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RE: Picatinny - Site 78 ROD - Vapor Intrusion Evaluation at Building 91 (UNCLASSIFIED)

Tuesday, August 17, 2010 3:50 PM

From: "Gabel, Ted Mr CIV USA IMCOM" <ted.gabel@us.army.mil>

To: Roach.Bill@epamail.epa.gov

Cc: michaelglaab@worldnet.att.net, "Greg Zalaskus" <Greg.Zalaskus@dep.state.nj.us>, "Joe Marchesani" <Joe.Marchesani@dep.state.nj.us>

1 File (605KB)

VI Technica

Classification: UNCLASSIFIED
Caveats: NONE

Bill and Joe/Greg: ;

Attached is a TECH Memo developed by Nadine Weinberg of ARCADIS addressing your concerns related to the CERCLA –related vapor Intrusion issue for PICA 13/Bldg 91. Basically the weight of evidence evaluation indicates that the level of the VOC concentrations in groundwater are not of concern for the vapor intrusion pathway; no further investigation is necessary.

Please distribute this and get back sp we can move forward.

Ted Gabel
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From: Roach.Bill@epamail.epa.gov [mailto:Roach.Bill@epamail.epa.gov]
Sent: Friday, August 06, 2010 10:25 AM
To: Gabel, Ted Mr CIV USA IMCOM
Cc: michaelglaab@worldnet.att.net; Greg Zalaskus
Subject: Picatinny - Site 78 ROD - Vapor Intrusion Evaluation at Building 91

Ted,

The Site 78 draft ROD indicated that indoor air quality (IAQ) assessment at Building 91 resulted in an average of 240 ppb of total volatile organic compounds (TVOC) of which vinyl chloride (VC) was identified as the primary pollutant of concern. The ROD also indicated that the IAQ assessment was conducted to determine whether indoor air quality at Building 91 was impacted by the groundwater contaminated with VOCs at site 78. The section of the ROD which addresses this issue references the threshold limit value - time weighted average (TLV-TWA) for VC established by the American Conference of Industrial Hygienists (ACGIH) of 1,000 ppb. The ROD also states that the "TVOC levels in Building 91 did not exceed the field experience guidlines of 100 to 400 ppb for normal indoor air".

EPA does not recognize ACGIH standards when addressing vapor intrusion at CERCLA sites. Since Building 91 is proximate to VOC-contaminated groundwater, EPA requests that a subslab investigtion be conducted to determine whether the VOCs found in Building 91 are originating from beneath the building and hence from contaminated groundwater. The Army should submit a work plan for this work to EPA and NJDEP for their review and approval. If it is determined that subslab vapors are causing the CVOC detections in Building 91 then a remedy will have to be selected and documented in the Site 78 ROD before it can finalized and signed by EPA.

Classification: UNCLASSIFIED
Caveats: NONE

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MEMO

To:
Mr. William Roach
U.S. Environmental Protection Agency

Copies:
Tim Llewellyn
Ted Gabel
Richard Braun

From:
Ms. Nadine Weinberg, ARCADIS

Date:
August 17, 2010

ARCADIS Project No.:
GP06PICA.0013.KG001

Subject:
Vapor Intrusion Evaluation
Site 78, Building 91

ARCADIS U.S., Inc. (ARCADIS), on behalf of the U.S. Department of the Army (Army), has prepared this Technical Memorandum to evaluate the potential for vapor intrusion at Building 91, located within Site 78 (Site Number PICA-013). The Final Proposed Plan Area P – Site 78 (PICA 013) did not specifically address the vapor intrusion pathway. However, vapor intrusion was considered and determined not be a pathway of concern in the risk assessment that was approved by USEPA. The Draft Final Record of Decision for Groundwater and Surface Water Site 78 (PICA 013) indicated that a vapor intrusion evaluation was conducted; however, the indoor air samples collected were not consistent with U.S. Environmental Protection Agency (USEPA 2002) or New Jersey Department of Environmental Protection (NJDEP 2005) vapor intrusion guidance and approach.

The indoor air monitoring event conducted by the Army at Building 91 used only a hand held monitoring device capable of detecting total VOC (tVOC) concentrations. The memo describing the results (Attachment 1) indicates that tVOC concentrations ranged from 233 to 244 parts per billion (by volume). Although the memo implies that these results are potentially representative of site-related VOC concentrations including vinyl chloride, there is no evidence or information to suggest that vinyl chloride is present in indoor air. Indeed, based on the analysis presented below, it is highly unlikely that any site-related VOCs were detected in indoor air. Instead, the tVOC concentrations are more likely representative of background VOCs present in the building.

In addition to office space, Building 91 houses a small machine shop, an electronics lab that does soldering and shrink wrapping of wire, and a warehouse (Figure1). At the time of the sampling, the building was also undergoing significant renovations including painting, new flooring, dry walling, and new furniture. Any of these activities or products could be the source of the VOCs detected by the Army. In light of the Army findings, this Technical Memorandum provides a detailed evaluation of the potential for vapor intrusion at Building 91 consistent with both USEPA and NJDEP guidance.

