

Public Health Assessment

Final Release

**LAMMERS BARREL FACTORY
BEAVERCREEK, GREENE COUNTY, OHIO**

EPA FACILITY ID: OHD981537582

**Prepared by the
Ohio Department of Health**

AUGUST 10, 2009

Prepared under a Cooperative Agreement with the
U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia 30333

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

This Public Health Assessment was prepared by ATSDR's Cooperative Agreement Partner pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) section 104 (i)(6) (42 U.S.C. 9604 (i)(6)), and in accordance with our implementing regulations (42 C.F.R. Part 90). In preparing this document, ATSDR's Cooperative Agreement Partner has collected relevant health data, environmental data, and community health concerns from the Environmental Protection Agency (EPA), state and local health and environmental agencies, the community, and potentially responsible parties, where appropriate.

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 30-day public comment period. Subsequent to the public comment period, ATSDR's Cooperative Agreement Partner addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes 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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SUMMARY

The former Lammers Barrel Factory, also known as the Kohen and Lammers Barrel Company, in Beavercreek, Greene County, Ohio bought, stored, reclaimed, and sold flammable chemicals and solvents from 1953 to 1969. A major fire occurred at the site in 1969 as the result of a spark being emitted during the transfer of methyl ethyl ketone from a 55-gallon drum. During the fire, drums were reported to have exploded and traveled up to 100 feet in the air, landing in surrounding largely residential properties. A combination of past site operations and the fire at the facility has resulted in the contamination of the groundwater beneath the former facility and the surrounding residential community. In September, 2002 the site was proposed for inclusion on the National Priorities List (NPL) of Superfund hazardous waste sites. The site was officially placed on the NPL on September 29, 2003. The Agency for Toxic Substances and Disease Registry (ATSDR) is required by a congressional mandate to complete a Public Health Assessment for each site proposed for listing as a Superfund site. The Health Assessment Section of the Ohio Department of Health has maintained a cooperative agreement with the ATSDR since 1990 and was tasked with completing the required Public Health Assessment.

Discovery and Exposure - A majority of the homes in the vicinity of the Lammers Barrel facility depend on private wells for their drinking water. In October, 1985, residential wells along Dayton-Xenia Road, one mile north of the site, were reported to be contaminated with a variety of industrial chemicals. Because of these detections, several residents along East Patterson Road had their wells tested for volatile organic compounds (VOCs). One well tested contained low levels of several VOCs. As a result of this detection, an additional 93 wells along East Patterson Road and in the nearby Woodhaven subdivision were sampled. VOCs were discovered in 14 of the 93 wells sampled with the main chemicals of concern being vinyl chloride, trichloroethylene, and 1,2 dichloroethene. As a result of this contamination, the Ohio National Guard provided temporary drinking water until the contaminated homes could be connected to the public water supply. In 1986, using their Superfund authority, US EPA hooked up impacted residences to the county water supply.

Additional investigations in 1992, 1997, 2000, 2001, and 2003 have confirmed the presence of VOCs in ground water along East Patterson Road and under portions of the Woodhaven Subdivision. To date, 19 residential wells have been found to be contaminated with VOCs at levels above the Maximum Contaminant Levels (MCL) established for public drinking water systems. All of these homes have been connected to the public water supply. Recent site investigations have also indicated two distinct areas of soil contamination located on the facility property that likely are serving as sources of this groundwater contamination.

Site Cleanup - In April 2002, U.S. EPA signed an agreement with 20 companies, known as the Lammers Barrel Site Group, to conduct a complete site investigation and develop remedial alternatives to clean-up the site. This Remedial Investigation/Feasibility Study was initiated in May 2003 with a new round of residential well sampling. This was followed by the installation and sampling of off-site monitoring wells in the neighborhood in 2004 and further

characterization of the on-site contamination at the Lammers Barrel site in 2003 and 2004. Additional environmental sampling is being conducted at the site as part of the Superfund Remedial Investigation / Feasibility Study (RI/FS) process.

Community health concerns – Most of the community concerns that have been expressed to HAS in the past have been concerns with water quality (aesthetics) and not exposure to carcinogens or probable carcinogens in the well water. The exposed population in the community to date consists of the past occupants of 19 residences and health concerns, cancer or non-cancer, in this exposed population have been minimal or lacking so that no community cancer assessment was ever requested or completed for this particular community. The small number of exposed residents also makes it statistically difficult to calculate meaningful cancer rates for these exposed residents. As a result, there is no health outcome information for the exposed community. None of the respondents who expressed cancer concerns in the 2008 Public Comment PHA lived within or were closely proximal to the documented area of groundwater contamination.

Conclusions - Based on the review of the available data, the Health Assessment Section has concluded that *in the past*, the Lammers Barrel Factory Site posed a *Public Health Hazard* to area residents who used private wells for their source of drinking water. Vinyl chloride, a known human cancer causing chemical and trichloroethylene, a probable human carcinogen, were detected at levels of health concern in 19 identified contaminated wells. All homes with water wells with VOC levels above federal drinking water standards have been connected to the Greene County public water supply. The site *currently* poses an *Indeterminate Public Health Hazard* because the extent of the soil and groundwater contamination both on and off-site has not yet been fully characterized. There is also a remote possibility that chemicals in the groundwater could be migrating through the soil and volatilizing into residential homes. The potential exists for additional residential wells to be impacted *in the future* if the source of the contamination is not remediated or removed.

Recommendations - The Lammers Barrel Site Group, in conjunction with US EPA, should fully characterize the extent of the both on and off-site contamination and develop remedial alternatives that will eliminate the threat that area residents might be exposed to site-related chemicals in the future at levels that could harm their health.

- The soil and groundwater contamination associated with the Lammers Barrel Factory site should be fully characterized, both onsite and offsite.
- The contaminated soil and source(s) of groundwater contamination under the site should be identified and remediated to eliminate future offsite groundwater contamination.
- The off-site groundwater contamination should be further investigated to clearly define the extent of off-site groundwater contamination.

- The distribution of the contaminants in off-site areas should be more fully investigated to insure that all sources are identified and remediated.
- The vapor intrusion pathway should be evaluated to determine if the potential exists for vapors to migrate from the contaminated groundwater into the overlying homes.
- Residential well sampling should be continued to insure that additional residential wells do not become contaminated during the course of the clean-up process.

Next steps – HAS will review and evaluate the additional environmental data collected as part of the Superfund RI/FS process and provide any additional recommendations to limit or prevent exposure to area residents. HAS will attend any future public meetings to gather community concerns and answer questions related to human exposure to the chemicals of concern at the Lammers Barrel site.

PURPOSE AND STATEMENT OF ISSUES

The Health Assessment Section (HAS) at the Ohio Department of Health (ODH) has previously written two health consultations evaluating residential well contamination in the neighborhood adjacent to the former Lammers Barrel Factory in Beavercreek, Ohio (HAS, 1996A; 1996B). In 2002, the Lammers Barrel Facility was proposed for inclusion in the National Priorities List (NPL) of Superfund hazardous wastes sites. The site was officially placed on the NPL on September 29, 2003. Upon listing of the site on the NPL, the Agency for Toxic Substance and Disease Registry (ATSDR) is required by a congressional mandate to complete a Public Health Assessment evaluating the public health hazard posed by the site.

The Health Assessment Section of the Ohio Department of Health has had a cooperative agreement with ATSDR since 1990 and, as part of this agreement, HAS has agreed to complete the public health assessment for this site. A health assessment is not a health study. This health assessment will evaluate the environmental data collected at the site since the last health consultation was written in 1996 and will make conclusions and recommendations on additional actions that may be necessary to protect the public health of area residents. The main focus of the evaluation will be on the groundwater contamination that has migrated off-site and impacted residential drinking water wells near the site and whether or not this contamination currently poses a public health threat to residents obtaining their drinking water from these wells.

BACKGROUND

Site Location and History

The Lammers Barrel Factory site is a former waste storage, solvent recycling, and disposal facility at the northeast corner of Patterson and Grange Hall roads in the city of Beavercreek, Greene County, Ohio (Figure 1). The site today is a two-acre vacant lot that includes a large concrete pad. Little Beaver Creek flows west to east, bisecting the site into north and south sections. Along the banks of the creek, the land slopes steeply down 8-12 feet to the creek. The former Lammers property extends north of the creek to the abandoned railroad right-of-way. It is bounded to the west by Grange Hall Road, to the south by Patterson Road, and to the east by a parking lot and picnic area owned by the Fraternal Order of Eagles (Figure 2).

The site is in a mixed commercial and residential area of Beavercreek Township. Commercial businesses or properties near the site include a gas station, the Fraternal Order of Eagles Lodge, and a small shopping center. There are single-family homes on large lots east and southeast of the site, along Patterson Road. The Woodhaven Subdivision, a single-family housing development, is 900-1,000 feet south-southeast of the site (Figure 1). The area just north of Little Beaver Creek has been developed for light industries.

The former Kohen and Lammers Chemical Company bought, sold, and reclaimed flammable chemicals and solvents at the site from 1953 to 1969 (Weston, 1986). The facility had an above-

ground storage capacity of 500,000 gallons, including 18 vertical tanks, ranging in size from 2,500 to 25,000 gallons, and, at the time of the 1969 on-site fire, 6,000 55-gallon drums. The facility included a concrete storage pad and a two-story processing building. Chemicals stored on-site included 1,1,1 trichloroethane, perchloroethylene, and methyl ethyl ketone (Ohio EPA, 1992). On September 30, 1969, the facility exploded and burned to the ground. Explosions at the site could be felt up to 2 miles away (R.C. Frey, pers. comm., 2008) and heat from the fire could be felt up to 0.5 miles away. Ignition of methyl ethyl ketone during transfer from a drum was believed to be the cause of the explosion and fire. Anecdotal testimony from residents reported exploding drums from the site shooting up into the air and landing in residential yards as far away as Rockfield Drive. Debris from the fire was reportedly disposed of in a private gravel pit approximately 0.5 miles south of the site (Weston, 1986).

During the 1980's, the site was a vacant lot surrounded by a metal fence. The 55-foot deep on-site production well had been improperly abandoned and filled with demolition debris. Five pipes were observed leading from the old foundation directly to Little Beaver Creek (Weston, 1986).

