8	20.8	20.8	YSI-55
pH		7.0	7.0	~	7	7	Litmus Paper
Cond (µS/cm)	—	—	—	—	—	—	—
Do (mg/L)	2.73	0.18	0.15	0.11	0.11	0.11	YSI-55
Redox (mv)	-107.7	-172.9	-182.9	-189.6	-191.7	-193.3	ORION 250A
Observations: Turbidity	>20 440	37.7	—	12.9	2.6	4/16	I-HACH
gallons purged	3	8	13	23	28		

Additional Comments: DO zeroed at 0.10 mg/L
Purge Rate = 1 gpm

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate	No	0, 0	No Turbidity
(2) Sulfide	No	0.021, 0.013 mg/L	- Slight, Slight Yellow. No Blue — should be
(3) Manganese	No	3.1, 3.4 mg/L	Violet Color, No Turb.
(4) Ferrous Iron	No	4.23, 4.68 mg/L	Deep Rust. Duplicates taken.
(5) Alkalinity	1:4; 12.5 + 37.5	9 drops x 20 = 180 x 4 = 720 mg/L as CaCO3	
(6) Carbon Dioxide	No	50 ppm.	Chemetrics, 10-100.
(7) ~~Chloride~~ Reported ⇒ Acme		9 drops x 20 = 180 x 4 = 720 mg/L	as CaCO3.

Additional Comments: (6) repeated with Hach CO2 test kit 1436-01. Ran out of Chemetrics - New test kit reads 90 ppm CO2 as 18 drops x 5 mg/L per drop = 90 ppm.

FIELD QA/QC PERFORMED AT THIS LOCATION? [X] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

PARSONS ENGINEERING SCIENCE, INC.

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GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [ ] 1800-Area; [X] 2500-Area MONITORING WELL: A39611PZ

DATE AND TIME OF SAMPLING: May 06, 1999 18:05 a.m./p.m.
SAMPLE COLLECTED BY: DW / TH of Parsons ES: Houston and Denver Offices.
WEATHER: Sunny, Hot, Muggy

MONITORING WELL CONDITION:
1 [X] WELL NUMBER IS APPARENT on Tag in Box
2 [ ] WELL NUMBER IS NOT APPARENT. EXPLAIN:
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN:
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

PRODUCT INFORMATION:
5 [ ] PRODUCT OBSERVED AT DEPTH OF ____ FT. BELOW DATUM WITH
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:
7 [ ] WATER DEPTH MEASURED AT 11.86 FT. BELOW DATUM WITH
8 [ ] OTHER. EXPLAIN:

MONITORING WELL EVACUATION METHOD:
9 [X] PERISTALTIC PUMP AND DEDICATED TUBING dH2
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: Purging ; probe Ready
Items Cleaned (List):

MONITORING WELL EVACUATION OBSERVATIONS:
Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments:
Other comments:

ON-SITE MEASUREMENTS:
12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN:

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:
14 [X] 1 MICROSEEPS Dissolved Hydrogen Vials (20 mL) collected @ 18:54

15 [ ] Notes/Comments/Other:

ON-SITE SAMPLE TREATMENT:
16 [X] NONE
17 [ ] [ ] FILTRATION: Method Containers:
[ ] PRESERVATIVES Method Containers:

CONTAINER HANDLING:
18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [ ] Containers Placed in Ice Chest

OTHER COMMENTS: 52 ft Deep ≈ 40' of H2O - ~~20~~ 20 gallons for 3 purges.

PARSONS ENGINEERING SCIENCE, INC.

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB. [ ] 800-Area; [X] 2500-Area MONITORING WELL: A39L011PZ

DIRECT INSTRUMENT READINGS

Time	18:28	18:32	18:36	18:40			Measured With
Temp (°C)	25.66	21.59	21.55	21.54			
pH	7.52	6.61	6.61	6.63			
Cond (µS/cm)	0.966	1.109	1.187	1.117			
Do (mg/L)	7.21	0.39	0.05	0.06			
Redox (mv)	98.2	-142.6	-150.8	-152.4			3/6
Observations:	Clear	Grey/turbid →		→		1 unit = 1 NTU.	
gallons purged	1 gallon	7 gallon	13 gallon	20 gallon			

Additional Comments: 3 purges.

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate			
(2) Sulfide			
(3) Manganese			
(4) Ferrous Iron			
(5) Alkalinity			
(6) Carbon Dioxide			
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [ ] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: 12PZ

DATE AND TIME OF SAMPLING: March 12, 1999 0835 (a.m.)/p.m.
SAMPLE COLLECTED BY: (DW) / TH / JB of Parsons ES: Houston and Denver Offices.
WEATHER: 52°F, RAIN, Lightning

MONITORING WELL CONDITION:

1 [X] WELL NUMBER IS APPARENT
2 [ ] WELL NUMBER IS NOT APPARENT. EXPLAIN: _____
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:

5 [ ] PRODUCT OBSERVED AT DEPTH OF ____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:

7 [ ] WATER DEPTH MEASURED AT 7.68 FT. BELOW DATUM WITH _____
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:

9 [ ] PERISTALTIC PUMP AND DEDICATED TUBING
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: GRUNDFOS
Items Cleaned (List): _____

MONITORING WELL EVACUATION OBSERVATIONS:

Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments: _____
Other comments: _____

ON-SITE MEASUREMENTS:

12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:

14 [X] 4 SW8260A (40 mL VOAs); 1 DOC by E415.1 (500mL GA Bottle); 3 NRMRL-147 (40 mL VOAs)
1 (Sulfate/Chloride) by Meth. N-601 (___mL ___Bottle); X Nitrate by E300/SW9056 (___mL ___Bottle)
15 [X] NONE/OTHER: 1 Total Iron in 500mL Plastic Bottle

ON-SITE SAMPLE TREATMENT:

16 [X] NONE
17 [ ] [ ] FILTRATION: Method _____ Containers: _____
[ ] PRESERVATIVES Method _____ Containers: _____

CONTAINER HANDLING:

18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [X] Containers Placed in Ice Chest

OTHER COMMENTS: _____

PARSONS ENGINEERING SCIENCE, INC.

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: 12PZ

DIRECT INSTRUMENT READINGS

Time	0840	0845	0853	0900	0910		Measured With
Temp (°C)	19.8	20.39	20.49	20.49	20.47		
pH	6.82	6.83	6.83	6.83	6.84		
Cond (µS/cm)	0.886	0.907	.910	0.910	0.909		
Do (mg/L)	2.02	0.45	0.38	0.35	0.35		
Redox (mv)	-139	-162.5	-175.0	-177.7	-179.7		
Observations: spc	0.985	0.989	###	0.995	0.990		
gallons purged	0.5	13	21	28	38		

Additional Comments: Well cleared after ~1 gal pumped Turbidity = 2.9
Started at 2.5 gal/min, ~~[illegible]~~ slowed pump to ~1 gal/min
* DO calibrated to 0.14 as zero. not corrected on this pg.

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate	No	0.0	No Color or Turb.
(2) Sulfide	No	0.0	No color or Turb.
(3) Manganese	No	2.2 mg/L	Violet Color.
(4) Ferrous Iron	No	4.33	Rust colored
(5) Alkalinity	1:4; 13.5 + 37.5	8 drops x 20 = 160 x 4 = 620 mg/L	as CaCO3
(6) Carbon Dioxide	No	85 ppm	Chemetrics Titrets
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [X] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

PZ

SAMPLING LOCATION: England AFB, [X] 1800-Area; [ ] 2500-Area MONITORING WELL: A39L013 ~~PZ~~ ~~EW~~

DATE AND TIME OF SAMPLING: May 25, 1999 16:16 a.m./p.m.
SAMPLE COLLECTED BY: DW / TH of Parsons ES: Houston and Denver Offices.
WEATHER: Breezy, Muggy, Warm

MONITORING WELL CONDITION:
1 [X] WELL NUMBER IS APPARENT ON TAG in well
2 [ ] WELL NUMBER IS NOT APPARENT. EXPLAIN:
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN:
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe):

PRODUCT INFORMATION:
5 [ ] PRODUCT OBSERVED AT DEPTH OF ____ FT. BELOW DATUM WITH
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:
7 [ ] WATER DEPTH MEASURED AT 10.12 FT. BELOW DATUM WITH
8 [ ] OTHER. EXPLAIN:

MONITORING WELL EVACUATION METHOD:
9 [X] PERISTALTIC PUMP AND DEDICATED TUBING dtd
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: Purging ; Direct Probe Readings
Items Cleaned (List):

MONITORING WELL EVACUATION OBSERVATIONS:
Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy Clear
Water level (rose - fell - no change)
Water odors/comments:
Other comments:

ON-SITE MEASUREMENTS:
12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN:

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:
14 [X] ____ MICROSEEPS Dissolved Hydrogen Vials (____ mL)

15 [ ] Notes/Comments/Other:

ON-SITE SAMPLE TREATMENT:
16 [X] NONE
17 [ ] [ ] FILTRATION: Method Containers:
[ ] PRESERVATIVES Method Containers:

CONTAINER HANDLING:
18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [ ] Containers Placed in Ice Chest

OTHER COMMENTS: TD ~ 67.4', water column ≈ 57'

3 purge Volumes ≈ 30 gallons.

PARSONS ENGINEERING SCIENCE, INC.

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: A39LD13PZ

DIRECT INSTRUMENT READINGS

Time	16:20	16:25	16:30	16:35	16:40		Measured With
Temp (°C)	20.71	20.71	20.68	20.67	20.68		
pH	6.65	6.74	6.74	6.75	6.77		
Cond (µS/cm)	0.744	0.84	1.041	1.073	1.079		
Do (mg/L)	1.81	1.99	1.89	1.89	1.90		
Redox (mv)	-129.0	-135.8	-135.0	-131.1	-128.6		
Observations:	Tan, cloudy		Less Turbid.	Slightly Turbid	Clear.	Turb = 11.0 NTU	
gallons purged	35 gallons	12.5 gal.	20 gal.	27.5 gal.	35 gal		

Sp. Do suspect. Erratic behavior of probe.

Additional Comments: Pumping at 1.5 gal/min.

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate			
(2) Sulfide			
(3) Manganese			
(4) Ferrous Iron			
(5) Alkalinity			
(6) Carbon Dioxide			
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [ ] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: A39L013P7

DATE AND TIME OF SAMPLING: March 11, 1999 _____ a.m./p.m.
SAMPLE COLLECTED BY: ~~DW~~ TH JB of Parsons ES: Houston and Denver Offices.
WEATHER: cool, overcast, breezy, ~ 60°F.

MONITORING WELL CONDITION:

1 [X] WELL NUMBER IS APPARENT
2 [ ] WELL NUMBER IS NOT APPARENT. EXPLAIN: _____
3 [ ] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:

5 [ ] PRODUCT OBSERVED AT DEPTH OF _____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:

7 [X] WATER DEPTH MEASURED AT 9.10 FT. BELOW DATUM WITH ART, interface probe (EIP)
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:

9 [ ] PERISTALTIC PUMP AND DEDICATED TUBING
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [ ] BLADDER PUMP OR OTHER: GRUNDFOS
Items Cleaned (List): _____

MONITORING WELL EVACUATION OBSERVATIONS:

Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly ~~very~~) ~~cloudy~~
Water level (rose - fell - no change)
Water odors/comments: NA
Other comments: _____

ON-SITE MEASUREMENTS:

12 [ ] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:

14 [ ] 4 SW8260A (40 mL VOAs); 1 DOC by E415.1 (250 mL ___ Bottle); X 3 NRMRL-147 (40 mL VOAs)
X Sulfate/Chloride by ~~Meth. N-601~~ E300 (___ mL ___ Bottle); 1 Nitrate by E300/SW9056 (100 mL 1 Bottle)
15 [ ] NONE/OTHER:

ON-SITE SAMPLE TREATMENT:

16 [X] NONE
17 [ ] [ ] FILTRATION: Method _____ Containers: _____
[ ] PRESERVATIVES Method _____ Containers: _____

CONTAINER HANDLING:

18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [X] Containers Placed in Ice Chest

OTHER COMMENTS: _____

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: 13 P7

DIRECT INSTRUMENT READINGS

Time	15 0519	15 0524	15 0529	15 0539	15 0549		Measured With
Temp (°C)	20.81	21.11	21.53	21.59	21.60		
pH	7.00	6.94	6.91	6.90	6.90		
Cond (µS/cm)	.756	0.793	0.877	0.966	0.982		
Do (mg/L)	0.65	0.40	0.37	0.34	0.34		
Redox (mv)	-95.7	-110.9	-121.0	-127.9	-130.2		
Observations: Spc / Sal	.821 /	0.859 /	0.942 /	1.034 /	1.051 /		
gallons purged	2	10	20	40	60		

Additional Comments:

TURBIDITY = ~~42.6~~ 6.9

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate	No	0, 0	No Color in Turb.
(2) Sulfide	No	0, 0	No color in Turb.
(3) Manganese	No	3.0, 3.0 mg/L	Violet color.
(4) Ferrous Iron	No	4.24, 4.32 mg/L	Dark purple color
(5) Alkalinity	Yes, 1:4 ; 12.5+37.5	9 drops x 20=180 x 4 = 720	Repeated for 8 drops x 20 = 160 x 4 = 640 mg/L
(6) Carbon Dioxide	No.	60 mg/L, 80 mg/L	
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [ ] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: A39L018 PZ

DATE AND TIME OF SAMPLING: March 13, 1999 1024 a.m./p.m.
SAMPLE COLLECTED BY: (DW / TH / JB) of Parsons ES: Houston and Denver Offices.
WEATHER: cloudy ~60°F calm winds

MONITORING WELL CONDITION:

1 [X] WELL NUMBER IS APPARENT
2 [ ] WELL NUMBER IS NOT APPARENT. EXPLAIN: _____
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:

5 [ ] PRODUCT OBSERVED AT DEPTH OF _____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:

7 [X] WATER DEPTH MEASURED AT 0.45 FT. BELOW DATUM WITH _____
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:

9 [ ] PERISTALTIC PUMP AND DEDICATED TUBING
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: GRUNDFOS
Items Cleaned (List): _____

MONITORING WELL EVACUATION OBSERVATIONS:

Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments: _____
Other comments: _____

ON-SITE MEASUREMENTS:

12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:

14 [X] 4 SW8260A (40 mL VOAs); 1 DOC by E415.1 (~~500~~ mL GA Bottle); 3 NRMRL-147 (40 mL VOAs)
~~Sulfate/Chloride by Meth~~ N-601 (____mL ____Bottle); ____Nitrate by E300/SW9056 (___mL ___Bottle)
15 [X] NONE/OTHER: TOTAL IRON 1 L Plastic NA ? — collect on ?

ON-SITE SAMPLE TREATMENT:

16 [X] NONE
17 [ ] [ ] FILTRATION: Method _____ Containers: _____
[ ] PRESERVATIVES Method _____ Containers: _____

CONTAINER HANDLING:

18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [ ] Containers Placed in Ice Chest

OTHER COMMENTS: _____

PARSONS ENGINEERING SCIENCE, INC.

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: 18 PZ

DIRECT INSTRUMENT READINGS

Time	0949	0957	0959	1009	1014	1019	Measured With
Temp (°C)	20.87	22.14	22.16	22.16	22.25	22.02	
pH	6.80	6.91	6.90	6.89	6.88	6.88	
Cond (µS/cm)	0.868	0.907	0.917	0.915	0.922	0.918	
Do (mg/L)	1.38	0.46	.43	0.37	0.36	0.35	
Redox (mv)	-98	-152.9	-159.0	-155.5	-156.9	-156.4	
Observations: Spc/Avb	0.737	0.950	0.971	0.968	0.973 / 53.5	0.974 /	
gallons purged	1	~~09~~	12	27	35	43	

Additional Comments: Purge Rate = ~1.5 gpm after 8 minutes
Turbidity 16.1 at time of sampling.

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate	No.	0.	No Yrs Turb.
(2) Sulfide	No	0.013 mg/L	No Yrs. Colg (pink) in Turb.)
(3) Manganese	No	1.4 mg/L	Mod. Violet Colr
(4) Ferrous Iron	No	4.820 mg/L	Deep Rust Colr.
(5) Alkalinity	1:4; 25mL + 75mL	7 drops x 20 mg/drop = 140 x 4 = 560	mg/L as CaCO3
(6) Carbon Dioxide	No	50 ppm.	
(7) Chloride			

Additional Comments: Filtered before performing analyses.

FIELD QA/QC PERFORMED AT THIS LOCATION? [X] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: A39L019P2

DATE AND TIME OF SAMPLING: May 26, 1999 16:50 a.m./p.m.
SAMPLE COLLECTED BY: DW / TH of Parsons ES: Houston and Denver Offices.
WEATHER: Sunny, Hot, Muggy

MONITORING WELL CONDITION:
1 [X] WELL NUMBER IS APPARENT on top of well box
2 [ ] WELL NUMBER IS NOT APPARENT. EXPLAIN: _____
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:
5 [ ] PRODUCT OBSERVED AT DEPTH OF ____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:
7 [X] WATER DEPTH MEASURED AT 11.48 FT. BELOW DATUM WITH Lok Probe
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:
9 [X] PERISTALTIC PUMP AND DEDICATED TUBING for dH_2 tch @ 17:32
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: for purging; probe measurements
Items Cleaned (List): _____

MONITORING WELL EVACUATION OBSERVATIONS:
Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments: _____
Other comments: _____

ON-SITE MEASUREMENTS:
12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:
14 [X] 1 MICROSEEPS Dissolved Hydrogen Vials (20 mL)

15 [ ] Notes/Comments/Other: _____

ON-SITE SAMPLE TREATMENT:
16 [X] NONE
17 [ ] [ ] FILTRATION: Method _____ Containers: _____
[ ] PRESERVATIVES Method _____ Containers: _____

CONTAINER HANDLING:
18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [ ] Containers Placed in Ice Chest

OTHER COMMENTS: TD = 90' ≈ 59' of H_2O
Need ≈ 30 gallons for 3 purges.

PARSONS ENGINEERING SCIENCE, INC.

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: A39L019PZ

DIRECT INSTRUMENT READINGS

Time	16:53	17:00	19:08	17:15			Measured With
Temp (°C)	26.07	20.69	20.68	20.72			
pH	8.04	6.59	6.63	6.59			
Spl Cond (µS/cm)	0.151	0.970	0.990	0.992			
Do (mg/L)	7.44	0.22	0.21	0.22			
Redox (mv)	36.9	-152.3	-155.4	-153.7			
Observations:	Clear.	Slightly Turbid			Turb =		24 NTU
gallons purged	1	12.5	24.5	35			

Additional Comments:

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate			
(2) Sulfide			
(3) Manganese			
(4) Ferrous Iron			
(5) Alkalinity			
(6) Carbon Dioxide			
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [ ] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [ ] 800-Area; [x] 2500-Area MONITORING WELL: 19 PZ

DATE AND TIME OF SAMPLING: March 12, 1999 16:45 a.m./p.m.
SAMPLE COLLECTED BY: DW / TH / JB of Parsons ES: Houston and Denver Offices.
WEATHER: _____

MONITORING WELL CONDITION:
1 [X] WELL NUMBER IS APPARENT
2 [ ] WELL NUMBER IS NOT APPARENT. EXPLAIN: _____
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:
5 [ ] PRODUCT OBSERVED AT DEPTH OF _____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:
7 [X] WATER DEPTH MEASURED AT 9.92 FT. BELOW DATUM WITH _____
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:
9 [ ] PERISTALTIC PUMP AND DEDICATED TUBING
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: GROUNDFOS
Items Cleaned (List): pump/tubing (before insertion)

MONITORING WELL EVACUATION OBSERVATIONS:
Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments: _____
Other comments: _____

ON-SITE MEASUREMENTS:
12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:
14 [ ] 4 SW8260A (40 mL VOAs); 1 DOC by E415.1 (500 mL 6A Bottle); 3 NRMRL-147 (40 mL VOAs)
___Sulfate/Chloride by Meth. N-601 (___mL ___Bottle); ___Nitrate by E300/SW9056 (___mL ___Bottle)
15 [ ] NONE/OTHER: T. IRON - 1 L Pl. 1 1L Plastic

ON-SITE SAMPLE TREATMENT:
16 [X] NONE
17 [ ] [ ] FILTRATION: Method _____ Containers: _____
[ ] PRESERVATIVES Method _____ Containers: _____

CONTAINER HANDLING:
18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [ ] Containers Placed in Ice Chest

OTHER COMMENTS: _____

PARSONS ENGINEERING SCIENCE, INC.

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: 1997

DIRECT INSTRUMENT READINGS

Time	1645	1650	1655	~~1705~~	1710	1715	Measured With
Temp (°C)	20.56	21.25	21.25	21.29	21.27	21.29	
pH	6.80	6.83	6.83	6.83	6.83	6.83	
Cond (µS/cm)	0.799	0.975	0.975	0.973	0.973	0.974	
Do (mg/L)	2.41	0.39	0.37	0.36	0.36	0.37	
Redox (mv)	-96.4	-139.2	-145.7	-149.5	-150.4	-151.1	
Observations: sp	0.833	1.050	1.050	1.048	1.047	1.048	
gallons purged	1	11	21	41	51	61	

Additional Comments: 2 gpm purge Rate ; DO calibration = zero = 0.20 mg/L
Turbidity = ca. 2

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate	No	0.0	No Vis Color or Turb.
(2) Sulfide	No	0.0	No Vis color or Turb.
(3) Manganese	No	1.7, 1.6 mg/L	Mod Violet Color
(4) Ferrous Iron	No	4.71, 4.43 mg/L	Pink Red
(5) Alkalinity	1:4; 12.5+375	8 drops x 20 x 4 = 640	mg/L as CaCO3 (High Range)
(6) Carbon Dioxide	No	61 ppm	
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [X] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: A39L022PZ

DATE AND TIME OF SAMPLING: March 11, 1999 8:30 (a.m.)/p.m.
SAMPLE COLLECTED BY: (DW / TH / JB) of Parsons ES: Houston and Denver Offices.
WEATHER: overcast, fog & drizzel, cool, ~ 60°F

MONITORING WELL CONDITION:
1 [X] WELL NUMBER IS APPARENT with Tag in well
2 [ ] WELL NUMBER IS NOT APPARENT. EXPLAIN: _____
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:
5 [ ] PRODUCT OBSERVED AT DEPTH OF ____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:
7 [X] WATER DEPTH MEASURED AT 8.58 FT. BELOW DATUM WITH ART ind. probe.
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:
9 [ ] PERISTALTIC PUMP AND DEDICATED TUBING
10 [ ] DEDICATED QED WELL WIZARD PUMP.
11 [X] BLADDER PUMP OR OTHER: Grundfos pump - decomed.
Items Cleaned (List): ~~Dbl +~~ New tubing.

MONITORING WELL EVACUATION OBSERVATIONS:
Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments: _____
Other comments: _____

ON-SITE MEASUREMENTS:
12 [ ] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:
14 [ ] X SW8260A (40 mL VOAs); X DOC by E415.1 (500 mL 6 Bottle); X NRMRL-147 (40 mL VOAs)
___Sulfate/Chloride by Meth. N-601 (____mL ____Bottle); X Nitrate by E300/SW9056 (250 mL 1 Bottle)
15 [ ] NONE/OTHER:

ON-SITE SAMPLE TREATMENT:
16 [X] NONE
17 [ ] [ ] FILTRATION: Method _____ Containers: _____
[ ] PRESERVATIVES Method _____ Containers: _____

CONTAINER HANDLING:
18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [ ] Containers Placed in Ice Chest

OTHER COMMENTS: STANDARD ADDITIONS PERFORMED FOR THIS SAMPLE, SEE "ON SITE MEASUREMENT FORM".

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [ ] 800-Area; [X] 2500-Area MONITORING WELL: 022P7

DIRECT INSTRUMENT READINGS

Time	8:~~36~~	8:42	8:46	8:56	9:06		Measured With
Temp (°C)	21.70	21.81	21.80	2680	21.81		
pH	7.42	6.89	6.87	6.86	6.86		
Cond (µS/cm)	0.84	0.881	~~0.732~~	.872	.869		
Do (mg/L)	1.0	0.47	0.30	0.22	0.21		
Redox (mv)	-40	-69.3	-73.9	-82.5	-87.1		
Observations: ~~Specific~~ con.					.927		
gallons purged	.5	~~5~~ 5.13	~~10~~ 11	~~20~~ 41	60		

Additional Comments: ~~Specific~~ Con

Turbidity 4/4/4

3 gal/min pumping Rate

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate	No	0.0	No turb in Sample
(2) Sulfide	No	0.014	No obvious color or turb.
(3) Manganese	NO	3.5 mg/L Mn	Slight Violet color & turb.
(4) Ferrous Iron	1:2 .50mL + 50mL	2.96mg/L x 2 = 5.92 mg/L	Rust colored.
(5) Alkalinity	No	26 drops x 20 = 520 mg/L	High Range - as CaCO3.
(6) Carbon Dioxide	No	60 ppm	Used Chemetrics.
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [ ] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes
Mn.	1 mg/L	~~0.0~~ 1.9	
	2.5 mg/L	4.1	
	5.0 mg/L	6.6	
	10.0 mg/L	10.7	
	0.0 mg/L	1.9	
CO_2	10 ppm	40 ppm	
	50 ppm	65 ppm	
	100 ppm	102 ppm	
	200 ppm	155 ppm	
	0 ppm	40 ~~45~~ ppm	
Sulfate	0 ~~ppm~~ mg/L	0 mg/L	No turbidity visible
	20 mg/L	19.1 mg/L	
	40 mg/L	48.2 mg/L	
	60 mg/L	73.5 mg/L	
	80 mg/L	89.6	
Alkalinity ↑	0 mg/L	8 drops x 20 = 160 mg/L x 4 = 640 mg/L	
	50 mg/L	8 drops x 20 = 160 mg/L x 4 = 640 mg/L	
Dilute ←	100 mg/L	9 drops x 20 = 180 mg/L x 4 = 720 mg/L	
1:4	200 mg/L	9 drops x 20 = 180 mg/L x 4 = 720 mg/L	
↓	300 mg/L	10 drops x 20 = 200 mg/L x 4 = 800 mg/L	

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: SS45L002MW

DATE AND TIME OF SAMPLING: May _____, 1999 _____ a.m./p.m.
SAMPLE COLLECTED BY: DW / TH of Parsons ES: Houston and Denver Offices.
WEATHER: _____

MONITORING WELL CONDITION:
1 [ ] WELL NUMBER IS APPARENT
2 [X] WELL NUMBER IS NOT APPARENT. EXPLAIN: No markings or tags
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:
5 [ ] PRODUCT OBSERVED AT DEPTH OF ____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:
7 [ ] WATER DEPTH MEASURED AT 7.27 FT. BELOW DATUM WITH _____
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:
9 [X] PERISTALTIC PUMP AND DEDICATED TUBING for dH2; methane
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: for purge; Probe readings
Items Cleaned (List): _____

MONITORING WELL EVACUATION OBSERVATIONS:
Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy clear
Water level (rose - fell - no change)
Water odors/comments: no odors
Other comments: _____

ON-SITE MEASUREMENTS:
12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:
14 [ ] X MICROSEEPS Dissolved Hydrogen Vials (20 mL) - Taken @ 08:53.
15 [ ] Notes/Comments/Other: Methane - Taken @ 08:40

ON-SITE SAMPLE TREATMENT:
16 [X] NONE
17 [ ] [ ] FILTRATION: Method _____ Containers: _____
[ ] PRESERVATIVES Method _____ Containers: _____

CONTAINER HANDLING:
18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [ ] Containers Placed in Ice Chest

OTHER COMMENTS: TD @ 64 feet ≈ 58 feet water column 29 gallons - 3 purge vol.

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: SS45L001MW

DIRECT INSTRUMENT READINGS

Time	08:08	08:13	08:23	08:28			Measured With
Temp (°C)	20.64	20.63	20.63	20.62			
pH	6.89	6.78	6.78	6.78			
Cond (µS/cm)	0.945	1.033	1.029	1.028			
Do (mg/L)	1.08	0.24	0.24	0.23			
Redox (mv)	-66.9	-83.0	-86.7	-89.4			
Observations:	clear	→	→	→	turb = 6		
gallons purged	2	9.5	24.5	32			

Additional Comments: 1.5 gpm

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate			
(2) Sulfide			
(3) Manganese			
(4) Ferrous Iron			
(5) Alkalinity			
(6) Carbon Dioxide			
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [ ] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

GROUNDWATER SAMPLING RECORD

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: SS45L002MW

DATE AND TIME OF SAMPLING: May 27, 1999 07:30 a.m./p.m.
SAMPLE COLLECTED BY: DW / TH of Parsons ES: Houston and Denver Offices.
WEATHER: warm, slight breeze, partly sunny

MONITORING WELL CONDITION:
1 [ ] WELL NUMBER IS APPARENT
2 [X] WELL NUMBER IS NOT APPARENT. EXPLAIN: No Tag or Markings
3 [X] PVC CONDITION IS UNDAMAGED
4 [ ] PVC CONDITION IS DAMAGED. EXPLAIN: _____
[ ] DEFICIENCIES CORRECTED BY SAMPLE COLLECTOR
[ ] MONITORING WELL REQUIRED REPAIR (describe): _____

PRODUCT INFORMATION:
5 [ ] PRODUCT OBSERVED AT DEPTH OF ____ FT. BELOW DATUM WITH _____
6 [X] PRODUCT NOT OBSERVED

WATER LEVEL/CONDITION INFORMATION:
7 [X] WATER DEPTH MEASURED AT 7.46 FT. BELOW DATUM WITH H2L Meter
8 [ ] OTHER. EXPLAIN: _____

MONITORING WELL EVACUATION METHOD:
9 [X] PERISTALTIC PUMP AND DEDICATED TUBING dHg ; methene
10 [ ] DEDICATED QED WELL WIZARD PUMP:
11 [X] BLADDER PUMP OR OTHER: Purging ; probe readings
Items Cleaned (List): _____

MONITORING WELL EVACUATION OBSERVATIONS:
Volume Removed: SEE "ON SITE MEASUREMENT FORM"
Initial Observations: Water (slightly - very) cloudy
Water level (rose - fell - no change)
Water odors/comments: _____
Other comments: _____

ON-SITE MEASUREMENTS:
12 [X] SEE "ON SITE MEASUREMENT FORM"
13 [ ] NOT PERFORMED, EXPLAIN: _____

GROUNDWATER SAMPLES COLLECTED FOR OFF-SITE ANALYSES:
14 [X] 1 MICROSEEPS Dissolved Hydrogen Vials (20 mL)

15 [X] Notes/Comments/Other: 2 methene 40 mL VOAs - taken @ 08:12

ON-SITE SAMPLE TREATMENT:
16 [X] NONE
17 [ ] [ ] FILTRATION: Method _____ Containers: _____
[ ] PRESERVATIVES Method _____ Containers: _____

CONTAINER HANDLING:
18 [X] Container Sides Labeled
19 [ ] Container Lids Taped
20 [ ] Containers Placed in Ice Chest

OTHER COMMENTS: TD = 99 feet, water column = ~92 feet.
Need ≈ 46 gallons of H2O

ON-SITE MEASUREMENT FORM

SAMPLING LOCATION: England AFB, [X] 800-Area; [ ] 2500-Area MONITORING WELL: SS45L002MW

DIRECT INSTRUMENT READINGS

Time	07:35	07:42	07:53	08:00	08:06		Measured With
Temp (°C)	21.04	20.68	20.63	20.64	20.64		
pH	7.68	6.90	6.72	6.72	6.72		
Cond (µS/cm)	0.670	0.931	1.080	1.077	1.073		
Do (mg/L)	2.47	0.26	0.37	0.26	0.26		
Redox (mv)	40.7	-61.0	-110.7	-111.1	-110.9		
Observations:	clear.	clear →	→	→	→	Turb = .22 NTU	
gallons purged	1 gallon	11.5	28	38.5	47.5		

Additional Comments:

FIELD CHEMISTRY RESULTS

Analyte	Dilution?	Concentration	Observations/Notes
(1) Sulfate			
(2) Sulfide			
(3) Manganese			
(4) Ferrous Iron			
(5) Alkalinity			
(6) Carbon Dioxide			
(7) Chloride			

Additional Comments:

FIELD QA/QC PERFORMED AT THIS LOCATION? [ ] No; [ ] Yes (see below)

Analyte	Standard Addition Conc.	Measured Conc.	Notes

PARSONS ENGINEERING SCIENCE, INC.

England Air Force Base
Rapides Parish, Louisiana

Monitoring Well Designation	Latitude/ Longitude	State Plane Coordinates (NAD 27)	Top of Casing Elevation
MW-2	31°19'19.4" 92°31'40.9"	N=238394.2266 E=1991247.9997	90.33
A39L012PZ	31°19'11.5" 92°31'33.6"	N=237603.8015 E=1991877.0144	85.05
MW-1	31°19'07.1" 92°31'45.7"	N=237157.4225 E=1990831.0492	84.21
MW-10	31°19'34.6" 92°31'12.0"	N=239932.2042 E=1988550.181	88.02
A39L001BH	31°19'37.7" 92°32'19.2"	N=240244.5992 E=1987926.724	83.13
A39L014DP	31°19'38.9" 92°32'07.3"	N=240366.6786 E=1988961.624	85.19

Pan American Engineers
P.O. Box 89
Alexandria, Louisiana 71309-0089

1/28/99
Revised 6/16/99

PARSONS ENGINEERING SCIENCE, INC.

England Air Force Base
Rapides Parish, Louisiana

Monitoring Well Designation	Latitude/ Longitude (NAD 27)	State Plane Coordinates	Top of Casing Elevation
A39L008PZ	31°19'39.0" 92°32'07.1"	N=240376.0378 E=1988975.471	85.19
A39L008DP	31°19'43.7" 92°32'16.7"	N=240850.7268 E=1988138.782	83.38
A39L001PZ	31°19'43.6" 92°32'16.9"	N=240843.7584 E=1988122.671	83.11
BKGL039MW	31°19'37.8" 92°32'19.2"	N=240260.0921 E=1987925.192	83.30

PARSONS ENGINEERING SCIENCE, INC.

England Air Force Base
Rapides Parish, Louisiana

Monitoring Well Designation	Latitude/ Longitude	State Plane Coordinates (NAD 27)	Top of Casing Elevation
MW-3	31°19'25.9" 92°31'46.4"	N=238988.9657 E=1990815.3458	88.55
MW-4	31°19'21.3" 92°31'43.5"	N=238523.7110 E=1991064.8907	88.97
MW-5	31°19'14.3" 92°31'47.3"	N=237820.9884 E=1990733.8525	85.50
MW-6	31°19'05.3" 92°31'46.1"	N=236910.9112 E=1990843.9439	83.42
MW-7	31°19'05.5" 92°31'52.5"	N=236924.2460 E=1990282.6706	91.16
MW-11	31°19'36.1" 92°32'18.0"	N=240021.4188 E=1988070.1551	86.88

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2/25/99

PARSONS ENGINEERING SCIENCE, INC.

England Air Force Base
Rapides Parish, Louisiana

Monitoring Well Designation	Latitude/ Longitude	State Plane Coordinates (NAD 27)	Top of Casing Elevation
MW-12	31°19'36.2" 92°32'17.9"	N=240028.6456 E=1988082.9627	87.35
MW-13	31°19'40.8" 92°32'11.2"	N=240491.5534 E=1988661.2809	87.38
MW-14	31°19'39.8" 92°32'15.7"	N=240393.7464 E=1988274.3133	86.31
MW-15	31°19'39.7" 92°32'15.9"	N=240384.1721 E=1988258.4773	86.77
MW-16	31°19'46.7" 92°32'17.1"	N=241095.7838 E=1988156.4034	81.56
MW-17	31°19'46.9" 92°32'12.9"	N=241116.2153 E=1988517.5491	83.93

PARSONS ENGINEERING SCIENCE, INC.

England Air Force Base
Rapides Parish, Louisiana

Monitoring Well Designation	Latitude/ Longitude	State Plane Coordinates (NAD 27)	Top of Casing Elevation
MW-18	31°19'48.2" 92°32'23.3"	N=241239.7776 E=1987610.9854	85.05
MW-19	31°19'48.0" 92°32'23.6"	N=241223.8343 E=1987589.5080	85.26
MW-20	31°19'46.1" 92°32'16.0"	N=241030.4841 E=1988244.3258	82.17
A39L082DP	31°19'17.2" 92°31'44.5"	N=238105.5996 E=1990978.0819	87.26
A39L019PZ	31°19'23.4" 92°31'51.6"	N=238733.0683 E=1990363.9545	87.73
A39L010PZ	31°19'17.2" 92°31'44.5"	N=238111.0303 E=1990975.3986	87.11

Post-it™ Fax Note 7671	Date	# of pages ▶
To John Anthony	From David White	
Co./Dept.	Co.	
Phone #	Phone #	
Fax #	Fax #	

PARSONS ENGINEE

England Ai
Rapides Par

Monitoring Well Designation	Latitude/ Longitude (NAD 27)	State Plane Coordinates	Top of Casing Elevation (Basis of Elevations = USGS BM No. A238, Elevation = 85.80)
MW-4	31°19'21.3" 92°31'43.5"	N=238523.7110 E=1991064.8907	88.22
A39L018PZ	31°19'22.6" 92°32'00.2"	N=238717.1256 E=1989577.9375	78.02
MW-13	31°19'40.8" 92°32'11.2"	N=240491.5534 E=1988661.2809	86.63
MW-16	31°19'46.7" 92°32'17.1"	N=241095.7838 E=1988156.4034	79.65
MW-21	31°19'49.5" 92°32'11.3"	N=241437.5730 E=1988608.2603	82.73
MW-8	31°19'10.1" 92°31'39.9"	N=237454.3278 E=1991332.4758	90.61

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Alexandria, Louisiana 71309-0089

8/17/99
Revised 8/18/99

45059
7:50
0198

A Waste Management Company

NON-HAZARDOUS MANIFEST

GENERATOR

Generator US Air Force Base, ATTN: S. Whitley EPA

Address 3711 Fighter Drive I.D.# LA9572124452

Austin, TX 78719-2557 Shipping Location England Air Park

Address Alexandria, La

Phone (512) 386-5425 ext 14 Phone (303) 764-1910

Description of Waste Materials	Industrial Waste Code #	Profile Number	Total Quantity	Unit of Measure	Container Type
Dirt (soil)	014	BT3223	10	yds	20yd roll-off
			9.56 Tons		

I hereby certify that the above-described materials are not hazardous wastes as defined by 40 CFR, Part 261 or any applicable state law or regulation, have been fully and accurately described, classified and packaged, and are in proper condition for transportation according to applicable law and regulations.

Stephen Whitley, AFBCA/DC — Generator Authorized Agent Name (Print)

Signature

7-21-99 — Delivery Date

TRANSPORTER

Transporter Name The Omega One Co

LAD981902133

Address 1515 England Dr.

Alexandria, LA 71303

Driver Name (Print) McMac Withoward

Truck Number #122

Truck Type Mack Roll off

I hereby acknowledge receipt of the above-described materials for transport from the generator shipping location listed above.

Driver Signature — 7/27/99 Shipment Date

I hereby acknowledge that the above-described materials were received from the generator shipping location and were transported without incident to the destination listed below.

Driver Signature — 7/28/99 Delivery Date

DESTINATION

Site Name LaSalle/Grant Landfill

Address 9 miles N. of Jena Hwy 127

Jena, LA 71342

LADEQ Facility # D-059-1658

LADEQ Permit # P-0119 R1

Phone Number 318-992-5571

Disposal Location: North _____ East _____ Level _____

I hereby acknowledge receipt of the above-described materials.

CHRISTY F. SMITH — Name of Authorized Agent (Print)

Signature

7/28/99 — Receipt Date

White - Original Canary - Disposer Retain Pink - Transporter Retain Goldenrod - Generator Retain

45058
7:50

A Waste Management Company

NON-HAZARDOUS MANIFEST

1999 AUG 10 AM 11: 42

0199

GENERATOR

Generator US Air Force Base Attn: S. Whatley EPA

Address 3711 Fighter Drive I.D.# LA9572124452

Austin, TX 78719-2557 Shipping Location England Air Parks

Address Alexandria, La

Phone (512) 386-5425 ext 19 Phone (303) 764-1910

Description of Waste Materials	Industrial Waste Code #	Profile Number	Total Quantity	Unit of Measure	Container Type
Dirt (Soil)	014	BT3223	15 / 11.13 Tons	yds	30yd roll-of

I hereby certify that the above-described materials are not hazardous wastes as defined by 40 CFR, Part 261 or any applicable state law or regulation, have been fully and accurately described, classified and packaged, and are in proper condition for transportation according to applicable law and regulations.

Stephen Whatley, AFBCA/DC — Generator Authorized Agent Name (Print)

Signature

7-21-99 — Delivery Date

TRANSPORTER

Transporter Name The Omega Oil Co

LAD 981902133

Address 1515 England Dr

Alexandria LA 71303

I hereby acknowledge receipt of the above-described materials for transport from the generator shipping location listed above.

Curtis Morrow Jr — Driver Signature

7/28/99 — Shipment Date

Driver Name (Print) Curtis Morrow Jr

Truck Number 123

Truck Type Mack 95

I hereby acknowledge that the above-described materials were received from the generator shipping location and were transported without incident to the destination listed below.

Curtis Morrow Jr — Driver Signature

7/28/99 — Delivery Date

DESTINATION

Site Name LaSalle/Grant Landfill

Address 9 miles N. of Jena Hwy 127

Jena, LA 71342

LADEQ Facility # D-059-1658

LADEQ Permit # P-0119 R1

Phone Number 318-992-5571

Disposal Location: North _____ East _____ Level _____

I hereby acknowledge receipt of the above-described materials.

CHRISTY F. SMITH — Name of Authorized Agent (Print)

Christy Smith — Signature

7/28/99 — Receipt Date

White - Original | Canary - Disposer Retain | Pink - Transporter Retain | Goldenrod - Generator Retain

45068
10:38
0200

A Waste Management Company

1999 AUG 10 AM 10:16

NON-HAZARDOUS MANIFEST

GENERATOR

Generator US Air Force Base: Attn S. Whatley
Address 3711 Fighter Drive
Austin, TX 78719-2557
Phone (512) 386-5425 ext 19

EPA I.D.# LA 9572124452
Shipping Location England Air Park
Address Alexandria, La
Phone (303) 764-1910

Description of Waste Materials	Industrial Waste Code #	Profile Number	Total Quantity	Unit of Measure	Container Type
Dirt (Soil)	014	BT3223	10	yds	20 yd roll-off
			11.94	TONS	

I hereby certify that the above-described materials are not hazardous wastes as defined by 40 CFR, Part 261 or any applicable state law or regulation, have been fully and accurately described, classified and packaged, and are in proper condition for transportation according to applicable law and regulations.

Stephen Whitley, AFBCA/DC — Generator Authorized Agent Name (Print)
Signature
7-21-99 — Delivery Date

TRANSPORTER

Transporter Name Hy-Wire Environmental
Address White Chuckes Opelousas LA.
1-800-256-7745

Driver Name (Print) David mobile
Truck Number 1108
Truck Type Rolloff

I hereby acknowledge receipt of the above-described materials for transport from the generator shipping location listed above.

David Mobile — Driver Signature
7/28/99 — Shipment Date

I hereby acknowledge that the above-described materials were received from the generator shipping location and were transported without incident to the destination listed below.

David Mobile — Driver Signature
7/28/99 — Delivery Date

DESTINATION

Site Name LaSalle/Grant Landfill
Address 9 miles N. of Jena Hwy 127
Jena, LA 71342

LADEQ Facility # D-059-1658
LADEQ Permit # P-0119 R1
Phone Number 318-992-5571

Disposal Location: North _____ East _____ Level WESTSIDE Cell 6 H-J
50' off bottom

I hereby acknowledge receipt of the above-described materials.

CHRISTY F. SMITH — Name of Authorized Agent (Print)
Christy Smith — Signature
7/28/99 — Receipt Date

White - Original | Canary - Disposer Retain | Pink - Transporter Retain | Goldenrod - Generator Retain

APPENDIX D

PROPERTIES OF CHEMICALS OF POTENTIAL CONCERN AND THEIR MOVEMENT AND FATE IN THE ENVIRONMENT

APPENDIX D

PROPERTIES OF CHEMICALS OF POTENTIAL CONCERN AND THEIR MOVEMENT AND FATE IN THE ENVIRONMENT

The risk-based paradigm, established by the U.S. EPA as part of the Superfund program, consists of four basic technical elements that progress logically to a quantitative evaluation of the site-specific risks to human health and the environment. The elements required for risk-based site assessments are:

- Hazard identification,
- Exposure assessment,
- Toxicity assessment, and
- Risk characterization.

Hazard identification consists of identifying the site-specific constituents of potential concern and contaminated media that represent potential threats to human health and the environment. This identification is accomplished by reviewing the available site characterization information, and evaluating the hazard potential of detected constituents, based on their known effects to human and/or environmental receptors. This evaluation establishes the list of constituents of potential concern that will form the basis for subsequent risk-based analysis.

The *exposure assessment* is used to develop an understanding of the movement of constituents of potential concern from contaminated media at the site, through the environment, to a point of contact with human or environmental receptors. Site-specific factors examined in the exposure assessment include identification of contaminated media, evaluation of the physical and chemical properties controlling the occurrence, movement and fate of site-related constituents in the environment, and a qualitative assessment of the rates and directions of chemical migration. General considerations governing the movement and fate of site-related constituents in the environment are discussed in this section.

The toxicological effects of site-related constituents and contaminated media on potential receptors are evaluated as part of the *toxicity assessment.* The effects of concern include acute and chronic effects, and address both carcinogenic and non-carcinogenic toxicological endpoints. This information is used to estimate the toxicological effect to a receptor that could result from a specific intake ("dose") of the

constituent. *Risk characterization* integrates the information from the hazard identification, exposure assessment, and toxicity assessment to develop a quantitative evaluation of the risk associated with a site. The risk characterization thus begins with the identification of site-related constituents, projects their release and movement in the environment, estimates their uptake by potential human and environmental receptors, and evaluates the possible toxicological effects of these chemical "doses" on receptors as a measure of potential risk

Consideration of the physical and chemical properties of the chemicals of potential environmental concern is critical in evaluating the fate of those chemicals in the environment, and the possible range in performance of various remedial alternatives (Nyer and Skladany, 1989). A general review of the properties of the volatile organic chemicals that have been detected in groundwater beneath Site SS-45, England AFB, is therefore appropriate.

D1.0 CHEMICAL STRUCTURE AND ITS INFLUENCE ON CHEMICAL PROPERTIES

D1.1 Organic Compounds at Site SS-45, England AFB

Several volatile organic compounds, including the volatile halogenated organic compounds TCE, the isomers of DCE, DCA, and vinyl chloride, and the volatile aromatic compounds benzene, toluene, ethylbenzene, and xylene isomers (BTEX compounds), have been detected in groundwater beneath Site SS-45, England AFB. These chemicals have been detected at concentrations judged to be above background and are considered to be site-related at Site SS-45, as a probable consequence of historic activities on the facility. The volatile organic compounds that have been detected are of two general types: organic solvents, and constituents of petroleum fuels.

Organic Solvents

Various types of industrial solvents are typically used for cleaning and degreasing, paint thinning, and adhesive mixing. Solvents generally consist of volatile organic compounds, together with an inert base. These are mixed in varying proportions depending on specific applications. The compounds that have been identified in groundwater at Site SS-45, including TCE, 1,1-DCA, 1,1-DCE, cis-1,2-DCE, and trans-1,2-DCE, are generally considered to be constituents of solvents (Howard, 1990b).

Petroleum Distillate Fuels

Petroleum fuels are distillates of crude petroleum comprising a complex mixture predominantly composed of paraffins, cycloparaffins and aromatic groups, together with other minor constituents added as octane enhancers, or to improve evaporation and condensation characteristics of the fuel. The aromatic BTEX compounds are primary constituents of petroleum- distillate fuels, and are chemicals of potential environmental concern in fuels because they are relatively toxic, and can be mobile in the environment (California Department of Health Services, 1988).

Nearly all organic chemicals are products or byproducts of the refining and processing of crude petroleum. Petroleum hydrocarbon compounds are composed of carbon and

hydrogen atoms, arranged into an almost infinite number of discrete molecules. These molecules are classified as alkanes, alkenes, and aromatic hydrocarbons, on the basis of their structure.

Halogenated hydrocarbon compounds are composed primarily of carbon and hydrogen atoms, arranged into an almost infinite number of discrete molecules, with one or more halogen atoms (usually, chlorine, bromine, or fluorine), attached to the hydrocarbon structure as a functional group (Dickerson *et al.*, 1970). Alkanes contain only carbon-carbon single bonds, while alkenes contain carbon-carbon double bonds, which tend to increase the polarity and solubility of the molecule (Schwarzenbach *et al.*, 1993). Aromatic hydrocarbon compounds are based on the benzene ring structure, with conjugated carbon-carbon double bonds, which imparts some unique properties. The monoaromatic compounds (benzene, toluene, ethylbenzene, and xylene isomers), are very soluble in water, as compared with most alkanes and alkenes. Their high solubility causes aromatic compounds to be quite mobile in the environment (Zemo *et al.*, 1995).

The number of carbon atoms, the nature of the carbon-carbon bonds, and the number of halogen functional groups in a halogenated hydrocarbon compound have major effects on its properties (Nyer and Skladany, 1989; Schwarzenbach *et al.*, 1993). Halogenated hydrocarbons are nonelectrolytes, in that they do not dissociate into cations and anions in aqueous solution, but rather dissolve as neutral species. Halogen functional groups, and alkene bonds, increase the polarity of halocarbon molecules; and the halogen functional groups associate with water molecules by hydrogen bridging, which increases the solubility of polar nonelectrolytes, as compared to non-halogenated hydrocarbons of similar structure (Luckner and Schestakow, 1991). Halocarbon solubility rapidly decreases as the number of carbon atoms, and/or the number of halogen atoms in the compound increase(s); vapor pressures also decrease as carbon or halogen numbers increase. High vapor pressures indicate that a compound is readily volatilized; low vapor pressures are associated with chemicals that are semi-volatile or non-volatile. For all classes of halogenated hydrocarbons, aqueous solubility decreases, and the tendency of the hydrocarbon compound to sorb to soil particles (or "partition" to soil), increases as the number of halogen atoms and molecular weight increase (Schwarzenbach *et al.*, 1993). A summary of all the volatile organic compounds that have been detected in groundwater at Site SS-45, England AFB, together with the chemical properties of each compound, that influence its mobility in the environment, is presented in Table D.1.

D1.2 Exposure Pathways and Routes of Chemical Migration

As described in the Superfund Public Health Evaluation Manual (U.S. EPA, 1986), an exposure pathway consists of four necessary elements:

1. A source and mechanism of chemical release to the environment;

2. An environmental transport medium for the released chemical;

3. A point of potential contact for human or environmental receptors with the contaminated medium (referred to as the exposure point); and

4. A receptor exposure route at the exposure point.

An exposure pathway is complete when all four elements are present and is incomplete when elements are missing. Exposure estimates can only be calculated for completed exposure pathways.

Two general pathways – surface pathways and subsurface pathways – can function as potential routes of chemical migration from source areas to other media, and/or to potential receptors. Surface transport mechanisms can include surface-water runoff; entrainment and transport of soil (as sediment) during precipitation events; overland flow from springs and seeps; airborne transport of fugitive dusts, aerosols, or vapors; and anthropogenic transport (e.g., excavation and removal of soil). Subsurface transport mechanisms can include movement of site-related constituents as a free phase ("non-aqueous phase"), as a dissolved phase in infiltrating precipitation, or in water within the saturated zone; and as a vapor phase in unsaturated pore spaces.

The four environmental media in which transport of site-related constituents can occur, potentially resulting in exposure of susceptible populations to chemicals, are groundwater, surface water and sediment, soil, and air. Numerous factors can affect the migration and potential bioavailability of chemicals, including:

Groundwater	Surface Water and Sediment
Direction of flow	Flow velocity
Gradient	Slope
Hydraulic conductivity	Discharge rate
Chemical partitioning	Sediment load

Soil	Air
Chemistry of soil	Temperature
Degree of saturation	Wind velocity
Chemical partitioning	Chemical volatility

The results of intensive site investigations indicate that groundwater is the only environmental medium at Site SS-45 that has been adversely affected by volatile organic chemicals (Section 4 of the CMS report). Despite extensive sample-collection programs, no discrete sources of volatile organic chemicals in soil have been identified; and the depth to groundwater and stratigraphic position of water-bearing units (the Intermediate and Deep Sand units) beneath an extensive, surficial clay indicates that volatilization to the atmosphere is probably not an important fate mechanism for chemicals at Site SS-45.

TABLE D.1-1
PROPERTIES OF SELECTED ORGANIC COMPOUNDS
SITE SS-45
ENGLAND AIR FORCE BASE
ALEXANDRIA, LOUISIANA

Compound[b]	Molecular Weight (g/mol)[c]	Henry's Law Constant (atm-m³/mol)[d]	Vapor Pressure (mm Hg @ 20°C)[e]	Density (g/cm³)[f]	Solubility (mg/L)[g]	Vapor-Air Diffusion Coefficient (cm²/day)[h]	Water-Liquid Diffusion Coefficient (cm²/day)	K_{oc}[a] (mL/g)[i]	log K_{oc}	First Order Decay Constant in Water (1/days)[j]
Methane	16.04 [k]	1.83E+01 [l]	2.08E+04 [l]	0.420 [m]	24 [m]	17,680 [l]	1.55 [l]	7.60E+02 [l]	2.88	N/A
Ethane	30.07 [k]	1.92E+01 [l]	2.93E+04 [m]	0.561 [m]	60.4 [m]	11,870 [l]	1.12 [l]	4.58E+02 [l]	2.66	N/A
Ethene	28.05 [k]	8.60E+00 [l]	3.08E+04 [l]	0.566 [m]	131 [l]	12,510 [l]	1.22 [l]	2.99E+02 [l]	2.48	0.006 - 0.17 [n]
1,1-DCA	98.96 [k]	4.32E-03 [o]	1.80E+02 [m]	1.176 [k]	5,500 [m]	7,690 [p]	0.79 [p]	3.00E+01 [q]	1.48	0.002 [n]
1,2-DCA	98.96 [k]	9.77E-04 [r]	6.10E+01 [m]	1.235 [k]	8,690 [m]	7,680 [l]	0.79 [l]	1.90E+01 [q]	1.28	0.002 [n]
TCE	131.39 [k]	7.19E-03 [o]	6.00E+01 [m]	1.464 [k]	1,100 [m]	7,603 [p]	0.72 [p]	1.07E+02 [q]	2.03	0.0001 - 0.001 [n] [s]
1,1-DCE[t]	96.94 [k]	2.07E-02 [o]	5.00E+02 [m]	1.218 [k]	2,250 [q]	8,122 [p]	0.82 [p]	6.50E+01 [q]	1.81	0.005 [n]
cis-1,2-DCE	96.94 [k]	2.97E-03 [o]	2.00E+02 [r]	1.284 [k]	800 [m]	8,122 [p]	0.82 [p]	4.47E+01 [l]	1.65	0.0001 - 0.004 [n] [u]
trans-1,2-DCE	96.94 [k]	7.26E-03 [o]	3.40E+02 [r]	1.257 [k]	600 [m]	7,860 [l]	0.83 [l]	5.90E+01 [q]	1.77	0.0001 - 0.004 [n]
Vinyl Chloride	62.50 [k]	2.18E-02 [o]	2.66E+03 [m]	0.911 [k]	1,100 [m]	9,245 [p]	0.98 [p]	2.50E+00 [q]	0.40	0.0002 [n] [s]
Benzene	78.11 [k]	5.43E-03 [r]	7.60E+01 [m]	0.877 [k]	1,780 [m]	7,980 [l]	0.94 [p]	9.12E+01 [m]	1.96	0.001 [n]
Toluene	92.14 [k]	5.94E-03 [r]	2.20E+01 [m]	0.867 [k]	515 [m]	7,344 [p]	0.82 [p]	1.51E+02 [q]	2.18	0.001 [n]
Ethylbenzene	106.17 [k]	8.44E-03 [u]	7.00E+00 [m]	0.867 [k]	152 [m]	6,566 [p]	0.78 [p]	2.57E+02 [q]	2.41	0.001 [n]
o-Xylene	106.17 [k]	5.10E-03 [r]	5.00E+00 [m]	0.880 [k]	175 [m]	6,307 [p]	0.61 [p]	1.29E+02 [q]	2.11	0.002 [n]
m-Xylene	106.17 [k]	7.68E-03 [r]	6.00E+00 [m]	0.864 [k]	146 [r]	5,962 [p]	0.61 [p]	1.59E+03 [q]	3.20	0.01 [n]
p-Xylene	106.17 [k]	7.68E-03 [r]	6.50E+00 [m]	0.861 [k]	198 [m]	5,789 [p]	0.61 [p]	2.04E+02 [q]	2.31	0.01 [n]

[a] K_{oc} = Organic carbon partition coefficient.
[b] DCA = dichloroethane, TCE = trichloroethene, DCE = dichloroethene.
[c] grams/mole.
[d] atmospheres-cubic meters per mole.
[e] millimeters mercury at 20 degrees Centigrade.
[f] grams per cubic centimeter.
[g] milligrams per liter.
[h] square centimeters per day.
[i] milliliters per gram.
[j] per day.
[k] Weast *et al.*, 1989.
[l] estimated using: Lyman *et al.*, 1990.
[m] Verschueren, 1983.
[n] Howard, *et al.*, 1991.
[o] Gossett, 1987.
[p] Tetra Tech, Inc., 1988.
[q] Montgomery and Welkom, 1990.
[r] Howard *et al.*, 1990.
[s] Wiedemeier et al., 1999.
[u] Anthony et al., 1997.
[t] Howard *et al.*, 1990.

The general physical and chemical characteristics governing the movement and fate of constituents of potential concern in groundwater are detailed in the following sections.

D1.3 Physico-Chemical Transport and Attenuation Mechanisms

Several transport processes control the physical movement of chemicals through soils, as non-aqueous phase liquid (NAPL), dissolved (aqueous) phase, and sorbed (solid) phase. When initially released to the subsurface environment, petroleum hydrocarbons and organic solvents are usually in the NAPL (oil) phase. Once a chemical has been introduced into the environment, it interacts with the surrounding soils. The major processes affecting chemicals in the subsurface include sorption to soil, diffusion, dissolution, chemical and biological degradation, and volatilization (Nyer and Skladany, 1989).

Under particular conditions, chemicals can exist in the environment in any of four different phases – as pure compound or in a chemical mixture; dissolved in water; sorbed to soil particles; or as a vapor. The degree to which a particular chemical is segregated among these phases, under specified conditions of temperature, pressure, and moisture content, in a particular soil matrix, is known as *partitioning*. Two basic types of partitioning are significant when evaluating the fate and transport of most chemical compounds. The first is partitioning of a single compound from a pure chemical phase or chemical mixture into air and/or water (e.g., partitioning of BTEX constituents from free-phase fuel oil into water in the unsaturated zone). After removal from the pure chemical phase or chemical mixture, compounds dissolved in water or present in the vapor phase will partition among the three phases in the subsurface environment, becoming dissolved in water, sorbed to soil, or volatilized in soil gas. The partitioning of a particular compound among the three phases, and its subsequent migration and fate in the environment, depends on its chemical properties (Jury *et al.*, 1983), including:

- Solubility of the compound in water;
- Chemical air-gas diffusion coefficient (related to the chemical's volatility);
- Chemical water-liquid diffusion coefficient;
- Chemical organic-carbon partition coefficient;
- Henry's Law constant for the chemical; and
- Rate of chemical decay.

Subsurface transport of chemicals as NAPL, dissolved-phase, or vapor-phase, like movement of any liquid in the subsurface, is driven by potential gradients – gravitational, hydraulic, or chemical. In the unsaturated zone, gravitational and hydraulic potential gradients are primarily vertical, so that the direction of movement is generally downward. In most situations, NAPLs denser than water will migrate through the soil in the unsaturated zone until they reach the capillary fringe, (in which the soil is fully saturated, but hydrostatic pressure is less than atmospheric pressure) above the water table. At that point, the NAPL spreads until sufficient pressure (NAPL head) develops to enable the

liquid to penetrate the capillary fringe and migrate to the water table (Mallon, 1989). As water percolates through the unsaturated zone, chemicals present as non-aqueous phase, a sorbed phase, or a vapor phase, can be dissolved and migrate with the infiltrating water to the water table. Dissolved constituents are carried downward in percolating water ("advective transport"). Volatilized compounds move in response to chemical concentration gradients between soil moisture and air-filled pore spaces ("diffusive transport"). If the relative vapor density of the volatile phase is greater than that of air, some chemical migration in the vapor phase may be downward (Mallon, 1989). In general, however, vapor-phase migration is from the subsurface to the atmosphere.

The transport rate of dissolved constituents in the unsaturated zone depends primarily on the permeability of the soil, its water content, and the concentrations of dissolved chemicals in percolating water. The transport of volatilized compounds in the unsaturated zone depends primarily on the permeability of the soil, its water content, and the ambient air temperature and barometric pressure. Below the water table, there are no continuous air-filled pores, and vapor-phase transport does not occur. Depending on local conditions, the primary mechanism by which dissolved constituents migrate in the saturated zone is usually advective transport, and the direction and rate of advective transport are controlled primarily by the hydraulic conductivity of the soil, and local hydraulic gradients (Neff *et al.*, 1994; Reilly *et al.*, 1987; U.S. EPA, 1989a). However, under conditions of very low groundwater flow velocities, such as appear to occur at Site SS-45, England AFB, chemical diffusive migration, driven by chemical concentration gradients, and controlled primarily by site-specific chemical diffusion coefficients, is the primary transport mechanism in the subsurface (Gillham and Cherry, 1982).

The physico-chemical mechanisms governing the migration of contaminants in the subsurface at Site SS-45 include volatilization, dissolution, dispersion, diffusion, and sorption. Examination of the chemical properties that control these mechanisms (volatility, solubility, and solid/liquid partitioning) with respect to current conditions in the physical environment can assist in predicting how site-related chemicals will interact with the environment, and how site conditions might influence the fate of the contaminants of potential concern. Representative chemical properties for the identified site-related contaminants are summarized in Table D.1. (Note that the literature values, reported by different workers, for a particular chemical property can vary widely. The values listed in Table D.1 represent chemical property values judged to be most representative, or are in the median range of values reported for a particular chemical.)

D1.3.1 Volatility

Volatilization is the process by which a constituent is converted from a solid or liquid phase to vapor, ultimately resulting in transfer of the chemical to the atmosphere. The volatility of a particular chemical is a function of that chemical's vapor pressure and Henry's Law constant. The vapor pressure of a substance at a reference temperature is the pressure exerted by the vapor phase of the substance in equilibrium with the liquid or solid phase of the substance, at that temperature. A chemical with a high vapor pressure has a greater tendency to volatilize to the atmosphere than does a chemical with a low vapor pressure. The Henry's Law constant is a measure of the relative tendency of a chemical to move between the dissolved phase and vapor phase, and is a function of the vapor pressure and solubility of the chemical. A chemical with a high Henry's Law

constant will have a high ratio of chemical concentration in the vapor phase compared with that chemical's concentration in the dissolved phase, and again will be more likely to volatilize to the surrounding atmosphere.

D1.3.2 Solubility

The aqueous solubility of a chemical species provides an indication of how readily that particular chemical could dissolve into and migrate with groundwater. Volatile organic compounds (e.g., the BTEX constituents) are moderately soluble, as a consequence of their molecular structure; and the attached chlorine atoms confer a moderate degree of solubility on substituted hydrocarbon compounds.

Constituents having moderate to high solubilities may be available for transport as a dissolved phase in the subsurface. The less soluble chemicals will become absorbed or occluded in soil, and are unlikely to migrate with infiltrating vadose-zone water, or in groundwater.

D1.3.3 Solid/Liquid Partitioning

The rate of migration of a chemical in the subsurface also depends on the tendency of that chemical to partition between the dissolved (in water) and solid phases (on soil particles). Partitioning of a chemical between the dissolved phase and solid phase is commonly referred to as *soil adsorption* ("sorption"), and is quantified by the soil partition coefficient or distribution coefficient (K_d), which is the proportionality constant relating the amount of chemical sorbed to soil and the concentration at equilibrium in soil water (McCall *et al.*, 1983):

$$C_{sorbed} = K_d \times C_{dissolved} \qquad \text{(D-1)}$$

where

C_{sorbed} = Concentration of chemical sorbed to soil [M/L^3];

K_d = Soil partition coefficient [L^3/M]; and

$C_{dissolved}$ = Concentration of chemical in adjacent soil water, at equilibrium with sorbed phase in soil [M/L^3].

This description of the process assumes that partitioning between the sorbed and dissolved phases is completely reversible, and that the equilibrium isotherm relating the relative concentrations in the two phases is linear (Neff *et al.*, 1994; Lyman *et al.*, 1990).

Soils are extremely heterogeneous mixtures of different particle types, composition, and sizes. Because of this heterogeneity, the partition coefficient for a particular chemical is usually regarded as a site-specific property, and is likely to vary substantially with location, depending on the chemical composition and grain-size distribution of the soil used for determination of the partition coefficient. However, sorption studies on a wide variety of nonpolar organic compounds and soil and sediment types indicate that organic matter in soil controls sorption where there is sufficient organic matter present

(more than about 0.1 percent organic carbon). This observation has been used as the basis for normalizing the linear partition coefficient to the concentration of total organic carbon in the soil (Karickhoff *et al.*, 1979; Karickhoff, 1981). The normalized partition coefficient for a particular chemical (K_{oc}) is calculated from the results of sorption studies, using

$$K_{oc} = \frac{K_d}{f_{oc}} \qquad \text{(D-2)}$$

where

K_{oc} = Organic carbon partition coefficient [L^3/M]; and
f_{oc} = Fraction of organic carbon in the soil [ ].

