# Health Consultation

**RESPONSE TO PUBLIC COMMENTS**

GRASSY ISLAND

DETROIT RIVER, WAYNE COUNTY, MICHIGAN

EPA FACILITY ID:  MIN000509205

SEPTEMBER 19, 2007

U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Public Health Service
Agency for Toxic Substances and Disease Registry
Division of Health Assessment and Consultation
Atlanta, Georgia  30333

**Health Consultation: A Note of Explanation**

An ATSDR health consultation is a verbal or written response from ATSDR to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation 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.

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# HEALTH CONSULTATION

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EPA FACILITY ID:  MIN000509205

Prepared By:

Michigan Department of Community Health
Under Cooperative Agreement with the
U.S. Department of Health and Human Services
Agency for Toxic Substances and Disease Registry

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# Acronyms and Abbreviations

| | |
|---|---|
| μg | microgram |
| $AE_d$ | dermal absorption efficiency |
| $AE_i$ | ingestion absorption efficiency |
| ATSDR | Agency for Toxic Substances and Disease Registry |
| BHC | benzene hexachloride (hexachlorocyclohexane) |
| BW | body weight |
| CF | conversion factor |
| cm | centimeter |
| COE | U.S. Army Corps of Engineers |
| CREG | Cancer Risk Evaluation Guide |
| CSF (or SF) | oral cancer slope factor |
| DCC | Direct Contact Criteria |
| DDD | dichlorodiphenyldichloroethane |
| DDE | dichlorodiphenyldichloroethylene |
| DDT | dichlorodiphenyltrichloroethane |
| DF | age-adjusted soil dermal factor |
| ED | exposure duration |
| EF | exposure frequency |
| $EF_d$ | dermal exposure frequency |
| $EF_i$ | ingestion exposure frequency |
| EMEG | Environmental Media Evaluation Guide |
| EPA | U.S. Environmental Protection Agency |
| EV | event frequency |
| GCC | Groundwater Contact Criteria |
| gps | gallons per second |
| IEUBK | Integrated Exposure Uptake Biokinetic Model for Lead in Children |
| IF | age-adjusted soil ingestion factor |
| IR | ingestion rate |
| kg | kilogram |
| L | liter |
| MDCH | Michigan Department of Community Health |
| MDEQ | Michigan Department of Environmental Quality |
| m | meter |
| mg | milligram |
| MRL | Minimal Risk Level |
| PAHs | polycyclic aromatic hydrocarbons |
| PCBs | polychlorinated biphenyls |
| ppb | parts per billion |
| ppm | parts per million |
| RfD | Reference Dose |
| RMEG | Reference Dose Media Evaluation Guide |
| RSC | relative source contribution |
| SA | skin surface area |
| SP | skin penetration per event factor |

| | |
|---|---|
| STORET | EPA's "STOrage and RETrieval" database |
| SVOC | semivolatile organic compound |
| THQ | target hazard quotient |
| TR | target risk |
| UCL | Upper Confidence Limit |
| USFWS | U.S. Fish and Wildlife Service |
| USGS | U.S. Geological Survey |
| VOC | volatile organic compound |

## Summary

Grassy Island is a former diked disposal facility in the Detroit River in Wayne County, Michigan. The U.S. Army Corps of Engineers built dikes around a coastal marsh and disposed of dredging spoils there from 1960 to 1982. The U.S. Fish and Wildlife Service (USFWS) manages the island and requested that the Michigan Department of Community Health (MDCH) evaluate the public health implications of exposure to the island's contaminants.

MDCH reviewed environmental data for island soils and offshore Detroit River water and sediments. Grassy Island is contaminated with polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), and metals. The USFWS has prohibited public access to the island, although there are anecdotal reports of trespassing. There are no plans to promote public use of the island in the future. Therefore, the contamination in the island's near-surface soil poses no apparent current or future public health hazard.

The topography and lack of active management of Grassy Island have resulted in several physical hazards that should be addressed to protect trespassers and agency personnel accessing the island: the overflow weir on the northeast end of the island poses an attractive nuisance and possible drowning hazard for children, the dike slopes are steep and people walking on the dikes could slip and fall, and the riprap on the shore of the island makes disembarking treacherous for boaters docking at the island.

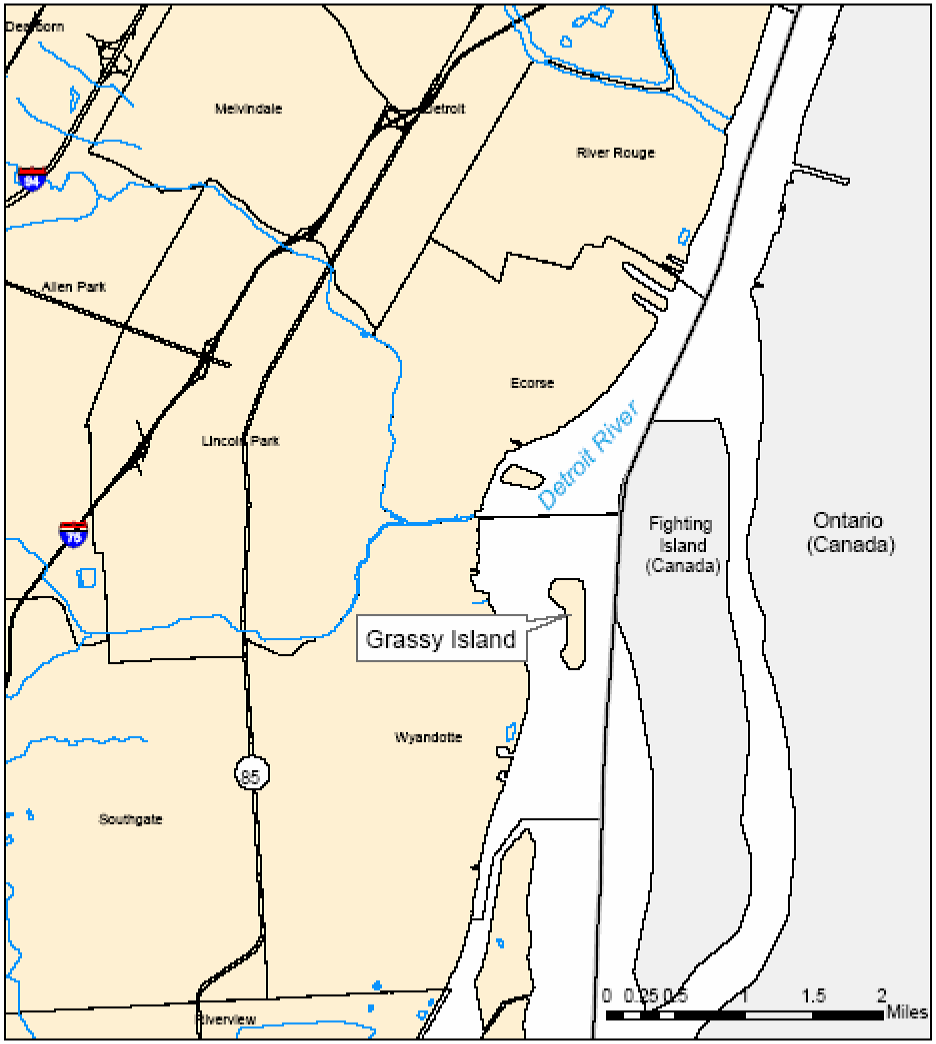
In the past, pesticide and PCB residues have been detected in the flesh of waterfowl sampled from the island. There are no plans to develop wetland or waterfowl habitat on the island. Until contaminant concentrations in resident deer are known, consuming venison taken from the island, if the herd is thinned, should be prohibited.

Detroit River water and sediments offshore from Grassy Island pose no apparent public health hazard. In general, people eating fish from the Detroit River should follow the advice in the Michigan Family Fish Consumption Guide. Recreational boaters and swimmers should stay out of the shipping channel on the east side of the island.

Lastly, the dikes enclosing Grassy Island were constructed without engineering controls considered standard today. The integrity of the dike walls is questionable. Inspection and mitigation plans should be in place to prevent a failure of the dikes. (del'd "catastrophic")

## Purpose and Health Issues

The U.S. Fish and Wildlife Service (USFWS) requested an assessment of the contamination on Grassy Island, a former diked disposal facility in the Detroit River in Wayne County, Michigan (Figure 1). The U.S. Army Corps of Engineers (COE) placed sediment spoils from dredging operations on the island. Grassy Island is part of the Detroit River International Wildlife Refuge. USFWS wants to ensure that contaminant concentrations on the island do not pose risks to wildlife or human visitors. This health consultation examines the human health implications of exposure to contaminants on Grassy Island and responds to comments received on the February 6, 2007 public-comment consultation.



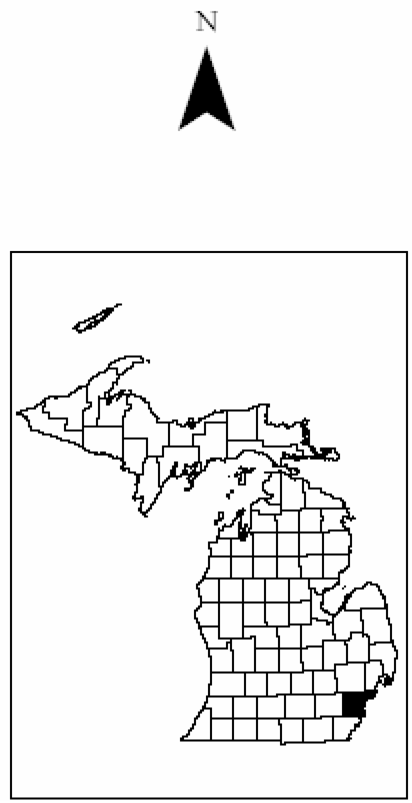




**Figure 1. Grassy Island, Detroit River, and Vicinity**

MDCH conducted this health consultation for the federal Agency for Toxic Substances and Disease Registry (ATSDR) under a cooperative agreement. ATSDR conducts public health activities (assessments/consultations, advisories, education) at sites of environmental contamination and concern. ATSDR is primarily an advisory agency. Therefore, its reports usually identify what actions are appropriate to be undertaken by the regulatory agency overseeing the site, other responsible parties, or the research or education divisions of ATSDR. As such, ATSDR recommendations may not encompass all types of federal and state requirements from a regulatory perspective. Thus, the purpose of a health consultation is not to evaluate or confirm regulatory compliance but to determine if any potentially harmful exposures are occurring or may occur in the future.

## Background

Grassy Island is a 72-acre artificial island in the Detroit River, east of the city of Wyandotte, Michigan (Figure 1). The island was originally a coastal marsh, a low-lying swampy area surrounded by shoals. In 1959, the COE constructed a six-foot (above water level) confining dike around the island and, in 1960, began disposing of sediments from the Rouge River, collected during maintenance dredging. The major industrial facilities along the Rouge River in the 1960s produced steel, fabricated metals, heavy chemicals, pulp and paper, cement, and meat-rendering products. The primary wastes released to the river were iron, oxygen-demanding materials, bacteria, suspended solids, oil, pickling liquor, phenols, chlorides, cyanides, toxic metals and ammonia. Other contaminant sources to the Rouge River include sewage treatment plant effluent and stormwater outfalls (FWPCA 1967).

It should be noted that the Grassy Island facility, the first diked disposal facility operated by the COE in the Great Lakes, was built without engineered dikes and did not incorporate the features (liners, caps, riprap protection, etc.) of later structures (Best et al. 1992). Rather, the original six-foot dike was river bottom material composed of uncompacted clay, sand, and gravel (Manny 1999a).

In 1971, the COE increased the capacity of Grassy Island by constructing a 20-foot dike within the perimeter of the original six-foot dike. The COE stopped using the island for disposal following a 1982 rupture in the south dike wall. The COE repaired the rupture and reinforced the dikes along the navigation channel (east side of the island) with filter cloth and riprap to prevent further failure. Over its 22-year use, Grassy Island received over three million cubic yards of dredged materials (USFWS 2005).

Since taking over management of Grassy Island in 1987, USFWS has not manipulated vegetation, graded soils, or conducted any other active management of the island beyond posting refuge signs on the property and conducting various surveys (USFWS 2005). Different agencies and groups have conducted several environmental studies. The results of those studies are discussed later in this document.

In March 2006, USFWS requested assistance from MDCH to determine what public health issues, if any, the contamination on the island presents, currently or in the future.

USFWS has held three forums to engage the public (December 1, 2005, and March 9 and October 12, 2006). Stakeholders include Wayne County government, the Detroit River Remedial Action Plan, the Detroit River International Wildlife Refuge, Friends of the Detroit River, the International Wildlife Refuge Alliance, the U.S. Coast Guard, and the University of Michigan – Dearborn. The Michigan Department of Environmental Quality (MDEQ) will be overseeing any remedial action that takes place on the island.

## Discussion

Site Visit Observations and Physical Hazards

On June 30, 2006, MDCH accompanied USFWS and representatives from the U.S. Coast Guard on a site visit to Grassy Island. Agency personnel observed the shoreline of the island and walked on the north and south ends of the island.

Riprap around the island prevents easy access and can be treacherous when walking across to gain access to the island from the shore. There are two bulkhead docks on the east side of the island, but these are very close to an active shipping channel. Only one of the docks has a ladder for access.

The sides of the dike walls have steep slopes and can be treacherous for walking. There are no maintained trails, so people walking on the island must use game (deer) trails or walk on top of the dikes, where vegetation is generally, but not always, less dense.

Although the dikes appear stable, their integrity is questionable given that the older, six-foot dike was built without features now considered standard. Also, the repairs and reinforcements made after the 1982 rupture of the south dike wall have an unknown life expectancy. On May 17, 2006, the COE and USFWS conducted a visual inspection of both dikes and the weir on Grassy Island. The purpose of the inspection was to determine if vegetation growing on the dike walls was compromising the integrity of the dikes, if there was evidence of erosion or settlement of the dike walls, and if debris and sediment accumulation were affecting weir function. (The weir still allows for runoff to the river via an underground pipe.) The inspection did not determine the physical composition of the dike walls, their porosity, or other geotechnical properties. The COE recommended that structural testing occur should “any significant changes” be made to the former disposal facility (e.g., placement of additional fill material or a cap). The COE also recommended that trees greater than 18 inches in diameter growing on the dikes be removed (COE 2006). The USFWS is considering removing all trees, regardless of size, from the dikes (2006, S. Millsap, USFWS, personal communication).

The weir on the north end of Grassy Island (Figure 2) could be entered by climbing or slipping under the gate attached to it. It is not known how deep the water in the weir can get, but a child may be at risk of drowning if he were to enter the weir.

One researcher (Lewis 1991) reported the likelihood of about 20 five-gallon paint cans being buried on the island. The location (southwest end of island) and depth (20-24 feet) of this waste were identified by electromagnetic surveys. If the waste is not disturbed, it should not pose any human health threat.


Figure 2. Structure of weir at north end of Grassy Island, Detroit River, Michigan.

Environmental Contamination

Table 1 shows the list of chemicals tested for by Manny (1999b) and Sweat (1999a) in their assessments of contamination on and near Grassy Island. These are the most recent environmental data for the site. Although the data are about 10 years old, the soil on the island has not been disturbed and the data for that medium should represent current conditions. River water and sediment conditions would be more dynamic and the concentrations from 1997 for those media may not represent current conditions.

*Screening Values Used*

MDCH first compared contaminant concentrations in the island soils and the river water and sediments to appropriate screening values derived by ATSDR and MDEQ. Different agencies often have different screening levels for environmental contaminants. These discrepancies are due to the scientific data, exposure assumptions, and equations used by the agencies to derive the values.