To evaluate vapor intrusion at Building 91, ARCADIS conducted a weight of evidence evaluation that considered the following information: (1) The historical source of trichloroethene (TCE), cis-1,2-dichloroethene (cDCE), and other chlorinated volatiles in groundwater is downgradient of Building 91 and groundwater flow is away from the building; (2) All volatile organic compounds (VOCs) in groundwater within 100 feet of Building 91 are below NJDEP and USEPA screening levels; and (3) The center of mass of VOCs in groundwater, located greater than 350 feet downgradient, has been treated and groundwater concentrations continue to decline. Based on these facts, ARCADIS and the Army believe that the vapor intrusion pathway at Building 91 is incomplete and that no further analysis or sampling is necessary. The specific evidence related to each of these points is described below.

Historical Source and Groundwater Flow

As described in the Final Proposed Plan, multiple groundwater sampling programs have determined that a localized plume of VOCs is present in the unconfined aquifer (approximately 2 to 12 feet below ground surface [bgs]). Although the source of VOCs was not identified, the center of the mass of the plume was found to be greater than 350 feet downgradient of Building 91. Groundwater flow near Building 91 is to the south/southwest, indicating that all VOCs in groundwater are moving away from the building.

Comparison to Screening Levels

Consistent with USEPA (2002) and NJDEP (2005) guidance, vapor intrusion is a potential concern if VOCs are present in groundwater within 100 feet of an occupied building. As noted above, the highest concentrations in groundwater near Building 91 are located approximately 350 feet downgradient. Results from five groundwater monitoring wells are located within 100 feet of Building 91 (Figure 1). VOC concentrations in these wells are all below USEPA Maximum Contaminant Levels. The VOC concentrations in the wells located within 100 feet of the building were also compared to NJDEP groundwater screening levels (GWSLs) (Table 1). Well 78GP-1 is not included in Table 1 as no VOCs were detected in groundwater at this location. All VOCs within 100 feet of Building 91 are less than the GWSL. Although vinyl chloride was detected at a concentration of 2.4 micrograms per liter (µg/L) in 2000, this dropped to 0.55 µg/L, below the GWSL of 1 µg/L in the 2002 sampling event.

For TCE, the GWSL was adjusted to be consistent with more recent toxicity data developed by USEPA. As outlined in NJDEP (2005) guidance, screening values may be updated based on “use of recent chemical toxicity, risk assessment methodology, or exposure parameter changes not yet reflected in the NJDEP guidance.” (p. 30).

A modified, NJDEP Guidance-based GWSL for TCE was calculated using the screening version of the Johnson & Ettinger (J&E) model. ARCADIS recalculated the GWSL using NJDEP-specific inputs as outlined in Appendix G of NJDEP (2005) guidance. The only changes to the model were to revise the calculation to use the USEPA unit risk estimate as presented in the Regional Screening Level table and to revise the exposure duration and exposure frequency for a non-residential scenario. The J&E model calculated a GWSL of 7.92 µg/L for TCE (Attachment 2). The only detected groundwater concentration for TCE (1.8 µg/L) is well below this revised GWSL

Source Remediation and Decline

To date, remedial activities performed at Site 78 include the removal of all underground storage tanks and the performance of a pilot study using sodium lactate. Groundwater sampling after the pilot study indicated that TCE concentrations downgradient of the injection were reduced to below the detection limit and cDCE concentrations were reduced by approximately 60 percent. Significant cDCE and vinyl chloride reductions were also seen downgradient of the injection line 11 months after the pilot test. As a result, the data confirm that the pilot test was successful in reducing the bulk of the mass present within Site 78. The remaining concentrations in groundwater will be addressed through natural attenuation processes; however, the data confirm that any existing VOC concentrations in groundwater are decreasing and will continue to decrease into the future.

Conclusions and Recommendations

An evaluation was performed of the potential for vapor intrusion for Building 91. As presented above:

- The known historical source of chlorinated VOCs in groundwater is downgradient of Building 91 and groundwater flow is away from the building.

- The center of mass of the VOCs in groundwater has been treated. Concentrations of VOCs were reduced and continue to decline.

- All VOC concentrations in groundwater within 100 feet of Building 91 are below NJDEP and USEPA screening levels.

The information presented in the weight of evidence evaluation indicates that VOC concentrations in groundwater are not of concern for the vapor intrusion pathway. Based on this finding, no further sampling is recommended at Building 91.

References

NJDEP. 2005. Vapor Intrusion Guidance. New Jersey Department of Environmental Protection. October.

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

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Table 1. Historic Groundwater Sampling Results Within 100 Feet of Building 91, Site 78 (PICA 013), Picatinny Arsenal, New Jersey

