HEALTH CONSULTATION

FREELAND GROUNDWATER SITE
FREELAND, LUZERNE COUNTY, PENNSYLVANIA

August 9, 2004

Prepared by:

Pennsylvania Department of Health
Division of Environmental Health Epidemiology
Under a Cooperative Agreement with the
Agency for Toxic Substances and Disease Registry

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Executive Summary

At the request of the Pennsylvania Department of Environmental Protection (PADEP), the Pennsylvania Department of Health (PADOH) prepared this health consultation (HC) to determine whether residents near the Freeland Groundwater Site (the Site) are exposed to volatile organic compounds (VOCs) in their homes at levels that would harm their health. The PADOH worked under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR) for this HC.

PADOH determined that children and adults living in the homes discussed in this HC would not currently experience a health risk from exposure to the contaminants detected in their indoor air. Relatively low levels of acetone, tetrachloroethylene (PCE), and other VOCs were detected in residents' basement air at levels that were well below health-based screening values and were not evaluated further. Concentrations of acetonitrile, acrolein, and benzene were detected in basement air in residences near the Site, specifically along Washington, Centre and South Streets, and further evaluated since concentrations were above relevant health-based screening values. Trichloroethylene (TCE) was not detected in the basement air in any of the homes. After completion of this public health evaluation, PADOH concluded that none of the chemicals detected in indoor air of homes at this site currently represent a health threat for children or adults living in the sampled homes. Potential past exposure to these chemicals in the homes is an indeterminate health hazard because information is not available regarding possible historical levels.

The interpretation, conclusions, and recommendations regarding the Freeland Groundwater Site are site-specific and do not necessarily apply to any other site.

Background and Statement of Issues

Site Description and History

The Freeland Groundwater Site (the site) is in a residential area of Freeland Borough. The Freeland Borough is in a relatively rural area of Luzerne County, Pennsylvania (Figures 1-3) and is located near the center of town at the northeast corner of the intersection of Centre and South Streets. This commercial property was historically utilized as a dry cleaner and ceased operation approximately 30 years ago. Prior investigations have indicated that VOCs, specifically PCE and TCE (dry cleaning chemical constituents), were detected in the groundwater at elevated concentrations from this portion of the site [1]. Currently the property is utilized for retail sales of clothing and no longer used for dry cleaning. Since all homes are utilizing the municipal water system near this location, they are not receiving water from the contaminated aquifer. There is not a current route of exposure of the VOCs through the drinking water for these residents. However, the potential vapor intrusion of VOCs from the contamination plume into the indoor air of homes in the vicinity of the source represents a possible health threat to nearby residents. Past exposures to VOCs are indeterminate because no data has been collected. Therefore, the PADEP sampled and provided PADOH with two rounds of indoor air sampling data, which were analyzed for the presence of VOCs, from residential locations in this vicinity of the site. In this HC, PADOH, at the request of PADEP, evaluated the results of indoor air samples collected from the former dry cleaning facility and nearby residences.

Site Visits

On September 17, 2003, two PADOH staff viewed the site with a PADEP hydrogeologist. During this site visit, PADOH staff observed the site, and discussed the groundwater and indoor air sampling schedule for this HC.

On March 9, 2004, a PADOH Environmental Health Specialist conducted a site visit with a PADEP hydrogeololist, and a representative of ATSDR Region III. The extent of the PCE and TCE contamination plumes was located and results of the site characterization were discussed. PADEP's on-site and off-site groundwater monitoring plan was discussed. Also during this site visit, AMEC, PADEP's consultants, were actively collecting soil gas samples from areas near the PCE contamination plume located near the intersection of South and Centre Streets. AMEC was also collecting indoor air samples from residences near this location.

Sampling Events

During October 2003, PADEP sampled indoor air from the basements of four (4) homes near the site along South and Washington Streets. One of the four residential locations was sampled outside the area of concern along Washington Street to serve as a background sample for comparison purposes. The air in the basement of the commercial property located at the intersection of Centre and South Streets was also sampled. This property is located where the

source of the contamination was discovered. In addition, an ambient (outside) air sample was collected during this sampling event [2].

