

# GROUNDWATER CONTAMINATION in WEST WICHITA

*a technical review of the site history, contaminants, and remediation efforts*

Technical Report

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prepared by

**Environmental Finance Center**

at **Wichita State University's Hugo Wall School of Public Affairs**

in partnership with

**University of Kansas School of Medicine – Wichita**



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## TABLE OF CONTENTS

EXECUTIVE SUMMARY .....	3
RESEARCH BACKGROUND .....	5
SITE HISTORY AND DESCRIPTION .....	6
Site 1 .....	6
Site 2 .....	6
Impacted Neighborhood .....	6
Stakeholders.....	8
Timeline of Events.....	10
CONTAMINANTS AND RISKS.....	11
Dry Cleaning Process .....	11
Perchloroethylene .....	11
Trichloroethylene .....	13
CIS 1, 2-dichloroethene .....	14
Vinyl chloride.....	15
INVESTIGATION AND REMEDIATION .....	16
Site Studies by KDHE .....	16
KDHE Activities to Date .....	19
City of Wichita Activities to Date.....	21
CURRENT STATUS AND NEXT STEPS.....	23
CONTACTS .....	25
REFERENCES .....	26

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## EXECUTIVE SUMMARY

In 2009, the Kansas Department of Health and Environment (KDHE) discovered groundwater contamination at a former industrial site in West Wichita. Efforts by state and local agencies between 2013 and 2015 worked to address the potential negative health impacts of the contamination on local residents. This project provides a two-pronged approach to assess the actions to date and the needs and concerns of the residents. This project is a partnership between Wichita State University's Environmental Finance Center and the University of Kansas School of Medicine – Wichita and lays the groundwork for future study into the West Wichita groundwater contamination site and its stakeholders. The intent of this document is to serve as the technical report for the project. A second report providing the needs assessment is provided in an accompanying document.

While conducting an environmental site assessment at a closed radium dial shop on West Kellogg, KDHE found tetrachloroethylene, also known as perchloroethylene (PCE), in the groundwater. PCE levels were found to be above the actionable levels set by KDHE and the Environmental Protection Agency (EPA). The West Kellogg site was subsequently placed on a "sites to be investigated" list, therefore, further testing did not occur at the site until 2013.<sup>1</sup> In February of 2014, the contamination source was confirmed and traced back to two different dry cleaning business locations that had been in operation near the West Central and Tyler Road intersection since the 1960's (see the timeline on page 10).

PCE is frequently used in dry cleaning and other industrial operations. The timing and cause of the initial contamination at this site is unknown. Contamination could have occurred at any time since the 1960's when dry cleaning operations began at each site.<sup>2</sup> Potential causes of PCE contamination include leaky sewer connections, poor dry cleaning filter disposal practices and routine spills and leaks. Each of these causes could have allowed the solvent to leach into groundwater from the soil surface.<sup>3</sup>

PCE is classified as a volatile organic compound (VOC), and it poses developmental, neurological, respiratory and carcinogenic risks to humans.<sup>4</sup> PCE and various volatile organic compounds that are degradation products of PCE were found at the site in levels exceeding the Federal Safe Drinking Water Act Standards. The mandated drinking water standard for PCE is 5 parts per billion because of the health risks posed by PCE and its degradation compounds. The public health consequences of even small amounts of PCE exposure are significant and underscore the need to minimize exposure.

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<sup>1</sup> KDHE (2014). "KDHE Testing for Dry Cleaning Chemicals found in West Wichita Groundwater." [http://www.kdheks.gov/news/web\\_archives/2014/04152014.htm](http://www.kdheks.gov/news/web_archives/2014/04152014.htm)

<sup>2</sup> Sandefur, Sean and Kirtley, Jordan (2014). "Dangerous Chemical Invades West Wichita Drinking Water." KMWU Public Radio, <http://kmwu.org/post/spj-award-winner-dangerous-chemical-invades-west-wichita-drinking-water>.

<sup>3</sup> Colorado Department of Public Health, Hazardous Materials and Waste Management Division (2006). "Dry Cleaner Remediation Guidance Document." [https://www.colorado.gov/pacific/sites/default/files/HM\\_dry-cleaner-remediation.pdf](https://www.colorado.gov/pacific/sites/default/files/HM_dry-cleaner-remediation.pdf).

<sup>4</sup> Centers for Disease Control and Prevention (1997). "Toxicological Profile for Tetrachloroethylene." <http://www.atsdr.cdc.gov/toxprofiles/tp18.pdf>.

Since it is unknown when the groundwater contamination began, it is also unknown how many persons were exposed to the contamination and for how long through the use of private drinking water wells. The impacted region is thought to encompass nearly 200 homes.<sup>5</sup> At the time of the contamination's discovery, much of the area was not served by a public water supply, residents therefore relied on private wells for drinking, cooking and bathing. Residents using this water source were potentially exposed to PCE and other chemicals through ingestion, dermal absorption and vapor inhalation.

PCE levels in the impacted area ranged from less than 5 ppb to as much as 760 ppb, which far exceeds EPA's maximum contaminant level in drinking water of 5 ppb. According to KDHE, as a public health initiative the safest course for residences impacted by the contamination was to discontinue drinking and home-use of the groundwater from private water wells and to provide safe water (bottled or filtered) until the impacted homes could be connected to the City of Wichita public water supply. In the spring of 2014, soon after the contamination area was delineated the process of connecting homes to public water began.<sup>1</sup>

During the public water supply installation process, which included adding new water mains, bottled water was supplied by KDHE to all residents with PCE levels in their drinking water at or above 5 ppb. At 17 homes PCE levels were so high that all water use was determined to be hazardous. Those homes were provided with air carbon filtration systems.<sup>6</sup> By the end of 2014, 196 residences in the impacted area were connected to the City of Wichita's water supply, and KDHE spent more than \$2.4 million dollars on the project, as of early 2016.<sup>7</sup>

Since completing the residential City water hook-ups, there are still a number of other initiatives being conducted by state and local agencies. KDHE continues to monitor the contaminants via perimeter groundwater wells, and will assess the situation for potential remediation during the 2016 fiscal year.<sup>8</sup> A two phase study on the health impacts of the PCE contamination on residents is underway by KDHE Bureau of Epidemiology and Public Health Informatics. The City of Wichita Environmental Health Department has located other potential dry cleaner PCE contamination sites and recommends that all property transactions in those areas include water well sampling and analysis to determine if PCE is present.

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<sup>5</sup> Leiker, Amy Renee (2014). "West Wichita Groundwater Contamination Meeting brings some Answers, Many more Questions." The Wichita Eagle, <http://www.kansas.com/news/article1139810.html>.

<sup>6</sup> Mann, Fred (2014). "KDHE Identifies Contaminant in 24 Private Wells in West Wichita." The Wichita Eagle, <http://www.kansas.com/news/article1139323.html>.

<sup>7</sup> KDHE (2014). "Homes Affected by West Wichita Groundwater Contamination Connected to City Water." [http://www.kdheks.gov/news/web\\_archives/2014/12292014.htm](http://www.kdheks.gov/news/web_archives/2014/12292014.htm).

<sup>8</sup> Sandefur, Sean (2014). "Response to West Wichita Groundwater Contamination Winding Down." KMUW Public Radio, <http://kmuw.org/post/response-west-wichita-groundwater-contamination-winding-down>.