The ATSDR Environmental Media Evaluation Guides (EMEGs) help public health assessors determine which contaminants at a site should be evaluated in depth. EMEGs are used for non-carcinogenic (non-cancer-causing) chemicals. If media concentrations are less than a corresponding EMEG, then the contaminant is unlikely to pose a health threat. If media concentrations exceed an EMEG, that does *not* indicate that negative health effects will occur. Rather, it indicates that the situation requires further evaluation,

Table 1. Chemicals analyzed for by Manny (1999b), Sweat (1999a), and USGS (unpublished data, 2006) in Grassy Island soils and Detroit River sediments and water near Grassy Island, Detroit River, Michigan. (Chemicals listed in bold were detected in at least one environmental medium.)

| Metals/Inorganics | SVOCs | SVOCs | VOCs | Pesticides/PCBs |
|---|---|---|---|---|
| **Aluminum** | 1,2,4-Trichlorobenzene | **Acenaphthene** | 1,1,1-Trichlorethane | **4,4'-DDD** |
| **Antimony** | 1,2-Dichlorobenzene | Acenaphthylene | 1,1,2,2-Tetrachloroethane | **4,4'-DDE** |
| **Arsenic** | **1,2-Dimethylnaphthalene** | **Anthracene** | 1,1,2-Trichloroethane | **4,4'-DDT** |
| **Barium** | 1,3-Dichlorobenzene | **Benzo(a)anthracene** | 1,1-Dichloroethane | **Aldrin** |
| **Beryllium** | 1,4-Dichlorobenzene | **Benzo(a)pyrene** | 1,1-Dichloroethene | **alpha-BHC** |
| **Boron** | **1,6-Dimethylnaphthalene** | **Benzo(b)fluoranthene** | 1,2-Dichloroethane | **alpha-Chlordane** |
| **Cadmium** | **1-Methyl-9h-fluorene** | **Benzo(g,h,i)perylene** | 1,2-Dichloroethene (total) | **beta-BHC** |
| **Calcium** | **1-Methylphenanthrene** | **Benzo(k)fluoranthene** | 1,2-Dichloropropane | **delta-BHC** |
| **Chlorine** | **1-Methylpyrene** | bis(2-chloroethoxy)methane | **2-Butanone** | **Dieldrin** |
| **Chromium** | 2,2'-oxybis(1-Chloropropane) | bis(2-chloroethyl)ether | **2-Hexanone** | **Endosulfan I** |
| **Cobalt** | **2,3,6-Trimethylnaphthalene** | **bis(2-Ethylhexyl)phthalate** | **4-Methyl-2-pentanone** | **Endosulfan II** |
| **Copper** | 2,4,5-Trichlorophenol | Butylbenzylphthalate | **Acetone** | **Endosulfan sulfate** |
| **Iron** | 2,4,6-Trichlorophenol | **Carbazole** | **Benzene** | **Endrin** |
| **Lead** | 2,4-Dichlorophenol | **Chrysene** | Bromodichloromethane | **Endrin aldehyde** |
| **Magnesium** | 2,4-Dimethylphenol | **Dibenz(a,h)anthracene** | Bromoform | **Endrin ketone** |
| **Manganese** | 2,4-Dinitrophenol | **Dibenzofuran** | Bromomethane | **gamma-BHC (Lindane)** |
| **Mercury** | 2,4-Dinitrotoluene | Diethylphthalate | **Carbon disulfide** | **gamma-Chlordane** |
| **Molybdenum** | **2,6-Dimethylnaphthalene** | Dimethylphthalate | Carbon tetrachloride | Heptachlor |
| **Nickel** | 2,6-Dinitrotoluene | Di-n-butylphthalate | Chlorobenzene | Heptachlor epoxide |
| **Phosphorous** | 2-Chloronaphthalene | **Di-n-octylphthalate** | Chloroethane | **Methoxychlor** |
| **Potassium** | 2-Chlorophenol | **Fluoranthene** | Chloroform | **PCBs (total)** |
| **Selenium** | **2-Ethylnaphthalene** | Fluorene | Chloromethane | Toxaphene |
| **Silicon/Silica** | **2-Methylnaphthalene** | Hexachlorobenzene | cis-1,3-Dichloropropene | |
| **Silver** | 2-Methylnaphthalene | Hexachlorobutadiene | Dibromochloromethane | |
| **Sodium** | 2-Methylphenol | Hexachlorocyclopentadiene | **Ethylbenzene** | |
| **Strontium** | 2-Nitroaniline | Hexachloroethane | **Methylene chloride** | |
| **Thallium** | **2-Nitrophenol** | **Indeno(1,2,3-cd)pyrene** | Styrene | |
| **Tin** | 3,3'-Dichlorobenzidine | **Isophorone** | Tetrachloroethene | |
| **Titanium** | 3-Nitroaniline | **Naphthalene** | **Toluene** | |
| **Vanadium** | 4,6-Dinitro-2-methylphenol | Nitrobenzene | trans-1,3-Dichloropropene | |
| **Zinc** | 4-Bromophenyl-phenylether | N-Nitroso-di-n-propylamine | Trichloroethene | |
| | 4-Chloro-3-methylphenol | **N-Nitrosodiphenylamine** | Vinyl Chloride | |
| | | Pentachlorophenol | **Xylenes (total)** | |
| | **4-Chlorophenyl-phenylether** | **Phenanthrene** | | |
| | **4h-Cyclopenta(def)phenanthrene** | **Phenanthridine** | | |
| | **4-Methylphenol** | **Phenol** | | |
| | | **Pyrene** | | |
| | 4-Nitrophenol | | | |

Notes:

| | | | | | |
|---|---|---|---|---|---|
| BHC | benzene hexachloride | DDT | dichlorodiphenyltrichloroethane | USGS | U.S. Geological Survey |
| DDD | dichlorodiphenyldichloroethane | PCBs | polychlorinated biphenyls | VOCs | volatile organic compounds |
| DDE | dichlorodiphenyldichloroethylene | SVOCs | semivolatile organic compounds | | |

4-chloroaniline

such as determining degree and nature of exposure. There are separate soil EMEGs for children and adults (ATSDR 2005b). MDCH compared soil and sediment concentrations at Grassy Island to child EMEGs for chronic exposure, to maximize protectiveness, in the screening step (Tables A-1 and A-2 in Appendix A). For those chemicals requiring further evaluation, MDCH adjusted the inputs into the equation that calculates the default EMEG to simulate a more realistic exposure scenario (Appendices B and C).

ATSDR calculates EMEGs using the agency's Minimal Risk Level (MRL) for a chemical. An MRL is an estimate of the daily human exposure to a substance that is likely to be without appreciable risk of adverse (non-cancer) health effects during a specified duration of exposure. Exposure duration can be acute (up to 14 days), intermediate (15 to 365 days), or chronic (greater than 1 year). ATSDR uses experimental data of the same exposure duration to calculate MRLs. There may not be chronic-exposure data available for some chemicals. In these cases, ATSDR does not calculate a chronic EMEG. If a U.S. Environmental Protection Agency (EPA) Reference Dose (RfD) exists for that chemical, ATSDR will use the RfD and calculate a Reference Dose Media Evaluation Guide (RMEG; ATSDR 2005b). If a chronic soil EMEG for a child was not available, MDCH compared soil and sediment concentrations at Grassy Island to the child RMEG for that chemical in the screening step (Tables A-1, A-2a and A-2b in Appendix A). For those chemicals requiring further evaluation, MDCH adjusted the inputs into the equation that calculates the default RMEG to simulate a more realistic exposure scenario (Appendices B and C).

The ATSDR Cancer Risk Evaluation Guides (CREGs) help public health assessors determine which carcinogenic contaminants at a site should be evaluated further. The CREG value reflects a theoretical cancer risk of 1 in one million. (This means that, out of 1,000,000 people exposed to a chemical, no more than 1 additional cancer would occur due to that exposure.) Similar to EMEGs, if media concentrations do not exceed a corresponding CREG, then the contaminant is unlikely to increase the risk of negative health effects, in this case, cancer. If media concentrations exceed a CREG, that does *not* indicate that cancer will occur. Rather, the *risk* of cancer occurring may increase (ATSDR 2005b). MDCH compared soil and sediment concentrations at Grassy Island to the CREGs for those chemicals (CREGs apply only to adult exposures) in the screening step (Tables A-1, A-2a and A-2b in Appendix A). For those chemicals requiring further evaluation, MDCH adjusted the inputs into the equation that calculates the default CREG to simulate a more realistic exposure scenario (Appendices B and C).

ATSDR also develops EMEGs and CREGs for exposure to chemicals in drinking water. MDCH chose not to use these values in the public-comment version of this consultation because, although the Detroit River is used as a source of drinking water, the volume of the river flowing past Grassy Island would dilute any chemicals leaching from or running off the island. Thus, any contamination in the river that originated from Grassy Island, under stable conditions, would likely not have a significant impact on water quality. However, MDEQ requested that MDCH compare concentrations of chemicals in Detroit River water sampled near the island to the MDEQ Water Bureau Rule 57 Water Quality Values (discussed below). Therefore, MDCH also included a comparison to the chronic

EMEGs for those chemicals detected (Table A-3 in Appendix A). ATSDR does not develop screening values that consider dermal contact with water.

The MDEQ Part 201 Generic Cleanup Criteria are media-specific values that guide risk assessors evaluating a site for possible cleanup. MDEQ uses these criteria for both carcinogens and non-carcinogens. For this assessment, MDCH used the Residential and Commercial I Direct Contact Criteria (DCC) to evaluate soil contamination at Grassy Island. The DCC identifies a soil concentration that is protective against adverse health effects due to long-term, daily ingestion (eating) of and dermal (skin) exposure to contaminated soil (MDEQ 2005). Similar to the default ATSDR EMEGs, RMEGs, and CREGs, if a soil concentration exceeds the generic DCC, further evaluation is necessary to determine the risk. The criteria assume that exposure occurs 350 days per year for 30 years (MDEQ 2005). Direct contact with the soil is the most likely human exposure route to occur at Grassy Island, however not with the frequency and duration assumed in the generic MDEQ value. MDCH used the generic DCC to screen out soil contaminants that should not pose a health threat following long-term and frequent exposure (Table A-1 in Appendix A). For those contaminants requiring further evaluation, MDCH adjusted inputs into the equation that calculates the DCC to simulate a more realistic exposure scenario (Appendix B).

There are no Part 201 criteria that address human exposure to contaminants in sediments. However, when necessary, the inputs to the DCC may be adjusted to derive an informal screening value to evaluate dermal and oral (eating) exposure to sediments, such as when people wade in the shallows while fishing. MDCH used the generic DCC to screen out sediment contaminants that should not pose a health threat following long-term and frequent exposure (Tables A-2a and A-2b in Appendix A). For those contaminants requiring further evaluation, MDCH adjusted inputs into the equation that calculates the DCC to simulate a sediment exposure scenario (Appendix C).

There are no Part 201 criteria that address human exposure to contaminants in surface water. (The Part 201 Drinking Water Criteria are screening levels for groundwater.) The generic Groundwater Contact Criterion (GCC) identifies a groundwater concentration that is protective against adverse health effects resulting from dermal exposure to contaminated groundwater. This criterion normally is applied in situations where utility or construction workers are conducting short-duration, intermittent activities in subsurface excavations (MDEQ 2006c). The inputs to the GCC may be adjusted to derive an informal screening value to evaluate dermal exposure to surface water, such as when people are swimming. MDCH's experience in adjusting the GCC for other sites suggests that the adjusted value may be more conservative (lower) than the generic value. Therefore, MDCH used both the generic and adjusted GCC to screen out water contaminants that should not pose a health threat following long-term and frequent or short-term and infrequent exposure, respectively (Table A-3 in Appendix A).

The MDEQ Rule 57 Water Quality Values are concentrations of chemicals in ambient surface water protective of humans, wildlife, and aquatic life. The MDEQ Water Bureau derives both acute and chronic values (MDEQ 2007). Following a request by MDEQ, MDCH used the human chronic values to screen out water contaminants that should not pose a health threat following long-term exposure to drinking water from the Detroit River (Table A-3 in Appendix A).

*Island Soils*

Two researchers from the U.S. Geological Survey (USGS) collected the most recent data regarding concentrations of contaminants in the soils at Grassy Island (Manny 1999b, Sweat 1999a). Manny (1999b) sampled soil from 41 locations in a stratified-random manner (a grid pattern that reduces sampling bias) at depths ranging from about 10 inches to 5 feet. He analyzed these samples for metals, polychlorinated biphenyls (PCBs), and total polycyclic aromatic hydrocarbons (PAHs). Sweat (1999a) collected eight soil samples from depths of 6 inches to 20 feet and analyzed the samples for metals, semivolatile organic compounds (SVOCs), volatile organic compounds (VOCs), pesticides, and PCBs. The rationale for sampling location selection is not indicated in the Sweat report. Several locations were at the northern end of the island, with the remaining locations moving south along the midline of the island.

Table A-1 in Appendix A shows chemicals detected in the soil samples, concentration ranges, and comparison to the default ATSDR or generic MDEQ screening values. (There is no information regarding the concentrations of individual chemicals that comprised the "total PAHs" in the Manny [1999b] analysis. There are no ATSDR or MDEQ screening values for "total PAHs," only for individual compounds. Therefore, "total PAHs" data are not shown.) For those chemicals exceeding the screening values, MDCH calculated an exposure-specific value. Appendix B discusses the adjustments made and the resulting values. Table 2 shows those chemicals for which adjustments were made. Concentrations of benzo(a)pyrene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene (all SVOCs), and PCBs remain above the adjusted criteria and will be discussed further under the *Exposure Pathways* section of this document.

Eighteen samples exceeded the generic DCC for lead. The DCC for lead is determined using the IEUBK model (Integrated Exposure Uptake Biokinetic Model for Lead in Children), which considers other environmental lead sources along with contaminated soil (EPA 2004). Due to the complexity of the model, it is difficult to adjust the DCC for lead. Therefore, samples containing elevated concentrations of lead will be discussed further under the *Exposure Pathways* section of this document.

Several detected chemicals have neither an EMEG or CREG for soil nor a DCC: 4-chlorophenyl-phenylether, calcium, delta-BHC (delta-hexachlorocyclohexane), dibenzofuran, endrin aldehyde, endrin ketone, potassium, silicon, tin, and titanium. Those chemicals will be discussed further in the *Chemicals Without Screening Values* section of this document.

*Detroit River Water and Sediments*

In 1967, the Federal Water Pollution Control Agency (a precursor to the EPA) measured seepage through the dike walls during active disposal operations at Grassy Island. The agency measured water levels in seven wells installed along the circumference of the

Table 2. Chemicals in Grassy Island (Detroit River, Michigan) soils that exceed default or generic screening values, and comparison to adjusted screening values. (Concentrations in parts per million [ppm]. Chemicals in bold print exceed adjusted screening value.)

| Chemical | No. detects / No. samples | Concentration Range | Default and Adjusted ATSDR Comparison Values | | Generic and Adjusted MDEQ Criteria | |
|---|---|---|---|---|---|---|
| | | | Default Chronic Soil Value (No. exceedances) | Adjusted Value (No. exceedances) | MDEQ Generic DCC (No. exceedances) | Adjusted DCC (No. exceedances) |
| Aldrin | 2 / 8 | 0.055 - 0.071 | 0.04 (2)[A] | 5.7 (0) | 1 (0) | --- |
| Arsenic | 29 / 49 | 5 - 22.5 | 0.5 (29)[A] | 33 (0) | 7.6 (14) | 36 (0) |
| Benzo(a)anthracene | 8 / 8 | 0.90 - 31.6 | NC | **---** | 20 (2) | 49 (0) |
| **Benzo(a)pyrene** | 8 / 8 | 0.87 - 29.2 | 0.1 (8)[A] | **6.8 (5)** | 2 (7) | **4.9 (7)** |
| Benzo(b)fluoranthene | 8 / 8 | 0.92 - 21.6 | NC | **---** | 20 (1) | 49 (0) |
| Cadmium | 41 / 49 | 1 - 19 | 10 (19)[B] | 986 adult (0)[F]<br>303 child (0)[F] | 550 (0) | --- |
| **Dibenz(a,h)anthracene** | 7 / 8 | 1.67 - 35.3 | NC | --- | 2 (4) | **4.9 (8)** |
| **Indeno(1,2,3-cd)pyrene** | 8 / 8 | 0.51 - 171.8 | NC | --- | 20 (3) | **49 (1)** |
| Lead | 49 / 49 | 37 - 2,000 | NC | --- | 400 (18) | See note D |
| Manganese | 49 / 49 | 330 - 14,000 | 3,000 (1)[C] | 231,690 adult (0)[F]<br>71,212 child (0)[F] | 25,000 (0) | --- |
| **PCBs (total)** | 48 / 49 | 0.18 - 18.9 | 0.4 (47)[A, E] | 25 (0) | 4 (18) | **15 (1)** |

Notes:

ATSDR Agency for Toxic Substances and Disease Registry

MDEQ Michigan Department of Environmental Quality

DCC Direct Contact Criteria

NC no criterion for this chemical

A. Value is Cancer Risk Evaluation Guide (CREG)
B. Value is Environmental Media Evaluation Guide (EMEG)
C. Value is Reference Dose Media Evaluation Guide (RMEG)
D. Screening value for lead cannot be readily adjusted. See consultation text.
E. PCB default screening value shown is the CREG for Aroclor 1254.
F. Adjusted comparison values for noncarcinogens assume adult exposure is once a week and child exposure is once a month. See Appendix B.

References: ATSDR 2005c, Manny 1999b, MDEQ 2006a, Sweat 1999a

dike. The estimated seepage flow from the island was less than 1.5 gallons per second (gps), which was considered a low rate, typical of clayey soils. Although water collected from the wells was grossly polluted, water quality in the Detroit River downstream of the island was considered not to be degraded (FWPCA 1967). It should be noted that this study occurred before construction of the second dike and during active disposal operations at the island, which stopped in 1982. Since then, the disposed material has dried up, and the dike walls likely have become even less permeable, due to settling of the wall material and the accumulation of sediment against the base of the walls. The current seepage rate is estimated to be 0.01 gps (USDOD 2006). As a comparison, the average flow of the Detroit River is 1.4 million gps, with an average flushing rate of 20 hours [Environment Canada 1994, in USFWS 2005]. The current estimated seepage rate does not contribute a significant amount to the river.

Further study by the USGS, using seismic-reflection profiling, indicated that the bedrock underlying Grassy Island does not appear fractured or cavernous and would not be conducive to the ready flow of fluids (Sweat 1999b). This finding suggests that the contamination on the island is contained securely from underneath and is not leaking to the Detroit River or to an underlying aquifer.

Water quality monitoring by the COE from 1979 to 1982 led the Corps to conclude that Grassy Island effectively trapped contaminants within its dikes. Any overflow material was discharged to the Detroit River via a weir at the northeast end of the island. (Unloading of sediments occurred at the south end of the island.) Contaminant concentrations in the Detroit River upstream and downstream of the island were similar, indicating rapid dilution to ambient conditions (COE 1979, 1980, 1981, 1982, in USFWS 2005).