On October 4, 1985, following published reports of contaminated wells along Dayton-Xenia Road, one mile to the north of the site, several residents living along East Patterson Road had their wells tested for volatile organic compounds (VOCs). One well contained chloroethane at 35 parts per billion (ppb). The well was re-sampled and was found to contain chloroethane at 69.5 ppb, 1,2 dichloroethene at 3.8 ppb, as well as a third unknown organic compound (Weston, 1986). In response to this contamination, an additional 93 wells in the vicinity of the former Lammers Barrel site were eventually sampled from October to December, 1985. The wells included nine commercial wells, one well servicing an 87-unit apartment complex, and 83 private residential wells. Volatile organic compounds were found in 14 of the 93 wells sampled; nine on East Patterson Road just east of the site and five on Stanwick Drive, Trailee Trail, and Kenora Circle, all in the Woodhaven Subdivision (Figure 1). Total VOC levels ranged from 3.4 to 529 ppb, with the highest levels found in wells servicing several homes on the north side of East Patterson Road, 400-500 feet east of the site. Specific VOCs detected included vinyl chloride (VC) up to 320 ppb, chloroethane up to 78 ppb, 1,2 dichloroethene (DCE) up to 210 ppb, perchloroethylene (PCE) up to 3.4 ppb, and trichloroethylene (TCE) up to 24 ppb (Ohio EPA, 1992; Greene County Health Department, 1995). Vinyl chloride and dichloroethene are degradation products of the solvents perchloroethylene and/or trichloroethylene (Vogel and McCarty, 1985). Chloroethane is a break-down product of the solvent 1,1,1 trichloroethane (ATSDR, 2006).

The Ohio National Guard provided 350-gallon mobile water tanks as emergency water supplies for five homes along E. Patterson Road whose drinking water contained contamination above USEPA Maximum Contaminant Levels (MCLs) established to be protective of public drinking water supplies. In November, 1985, U.S. EPA provided temporary water lines and extended municipal water lines to nine residences with contaminated wells (HAS, 1996A). Currently, county water mains extend down Grange Hall Road, E. Patterson Road, Kenora Circle, the north

end of Stanwick Drive, and Tralee Trail (Figure 3).

Additional groundwater sampling events were conducted in 1986, 1988, 1991, and 1997, in addition to the more recent groundwater sampling events conducted in 2003 and 2004. Data from these sampling events were used to confirm initial results from 1985. These investigations showed a general drop in VOC concentrations in most of the wells that were sampled multiple times during the various investigations. However, contaminant levels in several wells showed a significant increase and several of the wells that had no detects of chemicals in 1985 were found to be contaminated with site-related chemicals in 1997 (E&E, 1997). VOC concentrations in some of the wells that had detections in 1985 continued to have levels of individuals chemicals exceeding US EPA drinking water Maximum Contaminant Levels (MCLs) in 2005 (Ohio EPA, pers. comm., 2005).

Site Hydrogeology

The Lammers Barrel site is underlain by buried-valley sand and gravel deposits up to 240 feet thick. Wells in this sand and gravel aquifer can yield up to 1,000 gallons of water per minute (Norris and Goldthwait, 1950; Schmidt, 1990). Greene County's south wellfield on Shakertown Road (2.75 miles east/southeast of the site) provides between 0.8 and 1.2 million gallons a day to residences in Greene County. These wells are screened in gravel at depths greater than 240 feet below the surface (Ohio EPA, 1991). The upper portions of this aquifer (to depths of 70 feet) in the vicinity of the site, consists of complex, discontinuous layers and /or lenses of clay till, sand, and gravel (ODNR well logs). Near the site there is a clay layer, up to 50 feet thick that separates the underlying water-bearing sand and gravel layers from the ground surface. This causes the deeper part of the aquifer to operate as a confined system. The hydrologic connections between Little Beaver Creek and the underlying aquifer are not well known, although it has been suggested that the creek is recharging the aquifer in the vicinity of the Lammers Barrel site (Ohio EPA, 1991). Prior to 1985, most of the area residential and commercial properties used private wells for obtaining their water supply (HAS, 1996B). This included approximately 400 residential wells within a one-mile radius of the site. Most wells in the area were drilled in the late 50's and early 60's into the underlying sand and gravel aquifer and typically are cased to depths of 40-45 feet (ODNR well logs). Prior groundwater investigations have shown that groundwater in the vicinity of the Lammers Barrel Factory flows east and southeast toward the Woodhaven Subdivision and the Little Miami River (WESTON, 1986; Ohio EPA, 1991; 1992).

Previous Site Investigations

The Ohio Environmental Protection Agency (Ohio EPA) collected six soil samples, four sediment samples, and four surface water samples as part of a 1992 Site Inspection. Soil samples were collected at depths ranging from two to four feet below ground surface. Surface water and sediment samples were collected from the Little Beaver Creek upstream of the site, just

downstream of where several pipes extend from the bank into the creek, and downstream of the site. The soil data collected indicated that the on-site soil is heavily contaminated with a variety of VOCs, polychlorinated biphenyls (PCBs), and metals. The results of these samples were previously presented in the two ODH Health Consultations completed in 1996.

Between 1985 and 1992 seventeen residential wells were found to be contaminated with VOCs. All of the homes with levels of VOCs above US EPA MCLs were connected to the municipal water system. In addition to these homes, approximately 35 homes were voluntarily connected to the municipal water system prior to 1997. These homes were located along E. Patterson Road, Stanwick Drive, and Tralee Trail (HAS, 1996B). The majority of the homes in the Woodhaven Subdivision, however, continue to depend on private wells for their drinking water.

1997 Engineering Evaluation/Cost Analysis

In 1997, the U.S. EPA conducted an Engineering Evaluation/Cost Analysis (EE/CA) for the Lammers Barrel Factory. The EE/CA was designed to evaluate site conditions and determine the extent of contamination at the site. As part of this EE/CA, a streamlined risk assessment was completed to evaluate threats posed by the contamination present at the site and in the nearby residential homes impacted by the plume of groundwater contamination present in the underlying aquifer. Based on the data collected, several possible site clean-up options were proposed along with the costs associated with each option.

As part of the 1997 EE/CA, environmental samples were collected from on-site soils, sediment, and groundwater, in addition to off-site groundwater in residential wells. In March 1997, 40 residential well samples were collected from the adjacent Woodhaven community and analyzed for VOCs. Fifty-one soil samples were collected from the Lammers Barrel Factory site. Samples were collected from depths ranging from 0 to 13 feet below ground surface. Soil samples were analyzed for VOCs, PCBs, and lead. An additional eight soil samples were collected in June 1997. A total of seven sediment samples were collected from the Little Beaver Creek in April 1997. Sediment samples were collected from a depth of 0 to 6 inches and analyzed for semi-volatile VOCs, PCBs, and arsenic (Ecology and Environment, 1997). In addition to on-site soil and sediment sampling and the residential well sampling, a total of four monitoring wells were installed on-site.

VOCs were detected in 25 of the 40 residential wells sampled. VOCs detected included vinyl chloride (eight locations); 1,1-dichloroethane (six locations); trichloroethylene (nine locations); tetrachloroethene (three locations); 1,1,1-trichloroethane (seven locations); and cis-1,2-dichloroethene (seven locations). Other compounds detected include xylenes, ethylbenzene, toluene, benzene, chloroform, and chloroethane (E&E, 1997).

Eight of the residential wells had detections of VOCs that exceeded U.S. EPA Maximum Contaminant Levels established for public drinking water supplies. Six of the eight homes with MCL exceedences were already connected to the municipal drinking water supply and no longer used their wells for drinking water purposes. The remaining two wells exceeded the MCL for TCE. In 1985, both wells had no detects of this chemical. These wells (Kenora Circle and Rosendale Drive) were later connected to the municipal water supply. Historical residential well sampling results are summarized in Table 1.

Soil samples were taken from both the north and south portions of the Lammers Barrel Factory site. Samples were collected from a depth of 0 to 13 feet with the majority of the samples being collected at depth of 4 to 5 and 8 to 9 feet below ground surface (E&E, 1997). VOCs detected on site subsurface soils included PCE (500,000 ppb); TCE (21,000 ppb); 1,1,1 TCA (21,000 ppb); 1,2-DCE (11,000 ppb); toluene (3,700,000 ppb); ethylbenzene (1,100,000 ppb); and xylenes (6,600,000 ppb). PCBs were also detected on on-site soils at a maximum concentration of 42 parts per million (ppm) for Aroclor-1254. Lead concentrations in the on-site soil ranged from 4.7 to 4,260 ppm (E&E, 1997). Lead levels in native soils in southwest Ohio typically range up to 16 ppm (Logan and Miller, 1983).

Sediment samples were analyzed for VOCs, semi-volatile VOCs, and total arsenic. VOCs detected in the sediments of the Little Beaver Creek included xylenes (19,000 ppb) and ethylbenzene (1,200 ppb). Semi-volatile VOC analysis revealed several polycyclic aromatic hydrocarbons (PAHs), including, chrysene (730 ppb), pyrene (1,400 ppb), and fluoroanthene (1,100 ppb). Arsenic was detected in sediment samples at concentrations up to 10 ppm.

Groundwater samples from the four on-site monitoring wells were analyzed for VOCs, PCBs, and total metals. VOCs detected included vinyl chloride (17 ppb), TCE (110 ppb), PCE (13 ppb), xylenes (95 ppb), benzene (30 ppb), and ethylbenzene (52 ppb). PCBs were not detected in any of the on-site monitoring wells. The metals arsenic (28.8 ppb) and lead (36.0 and 26.2 ppb) were also detected in groundwater in on-site monitoring wells.

The EE/CA also included a streamlined risk assessment. The risk assessment determined that significant cancer risks were associated with the use of groundwater contaminated with vinyl chloride for general household purposes by residents living down gradient from the site, and for drinking water for potential site workers (E&E, 1997).

Based on the results of the environmental sampling and the streamlined risk assessment, US EPA selected several non-time critical removal actions. It was proposed that the levels of contaminants in the soils be reduced using Dual Phase Extraction Technology which uses a vacuum system to simultaneously remove liquid and gas phase contaminants from contaminated soils and groundwater. It was also recommended that long-term monitoring of the site and the groundwater contamination take place to insure protection of residents whose wells are not currently impacted by the site (E&E, 1997).

Phase I & II Hydrogeologic Characterizations 2000

In 2000, the U.S. Army Corp of Engineers contracted with Adrian Brown Associates to further investigate the extent of chemical contamination at the Lammers Barrel Factory Site. The purpose of the study was to provide additional data on perched water zones present at various locations across the site; further assess contaminated soil and groundwater at the site; and, assess soil and groundwater along a proposed waterline extension scheduled to connect additional homes in the Woodhaven Subdivision to the county water system (Adrian Brown, 2000).

