

Health Consultation

Vapor Intrusion Issues in Hooven, Ohio

FORMER CHEVRON REFINERY
(a/k/a GULF OIL CORPORATION US)

HOOVEN, HAMILTON COUNTY, OHIO

EPA FACILITY ID: OHD00425132

MAY 6, 2004

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

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Prepared by:

Health Assessment Section
of the Ohio Department of Health
Under a Cooperative Agreement with the
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Former Chevron Refinery
(Vapor Intrusion Issues in Hooven, Ohio)

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PURPOSE AND STATEMENT OF ISSUES

The Health Assessment Section (HAS) of the Ohio Department of Health was contacted on September 11, 2003, by the Ohio Environmental Protection Agency (Ohio EPA) and was asked to address concerns posed by several citizens in regards to possible exposure to groundwater contamination created by the former Gulf (now Chevron) Refinery in Hooven, Ohio. The concerns were initially presented to the United States Environmental Protection Agency (USEPA) who contacted Ohio EPA who, in turn, contacted HAS. Citizens in Hooven also expressed concerns to the Whitewater Township Trustees and the Hamilton County General Health District. Because of these concerns the Health Commissioner of Hamilton County submitted a letter to the director of the Ohio Department of Health and formally requested that HAS review the available environmental data and determine if residents of Hooven are currently being exposed to environmental contaminants in groundwater from Chevron.

This report will not address past exposures because past environmental data is not available and there is no way to determine what levels of contaminants the residents may have been exposed to while the refinery was in operation. Residents of the village of Hooven obtain their water from the Cleves public drinking water supply which has never contained contamination from Chevron so drinking water was ruled out as an exposure pathway of concern. The primary exposure pathway of concern was determined to be the potential for residents to be exposed to vapors that may be volatilizing off of an underlying groundwater gasoline plume. HAS was asked to determine whether vapors from this large groundwater plume containing leaded gasoline, diesel, and other fuels, could possibly be migrating into the homes in Hooven and adversely impacting the health of the residents of the village.

BACKGROUND

The Chevron Refinery Site is a former fuels and asphalt refinery on the flood plain of the Great Miami River, twenty miles west of Cincinnati in Hamilton County, Ohio. The site occupies 250 acres in a mixed rural-residential-commercial area along State Route 128, just north of its junction with U.S. Rt. 50 (Figure 1). The former refinery is bordered by the Great Miami River to the east, northeast, and southeast, and by State Route 128 to the west. The village of Hooven is located on a low hill elevated 30 to 40 feet above and immediately west of the State Route 128 and the former refinery. The Village of Cleves is located on the east side of the Great Miami River, 1/2 mile southeast of the Chevron Refinery Site (Figure 1).

Geology and Hydrogeology

The Chevron Refinery Site is located on the flood plain of the Great Miami River, a south-flowing tributary of the Ohio River. The current flood plain is situated over a buried bedrock valley filled with from 70 to 120 feet of sand and gravel with minor silt and clay (Durrell, 1961; Ohio Department of Natural Resources, well logs). These porous and permeable sand and gravel layers hold large quantities of groundwater and wells drilled into these sand and gravel deposits are the major sources of drinking water for area residents and process water for a number of large industries. Large-diameter production wells at the Chevron Refinery Site, drilled to depths of 80-90 feet, yielded up to 2,000 gallons of water per minute (Walker, 1986; ODNR well logs).

Limestone and shale bedrock forms the valley walls and ridges bracketing the river's flood plain to the east and the west. These materials are poor sources of groundwater resources due to their low permeability.

Groundwater in the area flows to the south and southwest, following the course of the present day Great Miami River (ChevronTexaco, 2003). The water table (depth to the groundwater) in the vicinity of the Chevron Refinery site ranges from 15 to 30 feet below the ground surface. The river and the underlying groundwater resources are in direct hydraulic contact with one another with groundwater seasonally discharging to the river and river water occasionally infiltrating down to the groundwater in the flood plain. Evaluations of this buried valley aquifer system indicate that the groundwater in these porous and permeable sand and gravel deposits is highly vulnerable to contamination from the ground surface (ODNR, Division of Water, Report No. 7, 1989). The permeable soils in the area readily facilitate the seepage of chemical contaminants down to the water table.

The Village of Hooven lies atop a sand and gravel terrace at an elevation 30-40 feet above the level of Great Miami River flood plain and the Chevron Refinery site to the east. The depth to the groundwater table directly under the village is roughly 50-60 feet below the ground surface (QST Environmental, 1998). In contrast, the so-called "Southwest Quadrant", a largely commercial area immediately south of Hooven and north of U.S. Rt. 50, is continuous with the flood plain of the river and the water table in this area is also 15-30 feet below the ground surface.

Site History

The refinery was initially operated by Gulf Oil Corporation (Gulf) starting in 1931. The major products produced at the refinery included gasoline, jet fuels, diesel, home-heating oils, and sulfur. The facility was acquired by Chevron in 1985. Chevron ceased operations at the refinery in 1986. On May 13, 1993, Chevron entered into an Administrative Order on Consent with the USEPA Region 5 office to perform an environmental assessment and clean-up at the site. Prior to Chevron purchasing the property, Gulf initiated a voluntary corrective action with Ohio EPA in 1985 due to a report of fuels seeping into the Great Miami River. This corrective action was incorporated into the consent order signed in 1993 (Ecology and Environments, 2000).

