Health Consultation

ELM STREET GROUNDWATER CONTAMINATION

TERRE HAUTE, VIGO COUNTY, INDIANA

EPA FACILITY ID: INN000509938

AUGUST 13, 2008

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

HEALTH CONSULTATION

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Prepared By:

U.S. Department of Health and Human Services
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FOREWORD

The Agency for Toxic Substances and Disease Registry, ATSDR, was established by Congress in 1980 under the Comprehensive Environmental Response, Compensation, and Liability Act, also known as the *Superfund* law. This law set up a fund to identify and clean up our country's hazardous waste sites. The Environmental Protection Agency, EPA, and the individual states regulate the investigation and clean up of the sites.

In 1986, ATSDR was authorized by Superfund to conduct a public health assessment at each of the sites on the EPA National Priorities List. The aim of these evaluations is to find out if people are being exposed to hazardous substances and, if so, whether that exposure is harmful and should be stopped or reduced. If appropriate, ATSDR may conduct public health assessments when petitioned by concerned individuals or requested by other local, state, or federal agencies. Public health assessments are carried out by environmental and health scientists from ATSDR and from the states with which ATSDR has cooperative agreements. The public health assessment process allows ATSDR scientists and public health assessment cooperative agreement partners flexibility in document format when presenting findings about the public health impact of hazardous waste sites. The flexible format allows health assessors to convey to affected populations important public health messages in a clear and expeditious way.

Exposure: As the first step in the evaluation, ATSDR scientists review environmental data to see how much contamination is at a site, where it is, and how people might come into contact with it. Generally, ATSDR does not collect its own environmental sampling data but reviews information provided by EPA, other government agencies, businesses, and the public. When there is not enough environmental information available, the report will indicate what further sampling data is needed.

Health Effects: If the review of the environmental data shows that people have or could come into contact with hazardous substances, ATSDR scientists evaluate whether or not these contacts may result in harmful effects. ATSDR recognizes that children, because of their play activities and their growing bodies, may be more vulnerable to these effects. As a policy, unless data are available to suggest otherwise, ATSDR considers children to be more sensitive and vulnerable to hazardous substances. Thus, the health impact to the children is considered first when evaluating the health threat to a community. The health impacts to other high risk groups within the community (such as the elderly, chronically ill, and people engaging in high risk practices) also receive special attention during the evaluation.

ATSDR uses existing scientific information, which can include the results of medical, toxicologic and epidemiologic studies and the data collected in disease registries, to evaluate possible health effects that may result from exposures. The science of environmental health is still developing, and sometimes scientific information on the health effects of certain substances is not available.

Community: ATSDR also needs to learn what people in the area know about the site and what concerns they may have about its impact on their health. Consequently, throughout the evaluation process, ATSDR actively gathers information and comments from the people who live or work near a site, including residents of the area, civic leaders, health professionals and community groups. To ensure that the report responds to the community's health concerns, an early version is distributed to the public for their comments. Comments received during the public comment period and that are related to the document are summarized and addressed in the final version of the report.

Conclusions: The report presents conclusions about the public health threat posed by a site. Ways to stop or reduce exposure will then be recommended in the public health action plan. ATSDR is primarily an advisory agency, so usually these reports identify what actions are appropriate to be undertaken by EPA or other responsible parties. However, if there is an urgent health threat, ATSDR can issue a public health advisory warning people of the danger. ATSDR can also recommend health education or pilot studies of health effects, full-scale epidemiology studies, disease registries, surveillance studies or research on specific hazardous substances.

Comments: If, after reading this report, you have questions or comments, we encourage you to send them to us.

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List of Abbreviations

ATSDR	Agency for Toxic Substances and Disease Registry
bgs	below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COCs	contaminants of concern
CV	comparison value
DCE	dichloroethylene
EMEG	environmental media evaluation guide (ATSDR)
EPA	U.S. Environmental Protection Agency
IAWC	Indiana American Water Company
IDEM	Indiana Department of Environmental Management
MCL	EPA's maximum contaminant level
MGD	Million of gallons per day
MRL	ATSDR's minimal risk level
NPL	National Priorities List (EPA)
PCE	tetrachloroethylene
PHA	public health assessment
ppb	parts per billion
ppm	parts per million
RCRA	Resource Conservation and Recovery Act
RfD	reference dose (EPA)
RMEG	reference media evaluation guide (ATSDR)
SSA	site screening assessment area
TCA	trichloroethane
TCE	trichloroethylene
TOT	time-of-travel
VCHD	Vigo County Health Department
VOC	Volatile Organic Compound
WHP	wellhead protection

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Summary and Statement of Issues

The Indiana American Water Company (IAWC), a private for-profit water company, serves 64,880 people in Terre Haute, Indiana. The well field, including vertical wells and a radial collector, supplies groundwater for the municipal water supply system. Their vertical wells are contaminated with chlorinated organic solvents at *low concentrations.* Contaminants include the chlorinated solvents tetrachloroethylene (PCE), trichloroethylene (TCE), and 1,1,1-trichloroethane (TCA). Three industrial sites to the east of the IAWC are contributing to groundwater contamination and are part of the Elm Street Groundwater Contamination site.

Solvent concentrations have the potential to exceed EPA's Maximum Contaminant Levels (MCLs) if groundwater is not mixed prior to distribution. IAWC is blending and treating the water to insure that distribution waters are not above regulatory limits and not at levels that would pose a public health hazard. From 1983 to present, concentrations of chlorinated volatile organic contaminants have not exceeded 1 ppb in finished (treated) water that is distributed to IAWC customers.

However, due to the proximity of contaminant sources, the Elm Street Groundwater Contamination site represents a potential future public health hazard. In times of high demand, maintenance or repair, the contaminated vertical wells may contribute a greater percentage of water or be used exclusively as the source for groundwater. Currently, most of the water is being supplied by the radial collector, which, except upon rare occasion, does not have detectable levels of contamination. If the radial collector is shut down for cleaning, the vertical wells may need to be used as a primary water source. IAWC plans to look for additional sources of water by 2010 and to maintain the integrity of the drinking water supply. Additionally, all public water supplies must abide by EPA's National Primary Drinking Water Regulations such that contaminants and their concentrations are regulated.

Background

Site Description and History

The Elm Street Groundwater Contamination site is located in western Indiana in the city of Terre Haute (Figure 1). The Indiana American Water Company (IAWC) is a private for-profit water company that supplies drinking water to 64,880 customers in Terre Haute. IAWC, located at 51 Locust Street in Terre Haute, began operations in 1872 by providing water from the adjacent Wabash River for fire protection. In the early 1980s during routine monitoring, the Indiana American Water Company (IAWC) began noticing chlorinated organic contamination in their wells making up the wellfield. Contaminants such as PCE and TCE were detected in their municipal well water supply (IAWC 2007). Three nearby companies east of the IAWC are alleged sources of contaminants reaching the municipal wells and comprise the Elm Street Groundwater Contamination site: the I Gurman and Son, BiState Products, and Machine Tool Service (Figure 2) (IDEM 2002a & b). Solvents are believed to have been released from these companies during poor product or waste handling practices or accidental spills. The locations of other potential contaminant sources near the Elm Street Groundwater Contamination Site are shown on Figure 2.

I Gurman and Son, a container and drum refurbishing facility, has been in business since 1922 (US EPA 2006). It is located 600 feet east of IAWC at 800 North 3rd Street in Terre Haute (US EPA 2006b) (Figure 2). In 1988, there were about 4000 drums stored on the property which were believed to be empty or nearly empty (IDEM 1988). It appears that a similar number of drums are currently stored there (ATSDR November 2007 drive-by). Site inspections, conducted in 1988 and 1999 by the Indiana Department of Environmental Management (IDEM), showed soil contamination extending from the surface to approximately 15 feet below ground surface (bgs) in a former drum storage area and an existing drum processing area (US EPA 1999). The highest concentrations of these contaminants were found in surface soils (ground surface to one foot below) in 1988 at 19,000 ppb PCE, 3,200 ppb TCE, and 920 ppb TCA (US EPA 2006a). In 1999, PCE was found in soil to depths of 15 feet in the subsurface, ranging from 12 to 85 ppb, and TCE was also found at 15 feet in the subsurface at 12 ppb. These contaminants were also detected in groundwater beneath this property. Historical practice (1940s-1970s) was to empty drum content onto the ground surface, rinse the drum, and send the rinse water down the sewer system prior to refurbishing (US EPA 2006a & b).

BiState Products was a former Texaco fuel and product distribution facility and a used oil storage facility (US EPA 2006a). It is located 100 feet east of IAWC at 118 Elm Street in Terre Haute. It operated from the mid-1930s through about 1980. Several above ground tanks are still on the property (ATSDR November 2007 drive-by). Petroleum products and solvents for parts cleaning were stored at and distributed from this facility. The site was purchased in 1980 by the owners of Machine Tool Service, a company directly south of BiState Products. In 1987, it was purchased by Consolidated Recycling (IDEM 1989). BiState Products was also called First Recovery. Contaminants (PCE and 1,2-DCE) were detected in the on-site soils and in groundwater beneath the property (US EPA 2006a). The Site Inspection conducted for BiState Products in 1989 showed TCE in surface soil (surface to 1 foot below) at 19 ppb, total 1,2-DCE at 640 ppb (surface to 30 inches subsurface), and PCE at 27 ppb (15 feet in the subsurface).

The Machine Tool Service facility is a machine tool repair operation. Although historically solvents were probably used at this facility, preliminary sampling conducted by IDEM in 1989 and 2004, did not document hazardous substances (US EPA 2006a). However, groundwater data suggest TCA contamination on this property (Figure 6).

The groundwater pathway is the primary means by which contaminated water can reach area municipal wells and therefore, this health consultation focuses primarily on the groundwater pathway. The groundwater migration pathway was the only pathway scored by US EPA. The site was proposed to the National Priorities List (NPL) on September 27, 2006 (US EPA 2006b).

ATSDR Involvement

ATSDR is mandated by Congress to conduct an evaluation of sites listed on the EPA's NPL. This health consultation is our evaluation. On November 14, 2007, ATSDR staff accompanied by an EPA representative met with IAWC representatives at the water company and toured the plant area. We also visited the Vigo County Health Department (VCHD) and drove through neighborhoods near the site. Neither the IAWC nor VCHD personnel knew of any private well surveys for the area. This consultation serves as a record and summary of our trip findings. ATSDR also performed a site file review of IDEM's records for the site on November 13 and 14 and met with IDEM representatives on November 15, 2007 to discuss our plans for this evaluation. This health consultation was released for public comment from April 3 through May 5, 2008. No comments were received during this period.

Demographics

Within one mile of the potential source areas for Elm Street Groundwater Contamination, the population is estimated at 8,863 people (Figure 1). There are estimated to be 521 children and 3,114 females aged 15 to 44. Indiana State University is nearby including fraternity and sorority housing in the neighborhood east of the site. The ISU population is estimated to range between 7,000 and 11,000 people (IAWC 2007). The potentially affected population is 64,880 customers served by IAWC (IAWC 2007). IAWC sells water to the nearby town of Riley (IAWC 2007). Just north of IAWC, Indiana State University has an irrigation well used for watering an athletic field. There are 3 private wells that serve the new Federal Penitentiary, south of the site (IAWC 2007). The old Penitentiary is approximately 7 miles downstream of the site and should not be affected by Elm Street Groundwater Contamination. If the new Penitentiary is in the same area, it also would be essentially unaffected.

Community Health Concerns

To date, no community health concerns or complaints about drinking water quality and no private well surveys have been identified. ATSDR inquired about these issues while visiting the Vigo County Health Department on November 14, 2007. No comments on this consultation were received from the public during the comment period, April 3 through May 5, 2008.

Groundwater

The groundwater pathway is the primary means by which contaminated water can reach area municipal wells and therefore, this health consultation focuses on the groundwater pathway. The groundwater migration pathway was the only pathway scored by US EPA when the site was proposed to the NPL.

Hydrogeology and IAWC operations

The IAWC municipal wells are located on the floodplain of the Wabash River and draw groundwater primarily from a sand and gravel unconfined aquifer. This surficial aquifer consists of deposits of the Wabash Lowland physiographic province underlain by shale bedrock (IDEM 2002a & b); the bedrock in the area is primarily shale and sandstone with thin beds of limestone and coal (IDEM 1988; Panterra 1999). Thin clay and silt layers are interbedded with the sand and gravel (Panterra 1999). The thick sand and gravel aquifer beneath the site lies in the deeper portion of the bedrock valley (Panterra 1999). Groundwater flow in the aquifer is westerly from the site facilities toward the IAWC. Limited aquifer data indicate shallow groundwater flow is west southwest toward the Wabash River Valley (IDEM 2002a). The surficial aquifer is extremely susceptible to contamination due to high permeability and capacity to transport contaminants. The site and IAWC are on the high east bank of the Wabash River; there is a drop of approximately 40 feet between the site and river. Therefore, most groundwater flowing westerly from the site within about 40 feet in the subsurface discharges to the Wabash River if not impeded by pumping wells. Depth to the water table in the area is approximately 20 (IAWC 2007) to 40 feet below ground surface (bgs) and depth to bedrock is approximately 110-130 feet bgs (IAWC 2007-well log records).