In March 2004 another round of air samples were collected from the same residential and commercial locations, with the exception of one residential location along Washington Street that was inaccessible at the time of the inspection. Indoor air samples were collected from the first floor, as well as the basement, during this sampling event. Since building occupants spend more time on the first floor than these non-livable basement areas, the first floor samples generally represent a more realistic estimate of residents' possible exposure to VOCs [3].

Summary of Sample Results

Low levels of acetone, acetonitrile, acrolein, benzene, propene, PCE, 1,2,4-trimethylbenzene, 1,3,5-trimethylbenzene, and other VOCs were detected in the indoor air in all or some of the sample locations [Table 1]. PCE was detected at a maximum concentration of 5 parts per billion by volume (ppbv) in the basement air of the commercial property, where the source of the PCE contamination plume is located. PCE was not detected in indoor air in the surrounding nearby residential properties. TCE was detected in the background residential sample at an estimated concentration of 0.5 ppbv, which was below the limit of quantitation for the instrument. TCE was not detected in any of the other homes sampled.

In the October 2003 sampling event, acetonitrile was detected in the indoor air of only one residential basement along South Street at an elevated concentration of 180 ppbv. However, sample results indicated that acetonitrile was not detected in any of the samples during the March 2004 sampling event. The maximum concentrations of acetone (21 ppbv) and acrolein (7 ppbv) were detected in a first floor samples along Washington Street. The highest concentration of benzene (3 ppbv) was detected in basement air in a residence along South Street during the March 2004 sampling event. Propene was detected at the greatest concentration of 220 ppbv in first floor air of the commercial property. The maximum concentrations of 1,2,4-trimethylbenzene (9 ppbv) and 1,3,5-trimethylbenzene (2 ppbv) were found in ambient air samples collected during the October 2003 sampling event. Sample results indicated that concentrations of these VOCs decreased to concentrations below or near the detection limit in the indoor air samples [Table 1].

Quality Assurance and Quality Control

In preparing this HC, ATSDR and PADOH relied on the information provided in referenced documents. We assumed adequate quality assurance and quality control measures were followed regarding data gathering, chain-of-custody, laboratory procedures, and data reporting. We expect that to ensure high quality data, extreme care was taken during all aspects of sample collection. We expect that the laboratory only used certified, clean-sample collection devices. Once samples were collected, we expect they were stored according to the method protocol and were delivered to the analytical laboratory as soon as possible. Finally, we expect that laboratory Standard Operating Procedures and other procedures and guidance for sample analysis, reporting, and

chains of custody were followed. The analyses, conclusions, and recommendations in this health consultation are valid only if the referenced documents are complete and reliable.

Previous Health Consultations

To date, two HCs have been completed for a site in Freeland Borough that is known as the Freeland/Garland TCE Site. This site, owned by Garland Commercial Industries, Inc., is on the east end of the Freeland Borough [1] (Figures 1, 2). As a continuation of the previous HCs, PADEP collected additional groundwater samples from those homes with residential wells in close proximity to the Garland Industries portion of the site to determine if the groundwater contamination plume that originated from the Garland Commercial Industry site has contaminated these residential wells with VOCs. The first two of four quarters of residential well sampling, collected October 2003 and February 2004, indicated that VOCs were not present in any concentration above the limits of detection. PADEP anticipates collecting two additional quarters of groundwater samples from these residential wells in the spring and summer of 2004. In the previous HC, PADEP requested that PADOH also conduct an evaluation of these residential well sampling results. A separate HC will respond to this request after all four quarters of residential well sampling data has been received and evaluated by the PADOH.

Discussion

In this section, PADOH evaluated indoor air data and determined whether the residents are being exposed to harmful levels of the VOCs detected in the indoor air of their homes. PADOH considers how occupants came into contact with the VOCs as well as the frequency of exposure. PADOH also considers whether the contaminants were present at harmful levels.

To determine the likelihood of possible health effects of site-specific chemicals, ATSDR has developed health-based comparison values (CVs). These CVs include Minimal Risk Levels (MRLs) for non-cancerous health effects, Cancer Risk Evaluation Guides (CREGs) for cancerous health effects, and Environmental Media Evaluation Guides (EMEGs). If EMEGs cannot be established due to lack of health data, other comparison values may be used, such as the Reference Concentations (RfCs) established by the Environmental Protection Agency (EPA).