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## RESEARCH BACKGROUND

This project is a pilot study that reviewed actions to date for the West Wichita groundwater contamination site, assessed the needs and concerns of stakeholders, and laid the groundwork for future study. Two local institutions, University of Kansas School of Medicine - Wichita and Wichita State University's Environmental Finance Center partnered together to research and gather feedback in order to create and inform environmental and health agencies and the community about services, research or further needs would most benefit the impacted community.

Efforts by environmental and health organizations to engage and support the affected community to date were limited. This project aimed to fill that void and initiate community-based efforts to engage the population, asking for their environmental and health concerns and needs. Since many of the health effects resulting from exposure to PCE and other volatile organic compounds are long-term, it was vital that this project establish a good working relationship with those affected so as to ensure their trust and cooperation in future efforts.

The specific aims of this project are:

- Examine the investigative actions conducted to date in west Wichita regarding tetrachloroethylene (PCE) and other volatile organic compounds (VOCs) groundwater contamination.
- Conduct a qualitative assessment of remaining needs among the affected community in response to PCE and other VOC contamination in their private domestic drinking water wells.
- Identify what, if any, health concerns were raised by the affected community.

To achieve these goals, the project utilized a two-pronged approach consisting of a review of documents and actions pertaining to the site and a community needs assessment. To complete the document review, team members accessed KDHE records from the initial environmental assessment, field sampling and analytical reports, corrective actions taken and the public engagement strategies used to address the site.

The team systematically reviewed all available resources and assembled all pertinent information into the following technical report, including timelines, official responses, and media coverage, among others. This technical report provides a comprehensive review of all information available on the site's characteristics, history of events, contaminants and risks, as well as investigation and remediation activities. In addition to the technical report, a needs assessment was completed with the area residents through the use of focus groups. A second report providing the needs assessment is provided in an accompanying document

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## SITE HISTORY AND DESCRIPTION

### Site 1 Location: 8947 W. Central

The Four Seasons Dry Cleaners site, one of the sources of the contamination, is located in a strip mall at 8947 W. Central, referred to in this document as Site 1. This location housed dry cleaning businesses from the 1960's until a major fire led to the closing of the operation in 2008. Cowboy Cleaners, a coin operated laundry, opened in the 1960's on the site of what became Four Seasons, and is now a bridal shop. It is possible that PCE, the carcinogenic groundwater contaminant discovered by KDHE in in 2009 and confirmed in 2014, had been used at the Four Seasons site location since the 1960's.

- 1960s – 1977: Cowboy Cleaners
- 1978 – 2005: Four Seasons Dry Cleaners – Active plant
- 2005 – 2008: Four Seasons – Drop-off store
- 2008 – Present: Uniquely You Bridal & Tuxedo Junction

### Site 2 Location: 9334 W. Central

A second source of contamination was discovered at a Best Cleaners site at 9334 W. Central, referred to in this document as Site 2. The impacted area is south-southeast of this location, in the same general direction groundwater flows in this area.<sup>9</sup> This location had various dry cleaning businesses since the late 1960's. Currently, the location is a storefront.

- 1968 – 1978: Clothes Cleaners
- 1979 – 1986: One Hour Martinizing
- 1987 – 1991: Best Cleaners
- 1992: Vacant
- 1993 – Present: Kansas Vacuum Center<sup>10</sup>

### Impacted Neighborhood

The impacted site is largely bordered by Central Street to the North, Kellogg Avenue (U.S. 54) to the South, Caddy Street to the West and Woodchuck Street to the East. The area of concern includes the groundwater plume plus a buffer zone of up to one block from the suspected boundary of the contaminant. Figure 1 shows the probe locations that were used to determine the where the PCE plume was located, and then the buffer was included to create the boundaries of the area of concern.

Most homes in the impacted neighborhood area were built in the 1950's and 1960's. At the time of the PCE contamination discovery, the most pressing issue was that many homes had relied on private water wells for their drinking water since they were built.

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<sup>9</sup> KDHE, Four Seasons Dry Cleaners Site Page, [http://www.kdheks.gov/dryclean/four\\_seasons.html](http://www.kdheks.gov/dryclean/four_seasons.html).

<sup>10</sup> KDHE 2013. "Field Sampling Outline, SSQA, and H&S Plan." C2-087-72515.

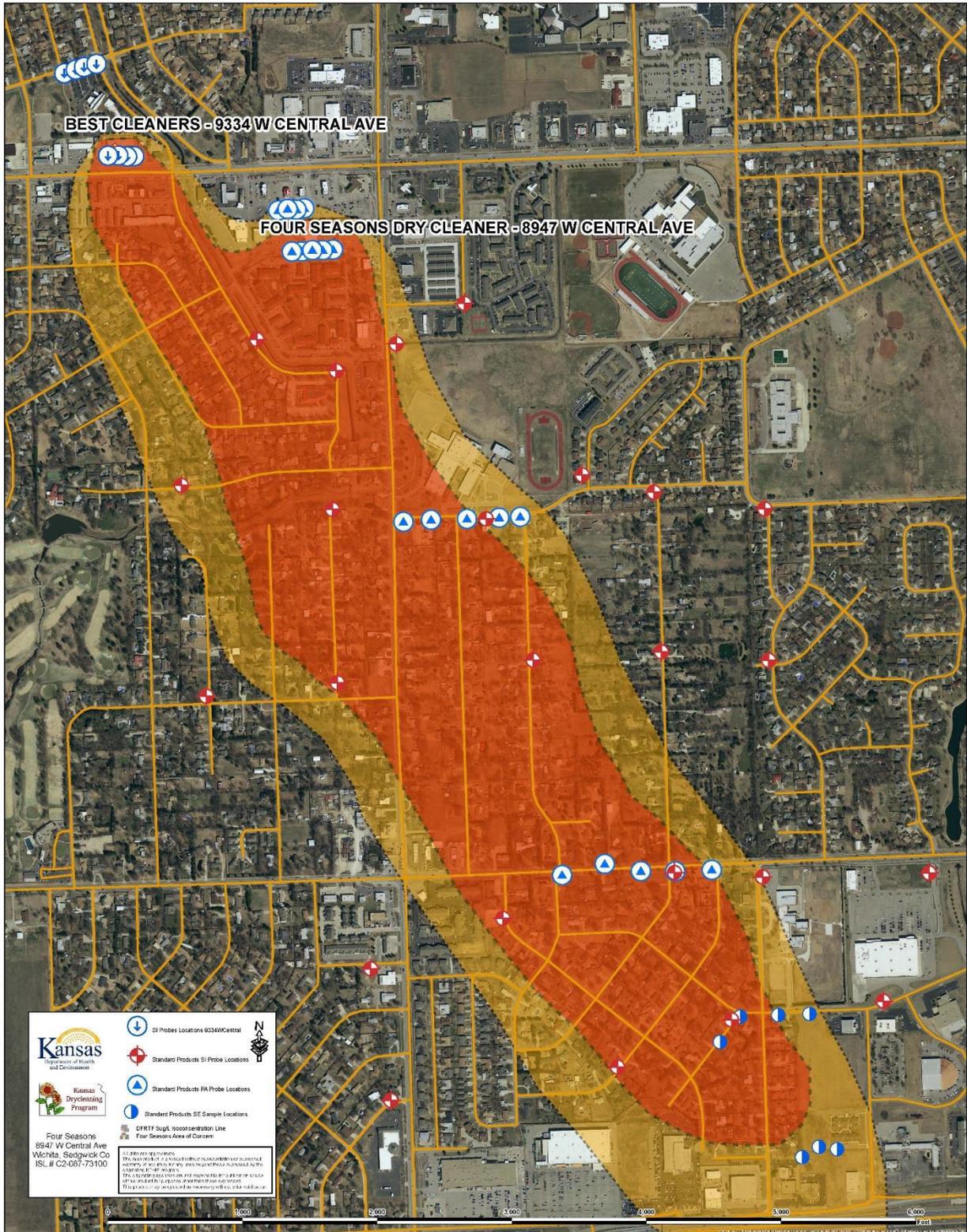


Figure 1. Area of Concern. The orange-shaded area indicates the area where the PCE is above the MCL, known as the contamination plume. The yellow-shaded area is the buffer. The entire shaded region is the area of concern. Symbols indicate the various probe and sample locations that KDHE utilized to determine the PCE plume location and the area of concern.

