Ecosystem-Based Environmental Management System Assessment Report

Harbors, Marinas and Related Infrastructure
Muskegon, Michigan

Prepared for
The Lake Michigan Forum

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1.0 Introduction

1.1 Overview

In November 2006, the Lake Michigan Forum proposed an initiative centered on mercury in ports and marinas. After some preliminary investigation, the initiative was reframed with the broader scope of environmental management, providing greater long-term impact to the ports around the Lake Michigan Basin.

Ports facilities are highly concentrated industrial areas near water and contain a variety of facilities including container terminals, boat repair shops, and industries related to the transportation of goods. However, the role of ports and their potential for improvement of environmental quality is relatively unexplored. Ports have a unique position between land and water, government and industry, public and private, and economic and environmental issues, which could be a powerful catalyst in fostering more sustainable practices and improve environmental quality and economic growth around Lake Michigan and the Great Lakes.

Generally, individual ports are represented by quasi-governmental entities know as Port Authorities. The broad role of the Port Authority is as the advocate and spokesperson for the industry by educating elected officials and the public in general on the economic, social and environmental impact of port and marina facilities. Port Authorities also coordinate harbor activities, manage land-side facilities for ships and facilitate inter-modal transport corridors, and manage development activities.[1] However, there are many Lake Michigan communities with small commercial ports that do not have Port Authorities. As a result, the port and marina entities do not speak with a unified voice or share a unified vision for the economic growth and sustainability of the local community.

As a result, the Lake Michigan Forum is encouraging a dialogue between port and marina representatives, Forum members and other Lake Michigan stakeholders. Initially, the Lake Michigan Forum would like to discuss how ports could improve environmental quality in Lake Michigan. Issues to be explored could include:

- The role of ports in mitigating the introduction and spread of aquatic invasive species;
- Pollution prevention (source and non-point source) along the shoreline as well as toxics reduction;
- The use of Port Authorities to stimulate sustainable economic development.

To this end, the Lake Michigan Forum tasked the Delta Institute, facilitator of the Forum, with benchmarking the environmental footprint of port and marina operations along Muskegon Lake. Delta employed its ecosystem-based, environmental management systems (ECO-EMS) approach to document the emissions and discharges from facilities that have port operations or entities that directly service port operations, such as railroads. This document is the first product from the Lake Michigan Forum's Sustainable Ports Initiative.

The Lake Michigan Forum hopes that the environmental benchmarking of Muskegon ports and marinas will lead to the development of an implementation plan to address identified priorities. The

[1] Dave Bergeron, Extension Educator, Minn. SeaGrant Program, Workshop at Lake Michigan Forum Meeting (Mar. 1, 2007).

implementation planning process will include the identification of stakeholders to participate in the project and give guidance to the realities of the area and the feasibility of implementation. The stakeholders would assist in creating a local consensus for port project and act as a unified entity while implementing activities in their own operations.

The goal of this ECO-EMS process is to benchmark current environmental performance, so ports and marinas can measure improvements over time. Delta does not provide this information to implicate facilities for poor management practices, nor is Delta implying that the facilities along Muskegon Lake are making illegal discharges. In fact, all of the emissions and discharges identified within this report are within permitted levels. However, some of the data used in this report can be misleading if one does not understand the process by which the data is compiled. This is particularly true for the U.S. Environmental Protection Agency's Toxic Releases Inventory (TRI), which requires regulated companies to report the chemical composition of waste products, not the waste product itself, implying that the manufacturer released chemicals directly to the air, water or land. Thus, without an understanding of how the government collects the data, one is likely to get a false impression of the environmental contamination around Muskegon Lake.

1.2 Process Overview

In 2007, the Delta Institute, at the request of the Lake Michigan Forum, began working to complete an Eco-EMS assessment of the port and marina facilities, as well as related infrastructure, along Muskegon Lake. This section describes the evaluation process used by the Delta Institute to complete its analysis of the environmental impact of facilities located along Muskegon Lake. A flowchart outlining the process is below.

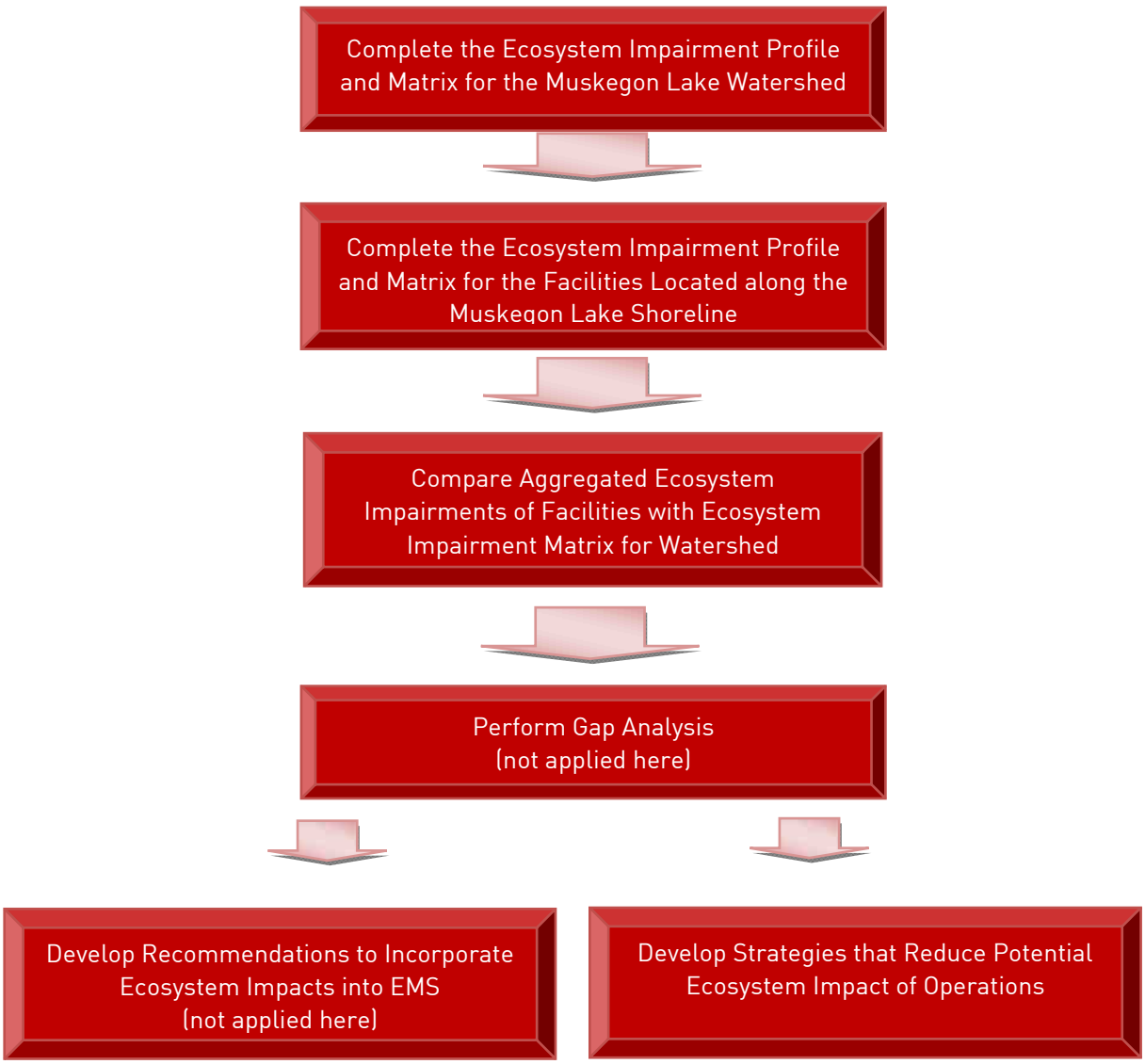
The first step in the Eco-EMS assessment process is completing an Ecosystem Impairment Profile and Matrix. Delta used the Profile and Matrix to identify local ecosystem impairments and community issues of concern in the Muskegon Lake Watershed. To complete the Profile and Matrix, Delta compiled existing publicly available information and worked with Lake Michigan Forum members to determine priority impairments in the Muskegon Lake Watershed. A brief explanation of the rationale behind this tool is included in Sections 2.1 and 2.2 of this report.

The next step is comparing the aggregated ecosystem impairments of port, marina, and other facilities with the ecosystem impairments identified for the Muskegon Lake Watershed in the Profile and Matrix. The purpose of this comparison is to evaluate the potential effects (positive or negative) of facility operations on the local ecosystem. The results of aggregated ecosystem impairments are provided in Attachments B and C of this report.

Typically, Delta would then complete a gap analysis of each facility's Environmental Management System (EMS) to evaluate the effectiveness of the objectives and targets to minimize the potential impacts of a facility's operations on the identify ecosystem impairments. For those operations where the objectives and targets are not completely protective of the local ecosystem impacts, Delta would develop recommendations that would incorporate ecosystem impairments into the EMS and identify strategies to reduce those potential impacts. However, Delta did not perform the gap analysis because we are examining the cumulative impact of multiple port facilities, rather than the impact of a single facility. Additionally, Delta does not have any specific information on the current environmental management practices at the facilities identified in this report. Thus, there is no means for Delta to evaluate the effectiveness of a single facility's environmental management system relative to the ecosystem impairments.

Finally, using the Profile and Matrix as a guide, Delta developed a series of recommendations and strategies, based extensively on best management practices for ports. These strategies are described in Section 4.0 of this report.

Figure 1 Eco-EMS Process



1.3 Understanding the Data Used in this Report

The data documenting the air, water and land discharges is compiled form two publically available sources: the Michigan Air Emissions Reporting System (MAERS) and the U.S. Environmental Protection Agency Toxic Releases Inventory (TRI). The baseline air and water emissions data is the total emissions reported to TRI and MAERS for facilities located within the Muskegon Lake Watershed. The port emissions data represents facilities and infrastructure located between the Muskegon Lake shoreline and following roads: Lakeshore Drive, W. Western Avenue, Shoreline Drive, E. Western Avenue, and N. Causeway Street.

1.3.1 Michigan Air Emissions Reporting System (MAERS)[2]

The federal Clean Air Act requires that each state maintain an inventory of air pollution emissions for certain facilities and update this inventory every year. Michigan's emission inventory is the Michigan Air Emissions Reporting System (MAERS). The Michigan Department of Environmental Quality (DEQ), Air Quality Division maintains MAERS reports for commercial, industrial, and governmental sources of air pollution in Michigan. Emissions data is submitted to the United States Environmental Protection Agency (U.S. EPA) to be added to the national data bank. This information is used to track air pollution trends, determine the effectiveness of current air pollution control programs, serve as a basis for future year projections of air quality, track source compliance, provide information for permit review, and calculate the emissions portion of the air quality fee.

The Air Quality Division's Operational Memorandum No. 13 generally explains which Michigan facilities that operate sources of air pollution are required to report their annual emissions under MAERS. They include the following:

- Facilities subject to the Renewable Operating Permit (ROP) Program.
- Facilities that have opted out of the ROP Program by using Michigan Air Pollution Control Rule 208(a) or obtaining an Opt Out Permit to Install.
- Facilities subject to a federal New Source Performance Standard (NSPS).
- Facilities participating in the Emissions Trading Program.
- Facilities whose actual emissions exceed the following thresholds

Pollutant	Threshold[3]
Carbon monoxide (CO)	100 tons per year
Nitrogen oxides (NO_X)	40 tons per year
Sulfur dioxide (SO_2)	40 tons per year
Particulate matter (PM)	25 tons per year
Particulate matter (PM_{10})	15 tons per year
Volatile organic compounds (VOC)	10 tons per year
Lead (Pb)	0.6 tons per year

- Any facility receiving notification from the Air Quality Division to report.

The best publicly available data from MAERS reflects 2005 emissions. The State of Michigan has collected data for 2006 emissions, but has not made it available to the public yet. Delta could have obtained this data through a Freedom of Information Act request, but did not have the time to work through the FOIA process. Of the thirty-eight reporting facilities for Muskegon County, only seventeen (17) facilities are within the Muskegon Lake Watershed, with three (3) facilities along the shoreline. Figure 2 lists the companies within the Muskegon Lake Watershed that reported emissions to MAERS in 2005. The companies in **bold** are located along the shoreline and included in the port emissions data.

[2] *See* www.michigan.gov/deq.

[3] These thresholds are based on the significant levels defined in Rule 119(e) of the Michigan Air Pollution Control Rules, with the exception of VOC. The VOC threshold is based on the major source definition for a single hazardous air pollutant in Section 112 of the federal Clean Air Act and the requirement to identify VOC point sources greater than 10 tons per year in the Michigan State Implementation Plan (SIP).

Figure 2 – Companies Reporting to Michigan Air Emissions Reporting System

B.C. Cobb Generating Plant	Kaydon Bearing Co
Bayer Cropscience LP	L-3 Communiciations Corp
Brunswick Bowling & Billiards	Marathon Petroleum Co LLC
Cannon Muskegon Corp	Michigan Steel Inc
Century Foundry Inc	Nupak Solutions
CWC Textron	S.D. Warren (Sappi)
Dana Corp - Harvey St Facility	Tech Line Products
Dana Corp - Sanford St Facility	The Nugent Sand Co
Hackley Hospital	

1.3.2 U.S. Environmental Protection Agency – Toxic Releases Inventory (TRI) Program[4]

The Toxics Release Inventory (TRI) is a publicly available EPA database that contains information on toxic chemical releases and other waste management activities reported annually by certain covered industry groups as well as federal facilities. This inventory was established under the Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) and expanded by the Pollution Prevention Act of 1990.

EPCRA's primary purpose is to inform communities and citizens of chemical hazards in their areas. Sections 311 and 312 of EPCRA require businesses to report the locations and quantities of chemicals stored on-site to state and local governments in order to help communities prepare to respond to chemical spills and similar emergencies. EPCRA Section 313 requires EPA and the States to annually collect data on releases and transfers of certain toxic chemicals from industrial facilities, and make the data available to the public in the Toxics Release Inventory (TRI). In 1990 Congress passed the Pollution Prevention Act which required that additional data on waste management and source reduction activities be reported under TRI. The goal of TRI is to empower citizens, through information, to hold companies and local governments accountable in terms of how toxic chemicals are managed.

Toxics Release Inventory data are reported by individual facilities, which send yearly reports to federal EPA on a form called "Form R". EPA converts these forms into an electronic database. A facility must report to TRI if the facility:

- Has 10 or more full-time employees, and
- Manufactures or processes over 25,000 pounds of the approximately 650 designated chemicals or 28 chemical categories specified in the regulations, or uses more than 10,000 pounds of any designated chemical or category, and
- Engages in certain manufacturing operations in the industry groups specified in the U.S. Government Standard Industrial Classification Codes (SIC) 20 through 39, or
- Is a federal facility which are all now required to report per the August, 1995 Executive Order signed by President Clinton.

EPA compiles the TRI data each year and makes it available through several data access tools, including the TRI Explorer and Envirofacts. There are other organizations which also make the data available to the public through their own data access tools, including Unison Institute which puts out a tool called "RTKNet" and Environmental Defense which has developed a tool called "Scorecard."

[4] *See* http://www.epa.gov/tri/.

The TRI program has expanded significantly since its inception in 1987. The Agency has issued rules to roughly double the number of chemicals included in the TRI to approximately 650. Seven new industry sectors have been added to expand coverage significantly beyond the original covered industries, i.e. manufacturing industries. Most recently, the Agency has reduced the reporting thresholds for certain persistent, bioaccumulative, and toxic (PBT) chemicals in order to be able to provide additional information to the public on these chemicals.

One must understand the intricacies of the TRI program to best understand the risk that certain emissions and discharges posed to public health and the environment. Generally, we can assume that chemicals, discharged to air or water, are in a chemical state that could potentially impact human health or the environment. Conversely, for discharges to land, one cannot assume that a chemical is in a state that could potentially impact human health and the environment. For example, if a manufacturer has steel as a waste product, TRI requires the manufacturer to report the amount of each toxic chemical within the waste steel, implying a direct release of the chemical. As a result, a steel manufacturer reporting on/off-site disposal of chromium probably has not released elemental chromium or chromium compounds to the environment. Rather, the manufacturer probably has scraps of waste steel needing recovery or disposal. Thus, before implicating companies for poor environmental practices, please take a moment to understand how the data is reported and the extent of the actual discharge.

The TRI program has twenty-six different categories for which entities can report emissions or waste discharges. To simplify the process, Delta has aggregated the categories to measure the discharges to air, water and land. The discharges to air are reported in two categories – Fugitive and Stack Emissions. The discharges to water are reported in two categories – Surface Water and POTW (Publicly-Owned Treatment Works). The discharges to land are reported in three categories – On-Site Land Disposal, Off-Site Land Disposal and Off-Site RCRA (Resource Conservation and Recovery Act) Disposal. For future explanation on specific TRI categories, see Attachment A at the end of this report.

The facilities listed in Figure 3 are located within the Muskegon Lake Watershed and serve as the baseline for this Eco-EMS. The facilities in **bold** are located along the shoreline and included within the port emissions data.

Figure 3 – Companies Reporting to the Toxic Release Inventory

Bayer Cropscience LP	Kaydon Bearing Co
B.C. Cobb Generating Plant	Knoll Inc - Estes St Facility
Brunswick Bowling & Billiards	**Knoll Inc - Western Ave Facility**
Cannon Muskegon Corp	M. Argueso & Co Inc
Century Foundry Inc	Marathon Petroleum Co LLC
CWC Textron	Michigan Spring & Stamping
Dana Corp - Harvey St Facility	**Michigan Steel Inc**
Dana Corp - Sanford St Facility	**S.D. Warren (Sappi)**
Eagle Aluminum Cast Products Inc	Tech Line Products
GMI Composites Inc	Yale/Life Tech
Great Lakes Die Cast Corp	

1.3.3 Lake Michigan Air Director Consortium (LADCO)[5]

This report outlines the results of the work to improve the emission inventories for the off-road emission categories: locomotives, commercial marine, and pleasure craft. This work identified the available sources of equipment activity information for local emission sources for overall and by county activity estimates.

For the rail operations, we focused on the CSX line since it serves port facilities. However, the LADCO report lists the total fuel usage for statewide CSX rail operations. To obtain data for the Muskegon operations, we isolated CSX operations to a 46 mile stretch that runs West Olive through Muskegon to Fremont. Since the West Olive-Muskegon-Fremont line equals 5% of CSX rail lines statewide, we assumed that the Muskegon line comprised 5% of statewide fuel usage. Having an estimate of fuel use per year, we applied emissions factors for criteria pollutants listed in the LADCO report.

The emissions from commercial marine operations were taken directly from the LADCO report.

1.3.4 Energy Information Administration

To estimate carbon dioxide emissions, we relied on data collected by the Energy Information Administration. Through the EIA-906/920 database, Delta was able to record the quantity of fuel burned for electricity by the B.C. Cobb generating station and the S.D. Warren (SAPPI) facilities. With this data, we multiplied consumption by carbon dioxide emissions factors for each fuel type to estimate carbon dioxide emissions.

The EIA databases are available at http://www.eia.doe.gov/cneaf/electricity/page/eia906_920.html.

1.3.5 Binational Toxics Strategy[6]

Additionally, Delta included impairments addressing regional issues in this analysis. For the Muskegon Lake Watershed, regional issues include the chemicals of concern identified by the Binational Toxics Strategy. The Binational Toxics Strategy is a multi-stakeholder process to reduce or eliminate critical pollutants to the Great Lakes. Level I pollutants are those pollutants identified under the Binational Toxics Strategy to require immediate action. Level I substances include:

- Aldrin/dieldrin
- Benzo(a)pyrene
- Chlordane
- DDT
- Hexachlorobenzene (HCB)
- Alkyl-lead
- Mercury and mercury compounds
- Mirex
- Octochorostyrene
- PCBs
- PCDD (Dioxins) & PCDF (Furans)
- Toxaphene

[5] CHRISTIAN E. LINDHJEM, LADCO NONROAD EMISSION INVENTORY PROJECT FOR LOCOMOTIVE, COMMERCIAL MARINE, AND RECREATIONAL MARINE EMISSION SOURCES (2004); *See also* http://www.midwestrailfan.com/mmrr.html and http://www.midwestrailfan.com/muskops.html for information on railroad operations around Muskegon Lake.
[6] THE GREAT LAKES BINATIONAL TOXICS STRATEGY, *available at* http://www.epa.gov/greatlakes/p2/bnssign.PDF.

Level II substances are those pollutants that will be addressed at a later time through the Binational Toxics Strategy process but are still of concern to the Great Lakes. Level II substances include:

- Cadmium and cadmium compounds
- 1,4-dichlorobenzene
- 3,3'-dichlorobenzene
- Dinitropyrene
- Endrin
- Heptachlor (+Heptachlor epoxide)
- Hexachlorobutadiene (+Hexachloro-1,3-butadiene)
- Hexachlorocyclohexane
- 4,4'-methylenebis(2-chloroaniline)
- Pentachlorobenzene
- Pentachlorophenol
- Tetrachlorobenzene (1,2,3,4- and 1,2,4,5-)
- Tributly tin.
- Polycyclic Aromatic Hydrocarbons (PAHs) as a group, including by not limited to:
    - Anthracene
    - Benzo(a)anthracene
    - Benzo(g,h,i)perylene
    - Perylene
    - Phenanthrene

Whenever possible, facilities should eliminate these compounds from their operations.

1.4 Muskegon Lake Watershed[7]

Muskegon Lake is a 4,150-acre inland coastal lake located on the west shoreline of Michigan's Lower Peninsula. Muskegon Lake is fed by the Muskegon River, which ultimately empties into Lake Michigan through a navigation channel. For the purpose of this project, the watershed boundary for Muskegon Lake was defined as the vicinity drained by the urbanized area within Muskegon County, excluding the Mona Lake Watershed and the Lower Grand River Watershed.

The Muskegon Lake Watershed (Watershed) drains approximately 130 square miles and covers all or parts of two counties, nine townships, and five cities. Included in the system are several creeks, rivers, drains, and lakes. Waterways that discharge directly into Muskegon Lake include Ruddiman Creek, Ryerson Creek, Muskegon River, Green Creek, and the Bear Lake channel. Forests (38%), development (17%), agriculture (13%), wetlands (12%), grasslands/shrublands (10%), and open water/barren land (10%) cover the landscape.

The Watershed is part of the larger Muskegon River Watershed, which covers 2,725 square miles and has forty sub-basins. The Muskegon River, approximately 219 miles in length, flows from Higgins and Houghton Lakes to its mouth at Muskegon Lake. The Muskegon River is fed by an estimated 94 tributaries including the West Branch of the Muskegon River, Butterfield Creek, Clam River, Middle Branch River, Hersey River, Little Muskegon River, Bigelow Creek, Brooks Creek, Maple River, and Cedar Creek.

[7] FISHBECK, THOMPSON, CARR & HUBER, INC, MUSKEGON LAKE WATERSHED MANAGEMENT PLAN 1 (2005), *available at* http://www.michigan.gov/documents/deq/ess-nps-muskegon-lake-wmp_198337_7.pdf.

Hydrology

Muskegon Lake is a drowned river mouth that supports a warm water fishery and covers approximately 4,150 acres. Waterways that discharge directly into Muskegon Lake include the Muskegon River, Ruddiman Creek, Ryerson Creek, Green Creek, and the Bear Lake Channel. Other waterways within the Watershed include Little Bear Creek, Bear Creek, Four Mile Creek, Spring Creek, Mosquito Creek, and the Maple River. These waterways are runoff driven with moderate to low base flow, moderate to high peak flows, have the potential to be flashy during heavy precipitation, and are eutrophic. The main trunk of the Muskegon River, however, is groundwater fed with high to moderate base flow, low to moderate peak flows, and is mesotrophic with moderate amounts of nutrients. The Muskegon River, Little Bear Creek, and Muskegon River tributaries (from Section 18 of the City of North Muskegon, east to Section 18 of Croton Township) are designated trout streams (coldwater streams).

Land Use

Prior to widespread European settlement in the 1800's, over half (51%) of the Watershed was covered by White Pine - White Oak forests. Mixed conifer swamps (10%), Hemlock - White Pine forests (9%), and mixed hardwood swamps (8%) were the other major types of vegetation. Since European settlement, the Watershed's landscape has changed significantly. By 1890, the Watershed's dense White Pine forest was almost completely harvested and in the 1900's major factories, including the Central Paper Company, began locating to the Muskegon Lake shoreline. At the same time, the lake was dominated by industrial growth related to foundries, metal finishing facilities, petrochemical production and shipping.

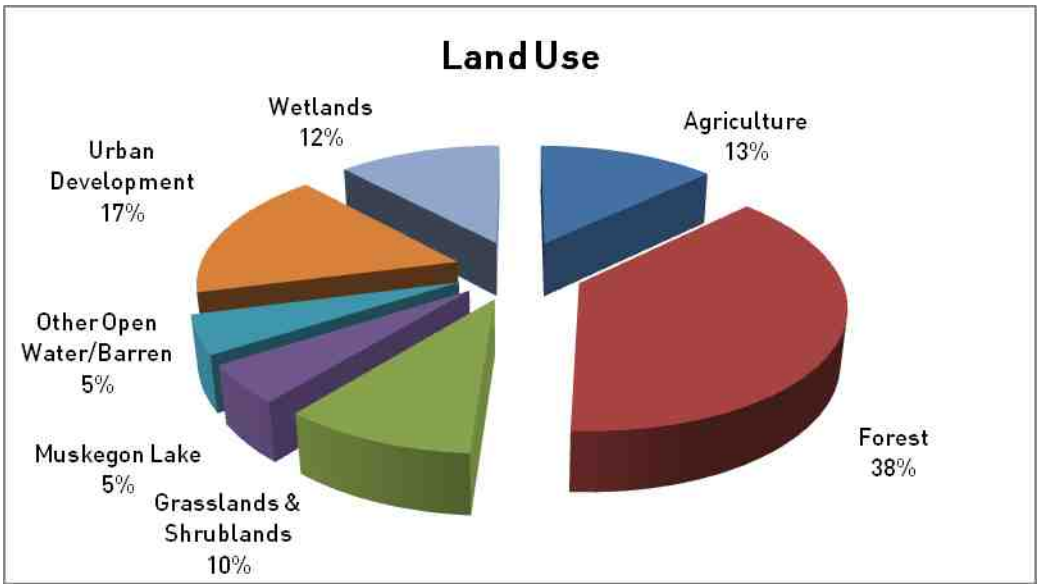
Present land use/cover is predominately forests (38%), according to the 1992 National Land Cover Dataset. However, development encompasses 17% of the Watershed with high-intensity development (7%) concentrated south of Muskegon Lake and low intensity development (10%) mainly surrounding lakes, waterways, and major roadways. Agriculture covers 13% of the Watershed and is concentrated in an area north of the Muskegon County Wastewater Treatment Facility. This 5,200-acre area of crop-producing farmland is an integral part of the Muskegon County Wastewater Management System. Wetlands (12%) are found primarily along the Muskegon River corridor, and grasslands and shrublands (10%) can be found where forests are located. Open water and barren land make up the remaining 10% of the Watershed.

Over many years, the shoreline and wetlands of Muskegon Lake have been filled with debris such as wood, metal and concrete, creating a situation where Muskegon Lake is now 73% of its original size.[8] In fact, the 'hardening' of the shoreline is a significant concern for organizations working to remove delist Muskegon Lake from the Areas of Concern.

Figure 4 – Land Use Characterization

Land Use Activity	Acres	% of Watershed
Agriculture	10,816	13%
Forest	31,616	38%
Grasslands/Shrublands	8,320	10%
Muskegon Lake	4,150	5%
Other Open Water/Barren	4,170	5%
Urban Development	14,144	17%
Wetlands	9,984	12%
	83,200	

[8] MUSKEGON LAKE WATERSHED PARTNERSHIP and MUSKEGON RIVER WATERSHED ASSEMBLY [*Hereinafter* MLWP & MWRA], A GUIDE TO THE RESTORATION OF MUSKEGON LAKE FISH AND WILDLIFE HABITAT (2007).



Environmental Issues[9]

Muskegon Lake's sub-watershed is one of fourteen (14) Areas of Concern (AOC) in Michigan. In 1985, the lake and tributaries were designated as an AOC because of degraded ecological conditions that correspond to criteria known as Beneficial Use Impairments (BUIs). Each AOC is guided by a voluntary Remedial Action Plan (RAP), which establishes goals for restoring Muskegon Lake and 'de-listing' it as an Area of Concern. The RAP is designed to guide community actions to restore Muskegon Lake's nine Beneficial Use Impairments.

