Health Consultation

PUBLIC COMMENT VERSION

SPRING PARK MUNICIPAL WELL FIELD NPL SITE

SPRING PARK, HENNEPIN COUNTY, MINNESOTA

EPA FACILITY ID: MNN000502963

Prepared by:
Minnesota Department of Health

MAY 2, 2023

COMMENT PERIOD ENDS: JUNE 20, 2023

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Office of Capacity Development and Prevention Services
Atlanta, Georgia 30333

Health Consultation: A Note of Explanation

A health consultation is a verbal or written response from the Agency for Toxic Substances and Disease Registry (ATSDR) or ATSDR's Cooperative Agreement Partners 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.

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The Minnesota Department of Health (MDH) prepared this Health Consultation for the Spring Park Municipal Wells Superfund site, located in Spring Park, Hennepin County, Minnesota. This publication was made possible by a cooperative agreement [program #TS20-2001] with the federal Agency for Toxic Substances and Disease Registry (ATSDR). MDH evaluated data of known quality using approved methods, policies, and procedures existing at the date of publication. ATSDR reviewed this document and concurs with its findings based on the information presented by MDH. The Health Consultation for the Spring Park Municipal Wells Superfund site is released for a 45-day public comment period. Subsequent to the public comment period, ATSDR's Cooperative Agreement Partner (MDH) will address all public comments and revise or append the document as appropriate. The Health Consultation will then be reissued as a final document. The final document will conclude the public health assessment process for this site, unless additional information is obtained by ATSDR's Cooperative Agreement Partner which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Foreword

This document summarizes public health concerns related to contamination at a site in Minnesota. It is based on a formal evaluation prepared by the Minnesota Department of Health (MDH). For a formal site evaluation, a number of steps are necessary:

- *Evaluating exposure:*
  MDH scientists begin by reviewing available information about environmental conditions at the site. The first task is to find out how much contamination is present and how people might be exposed to it. Usually, MDH does not collect its own environmental sampling data. Rather, MDH relies on information provided by the Minnesota Pollution Control Agency (MPCA), the U.S. Environmental Protection Agency (U.S. EPA), other government agencies, private businesses, and the general public.

- *Evaluating health effects:*
  If there is evidence that people are being exposed—or could be exposed—to hazardous substances, MDH scientists will take steps to determine whether that exposure could be harmful to human health. MDH's report focuses on public health— that is, the health impact on the community as a whole. The report is based on existing scientific information.

- *Developing recommendations:*
  In the evaluation report, MDH outlines its conclusions regarding any potential health threat posed by a site and offers recommendations for reducing or eliminating human exposure to pollutants. The role of MDH is primarily advisory. For that reason, the evaluation report will typically recommend actions to be taken by other agencies—including the U.S. EPA and MPCA. If, however, an immediate health threat exists, MDH will issue a public health advisory to warn people of the danger and will work to resolve the problem.

- *Soliciting community input*:
  The evaluation process is interactive. MDH starts by soliciting and evaluating information from various government agencies, the individuals or organizations responsible for the site, and community members living near the site. Any conclusions about the site are shared with the individuals, groups, and organizations that provided the information. Once an evaluation report has been prepared, MDH seeks feedback from the public. If you have questions or comments about this report, we encourage you to contact us.

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I. Summary

A. Introduction

The Spring Park Municipal Well Field Site was added to the U.S. Environmental Protection Agency (U.S. EPA) Superfund program's National Priorities List (NPL) in May 2018. It was added in order to investigate and address the possible source(s) of the chemical trichloroethylene (TCE) that contaminated groundwater in two out of three wells that make up the city municipal water supply. TCE was first detected in the Spring Park municipal drinking water in 2004. Although TCE concentrations in the finished drinking water never exceeded federal drinking water criteria of 5 µg/L (micrograms per liter), the TCE detections became a concern in 2013 when the Minnesota Department of Health (MDH) lowered its TCE health-based drinking water guidance value to 0.4 µg/L based on updated U.S. EPA toxicity information. As a result of exceedances of the MDH drinking water value, a new water treatment plant was built and began operating in 2017 to reduce TCE in drinking water and protect the health of Spring Park water users.

The source(s) of the TCE in the municipal wells is currently unknown. TCE is a common solvent that may have been used at several manufacturing or commercial properties in Spring Park. U.S. EPA began its enforcement process once the site was listed on the NPL to identify potentially responsible parties (PRPs) and plans to begin a Superfund-lead Remedial Investigation/Feasibility Study (RI/FS) in 2023. The goal of the RI/FS is to determine the nature, extent, and source(s) of contamination, and to identify PRPs.

Two other contaminated properties are located approximately 0.2 miles east of the Spring Park NPL site--the former Advance Machine property and the former J.R. Clark property. TCE has been found in the shallow groundwater and in soil vapor at and near these sites. Groundwater and soil vapor investigations are ongoing to make sure all potential vapor intrusion risks are addressed to protect public health and the environment. To date, the investigations of these two sites have not demonstrated that they are the source of the TCE contamination in the Spring Park municipal wells.

B. Conclusions

MDH reached six conclusions about the Spring Park Municipal Well Field NPL site.

Conclusion 1: Spring Park residents and other users of the city water supply are exposed to small amounts of TCE from ingestion of drinking water and inhalation of TCE that evaporates from the water into the indoor air. Exposures to TCE in the city water, both current and in the past, are not expected to harm people's health.

Basis for Conclusion 1: The highest concentrations of TCE in the drinking water were approximately 2 µg/L, from 2009-2013. No adverse health effects are expected as a result of this exposure because calculated exposure doses were just above health guidelines and well below effect levels identified in human and animal studies. TCE is currently removed from drinking water by a treatment system that has been in place since April 2017. TCE is frequently detected in city water at low concentrations (shown in Appendix C, Table 3).

Next Steps: MDH and the city of Spring Park should continue to monitor TCE concentrations in finished drinking water. The city should maintain the water treatment system to optimize TCE removal.

Conclusion 2: Limited indoor air sampling for the potential for vapor intrusion into West Arm Townhomes indicated one home with potentially harmful levels of TCE. Indoor air sampling in other homes did not indicate harmful exposures, but only limited sampling was conducted and many homeowners did not grant access for sampling.

Basis for Conclusion 2: One home had an amount of TCE (17 µg/m^3) measured in indoor air in 2007 that is a potential past health concern based on a small risk of fetal heart defects if a pregnant woman was exposed in the first eight weeks of pregnancy. A mitigation system was installed in this home, as well as in a majority of the West Arm Townhomes in 2013, in an effort to prevent vapor intrusion in all of these townhomes. Currently 24 out of 25 townhomes have vapor mitigation systems. Thirteen townhomes had indoor air sampling in 2020 and results ranged from not detected to 0.86 µg/m^3 TCE. MDH's evaluation showed that exposures in these households were well below those that would be expected to lead to harmful noncancer or cancer health effects. Many townhome owners have refused access for additional sampling. Allowing access is considered voluntary.

Next steps: MDH recommends that owners allow access for sampling indoor air, sub-slab vapor, and pressure differential readings to ensure the home's mitigation system is working as intended. The Minnesota Pollution Control Agency (MPCA) should oversee this remedial work in accordance with MPCA's vapor intrusion best management practices. Continued operation, maintenance, and inspections of vapor intrusion mitigation systems and periodic monitoring as necessary are important for continued protection of health at these locations. MDH will continue to be available to respond to questions or concerns from the community.

Conclusion 3: For two unmitigated residences west of the townhomes, MDH cannot conclude whether breathing indoor air could harm people's health.

Basis for Conclusion 3: Two residences west of the townhomes have no recent indoor air data indicating current conditions. One residence was offered a mitigation system in 2015 based on slight exceedances of TCE screening values in the indoor and crawl space air. The other residence has not provided access for sampling. Allowing access is considered voluntary.

Next Steps: MDH recommends homeowners allow access for seasonal sampling events and/or mitigation system installation. MPCA should oversee this remedial work in accordance with MPCA's vapor intrusion best management practices. MDH will continue to be available to respond to questions or concerns from these residents.

Conclusion 4: It is possible that past occupants at the Tonka Business Center (east building) were exposed to TCE and to a lesser extent, tetrachloroethylene (PCE), in indoor air due to vapor intrusion. MDH cannot conclude whether breathing indoor air in the past could have harmed people's health. A mitigation system has been installed at the Tonka Business Center (east building), and as long as the system is properly maintained, vapor intrusion should not be a concern.

Basis for Conclusion 4: Sub-slab vapor concentrations sampled in early 2019 below the Tonka Business Center (east building) were up to 3,670,000 µg/m^3 TCE and up to 27,100 µg/m^3 PCE. It is possible that these vapors were affecting indoor air, but indoor air samples were not collected until after mitigation systems were put in place. There were no TCE or PCE exceedances of screening values in post-mitigation indoor air samples.

Next Steps: Tonka Business Center should continue operation, maintenance, and inspections of the vapor intrusion mitigation systems and periodic monitoring as necessary to protect the health of workers and visitors at this location.

Conclusion 5: Contaminants in indoor air from occupational uses in the Tonka Business Center (east building) may have harmed building occupant's health.

Basis for Conclusion 5: Isopropyl alcohol was detected in indoor air at Boomerang Labs in 2019 and 2020 at amounts that approach health effect levels, despite the maximum measured air concentration being less than four percent of the applicable Minnesota OSHA standard. Boomerang Labs reportedly took several measures to limit the quantity and frequency of isopropyl alcohol use in 2019; indoor air concentrations measured in 2020 were less than half of 2019 levels. While efforts were undertaken to reduce the use and exposure to isopropyl alcohol, there could remain a small risk to workers exposed over many years.

Next Steps: If isopropyl alcohol indoor air concentrations continue to be at 2020 levels or above, continued efforts to reduce exposures is supported.

Conclusion 6: MDH cannot conclude whether breathing indoor air could harm people's health in the Lakeview Lofts, Tonka Business Center (west building), and properties south of these buildings.

Basis for Conclusion 6: These buildings were not sampled. The soil vapor plume boundaries have not been defined in these areas.

Next Steps: MPCA should oversee or conduct sampling to delineate the soil vapor plume, including sampling at the Lakeview Lofts and the Tonka Business Center (west building) to determine the need for vapor mitigation. All buildings where sampling shows the vapor plume may extend should be investigated for vapor intrusion. The extent of the shallow groundwater contamination should also be defined.

C. For More Information

For more information about this health consultation, contact Minnesota Department of Health, Site Assessment and Consultation Unit at 651-201-4897 or health.hazard@state.mn.us.

II. Background and Statement of Issues

The Agency for Toxic Substances and Disease Registry (ATSDR) is required by law to conduct public health assessment activities at each site listed on the U.S. EPA NPL. MDH prepared this public health consultation under a cooperative agreement with ATSDR.

For communities living near state or federal Superfund sites, MDH's goal is to provide information they need and can use to take actions to protect their health. MDH also evaluates environmental data and advises state and federal regulatory agencies and local governments on actions that can be taken to protect public health.

The main purpose of this health consultation is to evaluate the health risks of exposure to TCE from groundwater contamination and to provide updated information to the community about the status of TCE in the Spring Park municipal water supply system. In addition, this document aims to inform the community about soil vapor investigations from TCE contaminated properties in Spring Park.

A. Spring Park Municipal Well Field NPL Site

The U.S. EPA formally listed the Spring Park Municipal Well Field Site on the NPL in May 2018. EPA's initial efforts have focused on formal searches to identify potential responsible parties (PRPs) who could be considered sources for the TCE groundwater contamination impacting the well field. No source of the groundwater contamination has been confirmed and additional work is necessary to identify PRPs.

U.S. EPA plans to begin Remedial Investigation/Feasibility Study (RI/FS) work in 2023. The RI will involve collecting data to characterize the site conditions, determine the nature and extent of contamination by collecting environmental samples, and determine the source(s) of contamination so that PRPs can be identified. The FS will involve the development, screening, and evaluation of alternative remedial actions that can be taken to address the impacted well field. Based on the results of the FS, U.S. EPA will develop a proposed plan for remediating the contamination. Proposed cleanup options will be made available for public input before the final proposed remedies are approved and implemented. In the event it is determined that the soil vapor contamination (see Section B. below) above acceptable health criteria is from the same sources as the groundwater contamination affecting the municipal well field, the U.S. EPA would also become responsible for overseeing vapor intrusion investigations and possible mitigation.

What is TCE? How Does it Move Through the Environment?

Historically, TCE was widely used as a solvent for degreasing metal parts during the manufacture of a variety of products. It can be found in consumer products, including some wood finishes, adhesives, paint removers, and stain removers. TCE is also used in the manufacture of other chemicals. It is a known human carcinogen and may harm the developing fetus. TCE may also affect the liver, kidneys, immune system, central nervous system, and male reproductive system.

TCE that spilled or was dumped on the ground can pollute soil and groundwater. Because TCE moves from water to air easily, it is not usually found in surface soils or in open surface water. However, if enough TCE is released, it can move down through the soil and into groundwater where it may pollute private and public drinking water wells. TCE in shallow groundwater can also move into the air as soil vapor and potentially contaminate the indoor air in buildings above the groundwater plume. Many other volatile organic compounds (VOCs) behave in similar ways to TCE in the environment.

Site Location, City Wells, and Hydrogeology

Located in Hennepin County, the city of Spring Park has a land area of 0.4 square miles and has a population of approximately 1,900 people. A map displaying the boundary of Spring Park accompanied by a table of selected demographic information is in Appendix A. All residential properties in Spring Park are connected to city water provided by three municipal drinking water supply wells, all drawing from different bedrock aquifers. A summary of the main geologic units and aquifers in the Spring Park area is provided in Appendix C, Table 1.

Spring Park Well 1 draws water from the Tunnel City Group aquifer, Spring Park Well 2 draws water from the Jordan Sandstone aquifer, and Spring Park Well 3 draws water from the Mt. Simon aquifer. Shallow, unconsolidated deposits of sand, gravel, silt, and clay overlying the bedrock aquifers include a water table aquifer and a deeper, buried artesian aquifer. Table 2 in Appendix C summarizes general construction and completion depth information for the Spring Park municipal wells and other nearby public supply wells.

