NIAGARA POWER PROJECT

RELICENSING

DETERMINE IF WATER LEVEL FLUCTUATIONS IN LEWISTON RESERVOIR INCREASE MERCURY THAT IS BIOAVAILABLE

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GLOSSARY AND ABBREVIATIONS

anoxic	without oxygen or deoxygenated
cfs	cubic feet per second
cm	centimeter
DO	dissolved oxygen
DOC	Dissolved Organic Carbon
Hg(0)	elemental mercury
Hg(II)	mercury II or ionic mercury
hypolimnia	the lower portion of the lake water column
L	liter
Littoral	the shallow portion of the lake
LPGP	Lewiston Pump Generating Plant
M	mega (prefix for one million)
m	meter
MeHg	methylmercury
ml	milliliter

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mm	millimeter
MW	megawatt
NPP	Niagara Power Project
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
oxic	oxygenated
ppb	parts per billion
ppm	parts per million
Profundal	the deepwater portion of the lake
RMNPP	Robert Moses Niagara Power Plant
µ	micro (prefix for one-millionth)
µg	microgram

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EXECUTIVE SUMMARY

The New York Power Authority (NYPA) is engaged in the relicensing of the Niagara Power Project in Lewiston, Niagara County, New York. The present operating license of the plant expires in August 2007. As part of its preparation for the relicensing of the Niagara Project, NYPA is developing information related to the ecological, engineering, recreational, cultural, and socioeconomic aspects of the project.

One of the major components of the Niagara Power Project is the 22-billion-gallon Lewiston Reservoir, which was built in the late 1950s and serves as a pumped storage reservoir for the Power Project. Operation of the Niagara Power Project can result in water level fluctuations in the Lewiston Reservoir of 8-18 feet per day, and as much as 36 feet per week. Concerns have been raised regarding the influence of changing water levels, or drawdown, on the mercury concentrations found in the water and biota of the reservoir. One of the unique features of Lewiston Reservoir is that up to 93% of the water in the reservoir is exchanged on a weekly basis. This rapid exchange of water mitigates against the formation and accumulation of bioavailable mercury. Methylmercury is the form of mercury that is bioavailable, and the formation of methylmercury is called methylation. Unfortunately, most of the research performed to-date on mercury in reservoirs has involved systems with physical, flow, and drawdown characteristics very different from those in Lewiston Reservoir. However, much of the research on the effects of water level fluctuations on methylation is still relevant to Lewiston, despite the much more frequent and extensive drawdown characteristics of the Lewiston Reservoir. In addition, some previous research results are presented to provide background information on why concerns have been presented with regard to mercury in Lewiston Reservoir.

Data exist for multiple sites in North America and Europe that show a clear increase in the concentration of mercury in fish due to reservoir creation. Elevated concentrations of mercury in fish have also been reported downstream of some hydroelectric developments. The increase in the concentration of mercury in fish in reservoirs is time dependent, first rising after reservoir creation and then declining over time. The magnitude and duration of the observed increases appear to depend on fish

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species and local conditions. Typically the concentrations of mercury in fish have been reported to increase and then return to background concentrations within 10-30 years.

Drawdown has been discussed in the literature as a possible mechanism to influence the concentration of mercury in fish, both positively and negatively, when considering older reservoirs. These studies have presented several possible mechanisms relating water level fluctuations to mercury bioaccumulation in reservoirs, but significant gaps in our understanding of the relevant processes still exist. Unfortunately, most of the literature involves reservoirs that are drawn down once or twice per year, whereas Lewiston Reservoir is drawn down on a weekly basis. To our knowledge, there are no studies that have specifically investigated the effects of drawdowns on mercury bioaccumulation in pump-storage reservoirs.

These factors relating mercury bioaccumulation to reservoir drawdown have been evaluated with respect to the unique characteristics of Lewiston Reservoir. Some of the key characteristics of Lewiston Reservoir that mitigate against the formation and accumulation of methylmercury include short hydraulic residence time, low organic content of the sediments of the drawdown zone (riprap shoreline area), high pH and high dissolved oxygen concentrations.

The short hydraulic residence time of water in the Lewiston Reservoir plays a critical role in mitigating the formation of methylmercury. Nearly the entire volume of the reservoir can be exchanged on a weekly basis. Many of the processes that regulate the formation and accumulation of methylmercury are kinetic, or time-dependent processes. The shorter the residence time of a water body, the less impact in-situ methylation is able to have on the mercury characteristics of that water. Since the residence time of water within Lewiston Reservoir is so short, many of these processes do not have time to take place. This applies to both chemical and physical processes. One of the factors considered that might lead to enhanced methylation was the possibility that water temperature would be elevated in the drawn-down reservoir, thus accelerating microbial activity and methylation. However, data indicate that the water temperatures are controlled by inputs from the Niagara River. The water stays in the reservoir for such a short amount of time it does not have the opportunity to warm significantly and accelerate methylation.

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A supply of organic matter is a pre-requisite for enhanced microbial activity and enhanced methylation. The majority of the drawdown zone in Lewiston Reservoir is made up of riprap shorelines that are exposed during the week to progressively lower levels. Part of the bottom of the Lewiston Reservoir is often exposed at the end of the week for a short period of time. The riprap shorelines have very low organic matter content – only the bottom has the potential to supply organic material, and sampling has shown that these sediments have a low organic content. There is nothing to indicate that there is a significant supply rate of organic carbon to the riprap sediments that is being used to fuel microbial action that could support enhanced methylation.

Methylation is enhanced in low-pH waters. However, the surface water pH in the reservoir is near 8, a relatively high value that would not foster methylation.

The available data also suggest that the dissolved oxygen concentration in the reservoir is relatively high both at the surface and at depth. Methylation occurs in low-oxygen environments, and thus water column methylation is unlikely in Lewiston Reservoir. Sediment methylation is still possible since low oxygen conditions are undoubtedly present in the deeper sediments.

There are some characteristics of Lewiston Reservoir that suggest it may be susceptible to enhanced methylation and/or accumulation of bioavailable mercury. Methylmercury is formed in zones where water shifts from oxygenated (or oxic) conditions to deoxygenated (or anoxic) conditions due to physical impediments to the movement of oxygen and\or biological activity. Drawdown has the potential to create transitional oxic/anoxic zones within the reservoir that favor the formation of bioavailable mercury. This may occur in portions of the reservoir where bottom sediments are often exposed. Methylation in these transitional oxic/anoxic zones can be related to changes in microbial activity or changing speciation of sulfur, which then stimulates methylation. There are no data to suggest that this is indeed happening in Lewiston Reservoir sediments, but neither are there data to refute it. Finally, the presence of periodically flooded soils in the drawdown zone creates the potential for mercury migration along with reduced iron. This may occur in the surface layers of the material forming the dikes, although this potential is very small.

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Based on observed physical and chemical characteristics, it seems unlikely that drawdown would be a significant factor in enhancing the bioaccumulation of mercury by fish in Lewiston Reservoir. Aqueous sampling in the reservoir indicated that most samples had concentrations below detection levels, and that the one sample with detectable methylmercury had a very low concentration. Although there is very little aqueous phase mercury data available, what is available supports the conclusion that Lewiston Reservoir is not a site of enhanced methylation. Nonetheless, fish throughout the Niagara River corridor, and indeed throughout New York, may have enhanced levels of mercury due to the widespread nature of this metal. Any fish consumption advisory that applies to the upper Niagara River should also logically apply to fish from the Lewiston Reservoir.

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1.0 BACKGROUND

The New York Power Authority (NYPA) is engaged in the relicensing of the Niagara Power Project in Lewiston, Niagara County, New York. The present operating license of the plant expires in August 2007. As part of its preparation for the relicensing of the Niagara Project, NYPA is developing information related to the ecological, engineering, recreational, cultural, and socioeconomic aspects of the project.

The 1,880-MW Niagara Power Project (NPP or the Project) is one of the largest non-federal hydroelectric facilities in North America. The Project was licensed to the Power Authority of the State of New York (now the NYPA) in 1957. Construction of the Project began in 1958, and the first electricity was produced in 1961.

The Project has several components. Twin intakes are located approximately 2.6 miles above Niagara Falls. Water entering these intakes is routed around the Falls via two large low-head conduits to a 1.8-billion-gallon forebay, lying on an east-west axis about 4 miles downstream of the Falls. The forebay is located on the east bank of the Niagara River. At the west end of the forebay, between the forebay itself and the river, is the Robert Moses Niagara Power Plant (RMNPP), NYPA's main generating plant at Niagara. This plant has 13 turbines that generate electricity from water stored in the forebay. Head is approximately 300 feet. At the east end of the forebay is the Lewiston Pump Generating Plant (LPGP). Under non-peak-usage conditions (i.e., at night and on weekends), water is pumped from the forebay via the plant's 12 pumps into the 22-billion-gallon Lewiston Reservoir, which lies east of the plant. During peak usage conditions (i.e., daytime Monday through Friday), the pumps are reversed for use as generators, and water is allowed to flow back through the plant, producing electricity. The forebay therefore serves as headwater for the RMNPP and tailwater for the LPGP. South of the forebay is a switchyard, which serves as the electrical interface between the Project and its service area.

Operation of the NPP can result in water level fluctuations in the Lewiston Reservoir of 8-18 feet per day, and as much as 36 feet per week.

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Data exist for multiple sites in North America and Europe that show a clear increase in the concentration of mercury in fish due to reservoir creation (e.g. Bodaly et. al. 1984, Brouard et. al. 1990). Elevated concentrations of mercury in fish have also been reported downstream of some hydroelectric developments (Brouard et. al. 1992). The increase in the concentration of mercury in fish in reservoirs is time dependent, first rising and then declining (Canada-Manitoba Governments 1987). The magnitude and duration of the observed increases appear to depend on fish species and local conditions. Current estimates of the duration are on the order of 10-30 years for the increase and decline to occur. Top predatory fish respond later than fish at lower trophic levels.

Drawdown, or the decrease in reservoir water level, has been discussed in the literature as a possible mechanism to influence fish mercury concentrations, both positively and negatively, when considering older reservoirs. Some studies address reservoir drawdown directly (e.g. in Minnesota, South Carolina, British Columbia, Ontario and Finland: Bloom et al. 1992, Jagoe et al. 1994, Watson et al. 1994, Verta et al. 1986). Others address mercury and water level fluctuations, or changes in the water level in the reservoir, although not specifically drawdown. Unfortunately, most of the literature involves reservoirs that are drawn down once or twice per year, whereas Lewiston Reservoir is drawn down on a weekly basis.

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2.0 OBJECTIVE

The objective of the current study is to determine whether water level fluctuations and environmental conditions in the Lewiston Reservoir contribute to the bioaccumulation of mercury. The study approach involved the following tasks:

- Review of the literature involving mercury cycling in surface waters
- Description of Lewiston Reservoir characteristics and Niagara River mercury contamination
- Evaluation of potential effects of reservoir water level fluctuations on methylmercury levels.

The following sections of this report describe the results of conducting these tasks and conclusions that can be reached as a result of the analyses performed.

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3.0 MERCURY CYCLING

3.1 Introduction

Mercury cycling is an area of active research. Significant gains have been made in the recent past in terms of our understanding of the processes that influence mercury cycling and accumulation in biota. However, significant gaps still exist in our understanding of mercury processes in the environment.

Mercury cycling in reservoirs is one of the active areas of mercury research currently being pursued. Much of the mercury research conducted to date involves systems that are significantly different than Lewiston Reservoir. For example, many of the reservoirs studied to date are in areas that are significantly impacted by peat deposits or other types of wetlands. Lewiston Reservoir is not influenced by peat deposits or wetlands. In addition, many of the systems discussed in the literature undergo annual drawdown cycles, whereas Lewiston Reservoir is nearly completely drawn down on a weekly basis (URS et al. 2002a). For this reason, much of the information presented below does not have direct application for Lewiston Reservoir, but is included to give a more complete picture of the state of the science in terms of mercury cycling in reservoirs.

There are several factors that are important in terms of mercury cycling in Lewiston Reservoir. These include the following:

- Hydraulic retention time
- Organic matter content
- Lakewater pH
- Dissolved oxygen concentration

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- Transitional oxic/anoxic conditions
- Potential mercury migration with reduced iron
- Water temperature effects

All of these factors are discussed in general terms below, and their specific influence in Lewiston Reservoir is discussed in Section 5.0.

3.2 Background

Historically, high concentrations of mercury in fish have been attributed to point sources of mercury generally associated with industrial discharges (Furutani and Rudd 1980; Parks et al. 1989; Bloom and Effler 1990). During the 1960s, several hundred people in Minamata, Japan, became seriously ill after eating fish contaminated with mercury. The source of the mercury in Minamata Bay was a factory producing vinyl chloride, and in the process, dumping methylmercury (MeHg) directly into the bay (D'Itri 1982). In the 1970s, Onondaga Lake, New York (Effler 1987), and the Wabigoon River, Manitoba (Rudd et al. 1983), were found to be contaminated by mercury from the wastewater discharges of chlor-alkali plants.

More recently, lakes with no apparent point source of mercury have also been found to contain fish with elevated levels of mercury (Suns and Hitchins 1990; Bodaly et al. 1993; Lange et al. 1993). Studies in Europe and North America indicate that atmospheric deposition provides a significant portion of the mercury entering these lakes (Lee and Iverfeldt 1991; Sorenson et al. 1990; Fitzgerald et al. 1991).

Mercury found in fish occurs almost entirely as methylmercury in muscle tissue (Grieb et al. 1990; Bloom 1992). Since the muscle tissue is the part of the fish that people eat, people who eat large quantities of mercury-contaminated fish can also accumulate mercury. Methylmercury is highly toxic; it can lead to numbness in the fingers and lips, constriction of the visual field, impaired motor skills, mental

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retardation, and in severe cases, death. Fetal exposure to methylmercury can cause general damage to brain functions, leading to physical and mental retardation in the child.

Because methylmercury accumulates in fish, it represents a risk to human health. The U.S. Food and Drug Administration (FDA) has established a federal action level for mercury in fish of 1 ppm wet weight. Fish exceeding this level are considered hazardous for consumption and are banned from interstate commerce. The New York State Department of Health (NYSDOH) establishes fish consumption advisories for waters in the state of New York. The NYSDOH has established a statewide advisory for consumption of freshwater fish that recommends eating no more than 1 meal/week (one half pound). For lakes where data are available, if more than 2-3 fish tested have more than the FDA action level of 1 ppm, the advisory states that no more than 1 meal/month should be consumed. If the observed concentration in a standard fillet exceeds 3 ppm, NYSDOH recommends that none should be eaten.

Several studies have reported correlations of watershed characteristics or water quality parameters such as pH, dissolved organic carbon (DOC), calcium and others with mercury concentrations in fish (Grieb et al. 1990; Lee and Iverfeldt 1991; Winfrey and Rudd 1990; Gilmour and Henry 1991). However, in many cases, mechanistic analyses on the relationship of mercury concentrations in fish to mercury concentrations in water were not possible because the aqueous concentrations were too low to be detected. This difficulty has been overcome through the development of innovative sampling and analytical techniques that can detect aqueous mercury concentrations that are one million times lower than those found in the fish (Bloom 1989; Bloom 1992: USEPA 1995a; USEPA 1995b). These methods divide the mercury into three forms: mercuric (inorganic Hg(II)), elemental (Hg(0)), and methylmercury (MeHg). The application of these techniques has produced significant insights regarding mercury cycling in lake-watershed systems.

3.3 Mercury Cycling in Lakes

Mercury entering lakes as atmospheric deposition, principally in the inorganic Hg(II) form, undergoes a variety of transformations that determine its ultimate concentration in fish (Figure 3.3-1;

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Hudson et al. 1994). Hg(II) binds strongly to both inorganic and organic particulates and forms chemical complexes with dissolved organic matter and ions such as chloride and hydroxide. Hg(II) that binds to particles can be deposited in sediments and effectively removed from the system. Dissolved complexes of Hg(II) are subject to conversion to other forms of mercury. Thus the competition of dissolved substances and particulates for Hg(II) plays a critical role in determining the ultimate fate of the mercury that enters with atmospheric deposition (Watras et al. 1990).

Elemental mercury can be formed by the photo-reduction of Hg(II) or through demethylation of MeHg. Most lakes are supersaturated with Hg(0), and thus Hg(0) formed within lakes is typically volatilized to the atmosphere. This can represent a significant mechanism for the removal of mercury from lakes (Fitzgerald et al. 1991).

As indicated above, almost all of the mercury in fish is methylmercury. Because of its strong tendency to accumulate in living organisms, half or more of all the methylmercury in the water column of many lakes can be found in the muscle of fish (Watras et al. 1990) where it binds to protein sulfide and disulfide linkages and sulfhydryl groups (Morel 1983; Montura et al. 1978). Therefore, processes influencing MeHg concentrations have received significant attention.

Methylmercury is formed as a result of microbially mediated methylation of Hg(II) within the low oxygen/low sulfide redox transition zone. The redox transition zone is where water shifts from oxygenated conditions to deoxygenated conditions due to physical impediments to the movement of oxygen and\or biological activity (e.g., an interface layer within the sediments, or at the boundary of anoxic hypolimnia) (Korthals and Winfrey 1987; Ramlal et al. 1993; Gilmour et al. 1992; Watras et al. 1995). Methylation is a kinetic, or time-dependent process. Thus the amount of time water is present in a lake has a significant influence on the amount of methylation that can take place. Lakes with short hydraulic residence times have lower levels of methylation than lakes with longer hydraulic residence times. It appears that sulfate-reducing bacteria play an important role in the methylation process (Compeau and Bartha 1985).

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Analysis of aqueous phase data from a lake in Wisconsin also provides significant insights into the importance of redox conditions and sulfur in the methylation process (Bloom et al. 1991; Watras et al. 1994). As indicated in Figure 3.3-2, which plots the concentrations of mercury species, dissolved oxygen, and sulfide versus lake depth, MeHg concentrations are relatively low in the oxygenated upper 10 meters of the lake. From 10 to 14 meters depth, the dissolved oxygen concentration decreases and the sulfide concentration increases from near zero to about 40 mg/l as a result of sulfate reduction. In this same depth range, MeHg concentrations increased significantly, composing a larger fraction of the total. This provides a graphical representation that sulfate reduction and mercury methylation occur in the same place in the environment and supports the hypothesis that mercury methylation is related to sulfate reduction. The co-location of sulfate reduction and mercury methylation has been observed in other studies as well (Watras et al. 1995; Krabbenhoft et al. 1998).

As indicated above, demethylation results in the formation of elemental mercury, effectively removing the mercury from the system. As with methylation, significant effort has been expended to characterize the demethylation process. It appears that sulfate reducing bacteria also play an important role in demethylation in anaerobic freshwater sediments (Oremland et al. 1991).

3.4 Mercury in Watersheds and Wetlands

In addition to receiving mercury from atmospheric deposition, lakes and streams receive mercury from their surrounding watersheds, which often include wetlands. Processes occurring in watershed soils and in wetland environments can have significant impacts on the quantity and form of mercury entering many surface waters and thus on the ultimate concentration of mercury in fish. Because of the unusual hydrologic characteristics of Lewiston Reservoir (discussed below), it is unlikely that these processes play a significant role in mercury cycling in Lewiston Reservoir. These processes are discussed below to provide some context for the discussion of the process that may occur in Lewiston Reservoir, and to give the reader some insight into mercury cycling in general.

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Soil type and hydrology appear to be factors in determining total and methylmercury profiles, retention, and transport. Observations by Fowle et al., (1994), Mucci et al., (1995), Lee et al., (1994) and others indicate that the influence of flowpath through a watershed plays an important role in determining the watershed contribution of mercury to surface waters. Even if the mercury content of a particular soil layer is high, it can only contribute mercury to surface waters if water flows laterally through that layer to a lake or stream. Since flowpaths are site-specific, it is difficult to generalize the impact of watersheds on the mercury behavior in surface waters.

The importance of flowpaths is also illustrated in the results of a Canadian study in which the MeHg concentration in streamwater was measured both before and after the stream had passed through a peatland. Under base flow conditions the MeHg concentration of the stream increased from 0.09 ng/l to 0.38 ng/l as a result of lateral flows from the peatland into the stream. However, in response to a storm event, when lateral flow through the peat was even higher, the MeHg concentration in the stream downgradient of the peat increased to 0.53 ng/l. The MeHg concentration in the peat porewater ranged from 0.2 ng/l to greater than 6 ng/l. When more water moved laterally through the high-MeHg peat, the higher concentration was reflected in the stream as well (Fowle et al. 1994).

Wetlands seem to be an extreme example of the importance of flowpaths on the transport of mercury to surface waters. Since there are only small vertical gradients and the water entering the wetland has minimal contact with soils, mercury deposited in wetlands is largely free to flow directly into surface waters rather than sorb to soil. In addition, the enhanced microbial activity in wetlands seems to provide an ideal environment for methylation reactions to occur. These hypotheses are supported by data from a variety of sources.

3.5 Mercury in Fish

Mercury is one of the chemicals that undergo biomagnification, or increased concentrations in organisms that feed at higher levels of the food chain. The increase occurs largely because the lower levels in the food chain bioaccumulate much of the available mercury from the water. Then each higher

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level of the food chain takes in mercury from both water and food, and because biota are more efficient at retaining methylmercury than using food for growth, methylmercury concentration increases over that of the preceding level. Fish accumulate mercury almost entirely from food (Hall et al. 1998; Harris and Bodaly 1998). Mercury concentrations in fish generally increase with weight, length and age. The pattern of increasing mercury concentration in older fish likely reflects changes in prey selection and biomagnification of mercury along the food chain (Harris and Snodgrass 1993; Heath 1987; Hewett and Johnson 1992; MacCrimmon et al. 1983; Mathers and Johansen 1985).

Relationships between mercury concentrations in fish and aqueous water quality are quite complex. Analyses of hydraulically isolated lakes and low-organic western drainage lakes show linear relationships between mercury concentrations in fish and aqueous methylmercury concentrations (Watras et al. 1994; Gill and Bruland 1990). However, in studies in Sweden and in the Adirondacks, the relationship between mercury in fish and aqueous methylmercury concentrations is not observed (Lee and Iverfeldt 1991; Driscoll et al. 1994), complicating the use of simple relationships. Several studies, however, have shown that low pH is associated with high concentrations of mercury in fish (Driscoll et al. 1994; Hudson et al. 1994; Watras et al. 1995).

3.6 Mercury in Reservoirs

Data exist at several locations that show a clear increase in the concentration of mercury in fish due to reservoir creation (e.g. Bodaly et. al. 1984, Brouard et. al. 1990). Elevated concentrations of mercury in fish have also been reported downstream of some hydroelectric developments (Brouard et. al. 1992). The increase in the concentration of mercury in fish in reservoirs is time dependent, first rising and then declining (Canada-Manitoba Governments 1987). The magnitude and duration of the observed increases appear to depend on fish species and local conditions.