The Wabash River flows from the northeast to the southwest. No significant surface water withdrawal facilities are located on the Wabash River within 15 miles downstream of the site. Area storm sewers discharge directly to the river (IDEM 2002a).

The IAWC began operating in 1872 and provided water from the adjacent Wabash River for fire protection (IAWC 2007). IAWC was initially providing river water (carbon filters were used at one time to help eliminate bacteriological problems) then river water plus some vertical well water; the municipal well water was mixed with surface water intakes (river water) to produce the drinking water supply (IDEM 1988). The intakes were upstream of any surface water discharge from I Gurman and Son (IDEM 1988); however, the intakes captured surface drainage from Bi-State Products (IDEM 1989). The vertical wells were completed in the late 1970s-1980s. In the late 1980s, the vertical wells were replaced by adjacent vertical wells and given with the same well number but with an "A" designation (for example, Well 4 was replaced with Well 4A). The radial collector was put on-line in 1991 (IAWC 2007). After 1994, 100% of their water was groundwater from the radial collector well and the vertical wells, which were intermittently pumped and cycled to supplement water from the collector (IAWC 2007).

Currently, groundwater is being drawn from three vertical wells (IAWC wells 3, 5, and 6 as shown on Figure 3; IAWC wells 1, 4, and recently 2 were retired) and one radial collector well (IAWC 2007). Pumping of the vertical wells is cycled such that groundwater is drawn on a rotating basis and mostly at low and high treatment flows.

The well field produces approximately ten million gallons of groundwater per day (MGD) (Panterra 1999). The vertical wells supplement the groundwater from the radial collector, which is rated for 12 MGD. The collector well has eight lateral collectors, three which extend westward below the river bed and five that extend eastward. The laterals collect groundwater at approximately 60 (Panterra 1999) to 80 feet below ground surface (IAWC 2007). The length of each lateral is about 200 feet. When the radial collector went on-line the rate of pumping of the vertical wells was reduced from 2 to 1 MGD. The maximum past pumping rate for the vertical wells was 3 MGD. The vertical wells draw groundwater from depths exceeding 100 feet bgs. (Although we have no depth or other information on the original vertical wells which were replaced by the current vertical wells, we anticipate similar depths and other parameters due to their proximity). Most of the municipal water is being pumped from the collector well which was on-line in 1991. For example, in 1996, approximately 10 MGD was supplied by the radial collector and 0.6 by the vertical wells (Panterra 1999).

Recharge of water into the aquifer occurs through precipitation north and east of the wellfield and through induced infiltration due to pumping in the area. The cones of depression around water supply wells, created by pumping, influence groundwater and contaminant flow directions. There is some recharge of the aquifer from the river induced by production wells/radial collector. There is a high degree of connection between the water in the aquifer and the river (Panterra 1999). This connectivity was supported by aquifer testing at the well field area and comparisons of surface and ground water temperatures (US EPA 2006a).

Sands and gravels are conducive to rapid contaminant migration. PCE, TCE, and TCA have densities greater than water (they're heavier than water and tend to sink) and will tend to move vertically in an aquifer that is porous and permeable until they reach bedrock or another less porous and permeable unit of sediments or rock. If these contaminants reach impermeable bedrock, they will tend to follow the bedrock slope. However, in the Elm Street Groundwater

Contamination site area, the horizontal to vertical permeability is 20:1 (Panterra 1999) such that contaminants will move easier in a horizontal direction. Therefore, the primary flow component of contaminants in groundwater is horizontal along with groundwater flow.

The current water treatment process includes filtering to remove iron and manganese, splash tray aeration, and the addition of chlorine and fluoride. Lastly, ammonia is added to the processed water after the clear well stage to reduce the free chlorines to chloramines (IAWC 2007).

A wellhead protection (WHP) area has been established around the Terre Haute municipal wellfield. The wellhead protection program for Terre Haute was developed in accordance with Section 1428 of the Safe Drinking Water Act (US EPA 2006a). The area was delineated by a computer-based numerical groundwater flow model (Panterra 1999). The WHP area extends primarily to the east and north of the wellfield and encompasses about 1.3 square miles (Figure 2). The outer boundary of the WHP area is a five-year time-of-travel (TOT) boundary (Panterra 1999) meaning contamination from any point within the boundary is estimated to take less than 5 years to reach the wellfield. The WHP area contains no known septic systems. Within the 5 year TOT, there are 21 sites designated as high potential contaminant sources; these sites are ones that have some evidence of past or present waste disposal, spills or leaks. There are 9 high potential contaminant sources within the 1 year TOT, closest to the wellfield (Panterra 1999).

Private Wells

There are approximately 1500 private residential wells (an estimated 3500 people drinking private well water) within a 4-mile radius of the Elm Street Groundwater Contamination site (IDEM 2002a). There are no known private wells within a quarter mile of the site and an estimated 125 private wells within a half-mile (IDEM 2002a). Neither the IAWC nor VCHD personnel knew of any private well surveys for the area. Groundwater flow is westerly from the site and away from Terre Haute private wells. The private wells are unlikely to be contaminated by the Elm Street Groundwater Contamination site because they are not located along the contaminated groundwater migration pathway to the Wabash River.

However, since the IAWC is pumping about 10 MGD, other sources of contamination besides the Elm Street Groundwater site could contribute to area groundwater contamination and to IAWC municipal wells. Westerly groundwater flow is induced further by pumping of the IAWC municipal wells. There are 9 high potential contaminant sources (some evidence of past or present waste disposal, spills or leaks) within the 1 year TOT, closest to the wellfield, and 21 sites within the 5 year TOT (Panterra 1999). Sampling of some of the private wells could better define background groundwater contamination, the eastern boundary of existing site contamination, and lead to additional protection for municipal and private well water supplies. This strategy is recommended for the protection of public health.

Groundwater Monitoring and Production Well Results

There are basically two sets of data that provide results for Terre Haute groundwater in the vicinity of the Elm Street Groundwater Contamination site: results for productions wells in the IAWC wellfield from 1983- 2007 and monitoring wells established and sampled by IDEM immediately east of the wellfield. The IDEM monitoring wells were sampled in 1999 and 2000. IDEM samples were analyzed for VOCs by SW-846 Method 8260; Field duplicates and trip blanks were used for quality assurance/control purposes. Some limitations of our evaluation are that we have no groundwater data prior to 1983 and no river water quality data.

IDEM Groundwater Monitoring Well Results

IDEM sampled groundwater in monitoring wells in 1999 and 2000. Figures 3 through 7 show contours of the contamination based on modeling.

In 1999, IDEM installed 22 nested monitoring wells east of IAWC and conducted the initial sampling. Groundwater from twenty monitoring wells was sampled in August 1999. Volatile organic compounds such as PCE, TCE, and TCA were detected in groundwater (IDEM 2002a). Water sample results are shown in Table 1; results exceeding our screening values are in bold. PCE, the only contaminant exceeding our screening values, exceeded the MCL of 5 ppb in five shallow monitoring wells (wells 1, 2, 3, 5, 8). The PCE contour concentrations in the shallow aquifer in August of 1999 are depicted on Figure 4. A trace of PCE was also detected in deep monitoring well 8.

Follow-up to the 1999 sampling was conducted by the IDEM in October of 2000 (Table 1). Once again the PCE concentrations exceeded our comparison values in shallow monitoring wells 1, 2, 3, 5, and 8. Contaminants exceeding our comparisons values were 1,1-DCE, PCE, TCA, and TCE (Table 1). Shallow monitoring well 8 contained many chlorinated organic solvents such as 23 ppb PCE, 25 ppb TCE, and 10 ppb TCA (Table 1). A trace of PCE and TCE were detected in deep monitoring well 8. PCE contaminant contour maps for the 1999 and 2000 data are provided as Figures 4 and 5, respectively. Shallow TCE contamination is depicted in Figure 3. These maps indicate a potential source area of PCE and TCE in the vicinity of the I Gurman and Son property. TCA contaminant contour maps for the shallow and deep aquifers are shown on Figures 6 and 7, respectively. TCA was highest in monitoring well 12 at 600 ppb. It was above the MCL of 200 ppb in monitoring well 9 (220 ppb) and at 37 ppb in monitoring well 10. The TCA map indicates a potential source of groundwater contamination on or in the vicinity of the Machine Tool property.

IAWC Production Groundwater Results

Sampling data for Terre Haute vertical wells from 1983 through 2007 show groundwater contamination ranging from non-detectable to above MCLs (Table 2). This is not the finished water that is distributed to their local customers but water that is blended with radial collector water. PCE exceeded a comparison value of 5 ppb in vertical wells 2 and 5. Well 5 water contained many detections exceeding the MCL for PCE and was and is the most contaminated well for PCE. TCE exceeded a comparison value of 5 ppb in vertical wells 3 and 5. Well 3 had many detections for TCE exceeding the MCL from 1983-1992. Contamination was not generally found at the radial collector but twice a volatile organic compound was detected during quarterly sampling in 2006 (Note section of Table 2: 1,1-DCE in July 2006; possibly TCA in 2006). Recently, IAWC began sampling the collector on a monthly basis (December 2007 email communication with J. Durham, IAWC).

IAWC Finished (treated) Drinking Water

Groundwater that has completed the IAWC process (it has been filtered and disinfected and fluoride and phosphate have been added) is sampled just prior to the high service pumps. The finished water (effluent) is sampled quarterly along with the vertical wells. Recently, IAWC began sampling the collector on a monthly basis (December 2007 email communication with J.

Durham, IAWC). Sampling results from 1984 through 2006 indicate no exceedances of MCLs and that no chlorinated organic compound exceeded 1 ppb (Table 3). Carbon tetrachloride was detected at maximum of 1.7 ppb in July 2006 and exceeded our cancer risk evaluation guide (CREG) of 0.3 ppb during 4 quarterly samplings. CREGs and other comparison values used by ATSDR are explained in Appendix A. Carbon tetrachloride is not discussed further because of its low concentrations and low frequency of detection in finished water.

Discussion

The contaminants in groundwater that routinely exceeded our comparison values were PCE and TCE. TCA exceedances of the MCL were reported for the monitoring wells only but not in the vertical wells nor finished water (Tables 1 through 3). Carbon tetrachloride is not discussed further because of its low concentrations and low frequency of detection in finished water. ATSDR has a toxicological profile for 1,1,1-trichloroethane and carbon tetrachloride in the event further information is desired (ATSDR 2005 and 2006).

The MCL for PCE and TCE has been set at 5 ppb because EPA believes, given present technology and resources, this is the lowest level to which water systems can reasonably be required to remove this contaminant should it occur in drinking water. These drinking water standards and the regulations for ensuring these standards are met, are called National Primary Drinking Water Regulations. The IAWC, serving 64,880 customers, must abide by these regulations.

At the low concentrations of chlorinated solvents in groundwater at the Elm Street Groundwater Contamination site and with blending of well and radial collector waters, adverse health effects are not expected to occur. No contaminants exceeded MCLs in finished drinking water. Of the four contaminants detected to date in finished water, most of them were detected in the 1980s (Table 3).

Tetrachloroethylene (PCE)

The highest PCE concentration in groundwater was 23 ppb in a monitoring well (Table 1) and 12 ppb in a production well (Table 2). PCE was detected at a maximum of 1 ppb only twice in finished water, once in March 1984 and again in March 1985. The acute oral Minimal Risk Level for PCE is 0.05 mg/kg/day and is based on changes in behavior (hyperactivity) observed at the lowest dose of 5 mg/kg/day. The doses of PCE at the Elm Street Groundwater Contamination site would be many times lower than the MRL (less than 0.05 mg/kg/day). Cancer was observed in animals at doses exceeding 350 mg/kg/day. Some epidemiological studies suggest possible associations between PCE and leukemia and non-Hodgkin's lymphoma (ATSDR 1997a). We do not know the effects of long-term low level exposure. Due to the low levels of PCE in groundwater at the site, blending of waters for drinking water, and rare detections of PCE in finished drinking water, we do not anticipate adverse health effects. If conditions were to change such that drinking water levels were above the MCLs, IAWC would need to take measures to reduce the levels of contamination.