ATSDR established MRLs based upon an evaluation of the toxicological literature for a given substance. MRLs are not established as thresholds of toxicity, but were developed as screening tools, below which non-cancer adverse health effects are unlikely. In that framework, a lifetime of exposure below a chronic MRL would not be expected to result in adverse health effects. However, exposure to levels above the MRL may or may not necessarily lead to adverse health effects. There is a wide range of uncertainty between levels known to cause adverse health effects and the MRLs. If environmental exposures occur at concentrations exceeding the MRL, then further evaluation is necessary to determine the health risks of those exposures.

The RfC is an estimate of a continuous inhalation exposure to the human population that is likely to be without appreciable risk of deleterious noncancer effects during a lifetime. It is not a direct estimator of risk, but rather a reference point to gauge the potential effects. At exposure

increasingly greater than the RfC, the potential for adverse health effects increases. Lifetime exposure above the RfC does not imply that an adverse health effect would necessarily occur.

Contaminant Evaluation

Samples results indicated that exposures to acetone, benzene, PCE, and TCE are at concentrations below their corresponding MRLs for chronic or intermediate exposure [4] and should not cause non-cancerous health effects to residents. Therefore, these contaminants, with the exception of benzene, will not be further addressed in this HC. Benzene is a known carcinogen [5], and was detected in concentrations that were in exceedance of the chronic CREG for benzene (0.03 ppbv), which necessitates further evaluation. Acrolein was found in concentrations exceeding the intermediate exposure MRL and therefore chosen for further assessment; it also exceeds the acute exposure MRL (0.05 ppbv). In addition, acetonitrile was selected for further evaluation because it was detected in a concentration that was above EPA's Intermediate RfC.

Benzene

Benzene is commonly found in the environment. Industrial processes are the main sources of benzene in the environment. Benzene levels in the air can increase from emissions from burning coal and oil, benzene waste and storage operations, motor vehicle exhaust, and evaporation from gasoline service stations. Since tobacco smoke contains high levels of benzene, tobacco smoke is another source of benzene in air. Benzene can also pass into air from water and soil surfaces contaminated with benzene. Once in the air, benzene reacts with other chemicals and breaks down within a few days [6].

Although a chronic MRL for benzene does not currently exist, ATSDR guidance states that when evaluating exposures where the maximum concentration is at or below 10 ppbv, a finding of no apparent public health hazard (exposures are not at levels expected to cause adverse health effects) is an appropriate conclusion [7]. The concentrations of benzene (1 ppbv to 3 ppbv) detected in all of the homes are below levels that ATSDR and PADOH consider a threat to health. The range of detected benzene concentrations also falls within the normal background concentrations (0.02 to 34 ppbv) that have been reported for ambient air [6]. Exposure to benzene at the levels found in the indoor air would not be expected to cause noncarcinogenic adverse health effects in residents.

PADOH estimates the maximum excess cancer risk for lifetime exposure (24 hours per day) to benzene at 3 ppbv is one additional cancer per 10,000 people or a low increased risk [8]. Our calculation is based on the assumption there is no safe level of exposure to a chemical that causes cancer. However, the calculated risk is not exact and tends to overestimate the actual risk associated with exposures that may have occurred. Also assuming that residents spend less than 24 hours per day in their homes, the overall cancer risk would further decrease. Given the relatively low level of the maximum detected concentration of benzene (3 ppbv) in comparison to studies that associated benzene to leukemia [9], and given an intermittent residential exposure environment, it is unlikely that the estimated exposure would result in increased cancer.

Acrolein

Acrolein can be formed and can enter the air when organic matter such as tobacco and fuels such as gasoline and oil are burned. Acrolein can also be formed when fats are heated and can be found in fried foods, cooking oils, and roasted coffee [10]. Acrolein may make up 3-10% of total vehicle exhaust aldehydes. Smoking one cigarette yields 3 – 228 micrograms (μg) acrolein or can lead to concentrations of 196 – 366 ppbv acrolein in 10 – 13 minutes of burning. Average ambient levels of acrolein of up to approximately 6.5 ppbv and maximum levels of up to 14 ppbv have been measured in urban air. Levels that are ten to one hundred times higher may occur in the vicinity of exhaust pipes [11].