Chemical Name	NJDEP GW to Indoor Air Screening Level (ug/L)	USEPA Target GW Concentration (ug/L) (b)		USEPA Maximum Contaminant Level (ug/L)	Location ID Sample Date Depth Interval Units	P-78-GP-002 11/8/2000 4.2 - 5.2 ug/L	P-78-GP-006 4/5/2001 5.5 - 9 ug/L	P-T19-MW1 9/30/2002 2 - 12 ug/L	P-T19-MW2 9/30/2002 2 - 12 ug/L	P-T81-MW1 12/26/2000 4 - 14 ug/L	P-T81-MW1 9/26/2002 4 - 14 ug/L
Volatile Organic Compounds											
1,1,1-Trichloroethane	2300	3100	NC	200		**4.9**	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U
1,1,2,2-Tetrachloroethane	4	3	C	NA		< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U
1,1,2-Trichloro-1,2,2-trifluoroethane	2400	1500	NC	NA		< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U
1,1,2-Trichloroethane	5	5	C	5		< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U
1,1-Dichloroethane	3600	2200	NC	NA		**0.23 J**	< 1 U	< 1 U	< 1 U	**0.12 J**	**0.3 J**
1,1-Dichloroethene	250	190	NC	7		< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U
1,2-Dichloroethane	2	5	C	5		< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U
1,2-Dichloropropane	1	35	NC	NA		< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U
2-Butanone	2700000	440000	NC	NA		< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
2-Hexanone	NA	NA	NA	NA		< 10 U	< 10 U	< 10 U	< 10 U	< 10 U	< 10 U
4-Methyl-2-pentanone (MIBK)	880000	14000	NC	NA		< 5 U	< 5 U	< 5 U	< 5 U	< 5 U	< 5 U
Acetone	1900000	220000	NC	NA		< 10 (U)	**8.8 J**	**1.8 J**	< 10 U	< 10 (U)	< 10 U
Acetonitrile	NA	42000	NC	NA		< 20 U	< 20 U	< 20 U	< 20 U	< 20 R	< 20 U
Benzene	15	5	C	5		< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U
Bromodichloromethane	5	2.1	C	NA		< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U
Bromoform	370	0.0083	C	NA		< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U
Bromomethane	29	20	NC	NA		< 2 U	< 2 U	< 2 UJ	< 2 (U)	< 2 U	< 2 U
Carbon disulfide	710	560	NC	NA		< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U
Carbon tetrachloride	1	5	C	5		< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U
Chlorobenzene	640	390	NC	100		< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U
Chloroethane	4	28000	NC	NA		< 2 U	< 2 U	< 2 U	< 2 U	< 2 UJ	< 2 U
Chloroform	70	5	C	NA		< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U
Chloromethane	240	6.7	C	NA		< 2 U	< 2 U	< 2 U	< 2 U	< 2 U	< 2 UJ
cis-1,2-Dichloroethene	350	210	NC	70		**0.27 J**	< 0.5 U	< 0.5 U	< 0.5 U	**0.43 J**	< 0.5 U
cis-1,3-Dichloropropene	1(b)	NA	C	NA		< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U
Dibromochloromethane	9	3.2	C	NA		< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U
Dichlorodifluoromethane	1000	14	NC	NA		< 2 U	< 2 U	< 2 U	< 2 U	< 2 UJ	< 2 U
Ethyl benzene	61000	700	C	700		< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U
Methylene chloride	53	58	C	NA		< 1 U	< 1 (U)	< 1 U	< 1 U	< 1 U	< 1 U
Styrene	18000	8900	NC	NA		< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U
Tetrachloroethene	1	5	C	5		< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U
Toluene	310000	1500	NC	1000		< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U
trans-1,2-Dichloroethene	300	180	NC	100		< 0.5 U	< 0.5 U	< 0.5 U	< 0.5 U	**1.1**	< 0.5 U
trans-1,3-Dichloropropene	1(b)	NA	C	NA		< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U
Trichloroethene	7.92 (c)	5	C	5		**1.6**	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U
Trichlorofluoromethane	2000	180	NC	NA		< 2 U	< 2 U	< 2 U	< 2 U	< 2 U	< 2 U
Vinyl chloride	1	2	C	2		< 2 U	< 2 U	< 2 U	< 2 U	**2.4**	**0.55 J**
Xylenes	7000	22000	NC	10000		< 1 U	< 1 U	< 1 U	< 1 U	< 1 U	< 1 U

Notes:

All detections are boldfaced.

(a) At 1 x 10^{-6} risk or hazard quotient of 1.

(b) Screening value for total 1,3-dichloropropene.

