# Public Health Consultation

## Bay Harbor Cement Kiln Dust Seep Discharge
## Bay Harbor, Emmet County, Michigan

**April 4, 2005**

**Prepared by:**

**Michigan Department of Community Health**

**Under a Cooperative Agreement with the**
**Agency for Toxic Substances and Disease Registry**

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## Foreword

The Federal Agency for Toxic Substances and Disease Registry (ATSDR) and the Michigan Department of Community Health (MDCH) have a cooperative agreement to conduct public health assessments of potential health hazards at sites of environmental chemical contamination within the State of Michigan. In 2004, the United States Environmental Protection Agency (EPA) requested the assistance of the MDCH to complement their activities focused on the contamination seeping into Lake Michigan in the lakeshore area near a former Penn-Dixie cement plant operation. The EPA was initiating an investigation of the impact of the cement kiln dust (CKD) leachate on the community and environment and asked MDCH to provide support in conjunction with ATSDR and local health agency representatives. This Public Health Consultation addresses the potential human health hazard associated with exposure to the contamination seeping onto the beach and into the water in the Bay Harbor area approximately seven miles west of the city of Petoskey.

## Summary

High pH levels found in puddled seep discharge water on the shoreline at Bay Harbor, Michigan, pose a **public health hazard**. A January 2004 interruption in the collection of seep water from a cement kiln dust (CKD) pile resulted in the discharge of affected groundwater to the beach and near-shore water of Lake Michigan's Little Traverse Bay. Direct exposure to pH levels ranging between 9 and 13.5 detected in seep water puddled on a private beach in close proximity to residential homes may result in irritation of eyes, skin and mucous membranes. Exposure to water at a pH greater than 11.5 may result in irreversible damage to these tissues.

Mercury levels detected in the seep discharge water pose a **public health hazard**. Mercury is a bioaccumulative chemical that has been found in Lake Michigan walleye at levels that could produce human health effects. A Michigan fish advisory in effect for northern Lake Michigan recommends that women of childbearing age and children under the age of 15 limit their consumption of walleye because of unacceptable levels of mercury found in these fish.

Levels of other inorganic contaminants detected in the seep discharge water pose **no apparent public health hazard** to people. However, these contaminants may have adverse effects on aquatic wildlife in the area.

## Background and Statement of Issues

Bay Harbor is located on Lake Michigan's Little Traverse Bay west of the City of Petoskey in Emmet County, Michigan. The Bay Harbor Development and the Resort Township East Park are located along five miles of the shoreline in Resort Township (Figure 1.). Cement kiln dust (CKD) waste from the former Penn-Dixie cement manufacturing plant was disposed of on-site in large piles from approximately 1921 to 1980. Bay Resort Properties Limited Partnership purchased approximately 300 acres of the former Penn-Dixie site in 1989. Five private entities and the State of Michigan entered into an Administrative Agreement and Covenant Not to Sue (CNTS) and the land has since been developed for mixed residential, commercial, open space, and golf course recreational use (MDNR 1994). The Bay Harbor Company (Bay Harbor) currently operates the development. The Resort Township East Park portion of the former Penn-

Dixie property was transferred to Emmet County in December of 1995 and has been developed into a public park.

As part of the closure agreement for the site, Bay Harbor was required to collect seepage flow from the western CKD pile, sample for pH, metals, and other contaminants, and pump the effluent to a treatment facility. Seepage water from the collection system installed along Coastal Ridge Drive (Figure 2) is pumped to a treatment facility where it is mixed with acid to neutralize the pH. The treated water is then discharged to the Petoskey Waste Water Treatment Plant.

During a routine inspection visit to the Petoskey Wastewater Treatment Plant on August 17, 2004, Michigan Department of Environmental Quality (MDEQ), Cadillac District Office staff learned that the plant had not received discharge water from the Bay Harbor collection and treatment facility since January 3, 2004 (MDEQ 2004a, 2004b). In August and September, MDEQ conducted site visits to the shoreline area proximate to the site to investigate CKD leachate seeps to the shore of the Little Traverse Bay.