A geologic cross-section of the area near the city well field is provided in Figure 1. The location of the cross-section is shown in Figure 2. As Figure 1 illustrates, geologic faults in this area have caused the layers of bedrock on one side of the fault to be displaced vertically with respect to the layers of bedrock on the other side of the fault (the direction of displacement is shown by the arrows in the figure). Less permeable formations such as the St. Lawrence and Eau Claire formations normally would help to protect the aquifers below them by limiting downward migration of contaminants. However, the disruption of the bedrock caused by the faults may mean that these layers do not provide as much protection for the deeper aquifers in this area as they would in undisturbed areas.

Shallow groundwater flow (in the unconsolidated materials above the bedrock) in the TCE impacted area of Spring Park is generally to the north toward the West Arm of Lake Minnetonka. However, the city is located on a narrow strip of land between two bays of Lake Minnetonka and shallow groundwater flow directions across Spring Park may vary widely, controlled primarily by topography and water levels in the nearest part of the lake.

In contrast, the regional groundwater flow direction in the underlying bedrock aquifers, from which the city water is drawn, is from the northwest to the southeast (Figure 3). The city wells draw water primarily from the area located upgradient, or northwest, of the well field while active pumping also draws some groundwater from downgradient locations to the east-southeast. Groundwater modeling conducted by MDH has defined the wellhead protection area for the Spring Park municipal wells based on an estimated 10-year capture zone as shown in Figure 3. The ten-year capture zone represents the area of groundwater that is estimated to be pumped to the municipal wells over a ten-year period. It is important to note that over a longer period, the wells will have drawn water from a larger area than shown in this figure, so the capture zone is not the only area within which the source of the TCE may be located.

Spring Park Wells 1 and 2, which draw from aquifers at depths of 391-640 feet (Appendix C, Table 2), contain TCE, cis-1,2-dichloroethylene (cis-1,2-DCE) and vinyl chloride, while Spring Park Well 3, which draws from the deeper Mt. Simon aquifer, is free of contamination. Table 3 in Appendix C provides a summary of the TCE, cis-1,2-DCE, and vinyl chloride sampling results from Spring Park Wells 1 and 2 from 2013 to 2022.

The water from the three municipal wells has historically been pumped to a single treatment plant where excess iron is removed, fluoride is added, and the water is chlorinated prior to being pumped to the distribution system as finished drinking water. Each well is pumped at different times and the volume pumped varies according to demand and well maintenance needs. The relative volumes pumped from each well has changed over time, with the largest volumes typically coming from Wells 1 and 2. As discussed below, in 2014-2017, the city relied primarily on Spring Park Well 3 until a treatment system was built for Wells 1 and 2.

Spring Park Treatment System

The highest concentrations of TCE in the Spring Park drinking water were approximately 2 µg/L, from 2009-2013. In 2014, the MPCA established the Spring Park Municipal Wells State Superfund site and listed it on the state's Permanent List of Priorities (PLP). The listing allowed the MPCA to access funding to design and construct a treatment system to remove the TCE contamination from the public water supply. A combination of state Superfund and legislative bonding funding was used to hire a contractor to evaluate the remedial alternatives. The option chosen was to design and construct an air stripper treatment system as an addition to the City's current treatment plant.

The air stripper design directs pumped groundwater from the Spring Park municipal wells to cascade down a series of stacked trays while air under pressure is forced up through it from below, taking advantage of the fact that TCE will readily transfer from water into air. The air flow "strips" TCE from the water and the treated clean water is discharged into the public water supply. The air stripper design was completed in June 2015 and the new treatment system was constructed from April 2016 to April 2017.

Meanwhile, beginning in August 2014, the City began relying solely on Spring Park Well 3--their one clean municipal well—to provide approximately 98% of the city's drinking water (MPCA, 2015). MDH and the MPCA evaluated options to address the Spring Park water supply and concluded that Spring Park Well 3 could be used as the sole water source temporarily but not indefinitely.

The new air stripper has been operating since April 2017 (MPCA, 2022). However, some of the finished drinking water samples still had TCE detections (up to 0.41 µg/L). Due to the need to improve the efficiency of the air stripper, MPCA, MDH, and the contractor reassessed several design parameters for possible improvements. In the fall of 2019, changes were made to the system that increased the air inflow to the treatment system, which has since resulted in increased TCE removal from the treated public water supply. The city of Spring Park, MPCA and MDH continue to closely monitor the treatment system to ensure removal of TCE from the public water supply.

Preceding MPCA Site Assessment Investigations

The MPCA Site Assessment Program investigates environmental release sites that have no identified responsible parties. MPCA assesses risks to human health and the environment and determines whether the site qualifies for funding under either the state or federal Superfund Program for further investigation and cleanup. While the state Superfund process provided funding to design and construct the new treatment system, the MPCA sought support from the U.S. EPA to conduct additional groundwater investigation, identify sources of the contamination, and eventually clean up the impacted bedrock aquifers. The Site Assessment Program's process required the MPCA to collect additional data to support the potential listing of the site on the U.S. EPA NPL for obtaining federal resources and oversight.

In 2013, the Site Assessment Program hired a contractor and began a series of state-funded investigations into potential sources for the TCE contamination in Spring Park Wells 1 and 2. An area-wide environmental assessment report was prepared that summarized area-wide geology and known information on nearby environmental releases in Spring Park (AECOM, 2014). Notable suspected or known releases of TCE in the vicinity of the Spring Park Municipal Wells site identified in this report included the Minnetonka Lakeshore–Advance Machine property (former Advance Machine) and the former J.R. Clark property (now developed as the Tonka Business Center). These properties are side-gradient to the city wells, and TCE contamination has been found in the shallow groundwater at both properties. The westernmost part of the former Advance Machine shallow groundwater contamination is within the city well capture zone, but to date neither site has definitively been identified as the source of the TCE contamination in the Spring Park municipal wells.

A Preliminary Assessment Report was prepared (MPCA, 2014) that provided the initial documentation to U.S. EPA

- on the nature of the TCE release in the Spring Park municipal wells area,
- the area geology and hydrogeology, and
- the results of the area-wide environmental assessment.

Subsequent reports to U.S. EPA (MPCA, 2015; MPCA 2017b) summarized hydrogeology and testing results from the Spring Park wells, other nearby municipal wells, commercial wells, and private domestic wells. Testing of other nearby public, commercial, and private wells has not identified any evidence that TCE contamination had impacted any wells other than Spring Park Wells 1 and 2. This includes testing from two commercial wells in Spring Park completed in the Buried Artesian Aquifer overlying the Jordan Sandstone Aquifer approximately 1,000 feet east of the Spring Park well field and a new Jordan Sandstone monitoring well (MW01-16-JDN) installed approximately 500 feet northeast of the Spring Park well field in 2016.

B. TCE Releases in Spring Park and Vapor Intrusion

The TCE contamination in the Spring Park municipal wells is located approximately 300 feet below ground surface, in deep bedrock aquifers. However, just east-northeast of the Spring Park well field, the shallow groundwater is contaminated with TCE approximately 30 feet below ground surface (Figure 4).

TCE can evaporate from soil and shallow groundwater and rise toward the ground surface. TCE vapors can build up underneath buildings and enter the indoor air through cracks in foundations or pipe openings, or through a sump or drain. This process, when pollution moves from air spaces in soil to indoor air, is called vapor intrusion.

Two contaminated properties are located approximately 0.2 miles east of the Spring Park Municipal Wells site—the former Advance Machine property and the former J.R. Clark property. TCE has been detected in the soil vapor on both properties (Figure 4). The former Advance Machine property is currently administered within the MPCA State Superfund Program. The former J.R. Clark property owner voluntarily conducted remedial activities under the MPCA Voluntary Investigation and Cleanup Program.

Former Advance Machine Property

The Advance Machine facility was a producer of industrial cleaning equipment that operated along the shoreline of West Arm Bay of Lake Minnetonka from approximately 1958 to 1985 (Wenck, 2002) at which time Advance Machine relocated their business. The Spring Park facility was demolished in 1989 and the Advance Machine property was sold to developers who constructed the West Arm Townhomes in the mid- to late-1990s. In 1994, prior to construction of the townhomes, groundwater sampling conducted by contractors hired by the developers identified elevated concentrations of TCE in the groundwater and they reported the contamination to the MPCA. MPCA conducted a search of potentially responsible parties for the TCE contamination.

At the request of the MPCA, Advance Machine voluntarily agreed to investigate the groundwater contamination and conduct cleanup actions. Nilfisk, Inc. acquired Advance Machine in 1997 and has conducted environmental investigations and groundwater remediation since 1998. Investigations at this property have identified elevated concentrations of TCE in the shallow water-table aquifer, both on land and beneath Lake Minnetonka, that are significantly greater than both drinking water criteria and surface water standards (Wenck, 2002, 2013, 2014a, 2014b, 2016). After an initial remedial investigation and approval by the MPCA, Nilfisk constructed a groundwater pump and treat system that began operating to remove the contaminants from the groundwater in April 2004.

In 2006, at the request of the MPCA, Nilfisk initiated a vapor intrusion investigation at the West Arm Townhomes. TCE was detected in indoor air at four of six townhomes sampled in January 2007. In 2013, at the request of the MPCA, MDH prepared a Health Consultation for the residents of West Arm Townhomes outlining potential health risks associated with TCE from vapor intrusion and the Spring Park public water supply (MDH, 2013). Gaining access from townhome owners to collect sub-slab vapor samples took years, but eventually most of the townhomes were sampled. Nilfisk proposed installation of vapor mitigation systems in every townhome. For the West Arm Townhome vapor sampling results, please see Appendix C, Table 4. For a discussion of TCE inhalation health risks, please see the Air Screening Values and Health Effects Evaluation for Vapor Intrusion section below.

Vapor mitigation systems (sub-slab depressurization systems, or SSDS) installed to reduce chemical vapors from the soil are the same systems that are installed to reduce radon levels in the home. An SSDS prevents soil vapor from entering the home by using a fan to create a slight vacuum beneath the slab relative to the interior air pressure to draw the gases from below the building slab. Soil vapor is vented through a pipe to the outside air above the home.

By the end of 2013, vapor mitigation systems were installed in 21 of the 25 townhomes. Townhome owners received an operation, maintenance, and implementation report with the installation of their mitigation system with instructions on how to periodically check to be sure the system is functioning (Wenck, 2016). Systems were installed in three additional townhomes between 2015 and 2017, and one remaining West Arm Townhome owner has not yet agreed to mitigation (Wenck, 2019). An additional residence west of the Townhomes was offered mitigation but has also not agreed to have a system installed (for vapor sampling data for this residence, see Appendix C, Table 5 and footnotes) and another residence west of this residence needs to be assessed. Figure 4 illustrates West Arm Townhomes that have been mitigated and the nearby former J.R. Clark property, now developed as the Tonka Business Center, which was mitigated by the property owner in 2019.

MPCA has requested that Nilfisk conduct additional groundwater remediation and soil vapor testing. In May 2019, MPCA approved a Remediation Action Plan for groundwater remediation. Nilfisk proposed to upgrade the existing groundwater recovery and treatment system at the former Advance Machine property. The upgrade would remove additional contaminant mass from the aquifer. No work has started on this yet.

In 2020, Nilfisk attempted to collect additional vapor samples and inspect the vapor mitigation systems at the West Arm Townhomes to verify system effectiveness (Wenck, 2021b). Many residents did not respond to letters requesting access or did not want sampling in their homes. Indoor air was sampled in 13 homes (TCE was detected in five) and sub-slab concentrations were sampled in 12 homes. Three homes had TCE concentrations in sub-slab samples and pressure readings indicating that these three mitigation systems were not operating as intended. The initial response action has been to install new fans in these homes and further confirmation testing is needed to ensure the systems are working properly.

Also in 2020, Nilfisk collected soil vapor samples at ten locations to the west and southwest of the former Advance Machine property to determine the extent of the TCE soil vapor (see Figure 4). Soil vapor samples were collected at depths between 3 to 10 feet. Eight of these locations were sampled twice (in March and September 2020), with TCE results below levels of concern. Despite this progress, the extent of the area in Spring Park where TCE is present in soil vapor has not yet been completely defined.

Former J.R. Clark Property

At the end of 2018, MPCA sent a Notice of Potential Contamination letter to the owner of the Tonka Business Center (TBC) at 4144-4164 Shoreline Drive (see Figure 4). The MPCA sent this letter because they suspected there was TCE soil vapor below the building from historical machining operations at the former J.R. Clark facility, which operated there from the 1940’s into the 1970’s. Groundwater sampling conducted by Nilfisk near the property indicated that the groundwater is likely contaminated beneath a portion of the TBC. MPCA staff were concerned that potential contamination beneath the TBC could pose a health risk to occupants and urged the owner to conduct a soil vapor investigation.

The owner voluntarily conducted a soil vapor investigation at the TBC in January-March 2019. The sub-slab soil vapor sampling results had concentrations of TCE up to 3,670,000 $\mu g/m^3$. Tetrachloroethylene (PCE), another chlorinated solvent, was also detected in sub-slab soil vapor at concentrations as high as 27,100 $\mu g/m^3$ (Vieau, 2019). MPCA and MDH worked with the property owner to develop a notification that the property owner distributed to tenants in April 2019 (see Appendix E).

The TBC property owner initiated the design work needed to install a mitigation system. The western-most portion of the building did not need mitigation because sub-slab concentrations did not exceed screening criteria for soil vapor. The rest of the building was mitigated in stages, between April and July 2019 (Vieau, 2020). It is unknown if TCE in soil vapor extends to the east and south of the TBC building.

Two rounds of post-mitigation sub-slab and indoor air sampling events were conducted–the first in August 2019, one month after mitigation was completed, and the second in March 2020, during the heating season (Vieau, 2020). The results showed good pressure field extension across the sub-slab and significantly decreased TCE sub-slab concentrations, indicating that the mitigation system was working as intended. Indoor air samples showed some low detections of TCE and PCE that are not of health concern (see Appendix E for indoor air data). The mitigation system is expected to run continuously. To ensure the system works properly, the operation and maintenance plan calls for monthly system inspections by a qualified person designated by the property owner. The owner is expected to be notified immediately of any problems with the system.

Lakeview Lofts Redevelopment

The Lakeview Lofts condominium and mixed retail building at 4100 Spring Street was constructed in 2005 (see Figure 4). Groundwater beneath that property contains TCE. in October 2004, five soil vapor samples were collected within the current building footprint at a depth of 20 feet. TCE was detected in two of the vapor samples at the western edge of the property at 33 and 806 $\mu g/m^3$. Lower concentrations of other contaminants, mainly petroleum compounds, were also detected in the soil vapor samples (Javelin, 2005a).

