

Redfield Site

Environmental Fact Sheet

September 2006

The Site

Located at 5800 E. Jewell Ave. in Denver, Colorado, the Redfield site is situated on approximately 11 acres and includes a building where scopes for rifles and binoculars were manufactured by various entities using the Redfield name from 1967 to 1998.

Businesses to the south and west of the site include a Farm Crest Dairy store and gas station, an auto repair facility and a dry cleaner. The Colorado Department of Transportation (CDOT) Region 6 Headquarters occupies a large facility comprised of a number of buildings and facilities adjacent to the Redfield site on the west and south.

From completion of construction in 1957 until 1998, a variety of products ranging from precision electrical instruments to mainframe computer drives and rifle scopes were assembled or manufactured in the building on the Redfield site. A predecessor to Brown Group Retail, Inc. (Brown Retail) purchased the property and operations in 1971. Brown Retail operated at the site for five years, from 1979-1984. In 1984, Brown Retail sold the business and operations to Redfield Rifle Scopes, Inc., (RRSI), who operated the site from 1984 to 1998.

Brown Retail continues to own the property and has leased the building to CAPCO Tile and Stone, a wholesaler and retailer of stone and tile, since 2000.

Environmental Investigation and Response

Beginning in 1993, Brown Retail initiated environmental investigations of the site in anticipation of putting the site up for sale. In 1994, testing performed on behalf of a potential purchaser of the property revealed the presence of cleaning solvents in groundwater under the site. The environmental investigations further indicated that a degreaser used in the manufacturing facility to remove oil and grease from manufactured parts was a possible source of the contamination. RRSI had removed the degreaser unit in 1993, and only limited, small-scale chlorinated solvent-based cleaning operations took place on the site after that.

Upon discovering the presence of solvents in the groundwater beneath the site, Brown Retail caused RRSI, as the site operator, to notify the Colorado Department of Public Health and Environment (CDPHE) of the discovery in a letter dated July 18, 1994. After the groundwater contamination was discovered, further investigation and monitoring by Brown Retail indicated that the contaminant levels in groundwater beneath the property were decreasing and that the groundwater beneath the site was moving slowly. Brown Retail's investigation was thus focused within the boundaries of the site at that time.

In further groundwater testing in the northwestern part of the site, chemicals associated with gasoline were discovered. Brown Retail again caused RRSI to provide notice of this fact to CDPHE. In this same time frame, Brown Retail also undertook initial measures to remediate soils in the area where the degreaser unit had been located. Brown Retail also provided notice to CDPHE of this activity.

In June 1997, following a site inspection by CDPHE, Brown Retail met with CDPHE to discuss the site and its investigation and monitoring efforts performed to date. In late 1997, Brown Retail agreed to undertake further environmental investigation activities under the direction of CDPHE. In January 1998, samples taken from groundwater monitoring wells near the northeast corner of the site indicated that groundwater containing cleaning solvents might be moving from beneath the site into the surrounding neighborhoods. In February 1998, Brown Retail initiated efforts

to communicate the situation to area residents and began an off-site investigation to identify areas possibly impacted by the groundwater contamination.

In May 1998, CDPHE issued a Compliance Order to Brown Retail and RRSI, formally requiring site investigation and remediation activities. This Order was superseded by another Compliance Order entered into by CDPHE and Brown Retail in January 1999. The investigation and an extensive environmental cleanup program continue to date, including off-site groundwater cleanup and mitigation of the indoor air in certain homes near the site.

Chemical Descriptions

Several chemical substances have been found in varying quantities and locations in the groundwater under the site and surrounding areas. Where these substances have been found, they vary in quantity from trace amounts (below what can be detected) to levels of about 1 part per million (half a gallon in an Olympic-size swimming pool).