MDCH staff visited the property in November 2004, accompanied by representatives of Bay Harbor, a contractor for the U.S. EPA, and staff from the North West Michigan Community Health Agency. The development property is a gated community with private roads. The only entry is controlled by a manned checkpoint. At the time of the visit Bay Harbor had arranged to have a security guard stationed in a car parked with an unobstructed view of the shoreline. The security monitoring was in effect during daylight hours to guard against anyone arriving on the shore by boat from Lake Michigan. There were small warning signs on freestanding posts at intervals along the affected areas of the beach. MDCH staff toured three separate areas along the shore and saw several shallow pools of dark amber water. In other areas where ponding was no longer occurring, limestone and round stones were stained in colors ranging from brown to black. Two vacant lots on Coastal Ridge Drive are adjacent to Seep #2 (Figure #2.). There are completed private homes on either side of those lots Seep # 1 is located to the east of that area and is below a ridge that borders a golf course on the development property.

East Park is located on Little Traverse Bay close to the easternmost CKD waste pile (Figure 2). The park is bordered on its east side by land owned by the Little Traverse Bay Bands of Odawa Indians, a federally recognized tribe. The Tribe is conducting lake trout spawning research in the Bay about 100 meters offshore in five to ten feet of water. As part of this project, egg nets are buried by divers in the lake bottom in late September or early October, and retrieved after the peak lake trout spawn has occurred (Steve Lenart. Great Lakes Fisheries Biologist. Little Traverse Bay Bands of Odawa Indians, Natural Resources Department. Harbor Springs. Personal Communication, February 9, 2005).

## Discussion

**Environmental Contamination and Other Hazards**

MDEQ has promulgated a surface water quality standard for pH of 6.5 to 9 standard units (MDEQ 1999). The pH scale is a measure of whether a liquid solution is acid, neutral, or alkaline. A neutral solution has a pH of about seven. Acidic solutions will exhibit a lower pH with the lowest pH values indicating the strongest acid. The pH of alkaline or base solutions will be higher, with the highest pH values indicating the strongest base. The MDEQ standard is intended to be protective both for people who use the surface water recreationally and for aquatic life that inhabit the water.

MDEQ staff conducted several site inspections at Bay Harbor between August 17 and September 15, 2004. They observed that the CKD seepage in the Seep #1 and #2 area appeared as a plume or band of dark brown, almost black, water along the shoreline, extending out 5 to 10 feet from shore and laterally several hundred yards along the shoreline in either direction. They further noted that many of the limestone and cobblestone rocks that constitute the shore in that area appeared to have been stained black by the seep. The pH of near shore lake water about seven feet from shore was measured at 10.15. MDEQ staff identified an approximately 1000-foot length of shoreline where sampled pools of water puddled on the beach registered between 9 and 13.2 on a handheld pH meter (MDEQ 2004a, 2004b).

Seep water puddled on the shore near East Park showed a pH range of 8.64 to 10.43 during the MDCH November 2004 site visit. Water in two small creeks flowing into the bay in the vicinity of East Park showed pH levels of 8.63 and 8.78.

MDEQ has also established surface water quality standards for chemical contaminants (MDEQ 1999). The approach used in developing these standards considers potential effects on aquatic and terrestrial wildlife as well as potential effects on people who may swim or eat fish taken from the water. In addition, Lake Michigan is protected as a source of potable drinking water.

Surface water samples collected on September 8, 2004 were analyzed for inorganic chemicals. Contaminants that exceeded a surface water quality standard are shown in bold in Table 1. All concentrations are shown in micrograms per liter (ug/L). The acronyms are explained in the text below the table.

