Petitioned Health Consultation:
Dow Chemical Company Michigan Division
Dioxin Contamination in Soil in Midland, Midland County, Michigan

EPA ID #: MID000724724

Prepared by

Michigan Department of Community Health
Under a Cooperative Agreement with
Agency for Toxic Substances and Disease Registry

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Summary

A Midland resident and two Michigan-based environmental organizations petitioned the federal Agency for Toxic Substances and Disease Registry (ATSDR) to conduct a public health assessment of dioxin and dioxin-like compound (DLC) contamination in Midland, Michigan. The present public health consultation addresses soil contamination in the Midland area. An initial draft of this health consultation was released for public comment. The data necessary to determine if DLC-contaminated soil in the Midland area poses a public health risk are not available; therefore, the site poses an indeterminate public health hazard.

The results of several preliminary soil sampling studies indicate that DLCs have been detected in soil at two locations in the Midland community at concentrations greater than the ATSDR residential action level. DLCs detected in most of the soil samples collected from the Midland community fell between the ATSDR screening level of 50 parts per trillion (ppt) and the ATSDR action level of 1,000 ppt. Therefore, the ATSDR guidance indicates that further site-specific evaluation is necessary to determine if DLC contamination in Midland soil presents a public health hazard.

The Michigan Department of Community Health (MDCH) recommends that soil-sampling plans for the Midland community be developed and implemented; including contingency plans for potential public health actions in residential areas if DLC concentrations exceed the ATSDR action level. The MDCH further recommends a comprehensive evaluation of site-specific exposure factors for the residents of the Midland area and a comprehensive assessment of exposure that includes all identifiable sources of DLC exposure. Priority should be given to people living in areas where DLC concentrations in soil exceed the ATSDR screening value.

Purpose and Statement of Health Issues

On May 1, 2001, a resident of the city of Midland and two Michigan-based environmental organizations petitioned the Agency for Toxic Substances and Disease Registry (ATSDR) to conduct a public health assessment of DLC contamination in Midland, Michigan (Attachment A). The petitioners stated that the "likely source of this contamination is the Dow Chemical Company" (Petitioners for the Dow Midland site 2001). Specific concerns noted by the petitioners included:

- DLCs had been detected in soil in Midland at concentrations above the Michigan Department of Environmental Quality (MDEQ) residential cleanup criterion. Levels of DLCs detected in soil adjacent to the eastern perimeter of the Dow plant site and along a road way (haul route) in the community exceeded 1,000 ppt.

- DLCs had been detected in fish taken from the Tittabawassee River downstream of Midland. Levels detected exceeded the State of Michigan trigger levels for fish consumption warnings. In 1985, the U.S. Environmental Protection Agency (EPA) noted that the highest national levels of DLCs in fish were found in the Tittabawassee River.

- In 1985, the EPA "called for a comprehensive health study" of DLC exposures and the resulting health effects in the Midland community (Petitioners for the Dow Midland site 2001). No such comprehensive study has ever been performed.

ATSDR and the Michigan Department of Community Health (MDCH) have a cooperative agreement for conducting public health assessments and health consultations for potential health hazards at sites of environmental contamination within the State of Michigan. MDCH staff and a representative from the ATSDR Region 5 office visited the Midland area on July 30, 2001, and toured the Dow Chemical Company (Dow) plant site. The MDCH completed a "Petition Scoping Report" and provided the information obtained from these activities to the ATSDR on August 31, 2001. A copy of the report is provided in Attachment B. The MDCH met with the petitioners on October 3, 2001, to discuss the health assessment process and to provide an opportunity for exchange of additional information.

ATSDR responded in writing (Attachment C) to the petitioners on November 2, 2001, stating that, "After reviewing the public health issues and community concerns about potential DLC contamination and the Dow Midland facility, ATSDR has found a reasonable basis to prepare public health consultations to address the concerns associated with the Dow facility" (ATSDR 2001). MDCH has agreed to address the petition through a series of health consultations. ATSDR will review MDCH's work and provide technical support as needed.

The present consultation will only address concerns related to DLC contamination in Midland soil. Additional consultations that address other contaminated media may be developed in the future with the ultimate goal of providing a full multi-media, multi-pathway public health assessment.