If the organic carbon content of a particular soil is known or can be estimated, the fraction of organic carbon can be used, together with published values of organic carbon partition coefficients (Table D.1) to evaluate chemical partitioning, using

$$K_d = f_{oc} \times K_{oc} \qquad \text{(D-3)}$$

All hydrocarbon compounds, and most other chemicals, sorb to soil to a greater or lesser degree; the fraction of sorbed hydrocarbons increases as the concentration of organic carbon in the soil increases. Chemicals having larger values of partition coefficients will be more strongly adsorbed to soil, and less mobile in the environment (Nyer and Skladany, 1989). Most fuel constituents and organic solvents have relatively large partition coefficient values (Table D.1), are strongly sorbed to soil particles, and travel only slowly in the dissolved (aqueous) phase.

D2.0 FATE OF CHEMICALS OF POTENTIAL CONCERN IN THE ENVIRONMENT

D2.1 Volatilization

In many circumstances, low-molecular-weight compounds will volatilize (evaporate) in the vadose-zone and diffuse upward in soil gas. Included in this category are volatile and volatile substituted hydrocarbon compounds, alkanes up through dodecane, and aromatic and substituted aromatic compounds through naphthalene (Neff *et al.*, 1994). The rates of volatilization of different hydrocarbons are directly proportional to their vapor pressures.

Because all volatile organic chemicals, including TCE, the DCE isomers, and vinyl chloride, have relatively high vapor pressures (Table D.1), volatilization is perhaps the most important fate mechanism removing these chemicals from the unsaturated environment near land surface. However, once a chemical has been dissolved in water, its potential for volatilization from the saturated zone in the subsurface is limited, because vapor transfer across the capillary fringe can be very slow (McCarthy and Johnson, 1992). For example, Chiang *et al.* (1989) demonstrated that less than 5 percent of the mass of dissolved BTEX is lost to volatilization in the saturated groundwater environment. Rivett (1995) observed that for dissolved-phase plumes deeper than about

one meter below the air/water interface, only low chemical concentrations would be detectable in soil gas due to the downward movement of groundwater near the water table. This suggests that very little, if any, chemical mass will be lost to volatilization, in areas in which chemicals occur in groundwater at depths greater than a few feet below the water table. The impact of volatilization is further diminished by the presence of the Upper Clay unit, and by clay layers within the sandy intervals.

D2.2 Dissolution

Chemicals with higher aqueous solubilities will tend to dissolve into the aqueous phase, and to migrate slowly through soil, transported by infiltrating vadose-zone water, or in groundwater. Dissolved-phase transport can occur in either the unsaturated or saturated zone. The unsaturated zone extends from land surface to the top of the water table, while the saturated zone generally includes all earth material below the water table. Dissolved constituents can enter the unsaturated zone via infiltration of water that contains chemicals, dissolved from an above-ground surface source, or the constituents can become dissolved as percolating water passes over a source of constituents in soil.

Chlorinated solvent constituents are moderately soluble (Table D.1), with aqueous solubilities ranging from 600 milligrams per liter (mg/L) for trans-1,2-DCE to about 2,250 mg/L (1,1-DCE). Therefore, TCE and the other solvent constituents detected at Site SS-45 can be relatively mobile in the aqueous environment, depending on local conditions.

D2.3 Dispersion

Solutes in transit through a groundwater system are affected by hydraulic and chemical processes, including advection, diffusion, dispersion, retardation, and chemical decay. A rigorous analysis of chemical transport in a ground-water system should examine the effects of all these processes. After a chemical has been dissolved in vadose-zone water or groundwater, it migrates in the dissolved phase through the unsaturated and saturated systems, under the influence of local hydraulic and/or chemical potentials. Depending on local conditions, the physical laws that govern fluid motion are such that water tends to move from areas of relatively greater hydraulic potential ("head") to areas of relatively lower hydraulic potential. The linear path along which water moves from a region of greater hydraulic potential to a region of lower hydraulic potential is known as a *flowpath*, and the change in hydraulic potential along that flowpath is known as a *hydraulic gradient.* Movement of groundwater in a flow system therefore occurs from *up-gradient* areas to *down-gradient* areas.

Transport of a chemical in the dissolved phase is usually regarded as the net effect of two processes – advection and dispersion (Gillham and Cherry, 1982). Advective transport is that component of movement of a solute that is attributable to the movement of the water in which it is dissolved. In other words, after some period of time, a chemical dissolved in groundwater will migrate a certain distance from the original source of the chemical, as a consequence of the movement of water in the subsurface. In the absence of other effects (e.g., sorption), the migration velocity of the center of mass of a dissolved chemical slug is the average groundwater flow velocity.

As the dissolved chemical moves away from its source, it is affected by dispersive processes – mechanical mixing of the dissolved chemical, and molecular diffusion. Mechanical mixing occurs because each molecule of dissolved chemical follows a slightly different flowpath through the pore spaces within the porous medium; each also moves at a slightly different velocity. As groundwater, containing dissolved chemical, moves along its tortuous flowpath in the subsurface, it tends to mix with water that contains no chemical (or contains the chemical at lower concentrations), diluting the dissolved-phase chemical. Molecular diffusion, occurring in the presence of a chemical concentration gradient, causes dissolved-phase chemical to migrate from areas of relatively higher concentration to areas of relatively lower concentration. (Because molecular diffusion operates on a microscopic scale, and because diffusive velocities are generally much lower than the advective transport velocity of dissolved-phase chemical, the effects of mechanical mixing on chemical distribution most groundwater systems are generally much greater than the effects due to chemical diffusion.) The net effect of dispersive processes acting on the dissolved chemical as it migrates through a porous medium, is that the mass of chemical becomes distributed through an ever-increasing volume of earth material. This results in a decrease in chemical concentration with increasing distance down-gradient from the chemical source.

Under particular hydraulic and chemical conditions, molecular diffusion may be more important than mechanical mixing in dispersing a dissolved chemical through a porous medium (Gillham and Cherry, 1982). The *Peclet number*, given as

$$\overline{P} = \frac{\overline{v} \times d_{characteristic}}{D_{liquid}^{water}} \qquad \text{(D-4)}$$

where

$\overline{P}$ = Peclet number [ ],

$\overline{v}$ = average solution velocity [L/T],

$d_{characteristic}$ = some characteristic length of the porous medium (usually taken to be the mean grain diameter) [L], and

D_{liquid}^{water} = chemical water-liquid diffusion coefficient [L^2/T],

is a measure of the relative importance of advection and diffusion in dispersing a dissolved constituent through a porous medium. A physical interpretation of Equation D-4 suggests that at low groundwater flow velocities (low Peclet number) the dispersion process is primarily the result of molecular diffusion, whereas at higher velocities (high Peclet number) mechanical mixing processes are more important. In general, in systems having Peclet numbers greater than about one (1), advection with mechanical mixing is the predominant dispersion process; and in systems for which the Peclet number is less than about 0.1, diffusion is the predominant dispersion process (Gillham and Cherry, 1982).

In order to estimate the Peclet number, describing the relative tendency for molecular diffusive transport of TCE in groundwater at Site SS-45, England AFB, we use the median groundwater flow velocity estimated for the Intermediate Sand unit (generally less than about 0.03 ft/day, or 1 x 10^{-5} cm/second), the mean grain diameter of a fine-grained sand (about 0.01 cm), and the water-liquid diffusion coefficient for TCE (Table D.1) in Equation D-4. The value of the Peclet number estimated for TCE migration in the Intermediate Sand unit is about 0.01, indicating that the distribution of volatile organic chemicals in groundwater at Site SS-45, England AFB, may be controlled primarily by chemical diffusion processes, rather than by advective transport.

D2.4 Retardation

As water, containing dissolved-phase chemical, moves through earth materials, the chemical tends to partition between the sorbed and dissolved phases (Section D.1.3.3). In most systems, chemical partitioning occurs at a rate that maintains chemical equilibrium (as expressed by the partition coefficient) between the sorbed and dissolved phases. Partitioning to the solid phase tends to remove a certain amount of chemical from the dissolved phase in groundwater, effectively slowing the rate of chemical migration, with respect to the rate of movement of the groundwater in which the chemical is dissolved. This phenomenon is known as *retardation*; and the ratio of the velocity of the retarded chemical to local groundwater flow velocity is known as the *retardation coefficient* (**R**):

$$R = \frac{V_{groundwater}}{V_{chemical}} = 1 + \left[\left(\frac{\rho}{n_e}\right) \times K_d\right] \qquad \text{(D-5)}$$

where

$V_{groundwater}$ = average groundwater flow velocity [L/T],

$V_{chemical}$ = average velocity of center of mass of dissolved chemical slug [L/T],

ρ = unit weight of porous medium [M/L^3], and

n_e = effective porosity of the medium [ ].

All the solvent constituents detected at Site SS-45, with the exception of vinyl chloride, have relatively high organic-carbon partitioning coefficients (Section D1.3.3), ranging from about 45 milliliters per gram (mL/g) for cis-1,2-DCE to 107 mL/g (TCE; Table D.1). This indicates that these solvent constituents will preferentially sorb to soil; and their migration can be significantly retarded with respect to the velocity of groundwater movement. The organic carbon partition coefficient for vinyl chloride, on the other hand, is only 2.5 mL/g, and vinyl chloride is consequently the most mobile of the chlorinated solvent constituents that have been detected at Site SS-45.

D3.0 CHEMICAL AND BIOLOGICAL DEGRADATION

D3.1 Biodegradation Processes

Nearly all soils contain colonies of bacteria and fungi that are capable of biodegrading at least some organic compounds. Soil bacteria and fungi are tremendously diverse, and readily adapt to utilizing different types of organic molecules as their sole or supplemental carbon source (Scow, 1990). Many genera of microorganisms are able to completely oxidize saturated, and to a lesser extent, aromatic hydrocarbons and heterocyclic compounds, to carbon dioxide and water. Although all organic compounds found in petroleum-based fuels can be degraded by bacteria (Dragun, 1988), the rates of fuel hydrocarbon degradation are much lower under anoxic than oxygen-rich conditions (Nyer and Skladany, 1989). Following a release of a petroleum-derived product to soil, different hydrocarbon classes are degraded simultaneously, but at widely varying rates, by indigenous microbiota. Normal alkanes of low molecular weight (C-8 to C-22) are metabolized most rapidly, followed by isoalkanes and higher-molecular-weight normal alkanes, olefins, monoaromatic compounds (benzenes), and polynuclear aromatic hydrocabon (PAH) compounds (Howard *et al.*, 1991; Neff *et al.*, 1994; Park *et al.*, 1990).

During biodegradation, microorganisms transform available nutrients (the "substrate") into forms useful for energy and cell reproduction by facilitating thermodynamically advantageous reduction/oxidation (redox) reactions involving the transfer of electrons from electron donors to electron acceptors. This results in oxidation of the electron donor and reduction of the electron acceptor. Electron donors can include natural organic material and anthropogenic hydrocarbon compounds. Electron acceptors are elements or compounds that occur in relatively oxidized states and can accept electrons generated during substrate oxidation. Without the complete transfer of electrons to an electron acceptor, a substrate cannot be fully oxidized. Electron acceptors commonly occurring in groundwater include dissolved oxygen (DO), nitrate, ferric iron (iron III), manganese, sulfate, carbon dioxide, and highly chlorinated solvents [e.g., TCE, TCA, and polychlorinated benzenes].

The driving force of biodegradation is electron transfer, which is quantified by the Gibbs free energy of the reaction ($\Delta G°_r$) (Stumm and Morgan, 1981; Bouwer, 1994; Godsey, 1994). The value of $\Delta G°_r$ represents the quantity of free energy consumed ($\Delta G°_r > 0$) or yielded ($\Delta G°_r < 0$) to the system during the reaction. Although thermodynamically favorable, most of the reactions involved in biodegradation of fuel hydrocarbons or chlorinated aliphatic hydrocarbons (CAHs) cannot proceed abiotically because of the lack of activation energy. Microorganisms are capable of providing the necessary activation energy; however, they will facilitate only those redox reactions that have a net yield of energy (i.e., $\Delta G°_r < 0$). Microorganisms preferentially utilize electron acceptors while metabolizing fuel hydrocarbons (Bouwer, 1992). DO is utilized first as the prime electron acceptor. After the DO is consumed, anaerobic microorganisms typically use native electron acceptors in the following order of preference: nitrate, manganese, ferric iron hydroxide, sulfate, and finally carbon dioxide. Chlorinated solvents are generally used as electron acceptors when aquifer conditions are such that sulfate or carbon dioxide is the preferred electron acceptor.

In addition to being controlled by the energy yield of the reaction, the expected sequence of redox processes also is a function of the oxidizing potential of the groundwater. This potential is a measure of the relative tendency of a solution or chemical reaction to accept or transfer electrons. As each subsequent electron acceptor is utilized, the groundwater becomes more reducing, and the oxidation/reduction potential (ORP) of the water decreases. The main force driving this change in redox potential is microbially mediated redox reactions. ORP can be used as an indicator of which redox reactions may be operating at a site. Environmental conditions and microbial competition ultimately determine which processes will dominate.

In contrast to fuel hydrocarbons, biodegradation of chlorinated solvent constituents is generally favored by low dissolved oxygen (anaerobic conditions) and reducing conditions (USEPA, 1998). Depending on the types and concentrations of electron acceptors present (e.g., nitrate, sulfate, carbon dioxide), pH conditions, and ORP, anaerobic biodegradation can occur by denitrification, manganese reduction, ferric iron reduction, sulfate reduction, or methanogenesis. Other, less common anaerobic degradation mechanisms such as manganese or nitrate reduction or reductive dechlorination may dominate if the physical and chemical conditions in the subsurface favor use of these electron acceptors.

When hydrocarbons are utilized as the primary electron donor for microbial metabolism, they typically are completely degraded or detoxified (Bouwer, 1992). When hydrocarbon compounds are not present in sufficient quantities to act as the primary metabolic substrate, they cannot support microbial growth as the sole electron donors. In this case, the contaminant can still be degraded, but the microorganisms will obtain the majority of their energy from alternative substrates in the aqueous environment. This type of metabolic degradation is referred to as "secondary utilization" because the hydrocarbon compound contributes only a small fraction of the energy and carbon needed for cell production and maintenance (Bouwer, 1992).

D3.2 Chemical Degradation as a First-Order Process

Because biodegradation may be the most important fate process removing organic chemicals from the environment, an evaluation of biodegradation rate constants is necessary to adequately assess the fate and transport of contaminants in the subsurface. While several different representations of the processes by which chemical degradation occurs at the microscopic level in the environment are currently in use, all require detailed knowledge of *in-situ* physical, chemical, and biological conditions (e.g., Baveye and Valocchi, 1989). For example, to properly account for biodegradation at a microscopic level, one must accurately describe such parameters as nutrient availability, cellular diffusion, cellular growth dynamics, the microscopic dimensions of individual pores, interpore substrate concentrations, and factors controlling potential changes in soil porosity and permeability; and must then incorporate these parameters into a nonlinear mathematical representation of process dynamics.

Fortunately, this level of effort may not be necessary. Two of the principal models proposed by researchers to describe degradation processes at the cell level (the biofilm and Monod kinetic models), can be simplified to a first-order kinetic approximation under certain limiting conditions or at field scales (Bouwer and McCarty, 1984;

MacQuarrie *et al.*, 1990). In addition, several authors have noted that first-order, or pseudo-first-order kinetics approximate the rate of hydrocarbon degradation observed at individual study sites (Berry-Spark *et al.*, 1988; Chiang *et al.*, 1989; Dragun, 1988; Kemblowski *et al.*, 1987). The use of first-order kinetics assumes that the rate of change in chemical concentration with time (t) is dependent only on the concentration of the chemical in soil or ground water (C):

$$\frac{\partial C}{\partial t} = \mu C \qquad \text{(D-6)}$$

where μ is a first-order rate constant [1/T]. The chemical concentration in soil or groundwater at a given time can be found by integrating Equation D- 6 to obtain:

$$C = C_0 e^{-\mu t} \qquad \text{(D-7)}$$

where C_0 is the initial concentration of the chemical.

Ranges of first-order rate constants have been estimated and tabulated for a number of organic chemicals (see, for example, Howard *et al.*, 1991 and Wiedemeier *et al.*, 1999). If neither site-specific information, nor tabulated rate constants are available, the first-order rate constant for a particular chemical can be estimated from reported half-life data, using:

$$\mu = \frac{\ln(2)}{\tau_{1/2}} \qquad \text{(D-8)}$$

where

$\tau_{1/2}$ = constituent half-life (days).

Historic chemical concentration information can also be used to estimate first-order rate constants, as long as the apparent degradation rate can be normalized to account for the effects of dilution, advective dispersion, diffusion, and sorption, or if simplifying, but conservative assumptions regarding these processes can be made. One method for determining first-order rate constants for BTEX compounds was proposed by Buscheck and Alcantar (1995). Because of the chemical similarities between BTEX and CAH compounds (Section D.1.1), the Buscheck and Alcantar method is applicable to the constituents in groundwater at Site SS-45, England AFB. The Buscheck and Alcantar (1995) method derives a relationship that allows calculation of first-order biodegradation rate constants for steady-state plumes. This method involves coupling the regression of contaminant concentration (plotted on a logarithmic scale) versus distance downgradient (plotted on a linear scale) with an analytical advection-dispersion equation for one-dimensional, steady-state contaminant transport (Bear 1979). Additional parameters that must be estimated to calculate the first-order rate constant include the retarded longitudinal velocity and longitudinal dispersivity of the contaminant.

Decay rates computed using the Buscheck and Alcantar method account for chemical (abiotic) decay and biological (aerobic and anaerobic) decay. For an expanding plume, this first-order approximation can be viewed as an upper bound on the biodegradation rate. Use of this method yields an overestimation of the rate of biodegradation because a typical expanding plume exhibits decreasing source-area concentrations, increasing downgradient concentrations, or both, as a consequence of source-area dispersion and down-gradient advection. Over time, these changes result in a decreasing slope on a log-linear plot, and consequently a decreasing biodegradation rate. In addition, the magnitude of the decay rate calculated using the Buscheck and Alcantar method is sensitive to the estimated migration velocity of the contaminant along the selected flowpath; therefore, inaccuracies in the estimated velocity will cause estimates of first-order rate constants to be less accurate. Overestimation of the groundwater velocity will result in overestimation of the decay rate, and vice versa.

D3.3 Degradation of Halogenated Compounds

Chlorinated solvents can also be transformed, directly or indirectly, by biological or abiotic processes (Mallon, 1989; USEPA, 1998). CAHs may undergo biodegradation along three different pathways: use as an electron acceptor, use as an electron donor, or cometabolism (degradation resulting from exposure to a catalytic enzyme fortuitously produced during an unrelated process). At a particular location, one or all of these processes may be operating, although at many sites the use of CAHs as electron acceptors appears to be the most likely.

In a pristine aquifer, native organic carbon is utilized as an electron donor, and DO is utilized first as the prime electron acceptor. Where anthropogenic carbon (e.g., fuel hydrocarbons, less-chlorinated CAHs, or chlorinated benzenes with four or fewer chlorine atoms) is present, it also may be utilized as an electron donor. Most chlorinated solvents that can act as electron donors have thus far only been demonstrated to do so under aerobic conditions, with the notable exception of vinyl chloride (Bradley and Chapelle, 1996). After the DO is consumed, anaerobic microorganisms typically use native electron acceptors (as available) in the following order of preference: nitrate, ferric oxyhydroxide, sulfate, and finally carbon dioxide. Evaluation of the distribution of these electron acceptors can provide evidence of where and how biodegradation of chlorinated solvents is occurring. A more complete description of the main types of biodegradation reactions affecting chlorinated solvents dissolved in groundwater is presented in the following subsections.

D3.3.1 Electron Acceptor Reactions (Reductive Dehalogenation)

Halogenated compounds are known to undergo chemical transformations, or degradation, in natural systems (Vogel and McCarty, 1985; Vogel *et al.*, 1987; Lesage *et al.*, 1990; Barbee, 1994), principally through the mechanism of sequential reductive dehalogenation, under anaerobic conditions. During this process, the halogenated hydrocarbon is used as an electron acceptor, not as a source of carbon, and a halogen atom is removed and replaced with a hydrogen atom at each reaction step (Criddle and McCarty, 1991). A typical reductive halogenation transformation sequence begins with a highly chlorinated alkene, e.g., TCE (Figure D.1). Through sequential reductive reactions, TCE is first transformed to 1,1-DCE, or either the cis- or trans- isomer of 1,2-

DCE; and DCE is transformed to vinyl chloride. In the final reductive dehalogenation step, vinyl chloride is mineralized (changed to carbon dioxide, water, and hydrogen chloride). Minor amounts of other chlorinated chemicals (for example, 1,1-DCA) can also be generated during reductive dehalogenation reactions; however, the sequence

TCE --> DCE --> vinyl chloride

is most typical (Vogel *et al*, 1987; Barbee, 1994). This chain of reaction products is referred to as "TCE and its *daughters*" (Barbee, 1994). In fact, the relative proportions of TCE and its daughters, and the relative locations at which these chemicals have been detected in groundwater at Site SS-45, indicate that TCE was the primary chemical, originally introduced to the subsurface, and the other halogenated chemicals have gradually appeared, as the precursor chemical (TCE) has evolved in the subsurface along its degradation path (Figure D.1). Reductive dehalogenation of some compounds also has been shown to preferentially produce specific daughter compounds. For example, during reductive dehalogenation of TCE, all three isomers of DCE can theoretically be produced; however, Bouwer (1994) reports that under the influence of biodegradation, *cis*-1,2-DCE is a more common intermediate than *trans*-1,2-DCE, and that 1,1-DCE is the least prevalent intermediate of the three DCE isomers.

Reductive dehalogenation affects each of the chlorinated compounds differently. Of the ethenes, tetrachloroethene (PCE) is the most susceptible to reductive dehalogenation because it is the most highly oxidized. Conversely, VC is the least susceptible to reductive dehalogenation because it is the least oxidized of these compounds. In general, the rate of reductive dehalogenation of chlorinated solvents has been observed to decrease as the degree of chlorination decreases (Vogel and McCarty, 1985; Bouwer, 1994). Murray and Richardson (1993) have postulated that this rate decrease may explain the apparent accumulation of VC in TCE plumes that are undergoing reductive dehalogenation.

In addition to being affected by the degree of chlorination of the compound, reductive dehalogenation also can be controlled by the redox conditions of the site groundwater system. In general, reductive dehalogenation has been demonstrated under anaerobic nitrate- and sulfate-reducing conditions, but the most rapid biodegradation rates, affecting the widest range of compounds, occur under methanogenic conditions (Bouwer, 1994). Dehalogenation of TCE to DCE can proceed under mildly reducing conditions, such as

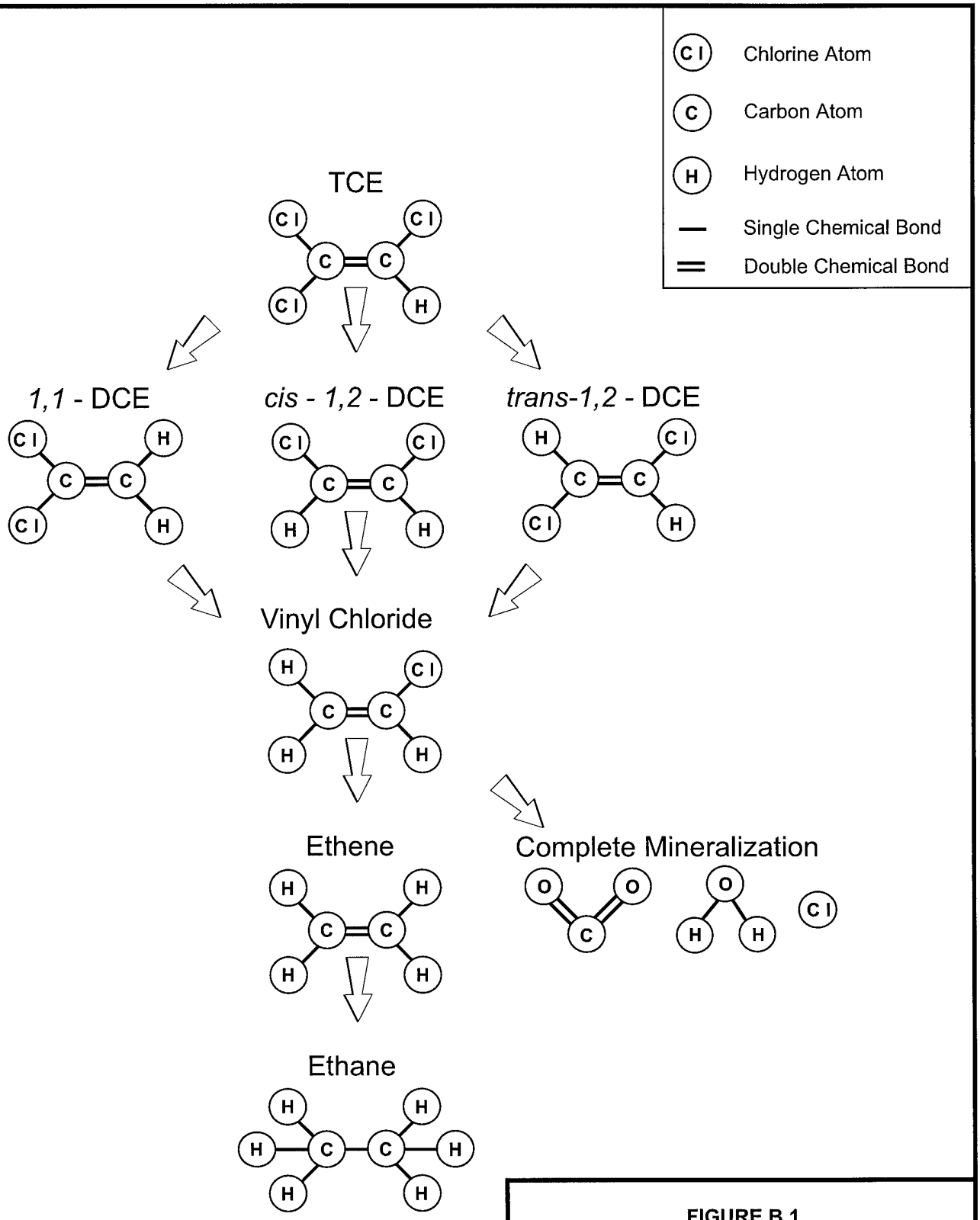


FIGURE B.1

REDUCTIVE DEHALOGENATION OF CHLORINATED ETHENES

Site SS-45
England Air Force Base
Alexandria, Louisiana

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Denver, Colorado

G:\COREL\DRAW\ANAER 3.CDR NAP 83099

nitrate reduction or ferric iron reduction (Vogel *et al.*, 1987), while the transformation of DCE to VC or the transformation from VC to ethene requires more strongly reducing conditions (Freedman and Gossett, 1989; DeStefano *et al.*, 1991; De Bruin *et al.*, 1992).

When chlorinated compounds are used as electron acceptors, there must be a biotically-available source of carbon for microbial growth in order for reductive dehalogenation to occur (Bouwer, 1994). Potential carbon sources/electron donors can include low-molecular-weight compounds (e.g., lactate, acetate, methanol, or glucose) present in natural organic matter, fuel hydrocarbons, or less-chlorinated solvents (as discussed below).

D3.3.2 Electron Donor Reactions

Under aerobic conditions some chlorinated solvents can be utilized as the primary substrate (i.e., electron donor) in biologically mediated redox reactions (McCarty and Semprini, 1994). In this type of reaction, the facilitating microorganism obtains energy and organic carbon from the degraded compound. In contrast to reactions in which the chlorinated compound is used as an electron acceptor, only the less oxidized chlorinated solvents (e.g., VC and DCE) may be utilized as electron donors in biologically mediated redox reactions. Chlorinated solvent oxidation may be characterized by a loss of solvent mass, a decreasing molar ratio of daughter solvents to other parent solvent compounds, and rarely, the production of chloromethane.

D3.3.3 Cometabolism

When a CAH is biodegraded through cometabolism, it serves as neither an electron acceptor nor a primary substrate in a biologically mediated redox reaction. Instead, an enzyme or cofactor that is fortuitously produced by organisms for other purposes catalyzes the degradation of the CAH. The organism receives no known benefit from the degradation of the CAH; rather the cometabolic degradation of the CAH may in fact be harmful to the microorganism responsible for the production of the enzyme or cofactor (McCarty and Semprini, 1994).

Cometabolism is best documented in aerobic environments, although it can potentially occur under anaerobic conditions. Under aerobic conditions, chlorinated ethenes, with the exception of PCE, are reported to be susceptible to cometabolic degradation (Murray and Richardson, 1993; Vogel, 1994; McCarty and Semprini, 1994). Vogel (1994) further elaborates that the cometabolism rate increases as the degree of halogenation decreases.

In the cometabolic process, bacteria indirectly transform TCE (or other chlorinated compound) as they use BTEX or another substrate to meet their energy requirements. Therefore, TCE does not enhance the degradation of BTEX or other carbon sources, nor will its cometabolism interfere with the use of electron acceptors involved in the oxidation of those carbon sources. Given this relationship, it would follow that depletion of suitable substrates (BTEX or other organic carbon sources) likely limits cometabolism of CAHs.

D3.4 Behavior of Chlorinated Solvent Plumes

Chlorinated solvent plumes can exhibit three types of behavior depending on the amount of solvent present, the amount of native and/or anthropogenic organic carbon in the subsurface, the distribution and concentration of natural electron acceptors, and the types of electron acceptors being utilized (USEPA, 1998). Individual plumes may exhibit all three types of behavior in different portions of the plume. The different types of plume behavior are summarized below.

D3.4.1 Type 1 Behavior

Type 1 behavior occurs where the primary substrate is anthropogenic carbon (e.g., BTEX or landfill leachate), that drives reductive dechlorination. When evaluating natural attenuation of a plume exhibiting Type 1 behavior, the following questions must be answered:

1. Is the electron donor supply adequate to allow microbial reduction of the chlorinated organic compounds to proceed? In other words, will the microorganisms deplete chlorinated aliphatic hydrocarbon compounds (CAHs) (used as electron acceptors) before they deplete the primary substrate (anthropogenic carbon)?

2. What is the role of competing electron acceptors (e.g., dissolved oxygen, nitrate, ferric iron and sulfate)?

3. Is VC being oxidized, or is it being reduced?

Type 1 behavior results in the rapid and extensive degradation of the highly chlorinated solvents such as PCE, TCE, or the DCE isomers.

D3.4.2 Type 2 Behavior

Type 2 behavior is the predominant process in areas that are characterized by relatively high concentrations of biologically-available native organic carbon. This natural carbon source drives reductive dehalogenation (i.e., the primary substrate for microorganism growth is native organic carbon). When evaluating natural attenuation of a Type 2 chlorinated solvent plume, the same questions as those posed in the description of Type 1 behavior must be answered. Type 2 behavior generally results in slower biodegradation of the highly chlorinated solvents than Type 1 behavior, but under the proper conditions (e.g., areas with naturally elevated levels of organic carbon), this type of behavior also can result in rapid degradation of these compounds.

D3.4.3 Type 3 Behavior

Type 3 behavior is the predominant process in areas that are characterized by low concentrations of native and/or anthropogenic carbon, and concentrations of DO that are greater than 1.0 milligram per liter (mg/L). Under such aerobic conditions, reductive dehalogenation will not occur, and there is little or no removal of PCE, TCE, or DCE. Biodegradation may proceed via the much slower process of cometabolism, but will be limited by the low concentrations of native or anthropogenic carbon. The most

significant natural attenuation mechanisms for CAHs, in plumes exhibiting Type 3 behavior, will be advection, dispersion, and sorption. However, VC can be rapidly oxidized under these conditions, DCE may be oxidized, and cometabolism may also occur.

D3.4.4 Mixed Behavior

It is possible for a single chlorinated solvent plume to exhibit all three types of behavior in different parts of the plume. This can be beneficial for natural biodegradation of CAH plumes. For example, Wiedemeier *et al.* (1996a) describe a plume at Plattsburgh AFB, New York that exhibits Type 1 behavior in the source area and Type 3 behavior downgradient from the source. The most favorable scenario involves a plume in which PCE, TCE, and DCE are reductively dehalogenated (Type 1 or Type 2 behavior), then VC is oxidized (Type 3 behavior), either aerobically or via iron reduction. VC is oxidized to carbon dioxide in this type of plume and does not accumulate. The following sequence of reactions occurs in a plume that exhibits this type of mixed behavior:

$$\text{PCE} \rightarrow \text{TCE} \rightarrow \text{DCE} \rightarrow \text{VC} \rightarrow \text{Carbon Dioxide}$$

In general, the TCE, DCE, and VC may attenuate at approximately the same rate, and thus these reactions may be confused with simple dilution. Note that no ethene is produced during this reaction. VC is removed from the system much faster under these conditions than it is under VC-reducing conditions.

A less desirable scenario, but one in which all contaminants may be entirely biodegraded, involves a plume in which all CAHs are reductively dehalogenated via Type 1 or Type 2 processes. VC is reduced to ethene, which may be further reduced to ethane or methane. The following sequence of reactions occur in this type of plume:

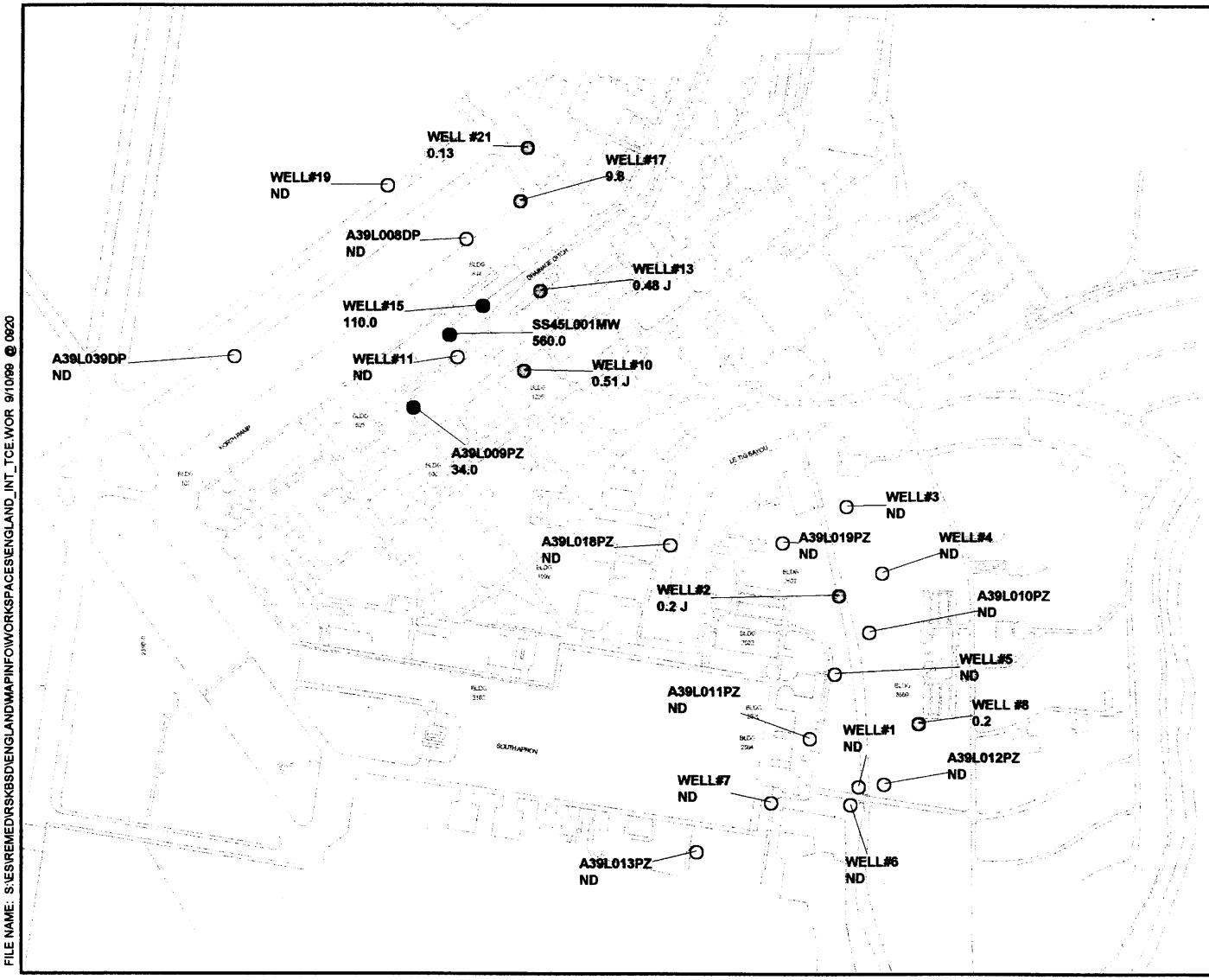
$$\text{PCE} \rightarrow \text{TCE} \rightarrow \text{DCE} \rightarrow \text{VC} \rightarrow \text{Ethene or Ethane}$$

Freedman and Gossett (1989) have investigated this sequence. In this type of plume, VC degrades more slowly than TCE, and thus tends to accumulate.

D3.5 Abiotic Degradation of Chlorinated Solvents

Chlorinated solvents dissolved in groundwater may also be degraded by abiotic mechanisms, although the reactions may not be complete and may result in the formation of a toxic intermediate. The most common abiotic reactions affecting chlorinated solvents are hydrolysis and dehydrohalogenation. Hydrolysis is a substitution reaction in which a halogen substituent is replaced with a hydroxyl (OH^-) group from a water molecule. Dehydrohalogenation is an elimination reaction in which a halogen is removed from a carbon atom, followed by removal of a hydrogen atom from an adjacent carbon atom, with a double bond between the carbon atoms being produced. Other possible reactions include oxidation and reduction, although Butler and Barker (1996) note that no abiotic oxidation reactions involving common halogenated solvents have been reported in the literature. They also note that reduction reactions are most commonly microbially mediated.

Butler and Barker (1996) note that attributing changes in the presence, absence, or concentration of halogenated solvents to abiotic processes is usually difficult, particularly at the field scale, because solvents may undergo both biotic and abiotic degradation, and discerning the relative effects of each mechanism may not be possible. In addition, the breakdown products of some reactions such as hydrolysis (e.g., acids and alcohols) may be readily degraded (biotically or abiotically); so that these products also require additional analyses that may not be feasible for a field investigation (Butler and Barker, 1996). This makes collection and interpretation of field evidence to demonstrate hydrolysis difficult at best, and such evidence has not yet been successfully collected and presented (Butler and Barker, 1996). Evidence of dehydrohalogenation is also difficult to collect.



N

0 375 750
Feet

LEGEND

SAMPLE LOCATION
TCE CONCENTRATION (µg/L)

ND = Not detected above the reported sample quantitation limit.

J = The result is qualified as an estimated value because it is greater than the method detection limit and less than the practical quantitation limit.

TCE Concentration Range (µg/L)

- > 100
- 10 to 100
- < 10
- Not Detected

FIGURE E.1
TCE CONCENTRATIONS IN GROUNDWATER SAMPLES FROM THE INTERMEDIATE SAND UNIT MARCH - JULY 1999

Site SS-45
England Air Force Base
Alexandria, Louisiana

PARSONS
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Denver, Colorado

FILE NAME: S:\ES\REMED\RSKBSD\ENGLAND\MAPINFO\WORKSPACES\ENGLAND_INT_TCE.WOR 9/10/99 @ 0920

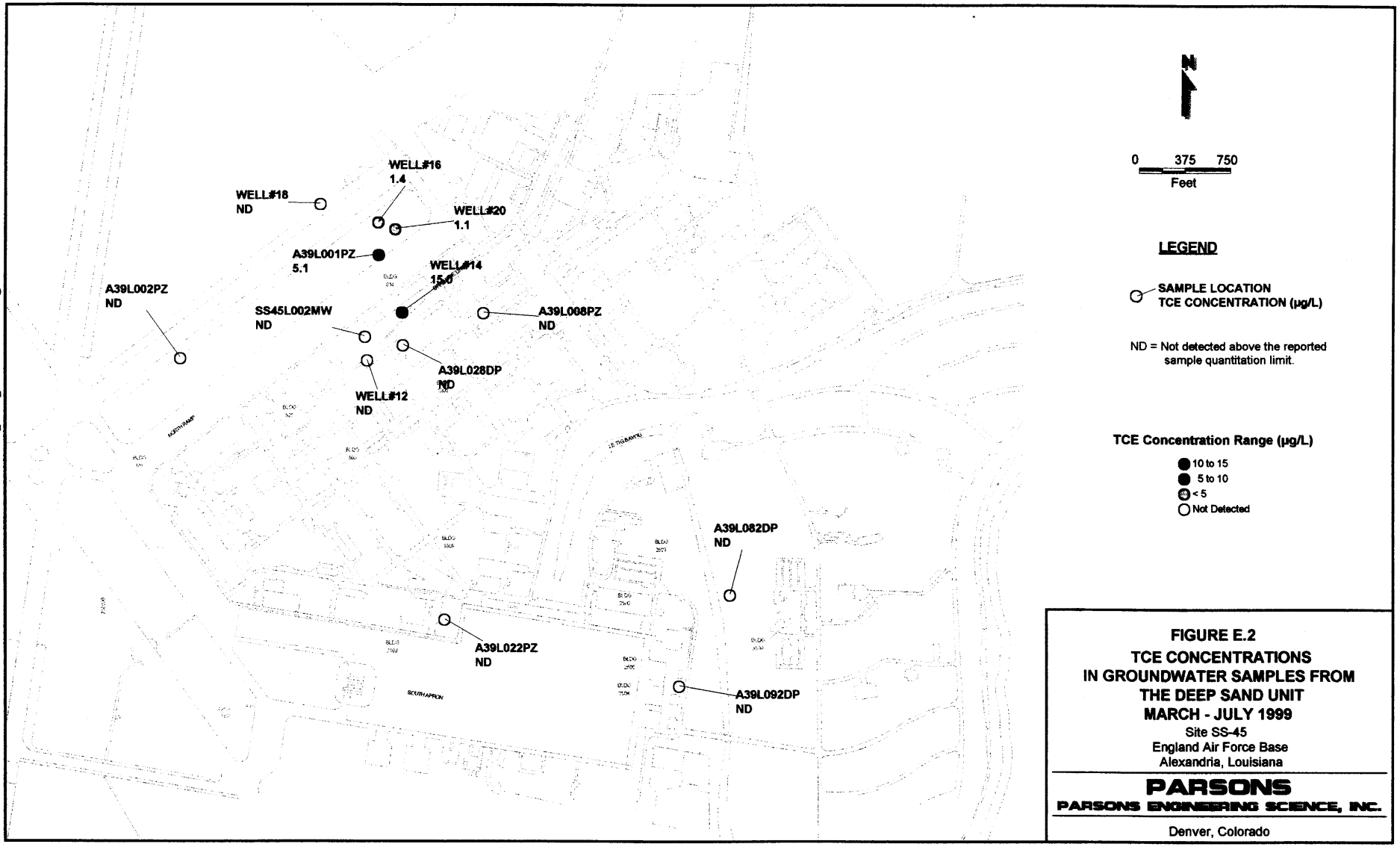
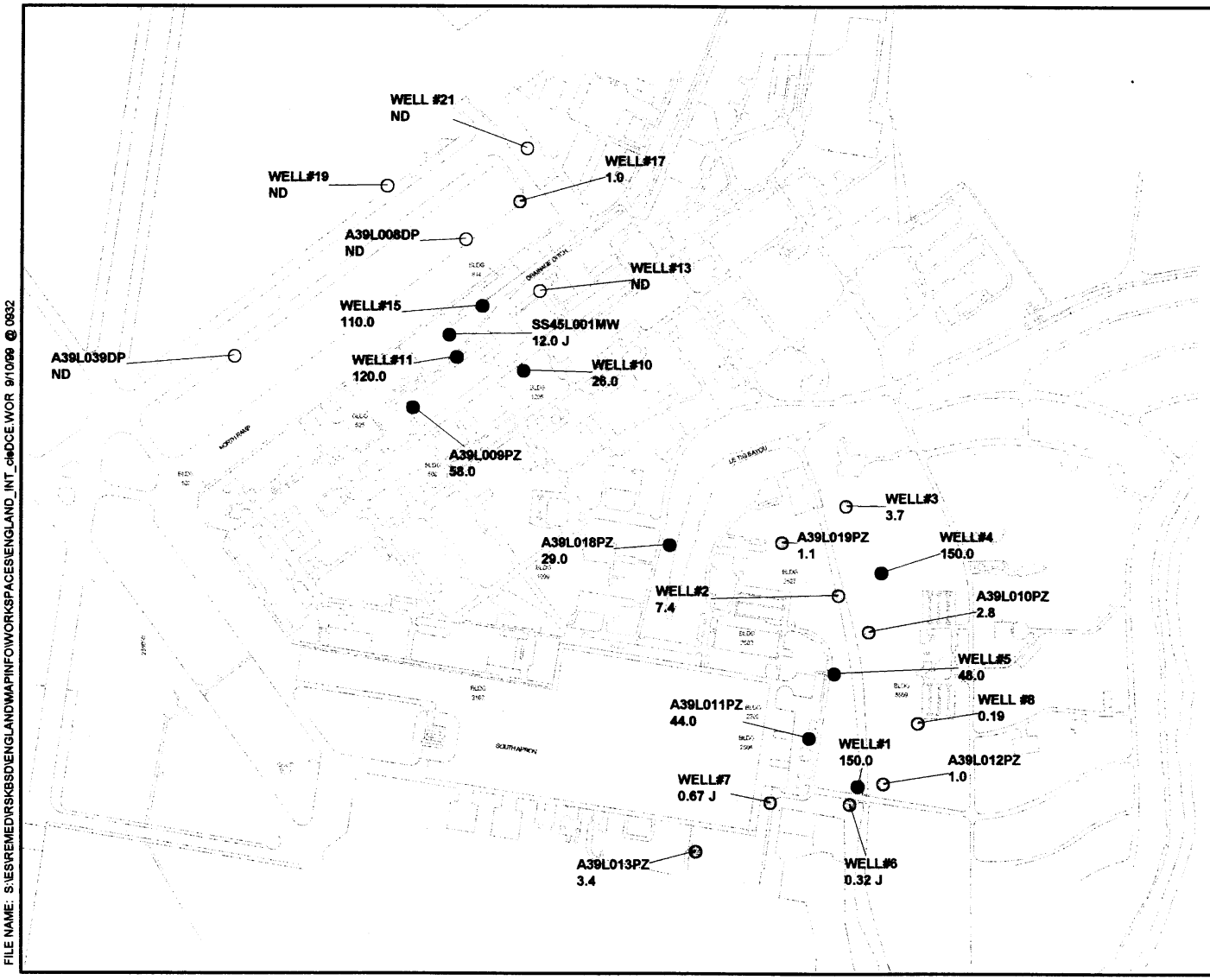


FIGURE E.2
TCE CONCENTRATIONS IN GROUNDWATER SAMPLES FROM THE DEEP SAND UNIT MARCH - JULY 1999
Site SS-45
England Air Force Base
Alexandria, Louisiana

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Denver, Colorado

FILE NAME: S:\ES\REMED\RSKBSD\ENGLAND\MAPINFO\WORKSPACES\ENGLAND_DEEP_TCE.WOR 9/10/99 @ 0930



N

0 375 750
Feet

LEGEND

SAMPLE LOCATION
cis-1,2-DCE CONCENTRATION (µg/L)

ND = Not detected above the reported sample quantitation limit.

J = The result is qualified as an estimated value because it is greater than the method detection limit and less than the practical quantitation limit.

cis-1,2-DCE Concentration Range (µg/L)

- > 100
- 10 to 100
- < 10
- Not Detected

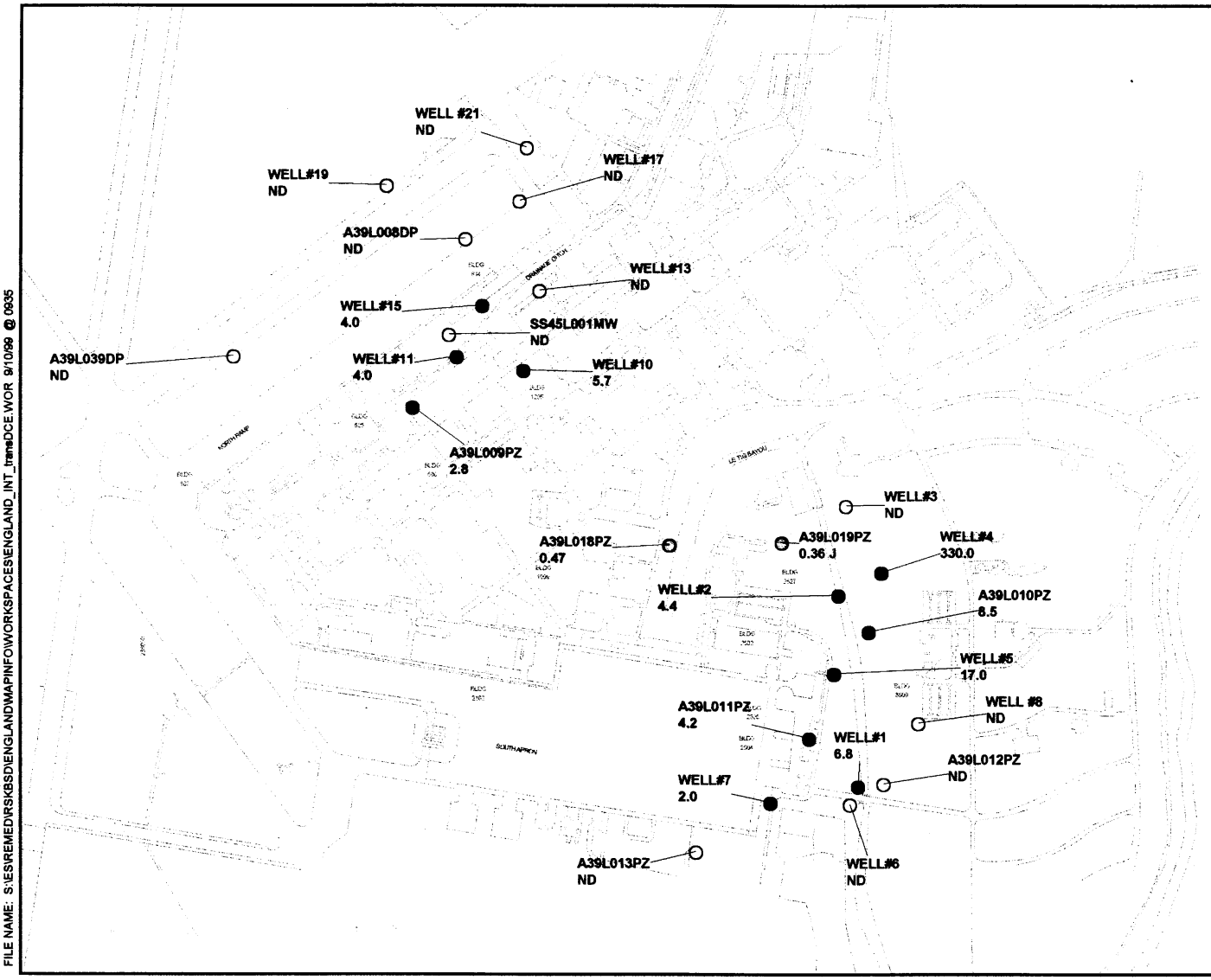
FIGURE E.3

cis-1,2-DCE CONCENTRATIONS IN GROUNDWATER SAMPLES FROM THE INTERMEDIATE SAND UNIT MARCH - JULY 1999

Site SS-45
England Air Force Base
Alexandria, Louisiana

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FILE NAME: S:\ES\REMED\RSKB\SD\ENGLAND\MAPINFO\WORK\SPACES\ENGLAND_INT_cisDCE.WOR 9/10/99 @ 0932



N

0 375 750
Feet

LEGEND

SAMPLE LOCATION
trans-1,2-DCE CONCENTRATION (µg/L)

ND = Not detected above the reported sample quantitation limit.

J = The result is qualified as an estimated value because it is greater than the method detection limit and less than the practical quantitation limit.

trans-1,2-DCE Concentration Range (µg/L)

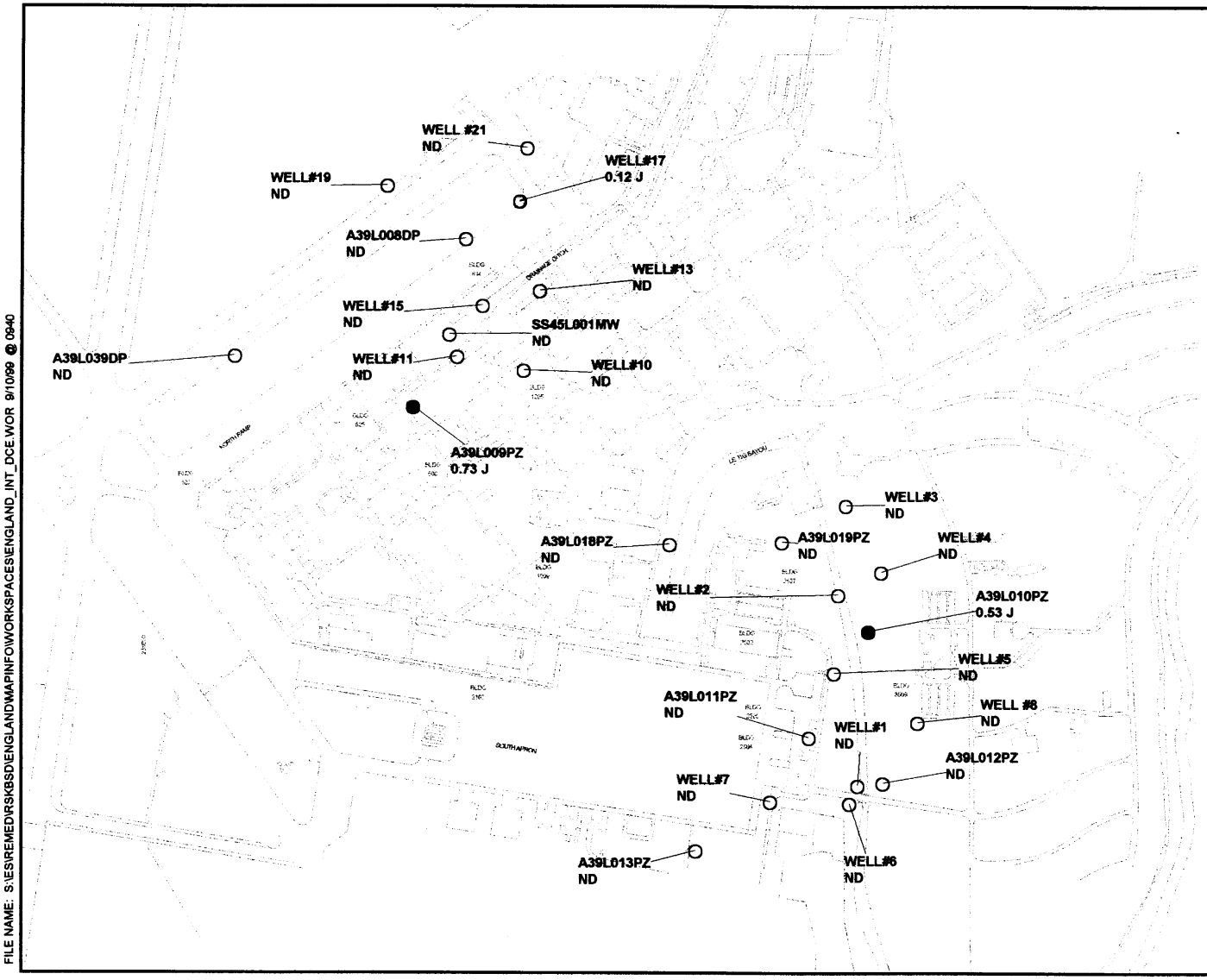
- > 10
- 1 to 10
- < 1
- Not Detected

FIGURE E.4
trans-1,2-DCE CONCENTRATIONS IN GROUNDWATER SAMPLES FROM THE INTERMEDIATE SAND UNIT MARCH - JULY 1999

Site SS-45
England Air Force Base
Alexandria, Louisiana

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FILE NAME: S:\ESWREMED\RSKBSD\ENGLAND\MAPINFO\WORKSPACES\ENGLAND_INT_transDCE.WOR 9/10/99 @ 0935



N

0 375 750
Feet

LEGEND

SAMPLE LOCATION
1,1-DCE CONCENTRATION (µg/L)

ND = Not detected above the reported sample quantitation limit.

J = The result is qualified as an estimated value because it is greater than the method detection limit and less than the practical quantitation limit.

1,1-DCE Concentration Range (µg/L)

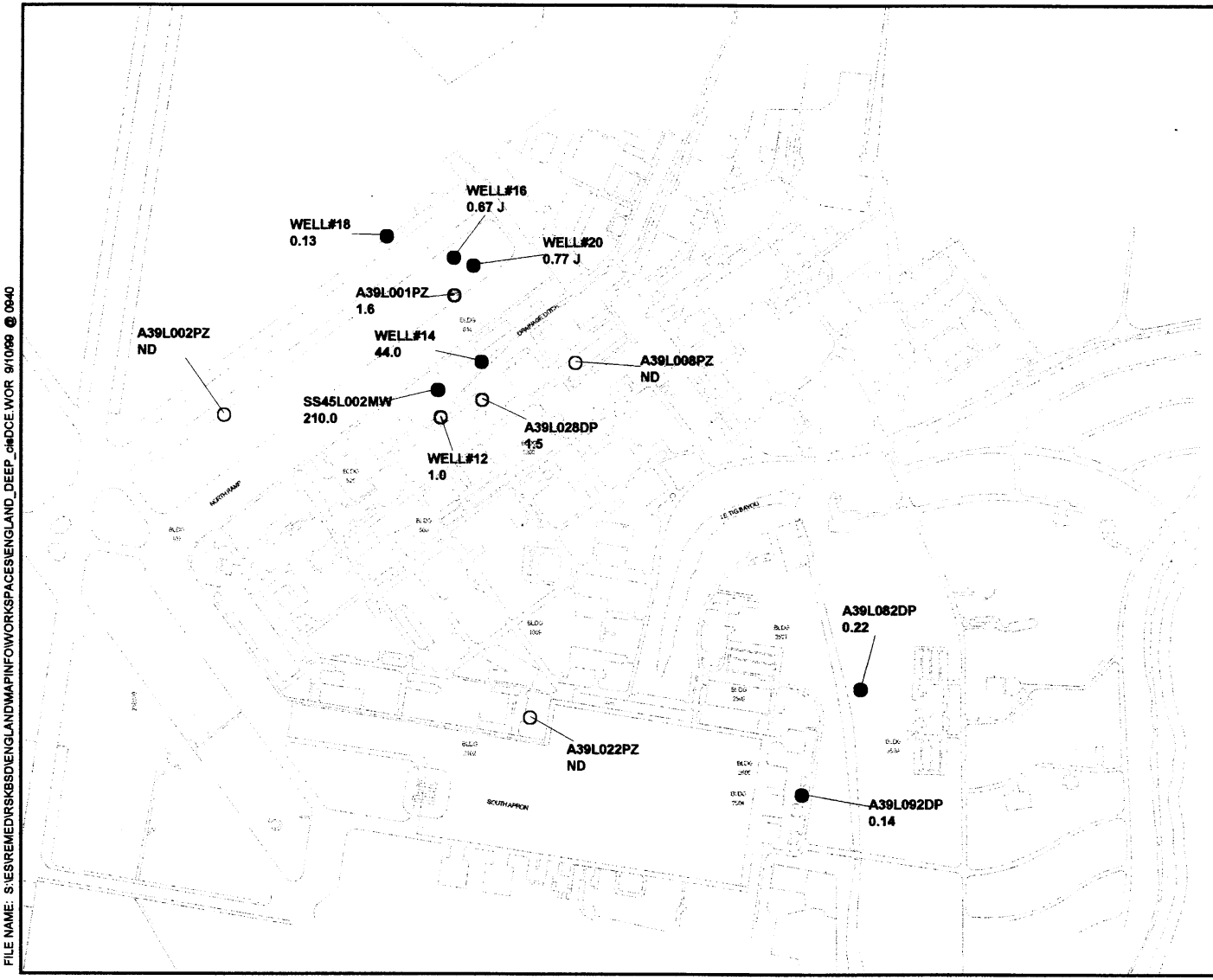
- > 1
- 0.5 to 1
- < 0.5
- Not Detected

FIGURE E.5
1,1-DCE CONCENTRATIONS IN GROUNDWATER SAMPLES FROM THE INTERMEDIATE SAND UNIT MARCH - JULY 1999

Site SS-45
England Air Force Base
Alexandria, Louisiana

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FILE NAME: S:\ES\REMED\RSKBSD\ENGLAND\MAPINFO\WORKSPACES\ENGLAND_INT_DCE.WOR 9/10/99 @ 0940



N

0 375 750
Feet

LEGEND

SAMPLE LOCATION
cis-1,2-DCE CONCENTRATION (µg/L)

ND = Not detected above the reported sample quantitation limit.