**Table 1. Comparison of Inorganic Chemicals found in Bay Harbor seep discharge to Michigan Surface Water Quality Standards**

| | Sample Concentration | FCV | HNV | WV | AMV |
|---|---|---|---|---|---|
| Arsenic | 220 | **150** | **50** | NA | 340 |
| Copper | 28 | **2.3** | 790 | NA | **2.9** |
| Mercury | 0.3 | 0.77 | **0.0018** | **0.0013** | 1.4 |
| Molybdenum | 500 | 800 | **120** | NA | 7200 |
| Nickel | 220 | **13** | 2600 | NA | **120** |
| Selenium | 110 | **5** | 120 | NA | **62** |
| Vanadium | 190 | **12** | 220 | NA | **110** |
| Zinc | 38 | **30** | 4500 | NA | **30** |

(MDEQ 2004b)

The final chronic value (FCV) is a concentration in water that will not be harmful to aquatic life over a lifespan. Concentrations of arsenic, copper, nickel, selenium, vanadium and zinc exceeded their respective FCVs.

The human noncancer value (HNV) is the concentration in surface water that is not expected to result in noncancer effects in people. Little Traverse Bay is part of Lake Michigan and so is protected as a source of drinking water. Concentrations of arsenic, mercury, and molybdenum exceeded their respective HNVs. While arsenic is considered a carcinogen, a surface water quality standard based on potential carcinogenic effects is not available. The HNV for mercury, a bioaccumulative compound, is based on protection of fish for human consumption and will be discussed in the Toxicological Evaluation.

While arsenic and molybdenum exceed their drinking water HNV values, the seep discharge water will be diluted in the surface water before reaching a drinking water source The levels of arsenic and molybdenum in the seep discharge do not exceed surface water quality standards for protection of people who may swim in the area. Therefore, people who come in contact with the seep discharge are not likely to experience health effects from exposure to these compounds.

The wildlife value (WV) is a concentration that will not be harmful to terrestrial wildlife that is exposed to the surface water over a lifetime. Mercury concentrations in the seep discharge exceeded the WV for this chemical.

The aquatic maximum value (AMV) is a concentration in water that is not likely to result in injurious or debilitating effects to aquatic life from brief exposures. Concentrations of copper, nickel, selenium, vanadium and zinc exceeded their respective AMVs.

The MDEQ has also developed groundwater contact criteria (GCC) that are concentrations that are not likely to cause harm to people from dermal exposure to contaminated water. None of the inorganic chemicals detected in the seep discharge water exceeded their respective GCC.

**Physical Hazards**

There were no apparent physical hazards observed during the MDCH site visit other than the natural rock on the shoreline.

**Human Exposure Pathways**

To determine whether nearby residents are, have been, or are likely to be exposed to contaminants associated with a property, 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 a complete pathway if there is evidence that all five of these elements are, have been, or will be present at the property. Alternatively, an exposure pathway is considered complete if there is a high probability of exposure. It is considered a potential pathway if at least one of the elements above are, have been, or will be present at the property, or that there is a lower probability of exposure. The table below lists the complete and potential pathways for human exposure to the chemicals of concern at the Bay Harbor site.

**Table 2. Human Exposure Pathways**

| Source | Environmental Transport and Media | Chemicals of Interest | Exposure Point | Exposure Route | Exposed Population | Time Frame | Status |
|---|---|---|---|---|---|---|---|
| CKD Seeps | Water | High pH. Arsenic, copper, mercury, nickel, selenium, vanadium, zinc. | Beach, and near-shore surface water. | Dermal contact | Residents Boaters Divers Park visitors | Past | Potential |
| | | | | | | Present | Complete |
| | | | | | | Future | Potential |
| CKD Seeps | Fish | Mercury | Lake Michigan | Ingestion | Sport and commercial fish eaters. | Past | Complete |
| | | | | | | Present | Complete |
| | | | | | | Future | Complete |

Several private homes are located adjacent to Seep #2. MDCH staff observed a "fire pit" approximately 10 feet from one location where pH readings of 13 were found in leachate water puddled on the beach. While this area is not land accessible by the general public, people may access the area by boat.