1. Restrictions on human consumption of fish and wildlife
2. Loss of fish and wildlife habitat
3. Degradation of fish and wildlife populations
4. Degradation of benthos (bottom dwelling organisms)
5. Restrictions on dredging
6. Degradation of aesthetics
7. Beach closings
8. Eutrophication or undesirable algae
9. Restriction on drinking water consumption[10]

Targets for restoration, indicators of success, and actions to address the restoration of impaired BUIs are organized by 15 categories:

1. Pollution Prevention
2. Near Shore Aquatic Habitat
3. Contaminated Sediments
4. Fisheries
5. Invasive Species
6. Shoreline and Wetland Habitat
7. Land Use, Green Space, and Brownfields

[9] *See generally,* http://www.muskegonlake.org/.

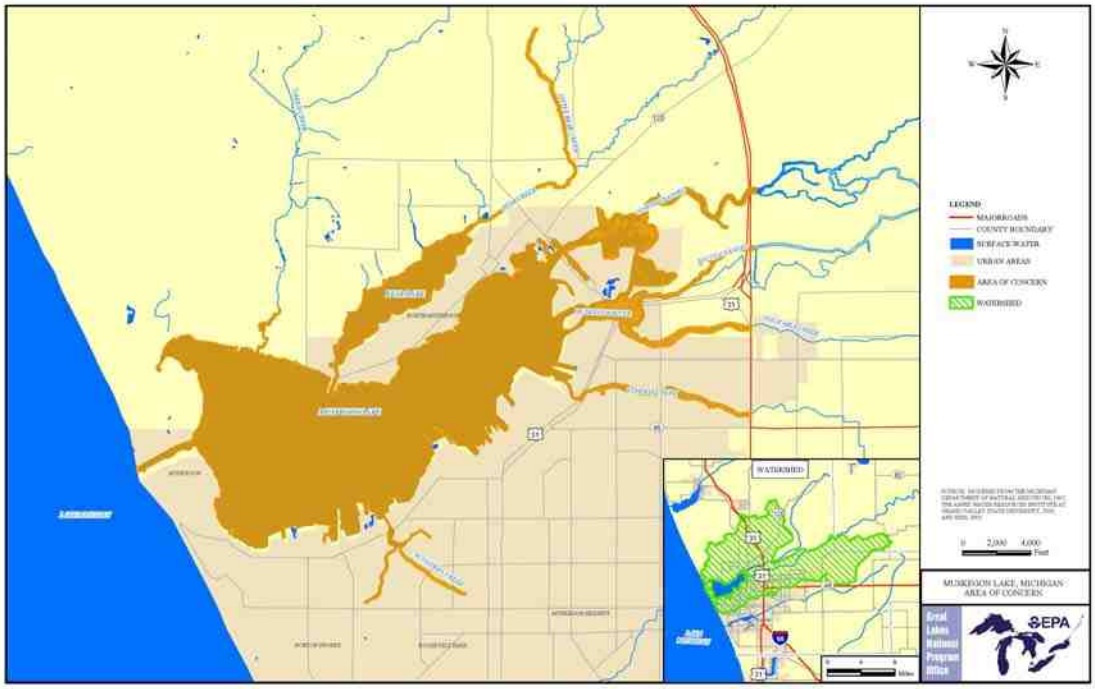
[10] *See* FISHBECK *supra* note 7 at 27.

8. Subwatersheds in the Area of Concern
9. Muskegon Lake's Total Maximum Daily Load (TMDL) Subwatersheds
10. Groundwater
11. Storm Water Runoff
12. Erosion and Sedimentation
13. Wastewater Management
14. Human Health
15. Public Education and Stewardship[11]

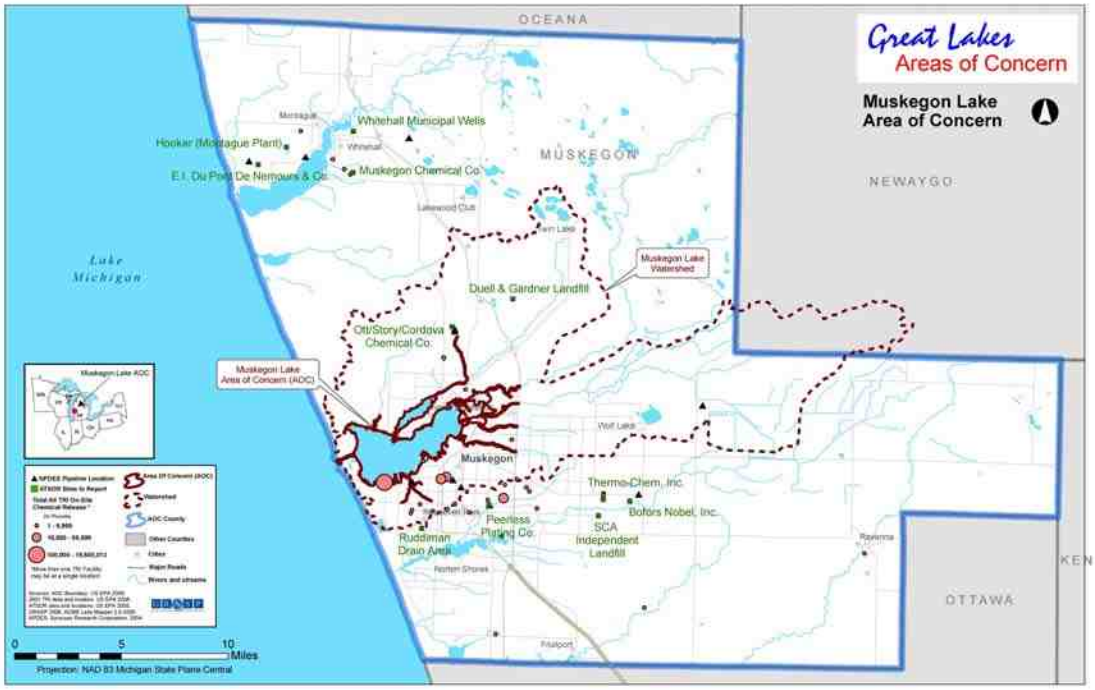
Even though significant water quality improvements resulted from the diversion of municipal and industrial wastewater from the lake to the Muskegon County Wastewater Management System in 1973, problems remain. During the 1980's and into the 2000's, Muskegon Lake's shoreline began to reflect more commercial and recreational uses, and heavy industry began to relocate.

To this day, Muskegon Lake remains an AOC because of water quality, sediment and habitat problems associated with urban runoff, dredging and filling at the shoreline, the historical discharges of polluted wastewater into the AOC, localized groundwater contamination moving toward the lake and its tributaries, and the potential effects on Lake Michigan.

Figure 5 – Maps of Muskegon Lake Area of Concern[12]



[11] *Id.* at 28.
[12] U.S. Envt'l Prot. Agency, *available at* http://www.epa.gov/glnpo/aoc/msklake/MuskegonLake_Final_State_Approved.pdf. *See also* U.S. Dept of Health & Human Services, Agency for Toxics Substances and Disease Registry, *Selected Information on Chemical Releases within Great Lakes Counties containing Areas of Concern* (2008 Draft for Public Comment), *available at* http://www.atsdr.cdc.gov/grtlakes/pdfs/2008/2008Maps/MuskegonLake_2008_TRI.pdf.



1.4.1 Economic Importance of Muskegon Harbor[13]

The Muskegon Harbor is located 114 miles northeast of Chicago, Illinois. Muskegon maintains a deep draft commercial harbor with depths of 28 – 29 feet and approximately 6,500 feet of maintained Federal Channel. The U.S. Army Corps of Engineers maintains over 6,200 feet of structures, including breakwaters, piers and revetments. Maintenance dredging is required on a 2 to 3 year cycle with the harbor was last dredged in 2004. In fiscal year 2008, the Federal Government allocated $523,000 for maintenance dredging, which is approximately half of what is needed for the Muskegon Harbor. The Army Corps of Engineers projects $519,000 of projects in FY2009 and $3,390,000 of projects in FY2010.

[13] U.S. ARMY CORPS OF ENG'RS, MUSKEGON HARBOR FACT SHEET (Apr. 2008).

Figure 6 – Projected Budget for Muskegon Harbor Projects

U.S. Army Corps of Engineers Fiscal Year (FY) 2008, 2009 and 2010
Muskegon Harbor, MI - Project Needs and President's Budget ($1,000)

Work Package	FY08 Need	FY08 Allocation	FY09 Need	FY09 President's Budget	FY10 Need	FY10 Budget*
Project Condition Surveys	66	66	69		72	
Maintenance Dredging – Primary Work Package	700	457			800	
Maintenance Dredging – Backlog Work Package					98	
Breakwater Repairs – by Gov. Floating Plant	275		350	350		
Sediment Budget Analysis – Section 111			100		150	
Repair North Breakwater Nose – by Contract					1,970	
Breakwater Repairs - by Floating Plant					300	
TOTALS	**1,071**	**523**	**519**	**350**	**3,390**	

*FY10 President's Budget will be available in February 2009.

Muskegon Harbor is 114th leading U.S. port with 2.2M tons of material shipped or received in 2006. In addition, Muskegon ranked 28th out of approximately 65 major international and smaller regional ports in the Great Lakes-St. Lawrence Seaway System in 2006.[14] If the harbor is not maintained through regular dredging, there would be a significant loss of jobs both locally and regionally. In addition, severe shoaling has caused four groundings in the past year, forcing ships to lighten loads before entering the harbor. A loss of 1 or 2 feet of channel depth results in increased transportation costs of between $150,000 and $350,000 annually.

The Muskegon Harbor is a major receiving port on the Great Lakes for commodities such as sand, gravel, limestone, cement, concrete, and coal. See Figure 7 below for a list of commodities entering Muskegon Lake.

[14] *See generally* http://www.great-lakes.net/teach/business/ship/ship_4.html, last visited July 28, 2008.

Figure 7 – Commodities Entering Muskegon Harbor[15]

Comparative Statement of Traffic (thousand short tons)

Year	Total	Year	Total	Year	Total	Year	Total
1996	2,172	1999	1,925	2002	2,187	**2005**	**2,063**
1997	2,061	2000	2,435	2003	2,545		
1998	1,936	2001	2,324	2004	2,684		

Freight Traffic, 2005 (thousand short tons)

Commodity	Grand Total	Canadian	Domestic			
		Inbound	Total	Lakewise		Internal
				Receipts	Shipments	Intraport
Total, all commodities	**2,063**	**224**	**1,839**	**1,816**	**16**	**7**
Total coal	**1,144**	—	**1,144**	**1,144**	—	—
1100 coal & lignite	1,144	—	1,144	1,144	—	—
Total crude materials, inedible except fuels	**777**	**224**	**552**	**552**	—	—
Subtotal soil, sand, gravel, rock and stone	**447**	**44**	**403**	**403**	—	—
4322 limestone	422	20	403	403	—	—
4331 sand & gravel	25	25	—	—	—	—
Subtotal sulphur, clay and salt	**3**	—	**3**	**3**	—	—
4782 clay & refrac. mat.	3	—	3	3	—	—
Subtotal slag	**163**	**16**	**147**	**147**	—	—
4860 slag	163	16	147	147	—	—
Subtotal other non-metal. min.	**164**	**164**	—	—	—	—
4900 non-metal. min. nec	164	164	—	—	—	—
Total primary manufactured goods	**143**	—	**143**	**120**	**16**	**7**
Subtotal lime, cement and glass	**143**	—	**143**	**120**	**16**	**7**
5220 cement & concrete	143	—	143	120	16	7

[15] U.S. ARMY CORPS OF ENG'RS, WATERBORNE COMMERCE OF THE UNITED STATES – WATERWAYS AND HARBORS GREAT LAKES 25 (2005).

Figure 8 – Trips and Drafts of Vessels in Muskegon Harbor[16]

Trips and Drafts of Vessels, 2005
(draft in feet)

Draft	Self Propelled Vessels				Non-Self Propelled Vessels		Self Propelled Vessels				Non-Self Propelled Vessels	
	Total	Dry Cargo	Tanker	Tow or Tug	Dry Cargo	Tanker	Total	Dry Cargo	Tanker	Tow or Tug	Dry Cargo	Tanker
MUSKEGON HARBOR, MI												
	Inbound						Outbound					
Grand Total	**164**	**117**	—	**21**	**23**	**3**	**156**	**112**	—	**18**	**25**	**1**
FOREIGN												
Total	**16**	**16**	—	—	—	—	**18**	**15**	—	**1**	**2**	—
26	3	3	—	—	—	—	—	—	—	—	—	—
25	4	4	—	—	—	—	—	—	—	—	—	—
24	6	6	—	—	—	—	—	—	—	—	—	—
23	1	1	—	—	—	—	—	—	—	—	—	—
22	1	1	—	—	—	—	12	12	—	—	—	—
21	—	—	—	—	—	—	1	1	—	—	—	—
19	—	—	—	—	—	—	1	1	—	—	—	—
18	1	1	—	—	—	—	2	1	—	—	1	—
16	—	—	—	—	—	—	1	—	—	1	—	—
≤ 12	—	—	—	—	—	—	1	—	—	—	1	—
DOMESTIC												
Total	**148**	**101**	—	**21**	**23**	**3**	**138**	**97**	—	**17**	**23**	**1**
28	—	—	—	—	—	—	1	1	—	—	—	—
27	10	10	—	—	—	—	1	1	—	—	—	—
26	21	19	—	—	2	—	8	7	—	—	1	—
25	20	17	—	—	3	—	6	4	—	—	2	—
24	17	14	—	—	3	—	6	5	—	—	1	—
23	8	7	—	—	1	—	2	2	—	—	—	—
22	7	7	—	—	—	—	8	8	—	—	—	—
21	7	6	—	—	1	—	7	7	—	—	—	—
20	10	9	—	—	1	—	15	14	—	—	1	—
19	12	7	—	—	5	—	5	5	—	—	—	—
18	—	—	—	—	—	—	13	10	—	—	3	—
17	—	—	—	—	—	—	11	11	—	—	—	—
16	13	—	—	8	5	—	19	4	—	8	7	—
15	4	—	—	4	—	—	8	4	—	2	2	—
14	1	1	—	—	—	—	5	1	—	—	4	—
13	4	—	—	4	—	—	4	—	—	4	—	—
≤ 12	14	4	—	5	2	3	19	13	—	3	2	1
										Total trips:		**320**

1.4.2 Economic Importance of Muskegon Marinas

Although much of this report is focused on the economic and environmental impacts of the ports of Muskegon Lake, it is important to consider the economic and environmental impacts of marinas as well. In 1999, Congress authorized a study to identify the economic benefits of recreational boating in the Great Lakes states.[17] Spending on boats and boating activities in the Great Lakes States totaled nearly $16 billion in 2003 and directly supported 107,000 jobs.[18] In Michigan, the boating industry has an average direct economic impact of $3.9 billion (trip and craft spending) and supports approximately 51,000 jobs.[19]

As a case study, the Great Lakes Commission studied the economic impact of the Tower Marine facility in Saugatuck-Douglas, Michigan. At this marina, 395 boats renting slips spent $2.85 million in annual craft expenses and $2.85 million on boating trips in 2004.[20] The direct economic impact of trip spending was $1.8 million in sales, $561,000 in wages and $952,000 in value added, supporting 37 jobs.[21] Annual craft

[16] *Id.* at 83.
[17] GREAT LAKES COMMISSION, GREAT LAKES RECREATIONAL BOATING'S ECONOMIC PUNCH 2 (2003).
[18] *Id.*
[19] *Id.* at 5.
[20] Dave Knight, GREAT LAKES COMMISSION, GREAT LAKES RECREATIONAL BOATING ECONOMIC BENEFITS STUDY, available at www.glc.org/dredging/scoop/documents/recboating6-28-05.ppt.
[21] *Id.*

expenses directly supported an additional 44 jobs from $2.6 million in direct sales, $834,000 in wages and $1.5 million in value added.[22]

"While the economic benefits identified in the recreational boating study appear significant, they are jeopardized in many Great Lakes shallow-draft harbors by a lack of maintenance dredging. In many shallow-draft harbors, entrance channels that provide access to the big lakes are becoming blocked by sediment accumulations, a problem made worse by low lake levels in recent years. Vessel groundings within these harbors are also becoming more common."[23]

In 2000, researchers surveyed two Michigan counties (Ottawa and Allegan) and determined that a third (34%) of the marinas has unusable slips due to low water.[24] In total, 600 slips were unusable with lost slip revenue of $600,000.[25] Furthermore, "thirty percent (30%) of marinas had slips that could not accommodate the size of boats they were designed to hold and that cost marinas an additional $184,000. In addition, there was a loss of $ 200,000 in revenues due to inaccessible facilities, e.g., fuel pumps, launch facilities. Twenty two percent (22%) of the marinas were required to do special dredging because of low water. The average dredging project removed 7,600 yards and cost $43,333. The cost includes removal and disposal. A number of marinas reported that even after incurring the cost of dredging in their marinas, access to Lake Michigan was blocked because dredging had not occurred in waterways that provided boating access. The direct economic impact (lost revenues and costs) on marinas in the two Michigan Counties is estimated to be $2 million." [26]

If water levels drop an additional 12" below 2000 levels, researchers estimate the loss of revenues and additional cost to the marinas in Ottawa and Allegan Counties at $3.99 million.[27] If water levels drop an additional 18" below the 2000 levels, the impact would be about $4.2 million.[28] Although this study was not performed for Muskegon County, Muskegon marinas would likely feel similar impacts.

1.5 Facility Descriptions

The following are short descriptions of the facilities that provide the port emissions data for this report.

1.5.1 B.C. Cobb Generating Station[29]

The Cobb plant is located on a 300-acre site beside Muskegon Lake, where its waters meet the Muskegon River. It was dedicated on April 28, 1949, and is named for Bernard Capen "Burt" Cobb, a former company president from 1915-34 and director from 1911-34. Cobb was the first president to succeed company founder William A. Foote.

The Cobb facility began producing electricity in 1948. Three of the original five coal-fired units were retired in 1990 and later repowered to burn natural gas. The remaining two coal units are considered baseload, because they are designed to run 24 hours a day, 365 days a year. The Cobb plant receives

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[22] *Id.*

[23] *Id.* at 10.

[24] PLANNING & ZONING CENTER, MICHIGAN STATE UNIVERSITY DEPARTMENT OF PARK, RECREATION AND TOURISM RESOURCES, ET AL, Economic Impact of Lake Michigan Levels on Recreational Boating and Charter Fishing in Five Counties 21 (March 2001).

[25] *Id.*

[26] *Id.*

[27] *Id.*

[28] *Id.*

[29] *See* http://www.consumersenergy.com/welcome.htm?/content/hiermenugrid.aspx?id=19, last visited 7/12/08.

western coal from the Powder River Basin in Wyoming and Montana and eastern coal from Kentucky, West Virginia and Pennsylvania. The gas units are peaking units, used during periods of high customer demand. In all, the plant can generate up to 500 megawatts, enough electricity to serve a community of about 300,000 people. The main stack soars to a height of 650 feet.

In 1998, Cobb became one of the first power plants in the state to earn certification from the Michigan Business Pollution Prevention Partnership. Sponsored by the Michigan Department of Environmental Quality, the partnership recognizes voluntary pollution prevention efforts. The plant's annual recertification recognizes continued commitment to environmental stewardship at the facility.

1.5.2 Knoll Inc[30]

Knoll is recognized internationally for creating workplace furnishings that inspire, evolve and endure. Knoll operates four manufacturing sites in North America, including facilities in Grand Rapids and Muskegon. All Knoll manufacturing facilities in North America are ISO 14001-certified, an important mark of commitment to environmentally responsible practices. Additionally, Knoll was the first U.S. OEM to receive ISO14000 Standard for Environmental Management Systems certification and Knoll was the seventh company in Michigan and first major OEM to win designation as a Michigan Clean Corporate Citizen.

The Knoll facility of interest to this report is the Western Ave Facility. However, this facility did not report any TRI emissions in 2006.

1.5.3 Michigan Steel Inc[31]

Michigan Steel, Inc. specializes in steel castings produced in a wide variety of alloys ranging in size from five to 3000 pounds. The business, which began producing steel castings in 1912, today utilizes some of the most efficient, automated, and technologically advanced casting processes in North America.

1.5.4 S.D. Warren (SAPPI)[32]

Sappi's Muskegon Mill produces text and cover weight coated wood-free papers used in annual reports, brochures and catalogs. During the 1990's, Muskegon Mill led the industry in the use of recycled fiber in high - quality printing papers. However, in 2005, SAPPI announced the closure of the Number 4 paper machine and the mothballing of the pulp mill. The Muskegon mill produces 170,000 tons of text and cover weight coated wood-free paper per year on its one operating paper machine. Recently, SAPPI announced that it would be investing $3.8 million in this facility and receiving seven (7) year tax abatement on new equipment, which totals $316,916 per year.[33]

Sappi's Muskegon Mill is an active participant in the Pulp and Paper Pollution Prevention Program (P5), a partnership between the Michigan Department of Environmental Quality and the Michigan Pulp and Paper Environmental Council, which includes Sappi Muskegon Mill as a charter member. Under P5, participating mills develop annual commitments to reduce pollution at their facilities through innovative approaches.

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[30] *See* http://www.knoll.com/aboutknoll/overview.jsp, last visited 7/12/08.
[31] *See* http://www.michigansteel.com/, last visited 7/12/08.
[32] *See* http://www.sappi.com/SappiWeb/About+Sappi/Sappi+Fine+Paper+North+America/Muskegon+Mill.htm, last visited 7/12/08.
[33] *See* Sappi Investing $3.8 Million in Muskegon Plant, MUSKEGON CHRONICLE, June 30, 2008.

In September 2000, P5 received the Most Valuable Pollution Prevention award by the National Pollution Prevention Roundtable. This award recognizes the sixteen P5 pulp and paper facilities that made voluntary commitments to increase pollution prevention and source reduction to achieve quantifiable reductions in air emissions, water effluent, and hazardous solid waste. As an example of Sappi Muskegon Mill's commitment to pollution prevention, water conservation projects in the mill's papermaking processes have resulted in a reduction of 180 million gallons per year in wastewater generation.

2.0 Ecosystem Impairment Profile and Matrix

2.1 Overview

The Ecosystem Impairment Profile summarizes the environmental concerns within the Muskegon Lake Watershed, the watershed in which the port, marina and related facilities are located. The Profile describes the Muskegon Lake Watershed and presents information about the levels of contaminants in the air, water and soil, hazardous waste releases, and non-point source pollution. The Matrix, show in Attachment B, summarizes the impairments discussed in the Profile as well as identifies the source of those impairments. Together, the Profile and the Matrix create an environmental 'snapshot' of the Muskegon Lake Watershed.

This snapshot can be used as a tool to understand how the actions of port entities may potentially contribute to the ecosystem's impairments and to identify and implement more sustainable actions that will have less impact on the local environment. For example, these impairments could be considered when identifying impacts as part of an EMS with the goal of adopting alternative practices included in the objectives and targets section of the EMS. Fro example, if a facility discharges large quantities of stormwater and stormwater is identified as an impairment in the Matrix, then controlling stormwater discharges could become a priority for the facility.

The watershed was selected as the unit of analysis because all processes within it are tied to one another – air quality affects the composition of water reaching the land, land use affects all water quality, groundwater quality affects surface water quality, and so on. In short, the introduction of contaminants to any medium within a watershed will affect the entire watershed.

The Profile expands on each of the ecosystem impairments identified below and presents the priority pollutants found in the watershed. Here is a summary of the impairments or pollutants identified for the Muskegon Lake Watershed:

Water Impairments

- Pathogens (*Applicable to tributaries not Muskegon Lake*)
- Nutrient Enrichment
- Sedimentation
- Heavy Metals
- Toxic Substances
- Hydrocarbons
- Thermal Pollution (*Applicable to tributaries not Muskegon Lake*)
- Unstable hydrologic flow (*Applicable to tributaries not Muskegon Lake*)

Air Impairments

- Criteria Air Pollutants
- Toxic Chemicals
- Greenhouse Gases

Land Impairments

- Heavy Metals
- Hazardous Waste

Community Concerns

- US EPA Area of Concern (AOC)
- Binational Toxics Strategy Level I & II pollutants

- Fish consumption advisories

2.2 How to Use the Profile and Matrix

The Ecosystem Impairment Matrix included on the following pages (Attachment B) summarizes the information included in the rest of this document. The Matrix correlates the chemicals present with resulting impairments to the watershed and identifies sources that contribute to these problems. Reading across a row, the "multi- media" nature of the impairments created by some of the pollutants is evident.

Each major column grouping (Air, Water, and Land) corresponds with a major section of the Profile included in this report. The impairments listed under each major column grouping are described in further detail in the Profile. Where possible, these impairments are quantified using available data.

2.2.1 Limitations

Delta used a combination of sources for this analysis, including U.S. EPA databases (TRI) and State of Michigan databases (MAERS). Whenever possible, Delta used the most current information available, but not older than 2005.

Environmental databases generally provide data based on political boundaries such as counties, rather than watershed boundaries. Where available, information is provided about the condition of the environment within the watershed boundaries. Where this is not possible, the information is provided as an aggregate of the information available at the county level. The following table summarizes the geographic coverage of each type of information outlined the report.

Figure 9 – Geographic Coverage of Data

Type of Information	Data Source	Geographic Coverage
Fish Consumption Advisory	U.S. EPA	Watershed
Ambient Air Quality	U.S. EPA	County
Criteria Air Pollutants	Michigan DEQ	County
Hazardous Air Pollutants	U.S. EPA	County
TRI On/off-site Disposal	U.S. EPA	County
Superfund Sites	U.S. EPA	County

2.3 Ecosystem Impairment Profile

2.3.1 Water Quality Impairments[34]

Muskegon Lake is less degraded than nearby Mona Lake or White Lake, most likely due to its large size, large inputs of high-quality water from the Muskegon River, short hydraulic retention time, and rare periods of anoxia (total lack of dissolved oxygen). Water quality of Muskegon Lake markedly improved between 1954 and 1972, although localized areas were degraded due to storm water and urban runoff discharges. Further improvement occurred in 1975 when a substantial amount of wastewater was diverted to the Muskegon County Wastewater Treatment Facility.

Current water quality conditions impair several of the Watershed's designated uses due to nonpoint source pollution and past source pollution. Pollutants and impairments of concern include sediment, heavy metals, toxic substances, hydrocarbons, nutrients, pathogens, thermal pollution, and unstable

[34] FISHBECK *supra* note 7 at 1-2.

hydrology. Poor water quality has resulted in the following impaired and threatened designated uses of the Watershed:

- Coldwater fishery;
- Warmwater fishery;
- Other indigenous aquatic life and wildlife;
- Partial and total body recreation.

Biological surveys and other watershed studies have found a number of Muskegon Lake's tributaries have poor macro invertebrate and fish communities. In addition, Muskegon Lake and several sub-watersheds do not meet water quality standards.

In 2002, researchers from the Annis Water Resources Institute at Grand Valley State University and the U.S. EPA completed an investigation of the extent of sediment contamination in Muskegon Lake[35]. The sampled fifteen (15) locations throughout Muskegon Lake and found the following heavy metals: arsenic, barium, cadmium, chromium, copper, lead, mercury, nickel, selenium, and zinc. The researchers discovered three areas of significant sediment contamination: the Division Street outfall, the lakeshore industrial area, and the Ruddiman Creek confluence.

The overall goal established for the Watershed is to restore and improve its impaired and threatened designated uses. Six long-term goals were established to achieve this overall goal:

1. Prevent soil erosion and reduce sedimentation in Muskegon Lake and its tributaries.
2. Reduce concentrations of heavy metals, toxic substances, and hydrocarbons in the Muskegon Lake Watershed, focusing initial efforts on Ryerson Creek, Ruddiman Creek, and the Division Street outfall area.
3. Reduce nutrient loading of Muskegon Lake and its tributaries, giving particular attention to sources of phosphorus.
4. Prevent pathogens from entering surface waters of the Watershed and strive to meet applicable water quality standards in Ruddiman Creek.
5. Reduce sources of thermal pollution impacting the Muskegon River, Bear Creek and Little Bear Creek.
6. Stabilize stream flows to moderate hydrology and increase base flow. This is especially important in the urban wetland areas of Ruddiman Creek, Ryerson Creek, and Four Mile Creek, which are impacted by unstable hydrology from storm water flows."