DLCs are a group of chlorinated chemicals with similar structures and chemical properties, including chlorinated dioxins, furans, and some polychlorinated biphenyls. For simplicity, this group of chemicals is referred to here collectively as "dioxin-like compounds (DLCs)." Where analytical concentrations are reported in this discussion, the term total dioxin TEQ (toxic equivalents) will be used. Please see the text of the consultation for an explanation of the TEQ approach for reporting DLC concentrations in the environment.

Background

The Dow Chemical Company (Dow), founded in 1897, operates a chemical manufacturing plant in the city of Midland, Michigan. The Dow plant encompasses approximately 1,900 acres on the southern perimeter of the city (Figure 1). The Tittabawassee River forms the southern boundary of the plant site and flows east to the Saginaw Bay of Lake Huron.

Chemicals that have been produced at the Dow plant include but are not limited to: styrene, butadiene, picric acid, mustard gas, Saran Wrap, Styrofoam, Agent Orange, and other various chemicals including chlorpyrifos (Dursban) and 2,4,5-trichlorophenoxyacetic acid (2,4,5-T). Chlorophenol production began in 1915. Wastes generated from this process were initially disposed of in 600 acres of on-site waste ponds. During high flow periods in the early 1900s,

wastes from these ponds would be intentionally released to the Tittabawassee River (Brandt 1997). Dow currently operates its own wastewater treatment plant on-site.

Two rotary kiln incinerators were formerly used for treatment of liquid and solid hazardous and non-hazardous wastes generated from manufacturing activities at the facility (SAF·Risk 2001). These incinerators were replaced with a new incinerator that came on line in 2003. The new permitted emission rate will result in a substantial reduction in DLC emissions and impacts, compared with the operation of the two previously existing incinerators. However, ambient air dispersion modeling and monitoring indicate that the northeastern quadrant of the city of Midland has been impacted by historical emissions from the incinerators. Some site refuse has been and is taken by truck from the Dow plant to local landfills, including the currently operating Salzburg Landfill and the closed Rockwell Road Landfill, via an off-site haul route named Salzburg Road (Figure 1.) The Dow property and releases from the Dow property are subject to the corrective action program administered by the MDEQ under Part 111, Hazardous Waste Management, of the Michigan Natural Resources and Environmental Protection Act (NREPA), 1994 PA 451. The EPA sampled soil in the city of Midland in the 1980s as part of the corrective action plan for the property. Samples collected during these studies were analyzed only for the most toxic dioxin congener, 2,3,7,8-tetrachlorodibenzo-p-dioxin (2,3,7,8-TCDD). Concentrations of 2,3,7,8-TCDD were found at several locations and the EPA recommended additional sampling in the future to monitor levels of DLCs in the community (MDEQ 2001).

Discussion

Environmental Contamination and Other Hazards

In September 1996, the MDEQ conducted what was intended to be the first phase of a study to determine the current levels of dioxins and furans in surficial soils and sediments around Midland. Dioxins and furans are known to be impurities in some chlorinated phenolic chemicals—such as the herbicide 2,4,5-T—that were manufactured at Dow until the late 1970s. These studies were conducted to characterize sources and to identify environmental levels of dioxins and furans that were emitted from certain production, waste treatment, and combustion processes. Samples collected during the 1996 Midland community study were analyzed for all 17 of the 2,3,7,8-substituted dioxin and furan congeners that are necessary to evaluate the total toxic equivalent (TEQ) concentration of a mixture of dioxins and furans. Samples were collected at 35 locations that included schools, parks, community use and other areas, and at 15 locations on-site at the Dow plant. Sample locations were selected as a follow-up to the studies conducted in Midland during the mid-1980s by Dow and the EPA (MDEQ 1997).

A comparison of results from samples collected in the same or nearby locations generally indicated that levels of DLCs had not changed substantially, although the data suggested a decline in the concentration of 2,3,7,8-TCDD in the Midland community samples (MDEQ 1997). All of the total dioxin TEQ concentrations for the Midland community samples (Table 1) were below the 1,000 parts per trillion (ppt) action level[1] for residential soils used by the ATSDR (De Rosa et al. 1997a). However, many of the samples, especially those located directly adjacent to and downwind to the northeast of the Dow plant exceeded the MDEQ residential soil direct contact criterion of 90 ppt for total dioxins TEQs (MDEQ 2000).

Dioxin Toxic Equivalencies
Dioxin toxic equivalents (TEQs) are calculated by multiplying the level of a particular dioxin-like compound by its toxicity equivalency factor (see page 7 for additional information). The resulting TEQs are then added together to determine the total dioxin TEQ concentrations in a soil sample.

