

Admin # 200



(67)

**PROPOSAL
ENVIRONMENTAL ASSESSMENT SERVICES
FOR
THERMAL DISCHARGES
FROM
MERRIMACK STATION**

BID # JES 112

Submitted to

**NORTHEAST UTILITIES SERVICE COMPANY
Purchasing Department
107 Selden Street
Berlin, Connecticut**

Submitted by

**NORMANDEAU ASSOCIATES INC.
25 Nashua Road
Bedford, New Hampshire 03110-5500**

P-14395.099

August 1994

Normandeau Associates, Inc.
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NORMANDEAU ASSOCIATES

August 16, 1994

Northeast Utilities Service Company
Purchasing Department
107 Selden Street
Berlin, Connecticut

ATTN: Joe Smith

Dear Mr. Smith:

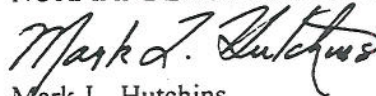
Normandeau Associates Inc. (NAI) is pleased to submit a proposal for Environmental Assessment Services for Thermal Discharges from Merrimack Station, Bid Number JES 112. As you may be aware, NAI conducted most of the environmental studies for Merrimack Station during the late 1960's and 1970's and we are anxious to continue our relationship with PSNH/NUSCO on this important and highly visible project. As you will see in our proposal, NAI has provided the types of services required of Merrimack Station to numerous electric utilities for many years. We are also pleased to announce that we have teamed with RMC-Environmental for this project. Like NAI, RMC is a major player in providing environmental consulting and field services to the electric utilities industry. RMC will be providing staff and equipment for the electrofishing component of this project. We hope you will agree that our team qualifications and location make us uniquely qualified to provide PSNH/NUSCO with a quality product at a reasonable cost.

We would note that there is considerable uncertainty regarding the appropriate scope for Study 1, the temperature monitoring and modeling portion of the project. This is particularly true with the modeling requirements. NAI has costed this study assuming that: 1) daily temperature-duration curves and daily temperature predictions for the 1985-1994 will be necessary to satisfy the agency concerns regarding "the number of days" that temperatures may impact the spring and fall migration runs; and 2) daily paper records for river flow, ambient temperature and plant output will have to be retrieved from PSNH and computerized. The level of effort needed to accomplish this is quite substantial as compared to weekly or monthly simulations, but we believe that daily simulation may also assist PSNH in limiting the length of time that mitigation might be needed. Regardless, should other modeling time steps be deemed satisfactory to PSNH and the TAC, NAI costs would be reduced accordingly.

We look forward to your favorable response. If you require clarification or further information, please do not hesitate to call.

Sincerely,

NORMANDEAU ASSOCIATES INC.



Mark L. Hutchins
Project Manager
Senior Water Resources Engineer

Bedford, NH
Hampton, NH
Yarmouth, ME
Middleboro, MA

Bloomfield, CT
Peekskill, NY
Lakewood, NJ
Greenville, SC

New Ellenton, SC
Ann Arbor, MI
Oak Ridge, TN
Richmond, CA

1.0 INTRODUCTION

Merrimack Station, located in Bow, New Hampshire, draws substantial volumes of once-through cooling water from the Merrimack River. The Station has been in operation in its present capacity since 1968. From 1967 through 1978, Public Service Company of New Hampshire (PSNH) conducted numerous thermal and biological studies of the river, assessing potential impacts from Station operation. Normandeau Associates Inc. (NAI) conducted most of those studies.

During recent relicensing proceedings, review agencies raised a number of concerns relative to Merrimack Station potential impacts to the river, given the current state of water quality and fishery recovery/re-introductions. In response, PSNH revisited the historic data and successfully satisfied some of the agencies' concerns. However, data was not sufficient to address all issues and it was concluded that three additional studies would be required to complete the evaluation of potential impact from Merrimack Station's thermal plume. These studies are:

1. An assessment of the effects of thermal inputs from Merrimack Station on the potential duration of the anadromous fish migration season.
2. An assessment of the potential for entrainment of yellow perch larvae in the thermal plume at Merrimack Station.
3. An assessment of the abundance of yellow perch in the Hooksett Pool relative to their historic abundance and, collection of additional information on the spatial distribution of target fish populations in the Hooksett Pool in relation to the portions of those populations in the present discharge canal.

The following sections detail NAI's proposal for completing these studies for PSNH.

TABLE OF CONTENTS

	PAGE
1.0 INTRODUCTION	1
2.0 STUDY 1. ASSESSMENT OF EFFECTS OF THERMAL INPUTS ON THE DURATION OF THE MIGRATION SEASON	2
3.0 STUDY 2. ASSESS THE POTENTIAL FOR ENTRAINMENT OF YELLOW PERCH LARVAE IN THE MERRIMACK STATION THERMAL PLUME	6
4.0 STUDY 3. INDIGENOUS FISH COMMUNITY ABUNDANCE AND DISTRIBUTION	7
5.0 PROJECT MANAGEMENT AND STAFFING	8
6.0 SCHEDULE AND REPORTS	11
7.0 PERSON-HOUR ALLOCATIONS, RATES AND PROJECT COSTS	13
8.0 QUALIFICATIONS	17
8.1 NORMANDEAU ASSOCIATES	17
8.2 RMC ENVIRONMENTAL	32
9.0 RESUMES	37

2.0 STUDY 1. ASSESSMENT OF EFFECTS OF THERMAL INPUTS ON THE DURATION OF THE MIGRATION SEASON

USFWS and NHDES have expressed concerns about the potential impact of Merrimack Station's thermal discharge on spring spawning runs of anadromous fish (primarily shad) and on fall downstream migration runs (primarily juvenile clupeids), respectively. These concerns focus on the Amoskeag headpond where it is believed that more or less complete mixing at the Hooksett Hydro facility (either by passage through the turbines, over the dam or a combination of both) may eliminate stratification that is evident in the Hooksett headpond, thereby eliminating a "safe" zone of passage.

It has been recommended that some type of temperature modeling may be necessary to make an adequate demonstration of impact. In previous comments to PSNH, NAI suggested that it may be possible to derive a relatively simple, statistically-based model, rather than attempting to construct, calibrate and verify a more sophisticated and expensive model such as QUAL 2e or IWTM. We continue to believe that this is the best approach to take at this time. Our proposed study plan for this task is detailed below.

Ambient river temperature is largely controlled by a very complex set of meteorological forcing functions. These functions include solar radiation; shading from clouds, topographical features and vegetation; secondary radiation from other sources such as the atmosphere, vegetation and natural and man-made structures; evaporation; time of year; and many other factors. River hydrology and geometry also play roles as do artificial sources of heat such as thermal discharges. If one is attempting to do real-time forecasting of river temperature, then all of these influencing factors must be considered. However, if one is trying to evaluate the impact of a thermal discharge on ambient river temperature during some predefined time period and "critical condition" (e.g., 7Q10 flow during August), then meteorological factors may not play any role at all.

NAI believes that the task before PSNH is more of the latter than the former. Meteorological data play a role only to the extent that they determine anticipated ambient river temperatures during the May 1 - June 30 and September 1 - October 31 periods of concern.

Because ambient river temperature is ultimately the parameter needed for the analysis and because these data are readily available, an alternative approach would be to statistically develop temperature-duration curves for points of concern rather than using complex meteorological data. By taking this approach, the forcing functions to be incorporated into a predictive model are relatively few; namely, they are ambient river temperature, river flow, thermal output from Merrimack Station, and location downstream. Most required data are readily available although a modest field component will be necessary to supplement the existing database.

Therefore, NAI's proposed study plan for assessing thermal impacts involves the following components:

- 1) conduct periodic intensive field surveys during the May 1 - June 30 and September 1 - October 31 time periods to supplement the existing temperature database;
- 2) develop a statistically-based predictive model using available data and data collected during #1 to calibrate and verify the model;
- 3) using the calibrated and verified model, make a ten-year time series demonstration of predicted thermal impacts for the 1985-1994 time period;
- 4) using the long-term monitoring data available for the Merrimack Station intake, develop temperature-duration curve(s) for the time periods of interest, and;
- 5) using the model, ambient temperature-duration curve(s), and three Station operational scenarios, develop predictions of the number of days favorable and unfavorable temperatures are expected to occur at downstream locations during the time periods of concern.

NAI believes that the existing database (both historic and that which is currently being collected) is not sufficient to complete the necessary analysis. Therefore, we propose the following field sampling program to supplement available data. Once every other week during each period of concern (4 events in the spring; 4 events in the fall), NAI will collect temperature data at selected transects in the study area. This effort will focus on the Amoskeag headpond but will also include selected transects above Hooksett Hydro to insure that conditions downstream of Hooksett can be adequately correlated to conditions upstream of

Hooksett. As of this time, we propose to reoccupy selected historic temperature collection sites to provide continuity and comparability with prior studies. These transects are tentatively identified as N10, O, S4, S8, S12, S16, S20, S24, and AO-7. Measurements will be made by 1-foot profiles at six equi-spaced stations along each transect. All monitoring will be conducted by boat using calibrated field temperature monitoring meters.

These new data will be combined with the temperature data presently being collected by PSNH at Merrimack Station intake and discharge, Hooksett Hydro and Amoskeag Hydro, with river flows provided by PSNH for Garvins Falls and with Merrimack Station plant output, also provided by PSNH, to form the database for developing the predictive model. At present, NAI anticipates evaluating these data statistically with the end result being one or more regression equations which will describe river temperature at selected downstream locations as functions of ambient river temperature, river flow and station output.

If the "model" is not capable of accounting for 90% of the variation in downstream river temperature, this study component will be terminated and alternative methods of study will be evaluated and proposed to PSNH. If 90% or more of the variation can be accounted for, NAI will proceed with the tasks discussed below.

First, NAI will gather ambient river temperature, river flow and plant output data from PSNH for the 1985-1994 time period (for the spring and fall periods of concern). These data will then become input to the model to generate a ten-year simulation of predicted plant impacts at selected downstream locations based on actual conditions that occurred during that 10-year period.

Second, NAI will develop temperature-duration curves for ambient river temperatures using the entire period of record at the plant intake station. It is not known, at present, how many temperature-duration curves will be required (a minimum of two would be necessary to describe the spring and fall periods of interest), but NAI anticipates weekly and perhaps daily curves will be necessary to provide the level of detail suggested in the RFP (e.g., "the number of days" that favorable/unfavorable conditions exist).

Finally, NAI, in consultation with PSNH, USFWS and NHFGD, will develop criteria that define the level and duration of temperatures that are likely to impact spring and fall migration patterns. When these criteria are defined, NAI will re-examine the recent 10-year record to determine to what extent significant impact was likely to have occurred and the number of days that the impact occurred in excess of what would have occurred naturally. In addition, NAI will forecast future predicted impacts using the historic temperature-duration curve(s), the criteria developed above, and three plant operating scenarios (zero output, Unit 2 output only and maximum generating capacity). These results will be used to assess the potential thermal impact of Merrimack Station on migrating fish and assist in determining the extent of mitigation that might be necessary to avoid unacceptable impact, should such an impact exist.

3.0 STUDY 2. ASSESS THE POTENTIAL FOR ENTRAINMENT OF YELLOW PERCH LARVAE IN THE MERRIMACK STATION THERMAL PLUME

NAI will conduct Study 2 as described in the Request for Proposal. Ichthyoplankton drift net samples (0.5 m diameter, 505 micron) will be collected during the day from two depths at three mid-stream locations in each of three Merrimack River regions during each of eight weeks. A total of 144 samples will be collected during May and June 1995 (2 x 3 x 3 x 8 = 144). A minimum volume of 50 cubic meters will be collected with each sample, as measured by a General Oceanics 2030R flowmeter. These samples will be processed and analyzed as described in the Request for Proposal. Processed samples will be held for a period of one year after sampling or until the final report is accepted by the client, whichever is the shorter duration. These samples and residue will be disposed of in accordance with federal, state and local regulations for solid and hazardous wastes.

4.0 STUDY 3. INDIGENOUS FISH COMMUNITY ABUNDANCE AND DISTRIBUTION

The NAI/RMC team will conduct Study 3 as described in the Request for Proposal. Fyke net samples will be collected with the same gear used by NAI during the 1972-1978 study. Six stations will be sampled with two consecutive 48-hour fyke net sets during each of eight sampling events (May, June, July, August, September, October, fall, and winter). A total of 96 fyke net samples will be collected between September 1994 and August 1995. Thirteen 300 m long electrofishing transects will be sampled during the day for each of the same eight sampling events proposed for fyke netting. A total of 104 electrofishing transects will be sampled between September 1994 and August 1995. Electrofishing will be conducted with 8-10 amps of pulsed DC (120 pps) current administered to the water from boom-mounted electrodes of an 18-ft. shock boat. A three-person crew will conduct the electrofishing operation.

All fish caught in each fyke net or electrofishing sample will be identified to species and enumerated, and up to 20 individuals of each fish species in each sample will be measured to the nearest mm (total length) and weighed in grams ($\pm 1\%$). Notes will also be made on external condition (eg. fin rot, ulcers or skeletal anomalies) of the fish caught. Water temperature will be measured at two depths at all fyke net and electrofishing stations (30 cm below the surface and 10 cm above the bottom). Water quality measurements will be made with instruments calibrated at the start and end of each sampling day. We will also observe air temperature, weather conditions and fish habitat during sampling.

All field measurements will be provided with a 10% average outgoing quality limit (AOQL). All data tables, files and calculations will be provided with a 1% AOQL. Fyke net and electrofishing catch per unit of effort indices will be analyzed to compare the relative abundance of target fish species in the canal and the river sampling stations.

5.0 PROJECT MANAGEMENT AND STAFFING

NAI has put together a highly qualified team of scientists to conduct this project. Mark Hutchins, Senior Water Resources Engineer and Group Manager of NAI's Water Resources Group, will serve as Project Manager. Mr. Hutchins has more than 20 years of experience dealing with water resources issues and has special expertise in the areas of waste discharge, plume mapping and modeling and thermal discharge evaluation. In addition to supervising the overall conduct of this project, Mr. Hutchins will oversee the thermal monitoring and modeling component.

Dr. Mark Mattson, assistant vice president and Senior Group Manager of NAI's New York and Fisheries Groups, will oversee the fisheries studies. Dr. Mattson has been closely affiliated with the electric utility industry throughout his career, having conducted dozens of fisheries studies for the New York utilities on the Hudson River. The studies required for Merrimack Plant are virtually identical in nature to some of those that he and his group have been conducting for more than 10 years.

Mr. Hutchins and Dr. Mattson will be assisted by several key senior staff. Richard Simmons, senior fishery scientist and manager of our Bedford office's fishery field studies, will be responsible for the field components of the fishery studies for this project. Mr. Simmons has conducted numerous drift net, fyke net and electrofishing studies on major rivers throughout the Northeast and is presently actively involved in anadromous fish issues on the Merrimack River. Paul Geoghegan and Paul Lindsay, both senior fishery scientists, will provide analytical support for evaluating the fisheries data. Mr. Geoghegan and Mr. Lindsay both have many years of experience statistically analyzing ichthyoplankton and fish data, generally as it relates to potential impacts from cooling water intake/discharges from electric utilities. Don Kretchmer, Senior Scientist in NAI's Water Resources Group, will be responsible for conducting the temperature monitoring component of this project and for creating the prediction model for assessing potential downstream thermal impacts. Mr. Kretchmer has had technical responsibilities for virtually every lake, river and estuary water quality study conducted by NAI over the last 7 years and has played major roles in every river modeling study over the same time frame.

