HEALTH CONSULTATION

HUSKY LIMA REFINERY RELEASE

LIMA, ALLEN COUNTY, OHIO

Prepared by:

Ohio Department of Health
Health Assessment Section

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SUMMARY

Introduction

The Health Assessment Section (HAS) of the Ohio Department of Health (ODH), in cooperation with the Agency for Toxic Substances and Disease Registry (ATSDR), seeks to assist the Lima, Ohio community by using the best environmental science, providing accurate health information, and taking public health actions to prevent harmful exposures and disease related to toxic substances.

This public health consultation is HAS's evaluation of environmental data to assess impacts on public health following the release and cleanup of a petroleum aerosol in Lima, Ohio. This report reviews the analytical results of soil samples collected by Cox-Colvin and Associates, Inc. for Husky Energy, Inc., Lima Refining Company, under the guidance of U.S. EPA and Ohio EPA.

ODH HAS reached one conclusion about the Husky Lima Refinery Release in Lima, Ohio.

Conclusion

HAS concludes that the residual petroleum chemicals detected in soil in the affected area downwind of the Husky Lima Refinery are not expected to harm people's health because the residual levels in soil are below levels of health concern.

Basis for decision

A release of petroleum products into the air on November 22, 2009 at the Husky Lima Refinery affected a residential area downwind of the facility. An extensive response was completed by the company to clean up the deposited material, which was followed up by soil sampling the following spring to evaluate residual risk. Based on the environmental sample information reviewed and the exposure scenarios evaluated, HAS concludes that exposure to the chemicals of concern [benz(a)anthracene, 2-methylnaphthalene, and total petroleum hydrocarbons (C_{20}-C_{34})] detected in the soil downwind of the Husky Lima Refinery are not expected to harm people's health. The levels of residual chemicals in soil are below levels of health concern. **No additional cleanup of soil is considered to be necessary.**

Next steps

All cleanup work has been completed and no additional cleanup is necessary. Husky Lima Refinery completed appropriate cleanup actions that included washing and/or remediating 250 residential homes and commercial properties, 937 vehicles, sweeping and /or washing roadways and paths in Woodlawn Cemetery, along with streets and roadways downwind of the facility.

For more information

For more information about hazardous substances, including health effects, please see ODH chemical fact sheets available on-line at: http://www.odh.ohio.gov *(go to "H" and "Health Assessment Section")* or ATSDR's toxicological information online at: http://www.atsdr.cdc.gov.

For information about this site, including site remediation, please see the U.S. EPA site fact sheet available at: http://www.epaosc.org/site/site_profile.aspx?site_id=5625.

BACKGROUND AND STATEMENT OF ISSUES

Site Description and Release Event

Husky Lima Refinery is located at 1150 South Metcalf Street in Lima, Allen County, Ohio. The facility is bordered to the north by parks, residential and commercial properties, to the west by residential areas and the Ottawa River, and to the south and east by commercial and industrial areas. On November 22, 2009, an above ground storage tank (57 Tank) at the Husky Lima Refinery ruptured and released petroleum products into the air which was carried by the wind and deposited downwind of the facility (U.S. EPA 2009b). As a part of an incident response, the U.S. Environmental Protection Agency (EPA) Emergency Response Branch detected fall-out of an oil mist in residential and commercial properties in Lima as far as five miles downwind (NW) of the refinery site (Figure 1). Heavy-molecular weight hydrocarbons were released as a heated semi-fluid mist as the tank was being refilled following maintenance. The mist solidified upon contact with the air, falling out as tiny beads of a tar-like substance that was deposited on the ground surface, grass, leaves, buildings, cars, and other exposed objects. The material had high viscosities and was insoluble, adhering to objects once deposited. U.S. EPA ambient air monitoring did not indicate the presence of any volatile or semi-volatile organic compounds at levels of health concern.