The data in this section was compiled from the 2006 Toxic Releases Inventory. The 'Surface Water' releases comprises discharges to streams, rivers, lakes, oceans and other bodies of water, including releases from both point sources, such as industrial discharge pipes, and nonpoint sources, such as storm water runoff, but not releases to sewers or other off-site wastewater treatment facilities. It does not include releases to ground water.

A POTW is a wastewater treatment facility that is owned by a state or municipality. Wastewaters from facilities reporting under TRI are transferred through pipes or sewers to a POTW. Treatment or removal of a chemical from the wastewater depends upon the nature of the chemical, as well as the treatment methods present at the POTW. In general, chemicals that are easily utilized as nutrients by microorganisms, or have a low solubility in water, are likely to be removed to some extent. Chemicals that are volatile and have a low solubility in water may evaporate into the atmosphere. Not all TRI

[35] See RICHARD REDISKE, CYNTHIA THOMPSON, ET AL, PRELIMINARY INVESTIGATION OF THE EXTENT OF SEDIMENT CONTAMINATION IN MUSKEGON LAKE (2002), available at http://epa.gov/glnpo/sediment/muskegon/MuskRpt8.pdf.

chemicals can be treated or removed by a POTW. Some chemicals, such as metals, may be removed, but are not destroyed and may be disposed of in landfills or discharged to receiving waters; transfers of metals and metal compounds to POTWs are categorized as off-site releases.

2.3.1.1 Heavy Metals, Hydrocarbons and Toxic Substances[36]

Heavy Metals are defined as any metallic chemical element that has a relatively-high density and is toxic or poisonous at low concentrations. Heavy metals can enter a water supply by industrial and consumer waste, or even from acidic rain breaking down soils and releasing heavy metals into streams, lakes, rivers, and groundwater. Heavy metals are dangerous because they tend to bio-accumulate. Heavy metals can also enter surface water via runoff from coal piles.

The following heavy metals were discharged to either surface water of publicly owned treatment works in 2006. For a description of each metal, see Attachment D.

- Barium & Barium Compounds
- Chromium & Chromium Compounds
- Cobalt & Cobalt Compounds
- Copper & Copper Compounds
- Lead & Lead Compounds
- Manganese & Manganese Compounds
- Mercury & Mercury Compounds
- Nickel & Nickel Compounds
- Zinc & Zinc Compounds

Toxic Substances are defined as "a substance, except for heat, that is present in sufficient concentration or quantity that is or may be harmful to plant life, animal life, or designated uses." Toxic substances can affect the reproductive health of aquatic life and may pose a health risk to recreational users who use a water body for partial/total body contact recreational uses or consume its fish.

The following toxic substances were discharged to either surface water of publicly owned treatment works in 2006. For a description of each toxic substance, see Attachment D.

- Benzo(g,h,i)perylene
- Polycyclic Aromatic Hydrocarbons (PAHs)

In addition, according to the Michigan Department of Environmental Quality Storage Tank Information Database, there are 179 "Open" Leaking Underground Storage Tanks (LUSTs) in Muskegon County.[37] An Open LUST site means a location where a release has occurred from an underground storage tank system, and where corrective actions have not been completed to meet the appropriate land use criteria.[38] An OPEN LUST site may have more than one confirmed release. Most of the LUSTs in Muskegon County have released gasoline or diesel fuel.

A convincing body of scientific research clearly links human exposure to toxic substances in the Great Lakes to serious injury to health. These investigations include both epidemiological and experimental research studies, undertaken by Canada's former Great Lakes Health Effects Program and, in the U.S., by

[36] FISHBECK *supra* note 7 at 42-43.
[37] *See* http://www.deq.state.mi.us/sid-web/LUST_Search.aspx, last visited 7/13/2008.
[38] *Id.*

the Agency for Toxic Substances and Disease Registry.[39] The greatest health impacts come from the human consumption of fish that are contaminated with heavy metals, PBTs, and PCBs. Because the most significant known human exposure to toxins from the lakes comes from consuming contaminated Great Lakes fish[40], the State of Michigan publishes fish consumption advisories to inform citizens of the potential impacts from eating too much fish. While human exposure to persistent toxic substances in the aquatic environment is an obvious concern, some preliminary data now suggest that simply living near contaminated sites and/or in the geographic boundaries of an Area of Concern may also result in increased rates of illness and mortality beyond those experienced by the general population elsewhere in that state or province[41]

The Muskegon Lake Watershed Management Plan classifies heavy metals, hydrocarbons, and toxic substances at Group 1 pollutants, giving top priority to implementation measures that focus on these areas.[42]

2.3.1.2 Storm water, Snow Removal, Sedimentation, Pathogens, Nutrients

The U.S. EPA identifies polluted runoff as the most important remaining uncontrolled source of water pollution and provides for a coordinated effort to reduce polluted runoff from a variety of sources. Previous technology based controls, such as secondary treatment of sewage, effluent limitation guidelines for industrial sources, point sources and management practices for some nonpoint sources have dramatically reduced water pollution and laid the foundation for further progress. However, nonpoint source loads continue to fill rivers and streams with pollutants. Major sources of nonpoint pollution include urban storm water runoff, discharges from animal feeding operations, cropland runoff, and episodic combined sewer overflows. Urban nonpoint source storm water is water from rain or snow that runs off city streets, parking lots, construction sites, and residential yards. It can carry sediment, oil, grease toxicants, pesticides, pathogens, and other pollutants into nearby storm drains. Once this polluted runoff enters the storm sewer system, it is discharged, usually untreated, into local streams and waterways. It can contaminate drinking and recreational waters and remains a major source of beach closures.

Impervious surfaces accumulate pollutants deposited from the atmosphere, leaked from vehicles, or windblown from adjacent areas. During storm events, these pollutants quickly wash off and are rapidly delivered to downstream waters. Some common pollutants found in urban storm water runoff include:

Nutrients[43] - Urban runoff has elevated concentrations of both phosphorus and nitrogen, which can enrich streams, lakes, reservoirs and estuaries (known as eutrophication). In particular, excess nutrients have been documented to be a major factor in the decline of many lakes. Excess nutrients promote algal growth that blocks sunlight from reaching underwater grasses and depletes oxygen in bottom waters. Urban runoff has been identified as a key and controllable source.

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[39] INT'L JOINT COMM'N, 11TH BIENNIAL REPORT: GREAT LAKES WATER QUALITY (2002), *available at* http://www.ijc.org/php/publications/html/11br/english/report/pdfs/11rep-e.pdf.

[40] *See* http://www.atsdr.cdc.gov/grtlakes/historical-background.html. "Several investigators have shown that [toxic] exposure from fish far outweighs atmospheric, terrestrial, and water column sources."

[41] J. M. Courval, J.V. DeHoog, et. al., *Sport-caught Fish Consumption and Conception Delay in Licensed Michigan Anglers*, Envt'l Res. 80: S183-S188 (1999).

[42] FISHBECK *supra* note 7 at 45.

[43] MARYLAND DEPT. OF ENVIRONMENT, 2000 MARYLAND STORMWATER DESIGN MANUAL VOLUME I & II (OCT. 2000), *available at* http://www.mde.state.md.us/assets/document/chapter1.pdf.

Suspended solids[44] - Sources of sediment include run-off of particles that are deposited on impervious surfaces and the erosion of stream banks and construction sites. Both suspended and deposited sediments can have adverse effects on aquatic life in streams, lakes and estuaries. Sediments also transport other attached pollutants.

Organic matter,[45] washed from impervious surfaces during storms, can present a problem in slower moving downstream waters. As organic matter decomposes, it depletes dissolved oxygen in lakes and rivers, adversely impacting aquatic life.
Bacteria[46] levels in storm water runoff routinely exceed public health standards for water contact recreation. Storm water runoff can also lead to the closure of swimming beaches and may increase the cost of treating drinking water at water supply reservoirs.

Hydrocarbons[47]are defined as organic compounds (as acetylene or butane) containing only carbon and hydrogen and often occurring in petroleum, natural gas, coal, and bitumens (asphalt and tar are the most common forms of bitumen). The presence of hydrocarbons in a waterbody can result from the input of road runoff containing automotive petroleum products, illicit dumping of used motor oil into storm drains, or discharge from industrial sites.

Trace Metals,[48] such as cadmium, copper, lead and zinc, are routinely found in storm water runoff. These metals can be toxic to aquatic life at certain concentrations and can also accumulate in the sediments of streams and lakes.

Pesticides[49] - A modest number of currently used and recently banned insecticides and herbicides can be present in urban stream flow at concentrations that approach or exceed toxicity thresholds for aquatic life.

Chlorides[50] - Salts that are applied to roads and parking lots in the winter months appear in storm water runoff and melt water at much higher concentrations than many freshwater organisms can tolerate.

Trash and Debris[51] - Considerable quantities of trash and debris are washed through storm drain networks. The trash and debris accumulate in streams and lakes and detract from their natural beauty.

Thermal Pollution can result from the input of heated liquids from industrial discharges or hot impervious surfaces, such as parking lots, roads and rooftops. A significant lack of streamside vegetation and ditching practices will also lead to thermal pollution due to direct exposure of surface waters to the sun. A significant reduction in water levels from water withdrawals will also cause a stream to be more easily heated by the sun. Dark sediment particles absorb heat, increasing the temperature of surface water as well. Thermal pollution is harmful to cold water species…because warm water holds less dissolved oxygen than cold water and may lower the dissolved oxygen level beyond a species' tolerance level." [52]

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[44] *Id.*
[45] *Id.*
[46] *Id.*
[47] *Id.*
[48] *Id.*
[49] *Id.*
[50] *Id.*
[51] *Id.*
[52] FISHBECK *supra* note 7 at 44.

Snow and snow removal[53] can function as a significant source of water pollution since it accumulates a variety of contaminants from the atmosphere and roadways. These contaminants include salts and salt additives, heavy metals, asbestos, petroleum products such as oil and grease nutrients, bacteria, organic chemicals such as pesticides and PCBs, soil materials and litter. Although snow melt water typically contains lower contaminant concentrations than rainfall run-off, contaminant loads generated from urban roadways and carried in run-off and snow melt water are of the same magnitude as that of raw sewage. In addition, the solid materials such as sand and other soil particles, which accumulate in roadway removed snow, act as contaminants by filling in streams, lakes and navigation channels.

Salt becomes a component of removed snow and the resulting melt water. In lakes, salt contamination can cause increased density in the lower lake strata preventing normal mixing. Decreased mixing of the lake can result in degraded lake conditions. Increased chloride and sodium concentrations may contribute to excessive growth of undesirable blue-green algae in lakes and can be harmful to aquatic life in both lakes and streams.

"*Inorganic fine sediments* are naturally present to some extent in all streams, but are considered pollutants are excessive levels. Precipitation, including secondary events such as floods and melting snow packs, will transport sediment from eroded uplands to nearby water bodies. In addition, channel movement will scour streambanks and streambeds and contribute additional amounts of inorganic sediment. Because storm events increase stream velocity, more sediment is added by channel movement during rainfall events. Sediment can be suspended, causing turbidity, or deposited on the streambed, causing a loss of benthic productivity and fish habitat. The deposit of an excessive amount of sediment in a stream will cover spawning habitat, clog fish gills, and generally degrade the aquatic habitat of fish and macroinvertebrate species. Human activities, related to agriculture, forestry, mining, and urban development, contribute excessive amounts of sediment that often overwhelm the 'assimilative capacity of a stream and affect aquatic life."[54]

Due to federal regulations governing storm water discharges, the State of Michigan began issuing three types of permits: a generic baseline general permit, a generic general permit with monitoring requirements, or a site specific individual permit.[55] Michigan's storm water permit authorization requires facilities to obtain a certified operator to have supervision and control over the control structures at the facility, eliminate any unauthorized non-storm water discharges, develop and implement a storm water pollution prevention plan for their facility, including structural and nonstructural control measures.[56] Currently, the State of Michigan has issued 91 stormwater permits for facilities in Muskegon County.[57]

The primary impact to human health occurs when rainstorms send untreated sewage in Muskegon Lake and Lake Michigan. To a lesser extent, boaters add nutrients to Muskegon Lake when they flush sanitary tanks. Regardless, when untreated human waste enters the water, it carries many pathogens, including Cryptosporidium parasite and Escherichia coli (E. coli), which can cause severe, and sometimes deadly,

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[53] S. D. DEPT. OF WATER AND NATURAL RES., NONPOINT SOURCE PROGRAM (1990), *available at* http://www.state.sd.us/DENR/DFTA/WatershedProtection/snow.htm.
[54] FISHBECK *supra* note 7, at 42.
[55] *See* http://www.michigan.gov/deq/0,1607,7-135-3313_3682_3716-24018--,00.html, last visited September 25, 2008.
[56] *Id.*
[57] *Id.*

intestinal diseases.[58] The Muskegon County Health Department monitors beaches during the summer for E. coli.

The Muskegon Lake Watershed Management Plan considers nutrients and excessive sediment as Group 2 pollutants, meaning the pollutants are not the top priority when it comes to implementation.[59]

2.3.1.3 Marine Debris

Although not identified as an impairment of Muskegon Lake, marine debris, often called litter, has become a problem along shorelines, coastal waters, estuaries, and oceans throughout the world.[60] It is defined as any man-made, solid material that enters our waterways directly (e.g., by dumping) or indirectly (e.g., washed out to sea via rivers, streams, storm drains, etc.). Objects ranging from detergent bottles, hazardous medical wastes, and discarded fishing line all qualify as marine debris. In addition to being unsightly, it poses a serious threat to everything with which it comes into contact. Marine debris can be life-threatening to marine organisms and humans and can wreak havoc on coastal communities and the fishing industry. Common types of marine debris include plastic bags, bottles and cans, cigarette filters, bottle caps, and lids.

Floatable debris also can have serious consequences for people.[61] First, floatables can endanger human health and safety. Sharp objects, such as broken glass and rusty metal, can cause injuries when people step on them on the beach or ocean floor. Abandoned fishing nets and lines can entangle scuba divers, and some divers have barely escaped serious injury or death. Floatables that wrap around boat propellers or puncture holes in the bottom of boats can disable vessels, thereby endangering human lives. This problem is especially serious if power is lost in a storm and the boat cannot return to shore or steering is hampered and the boat cannot avoid a collision. Contaminated debris, including medical waste and sewage, can pose a public health hazard through disease transmission. There is a strong correlation between swimmers in contaminated waters and higher rates of gastrointestinal illness compared to non-swimmers.

The two primary problems that floatable debris poses to wildlife are entanglement and ingestion.[62] Entanglement results when an animal becomes encircled or ensnared by debris. It can occur accidentally or when the animal is attracted to the debris as part of its normal behavior or out of curiosity. Entanglement can cause wounds that can lead to infections or loss of limbs and strangulation or suffocation. In addition, entanglement can impair an animal's ability to swim, which can result in drowning or difficulty in moving about, finding food, and escaping from predators.

Ingestion occurs when an animal swallows floatable debris. It sometimes occurs accidentally, but usually animals feed on debris because it looks like food. Ingestion of debris can lead to starvation or malnutrition if the ingested items block the intestinal tract, preventing digestion, or accumulate in the digestive tract, making the animal feel "full" and lessening its desire to feed. Ingestion of sharp objects can damage the mouth, digestive tract, or stomach lining and cause infection or pain. Ingested items also can block air passages and prevent breathing, thereby causing death.

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[58] Scott Field, *Great Lakes: Resource at Risk*, ENVT'L HEALTH PERSPECTIVES (Mar. 1, 2005), available at http://www.mindfully.org/Water/2005/Great-Lakes-At-Risk1mar05.htm.
[59] FISHBECK *supra* note 7, at 42.
[60] *See* http://www.epa.gov/owow/oceans/debris/.
[61] U.S. ENVTL. PROT. AGENCY, ASSESSING AND MONITORING FLOATABLE DEBRIS (2002), *available at* http://www.epa.gov/owow/oceans/debris/floatingdebris/debris-final.pdf.
[62] *Id.*

2.3.1.4 – Invasive Species

During the past two hundred years, invasive species have significantly changed the Great Lakes ecosystem, leading to broad economic and social effects on people that rely on the system for food, water, and recreation.[63] The U.S. Environmental Protection Agency (U.S. EPA) defines an "invasive species" as "a plant or animal that is non-native (or alien) to an ecosystem, and whose introduction is likely to cause economic, human health, or environmental damage in that ecosystem. Once established, it is extremely difficult to control their spread."[64]

According to the EPA, "at least 25 non-native species of fish have entered the Great Lakes since the 1800s, including round goby, sea lamprey, Eurasian ruffe, alewife and others."[65] Non-native mussels and mollusks have also impaired the natural food chain.[66] For example, zebra mussels were inadvertently introduced to Lake St. Clair in 1988 and quickly spread throughout the Great Lakes and into many inland lakes, rivers, and canals, eliminating the native clam population and causing severe problems at power plants and municipal water supplies by clogging intake screens, pipes, and cooling systems.[67]

The most recent invasive species to enter the Great Lakes is the spiny water flea (*Cercopagis pengoi*).[68] "This organism, a native of Middle Eastern seas, is a tiny predatory crustacean that can reproduce both sexually and, more commonly, parthenogenically (without fertilization)," which has allowed them to quickly populate Lake Ontario.[69] "Although not yet established in the Great Lakes, several species of Asian carp are under surveillance for their potentially devastating effects upon the Great Lakes-St. Lawrence ecosystem. These species fit the profile of successful Great Lakes invaders because of their vast mobility, high reproductive capacity and voracious consumption habits."[70]

Purple Loosestrife

The Great Lakes have also been impacted by fast-growing invasive plants such as common reed (*Phragmites australis*), reed canary grass (*Phalaris arundinacea*), purple loosestrife (*Lythrum salicaria*), curly pondweed (*Potamogeton crispus*), Eurasian milfoil (*Myriophyllum spicatum*), frogbit (*Hydrocharis morsus-ranae*), and two types of non-native cattails (*Typha angustifolia* and *Typha glauca*).[71] Some of these plants, like purple loosestrife, are prolific seed producers, producing 2.7 million seeds each year, while others reproduce from fragments of root or rhizome, which hinders removal and control.[72] Regardless of the reproductive method, all these invasive plants have become established in the Great Lakes, displacing the native plant populations that support wildlife habitat and prevent erosion and hindering swimming and boating.[73]

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[63] *See* http://www.epa.gov/glnpo/invasive/index.html, last visited September 11, 2008.
[64] *Id.*
[65] *Id.*
[66] *Id.*
[67] *Id.*
[68] *Id.*
[69] *Id.*
[70] *See* http://www.glc.org/ans/, last visited September 11, 2008.
[71] *See* http://www.epa.gov/glnpo/invasive/index.html
[72] *Id.*
[73] *Id.*

2.3.2 Air Quality Impairments

Although this report defines the ecosystem in which the port and marina entities are located as the Muskegon Lake Watershed, it is important to consider the air quality within these boundaries as well. Many pollutants released into the air are deposited on the land and in the waterways through air deposition, while other pollutants in the land and soil can enter the atmosphere when disturbed. Examining the multi-media impacts of pollutants present in the Muskegon Lake Watershed provides a more complete picture of its condition than an analysis of impairments to water alone.

To conduct this analysis, Delta used 2006 data from the U.S. EPA Toxic Release Inventory (TRI). Unlike the information collected about the status of the water quality, the information about air impairments was not available on a watershed basis. Instead, EPA prepares this data on a county basis, and the analysis reflects that limitation. However, since the majority of the watershed shed lies in Muskegon County, Delta is confident in the portrayal of the data.

2.3.2.1 Criteria Air Pollutants[74]

EPA uses six "criteria pollutants" as indicators of air quality and has established for each of them a maximum concentration above which adverse effects on human health may occur. These threshold concentrations are called National Ambient Air Quality Standards (NAAQS). When an area does not meet the air quality standard for one of the criteria pollutants, it may be subject to the formal rule-making process which designates it as nonattainment. The Clean Air Act further classifies ozone, carbon monoxide and particulate matter nonattainment areas based on the magnitude of an area's problem. Nonattainment classifications may be used to specify what air pollution reduction measures an area must adopt, and when the area must reach attainment. Here is a description of the six criteria air pollutants:
Ozone (O_3) is a photochemical oxidant and the major component of smog. O_3 is not emitted directly into the air but is formed through chemical reactions between emissions of volatile organic compounds (VOC) and nitrogen oxides (NOx) in the presence of sunlight. Both VOCs and NOx are emitted by transportation and industrial sources. VOCs are emitted from sources as diverse as autos, chemical manufacturing, dry cleaners, paint shops and other sources using solvents.

Carbon monoxide (CO) is a colorless, odorless and poisonous gas produced by incomplete burning of carbon in fuels. Seventy-seven percent of the nationwide CO emissions are from transportation sources. The largest emissions contribution comes from highway motor vehicles. Other major CO sources are wood-burning stoves, incinerators and industrial sources.

Nitrogen dioxide (NO_2) is a brownish, highly reactive gas that is present in all urban atmospheres. The major mechanism for the formation of NO_2 in the atmosphere is the oxidation of the primary air pollutant nitric oxide (NO). Along with VOCs, NO_X plays a major role in the atmospheric reactions that produce ground-level ozone, i.e. smog. NO_X forms when fuel is burned at high temperatures. The two major emissions sources are transportation and stationary fuel combustion sources such as electric utility and industrial boilers.

Did You Know?
Nationally, non-road diesel engines are responsible for 16% of NO_X emissions (3,600 tons/yr) and 8% of $PM_{2.5}$ emissions (222 tons/yr).

Source: U.S. EPA, 2001 National Emission Inventory

Sulfur Dioxide (SO_2) is a primary contributor to acid deposition, or acid rain, which causes acidification of lakes and streams and can damage trees, crops, historic buildings and statues. In addition, sulfur compounds in the air contribute to visibility impairment in large parts of

[74] *See* http://www.epa.gov/air/oaqps/greenbk/o3co.html.

the country. Ambient SO_2 results largely from stationary sources such as coal and oil combustion, steel mills, refineries, pulp and paper mills and from nonferrous smelters.

Particulate matter (PM) is compilation of several air pollutants, including dust, dirt, soot, smoke and liquid droplets. PM is emitted directly into the air by factories, power plants, cars, construction activity, fires and natural windblown dust. Particles formed in the atmosphere by condensation or the transformation of emitted gases such as SO_2 and VOCs are also considered particulate matter. The EPA has multiple standards for particulate matter based on the size of each particle – $PM_{2.5}$ (2.5 microns) and PM_{10} (10 microns).

Lead (Pb) is an element that the EPA has regulated since 1978. Lead gasoline additives, non-ferrous smelters, and battery plants are the most significant contributors to atmospheric Pb emissions. The EPA's long term goal is to reduce lead exposure to the fullest extent possible.

In terms of health effects, criteria air pollutants impact the respiratory and cardiovascular systems. [75] For example, ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide and particulate matter significantly reduces lung functions, creating respiratory problems for children, seniors, asthmatics, and healthy adults. Lead, on the other hand, can damage the central nervous system, cause seizures and mental retardation, especially in children.

The U.S. EPA considers Muskegon County in attainment for all criteria pollutants except for 1-hr and 8-hr ozone levels, where the county is classified as a non-attainment maintenance area with a "marginal" rating.[76]

2.3.2.2 Toxic Pollutants

Generally, toxic air pollutants are those pollutants that are known or suspected to cause cancer or other serious health effects, such as reproductive effects or birth defects, or adverse environmental effects. This broad category includes persistent bio-accumulative toxics (PBTs), heavy metals, hazardous air pollutants, volatile organic compounds (VOCs) and other emissions into the air. The following toxic chemicals were released into the air in 2006 by facilities within the Muskegon Lake Watershed. For a complete description of each toxic substance, see Attachment D.

A. Persistent Bio-accumulative Toxics (PBTs)

- Dioxins & Dioxin-like Compounds
- Polycyclic Aromatic Hydrocabons (PAHs)

B. Heavy Metals

- Barium & Barium Compounds
- Chromium & Chromium Compounds
- Cobalt & Cobalt Compounds
- Copper & Copper Compounds
- Lead & Lead Compounds
- Manganese & Manganese Compounds
- Mercury & Mercury Compounds
- Nickel & Nickel Compounds
- Vanadium & Vanadium Compounds

[75] *See* http://www.epa.gov/air/oaqps/greenbk/o3co.html.
[76] *See* http://www.epa.gov/air/oaqps/greenbk/gmcs.html#MICHIGAN.

- Zinc & Zinc Compounds

C. Hazardous Air Pollutants and Volatile Organic Compounds

- Acetonitrile
- Ammonia
- Benzene
- Chloroform
- Chloromethane
- Dichloromethane (Methylene chloride)
- Dimethyl phthalate
- Ethylbenzene
- n-Hexane
- Hydrochloric acid
- Hydrogen fluoride
- Methanol
- Methyl tert-butyl ether (MTBE)
- Naphthalene
- Phenol
- Phthalic anhydride
- Styrene
- Toluene
- Xylene

D. Other Emissions

- n-Butyl alcohol
- Diisocyanates
- 4,4'-Isopropylidenediphenol
- M-Cresol
- Nitrate compounds
- Nitric acid
- Pyridine
- Sulfuric acid
- 1,2,4-Trimethylbenzene

People who are exposed to toxic air pollutants at sufficient concentrations and for sufficient durations may increase their chances of getting cancer or experiencing other serious health effects.[77] Depending on which air toxics an individual is exposed to, these health effects can include damage to the immune system, as well as neurological, reproductive (e.g., reduced fertility), developmental, and respiratory problems. A growing body of evidence indicates that some air toxics (e.g., DDT, dioxins, and mercury) may disturb hormonal (or endocrine) systems. In some cases this happens by pollutants either mimicking or blocking the action of natural hormones. Health effects associated with endocrine disruption include reduced male fertility, birth defects, and breast cancer.

Toxic pollutants in the air, or deposited on soils or surface waters, can have a number of environmental impacts.[78] Like humans, animals can experience health problems if they are exposed to sufficient concentrations of air toxics over time. Numerous studies conclude that deposited air toxics are

[77] *See* http://www.epa.gov/air/toxicair/takingtoxics/p1.html#3.
[78] *Id.*

contributing to birth defects, reproductive failure, and disease in animals. Persistent toxic air pollutants are of particular concern in aquatic ecosystems because the pollutants accumulate in sediments and may bio-magnify in tissues of animals at the top of the food chain to concentrations many times higher than in the water or air.

Toxic pollutants that mimic hormones also pose a threat to the environment. In some wildlife (e.g., birds, shellfish, fish, and mammals), exposures to pollutants such as DDT, dioxins, and mercury have been associated with decreased fertility, decreased hatching success, damaged reproductive organs, and altered immune systems.

Other toxics, like volatile organic compounds, combine with NO_X and SO_X to form ground level ozone or smog. Reductions of smog-causing pollutants and particulate matter are important because of the health and environmental problems they can cause. Most notably, urban smog can damage vegetation and contribute significantly to impaired visibility in places, such as national parks, that are valued for their scenic views and recreational opportunities.

2.3.2.3 Greenhouse Gases[79]

Many chemical compounds present in Earth's atmosphere behave as 'greenhouse gases'. These are gases which allow direct sunlight (relative shortwave energy) to reach the Earth's surface unimpeded. As the shortwave energy (that in the visible and ultraviolet portion of the spectra) heats the surface, longer-wave (infrared) energy (heat) is reradiated to the atmosphere. Greenhouse gases absorb this energy, thereby allowing less heat to escape back to space, and 'trapping' it in the lower atmosphere. Many greenhouse gases occur naturally in the atmosphere, such as carbon dioxide, methane, water vapor, and nitrous oxide, while others are synthetic. Those that are man-made include the chlorofluorocarbons (CFCs), hydrofluorocarbons (HFCs) and Perfluorocarbons (PFCs), as well as sulfur hexafluoride (SF_6). Atmospheric concentrations of both the natural and man-made gases have been rising over the last few centuries due to the industrial revolution. As the global population has increased and our reliance on fossil fuels (such as coal, oil and natural gas) has been firmly solidified, so emissions of these gases have risen. While gases such as carbon dioxide occur naturally in the atmosphere, through our interference with the carbon cycle (through burning forest lands, or mining and burning coal), we artificially move carbon from solid storage to its gaseous state, thereby increasing atmospheric concentrations.

