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RISK ASSESSMENT OF AREA SURROUNDING M - 8 AT THE ATF/DAVIDSON ARCADE FACILITY WHITINSVILLE, MASSACHUSETTS

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INTRODUCTION

The purpose of this public health assessment is to evaluate the potential risks associated with exposure to certain volatile organic compounds known to exist in the ground water at the ATF/Davidson Arcade Facility, Whitinsville, Massachusetts. Past October 1985, October 1986 and March 1987 field study reports have shown the only consistent contamination of any elevated significance exists locally near monitoring well M-8. As standard procedure in this type of assessment, the impacts of this localized site condition on human health will be evaluated under baseline conditions that represent a "No-Action" remedial alternative.

The assessment is comprised of three components:

- Hazard Assessment
- Exposure Assessment
- Risk Assessment

The objectives of the Hazard Assessment are to review site investigation data, and to summarize the nature and extent of observed contamination. Based upon this review, indicator substances are normally selected for further assessment. In that only three volatile organic compounds have consistently been present in groundwater samples from monitoring well M-8, all three will be considered.

The Exposure Assessment indentifies potential receptors and exposure pathways. Additionally, concentrations of contaminants at points of exposure are estimated based on available site data and are compared to applicable public health standards and guidelines.

The Risk Assessment is a quantitative evaluation of risks associated with single and multiple chemical exposures for each identifed pathway. Projected levels of chemical intake are compared to established critical toxicity values. These values represent acceptable intake levels for noncarcinogens, and carcinogenic potency factors for potential carcinogens.

HAZARD ASSESSMENT

SITE CHARACTERIZATION

Location And General Setting: The ATF/Davidson Arcade Facility is located on the north bank of the Mumford River, approximately one mile west of the center of town in Whitinsville, Massachusetts. The area is culturally characterized by other industrial facilities 1000 feet to the east and residential units 400 feet to the northeast. The facility is bounded by a security fence, and twenty-four hour guard service is maintained. The area is serviced by both municipal water and sewer systems.

Hydrogeologic Setting: The site is best described as a flat plain that spans 2800 feet along the north bank of the Mumford River. This plain was created by filling the river embayment with foundry bed fill that principably consists of coarse grained sand and gravel, and fine ash. The foundry that was the source of this fill since the late nineteenth century is located in the present Covitch complex east of the Arcade Facility. As described in an earlier CEH report (October 1985), the hydraulic gradient across the Arcade site is nearly flat; this finding is consistant with what would be expected, given the coarse grained nature of the fill placed in the river. Although gradual, the gradients support a flow direction toward the river.

Mumford River Hydraulics: Personal communication with the U.S Geological Survey, Water Resources Division shows that the hydraulic data concerning the river is somewhat limited, especially in the Arcade site area. Twelve years of flow records are available, however, for the East Douglas station from July, 1939 to September 1951. This station, which exists approximately three miles up-river from the site, measures flow from a 29.1 square mile drainage area. The annual average discharge in this location has been calculated at 44.8 cubic feet per second (cfs). Clearly, use of these data will result in a conservative impact assessment later in this report because significant drainage basin area and concommitant flow have not been included in the analyses.

Local Wind Speed and Direction: Personal communication with the Weather Service at the Worcester Municipal Airport shows the average annual wind speed and direction at that location to be 10.2 miles per hour from the southwest.

CONTAMINANT CHARACTERIZATION

Probable Source of Contamination: Discussions with present and former employees of ATF/Davidson have been inconclusive as to the etiology of the volatile organic compounds that exist in the ground water at monitoring well M-8. Given the many years that have passed since the foundry fill was placed in this location, a buried source seems unlikely. Further, personal communications with the employees shows no evidence of subsequent burial or storage in this area. An undocumented spill, therefore, seems the only other event that could explain the existence of the noted contamination.

Contaminant Levels: As summarized in the CEH October 1986 report, volatile organic compounds found in M-8 include Trichloroethylene (TCE), trans-1,2-Dichloroethylene (t-DCE), and vinyl chloride (VC). The latter two compounds are common weathered (break-down products) species of the parent compound, Trichloroethylene. Table 1 shows the historical record of the compound concentrations.