Land Use and Demographics

The city of Lima, Ohio has a population of 40,000 people, living in a total of 15,000 occupied housing units, including about 8,000 owner-occupied, single-family homes (U.S. Census 2000). The area located near the Husky Lima Refinery is of mixed residential and commercial use. The area affected by the petroleum release was about five miles to the west and north (downwind) of the Husky Lima Refinery and included predominantly residential neighborhoods and commercial properties (Figure 1). The heaviest petroleum deposits covered the ground, soil, grass, and vertical surfaces about one mile downwind of the facility in Collett Park, Woodlawn Cemetery, a small section of residential homes, and the Ottawa River (U.S. EPA 2009b).

Emergency Removal Action

Immediately after the oil release, Husky Refinery deployed crews to assess and document all impacted areas and began remediation, including washing of external home and vehicle surfaces and removal of impacted vegetation. Product was captured and removed as sheen from the nearby Ottawa River and from nearby roads and parking lots by street cleaners. A call-center was created to handle residential complaints. Surfaces of homes, buildings, and cars were inspected and washed by Lima Refinery contractors. As of December 2009, Husky Lima Refinery contractors inspected and washed surfaces of 245 of 550 residential homes, 5 commercial properties, and a total of 937 vehicles. A total of 810 complaints were received by the Husky call center regarding impacted properties. Leaves and impacted vegetation were removed from along the bank of the Ottawa River and immediately downwind of the release. Impacted grass and vegetation from Collett Park and tree covered areas in Woodlawn Cemetery were cut and removed. Some areas were fenced off and treated with Micro-Blaze to assist in the natural degradation of the residual oil. Free petroleum product was contained and collected from five

collection points on the Ottawa River. Soil samples were collected from heavily impacted areas nearest the site. A total of 13 roll-off boxes of oil-contaminated debris were transported off-site for disposal at County Environmental of Wyandot in Carey, Ohio. Five animals (all family pets, including 2 ducks, 2 cats and 1 dog) were washed at a center established for treating oiled-impacted wildlife. In addition, the company coordinated with Allen County Health Department and a private doctor to address any health related questions and concerns. Recovered liquids were treated and processed at the Husky Refinery (U.S. EPA. 2009b).

Some of the planned activities for the spring of 2010 were not implemented due to conditions after the snow melt. For instance, no grass clippings were collected from the first mowing, because there were no longer visible impacts on ground vegetation (Steve Snyder, Ohio EPA, personal communication, Nov. 12, 2010). In February 2011, an update regarding the company's completed remediation efforts was provided by Husky Lima Refinery (Paul Logsdon, Husky Energy, personal communication, February 8, 2011). The completed actions are listed below:

1. All oil residue has been removed from the homes, with 962 homes cleaned of residual oil deposits. There were a total of 971 claims; however, there still are 7 open claims with insurance settlement issues related to damage caused by the cleanup.
2. Grass clippings and leaves were removed from 61 yards. It was found that the need for clipping removal was less than expected due to natural degradation of the oil.
3. Test plots and field plots were treated using several grass and vegetation cleaning solutions, such as Micro-Blaze, Citrus Orange, and fertilizer to degrade the oil. No significant difference was found between the treated and the untreated test plots. Similar results were observed in the field applied plots.
4. All wipe test and water samples from contaminated properties were all below detection levels for the contaminants of concern.
5. The company conducted a residual risk assessment by collecting and analyzing 16 surface soil samples and comparing the results to clean-up standards for each constituent of concern.

ATSDR/HAS Involvement

The Agency for Toxic Substances and Disease Registry (ATSDR) Region 5 Office in Chicago was initially involved during the emergency phase of the tank release at the Husky Lima Refinery. Following the oil release in November 2009, the Health Assessment Section (HAS) of the Ohio Department of Health (ODH) was contacted with regard to continuing involvement in assessing the health impacts on the community. HAS was part of a multi-agency advisory group providing oversight to the company's contractors with regard to follow-up sampling and remediation. The company worked with Ohio EPA's Northwest District Office (NWDO) to develop a work plan (March 19, 2010) to conduct sampling of soils in April 2010 and follow-up remedial activities in the area as necessary.