In addition to groundwater beneath the site containing TCE, soil on the property was contaminated from its former use as a railroad spur and gas station. The entire property was excavated to at least 12 feet for the construction of the underground parking garage. Over 7,500 tons of contaminated soil were removed and disposed of at an industrial waste landfill. The soil contained crushed coal and/or slag along the former railroad spur and petroleum contamination from a former fuel oil underground storage tank (Javelin, 2005b).

A vapor barrier (10 mil polyethylene sheeting) was placed below the concrete floor of the underground parking garage to reduce the potential for vapor intrusion into the building (Javelin, 2005b). The parking garage at this facility likely serves to limit vapor intrusion of TCE into the building. However, current MPCA vapor intrusion guidance requires more information regarding the design of the parking garage structure, the type of ventilation, and possibly additional testing before concluding vapor intrusion risks are absent. Additional investigation is needed to ensure vapor intrusion risks are evaluated using current guidelines.

III. ATSDR Health Assessment Evaluation

A. ATSDR Health Assessment Evaluation Process

ATSDR's public health assessment process has four main scientific evaluation components:

- Exposure Pathways Analysis
- Screening Analysis
- Exposure Point Concentrations and Exposure Calculations
- In-Depth Toxicological Effect Analysis

These four components are described further below.

Exposure Pathway Analysis

Chemical contamination in the environment can only harm a person's health if there is contact with (exposure to) the chemical and if the amount of the chemical the person comes into contact with is high enough to cause harm. Whether people can be exposed to a chemical depends on several factors, including:

- the source of contamination (where the chemical comes from)
- how the chemical is transported through environmental media
- a point of exposure (how a person may come into contact with the chemical)
- a route of human exposure (e.g., ingestion, inhalation, dermal contact)
- a potentially exposed population

An exposure pathway is considered *completed* if all five of these elements have been, are, or will be present at a site.

Comparison Value Screening

The ATSDR health assessment process includes a screening analysis using ATSDR comparison values (CVs) to identify contaminants that exceed screening levels. CVs are the chemical- and media-specific (i.e., air, water, soil) concentrations of a contaminant that are not likely to harm people's health. There are a number of different CVs available for screening contaminants to determine if additional analysis is needed as described in Table 1 below. If contaminant concentrations are found above CVs, it does not mean that health effects are likely.

Table 1: Descriptions of ATSDR Comparison Values

Type of Comparison Value (CV)	Description
Environmental Media Evaluation Guide (EMEG)	EMEGs are estimated levels of chemicals to which humans might be exposed to over a certain period without experiencing adverse non-cancer health effects, based on ATSDR's minimal risk level (MRL)[1].
Reference Dose Media Evaluation Guide (RMEG)	RMEGs represent the level of a chemical in water or soil at which a chronic human exposure is not likely to result in adverse non-carcinogenic effects, based on EPA's reference dose.[2]
Cancer Risk Evaluation Guide (CREG)	CREGs are estimated contaminant concentrations that would be expected to cause no more than one excess cancer in a million persons exposed throughout their lifetime (78 years).

[1] An MRL is 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. Exposure duration might be up to 2 weeks (acute), 2 weeks to less than a year (intermediate), or more than a year (chronic).

[2] A reference dose is 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.

Exposure Point Concentrations and Exposure Calculations

After chemicals are screened and found to be above CVs, exposure point concentrations (EPCs) are calculated. EPCs are representative contaminant concentrations for a particular exposure area, pathway, and/or duration.

The EPCs are used in calculations to estimate exposure doses. An exposure dose is an estimate of the contaminant amount that gets into a person's body over a specific time. Exposure doses are calculated using health protective exposure assumptions for two exposure scenarios, a central tendency exposure (CTE) and a reasonable maximum exposure (RME). CTE refers to individuals who have an average or typical exposure to a contaminant. RME is referring to individuals at the upper end of the exposure distribution (about the 95th percentile), which is higher than average but within a realistic exposure range.

Exposure doses are used to compare to health guidelines such as ATSDR's minimum risk level (MRL) or EPA's reference dose to determine if noncancer health effects may be a concern. To facilitate this comparison, estimated doses are divided by the health guideline to calculate a hazard quotient (HQ). HQs greater than one require further evaluation because the health guideline has been exceeded, while HQs less than one are no longer evaluated. For contaminants that are carcinogens, the exposure dose can also be used to calculate an excess lifetime cancer risk.

In-Depth Toxicological Analysis

Exposure doses are evaluated further if they are greater than the MRL or if they represent a cancer risk of more than one in 1,000,000 (1E-06). An in-depth toxicological effects analysis can be done to examine if exposure to a contaminant to may be a health concern by comparing the dose to effect levels found in the scientific literature.

B. Spring Park Exposure Pathway Analysis

The following exposure pathway analysis identifies the different ways people could be or might have been exposed to contaminants in the groundwater in Spring Park. Table 2 below lists the exposure pathways at the site in the past, at the present time, and those expected to be present in the future.

Completed Exposure Pathways

Spring Park municipal water household water use

Past ingestion of drinking water, cooking with contaminated water, and inhalation of indoor vapors from household water use, such as showering, washing hands, using the dishwasher, etc. with the Spring Park municipal water represents a completed exposure pathway. Exposure from dermal contact with the water is expected to be minimal.

VOCs were first discovered in the municipal water in 2004. Well 3, which is not contaminated, was used almost exclusively from August 2014 to April 2017. Since April 2017, the municipal water supply uses water from Wells 1 and 2 after it is treated to remove VOCs. While the treatment reduces the VOCs, they are frequently detected in the finished water at low levels, which represents a present completed exposure pathway. It is likely that low levels of VOCs will continue to be present in finished drinking water in the future as well.

Past vapor intrusion from contaminants in shallow groundwater into the air of residences and commercial buildings

VOCs in shallow groundwater can migrate through the soil in the form of vapor and enter the indoor air of homes and workplaces in a process called vapor intrusion. TCE was measured in indoor air in West Arm Townhomes in the past, representing a completed exposure pathway.

Potential Exposure Pathways

Present and future vapor intrusion from contaminants in shallow groundwater into the air of residences and commercial buildings

Many West Arm Townhome owners have refused access for additional vapor intrusion sampling to determine if mitigation systems are working as intended. Additional nearby homeowners have refused access for sufficient sampling and/or installation of a mitigation system. The Tonka Business Center needs to conduct ongoing operation and maintenance and inspections of their mitigation systems to ensure they are protecting building occupants. Additional soil vapor sampling in Spring Park is also needed to delineate the soil vapor plume and to determine the need for additional mitigation systems. These represent potential vapor intrusion exposure pathways now and in the future.

Incomplete Exposure Pathways

Spring Park municipal water use for produce gardens

TCE and other VOCs move from water to air easily. When gardens are watered, especially with spray irrigation, the amount of TCE in the water will be significantly lowered as it moves into the air. Therefore, very little TCE is expected to be available to garden plants (especially in Spring Park with the relatively low TCE levels that were in municipal water). If any TCE actually enters fruit or vegetables, the movement of TCE into the air prevents it from collecting in the plants.

In addition, exposure to TCE from inhalation from watering gardens is expected to be negligible, due to dispersal and dilution of TCE in the outdoor air. Dermal contact exposure is also expected to be negligible.

Private well water use

Testing of other nearby public, commercial, and private wells has not identified any evidence that TCE contamination has impacted any wells other than Spring Park Wells 1 and 2. Therefore, this exposure pathway is incomplete.

Table 2: Human Exposure Pathway Evaluation in Spring Park

Source	Medium	Point of Exposure	Route of Exposure	Potentially Exposed Population	Timeframe & Type of Exposure Pathway
Unknown	Deep Groundwater	Spring Park municipal water (i.e., drinking and cooking)	Ingestion	Users of Spring Park municipal water	Past: Completed Current: Completed Future: Completed
Unknown	Deep Groundwater	Spring Park municipal water (showers and other household water use)	Inhalation of vapors and dermal contact	Users of Spring Park municipal water	Past: Completed Current: Completed Future: Completed
Unknown	Deep Groundwater	Spring Park municipal water (watering produce gardens)	Ingestion of produce, inhalation of vapors, and dermal contact	Users of Spring Park municipal water who water produce gardens	Past: Incomplete Current: Incomplete Future: Incomplete
Unknown	Deep Groundwater	Nearby public, commercial, and private wells	Ingestion	Users of nearby wells	Past: Incomplete Current: Incomplete Future: Incomplete
Former Industrial Operations (Advance Machine, J.R. Clark Building)	Indoor air (vapor intrusion from shallow groundwater plume)	Limited number of homes and other occupied buildings above the shallow groundwater plume	Inhalation	Limited number of residents (all ages) and other building occupants	Past: Completed Current: Potential Future: Potential

Completed = indicates all five elements of the exposure pathway are either expected to occur or are occurring
Potential = indicates that all five elements of the exposure pathway might have occurred in the past or might occur in the future
Incomplete = indicates at least one element of the exposure pathway was or is not present

C. Water Screening Values and Health Risk Evaluation

ATSDR Comparison Values Screening Analysis

Finished drinking water concentrations in Spring Park are screened using ATSDR's health-based comparison values (CVs) in Table 3 below. Table 3 in Appendix C provides concentrations of TCE, cis-1,2-DCE, and vinyl chloride in finished drinking water from 1995 to the present. TCE and cis-1,2-DCE were at their highest measured levels in finished drinking water in 2012, at 2.4 µg/L and 3.1 µg/L, respectively.

Table 3: Maximum Concentration of a Contaminant Detected in Finished Drinking Water in Spring Park from 1995 to 2022 Screened with ATSDR's Comparison Values

Contaminant	Maximum Concentration (µg/L)	ATSDR Comparison Value (µg/L)	Type of Comparison Value
TCE	2.4	0.43	CREG
cis-1,2-DCE	3.1	14	child chronic RMEG
Vinyl Chloride	<0.2*	0.017	CREG

*<0.2 indicates that vinyl chloride was not detected at or above the reporting level of 0.2, the lowest concentration of vinyl chloride the laboratory could quantify.

Exposure to chemicals at or below CVs is not expected to cause health effects in people. Although vinyl chloride has not been detected in finished drinking water, it is possible it is present above the ATSDR CV but below the laboratory's ability to detect it. Vinyl chloride and cis-1,2-DCE are not further evaluated because their known maximum concentrations are not considered a potential health hazard. Health risk from exposure to drinking water containing TCE is discussed below.

ATSDR Water Health Risk Evaluation

Drinking water risk calculations are provided and described in Appendix D.

Two exposure point concentrations (EPCs) were used to calculate exposure doses for different exposure durations. The 95 percent Upper Confidence Limit (95 UCL) of the mean for the ten-year period from 2004 to 2013 was used as the first EPC for TCE (1.8 µg/L), which was calculated using ATSDR's Exposure Point Concentration Tool. The maximum TCE concentration of 2.4 µg/L (measured in 2012) was used as a second EPC for a duration of one year.

To evaluate residents' past exposures to TCE in drinking water, MDH calculated exposure doses and estimated noncancer and cancer risks. The hazard quotients for a reasonable maximum exposure (RME) using the 95 UCL are all <1 for all life stages calculated, including for the infant as the most highly exposed life stage. The cancer risks for both the RME child and adult are <1E-6 and represent negligible cancer risks. The second calculation using the maximum concentration of TCE compared with an exposure of less than a year for an infant and pregnant woman resulted in hazard quotients for an RME exposure that are also <1. This means that exposures are below the MRL and thus non-cancer effects are unlikely.

ATSDR's Shower and Household Water-use Exposure (SHOWER) Model v3.0 (ATSDR, 2022) was used to estimate dermal doses and inhalation exposure concentrations using both EPCs. A protective default scenario based on a four-person household was used to estimate exposure of the highest exposed person in the household. This scenario includes a person showering for 15 minutes after three consecutive 10 minute morning showers with no ventilation fan in use. The predicted dermal risk is considered negligible for the most exposed individual with an HQ of 0.03 and a cancer risk of 9E-8. Inhalation cancer risk for a child exposure over ten years duration is 2E-6, lower than a level Minnesota considers for further evaluation. The estimated daily average air concentration for the highest exposed person is 2.4 µg/m^3, greater than the MRL of 2.1 µg/m^3 (an HQ of 1.1). Because the air concentration for this protective scenario is just slightly over the MRL, no health effects are expected from this exposure estimate, even though inhalation of TCE while showering can contribute significantly to total exposure.

MDH Health Risk Limits and Basis for State Action

TCE and one of its degradation products, cis-1,2-DCE, were first detected in Spring Park's public water supply in 2004. Trace levels (<1 µg/L) of PCE, toluene, and xylenes were also detected very infrequently. None of the VOCs detected in the city's finished drinking water have ever exceeded the U.S. EPA's enforceable drinking water standard for public water systems (i.e., maximum contaminant level or MCL). As required under the federal Safe Drinking Water Act, the city publishes an annual Consumer Confidence Report for the community summarizing the water quality of the public water supply, including TCE results. TCE was not consistently detected in samples of the finished drinking water because some of the samples were collected from Spring Park Well 3.

Prior to 2013, both the MCL and MDH's Heath Risk Limit (HRL) for TCE were 5 µg/L. An MDH HRL or Health-Based Value (HBV) is a level of a contaminant that can be present in water and pose little or no health risk to a person drinking that water.[1] For more information about Minnesota water guidance values, see Health-Based Guidance Development Process https://www.health.state.mn.us/communities/environment/risk/guidance/devprocess.html. MDH develops HRLs and HBVs to protect the most sensitive or highly exposed populations at any stage of development based only on potential health impacts; unlike the MCLs, they do not consider economic or technological feasibility of prevention and/or treatment. In May 2013, MDH changed its drinking water HBV for TCE to 0.4 µg/L based on updated U.S. EPA toxicity information. The short-term, subchronic, and chronic HBV values were promulgated by MDH as HRLs in December 2015 (MDH, 2015).

MDH also developed a HRL for cis-1,2-DCE of 6 µg/L. Vinyl chloride, which is found in Spring Park Well 1 and 2, but never detected in finished drinking water, has a HRL of 0.2 µg/L.

When HRLs are exceeded, MDH recommends action is taken to stop or reduce exposures, which led Spring Park to rely primarily on Well 3 prior to the operation of the water treatment system in 2017. The highest concentrations of TCE in the drinking water were approximately 2 µg/L, from 2009-2013. MDH considers this amount of TCE protective for most people. Exposure to TCE over the HRL does not mean health effects are expected, however, a discussion of the HRL values as the basis for action to protect health is described below.