Trichloroethylene (TCE)

ATSDR has completed its analyses of data in our national exposure registry for trichloroethylene—the Trichloroethylene Subregistry. The subregistry contains information on approximately 5000 people who were exposed to TCE in drinking water from 15 hazardous waste sites in five states. Data were collected from 1989 through 2000. Some people in the TCE subregistry reported higher rates of disease than the general U.S. population. However, data collected for the registry cannot establish that a health change resulted from exposure to TCE because other factors that may be responsible for disease (use of medication, lifestyle choices, heredity, etc.) were not taken into account. Additionally, ATSDR did not verify the presence of absence of health conditions reported by participants. Final reports and publications from the TCE subregistry are available on the Internet at www.atsdr.cdc.gov/NER.

At the Elm Street Groundwater Contamination site, the highest TCE concentration in groundwater was 25 ppb in a monitoring well (Table 1) and 10 ppb in a production well (Table 2). TCE was detected at a maximum of 1 ppb only twice in finished water distributed for drinking water, once in March 1985 and again in December 1988. Since 1992, the TCE levels in the IAWC well field have remained below the MCL of 5 ppb with one exception: a detection above the MCL occurred in well 5 in January 2003 (Table 2). From 1984 through 1992, production water from IAWC well 3 routinely exceeded the MCL of 5 ppb. Since the distribution water was blended and below MCLs (Table 3), we do not anticipate health effects from the Elm Street Groundwater Contamination site. If conditions were to change such that drinking water levels were above the MCLs, IAWC would need to take measures to reduce the levels of contamination.

Child Health Considerations

In communities faced with air, water, or food contamination, the many physical differences between children and adults demand special emphasis. Children could be at greater risk than are adults from certain kinds of exposure to hazardous substances. A child's lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. If toxic exposure levels are high enough during critical growth stages, the developing body systems of children can sustain permanent damage. Finally, children are dependent on adults for access to housing, for access to medical care, and for risk identification. Thus adults need as much information as possible to make informed decisions regarding their children's health.

The low concentrations of organic solvents in groundwater at the Elm Street Contamination site do not pose a health threat to children. To date, the maximum exposure to any chlorinated organic solvent in treated drinking water has been reported at 1 ppb (Table 3).

Conclusions

The unconfined sand and gravel aquifer, which is used for drinking water in Terre Haute, currently contains low levels of chlorinated volatile organic compounds (VOCs) in the vicinity of the Elm Street Groundwater Contamination site. The eastern boundary of groundwater contamination has not been delineated.

The Elm Street Groundwater Contamination site represents no apparent public health hazard. The blending and treatment of water by IAWC has decreased the concentrations of VOCs in drinking water such that it is and has been below levels of health concern (1983-2007 data).

Private wells in Terre Haute are unlikely to be contaminated by the Elm Street Groundwater Contamination site because groundwater flow is westerly from the site toward the Wabash River and away from private wells. Pumping of groundwater by IAWC induces groundwater flow westerly in the general direction of natural groundwater flow.

During times of high demand, maintenance or repair, the contaminated vertical wells may contribute a greater percentage of water or be used exclusively to produce the municipal drinking water supply. During these times, the concentrations of contaminants may increase and water quality may degrade. Also, there is potential for the radial collector, which is supplying most of the water, to become more contaminated in the future due to natural and induced groundwater flow.

Recommendations

Known sources of contamination to groundwater at the Elm Street Groundwater Contamination site should be remediated and any work practices contributing to this contamination should be improved.

The extent of groundwater contamination on the eastern boundary should be determined.

US EPA or IDEM should consider placing monitoring wells north of the radial collector well to help determine if contaminants could be coming from sources other than those already identified for the Elm Street Groundwater Contamination site. These monitoring wells could be located within the 1-mile TOT boundary and south of potential contaminant sources.

We suggest sampling private wells within and near the 5-year time-of-travel boundary to better define background groundwater contamination and to help establish the boundaries of existing site contamination. Private well data could also lead to additional protection for municipal and private well water supplies and users.

Due to the hydraulic connection between the aquifer and the Wabash River, we recommend sampling river water for contaminants such as pesticides, herbicides, and VOCs (from area surface water run-off such as area storm sewers) in the vicinity of the radial collector. If sufficient data already exist or are collected, we recommend they be evaluated to determine the potential impact on water going to the radial collector and municipal water supply.

Public Health Action Plan

US EPA and/or other agencies should sample private wells and Wabash River water near the site to help determine if there are any other threats to the municipal well system and if there are any non-site related water quality issues in area water wells.

US EPA is planning to conduct a Remedial Investigation/Feasibility Study for this site.

IAWC should notify health and regulatory agencies upon a major change in operations such as a shut down of the radial collector or if there are any exceedances of EPA's MCLs. IAWC plans to look for additional sources of water by 2010 and to maintain the integrity of the drinking water supply.

If conditions were to change such that drinking water levels were above the MCLs, IAWC would need to take measures to reduce the levels of contamination based on the EPA's National Primary Drinking Water Regulations.

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References

ATSDR. 2006. Toxicological Profile for 1,1,1-Trichloroethane. July 2006.

ATSDR. 2005. Toxicological Profile for Carbon Tetrachloride. August 2005.

ATSDR. 1997a. Toxicological Profile for Tetrachloroethylene. September 1997.

ATSDR. 1997b. Toxicological Profile for Trichloroethylene. September 1997.

[IAWC] Indiana American Water Company. 2007. Meeting with ATSDR and US EPA representatives on November 14, 2007. Received hardcopy of VOC Contamination of Terre Haute Vertical Wells 1983-2006 and some well log records.

[IDEM] Indiana Department of Environmental Management. 2002a. Expanded Site Inspection Report (ESI) for I Gurman and Son Site, Terre Haute, Indiana. U.S. EPA ID: IND016648230. June 15, 2002.

[IDEM] Indiana Department of Environmental Management. 2002b. Expanded Site Inspection Report (ESI) for BiState Products, Terre Haute, Indiana. U.S. EPA ID: IND155169451. June 15, 2002.

[IDEM] Indiana Department of Environmental Management. 2000. Analytical Results for Municipal Well Field site. Sampled October 2000. Analysis by Indiana State Department of Health (ISDH) Laboratories.

[IDEM] Indiana Department of Environmental Management. 1989. Screening Site Inspection Report for I. Gurman & Sons, Inc., Terre Haute, Indiana. August 19, 1989.

[IDEM] Indiana Department of Environmental Management. 1988. Screening Site Inspection Report for I. Gurman & Sons, Inc., Terre Haute, Indiana. Sept.12, 1988.

Panterra Corporation. 1999. City of Terre Haute, Indiana Wellhead Protection Area Delineation and Potential Contaminant Source Inventory. August 25, 1999.

US EPA. 2006a. HRS Documentation Record. September 2006.

US EPA. 2006b. Notice on National Priorities List for Elm Street Ground Water Contamination, Vigo County, Terre Haute, Indiana, September 2006.

Table 1: Water Analyses from IDEM Shallow Monitoring Wells East of Municipal Wellfield

Contaminant	*Concentration (ppb) August 1999**		*Concentration (ppb) October 2000*		*Comparison Value (ppb)*
	Conc.	*MW:*	*Conc.*	*MW:*	
Bromodichloromethane	10 in trip blank		Not found		0.6 CREG 80 MCL for total THM
Carbon Tetrachloride	Below detection limit of 1		Not Analyzed		0.3 CREG 5 MCL
Dibromochloromethane	1 in trip blank		Not found		0.4 CREG 80 MCL for total THM
1,2-Dibromomethane	Not reported		Not reported		
1,1-Dichloroethane (1,1-DCA)	3	MW-8	15 11 11 9.3 5.5 1.2	MW-8 MW-8 MW-2 MW-9 MW-3 MW-12	No CVs
1,1-Dichloroethylene or Dichloroethene (1,1-DCE)	less than 1		7.2 0.5	MW-12 MW-9	7 MCL
Cis-1,2-Dichloroethylene or Dichloroethene (cis-1,2-DCE)	12 2 2	MW-8 MW-2 MW-3	44 26 11	MW-8 MW-2 MW-3	70 MCL & LTHA
Tetrachloroethylene or Tetrachloroethene (PCE)*	14 8 7 7 5 1	MW-5 MW-8 MW-3 MW-2 MW-1 MW-13	23 8.7 7.6 7.2 5.3 0.5	MW-8 MW-1 MW-2 MW-3 MW-5 MW-13	5 MCL 10 LTHA 100 RMEG child
1,1,1-Trichloroethane (TCA)**	3 3 2 1 0.7J	MW-8 MW-2 MW-3 MW-1 MW-5	600 220 37 10 4.1 1.6	MW-12 MW-9 MW-10 MW-8 MW-3 MW-5	200 MCL & LTHA
1,1,2-Trichloroethane (1,1,2-TCA)	1 in trip blank		2.4	MW-8	0.6 CREG
Trichloroethylene or Trichloroethene (TCE)***	4 3	MW-2 MW-8	25 5.9	MW-8 MW-3	5 MCL

	2	MW-3	2.2	MW-5	
	2	MW-1	2.5	MW-1	
	0.8J	MW-5	1.4	MW-2	

- Deep Well Contamination:
- *a trace of PCE (0.6 ppb in 1999 and 0.9 ppb in 2000 MW-8D) was detected in deep wells
- **TCA was found in deep wells 2, 9, and 12 at 0.5 ppb, 1.0 ppb, and 2.8 ppb respectively.
- *** a trace of TCE (0.6 ppb in August 1999 MW-8D; 0.7 ppb in October 2000 MW-8D) was detected in a deep well

- These data have been deemed adequate for screening purposes.
- THM = trihalomethanes
- MW-7 is considered background
- Sources: IDEM 2002a and b; IDEM 2000

Table 2: Water Analyses from IAWC Vertical Wells in the Municipal Wellfield (3/1983 through 10/2007)

Contaminant	*Maximum Concentration (ppb) in production well**			*Comparison Value (ppb)*
	Conc.	*IAWC Well*	*Date (month/year)*	
Bromodichloromethane	8.1	Well 2	7/98	0.6 CREG 80 MCL for total THM
Carbon Tetrachloride	0.6	Well 3	10/99	0.3 CREG 5 MCL
Dibromochloromethane	3	Well 2	6/90	0.4 CREG 80 MCL for total THM
1,2-Dibromomethane	3.6	Well 2	7/98	0.02 CREG 0.05 MCL
1,1-Dichloroethane (1,1-DCA)	0.5 0.5	Well 2 Well 6	7/98 7/02 8/93	No CVs
1,1-Dichloroethene (1,1-DCE)	0.6 0.5 0.5	Well 6 Well 2 Well 5	7/06 1/05 1/05	7 MCL
Cis-1,2-Dichloroethylene or Dichloroethene (cis-1,2-DCE)	0.6 1.4	Well 6 Well 2	1/02 7/98 7/02	70 MCL & LTHA
Tetrachloroethylene or Tetrachloroethene (PCE)***	12 11	Well 5* Well 2	3/87 8/92	5 MCL 10 LTHA 100 RMEG child
1,1,1-Trichloroethane (TCA)***	6 6 6	Well 2 Well 5 Well 6	6/89 9/90 9/90	200 MCL & LTHA
1,1,2-Trichloroethane (1,1,2-TCA)	0.5	Well 2	8/93	0.6 CREG
Trichloroethylene or Trichloroethene (TCE)***	10 5	Well 3* Well 5	6/90 1/03	5 MCL

- the maximum concentration found does not represent what was actually used for drinking water because the waters were blended with other waters with lower to non-detectable concentrations.
- *** PCE, TCE, and TCA were the only contaminants detected on a routine basis.
- *Well 3 had many detections for TCE exceeding the MCL from 1983-1992.