J = The result is qualified as an estimated value because it is greater than the method detection limit and less than the practical quantitation limit.

cis-1,2-DCE Concentration Range (µg/L)

- > 100
- 10 to 100
- 1 to 10
- < 1
- Not Detected

FIGURE E.6
cis-1,2-DCE CONCENTRATIONS IN GROUNDWATER SAMPLES FROM THE DEEP SAND UNIT MARCH - JULY 1999
Site SS-45
England Air Force Base
Alexandria, Louisiana

PARSONS
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Denver, Colorado

FILE NAME: S:\ES\REMED\RSKBSD\ENGLAND\MAP\INFO\WORKSPACES\ENGLAND_DEEP_cisDCE.WOR 9/10/99 @ 0940

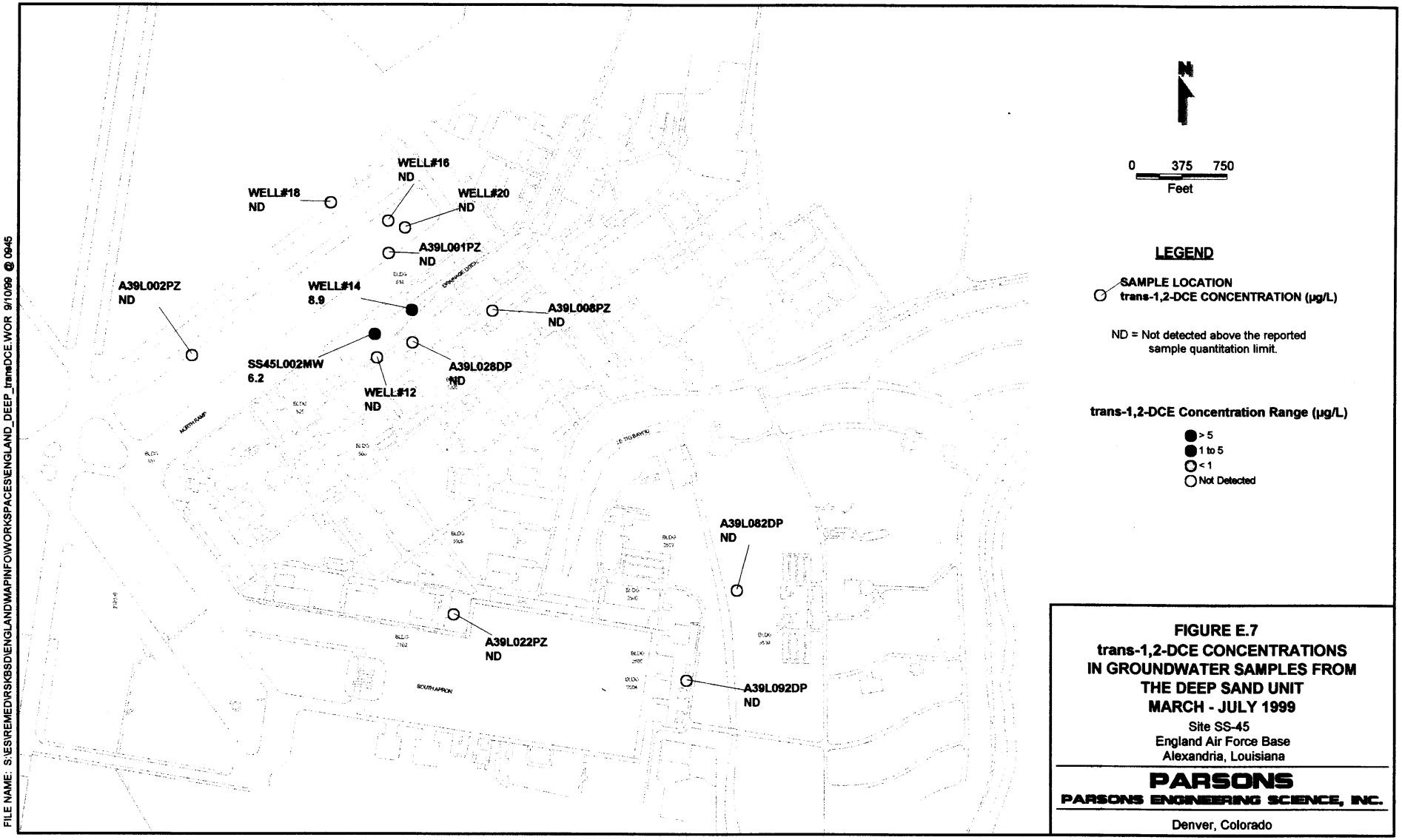
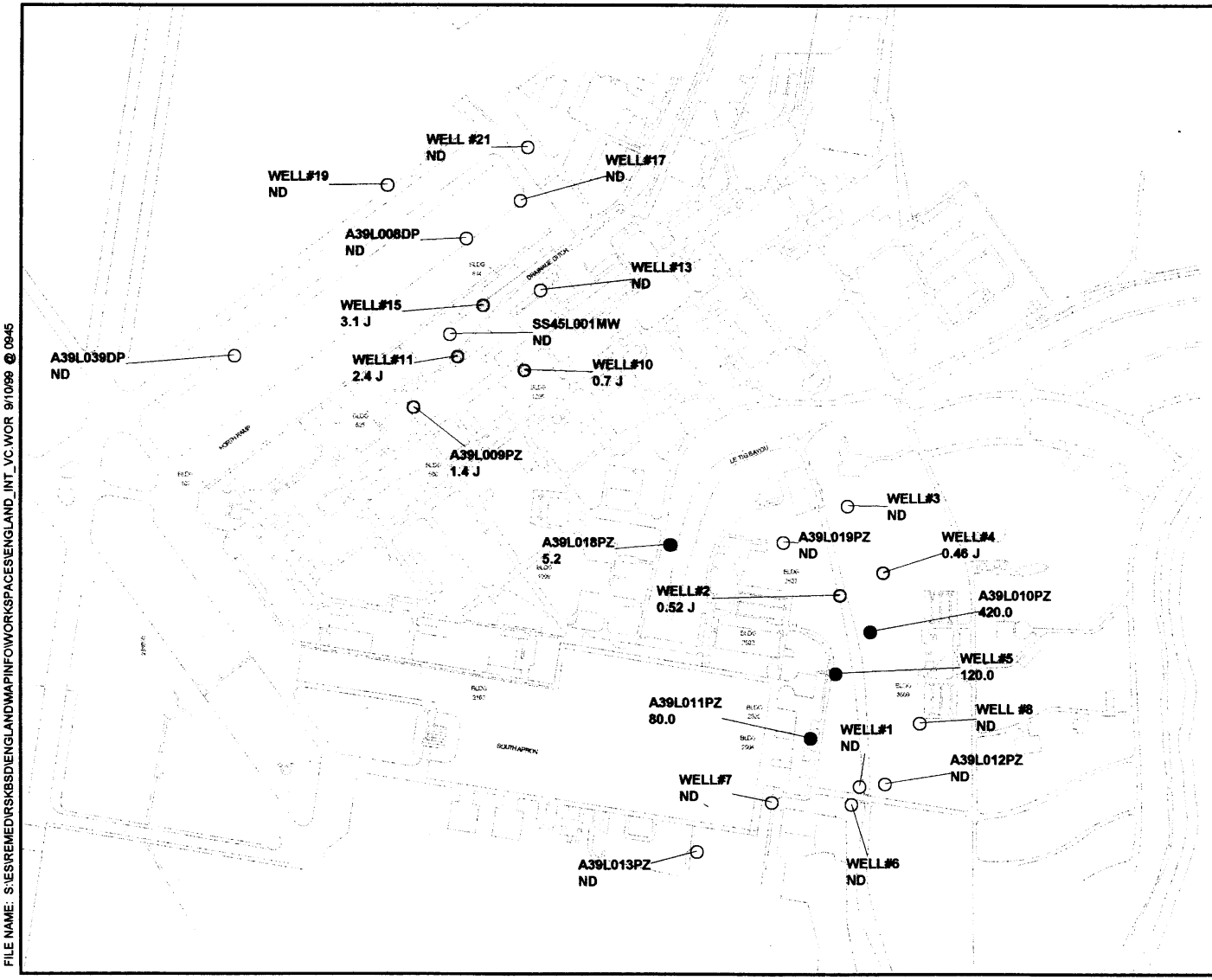


FIGURE E.7
trans-1,2-DCE CONCENTRATIONS IN GROUNDWATER SAMPLES FROM THE DEEP SAND UNIT MARCH - JULY 1999

Site SS-45
England Air Force Base
Alexandria, Louisiana

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Denver, Colorado

FILE NAME: S:\ESIREMED\RSKBSD\ENGLAND\MAPINFO\WORKSPACES\ENGLAND_DEEP_transDCE.WOR 9/10/99 @ 0945



N

0 375 750
Feet

LEGEND

SAMPLE LOCATION
VINYL CHLORIDE CONCENTRATION (µg/L)

ND = Not detected above the reported sample quantitation limit.

J = The result is qualified as an estimated value because it is greater than the method detection limit and less than the practical quantitation limit.

Vinyl Chloride Concentration Range (µg/L)

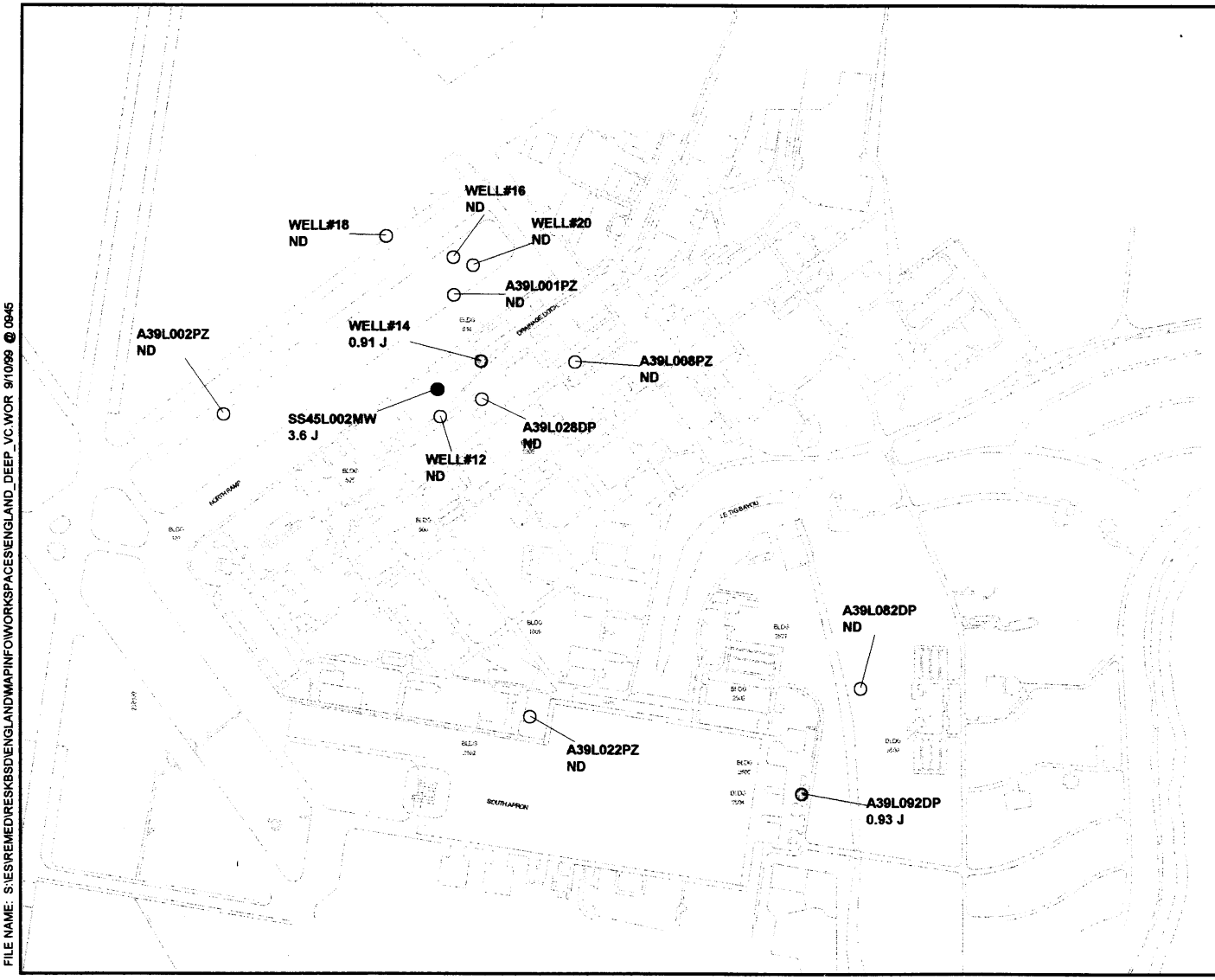
- > 10
- 5 to 10
- < 5
- Not Detected

FIGURE E.8
VINYL CHLORIDE CONCENTRATIONS IN GROUNDWATER SAMPLES FROM THE INTERMEDIATE SAND UNIT MARCH - JULY 1999

Site SS-45
England Air Force Base
Alexandria, Louisiana

PARSONS
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Denver, Colorado

FILE NAME: S:\ES\REMED\RSKBSD\ENGLAND\MAPINFO\WORKSPACES\ENGLAND_INT_VC.WOR 9/10/99 @ 0945



N

0 375 750
Feet

LEGEND

SAMPLE LOCATION
VINYL CHLORIDE CONCENTRATION (µg/L)

ND = Not detected above the reported sample quantitation limit.

J = The result is qualified as an estimated value because it is greater than the method detection limit and less than the practical quantitation limit.

Vinyl Chloride Concentration Range (µg/L)

- > 3
- 1 to 3
- < 1
- Not Detected

FIGURE E.9

VINYL CHLORIDE CONCENTRATIONS IN GROUNDWATER SAMPLES FROM THE DEEP SAND UNIT MARCH - JULY 1999

Site SS-45
England Air Force Base
Alexandria, Louisiana

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Denver, Colorado

FILE NAME: S:\ES\REMED\RESKBSD\ENGLAND\MAPINFO\WORKSPACES\ENGLAND_DEEP_VC.WOR 9/10/99 @ 0945

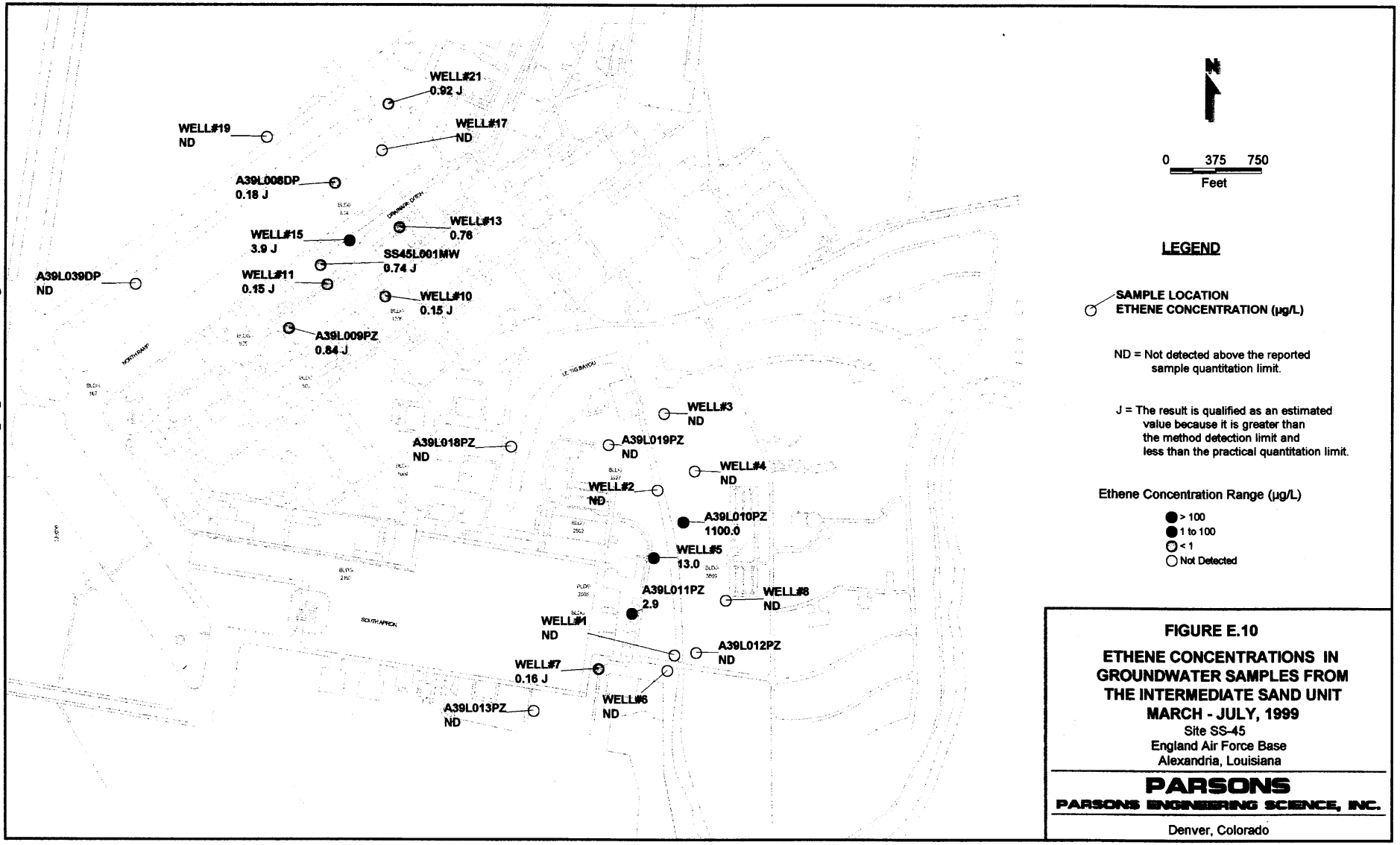


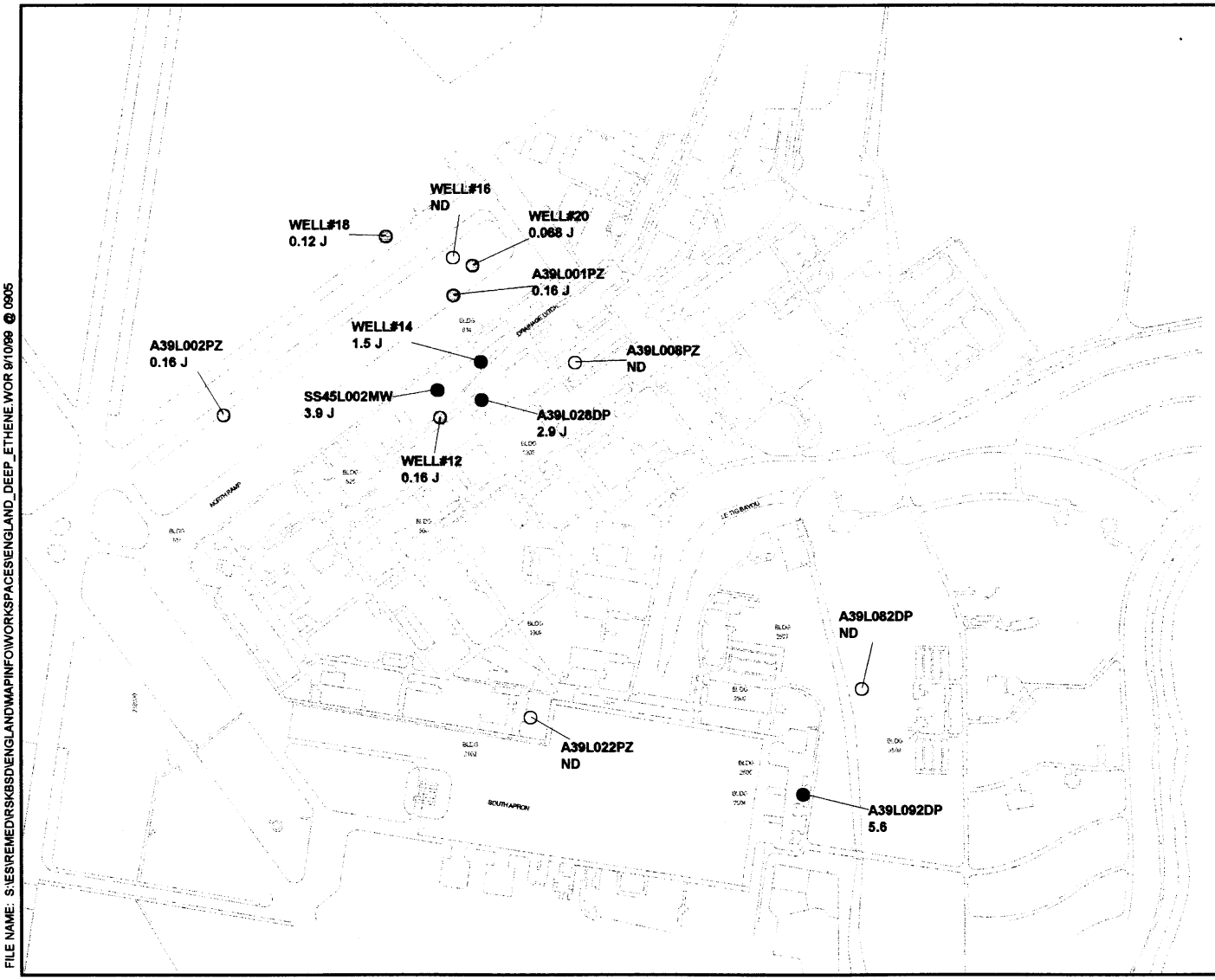
FIGURE E.10

ETHENE CONCENTRATIONS IN GROUNDWATER SAMPLES FROM THE INTERMEDIATE SAND UNIT MARCH - JULY, 1999

Site SS-45
England Air Force Base
Alexandria, Louisiana

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Denver, Colorado

FILE NAME: S:\ES\REMED\RSK\BSD\ENGLAND\MAPINFO\WORKSPACES\ENGLAND_INT_Ethene.WOR 9/10/99 @ 0950



N

0 375 750
Feet

LEGEND

SAMPLE LOCATION
ETHENE CONCENTRATION (µg/L)

ND = Not detected above the reported sample quantitation limit.

J = The result is qualified as an estimated value because it is greater than the method detection limit and less than the practical quantitation limit.

Ethene Concentration Range (µg/L)

- > 3
- 1 to 3
- < 1
- Not Detected

FIGURE E.11

ETHENE CONCENTRATIONS IN GROUNDWATER SAMPLES FROM DEEP SAND UNIT MARCH - JULY 1999

Site SS-45
England Air Force Base
Alexandria, Louisiana

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FILE NAME: S:\ES\REMED\RSKBSD\ENGLAND\MAPINFO\WORKSPACES\ENGLAND_DEEP_ETHENE.WOR 9/10/99 @ 0905

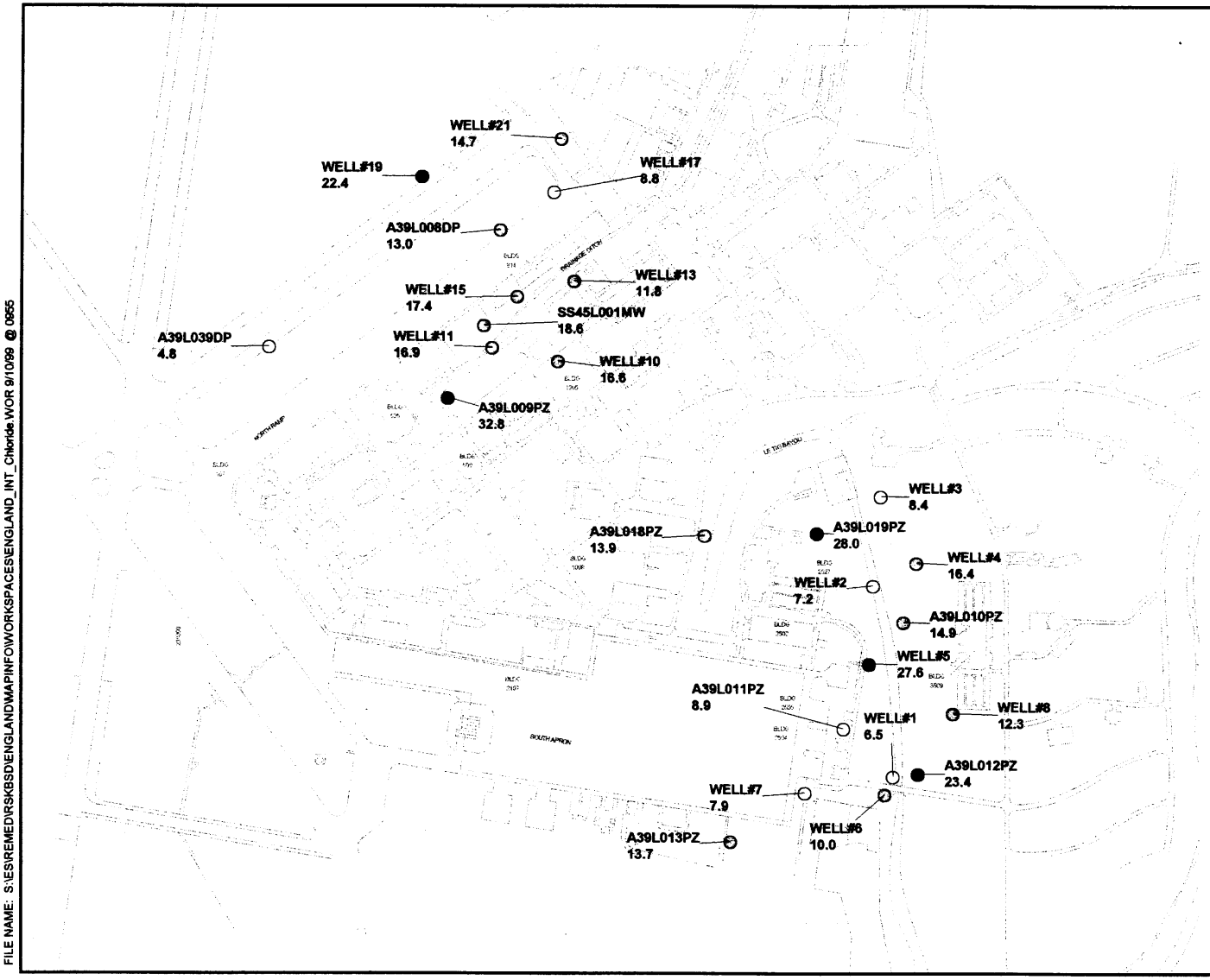
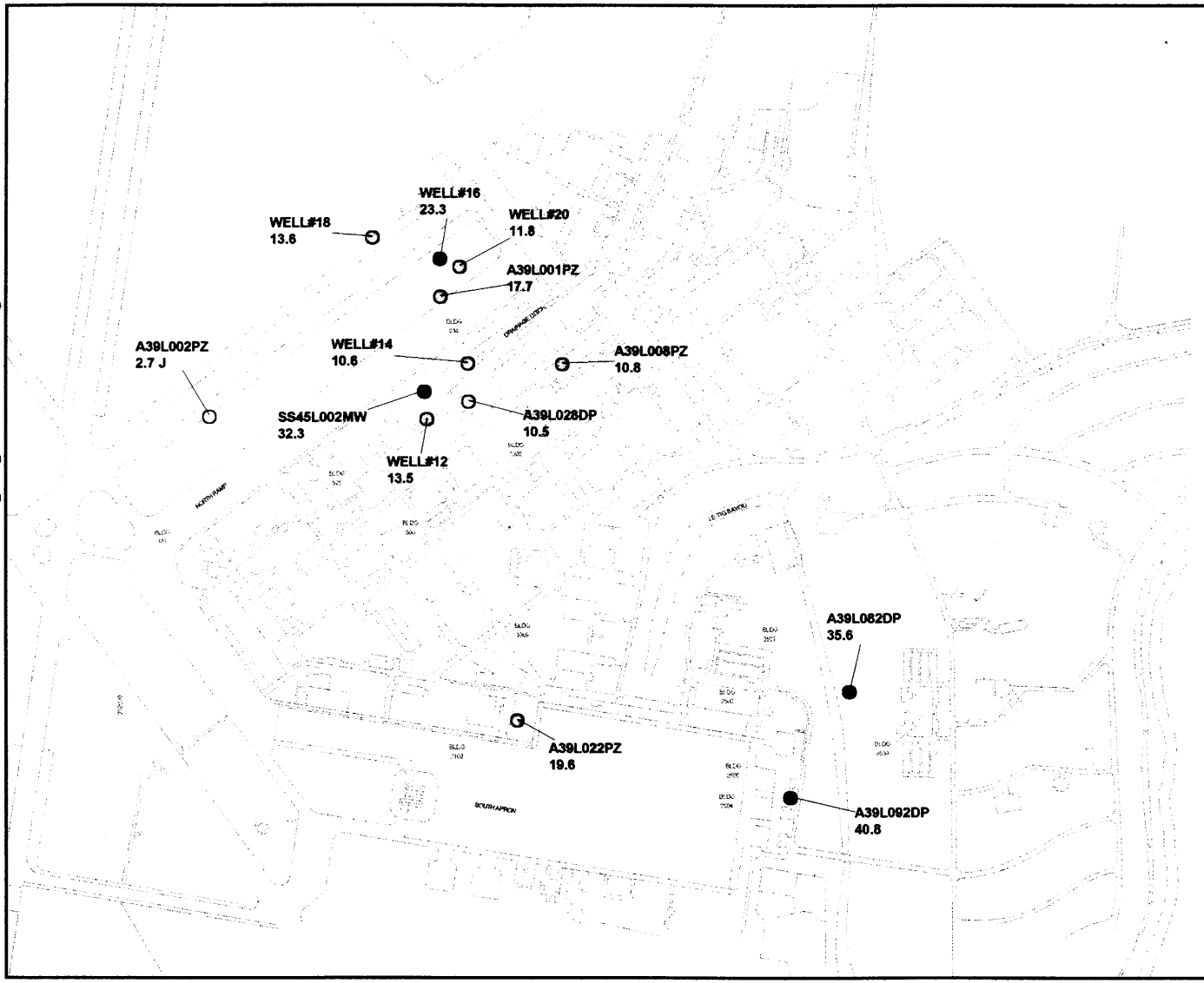


FIGURE E.12
CHLORIDE CONCENTRATIONS IN INTERMEDIATE SAND UNIT GROUNDWATER
MARCH - JULY 1999

Site SS-45
England Air Force Base
Alexandria, Louisiana

PARSONS
PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

FILE NAME: S:\ESVREMEDVRSKBSDVENGLANDVMAPINFOVWORKSPACESVENGLAND_INT_Chloride.WOR 9/10/99 @ 0855



N

0 375 750
Feet

LEGEND

SAMPLE LOCATION
CHLORIDE CONCENTRATION (mg/L)

J = The result is qualified as an estimated value because it is greater than the method detection limit and less than the practical quantitation limit.

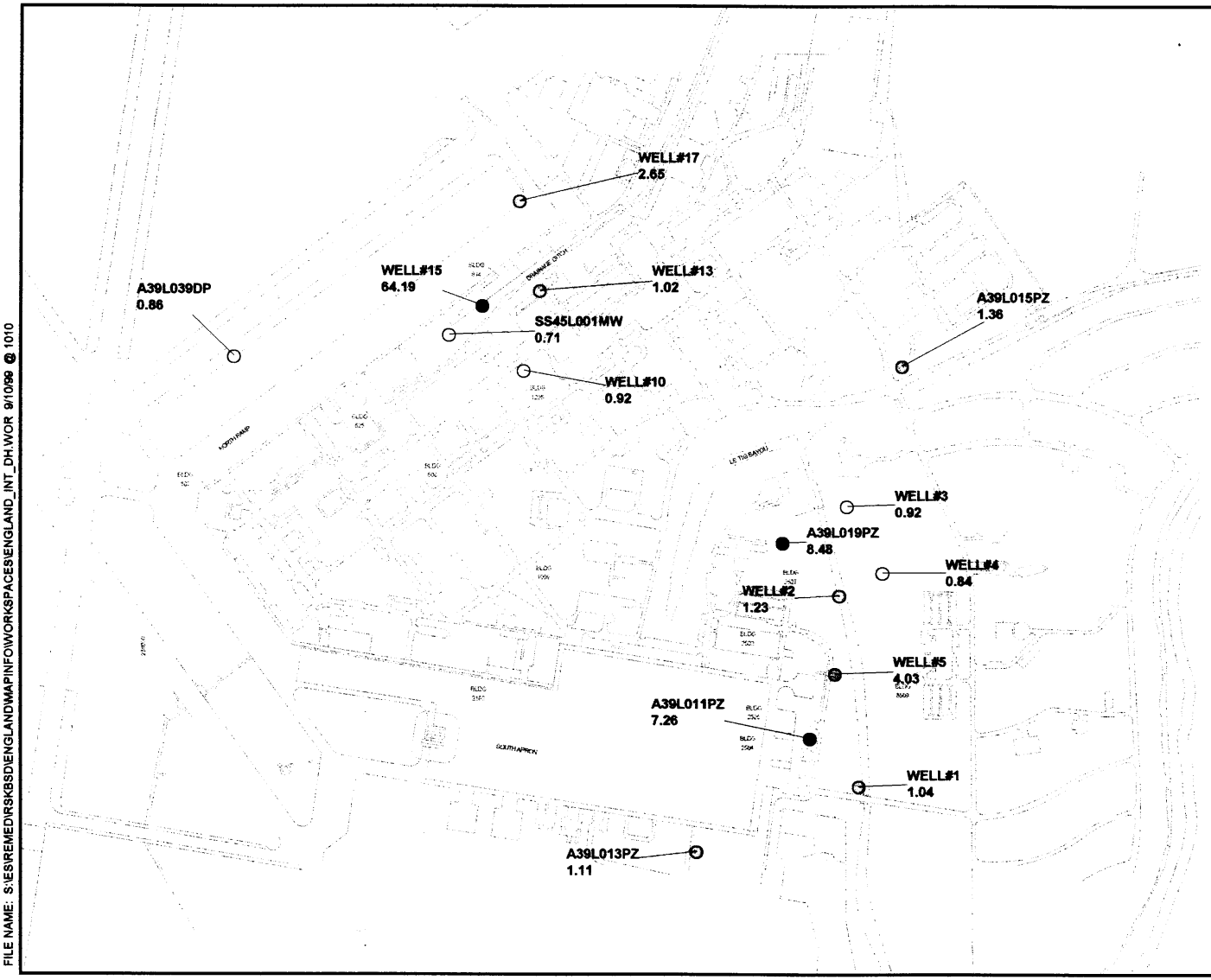
Chloride Concentration Range (mg/L)

- > 30
- 20 to 30
- 10 to 20
- < 10

FIGURE E.13
CHLORIDE CONCENTRATIONS IN DEEP SAND UNIT GROUNDWATER MARCH - JULY 1999
Site SS-45
England Air Force Base
Alexandria, Louisiana

PARSONS
PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

FILE NAME: S:\ES\REMED\RSKB\SD\ENGLAND\MAPINFO\WORKSPACES\ENGLAND_DEEP_CHLORIDE.WOR 9/10/99 @ 1000



N

0 375 750
Feet

LEGEND

SAMPLE LOCATION
DISSOLVED HYDROGEN CONCENTRATION (nM/L)

Dissolved Hydrogen Concentration Range (nM/L)

- > 10
- 5 to 10
- 1 to 5
- < 1

FIGURE E.14
DISSOLVED HYDROGEN CONCENTRATIONS IN INTERMEDIATE SAND UNIT GROUNDWATER
MAY 1999

Site SS-45
England Air Force Base
Alexandria, Louisiana

PARSONS
PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

FILE NAME: S:\ES\REMEDIR\KBSD\ENGLAND\MAPINFO\WORKSPACES\ENGLAND_INT_DH.WOR 9/10/99 @ 1010

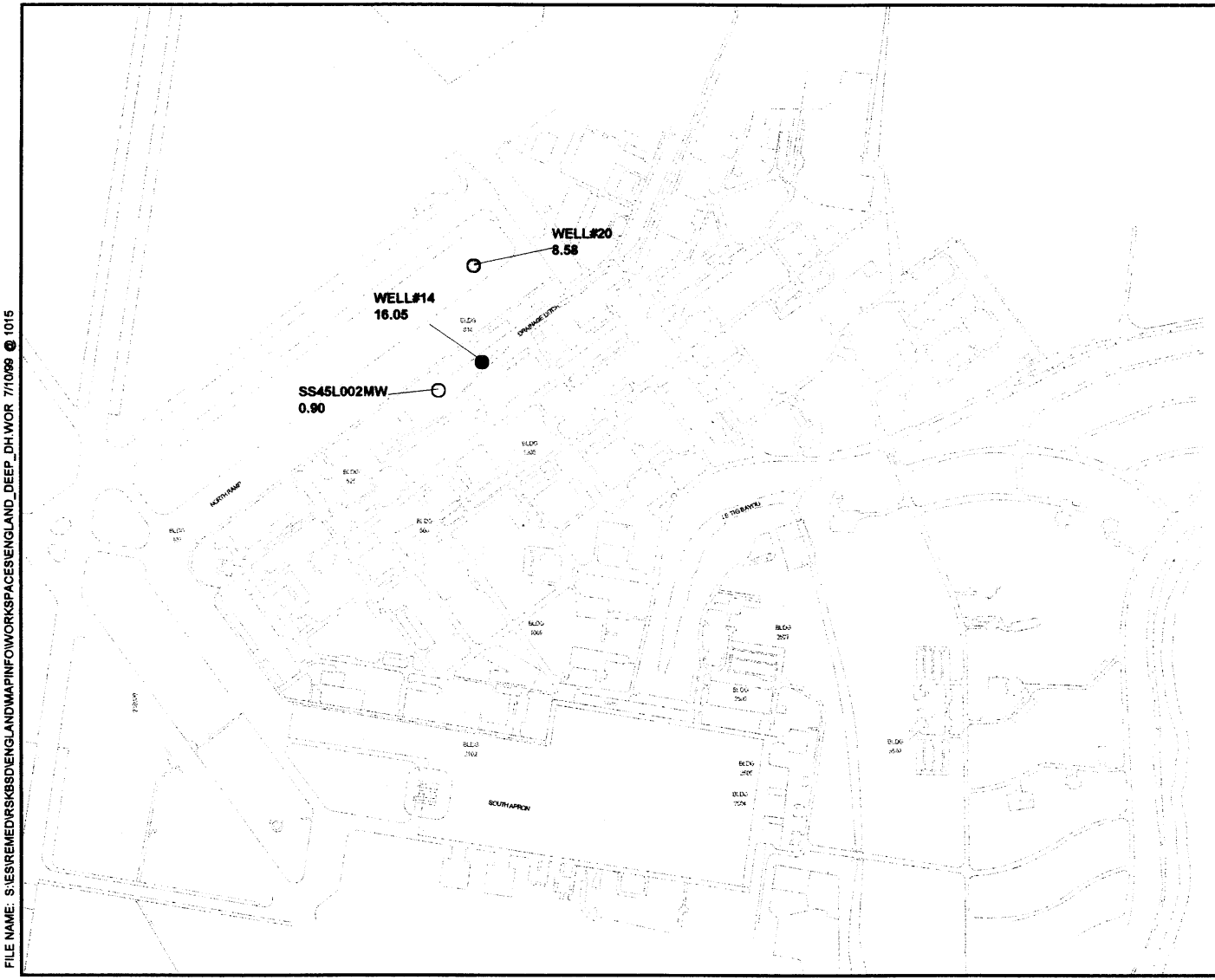


FIGURE E.15
DISSOLVED HYDROGEN CONCENTRATIONS IN DEEP SAND UNIT GROUNDWATER
MAY 1999

Site SS-45
England Air Force Base
Alexandria, Louisiana

PARSONS
PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

FILE NAME: S:\ES\REMED\RSKB\SD\ENGLAND\MAPINFO\WORKSPACES\ENGLAND_DEEP_DH.WOR 7/10/99 @ 1015

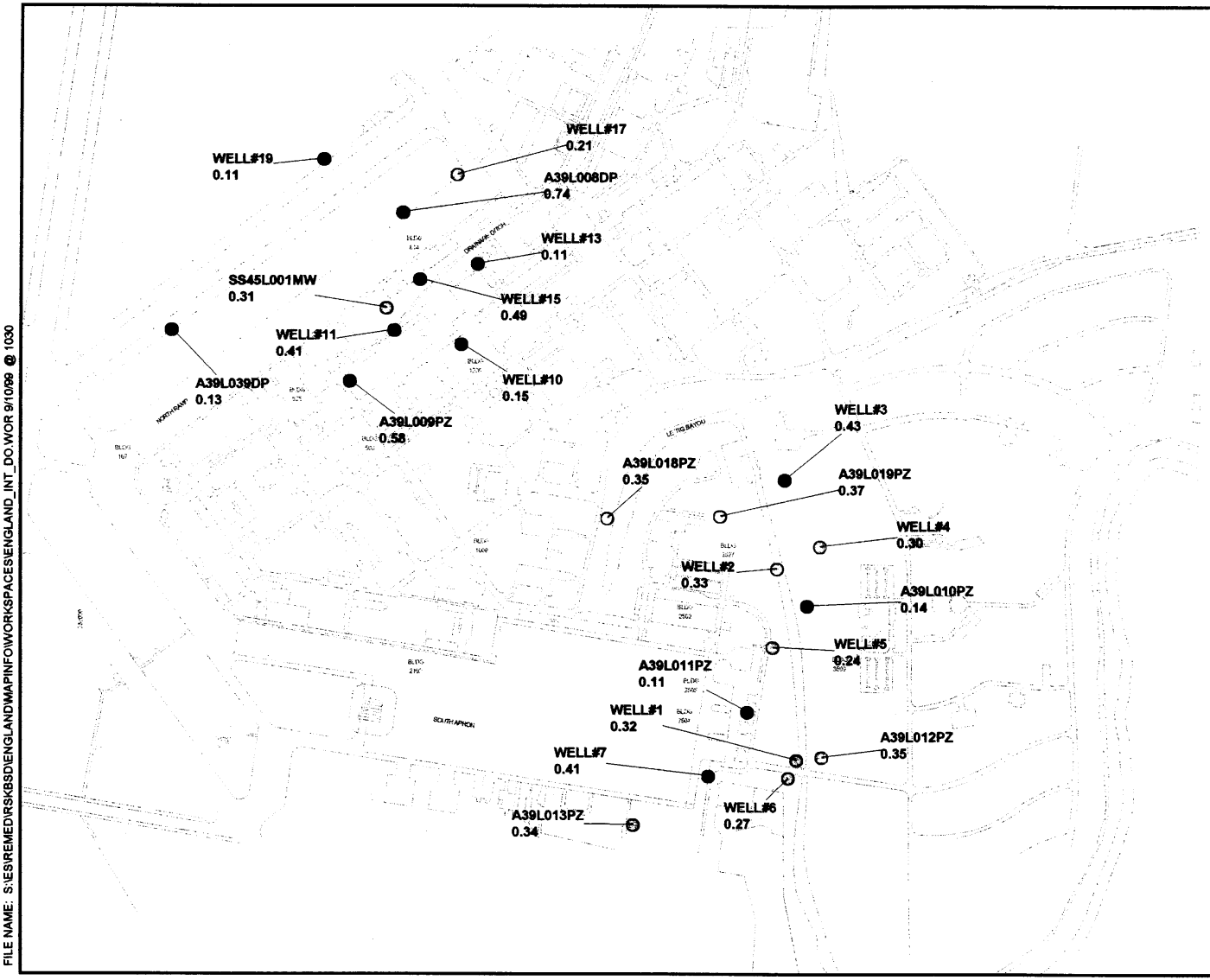


FIGURE E.16

DISSOLVED OXYGEN IN INTERMEDIATE SAND UNIT GROUNDWATER MARCH - JULY 1999

Site SS-45
England Air Force Base
Alexandria, Louisiana

PARSONS
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Denver, Colorado

FILE NAME: S:\ES\REMED\RSKBSD\ENGLAND\MAPINFO\WORKSPACES\ENGLAND_INT_DO.WOR 9/10/99 @ 1030

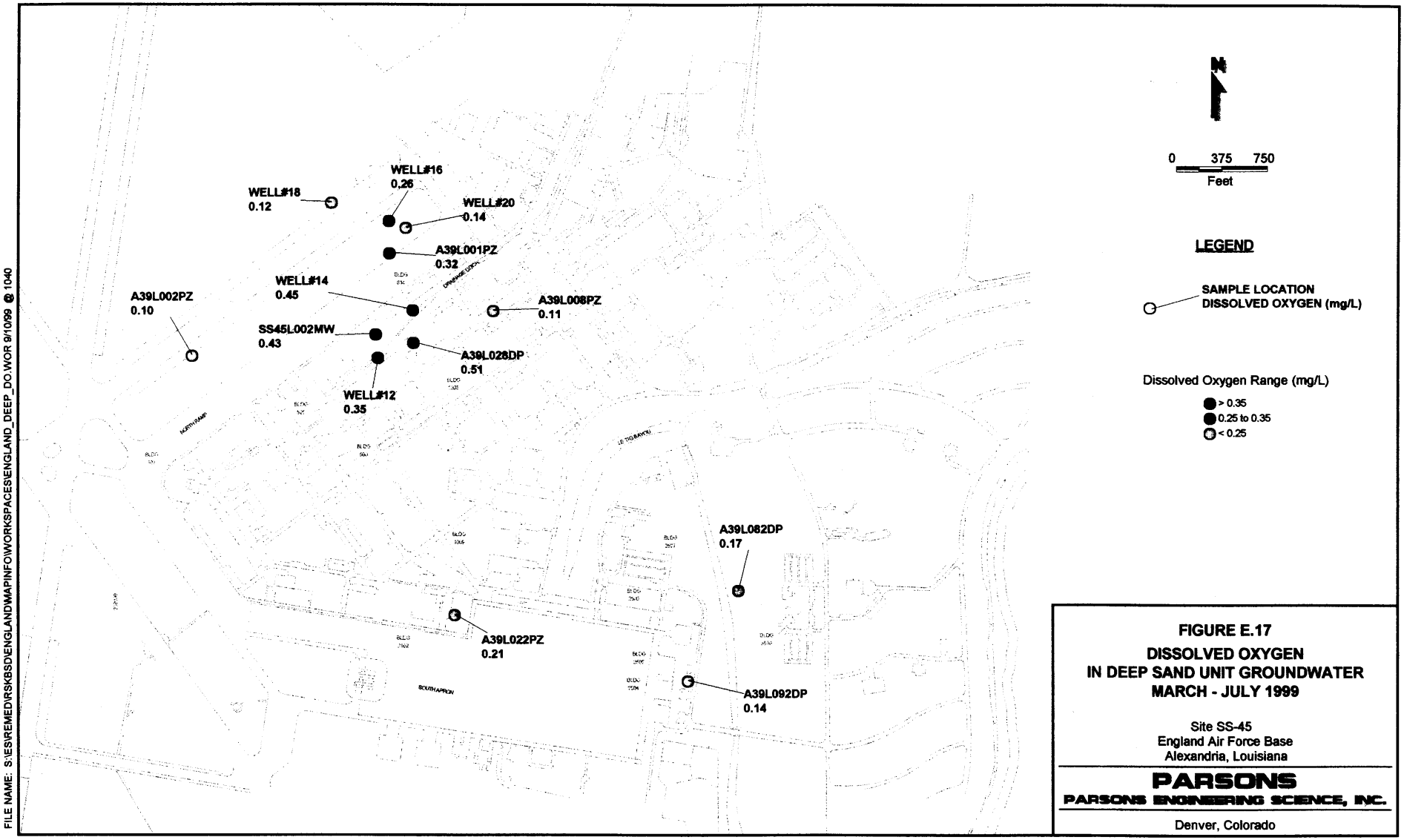
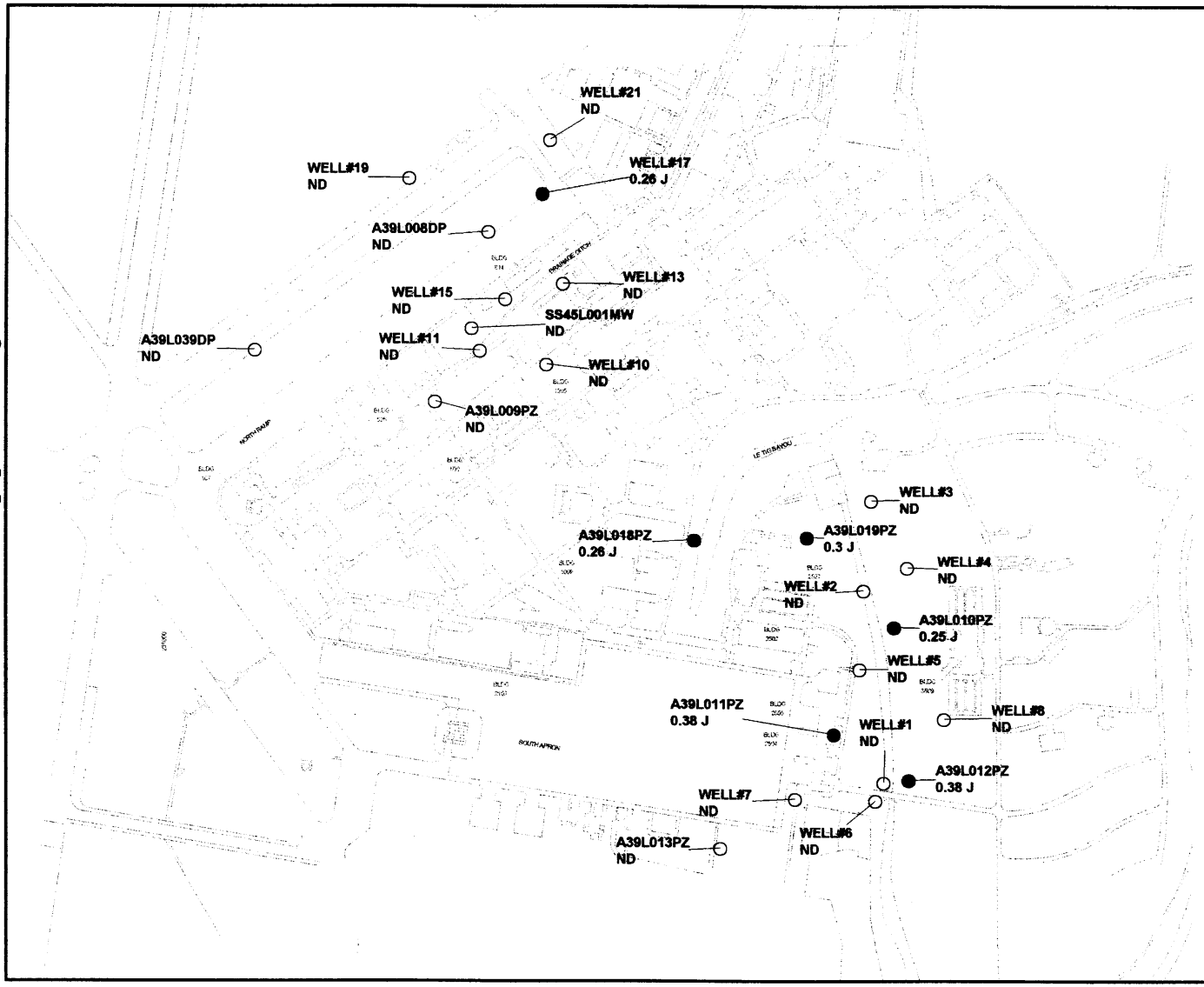


FIGURE E.17
DISSOLVED OXYGEN
IN DEEP SAND UNIT GROUNDWATER
MARCH - JULY 1999

Site SS-45
England Air Force Base
Alexandria, Louisiana

PARSONS
PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

FILE NAME: S:\ES\REMED\RSKBS\DE\NGLAND\MAPINFO\WORKSPACES\ENGLAND_DEEP_DO.WOR 9/10/99 @ 1040



N

0 375 750
Feet

LEGEND

SAMPLE LOCATION
NITRATE CONCENTRATION (mg/L)

ND = Not detected above the reported sample quantitation limit.

J = The result is qualified as an estimated value because it is greater than the method detection limit and less than the practical quantitation limit.

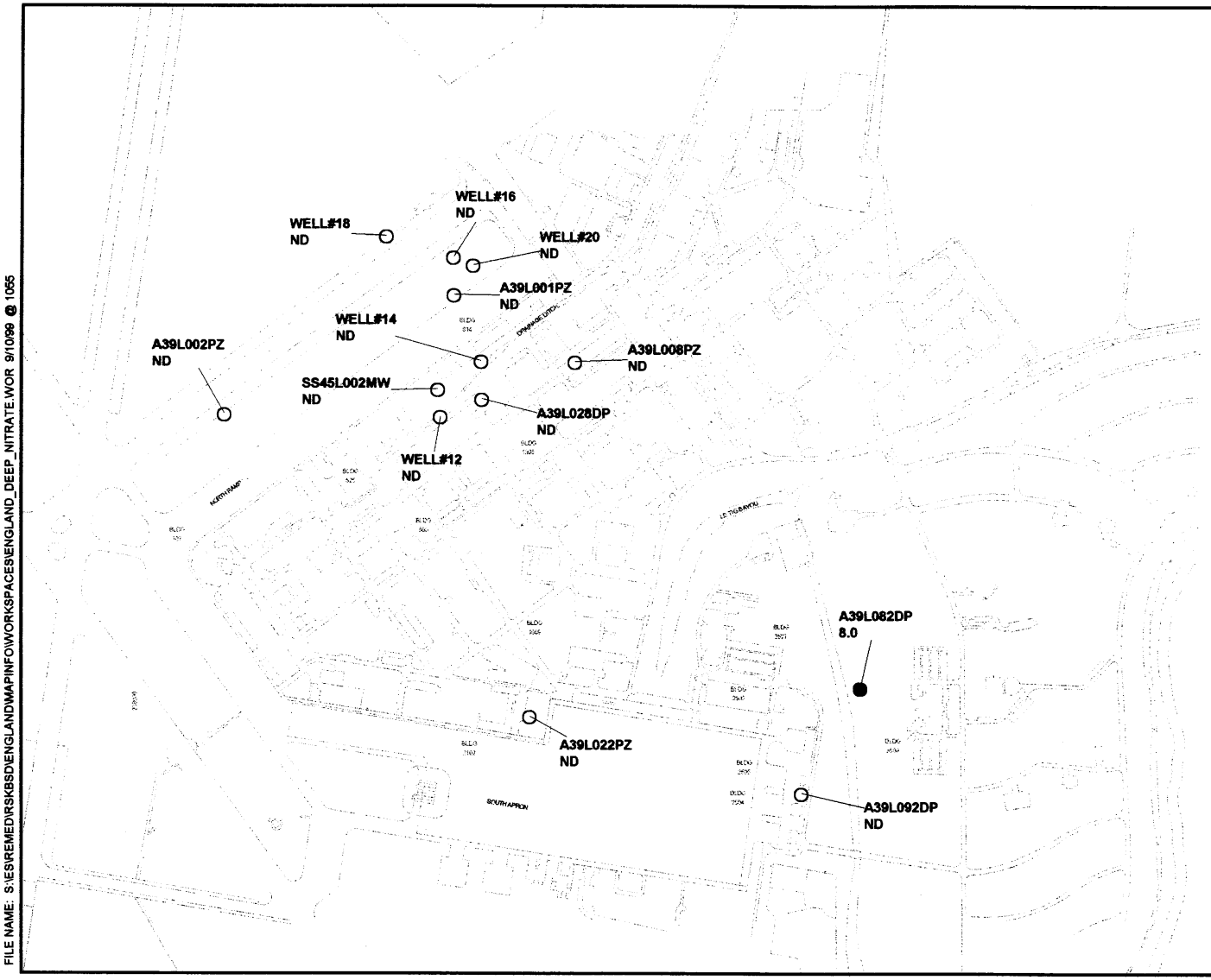
Nitrate Concentration Range (mg/L)

- 0 to 1
- Not Detected

FIGURE E.18
NITRATE CONCENTRATIONS IN INTERMEDIATE SAND UNIT GROUNDWATER MARCH - JULY 1999
Site SS-45
England Air Force Base
Alexandria, Louisiana

PARSONS
PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

FILE NAME: S:\ESIREMED\RSKBSD\ENGLAND\MAPINFO\WORKSPACES\ENGLAND_INT_Nitrate.WOR 9/10/99 @ 1045



N

0 375 750
Feet

LEGEND

SAMPLE LOCATION
NITRATE CONCENTRATION (mg/L)

ND = Not detected above the reported sample quantitation limit.

Nitrate Concentration Range (mg/L)

0 to 10
Not Detected

FIGURE E.19
NITRATE CONCENTRATIONS
IN DEEP SAND UNIT GROUNDWATER
MARCH - JULY 1999

Site SS-45
England Air Force Base
Alexandria, Louisiana

PARSONS
PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

FILE NAME: S:\ESVREMED\RSKB\SD\ENGLAND\MAPINFO\WORKSPACES\ENGLAND_DEEP_NITRATE.WOR 9/10/99 @ 1055

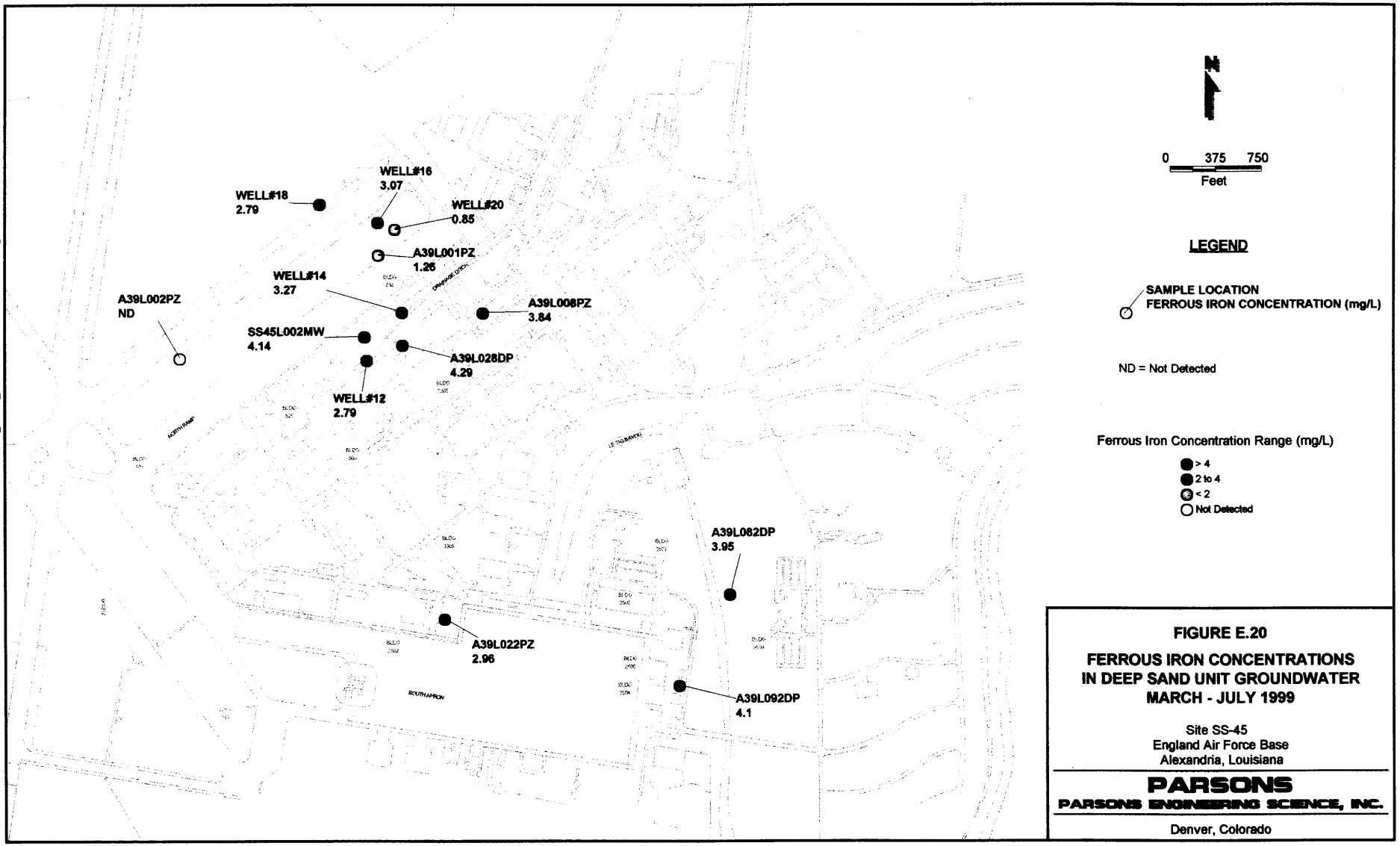


FIGURE E.20

FERROUS IRON CONCENTRATIONS IN DEEP SAND UNIT GROUNDWATER MARCH - JULY 1999

Site SS-45
England Air Force Base
Alexandria, Louisiana

PARSONS
PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

FILE NAME: S:\ES\REMED\RSK\BSD\ENGLAND\MAPINFO\WORKSPACES\ENGLAND_DEEP_FERROUSIRON.WOR 9/10/99 @ 1055

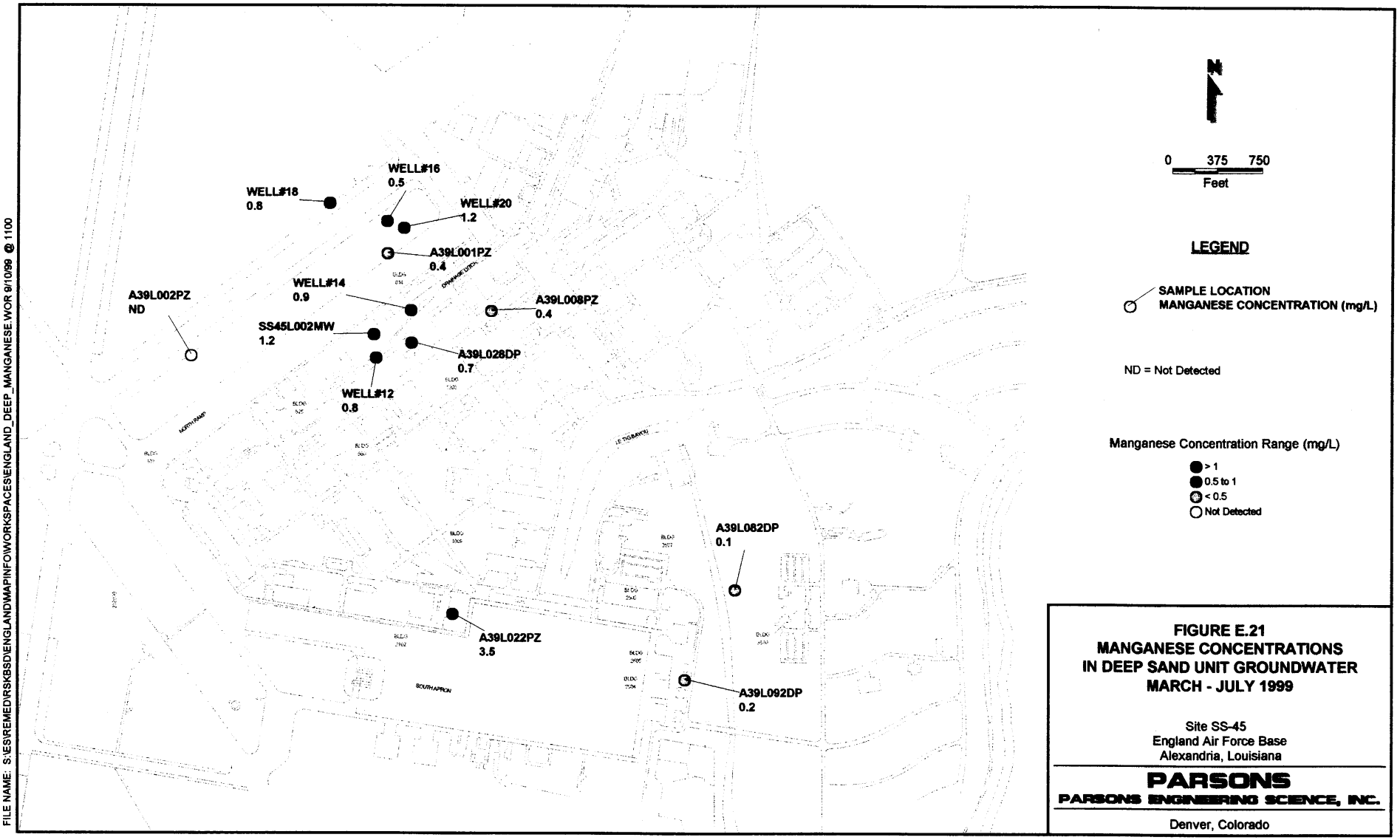
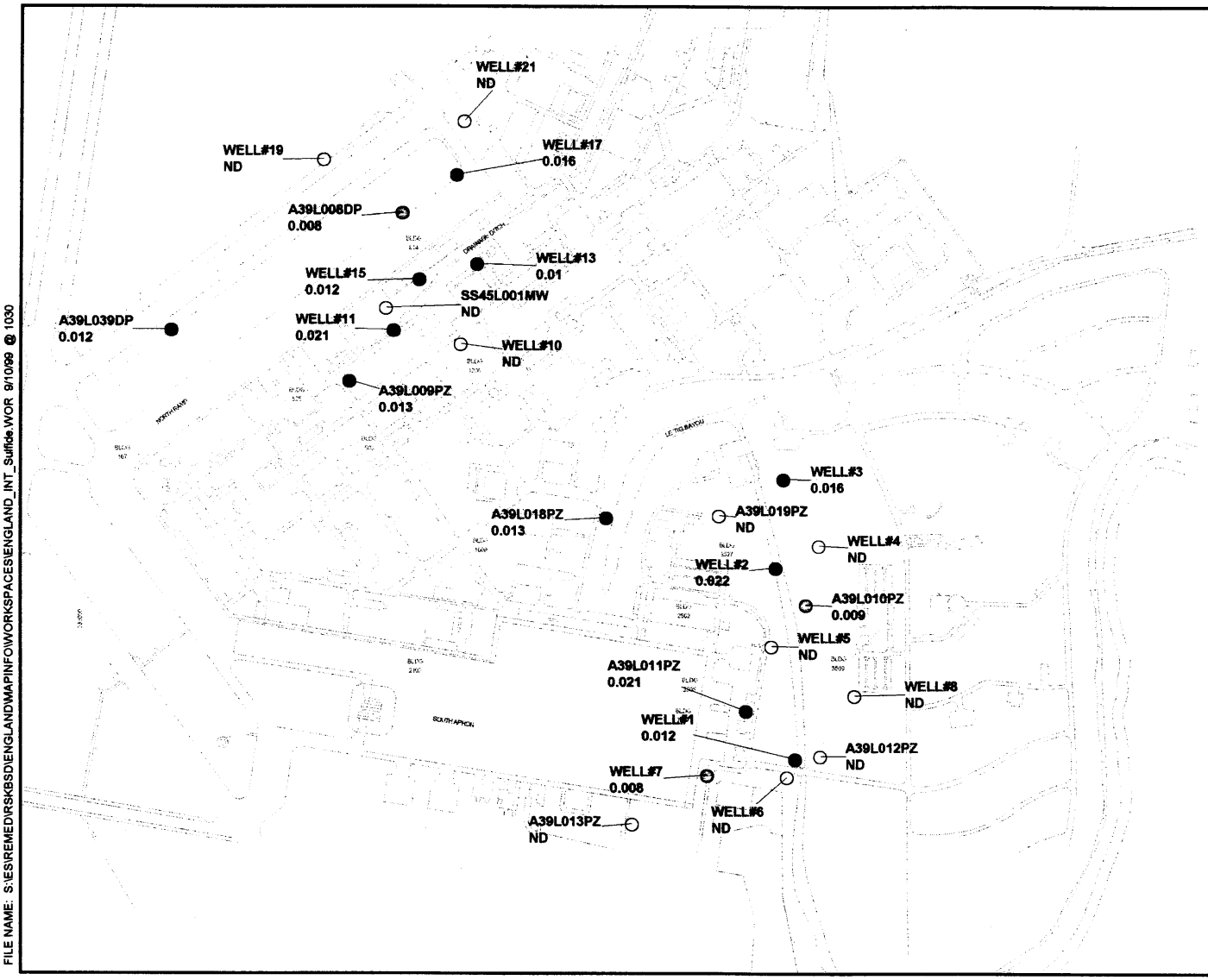


FIGURE E.21
MANGANESE CONCENTRATIONS
IN DEEP SAND UNIT GROUNDWATER
MARCH - JULY 1999

Site SS-45
England Air Force Base
Alexandria, Louisiana

PARSONS
PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

FILE NAME: S:\ES\REMED\RSKBSD\ENGLAND\MAPINFO\WORKSPACES\ENGLAND_DEEP_MANGANESE.WOR 9/10/99 @ 1100



N

0 375 750
Feet

LEGEND

SAMPLE LOCATION
SULFIDE CONCENTRATION (mg/L)

ND = Not detected

Sulfide Concentration Range (mg/L)