Greenhouse gases do not have any direct impacts on human health. Rather, the rise in greenhouse gases exacerbates existing air quality issues. For example, "the increase in greenhouse gases will lead to higher temperatures, contributing to increased ozone formation and increased emissions of ozone precursors, toxic air contaminants and fine particles. Furthermore, rising temperatures and associated emission increases will contribute to worsening air quality and respiratory illnesses, including aggravated asthma, increased hospitalizations for respiratory and cardiovascular disease, reduced lung capacity and premature deaths."[80]

According to the Pew Center on Global Climate Change, the following ecological effects of global warming can already be detected within the U.S.:[81]

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[79] *See* http://lwf.ncdc.noaa.gov/oa/climate/gases.html.

[80] Position Statement, American Lung Ass'n of California, Air Quality and Health Impacts of Greenhouse Gas Emissions and Global Warming (June 5, 2004), *available at* http://www.californialung.org/press/GHGGlobalWarmingPosStmt60504pdf.pdf.

[81] CAMILLE PARMESAN AND HECTOR GALBRAITH, OBSERVED IMPACTS OF GLOBAL CLIMATE CHANGE IN THE U.S. (2004), *available at* http://www.pewclimate.org/docUploads/final_ObsImpact.pdf.

1. The timing of important ecological events, including the flowering of plants and the breeding times of animals, has shifted, and these changes have occurred in conjunction with changes in U.S. climate.
2. Geographic ranges of some plants and animals have shifted northward and upward in elevation, and in some cases, contracted.
3. Species composition within communities has changed in concert with local temperature rise.
4. Ecosystem processes such as carbon cycling and storage have been altered by climate change.

2.3.3 Land Quality Impairments

As implied through this ecosystem impairment profile, changes in land use have heavily affected water quality and quantity, as well as wildlife habitat. Over the years, many of the natural wetlands around Muskegon Lake and its tributaries have been lost to urban development. As a result, precipitation and snow melt move across imperious surfaces, rather than filter through wetlands, depositing contaminants directly into Muskegon Lake. Arguably, land use changes, in the form of increased urbanization, pose the greatest threat to the long-term water quality of Muskegon Lake.

2.3.3.1 Industrial Waste, Solid Waste, Construction Debris

Ports and marinas generate a variety of solid waste through the activities that occur on marina property and at their piers. If adequate disposal facilities are not available there is a potential for disposal of solid waste in surface waters or on shore areas where the material can wash into surface waters.

Without adequate disposal of industrial waste, solid waste and construction debris, individuals could accidentally be exposed to toxic chemicals and solvents. Plus, the odor of poorly managed and maintained solid waste disposal facilities often deter visitors and create public and regulatory scrutiny of the facility.

The following industrial wastes were disposed, either in on-site landfills or off-site landfills, by facilities within the Muskegon Lake Watershed. Please note that many of the compounds are components of an actual waste product. In other words, these compounds were not dumped; rather, these compounds comprise a manufactured product that was discarded. For descriptions of each compound, see Attachment D.

A. Heavy Metals

- Aluminum (Fume or Dust)
- Barium & Barium Compounds
- Chromium & Chromium Compounds
- Cobalt & Cobalt Compounds
- Copper & Copper Compounds
- Lead & Lead Compounds
- Manganese & Manganese Compounds
- Mercury & Mercury Compounds
- Nickel & Nickel Compounds
- Vanadium & Vanadium Compounds
- Zinc & Zinc Compounds

B. Hazardous Air Pollutants and Volatile Organic Compounds

- Dimethyl phthalate
- Hydrogen fluoride
- Naphthalene

- Phenol
- Phthalic anhydride
- Styrene

C. Other Wastes

- Diisocyanates
- 4,4'-Isopropylidenediphenol
- Nitrate compounds
- Nitric acid

In addition to industrial wastes, leachate from solid waste containers can contaminate soils and eventually leach into groundwater supplies. Construction debris that is dumped along the shoreline, i.e. concrete and asphalt debris can leach hydrocarbons and other chemicals when exposed to precipitation. Uncovered construction debris can create tremendous amounts of sediment during rain events. Plus, the aesthetics of poorly managed and maintained solid waste disposal facilities often deter visitors and create public and regulatory scrutiny of the facility.

2.3.3.2 Dredge Materials

Although discharges of toxic substances into the Great Lakes Basin have been reduced in the last 20 years, persistent, high concentrations of contaminants remain in the bottom sediments of some of the rivers and harbors that feed into the Lakes. These contaminants have the potential to cause harm to humans, aquatic organisms, and wildlife, and there are advisories against consuming the fish from most water bodies around the Great Lakes. Unfortunately, Great Lakes navigation requires maintenance by dredging channels and harbors. Approximately 25 activities a year remove 2-4 million cubic yards of lake-bottom material. In addition to maintaining the channels for navigation, the Corps of Engineer's dredging program benefits environmental restoration of the Great Lakes. Each year, between 3 and 5 million cubic yards of sediments are dredged from the Great Lakes by the Corps, private industry, municipal and private marinas, utilities and others.[82] Over 90 million cubic yards of contaminated sediments, which threaten the health of the surrounding eight states, municipalities and the fisheries, have been removed and safely confined.[83]

There are several ways to dispose of dredged material spoils: open water disposal, confined disposal and beneficial use.[84] Open-water disposal is the placement of dredged material in rivers, lakes, estuaries, or oceans via pipeline or release from hopper dredges or barges. Confined disposal is placement of dredged material within dikes near shore or upland confined disposal facilities (CDFs) via pipeline or other means. Beneficial use includes a wide variety of options, which utilize the material for some productive purpose. Ten broad categories of beneficial uses have been identified, based on the functional use of the dredged material or site.

- Habitat restoration/enhancement (wetland, upland, island, and aquatic sites including use by waterfowl and other birds).
- Beach nourishment.
- Aquaculture.
- Parks and recreation (commercial and noncommercial).

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[82] *See* http://www.lrd.usace.army.mil/navigation/glnavigation/dredgedmaterialmanagement/.

[83] *See* http://www.lrd.usace.army.mil/_kd/go.cfm?destination=page&pge_id=1088.

[84] U.S. ENVTL. PROT. AGENCY AND U.S. ARMY CORPS OF ENG'RS, EVALUATING ENVIRONMENTAL EFFECTS OF DREDGED MATERIAL MANAGEMENT ALTERNATIVES – A TECHNICAL FRAMEWORK (2004), *available at* http://www.epa.gov/owow/oceans/regulatory/dumpdredged/framework/techframework.pdf.

- Agriculture, forestry, and horticulture.
- Strip mine reclamation and landfill cover for solid waste management.
- Shoreline stabilization and erosion control (fills, artificial reefs, submerged berms, etc.).
- Construction and industrial use (including port development, airports, urban, and residential).
- Material transfer (fill, dikes, levees, parking lots, and roads).
- Multiple purpose

The U.S. Army Corps of Engineers dredges the channel connecting Muskegon Lake and Lake Michigan approximately every two years. The cost of analyzing dredge spoils is very high.

Sediment dredged from the Great Lakes is likely contaminated with heavy metals (lead, mercury), PCB's, DDT and other legacy contaminants. The most direct impact on human health from dredge spoils occurs during dredging operations with open water disposal. In these operations, the contaminate sediment is re-suspended in the water column, allowing for further uptake and accumulation in fish, which may be eaten residents. In the Lake Michigan, the U.S. Army Corps of Engineers maintains multiple, near-shore confined disposal facilities (CDFs) for dredging operations.[85] CDFs function as settling ponds and are designed to retain 99.9% of contaminated sediments.[86] To the extent that heavy metals, PCBs and other toxins are confined to the CDF and bioaccumulation of pollutants by plants and animals in or near CDFs is not significant, then CDFs are presumed to be relatively efficient.[87] However, there is no system wide, continual monitoring program for Great Lakes CDFs, so there is no way to know for certain if there is the potential for long-term health impacts.

Contaminated sediments have been identified as a significant environmental problem in the Great Lakes and have been linked to the impairment of beneficial uses of Great Lakes waters at every one of the Areas of Concern designated in the Great Lakes Water Quality Agreement. Contaminated sediments have been dredged for environmental remediation at more than 30 Great Lakes sites.

The possible migration pathways of contaminants from confined disposal facilities (CDF) in the upland environment include effluent discharges to surface water during filling operations and subsequent settling and dewatering, rainfall surface runoff, leachate into groundwater, volatilization to the atmosphere, and direct uptake. Direct uptake includes plant uptake and subsequent cycling through food webs and direct uptake by animal populations living in close association with the dredged material. Effects on surface water quality, groundwater quality, air quality, plants, and animals depend on the characteristics of the dredged material, management and operation of the site during and after filling, and the proximity of the CDF to potential receptors of the contaminants.

2.3.4.3 Brownfield and Superfund Sites

A. Brownfield Sites[88]

A brownfield is a property on which expansion, redevelopment, or reuse may be complicated by the presence, or perceived presence, of contamination.

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[85] *See* JAN A. MILLER, U.S. ARMY CORPS OF ENGINEERS, CONFINED DISPOSAL FACILITIES ON THE GREAT LAKES (Oct 1998), available at http://www.lrd.usace.army.mil/_kd/Items/actions.cfm?action=Show&item_id=1213&destination=ShowItem.
[86] *Id.* at 13.
[87] Great Lakes Commission, Confined Disposal Facilities Fact Sheet, *available at* http://www.glc.org/dredging/outreach/cdffs.html.
[88] U.S. Envt'l Prot. Agency, Anatomy of Brownfields Redevelopment 1 (Oct. 2006), *available at* http://www.epa.gov/brownfields/anat_bf_redev_101106.pdf.

Several challenges make brownfields cleanup and redevelopment unique compared to other real estate development projects. These challenges include:

- **Environmental Liability Concerns:** Developers and property owners want to manage past and future liabilities associated with the property's environmental history.
- **Financial Barriers:** Private lenders are often reluctant to give loans for potentially impaired lands. In some cases, cleanup costs for a property may ultimately be more than the property's value.
- **Cleanup Considerations:** A brownfields redevelopment timeline may take longer than typical real estate development due to environmental assessment and cleanup activities.
- **Reuse Planning:** A reuse plan based on community goals or sound economic and environmental information (e.g., market potential) may be lacking.

In spite of these challenges, significant opportunities exist for successful brownfield redevelopment projects. A redevelopment idea that works to bring new life to an area, enhanced by public support for the project, can create the momentum necessary to overcome the challenges associated with brownfield transactions.

The West Michigan Regional Shoreline Development Council (WMSRDC) prepared a report titled, *West Michigan Shoreline Brownfields Inventory and Plan for Implementation*, to identify brownfields in five counties: Lake, Mason, Muskegon, Newaygo, and Oceana.[89] WMSRDC identified 104 brownfields in Muskegon County. Additionally, the Michigan Department of Environmental Quality maintains a Brownfields-USTfields Database, which contains information about state-nominated and state-funded cleanup sites as well as sites that have been redeveloped using the Baseline Environmental Assessment process. While it is not a full list of contaminated properties in Muskegon County, the database shows fifty-one (51) sites in varying stages of remediation.[90] All of the brownfields listed in this database are included in the WMRSDC's inventory.

B. Superfund Sites[91]

The Comprehensive Environmental Response, Compensation and Liability Act of 1980 (CERCLA) provides a federal "Superfund" to clean up uncontrolled or abandoned hazardous waste sites as well as accidents, spills and other emergency releases of pollutants and contaminants into the environment. The Superfund Amendments and Reauthorization Act of 1986 reauthorized CERCLA to continue cleanup activities around the country.

The Superfund Program involves a State/federal partnership to cleanup some of the most complex and controversial sites in Michigan. The U.S. Environmental Protection Agency Region 5 has primary responsibility. The EPA is obligated to consider and apply state and federal environmental laws, standards, technical comments, and community concerns when making cleanup decisions. The State of Michigan Department of Environmental Quality is responsible for financing 10% of the cost for a funded remedial action with the federal government contributing the remaining 90%. The state is responsible for 100% of the operation and maintenance costs after the remedial action is complete to verify that each site is clean.

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[89] WEST MICHIGAN SHORELINE REGIONAL DEVELOPMENT COUNCIL (WMSRDC), WEST MICHIGAN SHORELINE BROWNFIELDS INVENTORY AND PLAN FOR DEVELOPMENT 32-85 (Oct. 2006), available at www.wmsrdc.org.

[90] *See* http://www.deq.state.mi.us/ustfields/default.asp, last visited July 20, 2008.

[91] *See* http://www.michigan.gov/deq/0,1607,7-135-3311_4109_4217-88632--,00.html, last visited July 13, 2008.

The National Priorities List is a list of environmentally contaminated sites, published by USEPA, which pose an immediate or significant pubic health threat to the local community; therefore, these sites are eligible for extensive, long-term cleanup action under the Superfund program. The NPL is required to be maintained and revised at least annually. Currently, there are eight (8) sites in Muskegon County on the National Priorities List.[92] For detailed information on each superfund site, including a list of all contaminants present on site and a progress report on remediation, please visit http://cfpub.epa.gov/supercpad/cursites/srchsites.cfm.

2.3.4.4 Shoreline Hardening[93]

"Nearshore habitat in Muskegon Lake was severely impacted by logging in the 1800s when shoreline and shallow water vegetation was removed and the lake was filled. During the 1900s, dredging, filling and hardening the shoreline occurred with the establishment of industry and manufacturing.[94] However, the Muskegon Lake Watershed Partnership (MWLP) has worked with Muskegon residents and community leaders to develop a nearshore habitat restoration plan.[95] With input from the community and affected stakeholders, MLWP divided the Muskegon Lake shoreline into four Habitat Restoration & and Enhancement Areas. For each area, MLWP has evaluated the amount of hardened edge, wetland area, aquatic plants and lake fill and established restoration goals.

Figure 10 – Restoration Goals for Fish & Wildlife Habitat Beneficial Use Impairments

	Hardened Edge		Wetland		Aquatic Plants		Lake Fill	
Habitat Restoration & Enhancement Areas	Current Condition	BUI Restoration Goals	Current Condition	BUI Restoration Goals	Current Condition	BUI Restoration Goals	Current Condition	BUI Restoration Goals
1 - Southwest Focus Area	80.30%	48% (Soften 11,850 ft)	4.11 acres	9.11 acres	14.58 acres	19.58 acres	128.42 acres	25 acres to be improved
2 - South Lakeside & Ruddiman Focus Area	76.60%	50% (Soften 6,194 ft)	18.22 acres	36.5 acres	39.71 acres	39.71 acres	89.98 acres	42 acres to be improved
3 - Downtown and Ryerson Creek Focus Area	87.40%	76% (Soften 2,775 ft)	11.36 acres	14.69 acres	1.45 acres	6.45 acres	144.71 acres	7 acres to be improved
4 - Muskegon Lake East and River Mouth Focus Area	47.70%	34.6% (Soften 3,267 ft)	134.5 acres	181 acres	33.35 acres	42.35 acres	426.52 acres	47 acres to be improved

Historically, the Southwest Focus Area has consisted of coastal dunes. Created thousands of years ago, sand dunes provide unique wildlife habitat for wildlife and plants. For the Southwest Focus Area, the loss of fish and wildlife habitat has two primary causes:

1. Extensive shoreline alterations, filling and hardening from sawmill, industrial, commercial, residential and recreational development, resulting in historic direct was disposal, stormwater discharges, degraded aquatic habitat and habitat elimination;
2. Remove of Pigeon Hill, a large freshwater sand dune along the Muskegon Lake and Lake Michigan shoreline, resulting in degraded and fragmented dune habitat.

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[92] *See* http://www.epa.gov/superfund/sites/npl/mi.htm#statelist, last visited 7/13/08.
[93] *See* MLWP and MRWA, *supra* note 8. This entire section consists of excerpts from this guide.
[94] KATHY EVANS, Muskegon Lake Greenways, MUSKEGON LAKE VIEWS 3 (Feb 2007), available at http://muskegonlake.org/delisting/pdf/Feb07.pdf.
[95] *See* MLWP and MRAW, *supra* note 8.

By softening hardened shorelines, adding wetland areas, restoring aquatic plant areas, and removing fill, these coastal dune areas can, to some extent, be restored.

Muskegon Lake and the adjacent wetland habitats comprise one of four major freshwater estuary wetland complexes along the eastern shore of Lake Michigan. For the South Lakeside & Ruddiman Creek Focus Area, the loss of fish and wildlife habitat was caused by extensive shoreline filling from past sawmill and industrial land expansion, waste disposal and stormwater runoff. Removal of contaminated sediment and restoration and protection of wetlands around Muskegon Lake will provide additional habitat to support fish and wildlife habitat and encourage growth of native plant communities.

Muskegon Lake was instrumental in the formation of the City of Muskegon. Trees cut from Michigan forests were floated down the Muskegon River to sawmills in Muskegon. Over time, industry and development have changed the natural shape of Muskegon Lake. For the Downtown and Ryerson Creek Focus Area, the loss of fish and wildlife habitat has several causes:

1. Extensive shoreline alterations, filing and hardening from industrial, commercial, residential and recreational development, resulting in historic direct waste disposal and direct stormwater discharges;
2. Filling of lake and wetlands with sawmill and industrial waste;
3. Isolated and fragmented marsh, scrub wetlands and riparian buffers;
4. Degraded wetland, littoral zone and buffer areas.

Establishing native landscapes, rain gardens and buffers, removing fill and restoring emergent plants will attract and sustain wildlife.

The Muskegon River flows into Muskegon Lake on its eastern side. Logging and industrial filling have eliminated natural habitat and altered river flow. For the Muskegon Lake East and River Mouth Focus Area, the loss of fish and wildlife habitat has several causes:

1. Shoreline and river alterations and filling from logging, industrial, municipal, and commercial development, resulting in historic direct waste disposal, stormwater discharges and placement of landfills in the Muskegon River floodplain;
2. Alteration of river marsh to channelize the Muskegon River for logging;
3. Filling of wetlands, lake and river mouth with industrial, commercial and municipal waste.

Reestablishing emergent vegetation, restoring wetlands and removing fill will encourage wildlife and fish to return to this area of the lake.

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3.0 Ecosystem Impairment Profile and Matrix for Ports, Marinas and Related Infrastructure

3.1 Water Quality Impairments

Water pollution degrades surface waters making them unsafe for drinking, fishing, swimming, and other activities. As authorized by the Clean Water Act (CWA), the National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. Point sources are discrete conveyances such as pipes or man-made ditches. Individual homes that are connected to a municipal system, use a septic system, or do not have a surface discharge do not need an NPDES permit; however, industrial, municipal, and other facilities must obtain permits if their discharges go directly to surface waters.

Point Sources for Water Quality Impairments

- Commercial Ships
- Port Equipment, Materials, Facilities
- Bulk Storage of Raw Materials
- Recreational Boats in Harbors and Marinas
- Leaking Underground Storage Tanks (LUSTs)

"For regulatory purposes, pollutants have been grouped into three general categories under the NPDES Program: conventional, toxic, and non-conventional. There are five conventional pollutant; 1) Five Day Biological Oxygen Demand; 2) Total Suspended Solids; 3) pH; 4) Fecal Coliform; 5) Oil and Grease. Toxic pollutants, or priority pollutants, are those defined in Section 307(a)(1) of the CWA and include metals and manmade organic compounds. Non-conventional pollutants are those which do not fall under either of the above categories, and include such parameters as ammonia, nitrogen, phosphorus, chemical oxygen demand (COD), and whole effluent toxicity (WET)."[96]

"Pollutants can enter waters of the United States from a variety of pathways including agricultural, domestic, and industrial sources. For regulatory purposes these sources are generally categorized as either point sources or non-point sources. Typical point source discharges include discharges from publicly owned treatment works (POTWs), discharges from industrial facilities, and discharges associated with urban runoff."[97]

"Municipal sources are Publicly-Owned Treatment Works (POTWs) that receive primarily domestic sewage from residential and commercial customers. Larger POTWs will also typically receive and treat wastewater from industrial facilities (indirect dischargers) connected to the POTW sewerage system. The types of pollutants treated by a POTW will always include conventional pollutants, and may include non-conventional pollutants and toxic pollutants depending on the unique characteristics of the commercial and industrial sources discharging to the POTW."[98]

"Non-municipal sources, which include industrial and commercial facilities, are unique with respect to the products and processes present at the facility. Unlike municipal sources, at industrial facilities the

[96] U.S. ENVT'L PROT. AGENCY, OFFICE OF WASTEWATER MANAGEMENT, WATER PERMITTING 101, *available at* http://www.epa.gov/npdes/pubs/101pape.pdf.
[97] *Id.*
[98] *Id.*

types of raw materials, production processes, treatment technologies utilized, and pollutants discharged vary widely and are dependent on the type of industry and specific facility characteristics. Industrial facilities may have storm water discharges contaminated by manufacturing activities, contact with raw materials or product storage activities, and may have non-process wastewater discharges such as non-contact cooling water. The NPDES Program addresses these potential wastewater sources for industrial facilities."[99]

Currently, there are 88 NPDES permits issued for Muskegon County, with the following permits issued to ports and marinas located along Muskegon Lake:

- B.C. Cobb Generating Station
- Eagle Aluminum Cast Products, Inc
- Great Lakes Marina
- Knoll, Inc
- Michigan Steel Inc
- Pointe Marine
- S.D. Warren (SAPPI)
- Torrensen Marine, Inc
- West Michigan Dock and Mart[100]

Furthermore, the State of Michigan has established water quality standards to protect the Great Lakes, the connecting waters, and all other surface waters of the state. These rules define the water quality goals for a lake or stream. The goals are in three areas:

- Uses of the lake or stream, such as swimming and fishing;
- Safe levels to protect the uses, such as the minimum oxygen level needed for fish to live;
- Procedures to protect high quality waters.[101]

When a lake or stream does not meet water quality standards, the Michigan Department of Environmental Quality completes a study to determine the amount of a pollutant that can be put in a waterbody from point sources and nonpoint sources and still meet the water quality standards, including a margin of safety. A TMDL (Total Maximum Daily Load) is developed to determine how much pollutant load a lake or stream can assimilate.[102] The DEQ allocates this load to point source discharges, nonpoint source discharges, and a margin of safety reserve.

Once the U.S. EPA approves the TMDL, the state is required to implement it - through existing programs such as NPDES permits for point source discharges and nonpoint source control programs - to achieve the necessary pollutant reductions. Currently, there are no TMDLs designated for Muskegon Lake. However, the DEQ intends to write TMDLs for PCBs in 2008 and mercury in 2011.

3.1.1 Heavy Metals, Hydrocarbons and Toxic Substances

Ports facilities are highly concentrated industrial areas near water. In addition to abnormal, accidental or emergency situations, port activities can cause significant damage to water quality and marine ecosystems during routine operations. Typically activities that can affect water quality at ports include: building maintenance, boat building/repair, fueling operations, waste disposal, snow removal, wharf repair, plumbing, pavement repair, equipment maintenance, landscape maintenance, property

[99] *Id.*
[100] *See* http://www.deq.state.mi.us/owis/Page/main/Home.aspx, last visited 7/14/08.
[101] *See* http://www.michigan.gov/deq/0,1607,7-135-3313_3686_3728-12464--,00.html, last visited 7/14/08.
[102] *Id.*

renovation, and storm water management. In addition, pollution can arrive via air from outside a watershed. Urban nonpoint source storm water is water from rain or snow that runs off city streets, parking lots, construction sites, and residential yards. It can carry sediment, oil, grease toxicants, pesticides, pathogens, and other pollutants into nearby storm drains. Once this polluted runoff enters the storm sewer system, it is discharged, usually untreated, into local streams and waterways. It can contaminate drinking and recreational waters and remains a major source of beach closures.

The industrial port entities discharge virtually no chemicals or pollutants into the surface waters that flow into Muskegon Lake or Lake Michigan. In 2006, regulated facilities only reported discharges of 52.5 pounds of chemicals, all heavy metals, into surface waters or to POTWs. This is a dramatic decline from 2005, when the same the port facilities reported 2,312.88 pounds of discharges to surface water or POTWs. The cause of the decline is likely through reduced operations at the S.D. Warren (SAPPI) facility. For the full Matrix, see Attachment C.

Figure 11 – Heavy Metals Released by Stationary Sources along Muskegon Lake (2006 Data)

2006 TRI Data	Discharges to Water				Priority Level		
Heavy Metals (lbs)	Watershed Baseline	Port Discharges	% of Baseline	% Change from 2005 Levels	LaMP 2006	LaMP 2008	BTS
Chromium & compounds	66.73	0.10	0.15%	-90.00%	Concern	Concern	
Copper & compounds	6.28	0	0%	-100%	Concern	Concern	
Lead & compounds	113.52	52.10	46%	-29.12%	Concern	Concern	
Manganese & compounds	5.13	0.10	2%	-90.00%		Concern	
Mercury & compounds	0.10	0.10	100%	-66.67%	Critical	Critical	Level I
Nickel & compounds	0.18	0.10	55.56%	-90.00%		Concern	

Not included in Figure 10 are discharges from Leaking Underground Storage Tanks. According to the Michigan Department of Environmental Quality Storage Tank Information Database, there are ten (10) entities with a total of twelve (12) LUSTs within one half mile of Muskegon Lake. The names and locations of the facilities are listed in Figure 11. It is very important to note that the tank information in Figure 11 is based on forms provided to the Michigan Department of Environmental Quality (MDEQ) by the owner. The information may not be reflective of actual site and tank data due to various reasons, such as owner's failure to report changes, owner error in reporting ownership changes, and data entry errors. Delta urges each entity to review the data for accuracy and work with the MDEQ to remedy any inaccuracies. Figure 11 represents open LUST sites, where a release has occurred from an underground storage tank system and corrective actions have not been completed to meet the appropriate land use criteria.

Figure 12 – Leaking Underground Storage Tanks along Muskegon Lake

Facility Name	Location	Chemical Released	Release Date
Former Amoco Muskegon Terminal	1640 Lakeshore Dr		9/29/1989
Hartshorn Marina	920 W Western Ave		11/9/1990
CSX -Abandoned Gas Station	313 Ottawa St	Unknown	8/1/1999
CSX -Abandoned Gas Station	313 Ottawa St	Unknown	8/20/1997
David B Holst	30 E Clay Ave	Gasoline & Heating Oil	7/11/2000
Lakeview Mart	1930 Lakeshore Dr	Unknown	6/17/1998
City of North Muskegon	1503 Ruddiman Ave		3/5/1989
Paul Toppen	1122 Ruddiman		8/9/1995
Paul Toppen	1122 Ruddiman		10/1/1987
Port City Paints, Inc	1250 9th St	Unknown	11/1/1997
Sally A Broersma Trust	1106 Ruddiman Dr	Gasoline	11/12/2007
Shoreline Services Inc	2080 Lakeshore Dr	Diesel Fuel	10/4/2004

3.1.2 Storm Water, Sedimentation, Pathogens and Nutrients

"The majority of point source pollution has been successfully eliminated from impairing Michigan's water resources. However, water quality impairments still exist. Unlike discharges from wastewater treatment plants and industrial wastewater discharges, lingering impairments come from many diffuse sources called non-point source pollution. Non-point source pollution results from rain or snowmelt moving over or through the ground and picking up pollutants and depositing them in lakes, rivers, streams and groundwater."[103]

The most common form of non-point source pollution is storm water runoff, which occurs when rainfall travels over the surface of the land, rather than filtering through vegetation, soil and into the groundwater.[104] During heavy rainstorms, large volumes of water are conveyed directly to surface waters, typically contaminates with water pollutants such as sediment, oil, and grease. In fact, storm water runoff is largely a result of the development of hard (impervious) surfaces, primarily through the expansion of roads and urban development. As mentioned in Section 2.3.1.2, the State of Michigan has the authority to issue stormwater permits through the National Pollution Discharge Elimination System (NPDES) Program. Of the 91 permits issued by the State of Michigan, eight (8) have been issued to facilities and marinas along Muskegon Lake.[105]

Ironically, storm water management, originally a practice designed to control local flooding, has actually increased the water quality problem by increasing water flow and quantity to Muskegon Lake at levels that exceed the natural capacity of the system. Storm water runoff has also become a concern in Muskegon Lake tributaries, Ruddiman, Ryerson and Bear Creeks, because hydrologic flows are becoming unstable. Unstable hydrology can occur when impervious surfaces are developed or when natural stream beds are channelized. These changes increase the rate at which water enters the system, and scours out stream bed habitats and causes stream bank erosion. Both the amount of water entering a system and the contaminants in the water can impact water quality, wildlife and even human health.