The primary contaminants CDPHE has focused on are 1,1-Dichloroethene (1,1-DCE) and Trichloroethene (TCE). The primary chemicals that have been detected in the groundwater include:

- **1,1 Dichloroethene (1,1-DCE).** This compound can be formed in groundwater as a breakdown product of 1,1,1 Trichloroethane (TCA), TCE and Perchloroethylene (PCE).
- **Trichloroethene (TCE).** TCE is a solvent that commonly was used in the past for cleaning manufactured and machined parts, and in common household products such as pesticides, glues and adhesives. TCE continues to be used as an industrial cleaner in the automotive and metals industries, and still may be found in household products such as cleaning fluids for rugs, paint removers and cleaning solvents.
- **1,1,1 Trichloroethane (TCA).** TCA is a common industrial and home-cleaning compound. For example, it is used in spot removers and automobile cleaning supplies.
- **Perchloroethylene (or Tetrachloroethylene) (PCE).** This chemical primarily was (and continues to be) used in the dry cleaning process, but also was a cleaning agent used in manufacturing operations.

- **Methylene Chloride.** This compound is a paint thinner and stripper, and is used in some industrial-testing applications.
- **Benzene.** This chemical is a constituent of gasoline. It is in the groundwater beneath and near the Redfield site due to releases of gasoline from other properties upgradient of the Redfield site.

Health Effects

Since Denver Water supplies residential water in the areas with groundwater contamination, there is no danger from residential drinking water. A careful examination of water well records indicated that no one in the area is using well water for drinking and this practice is discouraged. Homeowners with wells on their property should only use the water for irrigation.

The primary potential avenue for people to be exposed to these compounds in the groundwater is by breathing vapors that have moved from the groundwater, up through the soil, and into the basements or lower levels of homes. Unless there is adequate ventilation, these vapors can collect inside a house or building.

No human clinical health effects have ever been observed at the concentration levels of 1,1-DCE or TCE measured in the homes near the site. A cancer incidence study and birth defects incidence study completed by CDPHE in December 2002 concluded the incidences of both cancer and birth defects in the neighborhood were no different than neighborhoods outside the Redfield test area. The studies did not find any excess cancer attributable to the solvents in the groundwater.

There should be no health effects due to exposure to any of the other chemicals Brown Retail is required to test for at the levels those chemicals have been measured in the indoor air of homes near the Redfield site. At significantly higher levels, some can have central nervous system effects, such as dizziness, drowsiness, and loss of coordination, or they can cause irritation of the eyes, nose and throat (HSDB National Library of Medicine). These effects generally persist for only a short time after exposure.

Other Sources of Contamination

Testing has established that some of the identified compounds or chemicals are entering the groundwater that flows beneath the Redfield site from surrounding properties. For example, CDOT's Region 6 Headquarters, adjacent to the Redfield site on the south and west, is a known source of contamination. In the summer of 2002, CDOT constructed a groundwater remediation system designed to treat contaminants that have migrated from the former dry-well facility located on CDOT's Region 6 Headquarters beneath the Redfield site.

In addition to contamination from CDOT, gasoline-contaminated groundwater flows beneath the northern parts of the site and surrounding areas. The Colorado Oil Inspection Section is continuing to study the scope and extent of this petroleum contamination. Solvent contamination from a dry cleaner located upgradient of the site to the west also is impacting groundwater in the area.

Neighborhood Testing and Remediation

In the spring of 1998, Brown Retail, under the supervision of CDPHE, initiated indoor air testing of select homes near the Redfield site to determine if vapors had entered those homes. The indoor air testing involves placing a vacuum canister in the lowest living level of each home and collecting an indoor air sample over a 24-hour period. The homes were selected for testing based on the likelihood that they had been affected by vapors from groundwater contamination. The canisters are removed after 24 hours and sent to an independent laboratory for analysis. CDPHE and residents are advised of the testing results as soon as they are available.