Soil and groundwater samples were collected on-site. Borings were advanced to a depth of

approximately 18 feet below ground surface and groundwater and soil samples were collected and analyzed for VOCs, PCBs, and metals. Soil samples showed two distinct areas of soil contamination, located on the northern and southern portions of the site. Three more or less discrete contaminated plumes in the shallow, perched groundwater on-site were identified; including a small area just north of Little Beaver Creek and larger areas south of and adjacent to Little Beaver Creek and just parallel with and north of Patterson Road (Adrian Brown, 2000). Lead (139 ppb), arsenic (32.9 ug/l), and chromium (333 ug/l) were detected in on-site groundwater at levels above background for southwest Ohio. VOCs detected during the Phase II investigation at elevated levels in the groundwater included benzene (130 ppb), ethylbenzene (15,000 ppb), toluene (62,000 ppb), cis-1,2-dichloroethene (4,100 ppb), TCE (380 ppb), and vinyl chloride (1,600 ppb).

The Phase I & II Hydrogeologic Characterizations produced the following results:

- The horizontal and vertical extent of soil contamination varied across the site.
- Shallow water-bearing zones were encountered in soils 15 to 19.5 feet below ground surface across the site.
- The hydrogeologic characteristics of these “perched” groundwater zones remain unknown.
- The horizontal and vertical extent of the groundwater contamination varies across the site.
- Groundwater and soil contamination likely extends beyond the site boundary to the east.
- The full horizontal and vertical extent of groundwater contamination remains undefined as the Phase II study was unable to explore the deeper groundwater contamination.
- The groundwater contamination associated with the site was more extensive than previously thought. It was determined that the selected remediation method of dual-phase vapor extraction may not be an effective method to treat contaminated groundwater that has traveled off-site and that may be located at greater depths below the ground surface than was previously believed.

2001 Residential Well Sampling

Between April and October 2001, the U.S. EPA sampled 30 residential wells along East Patterson Road and in the Woodhaven Subdivision in an attempt to further define the extent of the off-site groundwater contamination in the area. Samples collected were analyzed for VOCs. VOCs were detected in five of the wells sampled. Vinyl chloride was detected in one well on East Patterson Road at a concentration of 3.9 ug/l which is above the MCL of 2.0 ug/l (Table 1). This home previously was connected to the municipal water supply and the impacted well was no longer used for drinking water purposes. TCE, 1,1-dichloroethane, and methyl tert butyl ether (MTBE) were detected at levels below drinking water standards in the remaining four wells. MTBE is a gasoline additive that is more likely associated with area gas station operations than the Lammers Barrel Factory site.

2002 Administrative Order of Consent

U.S. EPA signed a consent agreement in April, 2002 with 20 companies that it considers to be

responsible for the soil and groundwater contamination at the Lammers facility. The parties involved, the Lammers Barrel Site Group (LBSG), agreed to conduct the site investigation that is part of the Superfund process. The Superfund process involves a 1) thorough site investigation (Remedial Investigation); followed by 2) a risk assessment that leads to 3) the development of a clean-up plan for the site (Feasibility Study). The proposed remedy then is provided to the public for comment before a final decision is made, 4) the site clean-up designed, and 5) implemented.

As part of the 2003 site investigation, the Lammers Barrel Site Group (LBSG) sampled 53 residential wells along East Patterson Road and in the Woodhaven subdivision. These samples were collected in May, 2003 and were analyzed for VOCs. One previously sampled well had vinyl chloride detected at 4.9 ug/l, above the MCL of 2 ug/l. This residence was connected to the public water supply in 1986 and the well had not been used as a drinking water supply since that time. Fifteen additional wells had low levels of other site-related VOCs but these levels did not exceed the MCLs for these chemicals. This sampling did, however, indicate that additional wells have the potential to become contaminated and pose a health threat to area residents in the future.

2003-2004 Remedial Investigation Sampling

Additional sampling was carried by Arcadis for the Lammers Barrel Site Group (LBSG) in 2003 and 2004 as part of the Superfund Remedial Investigation (RI). This included the installation and sampling of 15 additional on-site monitoring wells and 11 new off-site monitoring wells. On-site wells included “nested” shallow (10-20 ft below ground surface) and deep (30-50 ft bgs) monitoring wells. As indicated in Table 2, on-site monitoring well sampling results in 2003 and 2004 were similar to results obtained in 2000 by Adrian Brown. These included detections of very high levels of 1,2 DCE (11,100 ppb) and VC (7,100 ppb) in AMW-4S; high levels of hydrocarbons ethylbenzene (4,400 ppb), toluene (70,000 ppb), and xylene (23,000 ppb) in AMW-7S; and very high levels of 1,1,1 trichloroethane (7,300 ppb), 1,2 DCE (16,000 ppb), toluene (32,000 ppb), xylene (14,000 ppb), and VC (3,200 ppb) in well OW-3, all on the larger southern parcel, south of Little Beaver Creek (Figure 4).

Eleven new monitoring wells were installed off-site along the right-of-way of local streets in the Woodhaven area (Figure 5). In contrast to the very high levels of chlorinated solvents and volatile hydrocarbons detected in the shallow on-site groundwater (at depths 15-20 ft bgs), contamination of deeper off-site monitoring wells (31-56 ft bgs) was significantly less and consisted of low levels of TCE (2.0 ppb) and VC (1.3 ; 2.4 ppb) in wells along E. Patterson Road (OMW-4), Rosendale Drive (OMW-3), and Tralee Trail (OMW-6). These data (Table 3) do reinforce the idea that site-related groundwater contaminants are migrating off of the Lammers Barrel site and into adjacent neighborhoods along E. Patterson Road and in Woodhaven, posing a threat to the future safety of private drinking water wells in this area (Figure 3).

DISCUSSIONS

Exposure Assessment

Residents in the homes near the Lammers Barrel Factory site must come into physical contact

with contaminated soil or groundwater in order for the chemicals detected in these media to cause adverse health effects in these people. In order for residents to come into contact with the chemicals of concern, there must be a *completed exposure pathway*. A completed exposure pathway consists of five main parts that must be present for chemical exposure to occur. These include:

- 1) a Source of the toxic chemicals of concern;
- 2) a method of Environmental Transport, which is a way for the chemical to move from its source and bring it into contact with the residents (soil, air, groundwater, surface water);
- 3) a Point of Exposure, which is a place where the residents come into physical contact with the chemical (on-site, off-site);
- 4) a Route of Exposure, which is how the residents come into physical contact with the chemical (drinking, breathing, touching); and,
- 5) an Exposed Population, people who come into physical contact with site-related chemicals.

Physical contact with a chemical contaminant, in and by itself, does not necessarily result in adverse health effects. A chemical's ability to affect a resident's health is also controlled by a number of other factors including:

- How much of the chemical a person is exposed to (the dose).
- How long a person is exposed to the chemical (the duration).
- How often a person is exposed to the chemical (the frequency).
- The toxicity of the chemical the person is exposed to.

Other factors affecting a chemical's likelihood of causing adverse health effects upon contact include the resident's:

- past chemical exposure
- smoking, drinking alcohol, or taking certain medications
- current health status, sensitivity to certain substances
- age and sex
- family medical history

Current and former residents living along East Patterson Road and in the Woodhaven subdivision have been exposed to site-related VOCs in their drinking water in the past (Figure 3). *In the past*, 19 residential wells contained levels of VOCs, primarily vinyl chloride or TCE that exceeded federal drinking water standards (MCLs) and posed a *Public Health Hazard* to these residents (Table 1). While MCLs are only enforceable for public drinking water supplies, HAS uses MCLs as screening levels for determining whether or not a contaminated private drinking water well poses a health threat to residents.

Based on a review of groundwater sampling conducted at the site, it appears that every home that had a well with contaminant levels exceeding MCLs has been connected to the municipal drinking water supply; eliminating the public health hazard *currently* posed by drinking well water contaminated by site-related chemicals (Table 1). Three private wells along E. Patterson Road, previously determined to be contaminated and no longer used as drinking water wells, were resampled by Ohio EPA in May and June, 2005. Two of these three wells still had chemicals of concern at levels that exceeded MCLs (Ohio EPA, pers. comm., 2005). Several wells in the Woodhaven subdivision contain low levels of site-related VOCs, including TCE, 1,1,1-TCA, and xylenes. To date, none of these wells have had detections of VOCs that exceed MCLs or other drinking water screening levels. Without remediation or removal of the source of the groundwater contamination from the Lammers property, the potential exists for additional residential wells to become contaminated with site-related chemicals and pose a health threat to area residents *in the future*.

Toxicology of the Chemicals of Concern

Site-related chemicals of concern found in the groundwater plume associated with the Lammers Barrel Factory site include trichloroethylene (TCE), vinyl chloride (VC), and 1,2 dichloroethene (DCE). These chemicals are all man-made volatile organic compounds (VOCs). TCE is partially soluble in water and is heavier than water. When spilled on the ground, it will either rapidly vaporize to a gas upon exposure to the air or soak into the underlying soils. Significant rainfall events can flush TCE deeper into soils and then into the groundwater, potentially contaminating drinking water supplies that are obtained from groundwater. As it is denser than water, TCE typically sinks through the groundwater and accumulates at the bottom of the aquifer. As it travels further below the ground surface into low oxygen areas, TCE can be degraded into a variety of other chemicals by bacteria. TCE typically breaks down to 1,2 dichloroethene (DCE) and vinyl chloride (VC) (Vogel and McCarty, 1985). As indicated above, all three chemicals have been detected in the groundwater under the Lammers Barrel site and in a number of adjacent off-site drinking water wells along Patterson Road and in the Woodhaven subdivision.

These VOCs can occur in groundwater but can also vaporize off of the groundwater into the air spaces in the soil and migrate upward as soil gas into the basements of nearby residences. Once in the basements, contaminants may be distributed throughout the home and into the breathing air of the residents. This process is termed vapor intrusion (USEPA, 2002).

Trichloroethylene (TCE)

The primary use of TCE has been for the degreasing of metal parts and its use has been closely associated with automotive and metal-fabricating industries from the 1950's through the 1970's. It was used by itself or mixed with other chemicals as a solvent to remove grease, oils, waxes, inks and tars. TCE was also component of adhesives, lubricants, paints, varnishes, paint strippers, cold metal cleaners, and even was used as a surgical anesthetic and disinfectant. When spilled on the surface, most of the TCE will vaporize into the air where it will chemically break-

down within a week. TCE is, however, relatively mobile in soils and can be flushed readily down to the water table. TCE is a common groundwater contaminant at many hazardous waste disposal sites in Ohio, including the Lammers Barrel Factory site.