The mechanisms underlying increased fish mercury levels in *new* impoundments are being actively researched in several countries, and can be placed into two broad groups: (i) factors leading to increased methylmercury in the reservoir system (e.g. methylation, methylmercury leaching from flooded

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terrestrial or wetlands material), and (ii) factors relating to bioavailability and biomagnification in the food chain of the created reservoir (e.g. trophic structure, fish growth rates, fish diet, methylmercury partitioning into plankton). The relative importance of individual factors remains to be clarified.

3.6.1 Effects of Drawdown on Mercury in Reservoirs

Drawdown, the periodic lowering of water levels (either annually or more frequently), has been discussed as a possible mechanism to influence mercury concentrations in fish, both positively and negatively, when considering older reservoirs. The remainder of this section discusses studies that have monitored mercury concentrations in fish or water as a result of water level fluctuations in general. Some of the studies address reservoir drawdown directly (e.g. in Minnesota, South Carolina, British Columbia, Ontario and Finland: Sorensen et al. 1989, Bloom et al. 1992, Jagoe et al. 1994, Watson et al. 1994, Verta et al. 1986). Other studies discussed below, address mercury and water level fluctuations, although not specifically drawdown.

3.6.1.1 Drawdown in Minnesota Power Headwater Reservoirs

Sorensen et al. (1989) raised the possibility of a link between reservoir drawdown and fish mercury concentrations. The available data were inconclusive and the authors noted the need for further investigation. A panel of experts on mercury cycling assembled by Minnesota Power and stakeholders assessed several other studies. These included:

- Mercury in yearling perch from each of the five headwater reservoirs and two non-reservoir reference lakes (Minnesota Power 1992a);

- Mercury in gamefish (walleye and northern pike) for each of the headwater reservoirs (Minnesota Power 1992b);

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- Mercury in fish, plankton and water from the St. Louis River watershed and headwater reservoirs (Sorensen et al. 1992);

- Mercury levels and cycling in the Island Lake Reservoir (Brigham and Brezonik 1992); and

- Mercury levels in the surficial sediments of each of the five headwater reservoirs and two non-reservoir reference lakes (Minnesota Power 1992c).

The Minnesota Power Mercury Advisory Panel (Bloom et. al. 1992) reviewed these studies and concluded the following:

> The review panel concludes that given presently available data, it is not possible to evaluate the impact of reservoir operation on Hg in fish in Whiteface, Island, Boulder, Wild Rice, and Fish Lake Reservoirs. The issue is complicated by many factors including, but not limited to, the covariance of environmental variables, potentially inadequate reference lakes, and lack of process-oriented studies. Although it appears that fish Hg correlated positively with increasing water level fluctuation, we cannot separate this effect from that of other variables, such as water color.

3.6.1.2 Drawdown in Par Pond, South Carolina

Jagoe et al. (1994) studied mercury concentrations in largemouth bass in Par Pond, South Carolina. This is a 1200 ha impoundment formed in 1958, and has upstream industrial sources of mercury. In 1991, due to concerns about possible failure of an earth dam, the water level was lowered by about 3 m over 2 months. Nearly half (558 ha) of previously submerged sediments were exposed. This site does not reflect an annual drawdown cycle, but does represent a "one-way" drawdown. Mercury concentration in fish muscle was greater in the spring of 1992, six months post-drawdown, relative to all other sampling dates, on the basis of length or weight. Eighteen months after drawdown however, there was no significant overall trend in the mercury content of the bass. It was postulated that the transient

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increase in bass mercury could have been due to increased food intake, or altered prey species availability. In the spring of 1992, there was less submerged vegetation to provide cover, and bass fed heavily on small fish.

3.6.1.3 Drawdown in British Columbia Reservoirs

Watson et al. (1994) studied mercury concentrations in bull trout (*Salvelinus confluentus*) in 13 reservoirs in British Columbia, Canada. These reservoirs ranged in age from 10-80 years. In addition, a number of natural lakes were monitored. Mercury concentrations in bull trout were highest in Williston, Arrow and Revelstoke Lakes (all reservoirs). Mercury concentrations in Williston Lake appear not to have declined over the years, as is often reported for other reservoirs. A more complete assessment of geologic data did not support earlier hypotheses of geologic mercury sources. The authors postulated that the enhanced mercury concentrations in Williston Lake were more likely attributable to the wide range of water levels and subsequent inundation of perimeter vegetation.

Fish mercury concentrations in Williston Reservoir were measured by BC Hydro in 2001-2002 to determine if concentrations were influenced by a lingering "reservoir effect", or if fish mercury concentrations had returned to levels that would be expected 30 years after flooding (Tetra Tech 2002). Water level fluctuations were examined as a factor. The shoreline areas were not eroding on a widescale basis. There may be significant resuspension of shallow sediment materials, but this material was very low in organic content. Furthermore, bull trout mercury concentrations in 2000 did not seem unusually high with respect to the range of concentrations observed for adult predatory fish in many other studies. Based on these observations and hypotheses encountered on the topic, water level fluctuations in the Finlay Reach section of Williston Reservoir were not identified as a factor expected to contribute heavily to currently observed fish mercury concentrations.

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3.6.1.4 Drawdown in Lake 979, Experimental Lakes Area, Ontario

Several studies of mercury cycling in reservoirs significantly influenced by peat deposits or other wetlands have been conducted in, Canada, Sweden, Finland and other locations (St. Louis et al. 1994, Heyes et al. 1994a, Fowle et al. 1994, Heyes et al. 1994b, Allan et al. 1994, Moore et al. 1994, Rudd 1995; Verta et al. 1986; Rekolainen et al. 1986; Westling 1991; Driscoll et al. 1994). These systems are so different than Lewiston Reservoir, that details of the studies are not included. The studies can be summarized, however, by stating that it appears that water level fluctuations in reservoirs that include significant peat bogs can result in transport of mercury into reservoir waters.

3.6.2 Factors Associating Fish Mercury Concentrations with Drawdown

Several cause/effect relationships have been postulated between drawdown and fish mercury concentrations, but none has been well tested. This section reviews possible links between reservoir drawdown cycles and fish mercury concentrations in view of recently available scientific studies.

3.6.2.1 Increased Activity of Microbial Methylators

Lakes and reservoirs receive methylmercury from three sources: in-situ methylation, the atmosphere, and the watershed. Each of these sources is potentially important, depending on the circumstances (Harris 1991). Increased rates of in-situ methylation are likely contributors to increased fish mercury concentrations in newly flooded reservoirs.

Mechanisms also exist with the potential to link drawdown in older reservoirs with increased rates of in-situ methylation. In-situ methylation is likely enhanced when general microbial activity is increased (Furitani and Rudd 1980, Callister and Winfrey 1986). In particular, any tendency of drawdown to enhance the activity of methylating microbes would contribute to higher methylmercury production in the reservoir system. Factors that have been investigated in connection with increased activity of microbial methylators include increased activity of sulfate reducers (e.g. Gilmour 1994, Watras

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et al. 1994, Matilianen 1994), optimal net methylation rates under transitional oxic/anoxic conditions (Watras et al. 1994, Craig and Moreton 1986, Wollast et al. 1975), and temperature (Callister and Winfrey 1986, Fagerstrom and Jernelov 1972).

Drawdown, then, could enhance the activity of microbial methylators *if:* (i) it created an environment in the littoral zone that promoted transitional oxic/anoxic conditions, enhanced the activity of sulfate reducers, and/or increased temperatures in the drawdown zone, and (ii) these factors do in fact promote the activity of methylating microbes. Furthermore, microbial activity could be enhanced generally by the breakdown of organic matter in the drawdown zone via freeze/thaw cycles and ice pressure, both of which have been investigated (Hellsten et al. no date, Virtanen et al. 1994, Verta et al. 1986).

The following section discusses the potential significance of the type of terrain in the drawdown zone, and the potential influence of the hydrologic cycle on methylmercury production and mobility.

3.6.2.2 The Role of Terrain Type and the Hydrologic Cycle

In soils with temporarily higher ground water tables and more neutral pH (e.g. 5.5 to 6.0), Andersson (1979) observed that total mercury profiles paralleled iron. It was suggested that low redox conditions in these soils mobilized iron from deeper zones. This reduced iron then rose until oxidizing conditions prevailed again, and precipitation of iron occurred. Elevated mercury levels in these zones of higher iron may have occurred due to upward migration of mercury and effective association between iron and total mercury in this higher pH range (Andersson 1979).

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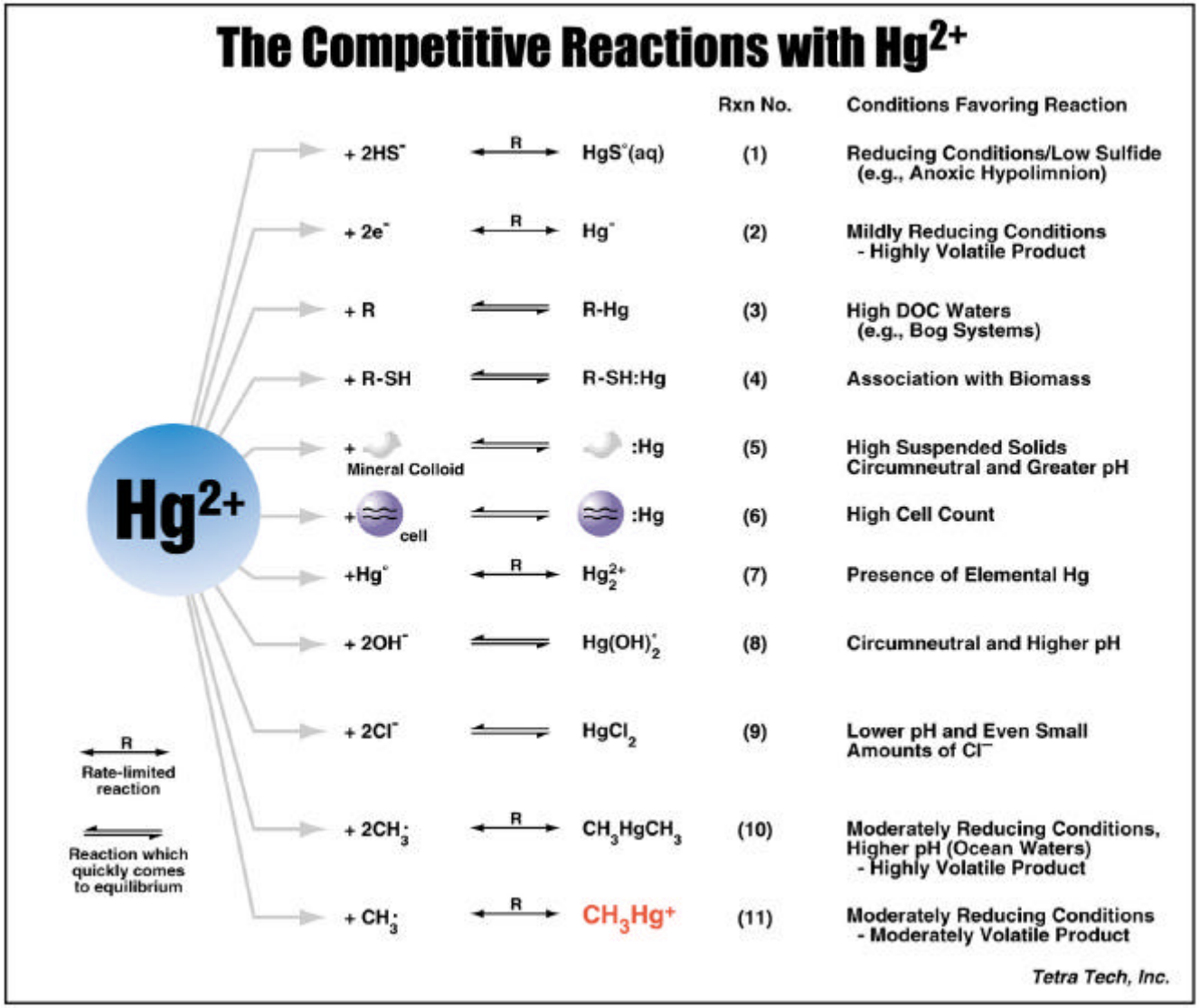

Figure 3.3-1 Examples of competitive reactions (parallel reactions with Hg(II)). Reactions 1-8 all compete with reactions 10 and 11 that form methylmercury.

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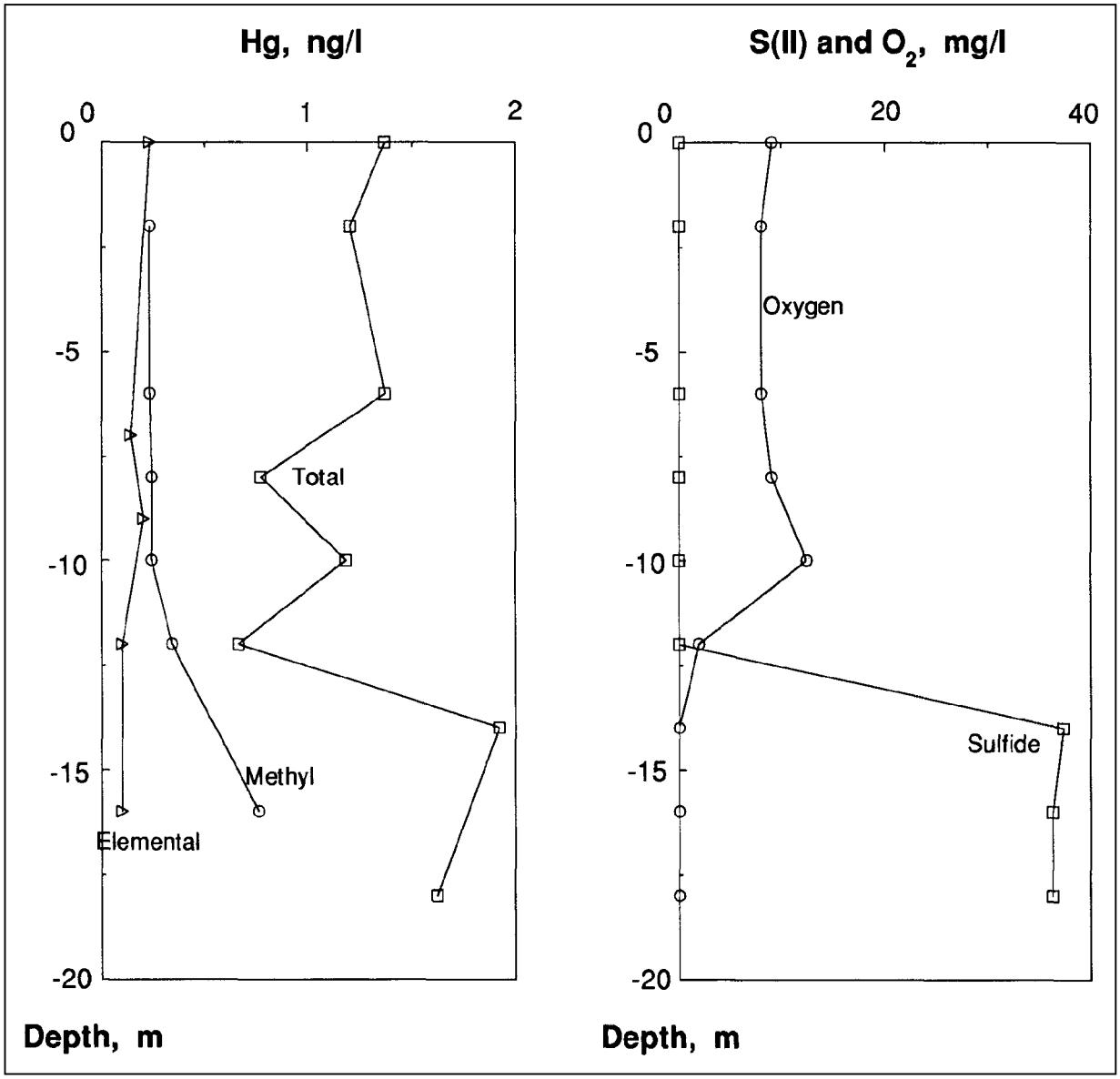

Figure 3.3-2 Concentration of mercury species, sulfide, and dissolved oxygen versus lake depth in Pallette Lake, WI. MeHg and sulfide concentrations are low in the oxygenated upper 10 meters of the lake, but the sulfide concentration increases significantly between 10 and 14 meters depth due to sulfate reduction. In this same depth range MeHg concentration also increased suggesting that mercury methylation and sulfate reduction are co-located and thus related (Watras et al., 1990).

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4.0 LEWISTON RESERVOIR CHARACTERISTICS

4.1 Background

Lewiston Reservoir is located fives miles north of the City of Niagara Falls along the east shore of the Niagara River (Figure 4.1-1). The reservoir is part of the 1800 MW (firm capacity) Niagara Power Project. Construction of the Project began in 1958 and was completed in 1961. It is one of the largest non-federal hydroelectric facilities in North America. One of the key features of the construction of the reservoir is that it did not involve excavation. Dikes were constructed to hold the impounded water, and thus the current reservoir bottom represents the original land surface of the site. Thus the land area surrounding the reservoir does not contribute water to the reservoir. Prior to construction of the reservoir, most of the land now inundated was farmland.

The principal components of the Niagara Power Project are the Robert Moses Niagara Power Plant, Lewiston Pump Generating Plant, the Lewiston Reservoir, Niagara River twin water intakes, and two large conduits. The location of these components is shown on Figure 4.1-1.

The Project operates by diverting water out the Niagara River through water intakes located 2.6 miles upstream of Niagara Falls. Water flows through the intakes at a rate of up to 375,000 gallons per second (URS et al. 2005). The water diverted out of the river is transported via gravity through 4.5-mile long conduits into the 1.8 billion gallon forebay located between the Robert Moses Niagara Power Plant and the Lewiston Pump Generating Plant. The total conduit capacity is 110,000 cfs (NYPA 2002). The water entering the forebay is then used for the generation of electricity from the 13 turbines in Robert Moses Niagara Power Plant and from the 12 pumps/generators in the Lewiston Pump Generating Plant.

The Lewiston Reservoir plays a major role in the generation of electricity from the Lewiston Pump Generating Plant. Depending upon the time of day or day of the week, water either enters the reservoir for refilling purposes or water is drawn out of the reservoir for the generation of electricity. The Lewiston Pump Generating Plant operates on a weekly cycle. Monday through Friday, during

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daytime/peak demand operations, water leaves the Lewiston Reservoir, and electricity is generated. During weeknights, the reservoir is partially refilled by pumping at the plant. The weekends are strictly used for refilling the reservoir. Figures 4.1-2 and 4.1-3 show diagrams of directional water flows in the Niagara Power Project during peak demand (daytime) and off peak demand (nighttime and weekend) periods.

4.2 Bathymetry, Water Use/Level, and Water Quality

At full storage capacity, the Lewiston Reservoir has a surface area of approximately 1,900 acres, a total volume of about 22 billion gallons, a maximum depth of 42 feet, and an average depth of about 35 feet (URS et al. 2005). At maximum drawdown, the reservoir has an average depth of less than 3 feet (URS et al. 2005). The bottom of the reservoir has an average elevation of 620 feet above MSL, and ranges from 610 to 634 feet above MSL (Environnement Illimité 2001). At maximum pool elevation, the water surface elevation is approximately 658 feet above MSL (URS et al. 2005). The reservoir is ovate in shape and is approximately 2 miles long and 1.5 miles wide.

The Lewiston Reservoir is fairly uniform in depth. The shallowest part of the reservoir is located near the northeast corner. At the maximum drawdown level, the bottom in this section of the reservoir is partially exposed. The deepest parts of the reservoir are located near the center of the southern shoreline. A bathymetric map of the Lewiston Reservoir has been provided to show the depth profile for the entire reservoir (Figure 4.2-1). The brown areas on the map are the shallowest areas and the blue areas are the deepest areas of the reservoir.

The operation of the Niagara Power Project causes significant fluctuations in the water level of Lewiston Reservoir. These fluctuations can range from between 3 to 18 feet per day, and approximately 11 to 36 feet per week depending on the season and river flows (URS et al. 2005). Typically, varying amounts of bottom sediments are exposed from approximately 1 pm on Friday afternoon until about 5 am Saturday morning. These water level fluctuations can vary during the year depending on whether it is the tourist or non-tourist season. The tourist season runs from April 1st to October 31st and the non- tourist

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season runs from November 1st to March 31st. Table 4.2-1 shows the yearly average, minimum, and maximum water level in the Lewiston Reservoir during the tourist and non-tourist season for a twelve-year period (1991-2002). The yearly average and minimum water level elevations are typically lower during the tourist season as more storage is utilized for generation during the peak energy demand periods. However, maximum water level elevations remain fairly consistent for the two seasonal periods of the year.

Weekly drawdowns in the reservoir are 21 to 36 feet during the tourist season and 11 to 30 feet during the non-tourist season. The weekly drawdowns during the tourist season are greater because NYPA's allocated share of Niagara River water for power generation is reduced during daytime hours to provide higher flows for Niagara Falls. Water stored in the Lewiston Reservoir is used to generate power to meet daily peak demands during this period. Figures 4.2-2 and 4.2-3 show duration curves for daily and weekly water level fluctuations in the Lewiston Reservoir during the tourist and non-tourist periods from 1991-2002.

The Niagara Power Project operates on a weekly cycle that is based on the demand for electricity. During the weekdays, when demand for power is highest, both the Robert Moses Niagara Power Plant and the Lewiston Pump Generating Plant are used for power generation. At night and on weekends, when demand is lower, only the Robert Moses Niagara Power Plant is used for generation. During this period, the Lewiston Reservoir is used to store water for use during high-demand periods. Based on this weekly cycle, minimum water levels in the reservoir typically occur on Friday nights. The reservoir is refilled over the weekend; so maximum water levels in the reservoir are obtained on Monday mornings. Figure 4.2-4 shows a graph of daily water level fluctuations in the Lewiston Reservoir over a weekly period from July 16-22, 2001.

The magnitude of water level fluctuations in the Lewiston Reservoir increased by 21.6% between November 1999 and the end of 2002 (URS et al. 2005). This occurred because lower flows were observed in the Niagara River starting in November 1999, which means that a larger quantity of water from the Lewiston Reservoir had to be used to meet peak power demands. Figure 4.2-5 shows a duration curve of daily water level fluctuations before and after November 1999. The average water surface

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elevation in the reservoir before November 1999 was 644.8 feet, while the average after November 1999 was 643.4 feet (URS et al. 2005).

Water quality data from the Lewiston Reservoir were collected as part of the 1982-83 Aquatic Ecology and Water Quality Study (Ecological Analysts 1984a) and as part of the Lewiston Reservoir Fish Survey conducted in 2000 (Environment Illimité 2000). In the Aquatic Ecology Study, measurements were made in eight different zones in the reservoir from November 1982 through August 1983 as part of what was referred to in the project report as an in situ study. These measurements were taken at the surface, mid-depth, and bottom. The parameters measured as part of the in situ study included water temperature, dissolved oxygen, conductivity, pH, and Secchi disk depth (Appendix A). A map of each zone in the reservoir is included in Figure 4.2-6.