In 1997, Sweat (1999a) analyzed a Detroit River water sample taken off the south shore of Grassy Island. None of the detected chemicals exceeded the generic or adjusted GCC (Table A-3 in Appendix A). However, a single sample, especially a historic sample under dynamic conditions, is not sufficient to reach conclusions about water quality. MDCH searched the EPA “STOrage and RETrieval” (STORET) database, which contains water-quality, biological, and physical data on watersheds and water bodies in the U.S., for more recent data for the Detroit River. The river water was analyzed as recently as 2003 and 2004 for metals and other inorganics, several VOCs, some pesticides, and PCBs. The two monitoring stations were located at Canada’s Peche Island (where Lake St. Clair empties into the Detroit River) and near Rockwood, Michigan (by the mouth of the river, in Wayne County; EPA 2006). Although the list of chemicals tested for was not as extensive as the analysis by Sweat (1999a), the concentrations of the chemicals detected were well below their respective generic GCCs (by more than three orders of magnitude, or more than 1,000 times; data not shown). The adjusted GCCs in Table A-3 are 10 to 25 times lower than their respective generic GCCs. Thus, it is likely that exposure to chemicals in the Detroit River will not cause adverse health effects.

Manny (1999b) sampled river sediments near the island and determined that the sediments had not been impacted by contaminants leaving the island. The samples were composites of three individual samples from each of two transects 300 meters upstream of the island and two transects 400 meters downstream. Sweat (1999a) also analyzed two offshore sediment core samples, one upstream, one downstream of Grassy Island. Several samples exceeded the default ATSDR CREG for arsenic and benzo(a)pyrene but did not exceed the adjusted CREG for those chemicals (Table 3a, and Table A-2a in Appendix A). However, the small number of samples (a total of three upstream and three downstream from the island) does not provide sufficient evidence that the sediments pose no health threat. Additionally, these historic samples may not represent current conditions due to the dynamic conditions of the river. MDCH searched the EPA STORET database for more recent sediment sampling data from the Detroit River, but no data from 1995 or later were available.

In August 2006, USGS collected sediment samples around Grassy Island. Those data were not yet available when the public-comment version of this health consultation was released. The unpublished data have since become available. Researchers developed a hydrodynamic flow model to simulate where river flow would deposit particles released upstream of the island or from the overflow weir. Five sampling locations were chosen: an upstream (north of the island) location, a location near the weir discharge point (east of the northeast corner of the island), within the southern portion of the bay on the west side of the island, and a downstream (south of the island) location. The fifth location, east of the southeast corner of the island, was not used, possibly due to its proximity to the shipping channel and the depth to sediment. Samples were analyzed for inorganics and metals, SVOCs, and total PCBs (USGS, unpublished data, 2006). Several samples exceeded the default ATSDR CREG and the generic MDEQ DCC for arsenic, benzo(a)pyrene, and total PCBs (Table A-2b in Appendix A). Some of the samples exceeded the adjusted screening values as well (Table 3b). Further discussion of the contamination in the sediments is in the *Exposure Pathways Analysis* section. In general, the higher concentrations of SVOCs and total PCBs occurred near the weir discharge point whereas the higher concentrations of inorganics and metals occurred in the bay area of the island.

Although most of the island topography is flat (Manny 1999a), runoff may occur. The runoff flow is estimated to be 0.15 gps (USDOD 2006). When compared to the average flow of the Detroit River (1.4 million gps [Environment Canada 1994, in USFWS 2005]), the estimated runoff does not contribute a significant amount to the river.

There is no information available regarding how much material from Grassy Island was released into the Detroit River following the November 1982 rupture of the south dike wall (USFWS 2005). Although repairs and reinforcements have been made, it is not known what the life expectancy of those repairs is nor what maintenance is needed to ensure dike stability.

Table 3a. Chemicals in Detroit River sediments detected in earlier studies near Grassy Island (Detroit River, Michigan) that exceed default or generic screening values, and comparison to adjusted screening values. (Concentrations in parts per million [ppm].)

| **Chemical** | ***Upstream*** | | ***Downstream*** | | | | |
|---|---|---|---|---|---|---|---|
| | **No. detects / No. samples** | **Concentration Range** | **No. detects / No. samples** | **Concentration Range** | **ATSDR Soil CREG (No. exceedances)** | **Adjusted CREG (No. exceedances)** | **Generic DCC (No. exceedances)** |
| Arsenic | 2 / 3 | 3.1 - 4 | 2 / 3 | 2.7 - 3.1 | 0.5 (2, 2)[A] | 19 (0, 0)[A] | 7.6 (0, 0)[A] |
| Benzo(a)pyrene | 3 / 3 | 0.38 - 1.1 | 0 / 3 | ND | 0.1 (3, 0)[A] | 3.9 (0, 0)[A] | 2 (0, 0)[A] |

Notes:

ATSDR Agency for Toxic Substances and Disease Registry
CREG Cancer Risk Evaluation Guide
DCC Direct Contact Criteria
MDEQ Michigan Department of Environmental Quality

A. Values in parentheses show exceedances upstream, then exceedances downstream of Grassy Island.

References: ATSDR 2005c, Manny 1999b, MDEQ 2006a, Sweat 1999a

Table 3b. Chemicals in Detroit River sediments detected in a more recent study near Grassy Island (Detroit River, Michigan) that exceed default or generic screening values, and comparison to adjusted screening values. (Concentrations in parts per million [ppm].)

| | ***Upstream*** | | ***Weir*** | | ***Downstream*** | |
|---|---|---|---|---|---|---|
| **Chemical** | **No. detects / No. samples** | **Concentration Range** | **No. detects / No. samples** | **Concentration Range** | **No. detects / No. samples** | **Concentration Range** |
| Arsenic | 1 / 1 | 3.54 | 1 / 1 | 4.73 | 2 / 2 | 2.24 - 5.30 |
| Benzo(a)pyrene | 1 / 1 | 2.290 | 1 / 1 | 9.050 | 2 / 2 | 0.48 - 1.870 |
| PCBs (total) | 1 / 1 | 0.089 | 1 / 1 | 1.331 | 2 / 2 | 0.033 - 0.058 |

| **Chemical** | **ATSDR Soil Value (No. exceedances)[A]** | **Adjusted ATSDR Value (No. exceedances)[A]** | **Generic MDEQ DCC (No. exceedances)[A]** | **Adjusted DCC (No. exceedances)[A]** |
|---|---|---|---|---|
| Arsenic | 0.5 (1, 1, 2) | 19 (0, 0, 0) | 7.6 (0, 0, 0) | NA[B] |
| Benzo(a)pyrene | 0.100 (1, 1, 2) | 3.9 (0, 1, 0) | 2 (1, 1, 0) | 2.8 (0, 1, 0) |
| PCBs (total) | 0.4 (0, 1, 0) | NA[C] | 4,000 (0, 0, 0) | NA[B] |

Notes:

ATSDR Agency for Toxic Substances and Disease Registry
MDEQ Michigan Department of Environmental Quality
USGS U.S. Geological Survey
DCC Direct Contact Criterion
NA not applicable

A. Numbers in parentheses indicate exceedances near the upstream shore, the weir discharge point, and the downstream shore, respectively, of Grassy Island.

B. Because the concentrations did not exceed the generic DCC, it was not necessary to adjust the DCC for exposure-specific evaluation.

C. The exceedance occurred at the weir discharge point, an area not conducive for wading. Exposure will not occur. Therefore, it was not necessary to adjust the ATSDR value for exposure-specific evaluation.

References: ATSDR 2005c, MDEQ 2006a, USGS 2006 (unpublished data)

### *Waterfowl, Game, and Fish*

In 1988, USFWS conducted a study to determine if waterfowl and game birds on Grassy Island were accumulating potentially hazardous chemicals. At the time of this study, two ponds existed on the northern end of the island. Researchers sampled the sediment in these ponds and liver tissue from several bird species using the island (Canada goose, mallard, gadwall, blue-winged teal, and woodcock). Some waterfowl collected from Grassy Island had total PCB and total dichlorodiphenyltrichloroethane (DDT) concentrations exceeding the U.S. Food and Drug Administration's Tolerance Level for poultry in interstate commerce (3 parts per million [ppm] and 5 ppm, lipid basis, respectively [IOM 1997, 2004]), posing a risk to consumers of the waterfowl (Best et al. 1992). It is not known if the contamination in the waterfowl originated from Grassy Island or elsewhere. The ponds sampled in the 1988 study have since dried up; the marshy areas now support giant reed grass (USFWS 2005). It is not likely that these areas currently support waterfowl habitat. Additionally, USFWS has no plans for creating wetland or waterfowl habitat on the island (S. Millsap, USFWS, personal communication, 2007). More recent analysis of the soils in this area of the island was discussed in the *Island Soils* section of this document.

There is a deer herd on Grassy Island. It is unknown what contaminants, if any, might exist in the venison muscle or organ meats. Other mammalian wildlife on the island that might be hunted or trapped include raccoon and muskrat (Great Lakes Science Center, unpublished data, in Manny 1999a). There are no data regarding chemical residues in these species.

Some fish species in the Detroit River are covered by the MDCH Family Fish Consumption Guide. MDCH recommends that no one eat carp from the river, because of the high levels of PCBs and dioxins found in those fish. The MDCH guidance also states that children and women of childbearing age should limit their consumption of freshwater drum, northern pike, redhorse sucker, walleye and yellow perch caught from the river. This advice is based on the level of PCBs or mercury found in these species (MDCH 2004). There are many sources of pollutants to the Detroit River. It cannot be determined what proportion (if any) of the hazardous chemicals in the fish came from contaminants originally disposed of on Grassy Island.

## Exposure Pathways Analysis

To determine whether persons are being or are likely to be exposed to contaminants, MDCH evaluates the environmental and human components that could lead to human exposure. An exposure pathway contains five elements:

- a source of contamination,
- contaminant transport through an environmental medium,
- a point of exposure,
- a route of human exposure, and
- a receptor population.

An exposure pathway is considered complete if there is evidence, or a high probability, that all five of these elements are or will be present at a site. It is considered either an incomplete or a potential pathway if there is no evidence that at least one of the elements above are or will be present, or that there is a lower probability of exposure. The exposure pathway elements for Grassy Island are shown in Table 4.

*Exposure to Soil*

Grassy Island currently is not open to visitors. However, there is anecdotal evidence reporting human activity on the island, including camping (USFWS 2006). It is likely that people accessed the island by boat in the past, after disposal operations had ceased. USFWS does not plan to promote the island for public use (J. Hartig, USFWS, personal communication, 2007). Trespassers, USFWS staff, and other agency personnel accessing the island could be exposed to contaminated soil currently and in the future.

Table 4. Analysis of exposure pathways for chemicals of interest on or near Grassy Island, Detroit River, Michigan.

| Source | Environmental Transport and Media | Chemicals of Interest | Exposure Point | Exposure Route | Exposed Population | Time Frame | Status |
|---|---|---|---|---|---|---|---|
| Dredged spoils from Rouge River placed on Grassy Island | Soil (dried spoils) | SVOCs, PCBs, lead | Island soils | Dermal, ingestion, inhalation | Trespassers and agency personnel | Past | Potential |
| | | | | | | Present | Complete |
| | | | | | | Future | Potential |
| | Soil (dried spoils) | PCBs, DDT | Wild game, waterfowl, and gamebirds on the island | Ingestion | Hunters, people served by food banks supplied with Grassy Island game | Past | Potential |
| | | | | | | Present | Potential |
| | | | | | | Future | Potential |
| | Detroit River sediments | Benzo(a)-pyrene | Sediment near weir discharge point | Dermal, ingestion | Waders, recreational and subsistence fishers | Past | Incomplete |
| | | | | | | Present | Incomplete |
| | | | | | | Future | Incomplete |
| | Detroit River sediments | PCBs, dioxins, mercury | Fish from Detroit River | Ingestion | Recreational and subsistence fishers | Past | Potential |
| | | | | | | Present | Potential |
| | | | | | | Future | Potential |

Acronyms and Abbreviations:
- DDT dichlorodiphenyltrichloroethane
- PCB polychlorinated biphenyl
- SVOC semivolatile organic compound

NOTE: THE PRESENCE OF A COMPLETE EXPOSURE PATHWAY IN THIS TABLE DOES NOT IMPLY THAT AN EXPOSURE WOULD BE SUBSTANTIVE OR THAT AN ADVERSE HEALTH EFFECT WOULD OCCUR.

As discussed in the *Environmental Contamination* section, several chemicals exceeded the adjusted soil screening values: benzo(a)pyrene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, and PCBs. Repeated exposure to SVOCs at specific locations could cause adverse health effects. However, it is more likely that a person would be exposed to an average concentration, from multiple locations on the island, not just the “hotspot.” The average concentrations of benzo(a)pyrene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene in the shallow soil samples taken from the island were 7.8, 5.5, and 26.7 ppm, respectively. (Only Sweat [1999a] analyzed for individual PAHs, but the sample size of eight does not lend itself to conducting a statistical analysis of the data. Therefore, the arithmetic mean [sum divided by number of samples] was calculated.) Although the average concentrations of benzo(a)pyrene and dibenz(a,h)anthracene in the top layer of soil sampled (maximum depth of 8 feet) still exceed the adjusted screening values, the exceedances are less than twice the screening value, which does not substantially increase the risk of negative health effects. The average concentration of indeno(1,2,3-cd)pyrene in the top layer of soil sampled did not exceed the adjusted screening value for that chemical. It is *not* likely that exposure to the average concentrations of benzo(a)pyrene, dibenz(a,h)anthracene, and indeno(1,2,3-cd)pyrene in shallow soils on Grassy Island would cause adverse health effects.

Although only one soil sample exceeded the adjusted DCC for PCBs, seven samples exceeded the adjusted EMEG. Four of these exceedances occurred within the first foot of soil while the remainder were in deeper, less accessible, soil. Similar to the discussion for the SVOCs, it is more likely that a person would be exposed to an average concentration of PCBs on Grassy Island and not just to the “hotspots.” Following State of Michigan guidance (MDEQ 2002), MDCH conducted a statistical analysis on the Manny (1999b) soil PCB data and determined the 95% Upper Confidence Limit (UCL) of the mean to be 4.9 ppm. (The 95% UCL provides reasonable confidence that the true site average will not be underestimated. As a comparison, the arithmetic mean of the Manny [1999b] data was 4.1 ppm. MDCH did not include the Sweat [1999a] data in the statistical analysis because the sampling strategy for that study appeared biased.) The 95% UCL is less than the Adjusted CREG and Adjusted DCC for PCBs (Table 2 and Appendix B). Therefore, it is *not* likely that exposure to PCBs on Grassy Island would cause adverse health effects under the current use scenario.

The highest lead concentration, 2,000 ppm, occurred on the east shore of Grassy Island, about midway between the north and south ends of the island, at a depth of about 2 feet. Although people may not be exposed to soils at this depth, the next highest concentration, 630 ppm, occurred closer to the surface, at a depth of about 10 inches. MDCH conducted a statistical analysis on the Manny (1999b) soil lead data and determined the 95% UCL of the mean to be 461 ppm. This is only slightly greater than the generic DCC for lead, which assumes that exposure is occurring on a daily basis. Exposure to Grassy Island soils is likely once a week or less. It is *not* likely that infrequent exposure to lead on Grassy Island would cause adverse health effects.

It should be noted that, although exposure to an average concentration of a specific contaminant should not result in negative health effects, it is not clear what areas of the island people are most likely to access. It is possible that persons using specific areas of Grassy Island may be exposed to higher concentrations. Prevention of unacceptable exposure is discussed in the *Recommendations* and *Public Health Action Plan* sections of this document.

### *Exposure to Waterfowl and Game*

The Detroit River is a popular spot for duck hunting. Marshes along the river provide staging, feeding, and resting areas for migratory species such as canvasbacks, redheads, and scaups (Manny et al. 1988, in USFWS 2005). Currently, Grassy Island itself is not open to waterfowl or gamebird hunting, however duck hunters are allowed to hunt from the river immediately adjacent to the island (S. Millsap, USFWS, personal communication, 2006). USFWS has no plans for creating wetland or waterfowl habitat on the island (J. Hartig, USFWS personal communication, 2007). Poaching might occur on the island, though no incidents have been reported. Current contaminant levels in waterfowl from the island are not known. Chemicals detected historically in waterfowl from the island are discussed further in the *Toxicological Evaluation* section of this document.

There is a deer herd on Grassy Island, but currently the island is not open to game hunting. Poaching might occur, though no incidents have been reported. In the future, licensed harvesting could occur, if the deer herd requires thinning. It is unknown what contaminants, if any, might exist in the muscle or organ meats of deer that inhabit Grassy Island.

### *Exposure to River Sediments*

People fishing or swimming in the Detroit River next to Grassy Island may stand in the sediment offshore. The only area where chemical concentrations in the sediment exceeded adjusted screening values was at the weir discharge point. People are not likely to use this area because it is very near the shipping channel and the underwater terrain has a steep slope to accommodate the ships using the channel. Therefore, exposure to elevated concentrations of benzo(a)pyrene in the sediment is not expected to occur.

### *Exposure to Fish*

Many people fish in the Detroit River, recreationally and for food. The river bottom around Grassy Island provides rocky bottom substrate preferred by spawning lake sturgeon. Lake sturgeon have been caught between Grassy Island and Mud Island, to the north (USFWS 2005). A 2001 assessment of fish communities in the waters around Grassy Island found that the area supports a warm water fish community, particularly sunfish and minnow species (Hintz 2001, in USFWS 2005). White bass, walleye, and yellow perch are important recreational species that spawn in the Detroit River (Manny et al. 1988, in USFWS 2005).

