



**Public Health
Assessment
for**

**KOPPERS INDUSTRIES, INCORPORATED
(a/k/a KOPPERS COMPANY, INCORPORATED)
NORTH LITTLE ROCK, PULASKI COUNTY, ARKANSAS
EPA FACILITY ID: ARD006344824
JANUARY 27, 2005**

**U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
Agency for Toxic Substances and Disease Registry**

THE ATSDR PUBLIC HEALTH ASSESSMENT: A NOTE OF EXPLANATION

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

In addition, this document has previously been provided to EPA and the affected states in an initial release, as required by CERCLA section 104 (i)(6)(H) for their information and review. The revised document was released for a 30-day public comment period. Subsequent to the public comment period, ATSDR addressed all public comments and revised or appended the document as appropriate. The public health assessment has now been reissued. This concludes the public health assessment process for this site, unless additional information is obtained by ATSDR which, in the agency's opinion, indicates a need to revise or append the conclusions previously issued.

Agency for Toxic Substances & Disease Registry..... Julie L. Gerberding, M.D., M.P.H., Administrator
Henry Falk, M.D., M.P.H., Director

Division of Health Assessment and Consultation..... William Cibulas, Jr., Ph.D., Director
Sharon Williams-Fleetwood, Ph.D., Deputy Director

Community Involvement Branch..... Germano E. Pereira, M.P.A., Chief

Exposure Investigations and Consultation Branch..... Donald Joe, M.S., Deputy Branch Chief

Federal Facilities Assessment Branch..... Sandra G. Isaacs, B.S., Chief

Superfund Site Assessment Branch..... Richard E. Gillig, M.C.P., Chief

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Koppers Industries, Incorporated
(a/k/a Koppers Company, Incorporated)

Final Release

PETITIONED PUBLIC HEALTH ASSESSMENT

KOPPERS INDUSTRIES, INCORPORATED
(a/k/a KOPPERS COMPANY, INCORPORATED)

NORTH LITTLE ROCK, PULASKI COUNTY, ARKANSAS

EPA FACILITY ID: ARD006344824

Prepared by
Arkansas Department of Health
Little Rock, Arkansas

Under Cooperative Agreement with
The U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry
Atlanta, Georgia

FOREWORD

The Agency for Toxic Substances and Disease Registry, ATSDR, was established by Congress in 1980 under the Comprehensive Environmental Response, Compensation, and Liability Act, also known as the *Superfund law*. This law set up a fund to identify and clean up our country's hazardous waste sites. The Environmental Protection Agency, EPA, and the individual states regulate the investigation and clean up of the sites.

Since 1986, ATSDR has been required by law to conduct a public health assessment at each of the sites on the EPA National Priorities List. The aim of these evaluations is to find out if people are being exposed to hazardous substances and, if so, whether that exposure is harmful and should be stopped or reduced. (The legal definition of a health assessment is included on the inside front cover.) If appropriate, ATSDR also conducts public health assessments when petitioned by concerned individuals. Public health assessments are carried out by environmental and health scientists from ATSDR and from the states with which ATSDR has cooperative agreements. The public health assessment program allows the scientists flexibility in the format or structure of their response to the public health issues at hazardous waste sites. For example, a public health assessment could be one document or it could be a compilation of several health consultations - the structure may vary from site to site. Nevertheless, the public health assessment process is not considered complete until the public health issues at the site are addressed.

Exposure: As the first step in the evaluation, ATSDR scientists review environmental data to see how much contamination is at a site, where it is, and how people might come into contact with it. Generally, ATSDR does not collect its own environmental sampling data but reviews information provided by EPA, other government agencies, businesses, and the public. When there is not enough environmental information available, the report will indicate what further sampling data is needed.

Health Effects: If the review of the environmental data shows that people have or could come into contact with hazardous substances, ATSDR scientists evaluate whether or not these contacts may result in harmful effects. ATSDR recognizes that children, because of their play activities and their growing bodies, may be more vulnerable to these effects. As a policy, unless data are available to suggest otherwise, ATSDR considers children to be more sensitive and vulnerable to hazardous substances. Thus, the health impact to the children is considered first when evaluating the health threat to a community. The health impacts to other high risk groups within the community (such as the elderly, chronically ill, and people engaging in high risk practices) also receive special attention during the evaluation.

ATSDR uses existing scientific information, which can include the results of medical, toxicologic and epidemiologic studies and the data collected in disease registries, to determine the health effects that may result from exposures. The science of environmental health is still developing, and sometimes scientific information on the health effects of certain substances is not available. When this is so, the report will suggest what further public health actions are needed.

Conclusions: The report presents conclusions about the public health threat, if any, posed by a site. When health threats have been determined for high risk groups (such as children, elderly, chronically ill, and people engaging in high risk practices), they will be summarized in the conclusion section of the report. Ways to stop or reduce exposure will then be recommended in the public health action plan.

ATSDR is primarily an advisory agency, so usually these reports identify what actions are appropriate to be undertaken by EPA, other responsible parties, or the research or education divisions of ATSDR. However, if there is an urgent health threat, ATSDR can issue a public health advisory warning people of the danger. ATSDR can also authorize health education or pilot studies of health effects, full-scale epidemiology studies, disease registries, surveillance studies or research on specific hazardous substances.

Interactive Process: The health assessment is an interactive process. ATSDR solicits and evaluates information from numerous city, state and federal agencies, the companies responsible for cleaning up the site, and the community. It then shares its conclusions with them. Agencies are asked to respond to an early version of the report to make sure that the data they have provided is accurate and current. When informed of ATSDR's conclusions and recommendations, sometimes the agencies will begin to act on them before the final release of the report.

Community: ATSDR also needs to learn what people in the area know about the site and what concerns they may have about its impact on their health. Consequently, throughout the evaluation process, ATSDR actively gathers information and comments from the people who live or work near a site, including residents of the area, civic leaders, health professionals and community groups. To ensure that the report responds to the community's health concerns, an early version is also distributed to the public for their comments. All the comments received from the public are responded to in the final version of the report.

Comments: If, after reading this report, you have questions or comments, we encourage you to send them to us.

Letters should be addressed as follows:

Attention: Division of Health Assessment and Consultation, Agency for Toxic Substances and Disease Registry, 1600 Clifton Road (E-60), Atlanta, GA 30333.

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SUMMARY

In accordance with a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR), the Arkansas Department of Health (ADH) prepared this Petitioned Public Health Assessment (PHA) at the request of Glenview and Poe Addition neighborhood associations to address concerns about past, current, and future health hazards and odors associated with Koppers Industries Incorporated (KII) operations. (Note: Appendix A provides a glossary of terms used in this report.)

In preparing this PHA, ADH reviewed available data from the Arkansas Department of Environmental Quality (ADEQ) and the United States Environmental Protection Agency (USEPA). ADH identified several exposure situations for evaluation. These include possible contact with site contaminants in the air, soil, garden vegetables, and groundwater. ADH evaluated potential health effects that could be associated with the identified exposure situations. *On the basis of available information, under the present site conditions, the KII site is considered to present no apparent public health hazard for exposures to site-related chemicals.*

Air monitoring confirmed the presence of site-related chemicals (naphthalene) at levels people could detect, i.e., they could smell a chemical odor. A point has not been established when an individual's response to an unpleasant odor can be considered an adverse health effect. If concentrations of a chemical are below the level expected to produce a health effect, individual sensitivity to the chemical must be considered, as should the presence of an unpleasant odor which may interfere with quality of life. Studies suggest that odors may trigger respiratory effects among sensitive populations, such as people with asthma, children, elderly people, and immune-suppressed people. Odor triggers may be further confounded by other respiratory environmental triggers, such as dust mites, animal dander, tobacco smoke, and other types of outdoor air pollution.

The limited air data available for the site detected small concentrations of polycyclic aromatic hydrocarbons (PAHs) in the air, but those concentrations were below levels that cause adverse health effects. Exposures to contaminated soils have occurred and continue to occur, but the concentrations of the contaminants in the soils are below levels found to cause adverse health effects. Edible portions of garden plants grown in soils containing PAH concentrations that were detected in the community soil samples were not expected to cause adverse health effects. No evidence exists to indicate that contaminated groundwater in the vicinity of the site was used as a source of drinking, bathing, or irrigation water. Currently, the residents in the area use a public water system that obtains its water from a distant source not influenced by the water table in the vicinity of the site. Thus, the residents' potable water source is not adversely impacted by contaminated groundwater. Therefore, even though the site contaminants have adversely impacted the environmental water quality, no apparent exposure points in the contaminated groundwater put people at risk for exposure.

BACKGROUND

Site Description and History

KII is an active wood-treatment facility located at 2201 Edmonds Street, North Little Rock, Pulaski County, Arkansas. An ariel photo and site map of KII can be found in Appendix B, Figures 3 and 4. Wood has been treated at this property since 1907, when it was owned by the Ayer and Lord Tie Company. Koppers Company, Inc., acquired the plant in 1944. BNS Acquisitions, Inc. (a subsidiary of Beazer PLC) acquired the outstanding common stock of Koppers. In December 1988, BNS sold some Koppers assets including the Koppers name to a management-led buyout group known as KII. The plant is currently owned and operated by KII.