Homes that test above the State's action level of 5.0 micrograms per cubic meters of air ($\mu\text{g}/\text{m}^3$) for 1,1-DCE (until late 2004, the action level was $0.49 \mu\text{g}/\text{m}^3$) are remediated by installing a ventilation system identical to the type used to remediate radon. Ventilation systems usually eliminate vapors in homes within a few days to a week after installation. This type of

ventilation system is the most effective method of eliminating vapors from impacted homes. Brown Retail modifies ventilation systems, if necessary, to achieve indoor air mitigation goals, with the homeowner's permission.

EnviroGroup Limited, a Denver-based environmental engineering firm, is conducting the testing and overseeing all Redfield site-related remediation for Brown Retail. As of August 2005, 729 homes have been tested. Of these, 395 tested above the state's previous action level of $0.49 \mu\text{g}/\text{m}^3$ and 381 were remediated using the above-described ventilation system.

In the fourth quarter of 2004, CDPHE increased the indoor air action level for 1,1-DCE from $0.49 \mu\text{g}/\text{m}^3$ to $5.0 \mu\text{g}/\text{m}^3$ for the environmental programs it oversees in Colorado. The change was made after CDPHE evaluated 1,1-DCE toxicity reassessments conducted by the U.S. Environmental Protection Agency (EPA), the Agency for Toxic Substances and Disease Registry (ATSDR), and other health and regulatory agencies in 2002. After its evaluation, the EPA concluded that the evidence that breathing 1,1-DCE could cause cancer in humans was too limited to warrant any quantitative estimate, and proposed a remediation guideline of $200 \mu\text{g}/\text{m}^3$.

CDPHE, however, concluded that the toxicity assessments were limited or contained uncertainties. It therefore selected $5.0 \mu\text{g}/\text{m}^3$ as the new indoor air remediation standard for 1,1-DCE for indoor air programs it oversees -- a significantly more conservative standard than EPA's guideline of $200 \mu\text{g}/\text{m}^3$. To date, none of the homes near the Redfield site have ever tested above EPA's 2002 guideline. The highest level of DCE found in indoor air in a home tested as part of the Redfield site work was $131 \mu\text{g}/\text{m}^3$.

Additionally in late 2004, CDPHE published a new interim policy that revises interim screening and remediation levels for TCE in indoor air. Under the new policy, if indoor air concentrations of TCE range from $0.8 \mu\text{g}/\text{m}^3$ to $1.6 \mu\text{g}/\text{m}^3$, CDPHE will require further study to determine the sources of contamination (i.e., indoor sources, such as household products, versus groundwater sources) and whether remediation will be required.

If indoor air concentrations exceed $1.6 \mu\text{g}/\text{m}^3$, remediation may be required. If concentrations are less than $0.8 \mu\text{g}/\text{m}^3$, neither remediation nor continued

monitoring may be required. Homes that currently have an indoor air ventilation system in place for 1,1-DCE mitigation should be protected from TCE in the indoor air, so long as the TCE is coming from the groundwater and not household products.

A total of 395 homes out of the 729 homes tested near the Redfield site had indoor air levels of 1,1-DCE that exceeded the former action level of $0.49 \mu\text{g}/\text{m}^3$. Of these 395 homes, 154 had concentrations that were below $5.0 \mu\text{g}/\text{m}^3$ for 1,1-DCE and below the new action level for TCE that originated from groundwater. Therefore, these 154 homes should no longer require remediation for 1,1-DCE and TCE. In addition, indoor air monitoring will no longer be necessary in some of the unventilated homes.

To respond to the changes in 1,1-DCE and TCE action levels, Brown Retail submitted and received approval from CDPHE on its plan, *Implementation of New 1,1-DCE Indoor Air Action Level*, outlining modifications to the indoor air monitoring and mitigation program. Under this plan, Brown Retail is employing a phased approach for evaluating homes that may no longer require operation of a ventilation system or indoor air monitoring.