NAI will be assisted by RMC in conducting the electrofishing component of this study. Mr. Tim Brush, Department Manager of RMC's Northeast Regional Office in Brattleboro, Vermont will oversee RMC's project involvement. Mr. Brush has more than 10 years of fisheries experience, almost all of which has been for the electric utilities industry.

The above key senior staff members will be assisted by several important support staff, each of which has at least several years of experience in their respective fields. Resumes for these key support staff as well as senior staff are provided in Section 9.0. Figure 5-1 presents NAI's proposed organizational chart and key staffing.

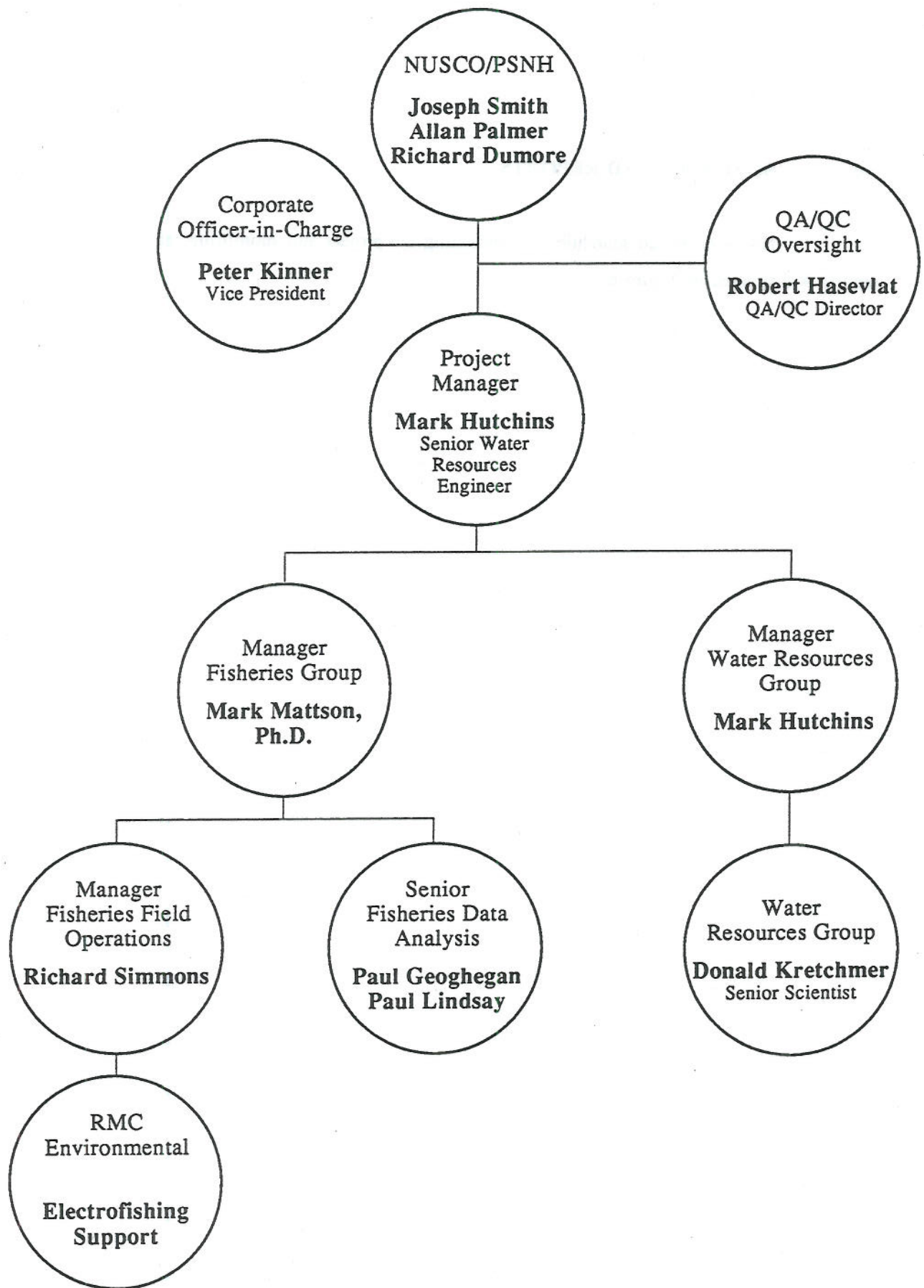


Figure 5-1. Project organization chart and senior staffing.

6.0 SCHEDULE AND REPORTS

NAI's proposed schedule for conducting the project and submitting required reports is displayed in Figure 6-1.

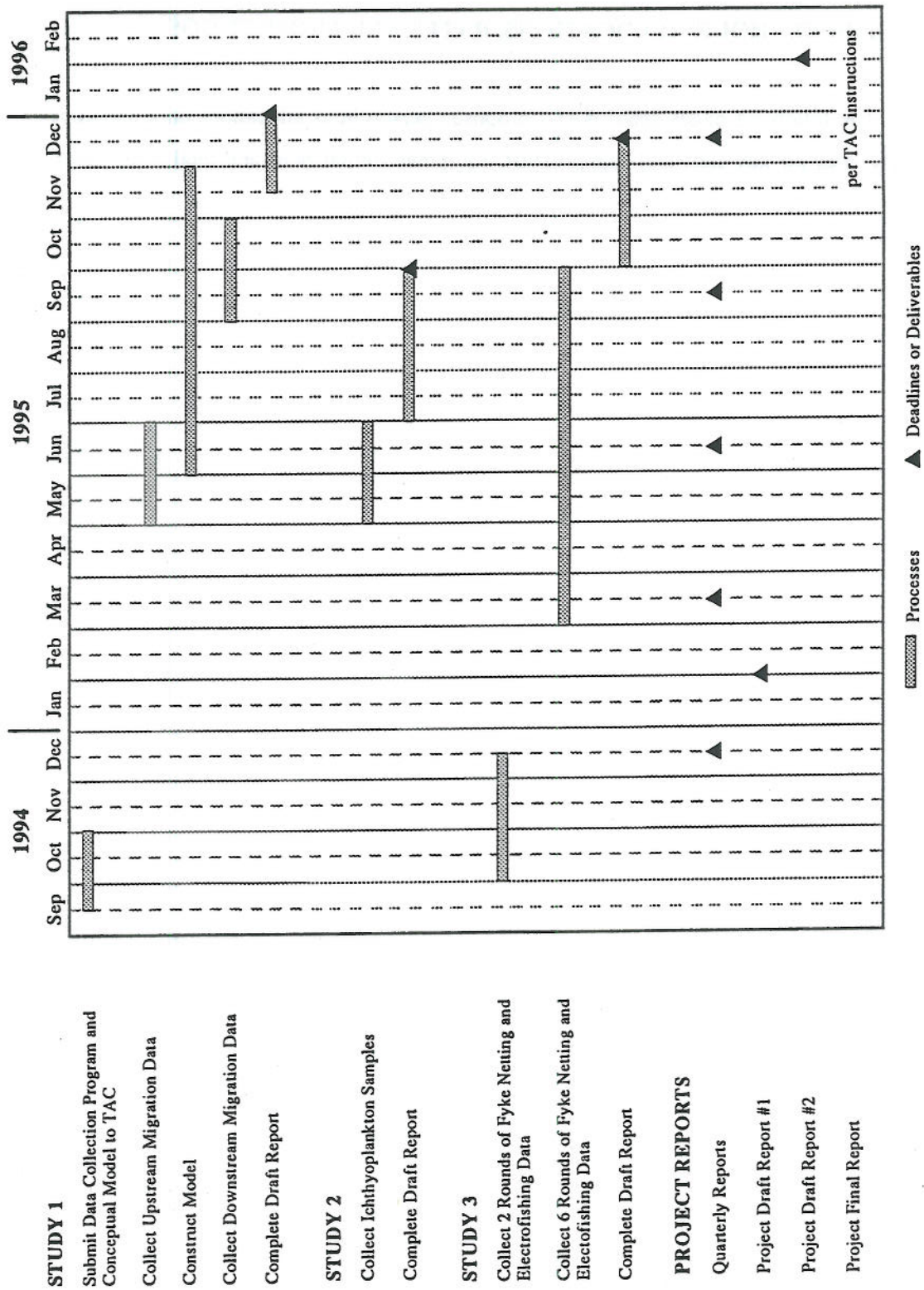


Figure 6-1. Proposed project schedule and reports.

7.0 PERSON-HOUR ALLOCATIONS, RATES AND PROJECT COSTS

The following pages detail NAI's proposed person-hour allocations on a per-study basis, hourly rates for key staff and support staff, equipment rental rates and total study costs.

STAFF HOURS ALLOCATIONS BY TASK

STAFF	STUDY 1*	STUDY 2*	STUDY 3*	TOTAL*
Hutchins	104	8	8	120
Mattson		8	8	16
Simmons		20	28	48
Brush			16	16
Kretchmer	176			176
Geoghegan		22	22	44
Lindsay		22	22	44
Staff	<u>756</u>	<u>450</u>	<u>982**</u>	<u>2,188</u>
Total	1,036	530	1,086	2,652

* Includes meeting and reporting time

**Includes hours for RMC's electrofishing activities

UNIT COSTS—LABOR AND NON-LABOR

PERSONNEL	HOURLY RATE	
	July 1, 1994—June 30, 1995	July 1, 1995—June 30, 1996*
Mattson	86.57	89.59
Hutchins	85.35	88.33
Brush (RMC)	80.00	82.80
Kretchmer	59.60	61.68
Geoghegan/Lindsay	57.71	59.73
Simmons	55.54	57.48
Staff (NAI & RMC)	17.40—43.65	18.01—45.17

NON-LABOR

Mileage—trucks	\$0.45/mi
Boats and Motor Rental	\$500**
Shock Boat Rental	\$150/day
Temperature Meter Rental	\$14/day
Per diem	\$5/day
Copies	\$0.10/page
Computer Time	No charge

*Estimated

**Duration of project

BID SCHEDULE

Study 1. \$54,220

Study 2. \$18,570

Study 3. \$39,214

Total Project \$112,004

8.0 QUALIFICATIONS

8.1 NORMANDEAU ASSOCIATES

Normandeau Associates Inc. (NAI) was founded in 1969 as an environmental consulting firm specializing in ecological impact assessment. In 1990, NAI was acquired by Thermo Analytical which is a subsidiary of Thermo Instruments and in turn, Thermo Electron of Waltham, Massachusetts. NAI's corporate headquarters and chemistry and aquatic/marine biological laboratories are located in Bedford, New Hampshire with branch offices located in Hampton, New Hampshire; Middleboro, Massachusetts; Peekskill, New York; Lakewood, New Jersey; Yarmouth, Maine; Aiken, South Carolina; and Richmond, California.

Throughout NAI's history, service to the electric utility industry has been an important component of our workload. As you are well-aware, NAI (or its predecessor) conducted virtually all of the environmental studies for Merrimack Stations during the late 60's and 70's. We have also provided environmental services for the Seabrook nuclear plant, from conception to present. Our New York office (managed by Mark Mattson) provides fisheries and water quality support to the New York utilities on the Hudson River (New York Power Authority, Consolidated Edison of New York, Central Hudson Gas and Electric Co., Niagara Mohawk). We are also involved periodically with numerous other Northeast utilities including New England Power, Consolidated Hydro and Central Maine Power.

In the following pages, we have enclosed selected project descriptions which display our recent experience with projects of a similar nature as the Merrimack Stations work. We think you will agree that we are eminently qualified to undertake this important project for PSNH. RMC qualifications and project descriptions follow NAI's material.

Client: Central Hudson Gas and Electric Corporation

Project: Roseton and Danskammer Point Generating Stations
Impingement Studies

Location: Hudson River, Newburgh, New York

Description: Weekly collection and analysis of impingement samples was conducted at two fossil-fuel electric generating stations that use water from the Hudson River for once-through cooling. In 1989, 1990, 1993 and 1994, impingement data were collected for fishes and for the larger invertebrates including blue crabs. Impingement samples were collected on one day per week throughout the year, and consisted of four consecutive six-hour diel periods. Length measurements were made on fish and carapace width measurement and sex were recorded for blue crabs. Water quality data that were collected with each sample included temperature, conductivity, dissolved oxygen, pH, and turbidity. A water quality sample was also obtained in each week from the near field river channel and analyzed for metals. Analysis of the data focused on seasonal (within-year) and long-term (among-year) patterns of water quality, species composition, abundance, and biomass of impinged fish. Total annual impingement was estimated by extrapolating the sample data on the basis of impingement rates and total plant flow.

Clients: Central Hudson Gas and Electric Corp.; Consolidated Edison Company of New York; New York Power Authority; Niagara Mohawk Power Corp.; Orange and Rockland Utilities

Project: Hudson River Fisheries Research and Monitoring Studies

Location: Hudson River, New York

Description: Several related studies have resulted from a regulatory settlement in which five major utilities agreed to fund scientific research on the fisheries and aquatic biota of the Hudson River Estuary. Annual investigations begun in 1981 under a 10-year biological monitoring program include: 1) determining the relative contribution to the Hudson River population of hatchery-reared striped bass fingerlings and 2) describing demographic characteristics of Hudson River fish stocks, such as abundance of various age groups, fish length at maturity, natural mortality rates of each lifestage, growth rate, and fecundity. One of the most important program tasks is to develop testable and practical hypotheses to interpret long-term responses of these population characteristics to such physical, chemical, and biotic (impact) factors as: fishing pressure, food availability, water temperature, salinity, and, possibly toxic contaminants. NAI studies have included: 1) striped bass population estimations, 2) estimation of abundance and description of demographic characteristics of Atlantic tomcod and white perch populations, 3) analysis of impingement and entrainment rates, 4) evaluation of quantitative fisheries sampling methodologies and associated gear types, and 5) the monitoring of densities and distributions of ichthyoplankton and young-of-the-year white perch, shad, striped bass, and tomcod.

Client: Consolidated Edison Company of New York, Inc.

Project: Hudson River Ichthyoplankton and Fall Juvenile Surveys and Special Studies of Ichthyoplankton and Juvenile Fish Distributions

Location: Hudson River between New York City and Albany, New York

Description: The Hudson River Ichthyoplankton and Fall Juvenile Surveys are biological monitoring studies that have been conducted for the Hudson River utilities since the early 1970s. These surveys are intended to satisfy certain NPDES (SPDES) cooling water withdrawal permit requirements by providing ichthyoplankton samples and data on juvenile fish. These data are used to calculate standing crops and conditional mortality rates selected fish species in the 152-mile tidal position of the Hudson River between New York City and Albany. The target fish species include striped bass, white perch, Atlantic tomcod, and American shad. NAI has been responsible for the collection of approximately 15,300 ichthyoplankton samples and 16,800 juvenile fish samples in the Hudson River; a total unmatched among environmental contractors.

A significant result of our sampling design and gear evaluations was replacement of a 1.0 m² epibenthic sled with a 3-m beam trawl to more efficiently sample juvenile fish in shoal and bottom areas of the Hudson River Estuary. NAI also provided ichthyoplankton density data from areas of the Hudson River not previously sampled due to obstructions and gear limitations. NAI effectively deployed ichthyoplankton nets from shallow draft, out-board vessels. NAI also successfully deployed a 2-m beam trawl indicating the potential for this gear to catch juvenile striped bass in shallow, shoal or near-shore areas.

NAI produced the annual year class reports which were intensive analytical examinations of ichthyoplankton and juvenile fish populations sampled in 1982 and 1983.

Client: Consolidated Edison Company of New York, Inc.