The site covers approximately 155 acres of generally flat plain that slopes to the south and southeast toward the Arkansas River. The Arkansas River flows to the east approximately 1 mile south of the plant. West of the facility is an open field and marsh area sometimes used for agriculture. To the north and northwest is an industrial area where operating plants engage in manufacturing, assembly, and fabrication. Two residential neighborhoods are located within a 1-mile radius of the site: the Glenview community is to the east of the facility and the Poe Addition community is to the south. Glenview Elementary School, at 2101 Edmond Street, borders an eastern portion of the site owned by KII. The Glenview Recreation Center also is less than ½ mile east of KII at 4800 East 19th Street.

A fence restricts facility access from the residential areas to the east and south and industrial areas to the north and northwest. Access to the site from the undeveloped property to the west is not fence-restricted. However, the area west of the plant is open fields and marsh with limited human use. Either an employee or a security guard attends a gate at the corner of Ira and Van streets from 6:30 a.m. until midnight; from midnight until 6:30 a.m., the gate is locked. Another gate on Edmonds Street is open and unattended from 6:30 a.m. until 4 p.m.; the gate is locked from 4 p.m. until 6:30 a.m.

Railroad tracks run throughout the facility generally in a north-south direction. Railroad gates next to the main gate at Van and Ira streets and at the southern end of the facility remain locked when not used for rail traffic. The facility's main office is in the northeastern area of the plant. The various buildings where the wood is cut, stacked, and prepared for treatment are scattered throughout the southern half of the property.

The tank farm, a bermed area where wood is treated, is in the southernmost end of the property. The area contains eight work tanks used for storing creosote mixtures and six treatment cylinders where wood products are treated with creosote. Also in the southern end of the property are the wastewater-treatment plant and the groundwater-treatment plant. The wastewater plant treats both the water produced from wood during treatment and the rainwater collected from the tank farm area and drip track. A groundwater-treatment plant and a product recovery well building are west of the cylinders.

The ground surface at the site is a mixture of sparse vegetation and bare soil. Approximately 10% of the total site area contains gravel cover or is paved. Some areas, including a former spray field area and the northern end of the former land farm area, are covered with mixed vegetation.

Unlined surface impoundments in the southwestern portion of the plant were used from 1930 to 1975. From 1975 through 1988, liquids were treated in two Resource Conservation and Recovery Act (RCRA)-regulated impoundments and were pumped to a spray-field north of the former impoundment area. In 1988, the impoundments were closed as a landfill. The wastewater treatment system used at the site was completed in 1988. In 1989 a concrete pad and a collection drain system were built in the drip track area. These were designed as part of the wastewater treatment system upgrade to collect creosote, oil, and other liquids such as wood fluids and rain water.

The wood-treatment facility is just north of the southern property boundary. It contains eight work tanks used for storing creosote mixtures and six treatment cylinders where wood products are treated with creosote. A large inventory of treated logs remain on the site because Koppers' primary customer, the Union Pacific Railroad Company, requires a certain quantity of treated logs be so retained.

Activities at the site consist primarily of pressure treating wooden railroad cross-ties and switch ties. However, the facility also can be used for treating lumber, utility poles, and some bridge piling material. Since 1907, wood has been treated using varying methods and technologies. Three types of wood-preserving compounds have historically been used at the site: organic-based creosote, inorganic salts such as chromated copper arsenate (from the late 1950s to 1964), and pentachlorophenol (from the early 1960s to 1982). Current treatment operations consist of the pressure treatment of railroad ties and bridge pilings with a creosote-oil mixture. The facility also treats some lumber and utility poles by the same process.

In November 1980, Koppers Company Inc. submitted an application to USEPA for a permit to generate and store wastes identified as hazardous under RCRA. In 1981 as a result of the application, groundwater monitoring began. The groundwater monitoring determined that former treatment methods had contaminated groundwater beneath the site. Site assessment inspections of the facility resulted in enforcement actions by USEPA and ADEQ to implement remedies for the groundwater contamination.

To prepare this PHA, data were analyzed from a number of sampling events which are summarized in the following section.

From September 1992 through March 1993, field activities characterized the potential source areas for the contamination and the potential extent of contaminant constituents. These field activities also collected samples to analyze the physical and chemical properties of soils not directly related to facility constituents. During this activity monitoring wells were installed at 32 locations on and off the site, and as part of the investigation, all wells were sampled. Air quality monitoring in the immediate vicinity of the plant assessed the nature and extent of particulate

matter at the site and organic constituents in the ambient air.

In 1995, further physical and chemical site characterization took place. These activities included the installation and sampling of new monitoring wells, sampling of most existing monitoring wells and selected former domestic wells, and off-site sediment sampling. Sediment samples were collected from the western and southeastern drainage ditches. Sediment samples also were collected from Prothro Swamp, near the discharge area from the southeast drainage ditch.

As part of the groundwater monitoring program initiated with the original RCRA application, monitoring wells have been sampled quarterly for many years. Groundwater data from quarterly sampling reports in 2000 were used to evaluate present site conditions. In December 2000, in conjunction with the groundwater monitoring, supplemental surface water and sediment from the western and southeastern drainage ditches was sampled.

ADH reviewed the available data to determine whether they were sufficient to address the community health concerns considered in the PHA. In previous investigations, ADH identified a data gap that would have severely restricted the air pathway analysis. In January 2000, ADH collected high-volume air samples at two locations in the concerned communities for qualitative analysis. The results of the analysis were presented to ADEQ to determine if there was a data gap supported justification for additional air sampling in the community. ADEQ and USEPA developed and implemented an air monitoring plan that was conducted in July and August 2000. Appendix B, Figure 5 shows KII wood-treatment production level values for the combined months of July and August from 1984 through 2003 resulted in a mean of 773,208.7 cubic yards (yds³). The wood-treatment production level value during the months that the air monitoring took place was 951,850 yds³.

In April 2001, ADH published a separate public health consultation evaluating the results of the July – August 2000 air sampling and determined a completed inhalation exposure pathway existed to semi-volatile organic compounds (SVOCs) in the communities surrounding KII. The health consultation also indicated that the levels detected do not represent a health threat under acute inhalation exposures. However, the samples indicated that community residents were chronically exposed to low concentrations of polycyclic organic matter (POM) (See page 19 for discussion of POM). The data evaluated in the health consultation accounted for a large portion, but not the entire POM component, and therefore were insufficient for a thorough analysis. The health consultation also indicated that health-based studies were insufficient to assess the impact of chronic inhalation exposures to the complex mixtures of POM or potential health effects associated with additive or synergistic effects of exposures to low concentrations of POM. In addition, the air was sampled only during the summer (July – August 2000) and may not represent seasonal weather conditions, and may not have represented the highest production activities at KII during 2000.

Site Visits

ADH first visited the site in October 1998 and received a plant tour from the KII safety officer. A community meeting and public availability session (PAS) also were held in October 1998. In

November 1998, ADH revisited KII to locate specific areas identified as areas of concern during the October public meeting. In May 1999, a follow-up public meeting was held with representatives from ADH, ADEQ, and USEPA. ADH held a PAS in conjunction with the public meeting. In December 1999 and January 2000, ADH conducted air sampling. In June 2000, a public meeting updated community members about past air sampling and proposed air-monitoring activities. In December 2001, a community advisory panel (CAP) was proposed; ADH was invited to become a member. The CAP includes industry and community representatives and municipal and state agencies. It has met monthly since April 2002. Ann Green Communications Inc. facilitates the CAP and provides an open forum for discussion of community and industry concerns. On June 17, 2002, KII hosted the CAP for a facility tour.

DEMOGRAPHICS, LAND USE, AND NATURAL RESOURCE USE

Hydrogeologic Conditions

The area in the vicinity of the site is a generally flat plain that slopes gently to the south and southeast toward the Arkansas River. The Arkansas River flows to the east approximately 1 mile south of the plant. The site area contains alluvial deposits that overlie a bedrock and clay-confining layer. The thickness of these unconsolidated materials varies beneath the site, ranging from about 75 feet to about 115 feet. The deposits coarsen with increasing depth, with clays and silts mostly at the surface and increasing amounts of sands and gravels with depth. A low permeability layer consisting mostly of clay and claystone underlies the unconsolidated materials within much of the site area. These unconsolidated deposits act as a water table aquifer beneath the facility and within the regional area. The underlying low permeability layer acts as a confining layer. Surface topography, recharge patterns, and the Arkansas River influence regional groundwater flow gradients. The groundwater flows generally to the south toward the river, which serves as a groundwater discharge area.

Climatic Conditions

In the Little Rock area, the climate is temperate and humid, with a mean average temperature of 60° F. Average precipitation is approximately 48 inches per year. Average relative humidity for a 24-hour period (given in 6-hour increments) is midnight - 78%; 6 a.m. - 83%; noon - 57%; and 6 p.m. - 60%. The wind prevails from the southwest, and mean hourly wind speed is 8 miles per hour.