Collector: **1,1-DCE was also found at the collector at 0.5 ppb in 1/05; **** In 07/06, 1.7 ppb TCA was recorded at the collector but was notated as "believed to be a sampling error". Source: IAWC 2007

Table 3: Terre Haute Drinking Water--Water Analyses from Plant Effluent

(IAWC treated water, detections only)

Contaminant	***Maximum Concentration in Drinking water (ppb)***		***Comparison Value (ppb)***
	Conc.	*Date (month/year)*	
Carbon Tetrachloride*	1.7	4/05	0.3 CREG 5 MCL
Tetrachloroethylene or Tetrachloroethene (PCE)	1	3/84 3/85	5 MCL 10 LTHA 100 RMEG child
1,1,1-Trichloroethane (TCA)	1	3/85 6/88	200 MCL & LTHA
Trichloroethylene or Trichloroethene (TCE)	1	3/85 12/88	5 MCL

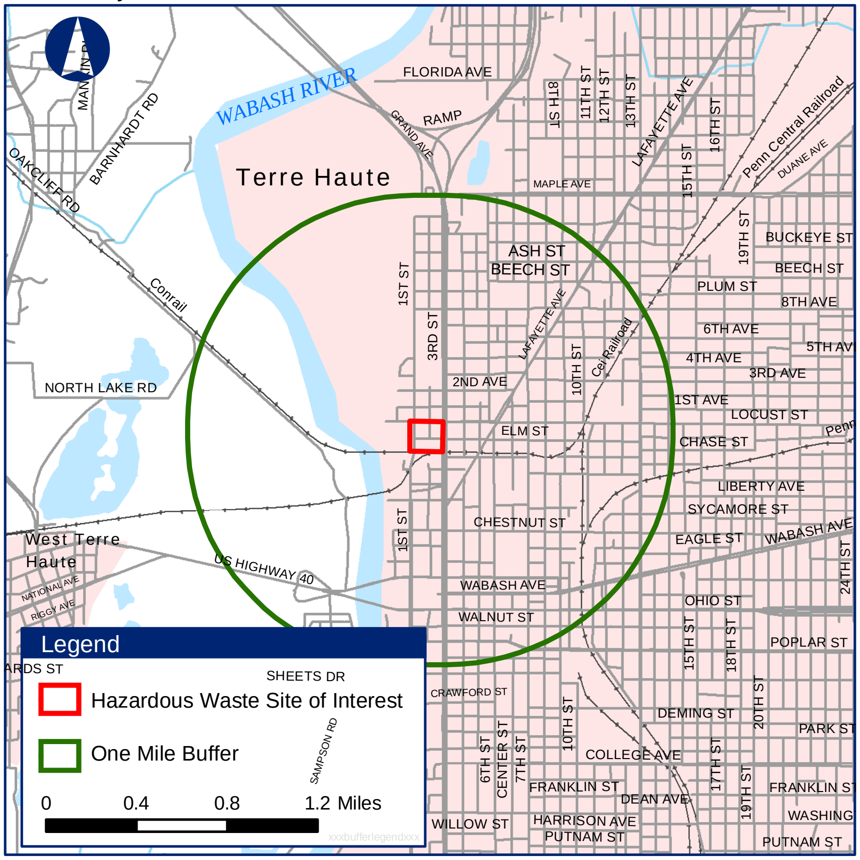
- detected three other tiimes at 0.5 or 0/6 ppb on 8/03,10/04 and 4/05.
- The last detection of PCE and TCE was in 1992. The last detection of TCA was in 1991.

Source: IAWC 2007

Elm Street Groundwater Contamination

Terre Haute, IN

EPA Facility ID: INN000509938



Base Map Source: Geographic Data Technology, May 2005.
Site Boundary Data Source: ATSDR Geospatial Research, Analysis, and Services Program, Current as of Generate Date (bottom left-hand corner).
Coordinate System (All Panels): NAD 1983 StatePlane Indiana West FIPS 1302 Feet

Site Location: Vigo County, IN

Demographic Statistics

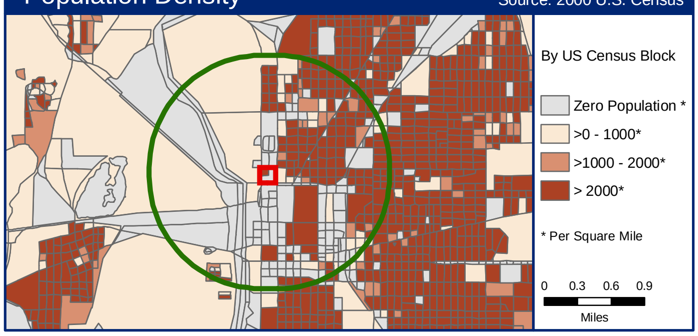
Within One Mile of Site*

Total Population	8,863
White Alone	7,516
Black Alone	962
Am. Indian & Alaska Native Alone	29
Asian Alone	137
Native Hawaiian & Other Pacific Islander Alone	4
Some Other Race Alone	66
Two or More Races	148
Hispanic or Latino**	125
Children Aged 6 and Younger	521
Adults Aged 65 and Older	602
Females Aged 15 to 44	3,175
Total Housing Units	3,000

Demographics Statistics Source: 2000 U.S. Census
* Calculated using an area-proportion spatial analysis technique
** People who identify their origin as Hispanic or Latino may be of any race.

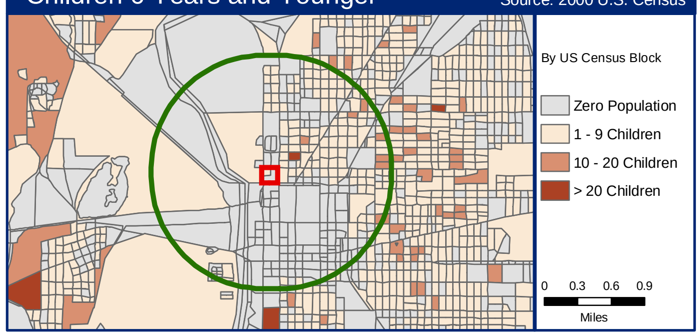
Population Density

Source: 2000 U.S. Census



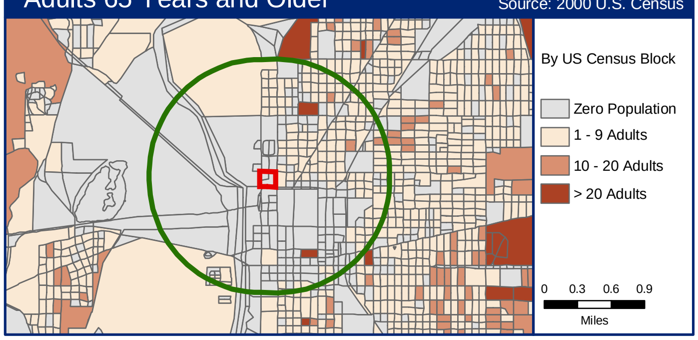
Children 6 Years and Younger

Source: 2000 U.S. Census



Adults 65 Years and Older

Source: 2000 U.S. Census



Females Aged 15 to 44

Source: 2000 U.S. Census

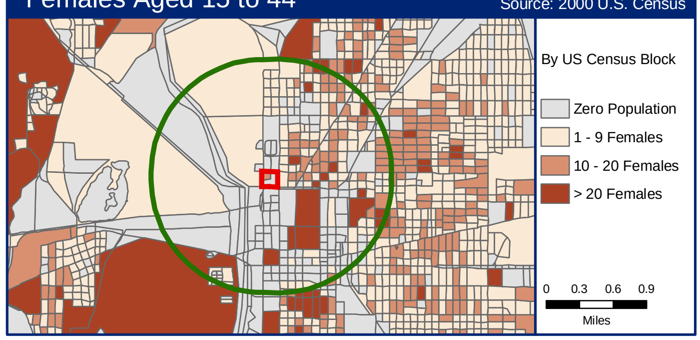


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Figure 1

Elm Street Groundwater Contamination
Terre Haute, Indiana (EPA facility INN000509938)
Time of Travel with PCS and Well Locations

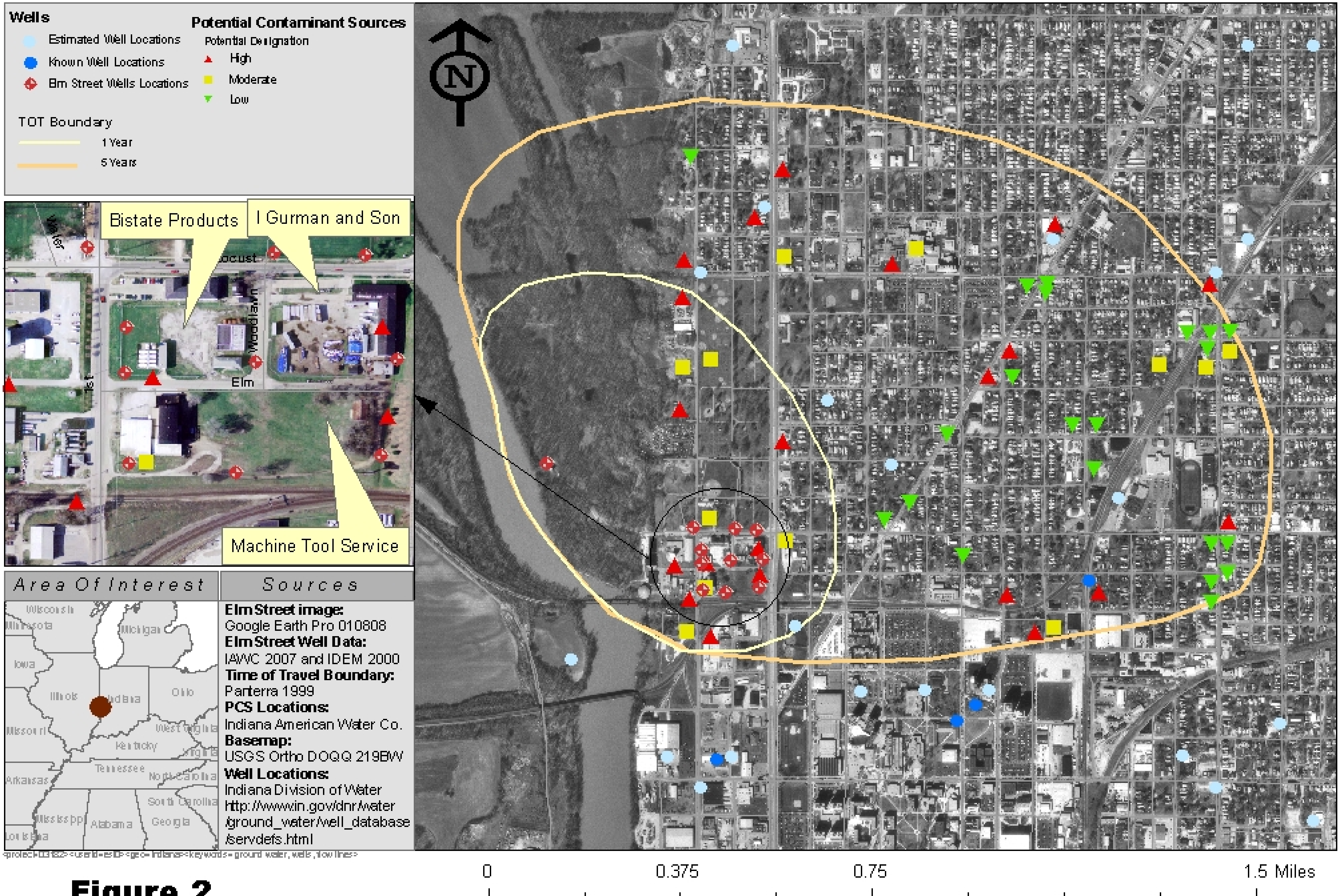
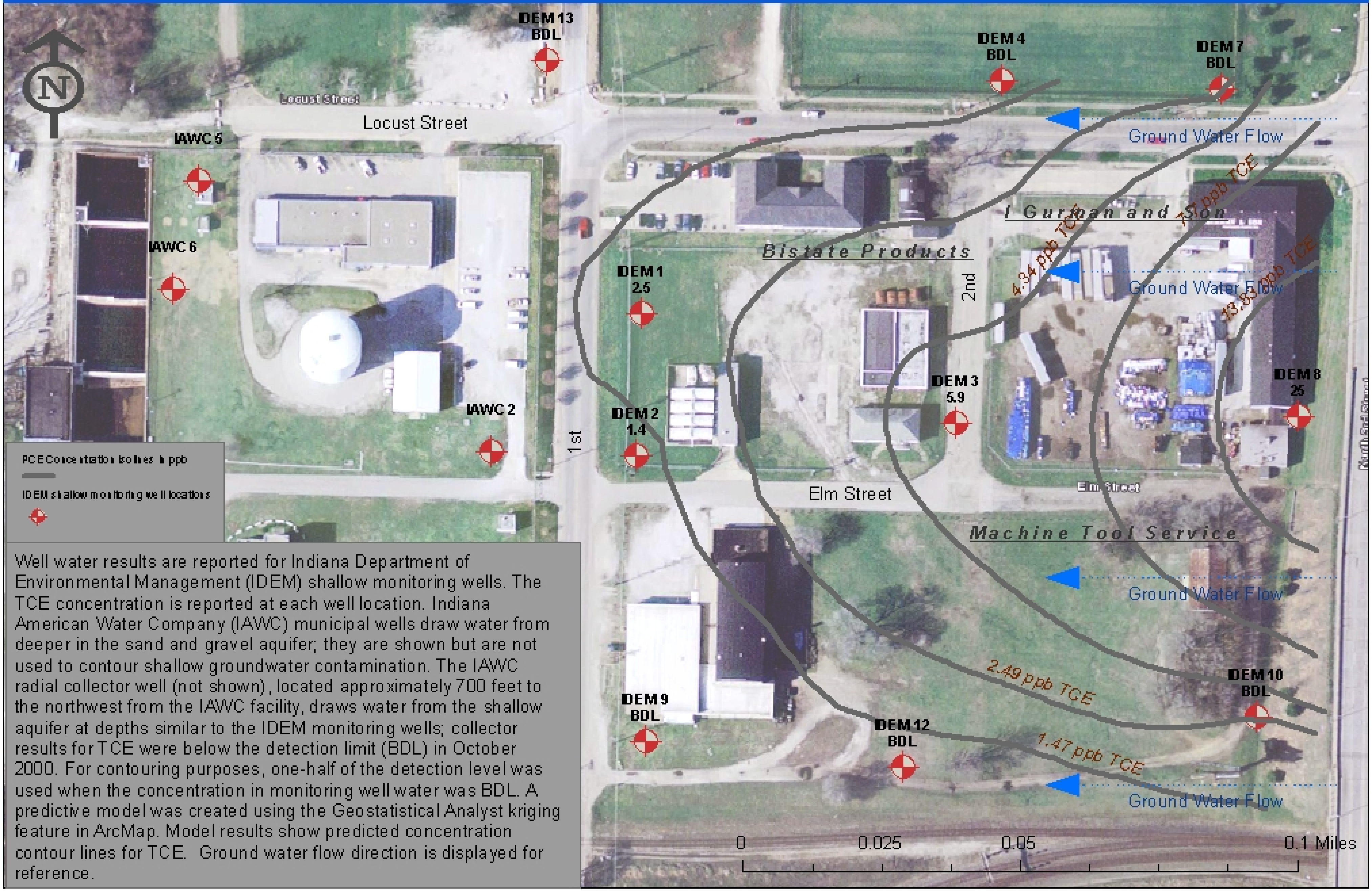