[103] FISHBECK, *supra* note 7 at 39.
[104] *See* http://muskegonlake.org/rap/stormwater.htm, last visited 7/14/08.
[105] *See* Michigan Dep't of Envtl Quality, *supra* note 55.

Another factor largely impacting the quality of water in storm water systems is the misuse of storm water sewers. Many people are unaware that street drains are not connected to treatment facilities. Anything that goes down the drain is directed to the nearest natural water body. What goes down the drain empties into the local stream, and eventually into Muskegon Lake and Lake Michigan. Muskegon Lake also faces a seasonal loading of salt during the winter because of road maintenance.

Since 1994, residents around Muskegon Lake have noticed an increasing presence of localized algal blooms. An over abundance of aquatic plant growth (eutrophication) can become unsightly for people and restrict recreational uses. Eutrophication also indicates an over abundance of plant decomposition, which uses oxygen, killing fish and other living organisms. In addition, human contact with degraded surface water can become a public health concern during certain conditions. In 2006, the Muskegon County Health Department warned swimmers and boaters about elevated levels of toxic algae in surface scum near Harbour Towne Beach along Muskegon Lake. The bacteria could cause rashes and liver damage, and in severe cases can kill animals and people if ingested.[106]

An excellent proxy for measuring water quality with regards to storm water run-off, pathogens and nutrients is beach closings. Beach closings are actually one of nine Beneficial Use Impairments (BUIs) outlined in the 2002 Remedial Action Plan Update, written for the Muskegon Lake Area of Concern.[107] Fortunately, there have been no beach closings yet in 2008.

3.1.2.1 Total Maximum Daily Loads (TMDLs)[108]

The Michigan Department of Environmental Quality is responsible for identifying water bodies that are not meeting Water Quality Standards (WQS), which are state rules established to protect surface waters of the state. Section 303(d) of the federal Clean Water Act and the EPA require states to develop TMDLs for surface waters that do not meet WQS. A Total Maximum Daily Load is the amount of a pollutant load that a water body can assimilate. To establish a TMDL for a water body, the State of Michigan completes a study that measures amount of a pollutant (with a margin of safety) that can be put in a water body from point sources and non-point sources and still meet State Water Quality Standards. Water bodies not meeting Water Quality Standards are placed on the non-attainment list published as part of a 303(d) report.

Within the Muskegon Lake Watershed, five water bodies (see below) have been placed on the non-attainment list published as part of the Water Quality and Pollution Control in Michigan: 2004 Sections 303(d) and 305(b) Integrated Report. Pollutants of concern in these waterbodies include PCBs, mercury, phosphorous, and pathogens. After approval from the EPA, the state will be required to take corrective action to meet WQS by the designated "TMDL year."

BEAR LAKE
Size: 415 acres
Location: Tributary to Muskegon Lake is located north of Muskegon Lake, Laketon Township
Problems: Fish consumption advisory for PCBs, nuisance algal growths, and phosphorus
TMDL Years: 2008 and 2009

MUSKEGON LAKE AND MUSKEGON RIVER
Size: 53 miles

[106] *See* http://www.wzzm13.com/news/news_article.aspx?storyid=78920, last visited 7/14/08.
[107] FISHBECK, *supra* note 7 at 27.
[108] *Id.* at 28-29.

Location: Lake Michigan confluence upstream to Croton Dam
Problems: Fish consumption advisory for PCBs, fish tissue mercury concentrations, and WQS exceedances for PCBs and mercury
TMDL Years: 2008 and 2011

RUDDIMAN CREEK

Size: 2 miles
Location: Upstream of Muskegon Lake confluence
Problems: Pathogens and fish and macroinvertebrate communities are rated poor
TMDL Year: 2008

RUDDIMAN CREEK (WETLAND)

Size: 9.5 acres
Location: Wetland/lagoon is at terminus of Ruddiman Creek, just prior to confluence with Muskegon Lake
Problem: Fish consumption advisory for PCBs
TMDL Year: 2013

RYERSON CREEK

Size: 3 miles
Location: Upstream of Muskegon Lake confluence
Problem: Fish and macroinvertebrate communities rated poor
TMDL Year: 2008

3.1.3 Marine Debris

There is no way to quantify the amount of trash or debris on the shores or within Muskegon Lake. During periods of low tide, the amount of debris and infill along the shoreline is evident. Old pilings, concrete, tires and construction materials are prevalent in the near-shore area. Judging by the annual clean-up events for Muskegon Lake, local residents must also be concerned the amount of trash and litter that surrounds the lake. While trash and marine debris is more of an aesthetic problem than an environmental problem, cleaning up the lake is an indication of the community's concern for the long-term ecologic, economic and social viability of Muskegon Lake.

Sources Marine Debris

- Beachgoers
- Recreational and Commercial Fisherman
- Ships and Recreational Vessels
- Illegal Dumping
- Storm Water Discharges
- Combined Sewer Overflows
- Solid Waste Disposal and Landfills
- Industrial Activities

Ironically, marine debris has recently made the news, as a large amount of garbage as washed up on Lake Michigan Beaches from Saugatuck to Sleeping Bear Dunes – 200 mile stretch.[109] On July 13, the City of Manistee discovered hundreds of pounds of garbage on a public beach.[110] This sudden influx of trash illustrates that some people still believe our lakes and rivers are dumping areas.

[109] Groups Help Trace Lake Trash, MUSKEGON CHRONICLE, July 25, 2008, available at http://www.mlive.com/news/chronicle/index.ssf?/base/news-14/1216997116294880.xml&coll=8, last visited July 28, 2008.
[110] *Id.*

It is important to note that the Muskegon Lake Watershed Partnership and the Michigan Department of Environmental Quality have approved an Area of Concern Delisting Target for "Degradation of Aesthetics", which encompasses marine debris.[111]

3.1.4 Invasive Species

Although there is no definitive list of invasive species in Muskegon Lake, it is likely that the following invasive species can be found within the lake: Zebra Mussels, Quagga Mussels, Spiny Water Flea, Round Goby, Enteromorpha, and Bloody Red Shrimp.

Similarly, there is not a comprehensive list of all known invasive plant species in Muskegon Lake. But, it is likely that the following species can be found along the lakeshore: common reed, reed canary grass, purple loosestrife, curly pondweed, Eurasian milfoil, frogbit, and two types of non-native cattails.

Sources of Criteria Air Pollutants

- Marine Vessels
  - Lakers
  - Tug/Push Boats
  - Ferries
  - Excursion/Fishing Vessels
  - Dredging Equipment
- Cargo Handling Equipment
  - Terminal Tractors
  - Top & Side Loaders
  - Forklifts
  - Cranes
- Locomotives
  - Line Haul Locomotives
  - Switch Yard Locomotives
- Vehicles
  - On-Road Trucks
  - Buses
  - Automobiles
- Facilities

3.2 Air Quality Impairments

3.2.1 Criteria Air Pollutants

As mentioned in Section 1.3.1, thirty-eight (38) facilities reported Criteria Air Pollutant emissions to the State of Michigan in 2005. Of the thirty-eight facilities, only three (3) are considered a stationary source along Muskegon Lake – B.C. Cobb Generating Station, Michigan Steel and S.D. Warren (SAPPI). Relative to other port facilities (See Figure 11), the B.C. Cobb facility contributes approximately 75% of the NOx emissions and approximately 33% of the CO emissions. The S.D. Warren (SAPPI) facility contributes approximately 20% of the NOx emissions, 65% of the NOx emissions, 100% of the SO_2 emissions, half of the particulate matter emissions, and nearly all the VOC emissions.

Figure 13 – Criteria Air Pollutant Emissions from Stationary and Mobile Sources along Muskegon Lake[112]

2005 MAERS Data	Baseline Watershed Emissions	Stationary Port Facilities	Rail Emissions	Commercial Marine Emissions	% of Baseline	% Change from 2005 Levels
Carbon monoxide (CO)	2,382.91	859.19	11	4	36.69%	-33.98%
Lead	0.43	0.26	No Data	No Data	60.47%	-13.33%
NOx	4,351.21	4,121.48	116	33	98.14%	-21.00%
Particulate Matter (PM)	24.58	0.00	3	2	20.34%	0.00%
$PM_{2.5}$	9.55	8.01	No Data	No Data	83.87%	46.44%
PM_{10}	9.94	8.40	No Data	No Data	84.51%	-70.63%
Sulfur dioxide (SO_2)	47.37	25.28	7	15	99.81%	-99.82%
Volatile Organic Compounds (VOCs)	343.39	184.00	No Data	No Data	53.58%	-32.91%

[111] Lake Michigan Lakewide Management Plan (LaMP) 2008 7-16, available at www.epa.gov/glnpo.
[112] Michigan Air Emissions Reporting System (2006), available at www.michigan.gov/deq.

3.2.2 Toxic Air Pollutants

As mentioned in Section 1.3.2, twenty-one (21) facilities in the Muskegon Lake Watershed reported data to the U.S. EPA Toxic Release Inventory, with four (4) facilities located along the shores of Muskegon Lake – B.C. Cobb Generating Station, Knoll Inc, Michigan Steel, S.D. Warren (SAPPI).

Sources of Toxic Air Pollutants

- Electric Generating Facilities
- Industrial Boilers
- Manufacturing Processes
- Locomotives
- Port Facilities

With the exception of a few pollutants specific to the generation of electricity, the five facilities along Muskegon Lake do not release a significant quantity of pollutants. As expected, the B.C. Cobb generating station releases the greatest quantity of pollutants - 506,000 lbs in total from the combustion of over 1 million tons of coal. S.D. Warren (SAPPI) released over 32,000 pounds of toxic pollutants to atmosphere, likely through the combustion of coal, black liquor, residual fuel oil and wood waste.

However, the quantity of toxics released to the atmosphere has declined significantly since 2005. Of the nineteen (19) pollutants released in 2005, port facilities have reduced emissions of sixteen (16) pollutants in 2006. The port facilities only emitted higher quantities of Naphthalene, Chromium and Manganese from 2005 to 2006.

Figure 14 – Toxic Air Pollutant Emissions from Stationary and Mobile Sources along Muskegon Lake

2006 TRI Data	Discharges to Air					
Persistent Bioaccumulative Toxics (lbs)	**Baseline**	**Port Facilities**	**Rail**	**Commericial Marine**	**% of Baseline**	**% Change from 2005 Levels**
Dioxins & dioxin-like compounds (grams)	0.17	0.17000	0	0	100%	-54.61%
Polycyclic Aromatic Hydrocarbons	8586.34	0.10	8,585.24	0	100%	-0.010%
Heavy Metals (lbs)						
Barium & compounds	791.00	791	0	0	100%	-9.18%
Chromium & compounds	3,651.50	10	0	0	0.27%	66.67%
Copper & compounds	4,046.24	0	0	0	0.00%	-100.00%
Lead & compounds	529.29	482	0	0	91%	-12.23%
Manganese & compounds	27,772.96	24,462	0	0	88%	17.82%
Mercury & compounds	82.20	82.20	0	0	100.00%	-43.58%
Nickel & compounds	3,695.45	10	0	0	0.27%	0.00%
Vanadium & compounds	2.00	2	0	0	100%	-33.33%
Hazardous Air Pollutants & Volatile Organic Compounds (lbs)						
Chlorine	0	0	0	0	0.00%	-100.00%
Hydrochloric acid	418,366	418,366	0	0	100.00%	-33.54%
Hydrogen fluoride	52,000	52,000	0	0	100.00%	-6.13%
Methanol	4,900	0	0	0	0.00%	-100.00%
Naphthalene	2073.00	2,068.00	0	0	99.76%	106.80%
Phenol	242	242	0	0	100%	-85.30%
Other Emissions (lbs)						
Ammonia	599.59	0	99.59	0	17%	-99.38%
Chlorine Dioxide	0.00	0	0	0	0%	-100%
Sulfuric acid	43,000	43,000	0	0	100%	-21.63%

3.2.3 Greenhouse Gas Emissions

Although not yet regulated by the Federal Government, greenhouse gas emissions, primarily carbon dioxide, are fast becoming the most pressing issue of the 21st century. For the first time in history, legislation to regulate greenhouse gas emissions (GHGs) received a vote in the U.S. Senate. While the legislation did not pass, there is momentum to pass another bill when the political landscape changes in 2009. If greenhouse gas legislation is passed by Congress and signed into law, the likely framework for greenhouse gas regulation will be a market-based approach, known as "cap-and-trade."

Under a cap-and-trade system, the government will cap the emissions of greenhouse gasses across one or many economic/industrial sectors and distribute allocations for the release of GHGs. Companies must have enough allocations to cover their annual emissions. If a company does not have enough allocations, then the company must buy surplus allocations from other companies or make emission reductions. In time, the government reduces the amount of annual allocations, increasing the value of an allocation. Eventually, the price of an allocation becomes so expensive that companies find it cheaper to make reductions rather than continually buying allocations. If properly implemented, a cap-and-trade system will spur technological innovation and provide the financial incentive to reduce greenhouse gas emissions.

Sources of Greenhouse Gas Emissions

Stationary

- Electric generating facilities that use fossil fuels
- Industrial facilities with fossil fuel-fired boilers
- Port facilities

Mobile

- Dock vehicles
- Commercial ships
- Recreational boats
- Locomotives

To facilitate discussion on this topic, Delta has estimated the direct greenhouse gas emissions from port facilities that generate electricity.

Figure 15 - Greenhouse Gas Emissions from Stationary Sources along Muskegon Lake

	Fuel Type	Fuel Consumption	Net Generation (mwH)	CO_2 (tons)	% Change from 2005 CO_2 Levels
Consumers Energy - BC Cobb	Bitumous Coal (tons)	206,917	499,608	528,335.46	-8.54%
	Natural Gas (Mcf)	259,655	25,239	15,595.41	-69.75%
	Sub-Bitumous Coal (tons)	939,875	1,644,730	1,739,301.98	12.10%
	Subtotal		2,169,577	2,283,232.84	4.70%
SD Warren (SAPPI)	Bitumous Coal (tons)	119,598	110,269	116,609.47	-16.73%
	Black Liquor (tons)	-	-	-	-100.00%
	Natural Gas (Mcf)	61,462	2,294	3,691.53	-72.14%
	Residual Fuel Oil (barrels)	-	-	-	-100.00%
	Wood Waste (tons)	58,661	20,349	111,866.53	42.85%
	Subtotal		132,912	232,167.53	-17.37%
	Grand Total			2,515,400.37	2.18%

This is 2007 data from the U.S. Department of Energy, Energy Information Administration 906/920 database.

Figure 16 – Greenhouse Gas Emissions from Mobile Sources along Muskegon Lake[113]

	Track Miles	Line-haul Fuel Use (gal/yr)	Business Days	Gallons/day	Gal/Track Mile/Day
CSX (Statewide)	838	7,095,267	251	28,268.0	33.7
West Olive/Msk/Fremont	46	389,530	251	1,551.91	33.7

	Track Miles	Fuel Use (gal/yr)	CO_2 (tons)
West Olive/Msk/Fremont	46	389,530	4,360

[113] U.S. DEP'T OF ENERGY, FUEL AND ENERGY SOURCE CODES AND EMISSION COEFFICIENTS, *available at* http://www.eia.doe.gov/oiaf/1605/factors.html. For this analysis, we used the emission coefficient for diesel fuel of 22.384 lb per gallon.

The amount of carbon dioxide release per gallon of diesel fuel combusted is 22.384 pounds.[114]

3.3 Land Quality Impairments

3.3.1 Industrial Waste, Solid Waste and Construction Debris

As expected, the facilities located along Muskegon Lake have quite a bit of industrial waste that is disposed of in on-site or off-site landfills. Since this information is from the 2006 Toxic Release Inventory, please note that each facility is required to report the chemical composition of its waste products. While it appears that port facilities are directly disposing heavy metals to landfills, the reality is that facilities are likely disposing of a manufactured product composed of a variety of metals and chemicals.

Sources of Solid Waste

- Recreational and Commercial Fisherman
- Ships and Recreational Vessels
- Harbor and Marinas
- Port Facilities
- Industrial Activities

With that caveat in mind, port facilities are sending over 400,000 pounds of chemicals and metals to landfills each year. Not surprisingly, the B.C. Cobb Generating Station landfills the most material. This material is likely fly ash, a residue of the coal combustion process, whose chemical composition will vary based on the type of coal burned. Michigan Steel disposed of approximately 18,000 pounds of metals and chemicals in 2006. Much, if not all, of this material was bound in byproducts and residues of the steel making process.

Of the eleven (11) chemicals and metals disposed of to landfills, the facilities along Muskegon Lake reduced the quantities of eight (8) between 2005 and 2006. It is not clear what factors caused the decline of chemicals and metals landfilled from 2005 to 2006, although the reduction of operations at the S.D. Warren (SAPPI) facility likely played a role.

Figure 17 –Land Disposal of Industrial Waste

2006 TRI Data	Baseline Emissions				Port Emissions					
	On-Site Land Disposal	Off-Site Land Disposal	Off-Site RCRA Disposal	Total	On-Site Land Disposal	Off-Site Land Disposal	Off-Site RCRA Disposal	Total	% of Baseline	% Change from 2005
Metals & Metal Compounds										
Barium & compounds	100,000.00	240,011.00		340,011.00	100,000.00	240,011.00		340,011.00	100.00%	22.55%
Chromium & compounds		16,432.71		16,432.71		250.00		250.00	1.52%	-66.67%
Copper & compounds		7,356.89		7,356.89				0.00	0.00%	-100.00%
Lead & compounds	1,100.74	6,766.29		7,867.03	1,099.10	4,869.40		5,968.50	75.87%	-21.57%
Manganese & compounds	18,900.00	98,159.32		117,059.32	18,900.00	44,751.70		63,651.70	54.38%	-17.22%
Mercury & compounds	2.20	11.01		13.21	2.20	11.01		13.21	100.00%	-70.09%
Nickel & compounds		3,660.53	250.00	3,910.53			250.00	250.00	6.39%	-69.84%
Vanadium compounds	6,500.00	17,000.00		23,500.00	6,500.00	17,000.00		23,500.00	100.00%	-25.00%
Hazardous Air Pollutants and Volatile Organic Compounds										
Naphthalene		16602.00		16602.00		16602.00		16602.00	100.00%	5.22%
Phenol		283.00		283.00		283.00		283.00	100.00%	-43.40%
Other Watershed Wastes and Pollutants										
Diisocyanates		12		12.00		12		12.00	100.00%	100.00%

3.3.2 – Dredge Materials

Over the last few years, declining lake levels combined with sedimentation have created a build-up of sand and silt in Muskegon's outer harbor. This build-up of sand grounded four (4) ships in 2007.[115] In

[114] *See* http://www.eia.doe.gov/oiaf/1605/coefficients.html, last visited July 21, 2008.

[115] KALAMAZOO GAZETTE, Mar. 17, 2008, available at http://blog.mlive.com/kalamazoo_gazette_extra/2008/03/dredging_of_west_michigan_harb.html, last visited July 20, 2008.

April 2008, the Army Corps of Engineers dredged a portion of Muskegon Lake, focusing on buildup of sand and silt between the outer pierheads but not the channel itself, which is of adequate depth for shipping.[116]

There are several concerns with regards to dredging and dredge materials. First, the very act of dredging allows sediments contaminated with heavy metals, PCB's and other toxins to re-suspend in the water column. During this time, the contaminated sediments could be ingested by fish and eventually consumed by humans. Another concern is in regards to the placement of dredge materials. Uncontaminated dredge spoils can be used for a variety of applications, include beach restoration, land application, and clean fill. Conversely, contaminated dredge spoils must be cleaned before use in areas where human contact is likely. While integrated approaches to contaminated sediment management are becoming more common, it is not clear what will become of the sediments removed during the dredging of Muskegon's outer harbor.

3.3.3 Brownfield and Superfund Sites

There appears to be twelve (12) brownfields located along the Muskegon Lake shorelines.[117] Some of these properties are vacant, some have been redeveloped and some are still being used.

Figure 18 – Brownfields along Muskegon Lake

Name	Address	Contamination	Current Status
Amazon	550 W Western Ave	Remediated	Developed - Loft Apts & Retail Space
Amoco Oil Terminal	1640 Lakeshore Dr	Benzene, Ethylbenzene, MTBE, Toluene, Xylenes	
Anaconda	1133 W Western Ave	Cresol, Solvents	Remediation in Progress
Carpenter Brothers Building	W. Western Ave @ Shoreline Dr	Unknown	
CMS-Consumers	151 N. Causeway	Diesel	Developed - Green Space
Edison Landing	Bus. 31 & Terrace St	Remediated	Developed - Commercial, Academic, Residential
Grand Trunk Railroad Dock	2100 Lakeshore Dr	Benzene, Ethylbenzene, Naphthalene, Toluene, Xylenes	Interim Remediation in Progress
MichCon - Lakey Foundry	Shoreline Dr @ 1st St	Benzene, Lead, Touluene, Xylenes, Zinc	Interim Remediation in Progress
Michigan Foundry Supply	700 W Western Ave	Remediated	Developed - Recreation (Heritage Landing)
Muskegon Rag & Metal	10 E. Western Ave	Unknown	
Verplank	205 E Western Ave	Unknown	
West Michigan Steel Foundry	1148/1204 W Western Ave	Unknown	

There are no superfund sites along the Muskegon Lake shoreline.

3.3.4 Shoreline Hardening[118]

Port and marina facilities occur within all four zones listed in section 2.3.4.4 and (to some extent) contribute to the hardening of the shoreline. In recent years, however, port and marina facilities, along with the Muskegon Lake Watershed Partnership, Muskegon River Watershed Alliance, other community organizations and private landowners, have taken actions to 'soften' the shoreline and improve fish and wildlife habitat in the near-shore area. For example, private landowners in zone 1 (coastal dune area) removed 60 cubic yards of concrete riprap to create a natural bank (planted with native vegetation) which filters stormwater run-off and creates wildlife habitat. Within zone 2 (wetlands), volunteers established a buffer strip of native flowers and grasses between the shoreline and the lakeshore trail. Furthermore, the MLWP and Great Lakes Dock & Materials (a port facility) partnered to restore five (5) acres of shoreline wetlands on a site formerly owned by the Grand Trunk railroad. Within zone 3 (aquatic life), MLWP partnered with LaFarge (a port facility) to improve a former gravel staging area by planting native grasses and trees, creating a buffer strip to filter stormwater and a greenway to provide habitat for

[116] *Id.*
[117] *See* WMRSDC, *supra* note 86.
[118] MLWP & MWRA, *supra* note 8.

wildlife. Finally, within zone 4 (riverine), the Muskegon River Watershed Alliance planted four (4) acres of estuary with wild rice, a native plant which grew abundantly in Muskegon Lake prior to settlement.

Although the MLWP and partners have made strides in softening the shoreline of Muskegon Lake, much work remains. Recently, Consumers Energy (a port facility), Muskegon Environmental Research & Education Society, MLWP, the West Michigan Shoreline Regional Development Council and the Great Lakes Commission have partnered on a NOAA Great Lakes Habitat Restoration grant, which, if funded, would support additional fish and wildlife habitat restoration.

4.0 Strategies to Reduce Ecosystem Impacts of Ports, Marinas and Related Infrastructure

4.1 Improving Water Quality

4.1.1 Reducing Heavy Metals, Hydrocarbons and Toxic Substances

4.1.1.1 Regulatory Strategies

The Clean Water Act[119] establishes the basic structure for regulating discharges of pollutants into the waters of the United States. Section 307 defines a list of priority pollutants for which the U.S. EPA must establish ambient water quality criteria (the basis of state water-quality standards) and effluent limitations (rules controlling environmental releases from specific industrial categories based on the "best available technology economically achievable").

The initial list of priority pollutants was based on a 1977 consent decree that settled a legal challenge to the U.S. EPA's program for controlling hazardous pollutants. A relatively small number of revisions to the list have been made by the U.S. EPA administrator since 1977. Decisions to expand the list must take into account the toxicity, persistence, and degradability of the pollutant; the potential presence and the importance of affected organisms in any waters; and the nature and extent of the effect of the toxic pollutant on such organisms.

The National Pollutant Discharge Elimination System (NPDES) permit program[120] controls water pollution by regulating point sources that discharge pollutants into waters of the United States. Point sources are discrete conveyances such as pipes or man-made ditches. Individual homes that are connected to a municipal system, use a septic system, or do not have a surface discharge do not need an NPDES permit. However, industrial, municipal, and other facilities must obtain permits if their discharges go directly to surface waters. In most cases, the NPDES permit program is administered by authorized states. Since its introduction in 1972, the NPDES permit program is responsible for significant improvements to our Nation's water quality.

The Pollution Prevention Act[121] focused industry, government, and public attention on reducing the amount of pollution through cost-effective changes in production, operation, and raw materials use. Opportunities for source reduction are often not realized because of existing regulations, and the industrial resources required for compliance, focus on treatment and disposal. Source reduction is fundamentally different and more desirable than waste management or pollution control.

The national policy of the U.S. states that:

- Pollution should be prevented or reduced at the source, whenever feasible;
- Pollution that cannot be prevented should be recycled in an environmentally safe manner, whenever feasible;
- Pollution that cannot be prevented or recycled should be treated in an environmentally safe manner, whenever feasible;

[119] *See* http://www.scorecard.org/chemical-groups/one-list.tcl?short_list_name=pp.
[120] *See* http://cfpub.epa.gov/npdes/
[121] *See* http://www.thecre.com/fedlaw/legal14air/ppa.htm.

- Disposal or other release into the environment should be employed only as a last resort and should be conducted in an environmentally safe manner.[122]

Pollution prevention also includes other practices that increase efficiency in the use of energy, water, or other natural resources, and protect our resource base through conservation. Practices include recycling, source reduction, and sustainable agriculture.

Great Lakes Legacy Act of 2002[123] authorizes $270 million in funding over five years, beginning in fiscal year 2004, to specifically assist with the remediation of contaminated sediment in the 31 designated U.S. Areas of Concern (AOCs).

Under the Act, priority is given to the following projects:

- Remedial action for contaminated sediment;
- Projects that have been identified in a Remedial Action Plan;
- Projects that are ready to be implemented;
- Projects that will use an innovative approach, technology, or technique that may provide greater environmental benefits, or equivalent environmental benefits at a reduced cost; or
- Projects that include remediation to be commenced not later than one year after the date of receipt of funds.[124]

4.1.1.2 Technological Strategies

Green Chemistry[125] refers to environmentally friendly chemicals and processes that result in:

- Reduced waste, eliminating costly end-of-the-pipe treatments;
- Safer products;
- Reduced use of energy and resources—all improving the competitiveness of chemical manufacturers and their customers.

There are twelve core principles of Green Chemistry:[126]

1. Prevent waste
2. Design safer chemicals and products
3. Design less hazardous chemical syntheses
4. Use renewable feedstocks
5. Use catalysts, not stoichiometric reagents
6. Avoid chemical derivatives
7. Maximize atom economy
8. Use safer solvents and reaction conditions
9. Increase energy efficiency
10. Design chemicals and products to degrade after use
11. Analyze in real time to prevent pollution
12. Minimize the potential for accidents

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[122] *See* http://www.compositesone.com/documents/regmanual/c1reg_tab3.pdf.
[123] U.S ENVTL. PROT. AGENCY, GREAT LAKES LEGACY ACT OF 2002 (Jan. 2004), *available at* http://www.epa.gov/glnpo/sediment/legacy/glla-factsheet-200401.pdf.
[124] *See* http://www.epa.gov/glnpo/sediment/legacy/priorities.html.
[125] *See* http://www.epa.gov/gcc/.
[126] PAUL ANASTAS AND JOHN WARNER, GREEN CHEMISTRY: THEORY AND PRACTICE (Oxford University Press 1998).