Project: Impingement and Entrainment Studies at East River, Ravenswood and Arthur Kill Generating Stations

Location: New York City, New York

Description: We conducted impingement and entrainment sampling at three fossil fuel powered generating stations in New York City for one year (1993-1994) to estimate: (1) the number of adult fish impinged on traveling screens, and (2) the amount of ichthyoplankton entrained into the cooling water systems of the stations. Impingement samples were collected weekly and consisted of a 24-hour collection of impinged fish from four six-hour diel periods. Entrainment samples were collected with pumps monthly or twice per month and consisted of a 24-hour sample from four six-hour diel periods. The number of fish impinged per unit of cooling water and per operating day as well as the total number of fish impinged in a year were estimated. These studies were conducted to satisfy New York State Pollution Discharge Elimination System (SPDES) operating permit requirements.

Client: Consolidated Hydro, Inc.

Project: Adult American Shad Telemetry Study

Location: Merrimack River, Lowell, Massachusetts

Description: NAI designed and conducted a radio telemetry study that identified downstream passage routes utilized by shad at the Lowell Hydroelectric Project. The study involved capturing and radio tagging adult shad at the Lowell Project during their upstream spawning migration. These fish were then followed by airplane and vehicle during the upstream and subsequent downstream migration.

Additionally, fixed location telemetry units were installed at the project to continuously monitor three possible downstream routes: the fish bypass, the powerhouse tailrace, and a canal system. NAI was able to remotely monitor these fixed location units via phone modems, and get daily updates on passage results.

Client: Consolidated Hydro, Inc.

Project: Assessment of Juvenile Alewife Movement Through a Downstream Fish Bypass

Location: Merrimack River, Lowell, Massachusetts

Description: NAI conducted a mark and recapture experiment to estimate the percentage of juvenile alewives using the downstream fish bypass at the Lowell Hydroelectric Project during their fall migration. Wild alewives were captured in the powerhouse forebay during the peak of their downstream migration. NAI biologists tested and applied a dye to mark the alewives which proved superior to any used previously. The dyed fish were released upstream of the powerhouse, where they had the option to pass downstream through either the fish bypass or the turbines.

NAI designed and constructed a net that filtered 100% of the bypass flow. It was fished continuously for five days to capture all fish exiting the bypass. NAI did additional netting in the powerhouse forebay to prove that marked fish were mixing with unmarked fish.

In addition to the bypass evaluation, the study was the first to document the seasonal and diel periodicity of emigrating juvenile clupeids in the Merrimack River.

Client: Consolidated Hydro, Inc.

Project: Radio Telemetry Assessment of a Downstream Fish Bypass and Turbine Mortality of Atlantic Salmon Smolts

Location: Merrimack River, Lowell, Massachusetts

Description: NAI conducted a radio telemetry study to evaluate the effectiveness of the Lowell Hydroelectric Project's fish bypass at passing downstream migrating Atlantic salmon smolts. In addition, radio telemetry techniques were used to determine the mortality rates of smolts which had passed through the powerhouse turbines. The study involved tagging and releasing salmon above the powerhouse, determining which passage route they chose, and tracking them for several hours downstream of the facility. The turbine mortality rates were determined based on the difference in the rate and pattern of movement of known dead fish equipped with radio tags versus the movement of radio tagged live "test" fish. NAI presented the results of this study at the 1991 Atlantic Salmon Workshop, held in Rockport, Maine.

Client: New York Power Authority

Project: Hudson River Striped Bass Program

Location: Hudson River and New York Harbor, New York

Description: As part of a mitigation effort under the 1980 Hudson River Settlement Agreement, the Hudson River Utilities have operated a striped bass hatchery and stocked more than two million striped bass fingerlings to the Hudson River. To evaluate the contribution by this hatchery to the wild stock, NAI has conducted the Hudson River Striped Bass Program annually from 1984 to present. Concurrent with the hatchery evaluation, NAI conducted a large scale wild striped bass stock assessment through a mark-recapture program. Program objectives were met by capturing striped bass in a winter trawling and Scottish seining effort in the lower Hudson River and New York Harbor. Hatchery contribution to the wild stock was assessed through a mark-recapture program which involved the capture of more than 200,000 striped bass and individually checking them with a magnetic tag detector. The annual winter population of striped bass was estimated by the release and recapture of more than 135,000 fish that were individually tagged by our field crews.

NAI developed gear deployment, tagging, fish handling, and gear evaluation techniques, as well as specialized fish holding equipment that resulted in minimal handling mortality to striped bass. NAI also evaluated different striped bass tags for retention and tagging mortality. The striped bass tag recommended by NAI is now the standard tag used in all east coast striped bass tagging programs. In addition, the relative costs of trawling and Scottish seining were evaluated to determine the most efficient method of capturing striped bass for tagging. NAI investigated striped bass, length frequency and age frequency distributions, food habits, mitigation, and made mark-recapture estimates of striped bass population size. NAI has developed the most comprehensive database on Hudson River striped bass known and continues to add to this database.

Client: Niagara Mohawk Power Corporation

Project: C.R. Huntley Steam Station Thermal Plume Analysis and Biological Impact Assessment

Location: Niagara River, Buffalo, New York

Description: Thermal plume surveys (in the Niagara River above Niagara Falls) and thermal analysis were performed in 1974-1975 to prepare a 316(a) Demonstration for the once-through cooling water system and shoreline discharge of this fossil fuel power generating station. We repeated these thermal studies in 1982-1983 to upgrade the previous work in compliance with a New York State Pollution Discharge Elimination System permit (SPDES) requirement. In 1988, Niagara Mohawk Power Corporation proposed to increase the delta-Ts at their Huntley Station during the winter operating mode. Normandeau Associates Inc. performed a modeling study to evaluate changes in the thermal plume and potential biotic impacts. Thermal plume surveys and modeling efforts, conducted by NAI several years earlier at this site, provided the basis for this additional assessment.

The basis for the biological impact assessment was an extensive literature review of the thermal tolerance of several key species of fish. Proposed changes in the thermal plume were evaluated with respect to the known temperature requirements of the fish at various life stages. The effects of changes in cooling water withdrawal rate on impinged fish and entrained fish eggs and larvae were also examined.

Results indicated no significant change in the thermal plume or in biotic impacts. Permit modification was promptly granted by the N.Y. State Department of Conservation.

A thermal plume validation study was conducted in 1991 which verified the predictions of our 1988 modeling study.

Client: Niagara Mohawk Power Corporation

Project: Dunkirk Steam Station 316 (a) Demonstration and Thermal Plume Studies

Location: Lake Erie, Dunkirk, New York

Description: A tri-axial thermal plume survey was conducted in Dunkirk Harbor during 1975-1976 to describe the three-dimensional shape of the cooling water plume discharged from the Dunkirk Steam Station into Lake Erie. The plume data and biological data were evaluated to assess the effects of the heated discharge on Dunkirk Harbor and the nearshore Lake Erie. Our results were presented as a National Pollution Discharge Elimination System (NPDES) 316 (a) demonstration to satisfy draft operating permit requirements.

Renewal of the discharge permit in 1982 required biological monitoring studies and a thermal modeling analysis to evaluate the extent of the 10 (°F) ΔT isotherm under plant loadings greater than or equal to 75%. Additional thermal plume modeling and fisheries studies were conducted in 1990 to satisfy the current discharge permit requirements. In these 1990 studies, we modeled discharge plume temperature increases under reduced circulating water flows. We also predicted the effects of temperature increases on the near-field fish community and on the survival of entrained fish. Finally, we characterized the effects of circulating water pump shutdown on resident fish species in the plume.

Client: North Atlantic Energy Service Corp.
(Yankee Atomic Electric Company)

Project: Seabrook Station Environmental Studies

Location: Seabrook, New Hampshire

Description: Comprehensive ecological studies have been performed in a complex marsh-estuarine-marine environment for a 1150 megawatt generating unit utilizing open-ocean, once-through cooling water systems; studies have supported various design considerations, including the final design with intake and discharge structures one mile offshore. Studies have also been performed in response to construction and preoperational monitoring requirements.

Ecological monitoring studies are continuing and have focused on: 1) soft-shell clam populations in the Hampton-Seabrook estuary and impacts due to construction and operation, especially entrainment of larvae; 2) finfish, plankton, benthos and lobster studies, especially quantitative description and community analysis associated with project impacts; 3) water quality and sediment studies in support of ecological characterizations and for impact analysis; and 4) hydrographic monitoring, especially to support hydrothermal analyses for intake and discharge design and to examine mixing of water masses, e.g. Hampton estuary waters mixing with offshore waters.

Studies in support of design and construction activities have included: 1) an evaluation of potential effects of dissolved substances released from marsh peat on estuarine organisms (construction impacts associated with early estuary intake designs); 2) aquatic effluent bioassays on a settling pond utilized during construction for site dewatering, stormwater runoff and tertiary treated sanitary wastewater; and 3) an off-site chlorine minimization pilot study.

NAI has also provided extensive expert witness testimony at hearings before the NRC and the USEPA.

Client: Northeast Utilities Company
(Harza Engineering Company)

Project: Turners Falls Juvenile Shad Study

Location: Connecticut River

Description: Study involved capturing juvenile american shad in a 20 mile segment of the River between the Vernon (VT) and Turners Falls dams (MA). The primary objective was to map their general distribution in space and time in the river, especially the area around the intake to the Northfield Pump Storage Project.

Shad were collected by day with a 300' beach seine at 27 stations, and at night with a boat electroshocker at 60 stations.

Client: Public Service Company of New Hampshire

Project: Merrimack Generating Station Anadromous Fisheries Investigations

Location: Merrimack River, Bow, New Hampshire

Description: NAI conducted environmental studies on the Merrimack River at a two-unit, 470-megawatt, coal-fired electric generating station. The plant's once-through cooling system utilizes the water of the Merrimack River. Studies during the first two years of operation were designed to accumulate baseline information, a program requirement of the State-issued water-use permit. Annual monitoring programs were then conducted to detect both seasonal changes in the ecology of the river and possible effects caused by the plant's thermal discharges.

The monitoring study program included investigations of chlorophyll *a*, plankton, aquatic plants and insects, benthic invertebrates, and fish communities. Chemical and physical water quality studies included characterization and delineation of the thermal plume. Hydrothermal studies were also used to monitor the efficiency of a spray cooling system. A special American shad egg and larvae rearing program was initiated and used in a determination of the effects of the plant's thermal effluent on potential shad habitat. These studies were conducted to determine 1) downstream drift characteristics of developing shad eggs, 2) early larval behavior, and 3) egg and larval tolerance to temperature increase through laboratory in situ bioassays. Data were synthesized into an assessment of the potential entrainment and thermal shock mortality for shad eggs and larvae at the power plant. This program required development of a well-equipped rearing laboratory with precisely controlled tanks of heated river water.

NAI also conducted a radiotelemetry study using adult American shad to determine whether the thermal discharge was acting as a barrier to upstream and downstream migrations and to see if the discharge affected swimming behavior of the shad.

Client: Public Service Company of New Hampshire

Project: Piscataqua River Ecological Studies Program

Location: Portsmouth, New Hampshire

Description: NAI conducted estuarine ecological monitoring studies in the Piscataqua River for the oil-fired Schiller Station and the adjacent 400-megawatt Newington Station. Schiller Station studies focused on thermal plume definition for various tidal and station operation conditions and on entrainment/entrapment. Both studies provided data useful in designing the intake and discharge structures for the Newington Station once-through cooling water system.

Detailed preoperational and operational monitoring programs conducted for the Newington Station included plankton, periphyton, finfish, commercially important shellfish, water quality and thermal plume mapping. Detailed benthic studies were conducted in the nearfield of the power plant utilizing highly replicated monthly sampling to try to separate thermal impacts from spatial and temporal variability. Each year a major analytical report was developed analyzing each of the programs. Finally, a 316(a&b) demonstration document was prepared which satisfied the requirements for the NPDES permit.

8.2 RMC ENVIRONMENTAL

RMC was originally founded in 1966 as Ichthyological Associates to assess the ecological impacts of a planned pumped storage hydroelectric generating station on the lower Susquehanna River in Pennsylvania. Many of the issues that staff biologists addressed during licensing proceedings for this station (fish entrainment, turbine mortality, water quality, etc.) remain as key environmental issues facing the nationwide hydroelectric and steam generating industry today.

RMC has retained a large and stable staff of biologists and scientists who have specialized in assessing and solving the environmental issues surrounding electric generation throughout our twenty-eight year history. The company has continually strived to remain involved in and apprised of technological and research advances affecting all aspects of this specialized field.

RMC biologists are known within the scientific community for our pioneering research and work in the areas of radio telemetry, turbine mortality, and entrainment, water quality, and instream flow. RMC's recent advances and research in the area of turbine survival of fishes have made a significant impact upon the way hydro turbine effects on fish are viewed.

RMC's Hydropower Consulting Division is headquartered at the Muddy Run Ecological Laboratory in Drumore, PA, on the banks of the pumped storage lake where its initial efforts in the hydroelectric field began. An additional office is located along the Connecticut River in Brattleboro, Vermont where staff biologists and scientists are involved in addressing fish passage and other concerns at a number of hydroelectric stations in the Northeastern United States. From these two locations, RMC biologists work across the country and internationally to address environmental concerns at hydroelectric generating stations.

316 EXPERIENCE PROFILE

RMC has been involved in 316(a) & (b) demonstrations at power plants since the early 1970's. RMC biologists have conducted original research on swim speeds of fishes, temperature preference and avoidance of numerous fish species, and other related studies. A representative listing of RMC publications is found at the end of this section. RMC works closely with J. E. Edinger and Associates, Inc., (JEEAI) to develop analyses and computer modeling of intake and discharge effects. Qualifications and experience of JEEAI are available upon request. The following lists specific 316 a & b studies conducted by RMC biologists.

316(a) EXPERIENCE

**Philadelphia Electric Company
Cromby Generating Station, 1971-1990**

**William F. McElroy
(215)841-4627**

RMC in 1988-1989 developed a real time load management thermal discharge control strategy for this two-unit once - through cooling power station (345 MW) located on the Schuylkill River. This development arose out of an NPDES permit appeal filed by Philadelphia Electric Company as supported by a Section 316(a) variance request prepared by RMC in the late 1970's. Philadelphia Electric Company and the PA DER agreed to Settlement and avoided a hearing as a direct result of RMC's ability to convince the PA DER and Pennsylvania Fish Commission that an alternative temperature limitation (in excess of State standards) would be sufficient to protect the selected representative important species, smallmouth bass and American shad. The key components of the load management plan which was put into operation calculate a mixed river temperature and an allowable percentage of full station output based upon certain temperature and duration limits. Based on simulations performed by RMC using 30 years of river temperature and flow data this load management plan was considered an economically attractive alternative to cooling towers.

Peach Bottom Atomic Power Station (PBAPS)

**Mr. John Ballantine
(215)640-6874**

A successful 316(a) demonstration was prepared by the firm over 10 years ago for this 2,230 MW once-through cooling power station. RMC is now occasionally involved in thermal discharge concerns at this power plant. A higher than normal water quality standard temperature limit for the discharge and part-time use of cooling towers were negotiated.

Confidential Client in New England

In 1990, RMC performed studies mandated by a State regulatory agency as part of a NPDES permit renewal on a major New England river which has recently experienced a return of migrating Atlantic salmon. The facility was a refuse-derived electric generating station. The vertical and horizontal extent of the thermal plume was determined under full load conditions at river flows near Q7-10. A laser, dynamic positioning system was used to track the location of the plume survey vessel. Cross-sectional vertical profiles of flow direction and velocity were assessed for four tidal stages, and a determination was made of the extent of cooling water recirculation (re-entrainment) under several operating conditions and river flows.