Demographics

The site is located in U.S. Department of Commerce Bureau of Census tract 27 immediately adjacent to the eastern boundary of census tract 28 and approximately ½ mile north of census tract 26. Census tract 27 comprises 5.0 square miles and, as of 1990, a population of 6,757 - 2,104 families, with an average of 3.18 persons per family.¹ Census tract 28, adjacent to the western boundary of the wood treatment plant, comprises 3.7 square miles and, as of 1990, a population of 888 families with an average of 3.47 persons per family.¹ Census tract 26,

¹Bureau of Census. 1990 census population, Data base C90STF3A. Washington, US Department of Commerce, 1990.

approximately ½ mile south of the wood-treatment plant, comprises 1.4 square miles and, as of 1990, a population of 2,226 - 519 families, with an average of 3.61 persons per family.¹

The surrounding communities are located in the 72117 U.S. Postal ZIP Code Area. (Note: The 1990 census data were used to maintain consistency throughout the development of this document. There were no significant changes to the 2000 census data for the area.)

Land Use

The facility is an active industrial site bordered by industrial, commercial, agricultural, and residential districts. To the south, west, and the east of the site are three residential areas. Industrial and commercial properties are to the north. Undeveloped land used for agriculture is to the west. Prothro Swamp is approximately 4,000 feet east-southeast of the wood-treatment plant. The facility is expected to remain an active industrial site in the foreseeable future. No change is anticipated in land use for the site or the surrounding areas.

Water Use

Two industrial and nine residential wells are on-site or down gradient of the site. One industrial well, formerly used as a water supply well for fires, is on plant property. The pump has been removed from this well and the cover has been welded shut. The well is not used for industrial or other purposes. The other 10 wells are off-site, near the immediate boundary of KII plant or down gradient of the plant. One of these off-site wells is for industrial use, and the other nine are at residences. The residential wells are not used as a drinking water supply. The residences in the vicinity of the plant receive municipal water from the city of North Little Rock.

Most of the storm water from the site eventually discharges to the Arkansas River. Runoff from the plant flows into a drainage channel that continues west and then south approximately 1.5 miles southwest of KII to the Arkansas River. In this area, the Arkansas River is used for recreation; as a domestic, industrial, and agricultural water supply; and for fish and wildlife propagation.

EVALUATION OF ENVIRONMENTAL CONTAMINATION AND POTENTIAL EXPOSURE PATHWAYS

To evaluate whether exposure to site-related chemicals pose an existing or potential hazard to an exposed or potentially exposed population, health assessors review all available on-site and off-site environmental contamination data for all media (e.g., soil, surface water, groundwater, air, biota). The validity of the conclusions in this PHA depends on the accuracy and reliability of the data provided in the cited reports.

Release of a chemical from a site does not always mean that the substance will be a contaminant of health concern to an off-site population. Health assessors must first determine whether a chemical in a medium (e.g., air, soil, water, and biota) should be a contaminant of concern. The criteria include (1) environmental levels exceeding medium-specific comparison values, (2) noted community concerns, and (3) the quality and extent of the sampling data used to evaluate potential human exposure and human health hazards. For an exposure to occur, a completed exposure pathway must exist. A completed exposure pathway exists when all of the following five elements are present: (1) a source of contamination, (2) an environmental medium through which the contaminant is transported, (3) a point of human exposure, (4) a route of human exposure, and (5) a receptor population. A potential exposure pathway exists when one or more

of the five elements are missing, but available information suggests that human exposure is possible. Also, an exposure pathway is considered potential when modeled data are used to predict human exposure. An incomplete exposure pathway exists when one or more of the elements are missing and available information indicates that human exposure is not expected to occur.

ADH's PHAs are exposure- or contact-driven. Chemical contaminants released into the environment can cause adverse health effects if concentrations are high enough. Still, a release does not always result in exposure. People can be affected by a chemical only if they contact with it. People can be exposed by breathing, eating, or drinking a substance, or by skin contact with a substance containing the contaminant. However, exposure to a chemical or multiple chemicals does not necessarily mean an adverse effect will result.

When evaluating exposure pathways, ADH identifies whether exposure to contaminated media (such as soil, water, air, or waste) has occurred, is occurring, or will occur through ingestion, skin contact, or inhalation.

Considerable uncertainty surrounds the true level of exposure to environmental contamination. To account for some of the uncertainty and to protect public health, health assessors typically use high-end, worst-case exposure level estimates to determine whether a chemical should be studied more thoroughly. Because of this conservative measure, the estimated exposure levels usually are much higher than the levels to which people actually are exposed. If estimated exposure levels are above ATSDR's screening levels, then exposure is reviewed in detail. That review is combined with scientific information from the toxicologic and epidemiologic literature about the health effects of exposure to hazardous substances.

EXPOSURE PATHWAYS OF CONCERN AT KII

Each source of contamination at KII was evaluated to determine whether a completed or potential exposure pathway existed. The issues discussed in this PHA were chosen on the basis of evaluations during the site visits, examination of environmental data, and concerns raised by community members. The routes of exposure considered for this assessment were, (1) inhalation of contaminants in air, (2) ingestion of contaminants in groundwater, surface water, and soil, and (3) dermal contact with contaminants in water and soil. Because KII is a regulated active facility, worker safety is monitored by the KII Health and Safety office under the regulatory authority of the Occupational Safety and Health Administration. This PHA concentrated on potential and known exposures to off-site individuals, not the facility workers. The following exposure pathways were evaluated:

Air: ADH evaluated inhalation exposures to contaminants adsorbed to airborne particulates. ADH also evaluated exposure to volatile and SVOCs such as polycyclic aromatic hydrocarbons (PAHs) that could have volatilized from the wood-treatment facility and from treated ties stored at the KII site.

Soil and Sediment: Exposure or potential exposure to soils and sediments that could have migrated from the site or were adversely affected by contaminants from the site were evaluated.

Groundwater: On the basis of community health concerns, residential well water data and monitoring well data were evaluated to assess the potential for exposures to water with

contaminant concentrations of health concern. Residents near the plant currently use the public water supply system. Thus, ADH considers groundwater an incomplete pathway for present and future use. Some community members also were concerned that contamination of groundwater could impact residential gardens used to grow fruits and vegetables. Because of this community concern, ADH considered the garden pathway (Table 1).

**Table 1
Exposure Pathways
Koppers Industries Inc.; North Little Rock, Arkansas**

Exposure Pathways						
Pathway Name	Source	Transport Media	Point of Exposure	Route of Exposure	Exposed Population	Time
Completed Exposure Pathway						
Ambient Air	Process operations	Air	Air	Inhalation	Local residents and site visitors	Past Present Future
Area Soils	Process operations	Soil Sediment	Area soils	Ingestion Skin contact	Local residents and site visitors	Past Present Future
Potential Exposure Pathway						
Private Wells	Process operations	Groundwater	Residence tap	Ingestion Inhalation Skin contact	Local residents and site visitors	Past
Garden	Process operations	Groundwater Soil	Fruits and vegetables	Ingestion	Local residents	Past Present Future
Incomplete Exposure Pathway						
Private Wells	Process operations	Groundwater	Residence tap	Ingestion Inhalation Skin contact	Local residents and site visitors	Present Future

PUBLIC HEALTH IMPLICATIONS

ADH addressed the likelihood that exposure to contaminants at the maximum concentrations detected would result in adverse health effects. Although the relative toxicity of a chemical is important, the response of the human body to a chemical exposure is determined by several additional factors, including concentration (how much), duration of exposure (how long), and the route of exposure (i.e., breathing, eating, drinking, or skin contact). Lifestyle factors (i.e., occupation and personal habits) have a major impact on the likelihood, magnitude, and duration

of exposure: Individual characteristics, such as age, sex, nutritional status, overall health, and genetic constitution, affect the way a human body absorbs, distributes, metabolizes, and eliminates a contaminant. A unique combination of these factors determines a person's physiologic response to a chemical contaminant and any adverse health effects that could result from the exposure.

On the basis of scientific data ATSDR has collected in its toxicological profiles, ATSDR has determined levels of chemicals that can reasonably (and conservatively) be regarded as harmless. The resulting comparison values and health guidelines are used to screen contaminant concentrations at a site and to select substances warranting closer scrutiny by agency health assessors and toxicologists. Of key importance is that ATSDR's (and USEPA's) comparison values and health guidelines represent conservative levels of safety and not thresholds of toxicity. Thus, although concentrations at or below a comparison value are considered safe, it does not automatically follow that any concentration above a comparison value will necessarily produce toxic effects. To the contrary, ATSDR's (and USEPA's) comparison values intentionally are designed to be much lower than the corresponding no-effect levels (or lowest-effect levels) determined in laboratory studies. ATSDR uses comparison values (regardless of the source) solely to screen individual contaminants. ATSDR considers that a compound warrants further evaluation if the highest single recorded concentration of that contaminant in the medium in question exceeds that compound's lowest available comparison value (e.g., cancer risk evaluation guides or other chronic exposure values) for potentially exposed people. This process results in the selection of many chemicals as "contaminants of concern" that will not, upon closer scrutiny, be judged to pose any hazard to human health. Even contaminants of concern that ultimately are labeled in the toxicologic evaluation as potential public health hazards are so identified solely on the basis of the maximum concentration detected. Thus, when considering the potential health implications of ATSDR's toxicologic evaluations, one should keep in mind the protectiveness of this approach.