Table 1. Dioxin TEQ Concentrations Detected in Soil Samples Collected in the Midland Community and from the Dow Plant Site In 1996

Soil Samples Location	Range of TEQ Detected (ppt)	Number of Samples	DEQ Cleanup Criterion (ppt)	ATSDR Screening Level (ppt)	ATSDR Action Level (ppt)
Southeast Quadrant	6 - 602	4	90	50	1,000
Southwest Quadrant	10 - 95	5	90	50	1,000
Northeast Quadrant	77 – 598	14	90	50	1,000
Northwest Quadrant	22 – 125	3	90	50	1,000
Dow Plant Site	16.5 – 8,840	15	990	50	1,000

De Rosa et al. 1997a; MDEQ 1997, 2000.

The highest detected total dioxin TEQ concentration in the northeast quadrant (598 ppt) was found in a soil sample taken near the intersection of South Saginaw and Bay City roads at the northeast corner of the Dow plant site (Figure 1). Dioxin TEQ concentrations up to 602 ppt (Table 1) were also detected in soil samples taken along the Salzburg Road haul route in the southeastern quadrant (Figure 1). The highest detected total dioxin TEQ concentration on the Dow plant site was 8,840 ppt in a sample taken near the incinerator complex.

Based on the levels of DLCs detected in soil in the 1996 Midland community study, the MDEQ staff recommended that additional investigations needed to be planned and completed. Pursuant to the corrective action requirements of its federal hazardous waste permit issued in 1988, Dow

[1] A concentration of chemicals at which consideration of action to interdict/prevent exposure occurs (De Rosa et al. 1997a).

is responsible for conducting several dioxin/furan monitoring programs (e.g., community and Midland Plant soil, surface water sediment, incinerator stack, ambient air, dust, food chain) under the oversight of the MDEQ and the EPA. Information from these studies was expected to be used to assess the need for corrective action activities (MDEQ 2001).

In 1998, as a follow-up to the 1996 study, Dow collected samples on the Dow Corporate Center property (Dow 1999). The Dow Corporate Center is located in the northeastern quadrant of the city of Midland within the predicted area of impact for the Dow incinerators and adjacent to residential areas (Figure 1). Therefore the MDEQ agreed to accept DLC concentrations detected in soil samples taken from the Corporate Center as a surrogate for DLC concentrations that might be found in soil in the surrounding residential areas. Historical records and photographs were consulted to identify areas that had not been disturbed during construction of the buildings now located on the Corporate Center property. Soil samples were collected from four grassy areas with some trees. Detected total dioxin TEQ concentrations ranged from 0.077 to 584 ppt in surface soils (Table 2). The highest detected concentration was in a soil sample taken across the street from residential homes.

Samples were also collected from the Midland Plant site along internal plant haul routes, along the northeast plant perimeter at the intersection of South Saginaw and Bay City roads, and along the Salzburg Road haul route (Dow 1999). Table 2 presents the range of concentrations detected in these areas.

Table 2. Dioxin TEQ Concentrations Detected in Soil Samples Collected from the Northeast Perimeter of the Dow Plant Site, Salzburg Road Haul Route, the Dow Plant Site, and the Dow Corporate Center In 1998

Soil Samples Location	Range of TEQ Detected	Number of Samples	MDEQ Residential Direct Contact Criterion (ppt)	ATSDR Screening Level (ppt)	ATSDR Action Level (ppt)
Northeast Perimeter	6 – 1,068	11	90	50	1,000
Salzburg Road	10 – 2,663	16	90	50	1,000
Dow Plant Site	170 – 17,030	18	90	50	1,000
Dow Corporate Center	77 - 584	39	90	50	1,000

De Rosa et al. 1997a; Dow, 1999; MDEQ 2000

Total dioxin TEQs were detected on the Dow plant site at concentrations ranging up to 17,000 ppt. Detected concentrations of total dioxin TEQs ranged up to 1,068 ppt on the northeast plant perimeter on the west side of South Saginaw Road (Figure 1). Properties located directly across the road are primarily commercial with residential homes located immediately behind and to the east. Detected concentrations of total dioxin TEQs ranged up to 2,663 ppt in samples taken along the Salzburg Road haul route (Figure 1). The highest concentration was found on the haul route approximately midway between Waldo and Midland County Line roads. This sample location has been remediated, however only 16 samples were taken on a 775-foot interval over a 2.6-mile length of this road. This relatively low frequency sampling identified several areas on the haul route with elevated concentrations. The level of 2,600 ppt found at one sampling

location suggests that other areas of elevated concentrations might have been missed. Most of the surrounding property is privately owned, but currently unoccupied.