In addition to the in situ study measurements, analyses were conducted on samples collected from the surface, mid-depth, and bottom of the reservoir during November 1982 and from mid-depth during June and July 1983 for what was referred to as a laboratory study. For each sampling period of the laboratory study, two water quality samples were collected: one during a low-water period and one during a high-water period. The parameters analyzed in these samples included the total alkalinity, ammonia-nitrogen, nitrate-nitrogen, total phosphorus, ortho-phosphorus, total dissolved solids, suspended sediments, turbidity, chlorophyll a, ferrous iron, water temperature, dissolved oxygen, conductivity, pH, and Secchi disk depth (Appendix B).

Based upon data from the 1982-83 study, the water quality of the Lewiston Reservoir was judged to be generally good to excellent for the variables reported and was more than adequate to support aquatic life. The reservoir was very well mixed vertically and spatially. The waters were characterized as fresh, moderately hard, neutral to slightly alkaline, and highly oxygenated. Nutrient and chlorophyll a concentrations were found to be low and similar to background concentrations. Also, no major differences were observed in water quality characteristics between high- and low-water periods (Ecological Analysts 1984a).

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Table 4.2-2 provides summary statistics for each of the parameters analyzed in the 1982-83 study. For the statistical analyses, the in situ study samples and laboratory study samples were analyzed separately. The samples from the different zones and for the different depths were grouped together for the statistical analyses because the water quality was found to be similar throughout the Lewiston Reservoir.

As part of the Lewiston Reservoir Fish Survey in 2000, during each sampling period water quality samples were collected during each deployment of fish sampling gear. The parameters analyzed in these water samples included water temperature, pH, D.O., conductivity, and Secchi disk depth. Table 4.2-3 presents these parameters averaged over all gears and all sites. For the surface samples, average water temperature ranged from 13 degrees C in May to 22.7 degrees C in July, the pH was 8.3 for all three months, the dissolved oxygen ranged from 8.6 mg/L in July to 11.7 mg/L in May, and the conductivity ranged from 273 µS/cm in October to 308.3 µS/cm in May. For the bottom samples, average water temperature ranged from 12.9 degrees C in May to 22.4 degrees C in July, the pH ranged from 8.2 in July and October to 8.4 in May, the dissolved oxygen ranged from 8.5 mg/L in July to 11.6 mg/L in May, and the conductivity ranged from 273 µS/cm in October to 309.8 µS/cm in May. The Secchi disk measurements ranged from 2.7 m in May to 4 m in July. The surface and bottom samples collected during this study showed very similar water quality characteristics (Environment Illimité 2001).

In the fall of 2003, samples were collected and analyzed for total and methylmercury concentration. Most of the samples were non-detects, but one sample had a detectable methylmercury concentration of 0.074 ng/l. This is a low concentration that is not indicative of significant methylating activity.

4.3 Habitat Character

The Lewiston Reservoir is a fairly deep, open water reservoir. The entire 6.5-mile-long shoreline is composed of barren riprap rock material (ESI 2002). This riprap habitat experiences a weeklong cycle of flooding and drying. Above the riprap shoreline, the reservoir is mainly surrounded by the steep grassy

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hillsides that comprise the highest portions of the dikes. Lower portions of the reservoir (below the low pool elevation of 620 feet above MSL) remain consistently submerged (URS et al. 2002a).

The Lewiston Reservoir provides habitat for a variety of aquatic and terrestrial organisms. Many species of fish, birds, plants, mammals, amphibians, and reptiles have been documented in the reservoir or along its shoreline. The reservoir has been noted as an important habitat for migrating waterfowl during the late fall and throughout the winter months. The reservoir bottom provides suitable habitat for benthic macroinvertebrates. The most common types found include oligochaeta, chironomidae, gastropoda, amphipoda, and several species of pisidiid clams (Ecological Analysts 1984a). The composition of the benthic invertebrate community of Lewiston Reservoir is similar to that of the Niagara River (Ecological Analysts 1984a).

The reservoir also provides habitat for numerous species of microorganisms including periphyton, phytoplankton, and zooplankton. Diatoms, green algae, blue-green algae, yellow-brown algae, and cryptophytes were the major components of the phytoplankton community in terms of both number of taxa and abundance. Blue-green algae, green algae, and diatoms were found to be the major components of the periphyton community in terms of both number of taxa and abundance (URS et al. 2002a). The phytoplankton and periphyton found in the reservoir are not substantially different from common assemblages found elsewhere in the region (Ecological Analysts 1984a).

During the 1982-83 Aquatic Ecology and Water Quality Study, comprehensive data on the zooplankton community in the reservoir were collected. The study looked at the composition of the zooplankton community during different times of the year. In May and July, rotifers were the predominant group (50 to 84% of the population in May and 62 to 68% in July). In November, copepods and cladocerans were the primary groups identified with copepods being slightly more abundant (URS et al. 2002a). In all, the study identified more than 50 zooplankton species in the Lewiston Reservoir. The authors concluded that the macroinvertebrate and zooplankton communities reflected the species composition of the Niagara River, due largely to the high rate of water exchange with the River. (Ecological Analysts 1984a).

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4.4 Sediment Composition, Sedimentation, and Organic Content

As indicated above, much of the bottom of the Lewiston Reservoir is covered with fine-grained sediment. These sediments consist primarily of dark gray silt and clay, with varying amounts of medium to fine sand (ESI 2005). The percent of sand, silt, gravel, and clay in each of the sediment samples collected during the sediment survey in 2002 is shown in Table 4.4-1. The estimated sediment depth varies throughout the reservoir. As indicated, in Figure 4.4-1, the deepest estimated sediment thickness (greater than 4 feet) occurs along the southern shoreline, northeast corner, and in a small area near the middle of the reservoir. In general, the greatest extent of sediment deposition appears to be occurring near the middle of the reservoir and along the southern shoreline.

Erosion has occurred throughout several different areas of the reservoir, based on the pre-project contours and estimated sediment accumulation (Louis Berger 2004, in preparation). However, the largest extent of estimated erosion is occurring in the southeast corner of the reservoir and just upgradient of the Lewiston Pump Generating Plant moving to the east. The erosion occurring just upgradient of the plant is likely due to frequent turbulent water flow into and out of the reservoir through the pumping plant (ESI 2005).

The only available data on the organic content of sediments from the Lewiston Reservoir was from the 2002 sediment survey. The content of total organic carbon (TOC) was analyzed in five sediments samples from the reservoir (Table 4.4-2). The range of TOC concentration in these samples was 13400 to 16800 mg/kg. The average TOC concentration from these samples was 15,567 mg/kg.

4.5 Sediment Mercury Levels

Sediment mercury data for the Lewiston Reservoir were available from the 2002 sediment survey, from a 1983 sediment sampling program conducted as a supplement to the Aquatic Ecology and Water Quality Study (Ecological Analysts 1984b), and from a study conducted in the early 1980s (Breteler et al., 1984). The Breteler et al. study examined sediment cores from western Lake Ontario, eastern Lake Erie,

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and Lewiston Reservoir to evaluate changes in sediment mercury concentrations. The cores were sectioned, and radio-isotopic dating analysis determined when a particular section of the core was deposited. The results of this analysis are presented in Table 4.5-1. As indicated in the table, sediment concentrations in Lake Ontario and Lewiston Reservoir are similar and higher than the concentrations observed in Lake Erie. This is likely attributable to historical discharges from a chloralkali facility in the upper Niagara River. The concentrations in the most recent sediments examined are significantly lower than concentrations in the deeper, older sediments. This trend is similar to that reported by Marvin et al. (2003) and reinforces the notion that point-source inputs accounted for the mercury found in deeper sediments. It is also quite plausible that much of the mercury found in more recent sediments results from the resuspension of those impacted by historical inputs.

In the 1983 sediment-sampling program, five sediment samples were collected approximately 600 feet north of the LPGP. Three samples were collected approximately 50 feet from the shoreline and about 10 feet apart from one another by a scuba diver. One of the goals of this effort was to determine if excavated materials from the reservoir could be safely disposed of in an upland disposal area. An EP Toxicity leaching test was conducted on the sediment samples collected from the reservoir. The mercury concentrations were below the method detection limit of 0.2 ppb for the three sediment samples analyzed in this study.

In the 2002 sediment survey for Lewiston Reservoir, five sediment samples were collected and analyzed for a variety chemical constituents including mercury (Figure 4.5-1, Table 4.5-2). These samples were collected in areas of the reservoir with the thickest sediment accumulations (Figure 4.4-1). The concentrations of mercury in these samples ranged from 0.163 to 0.206 mg/kg. However, sediment concentrations are typically not good predictors of either aqueous or biota concentrations of mercury

4.6 Fish Community of the Lewiston Reservoir

The Lewiston Reservoir contains a variety of fish species including both warm and cold-water species. Fish surveys were conducted in the reservoir in June 1975, from November 1982 to August

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1983, and from May 2000 to October 2000. During these studies, a total of 39 different species of fish were identified (URS et al. 2002b). The families of fish collected during the surveys included salmonids, centrarchids (sunfishes), esocids (pike), percids (perches), and cyprinids (minnows). A list of the different fish species collected during the fish survey in 2000 is provided in Table 4.6-1.

For the fish surveys, the reservoir was divided into eight sampling zones to help determine the areas containing the highest abundance of fishes (Figure 4.2-6). Zones 1 through 7 cover the perimeter or shoreline areas, while Zone 8 is in the open water area of the reservoir. During all of the sampling events, more fish were captured in Zones 4 and 5 compared to the other zones (URS et al. 2002b). Zones 4 and 5 are located near the northeast corner of the reservoir. These zones contain most of the higher elevation sand/gravel substrate, which may provide more suitable fish habitat than the remainder of the reservoir.

The seasonal abundance of some of the key species in the reservoir was also determined by the surveys. The lowest numbers of yellow perch and rock bass were recorded in the late fall, and the highest numbers of these species were recorded during the spring spawning season. Over the summer period, the populations of yellow perch and rock bass typically declined. Smallmouth bass numbers typically increased in late fall to spring and reached a maximum in the summer (URS et al. 2002b).

Part of the 1982-83 fish survey included looking at the abundance of larval fishes to help determine if some of the fish species are successfully spawning in the reservoir. The results of the larval fish survey indicated that spawning in the reservoir occurs on a very limited basis. This can be attributed to water level fluctuations and the fact that the reservoir contains very little suitable substrate for spawning. Based on field observations conducted in the 1982-83 survey, there are only about 75-100 acres of relatively shallow habitat with suitable spawning substrate. This area is located along the eastern perimeter of the reservoir. Other factors that may have negative impacts on the success of spawning in the reservoir would be the lack of aquatic vegetation and fluctuating water levels. The investigators of the 1982-83 larval study concluded that fish populations in the reservoir are likely maintained by the movement of fish from the Niagara River through the conduits and the Lewiston Pump Generating Plant.

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The most abundant fish species in all of the surveys conducted at the Lewiston Reservoir was yellow perch. From the 1975 fish survey, 81% of the fish captured were yellow perch, 7% were white suckers, 5% were rock bass, and 2% were spottail shiners. During the 1982-83 survey, yellow perch made up 40.2% and rock bass made up 25.6 % of the fish captured in November 1982. In the May/July 1983 portion of this study, yellow perch made up 58.5% and rock bass made up 41.6% of the fish captured. From the most recent fish survey conducted in 2000, 29.7% of the fish captured were yellow perch, 26.5% were rock bass, and 8.7% were northern pike (URS et al. 2002b).

In the 1982-83 study, the age distribution of yellow perch in the Lewiston Reservoir was assessed. The population was comprised mainly of three, four, and five year-old fish. Three year-old fish made up 36%, 4 year-old fish made up 48.1%, and 5 year-old fish made up 13.1% of the yellow perch collected. It was estimated that one to two year-old fish made up less 2 percent of the population and that six year-old made up about 1% of the perch population in the reservoir. The oldest yellow perch collected during the study was eight years old.

The 1982-83 study also analyzed the lengths and weights of yellow perch collected during the study. In the November 1982 sampling period, the lengths ranged from 188 to 287 mm with the average length being 226 mm. From the November sampling period, the weights ranged from 54 grams to 327 grams with the average weight being 146 grams. In the May to July 1983 sampling period, the lengths ranged from 118 to 235 mm with the average length being 219 mm. During this same period, the weights ranged from 16 grams to 709 grams with the average weight being 121 grams.

Creel surveys of fishermen at the reservoir have indicated that the yellow perch is the most desirable sport fish in the reservoir. Adult yellow perch are typically between 6 and 12 inches long. Yellow perch prefer cool clear lakes with large deep-water areas surrounded by shallow weedy areas, but they are very adaptable to a variety of habitat conditions (Becker 1983). Adult yellow perch are omnivores, which means they feed on a variety of different organisms. These organisms include small mollusks, worms, aquatic insects and insect larvae, snails, small crayfish, fish eggs, large zooplankton, and small minnows. Young yellow perch feed almost exclusively on small zooplankton (Becker, 1983).

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4.7 Niagara River Mercury Characteristics

As indicated above, the Lewiston Reservoir is refilled with Niagara River water each week. Therefore the mercury characteristics of the Niagara River may have a significant influence on the mercury characteristics of the Reservoir. Although there is more mercury data for the Niagara River than is available for Lewiston Reservoir, much of the data, especially fish tissue concentration data, is old, dating back to the early 1970s. The description below is based on the most recent data available for the Niagara River and the eastern basin of Lake Erie and the western (or Niagara) basin of Lake Ontario.

4.7.1 Niagara River System Sediment Mercury

There have been some recent measurements of sediment mercury concentrations in Lake Erie and Lake Ontario. Marvin et al. (2003) compare sediment mercury levels in the two lakes and show that concentrations are substantially higher in the Niagara basin of Lake Ontario than in the eastern basin of Lake Erie, indicating that the Niagara River serves as a source of mercury to Lake Ontario. Marvin et al. (2003) report that in 1998, the surficial (0-3 cm) sediment mercury concentrations in the Niagara basin of Lake Ontario ranged from 0.15 µg/g to 1.2 µg/g with a mean value of 0.56 µg/g. These values represent a significant reduction in concentrations compared to data collected in 1968 (Marvin et al. 2003).

The best data available for the Niagara River itself were collected in 1979, 1980, and 2003. Kauss (1983) evaluated sediment samples from several stations on the Niagara River both upgradient and downgradient of Lewiston Reservoir. The stations sampled upgradient from Lewiston Reservoir were all above Niagara Falls, near Grand Island. The surface sediment mercury concentrations for these stations ranged from 0.04 µg/g to 0.67 µg/g, with the highest concentrations at stations near the southeast and northeast corners of Grand Island. The downgradient stations were located from approximately 4,000 m to 13,000 m downstream from the point that Lewiston Reservoir waters re-enter the Niagara River. Sediment mercury concentrations at these stations ranged from 0.03 µg/g to 3.2 µg/g (Kauss 1983). The higher concentrations in the downgradient samples likely reflect the presence of industrial sources just downstream of the Project intakes.

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In the 2003 sediment survey (ESI 2005), four sediment samples were collected from the Niagara River and analyzed for a variety of constituents including mercury. Two samples were collected from the upper river and two from the lower river below Niagara Falls. Mercury was not detected in one of the upper river samples and one of the lower river samples. The sediment mercury concentrations for the other two samples were 0.265 mg/kg and 0.577 mg/kg, in the upper and lower river samples respectively.

4.7.2 Niagara River System Fish Mercury

As indicated above, much of the fish tissue mercury data from the Niagara River system is old. The best data set for fish tissue mercury concentrations from the Niagara River is an unpublished NYSDEC database that was provided by Howard Simonin of the NYSDEC. This database includes fish tissue samples from the Niagara River for multiple fish species. Some of these data are from early surveys conducted in the 1970s, but there are also concentrations reported for samples collected during the 1990s. For yellow perch, the available data are summarized in Table 4.7.2-1. The entire database is included in Appendix C.

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TABLE 4.2-1

YEARLY AVERAGE, MINIMUM, AND MAXIMUM WATER LEVEL IN THE LEWISTON RESERVOIR DURING THE TOURIST AND NON-TOURIST SEASON, 1991-2002

Year	Tourist Season Water Level (USLS 1935)			Non-Tourist Season Water Level (USLS 1935)			Yearly Water Level (USLS 1935)			Tourist/Non-Tourist Comparison (Diff. in Feet)		
	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg	Min	Max	Avg
1991	620.62	658.49	640.71	624.71	657.84	642.24	620.62	658.49	641.26	-4.09	0.65	-1.53
1992	621.27	658.46	641.23	629.05	658.23	648.65	621.27	658.46	644.27	-7.78	0.23	-7.42
1993	620.98	658.46	640.78	627.4	658.34	646.8	620.98	658.46	643.27	-6.42	0.12	-6.02
1994	620.16	658.56	640.47	620.3	658.17	644.24	620.16	658.56	642.07	-0.14	0.39	-3.77
1995	620.33	658.58	640.15	620.59	658.38	643.23	620.33	658.58	641.42	-0.26	0.2	-3.08
1996	625.98	658.47	643.1	627.21	658.38	645.84	625.98	658.47	644.24	-1.23	0.09	-2.74
1997	627.87	658.6	644.72	626.93	658.44	648.89	626.93	658.6	646.43	0.94	0.16	-4.17
1998	621.87	658.44	641.39	625.09	658.46	646.67	621.87	658.46	643.57	-3.22	-0.02	-5.28
1999	621.94	658.62	642.04	623.66	658.57	643.22	621.94	658.62	642.53	-1.72	0.05	-1.18
2000	624.35	658.63	645.36	624.43	658.61	645.01	624.35	658.63	645.22	-0.08	0.02	0.35
2001	621.44	658.82	642.52	623.95	658.56	647.84	621.44	658.82	644.72	-2.51	0.26	-5.32
2002	621.86	658.59	643.5	625.08	658.49	646.75	621.86	658.59	644.84	-3.22	0.1	-3.25

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TABLE 4.2-2

SUMMARY STATISTICS FOR WATER QUALITY DATA COLLECTED DURING THE 1982-82 STUDY

Statistic	Water Temp. (C)	D.O. (mg/L)	Cond. (umhos)	pH (S.U.)	Secchi Disk Depth (m)	Total Alk. (mg/L)	NH3-N (mg/L)	NO3-N (mg/L)	Tot. P (mg/L)	PO4 (mg/L)	Total Dis. Solids (mg/L)	Susp. Sed. (mg/L)	Turb. (NTUs)	Chl a (ug/L)	Ferrous Iron (mg/L)
In Situ Samples															
Minimum	1.7	7.5	200	8.5	1	-	-	-	-	-	-	-	-	-	-
Maximum	26.7	13.4	390	7.1	4	-	-	-	-	-	-	-	-	-	-
Average	16.35	10.79	293.86	7.64	2.45	-	-	-	-	-	-	-	-	-	-
Median	17.8	10.9	280	7.7	2.2	-	-	-	-	-	-	-	-	-	-
Std. Dev.	6.57	0.99	56.87	-	0.73	-	-	-	-	-	-	-	-	-	-
Count	296	296	296	290	79	-	-	-	-	-	-	-	-	-	-
Laboratory Samples															
Minimum	8.5	10.1	205	7.9	1	24	<0.01	0.15	<0.1	<0.01	37	0.5	1	1.5	0.02
Maximum	22.3	112.6	308	7.1	4	134	0.15	1.28	0.2	0.04	157	31	15	4.8	0.13
Average	13.28	13.74	257.48	7.40	2.75	101.30	0.05	0.26	0.05	0.01	99.25	4.11	3.28	2.88	0.09
Median	9.5	11.15	264	7.4	3	99	0.04	0.25	0.05	0.005	110	3	2.05	2.8	0.085
Std. Dev.	5.36	16.05	31.71	-	0.93	15.09	0.04	0.17	0.02	0.01	33.39	4.69	2.48	0.86	0.03
Count	40	40	40	40	20	40	40	40	40	40	16	40	40	16	16

Source: Ecological Analysts 1984a. Statistics were calculated using 1/2 the method detection limit value.

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TABLE 4.2-3

AVERAGE WATER QUALITY DATA OVER ALL GEARS AND SAMPLE SITES FOR THE LEWISTON RESERVOIR FROM THE FISH SURVEY CONDUCTED IN 2000

Month	Water temperature (oC)		pH		Dissolved oxygen (mg/L)		Conductivity		Secchi disk (m)
	Surface	Bottom	Surface	Bottom	Surface	Bottom	Surface	Bottom	
May	13.0	12.9	8.3	8.4	11.7	11.6	308.3	309.8	2.7
July	22.7	22.4	8.3	8.2	8.6	8.5	282.1	282.5	4.0
October	14.6	14.6	8.3	8.2	9.7	9.0	273.0	273.0	3.1

Source: Environnement Illimité 2001

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TABLE 4.4-1

GRAIN SIZE DISTRIBUTION FOR SEDIMENT SAMPLES COLLECTED DURING THE 2002 SEDIMENT SURVEY OF LEWISTON RESERVOIR

Soil Classification*	RES-SED05	RES-SED06	RES-SED07	RES-SED08	RES-SED09
Gravel	0	0	0	0	0
Sand	7.4	4.1	1.2	0.3	0.1
Coarse Sand	0	0	0	0	0
Medium Sand	0.4	0.5	0.2	0.1	0
Fine Sand	7	3.6	1	0.2	0.1
Silt	59	63.1	61.4	55.9	44.5
Clay	33.6	32.9	37.4	43.9	55.4

Source: ESI 2005

*Units are in percent by weight of total sample.