## Stakeholders

There were several groups of stakeholders that were identified as a part of the evaluation process.

- **Current Residents** – Residents living in the impacted area who relied on private well water for drinking and home-use had a vested interest in being connected to the City of Wichita water system for their personal health. Many questioned the health risks of their exposure to PCE in their drinking water over the months, years or decades living in their homes. Many were also concerned about pet health. Current residents also had concerns about the financial impact of the groundwater contamination on their past and future medical bills, property values, the cost of new water infrastructure and future water bills.
- **Former Residents** – Residents who previously lived in the impacted area are burdened with the potential health impacts of the groundwater contamination they were exposed to while living in the area without the assurance of notification that they had been exposed. Since it is unknown when the PCE spill(s) occurred, it is unknown when the contaminated drinking water began to be ingested by residents. The previous homeowners and home-renters who moved in and out of the area during the time the contamination was impacting drinking water is unknown. There are no regulations regarding contacting past residents to inform them of their exposure.
- **Kansas Department of Health and Environment (KDHE)** – KDHE first discovered elevated levels of PCE in groundwater samples taken near west Kellogg Avenue in Wichita 2009 while conducting tests for a separate project. The potential contamination site was added to a “sites to be investigated” list, which KDHE maintains. In February 2014, KDHE began testing private wells to determine if residents were impacted by the identified PCE plume. In late March 2014, KDHE determined that the former Four Seasons Dry Cleaners and former Best Cleaners were the origin of the PCE contamination and that residents in the impacted area were at risk of negative health impacts due to PCE exposure.
- **Kansas Dry Cleaning Program** – The Kansas Drycleaner Environmental Response Act created the Kansas Dry Cleaning Program in 1995. A Dry Cleaning Facility Release Trust Fund, operated by KDHE, was developed as the funding mechanism for investigations and remediation of soil and groundwater contamination for KDHE-led projects at current and former dry cleaning sites. In March of 2014, the Dry Cleaning Program received the West Wichita groundwater contamination remediation as one of its projects to be funded through the Dry Cleaning Facility Release Trust Fund. Most, if not all, of the funds in Kansas Dry Cleaning Program were depleted in the effort to hook up the homes in the area of concern to public water.
- **City of Wichita** – The area of concern was within the City of Wichita limits when the contamination was discovered. Many of the residents in the area used private wells for drinking water. The resolution to the health hazard of drinking contaminated groundwater would involve nearly 200 residences being connected to the City of Wichita water system. This would involve close collaboration between KDHE and the City of Wichita to provide new infrastructure for water mains and water hookups in a short period of time in order to protect the residents as quickly as possible. Additionally, the City of Wichita was a partner in providing data related to the site for KDHE to appropriately evaluate the project.

- **Environmental Protection Agency (EPA)** — EPA funded the initial KDHE study of a former Standard Products site. EPA was sampling for industrial pollution related to radium dial operations and found the PCE pollution that migrated to that site from the former dry cleaning operations.
- **Local Media** — Media outlets like television news, newspaper and local public radio were able to get the word out to residents in the impacted area quickly regarding the contamination, the specific hazards and potential courses of action. The media was key to getting announcements out to the community regarding public meetings and post-project focus groups.
- **Residents in Surrounding Neighborhoods** — Residents residing immediately outside of the contamination plume's buffer zone expressed concerns about the potential for the plume to migrate over time. They are also worried about the contamination's health impacts and effects on property values among others.

## Timeline of Events

The timeline below identifies the major events and decision points that occurred from the time the groundwater contamination potentially began; discovery of the contamination plume; connection of residences to City of Wichita water; and initial steps of the remediation process. Events outlined begin in the 1960's and end in 2014.

<b>1960</b>	Site 1 - Cowboy Cleaners Opens (Coin Operated dry cleaning machines)
<b>1960's</b>	Site 1 converted to a dry cleaning facility – no longer coin operated
<b>1968</b>	Site 2 - Clothes Cleaners opens
<b>1979</b>	Site 2 - Business name changes to One Hour Martinizing
<b>1980</b>	Site 1 - Name changed to Four Seasons Dry Cleaners
<b>1987</b>	Site 2 - Best Cleaners opens at this location
<b>1991</b>	Site 3 - Best Cleaners closes
<b>2001</b>	Site 1 - Ownership changes within the family
<b>2004</b>	Phase II Environmental Site Assessment – 2 soil borings
<b>2005</b>	Site 1 - Last year as a registered dry cleaning facility
<b>2006-2008</b>	Site 1 - Registered as a drop off location
<b>2008</b>	Four Seasons Dry Cleaners closes after a building fire
<b>2008</b>	"Damage from Fire: \$4 Million – Cause of Westlink Shopping Center Inferno is Uncertain" -Wichita Eagle
<b>Dec. 2009</b>	PCE identified in monitoring wells at West Kellogg site. At the time, contamination was not associated with a specific site. The site goes onto a list to await future federal funding for additional investigations.
<b>2014</b>	KDHE Site Assessment Program – Investigation to identify source of West Kellogg contamination. Identify domestic wells up gradient from Standard Products.
<b>Feb. 2014</b>	KAKE News reports KDHE was sending letters and surveys to residents with private wells
<b>Mar. 2014</b>	Groundwater assessment confirms a source of groundwater contamination as Four Seasons Dry Cleaners and transfers to KDHE Dry Cleaner Remediation Program.
<b>Mar. 2014</b>	Residents receive letters from KDHE advising them not to drink the water
<b>Mar. 2014</b>	KAKE News first to report the news about the contamination
<b>Mar. 2014</b>	KDHE supplemental field investigation to delineate the contamination with mobile laboratory. Groundwater sampling 3 depths between 30-55'.
<b>Apr. 2014</b>	KDHE publishes the first map with a clear understanding of the boundaries of the PCE plume.
<b>Apr. 2014</b>	First carbon filtration systems are installed for systems above removal management levels.
<b>Apr. 2014</b>	"KDHE identifies Contaminant in 24 Private Wells in West Wichita" -Wichita Eagle
<b>Apr. 2014</b>	KDHE organizes the first public meeting at Wilbur Middle School
<b>May 2014</b>	"Dangerous Chemical Invades West Wichita Drinking Water" -KMUW
<b>Dec. 2014</b>	"State Finishes Linking West Wichita Homes to City Water After Contamination." -Wichita Eagle

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## CONTAMINANTS AND RISKS

### Dry Cleaning Process

Dry cleaning is the process of cleaning fabrics using liquid chemicals, called solvents, instead of soap and water. Perchloroethylene (PCE) is the primary solvent used in most dry cleaning operations. The dry cleaning process involves four steps.