Subsequent environmental investigations revealed a very large (7 to 20 acre) plume of liquid phase hydrocarbons (mostly gasoline) floating on the groundwater beneath the facility and extending west beneath the village of Hooven (Figure 2). The plume underlies the eastern portion of Hooven which includes several small businesses and residential homes. Most of the homes in Hooven have basements and some of them have crawl spaces that are not covered. It is believed that over five million gallons of product, estimated to be 80% leaded gasoline and 20% diesel fuel, are floating on the water table in this area (ChevronTexaco, 2003).

Since 1985, over 140 monitoring wells and 14 water production/product recovery wells have been installed on the property. Groundwater treatment systems have been in operation since 1985 and have removed approximately 3.5 million gallons of liquid-phased petroleum hydrocarbons (Chevron Presentation, 2003).

Village Drinking Water Supply

Residents in the Village of Hooven obtain their drinking water from Village of Cleves public drinking water supply. It is believed that no residents of Hooven are using private wells for drinking water at this time. The production wells that were the source of the Cleves water supply were originally located roughly ½ mile south-southeast of the former Chevron Refinery, on the eastern portion of the flood plain of the Great Miami River (Ohio EPA, 2001; USGS, 1996). The water supply obtained its water from four production wells drilled into valley fill sand and gravels deposits 70 feet below the ground surface (Ohio EPA, 2001; ODNR well logs). Monitoring wells were placed at the perimeter of the old Cleves well field after the discovery of the groundwater contamination under the Chevron Refinery Site in the early 1990's. Production wells and monitoring wells were regularly sampled for gasoline-related VOCs throughout the latter half of the decade. No site-related contaminants were detected in the Cleves public water supply wells during this time period (Ohio EPA, Division of Ground and Drinking Water staff, pers. comm., March, 2004).

After concerns were expressed that groundwater contamination from the Chevron Refinery Site may eventually reach the Cleves well field, an agreement was reached between the Village of Cleves and Chevron to relocate the water supply wells to a rural portion of Whitewater Township that is separated from the Chevron groundwater contaminant plume by a 200-foot high, north-south trending bedrock ridge. The new Cleves water supply well field became operational in January, 2001. Production wells in the old well field were abandoned following state requirements.

The new well field consists of three production wells and a water plant located in the flood plain of the Whitewater River, east of the river and north of U.S. Rt. 50. Well field production wells are from 70 to 109 feet in depth and obtain their water from a separate buried valley sequence of sand and gravel valley fill underlying the Whitewater River valley. The current well field can provide up to 1,656,000 gallons of water per day and services 4,950 people in Whitewater Township, including residents of Cleves and Hooven (Ohio EPA, 2003). The new well field is not located in the same groundwater basin as the old well field and is not at risk of becoming contaminated by the groundwater plume under the Chevron Refinery Site.

CAP Meetings

A Community Advisory Panel (CAP) was established by Chevron in 1996 to address community concerns about activities being conducted at the former refinery and to involve the local community in the decision making process. The CAP was designed to involve local community members in the corrective action and redevelopment plans for the facility. CAP members aid Chevron in choosing reuse options for the site in addition to deciding the best way to disseminate information to the public.

Attendance at the CAP meetings was limited to a small number of residents until 2003. In July 2003, a public information meeting was held to discuss the disposal of sludges removed from the

former refinery property. Approximately 40-50 residents attended this meeting and expressed concern that the gasoline plume beneath Hooven may be impacting their health. At this and subsequent CAP meetings, Chevron presented information to the residents on environmental sampling and site clean-up activities that had been done. The company's representatives also discussed the results of a risk assessment carried out by the company that suggested that the health of residents was not likely to be impacted by the large groundwater contaminant plume that underlies the village (Ecology & Environment, Inc., 2000).

HAS staff attended a CAP meeting on October 1, 2003, to gain first hand knowledge of the health concerns expressed by the residents. The 30 residents that attended the meeting expressed concerns about high cancer numbers in their community and neurological problems in their children. The residents were concerned about possible exposure to vapors from the fuel plume beneath the village and also about past exposures to pollutants released by the refinery when it was in operation. HAS informed the residents that it was necessary to document a completed exposure pathway to contaminants at levels that could cause adverse health in order to determine if any of their health concerns could be related to groundwater contamination. HAS informed residents that it is unlikely that exposure to chemicals prior to the 1997 thru 1999 data collected to complete the Hooven risk assessment could be documented due to the lack of environmental data collected while the refinery was in operation. HAS informed the residents that the best option was to evaluate current conditions to determine if residents are being exposed to contamination from the former Chevron facility. HAS attended a subsequent CAP meeting in November and in December participated in a public availability session put on by the Hamilton County General Health District. At this December meeting, HAS staff announced that they would be completing a review of the available environmental data and would be writing a Health Consultation to document the results of this review, draw health conclusions, and make recommendations.