- > 0.02
- 0.01 to 0.02
- < 0.01
- Not Detected

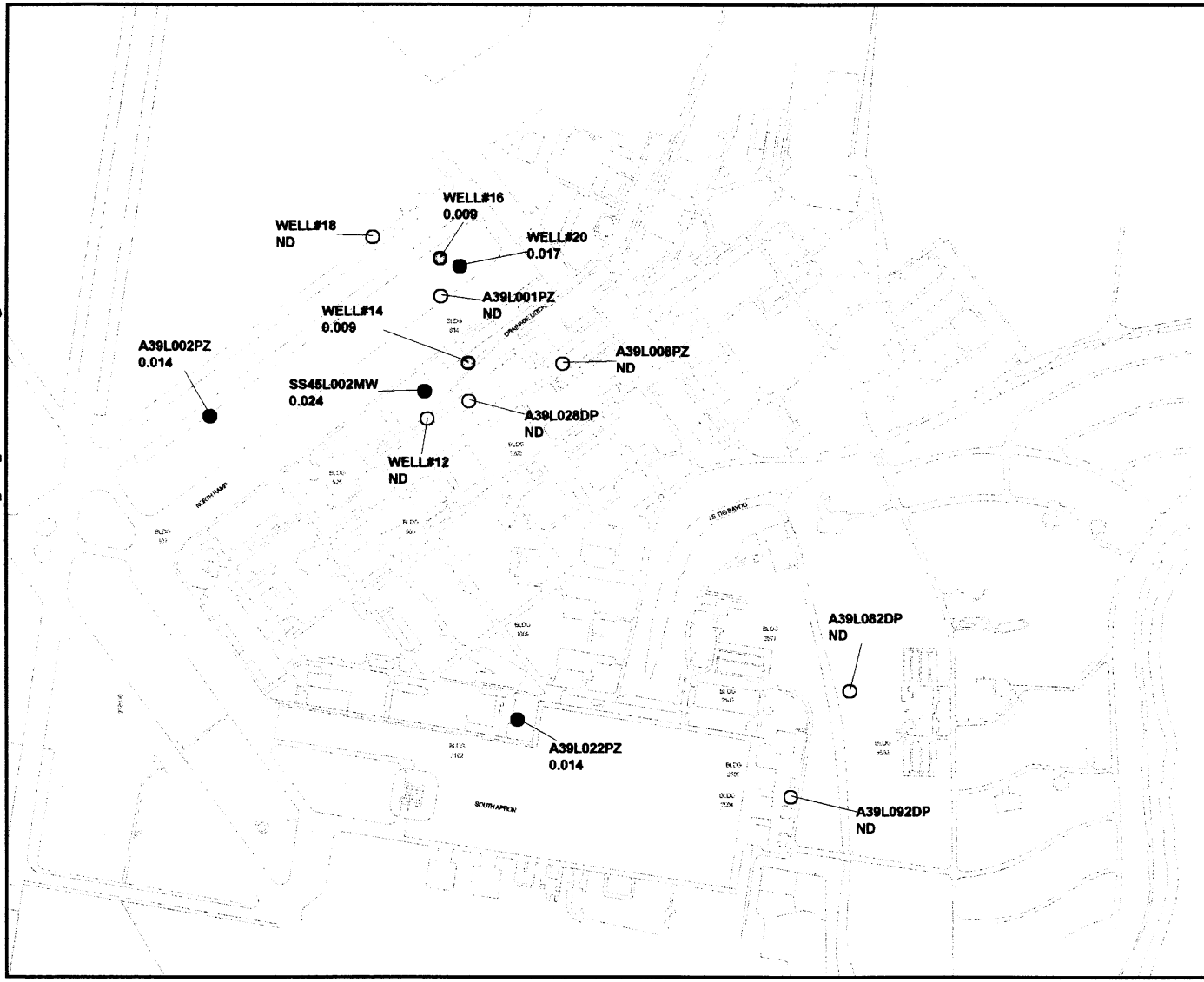
FIGURE E.22

SULFIDE CONCENTRATIONS IN INTERMEDIATE SAND UNIT GROUNDWATER MARCH - JULY 1999

Site SS-45
England Air Force Base
Alexandria, Louisiana

PARSONS
PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

FILE NAME: S:\ES\REMED\RSKBSD\ENGLAND\MAPINFO\WORKSPACES\ENGLAND_INT_Sulfide.WOR 9/10/99 @ 1030



N

0 375 750
Feet

LEGEND

SAMPLE LOCATION
SULFIDE CONCENTRATION (mg/L)

ND = Not Detected

Sulfide Concentration Range (mg/L)

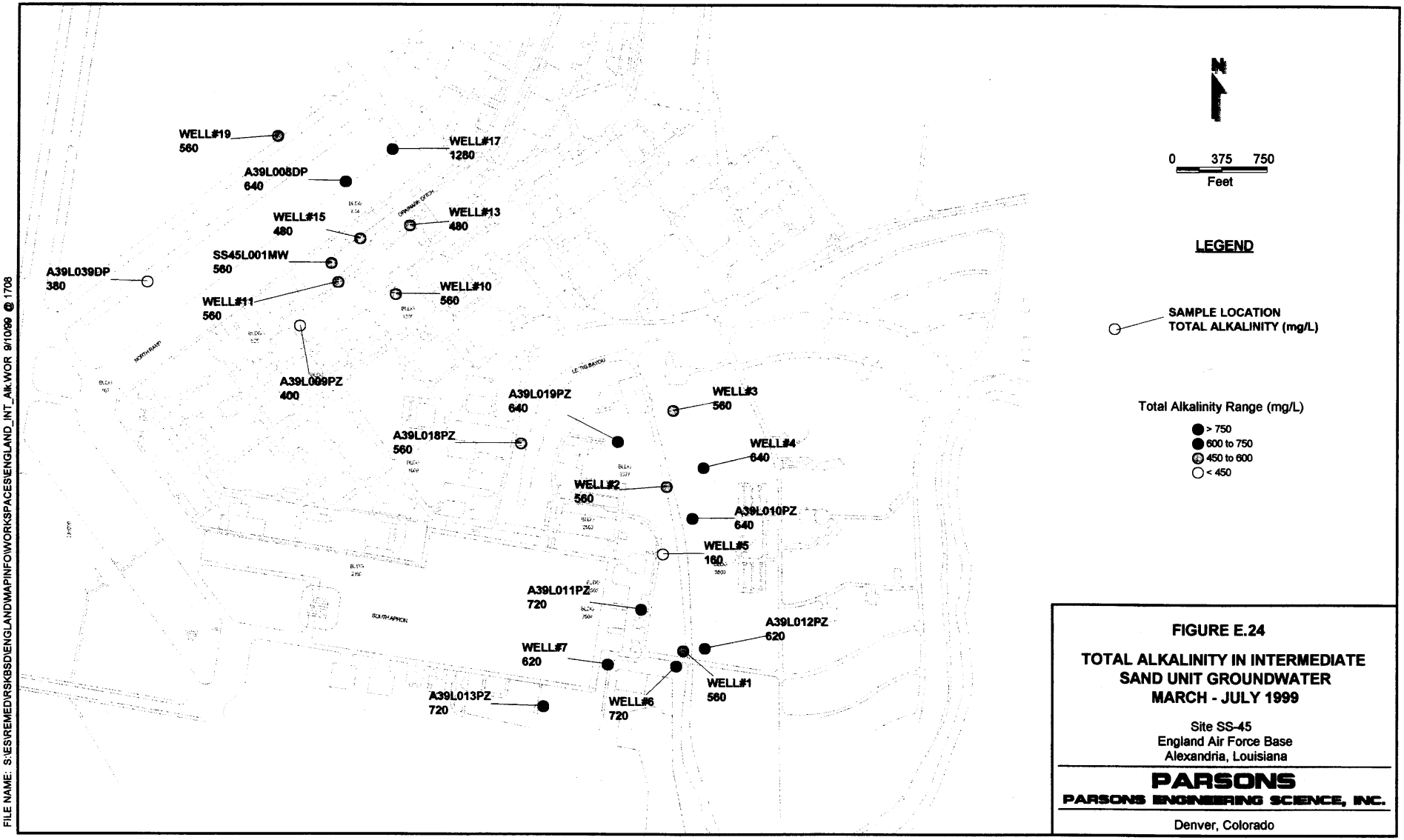
- > 0.02
- 0.01 to 0.02
- < 0.01
- Not Detected

FIGURE E.23
SULFIDE CONCENTRATIONS
IN DEEP SAND UNIT GROUNDWATER
MARCH - JULY 1999

Site SS-45
England Air Force Base
Alexandria, Louisiana

PARSONS
PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

FILE NAME: S:\ES\REMED\RSKBSD\ENGLAND\MAPINFO\WORKSPACES\ENGLAND_DEEP_SULFIDE.WOR 9/10/99 @ 1115



FILE NAME: S:\ES\REMED\RSKB\SD\ENGLAND\MAPINFO\WORKSPACES\ENGLAND_INT_Alk.WOR 9/10/99 @ 17:08

FIGURE E.24

TOTAL ALKALINITY IN INTERMEDIATE SAND UNIT GROUNDWATER MARCH - JULY 1999

Site SS-45
England Air Force Base
Alexandria, Louisiana

PARSONS
PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

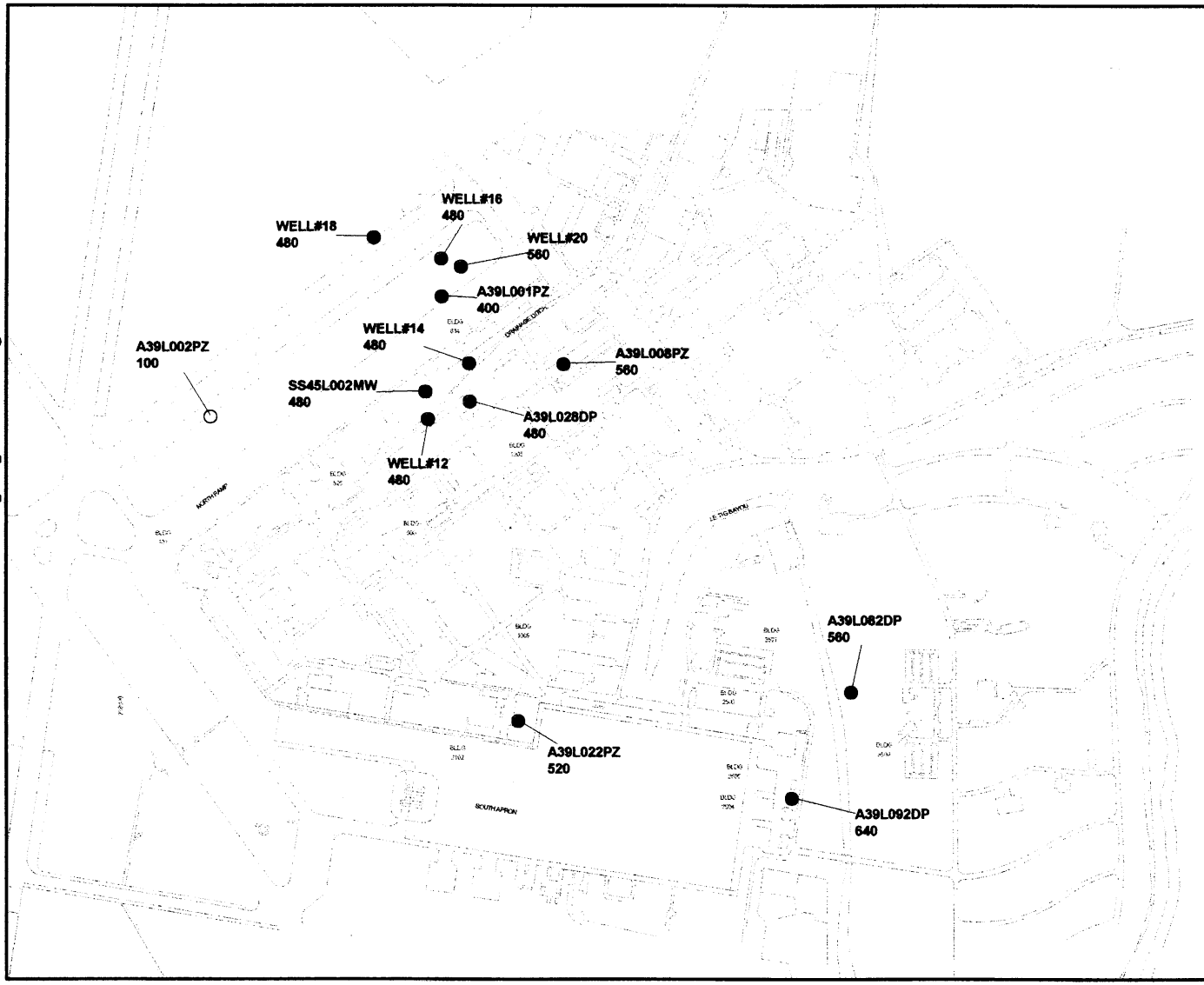


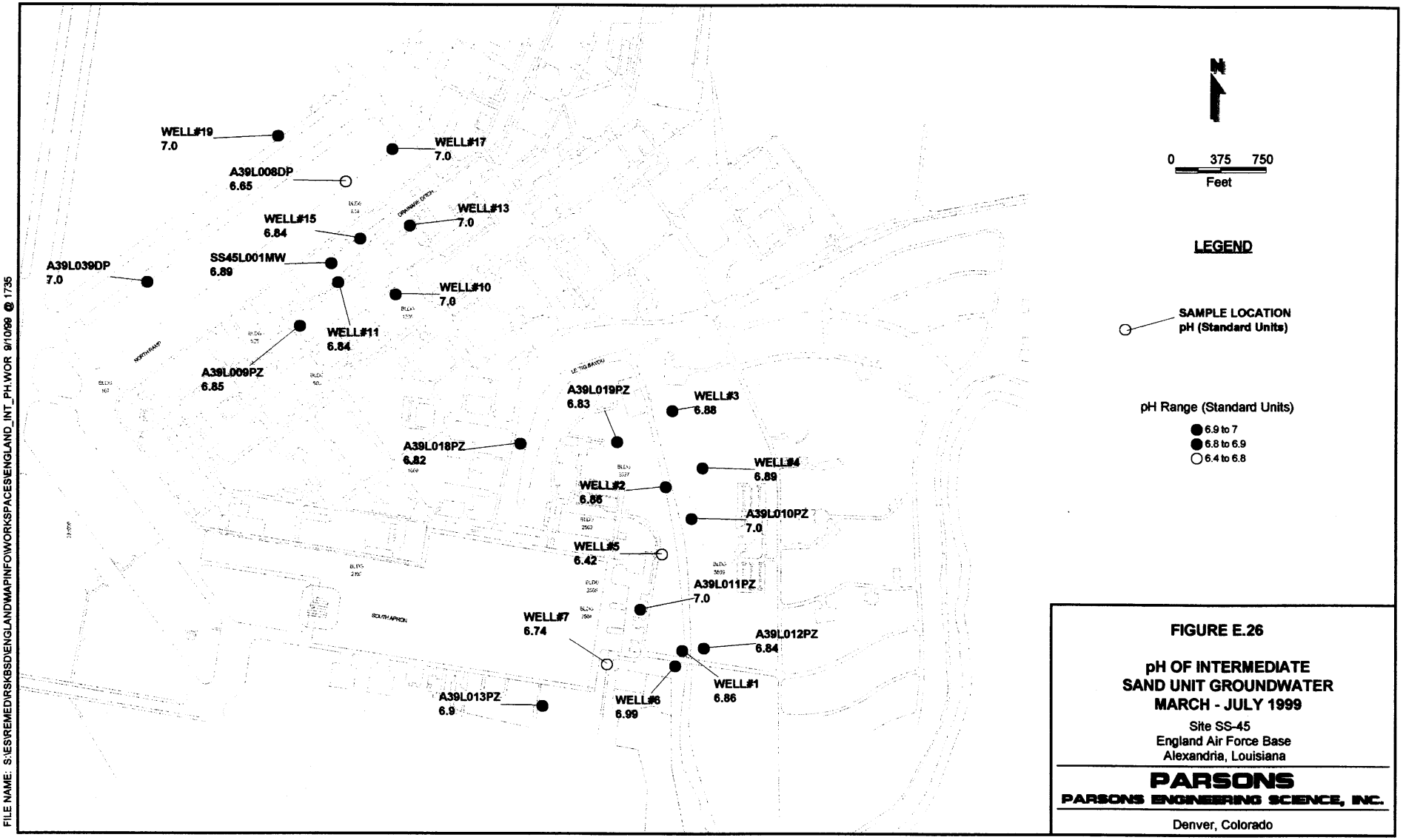
FIGURE E.25

TOTAL ALKALINITY IN DEEP SAND UNIT GROUNDWATER MARCH - JULY 1999

Site SS-45
England Air Force Base
Alexandria, Louisiana

PARSONS
PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

FILE NAME: S:\ESVREMED\RSKBSD\ENGLAND\MAPINFO\WORKSPACES\ENGLAND_DEEP_ALK.WOR 9/10/99 @ 1725



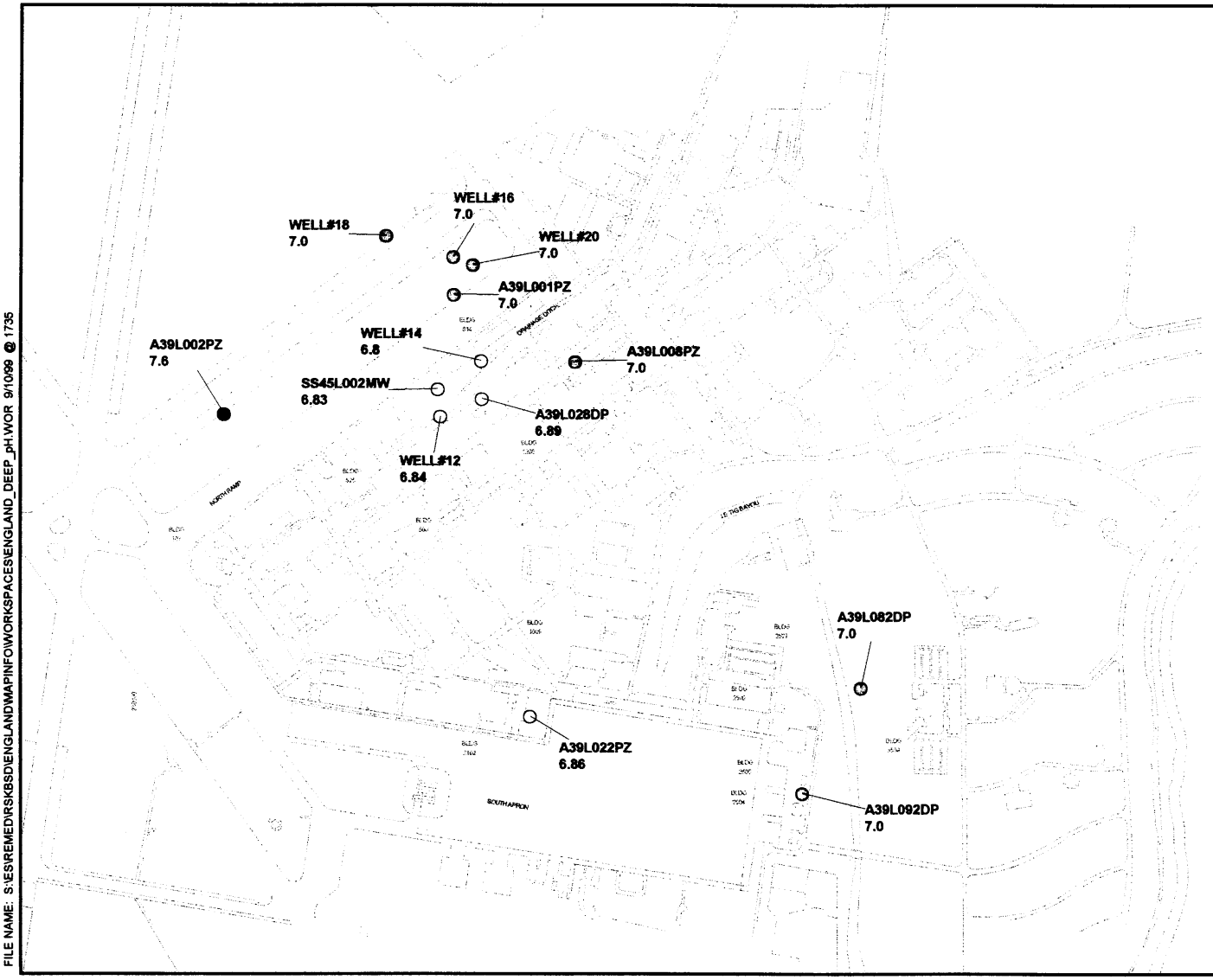
FILE NAME: S:\ESVREMED\RSKBSD\ENGLAND\MAPINFO\WORKSPACES\ENGLAND_INT_PH.WOR 9/10/99 @ 1735

FIGURE E.26

pH OF INTERMEDIATE SAND UNIT GROUNDWATER MARCH - JULY 1999

Site SS-45
England Air Force Base
Alexandria, Louisiana

PARSONS
PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado



N

0 375 750
Feet

LEGEND

SAMPLE LOCATION
pH (Standard Units)

pH RANGE (Standard Units)

- 7.4 to 7.6
- 7.2 to 7.4
- 7.0 to 7.2
- 6.8 to 7.0

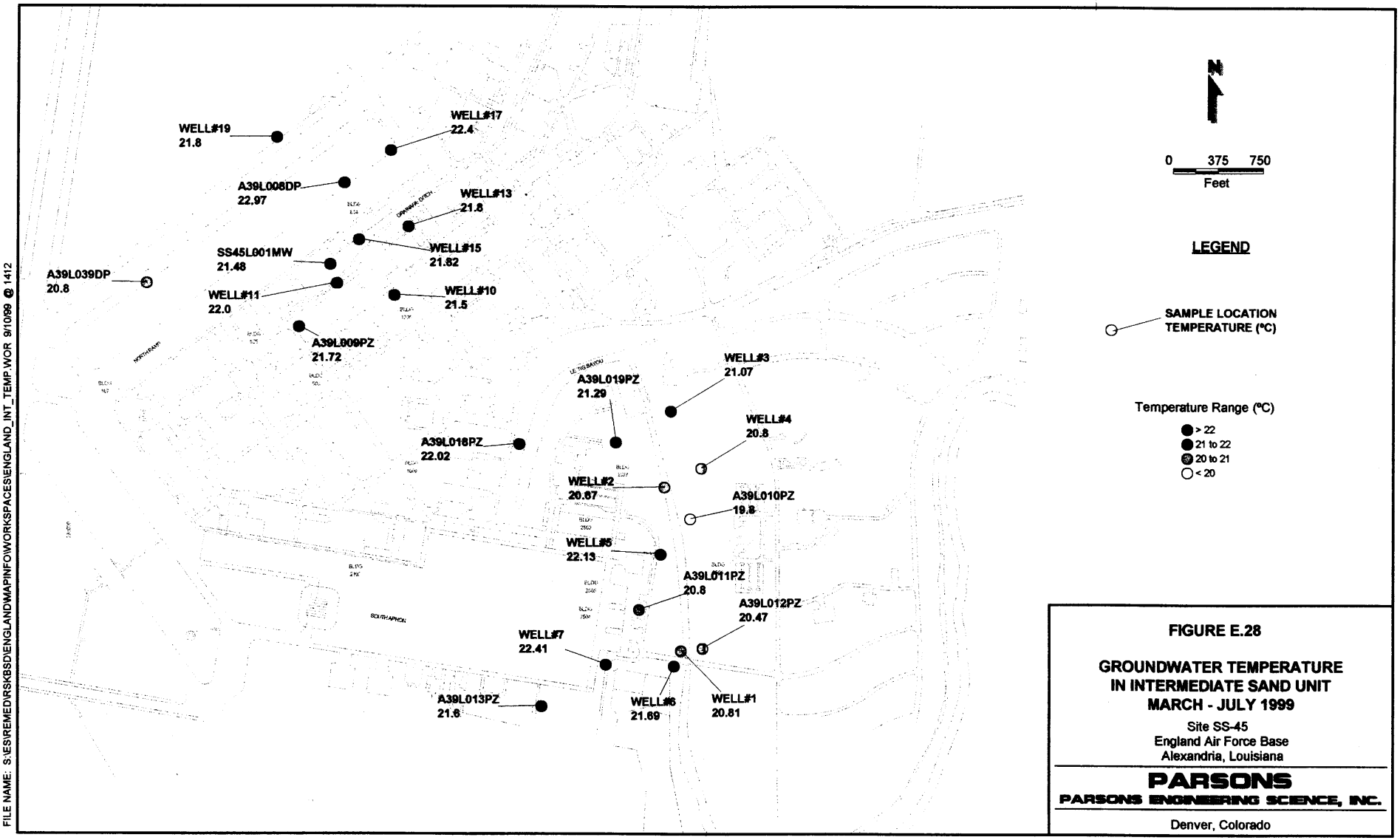
FIGURE E.27

pH OF DEEP SAND UNIT GROUNDWATER MARCH - JULY 1999

Site SS-45
England Air Force Base
Alexandria, Louisiana

PARSONS
PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

FILE NAME: S:\ESVREMED\RSKBSD\ENGLAND\MAPINFO\WORKSPACES\ENGLAND_DEEP_pH.WOR 9/10/99 @ 1735



FILE NAME: S:\ES\REMEDIR\SKBSD\ENGLAND\MAPINFO\WORKSPACES\ENGLAND_INT_TEMP.WOR 9/10/99 @ 1412

FIGURE E.28

GROUNDWATER TEMPERATURE IN INTERMEDIATE SAND UNIT MARCH - JULY 1999

Site SS-45
England Air Force Base
Alexandria, Louisiana

PARSONS
PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

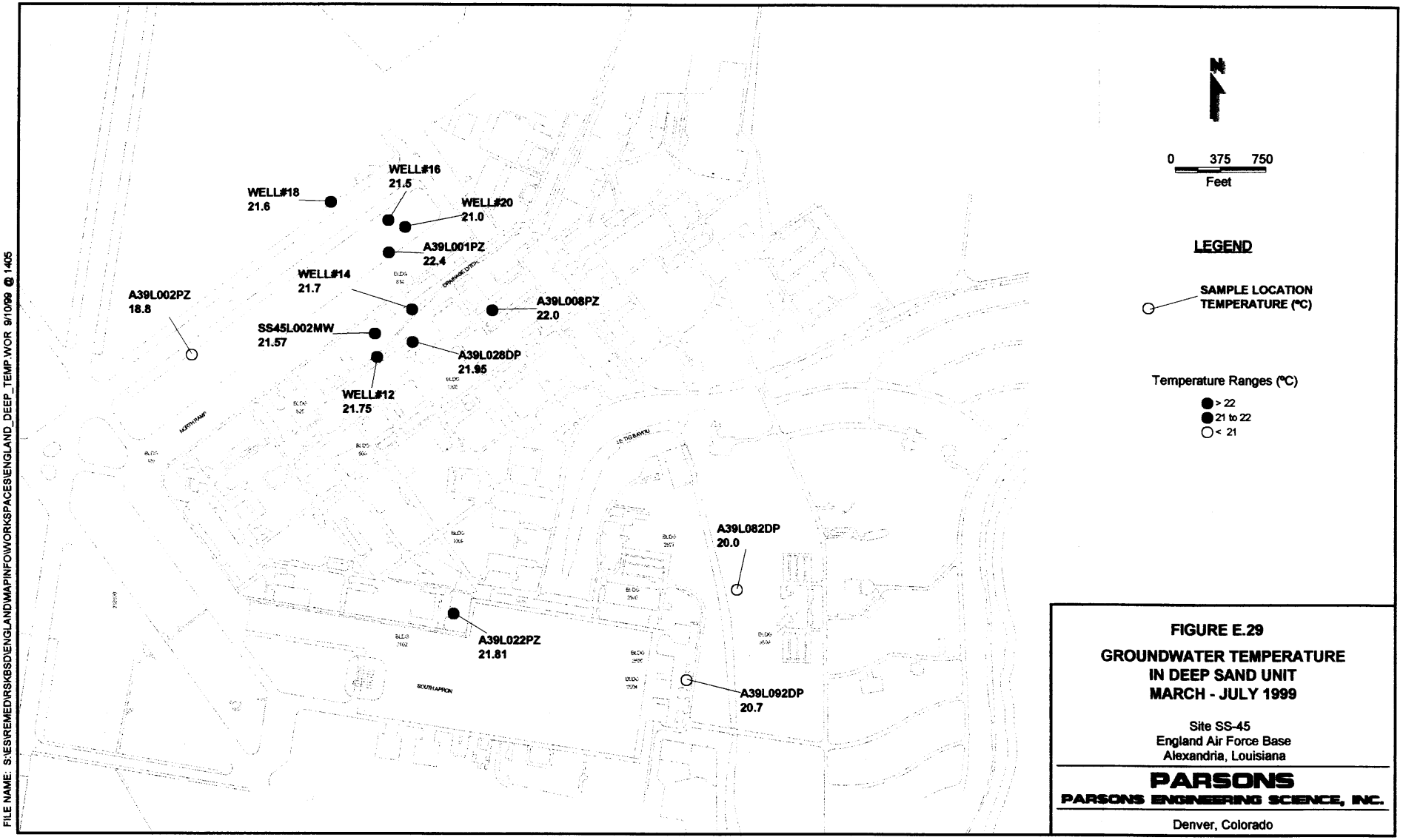


FIGURE E.29

GROUNDWATER TEMPERATURE IN DEEP SAND UNIT MARCH - JULY 1999

Site SS-45
England Air Force Base
Alexandria, Louisiana

PARSONS
PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

FILE NAME: S:\ES\REMED\RSKBSD\ENGLAND\MAP\INFO\WORKSPACES\ENGLAND_DEEP_TEMP.WOR 9/10/99 @ 1405

APPENDIX F

ESTIMATION OF FIRST-ORDER RATE CONSTANTS FOR CHEMICAL DEGRADATION

APPENDIX F
ESTIMATION OF FIRST-ORDER RATE CONSTANTS FOR CHEMICAL DEGRADATION

F1.0 CHEMICAL REMOVAL BY NATURAL ATTENUATION

The results of investigations indicate that trichloroethene (TCE) was the primary chemical, originally introduced to the subsurface at England Air Force Base (AFB), and other halogenated chemicals (the dichloroethene isomers [cis- and trans-1,2-DCE, and 1,1-DCE], and vinyl chloride -- all TCE daughter products) gradually appeared, as TCE degraded in the subsurface (refer to Section 4 of the report). The history of the Base suggests that chemical discharge probably did not occur prior to the mid- to late 1950s, and may have continued into the early to mid- 1980s (LAW, 1998, Section 4.2.2) -- a disposal history possibly as long as 30 years.

The relative concentrations of TCE and its daughter products in groundwater beneath, and down-gradient of the 800 Area and 2500 Area, indicate that these chemicals have been, and are currently being removed from the groundwater system as a result of naturally-occurring chemical degradation processes (refer to Appendix D, and to Section 4.2 of the CMS report). The current concentrations of TCE and its daughter products, detected in groundwater beneath the property, provide an indication of the relative rates of chemical degradation in the subsurface, established through the period during which chemicals have been present in soils and groundwater.

Biotic, or abiotic degradation of chemicals is often considered to be a first-order process (Appendix D). The use of first-order kinetics to approximate naturally-occurring chemical degradation assumes that the rate of change in chemical concentrations in groundwater through time is dependent only on the concentration of the chemical in groundwater:

$$C_{final} = C_{initial} \times e^{-\mu t} \qquad \text{F-1}$$

where

C_{final} = concentration of chemical in water at the end of time t [M/L^3],

$C_{initial}$ = initial concentration of chemical in water [M/L^3], and

μ = first-order rate constant [1/T].

If all the DCE isomers, and vinyl chloride, currently present in groundwater beneath the 800 Area and 2500 Area on the Base, are degradation daughter products of TCE, the stoichiometry of the degradation reaction can be used to examine the degradation of TCE and its daughters in groundwater. Because one mole of TCE will degrade to one mole of DCE isomers, and, eventually, one mole of vinyl chloride, use of *molar chemical concentrations*, rather than *mass-based concentrations*, allows the amounts of chemical produced (or removed) during degradation reactions to be compared directly. Mass-based chemical concentrations (milligrams per liter; mg/L) can be converted to molar-based concentrations (moles per liter; mol/L), using:

$$C_{molar} = \frac{C_{mass}}{Mol\ Wt} \times \frac{1\ g}{1{,}000\ mg} \qquad \text{F-2}$$

where

C_{molar} = molar concentration of chemical [mol/L],

C_{mass} = mass concentration of chemical [mg/L], and

$Mol\ Wt$ = molecular weight of chemical [g/mol].

Molar chemical concentrations are used in all subsequent geochemical calculations.

F2.0 ESTIMATION OF FIRST-ORDER RATE CONSTANTS BY DIRECT CALCULATION

F2.1 Degradation Pathway of TCE

Chemical degradation, via biotic or abiotic mechanisms, may be the most important process acting to remove chemical mass from the subsurface (Appendix D). Therefore, estimation of the rates of chemical degradation is necessary to properly evaluate the ultimate fate of TCE and its daughter products at Site SS-45, England AFB. First-order degradation rate constants may be calculated using field data, or by using representative samples of the aquifer material and groundwater in microcosm studies (USEPA, 1998). Microcosm studies can be used to demonstrate that the microorganisms necessary for biodegradation are present and to enable quantification of rates of biodegradation. However, because microcosm studies are time consuming and expensive, they are undertaken only at sites where there is considerable uncertainty regarding the occurrence of contaminant biodegradation. Furthermore, the results of microcosm studies can be influenced by the nature of the geological material collected for the microcosm, the physical properties of the microcosm, the sampling strategy, and the duration of the study. The rates of biodegradation determined on the basis of microcosm studies often are much higher than those observed in the field. Microcosms are most appropriate as indicators of the potential for natural bioremediation, and to evaluate whether losses of chemical mass are a result of biological activity, but it may be inappropriate to use them to generate rate constants. The preferred method of evaluating degradation rate constants is by use of field data.

All available evidence indicates that DCE in groundwater originated as impurities in TCE, and/or as a degradation product of TCE; and the DCE isomers degraded to vinyl chloride, in a degradation sequence conceptually presented as follows:

$$TCE_{water}$$

$$\downarrow \mu_{TCE\text{-}DCE}$$

$$DCE_{water}$$

$$\downarrow \mu_{DCE\text{-}VC} \qquad \text{F-3}$$

$$VC_{water}$$

$$\downarrow \mu_{VC\text{-}CM}$$

Complete Mineralization

where

TCE_{water} = concentration of TCE in water [mol/L^3], and

$\mu_{TCE\text{-}DCE}$ = rate constant for degradation of TCE to DCE [T^{-1}].

This observation suggests that, in the absence of significant mass loss due to processes other than chemical degradation (e.g., volatilization or advective transport), first-order degradation rate constants can be estimated by direct calculation, as long as additional chemical mass is not being introduced into the system. If chemical mass loss, or apparent mass loss, is occurring as a consequence of dilution or dispersion, resulting from chemical migration, the apparent degradation rate estimated using field data, must be normalized to account for these effects. However, evaluation of hydraulic gradients and groundwater flow velocities in the subsurface at Site SS-45 (Appendix D and Section 4.4 of the CMS report) indicates that advective transport may be a minor component of chemical migration, so that the effects of advective dispersion and resulting chemical dilution are probably relatively small.

F2.2 Temporal Trends in Chemical Concentrations

If removal of chemical mass is occurring in the subsurface as a consequence of natural degradation processes, mass removal will be manifest as a decrease in chemical concentrations through time at a particular sampling location, as a decrease in chemical concentrations with increasing distance from chemical source areas, or as a change in the suite of chemicals through time or with increasing migration distance. Therefore, as a first step in estimating the possible range of rates of chemical degradation, it is necessary to identify those sampling locations at which chemical concentrations have decreased through time. Of the groundwater monitoring wells associated with Site SS-45, England AFB, the most extensive monitoring histories have been recorded for wells A39L009PZ, SS45L001MW and SS45L002MW in the 800 Area, and wells A39L010PZ and A39L011PZ in the 2500 Area (Table F.1 and Figures F.1 through F.6. Note that the concentrations of TCE, DCE isomers,

TABLE F.1
CONCENTRATIONS OF VOLATILE ORGANIC COMPOUNDS
DETECTED IN GROUNDWATER SAMPLES FROM MONITORING WELLS
SITE SS-44
ENGLAND AIR FORCE BASE
ALEXANDRIA, LOUISIANA

Monitoring Well ID	Date Sampled	Volatile Organic Compound																		Equivalent Initial Concentration of TCE (w/ethene)		Equivalent Initial Concentration of TCE (without ethene)	
		TCE		1,1-DCA		1,2-DCA		1,1-DCE		cis-1,2-DCE		trans-1,2-DCE		Total DCE Isomers		Vinyl Chloride		Ethene					
		(µg/L)	(µmol/L)	(µg/L)	(µmol/L)	(µg/L)	(µmol/L)	(µg/L)	(µmol/L)	(µg/L)	(µmol/L)	(µg/L)	(µmol/L)	(µg/L)	(µmol/L)	(µg/L)	(µmol/L)	(µg/L)	(µmol/L)	(µmol/L)	(µg/L)	(µmol/L)	(µg/L)
A39L009PZ	Apr-1996	34.8	0.265	ND	--	ND	--	ND	--	106	1.09	21.6	0.223	128	1.32	ND	--	NA	--	1.58	208	1.58	208
	Jun-1997	35.8	0.272	ND	--	ND	--	ND	--	80.3	0.828	4.6	0.048	84.9	0.876	ND	--	NA	--	1.15	151	1.15	151
	Sep-1997	9	0.068	ND	--	ND	--	ND	--	95.7	0.987	1.3	0.013	97	1.00	ND	--	ND	--	1.07	140	1.07	140
	Dec-1997	6.9	0.053	ND	--	ND	--	0.5 JQ	0.005	79.8	0.823	2.7	0.028	83	0.856	1.1	0.017	ND	--	0.926	122	0.926	122
	Mar-1999	34	0.259	ND	--	0.4 J1	0.004	0.7 J1	0.007	57	0.588	2.7	0.028	60.4	0.623	1.4 J1	0.022	0.5 J1	0.019	0.93	122	0.91	119
	Mar-1999 (dup)	34	0.259	ND	--	0.4 J1	0.004	0.7 J1	0.008	58	0.598	2.8	0.029	61.5	0.635	1.4 J1	0.022	0.8 J1	0.030	0.95	125	0.92	121
A39L010PZ	Jun-1996	ND	--	ND	--	ND	--	ND	--	31	0.320	140	1.44	171	1.76	1,260	20.2	NA	--	21.9	2,881	21.9	2,881
	Jun-1997	ND	--	ND	--	ND	--	ND	--	9.5	0.098	31.4	0.324	40.9	0.421	549	8.78	720 J	25.7	34.9	4,582	9.2	1,210
	Jun-1997 (dup)	ND	--	ND	--	ND	--	ND	--	9.4	0.097	30.1	0.311	39.5	0.408	540	8.64	400 J	14.3	23.3	3,062	9.0	1,189
	Sep-1997	ND	--	ND	--	ND	--	ND	--	4.5	0.047	18.4	0.190	22.9	0.236	605	9.68	680	24.2	34.2	4,488	9.9	1,303
	Sep-1997 (dup)	ND	--	ND	--	ND	--	ND	--	8.5	0.088	32.8	0.338	41.3	0.426	655	10.5	630	22.5	33.4	4,384	10.9	1,433
	Dec-1997	ND	--	0.6	0.006	ND	--	ND	--	6.7	0.069	21.7	0.224	28.4	0.293	695	11.1	380	13.5	25.0	3,280	11.4	1,500
	Dec-1997 (dup)	ND	--	0.6	0.006	ND	--	ND	--	6.4	0.066	21.5	0.222	27.9	0.288	619	9.90	340	12.1	22.3	2,933	10.2	1,340
	Mar-1999	ND	--	ND	--	ND	--	0.5 J1	0.005	2.8	0.029	8.5	0.088	11.8	0.122	420	6.72	1,100	39.2	46.1	6,052	6.8	899
A39L011PZ	Aug-1996	ND	--	ND	--	ND	--	0.8 JQ	0.008	479	4.94	ND	--	480	4.95	7.4	0.118	NA	--	5.07	666	5.07	666
	Jun-1997	ND	--	0.8	0.008	ND	--	ND	--	77.2	0.796	6.4	0.066	84	0.862	85.3	1.36	ND	--	2.24	294	2.24	294
	Sep-1997	ND	--	1.1	0.011	ND	--	ND	--	189	1.95	8.0	0.083	197	2.03	59.2	0.947	ND	--	2.99	393	2.99	393
	Dec-1997	ND	--	1.1	0.011	ND	--	0.8	0.008	186	1.92	7.4	0.076	194	2.00	22.7	0.363	ND	--	2.38	312	2.38	312
	Mar-1999	ND	--	0.7 J1	0.007	ND	--	0.5	0.005	44	0.454	4.2	0.043	48.7	0.503	80.0	1.28	2.9	0.103	1.89	249	1.79	235
A39L012PZ	Sep-1996	ND	--	ND	--	ND	--	ND	--	ND	--	ND	--	--	--	ND	--	NA	--	--	--	--	--
	Dec-1997	ND	--	ND	--	ND	--	ND	--	ND	--	ND	--	--	--	ND	--	ND	--	--	--	--	--
	Mar-1999	ND	--	ND	--	ND	--	ND	--	1	0.010	ND	--	1	0.010	ND	--	ND	--	0.010	1	0.010	1
SS45L001MW	Mar-1996	507	3.86	ND	--	ND	--	ND	--	11	0.113	ND	--	11	0.113	ND	--	NA	--	3.97	522	3.97	522
	Jun-1997	451	3.43	ND	--	ND	--	0.5	0.005	4.31	0.044	0.3 J	0.003	5.1	0.053	0.5 J	0.009	NA	--	3.49	459	3.49	459
	Sep-1997	697	5.30	ND	--	ND	--	0.7	0.007	14.7	0.152	1.9	0.020	17.3	0.178	ND	--	ND	--	5.48	720	5.48	720
	Dec-1997	598	4.55	ND	--	ND	--	0.9	0.010	16.8	0.173	2.4	0.024	20.1	0.207	ND	--	ND	--	4.76	625	4.76	625
	Mar-1999	560	4.26	ND	--	ND	--	ND	--	12 J	0.124	ND	--	12	0.124	ND	--	0.7 J1	0.026	4.41	580	4.39	576
SS45L002MW	Apr-1996	ND	--	ND	--	ND	--	ND	--	234	2.41	ND	--	234	2.41	ND	--	NA	--	2.41	317	2.41	317
	Jun-1997	ND	--	ND	--	ND	--	ND	--	111	1.15	5.3	0.055	116	1.20	2.5	0.040	NA	--	1.24	163	1.24	163
	Jun-1997 (dup)	ND	--	ND	--	ND	--	ND	--	128	1.32	6.2	0.063	134	1.38	2.9	0.047	ND	--	1.43	188	1.43	188
	Sep-1997	0.4 J	0.003	ND	--	ND	--	ND	--	186	1.92	6.3 J	0.065	192	1.98	3.4 J	0.054	ND	--	2.04	268	2.04	268
	Sep-1997 (dup)	0.4 J	0.003	ND	--	ND	--	ND	--	183	1.89	2.6 J	0.027	186	1.91	ND	--	ND	--	1.92	252	1.92	252
	Dec-1997	ND	--	ND	--	ND	--	ND	--	180	1.86	4.7	0.048	185	1.90	3.6	0.057	ND	--	1.96	258	1.96	258
	Mar-1999	ND	--	ND	--	ND	--	ND	--	210	2.17	6.2	0.064	216	2.23	3.6 J1	0.058	3.9 J1	0.139	2.43	319	2.29	301
Well #4	Mar-1999	ND	--	ND	--	ND	--	ND	--	140	1.44	320	3.30	460	4.75	ND	--	ND	--	4.75	623	4.75	623
	Mar-1999 (dup)	ND	--	ND	--	ND	--	ND	--	150	1.55	330	3.40	480	4.95	ND	--	ND	--	4.95	651	4.95	651

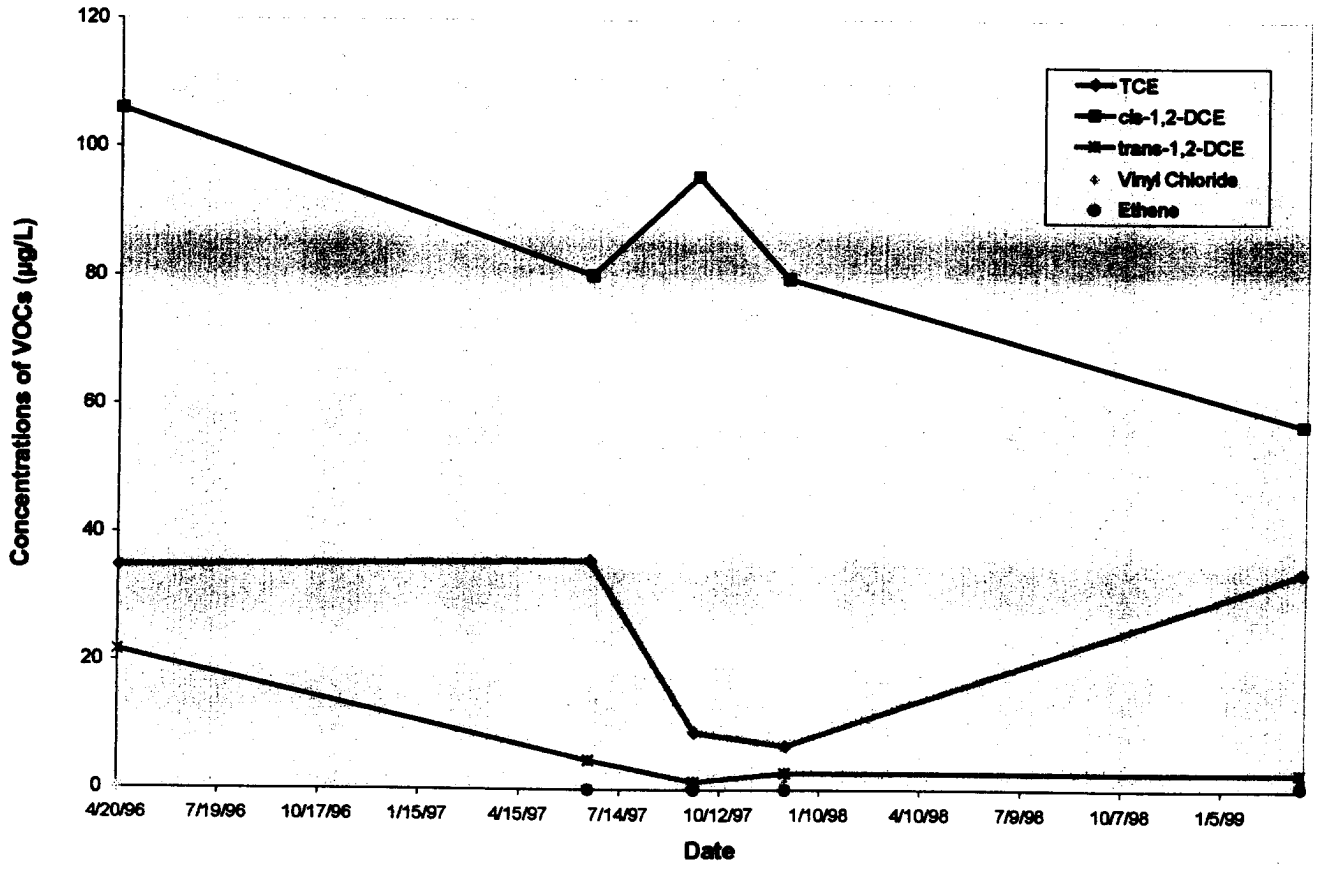


FIGURE F.1

TEMPORAL TRENDS OF CHEMICAL CONCENTRATIONS (µg/L) IN GROUNDWATER SAMPLES FROM WELL A39L009PZ

Site SS-45

England Air Force Base

Alexandria, Louisiana

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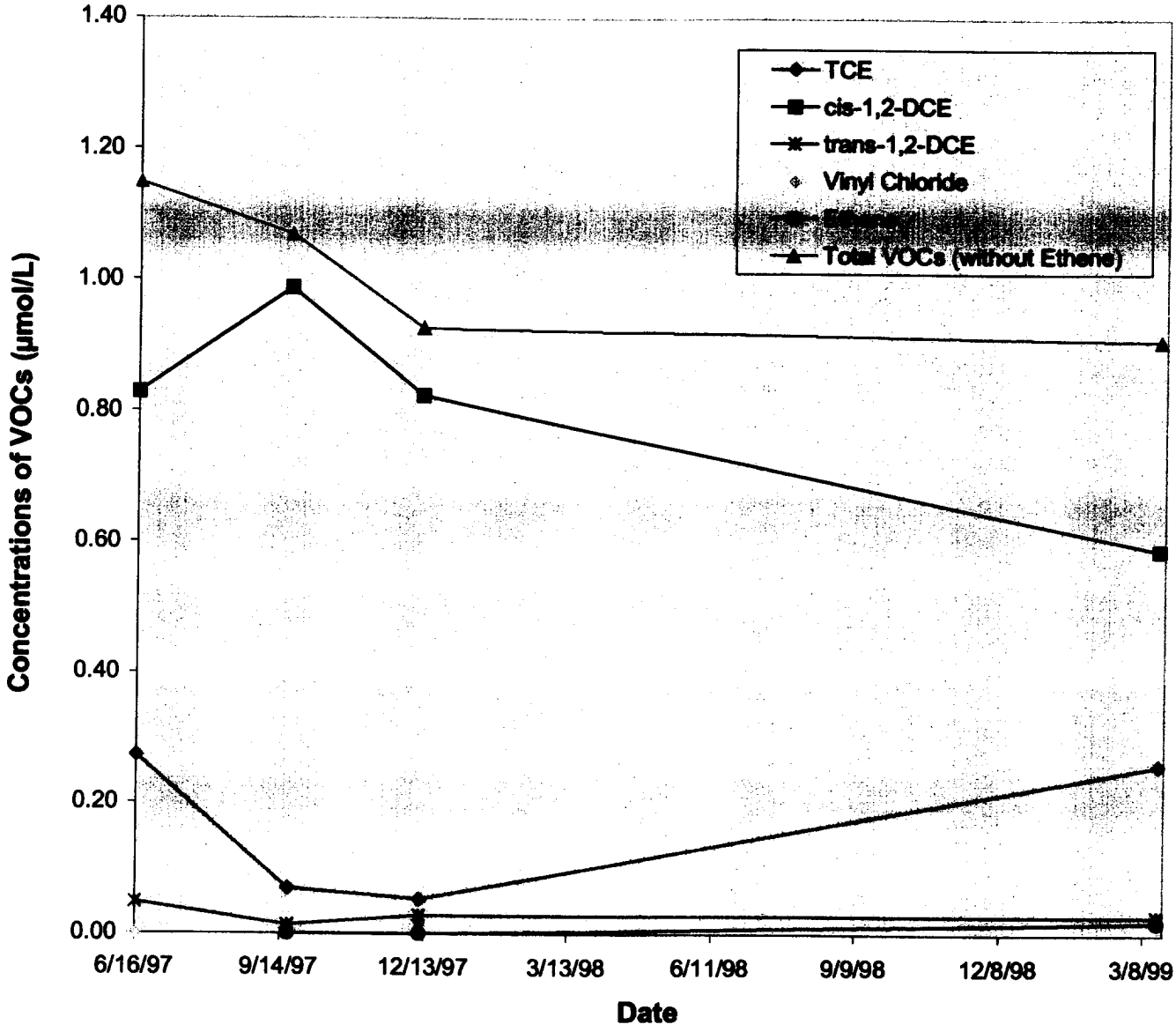


FIGURE F.2

TEMPORAL TRENDS OF CHEMICAL CONCENTRATIONS (µmol/L) IN GROUNDWATER SAMPLES FROM WELL A39L009PZ (2)

Site SS-45
England Air Force Base
Alexandria, Louisiana

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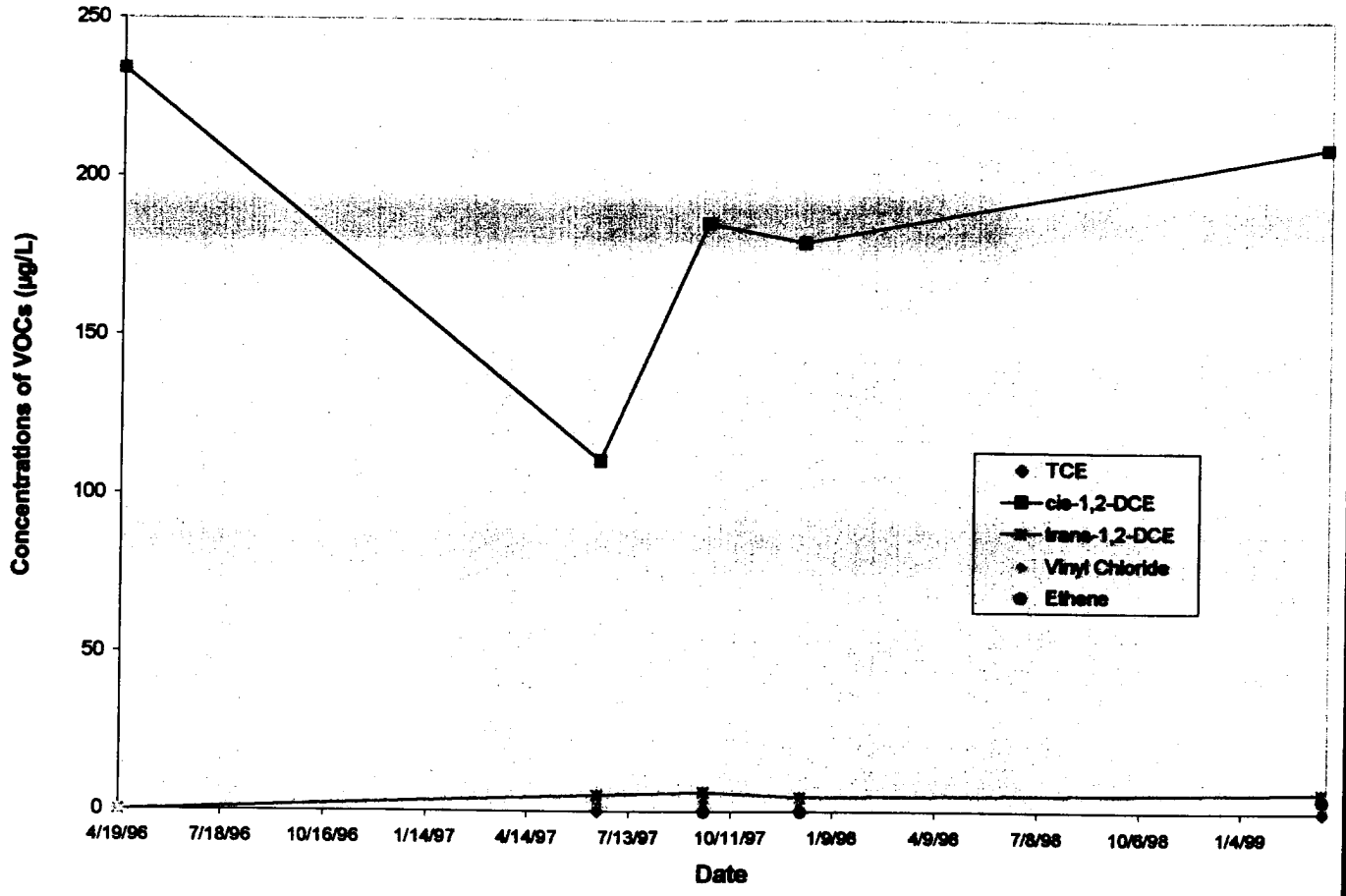


FIGURE F.3

TEMPORAL TRENDS OF CHEMICAL CONCENTRATIONS (µg/L) IN GROUNDWATER SAMPLES FROM WELL SS45L002MW

Site SS-45
England Air Force Base
Alexandria, Louisiana

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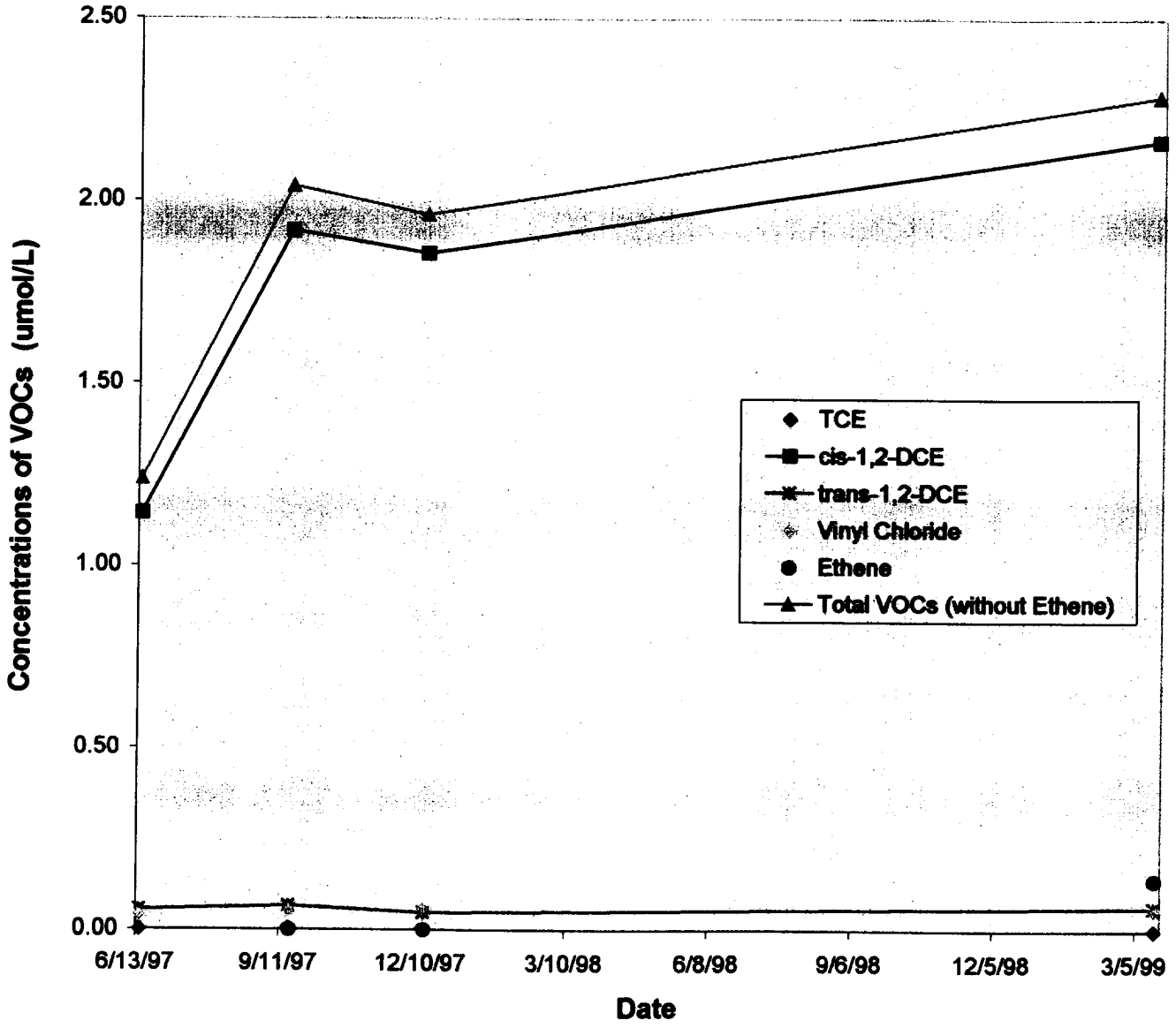


FIGURE F.4

TEMPORAL TRENDS OF CHEMICAL CONCENTRATIONS (µmol/L) IN GROUNDWATER SAMPLES FROM WELL SS45L002MW(2)

Site SS-45
England Air Force Base
Alexandria, Louisiana

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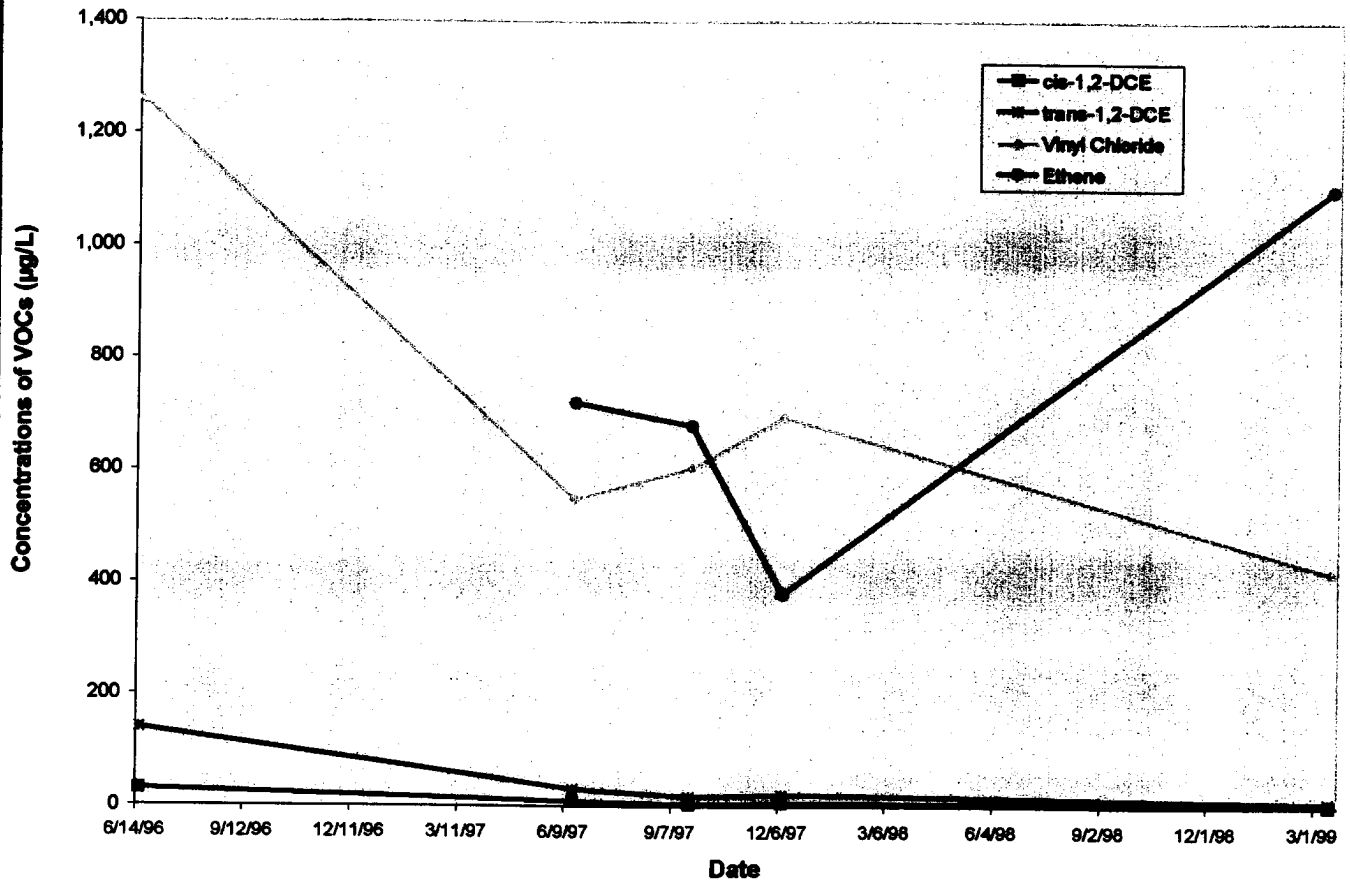


FIGURE F.5

TEMPORAL TRENDS OF CHEMICAL CONCENTRATIONS (µg/L) IN GROUNDWATER SAMPLES FROM WELL A39L010PZ

Site SS-45
England Air Force Base
Alexandria, Louisiana

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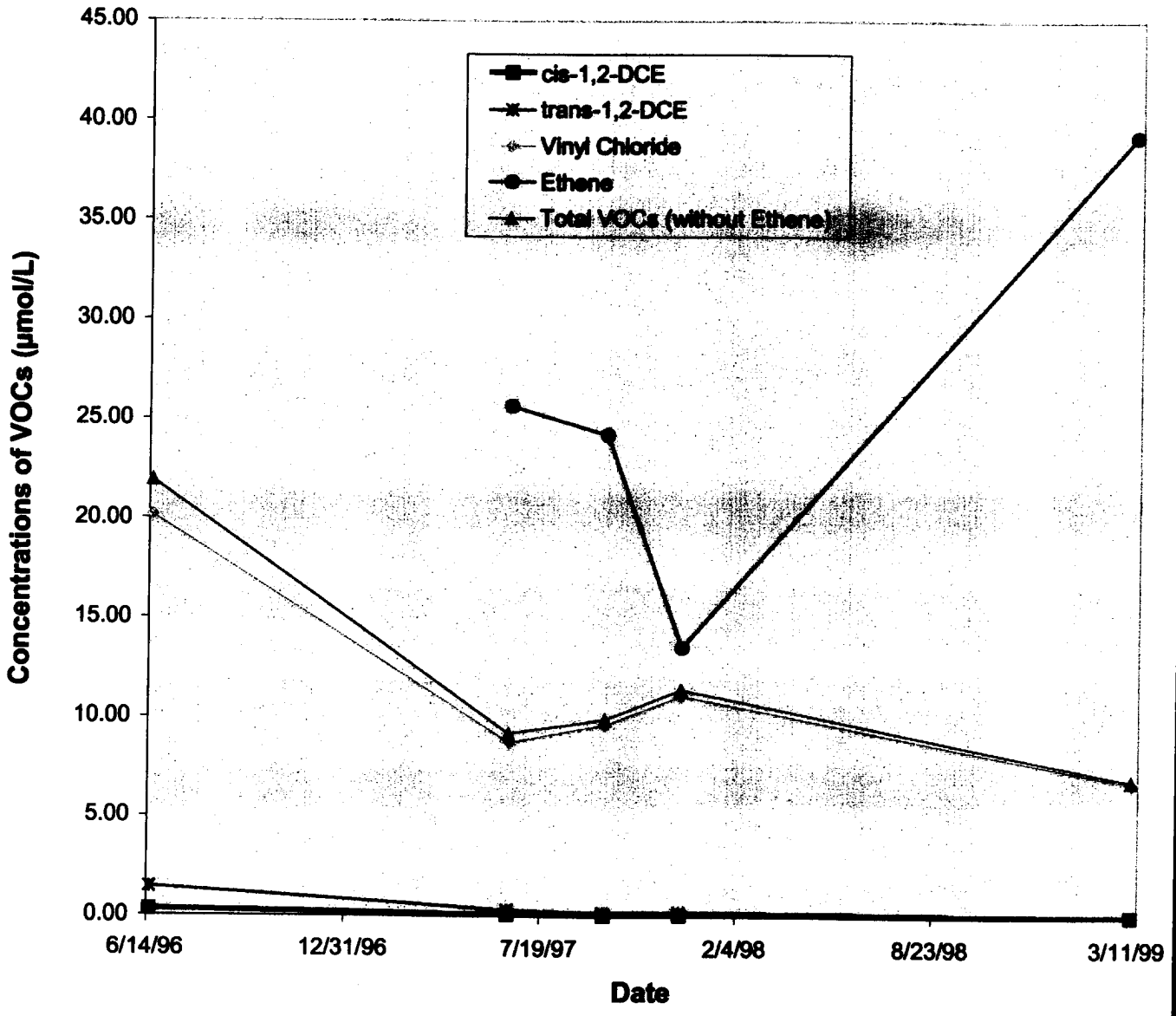


FIGURE F.6

TEMPORAL TRENDS OF CHEMICAL CONCENTRATIONS (µmol/L) IN GROUNDWATER SAMPLES FROM WELL A39L010PZ (2)

Site SS-45
England Air Force Base
Alexandria, Louisiana

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Denver, Colorado

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vinyl chloride, and ethene through time are presented for each well, in mass-based units [µg/L]; and the concentrations of TCE, DCE isomers, vinyl chloride, ethene, and total volatile organic chemicals are also presented in molar concentration units [µmol/L].) The initial sampling event at each well location is considered to be the collection of groundwater samples during the 1996 HydroPunch™ investigation, completed by LAW Engineering and Environmental Services, Inc. (LAW, 1998). The results of analyses of groundwater samples, collected from the particular interval of each HydroPunch™ boring that was eventually screened as a groundwater monitoring well, were incorporated into the historic monitoring record for these five wells (Table F.1); and the monitoring histories were examined for evidence of trends of increasing or decreasing chemical concentrations through time.