Edge Moor Power Plant
Delmarva Power & Light Company

Mr. Frank Henshaw
(302)454-4427

RMC prepared the 316(b) evaluation for Edge Moor in 1979 and within the past 5 years has been involved in three additional projects related to 316 and NPDES issues at the EMPP. The first in 1989 was an ichthyoplankton study of use of the Delaware River near EMPP as a spawning and nursery area by striped bass. Densities of striped bass eggs and larvae were determined and related to temperature and fresh water impact to the estuary. Densities were also compared to available existing data for the Delaware and other East Coast waters with striped bass populations.

The second project, in 1989-1990, evaluated thermal plume compliance with new emerging water quality regulations. Thermal plume surveys were conducted by RMC to assess the horizontal and vertical distribution of the plume under four tidal stages at both spring and neap tide. Results were assessed with respect to maximum temperatures, delta-T, and thermal block and surface area water quality standards.

RMC in early 1991 performed a Section 316 Compliance Review for EMPP which was necessitated by control zone permit and NPDES permit issues associated with siting of a new power plant immediately adjacent to EMPP. This study evaluates both 316(a) & (b) compliance with current regulations provides an of date evaluation of intake impact, and examines alternative intake structures and compliance strategies, if needed.

316(b) EXPERIENCE

Public Service Electric & Gas
Newark, NJ, 1991

Robert P. Douglas
(201)430-8258

RMC is currently conducting 316(b) compliance reviews at the Burlington and Mercer Generating Stations on the Delaware River for PSE&G. Entrainment and impingement data from each station is being collected between January and December 1991. This information will be compared with results from the original 316(b) studies performed in the mid-1970's and all the information collected will serve as the basis for an updated evaluation of compliance with the Best Technology Available guidelines.

Philadelphia Electric Company

William G. McElroy
(215)841-4627

Delaware River Estuary 1969-Present

RMC personnel have been involved since 1969 in impingement and entrainment matters at all of Philadelphia Electric Company's Philadelphia area power plants on the Delaware River Estuary. Prior to 1975 monitoring of impingement at the five of the Delaware River plants and the single Schuylkill River plant.

In 1975-1979, RMC performed detailed 24-hour impingement and entrainment studies and prepared 316(b) demonstrations for the six stations. The intakes at all of the stations except Eddystone were deemed to be in compliance by the PA DER and EPA.

Continuing from 1979 through the present RMC has provided expert consulting support in response to regulatory agency concerns about impingement at Eddystone. As water quality conditions improved during the 1980's in the tidal Delaware, regulatory agency attention toward Eddystone has increased such that Philadelphia Electric Company has been required to reinstate impingement monitoring during summer and fall when high numbers of fish can be expected. In addition, RMC has provided an on-call fish rescue service which is activated to provide 24-hour coverage to return impinged fish alive to the river during episodes of especially high impingement catches. This service was activated over a three month-long period when certain river flow and salinity coincided with an especially strong year class of young spot.

In response to increasing numbers of fish, especially striped bass, in the River in the vicinity of Eddystone (near Chester, PA), RMC was called upon to evaluate means of reducing the number of fish impinged at Units I and II (oldest of the four units). The client selected wedge-wire screens from a broad selection of behavioral and hardware options evaluated by RMC. Wedge-wire screens were installed at Unit I in 1990 and will be installed at Unit II in 1991.

Delaware River 1973-Present

Since 1973 senior RMC personnel have been involved in the Point Pleasant Pumping Station, an alternate water supply for Limerick Generating Station. They conducted the site-specific ecological and hydrological studies, and alternative intake evaluation that lead Philadelphia Electric Company to redesign and relocate the intake. RMC provided expert testimony regarding the intake design and operation, and its fish-protective features before the USNRC and PA Environmental Hearing Board. Limerick Station's intakes on the Delaware River, as well as on the Perkiomen Creek and Schuylkill River, all of which required similar involvement by RMC, have been judged state-of-the-art by PA DER.

Schuylkill River 1971-1978

Monitoring programs, and 316(a) and (b) submittal for Barbadoes and Cromby Stations. The largest of these stations, Cromby, has required continuing interaction by RMC with Philadelphia Electric Company and the regulatory agencies.

1979-Present

Expert consulting in support of cooling water intake for Limerick Station, Schuylkill River. Operational monitoring and consulting to support position that vertical travelling screens at the main intake structure on the Schuylkill River comply with 316(b) requirements.

Susquehanna River

Since the mid-1970's RMC personnel have evaluated entrainment and impingement and interacted with the regulatory agencies regarding their concerns about losses of aquatic life to the Peach Bottom Atomic Power Station on the Susquehanna River. Recent concerns have centered on impacts to American shad which have become more numerous on the Susquehanna (as they have in the Delaware).

RMC personnel managed and prepared 316(b) demonstrations and conducted compliance studies at Peach Bottom, consulted on the Design for the Unit II and III intake, and coordinated an intake volume reduction plan with part-time use of cooling towers

Delmarva Power and Light Company

**Frank Henshaw
(302)454-4427**

In 1978-1979 RMC performed an evaluation of entrainment and impingement data and prepared a 316(b) demonstration document for the Edge Moor Power Plant near Wilmington, DE. RMC consolidated the pertinent existing plant specific biological and plant operating data into a demonstration which showed that the existing intake qualified for a "Best Technology Available" decision by the DE DNREC.

Jersey Central Power & Light Company

Proj. Mgr. Reassigned

RMC personnel in the late 1970's performed essential data gathering and evaluation concerning entrainment and impingement at Gilbert Generating Station, located on the middle (non-tidal) Delaware River.

Metropolitan Edison Company

Proj. Mgr. Reassigned

In the late 1970's RMC personnel obtained impingement and entrainment, and in-river biota at Portland Generating Station, located on the middle Delaware River.

**GPU Nuclear Corporation
2574 Interstate Drive
Harrisburg, PA 17110**

**Thomas Teitt
(717)540-4510**

Impingement and entrainment studies at Three Mile Island, part of operational monitoring program with which RMC has been involved since the early 1980's.

**Metropolitan Edison Company
Reading, PA**

RMC performed a 316(b) entrainment and impingement study at Titus Generating Station, Schuylkill River, in 1984. The vertical traveling screens were found to comply with 316(b) requirements.

9.0 RESUMES

NAI

Scott Farrell
Paul Geoghegan
Robert Hasevlat
Mark Hutchins
Jeff King
Peter Kinner
Donald Kretchmer
B. Paul Lindsay
Donald Mason
Mark Mattson
Richard Simmons
Joseph Strube

RMC

Ray Bleistine
Timothy Brush
Scott Copenheaver
Lynn DeWald
Paul Heisey

SCOTT FARRELL

Fishery Technician/
Marine and Freshwater Taxonomist

Mr. Farrell has over 5 years experience in fisheries related work. he is proficient with all types of fishery sampling gear and has worked for the last 4 years on radio telemetry and upstream and downstream fish passage studies.

EDUCATION

1986 Goffstown High School

SPECIAL TRAINING

PADY certified diver

PROFESSIONAL EMPLOYMENT HISTORY

1989-present Normandeau Associates Inc.

SELECTED PROJECT EXPERIENCE

Plattsburg (NY)
Lower Saranac River Telemetry Studies; Senior Field Biologist; 1993. Conducted Radio Telemetry studies on Atlantic Salmon and Steelhead Trout to determine downstream passage routes of these species through the lower Saranac River Hydroelectric Facility.

Lawrence (MA)
1. Radio telemetry assessment of upstream and downstream passage of radio tagged adult American shad through the Lawrence Hydroelectric Project. Field Biologist, 1993.

2. Downstream evaluation of bypass for Atlantic salmon smolts and adult American shad and alewife at the Lawrence Hydroelectric project. Field Biologist, 1993.

3. Mark and recapture study to determine the percent use of a downstream fish bypass system by juvenile American shad, alewife and blueback herring. Field Biologist, 1992, 1993.

4. Underwater camera study to assess internal fish lift efficiency for adult American shad and Atlantic salmon. Field Biologist, 1993.

Lowell (MA)

1. Radio telemetry study to determine upstream and downstream passage of radio tagged adult American shad through the Lowell Hydroelectric project. Field Biologist, 1993.

2. Mark and recapture studies to determine the percentage of juvenile clupeids through various entrance configurations for a downstream bypass system. Field Biologist, 1991, 1992, 1993.

3. Underwater camera study to assess the downstream movement of adult clupeids through the downstream fish bypass system. Field Biologist, 1993.

4. Inclined plane trap studies to determine the start of downstream movement of juvenile clupeids at the Lowell Hydroelectric Project. Field Biologist, 1991.

New Bedford (MA); Collection of sediment and water quality samples associated with the clean up of EPA Superfund site. Field Technician, 1992, 1993.

Gloucester (MA); Collection of sediment samples associated with the enlarging of the Gloucester Fish Pier. Field Technician, 1993.

Hampton (NH); Collection and workup of samples taken for the Seabrook Environmental Studies, 1989 to present.

SCOTT FARRELL

Fishery Technician/
Marine and Freshwater Taxonomist

SELECTED PROJECT EXPERIENCE (continued)

Ustus (ME); Minimum flow survey on the Dead River, Maine for relicensing of Flagstaff Hydroelectric Project. Field Technician, 1990.

Berlin (NH); Minimum flow survey for the relicensing of the hydroelectric project.

Bristol (NH); Fisheries and IFIM studies associated with the relicensing of the Ayers Island Hydroelectric project. Field Biologist, 1990-1991.

PAUL GEOGHEGAN

Fisheries Biologist

Mr. Geoghegan is experienced in environmental monitoring, fish population dynamics, and evaluation of fish conservation strategies. He has worked in communities ranging from cold water salmonid fisheries of northern New England to demersal fish of the Gulf of Mexico. In addition, he is experienced in quantitative habitat assessment and biostatistics.

EDUCATION

M.S. 1981 Wildlife and Fisheries Sciences
Texas A&M University

B.S. 1978 Marine Biology
Southeastern Massachusetts University

SPECIAL TRAINING

Fisheries Hydroacoustic Assessment Techniques
Certified in Habitat Evaluation Procedures; 1984
Certified Scuba Divemaster; 1983

PROFESSIONAL EMPLOYMENT HISTORY

1984-present Normandeau Associates Inc.
1982-1984 Metcalf & Eddy, Inc.
1980-1981 Massachusetts Division of
Marine Fisheries

PROFESSIONAL AFFILIATIONS

American Fisheries Society - Certified
Fisheries Scientist
National Shellfisheries Association
New England Estuarine Research Society

SELECTED PROJECT EXPERIENCE

Damariscotta Hydroelectric Project Exhibit E (ME);
1993-1994; Report Author.

Lawrence Hydroelectric Station Spring Downstream
Passage Studies (MA); 1993-1994; Report Author.

Central Artery/Third Harbor Tunnel Mitigation
Project (MA); 1993-1994; Fisheries Biologist.

East River, Ravenswood and Arthur Kill Generating
Stations Impingement and Entrainment Studies
(NY); 1993; Program Manager.

Seabrook Nuclear Generating Station Annual Opera-
tional Report (NH); 1992-1993; Report Author.

Fish Turbine Entrainment/Mortality Study Plan (WI);
1990; Technical Director.

James F. Fitzpatrick Nuclear Power Plant Fish
Deterrence Studies (NY); 1990; Technical Director.

Albany Steam Generating Station Intake Studies
(NY); 1990; Technical Director.

Biological Monitoring Studies at C.R. Huntley
Generating Station (NY); 1990-91; Program Manag-
er.

1988-1990 New York Power Authority Fish Deter-
rence Studies (NY); Program Manager.

1987-88 New York Power Authority Indian Point
No. 3 Fish Deterrence Studies (NY); Program
Manager.

Indian Point Nuclear Generating Station (NY) Im-
pingement Studies; 1985, 1986, 1989; Technical
Director.

1988 Relative Probability of Capture Program (NY);
Technical Director.

PAUL GEOGHEGAN

Fisheries Biologist

SELECTED PROJECT EXPERIENCE (Cont.)

1988-1989 Hudson River Ichthyoplankton and Fall Juvenile Surveys (NY); Program Manager.

1985-present Hudson River Striped Bass Hatchery Evaluation/Atlantic Tomcod Program (NY); Technical Director.

1985-1986, 1991-1992 Long River Ichthyoplankton and Fall Juvenile Surveys on the Hudson River (NY); Technical Director.

1986 and 1987 Special Studies to Examine Fish Abundance in Unsampled Areas of the Hudson River (NY); Technical Director.

Adult Striped Bass Tagging Study (NY); 1984; Report Author.

Big "A" Hydroelectric Facility (ME); 1984-1985; Fishery Biologist.

Environmental Evaluation of Wastewater Disinfection Practices in Northern New England; 1983; Report Co-author.

Combined Sewer Overflow Abatement Applications; 1983; Biologist.

Plymouth Massachusetts Wastewater Outfall Siting; 1983; Biologist & Co-Author.

Massachusetts Estuary and Shellfish Heavy Metal Survey; 1982; Biologist.

Bryan Mound Brine Disposal; 1978-1981; Research Assistant.

SELECTED PRESENTATIONS AND PUBLICATIONS

Geoghegan, P., and M.E. Chittenden. 1982. Reproduction, movements and population dynamics

of the longspine porgy, *Stenotomus caprinus*. Fishery Bulletin 80(3):523-540.

Geoghegan, P., M.T. Mattson, D. Dunning and Q.E. Ross. 1989. Improved data in a tagging program through quality assurance and quality control. American Fisheries Society Symposium 7:714-719.

Geoghegan, P., M.T. Mattson, and R. Keppel. 1992. Distribution of the shortnose sturgeon in the Hudson River estuary, 1983-1988. In: C.L. Smith Ed., Fisheries Research in the Hudson River. Hudson River Environmental Society. p. 217-227.

Geoghegan, P., M.T. Mattson, J.J. Reichle and R.G. Keppel. 1992. Influence of salt front position on the occurrence of uncommon marine fishes in the Hudson River Estuary. Estuaries 15(2):251-254.

Dunning, D.J., Q.E. Ross, P. Geoghegan, J.J. Reichle, J.K. Menezes, and J.K. Watson. 1992. Alewives avoid high frequency sound. North American Journal of Fisheries Management 12(3):407-416.

Dunning, D.J., Q.E. Ross, M.T. Mattson, P. Geoghegan and J.R. Waldman. 1989. Reducing mortality of striped bass captured in seines and trawls. North American Journal of Fisheries Management 9(2):171-176.

Mattson, M.T., P. Geoghegan, D.J. Dunning. 1992. Accuracy of catch per unit effort indices of Atlantic tomcod in the Hudson River. In: C.L. Smith ed., Fisheries Research in the Hudson River. Hudson River Environmental Society. p. 323-338.

Metzger, S., R. Keppel, P. Geoghegan, A. Wells. 1992. Abundance of selected Hudson River fish species in previously unsampled regions: Effect on standing crop estimates. In: C.L. Smith ed., Fisheries Research in the Hudson River. Hudson River Environmental Society. p. 348-375.

PAUL GEOGHEGAN

Fisheries Biologist

**SELECTED PRESENTATIONS
AND PUBLICATIONS (Cont.)**

Geoghegan, P. 1993. Is development in aquatic vegetated areas always detrimental to water quality and fisheries resources? A case study. Presented at the 1993 New England Estuarine Research Society Meeting.

Geoghegan, P., and M.E. Chittenden. 1982. Reproduction, movements and population dynamics of the longspine porgy, *Stenotomus caprinus*. Presented at the 112th Annual Meeting of the American Fisheries Society, Hilton Head, South Carolina, USA.

Geoghegan, P., M.T. Mattson, D. Dunning and Q.E. Ross. 1986. Effects of water temperature, collection gear, and tag type on handling mortality of striped bass. Presented at the 1986 Northeast Fish and Wildlife Conference, Hershey, Pennsylvania USA.