No information is available on the carcinogenic effects of acrolein in humans. Limited animal cancer data are available. One inhalation study in rats reported no evidence of tumors in the respiratory tract or in other tissues and organs, while another study reported an increased incidence of adrenocortical tumors in female rats exposed to acrolein in drinking water [10, 12]. The major effects from chronic inhalation exposure to acrolein in humans consist of general respiratory congestion and eye, nose, and throat irritation [10, 13].

Acrolein was detected in residential basement air in the October 2003 sampling event at the site up to a maximum concentration of 7 ppbv acrolein, and was not detected in the basement air in the same four (4) basements that were re-sampled in the March 2004 sampling event. However, the air sampling data from the second round of indoor air sampling indicated detectable acrolein concentrations in first floor indoor air in two (2) residential locations with a maximum concentration of 7 ppbv acrolein (Table 1). The two homes where acrolein was detected during the March 2004 sampling event were indicative of at least one smoker present in the household [1].

The EPA RfC is 0.02 $\mu g/m^3$ (0.009 ppbv) based on squamous metaplasia and neutrophilic infiltration of nasal epithelium in rats [12]. ATSDR's Intermediate EMEG/MRL is based on this value [4]. EPA only has medium confidence in the studies supporting the intermediate exposure RfC. To err on the side of safety, an uncertainty factor (UF) of 1,000 was used in developing the RfC for acrolein [12].

Lowest-Observed-Adverse-Effect Levels (LOAELs) in humans were identified at concentrations of 170 ppbv acrolein. Acute inhalation exposures to 170 ppbv acrolein for 40 minutes resulted in eye irritation. Acute inhalation exposures to 260 ppbv acrolein for 40 minutes resulted in nose irritation, and 430 ppbv acrolein for 40 minutes resulted in sore throat for a less serious LOAEL (effect) in human studies. Another study in humans indicated a less serious LOAEL of 810 ppbv and a more serious LOAEL of 1,220 ppbv. In this study, acute inhalation exposures to these concentrations resulted in varying degrees of eye irritation after 5 – 10 minutes of exposure. In other studies, the threshold levels of acrolein causing irritation and health effects through inhalation are 0.07 mg/m^3 (30 ppbv) for odor perception, 0.13 mg/m^3 (57 ppbv) for eye irritation, 0.3 mg/m^3 (130 ppbv) for nasal irritation and eye blinking, and 0.7 mg/m^3 (300 ppbv) for decreased respiratory rate. As the level of acrolein rarely exceeds 0.3 mg/m^3 (13 ppbv) in urban air, it is not likely to reach annoyance or harmful levels in normal circumstances [11]. In

comparison to the maximum residential exposure of 7 ppbv acrolein, PADOH does not expect exposures to acrolein at these levels to result in adverse health effects in humans.

Acetonitrile

Sources of acetonitrile emissions into the air include manufacturing and industrial facilities, automobile exhaust, and volatilization from aquatic environments. Individuals may be exposed to acetonitrile through breathing contaminated air, from smoking tobacco or proximity to someone who is smoking, or through dermal contact in the workplace [14].

In the October 2003 sampling event, acetonitrile was detected in the basement air of one residential basement location at a concentration of 180 ppbv. No other indoor air sample results yielded detectable concentrations of acetonitrile during this sampling event (Tables 1). The source of the acetonitrile detected in the isolated residence during the first round of sampling is unconfirmed because the occupants indicated that no smokers were occupying this household, and ambient air samples collected near this location did not indicate a detectable concentration of acetonitrile, which would exclude automobile exhaust as a potential source. Since the potential sources for acetonitrile could not be identified for this sampling location, laboratory error or sample contamination may have resulted for this elevated level of acetonitrile. Furthermore, the results from the second round of indoor air samples indicated that there were no detectable concentrations of acetonitrile at the same location in basement and first floor samples (Tables 1).