DISCUSSION

In April 2010, Cox-Colvin personnel collected eight surface soil samples within the affected area. The affected area is downwind of the Husky Lima Refinery and includes predominantly residential neighborhoods and commercial properties. Colvin also collected eight surface soil

samples outside of the affected area to determine soil background levels of the chemicals of concern (Figure 1). On June 14, 2010, the Lima Refining Company provided a report prepared by Cox-Colvin & Associates, Inc. containing the results of an evaluation of the residual risk associated with the release using a reverse risk assessment process (Cox-Colvin 2010). In order to provide an independent evaluation of the environmental data, HAS reviewed the levels of chemicals of concern detected in soil samples to determine whether the detected levels pose a health hazard to residents following the extensive response actions described above.

The soil samples were analyzed for a wide variety of compounds that could have been released from the tank at the Husky Lima Refinery, including volatile organic compounds, semi-volatile organic compounds, long-chained petroleum hydrocarbons, and metals. Based on the analysis of the tank material and the compounds that exceeded Ohio EPA and U.S. EPA risk-based screening concentrations, the chemicals of concern were determined to be benz(a)anthracene, 2-methylnaphthalene, and total petroleum hydrocarbons (C20-C34). The risk-based standards used for this determination were Ohio EPA's Voluntary Action Program (VAP) Generic Direct-Contact Soil Standards for the Residential Land-Use Category (Residential Standards).

To determine the potential health risks associated with the contaminants found in the soil samples, the HAS reviewed and compared the chemicals of concern detected in the soil samples to ATSDR, U.S. EPA, and other health-based comparison values. Comparison values are calculated concentrations of substances that are unlikely to cause harmful (adverse) health effects in exposed people. For further evaluation, HAS estimated exposure doses to the chemicals of concern and compared them to health guideline values or doses from toxicological studies. An "exposure dose" is how much of a substance that is encountered in the environment, expressed in milligrams (amount of a substance) per kilogram (body weight) per day (mg/kg/day).

For contaminants that are considered to be known or suspected human carcinogens, an estimation of cancer risk may be calculated using U.S. EPA's chemical-specific cancer slope factors and compared to an excess lifetime cancer risk of one-in-one million to one-in-ten thousand persons exposed for a lifetime.

Benz(a)anthracene

Benz(a)anthracene is one of many polycyclic aromatic hydrocarbons (PAHs) that are formed during the incomplete burning of coal, oil and gas, garbage, or other organic substances like tobacco or charbroiled meat (ATSDR 1995). Benz(a)anthracene is found in gasoline and diesel exhaust, cigarette smoke and smoke condensate, amino acid, fatty acid, and carbohydrate pyrolysis products, coal tar and coal tar pitch, asphalt, soot and smoke, wood smoke, coal combustion emissions, commercial solvents, waxes, mineral oil, and creosote (NTP 2005). Urban soils contain measurable amounts of PAHs, primarily from airborne fallout from car and truck exhaust, residential burning of wood, and industrial sources. Background soil concentrations of benz(a)anthracene range from 1-20 parts per billion (ppb) in rural soil, 4.6-900 ppb in agricultural soil and 165-220 ppb in urban soil (ATSDR 1995).

Benz(a)anthracene levels detected in the soil samples at the Husky Lima Refinery site ranged from not detected (ND) to 1,200 ppb in the affected area samples and ND to 91 ppb in the

background samples (Tables 1 and 2). The site is in a residential area and the main exposure route was assumed to be incidental ingestion from direct contact with contaminated soil. ATSDR has not established a minimal risk level (MRL) for exposure to benz(a)anthracene. EPA has derived a screening level of 150 ppb for benz(a)anthracene in residential soil, based on cancer risk (U.S. EPA 2009a).