TCE was most recently classified by US EPA as a B2 carcinogen – *a probable human cancer-causing agent*. However, the cancer classification of TCE has been withdrawn and is currently under review by US EPA. The current US EPA drinking water standard (MCL) for TCE is 5.0 parts TCE per billion parts of water (= 5 ppb).

The health effects from drinking and inhaling low levels of TCE over long periods of time remain poorly-documented and controversial (ATSDR, 1997). A study of residents in Woburn, Massachusetts associated excess cases of acute lymphocytic leukemia in children with their mother's exposure to elevated levels of TCE (183-267 ppb) in a public drinking water well over the course of 5 to 10 years (Lagako et al., 1984). The impacted well also contained low levels (< 50 ppb) of the chemicals perchloroethylene, 1,2 DCE, and chloroform. Statistically significant excess leukemia cases in females were associated with residents exposed to TCE and other VOCs, both in their drinking water and from factory air emissions in New Jersey (Fagliano et al., 1990). A health study conducted by ATSDR (2003) of birth defects and childhood leukemia in children born to parents stationed at Camp Lejeune Marine base between 1975 and 1988 linked an increased incidence of these adverse health effects to the parents exposure to high levels of TCE (up to 1,400 ppb), perchloroethylene (up to 407 ppb), and 1,2 DCE (up to 215 ppb) in the base public drinking water supply (ATSDR, 2003).

Consecutive surveys of self-reported health effects from over 4,000 residents at 15 sites in five states exposed to TCE through their drinking water (at levels of from 3.0 to 24,000 ppb) for varying periods of time (7-20 years) failed to link these exposures with the development of excess cancer cases. Non-cancer health effects tentatively linked to TCE exposure included an increased incidence of strokes, diabetes, some increased incidence of liver and kidney disease, and urinary tract disorders (ATSDR, 1999)

Concentrations of TCE found in residential well water near the Lammers Barrel Factory site (up to 24 ppb) are significantly less than those in the examples cited above. The potential health impacts from exposures to TCE at the levels in these wells are largely unknown. The length of time people were using these TCE-contaminated wells is also unknown for some of these wells. However, several of these wells (Kenora Circle and Rosendale Drive) were sampled several times since 1985 and only recently (1997) had detections of TCE. These residences, like others with contaminated wells, were quickly hooked up to the county public water supply by US EPA. For these residences, exposures were likely limited to a time period of less than 10 years.

1,2 Dichloroethene (DCE)

This chemical has been manufactured as a chlorinated solvent, but at the Lammers Barrel site is believed to be present as a by-product of the anaerobic biodegradation of the solvent TCE in

groundwater. DCE, like TCE, readily vaporizes upon exposure to air and significant rainfalls will wash it through sandy, gravelly soils to the underlying groundwater. Both the *cis*- and *trans*- varieties of 1,2 DCE have been detected in groundwater at the Lammers Barrel. Cis- 1,2 DCE is classified by US EPA as a Class D carcinogen as there is no data that indicates that this chemical promotes tumor formation in the body (ATSDR, 1996). Trans- 1,2 DCE is also classified as not being a human cancer-causing chemical.

There is no significant research documenting the adverse health effects in humans from drinking DCE-contaminated water. Occupational studies indicate central nervous system dysfunction in workers breathing very high levels of DCE in the air (1,000 to 2,000 parts per million). The concentrations of 1,2 DCE found in residential wells near the Lammers Barrel Factory site are comparatively low (< 300 ppb) but did exceed federal drinking water standards for this chemical (MCL = 70 ppb) in several wells along East Patterson Road. However, as these levels are below USEPA drinking water standards based on non-cancer health effects, these exposures are not likely to have resulted in adverse health effects in these residents.

Vinyl Chloride (VC)

Vinyl chloride is a man-made chemical, typically a sweet-smelling colorless gas that is used in the manufacture of polyvinyl chloride (PVC) products. As indicated above, it also forms as the result of the biological breakdown of chlorinated solvents like TCE in groundwater under oxygen-poor conditions that increase with depth below the ground surface (Smith and Dragun, 1984; Vogel and McCarty, 1985). It is likely that the bulk of the vinyl chloride at the Lammers Barrel site and in the adjacent off-site groundwater contaminant plume is the result of the breakdown of TCE and other chlorinated solvents in groundwater under the site. TCE is broken down by bacteria and one of the primary by-products of this breakdown is VC, the other being 1,2 DCE. VC is a gas but can dissolve in the groundwater. Vinyl chloride does not readily absorb to soil particles. When the groundwater comes into contact with the air, VC will be quickly released as a gas. When it is released to the ambient air, it is quickly degraded in the presence of certain chemicals and sunlight.

Vinyl chloride is currently classified as a Group A carcinogen – a *known human cancer causing agent* – by the US EPA and the US Department of Health & Human Services based on evidence from both human occupational studies and animal laboratory studies (ATSDR, 2004). Occupational studies of workers in the vinyl chloride industry in the 1970's (Creech and Johnson, 1974; Health et al., 1975; Fox and Collier, 1977) demonstrated a link between chronic occupational exposure to very high levels of VC in the air in an enclosed environment (estimated concentrations of VC at several thousand parts per million) and the development of hepatic angiosarcoma, a rare and fatal form of liver cancer. Besides liver cancer, workers exposed to very high levels of VC in the air on a regular basis also developed “vinyl chloride disease”. Symptoms included liver abnormalities; the degenerative loss of bone from the tips of fingers; plus the formation of skin lesions and nodules on the hands and forearms. Additional studies of workers in the VC industry indicated less conclusively an association between exposures to high

levels of VC vapor and the development of cancers of the brain, lungs, and digestive tract (Wagoner et al., 1980; Wong et al., 1991).

In contrast to occupational studies of human exposures to VC via the inhalation route, no similar epidemiological studies have indicated associations between drinking VC-contaminated water and the development of cancers in humans. Similarly, no studies could be found linking oral exposure to VC in humans with the development of neurological, developmental, reproductive, genotoxic, or dermal health effects (ATSDR, 2004). However, studies of laboratory rats fed large doses of VC as PVC powder led to statistically-significant increases in the incidence of liver cancer in these animals (Feron et al., 1981; Maltoni et al., 1981; Til et al., 1983).

Based on the evidence of carcinogenicity in animals after oral exposure, both the Department of Health & Human Services (2005) and the US EPA (2006) have considered it prudent public health practice to consider the potential for carcinogenic effects in humans by this route as well as via inhalation. US EPA's current weight-of-evidence characterization of VC concludes that VC is a known human carcinogen by the inhalation route based on human epidemiological studies and is considered to be carcinogenic by the oral route based on positive laboratory animal test data.

On this basis, US EPA established a public drinking water Maximum Contaminant Level goal of zero for VC in public drinking water supplies. The actual MCL for VC has been established to be 2.0 parts VC per billion parts of water (= 2ppb). This concentration has also been adopted as the Removal Action Level (RAL) for VC in drinking water at federal Superfund sites by US EPA (1997). The US EPA Drinking Water Equivalent Level (DWEL) for non-cancer health effects resulting from a life-time of drinking water contaminated with VC is 100 ppb. The US EPA One-Day and Ten-Day Health Advisories for children drinking VC contaminated water (=acute exposure scenario) are both at 3,000 ppb (USEPA, 2006).

The ATSDR has also developed Cancer Risk Evaluation Guide (CREG) numbers for specific carcinogens that calculate at what levels exposure to the chemical could result in additional cancer cases per million people (1×10^{-6} risk). The CREG for VC in drinking water is only 0.03 ppb (ATSDR, 2004). VC levels in 12 area wells exceeded this value in the past. As indicated above, a "streamlined" risk assessment was carried out as part of the EE/CA study in 1997. This USEPA risk assessment determined that significant cancer risks were associated with use of groundwater contaminated with VC for drinking water and general household purposes.

VC has historically been detected at levels up to 320 ppb in several residential wells along East Patterson Road, immediately east of the Lammers site. VC has been detected in 12 area wells. Most wells that have been sampled in the area either did not detect VC in the water or detected it at levels less than 15 ppb. Residents with VC levels in their well water in excess of the MCL have all been hooked up to the public water supply (Table 3). The duration of exposure to VC in well water in the past is unknown. Although HAS calculated cancer risk numbers for VC were

exceeded in 12 area wells, the likelihood and nature of the adverse health effects possibly resulting from these exposures remain largely unknown.

Current Exposure Concerns

The current configuration of the groundwater plume in the vicinity of the Lammers Barrel site, East Patterson Road, and the northwest corner of the Woodhaven subdivision, is problematic. Past experience with similar chlorinated solvent plumes have demonstrated the highest concentrations of the “parent” solvent (PCE or TCE) are nearest to the source. Concentrations of the “daughter” break-down products (1,2 DCE and VC) increase with greater distance and depth away from the source. The configuration of the plume associated with the Lammers Barrel site is the reverse, with highest levels of the breakdown products 1,2 DCE and VC nearest the site and along E. Patterson Road (Figure 6). Detections of low levels of TCE occur further to the south and east in the Woodhaven subdivision (Rosendale, Kenora Circle, Stanwick, and Tralee Trail).

Historical sampling data from residential wells in the area is suggestive of the possibility that two more or less distinct plumes might be impacting local wells. One originates with the Lammers Barrel site, having 1,2 DCE and VC as the contaminants of concern, and extending nearly due east of the site along E. Patterson Road. The second appears to extend southwest to northeast across the northwest corner of the Woodhaven subdivision and having TCE as the primary chemical of concern. The two plumes appear to merge along East Patterson Road in the vicinity of Tralee Trail. The source of this potential second plume is unknown. A more detailed hydrogeologic study of this contaminant plume is recommended to insure that there is only one current source of groundwater contamination is impacting well quality in the Woodhaven neighborhood.

