

Health Consultation

**Cooper Commerce (Unichem) Industrial Site
CERCLIS No. AZR000002550
Gilbert, Maricopa County, Arizona**

**Evaluation of Recent Data
From
Groundwater Monitoring Wells**

Prepared by

**Office of Environmental Health
Environmental Health Consultation Services
Arizona Department of Health Services
Under Cooperative Agreement With the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry (ATSDR)**

Purpose

This health consultation evaluates tetrachloroethylene (perchloroethylene, perc, PCE) and trichloroethylene (TCE) results obtained from groundwater monitoring wells in 2004. The primary public health concerns were exposures to children by incidental contact with groundwater used for watering yards and potential exposures from using groundwater for drinking water. Another concern was contamination migrating beyond the site boundaries in two groundwater aquifers.

Site Description

Cooper Commerce Industrial Park (CCIP) is located in Gilbert, Arizona, about 25 miles southeast of Phoenix. The industrial park is comprised of mixed-use light and heavy industrial enterprises, and is about 80 acres in size. It is located off Cooper Road, ½ mile south of Guadalupe Road, in the 800 block of West Commerce Avenue (Appendix A). CCIP is adjacent to other mixed-use industrial facilities along the rail line that serves the area. Residential developments have been built to the west of the industrial area, across Cooper Road.

The initial discovery of PCE and TCE in shallow groundwater near the industrial park in 1990 led to an investigation to determine the sources of these contaminants. A large metal fabrication enterprise at the east end of the business park was determined to be the source (J. Little, Arizona Department of Environmental Quality, personal communication, August 11, 2004).

The primary groundwater contaminant, PCE, is used as a solvent in many of the industrial operations common in CCIP. TCE was also found at concentrations near the maximum contaminant level (MCL) of 5 micrograms/liter ($\mu\text{g/L}$). These contaminants were discarded in dry wells or directly onto the ground before environmental regulations prohibited such disposal practices. Although shallow groundwater contamination was initially discovered on this site in 1990, this site was not placed on the state's Superfund (Water Quality Assurance Revolving Fund) list until 2003 because of site ranking criteria.

Background

This area contains two groundwater aquifers. One is shallow, with water from 115–165 feet; the other is deep, with water from 580–610 feet. Presently, there are no known connections between these aquifers, and only the deep aquifer is used for drinking water supply.

In 1990, land surrounding CCIP was largely agricultural and the population of Gilbert was less than 25,000. By 2004, about 125,000 people were living within the incorporated area of Gilbert. This growth has placed a premium on all groundwater supplies within the town limits. Gilbert currently uses the deep groundwater aquifer for 25% of its water supply. Water in the shallow aquifer is affected by PCE and TCE, but this aquifer is not used for drinking water at this time. Arizona groundwater regulations consider all groundwater to be of drinking water quality, even if at the present time the water is not potable. Therefore, the contaminated aquifer has the potential to be a future drinking water source (ADEQ 1992).

Prolonged drought conditions extending back about 9 years, and expected to continue for several more years, have placed a strain on surface water supplies. This demand on surface water sources may result in some shallow, otherwise unused groundwater sources being tapped for drinking water. The closest drinking water well is presently located within ½ mile down-gradient of the plume of the contaminants. This well is drilled into the deep aquifer, in which neither PCE nor TCE have been detected.

Groundwater Contamination

Both PCE and TCE were found in a Salt River Project (SRP) irrigation well located adjacent to CCIP in June 2001. This well is drilled 615 feet into the deeper aquifer and has a 24-inch perforated case from 210 to 580 feet. The SRP well is currently used to supply irrigation water to local users (Personal Communication with Dr. Greg Elliott, SRP water quality expert, October 15, 2004). PCE and TCE levels in this well were below the respective MCL (5 µg/L) for each chemical, but there was concern about groundwater contamination spreading beyond the boundaries of the industrial park. The perforated casing of the SRP well is below the shallow aquifer. To the best of our knowledge, the SRP well does not provide a connection between the shallow and deep aquifers.

In response to finding PCE and TCE in the SRP irrigation well, two monitoring wells (104S and 104D) were installed about 1,000 feet north of CCIP in July 2003. These wells are located between the contaminated area of the shallow aquifer and the nearest drinking water supply well. The closest drinking water well is about ½ mile north of CCIP, near the intersection of Guadalupe and Cooper Road, and is drilled into the deeper aquifer. Groundwater flows to the northwest and this drinking water well is in the path of contaminants that could be carried off-site. To date, neither PCE nor TCE have been detected in this well.

