

The Water in Weberville: Assessing the Risks to Human Health

by

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At a recent town meeting Weberville residents were made aware that the town’s groundwater supply was contaminated with trichloroethene (TCE). Those with drinking water wells that draw from the contaminated aquifer were advised to stop using their water altogether. Town residents became alarmed, and during the question and answer session one resident asked, “What about my child? Who is responsible for poisoning our community?”

Site Description

The source of the TCE contamination was later identified as J.R. Miller Manufacturing, a four-acre site in Laketown located on the border of Weberville. The facility operated from 1963 to 1991 as a manufacturer of small parts used in the assembly of automobiles. TCE was used extensively in the manufacturing process as a metal degreaser. When the facility was first constructed, the area near the facility was not developed and was surrounded by forested areas. Around 1970, the area started to be developed with single-family homes but no other commercial properties were ever built.

Groundwater is found at between 20 and 25 feet below ground surface and moves downgradient in a north to south direction. There is no surface water on site. The former manufacturing facility received water through the municipal water system of Laketown.

Currently there is one building at the site which includes both the former manufacturing facility and administrative office space. At one time there was a warehouse with a loading dock toward the northeast end of the property and a garage at the southwest side. The four-acre site is surrounded by a 6-foot tall chain link fence. No remediation (cleanup) has occurred to date.

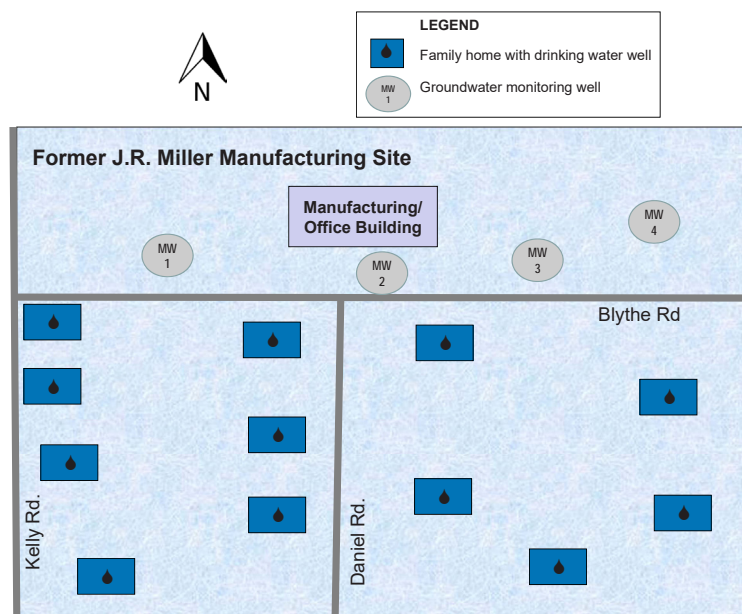


Figure 1: Former manufacturing site and nearby homes.

Community Description

The town of Weberville has a total population of 52, living in 12 single-family homes, all with private wells that draw water from the same aquifer contaminated with TCE (Figure 1). The population of 52 consists of 27 adults (age 18 and above), 11 teenagers, 13 children (age 1–12 years) and 1 infant (<1 year old). Two homes have above-ground

pools and two families have their own vegetable gardens. There is no surface water (creeks, rivers or ponds) in the area between the manufacturing facility and Weberville.

Sampling Information

Manufacturing Site: Sampling results show a large amount of TCE contamination in the soil east of the building where the loading dock and storage area were located (refer to Table 1). As a result, four groundwater monitoring wells were installed at the site and three samples were collected from each of these wells (total = 12) during May of 2016.

Nearby Homes: Tap water samples from each of the nearby homes were collected on three occasions in May of 2016 representing a total of 36 water samples. These samples were tested for TCE and ten other chemicals that were identified as being at the manufacturing site. Only TCE was found in concentrations that were of concern. In addition to the water samples, four soil samples were also taken from the residential properties directly adjacent to the manufacturing site and were found to have non-detect levels of TCE. The summarized results of the water sampling effort are summarized in Table 1.

Table 1. Water Sampling Results (May 2016)

Parameter	Number of samples	Mean TCE concentration (ppb)
Tap water samples from homes	36	51.2
Monitoring well (MW) samples from manufacturing site	12	67.5
All water samples	48	58.6

Figure 1. Intake (CDI) Calculations for Ingestion of Drinking Water

$$CDI = \frac{CW \times IR \times EF \times ED}{BW \times AT}$$

CW = chemical concentration in water (mg/L)
 IR = ingestion rate (L/dy)
 EF = exposure frequency (dy/yr)
 ED = exposure duration (yr)
 BW = body weight (kg)
 AT = averaging time
 for non-cancer risks: AT = 365 dy/yr × ED
 for cancer risks: AT = 365 dy/yr × 78.8 yr

Table 2. Default Values for Exposure Assessment Calculations: Adults and Child Residents

	Adult resident	Child resident (0-6 years of age)
IR – ingestion rate	90 th %tile: 2 L/dy	1 L/dy
ED – exposure duration	30 yr	6 yr
EF – exposure frequency	350 dy/yr	350 dy/yr
BW – body weight	80 kg	16 kg
AT – averaging time	Non-cancer risks: 365 dy/yr × ED Cancer risks: 365 dy/yr × 78.8 yr	Non-cancer risks: 365 dy/yr × ED Cancer risks: 365 dy/yr × 78.8 yr
Average lifetime	78.8 yr	78.8 yr

Questions

1. For each of the exposure pathways listed in the table below, indicate whether you would include or exclude this pathway in a comprehensive risk assessment of the Miller Site/Weberville scenario. Briefly explain why you included or excluded this pathway.

<i>Potential exposure pathway</i>	<i>Include/Exclude and Reason</i>
Ingestion of groundwater	
Incidental ingestion of soil	
Ingestion of wild and farmed foods	
Ingestion of surface water	
Inhalation of outdoor air	
Inhalation of indoor air	
Inhalation of vapors from volatile compounds in tap water	
Inhalation of dust	
Dermal contact with soil or sediment	
Dermal contact with groundwater or surface water	

- For each of the potentially exposed populations listed in the table, determine if you would include or exclude this population based on the site and community description. Briefly discuss how these populations would be exposed to TCE. Only consider currently exposed populations based on how the site is currently being used. Disregard any future land use considerations (i.e., if the site is being developed).

<i>Potentially exposed populations</i>	<i>Include/Exclude and How exposed</i>
Adult resident	
Child resident	
Commercial or industrial worker	
Construction/trench worker	
Trespasser; (this generally refers to a trespasser on a contaminated industrial site)	
Recreational user; (this would involve a scenario of a contaminated site that is used for recreation such as a park, lake or hunting grounds)	
Farmer	
Populations at increased risk (nursing home residents, infants or children, individuals with chronic illnesses)	

- Calculate the RME-CDI for non-cancer risks from ingesting TCE-contaminated drinking water among adult residents in Webersville. Interpret the meaning of this value.
- Calculate the RME-CDI for cancer risks from ingesting TCE-contaminated drinking water among adult residents in Webersville. Interpret the meaning of this value.