The No-Observed-Adverse-Effect Level (NOAEL) human equivalent concentration and a margin of safety of 1,000 is the basis for the EPA-derived RfC of 0.06 mg/m^3 (36 ppbv) for acetonitrile. If intermediate exposures of 180 ppbv acetonitrile were to occur, inhalation exposures would be 200 times lower than the NOAEL of 60 mg/m^3 (36,000 ppbv) [15]. EPA has not established a reference dose (RfD) for acetonitrile [15]. Based on PADOH's review of the available information on acetonitrile, PADOH does not expect exposures at these levels to result in observable health effects in residents in the vicinity of the site.

Child Health Considerations

PADOH and ATSDR recognize that infants and children may be more vulnerable to chemical exposure than adults. PADOH and ATSDR is committed to evaluating children's special interests. Considering exposure to indoor residential air near the Freeland Groundwater Site, children may have an increased vulnerability due to many factors including: 1) children weigh less than adults, resulting in higher doses of chemical exposure relative to body weight, 2) children have higher rates of respiration, 3) metabolism and detoxification mechanisms differ in both the very young and very old an may increase or decrease susceptibility, and 4) the developing body systems of children can sustain permanent damage if toxic exposures occur during critical growth stages. PADOH and ATSDR considered child-specific doses in the analysis for this HC document and do not expect children living in these homes to be at an increased risk.

Conclusions

The PCE contamination plume identified near the center of Freeland Borough in groundwater, currently, does not appear to be migrating into the indoor air of nearby residences in concentrations that would threaten the health of the residents near the site. Exposure by children and adults to benzene, acrolein, acetonitrile, and other VOCs at the levels detected in the residential indoor air for this HC would not threaten the health of the residents. The presence of the VOCs in indoor air currently represents no apparent health hazard for families living in the homes discussed in this HC. Past exposures to VOCs in the residential locations in the vicinity of the site represent an indeterminate health hazard because historical indoor air data are lacking.

Public Health Recommendations

1. In order to reduce cumulative exposures to VOCs, ATSDR and PADOH recommend that residents on properly use, store, and dispose of VOC-containing household products.

2. No further public health action is needed at this time.

Public Health Actions Completed

1. PADOH and PADEP contacted the affected residents identified in this HC and discussed the public health significance of their exposure to VOCs in their indoor air. PADOH and PADEP encouraged the proper use, storage and disposal of household containing VOCs. PADOH will continue to be available to answer residents' health questions.

2. PADEP fully characterized the site with special emphasis on defining the groundwater contamination plume to determine if PCE or other contaminants are present in ground water. PADOH and PADEP identified residences that could be potentially impacted through indoor air vapor intrusion, and PADEP sampled these homes. PADOH evaluated the public health significance of the sampling results for these residences in this HC.

Public Health Actions Planned

1. PADOH will distribute information to residents identified in this HC to address the identification and proper use, storage and disposal of household containing VOCs.

2. PADOH will also present information to the residents identified in this HC to address the actions that they can take to reduce exposure to second hand cigarette smoke.

3. ATSDR and PADOH will make this HC available to the Freeland Borough Community.

4. At the request of PADEP, PADOH will review and evaluate future indoor air quality analysis data from this site.

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Certification

This Health Consultation for the Freeland Groundwater Site was prepared by the Pennsylvania Department of Health under a cooperative agreement with the federal 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 initiated.

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The Division of Health Assessment and Consultation (DHAC), ATSDR, has reviewed this health consultation and concurs with its findings.

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Appendix A

Table 1

TABLE 1. SUMMARY OF DATA FOR SELECTED VOCS DETECTED IN AIR SAMPLES COLLECTED IN THE VICINITY OF THE FREELAND GROUNDWATER SITE (All units are in parts per billion by volume) – continued on page 15