MDH identified immune and developmental effects as the most sensitive health effects that may be caused by exposure to TCE in drinking water. The HRL of 0.4 µg/L is calculated to be protective for exposures a young child or bottle-fed infant could experience. It is considered an amount of TCE in drinking water that is safe for all life stages, including developing fetuses, infants, children, and

[1] HRLs and HBVs are guidance used by the public, risk managers, and other stakeholders to make decisions about managing the health risks of contaminants in groundwater and drinking water. The difference between HRLs and HBVs is that the former are promulgated through Minnesota's rulemaking process.

individuals with impaired immune systems. MDH also determined that a drinking water concentration of 2 µg/L is protective for healthy adults who are only exposed after age 18; this level is also protective for pregnant women and the developing fetus. A concentration of 2 µg/L is also protective for cancer for all individuals, even those exposed for an entire lifetime. The applicability of these two different HRL values are displayed in the table below. The HRL calculation used by MDH also accounts for exposures that may include inhalation or dermal contact.

Table 4: Description of the MDH TCE Health Risk Limits

MDH TCE Health Risk Limit	Description
0.4 micrograms per liter (µg/L)	▪ Protects all people exposed to TCE in drinking water at any time during their life, from conception through old age. ▪ This value is based on developmental immune effects for bottle-fed infants and young children.
2 micrograms per liter (µg/L)	▪ Protects against cancer for all people who are exposed for an entire lifetime, from conception through old age. ▪ Protects healthy adults who are only exposed to TCE after age 18. ▪ Protects pregnant women and the developing fetus against heart defects.

D. Air Screening Values and Health Effects Evaluation for Vapor Intrusion

ATSDR Comparison Values Screening Analysis

Indoor air and sub-slab soil vapor concentrations from Spring Park vapor intrusion investigation data were screened with ATSDR's TCE CVs as shown below.

Table 5: ATSDR TCE Comparison Values

Media	ATSDR TCE Comparison Value*	Type of Comparison Value
Air	0.21 µg/m^3	CREG
Sub-slab soil vapor	7 µg/m^3	CREG

*in micrograms of TCE per cubic meter of air (µg/m^3)

There are limited indoor air data collected from properties in Spring Park as part of the vapor intrusion investigation (vapor sampling results greater than the CVs are shown in Appendix C, Tables 4 and 5). There are more sub-slab data, showing the potential for vapor intrusion to occur. Over multiple sampling events from 2007 to 2020, sub-slab vapor TCE results at residential properties ranged from 2.1 to 1,470 µg/m^3, with the exception of two townhomes that did not detect TCE vapor in the sub-slab (Wenck, 2019).

In January 2007, TCE was detected in indoor air of four West Arm Townhomes, with three homes' results ranging from 1.4 to 2.8 μg/m^3. The remaining townhome had 17 μg/m^3 TCE in indoor air (Liesch, 2009). In 2020, TCE in indoor air was detected in 5 of 13 townhomes sampled, all above the CV (0.23-0.86 μg/m^3). These samples were collected in February and March, except for one sample that was collected in April and one that was collected in June.

ATSDR Inhalation Health Risk Evaluation

The TCE CV concentration of 0.21 μg/m^3 is expected to cause no more than one excess cancer in a million people exposed throughout their lifetime (78 years). Based on the available indoor air results and the shorter durations that people may have been exposed, cancer risk is not expected to be of significance. Indoor air results that exceed the TCE CV are further evaluated by comparing to the TCE noncancer inhalation MRL of 2.1 μg/m^3. Indoor air concentrations from five different residences exceeded the MRL at one point in time, at concentrations (2.6, 2.7, 2.8, 3.5, and 17 μg/m^3) (Appendix C, Tables 4 and 5). All but one of these residences has been mitigated.

The U.S. EPA and ATSDR completed a toxicological review of TCE in 2011 and 2019, respectively. EPA developed a reference concentration (RfC) for TCE of 2 μg/m^3. An RfC is an estimate of daily inhalation exposure to a contaminant that is likely to be without a discernable risk of deleterious effects to the general human population, including sensitive subgroups, during a lifetime of exposure. The ATSDR TCE inhalation MRL is 2.1 μg/m^3, and it represents an estimate of daily human exposure to TCE that is not expected to cause non-cancer health effects during an intermediate (15-364 days) or chronic (≥365 days) duration.

EPA and ATSDR reviewed all published studies of animals and humans exposed to TCE and chose two critical rodent studies as the basis for the RfC and MRL. The selected studies are described below.

- The first critical study showed an increased risk of subtle impacts to the immune system; the thymus (a specialized organ of the immune system) weighed less than normal and there was an increase in markers associated with autoimmune disease after mice were exposed to TCE in drinking water.
    - Effect level finding -- A small risk of immune system effects may exist for people exposed to TCE at ~200 μg/m^3 continuously over a long time period.
- The second critical study showed heart defects in rats whose mothers were exposed to TCE in drinking water during pregnancy.
    - Effect level finding -- For women in the first eight weeks of pregnancy exposed to TCE at ~20 μg/m^3, there may be a small risk of fetal heart defects. At this level, very few women (no more than 1 in 100) would have an amount of TCE in their body that might cause a fetal heart defect less than 1% of the time.

To be protective in accounting for uncertainty, EPA divided the effect levels from these two critical studies by uncertainty factors of 100 in the first case and 10 in the second, to arrive at the RfC of 2 μg/m^3. Note however, that exposure to amounts of TCE greater than 2 μg/m^3 does not mean health effects will occur or are likely; although the risk of health effects increases as the amount and duration of TCE exposure increases.

This health consultation concludes that the measurement of 17 μg/m^3 TCE in the indoor air of one home in the past was a potential health concern. This is based on a small risk of fetal heart defects should a pregnant woman be exposed in the first eight weeks of pregnancy, because 17 μg/m^3 is approaching the effect level of 20 μg/m^3 described above. The other indoor air detections, up to 3.5 μg/m^3, are likely not high enough to cause health effects.

In addition, it is likely that past occupants at the Tonka Business Center (TBC; former J.R. Clark Property) were exposed to TCE and to a lesser extent PCE, in indoor air due to vapor intrusion. The historical amount of TCE and PCE in the indoor air and timing or duration of vapor intrusion at the TBC is not known because indoor air was not sampled before that building's mitigation system was installed.

VOCs are commonly found in indoor air, especially in workplaces that use chemicals. A number of VOCs were detected in the TBC indoor air during the post-mitigation sampling, in various tenant spaces, with no evidence they are from vapor intrusion. Isopropyl alcohol was detected in indoor air throughout the building, from use at Boomerang Laboratories, the largest TBC building tenant. For more information on the isopropyl alcohol and other indoor air results at TBC, see Appendix E.

Minnesota Intrusion Screening Values and Basis for State Action

In Minnesota, data from vapor intrusion investigations are compared to Minnesota-specific Intrusion Screening Values (ISVs) to make decisions on the need for building mitigation or other actions to protect health. An ISV is defined as an amount of a chemical in indoor air that is unlikely to harm health. A sub-slab ISV is defined by the state of Minnesota as an amount of a chemical in soil vapor beneath a building that is not expected to result in indoor air levels that exceed the ISV. There are two sets of ISVs, residential and commercial/industrial, scaled to reflect different amounts of time people are likely to spend at home or at work.

Minnesota's TCE ISVs are based on the U.S. EPA's and ATSDR's toxicological reviews described earlier and also on MDH's own toxicological assessment. The MPCA requires mitigation of buildings based on an exceedance of the sub-slab action level (33 times the ISV). Minnesota TCE ISVs for the vapor intrusion pathway are shown below.

Table 6: Description of the Minnesota Intrusion Screening Values

Type of Intrusion Screening Value (ISV)	TCE concentration*	Description
Residential ISV	2.1 µg/m^3	A safe indoor air level that protects all people from health effects
Residential Sub-Slab Value (33X ISV)	70 µg/m^3	A safe level in soil vapor beneath a home
Commercial/Industrial ISV	7 µg/m^3	A safe indoor air level for people who have exposures in the workplace over many years
Commercial/Industrial Sub-Slab Value (33X ISV)	230 µg/m^3	A safe level in soil vapor beneath a workplace

*in micrograms of TCE per cubic meter of air (µg/m^3)

As described above, all but one West Arm Townhomes residence has been mitigated, and there are two additional homes that need mitigation or additional sampling based on the ISVs and Minnesota's vapor intrusion guidance. Vapor intrusion data compared to the ISVs and 33X ISVs are found in Appendix C, Tables 4 and 5.

Soil vapor results at ten sample locations west and southwest of the former Advance Machine property in 2020 (shown on Figure 4) were all below 33X ISVs; the highest result was TCE at 18 µg/m^3 (Wenck, 2021a). This data defines the boundary of the soil gas plume in that direction, but there are still data gaps where the vapor plume boundaries are not defined. All buildings where sampling shows the vapor plume may extend should be investigated for vapor intrusion.

IV. Conclusions

MDH reached six conclusions about the Spring Park Municipal Well Field NPL site.

Conclusion 1: Spring Park residents and other users of the city water supply are exposed to small amounts of TCE from ingestion of drinking water and inhalation of TCE that evaporates from the water into the indoor air. Exposures to TCE in the city water, both current and in the past, are not expected to harm people's health.

Basis for Conclusion 1: The highest concentrations of TCE in the drinking water were approximately 2 µg/L, from 2009-2013. No adverse health effects are expected as a result of this exposure because calculated exposure doses were just above health guidelines and well below effect levels identified in human and animal studies. TCE is currently removed from drinking water by a treatment system that has been in place since April 2017. TCE is frequently detected in city water at low concentrations (shown in Appendix C, Table 3).

Conclusion 2: Limited indoor air sampling for the potential for vapor intrusion into West Arm Townhomes indicated one home with potentially harmful levels of TCE. Indoor air sampling in other homes did not indicate harmful exposures, but only limited sampling was conducted and many homeowners did not grant access for sampling.

Basis for Conclusion 2: One home had an amount of TCE (17 $\mu g/m^3$) measured in indoor air in 2007 that is a potential past health concern based on a small risk of fetal heart defects if a pregnant woman was exposed in the first eight weeks of pregnancy. A mitigation system was installed in this home, as well as in a majority of the West Arm Townhomes in 2013, in an effort to prevent vapor intrusion in all of these townhomes. Currently 24 out of 25 townhomes have vapor mitigation systems. Thirteen townhomes had indoor air sampling in 2020 and results ranged from not detected to 0.86 $\mu g/m^3$ TCE. MDH's evaluation showed that exposures in these households were well below those that would be expected to lead to harmful noncancer or cancer health effects. Many townhome owners have refused access for additional sampling. Allowing access is considered voluntary.

Conclusion 3: For two unmitigated residences west of the townhomes, MDH cannot conclude whether breathing indoor air could harm people's health.

Basis for Conclusion 3: Two residences west of the townhomes have no indoor air data indicating current conditions. One residence was offered a mitigation system based on slight exceedances of TCE screening values in the indoor and crawl space air. The other residence has not provided access for sampling.

Conclusion 4: It is possible that past occupants at the Tonka Business Center (east building) were exposed to TCE and to a lesser extent, PCE, in indoor air due to vapor intrusion. MDH cannot conclude whether breathing indoor air in the past could have harmed people's health. A mitigation system has been installed at the Tonka Business Center (east building), and as long as the system is properly maintained, vapor intrusion should not be a concern.

Basis for Conclusion 4: Sub-slab vapor concentrations sampled in early 2019 below the Tonka Business Center (east building) were up to 3,670,000 µg/m^3 TCE and up to 27,100 µg/m^3 PCE. It is possible that these vapors were affecting indoor air, but indoor air samples were not collected until after mitigation systems were put in place. There were no TCE or PCE exceedances of screening values in post-mitigation indoor air samples.

Conclusion 5: Contaminants in indoor air from occupational uses in the Tonka Business Center may have harmed building occupant's health.

Basis for Conclusion 5: Isopropyl alcohol was detected in indoor air at Boomerang Labs in 2019 and 2020 at amounts that approach health effect levels, despite the maximum measured air concentration being less than four percent of the applicable Minnesota OSHA standard. Boomerang Labs reportedly took several measures to limit the quantity and frequency of isopropyl alcohol use in 2019; indoor air concentrations measured in 2020 were less than half of the 2019 levels. While efforts were undertaken to reduce the use and exposure to isopropyl alcohol, there could remain a small risk to workers exposed over many years.

Conclusion 6: MDH cannot conclude whether breathing indoor air could harm people's health in the Lakeview Lofts, Tonka Business Center (west building), and properties to the south.

Basis for Conclusion 6: These buildings were not sampled. The soil vapor plume boundaries have not been defined.

V. Recommendations

1) MDH and the city of Spring Park should continue to monitor TCE concentrations in finished drinking water. The city should maintain the water treatment system to optimize TCE removal.
2) MDH recommends that West Arm Townhome owners allow access for sampling indoor air, sub-slab vapor, and pressure differential readings to ensure the home's mitigation system is working as intended. MPCA should this remedial work in accordance with MPCA's vapor intrusion best management practices. Continued operation and maintenance and inspections of vapor intrusion mitigation systems and periodic monitoring as necessary are important for continued protection of health at these locations. MDH will continue to be available to respond to questions or concerns from the community.
3) MDH recommends homeowners allow access for seasonal vapor intrusion sampling events and/or mitigation system installation. MPCA should oversee this remedial work in accordance with MPCA's vapor intrusion best management practices. MDH will continue to be available to respond to questions or concerns from these residents.

4) The Tonka Business Center should continue to operate and maintain their vapor mitigation systems (and conduct inspections and periodic monitoring as needed) for continued protection of health at this location. If isopropyl alcohol indoor air concentrations continue to be at 2020 levels or above, continued efforts to reduce exposures is supported.
5) MPCA should oversee or conduct sampling to delineate the soil vapor plume, including sampling at the Lakeview Lofts and the Tonka Business Center (west building) to determine the need for vapor mitigation. All buildings where sampling shows the vapor plume may extend should be investigated for vapor intrusion. The extent of the shallow groundwater contamination should also be defined.

VI. References

AECOM, 2014. Limited Site Assessment – Spring Park Wells Site Assessment Project, Spring Park, Minnesota. Prepared for the Minnesota Pollution Control Agency by AECOM Minneapolis, MN Project 60305958, June 2014.