Using an exposure scenario for an adult weighing 70 kilograms (kg) ingesting 100 milligrams of soil per day (mg/day) at the maximum concentration of 1,200 ppb, the estimated exposure dose of benz(a)anthracene would be 1.71×10^{-6} mg/kg/day. For the exposure of a small child (1-6 years) weighing 16 kg ingesting 200 mg/day of soil with the highest concentration of benz(a)anthracene, the estimated exposure dose of benz(a)anthracene would be 1.50×10^{-5} mg/kg/day. Although ATSDR has not derived a MRL for benz(a)anthracene, the more toxic benzo(a)pyrene (B(a)P) can be used as a surrogate to assess the relative toxicity of PAHs in soil. There are LOAELs (lowest-observed-adverse-effect-levels) and NOAELs (no-observed-adverse-effect-levels) available for B(a)P (ATSDR 1995). An intermediate NOAEL of 1.3 mg/kg/day was observed for mice exposed to B(a)P; a LOAEL of 2.6 mg/kg/day was based on the appearance of gastric tumors in mice. The estimated exposure doses for both adults and small children for benz(a)anthracene are several orders of magnitude below the NOAEL and LOAEL for B(a)P. Therefore, exposures to benz(a)anthracene in the soil at the Husky Lima Refinery site are not expected to result in adverse health effects.

The EPA has determined that benz(a)anthracene (along with six other PAHs) are probable human carcinogens (ATSDR 1995). The National Toxicology Program (NTP) at the U.S. Public Health Service lists benz(a)anthracene as one of 15 polycyclic aromatic hydrocarbons that that are “reasonably anticipated to be human carcinogens” (NTP 2005). The International Agency for Research on Cancer (IARC) has classified benz(a)anthracene as possibly carcinogenic to humans (Group 2B) due to sufficient evidence in animals and limited evidence in humans (IARC 1973, 2010). To determine its toxicity, the concentration of benz(a)anthracene was multiplied by a Toxic Equivalency Factor (TEF) of 0.1, which relates its toxicity to that of B(a)P (U.S. EPA 1993). A maximum B(a)P Toxicity Equivalency (TEQ) concentration of 120 ppb was used to estimate a theoretical lifetime risk of developing cancer using the adult scenario. The theoretical lifetime risk was estimated to be 1.2×10^{-6}, which would be interpreted as no apparent increase in lifetime risk for developing cancer. The actual risk is most likely to be even lower, because incidental ingestion of soil is considered to be an intermittent exposure rather than a chronic exposure over a lifetime. Therefore, HAS expects no significant increase in cancer risk from exposures to benz(a)anthracene in the soil at this site.

2-Methylnaphthalene

2-Methylnaphthalene, also called beta methylnaphthalene, is a solid like naphthalene. The taste and odor of 2-methylnaphthalene have not been described, but you can smell it in air or water when only 10 ppb are present. 2-Methylnaphthalene, along with 1-methylnaphthalene is used to make other chemicals such as dyes and resins. 2-Methylnaphthalene is also used to make vitamin K. It is also present in cigarette smoke, wood smoke, tar, asphalt, and at some hazardous waste sites. Naphthalene and methylnaphthalenes have been reported at low concentrations in uncontaminated soils and sediments and at higher concentrations near or within sources of

contamination. Naphthalene was detected in urban soil samples from various cities at an average concentration of 125 ppb. Reported concentrations in contaminated soils included 6,100 ppb naphthalene and 2,900 ppb methylnaphthalene (isomer not specified) in coal-tar contaminated soil (ATSDR 2005).

2-Methylnaphthalene levels detected in the soil samples at the Husky Lima Refinery site ranged from not detected (ND) to 64 ppb in the affected area samples and ND to 140 ppb in the background samples (Tables 1 and 2). Using the same exposure route and scenarios for benz(a)anthracene, the estimated exposure doses of 2-methylnaphthalene for an adult was calculated to be 2.0×10^{-7} mg/kg/day. Similarly, the calculated exposure dose for a child was 1.75×10^{-6} mg/kg/day. ATSDR has derived an MRL of 0.04 mg/kg/day for chronic-duration oral exposure to 2-methylnaphthalene, based on a study in male mice exposed to 2-methylnaphthalene in the diet. This MRL includes an uncertainty factor of 100 (10 for extrapolation from animals to humans and 10 for human variability). The estimated exposure doses are approximately 20,000 to 200,000 times lower than the MRL. It is also lower than the oral exposure reference dose (RfD) of 0.004 mg/kg-day established by the U.S. EPA for 2-methylnaphthalene. HAS and ATSDR do not expect exposure to 2-methylnaphthalene in the soil to result in noncancer adverse health effects. In addition, there was no appreciable difference in the concentration found in the background samples and samples collected in the affected areas.