Historical Groundwater Contamination in Hooven

In 1996, the initial off-site monitoring wells were installed in the village of Hooven. The MW-81 series wells were installed west of State Route 128 near the intersection with Washington Street (Figure 2 and 3). The MW-81 series included three wells (shallow, intermediate, and deep) with sampling of these wells indicating that liquid phase hydrocarbons had migrated off-site under Hooven. The MW-92 and MW-93 series wells were also installed in 1996 and also indicated the presence of product floating on the water table. The MW-94, MW-95, MW-96, and MW-97 series wells were installed in 1997. Product was discovered in monitoring wells MW-96S and MW-96D in 1997. Three additional wells were installed in 1997 to further delineate the plume (QST, 1998). The MW-99, MW-100, and MW-101 series wells were installed in late 1997 (Figure 2). Volatile organic compounds (VOCs) have been consistently detected in the monitoring wells in the Hooven area at levels above the U.S. EPA maximum contaminant levels established for drinking water. Additionally, the semi-volatile organic compound, naphthalene, has been detected in several monitoring wells. A summary of the sampling data collected in the Hooven area during 1996 and 1997 is given in Table 1.

Table 1
Summary of Groundwater Monitoring Well Data in Hooven area in 1996 and 1997
[micrograms per liter (ug/l)/ parts per billion (ppb)]

Chemical		Benzene	Ethylbenzene	Toluene	Xylenes	Naphthalene
Well #	Date	MCL=5	MCL=700	MCL=1000	MCL=10,000	MCL=NA
81D	6/20/96	15	25	ND	89	ND
	9/19/96	5.3	8.7	ND	28	ND
	12/10/96	5.8	8.6	ND	28	ND
	3/18/97	ND	5.5	ND	18	ND
81I	6/20/96	1600	ND	ND	82	ND
	9/18/96	150	ND	8.9	27	ND
	12/10/96	200	59	10	190	10
	3/18/97	6.4	ND	ND	16	ND
	6/9/97	6.1	ND	ND	9.3	ND
81S	6/20/96	3300	1700	ND	4100	250
	12/10/96	3600	1800	140	5300	450
	6/9/97	2500	1100	ND	2700	270
82D	6/18/96	ND	ND	ND	ND	ND
	9/17/96	ND	ND	ND	ND	ND
	12/9/96	ND	ND	ND	13	ND
	3/18/97	ND	ND	ND	ND	ND
92D	3/18/97	39	130	10	370	38
	6/9/97	18	86	6.8	260	33
	8/27/97	37	62	ND	180	37
	12/9/97	68	40	5.0	120	16
92S	3/18/97	920	190	ND	560	38
	6/9/97	3000	520	ND	1200	100
93D	3/18/97	ND	ND	ND	ND	ND
	8/27/97	ND	ND	ND	ND	ND
93S	3/18/97	2300	870	110	2000	190
	6/9/97	2600	1100	160	2500	210
	8/27/97	2500	1500	170	3800	400
94D	8/27/97	ND	ND	ND	ND	ND
94S	8/27/97	ND	ND	ND	ND	ND
	12/9/97	ND	ND	ND	ND	ND
95D	8/27/97	ND	ND	ND	ND	ND
95S	8/27/97	ND	ND	ND	ND	ND
	12/9/97	ND	ND	ND	ND	ND
96D	8/27/97	120	52	16	250	ND

Chemical		Benzene	Ethylbenzene	Toluene	Xylenes	Naphthalene
Well #	Date	MCL=5	MCL=700	MCL=1000	MCL=10,000	MCL=NA
	12/10/97	22	ND	ND	19	ND
97D	8/27/97	ND	ND	ND	ND	ND
	12/10/97	ND	ND	ND	ND	ND
99S	12/10/97	1900	1000	110	2000	180
100S	12/9/97	ND	ND	ND	ND	ND
101S	12/9/97	ND	170	ND	680	59

ND = not detected

MCL = Maximum Contaminant Limit

NA = not applicable

Recent Groundwater Sampling

As mentioned above, there are more than 140 groundwater monitoring wells located on the Chevron property and in the village of Hooven. The off-site contamination under Hooven was first discovered as part of the Remedial Investigation in 1996. Since that time, additional wells have been installed throughout Hooven in an attempt to define the extent of the groundwater contamination. A layer of Liquid-Phase Hydrocarbons (free-floating gasoline and other fuel products) has been identified in a large number of the groundwater monitoring wells beneath Hooven at varying thicknesses. Groundwater sampling is conducted on a semi-annual basis on both the Chevron property and in the village of Hooven. Samples are analyzed for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), metals, cyanide, and sulfide (QST Environmental, 1998). Chemicals of interest for this report are the VOCs and SVOCs because of their ability to volatilize and their potential to contaminate the indoor air of homes in Hooven.

HAS also reviewed groundwater sampling conducted in April 2003 to gauge recent groundwater conditions. In addition to 20 on-site monitoring wells and production wells, 21 monitoring wells located in Hooven and in an area known as the southwest quadrant were sampled. Samples were analyzed for VOCs, including dissolved lead and BTEX (benzene, toluene, ethylbenzene, and total xylenes). VOCs were reported as being present in the following Hooven/Southwest Quadrant wells: MW-81S, MW-93S, MW-94S, MW-101, MW-115S, MW-117S, and MW-118. Liquid-Phase product was discovered in MW-99 in the village of Hooven (Figure 2). A summary of groundwater sampling data for the Hooven area wells is provided in Table 2.