TOXICOLOGY EVALUATION

A contaminant must first enter the body before it can affect the body. Thus, the toxicologic evaluation in PHAs focuses primarily on completed pathways of exposure and potential pathways where a high probability exists that exposures have occurred or will occur.

Air

ADEQ monitored air in the vicinity of KII in July and August 2000 (Appendix C, Tables 16-21). Six monitors collected samples at a height of 4-10 feet at locations within the communities surrounding the facility. A duplicate sampler was rotated among the sampling sites as a quality control measure. SVOCs were absorbed from air into a chilled acetone impinger at a nominal flow rate of 50 cubic centimeters per minute. The acetone containing the analytes was analyzed by gas chromatography/mass spectrometry using USEPA Method 8270 in accordance with the ADEQ *Work Plan for Ambient Air Monitoring at Koppers Industries Inc., North Little Rock, Arkansas*, published in July 2000. To collect comparison data, one monitor was moved during the last 5 days of sampling approximately 10 miles upwind of the site. Samples were analyzed for 61 SVOCs.

Analytical results for 151 air samples were evaluated. The samples collected by the six monitors at the seven monitoring sites indicated the presence (in at least one sample) of 33 of the 61 SVOCs. In at least one sample, 16 of the detected chemicals exceeded USEPA risk-based concentrations for ambient air. The USEPA screening values listed below in Table 2 are media-specific concentrations. The screening values represent concentrations of a contaminant that are considered unlikely to cause adverse health effects over a lifetime of chronic exposure. A contaminant was selected for evaluation if the concentration of it exceeded the conservative screening values at any of the monitoring locations at any time during the monitoring period. The chemicals selected for toxicologic evaluation were recorded with their five highest concentrations in the following table (Table 2).

Table 2 Highest Recorded Concentrations From All Air-Monitoring Stations 7/17/00-8/15/00 Koppers Industries Inc., North Little Rock, Arkansas						
Polyaromatic Hydrocarbons	Concentration					USEPA Screen
	micrograms/cubic meter of air ($\mu\text{g}/\text{m}^3$)					
Naphthalene	67.4600	61.0380	48.5420	46.8870	44.5180	3.3
Phenanthrene	3.8110	3.7466	3.4554	3.4466	3.2466	2
Benzo(a)anthracene	0.5940	0.1511	0.1160			0.0086
Benzo(b)fluoranthene	1.3540	0.6499	0.3081	0.3045	0.2430	0.0086
Benzo(k)fluoranthene	1.0417	0.8548	0.4032	0.2452	0.2333	0.0086
Benzo(a)pyrene	0.8352	0.4436	0.2226	0.1373	0.1211	0.002
Dimethylbenzo(a)anthracene	0.2197					0.2
Dibenzo(a-j)acridine	0.6171	0.4071	0.3431	0.2970	0.2672	0.2
Indeno(1-2-3-cd)pyrene	0.8170	0.6224	0.3527	0.2641	0.2280	0.0086
Dibenz(a-h)anthracene	0.9475	0.6147	0.3850	0.3755	0.2537	0.00086
Benzo(g-h-i)perylene	0.8088	0.5560	0.2816	0.2656	0.2112	0.2
Other Semivolatile Organic Compounds (SVOCs)						
Acetophenone	6.0589	5.1744	5.0669	2.9452	2.0527	0.021
Bis(2-chloroethyl)-Ether	1.6703					0.003
1-4 Dichlorobenzene	2.0882	1.7375	1.7189	1.3756	1.2201	0.28
Hexachlorobenzene	0.1400	0.0467	0.0425			None
Pentachlorophenol	0.2309	0.2302				0.056

Note: USEPA Screen - USEPA Region III Risk-Based Concentrations; reported in micrograms/cubic meter of air ($\mu\text{g}/\text{m}^3$)

In response to resident complaints during monitoring days when the odor in the area was most noticeable, ADEQ collected and analyzed four canister grab samples for naphthalene only. In July 2000, representatives from the Poe Addition and Glenview communities, and an attorney representing the two communities arranged a meeting with the mayor of North Little Rock. At the meeting, a representative from the technical services branch of ADEQ explained the sampling plan. The representatives from the communities and their attorney requested the canister samples. North Little Rock's mayor directed ADEQ to collect the samples to verify a potential source for intensified odors in the air. The analytical method used was not a validated method, but the results can be considered estimates of the concentrations. Canister results were not used to make health conclusions but for indicators of odor only. The results of the canister analysis are recorded in the following table (Table 3).

Sample	Date	Location	Naphthalene Concentration ($\mu\text{g}/\text{m}^3$)
1	7/19/00	Ben Street	29
2	7/21/00	Atkinson /Rogers Street Intersection	36
3	7/24/00	Atkinson/Short Street Intersection	75
4	7/27/00	Van Street (near Glenview School)	233

$\mu\text{g}/\text{m}^3$ - micrograms per cubic meter of air

The polyaromatic hydrocarbons—including naphthalene—are grouped together in the tables (Tables 4, 15-21). Polyaromatic hydrocarbons are a large group of complex molecules. In toxicological analysis, the large subgroup of polyaromatics referred to as PAHs generally are discussed together. Naphthalene is one of the least complex of the PAHs and was specifically cited by ADEQ as the major contaminant of concern. In this toxicological evaluation, naphthalene is discussed separately from the other PAHs.

The evaluation of health effects associated with inhalation involves comparing air concentrations from the sampling event to health-based guidelines developed by ATSDR and other agencies. People exposed for a specified length of time to contaminants of concern at levels greater than established guidelines are more likely to have an associated illness or disease. Accordingly, air monitoring samples of contaminant concentrations were compared with chemical-specific information about health effects that could occur at or below concentrations detected in the air monitoring samples.

Toxicology studies report air concentrations as parts per billion (ppb), parts per million (ppm), micrograms per cubic meter of air ($\mu\text{g}/\text{m}^3$), or milligrams per cubic meter of air (mg/m^3). Parts per million are converted to mg/m^3 of air by multiplying the concentration in ppm by the molecular weight of the compound divided by 24.45. To enable cross-referencing, Appendix C,

Table 15, displays the maximum and mean concentrations converted to ppm. (Note: Appendix C, Tables 16-21, show the air monitoring concentrations for all six sampling stations, respectively.)

To identify contaminants of concern, the highest concentration and the mean concentration for each of the contaminants that exceeded the environmental screening values were compared with the inhalation health effect concentrations of those contaminants. A chemical was identified as a contaminant of concern if the highest concentration of the chemical exceeded either an environmental or dose comparison value in at least one sample collected during the air monitoring. Contaminants of concern were evaluated further to determine whether an increased likelihood existed that inhalation of the contaminant at the reported concentrations could adversely affect health. Although the air monitoring was limited to 1 month, evaluation of effects associated with chronic exposure assumed that the monitoring period captured typical exposures. Exceeding the comparison value does not necessarily mean a contaminant represents a public health threat; it does, however, suggest that the contaminant warrants further consideration. *Because of variations in seasonal weather conditions and in the production levels of KII, ADH recommends additional unannounced air sampling be conducted by USEPA and/or ADEQ when odors are strongest.*

The public health importance of contaminants exceeding comparison values is assessed by reviewing and integrating relevant toxicological information with plausible exposure scenarios. Estimated exposures were compared with reported "No Observed" and "Lowest Observed" Adverse Effect Levels (NOAELs and LOAELs) and to known effect levels in humans, when available. The air contaminants of concern identified were acetophenone, bis(2-chloroethyl)ether, 1-4 dichlorobenzene, hexachlorobenzene, pentachlorophenol, and the polyaromatic hydrocarbons (including naphthalene) (See Table 15).

Acetophenone

Acetophenone is used as a fragrance ingredient in soaps, detergents, creams, lotions, and perfumes and as a flavoring agent in foods and tobacco. It also is used as a specialty solvent for plastics and resins. No reference concentration exists for acetophenone, and its screening value is based on oral exposure rather than an inhalation. No studies support any anticipated health effect associated with inhalation of acetophenone at the concentrations found in the samples (See Table 2). The maximum level of acetophenone detected was $6.0 \mu\text{g}/\text{m}^3$. The health concerns identified by USEPA are based on the irritant effect of acetophenone on the skin and eyes in its liquid form. The potential for irritation from inhaling heated vapor from the liquid form is speculative, and no supporting human or animal studies are available to confirm the concern [2]. ATSDR has not established a comparison value for acetophenone; however, the occupational level is $49 \text{ mg}/\text{m}^3$, established by the American Conference of Governmental Industrial Hygienists (<http://www.itcilo.it/actrav/actrav-english/telearn/osh/ic/98862.htm>). No adverse health effects should result from inhalation exposure to acetophenone at the sample concentrations detected.