In past years, the Lammers Barrel Factory site was unfenced and provided unrestricted access to area residents. Visible trash and worn trails indicated that some residents may have trespassed on the site. Prior to the onset of remedial actions at the site in 2001, the site was covered with dense growth of vegetation, probably limiting potential exposure of trespassers to on-site contaminated soils. A fence was later erected at the site and limited access, although, the site was still accessible to entry along the creek bank where there was no fence. Previous environmental sampling has indicated that there are two main areas of soil contamination on the facility property. Data indicates that most of the on-site soil contamination is located approximately 4 to 10 feet below ground surface. It is unlikely that residents would have been exposed to this contamination, however soil contamination at the site has not been completely characterized and it is not known with any certainty if surface soils are present on-site that contain levels of contaminants that could have posed a health threat to trespassing residents. The site was fully fenced when it was listed on the NPL and currently restricts access to residents. The site remedial investigation recently completed at the site should provide data which will more fully characterize the extent of soil contamination on-site.

Another exposure pathway that should be considered is vapor intrusion. Because VOCs have been detected in the groundwater beneath several residential homes in an area where groundwater is relatively shallow (15-25 feet bgs), investigations should be conducted to evaluate whether the possibility exists that the chemicals in the groundwater are volatilizing and moving through preferred pathways in the soil and entering the indoor air of the overlying residences. With increasing distance from the site, it appears unlikely that vapors could migrate into the overlying homes due to a layer of clay soil that separates the homes from the sand and gravel aquifer that they obtain their drinking water from. The clay layer is likely largely impermeable and may provide a protective barrier from vapor migration (U.S. EPA, 2002). However, this pathway should not be arbitrarily ruled out and should be more fully investigated to ensure that residents are not being impacted by vapor intrusion coming off the contaminated groundwater.

COMMUNITY HEALTH CONCERNS

HAS staff attended and participated in at least three public meetings with regard to the Lammers Barrel Site in 1996, 1998, and 1999. There have been no public meetings with regard to the site since it was listed as a Superfund site in 2003. In the past, HAS sent out a well survey to area residents to gather their concerns about the site (HAS, 1996B). Most of the concerns of residents at that time had to do with water quality (aesthetics) and not exposure to carcinogens or probable carcinogens in the well water. One resident whose well was contaminated and whose home was subsequently connected to municipal water expressed concern about using their contaminated well for irrigation for their yard and garden. Due to the low levels of VOCs in their well and the likelihood that chemicals present in their well would volatilize upon exposure to the air, the residents were informed that using the well for irrigation purposes likely posed no health threat through this route. Most of the people living in the area at that time were very familiar with the site and had minimal concerns about it. The exposed population in the community to date consist of the past occupants of 19 residences and health concerns, cancer or non-cancer, in this exposed population have been minimal or lacking so that no community cancer assessment was ever done for this particular community. In addition, most of the people exposed to groundwater contamination in wells identified back in 1986, retired years ago and have passed away or moved out of the area. Since residential well contamination was first discovered in 1985, the U.S. EPA has been proactive in seeing that all homes that have been found to have detections of site-related VOCs have been connected to the municipal water supply (Table 1). The small number of exposed residents also makes it statistically difficult to calculate meaningful cancer rates for these residents. As a result, there is no health outcome information for the exposed community.

The Draft Lammers Public Health Assessment document was made available for public comment from October 21, 2008 through December 22, 2008 at the USEPA site repository (the Beavercreek Community Library, 3618 Dayton-Xenia Road in Beavercreek, Ohio) and on the ODH web location. A total of 14 comments were received; 6 comments from the Ohio EPA Site Coordinator for the Lammers Barrel Factory site and 7 from the community. None of the respondents who expressed cancer concerns in the 2008 Public Comment PHA lived within or in close proximity to the documented area of groundwater contamination. All Ohio EPA comments and response to comments can be found in the Appendix of this document. This public health assessment focuses on environmental data from sampling conducted as late as 2004 and prior to USEPA's recently approved Remedial Investigation (RI) Report Addendum, September, 2008. USEPA and PRP investigations have new information that will be considered in a follow-up Health Consultation.

CHILDRENS HEALTH CONSIDERATIONS

ATSDR and HAS recognize the unique vulnerabilities of children exposed to environmental contamination and hazards. As part of this health assessment, HAS considered the greater sensitivity of the children in the area when drawing conclusions and making recommendations

regarding health effects from exposure to chemicals related to the former Lammers Barrel Factory.

CONCLUSIONS

- *In the past*, the groundwater contamination associated with the former Lammers Barrel Factory posed a “*Public Health Hazard*” to residents using contaminated private wells as their drinking water source along East Patterson Road and in the Woodhaven subdivision where their well water contained levels of vinyl chloride and trichloroethylene above US EPA drinking water standards and/or ATSDR Cancer Risk Evaluation Guides. Elevated levels of vinyl chloride detected in some of these wells in the past likely posed an increased cancer risk to residents drinking this water.
- *Currently soil contamination* on the former Lammers Barrel Factory poses *No Apparent Public Health Hazard* to area residents as the site is now fully fenced, limiting access to contaminated on-site soils. The *hazard to on-site workers* is currently an “*Indeterminate Public Health Hazard*” as the extent of surface soil contamination at the site has not been completely characterized.
- *Off-site groundwater contamination currently* poses an “*Indeterminate Public Health Hazard*” to area residents. Based on well sampling data received to date, it does not appear that any area residents are currently being exposed to contaminated drinking water at levels that would be expected to cause adverse health effects. However, the potential exists for additional wells to be impacted *in the future* if the source of the groundwater contamination is not remediated, contained, or removed.
- In addition to the drinking water pathway, a data gap also exists with regard to potential vapor migration from the contaminated groundwater into the overlying homes, especially in those in close proximity to the Lammers Barrel Factory site.

RECOMMENDATIONS

- The Lammers Barrel Site Group should fully characterize the soil and groundwater contamination at the site to determine both the full horizontal and vertical extent of the contamination.
- The source(s) of groundwater contamination under the site should be identified and remediated to eliminate future offsite groundwater contamination.
- The Lammers Barrel Site Group should further investigate the extent of off-site groundwater contamination. Residential wells are not an appropriate sampling device for the determination of the full extent of a groundwater plume. Groundwater samples should be collected at off-site locations at various depths to determine the vertical as well as horizontal extent of groundwater contamination.

- The curious distribution of the contaminants of concern in off-site areas should be more fully investigated to insure that all likely contaminant sources are identified and remediated as part of the RI/FS process.
- The Lammers Barrel Site Group should evaluate the vapor intrusion pathway to determine if the potential exists for VOC vapors to migrate from the contaminated groundwater into the overlying homes.
- Residential well sampling should be continued to insure that additional residential wells do not become contaminated during the course of the clean-up process.

PUBLIC HEALTH ACTION PLAN

The U.S. EPA and Ohio EPA are currently overseeing the Superfund Remedial Investigation/ Feasibility Study process being conducted by the Lammers Barrel Site Group under an agreement with the US EPA. The investigation is designed to characterize the extent of on and off-site contamination and to develop a plan to contain, reduce, or eliminate the chemical contamination coming from the site. HAS will review any additional environmental data collected and provide recommendations to limit or prevent exposure to area residents. HAS will attend any future public meetings to gather community concerns and answer questions related to human exposure to the chemicals of concern at the Lammers Barrel site.

PREPARED BY

Peter J. Ferron – Environmental Specialist
Robert C. Frey, Ph. D. – Principal Investigator/Reviewer

CERTIFICATION

The Ohio Department of Health prepared this Health Assessment, Lammers Barrel Factory, under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). At the time this Health Consultation was written, it was in accordance with the approved methodologies and procedures. Editorial review was completed by the Cooperative Agreement partner.



Technical Project Officer, Cooperative Agreement Team, CAPEB, DHAC, ATSDR

The Division of Health Assessment and Consultation, ATSDR, has reviewed this public health consultation and concurs with the findings.



Team Leader, Cooperative Agreement Team, CAPEB, DHAC, ATSDR

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TABLE 1
Maximum contaminant levels from historical Residential Well Sampling Results,
Lammers Barrel Factory Site (1985-2004)

Residential Well Location	Maximum Concentration of Chemical Detected (ppb)	US EPA Public Drinking Water Standard (ppb)	Home hooked up to Public Water?
East Patterson Rd			
RES 1	TCE = 12 (1988)	5	Yes
RES 2	VC = 50 (1992)	2	Yes
RES 3	VC = 4 (2001)	2	
RES 4	VC = 15 (1985)	2	Yes
RES 5	VC = 6 (1985)	2	Yes
RES 6	VC = 12 (1985)	2	Yes
RES 7	VC = 78 (1985)	2	Yes
RES 8	VC = 103 (1997)	2	Yes
RES 9	VC = 176 (1985) c-DCE = 210 (1992)	2 70	Yes
RES 10	VC = 320 (1985) c-DCE = 210 (1992)	2 70	Yes
Stanwick Drive			
RES 11	TCE = 15 (1985)	5	Yes
RES 12	VC = 6 (1985)	2	Yes
Kenora Circle			
RES 13	TCE = 1.3 (1997)	5	Yes
RES 14	TCE = 2 (1997)	5	Yes
RES 15	TCE = 6 (1997)	5	Yes
RES 16	VC = 3 (1985)	2	Yes
Rosendale Drive			
RES 15	TCE = 3.3 (1997)	5	Yes
RES 17	TCE = 5.3 (1997)	5	Yes
RES 19	TCE = 12.9 (1997)	5	Yes
RES 20	TCE = 7.4 (1997)	5	Yes
Tralee Trail			
RES 18	TCE = 11 (1985)	5	
RES 19	TCE = 24 (1985)	5	Yes

ppb = Parts of chemical per billion parts of water
TCE = Trichloroethylene
c-DCE = cis 1,2 Dichloroethene
VC = Vinyl chloride

TABLE 2
On-Site Groundwater Monitoring Well Sampling Results,
Lammers Barrel Factory Site, (2003-2004)

Monitoring Well Number	Depth to sample (feet bgs)	2003 Sample Results (ppb)	2004 Sample Results (ppb)	US EPA Superfund Removal Action Levels (ppb)
AMW-2S	9-14	Ethylbenzene = 1,300	Ethylbenzene = 1,300	1,000
AMW-4S	15-20	Ethylbenzene = 790 c-DCE = 7,200 t-DCE = 4,700 VC = 7,100	Ethylbenzene = 1,000 c-DCE = 2,600 t-DCE = 4,700 VC = 2,600	1,000 400 600 2
AMW-6S	15-20	c-DCE = 920 VC = 120	c-DCE = 620 VC = 110	400 2
AMW-7S	13-18	Benzene = 390 Ethylbenzene = 4,400 Toluene = 70,000 TCA = 1,700 c-DCE = 3,200 TCE = 280 VC = 160	Benzene = ND Ethylbenzene = 4,600 Toluene = 65,000 TCA = 1,200 c-DCE = 1,700 TCE = ND VC = ND	100 1,000 2,000 1,000 400 300 2
AMW-7D	33-38	TCE = 1,100 VC = 5	TCE = 600 VC = ND	300 2
OW-1	19-24	c-DCE = 870 VC = 1,000	Not Sampled	400 2
OW-3	13-18	Benzene = 140 Ethylbenzene = 3,000 Toluene = 32,000 TCA = 7,300 c-DCE =	Not Sampled	100 1,000 2,000 1,000 400 2