Figure 2

Elm Street Groundwater Contamination
Terre Haute, Indiana (EPA facility INN000509938)
TCE Well Water Concentrations (ppb) in 2000 - Shallow Aquifer with Modeled Contour Lines



Well water results are reported for Indiana Department of Environmental Management (IDEM) shallow monitoring wells. The TCE concentration is reported at each well location. Indiana American Water Company (IAWC) municipal wells draw water from deeper in the sand and gravel aquifer; they are shown but are not used to contour shallow groundwater contamination. The IAWC radial collector well (not shown), located approximately 700 feet to the northwest from the IAWC facility, draws water from the shallow aquifer at depths similar to the IDEM monitoring wells; collector results for TCE were below the detection limit (BDL) in October 2000. For contouring purposes, one-half of the detection level was used when the concentration in monitoring well water was BDL. A predictive model was created using the Geostatistical Analyst kriging feature in ArcMap. Model results show predicted concentration contour lines for TCE. Ground water flow direction is displayed for reference.

<project=03182><userid=est0><geo=indiana><keywords=ground water, wells, flow lines>

References:
Elm Street image – Google Earth Pro 010808
Elm Street Well Data – IAWC 2007 and IDEM 2000

Figure 3

Elm Street Groundwater Contamination
Terre Haute, Indiana (EPA facility INN000509938)
PCE Well Water Concentrations (ppb) in 1999 - Shallow Aquifer with Modeled Contour Lines

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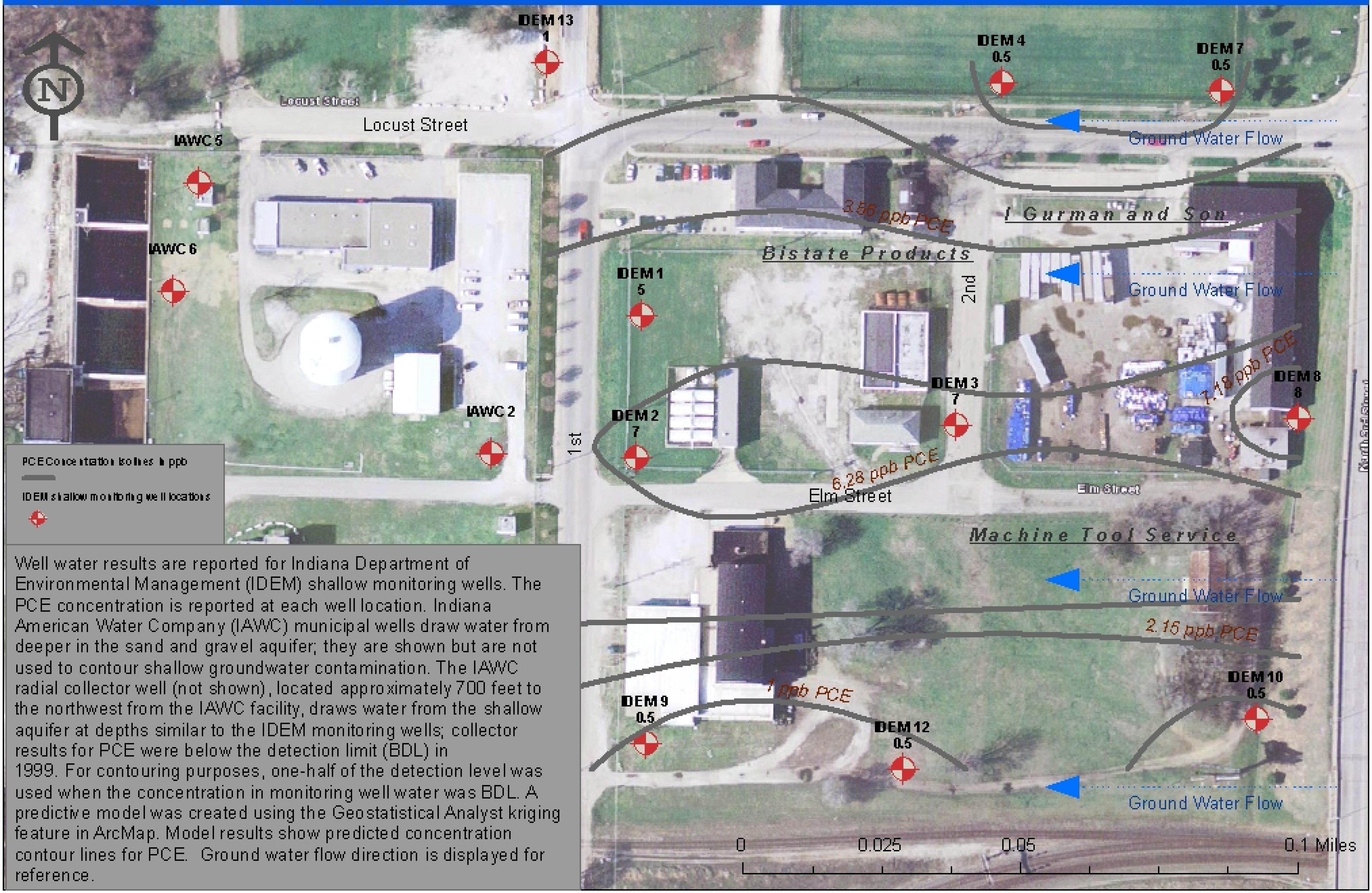

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References:
Elm Street image – Google Earth Pro 010808
Elm Street Well Data – IAWC 2007 and IDEM 2000

Figure 4

Elm Street Groundwater Contamination
Terre Haute, Indiana (EPA facility INN000509938)
PCE Well Water Concentrations (ppb) in 2000 - Shallow Aquifer with Modeled Contour Lines

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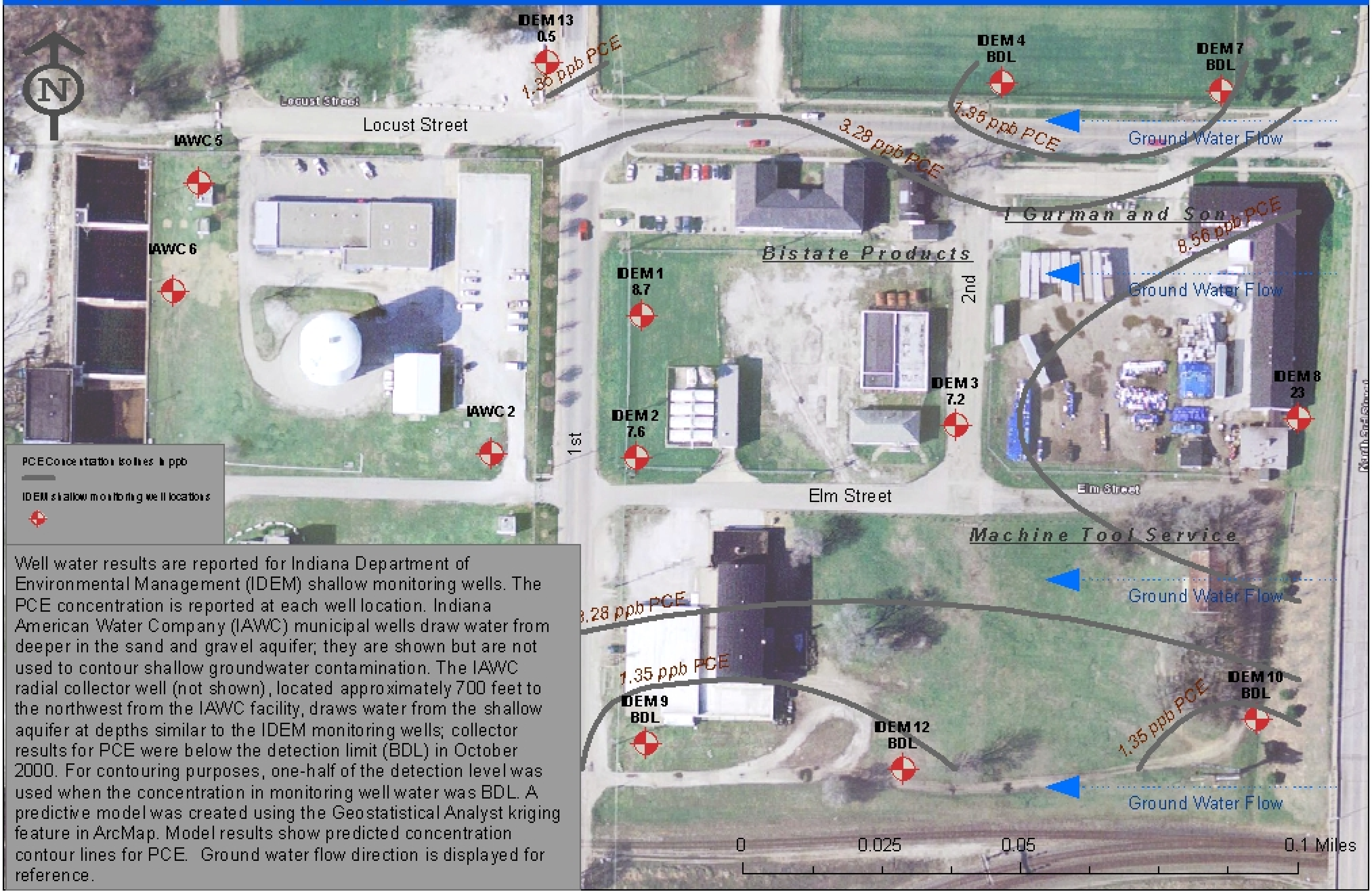

References:
Elm Street image – Google Earth Pro 010808
Elm Street Well Data – IAWC 2007 and IDEM 2000

Figure 5

Elm Street Groundwater Contamination
Terre Haute, Indiana (EPA facility INN000509938)
TCA Well Water Concentrations (ppb) in 2000 - Shallow Aquifer with Modeled Contour Lines