Monitoring well 104S was drilled approximately 125 feet below ground surface into the shallow aquifer where PCE and TCE were initially found. Monitoring well 104D was drilled into the deeper aquifer from which drinking water is presently drawn.

Data Used

Monitoring Well Data

Monitoring wells 104S and 104D were sampled in August, September, and December of 2003, and March 2004. Table 1 shows the levels of PCE and TCE found in these wells. PCE and TCE were not detected in samples collected from monitoring well 104D, which is in the deep aquifer used for drinking water supply.

Table 1. Data for recently installed monitoring wells in Gilbert, Arizona (ADEQ 2004)

	PCE (µg/L)*	TCE (µg/L)*
Date	MW104D (deep)	
8/7/03	<2.0	<2.0
9/4/03	<2.0	<2.0
12/8/03	<2.0	<2.0
3/10/04	<2.0	<2.0
Date	MW104S (shallow)	
8/7/03	16	6
9/4/03	5.8	3.6
12/8/03	17	4.5
3/16/04	10	2.4

* Numbers in bold exceeded maximum contaminant levels (MCLs) of 5 µg/L for tetrachloroethylene (perchloroethylene, perc, PCE) and trichloroethylene (TCE).

Drinking Water Well Data

Neither PCE nor TCE have been detected in the nearest drinking water supply well.

Contaminants of Concern

The primary contaminant of concern in shallow groundwater is PCE, which was found at more than 3 times the U.S. Environmental Protection Agency (EPA) MCL of 5 µg/L (EPA, 1992). TCE slightly exceeded the EPA MCL of 5 µg/L in one sample (Table 1).

Exposure Analysis

This section analyzes the exposure pathways by which children and adults may come into contact with contaminated water in the irrigation canals. The analyses use ATSDR and ADHS standard exposure assumptions for intake rates, body weights, exposed skin surface area, averaging times, and exposure duration. Equations and exposure factors are provided in Appendix B. Table 2 shows the current EPA MCL, the ADEQ noncancer health-based guidance levels (HBGLs) (ADHS, 1996), and the ATSDR oral Minimal Risk Levels (MRLs), (ATSDR 2004).

Table 2. EPA maximum contaminant levels (MCLs), ADEQ health-based guidance levels (HBGLs) for flood irrigation, and ATSDR oral minimal risk levels (MRLs) for PCE and TCE

Chemicals of Concern	MCLs (µg/L)	HBGLs (µg/L)	Oral MRLs (mg/kg/day)
Tetrachloroethylene (perchloroethylene, PCE)	5	170	0.05 (acute)*
Trichloroethylene (TCE)	5	920	0.2 (acute)*

*No chronic MRLs currently available.

Our exposure analysis focused on use of contaminated water for flood irrigation of yards in neighborhood residences, with child exposures being the primary concern. Flood irrigation adequate to maintain Bermuda grass was used to quantify water applications (K. Tiggs, R. Templeton, City of Phoenix Parks and Recreation Department, personal communication, January 22, 1998). An irrigation frequency of 24 days per year was used. The duration of each irrigation flood event was assumed to be 4 hours. These are considered to be independent acute exposures.

We used EPA standard default assumptions to calculate potential exposures from contaminants in flood irrigation water. Inhalation exposures were calculated using a mass transfer model for bodies of water (EPA 1995). We also used primarily EPA standard default exposure assumptions to quantify potential exposures to nearby residents.

Estimating wind dispersion of these contaminants was done by applying the EPA Q/C dispersion term for Phoenix, Arizona. Q/C is the inverse concentration factor for air dispersion (EPA 1996 b). The model uses the inverse of the mean concentration at the center of a 0.5-acre body of water. Skin absorption of the contaminants is quantified using chemical-specific permeability coefficients (EPA 1992).

Skin contact and inhalation pathways were assessed using the ADHS noncancer HBGLs for incidental contact end uses of water developed for the State of Arizona (ADHS 1996). HBGLs are calculated using a human health-based approach generally consistent with risk assessment methodologies recommended by EPA and ADHS. These guidance levels use standard default exposure assumptions. Where necessary, the levels reflect conservative assumptions based upon research of the particular exposure scenario and professional judgment. Equations used to quantify exposures were based upon generally accepted methods, models, toxicity values, and assumptions developed by EPA. The standard exposure assumptions were obtained primarily from *Risk Assessment Guidance for Superfund (RAGS), Supplemental Guidance Standard Default Exposure Factors* (EPA 1990).