		16,000 VC	= 3,200		
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Bgs = feet below the ground surface

ppb = Parts chemical per billion parts of water

ND = Chemical Not Detected

c-DCE = cis 1,2 Dichloroethene

t-DCE = trans 1,2 Dichloroethene

TCA = 1,1,1 Trichloroethane

TCE = Trichloroethylene

VC = Vinyl chloride

TABLE 3
Off-site Groundwater Monitoring Well Sampling Results,
Lammers Barrel Factory Site, May 20, 2004

Monitoring Well	Sampled Interval (feet bgs)	Sampling Results (ppb)	Federal Drinking Water Standard (ppb)
OMW-01 (Richfield Center)	43-48 (69 ft)	ND	
OMW-02 (Rockfield Drive)	31-36 (69 ft)	ND	
OMW-03 (Rosendale Drive)	45-50 (69 ft)	TCE = 2.0	5.0
OMW-04 (E.Patterson Road)	46-51 (89 ft)	VC = 2.4	2.0
OMW-05 (Kenora Circle)	41-46 (69 ft)	TCE = 0.38	5.0
OMW-06 (N. Tralee Trail)	51-56 (69 ft)	VC = 1.3	2.0
OMW-07 (Patterson & Fergus)	40-45 (69 ft)	ND	
OMD-08 (Fergus Drive)	30-35 (69 ft)	ND	
OMD-09 (S. Tralee Trail)	31-36 (69 ft)	ND	
OMD-10 (Rockdell Court)	31-36 (69 ft)	ND	
OMD-11 (Rexford Road)	31-36 (69 ft)	ND	

bgs = depth below the ground surface
ppb = Parts chemical per billion parts of water
ND = Chemical not detected in sample
TCE = Trichloroethylene
VC = Vinyl chloride

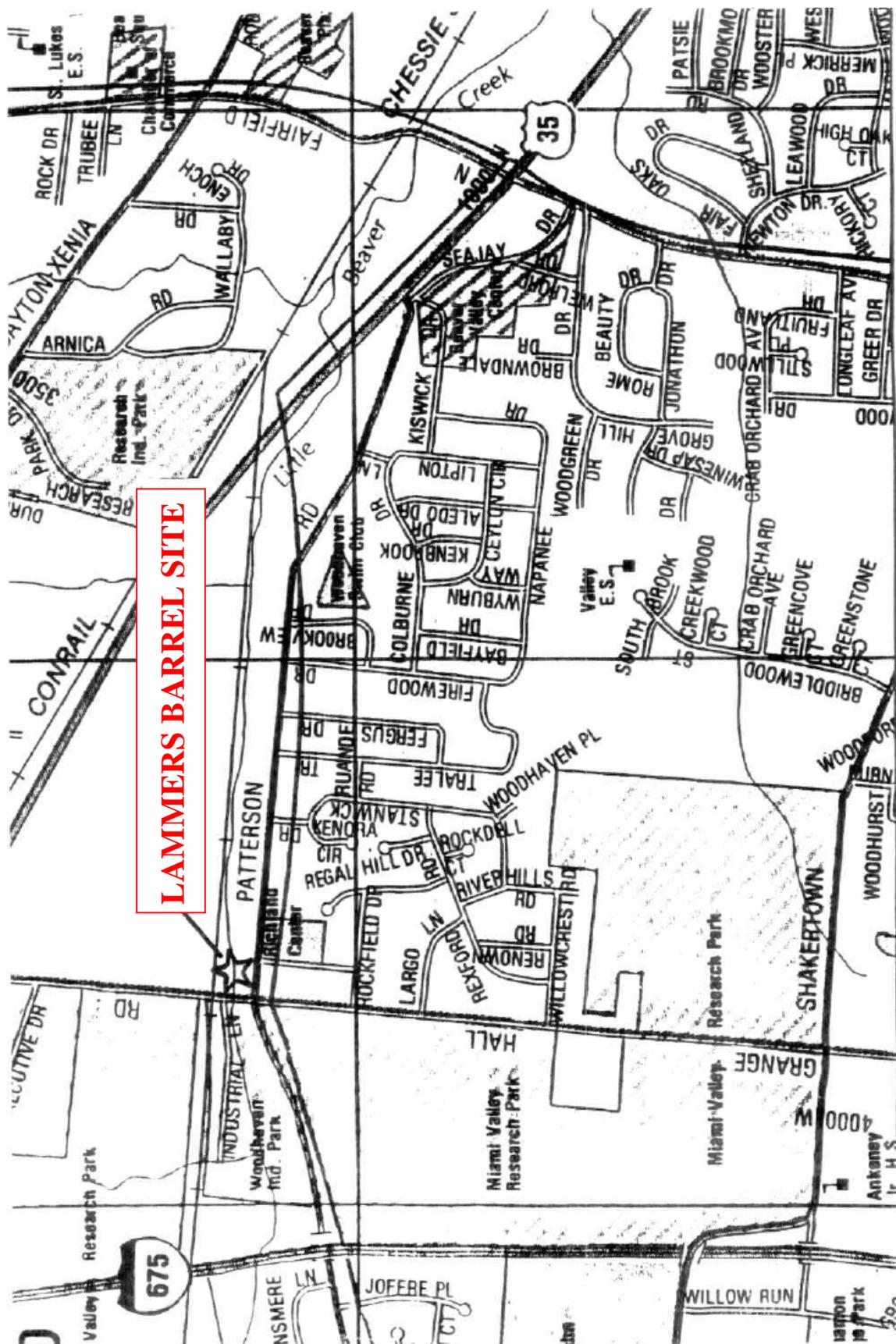
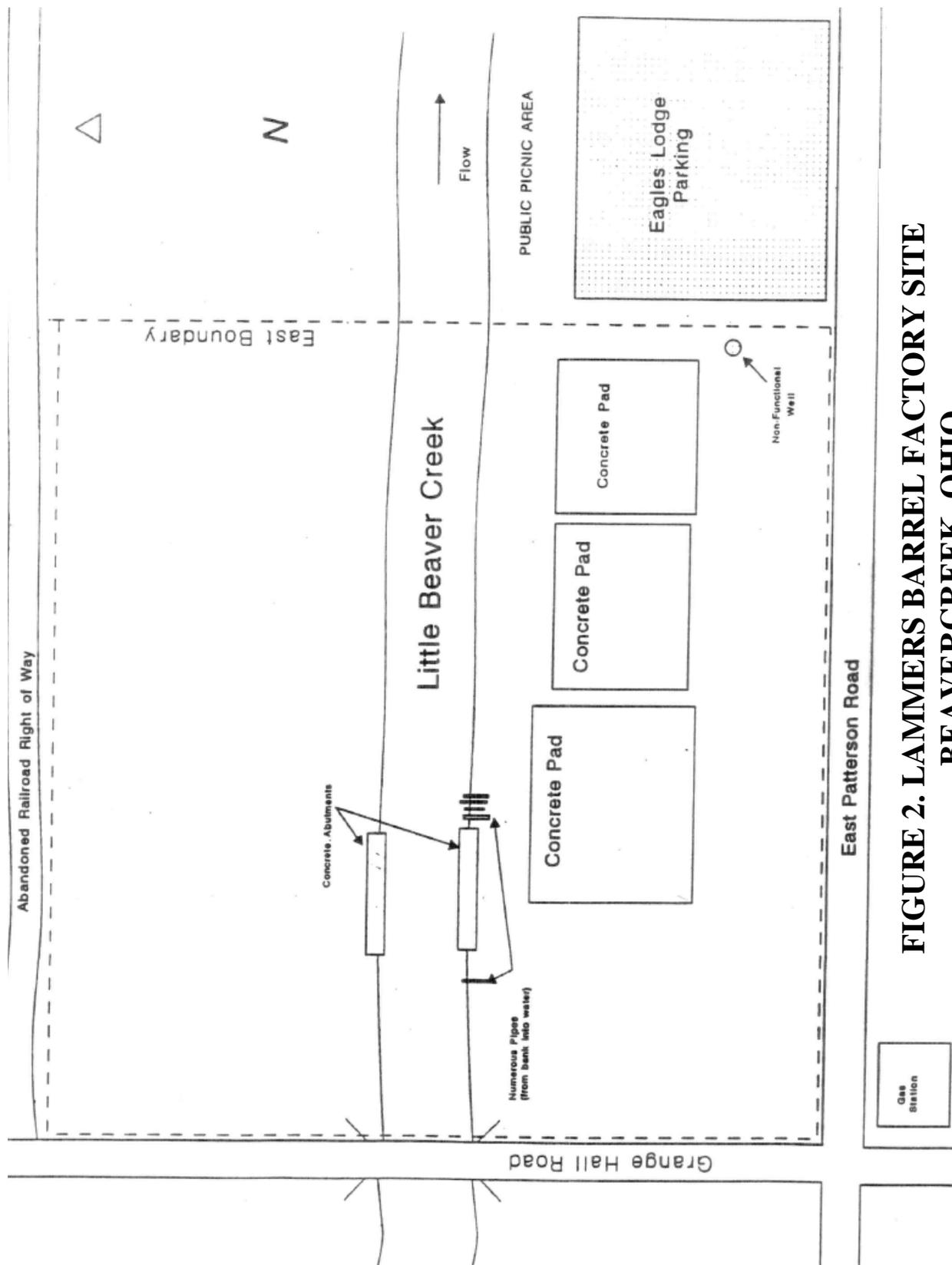