Compound	Sampling Event	Sample Locations	Frequency of Detection	Range of Concentrations	ATSDR Comparison Values (CV)	CV Source(s)*
acetone	October 2003	Basements	5/5	2 - 10	13000	Chronic EMEG/MRL
	March 2004	Basements	4/4	1(U) - 12		
	March 2004	First Floors	4/4	4 - 21		
	October 2003	Ambient	2/2	2 - 10		
	March 2004	Ambient	2/2	2 (J) - 3		
acetonitrile	October 2003	Basements	1/5	0.5 (U) - **180 (D)**[†]	36	Intermediate RfC
	March 2004	Basements	0/4	0.5 (U)		
	March 2004	First Floors	1/4	0.5 (U) - 8		
	October 2003	Ambient	0/2	0.5 (U)		
	March 2004	Ambient	0/2	0.5 (U)		
acrolein	October 2003	Basements	4/5	**0.5 (U) - 7**	0.009	Intermediate EMEG/MRL
	March 2004	Basements	0/4	**0.5 (U)**		
	March 2004	First Floors	2/4	**0.5 (U) - 7**		
	October 2003	Ambient	1/2	**0.5 (U) - 1**		
	March 2004	Ambient	0/2	**0.5 (U)**		
benzene	October 2003	Basements	4/5	**0.2 (U) - 2**	0.03	Chronic CREG
	March 2004	Basements	4/4	**0.4 (J) - 3**		
	March 2004	First Floors	4/4	**0.5 (J) - 2**		
	October 2003	Ambient	2/2	**0.2 (J) - 0.5 (J)**	4	Intermediate MRL
	March 2004	Ambient	2/2	**0.4 (J) - 1**		
propene	October 2003	Basements	4/5	0.2 (U) - 1	n/a	n/a
	March 2004	Basements	4/4	0.2 (U) - 19		
	March 2004	First Floors	4/4	3 - 220		
	October 2003	Ambient	2/2	0.5 (J) - 2		
	March 2004	Ambient	2/2	0.5 (J) - 1		

*See Table 1a

U = Compound was undetected at the specified quantitation limit
J = Compound was detected, but is estimated below quantitation limit
D = Analysis of diluted sample
[†]Unconfirmed Result

n/a = not available

Bolded = Result exceeds CV

TABLE 1. (continued) SUMMARY OF DATA FOR SELECTED VOCS DETECTED IN AIR SAMPLES COLLECTED IN THE VICINITY OF THE FREELAND GROUNDWATER SITE (All units are in parts per billion by volume)

Compound	Sampling Event	Sample Locations	Frequency of Detection	Range of Concentrations	ATSDR Comparison Values (CV)	CV Source(s)*
tetrachloroethene (PCE)	October 2003	Basements	2/5	0.2 (U) - 5	40	Chronic EMEG/MRL
	March 2004	Basements	2/4	0.2 (U) - 1		
	March 2004	First Floors	2/4	0.2 (U) - 1		
	October 2003	Ambient	0/2	0.2 (U)		
	March 2004	Ambient	0/2	0.2 (U)		
trichloroethene (TCE)	October 2003	Basements	1/5	0.2 (U) - 0.5 (J)	100	Intermediate EMEG/MRL
	March 2004	Basements	0/4	0.2 (U)		
	March 2004	First Floors	0/4	0.2 (U)		
	October 2003	Ambient	0/2	0.2 (U)		
	March 2004	Ambient	0/2	0.2 (U)		
1,2,4-trimethylbenzene	October 2003	Basements	3/5	0.2 (U) - 1	n/a	n/a
	March 2004	Basements	4/4	0.2 (U) - 1		
	March 2004	First Floors	4/4	0.4 (J) - 0.9 (J)		
	October 2003	Ambient	1/2	0.2 (U) - **9**		
	March 2004	Ambient	1/2	0.2 (U) - 0.6 (J)		
1,3,5-trimethylbenzene	October 2003	Basements	3/5	0.2 (U) - 0.4 (J)	n/a	n/a
	March 2004	Basements	4/4	0.2 (U) - 0.6 (J)		
	March 2004	First Floors	2/4	0.2 (U) - 0.6 (J)		
	October 2003	Ambient	1/2	0.2 (U) - **2**		
	March 2004	Ambient	1/2	0.2 (U) - 0.3 (J)		

U = Compound was undetected at the specified quantitation limit

J = Compound was detected, but is estimated below quantitation limit

D = Analysis of diluted sample

*See Table 1a n/a = not available

TABLE 1a. COMPARISON VALUE (CV) DEFINTIONS

CREG	Cancer Risk Evaluation Guide for 1 X 10^{-6} excess cancer risk
EMEG	Environmental Media Evaluation Guide
MRL	Minimal Risk Level
RfC	Reference Concentration (EPA)