When mice were fed food containing 1-methylnaphthalene or 2-methylnaphthalene for most of their lives (81 weeks), the gas-exchange part of the lungs of some mice became filled with an abnormal material. This type of lung injury is called pulmonary alveolar proteinosis. A few mice also had lung tumors, but the numbers of mice with lung tumors were not enough to conclude that 2-methylnaphthalene (or 1-methylnaphthalene) caused the tumors. Pulmonary alveolar proteinosis has been seen in some people, but the cause of this uncommon lung disease in humans is unknown. There are no studies that link the development of cancer in humans to oral exposure to 2-methylnaphthalene, 1-methylnaphthalene, or naphthalene (ATSDR 2005). Therefore, exposure to 2-methylnaphthalene in the soil is not expected to cause an increase in cancer incidence in the community.

Total Petroleum Hydrocarbons (C20-C34)

Total Petroleum Hydrocarbons (TPHs) is a term used to describe a broad family of several hundred chemical compounds that originate from crude oil. Crude oils are very complex mixtures that vary greatly depending on their source. Most of the compounds in crude oils are hydrocarbons: chemicals made from hydrogen and carbon. They include straight-chained, branched, and cyclic aliphatic hydrocarbons; and aromatic hydrocarbons, a group of cyclic hydrocarbons containing one or more rings, such as benzene, alkylbenzenes, naphthalenes, and PAHs (ATSDR 1999). The soil samples collected after the Husky Lima Refinery tank release were also analyzed for long-chained total petroleum hydrocarbons in the C_{20} to C_{34} range. All of the samples, including the background samples, showed levels of TPHs above the laboratory reporting limit (Tables 1 & 2).

The released material was known to contain long-chained petroleum hydrocarbons, therefore soil samples were analyzed with a focus on C_{20} to C_{34} hydrocarbons. ATSDR has not established a

fraction-specific MRL for inhalation and oral exposure to total petroleum hydrocarbons in the C_{20} to C_{34} range. ATSDR has based its approach in evaluating potential health impacts of TPHs on the work done by the Total Petroleum Hydrocarbon Criteria Working Group (TPHCWG) by dividing TPHs into a reduced number of fractions. ATSDR's TPH fractions include three groups of aliphatic fractions and three groups of aromatic fractions. ATSDR then established health effects screening values based on the toxicity of representative chemicals or mixtures (serving as surrogates) for each of these fractions. In general, the most toxic surrogate compound or mixture was used to indicate the potential toxicity of the entire fraction (ATSDR 1999).

The ATSDR fraction that matches best with the C_{20}-C_{34} TPHs found in the soil samples corresponds best with the fraction with a carbon range of $C_{>16}$-C_{35}, with mineral oils serving as the surrogate mixture. Hydrocarbons in the $C_{>16}$- C_{35} fraction are poorly absorbed, regardless of the route of exposure, and slowly metabolized. Toxicity studies of some mineral oil mixtures fed to laboratory rats have identified the liver and the mesenteric lymph nodes as potential targets of toxicity from exposure to these mineral oils. The effect on the mesenteric lymph nodes (histiocytosis), which occurred at lower exposure levels than did the effects on the liver, was judged a nonadverse, adaptive response to the ingestion of foreign material (ATSDR 1999). ATSDR does not have a MRL available for mineral oils. However, TPHCWG recommended a non-cancer oral toxicity reference value of 2.0 mg/kg/day for the aliphatic fraction of TPHs in this carbon range (TPHCWG 1997).

Using the same exposure scenarios used for the other chemicals identified in soil samples and the maximum concentration of 160 milligrams per kilogram (mg/kg), the estimated exposure dose of TPHs was calculated to be 2.3×10^{-4} for an adult and 2.0×10^{-3} for a child. The estimated exposure doses for both adults and small children are 1,000 and 10,000 times below the oral reference dose for TPHs. Based on these exposure scenarios, HAS does not expect exposures to TPHs in the soil to result in non-cancer adverse health effects.