TABLE 1

WATER QUALITY - MONITORING WELL M-8

Date	Trichloroethylene (ug/l)	trans-1,2-Dichloroethylene (ug/l)	Vinyl Chloride (ug/l)
7-18-85	30	610	260
11-13-85	Trace ($\geq$ 10)	1100	380
2-10-86	Trace ($\geq$ 10)	380	Trace ($\geq$ 10)
5-13-86	26	1600	600
8-06-86	15	720	220
2-02-87	17	640	280
Average	18 (1.5%)	842 (73%)	292 (25.5%)

As these data show, the mass balance is shifted toward the weathered species. This may indicate a relatively lenghly period of time has elapsed since emplacement, or that significant biological and physio-chemical reactions have occured in a shorter time frame. New evidence suggests that the presence of aluminum silicates (somewhat prevalent in foundry bed materials), and nutrient enhanced/elevated temperature ground water (fed by upgradient surface water) can significantly accelerate the weathering process. Which time frame is accurate at the M-8 location is unknown, and may not be able to be determined given the present research data.

Aerial Extent of Contamination: The CEH March 1987 report shows the locations of additional monitoring wells (M-9, M-10 and M-11) that were placed hydraulically upgradient of M-8. Additionally, water quality results from wells M-6, M-7, M-8, M-9, M-10 and M-11 are included in the report. Given the relatively uncontaminated nature of M-9, M-10, and

M-11, a reasonable assumption may place the center of the contaminated area at M-8, with the edge of the plume extending one-half the distance toward each well. Additionally, a mirror image of this defined plume would presumably exist to the east of M-8. Figure 1 shows this plume interpretation, the surface area of which covers approximately 13,100 square feet. As mentioned earlier, ground water, and thusly the plume of contamination flow toward the adjacent river.

Properties, Criteria and Standards: Table 2 provides a summary of the physical and chemical properties of TCE, t-DCE, and VC. These properties relate to the fate of each species in given environmental media.

TABLE 2

PHYSICAL AND CHEMICAL PROPERTIES

Chemical	Molecular Weight	Melting Point (°C)	Boiling Point (°C)	Specific Gravity	Solubility (Water) (mg/l)	Log Octanol/ Water Partition Coefficient	Vapor Pressure (mm\Hg)
TCE	131.4	-73	87	1.464	1100	2.29	57.9
t-DCE	96.95	-50	48	1.26	600	0.48	200
VC	62.5	-153	-13.9	0.912	1100	1.40	2660

As these values show, these compounds are moderately soluble in water, and have generally high vapor pressures. Because of these properties, these compounds volatize from surface waters rapidly. The USEPA has determined the surface water half-lives for these compounds to range from a few hours (VC) to a few days (TCE).

Octanol/water partition coefficients are low to moderate, indicating that the compounds do not tend to bioaccumulate or adsorb significantly to soils. With specific gravities greater than or nearly equal to one, these compounds tend to sink in groundwater if present as a separate phase.