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TABLE 4.4-2

TOC DATA FROM THE 2002 SEDIMENT SURVEY OF THE LEWISTON RESERVOIR

Sampling Location	TOC Concentration (mg/kg)
SED-05	15100 J
SED-06	13400 J
SED-07	16800 J
SED-08	15300 J
SED-08 dup.	16200 J
SED-09	16600 J

Source: ESI 2005

J = estimated value

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TABLE 4.5-1

CHANGES IN SEDIMENT MERCURY CONCENTRATION OVER TIME

Sedimentation Period	Western Lake Ontario Sediment Hg (µg/g)	Lewiston Reservoir Sediment Hg (µg/g)	Eastern Lake Erie Sediment Hg (µg/g)
1978-1979	0.21	0.17	0.072
1974-1975	0.46	0.46	NA
1972-1973	0.45	0.42	NA
1971-1972	0.75-1.1	NA	0.29
1969-1970	1.3-1.7	1.6	NA
1963-1964	1.9-3.6	1.5	0.054-0.087

NA – not analyzed

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TABLE 4.5-2

MERCURY DATA FROM THE 2002 SEDIMENT SURVEY OF THE LEWISTON RESERVOIR (ENVIRONMENTAL STANDARDS, INC., 2005)

Sampling Location	Mercury Concentration (mg/kg)
SED-05	0.206
SED-06	0.169 J
SED-07	0.171 J
SED-08	0.175 J
SED-08 dup.	0.163 J
SED-09	0.173 J

Source: ESI 2005

J – estimated value

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TABLE 4.6-1

FISH SPECIES - LEWISTON RESERVOIR FISH SURVEY

Common name	Scientific name	Family
Alewife	*Alosa pseudoharengus*	Clupeidae
American eel	*Anguilla rostrata*	Anguillidae
Black crappie	*Pomoxis nigromaculatus*	Centrarchidae
Bluntnose minnow	*Pimephales notatus*	Cyprinidae
Brown bullhead	*Ameiurus nebulosus*	Ictaluridae
Carp	*Cyprinus carpio*	Cyprinidae
Channel catfish	*Ictalurus punctatus*	Ictaluridae
Common shiner	*Luxilus cornutus*	Cyprinidae
Emerald shiner	*Notropis atherinoides*	Cyprinidae
Freshwater drum	*Aplodinotus grunniens*	Sciaenidae
Golden shiner	*Notemigonus crysoleucas*	Cyprinidae
Greater redhorse	*Moxostoma valenciennesi*	Catostomidae
Johnny darter	*Etheostoma nigrum*	Percidae
Largemouth bass	*Micropterus salmoides*	Centrarchidae
Logperch	*Percina caprodes*	Percidae
Muskellunge	*Esox masquinongy*	Esocidae
Northern pike	*Esox lucius*	Esocidae
Pumpkinseed	*Lepomis gibbosus*	Centrarchidae
Rainbow smelt	*Osmerus mordax*	Osmeridae
Rainbow trout	*Onchorhynchus mykiss*	Salmonidae
Rock bass	*Ambloplites rupestris*	Centrarchidae
Shorthead redhorse	*Moxostoma macrolepidotum*	Catostomidae
Silver redhorse	*Moxostoma anisurum*	Catostomidae
Smallmouth bass	*Micropterus dolomieui*	Centrarchidae
Spottail shiner	*Notropis hudsonius*	Cyprinidae

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TABLE 4.6-1 (CONT.)

FISH SPECIES - LEWISTON RESERVOIR FISH SURVEY

Common name	Scientific name	Family
White bass	*Morone chrysops*	Percichthyidae
White sucker	*Catostomus commersoni*	Catostomidae
Yellow perch	*Perca flavescens*	Percidae

Source: Environnement Illimité 2001

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TABLE 4.7.2-1

YELLOW PERCH MERCURY CONCENTRATIONS

Sampling Location	Year Sampled	Fish Tissue Hg Concentration (µg/g)
Lake Ontario Inflow (Lower River)	1994	0.11
Upgradient of Lake Ontario Inflow (Lower River)	1994	0.15
Downgradient of Strawberry Island (Upper River)	1981	0.17
Strawberry Island (Upper River)	1970	0.57
Upgradient of Strawberry Island (Upper River)	1970	0.37

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FIGURE 4.1-1

LEWISTON RESERVOIR AND THE NPP

[NIP – General Location Maps]

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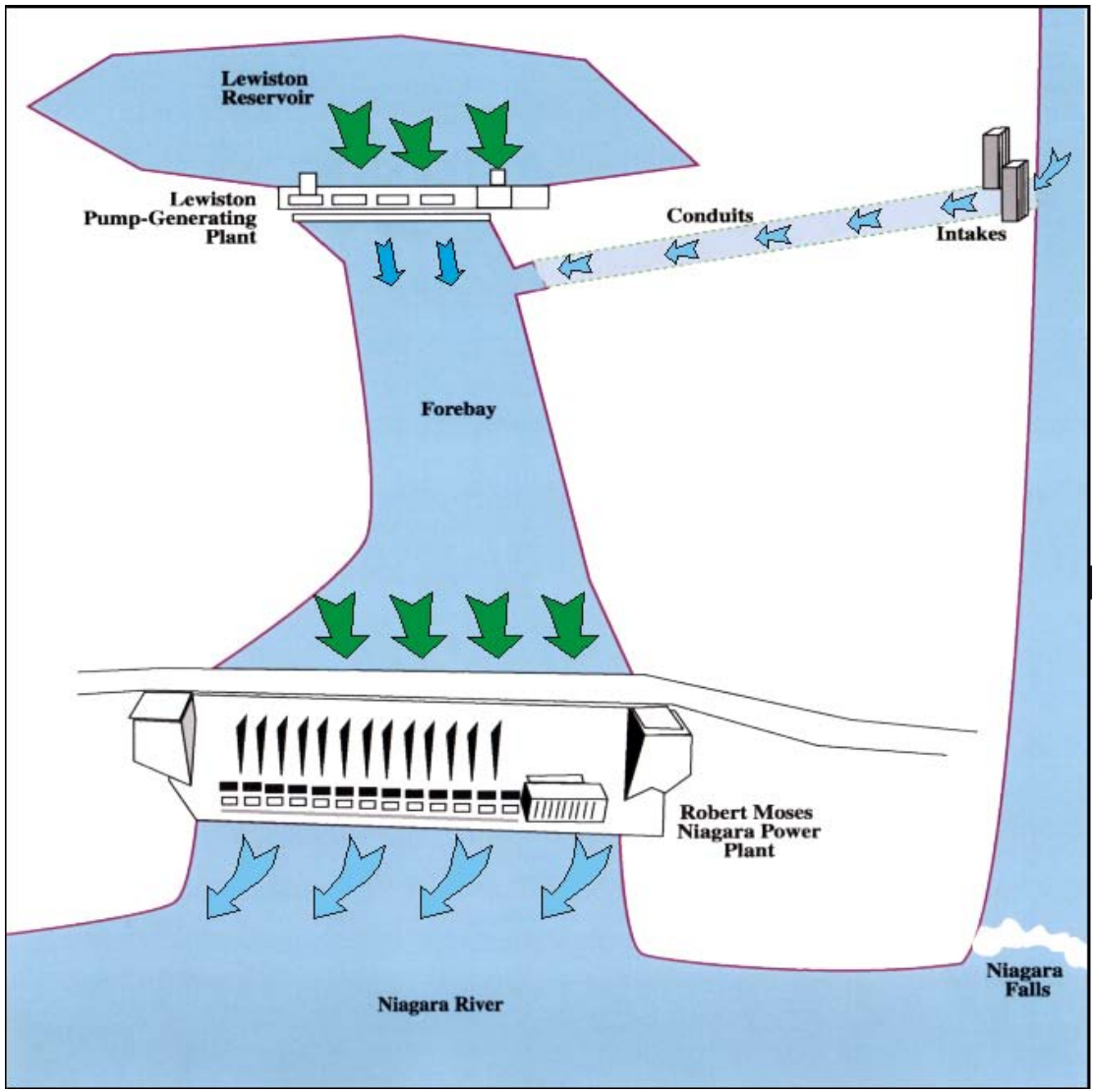

Water Flow During Peak Demand (Daytime)

- Power Being Generated
- Gravity Flow from River
- Tailwater to Forebay
- Tailwater to River

Figure 4.1-2

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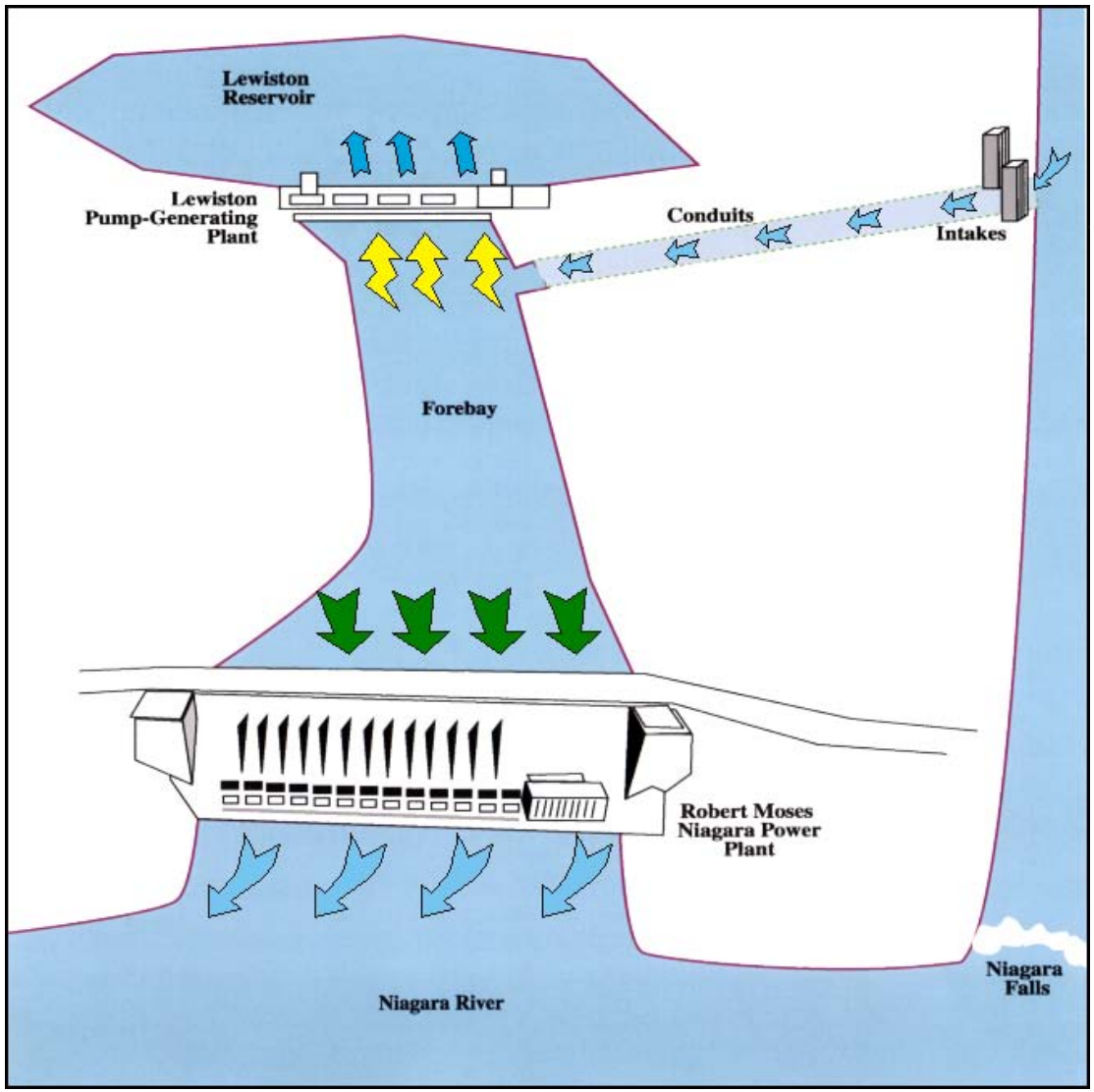

Water Flow During Off-Peak Demand (Nights & Weekends)

- Power Being Used to Pump Water Back into Reservoir
- Power Being Generated
- Gravity Flow from River
- Water Pumped to Reservoir
- Tailwater to River

Figure 4.1-3

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FIGURE 4.2-1

BATHYMETRIC MAP OF LEWISTON RESERVOIR

[NIP – General Location Maps]

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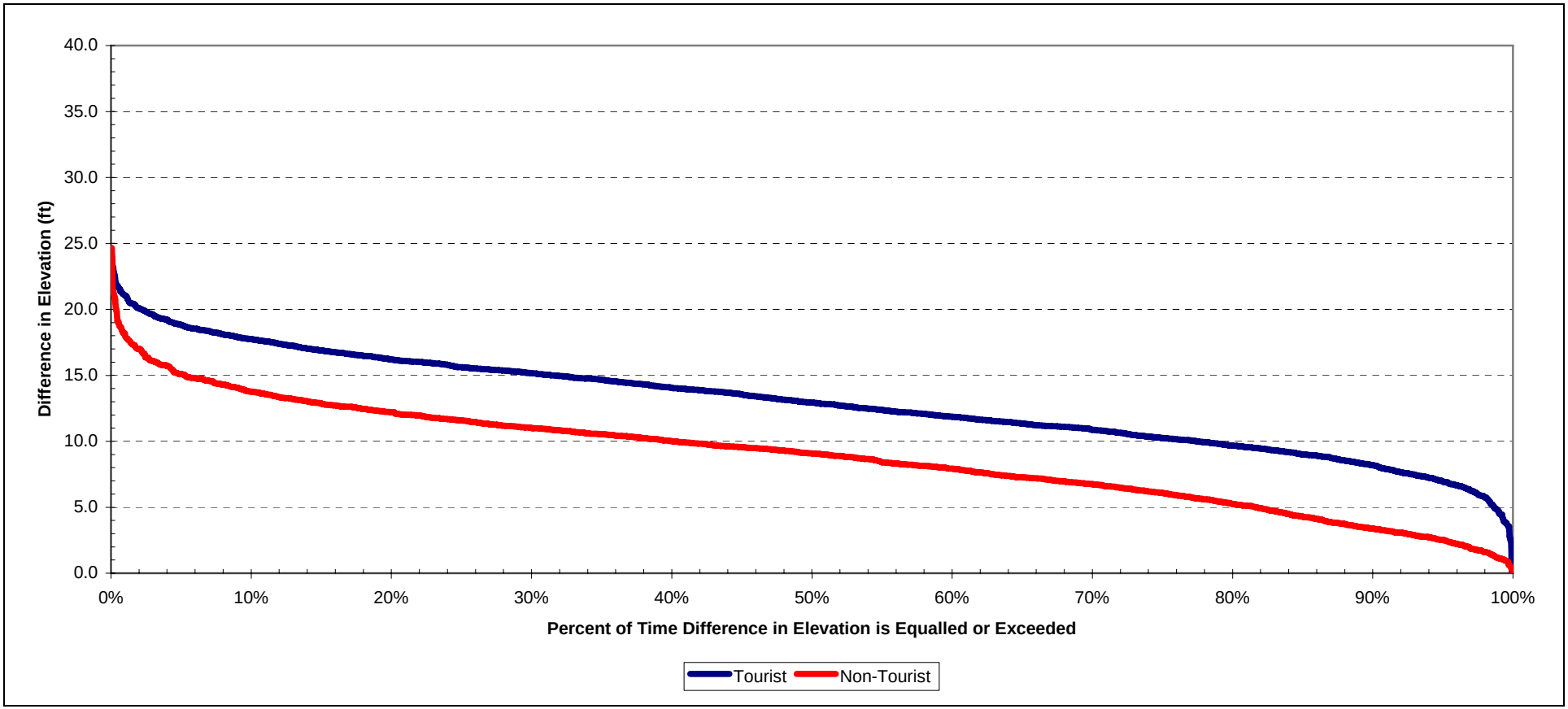
FIGURE 4.2-2

DAILY WATER LEVEL DURATION CURVES FOR THE LEWISTON RESERVOIR (1991-2002)



Source: URS et al. 2005

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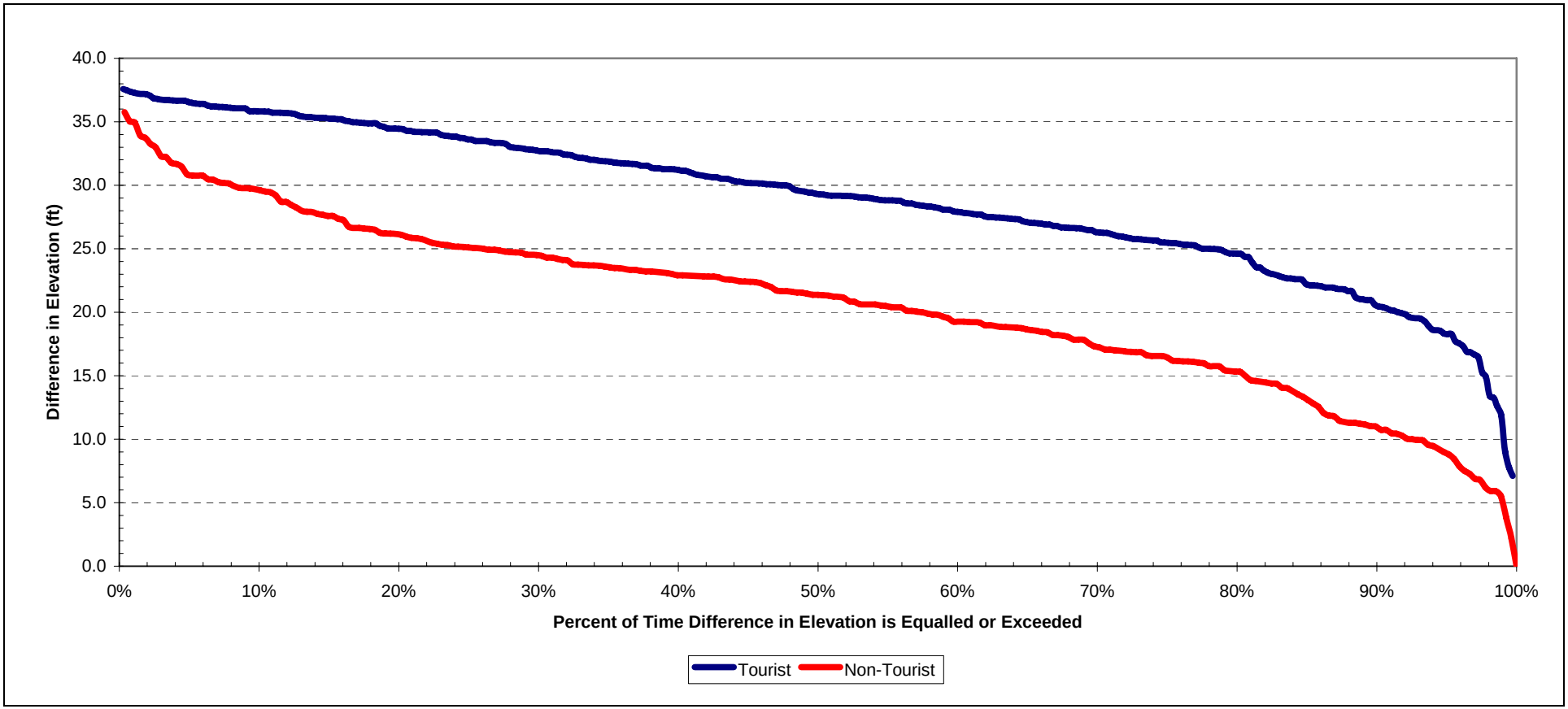
FIGURE 4.2-3

WEEKLY WATER LEVEL DURATION CURVES FOR THE LEWISTON RESERVOIR (1991-2002)



Source: URS et al. 2005

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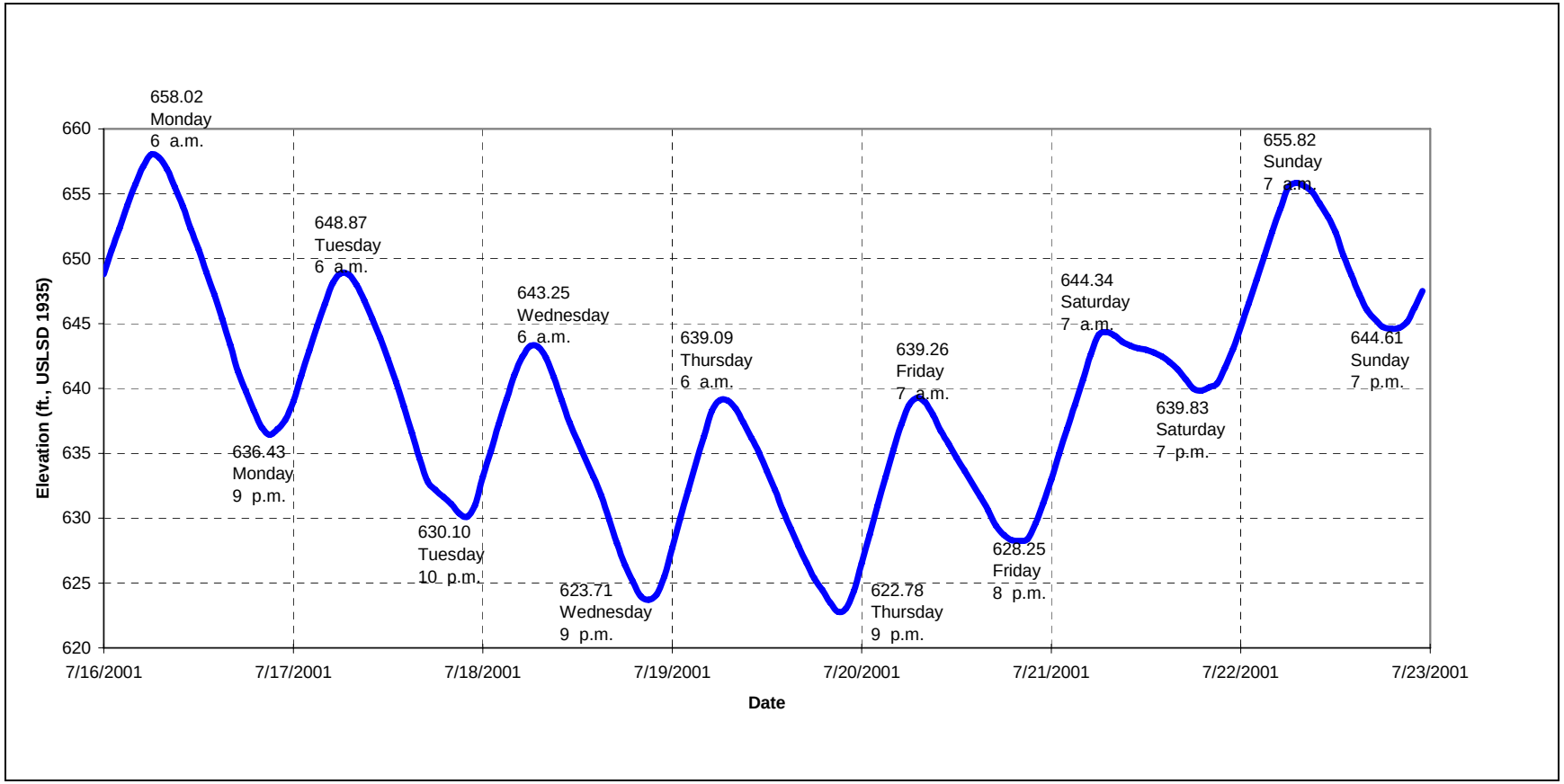
FIGURE 4.2-4

DAILY WATER LEVEL FLUCTUATIONS IN THE LEWISTON RESERVOIR FOR A WEEKLY PERIOD (JULY 16-22, 2001)



