REPORT ON MIDGE MITIGATION STUDY

A STUDY OF THE WATER QUALITY & MIDGE POPULATION DYNAMICS OF STRAIT'S POND IN THE TOWNS OF HULL, COHASSET, AND HINGHAM, MASSACHUSETTS

HULL PUBLIC SCHOOLS FOR TOWN OF HULL, MASSACHUSETTS

FUNDED BY: TOWN OF HULL & MASSACHUSETTS ENVIRONMENTAL TRUST

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TABLE OF CONTENTS

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September 4, 1992

Board of Selectmen
Town of Hull
Town Hall
Hull, Massachusetts 02045

Dear Selectmen:

On August 21, 1991, the Board of Selectmen of Hull signed an agreement with the Hull School Committee by which the professionally-guided 9th grade students of the Hull Environmental High School would conduct a one-year study of the midge infestation and environmental problems of Straits Pond. The agreement called for the students and participating adult volunteers (funded by a grant from the Massachusetts Environmental Trust to the Hull Council for Business and Cultural Development) to research and test several potential non-chemical methods to reduce the midge infestation of the pond and to research and test the 9 options for improving the pond that were recommended by the Hull Conservation Commission.

There were two established goals for this project: (1) a more comprehensive understanding of Straits Pond; and (2) a strong, activity-based learning experience for some of the 9th graders of the new Hull Environmental High School. Unlike the 1980 study of the pond by IEP; we hope that this project and report will result in specific actions that will improve the pond's life and that of the residents who live on its shore.

Over the past few months, about 25 of Hull's 9th grade students and a group of 30 volunteers from three towns have been recruited and trained and have gathered information on midges and on the life of the pond. (These volunteers have now formed the Friends of the Weir River Estuary.) This work has been advised by ten research scientists drawn from several areas of expertise. Eight of these doctors serve on our Scientific Research Advisory Committee.

9TH GRADE STUDENTS' ROLE

This project's educational goal had the following objectives:

1. To help the participating students to learn the

significance of water quality parameters to general water quality;

2. To help them learn about the sources of water pollution;

3. To help them learn how to plan, design, and conduct accurate field studies; and

4. To help them learn about the complex integration of political, economic, and attitudinal factors involved in finding workable solutions to local environmental problems.

During the course of the project, 25 of Hull's 9th grade students acted as the "consultants" under this innovative contract with the Town of Hull. Teams have gone to UMass. to learn about mapping the pond, gathered information on midges, set-up lab experiments with midge larvae, developed a public attitude survey, helped develop a public brochure, conducted field research on the pond, and prepared materials for their presentation to the Board of Selectmen.

During their weekly meetings and through their field work, the five 9th grade student leaders gradually expanded their involvement in and ownership of the many different aspects of this study. Their role and that of their successors will continue to expand this next year as everyone becomes more familiar with the project and the complexity of fully involving high school students in this type of consultancy.

As the project moved forward, the five student leaders and the 20 other participating 9th grade students took increasingly strong roles in each of the following components:

* Field Research
* Brochure Publication
* Background Research
* Report Preparation
* Community Surveying
* 3 Dimensional Mapping
* Area History

We believe that the student group leaders accomplished and mastered the following:

1. They have demonstrated a clear understanding of the problems affecting the pond;

2. They have made considerable progress in comprehending the complexities inherent in analyzing a problem within a natural system;

3. They have conducted field studies, and gathered appropriate data, and used standardized methods to ensure replicability and accuracy. They are familiar enough that they have begun to suggest modifications to midge sampling techniques;

4. They have become competent in using water chemistry test kits and have demonstrated accurate and replicable results;

5. They have demonstrated competency in biological sampling techniques;

6. They have analyzed the data collected, made comparisons to the other studies, and suggested future studies which would enhance their knowledge and understanding of the problems that they are attempting to solve;

7. They have learned to make and use graphs to help analyze data and how to use computer spread sheets for data storage;

8. They have learned how to prepare and conduct a survey of community attitudes;

9. They have demonstrated leadership skills by starting their own work groups and involving other students in field and lab work; and

10 They are prepared to take more direct roles in the research and are assuming greater responsibility in all areas.

During this next year, we hope to have the students become involved in some mitigation measures to improve the pond. Mr. Anson Wheeler, an engineer who lives in Cohasset, and several students are ready to develop designs for the fabrication of several midge traps to be used along the shore of the pond this Spring. Our attitude survey indicated that most abutters would be willing to have them placed on their private property and to pay for the electricity costs. The high school principal and the shop teachers have agreed to fabricate these traps when the design is ready.

The student leaders also were able to make presentations or "exhibitions" of their mastery before their classmates and teachers, and before the High School's Advisory Board.

As interesting side benefit to this project was that it allowed the schools to develop a model for future "activity-based" learning projects. We will be experimenting with more of these type of projects during this next school year.

ADULT VOLUNTEERS' ROLE

We have held six evening training sessions for many of the 30 adult volunteers that we have been able to recruit for this

project. The adult volunteers have begun helping in all aspects of the project. The adults now assist the students in field research. The costs of Linda Beres' work on the community portions and the other project costs for the community portions of this project were paid for by the Massachusetts Environmental Trust. The project has just received two small grants to continue this community involvement from the Massachusetts Bays Program.