4.1.1.3 Operational Strategies

A. Port Facilities

1. Structures
    a) Use piers and bulkheads made of concrete, where possible
        i) Steel may deteriorate over time, releasing paints and metals
        ii) Creosote treated wood may leach toxic chemicals
    b) Retrofit existing vehicle maintenance facilities to include oil/water separators
2. Port Design
    a) Slope storage areas to enhance collection through separate storm drain system
    b) Provide and maintain separating mechanisms, such as oil/water separators, to keep spills and leaks from stormwater
    c) Install separate collection systems for areas where maintenance and washing occur. Discharge contaminated waters from these areas to water treatment facility
    d) Ensure vehicle washing and maintenance areas are routed to sanitary sewers, not storm sewers
    e) Contain piles of bulk materials with perimeter walls
    f) Provide concrete bases for bulk storage facilities and liners under storage facilities to ensure that no releases reach the groundwater
3. Operations and Maintenance
    a) Seal pavement to minimize the release of pollutants
    b) Inspect storage area frequently for leaks of oils, hydraulic fluids, antifreeze, and other lubricants
    c) Encourage use of water soluble vehicle protection coatings
    d) Label storm drains "No Dumping – Storm Drain"
    e) Switch to longer lasting, less-toxic antifouling paints where possible
    f) Develop or regularly update a Spill Prevention, Control and Countermeasure Plan
        i) Purchase/maintain sufficient amount of spill containment equipment
        ii) Have spill response materials readily available
        iii) Provide ability to quickly install booms to capture fuel and other floatables
    g) Immediately contain and stop leaks and spills
4. Chemical/Fuel Management
    a) Develop chemical management procedures
        i) Provide adequate space to allow for safe management of fuels
        ii) Ensure only compatible materials are stored together
        iii) Ensure all containers are marked and labeled properly
        iv) Read and understand material safety data sheets for all chemicals
    b) All chemicals should be stored with proper secondary containment and leak detection
    c) Provide overfill protection and alarms for liquid bulk storage facilities
    d) Provide flame resistant lockers for small quantities of materials

Operational Strategies for Marinas

1. Provide sewage pump-out facilities which are connected to oil/water separator and sanitary sewer
2. Provide bilge water management options including low cost or no cost absorbent pads
3. Include oil/water separators in parking lots
4. Do not allow in-water boat cleaning
    a) Encourage use of phosphate free soaps and detergents
    b) Encourage use of alternative antifouling paints
    c) Encourage use of natural cleansers, instead of solvents

B. Cargo Handling Equipment & Locomotives

1. Install self-contained truck and railcar wash facilities
    a) Ensure vehicle cleaning occurs away from storm drains
2. Conduct regularly inspection and maintenance program on equipment
3. Develop fuel management procedures
    a) Design fueling areas to prevent run-on of storm water and run-off of spills
    b) Use a perimeter drain and slope fueling area to a dead end sump or oil/water separator
    c) Pave fueling area with concrete
    d) Avoid mobile fueling when possible
4. Use non-chlorinated solvents and cleaning agents
    a) Where possible, use biodegradable products and substitute materials with less hazardous properties
5. Recycle or properly dispose of the following: greases, oils, antifreeze, brake fluid, cleaning solutions, hydraulic fluids, batteries, transmission fluids, filters

C. Marine Vessels

1. Conduct repairs in dry dock, whenever possible

D. Bulk Storage of Raw Materials

1. Salt piles[127]
    a) Pad Design
        i) Evaluate site to determine potential environmental impact on surface water and groundwater
        ii) Site drainage systems must prevent contract between salt and storm water runoff from adjacent terrain
        iii) The sub-base and pad must be constructed to achieve lowest permeability to prevent downward seepage of brine
    b) Stockpile Configuration
        i. Ensure that the working end of the pile is at the downwind end
    c) Best Management Practices and Stormwater Controls
        a) For clamshell, end-loader, truck or bulldozer operations, ensure that equipment operators lower the clamshell or bucket to the minimum feasible distance from the pile before discharging a load of salt
        b) Promptly clean up salt spilled by arriving/departing trucks, railcars or other vessels
        c) Load salt within the designated pad area
        d) Adjust truck tailgates to avoid spillage and sweep tailgate apron if there is spillage
    d) Covering Procedures for Stockpiles[128]
        i. Stockpiles should be covered at all times, except when receiving salt, building the stockpile or loading out, to prevent precipitation contact.
        ii. Types of covering include canvas, polyethylene films, and fabrics made from synthetic fibers
            1. Seams must be watertight and resistant to damage in winds up to 69 mph.

[127] *See* http://www.saltinstitute.org/51.html.

[128] *See* ROY D. DODSON, STORMWATER POLLUTION CONTROL: MUNICIPAL, INDUSTRIAL AND CONSTRUCTION NPDES COMPLIANCE 172 (McGraw Hill Professional 1999). "Facilities that collect all the runoff from their salt piles and reuse it in their processes or discharge it subject to a separate National Pollutant Discharge Elimination System (NPDES) permit, do not need to enclose or cover their piles."

2. Properly maintain covering to prevent contact with precipitation
3. Seal the perimeter of the stockpile cover to the pad with ballast to prevent washout of salt from the toe of the stockpile. Ballast must be placed high enough on the sides of the stockpile to minimize slackness in the cover as salt shifts and flows beneath the cover down to the perimeter of the stockpile.

iii. Maintain complete perimeter cover ballast until the stockpile is exhausted

4. Remove covering at the working face just high enough to load out day's shipment

e) Install storm water containment systems for stockpiles
   i. Earthen collection basins must be synthetically lined and holding tanks corrosion-protected to assure continued low permeability
   ii. Ensure proper capacity of storm water containment systems by reviewing historic precipitation events and discharge frequency
f) Regularly inspect pad, drainage and collection systems; Perform preventative maintenance such as periodic resealing of the pad
g) Obtain appropriate permits when necessary
h) Prepare a written pollution prevention plan

2. Coal Piles
   a) Stormwater Runoff[129]
      i. Cover coal piles to limit exposure to precipitation
      ii. Install and maintain berms to prevent storm water run-on
      iii. Install and maintain collection systems that capture and treat coal pile runoff
         1. Drainage ditches around perimeter of coal pile, connected to settling ponds
      i. Technology options for treating coal pile runoff
         1. Equalization, pH adjustment, settling;
         2. Equalization, chemical precipitation treatment, settling, pH adjustment

4.1.2 Reducing Storm Water, Sedimentation, Pathogens and Nutrients

4.1.2.1 Regulatory Strategies

The National Pollutant Discharge Elimination System (NPDES) permit program controls water pollution by regulating point sources that discharge pollutants into waters of the United States. Point sources are discrete conveyances such as pipes or man-made ditches. Individual homes that are connected to a municipal system, use a septic system, or do not have a surface discharge do not need an NPDES permit. However, industrial, municipal, and other facilities must obtain permits if their discharges go directly to surface waters. In most cases, the NPDES permit program is administered by authorized states. Since its introduction in 1972, the NPDES permit program is responsible for significant improvements to our Nation's water quality.

The main goal of *Storm Water Management Ordinances* for existing development is to limit surface runoff volumes and reduce water runoff pollution loadings. To be most effective, the ordinance will reference a guidance manual for BMP design and implementation. This design manual contains information on sizing criteria, performance criteria, and guidance on selection and location of BMPs. Second, the ordinance should have language requiring that all development projects include a post-construction storm water management plan. The ordinance should include information on what the contents of an acceptable plan are and who is responsible for operation and maintenance. The operation and maintenance section will

[129] *Id.* at 173.

include a mechanism for inspection of all storm water control practices. A final requirement is language explaining the mechanisms for enforcement of the requirements of the ordinance, including the civil and criminal penalties that may apply.[130]

There are other ideas that can be included in an ordinance to improve its ability to control storm water runoff. The ordinance could include what nonstructural and structural storm water practices are allowed within the community. Communities may also wish to add language regarding on-site storm water requirements and whether off-site treatment is an option.[131]

Water Quality Trading[132] is an innovative approach to achieve water quality goals more efficiently. Trading is based on the fact that sources in a watershed can face very different costs to control the same pollutant. Trading programs allow facilities facing higher pollution control costs to meet their regulatory obligations by purchasing environmentally equivalent (or superior) pollution reductions from another source at lower cost, thus achieving the same water quality improvement at lower overall cost. While trading can take many different forms, the foundations of trading are that a water quality goal is established and that sources within the watershed have significantly different costs to achieve comparable levels of pollution control.

4.1.2.2 Technological Strategies[133]

Storm Water Devices such as pipes, culverts, ditches, catch basins, grit traps, secondary containment, and oil/water separators.
Detention Facilities such as wet ponds, extended detention dry/wet ponds, vaults and tanks.
Infiltration Facilities such as infiltration basins, infiltration trenches, rain gardens and porous pavements.
Bio-filters such as vegetated swales, constructed wetlands and filter strips.

4.1.2.3 Operational Strategies

A. Facilities

1. Structures
    a. Consider placement of pier/bulkhead and the potential impacts on sediment transport and shoaling
    b. Consider the use of structural sediment and erosion control devices to reduce peak runoff flow
        i. Earth dikes, drainage swales, interceptor dikes and swales, temporary storm drain diversion, subsurface drains, silt fences, straw bale barriers, brush barriers, gravel or stone filter berms, storm drain inlet protection, silt curtains
2. Port Design
    a. Maintain original vegetation where ever possible; Plant grasses, shrubs and trees in drainage ways to slow erosion or along shorelines to filter sediment; Create buffer zones of natural vegetation between construction areas and storm drains to trap and remove sediments
3. Operations and Maintenance
    a. Properly store and dispose of construction/demolition debris[134]

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[130] *See* http://www.stormwatercenter.net/
[131] *Id.*
[132] *See* http://www.epa.gov/OWOW/watershed/trading.htm.
[133] MICH. DEPT. OF ENVTL. QUALITY, MDEQ GUIDANCE FOR STORMWATER POLLUTION PREVENTION INITIATIVES (SWPPI) (2005), *available at* http://www.deq.state.mi.us/documents/deq-water-stormwater-SWPPI_guidance.pdf.
[134] AMERICAN ASS'N OF PORT AUTH., ENVIRONMENTAL MANAGEMENT HANDBOOK (1998), *available at* http://www.aapa-ports.org/Issues/content.cfm?ItemNumber=989.

i. When possible, cover construction debris and stockpiles
ii. Recycle construction debris when possible
iii. Do not wash sweepings into street or storm drain
iv. Properly dispose of landscape waste

b. When sandblasting, prevent runoff from misting operations from entering drainage systems[135]
c. Ensure used paints are not poured on the ground or near storm drains[136]
d. Minimize the amount of time that soil remains exposed without cover
    i. Use a mulch, like wood chips or straw to minimize erosion; Consider using netting or mats as a supplement to mulch

i. Regularly clean catch basins
ii. Discharge boiler blow down materials into the sanitary sewer system

4.1.2.4 Voluntary Strategies

The *Michigan Clean Marina program*[137] was developed through a public-private partnership involving the marine industry, academic institutions and state government. The clean marina program encourages marinas to develop technically sound and economically achievable approaches to prevent the release of hazardous substances and reduce the generation of waste. Objectives include the following:

- Foster communication among the marina industry, state agencies, academic institutions and environmental groups;
- Promote voluntary implementation of pollution prevention (P2) strategies, environmental risk reduction and fish and wildlife habitat enhancement in the context of good business practice;
- Promote industry compliance with environmental laws and regulations impacting the marina industry through education and outreach;
- Develop recognition and economic incentives for environmentally proactive marina operations.

4.1.3 Reducing Marine Debris

4.1.3.1 Regulatory Strategies[138]

Beaches Environmental Assessment and Coastal Health Act (BEACH) of 2000 was signed into law to reduce the risk of illness to the nation's recreational waters. The legislation mandates the following actions:

1. Publish new or revised microbiological water quality criteria within 5 years of enactment and review the criteria every 5 years;
2. Ensure state or tribal adoption of existing microbiological water quality criteria within 42 months of enactment and within 36 months of revisions;
3. Provide technical assistance to states, tribes, and local governments for assessment and monitoring of floatable debris;
4. Maintain a public right-to-know database;
5. Implement a state and tribal grant program for beach monitoring and notification consistent with performance criteria.

Shore Protection Act of 1988 was enacted to minimize trash, medical debris and other unsightly and potentially harmful materials from being deposited into the coastal waters of the United States as a

[135] *Id.*
[136] *Id.*
[137] *See* http://www.miseagrant.umich.edu/downloads/cmp/clean_marinas.pdf
[138] *Id.*

result of inadequate waste handling procedures by vessels transporting wastes on U.S. coastal waters and at associated loading and offloading facilities.

4.1.3.2 Operational Strategies

1. Properly store and dispose of construction/demolition debris
2. Provide adequate space to allow for safe management of solid and sanitary wastes
3. Provide adequate waste containers for daily trash; Ensure that receptacles are covered; Empty waste receptacles frequently
4. Use compactors to minimize storage requirements and disposal for all solid wastes
5. Provide receptacles for recyclable materials
6. Develop information packages designed for ship captains that identify solid waste reception facilities

4.1.3.3 Voluntary Strategies

1. *International Coastal Cleanup* occurs on the Third Saturday in September.
2. The *Storm Drain Sentries* program aims to increase public awareness regarding the impact of trash and other pollutants being dumped or poured into storm drains by painting warning messages on storm water drains across the United States.
3. Clean Marinas Program (described in Section 3.2).

4.1.4 Managing Invasive Species

4.1.4.1 Regulatory Strategies[139]

"The National Invasive Species Act (NISA) is the primary legislation for the prevention and control of aquatic nuisance species in the United States. NISA was slated for review by the U.S. Congress and eligible for re-authorization in 2002, however, despite new introductions of ANS in the Great Lakes and pressure from the Great Lakes States to take action at a national level, Congress has failed to pass a comprehensive reauthorization of NISA at the time of this report. Several bills have been introduced in the House and Senate including bills that would, specifically, regulate ballast water discharges, however, these bills are still pending. Below are examples of initiative that would regulate ballast water as a way of control the spread of invasive species.

A. Saint Lawrence Seaway Development Corporation[140]

"The Saint Lawrence Seaway Development Corporation, in conjunction with the St. Lawrence Seaway Management Corporation of Canada, have updated their rules and regulations to require that all ships coming into the Great Lakes and Saint Lawrence River from foreign waters and that are reporting no ballast on board (NOBOB) will be required to flush their ballast tanks with sea water in order to reduce the risk of the introduction of exotic species. Ships that enter the Saint Lawrence Seaway from foreign waters [outside of the Exclusive Economic Zone (EEZ)] and are reporting to the U.S. Coast Guard that they have ballast water in their tanks are required to exchange that water with sea water before entering however, until the recent rule change, ships reporting no ballast on board were under no such requirements.

Specifically, ships coming from outside waters under Canadian jurisdiction, declaring no ballast on board, must ensure that the residual ballast water in tanks has been exposed to salinity conditions equivalent to ballast water exchange. It has been recognized that NOBOB ships often contain residual ballast water

[139] *See* LaMP, *supra* note 111 at 8-3 – 8-16.
[140] *Id.* at 8-3.

and sediments in their ballast tanks that can harbor exotic species and pathogens. When these ships enter the Great Lakes, they may visit more than one port and take on ballast water from the Great Lakes in one place and then release that water in another place allowing the foreign organisms to be released.

B. Aquatic Invasive Species Rapid Response Initiative[141]

"The first line of defense against aquatic invasive species (AIS) introductions is prevention; however, even the best prevention efforts may not stop all introductions. Early detection and rapid response efforts increase the likelihood that invasions will be addressed successfully while populations are still localized and can be contained and eradicated. There are a variety of species-specific and location-specific contingency plans that have been completed by natural resource, environmental protection, and land management agencies. However, current organizational and fiscal resources do not allow for planning for all possible events. As an interim step toward improving AIS response capability in situations where specific contingency planning does not exist, a Rapid Response Communication Protocol has been developed to insure that agencies can efficiently coordinate and pool resources as soon as a new invader is detected."

C. Clean Boats Initiative[142]

"The proposed "Great Lakes Clean Boat Initiative" would promote these goals.

- The Great Lakes Regional Collaboration Executive Committee Sub-committee has proposed that U.S. Sea Grant representatives lead regional efforts on the Clean Boats Initiative. An initial conference call with GLRC partners, Sea Grant staff and other interested parties will be held in coming weeks to clarify the workplan and timeline moving forward.
- An informal steering group will be established that will coordinate efforts to establish a compendium of existing boater education and outreach materials. It is possible that the steering group will coordinate with the existing database hosted by Portland State University (http://www.clr.pdx.edu/projects/edoutreach/content/browse.php).
- Steering group members will also select a date or dates for Clean Boat Day to be held during the 2008 boating season. It is possible that Clean Boat Day will be held in conjunction with, or promoted along with, the GLRC Rapid Response mock

D. Ballast Reporting Laws[143]

"Michigan passed a ballast water reporting law that requires the Michigan Department of Environmental Quality (MDEQ) to determine whether ballast water management practices are being complied with by all vessels operating on the Great Lakes and the St. Lawrence waterway.

The State of Michigan wants to take action to protect the Great Lakes from aquatic invasive species. Law supporters believe that If actions are not taken to stop the spread of aquatic invasive species, additional species will be transported into the Great Lakes (and from the Great Lakes to other parts of the world) through ballast water. Additional major impacts such as elimination of native species may be seen on the Great Lakes ecosystem.

Under the law, owners/operators of vessels must register with The Michigan Department of Environmental Quality's Ballast Water Reporting List and fill out a Ballast Water Management Practices Report Form. Information required on the form includes:

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[141] *Id.* at 8-8.
[142] *Id.* at 8-11.
[143] *Id.* at 8-15.

For oceangoing vessels:
• Indicate whether during the last 12 months, the vessel maintained compliance with the Code of Best Management Practices for Ballast Water Management provided by the Shipping Federation of Canada;
• Indicate whether the vessel is currently complying with the ballast water management practices.

For non-oceangoing vessels:
• Indicate whether during the last 12 months, the vessel maintained compliance with the Voluntary Management Practices to Reduce the Transfer of Aquatic Nuisance Species within the Great Lakes by the United States and Canadian Domestic Shipping, provided by the Lake Carriers' Association and the Canadian Shipowners' Association;
• Indicate whether the vessel is currently complying with the ballast water management practices.

As a result of Public Act 33 of 2005, Michigan's Ballast Water Control General Permit became effective January 1, 2007. As of October 2007, MDEQ has issued 83 permits to 28 international shipping companies to conduct port operations in Michigan."

4.1.4.2 Technological Strategies[144]

Barrier construction: Barriers use a variety of methods, including sound waves, electrical impulses, and visual and physical deterrents. These barriers can help prevent the spread of exotics in smaller waterways like canals and streams.

4.1.4.3 Operational Strategies[145]

Biocides: Chemicals, such as the lampricide TMF (used to control sea lamprey populations) and herbicides on aquatic plants, are sometimes used to reduce or eradicate local populations of exotic species.

Physical removal: Harvesting small populations of aquatic plants, for instance, can act as a temporary control in smaller inland lakes and waterways.

Biological control: Very carefully selected nonnative species, usually predators, are introduced to control population growth of another invasive species. A good example of this is work done with insects that specialize in eating purple loosestrife.

Public education

4.2 Improving Air Quality

4.2.1 Reducing Emissions of Criteria Air Pollutants

There are four broad categories by which one can classify criteria air pollutant reduction strategies: Regulatory, Technological, Operational, and Voluntary. The strategies presented here do not represent a complete list of applicable regulations, emission reduction technologies or best management practices. Rather, these strategies are a sampling of the most common approaches and practices to reducing criteria air pollutant emissions.

[144] *Id.* at 8-11.
[145] *Id.*

4.2.1.1 Regulatory Strategies[146]

A. Emission standards

For non-road and marine diesel engines, the EPA is implementing more stringent standards for new engines and equipment, modeled after the 2007/2010 diesel standards for on-road vehicles. The EPA also intends to propose similar stands for locomotives.

B. Fuel Standards

Beginning in 2007, EPA set a sulfur limit in diesel fuel for non-road engines at 500 ppm. By 2010, the EPA will require a sulfur limit of 15 ppm (ultra-low sulfur diesel) for non-road engines. By 2012, ultra-low sulfur diesel will be required for locomotive and marine engines.[147]

4.2.1.2 Technological Strategies[148]

E. Diesel Retrofit Technologies

Diesel Oxidation Catalysts use a chemical process to convert PM to less harmful components. This is a proven technology that can lower PM emissions by 20-30%. It works best with low sulfur fuel, e.g. ‹350 ppm.

Diesel Particulate Filters collect particulate matter in the exhaust stream and allow particles to be converted to carbon dioxide and water vapor. These filters can be installed on new and used vehicles, but must be used with ultra-low sulfur fuel and duty cycles with high exhaust temperatures. Diesel particulate filers can reduce PM emissions by 50-90%.

NO_X Catalysts use chemical process to lower NO_X emissions, but are not tested extensively in off-road applications. Examples include lean NO_X catalysts, which use diesel fuel spray to lower emissions up to 25% and NO_X absorbers which can eliminate more than 70% of NO_X emissions when used with ultra-low sulfur fuel. However, NO_X absorbers are not commercially available.

Selective Catalytic Reduction is used at electric generating facilities to convert NO_X emissions to nitrogen and water through a reducing agent injected into exhaust stream. This system can reduce NO_X emissions 75-90%. If SCR is used in conjunction with diesel Particulate Filter, then it can reduce PM and NO_X 80-90%.

Did You Know?
Emulsified diesel is sold under several brand names, including Lubrizol PuriNOx™ and Aquazole™. Emulsified diesel can reduce NOx emissions 17-20% and PM emissions 17-50%.

Source: ICF Consulting, Emission Reduction Incentives for Off-Road

F. **Diesel Repower** - The act of replacing an existing engine with a new engine that meets lower emission standards or converting diesel-powered equipment to electrical power is known as diesel repower.

G. **Alternative Fuels** - *Emulsified Diesel* is blended mixture of diesel fuel, water, and additives that reduce PM and NOX emissions. However, the addition of water reduces the energy content of fuel, so

[146] ICF Consulting, Emission Reduction Incentives for Off-Road Diesel Equipment Used in the Port and Construction Sectors 14-21 (2005), *available at* http://www.epa.gov/sectors/pdf/emission_20050519.pdf.
[147] Sulfur levels in residual ("bunker") fuel not subject to EPA regulation
[148] *Id.* at 17-19.

some reduction in power and fuel economy can be expected. This fuel reduces NO_X and PM emissions.

Biodiesel is renewable fuel that is manufactured from new and used vegetable oils and animal fats. Common blends, such as B10 and B10, can be use in diesel engines without retrofit. Biodiesel reduces PM, CO, HC (hydrocarbons), air toxics.

Natural Gas (LNG) is fossil fuel that burns cleaner than diesel fuel. Existing diesel engines can be converted to run on natural gas or existing diesel engines can be replaced with natural gas engines. However, there is often a fuel penalty and power loss when switching to natural gas. In addition, the use of natural gas creates infrastructure challenges, such as storage, safe handling and delivery.

Propane (LPG) is a fossil fuel that burns cleaner than diesel fuel. Commercial kits are available to retrofit diesel engines to propane. Propane gas engines significantly reduce NO_X and PM emissions. However, propane use often increases hydrocarbon emissions.
Ethanol is a bio-fuel common formulated from corn which can be blended with diesel to reduce emissions. While not widely used, it is sold as "E-diesel" or "oxydiesel" and typically has 10% ethanol.

Hybrid-Electric Power engines are a combination of diesel engines and electric motors. Many freight railroads are experimenting with hybrid switcher locomotives, such as the 'Green Goat," which rely on battery power to run electric traction motors on axles

H. **Replacement** - A common strategy is the selective replacement of older diesel equipment with newer, more efficient equipment. Sometimes known as "Scrappage" or "Fleet Renewal" programs, replacement of older diesel engines can result in improved fuel economy and lower maintenance costs.

I. **Repair/Rebuild** - Routine maintenance and repairs ensure that engines operate at maximum performance rate. In addition, major maintenance provides opportunity to rebuild engines to more stringent emission standards. This strategy is often used with locomotive rebuilds.

4.2.1.3 Operational Strategies

A. Port Facilities

1. Install dust suppression mechanisms for dry bulk storage and handling activities
2. Implement good sand blasting practices
    - Sand blast should be non-degradable and inert
    - Install dust shielding around sandblasting areas
    - Collect and dispose of all spent sandblast grit; use dust containment fabrics & dust collection hoppers and barrels
    - Install misting equipment to remove sandblast grit from air
    - Use vacuum grit collection systems
3. Lead-based paint abatement by licensed professionals
4. Cover storage and handling facilities where practicable and necessary
5. Minimize free fall of materials by installing telescoping arm loaders and conveyors; Cover conveyors when possible
    - Remove materials from the bottom of piles to minimize dust re-suspension
6. Conduct stripping and painting indoors where possible
    - Use paint booths
    - Re-use solvents and thinners; use water-based paints and solvents when possible

- Use brush or roller painting, rather than spray painting

7. Provide vapor recovery units for fueling activities of docked ships

B. Bulk Storage of Raw Materials

1. Salt piles[149]
   - Dust control/Air emissions
     i. For clamshell, end-loader, truck or bulldozer operations, ensure that equipment operators lower the clamshell or bucket to the minimum feasible distance from the pile before discharging a load of salt
     ii. Tarp all trucks before leaving the site
     iii. Sweep roadways to minimize traffic-generated dust
   - Covering Procedures for Stockpiles[150]
     iv. Stockpiles should be covered at all times, except when receiving salt, building the stockpile or loading out, to prevent precipitation contact.
   - Types of covering include canvas, polyethylene films, and fabrics made from synthetic fibers
     v. Seams must be watertight and resistant to damage in winds up to 69 mph.
   - Stockpile Configuration
     ii. Ensure that the working end of the pile is at the downwind end
     iii. Remove covering at the working face just high enough to load out day's shipment
2. Coal Piles[151]
   a. Dust Control/Air Emissions
      i. Cover coal piles to limit exposure to wind
         a. For environmental sensitive areas, consider the use of coal storage domes[152]
      ii. Sprinklers for fugitive dust suppression
         a. Consider the use of commercial dust suppressants
      iii. Enclose conveyors

C. Automobile Storage & Transport

1. Minimize travel distance from off-loading and on-loading facilities to storage areas to minimize emissions
2. Pave on-loading, off-loading and storage areas to reduce dust
3. Encourage reduction in idling during on- and off-loading activities
4. Encourage minimal re-storage and re-shuffling of vehicles in storage area to reduce emissions

D. Cargo Handling Equipment

1. Idling Reductions - consider using an auxiliary power unit (APU), which produces far fewer PM and NO_X emissions.
2. Conduct regular inspections and maintenance program on equipment
3. On-dock rail – eliminates the movement of on-road trucks between rail cars and marine vessels

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[149] *See* http://www.saltinstitute.org/51.html.

[150] *See* ROY D. DODSON, STORMWATER POLLUTION CONTROL: MUNICIPAL, INDUSTRIAL AND CONSTRUCTION NPDES COMPLIANCE 172 (McGraw Hill Professional 1999). "Facilities that collect all the runoff from their salt piles and reuse it in their processes or discharge it subject to a separate National Pollutant Discharge Elimination System (NPDES) permit, do not need to enclose or cover their piles."

[151] *See generally* Rod Hatt, Moisture Impacts on Coal Handling and Heat Rate, *available at* http://www.coalcombustion.com/PDF%20Files/MOISTURE%2003.pdf.

[152] *See generally* www.coalstorage.com.

4. Cover fueling areas and install and maintain vapor recovery systems

E. Marine Vessels

1. Cold Ironing – retrofit marine vessels, allowing them to receive shore power to meet energy needs while docked at port, allowing them to shut off auxiliary engines
2. Marine Vessel Speed Reductions - Reducing ship speed typically reduces emissions
3. Consider eliminating loading/unloading during air quality alerts or advisory warnings
4. Do not blow tubes while in port

F. Productivity Improvements

1. Environmental Management Systems – ISO 14001 certification

4.2.1.4 Voluntary Strategies

A. U.S. EPA Smartway Transport Partnership

Smartway is a voluntary partnership between various freight industry sectors and EPA that establishes incentives for fuel efficiency improvements. By 2012, the program hopes to reduce NO_X emissions by 200,000 tons. For more information, please visit www.epa.gov/smartway.

4.2.2 Reducing Emissions of Toxic Pollutants

There are three broad categories by which one can classify toxic pollutant reduction strategies: Regulatory, Technological, and Operational. The strategies presented here do not represent a complete list of applicable regulations, emission reduction technologies or best management practices. Rather, these strategies are a sampling of the most common approaches and practices to reducing toxic air pollutant emissions.