Source: URS et al. 2005

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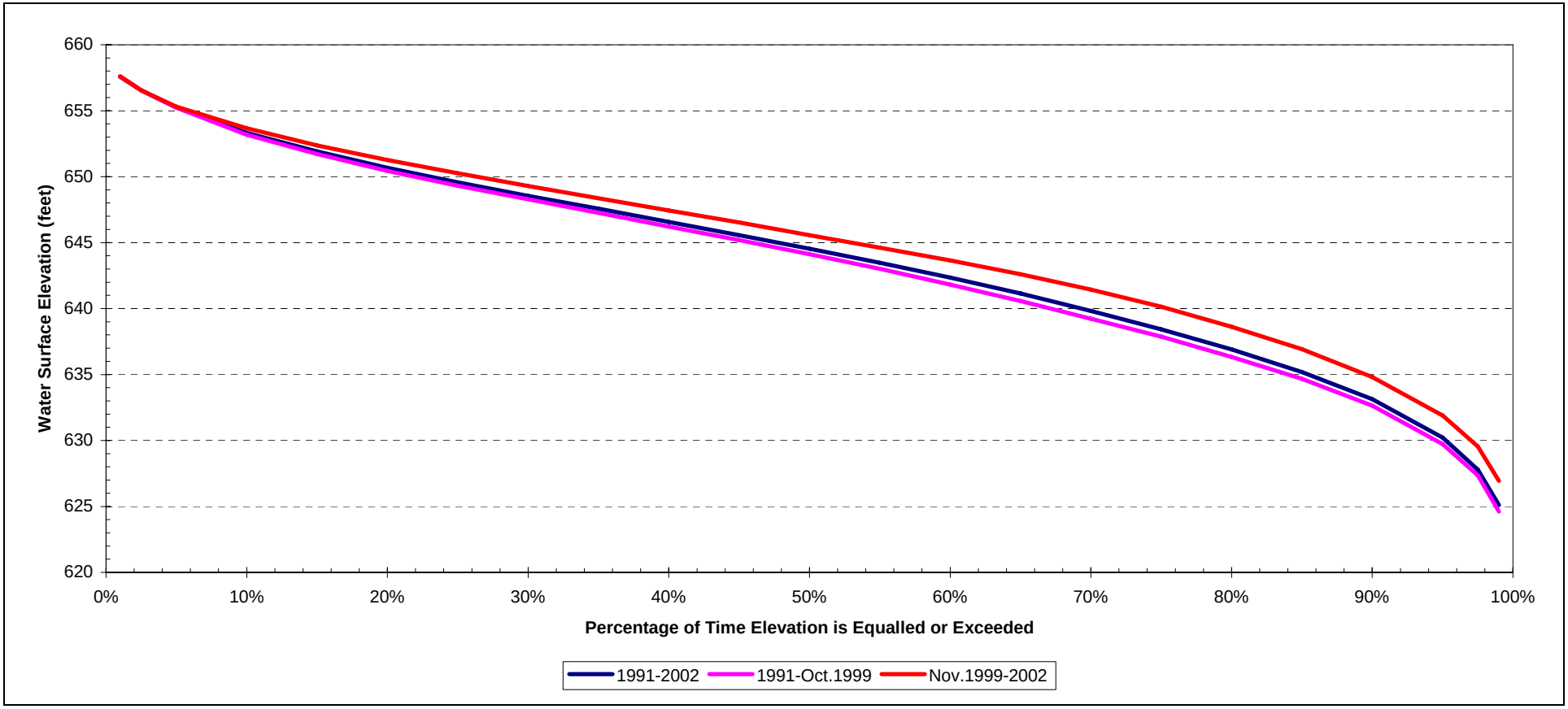
FIGURE 4.2-5

DAILY WATER LEVEL DURATION CURVES FOR THE LEWISTON RESERVOIR BEFORE AND AFTER NOVEMBER 1999



Source: URS et al. 2005

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FIGURE 4.2-6

SAMPLING COLLECTION ZONES IN THE LEWISTON RESERVOIR FOR THE 1982-83 AQUATIC ECOLOGY AND WATER QUALITY STUDY

[NIP – General Location Maps]

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FIGURE 4.4-1

EXTENT OF SEDIMENTATION IN THE LEWISTON RESERVOIR

[NIP – General Location Maps]

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FIGURE 4.5-1

SEDIMENT DEPTH CONTOURS AND SEDIMENT SAMPLING LOCATIONS, 2002

[NIP – General Location Maps]

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5.0 EVALUATION OF DRAWDOWN EFFECTS ON MERCURY BIOACCUMULATION IN LEWISTON RESERVOIR

In Section 3.0 of this report, a number of factors regarding the effects of drawdown on mercury characteristics of reservoirs were presented. In this section, we will summarize the factors presented in Section 2.0 and evaluate them as they relate to specific conditions in Lewiston Reservoir.

5.1 Hydraulic Residence Time

As indicated above, a short hydraulic residence time in a water body mitigates against the formation and accumulation of bioavailable mercury. Lewiston Reservoir has an extremely short hydraulic residence time. Up to 93% of the volume of the reservoir is exchanged on a weekly basis (URS et al. 2005). This rapid water exchange provides very little opportunity for methylation reactions to occur. The short hydraulic residence time for Lewiston Reservoir is likely the most important factor in regulating the formation and accumulation of bioavailable mercury in the reservoir.

Many of the processes that regulate the formation and accumulation of methylmercury are kinetic, or time-dependent processes. The shorter the residence time of a water body, the less impact in-situ methylation is able to have on the mercury characteristics of that water. Since the residence time of water within Lewiston Reservoir is so short, many of these processes do not have time to take place.

This applies to both chemical and physical processes. One of the factors considered that might lead to enhanced methylation was the possibility that water temperature would be elevated in the drawn-down reservoir, thus accelerating microbial activity and methylation. However, preliminary analyses of data collected by URS in 2003 indicate that the water temperatures in the reservoir are controlled by inputs from the Niagara River. The water stays in the reservoir for such a short amount of time that it apparently does not have the opportunity to warm and accelerate methylation.

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5.2 Organic Matter Content

A supply of organic matter is a pre-requisite for enhanced microbial activity and enhanced methylation. One of the significant features of Lewiston Reservoir that mitigates against increased microbial activity in response to drawdown is the nature of the substrate in the most frequently exposed parts of the drawdown zone. Much of the drawdown zone is covered in riprap and has very low organic matter content. Only the bottom sediments have significant organic content and only a portion of these sediments are exposed. Given that the factors regarding enhanced microbial and bacterial activity both depend on the breakdown of organic matter, minimal enhancement is likely in the low organic environment of Lewiston Reservoir. In addition, there is nothing to indicate that there is a significant supply of organic carbon to the riprap sediments that is being used to fuel microbial action. In terms of sulfate reduction, in order for sulfate reduction to occur, the essential ingredients are transitional oxic/anoxic conditions and the presence of sulfate and organic carbon. The low organic matter content of the riprap sediments minimizes the availability of one of these essential ingredients.

5.3 Lakewater pH and Dissolved Oxygen Concentration

In terms of changes in water quality characteristics as a consequence of drawdown and their subsequent impacts on mercury concentrations, there is no evidence that drawdown has any impact on pH. The observed pH in Lewiston Reservoir is near 8. Observations indicate that low pH increases methylation, so this high observed value likely inhibits methylation in comparison to lower pH waters. In terms of dissolved oxygen, data indicate that Lewiston Reservoir dissolved oxygen concentrations are typically high in both surface and deep waters. This reflects the influence of Niagara River inflows. Since water moves in and out of the reservoir so rapidly, there is not sufficient time or biological activity to support oxygen depletion. Since oxygen may directly inhibit methylation, water column methylation is unlikely in the reservoir.

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5.4 Transitional Oxic/Anoxic Conditions

Drawdown at Lewiston Reservoir will likely change the locations in the reservoir and sediments where transitional oxic/anoxic conditions exist. While the impact of this on microbial activity is likely minimized in the riprap zone due to the low organic matter content present, it could influence microbial activity in the sediments of the reservoir bottom, outside of the riprap zone. The reservoir bottom sediments have higher organic matter content than the riprap sediments, but most of the bottom sediments are permanently inundated. Drawdown will not have a significant impact on the bottom sediments that are permanently inundated. For the sections of the reservoir where bottom sediments are exposed, drawdown could potentially lead to shifts in transitional oxic/anoxic conditions and thus enhance methylation. As indicated above, sediments are exposed for approximately 17 hours per week. In addition, the rapid refilling of the reservoir following the period when sediments are exposed provides a significant diluting effect, so the impact of any enhanced methylation that may be occurring is minimized as a result of the way the reservoir is operated. There are currently no data to indicate whether there is indeed enhanced methylation due to the movement of transitional oxic/anoxic zones within Lewiston Reservoir. The one detectable aqueous methylmercury observation does not indicate that enhanced methylation is occurring.

5.5 Potential Mercury Migration with Reduced Iron

In periodically flooded soils, like those making-up the dikes surrounding Lewiston Reservoir, total mercury concentrations may more closely follow iron as opposed to organics. Reducing conditions in these types of soils allow for the mobilization of iron, which is precipitated when it reaches an oxidizing environment. It is thought that mercury is associated with the iron under these reducing conditions. However, much of the mercury mobilized under these conditions is thought to be scavenged by organics and thus does not enter the water column. If this mechanism is active in Lewiston Reservoir, the low organic content of sediments in the drawdown zone may allow more of the mercury mobilized by this process to enter the water column. However, no data are available to indicate whether or not this is indeed occurring. In addition, the volume of water associated with the draining of the water in the dikes is miniscule compared with the flows from the Niagara River.

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6.0 SUMMARY AND CONCLUSIONS

The impact of drawdown on bioaccumulation of mercury in reservoirs is an area of active research. Several factors have been put forth in the literature related to mercury bioaccumulation in reservoirs, but some gaps in our understanding of the relevant processes still exist. Factors presented include the following:

- Hydraulic retention time
- Organic matter content
- Lakewater pH
- Dissolved oxygen concentration
- Transitional oxic/anoxic conditions
- Potential mercury migration with reduced iron
- Water temperature effects

These factors have been evaluated taking into consideration the unique characteristics of Lewiston Reservoir. Conclusions that can be drawn include the following.

The short hydraulic residence time of water in the Lewiston Reservoir plays a critical role in mitigating the formation of methylmercury. Nearly the entire volume of the reservoir can be exchanged on a weekly basis. Many of the processes that regulate the formation and accumulation of methylmercury

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are kinetic, or time-dependent processes. The shorter the residence time of a water body, the less impact in-situ methylation is able to have on the mercury characteristics of that water. Since the residence time of water within Lewiston Reservoir is so short, many of these processes do not have time to take place. This applies to both chemical and physical processes. One of the factors considered that might lead to enhanced methylation was the possibility that water temperature would be elevated in the drawn-down reservoir, thus accelerating microbial activity and methylation. However, data indicate that the water temperatures are controlled by inputs from the Niagara River. The water stays in the reservoir for such a short amount of time it does not have the opportunity to warm and accelerate methylation.

A supply of organic matter is a pre-requisite for enhanced microbial activity and enhanced methylation. The vast majority of the drawdown zone in Lewiston Reservoir is made up of riprap and has very low organic matter content. There is nothing to indicate that there is a significant supply rate of organic carbon to the riprap sediments that is being used to fuel microbial action. This riprap material is not conducive to supporting enhanced methylation.

In addition, the surface water pH in the reservoir is near 8. Methylation is enhanced in low-pH waters.

The available data also suggest that the dissolved oxygen concentration in the reservoir is relatively high both at the surface and at depth. Methylation occurs in low-oxygen environments, and thus water column methylation is unlikely in Lewiston Reservoir, although sediment methylation is still possible. There are some characteristics of Lewiston Reservoir that suggest it may be susceptible to enhanced methylation and/or accumulation of bioavailable mercury. Methylmercury is formed in zones where water shifts from oxygenated (or oxic) conditions to deoxygenated (or anoxic) conditions due to physical impediments to the movement of oxygen and\or biological activity. Drawdown has the potential to create zones within the reservoir favoring the formation of bioavailable mercury under transitional oxic/anoxic conditions, especially in the portions of the reservoir where bottom sediments are often exposed. This can be related to changes in microbial activity or changing speciation of sulfur, which then stimulates methylation. There are no data to suggest that this is indeed happening, but neither are there data to refute it. Finally, the presence of periodically flooded soils in the drawdown zone creates the

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potential for mercury migration from the riprap material forming the dikes along with reduced iron, although this potential is very small. Based on observed physical and chemical characteristics, it seems unlikely that drawdown would be a significant factor in enhancing the bioaccumulation of mercury by fish in Lewiston Reservoir. Aqueous sampling in the reservoir indicated that most samples had concentrations below detection levels, and that the one sample with detectable methylmercury had a very low concentration. Although there is very little aqueous phase mercury data available, what is available supports the conclusion that Lewiston Reservoir is not a site of enhanced methylation.

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APPENDICES

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APPENDIX A – WATER QUALITY DATA FROM THE LEWISTON RESERVOIR FROM IN-SITU MEASUREMENTS TAKEN AS PART OF THE AQUATIC ECOLOGY AND WATER QUALITY STUDY, 1982-83

Sampling Date	Depth	Zone	Water Temp. (C)	D.O. (mg/L)	Cond. (µmhos)	pH (S.U.)	Secchi Disk Depth (m)
11/17/82	Surface	1	8.3	10.9	200	7.7	1.5
11/17/82	Mid	1	8.5	9.6	200	7.7	-
11/17/82	Bottom	1	8.5	9.8	210	7.7	-
11/17/82	Surface	2	8.5	11.2	205	7.7	1.8
11/17/82	Mid	2	8.5	10.8	205	7.7	-
11/17/82	Bottom	2	8.8	10.7	205	7.7	-
11/17/82	Surface	3	8.6	11.2	205	7.7	1.9
11/17/82	Mid	3	8.5	11	205	7.7	-
11/17/82	Bottom	3	8.5	10.8	205	7.7	-
11/18/82	Surface	1	9.5	11	250	7.1	1
11/18/82	Mid	1	9.3	10.8	255	7.4	-
11/18/82	Bottom	1	9.3	10.6	260	7.4	-
11/18/82	Surface	2	9.4	11.7	220	7.4	1.4
11/18/82	Mid	2	9.4	11.3	220	7.2	-
11/18/82	Bottom	2	9.3	11.1	220	7.2	-
11/18/82	Surface	3	8.5	11.6	220	7.3	2.4
11/18/82	Mid	3	8.5	11.2	215	7.3	-
11/18/82	Bottom	3	8.3	11	218	7.3	-
11/18/82	Surface	4	8.5	11.8	215	7.3	1.9
11/18/82	Mid	4	8.5	11.4	215	7.4	-
11/18/82	Bottom	4	8.5	11.1	215	7.4	-
11/18/82	Surface	5	8.9	11.9	210	7.4	1.9
11/18/82	Mid	5	8.5	10.5	210	7.4	-
11/18/82	Bottom	5	8.5	10.2	210	7.4	-
11/18/82	Surface	6	8.9	11.7	210	7.3	1.9
11/18/82	Mid	6	8.3	11.4	210	7.3	-
11/18/82	Bottom	6	8.3	10.8	210	7.3	-
11/18/82	Surface	7	9.5	11.4	205	7.2	1.5
11/18/82	Mid	7	9.1	11.1	205	7.3	-
11/18/82	Bottom	7	9.1	11.2	210	7.4	-
11/18/82	Surface	8	9.1	11.9	225	7.5	1.3

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APPENDIX A (CONT.) – WATER QUALITY DATA FROM THE LEWISTON RESERVOIR FROM IN-SITU MEASUREMENTS TAKEN AS PART OF THE AQUATIC ECOLOGY AND WATER QUALITY STUDY, 1982-83

Sampling Date	Depth	Zone	Water Temp. (C)	D.O. (mg/L)	Cond. (µmhos)	pH (S.U.)	Secchi Disk Depth (m)
11/18/82	Mid	8	9	11.2	220	7.4	-
11/18/82	Bottom	8	9	10.2	225	7.3	-
11/19/82	Surface	2	8.8	11.4	210	7.8	1.7
11/19/82	Surface	4	9	11.8	240	7.9	1.7
11/19/82	Surface	5	8.5	11.4	220	7.8	1.1
11/19/82	Mid	5	8.5	11.2	220	7.8	-
11/19/82	Bottom	5	8.5	11	220	7.8	-
11/19/82	Surface	6	8.5	11.4	220	7.8	1.1
11/19/82	Mid	6	8.5	11.2	220	7.8	-
11/19/82	Bottom	6	8.5	11	220	7.8	-
11/19/82	Surface	7	8.5	11.2	218	7.8	1.5
11/19/82	Mid	7	8.5	11.1	220	7.8	-
11/19/82	Bottom	7	8.5	11	220	7.8	-
11/19/82	Surface	8	8.8	11.4	210	7.8	1.7
11/19/82	Mid	8	8.8	11.2	210	7.8	-
11/19/82	Bottom	8	8.8	11	210	7.8	-
11/22/82	Surface	1	9	11.4	280	7.3	-
11/22/82	Mid	1	9	11.2	280	7.5	-
11/22/82	Bottom	1	9	11.2	280	7.5	-
11/22/82	Surface	4	9.5	10.9	280	7.3	-
11/22/82	Mid	4	9.5	10.9	280	7.3	-
11/22/82	Bottom	4	9.5	10.4	285	7.8	-
11/22/82	Surface	7	9	10.9	280	7.1	-
11/22/82	Mid	7	9	10.4	280	7.1	-
11/22/82	Bottom	7	9	10.4	280	7.1	-
11/22/82	Surface	8	9	11	280	7.3	-
11/22/82	Mid	8	9	10.8	280	7.3	-
11/22/82	Bottom	8	9	10.8	280	7.8	-
11/23/82	Surface	2	9	11.2	235	7.3	2.2
11/23/82	Mid	2	9	11	235	7.3	-
11/23/82	Bottom	2	9	10.8	235	7.3	-

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APPENDIX A (CONT.) – WATER QUALITY DATA FROM THE LEWISTON RESERVOIR FROM IN-SITU MEASUREMENTS TAKEN AS PART OF THE AQUATIC ECOLOGY AND WATER QUALITY STUDY, 1982-83

Sampling Date	Depth	Zone	Water Temp. (C)	D.O. (mg/L)	Cond. (µmhos)	pH (S.U.)	Secchi Disk Depth (m)
11/23/82	Mid	4	9	10.8	390	7.4	-
11/23/82	Bottom	4	9	9.8	390	7.4	-
11/23/82	Surface	5	9	10.8	390	7.2	2.2
11/23/82	Mid	5	9	10.4	390	7.2	-
11/23/82	Bottom	5	9	10.4	390	7.2	-
11/23/82	Surface	6	9	11.2	350	7.4	2.2
11/23/82	Mid	6	9	11	355	7.4	-
11/23/82	Bottom	6	9	10.9	355	7.4	-
11/23/82	Surface	7	9	11.4	340	7.2	2.2
11/23/82	Mid	7	9	11.1	340	7.2	-
11/23/82	Bottom	7	9	10.9	340	7.2	-
11/23/82	Surface	8	9	11.1	260	7.4	2.2
11/23/82	Mid	8	9	11	270	7.4	-
11/23/82	Bottom	8	9	10.8	265	7.4	-
5/11/83	Surface	2	11.7	11.5	266	8	2.1
5/11/83	Mid	2	9.4	11.2	264	8.2	-
5/11/83	Bottom	2	11.1	9.7	251	8.2	-
5/11/83	Surface	3	12	11.5	286	8	2.1
5/11/83	Mid	3	10.3	10.6	302	8.3	-
5/11/83	Bottom	3	11.8	9.4	294	8.2	-
5/11/83	Surface	7	12.3	11.4	318	7.8	1.9
5/11/83	Mid	7	11.9	10.8	319	8.1	-
5/11/83	Bottom	7	10.3	10.4	325	8.2	-
5/11/83	Surface	8	10.8	11.5	317	8.2	1.9
5/11/83	Mid	8	10.5	11.1	316	8.3	-
5/11/83	Bottom	8	9.9	10.8	319	8.3	-
5/13/83	Surface	1	12.1	12	268	8.1	1.9
5/13/83	Mid	1	12.2	11.5	268	8.1	-
5/13/83	Bottom	1	12	11.4	267	8.2	-
5/13/83	Surface	2	12.8	12.3	268	8	1.9
5/13/83	Mid	2	12.5	11.3	268	8.2	-

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APPENDIX A (CONT.) – WATER QUALITY DATA FROM THE LEWISTON RESERVOIR FROM IN-SITU MEASUREMENTS TAKEN AS PART OF THE AQUATIC ECOLOGY AND WATER QUALITY STUDY, 1982-83

Sampling Date	Depth	Zone	Water Temp. (C)	D.O. (mg/L)	Cond. (µmhos)	pH (S.U.)	Secchi Disk Depth (m)
5/13/83	Surface	3	12.2	12.5	214	8	1.9
5/13/83	Mid	3	12.1	12	215	8.3	-
5/13/83	Bottom	3	10.3	8.2	215	-	-
5/13/83	Surface	4	10.8	12.2	266	8	1.9
5/13/83	Mid	4	10	11.3	266	8.3	-
5/13/83	Bottom	4	9.8	10.7	266	8.1	-
5/13/83	Surface	5	10.9	12.2	266	8.2	1.9
5/13/83	Mid	5	10.2	11.3	265	8.3	-
5/13/83	Bottom	5	9.8	10.9	266	8.3	-
5/13/83	Surface	6	12.1	12.2	267	8	1.9
5/13/83	Mid	6	12	11.7	267	8.1	-
5/13/83	Bottom	6	11.9	11.6	266	8.1	-
5/13/83	Surface	7	12.2	12	265	8.1	1.9
5/13/83	Mid	7	12	11.7	267	8.2	-
5/13/83	Bottom	7	11.3	11.5	265	8.3	-
5/13/83	Surface	8	11.6	12	266	8	1.9
5/13/83	Mid	8	10.9	11.6	266	8.3	-
5/13/83	Bottom	8	10.3	11.4	265	8.3	-
5/14/83	Surface	5	12.3	12	267	8	-
5/14/83	Mid	5	1.7	11.5	266	8.3	-
5/14/83	Bottom	5	10.5	11.2	268	8.1	-
5/14/83	Surface	6	12.4	12	224	8	-
5/14/83	Mid	6	10.7	12.1	263	8.5	-
5/14/83	Bottom	6	10.6	11.9	263	8.5	-
5/14/83	Surface	8	11.4	12.7	265	8	-
5/14/83	Mid	8	10.4	11.6	263	8.1	-
5/14/83	Bottom	8	10.2	11.8	265	8.2	-
5/16/83	Surface	6	10.8	12	269	8.3	2.1
5/16/83	Mid	6	10.8	11.6	269	8.2	-
5/16/83	Bottom	6	10.8	11.6	268	8.2	-
5/16/83	Surface	7	10.7	12	270	7.9	2

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APPENDIX A (CONT.) – WATER QUALITY DATA FROM THE LEWISTON RESERVOIR FROM IN-SITU MEASUREMENTS TAKEN AS PART OF THE AQUATIC ECOLOGY AND WATER QUALITY STUDY, 1982-83