No additional soil samples for dioxin and furan analysis have been collected in the Midland community since 1998. When considered together, the data gathered in the 1996 and 1998 soil studies indicate that detected total dioxin TEQ concentrations are generally very high on the Dow plant site and decrease as a function of distance from the Dow plant perimeter. However, data are available for only one community soil sample within a ¾ mile radius of the location on the northeast plant perimeter where total dioxin TEQ concentrations were detected at 1,068 ppt.

On June 12, 2003, the Department of Environmental Quality (DEQ) issued a hazardous waste management facility renewal operating license to The Dow Chemical Company (Dow), Michigan Operations for its treatment, storage, and disposal facility in Midland, Michigan, and related corrective action activities. In addition to on-site corrective action activities, the operating license also addresses major off-site corrective action activities for Midland area soils.

Human Exposure Pathways

To determine whether people are or could be exposed to environmental contaminants, ATSDR and MDCH evaluate the environmental and human components that lead to human exposure. An exposure pathway contains five major elements: 1) a source of contamination, 2) contaminant transport through an environmental medium, 3) a point of exposure, 4) a route of human exposure, and 5) a receptor population. An exposure pathway is considered complete if there is evidence that all five of these elements are, have been, or will be present at the property.

Table 3. Exposure Pathway for Dioxin-Contaminated Soil in Midland

Source	Environmental Transport and Media	Chemicals of Concern	Exposure Point	Exposure Route	Exposed Population	Time Frame	Status
The Dow Chemical Company	Former Incinerator Emissions, Soil Erosion, Loss and Track-Out	Chlorinated Dioxins and Furans	Midland Community Soil	Incidental Ingestion, Dermal Contact, Inhalation	Residents of Midland	Past	Complete
						Current	Complete
						Future	Complete

Chlorinated dioxins and furans have been detected in soil samples taken from the Dow plant site, from the plant perimeter, from haul routes leading from the plant to near-by landfills, from the Dow Corporate Center, and in soil samples taken from parks, playgrounds and other locations within the Midland community. The likely source of these contaminants is chemical manufacturing activities on the Dow plant site. Former emissions from the on-site incinerator complex, wind blown transport of contaminated soil, and loss or track-out of contaminants during waste transport are all possible mechanisms of transport from the Dow plant site to the surrounding community. Residents of Midland and the surrounding communities could be exposed to dioxins and furans in the soil through incidental ingestion, direct dermal contact, and inhalation of soil and dust. Chlorinated dioxins and furans were produced during historical processes; therefore, exposure is likely to have occurred in the past and will continue in the absence of any remedial action.

Demographics

The city of Midland is the county seat of Midland County, Michigan and encompasses an area approximately 28 square miles. The population of Midland was approximately 38,090 in 1990. Twenty-five percent of the population in 1990 was children under the age of 17 years (U.S. Census Bureau 1990).

Residential neighborhoods are located in close proximity to the northeast perimeter of the Dow plant and within a quarter of a mile from a soil sampling location where total dioxin TEQs were detected at concentrations greater than the ATSDR action level of 1,000 ppt. No soil data are available for these residential neighborhoods.

Toxicological Evaluation

Health Effects

DLCs are a group of over 210 chlorinated chemicals with similar structures and chemical properties. This group of chemicals, which includes chlorinated dioxins, furans, and some polychlorinated biphenyls (PCBs), is often referred to collectively as simply "dioxins" or "dioxin-like compounds (DLCs)." When found in the environment, dioxins are usually a mixture of several of these chemicals. Most DLCs are not intentionally produced and have no known use. Not all DLCs have the same toxicity or ability to cause illness and adverse health effects. However, it is assumed that dioxins and dioxin-like compounds cause adverse health effects through a similar biological mechanism of action. Further, the available science indicates that the health effects resulting from exposure to multiple DLCs are additive, meaning that the health effects are greater than would be expected for a single compound.