HBGLs are individually protective of human health, including sensitive groups, over a lifetime. Chemical concentrations for a particular exposure use that exceed the applicable HBGL may not necessarily represent a health risk. Rather, when contaminant concentrations exceed the HBGL, further evaluation may be necessary to determine whether using groundwater for the given purpose poses an unacceptable risk to human health.

HBGLs consider human health risks from inhalation, ingestion, and skin contact with chemicals in groundwater. ADEQ plans to include HBGLs as the human health-based criteria in the final end use standards for groundwater that will be protective of human health and the environment, including groundwater and the ecology.

The methods used to calculate noncancer HBGLs are conservative, which means that equations and assumptions tend to over-estimate risk. For example, the equations that quantify exposures do not consider attenuation of contaminants over time. Additionally, for scenarios with serial exposure pathways and routes, such as flood irrigation, the equations assume that no contaminant mass is lost before the last exposure in the series.

Our residential exposure scenario assumes that adults and children are exposed to contaminated irrigation water by inhalation, ingestion, and skin contact during periodic flood irrigation of yards. We also considered that children be exposed to contaminants by playing in canal water. Children are assumed to play in the irrigation water for a total of 4 hours/day, 24 days/year, for 12 years.

This is based upon the premise that the yard is flooded once per week for a 6-month period, which is the normal irrigation schedule for the properties that receive flood irrigation water. The child in our scenario is exposed through incidental ingestion and skin contact with the contaminants in the water for a 4-hour period during each irrigation event (EPA 1989). The adult is exposed by inhalation of contaminants escaping from the flood irrigation waters for the 4 hours that the water is assumed to be standing on the property (K. Tiggs, R. Templeton, City of Phoenix Parks and Recreation Department, personal communication, January 22, 1998). This scenario is considered to be a series of independent acute exposure events because these chemicals do not bioaccumulate.

PCE

As noted in Table 2, the HBGL for PCE in flood irrigation water is 170 µg/L. The highest PCE level found in samples from the SRP irrigation well was 10 times less than the HBGL (Table 3).

To estimate exposure, we assumed a child might play in flood irrigation water containing PCE for a 4-hour period, 1 day per week, for 6 months each year over 12 years. A child is assumed to incidentally ingest 0.05 liters (50 milliliters) during each play event. We used a standard child body weight of 15 kilograms (kg) (EPA 1992). The highest chemical concentration detected was used to represent a worst-case exposure scenario. This scenario is considered to be a series of acute exposure events.

Table 3. Comparison of PCE* Concentrations in MW104S to the HBGL†

Exposure Pathways	Private Well Use	Highest PCE Level	HBGL	HBGL Exceeded?
Ingestion, Inhalation, Dermal	Irrigation of yards	17 µg/L‡	170 µg/L	No

*PCE=tetrachloroethylene; † HGBL= noncancer health-based guidance level. These HGBLs assume that adults and children are exposed to the contaminated irrigation water 24 days per year; ‡ µg/L = micrograms per liter.

The ingested dose from flood irrigation water was doubled to take into account skin absorption and inhalation of vapors resulting from contact with the irrigation water. The assumption is that the combined dose from these two routes of exposure is equivalent to that of ingestion. Appendix B shows the calculations to determine the HGBL for exposures to PCE from the flood irrigation water.

We compared the estimated child exposure dose for PCE to the acute ATSDR MRL for oral ingestion of PCE. MRLs are levels at which no adverse, noncancer health effects are expected. Our estimated child exposure dose was 25 times below the MRL of 0.05 mg/kg/day (Table 4). Our estimated child exposure dose was also 5 times below the EPA chronic reference dose (RfD) of 0.01 mg/kg/day.

Table 4. Comparison of Estimated Child Exposure Dose to PCE* with ATSDR MRL[†]

Exposure Pathways	Private Well Use	Estimated Exposure Dose [‡]	MRL [†]	MRL Exceeded?
Ingestion, Inhalation, Dermal	Irrigation of yards	0.0002 mg/kg/day	0.05 mg/kg/day (acute)	No

*PCE = tetrachloroethylene; [†] MRL = ATSDR minimal risk level. [‡]Total dose from all pathways was calculated by doubling the assumed ingestion dose.

TCE

As noted in Table 2, the HGBL for TCE in flood irrigation water is 920 µg/L. The highest TCE level from our monitoring well samples was about 153 times below the HBGL (Table 5).