Table 3 summarizes the toxicity criteria and standards for TCE, t-DCE

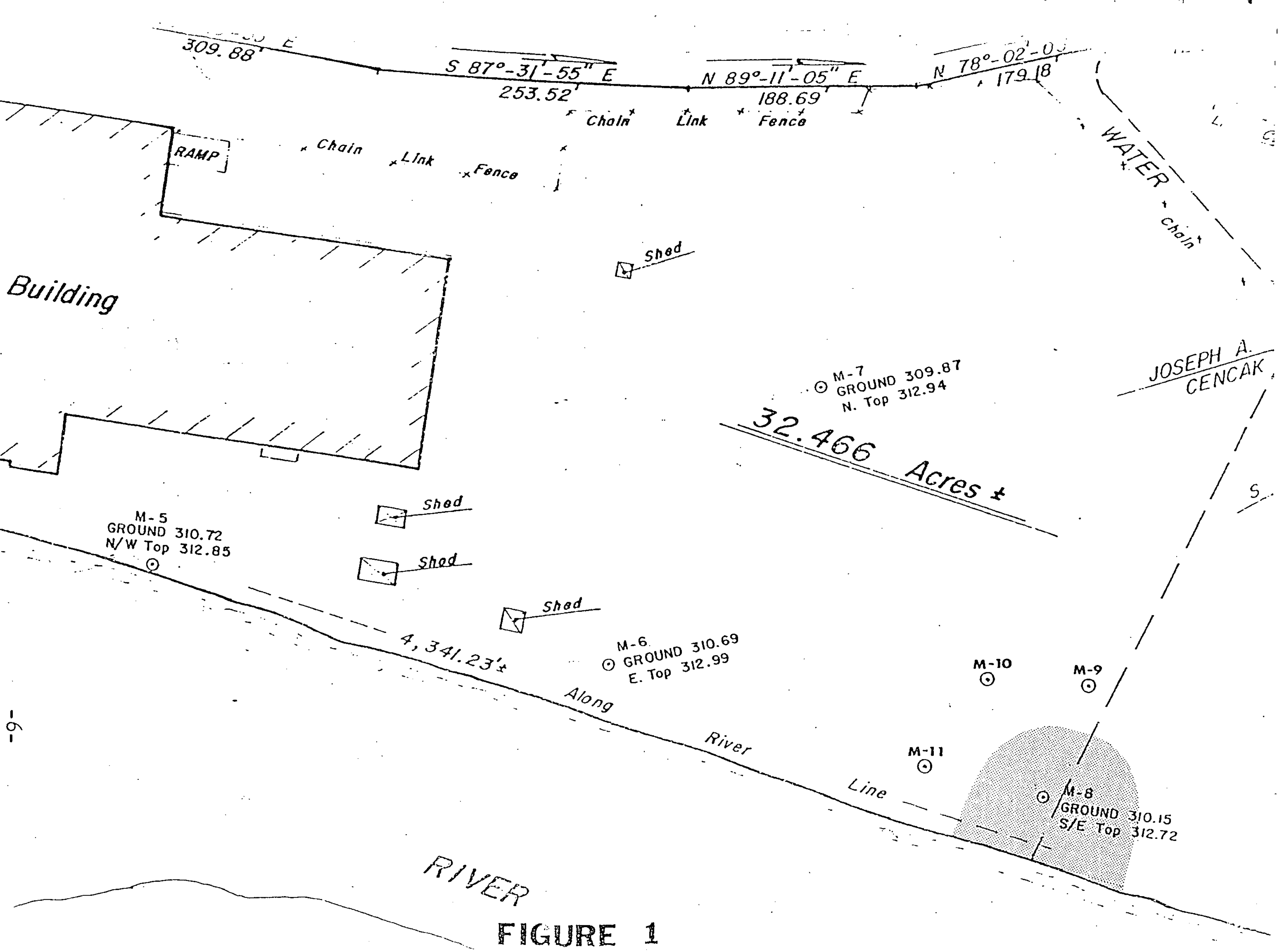
309.88'
S 87°-31'-55" E
253.52'
N 89°-11'-05" E
188.69'
N 78°-02'-0
179.18'
Chain Link Fence
RAMP
Chain Link Fence
WATER
Chain
Shed
Building
M-7
GROUND 309.87
N. Top 312.94
JOSEPH A. CENCAK
32.466 Acres ±
Shed
M-5
GROUND 310.72
N/W Top 312.85
Shed
Shed
4,341.23'±
Along River Line
M-6
GROUND 310.69
E. Top 312.99
M-10
M-9
M-11
M-8
GROUND 310.15
S/E Top 312.72
RIVER

FIGURE 1

and VC. Brief descriptions and explanations of these criteria and standards follow the table.

TABLE 3

EXISTING STANDARDS AND CRITERIA

Chemical	MPDWR[1] MCL (mg/l)	TLV[3] TWA (mg/m^3)	CAG[5] (CLASS) (ingestion)	CPI[5] $(mg/kg/day)^{-1}$ (ingestion)	USEPA[5] WQCOW (mg/l)	MAC[6] PFAL (mg/l)
TCE	0.005[2]	270.0	B	0.011	0.0028	45.0
t-DCE	-	790.0	D	-	-	-
VC	0.001[2]	10.0	A	2.30	0.002	-

(1) National Primary Drinking Water Regualtions, Maximum Contaminant levels, 40 CFR 141.

(2) Proposed Maximum Contaminant Levels for the NPDWR, FR 11/25/85.

(3) Threshold Limit Value-Time Weighted Average for inhalation exposure during an 8 hour day, 5 days per week; American Conference of Governmental Industrial Hygienists, 1986-87.

(4) USEPA Carcinogen Assessment Group - Weight of Evidence: A - proven human carcinogen; B - probable human carcinogen; C - possible human carcinogen; D - not enough eveidence to evaluate potential carcinogenicity.

(5) Carcinogenic Potency Index (CPI); Water Quality Criteria for Drink Water (WQCDW) - USEPA Superfund Public Health Evaluation Manual, October 1986.