(c) Calculated using USEPA revised unit risk

ug/L - Micrograms per liter

NA - Not available

NC = noncancer

C = cancer

NJDEP - New Jersey Department of Environmental Protection

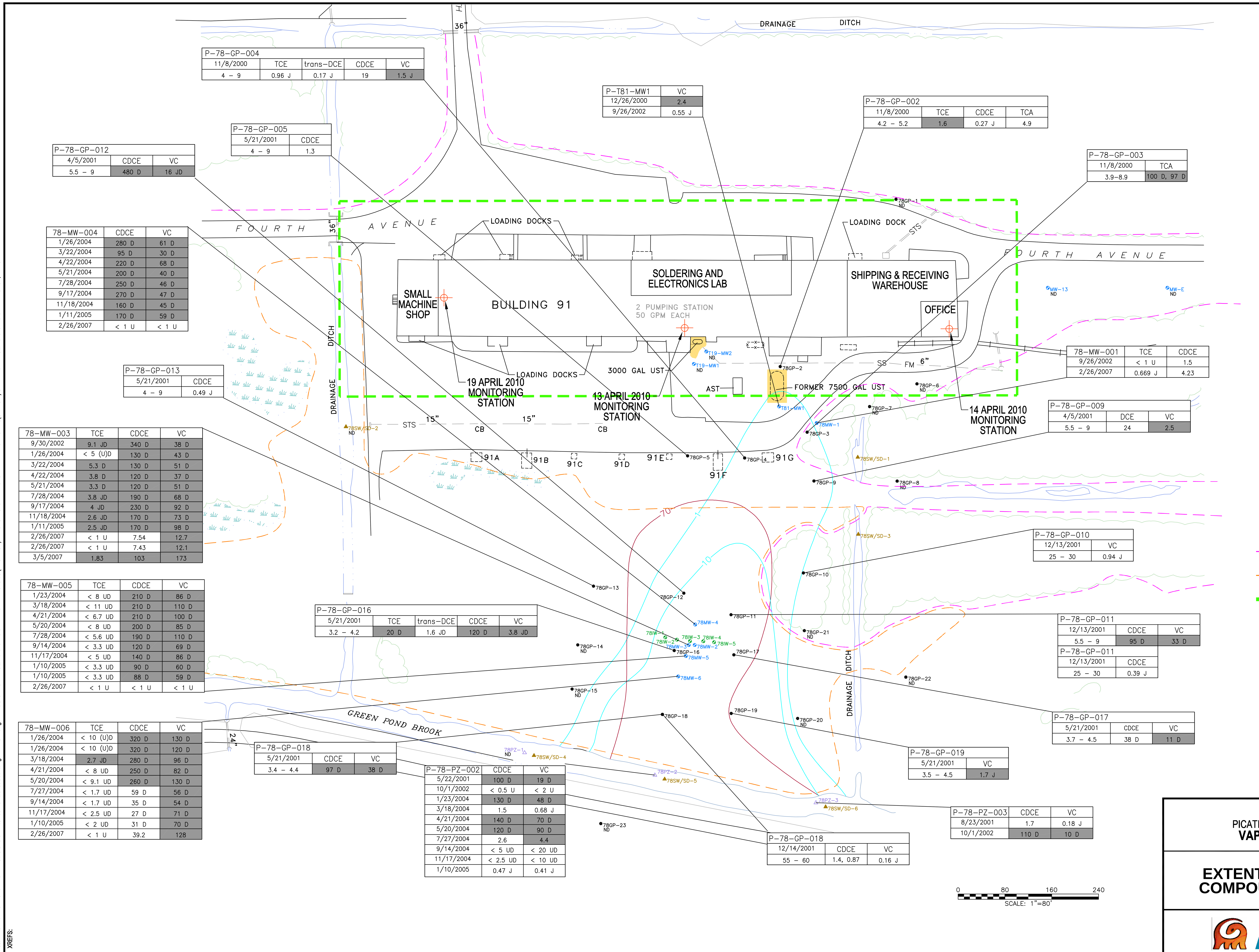
FD - Field duplicate

GW = Groundwater

J - Estimated concentration

R - The sample results are rejected as unusable. The compound may or may not be present in the sample.

U - Non-detect at the specified reporting limit



P-78-GP-004	TCE	trans-DCE	CDCE	VC
11/8/2000				
4 – 9	0.96 J	0.17 J	19	1.5 J

P-78-GP-005	
5/21/2001	CDCE
4 – 9	1.3

P-78-GP-012		
4/5/2001	CDCE	VC
5.5 – 9	480 D	16 JD

78-MW-004	CDCE	VC
1/26/2004	280 D	61 D
3/22/2004	95 D	30 D
4/22/2004	220 D	68 D
5/21/2004	200 D	40 D
7/28/2004	250 D	46 D
9/17/2004	270 D	47 D
11/18/2004	160 D	45 D
1/11/2005	170 D	59 D
2/26/2007	< 1 U	< 1 U

P-78-GP-013	
5/21/2001	CDCE
4 – 9	0.49 J

78-MW-003	TCE	CDCE	VC
9/30/2002	9.1 JD	340 D	38 D
1/26/2004	< 5 (U)D	130 D	43 D
3/22/2004	5.3 D	130 D	51 D
4/22/2004	3.8 D	120 D	37 D
5/21/2004	3.3 D	120 D	51 D
7/28/2004	3.8 JD	190 D	68 D
9/17/2004	4 JD	230 D	92 D
11/18/2004	2.6 JD	170 D	73 D
1/11/2005	2.5 JD	170 D	98 D
2/26/2007	< 1 U	7.54	12.7
2/26/2007	< 1 U	7.43	12.1
3/5/2007	1.83	103	173

78-MW-005	TCE	CDCE	VC
1/23/2004	< 8 UD	210 D	86 D
3/18/2004	< 11 UD	210 D	110 D
4/21/2004	< 6.7 UD	210 D	100 D
5/20/2004	< 8 UD	200 D	85 D
7/28/2004	< 5.6 UD	190 D	110 D
9/14/2004	< 3.3 UD	120 D	69 D
11/17/2004	< 5 UD	140 D	86 D
1/10/2005	< 3.3 UD	90 D	60 D
1/10/2005	< 3.3 UD	88 D	59 D
2/26/2007	< 1 U	< 1 U	< 1 U