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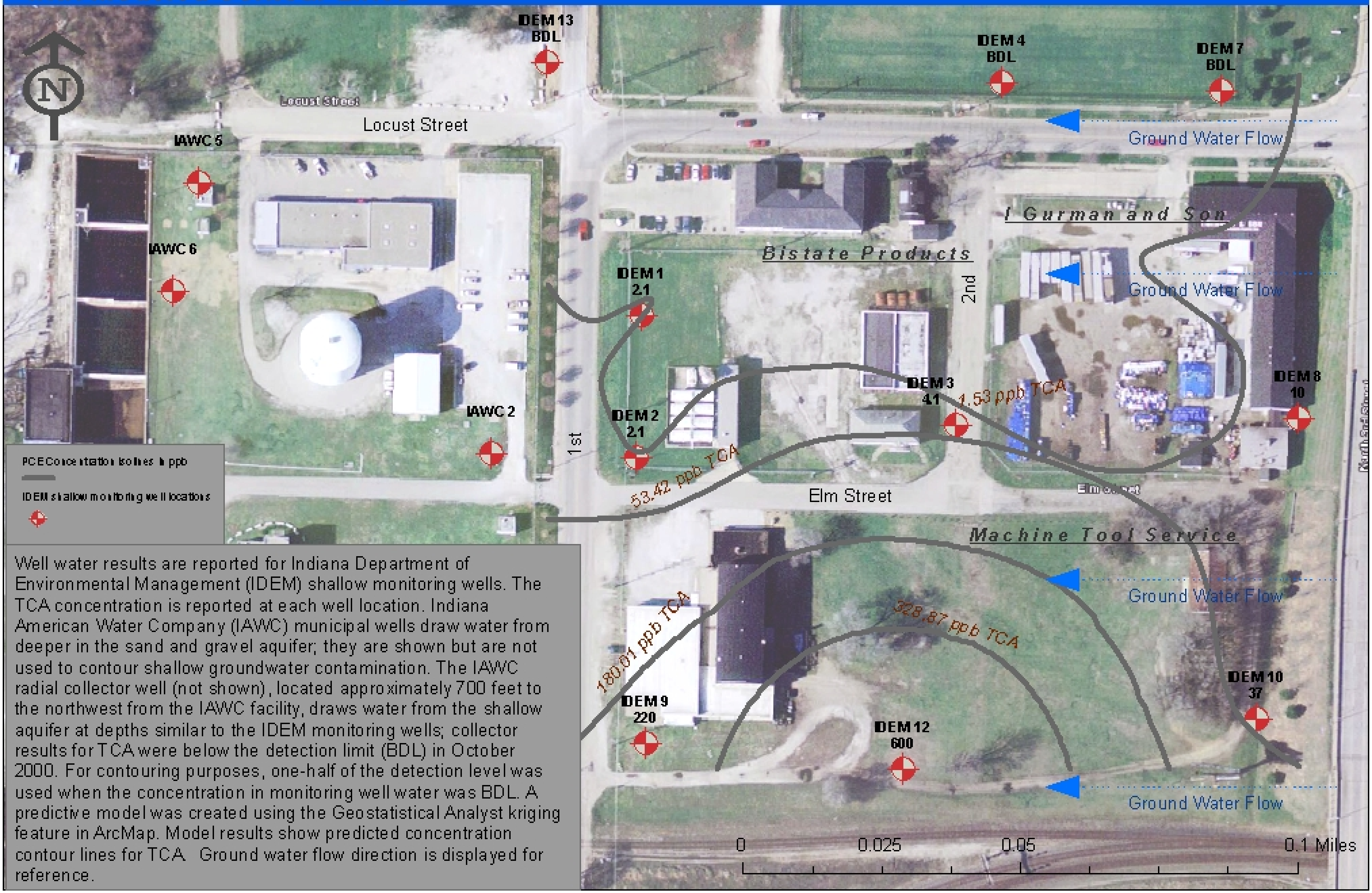

References:
Elm Street image – Google Earth Pro 010808
Elm Street Well Data – IAWC 2007 and IDEM 2000

Figure 6

Elm Street Groundwater Contamination
Terre Haute, Indiana (EPA facility INN000509938)
TCA Well Water Concentrations (ppb) in 2000 - Deep Aquifer with Modeled Contour Lines

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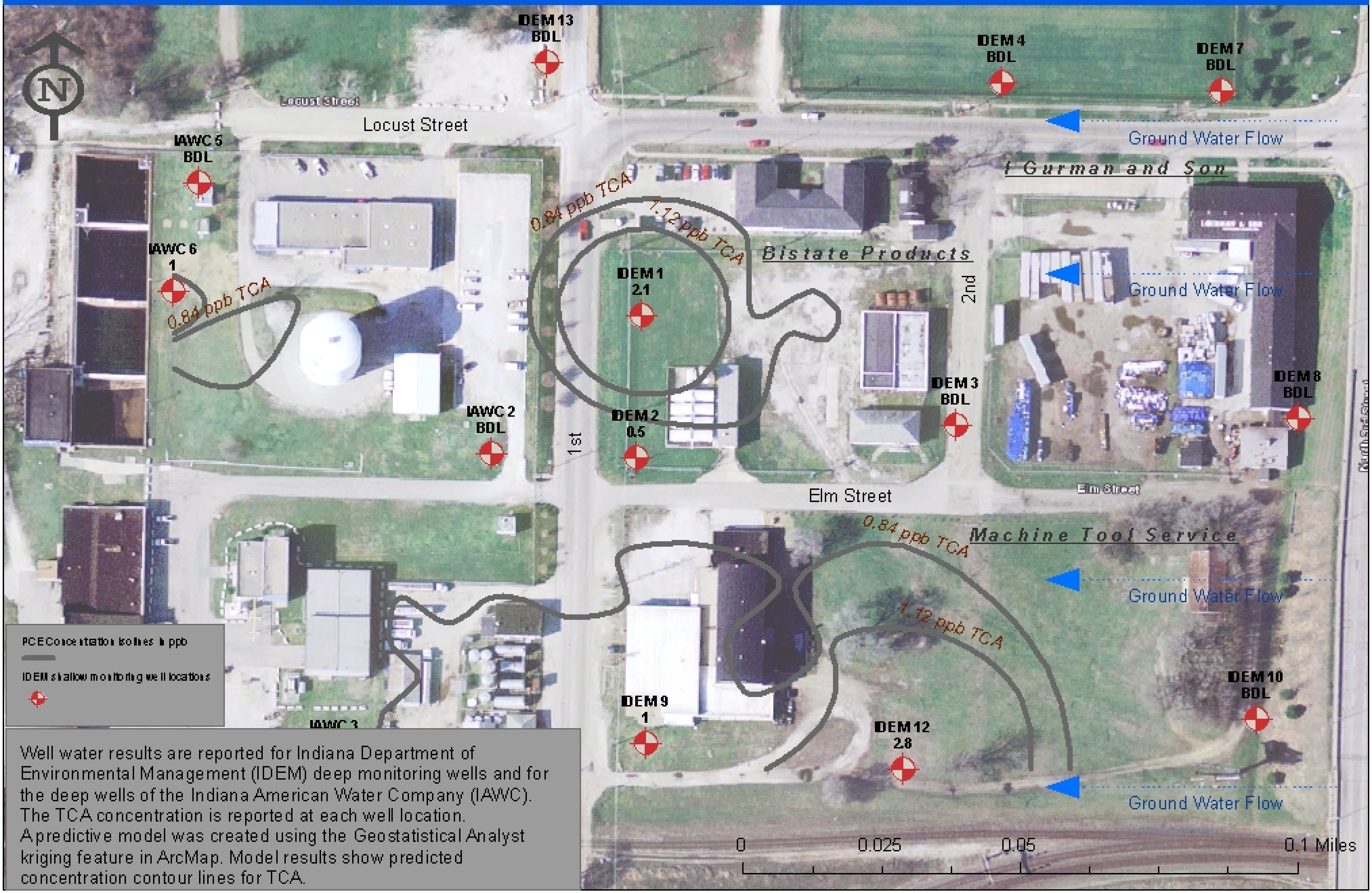

Well water results are reported for Indiana Department of Environmental Management (IDEM) deep monitoring wells and for the deep wells of the Indiana American Water Company (IAWC). The TCA concentration is reported at each well location. A predictive model was created using the Geostatistical Analyst kriging feature in ArcMap. Model results show predicted concentration contour lines for TCA.

<project=03182><userid=esID><geo=Indiana><keywords=ground water, wells, flow lines>

References:
Elm Street image – Google Earth Pro 010808
Elm Street Well Data – IAWC 2007 and IDEM 2000

Figure 7

APPENDICES

Appendix A. List of Comparison Values Used by ATSDR

Comparison Values

ATSDR comparison values are media-specific concentrations that are considered to be safe under default conditions of exposure. They are used as screening values in the preliminary identification of site-specific “contaminants of concern.” The latter term should not be misinterpreted as an implication of “hazard.” As ATSDR uses the phrase, a “contaminant of concern” is a chemical substance detected at the site in question and selected by the ATSDR scientist for further evaluation of potential health effects. Generally, a chemical is selected as a “contaminant of concern” because its maximum concentration in air, water, or soil at the site exceeds one of ATSDR's comparison values.

Nevertheless, it must be emphasized that comparison values are not thresholds of toxicity. Although concentrations at or below the relevant comparison values could reasonably be considered safe, it does not automatically follow that any environmental concentration that exceeds a comparison value would be expected to produce adverse health effects. The principal purpose behind conservative, health-based standards and guidelines is to enable health professionals to recognize and resolve potential public health hazards before they become actual public health consequences. Thus comparison values are designed to be preventive—rather than predictive—of adverse health effects. The probability that such effects will actually occur does not depend on environmental concentrations alone, but on a unique combination of site-specific conditions and individual lifestyle and genetic factors that affect the route, magnitude, and duration of actual exposure.

Listed and described below are the various comparison values that ATSDR uses to select chemicals for further evaluation, as well as other non-ATSDR values that are sometimes used to put environmental concentrations into perspective.

CREG	=	Cancer Risk Evaluation Guide
MRL	=	Minimal Risk Level
EMEG	=	Environmental Media Evaluation Guide
IEMEG	=	Intermediate Environmental Media Evaluation Guide
RMEG	=	Reference Dose Media Evaluation Guide
RfD	=	Reference Dose
RfC	=	Reference Dose Concentration
RBC	=	Risk-Based Concentration
MCL	=	Maximum Contaminant Level
LTHA	=	Lifetime Health Advisory

Cancer Risk Evaluation Guides (CREGs) are estimated contaminant concentrations expected to cause no more than one excess cancer in a million persons exposed over a lifetime. CREGs are calculated from EPA's cancer slope factors, or cancer potency factors, using default values for exposure rates. That said, however, neither CREGs nor cancer slope factors can be used to make realistic predictions of cancer risk. The true risk is always unknown and could be as low as zero.

Minimal Risk Levels (MRL) are estimates of daily human exposure to a chemical (doses expressed in mg/kg/day) that are unlikely to be associated with any appreciable risk of deleterious non-cancer effects over a specified duration of exposure. MRLs are calculated using data from human and animal studies and are reported for acute (those occurring for 14 days or less), intermediate (those occurring for more than 14 days and less than 1 year [15-364] days), and chronic (those occurring for one year [365 days] or greater) exposures. MRLs for specific chemicals are published in ATSDR toxicological profiles.

Environmental Media Evaluation Guides (EMEGs) are concentrations that are calculated from ATSDR minimal risk levels by factoring in default body weights and ingestion rates.

They factor in body weight and ingestion rates for acute exposures (Acute EMEGs — those occurring for 14 days or less), for intermediate exposures (Intermediate EMEGs — those occurring for more than 14 days and less than 1 year), and for chronic exposures (Chronic EMEGs — those occurring for one year [365 days] or greater).

Lifetime Health Advisory is an EPA value used for drinking water.

Reference Dose Media Evaluation Guides (RMEGs) represent the concentration of a contaminant in air, water, or soil that corresponds to EPA's RfD for that contaminant when default values for body weight and intake rates are taken into account.

Reference Dose (RfD) is an estimate of the daily exposure to a contaminant unlikely to cause noncarcinogenic adverse health effects. Like ATSDR's MRL, EPA's RfD is a dose expressed in mg/kg/day.

Reference Concentrations (RfC) is a concentration of a substance in air that EPA considers unlikely to cause noncancer adverse health effects over a lifetime of chronic exposure.

Risk-Based Concentrations (RBC) are media-specific concentrations derived by Region III of the Environmental Protection Agency from RfDs, RfCs, or EPA's cancer slope factors. They represent concentrations of a contaminant in tap water, ambient air, fish, or soil (industrial or residential) that are considered unlikely to cause adverse health effects over a lifetime of chronic exposure. RBCs are based either on cancer or non-cancer effects.

Maximum Contaminant Levels (MCLs) represent contaminant concentrations in drinking water that EPA deems protective of public health (considering the availability and economics of water treatment technology) over a lifetime (70 years) at an exposure rate of 2 liters of water per day.

More information about the ATSDR evaluation process can be found in ATSDR's Public Health Assessment Guidance Manual at http://www.atsdr.cdc.gov/HAC/phamanual/. A hard copy can be obtained by contacting the ATSDR information line toll-free at (888) 422-8737.

Appendix B. ATSDR's Methods

Contaminant Data Evaluation

In public health assessments, ATSDR addresses the likelihood that exposure to contaminants, using the maximum or average concentrations detected, would result in adverse health effects. While the relative toxicity of a chemical is important, the response of the human body to a chemical exposure is determined by several additional factors, including the concentration (how much), the duration of exposure (how long), and the route of exposure (breathing, eating, drinking, or skin contact). Lifestyle factors (i.e., occupation and personal habits) also have a major impact on the likelihood, magnitude, and duration of exposure. Individual characteristics such as age, sex, nutritional status, overall health, and genetic constitution affect how a human body absorbs, distributes, metabolizes, and eliminates a contaminant. A unique combination of all these factors will determine the individual's physiologic response to a chemical contaminant and any adverse health effects the individual could suffer as a result of the chemical exposure.

ATSDR has determined levels of chemicals that can reasonably (and conservatively) be regarded as harmless, based on the scientific data the agency has collected in its toxicological profiles. The resulting comparison values and health guidelines, which include ample safety factors to ensure protection of sensitive populations, are used to screen contaminant concentrations at a site and to select substances ("chemicals of concern") that agency environmental health scientists and toxicologists scrutinize more closely.