The most toxic chemical in the group is 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (2,3,7,8-TCDD). Toxic equivalency factors (TEF) have been developed to compare the relative toxicity of other dioxins and dioxin-like compounds with that of 2,3,7,8-TCDD. The levels of other dioxin-like compounds measured in the environment are multiplied by a TEF to produce a 2,3,7,8-TCDD toxic equivalent (TEQ) concentration. The resulting TEQs for all dioxin-like compounds measured in a sample are then added together to determine the total dioxin TEQ concentration for that sample.

People who have been exposed to high levels of DLCs (such as those found in an industrial setting or due to a significant industrial explosion) have developed chloracne, a skin disease with severe acne-like pimples. Chloracne can persist for years, sometimes clearing only to recur several years later. Changes in blood and urine that may indicate liver damage have also been seen in some people. Exposure to high concentrations of DLCs may cause long-term alterations in glucose (blood sugar) metabolism and slight changes in hormone levels (ATSDR 1998).

Exposure to lower levels of DLCs in laboratory animals has resulted in a wide variety of adverse health effects such as cancer, liver damage, and disruption of the endocrine system. In many species of animals, DLCs weaken the immune system and cause a decrease in the system's ability to fight infection. In other animal studies, exposure to DLCs has caused reproductive damage and birth defects. Some animal species, including monkeys, exposed to DLCs during

pregnancy had miscarriages, and the offspring of animals exposed to DLCs during pregnancy often had birth defects including skeletal deformities, kidney defects, weakened immune responses, and neurodevelopmental effects (ATSDR 1998).

It is not known whether people exposed to low levels of DLCs will experience the same health effects seen in animal studies. However, based on the available information, DLCs are believed to have the potential to cause a wide range of adverse effects in humans, including cancer. The EPA (EPA 2000) has characterized the mixture of DLCs to which people are commonly exposed as "*likely human carcinogens*." The EPA has also characterized 2,3,7,8-TCDD as a "*human carcinogen"* (EPA 2000). The U.S. Department of Health and Human Services, National Toxicology Program 9th Report on Carcinogens (NTP 2001) lists 2,3,7,8-TCDD as a substance "*known to be a human carcinogen*." The International Agency for Research on Cancer (IARC) has determined that 2,3,7,8-TCDD is *"carcinogenic to humans"* based on limited human data and sufficient animal data (IARC 1997)

ATSDR Interim Guidance

Because of the potential for adverse health effects in human populations exposed to environmental levels of DLCs, the ATSDR has developed interim policy guidelines to assist health assessors in identifying soil concentrations of potential concern (Attachments D and E). The guidelines recommend the tiered approach shown in the table below to evaluate DLC concentrations in soil. MDCH follows these guidelines when evaluating the public health hazard posed by DLC contamination in soil.

Table 4. ATSDR's Decision Framework for Sites Contaminated with Dioxin and Dioxin-Like Compounds.

Screening Level ≤ 50 ppt TEQs	Evaluation Level > 50 ppt but < 1,000 ppt TEQs	Action Level ≥ 1,000 ppt TEQs
Health effects are unlikely and further evaluation is not necessary, unless there are community health concerns.	Evaluation of site-specific factors, such as • Bioavailability • Ingestion rates • Pathway analysis • Soil cover • Climate • Other contaminants • Community concerns • Demographics • Background exposure	Potential public health actions considered, such as • Surveillance • Research • Health studies • Community education • Exposure investigations

(De Rosa et al. 1997a)

The screening level of 50 ppt total dioxin TEQ is the environmental media evaluation guide (EMEG) for 2,3,7,8-TCDD. The EMEG was developed from the ATSDR minimum risk level (MRL) based on neurodevelopmental effects observed in the offspring of female rhesus monkeys exposed during pregnancy and after birth through nursing (ATSDR 1998). EMEGs are very

conservative and protective values. Generally, if soil concentrations do not exceed the EMEG, ATSDR assumes that exposure is not likely to result in adverse health effects. However, if soil concentrations exceed the EMEG, this does not mean that adverse human health effects are likely. Instead, soil concentrations greater than 50 ppt total dioxin TEQ indicate further site-specific evaluation is necessary (De Rosa et al. 1997a).

The action level of 1,000 ppt TEQ is a concentration of DLC in residential soil at which various actions might be considered to prevent or limit exposure. The action level is based on the analysis by Kimbrough et al (1984). of the carcinogenic potential of 2,3,7,8-TCDD. ATSDR recommends that the action level for soil be used in full consideration of site-specific factors that could affect total exposure to DLCs through all media and exposure pathways (De Rosa et al. 1997b).

