Table 5-41. Estimated Atrazine Loads From Lake Michigan Tributaries (EPA No date[j])

Tributary	Atrazine Estimated Load (kg/yr)	Atrazine Estimated Load (lb/yr)
Fox	255.3	562
Kalamazoo	83.5	184
Grand Calumet	25.4	56
Grand	362.3	797.1
St. Joseph	605	14.3
Sheboygan	3.2	7.04
Milwaukee	9.6	21.1
Menominee	11.5	25.3
Pere Marquette	19	41.8
Manistique	3.8	8.4
Muskegon	36.5	80.3

IMPACT ON LAKE MICHIGAN

Most of the atrazine use is concentrated in the southern portion of the basin, as the northern portion of the basin is highly forested. The intensive use of atrazine in Lake Michigan for about 25 years and its long half-life in these waters may make Lake Michigan act as end points in the environmental transport of atrazine. Tributary loading is the most important input to Lake Michigan. Information on the human health and ecological effects of atrazine is presented in Appendix C.

According to the Tierney, Nelson, Christensen, and Kloibery Watson model, available monitored atrazine concentrations in Lake Michigan are very similar to the most-likely loading rate and indicate a half-life of 2 years (Tierney, Nelson, Christensen, and Watson 1999). According to this study, historical and current atrazine concentrations are below the U.S. drinking water lifetime MCL of 3.0 μg/l (ppb). However, the Schottler and Eisenreich model predicts a half-life for atrazine exceeding 5 years in Lake Michigan. This long-half life has allowed atrazine to accumulate in Lake Michigan over the last decades. Schottler and Eisenreich's model shows that if atrazine use remains at current amounts and that the atrazine concentration remains at current amounts until the year 2010, the atrazine inventory will show minimal change.

SPECIAL MANAGEMENT ISSUES

Specific actions to address ATRAZINE are presented in Chapter 6, Table 6-1: RM11, IS1, IS9, IS13 6

Programs regulating and controlling the management of atrazine are presented in Appendix A. Special management issues for atrazine include the following:

- Internal transformation and outflow may produce a water column residence time of greater than 5 years in Lake Michigan.

- Although quantity of atrazine applied to crops has decreased, atrazine is still a widely used herbicide in the southern portion of the Lake Michigan basin.

- Atrazine is considered a key component to successful conservation tillage by the agricultural community.

5.3.3.12 Selenium

Emerging Pollutant

Selenium is a naturally occurring element widely distributed in the earth's crust and commonly found in sedimentary rock formations. Selenium is released to the environmental media by both natural processes and anthropogenic sources.

Naturally, selenium is not often found in its pure form but is usually combined with other substances. Selenium in rocks is combined with sulfide minerals or with silver, copper, lead and nickel minerals. Selenium and oxygen combine to form several compounds such as sodium selenite and sodium selenate. See Physical and Chemical Properties of selenium in Appendix B. Although it is an essential food element needed by humans in small amounts, too much selenium can be harmful to health.

Following is a discussion of the potential and actual releases of selenium into the environment, (the potential load to the lake), the current and past loading of selenium to the lake, the impact of selenium on achieving the vision for the Lake Michigan ecosystem, and unique issues with managing selenium.

POTENTIAL RELEASES OF SELENIUM TO THE ENVIRONMENT

Selenium enters the air, water, and soil as a result of both natural processes and human activities. Most selenium enters the environment as the result of human activities.

In the Lake Michigan basin, selenium compounds are released to the air during the combustion of coal and petroleum fuels, and during the smelting and refining of other metals. Other selenium emissions are released to the environment from glass manufacturing, electronics and electrical manufacturing, milling operations, duplicating equipment, pigments, fungicides, gaseous insulators, and solid waste (EPA No date[k]).

- **Metals industry**. Selenium has many uses in industry and is used for a variety of processes including making metal alloys. There are 271 metals industry-related facilities in the basin that may serve as sources of selenium.

- **Use of selenium as part of a manufacturing process or within a product.** The greatest use of selenium compounds is in electronic and photocopier components, but they are also widely used in glass, rubber, textiles, petroleum, medical therapeutic agents, and photographic emulsions.

- **Selenium product use and disposal.** Selenium is regulated by the federal government as a nonradioactive hazardous element. Disposal of selenium consists of treating an acidified solution of selenium with sodium sulfite to form the reducing agent, sulfur dioxide. The selenium solution is then heated to produce elemental selenium, which is less mobile in the environment and less bioavailable, and the solution is filtered and washed (HHS 1996b).