**Step 1. Adding Solvents** – Liquid solvents, detergents and sometimes a small amount of water are added to machines that agitate clothes to remove dirt, oil and stains. Clothes become “wet” with liquid solvents in this process.

**Step 2. Drying** – Once clean, the clothes are either dried in the same machine or transferred to a separate dryer. Then, clothes are pressed and shaped.

**Step 3. Distillation** – Used solvent is distilled, or separated, from waste residues such as detergents, dye, dirt and oil, so the solvent can be reused. In addition to distillation, most machines also use filters to clean used solvent.

**Step 4. Disposal** – After distillation and purification, filters containing small amounts of solvent and solvent residues, like PCE, must be managed and disposed of as hazardous waste. Dry cleaners can treat wastewater on site according to state regulations or send waste to special facilities for recycling or incineration.<sup>11 12</sup>

When PCE is not handled or disposed of properly there is potential for soil, surface or groundwater contamination. PCE is prohibited from disposal in the sanitary sewer system. If PCE ends up in the sanitary sewer system it will degrade the sewer pipe joint seals and cause leakage into surrounding soils that can then be washed down in to groundwater.

### Perchloroethylene (PCE)

PCE is used during the dry cleaning process. PCE is also a “likely carcinogen,” a substance capable of causing cancer. After PCE is added to typical dry cleaning machines, distillation separates the solvent from waste. PCE collects in filters that should be disposed of according to hazardous waste regulations. If handled properly PCE is never in contact with the environment. However improper handling or disposal can cause contamination of air, soils, surface water or groundwater. PCE is highly volatile, thus it evaporates quickly at room temperature causing airborne contamination. Liquid PCE can contaminate soil and surface water via leaky sewer connections, poor dry cleaning filter disposal practices, purposeful dumping and routine spills and leaks. When PCE in the soil moves downward and enters the groundwater it sinks because PCE is 60% heavier than water. This deep layer of PCE is extremely difficult to remove from the aquifer, which is the current condition at the West Wichita groundwater contamination site.

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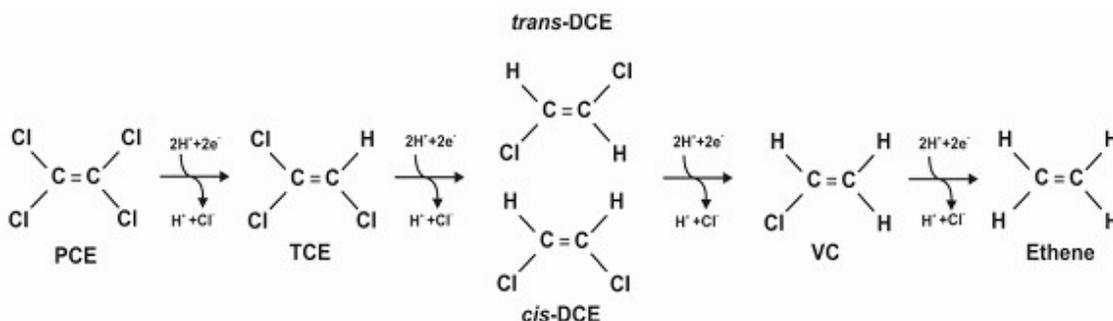
<sup>11</sup> EPA (2012). “Basic Information About Vinyl Chloride in Drinking Water.”  
<http://water.epa.gov/drink/contaminants/basicinformation/vinyl-chloride.cfm>

<sup>12</sup> DEQ (2013). “Dry Cleaners: Wastewater Management.”  
<http://www.deq.state.or.us/lq/pubs/factsheets/cu/dryclnr/ENGWastewaterManagement.pdf>

When surface or groundwater are suspected to contain PCE, especially if that water is a drinking water source, it must be sampled and tested. Water that contains PCE is tested and lab results are compared to EPA's maximum contamination level (MCL) for PCE. The maximum contamination level is the highest level of a contaminant that EPA allows in public drinking water supplies.

Individual domestic water wells are not regulated at the state or national level with regards to water quality. However when contamination is discovered at a listed site the Safe Drinking Water Act Maximum Contaminate Levels (MCL's) are used as a cleanup standard. MCLs ensure drinking water does not pose either a short-term or long-term health risk. MCLs for PCE are measured in parts per billion (ppb). One ppb is equivalent to one drop of food coloring in an Olympic sized swimming pool or one penny in \$10,000,000. A part per billion is a very small amount, but even that small amount may harm human health. For PCE, 5 ppb of PCE in drinking water is presumed safe by EPA. Amounts above that may have negative health impacts.

PCE does break down naturally in the environment (see Figure 3). The anaerobic (without oxygen) microbes responsible for the breakdown of PCE replace the chlorine atoms in the PCE molecule with hydrogen atoms. Each time this occurs, PCE degrades into another chlorinated compound, each with its own MCL. The first degradation process results in the formation of Trichloroethylene (TCE), TCE then degrades into Dichloroethene (DCE), followed by vinyl chloride, with the entire process becoming complete with the formation of ethene (a non-toxic chemical).<sup>13</sup>



**Figure 3. Dechlorination of PCE.** As PCE breaks down in the environment, chlorine atoms are replaced by hydrogen atoms. Each subsequent chemical has unique, negative health impacts.<sup>14</sup>

<sup>13</sup> EnviroForensics (2011). "The Unbalanced Cost of PCE Spills." <http://www.enviroforensics.com/the-unbalanced-cost-of-pce-spills/>

<sup>14</sup> Parsons. 2004. [Principles and Practices of Enhanced Anaerobic Bioremediation of Chlorinated Solvents](#). AFCEE, NFEC, ESTCP 457 pp, August 2004

The health impacts of PCE may vary depending on the amount of exposure (concentration) and length of time (duration) of the exposure. Short-term symptoms may include:

- dizziness
- fatigue
- headaches
- confusion
- nausea
- skin irritation
- lung irritation
- eye irritation
- mucous membrane irritation<sup>15</sup>

PCE is considered to be a “likely human carcinogen” by EPA. One retrospective study suggested that PCE in drinking water increased the risk of cervical cancer and epilepsy among the subjects observed.<sup>16</sup> Long-term exposure to PCE may negatively impact reproduction and development. PCE is also a health concern for the kidney, liver, immune and hematologic systems. In another retrospective study, subjects that are exposed to PCE in drinking water had elevated risks of bipolar disorder and post-traumatic stress disorder prenatally and during early childhood.<sup>17</sup>

### Trichloroethylene

Trichloroethylene (TCE) is a commonly used toxic chemical found in a variety of different products including de-greasers, adhesives, paint, paint removers, rug-cleaners, spot removers, sheet vinyl flooring, pepper sprays, and through the degradation of PCE (as seen in Figure 3). TCE is a colorless or blue liquid, has a sweet odor and, like PCE, is highly volatile.<sup>18 19</sup> The MCL of TCE is also 5 ppb.<sup>20</sup>