(6) Maximum Allowable Concentration for Protection of Freshwater Aquatic Life - USEPA Quality Criteria for Water, 1986.

Descriptions of criteria and standards are as follows:

a) National Primary Drinking Water Regulations, 40 CFR 141: These regulations set Recommended Maximum Contaminant Levels (MCLs) for several organic, inorganic, microbiological, and radiological contaminants. RMCLs are the maximum level of a contaminant in drinking water at which no known or anticipated adverse effect on the health of persons would occur, and which includes an adequate margin of safety. RMCLs are non-enforceable health goals. The MCL standards are enforceable only in community water systems and are based both on health-related criteria for long-term, chronic exposure and practical treatment technology currently available. RMCLs and MCLs for eight volatile synthetic organic chemicals were proposed in the Federal Register, November 13, 1985.

b) TLV-TWA (ACGIH, 1986-87): The threshold limit value (TLV)-time weighted average (TWA) of a compound is the average concentration in air for a normal 8-hour work day and a 40-hour work week to which nearly all workers may be repeatedly exposed, day after day, without adverse effect. Although the TLVs were not developed to rank relative toxicity of the airborne chemicals, the TLVs represent the most substantial set of health-based criteria for airborne contaminants.

c) Carcinogenic Potency Index (USEPA, 1986a): For many known and suspected carcinogenic substances, a carcinogenic potency index has been developed by the USEPA Carcinogen Assessment Group (CAG).

This index reflects the carcinogenic potential of a unit dose of chemical. It indicates the relative potency of contaminants in inducing cancer, and can therefore be used to develop relative rankings of carcinogens.

d) <u>USEPA Water Quality Criteria (USEPA, 1986b)</u>: USEPA Water Quality Criteria specify concentrations of pollutants or pollutant catergories in water which will generally ensure water quality adequate to support a specified water use. The criteria are guidance levels only and have no regulatory impact. Two criteria, representing acute and chronic levels, are presented for freshwater aquatic life.

e) <u>Cancer Risk Value (USEPA, 1986a)</u>: This value is the dose (either ingested or inhaled) calculated by the USEPA Carcinogen Assessment Group (CAG) which is expected to result in an increased lifetime risk of cancer of one in an exposed population of 100,000. This risk assessment is based on values of oral (ingestion) or inhalation routes of exposure, where apporpriate.

<u>Toxicity Profiles</u>: The three chemical compounds in question are toxicologically understood and regulated as follows:

a) <u>Trichloroethylene (TCE)</u>: Ingestion of large amounts TCE results in vomiting and abdominal pain followed by transient unconsciousness. Prolonged exposure may cause liver damage. Long-term inhalation and ingestion studies with animals have shown evidence of carcinogenicity. The CAG has designated TCE as a Group B - probable human carcinogen (USEPA, 1985a).

The proposed MCL for TCE in drinking water is 5 ug/l. Since this chemical is considered a potential carcinogen, the RMCL is zero. The CAG has estimated that a lifetime cancer risk of 10^{-5} is associated with ingestion of water containing 27 ug/l of TCE.

b) trans-1,2-Dichloroethylene: Little information concerning exposure to trans-1,2-dichlorethylene is available. There are no reports that t-DCE is carcinogenic in humans or animals. Human exposure to high concentrations has been shown to have anesthetic effects as well as nausea, vomiting, weakness, tremor, and cramps. Repeated exposure to high concentrations produced fatty degeneration of the liver in rats (USEPA, 1985a).

A one-day NOAEL for t-DCE has been established by the USEPA Office of Drinking Water. The one-day NOAEL is the concentration of t-DCE in water which results in no observable adverse effects (based on non-carcinogenic end-point of toxicity) assuming that two liters of that water are consumed per day over the course of 10 days. The one-day NOAEL for a 10 kg child is 2.7 mg/l (USEPA, 1985b).

The Office of Drinking Water has also published a Lifetime NOAEL. The Lifetime NOAEL is the amount of t-DCE in water at which, when two liters are ingested per day, over the course of a lifetime, no adverse effect would be observed. The lifetime NOAEL for a 70 kg adult is 0.35 mg/l (USEPA, 1985b).

c) Vinyl Chloride: Most toxicological data about vinyl chloride involves inhalation data only. Short-term high level exposure can produce syptoms of narcosis, respiratory tract irritation, bronchitis, headache, and dizziness in humans. Long-term exposure to vinyl chloride results in liver, cardiovascular and gastrointestinal damage (USEPA, 1985a).