Bis(2-chloroethyl)-Ether

Bis(2-chloroethyl) ether (BCEE) is a colorless nonflammable liquid with a strong, unpleasant odor. It does not occur naturally but is manufactured for use in the production of pesticides and other chemicals. Limited amounts of BCEE will dissolve in water, and it will slowly evaporate

into air. In the environment, BCEE is broken down by bacteria in soil and water and by chemical reactions in the air, so it does not tend to persist for long periods.

BCEE was found in only one of the 151 samples. The sample concentration was 0.000285 ppm (or 0.00167 mg/m³). The LOAEL in humans occurred at a concentration of 35 ppm. Human effects, i.e., eye and nose irritations occur in the general population exposed to concentrations of 100 ppm. ATSDR has established an intermediate (15-364 days) inhalation minimum risk level (MRL) of 0.02 ppm [3]. The sample concentration was approximately 100 times below the MRL. The MRL is an estimate of daily exposure of a human to a chemical that is likely to be without appreciable risk for deleterious effects over a specified duration of exposure. MRLs generally are based on the most sensitive chemical induced endpoint considered relevant to humans. Uncertainty factors are used in the derivation of MRLs resulting in doses that could be as much as a hundredfold below nontoxic levels. This is a conservative approach that ensures the MRL is protective.

No adverse health effects are expected to from inhalation exposure to air containing concentrations of 0.000285 ppm BCEE.

1,4-Dichlorobenzene

1,4-Dichlorobenzene usually is called para-DCB or p-DCB, but it has about 20 additional names, including para crystals and paracide. It also is called paramoth because it is one of two chemicals commonly used to make mothballs. 1,4-DCB does not occur naturally, but is produced by chemical companies to make products for home use and other chemicals such as resins.

1,4-DCB is used to make deodorant blocks for garbage cans and restrooms, as well as to help control odors in animal-holding facilities. 1,4-DCB also has been used as an insecticide on fruit and as an agent to control mold and mildew growth on tobacco seeds, leather, and some fabrics. At room temperature, 1,4-DCB is a white solid with a strong 'mothball like' odor. When a package of 1,4-DCB is opened, it slowly changes from a solid into a vapor and is released into the atmosphere. The released vapor acts as a deodorizer and insect killer. Most of the 1,4-DCB released to the general environment is present as a vapor. Most people begin to smell 1,4-DCB at concentrations in the air of 0.18 ppm.

The highest detected concentration of 1,4-DCB was 0.003 ppm (or 0.018 mg/m³). ATSDR has established inhalation MRLs for acute (less than or equal to 14 days), intermediate (15-364 days), and chronic (greater than or equal to 365 days) inhalation exposure to 1,4-DCB. The acute MRL is 0.8 ppm, the intermediate MRL is 0.2 ppm, and the chronic MRL is 0.1 ppm. The highest sample concentration is well below the MRLs for inhalation exposure. In humans, adverse health effects such as nose and eye irritation generally occur at exposures to air with 80 ppm of 1,4-DCB [4].

We do not expect adverse health effects to result from exposure to air with less than or equal to 0.003 ppm 1,4-DCB.

Hexachlorobenzene

Hexachlorobenzene is a white crystalline solid. It does not occur naturally but is formed as a by-product during the manufacture of chemicals used as solvents (substances used to dissolve other substances), other chlorine-containing compounds, and pesticides. Small amounts of hexachlorobenzene also can be produced during combustion processes such as burning of city wastes. It also can be produced as a by-product in waste streams of chlor-alkali and wood preservative processing. Until 1965, hexachlorobenzene was used widely as a pesticide and in the manufacturing of fireworks, ammunition, and synthetic rubber.

Hexachlorobenzene was detected only in three of the 151 samples. ATSDR has not established inhalation MRLs for hexachlorobenzene. Studies are limited on inhalation exposure to hexachlorobenzene, but a chronic human exposure study showed no hepatic effect at exposure to $0.035 \mu\text{g}/\text{m}^3$. The greatest sample concentration was $0.14 \mu\text{g}/\text{m}^3$. In animal studies, slight impairment of pulmonary defenses has been observed at $33,000 \mu\text{g}/\text{m}^3$, but in the same study, no adverse effect was observed at $4,400 \mu\text{g}/\text{m}^3$ [5].

The available toxicity data in humans and laboratory animals indicate that the liver -- and specifically, the heme biosynthesis pathway -- is the major target of hexachlorobenzene toxicity. The chronic human study showing no hepatic effect was at a concentration 25% lower than the highest sample concentration.

This study, coupled with the animal study data that indicate effects are not observed until concentrations are 10,000 times greater than the sample concentration's, supports the conclusion that no adverse effects would be anticipated for inhalation exposures to air containing $0.14 \mu\text{g}/\text{m}^3$ hexachlorobenzene.

Pentachlorophenol

In the past, pentachlorophenol was one of the most widely used pesticides in the United States. It is a human-made substance used primarily as a biocide and wood preserver. Today it is a restricted-use pesticide. Its principal use is as a wood preservative, and it is registered by USEPA as such. Historically, the treatment of wood for utility poles represents 80% of the U.S. consumption of technical-grade pentachlorophenol. Pentachlorophenol exists as colorless or white crystals (when pure) with a sharp characteristic odor when hot but little odor at room temperature. Pentachlorophenol's odor threshold is 12 ppm [6].

Studies involving the inhalation toxicity of pentachlorophenol in humans are limited, and no studies were found on systemic effects of inhalation exposure to pentachlorophenol in animals. Most available information comes from cases of acute poisoning after home use of pentachlorophenol in such products as wood preservatives or garden herbicides (USEPA no longer approves home and garden use of pentachlorophenol) and after occupational exposure in agricultural and wood-treatment industries. In the occupational studies, concentrations and duration of exposure are not well documented, but no evidence exists of any effects from exposure to the sample concentrations detected at KII.

USEPA lists pentachlorophenol as a probable human carcinogen, but its listing is based on oral exposure. Studies indicate no clear evidence that high occupational exposures to

pentachlorophenol causes cancer in humans. Therefore, the probability is even lower that lower environmental exposures would produce cancer. Several epidemiological studies found no association between inhalation of pentachlorophenol and any form and cancer [6].

Pentachlorophenol was detected in less than 2% of the 151 air samples collected. The maximum level of pentachlorophenol detected was $0.23 \mu\text{g}/\text{m}^3$, which is above the USEPA comparison value for air (Table 2). ATSDR has not established a comparison value for pentachlorophenol; however, the occupational level is $500 \mu\text{g}/\text{m}^3$ [6]. On the basis of the scientific studies available and the frequency of detection, we do not expect adverse health effects to result from inhalation exposure to pentachlorophenol at the sample concentrations detected.

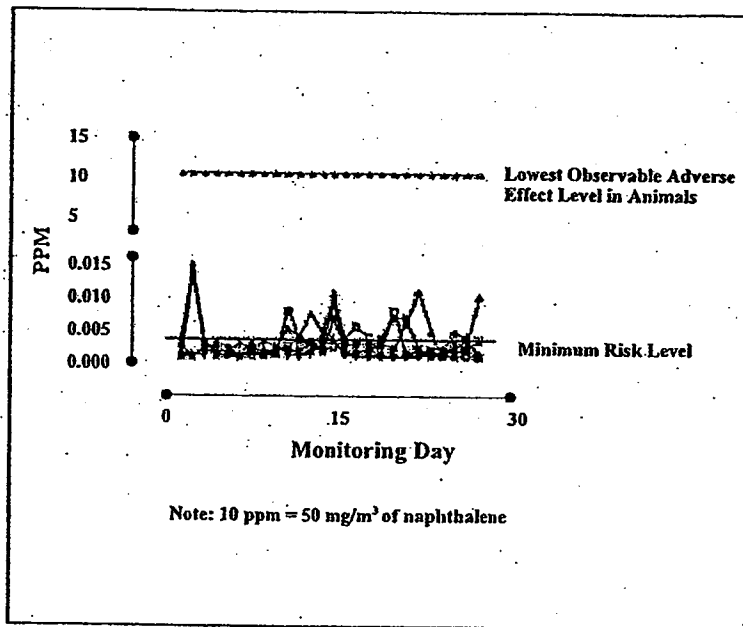
Naphthalene

Naphthalene is a white, easily evaporating solid. It also is called mothballs, moth flakes, white tar, and tar camphor. When mixed with air, naphthalene vapors readily burn. Fossil fuels, such as petroleum and coal, naturally contain naphthalene. Burning tobacco or wood produces naphthalene. The major products made from naphthalene are moth repellents, in the form of mothballs or crystals, and toilet deodorant blocks. It also is used to make dyes, resins, leather tanning agents, and the insecticide carbaryl. Naphthalene has a strong smell, but the smell is generally not considered unpleasant. One can smell naphthalene in the air at a concentration of 0.084 ppm and of air. You can smell naphthalene-related compounds at concentrations as low as 0.0075 ppm [7]. A study presented a collation of odor threshold data for approximately 450 chemical substances, including naphthalene. The point at which the concentration level of naphthalene is expected to cause irritation is 14.3 ppm [8].