Table 2
Summary of Groundwater Monitoring Data Collected in Hooven in April 2003
[micrograms per liter (ug/l)/parts per billion (ppb)]

Well #	MW-81S	MW-93S	MW-94S	MW-101	MW-115S	MW-117S	MW-118
Chemical							
1,2 Dichlorobenzene	450	290	24	19	12	490	320
1,3 Dichlorobenzene	21J	ND	7	5	3	17	17
Benzene	610	1800	3	3	4	1400	15
Chlorobenzene	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	400	710	11	24	ND	710	72
Toluene	24	61	ND	ND	ND	25	11
Xylenes	270	640	8	24	ND	350	61

Although local groundwater resources in the immediate vicinity of Hooven are contaminated with gasoline and diesel fuel, exposure to the chemicals through the drinking water route is unlikely as all residents in the village obtain their drinking water from the Village of Cleves public drinking water supply. Because the new Cleves well field is located in a different groundwater basin than the Chevron-Hooven site and is separated from it by a bedrock ridge, the Cleves water supply is no longer at risk of being contaminated by the gasoline plume under the Chevron-Hooven site.

Initial Vapor Sampling Activities

VOCs like benzene, ethylbenzene, toluene, and xylene (BTEX) will readily vaporize from the groundwater upon coming into contact with the air. These vapors can migrate through porous sand and gravel soils and accumulate in enclosed spaces indoors in homes and businesses. Especially during the winter time when these homes are shut up and the ground is frozen, these chemicals have the potential to accumulate indoors and residents can be exposed to these chemicals by breathing the indoor air in these enclosed areas.

Because of the high concentrations of BTEX compounds in the groundwater and the presence of pure product beneath the village of Hooven, Chevron began an investigation into the potential for vapor migration. The first vapor sampling wells were installed adjacent to the MW-81, MW-92, and MW-93 series wells (identified as VB-81, VB-92, and VB-93) in June 1997 because these groundwater monitoring wells contained high levels of VOCs (Figure 3). Vapor samples were also collected during the installation of groundwater monitoring wells MW-94S, MW-95S, and MW-96S. Additional vapor sampling wells were installed in the village of Hooven adjacent to the MW-93, MW-96, and MW-99 series of groundwater monitoring wells (VW-93, VW-96, and VW-99). The vapor monitoring wells were designed with eleven separate monitoring points set at 5-foot intervals to evaluate vapor conditions at various depths below the ground surface. For the purpose of evaluating exposure for the residents of Hooven, HAS is most concerned

about vapor concentrations of BTEX at the five to ten foot level below ground surface because these are the vapors most likely to migrate into the overlying homes.

Analysis of vapor data indicates that the highest concentrations of vapors are down near the water table at depths of 50-60 feet below ground surface. Vapor concentrations in the vapor sampling wells generally decrease nearer to the surface. Vapor samples collected from vapor wells VW-93, VW-96, and VW-99 located in Hooven indicated low levels of BTEX compounds at the 10-foot depth interval ranging from 0.018 to 1.2 parts per million by volume (ppm). Vapor levels were higher at depths greater than 30 feet below ground surface. There appears to be a layer between 10 and 30 feet below ground surface in VW-93, 96 and 99 that had no detections of BTEX compounds. This is most likely explained by vapors migrating to the surface where they meet less permeable materials such as clay soils, asphalt parking lots, or buildings with concrete foundations and then accumulate at a level 10 feet below the ground surface.

To address vapor migration issues in Hooven, Chevron installed a soil vapor extraction (SVE) system beneath the village in 1999. Initially, one horizontal well was drilled beneath the village in 1999 with two additional wells coming on-line in 2001. The vapor extraction wells were drilled from the Chevron facility approximately 800 feet beneath the village of Hooven. A vacuum is applied to each well and hydrocarbon vapors are removed and treated before being released to the air. The purpose of the SVE system is to extract gasoline contaminated soil vapors from beneath the village before they have to opportunity to migrate to the surface and potentially impact the residents. Periodic sampling of the vapor extraction systems showed that a large volume of gasoline vapors was extracted during the first year of operation with a progressive decline until the beginning of 2001. Since that time, the SVE system has operated only periodically due to high water tables in the flood plain beneath Hooven. When the water table reaches a certain level, the amount of gasoline floating on the top of the water table that is available for extraction is decreased which limits the effectiveness of the SVE system. Due to the high water table, the SVE system has operated very infrequently since the start of 2003. Since its start up, the SVE system has removed approximately 425,500 pounds of petroleum hydrocarbons as vapor from the soils beneath Hooven (Pers. Comm. w/ John Tiffany of Chevron, February, 2004).

Human Health Risk Assessment

Due to the high concentrations of BTEX compounds in the groundwater and the detection of BTEX vapors at near ground surface, Chevron deemed it necessary to determine the potential for BTEX vapors to migrate from the underlying groundwater plume and come into contact with the residences in Hooven. As part of this investigation conducted in 1999, Chevron collected additional soil vapor samples from both the surface and at depths of up to ten feet below the ground surface. Using the newly collected data Chevron completed a human health risk assessment to develop mathematical estimations of the risks posed to residents of Hooven from vapors migrating from the groundwater plume to the overlying residences. It should be noted that all soil vapor data collected was collected prior to the SVE system being installed and becoming operational. It is unknown what effect the system has had on soil vapor concentrations near the ground surface under Hooven. It will be necessary to collect additional soil vapor data to

determine if the SVE system has had any impact on soil vapor levels of gasoline or diesel fuel related compounds.