Sampling Date	Depth	Zone	Water Temp. (C)	D.O. (mg/L)	Cond. (µmhos)	pH (S.U.)	Secchi Disk Depth (m)
5/16/83	Bottom	7	11.2	11	264	8	-
5/17/83	Surface	4	11	12	271	7.9	2.1
5/17/83	Mid	4	10.7	11.5	270	8.2	-
5/17/83	Bottom	4	10.4	11.1	268	8.1	-
5/17/83	Surface	5	10.9	11.8	271	8	2.1
5/17/83	Mid	5	10.5	11.3	269	8.1	-
5/17/83	Bottom	5	10.4	11.2	268	8.1	-
5/17/83	Surface	6	10.7	11.9	270	8	2.1
5/17/83	Mid	6	10.4	11.3	269	8.2	-
5/17/83	Bottom	6	10.4	11	268	8.2	-
5/17/83	Surface	7	10.8	11.8	272	7.9	2.1
5/17/83	Mid	7	10.4	11.5	272	8.1	-
5/17/83	Bottom	7	10.4	11.6	271	8.1	-
5/17/83	Surface	8	11.1	12	271	8.1	2.3
5/17/83	Mid	8	10.5	11.5	268	8.3	-
5/17/83	Bottom	8	10.4	10.6	265	8.2	-
6/15/83	Surface	1	17.5	10.4	234	7.6	2.5
6/15/83	Mid	1	17.2	10.4	231	7.6	-
6/15/83	Bottom	1	16.4	10.3	219	7.7	-
6/15/83	Surface	7	19	10.5	238	7.6	2.5
6/15/83	Mid	7	17.5	10.8	227	7.6	-
6/15/83	Bottom	7	17	10.6	219	7.6	-
6/16/83	Surface	5	19.7	9.9	252	7.7	2.5
6/16/83	Mid	5	19.1	10	258	7.6	-
6/16/83	Bottom	5	18.1	10	248	7.6	-
6/16/83	Surface	6	19.6	10.4	249	7.7	3
6/16/83	Mid	6	18.9	10.4	249	7.7	-
6/16/83	Bottom	6	18.3	10.3	249	7.8	-
6/16/1983	Surface	1	19	11.7	241	7.9	-
6/16/1983	Surface	2	18.9	11.8	241	7.6	-
6/16/1983	Surface	3	20.9	11.3	253	7.6	-
6/16/1983							

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APPENDIX A (CONT.) – WATER QUALITY DATA FROM THE LEWISTON RESERVOIR FROM IN-SITU MEASUREMENTS TAKEN AS PART OF THE AQUATIC ECOLOGY AND WATER QUALITY STUDY, 1982-83

Sampling Date	Depth	Zone	Water Temp. (C)	D.O. (mg/L)	Cond. (µmhos)	pH (S.U.)	Secchi Disk Depth (m)
6/16/1983	Surface	5	20.3	13.1	246	7.5	-
6/16/1983	Surface	6	19.2	13.2	242	7.6	-
6/16/1983	Surface	7	19.1	13.4	240	7.7	-
6/16/1983	Surface	8	20.5	11.4	240	7.6	-
6/17/83	Surface	4	21.3	11.6	251	7.8	2.5
6/17/83	Surface	5	21.3	11	249	8	3
6/17/83	Mid	5	21.2	10.8	259	8	-
6/17/83	Bottom	5	18.1	10.9	244	8	-
7/12/83	Mid	1	20.6	12.3	268	7.7	3.5
7/12/83	Surface	2	21.4	12.2	299	7.7	3.5
7/12/83	Mid	2	20.7	11.9	299	7.7	-
7/12/83	Bottom	2	20.4	11.7	300	7.7	-
7/12/83	Surface	4	21.3	12.5	291	7.5	3.5
7/12/83	Mid	4	21	12.1	298	7.8	-
7/12/83	Bottom	4	20.8	11.9	298	7.8	-
7/12/83	Surface	7	21	13	283	7.6	3.5
7/12/83	Mid	7	20.8	12.2	284	7.6	-
7/12/83	Bottom	7	20.5	11.7	282	7.8	-
7/12/83	Surface	8	21.1	12.6	289	7.8	3.5
7/12/83	Mid	8	20.7	12	288	7.8	-
7/12/83	Bottom	8	20.3	11.6	293	7.8	-
7/13-14/83	Surface	1	21.8	11.2	291	7.8	-
7/13-14/83	Surface	2	22.2	11.4	303	7.8	-
7/13-14/83	Surface	3	22.4	11	309	7.7	-
7/13-14/83	Surface	4	21.9	10.8	305	7.6	-
7/13-14/83	Surface	5	21.4	10.8	299	7.7	-
7/13-14/83	Surface	6	21.2	11.5	295	7.7	-
7/13-14/83	Surface	7	21.2	11.6	293	7.8	-
7/13-14/83	Surface	8	21.3	10.6	303	7.6	-
7/13-14/83	Mid	8	21.3	10.6	301	7.7	-
7/13-14/83	Bottom	8	21.5	10.6	296	7.7	-

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APPENDIX A (CONT.) – WATER QUALITY DATA FROM THE LEWISTON RESERVOIR FROM IN-SITU MEASUREMENTS TAKEN AS PART OF THE AQUATIC ECOLOGY AND WATER QUALITY STUDY, 1982-83

Sampling Date	Depth	Zone	Water Temp. (C)	D.O. (mg/L)	Cond. (µmhos)	pH (S.U.)	Secchi Disk Depth (m)
7/14/83	Mid	4	22.3	11.5	308	7.8	4
7/14/83	Surface	7	22.5	11.4	303	7.8	3.5
7/14/83	Mid	7	21.8	11.2	302	7.8	-
7/14/83	Bottom	7	21.6	11.2	307	7.8	-
7/14/83	Mid	8	22.1	11.4	300	7.8	3.7
7/14-15/83	Surface	1	22.1	9.2	309	-	-
7/14-15/83	Surface	2	21.9	9.9	310	7.6	-
7/14-15/83	Surface	3	22.4	10	311	7.7	-
7/14-15/83	Surface	4	22.6	9.6	315	7.8	-
7/14-15/83	Surface	5	22.1	9.3	311	7.5	-
7/14-15/83	Surface	6	21.7	9	309	7.4	-
7/14-15/83	Surface	7	21.7	9.8	303	7.4	-
7/14-15/83	Surface	8	21.9	9.5	309	-	-
7/14-15/83	Mid	8	21.9	9.5	320	-	-
7/14-15/83	Bottom	8	21.9	9.5	319	-	-
7/16/83	Surface	1	24.1	10.8	353	7.9	2.5
7/16/83	Mid	1	23.3	10.7	356	7.8	-
7/16/83	Bottom	1	22.8	10.2	357	7.7	-
7/16/83	Surface	7	23.3	10.7	347	8.1	2.5
7/16/83	Mid	7	23	10.7	358	7.8	-
7/16/83	Bottom	7	22.5	10.3	359	7.8	-
7/17/83	Surface	2	25	11.6	359	7.8	3
7/17/83	Mid	2	24.3	12.1	376	7.8	-
7/17/83	Bottom	2	23.1	10.3	361	7.7	-
7/17/83	Surface	3	25.1	11.8	368	7.8	3
7/17/83	Mid	3	23.4	10.9	370	-	-
7/17/83	Bottom	3	23	10.4	373	7.6	-
7/18/83	Surface	2	25.3	11.1	369	7.9	3
7/18/83	Mid	2	23.4	9.8	373	7.6	-
7/18/83	Bottom	2	23.1	9.3	382	7.5	-
7/18/83	Surface	3	25.2	10.8	378	7.7	3

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APPENDIX A (CONT.) – WATER QUALITY DATA FROM THE LEWISTON RESERVOIR FROM IN-SITU MEASUREMENTS TAKEN AS PART OF THE AQUATIC ECOLOGY AND WATER QUALITY STUDY, 1982-83

Sampling Date	Depth	Zone	Water Temp. (C)	D.O. (mg/L)	Cond. (µmhos)	pH (S.U.)	Secchi Disk Depth (m)
7/18/83	Bottom	3	23.1	9.2	384	7.5	-
7/18/83	Surface	4	26.7	10.8	386	7.7	3
7/18/83	Mid	4	23.8	10.6	374	7.7	-
7/18/83	Bottom	4	23.3	9.9	381	7.6	-
7/18-19/83	Surface	1	23.1	9.1	351	7.7	-
7/18-19/83	Surface	2	23.1	9.8	357	7.5	-
7/18-19/83	Mid	2	22.9	8.7	368	7.5	-
7/18-19/83	Bottom	2	22.6	7.5	378	7.4	-
7/18-19/83	Surface	3	24.3	10.6	360	7.8	-
7/18-19/83	Surface	4	24.5	10.2	361	7.8	-
7/18-19/83	Mid	4	24.4	10.4	370	7.9	-
7/18-19/83	Bottom	4	24.2	10.4	377	7.7	-
7/18-19/83	Surface	5	24.8	10.3	364	7.9	-
7/18-19/83	Surface	6	23.1	9	358	7.7	-
7/18-19/83	Surface	7	23.1	9.2	351	7.6	-
7/18-19/83	Mid	7	23.1	8.8	363	7.6	-
7/18-19/83	Bottom	7	23.1	8.7	370	7.6	-
7/18-19/83	Surface	8	23.3	9.7	359	7.7	-
7/18-19/83	Mid	8	23.3	9.6	367	7.8	-
7/18-19/83	Bottom	8	22.9	7.9	375	7.5	-
7/19/83	Surface	4	24.2	10.6	360	7.7	3
7/19/83	Mid	4	23.6	10.6	362	7.6	-
7/19/83	Bottom	4	23.1	8.5	369	7.4	-
7/19/83	Surface	5	24.6	11.8	360	7.9	3
7/19/83	Mid	5	23.6	10.4	365	7.6	-
7/19/83	Bottom	5	23.2	8.6	370	7.4	-
7/19/83	Surface	6	24.9	11.9	363	7.9	3
7/19/83	Mid	6	24.1	11.6	369	7.9	-
7/19/83	Bottom	6	23.2	8.9	370	7.7	-
7/20/83	Surface	2	23.6	9.4	368	7.6	2.5
7/20/83	Mid	2	23.5	9.3	366	7.5	-

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APPENDIX A (CONT.) – WATER QUALITY DATA FROM THE LEWISTON RESERVOIR FROM IN-SITU MEASUREMENTS TAKEN AS PART OF THE AQUATIC ECOLOGY AND WATER QUALITY STUDY, 1982-83

Sampling Date	Depth	Zone	Water Temp. (C)	D.O. (mg/L)	Cond. (µmhos)	pH (S.U.)	Secchi Disk Depth (m)
7/20/83	Surface	4	24.3	10.2	354	7.8	3.3
7/20/83	Mid	4	23.7	10	364	7.7	-
7/20/83	Bottom	4	23.3	9.6	370	7.6	-
7/20/83	Surface	5	24.6	10.5	356	7.8	3.5
7/20/83	Mid	5	23.9	10.5	368	7.7	-
7/20/83	Bottom	5	23.7	10.5	374	7.6	-
7/20/83	Surface	6	24.3	10.6	366	7.8	3.8
7/20/83	Mid	6	23.7	10.7	368	7.8	-
7/20/83	Bottom	6	23.5	10.5	373	7.4	-
7/20/83	Surface	7	24.7	10.6	361	7.8	4
7/20/83	Mid	7	23.9	10.8	368	7.8	-
7/20/83	Bottom	7	23.7	10.6	373	7.9	-
7/20/83	Surface	8	24.3	10.4	363	7.8	3.4
7/20/83	Mid	8	23.6	9.1	371	7.7	-
7/20/83	Bottom	8	23.3	8.6	378	7.5	-
7/21/83	Surface	2	24.3	10.6	368	7.6	3
7/21/83	Mid	2	23.4	9.4	360	7.5	-
7/21/83	Bottom	2	23.4	8.7	374	7.4	-
7/21/83	Surface	3	24.3	10.2	355	7.8	2.8
7/21/83	Mid	3	24.2	10.4	363	7.7	-
7/21/83	Bottom	3	23.9	9.7	369	7.5	-
7/21/83	Surface	4	24.5	10.4	359	7.8	3.2
7/21/83	Mid	4	24.3	10.6	367	7.8	-
7/21/83	Bottom	4	23.9	10.3	372	7.4	-
7/21/83	Surface	5	24.3	10.4	349	7.8	2.8
7/21/83	Mid	5	24	9.8	361	7.8	-
7/21/83	Bottom	5	23.7	9.2	370	7.7	-
7/21/83	Surface	6	23.9	9.7	353	7.7	2.9
7/21/83	Mid	6	23.7	9	362	7.6	-
7/21/83	Bottom	6	23.5	8.6	371	7.5	-
7/21/83	Surface	8	24.3	10.5	363	7.6	2.6

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APPENDIX A (CONT.) – WATER QUALITY DATA FROM THE LEWISTON RESERVOIR FROM IN-SITU MEASUREMENTS TAKEN AS PART OF THE AQUATIC ECOLOGY AND WATER QUALITY STUDY, 1982-83

Sampling Date	Depth	Zone	Water Temp. (C)	D.O. (mg/L)	Cond. (µmhos)	pH (S.U.)	Secchi Disk Depth (m)
7/21/83	Bottom	8	23.4	8.7	378	7.5	-
8/17/83	Surface	1	23.6	9.5	265	7.8	-
8/17/83	Surface	2	23.4	8.7	266	8	-
8/17/83	Surface	3	23.7	9.9	270	7.6	-
8/17/83	Surface	4	24	10.3	270	7.9	-
8/17/83	Surface	5	23.8	9.7	269	7.9	-
8/17/83	Surface	6	23.6	9.4	269	7.7	-
8/17/83	Surface	7	23.6	9.5	269	7.7	-
8/17/83	Surface	8	23.4	8.6	269	7.5	-

Source: Ecological Analysts 1984a

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APPENDIX B – WATER QUALITY DATA FOR THE LEWISTON RESERVOIR FROM LABORATORY SAMPLES COLLECTED AS PART OF THE AQUATIC ECOLOGY AND WATER QUALITY STUDY, 1982-83

Sampling Date	Depth	Zone	Total Alk. (mg/L)	NH3-N (mg/L)	NO3-N (mg/L)	Tot. P (mg/L)	PO4 (mg/L)	Total Dis. Solids (mg/L)	Susp. Sed. (mg/L)	Turb. (NTUs)	Chl a (ug/L)	Ferrous Iron (mg/L)	Water Temp. (C)	D.O. (mg/L)	Cond. (umhos)	pH (S.U.)	Secchi Disk Depth (m)
Minimum Pool																	
11/18/82	Surface	1	97	<0.01	0.24	<0.1	<0.01	-	2	6	-	-	9.5	11	250	7.1	1
11/18/82	Mid	1	97	0.04	0.3	<0.1	<0.01	-	31	15	-	-	9.3	10.8	255	7.4	-
11/18/82	Bottom	1	102	0.13	0.28	<0.1	<0.01	-	5.5	6	-	-	9.3	10.6	260	7.4	-
11/18/82	Surface	4	99	0.04	0.25	<0.1	<0.01	-	1.5	4	-	-	8.5	11.8	215	7.3	1.9
11/18/82	Mid	4	99	0.15	0.26	<0.1	<0.01	-	3	4	-	-	8.5	11.4	215	7.4	-
11/18/82	Bottom	4	96	<0.01	0.26	<0.1	<0.01	-	0.5	4	-	-	8.5	11.1	215	7.4	-
11/18/82	Surface	7	97	0.13	0.27	<0.1	<0.01	-	2.5	5	-	-	9.5	11.4	205	7.2	1.5
11/18/82	Mid	7	96	<0.01	0.23	<0.1	<0.01	-	2	5	-	-	9.1	11.1	205	7.3	-
11/18/82	Bottom	7	97	<0.01	0.27	<0.1	<0.01	-	3	6	-	-	9.1	11.2	210	7.4	-
11/18/82	Surface	8	97	<0.01	0.26	<0.1	<0.01	-	8	6	-	-	9.1	11.9	225	7.5	1.3
11/18/82	Mid	8	96	<0.01	0.28	<0.1	<0.01	-	4	6	-	-	9	11.2	220	7.4	-
11/18/82	Bottom	8	96	0.12	0.25	<0.1	<0.01	-	4.5	6	-	-	9	10.2	225	7.3	-
6/16/83	Mid	1	108	0.07	0.25	<0.1	0.02	124	7	1.8	2.3	0.08	17.9	10.6	242	7.9	3
6/16/83	Mid	4	106	0.05	0.25	<0.1	0.02	157	4	1.3	2.1	0.06	19.8	10.3	249	7.6	3
6/16/83	Mid	7	110	0.05	0.25	<0.1	0.02	59	7	1.3	3.4	0.06	18.7	10.7	242	7.8	3
6/16/83	Mid	8	110	0.06	0.25	<0.1	0.02	66	4	1.3	1.5	0.02	18.5	10.1	240	7.6	3.5
7/14/83	Mid	1	112	0.04	0.16	<0.1	<0.01	128	3	2	2.8	0.13	21.4	10.6	302	7.6	3.5
7/14/83	Mid	4	118	0.02	0.15	<0.1	<0.01	110	1	1	2.9	0.13	22.3	11.5	308	7.8	4
7/14/83	Mid	7	116	0.06	0.16	<0.1	<0.01	104	2	2	3.6	0.13	21.8	11.2	302	7.8	3.5
7/14/83	Mid	8	116	0.08	1.28	<0.1	<0.01	112	1	1	3.2	0.08	22.1	11.4	300	7.8	3.7

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APPENDIX B (CONT.) - WATER QUALITY DATA FOR THE LEWISTON RESERVOIR FROM LABORATORY SAMPLES COLLECTED AS PART OF THE AQUATIC ECOLOGY AND WATER QUALITY STUDY, 1982-83

Sampling Date	Depth	Zone	Total Alk. (mg/L)	NH3-N (mg/L)	NO3-N (mg/L)	Tot. P (mg/L)	PO4 (mg/L)	Total Dis. Solids (mg/L)	Susp. Sed. (mg/L)	Turb. (NTUs)	Chl a (ug/L)	Ferrous Iron (mg/L)	Water Temp. (C)	D.O. (mg/L)	Cond. (umhos)	pH (S.U.)	Secchi Disk Depth (m)
Maximum Pool																	
11/22/82	Surface	1	99	0.07	0.28	<0.1	<0.01	-	4	3	-	-	9	11.4	280	7.3	-
11/22/82	Mid	1	99	0.04	0.24	<0.1	<0.01	-	2.5	3	-	-	9	11.2	280	7.5	-
11/22/82	Bottom	1	97	0.02	0.24	<0.1	<0.01	-	6	3	-	-	9	11.2	280	7.5	-
11/22/82	Surface	4	99	0.02	0.25	<0.1	0.02	-	3	2	-	-	9.5	10.9	280	7.3	-
11/22/82	Mid	4	97	0.02	0.25	<0.1	0.02	-	4.5	3	-	-	9.5	10.9	280	7.3	-
11/22/82	Bottom	4	99	0.02	0.24	<0.1	<0.01	-	3.5	3	-	-	9.5	10.4	285	7.8	-
11/22/82	Surface	7	99	0.12	0.31	<0.1	<0.01	-	2	2	-	-	9	10.9	280	7.1	-
11/22/82	Mid	7	99	0.02	0.25	<0.1	<0.01	-	3	3	-	-	9	10.4	280	7.1	-
11/22/82	Bottom	7	98	0.01	0.25	<0.1	<0.01	-	2.5	2	-	-	9	10.4	280	7.1	-
11/22/82	Surface	8	98	0.01	0.25	0.2	<0.01	-	3.5	2	-	-	9	11	280	7.3	-
11/22/82	Mid	8	98	0.01	0.26	<0.1	<0.01	-	2.5	2	-	-	9	10.8	280	7.3	-
11/22/82	Bottom	8	98	0.01	0.27	<0.1	<0.01	-	4	2	-	-	9	10.8	280	7.8	-
6/13/83	Mid	1	97	0.02	0.24	<0.1	0.02	37	2	1.9	3.2	0.09	16.8	12.6	225	7.4	2
6/13/83	Mid	4	110	0.03	0.2	<0.1	0.03	60	4	2.1	1.9	0.11	17.2	112.6	229	7.4	2
6/13/83	Mid	7	134	0.07	0.2	<0.1	0.04	112	5	2.6	2.7	0.08	17.1	12.9	228	7.2	2
6/13/83	Mid	8	24	0.03	0.27	<0.1	0.04	57	4	2	2.2	0.08	16.5	12.5	229	7.2	2
7/12/83	Mid	1	114	0.14	0.15	<0.1	<0.01	128	6	2	4.8	0.1	20.6	12.3	268	7.7	3.5
7/12/83	Mid	4	111	0.07	0.17	<0.1	<0.01	124	2	2	4.2	0.08	21	12.1	298	7.8	3.5
7/12/83	Mid	7	111	0.09	0.17	<0.1	<0.01	100	1	2	2.4	0.1	20.8	12.2	284	7.6	3.5
7/12/83	Mid	8	106	0.11	0.18	<0.1	<0.01	110	3	2	2.8	0.1	20.7	12	288	7.8	3.5

Source: Ecological Analysts 1984a

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APPENDIX C – NYSDEC NIAGARA RIVER FISH TISSUE MERCURY DATA

Feature	Location	Sample Date	Species	Length, mm	Weight, g	Hg, µg/g
LAKE ONTARIO	LOWER NIAGARA R.	940622	ALW	143	20	-0.05
LAKE ONTARIO	LOWER NIAGARA R.	940622	ALW	147	25	-0.05
LAKE ONTARIO	LOWER NIAGARA R.	940622	ALW	161	26	-0.05
LAKE ONTARIO	LOWER NIAGARA R.	940622	ALW	139	22	-0.05
LAKE ONTARIO	LOWER NIAGARA R.	940622	ALW	142	19	-0.05
LAKE ONTARIO	LOWER NIAGARA R.	940622	ALW	153	26	-0.05
LAKE ONTARIO	LOWER NIAGARA R.	940622	ALW	134	18	-0.05
LAKE ONTARIO	LOWER NIAGARA R.	940622	ALW	137	18	-0.05
LAKE ONTARIO	LOWER NIAGARA R.	940622	ALW	131	16	-0.05
LAKE ONTARIO	LOWER NIAGARA R.	940622	ALW	132	16	-0.05
LAKE ONTARIO	LOWER NIAGARA R.	940622	ALW	129	16	-0.05
LAKE ONTARIO	LOWER NIAGARA R.	940622	ALW	158	27	0.08
LAKE ONTARIO	LOWER NIAGARA R.	940622	ALW	159	29	0.1
LAKE ONTARIO	LOWER NIAGARA R.	940622	AMEL	928	2438	-0.05
LAKE ONTARIO	LOWER NIAGARA R.	940622	AMEL	739	1021	-0.05
LAKE ONTARIO	LOWER NIAGARA R.	940622	AMEL	751	907	0.09
LAKE ONTARIO	LOWER NIAGARA R.	940622	AMEL	682	595	0.13
LAKE ONTARIO	LOWER NIAGARA R.	940622	AMEL	956	2240	0.13
LAKE ONTARIO	LOWER NIAGARA R.	940622	AMEL	770	1106	0.15
LAKE ONTARIO	LOWER NIAGARA R.	940622	AMEL	511	227	0.15
LAKE ONTARIO	LOWER NIAGARA R.	940622	AMEL	605	454	0.17
LAKE ONTARIO	LOWER NIAGARA R.	940622	AMEL	818	1304	0.18
LAKE ONTARIO	LOWER NIAGARA R.	940622	AMEL	805	1446	0.19
LAKE ONTARIO	LOWER NIAGARA R.	940622	AMEL	756	822	0.21
LAKE ONTARIO	LOWER NIAGARA R.	940622	AMEL	615	397	0.23
LAKE ONTARIO	LOWER NIAGARA R.	940622	AMEL	480	198	0.24
LAKE ONTARIO	LOWER NIAGARA R.	940622	AMEL	605	340	0.27
LAKE ONTARIO	LOWER NIAGARA R.	940622	AMEL	825	1389	0.29
LAKE ONTARIO	LOWER NIAGARA R.	940622	BB	231	198	-0.05
LAKE ONTARIO	LOWER NIAGARA R.	940622	BB	247	255	-0.05
LAKE ONTARIO	LOWER NIAGARA R.	940622	BB	253	255	0.05
LAKE ONTARIO	LOWER NIAGARA R.	940622	BB	325	624	0.06
LAKE ONTARIO	LOWER NIAGARA R.	940622	BB	252	255	0.06
LAKE ONTARIO	LOWER NIAGARA R.	940622	BB	333	567	0.07
LAKE ONTARIO	LOWER NIAGARA R.	940622	BB	308	510	0.07
LAKE ONTARIO	LOWER NIAGARA R.	940622	BB	340	624	0.09
LAKE ONTARIO	LOWER NIAGARA R.	940622	BB	266	340	0.11
LAKE ONTARIO	LOWER NIAGARA R.	940622	BB	294	397	0.12
LAKE ONTARIO	LOWER NIAGARA R.	940622	BB	280	482	0.14
LAKE ONTARIO	LOWER NIAGARA R.	940622	BB	354	709	0.16
LAKE ONTARIO	LOWER NIAGARA R.	940622	BB	350	624	0.16
LAKE ONTARIO	LOWER NIAGARA R.	940622	BB	329	567	0.18