78-MW-006	TCE	CDCE	VC
1/26/2004	< 10 (U)D	320 D	130 D
1/26/2004	< 10 (U)D	320 D	120 D
3/18/2004	2.7 JD	280 D	96 D
4/21/2004	< 8 UD	250 D	82 D
5/20/2004	< 9.1 UD	260 D	130 D
7/27/2004	< 1.7 UD	59 D	56 D
9/14/2004	< 1.7 UD	35 D	54 D
11/17/2004	< 2.5 UD	27 D	71 D
1/10/2005	< 2 UD	31 D	70 D
2/26/2007	< 1 U	39.2	128

P-78-GP-016	TCE	trans-DCE	CDCE	VC
5/21/2001				
3.2 – 4.2	20 D	1.6 JD	120 D	3.8 JD

P-78-GP-018		
5/21/2001	CDCE	VC
3.4 – 4.4	97 D	38 D

P-78-PZ-002	CDCE	VC
5/22/2001	100 D	19 D
10/1/2002	< 0.5 U	< 2 U
1/23/2004	130 D	48 D
3/18/2004	1.5	0.68 J
4/21/2004	140 D	70 D
5/20/2004	120 D	90 D
7/27/2004	2.6	4.4
9/14/2004	< 5 UD	< 20 UD
11/17/2004	< 2.5 UD	< 10 UD
1/10/2005	0.47 J	0.41 J

P-78-GP-018		
12/14/2001	CDCE	VC
55 – 60	1.4, 0.87	0.16 J

P-T81-MW1	VC
12/26/2000	2.4
9/26/2002	0.55 J

P-78-GP-002			
11/8/2000	TCE	CDCE	TCA
4.2 – 5.2	1.6	0.27 J	4.9

P-78-GP-003	
11/8/2000	TCA
3.9-8.9	100 D, 97 D

78-MW-001	TCE	CDCE
9/26/2002	< 1 U	1.5
2/26/2007	0.669 J	4.23

P-78-GP-009		
4/5/2001	DCE	VC
5.5 – 9	24	2.5

P-78-GP-010	
12/13/2001	VC
25 – 30	0.94 J

P-78-GP-011		
12/13/2001	CDCE	VC
5.5 – 9	95 D	33 D

P-78-GP-011	
12/13/2001	CDCE
25 – 30	0.39 J

P-78-GP-017		
5/21/2001	CDCE	VC
3.7 – 4.5	38 D	11 D

P-78-GP-019	
5/21/2001	VC
3.5 – 4.5	1.7 J

P-78-PZ-003	CDCE	VC
8/23/2001	1.7	0.18 J
10/1/2002	110 D	10 D

LEGEND:

- 78MW-1 — MONITORING WELL
- 78IW-3 — INJECTION WELL
- 78SW/SD-3 — SURFACE WATER/SEDIMENT SAMPLE LOCATION
- 78PZ-3 — PIEZOMETER
- 78GP-10 — DIRECT PUSH BORING LOCATION
- MONITORING LOCATION
- 70 — cis-1,2 DICHLOROETHENE CONCENTRATION (ug/L)
- 10 — VINYL CHLORIDE CONCENTRATION (ug/L)
- EXCAVATED AREA
- ND — NOT DETECTED IN SAMPLE OR DID NOT EXCEED SITE LOCs
- J — ESTIMATED VALUE
- D — DILUTED SAMPLE
- U — NOT DETECTED
- FRESHWATER FORESTED AND SHRUB WETLAND BOUNDARY
- FRESHWATER EMERGENT WETLAND BOUNDARY
- AREA WITHIN 100 FEET OF BUILDING 91

Contaminant	Abbreviation	LOC (µg/L)
1,1,1–Trichloroethane	TCA	30
Trichloroethene	TCE	1
Trans–1,2,–dichloroethene	trans–DCE	100
Cis–1,2–dichloroethene	CDCE	70
Vinyl Chloride	VC	1

NOTE:

WETLAND BOUNDARIES ARE APPROXIMATE AND WERE ESTIMATED USING AN ARMY PROVIDED GIS LAYER

SITE 78 (PICA 013)
PICATINNY ARSENAL, DOVER, NEW JERSEY
VAPOR INTRUSION EVALUATION

EXTENT OF VOLATILE ORGANIC COMPOUNDS IN GROUNDWATER

ARCADIS

FIGURE
1

Attachment 1

MCUD-PIC-IH 27 April 2010

MEMORANDUM FOR RDAR-WSF-A, Mr. Jeff Coffman

SUBJECT: Bldg. 91, Indoor Air Quality Monitoring Results in Response to Public Notice on Proposed Plan for Site 78

1. References:

a. AR 40-5, Preventive Medicine.

b. EPA's "Building Air Quality, A Guide for Building Owners and Facility Managers," December 1991.