The new field data was collected using flux chamber equipment in August 1998 (QST, 1998c). The flux chamber technology allows for collection of soil vapors emitted at the ground surface (Schmidt, 1998a). The surface flux chamber resembles a large stainless steel bowl that fits tightly against the ground surface and allows a vapor sample to be collected without interference from outside ambient air. Surface flux samples were collected from 23 locations in Hooven (Ecology & Environment, 2000). In addition to surface flux samples, down-hole flux samples were also collected from three locations within Hooven (Figure 3). These samples were collected from the ten foot depth interval and were used to assess potential residential exposure in a basement setting.

Using the soil vapor data collected, Chevron was able to calculate the theoretical risk that residents of Hooven would develop cancer from exposure to vapors that are volatilizing from the underlying groundwater contamination. A risk of developing non-cancer health effects was also calculated for the chemicals detected. Looking strictly at the surface vapor data, Chevron indicated that the calculated theoretical risk range for both cancer effects was within the acceptable risk range allowed by U.S. EPA persons (Ecology & Environment, 2000). However ODH and USEPA do not strictly abide by an allowable risk range and generally begin to look closer at an exposure when the theoretical cancer risk exceeds 1 case in 100,000. This means that if residents are exposed to these concentrations for 30 years, that one person out of a population of 100,000 people would be expected to develop cancer from that exposure.

Chevron also calculated theoretical risks based on concentrations of vapors detected in samples collected from 10 feet deep. This sampling is more likely to be representative of the actual exposures in homes that would have basements or crawl spaces located below the ground surface and closer to the groundwater contamination. In this scenario the calculated cancer risk was 8 in 100,000. This is above the generally accepted cancer risk of 1 in a population of 100,000. This risk was mainly driven by levels of benzene in vapor samples collected from 10 feet below the ground surface. This risk value was derived by assuming that the amount of cracks in the foundation and basement floor was equal to or below one percent of the total surface area of the basement. This assumption may not be acceptable for all of the homes in Hooven as many of the homes have dirt floors and/or crawl spaces (testimony from residents, CAP meeting, 10/01/03). Chevron indicated that this risk was acceptable because a resident would have to be in the basement of a home located directly over the hydrocarbon plume for 16 hours per day for 365 days per year for 30 years. While it is unlikely that residents would spend that amount of time in a basement, there may be several homes that have bedrooms in the basement that would allow for longer exposures. Chevron also calculated this risk on the basis of only three vapor samples collected at depth. These samples were generally collected on easements and common areas and not near residential structures so it is unknown if the concentrations detected are actually indicative of what residents are being exposed to. It would be necessary to collect additional soil vapor data from areas closer to residential homes and use proper assumptions in the risk calculation (presence of dirt floors in most homes) in order to determine if residents are being exposed to unacceptable levels of VOCs in their homes.

The non-cancer health risk is determined by looking at the concentration of a chemical detected and then comparing it to a specified reference concentration. If the ratio of that comparison exceeds one, the potential exists for exposure to occur at levels that could cause adverse non-cancer health effects. This number is called a Hazard Index. In the sampling conducted by Chevron, naphthalene was detected in the vapor samples at levels that resulted in a Hazard Index of two, which is double the acceptable level.

USEPA provided comments to Chevron in a January 2004 letter that commented on and listed concerns about the human health risk assessment completed for the Hooven area. In the letter USEPA indicated that “EPA recommends the use of 1 in 100,000 cancer risk and a Hazard Index of 1 for non-cancer risk. The risk assessment conducted by Chevron on Hooven basement exposure scenario indicated a total cancer risk of 8 in 100,000 and a total non-cancer Hazard Index of 2.0” (Ecology and Environment, May 2000). HAS agrees with the comments made by USEPA and also recommends the use of the above mentioned risk values.

USEPA also makes note of new toxicological information that is now available that was not available when Chevron first completed the Hooven risk assessment in 2000. In April 2003, the USEPA Integrated Risk Information System (IRIS) updated the chronic health hazard information for benzene for non-cancer health effects and also included a new cancer risk slope factor for ethylbenzene. According to USEPA, “based on the current toxicity data on benzene and ethylbenzene it is estimated that the cumulative cancer risk and the Hazard Index for the Hooven basement exceed the targeted value of $1.0E-5$ [=1 in 100,000] and a Hazard Quotient of 1 for non-cancer risk” (USEPA letter, 2003). HAS agrees with these comments and recommends that Chevron collect additional soil vapor data from the five to ten foot interval below the ground surface to obtain up-to-date environmental data. HAS also recommends that Chevron complete a new risk assessment using the new data and methods outlined in the Draft Vapor Intrusion Guidance Manual published by USEPA in November 2002. HAS believes that the SVE system installed by Chevron should have further reduced the risk from vapor intrusion posed to residents in Hooven. The only way to determine the current risk to the residents of Hooven is to collect additional soil vapor data and complete a new risk assessment.

CHILDREN’S HEALTH CONSIDERATIONS

HAS and ATSDR understand that children are often at a greater risk of developing illness due to exposure to hazardous chemicals because of their smaller stature and developing body systems. Children are likely to breathe more air and consume more food and water per body weight than are adults. Children are also likely to spend more time outside and have more opportunity to come into contact with environmental pollutants. To be protective of the health of children, HAS has reviewed all data for this report as if children were the primary population being exposed. HAS will also make recommendations that will provide for the highest level of protection for children in the Hooven area.