The first phase, which began in April 2005, evaluated the indoor air of 88 ventilated homes that originally tested between $0.49 \mu\text{g}/\text{m}^3$ and $2.5 \mu\text{g}/\text{m}^3$ for 1,1-DCE and below $0.8 \mu\text{g}/\text{m}^3$ for TCE. In order to evaluate the indoor air of these homes, homeowners were asked to temporarily shut off their indoor air ventilation systems so that indoor air testing could be conducted to confirm that the new cleanup levels are met without mitigation.

Of the 88 homes re-evaluated in Phase I, 86 met the state's new action levels and therefore, do not require continued operation of the ventilation systems.

Homeowners who meet the state's new action levels were sent a letter notifying them that they no longer need to operate their indoor air remediation system for compounds associated with the Redfield site. However, because the systems also eliminate radon, both CDPHE and the City and County of Denver Department of Environmental Health recommend that homeowners conduct radon tests in their homes to determine if they should continue operating the system to safeguard against radon. Homeowners may opt to continue operating and maintaining their ventilation systems at their own expense. Operating

the system is economical, averaging slightly more than \$100 annually in electricity costs. Indoor-air testing of these homes is no longer necessary and will be discontinued.

Evaluation of the Phase II houses began in December 2005 and is scheduled to conclude in early 2007. Phase II evaluates homes that initially tested between 2.5 and $5.0 \mu\text{g}/\text{m}^3$ for 1,1-DCE and below $0.8 \mu\text{g}/\text{m}^3$ for TCE. To date, 44 homes have been re-tested.

Homeowners who opt to voluntarily shut off their system temporarily for confirmation sampling are asked to turn them off for 1-2 weeks before testing. The system can be turned back on once the sampling canister is removed. A second sample will be collected during the upcoming winter season using the same procedure. Once testing is complete, homes with two consecutive tests below the new action levels will also be notified that they no longer need to operate their system for Redfield related compounds.

For houses where homeowners deny permission for the re-testing or do not respond to the request after repeated attempts, EnviroGroup Ltd. uses a comprehensive "lines-of-evidence" evaluation to determine the status of these homes. The evaluation takes into account solvent concentrations, approved by the state, in groundwater and nearby indoor-air data to determine if indoor-air levels in these homes would meet state criteria if the ventilation systems were turned off. CDPHE considers the lines-of-evidence evaluation when determining which homes meet the state's new indoor-air standards for 1,1-DCE and TCE.

Homes located along the narrow bedrock channel in the vicinity of South Jasmine Street and East Mexico Avenue will remain vented and in the monitoring program until the offsite groundwater bioremediation system is evaluated in 2007 to monitor the impact of bioremediation in indoor air, if any.

Evaluation of homes in Phase III will begin in 2007. Indoor air concentrations of 1,1-DCE and TCE will decrease over time as the underlying groundwater continues to be treated and cleaned up. Until their homes are evaluated, Phase III homeowners should continue to operate their ventilation systems and monitoring will continue.

Groundwater Cleanup

In addition to 68 on-site monitoring wells, Brown Retail monitors 92 off-site groundwater monitoring wells to date, initially to determine the nature and extent of the groundwater contamination, and now to monitor the improvement in groundwater quality resulting from remedial measures undertaken by Brown Retail.

The first remedial measure undertaken by Brown Retail to address groundwater contamination associated with the Redfield site was to install a groundwater “pump-and-treat” system along the northeastern boundaries of the site (the area where groundwater exits from beneath the site). The system consists of 15 extraction wells that capture contaminated water before it flows off-site, pumping it to the surface where it is cleaned and then reinjected into the ground through 26 injection wells. The system, which began operating in March 2000, operates continuously to prevent solvents in groundwater from flowing away from the Redfield site and beneath the surrounding area. The system also captures and cleans groundwater a short distance beyond the fence line. The downgradient (i.e., downstream) portion of the existing plume is being diluted and flushed by the clean water reinjected by this system. The system currently is treating two to three million gallons of groundwater annually. Quarterly monitoring of more than 90 off-site wells over the past few years has shown a declining trend of 1,1-DCE concentrations.