Vinyl chloride is considered a human carcinogen based on extensive studies involving humans and occupational exposure data. It is classified as a Group A - proven human carcinogen by the CAG. The CAG has estimated that a lifetime carcer risk of 10^{-5} is associated with ingestion of water containing 20 ug/l of vinyl chloride. The proposed RMCL is zero based on carcinogenicity, however, the proposed, enforceable, MCL is 1 ug/l.

EXPOSURE ASSESSMENT

POTENTIAL RECEPTORS

Residential and Industrial Community: The area immediately surrounding the ATF/Davidson Arcade facility is fairly densely populated, especially during the work day. Residents and employees of the area could potentially be exposed to volatized air emissions in the vacinity of the contaminated zone. The zone of contamination is relatively isolated, however, with the nearest residences, and businesses being approximately 400 feet to the northeast. Given the dynamics of local groundwater hydraulics, contaminent transport is understood to flow away from residences and comercial/industrial establishments, and toward the Mumford River.

Surface Water: Given the proximity of the known groundwater contamination to the river and groundwater flow direction being toward the river, contamination will undoubtedly discharge to the Mumford River.

EXPOSURE PATHWAYS AND CONCENTRATION ESTIMATES

AIR: Volatile organic contaminants that are present in ground water have relatively high vapor pressures and can potentially evaporate into the atmosphere through soil, or after discharging to surface water.

Once in the air, the contaminants could be transported off-site by winds. The following conservative assumptions were used in calculating possible airborne concentrations of TCE, t-DCE, and VC:

a) Ground water at M-8 contains average concentrations of 0.018 mg/l TCE, 0.842 mg/l t-DCE, and 0.292 mg/l VC. All flux concentrations of these substances has been assumed to volatilize into the atmosphere at the M-8 location.

b) Contaminated groundwater flux to the Mumford River is at a rate of 0.68 liters per minute (0.011 liters/sec) across the plume's down-gradient seepage face. Basic data for this calculations is contained in the October 1985 CEH report, where:

$Q = KiA$

$= (3.28 \times 10^{-5}$ ft/sec$)(4.44 \times 10^{-3}$ ft/ft$)(2760$ ft$^2)$
$= 4.02 \times 10^{-4}$ ft^3/sec
$Q = 0.68$ liters/minute

where,

A = Length x Depth = (138ft)(20 ft assumed) = 2760 ft^2

c) The breathing zone of an individual standing downwind is 2 meters from ground surface, with mixing taking place throughout this distance.

d) Average wind speed and direction for the area is 10.2 miles per hour (4.48 meters per second) from the southwest.

e) No dispersion or disipation takes place within or from the 2 meter by 42 meter by 120 meter corridor that separates the zone of contamination from the nearest receptors (residents) to the north-east.

The following calculations conservatively estimate the concentrations of TCE, t-DCE and VC in the air at the nearest long term receptors:

a) TCE:

If: $W_{tce} = (Q)(C_{tce})$

where, W_{tce} = mass flux of TCE in ground water
Q = groundwater flux
C_{tce} = concentration of TCE in ground water

then W_{tce} = (0.011 l/sec)(0.018 mg/l)

= $\underline{1.98 \times 10^{-4} \text{ mg/sec}}$

and: Va = (A)(W)

where, Va = volume flux of air through breathing zone

A = cross sectional area of air flow

W = wind speed

and, A = (42 meters)(2 meters) = 84 square meters

then, Va = (84 m^2)(4.48 m/sec)

= $\underline{376.32 \text{ m}^3\text{/sec}}$

and: B_{tce} = (W_{tce})/Va

where, B_{tce} = breathing zone concenration of TCE

then, B_{tce} = (1.98 x 10^{-4} mg/sec)/(376.32 m^3/sec)

= $\underline{5.26 \times 10^{-7} \text{ mg/m}^3}$

= $\underline{8.92 \times 10^{-5} \text{ ppb}}$

b) t-DCE:

If: W_{t-DCE} = (Q)(C_{t-DCE})

where, W_{t-DCE} = mass flus of t-DCE in ground water

Q = ground water flux

C_{t-DCE} = concentration of t-DCE in ground water

then, W_{t-DCE} = (0.011 l/sec)(0.842 mg/l)

