I. INTRODUCTION

A. Background

The Federal Water Pollution Control Act Amendments of 1972, PL 92-500, require utilities in the Great Lakes region, as elsewhere in the United States, to conduct 316(b) studies demonstrating that their cooling water intake structures reflect the best available technology for minimizing adverse environmental impacts. Most of these adverse impacts result from the entrainment of small aquatic organisms, such as invertebrates and larval fish, and the impingement of larger organisms, usually adult fish. The objectives of the 316(b) intake study are (1) to accurately quantify entrainment and impingement losses at a power plant and (2) to predict the associated impacts of these losses on source populations in the water body from which that plant draws cooling water. If the responsible state or federal agency, by reviewing a particular 316(b) demonstration study and associated data, finds that entrainment and impingement losses are adversely affecting the source populations, that agency could require that the utility provide "better technology" to minimize these impacts.

In response to a request from the U.S. Fish and Wildlife Service's East Lansing Field Office/Office of Ecological Services (ELFO, East Lansing, Michigan), the Great Lakes Fishery Laboratory (GLFL) undertook an evaluation of Detroit Edison's recently completed 316(b) demonstration (Detroit Edison 1976a) for its coal-fired power plant at Monroe, Michigan. The evaluation was to serve (1) as a detailed critique of the Monroe plant 316(b) demonstration, for use by the field staff and other agencies responsible for reviewing that document, and (2) by way of example, as a guide to assist the field staff in their review of 316(b) demonstrations for other Great Lakes region power plants.

The work agreement between ELFO and GLFL (Appendix A) became effective on April 1, 1977, and an evaluation of Detroit Edison's 316(b) demonstration was initiated on April 4, 1977. An interim progress report was submitted to USFWS Regional Office, Twin Cities, Minnesota, and to the East Lansing Field Office on June 2, 1977, as required in the work agreement; a draft copy of the present report was submitted to the Twin Cities and East Lansing offices for review on February 27, 1978.

B. Procedures and Materials Used in the Evaluation

This evaluation, conducted according to the specifications of the work agreement (Appendix A), involved consideration of the following major elements of Detroit Edison's 316(b) demonstration: (1) the kinds of sampling gear and the manner in which that gear was employed to collect samples from which impingement and entrainment losses of aquatic organisms at the plant could be estimated, (2) the manner in which the impingement and entrainment samples and data were processed and analyzed to provide estimates of entrainment and impingement losses at the Monroe plant, and (3) the manner in which the estimates of impingement and entrainment losses and the other available information were used to arrive at an estimate of the impact of plant operation on the source populations of various aquatic organisms in western Lake Erie and the Raisin River, which serve as cooling water sources for the Monroe plant.

This evaluation required examining many of the original data bases summarized by Detroit Edison in their 316(b) demonstration. Included among these data bases are the following:

- Daily Impingement Data Sheets--Copies of the records listing the total numbers of each species impinged at the Monroe plant from June 1975 through May 1976 were furnished by Detroit Edison.
- Impingement Tally Sheets--Copies of the sheets upon which the numbers of fish collected from the test screenwells were recorded were obtained from Detroit Edison for 20 of the 164 test days. The totals from these tally sheets were transferred by Detroit Edison to the daily impingement data sheets.
- Length Data Sheets--Copies of the records of length measurements of fish from the test screenwells were furnished by Detroit Edison.
- Monthly Impingement Summary Sheets--Copies of Detroit Edison records summarizing the number of each species counted each month from the intake screens and the number of sampling days each month for 1972-76 were furnished to us by the Michigan Department of Natural Resources (MDNR).
- Daily Entrainment Data Sheets--A set of entrainment data collected at the Monroe plant from mid-April 1975 through mid-May 1976 was furnished to us by MDNR, which in turn obtained it from Detroit Edison.

A complete set of the above data bases is on file at GLFL.

As specified in the work agreement, this evaluation also presents an "alternative" evaluation of the impact on the source populations of western Lake Erie and the Raisin River of cooling water use at the Monroe plant. This alternative evaluation, designed to update and otherwise supplement the impact evaluation presented in the 316(b), was based, in part, on materials and data from the 316(b) demonstration, but also included other available information that seemed appropriate for a state-of-the-art impact evaluation.

C. Description of the Once-Through Cooling System at the Monroe Plant

This section, describing the general engineering and operating characteristics and site specific features of the Monroe plant cooling system, is presented to facilitate discussion of impingement and entrainment at the Monroe plant and to provide a general orientation for the reader who may not have a copy of the Monroe plant 316(b) demonstration (Detroit Edison 1976a) available for ready reference.

The Detroit Edison Company plant at Monroe, Michigan, has four generating units with a total rated capacity of 3,150 MW and is the largest generating facility on western Lake Erie. The plant has a once-through cooling system that draws water from the Raisin River via an intake canal at a point about 650 m upstream from the river mouth (Fig. 1). When the plant is operating at full capacity, the cooling water requirement is 3,248 cfs, which is considerably greater than the average flow of the Raisin River (698 cfs; USGS 1977). Throughout most of the year the entire flow of the Raisin River is diverted through the Monroe plant's cooling system, and the additional cooling water demand is met with water from Lake Erie, which is drawn "upstream" to the plant's intake canal through the Raisin River's lower channel. When the Raisin River is at peak flow (usually in February or March; USGS 1976, 1977) or when the plant is operating at sharply reduced capacity, the cooling water requirements of the plant may be met entirely with Raisin River water; at these times, surplus river water flows into Lake Erie via the river's lower channel.