Appendix B

Figures

Figure 1

Freeland Groundwater Site Location Map

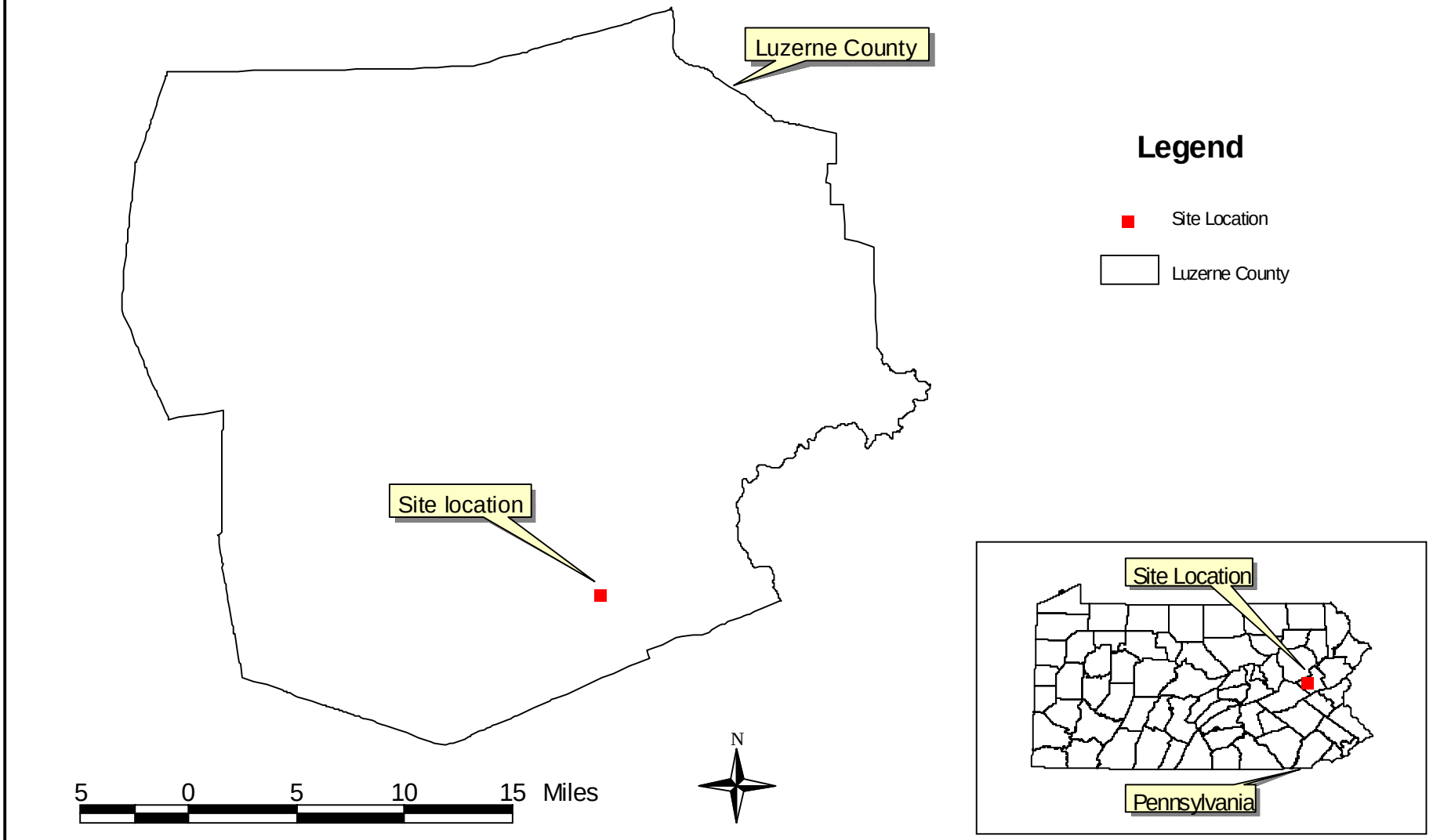

Figure 2

Freeland Groundwater Site Location Map