c. OSHA's Standard Interpretations, 02/24/2003 - Reiteration of Existing OSHA Policy on Indoor Air Quality: Office Temperature and Environmental Tobacco Smoke, http://www.osha.gov/pls/oshaweb/owadisp.show_document?p_table=INTERPRETATIONS&p_id=24602

d. Final Proposed Plan For Site 78 (PICA 013), Picatinny Arsenal, NJ, February 2010, Provided by Mr. Ted Gabel, Environmental Affairs Office

e. Agency for Toxic Substances and Disease Registry, Division of Toxicology and Environmental Medicine ToxFAQ's for Vinyl Chloride, July 2006. http://www.atsdr.cdc.gov/tfacts20.pdf

f. NIOSH Pocket Guide to Chemical Hazards, Pub. No. 2005-149, Vinyl Chloride, September 2005. http://www.cdc.gov/niosh/npg/npgd0658.html

g. ACGIH 2009 Threshold Limit Values & Biological Exposure Indices

2. At the request of ARDEC Risk Management Office, the Industrial Hygiene Office performed indoor air quality monitoring (IAQ) to include total volatile organic compounds (TVOCs) in Bldg. 91 on 13, 14, & 19 Apr 10. IAQ monitoring was requested as a result of employee concerns about the public notice published in the Picatinny Express regarding the proposed plan for Site 78. Site 78 encompasses four acres and is located to the west of Green Pond Brook on the southwest side of the installation. According to the Final Proposed Plan for Area P – Site 78 (PICA 013) provided to the Industrial Hygiene Office by Mr. Ted Gabel of the Environmental Affairs Office, as a result of ground water sampling, a localized plume of chlorinated volatile organic compounds above levels of concern (the lowest value based on either human or ecological concern that is used to screen the detected chemicals for further consideration during the remedial investigation and feasibility study process) was identified. No source was located; however, the center of mass of the plume was identified to be approximately 350 ft. down gradient of Bldg. 91. It is speculated that contamination is the result of biodegradation of trichloroethylene (TCE), an industrial solvent, which may have been introduced into the environment due to historical activities conducted at Site 78, specifically Bldg. 91. Bldg. 91 was constructed in 1942 as a storehouse and supply building and contained an optics laboratory in which operations were conducted between 1980 and the mid 1990s. Due to the relative toxicity and the number of samples found exceeding the levels of concern, the primary pollutant of concern is vinyl chloride. Vinyl chloride is a colorless gas with a mild, sweet odor. It does not occur naturally and is formed when other substances such as TCE are broken down. It is also present in low levels in tobacco smoke. Vinyl chloride in water or soil evaporates rapidly if it is near the surface. Vinyl chloride in air breaks down to other substances within a few days. Exposure to high levels of vinyl chloride can cause weakness, exhaustion, abdominal pain, gastrointestinal bleeding, enlarged liver, pallor or cyanosis of extremities and is considered to be a potential

occupational carcinogen. The American Conference of Governmental Industrial Hygienists (ACGIH) has established a Threshold Limit Value – Time Weighted Average (TLV-TWA) for vinyl chloride of 1 part per million (1000 parts per billion). The ACGIH TLV-TWA is the average airborne exposure in any 8-hour work shift of a 40-hour work week that should not be exceeded. According to the human health risk assessment in the Final Proposed Plan, three primary exposure pathways were identified for current industrial/research workers located within site 78 where Bldg. 91 is located. They are as follows: 1) incidental ingestion and dermal absorption of chemicals in surface soil, 2) incidental inhalation of dust particles and volatilization of constituents in soil to ambient air followed by inhalation, and 3) ingestion, dermal absorption, and inhalation of chemicals in groundwater (e.g., drinking, cooking, or bathing with contaminated water). As per the Environmental Affairs Office, the site 78 groundwater is not the source of Bldg. 91's potable and service water. The monitor used in the studies below is a broad range detector of VOCs including vinyl chloride and does not differentiate between the various chemicals present. The purpose of the survey is an attempt to determine if volatilization of VOCs from contaminated groundwater which has reached the surface and/or soil into the ambient indoor air is occurring thus subjecting the occupants of Bldg. 91 to the inhalation exposure pathway described above.

3. The IAQ monitoring results are as follows:

a. A GrayWolf Model #TG-502 Indoor Air Quality Probe S/N 04-113 (factory calibrated 21 Jan 10) was placed on a small desk in the main entrance lobby in the center portion of Bldg. 91 on 13 Apr 10. The results are as follows:

	8-hour Time Weighted Average	**Exceed Standards or Guidelines?**
Temperature	75.33°F	No
Relative Humidity	30.01%	No
TVOCs	233.3 parts per billion	No

b. A GrayWolf Model #TG-502 Indoor Air Quality Probe S/N 04-113 (factory calibrated 21 Jan 10) was placed on a table in the mail room office at the south end of Bldg. 91 on 14 Apr 10. The results are as follows:

	8-hour Time Weighted Average	**Exceed Standards or Guidelines?**
Temperature	78.88°F	YES (high)
Relative Humidity	38.58%	No
TVOCs	240.4 parts per billion	No

c. A GrayWolf Model #TG-502 Indoor Air Quality Probe S/N 04-113 (factory calibrated 21 Jan 10) was place in an empty cubicle in the center of the EOD office at the north end of Bldg. 91 on 19 Apr 10. The results are as follows:

	8-hour Time Weighted Average	**Exceed Standards or Guidelines?**
Temperature	76.95°F	YES (high)
Relative Humidity	31.92%	No
TVOCs	244.1 parts per billion	No

Notes:

As a general rule, office temperature and humidity are matters of human comfort. OSHA has no regulations specifically addressing temperature and humidity in an office setting. However, Section III, Chapter 2, Subsection V of the OSHA Technical Manual

<http://www.osha.gov/dts/osta/otm/otm_iii/otm_iii_2.html#5>, "Recommendations for the Employer," provides engineering and administrative guidance to prevent or alleviate indoor air quality problems. Air treatment is defined under the engineering recommendations as, "the removal of air contaminants and/or the control of room temperature and humidity." OSHA recommends temperature control in the range of 68-76°F and humidity control in the range of 20%-60%.