Table 5. Comparison of TCE* Concentrations in MW104S with HBGL[†]

Exposure Pathways	Private Well Use	Highest PCE Level	HBGL	HBGL Exceeded?
Ingestion, Inhalation, Dermal	Irrigation of yards	6 µg/L	920 µg/L	No

*TCE = trichloroethylene; [†] HGBL= health-based guidance level. This HBGL assumes that adults and children are exposed to the contaminated irrigation water 24 days per year; [‡] µg/L = micrograms per liter.

Child exposures to irrigation water containing TCE were estimated in the same manner previously described for PCE. Calculations to determine the HGBL for exposures to TCE from the flood irrigation water are shown in Appendix B.

The estimated child exposure dose for TCE was compared to the acute ATSDR MRL for oral ingestion of TCE. MRLs are levels at which no adverse, noncancer health effects are expected. Our estimated child exposure dose was about 1,000 times less than the acute MRL (Table 6). There is currently no EPA chronic RfD for this chemical. Our scenario considers the typical type of exposure to be a series of independent exposure events.

Table 6. Comparison of Child Estimated Exposure Dose to TCE* in Irrigation Water With ATSDR MRL[†]

Exposure Pathways	Private Well Use	Estimated Exposure Dose [‡]	MRL	MRL Exceeded?
Ingestion Inhalation Dermal	Irrigation of yards	0.00006 mg/kg/day	0.2 mg/kg/day (acute)	No

* TCE = trichloroethylene; [†]MRL= ATSDR minimal risk level; [‡]Total dose from all pathways was calculated by doubling the assumed ingestion dose.

Cancer

EPA is currently re-evaluating the carcinogenic classification for TCE. There is currently no cancer risk evaluation guide available for TCE or PCE. The International Agency for Research on Cancer has determined that TCE is a probable human carcinogen. That determination is based on limited human data and sufficient data in experimental animals (ATSDR 2001). At the Cooper Commerce Site, exposures to TCE and PCE, if they occur, are infrequent and to very low levels. No increased risk of cancer is expected as a result of these exposures.

Child Health Issues

All exposure dose estimates were calculated assuming childhood exposure, thus incorporating exposure assumptions that reflect a child's greater intake of water relative to body weight. All conclusions and recommendations about using water from these wells were based on the characteristics of this sensitive population. The highest concentration of TCE or PCE in the contaminated groundwater would not be considered to cause adverse health effects when used for irrigation purposes in the yards.

ADHS used the noncancer health effects calculations with intermediate duration exposures to estimate the childhood exposures, and the use of the HBGLs to determine if any adverse health effects would result.

Conclusions

Use of the SRP irrigation well for flood irrigation purposes poses **no public health hazard**.

Estimated exposure doses for ingesting contaminated water from the SRP irrigation well were below those associated with adverse health effects. The SRP well is used solely for flood irrigation.

Although water in the shallow aquifer is contaminated with PCE and TCE at levels above the MCLs, this water is not currently used for drinking water purposes.

PCE and TCE were not detected in new wells located between the site and the nearest drinking water wells drilled into the deep aquifer.

Drinking water supplied from Gilbert's municipal well currently meets all federal and state standards indicating that the water is safe. Contaminants associated with this site have not been detected in an aquifer currently used for drinking water. Future use of the shallow aquifer for drinking water purposes raises the question of future exposures.

The levels of tetrachloroethylene (perchloroethylene, perc, PCE) and trichloroethylene (TCE) in the irrigation well would not be considered a health hazard to children who might play in or otherwise contact the irrigation water.

Recommendations

Continue monitoring of the lower aquifer data collected by ADEQ to determine if the contaminants will affect the drinking water supply.

Public Health Action Plan

ADHS will review follow-up sampling results.

ADHS will work with the ADEQ to keep the public informed about sampling results.

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CERTIFICATION

The Arizona Department of Health Services, under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR), prepared this health consultation on Cooper Commerce Industrial Park. This consult was prepared in accordance with approved methodology and procedures existing at the time.

Allen Robison
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The Division of Health Assessment and Consultation has reviewed this health consultation and concurs with its findings.