$\underline{9.26 \times 10^{-3} \text{ mg/sec}}$

and: $Va = (A)(W)$

where, Va = volume flux of air through breathing zone
A = cross sectional area of air flow
W = wind speed

and, A = (42 meters)(2 meters) = 84 square meters

then, $Va = (84\ m^2)(4.48\ m/sec)$

$= \underline{376.32\ m^3/sec}$

and: $B_{t-DCE} = (W_{t-DCE})/Va$

where, B_{t-DCE} = breating zone concentration of t-DCE

then, $B_{t-DCE} = (9.26 \times 10^{-3}\ mg/sec)/(376.32\ m^3/sec)$
$= \underline{2.46 \times 10^{-5}\ mg/m^3}$

$= \underline{6.15 \times 10^{-3}\ ppb}$

c) VC:

If: $W_{VC} = (Q)(C_{VC})$

where, W_{VC} = mass flux of VC in ground water
Q = ground water flux
C_{VC} = concentration of VC in ground water

then, $W_{VC} = (0.011\ l/sec)(0.292\ mg/l)$
$= \underline{3.21 \times 10^{-3}\ mg/sec}$

where, D_{sw} = dilution factor
Q_{gw} = ground water flux
Q_r = annual average Mumford River discharge

Based upon the average concentrations derived in Table 1, the concentrations in the river are conservatively estimated as follows:

$$TCE = (18\ ug/l)(8.70 \times 10^{-6}) = \underline{1.56 \times 10^{-4}\ ug/l}$$

$$t\text{-}DCE = (842\ ug/l)(8.70 \times 10^{-6}) = \underline{7.30 \times 10^{-3}\ ug/l}$$

$$VC = (292\ ug/l)(8.70 \times 10^{-6}) = \underline{2.53 \times 10^{-3}\ ug/l}$$

RISK ASSESSMENT

As discussed in the Exposure Assessment section, the primary pathways associated with off-site exposure to TCE, t-DCE and VC are transport by air and surface water. This Risk Assessment section will evaluate the chemical concentration levels estimated to exist within these air and surface water pathways in terms of relevant standards and toxicity criteria.

TCE is considered a Group B (probable human carcinogen) substance, and VC is a Group A (proven human carcinogen) substance. Potential lifetime cancer risks will be calculated for exposure to their estimated pathway concentrations. Because t-DCE is considered a Group D (not enough evidence to evaluate potential carcinogenicity) substance, exposure to its pathway concentration will be evaluated in terms of TLV-TWA criteria (Threshold Limit Value - Time Weighted Average).

AIR: Risks associated with pathway concentrations are estimated assuming a typical 70 kg adult, breathing $20m^3$ of air per day, is living at the site boundry. Potential carcinogenic risks for TCE and VC are calculated as follows:

a) TCE:

$$R_c = (C_{tce})(Pf_{tce})(1/70 \text{ kg})(20 \text{ m}^3/\text{day})$$

$$= (5.26 \times 10^{-7} \text{ mg/m}^3) \times (4.6 \times 10^{-3} (\text{mg/kg/day})^{-1}) \times (1/70 \text{ kg}) \times (20 \text{ m}^3/\text{day})$$

$$= \underline{6.95 \times 10^{-10}}$$

where, R_c = carcinogenic risk
C_{tce} = projected concentration of TCE in air
Pf_{tce} = potency factor of TCE (USEPA)
70kg = average adult weight (USEPA)
20 m^3/day = average amount of air breathed by average adult per day (USEPA)

b) VC:

$$R_c = (C_{vc})(Pf_{vc})(1/70 \text{ kg})(20 \text{ m}^3/\text{day})$$

$$= (8.53 \times 10^{-6} \text{ mg/m}^3) \times (2.5 \times 10^{-2} (\text{mg/kg/day})^{-1}) \times (1/70 \text{ kg}) \times (20\text{m}^3/\text{day})$$

$$= \underline{6.06 \times 10^{-8}}$$

where, R_c = carcinogenic risk
C_{vc} = projected concentration of VC in air
Pf_{vc} = potency factor of VC (USEPA)
70kg = average adult weight (USEPA)
20m^3/day = average amount of air breathed by average adult per day (USEPA)

Table 4 summarizes projected airborne contaminant concentrations, TLV standards and potential lifetime cancer risks.