Volatile organic compounds (VOCs) are emitted as gases from certain solids or liquids. VOCs include a variety of chemicals, some of which may have short- and long-term adverse health effects. Concentrations of many VOCs are consistently higher indoors (up to ten times higher) than outdoors. VOCs are emitted by a wide array of products numbering in the thousands. Examples include: paints and lacquers, paint strippers, cleaning supplies, pesticides, building materials and furnishings, office equipment such as copiers and printers, correction fluids and carbonless copy paper, graphics and craft materials including glues and adhesives, permanent markers, and photographic solutions.

No standards have been set for VOCs in non industrial settings. Field experience suggests the following guide for TVOCs to assess indoor environments:

- <100 ppb (parts per billion): normal outdoor air
- 100-400 ppb: normal indoor air
- 500+ ppb: indicates potential of IAQ contaminants

A volatile organic compound (VOCs) refers to any hydrocarbon, except methane and ethane, with a vapor pressure equal to or greater than 0.1 mm Hg.

4. Recommendations:

a. The TVOC levels in the Bldg. 91 on 13, 14, & 19 Apr 10, did not exceed the field experience guidelines. As mentioned above, the monitor used is a broad range detector of VOCs. TVOCs levels, which may include a variety of different chemicals, during the days surveyed averaged to about 240 ppb which would be significantly less than the ACGIH's TLV-TWA of 1000 ppb (1 ppm) for vinyl chloride. If concerns still exist however, contact the Industrial Hygiene Office to perform additional air sampling specific to vinyl chloride which would utilize an alternative method.

b. Ensure all activities which may disturb the soil within site 78 is cleared through PEMS and the Environmental Affairs Office.

c. Notify employees/contractors of the results of this survey.

5. If there are any further questions on this matter, feel free to contact W. Timothy DeWald or the undersigned at x8458 or email tim.dewald@us.army.mil or christa.j.calvin@us.army.mil.

CHRISTA J. CALVIN
Chief, Industrial Hygiene Office
Picatinny Occupational Health Clinic

CF:
ARDEC Risk Management Office
Mr. John Harrison, Installation Safety Office
Mr. Ted Gabel, Environmental Affairs Office
Mr. Jay Romania, RDAR-WSF-A

Attachment 2

Johnson and Ettinger Vapor Intrusion Model Input Parameters

Input Parameters	Symbol	Units	USEPA Default Value	NJDEP Site-Specific Value
Depth below grade to bottom of enclosed space floor	L_F	cm	15/200	200
Depth below grade to water table	L_{WT}	cm	Site-Specific	352.5
Geology/Hydrogeology				
Average Soil /GW Temperature	T_S	^oC	10	13
Vadose Zone Soil Parameters				
Vadose zone SCS soil type			Sand	Sand
Soil Dry Bulk Density	rb^A	g/cm^3	1.66	1.66
Soil Total Porosity	n^A	cm^3/cm^3	0.375	0.375
Air Filled Porosity (intercalcs)	qa, cz	cm^3/cm^3	0.321	0.321
Soil Water-filled Porosity	$q_w{}^A$	cm^3/cm^3	0.054	0.054
Ave. Vapor Flow Rate into Building	Q_{soil}	L/m	5	5
Exposure Parameters				
Averaging Time for Carcinogens	AT_C	years	70	70
Averaging Time for Noncarcinogens	AT_{NC}	years	30	25
Exposure Duration	ED	years	30	25
Exposure Frequency	EF	days/year	350	250
TCE Unit Risk Estimate	UR	$(ug/m^3)^{-1}$	1.1E-04	2.0E-06
TCE Reference Concentration	RfC	ug/m^3	4.0E+01	NA

Notes:
cm = centimeter
^oC = Degrees Celsius
cm^3/cm^3 = cubic centimeters per cubic centimeter
g/cm^3 = grams per cubic centimeter
L/m = liters per minute
$\mu g/m^3$ = micrograms per cubic meter

DATA ENTRY SHEET

GW-SCREEN
Version 3.1; 02/04

Reset to Defaults

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

YES: X

OR

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

YES:

ENTER Chemical CAS No. (numbers only, no dashes)	ENTER Initial groundwater conc., C_W (µg/L)	Chemical
79016		Trichloroethylene

MORE ê

ENTER Depth below grade to bottom of enclosed space floor, L_F (cm)	ENTER Depth below grade to water table, L_{WT} (cm)	ENTER SCS soil type directly above water table	ENTER Average soil/ groundwater temperature, T_S (°C)	ENTER Average vapor flow rate into bldg. (Leave blank to calculate) Q_{soil} (L/m)
200	352.5	S	13	5

MORE ê

ENTER Vadose zone SCS soil type (used to estimate soil vapor permeability)	OR	ENTER User-defined vandose zone soil vapor permeability, k_v (cm²)	ENTER Vadose zone SCS soil type (Lookup Soil Parameters)	ENTER Vadose zone soil dry bulk density, ρ_b^V (g/cm³)	ENTER Vadose zone soil total porosity, n^V (unitless)	ENTER Vadose zone soil water-filled porosity, θ_w^V (cm³/cm³)
S			S	1.66	0.375	0.054

MORE ê

ENTER Target risk for carcinogens, TR (unitless)	ENTER Target hazard quotient for noncarcinogens, THQ (unitless)	ENTER Averaging time for carcinogens, AT_C (yrs)	ENTER Averaging time for noncarcinogens, AT_{NC} (yrs)	ENTER Exposure duration, ED (yrs)	ENTER Exposure frequency, EF (days/yr)
1.0E-06	1	70	25	25	250

Used to calculate risk-based groundwater concentration.

