ANNUAL REPORT

RENSSELAER FRESH WATER INSTITUTE

AT LAKE GEORGE (FWI).

FWI REPORT 72-25

DECEMBER 8, 1972

In recent years, there have been many changes -- at a rapid rate -- within the set of complexities which makes up modern society. Due to these changes, a newly defined role has evolved for technology and its application in solving environmental problems. Keeping pace with these changes, Rensselaer Polytechnic Institute established in 1967 the Rensselaer Fresh Water Institute at Lake George (FWI). The FWI is located on the northeastern shore of this lake in the Adirondack Mountains of New York State. Since 1967, the FWI research program has expanded from an activity supported by the School of Engineering to a program - budgeted independent university activity.

As an independent activity, the FWI is responsible for its financial viability and its Director reports to the Vice-President and Provost, enhancing efficiency and flexibility. This administrative arrangement provides a strong basis for action-orientation in order that the basic research necessary for the solution of today's pollution problems can be compressed into the shortest possible time-frame. The FWI staff consists of the Director, Dr. Nicholas L. Clesceri, Dr. James J. Ferris, Research Coordinator, Mr. John S. Heywood, Manager, and Mr. Shigeru Kobayashi, Laboratory Director.

This organizational arrangement also provides for the training of new personnel having the advantage of multidisciplinary exposure. Although the FWI is not an academic department and does not grant degrees, it has provided the training and facilities necessary for awarding degrees to sixteen students by the departments in which they were enrolled who are currently employed by government and industry in various environmental engineering and science capacities. Twenty other students in several academic disciplines will receive degrees during the next two years.

In addition to students, this multidisciplinary approach involves the participation of some thirty-six faculty and staff representing seven curricular areas and other institutions from the Capital District Region.

The curricula represented are Biology, Chemistry, Economics, Environmental Engineering, Geology, Operations Research and Statistics and Systems Engineering. As an outgrowth of participation in FWI research, these departments offer the following new or revised courses: Management and Planning for Pollution Abatement, Mathematical Modeling for Environmental Systems, Quantitative Geology, Limnology and Environmental Science. Much of the involvement of faculty and students in these areas deals with the development and application of methodology related to the description and potential management of the environment.

The research participants have adequate living and laboratory facilities available at the research site including more than 2,500 square feet of laboratory space. Specialized instrumentation provides analytical capability in atomic absorption spectrophotometry, infrared spectrophotometry, liquid scintillation counting, gas chromatography, carbon analyses and UV - visible spectrophotometry in addition to other specialized apparatus. This equipment is utilized extensively by the FWI staff and associates on a twelve month basis.

Based upon the cooperative involvement of faculty and staff from various university departments, the FWI has developed the capability to respond -- in a short time frame -- to the needs of various organizations. Research activities span the spectrum from experimentation on physical, chemical and biological interactions within ecosystems to mathematical modeling of complex systems including man and his impact on these environmental systems. Inherent in this approach is the development of data analysis, data management and data handling techniques for large blocks of information generated in either the technical or social areas of research.

A significant segment of the FWI research activities is part of the Eastern Deciduous Forest Biome (EDFB). The EDFB is an intergrated

research program within the Ecosystems Analysis portion of the United States' endeavor in the International Biological Program (IBP) which has as its goal the development of research results which will adequately describe terrestrial and aquatic systems so that they may be more wisely managed for the benefit of mankind. The basic unit for investigation has been selected as whole landscapes such as complete drainage basins in which both terrestrial and aquatic studies could be undertaken and the interactions between land and water analyzed and defined. Lake George, a large, oligotrophic, stratified, soft water lake, is one of five sites in the EDFB, and the FWI basically serves as the field facility for these activities. Dr. Clesceri (FWI Director) is the Lake George Site Coordinator for the IBP-related research.