Estimates of seepage through the dikes and runoff from Grassy Island suggest that contaminants from the island should not contribute a significant amount of contamination to the fish in the Detroit River. However, due to the multiple pollutant sources to the river, people consuming fish caught near Grassy Island may be exposed to PCBs or mercury in that fish. Fish advisories for the Detroit River exist, but it is not known how many persons who fish the river are aware of the advice or adhere to it. Further discussion of these chemicals is in the *Toxicological Evaluation* section of this document.

### *Excluded Pathways*

Anecdotal evidence indicates that people swim in the waters off Grassy Island, particularly on the sheltered west side of the island (USFWS 2006). Watercraft users may be exposed to river water. MDCH excluded the pathway involving dermal exposure to river water from further evaluation because chemical contaminants detected in the Detroit River near the island did not exceed the adjusted screening values (Appendix D), and exposure is not expected to cause adverse health effects.

The local population obtains drinking water from the Detroit River. The municipal water intake closest to Grassy Island lies less than one-tenth of a mile from the northeast corner of, and just upstream from, the island. This upstream intake, which serves the City of Detroit and several neighboring communities, likely would not be affected by contaminant releases from the island. The next nearest municipal intake is that for the City of Wyandotte and is located about 2/3 of a mile downstream from the southwest corner of the island. Another municipal intake is located on the Canadian side of the river, about 6.5 miles away. All other water intakes within 15 miles downstream of Grassy Island serve industrial purposes (USFWS 2005). Due to the massive volume of the Detroit River compared with any potential seepage or runoff from Grassy Island, any contamination from the island would be diluted to background conditions. Therefore, MDCH excluded the drinking water pathway from further evaluation.

## Toxicological Evaluation

### *PCBs*

PCBs are complex mixtures of synthetic organic chemicals with no known natural source. They exist as colorless to light yellow, oily liquids or solids. They have no known smell or taste. Some PCBs are volatile and may exist as a vapor in air. Because they do not burn easily and are good insulating materials, PCBs were used widely as coolants and lubricants in transformers, capacitors, and other electrical equipment. The manufacture of PCBs stopped in the U.S. in 1977 because there was evidence that the chemicals build up in the environment and may cause harmful effects. Products that may contain PCBs include old fluorescent lighting fixtures, electrical devices or appliances containing PCB capacitors made before PCB use was stopped, old microscope oil, and old hydraulic oil (ATSDR 2000).

In general, PCBs are relatively insoluble in water. Sediments that contain PCBs can release the PCBs into the surrounding water, but the nature of the chemicals causes them to attach more strongly to soil particles rather than enter the water column. PCBs are taken up into the bodies of small aquatic organisms and fish, especially those fish that are bottom-feeders. As the food chain progresses, PCB concentrations increase. The most likely source of human exposure to PCBs is through the eating of contaminated fish, although PCBs also can be absorbed through the skin and via inhalation. PCBs can enter breast milk (ATSDR 2000).

PCBs are probable human carcinogens. The EPA RfD is based on noncancer health effects in which monkeys fed a specific PCB mixture experienced a decreased immune response, abnormal discharge from the eye, and abnormal growth of fingernails (EPA

1994). Human dermal or oral exposure to high levels of PCBs can result in a severe skin condition called chloracne. The condition results in pustules and rashes. People who regularly work with PCBs may develop liver damage (ATSDR 2000). These health effects, however, would not be expected in people exposed to the PCBs in Grassy Island soils. At the lower PCB concentrations found at most sites of environmental contamination, the chemicals tend to adhere to organic materials in the soil and migrate through the skin less easily than pure PCBs or technical-grade PCB mixtures (ATSDR 2000).

Long-term consumption of Great Lakes sport fish has been implicated in behavioral and learning deficits detected in children born to mothers who have eaten the fish (ATSDR 2000). However, effects seen are not consistent across populations or across specific functions, possibly because of different susceptibilities of different populations, uncertainty about the concentration, rate, and mixture of the PCBs, or other confounders. It should be noted that epidemiological (population) studies such as these show associations rather than causation. Therefore, it cannot be concluded, as yet, that PCBs are the causative agents for the effects seen.

People who eat fish from the Detroit River and go onto Grassy Island may have multiple exposures to PCBs. People should use the MDCH Family Fish Consumption Guide to determine which fish from the Detroit River are more likely to contain PCBs and how to prepare their catch to minimize exposure.

### *DDT*

DDT, a pesticide, was once widely used to control insects in both agricultural and community settings. Its use in the U.S. was banned in 1972 when researchers discovered that DDT and its breakdown products caused damage to wildlife (especially eggshell thinning, causing egg collapse; ATSDR 2002). DDT and its breakdown products, DDD (dichlorodiphenyldichloroethane) and DDE (dichlorodiphenyldichloroethylene), are commonly found in environmental media and may still be detected in wildlife.

Large amounts of DDT can cause nervous system damage in humans. This is also seen in research animals, as are reproductive effects. DDT may cause reproductive effects in humans. It can enter the breast milk (ATSDR 2002).

DDT was detected in some waterfowl samples taken on Grassy Island in 1988 (Best et al. 1992). Current concentrations are not known, but USFWS has no plans for creating wetland or waterfowl habitat on the island (S. Millsap, USFWS, personal communication, 2007). Until current levels of pesticide residues or other chemicals in deer on Grassy Island are known, consuming the venison or organ meat from this species, if the herd requires thinning, should be prohibited.

### *Mercury*

Mercury is a naturally occurring metal. In its elemental form, it is used in thermometers, barometers, and some electrical equipment (cathode ray tubes, switches). Mercury compounds are emitted to the air from coal-fired electrical plants and some manufacturing plants. Methylmercury, an organic mercury compound, is formed by bacteria in soil or water where airborne mercury compounds have deposited. Methylmercury builds up in the aquatic food chain, with higher concentrations being found in predator fish (ATSDR 1999). Mercury cannot be removed from the edible portion of fish.

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).

People who eat fish from the Detroit River, regardless of whether or not their catch comes from waters near Grassy Island, might be exposed to levels of mercury in the fish (particularly in freshwater drum; MDCH 2004) that, in the long-term, may cause negative health effects. People should use the MDCH Family Fish Consumption Guide to determine which fish from the Detroit River, and other waters of the state, are more likely to contain mercury and how to decide whether to eat their catch.

Chemicals Without Screening Values

**Calcium** and **potassium** are required in the human diet. They are required in milligrams per day and thus have a greater margin of safety than nutrients with lower requirements (micrograms per day). Calcium is necessary for proper bone and tooth formation, blood clotting, muscle contraction, and nerve transmission (IOM 1997). Potassium is an electrolyte that helps regulate blood pressure and heart function (IOM 2004). Exposure to calcium and potassium at Grassy Island is *not* expected to result in negative health effects.

**Silicon**, **tin**, and **titanium** were tested for in all media and were detected in soils and sediments (tin was detected only in soils). These metals are used in the manufacture of steel and metal alloys and electrical equipment. Titanium may be used in pyrotechnics (fireworks), paints, welding rod, and prosthetics (artificial limbs). These metals are not very toxic orally but may be toxic, or at least a nuisance, when inhaled as a dust (HSDB 2006). The operation of heavy equipment on Grassy Island could cause the soil to become airborne, however bulldozing or excavating are not anticipated activities at this time. It is *not* likely that exposure to these metals in soil or sediments would cause adverse health effects.

**Delta-BHC** (delta-hexachlorocyclohexane) is a pesticide component of benzene hexachloride (BHC). (The gamma form of BHC is lindane, a pesticide commonly used for the treatment of head lice, although that use is now being phased out.) **Endrin aldehyde** and **endrin ketone** are degradants of the pesticide endrin (HSDB 2006). These chemicals were tested for in all media and detected only in soil, at depths of at least 5 feet. Because people would not likely be exposed to Grassy Island soils at these depths, these chemicals are *not* expected to cause negative health effects.

**4-Chlorophenyl-phenylether**, an SVOC, was used as a dielectric fluid in capacitors (HSDB 2006). This chemical was tested for in all media and detected only in soils, but at multiple depths including less than 1 foot. All the near-surface (less than 1 foot depth) concentrations were less than 1 ppm. MDCH could find no toxicity data for this chemical. Because 4-chlorophenyl-phenylether was used as a replacement for PCBs (HSDB 2006), it may be less toxic than PCBs. The near-surface concentrations of this chemical were all less than the default/generic screening values for PCBs (Table 2). Exposure to 4-chlorophenyl-phenylether in the soils at Grassy Island would *not* be expected to cause adverse health effects.

**Dibenzofuran**, an SVOC, is a component of coal tar, creosote, and heat-transfer oil. It is used as a carrier for dyeing and printing textiles, an intermediate for production of dyes, and an antioxidant in plastics (HSDB 2006). Dibenzofuran was tested for in all media at Grassy Island and detected only in soil, but at multiple depths including less than 1 foot. The maximum near-surface concentration was 1.2 ppm. Toxicity data for dibenzofuran are insufficient for determining the chemical's potential for harm. Chlorinated dibenzofurans, which are associated with the dioxin family of chemicals, are known to be highly toxic. However, non-chlorinated dibenzofuran does not contribute to dioxin's toxicity (HSDB 2006).

The USGS sediment sampling conducted in 2006 detected additional SVOCs not tested for in earlier studies. Most of the chemicals likely are impurities related to more common SVOCs. The chemicals include **1,2-dimethylnaphthalene**; **1,6-dimethylnaphthalene**; **2,3,6-trimethylnaphthalene**; **2,6-dimethylnaphthalene**; and **2-ethylnaphthalene** (all likely impurities within naphthalene itself); **1-methyl-9h-fluorene** (likely an impurity within fluorene); **1-methylphenanthrene** and **4h-cyclopenta(def)phenanthrene** (impurities of phenanthrene); **1-methylpyrene** (an impurity of pyrene); and **2-methylanthracene** (an impurity of anthracene). **Phenanthridine**, a mixture of phenanthrene and pyridine, was also detected in the USGS sediment samples (Table A-2b in Appendix A). Extended dermal contact with SVOCs can increase the risk of skin cancer. However, when considering that the impurities make up only a small percentage of "pure" product, that the concentrations found were at least several orders of magnitude (1,000 times) less than the screening values for the "pure" products, and that the higher concentrations of SVOCs occurred near the weir discharge point, an area where people are not likely to go, the risk of adverse health effects from exposure to the contaminated sediments is minimal and may not exist.

<u>Children's Health Considerations</u>

Children may be at greater risk than adults from exposure to hazardous substances at sites of environmental contamination. Children engage in activities such as playing outdoors and hand-to-mouth behaviors that could increase their intake of hazardous substances. They are shorter than most adults, and therefore breathe dust, soil, and vapors found closer 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. Even before birth, fetuses are forming the body organs they need to last a lifetime. Injury during key periods of prenatal growth and development could lead to malformation of organs (teratogenesis), disruption of function, and premature death. Exposure of the mother could lead to exposure of the fetus, via the placenta, or affect the fetus because of injury or illness sustained by the mother (ATSDR 1998). The obvious implication for environmental health is that children can experience substantially greater exposures to toxicants in soil, water, or air than adults can.

Although Grassy Island is currently off-limits to the public, trespassing has and may continue to occur.  Younger children are likely to be accompanied by their parent or guardian when coming to Grassy Island. Teenagers may come to the island without adult supervision. Both younger children and teens may be more exposed to the soils on the island than would adult visitors. Unsupervised children, busy exploring or playing, may be more at risk to physical hazards on the island as well. Women who are breast-feeding may expose their child via breast milk to contaminants in fish from the Detroit River or from waterfowl or game from the island.

## Community Health Concerns

At the March 9, 2006 public forum, several people reported seeing picnickers and campers on Grassy Island. This indicates that, although access may be difficult, it is not impossible. Citizens concerned about the contamination on the island urged USFWS to post signs to discourage people from accessing the island. USFWS has posted signs, shown in Figure 3.

At least one person has expressed concern over people swimming near the island, that swimmers might be exposed to contaminants in the water and sediment. This document has addressed that concern in the *Environmental Contamination* section.


Figure 3. Signs prohibiting public access at Grassy Island, Detroit River, Michigan.

## Conclusions

**The contamination on Grassy Island poses no apparent current or future public health hazard to persons who access the island no more than once a week.** Exposure to the *average* concentration of the various contaminants in the soil is not expected to cause adverse health effects.

There are **physical hazards** present on Grassy Island: steep dike walls, treacherous riprap, and dense vegetation with no established foot-trails. The integrity of the dike walls remains in question, since the exterior six-foot dike was not built with engineering controls.

**Eating deer taken from Grassy Island poses an indeterminate public health hazard**. Current contaminant levels in these animals are not known.

**Eating fish taken from the Detroit River near Grassy Island poses no apparent public health hazard if people adhere to the advice in the MDCH Family Fish Consumption Guide.**

## Recommendations

Allow access to Grassy Island only to government agencies whose responsibilities extend to the island (e.g., USFWS, U.S. Coast Guard, MDEQ). People may swim in the Detroit River near the island, except in or near the shipping channel due to physical safety, and may stand in the sediment while fishing.

Prevent additional exposures (beyond that assumed for this evaluation) to contaminants on Grassy Island.

Set a schedule for regularly assessing dike integrity, checking for seepage or erosion. Establish a contingency plan should the dikes fail (catastrophically or slowly).

Consumption of venison from deer taken from the island should not occur until chemical concentrations in the edible portions are known.

Maintain fish advisory, updating as new data become available.

## Public Health Action Plan

1. USFWS has placed and will maintain signs on the perimeter of the island that indicate public access to Grassy Island is prohibited.

2. MDCH will educate USFWS and other governmental employees regarding contamination present on the island, exposure pathways, and prevention of exposure.

3. USFWS will confer with MDEQ regarding how best to address the contamination on the island.

4. USFWS will conduct routine visual dike inspections. The Service will confer with COE and other appropriate agencies regarding physical and structural inspections of the dikes to ensure long-term stability of the facility and the development of a contingency plan.

5. With public access prohibited, no hunting should occur. If USFWS chooses to open Grassy Island to deerhunters, for herd thinning, the Service will first confer with MDNR, MDEQ, and MDCH to ensure that hunters are not exposed to harmful concentrations of contaminants on the island or in its wildlife.

6. MDCH will maintain the Family Fish Consumption Guide, updating it as necessary based on data received from MDEQ.

MDCH will remain available as needed for future consultation at this site.

If any citizen has additional information or health concerns regarding this health consultation, please contact MDCH's Division of Environmental and Occupational Epidemiology at 1-800-648-6942.

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**Appendix A. Concentrations of Chemicals Detected in Grassy Island Soils or Nearby Detroit River Sediments or Water and Comparison to Default/Generic Screening Values**

Table A-1. Concentrations of chemicals detected in soils at Grassy Island, Detroit River, Michigan. (Soil sampled April 1997. Concentration in parts per million [ppm]. Chemicals listed in bold exceed their screening value.)

| Chemical | No. detects / No. samples | Concentration Range | ATSDR Chronic Soil Value (No. exceedances) | Generic MDEQ DCC (No. exceedances) |
|---|---|---|---|---|
| 2-Hexanone | 1 / 8 | 0.06 | NC | 2,500 (0) |
| 2-Nitrophenol | 1 / 8 | 0.87 | NC | 630 (0) |
| 4,4'-DDD | 4 / 8 | 0.013 - 0.455 | 3 (0)[A] | 95 (0) |
| 4,4'-DDE | 7 / 8 | 0.04 - 0.19 | 2 (0)[A] | 45 (0) |
| 4-Chlorophenyl-phenylether | 7 / 8 | 0.56 - 21.2 | NC | NC |
| 4-Methyl-2-pentanone | 4 / 8 | 0.1 - 14 | NC | 2,700 (0) |
| Acenaphthene | 7 / 8 | 0.87 - 27.8 | 3,000 (0)[B] | 41,000 (0) |
| Acetone | 5 / 8 | 0.13 - 0.56 | 50,000 (0)[B] | 23,000 (0) |
| **Aldrin** | 2 / 8 | 0.055 - 0.071 | **0.04 (2)**[A] | 1 (0) |
| alpha-BHC | 1 / 8 | 0.005 | 0.1 (0)[A] | 2.6 (0) |
| alpha-Chlordane | 5 / 8 | 0.013 - 0.059 | 2 (0)[A, C] | 31,000 (0)[C] |
| Aluminum | 49 / 49 | 2,600 - 22,000 | NC | 50,000 (0) |
| Anthracene | 7 / 8 | 1.4 - 60.8 | 20,000 (0)[B] | 230,000 (0) |
| Antimony | 11 / 49 | 2 - 16 | 20 (0)[B] | 180 (0) |
| **Arsenic** | 29 / 49 | 5 - 22.5 | **0.5 (29)**[A] | **7.6 (14)** |
| Barium | 41 / 49 | 33 - 310 | 10,000 (0)[B] | 37,000 (0) |
| Benzene | 2 / 8 | 0.03 | 10 (0)[A] | 180 (0) |
| **Benzo(a)anthracene** | 8 / 8 | 0.90 - 31.6 | NC | **20 (2)** |
| **Benzo(a)pyrene** | 8 / 8 | 0.87 - 29.2 | **0.1 (8)**[A] | **2 (7)** |
| **Benzo(b)fluoranthene** | 8 / 8 | 0.92 - 21.6 | NC | **20 (1)** |
| Benzo(g,h,i)perylene | 8 / 8 | 0.54 - 28 | NC | 2,500 (0) |
| Benzo(k)fluoranthene | 7 / 8 | 1.24 - 30 | NC | 200 (0) |
| Beryllium | 41 / 49 | 1 - 3 | 100 (0)[D] | 410 (0) |
| beta-BHC | 1 / 8 | 0.02 | 0.4 (0)[A] | 5.4 (0) |
| bis(2-ethylhexyl)phthalate | 7 / 8 | 0.89 - 13.1 | 600 (0)[A] | 2,800 (0) |
| Boron | 40 / 41 | 16 - 63 | 10,000 (0)[B] | 48,000 (0) |
| **Cadmium** | 41 / 49 | 1 - 19 | **10 (19)**[D] | 550 (0) |
| Calcium | 41 / 49 | 34,000 - 140,000 | NC | NC |
| Carbazole | 6 / 8 | 0.84 - 33.3 | NC | 530 (0) |
| Carbon disulfide | 1 / 8 | 0.02 | 5,000 (0)[B] | 280 (0) |
| Chlorine[F] | 41 / 41 | 20 - 370 | 5,000 (0)[B] | 500 (0) |
| Chromium | 6 / 8 | 213 - 306 | NC | 2,500 (0) |