FIGURE 1. SITE LOCATION MAP



**FIGURE 2. LAMMERS BARREL FACTORY SITE
BEAVERCREEK, OHIO**



FIGURE 3. LOCATION OF HOMES CONNECTED TO COUNTY WATER – WOODHAVEN SUBDIVISION

Homes using county water

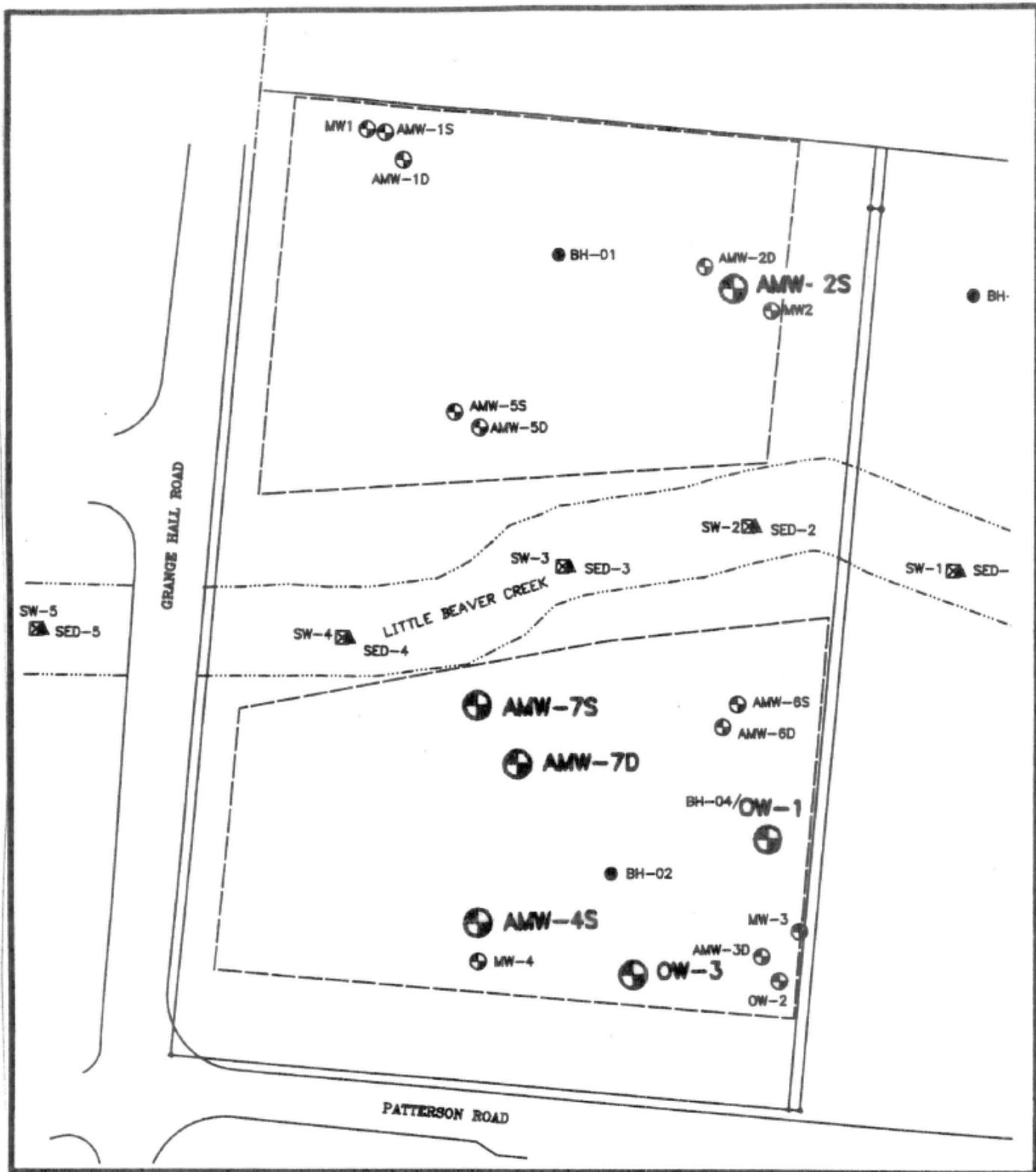


FIGURE 4. ON-SITE MONITORING WELL LOCATIONS

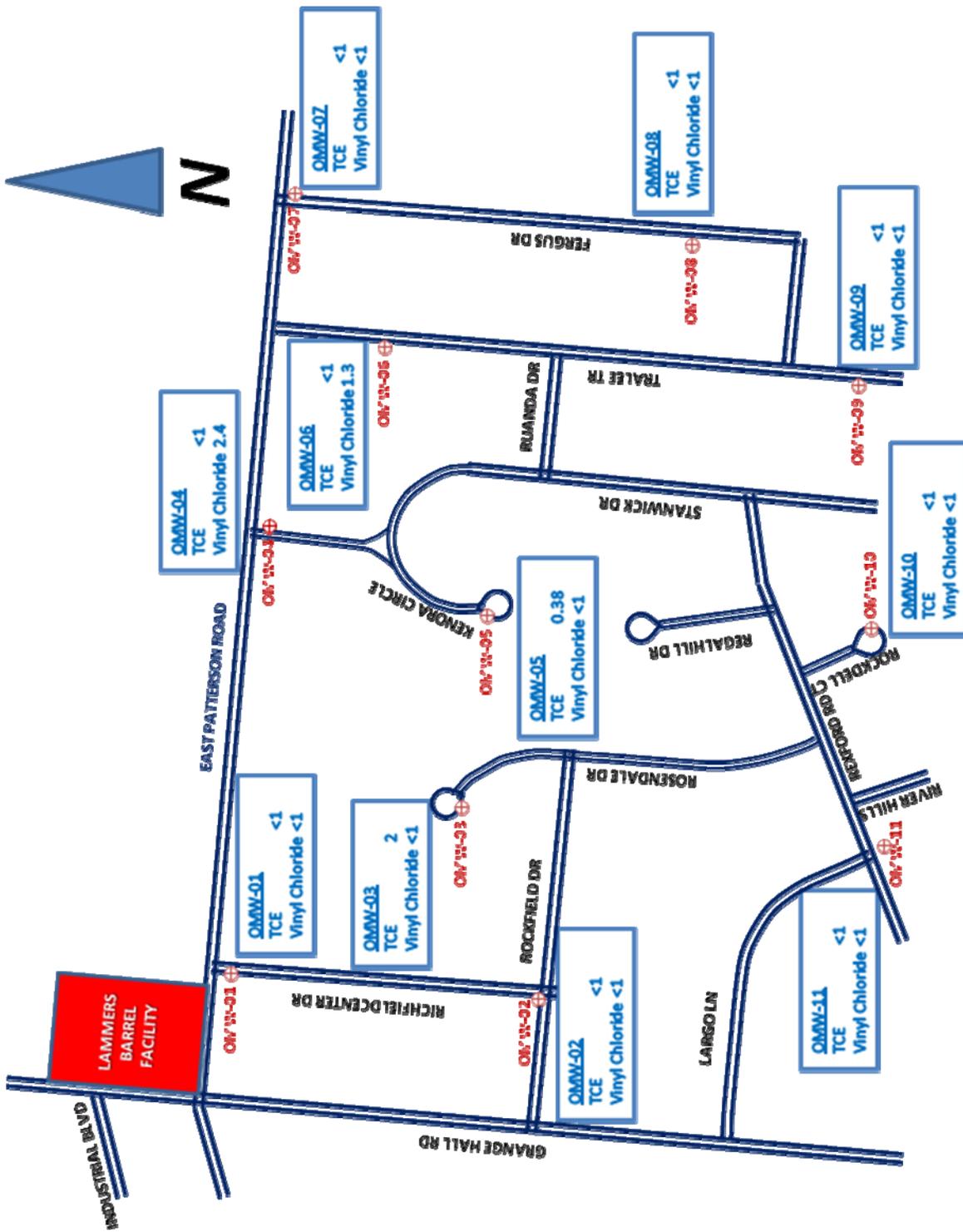


FIGURE 5. OFF-SITE GROUNDWATER RESULTS, MAY 2004
LAMMERS BARREL FACILITY, BEAVERCREEK, OHIO



FIGURE 6. EXTENT OF RESIDENTIAL WELL CONTAMINATION - WOODHAVEN SUBDIVISION

□ Contaminated Wells

APPENDIX

The public was asked to review this Public Health Assessment for the Lammers Barrel Factory site and provide comments and questions. It was made available for public comment from October 21, 2008 until December 22, 2008 and copies of the assessment were located at the Beavercreek Community Library, 3618 Dayton-Xenia Road, Beavercreek, Ohio, 45432, and at the Ohio Department of Health web site. The purpose of the comment period was to provide the community with an opportunity to express what health concerns they have, including suspected exposures and the health effects of exposures.

Several comments or questions were received from the community regarding suspected exposures or health effects from exposures from the Lammers Barrel Factory site. There were a total of 14 comments received; 6 comments were received from the Ohio EPA Site Coordinator for the Lammers Barrel Factory site and 7 comments from community members.

It is important to note that this health assessment focuses on environmental data from sampling and investigations conducted as late as 2004 and prior USEPA's recently approved Remedial Investigation (RI) Report Addendum, September, 2008. The USEPA and the PRPs have recently completed the Remedial Investigation (RI) and are currently working on the Feasibility Study (FS). The RI has provided new data that will be used to clean up the site and which will be reviewed and evaluated in a follow-up Health Consultation for this site.

Public Comments
Public Health Assessment Lammers Barrel Factory Site
September 22, 2008 Draft

The Ohio Department of Health (ODH), Health Assessment Section (HAS) produced two Health Consultations (HCs) for the Lammers Barrel Factory Site in 1996 and a draft Public Health Assessment (PHA) document in 2008. The second Health Consultation in 1996 presented results of a survey that indicated that most residents in the area used well water as their drinking water supply. The HCs also recommended sampling additional private wells to determine if their drinking water was contaminated. If any wells were found to be contaminated, the recommendation was to supply an alternative drinking water source to the residents. Additionally, the HCs and draft PHA recommended that the source of the contamination be fully characterized and cleaned up.

The 2008 draft PHA identifies and documents the current, past, and potential future health threats posed by the Lammers Barrel Factory Site contamination. The general purpose of the 2008 draft PHA is to evaluate environmental data and make conclusions and recommendations to protect the public health of area residents. ODH HAS does not have a regulatory role at the Lammers Barrel Factory site. ODH HAS has no regulatory authority to conduct sampling or the clean-up of hazardous waste sites. This authority has been given to Ohio EPA and USEPA. By reviewing the available environmental data and documenting our public health conclusions and recommendations, our intent is that our regulatory agency partners consider our recommendations when developing their plans for site investigation and clean up. Please review our Conclusions and Recommendations found on Pages 19 and 20 of the 2008 PHA.