The East Park and beach are open to public access during the warmer months. A pH of 10.43 was found in beach puddles 50 feet east of the picnic shelter at the park. Divers from the Little Traverse Bay Band of Odawa Indians are conducting lake trout research in the near-shore area adjacent to East Park.

Lake Michigan is abundant in aquatic life and is a highly prized commercial and recreational fishery resource.

**Toxicological Evaluation**

Substances that exhibit a high pH range from being merely irritating to corrosive to skin, eyes and mucus membranes that come in contact with it. Irritation is defined as reversible inflammatory changes in exposed tissue. The severity of the health effect is dependant on the pH and the duration and frequency of the exposure. Intermittent exposure that allows for healing to take place between exposures may result in minimal irritation and discomfort. Prolonged exposure and high pH may result in chronic effects such as dermatitis or conjunctivitis. The EPA recommends a surface water pH range of 6.5 to 9.0 to protect against health effects (MDEQ 1996).

Corrosive substances can produce irreversible tissue damage following a single application to the skin or eyes. Test procedures for animal bioassays are available for determination of the corrosive potential for a substance (EPA 1998). These tests are not required if the pH of a substance is greater than 11.5 since it may be assumed from previous data that substances which exhibit pH levels will be corrosive and may produce irreversible damage.

The pH of some of the puddled seep discharge water found on the shoreline ranged from 11.5 to 13. People who make direct contact with the puddles could experience irreversible damage to eyes, skin, and mucous membranes. Other areas of puddled water showed pH ranges of 9 to

11.5. Exposure to water at these pHs could result in irritation, dermatitis, or conjunctivitis. Near-shore lake water showed a pH of 10.15 in the Seep #1 and #2 area. The pH of lake water in the East Park area near where divers place egg nets is not known.

Mercury concentrations released to Little Traverse Bay from the CKD seep discharge may present a human health hazard via ingestion of sport caught fish. When mercury is released into surface water, microorganisms change it to methylmercury, a highly toxic form that builds up in fish, and in animals that eat fish including humans. Exposure to high levels of mercury can permanently damage the brain, kidneys, and developing fetus. Effects on brain functioning may result in irritability, shyness, tremors, changes in vision or hearing, and memory problems. Methylmercury exposure can have adverse cardiovascular effects for adults, resulting in elevated blood pressure and incidence of heart attack (ATSDR 1999).

There is an existing fish advisory for Lake Michigan walleye based on mercury (MDCH 2004). Walleye eat smaller fish and are likely bioaccumulating mercury in the food chain. The discharge of seep water from the CKD piles on the Bay Harbor shore contributes to the mercury content of the fish and other members of the aquatic community in the area. The condition exacerbates the hazard to the people who eat walleye from Lake Michigan.

While arsenic, copper, nickel, selenium, vanadium and zinc concentrations in the seep discharge water exceeded surface water quality standards for the protection of aquatic wildlife, these levels are not expected to result in human health effects. However, both the high pH levels and the elevated levels of inorganic contaminants found in the seep discharge may negatively impact aquatic wildlife.

**Child Health Issues**

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.

The concern for children's health is very important in this setting since they are the most likely people to be exploring and playing in or near the puddled water on the private beach. Children might not recognize the discolored water in pools as a danger and might accidentally get high pH water in their eyes, soaked through their footwear or elsewhere on their skin. They might also expose pets to the contaminants as they walk, run and play on the beach.

Mercury levels in the seep discharge may be contributing to elevated mercury in Lake Michigan walleye, a popular game fish. Very young children are more sensitive to mercury than adults. Mercury in the mother's body passes to the fetus and may accumulate there. It can also pass to a nursing infant through breast milk. Children poisoned by mercury may develop problems of their nervous and digestive systems, and kidney damage (ATSDR 1999). MDCH fish advisories recommend that women of childbearing age and children under the age of 15 limit their consumption of Lake Michigan walleye to one meal a week for smaller fish to one meal every six months for fish greater than 26 inches in length (MDCH 2004).