Visual inspection of the temporal trends in chemical concentrations suggests that:

- The concentrations of cis-1,2-DCE in groundwater samples from well A39L009PZ have been decreasing through time, while the concentrations of TCE have been increasing (Figures F.1 and F.2);

- The concentrations of TCE in groundwater samples from well SS45L001MW have decreased slightly since mid-1997, while the concentrations of other volatile organic chemicals have remained relatively constant;

- The concentrations of cis-1,2-DCE in groundwater samples from well SS45L002MW have increased through time (Figures F.3 and F.4);

- The concentrations of DCE isomers and vinyl chloride in groundwater samples from well A39L010PZ have decreased through time, while the concentrations of ethene have increased (Figures F.5 and F.6); and

- The concentrations of cis-1,2-DCE in groundwater samples from well A39L011PZ have decreased through time, while the concentrations of other volatile organic chemicals have remained relatively constant.

A more rigorous examination of temporal trends in chemical concentrations can be completed using a statistical procedure – the Mann-Kendall test for trends. The Mann-Kendall non-parametric test (Gilbert, 1987) is well suited for application to the evaluation of environmental data because the sample size can be small (as few as 4 data points), no assumptions are made regarding the underlying statistical distribution of the data, and the test can be adapted to account for seasonal variations in the data. The null hypothesis (*there is no trend in chemical concentrations*) was examined for the historic record for each of the five wells, using the Mann-Kendall test, at the 90 percent confidence level (one-tailed; trend can be up or down). Rejection of the null hypothesis indicates that an increasing or decreasing trend is present. If a trend is determined to be present, a non-parametric slope of the trend line (change per unit time) can also be estimated using the test procedure.

Application of the Mann-Kendall test to the complete historic record for each of the five wells indicates that:

- The concentrations of cis-1,2-DCE and total volatile organic chemicals (molar concentrations) in groundwater samples from well A39L009PZ have been decreasing

through time. No other trend in chemical concentrations in groundwater samples from well A39L009PZ can be confirmed statistically.

- No statistical trend can be confirmed in chemical concentrations in groundwater samples from well SS45L001MW.

- The concentrations of vinyl chloride in groundwater samples from well SS45L002MW have increased through time. No other trend in chemical concentrations in groundwater samples from well SS45L002MW can be confirmed statistically.

- The concentrations of cis-1,2-DCE and trans-1,2-DCE in groundwater samples from well A39L010PZ have decreased through time. . No other trend in chemical concentrations in groundwater samples from well A39L009PZ can be confirmed statistically.

- No statistical trend can be confirmed in chemical concentrations in groundwater samples from well A39L011PZ.

These results are summarized in Table F.2. Note that groundwater samples have been collected from these wells during a maximum of five distinct sampling events (including the initial samples collected during the HydroPunch™ investigation), over a three-year period (1996 – 1999). The apparent absence of statistically-demonstrable trends of decreasing chemical concentrations through time may simply be a result of the limited historical monitoring record for groundwater at Site SS-45.

F2.3 Direct Calculation of First-Order Rate Constants

The simplest means of estimating rates of chemical removal is by direct calculation. In order to use direct calculation methods to estimate first-order rate constants, the concentrations of TCE and its daughter products detected in groundwater samples collected from a single well, during two or more sequential sampling events, are used in Equation F-1. For example, direct calculation, using sampling results from wells A39L010PZ and A39L011PZ (Table F.1) can be used to estimate the first-order degradation rate constant for cis-1,2-DCE in the 2500 Area on the Base (Table F.3). During the sampling event of June 1996, cis-1,2-DCE was detected in the groundwater sample from well A39L010PZ (Table F.1), at a concentration of 31 μg/L (0.32 μmol/L). By June 16, 1997 (364 days later), the concentration of cis-1,2-DCE detected in the groundwater sample from well A39L010PZ had decreased, to 9.5 μg/L (0.098 μmol/L). Substituting the detected concentrations, and the elapsed time between sampling events, into Equation F-1, and taking logarithms,

$$\ln\left(\frac{C_{final}}{C_{initial}}\right) = -\mu t \qquad \text{F-4}$$

$$\ln\left(\frac{0.098}{0.32}\right) = -\mu \times 364 \qquad \text{F-5}$$

$$\mu = 0.0033/day$$

TABLE F.2
SUMMARY OF TRENDS IN CAH CONCENTRATIONS THROUGH TIME
SITE SS-45
ENGLAND AIR FORCE BASE, LOUISIANA

Well	Location and Completion	Chemical	Concentration Versus Time Trend Analysis
A39L009PZ	Intermediate Sand unit monitoring well, in southwestern part of 800 Area	TCE	Appear to be increasing through time; not confirmed statistically
		cis-1,2-DCE	Decreasing through time; confirmed statistically
		trans-1,2-DCE	Erratic variation; no trend apparent
		total DCE isomers	No trend apparent
		Vinyl chloride	Appear to remain relatively constant
		Total CAHs	Decreasing through time; confirmed statistically
SS45L001MW	Intermediate Sand unit monitoring well, in central part of 800 Area; paired with SS45L002MW	TCE	Appear to be decreasing slightly through time; not confirmed statistically
		cis-1,2-DCE	Appear to remain relatively constant
		trans-1,2-DCE	Appear to remain relatively constant
		Total DCE isomers	Appear to remain relatively constant
		Total CAHs	Appear to remain relatively constant
SS45L002MW	Deep Sand unit monitoring well, in central part of 800 Area; paired with SS45L001MW	*cis*-1,2-DCE	Appear to be increasing through time
		trans-1,2-DCE	Appear to remain relatively constant
		total DCE isomers	Appear to be increasing through time
		Vinyl chloride	Increasing through time; confirmed statistically
		Total CAHs	Appear to be increasing through time
A39L010PZ	Intermediate Sand unit monitoring well, in central part of 2500 Area	*cis*-1,2-DCE	Decreasing through time; confirmed statistically
		trans-1,2-DCE	Decreasing through time; confirmed statistically
		total DCE isomers	Decreasing through time; confirmed statistically
		Vinyl chloride	Appear to be decreasing through time
		Total CAHs	Appear to be decreasing through time
A39L011PZ	Intermediate Sand unit monitoring well, in southwestern part of 2500 Area	*cis*-1,2-DCE	Appear to be decreasing through time
		trans-1,2-DCE	Appear to remain relatively constant through time
		total DCE isomers	Appear to be decreasing through time
		Vinyl chloride	Erratic variation; no trend apparent
		Total CAHs	Appear to be decreasing through time

TABLE F.3
FIRST-ORDER DEGRADATION RATE CONSTANTS ESTIMATED FOR CAH USING CHEMICAL DATA COLLECTED DURING GROUNDWATER MONITORING
SITE SS-44
ENGLAND AIR FORCE BASE
ALEXANDRIA, LOUISIANA

Rate Constants and Half-Lives for TCE and Daughter Compounds

Total Attenuation Rate Constants by Direct Calculation

Groundwater Analytical Results Used in Calculation	Time Period Used in Calculation	TCE Rate Constant ($days^{-1}$)	TCE Half-Life (years)	cis-1,2-DCE Rate Constant ($days^{-1}$)	cis-1,2-DCE Half-Life (years)	trans-1,2-DCE Rate Constant ($days^{-1}$)	trans-1,2-DCE Half-Life (years)	Total DCE Isomers Rate Constant ($days^{-1}$)	Total DCE Isomers Half-Life (years)	Vinyl Chloride Rate Constant ($days^{-1}$)	Vinyl Chloride Half-Life (years)
A39L009PZ	6/16/1997 -- 3/17/1999	--	--	0.0009	2.0	0.0032	0.6	0.0011	1.7	--	--
	6/17/1996 -- 6/16/1997	--	--	0.0033	0.6	0.0041	0.5	0.0039	0.5	0.0023	0.8
A39L010PZ	6/16/1997 -- 12/9/1997	--	--	0.0020	1.0	0.0021	0.9	0.0021	0.9	--	--
	12/9/1997 -- 3/14/1999	--	--	0.0019	1.0	0.0020	0.9	0.0020	0.9	0.0011	1.7
	6/17/1996 -- 3/14/1999	--	--	0.0024	0.8	0.0028	0.7	0.0027	0.7	0.0011	1.7
A39L011PZ	8/21/1996 -- 3/14/1999	--	--	0.0026	0.7	--	--	0.0024	0.8	--	--
	9/16/1997 -- 12/11/1997	0.0018	1.1	--	--	--	--	--	--	--	--
SS45L001MW	12/11/1997 -- 3/17/1999	0.0001	13.3	0.0007	2.6	--	--	0.0011	1.7	--	--
	9/16/1997 -- 3/17/1999	0.0004	4.7	0.0004	5.1	--	--	0.0007	2.8	--	--

Rate Constants by Method of Buscheck and Alcantar

Flowpath in March 1999:	Chemical Concentrations in March 1999 (mg/L) cis-1,2-DCE	trans-1,2-DCE	VC	TCE (along complete flowpath) Rate Constant ($days^{-1}$)	TCE Half-Life (years)	cis-1,2-DCE (along complete flowpath) Rate Constant ($days^{-1}$)	cis-1,2-DCE Half-Life (years)	trans-1,2-DCE (along complete flowpath) Rate Constant ($days^{-1}$)	trans-1,2-DCE Half-Life (years)	Total DCE Isomers Rate Constant ($days^{-1}$)	Total DCE Isomers Half-Life (years)	Vinyl Chloride (A39L010PZ -> A39L012PZ) Rate Constant ($days^{-1}$)	Vinyl Chloride Half-Life (years)
Well # 4	150	330	ND (< 1)										
to				--	--	0.000013	146.0	0.000018	105.4	0.000017	111.6		
A39L010PZ	2.8	8.5	420										
to				--	--	0.000013	146.0	0.000018	105.4	0.000017	111.6	0.000031	61.2
A39L012PZ	1	ND (< 0.5)	ND (< 1)										

Rate Constants by First-Order Curve Matching (Aqueous Phase Only)

Groundwater Analytical Results Used in Curve Matching	Initial Conditions for Introduction of TCE Starting Date	Initial Concentration (mg/L)	TCE Rate Constant ($days^{-1}$)	TCE Half-Life (years)	cis-1,2-DCE Rate Constant ($days^{-1}$)	cis-1,2-DCE Half-Life (years)	trans-1,2-DCE Rate Constant ($days^{-1}$)	trans-1,2-DCE Half-Life (years)	Total DCE Isomers Rate Constant ($days^{-1}$)	Total DCE Isomers Half-Life (years)	Vinyl Chloride Rate Constant ($days^{-1}$)	Vinyl Chloride Half-Life (years)
A39L009PZ	1/1/1960	0.21	0.00014	13.6	NA	--	NA	--	0.00002	94.9	0.0007	2.7
A39L010PZ	1/1/1960	3	0.00066	2.9	NA	--	NA	--	0.00022	8.6	0.00006	31.6
A39L011PZ	1/1/1960	0.70	0.00055	3.5	NA	--	NA	--	0.00005	38.0	0.0002	9.5
SS45L001MW	1/1/1960	0.75	0.00002	94.9	NA	--	NA	--	0.0004	4.7	0.004	0.5

Rate Constants by First-Order Curve Matching (Kinetic Model with Sorbed and Aqueous Phases, and Chemical Diffusion)

Groundwater Analytical Results Used in Curve Matching	Initial Conditions for Introduction of TCE Starting Date	Initial Concentration Dissolved (mg/L)	Initial Concentration Sorbed (mg/kg)	TCE Rate Constant ($days^{-1}$)	TCE Half-Life (years)	cis-1,2-DCE Rate Constant ($days^{-1}$)	cis-1,2-DCE Half-Life (years)	trans-1,2-DCE Rate Constant ($days^{-1}$)	trans-1,2-DCE Half-Life (years)	Total DCE Isomers Rate Constant ($days^{-1}$)	Total DCE Isomers Half-Life (years)	Vinyl Chloride Rate Constant ($days^{-1}$)	Vinyl Chloride Half-Life (years)
A39L009PZ	1/1/1960	0.21	0.13	0.00014	13.6	NA	--	NA	--	0.00006	31.6	0.0035	0.5
A39L010PZ	1/1/1960	3	3.7	0.00066	2.9	NA	--	NA	--	0.0003	6.3	0.00015	12.7
A39L011PZ	1/1/1960	0.70	0.87	0.00055	3.5	NA	--	NA	--	0.00011	17.3	0.00035	5.4
SS45L001MW	1/1/1960	0.75	0.47	0.00002	94.9	NA	--	NA	--	0.0001	19.0	0.0045	0.4

Summary Statistics for Estimates of Rate Constants and Half-Lives

	TCE Rate Constant ($days^{-1}$)	TCE Half-Life (years)	cis-1,2-DCE Rate Constant ($days^{-1}$)	cis-1,2-DCE Half-Life (years)	trans-1,2-DCE Rate Constant ($days^{-1}$)	trans-1,2-DCE Half-Life (years)	Total DCE Isomers Rate Constant ($days^{-1}$)	Total DCE Isomers Half-Life (years)	Vinyl Chloride Rate Constant ($days^{-1}$)	Vinyl Chloride Half-Life (years)
Maximum First-Order Rate Constant	0.0018	1.1	0.0033	0.6	0.0041	0.5	0.0039	0.5	0.0045	0.4
Minimum First-Order Rate Constant	0.00002	94.9	0.000013	146.0	0.000018	105.4	0.000017	111.6	0.000031	61.2
Median First-Order Rate Constant	0.0004	4.7	0.0019	1.0	0.0021	0.9	0.0004	4.6	0.0009	2.1
Literature Values of First-Order Rate Constants[a]	0.0004	4.5	NA	--	NA	--	0.004	0.5	0.0002	7.9

[a] Literature values for first-order rate constants (TCE and vinyl chloride) from Wiedemeier *et al* (1999) and Anthony *et al.* (1997; DCE isomers).

Similarly, by March 14, 1999, 935 days after the first sampling event at well A39L010PZ in June 1996, the concentration of cis-1,2-DCE in groundwater at that location had decreased, to 28 µg/L (0.029 µmol/L; Table F.1). The first-order degradation rate constant, calculated for cis-1,2-DCE in groundwater at the location of well A39L010PZ, for the period June 17, 1996 through March 14, 1999, is therefore 0.0024 $days^{-1}$, corresponding to a half-life of 0.8 years (Table F.3). Note that because several different processes (volatilization, dilution, advective removal, degradation) may be contributing to declines in concentrations, first-order rate constants estimated using this method are properly referred to as "*total attenuation rate constants*".

Direct calculation of first-order degradation rate constants using this method is only applicable for those locations and time periods for which chemical concentrations (and chemical mass) are decreasing, as a direct consequence of chemical degradation, rather than as a result of diffusion, dispersion, or other attenuation processes. Strictly speaking, then, direct calculation of first-order rate constants is valid only for degradation of cis-1,2-DCE in groundwater at the location of well A39L009PZ, and cis- and trans-1,2-DCE in groundwater at the location of well A39L010PZ, because decreasing trends in the concentrations of these chemicals, at these well locations, can be confirmed statistically (preceding section). However, for the purpose of illustrating the method, first-order total attenuation rate constants have also been calculated for those chemicals having visually-apparent decreasing concentration trends during particular time periods (Table F.3).

F3.0 ESTIMATION OF FIRST-ORDER RATE CONSTANTS USING METHOD OF BUSCHECK AND ALCANTAR

Another method for evaluating first-order rate constants for chemical degradation is described by USEPA (1998). The method, proposed by Buscheck and Alcantar (1995), is based on the one-dimensional, steady-state analytical solution to the advection-dispersion equation presented by Bear (1979), and is used to examine the distribution of chemical concentrations in a contaminant plume, presumed to be at steady-state conditions (Appendix D). Decay rates computed using this method account for chemical (abiotic) decay and biological (aerobic and anaerobic) decay. If the plume is actually expanding, rather than being at steady-state, this first-order approximation can be viewed as an upper bound on the chemical degradation rate. Application of this method to the evaluation of an expanding plume will produce an overestimate of the rate of degradation, because a typical expanding plume exhibits decreasing source area chemical concentrations, increasing down-gradient concentrations, or both. Over time, these changes result in a decreasing slope on a log-linear plot of concentration versus chemical migration distance, and consequently a decreasing biodegradation rate.

The method of Buscheck and Alcantar (1995) uses plume length and chemical concentrations along the plume centerline to calculate first order decay rates. The magnitudes of chemical decay rates calculated using these methods are sensitive to the estimated migration velocity of the contaminant along the selected flowpath; therefore, inaccuracies in the estimated velocity will cause the decay rates to be less accurate. Overestimation of the groundwater velocity will result in overestimation of the decay rate, and vice versa.

The method of Buscheck and Alcantar (1995) implicitly assumes that chemical migration occurs via advective transport from a known source of chemicals along an identifiable groundwater flowpath, down-gradient from the source; and the solution corrects for retardation,

dispersion and dilution occurring during advection along the flowpath. Application of the method therefore requires that:

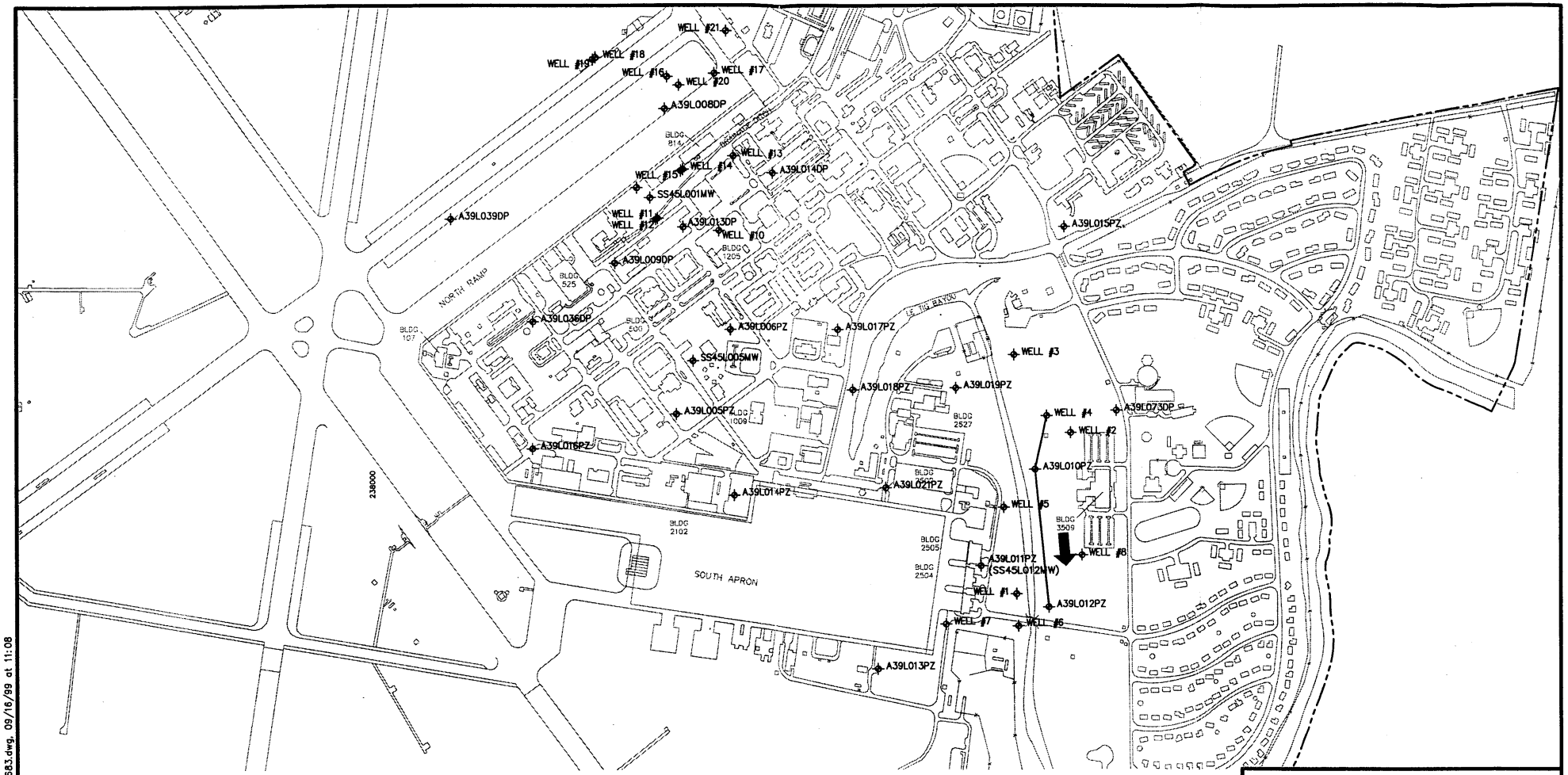
- The suites and concentrations of chemicals detected in groundwater at an up-gradient monitoring point are related to the suites and concentrations of chemicals detected in groundwater at one or more down-gradient locations, in that they share a common source, and lie along a flowpath originating at that source.

- Chemical migration is controlled by advective transport in groundwater, with transport occurring at a constant groundwater flow velocity along a constant flowpath, so that the relationship between travel distance and travel time between monitoring points remains fixed.

Application of the method may not be appropriate in situations where a well-defined source area cannot be identified, or where more than one chemical source may be present (in this situation, the suites and concentrations of chemicals in groundwater at several locations may not be related), or where the migration and distribution of chemicals are controlled by processes other than advection. As a consequence of the extremely low hydraulic gradients in the groundwater system beneath England AFB, the distribution of chemicals in most parts of Site SS-45 may be a result of molecular diffusion processes (Appendix D and Section 4.4 of the CMS report). Alternatively, because groundwater flow directions beneath the 800 Area and 2500 Area are generally indeterminate (in that the potentiometric surface is nearly flat, and hydraulic gradients do not appear to extend continuously over appreciable distances in any direction), the distribution of chemicals may have occurred as a result of inconsistent or oscillating advective migration along poorly-defined flowpaths. Therefore, because distinct, identifiable chemical sources may not be present (Sections 1 and 4 of the report), and because advection of dissolved constituents may be at most, a minor component of the current chemical migration process, the method of Buscheck and Alcanatar (1995) is probably not applicable evaluation of chemical decay in groundwater at most areas of Site SS-45.

An exception may be the south-central part of the 2500 Area, adjacent to Le Tig Bayou. In this area, the flowpath beginning at Well #4, located in a part of the 2500 Area containing relatively higher concentrations of volatile organic chemicals, extends to wells A39L010PZ and A39L012PZ, in areas of generally lower chemical concentrations, and approximately parallels the bayou (Figure F.7). During much of the year, this flowpath apparently is aligned with the hydraulic gradient near Le Tig Bayou (Figures 3.4-6 and 3.4-7, and Section 3.4 of the report), although the gradient is low enough that under certain conditions, flow reversal may occur. For example, water-level measurements collected in Well #4, and wells A39L010PZ and A39L012PZ, in March 1999 and July 1999 indicate that a gradient of about 0.0003 ft/ft existed between Well #4 and well A39L012PZ (the beginning and ending points of the flowpath considered). However, in March 1999, no gradient, or a very slight northerly gradient (on the order of 0.0001 ft/ft) existed between well A39L010PZ and Well #4, in the northern segment of the flowpath (Table 3.4-3 of the report).

Chemical data collected from Well #4, and wells A39L010PZ and A39L012PZ also suggest that groundwater flow in this area may be generally north to south. The chemical trans-1,2-DCE is the principal volatile organic chemical constituent in groundwater near Well #4, having been detected at a concentration of 320 µg/L in the primary groundwater sample (330 µg/L in the duplicate sample) collected from this well in March 1999 (Table F.1). cis-1,2-DCE was also



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FIGURE F.7

GROUNDWATER FLOWPATH FROM WELL #4 TO A39L010PZ TO A39L012PZ

Site SS-45
England Air Force Base
Alaxandria, Louisiana

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Denver, Colorado

detected, at a concentration of 140 µg/L in the primary groundwater sample (150 µg/L in the duplicate sample) from Well #4; vinyl chloride was not detected. trans-1,2-DCE has historically been detected in groundwater samples from down-gradient well A39L010PZ (Table F.1), and was detected at a concentration of 8.5 µg/L in the sample collected in March 1999. Historically, vinyl chloride (a degradation product of DCE) has been the principal volatile organic chemical constituent in groundwater near well A39L010PZ, and has been detected at concentrations ranging from 420 µg/L (in the groundwater sample collected in March 1999) to 1,260 µg/L (in the sample collected in June 1996). The concentrations of halogenated constituents in groundwater samples from both wells are comparable; however, the differences in chemical composition suggest either that chemicals at the two locations originated at different sources or during different "spill" events, separated in time, or that chemicals in groundwater near well A39L010PZ originated near Well #4, and have evolved, during migration to the south along the flowpath between the well locations. Well A39L012PZ is located approximately 1,050 feet further to the south (down-gradient) of well A39L010PZ (Figure F.7). Volatile organic chemicals were not detected in groundwater samples, collected from this well during sampling events in June 1996 and December 1997; however, cis-1,2-DCE was detected, at a concentration of 1 µg/L in the groundwater sample, collected in March 1999 (Table F.1). This suggests that well A39L012PZ may be near the ultimate down-gradient extent of volatile organic chemicals originating near Well #4. Vinyl chloride has not been detected in groundwater samples from well A39L012PZ, indicating that vinyl chloride, in addition to the DCE isomers, is being degraded and removed from the groundwater system during chemical migration.

The method of Buscheck and Alcantar (1995) was used to estimate first-order degradation rate constants for cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride, along the flowpath extending from Well #4, through well A39L010PZ to well A39L012PZ (Figure F.7). First-order degradation rate constants for TCE could not be estimated using this method applied to the flowpath extending from Well #4, through well A39L010PZ to well A39L012PZ, because TCE has not been detected in groundwater samples from wells in the vicinity. Well #4 was assumed to be located near the "source" of chemicals in the 2500 Area, because the concentrations of chemicals detected in groundwater samples from Well #4 are generally greater than have been detected in other nearby wells; and the suite of chemicals in groundwater from Well #4 (cis- and trans-1,2-DCE) is less evolved than the suite of chemicals in groundwater samples from well A39L010PZ (vinyl chloride, with lesser concentrations of DCE isomers).

Information required for calculations using the method of Buscheck and Alcantar includes:

- concentrations of primary compound and daughter products at known distances down-gradient from an identified source of chemicals,
- migration velocity of the primary compound and daughter products (the seepage velocity incorporating chemical retardation), and
- longitudinal dispersivity.

The concentrations of cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride, detected in groundwater samples collected in March 1999, were used in the calculation. Neither trans-1,2-DCE nor vinyl chloride were detected in groundwater samples collected from well A39L012PZ in March 1999; for purposes of the calculation, the concentrations of these compounds in groundwater at this location were assumed to be one-half the detection limit (detection limit of

0.5 µg/L for trans-1,2-DCE; detection limit of 1 µg/L for vinyl chloride). The hydraulic gradient was calculated using the potentiometric elevations measured in Well #4 and well A39L012PZ (the beginning and endpoint of the flowpath) in March 1999 (for the complete flowpath used to examine the degradation of the DCE isomers), and was calculated using the potentiometric elevations measured in wells A39L010PZ and A39L012PZ in March 1999, for the segment of the flowpath extending between these two wells, and used to examine the degradation of vinyl chloride. A value for hydraulic conductivity of 5.4 ft/day, representing the median hydraulic conductivity determined by displacement tests ("slug tests") of wells at Site SS-45 (Table 3.4-2), and an effective porosity of 0.28, measured in soil samples collected from the Intermediate Sand unit (Section 3.4 of the report), were used, with the hydraulic gradient, to calculate the seepage velocity along the complete flowpath, and along its southern segment. Compound-specific retardation coefficients were estimated using the method of Karickhoff *et al.* (1979), and the median fraction organic carbon value (0.0013) detected in soil samples collected from the Intermediate Sand unit in the 2500 Area (Section 3.4 of the report). The retardation coefficients were used to estimate compound-specific contaminant migration velocities; these ranged from 0.004 ft/day (cis-1,2-DCE) to 0.006 ft/day (vinyl chloride). The empirical method of (1993) was used to estimate longitudinal dispersivity.

The decay-rate calculations, completed using the method of Buscheck and Alcantar (1995) are attached to Appendix F and summarized in Table F.3.

First-order rate constants of 0.000013 day^{-1}, 0.000018 day^{-1}, and 0.000031 day^{-1} were calculated for cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride, respectively, using the method of Buscheck and Alcantar (1995). These correspond to half-lives of about 146, 103, and 60 years, respectively (Table F.3). However, no TCE has been detected in groundwater samples collected from well A39L010PZ during its monitoring history; and the molar concentrations of vinyl chloride detected in groundwater samples from well A39L010PZ have historically been more than 20 times the molar concentrations of DCE isomers detected in the same groundwater samples (Table F.1). This indicates that the estimated first-order rate constants are unrealistically low (half-lives are unrealistically long), because otherwise the DCE isomers would be the principal chemical species at this down-gradient location. The unrealistically low estimates for first-order rate constants suggest that one or more of the implicit assumptions of the method of Buscheck and Alcantar (1995) have not been met:

- Well #4, and wells A39L010PZ and A39L012PZ may not actually lie along a single flowpath;
- Volatile organic chemicals detected in wells A39L010PZ, A39L012PZ, and Well #4 originated at different sources; or
- Contaminant migration and contaminant distribution in this part of the groundwater system does not occur as a result of advective-dispersive mechanisms.

F4.0 APPLICATION OF HISTORY MATCHING TO ESTIMATION OF CHEMICAL REMOVAL RATES

F4.1 Initial Conditions and Assumptions

The method of Buscheck and Alcantar requires that the chemical suites and concentrations in groundwater near two or more monitoring points be related by having a common source of

chemicals, and by lying along a single flowpath, originating at the source, along which the groundwater flow velocity is well-defined and constant (chemical concentrations are related by distance and time). In situations where the necessary relationships among several monitoring points are not defined or do not exist, the self-similarity of the suites and concentrations of chemicals in groundwater near a single monitoring point, through time, may be greater than the similarities among the suites and concentrations of chemicals in groundwater near several, spatially-separated monitoring points at a single point in time. This means that the changes in composition and chemical concentrations in groundwater at a particular location through time may depend more strongly on previous conditions at that location, than on conditions at other locations in the groundwater system. In the absence of significant mass loss resulting from processes other than chemical degradation (e.g., advection), this situation is equivalent to a large-scale, *in-situ* microcosm; and periodic groundwater monitoring events can be regarded as samples collected to track the progress of the microcosm in degrading chemicals through time. Therefore, as an alternative to direct calculation (Section F 2.0) or application of the method of Buscheck and Alcantar (1995; Section F 3.0), the sequential degradation of TCE in groundwater at a single monitoring location (the "*in-situ* microcosm"), through its chain of daughter products to complete mineralization of vinyl chloride, could be represented by a system of differential equations, one equation (similar to Equation F-3) per degradation step (TCE to DCE isomers, DCE to vinyl chloride, and so on). This would result in a system of three differential equations, with five unknown, independent variables:

- Three, first-order degradation rate constants,
- The initial concentration of TCE in groundwater beneath chemical discharge areas, and
- The time ***t*** since TCE was originally introduced to groundwater.

The history of solvent use on the Base suggests that chemical discharge probably occurred over a relatively long period of time; chemicals were discharged in unknown, but probably different quantities at several different locations; the soils at each discharge site served as a source for continuing contribution of chemicals to groundwater through unknown periods of time; and the rates of dispersal of volatile organic chemicals to groundwater varied among the discharge sites, because of variations in quantities of chemicals, depth of discharge, and composition of the local soil. As a consequence, neither the initial concentration of TCE in groundwater at each discharge site, nor the time elapsed since the introduction of TCE to groundwater, can be precisely quantified. The system of equations, represented by Equation F-3 (above), is therefore indeterminate, and cannot be solved directly.

However, if several simplifying assumptions are made, the relative proportions of historic concentrations of TCE and its daughter products at individual monitoring points can be used to generate estimates of the ranges of first-order degradation rate constants that could have produced the observed chemical concentrations. The assumptions that were made, for the purpose of estimating degradation rate constants, are as follow:

- TCE was assumed to be only chemical, initially present in groundwater, and was introduced as a single "slug", on January 1, 1960. This is near the beginning of the suspected history of TCE use at the Base, and is in the time frame within which TCE may have been introduced to groundwater in the 800 and 2500 Areas (about 1960 through the early to mid-1980s; refer to Section 1 of the report). This is "conservative," in that if TCE

were introduced to groundwater at a date later than January 1, 1960, less time would be available to degrade TCE and daughter products, and a faster rate estimate would result.

- The degradation of TCE, through its chain of daughter products, was assumed to proceed as a series of first-order degradation reactions (Equations F-1 and F-3, above).

- Removal of TCE and daughter products from the groundwater system, via mechanisms other than chemical decay (volatilization, advection, diffusion), was assumed to be minimal. This assumption is in accordance with the observation that diffusion is probably the primary mechanism of dissolved-phase chemical transport in the subsurface (Appendix D). The rates of chemical removal estimated to result from diffusive transport beneath SS-45, England AFB, are several orders of magnitude lower than the possible ranges of chemical removal, resulting from chemical decay, indicating that under most circumstances, chemical removal via diffusion mechanisms can be neglected (subsequent sections).

For simplicity, TCE, DCE isomers, and vinyl chloride were assumed to be the only chemicals present in the groundwater system. (Because all of the DCE isomers can be generated by degradation of TCE, and all of the DCE isomers will eventually degrade to vinyl chloride, the concentrations of 1,1-DCE, cis-1,2-DCE, and trans-1,2-DCE, detected in the groundwater sample collected from a particular well during each sampling event, were summed to produce a concentration of "total DCE isomers" for that event).

It was also necessary to estimate the initial concentrations of TCE, present in groundwater at, and near, chemical source areas. The historic concentrations of TCE, DCE isomers, and vinyl chloride, detected in groundwater samples from wells A39L009PZ and SS45L001MW were assumed to be representative of the concentrations of chemicals in groundwater near chemical sources in the 800 Area; and the historic concentrations of DCE isomers and vinyl chloride, detected in groundwater samples from wells A39L010PZ, and A39L011PZ were assumed to be representative of the concentrations of chemicals in groundwater near chemical sources in the 2500 Area. These wells were selected because they have the most extensive monitoring records at Site SS-45, England AFB, have historically been associated with the highest concentrations of volatile organic chemicals detected at Site SS-45, or both.

The total molar concentration of chlorinated hydrocarbons detected in the groundwater sample from well A39L010PZ in the 2500 Area at the beginning of monitoring, in June 1996 (about 31 µg/L of cis-1,2-DCE, 140 µg/L of trans-1,2-DCE, and 1,260 µg/L of vinyl chloride; Table F.1) was about 21.9 µmol/L. The total molar concentration represents the concentrations of TCE daughter products that could be produced by completely degrading an initial concentration of TCE in water (21.9 µmol/L) equivalent to about 3,000 µg/L (Table F.1). This does not account for any additional, equivalent mass of TCE that may have been removed from the system as a result of complete mineralization. For the purposes of estimating degradation rate constants, the initial concentration of TCE in groundwater, near well A39L010PZ, was therefore assumed to be 21.9 µmol/L (a mass-based initial concentration of about 3,000 µg/L of TCE).

Note that the estimated, initial concentration of TCE in groundwater is the minimum concentration required to produce the observed concentrations of TCE daughter compounds in the groundwater sample from well A39L010PZ – a total concentration of at least 21.9 µmol/L (3,000 µg/L) of TCE must have been introduced to the groundwater system at this location.

Furthermore, the assumptions regarding the initial equivalent mass of TCE, its introduction as a single slug at that concentration, and the date of introduction (January 1, 1960) are all extremely conservative, in that application of these assumptions produces estimates of first-order decay rate constants that are lower than would result if other assumptions were used. For example, if TCE were introduced to the groundwater system at an initial concentration greater than 3,000 µg/L, degradation of TCE and all of its daughters would have to proceed at a faster rate to remove all of the TCE, and generate the observed concentrations of daughter compounds, than the rate calculated assuming an initial concentration of 3,000 µg/L. Similarly, if TCE were introduced to groundwater at a date later than January 1, 1960, at a concentration of 3,000 µg/L, less time would be available to degrade the TCE and daughter products, generating the observed daughter-product concentrations; and again, a faster rate estimate would result. As a final possibility, TCE could have been continuously introduced to groundwater at this location at much lower concentrations over an extended period of time, with the resulting total concentration of TCE daughter products equaling 21.9 µmol/L (equivalent to 3,000 µg/L of TCE). Again, however, if TCE were introduced to groundwater over an extended period, faster degradation rate constants are required to degrade TCE and daughter products than would be required if TCE were introduced as a single "slug", because otherwise TCE daughter products tend to accumulate, and the calculated daughter-product concentrations do not match the concentrations that have historically been detected in groundwater samples from this well.

(Although ethene, a possible daughter product of the degradation of TCE, was detected in groundwater samples from well A39L010PZ, the molar concentrations of ethene were not used in estimating the equivalent, initial concentration of TCE that might have produced TCE daughter products. This is because ethene has by far the highest Henry's Law constant and molecular diffusion coefficient of any of the TCE daughter products, indicating that ethene can readily migrate in the subsurface in the volatile phase or via diffusive mechanisms. Consequently, it is not certain that ethene, detected in groundwater at a particular location, was generated as a consequence of TCE or daughter compound degradation, occurring at that location. Therefore, ethene is regarded as a qualitative indicator of the occurrence of dehalogenation processes, but was not used in calculations that rely on reaction stoichiometry.)

The total molar concentration of chlorinated hydrocarbons detected in the groundwater sample from well A39L011PZ in the 2500 Area at the beginning of monitoring, in June 1996 (about 0.8 µg/L of 1,1-DCE, about 479 µg/L of cis-1,2-DCE, and 7.4 µg/L of vinyl chloride; Table F.1) was about 5.1 µmol/L. The total molar concentration represents the concentrations of TCE daughter products that could be produced by completely degrading an initial concentration of TCE in water (5.1 µmol/L) equivalent to about 700 µg/L (Table F.1). Therefore, for the purposes of estimating degradation rate constants, the initial concentration of TCE in groundwater, near well A39L011PZ, was assumed to be 5.1 µmol/L (a mass-based initial concentration of about 700 µg/L of TCE).

The total molar concentration of chlorinated hydrocarbons detected in the groundwater sample from well A39L009PZ in the 800 Area, during the first sampling event that included this well, in June 1997 (about 36 µg/L of TCE, about 80 µg/L of cis-1,2-DCE, and 4.6 µg/L of trans-1,2-DCE; Table F.1) was about 1.15 µmol/L. The total molar concentration represents the concentrations of TCE daughter products that could be produced by completely degrading an initial concentration of TCE in water (1.15 µmol/L) equivalent to about 151 µg/L (Table F.1). For the purposes of estimating degradation rate constants, the initial concentration of TCE in

groundwater, near well A39L009PZ, was therefore assumed to be 1.15 µmol/L (a mass-based initial concentration of about 151 µg/L of TCE).

The total molar concentration of chlorinated hydrocarbons detected in the groundwater sample from well SS45L001MW in the 800 Area, during the first sampling event that included this well, in June 1997 (about 451 µg/L of TCE, about 0.5µg/L of 1,1-DCE, 4 µg/L of cis-1,2-DCE, 0.3JQ µg/L of trans-1,2-DCE, and 0.5JQ µg/L of vinyl chloride; Table F.1) was about 3.5 µmol/L. This was the lowest total molar concentration of chlorinated hydrocarbons that has historically been detected in groundwater samples from well SS45L001MW. By contrast, the total molar concentration of chlorinated hydrocarbons detected in the groundwater sample, collected in September 1997, was about 5.5 µmol/L. It seems prudent to assume that the higher concentration, detected in the September 1997 groundwater sample, is more likely to represent the initial chemical concentration. Therefore, the initial equivalent concentration of TCE in groundwater near well SS45L001MW was assumed to be 5.5 µmol/L (a mass-based initial concentration of about 750 µg/L of TCE).

For the purposes of the calculations, TCE was assumed to be instantaneously introduced to groundwater as a single "slug", at a fixed, initial concentration (21.9 µmol/L at well A39L010PZ; 5.1 µmol/L at well A39L011PZ; 1.15 µmol/L at well A39L009PZ; and 7.5 µmol/L at well SS45L001MW; Table F-1). As TCE continues to degrade in the subsurface, following its initial introduction, then the concentrations of TCE in groundwater near each of the wells will decrease, because the calculations assume that no additional TCE will move from soil in areas where TCE was discharged, to groundwater. We then used the known characteristics of the degradation pathway to estimate the degradation rates of TCE and its daughters. As TCE degrades, it is converted to DCE isomers; and the DCE isomers, in turn, degrade to vinyl chloride, which volatilizes or is mineralized.

F4.2 Estimation of Rate of Chemical Removal

Systems of equations, containing several variables (such as Equation F-3, above), are conveniently evaluated using an electronic spreadsheet. The spreadsheets were constructed so that chemical degradation proceeded through the sequence presented conceptually in Equation F-3, using first-order degradation reactions (Equation F-1), and are structured so that the independent variables (initial concentrations, beginning time, rate constants) can be readily changed. This allows the results associated with different initial conditions, and different sets of rate constants, to be easily evaluated. The results of calculations are presented graphically in the spreadsheets, and are displayed with the historical results of analyses of groundwater samples from wells A39L010PZ, A39L011PZ, A39L009PZ, and SS45L001MW, so that the similarities and differences between calculations and historical results are readily apparent.

The objective of the history-matching calculations was to obtain estimates of first-order degradation rate constants for TCE and its daughter products, by adjusting the values of the degradation rate constants so that introduction of TCE in a single "slug", at an assumed, initial concentration equivalent to the total molar concentration of TCE and daughter products, on January 1, 1960, would produce the concentrations of TCE and daughter products, detected in groundwater samples from a particular well during historic sampling events. Estimation of first-order rate constants for TCE and its daughters using this method is constrained by the following observations:

- First-order degradation, operating over a long period of time, has established characteristic relative concentrations of TCE and its daughter products ("quasi-steady-state" concentrations). As degradation proceeds, those relative concentrations should remain approximately constant (Figures F.8 and F.9).

- Groundwater that contains TCE also generally contains DCE isomers; and the concentrations of DCE are relatively stable, or decreasing through time (e.g, groundwater samples from wells A39L009PZ and SS45L001MW in the 800 Area; Table F.1). This indicates that the rate of degradation of TCE to DCE isomers is approximately the same as the rate of degradation of DCE isomers to vinyl chloride. If the rate of TCE degradation were appreciably faster (orders of magnitude) than the rate of DCE degradation, DCE would tend to accumulate in the system (DCE concentrations would increase dramatically); whereas if the rate of TCE degradation were appreciably slower than the rate of DCE degradation, DCE would probably not be detected (because a molecule of DCE would degrade relatively quickly after its generation from TCE).

- With the exception of groundwater samples from well A39L010PZ, groundwater that contains DCE isomers contains much lower (often, non-detectable) molar concentrations of vinyl chloride. This indicates that in most areas, the rate of degradation of DCE isomers to vinyl chloride is approximately the same as, or somewhat slower than the rate of degradation of vinyl chloride.

- TCE has not been detected in groundwater samples from wells A39L010PZ and A39L011PZ, in the 2500 Area. Therefore, for calculations involving the monitoring history of these wells, the first-order rate constant for degradation of TCE to DCE was adjusted so that introduction of TCE at the initial concentration assumed for these two wells produced calculated, non-detectable concentrations of TCE (assumed to be 0.5 µg/L) immediately prior to the first sampling event recorded for these two wells (in mid-year 1996).

- No additional chemical mass was assumed to be introduced to groundwater, following the initial introduction of chemicals. It is therefore unlikely that rapid increases in absolute chemical concentrations, or rapid changes in relative concentrations, would occur, as chemical degradation proceeds. A degradation path, as shown in Figure F.10, which could result if the degradation of one daughter product (e.g., cis-1,2-DCE) proceeded at a much slower rate than other chemicals, produces a persistent increase in the absolute concentration of the resistant daughter product, and in addition prevents a match in calculated and observed concentrations for the resistant daughter product (e.g., cis-1,2-DCE), and subsequently-generated daughters (e.g., vinyl chloride). In view of the historic, relative concentrations of TCE and its daughters, detected in groundwater samples, such an occurrence is highly unlikely.

These constraints limit the possible first-order rate constants for degradation of TCE and its daughters to a fairly narrow range. The ranges of possible degradation rate constants, estimated using the historic relative concentrations of TCE and its daughters are presented in Table F.3. The ranges reported for TCE and its daughters represent those values of first-order rate constants, which produced results that appeared to be acceptable, when compared with historic, relative concentrations of chemicals in detected samples from wells A39L010PZ, A39L011PZ, A39L009PZ, and SS45L001MW.

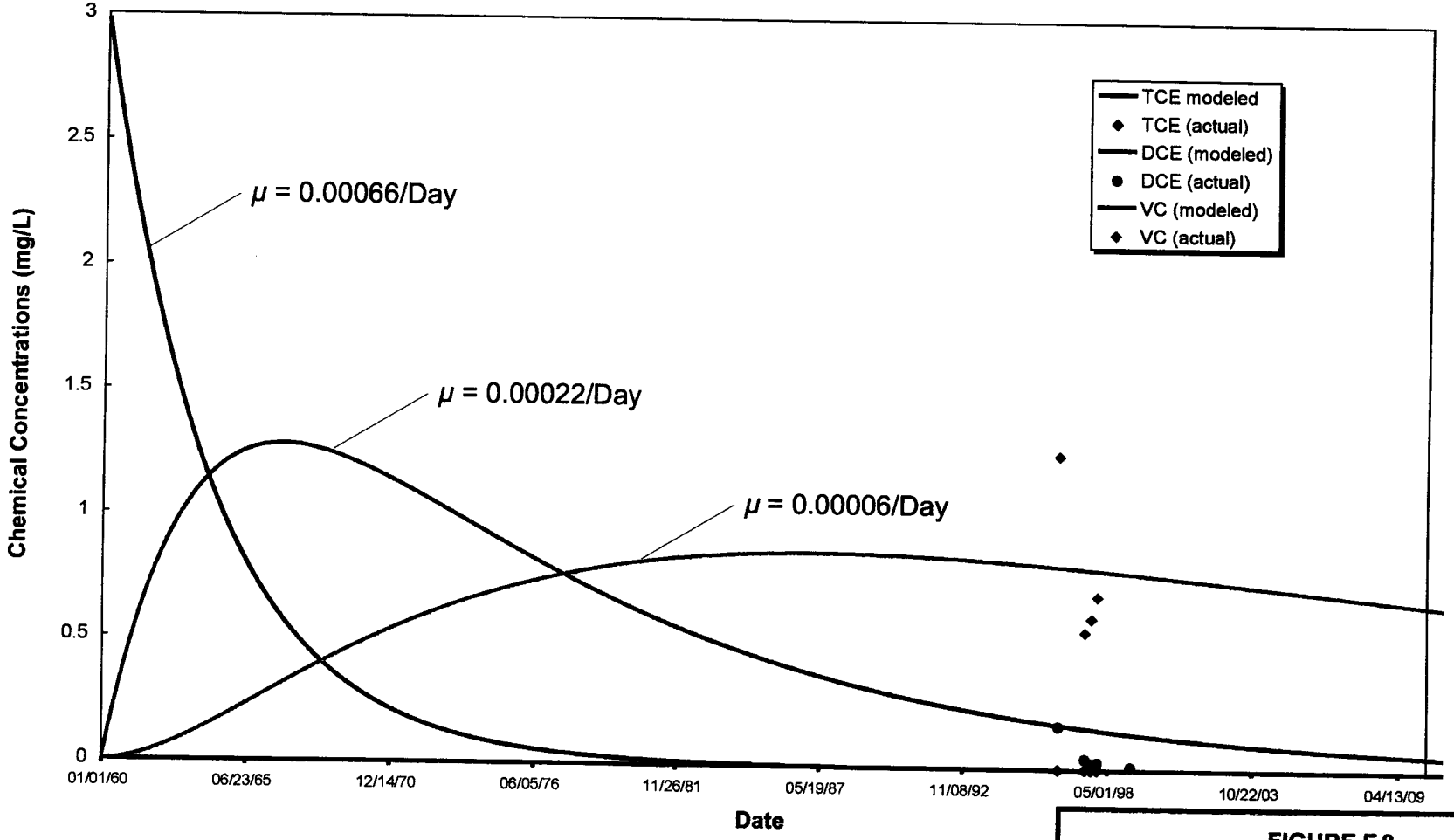


FIGURE F.8

CALCULATED CONCENTRATIONS OF TCE AND DAUGHTER PRODUCTS THROUGH TIME IN GROUNDWATER NEAR WELL A39L010PZ

Site SS-45
England Air Force Base
Alexandria, Louisiana

PARSONS
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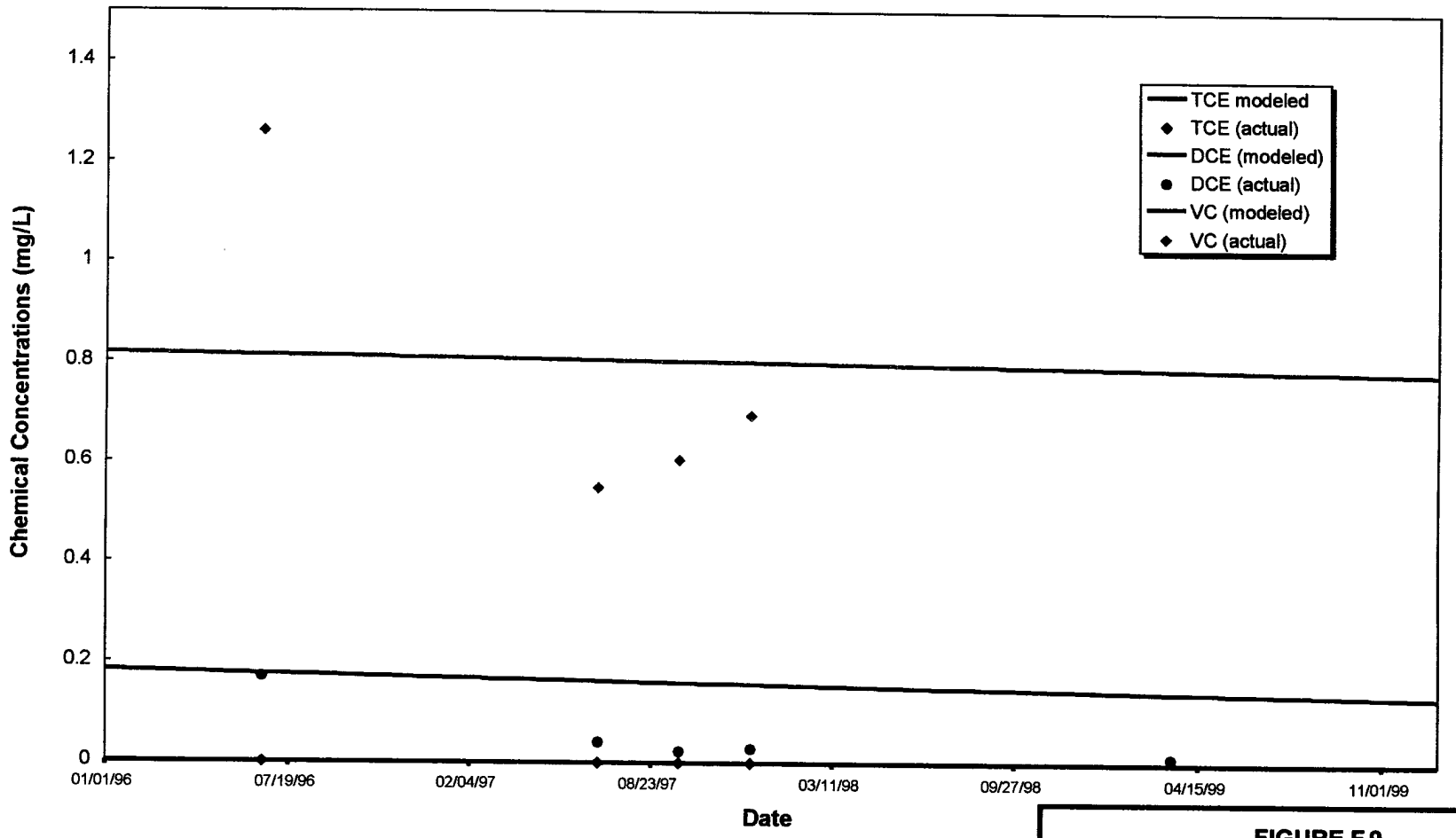


FIGURE F.9

CALCULATED CONCENTRATIONS OF TCE AND DAUGHTER PRODUCTS THROUGH TIME IN GROUNDWATER NEAR WELL A39L010PZ (DETAIL)

Site SS-45
England Air Force Base
Alexandria, Louisiana

PARSONS
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Denver, Colorado

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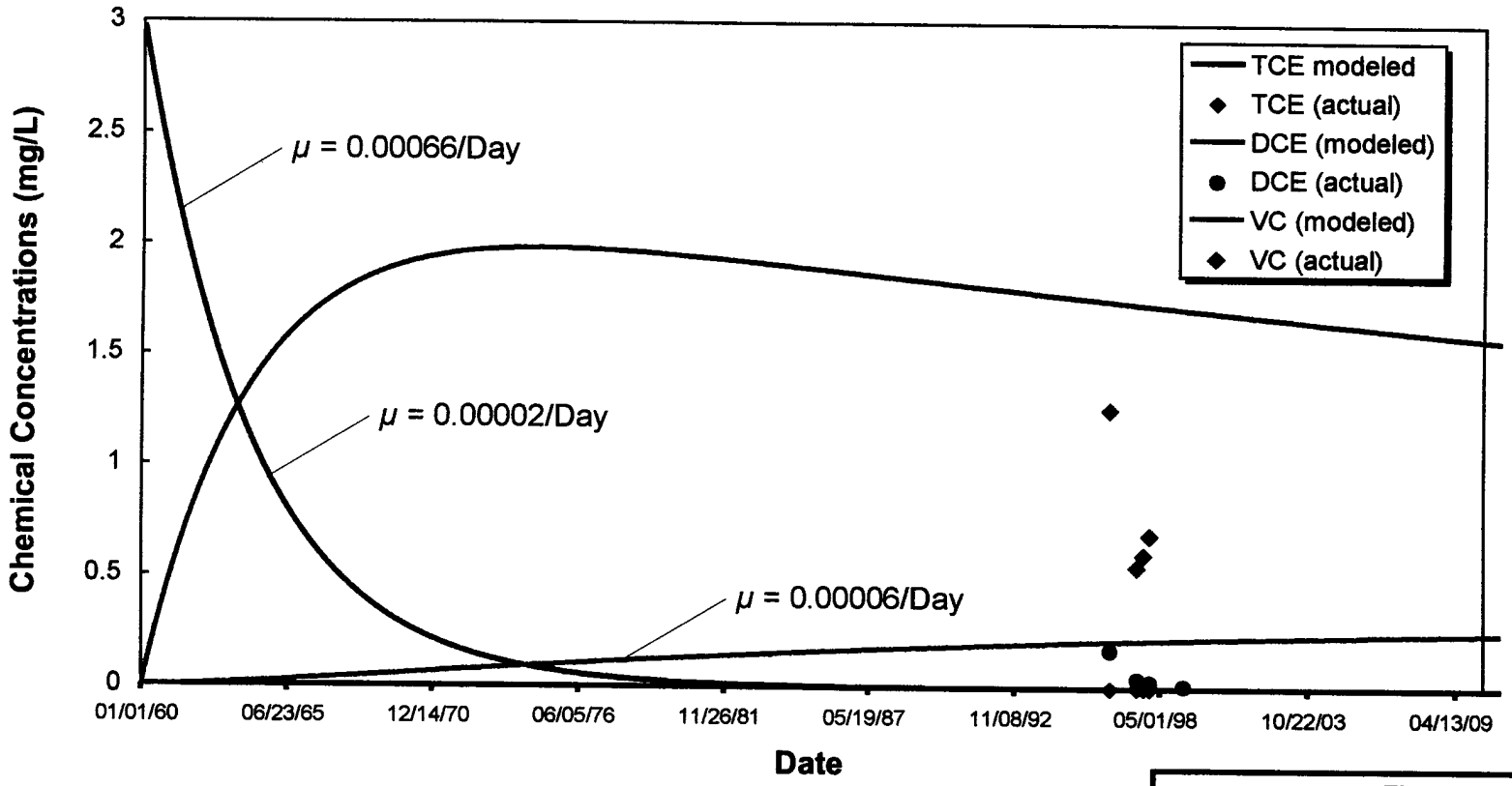


FIGURE F.10

CALCULATED CONCENTRATIONS OF TCE AND DAUGHTER PRODUCTS, IF RATE OF DCE DEGRADATION IS MUCH LOWER THAN RATE OF TCE DEGRADATION

Site SS-45

England Air Force Base

Alexandria, Louisiana

PARSONS

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Denver, Colorado

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The first-order rate constants, developed in these calculations, are representative of ranges, reported for TCE, DCE isomers, and vinyl chloride, in the literature (Table F.3; Anthony *et al.*, 1997; Dragun, 1988; Sivavec and Horney, 1995; Wilson *et al.*, 1994; Wiedemeier *et al.*, 1999). It must be recognized that, although some uncertainty is associated with these estimates, the estimated degradation rates are consistent with current knowledge of the discharge history of TCE on the Base, and with the relative concentrations of TCE and its daughter products, detected in groundwater samples from the 800 and 2500 Areas, Site SS-45.

F5.0 HISTORY MATCHING WITH GEOCHEMICAL MODEL

The curve-matching technique used with Equation F-3 (above) to estimate ranges of degradation rates for TCE and its "daughter products" considers only the concentrations of chemicals in the aqueous phase. However, as a consequence of sorption reactions (Appendix D), chemicals in the subsurface actually exist in two phases – dissolved and sorbed to soil. Consideration of the fate of TCE and its daughter products in the dissolved phase alone may overly simplify the representation of the processes occurring during chemical degradation. Because several TCE daughter products (each species having different chemical properties) can be generated during the degradation of TCE, it is necessary to consider the sorption and degradation mechanisms affecting TCE and its daughters in greater detail than allowed by simple calculations that utilize Equation F-3, to properly evaluate the ultimate fate of these constituents in the subsurface. Accordingly, a series of kinetic-based geochemical calculations was completed, to refine the estimate of ranges of degradation rates, that are acting to remove chemical mass from groundwater. The system of differential equations ("model"), used in the calculations, depicts the changes in chemical concentrations through time in groundwater, within a two-phase system (soil and groundwater) in which sorption and chemical degradation both occur. The model simulates the sequential degradation of TCE to the dichloroethene isomers (DCE), DCE to vinyl chloride, and finally vinyl chloride to ethene, carbon dioxide, hydrogen gas, and water.

The kinetic-based model was initially formulated to simulate the following series of reactions:

$$
\begin{array}{ccc}
TCE_{soil} & \leftarrow \frac{k^{+}_{TCE}}{k^{-}_{TCE}} \rightarrow & TCE_{water} \\
\downarrow \mu_{TCE-DCE} & & \downarrow \mu_{TCE-DCE} \\
DCE_{soil} & \leftarrow \frac{k^{+}_{DCE}}{k^{-}_{DCE}} \rightarrow & DCE_{water} \\
\downarrow \mu_{DCE-VC} & & \downarrow \mu_{DCE-VC} \\
VC_{soil} & \leftarrow \frac{k^{+}_{VC}}{k^{-}_{VC}} \rightarrow & VC_{water} \\
\downarrow \mu_{VC-CM} & & \downarrow \mu_{VC-CM} \\
\multicolumn{3}{c}{\textit{Complete Mineralization}}
\end{array}
\qquad \text{F-6}
$$

where

TCE_{soil} = effective concentration of TCE (in soil in contact with 1 liter of water) [M/L^3],

TCE_{water} = concentration of TCE in water [M/L^3],

k_{TCE}^{+} = mass-transfer coefficient of TCE from soil to water ("forward mass-transfer coefficient") [T^{-1}],

k_{TCE}^{-} = mass-transfer coefficient of TCE from water to soil ("reverse mass-transfer coefficient") [T^{-1}],

$\mu_{TCE\text{-}DCE}$ = rate constant for degradation of TCE to DCE [T^{-1}].

Because one mole of TCE will degrade to one mole of DCE isomers, and, eventually, one mole of vinyl chloride, use of *molar chemical concentrations* (Equation F-2), rather than *mass-based concentrations*, allows the amounts of chemicals produced (or removed) during degradation and sorption reactions to be compared directly.

F5.1 DESCRIPTION OF MODEL STRUCTURE[1]

F5.1.1 Geochemical Processes in Reaction Model

In geochemical calculations involving sorbed and dissolved phases, the *equivalent concentration* of TCE is used to represent the concentration of TCE in soil, to properly account for the total mass of TCE in the two-phase system. The equivalent concentration of TCE in soil is defined to be the mass of TCE in soil that is in "contact" with one liter of water, and is thus available to be dissolved. At the beginning of a simulation (time equal to 0), the equivalent concentration of TCE in soil is

$$[\ TCE_{soil}\ ] = [\ TCE_{water}\ ]\ x \left(\frac{\rho}{n_e}\ x\ K_d^{TCE} \right), \qquad \text{F-7}$$

where

ρ = bulk density of the soil [M/L^3],

n_e = effective porosity [ ], and

K_d^{TCE} = distribution coefficient for TCE [L^3/M].

---

1 Emphasis in this discussion is placed on TCE, but the processes, reaction mechanics and parameters discussed for TCE also apply to the daughter products in the reaction chain (DCE isomers and vinyl chloride).

As illustrated graphically in Equation F-6, TCE adsorbed to soil (TCE_{soil}) is released to the dissolved phase (TCE_{water}), at a rate controlled by the value of the forward mass-transfer coefficient (k^+). TCE in the dissolved phase (water) can partition to soil, at a rate controlled by the value of the reverse mass-transfer coefficient (k^-). The exchange of a compound between the sorbed and dissolved phases is assumed to be rapid, so that equilibrium is maintained. This is a consequence of the *principle of detailed balancing,* which states that at equilibrium, the rates of forward and reverse microscopic processes (e.g., adsorption and desorption reactions) are equal (Lasaga, 1981). Thus, when TCE concentrations are in equilibrium between the sorbed and dissolved phases, the rate of release of TCE from soil into water, and the rate of sorption of TCE from water to soil, are equal:

$$k^+_{TCE} \; [\; TCE_{soil} \;] = k^-_{TCE} \; [\; TCE_{water} \;] . \qquad \text{F-8}$$

Collectively, k^+ and k^- are referred to as *the set of mass-transfer coefficients.*

The calculation of k^- for the general case is a consequence of the principle of detailed balancing (Equations F-7 and F-8):

$$k^- = k^+ \; x \left(\frac{\rho}{n_e} \; x \; K_d \right). \qquad \text{F-9}$$

Equilibrium is assumed to occur under static or near-static flow conditions. Given the extremely low velocity of groundwater flow beneath the Base, under natural conditions (Appendix D and Section 3.4 of the CMS report), the assumption that chemical concentrations are at equilibrium, between soil and groundwater, is justified. In model calculations, equilibrium is maintained, even under conditions of moderate flow velocities, by using large ("fast") values of k^+, so that the rate of desorption is rapid, relative to the rate of water flux through the system. In situations where $([\rho/n_e] \; x \; K_d)$ is greater than 1.0, the rate of adsorption, controlled by the value of k^-, will be even faster than the rate of desorption, controlled by k^+. If large mass-transfer coefficients are used to describe the desorption and adsorption reactions, producing rapid mass-transfer rates, the slight changes in mass of TCE caused by mass losses resulting from chemical degradation and advection or diffusion are quickly accommodated and a new equilibrium condition is established.