A point has not been established when an individual's response to an unpleasant odor can be considered an adverse health effect. If concentrations of a chemical are below the level expected to produce a health effect, individual sensitivity to the chemical must be considered, as must the presence of an unpleasant odor that may interfere with quality of life. Studies suggest that odors may trigger respiratory effects among sensitive populations, such as people with asthma, children, elderly people, and immune-suppressed people. Odor triggers may be further confounded by other respiratory environmental triggers, such as dust mites, animal dander, tobacco smoke, and other types of outdoor air pollution [9].

For chronic (365 days or more) inhalation exposure to naphthalene, ATSDR has calculated an MRL of 0.002 ppm. Twenty-one percent of the samples exceeded the MRL concentration. This MRL is based on a LOAEL in mice exposed to 10 ppm naphthalene vapors for 2 years. Some of the mice had chronic inflammation and hyperplasia of the lungs and both inflammation and metaplasia of the respiratory passages [10]. The 10-ppm exposure concentration was normalized by adjusting for a 6-hour-per-day and 5-day-per-week exposure pattern. None of the sample concentrations exceeded the LOAEL. The highest sample concentration was 0.013 ppm naphthalene. Animal studies involving extensive inhalation exposure have found no systemic effects below concentrations of 10 ppm naphthalene. The relation between the environmental concentrations detected in the samples and the LOAEL in animals is shown in Figure 1.

Figure 1
Naphthalene Air Concentrations
(Air Monitoring Impinger Samples)
Koppers Industries, Inc., North Little Rock, Arkansas



Conflicting information concerns the carcinogenicity of inhaled naphthalene. In 1992, a National Toxicology Program (NTP) study indicated that female mice had an increased incidence of pulmonary tumors after a lifetime exposure to 30 ppm naphthalene. In the same study, animals exposed to 10 ppm actually had a lower incidence of pulmonary tumors than the unexposed control group. On the basis of this study, NTP stated that some evidence of naphthalene carcinogenicity existed in female mice. NTP conducted a second 2-year rodent study that was completed in December 2000 that used rats. NTP found evidence that nasal tumor incidence increased after chronic inhalation of concentrations greater than or equal to 10 ppm naphthalene. Although this study supports grouping naphthalene with the other carcinogenic aromatic hydrocarbons, the exposure concentrations far exceeded any concentrations detected during the monitoring period. The mean concentration of naphthalene (which would indicate chronic exposure concentrations) during the monitoring was 0.0014 ppm. The greatest concentration (which was detected in one of the nonvalidated grab samples) was 0.04 ppm naphthalene. No inhalation studies were conducted at such low concentrations of naphthalene. However, just as no studies exist to support a cancer effect level below 10 ppm, studies can not verify any cancer effect at lower concentrations. Because the NTP study identified nasal tumors as the neoplastic effect, the cancer morbidity data were used as the comparison parameter to determine whether the incidence of cancers from inhalation of naphthalene was higher in the vicinity of KII. No

nasal cancers were reported to the Arkansas Central Cancer Registry for the 72117 ZIP code area.

The scientific review indicates that at the sample concentrations, no adverse health effects are expected to be associated with inhalation exposure to naphthalene.

Polycyclic Aromatic Hydrocarbons

The public health impact of inhalation of PAHs is difficult to assess on the basis of limited sample data and the limited study data available. The sample data indicate that, although some of the PAHs are present in air at concentrations exceeding screening levels and in some cases at levels exceeding health guidelines, they are present only in very low concentrations (refer to Table 2 for highest PAH concentrations). The air monitoring samples also indicate that the PAHs are found only periodically and do not concentrate in a specific area. For example, benzo(a)pyrene was detected in only nine (6%) of the 151 samples, and the nine samples were dispersed through five sampler locations. Dibenz(a-h)anthracene was detected in 22 (15%) of the samples. This exposure scenario indicates that, even though inhalation exposure is occurring, the exposure is sporadic and at low concentrations of PAHs. Adverse health outcomes should not be expected in the general population associated directly with exposure to PAHs in air at the sample concentrations detected. In addition, no studies were found supporting adverse health effects associated with exposures to the levels of contaminants detected in the air samples. However, the data available from the sampling and from toxicological studies are insufficient to evaluate the impact on sensitive sub populations, especially those exposed to PAHs at these sample concentrations in conjunction with inhalation of other air contaminants in the area.

PAHs are a group of chemicals formed during the incomplete burning of coal, oil, gas, wood, garbage, or other organic substances. More than 100 different PAHs are known, but reliable health-based and environmental information exists only for a few. PAHs generally occur as complex mixtures rather than as single compounds. Many products – including crude oil, coal tar, coal tar pitch, creosote, and roofing tar – contain PAHs. They are found throughout the environment in the air, water, and soil. They occur in both indoor and outdoor air usually attached to dust particles [11]. One study, which monitored concentrations of PAHs in the indoor and outdoor air of eight homes in Columbus, Ohio, found benzo(a)pyrene concentrations of 0.52-5.5 $\mu\text{g}/\text{m}^3$, with an outdoor concentration of 0.46 $\mu\text{g}/\text{m}^3$ [12]. Exposure to concentrations of PAHs in the ranges detected during the monitoring period is not unusual for urban dwellers, especially in an industrial area.

Although the health effects of individual PAHs are not exactly alike, in this toxicological evaluation they are considered as a group. The evaluation emphasizes the PAHs considered most harmful and those most prevalent at the site. To compare the PAHs that are not well documented in the literature, toxicity equivalents factors (TEFs) are used. In this approach, benzo(a)pyrene (BAP) is the reference compound (with a TEF of 1) because it is one of the few PAHs that have been studied sufficiently to allow toxicological evaluation.

For PAHs, ATSDR has not derived an inhalation MRL, and USEPA has not derived a reference concentration. Limited inhalation exposure information exists for PAHs. We found only one study

regarding respiratory effects in humans after inhalation exposure to PAHs, specifically, BAP. The respiratory health of 667 workers in a rubber factory was investigated [13]. Decrements in ventilatory function occurred after prolonged exposure as assessed by duration of employment. The workers most affected were from an area of the factory with the highest exposure to particulate matter and BAP; they exhibited radiographic abnormalities, including patch opacities, prominent bronchiovascular markings, and pleural effusions. Workers in other areas of the plant exposed to lower levels of particulate matter and BAP were similarly affected but to a lesser degree and in fewer numbers. No attempt was made to separate the effects of exposure to BAP and particulate matter or to identify possible simultaneous exposure to other toxic chemicals.

In another study, Fisher rats were exposed (nose only) to an aerosol of BAP (7.7 mg/m^3) 2 hours/day, 5 days/week, for 4 weeks [14]. Nasal and left lung sections were examined histopathologically. No treatment-related lesions were noted in the lungs or nasal cavities of the exposed animals to BAP. Although this was a well-conducted inhalation toxicity study, it was limited to only one concentration. This precludes assessing a dose-response relationship. No adverse treatment-related effects were observed, but the only parts of the respiratory tract examined histopathologically were the lungs and nose.

Data from other non cancer systemic effect studies indicate that, after exposure to high concentrations of PAH in conjunction with inhalation exposure to other contaminants, possible effects exist. Still, no studies were found that supported adverse health effects associated with exposure to air with concentrations in the range of the sample concentrations.

In studies with laboratory animals, various PAHs have induced tumors after *dermal* exposure. Data are limited, however, on induction of tumors after exposure through routes by which the general population is principally exposed. Only a few limited laboratory studies – all of which were restricted to BAP – have examined the carcinogenic effect of exposure to PAHs by inhalation. In only one of these investigations were animals exposed to BAP alone. In the study, groups of 24 male Syrian golden hamsters were exposed by inhalation (nose only) to 0, 2.2, 9.5, and 45.6 mg/m^3 BAP for 4.5 hours/day, 7 days a week, for the first 10 weeks and for 3 hours/day for the rest of the exposure period (up to 96 weeks). Though body weight gain decreased in exposed animals during the first 10 weeks of the study, from the 10th to the 60th week the body weights of all surviving exposed animals were similar to those of the controls (except for the high exposure group). Mean survival also decreased in the group exposed to 46.5 mg/m^3 . The incidences of unspecified tumors of the respiratory tract (nasal cavity, larynx, and trachea) were 0/27 for controls, 0/27 for the low-dose group, 9/26 (34.6 %) for the mid-dose group, and 13/25 (52 %) for the high-dose group. Exposure-related neoplasms (unspecified) were present in the pharynx (0%, 0%, 23%, and 56% for control, low-, mid-, and high-dose, respectively), esophagus (0%, 0%, 0%, and 8% for control, low-, mid-, and high-dose, respectively), and for the stomach (0%, 0%, 4%, and 4% for control, low-, mid-, and high-dose, respectively). Lung tumors were not observed [15].