The U.S. EPA Remedial Investigation has recently been completed (September 2008) and the U.S. EPA Remedial Response Branch is the lead agency. Please contact the U.S. EPA Remedial Project Manager, Timothy Fischer, for an update on the site investigation and cleanup progress. Or visit the U.S. EPA Superfund Web site for Lammers Barrel Factory at: <http://cfpub.epa.gov/supercpad/cursites/csitinfo.cfm?id=0504896> .

1. **Comment:** My mother, father, and I lived about a half mile to the southeast of the Lammers Barrel Factory site in the 1960's and 1970's. Is it possible that the contamination from the Lammers Barrel Factory could have spread as far as our home when we were living there (address withheld for privacy)?

Response: Wells throughout the area were sampled for site-related chemicals in the 1980's and 1990's. Samples were taken from the Lammers Barrel Factory site, east along East Patterson Road to Fairfield Road, and in the neighborhood southeast of the

site. Sample results indicated the contamination plume slowly migrated (moved) in an easterly direction from the Lammers Barrel Factory site, along the north side of Patterson Road, toward Trailee Trail. Initial and extensive subsequent sampling of area groundwater provides no evidence that site-related chemicals have ever made it east of Trailee Trail in the Woodhaven subdivision.

2. **Comment:** My mother, father, and I were diagnosed with cancers in 1980 within 2 months of each other. Could exposure to this site's contamination have caused this rare occurrence of cancer?

Response: Unfortunately, cancer is not a rare disease. Cancer is the second-leading cause of death in the United States and it is estimated that half of all men and one-third of all women in the United States will develop cancer during their lifetimes. It is important to keep in mind that cancer is not one single disease but is a group of many diseases that develop and grow at different rates and respond to different treatments (lung, breast, skin, cervical, liver, throat, colon and rectum, pancreas, etc.). It is also important to note that different chemicals can cause different types of cancer. For instance, benzene is a known to cause cancers (carcinogen) of the blood (leukemia and lymphoma). So it would be important to note what type(s) of cancers you and your family had. Due to the fact that you and your family lived well east of the known extent of the groundwater contamination associated with the Lammers Barrel Factory site, it would be very difficult to link these cancer diseases to the Lammers Barrel site.

3. **Comment:** Are there currently potential exposures to contamination from well water and indoor air and are there increased susceptibilities of health affects for family members from exposures when they have other health problems? Our son is experiencing health problems, our daughter has multiple disabilities, and I have had cancer in the past.

Response: As you point out, there are people who are more sensitive to the affects of chemical exposure. Established safe levels of chemicals have been conservatively selected with a consideration of people who may be more sensitive to exposures, such as children, the elderly, pregnant women/unborn, and people with pre-existing medical conditions. It is important to note that all residents whose wells were found to have levels of contamination that pose a health risk were provided an alternative water supply. Your identified address indicates that you lived outside the area of contamination and no wells in your immediate area have detected the site-related chemicals of concern.

4. **Comment:** Is there a potential exposure to contaminants from vapor intrusion of the contaminants from the groundwater into our home (address withheld for privacy)?

Response: Vapor intrusion refers to the vapors produced by a chemical spill or leak that make their way into indoor air. When chemicals are spilled on the ground or leak from an underground storage tank, they will seep into the soils and will sometimes make their way into the groundwater (underground drinking water). These vapors can travel in the groundwater and through soils, especially if the soils are sandy, gravelly or have a lot of cracks (fissures). These vapors can then enter a home through cracks and joints in the basement floors and walls or directly into homes with dirt floors. Since 1985, numerous sampling events in the area have provided evidence that no site-related groundwater contamination has made it east of Trailee Trail. In the last paragraph of the “Current Exposure Concerns” section of the draft 2008 Public Health Assessment (PHA), it points out that there is a near-surface clay layer that likely provides a protective barrier and prevents vapors traveling from the contaminated groundwater into nearby homes. However, it also states that although this pathway is unlikely, it should be fully investigated.

5. **Comment:** How do I get my water tested from my well (address withheld for privacy)?

Response: Although the U.S. EPA Remedial Investigation has been completed and the data indicates that your well lies outside the plume area, we encourage you to speak with the Remedial Site Manager about potentially sampling your well. If you want to have the well water tested on your own, the Remedial Site Manager may provide you with a list of contaminants of concern and the appropriate sampling and test methods for your well water analyses.

6. **Comment:** “You have very thoroughly identified and documented the past and current harm and certainly clearly identified future harm. To delay making a professional judgment (given the significant amount of information and data you have cited) until after contamination of additional well systems has occurred is, at best irresponsible and unprofessional.” (address withheld for privacy)

Response: We respectfully disagree. The function of HAS at Ohio Department of Health (vs. that of Ohio EPA and USEPA) and the meaning of the ATSDR conclusion categories appear to have been misunderstood by the author of the comment. Currently off-site groundwater contamination poses an *Indeterminate Public Health Hazard*. “Based on well sampling data received to date, it does not appear that any area residents are currently being exposed to contaminated drinking water at levels that would be expected to cause adverse health effects. However, the potential exists for additional wells to be impacted in the future if the source of the groundwater contamination is not remediated, contained, or removed.” Existing environmental data indicates residents are not being exposed to contaminated drinking water at levels that would be expected to cause any adverse health effects. The identified road you lived on is over a half mile away to the

southeast. As stated in the previous questions and responses, extensive initial and subsequent sampling events provide no evidence that groundwater contamination originating at the Lammers Barrel Factory site ever made it east of Trailee Trail. However, as stated in the draft 2008 PHA conclusions, until the source of the groundwater contamination is remediated, contained, and/or removed, there is a potential for additional wells to be impacted in the future. Included in our recommendations section of the PHA, we state that the off-site areas of contamination should be fully identified and remediated. We also state that residential well sampling should be continued to ensure that additional residential wells do not become contaminated during the course of the clean-up process.

7. **Comment:** “It appears that the ODH has limited it’s commitment to the public health to only be in the area of corrective actions – eliminating detected contaminations and waiting until citizens have already been exposed, rather than to preventive actions - eliminating the causes of potential contaminations in order to keep citizens from being exposed. This certainly does not meet the ODH’s mission of “...fulfilling society’s interest in assuring conditions in which people can be healthy”. The recommendations made by ODH at the end of this Public Health Assessment are simply additional evidence that delays, investigations, samplings, and characterizations will continue as infinitum, with no proactive, preventive public health action taken by the ODH until after exposures occur.”

Response: The role of the ODH Health Assessment Section (HAS) is to present an independent assessment of potential risks for human health effects using available environmental data. The objective of the assessment is to mitigate any current contamination and to prevent future contamination. ODH HAS has no regulatory authority to conduct environmental sampling and site clean-ups. ODH HAS conclusions and recommendations presented in our PHA and HC documents are provided to be used by the authorized regulatory agencies, like the U.S. EPA, when developing their plans to investigate and/or clean up contaminated sites.

The current environmental data indicates that there are no on-going exposures to contaminants from this site. In the 2008 draft PHA, ODH recommends the elimination of the source of the contamination and the continued testing of residential wells to ensure that additional wells do not become contaminated. The purpose of our PHA recommendations is to ensure any future exposures will be prevented.

Ohio EPA Comments
Public Health Assessment Lammers Barrel Factory Site
September 22, 2008 Draft

General Comment

1. U.S. EPA recently approved a Remedial Investigation (RI) Report Addendum for the Lammers Barrel site on September 30, 2008. The RI Addendum presents the results of a supplemental off-property groundwater investigation that was requested by USEPA and Ohio EPA. This investigation, conducted in 2006 and 2007, identified a plume of chlorinated volatile organic compounds (CVOC) in the upper aquifer which extends over 1,800 feet east from the Lammers Barrel property. A scanned electronic copy of the Addendum sections pertaining to off-property groundwater contamination will be provided to ODH via e-mail. A figure showing the additional monitoring well locations and CVOC concentrations will also be provided. Please review this information and revise the Public Health Assessment accordingly.

Response: Although the 30 day comment period for this Health Assessment ended on December 22, 2008, this report was finalized on September 22, 2008. The RI Report Addendum was not available when the Health Assessment was written and finalized. The RI Report Addendum was not approved until September 30, 2008. New environmental data from the RI Report Addendum will be considered in a follow-up Health Consultation.

Specific Comments

1. Page 17, Paragraph 4, last sentence
The text states “*The current site remedial investigation being conducted at the site should more fully characterize the extent of soil contamination at the site.*” Please be aware that the remedial investigation has been completed. Soil contamination has been characterized and evaluated in the baseline human health risk assessment. A scanned electronic copy of the risk assessment results section of the RI Addendum will be provided to ODH via e-mail. Please review this information and revise the Public Health Assessment accordingly.

Response: See above response.

2. Page 18, Paragraph 1
The text states that the vapor intrusion pathway should be more fully investigated. Please be aware that this pathway was investigated and evaluated in the baseline human health risk assessment. A scanned electronic copy of the risk assessment results section of the

RI Addendum will be provided to ODH via e-mail. Please review this information and revise the Public Health Assessment accordingly.

Response: Our experience at potential vapor intrusion sites indicate that analytical data from soil gas and sub-slab samples are needed to provide evidence that there is or is not a potential risk to public health, especially at sites where chlorinated solvents are the contaminants of concern. Studies have indicated that calculated risk for vapor intrusion based on modeling alone does not provide results with a level of certainty sufficient for a public health assessment.

3. Page 19, Conclusions

Please revise the conclusions to incorporate the RI Addendum information provided for General Comment 1 and Specific Comments 1 and 2.

Response: See response to General Comment 1.

4. Page 19, Recommendations

Please revise these recommendations in accordance with General Comment 1 and Specific Comments 1 and 2. Also, the third recommendation should be revised or eliminated because other contaminant sources in the area that are unrelated to Lammers Barrel will not be identified or remediated under USEPA's Administrative Order of Consent.

Response: See response to General Comment 1. USEPA's reports and recommendations are strictly tied to each regulated site; however, the Health Assessment Section considers all environmental data provided for their assessments of potential public health threats. If other sources of contamination are not addressed under the RIFS, they should be investigated by another regulatory avenue.

5. Page 22, References

Please add the following reference:

Arcadis. 2008. Remedial Investigation Report Addendum. Lammers Barrel Factory Site. Beavercreek, Ohio. August 8, 2008.

Response: See response to General Comment 1.