The rate of degradation of TCE is controlled by the value of $\mu_{TCE\text{-}DCE}$. In keeping with previous discussions concerning naturally-occurring chemical degradation (Appendix D and preceding sections of Appendix F), the sorption and degradation reactions in the geochemical model depicted above are assumed to be first-order processes. Thus, the amount of mass moving between phases (or degrading) is a function of the concentration (or mass) in each phase.

TCE in both phases (sorbed and dissolved) is assumed to be available for degradation to DCE. As an alternative, a two-phase model could be constructed, in which chemical degradation in the solid phase does not occur. This is the computational equivalent of the two-phase model with degradation in the solid phase, as long as the rate constants used in the alternative two-phase system are adjusted, to approximate the "true" rate constants, estimated for the actual system that

the model simulates. This concept is examined in detail in subsequent sections. After both approaches were evaluated separately, it became apparent that they produced the same results.

F5.1.2 Reaction Constants and Observed Concentrations

The rate constants that describe chemical degradation were initially estimated based on the proportional concentrations of TCE and its daughter products in the aqueous phase (groundwater) only (preceding sections). These initial estimates did not directly consider the role of rapid partitioning between the sorbed and aqueous phases.

Any geochemical model that includes partitioning reactions may require adjustment to include the effects of the partitioning reactions. This can be illustrated by considering two different geochemical systems. The first system consists of one liter of water, containing TCE at an initial concentration of 1.0 mg/L. At the end of one year, the concentration in the aqueous phase has changed from 1.0 mg/L to 0.367 mg/L (0.63 mg of TCE was removed from the system through chemical degradation). If a first-order degradation relationship is assumed (Appendix D), the degradation rate can be calculated using:

$$C_{final} = C_{initial} \times e^{-\mu t} \qquad \text{F-10}$$

where

C_{final} = concentration of TCE in water at the end of time t (0.367 mg/L),

$C_{initial}$ = initial concentration of TCE in water (1.0 mg/L), and

μ = first-order rate constant [1/T].

For the one-phase system described above, the first-order degradation rate constant is calculated to be 1 year^{-1}.

The second system consists of two phases: one liter of water that contains TCE at a concentration of 1.0 mg/L, and a mass of soil that is completely in contact with the liter of water. For illustrative purposes, we assume that the value of $([p/n_e] \times K_d)$ for the soil is 5, and the concentrations of TCE in the two phases are in equilibrium. Therefore, the total mass of TCE in the system is 6.0 mg (1.0 mg in water, and 5.0 mg in soil). After one year, the concentration in the aqueous phase decreases from 1.0 mg/L to 0.367 mg/L. The first-order degradation rate constant for TCE in water in the two-phase system is calculated to be 1.0 year^{-1}. However, because equilibrium between the soil and water phases is constantly maintained, the mass of TCE in soil has also decreased, from 5.0 mg to 1.84 mg. Therefore, the first-order degradation rate constant for TCE in the sorbed phase is also 1 year^{-1}.

The total mass of TCE in the two-phase system (initially, 6.0 mg) has decreased to 2.2 mg in one year. Therefore, a total mass of 3.79 mg of TCE, representing 0.63 mg of TCE "originally" in the aqueous phase, and 3.16 mg of TCE desorbed from the solid phase, has been removed from the two-phase system, during the one-year period. Because additional TCE was initially present in the sorbed phase, six times more TCE was degraded in the two-phase system during the year, than was degraded in the one-phase system, during the same time period; yet the first-order rate constants, calculated using only the concentrations observed in the aqueous phase, are apparently identical.

The rate constant calculated for the two-phase system represents an average (or overall) rate constant for both phases; therefore, it is necessary to include a step to account for degradation of TCE in the sorbed phase. If degradation does not actually occur in the sorbed phase, then because the rapid partitioning reactions maintain TCE concentrations in equilibrium between the two phases, the actual rate of degradation in the aqueous phase must be six times greater than the calculated rate. Therefore, any calculational model that uses observed degradation rates, and which assumes that all chemical degradation occurs only in the aqueous phase, must correct for the degradation of additional chemical mass of TCE that is exchanged from the solid phase into the aqueous phase.

If first-order degradation rate constants, calculated using aqueous-phase concentrations, are to be applied to the kinetic model, the *effective* rate of chemical degradation throughout the entire two-phase system must be taken into account. Two equivalent methods can be used to correct for the effects of chemical partitioning in the model:

- adjust the rate constants that control the rate of chemical degradation in the aqueous phase; or
- permit degradation to occur in both phases.

The chemical concentrations and mass-transfer coefficients in the computational method can be referenced to the aqueous phase. For example, in a two-phase system, the concentration of TCE sorbed to soil is related to the concentration in the aqueous phase through the $(\rho/n_e \times K_d)$ term; and the mass-transfer coefficients are also influenced by the $(\rho/n_e \times K_d)$ term. To correct the *observed* first-order degradation rate constant to a *model* rate constant, the observed rate constant is multiplied by the retardation factor (R), where

$$R = 1 + \left(\frac{\rho}{n_e} \times K_d\right) \qquad \text{F-11}$$

The retardation factor is necessary because the model requires an equivalent reaction rate for both phases, but only uses the rate in the aqueous phase. The single-phase system (aqueous phase only) is then a limiting case, because $(\rho/n_e \times K_d)$ equals 0.0 (R equals 1.0).

The chemical concentrations and coefficients in the computational system can also be referenced to the sorbed (solid) phase, as follows. For each chemical, two differential equations were developed to describe the set of reactions presented graphically in Equation F-6. The change in equivalent concentration of TCE in soil is described by

$$\frac{d\,[\,TCE_{soil}\,]}{dt} = -k_T^{+}\,[\,TCE_{soil}\,] + k_T^{-}\,[\,TCE_{water}\,] - \mu_{TCE\text{-}DCE}\,[\,TCE_{soil}\,] \qquad \text{F-12}$$

and the change in concentration of TCE in water is described by

$$\frac{d\ [\ TCE_{water}\ ]}{dt} = k_T^+\ [\ TCE_{soil}\ ]\ -\ k_T^-\ [\ TCE_{water}\ ]\ -\ \mu_{TCE\text{-}DCE}\ [\ TCE_{water}\ ]\ .\qquad \text{F-13}$$

For compounds (e.g., DCE) that are produced by the degradation of a parent compound (e.g., TCE), an additional term is required in the differential equation, to account for the contribution of additional mass from degradation of the parent compound. The change in DCE concentration in water is described by

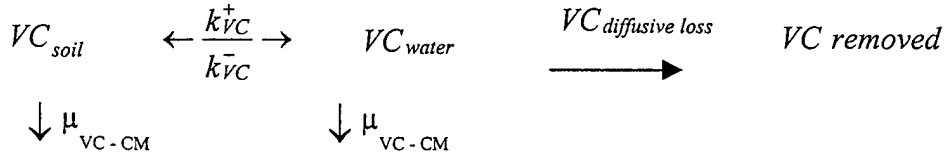
$$\frac{d\ [\ DCE_{water}\ ]}{dt} = k_D^+\ [\ DCE_{soil}\ ]\ -\ k_D^-\ [\ DCE_{water}\ ]\ -\ \mu_{DCE\text{-}VC}\ [DCE_{water}] + \mu_{TCE\text{-}DCE}\ [TCE_{water}]\ ,\qquad \text{F-14}$$

and DCE reactions in the sorbed phase are comparable to TCE reactions in the sorbed phase.

F5.2 Chemical Diffusion

Calculation of the Peclet number (the ratio of mechanical mixing to molecular diffusion) describing the system beneath England AFB (Appendix D) indicates that dispersion of TCE and its daughter products in groundwater may be primarily a consequence of molecular diffusion, rather than advective transport in groundwater. This calculation is supported by the general absence of well-defined groundwater flow directions, and by the observation that the areal distribution of TCE and daughter products in groundwater beneath the 800 Area and 2500 Area is not typical of plumes that result from advective transport (Section 4.4 of the report). Well-defined source areas do not exist; rather, relatively higher chemical concentrations in groundwater at some locations decline gradually with distance to relatively lower concentrations, across rather broad areas. This suggests that some of the apparent loss of chemical mass occurring beneath the 800 Area and 2500 Area on the base may actually be due to chemical dispersion resulting from diffusive processes, acting on chemicals in areas of relatively higher concentration, or at a number of small, areally-distributed sources. Therefore, to be as representative of actual conditions as possible, mass removal resulting from chemical diffusion should also be accounted for in the model. Conceptually, mass removal resulting from chemical diffusion can be represented as follows:

$$\begin{array}{ccccc} TCE_{soil} & \leftarrow \frac{k_{TCE}^+}{k_{TCE}^-} \rightarrow & TCE_{water} & \xrightarrow{TCE_{diffusive\ loss}} & TCE\ removed \\ \downarrow \mu_{TCE\text{-}DCE} & & \downarrow \mu_{TCE\text{-}DCE} & & \\ DCE_{soil} & \leftarrow \frac{k_{DCE}^+}{k_{DCE}^-} \rightarrow & DCE_{water} & \xrightarrow{DCE_{diffusive\ loss}} & DCE\ removed \\ \downarrow \mu_{DCE\text{-}VC} & & \downarrow \mu_{DCE\text{-}VC} & & \end{array}\qquad \text{F-15}$$



where

$TCE_{diffusive\ loss}$ = rate constant for diffusive loss of TCE from the system [T^{-1}].

Chemical diffusion is the result of the thermal kinetic energy of the molecules, which, in the presence of a chemical concentration gradient, produces a net flux of dissolved-phase chemical from zones of relatively higher concentration to zones of generally lower concentration. An expression for diffusive flux in a porous medium

$$J_D = - n_e \times D_D \times \frac{dC}{dx} \qquad \text{F-16}$$

where

J_D = diffusive flux of dissolved chemical [$M/L^2/T$],

D_D = effective chemical diffusion coefficient [L^2/T], and

dC/dx = chemical concentration gradient [M/L^4],

can be derived as a direct consequence of Fick's first law (Gilham and Cherry, 1982). Note that in this formulation, net diffusive flux is considered to be the mass of dissolved chemical passing through a unit area of porous medium that is transverse to the chemical concentration gradient, per unit time; because this flux represents a net loss of chemical, the sense (sign) of the flux expression is negative. Only the interconnected pore spaces of the medium are capable of transmitting dissolved chemical, and the expression therefore incorporates a term to account for effective porosity (n_e); and as a consequence of the tortuous diffusion pathways within a porous medium and the existence of the interface between solids (soil particles) and the solution (groundwater and dissolved chemical), the effective diffusion coefficient is a property of both the chemical and the porous medium, and is generally less than the chemical diffusion coefficient in free solution.

Using particular simplifying assumptions, it is possible to derive an expression for the net diffusive loss of chemical mass from a volume of water containing dissolved chemical at a relatively higher concentration to a volume of water containing chemical at a relatively lower concentration. We assume that a uniform, higher concentration (C_1) of chemical, initially at a concentration of C_0, is contained within a fully-saturated cylindrical volume of medium, having radius R and an effective porosity n_e (Figure F.11). The volume of water at higher concentration (inside the cylinder) is separated from the volume at lower concentration (C_2, outside the cylinder) by the cylinder wall, of area $2 \times \pi \times R \times h$. The volume outside the cylinder is very large – infinite, in fact, so that the bulk concentration of chemical outside the cylinder (C_2) will remain quasi-constant, despite the diffusive flux of chemical from within the cylinder to the outside. The chemical concentration outside the cylindrical volume is initially 0; after some long

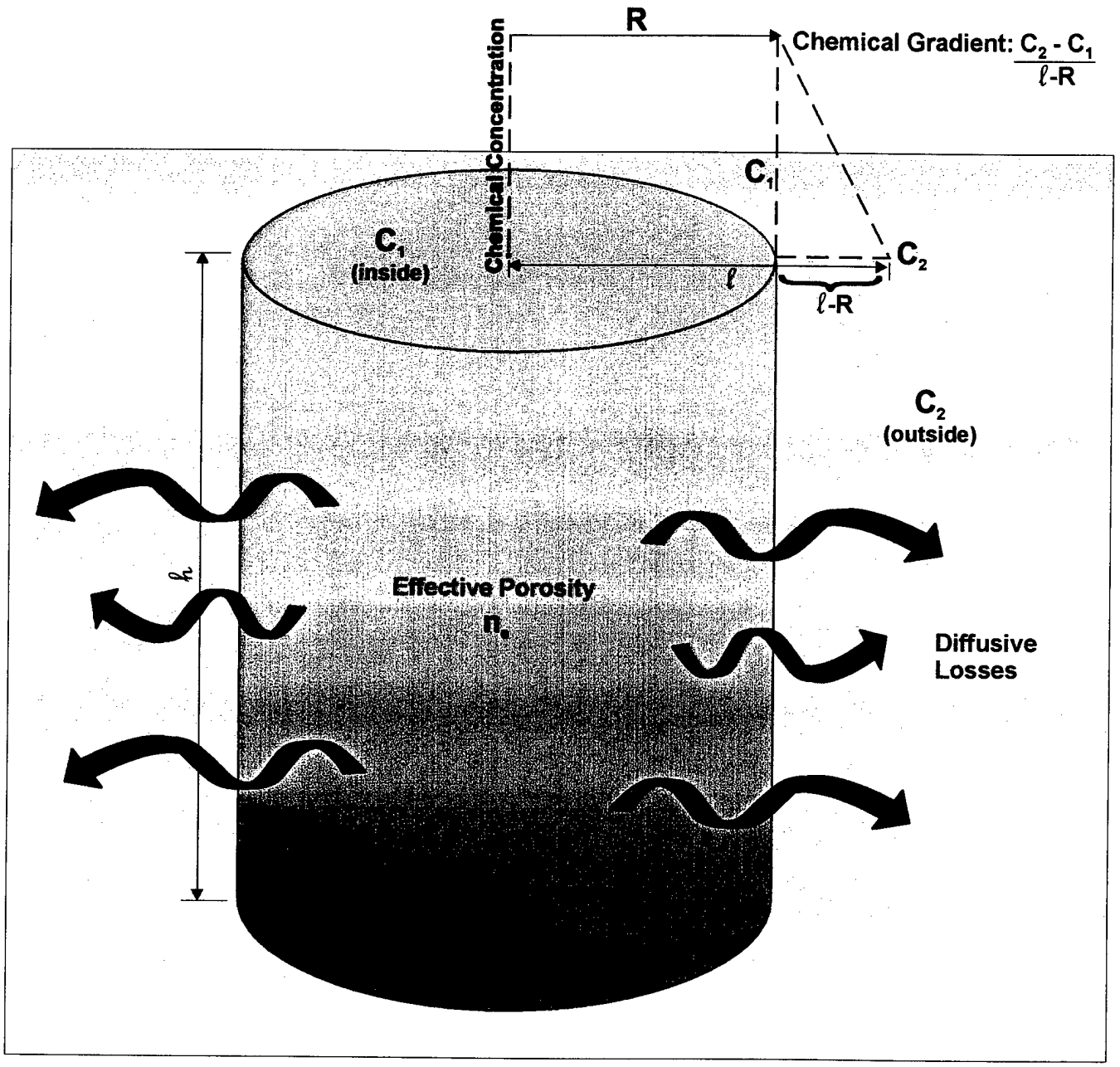


FIGURE F.11

CONCEPTUAL MODEL OF DIFFUSIVE MIGRATION FROM CHEMICAL SOURCE ZONE

Site SS-45
England Air Force Base
Alexandria, Louisiana

PARSONS
PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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period of time, the chemical concentration at a distance ***l*** from the center of the cylinder remains at ***0,*** so that the expression for the chemical concentration gradient in any direction from the center of the cylinder (assuming radial symmetry) is

$$Concentration\ gradient \quad = \quad \frac{C_2 - C_1}{l - R} \quad = \quad -\frac{C_1}{l - R} \qquad \text{F-17}$$

Note that this formulation is conservative, in that it assumes that the concentration gradient remains constant through time, while in reality, the gradient will decrease through time as mass is lost from the cylinder through diffusive migration.

The mass balance expression for the change in mass of chemical at relatively higher concentration within the cylindrical volume is (Trapp and Matthies, 1998)

$$\frac{d\,m_1}{dt} \quad = \quad -J_D \quad \times \quad A \qquad \text{F-18}$$

where

dm/dt = mass loss of dissolved chemical moving across the cylindrical surface of area ***A*** through time [M/T].

The chemical mass dissolved in water within the cylindrical volume is

$$m_1 \quad = \quad C_1 \quad \times \quad Volume\ of\ Water\ in\ Cylinder \quad = \quad C_1 \quad \times \quad \pi \quad \times \quad R^2 xh \quad \times \quad n_e \qquad \text{F-19}$$

and the mass balance equation (Equation F-18) therefore becomes

$$\frac{dm_1}{dt} \quad = \quad -n_E \times D_D \times \frac{dC_1}{dx} \times A \qquad \text{F-20}$$

$$= \quad 2 \times \pi \times R \times n_e \times D_D \times \frac{-C_1}{l - R} \qquad \text{F-21}$$

Simplifying the equation and separating variables produces

$$-\frac{1}{C_1} dC_1 \quad = \quad \frac{2\,D_D}{R \times (l - R)} dt \quad , \qquad \text{F-22}$$

indicating that under the conditions and assumptions described above, diffusive mass loss is a first-order process, similar to chemical decay. Integrating and solving for the constant of integration, we find that the chemical concentration within the cylindrical volume changes through time as a result of diffusive loss of chemical mass as

$$C_1 \quad = \quad C_0\, e^{-k_{diffusion} t} \qquad \text{F-23}$$

where

$$k_{diffusion} = \frac{2 D_D}{R \times (l - R)} \quad . \qquad \text{F-24}$$

Because effective chemical diffusion coefficients are generally quite small (less than 1 cm^2/day) and chemical gradients are also relatively small, as a consequence of the large diffusive travel distances under field conditions, the first-order diffusive mass-loss coefficient is several orders of magnitude smaller than the first-order chemical degradation rate constant. This indicates that under most situations, degradation processes are more important than chemical diffusion in removing chemicals from the subsurface, although given sufficient time, diffusive processes are capable of distributing chemical mass across broad areas. Nevertheless, for the sake of accuracy and completeness, chemical diffusion losses were incorporated into the kinetic model. Because this formulation of diffusion loss (Equations F-23 and F-24) is a first-order expression, diffusion loss was incorporated into the set of reaction equations (Equations F-12 and F-13) in a manner similar to chemical decay (although diffusion losses were assumed to occur only in the aqueous phase). The change in equivalent concentration of TCE in soil, considering mass transfer from sorbed and dissolved phases, and first-order chemical degradation, is described by

$$\frac{d\ [\ TCE_{soil}\ ]}{dt} = -\ k_T^+\ [\ TCE_{soil}\ ] + k_T^-\ [\ TCE_{water}\ ] - \mu_{TCE\text{-}DCE}\ [\ TCE_{soil}\ ] \qquad \text{F-25}$$

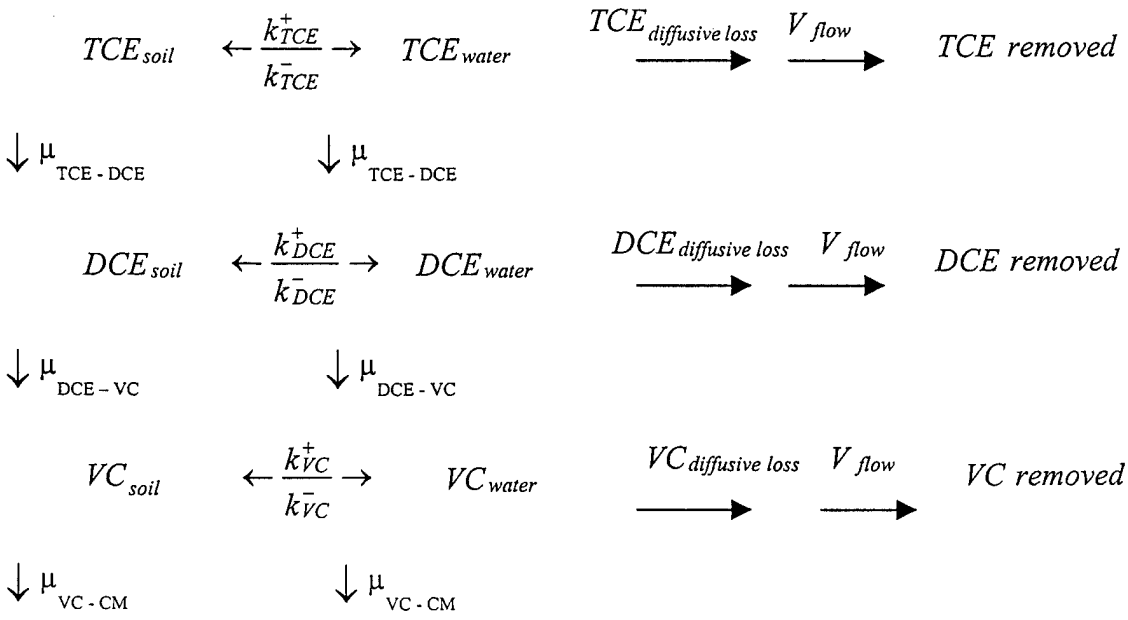
and the change in concentration of TCE in water, considering mass transfer from sorbed and dissolved phases, first-order chemical degradation, and first-order diffusion losses, is described by

$$\frac{d\ [\ TCE_{water}\ ]}{dt} = k_T^+\ [\ TCE_{soil}\ ] - k_T^-\ [\ TCE_{water}\ ] - \mu_{TCE\text{-}DCE}\ [\ TCE_{water}\ ] - k_{TCE\ diffusion}\ [TCE_{water}] \quad , \qquad \text{F-26}$$

with similar expressions for TCE daughter products in sorbed and aqueous phases (e.g., Equation F-14).

F5.3 Chemical Losses Due To Advection and Pumping

Under certain conditions, it may be necessary to consider the effects of pumping, or other types of advective mass removal from the two-phase system. For these situations, TCE and daughter products dissolved in water can be removed from the system by advective flow, at a rate controlled by the rate of water movement through the system (V_{flow}), in accordance with the following series of reactions:



F-27

where

V_{flow} = volume of water removed from system per unit time (as pore volumes) [T^{-1}].

The final term required for the kinetic-based calculations is thus an expression for the advective removal rate. This representation of the system assumes that mass flux out of the system, due to pumping or advective transport, occurs only in the aqueous phase, and also assumes that the system always contains one unit volume of water (i.e., the system is never "pumped dry"). Consequently, the advective (or pumping) removal rate can be represented by a term for rate of removal of water (as pore volumes per unit of time). The change in equivalent concentration of TCE in soil, considering mass transfer from sorbed and dissolved phases, and first-order chemical degradation, is then described by

$$\frac{d\ [\ TCE_{soil}\ ]}{dt} = -\ k^{+}_{T}\ [\ TCE_{soil}\ ] + k^{-}_{T}\ [\ TCE_{water}\ ] - \mu_{TCE\text{-}DCE}\ [\ TCE_{soil}\ ] \qquad \text{F-28}$$

and the change in concentration of TCE in water, considering mass transfer from sorbed and dissolved phases, first-order chemical degradation, and first-order diffusion losses, is described by

$$\frac{d\ [\ TCE_{water}\ ]}{dt} = k^{+}_{T}\ [\ TCE_{soil}\ ] - k^{-}_{T}\ [\ TCE_{water}\ ] - \mu_{TCE\text{-}DCE}\ [\ TCE_{water}\ ] - k_{TCE\ diffusion}\ [TCE_{water}] - V_{flow}\ [TCE_{water}] \qquad \text{F-29}$$

The resulting set of six differential equations was solved simultaneously, using a fourth-order Runge-Kutta method (Rice, 1993). The original solution routine was written in *BASIC*.

The structure of the computer code used to solve the system of differential equations allows different scenarios to be simulated simply by modifying the input files. For example, a one-phase system (water) can be simulated using the two-phase code, merely by setting the initial chemical concentrations in soil, and the values of the forward and reverse mass transfer coefficients, to zero. For calculations in which no advective mass loss or pumping is assumed to occur, the advective flux term (V_{flow}) is likewise set to zero.

For calculations in which degradation was assumed not to occur in the solid phase, the observed first-order chemical degradation rate constants were converted to partitioning-adjusted rate constants, using chemical-specific values for retardation, and the rate constants estimated from observed concentrations (Table F.4). An alternative version of the code was prepared, to allow chemical degradation in the solid phase, as a check on the first method. The results of calculations, completed using the adjusted aqueous-phase rate constants, and calculations using the observed rate constants with sorbed-phase degradation, were the same, demonstrating the equivalency of the two models.

F5.4 MODEL PARAMETERS

F5.4.1 Physical and Chemical Properties

Geochemical calculations were conducted using physical and chemical parameters, specific to soils on England AFB, that had been measured or estimated during the current, and prior investigations (LAW, 1998). The physical parameters required to define the system include:

- Bulk density of the soil,
- Effective porosity of the soil,
- A distribution coefficient for each compound, and
- An effective chemical diffusion coefficient for each compound.

A bulk density of 102 pounds per cubic foot (lbs/ft^3 – equivalent to 1.63 grams per cubic centimeter) and an effective porosity of 28 percent (Table F.4) were used to define the relationship between bulk density and porosity (p/n_e term). The value of p/n_e (5.82; Table F.3) represents the mass proportion of solids in contact with one liter of groundwater.

Distribution coefficients (K_d *s*) for TCE, cis-1,2-DCE, and vinyl chloride were estimated using the method of Karickhoff *et al.* (1979):

TABLE F.4
PARAMETERS USED IN KINETIC-BASED MODEL OF 800 AREA

Physical Parameters			
Soil Bulk Density (lbs/ft^3)[1]		102	
Effective Porosity (percent)[1]		28	
ρ/n		5.82	
Fraction of Organic Carbon[1]		0.001	
Compound-Specific Chemical Parameters	**TCE**	**DCE**	**VC**
Chemical Organic Carbon Partition Coefficient[2]	107	45	2.5
Distribution Coefficient (mL/g)[3]	0.107	0.045	0.002
Retardation Factor	1.62	1.26	1.01
Rate Constants (1/year)			
Desorption Rates {R+ (1,5,9)}[4]	100	100	100
Adsorption Rates {R- (2,6,10)}[4]	62.3	26.0	1.5
Diffusion Rates {R (4,8,12)}[4]	.0021	.0024	.0028
Pumping Rate {PVPUMP}	0.0	0.0	0.0

TABLE F.4 (continued)
PARAMETERS USED IN KINETIC-BASED MODEL OF 2500 AREA

Physical Parameters			
Soil Bulk Density (lbs/ft^3)[1]		102	
Effective Porosity (percent)[1]		28	
ρ/n		5.82	
Fraction of Organic Carbon[1]		0.0013	
Compound-Specific Chemical Parameters	**TCE**	**DCE**	**VC**
Chemical Organic Carbon Partition Coefficient[2]	107	45	2.5
Distribution Coefficient (mL/g)[3]	0.139	0.058	0.003
Retardation Factor	1.81	1.34	1.02
Rate Constants (1/year)			
Desorption Rates {R+ (1,5,9)}[4]	100	100	100
Adsorption Rates {R- (2,6,10)}[4]	81	33.8	1.9
Diffusion Rates {R (4,8,12)}[4]	.0021	.0024	.0028
Pumping Rate {PVPUMP}	0.0	0.0	0.0

1. Results of geotechnical analyses of field samples, collected during the Remedial Investigation (LAW, 1998) and the current field investigation (Section 4.1 of the report).
2. Chemical properties for TCE from Montgomery and Welkom (1990). Chemical properties for DCE and VC from Howard (1990, Volumes I and II).
3. Distribution coefficients for TCE, DCE, and VC obtained by calculation (refer to text).
4. The term {R#} represents the variable name for the rate constant, used in the computer code.

$$K_d = f_{oc} \times K_{oc} \qquad \text{F-30}$$

where

K_{oc} = chemical organic carbon partitioning coefficient, and

f_{oc} = fraction of organic carbon in the soil.

The organic carbon content of soil samples, detected during the current, and previous investigations at England AFB, ranged from "not detected" to 0.016 (Table 4.1-1; Section 4.1 of

the report). An organic-carbon content of 0.001, equivalent to the median organic carbon content of soil samples collected from the Intermediate Sand unit in the 800 Area, and an organic carbon content of 0.0013, equivalent to the median organic carbon content of soil samples collected from the Intermediate Sand unit in the 2500 Area, were substituted into Equation F-30, together with published values of the organic carbon partitioning coefficients for TCE, cis-1,2-DCE, and vinyl chloride, to estimate distribution coefficients for use in subsequent calculations. (Median values of fraction of organic carbon were used in calculations, because unless the statistical distribution of the underlying population [the values of organic carbon content in all the soil at Site SS-45] is known to be Normal, use of the arithmetic mean to estimate the "average" value of organic carbon content is inappropriate [Rock, 1988; de Marsily, 1986]. Rather, if the population distribution is not known, the median is statistically the most robust estimator of the "average" value [Rock, 1988, p. 86ff]). The distribution coefficients used in subsequent geochemical calculations are summarized in Table F.4.

A retardation factor was calculated for each compound (Table F.4), using Equation F-11, the values of bulk density and effective porosity presented above, and the compound-specific distribution coefficients.

F5.4.2 RATE CONSTANTS

The differential equations used in the kinetic-based geochemical calculations describe the rate of change of concentrations, for the three compounds (TCE, DCE, and vinyl chloride), as a function of time (Equations F-28 and F-29). As many as 13 different rate constants are thus required to describe the set of reactions (Equation F-27):

- Three sets of forward and reverse mass-transfer coefficients (k^+, k^-),
- Degradation rate constants (μ) for each of the three compounds,
- Chemical- and medium-specific diffusion rate constants for each of the three compounds ($k_{diffusion}$); and
- The rate constant used to define pumping or other form of advective mass removal from the system (V_{flow}).

Two rate constants (the forward and reverse mass-transfer coefficients) were used to define the adsorption/desorption reactions for each compound (Equation F-8). Equilibrium between the chemical concentrations in the sorbed and aqueous phases was constantly maintained in the calculations, by using reaction rates that were rapid, relative to other reactions considered in the model. Forward mass-transfer coefficients were arbitrarily defined to be 100 $year^{-1}$ for all three compounds -- a rate approximately 100,000 times greater than the mass flux due to chemical diffusion. Reverse mass transfer coefficients were calculated using Equation F-9, with the values for bulk density, effective porosity, and chemical-specific distribution coefficients presented in Table F.4.

To account for mass losses resulting from diffusion, an effective first-order diffusion rate constant was calculated for each chemical, using the method developed in Section F 5.2 (above), and assuming that a uniform, initial concentration of TCE was present within a cylindrical volume of the groundwater system, having a radius of 5 feet, around the monitoring point; and that chemical concentrations outside the cylindrical "source" volume remained at zero at a radial

distance of 10 feet from the center of the cylinder (the concentration gradient was established over a distance of 5 feet, and remained fixed). Because advective mass loss was assumed not to occur, the advective (pumping) removal rate term was set to zero for this series of calculations.

Estimates of first-order degradation rate constants were initially obtained from a series of calculations, which compared the relative concentrations of TCE and its daughter products in groundwater samples at several locations within Site SS-45 (preceding sections of Appendix F) in units of $days^{-1}$; however, for the purposes of kinetic-based geochemical calculations, the original units ($days^{-1}$) were converted to $years^{-1}$ (Table F.4). First-order degradation rate constants were adjusted, as necessary, during calculations to achieve a reasonable correspondence between the concentrations of TCE and its daughter products calculated to result during simulations, and the actual concentrations detected during groundwater monitoring events at individual sampling locations.

F5.5 Results of Calculations

The objective of the history-matching calculations, conducted using the kinetic model described in preceding sections, was to obtain estimates of first-order degradation rate constants for TCE and its daughter products, by adjusting the values of the degradation rate constants (μ in Equation F-27) so that introduction of TCE in a single "slug", at an assumed, initial concentration equivalent to the total molar concentration of TCE and daughter products, on January 1, 1960, would produce the concentrations of TCE and daughter products, detected in groundwater samples from a particular well during historic sampling events. Assumptions, initial conditions, and constraints for these calculations were as described in Section F4.

Mass-based chemical concentrations were converted to molar concentrations, using Equation F-2, for use in subsequent geochemical calculations. The geochemical calculations were structured to represent a two-phase system, consisting of soil and water (Figure F.12). The structure of the model (Equations F-6, F-17, and F-27) allows different initial concentrations to be specified in both the sorbed and aqueous phases. For example, if the concentration of a particular chemical in groundwater is known, the sorbed-phase chemical concentration in equilibrium with the dissolved concentration can be estimated, using an initial aqueous-phase chemical concentration, and Equation F-7. Although no source of chemicals in soil has been identified at England AFB Site SS-45 during past investigations, volatile organic chemicals are known to sorb to soil material, and therefore detectable concentrations of TCE (and possibly its daughter products) are probably present in soil, in areas of Site SS-45 having elevated concentrations of volatile organic chemicals in groundwater. Therefore, a two-phase system consisting of soil and water (with the initial concentrations of TCE, DCE isomers, and vinyl chloride, presented in Table F.3), was used in all calculations.

In this situation, soil is able to act as a source of additional volatile organic chemicals; however, chemicals can partition from the aqueous phase to soil, so that the mass-transfer coefficients are assigned positive values (the values for the mass transfer coefficients in Table F.4). All organic chemicals in the system are assumed to be present initially in the sorbed and aqueous phases, but mass-transfer reactions with the sorbed phase permit a redistribution of chemical mass between the two phases. In essence, this simulates conditions in which chemicals, dissolved in groundwater, are in equilibrium with chemicals sorbed to soil, within a "plume", in which chemical retardation occurs.

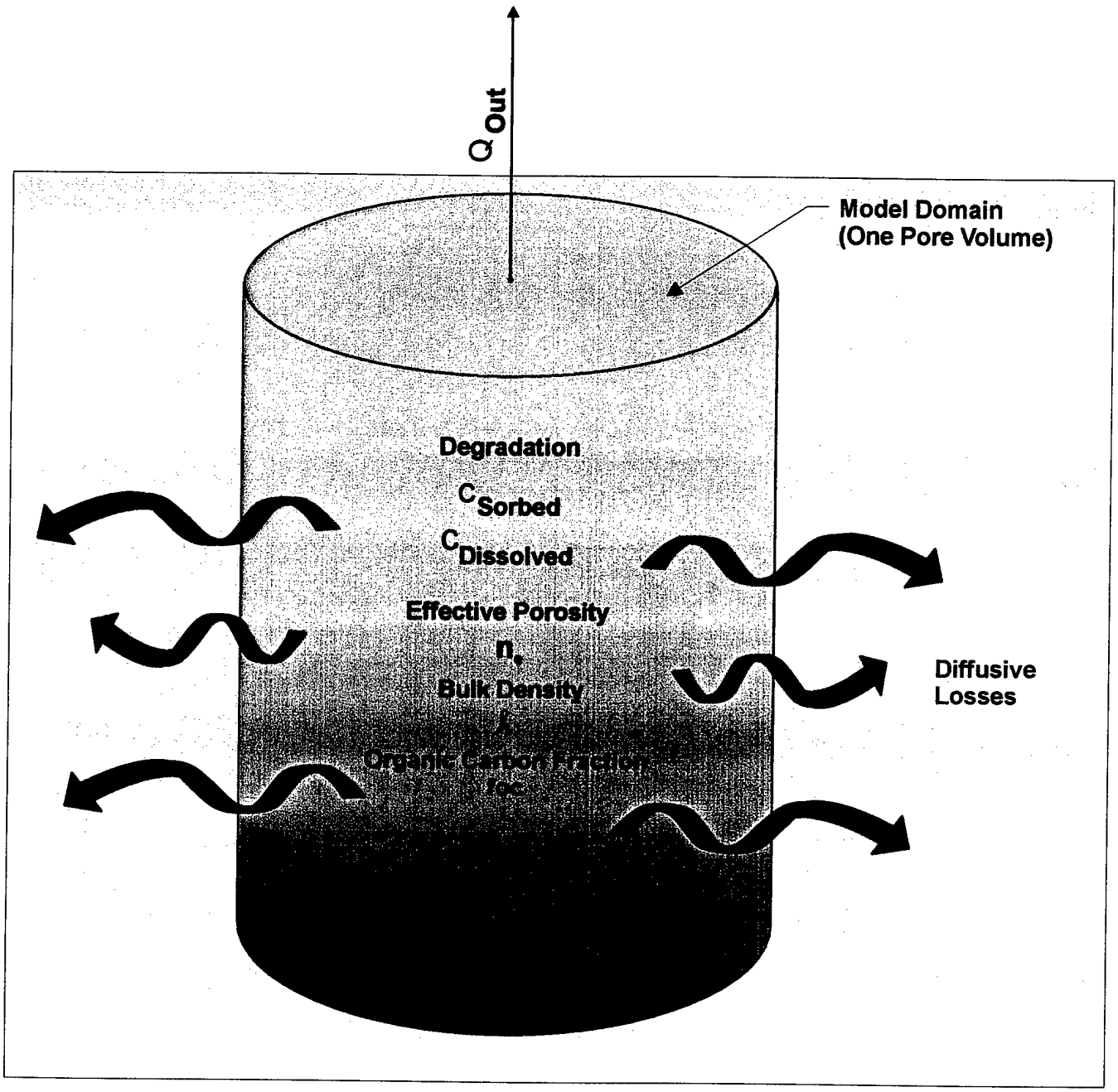


FIGURE F.12

CONCEPTUAL STRUCTURE OF KINETICS BASED GEOCHEMICAL MODEL

Site SS-45
England Air Force Base
Alexandria, Louisiana

PARSONS
PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

drawn\england3.cdr nap p1 83099

As with the spreadsheet calculations (Section F4), the assumptions and constraints used in developing the kinetic model limit the possible first-order rate constants for degradation of TCE and its daughters to a fairly narrow range. The ranges of possible degradation rate constants, estimated using the historic relative concentrations of TCE and its daughters are presented in Table F.3. The ranges reported for TCE and its daughters represent those values of first-order rate constants, which produced results that appeared to be acceptable, when compared with historic, relative concentrations of chemicals in detected samples from wells A39L010PZ, A39L011PZ, A39L009PZ, and SS45L001MW, and are in accordance with ranges of first-order degradation rate constants, reported for TCE, DCE isomers, and vinyl chloride, in the literature (Table F.2; Anthony *et al.*, 1997; Dragun, 1988; Sivavec and Horney, 1995; Wilson *et al.*, 1994; Wiedemeier *et al.*, 1999).

F5.6 Model Verification

Certain aspects of the computational and modeling approach described above were verified, as part of a Technical Impracticability Waiver at the Crystal Chemical Superfund Site in Houston, Texas (Hydrologic Consultants, Inc., 1996). The verification process evaluated the number of pore volumes of arsenic-bearing groundwater that would have to be removed through a specific capture zone, using an extraction system, to achieve specified action-level concentrations. This general procedure is commonly used to estimate the number of years required to achieve a specified chemical concentration (Zheng *et al.*, 1991). Because arsenic does not chemically degrade, the model used at the Crystal Chemical site only considered partitioning reactions and mass loss through the flux (V_{flow}) term.

An equilibrium-based (batch flushing) model, similar to those provided in USEPA guidance documents (USEPA, 1988), was used during the Crystal Chemical modeling investigation, to verify the results of the kinetic-based models. An equilibrium-based model was used in the verification process because models of this type are widely accepted, and therefore provide a benchmark for comparison. Furthermore, when a set of fast mass-transfer coefficients is used in a kinetic-based model, the results obtained using the kinetic-based and equilibrium-based models should be essentially identical.

The model that was used in the verification calculations is similar to that described by Zheng *et al.* (1991), who used an equilibrium-based method to estimate the number of pore volumes required to be flushed through soil at the Lone Pine Landfill Superfund Site in New Jersey. The number of pore volumes (PV) required to attain a specified concentration (C_s) was obtained by solving the following equation:

$$PV = -R \; x \; \ln\left[\frac{C_s}{C_{initial}}\right] \qquad \text{F-31}$$

During the Crystal Chemical investigation (Hydrologic Consultants, Inc., 1996), 11 different model scenarios were used in the verification process, and the results of kinetic-based calculations were compared with the results of equilibrium-based calculations. The results of all 11 kinetic-based numerical simulations were within four percent of the values estimated using the equilibrium-based model (Equation F-31); the results of many of the kinetic-based calculations were identical with the results obtained using Equation F-31. The kinetic-based

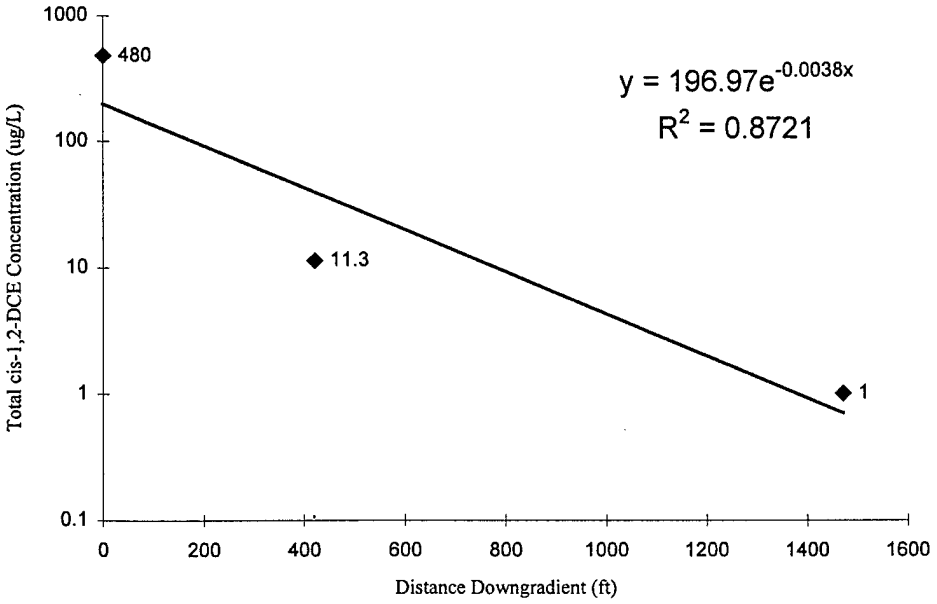
model was therefore regarded as successfully verified, and was accepted as such by the U.S. EPA.

As an additional check on the approach, a simple calculation was completed using Equation F-1, to examine the first-order degradation of TCE under a zero-flux, zero-diffusion condition. The results of the calculation (using Equation F-1) were compared with simulation results, for a single-phase system (TCE is present in water only), with no pumping or chemical diffusion. The results were identical, demonstrating that first-order degradation mechanisms have been correctly incorporated into the model. Concentrations of the daughter compounds DCE and vinyl chloride do not change in as simple a manner as do the concentrations of the precursor chemical (TCE). Therefore, elementary first-order calculations, completed using Equation F-1, cannot be used to assess the degradation of TCE daughter products.

FIRST-ORDER DECAY RATE CALCULATION
USING THE METHOD OF BUSCHECK AND ALCANTAR (1995)
SITE SS-45
ENGLAND AFB, ALEXANDRIA, LOUISIANA

Point	Distance (ft) Downgradient	total DCE (µg/L) Mar-99
Well #4	0	480
A39L010PZ	420	11.3
A39L012PZ	1470	1

PLOT OF TOTAL DCE ISOMERS CONCENTRATION VERSUS DISTANCE



$\lambda = v_c/4\alpha_x([1+2\alpha_x(k/v_x)]^2-1)$

dh/dl = (78.11 - 77.63)/1470 = 0.0003 ft/ft

K = 5.4 ft/day

n_e = 0.28

$V_g = K/n_e * dh/dl$ = 0.006 ft/day

R = 1.34

$V_c = V_g/R$ = 0.0045 ft/day

where v_c = 0.00446 ft/day

α_x = 1 feet

k/v = 0.0038

therefore λ = 1.70E-05 days-1

half-life = 111.6 years

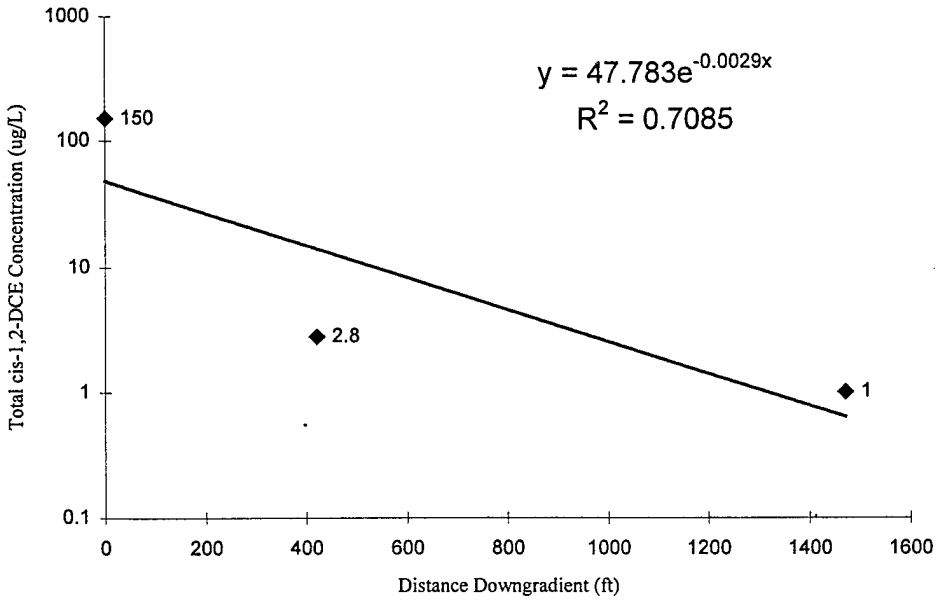
FIRST-ORDER DECAY RATE CALCULATION
USING THE METHOD OF BUSCHECK AND ALCANTAR (1995)

SITE SS-45

ENGLAND AFB, ALEXANDRIA, LOUISIANA

Point	Distance (ft) Downgradient	*cis*-1,2-DCE (µg/L) Mar-99
Well #4	0	150
A39L010PZ	420	2.8
A39L012PZ	1470	1

PLOT OF cis-1,2-DCE CONCENTRATION VERSUS DISTANCE



$\lambda = v_c/4\alpha_x([1+2\alpha_x(k/v_x)]^2-1)$

dh/dl = (78.11 - 77.63)/1470 = 0.0003 ft/ft

K = 5.4 ft/day

n_e = 0.28

$V_g = K/n_e * dh/dl$ = 0.006 ft/day

R = 1.34

$V_c = V_g/R$ = 0.0045 ft/day

where v_c = 0.00446 ft/day

α_x = 1 feet

k/v = 0.0029

therefore λ = 1.30E-05 days-1

half-life = 146.4 years

FIRST-ORDER DECAY RATE CALCULATION
USING THE METHOD OF BUSCHECK AND ALCANTAR (1995)

SITE SS-45

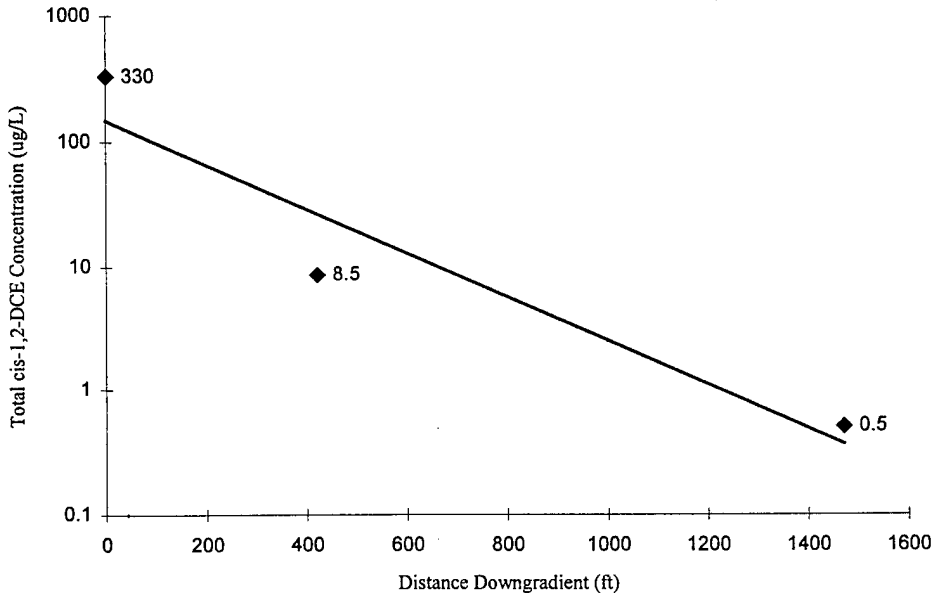
ENGLAND AFB, ALEXANDRIA, LOUISIANA

Point	Distance (ft) Downgradient	*trans*-1,2-DCE (µg/L) Mar-99
Well #4	0	330
A39L010PZ	420	8.5
A39L012PZ	1470	0.5

PLOT OF TRANS-1,2-DCE CONCENTRATION VERSUS DISTANCE

$y = 146.87e^{-0.0041x}$

$R^2 = 0.9035$



$\lambda = v_c/4\alpha_x([1+2\alpha_x(k/v_x)]^2-1)$

dh/dl = (78.11 - 77.63)/1470 = 0.0003 ft/ft

K = 5.4 ft/day

$n_e = 0.28$

$V_g = K/n_e * dh/dl = 0.006$ ft/day

R = 1.34

$V_c = V_g/R = 0.0045$ ft/day

where $v_c = 0.00446$ ft/day

$\alpha_x = 1$ feet

$k/v = 0.0041$

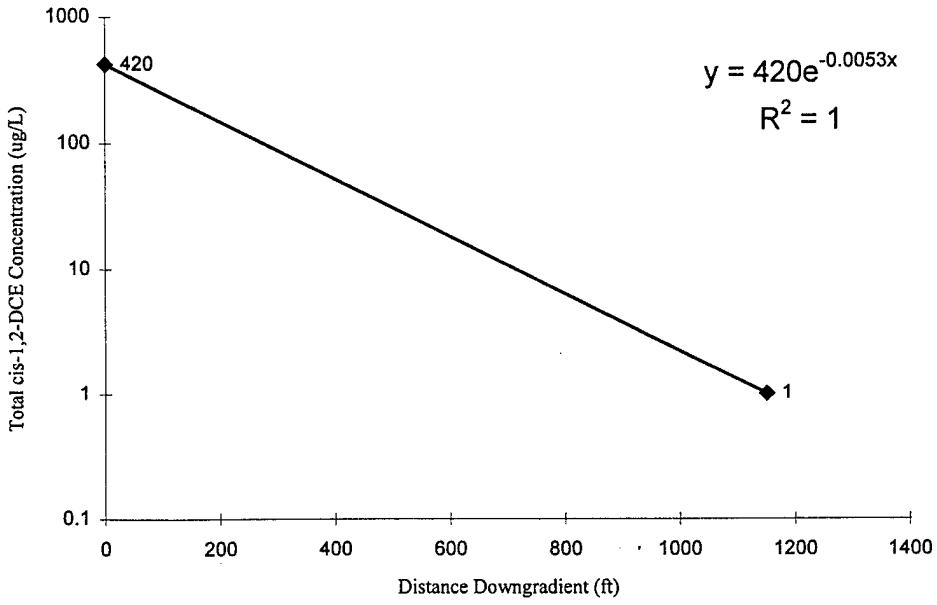
therefore $\lambda = 1.84E\text{-}05$ days-1

half-life = 103.4 years

FIRST-ORDER DECAY RATE CALCULATION
USING THE METHOD OF BUSCHECK AND ALCANTAR (1995)
SITE SS-45
ENGLAND AFB, ALEXANDRIA, LOUISIANA

Point	Distance (ft) Downgradient	Vinyl Chloride (µg/L) Mar-99
A39L010PZ	0	420
A39L012PZ	1150	1

PLOT OF VINYL CHLORIDE CONCENTRATION VERSUS DISTANCE



$$\lambda = v_c/4\alpha_x([1+2\alpha_x(k/v_x)]^2-1)$$

dh/dl = (78.11 - 77.63)/1470 = 0.0003 ft/ft

K = 5.4 ft/day

n_e = 0.28

$V_g = K/n_e * dh/dl$ = 0.006 ft/day

R = 1.02

$V_c = V_g/R$ = 0.0059 ft/day

where v_c = 0.0059 ft/day

α_x = 1 feet

k/v = 0.0053

therefore λ = 3.14E-05 days-1

half-life = 60.4 years

APPENDIX G

EVALUATION OF RELATIVE EFFECTIVENESS AND COST OF REMEDIAL ALTERNATIVES

APPENDIX G
EVALUATION OF RELATIVE EFFECTIVENESS AND COST OF REMEDIAL ALTERNATIVES

G1.0 CONCEPTUAL DESCRIPTION OF ALTERNATIVE REMEDIES FOR GROUNDWATER AT SITE SS-45

G1.1 Alternative 1 -- Monitored Natural Attenuation

This alternative assumes that no active groundwater remediation would be conducted. The monitored natural attenuation (MNA) alternative relies on natural attenuation mechanisms to remove chlorinated aliphatic hydrocarbons (CAHs) from groundwater in the Intermediate and Deep Sand units. Periodic monitoring would be conducted, to assess whether further migration of chemicals from source areas was occurring, and to evaluate the natural removal rate of chemicals from the groundwater system.

G1.2 Alternative 2 -- Groundwater Pump-and-Treat with Monitored Natural Attenuation

Under active groundwater extraction alternatives, a three-well groundwater extraction system would be installed within the 800 and 2500 Areas at Site SS-45 where elevated concentrations of trichloroethene (TCE) and its degradation daughter products have been detected in groundwater. Extracted groundwater would be treated using onsite air strippers to remove VOCs. Treated groundwater would be discharged to a local publicly-owned treatment works (POTW) via the sanitary sewer.

The conceptual groundwater extraction system would consist of wells completed to the base of the Intermediate Sand unit (80 feet below ground surface [bgs]) and screened across the full saturated thickness of the Intermediate Sand. The approximate range of pumping rates for wells completed in the Intermediate Sand unit system can be estimated (Czarnecki and Craig, 1985; Theis *et al.*, 1963) using values of transmissivity calculated from well-displacement ("slug") tests (Table 3.4-2 of the focussed corrective measures study [CMS] report). Specific capacity, measured in gallons per minute (gpm) of well production per foot of resulting drawdown in the well, is a measure of the sustained rate at which a well can be pumped. Application of an approximate relationship (Driscoll, 1986), to estimate the specific capacity for wells in the Intermediate Sand unit:

$$\frac{Q}{s} = \frac{T}{267.3} \qquad \text{(G-1)}$$

where

Q = well yield [gpm];
s = drawdown in the pumping well [feet]; and
T = transmissivity of the porous medium [200 to 1,350 ft^2/day for the Intermediate Sand unit; refer to Table 3.4-2 of the focussed CMS report];

produces estimates ranging between 0.7 and 5.1 gallons per minute per foot of drawdown. This indicates that the maximum pumping rate from each well will probably be on the order of 20 to 120 gpm, because the available drawdown for wells completed in the Intermediate Sand unit system will be no greater than about 25 feet to allow some freeboard above the intakes of submersible pumps.

The results of screening-level capture-zone analyses (Keely and Tsang, 1983; Blandford and Huyakorn, 1990) indicate that a single well completed in the Intermediate Sand unit and pumping at a rate of about 20 gpm theoretically would be capable of capturing all dissolved chemicals within a radial distance of nearly 20,000 feet from the pumping well. This extremely large radius of capture is a result of the low hydraulic gradients in the groundwater system at Site SS-45, and the consequent extremely low groundwater flow velocities (generally less than 1 foot per year; Section 3.4 of the report). The calculated radius of the capture zone appears to be excessively large; therefore, as an alternative, the radial distances to which observable drawdown (arbitrarily defined to be 0.1 foot below static water levels) would occur as a result of pumping were estimated. Application of the Theis equation (Theis, 1935; Lohman, 1979) to consideration of a well pumping at a rate of 20 gpm from the Intermediate Sand unit indicates that observable drawdown (the "effective" radius of capture) would occur to a radial distance of about 2,000 feet from the pumping well. At a pumping rate of 120 gpm, observable drawdown would occur to a radial distance of about 5,000 feet from the well.

Because hydraulic gradients in the groundwater system beneath Site SS-45 are extremely low (nearly non-existent), hydraulic gradient control is not an issue for a groundwater extraction system in either the 800 Area or 2500 Area. Rather, the only purpose for installing and operating a groundwater extraction system would be to effect removal of contaminant mass by moving groundwater through zones within the groundwater system that contain elevated CAH concentrations so that the dissolved chemicals will be drawn by advection (flushed) to the extraction point (a well) and removed from the groundwater system. To achieve that end, a single extraction well, installed near the center of the zone containing elevated CAH concentrations in groundwater beneath the 800 Area (near existing groundwater monitoring well SS45L001MW) and pumping at a rate between 20 and 120 gpm, would be sufficient to remove contaminant mass from the CAH plume in the 800 Area. Two extraction wells, one each installed near the center of the two zones containing elevated concentrations of chemicals in groundwater beneath the 2500 Area (near existing groundwater monitoring Wells #1 and #4, in the southern and northern parts of the 2500 Area, respectively), each pumping at a rate between 20 and 120 gpm, would be sufficient to remove contaminant mass from the CAH plume in the 2500 Area.

Therefore, the conceptual extraction and treatment system design consists of three groundwater extraction wells, each 8 inches in diameter to accommodate a submersible pump of up to 120-gpm capacity. Underground distribution lines from the two wellheads in the 2500 Area would connect to a centrally located clarifying tank. A holding tank and a low-profile air stripper would be located adjacent to the clarifying tank. The clarifying tank would be used to remove sediment from the extracted groundwater; clarified water would be gravity-fed into the holding tank. A sump pump would move the water from the holding tank to the air stripper, and treated water would flow through a buried pipeline to the nearest accessible POTW sewer line, assumed to be within 1,000 feet of the treatment system. A holding tank would be necessary for this system to maintain a constant throughflow rate to the air stripper, despite possible fluctuations in well production rates.

In **Alternative 2a – the low-extraction-rate alternative,** each well would be pumped at a rate of 20 gpm. This low production rate is intended to reduce long-term costs, while still capturing some dissolved chemical mass, and preventing further migration. The total production of the extraction system in the 2500 Area (two wells, each producing at a rate of 20 gpm) would be about 40 gpm; and the minimum throughflow rate of a low-profile air stripper is 20 gpm. A 6,000-gallons-capacity holding tank equipped with an automated control system would allow the air stripper to operate continuously, while the wells could cycle as necessary to keep the holding tank replenished.

The total production of the extraction system in the 800 Area (one well, producing at a rate of 20 gpm) would be about the minimum throughflow rate of the low-profile air stripper. However, because of the distance between well locations in the 2500 Area and the 800 Area (about 3,500 feet separates the two), the extraction system in the 800 Area would require a separate treatment system. This system also is assumed to consist of a clarifier, holding tank, and low-profile air stripper, and would discharge treated water to a POTW sewer line.

In **Alternative 2b – the high-extraction-rate alternative,** each well would be pumped at a rate of 120 gpm, the approximate maximum possible production rate of wells completed in the Intermediate Sand unit. This production rate is intended to increase the rate of groundwater movement through the capture zone, maximizing the removal rate of dissolved chemical mass. The total production of the extraction system in the 2500 Area (two wells, each producing at a rate of 120 gpm) would be about 240 gpm; and the total production of the extraction system in the 800 Area would be about 120 gpm. As in Alternative 2, a separate treatment system, consisting of a clarifier, low-profile air stripper, and a holding tank, would be required for each of the extraction systems. Treated water would be discharged to a POTW sewer line.

G2.0 ESTIMATION OF TIME REQUIRED FOR REMEDIATION OF GROUNDWATER

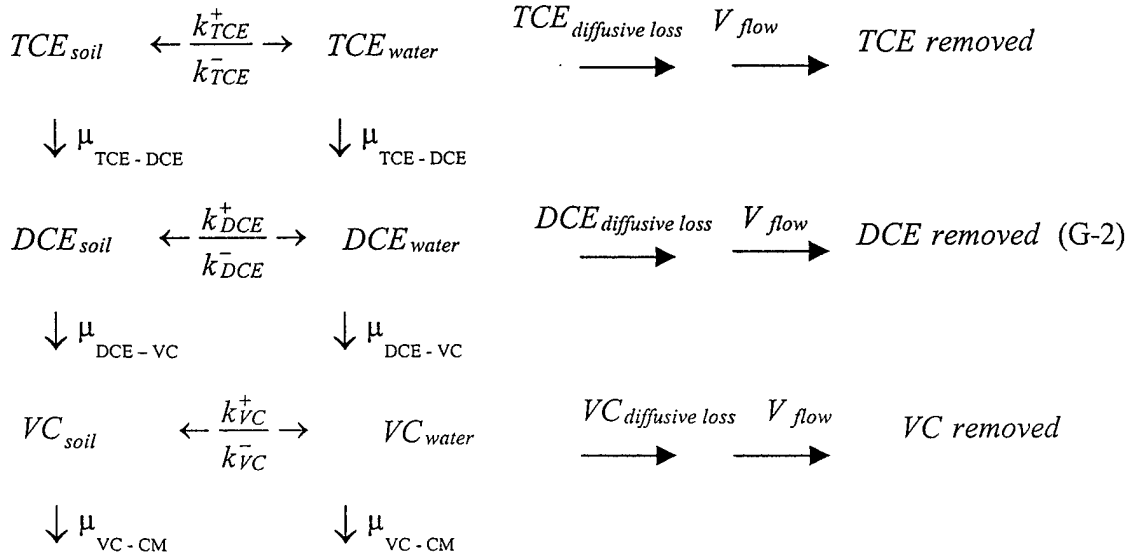
Estimation of the time required for each remedial alternative to achieve cleanup goals is a necessary component of the effectiveness and cost evaluation. Ranges of the lengths of time required to reduce the concentrations of TCE and its degradation daughter products to specified levels in groundwater at Site SS-45 were estimated using the kinetic-based geochemical model developed in Appendix F.

G2.1 Structure of Geochemical Model

The primary mechanisms controlling the movement and fate of CAHs in the environment include dissolution, dispersion, sorption, and chemical decay (Appendix D). Most methods of simulating the movement of chemicals in the environment utilize relatively simplistic methods of accounting for the various fate mechanisms, including in particular sorption and chemical decay (*c.f.*, Spitz and Moreno, 1996). Furthermore, dissolved-chemical migration in the groundwater system at Site SS-45 45 may occur primarily as a result of chemical diffusion rather than advection, and most numerical codes are not designed to simulate diffusive migration, or advective migration in the absence of well-defined groundwater flow directions. Accordingly, application of a numerical model to the evaluation of the migration and fate of CAHs in groundwater at Site SS-45 was judged to be inappropriate. Rather, a series of kinetic-based geochemical calculations was completed, to compare the potential effectiveness of remediation by natural attenuation (RNA) with a groundwater pump-and-treat system, in removing chemical

mass from groundwater, and to provide estimates of the times required to achieve cleanup goals. The system of differential equations (the "model") used in the calculations depicts the changes in chemical concentrations through time in groundwater in a two-phase system (soil and groundwater) in which sorption, chemical diffusion, advective mass loss, and chemical degradation all occur. The model simulates the sequential degradation of TCE to the dichloroethene (DCE) isomers, DCE to vinyl chloride (VC), and finally VC to its mineralization products (ethene, carbon dioxide, hydrogen gas, and water). Development of the kinetic model, together with the governing differential equations and assumptions is described in detail in Appendix F.

The kinetic-based model was formulated to simulate the following series of reactions:



(G-2)

where

TCE_{soil} = effective concentration of TCE (in soil in contact with 1 liter of water) [mol/L^3],

TCE_{water} = concentration of TCE in water [mol/L^3],

k_{TCE}^{+} = mass-transfer coefficient of TCE from soil to water (forward mass-transfer coefficient) [T^{-1}],

k_{TCE}^{-} = mass-transfer coefficient of TCE from water to soil (reverse mass-transfer coefficient) [T^{-1}],

$\mu_{TCE\text{-}DCE}$ = rate constant for degradation of TCE to DCE [T^{-1}],

$TCE_{diffusive\ loss}$ = rate constant for diffusive loss of TCE from the system [T^{-1}], and

V_{flow} = volume of water removed from system per unit time (as pore volumes) [T^{-1}].

Because one mole of TCE will degrade to one mole of DCE isomers, and eventually to one mole of VC, use of molar chemical concentrations (Appendix F) rather than mass-based concentrations, allows the amounts of chemicals produced (or removed) during degradation and sorption reactions to be compared directly. Therefore, molar chemical concentrations are used in all subsequent geochemical calculations.