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Appendix A

Site Maps

Regional Location Map adapted from
<http://www.ci.gilbert.az.us/generalplan/regional-vicinity.html>

Location of Unichem International Map adapted from www.mapquest.com

Map of Well Locations adapted from
<http://www.ci.gilbert.az.us/generalplan/public-facilities.html>

Regional Location Map

Location of Unichem International

Unichem

Location of New Monitoring Wells, Salt River Project Well and Gilbert Wells
(adapted from <http://www.ci.gilbert.az.us/generalplan/public-facilities.html>)

Unichem
International (x)

Gilbert Well (●)

New Monitoring
Wells

Salt River Project
(SRP) Well (●)

Appendix B

Exposure Dose Equations

Tetrachloroethylene (perchloroethylene, perc, PCE) and trichloroethylene (TCE) have been detected in the shallow aquifer below Gilbert, Arizona. People could be exposed to those contaminants in water from the aquifer. The Arizona Department of Health Services (ADHS) used Agency for Toxic Substances and Disease Registry (ATSDR) guidance documents to calculate potential exposure doses for people exposed to that water. The doses were calculated using the following equations:

Ingestion of chemicals in water:

$$EED = \frac{CW \times IR \times EF}{BW}$$

EED: Estimated exposure dose (mg/kg/day)
CW: Contaminant concentration in water (mg/L)
IR: Water intake rate (L/day)
EF: Exposure factor
BW: Body weight (kg)

$$CW = 0.017 \text{ mg/L (PCE)} \quad 0.006 \text{ mg/L (TCE)}$$

	<u>Adults</u>	<u>Children</u>
IR:	2 L/day	1 L/day
BW:	70 kg	15 kg

$$EF = \frac{\text{Annual Exposure Frequency} \times \text{Annual Exposure Duration} \times \text{No. of Years of Exposure}}{\text{Averaging Time}}$$

$$\text{Child EF} = \frac{1 \text{ day/week} \times 24 \text{ weeks/year} \times 12 \text{ yrs}}{12 \text{ yrs} \times 365 \text{ days/yr}} = \frac{288 \text{ days}}{4,380 \text{ days}} = 0.066$$

$$\text{Child EED} = \frac{0.017 \text{ mg/L (PCE)} \times 1 \text{ L/day} \times 0.066}{15 \text{ kg}} = \frac{0.0011}{15} = 0.000075 \text{ mg/kg/day}$$

Adult EF also equals 0.066

$$\text{Adult EED} = \frac{0.017 \text{ mg/L (PCE)} \times 1 \text{ L/day} \times 0.066}{70 \text{ kg}} = \frac{0.0011}{70} = 0.000016 \text{ mg/kg/day}$$

$$\text{Child EED} = \frac{0.006 \text{ mg/L (TCE)} \times 1 \text{ L/day} \times 0.066}{15 \text{ kg}} = \frac{0.0004}{15} = 0.00003 \text{ mg/kg/day}$$

$$\text{Adult EED} = \frac{0.017 \text{ mg/L (TCE)} \times 1\text{L/day} \times 0.066}{70 \text{ kg}} = \frac{0.0004}{70} = 0.000006 \text{ mg/kg/day}$$

Conclusions

Using conservative exposure assumptions, the estimated exposure doses for children and adults to PCE and TCE in irrigation water are well below respective minimal risk levels or reference dose values.

Landscape Flood Irrigation

Childhood ingestion of volatile organic compounds, noncancer

$$C_{W_2} (\mu\text{g/L}) = \frac{HQ \times BW_{ch} \times AT_{nc} \times RfD_o \times CF_5}{IR_w \times IT_{ing} \times EF_{ing} \times ED_{ch}}$$

Parameter	Definition (units)	Default	Reference
HQ	Hazard Quotient, (unitless)	1	ADHS 1997
BW _{ch}	Body Weight, child (kg)	15	EPA 1989
AT _{nc}	Averaging Time, noncancer (days)	2,190	EPA 1989
RfD _o	Reference Dose, oral (mg/kg/day)	Chemical-Specific	EPA 1997, 1998, or NCEA
CF ₅	10 ³ (μg/mg)	1,000	-----
IR _w	Ingestion Rate, water (L/hour)	0.05	EPA 1991
IT _{ing}	Irrigation Time, ingestion (hours/day)	4	ADHS 1998
EF _{ing}	Exposure Frequency, ingestion (days/year)	33	COP 1998
ED _{ch}	Exposure Duration, child (years)	6	EPA 1991

ADD CORRECT REFERENCES THAT CORRESPOND TO LISTINGS IN MAIN REFERENCE SECTION. COP 1998 IS PERSONAL COMMUNICATION; ADD FOOTNOTE HERE. IRIS WOULD BE EPA 1998; HEAST WOULD BE EPA 1997; NCEA = ???. ADHS 1997 AND 1998 NEED TO BE ADDED OR REVISED.