CONCLUSIONS

The intrusion of vapors into area homes resulting from groundwater contamination beneath the Village of Hooven currently poses an Indeterminate Public Health Hazard to the residents of

Hooven which means that we do not have enough current environmental data to evaluate whether residents in Hooven are being exposed to vapors volatilizing from the underlying groundwater contamination. An initial risk assessment conducted by Chevron indicated that levels of benzene and naphthalene are present in the soil vapor that could possibly migrate into the overlying homes. The risk assessment indicated that the theoretical risk posed by benzene and naphthalene were within a range that is generally considered unacceptable by ODH and USEPA. However, past exposure to these levels still poses an indeterminate public health threat because it is unknown what the actual levels of contaminants in the indoor air were or how much time residents actually spend in the basements. The data used in the risk assessment was collected between 1997 and 1999. Since that time Chevron has installed and operated a SVE system designed with the intention to lower vapor concentrations of petroleum hydrocarbons in area soils.

There is no evidence that the contaminant plume in the groundwater under the Chevron Refinery Site and the surrounding area ever impacted the public drinking water supply used by area residents. The new Cleves well field west of Hooven and the Chevron site is located in a different groundwater basin than the contaminant plume and cannot be impacted by it.

RECOMMENDATIONS

1. HAS recommends that Chevron collect new soil vapor data in Hooven from 5 to 10 feet below the ground surface to obtain an up-to-date picture of the conditions in Hooven.
2. Chevron should also update the previous risk assessment, following the recommendations made by USEPA to utilize the new toxicological information available for benzene and ethylbenzene, and should follow the steps outlined in the recently published draft USEPA vapor intrusion guidance manual.
3. If the new risk assessment determines that residents could be exposed to VOCs or SVOCs at elevated levels then Chevron should consider collecting indoor air samples from those residences most likely to be impacted.

PUBLIC HEALTH ACTION PLAN

Chevron recently submitted a work plan to the Whitewater Township Regional Sewer District (Civil & Environmental Consultants, March 2004). The work plan is meant to address potential exposure to metals and petroleum compounds in soils and soil vapors for workers and residents during the installation of a proposed sanitary sewer system in Hooven. The work plan calls for the collection of soil and soil vapor samples at various locations along the proposed sanitary sewer route in Hooven. The soil vapor samples are proposed to be collected at various depths ranging from five to twenty-five feet below ground surface. This work plan addresses many of

the recommendations that were proposed above. HAS will review the results of this sampling to determine if soil vapor levels are high enough to pose a risk to nearby residents. HAS also recommends that Chevron use this additional soil vapor data to re-evaluate the potential for soil vapor to migrate into residential homes in Hooven. HAS will review any additional environmental data collected and will attend future public meeting to address health concerns posed by residents of Hooven.

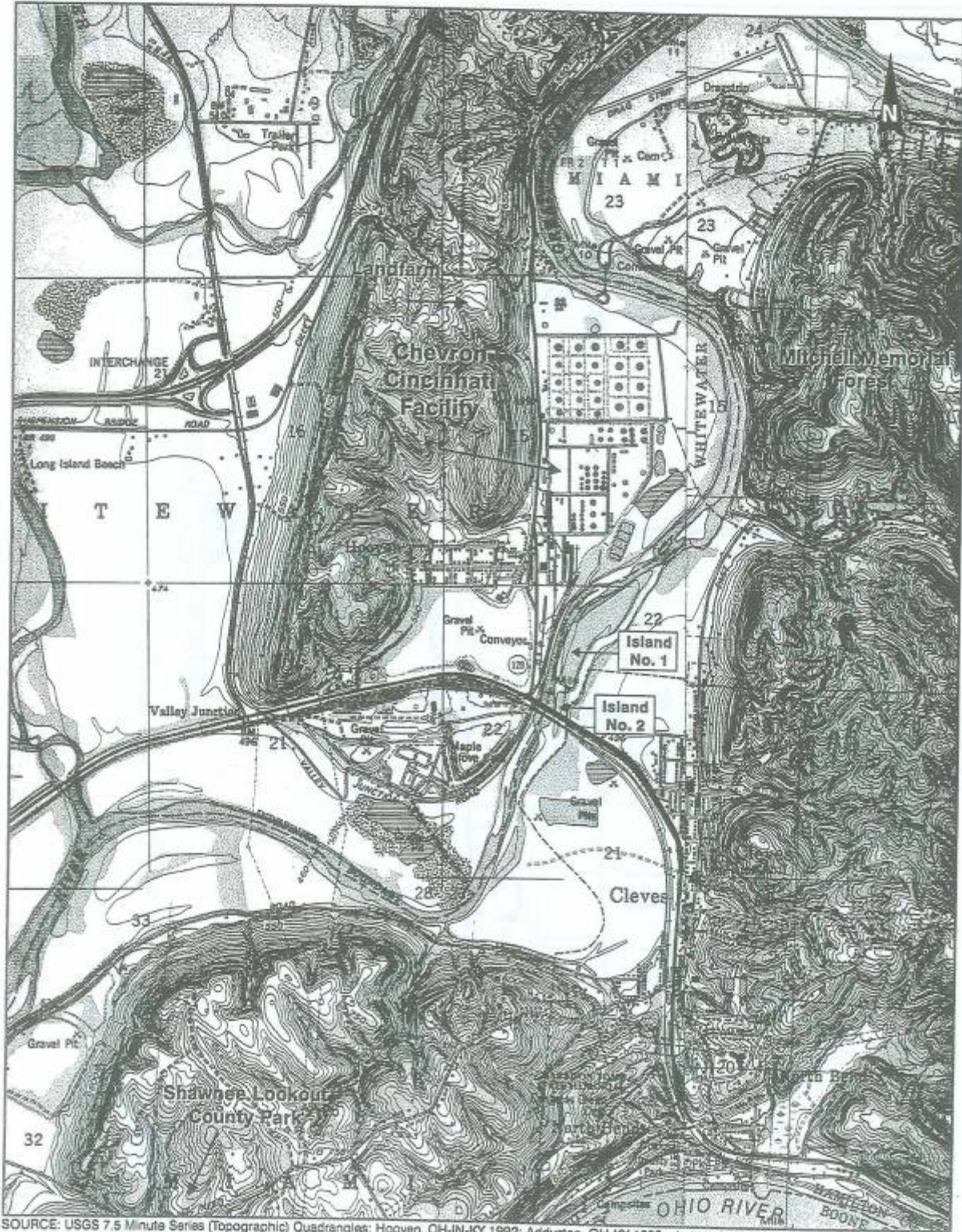
Residents of Hooven have also expressed concern about levels of metals in the soil. During the sanitary sewer project Chevron plans to collect soil data to determine if there is potential for workers installing the sewer lines to be exposed to elevated levels of petroleum hydrocarbons and metals in the soils. The submitted workplan does not call for the collection of surface soil samples which is the area of soil that most residents would be exposed to. However HAS will review data collected to determine if levels of metals in the soils at depth are high enough to pose a health threat to the residents and make recommendation to reduce exposure if elevated levels of metals exist. It will be difficult to determine a source of metals in the soils but it will be possible to make recommendations to reduce exposure.