ATSDR, 2019. Toxicological Profile for Trichloroethylene. U.S. Department of Health and Human Services, June 2019. Accessed at: https://wwwn.cdc.gov/TSP/ToxProfiles/ToxProfiles.aspx?id=173&tid=30 on September 2, 2021.

ATSDR, 2022a. Shower and Household Water-use Exposure (SHOWER) Model v3.0, User's Guide. Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service, May 4.

ATSDR, 2022b. Public Health Assessment Guidance Manual (PHAGM). Accessed at https://www.atsdr.cdc.gov/pha-guidance/ on September 22, 2022.Javelin Group, 2005a. Final Report Supplemental Phase II Environmental Investigation, Lakeview Lofts Development 4102, 4110-4114, 4120, & 4136 Spring Street Spring Park, Minnesota. February 14, 2005.

Javelin Group, 2005b. Development Response Action Plan Implementation, Lakeview Lofts Development 4102, 4110-4114, 4120, & 4136 Spring Street Spring Park, Minnesota. October 25, 2005.

Liesch, 2009. Soil Vapor Response Action Plan – Former Advance Machine Company, 4080 Sunset Drive, Spring Park, Minnesota 55384. Prepared for Nilfisk Advance, Inc. August 2009.

MDH, 2013. Health Consultation: Minnetonka Lakeshore- Advance Machine Superfund Site, Spring Park, Hennepin County, Minnesota. October 22, 2013, Addendum January 29, 2014.

MDH, 2015. Toxicological Summary for: Trichloroethylene (TCE). Accessed at: https://www.health.state.mn.us/communities/environment/risk/docs/guidance/gw/tcesummary.pdf on September 2, 2021.

MPCA, 2014. Preliminary Assessment Report for Spring Park Municipal Wells Site, Spring Park, Hennepin County, MN. Prepared for U.S. EPA. December 29, 2014.

MPCA, 2015. Site Inspection Report for Spring Park Municipal Wells Site, Spring Park, Hennepin County, MN. Prepared for U.S. EPA. December 28, 2015.

MPCA, 2017. Expanded Site Inspection Report for Spring Park Municipal Wells Site, Spring Park, Hennepin County, MN. Prepared for U.S. EPA. May 15, 2017.

MPCA, 2019. Letter to Emilie Vingtoft Rye-Anderson, Group Senior Counsel Nilfisk A/S, RE: MPCA Conditional Approval of Work Plan for Further Vapor Evaluation, Minnetonka Lakeshore – Advance Machine site, Spring Park. November 8, 2019.

MPCA, 2022. Minnesota Groundwater Contamination Atlas. Spring Park Municipal Wells – Superfund site. Accessed at: https://webapp.pca.state.mn.us/cleanup/search/superfund?text=spring%20park&siteId=88053-AREA0000000003 on March 3, 2022.

U.S. EPA, 2011. Toxicological Review of Trichloroethylene in Support of Summary Information on the Integrated Risk Information System (IRIS). EPA/635/R-09/011F. September 2011.

U.S. EPA, 2014. Provisional Peer-Reviewed Toxicity Values for Isopropanol (CASRN 67-63-0). Superfund Health Risk Technical Support Center, National Center for Environmental Assessment, Office of Research and Development. Accessed at: https://cfpub.epa.gov/ncea/pprtv/documents/Isopropanol.pdf on December 29, 2021.

Vieau, 2019. Response Action Plan, Former J.R. Clarke Property 4144-4164 Shoreline Drive Spring Park, MN 55384. April 23, 2019.

Vieau, 2020. RAP Implementation Report, SSD System Implementation Report J.R. Clarke Facility 4144-4164 Shoreline Drive Spring Park, MN 55384. Prepared for Tonka Ventures LLC. May 7, 2020.

Wenck Associates, Inc., 2002. Remedial Investigation/Feasibility Study, Former Advance Machine Company, 4080 Sunset Drive, Spring Park, Minnesota, Wenck File #0912-01. Prepared for Nilfisk-Advance, Inc. December 2002.

Wenck Associates, Inc., 2013. Groundwater Profiling Assessment Former Advance Machine Site. Prepared for Nilfisk Advance, Inc. November 2013.

Wenck Associates, Inc., 2014a. Additional Soil, Groundwater, and Soil Gas Assessment Data Submittal (August through October 2014). Former Advance Machine – Spring Park, Minnesota, MPCA Site #SR197. November 20, 2014.

Wenck Associates, Inc., 2014b. Remedial Groundwater Assessment Report Former Advance Machine Site. Prepared for Nilfisk Advance Inc. July 2014, Revised November 2014.

Wenck Associates, Inc., 2016. 2015 Annual Report Former Advance Machine Site. Prepared for Nilfisk, Inc. March 2016.

Wenck Associates, Inc., 2019. Letter to Rick Jolley, MPCA Superfund Section RE: Work Plan for Further Vapor Evaluation for the WATH and Delineation of the Vapor Area of Concern – Former Advance Machine – Spring Park, Minnesota, MPCA Site #SR197. September 10, 2019.

Wenck Associates, Inc., 2021a. Technical Memo to Brigitte Hay, Michael Ginsbach, Rick Jolley, MPCA. Subject: Further Vapor Evaluation for the Delineation of the Vapor Area of Concern (West of Former Advance Machine) – Spring Park, Minnesota, MPCA Site # SR197. March 9, 2021.

Wenck Associates, Inc., 2021b. 2020 Annual Report Former Advance Machine Site. Prepared for Nilfisk, Inc. April 2021.

VII. Report Preparation

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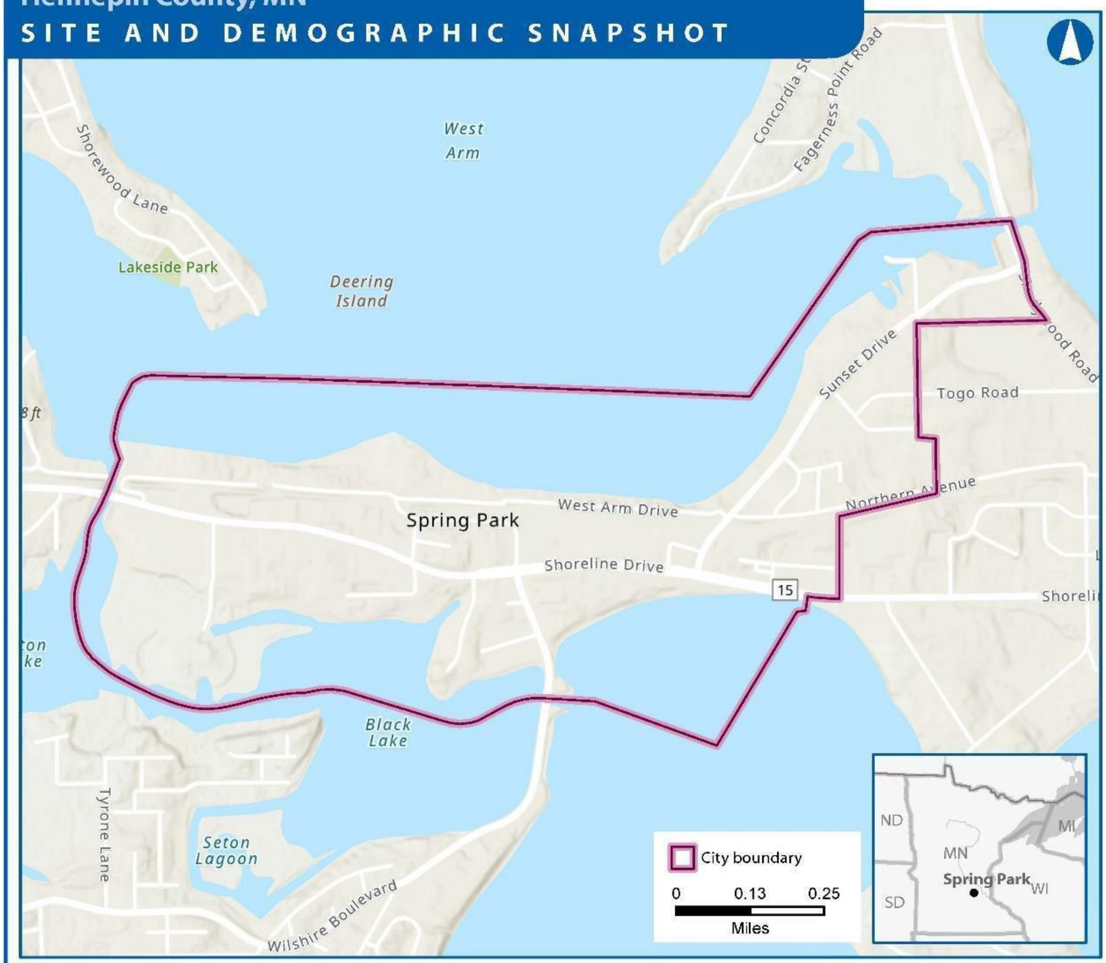
Appendix A: Site and Demographic Snapshot

City of Spring Park

Hennepin County, MN

SITE AND DEMOGRAPHIC SNAPSHOT



Demographic Estimates
for City of Spring Park

Measure	2019 estimate	Margin of error
Total Population	1,906	±204
White Alone	1,732	±211
Black Alone	59	±49
Am. Indian & AK Native Alone	0	±9
Asian Alone	35	±25
Native Hawaiian & Other Pacific Islander Alone	15	±21
Some Other Race Alone	0	±9

Measure	2019 estimate	Margin of error
Two or More Races	65	±66
Hispanic or Latino[6]	9	±13
Children Under Age 5	43	±38
Adults Aged 65 and Older	665	±117
Females Aged 15 to 44	229	±66
Percent Age 5 and Older Who Speak English Less Than "Very Well"	0.6%	±0.7

Data Sources: City boundary: US Census 2020 TIGER/Line Incorporated Places. Basemaps: Esri. Demographic estimates: US Census, 2019 American Community Survey 5-year estimates data profiles and subject tables.
Note: [1]Individuals identifying origin as Hispanic or Latino may be of any race. **Projection:** NAD 1983 StatePlane Minnesota South FIPS 2203 Feet.

PRJ 06218 WSH0 2/7/22

GRASP

Agency for Toxic Substances and Disease Registry
Office of Innovation and Analytics

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ATSDR

Note: The source of this snapshot is the ATSDR's Geospatial Research, Analysis and Services Program.

Appendix B: Figures

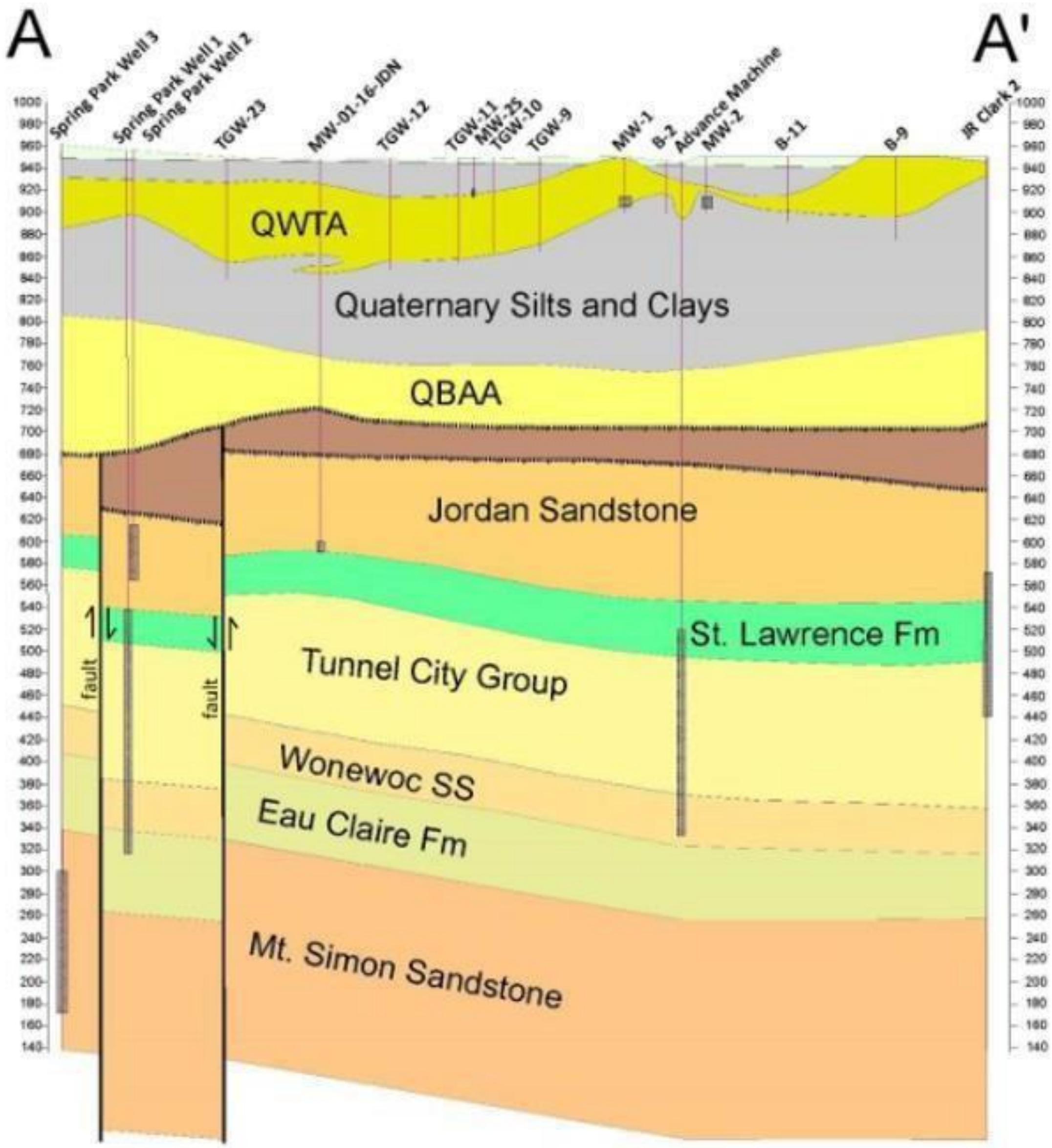


Figure 1 – Geologic Cross-Section Near Spring Park City Well Field

Location of this cross-section view is shown in Figure 2. The city wells area shown here only to aid understanding of the local geology and to illustrate the aquifers from which the city wells draw water. The horizontal axis of this figure is not to scale and should be used for well location purposes.