Table A-1. Concentrations of chemicals detected in soils at Grassy Island, Detroit River, Michigan. (Soil sampled April 1997. Concentration in parts per million [ppm]. Chemicals listed in bold exceed their screening value.)

| Chemical | No. detects / No. samples | Concentration Range | ATSDR Chronic Soil Value (No. exceedances) | Generic MDEQ DCC (No. exceedances) |
|---|---|---|---|---|
| Chrysene | 8 / 8 | 0.82 - 39 | NC | 2,000 (0) |
| Cobalt | 41 / 49 | 3 - 16 | NC | 2,600 (0) |
| Copper | 41 / 49 | 37 - 360 | NC | 20,000 (0) |
| delta-BHC | 3 / 8 | 0.007 - 0.013 | NC | NC |
| **Dibenz(a,h)anthracene** | 7 / 8 | 1.67 - 35.3 | NC | **2 (4)** |
| Dibenzofuran | 7 / 8 | 0.61 - 18 | NC | NC |
| Dieldrin | 2 / 8 | 0.021 - 0.023 | 0.04 (0)[A] | 1.1 (0) |
| Di-n-ocytlphthalate | 1 / 8 | 0.7 | NC | 6,900 (0) |
| Endosulfan I | 4 / 8 | 0.004 - 0.02 | 100 (0)[C, D] | 1,400 (0)[C] |
| Endosulfan II | 2 / 8 | 0.014 - 0.441 | 100 (0)[C, D] | 1,400 (0)[C] |
| Endosulfan sulfate | 3 / 8 | 0.017 - 0.026 | 100 (0)[C, D] | 1,400 (0)[C] |
| Endrin | 3 / 8 | 0.015 - 0.082 | 20 (0)[D] | 65 (0) |
| Endrin aldehyde | 1 / 8 | 0.03 | NC | NC |
| Endrin ketone | 2 / 8 | 0.01 - 0.045 | NC | NC |
| Ethylbenzene | 2 / 8 | 0.04 - 0.09 | 5,000 (0)[B] | 140 (0) |
| Fluoranthene | 8 / 8 | 1.28 - 65.5 | 2,000 (0)[B] | 46,000 (0) |
| gamma-BHC (Lindane) | 2 / 8 | 0.004 - 0.006 | 20 (0)[B] | 8.3 (0) |
| gamma-Chlordane | 3 / 8 | 0.025 - 0.048 | 2 (0)[A, C] | 31 (0)[C] |
| **Indeno(1,2,3-cd)pyrene** | 8 / 8 | 0.51 - 171.8 | NC | **20 (3)** |
| Iron | 49 / 49 | 14,000 - 75,000 | NC | 160,000 (0) |
| Isophorone | 2 / 8 | 1.2 - 1.5 | 10,000 (0)[D] | 2,400 (0) |
| **Lead** | 49 / 49 | 37 - 2,000 | NC | **400 (18)** |
| Magnesium | 41 / 49 | 14,000 - 84,000 | NC | 1,000,000 (0) |
| **Manganese** | 49 / 49 | 330 - 14,000 | **3,000 (1)[B]** | 25,000 (0) |
| Mercury | 35 / 49 | 0.5 - 1.4 | NC | 160 (0) |
| Methoxychlor | 1 / 8 | 0.027 | 300 (0)[B] | 1,900 (0) |
| Methylene chloride | 6 / 8 | 0.09 - 0.13 | 90 (0)[A] | 1,300 (0) |
| Molybdenum | 34 / 41 | 5 - 23 | 300 (0)[B] | 2,600 (0) |
| Naphthalene | 7 / 8 | 10.2 - 14 | 1,000 (0)[B] | 16,000 (0) |
| Nickel | 41 / 49 | 13 - 100 | 1,000 (0)B | 40,000 (0) |
| N-Nitrosodiphenylamine | 5 / 8 | 0.55 - 7.6 | 100 (0)[A] | 1,700 (0) |
| **PCBs (total)** | 48 / 49 | 0.18 - 18.9 | **0.4 (47)[A, E]** | **4 (18)** |

Table A-1. Concentrations of chemicals detected in soils at Grassy Island, Detroit River, Michigan. (Soil sampled April 1997. Concentration in parts per million [ppm]. Chemicals listed in bold exceed their screening value.)

| Chemical | No. detects / No. samples | Concentration Range | ATSDR Chronic Soil Value (No. exceedances) | Generic MDEQ DCC (No. exceedances) |
|---|---|---|---|---|
| Phenanthrene | 8 / 8 | 0.92 - 165.7 | NC | 1,600 (0) |
| Phenol | 1 / 8 | 0.65 | 20,000 (0)[B] | 12,000 (0) |
| Phosphorous | 41 / 41 | 250 - 2,700 | NC | 1,000,000 (0) |
| Potassium | 41 / 49 | 450 - 3,600 | NC | NC |
| Pyrene | 8 / 8 | 1.55 - 65.8 | 2,000 (0)[B] | 29,000 (0) |
| Selenium | 13 / 49 | 11 - 34 | 300 (0)[D] | 2,600 (0) |
| Silicon | 41 / 41 | 480 - 1,900 | NC | NC |
| Silver | 6 / 49 | 1 - 5 | 300 (0)[B] | 2,500 (0) |
| Sodium | 41 / 49 | 100 - 370 | NC | 1,000,000 (0) |
| Strontium | 41 / 41 | 46 - 110 | 30,000 (0)[B] | 330,000 (0) |
| Thallium | 4 / 49 | 11 - 16 | NC | 35 (0) |
| Tin | 39 / 41 | 6 - 50 | NC | NC |
| Titanium | 41 / 49 | 84 - 370 | NC | NC |
| Toluene | 1 / 8 | 0.02 | 10,000 (0)[B] | 250 (0) |
| Vanadium | 41 / 41 | 6 - 82 | NC | 750 (0) |
| Xylenes (total) | 4 / 8 | 0.07 - 0.4 | 10,000 (0)[B] | 150 (0) |
| Zinc | 48 / 49 | 120 - 2,000 | 20,000 (0)[D] | 170,000 (0) |

Notes:

| | | | |
|---|---|---|---|
| ATSDR | Agency for Toxic Substances and Disease Registry | BHC | benzene hexachloride |
| DCC | Direct Contact Criteria | DDD | dichlorodiphenyldichloroethane |
| DDE | dichlorodiphenyldichloroethylene | MDEQ | Michigan Department of Environmental Quality |
| NC | no criterion for this chemical | PCBs | polychlorinated biphenyls |

A. Value is Cancer Risk Evaluation Guide (CREG)
B. Value is Reference Dose Media Evaluation Guide (RMEG)
C. Value must be compared to sum of concentrations for all isomers of chemical.
D. Value is Environmental Media Evaluation Guide
E. PCB default screening value shown is the CREG for Aroclor 1254.
F. The Manny 1999b report listed "chlorine," which is a gas. The ATSDR value is for chlorine. The MDEQ value is for chloride.

References: ATSDR 2005c, Manny 1999b, MDEQ 2006a, Sweat 1999a

**Table A-2a. Concentrations of chemicals detected in Detroit River sediments near Grassy Island, Detroit River, Michigan in earlier studies. (Sediments sampled April and October 1997. Concentration in parts per million [ppm]. Chemicals listed in bold exceed their screening value.)**

| Chemical | *Upstream* | | *Downstream* | | ATSDR Chronic Soil Value (No. exceedances)[A] | Generic MDEQ DCC (No. exceedances)[A] |
|---|---|---|---|---|---|---|
| | No. detects / No. samples | Concentration Range | No. detects / No. samples | Concentration Range | | |
| Aluminum | 3 / 3 | 1,700 - 10,882 | 2 / 2 | 2,000 - 9,509 | NC | 50,000 (0, 0) |
| Anthracene | 1 / 3 | 0.68 | 0 / 3 | ND | 20,000 (0, 0)[B] | 230,000 (0, 0) |
| **Arsenic** | 2 / 3 | 3.1 - 4 | 2 / 3 | 2.7 - 3.1 | 0.5 (2, 2)[C] | 7.6 (0, 0) |
| Barium | 1 / 3 | 21 | 1 / 3 | 25 | 10,000 (0, 0)[B] | 37,000 (0, 0) |
| Benzo(a)anthracene | 2 / 3 | 0.66 - 1.4 | 2 / 3 | 0.32 - 0.47 | NC | 20 (0, 0) |
| **Benzo(a)pyrene** | 3 / 3 | 0.38 - 1.1 | 0 / 3 | ND | 0.1 (3, 0)[C] | 2 (0, 0) |
| Benzo(b)fluoranthene | 2 / 3 | 0.41 - 0.76 | 0 / 3 | ND | NC | 20 (0, 0) |
| Benzo(k)fluroanthene | 2 / 3 | 0.49 - 0.92 | 0 / 3 | ND | NC | 200 (0, 0) |
| Boron | 1 / 2 | 13 | 0 / 2 | ND | 10,000 (0, 0)[B] | 48,000 (0, 0) |
| Calcium | 2 / 3 | 13,000 - 17,000 | 2 / 3 | 8,300 - 17,000 | NC | NC |
| Chromium | 2 / 3 | 7.5 - 9.9 | 2 / 3 | 7.4 - 9.8 | NC | 2,500 (0, 0) |
| Chrysene | 2 / 3 | 0.91 - 1.9 | 2 / 3 | 0.35 - 0.43 | NC | 2,000 (0, 0) |
| Cobalt | 2 / 3 | 2.8 - 3.0 | 2 / 3 | 3.1 - 4.2 | NC | 2,600 (0, 0) |
| Copper | 2 / 3 | 9.1 - 21 | 2 / 3 | 8.8 - 12 | NC | 20,000 (0, 0) |
| Fluoranthene | 2 / 3 | 1.3 - 2.8 | 2 / 3 | 0.62 - 0.73 | 2,000 (0, 0)[B] | 46,000 (0, 0) |
| Indeno(1,2,3-cd)pyrene | 1 / 3 | 0.44 | 0 / 3 | ND | NC | 20 (0, 0) |
| Iron | 3 / 3 | 5,600 - 12,141 | 3 / 3 | 6,600 - 19,021 | NC | 160,000 (0, 0) |
| Lead | 3 / 3 | 9.4 - 18 | 1 / 3 | 8.7 | NC | 400 (0, 0) |
| Magnesium | 2 / 3 | 6,100 - 7,400 | 2 / 3 | 4,600 - 7,900 | NC | 1,000,000 (0, 0) |
| Manganese | 2 / 3 | 100 - 120 | 3 / 3 | 92 -372 | 3,000 (0, 0)[B] | 25,000 (0, 0) |
| Mercury | 1 / 3 | 0.13 | 0 / 3 | ND | NC | 160 (0, 0) |
| Methylene chloride | 1 / 1 | 0.08 | 1 / 1 | 0.12 | 90 (0, 0)[C] | NC |
| Nickel | 2 / 3 | 7.8 - 8.4 | 2 / 3 | 8.8 - 12 | 1,000 (0, 0)[D] | 40,000 (0, 0) |

**Table A-2a. Concentrations of chemicals detected in Detroit River sediments near Grassy Island, Detroit River, Michigan in earlier studies. (Sediments sampled April and October 1997. Concentration in parts per million [ppm]. Chemicals listed in bold exceed their screening value.)**

| **Chemical** | ***Upstream*** No. detects / No. samples | ***Upstream*** Concentration Range | ***Downstream*** No. detects / No. samples | ***Downstream*** Concentration Range | **ATSDR Chronic Soil Value (No. exceedances)[A]** | **Generic MDEQ DCC (No. exceedances)[A]** |
|---|---|---|---|---|---|---|
| Phenanthrene | 2 / 3 | 0.43 - 1.3 | 2 / 3 | 0.34 - 0.37 | NC | 1,600 (0, 0) |
| Phosphorus | 2 / 2 | 170 - 200 | 2 / 2 | 200 - 230 | NC | 1,000,000 |
| Potassium | 2 / 3 | 330 - 410 | 2 / 3 | 400 - 420 | NC | NC |
| Pyrene | 2 / 3 | 0.94 - 2.1 | 2 / 3 | 0.41 - 0.71 | 2,000 (0, 0)[B] | 29,000 (0, 0) |
| Silica | 2 / 2 | 810 - 820 | 2 / 2 | 980 | NC | NC |
| Sodium | 1 / 3 | 45 | 2 / 3 | 33 - 43 | NC | 1,000,000 (0, 0) |
| Strontium | 2 / 2 | 14 - 20 | 2 / 2 | 15 | 30,000 (0, 0)[B] | 330,000 (0, 0) |
| Titanium | 2 / 2 | 55 - 77 | 2 / 2 | 71 - 82 | NC | NC |
| Vanadium | 2 / 3 | 5.5 - 6.8 | 2 / 3 | 6.9 - 8.4 | NC | 750 (0, 0) |
| Zinc | 2 / 3 | 32 - 47 | 2 / 3 | 36 - 41 | 20,000 (0, 0)[D] | 170,000 (0, 0) |

<u>Notes:</u>

| | | | |
|---|---|---|---|
| ATSDR | Agency for Toxic Substances and Disease Registry | DCC | Direct Contact Criteria |
| MDEQ | Michigan Department of Environmental Quality | NC | no criterion for this chemical |

A. Values in parentheses show exceedances upstream, then exceedances downstream of Grassy Island.

B. Value is Reference Dose Media Evaluation Guide

C. Value is Cancer Risk Evaluation Guide

D. Value is Environmental Media Evaluation Guide

<u>References</u>: ATSDR 2005c, Manny 1999b, MDEQ 2006a, Sweat 1999a

**Table A-2b. Concentrations of chemicals detected in Detroit River sediments near Grassy Island, Detroit River, Michigan in a more recent study. (Sediments sampled August 2006. Concentration in parts per million [ppm]. Sampling locations with more than one sample taken have only the higher detected concentration shown. Chemicals listed in bold exceed their screening value.)**

| Chemical | *Upstream* | | *Weir* | | *Downstream* | | | |
|---|---|---|---|---|---|---|---|---|
| | No. detects / No. samples | Concentration Range | No. detects / No. samples | Concentration Range | No. detects / No. samples | Concentration Range | ATSDR Soil Value (No. exceedances)[A] | Generic MDEQ DCC (No. exceedances)[A] |
| 1,2-Dimethylnaphthalene | 1 / 1 | 0.093 | 1 / 1 | 0.142 | 2 / 2 | 0.014 - 0.060 | NC | NC |
| 1,6-Dimethylnaphthalene | 1 / 1 | 0.113 | 1 / 1 | 0.240 | 2 / 2 | 0.033 - 0.067 | NC | NC |
| 1-Methyl-9h-fluorene | 1 / 1 | 0.180 | 1 / 1 | 0.410 | 2 / 2 | 0.034 - 0.149 | NC | NC |
| 1-Methylphenanthrene | 1 / 1 | 0.552 | 1 / 1 | 1.610 | 2 / 2 | 0.060 - 0.603 | NC | NC |
| 1-Methylpyrene | 1 / 1 | 0.584 | 1 / 1 | 2.260 | 2 / 2 | 0.093 - 0.673 | NC | NC |
| 2,3,6-Trimethylnaphthalene | 1 / 1 | 0.140 | 1 / 1 | 0.253 | 2 / 2 | 0.029 - 0.143 | NC | NC |
| 2,6-Dimethylnaphthalene | 1 / 1 | 0.196 | 1 / 1 | 0.385 | 2 / 2 | 0.053 - 0.149 | NC | NC |
| 2-Ethylnaphthalene | 1 / 1 | 0.151 | 1 / 1 | 0.349 | 2 / 2 | 0.031 - 0.109 | NC | NC |
| 2-Methylanthracene | 1 / 1 | 0.438 | 1 / 1 | 1.340 | 2 / 2 | 0.062 - 0.400 | NC | NC |
| 4h-Cyclopenta(def)phenanthrene | 1 / 1 | 0.722 | 1 / 1 | 2.090 | 2 / 2 | 0.103 - 0.510 | NC | NC |
| Acenaphthene | 1 / 1 | 0.561 | 1 / 1 | 0.772 | 2 / 2 | 0.066 - 0.163 | 30,000[B] (0, 0, 0) | 41,000 (0, 0, 0) |
| Acenaphthylene | 1 / 1 | 0.398 | 1 / 1 | 1.740 | 2 / 2 | 0.103 - 0.453 | NC | 1,600 (0, 0, 0) |
| Aluminum | 1 / 1 | 6,782 | 1 / 1 | 7,087 | 2 / 2 | 6,5983 - 14,780 | 50,000[C] (0, 0, 0) | 50,000 (0, 0, 0) |
| Anthracene | 1 / 1 | 1.180 | 1 / 1 | 3.330 | 2 / 2 | 0.206 - 0.767 | 500,000[B] (0, 0, 0) | 230,000 (0, 0, 0) |