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<sup>15</sup> EPA (2015). “Fact Sheet on Perchloroethylene, Also Known as Tetrachloroethylen.” [http://www.epa.gov/oppt/existingchemicals/pubs/perchloroethylene\\_fact\\_sheet.html](http://www.epa.gov/oppt/existingchemicals/pubs/perchloroethylene_fact_sheet.html)

<sup>16</sup> Aschengrau et al.: “Occurrence of mental illness following prenatal and early childhood exposure to tetrachloroethylene (PCE)-contaminated drinking water: a retrospective cohort study.” *Environmental Health* 2012 11:2

<sup>17</sup> Aschengrau et al.: “Long-term health effects of early life exposure to tetrachloroethylene (PCE)-contaminated drinking water: a retrospective cohort study.” *Environmental Health* 2015 14:36

<sup>18</sup> EPA (2007). “Trichloroethylene (TCE).” [http://www.epa.gov/teach/chem\\_summ/TCE\\_summary.pdf](http://www.epa.gov/teach/chem_summ/TCE_summary.pdf)

<sup>19</sup> ATSDR (2011). “Trichloroethylene (TCE).” <http://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=30>

<sup>20</sup> EPA (2014). “Basic Information About Trichloroethylene in Drinking Water.” <http://water.epa.gov/drink/contaminants/basicinformation/trichloroethylene.cfm>

TCE is a carcinogen, but also has negative impacts on the central nervous system, immune system, and endocrine (hormonal) system in adults.<sup>21</sup> Symptoms will vary depending on concentration and duration. Short-term symptoms may include:

- fatigue
- sleepiness
- headache
- confusion
- blurred vision

Long-term exposure of low concentrations of TCE or short term exposure of high levels of TCE can have negative impacts in the liver, kidney, gastrointestinal tract and skin. There are also some reports of cancer in the liver and non-Hodgkin's-lymphoma.<sup>22</sup>

### CIS 1,2-Dichloroethene

CIS 1,2-Dichloroethene (DCE), is a flammable, clear liquid with a sharp, harsh acrid and chloroform-like odor.<sup>23 24</sup> It is used to produce solvents, is often in chemical mixtures and is the third by-product of the breakdown of PCE (see Figure 3).<sup>25</sup> The MCL for CIS 1,2-DCE is 70 ppb.<sup>23</sup>

Health impacts of CIS 1,2-DCE vary depending on concentration and duration. In animal testing, symptoms included damage to the hearts, livers and lungs. CIS 1,2-DCE is not classified as being a carcinogen. Short-term exposure symptoms include:

- Nausea
- Drowsiness
- Fatigue
- Irritated eyes
- Irritate respiratory system
- Central nervous system depression

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<sup>21</sup> EPA (2007). "Trichloroethylene (TCE)." [http://www.epa.gov/teach/chem\\_summ/TCE\\_summary.pdf](http://www.epa.gov/teach/chem_summ/TCE_summary.pdf)

<sup>22</sup> ATSDR (2011). "Trichloroethylene (TCE)." <http://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=30>

<sup>23</sup> ATSDR (2015). "Public Health Statement." [www.atsdr.cdc.gov/toxprofiles/tp87-c1.pdf](http://www.atsdr.cdc.gov/toxprofiles/tp87-c1.pdf)

<sup>24</sup> CDC (2015). "1,2-Dichloroethylene." <http://www.cdc.gov/niosh/npg/npgd0195.html>

<sup>25</sup> ATSDR (2011). "Vinyl Chloride." <http://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=51>

## Vinyl chloride

Vinyl chloride is also known as chloroethene, chloroethylene and ethylene monochloride.<sup>26</sup> Vinyl chloride is used to make polyvinyl chloride (PVC) and many plastic products including pipes, wirecoatings, medical supplies, household equipment and packaging materials.<sup>27 28</sup> Vinyl chloride is also the third step in the degradation of PCE (see Figure 3). Vinyl chloride has an MCL of 2 ppb.<sup>29</sup> Vinyl chloride negatively affects the heart, blood vessels, and liver. It can also affect the immune system, reducing the body's ability to fight off pathogens and disease. Vinyl chloride is classified as a known carcinogen.<sup>26</sup> Short-term exposure to vinyl chloride include:

- Dizziness
- Drowsiness
- Headaches
- Giddiness
- Loss of consciousness
- Lung and kidney irritation
- Inhibition of blood clotting

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<sup>26</sup> ATSDR (2011). "Vinyl Chloride." <http://www.atsdr.cdc.gov/substances/toxsubstance.asp?toxid=51>

<sup>27</sup> EPA (2012). "Basic Information About Vinyl Chloride in Drinking Water." <http://water.epa.gov/drink/contaminants/basicinformation/vinyl-chloride.cfm>

<sup>28</sup> EPA (2007). "Vinyl Chloride." [http://www.epa.gov/teach/chem\\_summ/VC\\_summary.pdf](http://www.epa.gov/teach/chem_summ/VC_summary.pdf)

<sup>29</sup> DEQ (2013). "Dry Cleaners: Wastewater Management." <http://www.deq.state.or.us/lq/pubs/factsheets/cu/dryclnr/ENGWastewaterManagement.pdf>

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## INVESTIGATION AND REMEDIATION

### Site Studies by KDHE

The first report of Perchloroethylene (PCE) in groundwater near the West Central site occurred during a Kansas Department of Health and Environment (KDHE) Unified Focused Assessment at a former radium dial shop on W. Kellogg Road in December of 2009. During this assessment, a groundwater sample was taken that showed PCE at 8.1 parts per billion (ppb), which exceeds EPA's maximum contaminant level (MCL) of 5 ppb. The site was then placed on a list of contamination to be investigated.<sup>30</sup>

In February 2014, KDHE's Site Assessment Program investigated the contamination to identify the source of the PCE. Wells were surveyed between West 2<sup>nd</sup> Street North and Maple, and North Tyler Road and Socora Street. PCE was identified in one of the seven samples taken. The sample was upgradient from the W. Kellogg location and indicated PCE at 7.4 ppb.<sup>31</sup> KDHE's team then conducted a Preliminary Assessment and discovered the following:

- PCE was detected in drinking water well samples in four of the six samples collected. Three samples contained concentrations that exceeded the MCL. Concentrations ranged from 8.0 to 554.4 ppb.
- Two samples also tested positive for Trichloroethylene (TCE). One sample was above the MCL at 19.3 ppb.
- CIS 1,2-Dichloroethylene (CIS 1,2-DCE) was reported in the two samples that also contained TCE, but CIS 1,2-DCE concentrations were below MCL.<sup>31</sup>

During March and April of 2014, KDHE Bureau of Environmental Remediation conducted a Site Inspection. The purpose of this inspection was to determine the source of the contaminants, collect information for environmental and human health threat assessment, and determine needs for further action. Eighty-seven (87) groundwater samples were collected from direct-push groundwater probe locations and 78 domestic wells.

- PCE was detected in 38 groundwater probe locations, and 24 of those samples measured PCE concentrations above the MCL. The highest detection was 870 ppb. 14 probe samples were below the MCL, and the remaining 49 probe samples were non-detect for PCE.
- TCE was detected in 16 groundwater probe locations, and 5 of those samples measured TCE concentration above the MCL. The highest detection was 14 ppb. 11 probe samples were below the MCL, and the remaining 11 probe samples were non-detect for TCE.