CHEMICAL PROPERTIES SHEET

ABC

Diffusivity in air, D_a (cm^2/s)	Diffusivity in water, D_w (cm^2/s)	Henry's law constant at reference temperature, H ($atm\text{-}m^3/mol$)	Henry's law constant reference temperature, T_R (^oC)	Enthalpy of vaporization at the normal boiling point, $\Delta H_{v,b}$ (cal/mol)	Normal boiling point, T_B (^oK)	Critical temperature, T_C (^oK)	Organic carbon partition coefficient, K_{oc} (cm^3/g)	Pure component water solubility, S (mg/L)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
7.90E-02	9.10E-06	1.03E-02	25	7,505	360.36	544.20	1.66E+02	1.47E+03	2.0E-06	0.0E+00

END

INTERMEDIATE CALCULATIONS SHEET

Source-building separation, L_T (cm)	Vadose zone soil air-filled porosity, θ_a^V (cm^3/cm^3)	Vadose zone effective total fluid saturation, S_{te} (cm^3/cm^3)	Vadose zone soil intrinsic permeability, k_i (cm^2)	Vadose zone soil relative air permeability, k_{rg} (cm^2)	Vadose zone soil effective vapor permeability, k_v (cm^2)	Thickness of capillary zone, L_{cz} (cm)	Total porosity in capillary zone, n_{cz} (cm^3/cm^3)	Air-filled porosity in capillary zone, $\theta_{a,cz}$ (cm^3/cm^3)	Water-filled porosity in capillary zone, $\theta_{w,cz}$ (cm^3/cm^3)	Floor-wall seam perimeter, X_{crack} (cm)
152.5	0.321	0.003	9.98E-08	0.998	9.96E-08	17.05	0.375	0.122	0.253	4,000

Bldg. ventilation rate, $Q_{building}$ (cm^3/s)	Area of enclosed space below grade, A_B (cm^2)	Crack-to-total area ratio, η (unitless)	Crack depth below grade, Z_{crack} (cm)	Enthalpy of vaporization at ave. groundwater temperature, $\Delta H_{v,TS}$ (cal/mol)	Henry's law constant at ave. groundwater temperature, H_{TS} ($atm\text{-}m^3/mol$)	Henry's law constant at ave. groundwater temperature, H'_{TS} (unitless)	Vapor viscosity at ave. soil temperature, μ_{TS} (g/cm-s)	Vadose zone effective diffusion coefficient, D^{eff}_V (cm^2/s)	Capillary zone effective diffusion coefficient, D^{eff}_{cz} (cm^2/s)	Total overall effective diffusion coefficient, D^{eff}_T (cm^2/s)
2.54E+04	1.80E+06	2.22E-04	200	8,520	5.62E-03	2.39E-01	1.76E-04	1.28E-02	5.09E-04	3.46E-03

Diffusion path length, L_d (cm)	Convection path length, L_p (cm)	Source vapor conc., C_{source} ($\mu g/m^3$)	Crack radius, r_{crack} (cm)	Average vapor flow rate into bldg., Q_{soil} (cm^3/s)	Crack effective diffusion coefficient, D^{crack} (cm^2/s)	Area of crack, A_{crack} (cm^2)	Exponent of equivalent foundation Peclet number, $\exp(Pe^f)$ (unitless)	Infinite source indoor attenuation coefficient, α (unitless)	Infinite source bldg. conc., $C_{building}$ ($\mu g/m^3$)	Unit risk factor, URF ($(\mu g/m^3)^{-1}$)	Reference conc., RfC (mg/m^3)
152.5	200	2.39E+02	0.10	8.33E+01	1.28E-02	4.00E+02	7.02E+70	1.08E-03	2.58E-01	2.0E-06	NA

RESULTS SHEET

RISK-BASED GROUNDWATER CONCENTRATION CALCULATIONS:

Indoor exposure groundwater conc., carcinogen (µg/L)	Indoor exposure groundwater conc., noncarcinogen (µg/L)	Risk-based indoor exposure groundwater conc., (µg/L)	Pure component water solubility, S (µg/L)	Final indoor exposure groundwater conc., (µg/L)
7.92E+00	NA	7.92E+00	1.47E+06	7.92E+00

INCREMENTAL RISK CALCULATIONS:

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

MESSAGE SUMMARY BELOW:

MESSAGE: The values of Csource and Cbuilding on the INTERCALCS worksheet are based on unity and do not represent actual values.

MESSAGE: Risk/HQ or risk-based groundwater concentration is based on a route-to-route extrapolation.

END

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