Studies currently being conducted under the IBP program at the FWI include:

Lake George Project No.	Project Title	Institution
1	Management of the IBP-Lake George Study	Rensselaer Polytechnic Institute
2	Lake George Ecosystems Modeling and Data Management	Rensselaer Polytechnic Institute
3	Macro-Nutrients in the Lake George Ecosystem	Rensselaer Polytechnic Institute
4	Nutrient Cycles: (1) Dissolved Organic Compounds in Lake George (2) Nutrient Exchange with Lake Sediments	Rensselaer Polytechnic Institute
5	Primary Productivity of	Rensselaer Polytechnic Institute

Lake George Project No.	Project Title	Institution
5	Rooted Macrophytes in the Littoral Zone	Rensselaer Polytechnic Institute
6	Meteorology of the Lake George Basin	Rensselaer Polytechnic Institute
7	Perturbation Study of Microbial Recycling of Soluble Organics in a Lake	Rensselaer Polytechnic Institute
8	Role of the Heterotrophic Micro-organisms in the Recycling of Particulate Organics	Rensselaer Polytechnic Institute
9	Lake George Hydrologic Study	Rensselaer Polytechnic Institute
10	Remineralization and Resporation of Zooplankton	Rensselaer Polytechnic Institute
11	Zooplankton Production in Lake George: (1) Acoustical and Actuarial Determination of Secondary Production (2) Relation of Community and Trophic Structure to Productivity	State University of New York at Albany
12	Biomass and Feeding of Fishes in Lake George	Rensselaer Polytechnic Institute

Lake George Project No.	Project Title	Institution
13	Macro-Benthic Production in Lake George	Marist College
14	Primary Productivity of Lake George: Its Estimation and Regulations	State University of New York at Albany
15	Population Dynamics of the Algae in Lake George	Skidmore College

Other studies are underway dealing with the potential effect on Lake George of the exhaust discharge from two-cycle outboard engines. In order to preserve suitable water quality in our natural waters, it is important to understand the degree and influence of pollution from outboard engines. This work includes an investigation of the levels of discharges which include fuel and fuel combustion products that exist under a variety of use patterns as a function of time of year. Measurements of discharges which are associated with water surface, water column, sediments and the littoral zone (shallow water area where light penetrates to the bottom) are being measured by various techniques. Studies are also being made to correlate these levels with primary productivity and consumer and decomposer activity. Laboratory and field studies are being made to establish the kinetics of the removal of these materials by way of microbial, adsorptive and evaporative mechanisms. One objective of this work is to establish loading estimates in terms of a boating-house index.

This work is a continuation of a previous study which established the levels of pollution which could be expected from the operation of a

two-cycle outboard engine. In these studies, tests were made in a swimming tank with both an untuned engine and a tuned engine. For an untuned engine it was found that the quantity of fuel wasted as exhaust varied from about 7% of the volume of fuel used at high speeds to over 30% at low speeds. For a recently tuned engine the quantity of fuel discharged ranged from about 3% at high speeds to about 26% at low speeds. Analyses at various depths indicated that nearly all products separated from the water in a short time and collected on the surface; very little dissolved or emulsified oil was noted. This work also indicated that fuel and exhaust products are capable of supporting microbial growth. Growth rates, however, appeared to be limited by available oxygen.

It is felt that this current work will provide information which will indicate considerable limits of boating activity in natural waters. It will also provide information regarding the effects of hydrocarbon fuels and related materials on the biological life in a water environment.

Another study deals with the determination of mercury in aquatic environments. Involved is the determination of mercury dissolved in the water, in the sediments, and in various forms of plant and animal life.

Efforts in the past year have been directed toward elimination of interferences that vitiate results for determination of mercury in industrial effluents that contain significant quantities of industrial chemicals. A combination of chemical and instrumental techniques permits suppression of virtually all such interferences that have been tested.