The chemical concentrations and coefficients in the computational system (Equation G-2) can be referenced to the sorbed (solid) and aqueous (dissolved) phases. For each chemical, two differential equations were developed to describe the set of reactions presented graphically in Equation G-2. The change in equivalent concentration of TCE in soil, considering mass transfer from sorbed and dissolved phases and first-order chemical degradation, is described by:

$$\frac{d\,[\,TCE_{soil}\,]}{dt} = -\,k_T^{+}\,[\,TCE_{soil}\,] + k_T^{-}\,[\,TCE_{water}\,] - \mu_{TCE\text{-}DCE}\,[\,TCE_{soil}\,] \qquad \text{(G-3)}$$

and the change in concentration of TCE in water, considering mass transfer from sorbed and dissolved phases, first-order chemical degradation, first-order diffusion losses, and advective ("pumping") mass removal is described by

$$\frac{d\,[\,TCE_{water}\,]}{dt} = k_T^{+}\,[\,TCE_{soil}\,] - k_T^{-}\,[\,TCE_{water}\,] - \mu_{TCE\text{-}DCE}\,[\,TCE_{water}\,] - k_{TCE\ diffusion}\,[TCE_{water}] - V_{flow}\,[TCE_{water}]. \qquad \text{(G-4)}$$

For compounds (e.g., DCE) that are produced by the degradation of a parent compound (e.g., TCE), an additional term is required in the differential equation, to account for the contribution of additional mass from degradation of the parent compound. The change in DCE concentration in water is described by

$$\frac{d\,[\,DCE_{water}\,]}{dt} = k_D^{+}\,[\,DCE_{soil}\,] - k_D^{-}\,[\,DCE_{water}\,] - \mu_{DCE\text{-}VC}\,[DCE_{water}] - k_{DCE\ diffusion}\,[DCE_{water}] - V_{flow}\,[DCE_{water}] + \mu_{TCE\text{-}DCE}\,[TCE_{water}], \qquad \text{(G-5)}$$

and DCE reactions in the sorbed phase are comparable to TCE reactions in the sorbed phase.

G2.2 Model Parameters

Geochemical calculations were conducted using site-specific physical and chemical parameters that had been measured or estimated during the current, and prior investigations (LAW, 1998a). The physical parameters required to define the system include:

- Bulk density of the soil,
- Effective porosity of the soil,
- A distribution coefficient for each compound, and
- An effective chemical diffusion coefficient for each compound.

A bulk density of 102 pounds per cubic foot (lbs/ft^3), equivalent to 1.63 grams per cubic centimeter (g/cm^3) and an effective porosity of 28 percent (Table G.1) were used to define the relationship between bulk density and porosity (p/n_e term). The value of p/n_e (5.82; Table G.1) represents the mass proportion of solids in contact with 1 liter of groundwater.

Distribution coefficients (K_d *s*) for TCE, *cis*-1,2-DCE, and VC were estimated using the method of Karickhoff *et al.* (1979) (Appendix F). A retardation factor was calculated for each compound (Table G.1), using Equation F-11 (Appendix F), the values of bulk density and effective porosity presented in Table G.1, and the compound-specific distribution coefficients.

G2.3 Rate Constants

The differential equations used in the kinetic-based geochemical calculations describe the rate of change of concentrations, for the three compounds (TCE, DCE, and VC) as a function of time (Equations G-2 and G-3). As many as 13 different rate constants are thus required to describe the set of reactions (Equations G-2, G-3, and G-4):

- Three sets of forward and reverse mass-transfer coefficients (k^+, k^-),
- Degradation rate constants (μ) for each of the three compounds,
- Chemical- and matrix-specific diffusion rate constants for each of the three compounds ($k_{diffusion}$); and
- The rate constant used to define pumping or other form of advective mass removal from the system (V_{flow}).

Two rate constants (the forward and reverse mass-transfer coefficients) were used to define the adsorption/desorption reactions for each compound (Appendix F, Equation F-8). Equilibrium between the chemical concentrations in the sorbed and aqueous phases was constantly maintained in the calculations by using reaction rates that were rapid relative to other reactions considered in the model. Forward mass-transfer coefficients were arbitrarily defined to be 100 year^{-1} for all three compounds -- a rate approximately 1,000 times greater than the mass flux due to advective removal ("pumping"). Reverse mass transfer coefficients were calculated using Equation F-9 (Appendix F), with the values for bulk density, effective porosity, and chemical-specific distribution coefficients presented in Table G.1.

Estimates of first-order degradation rate constants were obtained from a series of calculations that examined the relative concentrations of TCE and its daughter products in groundwater samples through time (Appendix F). Ranges of first-order degradation rate constants were estimated for TCE and its daughter products using historic concentration information from several different sampling locations (Appendix F, Table F.3). The median value of the first-order rate constant estimated for each compound was used in this series of kinetic-based calculations because the distribution of the underlying population (the values of rate constants at every point in the subsurface at Site SS-45) is unknown. Use of the arithmetic mean to estimate the "average" value of a particular variable [e.g., rate constant] is inappropriate unless the underlying distribution is known to be normal (Rock, 1988; de Marsily, 1986). The estimated rates were originally reported (Appendix F) in units of days-1; however, for the purposes of

TABLE G.1
PARAMETERS USED IN GEOCHEMICAL MODEL OF 800 AREA

Physical Parameters			
Soil Bulk Density [lbs/ft^3] [a/]		102	
Effective Porosity [percent] [a/]		0.28	
ρ/n_e		5.82	
Fraction of Organic Carbon [a/]		0.001	
Chemical-Specific Parameters	**TCE**	**DCE**	**VC**
Chemical Organic Carbon Partition Coefficient [b/]	107	45	2.5
Distribution Coefficient [mL/g] [c/]	0.107	0.045	0.002
Retardation Factor	1.62	1.26	1.01
Target Concentration [µg/L]	5	70	2
Rate Constants (1/year)			
Desorption Rates {R+ (1,5,9) [d/]	100	100	100
Adsorption Rates {R- (2,6,10) [d/]	62.3	26.0	1.5
Diffusion Rates {R (4,8,12) [d/]	0.0021, 0.0	0.0024, 0.0	0.0028, 0.0
Pumping Rate {PVPUMP}	0.0, 0.01, 0.06	0.0, 0.01, 0.06	0.0, 0.01, 0.06
Estimated Chemical Degradation Rates (1/year) [e/]			
Degradation Rate for TCE → DCE {R3}	0.15		
Degradation Rate for DCE → VC {R7}		0.15	
Degradation Rate for VC → ETHENE (or other) {R11}			0.33

TABLE G.1 (continued)
Parameters Used in Geochemical Model of 2500 Area

Physical Parameters			
Soil Bulk Density [lbs/ft^3] [a/]		102	
Effective Porosity [ ] [a/]		0.28	
ρ/n_e		5.82	
Fraction of Organic Carbon [a/]		0.0013	
Chemical-Specific Parameters	**TCE**	**DCE**	**VC**
Chemical Organic Carbon Partition Coefficient [b/]	107	45	2.5
Distribution Coefficient (mL/g) [c/]	0.139	0.058	0.003
Retardation Factor	1.81	1.34	1.02
Target Concentration (μg/L)	5	70	2
Rate Constants (1/year)			
Desorption Rates {R+ (1,5,9) [d/]	100	100	100
Adsorption Rates {R- (2,6,10) [d/]	81	33.8	1.9
Diffusion Rates {R (4,8,12) [d/]	0.0021, 0.0	0.0024, 0.0	0.0028, 0.0
Pumping Rate {PVPUMP}	0.0, 0.01, 0.06	0.0, 0.01, 0.06	0.0, 0.01, 0.06
Estimated Chemical Degradation Rates (1/year) [e/]			
Degradation Rate for TCE → DCE {R3}	0.15		
Degradation Rate for DCE → VC {R7}		0.15	
Degradation Rate for VC → ETHENE (or other) {R11}			0.33

a/ Results of geotechnical analyses of field samples, collected during the RFI (LAW, 1998a) and the RNA field investigation (Sections 3 and 4 of the Report).

b/ Chemical properties for TCE from Montgomery and Welkom (1990). Chemical properties for DCE and VC from Howard (1990a).

c/ Distribution coefficients for TCE, DCE, and VC obtained by calculation (refer to text).

d/ The term {R#} represents the variable name for the rate constant used in the computer code.

e/ Chemical degradation rates were estimated in Appendix F, in units of 1/day, and 1/year.

kinetic-based geochemical calculations, the original units (days-1) were converted to years-1 (Table G.1).

To account for mass losses resulting from chemical diffusion, an effective first-order diffusion rate constant was calculated for each chemical using the method developed in Section F5.2 (Appendix F) and assuming that a uniform, initial concentration of chemical was present within a cylindrical volume of the groundwater system having a radius of 5 feet, around the monitoring point, and that chemical concentrations outside the cylindrical "source" volume remained at zero at a radial distance of 10 feet from the center of the cylinder (the concentration gradient was established over a distance of 5 feet, and remained fixed). Because an inwardly directed hydraulic gradient established by advective mass removal ("pumping") will overwhelm any outwardly directed chemical diffusion gradient, chemical diffusion was assumed to occur only in those situations for which no pumping was specified (V_{flow} equal to 0).

TCE and daughter products in water also can be removed from the system by advective flow at a rate controlled by the rate of water movement through the system (V_{flow}). The final term required for the geochemical calculations is thus an expression for the advective removal rate. This representation of the system assumes that mass flux out of the system due to pumping or advective transport occurs only in the aqueous phase, and that the system always contains one unit volume of water (i.e., the system is never "pumped dry"). Consequently, the advective (or pumping) removal rate can be represented by a term for rate of removal of water (as pore volumes per unit of time).

The maximum sustained pumping rate for a well, completed in the Intermediate Sand unit at the Base, was estimated to range between about 20 and 120 gpm (Section G1.2). The results of screening-level capture-zone calculations using analytical methods (Section G1.2) indicated that the radius of capture for a single well, pumping in a homogeneous, isotropic, infinite aquifer at a sustained rate of 20 gpm, would be on the order of 2,000 feet; and the radius of capture for a single well, pumping at a sustained rate of 120 gpm, would be on the order of 5,000 feet. The saturated thickness of the Intermediate Sand unit is about 40 feet; the volume of water contained within the capture zone of a single well ("one pore volume") is therefore

$$Volume = \pi \times (Radius\ of\ Capture)^2 \times (Saturated\ Thickness) \times n_e, \qquad \text{(G-6)}$$

or about 140,750,000 cubic feet of water, assuming a 2,000-foot radius of capture, a 40-foot saturated thickness, and an effective porosity of 28 percent (Table G.1). A single well pumping at a rate of 20 gpm would withdraw about 1,400,000 cubic feet of water in a one-year period. The rate of pore-volume removal for a single-well pumping system completed in the Intermediate Sand unit on England AFB and pumping at a rate of 20 gpm is therefore approximately 0.01 pore volume per year. The results of a similar calculation completed for a single-well system pumping at a rate of 120 gpm indicate that the rate of pore-volume removal for 120-gpm system, completed in the Intermediate Sand unit also is approximately 0.01 pore volume per year (as a consequence of the greater radius of capture). However, because a radius of capture much greater than 2,000 feet is not necessary to control chemical migration or increase mass removal rates, it was arbitrarily assumed that a single well, pumping at a rate of 120 gpm, would also withdraw water from a capture zone having a radius of 2,000 feet. The rate of pore-volume removal for a single well, complete in the Intermediate Sand unit and pumping at a rate of 120 gpm was therefore established at 0.06 pore volume per year. The initial calculations

assumed that groundwater was removed from the subsurface surrounding a particular extraction well at the rate of 0.01 pore volume per year (equivalent to 20 gpm). This extraction rate was later increased to 0.06 pore volume per year in some simulations, to evaluate the effects of pumping at the higher rate (120 gpm).

The resulting set of six differential equations was solved simultaneously, using a fourth-order Runge-Kutta method (Rice, 1993). The original solution routine was written in *BASIC*. The structure of the computer code used to solve the system of differential equations allows different scenarios to be simulated simply by modifying the input values. For example, a one-phase system (water) can be simulated using the two-phase code by setting the initial chemical concentrations in soil, and the values of the forward and reverse mass transfer coefficients, to zero. For calculations in which no advective mass loss or pumping is assumed to occur, the advective flux term (V_{flow}) is likewise set to zero.

G3.0 INITIAL CONDITIONS AND ASSUMPTIONS

The objective of the kinetic-based calculations was to estimate the amount of time required to reduce the concentrations of TCE, DCE isomers, and VC in the groundwater system, to concentrations less than specified values. The rates of chemical mass removal for TCE and its daughter products (DCE and VC), were calculated for a system in which chemical removal occurs through degradation and diffusion only, and for a system in which chemical removal occurs through a combination of chemical degradation and pumping. The initial chemical concentrations for model simulations were the concentrations detected in groundwater samples from three different wells on the Base (Wells #1, #4, and SS45L001MW). The concentrations of TCE in groundwater samples from well SS45L001MW, in the 800 Area, have historically been among the highest concentrations detected at Site SS-45. Therefore, because the time required for TCE to degrade completely through its chain of daughter products (TCE to DCE to VC) is greater than the time required simply to degrade the daughter products (e.g., mineralize VC), the time required for chemical concentrations to decrease to levels below the target concentrations at well SS45L001MW represents the maximum amount of time that would elapse before all target concentrations were achieved. Although the concentrations of CAHs detected in groundwater samples from Wells #1 and #4 were lower than concentrations historically detected in samples from well SS45L001MW, groundwater samples from Wells #1 and #4 contained the highest concentrations of DCE isomers detected the 2500 Area. The concentrations of DCE isomers and VC, in samples from Wells #1 and #4, were therefore selected to represent chemical conditions within the 2500 Area.

Mass-based chemical concentrations were converted to molar concentrations using Equation F-2 (Appendix F) for use in geochemical calculations. Accordingly, the concentration of TCE in groundwater samples from well SS45L001MW (560 μg/L) is equivalent to a molar concentration of 4.26 μmol/L; and the concentration of DCE isomers in groundwater samples from well SS45L001MW (12J μg/L) is equivalent to a molar concentration of 0.124 μmol/L. VC was not detected in groundwater samples from well SS45L001MW. The chemical concentrations in groundwater samples from Wells #1 and #4 were similarly converted to molar concentrations (Table G.2).

LDEQ (1998) has adopted the federal MCLs for TCE, the DCE isomers, and VC as risk-based screening levels (RBSLs) under their risk-based corrective action (RBCA) guidance (LDEQ, 1998). **The England AFB BCT has concurred with the use of these promulgated**

groundwater standards as conservative long-term cleanup goals for site groundwater. For the purpose of these calculations, the MCLs for TCE, cis-1,2-DCE, and vinyl chloride were the target concentrations specified (Table 5.4-1). Because all of the DCE isomers will eventually degrade to VC, the concentrations of 1,1-DCE, *cis*-1,2-DCE, and *trans*-1,2-DCE, detected during each sampling event, were summed to produce a concentration of "total DCE isomers" during that event (Table G.2). Although the concentration of "total DCE isomers" includes the concentrations of 1,1-DCE, *cis*-1,2-DCE, and trans-1,2-DCE, the drinking-water standard for cis-1,2-DCE was used as the target concentration for DCE isomers, because *cis*-1,2-DCE has historically comprised greater than 90 percent of the total mass of DCE isomers detected in groundwater samples from most wells at Site SS-45 (refer to Tables 1.3-2 and 4.3-1 of the focussed CMS report).

The geochemical calculations were structured to simulate a two-phase system, consisting of soil and water. All organic chemicals in the system are assumed to be present initially in the sorbed and aqueous phases, but mass-transfer reactions with the sorbed phase permit a redistribution of chemical mass between the two phases. In this situation, chemicals can partition from soil to the aqueous phase, so that soil is able to act as a source of volatile organic chemicals in groundwater. However, chemicals can also partition from the aqueous phase to soil ("sorb" to soil). The structure of the model (Equation G-1) allows different initial concentrations to be specified in both the sorbed and aqueous phases. For example, if a source of chemicals is known or suspected to be present in soil, the sorbed-phase chemical concentration can be estimated, using an initial aqueous-phase chemical concentration (Appendix F). For the current series of calculations, a two-phase system consisting of soil and water (with the initial concentrations of TCE, DCE isomers, and vinyl chloride, presented in Table G.2) was used in all calculations. In essence, this simulates conditions in which chemicals dissolved in groundwater are in equilibrium with chemicals sorbed to soil, within a "plume", in which chemical sorption and retardation occur.

G4.0 RESULTS OF CALCULATIONS

G4.1 Initial Chemical Concentrations are Concentrations Detected at Well

Initially, two simulations were completed for each set of chemical concentrations, to evaluate the effects of pumping groundwater representative of current conditions in the groundwater system at each of three wells (well SS45L001MW, and Wells #1 and #4). The first simulation at each well (**Alternative 1**) assumed that no pumping occurred ($V_{flow} = 0$), so that all chemical mass removal occurred as a result of chemical degradation (and, secondarily, of diffusion). The second simulation at each well (**Alternative 2a**) assumed that a pumping system, extracting water at the rate of 0.01 pore volume per year ($V_{flow} = 0.01$; equivalent to 20 gpm), would operate until the target concentration for each chemical was attained.

The calculated times required to achieve target concentrations of TCE, cis-1,2-DCE, and vinyl chloride, in groundwater near Well #1, Well #4, and SS45L001MW, with and without active pumping, are summarized in Table G.2, and described as follow:

- TCE is not present in groundwater near Well #1. In the absence of future introduction of TCE to groundwater in this area, target concentrations of TCE have been achieved.

TABLE G.2
Summary of Kinetic-Based Calculations
Initial Chemical Concentrations are Concentrations Detected at Well

	VOLATILE ORGANIC CHEMICALS		
	TCE	**Total DCE Isomers**	**Vinyl Chloride**
Maximum Contaminant Level Concentrations (μg/L)	**5**	**70**	**2**
WELL #1			
Initial Dissolved Concentrations (μg/L)	ND	157	ND
Initial Sorbed Concentrations (mg/kg)	ND	0.053	ND
Time to Achieve Target Concentrations at Well #1			
Natural attenuation only	currently achieved	5.5 years	26.5 years
Pumping at rate of 0.01 pore volume per year	currently achieved	5.5 years	25.5 years
Pumping at rate of 0.06 pore volume per year	currently achieved	4.5 years	21 years
WELL #4			
Initial Dissolved Concentrations (μg/L)	ND	480	ND
Initial Sorbed Concentrations (mg/kg)	ND	0.162	ND
Time to Achieve Target Concentrations at Well #4			
Natural attenuation only	currently achieved	13 years	34 years
Pumping at rate of 0.01 pore volume per year	currently achieved	12.5 years	33.5 years
Pumping at rate of 0.06 pore volume per year	currently achieved	10 years	26 years
WELL SS45L001MW			
Initial Dissolved Concentrations (μg/L)	560	12	ND
Initial Sorbed Concentrations (mg/kg)	0.35	0.003	ND
Time to Achieve Target Concentrations at Well SS45L001MW			
Natural attenuation only	32 years	21.5 years	47 years
Pumping at rate of 0.01 pore volume per year	31 years	20.5 years	45 years
Pumping at rate of 0.06 pore volume per year	25.5 years	15 years	35 years

Notes:

1. Chemical concentrations and target concentration levels presented in Sections 4 and 5 of the Report.

- Chemical degradation alone will reduce the concentration of total DCE isomers in groundwater near Well #1 to the target concentration for cis-1,2-DCE in a period of about 5.5 years. If pumping at a rate of 0.01 pore volume per year is implemented near Well #1, the target concentration for cis-1,2-DCE will be achieved in a period of about 5.5 years.

- Chemical degradation alone will reduce the concentration of vinyl chloride in groundwater near Well #1 to the target concentration for vinyl chloride in a period of about 26.5 years. If pumping at a rate of 0.01 pore volume per year is implemented near Well #1, the target concentration for vinyl chloride will be achieved in a period of about 25.5 years.

The concentrations of volatile organic chemicals in groundwater near Well #1 are somewhat lower than the concentrations in groundwater near either of Wells #4 or SS45L001MW; and the times required to achieve the target concentrations are correspondingly shorter at Well #1 than at either of the other two wells. The additional time required to remove volatile organic chemicals from groundwater near well SS45L001MW is a consequence not only of the higher concentrations of volatile organic chemicals in this area, but also of the fact that TCE is the primary chemical in groundwater samples from well SS45L001MW, while TCE has not been detected in groundwater samples from Well #1. The additional time required to degrade TCE to DCE, prior to degrading DCE to vinyl chloride, increases the length of time required for complete chemical removal. For example, the calculated time for chemical degradation alone to achieve the target concentration for TCE in groundwater near well SS45L001MW is about 32 years; if pumping at a rate of 0.01 pore volumes per year were implemented near well SS45L001MW, the target concentration for TCE would be achieved in 31 years. However, because of the additional time required to degrade the TCE daughter products, the total length of time required for chemical degradation alone to achieve the target concentration for vinyl chloride in groundwater near well SS45L001MW is about 48 years; if pumping at a rate of 0.01 pore volumes per year were implemented near well SS45L001MW, target concentrations of vinyl chloride would be achieved in about 45 years (Table G.2).

Note that description of the removal of chemical mass due to advection ("pumping"), in terms of pore volumes, assumes that chemical concentrations are uniform throughout the pore volume at a particular point in time; and that the rate of mass removal occurs at the same rate throughout the pore volume as water moves advectively through the medium. Therefore, representation of the system at initial chemical concentrations equal to the concentrations detected in a particular well assumes that groundwater throughout the entire pore volume surrounding the well contains chemicals at that concentration (e.g., DCE isomers are initially present to a radius of 2,000 feet throughout the groundwater system surrounding Well #1, at a concentration of 157 μg/L). Furthermore, this description of pore-volume removal rates is the conceptual equivalent of a batch-flushing model (Appendix G, Section G5.6), and groundwater flow velocities are implicitly assumed to be equal throughout the pore volume (e.g., the rate of advective removal of water and chemicals is everywhere the same). In fact, as a consequence of the radial flow field surrounding a pumping well, the rate of pore-volume removal is faster near the well than at larger radial distances from the well.

Although capture-zone calculations indicate that groundwater will be extracted from the Intermediate Sand unit at radial distances at least 2,000 feet from a well, pumping at a rate of 20 gpm, chemicals within the porous medium nearest the extraction well will be more effectively removed by pumping, because (assuming rapid equilibration between sorbed and dissolved

chemical phases) the rate of extraction per unit time is greater nearer the well. Additional simulations were therefore completed to address the simplifications, inherent in the batch-flushing conceptualization. The extraction rate of the pumping well was increased, to 120 gpm (**Alternative 2b**), and the capture zone for the pumping well was arbitrarily assumed to remain at a radial distance of 2,000 feet from the pumping well. A single well, pumping at a rate of 120 gpm, will move about 0.06 pore volume per year through a cylindrical volume of porous medium, of radius 2,000 feet, surrounding the well. The calculated times required to achieve target concentrations of TCE, cis-1,2-DCE, and vinyl chloride, in groundwater near Well #1, Well #4, and SS45L001MW, with active pumping occurring at a rate of 0.06 pore volume per year, are summarized in Table G.2, and described as follow:

- Chemical degradation alone will reduce the concentration of total DCE isomers in groundwater near Well #1 to the target concentration for cis-1,2-DCE in a period of about 5.5 years. If pumping at a rate of 0.06 pore volume per year is implemented near Well #1, the target concentration for cis-1,2-DCE will be achieved in a period of about 4.5 years.

- Chemical degradation alone will reduce the concentration of vinyl chloride in groundwater near Well #1 to the target concentration for vinyl chloride in a period of about 26.5 years. If pumping at a rate of 0.06 pore volume per year is implemented near Well #1, the target concentration for vinyl chloride will be achieved in a period of about 21 years.

Similarly, the calculated time for chemical degradation alone to achieve the target concentration for TCE in groundwater near well SS45L001MW is about 32 years; if pumping at a rate of 0.06 pore volume per year were implemented near well SS45L001MW, the target concentration for TCE would be achieved in 25.5 years. The time required for chemical degradation alone to achieve the target concentration for vinyl chloride in groundwater near well SS45L001MW is about 48 years; if pumping at a rate of 0.06 pore volume per year were implemented near well SS45L001MW, target concentrations of vinyl chloride would be achieved in about 35 years (Table G.2).

G4.2 Initial Chemical Concentrations are Maximum Concentrations Detected in Vicinity of Well

The distribution of groundwater flow velocities in the vicinity of a pumping well is such that groundwater within the radius of influence near the well moves toward the well screen at higher velocities than does groundwater at greater radial distances (Keely and Tsang, 1983). Consideration of the batch-flushing concepts inherent in the structure of the kinetic-based model indicates that removal ("flushing") of chemicals from the porous medium at small radial distances from an extraction well will occur more rapidly than will flushing of chemicals at larger radial distances, as a consequence of the decreasing groundwater flow velocities (and consequent declining rate of pore-volume removal) with radial distance. The first series of kinetic-based calculations (Section G4.1, above) assumed that the initial concentrations of chemicals in groundwater within a radial distance encompassing one pore volume surrounding an extraction well were equal to the concentrations that have been detected in groundwater samples from that well (e.g., 157 μg/L of total DCE isomers in groundwater samples from Well #1; Table G.2).

In reality, chemical concentrations in groundwater within Site SS-45, England AFB, are spatially variable, as a consequence of subsurface heterogeneities, widely-distributed points of

introduction of chemicals to groundwater, and differences in history of chemical discharge. It therefore seems likely that groundwater in some parts of the pore volume within the radius of influence (radius of capture) of an extraction well could contain chemicals at higher concentrations than have been detected in groundwater samples collected from the locations considered for extraction wells (Wells #1, #4, and SS45L001MW). For example, vinyl chloride was not detected in groundwater samples collected from Well #4, in the 2500 Area of the Base (Section 4 of the report). However, elevated concentrations of vinyl chloride, ranging from 420 μg/L to 1,260 μg/L, have historically been detected in groundwater samples from Well A39L010PZ. Well A39L010PZ is about 400 feet south of Well #4, and thus lies within the pore volume surrounding Well #4. If groundwater extraction were implemented in the 2500 Area, the ultimate fate of vinyl chloride in groundwater near well A39L010PZ would thus be to degrade naturally, or to be removed with groundwater pumped from an extraction well near Well #4.

Such zones, containing chemicals at relatively elevated concentrations, may occur at any point within the pore volume surrounding an extraction well; and removal of chemicals from the porous medium at greater radial distances from the extraction well will occur more slowly than will removal of chemicals from nearby locations. Therefore, a second series of calculations was completed, using the maximum concentrations of chemicals detected in the vicinity of each extraction point as the initial concentrations in the groundwater system within the pore volume surrounding the extraction point (Table G.3). Use of the maximum chemical concentrations detected in groundwater within a particular area as the initial concentrations for a simulation provides an upper-bound estimate of the length of time required to achieve the specified target concentrations.

The maximum concentration of DCE isomers in groundwater in the southern part of the 2500 Area (157 μg/L of DCE as total isomers) was detected in the groundwater sample collected from Well #1, in March 1999. The maximum concentration of vinyl chloride detected in groundwater in the vicinity of Well #1 within the same time frame (120 μg/L) was detected in the groundwater sample, collected from Well #5 in March 1999. TCE was not detected in groundwater samples collected from the southern part of the 2500 Area. The concentrations of total DCE isomers and vinyl chloride detected in groundwater samples from Wells #1 and #5, respectively, were therefore used as initial chemical concentrations in the second series of kinetic-based calculations, completed for the southern part of the 2500 Area.

The maximum concentration of DCE isomers in groundwater in the northern part of the 2500 Area (480 μg/L of DCE as total isomers) was detected in the groundwater sample collected from Well #4, in March 1999; and vinyl chloride was detected, at a concentration of 420 μg/L in the groundwater sample, collected from Well A39L010PZ in March 1999. These were used as the initial chemical concentrations in the second series of kinetic-based calculations, completed for the northern part of the 2500 Area.

The maximum concentration of TCE in groundwater in the 800 Area (560 μg/L) in March 1999 was detected in the groundwater sample collected from Well SS45L001MW. The maximum concentrations of DCE isomers and vinyl chloride (124 μg/L and 3 μg/L, respectively) in samples collected from the vicinity of Well SS45L001MW, in March 1999, were detected in groundwater samples from Wells #11 and #15. These were used as the initial chemical concentrations in the second series of kinetic-based calculations, completed for the 800 Area.

TABLE G.3
Summary of Kinetic-Based Calculations
Initial Chemical Concentrations are Maximum Concentrations Detected in Vicinity

	VOLATILE ORGANIC CHEMICALS		
	TCE	**Total DCE Isomers**	**Vinyl Chloride**
Maximum Contaminant Level Concentrations (μg/L)	**5**	**70**	**2**
WELL #1			
Initial Dissolved Concentrations (μg/L)	ND	157	120
Initial Sorbed Concentrations (mg/kg)	ND	0.053	0.002
Time to Achieve Target Concentrations at Well #1			
Natural attenuation only	currently achieved	5.5 years	26.5 years
Pumping at rate of 0.01 pore volume per year	currently achieved	5.5 years	25.5 years
Pumping at rate of 0.06 pore volume per year	currently achieved	4.5 years	21 years
WELL #4			
Initial Dissolved Concentrations (μg/L)	ND	480	420
Initial Sorbed Concentrations (mg/kg)	ND	0.162	0.008
Time to Achieve Target Concentrations at Well #4			
Natural attenuation only	currently achieved	13 years	34 years
Pumping at rate of 0.01 pore volume per year	currently achieved	12.5 years	33.5 years
Pumping at rate of 0.06 pore volume per year	currently achieved	10 years	26 years
WELL SS45L001MW			
Initial Dissolved Concentrations (μg/L)	560	124	3
Initial Sorbed Concentrations (mg/kg)	0.35	0.032	ND
Time to Achieve Target Concentrations at Well SS45L001MW			
Natural attenuation only	32 years	22 years	48 years
Pumping at rate of 0.01 pore volume per year	31 years	21.5 years	47 years
Pumping at rate of 0.06 pore volume per year	25.5 years	15.5 years	35 years

Notes:

1. Chemical concentrations and target concentration levels presented in Sections 4 and 5 of the Report.

Three simulations were completed for each set of chemical concentrations, to evaluate the effects of pumping groundwater representative of maximum detected chemical concentrations in the groundwater system in the vicinity of each of three wells (well SS45L001MW, and Wells #1 and #4). The first simulation at each well assumed that no pumping occurred ($V_{flow} = 0$), so that all chemical mass removal occurred solely as a result of chemical degradation. The second simulation at each well assumed that a pumping system, extracting water at the rate of 0.01 pore volume per year ($V_{flow} = 0.01$), would operate until the target concentration for each chemical was attained. The third simulation at each well assumed that a pumping system, extracting water at the rate of 0.06 pore volume per year ($V_{flow} = 0.06$), would operate until the target concentration for each chemical was attained.

The calculated times required to achieve target concentrations of TCE, cis-1,2-DCE, and vinyl chloride, in groundwater near Well #1, Well #4, and SS45L001MW, with and without active pumping, are summarized in Table G.3, and described as follow:

- TCE is not present in groundwater near Well #1. In the absence of future introduction of TCE to groundwater in this area, target concentrations of TCE have been achieved.

- Chemical degradation alone will reduce the maximum concentration of total DCE isomers in groundwater near Well #1 to the target concentration for cis-1,2-DCE in a period of about 5.5 years. If pumping at a rate of 0.01 pore volume per year is implemented near Well #1, the target concentration for cis-1,2-DCE will be achieved in a period of about 5.5 years. If pumping at a rate of 0.06 pore volume per year is implemented near Well #1, the target concentration for cis-1,2-DCE will be achieved in a period of about 5.5 years.

- Chemical degradation alone will reduce the maximum concentration of vinyl chloride in groundwater near Well #1 to the target concentration for vinyl chloride in a period of about 26.5 years. If pumping at a rate of 0.01 pore volume per year is implemented near Well #1, the target concentration for vinyl chloride will be achieved in a period of about 25.5 years. If pumping at a rate of 0.06 pore volume per year is implemented near Well #1, the target concentration for vinyl chloride will be achieved in a period of about 21 years.

These results are nearly identical to the results, previously obtained, assuming that the chemical concentrations historically detected in groundwater samples from Well #1 represent current conditions throughout the pore volume surrounding the well (neglecting maximum chemical concentrations detected elsewhere). This occurs because Well #1 was selected as an extraction location on the basis of having the highest concentrations of the most highly chlorinated CAH detected in the southern part of the 2500 Area. Dechlorination of the most highly chlorinated CAH occurring in groundwater is the rate-limiting step for removal of chlorinated constituents, and daughter products, from groundwater. Dehalogenation of vinyl chloride cannot proceed to complete mineralization until all the DCE has already been degraded to vinyl chloride. Similar results are obtained using the maximum concentrations of TCE and daughter products detected in groundwater in the vicinity of Wells #4 and SS45L001MW as the initial concentrations of chemicals in the pore volume surrounding those wells.

G4.3 Initial Chemical Concentrations are Median Concentrations Detected in Vicinity of Well

The assumption that all groundwater contained within one pore volume of the Intermediate Sand unit initially contains chemicals at the maximum concentrations detected in the vicinity of the extraction wells provides an upper-bound estimate of the probable length of time required to achieve the specified target concentrations. However, the spatial variability of chemical concentrations in groundwater within Site SS-45, England AFB, suggests that this assumption may be overly conservative when applied to estimation of the most likely time period required to achieve the specified concentrations. If the concentrations of chemicals detected in groundwater samples collected from wells in the vicinity of a particular extraction point are generally representative of chemical conditions throughout the groundwater system surrounding that extraction point, then some "average" value of chemical concentrations will be more representative of conditions within the pore volume of the Intermediate Sand unit surrounding the extraction point. In order to evaluate the length of time required to achieve target concentrations, with initial chemical concentrations representative of current conditions, a third series of kinetic-based calculations was completed, using median values of chemical concentrations detected in groundwater samples collected in the vicinity of each extraction point. (Median chemical concentration values were used, because the underlying population distribution of concentrations is not known, and the median is statistically the most robust estimator of the "average" value in this situation [Rock, 1988, p. 86ff]).

Wells #5, #6, #7, A39L011PZ, and A39L012PZ are completed in the Intermediate Sand unit in the vicinity (a radial distance of 750 feet) of the assumed extraction point (Well #1), in the southern part of the 2500 Area (Figure 4.4-3 of the focussed CMS report). TCE was not detected in groundwater samples collected from any of these wells in March 1999. The median concentration of DCE in groundwater in the vicinity of Well #1 (48 μg/L as total isomers) was detected in the sample collected from well A39L011PZ; and the median concentration of vinyl chloride, detected in groundwater samples collected from the seven wells in March 1999 was 0.0 μg/L. The median concentrations of total DCE isomers and vinyl chloride detected in groundwater samples from the vicinity of Well #1 were used as initial chemical concentrations in the third series of kinetic-based calculations, completed for the southern part of the 2500 Area (Table G.4).

Wells #2, #3, #5, A39L010PZ, and A39L019PZ are in the vicinity of the assumed extraction point (Well #4), in the northern part of the 2500 Area (Figure 4.4-3 of the report). TCE was not detected in groundwater samples collected from any of these wells in March 1999. The median concentration of DCE in groundwater in the vicinity of Well #4 (12 μg/L as total isomers) was detected in the sample collected from well A39L010PZ in March 1999. The median concentration of vinyl chloride in groundwater in the vicinity of Well #4 (0.5 μg/L) was detected in the groundwater sample collected from Well #2. These median concentrations of total DCE isomers and vinyl chloride were used as initial chemical concentrations in the third series of kinetic-based calculations, completed for the northern part of the 2500 Area (Table G.4).

Wells #10, #11, #13, #15, and A39L009PZ, completed in the Intermediate Sand unit in the vicinity of the assumed extraction point (Well SS45L001MW) in the 800 Area (Figures 4.4-2 and 4.4-3 of the focussed CMS report), were sampled in March 1999. The median concentration of TCE detected in groundwater samples, collected in the vicinity of Well SS45L001MW in March 1999 (34 μg/L) was detected in the sample from Well A39L009PZ. The median

TABLE G.4
Summary of Kinetic-Based Calculations
Initial Chemical Concentrations are Median Concentrations Detected in Vicinity

	VOLATILE ORGANIC CHEMICALS		
	TCE	**Total DCE Isomers**	**Vinyl Chloride**
Maximum Contaminant Level Concentrations (μg/L)	**5**	**70**	**2**
WELL #1			
Initial Dissolved Concentrations (μg/L)	ND	48	ND
Initial Sorbed Concentrations (mg/kg)	ND	0.016	ND
Time to Achieve Target Concentrations at Well #1			
Natural attenuation only	currently achieved	currently achieved	18.5 years
Pumping at rate of 0.01 pore volumes per year	currently achieved	currently achieved	18 years
Pumping at rate of 0.06 pore volumes per year	currently achieved	currently achieved	14 years
WELL #4			
Initial Dissolved Concentrations (μg/L)	ND	12	0.5
Initial Sorbed Concentrations (mg/kg)	ND	0.004	ND
Time to Achieve Target Concentrations at Well #4			
Natural attenuation only	currently achieved	currently achieved	8 years
Pumping at rate of 0.01 pore volumes per year	currently achieved	currently achieved	7.5 years
Pumping at rate of 0.06 pore volumes per year	currently achieved	currently achieved	4.5 years
WELL SS45L001MW			
Initial Dissolved Concentrations (μg/L)	34	32	1.4
Initial Sorbed Concentrations (mg/kg)	0.021	0.008	ND
Time to Achieve Target Concentrations at Well SS45L001MW			
Natural attenuation only	13 years	currently achieved	25 years
Pumping at rate of 0.01 pore volumes per year	12.5 years	currently achieved	23.5 years
Pumping at rate of 0.06 pore volumes per year	10.5 years	currently achieved	17.5 years

Notes:
1.Chemical concentrations and target concentration levels presented in Sections 4 and 5 of the Report.

concentration of DCE in groundwater in the vicinity of Well #SS45L001MW (32 μg/L as total isomers) was detected in the sample collected from Well #10; and median concentration of vinyl chloride (1.4 μg/L) was detected in the groundwater sample from well A39L009PZ. These median concentrations were used as initial chemical concentrations in the third series of kinetic-based calculations, completed for the 800 Area (Table G.4).

Three simulations were completed for each set of chemical concentrations, to evaluate the effects of pumping groundwater containing TCE and its daughter products at concentrations representative of concentrations throughout the groundwater system (the median concentrations) in the vicinity of each of three wells (well SS45L001MW, and Wells #1 and #4). The first simulation at each well assumed that no pumping occurred ($V_{flow} = 0$), so that all chemical mass removal occurred solely as a result of chemical degradation. The second simulation at each well assumed that a pumping system, extracting water at the rate of 0.01 pore volume per year ($V_{flow} = 0.01$), would operate until the target concentration for each chemical was attained. The third simulation at each well assumed that a pumping system, extracting water at the rate of 0.06 pore volume per year ($V_{flow} = 0.06$), would operate until the target concentration for each chemical was attained.

The calculated times required to achieve target concentrations of TCE, cis-1,2-DCE, and vinyl chloride, in groundwater near Well #1, Well #4, and SS45L001MW, with and without active pumping, are summarized in Table G.4, and described as follow:

- TCE is not present in groundwater near Well #1. In the absence of future introduction of TCE to groundwater in this area, target concentrations of TCE have been achieved.

- The median concentration of total DCE isomers in groundwater near Well #1 is currently below the target concentration for cis-1,2-DCE. In the absence of future introduction of TCE or DCE isomers to groundwater in this area, the median concentration of DCE isomers will remain below the target concentration for cis-1,2-DCE.

- Chemical degradation alone will reduce the median concentration of vinyl chloride in groundwater near Well #1 to the target concentration for vinyl chloride in a period of about 18.5 years. This is about eight years less than would be required for chemical degradation alone to reduce the maximum concentration of vinyl chloride in groundwater near Well #1 to the target concentration for vinyl chloride. If pumping at a rate of 0.01 pore volume per year is implemented near Well #1, the target concentration for vinyl chloride would be achieved in a period of about 18 years. If pumping at a rate of 0.06 pore volume per year were implemented near Well #1, the target concentration for vinyl chloride would be achieved in a period of about 14 years.

Similarly, shorter periods of time are required to achieve target concentrations of TCE, cis-1,2-DCE, and vinyl chloride in groundwater if median, rather than maximum, chemical concentrations in groundwater in the vicinity of extraction wells located at Well #4 and SS45L001MW are assumed to represent the initial concentrations of chemicals in the pore volume surrounding those wells (Table G.4).

G4.4 Discussion

The results of kinetic-based geochemical calculations indicate that, under the assumptions made to estimate initial and existing conditions in the subsurface, and given the simplifications inherent in portraying a complex, heterogeneous system with a set of differential equations, in most circumstances there is little difference in the times required to reach target concentrations of TCE and its daughters, with or without pumping. This occurs primarily because sorption of chemicals to soil hinders the removal of chemicals via groundwater extraction.

Because natural attenuation processes will, in time, remove most of the chemical mass from groundwater at Site SS-45, whether or not groundwater extraction is implemented, the length of time required for full implementation of a natural attenuation remedy, or of a remedy that combines natural attenuation and groundwater extraction, depends on the mechanics of the degradation process (Equation G-2). As TCE and its DCE daughter compounds are removed from the groundwater system by degradation or extraction processes, vinyl chloride is generated, and will thus be the last of the TCE daughter products remaining in groundwater at Site SS-45. Furthermore, the target concentration of vinyl chloride (2 μg/L) is the lowest of any compound in the TCE degradation chain. Because vinyl chloride is generated as other CAH compounds are degraded, and because the target concentrations of vinyl chloride are lower than those of TCE and its other daughters, the time required to achieve target concentrations of vinyl chloride in groundwater is correspondingly longer than the times required to achieve target concentrations of TCE or DCE isomers. Therefore, the time required to achieve target concentrations of vinyl chloride represents the full implementation period for any groundwater remedy.

A relatively broad range of initial chemical concentrations was used in the kinetic-based calculations -- concentrations detected in samples at the locations of the assumed extraction wells, maximum concentrations, and median concentrations detected in groundwater samples from the vicinity of assumed extraction wells. Several different pumping rates (expressed as pore volumes per year) were also examined – no pumping; pumping at a rate of 0.01 pore volume per year, equivalent to a single well extracting groundwater at a rate of 20 gpm from a cylindrical volume having a 2,000-foot radius; and pumping at a rate of 0.06 pore volume per year, equivalent to a single well extracting groundwater at a rate of 120 gpm from a cylindrical volume having a 2,000-foot radius. These provide reasonable estimates of upper and lower bounds for the length of the time period required to achieve target concentrations of TCE and its daughter products in groundwater at Site SS-45, for a system in which chemical removal occurs through degradation only, and for a system in which chemical removal occurs through a combination of chemical degradation and pumping. Those estimates can be further refined, for the purposes of evaluating and costing a conceptual extraction and treatment system for groundwater, containing volatile organic chemicals at Site SS-45, England AFB.

G4.4.1 Time Required for Natural Attenuation Alone to Achieve Target Chemical Concentrations in Groundwater

We note first that no groundwater extraction will occur during implementation of remedies depending solely on natural attenuation of TCE and daughter products to achieve target concentrations. This means that movement of groundwater in the subsurface, and associated migration and mixing of chemicals from point to point, will be minimal during the implementation period of a natural attenuation remedy. Furthermore, first-order degradation processes are assumed to proceed at the same rate at every point in the subsurface, regardless of

the initial chemical concentrations. If reduction of the concentrations of TCE and its daughter products to target concentrations at every point in groundwater in the Intermediate and Deep Sand units is identified as the remediation criterion for Site SS-45, then because mixing of chemicals will not occur, the maximum chemical concentrations detected in the 800 Area and 2500 Area are the appropriate initial chemical concentrations for estimating the time required for full implementation of remedies depending solely on natural attenuation. Therefore, a remedial measure for groundwater relying on natural attenuation alone, implemented in the southern part of the 2500 Area (in the vicinity of Well #1), will require a period of about 26.5 years to achieve target concentrations of vinyl chloride. A natural-attenuation remedy for groundwater implemented in the northern part of the 2500 Area (in the vicinity of Well #4) will require a period of about 34 years to achieve target concentrations of vinyl chloride; and a natural-attenuation remedy for groundwater implemented in the 800 Area will require a period of about 48 years to achieve target concentrations of vinyl chloride.

G4.4.2 Time Required for Natural Attenuation in Combination with Groundwater Extraction to Achieve Target Chemical Concentrations in Groundwater

Remedies that utilize groundwater extraction also rely to a large degree on natural attenuation mechanisms to remove chemicals from groundwater. In active extraction remedies, RNA is supplemented by pumping, which moves groundwater through zones that contain chemicals to advectively transport dissolved chemical mass to the extraction point. The rate of groundwater movement (the groundwater flow velocity) varies with radial distance from the extraction point – higher velocities occur near an extraction well, and lower velocities occur at greater distances from the well. The radius of capture for a well that withdraws water from the Intermediate Sand unit will probably exceed 2,000 feet (Section G1.2). It is not possible to estimate the varying concentrations of chemicals throughout the full saturated volume of the Intermediate Sand unit that would be affected by an extraction well. Neither is it possible to calculate directly the time required for chemical removal, assuming a spatially-variable distribution of chemical concentrations, because calculation of groundwater extraction and chemical removal rates in terms of pore volumes requires that the initial concentrations of chemicals within a pore volume be uniform. If some zone within the Intermediate Sand unit, containing elevated concentrations of TCE and daughter products, is located at a relatively great distance from a groundwater extraction point (e.g., near the extreme radius of influence of an extraction well), then groundwater flow velocities through that zone will be relatively low (perhaps 0.01 pore-volume equivalents per year, or less), and most removal of chemical mass will occur as a consequence of *in-situ* chemical degradation, rather than groundwater extraction. This is a direct consequence of Equation G-4, which states that extractive removal of chemical mass depends on the rate of pore-volume removal (V_{flow} term) – faster groundwater flow velocities result in more rapid extraction of chemical mass. Therefore, if reduction of the chemical concentrations to target concentrations at every point in groundwater in the Intermediate and Deep Sand units is identified as the remediation criterion for Site SS-45, the time required to reduce the maximum concentrations of chemicals detected in groundwater at Site SS-45 to target concentrations, by natural attenuation processes alone, or by natural attenuation in combination with groundwater extraction at a low rate, may also represent an upper bound estimate for the time required for full implementation of a remedy that combines natural attenuation and groundwater extraction.

In reality, an extraction well could be located near every identified area, containing elevated concentrations of chemicals, in Site SS-45; and groundwater movement toward an extraction well could be sustained at some velocity greater than 0.01 pore-volume equivalents per year

(perhaps as great as 0.06 pore-volume equivalents per year). However, because of the large radius of influence (and radius of capture) of any well pumping from the Intermediate Sand unit, most groundwater removed by an extraction well will contain relatively low concentrations of chemicals, because zones of the groundwater system that contain chemicals at elevated concentrations are relatively limited in areal extent (probably much less than one pore volume), and mixing of groundwater containing relatively higher concentrations of chemicals with groundwater containing lower concentrations will occur, as groundwater moves toward the extraction point. Therefore, if reduction of some "average" chemical concentrations in groundwater in the Intermediate and Deep Sand units to target concentrations is identified as the remediation criterion for Site SS-45, the time required to reduce the median concentrations of chemicals detected in groundwater at Site SS-45 to target concentrations, by natural attenuation in combination with groundwater extraction at a relatively higher rate, may represent a lower bound estimate for the time required for full implementation of a remedy that combines natural attenuation and groundwater extraction.

Using the results of the kinetic-based geochemical model, we calculated that a remedy combining natural attenuation and low-flow-rate groundwater extraction (**Alternative 2a**) would require a period of 25.5 years to achieve target concentrations of vinyl chloride in groundwater in the vicinity of Well #1, in the 2500 Area, if the maximum concentrations detected in the vicinity represented initial chemical concentrations in groundwater throughout the pore volume surrounding Well #1 (Table G.3). If median concentrations of chemicals detected in groundwater samples collected in the vicinity of Well #1 are representative of initial chemical conditions throughout the southern part of the 2500 Area, then a period of 18 years would be required to achieve target concentrations of vinyl chloride in groundwater in the vicinity (Table G.4). Estimates for the period of time required to achieve target concentrations of vinyl chloride in groundwater in the vicinity of Well #1, using the low-extraction-rate alternative, therefore range from 18 to about 26 years, with a mid-range value of 22 years. For purposes of evaluating and costing a conceptual pump-and-treat system for groundwater in the southern part of the 2500 Area (in the vicinity of Well #1), we assume that the low-extraction-rate system (**Alternative 2a**) will require a period of 22 years to achieve target chemical concentrations, and will remain in operation through the full 22-year period.

Similarly, the remedy combining natural attenuation and high-flow-rate groundwater extraction (**Alternative 2b**) would require a period of 21 years to achieve target concentrations of vinyl chloride in groundwater in the vicinity of Well #1, in the 2500 Area, if the maximum concentrations detected in the vicinity represented initial chemical concentrations in groundwater throughout the pore volume surrounding Well #1 (Table G.3). If median concentrations of chemicals detected in groundwater samples collected in the vicinity of Well #1 are representative of initial chemical conditions throughout the southern part of the 2500 Area, then a period of 14 years would be required to achieve target concentrations of vinyl chloride in groundwater in the vicinity (Table G.4). Estimates for the period of time required to achieve target concentrations of vinyl chloride in groundwater in the vicinity of Well #1, pumping at a rate of 0.06 pore volume per year, therefore range from 14 to about 21 years, with a mid-range value of 18 years. For purposes of evaluating and costing a conceptual pump-and-treat system for groundwater in the southern part of the 2500 Area (in the vicinity of Well #1), we assume that the high-extraction-rate system (**Alternative 2b**) will require a period of 18 years to achieve target chemical concentrations, and will remain in operation through the full 18-year period.

A remedy combining natural attenuation and low-flow-rate groundwater extraction (**Alternative 2a**) would require a period of about 34 years to achieve target concentrations of vinyl chloride in groundwater in the vicinity of Well #4, in the 2500 Area, if the maximum concentrations detected in the vicinity represented initial chemical concentrations in groundwater throughout the pore volume surrounding Well #4 (Table G.3). If median concentrations of chemicals detected in groundwater samples collected in the vicinity of Well #4 are representative of initial chemical conditions throughout the northern part of the 2500 Area, then a period of about 7.5 years would be required to achieve target concentrations of vinyl chloride in groundwater in the vicinity (Table G.4). Estimates for the period of time required to achieve target concentrations of vinyl chloride in groundwater in the vicinity of Well #4, using the low-extraction-rate alternative, therefore range from 7.5 to about 34 years, with a mid-range value of about 20 years. For purposes of evaluating and costing a conceptual low-extraction-rate system (**Alternative 2a**) for groundwater in the northern part of the 2500 Area (in the vicinity of Well #4), we assume that the extraction and treatment system will require a period of 20 years to achieve target chemical concentrations, and will remain in operation through the full 20-year period.

The remedy combining natural attenuation and high-flow-rate groundwater extraction (**Alternative 2b**) would require a period of 26 years to achieve target concentrations of vinyl chloride in groundwater in the vicinity of Well #4, in the 2500 Area, if the maximum concentrations detected in the vicinity represented initial chemical concentrations in groundwater throughout the pore volume surrounding Well #4 (Table G.3). If median concentrations of chemicals detected in groundwater samples collected in the vicinity of Well #4 are representative of initial chemical conditions throughout the northern part of the 2500 Area, then a period of about 5 years would be required to achieve target concentrations of vinyl chloride in groundwater in the vicinity (Table G.4). Estimates for the period of time required to achieve target concentrations of vinyl chloride in groundwater in the vicinity of Well #4, pumping at a rate of 0.06 pore volume per year, therefore range from about 5 to 26 years, with a mid-range value of about 18 years. For purposes of evaluating and costing a conceptual pump-and-treat system for groundwater in the northern part of the 2500 Area (in the vicinity of Well #4), we assume that the high-extraction-rate system (**Alternative 2b**) will require a period of 18 years to achieve target chemical concentrations, and will remain in operation through the full 18-year period.

A remedy combining natural attenuation and low-flow-rate groundwater extraction (**Alternative 2a**) would require a period of about 47 years to achieve target concentrations of vinyl chloride in groundwater in the vicinity of well SS45L001MW, in the 800 Area, if the maximum concentrations detected in the vicinity represented initial chemical concentrations in groundwater throughout the pore volume surrounding well SS45L001MW (Table G.3). If median concentrations of chemicals detected in groundwater samples collected in the vicinity of the well are representative of initial chemical conditions throughout the 800 Area, then a period of about 23.5 years would be required to achieve target concentrations of vinyl chloride in groundwater in the 800 Area. Estimates for the period of time required to achieve target concentrations of vinyl chloride in groundwater in the 800 Area therefore range from about 24 to about 47 years, with a mid-range value of about 35 years. For purposes of evaluating and costing a conceptual extraction and treatment system for groundwater in the 800 Area (in the vicinity of well SS45L001MW), we assume that the low-extraction-rate system (**Alternative 2a**) will require a period of 35 years to achieve target chemical concentrations, and will remain in operation through the full 35-year period.

The remedy combining natural attenuation and high-flow-rate groundwater extraction (**Alternative 2b**) would require a period of about 35 years to achieve target concentrations of vinyl chloride in groundwater in the vicinity of well SS45L001MW, in the 800 Area, if the maximum concentrations detected in the vicinity represented initial chemical concentrations in groundwater throughout the pore volume surrounding well SS45L001MW (Table G.3). If median concentrations of chemicals detected in groundwater samples collected in the vicinity of the well are representative of initial chemical conditions throughout the 800 Area, then a period of about 17.5 years would be required to achieve target concentrations of vinyl chloride in groundwater in the 800 Area. Estimates for the period of time required to achieve target concentrations of vinyl chloride in groundwater in the 800 Area therefore range from about 18 to about 35 years, with a mid-range value of about 26 years. For purposes of evaluating and costing a conceptual extraction and treatment system for groundwater in the 800 Area (in the vicinity of well SS45L001MW), we assume that the high-extraction-rate system (**Alternative 2b**) will require a period of 26 years to achieve target chemical concentrations, and will remain in operation through the full 26-year period.

G4.5 Sensitivity Analysis

A sensitivity analysis was conducted to evaluate which of the input parameters to the kinetic-based geochemical model might have the greatest effect on the predictions made with the model. The primary purpose of such an analysis is to identify those parameters that should be the focus of continuing investigations in order to minimize the uncertainties associated with model predictions.

The parameters of primary interest in the sensitivity analysis were the first-order degradation rate constants for TCE, DCE isomers, and vinyl chloride, the fraction of organic carbon in soil, and the possible rates of groundwater extraction. The total length of time required to achieve target concentrations of vinyl chloride (2 μg/L or less) in groundwater at each of three possible extraction-well locations (well SS45L001MW in the 800 Area; and Wells #1 and #4 in the 2500 Area) was selected as the predictive result to be compared in the analysis.

The sensitivity analysis was conducted using a standard variational technique in which the value of a particular input parameter is changed within some specified range, and a new predictive simulation is made using the new initial conditions. The predicted result is then compared with the original result. A first-order approximation to the variance of chemical concentrations through time, which is a function of several hydraulic and chemical parameters, is (Benjamin and Cornell, 1970):

$$Var[C_t] = \sum_{i=1}^{n} \left(\frac{\Delta C_t}{\Delta x_i} \right)^2 \times Var[x_i] \quad \text{(G-7)}$$

where:

C_t = chemical concentration at time t,

x_i = a hydraulic or chemical parameter (e.g., first-order degradation rate constant for TCE), and

$\Delta C_t / \Delta x_i$ = the rate of change of C_t with respect to x_i.

Equation G-7 indicates that each of the hydraulic and chemical parameters contributes to the overall variance of the predicted chemical concentrations through time in proportion to its own variance and the cumulative rates of change in chemical concentrations in groundwater with respect to each of the varied parameters.

The results of the sensitivity analysis indicate that the model predictions are most sensitive to changes in the values used for the first-order degradation rate constant for vinyl chloride, and are slightly less sensitive to the first-order degradation rate constants for TCE and DCE isomers (Table G.5). Predictions of the time required to achieve target concentrations of vinyl chloride in groundwater are relatively insensitive to the rates of groundwater extraction, indicating that active extraction would be only marginally effective in achieving target concentrations of chemicals. This occurs because removal of chemical mass via advective movement of groundwater is hindered by chemical sorptive processes.

The ranges of time required to achieve target concentrations in groundwater near one well location (Well #1), derived using Equation G-7 over the range of hydraulic and chemical parameters in Table G.5 are shown on Figure G.1. The "model predicted concentrations of vinyl chloride" are those calculated using the median values of first-order rate constants, organic-carbon fractions, and groundwater extraction rates, used to generate the predictions of times required to achieve target concentrations of vinyl chloride, during comparison of natural attenuation alone and natural attenuation with groundwater-extraction (preceding sections). The upper and lower confidence limits define the envelope of vinyl chloride concentrations through time, calculated with two standard deviations derived from the variance obtained using Equation G-7. For the given ranges of hydraulic and chemical parameter values given in Table G-5, use of two standard deviations around the median prediction means that there is a 95 percent probability that the time required to achieve MCL concentrations of vinyl chloride in groundwater at a particular location will be within this envelope.

The median predictions and two-standard-deviation envelopes are presented for Well #1, for MCL concentrations of vinyl chloride achieved by natural attenuation alone, and for MCL concentrations achieved using a combination of natural attenuation and groundwater extraction (Figure G.1). The lower confidence limit for each set of calculations is less than one year, because fortuitous combinations of circumstances (low initial concentrations, elevated degradation rates for vinyl chloride, no degradation of DCE isomers) could cause all the vinyl chloride to be removed from groundwater in a short period of time. The upper 95 percent confidence limits establish the maximum length of time required to achieve MCL concentrations of vinyl chloride, under combinations of circumstances that tend to inhibit removal of TCE and its daughter products (in particular, vinyl chloride) from groundwater. The "envelopes" of upper 95 percent confidence limits of time predicted to reach MCL concentrations of vinyl chloride, with natural attenuation alone, and with natural attenuation supplemented by groundwater pump-and-treat (245 years and 440 years, respectively) are about one order of magnitude greater than the "base case" predictions for achieving target concentrations of vinyl chloride in groundwater at Well #1 (26.5 and 25.5 years, respectively). This is a consequence of the extreme sensitivity of the calculations to first-order degradation rate constants – use of the lowest values of first-order degradation constants lengthens considerably the time required to achieve target concentrations.

The confidence limits shown in Figure G.1 represent improbable scenarios since the values of several parameters would have to be near the extremes of their expected range to produce such results. For example, a period of 440 years would be required to achieve target concentrations of

TABLE G.5
SUMMARY OF SENSITIVITY ANALYSIS
EFFECT OF PARAMETER UNCERTAINTY ON CLEAN-UP TIME
SITE SS-45
ENGLAND AIR FORCE BASE
ALEXANDRIA, LOUISIANA

Monitoring Well ID	Site Area	Remedial Method	Parameters Varied in Sensitivity Analysis:	First-Order Degradation Rate Constant (day^{-1})			Fraction of Organic Carbon (f_{oc})	Extraction Rate (pore volumes per year)	Results: Range of Time to Achieve Action-Level Concentrations of Vinyl Chloride
				TCE[a]	DCE[b] Isomers	Vinyl Chloride			
SS45L001MW	800 Area	Natural Attenuation Only	Chemical:	TCE[a]	DCE[b] Isomers	Vinyl Chloride	--[c]	--	
			Initial Concentration (µg/L)[d]:	560	124	3	--	--	
			Minimum:	0.00002	0.000017	0.000025	0.000712	--	
			Median:	0.0004	0.0004	0.0009	0.001	--	
			Maximum:	0.0018	0.0039	0.0045	0.00171	--	
			Relative Sensitivity:	**Sensitive**	**Sensitive**	**Very Sensitive**	**Slightly Sensitive**	**N/A[e]**	**< 1 year to 510 years**
SS45L001MW	800 Area	Groundwater Extraction (Pump and Treat) with Natural Attenuation	Chemical:	TCE	DCE Isomers	Vinyl Chloride	--	--	
			Initial Concentration (µg/L):	560	12	ND[f]	--	--	
			Minimum:	0.00002	0.000017	0.000025	0.000712	0	
			Median:	0.0004	0.0004	0.0009	0.001	0.01	
			Maximum:	0.0018	0.0039	0.0045	0.00171	0.06	
			Relative Sensitivity:	**Sensitive**	**Sensitive**	**Very Sensitive**	**Slightly Sensitive**	**Insensitive**	**< 1 year to 310 years**
Well #1	2500 Area	Natural Attenuation Only	Chemical:	TCE	DCE Isomers	Vinyl Chloride	--	--	
			Initial Concentration (µg/L):	ND	157	120	--	--	
			Minimum:	0.00002	0.000017	0.000025	0.00072	--	
			Median:	0.0004	0.0004	0.0009	0.0013	--	
			Maximum:	0.0018	0.0039	0.0045	0.00606	--	
			Relative Sensitivity:	**N/A**	**Sensitive**	**Very Sensitive**	**Slightly Sensitive**	**N/A**	**< 1 year to 440 years**
Well #4	2500 Area	Natural Attenuation Only	Chemical:	TCE	DCE Isomers	Vinyl Chloride	--	--	
			Initial Concentration (µg/L):	ND	480	420	--	--	
			Minimum:	0.00002	0.000017	0.000025	0.00072	--	
			Median:	0.0004	0.0004	0.0009	0.0013	--	
			Maximum:	0.0018	0.0039	0.0045	0.00606	--	
			Relative Sensitivity:	**N/A**	**Sensitive**	**Very Sensitive**	**Slightly Sensitive**	**N/A**	**< 1 year to 535 years**
Well #1	2500 Area	Groundwater Extraction (Pump and Treat) with Natural Attenuation	Chemical:	TCE	DCE Isomers	Vinyl Chloride	--	--	
			Initial Concentration (µg/L):	ND	157	ND	--	--	
			Minimum:	0.00002	0.000017	0.000025	0.00072	0	
			Median:	0.0004	0.0004	0.0009	0.0013	0.01	
			Maximum:	0.0018	0.0039	0.0045	0.00606	0.06	
			Relative Sensitivity:	**N/A**	**Sensitive**	**Very Sensitive**	**Slightly Sensitive**	**Slightly Sensitive**	**< 1 year to 245 years**
Well #4	2500 Area	Groundwater Extraction (Pump and Treat) with Natural Attenuation	Chemical:	TCE	DCE Isomers	Vinyl Chloride	--	--	
			Initial Concentration (µg/L):	ND	480	ND	--	--	
			Minimum:	0.00002	0.000017	0.000025	0.00072	0	
			Median:	0.0004	0.0004	0.0009	0.0013	0.01	
			Maximum:	0.0018	0.0039	0.0045	0.00606	0.06	
			Relative Sensitivity:	**N/A**	**Sensitive**	**Very Sensitive**	**Slightly Sensitive**	**Slightly Sensitive**	**< 1 year to 305 years**

[a] TCE = Trichloroethene.
[b] DCE = Dichloroethene.
[c] "--" = not applicable
[d] µg/L = micrograms per liter.
[e] N/A = not applicable.
[f] ND = not detected.

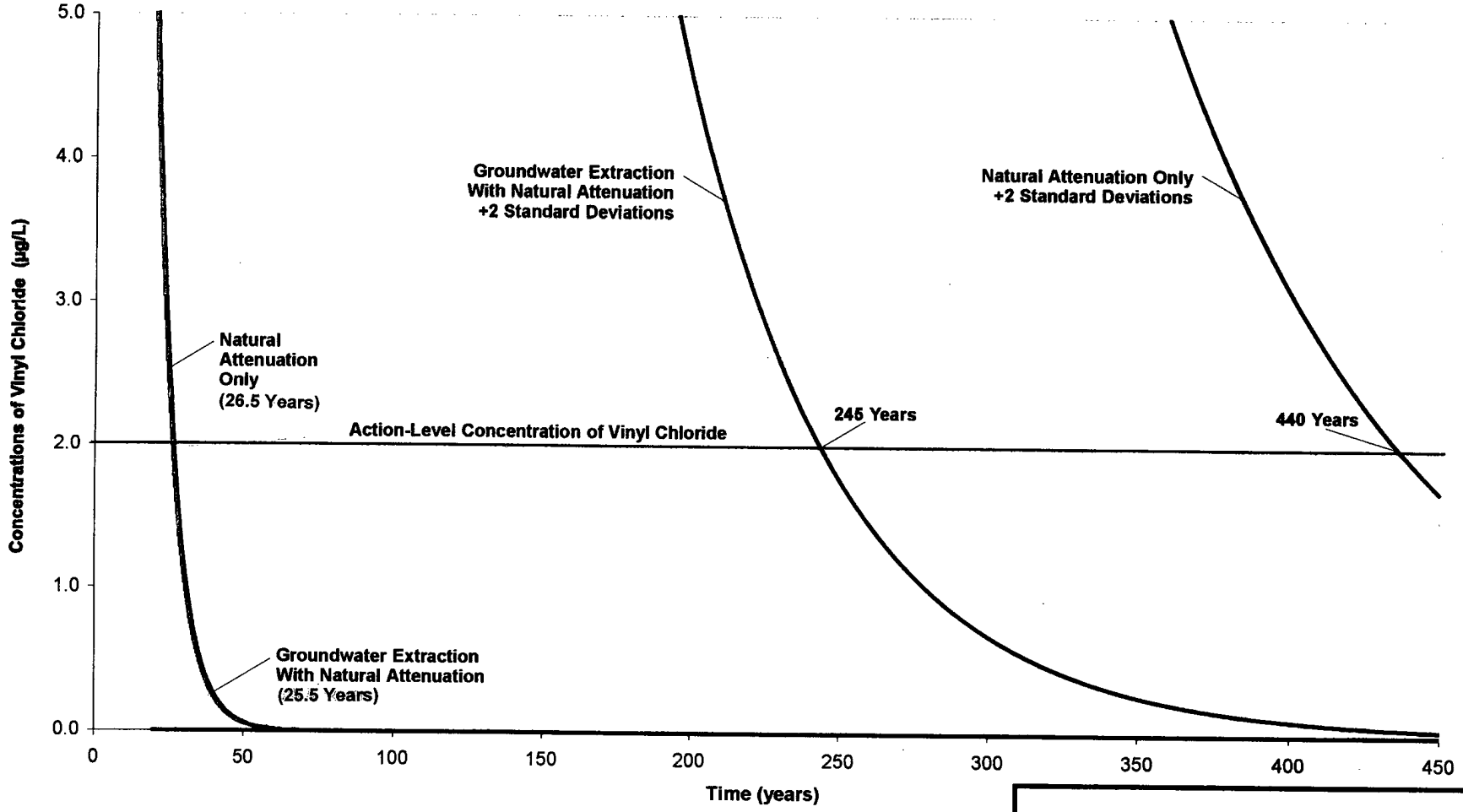


FIGURE G.1

RESULTS OF SENSITIVITY ANALYSIS OF CALCULATIONS AT WELL #1

Site SS-45
England Air Force Base
Alexandria, Louisiana

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PARSONS ENGINEERING SCIENCE, INC.
Denver, Colorado

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vinyl chloride in groundwater near Well #1, using natural attenuation alone, only if the first-order degradation rate constants for DCE isomers and vinyl chloride were all at their minimum values, and the fraction of organic carbon was the maximum value in soil within the 2500 Area (producing elevated sorbed concentrations of chemicals, and slow desorption rates). Nevertheless, as additional chemical concentration data are collected, and concentration trends are evaluated during long-term monitoring, future predictions can be refined using better estimates of those parameters to which the calculations are most sensitive (first-order degradation rate constants), thereby reducing the uncertainty of those parameters.