TABLE 4

AIRBORNE EXPOSURES, STANDARDS AND RISKS

Chemical	Projected Airborne Concentration (ug/m³)	TLV (ug/m³)	Potential Lifetime Cancer Risk
TCE	5.26×10^{-4}	2.70×10^{5}	6.95×10^{-10}
t-DCE	2.46×10^{-2}	7.90×10^{5}	—
VC	8.53×10^{-3}	1.00×10^{4}	6.06×10^{-8}

Projected lifetime cancer risks for airborne TCE and VC are both far less than 1 in 1,000,000 which is generally considered statistically insignificant. Projected concentrations of t-DCE, not classified as a carcinogen, are far less than 1/1,000,000 of the TLV; the health risks are also, thusly, not considered significant.

Surface Water: Risks associated with pathway concentrations are estimated assuming a typical 70 kg adult drinks 2 liter/day directly from the Mumford River, adjacent to the discharging zone of contamination. In that the area is served by public water supplies, this is highly unlikely and overly conservative. The point of treating the Mumford as a drinking water source adjacent to the site, however, is to place incidental ingestion by potential recreational users in perspective. Actual risks associated with contact recreation would be expected to be several orders of magnitude below these calculated values; contact would be intermittent, and incidential ingestion would be less than 2 liters per day. Potential carcinogenic risks associated with TCE and VC are calculated as follows:

a) TCE:

$$R_c = (C_{tce}) \times (Pf_{tce}) \times (1/70kg) \times (2\ liter/day)$$

$$= (1.56 \times 10^{-7} mg/l) \times (1.1 \times 10^{-2} (mg/kg/day)^{-1}) \times (1/70kg) \times (2\ liter/day)$$

$$= \underline{4.93 \times 10^{-11}}$$

where, R_c = carcinogenic risk

C_{tce} = projected concentration of TCE
Pf_{tce} = potency factor of TCE (USEPA)
70kg = average adult weight (USEPA)
2 liter/day = average amount of water ingested per day (USEPA)

b) VC:

$$R_c = (C_{VC}) \times (Pf_{VC}) \times (1/70kg) \times (2\ liters/day)$$

$$= (2.53 \times 10^{-6}\ mg/l) \times (2.30\ (mg/kg/day)^{-1}) \times (1/70\ kg) \times (2\ liters/day)$$

$$= \underline{1.69 \times 10^{-7}}$$

where, R_c = carcinogenic risk
C_{VC} = projected concentration of VC
Pf_{VC} = potency factor of VC (USEPA)
70 kg = average adult weight (USEPA)
2 liters/day = average amount of water ingested per day (USEPA)

Table 5 summarizes projected surface water contaminant concentrations, MCL standards, NOAEL standards (t-DCE), and potential lifetime cancer risks.

TABLE 5

SURFACE WATER EXPOSURES, STANDARDS AND RISKS

Chemical	Projected Surface Water Concentration (ug/l)	MCL (ug/l)	NOAEL (ug/l)	Potential Lifetime Cancer Risk
TCE	1.56×10^{-4}	5	-	4.93×10^{-11}
t-DCE	7.30×10^{-3}	-	350	-
VC	2.53×10^{-3}	1	-	1.69×10^{-7}

Projected lifetime cancer risks for daily ingestion of Mumford River water are far less than 1 in 1,000,000 for both TCE and VC; the risks are, therefore, considered statistically insignificant. Projected concentrations of t-DCE, not classified as a carcinogen, are approximately 50,000 times less than the NOAEL (no observable adverse effects level), as set by the USEPA Office of Drinking Water. Health effects are, thusly, considered insignificant.

SUMMARY AND CONCLUSIONS

Although the etiology of contamination in the vacinity of M-8 is undocumented, the aerial extent is localized. Given site security and the existence of public water supplies, the occasions for inadvertant direct exposure seem remote. Whereas the contaminated area lies directly adjacent to the river that receives groundwater discharge, contamination is undoubtedly mixing with surface water.

The noted contaminants, TCE, t-DCE and VC occur in concentrations equal to 1.5%, 73% and 25.5% of the mass balance, respectively. Whether this is indicative of a relatively old or recent incident is unknown. The physical and chemical properties of these compounds, at their noted concentrations, will tend to make them move with ground water flow. They will ultimately discharge to the Mumford River and volitalize into the atmosphere.

The potential receptors in the area include local residents and employees of local enterprises. Pathways of exposure are through the air, and through contact with the Mumford River. Concentrations of the contaminants are calculated to be very low in both pathways, and the risks associated with exposure are attendantly calculated to be negligable.

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