## Conclusions

High pH levels found in puddled discharge at Seep #1 and #2 on the shoreline at Bay Harbor and in near shore lake water pose a **public health hazard**. The condition existed in the summer of 2004 because the leachate collection system was not operational starting in January 2004 and the contamination seeps migrated to the shore of Lake Michigan sometime before they were discovered in August 2004. While the leachate collection system is now operational, high pH seep water continues to puddle on the beach and it is not know if the collection system is intercepting the entire leachate plume.

High pH levels in beach puddles on the shore near East Park pose a **public health hazard.** There is no seep collection system in the East Park area. The pH level of lake water in this area near where divers are conducting lake trout research is not known, and therefore poses an **indeterminate public health hazard**.

Mercury in the Bay Harbor seep discharge may be contributing to unsafe levels of mercury in Lake Michigan walleye and, therefore poses a **public health hazard**.

Several other inorganic contaminates were found in the seep discharge in excess of Michigan surface water quality standards. These pose **no apparent public health hazard** for people. However, these contaminants may be harmful to aquatic life in the area.

## Recommendations

- Alert those using the affected areas of the contamination. Information regarding the composition of the seep water and the potential for adverse health affects should be made available to the public. This will discourage trespass in the affected area and will alert local health care professionals of the contamination and the potential for health effects.

- Restrict the private beach area near Seep #1 and #2 from entry from the east or west shoreline of the property.

- Investigate the efficiency of the leachate collection system and additional remedial measures as necessary.

- Investigate the beach and near-shore surface water at and adjacent to East Park.

**Public Health Action Plan**

- At the time of the MDCH field visit, Bay Harbor had placed small signs on temporary posts on the impacted beach. Larger, more visible signs at more locations along the beach and closer to and facing the water are recommended. People who own the houses adjacent to the private beach have been told of the hazard, however people arriving by boat are not likely to see the existing signs until after exposure has occurred.

- The Bay Harbor Company has posted a security guard to watch over the private beach area during daylight hours and warn away potential trespassers.

- The Northwest Community Health Agency issued a public health advisory on September 3, 2004, advising the public of the contamination and to avoid the affected area of the beach. On December 2, 2004, the advisory was extended to additional areas identified during the November site visit.

- The Bay Harbor Company has retained an engineering company to investigate the contamination as well as the efficiency of the existing leachate collection system. Additional remedial measures will be proposed as necessary.

- The EPA is investigating the East Park area to better characterize the seep discharge and determine if remedial actions are necessary.

- MDCH will remain available to the Northwest Michigan Community Health Agency, the MDEQ, and the EPA to review any intervention and remediation plans for the site.

- MDCH will consider any information and data regarding the site that becomes available and issue further health consultations as necessary.