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<sup>30</sup> Wheeler, Kelsee and Mike LaBuda. "Unified Focus Assessment Report." KDHE 2009. ISL C2-087-72515.

<sup>31</sup> Jurgens, Bob. "Public Availability Session Groundwater Contamination." KDHE. Wilbur Middle School, Wichita, KS. 10 April 2014. Power Point.

- PCE was detected in 53 domestic well samples, and 37 of those samples measured PCE concentrations above the MCL. The highest detection was 760 ppb. 16 domestic well samples were below MCL for PCE, and the remaining 25 were non-detect for PCE.
- TCE was detected in 23 domestic well samples, and 9 of those samples measured PCE concentration above the MCL. The highest detection was 19.3 ppb. 14 domestic well samples were below MCL for TCE, and the remaining 55 were non-detect for TCE

Using the groundwater sample data and a review of historical Polk address directories, it was determined that the sources of contamination were two dry cleaner businesses 1) 8947 W. Central, formally Four Seasons Dry Cleaners, 1980– 2005, and 2) 9334 W. Central, formally Best Cleaners, 1987 – 1991. Four Seasons was confirmed as a contamination source on March 24, 2014, and Best Cleaners was confirmed as a contamination source on May 13, 2014. Both locations had long histories of dry cleaning, but are no longer in operation.<sup>32</sup>

During the site investigation, KDHE collected groundwater samples upgradient and downgradient of the former Four Seasons and Best Cleaners. PCE and TCE were not detected at concentrations above laboratory reporting limits in samples upgradient of these facilities. PCE was detected at levels exceeding MCL in samples collected downgradient of these facilities. Therefore, KDHE confirmed that the former Four Seasons Dry Cleaner, 8947 W. Central, and former Best Cleaners, 9334 W. Central as the sources of the PCE and TCE groundwater plumes emanating from the area of Central and Tyler. The official Area of Concern was established.

The project was then transferred to KDHE’s Dry Cleaner Remediation Program on March 24, 2014, and emergency response, including bottled water and water filters, was activated immediately.<sup>33</sup>

On March 31, 2014, KDHE began a supplemental field investigation to determine precisely where the contamination boundaries lay. By April 3, KDHE has a good understanding of the boundaries of the PCE groundwater plume.<sup>34</sup>

In the summer of 2014, a limited vapor intrusion (VI) assessment was conducted at Westlink Village Apts, 505 N. Tyler Rd, and Wilbur Middle School, 340 N. Tyler Rd, both within the area of concern, to determine if vapors from the PCE in the underlying groundwater were migrating upward into living spaces. Samples were taken at locations with the highest potential risk. PCE and TCE were detected, but at levels below the action level.<sup>35 36</sup>

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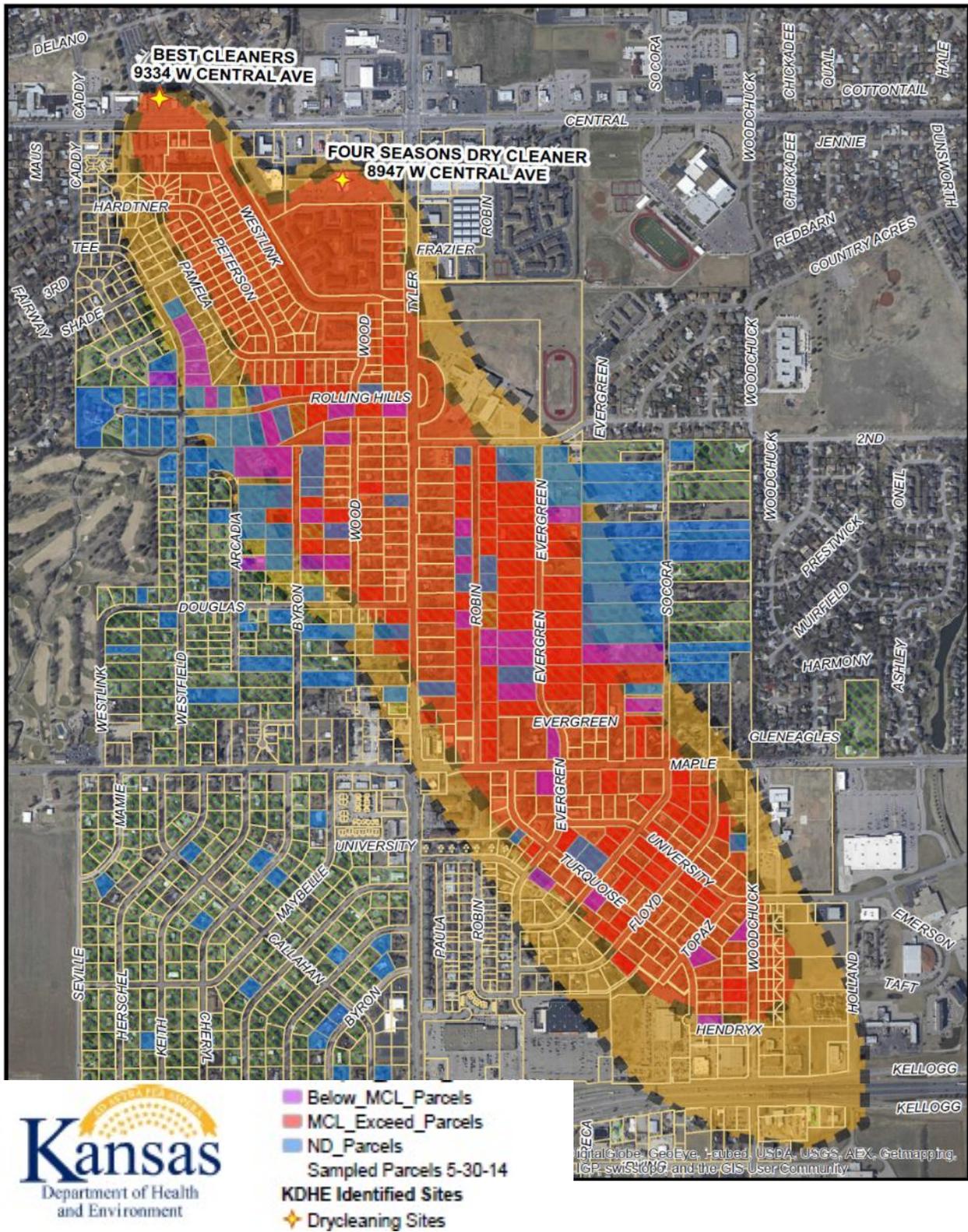
<sup>32</sup> KDHE 2013. “Field Sampling Outline, SSQA, and H&S Plan.” C2-087-72515.

<sup>33</sup> Jurgens, Bob. “Public Availability Session Groundwater Contamination.” KDHE. Wilbur Middle School, Wichita, KS. 10 April 2014. Power Point.

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<sup>36</sup> Morgan, Darryl. Kansas Department of Health and Environment. “4 Season Air Sampling.” 22 September 2014.



**Figure 4. Domestic Well PCE Results.** Red parcels exceeded the PCE MCL (5 ppb), purple parcels are below the PCE MCL, and blue parcels did not detect any PCE. PCE results vary depending on geology, hydrology and the depth of the well. The red shaded area is the area of contamination, and the yellow shaded area is a buffer zone. Both the red and yellow shaded areas encompass the area of concern. Properties without City water in the area of concern (yellow and red shaded areas) were connected at no cost to the homeowner.