ATSDR recommends that the action level be compared to the "maximum concentrations identified at the site" (De Rosa et al. 1997b). Dioxin TEQ concentrations greater than 1,000 ppt have been detected at two locations in the Midland community: 1,068 ppt dioxin TEQ was detected on the northeast perimeter of the Dow plant site near the intersection of South Saginaw and Bay City Roads, and 2,663 ppt dioxin TEQ was detected along the Salzburg Road haul route between Waldo and Midland County Line Roads.

Soil concentrations of dioxin TEQs that fall between the screening level and the action level warrant further site-specific study (De Rosa et al. 1997b). Many factors, such as those shown in the table above, can affect how much DLCs people are exposed to, how much is absorbed into the body, and whether or not adverse health effects will result. Most of the soil samples collected from the Midland community fall within 50 and 1,000 ppt, including all the samples taken from the Dow Corporate Center property that was intended to serve as a surrogate for the surrounding residential community.

Background Exposure to DLCs

An important consideration when evaluating DLC levels in soil is the level of exposure from all sources of DLCs, or the "background exposure." People can be exposed to DLCs from many sources other than contaminated soil. The general population is mainly exposed to DLCs through their diet by eating plants and animals that contain DLCs. People who live near or work at hazardous waste sites containing DLCs, waste incinerators, or manufacturing facilities that produce DLCs as a by-product could have additional DLC exposures beyond their diet. When people are exposed to and absorb DLCs, the DLCs are stored in fatty body tissues where they might persist for months or years. The half-life (the time needed for the body to rid itself of half the contaminants absorbed) for DLCs in humans is 5 to 14 years. Because they remain for a long time, DLCs accumulate in the body and can cause health effects long after exposures have ended. The amount of DLCs accumulated over time is referred to as the "body burden." The best available science suggests that body burden levels of DLCs are closely associated with the likelihood of health effects. Therefore, many scientists recommend comparing DLC body burden levels in at-risk populations to those associated with health effects observed in animal and human studies (EPA 2000, De Rosa et al. 1997b).

Because people might be exposed to DLCs from a variety of sources, and because all these exposures contribute to the body burden of DLCs accumulated over time, ATSDR recommends evaluation of the contribution of soil exposures to total exposures from all sources (De Rosa et al. 1997b). Evaluation of soil exposures would require sufficient knowledge of DLC concentrations in soil, bioavailability of DLCs in site soils, and human behaviors that can affect exposures. Additionally, evaluation of all other sources of DLC exposure would be required to evaluate the incremental contribution of soil exposures to the total body burden of DLCs in the at-risk population. Much of this information is not currently available for the Midland area.

DLC Concentrations in Michigan Soils

In 1997 and 1998, the MDEQ collected soil samples from 68 urban and rural locations in Michigan. These samples were taken to gain an understanding of statewide DLC concentrations that have resulted from industrial activities, waste incineration, and chemical use. Analysis of these samples indicates that DLC soil background concentrations vary from less than 1.0 ppt TEQ to 35 ppt TEQ with an average of 6.0 ppt TEQ. Similar nationwide efforts by the U.S. EPA found an average DLC soil concentration of 10 ppt TEQ (MDEQ 1999).

Community Involvement

This document was released for public comment in March 2002. The comment period lasted for 90 days. A public meeting was held to solicit comments. The comments that were received during the comment period are addressed in Attachment F.

ATSDR Child Health Considerations

Children may be at greater risk than adults from certain kinds of exposure to hazardous substances at sites of environmental contamination. They engage in activities such as playing outdoors and hand-to-mouth behaviors that increase their exposure to hazardous substances. They are shorter than adults, which means they breathe dust, soil, and vapors close to the ground. Their lower body weight and higher intake rate results in a greater dose of hazardous substance per unit of body weight. The developing body systems of children can sustain permanent damage if toxic exposures are high enough during critical growth stages. Prenatal exposures and those that occur in the first few years of life are more likely to cause permanent damage.

Fetuses, infants, and children may be especially sensitive to DLC exposure because of their rapid growth and development. In animal studies, exposure to DLC has caused reproductive damage and birth defects. Some animal species exposed to DLCs during pregnancy had miscarriages, and the offspring of animals exposed to DLCs during pregnancy often had birth defects including skeletal deformities, kidney defects, weakened immune responses, and neurodevelopmental effects (ATSDR 1998).