Geoghegan, P. and M.J. McGinniss. 1983. Impacts of chlorinated effluent on trout fisheries of the Dog River, Northfield, Vermont. Presented at the 1983 Northeast Fish and Wildlife Conference, Mount Snow, Vermont, USA.

McGinniss, M.J., P. Geoghegan and R.J. Reimold. 1983. Assessing the impacts of wastewater disinfection on coldwater fisheries; A hazard analysis procedure. Presented at the Fourth Annual Meeting of the Society of Environmental Toxicology and Chemistry. Arlington, Virginia, USA.

ROBERT C. HASEVLAT

Quality Assurance Director

SELECTED PROJECT EXPERIENCE (Cont.)

Quality Control Supervisor, Piscataqua Marine Laboratory; 1980-1983. Responsible for meeting quality control standards for taxonomic tasks in the laboratory.

St. Lawrence River, Superfund Site; 1991; QA Auditor.

Portsmouth (NH) Naval Shipyard Ecological Risk Assessment; 1991; Project Manager.

Central Artery/Third Harbor Tunnel Disposal Site Alternative Study, Boston (MA); 1990; Field Coordinator and Technical Writer.

New Bedford Harbor Superfund Site Sediment Sampling Program; 1990; Site Supervisor and Health and Safety Officer.

Charlestown Navy Yard Pier Contaminated Sediment Remedial Investigation, Boston (MA); 1989; Health and Safety Officer.

USEPA, Region V, Development of Dredging Handbook for Great Lakes Region; 1988-1989; Technical Writer.

SONO Seaport Seafood, Bloom Brothers, Norwalk (CT) Environmental Studies for Maintenance Dredging of Marina Facilities, Permitting; 1988-1990; Technical Writer.

Biological Evaluation of Proposed Borrow Sites for New Jersey Beach Erosion Control Project; 1987 and 1989; Project Manager.

Water Quality Monitoring Study of Channel Maintenance in Haverstraw Bay, Hudson River (NY); 1987; Project Manager.

Biological Monitoring of Maintenance Dredging in Newark Bay (NJ); 1987-1988; Project Manager.

Seabrook Environmental Studies (NH); 1981, 1984-1991; Technical Writer.

Piscataqua River (NH) Ecological Studies; 1976-1980; Assistant Project Director.

Piscataqua River (NH) Ecological Studies; 1970-1976; Marine Biologist.

SELECTED PRESENTATIONS AND PUBLICATIONS

Hasevlat, R. Size class distributions of adult lobsters off the New Hampshire coast, 1975-1988. Presented at the Workshop on the Life History of the American Lobster; University of Maine, Orono, Maine; November 29-30, 1989.

Bonin, J., M. Bowen, P. Kinner, R. Hasevlat, and J. Shipman. 1985. Temporal population characteristics of the American lobster off the coast of New Hampshire. Estuarine Research Federation - Eighth Biennial Conference, Durham, New Hampshire.

Trends in size, sex, movements and catchability of lobsters (*Homarus americanus*) and rock crabs (*Cancer irroratus*) in the Piscataqua River Estuary, NH. Paper presented at New England Estuarine Research Society. May, 1978.

Mathieson, A.C., J.W. Shipman, J.R. O'Shea and R.C. Hasevlat. 1976. Seasonal Growth and Reproduction of Estuarine Furoid Algae in New England. J. Exp. Mar. Biol. Ecol., Vol. 25, pp. 273-284.

Mr. Hasevlat has participated as a technical writer for numerous reports involving the oil and utility industries.

MARK L. HUTCHINS

Senior Water Resources Engineer

Mr. Hutchins possesses over 20 years experience in lake, river and estuary water quality assessments including nutrient and ecosystem modeling, thermal discharge evaluations, BOD-DO relationships and hydroelectric development studies. Mr. Hutchins has evaluated numerous existing and new waste discharges, hydroelectric development licenses/applications and surface water quality impacts for a variety of development activities throughout New England.

EDUCATION

M.S. 1977 Civil Engineering/Water Resources
University of Maine

B.A. 1973 Geological Sciences
University of Maine

SPECIAL TRAINING

Micro-computers and Engineering Applications
MIT 1984
EPA Waste Discharge Screening Techniques
Boston 1984
Water Quality Modeling with Qual Ite Tufts 1983

PROFESSIONAL EMPLOYMENT HISTORY

1985-present Normandeau Associates Inc.
1982-1985 Maine Department of Environmental
Protection
1973-1982 University of Maine, Environmental
Studies Center, Land and Water
Resources Center

SELECTED PROJECT EXPERIENCE

Farmington River Minimum Flow (CT), Connecticut
Department of Environmental Protection; 1992-
1993; Principal Investigator.

Moxie Stream Minimum/Maximum Flow (ME),
Central Maine Power Co.; 1990-1991; Principal
Investigator.

Ottawquechee River Minimum Flow (VT), Killington,
Ltd; 1992; Principal Investigator.

Danskammer Groundwater Monitoring (NY), Central
Hudson Gas & Electric Co; 1988-1991; Program
Manager.

Route 111 EIS, New Hampshire Department of
Transportation; 1990-ongoing; Program Manager.

Route 101 EIS, New Hampshire Department of
Transportation; 1990-ongoing; Principal Investiga-
tor.

Maine Turnpike Widening EIS, Maine Turnpike
Authority; 1988-ongoing; Principal Investigator.

Waste Discharge Evaluation, Stearns & Wheeler for
the Town of Seabrook (NH); 1987-ongoing; Princi-
pal Investigator.

Waste Discharge Dispersion (CT), The Upjohn Co.;
1987-1990; Project Manager-Principal Investigator.

Waste Discharge License (VT), Killington LTD;
1985-ongoing; Project Manager/Principal Investiga-
tor.

Water Quality Modeling (NH), James River Corp.;
1987-1989; Project Manager/Principal Investigator.

Biomass Boiler Electric Generating Facility (ME),
Swift River/Hafslund: 1987; Project Manager/
Principal Investigator.

MARK L. HUTCHINS

Senior Water Resources Engineer

SELECTED PROJECT EXPERIENCE (Cont.)

Motel Development (NH), Kimball-Chase, Inc.; 1986; Principal Investigator.

Cargo Port Development (ME), Maine Department of Transportation; 1985-ongoing; Participating Investigator.

Condominium Development (ME), Dictar Associates; 1986-1988; Principal Investigator.

Housing Development (MA), Heritage Builders; 1986; Project Manager/Principal Investigator.

Waste Discharge Relicense (ME), Great Northern Paper Company; 1985; Project Manager/Principal Investigator.

Waste Discharge Relicense (ME), Georgia-Pacific Paper Company; 1983-1985; Project Manager/Principal Investigator.

Waste Discharge Relicense (ME), Maine Public Service Company; 1985; Project Manager/Principal Investigator.

Hydroelectric Development (ME), Great Northern Paper Company; 1985; Participating Investigator.

Waste Discharge Relicenses and Wasteload Allocations (ME), Boise-Cascade Corporation and International Paper Company; 1982-1985; Assistant Engineer.

Messalonskee Stream Study (ME); 1984-1985; Project Manager/Principal Investigator.

Waste Discharge License (ME), Maine Energy and Recovery Company; 1984; Principal Investigator.

Hydroelectric Development (ME), Central Maine Power Company; 1984; Participating Investigator.

Hydroelectric Development (ME), Central Maine Power Co.; 1984; Assistant Engineer.

Lake Ecosystem Research; 1982; Principal Investigator.

Lake Biomanipulation; 1980-1982; Co-Principal Investigator.

Simplified Marine Water Quality Modeling; 1980; Principal Investigator.

Lake Input/Output Nutrient Models; 1976-1980; Assistant Investigator.

Farmington River Minimum Flow (CT), Connecticut Department of Environmental Protection; 1992-1993; Principal Investigator.

Moxie Stream Minimum/Maximum Flow (ME), Central Maine Power Co.; 1990-1991; Principal Investigator.

Ottawaquechee River Minimum Flow (VT), Killington, Ltd; 1992; Principal Investigator.

Danskammer Groundwater Monitoring (NY), Central Hudson Gas & Electric Co; 1988-1991; Program Manager.

Route 111 EIS, New Hampshire Department of Transportation; 1990-ongoing; Program Manager.

Route 101 EIS, New Hampshire Department of Transportation; 1990-ongoing; Principal Investigator.

Maine Turnpike Widening EIS, Maine Turnpike Authority; 1988-ongoing; Principal Investigator.

Waste Discharge Evaluation, Stearns & Wheler for the Town of Seabrook (NH); 1987-ongoing; Principal Investigator.

MARK L. HUTCHINS

Senior Water Resources Engineer

SELECTED PROJECT EXPERIENCE (Cont.)

Waste Discharge Dispersion (CT), The Upjohn Co.; 1987-1990; Project Manager-Principal Investigator.

Waste Discharge License (VT), Killington LTD; 1985-ongoing; Project Manager/Principal Investigator.

Water Quality Modeling (NH), James River Corp.; 1987-1989; Project Manager/Principal Investigator.

Biomass Boiler Electric Generating Facility (ME), Swift River/Hafslund; 1987; Project Manager/Principal Investigator.

Motel Development (NH), Kimball-Chase, Inc.; 1986; Principal Investigator.

Cargo Port Development (ME), Maine Department of Transportation; 1985-ongoing; Participating Investigator.

Condominium Development (ME), Dictar Associates; 1986-1988; Principal Investigator.

Housing Development (MA), Heritage Builders; 1986; Project Manager/Principal Investigator.

Waste Discharge Relicense (ME), Great Northern Paper Company; 1985; Project Manager/Principal Investigator.

Waste Discharge Relicense (ME), Georgia-Pacific Paper Company; 1983-1985; Project Manager/Principal Investigator.

Waste Discharge Relicense (ME), Maine Public Service Company; 1985; Project Manager/Principal Investigator.

Hydroelectric Development (ME), Great Northern Paper Company; 1985; Participating Investigator.

Waste Discharge Relicenses and Wasteload Allocations (ME), Boise-Cascade Corporation and International Paper Company; 1982-1985; Assistant Engineer.

Messalonskee Stream Study (ME); 1984-1985; Project Manager/Principal Investigator.

Waste Discharge License (ME), Maine Energy and Recovery Company; 1984; Principal Investigator.

Hydroelectric Development (ME), Central Maine Power Company; 1984; Participating Investigator.

Hydroelectric Development (ME), Central Maine Power Co.; 1984; Assistant Engineer.

Lake Ecosystem Research; 1982; Principal Investigator.

Lake Biomanipulation; 1980-1982; Co-Principal Investigator.

Simplified Marine Water Quality Modeling; 1980; Principal Investigator.

Lake Input/Output Nutrient Models; 1976-1980; Assistant Investigator.

JEFFREY R. KING

Water Quality Specialist

Mr. King has five years of experience in the area of water quality investigations specializing in non-point source pollution. His experience includes the use of models for impact assessment, water quality sampling, and various environmental permitting processes.

EDUCATION

M.S. 1990 Water Resources
University of Vermont

B.A. 1987 Biology
University of Southern Maine

SPECIAL TRAINING

Workshop on use of NH Erosion and Sediment Control Handbook, February 1992
American Red Cross Standard First Aid and Adult CPR
Certified SCUBA Diver (NAUI Openwater II)

PROFESSIONAL EMPLOYMENT HISTORY

1990-present Normandeau Associates Inc.
1989-1990 HMM Associates, Inc.
1987-1989 Vermont Water Resources Research Center

SELECTED PROJECT EXPERIENCE

Sebago Lake (ME) Ice Fishing Study; 1992-ongoing; Principal Investigator.

New England Power Company NPDES Permitting (MA, NH, VT); 1992-ongoing; Principal Investigator.

Salmon Falls River (ME) Water Quality Study; 1992-1993; Principal Investigator.

Saco River (ME) Waste Load Allocation; 1992; Field Investigator.

Bedford-Manchester-Londonderry (NH) Project Environmental Impact Statement; 1992-ongoing; Principal Investigator.

Maine DOT, Biddeford Monitoring Project; 1991-ongoing; Water Quality Investigator.

NH Route 111 Environmental Impact Statement; 1990-ongoing; Participating Investigator.

Public Service Company of New Hampshire, J. Brodie Smith Dam Minimum Flow Assessment; 1990-1991; Principal Investigator.

Massachusetts Department of Public Works, GEIR for Highway Deicing; 1991; Principal Investigator.

James River Paper Company (NH), Water Quality Modeling; 1991; Principal Investigator.

Maine Turnpike Portland Interchange Environmental Assessment; 1991-ongoing; Participating Investigator.

NH Route 101/51 Environmental Impact Statement; 1990-1992; Principal Investigator.

Algonquin Gas Transmission Company, Environmental Permitting (MA, CT, RI); 1989-1990; Participating Investigator.

SELECTED PRESENTATIONS AND PUBLICATIONS

King, J.R. and Clausen, J.C. 1989. Effects of a Hayland Manure Application on Surface Runoff Quality. *In*: Proceedings of the International Symposium on Dairy Manure Management, February 22-24, Syracuse, NY.

DONALD W. KRETCHMER

Limnologist

Mr. Kretchmer has over 10 years of experience as a limnologist, specializing in freshwater aquatic ecology and fisheries. His experience involves aquatic ecosystem restoration and management, nutrient and dissolved oxygen modeling in lakes and streams, bioenergetics modeling of fishes, environmental impact assessment and limnological, ground-water and fisheries fieldwork supervision, data interpretation and reporting.

EDUCATION

- M.S. 1986 Water Resources Management
University of Wisconsin-Madison
- B.S. 1982 Natural Resources
Cornell University

SPECIAL TRAINING

- United States Soil Conservation Service, Short Course on TR-20 and TR-55; Computational Methods for Hydrology, 1988.
- Maine Department of Environmental Protection, Short Course on Phosphorus Allocation Methodology for Lakes, 1989.
- New England Interstate Water Pollution Control Commission, Lakes Modeling Short Course, 1989.

PROFESSIONAL EMPLOYMENT HISTORY

- 1987-Present Normandeau Associates Inc.
- 1986-1987 Alliance Technologies Corp.
- 1985-1986 University of Wisconsin,
Center for Limnology
- 1982, New York State,
Cornell Field Station
- 1983-1984
1983 New York State Resource Information Laboratory

PROFESSIONAL AFFILIATIONS

- North American Lake Management Society
- American Society of Limnology and Oceanography

SELECTED PROJECT EXPERIENCE

- Damariscotta Lake Water Quality Assessment (ME); ongoing; Project Manager.
- Sebago Lake Water Quality Consultations (ME); Ongoing; Project Limnologist.
- Saco Wasteload Allocation (ME); Ongoing; Project Manager.
- Damriscotta Lake Hydroelectric Relicensing Studies (ME); 1993; Project Limnologist.
- Salmon Falls Relicensing Studies (ME, NH); 1992; Project Manager.
- Pittsfield Water Quality Exhibit E (ME); 1992; Report Author.
- Rattlesnake Cove Water Quality Study; 1991; Project Manager.
- Generic Environmental Impact Assessment of Road Salt Use (MA); 1991; Participating Investigator.
- Birge Pond Diagnostic/Feasibility Study (CT); 1991; Project Limnologist.
- L-Lake/Steel Creek Water Quality Studies (SC); 1991; Report Author.
- Moosehead Lake Water Quality (ME); 1990; Principal Investigator.
- Lacey Lakes Restoration Study (NJ); 1990-1991; Principal Investigator.