It is a point of key importance that ATSDR's (as well as state and federal regulatory agency) comparison values, screening numbers and health guidelines define very conservative and protective levels of environmental contamination and are not thresholds of toxicity. This means that although concentrations at or below a comparison value could reasonably be considered safe, it does not automatically follow that any concentration above a comparison value will necessarily produce toxic effects. To the contrary, ATSDR's comparison values are intentionally designed to be much lower, usually by at least two or three orders of magnitude, than the corresponding no-effect levels (or lowest-effect levels) determined from scientific studies. ATSDR uses comparison values (regardless of source) solely for the purpose of screening individual contaminants. In this highly conservative procedure, ATSDR may decide that a compound warrants further evaluation if the highest single recorded concentration of that contaminant in the medium in question exceeds that compound's lowest available comparison value (e.g., cancer risk evaluation guides or other chronic exposure values) for the most sensitive, potentially exposed individuals (e.g., children or pica children). This conservative process results in the selection of many contaminants as "chemicals of concern" that will not, upon closer scrutiny, be judged to pose any hazard to human health. Still, ATSDR judges it prudent to use a screen that "lets through" many harmless contaminants rather than one that overlooks even a single potential hazard to public health. Even those contaminants of concern that are ultimately labeled in the toxicologic evaluation as potential public health hazards are so identified solely on the basis of the maximum concentration detected. The reader should keep in mind the protective nature of this approach when considering the potential health implications of ATSDR's evaluations.

Because a contaminant must first enter the body before it can produce any effect on the body, adverse or otherwise, the toxicologic discussion in public health assessments focuses primarily on completed pathways of exposure, i.e., contaminants in media to which people are known to have been, or are reasonably expected to have been, exposed. Examples are water that could be used for drinking, and air in the breathing zone.

To determine whether people were, or continue to be, exposed to contaminants originating from a site, ATSDR evaluates the factors that lead to human exposure. These factors or elements include (1) a source of contamination, (2) transport through an environmental medium, (3) a point of exposure, (4) a route of human exposure, and (5) an exposed population. Exposure pathways fall into one of three categories:

- *Completed Exposure Pathway*. ATSDR calls a pathway “complete” if it is certain that people are exposed to contaminated media. Completed pathways require that the five elements exist and indicate that exposure to the contaminant has occurred, is occurring, or will occur.

- *Potential Exposure Pathway*. Potential pathways are those in which at least one of the five elements is missing but could exist. Potential pathways indicate that exposure to a contaminant could have occurred, could be occurring, or could occur in the future. Potential exposure pathways refer to those pathways where (1) exposure is documented, but there is not enough information available to determine whether the environmental medium is contaminated, or (2) an environmental medium has been documented as contaminated, but it is unknown whether people have been, or could be, exposed to the medium.

- *Eliminated Exposure Pathway*. In an eliminated exposure pathway, at least one of the five elements is missing and will never be present. From a human health perspective, pathways can be eliminated from further consideration if ATSDR is able to show that (1) an environmental medium is not contaminated, or (2) no one is exposed to contaminated media.

Appendix C. Glossary of Terms

The Agency for Toxic Substances and Disease Registry (ATSDR) is a federal public health agency in Atlanta, Georgia, with 10 regional offices in the United States. ATSDR serves the public by using the best science, taking responsive public health actions, and providing trusted health information to prevent harmful exposures and diseases from toxic substances. ATSDR is not a regulatory agency, unlike the U.S. Environmental Protection Agency (EPA), which is the federal agency that develops and enforces laws to protect the environment and human health. This glossary defines words used by ATSDR in communications with the public. It is not a complete dictionary of environmental health terms. For additional questions or comments, call ATSDR's toll-free telephone number, 1-888-42-ATSDR (1-888-422-8737).

Absorption
The process of taking in. For a person or an animal, absorption is the process of a substance getting into the body through the eyes, skin, stomach, intestines, or lungs.

Acute
Occurring over a short time [compare with chronic].

Acute exposure
Contact with a substance that occurs once or for only a short time (up to 14 days) [compare with intermediate duration exposure and chronic exposure].

Additive effect
A biologic response to exposure to multiple substances that equals the sum of responses of all the individual substances added together [compare with antagonistic effect and synergistic effect].

Adverse health effect
A change in body function or cell structure that might lead to disease or health problems

Aerobic
Requiring oxygen [compare with anaerobic].

Ambient
Surrounding (for example, ambient air).

Anaerobic
Requiring the absence of oxygen [compare with aerobic].

Analyte
A substance measured in the laboratory. A chemical for which a sample (such as water, air, or blood) is tested in a laboratory. For example, if the analyte is mercury, the laboratory test will determine the amount of mercury in the sample.

Analytic epidemiologic study
A study that evaluates the association between exposure to hazardous substances and disease by testing scientific hypotheses.

Antagonistic effect
A biologic response to exposure to multiple substances that is less than would be expected if the known effects of the individual substances were added together [compare with additive effect and synergistic effect].

Background level
An average or expected amount of a substance or radioactive material in a specific environment, or typical amounts of substances that occur naturally in an environment.

Bioavailability
The degree to which chemicals can be taken up by organisms

Biodegradation
Decomposition or breakdown of a substance through the action of microorganisms (such as bacteria or fungi) or other natural physical processes (such as sunlight).

Biologic indicators of exposure study
A study that uses (a) biomedical testing or (b) the measurement of a substance [an analyte], its metabolite, or another marker of exposure in human body fluids or tissues to confirm human exposure to a hazardous substance [also see exposure investigation].

Biologic monitoring
Measuring hazardous substances in biologic materials (such as blood, hair, urine, or breath) to determine whether exposure has occurred. A blood test for lead is an example of biologic monitoring.

Biologic uptake
The transfer of substances from the environment to plants, animals, and humans.

Biomedical testing
Testing of persons to find out whether a change in a body function might have occurred because of exposure to a hazardous substance.

Biota
Plants and animals in an environment. Some of these plants and animals might be sources of food, clothing, or medicines for people.

Body burden
The total amount of a substance in the body. Some substances build up in the body because they are stored in fat or bone or because they leave the body very slowly.

CAP [see Community Assistance Panel.]

Cancer
Any one of a group of diseases that occur when cells in the body become abnormal and grow or multiply out of control.

Cancer risk
A theoretical risk for getting cancer if exposed to a substance every day for 70 years (a lifetime exposure). The true risk might be lower.

Carcinogen
A substance that causes cancer.

Case study
A medical or epidemiologic evaluation of one person or a small group of people to gather information about specific health conditions and past exposures.

Case-control study
A study that compares exposures of people who have a disease or condition (cases) with people who do not have the disease or condition (controls). Exposures that are more common among the cases may be considered as possible risk factors for the disease.

CAS registry number
A unique number assigned to a substance or mixture by the American Chemical Society Abstracts Service.

Central nervous system
The part of the nervous system that consists of the brain and the spinal cord.

CERCLA [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980]

Chronic
Occurring over a long time [compare with acute].

Chronic exposure
Contact with a substance that occurs over a long time (more than 1 year) [compare with acute exposure and intermediate duration exposure]

Cluster investigation
A review of an unusual number, real or perceived, of health events (for example, reports of cancer) grouped together in time and location. Cluster investigations are designed to confirm case reports; determine whether they represent an unusual disease occurrence; and, if possible, explore possible causes and contributing environmental factors.

Community Assistance Panel (CAP)
A group of people from a community and from health and environmental agencies who work with ATSDR to resolve issues and problems related to hazardous substances in the community. CAP members work with ATSDR to gather and review community health concerns, provide information on how people might have been or might now be exposed to hazardous substances, and inform ATSDR on ways to involve the community in its activities.

Comparison value (CV)
Calculated concentration of a substance in air, water, food, or soil that is unlikely to cause harmful (adverse) health effects in exposed people. The CV is used as a screening level during the public health assessment process. Substances found in amounts greater than their CVs might be selected for further evaluation in the public health assessment process.

Completed exposure pathway [see exposure pathway].

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)
CERCLA, also known as Superfund, is the federal law that concerns the removal or cleanup of hazardous substances in the environment and at hazardous waste sites. ATSDR, which was created by CERCLA, is responsible for assessing health issues and supporting public health activities related to hazardous waste sites or other environmental releases of hazardous substances. The Superfund Amendments and Reauthorization Act (SARA) later amended this law.

Concentration
The amount of a substance present in a certain amount of soil, water, air, food, blood, hair, urine, breath, or any other media.

Contaminant
A substance that is either present in an environment where it does not belong or is present at levels that might cause harmful (adverse) health effects.

Delayed health effect
A disease or an injury that happens as a result of exposures that might have occurred in the past.

Dermal
Referring to the skin. For example, dermal absorption means passing through the skin.

Dermal contact
Contact with (touching) the skin [see route of exposure].

Descriptive epidemiology
The study of the amount and distribution of a disease in a specified population by person, place, and time.

Detection limit
The lowest concentration of a chemical that can reliably be distinguished from a zero concentration.

Disease prevention
Measures used to prevent a disease or reduce its severity.

Disease registry
A system of ongoing registration of all cases of a particular disease or health condition in a defined population.

DOD
United States Department of Defense.

DOE
United States Department of Energy.

Dose (for chemicals that are not radioactive)
The amount of a substance to which a person is exposed over some time period. Dose is a measurement of exposure. Dose is often expressed as milligram (amount) per kilogram (a measure of body weight) per day (a measure of time) when people eat or drink contaminated water, food, or soil. In general, the greater the dose, the greater the likelihood of an effect. An "exposure dose" is how much of a substance is encountered in the environment. An "absorbed dose" is the amount of a substance that actually got into the body through the eyes, skin, stomach, intestines, or lungs.

Dose (for radioactive chemicals)
The radiation dose is the amount of energy from radiation that is actually absorbed by the body. This is not the same as measurements of the amount of radiation in the environment.

Dose-response relationship
The relationship between the amount of exposure [dose] to a substance and the resulting changes in body function or health (response).

Environmental media
Soil, water, air, biota (plants and animals), or any other parts of the environment that can contain contaminants.

Environmental media and transport mechanism
Environmental media include water, air, soil, and biota (plants and animals). Transport mechanisms move contaminants from the source to points where human exposure can occur. The environmental media and transport mechanism is the second part of an exposure pathway.

EPA
United States Environmental Protection Agency.

Epidemiologic surveillance [see Public health surveillance].

Epidemiology
The study of the distribution and determinants of disease or health status in a population; the study of the occurrence and causes of health effects in humans.

Exposure
Contact with a substance by swallowing, breathing, or touching the skin or eyes. Exposure may be short-term [acute exposure], of intermediate duration, or long-term [chronic exposure].

Exposure assessment
The process of finding out how people come into contact with a hazardous substance, how often and for how long they are in contact with the substance, and how much of the substance they are in contact with.

Exposure-dose reconstruction
A method of estimating the amount of people's past exposure to hazardous substances. Computer and approximation methods are used when past information is limited, not available, or missing.

Exposure investigation
The collection and analysis of site-specific information and biologic tests (when appropriate) to determine whether people have been exposed to hazardous substances.

Exposure pathway
The route a substance takes from its source (where it began) to its end point (where it ends), and how people can come into contact with (or get exposed to) it. An exposure pathway has five parts: a source of contamination (such as an abandoned business); an environmental media and transport mechanism (such as movement through groundwater); a point of exposure (such as a private well); a route of exposure (eating, drinking, breathing, or touching), and a receptor population (people potentially or actually exposed). When all five parts are present, the exposure pathway is termed a completed exposure pathway.

Exposure registry
A system of ongoing followup of people who have had documented environmental exposures.

Feasibility study
A study by EPA to determine the best way to clean up environmental contamination. A number of factors are considered, including health risk, costs, and what methods will work well.

Geographic information system (GIS)
A mapping system that uses computers to collect, store, manipulate, analyze, and display data. For example, GIS can show the concentration of a contaminant within a community in relation to points of reference such as streets and homes.

Grand rounds
Training sessions for physicians and other health care providers about health topics.

Groundwater
Water beneath the earth's surface in the spaces between soil particles and between rock surfaces [compare with surface water].

Half-life ($t_{½}$)
The time it takes for half the original amount of a substance to disappear. In the environment, the half-life is the time it takes for half the original amount of a substance to disappear when it is changed to another chemical by bacteria, fungi, sunlight, or other chemical processes. In the human body, the half-life is the time it takes for half the original amount of the substance to disappear, either by being changed to another substance or by leaving the body. In the case of radioactive material, the half life is the amount of time necessary for one half the initial number of radioactive atoms to change or transform into another atom (that is normally not radioactive). After two half lives, 25% of the original number of radioactive atoms remain.