POM is a general term referring to a complex mixture of polycyclic aromatic compounds including diverse classes of hydrocarbons (including PAHs), substituted aromatic hydrocarbons, and heterocyclic aromatic compounds. PAHs account for a significant portion of the risk for

adverse health effects associated with inhalation of POM. However, the PAHs do not account for all the health effects. Other POM sources (for example, cigarette smoke, diesel emissions, and urban aerosols) also are associated with adverse health effects. The additive (combination) effect of the entire POM component of inhaled air contributes to systemic health effects [16]. Lung tumor incidence has increased in populations of workers exposed to complex mixtures of POM containing principally PAHs. Nevertheless, these data have been considered inadequate as a basis for assessing the evidence of carcinogenicity in humans. Moreover, given these data effects of individual PAHs are not possible to assess. The compositions of mixtures to which these workers (principally those in coke production, roofing, oil refining, or coal gasification) are exposed vary considerably, and PAHs have not been clearly identified as a causative agent. The data collected during the air-monitoring event accounted for only a portion of POM component.

The Poe Addition and Glenview communities are located in an urban area with several industries and several small industrial and automotive businesses close to the residential areas. An interstate highway with trucking hubs and a freight yard at the intersection of two rail lines are within a 3-mile radius of the two communities. These are all sources of POM that could contribute to poor air quality. *As stated previously in this document, ADH recommends that USEPA and/or ADEQ conduct additional unannounced air monitoring to better quantify air quality.*

Soil and Sediment

Numerous soil and sediment samples have been collected from KII in conjunction with RCRA facility inspections, supplemental investigations, and the corrective action strategy. This PHA evaluates the site-related contaminants in off-site surface soil and sediment samples to determine whether the facility adversely affected the surrounding community soils. The samples evaluated were collected during 1994-2002.

An ADEQ 1994 Air Dispersion Soil Investigation Study included the random sampling and analysis of soils in the surrounding communities of KII. The soil analysis consisted of all the applicable organic chemicals and toxic metals ever used at the facility. No chemicals or toxic metals were detected in the off-site topsoil.

However, impacted sediments were found in the two storm water drainage ditches, one on the western side of the site and the other on the southeast side. The samples taken in December 2000 from these ditches contained detectable levels of PAHs and nine inorganic constituents (Table 4).

Table 4
Sediment Sampling Analytical Results: Off-Site Fence Line, December 2000
Koppers Industries Inc., North Little Rock, Arkansas

	Southwest Ditch		Southeast Ditch		Comparison Value
PAHs	Concentration (mg/kg or parts per million)				
Naphthalene	0.69	0.74	0.56	0.35	1000
Acenaphthylene	3.60	2.60	0.14	4.40	None
Acenaphthene	0.50	0.47	0.56	0.71	30000
Fluorene	0.70	0.67	0.56	1.00	20000
Phenanthrene	5.00	4.60	0.68	5.40	20000
Anthracene	5.40	4.80	0.60	7.50	20000
Fluoranthene	24.00	21.00	6.90	57.00	20000
Pyrene	35.00	29.00	6.50	53.00	2000
Benzo(a)anthracene	10.00	10.00	2.90	43.00	200
Chrysene	27.00	25.00	5.00	62.00	10000
Benzo(b)fluoranthene	42.00	35.00	5.90	59.00	1
Benzo(k)fluoranthene	36.00	36.00	5.50	28.00	1
Benzo(a)pyrene	23.00	22.00	3.10	52.00	0.1
Indeno(1,2,3-cd)pyrene	29.00	22.00	2.40	27.00	1
Dibenzo(a,h)anthracene	6.70	6.40	0.78	8.50	0.05
Benzo(g,h,i)perylene	29.00	22.00	2.00	20.00	10
Metals					
Arsenic	10.40	8.00	4.00	3.10	20
Barium	394.00	387.00	101.00	48.90	4000
Cadmium	3.50	0.68	0.07	0.27	10
Chromium (total)	25.60	20.20	17.20	8.00	200
Copper	119.00	51.10	20.60	12.70	2000
Lead	235.00	123.00	26.90	28.20	1400
Mercury	0.30	0.12	0.09	0.07	23 (EPA)
Selenium	1.30	0.55	0.25	0.24	300
Silver	0.13	0.11	0.09	0.07	300
Constituents in bold exceeded screening values					
Although chromium was detected in the sediment samples, hexavalent chromium was not detected					
Comparison Value - ATSDR Environmental Media Evaluation Guide (EMEG)					

Because residential properties adjoin the facility, exposure to surface soil in the vicinity of the site is considered a completed exposure pathway. The PAHs detected above the screening levels were dibenzo(a,h)anthracene, BAP, benzo(b)fluoranthene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, and benzo(g,h,i)perylene. Reliable health-based and environmental information exists on only a few PAHs and potential health effects of the others can be inferred only from the information about those that have been studied. The best studied of the PAHs is BAP. USEPA and other agencies have developed a relative potency estimate approach to estimate the toxicity of other PAHs. TEFs have been assigned to the other PAHs on the basis of their relative toxicity to BAP. The highest concentrations detected in the samples were multiplied by the TEF to produce a BAP equivalent value for comparing to BAP study findings. Whenever a study of the

specific PAH was found, it was given greater weight in the toxicologic evaluation. The BAP equivalent values are listed in Table 5:

Table 5 Benzo(a)pyrene Equivalents Sediment Sampling: December 2000 Koppers Industries Inc., North Little Rock, Arkansas			
	Highest Concentration (mg/kg)	TEF	BAP Equivalent (mg/kg)
Benzo(b)fluoranthene	59.0	0.10	5.90
Benzo(k)fluoranthene	36.0	0.10	3.60
Benzo(a)pyrene	52.0	1.00	52.00
Indeno(1,2,3-cd)pyrene	29.0	0.10	2.90
Dibenzo(a,h)anthracene	8.5	5.00	42.50
Benzo(g,h,i)perylene	29.0	0.01	0.29

mg/kg - milligrams per kilogram
BAP - benzo(a)pyrene
TEF - Toxicity equivalent factor

Oral Exposure Doses

After converting the concentrations of the detected PAHs to BAP equivalent concentrations, dose estimations were calculated for incidental ingestion of the soils. The theoretical exposure doses were estimated using the BAP equivalents for each of the detected PAHs that exceeded comparison values. The concentration used to estimate the dose was the greatest concentration detected in any of the samples. The samples were taken from drainage ditches rather than residential yards, so potential exposure durations probably are limited to short term and occasional. The exposure factor used to estimate doses was intentionally overestimated to ensure inclusion of all potential exposures in the estimate. The estimated doses for a 'worst-case scenarios' of a 5-year exposure at a frequency of 5 days per week are recorded in Table 6.

Table 6
Benzo(a)pyrene Equivalent Incidental Ingestion Doses
(5 Days per Week Exposure for 5 Years)
Koppers Industries Inc., North Little Rock, Arkansas

	BAP Equivalent mg/kg	Adult Dose mg/kg/day	Child Dose mg/kg/day
Benzo(b)fluoranthene	5.9	0.00000598	0.00008378
Benzo(k)fluoranthene	3.6	0.00000365	0.00005112
Benzo(a)pyrene	52	0.00005274	0.00073840
Ideno(1,2,3-cd)pyrene	2.9	0.00000294	0.00004118
Dibenzo(a,h)anthracene	42.5	0.00004311	0.00060350
Benzo(g,h,i)perylene	0.29	0.00000029	0.00000412
Total BAP Equivalents	107.19	0.00020200	0.00282700

*BAP - benzo(a)pyrene
mg/kg - milligrams per kilogram*

The individual chemicals were evaluated separately because the greatest concentrations were detected at various sites. The drainage ditch samples also were evaluated using the total BAP equivalents for all of the PAHs detected (Table 7). This method of analysis is used to evaluate the overall toxicity (or potency) of PAH contaminated soils and is preferable to attempting to estimate actual doses of the individual PAHs. This comparison is based on the assumption that PAHs act through similar mechanisms and that the total potency of all PAHs detected in the soils needs to be considered.