PREPARERS OF THE REPORT

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Robert Frey, Principal Investigator/Geologist

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SOURCE: USGS 7.5 Minute Series (Topographic) Quadrangles: Hooven, OH-IN-KY 1992; Addyston, OH-KY 1982, photorevised 1987.

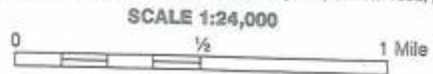


Figure 1 SITE LOCATION MAP

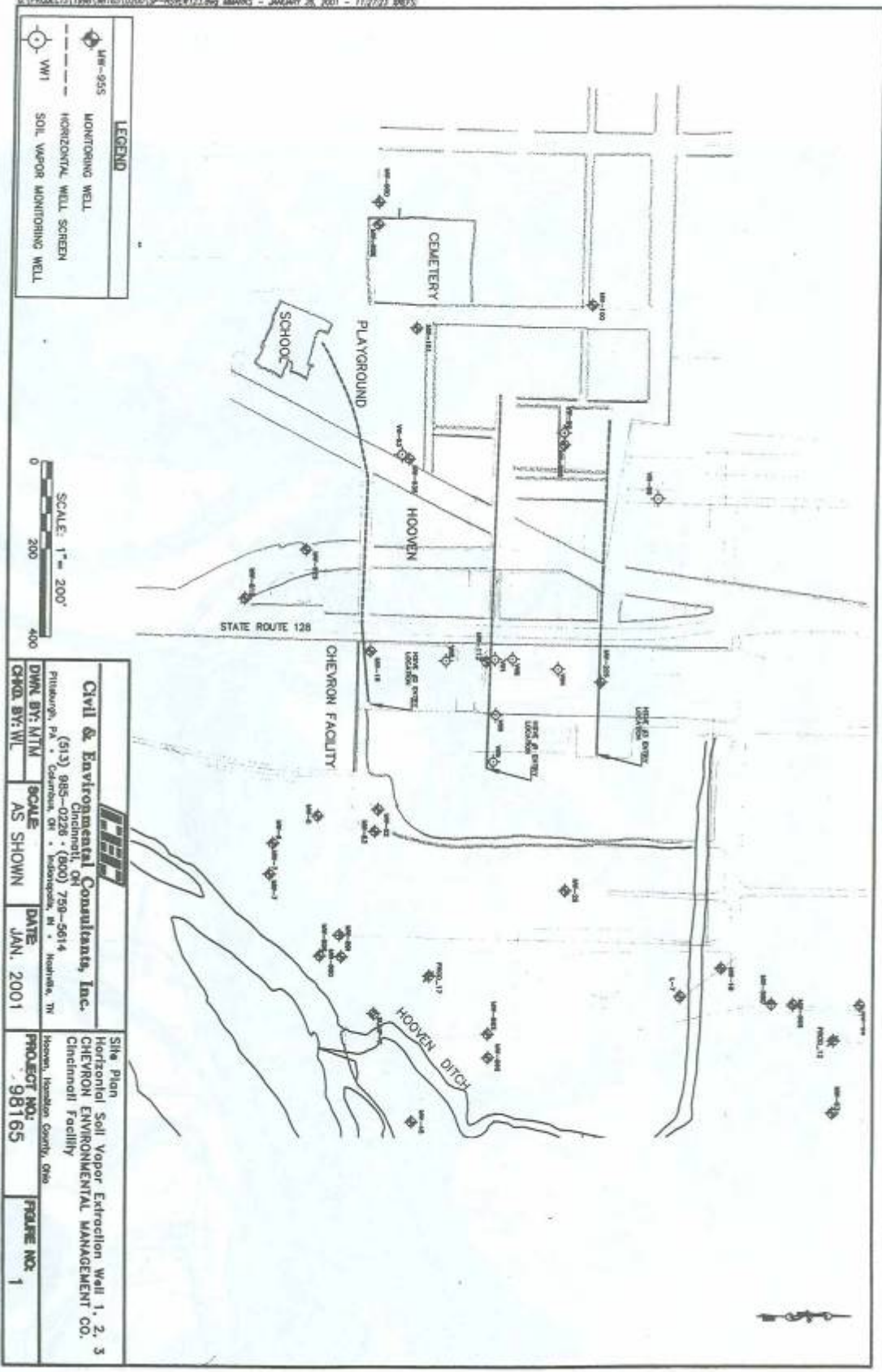