Hazard
A source of potential harm from past, current, or future exposures.

Hazardous Substance Release and Health Effects Database (HazDat)
The scientific and administrative database system developed by ATSDR to manage data collection, retrieval, and analysis of site-specific information on hazardous substances, community health concerns, and public health activities.

Hazardous waste
Potentially harmful substances that have been released or discarded into the environment.

Health consultation
A review of available information or collection of new data to respond to a specific health question or request for information about a potential environmental hazard. Health consultations are focused on a specific exposure issue. Health consultations are therefore more limited than a public health assessment, which reviews the exposure potential of each pathway and chemical [compare with public health assessment].

Health education
Programs designed with a community to help it know about health risks and how to reduce these risks.

Health investigation
The collection and evaluation of information about the health of community residents. This information is used to describe or count the occurrence of a disease, symptom, or clinical measure and to evaluate the possible association between the occurrence and exposure to hazardous substances.

Health promotion
The process of enabling people to increase control over, and to improve, their health.

Health statistics review
The analysis of existing health information (i.e., from death certificates, birth defects registries, and cancer registries) to determine if there is excess disease in a specific population, geographic area, and time period. A health statistics review is a descriptive epidemiologic study.

Indeterminate public health hazard
The category used in ATSDR's public health assessment documents when a professional judgment about the level of health hazard cannot be made because information critical to such a decision is lacking.

Incidence
The number of new cases of disease in a defined population over a specific time period [contrast with prevalence].

Ingestion
The act of swallowing something through eating, drinking, or mouthing objects. A hazardous substance can enter the body this way [see route of exposure].

Inhalation
The act of breathing. A hazardous substance can enter the body this way [see route of exposure].

Intermediate duration exposure
Contact with a substance that occurs for more than 14 days and less than a year [compare with acute exposure and chronic exposure].

In vitro
In an artificial environment outside a living organism or body. For example, some toxicity testing is done on cell cultures or slices of tissue grown in the laboratory, rather than on a living animal [compare with in vivo].

In vivo
Within a living organism or body. For example, some toxicity testing is done on whole animals, such as rats or mice [compare with in vitro].

Lowest-observed-adverse-effect level (LOAEL)
The lowest tested dose of a substance that has been reported to cause harmful (adverse) health effects in people or animals.

Medical monitoring
A set of medical tests and physical exams specifically designed to evaluate whether an individual's exposure could negatively affect that person's health.

Metabolism
The conversion or breakdown of a substance from one form to another by a living organism.

Metabolite
Any product of metabolism.

mg/kg
Milligram per kilogram.

mg/cm^2
Milligram per square centimeter (of a surface).

mg/m^3
Milligram per cubic meter; a measure of the concentration of a chemical in a known volume (a cubic meter) of air, soil, or water.

Migration
Moving from one location to another.

Minimal risk level (MRL)
An ATSDR estimate of daily human exposure to a hazardous substance at or below which that substance is unlikely to pose a measurable risk of harmful (adverse), noncancerous effects. MRLs are calculated for a route of exposure (inhalation or oral) over a specified time period (acute, intermediate, or chronic). MRLs should not be used as predictors of harmful (adverse) health effects [see reference dose].

Morbidity
State of being ill or diseased. Morbidity is the occurrence of a disease or condition that alters health and quality of life.

Mortality
Death. Usually the cause (a specific disease, a condition, or an injury) is stated.

Mutagen
A substance that causes mutations (genetic damage).

Mutation
A change (damage) to the DNA, genes, or chromosomes of living organisms.

National Priorities List for Uncontrolled Hazardous Waste Sites (National Priorities List or NPL)
EPA's list of the most serious uncontrolled or abandoned hazardous waste sites in the United States. The NPL is updated on a regular basis.

National Toxicology Program (NTP)
Part of the Department of Health and Human Services. NTP develops and carries out tests to predict whether a chemical will cause harm to humans.

No apparent public health hazard
A category used in ATSDR's public health assessments for sites where human exposure to contaminated media might be occurring, might have occurred in the past, or might occur in the future, but where the exposure is not expected to cause any harmful health effects.

No-observed-adverse-effect level (NOAEL)
The highest tested dose of a substance that has been reported to have no harmful (adverse) health effects on people or animals.

No public health hazard
A category used in ATSDR’s public health assessment documents for sites where people have never and will never come into contact with harmful amounts of site-related substances.

NPL [see National Priorities List for Uncontrolled Hazardous Waste Sites]

Physiologically based pharmacokinetic model (PBPK model)
A computer model that describes what happens to a chemical in the body. This model describes how the chemical gets into the body, where it goes in the body, how it is changed by the body, and how it leaves the body.

Pica
A craving to eat nonfood items, such as dirt, paint chips, and clay. Some children exhibit pica-related behavior.

Plume
A volume of a substance that moves from its source to places farther away from the source. Plumes can be described by the volume of air or water they occupy and the direction they move. For example, a plume can be a column of smoke from a chimney or a substance moving with groundwater.

Point of exposure
The place where someone can come into contact with a substance present in the environment [see exposure pathway].

Population
A group or number of people living within a specified area or sharing similar characteristics (such as occupation or age).

Potentially responsible party (PRP)
A company, government, or person legally responsible for cleaning up the pollution at a hazardous waste site under Superfund. There may be more than one PRP for a particular site.

ppb
Parts per billion.

ppm
Parts per million.

Prevalence
The number of existing disease cases in a defined population during a specific time period [contrast with incidence].

Prevalence survey
The measure of the current level of disease(s) or symptoms and exposures through a questionnaire that collects self-reported information from a defined population.

Prevention
Actions that reduce exposure or other risks, keep people from getting sick, or keep disease from getting worse.

Public availability session
An informal, drop-by meeting at which community members can meet one-on-one with ATSDR staff members to discuss health and site-related concerns.

Public comment period
An opportunity for the public to comment on agency findings or proposed activities contained in draft reports or documents. The public comment period is a limited time period during which comments will be accepted.

Public health action
A list of steps to protect public health.

Public health advisory
A statement made by ATSDR to EPA or a state regulatory agency that a release of hazardous substances poses an immediate threat to human health. The advisory includes recommended measures to reduce exposure and reduce the threat to human health.

Public health assessment (PHA)
An ATSDR document that examines hazardous substances, health outcomes, and community concerns at a hazardous waste site to determine whether people could be harmed from coming into contact with those substances. The PHA also lists actions that need to be taken to protect public health [compare with health consultation].

Public health hazard
A category used in ATSDR's public health assessments for sites that pose a public health hazard because of long-term exposures (greater than 1 year) to sufficiently high levels of hazardous substances or radionuclides that could result in harmful health effects.

Public health hazard categories
Public health hazard categories are statements about whether people could be harmed by conditions present at the site in the past, present, or future. One or more hazard categories might be appropriate for each site. The five public health hazard categories are no public health hazard, no apparent public health hazard, indeterminate public health hazard, public health hazard, and urgent public health hazard.

Public health statement
The first chapter of an ATSDR toxicological profile. The public health statement is a summary written in words that are easy to understand. The public health statement explains how people might be exposed to a specific substance and describes the known health effects of that substance.

Public health surveillance
The ongoing, systematic collection, analysis, and interpretation of health data. This activity also involves timely dissemination of the data and use for public health programs.

Public meeting
A public forum with community members for communication about a site.

Radioisotope
An unstable or radioactive isotope (form) of an element that can change into another element by giving off radiation.

Radionuclide
Any radioactive isotope (form) of any element.

RCRA [see Resource Conservation and Recovery Act (1976, 1984)]

Receptor population
People who could come into contact with hazardous substances [see exposure pathway].

Reference dose (RfD)
An EPA estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans.

Registry
A systematic collection of information on persons exposed to a specific substance or having specific diseases [see exposure registry and disease registry].

Remedial investigation
The CERCLA process of determining the type and extent of hazardous material contamination at a site.

Resource Conservation and Recovery Act (1976, 1984) (RCRA)
This Act regulates management and disposal of hazardous wastes currently generated, treated, stored, disposed of, or distributed.

RFA
RCRA Facility Assessment. An assessment required by RCRA to identify potential and actual releases of hazardous chemicals.

RfD [see reference dose]

Risk
The probability that something will cause injury or harm.

Risk reduction
Actions that can decrease the likelihood that individuals, groups, or communities will experience disease or other health conditions.

Risk communication
The exchange of information to increase understanding of health risks.

Route of exposure
The way people come into contact with a hazardous substance. Three routes of exposure are breathing [inhalation], eating or drinking [ingestion], or contact with the skin [dermal contact].

Safety factor [see uncertainty factor]

SARA [see Superfund Amendments and Reauthorization Act]

Sample
A portion or piece of a whole. A selected subset of a population or subset of whatever is being studied. For example, in a study of people the sample is a number of people chosen from a larger population [see population]. An environmental sample (for example, a small amount of soil or water) might be collected to measure contamination in the environment at a specific location.

Sample size
The number of units chosen from a population or an environment.

Solvent
A liquid capable of dissolving or dispersing another substance (for example, acetone or mineral spirits).

Source of contamination
The place where a hazardous substance comes from, such as a landfill, waste pond, incinerator, storage tank, or drum. A source of contamination is the first part of an exposure pathway.

Special populations
People who might be more sensitive or susceptible to exposure to hazardous substances because of factors such as age, occupation, sex, or behaviors (for example, cigarette smoking). Children, pregnant women, and older people are often considered special populations.

Stakeholder
A person, group, or community who has an interest in activities at a hazardous waste site.

Statistics
A branch of mathematics that deals with collecting, reviewing, summarizing, and interpreting data or information. Statistics are used to determine whether differences between study groups are meaningful.

Substance
A chemical.

Substance-specific applied research
A program of research designed to fill important data needs for specific hazardous substances identified in ATSDR's toxicological profiles. Filling these data needs would allow more accurate assessment of human risks from specific substances contaminating the environment. This research might include human studies or laboratory experiments to determine health effects resulting from exposure to a given hazardous substance.

Superfund [see Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and Superfund Amendments and Reauthorization Act (SARA)]

Superfund Amendments and Reauthorization Act (SARA)
In 1986, SARA amended the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and expanded the health-related responsibilities of ATSDR. CERCLA and SARA direct ATSDR to look into the health effects from substance exposures at hazardous waste sites and to perform activities including health education, health studies, surveillance, health consultations, and toxicological profiles.

Surface water
Water on the surface of the earth, such as in lakes, rivers, streams, ponds, and springs [compare with groundwater].

Surveillance [see public health surveillance]

Survey
A systematic collection of information or data. A survey can be conducted to collect information from a group of people or from the environment. Surveys of a group of people can be conducted by telephone, by mail, or in person. Some surveys are done by interviewing a group of people [see prevalence survey].

Synergistic effect
A biologic response to multiple substances where one substance worsens the effect of another substance. The combined effect of the substances acting together is greater than the sum of the effects of the substances acting by themselves [see additive effect and antagonistic effect].

Teratogen
A substance that causes defects in development between conception and birth. A teratogen is a substance that causes a structural or functional birth defect.

Toxic agent
Chemical or physical (for example, radiation, heat, cold, microwaves) agents that, under certain circumstances of exposure, can cause harmful effects to living organisms.

Toxicological profile
An ATSDR document that examines, summarizes, and interprets information about a hazardous substance to determine harmful levels of exposure and associated health effects. A toxicological profile also identifies significant gaps in knowledge on the substance and describes areas where further research is needed.

Toxicology
The study of the harmful effects of substances on humans or animals.

Tumor
An abnormal mass of tissue that results from excessive cell division that is uncontrolled and progressive. Tumors perform no useful body function. Tumors can be either benign (not cancer) or malignant (cancer).

Uncertainty factor
Mathematical adjustments for reasons of safety when knowledge is incomplete. For example, factors used in the calculation of doses that are not harmful (adverse) to people. These factors are applied to the lowest-observed-adverse-effect-level (LOAEL) or the no-observed-adverse-effect-level (NOAEL) to derive a minimal risk level (MRL). Uncertainty factors are used to account for variations in people's sensitivity, for differences between animals and humans, and for differences between a LOAEL and a NOAEL. Scientists use uncertainty factors when they have some, but not all, the information from animal or human studies to decide whether an exposure will cause harm to people [also sometimes called a safety factor].

Urgent public health hazard
A category used in ATSDR's public health assessments for sites where short-term exposures (less than 1 year) to hazardous substances or conditions could result in harmful health effects that require rapid intervention.

Volatile organic compounds (VOCs)
Organic compounds that evaporate readily into the air. VOCs include substances such as benzene, toluene, methylene chloride, and methyl chloroform.

Other glossaries and dictionaries:
Environmental Protection Agency (http://www.epa.gov/OCEPAterms/)
National Library of Medicine (NIH)
(http://www.nlm.nih.gov/medlineplus/mplusdictionary.html)

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