**Table A-2b. Concentrations of chemicals detected in Detroit River sediments near Grassy Island, Detroit River, Michigan in a more recent study. (Sediments sampled August 2006. Concentration in parts per million [ppm]. Sampling locations with more than one sample taken have only the higher detected concentration shown. Chemicals listed in bold exceed their screening value.)**

| Chemical | *Upstream* No. detects / No. samples | *Upstream* Concentration Range | *Weir* No. detects / No. samples | *Weir* Concentration Range | *Downstream* No. detects / No. samples | *Downstream* Concentration Range | ATSDR Soil Value (No. exceedances)[A] | Generic MDEQ DCC (No. exceedances)[A] |
|---|---|---|---|---|---|---|---|---|
| **Arsenic** | **1 / 1** | **3.54** | **1 / 1** | **4.73** | **2 / 2** | **2.24 - 5.30** | **0.5[D] (1, 1, 2)** | **7.6 (0, 0, 0)** |
| Barium | 1 / 1 | 30.7 | 1 / 1 | 31.7 | 2 / 2 | 28.3 - 68.4 | 30,000[C] (0, 0, 0) | 37,000 (0, 0, 0) |
| Benz(a)anthracene | 1 / 1 | 2.220 | 1 / 1 | 8.600 | 2 / 2 | 0.435 - 1.680 | NC | 20 (0, 0, 0) |
| **Benzo(a)pyrene** | **1 / 1** | **2.290** | **1 / 1** | **9.050** | **2 / 2** | **0.48 - 1.870** | **0.100[D] (1, 1, 2)** | **2 (1, 1, 0)** |
| Benzo(b)fluoranthene | 1 / 1 | 2.700 | 1 / 1 | 10.100 | 2 / 2 | 0.558 - 2.120 | NC | 20 (0, 0, 0) |
| Benzo(g,h,i)perylene | 1 / 1 | 0.877 | 1 / 1 | 3.910 | 2 / 2 | 0.276 - 0.786 | NC | 2,500 (0, 0, 0) |
| Benzo(k)fluoranthene | 1 / 1 | 0.796 | 1 / 1 | 3.870 | 2 / 2 | 0.214 - 0.766 | NC | 200 (0, 0, 0) |
| Cadmium | 1 / 1 | 0.61 | 1 / 1 | 0.66 | 2 / 2 | 0.31 - 1.97 | 10[C] (0, 0, 0) | 550 (0, 0, 0) |
| Chromium | 1 / 1 | 18.70 | 1 / 1 | 19.18 | 2 / 2 | 15.45 - 35.59 | 200[E,F] (0, 0, 0) | 2,500[F] (0, 0, 0) |
| Chrysene | 1 / 1 | 2.200 | 1 / 1 | 7.930 | 2 / 2 | 0.450 - 1.740 | NC | 2,000 (0, 0, 0) |
| Cobalt | 1 / 1 | 4.61 | 1 / 1 | 4.88 | 2 / 2 | 4.99 - 7.23 | 500[B] (0, 0, 0) | 2,600 (0, 0, 0) |
| Copper | 1 / 1 | 21.54 | 1 / 1 | 16.49 | 2 / 2 | 12.79 - 39.51 | 500[B] (0, 0, 0) | 20,000 (0, 0, 0) |
| Dibenz(a,h)anthracene | 1 / 1 | 0.306 | 1 / 1 | 1.040 | 2 / 2 | 0.095 - 0.290 | NC | 2 (0, 0, 0) |
| Fluoranthene | 1 / 1 | 3.630 | 1 / 1 | 12.900 | 2 / 2 | 0.764 - 2.210 | 20,000[B] (0, 0, 0) | 46,000 (0, 0, 0) |
| Fluorene | 1 / 1 | 0.646 | 1 / 1 | 1.170 | 2 / 2 | 0.097 - 0.281 | 20,000[B] (0, 0, 0) | 27,000 (0, 0, 0) |

**Table A-2b. Concentrations of chemicals detected in Detroit River sediments near Grassy Island, Detroit River, Michigan in a more recent study. (Sediments sampled August 2006. Concentration in parts per million [ppm]. Sampling locations with more than one sample taken have only the higher detected concentration shown. Chemicals listed in bold exceed their screening value.)**

| Chemical | *Upstream* | | *Weir* | | *Downstream* | | | |
|---|---|---|---|---|---|---|---|---|
| | No. detects / No. samples | Concentration Range | No. detects / No. samples | Concentration Range | No. detects / No. samples | Concentration Range | ATSDR Soil Value (No. exceedances)[A] | Generic MDEQ DCC (No. exceedances)[A] |
| Indeno(1,2,3-cd)pyrene | 1 / 1 | 0.854 | 1 / 1 | 3.030 | 2 / 2 | 0.241 - 0.708 | NC | 20 (0, 0, 0) |
| Iron | 1 / 1 | 12,810 | 1 / 1 | 12,530 | 2 / 2 | 11,200 - 17,770 | NC | 160,000 (0, 0, 0) |
| Lead | 1 / 1 | 30.05 | 1 / 1 | 25.25 | 2 / 2 | 10.16 - 41.90 | NC | 400 (0, 0, 0) |
| Manganese | 1 / 1 | 185.5 | 1 / 1 | 198.5 | 2 / 2 | 176.5 - 287.5 | 3,000[E] (0, 0, 0) | 25,000 (0, 0, 0) |
| Mercury | 1 / 1 | 0.137 | 1 / 1 | 0.260 | 2 / 2 | 0.027 - 0.229 | NC | 160 (0, 0, 0) |
| Molybdenum | 1 / 1 | 0.78 | 1 / 1 | 1.39 | 2 / 2 | 0.34 - 0.82 | 300[E] (0, 0, 0) | 2,600 (0, 0, 0) |
| Naphthalene | 1 / 1 | 0.427 | 1 / 1 | 1.280 | 2 / 2 | 0.230 - 0.369 | 30,000[B] (0, 0, 0) | 16,000 (0, 0, 0) |
| Nickel | 1 / 1 | 13.34 | 1 / 1 | 13.38 | 2 / 2 | 12.45 - 21.87 | 1,000[E] (0, 0, 0) | 40,000 (0, 0, 0) |
| **PCBs (total)** | **1 / 1** | **0.089** | **1 / 1** | **1.331** | **2 / 2** | **0.033 - 0.058** | **0.4[D] (0, 1, 0)** | **4,000 (0, 0, 0)** |
| p-Cresol | 1 / 1 | 0.060 | 1 / 1 | 0.120 | 2 / 2 | 0.049 - 0.085 | 100[G] (0, 0, 0) | 11,000 (0, 0, 0) |
| Phenanthrene | 1 / 1 | 2.910 | 1 / 1 | 7.080 | 2 / 2 | 0.342 - 1.430 | NC | 1,600 (0, 0, 0) |
| Phenanthridine | 1 / 1 | 0.038 | 1 / 1 | 0.115 | 1 / 2 | 0.027 | NC | NC |
| Pyrene | 1 / 1 | 4.070 | 1 / 1 | 14.400 | 2 / 2 | 0.697 - 2.560 | 2,000[E] (0, 0, 0) | 29,000 (0, 0, 0) |
| Selenium | 1 / 1 | 0.39 | 1 / 1 | 0.39 | 2 / 2 | 0.52 - 0.60 | 300[C] (0, 0, 0) | 2,600 (0, 0, 0) |
| Silver | 0 / 1 | ND | 1 / 1 | 0.81 | 1 / 2 | 0.82 | 300[E] (0, 0, 0) | 2,500 (0, 0, 0) |

**Table A-2b. Concentrations of chemicals detected in Detroit River sediments near Grassy Island, Detroit River, Michigan in a more recent study. (Sediments sampled August 2006. Concentration in parts per million [ppm]. Sampling locations with more than one sample taken have only the higher detected concentration shown. Chemicals listed in bold exceed their screening value.)**

| **Chemical** | ***Upstream*** No. detects / No. samples | ***Upstream*** Concentration Range | ***Weir*** No. detects / No. samples | ***Weir*** Concentration Range | ***Downstream*** No. detects / No. samples | ***Downstream*** Concentration Range | **ATSDR Soil Value (No. exceedances)[A]** | **Generic MDEQ DCC (No. exceedances)[A]** |
|---|---|---|---|---|---|---|---|---|
| Tin | 0 / 1 | ND | 1 / 1 | 0.98 | 1 / 2 | 0.61 | 20,000[B] (0, 0, 0) | NC |
| Zinc | 1 / 1 | 80.76 | 1 / 1 | 75.92 | 2 / 2 | 46.63 - 131.50 | 20,000[C] (0, 0, 0) | 170,000 (0, 0, 0) |

Notes:

ATSDR Agency for Toxic Substances and Disease Registry

MDEQ Michigan Department of Environmental Quality

DCC Direct Contact Criterion

NC no criterion for this chemical

A. Numbers in parentheses indicate exceedances near the upstream shore, the weir discharge point, and the downstream shore, respectively, of Grassy Island.

B. Value is Environmnetla Media Evaluation Guide (EMEG) for intermediate exposure duration (greater than 2 weeks to 1 year).

C. Value is EMEG for chronic exposure duration (greater than 1 year).

D. Value is Cancer Risk Evaluation Guide.

E. Value is Reference Dose Media Evaluation Guide.

F. Value is for hexavalent chromium, a more protective value than for total or trivalent chromium.

G. Value is EMEG for acute, pica exposure duration (up to 2 weeks, in individuals who tend to eat non-food material).

Table A-3. Concentrations of chemicals detected in Detroit River water sampled near Grassy Island, Detroit River, Michigan. (Water sampled in April 1997. Concentrations in parts per billion [ppb].)

| **Chemical** | **No. detects / No. samples** | **Concentration** | **ATSDR EMEG (No. exceedances)** | **Generic MDEQ GCC (No. exceedances)** | **Adjusted GCC (No. exceedances)** | **MDEQ Rule 57 Value (No. exceedances)** |
|---|---|---|---|---|---|---|
| 2-Butanone | 1 / 1 | 10 | 4,000 (0)[A] | 240,000,000 (0) | 12,000,000 (0) | 49,000 (0) |
| 4-Methyl-2-pentanone | 1 / 1 | 35 | NC | 13,000,000 (0) | 560,000 (0) | NC |
| Acetone | 1 / 1 | 20 | 9,000 (0)[B] | 31,000,000 (0) | 1,300,000 (0) | 5,600 (0) |
| Calcium | 1 / 1 | 30,192 | NC | NC | --- | NC |
| Iron | 1 / 1 | 209 | NC | 58,000,000 (0) | 2,500,000 (0) | NC |
| Magnesium | 1 / 1 | 8,434 | NC | 1,000,000,000 (0) | 91,000,000 (0) | NC |
| Phenol | 1 / 1 | 25 | 2,000 (0)[A] | 29,000,000 (0) | 1,300,000 (0) | 1,100 (0) |
| Sodium | 1 / 1 | 5,623 | NC | 1,000,000,000 (0) | --- | NC |
| Zinc | 1 / 1 | 24 | NC | 110,000,000 (0) | 4,500,000 (0) | 3,300 (0) |

Notes:

A. Value is the EPA Lifetime Health Advisory level (LTHA), the most protective value ATSDR uses.

B. Value is the chronic EMEG for children.

ATSDR Agency for Toxic Substances and Disease Registry
EPA U.S. Environmental Protection Agency
GCC Groundwater Contact Criteria
MDEQ Michigan Department of Environmental Quality
NC no criterion/comparison value for this chemical

References: Sweat 1999b, MDEQ 2006a

**Appendix B. Adjustment of ATSDR Comparison Values and MDEQ Residential Direct Contact Criteria to Address Infrequent Contact with Contaminated Soils on Grassy Island**

I. Chemicals Exceeding ATSDR Chronic Soil EMEG or RMEG (for children)

The purpose of the ATSDR Environmental Media Evaluation Guide (EMEG) or Reference Dose Media Evaluation Guide (RMEG) is to help public health assessors determine which non-carcinogenic (non-cancer-causing) chemicals at a contaminated site should be evaluated in depth. The chronic soil EMEG and the RMEG consider daily exposures greater than 1 year (ATSDR 2005b). The following discussion will demonstrate how the comparison values were adjusted to account for an adult going onto Grassy Island once a week per year and a child going onto the island once a month per year. MDCH assumed the more frequent exposure for the adult would reflect a US Fish and Wildlife Service (USFWS) or Coast Guard staff person regularly accessing the island as part of their job. Although public access to Grassy Island currently is prohibited, anecdotal evidence indicates that some people have been on the island. Therefore, to be protective, MDCH also evaluated exposure to children, however at a lower frequency.

Those chemicals in Grassy Island soils that exceeded their respective chronic soil EMEG or RMEG, for children (a more protective number than that used for adults), were:

- aldrin
- arsenic
- cadmium
- manganese
- PCBs.

Aldrin, arsenic, and PCBs are carcinogens (EPA 1991, 1994a, 1998) and have Cancer Risk Evaluation Guide (CREG) values for soil as well. MDCH adjusted both screening values for each chemical to determine the more protective number. Cadmium is a carcinogen but only by the inhalation route (EPA 1992). It does not have a soil CREG.

The equation used to determine the default EMEG or RMEG is (ATSDR 2005b):

$$EMEG(orRMEG) = \frac{MRL(orRfD) \times BW}{IR \times CF}$$

**MRL** is the ATSDR Minimal Risk Level. An MRL is an estimate of the daily human exposure to a substance that is likely to be without appreciable risk of adverse (non-cancer) health effects during a specified duration of exposure. MRL values for chronic exposure are lower than those for acute (up to 2 weeks) or intermediate (greater than 2 weeks up to 1 year) exposure (ATSDR 2005b). Lower values used for the MRL (or RfD) will result in a more protective EMEG (or RMEG). **RfD** is the U.S. Environmental Protection Agency (EPA) Reference Dose. It is similar to a chronic MRL, although EPA considers the exposure duration to be “lifetime” and not just greater than 1 year. EPA does not derive RfDs for less-than-chronic exposures (ATSDR 2005b). Table B-1 shows the MRL or RfD for the chemicals of interest in this exercise.

**BW** is the body weight of the person being exposed. In this exercise, to be protective, MDCH is adjusting the EMEG or RMEG for a child. The EPA default BW for a child is 15 kg (EPA 1997). However, MDCH used the more protective ATSDR value of 10 kg (ATSDR 2005b).

**IR** is the daily soil ingestion rate. The default IR for an adult ingesting soil is 100 mg/day (EPA 1997), about $1/16^{th}$ teaspoon or a pinch. However, MDCH is assuming that an adult would not be exposed every day but only once a week. Therefore, IR for adults was adjusted to 14.2 mg/day (the result of 100 mg/day X 52 days/year ÷ 365 days/year). The default IR for a child ingesting soil is 200 mg/day (EPA 1997), about $1/8^{th}$ teaspoon. However, MDCH is assuming that a child is not exposed every day but only once a month. Therefore, IR was adjusted to 6.6 mg/day (the result of 200 mg/day X 12 days/year ÷ 365 days/year).

**CF** is the conversion factor used so that the appropriate units appear in the product of the equation. This value is $10^{-6}$ kg/mg (1E-6 kg/mg).

Table B-1 shows the Adjusted EMEG or RMEG for the chemicals of interest in this exercise.

Table B-1. MRL/RfDs and Adjusted EMEG/RMEGs for chemicals of interest in Grassy Island soils.

| **Chemical** | **MRL or RfD (mg/kg/day)** | **Adjusted EMEG/RMEG (ppm)** | |
|---|---|---|---|
| | | *Adult Exposure* | *Child Exposure* |
| Aldrin | 0.00003 | 148 | 45 |
| Arsenic | 0.0003 | 1,479 | 455 |
| Cadmium | 0.0002 | 986 | 303 |
| Manganese | 0.047 | 231,690 | 71,212 |
| PCBs | 0.00002 | 99 | 30 |

References: ATSDR 2005a, MDEQ 2006d

Notes:

EMEG Environmental Media Evaluation Guide
mg/kg/day milligram per kilogram per day
MRL Minimal Risk Level
PCBs polychlorinated biphenyls
ppm parts per million
RfD Reference Dose
RMEG Reference Dose Media Evaluation Guide

## II. Chemicals Exceeding ATSDR CREG

The ATSDR Cancer Risk Evaluation Guides (CREGs) help public health assessors determine which carcinogenic contaminants at a site need further evaluation. Unlike EMEGs or RMEGs, CREGs only consider exposure to adults. Also, because it is assumed that carcinogens do not have a threshold (a dose below which there would be no risk of developing cancer), CREGs are applied to any length exposure (ATSDR 2005b). The following discussion will demonstrate how the comparison values were adjusted to account for an adult going onto Grassy Island once a week per year.

Those chemicals in Grassy Island soils that exceeded their respective CREGs were:

- aldrin
- arsenic
- benzo(a)pyrene
- PCBs.

The equation used to determine the default CREG for a chemical is (ATSDR 2005b):

$$CREG = \frac{TR \times BW \times CF}{IR \times CSF}$$

**TR** is the target risk. The CREG value reflects a theoretical cancer risk of 1 in one million (1E-6). (This means that, out of 1,000,000 people exposed to a carcinogen, no more than 1 additional cancer would occur due to that exposure.) The acceptable cancer risk in Michigan, as legislated (State of Michigan 1994), is 1 in 100,000 (1E-5). MDCH used a TR of 1E-5 for this exercise.