## References

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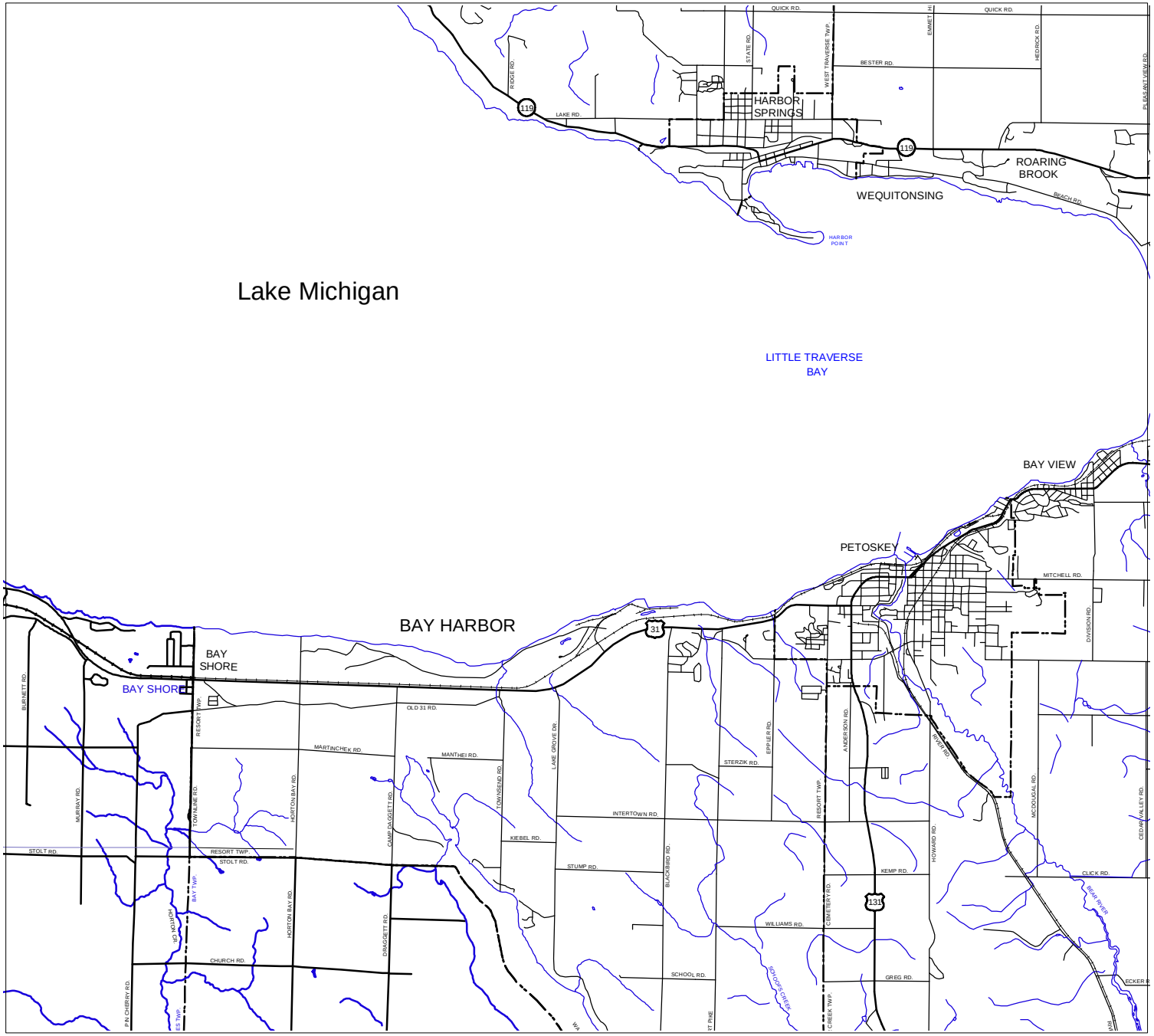
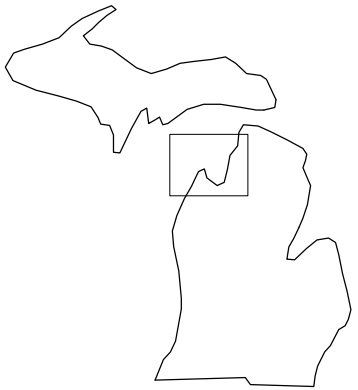
# BAY HARBOR, MICHIGAN



Location

N

0.5 0 0.5 1 Miles

Figure 1.