G5.0 CONCEPTUAL COST ESTIMATES FOR ALTERNATIVE REMEDIES FOR GROUNDWATER AT SITE SS-45

G5.1 Natural Attenuation with Long-Term Groundwater Monitoring (Alternative 1)

No active groundwater remediation would be conducted under the natural-attenuation alternative. Rather, the alternative relies on naturally-occurring mechanisms, to remove volatile organic chemicals from groundwater in the Intermediate and Deep Sand units. Periodic monitoring would be conducted, to assess whether further migration of chemicals from source areas was occurring, and to evaluate the natural removal rate of chemicals from the groundwater system.

There are no capital costs, or O&M costs, associated with installation or operation of a remediation system, in this alternative. Furthermore, we have assumed for the purposes of generating this cost estimate, that wells in the existing network would be sufficient to conduct long-term monitoring, with no additional monitoring wells required to be installed. Monitoring would initially be conducted on an annual basis, and would include visual inspection of wells and other facilities at Site SS-45, measurement of water levels in all wells within Site SS-45, and collection and analyses of groundwater samples from a selected subset (approximately 30; Table G.6) of the existing monitoring wells. Over the longer term, the frequency of monitoring might be adjusted, based on monitoring results, and on an assessment of the continued effectiveness of natural attenuation. For the purpose of developing this cost estimate, we have assumed that monitoring would be conducted on an annual basis for the first five years of monitoring, and that the frequency of monitoring would be reduced to once every two years (biennial monitoring) for the remaining 43-year period required.

During the period 1999 through 2033 (34 years) groundwater samples would be collected from 24 monitoring wells in the 800 Area, and from 4 wells in the 2500 Area (Table G.6). After chemical concentrations in groundwater beneath the 2500 Area have decreased to levels below target concentrations (calculated to require a period of about 34 years), groundwater monitoring in the 2500 Area would cease. Groundwater monitoring would be continued in the 800 Area for another 12 years, using 24 wells, until chemical concentrations in groundwater beneath the 800 Area have decreased to levels below target concentrations (calculated to occur in year 2047).

Costs for long-term monitoring activities were estimated on an annual basis, and are referenced to constant (1999) dollars (refer to attached cost estimate). The total cost of monitoring and reporting for the natural-attenuation alternative, assuming that monitoring activities would be conducted for a 48-year period, is estimated to be **$1,300,000**.

TABLE G.6
GROUNDWATER MONITORING WELLS TO BE SAMPLED DURING LONG-TERM MONITORING EVENTS
SITE SS-45
ENGLAND AFB, LOUISIANA

Sampling Location	Area	Completion Interval[d]	Screened Interval (feet bgs)[e]	Measure Water Levels	Chemical Analyses/Parameter Measurements (Analysis Method): VOCs[a] (USEPA SW8260B)[f]	Methane, Ethane, and Ethene (NRML-147)[g]	Natural Attenuation Parameters[b]	Field Parameters[c] (meter)	Monitoring Frequency (year): 2000 Q[h]	2000 A[i]	2001 - 2003 Q	2001 - 2003 A	2004 Q	2004 A	Rationale
WELL#11	800 Area, central	IS	60 - 70	X[j]	X	X	X	X	X			X	X		Monitor CAH[k] concentrations and trends in south-central part of main 800-Area plume
WELL#13	800 Area, east	IS	70 - 80	X	X	X	X	X	X			X	X		"Sentry" well east of main 800-Area plume
WELL#15	800 Area, central	IS	60 - 70	X	X	X	X	X	X			X	X		Monitor CAH concentrations and degradation in area of relatively elevated concentrations
WELL#17	800 Area, north	IS	55 - 65	X	X	X	X	X	X			X	X		"Sentry" well northeast of main 800-Area plume
WELL#19	800 Area, north	IS	65 - 75	X	X	X	X	X	X			X	X		"Sentry" well north of main 800-Area plume
WELL#21	800 Area, north	IS	75 - 85	X	X	X	X	X	X			X	X		"Sentry" well northeast of main 800-Area plume
WELL#22[j]	800 Area, north	IS	Proposed ~ 40 - 50	X	X	X	X	X	X			X	X		"Sentry" well southeast of main 800-Area plume
A39L008DP	800 Area, north	IS	38 - 48	X	X	X	X	X		X		X	X		Monitor CAH concentrations and trends in northern part of main 800-Area plume
A39L009PZ	800 Area, central	IS	64 - 74	X	X	X	X	X		X		X	X		Monitor CAH concentrations and trends in south-central part of main 800-Area plume
A39L013DP	800 Area, east	IS	40 - 50	X	X	X	X	X	X			X	X		Monitor CAH concentrations and trends in south-central part of main 800-Area plume
A39L014DP	800 Area, northeast	IS	40 - 50	X	X	X	X	X	X			X	X		"Sentry" well east of main 800-Area plume
A39L036DP	800 Area, south	IS	59 - 68	X	X	X	X	X	X			X	X		"Sentry" well south of main 800-Area plume
A39L039DP	800 Area, west	IS	54 - 64	X	X	X	X	X	X			X	X		"Sentry" well west of main 800-Area plume
SS45L001MW	800 Area, central	IS	54 - 64	X	X	X	X	X		X		X	X		Monitor CAH concentrations and degradation in area of relatively elevated concentrations
SS45L005MW	800 Area, south	IS	56 -66	X	X	X	X	X	X			X	X		"Sentry" well south of main 800-Area plume
WELL#12	800 Area, central	DS	90 - 100	X	X	X	X	X	X			X	X		"Sentry" well in Deep Sand south of main 800-Area plume
WELL#14	800 Area, central	DS	90 - 100	X	X	X	X	X	X			X	X		Monitor CAH concentrations and degradation in Deep Sand in area of relatively elevated concentrations
WELL#16	800 Area, north	DS	90 - 100	X	X	X	X	X	X			X	X		"Sentry" well in Deep Sand north of main 800-Area plume
WELL#18	800 Area, north	DS	90 - 100	X	X	X	X	X	X			X	X		"Sentry" well in Deep Sand northwest of main 800-Area plume
WELL#20	800 Area, north	DS	120 - 130	X											Measure groundwater elevations
A39L001PZ	800 Area, north	DS	88 - 98	X											Measure groundwater elevations
A39L002PZ	800 Area, southwest	DS	96 - 106	X	X	X	X	X		X		X	X		"Sentry" well in Deep Sand west of main 800-Area plume
A39L003PZ	800 Area, southwest	DS	110 - 120	X											Measure groundwater elevations
A39L008PZ	800 Area, east	DS	108 - 118	X	X	X	X	X	X			X	X		"Sentry" well in Deep Sand east of main 800-Area plume
A39L027DP	800 Area, southeast	DS	111 - 121	X	X	X	X	X	X			X	X		"Sentry" well in Deep Sand southwest of main 800-Area plume
A39L028DP	800 Area, east	DS	113 - 123	X	X	X	X	X	X			X	X		"Sentry" well in Deep Sand east of main 800-Area plume
SS45L002MW	800 Area, central	DS	89 - 99	X	X	X	X	X		X		X	X		Monitor CAH concentrations and degradation in Deep Sand in area of relatively elevated concentrations
WELL#3	2500 Area, north	IS	65 - 75	X	X	X	X	X	X			X	X		"Sentry" well north of main 2500-Area plume
WELL#4	2500 Area, northeast	IS	62 - 72	X	X	X	X	X	X			X	X		Monitor CAH concentrations and degradation in area of relatively elevated concentrations
WELL#5	2500 Area, west	IS	50 - 60	X	X	X	X	X	X			X	X		Monitor CAH concentrations and trends in south-central part of main 2500-Area plume
WELL#6	2500 Area, south	IS	50 - 60	X	X	X	X	X	X			X	X		"Sentry" well south of main 2500-Area plume
WELL#7	2500 Area, south	IS	50 - 60	X	X	X	X	X	X			X	X		"Sentry" well southwest of main 2500-Area plume
WELL#8	2500 Area, south	IS	70 - 80	X	X	X	X	X	X			X	X		"Sentry" well east of main 2500-Area plume
WELL#9[j]	2500 Area, south	IS	Proposed ~ 65 - 75	X	X	X	X	X	X			X	X		"Sentry" well northeast of main 2500-Area plume
WELL#23[j]	2500 Area, south	IS	Proposed ~ 61-71	X	X	X	X	X	X			X	X		"Sentry" well east of main 2500-Area plume
A39L010PZ	2500 Area, northeast	IS	55 - 65	X	X	X	X	X		X		X	X		Monitor CAH concentrations and degradation in area of relatively elevated concentrations
A39L011PZ	2500 Area, south	IS	40 - 50	X	X	X	X	X		X		X	X		Monitor CAH concentrations and degradation south of area of relatively elevated concentrations
A39L012PZ	2500 Area, south	IS	60 - 70	X	X	X	X	X	X			X	X		"Sentry" well south of main 2500-Area plume
A39L013PZ	2500 Area, south	IS	58 - 67	X											Measure groundwater elevations
A39L018PZ	2500 Area, north	IS	40 - 50	X											Measure groundwater elevations
A39L019PZ	2500 Area, north	IS	60 - 70	X	X	X	X	X	X			X	X		"Sentry" well west of main 2500-Area plume
A39L073DP	2500 Area, east	IS	62 - 71	X	X	X	X	X	X			X	X		"Sentry" well east of main 2500-Area plume
A39L020PZ	2500 Area, west	DS	110 - 120	X											Measure groundwater elevations
A39L082DP	2500 Area, central	DS	108 - 118	X	X	X	X	X	X			X	X		"Sentry" well in Deep Sand east of main 2500-Area plume
A39L092DP	2500 Area, south	DS	113 - 123	X											Measure groundwater elevations
A39L005PZ	Between 800 and '2500 Areas	IS	59 - 69	X											Measure groundwater elevations
A39L006PZ	Between 800 and '2500 Areas	IS	62 - 72	X											Measure groundwater elevations
A39L014PZ	Between 800 and '2500 Areas	IS	60 - 70	X											Measure groundwater elevations
A39L017PZ	Between 800 and '2500 Areas	IS	58 - 67	X											Measure groundwater elevations
A39L007PZ	Between 800 and '2500 Areas	DS	105 - 115	X											Measure groundwater elevations
A39L022PZ	Between 800 and '2500 Areas	DS	110 - 120	X											Measure groundwater elevations
Staff Gage	South of 2500 Area	Le Tig Bayou	N/A[mv]	X											Measure water surface elevations to evaluate interactions between groundwater and surface water
Staff Gage	North of 800 Area	North Ditch	N/A	X											Measure water surface elevations to evaluate interactions between groundwater and surface water

[a] VOCs = Volatile organic compounds.

[b] Natural Attenuation Parameters include Sulfate (USEPA 300), Ferrous Iron (HACH 8146), Dissolved Organic Carbon (USEPA 415.1), and Alkalinity (HACH 8221).

[c] Field Parameters include Redox Potential (meter), pH (meter), Conductivity (meter), Temperature (meter), and Turbidity (USEPA 180.1).

[d] Completion intervals: IS = Intermediate Sand unit; DS = Deep Sand unit.

[e] feet bgs = feet below ground surface.

[f] USEPA = United States Environmental Protection Agency.

[g] NRML = USEPA National Risk Management Research Laboratory.

[h] "Q" denotes that the indicated well will be sampled quarterly.

[i] "A" denotes that the indicated well will be sampled annually.

[j] "X" denotes that the indicated parameter will be measured or sampled at that corresponding well/staff gage.

[k] CAHs = Chlorinated Aliphatic Hydrocarbons.

[l] Proposed Monitoring Well.

[mv] Screened Interval not applicable for surface-water staff gage.

G5.2 Low-Pumping-Rate Groundwater Extraction Combined with Natural Attenuation and Long-Term Groundwater Monitoring (Alternative 2a)

In this alternative, a groundwater extraction system, consisting of three groundwater extraction wells would be installed at Site SS-45. A single extraction well would be installed near existing groundwater monitoring well SS45L001MW, and would pump at a rate of 20 gpm. One extraction well would be installed near existing groundwater monitoring Well #1, and a third extraction well would be installed near existing groundwater monitoring Well #4, in the southern and northern parts of the 2500 Area, respectively. Each of the wells in the 2500 Area would also pump at a rate of 20 gpm, so that the total pumping rate of the system would be 60 gpm. Extracted groundwater would be treated, and discharged to a local POTW. Because of the relatively great distance between the 800 Area and 2500 Area (about 3,000 feet), two treatment systems would be required – one each for the 800 and 2500 Areas. Each treatment system would consist of a clarifying tank, holding tank, and low-profile air stripper, with ancillary equipment (piping, pumps, electrical equipment, controls).

Electrical service to a central location would be required to provide power for the pumps and the air-stripping equipment. Well construction costs would include costs of drilling, well materials, and well development. The selection of pumps for the wells and holding tank would be based on the anticipated equipment performance and useful life in a groundwater environment having low concentrations of halogenated organic compounds. Pump controls would be automated to the greatest extent possible.

Total daily discharge of treated water to the POTW is estimated to be about 90,000 gallons for the first 20 years of operation; the resulting annual discharge would be about 32 million gallons. After chemical concentrations in groundwater near Well #4 in the 2500 Area have been reduced to levels below target concentrations (calculated to require a period of about 20 years), groundwater extraction at Well #4 would cease, but pumping would continue at Well #1 for another two years, until target concentrations had also been achieved in the southern part of the 2500 Area. Groundwater extraction and treatment would continue in the 800 Area until chemical concentrations in groundwater beneath the 800 Area have decreased to levels below target concentrations (calculated to occur after another 13-year period of pumping has elapsed, in year 2035). Total daily discharge of treated water to the POTW during the last ten years of operation is estimated to be about 30,000 gallons, with resulting annual discharge of about 11 million gallons.

Water samples, collected from the influent and effluent treatment streams would be analyzed for volatile organic chemicals, to ensure that POTW standards were met, and to assess the effectiveness of air stripping. We anticipate that a permit-fee equivalent, or one-time hookup fee would be assessed by the local jurisdiction, prior to initiating discharge to the POTW; this fee would be in addition to the annual POTW fees, prorated according to the volume of water discharged. The total initial capital and construction costs for the low-pumping-rate groundwater extraction and treatment alternative are estimated to be **$565,000** (refer to attached cost estimate).

Operation and maintenance activities would include inspection and sampling of the system, chemical analyses of water and effluent airstream samples, monitoring of environmental conditions on the property, and reporting. The groundwater extraction and treatment system would be inspected on a weekly basis; water samples, collected bi-weekly from the influent and

effluent treatment streams during inspections, would be analyzed for volatile organic chemicals, to ensure that the required level of chemical removal was attained during treatment. Monitoring would be conducted on an annual basis, and would include inspection of the property and the extraction and treatment system, measurement of water levels in all wells on the property, and collection and analyses of groundwater samples from a selected subset (approximately 38) of the monitoring wells. For purposes of this cost estimate, we assume that the monitoring programs for the natural-attenuation alternative and the groundwater–extraction alternative would be identical. In reality, groundwater monitoring for the groundwater extraction and treatment alternative would probably be conducted more frequently than biennially, after the first five years of monitoring, with consequently higher costs. Costs for O&M activities were estimated on an annual basis and are referenced to constant (1999) dollars (refer to attached cost estimate). The constant-dollar value of O&M costs for the low-extraction-rate groundwater treatment alternative (**Alternative 2a**), assuming that O&M activities would be conducted through a 35-year period, is calculated to be about **$6,000,000**.

G5.3 High-Pumping-Rate Groundwater Extraction Combined with Natural Attenuation and Long-Term Groundwater Monitoring (Alternative 2b)

In this alternative, a groundwater extraction system, consisting of three groundwater extraction wells would be installed at Site SS-45. A single extraction well would be installed near existing groundwater monitoring well SS45L001MW, and would pump at a rate of 120 gpm. One extraction well would be installed near existing groundwater monitoring Well #1, and a third extraction well would be installed near existing groundwater monitoring Well #4, in the southern and northern parts of the 2500 Area, respectively. Each of the wells in the 2500 Area would also pump at a rate of 120 gpm, so that the total pumping rate of the system would be 360 gpm. Extracted groundwater would be treated, and discharged to a local POTW. As in Alternative 2a, two treatment systems would be required – one each for the 800 and 2500 Areas. Each treatment system would consist of a clarifying tank, holding tank, and low-profile air stripper, with ancillary equipment.

Electrical service to a central location would be required to provide power for the pumps and the air-stripping equipment. Well construction costs would include costs of drilling, well materials, and well development. Pump controls would be automated to the greatest extent possible.

Total daily discharge of treated water to the POTW is estimated to be about 520,000 gallons for the first 18 years of operation; the resulting annual discharge would be about 200 million gallons. After chemical concentrations in groundwater within the 2500 Area have been reduced to levels below target concentrations (calculated to require a period of about 18 years), groundwater extraction in the 2500 Area would cease. Groundwater extraction and treatment would continue in the 800 Area until chemical concentrations in groundwater beneath the 800 Area have decreased to levels below target concentrations (calculated to occur after another 8-year period of pumping has elapsed, in year 2026). Total daily discharge of treated water to the POTW during the last ten years of operation is estimated to be about 175,000 gallons, with resulting annual discharge of about 63 million gallons.

Water samples, collected from the influent and effluent treatment streams would be analyzed for volatile organic chemicals, to ensure that POTW standards were met, and to assess the effectiveness of air stripping. We anticipate that a permit-fee equivalent, or one-time hookup fee

would be assessed by the local jurisdiction, prior to initiating discharge to the POTW; this fee would be in addition to the annual POTW fees, prorated according to the volume of water discharged. The total initial capital and construction costs for the high-pumping-rate groundwater extraction and treatment alternative are estimated to be **$685,000** (refer to attached cost estimate). Initial capital costs are greater than for the low-pumping-rate alternative, because larger (more expensive) pumping and air-stripping equipment would be required to handle the greatly increased discharge.

Operation and maintenance activities would include inspection and sampling of the system, chemical analyses of water and effluent airstream samples, monitoring of environmental conditions on the property, and reporting. The groundwater extraction and treatment system would be inspected on a weekly basis; water samples, collected bi-weekly from the influent and effluent treatment streams during inspections, would be analyzed for volatile organic chemicals, to ensure that the required level of chemical removal was attained during treatment. Monitoring would be conducted on an annual basis, and would include inspection of the property and the extraction and treatment system, measurement of water levels in all wells on the property, and collection and analyses of groundwater samples from a selected subset (approximately 38) of the monitoring wells. For purposes of this cost estimate, we have again assumed that the monitoring programs for the natural-attenuation alternative and the groundwater–extraction alternative would be identical. Costs for O&M activities were estimated on an annual basis and are referenced to constant (1999) dollars (refer to attached cost estimate). The constant-dollar value of O&M costs for the high-extraction-rate groundwater treatment alternative (**Alternative 2b**), assuming that O&M activities would be conducted through a 26-year period, is calculated to be about **$15,500,000**.

PARSONS *Calculation Page*					Job Number 730486.09030	Page 1 of 3
Rev	Date 2/2/2000	By JWA	Ck	Subject:	Cost Calculations for Alternative 1 RNA + LTM Site SS-45, England AFB	

Groundwater Sampling - Years 1999 - 2034

38 Long-Term Monitoring Wells

10 QA/QC (3 duplicates, 1 field blank, 1 equipment blank, 3 trip blanks, 1 MS, 1 MSD)

48 Total Samples

Sampling Labor	228	hours	x	$62	/hour	$14,136
Analytical Subcontractor						
48 VOCs[a/]				$160	/each	$7,680
39 Methane/Ethane/Ethene				$125	/each	$4,875
38 Field Parameters				$30	/each	$1,140
Supplies				$1,500	lump sum	$1,500
Travel				$800	lump sum	$800
Per Diem	13	days	x	$88	/day	$1,144
Data Management	24	hours	x	$60	/hr	$1,440
Data Validation	16	hours	x	$60	/hr	$960
Reporting/Project Management Labor						
Word Processing	10	hours	x	$25	/hour	$250
CADD	15	hours	x	$50	/hour	$750
Reproduction	8	hours	x	$20	/hour	$160
Staff Level	50	hours	x	$60	/hour	$3,000
Proj. Manager	20	hours	x	$80	/hour	$1,600
Editor	5	hours	x	$60	/hour	$300
Reporting/Project Management ODCs				$400	lump sum	$400
				Total for 1 Sampling Event (rounded)		**$40,200**

[a/] VOC analysis includes standard SW8260B analyte list (primarily CAHs)

PARSONS Calculation Page					Job Number 730486.09030	Page 2 of 3
Rev	Date 2/2/2000	By JWA	Ck	Subject:	Cost Calculations for Alternative 1 RNA + LTM Site SS-45, England AFB	

Groundwater Sampling - Years 2034 - 2047

24 Long-Term Monitoring Wells
9 QA/QC (2 duplicates, 1 field blank, 1 equipment blank, 3 trip blanks, 1 MS, 1 MSD)
33 Total Samples

Sampling Labor	144	hours	x	$62	/hour	$8,928
Analytical Subcontractor						
33 VOCs				$160	/each	$5,280
25 Methane/Ethane/Ethene				$125	/each	$3,125
24 Field Parameters				$30	/each	$720
Supplies				$1,500	lump sum	$1,500
Travel				$800	lump sum	$800
Per Diem	9	days	x	$88	/day	$792
Data Management	24	hours	x	$60	/hr	$1,440
Data Validation	16	hours	x	$60	/hr	$960
Reporting/Project Management Labor						
Word Processing	10	hours	x	$25	/hour	$250
CADD	15	hours	x	$50	/hour	$750
Reproduction	8	hours	x	$20	/hour	$160
Staff Level	50	hours	x	$60	/hour	$3,000
Proj. Manager	20	hours	x	$80	/hour	$1,600
Editor	5	hours	x	$60	/hour	$300
Reporting/Project Management ODCs				$400	lump sum	$400
				Total for 1 Sampling Event (rounded)		**$30,100**

PARSONS Calculation Page					Job Number 730486.09030	Page 3 of 3
Rev	Date 2/2/2000	By JWA	Ck	Subject:	Cost Calculations for Alternative 1 RNA + LTM Site SS-45, England AFB	

Summary of Monitoring Costs

Monitoring Costs

Annual Monitoring of 38 wells, 1999-2003 (5 events)

Cost per Event **$40,200 x 5 events** **$201,000**

Biennial Monitoring of 38 wells, 2005-2033 (15 events)

Cost per Event **$40,200 x 15 events** **$603,000**

Biennial Monitoring of 24 wells, 2035 - 2047 (7 events)

Cost per Event **$30,100 x 7 events** **$210,700**

Site Management every year (48 years)

Annual Cost **$6,000 x 48 years** **$288,000**

Total Constant Dollar (1999 Dollars) Costs of LTM Program	**$1,302,700**

Remedial Alternative 2a Cost Estimate
3 Wells Each Pumping at 20 gpm
Site SS-45
Focussed Corrective Measures Study
England Air Force Base, Alexandria, Louisiana
730486.09030

Author: JWA
Date: 2/02/00
Checked by:
Date:

Capital Costs

Installation of the Groundwater Extraction System

Well Installation (3 8-inch wells)	3 wells	x	$10,000	per well	$30,000
Buildings/Controls/Piping/Accessories			$40,000	lump sum	$40,000
Equipment Costs 3 submersible pumps, 2 air strippers, electronics, PLC valves, and gages			$400,000	lump sum	$400,000
Design/perform/analyze 3, 24-hour pumping tests (lump sum)			$50,000	lump sum	$50,000
System Installation			$40,000	lump sum	$40,000
POTW Hookup Fee (one-time charge)			$5,000	lump sum	$5,000
			subtotal (rounded)		**$565,000**

Annual Operating Costs--Pump and Treat System, 2000 - 2019 (20 years)

Labor								
Weekly System Checks			8	hrs/week x	52	weeks /yr x	$60 / hr	$24,960
Monthly Sampling	12	hours per month x	12	months/year x	$60	/ hr		$8,640
Monthly Reporting	8	hours per month x	12	months/year x	$60	/ hr		$5,760
Maintenance	16	hours per month x	12	months/year x	$60	/ hr		$11,520
Analytical								
VOCs (air)	2	samples per month x	12	months/year x	$160	per analysis		$3,840
VOCs (water)	4	samples per month x	12	months/year x	$160	per analysis		$7,680
Sample shipping	2	events per month x	12	months/year x	$30	per event		$720
Electricity	$0.10	per kilowatt-hr for	3	wells pumping	20	gpm continuously		$33,300
POTW Discharge Fee	$2	per 1,000 gallons;	3	wells pumping	20	gpm continuously		$63,115
Site Management (included in LTM portion of Alternative 2a)								$0
						subtotal (rounded)		**$159,600**

Annual Operating Costs--Pump and Treat System, 2020 - 2022 (2 years)

Labor								
Weekly System Checks			8	hrs/week x	52	weeks /yr x	$60 / hr	$24,960
Monthly Sampling	12	hours per month x	12	months/year x	$60	/ hr		$8,640
Monthly Reporting	8	hours per month x	12	months/year x	$60	/ hr		$5,760
Maintenance	16	hours per month x	12	months/year x	$60	/ hr		$11,520
Analytical								
VOCs (air)	2	samples per month x	12	months/year x	$160	per analysis		$3,840
VOCs (water)	4	samples per month x	12	months/year x	$160	per analysis		$7,680
Sample shipping	2	events per month x	12	months/year x	$30	per event		$720
Electricity	$0.10	per kilowatt-hr for	2	wells pumping	20	gpm continuously		$22,200
POTW Discharge Fee	$2	per 1,000 gallons;	2	wells pumping	20	gpm continuously		$42,077
Site Management (included in LTM portion of Alternative 2a)								$0
						subtotal (rounded)		**$127,400**

Remedial Alternative 2a Cost Estimate (continued)
3 Wells Each Pumping at 20 gpm
Site SS-45
Focussed Corrective Measures Study
England Air Force Base, Alexandria, Louisiana
730486.09030

Annual Operating Costs--Pump and Treat System, 2022 - 2035 (13 years)

Labor								
Weekly System Checks			4	hrs/week x	52	weeks /yr x $60 / hr		$12,480
Monthly Sampling	12	hours per month x	12	months/year x	$60	/ hr		$8,640
Monthly Reporting	8	hours per month x	12	months/year x	$60	/ hr		$5,760
Maintenance	8	hours per month x	12	months/year x	$60	/ hr		$5,760
Analytical								
VOCs (air)	2	samples per month x	12	months/year x	$160	per analysis		$3,840
VOCs (water)	4	samples per month x	12	months/year x	$160	per analysis		$7,680
Sample shipping	2	events per month x	12	months/year x	$30	per event		$720
Electricity	$0.10	per kilowatt-hr for	1	wells pumping	20	gpm continuously		$11,100
POTW Discharge Fee	$2	per 1,000 gallons;	1	wells pumping	20	gpm continuously		$21,038
Site Management (included in LTM portion of Alternative 2a)								$0
						subtotal (rounded)		**$77,100**

Summary of Capital Costs (assuming system installation in 1999)

Installation of Groundwater Extraction System	$565,000		$565,000
		Total Capital Costs	**$565,000**

Summary of Constant Dollar Annual Costs (assuming 3-well system through a 20-yr operating period, 2000 - 2019)

O&M for Pump and Treat System (first 20 years)	$159,600	per year x	20 years	**$3,192,000**

Summary of Constant Dollar Annual Costs (assuming 2-well system through a 2-yr operating period, 2020 - 2022)

O&M for Pump and Treat System (next 2 years)	$127,400	per year x	2 years	**$254,800**

Summary of Constant Dollar Annual Costs (assuming 1-well system through a 13-yr operating period, 2023 - 2035)

O&M for Pump and Treat System (final 13 years)	$77,100	per year x	13 years	**$1,002,300**

Total Constant-Dollar Cost of System Installation and Operation Through 35-Year Period	**$4,449,100**
Total Constant Dollar Cost of LTM Program (includes site management, common to Alternatives 1 & 2)	**$1,023,700**
Total Capital + Annual + Future Costs for Alternative 2a	**$6,038,000**

Remedial Alternative 2b Cost Estimate
3 Wells Each Pumping at 120 gpm
Site SS-45
Focussed Corrective Measures Study
England Air Force Base, Alexandria, Louisiana
730486.09030

Author: JWA
Date: 2/02/00
Checked by:
Date:

Capital Costs

Installation of the Groundwater Extraction System

Well Installation (3 8-inch wells)	3 wells	x	$10,000	per well	$30,000
Building/Controls/Piping/Accessories			$40,000	lump sum	$40,000
Equipment Costs 3 submersible pumps, 2 air strippers, electronics, PLC valves, and gages			$500,000	lump sum	$500,000
Design/perform/analyze 3, 24-hour pumping tests (lump sum)			$60,000	lump sum	$60,000
System Installation			$50,000	lump sum	$50,000
POTW Hookup Fee (one-time charge)			$5,000	lump sum	$5,000
			subtotal (rounded)		**$685,000**

Annual Operating Costs--Pump and Treat System, 2000 - 2017 (18 years)

Labor								
Weekly System Checks			16	hrs/week x	52	weeks /yr x	$60 / hr	$49,920
Monthly Sampling	12	hours per month x	12	months/year x	$60	/ hr		$8,640
Monthly Reporting	8	hours per month x	12	months/year x	$60	/ hr		$5,760
Maintenance	16	hours per month x	12	months/year x	$60	/ hr		$11,520
Analytical								
VOCs (air)	2	samples per month x	12	months/year x	$160	per analysis		$3,840
VOCs (water)	4	samples per month x	12	months/year x	$160	per analysis		$7,680
Sample shipping	2	events per month x	12	months/year x	$30	per event		$720
Electricity	$0.10	per kilowatt-hr for	3	wells pumping	120	gpm continuously		$199,800
POTW Discharge Fee	$2	per 1,000 gallons;	3	wells pumping	120	gpm continuously		$378,691
Site Management (Included in LTM portion of Alternative 2)								$0
						subtotal (rounded)		**$666,600**

Remedial Alternative 2b Cost Estimate (continued)
3 Wells Each Pumping at 120 gpm
Site SS-45
Focussed Corrective Measures Study
England Air Force Base, Alexandria, Louisiana
730486.09030

Annual Operating Costs--Pump and Treat System, 2018 - 2025 (8 years)

Labor								
Weekly System Checks			8	hrs/week x	52	weeks /yr x	$60 / hr	$24,960
Monthly Sampling	12	hours per month x	12	months/year x	$60	/ hr		$8,640
Monthly Reporting	8	hours per month x	12	months/year x	$60	/ hr		$5,760
Maintenance	16	hours per month x	12	months/year x	$60	/ hr		$11,520
Analytical								
VOCs (air)	2	samples per month x	12	months/year x	$160	per analysis		$3,840
VOCs (water)	4	samples per month x	12	months/year x	$160	per analysis		$7,680
Sample shipping	2	events per month x	12	months/year x	$30	per event		$720
Electricity	$0.10	per kilowatt-hr for	1	well pumping	120	gpm continuously		$66,600
POTW Discharge Fee	$2	per 1,000 gallons;	1	well pumping	120	gpm continuously		$126,230
Site Management (Included in LTM portion of Alternative 2)								$0
						subtotal (rounded)		**$256,000**

Summary of Capital Costs (assuming system installation in 1999)

Installation of Groundwater Extraction System	$685,000		$685,000
		Total Capital Costs	**$685,000**

Summary of Constant Dollar Annual Costs (assuming 3-well system through an 18-yr operating period, 2000 - 2017)

O&M for Pump and Treat System (first 18 years)	$666,600	per year x	18 years	**$11,998,800**

Summary of Constant Dollar Annual Costs (assuming 1-well system through an 8-yr operating period, 2018 - 2025)

O&M for Pump and Treat System (final 8 years)	$256,000	per year x	8 years	**$2,048,000**

Total Constant-Dollar Cost of System Installation and Operation Through 26-Year Period	**$14,046,800**
Total Constant Dollar Cost of LTM Program (includes site management, common to Alternatives 1 & 2)	**$758,800**
Total Capital + Annual + Future Costs for Alternative 2b	**$15,491,000**

APPENDIX H

COMMENTS TO DRAFT REPORT

BY

LOUISIANA DEPARTMENT OF ENVIRONMENTAL QUALITY

AND

USEPA

Steve
505

State of Louisiana

Department of Environmental Quality

JAN 18 RECD

M.J. "MIKE" FOSTER, JR.
GOVERNOR

J. DALE GIVENS
SECRETARY

January 13, 2000

Mr. Rafael Vazquez
Regional BRAC Environmental Coordinator
AFBCA/ROL Bergstrom Air Force Base
3711 Fighter Drive
Austin, TX 78719-2557

RE: Focused Corrective Measures Study for Groundwater at SS-45
England AFB
LA9 572 124 452
CFIS #9029

Dear Mr. Vazquez:

The Louisiana Department of Environmental Quality, Remediation Services Division (LDEQ-RSD) is in receipt of the referenced document, received September 20, 1999. In addition to our review, a meeting was held December 7, 1999, at EPA offices in Dallas, Texas, to discuss the report and recommendations. The comments below represent the conclusions of the meeting discussions:

1. The recommendation of the CMS for this site is monitored natural attenuation (MNA) for the chlorinated solvents plumes in the 800 and 2500 areas. The Base Closure Team (BCT) concurred that this will be the *proposed conditional remedy* for this site.

2. The ultimate goal of the remedy is to restore the groundwater to levels that are fully protective of human health and the environment.

3. The remedy must continue to demonstrate that the plumes are stable, or shrinking, through long-term monitoring of a network of perimeter (sentry) wells. If any perimeter well analysis exceeds an MCL, a letter report must be provided to both the LDEQ and EPA within 90 days of the sampling event, notifying both agencies of the exceedence. Within 135 days of the original sampling event, a confirmatory sampling in the affected well shall be conducted, with a corresponding follow-up report submitted to both agencies. If any perimeter well is confirmed to exceed the MCL, the plume will be considered potentially unstable and a re-evaluation of the conceptual site model and the appropriateness of the MNA remedy will be necessary. This does not mean, however, that the MNA remedy will be abandoned, only that a complete evaluation, including the collection of appropriate field data as directed by both agencies may be required.

OFFICE OF ENVIRONMENTAL ASSESSMENT
P.O. BOX 82178 • BATON ROUGE, LOUISIANA 70884-2178 • TELEPHONE (225) 765-0355 • FAX (225) 765-0617
AN EQUAL OPPORTUNITY EMPLOYER

AFBCA BERGSTROM 5123865456 01/19/00 10:55

4. In connection with the above requirement, the following wells should be included as sentry wells in the **Intermediate Sand** of the Red River alluvial aquifer:

   2500 Area: existing wells #3, 6, 7 and 8; A39L012PZ and A39L019PZ; and wells to be installed at locations of A39L073DP, A39L095DP; and approximately 750 feet north-northeast of Well #4.

   800 Area: existing wells #13, 17, 19 and 21; SS45L005MW, A39L036DP, A39L039DP; and a well to be installed at each of the locations A391014DP, and approximately 750 feet east of well #10.

   The following wells should be included as sentry wells in the Deep Sand unit of the Red River alluvial aquifer:

   2500 area: existing well A39L082DP

   800 area: existing wells #12, 14, 16, and 18; A39L027DP, A39L028DP, A39L002PZ, and A39L008PZ.

If any monitoring wells in the resulting network exhibits a significantly increasing trend in concentrations, indicating a possible change in the site conditions, both regulatory agencies should be notified.

5. The list of geochemical indicator parameters, which provide another line of evidence supporting the efficacy of the proposed remedy, shall include parameters indicative of the dominant biotransformation processes affecting the contaminants of concern. These additional parameters may include, but not be limited to: Fe^{2+}, SO_4^{2-}, total organic carbon, and alkalinity.

6. As stated above, the MNA remedy is considered *conditional*. MNA must continue to be demonstrated to be capable of achieving the goal or groundwater restoration as defined above. The BCT has agreed that the performance of the remedy must be re-evaluated no later than 5 years from the date of the remedy selection document. Based on the information presented in the CMS, assuming the site characterization is accurately understood, the Air Force has projected rates of degradation that should result in about a 50% reduction in concentrations of chlorinated solvents at the site within 5 years. If this reduced level of contamination is achieved, the 5-Year Review of performance can be limited in scope to data analyses and evaluation of compliance with restricted land use. Conversely, if this level of reduction is not supported by the data, then a full 5-Year Review, must be conducted. The evaluation must include new rate calculations and projected cleanup times, as well as other potential remedies available at that time, with a view to determine whether the MNA remedy is appropriate, or should be modified or replaced. The 5-Year Review must be submitted to both regulatory agencies within 180 days following the final sampling event of the period.

7. All existing monitoring wells in the long-term monitoring network not having at least 4 previous sampling events, and all newly installed wells, will be sampled quarterly for one year, followed by annual monitoring for 3 years. Existing monitoring wells with adequate previous sampling events

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01/25/00 10:25 FAX 2105356509 AFCEE 003

8. will be monitored annually for 4 years. All wells will be monitored quarterly in the fifth year, prior to the preparation of the 5-Year Review. Said Review will evaluate the frequency of future monitoring efforts. Annual monitoring of wells will be required after the fifth year until such time as alternative frequencies are accepted by the LDEQ.

9. Because withdrawal of groundwater would change the hydraulic conditions of the site and potentially affect the protectiveness of the remedy, land use restrictions will be required to prevent the use of the groundwater in the Intermediate and Deep Sand units of the Red River Alluvial Aquifer within the remaining land areas of the former Base. The Air Force must implement a restriction, easement, covenant, or other appropriate mechanism on the title to the property, capable of being legally enforced by the Air Force and binding on future property owners and tenants, to prevent such use.

10. The EPA has already forwarded its comments, many of which are incorporated herein, on this submittal. Due consideration of EPA's contractor, ADA laboratory, comments should be given when revising this submittal. For the record, the Air Force has an additional responsibility to the EPA to demonstrate that the selected remedy is operating properly and successfully before the EPA will sign off on a deed to transfer the land area affected by the referenced plumes considered in the Corrective Measures Study.

All future correspondence in this matter should be in triplicate and addressed to Mr. Keith L. Casanova, Administrator, Remediation Services Division, P. O. Box 87178, Baton Rouge, LA 70884-2181. One copy should be sent to my attention.

Should you have any questions concerning this correspondence, please contact me at (225) 765-0936.

Sincerely,

MS Miller

Michael S. Miller, ES-3
Remediation Services Division

msm

c: HWD File Room
Michael Overbay, EPA Region 6

AFCEE/ERB

AIR FORCE CENTER FOR ENVIRONMENTAL EXCELLENCE (AFCEE)
BASE CLOSURE DIVISION (ERB)

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DATE:

No. of Pages: 4 Faxsimile Transmittal Sheet

TO: Mr Doug Downey — 303 831 8208 FAX NO.
Parsons — EXT.
CO — 303 764 1915

FROM: C. C. PRINGLE

SUBJECT: LDEQ Decision on Enfield TCE Cleanup Site SS-45

REMARKS: Per Request.

REVIEW COMMENTS ON THE DRAFT FOCUSED CORRECTIVE MEASURES STUDY FOR GROUNDWATER AT SITE SS-45, VOLUMES I AND II, ENGLAND AIR FORCE BASE, LOUISIANA

General Comments

- The report recommends natural attenuation with institutional controls as the most cost-effective method for achieving groundwater remedial action goals. This action is appropriate. The report indicates that groundwater contamination plume at each site appears to have stabilized, horizontally and vertically, in a relatively small area from when the disposal practices that caused the groundwater contamination started 30 to 40 years ago. The proposed long-term groundwater monitoring program includes sentry wells to provide assurance of the protectiveness of human health and the environment and trend analysis wells that demonstrates the effectiveness of the natural attenuation process. However, it is suggested that the proposed number of groundwater monitoring wells be reduced. (See specific comment 3.)

- Contaminant degradation rates must be established for each suspected source area (Areas 800 and 2500) with the information available to date; therefore, it is suggested that the contractor provide a narrow range of rates based on reasonable assumptions about the sources of contamination:
  - Since it has been determined that the contaminant plumes prefer to move vertically rather than horizontally, the most contaminated monitoring well at each site is designated as the location of the source.
  - The date that the facility used trichloroethene (TCE) as a cleaning solvent is designated as the date the source originated and that it entered the water table at the maximum solubility concentration.
  - The length of time that the facility used TCE determines the duration of TCE releases (i.e., contaminant source) to the groundwater.

Specific Comments

Item	Page(s)	Section/ Paragraph	Comments
1	ES-2	ES/3	The report provides details regarding the monitoring well construction and assessments performed at three boreholes at Site SS-45. It is suggested that the contractor include the location and any observations recorded regarding a fourth well. Installation was attempted but was unsuccessful due to heaving sands as related by Ms. Joy Lozano, previously at BDM.

2	ES-5	ES/4 and 5	Page F-19 of the report indicates that an estimation of first-order constants for chemical degradation could not be made for major portions of Site SS-45 due to the inability to identify the source area(s) of contamination. It is suggested that the contractor reiterate this point in the summary.
3	7-5	Table 7.2-1	The contractor proposes a list of groundwater wells in the intermediate and deep sands for an annual long-term groundwater monitoring program, and indicates the purpose for monitoring each well, either for detection of contamination or to continue the contamination degradation trend study. Some of the proposed trend analysis wells, such as Well #19, have already shown non-detection of contaminants, hence, it is suggested that groundwater wells A39L009PZ, A39LO11PZ, A39LO82DP, A45L002MW, SS45L001MW, and Wells #1, #4, #5, #14, #15, #16, and #17 be monitored for trend analysis. The monitoring wells proposed for detection purposes (i.e., sentry wells) are acceptable.
4	Appendix C		The laboratory data was not included in this section as the report indicated. It is recommended that the contractor provide a copy for each set of documents submitted.

December 17, 1999

Mr. Keith L. Casanova, Administrator
Remediation Services Division
P.O. Box 87178
Baton Rouge, LA 70884-2181

Re: Focused Corrective Measures Study for Groundwater
At Site SS-45 (Chlorinated Solvents Plume)
England Air Force Base, Alexandria, LA
EPA ID # LA9572124452

Dear Mr. Casanova:

The Environmental Protection Agency (EPA) has reviewed the referenced document, which was received by our office on September 20, 1999. A meeting was held in our offices on December 7, 1999, to discuss the document, and the recommendations for the site. Mr. David Beatty of your office attended. We offer the enclosed comments for your consideration in formulating the Louisiana Department of Environmental Quality's (LDEQ) final comments on this Corrective Measures Study (CMS).

In addition to the enclosed comments, the England Base Cleanup Team (BCT) agreed to a number of criteria for the remediation of this site. These criteria should be incorporated into the final remedy selection for this site. The format for documenting the remedy selection has not yet been determined. This site is not currently in the HSWA corrective action permit for England Air Force Base. The BCT has discussed the options of modifying the HSWA permit to include this site, or terminating the permit and incorporating corrective action into an enforceable agreement of some type, but this issue is not yet resolved. Other options may also exist. Regardless, because this remedy will require leaving hazardous constituents in place above health-based levels, and restricting the future use of the site, we believe the remedy selection process must include a public notice and provide for a public comment period before finalizing the remedy selection. Therefore, any agreements reached at the December 7th meeting as to the selection of the remedy for this site should be considered preliminary until any public comments, including those from the England Local Reuse Authority, are received and evaluated, and a final remedy selection is documented.

At the December 7th meeting, agreement was reached on the following criteria:

1. The CMS' recommended remedy for the chlorinated solvents plumes in the 800 and 2500 areas, i.e., monitored natural attenuation (MNA), will be the proposed conditional remedy.

2. The goal of the remedy is to restore the quality of the ground water to support unrestricted uses.

3. The remedy must continue to demonstrate the plume is stable, or shrinking, through long term monitoring of a network of perimeter (also referred to as sentry) wells. If any perimeter monitoring well analysis violates an MCL, a letter report must be provided to both LDEQ and EPA within 90 days of the sampling event, notifying both agencies of the exceedence. Within 135 days of the original sampling event, another confirmatory sampling in the affected well shall be completed and a follow-up letter report submitted to both LDEQ and EPA. If any perimeter well is confirmed to exceed the MCL, the plume will be considered potentially unstable and re-evaluation of the conceptual site model and the appropriateness of the MNA remedy will be necessary. This does not mean the MNA remedy will automatically be abandoned, but that a complete evaluation, including gathering additional field data as directed by the regulatory authorities, will be required.

After consultation with Mr. Steve Acree of EPA's Robert S. Kerr Lab in Ada, Oklahoma, to coordinate with comment 3.C. of the enclosed comments, EPA believes the following wells (as located on Figures 7.2-1, page 7-3; and Figure 7.2-2, page 7-4 of this CMS) should be considered perimeter/sentry wells in the Intermediate Sand unit of the Red River alluvial aquifer:

> In the 2500 area: existing wells # 3, 6, 7 & 8; A39L012PZ and A39L019PZ; and wells to be installed in the intermediate sand at the locations of A39L073DP, A39L095DP; and approximately 750 feet north-northeast of Well # 4.
>
> In the 800 area: existing wells # 13, 17, 19 & 21; SS45L005MW, A39L036DP, A39L039DP; and wells to be installed in the intermediate sand at locations A39l014DP, and approximately 750 feet to the east of well #10.

EPA recommends the following wells should be considered perimeter/sentry wells in the Deep Sand unit of the Red River alluvial aquifer:

> In the 2500 area: existing well A39L082DP.
>
> In the 800 area: existing wells # 12, 16 & 18; A39L027DP, A39L028DP, A39L002PZ, & A39L008PZ.

Also, if any monitoring well demonstrates a significantly increasing trend in concentrations, indicating a possible change in the site conditions, both LDEQ and EPA should be notified.

4. Additional parameters (as discussed in comment 3.B. of the enclosed comments) will be added to the long term monitoring analyses.

5. If the annual monitoring shows no exceedences of MCL's in the perimeter wells, and no significantly increasing concentration trends in the interior wells, an annual report of the monitoring results shall be submitted to both LDEQ and EPA. Although not discussed at the meeting, EPA would recommend this report be submitted within 90 days after the final sampling event of each year.

6. As previously stated, the MNA remedy is a conditional remedy, and must continue to be demonstrated to be capable of achieving the goal of restoring the site to unrestricted use. The BCT agrees the performance of the MNA remedy must be re-evaluated no later than five years from the date of the remedy selection. Based on the information presented in the CMS, if site conditions are adequately understood, and no significant source of TCE remains at this site, the Air Force has projected rates of degradation that should result in an approximately 50% reduction in concentrations of chlorinated solvents at the site within five years. If this reduced level of contamination is achieved (as measured by the criteria and in the wells identified in comment 3.D. of the enclosed comments), the Five Year Review of the performance of the remedy can be limited in scope to data analysis and evaluation of compliance with the land use restrictions. However, should this level of reduction not be demonstrated, a full Five Year Review, evaluating the performance of the MNA remedy, complete with new rate calculations and projected cleanup times, as well as other potential remedies available at that time, shall be performed to evaluate whether the MNA remedy continues to be appropriate, or should be modified or replaced. Although not discussed at the meeting, we suggest the Five Year Review should be required to be submitted to LDEQ and EPA within 180 days of the final sampling event of the five year period.

7. All existing monitoring wells in the long term monitoring network "without a history of previous sampling events" (which EPA recommends be considered to mean 4 previous sampling events), and all newly installed monitoring wells, will be sampled quarterly for one year, followed by annual monitoring for 3 years. Existing monitoring wells with adequate previous sampling events will be monitored annually for 4 years. All wells will be monitored quarterly in the fifth year, prior to preparation of the Five Year Review. The Five Year Review shall evaluate the frequency of future monitoring efforts. EPA recommends that annual monitoring be required after the fifth year until such time as alternative frequencies are accepted by LDEQ.

8. Because withdrawal of ground water would change the hydraulic conditions of the site and potentially effect the protectiveness of the remedy, land use restrictions will be required to prevent the use of the ground water in the Intermediate Sand and Deep Sand units of the Red River Alluvial Aquifer within the remaining land

area of England Air Force Base. The Air Force shall implement a restriction, easement, covenant, or other appropriate mechanism, on the title to the property, capable of being legally enforced by the Air Force and binding on future property owners and tenants, to prevent such use.

9. As you are aware, the Air Force is required by CERCLA §120 (h) to demonstrate to EPA that the remedy for this site is in place and operating properly and successfully (i.e, and OPS demonstration) before transfer of the property by deed (as opposed to a lease) to an entity outside the federal government can occur. As discussed in our enclosed comments, EPA (supported by LDEQ's staff) continues to have questions about the ability of MNA to restore the site to unrestricted use in a reasonable time frame, especially in the 800 area. Nevertheless, both EPA and LDEQ are willing to select MNA as a conditional remedy, subject to meeting measured performance criteria within a five year period. The BCT therefore has agreed that, before transfer of this area by deed to the LRA can occur, either the Five Year Review, or an intermediary report prepared in some shorter time frame, shall be prepared by the Air Force to demonstrate that the additional data being collected is adequate to demonstrate the remedy is indeed operating properly and successfully.

In addition to the above agreements of the BCT, the enclosed comments provide further clarification of some of the specific issues discussed, and also request revisions to the CMS document. Thank you for your consideration of these comments.

Should you have questions regarding these comments, please have a member of your staff contact Mr. Michael Overbay of my staff at (214)665-6482.

Sincerely,

David Neleigh, Chief
New Mexico and Federal Facilities Section

cc: Mr. Rafael Vazquez, AFBCA
Mr. Mike Miller, LDEQ
Mr. David Beatty, LDEQ
Mr. Steven Acree, EPA - RSKL
Mr. John T. Wilson, EPA - RSKL

December 14, 1999

MEMORANDUM

SUBJECT: England AFB, Alexandria, Louisiana (98RC06-002)
Focused Corrective Measures Study for Groundwater at Site SS-45

FROM: Steven D. Acree, Hydrogeologist
Technical Assistance & Technology Transfer Branch

TO: Michael Overbay, Senior Project Manager
Base Closure Team (6PD-NB)
U.S. EPA, Region 6

As requested during the meeting of December 7, 1999, previous comments regarding the referenced document have been modified to reflect additional information obtained during the meeting. In addition, specific recommendations concerning locations for long-term monitoring of attenuation rates are provided. As previously noted, the referenced document has been reviewed by Dr. John Wilson of this laboratory, Dr. Daniel Pope of Dynamac Corporation, and me. Dynamac Corporation is an off-site contractor providing technical support to this laboratory. In general, projections of the effectiveness of natural attenuation processes for remediation at this site, particularly with respect to restoration within specific time frames, should be considered to be highly uncertain. One of the greatest sources of uncertainty results from the fact that sources for contamination are not well defined. If Monitored Natural Attenuation is incorporated into the remedy for this site, it is recommended that definitive milestones in restoration progress be established and accompanied by criteria for triggering implementation of contingencies. Such milestones and criteria may be based on the projected degradation rates in this document. Detailed comments and recommendations regarding these issues and other concerns are provided below.

General Comments

1. There is significant uncertainty in the projection of natural attenuation processes at this site, particularly with respect to restoration within set time frames. Sources for contamination are speculated but not defined. Contaminant distribution is only grossly defined, due in large measure to the size and depth of the contaminant plumes. Geochemical data indicate biotransformation processes are occurring. However, the effectiveness of these processes for ground-water restoration within a few decades is highly uncertain based, in part, on uncertainties in the estimation and projection of attenuation rates.

The most important parameter that was used to project the behavior of the existing contamination was the rate of biological transformation. The report demonstrates that the approach of Buscheck and Alcantar to estimate the rate of biotransformation was not appropriate for England AFB. On page 4-83, lines 16 through 23, the authors argue that there is no significant mass reduction other than biodegradation, and that the site can be described as a "large scale microcosm." To fit a rate of attenuation to these "large scale microcosms", they first analyzed temporal tends in the concentration of contaminants of concern in selected monitoring wells over the time interval from June 1996 to March 1999. Over this relatively short time interval, there were few statistically significant trends. As a consequence, they attempted to estimate rates of degradation by history matching. This is a useful and powerful technique, and may be appropriate to this site, but it also assumes that the rate law does not change over time. The estimates of rates from history matching are useful for making projections of future behavior, but it is important that these projected rates be subject to verification and validation through long-term monitoring.

It should be noted that the range of potential attenuation rates calculated using data from the individual wells at the site is large. The data also indicate that geochemical conditions vary across the site. These differing geochemical conditions indicate that natural attenuation by biodegradation may vary in its effect at different locations on the England AFB, introducing more uncertainty into projection of attenuation rate constants. Discussions in this document focused only on a small sub-set of the wells. Some of the remaining data would have resulted in very low attenuation rate constants, or indicated that no attenuation may be taking place.

In their analysis and projection of the rate of natural attenuation (Page 5-5, Table 5.3-1), the authors of the report assumed a rate of attenuation for TCE of 0.15 per year, for DCE of 0.15 per year, and for vinyl chloride of 0.33 per year. For ground waters that contain appreciable methane and iron II, these rates are conservatively low. If this is an accurate characterization, it may be expected that these rates, or faster rates, would be attained over time during long term monitoring. After five years, a rate of 0.15 per year would reduce the concentration in ground water by one-half. After five years, a rate of 0.33 per year would reduce the concentration in ground water by 80%. As discussed below, it is recommended that specific criteria for evaluating restoration performance be developed based on these projected rates.

2. The report currently conceptualizes the dominant process for contaminant transport at the site as diffusion. Data cited in support of this conclusion include the relatively low hydraulic gradients in some parts of the site and hydraulic conductivities estimated from slug tests. In general, it appears that ground-water seepage velocities may still be underestimated and the role of diffusion may be greatly overestimated. However, the relatively low, and potentially, variable hydraulic gradients do appear to result is relatively low net flow velocities over much of the site. Exceptions to this analysis may be the northern and southern portions of the 2500 Area where hydraulic gradients may be higher and more consistent.

3. In general, these uncertainties necessitate additional performance monitoring than would be needed for a remedy that relied on hydraulic controls. It is recommended that, at a minimum, the following enhancements to the monitoring system be considered.

A. Based on the small database available to determine contaminant concentration trends and variability, it is recommended that the initial monitoring frequency for new wells be increased from the proposed annual basis. Monitoring at a higher frequency (e.g., quarterly) for a period of time may better define the representative ranges of concentrations in different areas of the site and determine potential temporal fluctuations. Monitoring of all wells at the increased frequency during the start and end of each review cycle (e.g., years 1 and 5 of a five year cycle) would also improve the evaluation of potential biodegradation rates. This increase in frequency is also useful in evaluations of potential plume migration. It is recommended that the monitoring frequency and locations be periodically re-evaluated and increased or decreased as warranted.

B. Monitoring of only a limited suite of geochemical parameters as indicators of continuing biotransformation processes is proposed. Such data provide another line of evidence supporting the continued reliance on natural attenuation processes and may serve as indicators of the potential for changes in dominant processes that affect progress toward restoration or may signal the potential for additional plume migration. It is recommended that other parameters indicative of the dominant biotransformation processes affecting the contaminants of concern (e.g., Fe^{2+}, SO_4^{2-}, total organic carbon, and alkalinity) be monitored.

C. It is noted that only ten wells are designated as sentry wells. Based on the lack of knowledge regarding sources and uncertainty concerning the ground-water flow field, it is recommended that additional monitoring locations be considered to determine plume stability. In the 2500 Area, it appears that additional Intermediate Sand locations approximately 750 ft north-northeast of Well #4 and in the vicinity of Hydropunch location A39L095DP, or between this point and Well #4, may potentially be downgradient of more highly contaminated areas and be appropriate for sentry well installation. It also appears that a well screened in the contaminated zone intercepted by flowmeter test well #1 may provide useful, long-term information regarding plume migration, complementing data available from the other intervals screened by wells A39L012PZ and #6 in this area. In the 800 Area, it appears that a location east-southeast of Well #10 may be appropriate for installation of a sentry well, based on observed contaminant distribution. Of the remaining wells currently proposed for monitoring, it is recommended that wells #3, #13, #16, #19, A39L028DP, and A39L027DP be re-designated as sentry wells to better evaluate potential plume migration. It is recommended that contaminant concentration trends in the sentry well network be used as indicators of plume migration.

D. It is recommended that specific criteria be developed for evaluation of acceptable performance with respect to restoration progress within established time frames. Such criteria should be as objective and quantitative as possible for determining compliance with remedial goals. It is recommended that the following criteria be considered for evaluating restoration performance in the most highly contaminated wells. The concentrations of TCE, all three DCE's and vinyl chloride should be expressed in umoles/liter. The total umolar concentrations during each period of monitoring would then be subjected to a log linear regression of concentration on elapsed time to calculate a first order rate constant. If the rate over the five year cycle of evaluation exceeds 0.15 per year, with 80% confidence, the progress will be considered satisfactory. The most appropriate wells for long-term monitoring of attenuation rates appear to be wells SS45L001MW, #11, #15, SS45L002MW, and A39L009PZ in the 800 Area and wells

#4, #5, A39L010PZ, and A39L011PZ in the 2500 Area. These represent the most contaminated wells and incorporate various mixtures of the contaminants of concern.

E. As requested, the monitoring network was reviewed with respect to possible redundancy and elimination of some of the proposed wells. Although some redundancy may be present, compelling technical arguments for its elimination could not be found due to the low density of monitoring points and high degree of uncertainty in site hydrology and contaminant source locations. Contaminant and geochemical trends observed in wells other than those chosen as sentry wells or restoration monitoring wells may be extremely valuable with respect to projecting future plume expansion or critical evaluation of the present conceptual model. Based on this review, it is suggested that one additional existing well (i.e., Well #14) be added to the deep sand monitoring network in the 800 Area. Samples from this well contained the second highest levels of contamination observed in this part of the formation. Temporal trends in this well may provide useful information for refining the conceptual model for transport to these depths.

Specific Comments

4. Executive Summary, Page ES-3

The report estimates ground-water seepage velocities to range from less than 0.1 to about 5 feet per year in the Intermediate and Deep Sand units and cites chemical diffusion as the most important solute transport mechanism. It is highly questionable as to whether this conceptual model is an accurate representation of site conditions. First, it appears that the hydraulic conductivity of these units and, therefore, seepage velocities may be significantly underestimated based on the short-term, single-well pumping tests performed during the borehole flowmeter survey. Second, chemical diffusion will not result in the large areal spread of contaminants within the available time frames unless there are perhaps tens to hundreds of small sources spread over the site. A more viable conceptual model for ground-water flow and contaminant transport at this site may be that relatively low hydraulic gradients exist near the center of the site due to the locations and rates of recharge and discharge. This situation may result in a ground-water divide that is temporally variable.

5. Executive Summary, Page ES-4

The report suggests that these diffusion-driven plumes may have stabilized. This suggestion is highly speculative. If contaminant transport is indeed as slow as is proposed, it would be many years before there would be enough data accumulated to determine if the plumes were actually stable. If the rate of biodegradation could be shown to exceed the rate of diffusion and advection, that would be reasonable evidence to indicate that the plume is stable, but the data presently available are not definitive.

6. Section 2.1.2.2, Page 2-8, Table 2.1-2; Section 4.1.1, Page 4-3, Table 4.1-1, Page 4-4

The investigators measured the total iron content of the core samples, not the content of iron III, which is an estimate of the capacity to support biological natural attenuation by iron reducing bacteria. They state that "Ferric iron (occurring as oxy-ferrihydroxide) is nearly insoluble, and generally remains sorbed to soil." This is true. Then they state that

"determination of total iron content in soil samples is therefore a good indicator of the content of ferric iron in soil." This is not true. The work of Dr. Lonnie Kennedy in projects for AFCEE clearly shows that much of the total iron, in some cases most of the total iron at hazardous waste sites is insoluble iron II as the monosulfide, as pyrite, and as the carbonate. However, the authors do not make any calculations with the measured concentrations of total iron, or any projections of the behavior of natural attenuation based on the availability of iron. Therefore, the inaccuracies in these discussions do not affect the conclusions of the report.

7. Section 4.3.9, Page 4-21

The diffusion coefficients of ethene and vinyl chloride are nearly the same, and neither compound sorbs to any appreciable extent. Fugacity is most important in multi-phase systems with oils and gas, neither of which occur in the intermediate and lower sand units at England AFB. A slightly greater fugacity would not explain the wider distribution of ethene.

8. Section 4.4, Page 4-29, Page 4-32, Pages 4-34 through 4-35, etc.

The report argues in a qualitative manner that the distribution of chlorinated organic compounds can best be described as being a product of chemical diffusion from "hot spots" instead of advective transport. This becomes a repeated theme throughout Volume I. This claim is directly contradictory to the elegant and detailed analysis of the role of diffusion in Appendix F, where it is shown that attenuation must be a consequence of biological transformation, and not simply diffusion. The authors describe the apparent first order rate of transfer of TCE from a cylinder having a radius of 5 feet around a monitoring well to a location with zero concentration of TCE at a radius of 10 feet. (See page F-55 lines 3 through 7 and equation F-24 on page F-47). The rate of transfer though diffusion over this five foot interval is 0.2 % per year (See Table F.4 on Page F-52 and F-53). Such a slow process could not effectively redistribute TCE over a scale of hundreds of feet, as in seen in both the 800 Area and the 2500 Area. In addition, on page 4-40 line 21 and 22 the authors turn around and refute their own claim, and postulate that diffusive migration has now ceased, and the diffusive plumes are stabilized. Based on these discussions and analysis of site data, it appears that sole reliance on diffusion is a poor conceptual model for evaluating contaminant transport at this site.

9. Section 4.5, Page 4-41

The report concludes that sources of carbon at the site indicate that the electron donor supply is adequate to allow continued microbial reduction of CAHs. It is noted that the dissolved organic carbon in ground water appears to be quite low in most cases, especially in the 800 Area, where TCE appears to be persistent. This persistence may not be coincidental but may be related to a lack of bio-available carbon source. Such issues add uncertainty to calculations of biotransformation rates and projections of those rates to estimate restoration time frames. In similar fashion, the concentrations of fuel hydrocarbons discussed on page 4-55 are not great enough to influence reductive dechlorination.

10. Section 4.5.5.3, Page 4-59; Section 4.5.6.3, Page 4-66

The report concludes: "It is therefore unlikely that DCE and VC are being degraded through use as electron donors in microbially mediated redox reactions." It also concludes: "it is possible that VC is being oxidized under iron-reducing conditions in both locations." These two

statements are contradictory. The latter conclusion is probably correct.

11. Section 4.5.6, Page 4-76

The report states: "Thus the process (methanogenesis) is not limited by the source of electron acceptors, but only by the rate of reaction." In fact, the rate of methanogenesis is limited by the supply of electron donor.

12. Section 6.4.4.3, Page 6-35

It is noted that the pump-and-treat system design used for comparison of remedial time frames would generally be inappropriate for attempting aquifer restoration due to the low pore volume flushing rate. Increasing the pore volume flushing rate would affect these analyses by increasing the cost of this technology and, conceptually, reducing the potential time frames for restoration to some extent. Such an exercise may be useful in the future for cost comparison purposes. However, the effectiveness of such systems with respect to restoration will be controlled by such factors as the presence of residual sources and contaminant mass transfer limitations (e.g., movement of contaminants into the principal flow zones). In general, such complex factors are not characterized and cannot be effectively modeled. Therefore, estimates of remediation time frames should be considered to be highly uncertain.

If you have any questions concerning these comments, please do not hesitate to call me at your convenience (580-436-8609). We look forward to future interactions with you concerning this and other sites.

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