The International Agency for Research on Cancer (IARC) reviewed a number of cancer studies of animals exposed to crude oil, along with studies involving workers in the petroleum industry. IARC concluded that there is inadequate evidence for the carcinogenicity of crude oil in humans and limited evidence for the carcinogenicity in experimental animals, with an overall evaluation that crude oil is not classifiable as to its carcinogenicity to humans (Group 3) (IARC 1989). Due to limited evidence and limited exposure, HAS does not expect a significant increase in cancer risk in the impacted neighborhoods from exposures to TPHs.

Child Health Issues

Children can be 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 have more opportunity to come into contact with environmental pollutants due to being closer to the ground surface and taking part in activities on the ground such as, crawling, sitting, and lying down on the ground. Exposure doses were calculated for both adults and children to address the greater exposure of children to environmental contaminants.

CONCLUSIONS

HAS concludes that the residual petroleum chemicals detected in soil in the affected area downwind of the Husky Lima Refinery are not expected to harm people's health. The reason for this is that the residual levels in soil are below levels of health concern. An extensive response was completed by the Husky Lima Refinery to clean up deposited material after an oil mist release in November 2009. This was followed by soil sampling the following spring to evaluate residual risk. Based on the environmental sample information reviewed and the exposure scenarios evaluated by ODH, HAS concludes that exposure to the chemicals of concern [benz(a)anthracene, 2-methylnaphthalene, and total petroleum hydrocarbons (C_{20}-C_{34})] detected in the soil in the affected area downwind of the Husky Lima Refinery are not expected to harm people's health. The levels of residual chemicals in soil are below levels of health concern. No additional cleanup of soil is considered to be necessary.

RECOMMENDATIONS

Based on the results of soil sampling, the levels of residual chemicals in soil are below levels of health concern and no additional cleanup of soil is necessary.

PUBLIC HEALTH ACTIONS

Immediately after the oil release in November 2009, Husky Refinery began a comprehensive environmental cleanup effort, which included washing homes, vehicles and external surfaces, and removing impacted vegetation. In addition, Husky Refinery implemented a work plan with U.S. EPA and Ohio EPA guidance and input from ODH and local community members which resulted in the collection of surface soil samples and an evaluation of the residual risk associated with the oil release. With the cleanup now completed, along with the facility's and HAS's evaluations of the follow-up soil sampling results, HAS does not anticipate any additional review regarding environmental contamination associated with the Husky Lima Refinery Release.

PREPARERS OF THE REPORT

Ohio Department of Health
Bureau of Environmental Health
Health Assessment Section
John Kollman, Environmental Specialist
Robert C. Frey, Chief

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TABLES

Table 1. Affected Area Soil Results

Chemical of Concern	*Range of Detections (ppb)*	*Average (ppb)*	*Frequency of Detections*	*Frequency Above Comparison Values*	*Comparison Value (ppb)*	*Type*
Benz(a)anthracene	ND–1,200	450	6/9	4	150	EPA RSL
2-Methylnaphthalene	ND–64	31	5/9	0	200,000	RMEG (child)
TPH (C20-C34)	5,000–160,000	83,000	9/9	0		

