

sources in the bay. However, the study did also observe unusually high mercury levels in fish from certain sites, and a slight increase in mean mercury tissue concentrations in the upper and lower bay compared with the middle bay fish. The authors suggest that these trends may indicate possible point sources, such as tributaries or contaminated sediments, in these areas. LMMB data indicates that the combined tributary loadings in Lake Michigan total 186 kg (410.1 lb) per year.

Hurley and others (1998b) studied mercury levels in several tributaries to Lake Michigan. Total, dissolved, and particulate-associated mercury were measured in 11 selected tributaries: the Manistique, Lower Menominee, Fox, Sheboygan, Milwaukee, Pere Marquette, Muskegon, Grand, Kalamazoo, and St. Joseph Rivers, as well as the Grand Calumet River/Indiana Harbor Ship Canal. Results indicated that both the form and flux of riverine mercury input to Lake Michigan were strongly dependent on seasonal influences and land use patterns. Mercury loading generally increased during spring melt and summer/fall storm events, and was associated with particulate mercury loading during these times of increased flow.

The LMMB estimated mercury loads from Lake Michigan tributaries based on data from April 1, 1994, to March 31, 1994 (see Table 5-26). According to these data, the Fox River contributes the largest load of mercury to Lake Michigan (76 kg/yr).

Table 5-26. Estimated Mercury Loads From Lake Michigan Tributaries (EPA No date[i])

Tributary	Estimated Load (kg/yr)	Estimated Load (lb/yr)
Fox	76.2	168.0
Kalamazoo	15.7	34.6
Grand Calumet	6.7	14.7
Grand	31.9	70.3
St. Joseph	19.4	42.8
Sheboygan	0.7	1.5
Milwaukee	1.1	2.4
Menominee	8.7	19.2
Pere Marquette	1.9	4.2
Manistique	3.5	7.7
Muskegon	2.8	6.2

The highest mercury concentration (182 ng/L [ppt]) was observed in the industrialized Fox River and was primarily associated with the particulate phase. The Grand Calumet River/Indiana Harbor Ship Canal, Grand River, and Kalamazoo River, all of which are thought to be strongly affected by point sources (such as the steel industry in the Indiana Harbor) and regional atmospheric deposition, also showed high mercury concentrations (up to 45.1 ng/L [ppt]) that were associated with particulate matter. In contrast, the tributaries in northern forested sites (Muskegon, Manistique, and Pere Marquette rivers) showed relatively low mercury concentrations, and mercury was primarily found in the dissolved (that is, filterable) phase.

Results also indicate that despite the higher total mercury concentrations in the Fox River and Indiana Harbor, the St. Joseph and Kalamazoo Rivers appear to be dominant in terms of total mercury flux to the open waters of Lake Michigan. Although the Fox River was observed to discharge, by far, the highest