Prepared by MDH, 2/11/2021

Figure 2 - Location of Geologic Cross-Section (Shown in Figure 1)

N
W E
S

Prepared by MDH, 2/11/2021

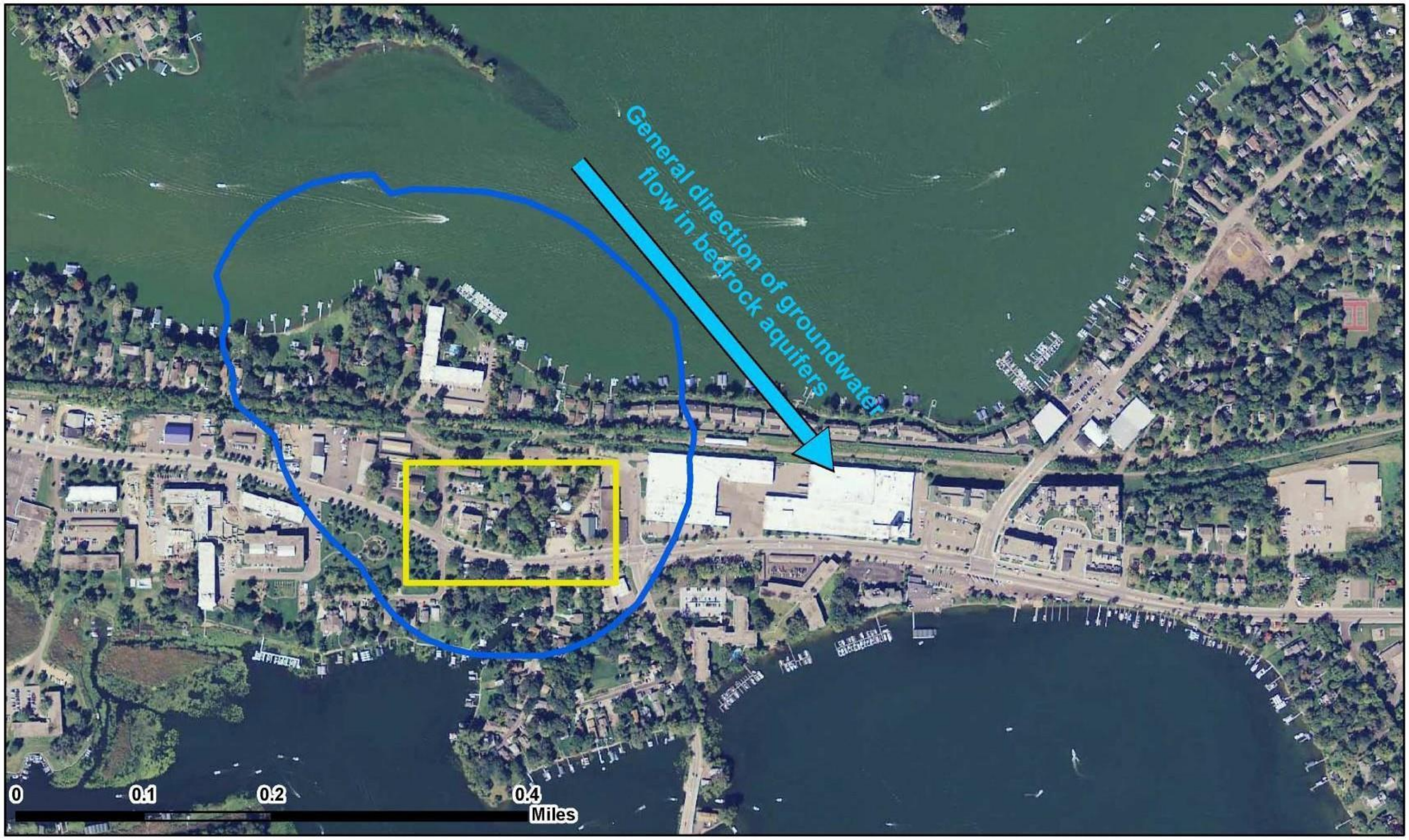


Figure 3 - Spring Park City Wells Capture Zone

Spring Park City Wells 10-Year Capture Zone | **Approximate location of Spring Park well field**

N W E S

NOTES:

1) Groundwater flow direction and capture zone are shown for the bedrock aquifers in which the city wells are completed. Flow direction in shallower aquifers may differ.

2) In accordance with Dept. of Homeland Security rules, the locations of the city wells are not shown

Prepared by MDH, 9/20/2021

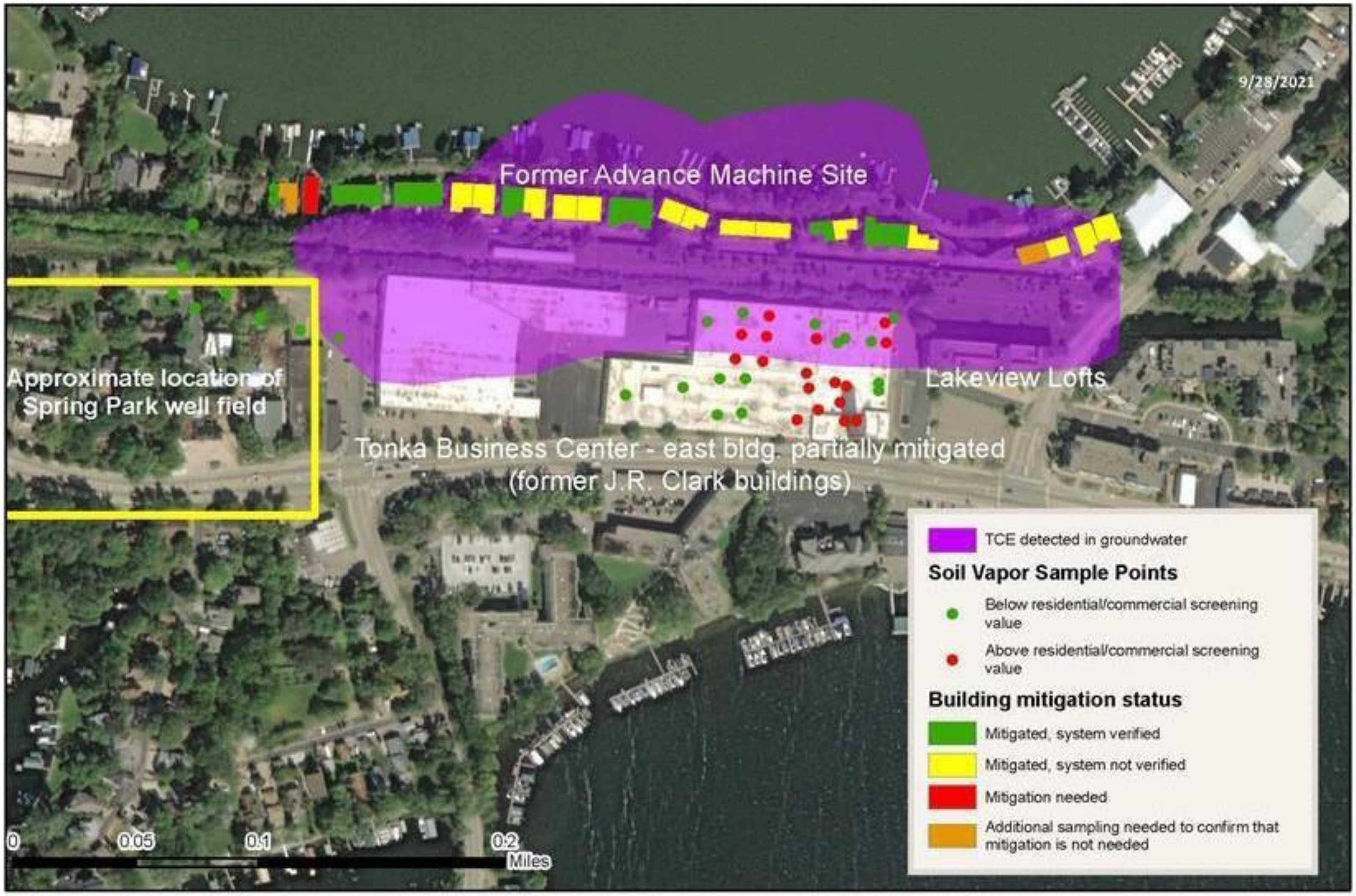


Figure 4 - TCE in Groundwater and Soil Vapor Near Former Advance Machine Site and J.R. Clark Buildings

Prepared by MPCA/MDH, 9/28/2021

Appendix C: Tables

Table 1: Geologic Units and Aquifers in the Spring Park Area

Geologic Unit	Approximate Thickness (feet)	Lithology	Hydrostratigraphic Units
Quaternary Glacial Overburden(QUUU)	186 to 280	Loamy till, lenses of sands, silts, gravel, sandy till and clayey till unconformably overlying bedrock, may be inhydrologic contact with the underlying St. Peter SS	Quaternary Water Table Aquifer (QWTA) Quaternary Buried Artesian Aquifer (QBAA)
Middle to Upper Ordovician St. Peter Sandstone (OSTP)	44	Fine-medium, well sorted quartzose friable sandstone overlain by denser, finer-grained sandstone with thin discontinuous shale beds, unconformable contact with Jordan SS	St. Peter Sandstone Aquifer
Upper Cambrian Jordan Sandstone (CJDN)	84	Fine to coarse-grained quartzose friable sandstone and more tightly cemented very fined grained feldspathic sandstone, siltstone and shale with transitional lower contact with the St. Lawrence	Jordan Sandstone Aquifer
St. Lawrence Formation (CSTL)	32	Interbedded very fine-grained fedspathic sandstone, siltstone, shale, and sandy dolostone, with dolostone and shale more common in the lower half	Partial Aquiclude
Upper Cambrian Tunnel CityGroup (CTCG): Upper Mazomanie Formation and lower Lone Rock Formation	123	Fine- to medium-grained cross-bedded, friable to well cemented (feldspar, dolomite) cross-bedded quartzose, sandstone, glauconitic sandstone, siltstone, shale and dolostone	Tunnel City - Wonewoc Sandstone Aquifer
Upper Cambrian Wonewoc Sandstone (CWOC)	46	Fine- to coarse-grained, quartz sandstone grading to lower very fine-grained sandstone towards its base	Tunnel City – Wonewoc Sandstone Aquifer
Middle to Upper Cambrian EauClaire Formation (CECR)	68	Upper portion shale and siltstone grading downwards to very fine- to fine-grained sandstone, siltstone, and shale, transitional with Mt. Simon	Partial Aquiclude
Middle Cambrian Mt. Simon Sandstone (CMST)	200	Med- to coarse-grained sandstone, with siltstone and very fine-grained sandstone, coarser base unconformable with Mesoproterozoic rocks	Mt. Simon Aquifer

This table was modified from Table 1 in MPCA, 2017.

Table 2: Well Construction

Well	MDH Unique Number	Year Installed	Depth to Bedrock (ft bgs)	Completed Interval (ft bgs)	Well Depth (ft bgs)	Aquifer
Spring Park Well 1	224642	1964	275	Open Hole: 418 to 640	640	Tunnel City Group and Wonowoc Sandstone Aquifer (CTCW) and partially into Eau Claire Formation
Spring Park Well 2	224643	1964	273	SS Screen: 341 to 391	391	Jordan Sandstone Aquifer (CJDN) - UpperSt. Lawrence Formation (CSTL)
Spring Park Well 3	165595	1980	280	Open Hole: 660 to 790	790	Mt. Simon Aquifer (CMST)
Mound Well 3	206994	1947	161	Open Hole: 164 to 317	317	Prairie du Chien-Jordan Aquifer (OPCJ)
Orono Well 1	205627	1971	270	SS Screen: 314 to 385	385	Jordan Sandstone (CJDN)
Boomerang Laboratories Well	776887	2010	NR	SS Screen: 196 to 208	208	Quaternary Buried Artesian Aquifer (QBAA)
Norling Well	737568	2007	NR	SS Screen: 173-178	178	Quaternary Buried Artesian Aquifer (QBAA)

*ft bgs = feet below ground surface

Note: The primary source of information in this table are the well records for the individual wells.

Table 3: TCE, cis-1,2-DCE, and Vinyl Chloride Concentrations in Spring Park City Wells 1 and 2 and in Finished Drinking Water

(all values are in micrograms per liter or µg/L)

-	Well 1 TCE	Well 1 cis-1,2-DCE	Well 1 vinyl chloride	Well 2 TCE	Well 2 cis-1,2-DCE	Well 2 vinyl chloride	Finished Drinking Water TCE	Finished Drinking Water cis-1,2-DCE	Finished Drinking Water vinyl chloride
Health Risk Limit[a]	0.4	6	0.2	0.4	6	0.2	0.4	6	0.2
ATSDR Comparison Value[b]	0.43	14	0.017	0.43	14	0.017	0.43	14	0.017
Maximum Contaminant Level[c]	5	70	2	5	70	2	5	70	2
3/1/1995	NS	NS	NS	NS	NS	NS	<0.1	<0.2	<0.5
10/27/2000	NS	NS	NS	NS	NS	NS	<0.1	<0.2	<0.5
9/21/2004	NS	NS	NS	NS	NS	NS	**0.9***	1.4	NS
9/13/2005	NS	NS	NS	NS	NS	NS	**0.7***	1.5	NS
3/21/2007	NS	NS	NS	NS	NS	NS	<0.1	<0.2	<0.2
6/28/2007	NS	NS	NS	NS	NS	NS	<0.1	<0.2	<0.2
11/18/2008	NS	NS	NS	NS	NS	NS	**1.1***	1.9	<0.2
6/10/2009	NS	NS	NS	NS	NS	NS	**1.6***	2.3	<0.2
8/27/2009	NS	NS	NS	NS	NS	NS	**1.7***	2.5	<0.2
8/31/2009	NS	NS	NS	NS	NS	NS	**1.8***	2.6	NS
12/8/2009	NS	NS	NS	NS	NS	NS	**1.4***	1.8	<0.2
5/18/2010	NS	NS	NS	NS	NS	NS	**1.7***	2.4	<0.2
7/8/2010	NS	NS	NS	NS	NS	NS	<0.1	<0.2	<0.2
11/10/2010	NS	NS	NS	NS	NS	NS	**1.8***	2.4	<0.2
8/30/2011	NS	NS	NS	NS	NS	NS	<0.1	<0.2	<0.2
6/26/2012	NS	NS	NS	NS	NS	NS	**2.4***	3	<0.2
8/2/2012	NS	NS	NS	NS	NS	NS	**2.3***	3.1	<0.2
12/13/2012	NS	NS	NS	NS	NS	NS	**1.8***	2.3	<0.2
5/1/2013	3.5	4.3	0.42	5	5.9	0.45	**2.2***	2.7	<0.2
9/24/2013	2.7	3.7	0.2	3.9	4.9	0.29	**1.6***	2.2	<0.2
11/19/2013	3	4	0.25	4.5	5.3	0.32	**2.2***	2.8	<0.2
2/14/2014	1.7	2	<0.2	1.9	3	<0.2	NS	NS	NS
5/14/2014	3	4	0.26	5	5.9	0.4	NS	NS	NS
8/6/2014	4.1	5.2	0.28	2.3	3.6	0.21	<0.1	<0.2	<0.2
11/5/2014	4.5	5.3	0.34	0.32	1.5	<0.2	<0.1	<0.2	<0.2