Conclusions

The data necessary to determine if DLC-contaminated soil in the Midland area poses a public health risk are not available; therefore the site poses an indeterminate public health hazard.

ATSDR classifies sites of environmental contamination into the indeterminate category when the data to make a final decision are lacking.

Several soil-sampling studies have been conducted in the Midland area by the EPA, the MDEQ, and by the Dow Chemical Company. The results of these studies indicate that dioxin TEQs have been detected in soil on the Dow plant site at concentrations up to 17,000 ppt. Total dioxin TEQs above the ATSDR action level for residential soils have been detected in off-site soil at the Dow plant perimeter at concentrations up to 1,068 ppt and along the Salzburg Road haul route at concentrations up to 2,663 ppt. Total dioxin TEQs detected in most of the soil samples collected from the Midland community fall between the ATSDR screening level and the action level, including all the samples taken from the Dow Corporate Center property intended to serve as a surrogate for the surrounding residential community. Therefore, the ATSDR guidance recommends a site-specific evaluation to determine if DLC contamination in Midland soil presents a public health hazard (De Rosa et al. 1997a, 1997b).

Soil data are not available for all of the Midland community, and it is likely that some areas are more heavily contaminated than others—particularly the northeast quadrant most impacted by historical emissions from the Dow incinerators. Of particular concern are those areas of the community closest to the Dow plant site to the east and north. No data are available concerning DLC concentrations in these areas of Midland.

Additional site-specific information including an assessment of background exposures is necessary to evaluate the incremental contribution of soil exposure to the total DLC body burden for the residents of Midland. This information is not currently available.

Recommendations

- Develop and implement a soil-sampling plan for residential areas closest to the Dow plant site. Sampling should begin at those residential properties that are most likely to be contaminated with DLC, east and north of the Dow plant site.

- Develop a contingency plan concurrent with the recommended residential soil-sampling plan for potential public health actions if total dioxin TEQ concentrations exceed the ATSDR action level, consistent with evaluation of site-specific exposure factors.

- Allow the sampling plans for the residential areas to be reviewed and commented upon by MDCH, ATSDR, and U.S. EPA prior to finalization and implementation. Feedback from MDCH and ATSDR will be solicited to assess whether the sampling plan will be adequate to collect the information necessary to better characterize the public health implications.

- Based on the environmental sampling results, conduct an Exposure Investigation (EI) to evaluate actual exposures in the community. The EI may consider biota sampling as a means to verify exposure to site contaminants.

Public Health Action Plan

- The MDEQ will review and approve, if acceptable, Dow proposals for interim response measures and remedial investigation and actions under the corrective action program. The MDEQ should require that Dow submit an interim response measure to develop, approve, and implement soil-sampling plans for properties in Midland most likely to have elevated levels of DLC in soil.

- The MDEQ should require that a contingency plan for potential public health actions to be developed as part of the Dow operating license under the corrective action program. Public health actions should be implemented immediately if total dioxin TEQ concentrations exceed the ATSDR action level, consistent with evaluation of site-specific exposure factors.

- The MDCH will request ATSDR collaboration and support for an exposure assessment for the Midland community. The exposure assessment will consist of an evaluation of site-specific exposure factors.

- The MDCH in cooperation with the Midland County Health Department and the city of Midland will undertake health education activities to define and respond to the information needs of the Midland community.

- The MDCH in cooperation with the Midland County Health Department and the city of Midland will be available to consult on the appropriateness and efficacy of future remedial actions.

Contact Information

If any citizen has additional information or health concerns regarding the Midland, Michigan petitioned health assessment/consultation, please contact the Michigan Department of Community Health, Division of Environmental and Occupational Epidemiology, at 1-800-648-6942.