4.2.2.1 Regulatory Strategies

A. Maximum Achievable Control Technology (MACT)

Emission levels achieved by the best performing facilities in a particular industry are the baseline or MACT floor for new standards

4.2.2.2 Technological Strategies[153]

A. Alternative Fuels

Emulsified Diesel is blended mixture of diesel fuel, water, and additives that reduce PM and NOX emissions. However, the addition of water reduces the energy content of fuel, so some reduction in power and fuel economy can be expected. This fuel reduces polycyclic aromatic hydrocarbons (PAHs).
Biodiesel is renewable fuel that is manufactured from new and used vegetable oils and animal fats. Common blends, such as B10 and B10, can be use in diesel engines without retrofit. Biodiesel reduces PM, CO, HC (hydrocarbons), air toxics. This fuel reduces polycyclic aromatic hydrocarbons (PAHs).
Hybrid-Electric Power engines are a combination of diesel engines and electric motors. Many freight railroads are experimenting with hybrid switcher locomotives, such as the 'Green Goat," which rely on battery power to run electric traction motors on axles.

4.2.2.3 Operational Strategies[154]

[153] ICF CONSULTING, EMISSION REDUCTION INCENTIVES FOR OFF-ROAD DIESEL EQUIPMENT USED IN THE PORT AND CONSTRUCTION SECTORS 17-19, (2005), *available at* http://www.epa.gov/sectors/pdf/emission_20050519.pdf.

A. Facilities

1. Provide paint booths to contain overspray and treat air emissions when painting equipment; Cover painting/stripping areas
2. Asbestos abatement by licensed professionals
3. Lead abatement by licensed professionals
4. Before building demolition or renovation, test equipment for PCBs; Hire licensed professional to handle materials when necessary
5. Develop a management plan for the identification and disposal of waste mercury containing lamps, including fluorescent, metal halide and high pressure sodium; Label containers with waste mercury products, store away from high traffic areas, and properly dispose at hazardous waste facility.

B. Cargo Handling Equipment & Locomotives

1. Idling Reductions - When power is needed, consider using an auxiliary power unit (APU)

C. Productivity Improvements

1. Environmental Management Systems – ISO 14001 certification

4.2.3 Reducing Emissions of Greenhouse Gases

There are four broad categories by which one can classify greenhouse gas reduction strategies: Regulatory, Technological, Operational, and Voluntary. The strategies presented here do not represent a complete list of applicable regulations, emission reduction technologies or best management practices. Rather, these strategies are a sampling of the most common approaches and practices to reducing greenhouse gas emissions.

4.2.3.1 Regulatory Strategies

There is legislation before Congress that would establish a regulated, cap-and-trade market for trading the greenhouse gas allowances and offset credits. If passed, this legislation would set mandatory greenhouse gas emission reduction targets for a variety of industries. Affected industries would have the option of either reducing greenhouse gas emissions outright or purchasing an equivalent amount of offset credits to account for emissions. Most observers expect a market-based system similar to the U.S. SO_2 market for electric generating facilities.

4.2.3.2 Technological Strategies

A. Alternative Fuels[155]

The definition of alternative fuel varies according to the context of its usage. In the context of petroleum substitutes, the term 'alternative fuel' can imply any available fuel or energy source, and does not necessarily refer to a source of renewable energy. In the context of environmental sustainability, 'alternative fuel' often implies an ecologically benign renewable fuel.

Alternative fuels, also known as non-conventional fuels, are any materials or substances that can be used as a fuel, other than conventional fuels. Conventional fuels include: fossil fuels (petroleum (oil), coal, propane, and natural gas), and also in some instances nuclear materials such as uranium. Some well-

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[154] AMERICAN ASS'N OF PORT AUTH., ENVIRONMENTAL MANAGEMENT HANDBOOK (1998), *available at* http://www.aapa-ports.org/Issues/content.cfm?ItemNumber=989.

[155] *See* http://en.wikipedia.org/wiki/Alternative_fuel.

known alternative fuels include biodiesel, bio-alcohol (ethanol, butanol), chemically stored electricity (batteries and fuel cells), hydrogen, non-fossil methane, non-fossil natural gas, vegetable oil and other biomass sources.

Bio-energy crops reduce carbon dioxide emissions three ways by 1) removing carbon dioxide from the air and storing it in crop roots and soil as organic carbon, 2) producing co-products like protein for animal feed, which saves on energy to make feed by other means, and 3) replacing a fossil fuel with a bio-based one "recycles" rather than adds more carbon dioxide to the atmosphere.[156]

B. Energy Efficiency

Reducing energy consumption by using energy-efficient products lowers the need for power plants to generate electricity, which means that they burn fewer fossil fuels and emit fewer greenhouse gases. Thus, port facilities should consider replacing lighting in facilities to fluorescent and lighting in parking lots to light emitting diodes (LEDs). LEDs have a higher initial cost but a much longer life span than traditional metal halide or sodium lights, allowing facilities to recoup their costs over time.

Port facilities should also upgrade mechanical systems to energy efficient units, such as those rated by Energy Star®, ensure buildings are adequately insulated, and have high efficiency windows. By implementing these measures, port facilities will use less natural gas or fuel oil to heat buildings.

4.2.3.3 Operational Strategies

To prevent greenhouse gas emissions during building renovation or demolition, facility managers should ensure the proper disposal of refrigerants that may contain chlorofluorocarbons (CFCs), which is a very potent greenhouse gas.

In addition, port facilities should obtain an investment grade energy assessment to identify inefficient areas within a facility, recommend energy conservation measures, and detail long-term cost savings. An energy assessment provides a benchmark or baseline of the facility's energy use, allowing managers to document the energy savings from efficiency measures.

4.2.3.4 Voluntary Strategies

The U.S. EPA manages the Smartway Transport Partnership, a voluntary partnership between various freight industry sectors and EPA that establishes incentives for fuel efficiency improvements and greenhouse gas reductions. By 2012, the EPA hopes to reduce GHG emissions between 33 and 66 million metric tons. For more information, please visit www.epa.gov/smartway.

4.3 Improving Land Quality

4.3.1 Reducing Industrial Waste, Solid Waste, Construction Debris

4.3.1.1 Regulatory Strategies

The *Shore Protection Act of 1988* was enacted to minimize trash, medical debris and other unsightly and potentially harmful materials from being deposited into the coastal waters of the United States as a result of inadequate waste handling procedures by vessels transporting wastes on U.S. coastal waters and at associated loading and offloading facilities.

4.3.1.2 Technological Strategies

[156] *See* http://www.ars.usda.gov/is/pr/2007/070608.htm.

Sustainable Purchasing considers the environmental, social and economic impacts of a product during its full life cycle. This refers to the materials, energy, other inputs and environmental releases (e.g. wastes, emissions) involved in raw materials acquisition, manufacturing processes, consumer use, maintenance, and disposal of the product.

Sustainable purchasing is important because it can help your business make better choices that positively impact your local economy, environment, community, and your bottom line. Every buying decision you make has a variety of environmental, social and economic factors associated with it, including:

- Consumption of raw materials and emissions and energy used to process or manufacture the product;
- Labor practices of manufacturers and suppliers;
- Geographic locations you import from and transportation required to get the product to you;
- Energy and materials required to operate the product
- Waste associated with the product, (e.g. waste packaging used to transport the product or the product itself at the end of its life cycle).[157]

4.3.1.3 Operational Strategies

A. Facility

1. Operations and Maintenance
    a. Provide adequate space to allow for safe management of solid and sanitary wastes
        i. Properly store and dispose of construction/demolition debris
            1. When possible, cover construction debris and stockpiles
            2. Recycle construction debris, especially concrete, steel, wood, glass
            3. Dispose of empty solvent and paint containers properly
    b. Provide receptacles for recyclable materials
    c. Clearly mark receptacles to minimize disposal of hazardous materials such as paints and solvents
    d. Use compactors to minimize storage requirements and disposal for all solid wastes; Ensure that receptacles are covered; Empty solid waste receptacles frequently
    e. When cleaning concrete waste, provide a designated cleaning area that restricts run-off
    f. Consider recycling creosote-treated timbers when conducting repairs or replacement
    g. Implement fluorescent light ballast recycling program
    h. Clean up debris from paint stripping operations regularly
    i. Develop information packages designed for ship captains
        i. Identify solid waste reception facilities
        ii. Identify acceptable handling procedures

4.3.2 Reducing Impacts of Dredge Materials

4.3.2.1 Regulatory Strategies

Section 404 of the Clean Water Act establishes a program to regulate the discharge of dredged material into waters of the United States, including wetlands. Activities in waters of the United States regulated under this program include fill for development, water resource projects (such as dams and levees), infrastructure development (such as highways and airports) and mining projects. Section 404 requires a

[157] Greater Vancouver Regional District, Sustainable Purchasing Guide, available at http://www.gvrd.bc.ca/smartsteps/pdfs/SustainablePurchasing.pdf.

permit before dredged or fill material may be discharged into waters of the United States, unless the activity is exempt from Section 404 regulation (e.g. certain farming and forestry activities).[158]

4.3.2.2 Technological Strategies

A. Treatment of Dredge Spoils

1. Bioremediation - use of bacteria, fungi, or enzymes to break down organic contaminants
2. Chemical treatment - oxidation, reduction, chelation, hydrolysis, detoxification, nucleophilic substitution, and thionation processes
3. Extraction - removal of contaminants by dissolution in fluid
4. Thermal - incineration
    i. Immobilization - processes which limit the mobility of contaminants
    ii. Volume reduction - physical separation of contaminated fractions

4.3.2.3 Operational Strategies[159]

1. Actively participate in local/state watershed protection programs
    a. Determine the boundaries of the port's watershed
    b. Identify all natural and man-made freshwater inputs to the watershed
    c. Identify all publically owned treatment discharges and combined sewer overflows
    d. Determine annual loading of various pollutants to harbor/port
2. Work with state/federal regulators to reduce sources of key contaminants
3. Actively participate in NPDES permitting efforts for sources in the port's watershed
4. Actively participate in zoning procedures
5. Use silt curtains to ensure compliance with water quality criteria and permit limits
6. Select suitable dredging equipment to reduce re-suspension and transport
    a. Clamshell dredges keep material consolidated, reduce re-suspension of contaminants, and limit the spread of material
7. Consider the use of submerged discharges for hydraulic disposal
    a. Discharges reduce the re-suspension and release of contaminants and increase the control over the location of deposition of dredged material
8. Consider the beneficial use of dredged materials such as wetland creation or enhancements, habitat restoration, or creation of public access/recreational facilities if sediment is not contaminated with PCB's or other toxic pollutants

4.3.3 Redeveloping Brownfield and Superfund Sites

4.3.3.1 Regulatory Strategies

Public financing is essential for encouraging the assessment and cleanup of brownfields. Increasingly, states are stepping in to assist communities and the private sector in bridging the financing gap associated with brownfields redevelopment. States offer a variety of incentive programs to encourage investment in brownfields development. The EPA published a report, *Financial Brownfields: State Program Highlights*,[160] which provides an overview of the types of financial tools and incentives offered by

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[158] U.S. Envtl. Prot. Agency, Wetland Regulatory Authority, available at http://www.epa.gov/owow/wetlands/pdf/reg_authority_pr.pdf.

[159] AMERICAN ASSN. OF PORT AUTHORITIES, ENVT'L MGT. HANDBOOK (Sept 1998).

[160] U.S. ENVT'L PROT. AGENCY, FINANCING BROWNFIELDS: STATE PROGRAM HIGHLIGHTS, (Sept. 2007), *available at* http://www.epa.gov/brownfields/partners/finan_brownfields_epa_print.pdf.

state governments to bridge financial gaps and encourage private sector investment in the revitalization of our communities.

Public financing is often used to "jump-start" a brownfield reuse project, by "balancing the economic scale between greenfields and brownfields."[161] States offer a variety of incentive programs, often to meet one of several objectives:

- Reduce the lender's risk by providing off-setting incentives such as loan guarantees, insurance, or property-specific legal clarifications, in order to make capital more readily available;
- Reduce the borrower's cost of financing by subsidizing loan carrying costs or by providing assistance that reduces loan underwriting and documentation expenses. Such assistance may increase the economic viability of smaller projects;
- Ease a purchaser's financial risk by providing incentives that can help improve the project's cashflow, such as tax credits or abatements; and
- Provide direct financial assistance, including loans or grants to help pay for site assessment or cleanup activities and support broader redevelopment needs.[162]

4.3.4 Softening the Muskegon Lake Shoreline[163]

The Muskegon Lake Watershed Partnership has solicited public input to develop the following recommendations for softening the Muskegon Lake shoreline and improving fish and wildlife habitat.

Southwest Focus Area (Zone 1)

- Remove any unneeded seawall remnants and old riprap fill northwest of Muskegon Yacht Club and along Edgewater. Replace with native soils and plants.
- Enhance former Pigeon Hill area with native dune plants and create a safe wildlife corridor.
- Assess bird migration needs and develop appropriate restoration activities.
- Encourage landowners to conserve natural areas and reestablish native plants and landscapes.

Lakeside Ruddiman Focus Area (Zone 2)

- Improve SAPPI riparian shoreline property at west end.
- Conserve and enhance Muskegon Country Club littoral zone, west of SAPPI.
- Connect bike trails with habitat/greenway.
- Enhance emergent plants between Grand Trunk and SAPPI.
- Enhance wetland buffer near railroad tracks and houses at Grand Trunk
- Continue habitat restoration of Ruddiman Creek cleanup sites, mouth and adjacent Muskegon Lake shoreline

Downtown Focus Area (Zone 3)

- Clean up scrap in shallow water/littoral zone between Heritage Landing and LaFarge
- Work with Lakeshore Yacht Harbor to develop wildlife opportunities.
- Improve habitat in shallow water/littoral zone at Michigan Steel.
- Work with City of Muskegon to reestablish native vegetation at Hartshorn Marina.
- Remove contaminated fill at Heritage Landing wetland. Replace soil and establish wetland plants.
- Determine environmental condition of former MichCon/Lake Foundry and Teledyne property, east of Mart Dock and west/east of Shoreline Inn.
- Enhance YMCA shoreline with littoral zone cleanup and native plantings.

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[161] *Id.* at 1.
[162] *Id.*
[163] MLWP & MWRA, *supra* note 8.

Muskegon River Mouth Focus Area (Zone 4)

- Ryerson Creek scrap yard assessment
- Ryerson Creek wastewater spill assessment
- Ryerson Creek sediment investigation
- Ryerson Creek stormwater management plan and phase II status
- Ryerson Valley/Charter park designation
- Ryerson Creek watershed rain gardens
- Improve Muskegon River mouth area for amphibians, turtles and riparian wildlife
- Partner with Verplank and Consumers to preserve habitat
- Restore and protect Richards Park for habitat and public access to trail
- Volunteer cleanups for habitat and aesthetic improvements

Attachment A – Description of TRI Categories

Water	Air	Land
POTW	**Fugitive**	**On-Site Disposal**
Wastewater Treatment (Metals Only)	Fugitive Air Emissions	Underground Injection Class I Wells
POTWs (Metal & Metal Cmpds)		RCRA Subtitle C Landfills
		Other On-Site Landfills
		Underground Injection Class II-V Wells
		Land Treatment
		RCRA Subtitle C Surface Impoundments
		Other Surface Impoundments
		Other Land Disposal
Surface	**Stack**	**Off-Site Disposal**
Surface Water Discharges	Point Source Air Emissions	Transfers to Underground Injection Class I Wells
		Transfers to Other Landfills
		Storage Only
		Solidification/Stabilization (Metals Only)
		Underground Injection Class II-V Wells
		Other Surface Impoundments
		Land Treatment
		Other Land Disposal
		Other Off-Site Management
		Waste Broker
		Unknown
		Off-Site RCRA Disposal
		Transfers to RCRA Subtitle C Landfills
		RCRA Subtitle C Surface Impoundments

Water Impairments

A. POTW

Transfers to Wastewater Treatment (metals only) - Transfers to wastewater treatment facilities (excluding to facilities that are publicly-owned treatment works (POTWs)) of metals and metal category compounds only.

POTWs (Metal and Metal Compounds Only) - Transfers to publicly-owned treatment works (POTWs) of metals and metal compounds only. Because metals are not destroyed by sewage treatment processes, amounts of metals and metal category compounds reported in Section 6.1 are considered transfers to disposal or other releases. Data from Section 6.1, metals and metal compounds only, on the TRI Form R.

B. Surface Water

Surface Water Discharges - Releases to water include discharges to streams, rivers, lakes, oceans, and other bodies of water. This includes releases from confined sources, such as industrial process outflow pipes or open trenches. Releases due to runoff, including stormwater runoff are also reportable to TRI under this category.

Air Impairments

A. Fugitive Emissions

Fugitive Air Emissions - Fugitive air emissions are all releases to air that are not released through a confined air stream. Fugitive emissions include equipment leaks, evaporative losses from surface impoundments and spills, and releases from building ventilation systems.

B. Stack Emissions

Stack or Point Source Air Emissions - Stack or point source air emissions occur through confined air streams such as stack, vents, ducts, or pipes.

Land Impairments

A. On-Site Disposal

Underground Injection on-site to Class I Wells - Underground injection is the subsurface emplacement of fluids through wells. TRI chemicals associated with manufacturing, the petroleum industry, mining, commercial and service industries, and Federal and municipal government related activities may be injected into class I, II, III, IV, or V wells, if they do not endanger underground sources of drinking water (USDW), public health or the environment. Class I wells are industrial, municipal, and manufacturing related wells which inject fluids into deep, confined and isolated formations below potable water supplies.

RCRA Subtitle C Landfills - RCRA Subtitle C landfills are those landfills which are authorized under the Resource Conservation and Recovery Act (RCRA) to accept hazardous waste for disposal. RCRA is the comprehensive federal law that, among other things, regulates the management of certain highly dangerous wastes from the moment they are generated until their ultimate destruction or disposal. Landfills authorized to accept these wastes must follow very stringent guidelines for their design and operation.

Other On-site Landfills - Other landfills are those landfills which are not authorized under Subtitle C of the Resource Conservation and Recovery Act (RCRA) to accept hazardous wastes. These landfills are commonly referred to as non-hazardous waste landfills and may be regulated under a variety of other Federal, state, and local programs.

Underground Injection on-site to Class II - V Wells - Underground injection is the subsurface emplacement of fluids through wells. TRI chemicals associated with manufacturing, the petroleum industry, mining, commercial and service industries, and Federal and municipal government related activities may be injected into class I, II, III, IV, or V wells, if they do not endanger underground sources of drinking water (USDW), public health or the environment. Class II wells are oil and gas related wells which re-inject produced fluids for disposal, enhanced recovery of oil, or hydrocarbon storage. Class III wells are those wells associated with the solution mining of minerals. Class IV wells are those wells which may inject hazardous or radioactive fluids directly or indirectly into USDW, only if injection is part of an authorized CERCLA/RCRA clean up operation. Class V wells, which include all types of injection wells which do not fall under I-IV, may inject only if they do not endanger USDW, public health or the environment. Class V wells are, generally, shallow drainage wells, such as floor drains connected to dry wells or drain fields.

Land Treatment/Application Farming - Land treatment refers to the incorporation of waste into the soil where the waste degrades in the soil.

RCRA Subtitle C Surface Impoundments - Surface impoundments include natural topographic depressions, man-made excavations and diked areas that primarily are made of earthen materials and which hold liquid wastes. These uncovered areas are commonly used to volatilize and/or settle materials. RCRA Subtitle C surface impoundments are those surface impoundments which are authorized under the Resource Conservation and Recovery Act (RCRA) to accept hazardous waste for disposal.

Other Surface Impoundments - Surface impoundments include natural topographic depressions, man-made excavations and diked areas that primarily are made of earthen materials and which hold liquid wastes. These uncovered areas are commonly used to volatilize and/or settle materials. Other surface impoundments are surface impoundments other than those which are authorized under the Resource Conservation and Recovery Act (RCRA) to accept hazardous waste for disposal.

Other On-site Land Disposal - Other land disposal is the disposal of the toxic chemical to land at the facility that does not fall into one of the other on-site land release categories found in Sections 5.5.1 through 5.5.3 on the TRI Form R. Other disposal includes such activities as placement in waste piles and spills or leaks.

B. Off-Site Disposal

Transfers to Other Landfills - Other landfills are those landfills which are not authorized under Subtitle C of the Resource Conservation and Recovery Act (RCRA) to accept hazardous wastes. These landfills are commonly referred to as non-hazardous waste landfills and may be regulated under a variety of other Federal, state, and local programs.

Transfers to Storage Only - On occasion, a toxic chemical is sent off-site for storage if there is no known disposal method. One example is toxic chemicals in mixed hazardous and radioactive waste. EPA considers this an off-site disposal or other release because this method is being used as a form of disposal and the toxic chemical will remain there indefinitely.

Transfers to Solidification/Stabilization (metals only) - Waste solidification/stabilization is a physical or chemical process used to either reduce the mobility of the chemical or to eliminate free liquids in a hazardous waste. A waste stabilization process includes mixing the hazardous waste with binders or other materials, and curing the resulting hazardous waste and binder mixture.

Transfers to Underground Injection Class II-V Wells - Underground injection is the subsurface emplacement of fluids through wells. TRI chemicals associated with manufacturing, the petroleum industry, mining, commercial and service industries, and Federal and municipal government related activities may be injected into class I, II, III, IV, or V wells, if they do not endanger underground sources of drinking water (USDW), public health or the environment. Class I wells are industrial, municipal, and manufacturing related wells which inject fluids into deep, confined and isolated formations below potable water supplies. Class II wells are oil and gas related wells which re-inject produced fluids for disposal, enhanced recovery of oil, or hydrocarbon storage. Class III wells are those wells associated with the solution mining of minerals. Class IV wells are those wells which may inject hazardous or radioactive fluids directly or indirectly into USDW, only if injection is part of an authorized CERCLA/RCRA clean up operation. Class V wells, which include all types of injection wells which do not fall under I-IV, may inject only if they do not endanger USDW, public health or the environment. Class V wells are, generally, shallow drainage wells, such as floor drains connected to dry wells or drain fields.

Transfers to Other Surface Impoundments - Surface impoundments include natural topographic depressions, man-made excavations and diked areas that primarily are made of earthen materials and which hold liquid wastes. These uncovered areas are commonly used to volatilize and/or settle materials. Other Surface Impoundments are surface impoundments other than those which are authorized under the Resource Conservation and Recovery Act (RCRA) to accept hazardous waste for disposal.

Transfers to Land Treatment - Land treatment refers to the incorporation of waste into the soil where the waste degrades in the soil.

Transfers to Other Off-site Management - Chemicals in waste sent to sites where the waste is managed by techniques not specifically listed in Section 6.2.

Transfers to Waste Broker for Disposal - Chemicals in waste sent to a broker where the broker sends the waste for disposal, but the facility sending the waste does not know the location of the disposal site and, therefore, reported the name of the waste broker instead.

Transfers to Unknown Waste Management - The "unknown" category of disposal indicates that a facility is not aware of the type of waste management used for the toxic chemical that is sent off-site. Therefore, EPA has categorized this method as the least desirable type of waste management (environmentally least desirable) and has included it as a type of disposal or other release for reporting purposes.

C. Off-Site RCRA Disposal

Transfers to RCRA Subtitle C Surface Impoundments - Surface impoundments include natural topographic depressions, man-made excavations and diked areas that primarily are made of earthen materials and which hold liquid wastes. These uncovered areas are commonly used to volatilize and/or settle materials. RCRA Subtitle C surface impoundments are those surface impoundments which are authorized under the Resource Conservation and Recovery Act (RCRA) to accept hazardous waste for disposal.

Transfers to RCRA Subtitle C Landfills - RCRA Subtitle C landfills are those landfills which are authorized under the Resource Conservation and Recovery Act (RCRA) to accept hazardous waste for disposal. RCRA is the comprehensive federal law that, among other things, regulates the management of certain highly dangerous wastes from the moment they are generated until their ultimate destruction or disposal. Landfills authorized to accept these wastes must follow very stringent guidelines for their design and operation.

Attachment B – Ecosystem Impairment Matrix for the Muskegon Lake Watershed

Attachment C – Ecosystem Impairment Matrix for Port Entities and Related Infrastructure

Attachment D – Descriptions of Substances Released within the Muskegon Lake Watershed[164]

Persistent Bioaccumulative Toxins (PBTs)

Dioxins are a family of 75 chemically related compounds, often formed during the chemical bleaching process at paper mills and during waste incineration. When released into water, dioxins readily accumulate within the fatty tissue of fish and build-up within the larger food chain. Dioxins are listed as a critical pollutant in the LaMP and a level 1 pollutant in the Binational Toxics Strategy. The EPA also lists dioxins as a Priority Pollutant and Hazardous Air Pollutant.

Polycyclic aromatic hydrocarbons (PAHs) are a group of more than a hundred organic compounds composed of two or more carbon rings derived from benzene. They are emitted into the environment from both natural and anthropogenic (human) sources. PAHs, although present in low concentrations virtually everywhere, occasionally reach elevated concentrations as the result of prolonged industrial activities involving burning, or by releases of materials such as creosote-based wood preservatives. PAHs are a concern because some of them can cause cancers in humans and are harmful to fish and other aquatic life. Sources of industrial emissions include: 1) Coal and oil-fired power plants; 2) Waste incinerators; 3) Wood preservation. PAHs are on the watch list for the LaMP and a level 2 pollutant in the Binational Toxics Strategy. The EPA also lists PAHs as Priority Pollutants and Hazardous Air Pollutants. Examples of PAHs include:

- Anthracene
- Benzo(a)anthracene
- Benzo(b,k)fluoranthene
- Benzo(g,h,i)perylene
- Benzo(a)pyrene
- Chrysene
- Fluoranthene
- Indeno(1,2,3-cd)pyrene
- Phenanthrene
- Pyrene

Polychlorinated Biphenyls (PCBs) are mixtures of up to 209 individual chlorinated compounds (known as congeners). There are no known natural sources of PCBs. PCBs are either oily liquids or solids that are colorless to light yellow. Some PCBs can exist as a vapor in air. PCBs have no known smell or taste. PCBs have been used as coolants and lubricants in transformers, capacitors, and other electrical equipment because they don't burn easily and are good insulators. Products made before 1977 that may contain PCBs include old fluorescent lighting fixtures and electrical devices containing PCB capacitors, and old microscope and hydraulic oils. PCBs are listed as a critical pollutant in the LaMP and a Level 1 pollutant in the Bi-National Toxics Strategy. The EPA lists PCBs are a Priority Pollutant and a Hazardous Air Pollutant.

Heavy Metals

Aluminum - Everyone is exposed to low levels of aluminum from food, air, water, and soil. Exposure to high levels of aluminum may result in respiratory and neurological problems. Aluminum (in compounds

[164] *See generally* http://www.atsdr.cdc.gov.

with other elements) has been found in at least 606 of the 1,678 National Priority List (NPL) sites identified by the Environmental Protection Agency (EPA).

Barium - Exposure to barium occurs mostly in the workplace or from drinking contaminated water. Ingesting drinking water containing levels of barium above the EPA drinking water guidelines for relatively short periods of time can cause gastrointestinal disturbances and muscle weakness. Ingesting high levels for a long time can damage the kidneys. Barium and barium compounds have been found in at least 798 of the 1,684 National Priority List sites identified by the Environmental Protection Agency (EPA). Barium often enters the atmosphere through the burning of coal and oil.

Chromium is often used in the make of steel or for chrome plating, dyes pigments and wood preserving. In the atmosphere, chromium compounds are generally present as a fine dust that eventually settles on land and water. Chromium is a pollutant of concern in the Lake Michigan Area-wide Management Plan (LaMP). The EPA also lists chromium as Priority Pollutant and Hazardous Air Pollutant.

Cobalt is a naturally occurring element found in rocks, soil, water, plants, and animals. Cobalt is used to produce alloys used in the manufacture of aircraft engines, magnets, grinding and cutting tools, artificial hip and knee joints. Cobalt enters the environment from natural sources and the burning of coal or oil or the production of cobalt alloys.

Copper is a metal that occurs naturally in the environment, and also in plants and animals. Low levels of copper are essential for maintaining good health. High levels can cause harmful effects such as irritation of the nose, mouth and eyes, vomiting, diarrhea, stomach cramps, nausea, and even death. Copper has been found in at least 906 of the 1,647 National Priority Sites identified by the Environmental Protection Agency (EPA). Copper is released into the environment by mining, farming, and manufacturing operations and through waste water releases into rivers and lakes. Copper is also released from natural sources, like volcanoes, windblown dusts, decaying vegetation, and forest fires. Copper is a pollutant of concern in the Lake Michigan Area-wide Management Plan (LaMP). The EPA also lists copper as Priority Pollutant and Hazardous Air Pollutant.