Table 7
Benzo(a)pyrene Toxicity Equivalent Quotient Concentrations
of Sediment Samples
Koppers Industries Inc., North Little Rock, Arkansas

<u>Compound</u>		<u>Concentration (milligrams per kilogram)</u>							
		TEF	SE1	BAP	SE2	BAP	SW1	BAP	SW2
Dibenzo(a,h)anthracene	5	6.70	33.50	6.40	32.00	0.78	3.900	8.500	42.50
Benzo(a)pyrene	1	23.00	23.00	22.00	22.00	3.10	3.100	52.00	52.00
Benzo(a)anthracene	0.1	10.00	1.000	10.00	1.000	2.90	0.290	43.00	4.300
Benzo(b)fluoranthene	0.1	42.00	4.200	35.00	3.500	5.90	0.590	59.00	5.900
Benzo(k)fluoranthene	0.1	36.00	3.600	36.00	3.600	5.50	0.550	28.00	2.800
Ideno(1,2,3-cd)pyrene	0.1	29.00	2.900	22.00	2.200	2.40	0.240	27.00	2.700
Anthracene	0.01	5.40	0.054	4.80	0.048	0.60	0.006	7.500	0.075
Benzo(g,h,i)perylene	0.01	29.00	0.290	22.00	0.220	2.00	0.020	20.00	0.200

Compound	TEF	Concentration (milligrams per kilogram)							
		SE1	BAP	SE2	BAP	SW1	BAP	SW2	BAP
Chrysene	0.01	27.00	0.270	25.00	0.250	5.00	0.050	62.00	0.620
Acenaphthene	0.001	0.50	0.001	0.47	0.000	0.56	0.001	0.710	0.001
Acenaphthylene	0.001	3.60	0.004	2.60	0.003	0.14	0.000	4.400	0.004
Flouranthene	0.001	24.00	0.024	21.00	0.021	6.90	0.007	57.00	0.057
Fluorene	0.001	0.70	0.001	0.67	0.001	0.56	0.001	1.000	0.001
Phenanthrene	0.001	5.00	0.005	4.60	0.005	0.68	0.001	5.400	0.005
Pyrene	0.001	35.00	0.035	29.00	0.029	6.50	0.007	53.00	0.053
TEQ			68.88		64.88		8.76		111.2

TEF - toxicity equivalent factor
TEQ - toxicity equivalent quotient
SE - Southeast (ditch)
SW - Southwest (ditch)
BAP - benzo(a)pyrene equivalent

The same exposure duration (5-year exposure at a frequency of 5 days per week) criteria used to calculate the component doses also were used to calculate the total PAH doses that would result from incidental ingestion of soils (Table 8).

Table 8
Total PAH Toxicity Equivalent Incidental Ingestion Doses
Koppers Industries Inc., North Little Rock, Arkansas

Sample Site	TEQ mg/kg	Adult Dose mg/kg/day	Child Dose mg/kg/day
Southeastern Ditch	68.88	0.00006986	0.00097810
Southeastern Ditch	64.88	0.00006581	0.00092130
Southwestern Ditch	8.76	0.00000889	0.00012439
Southwestern Ditch	111.22	0.00011281	0.00157932

TEQ - toxicity equivalent quotient
mg/kg - milligram per kilogram

Sampling within the community was not conducted in conjunction with the sediment sampling in 2000, but five off-site soil samples were collected within a ½ mile radius of the facility during the 1995 facility investigation. The PAH concentrations from the community samples were recorded (Table 9).

Table 9
Off-Site Soil Samples, 1995
Koppers Industries Inc., North Little Rock, Arkansas

Compound	Concentration (milligrams per kilogram)					Comparison Value
	Sample 1	Sample 2	Sample 3	Sample 4	Sample 5	
Acenaphthene	0	1.9	1.2	0	0	30000
Acenaphthylene	0	0	0.26	0	0	None
Anthracene	0	0	0.096	0	0	20000
Benzo(a)anthracene	0.68	0.66	0.21	0.57	0.29	200
Benzo(a)pyrene	0.53	0.86	0.21	0.62	0.27	0.1
Benzo(b)fluoranthene	1.5	2	0.3	1.5	0.86	1
Benzo(g,h,i)perylene	1.2	1.2	0.16	1.3	0.94	10
Benzo(k)fluoranthene	0.62	0.86	0.15	0.66	0.35	1
Chrysene	3.5	2.2	1.3	0.77	0.74	10000
Dibenzo(a,h)anthracene	0.073	0.22	0.034	0.1	0.068	0.05
Flouranthene	2	1.5	0.56	1.5	0.66	20000
Fluorene	0	0	0.11	0	0	20000
Ideno(1,2,3-cd)pyrene	0.31	0.092	0.11	0.61	0.18	1
Phenanthrene	0	0	0.14	0	0	20000
Pyrene	2.7	2.5	0.4	2.6	0.45	2000

Bolded values exceeded the comparison value

The highest concentrations of the compounds that exceeded comparison value were converted to BAP equivalents and incidental ingestion doses were calculated for a 5-year exposure at a frequency of 5 days per week (Table 10).

Table 10
Off-Site Soil Incidental Ingestion Doses
Koppers Industries Inc., North Little Rock, Arkansas

Compound	Concentration mg/kg	TEF	BAP	Adult Dose mg/kg/day	Child Dose mg/kg/day
Benzo(a)pyrene	0.86	1	0.86	0.00000087	0.00001221
Benzo(a)fluoranthene	1.5	0.1	0.15	0.00000015	0.00000213
Dibenzo(a,h)anthracene	0.1	5	0.5	0.00000051	0.00000710

TEF - toxicity equivalent factor
 BAP - benzo(a)pyrene equivalent concentration
 mg/kg - milligram per kilogram

Toxicity equivalent quotients from the soils near KII also were calculated, and doses were estimated for the sample with the highest quotient (Table 11).

Table 11
Off-Site Total PAH Toxicity Equivalent Concentrations
in Milligrams per Kilogram (mg/kg)
Koppers Industries Inc., North Little Rock, Arkansas

	TEF	S1	BAP	S2	BAP	S3	BAP	S4	BAP	S5	BAP
Acenaphthene	0.001	0.000	0.000	1.900	0.002	1.200	0.001	0.000	0.000	0.000	0.000
Acenaphthylene	0.001	0.000	0.000	0.000	0.000	0.260	0.000	0.000	0.000	0.000	0.000
Anthracene	0.01	0.000	0.000	0.000	0.000	0.096	0.001	0.000	0.000	0.000	0.000
Benzo(a)anthracene	0.1	0.680	0.068	0.660	0.066	0.210	0.021	0.57	0.057	0.290	0.029
Benzo(a)pyrene	1	0.530	0.530	0.860	0.860	0.210	0.210	0.62	0.620	0.270	0.270
Benzo(b)fluoranthene	0.1	1.500	0.150	2.000	0.200	0.300	0.030	1.50	0.150	0.860	0.086
Benzo(g,h,i)perylene	0.01	1.200	0.012	1.200	0.012	0.160	0.002	1.30	0.013	0.940	0.009
Benzo(k)fluoranthene	0.1	0.620	0.062	0.860	0.086	0.150	0.015	0.66	0.066	0.350	0.035
Chrysene	0.01	3.500	0.035	2.200	0.022	1.300	0.013	0.77	0.008	0.740	0.007
Dibenzo(a,h)anthracene	5	0.073	0.365	0.220	1.100	0.034	0.170	0.10	0.500	0.068	0.340
Flouranthene	0.001	2.000	0.002	1.500	0.002	0.560	0.001	1.50	0.002	0.660	0.001
Fluorene	0.001	0.000	0.000	0.000	0.000	0.110	0.000	0.000	0.000	0.000	0.000
Ideno(1,2,3-cd)pyrene	0.1	0.310	0.031	0.092	0.009	0.110	0.011	0.61	0.061	0.180	0.018
Phenanthrene	0.001	0.000	0.000	0.000	0.000	0.140	0.000	0.000	0.000	0.000	0.000
Pyrene	0.001	2.700	0.003	2.500	0.003	0.400	0.000	2.60	0.003	0.450	0.000
	TEQ		1.258		2.361		0.475		1.479		0.796
<i>TEF - toxicity equivalent factor</i> <i>TEQ - toxicity equivalent quotient</i> <i>S(#) - sample number</i> <i>BAP - benzo(a)pyrene equivalent</i>											

The highest BAP TEQ concentration from the samples was 2.361 mg/kg. The estimated child dose for a 5-year exposure at a 5 days per week is 0.00003280 mg/kg/day. The estimated adult dose is 0.00000234 mg/kg/day. Adult doses also were estimated assuming daily exposure durations of 30 and 70 years (child doses are not estimated for extended durations; during the extended duration their incidental ingestion behaviors change to adult behaviors). The maximum estimated incidental ingestion adult dose was 0.0000033 mg/kg/day.

BAP equivalent incidental ingestion doses for individual component and quotients of total PAHs in the facility drainage ditches and soils around the site ranged from 0.0000023 to 0.0015 mg PAH per kg soil per day. The highest dose estimated from samples other than the drainage ditch samples was 0.000033 mg/kg/day.

ADH estimated the cancer risk for a lifetime exposure (70 years), using the highest concentrations of BAP to represent the worst-case scenario. Cancer risk is expected to be 0.01095 or 1 cancer case over a lifetime for 100 persons exposed.

We do not expect adverse health effects from exposure to PAHs because none of the estimated exposure doses exceeded ATSDR's acute MRL of 0.1 mg/kg/day for BAP and other PAHs. Adverse health effects associated with oral exposure to PAHs occur at much higher doses than those estimated for potentially exposed populations in the community [11].