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APPENDIX C (CONT.) – NYSDEC NIAGARA RIVER FISH TISSUE MERCURY DATA

Feature	Location	Sample Date	Species	Length, mm	Weight, g	Hg, µg/g
LAKE ONTARIO	LOWER NIAGARA R.	940622	BB	311	454	0.22
LAKE ONTARIO	LOWER NIAGARA R.	940622	CARP	570	2608	0.1
LAKE ONTARIO	LOWER NIAGARA R.	940622	CARP	595	3345	0.13
LAKE ONTARIO	LOWER NIAGARA R.	940622	CARP	696	4593	0.14
LAKE ONTARIO	LOWER NIAGARA R.	940622	CARP	587	2948	0.14
LAKE ONTARIO	LOWER NIAGARA R.	940622	CARP	560	2948	0.14
LAKE ONTARIO	LOWER NIAGARA R.	940622	CARP	510	1928	0.15
LAKE ONTARIO	LOWER NIAGARA R.	940622	CARP	628	3600	0.15
LAKE ONTARIO	LOWER NIAGARA R.	940622	CARP	625	3062	0.2
LAKE ONTARIO	LOWER NIAGARA R.	940622	CARP	732	6294	0.21
LAKE ONTARIO	LOWER NIAGARA R.	940622	CARP	584	2892	0.21
LAKE ONTARIO	LOWER NIAGARA R.	940622	CARP	605	2892	0.22
LAKE ONTARIO	LOWER NIAGARA R.	940622	CARP	680	4423	0.24
LAKE ONTARIO	LOWER NIAGARA R.	940622	CARP	598	2948	0.27
LAKE ONTARIO	LOWER NIAGARA R.	940622	CARP	650	4026	0.34
LAKE ONTARIO	LOWER NIAGARA R.	940622	CARP	597	3118	0.41
LAKE ONTARIO	LOWER NIAGARA R.	940622	DRUM	337	397	0.09
LAKE ONTARIO	LOWER NIAGARA R.	940622	DRUM	327	283	0.1
LAKE ONTARIO	LOWER NIAGARA R.	940622	DRUM	284	227	0.11
LAKE ONTARIO	LOWER NIAGARA R.	940622	DRUM	310	283	0.15
LAKE ONTARIO	LOWER NIAGARA R.	940622	DRUM	377	539	0.16
LAKE ONTARIO	LOWER NIAGARA R.	940622	DRUM	299	283	0.19
LAKE ONTARIO	LOWER NIAGARA R.	940622	DRUM	371	539	0.2
LAKE ONTARIO	LOWER NIAGARA R.	940622	DRUM	370	624	0.21
LAKE ONTARIO	LOWER NIAGARA R.	940622	DRUM	382	765	0.24
LAKE ONTARIO	LOWER NIAGARA R.	940622	DRUM	436	1134	0.36
LAKE ONTARIO	LOWER NIAGARA R.	940622	DRUM	416	1106	0.41
LAKE ONTARIO	LOWER NIAGARA R.	940622	DRUM	401	850	0.42
LAKE ONTARIO	LOWER NIAGARA R.	940622	DRUM	401	652	0.44
LAKE ONTARIO	LOWER NIAGARA R.	940622	DRUM	441	1332	0.54
LAKE ONTARIO	LOWER NIAGARA R.	940622	DRUM	413	680	0.63
LAKE ONTARIO	LOWER NIAGARA R.	940622	RB	203	170	0.12
LAKE ONTARIO	LOWER NIAGARA R.	940622	RB	243	283	0.14
LAKE ONTARIO	LOWER NIAGARA R.	940622	RB	206	170	0.17
LAKE ONTARIO	LOWER NIAGARA R.	940622	RB	195	170	0.31
LAKE ONTARIO	LOWER NIAGARA R.	940622	RB	194	142	0.33
LAKE ONTARIO	LOWER NIAGARA R.	940622	RB	221	198	0.37
LAKE ONTARIO	LOWER NIAGARA R.	940622	RB	248	340	0.38
LAKE ONTARIO	LOWER NIAGARA R.	940622	RB	233	283	0.39
LAKE ONTARIO	LOWER NIAGARA R.	940622	RB	216	227	0.39
LAKE ONTARIO	LOWER NIAGARA R.	940622	RB	208	198	0.4
LAKE ONTARIO	LOWER NIAGARA R.	940622	RB	232	283	0.42
LAKE ONTARIO	LOWER NIAGARA R.	940622	RB	236	283	0.44

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APPENDIX C (CONT.) – NYSDEC NIAGARA RIVER FISH TISSUE MERCURY DATA

Feature	Location	Sample Date	Species	Length, mm	Weight, g	Hg, µg/g
LAKE ONTARIO	LOWER NIAGARA R.	940622	RB	225	255	0.46
LAKE ONTARIO	LOWER NIAGARA R.	940622	RB	231	255	0.47
LAKE ONTARIO	LOWER NIAGARA R.	940622	RB	221	227	0.52
LAKE ONTARIO	LOWER NIAGARA R.	940622	SMB	331	567	0.2
LAKE ONTARIO	LOWER NIAGARA R.	940622	SMB	366	765	0.21
LAKE ONTARIO	LOWER NIAGARA R.	940622	SMB	353	680	0.21
LAKE ONTARIO	LOWER NIAGARA R.	940622	SMB	316	482	0.24
LAKE ONTARIO	LOWER NIAGARA R.	940622	SMB	360	680	0.28
LAKE ONTARIO	LOWER NIAGARA R.	940622	SMB	371	794	0.32
LAKE ONTARIO	LOWER NIAGARA R.	940622	SMB	379	652	0.33
LAKE ONTARIO	LOWER NIAGARA R.	940622	SMB	361	680	0.34
LAKE ONTARIO	LOWER NIAGARA R.	940622	SMB	401	850	0.35
LAKE ONTARIO	LOWER NIAGARA R.	940622	SMB	403	964	0.37
LAKE ONTARIO	LOWER NIAGARA R.	940622	SMB	391	850	0.38
LAKE ONTARIO	LOWER NIAGARA R.	940622	SMB	386	850	0.39
LAKE ONTARIO	LOWER NIAGARA R.	940622	SMB	380	765	0.47
LAKE ONTARIO	LOWER NIAGARA R.	940622	SMB	377	850	0.48
LAKE ONTARIO	LOWER NIAGARA R.	940622	SMB	372	737	0.5
LAKE ONTARIO	LOWER NIAGARA R.	940622	YP	168	57	-0.05
LAKE ONTARIO	LOWER NIAGARA R.	940622	YP	147	57	-0.05
LAKE ONTARIO	LOWER NIAGARA R.	940622	YP	140	57	-0.05
LAKE ONTARIO	LOWER NIAGARA R.	940622	YP	157	57	-0.05
LAKE ONTARIO	LOWER NIAGARA R.	940622	YP	143	57	-0.05
LAKE ONTARIO	LOWER NIAGARA R.	940622	YP	142	57	-0.05
LAKE ONTARIO	LOWER NIAGARA R.	940622	YP	139	28	-0.05
LAKE ONTARIO	LOWER NIAGARA R.	940622	YP	195	113	0.08
LAKE ONTARIO	LOWER NIAGARA R.	940622	YP	186	85	0.08
LAKE ONTARIO	LOWER NIAGARA R.	940622	YP	160	57	0.08
LAKE ONTARIO	LOWER NIAGARA R.	940622	YP	170	57	0.1
LAKE ONTARIO	LOWER NIAGARA R.	940622	YP	192	85	0.11
LAKE ONTARIO	LOWER NIAGARA R.	940622	YP	223	142	0.13
LAKE ONTARIO	LOWER NIAGARA R.	940622	YP	218	142	0.13
LAKE ONTARIO	LOWER NIAGARA R.	940622	YP	221	142	0.15
LAKE ONTARIO	UPPER NIAGARA R.	940608	BB	293	454	0.07
LAKE ONTARIO	UPPER NIAGARA R.	940609	BB	328	510	0.08
LAKE ONTARIO	UPPER NIAGARA R.	940609	BB	319	539	0.09
LAKE ONTARIO	UPPER NIAGARA R.	940609	BB	332	567	0.09
LAKE ONTARIO	UPPER NIAGARA R.	940608	BB	329	510	0.1
LAKE ONTARIO	UPPER NIAGARA R.	940608	BB	330	510	0.11
LAKE ONTARIO	UPPER NIAGARA R.	940608	BB	315	454	0.11
LAKE ONTARIO	UPPER NIAGARA R.	940609	BB	303	397	0.13
LAKE ONTARIO	UPPER NIAGARA R.	940609	BB	280	340	0.14
LAKE ONTARIO	UPPER NIAGARA R.	940608	BB	325	624	0.15

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APPENDIX C (CONT.) – NYSDEC NIAGARA RIVER FISH TISSUE MERCURY DATA

Feature	Location	Sample Date	Species	Length, mm	Weight, g	Hg, µg/g
LAKE ONTARIO	UPPER NIAGARA R.	940609	BB	324	539	0.15
LAKE ONTARIO	UPPER NIAGARA R.	940608	BB	311	482	0.16
LAKE ONTARIO	UPPER NIAGARA R.	940608	BB	332	567	0.18
LAKE ONTARIO	UPPER NIAGARA R.	940609	BB	317	454	0.2
LAKE ONTARIO	UPPER NIAGARA R.	940609	BB	308	510	0.24
LAKE ONTARIO	UPPER NIAGARA R.	940609	CARP	497	1701	0.06
LAKE ONTARIO	UPPER NIAGARA R.	940609	CARP	582	2835	0.08
LAKE ONTARIO	UPPER NIAGARA R.	940609	CARP	575	2268	0.11
LAKE ONTARIO	UPPER NIAGARA R.	940609	CARP	631	2948	0.12
LAKE ONTARIO	UPPER NIAGARA R.	940609	CARP	616	3232	0.13
LAKE ONTARIO	UPPER NIAGARA R.	940609	CARP	497	1673	0.14
LAKE ONTARIO	UPPER NIAGARA R.	940609	CARP	533	2438	0.17
LAKE ONTARIO	UPPER NIAGARA R.	940609	CARP	564	2495	0.18
LAKE ONTARIO	UPPER NIAGARA R.	940609	CARP	542	2126	0.2
LAKE ONTARIO	UPPER NIAGARA R.	940609	DRUM	289	227	0.07
LAKE ONTARIO	UPPER NIAGARA R.	940609	DRUM	314	283	0.12
LAKE ONTARIO	UPPER NIAGARA R.	940609	DRUM	383	510	0.14
LAKE ONTARIO	UPPER NIAGARA R.	940608	DRUM	396	765	0.17
LAKE ONTARIO	UPPER NIAGARA R.	940609	DRUM	414	850	0.23
LAKE ONTARIO	UPPER NIAGARA R.	940609	DRUM	342	425	0.25
LAKE ONTARIO	UPPER NIAGARA R.	940609	DRUM	341	397	0.36
LAKE ONTARIO	UPPER NIAGARA R.	940609	DRUM	318	227	0.36
LAKE ONTARIO	UPPER NIAGARA R.	940609	DRUM	492	1106	0.36
LAKE ONTARIO	UPPER NIAGARA R.	940609	DRUM	391	539	0.43
LAKE ONTARIO	UPPER NIAGARA R.	940609	DRUM	469	765	0.56
LAKE ONTARIO	UPPER NIAGARA R.	940609	DRUM	446	680	0.61
LAKE ONTARIO	UPPER NIAGARA R.	940608	LMB	297	397	-0.05
LAKE ONTARIO	UPPER NIAGARA R.	940608	LMB	303	369	0.06
LAKE ONTARIO	UPPER NIAGARA R.	940608	LMB	275	312	0.06
LAKE ONTARIO	UPPER NIAGARA R.	940608	LMB	293	397	0.07
LAKE ONTARIO	UPPER NIAGARA R.	940609	LMB	342	652	0.09
LAKE ONTARIO	UPPER NIAGARA R.	940609	LMB	343	624	0.15
LAKE ONTARIO	UPPER NIAGARA R.	940609	LMB	337	680	0.16
LAKE ONTARIO	UPPER NIAGARA R.	940609	LMB	333	624	0.18
LAKE ONTARIO	UPPER NIAGARA R.	940609	LMB	394	1021	0.21
LAKE ONTARIO	UPPER NIAGARA R.	940609	LMB	385	1049	0.22
LAKE ONTARIO	UPPER NIAGARA R.	940608	LMB	381	936	0.24
LAKE ONTARIO	UPPER NIAGARA R.	940609	LMB	413	1134	0.26
LAKE ONTARIO	UPPER NIAGARA R.	940609	LMB	362	850	0.27
LAKE ONTARIO	UPPER NIAGARA R.	940609	LMB	400	1106	0.28
LAKE ONTARIO	UPPER NIAGARA R.	940608	LMB	403	1134	0.31
LAKE ONTARIO	UPPER NIAGARA R.	940609	NOP	693	1871	0.09
LAKE ONTARIO	UPPER NIAGARA R.	940608	NOP	559	1247	0.12

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APPENDIX C (CONT.) – NYSDEC NIAGARA RIVER FISH TISSUE MERCURY DATA

Feature	Location	Sample Date	Species	Length, mm	Weight, g	Hg, µg/g
LAKE ONTARIO	UPPER NIAGARA R.	940609	NOP	753	2353	0.12
LAKE ONTARIO	UPPER NIAGARA R.	940609	NOP	711	2608	0.13
LAKE ONTARIO	UPPER NIAGARA R.	940609	NOP	614	1332	0.14
LAKE ONTARIO	UPPER NIAGARA R.	940609	NOP	612	1106	0.14
LAKE ONTARIO	UPPER NIAGARA R.	940609	NOP	636	1474	0.17
LAKE ONTARIO	UPPER NIAGARA R.	940609	PKSD	181	142	-0.05
LAKE ONTARIO	UPPER NIAGARA R.	940609	PKSD	206	198	0.08
LAKE ONTARIO	UPPER NIAGARA R.	940609	PKSD	208	198	0.1
LAKE ONTARIO	UPPER NIAGARA R.	940609	PKSD	218	227	0.12
LAKE ONTARIO	UPPER NIAGARA R.	940609	PKSD	218	227	0.12
LAKE ONTARIO	UPPER NIAGARA R.	940608	PKSD	229	283	0.13
LAKE ONTARIO	UPPER NIAGARA R.	940608	PKSD	207	198	0.15
LAKE ONTARIO	UPPER NIAGARA R.	940609	PKSD	188	142	0.16
LAKE ONTARIO	UPPER NIAGARA R.	940609	PKSD	230	255	0.25
LAKE ONTARIO	UPPER NIAGARA R.	940609	PKSD	224	255	0.28
LAKE ONTARIO	UPPER NIAGARA R.	940609	RB	210	198	-0.05
LAKE ONTARIO	UPPER NIAGARA R.	940609	RB	211	170	-0.05
LAKE ONTARIO	UPPER NIAGARA R.	940609	RB	199	142	-0.05
LAKE ONTARIO	UPPER NIAGARA R.	940609	RB	165	85	-0.05
LAKE ONTARIO	UPPER NIAGARA R.	940609	RB	227	227	0.06
LAKE ONTARIO	UPPER NIAGARA R.	940609	RB	162	57	0.06
LAKE ONTARIO	UPPER NIAGARA R.	940609	RB	153	57	0.08
LAKE ONTARIO	UPPER NIAGARA R.	940609	RB	242	312	0.1
LAKE ONTARIO	UPPER NIAGARA R.	940609	RB	230	255	0.1
LAKE ONTARIO	UPPER NIAGARA R.	940609	RB	199	142	0.1
LAKE ONTARIO	UPPER NIAGARA R.	940609	RB	226	227	0.13
LAKE ONTARIO	UPPER NIAGARA R.	940609	RB	220	198	0.13
LAKE ONTARIO	UPPER NIAGARA R.	940609	RB	245	283	0.15
LAKE ONTARIO	UPPER NIAGARA R.	940609	RB	235	227	0.21
LAKE ONTARIO	UPPER NIAGARA R.	940609	RB	231	255	0.28
LAKE ONTARIO	UPPER NIAGARA R.	940608	SMB	347	567	0.11
LAKE ONTARIO	UPPER NIAGARA R.	940608	SMB	347	595	0.13
LAKE ONTARIO	UPPER NIAGARA R.	940608	SMB	355	680	0.14
LAKE ONTARIO	UPPER NIAGARA R.	940608	SMB	376	850	0.17
LAKE ONTARIO	UPPER NIAGARA R.	940609	SMB	365	680	0.17
LAKE ONTARIO	UPPER NIAGARA R.	940609	SMB	389	765	0.23
LAKE ONTARIO	UPPER NIAGARA R.	940609	SMB	360	652	0.25
LAKE ONTARIO	UPPER NIAGARA R.	940609	SMB	396	794	0.27
LAKE ONTARIO	UPPER NIAGARA R.	940608	SMB	368	794	0.33
LAKE ONTARIO	UPPER NIAGARA R.	940609	SMB	416	1021	0.33
LAKE ONTARIO	UPPER NIAGARA R.	940608	SMB	372	765	0.34
LAKE ONTARIO	UPPER NIAGARA R.	940608	SMB	411	1077	0.35
LAKE ONTARIO	UPPER NIAGARA R.	940609	SMB	416	964	0.39

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APPENDIX C (CONT.) – NYSDEC NIAGARA RIVER FISH TISSUE MERCURY DATA

Feature	Location	Sample Date	Species	Length, mm	Weight, g	Hg, µg/g
LAKE ONTARIO	UPPER NIAGARA R	940609	SMB	384	709	0.42
LAKE ONTARIO	UPPER NIAGARA R.	940608	SMB	408	1021	0.5
LAKE ONTARIO	UPPER NIAGARA R.	940609	WB	380	680	0.36
LAKE ONTARIO	UPPER NIAGARA R.	940608	YP	248	198	0.05
LAKE ONTARIO	UPPER NIAGARA R.	940608	YP	207	113	0.07
LAKE ONTARIO	UPPER NIAGARA R.	940608	YP	226	142	0.07
LAKE ONTARIO	UPPER NIAGARA R.	940609	YP	274	227	0.1
LAKE ONTARIO	UPPER NIAGARA R.	940609	YP	277	227	0.11
LAKE ONTARIO	UPPER NIAGARA R.	940609	YP	262	170	0.11
LAKE ONTARIO	UPPER NIAGARA R.	940609	YP	278	255	0.14
LAKE ONTARIO	UPPER NIAGARA R.	940608	YP	295	312	0.15
LAKE ONTARIO	UPPER NIAGARA R.	940609	YP	281	255	0.16
LAKE ONTARIO	UPPER NIAGARA R.	940608	YP	300	340	0.17
LAKE ONTARIO	UPPER NIAGARA R.	940609	YP	289	255	0.19
LAKE ONTARIO	UPPER NIAGARA R.	940609	YP	303	340	0.2
LAKE ONTARIO	UPPER NIAGARA R.	940609	YP	281	283	0.23
LAKE ONTARIO	UPPER NIAGARA R.	940609	YP	280	255	0.25
LAKE ONTARIO	UPPER NIAGARA R.	940609	YP	311	397	0.26
NIAGARA RIVER	AT BUFFALO	19770613	SMB	285.3	313.1	0.18
NIAGARA RIVER	AT BUFFALO	19770613	WS	242.5	122.2	0.11
NIAGARA RIVER	BEAVER IS ST PK	19970819	EMSH	24	2	-0.01
NIAGARA RIVER	BEAVER IS ST PK	19970819	SPSH	31	3	0.02
NIAGARA RIVER	BELOW BUFFALO	19810608	CARP	518.1	2359.7	0.38
NIAGARA RIVER	BELOW BUFFALO	19810608	SMB	341.2	637.9	0.4
NIAGARA RIVER	BELOW GRAND	19840918	SPSH	44	7	0.09
NIAGARA RIVER	BELOW LEWISTON	19810611	RB	214.6	205.8	0.48
NIAGARA RIVER	FORT NIAGARA	19810625	CARP	608.8	3214	0.44
NIAGARA RIVER	FORT NIAGARA	19790615	RB	183.8	152.8	0.5
NIAGARA RIVER	FORT NIAGARA	19790615	RB	205	219.8	0.56
NIAGARA RIVER	FORT NIAGARA	19810610	RB	197.4	178.7	0.59
NIAGARA RIVER	FORT NIAGARA	19810625	SMB	318.9	492.6	0.57
NIAGARA RIVER	FORT NIAGARA	19790615	WS	408.8	736.7	0.38
NIAGARA RIVER	FORT NIAGARA	19790615	WS	482.7	1353.3	0.51
NIAGARA RIVER	GENERAL	19700000	BLG	184	135	0.8
NIAGARA RIVER	GRATWICK PARK	19860827	EMSH	37	4	0.01
NIAGARA RIVER	GRATWICK PARK	19840917	SPSH	40	6	0.03
NIAGARA RIVER	GRATWICK PARK	19850920	SPSH	53	12	0.04
NIAGARA RIVER	LEWISTON	19970916	BNOSE	36	6	0.02
NIAGARA RIVER	LEWISTON	19810626	CARP	560.8	2766.6	0.36
NIAGARA RIVER	LEWISTON	19790615	RB	186	168.9	0.34
NIAGARA RIVER	LEWISTON	19790615	RB	214.2	268.2	0.39
NIAGARA RIVER	LEWISTON	19851007	SPSH	60	21	0.04
NIAGARA RIVER	LEWISTON	19860828	SPSH	37	5	0.07