-	Well 1 TCE	Well 1 cis-1,2-DCE	Well 1 vinyl chloride	Well 2 TCE	Well 2 cis-1,2-DCE	Well 2 vinyl chloride	Finished Drinking Water TCE	Finished Drinking Water cis-1,2-DCE	Finished Drinking Water vinyl chloride
1/29/2015	4.2	5.1	0.36	0.22	1.3	<0.2	<0.1	<0.2	<0.2
4/22/2015	4.2	5.4	0.3	0.14	0.99	<0.2	<0.1	<0.2	<0.2
9/2/2015	4.2	5.6	0.31	0.13	0.76	<0.2	<0.1	<0.2	<0.2
11/6/2015	4.7	6.4	0.46	0.15	1.1	<0.2	<0.1	0.2	<0.2
2/2/2016	4.5	6.1	0.37	2.3	3.2	<0.2	**0.89***	1.5	<0.2
4/12/2016	NS	NS	NS	NS	NS	NS	<0.2	<0.5	<0.2
8/25/2016	NS	NS	NS	NS	NS	NS	<0.1	<0.2	<0.2
4/24/2017	NS	NS	NS	NS	NS	NS	<0.1	0.3	<0.2
8/8/2017[c]	NS	NS	NS	NS	NS	NS	**1.8**[d*]	2.5[d]	<0.2
11/15/2017	6.1	7.1	0.43	4.0	5	0.28	**0.41***	0.8	<0.2
2/27/2018	NS	NS	NS	NS	NS	NS	<0.1	<0.2	<0.2
4/26/2018	3.7	4.4	0.21	4.1	5.1	0.27	<0.1	<0.2	<0.2
5/18/2018	NS	NS	NS	NS	NS	NS	<0.1	0.21	<0.2
7/18/2018	3.4	4.1	0.2	5.3	6	0.29	0.19	0.45	<0.2
8/20/2018	NS	NS	NS	NS	NS	NS	0.33	0.62	<0.2
9/24/2018	NS	NS	NS	NS	NS	NS	0.39	0.71	<0.2
11/13/2018	3.3	3.9	<0.2	5.1	5.4	0.25	0.33	0.63	<0.2
12/18/2018	4.2	4.8	0.23	4.6	5.1	0.24	0.30	0.62	<0.2
1/29/2019	NS	NS	NS	NS	NS	NS	0.10	0.28	<0.2
2/19/2019	NS	NS	NS	NS	NS	NS	0.10	<0.2	<0.2
3/22/2019	NS	NS	NS	NS	NS	NS	<0.1	0.24	<0.2
5/10/2019	3.3	3.8	<0.2	5.1	5.2	0.24	<0.1	<0.20	<0.2
7/19/2019	2.9	3.5	<0.2	4.7	5.2	0.26	0.17	0.39	<0.2
10/1/2019	NS	NS	NS	NS	NS	NS	0.32	0.59	<0.2
11/5/2019	NS	NS	NS	NS	NS	NS	0.20	0.39	<0.2
1/7/2020	NS	NS	NS	NS	NS	NS	<0.1	<0.2	<0.2
2/4/2020	NS	NS	NS	NS	NS	NS	<0.1	<0.2	<0.2
3/5/2020	NS	NS	NS	NS	NS	NS	<0.1	<0.2	<0.2
6/3/2020	2.7	3	<0.2	5.3	5.4	0.27	<0.1	0.22	<0.2
7/7/2020	NS	NS	NS	NS	NS	NS	0.11	0.2	<0.2
8/4/2020	NS	NS	NS	NS	NS	NS	0.15	0.26	<0.2
9/16/2020	NS	NS	NS	NS	NS	NS	<0.1	<0.2	<0.2
10/28/2020	2.8	3.3	<0.2	4.7	5.4	0.33	0.15	0.2	<0.2
4/28/2021	3.3	3.8	0.21	6.5	7.3	0.46	0.21	0.49	<0.2
11/4/2021	2.5	3.4	0.23	5.2	6.6	0.44	<0.1	<0.2	<0.2
12/21/2021	NS	NS	NS	NS	NS	NS	<0.1	<0.2	<0.2
6/16/2022	NS	NS	NS	NS	NS	NS	**0.92**[e*]	1.9[e]	<0.2

-	Well 1 TCE	Well 1 cis-1,2-DCE	Well 1 vinyl chloride	Well 2 TCE	Well 2 cis-1,2-DCE	Well 2 vinyl chloride	Finished Drinking Water TCE	Finished Drinking Water cis-1,2-DCE	Finished Drinking Water vinyl chloride
6/23/2022	3.0	3.6	<0.2	6.8	7.3	0.59	**0.88**[e*]	1.5[e]	<0.2
7/18/2022	NS	NS	NS	NS	NS	NS	0.15	0.45	<0.2

Table 3 footnotes:

[a]The current Health Risk Limits for TCE, cis-1,2-DCE, and vinyl chloride were promulgated in 2015, 2018, and 2018, respectively. This evaluation uses the HRLs for screening when lower than ATSDR comparison values.

[b]Comparison values are developed by ATSDR for screening to identify contaminants of concern.

[c]Maximum contaminant levels are the federal regulatory standard applicable to public water supplies.

[d]Sampling was conducted following an electrical storm when air stripper blowers were not fully operational.

[e]Exceedances of the TCE CV were due to a treatment system filter maintenance issue.

NS = not sampled

*** concentration in drinking water exceeds the lowest comparison value and the Health Risk Limit**

Table 4: West Arm Townhomes Vapor Intrusion Sampling Results

(all values are in micrograms per cubic meter or $\mu g/m^3$)

Townhome	Sample Date	Indoor Air TCE ($\mu g/m^3$)	Sub-Slab TCE ($\mu g/m^3$)
A	9/19/2013	--	2.1 [c]
B	11/5/2015	--	ND [c]
C	11/1/2010	--	7 [c]
D [a]	1/24/2007	<1.1	--
D [a]	8/29/2013	--	17.2
E	11/13/2010	--	**691** [d]
E	3/19/2020	<1.1	<1.1, 6.4, **85** [d]
F	1/23/2007	**17** [d]	--
F	12/10/2014	<0.8	--
F	4/13/2020	<1.1	--
G	1/23/2007	**2.8** [d], **2.5** [d]	--
G	2/27/2020	0.5	3.2, <11, 3.5
H	7/16/2013	--	40.8
I	9/10/2013	--	**234** [d]
I	3/13/2020	<1.1	2.3, <1.1, 1.3 [c]
J	11/17/2006	<2.1	--
J	1/23/2007	**2.6** [d], 2.1	--
J	10/22/2013	--	**662** [d]
K	8/2/2017	--	5.1 [c]
L	1/22/2007	1.4	--
M	8/15/2013	--	**122** [d]
N	7/31/2013	**3.5** [d]	24.9
N	10/23/2013	ND	--
N	2/7/2020	<1.1	0.47, 11
O	7/25/2013	--	12.9
O	2/18/2020	<1.1	1.1, 15
P	11/5/2015	--	25
Q	7/25/2013	--	**210** [d]
R	8/23/2013	--	**1470** [d]
R	3/12/2020	0.33	12, **210** [d], **380** [d]
S	9/19/2013	--	539 [d]
S	3/12/2020	0.23	<5.4, 0.93 [c]
T	8/8/2013	--	**500** [d]
U	8/29/2013	--	**797** [d]
U	2/27/2020	0.86	0.79, 27, **380** [d]
V	7/31/2013	--	ND [c]
V	2/7/2020	<1.1	0.67, 9.2

Address (West Arm Drive)	Sample Date	Indoor Air TCE ($\mu g/m^3$)	Sub-Slab TCE ($\mu g/m^3$)
W	9/10/2013	--	**149[d]**
W	2/12/2020	0.37	2.3, 39
X	7/16/2013	--	**80.6[d]**
X	2/12/2020	<1.1	1.1, 3.9[c]
Y	8/23/2013	--	28.6
Y	10/2/2014	--	**266[d], 374[bd]**
Y	6/9/2020	**<5.4[d]**	0.5, 4.1[c]

[a]This residence is not mitigated.

[b]near-slab soil gas samples

[c]does not exceed the ATSDR cancer risk evaluation guide (CREG) comparison value of 0.21 $\mu g/m^3$ for indoor air and 7 $\mu g/m^3$ for sub-slab TCE concentrations.

[d]exceeds the MPCA Intrusion Screening Values (ISV) of 2.1 $\mu g/m^3$ for indoor air and 70 $\mu g/m^3$ for sub-slab TCE concentrations.

Results that are not detected (shown by the less than [<] symbol) but the detection limit is greater than the CREG or ISV are also considered an exceedance.

ND= not detected

Sources: Wenck, 2021b; Wenck, 2016; and MDH, 2013

Table 5: Additional Residence* Vapor Intrusion Sampling Results

(all values are in micrograms per cubic meter or µg/m³)

Chemical	Indoor Air 6/19/15	Indoor Air 7/24/15	Crawl Space 5/12/15	Crawl Space 6/19/15	Crawl Space 7/24/15	Sub-slab* 5/12/15	Sub-slab* 6/19/15	Outdoor Air 6/19/15	Outdoor Air 7/24/15	Outdoor Air 7/24/15
1,2-DCA	**~<1.2**	**~0.43**	**~<0.64**	**~<1.3**	**~<0.81**	<0.69	^<1.5	**~<1.2**	**~<0.81**	**~<0.81**
1,3-butadiene	**~<0.67**	**~4.3**	**~<0.7**	**~<0.7**	**~2.9**	<0.76	<0.81	**~<0.67**	**~<0.44**	**~<0.44**
benzene	`1.2	**~5.3**	**~2.8**	`1.3	**~4.5**	2.3	^4.4	`0.76	`0.43	`0.35
carbon tetrachloride	**~2**	`0.63	`<0.99	**~2.1**	`0.55	<1.1	2.4	**~1.9**	`0.52	`0.45
chloroform	`<0.74	`0.65	`<0.77	`<0.77	`0.46	<0.83	<0.89	`<0.74	`<0.98	`<0.98
naphthalene	`<5.3	`1.7	`<5.5	**~55.3**	`1.7	^<5.9	**#857**	**~20.1**	`0.63	`0.71
PCE	1.5	**~4.3**	`7	<1.1	2.5	4.7	1.7	<1.0	<1.4	<1.4
TCE	**~2.7**	`<1.1	`<0.85	**~5.5**	`<1.1	<0.92	1.5	**~4.2**	`<1.1	`<1.1

Source: Wenck, 2016

*sub-slab results are compared to the soil gas CVs and 33x ISVs as shown below. All other results are compared with the air CVs and ISVs.

`exceeds air CV (CREG), or detection limit higher than CV

~exceeds air CV and ISV, or detection limit higher than ISV

^exceeds soil gas CV, or detection limit higher than CV

#exceeds soil gas CV and 33X ISV

Table 6: CVs and ISVs Used to Compare to Vapor Sampling Results

(all values are in micrograms per cubic meter or µg/m³)

Chemical	Air CV	Soil Gas CV	ISV	33X ISV
1,2-DCA	0.038	1.3	0.39	13
1,3-butadiene	0.033	1.1	0.28	9.3
benzene	0.13	4.3	1.3	43
carbon tetrachloride	0.17	5.7	1.7	57
chloroform	0.043	1.4	100	3,300
naphthalene	0.029	0.97	9.4	310
PCE	3.8	130	3.4	110
TCE	0.21	7	2.1	70

*****This residence was offered a vapor mitigation system but did not allow installation. In this dataset, it doesn't appear that contaminants in indoor air are from the vapor intrusion pathway. TCE appears to be from an outdoor air source. Other contaminants are likely from indoor sources, or the case of carbon tetrachloride from 6/19/15, results may be due to laboratory uncertainty. Health effects are unlikely from these generally low level, intermittent concentrations in indoor air; however removing or reducing use of chemicals indoors is recommended to improve air quality and protect health.

Appendix D: Drinking Water Risk Calculations

This appendix summarizes the ATSDR health effects evaluation process. The process involves looking more closely at site specific exposures, estimating exposure doses, and using the dose estimates to interpret health risk. Drinking water health risk calculations are explained and provided below.

For this evaluation, the ATSDR-recommended exposure parameters shown in Table 1 below were used to calculate exposure doses and health risk.

Table 1: Exposure Parameters

Exposure Group	Body Weight (kg)	Exposure Duration for Cancer (years)	Age Dependent Adjustment Factors	CTE Intake Rate (liters/day)	RME Intake Rate (liters/day)
Birth to < 1 year	7.8	1	10	0.504	1.11
1 to < 2 years	11.4	1	10	0.308	0.893
2 to < 6 years	17.4	4	3	0.376	0.977
6 to < 11 years	31.8	4	3	0.511	1.4
Total Child (all age groups)	-	10	-	-	-
Adult	80	10	-	1.23	3.09
Pregnant Women	73	-	-	0.872	2.59

Abbreviations: CTE = central tendency exposure (typical); kg = kilograms; RME = reasonable maximum exposure (higher)

Equations used to estimate exposure dose and health risk from past TCE contamination in the Spring Park municipal wells are shown below. These equations can be found in the ATSDR Public Health Assessment Guidance Manual (ATSDR, 2022b).