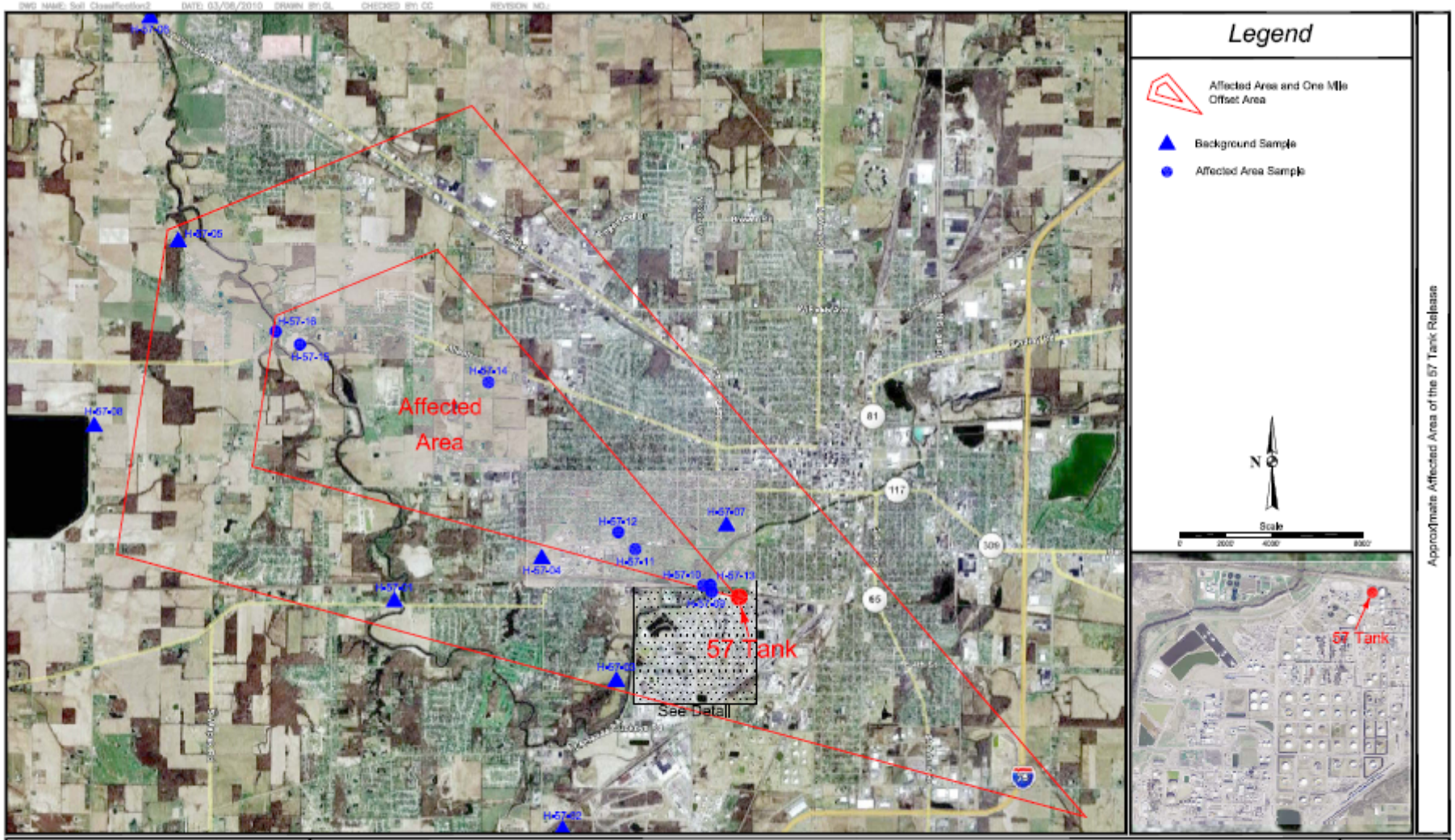
Table 2. Background Soil Results

Chemical of Concern	*Range of Detections (ppb)*	*Average (ppb)*	*Frequency of Detections*	*Frequency Above Comparison Values*	*Comparison Value (ppb)*	*Type*
Benz(a)anthracene	ND–91	29	4/9	0	150	EPA RSL
2-Methylnaphthalene	ND–140	23	3/9	0	200,000	RMEG (child)
TPH (C20-C34)	3,200J–68,000	31,000	9/9	0		

Source: Cox-Colvin 2010

ppb – parts per billion
ND – Not Detected
J – Estimated
RSL – Regional Screening Level (U.S. EPA)
EMEG – Environmental Media Evaluation Guide (ATSDR)
RMEG – Reference Dose Media Evaluation Guide (ATSDR)
TPH – Total Petroleum Hydrocarbons

FIGURES



Cox-Colvin & Associates, Inc. Environmental Services

Approximate Affected Area of the 57 Tank Release,
Husky Energy, Inc., Lima Refinery,
Lima, Ohio

Figure 1