More recently, Brown Retail has implemented two additional cleanup actions to address the off-site groundwater contamination: 1) enhanced injection of water currently being cleaned by the groundwater treatment system along the Redfield property line, and 2) installation of an underground “bioremediation” system.

The enhanced injection system consists of the installation of 18 additional wells for reinjection of treated water. These new wells allow for more clean water to be injected into the ground, which in turn, accelerates the flushing of residual solvents from the aquifer. Occasionally, treated water is discharged to a surface ditch when the injection wells have reached their capacity. Each time the aquifer is flushed with clean water, more solvents are removed and concen-

trations decrease, until Colorado groundwater standards are met.

The bioremediation system was installed in the area where there is a narrow bedrock channel that funnels the groundwater in the area beneath S. Jasmine Street, south of E. Mexico Avenue. This system, which began operating in January 2005, enhances the existing groundwater environment in which naturally occurring biological organisms break down the solvents in the groundwater. The system injects oxygen, nutrients and “food” into groundwater, using wells, so that the native biological organisms can grow. As these organisms consume the food and grow, they also break down the solvents more rapidly. By degrading the solvents as they pass through the bedrock channel at Jasmine Street, cleaner water flows away from the channel.

Additionally, some of the oxygen and nutrients injected into the treatment zone will travel with the groundwater, boosting the natural degradation processes downgradient from the channel. Therefore, while the enhanced pump-and-treat/reinjection system is cleaning the portion of the plume near the Redfield property, the underground bioremediation system at Jasmine Street will help flush clean water into the remainder of the plume and further accelerate the degradation of solvents to levels below Colorado’s groundwater standards.

Early indicators show reductions in concentrations of solvents in groundwater; however, it will take one to two years of data to more accurately assess the impact the bioremediation system is having on the entire plume. Preliminary calculations indicate that the portion of the aquifer near the Redfield site could be flushed clean in as few as five years or less, although diffusion of solvents trapped in clays and other less permeable materials may slow the flushing process to some degree.

On-Site Cleanup Pilot Test

Once the off-site impacts of the contaminated groundwater were addressed, CDPHE asked Brown Retail to consider on-site remedial measures. Currently, EnviroGroup is conducting a pilot test of a Multi-Phase Extraction (MPE) system to address contaminants on-site. After evaluating a number of cleanup activities, Brown Retail proposed MPE as

the most appropriate on-site technology. CDPHE approved a pilot test of the MPE system to evaluate its effectiveness and in 2004, the first phase of the pilot test began.

MPE systems remove contaminants by lowering the groundwater table to allow subsequent removal of solvents by a process known as soil-vapor extraction. The first phase of the pilot test involved pumping groundwater from two wells to lower the water table. At the Redfield site, groundwater removed by the MPE pilot test is treated by the existing groundwater pump-and-treat system. The second phase of the pilot test evaluated the feasibility of removing soil vapors from the ground in areas where the groundwater table has been lowered. An on-site vacuum blower was used to draw compounds and excess moisture out of the ground.

Brown Retail has concluded its pilot test of the MPE system and will submit a report to CDPHE by the end of 2006 with its findings from the pilot test.

For More Information:

We will continue to update our neighbors and other interested parties as new information about the site becomes available. We welcome your questions or comments. Please feel free to contact the following representatives for more information or call the Redfield information line at (303) 637-2503.

Lisa Sigler

Brown Group/Redfield Community Relations
Representative
(303) 778-8355 phone
(303) 778-8359 fax
lisa@siglerinc.com

Derek Boer

Colorado Department of Public Health and
Environment Community Involvement Specialist
(303) 692-3329 phone
(303) 759-5355 fax
derek.boer@state.co.us

Redfield Information Line: (303) 637-2503

Redfield Web site: <http://www.redfieldsite.org>

Information Repositories:

Virginia Village Library
1500 S. Dahlia St.
Denver, CO 80224
(303) 757-6662

Glendale Public Library
999 S. Clermont St.
Glendale, CO 80246
(303) 691-0331