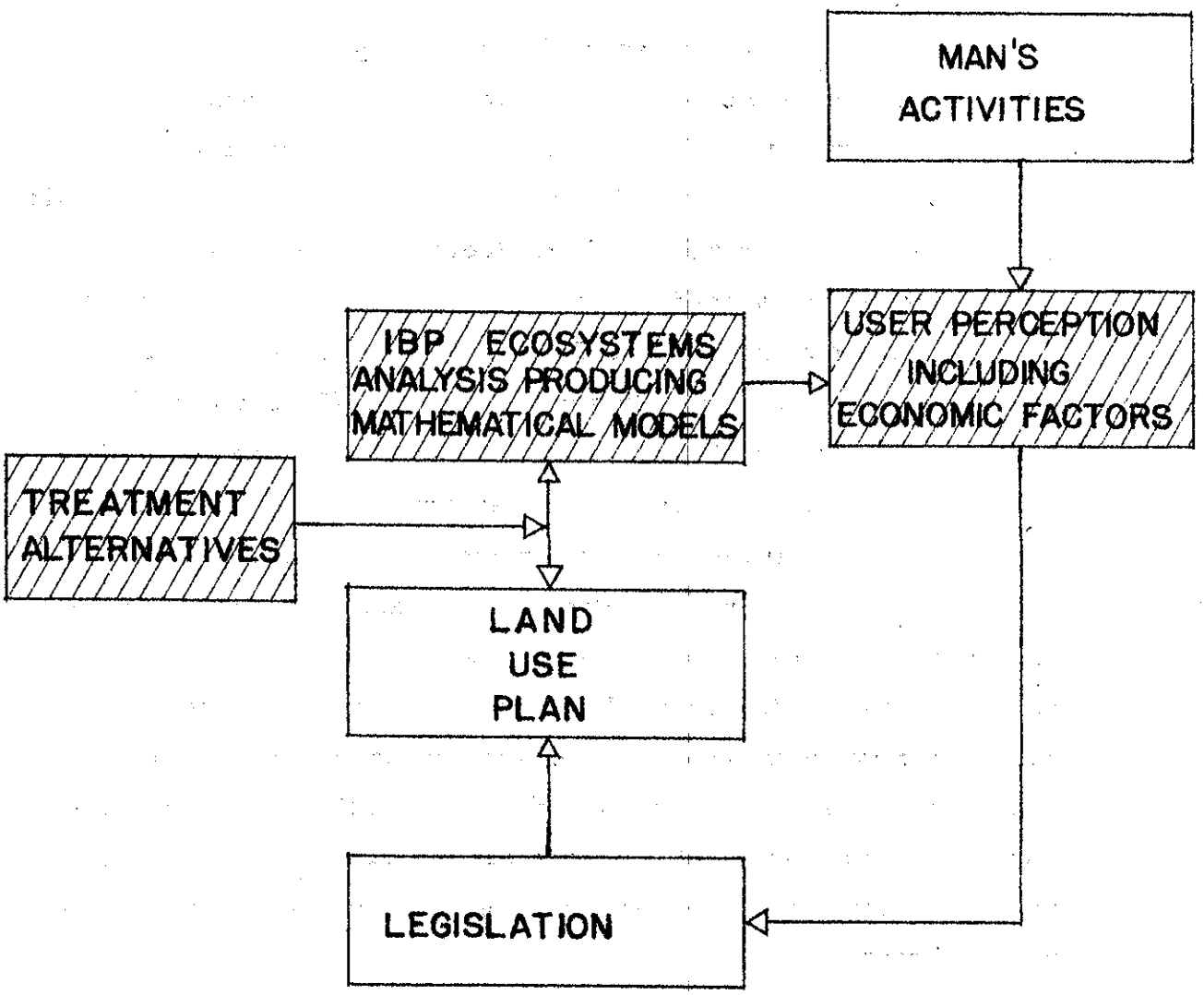
Present efforts are devoted to determination of mercury in the sediments of Lake George, for comparison with studies of heavily polluted lakes. Initial results suggest that the mercury levels in the sediments of Lake George are only slightly lower than those in Lake Ontario. This interesting result, which must be verified by more studies, suggests that either much mercury in lakes occurs naturally or that airborne

pollution is an important factor. These investigations as well as others not described herein are being extended to include the development of predictive capabilities of situations involving external or natural inputs into the lake's ecosystem.