## KDHE Activities to Date

On March 24, 2014, KDHE's Dry Cleaner Remediation Program received the west Wichita groundwater contamination project and immediately began emergency response actions. The KDHE Dry Cleaning Program emergency response activities included:

- 222 groundwater samples from private domestic wells within the area of concern (see Figure 4)
- 69 residences who were above the PCE MCL received a temporary bottled water supply
- 17 whole-house carbon systems were installed temporarily for residences above the PCE Removal Management Level to protect them from vapor intrusion
- 2 miles of City of Wichita water mains were installed in the area of concern

Due to the large local public interest in private drinking water well testing during this time, KDHE developed a Phase I and Phase II sampling approach. Phase I was for properties within the primary contaminant area, and KDHE provided sampling to all properties within the area of concern. Phase II involved taking contact information from residents outside the area of concern who were interested in testing their well water. Residences outside the primary area were representatively selected by KDHE for confirmation sampling, but not all homes requesting sampling were tested in Phase II.

From March through May, 2014, KDHE conducted water tests on private domestic and lawn/garden wells within the area of concern to test for contaminants. A laboratory analyzed 222 water samples, 178 within the area of concern.

On April 3, 2014 KDHE provided free bottled water to residents in the area of concern with more than 5 ppb of PCE or TCE through the Dry Cleaning Remediation Program. The first delivery was three 5-gallon bottles of drinking water, which was estimated to last two weeks for a household of three. If additional bottles were needed residents could contact KDHE for additional water. Every two weeks empty bottles were replaced with full bottles. Over the course of several months 69 residents were provided with 957 of the 5-gallon bottles of drinking water, a total of 4,785 gallons of water. The bottled water cost nearly \$8,000, which includes damage deposits, lost/stolen bottles, hand pumps and delivery.

In April, whole house carbon filtration systems were installed at residences with extremely elevated PCE levels. In these homes showering and washing with contaminated water was considered potentially dangerous.<sup>37</sup> A total of 17 carbon filtration systems were installed for \$4,645 each, \$78,965 total.

On April 10, 2014, KDHE held a public meeting at Wilbur Middle School for residents of the area of concern. Bob Jurgens, Section Chief of the Assessment and Restoration Section of KDHE, led the meeting. The Assessment and Restoration Section is responsible for assessing and restoring sites with natural resource damages and performs assessments and corrective actions at sites with environmental contamination at dry cleaning sites.<sup>38</sup> At the public meeting, Mr. Jurgens discussed the history of the contamination, the risks associated with PCE, and KDHE's response plan.

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<sup>37</sup> Jurgens, Bob. "Emergency Removal Action Supply Clean Drinking Water, Former Dry Cleaners, Wichita, Kansas." KDHE Public Meeting. Wichita, KS. 29 October 2014. Power Point.

<sup>38</sup> Morgan, Darryl. Kansas Department of Health and Environment. "4 Season Air Sampling." 22 September 2014.

GSI Engineering was contracted as the manager for the project and took care of the on-site logistics (permits, hiring plumbers, property restoration, etc). Eight plumbing companies were approved for the various projects and were awarded jobs based on cost, availability and resident preference.<sup>39</sup>

KDHE connected 196 residences who previously had private domestic wells (potentially contaminated), to existing or new city water mains. As of January 1, 2016, only one house remains that has not been connected. The remaining house is in foreclosure, is unoccupied but will be connected before sale. The capital cost of the water mains and the plumbing modifications required to serve every home was paid for entirely by the KDHE Dry Cleaning Remediation Program.

In order to avoid vapor intrusion, PCE vapors migrating up into the homes, 15 indoor wells were plugged according to KDHE Bureau of Water regulations. Vapor intrusion is the process by which VOCs in soil or groundwater migrate into indoor air above a contaminated site. Lawn and garden wells can continue to be used for irrigation, but owners must sign a waiver acknowledging the risks.

On October 29, 2014, KDHE held a second public meeting for residents of the area of concern. During this meeting, the public was informed of the problem, the history of the contamination, the risks, the alternative drinking water plan, the emergency response plan and the long-term plan for monitoring and remediation.<sup>39</sup>

There was \$1.7 million in the KDHE Dry Cleaning Facility Release Trust Fund. To date, KDHE has utilized \$2.47 million to fund the various aspects of this project, see Table 1. KDHE had to borrow the \$700,000 difference from other programs, during the 2015 fiscal year, the Dry Cleaning Facility Release Trust Fund is using the incoming program fees to pay back the borrowed funding. The average annual income for the Trust Fund is about \$800,000.

**Table 1. KDHE Total Expenses as of 02/18/16.**

<b>Activity</b>	<b>Number</b>	<b>Total Cost</b>
Lab Costs (water and air samples)	222 groundwater samples 2 Vapor intrusion test sites	\$14,825
Bottled water (957 5-gallon bottles, hand pumps, delivery, lost/stolen bottles and deposits)	69 houses	\$7,966
Carbon Filtration Systems (\$4,645/unit)	17 houses	\$78,965
Water Connections	196 houses	\$719,745
GSI Coordination	NA	\$100,000*
Water Main Installation	2 miles	\$1,115,000
Tap and Plant Equity Fees (paid in installments over the next 7 years)	NA	\$328,933
Site Investigation	NA	\$105,105
	<b>TOTAL</b>	<b>\$2,470,539</b>

\*Estimated cost

<sup>39</sup> KDHE 2013. "Field Sampling Outline, SSQA, and H&S Plan." C2-087-72515.

## City of Wichita Activities to Date

Beginning in March 2014, KDHE began working with the City of Wichita to identify areas where private water wells were being used for drinking water and other household uses. The City provided maps and data on residential wells, municipal wells and water mains surrounding the area of the contamination. In order to protect the health and safety of the residents in the area of concern, the City began to enforce the pre-existing Wichita City Ordinance regarding private drinking water wells in areas of known contamination. The ordinance reads as follows:

*Any existing water well shall cease to be used for personal use if the Health Officer determines that (1) the well is in a contaminated area, (2) public water is available to the water well user, and (3) the cessation of use of the water well for personal use is in the best interested of public health, safety and welfare.*

Wichita City Ordinance Sec. 7.30.105(b)  
Ord. No. 43-156, § 2

In order to help KDHE and residents living in the area of concern, the City enacted emergency steps to design and install water mains in a design-build project, the most time efficient method of construction. KDHE worked with City engineers to tap newly installed mains and set meters. The City was then able to bill KDHE for the residential water main hook ups.

A few residents refused to sign the waiver to allow KDHE to hook their homes up to City water. City staff then enforced the City Ordinance regarding contaminated wells by talking with homeowners about the cost, health and lawful benefits of connecting to the municipal water supply. All issues were quickly resolved, with costs of water connections paid for by the Dry Cleaning Remediation Program.

Since KDHE is only providing well tests for residences within the area of concern, the City of Wichita Office of Environmental Health-Water Quality program has and continues to sample and test residential wells outside the area of concern at homeowner's request for \$125.

The City of Wichita installed 2 miles of water mains with taps and meters within the area of concern (see Figure 5).<sup>40</sup>

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<sup>40</sup> KDHE, Four Seasons Dry Cleaners Site Page, [http://www.kdheks.gov/dryclean/four\\_seasons.html](http://www.kdheks.gov/dryclean/four_seasons.html).