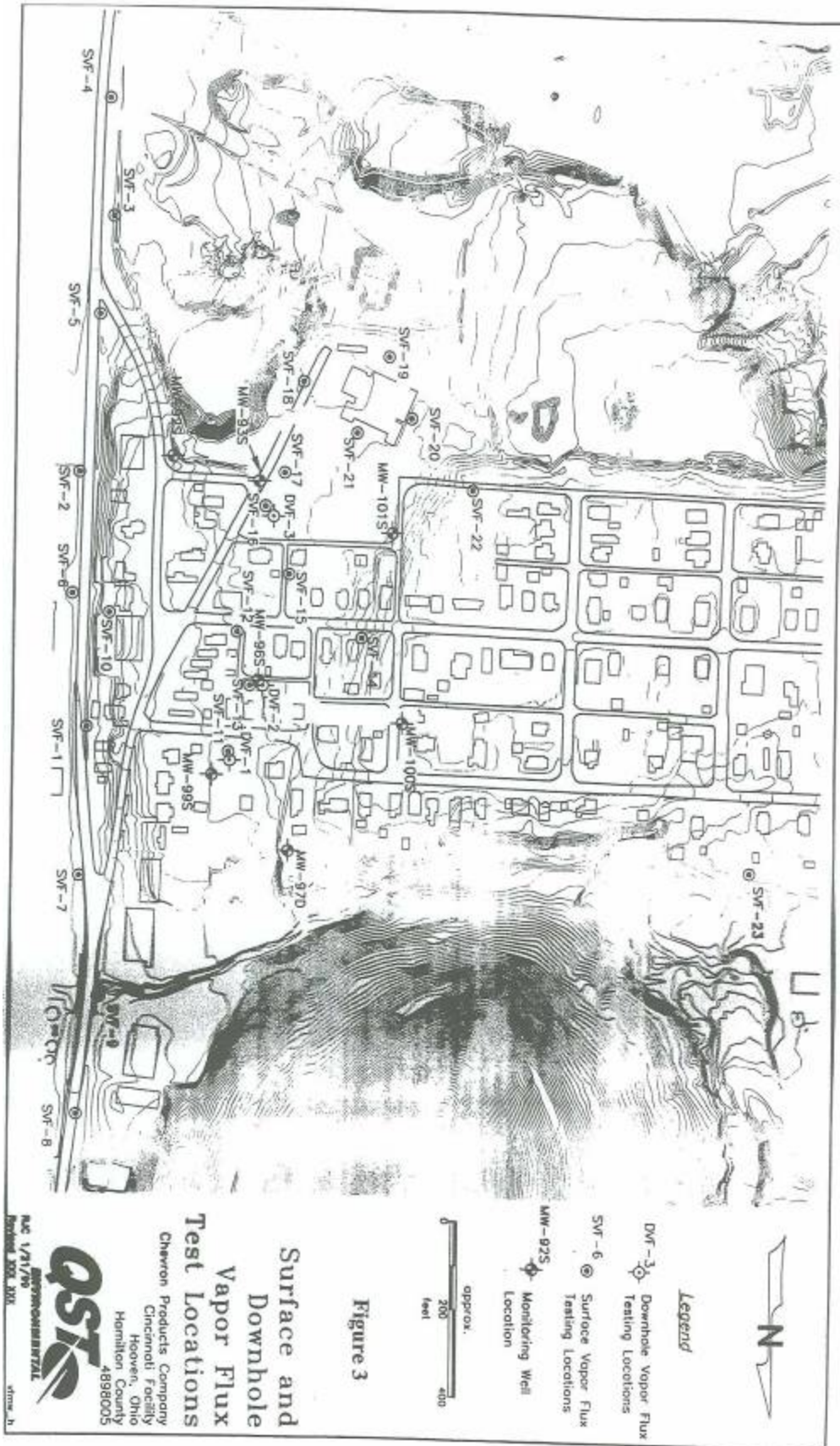


Figure 2



CERTIFICATION

This Former Chevron Refinery (Vapor Intrusion Issues in Hooven, Ohio) Health Consultation was prepared by the Ohio Department of Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was begun.

Technical Project Officer, CAT, SSAB, DHAC, ATSDR

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

Chief, Cooperative Agreement Team, SSAB, DHAC, ATSDR