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APPENDIX C (CONT.) – NYSDEC NIAGARA RIVER FISH TISSUE MERCURY DATA

Feature	Location	Sample Date	Species	Length, mm	Weight, g	Hg, µg/g
NIAGARA RIVER	LEWISTON	19840918	SPSH	48	9	0.07
NIAGARA RIVER	LEWISTON	19840918	SPSH	46	2	0.08
NIAGARA RIVER	LEWISTON	19840918	SPSH	46	2	0.08
NIAGARA RIVER	LEWISTON	19790615	WB	270.1	272.9	0.28
NIAGARA RIVER	LEWISTON	19790615	WB	334	676	0.31
NIAGARA RIVER	LEWISTON	19790615	WS	312.7	367.1	0.12
NIAGARA RIVER	LEWISTON	19790615	WS	396.9	731.4	0.25
NIAGARA RIVER	LOWER NIAGARA	19810611	AMEL	706.1	747.4	0.41
NIAGARA RIVER	LOWER NIAGARA	19810611	AMEL	891.2	1864	0.43
NIAGARA RIVER	LOWER NIAGARA	19700604	AMEL	911	2470	0.8
NIAGARA RIVER	LOWER NIAGARA	19700000	BLC	171	90	0.3
NIAGARA RIVER	LOWER NIAGARA	19700000	BLG	191	160	0.4
NIAGARA RIVER	LOWER NIAGARA	19700000	BLG	181	135	0.7
NIAGARA RIVER	LOWER NIAGARA	19700000	CARP	191	125	0.07
NIAGARA RIVER	LOWER NIAGARA	19810625	CARP	608.8	3214	0.44
NIAGARA RIVER	LOWER NIAGARA	19700000	DRUM	356	625	0.09
NIAGARA RIVER	LOWER NIAGARA	19700000	DRUM	241	155	0.2
NIAGARA RIVER	LOWER NIAGARA	19700000	DRUM	270	260	0.2
NIAGARA RIVER	LOWER NIAGARA	19700000	DRUM	305	300	0.2
NIAGARA RIVER	LOWER NIAGARA	19700000	DRUM	292	205	0.2
NIAGARA RIVER	LOWER NIAGARA	19700000	DRUM	241	125	0.3
NIAGARA RIVER	LOWER NIAGARA	19700000	DRUM	254	165	0.3
NIAGARA RIVER	LOWER NIAGARA	19700000	DRUM	330	420	0.3
NIAGARA RIVER	LOWER NIAGARA	19700000	DRUM	343	335	0.4
NIAGARA RIVER	LOWER NIAGARA	19700000	DRUM	330	430	0.5
NIAGARA RIVER	LOWER NIAGARA	19700000	GLDF	279	525	0.3
NIAGARA RIVER	LOWER NIAGARA	19700000	GLDF	406	1185	0.3
NIAGARA RIVER	LOWER NIAGARA	19700000	GLDF	318	565	0.3
NIAGARA RIVER	LOWER NIAGARA	19700000	GLDF	273	460	0.4
NIAGARA RIVER	LOWER NIAGARA	19700000	GLDF	254	300	0.4
NIAGARA RIVER	LOWER NIAGARA	19700000	GLDF	203	190	0.4
NIAGARA RIVER	LOWER NIAGARA	19700000	GLDF	238	255	0.5
NIAGARA RIVER	LOWER NIAGARA	19700000	GLDF	273	390	0.5
NIAGARA RIVER	LOWER NIAGARA	19700000	GLDF	222	225	0.6
NIAGARA RIVER	LOWER NIAGARA	19700000	GLDF	254	230	0.6
NIAGARA RIVER	LOWER NIAGARA	19700000	GLDF	267	340	0.6
NIAGARA RIVER	LOWER NIAGARA	19700000	GLDF	267	475	0.7
NIAGARA RIVER	LOWER NIAGARA	19700000	GLDF	267	430	0.7
NIAGARA RIVER	LOWER NIAGARA	19700000	GLDF	279	560	0.8
NIAGARA RIVER	LOWER NIAGARA	19700000	GLDF	279	405	0.8
NIAGARA RIVER	LOWER NIAGARA	19700000	GLDF	229	325	0.8
NIAGARA RIVER	LOWER NIAGARA	19700000	GLDF	216	225	0.8
NIAGARA RIVER	LOWER NIAGARA	19700000	GLDF	229	240	0.8

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APPENDIX C (CONT.) – NYSDEC NIAGARA RIVER FISH TISSUE MERCURY DATA

Feature	Location	Sample Date	Species	Length, mm	Weight, g	Hg, µg/g
NIAGARA RIVER	LOWER NIAGARA	19700000	GLDF	318	805	0.8
NIAGARA RIVER	LOWER NIAGARA	19700000	GLDF	254	375	0.9
NIAGARA RIVER	LOWER NIAGARA	19700000	GLDF	191	160	0.9
NIAGARA RIVER	LOWER NIAGARA	19700000	GLDF	305	625	0.9
NIAGARA RIVER	LOWER NIAGARA	19700000	GLDF	279	510	0.9
NIAGARA RIVER	LOWER NIAGARA	19700000	GLDF	216	195	1
NIAGARA RIVER	LOWER NIAGARA	19700000	GLDF	254	325	1
NIAGARA RIVER	LOWER NIAGARA	19700000	GLDF	273	410	1
NIAGARA RIVER	LOWER NIAGARA	19700000	GLDF	279	500	1.4
NIAGARA RIVER	LOWER NIAGARA	19700000	NOP	492	865	2
NIAGARA RIVER	LOWER NIAGARA	19700000	PKSD	171	145	1
NIAGARA RIVER	LOWER NIAGARA	19810610	RB	160.4	86.9	0.36
NIAGARA RIVER	LOWER NIAGARA	19810610	RB	197.4	178.7	0.59
NIAGARA RIVER	LOWER NIAGARA	19700604	RB	206	215	1
NIAGARA RIVER	LOWER NIAGARA	19700604	RB	219	230	1.3
NIAGARA RIVER	LOWER NIAGARA	19700604	RB	244	345	1.4
NIAGARA RIVER	LOWER NIAGARA	19700604	RB	194	175	2.6
NIAGARA RIVER	LOWER NIAGARA	19700604	RB	248	305	2.7
NIAGARA RIVER	LOWER NIAGARA	19700604	RHSPP	267	250	0.4
NIAGARA RIVER	LOWER NIAGARA	19810625	SMB	293.2	357.5	0.31
NIAGARA RIVER	LOWER NIAGARA	19700000	SMB	260	230	0.4
NIAGARA RIVER	LOWER NIAGARA	19810625	SMB	318.9	492.6	0.57
NIAGARA RIVER	LOWER NIAGARA	19700000	SMB	305	395	0.8
NIAGARA RIVER	LOWER NIAGARA	19700000	SUCK	406	840	0.3
NIAGARA RIVER	LOWER NIAGARA	19700000	SUCK	432	1005	0.5
NIAGARA RIVER	LOWER NIAGARA	19700000	SUCK	489	1165	3.4
NIAGARA RIVER	LOWER NIAGARA	19700000	SUN	165	145	0.8
NIAGARA RIVER	LOWER NIAGARA	19700000	SUN	178	145	0.9
NIAGARA RIVER	LOWER NIAGARA	19700604	WB	222	130	0.2
NIAGARA RIVER	LOWER NIAGARA	19700000	WEYE	279	325	0.3
NIAGARA RIVER	LOWER NIAGARA	19700000	WP	279	430	0.9
NIAGARA RIVER	LOWER NIAGARA	19700000	WP	210	205	1.6
NIAGARA RIVER	LOWER NIAGARA	19700000	WP	248	300	1.6
NIAGARA RIVER	N GRAND IS BRIDG	19970821	SPSH	29	3	0.02
NIAGARA RIVER	NIAGARA RIVER	19810608	CARP	395.1	922.2	0.12
NIAGARA RIVER	NIAGARA RIVER	19810626	CARP	560.8	2766.6	0.36
NIAGARA RIVER	NIAGARA RIVER	19810608	CARP	518.1	2359.7	0.38
NIAGARA RIVER	NIAGARA RIVER	19700000	COS	-9	-9	0.2
NIAGARA RIVER	NIAGARA RIVER	19700000	COS	-9	-9	0.5
NIAGARA RIVER	NIAGARA RIVER	19810620	RB	177.7	123.1	0.24
NIAGARA RIVER	NIAGARA RIVER	19810617	RB	214.6	205.8	0.48
NIAGARA RIVER	NIAGARA RIVER	19700000	RB	184	135	0.8
NIAGARA RIVER	NIAGARA RIVER	19810608	SMB	301	459.5	0.24

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APPENDIX C (CONT.) – NYSDEC NIAGARA RIVER FISH TISSUE MERCURY DATA

Feature	Location	Sample Date	Species	Length, mm	Weight, g	Hg, µg/g
NIAGARA RIVER	NIAGARA RIVER	19810608	SMB	341.2	637.9	0.4
NIAGARA RIVER	NIAGARA RIVER	19770613	SMB	350.7	600.6	0.46
NIAGARA RIVER	NIAGARA RIVER	19750905	WB	414	1244	0.91
NIAGARA RIVER	NIAGARA RIVER	19810626	YP	186.9	73.3	0.16
NIAGARA RIVER	NIAGARA RIVER	19810626	YP	209.6	109.4	0.18
NIAGARA RIVER	NIAGRA RIVER	19990907	LSTUR	932	1570	0.03
NIAGARA RIVER	STRAWBERRY ISLAND	19700526	RB	184	135	0.2
NIAGARA RIVER	STRAWBERRY ISLAND	19700526	RB	178	130	0.2
NIAGARA RIVER	STRAWBERRY ISLAND	19700526	RB	184	140	0.2
NIAGARA RIVER	STRAWBERRY ISLAND	19700803	RB	235	330	0.4
NIAGARA RIVER	STRAWBERRY ISLAND	19700803	RB	260	405	0.9
NIAGARA RIVER	STRAWBERRY ISLAND	19700803	RB	270	430	1.2
NIAGARA RIVER	STRAWBERRY ISLAND	19700613	SMB	260	295	0.1
NIAGARA RIVER	STRAWBERRY ISLAND	19700613	SMB	244	245	0.2
NIAGARA RIVER	STRAWBERRY ISLAND	19700613	SMB	251	265	0.2
NIAGARA RIVER	STRAWBERRY ISLAND	19700613	SMB	254	300	0.2
NIAGARA RIVER	STRAWBERRY ISLAND	19700617	SMB	337	650	0.3
NIAGARA RIVER	STRAWBERRY ISLAND	19700613	SMB	270	355	0.3
NIAGARA RIVER	STRAWBERRY ISLAND	19700613	SMB	295	415	0.3
NIAGARA RIVER	STRAWBERRY ISLAND	19700616	SMB	337	730	0.3
NIAGARA RIVER	STRAWBERRY ISLAND	19700613	SMB	257	290	0.3
NIAGARA RIVER	STRAWBERRY ISLAND	19700618	SMB	362	975	0.4
NIAGARA RIVER	STRAWBERRY ISLAND	19700613	SMB	324	605	0.4
NIAGARA RIVER	STRAWBERRY ISLAND	19700618	SMB	340	700	0.4
NIAGARA RIVER	STRAWBERRY ISLAND	19700613	SMB	305	580	0.4
NIAGARA RIVER	STRAWBERRY ISLAND	19700616	SMB	324	645	0.4
NIAGARA RIVER	STRAWBERRY ISLAND	19700616	SMB	349	935	0.5
NIAGARA RIVER	STRAWBERRY ISLAND	19700618	SMB	346	825	0.5
NIAGARA RIVER	STRAWBERRY ISLAND	19700618	SMB	346	490	0.6
NIAGARA RIVER	STRAWBERRY ISLAND	19700617	SMB	359	745	0.6
NIAGARA RIVER	STRAWBERRY ISLAND	19700616	SMB	368	750	0.7
NIAGARA RIVER	STRAWBERRY ISLAND	19700616	SMB	359	850	0.7
NIAGARA RIVER	STRAWBERRY ISLAND	19700617	SMB	419	1270	0.8
NIAGARA RIVER	STRAWBERRY ISLAND	19700618	SMB	384	1015	1
NIAGARA RIVER	STRAWBERRY ISLAND	19840912	SPSH	45	8	0.03
NIAGARA RIVER	STRAWBERRY ISLAND	19860828	SPSH	36	4	0.05
NIAGARA RIVER	STRAWBERRY ISLAND	19850904	SPSH	52	12	0.06
NIAGARA RIVER	STRAWBERRY ISLAND	19700000	WEYE	727	3365	1.4
NIAGARA RIVER	STRAWBERRY ISLAND	19700603	YP	305	410	0.4
NIAGARA RIVER	STRAWBERRY ISLAND	19700603	YP	343	520	0.6
NIAGARA RIVER	STRAWBERRY ISLAND	19700603	YP	340	480	0.7
NIAGARA RIVER	UPPER	19700000	BB	194	100	0.1
NIAGARA RIVER	UPPER	19700000	BB	184	95	0.1

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APPENDIX C (CONT.) – NYSDEC NIAGARA RIVER FISH TISSUE MERCURY DATA

Feature	Location	Sample Date	Species	Length, mm	Weight, g	Hg, µg/g
NIAGARA RIVER	UPPER	19700000	BB	244	225	0.2
NIAGARA RIVER	UPPER	19700000	BB	270	315	0.2
NIAGARA RIVER	UPPER	19700826	BB	295	410	0.3
NIAGARA RIVER	UPPER	19700826	BB	270	385	0.3
NIAGARA RIVER	UPPER	19700826	BB	276	345	0.3
NIAGARA RIVER	UPPER	19700000	BB	327	485	0.4
NIAGARA RIVER	UPPER	19700826	BB	318	515	0.4
NIAGARA RIVER	UPPER	19700000	BB	251	240	0.6
NIAGARA RIVER	UPPER	19700000	BB	286	360	0.6
NIAGARA RIVER	UPPER	19700000	BB	270	290	0.8
NIAGARA RIVER	UPPER	19700000	BB	267	280	0.9
NIAGARA RIVER	UPPER	19700826	CARP	350	655	-0.05
NIAGARA RIVER	UPPER	19700826	CARP	350	655	-0.05
NIAGARA RIVER	UPPER	19700826	CARP	419	1190	0.05
NIAGARA RIVER	UPPER	19700826	CARP	365	780	0.07
NIAGARA RIVER	UPPER	19700826	CARP	387	980	0.07
NIAGARA RIVER	UPPER	19700826	CARP	470	1615	0.08
NIAGARA RIVER	UPPER	19700826	CARP	430	1170	0.08
NIAGARA RIVER	UPPER	19700826	CARP	432	1195	0.09
NIAGARA RIVER	UPPER	19700826	CARP	345	610	0.1
NIAGARA RIVER	UPPER	19700826	CARP	430	1020	0.1
NIAGARA RIVER	UPPER	19700826	CARP	425	1165	0.1
NIAGARA RIVER	UPPER	19700826	CARP	508	2105	0.1
NIAGARA RIVER	UPPER	19700824	CARP	530	2215	0.1
NIAGARA RIVER	UPPER	19700826	CARP	460	1430	0.2
NIAGARA RIVER	UPPER	19700826	CARP	451	1505	0.2
NIAGARA RIVER	UPPER	19700826	CARP	565	3085	0.2
NIAGARA RIVER	UPPER	19700826	CARP	580	2430	0.2
NIAGARA RIVER	UPPER	19700826	CARP	570	3445	0.2
NIAGARA RIVER	UPPER	19700826	CARP	400	1020	0.2
NIAGARA RIVER	UPPER	19700826	CARP	465	1425	0.3
NIAGARA RIVER	UPPER	19700826	CARP	460	1620	0.3
NIAGARA RIVER	UPPER	19700824	CARP	400	1250	0.3
NIAGARA RIVER	UPPER	19700826	CARP	465	2005	0.4
NIAGARA RIVER	UPPER	19700826	CARP	520	2200	0.4
NIAGARA RIVER	UPPER	19700824	CARP	350	740	0.5
NIAGARA RIVER	UPPER	19700824	CARP	420	1320	0.5
NIAGARA RIVER	UPPER	19700826	CARP	565	2820	0.6
NIAGARA RIVER	UPPER	19700826	DRUM	355	620	0.3
NIAGARA RIVER	UPPER	19700826	DRUM	375	835	0.3
NIAGARA RIVER	UPPER	19700824	DRUM	514	2225	0.3
NIAGARA RIVER	UPPER	19700824	DRUM	464	1630	0.3
NIAGARA RIVER	UPPER	19700824	DRUM	356	760	0.4

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APPENDIX C (CONT.) – NYSDEC NIAGARA RIVER FISH TISSUE MERCURY DATA

Feature	Location	Sample Date	Species	Length, mm	Weight, g	Hg, µg/g
NIAGARA RIVER	UPPER	19700826	DRUM	425	1035	0.4
NIAGARA RIVER	UPPER	19700826	DRUM	445	1360	0.5
NIAGARA RIVER	UPPER	19700826	DRUM	375	765	0.5
NIAGARA RIVER	UPPER	19700826	DRUM	405	865	0.6
NIAGARA RIVER	UPPER	19700824	DRUM	464	1360	0.6
NIAGARA RIVER	UPPER	19700824	DRUM	432	960	0.6
NIAGARA RIVER	UPPER	19700824	DRUM	552	2905	0.6
NIAGARA RIVER	UPPER	19700826	DRUM	470	1680	0.6
NIAGARA RIVER	UPPER	19700824	DRUM	464	1630	0.6
NIAGARA RIVER	UPPER	19700826	DRUM	483	1535	0.7
NIAGARA RIVER	UPPER	19700826	DRUM	457	1735	0.7
NIAGARA RIVER	UPPER	19700826	DRUM	448	1155	0.8
NIAGARA RIVER	UPPER	19700826	DRUM	440	1085	0.9
NIAGARA RIVER	UPPER	19700826	DRUM	420	810	1.2
NIAGARA RIVER	UPPER	19700000	GLDF	270	410	0.1
NIAGARA RIVER	UPPER	19700000	GLDF	219	170	0.1
NIAGARA RIVER	UPPER	19700000	GLDF	200	150	0.1
NIAGARA RIVER	UPPER	19700000	GLDF	232	255	0.1
NIAGARA RIVER	UPPER	19700000	GLDF	225	235	0.1
NIAGARA RIVER	UPPER	19700000	GLDF	264	400	0.2
NIAGARA RIVER	UPPER	19700000	GLDF	273	505	0.2
NIAGARA RIVER	UPPER	19700000	GLDF	235	285	0.2
NIAGARA RIVER	UPPER	19700000	GLDF	276	415	0.2
NIAGARA RIVER	UPPER	19700000	GLDF	229	300	0.2
NIAGARA RIVER	UPPER	19700000	GLDF	283	660	0.2
NIAGARA RIVER	UPPER	19700000	GLDF	225	230	0.2
NIAGARA RIVER	UPPER	19700000	GLDF	210	175	0.2
NIAGARA RIVER	UPPER	19700000	GLDF	276	440	0.2
NIAGARA RIVER	UPPER	19700000	GLDF	276	445	0.3
NIAGARA RIVER	UPPER	19700000	GLDF	235	270	0.3
NIAGARA RIVER	UPPER	19700000	GLDF	232	295	0.4
NIAGARA RIVER	UPPER	19700000	GLDF	356	715	0.4
NIAGARA RIVER	UPPER	19700000	GLDF	222	225	0.4
NIAGARA RIVER	UPPER	19700000	GLDF	279	475	0.4
NIAGARA RIVER	UPPER	19700000	GLDF	222	240	0.4
NIAGARA RIVER	UPPER	19700000	GLDF	210	195	0.5
NIAGARA RIVER	UPPER	19700000	GLDF	283	445	0.5
NIAGARA RIVER	UPPER	19700000	GLDF	248	260	0.7
NIAGARA RIVER	UPPER	19700000	GLDF	238	285	0.8
NIAGARA RIVER	UPPER	19700000	NOP	464	750	0.2
NIAGARA RIVER	UPPER	19700000	NOP	451	1010	0.2
NIAGARA RIVER	UPPER	19700000	RB	178	125	0.2
NIAGARA RIVER	UPPER	19700000	RB	213	175	0.2

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APPENDIX C (CONT.) – NYSDEC NIAGARA RIVER FISH TISSUE MERCURY DATA

Feature	Location	Sample Date	Species	Length, mm	Weight, g	Hg, µg/g
NIAGARA RIVER	UPPER	19700000	RB	181	130	0.2
NIAGARA RIVER	UPPER	19700000	RB	178	120	0.2
NIAGARA RIVER	UPPER	19700000	RB	200	185	0.3
NIAGARA RIVER	UPPER	19700000	RB	184	135	0.3
NIAGARA RIVER	UPPER	19700000	RB	241	295	0.3
NIAGARA RIVER	UPPER	19700000	SMB	305	450	0.3
NIAGARA RIVER	UPPER	19700000	SMB	318	490	0.3
NIAGARA RIVER	UPPER	19700000	SMB	305	430	0.4
NIAGARA RIVER	UPPER	19700000	SMB	267	280	0.4
NIAGARA RIVER	UPPER	19700000	SMB	330	560	0.4
NIAGARA RIVER	UPPER	19700000	SMB	330	570	0.5
NIAGARA RIVER	UPPER	19700000	YP	156	60	-0.05
NIAGARA RIVER	UPPER	19700000	YP	156	60	-0.05
NIAGARA RIVER	UPPER	19700000	YP	222	187	0.2
NIAGARA RIVER	UPPER	19700000	YP	264	280	0.4
NIAGARA RIVER	UPPER	19700000	YP	254	265	0.5
NIAGARA RIVER	UPPER AT BUFFALO	19770613	WS	424.9	698.2	0.24

The fish species codes are:

ALW - ALEWIFE

AMEL - AMERICAN EEL

BB - BROWN BULLHEAD

BLC - BLACK CRAPPIE

BLG - BLUEGILL

BNOSE - BLACKNOSE DACE

CATFI - CATFISH

COS - COHO SALMON

EMSH - EMERALD SHINER

GLDF - GOLDFISH

LMB - LARGEMOUTH BASS

LSTUR - LAKE STURGEON

NOP - NORTHERN PIKE

PKSD - PUMPKINSEED

RB - ROCKBASS

RHSPP - REDHORSE SPECIES

SMB - SMALLMOUTH BASS

SPSH - SPOTTAIL SHINER

SUCK - SUCKER

SUN - SUNFISH SPECIES

WB - WHITE BASS

WEYE - WALLEYE

WP - WHITE PERCH

WS - WHITE SUCKER

YP - YELLOW PERCH

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