DONALD W. KRETCHMER

Limnologist

SELECTED PROJECT EXPERIENCE (continued)

Androscoggin River Hydroelectric Relicensing Studies; 1990-1991; Principal Investigator.

Ayers Island Water Quality Study (NH); 1991; Principal Investigator.

Water Quality Impact Assessment of a Residential Development on Sebago Lake (ME); 1989; Participating Investigator.

Maine Turnpike Environmental Impact Statement; 1989; Participating Investigator.

Ripogenus and Penobscot Mills Projects Water Quality Assessment (ME); 1988-1989; Participating Investigator.

Sluice, Flax and Floating Bridge Ponds Restoration Environmental Impact Report (MA); 1987-1988; Project Manager.

Androscoggin River Water Quality Study (ME); 1988-1991; Principal Investigator.

Estes Lake Water Quality Assessment (ME); 1989-1991; Principal Investigator.

Middle Dam Water Quality Assessment (ME); 1988; Principal Investigator.

Fawn Lake (MA) Diagnostic/Feasibility Study; 1987; Project Limnologist.

Cascading Trophic Interactions in Four Northern Wisconsin Lakes; 1985-1986; Project Assistant/Site Supervisor.

Delavan Lake (WI) Recovery and Management Study; 1986; Project Biologist.

Prey Selectivity by Young Yellow Perch (NY); 1983-1984; Participating Investigator.

Oneida Lake Water Quality and Fisheries Monitoring (NY); 1983-1984; Participating Investigator.

Lamprey Induced Mortality of Fish in Oneida Lake (NY); 1982; Participating Investigator.

SELECTED PRESENTATIONS AND PUBLICATIONS

Kretchmer, D.W., J. King and T. Hutchins. 1993. Ice fishing on a public water supply. Are there impacts? Presented at the 13th annual meeting of the North American Lake Management Society. Nov. 29-Dec. 4, 1993.

Mills, E.L., J.L. Confer and, D.W. Kretchmer. 1986. Predation by young yellow perch: The influence of light, prey density, and predator size. *Trans. Amer. Fish. Soc.* 115:716-725, 1986.

Carpenter, S.R., J.F. Kitchell, J.R. Hodgson, P.A. Cochran, J.J. Elser, M.M. Elser, D.M. Lodge, D.W. Kretchmer, X. He and, C.N. von Ende. 1986.

Regulation of lake ecosystem primary productivity by food web structure in whole lake experiments. *Ecology*. In press.

Water Resources Program. 1986. Delavan Lake: A recovery and management plan. Institute for Environmental Studies Special Report. Madison, Wisconsin, 420 pp.

B. PAUL LINDSAY

Senior Fisheries Biologist

Mr. Lindsay is an expert in larval fish ecology and identification and was manager of the fisheries laboratory staff at NAI's biological laboratory for several years. He is experienced in analyzing effects of pollution and commercial exploitation on fishes and other marine and aquatic organisms. He serves as coordinator and author on numerous technical reports and proposals, and has been technical director or project manager for several large projects.

EDUCATION

M.S. 1973 Zoology
University of Maine

B.A. 1969 Zoology
University of Connecticut

SPECIAL TRAINING

Quantitative Ecological Analysis - multivariate statistical techniques; University of New Hampshire; 1986

Design of Experiments - descriptive statistics, probability distributions, hypothesis testing, analysis of variance, regression; Southeastern Massachusetts University; 1978

Anatomy and Classification of Fishes; University of Maine; 1975

PROFESSIONAL EMPLOYMENT HISTORY

1980-present Normandeau Associates Inc.
1980 Beal College, Brunswick, Maine
1980 Maine Department of
Marine Resources

1969-1978, University of Maine
1979-1980

1974, 1975 Northeast Fisheries Center,
National Marine Fisheries Service
1973 Verrill, Dana, Philbrick, Putman
& Williamson, Attorneys,
Portland, Maine

PROFESSIONAL AFFILIATIONS

American Fisheries Society Early Life
History Section
New England Estuarine Research Society

SELECTED PROJECT EXPERIENCE

New York City Water Supply Zebra Mussel Monitoring Program; 1993; Program Manager.

Bowline and Lovett (NY) Impingement Monitoring Program; 1991-present; Program Manager.

Indian Point 3 Nuclear Power Plant (NY) Zebra Mussel Monitoring Program; 1991 to present; Technical Director.

Hudson River (NY) Ichthyoplankton Laboratory Program; 1989, 1991-present; Technical Director.

Roseton and Danskammer Point (NY) Impingement Monitoring Program; 1988-1991, 1993-present; Technical Director, Program Manager.

Adult Atlantic Tomcod Spawning Stock Survey (NY); 1984, 1990-present; Laboratory Supervisor and Report Author.

Seabrook (NH) Environmental Studies; 1980-present; Principal Investigator.

Pontook (NH) Creel Survey; 1992; Report Author.

B. PAUL LINDSAY

Senior Fisheries Biologist

SELECTED PROJECT EXPERIENCE (Cont.)

- Grand Rapids, (WI) Hydro Entrainment; 1992; Report Author.
- Roseton and Danskammer Point (NY) Zebra Mussel Monitoring Program; 1991; Technical Director.
- Dunkirk Station (NY) Biological Monitoring Program; 1990-1991; Program Manager.
- Huntley Station (NY) Biological Monitoring Program; 1990-1991; Technical Director.
- Albany Steam Station (NY) Fish Deterrence Sampling Design; 1990-1991; Report Author.
- Yankee Rowe (MA) Biological Monitoring Services; 1989-1990; Program Manager.
- Indian Point (NY) Relative Probability of Capture Study; 1989; Technical Director.
- L-Lake and Steel Creek (SC) Biological Monitoring Program; 1989; Report Author.
- Fore River (ME) Bridge Mitigation Study; 1988; Report Author.
- Huntley Station (NY) Thermal Plume Analysis and Biological Impact Assessment; 1988; Report Author.
- Indian Point (NY) Entrainment Abundance Program; 1985-1988; Program Manager.
- Granite State Minerals (NH) Environmental Assessment; 1987; Report Author.
- New Bedford (MA) Wetlands Study; 1987; Principal Investigator.
- 1982 and 1983 Year Class Reports for the Hudson River (NY) Monitoring Program; 1984-1985; Technical Director.
- Indian Point (NY) Impingement Study; 1984; Technical Director.
- White Perch Stock Assessment Study (NY); 1983-1984; Laboratory Supervisor.
- Dunkirk and Huntley Stations (NY) Entrainment and Impingement Studies; 1982-1984; Laboratory Supervisor and Principal Investigator.
- New Haven Harbor (CT) Station Ecological Studies; 1980-1984; Laboratory Supervisor and Principal Investigator.
- Delaware River Anadromous Salmonids Study; 1983; Technical Reviewer.
- Environmental Baseline Study for New Bedford (MA) 301(h) Waiver Application; 1983; Report Author.
- Wyman Station (ME) Meroplankton Entrainment Studies; 1981-1982; Project Director.
- Indian Point (NY) Juvenile Fish Entrainment Study; 1981; Laboratory Manager.
- Piscataqua River (NH) Ecological Studies; 1980; Laboratory Supervisor and Principal Investigator.
- H.A. Wagner Station Plankton Studies (MD); 1980; Principal Investigator.
- Identification Manual of Larval Fishes of Gulf of Maine Estuaries; 1979-1980; Research Associate.
- Maine Yankee Entrainment Studies; 1973-1978; Research Associate and Principal Investigator.

B. PAUL LINDSAY

Senior Fisheries Biologist

**SELECTED PRESENTATIONS
AND PUBLICATIONS**

Lindsay, B.P., K.W. Payne, and R.J. Dancewicz-Helmers. 1991. Distinguishing planktonic larvae of *Dreissena* and *Mytilopsis*. Second International Zebra Mussel Research Conference, November 1991, Rochester, New York.

DeWitt, H.H., P.A. Greco, J.S. Hacunda, B.P. Lindsay, R.F. Shaw and D.W. Townsend. 1981. An addition to the fish fauna of the Gulf of Maine with records of rare species. Proc. Biol. Soc. Wash. 94(3):669-674.

In addition, Mr. Lindsay has presented several fisheries papers at scientific meetings, authored numerous technical reports, and has served as a technical reviewer for a fisheries journal.

DONALD P. MASON

Aquatic Ecologist

Mr. Mason has over ten years experience at assessing the effects of habitat alteration on aquatic ecosystems. His specialties include evaluating the effects of hazardous substances, hydropower, and commercial development on fish and benthic macroinvertebrate communities, conducting fish and benthic population studies, using freshwater macroinvertebrates as pollution indicators, and assessing the impacts of road and highway construction on aquatic communities.

EDUCATION

M.S. 1982 Entomology
University of New Hampshire
B.A. 1976 Biology
Plymouth State College

SPECIAL TRAINING

Rapid Bioassessment Protocols (RBP)
Hazardous Material Supervisors Training
(OSHA 29 CFR 1910.120)
First Aid and CPR
Habitat Evaluation Procedures (HEP)

PROFESSIONAL EMPLOYMENT HISTORY

1985-present Normandeau Associates Inc.
1983-1985 Battelle New England
Marine Research
Laboratory
1982-1983 Normandeau Associates Inc.
1982 Charles T. Main, Inc.
1979-1982 University of New
Hampshire
1974-1976 Plymouth State College

PROFESSIONAL AFFILIATIONS

North American Benthological Society
New England Association of Environmental Biologists

SELECTED PROJECT EXPERIENCE

Buttery Brook Bioassessment (MA); 1992-1993;
Project Manager.

Lamington River (NJ) Wetland Bioassessment;
1992; Project Manager.

Grand Isle (VT) FCS Periphyton Monitoring Program;
1992; Project Manager.

International Paper (ME) Biomonitoring Project;
1992-Present; Project Manager.

L-Lake and Steel Creek (SC) Biomonitoring Program;
1992; Macroinvertebrate Taxonomist.

CWS Landfill (ME) Expansion Project; 1991-present;
Aquatic Studies Technical Director.

Turners Falls (MA) Fisheries Study, Connecticut
River; 1991; Crew Leader.

Lowell (MA) Juvenile Clupeid Studies, Merrimack
River; 1990-1991; Aquatic Ecologist.

Farmington River (CT) Aquatic Studies; 1991;
Senior Aquatic Ecologist.

Peshtigo River (WI) IFIM Study; 1990; Senior Field
Biologist.

Brassua Dam (ME) Hydropeaking Licensing Project;
1990-1991; Project Manager.

Sherman Hollow (VT) Aquatic Biota Impacts Project;
1988-1990; Technical Director-Aquatic Biota.

DONALD P. MASON

Aquatic Ecologist

SELECTED PROJECT EXPERIENCE (Cont.)

Maine Turnpike Widening Project; 1987-1991;
Aquatic Ecologist.

Great Northern Paper Hydroelectric Relicensing;
1986-1989; Aquatic Ecologist.

Conway (NH) Route 16 Bypass Project; 1986-1988;
Aquatic Ecologist.

Pontook Dam (NH) Licensing; 1987-1988; Techni-
cal Director-Macroinvertebrate Communities.

Aziscohos Dam (ME) Minimum Flow Study; 1985-
1986; Aquatic Ecologist.

SELECTED PRESENTATIONS AND PUBLICATIONS

Mason, D.P. and W.E. Hearn. Effects of fluctuating
flows on benthic communities. Presented to the
37th Annual Meeting of the North American Ben-
thological Society, May 1989, Guelph, Ontario,
Canada.

Mason, D.P., S.L. Radke, K.T. Tracewski, and P.C.
Johnson. Eclosion of gypsy moth (Lepidoptera:
Lymantriidae) egg masses held under constant
conditions as a function of sampling date. Present-
ed to the 52nd Annual Meeting of the Eastern
Branch of the Entomological Society of America,
September 1980, Baltimore, MD.

Haney, J.F., T.R. Beaulieu, R.P. Berry, D.P. Mason,
C.R. Miner, E.S. McLean, K.L. Price, M.A. Trout,
R.A. Vinton, and S.J. Weiss. 1983. Light intensity
and relative light change as factors regulating
stream drift. *Archiv fur Hydrobiologie* 97(1):73-88.

Johnson, P.C., D.P. Mason, S.L. Radke, and K.T.
Tracewski. 1983. Gypsy moth, *Lymantria dispar*
(L) (Lepidoptera: Lymantriidae), egg eclosion:
degree-day accumulation. *Environmental Entomology*
12(3):929-932.

Mason, D.P. 1982. Physical and hydrochemical
effects on stream insect communities in the White
Mountain National Forest of New Hampshire. M.S.
Thesis, University of New Hampshire, Durham, New
Hampshire. 106 pp.

MARK T. MATTSON

Assistant Vice President/Principal Aquatic Ecologist

Dr. Mattson is an Assistant Vice President who manages the Fisheries/Aquatics Group for NAI. He has over 14 years experience in aquatic ecology and is a specialist in biostatistics, sampling design and the population dynamics of aquatic organisms.

EDUCATION

- Ph.D. 1979 Zoology (Limnology)
University of New Hampshire
- M.S. 1975 Zoology
University of New Hampshire
- B.A. 1973 Biology
University of Connecticut

SPECIAL TRAINING

U.S. Fish and Wildlife Instream Flow Incremental Methodology Negotiations and Strategies, 1981;
Conducting Field Studies, 1984

NAUI Certified SCUBA diver

PROFESSIONAL EMPLOYMENT HISTORY

- 1981-Present Normandeau Associates Inc.
- 1979-1981 Texas Instruments Incorporated, Ecological Services

PROFESSIONAL AFFILIATIONS

- American Society of Limnology
and Oceanography
- International Limnological Society
- American Fisheries Society
- North American Lake Management Society

SELECTED PROJECT EXPERIENCE

Fish Entrainment and Turbine Mortality Studies at the Wausau Hydroelectric Project (WI); 1994-1995; Project Manager.

Fish Entrainment and Turbine Mortality Studies at the Grand Rapids Hydroelectric Project (WI); 1992-94; Project Manager.

Fish Turbine Entrainment/Mortality Study Plans for Nine Hydroelectric Facilities (WI); 1990; Project Manager.

New York Power Authority, Hudson River Striped Bass Hatchery Evaluation Program (NY); 1985-present; Project Manager.

Consolidated Edison Company of New York, Inc., Hudson River Atlantic Tomcod Spawning Stock Survey (NY); 1982-present; Project Manager.

Empire State Electric Energy Research Corporation, Demonstration of an Acoustic Fish Deterrence System at the James A. Fitzpatrick Nuclear Power Plant Cooling Water Intake (NY); 1990-1991; Project Manager.

Niagara Mohawk Power Corporation, Fish Guidance Study at Albany Steam Station (NY); 1990-1991; Project Manager/Technical Advisor.

Central Hudson Gas and Electric Corporation, Roseton and Danskammer Point Stations Impingement Monitoring Program (NY); 1989-1991; Project Manager.

Consolidated Edison Company of New York, Inc., Indian Point Nuclear Generating Station Ristroph Screen Impingement Mitigation Study (NY); 1985-1992; Project Manager.

MARK T. MATTSON

Assistant Vice President/Principal Aquatic Ecologist

SELECTED PROJECT EXPERIENCE (Cont.)

Consolidated Edison Company of New York, Inc., Indian Point Impingement Studies (NY); 1984-1986 and 1989-1991; Project Manager.

Great Northern Paper Company, Penobscot Mills and Ripogenus Dam Hydropower Relicensing Projects (ME); 1986-1992; Project Aquatic Ecologist.

New York Power Authority; Indian Point Unit 3 Nuclear Power Plant Zebra Mussel Monitoring Project; 1990; Project Manager.