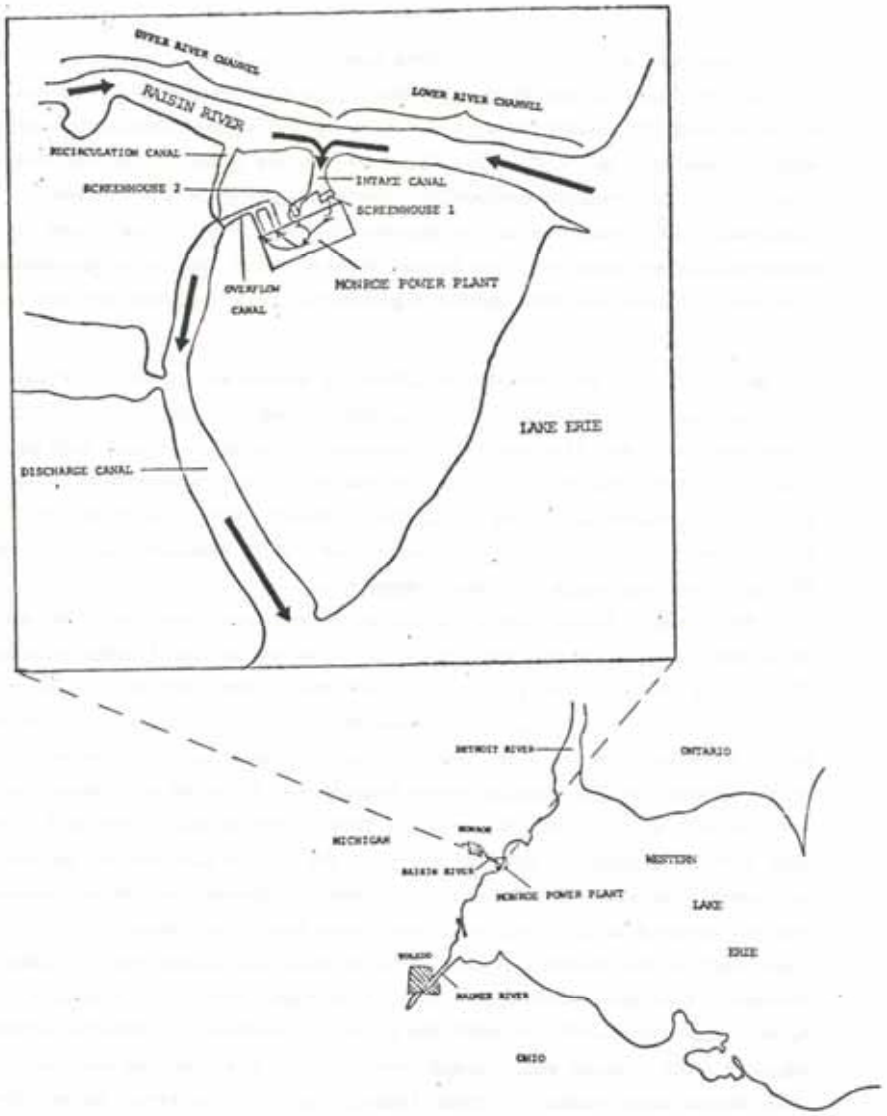

Figure 1. Location of Monroe Power Plant with respect to Lake Erie and the Raisin River (not to scale).

The intake canal branches and directs the cooling water flow into two screenhouses located immediately adjacent to the plant. In the screenhouses, the cooling water passes first through trash racks (fixed vertical metal bars 3 in. apart) and then through 3/8-in. mesh vertical traveling screens. Circulating pumps then force the water through the plant's heat exchangers, and the temperature of the cooling water rises about 22°F. The heated water passes out of the plant into the overflow canal and then into the discharge canal that empties into Lake Erie at a point about 2.5 km SSW of the mouth of the Raisin River. The prevailing lake currents at the plant site, which move along the shoreline from the mouth of the discharge canal towards the mouth of the Raisin River, may cause some recycling of the cooling water.

Organisms drawn into the plant's intake canal with the cooling water will be prevented from entering the plant if they are unable to pass through the 3-in. spacings between the bars of the trash rack. Those organisms that pass through the trash racks but are unable to pass through the 3/8-in. traveling screens will be impinged on these screens and killed. Detroit Edison is testing a prototype device designed to pump fish from immediately in front of the traveling screens and return them alive to Lake Erie. During June 1975-May 1976, a portion of the fish that would otherwise have been impinged in Screenhouse 1 were pumped into holding pools outside the plant for study and return to Lake Erie. Organisms that are not retained by the 3/8-in. screens (small fish, invertebrates, and phytoplankton) pass completely through the plant and return to Lake Erie via the discharge canal.