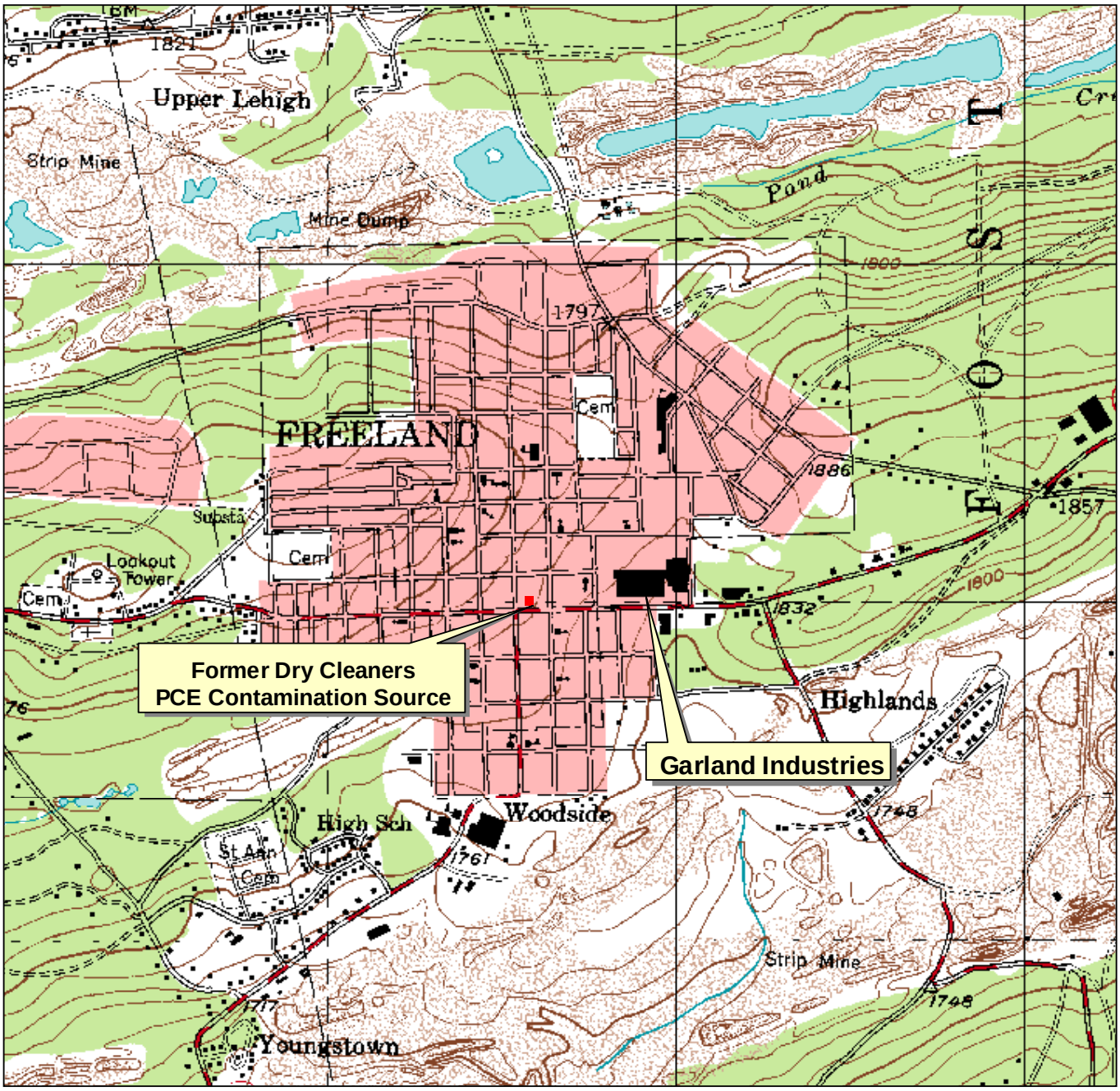

Figure 3

Residential Areas Near the Freeland Groundwater Site From Aerial Photograph (April, 1999)