**BW** is the body weight of the person being exposed. Since the CREG is only applied to adult receptors, MDCH used the default adult body weight of 70 kg (EPA 1997).

**CF** is the conversion factor used so that the appropriate units appear in the product of the equation. The factor here is $10^6$ mg/kg.

**IR** is the daily soil ingestion rate. Since the CREG is only applied to adult receptors, MDCH used the default adult soil ingestion rate of 100 mg/day (EPA 1997). However, MDCH is assuming that an adult would not be exposed every day but only once a week. Therefore, IR was adjusted to 14.2 mg (the result of 100 mg/day X 52 days/year ÷ 365 days/year).

**CSF** is the oral cancer slope factor, which is an estimate of the increased cancer risk from a lifetime exposure to a chemical. It is a probability estimate that is used only for comparative purposes and not a predictive tool. Table B-2 shows the CSFs and Adjusted CREGs for the chemicals of interest in this exercise. (MDCH used the benzo(a)pyrene CSF provided by EPA, which is a more protective value than that calculated by MDEQ.)

Table B-2. CSFs and Adjusted CREGs for chemicals of interest in Grassy Island soils.

| **Chemical** | **CSF ([mg/kg-day]$^{-1}$)** | **Adjusted CREG (ppm)** |
|---|---|---|
| Aldrin | 8.7 | 5.7 |
| Arsenic | 1.5 | 33 |
| Benzo(a)pyrene | 7.3 | 6.8 |
| PCBs | 2 | 25 |

References: EPA 1991, 1994a, 1994c, 1998

Notes:

CREG Cancer Risk Evaluation Guide
CSF cancer slope factor
mg/kg-day milligram per kilogram per day
PCBs polychlorinated biphenyls
ppm parts per million

The Adjusted CREGs for aldrin, arsenic, and PCBs are more protective (lower) than their respective Adjusted EMEGs.

## III. Chemicals Exceeding MDEQ Residential DCC

The purpose of the MDEQ Generic Residential and Commercial I Direct Contact Criteria (DCC) is to protect against adverse health effects, cancer or non-cancer, due to long-term ingestion of and dermal exposure to contaminated soil. The generic DCC are only protective of chronic, not acute, effects and do not address inhalation of any volatile chemicals (MDEQ 2005). The following discussion will demonstrate how the criteria were adjusted to account for a person going onto Grassy Island once a week per year. To be protective, MDCH assumed that a person would access the island from childhood through adulthood. (Unlike the ATSDR EMEG and RMEG, there are no child-specific or adult-specific DCC.)

*Carcinogens*

The carcinogens in Grassy Island soils that exceeded their respective DCCs were:

- arsenic
- benzo(a)anthracene
- benzo(a)pyrene
- benzo(b)fluoranthene
- dibenz(a,h)anthracene
- indeno(1,2,3-cd)pyrene
- PCBs.

The equation used to determine the Residential DCC of a known or probable carcinogen is below (MDEQ 2005):

$$ResidentialDCC_{carcinogen} = \frac{TR \times AT \times CF}{SF \times [(EF_i \times IF \times AE_i) + (EF_d \times DF \times AE_d)]}$$

**TR** is the target cancer risk, or the acceptable risk. An "acceptable" risk may range from 1 in 10,000 to 1 in 1,000,000, meaning that no more than one additional person in ten thousand (1E-4) or one million (1E-6) persons who are exposed to a specific carcinogen will die from cancer compared to a similar population not exposed to the carcinogen. The acceptable cancer risk in Michigan, as legislated (State of Michigan 1994), is 1 in 100,000 (1E-5). MDCH used a TR of 1E-5 for this exercise.

**AT** is the averaging time factor, which, for carcinogens, is equivalent to the average human lifespan of 70 years, or 25,550 days. When a chemical is found to be carcinogenic in laboratory animals, the research typically involves a high dose of the chemical given to the animal over a short period of time. Based on the assumption that a high dose of a carcinogen received over a short period of time is equivalent to a corresponding low dose spread over a lifetime, human exposures are calculated by prorating the total cumulative dose over an average person's lifetime.

**CF** is the conversion factor used so that the appropriate units appear in the product of the equation. This factor is equal to 1,000,000,000 micrograms per kilogram (1E+9 μg/kg).

**SF** is the oral cancer slope factor, which is an estimate of the increased cancer risk from a lifetime exposure to a chemical. It is a probability estimate that is used only for comparative purposes. It is not a predictive tool. The SFs for the carcinogens adjusted in this exercise are shown in Table B-3. (MDCH used the SFs provided by EPA for the SVOCs, which were more protective than the values calculated by MDEQ.)

$\mathbf{EF_i}$ is the ingestion exposure frequency. It is assumed in this exercise that a child or adult would be exposed to Grassy Island soils 52 days (once per week) per year. (For ease of calculation, MDCH did *not* proportion $EF_i$, with lower exposure frequency for children and higher for adults.)

**IF** is the age-adjusted soil ingestion factor. It assumes that a child through the age of six years eats 200 mg of soil per day, and that an adult will eat 100 mg of soil per day for 24 years. Each ingestion total (years X amount eaten/year) is divided by the respective default body weight and the resulting quotients are summed. In this exercise, the ATSDR default child body weight of 10 kg was used rather than the EPA default of 15 kg, to provide greater protection. Therefore, IF in this exercise is equal to 154 mg-year/kg-day.

$\mathbf{AE_i}$ is the ingestion absorption efficiency (a science-based estimate of what percentage of a chemical is absorbed through the gastrointestinal tract) and is chemical-specific. For all of the carcinogens adjusted in this exercise, the $AE_i$ is 0.5 (50 percent) (MDEQ 2006c).

$\mathbf{EF_d}$ is the dermal exposure frequency. Similar to $EF_i$ above, it is assumed that a person would be exposed to the island soils for 52 days per year. (For ease of calculation, MDCH did *not* proportion $EF_d$, with lower exposure frequency for children and higher for adults.)

**DF** is the age-adjusted soil dermal factor. It considers exposed skin surface area, a soil adherence factor (AF), number of events per day, and the exposure duration and divides the product of those factors by the body weight. Respective subfactors are determined for a child and an adult and then summed. The default AF for children is 0.2 milligrams per square centimeter ($mg/cm^2$), meaning 0.2 mg of soil would adhere to each square centimeter of exposed skin (MDEQ 2005). Similar to the IF above, MDCH used the ATSDR default child body weight of 10 kg when calculating the DF. No adjustments were made for the adult subfactor. The DF in this exercise is equal to 459.6 mg-year/kg-day.

**$AE_d$** is the dermal absorption efficiency (a science-based estimate of what percentage of a chemical is absorbed through the skin) and is chemical-specific. The $AE_d$ values and the Adjusted DCCs for the carcinogens adjusted in this exercise are shown in Table B-3.

Table B-3. SFs, $AE_d$s, and Adjusted DCCs for chemicals of interest in Grassy Island soils.

| **Chemical** | **SF ($[mg/kg\text{-}day]^{-1}$)** | **$AE_d$** | **Adjusted DCC (ppm)** |
|---|---|---|---|
| Arsenic | 1.5 | 0.03 | 36 |
| Benzo(a)anthracene | 0.73 | 0.13 | 49 |
| Benzo(a)pyrene | 7.3 | 0.13 | 4.9 |
| Benzo(b)fluoranthene | 0.73 | 0.13 | 49 |
| Dibenz(a,h)anthracene | 7.3 | 0.13 | 4.9 |
| Indeno(1,2,3-cd)pyrene | 0.73 | 0.13 | 49 |
| PCBs | 2 | 0.14 | 17 |

References: EPA 1994a, 1994b, 1994c, 1994d, 1994e, 1994f, 1998; MDEQ 2006c

Notes:

| | |
|---|---|
| $AE_d$ | dermal absorption efficiency |
| DCC | Direct Contact Criterion |
| mg/kg-day | milligram per kilogram per day |
| PCBs | polychlorinated biphenyls |
| ppm | parts per million |
| SF | cancer slope factor |

*Noncarcinogens*

To determine the more protective adjusted screening value, cancer or noncancer, for arsenic and PCBs, MDCH adjusted the noncarcinogen-DCC for these chemicals. (There are no non-cancer DCC values for PAHs.)

The equation used to determine the Residential DCC of a noncarcinogen is below (MDEQ 2005):

$$ResidentialDCC_{noncarcinogen} = \frac{THQ \times RfD \times AT \times CF \times RSC}{(EF_i \times IF \times AE_i) + (EF_d \times DF \times AE_d)}$$

**THQ** is the target hazard quotient. A hazard quotient is the relationship of an exposure dose to the Reference Dose (discussed below) of a chemical. If the quotient (exposure value divided by reference value) is less than or equal to 1, no adverse health effect would be expected (ATSDR 2005b). For this exercise, the THQ is 1.

**RfD** is the Reference Dose, an estimated concentration of a chemical that a person can be exposed to orally for a lifetime without experiencing noncancer health effects. Although uncertainty exists in deriving the estimate (EPA 2005a), the agency deriving the value (usually EPA) strives to protect the most sensitive population. The RfDs for arsenic and PCBs are shown in Table B-4.

**AT** is the averaging time, which, for noncarcinogens, is equal to the exposure duration in years times 365 days/year. For this exercise, the exposure duration is 30 years, from childhood through adulthood. Therefore, AT is 10,950 days.

**CF** is a conversion factor and is the same as that for carcinogens, 1E+6 mg/kg.

**RSC** is the relative source contribution. There may be other exposures that the receptor population may face beside the exposure of immediate concern. For this exercise, it is assumed that half of the total exposure to PCBs is via Grassy Island soils. (The other half is assumed to be through the consumption of PCB-contaminated Detroit River fish.) Therefore the RSC for PCBs in this exercise is 0.5 (50 percent). It is assumed that all arsenic exposure is via Grassy Island soils (a value of 1, or 100 percent).

**$EF_i$** is the ingestion exposure frequency and, for this exercise, is the same as that used for carcinogens, 52 days/year.

**IF** is the age-adjusted soil ingestion factor and, for this exercise, is the same as that used for carcinogens, 154 mg-year/kg-day.

**$AE_i$** is the ingestion absorption efficiency, which, for arsenic and PCBs, is 0.5 (50 percent) (MDEQ 2006c).

**$EF_d$** is the dermal exposure frequency and, for this exercise, is the same as that used for carcinogens, 52 days/year.

**DF** is the age-adjusted soil dermal factor and, for this exercise, is the same as that used for carcinogens, 459.6 mg-year/kg-day.

**$AE_d$** is the dermal absorption efficiency, shown in Table B-4.

Table B-4. RfDs, RSCs, $AE_d$s, and Adjusted DCCs for chemicals of interest in Grassy Island soils.

| **Chemical** | **RfD (mg/kg/day)** | **RSC** | **$AE_d$** | **Adjusted DCC (ppm)** |
|---|---|---|---|---|
| Arsenic | 2.7E-4 | 1 | 0.03 | 626 |
| PCBs | 2E-5 | 0.5 | 0.14 | 15 |

References: EPA 1994a, 1985; MDEQ 2006c

Notes:

| | |
|---|---|
| $AE_d$ | dermal absorption efficiency |
| DCC | Direct Contact Criterion |
| mg/kg/day | milligram per kilogram per day |
| PCBs | polychlorinated biphenyls |
| ppm | parts per million |
| RfD | Reference Dose |
| RSC | relative source contribution |

The adjusted DCC for cancer for arsenic is more protective than its adjusted DCC for noncancer. The adjusted DCC for noncancer for PCBs is more protective than their adjusted DCC for cancer.

**Appendix C. Adjustment of ATSDR Comparison Values to Address Infrequent Contact with Contaminated Sediments in the Detroit River near Grassy Island**

I. Chemicals Exceeding ATSDR Chronic Soil EMEG or RMEG (for children)

The purpose of the ATSDR Environmental Media Evaluation Guide (EMEG) or Reference Dose Media Evaluation Guide (RMEG) is to help public health assessors determine which non-carcinogenic (non-cancer-causing) chemicals at a contaminated site should be evaluated in depth. The chronic soil EMEG and the RMEG consider daily exposures greater than 1 year (ATSDR 2005b). The following discussion will demonstrate how the comparison values were adjusted to account for a person standing in sediments in the Detroit River near Grassy Island 90 days per year (three summer months). MDCH assumed this degree of exposure because the river shallows near the island are not off-limits to the public and people may fish in the protected bay on the west side of the island (see Figure 1).

The only chemical in sediment that exceeded its chronic soil EMEG, for children (a more protective number than that used for adults), was arsenic.

Arsenic is a carcinogen and has a Cancer Risk Evaluation Guide (CREG) value for soil as well. MDCH adjusted both screening values for arsenic to determine the more protective number.

The equation used to determine the default EMEG is (ATSDR 2005b):

$$EMEG = \frac{MRL \times BW}{IR \times CF}$$

**MRL** is the ATSDR Minimal Risk Level. An MRL is an estimate of the daily human exposure to a substance that is likely to be without appreciable risk of adverse (non-cancer) health effects during a specified duration of exposure. MRL values for chronic exposure are lower than those for acute (up to 2 weeks) or intermediate (greater than 2 weeks up to 1 year) exposure (ATSDR 2005b). Lower values used for the MRL will result in a more protective EMEG. The chronic MRL for arsenic is 0.0003 mg/kg/day (ATSDR 2005a).

**BW** is the body weight of the person being exposed. In this exercise, to be protective, MDCH adjusted the EMEG for a child. The EPA default BW for a child is 15 kg (EPA 1997). However, MDCH used the more protective ATSDR value of 10 kg (ATSDR 2005b).

**IR** is the daily soil ingestion rate. The default IR for a child ingesting soil is 200 mg/day (EPA 1997), about 1/8$^{th}$ teaspoon. However, MDCH is assuming that a child is not exposed every day but only 90 days per year (the summer months). Therefore, IR was adjusted to 49.3 mg/day (the result of 200 mg/day X 90 days/year ÷ 365 days/year).

**CF** is the conversion factor used so that the appropriate units appear in the product of the equation. This value is $10^{-6}$ kg/mg (1E-6 kg/mg).

The Adjusted EMEG for arsenic, to address occasional exposure to sediments, is

$$AdjustedEMEG_{Arsenic} = \frac{0.0003 \times 10}{49.3 \times 1E-6} = 61 mg / kg$$

The units "mg/kg" are equal to ppm.

II. Chemicals Exceeding ATSDR CREG

The ATSDR Cancer Risk Evaluation Guides (CREGs) help public health assessors determine which carcinogenic contaminants at a site near further evaluation. Unlike EMEGs or RMEGs, CREGs only consider exposure to adults. Also, because it is assumed that carcinogens do not have a threshold (a dose below which there would be no risk of developing cancer), CREGs are applied to any length exposure (ATSDR 2005b). The following discussion will demonstrate how the comparison values were adjusted to account for a person standing in sediments in the Detroit River near Grassy Island 90 days per year (three summer months).

Those chemicals in Grassy Island soils that exceeded their respective CREGs were:
- •arsenic
- •benzo(a)pyrene.

The equation used to determine the default CREG for a chemical is (ATSDR 2005b):

$$CREG = \frac{TR \times BW \times CF}{IR \times CSF}$$

**TR** is the target risk. The CREG value reflects a theoretical cancer risk of 1 in one million (1E-6). (This means that, out of 1,000,000 people exposed to a carcinogen, no more than 1 additional cancer would occur due to that exposure.) The acceptable cancer risk in Michigan, as legislated (State of Michigan 1994), is 1 in 100,000 (1E-5). MDCH used a TR of 1E-5 for this exercise.

**BW** is the body weight of the person being exposed. Since the CREG is only applied to adult receptors, MDCH used the default adult body weight of 70 kg (EPA 1997).

**CF** is the conversion factor used so that the appropriate units appear in the product of the equation. The factor here is $10^{6}$ mg/kg.

**IR** is the daily soil ingestion rate. Since the CREG is only applied to adult receptors, MDCH used the default adult soil ingestion rate of 100 mg/day (EPA 1997). However, MDCH is assuming that an adult would not be exposed every day but only 90 days per year. Therefore, IR was adjusted to 24.7 mg/day (the result of 100 mg/day X 90 days/year ÷ 365 days/year).

**CSF** is the oral cancer slope factor, which is an estimate of the increased cancer risk from a lifetime exposure to a chemical. It is a probability estimate that is used only for comparative purposes and not a predictive tool. Table C-1 shows the CSFs and Adjusted CREGs for arsenic and benzo(a)pyrene. (MDCH used the CSF for benzo(a)pyrene provided by EPA, which is a more protective value than that calculated by MDEQ.)

Table C-1. CSFs and Adjusted CREGs for chemicals of interest in Detroit River sediments near Grassy Island.

| **Chemical** | **CSF ([mg/kg-day]$^{-1}$)** | **Adjusted CREG (ppm)** |
|---|---|---|
| Arsenic | 1.5 | 19 |
| Benzo(a)pyrene | 7.3 | 3.9 |

References: EPA 1994c, 1998

Notes:

| | |
|---|---|
| CREG | Cancer Risk Evaluation Guide |
| CSF | cancer slope factor |
| mg/kg-day | milligram per kilogram per day |
| ppm | parts per million |

The Adjusted CREG for arsenic is more protective than its Adjusted EMEG.