Lead is an element that the EPA has regulated since 1978. Lead gasoline additives, non-ferrous smelters, and battery plants are the most significant contributors to atmospheric Pb emissions. Exposure to lead can happen from breathing workplace air or dust, eating contaminated foods, or drinking contaminated water. Children can be exposed from eating lead-based paint chips or playing in contaminated soil. Lead can damage the nervous system, kidneys, and reproductive system. The EPA's long term goal is to reduce lead exposure to the fullest extent possible. Lead is a pollutant of concern in the Lake Michigan Area-wide Management Plan (LaMP). The EPA also lists lead as Priority Pollutant and Hazardous Air Pollutant. Lead has been found in at least 1,272 of the 1,684 National Priority List sites identified by the Environmental Protection Agency (EPA).

Manganese is a trace element and eating a small amount from food or water is needed to stay healthy. Exposure to excess levels of manganese may occur from breathing air, particularly where manganese is used in manufacturing, and from drinking water and eating food. At high levels, it can cause damage to the brain, liver, kidneys, and the developing fetus. Manganese can also be combined with carbon to make organic manganese compounds. It enters the air from iron, steel and power plants, coke ovens and mining operations. This chemical has been found in at least 603 of 1,467 National Priorities List sites identified by the Environmental Protection Agency (EPA).

Mercury combines with other elements, such as chlorine, sulfur, or oxygen, to form inorganic mercury compounds or "salts". Mercury also combines with carbon to make organic mercury compounds, which can accumulate in the tissue of fish. Inorganic mercury enters the atmosphere from the burning of coal and from manufacturing plants. Exposure to mercury occurs from breathing contaminated air, ingesting contaminated water and food, and having dental and medical treatments. Mercury, at high levels, may damage the brain, kidneys, and developing fetus. This chemical has been found in at least 714 of 1,467 National Priorities List sites identified by the Environmental Protection Agency. Mercury is a critical pollutant in the LaMP and a Level 1 pollutant in the Binational Toxics Strategy.

Nickel is a naturally occurring element. Pure nickel is a hard, silvery-white metal used to make stainless steel and other metal alloys. It enters the atmosphere through oil and coal burning power plants and manufacturing processes that make or use nickel, nickel alloys or nickel compounds. Skin effects are the most common effects in people who are sensitive to nickel. Workers who breathed very large amounts of nickel compounds developed chronic bronchitis and lung and nasal sinus cancers. Nickel has been found in at least 882 of the 1,662 National Priority List sites identified by the Environmental Protection Agency (EPA).

Vanadium is combined with other metals to make alloys. Vanadium in the form of vanadium oxide is a component in special kinds of steel that is used for automobile parts, springs, and ball bearings. Most of the vanadium used in the United States is used to make steel. Vanadium often enters the air through the burning of fuel oils and remains in air, water and soil for long periods of time. Breathing high levels of vanadium may cause lung irritation, chest pain, coughing, and other effects. This chemical has been found in at least 385 of 1,416 National Priorities List sites identified by the Environmental Protection Agency.

Zinc is a naturally occurring element. Exposure to high levels of zinc occurs mostly from eating food, drinking water, or breathing workplace air that is contaminated. Low levels of zinc are essential for maintaining good health. Some is released into the environment by natural processes, but most comes from human activities like mining, steel production, coal burning, and burning of waste. Exposure to large amounts of zinc can be harmful. It can cause stomach cramps, anemia, and changes in cholesterol levels. Zinc has been found in at least 985 of the 1,662 National Priority List sites identified by the Environmental Protection Agency (EPA).

Hazardous Air Pollutants and Volatile Organic Compounds

Acetonitrile is a colorless liquid, widely used as a solvent.[165]

Ammonia is found throughout the environment in the air, soil, and water, and in plants and animals including humans. Exposure to high levels of ammonia can cause irritation and serious burns on the skin and in the mouth, throat, lungs, and eyes. At very high levels, ammonia can even cause death. Ammonia has been found in at least 137 of the 1,647 current or former National Priority Sites list identified by the Environmental Protection Agency (EPA).

Benzene is a widely used chemical formed from both natural processes and human activities. Breathing benzene can cause drowsiness, dizziness, and unconsciousness; long-term benzene exposure causes effects on the bone marrow and can cause anemia and leukemia. Benzene has been found in at least 1,000 of the 1,684 National Priority List sites identified by the Environmental Protection Agency (EPA). Industrial processes are the main source of benzene in the environment.

[165] *See* http://en.wikipedia.org/wiki/Acetonitrile, last visited July 25, 2008.

Chloroform - Exposure to chloroform can occur when breathing contaminated air or when drinking or touching the substance or water containing it. Breathing chloroform can cause dizziness, fatigue, and headaches. Breathing chloroform or ingesting chloroform over long periods of time may damage your liver and kidneys. It can cause sores if large amounts touch your skin. This substance has been found in at least 717 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

Chloromethane - Exposure to high levels of chloromethane can cause serious problems to your nervous system, including convulsions and coma. It can also affect your liver, kidneys, and heart. Chloromethane is found in air, surface water, groundwater, soil, and sediment. This substance has been found in at least 172 of the 1,467 National Priorities List sites identified by the Environmental Protection Agency (EPA).

Dichloromethane (methylene chloride) is a colorless, volatile liquid with a moderately sweet aroma. It is widely used as a solvent. Its high volatility makes it an acute inhalation hazard. Dichloromethane is also metabolized by the body to carbon monoxide potentially leading to carbon monoxide poisoning.[166]

Dimethyl phthalate has many uses, including in solid rocket propellants, plastics, and insect repellants. Acute (short-term) exposure to dimethyl phthalate, via inhalation in humans and animals, results in irritation of the eyes, nose, and throat. No information is available on the chronic (long-term), reproductive, developmental, or carcinogenic effects of dimethyl phthalate in humans. Animal studies have reported slight effects on growth and on the kidney from chronic oral exposure to the chemical. EPA has classified dimethyl phthalate as a Group D, not classifiable as to human carcinogencity.[167]

Ethylbenzene is a colorless liquid found in a number of products including gasoline and paints. Breathing very high levels can cause dizziness and throat and eye irritation. Breathing lower levels has resulted in hearing effects and kidney damage in animals. Ethylbenzene has been found in at least 829 of 1,689 National Priorities List sites identified by the Environmental Protection Agency (EPA). It is naturally found in coal tar and petroleum and is also found in manufactured products such as inks, pesticides, and paints. Ethylbenzene is used primarily to make another chemical, styrene. Other uses include as a solvent, in fuels, and to make other chemicals.

Hydrogen Fluoride is often used for etching glass and the making of other chemical compounds. When released into the air, it combines with water molecules to form hydrofluoric acid. Hydrogen fluoride is considered a hazardous air pollutant under the 1990 Clean Air Act. It has been found in at least 188 of the 1,636 National Priorities List sites identified by the Environmental Protection Agency (EPA).

Hydrochloric Acid is used in the production of chlorides, fertilizers, and dyes, in electroplating, and in the photographic, textile, and rubber industries. Hydrochloric acid is corrosive to the eyes, skin, and mucous membranes. Acute (short-term) inhalation exposure may cause eye, nose, and respiratory tract irritation and inflammation and pulmonary edema in humans. Acute oral exposure may cause corrosion of the mucous membranes, esophagus, and stomach and dermal contact may produce severe burns, ulceration, and scarring in humans. Chronic (long-term) occupational exposure to hydrochloric acid has been reported to cause gastritis, chronic bronchitis, dermatitis, and photosensitization in workers. Prolonged

[166] *See* http://en.wikipedia.org/wiki/Dichloromethane, last visited July 25, 2008.
[167] *See* http://www.epa.gov/ttn/atw/hlthef/dimet-ph.html, last visited July 25, 2008.

exposure to low concentrations may also cause dental discoloration and erosion.[168] Hydrochloric acid is considered a hazardous air pollutant under the 1990 Clean Air Act.

n-Hexane is mixed with solvents for a number of uses. Inhaling n-hexane causes nerve damage and paralysis of the arms and legs. Some people abuse products containing n-hexane by inhaling it to get "high." This substance has been found in at least 60 of the 1,467 National Priorities List sites identified by the Environmental Protection Agency (EPA). n-Hexane enters the environment during is manufacture and use.

Methanol is commonly used as a solvent in industrial applications. Methanol is considered a hazardous air pollutant under the 1990 Clean Air Act. It is also a volatile organic compound. [169]

Methyl tert-butyl ether (MTBE) is a flammable liquid which is used as an additive in unleaded gasoline. Drinking or breathing MTBE may cause nausea, nose and throat irritation, and nervous system effects. Small amounts of MTBE may dissolve in water and get into underground water. It remains in underground water for a long time. MTBE has been found in at least 11 of the 1,430 National Priorities List sites identified by the Environmental Protection Agency (EPA).

Naphthalene is an easily evaporated white solid, often contained within oil and coal. Naphthalene enters the environment primarily through the burning of coal, although burning wood also produces naphthalene. Exposure to naphthalene happens mostly from breathing air contaminated from the burning of wood, tobacco, or fossil fuels, industrial discharges, or moth repellents. Exposure to large amounts of naphthalene may damage or destroy some of your red blood cells. Naphthalene has caused cancer in animals. Naphthalene, 1-methylnaphthalene, and 2-methylnaphthalene have been found in at least 687, 36, and 412, respectively, of the 1,662 National Priority List sites identified by the Environmental Protection Agency (EPA). The EPA also lists naphthalene as Priority Pollutant and Hazardous Air Pollutant.

Phenol is both a manufactured chemical and a natural substance. Phenol is used as a disinfectant and is found in a number of consumer products. Skin exposure to high amounts can produce skin burns, liver damage, dark urine, irregular heart beat, and even death. Ingestion of concentrated phenol can produce internal burns. Phenol has been found in at least 595 of the 1,678 National Priority List (NPL) sites identified by the Environmental Protection Agency (EPA).The EPA lists phenol as Priority Pollutant and Hazardous Air Pollutant.

Styrene - Exposure to styrene is most likely to occur from breathing indoor air that is contaminated with styrene vapors from building materials, tobacco smoke, and use of copying machines. Exposure may also occur by breathing automobile exhaust. People who work where styrene is used or manufactured are likely to be exposed by breathing workplace air. Breathing styrene is most likely to affect the nervous system. Styrene has been found in at least 31 of 1,689 National Priorities List sites identified by the Environmental Protection Agency (EPA).

Toluene - Exposure to toluene occurs from breathing contaminated workplace air, in automobile exhaust, some consumer products paints, paint thinners, fingernail polish, lacquers, and adhesives. Toluene enters the environment when you use materials that contain it. It can also enter surface water and groundwater from spills of solvents and petrolieum products as well as from leasking underground

[168] *See* http://www.epa.gov/ttn/atw/hlthef/hydrochl.html, last visited July 25, 2008.
[169] *See* http://en.wikipedia.org/wiki/Methanol.

storage tanks at gasoline stations and other facilities. Toluene affects the nervous system. Toluene has been found at 959 of the 1,591 National Priority List sites identified by the Environmental Protection Agency (EPA).

Xylene - Exposure to xylene occurs in the workplace and when you use paint, gasoline, paint thinners and other products that contain it. People who breathe high levels may have dizziness, confusion, and a change in their sense of balance. Xylene has been found in at least 840 of the 1,684 National Priority List sites identified by the Environmental Protection Agency (EPA).

Other Watershed Wastes and Pollutants

N-butyl alcohol is a colorless liquid with a strong, mildly alcoholic odor. It is used as a solvent for vegetable oils, dyes, fats, waxes, resins, shellac, varnishes, rubbers, and alkaloids; as an intermediate in manufacturing pharmaceuticals, ethylene glycol monobutyl ether, butylamines, butyl acrylic, and 2,4-D esters. Exposure to n-butyl alcohol can cause death from respiratory failure and cardiac failure. Exposure can occur through inhalation, absorption through the skin, ingestion, and contact with eyes or skin.[170]

4,4'-Isopropylidenediphenol comes in the form of white flakes or crystals. Its primary use, or 53% of its total, is for epoxy resins; 31% is used as a chemical intermediary for polycarbonate resins; and 16% is used in miscellaneous applications, including as a chemical intermediary for phenoxy and polysufone resins. It is also used as a fungicide, and in the manufacturing of flame retardants and rubber chemicals. Solid 4,4'-isopropylidenediphenol is irritating to the skin and eyes; the dust is irritating to upper respiratory passages. The most probable routes of human exposure are inhalation and dermal contact of workers involved in the manufacture, use, transport, or packaging of the chemical.[171]

M-Cresol is obtained from coal tar or petroleum as a clear to amber colored liquid or semi-solid. M-cresol has many applications such as plasticizers, gasoline additives, making explosives, pigments, disinfectants, antioxidants, fumigants and pharmaceutical intermediates. Recent studies done by the U.S. National Toxicology Program have revealed that m-cresol is actually slightly to moderately toxic and the U.S. Environmental Protection Agency has declared that m-cresol is a possible carcinogen.[172]

Nitric acid is a highly corrosive and toxic strong acid that can cause severe burns.[173]

Pyridine - Everyone is exposed to very low levels of pyridine in air, water, and food. Workers who make or use the chemical may be exposed to higher levels of it. Pyridine is primarily released to the environment from industries that make and use this chemical. Studies in people and animals suggest that pyridine may damage the liver. This chemical has been found in at least 11 of 1,416 National Priorities List sites identified by the Environmental Protection Agency.

Sulfuric Acid is a clear, colorless, oily liquid that is very corrosive. It is also called sulphine acid, battery acid, and hydrogen sulfate. It is used in the manufacture of fertilizers, explosives, other acids, and glue; in the purification of petroleum; in the pickling of metal; and in lead-acid batteries (used in most vehicles).

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[170] *See* http://www.environmentwriter.org/resources/backissues/chemicals/nbutyl_alcohol.htm, last visited July 25, 2008.
[171] *See* http://www.environmentwriter.org/resources/backissues/chemicals/44isop.htm, last visited July 25, 2008.
[172] *See* http://www.reciprocalnet.org/recipnet/showsamplebasic.jsp?sampleId=27344150, last visited July 25, 2008.
[173] *See* http://en.wikipedia.org/wiki/Nitric_acid, last visited July 25, 2008.

Attachment E – Michigan Brownfield Financing Incentives[174]

Program: Brownfield Redevelopment Authorities

- ***Program type*** – Financing process support
- ***Role in meeting brownfield financing challenges*** – Expedites access to conventional economic development tools – i.e., TIF, bonding, site assembly – in a brownfields project context
- ***Type of benefit to Michigan program users*** – Affordable capital for site cleanup and preparation as part of the development process; available to small towns and rural communities, as well as urban areas
- ***Brownfield revitalization opportunities for Michigan participants*** – Ability to incorporate brownfield components into total, traditional project redevelopment financing packages
- ***Lessons and ideas for other states*** – Value of focusing traditional redevelopment tools to meet projects' specific brownfield development needs

In 1996, Michigan authorized cities and counties to establish local Brownfield Redevelopment Authorities (BRAs). BRAs have tax increment financing (TIF) and bonding authority, as well as the ability to carry out site assembly and other traditional economic tasks. Structurally, they are based on the widely recognized and popular development authority entities, which increases their acceptance among communities and private entities that might be uncomfortable with a strictly environmental program. The BRAs can adopt brownfield plans that identify the eligible activities to be conducted on an eligible property and provide for the use of TIF to capture property taxes to reimburse the costs of eligible activities.

TIF is based on the tax increment of a brownfield site. The baseline amount of tax revenues for a property is the amount generated the year it was included in the BRA's brownfield plan. When cleanup and redevelopment of the property increases its assessed value, and thus the tax revenues it generates, the increased tax revenues (captured taxes) are used to pay the cost of eligible environmental response and redevelopment activities at the site.

According to Michigan law, the categories of taxing jurisdictions that can use TIF vary with the type of authority. In the case of BRAs, the taxing jurisdictions are separated into two categories, "school" and "local." The school taxing jurisdictions include the local school district operating tax and the state education tax. The local taxing jurisdictions include the local governmental taxing jurisdictions in addition to community college and intermediate school districts. Tax increment revenues that are eligible for capture include all property taxes, including taxes levied for school operating purposes (with state agency approval). Taxes already captured as part of an existing TIF plan (under other state laws) and taxes levied to pay off other specific obligations (such as targeted revenue bonds) are exempt, or not available for brownfields financing.

[174] *See supra* note 123 at 42-46.

The law authorizing formation of the brownfield redevelopment financing authorities stipulates that only a BRA can capture new property tax value from a redeveloped eligible property and use the captured funds to reimburse those who incurred eligible expenses on that property. In addition, the statute permits BRAs, if they choose, to establish a Local Site Remediation

Revolving Fund from eligible tax capture to cover eligible expenses on other eligible properties within the BRA's jurisdiction.

As of January 2007, approximately 225 cities and towns and 11 counties had established BRAs. They have proven especially helpful in small towns, where they spearheaded redevelopment projects in towns with as few as 1,500 people.

For additional information:

Web site: http://www.michigan.gov/deq/0,1607,7-135-3311_4110_23246-63521--,00.html
Contact: Darlene Van Dale, Michigan Department of Environmental Quality, 989/705-3453, vandaled@michigan.gov

Program: Brownfield Tax Incentives

- ***Program type*** – Tax credits, tax abatements
- ***Role in meeting brownfield financing challenges*** – Frees up capital, provides flexibility in capital allocation choices, to help property owners address specific brownfield project needs
- ***Type of benefit to Michigan program users*** – Brings cashflow advantages to new users of brownfields, obsolete properties
- ***Brownfield revitalization opportunities for Michigan participants*** – Makes brownfields, abandoned and obsolete properties more cost competitive for reuse
- ***Lessons and ideas for other states*** – Value of targeting incentives to specific brownfield properties to address upfront costs to help equalize their appeal with undeveloped sites

Michigan offers several tax incentives to support site redevelopment and attract private investment to brownfields. In the context of Brownfield Redevelopment Authorities (see above), property owners may apply for a credit against Michigan business taxes for investments made at a brownfield property, as long as it is included in the local BRA's brownfield plan. This credit (the Single Business Tax Brownfields Redevelopment Credit) is available to parties that did not cause or contribute to the contamination and can total 10 percent of the development (not cleanup) costs, or up to $1 million.

In urban communities that used state authorization to create an Obsolete Property Rehabilitation District, property owners can receive an abatement of up to 100 percent of real property taxes for a brownfield site for up to 12 years.

In late 2006, Michigan modified its brownfield tax credit program. These changes greatly simplified the process for assigning brownfield credits and allowed multiple credit assignments. The result is that the credits are assignable to anyone willing to pay for them, which will increase their appeal and usefulness. In addition, brownfield developers of large-scale, multi-phase projects will now be able to claim credits after each phase of a brownfield project, rather than having to wait until the very end. Previously, in the case of multi-phase projects, developers had to pay their Single Business Tax annually and then wait until their project is complete to claim credits. This change will help cashflow and expedite project completion.

Finally, a 2006 Michigan law created a new $10 million pool of credits for small brownfield redevelopment projects, those with up to $2 million in costs. Before this change, these projects had to compete in the same pool of credits as very large projects, which often put them at a competitive disadvantage.

For additional information:

Contact: Michigan Department of Environmental Quality, http://www.michigan.gov/deq

Program: Brownfield Redevelopment Grants and Loans

- ***Program type*** – Direct financial assistance
- ***Role in meeting brownfield financing challenges*** – Provides capital, directly through grants or loans, to finance brownfield property needs and attract private capital to these sites
- ***Type of benefit to Michigan program users*** – Direct, bottom-line cash for brownfields
- ***Brownfield revitalization opportunities for Michigan participants*** – Makes brownfields more cost competitive for reuse; waterfront properties a key target
- ***Lessons and ideas for other states*** – Value of providing direct capital investments to bring properties back on line

The Michigan Department of Environmental Quality (MDEQ) offers grants and loans for environmental assessments and cleanups at properties with known or suspected contamination. This program was originally capitalized through Clean Michigan Initiative bond funds. Grants and loans made available through this program are targeted to projects that promote economic development and reuse of brownfield properties. These programs can attract developers to brownfields and leverage capital for Brownfield Redevelopment Authority (BRA) projects with loans.

Local governments, BRAs, along with other public entities such as state-funded schools and universities, can apply for these grants and loans to finance projects at sites or facilities with known contamination, properties with redevelopment potential and suspected contaminated, or waterfront properties with significant redevelopment proposals. Grants or loans can finance:

- Site evaluations and state Baseline Environmental Assessment (BEA) preparation, including PCB, asbestos, and lead-based paint surveys;
- Interim response activities;

- "Due care" plan preparation and response activities;
- Cleanup needed to comply with regulatory requirements and to promote redevelopment; and
- Demolition needed as a response activity.

Applicants can seek up to $1 million annually for each grant or loan. Property owners must provide access to the MDEQ and its contractors. Cleanup **grants** may be used at properties with known contamination and specific redevelopment proposals, where measurable economic benefits will exceed the grant amount. Cleanup **loans** may be used at properties with suspected contamination where there is economic development potential based on a planned reuse.

When loans are used, they carry an interest rate of 50 percent of the current prime rate, with a 15-year payback period. To provide some cashflow cushion, though, loans may be structured with a five year grace period, requiring no interest or payments. In addition, loans may be repaid using tax increment financing through a BRA.

As of September 2006, DEQ funded the following programs at the cumulative amounts listed below:

Funding Source	Total Amount
CMI Brownfield Redevelopment Grants	$20,669942
CMI Brownfield Redevelopment Loans	$10,868,690
Site Reclamation Grants	$39,316,054
Revitalizing Revolving Loans	$6,441,998
Site Assessment Grants	$12,770,385
Waterfront Redevelopment Grants	$46,820,884

SOURCE: Michigan DEQ, September 2006

Success Story – Ludington

The city of Ludington received a brownfield redevelopment grant to support the redevelopment of the former Star Watchcase property. The company manufactured the gold cases for pocket watches, and used the facility for metal stamping, plating, cleaning, and polishing processes from 1905 to 1981. It was acquired, and then conveyed to the city by a subsequent owner in 1984. Ludington used the building to store equipment. The $855,700 Site Reclamation Grant was obtained to define the nature and extent of contamination, develop a remedial action plan, and carry out cleanup.

Grant funds paid for demolition of the Star Watchcase manufacturing building to allow access to the contaminated soil beneath it. A pumping system was installed at the property to direct contaminated groundwater to the city's sewage treatment plant. Institutional controls were used at areas where contamination remained.

Since cleanup was completed, a local development company built a residential condominium project known as Harbor Front on the property, which is adjacent to a marina. Retail and office buildings are being added as a demand is identified. The developers invested approximately $8 million in the project. A real attraction of this development is that Harbor Front residents and marina users can watch the Lake Michigan Car Ferry, docked adjacent to the property, enter and leave port.

Success Story – Battle Creek

Battle Creek used both state site assessment and site cleanup grants to stimulate redevelopment of the former Captain Oil Change site. The property is located on a highly developed Battle Creek commercial corridor that is bordered by a residential area. The property, about 0.5 acre in size, housed a quick oil change operation from 1980 to 1994. From 1950 to 1980, the building either sat empty or was used for various commercial purposes. The building has remained vacant since 1994 and the property tax reverted back to the city.

Battle Creek conducted environmental site assessments in early 1999, using $20,000 in site assessment grant funds. Site assessment results indicated significant soil contamination. In addition, the building was in very poor condition and had a variety of abandoned containers with hazardous substances in them. There were also two abandoned underground storage tanks (USTs). Subsequently, $161,772 in Clean Michigan Initiative cleanup grant funds were used to remove hazardous substances from inside the building, complete asbestos abatement, remove the USTs, and address soil contamination.

When cleanup was complete, Battle Creek sold the property and a developer invested more than $250,000 to construct a new commercial plaza in 2006. Currently two businesses are located there, a Check into Cash and Papa Murphy's Pizza that created 17 jobs. A third unit is available for lease.

For additional information:

Web site: http://www.michigan.gov/deq/0,1607,7-135-3311_4110_29262---,00.html
Fact sheet: http://www.deq.state.mi.us/documents/deq-ess-bgl-factsheet.pdf

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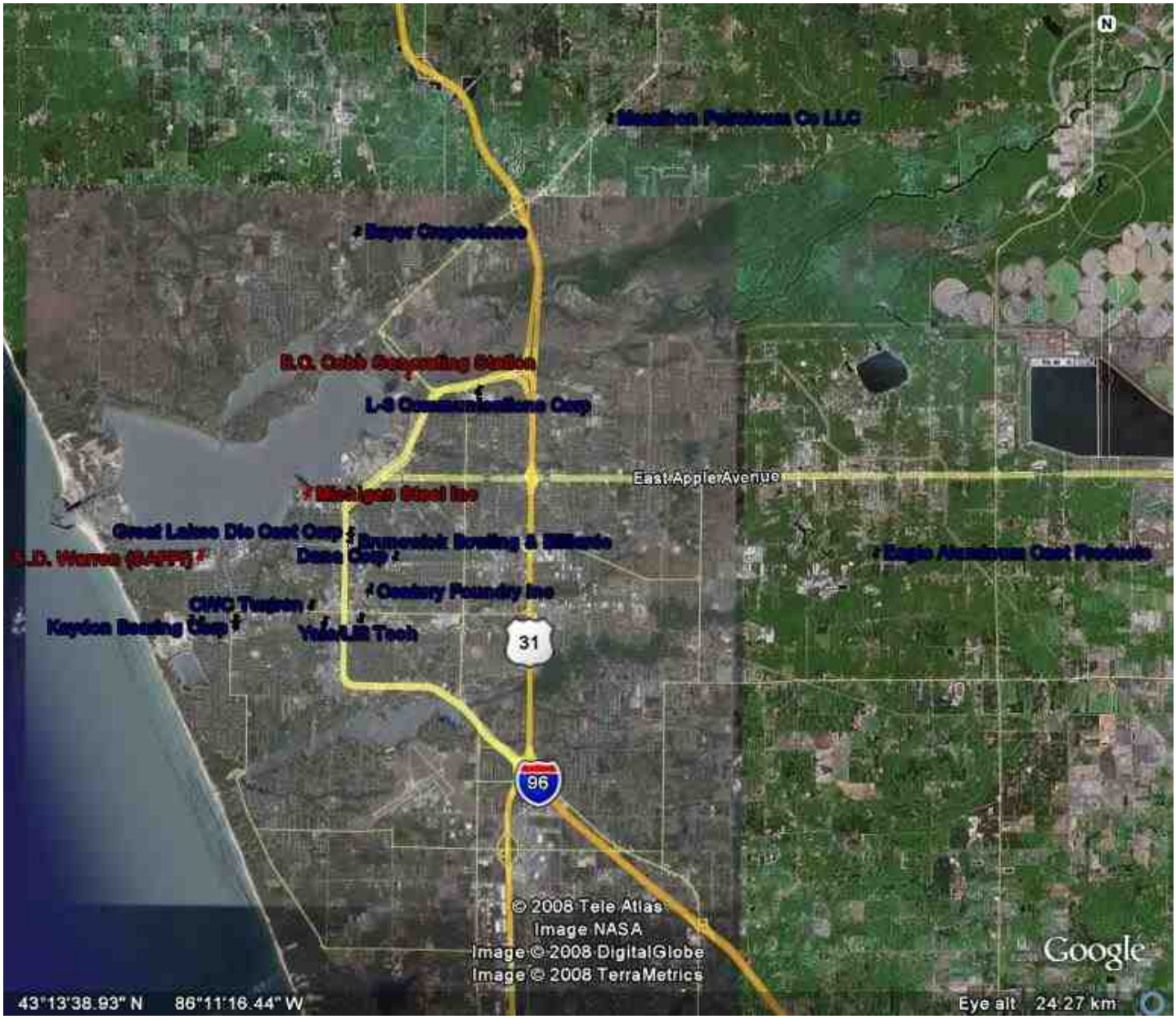
Attachment F – Map of Facilities Reporting Emissions to TRI and MAERS



Red indicates port facility
Blue indicates TRI or MAERS reporting facility within Muskegon Lake Watershed

Please note, not all reporting facilities are shown on this map.