Central Hudson Gas & Electric Corporation; Zebra Mussel Monitoring at Roseton and Danskammer Point Stations; 1990; Project Manager.

Central Hudson Gas & Electric Corporation; Survey of Hudson River Marinas for the Presence of Zebra Mussels; 1990; Project Manager.

The Upjohn Company, Quinnipiac River Study (CT); 1982, 1987-1990; Project Aquatic Ecologist.

New York Power Authority, Indian Point Fish Deterrence Studies (NY); 1986-1990; Corporate Officer/Technical Reviewer.

Consolidated Edison Company of New York, Inc., Hudson River Ichthyoplankton and Juvenile Surveys (NY); 1984-1989 and 1991-1994; Project Manager/Corporate Officer.

Consolidated Edison Company of New York, Inc., Hudson River Ichthyoplankton Laboratory Program (NY); 1988-1989 and 1991-1994; Project Manager/Corporate Officer.

Consolidated Edison Company of New York, Inc., Relative Probability of Entrainment Study for Indian Point Station (NY); 1989; Project Manager.

Central Hudson Gas and Electric Corporation, Danskammer Point Station Fine Mesh Fish Impingement Studies (NY); 1986-1988; Project Manager.

Consolidated Edison Company of New York, Inc., Special Studies to Examine Fish Abundance in Unsampled Areas of the Hudson River (NY); 1986-1987; Project Manager.

Consolidated Edison Company of New York, Inc., Indian Point Entrainment Abundance Studies (NY) 1986-1987; Technical Advisor.

Great Northern Paper Company, Hydroelectric Development Project (ME); 1981-1985; Project Aquatic Ecologist.

Consolidated Edison Company of New York, Inc., Sampling Design Evaluation for Indian Point Fish Impingement Programs (NY); 1981-1984; Project Manager.

New York Power Authority, Hudson River Gear Evaluation Studies (NY); 1980-1985; Project Manager.

New York Power Authority, Hudson River Adult Striped Bass Tagging Program (NY); 1984; Project Manager.

Orange and Rockland Utilities, Inc., Hudson River White Perch Stock Assessment Study (NY); 1983-1985; Project Manager.

Consolidated Edison Company of New York, Inc., Indian Point Juvenile Fish Entrainment Study (NY); 1981-1982; Project Manager.

Consolidated Edison Company of New York, Inc., 1982 and 1983 Year Class Reports for the Hudson River Monitoring Program (NY); 1984-1985; Technical Reviewer.

MARK T. MATTSON

Assistant Vice President/Principal Aquatic Ecologist

SELECTED PROJECT EXPERIENCE (Cont.)

Bangor Hydro Basin Mills Hydroelectric Project (ME); 1983-1984; Project Aquatic Ecologist.

Chicopee Falls Hydropower Project (MA); 1981; Project Aquatic Ecologist.

Metropolitan District Commission, Water Supply Alternatives (MA); 1982-1983; Project Aquatic Ecologist.

Town of Concord, Water Supply Study (MA); 1981; Project Aquatic Ecologist.

Bangor Hydro Telos Dam Reconstruction Project (ME); 1982; Project Aquatic Ecologist.

SELECTED PRESENTATIONS AND PUBLICATIONS

Mattson, M.T., P. Geoghegan, D.J. Dunning. 1992. Accuracy of catch per unit effort indices of Atlantic tomcod in the Hudson River. In: C.L. Smith ed., Fisheries Research in the Hudson River. Hudson River Environmental Society. p. 323-338.

Mattson, M.T., J.R. Waldman, D.J. Dunning, and Q.E. Ross. 1989. Abrasion and protrusion of internal anchor tags in Hudson River striped bass. American Fisheries Society Symposium 7:121-126.

Mattson, M.T., D.J. Dunning, Q.E. Ross and B.R. Friedman. 1989. Magnetic tag detection efficiency in a Hudson River striped bass hatchery evaluation program. American Fisheries Society Symposium 7: Fish Marking Techniques. p. 267-277.

Mattson, M.T., J.B. Waxman and D.A. Watson. 1988. Reliability of impingement sampling designs: an example from Indian Point Station. American Fisheries Society Monograph 4:161-169.

Geoghegan, P., M.T. Mattson, J.J. Reichle and R.G. Keppel. 1992. Influence of salt front position on the occurrence of uncommon marine fishes in the Hudson River Estuary. Estuaries 15(2):251-254.

Geoghegan, P., M.T. Mattson, D.J. Dunning and Q.E. Ross. 1989. Improved data through quality control and quality assurance in a large scale striped bass tagging program. American Fisheries Society Symposium 7: Fish Marking Techniques.

Geoghegan, P., M.T. Mattson, and R. Keppel. 1992. Distribution of the shortnose sturgeon in the Hudson River Estuary, 1983-1988. In: C.L. Smith ed., Fisheries Research in the Hudson River. Hudson River Environmental Society. p. 217-227.

Humphreys, M., M.T. Mattson, R.E. Park, J.J. Reichle, D.J. Dunning and Q.E. Ross. 1989. Stocking checks on scales for identifying hatchery striped bass in the Hudson River. Proceedings, International Symposium and Educational Workshop on Fish Marking Techniques, American Fisheries Society.

Dunning, D.J., Q.E. Ross, M.T. Mattson, P. Geoghegan and J.R. Waldman. 1989. Reducing mortality of striped bass captured in seines and trawls. North American Journal of Fisheries Management 9(2):171-176.

Dunning, D.J., Q.E. Ross, J. Waldman, and M.T. Mattson. 1987. Tag retention and tagging mortality in Hudson River striped bass. North American Journal of Fisheries Management 7(4):535-538.

Waldman, J.R., D.J. Dunning, Q.E. Ross, and M.T. Mattson. 1990. Range dynamics of Hudson River striped bass along the Atlantic coast. Transactions of the American Fisheries Society 119.

MARK T. MATTSON

Assistant Vice President/Principal Aquatic Ecologist

SELECTED PRESENTATIONS AND PUBLICATIONS (Cont.)

Waldman, J.R., D.J. Dunning and M.T. Mattson. 1990. A morphological explanation for size-differential anchor tag loss in Hudson River striped bass. Transactions of the American Fisheries Society 119.

Geoghegan, P., M.T. Mattson, D.J. Dunning and Q.E. Ross. 1986. Effects of water temperature, collection gear, and tag type on handling mortality of striped bass. Presented at the 1986 Northeast Fish and Wildlife Conference, Hershey, Pennsylvania USA.

Mattson, M.T., D.J. Dunning and Q.E. Ross. 1985. Relative catch efficiency of a 3 m beam trawl, 6.2 m high-rise trawl and 1.0 m epibenthic sled for sampling young of the year striped bass and other fishes in the Hudson River Estuary. American Fisheries Society, August 1985.

Mattson, M.T. and J. B. Waxman. 1985. Movements of spawning Atlantic tomcod (*Microgadus tomcod*) in the Lower Hudson River, Northeast Fish and Wildlife Conference; May 1985.

Mattson, M.T. 1980. Diel and seasonal horizontal movements in a population of the predatory cladoceran *Polyphemus pediculus*. American Society of Limnology and Oceanography, December 1980.

Mattson, M.T. and J.F. Haney. 1980. Factors influencing intrazooplankton predation by *Polyphemus pediculus*, Research Report No. 29. Water Resources Research Center, University of New Hampshire, Durham, NH. 149 pp.

In addition, Dr. Mattson has contributed to over 30 technical reports in the areas of aquatic ecology and sampling design.

RICHARD A. SIMMONS

Fisheries Biologist

Mr. Simmons has over 18 years experience in fisheries-related work. He is one of NAI's senior fisheries biologists with responsibility for project management, supervision of field crews and quality control procedures. His area of expertise is the design and conduct of fisheries studies at hydro-power facilities. Mr. Simmons has had extensive experience with all types of fishery and aquatic sampling gear, and is a licensed boat captain.

EDUCATION

B.S. 1975 Freshwater Fisheries Biology
University of Massachusetts

SPECIAL TRAINING

NAUI certified advanced diver; logged over 750 professional dive days.

Red Cross Multimedia First Aid and CPR.

U.S. Fish and Wildlife Service - Habitat Evaluation Procedures (HEP) Certification Course, 1986.

Fish Passageways and Diversion Structures Course, 1992; U.S. Fish and Wildlife Service.

U.S. Coast Guard Captain's License, 6 passenger, covers Portsmouth, N.H. to Cape Anne, Mass., up to 20 miles offshore and vessels up to 65 feet.

PROFESSIONAL EMPLOYMENT HISTORY

1978-Present Normandeau Associates Inc.
1976-1978 Ichthyological Associates, Inc.
1975 Normandeau Associates, Inc.

PROFESSIONAL AFFILIATIONS

American Fisheries Society

SELECTED PROJECT EXPERIENCE

Saranac River (NY) Telemetry Study: Conducted radio telemetry study to determine the downstream passage routes of Atlantic salmon and steelhead smolts at the Lower Saranac Hydroelectric facility. Survival of these species through the project's fish bypass pipe was also determined. Project Manager, 1993-present.

Lawrence (MA) Hydroelectric Project, Merrimack River:

Conducted adult shad telemetry study to determine the efficiency of the project's fish lift system, and identify downstream passage routes of post-spawned adults; 1993; Project Manager; Technical Director.

Underwater camera study to assess internal fish lift efficiency for adult shad and Atlantic salmon; 1992-1993; Project Manager.

Mark and recapture study to determine the percent use of a downstream fish bypass system by juvenile clupeids; ongoing; Project Manager.

Lowell (MA) Hydroelectric Project, Merrimack River:

Conducted adult shad telemetry study to evaluate the efficiency of the project's fish lift system; 1993; Project Manager.

Radio telemetry assessment of down stream passage routes used by adult American shad; 1989-1990; Technical Director.

Radio telemetry study to determine turbine mortality and use of a down stream fish bypass system by Atlantic salmon smolts; 1990-1991; Project Manager.

RICHARD A. SIMMONS

Fisheries Biologist

SELECTED PROJECT EXPERIENCE (Cont.)

Mark and recapture study to determine the percentage of juvenile alewives exiting through the fish bypass system; 1990; Technical Director.

Mark and recapture experiments testing various entrance configurations (i.e. wide spill; narrow, deep opening etc.) at a downstream fish bypass system, to improve downstream passage rates of juvenile clupeids; ongoing; Project Manager.

Turner Falls (MA), Connecticut River Juvenile Shad Study; 1991; Technical Director.

Farmington River (CT) IFIM Study; 1991; Senior Field Biologist.

Peshtigo River (WI) IFIM Study; 1990; Senior Field Biologist.

Floods Pond (ME) Sunapee Trout Study; 1989; Fisheries Biologist.

East and West Outlet (ME) IFIM Study, Moosehead Lake; 1989; Senior Field Biologist.

Seabrook (NH) Environmental Studies; 1978-1989; Senior Field Biologist.

Rapid River (ME) IFIM Study; 1988; Senior Field Biologist.

Salem Wetland Study, Danvers River Estuary (MA); 1988; Senior Field Biologist.

Seabrook Wastewater Treatment Facility (NH); 1987-1988; Field Operations Manager.

Pontook IFIM Study (NH); Androscoggin River; 1987; Senior Field Biologist.

Pulsifer Rips IFIM Study (NH); Androscoggin River; 1987; Senior Field Biologist.

Ripogenus Dam (ME) and Penobscot Mills Hydro-power Relicensing Projects; 1986-1987; Senior Field Biologist.

Sturbridge and Wales (MA) Trout Surveys; 1985-1986; Fisheries Biologist.

Basin Mills (ME) Hydroelectric Project; 1983; Senior Field Biologist.

American Shad Restoration Project; Susquehanna River; Project Leader.

Peach Bottom Nuclear Plant IPA Post-Operational Studies; 1977-1978; Field Leader.

Impingement/Entrainment Studies, Delaware River; 1976-1977; Crew Leader.

SELECTED PRESENTATIONS AND PUBLICATIONS

Simmons, R.A., and W.E. Hearn. 1991. Radio telemetry assessment of a down-stream fish bypass and turbine mortality of Atlantic salmon smolts at the Lowell hydroelectric facility. Annual Atlantic Salmon Workshop, Rockport, ME.

Simmons, R.A., and W.E. Hearn. 1991. Mark and recapture technique to assess juvenile alewife movement through a downstream fish bypass at the Lowell Hydroelectric Project. 47th Northeast Fish and Wildlife Conference, Portland, ME.

Nelson, W.E., R.A. Simmons and A.E. Knight. 1992. Differential Turbine Passage Survival of Atlantic Salmon Smolts and Post Smolts Progress Report. Proceedings of the Atlantic salmon workshop, Rockport, ME.

JOSEPH N. STRUBE

Fishery Biologist/Marine and
Freshwater Taxonomist

Mr. Strube has over 14 years experience in fisheries related work. His area of expertise is in fisheries field studies, ichthyoplankton and juvenile fish taxonomy. Mr. Strube has had extensive experience with all types of fishery sampling gear and is a licensed boat captain. Mr. Strube's other responsibilities include project management, supervision of field and laboratory personnel, and quality control procedures.

EDUCATION

B.S. 1977 Fisheries Biology
Long Island University

SPECIAL TRAINING

U.S. Coast Guard Captains License
(6 passenger maximum)
PADI Open Water Diver Certification

PROFESSIONAL EMPLOYMENT HISTORY

1981-present Normandeau Associates Inc.
1977-1981 Texas Instruments, Inc.,
Ecological Services Division

PROFESSIONAL AFFILIATIONS

American Fisheries Society

SELECTED PROJECT EXPERIENCE

Plattsburgh (NY) Lower Saranac River Telemetry Studies. Conducted radio telemetry studies on Atlantic salmon and steelhead trout to determine the downstream passage routes of these species through the lower Saranac River Hydroelectric facility. Technical Director, 1993.

Lawrence (MA)

1. Radio telemetry assessment of upstream and downstream passage of radio tagged adult American shad through the Lawrence Hydroelectric project. Senior Field Biologist, 1993.

2. Downstream evaluation of fish bypass system for Atlantic salmon smolts and adult American shad and alewife at the Lawrence hydroelectric project. Senior Field Biologist, 1993.

3. Mark and recapture study to determine the percent use of a downstream fish bypass system by juvenile clupeids. Technical Director, 1992-1993.

4. Underwater camera study to assess the internal fish lift efficiency for adult American shad and Atlantic salmon. Senior Field Biologist, 1993.

Lowell (MA)

1. Radio telemetry study to determine upstream and downstream passage of radio tagged adult American shad through the E.L. Field hydroelectric project. Senior Field Biologist, 1993.

2. Mark and recapture studies to determine the percentage of juvenile clupeids through various entrance configurations for a downstream bypass system. Senior Field Biologist (1990), Technical Director (1991-1993).

3. Inclined plane trap studies to determine the start of the downstream movement of juvenile clupeids at the E.L. Field hydroelectric project. Technical Director (1990), Project Manager (1991).

4. Salmon smolt telemetry studies to determine turbine mortality and use of a downstream fish bypass system. Senior Field Biologist (1990), Technical Director (1991).

Lowell (MA) Juvenile Clupeid Studies, Merrimack River; 1990-1991; Field Biologist (1990), Technical Director (1991).

JOSEPH N. STRUBE

Fishery Biologist/Marine and
Freshwater Taxonomist

SELECTED PROJECT EXPERIENCE (Continued)

Lowell (MA) Salmon Smolt Telemetry Studies, Merrimack River; 1990-1991; Field Biologist (1990), Technical Director (1991).

Farmington River (CT) IFIM Study; 1991; Field Biologist.

Berlin (NH) Minimum Flow Assessment Studies; 1990-1991; Senior Field Biologist.