III. Chemicals Exceeding MDEQ Residential DCC

The purpose of the MDEQ Generic Residential and Commercial I Direct Contact Criteria (DCC) is to protect against adverse health effects due to long-term ingestion of and dermal exposure to contaminated soil. The generic DCC are only protective of chronic, not acute, effects and does not address inhalation of any volatile chemicals. The generic DCC may be adjusted to address the protection of persons who may come into contact with contaminated sediments, such as by wading or playing in the Detroit River near Grassy Island. The following discussion will demonstrate how the criteria were adjusted to account for a person standing in the river. To be protective, MDCH assumed that a person would have exposure to the river and its sediments from childhood through adulthood.

Benzo(a)pyrene is a probable human carcinogen (EPA 1994). The equation used to determine the Residential DCC of a known or probable carcinogen is below (MDEQ 2005):

$$\mathrm{Re}\,sidentialDCCcarcinogen = \frac{TR \times AT \times CF}{SF \times [(EFi \times IF \times AEi) + (EFd \times DF \times AEd)]}$$

**TR** is the target cancer risk, or the acceptable risk. An “acceptable” risk may range from 1 in 10,000 to 1 in 1,000,000, meaning that no more than one additional person in ten thousand (1E-4) or one million (1E-6) persons who are exposed to a specific carcinogen will die from cancer compared to a similar population not exposed to the carcinogen. The target risk in this exercise is set at 1 in 100,000 (**1E-5**).

**AT** is the averaging time factor, which, for carcinogens, is equivalent to the average human lifespan of 70 years, or **25,550 days**. When a chemical is found to be carcinogenic in laboratory animals, the research typically involves a high dose of the chemical given to the animal over a short period of time. Based on the assumption that a high dose of a carcinogen received over a short period of time is equivalent to a corresponding low dose spread over a lifetime, human exposures are calculated by prorating the total cumulative dose over an average person's lifetime.

**CF** is the conversion factor used so that the appropriate units appear in the product of the equation. This factor is equal to 1,000,000,000 micrograms per kilogram (**1E+9 µg/kg**).

**SF** is the oral cancer slope factor, which is an estimate of the increased cancer risk from a lifetime exposure to a chemical. It is a probability estimate that is used only for comparative purposes. It is not a predictive tool. The SF for benzo(a)pyrene is 7.3 per milligram per kilogram-day **[7.3 (mg/kd-day)$^{-1}$]** (EPA 1994). (MDCH used the SF for bezno(a)pyrene provided by EPA rather than that calculated by MDEQ, for a more protective value.)

**$EF_i$** is the ingestion exposure frequency. It is assumed in this exercise that a child or adult would be exposed to the sediment in the Detroit River near Grassy Island **90 days** (3 months) per year.

**IF** is the age-adjusted soil ingestion factor. It assumes that a child through the age of six years eats 200 mg of soil per day, and that an adult will eat 100 mg of soil per day for 24 years. Each ingestion total (years X amount eaten/year) is divided by the respective default body weight and the resulting quotients are summed. In this exercise, the ATSDR default child body weight of 10 kg was used rather than the EPA default of 15 kg, to provide greater protection. Therefore, IF in this exercise is equal to **154 mg-year/kg-day**.

**$AE_i$** is the ingestion absorption efficiency (a science-based estimate of what percentage of a chemical is absorbed through the gastrointestinal tract) and is chemical-specific. For benzo(a)pyrene the $AE_i$ is **0.5** (50 percent) (MDEQ 2006).

**$EF_d$** is the dermal exposure frequency. Similar to $EF_i$ above, it is assumed that a person would be exposed to the sediment in the river no more than **90 days** per year.

**DF** is the age-adjusted soil dermal factor. It considers exposed skin surface area, a soil adherence factor (AF), number of events per day, and the exposure duration and divides the product of those factors by the body weight. Respective subfactors are determined for a child and an adult and then summed. The default AF for children is 0.2 milligrams per square centimeter (mg/cm$^2$), meaning 0.2 mg of soil would adhere to each square centimeter of exposed skin (MDEQ 2005). The default AF is applicable to the 95$^{th}$ percentile of children playing in *dry* soil (95 percent of children would have less soil adhering). In this case, however, the river sediments would be wet and likely adhere more readily than dry soil. Conversely, a child or adult would likely rinse off the majority of the sediment when coming out of the river. An AF value of 0.2 mg/cm$^2$ also applies to the *50$^{th}$* percentile of children playing in *wet* soil. This value affords some protection against adhered sediments, even though the majority, if not all, of the sediment would be washed off. Similar to the IF above, MDCH used the ATSDR default child body weight of 10 kg when calculating the DF. No adjustments were made for the adult subfactor. The DF in this exercise is equal to **459.6 mg-year/kg-day**.

**$AE_d$** is the dermal absorption efficiency (a science-based estimate of what percentage of a chemical is absorbed through the skin) and is chemical-specific. The value for benzo(a)pyrene is **0.13** (13 percent; MDEQ 2006).

The adjusted Residential DCC for benzo(a)pyrene is calculated as follows:

$$Adjusted\ \mathrm{Re}\,sidentialDCC = \frac{1E-5 \times 25{,}550 \times 1E+9}{7.3[(90 \times 154 \times 0.5) + (90 \times 459.6 \times 0.13)]}$$

$$Adjusted\ \mathrm{Re}\,sidentialDCC = 2{,}844 \mu g / kg = 2.8 mg / kg$$

The units mg/kg are equivalent to parts per million (ppm).

**Appendix D. Adjustment of MDEQ Groundwater Contact Criteria to Address Children Swimming in the Detroit River near Grassy Island**

The purpose of the MDEQ Groundwater Contact Criteria (GCC) is to protect workers in subsurface excavations from adverse (cancer and non-cancer) health effects that can result from coming into dermal (skin) contact with a hazardous substance. The GCC is protective of only chronic, not acute, effects, and it addresses only dermal exposure, not incidental ingestion nor inhalation of any volatiles (MDEQ 2006d). The GCC may be adjusted to address the protection of people who come into contact with contaminated surface water, such as swimming in a lake or river. This exercise will demonstrate how the criteria were adjusted to account for children, ages 9 to 12, swimming in the Detroit River near Grassy Island. MDCH assumed that this age-group of children would be the most likely people swimming near the island.

The chemicals detected in Detroit River water near Grassy Island were:

- 2-butanone
- 4-methyl-2-pentanone
- acetone
- iron
- magnesium
- phenol
- sodium
- zinc.

None of these chemicals is a carcinogen (EPA 2002, 2003a, 2003b, 2003c, 2005b; MDEQ 2006c).

The equation used to determine the GCC of a non-carcinogen is below (MDEQ 2006d):

$$GCC_{noncarcinogen} = \frac{THQxRfDxBWxATxCF1}{SAxSPxEVxEFxEDxCF2}$$

**THQ** is the target hazard quotient. An expected dose is compared to the reference dose (RfD), resulting in a hazard quotient, that is, the expected value divided by the reference value. If the quotient is less than or equal to 1, the expected dose is generally considered to be acceptable. The THQ in this exercise is the default, 1.

The **RfD** for a chemical is an estimate, with uncertainty or safety factors built in, of the daily lifetime dose of a substance that is unlikely to cause harm in humans (ATSDR 2005b). These are chemical-specific values and are shown in Table D-1.

**BW** is the body weight. The range of body weights for a child of either sex, aged 9 to 12 years, is 31.5 to 45.3 kilograms (kg; EPA 2000). To be protective, the lower weight was used.

**AT** is the averaging time. For noncarcinogens, it is the number of days over which the exposure is averaged, or ED (the exposure duration) times 365 days per year. Because it was assumed that children age 9 to 12 would swim in the Detroit River near Grassy Island, AT for this exercise is 3 years (ED) times 365 days/yr or 1,095 days.

**$CF_1$** is the first conversion factor used so that the appropriate units appear in the product of the equation. This factor is equal to one thousand micrograms per milligram (1E+3 μg/mg).

**SA** is the skin surface area. For a child of either sex between the ages of 9 and 12 years, the average total skin surface area is 1.16 square meters ($m^2$) or 11,600 square centimeters ($cm^2$; EPA 2000).

**SP** is the skin penetration per event factor and based on the rate at which a specific chemical penetrates the skin and the exposure time, which is assumed to be 2 hours per event. These are chemical-specific values and are shown in Table D-1.

**EV** is event frequency, or the frequency of contact (swimming in the river). It is assumed to be 1 two-hour event per day.

**EF** is exposure frequency. It is assumed in this exercise that a 9- to 12-year-old would swim in the river five days per week for 12 weeks (three summer months) for a total of 60 days per year. This scenario allows for bad weather and days spent away from the river. It may overestimate the frequency of exposure but it provides a protective estimate.

**ED** is exposure duration. It is assumed that the scenario will occur over three years, from age 9 to 12 years. Parents would likely have more control over where younger children would swim, and as a child enters adolescence, he or she might be more apt to use a community pool or beach as a social gathering place as well as for swimming.

**$CF_2$** is the second conversion factor used so that the appropriate units appear in the product of the equation. This factor is equal to 1 milliliter per square centimeter (1E-3 $L/cm^2$).

Table D-1 shows chemical-specific values and the Adjusted GCCs for the chemicals of interest in the Detroit River near Grassy Island.

Table D-1. RfDs, SPs, and Adjusted GCCs for chemicals of interest in Detroit River water near Grassy Island.

| **Chemical** | **RfD (mg/kg/d)** | **SP (cm/event)** | **Adjusted GCC (ppb)** |
|---|---|---|---|
| 2-Butanone | 1.8 | 0.0024 | 12,000,000 |
| 4-Methyl-2-pentanone | 0.25 | 0.0074 | 560,000 |
| Acetone | 0.1 | 0.0013 | 1,300,000 |
| Iron | 0.3 | 0.002 | 2,500,000 |
| Magnesium | 11 | 0.002 | 91,000,000 |
| Phenol | 0.6 | 0.0079 | 1,300,000 |
| Sodium | 34 | NA | --- |
| Zinc | 0.33 | 0.0012 | 4,500,000 |

References: EPA 2002, 2003a, 2003b, 2003c, 2005b; MDEQ 2006c

Notes:

| | |
|---|---|
| cm | centimeter |
| GCC | Groundwater Contact Criterion |
| mg/kg/d | milligram per kilogram per day |
| NA | not available |
| ppb | parts per billion |
| RfD | Reference Dose |
| SP | skin penetration |

## Appendix E. ATSDR Public Health Hazard Categories

Depending on the specific properties of the contaminant(s), the exposure situations, and the health status of individuals, a public health hazard may occur. Sites are classified using one of the following public health hazard categories:

*Urgent Public Health Hazard*
This category applies to sites that have certain physical hazards or evidence of short-term (less than 1 year), site-related exposure to hazardous substances that could result in adverse health effects. These sites require quick intervention to stop people from being exposed. ATSDR will expedite the release of a health advisory that includes strong recommendations to immediately stop or reduce exposure to correct or lessen the health risks posed by the site.

*Public Health Hazard*
This category applies to sites that have certain physical hazards or evidence of chronic (long-term, more than 1 year), site-related exposure to hazardous substances that could result in adverse health effects. ATSDR will make recommendations to stop or reduce exposure in a timely manner to correct or lessen the health risks posed by the site.

*Indeterminate Public Health Hazard*
This category applies to sites where critical information is lacking (missing or has not yet been gathered) to support a judgment regarding the level of public health hazard. ATSDR will make recommendations to identify the data or information needed to adequately assess the public health risks posed by this site.

*No Apparent Public Health Hazard*
This category applies to sites where exposure to site-related chemicals might have occurred in the past or is still occurring, but the exposures are not at levels likely to cause adverse health effects. ATSDR may recommend any of the following public health actions for sites in this category:

- cease or further reduce exposure (as a preventive measure)
- community health/stress education
- health professional education
- community health investigation.

*No Public Health Hazard*
This category applies to sites where no exposure to site-related hazardous substances exists. ATSDR may recommend community health education for sites in this category.

For more information, consult Chapter 9 and Appendix H in the 2005 ATSDR Public Health Assessment Guidance Manual (http://www.atsdr.cdc.gov/HAC/PHAManual/index.html).

**Appendix F. Public comments received on the February 6, 2007 "Grassy Island Health Consultation" and MDCH's responses.**

Note: rather than show the comments in their entirety, MDCH paraphrased the issues raised by the interested parties.

<u>Comments from MDEQ</u>

**The health consultation does not evaluate compliance with applicable land/water-related laws in Michigan.**

The primary purpose of a public health consultation or assessment is not to evaluate or confirm compliance with MDEQ Part 201 rules, but to determine if people are being exposed, or may be exposed in the future, to potentially harmful concentrations of chemicals. ATSDR is an advisory agency and recommendations made in its documents may not necessarily encompass all applicable regulatory requirements. MDCH added language to the *Purpose and Health Issues* section of the document to clarify its role at this site.

**The consultation should recognize that a prominent exposure pathway exists as the result of contaminants that may be leaving Grassy Island via groundwater.**

ATSDR and MDCH acknowledge that some metal and SVOC concentrations exceed their respective Part 201 Groundwater Surface Water Interface Protection Criteria (GSIPC; data not shown). While the GSIPC may be applicable at this site from a regulatory view, ATSDR and MDCH feel that the current estimated seepage rate does not affect the Detroit River from a public health point of view. Note that this does *not* exempt the U.S. Fish and Wildlife Service (USFWS) from required compliance with State of Michigan regulatory statutes.

**A fish consumption advisory is not an enforceable exposure control under state of Michigan regulations and cannot be relied upon to demonstrate compliance.**

ATSDR and MDCH agree that a fish consumption advisory is not enforceable and cannot be relied upon to demonstrate compliance with Part 201 requirements. However, as stated previously, the health agencies do not feel that the Detroit River, and the fish therein, are significantly affected by contamination at Grassy Island. Fish consumption is not a significant exposure pathway in relation to the island.

**MDCH should compare surface water data to the MDEQ Part 31 surface water criteria.**

MDCH has added discussion to the health consultation and listed the ATSDR and MDEQ values for human drinking water in Table A-3 in Appendix A. None of the detected chemicals exceeded the criteria.

Comments from private citizens

**Grassy Island has very substandard containment, is uncapped, contains heavy concentrations of mercury and PCBs, and is located between two drinking water intakes. It is endangering the public. MDCH and the Michigan Attorney General's office should investigate the U.S. Fish and Wildlife Service for negligence and dereliction of duty. The Service should fund current and future medical examinations for those persons who have come in contact with the island soil or nearby water or sediments. There should be compensation for individuals who experience health effects in the future.**

MDCH understands that some people are very concerned that contamination at Grassy Island could befoul the Detroit River. However, the agency does not believe that there is any immediate danger to public health. As discussed in the health consultation, the flow volume of the river is such that any present seepage from the island would be diluted to the point of non-detection when the water is tested at intake plants downstream.

MDCH's authority does not include investigating alleged actions (or non-actions) of other agencies. If ATSDR and MDCH conclude that action should be taken at a site, they inform the agency managing the site (MDEQ, EPA, USFWS) or, in public health emergencies, may take action themselves.

As discussed in the health consultation, ATSDR and MDCH do not feel that public exposure to the contamination at Grassy Island would result in negative health effects. Medical testing and surveillance are not necessary.

**Grassy Island is on the National Priorities List (Superfund site list) and should therefore undergo a full public health assessment for the contamination present. The fact that the contamination poses an "indeterminate future public health hazards" should be reason enough to conduct a public health assessment.**

Although Grassy Island has been assigned a CERCLIS (Comprehensive Environmental Response, Compensation, and Liability Information System) number (MIN000509205), it is not the National Priorities List (NPL). (Please see http://oaspub.epa.gov/enviro/cerclis_web.report?pgm_sys_id=MIN000509205.) When asked for public health assistance at non-NPL contaminated sites, ATSDR and its cooperative-agreement-partner states choose the most appropriate approach to evaluate a site.

The public-comment health consultation for Grassy Island stated that the hazard was indeterminate because it was unclear whether the island would have more human use in the future. Since the release of the public-comment document, MDCH has learned that the USFWS does not plan to promote the island for public use (J. Hartig, USFWS, personal communication, 2007). Therefore, there is no apparent future public health hazard. This change has been made to the health consultation.

**The same level of public health concern expressed in the remediation of the Rouge River must be expressed in the remediation of Grassy Island.**

ATSDR and MDCH agree that all sites of environmental contamination or concern should be viewed with the same degree of interest in public health. However, each site is unique, and its public use and exposure scenarios may result in a different conclusion as compared to a site with similar contamination.

**The bow wakes of large vessels using the Detroit River batter the poorly constructed dikes around Grassy Island. The current of the Detroit River has undermined the north end of the island. Only a dye test will reveal the threat of erosion currently existing at the island.**

According to the U.S. Army Corps of Engineers (COE), no subsurface investigations of the dikes have occurred offshore at Grassy Island. It is likely that, similar to any surface water interaction with a shore, some erosion is occurring (W. Schloop, COE, personal communication, 2007). A dye test would not be helpful in determining the threat or degree of erosion. Rather, a dike inspection would provide more information on the conditions of the dikes (P. Horner, COE, personal communication, 2007).

**I would like fishing piers to be installed on each side of Grassy Island, especially the west bay and the south side. Muskellunge and walleye could be caught from a shore fishing pier.**

MDCH has forwarded this comment to USFWS.

<u>Comments from U.S. Fish and Wildlife Service</u>

**Under current conditions, waterfowl are not likely to nest on the island. The Service has no plans for creating wetland or waterfowl habitat on the island.**

MDCH has added this comment to the health consultation.

**As of June 15, 2007, the Service does not plan to promote the island for public use.**

MDCH has added this comment to the health consultation.