Water Ingestion Exposure Dose Equation

$$D_{noncancer} = (C \times IR) \div BW$$

Where:

$D_{noncancer}$ = dose (mg/kg/day)
C = contaminant concentration (mg/L)
IR = intake rate (L/day)
BW = body weight (kg)

Hazard Quotient

$$HQ = D_{noncancer} \div MRL$$

Where:

HQ = hazard quotient (unitless)
$D_{noncancer}$ = dose (mg/kg/day)
MRL = Minimal Risk Level (mg/kg/day)

Cancer Risk Equations

$$CR = D_{noncancer} \times CSF \times (ED \div LY)$$

$$\text{ADAF-adjusted } CR = (D_{noncancer} \times CSF) \times (ED \div LY) \times ADAF$$

Total CR = Sum of the CR for all exposure groups

Where:

CR = cancer risk (unitless)
$D_{noncancer}$ = dose (mg/kg/day)
CSF = oral cancer slope factor [$(mg/kg/day)^{-1}$]
ED = exposure duration (years)
LY = lifetime years (78 years)
ADAF = age-dependent adjustment factor (unitless)

Using the exposure parameters in Table 1 above, highly protective exposure doses are calculated for both children and adults in Tables 2 and 3 below. An exposure dose is an estimate of the amount of a substance in the environment a person may come into contact with during a specific time period, expressed relative to body weight. The doses are then compared to the ATSDR minimal risk level (MRL) for TCE. ATSDR defines the MRL as an estimate of the daily human exposure to a hazardous substance that is likely to be without appreciable risk of adverse, non-cancer health effects over a specified exposure duration. The comparison is done by calculating a hazard quotient, defined as the ratio of the exposure dose to the MRL. If the hazard quotient is <1, then no adverse health effects are expected as a result of the exposure. If the HQ is >1, then further toxicological evaluation is needed to determine if exposed persons could be at risk of harmful effects.

The cancer risk is estimated by multiplying the dose by the substance's cancer slope factor and averaged over a lifetime. For mutagenic carcinogens such as TCE, age-dependent adjustment factors (ADAFs) are applied to account for infants and children's increased susceptibility to these types of effects. If the cancer risk is < 1E-6 (or 1 additional cancer in 1,000,000 people exposed), then the cancer risk is expected to be negligible and thus not a concern. ATSDR recognizes that greater cancer risk levels, such as 1E-5 (1 additional cancer in 100,000), can also be considered negligible risk.

Two different calculations were performed. The first used a statistic called the 95 percent upper confidence limit of the mean (95UCL). This value equals or exceeds an actual arithmetic mean 95 percent of the time and is therefore considered a health-protective estimate of the actual mean. The 95UCL of the TCE concentrations in the Spring Park municipal water for the 10-year period from 2004 to

2013 (Table 2) is 1.8 µg/L. This time period represents the years when TCE was first discovered in the drinking water (TCE was not detected in samples in 1995 and 2000) to when steps were taken to reduce exposure to TCE. The hazard quotients for a reasonable maximum exposure (RME) are all <1 for all life stages calculated, including for the infant as the most highly exposed life stage. The cancer risks for both the RME child and adult are <1E-6 and represent negligible cancer risks (also in Table 2). The second calculation (Table 3) uses the maximum concentration of TCE in the municipal drinking water of 2.4 µg/L from 2012 (see Appendix C Table 3) to compare with an exposure of less than a year for an infant and pregnant woman. The hazard quotients for an RME exposure are also <1. This means that exposures are below the MRL and thus non-cancer effects are unlikely.

Table 2: Drinking Water Ingestion – Chronic Exposure

Exposure doses, non-cancer hazard quotients, and cancer risk estimates for a ten-year chronic exposure to TCE in drinking water at 1.8 µg/L*

PHAST PUBLIC HEALTH ASSESSMENT SITE TOOL **Exposure Group**	**CTE Dose (mg/kg/day)**	**CTE Non-cancer Hazard Quotient**	**CTE Cancer Risk**	**RME Dose (mg/kg/day)**	**RME Non-cancer Hazard Quotient**	**RME Cancer Risk**
Birth to < 1 year	1.2E-4	0.2	-	2.6E-4	0.5	-
1 to < 2 years	4.9E-5	0.1	-	1.4E-4	0.3	-
2 to < 6 years	3.9E-5	0.08	-	1.0E-4	0.2	-
6 to < 11 years	2.9E-5	0.06	-	7.9E-5	0.2	-
Total Child	-	-	5E-7	-	-	1E-6
Adult	2.8E-5	0.06	2E-7	7.0E-5	0.1	4E-7
Pregnant Women	2.2E-5	0.04	-	6.4E-5	0.1	-

Source: [Appendix C, Table 3]
Abbreviations: CTE = central tendency exposure (typical); mg/kg/day = milligram chemical per kilogram body weight per day; µg/L = microgram chemical per liter water; RME = reasonable maximum exposure (higher)

*The TCE concentration is a 95UCL of the mean for the ten year period from 2004-2013 calculated by the ATSDR Exposure Point Concentration Tool. The calculations in this table were generated using ATSDR's PHAST v1.8.0.0. The non-cancer hazard quotients were calculated using the chronic (greater than 1 year) minimal risk level of 0.0005 mg/kg/day and the cancer risks were calculated using the cancer slope factors of 0.0216 [NHL], 0.0155 [liver], 0.00933 [kidney] (mg/kg/day)$^{-1}$ and age-dependent adjustment factors.

Table 3: Drinking Water Ingestion – Intermediate Exposure

Exposure doses and non-cancer hazard quotients for a less than one-year exposure to TCE in drinking water at 2.4 µg/L*

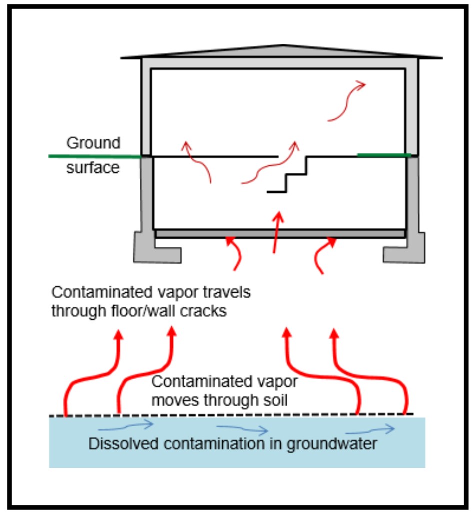
PHAST Public Health Assessment Site Tool Exposure Group	CTE Dose (mg/kg/day)	CTE Non-cancer Hazard Quotient	RME Dose (mg/kg/day)	RME Non-cancer Hazard Quotient
Birth to < 1 year	1.6E-4	0.3	3.4E-4	0.7
Pregnant Women	2.9E-5	0.06	8.5E-5	0.2

Source: [Appendix C, Table 3]
Abbreviations: CTE = central tendency exposure (typical); mg/kg/day = milligram chemical per kilogram body weight per day; µg/L = microgram chemical per liter water; RME = reasonable maximum exposure (higher)
*The calculations in this table were generated using ATSDR's PHAST v1.8.0.0. The non-cancer hazard quotients were calculated using the intermediate (two weeks to less than 1 year) minimal risk level of 0.0005 mg/kg/day.

Appendix E: Tonka Business Center Vapor Investigation

Occupant Notification – April 10, 2019

Your Health and Vapor Intrusion



A vapor mitigation system is being installed in the Tonka Business Center to address the potential for vapor intrusion. The building owner is voluntarily installing this system after discovering chemical vapors present beneath the building floor.

What is vapor intrusion?

Past activities sometimes resulted in chemical releases of volatile organic compounds (VOCs) to soil and groundwater. VOCs can easily evaporate into the air. VOCs that evaporate from polluted soil and groundwater can create chemical vapors underground. If these vapors move and come in contact with a building, they may enter through small openings in the foundation, around pipes, or through a drain system. When this occurs, the VOCs may affect indoor air quality. This process - when pollution moves from air spaces in soil beneath a building to indoor air - is called vapor intrusion.

What was found at the Tonka Business Center?

An industrial solvent, trichloroethylene (TCE), is the main contaminant found in soil vapor beneath the Tonka Business Center. Under a portion of the building, the TCE vapors were found at high levels, indicating the need to install a mitigation system. The source of the contamination appears to be associated with past building uses, not associated with the current ownership or tenants.

How is the situation being addressed?

The property owner is acting quickly to install a mitigation system to vent vapors beneath the foundation to the outside air. The owner already installed a partial mitigation system that is currently operating in part of the building. Additional portions of the building will be mitigated as soon as possible and is expected to be complete in approximately three weeks. After the system is completed, indoor air samples will be collected to confirm its effectiveness and the results will be shared.

Should I be concerned?

Usually, the amount of chemicals that enter a building from contaminated soil vapor is not a health concern for most people. However, even small amounts of TCE may pose a health concern for sensitive individuals, especially for **women who are pregnant or may become pregnant**. MDH is most concerned about women in the first trimester of pregnancy because TCE exposures may increase the risk of heart defects to the baby.

Questions?

For health questions contact MDH:
(651) 201-4897 health.hazard@state.mn.us

For questions on the investigation, contact MPCA:
Rick Jolley: 651-757-2475 rick.jolley@state.mn.us

Post-Mitigation Indoor Air Results

Indoor Air Results of TCE, PCE, and Isopropyl Alcohol in µg/m^3 at the Tonka Business Center August 2019 and March 2020

Sample Location	TCE 8/19	TCE 3/20	PCE 8/19	PCE 3/20	Isopropyl alcohol 8/19	Isopropyl alcohol 3/20
Comparison Value	0.21	0.21	3.8	3.8	--	--
Commercial/Industrial Intrusion Screening Value	7	7	33	33	700	700
Outside Air	<2.2	<0.85	<2.8	<1.1	<10.1	**5.9**
Integrity Communications	<0.8	<0.79	**2.2**	<0.99	**514**	**233**
All in 1 Fitness	<0.85	<0.86	<1.1	<1.1	**1,270**	**760**
All in 1 Fitness	<0.85	**0.95**	<1.1	<1.1	**4,040**	**3,940**
Glisten Detailing	**2.3**	<0.85	<1.1	<1.1	**8,100**	**3,250**
Katie Lien Dance School	<0.86	<0.88	**1.6**	**1.4**	**334**	**805**
Avanti Data Solutions	<0.83	<0.85	<1.0	**1.4**	**776**	**171**
Avanti Data Solutions	<0.77	<0.83	<0.97	<1.0	**671**	**186**
Boomerang Labs	<0.85	<0.88	<1.1	<1.1	**1,070**	**631**
Boomerang Labs	<0.73	<0.85	<0.92	<1.1	**339**	**569**
Boomerang Labs	<0.85	<1.6	**4.6**	<2.0	**31,800**	**8,000**
Boomerang Labs	<0.85	<0.88	<1.1	<1.1	**32,600**	**14,900**
Boomerang Labs	<0.86	<0.85	<1.1	<1.1	**23,400**	**15,800**
Boomerang Labs	<0.88	<0.88	<1.1	<1.1	**35,300**	**12,200**
Boomerang Labs	<0.81	<0.88	<1.0	<1.1	**25,800**	**8,340**
Boomerang Labs	<0.88	<1.5	<1.1	<1.9	**35,000**	**8,420**
Boomerang Labs	<0.86	<0.9	<1.1	<1.1	**21,300**	**8,280**
Boomerang Labs	<0.88	<0.96	<1.1	<1.2	**15,800**	**5,970**
Boomerang Labs	**2.3**	<0.9	<1.1	<1.1	**4,940**	**8,000**
Boomerang Labs	<0.81	<0.88	<1.0	<1.1	**5,170**	**7,900**
Boomerang Labs	<0.88	<0.88	<1.1	<1.1	**13,400**	**10,500**
Boomerang Labs	<0.86	<0.88	<1.1	<1.1	**17,000**	**11,800**
boiler room	<0.83	<0.76	**1.1**	<0.96	**1,030**	**498**
storage area	<0.81	<0.88	<1.0	**1.3**	**907**	**192**
storage area	**3.8**	**0.99**	<1.1	**1.3**	**2,810**	**264**

Detections are bolded to make the values easier to see.
While the TCE reporting limit and several results are above the CV (and one PCE result is above the CV), after adjusting for an occupational exposure scenario none of these results are of health concern.

Other chemicals found in indoor air in at least one tenant space in the most recent sampling event in 2020 that exceeded the CVs after adjusting for an occupational exposure scenario are methyl ethyl ketone, benzene, chloroform, and xylenes. These variable exposures are not expected to harm occupant's health. However, reducing the use of chemicals is recommended to improve air quality and protect health.

Isopropyl Alcohol in Indoor Air

Isopropyl alcohol is a clear, volatile liquid. It has an alcohol smell, with an odor threshold of about 2,500 µg/m^3 (U.S. EPA, 2014). It is also called "rubbing alcohol" when used as a disinfectant, commonly in a solution of about 70% isopropyl alcohol. Other uses include as a fuel drier/de-icer, for making other chemicals, and in cosmetics, pharmaceuticals, perfumes, dye solutions, soaps, and window cleaners (U.S. EPA, 2014).

Isopropyl alcohol was measured in indoor air above the ISV (700 µg/m^3) in the majority of indoor samples, up to 35,500 µg/m^3. Samples were collected from numerous businesses in the facility. One building tenant, Boomerang Laboratories, uses this chemical in their manufacturing process and has reportedly taken measures to reduce its use (Vieau, 2020). Concentrations were lower in the second (March 2020) sample round, although three adjacent tenant spaces had isopropyl alcohol in indoor air above the ISVs (see table above).

The commercial/industrial ISV of 700 µg/m^3 is a level in indoor air that is unlikely to harm health for workers exposed 10 hours/day, 5 days/week, for 25 years. The ISV is based on a rodent study showing decreased testes weights at much higher concentrations (a human equivalent concentration continuous exposure of 221,000 µg/m^3). Breathing isopropyl alcohol above the ISV does not mean health effects will occur. However, the risk for health effects increases as the amount and duration of exposure increases. The average isopropyl concentration in the Boomerang Labs ranged from 8,665 µg/m^3 (March 2020) to 18,780 µg/m^3 (August 2019). These levels are about 12 to 26 times lower than levels identified in mice that caused decreased testes weights, thus there may be a small risk of reproductive effects for male workers at Boomerang Labs.

Occupational limits are much higher than ISVs. The Minnesota Occupational Health and Safety Administration (MNOSHA) has an 8-hour time weighted average limit for isopropyl alcohol of 980,000 µg/m^3, and the American Conference of Governmental Industrial Hygienists (ACGIH) has a limit of 490,000 µg/m^3. MDH does not use occupational values in its evaluation, but we provide them for context and because the MNOSHA limit is an enforceable standard.