**Figure 5. City Water Main Installation.** From April 10 – August 25, 2014, the City of Wichita installed 2 miles of 8" pipe, 17 fire hydrants, 138 new service connections (\$2,370/service), 56 new service connections - existing mains. Total project cost was about \$1.5 million.

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## CURRENT STATUS AND NEXT STEPS

Engineering firm SCS Aquaterra, under contract with KDHE, has designed and installed 14 monitoring wells around the perimeter of the area of concern, see Figure 6. These wells will help KDHE monitor and track the groundwater plume at various depths,<sup>41</sup> and determine if the contamination plume is shifting due to the changes in withdraw due to plugged water wells. As of August, 2015, all 14 monitoring wells around the contamination plum have had sampling results that were below the detection limit of the laboratory equipment, which is below the MCL. So far, this indicates that the plume has not spread out past the area of concern.

Residents in four areas outside the area of concern, to the west, petitioned to receive water main installation at their homes as well. These petitions were approved and the water mains were installed in coordination with the KDHE project. These water mains outside the area of concern were installed at the cost of the homeowners through special assessments on their property taxes over 20 years, or paid in one lump sum at the time of installation.

KDHE Bureau of Epidemiology and Public Health Informatics are conducting a two part study. Phase one, which has been completed, is a disease cluster investigation that looks at the Kansas Cancer Registry and the Kansas Birth Defects Information System and current residents in the area of interest.<sup>42</sup>

Phase two of the KDHE's study is a more in-depth investigation. KDHE will establish a more thorough database that includes current and past residents of the area of interest between 1992 and 2014. A questionnaire will be sent out to all past and current residents. Questions will address two topics; exposure and health outcomes. Residents will be asked about their exposure to the contaminants: How long they lived in the home and if they used the water for drinking, showering, washing, etc. Then, residents will be asked about their health outcomes that were not able to be captured by the Kansas Cancer Registry or the Kansas Birth Defects Information System: Miscarriages, neurological impacts, etc.

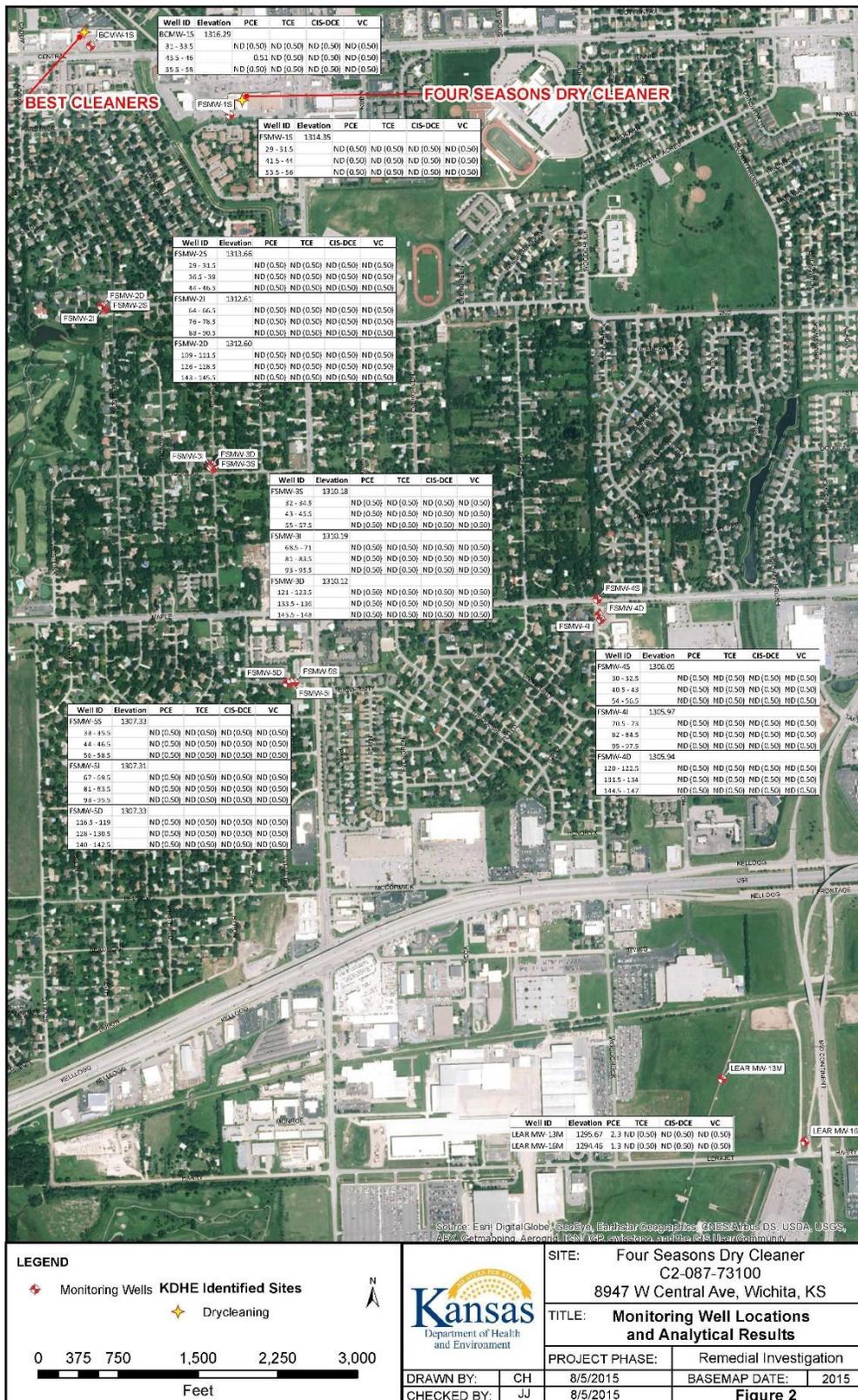
Since this incident, the City of Wichita's Office of Environmental Health has mapped other historical dry cleaning sites. When property transactions take place near those current or past dry cleaning sites, the City Water Quality staff will recommend that the property owner include a PCE test along with the traditional well water testing that occurs during every property transaction's well inspection. If a well is above the MCL for PCE then corrective action will be required by the well contamination ordinance (Wichita City Ordinance Sec. 7.30.105(b)).

In July of 2016, if funds are available, KDHE will begin looking at the source sites, the two former dry cleaner sites, and determine next steps for remediating the groundwater and possibly the soil.

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<sup>41</sup> KDHE, Four Seasons Dry Cleaners Site Page, [http://www.kdheks.gov/dryclean/four\\_seasons.html](http://www.kdheks.gov/dryclean/four_seasons.html).

<sup>42</sup> Ahmed, F.S., Hunt, D.C. "An Open Letter to the Community of West Wichita." KDHE. 5 October 2015. <https://keap.kdhe.state.ks.us/Ephtm/EphtContent/documents/West%20Wichita%20Investigation%202015.pdf>



**Figure 6. Fourteen Ongoing Groundwater Monitoring Wells.** Each monitoring well is indicated by a symbol and identification number. KDHE tests for PCE, TCE, CIS-DCE and vinyl chloride at each well. As of August 5, 2015 each well's sampling results have been below the detection limit, indicated here as ND (non-detect).

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