Supplemental to basic research one of the principal objectives of all FWI research projects is to provide data or information which can be used for environmental management. As a consequence of this objective, meetings are currently being held with personnel representing groups and agencies within the Lake George Basin and the Adirondack Region to establish specific programs for applying and making available the technology developed at the FWI for the prevention and control of fresh water pollution within this region. The FWI can now pursue this approach as it is one of the few examples of a long term lake study which is developing and accumulating large amounts of data on a variety of subjects in an integrated and coordinated manner. For example, the FWI is working with an Adirondack area municipality regarding the installation of tertiary treatment at its sewage treatment plant. Presently, secondary treatment plants are viewed as key point sources of nutrients (notably phosphorus) into fresh water bodies. The objective in this or any case is to eliminate their introduction not only to the fresh water body in question but other regional waters as well. Additional activities with a similar objective either are underway or have preliminary planning completed.

This approach to environmental management is illustrated on page 8, bearing in mind the objective is to provide information which can be used to formulate management. Currently, the FWI is involved in data production in the areas shaded in the Figure.

The New York State Science and Technology Foundation is supporting a project initiated this fall entitled "Phosphorus Removal Within Individual Septic Tank Systems." This is a one year project to develop


MAN'S
ACTIVITIES
USER PERCEPTION
INCLUDING
ECONOMIC FACTORS
IBP ECOSYSTEMS
ANALYSIS PRODUCING
MATHEMATICAL MODELS
TREATMENT
ALTERNATIVES
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a scheme capable of augmenting septic tank/leach field systems for nutrient removal, principally phosphorus. The scheme should be as simple as possible and should be serviceable by an authorized septic tank pump-out dealer. It must also be relatively inexpensive and trouble-free if it is to be adapted for use by the general populace. This project has been underway for two months and preliminary design work has been completed. In summary, nutrient removal is being attacked on both a large and small scale and positive results are anticipated in the very near future.

However, a gap exists between treatment for individual homes and municipal treatment - treatment for the smaller resort community. In recognition of this problem, planning has also been completed for wastewater treatment for such a community, i.e. 40 to approximately 160 dwelling units. The principal objective of this planned investigation is to demonstrate the economic, engineering and social feasibility and the applicability of advanced wastewater treatment techniques to waste streams generated in resort communities. The study will determine the acceptability of a physical-chemical wastewater treatment system which includes processes of coagulation-flocculation and sedimentation, activated carbon absorption, dual media filtration and disinfection. An evaluation of the overall system will be made regarding its waste treatment efficiency and socioeconomic practicability.

Social acceptance of the treatment system will be determined through questionnaires dealing with the following areas: the attitudes of the residents toward the need for advanced wastewater treatment, their willingness to provide economic support for the facility, and their acceptance of such a facility in a resort locale for maintenance of the region's environmental quality.

Every attempt will be made to achieve on line status by the summer of 1973. If funding and lease negotiations are not successful, alternatives

will be sought which will delay to a certain extent the on-line status. All other planning has been completed.

Conclusion

It is believed that these three studies referred to above, in conjunction with those previously listed, can be utilized when completed to prevent the input of pollutants within fresh water basins. The need to extend the capabilities of the FWI to freshwaters in addition to the region is becoming increasingly important. With its uniformly strong engineering and science schools, its experience with multidisciplinary programs, its depth of personnel with the necessary scientific and technical expertise, and its commitments to water resources improvement, Rensselaer Polytechnic Institute provides an important technological base for the further development of the FWI. As increased nutrients continue to be found in multiple sources and as man continues to expand contact with the supply of oligotrophic lakes, a thorough understanding and repetitive monitoring of fresh water resources is necessary.