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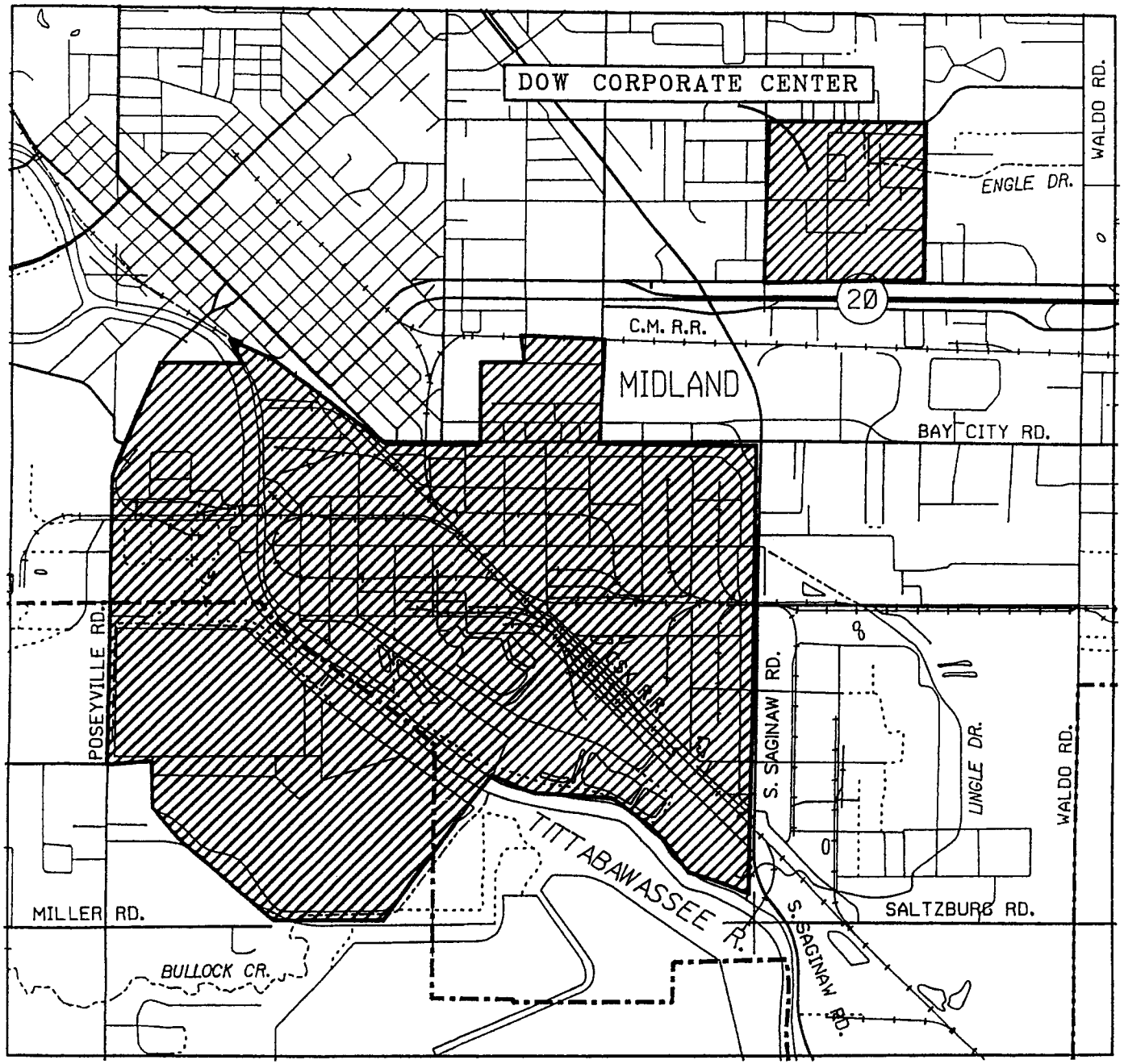
Figure 1

Figure 1.



DOW CHEMICAL COMPANY AND MIDLAND VICINITY MIDLAND COUNTY, MICHIGAN

- INTERSTATE HIGHWAYS (496)
- U.S. HIGHWAYS (2)
- STATE HIGHWAYS (55)
- OTHER MAJOR ROADS
- MINOR ROADS
- TWO-TRACK ROADS
- AIRPORTS
- GRASS AIRSTRIPS
- RAILROADS
- ABANDONED RAILROADS
- RIVERS AND STREAMS
- INTERMITTENT STREAMS
- POLITICAL BOUNDARIES
- DOW CHEMICAL COMPANY

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Michigan Department of Community Health

Base map information provided by Michigan Department of Natural Resources, MIRIS Program

12/03/2001

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CERTIFICATION

This Dow Chemical Company Midland Division Health Consultation was prepared by the Michigan Department of Community Health under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the health consultation was begun.

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Technical Project Officer, CAT, SSAB, DHAC, ATSDR

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

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Chief, Cooperative Agreement Team, SSAB, DHAC, ATSDR