Bristol (NH) Ayers Island Fisheries Studies; 1990; Senior Field Biologist.

Berlin-Gorham (NH) J. Brodie Smith and Gorham Hydroelectric Project Fisheries Studies; 1990; Senior Field Biologist.

Lowell (MA) Adult American Shad Telemetry Studies, Merrimack River; Senior Field Biologist; 1990.

Peshtigo River (WI) IFIM Study; 1990; Field Biologist.

Harriman Cove (ME) Ecological Baseline Studies; 1990; Laboratory Technician.

Hudson River (NY) Ichthyoplankton Laboratory Program; 1989; Laboratory Supervisor.

Indian Point (NY) Relative Probability of Capture Study; 1988-1989 Laboratory Task Leader.

Lock and Dam 14 (IA) Studies; 1988-1989; Taxonomist, Report Author.

Rapid River (ME) IFIM Study: 1988; Field Biologist.

Indian Point (NY) Entrainment Abundance Program; 1985-1987; Laboratory Task Leader.

Striped Bass Gear Evaluation/Atlantic Tomcod Program (NY); 1985-1986; Laboratory Technician and Field Crew Member.

Hudson River Striped Bass Hatchery Evaluation (NY); 1986-1987; Laboratory Technician.

Long River (NY) Ichthyoplankton and Fall Juvenile Surveys; 1984-89, 1991-1992; Marine Taxonomist.

Seabrook (NH) Environmental Studies; 1981-Present; Marine Taxonomist, Report Author.

New Haven Harbor Station (CT) Ecological Studies; 1981-1984; Marine Taxonomist.

White Perch Stock Assessment (NY); 1983-1984; Marine Taxonomist.

G.R. Huntley Generation Station (NY) Entrainment and Impingement Studies; 1982-1984; Marine Taxonomist.

Spawning Stock Characteristics of Atlantic Tomcod (NY); 1983-1984; Marine Taxonomist.

Adult Striped Bass Tagging Study (NY); 1984; Marine Taxonomist.

RAY A. BLEISTINE
FIELD BIOLOGIST

Mr. Bleistine has extensive experience in environmental monitoring studies. His expertise in fisheries studies includes: trap and transport of anadromous fishes; abundance, distribution, and species composition studies; relicensing studies at hydroelectric stations; identification of preserved fish collections; biofouling problems; and water quality monitoring on mid-Atlantic waterways. He is involved in the operation of two fish lift facilities on the lower Susquehanna River and two fish passage facilities on the Saco River, Maine; outmigration studies on the Connecticut River; and fish collections in support of radiological environmental monitoring programs (REMP) at two nuclear power stations on the Susquehanna River.

EDUCATION

B.S., 1984, Biology, Northland College

BACKGROUND AND EXPERIENCE

1987 to Present - Mr. Bleistine's current responsibilities include: supervision of the operation of two fish lift facilities located on the lower Susquehanna River during spring spawning runs of adult shad; trap and transport of Atlantic salmon, American shad, and River herring on the Sacco River, Maine; juvenile clupeid outmigration studies on the Connecticut River; collection and examination of fish for symptoms of gas bubble disease; fish entrainment studies at various hydrostations; and the collection of fish and silt for radiological environmental monitoring programs at two nuclear power stations located on the Susquehanna River.

He has conducted or assisted in several environmental monitoring studies, particularly fishery studies including trap and transport of anadromous fishes; the collection by haul seine and maintenance of juvenile American shad in holding tanks (up to 50,000 individuals) for studies determining the efficiency of bypass facilities located on the Connecticut River; abundance, distribution, and species composition studies; biology of fishes influenced by power stations throughout Pennsylvania; relicensing studies of hydroelectric stations in Virginia and West Virginia; identification of preserved fish collections; analysis of biofouling problems at hydroelectric and nuclear power stations; and water quality monitoring at various sites in the Susquehanna and Ohio drainages.

1986 - Mr. Bleistine served as a fisheries intern for The Conservancy, Inc., conducting a sportfishing creel survey of boat fishermen in Florida. His responsibilities included patrolling the area, interviewing fishermen, summarizing and entering data into a computer, obtaining meteorologic and hydrographic data, boat handling, and equipment maintenance.

1985 to 1986 - As Fisheries Compliance Inspector for the National Marine Fisheries Service, Mr. Bleistine was responsible for collecting data and monitoring foreign fishing vessels operating off the U.S. East Coast.



(RAY A. BLEISTINE)

1984 to 1985 - As the only American on board a foreign fishing vessel, Mr. Bleistine had three, 3-month projects as a foreign fisheries observer for Oregon State University. His three main responsibilities were: estimation of haul weights, determination of species composition of hauls, and monitoring the incidence of prohibited species in the trawl net.

1984 - Mr. Bleistine's 6-month undergraduate internship was with the U.S. Fish and Wildlife Service in Wisconsin, where his duties involved both field and lab work. The latter consisted of identification, age, and growth of fish determinations, and recording of data; the former, collection of aquatic plants and animals, use of gill and trap nets as well as electrofishing; scale sampling; water quality analysis; and boat handling.

CONTINUING EDUCATION

USFWS, NERC, Fort Collins, Colorado:

IF200 Designing and Negotiating Studies Using IFIM

IF305 Field Techniques for Stream Habitat Analysis

AFFILIATIONS

American Fisheries Society



TIMOTHY D. BRUSH
DEPARTMENT MANAGER

A fish and wildlife biologist, Mr. Brush's areas of expertise are diverse, and include aquatic ecology, anadromous fish biology, management and restoration, power plant impacts, terrestrial ecology, and wildlife management.

EDUCATION

M.S., 1987, Wildlife Management, Frostburg State College
B.S., 1979, Biology, Waynesburg College

BACKGROUND AND EXPERIENCE

1983 to Present - Mr. Brush, who joined RMC prior to writing his master's thesis, is Project Manager for licensing studies at hydroelectric facilities in Wisconsin and southwest Pennsylvania. He is responsible for study design and implementation, including entrainment and mortality studies. Mr. Brush has been involved since 1983 in studies of American Shad reproduction, survival, and reintroduction on the Susquehanna River related to relicensing Conowingo Dam. He is thoroughly familiar with shad biology and regulatory agency concerns. He has been a supervisor at the Conowingo Dam Fish Collection Facility, participating in the refinement of operational procedures, and design of a new fish lift facility. He has used computer population models to evaluate anadromous fish restoration. Mr. Brush has designed and conducted studies to assess the emigration of juvenile American shad in the Susquehanna and Connecticut Rivers. He developed and refined specialized gear for sampling in large hydroelectric facility tailwaters and is trained in the design and implementation of hydroacoustic and radio telemetry studies. Mr. Brush has designed and conducted striped bass angler mortality studies for a large electric utility company and a state resource agency. These studies have utilized novel techniques in evaluating angler induced mortality. He has conducted studies of tumors in bullhead catfish and physiological studies of transport stress in American shad. He has assisted in or conducted numerous programs related to hydroelectric station licensing and relicensing, and atomic power station ecological monitoring. He is experienced in the presentation of findings at professional and public meetings.

Mr. Brush also has experience in the analysis of environmental impacts on terrestrial biota. Mr. Brush also has conducted research and authored species workbooks for the Pennsylvania Game Commission Fish and Wildlife Database.

He has designed and conducted a terrestrial ecological assessment of a proposed power plant site. He has performed research on the geographic variation of parasite fauna in two leporid species and has completed contracts with the Pennsylvania Game Commission involving literature searches and reviews for 23 species of fish and mammals.

Mr. Brush was recently promoted to Department Manager at the Northeast Regional Office in Brattleboro, Vermont. As such, he is a co-manager of RMC's Hydropower Consulting Division and has business development, personnel management, and technical responsibilities.

AFFILIATIONS

American Fisheries Society

PUBLICATIONS

Mr. Brush has presented papers at several professional meetings, and authored published papers and numerous reports.



SCOTT T. COPENHEAVER
FIELD BIOLOGIST

Mr. Copenheaver has seven years' experience in environmental monitoring studies related to fisheries, especially at hydroelectric, pumped storage, and nuclear power stations. His experience in fisheries includes: trap and transport of anadromous fishes; abundance, distribution, and species composition studies; outmigration studies; and collecting fish for radiological monitoring programs. He has significant expertise in Pennsylvania, Maine, Virginia, and West Virginia, and on the Connecticut River in Massachusetts and Vermont. He has been a supervisor for the Conowingo Fish Collection Facility on the Susquehanna River for four years and holds a class B commercial driving license.

EDUCATION

B.S., 1987, Biology, York College

BACKGROUND AND EXPERIENCE

1987 to Present - As field biologist, Mr. Copenheaver's current responsibilities include supervision of the Conowingo Fish Collection Facility and involvement in various fisheries programs related to hydroelectric relicensing studies. He has set-up and maintained a fleet of eight transport vehicles and holding systems involved with this program. He has also coordinated programs related to abundance, distribution, species composition, and biology of fishes in aquatic systems influenced by the operations of hydroelectric, pumped storage, and nuclear power stations. These programs included using sampling gear with an electroshocker, seine and gill nets, trap and hoop nets, trawling, and collecting sediment samples. He assisted in and supervised investigations of spawning runs of anadromous fishes in the tailrace of a hydroelectric station on the Susquehanna River. He assisted in planning, data entry, and administration of biological investigations associated with Three Mile Island Nuclear Station. He was involved in conducting biological studies relative to the relicensing of five hydroelectric stations in Virginia and West Virginia. He was also involved with the collection, holding, and monitoring of tumorous brown bullhead on Lake Ontelaunee in Reading, PA. His experience also includes anadromous fish projects on the Connecticut River, which have involved outmigration studies and operation of downstream passage facilities. Connecticut River studies involved the collection, transport, and maintenance of 100,00 juvenile clupeids for mark/recapture studies. The use of a 300 foot haul seine was utilized in the collection of juvenile clupeids in 1990 through 1992 on the Connecticut River. He has assisted in a HI-Z Turb'N Tag study, which investigated turbine passage survival for American shad on the Susquehanna River.

AFFILIATIONS

American Fisheries Society, Northeast Division



LYNN C. DEWALD
BIOLOGIST

Ms. DeWald has a demonstrated expertise in aquatic ecology, specifically as it applies to North American waterways. She has, in addition, experience in collecting benthos, fish, and water samples as part of a multi-year monitoring plan at the U.S. Department of Energy's Savannah River Plant in South Carolina.

EDUCATION

M.S., 1990, Fisheries Management, Frostburg State University
B.S., 1988, Wildlife and Fisheries Management, Frostburg State University

REGISTRATIONS/CERTIFICATIONS

Certified Open Water SCUBA Diver, PADI

BACKGROUND AND EXPERIENCE

1990, 1992 to Present - Ms. DeWald was temporarily employed by RMC as a fisheries field biologist in 1990, to assist in a juvenile clupeid outmigration study, where she was responsible for the collection, transport, and maintenance of juvenile clupeids. She has been a biologist with RMC's Northeast Regional Office since her return in 1992. She is presently responsible for radio telemetry studies addressing the downstream migration of Atlantic salmon smolts in the Connecticut River.

1991 to 1992 - At Normandeau Associates, Inc., in New Hampshire, Ms. DeWald was a fisheries biologist, and participated in the field work and computer modelling aspects of several instream flow studies. She assisted in the preparation of Exhibit E documents as part of the relicensing studies at Public Service Company of New Hampshire's J. Brodie Smith, Gorham, and Ayers Island Hydroelectric Projects. Additional work involved monitoring studies on a Department of Energy power facility in Georgia and South Carolina.

1985 to 1990 - As an undergraduate, Lynn spent a semester as a research assistant for the Smithsonian Institute's Marine Systems Laboratory, where she established and maintained an at-sea hatchery for the mariculture of Caribbean king crabs. Her graduate work involved the design and conduction of laboratory experiments addressing growth, habitat use, and foraging behavior of allopatric and sympatric brook trout and brown trout. Lynn also participated in the collection of fish and benthic organisms from several rivers in Yellowstone National Park.

CONTINUING EDUCATION

USFWS, NERC, Fort Collins, Colorado:

IF310 Using the Computer Based Physical Habitat Simulation System

PUBLICATIONS

A recent article, "Interactions between native brook trout and hatchery brown trout: Effects on habitat use, feeding, and growth," has been published In Transactions of the American Fisheries Society.



PAUL G. HEISEY
PRINCIPAL BIOLOGIST

Mr. Heisey has extensive experience in environmental assessment projects, particularly those related to fisheries impacts. His areas of technical expertise, particularly in radio telemetric techniques, lie in the analysis of fisheries impacted by electrical generating facilities. His experience has included impingement and entrainment studies; instream flow studies; instream mitigation; pre-operational studies; relicensing investigations; monitoring; and thermal discharge studies. Mr. Heisey was instrumental in the development of RMC's Turb'N Tag, a device that provides an efficient and economic method to estimate turbine mortality/survival rates of fish.

EDUCATION

B.S., 1968, Biology, Elizabethtown College

REGISTRATIONS/CERTIFICATIONS

Certified Fisheries Scientist

BACKGROUND AND EXPERIENCE

1968 to Present - Mr. Heisey joined Ichthyological Associates, Inc., a firm dedicated to aquatic and terrestrial consulting services, as a research biologist. Several present-day consultants and scientists at RMC, including Mr. Heisey, were employed by two of Ichthyological Associates' ecological laboratories, Pottstown and Muddy Run. In 1977, these two offices were reorganized to reflect a broader scope of services under Radiation Management Corporation. After a seven-year period, the firm reorganized once again when it was acquired by Canberra Industries, Inc., and operated as a division of Canberra, RMC Environmental Services. Since 1989, the firm has been independently owned and operated as a broad-range environmental consulting and laboratory firm. Mr. Heisey's areas of technical expertise are: fisheries biology; anadromous fishes; radio telemetry techniques and turbine mortality/survival of fishes. Using radio telemetry techniques, Mr. Heisey has devoted most of his research efforts to determining turbine passage and behavior of American shad, salmonids, and numerous resident species in the vicinity of hydroelectrical generation facilities.

He has extensive experience in environmental assessment projects. He has conducted and managed, using radio telemetry techniques, large-scale studies of fish in response to operation of hydroelectric stations; performed ecological surveys; and, directed minimum flow and dissolved oxygen studies in relation to electric generation schedules.

Mr. Heisey's experience extends to impingement and entrainment studies; pre-operational studies; relicensing investigations; plant shutdown monitoring; and, thermal discharge studies. He has developed sampling techniques for collecting fishes from the forebays and tailraces of hydroelectric projects, and is thoroughly familiar with the intricate problems associated with large and small scale power plants.

Mr. Heisey developed a specialized tag and recapture procedure that enables turbine passage survival of fishes to be determined rapidly and economically. His invention was patented in 1990 under the name HI-Z Turb'N Tag (U.S. Patent No. 4,970,988). The tag was patented in Canada in 1992 (Canada Patent No. 2,016,607). This tag has been successfully used at numerous power stations to determine downstream passage survival (turbine, fish bypass, and spillways) of fish, including the sensitive juvenile American shad. Using the Turb'N Tag recovery technique, Mr. Heisey has directed mortality/survival studies at numerous facilities on the East coast and conducted a similar turbine passage survival study on the Columbia River.



(PAUL G. HEISEY)

CONTINUING EDUCATION

Mr. Heisey completed courses (1983-84) in Instream Flow Incremental Methodology at the National Fisheries Academy. He has also completed a Biosonics Training Program on hydro-acoustics.

AFFILIATIONS

American Fisheries Society

PUBLICATIONS

Mr. Heisey is the author of numerous papers and technical reports.