# SEEP AREA LOCATION

## BAY HARBOR, MICHIGAN

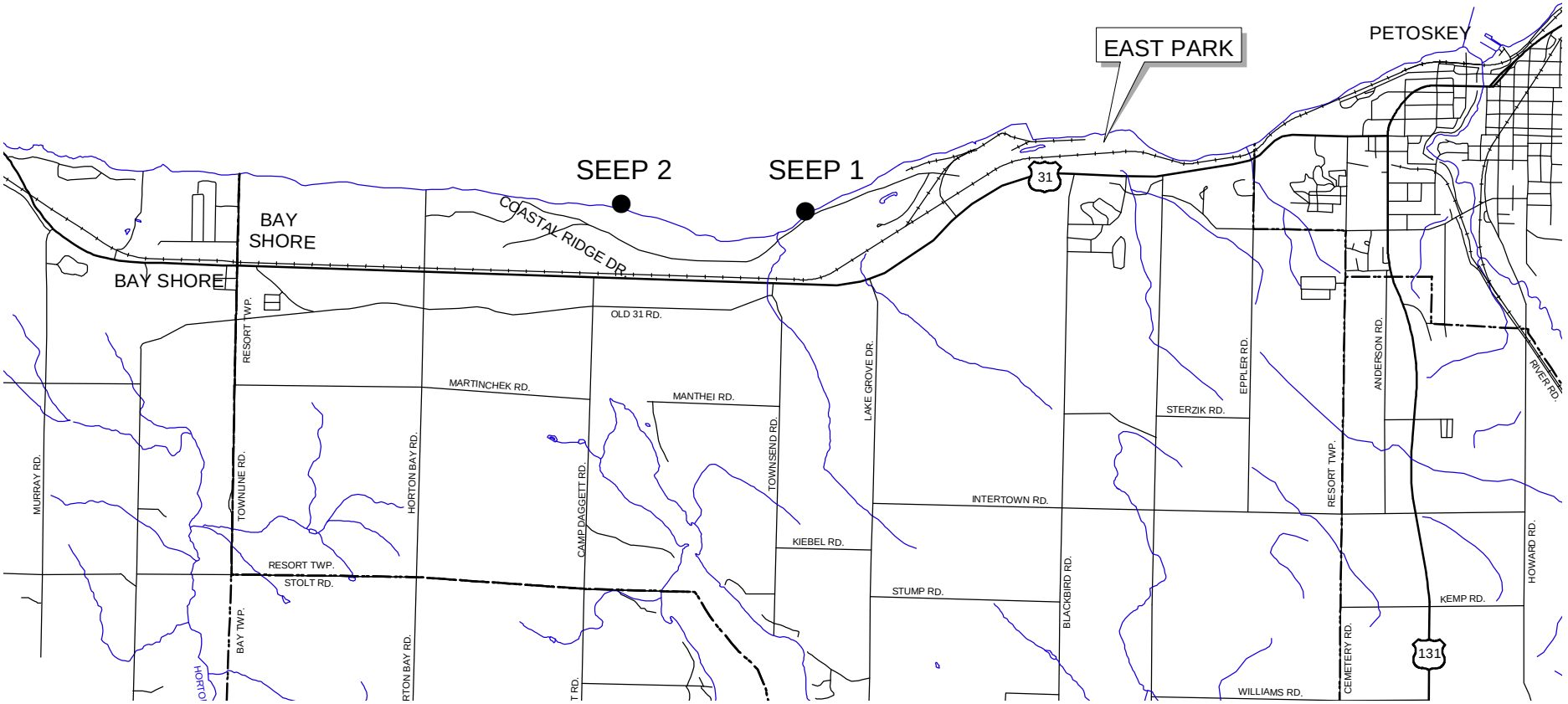



Figure 2.

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# CERTIFICATION

This Bay Harbor 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. Editorial review was completed by the Cooperative Agreement Partner.

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Technical Project Officer, Cooperative Agreement Team, Superfund and Program Assessment Branch, Division of Health Assessment and Consultation, ATSDR

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

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Team Leader, Cooperative Agreement Team, SPAB, DHAC, ATSDR