Within the Hull Community Schools portions of this project, we also completed the following objectives:

1. To advertise via newspapers and cable and then hold three more evening training and education sessions for all of the interested community members and volunteers; these were offered by research scientists;

2. To manage + conduct four more in-depth field surveys using trained adults to assist the participating 9th grade students;

3. To pair adult volunteers with students to survey Pond abutter attitudes;

4. To have volunteers conduct daily field studies on the Pond for a two week period in June and July.

5. To advertise and hold one-week in-depth research to check all data using teachers, students, adults, and other interested community members.

PROCESS BENCHMARKS 8/21/91 - 8/21/92

- Hired Linda Beres as study's Project Coordinator
- Managed 15 BU students in full week of data gathering
- Provided background and training for 9th grade teachers
- Provided background + training for participating 9th graders
- 9th grade students conducting field research of the pond
- Built a mailing list of 100 potential adult volunteers
- Recruited + provided training to 25 adult project volunteers
- Recruited 7 scientists to be on Research Advisory Committee
- Secured private funding for adult volunteers program
- Recruited support of 3 towns' Conservation Commissions
- Recruited support of 3 towns' Health agents and Boards
- Placed advertisements and articles on the project
- Secured use of labs at Suffolk, Cohasset Water, and Hull
- Developed attitude survey for pond abutters
- Secured assistance of school media coord. for cable show
- Secured assistance of Ansin Wheeler to design midge traps

- Secured assistance of school shop for building midge traps
- Set initial time line for the remainder of the project
- Retained Faith Burbank for project Quality Assurance
- Battelle Lab agreed to do pond core samples at cost
- Recruited adult volunteers to do daily pond studies

CONTENT BENCHMARKS 8/21/91 - 8/21/92

- Interviewed many of the Friends of Straits Pond
- Reviewed all prior research and reports on the Pond
- Identified locations of outfall pipes flowing into the Pond
- Revised our methodology with the Research Advisory Committee
- Produced initial three-dimensional maps of the pond at UMass.
- Developed 2 proposals for additional non-Town funding
- Students printed informative community outreach brochure
- Students evaluated Rattle Snake Run
- Students + adults conducted surveys of pond water chemistry
- Began to develop options for resolution of Pond's problems
- Reviewed scientific information on Abate and alternatives
- Interviewed national midge expert on our methodology
- Found pond midges are likely immune to legal levels of abate
- Developed initial theory on primary location of midge larvae
- Developed theory on reducing midge larvae by freezing
- Found that high levels of fecal coliform are in pond pipes
- Developed theory for targeted use of BTI on midge locations
- Determined that BTI in legal doses is effective on midges
- Determined that raw sewage is currently flowing into pond

I hope that you are as satisfied as we are with the work of the management team that guided this unique schools-community collaboration. The team was assembled and managed by Timothy Anderson and included Linda Beres, Robert Burwood, Pamela Cooney, and Faith Burbank.

While this is the final report of this consultancy; the Hull Public Schools, The Hull Council for Business and Cultural Development, and the Friends of the Weir River are committed to continue the necessary monitoring, data collecting, and testing of indicated changes in the management of the pond.

One of the things that the scientists have been very clear about is that this must be a multi-year effort. For the near-term future, the Hull Public Schools has committed $2,500 to the coordination of further monitoring by groups of students of the Hull Environmental High School. The Massachusetts Bays Program recently funded the new Friends of the Weir River Estuary and the Schools with a total of $2,650 to continue and expand the involvement of the trained adult volunteers. We are also pursuing additional funding and participation from the Commonwealth, private foundations, and through the Hingham and Cohasset Public Schools.

We have submitted under separate cover a budget for Town Meeting to cover part of the capital and staffing needs to carry on this project during this next year.

Thank you for the opportunity for the Hull Public Schools and its students to be involved in this important consultancy. Our Scientific Research Committee has been most encouraging in their support of the quality of this report. We hope that you agree. Please call Timothy Anderson, our Ecology Study Coordinator, at 925-3078 if you require any additional information.

Sincerely yours,

Claire L. Sheff

Claire L. Sheff
Superintendent of Schools

APPENDIX LISTINGS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION

Straits Pond is a salt pond of about 92 acres on the Hull and Cohasset border. The pond is approximately 1-1.5 meters deep. The depth varies with the tides and seasons and is controlled by a tidal gate at the west end of the pond. Water is periodically allowed into the pond at high tide and out at low tide. Water entering the pond is from the Weir River. Strait's Pond and the Weir River are classified as "Area of Critical Environmental Concern" (ACEC) with class SB standards. This designation provides an additional higher standard of protection--"No degradation of water quality allowed under the law."

The pond's main opening to the ocean, at the east end, was closed off in the mid 1800's (APPENDIX 1: IEP: Section 1).

1. A species of Chironomids, a non-biting aquatic midge, has attained densities of approximately 5000 per square meter in some portions of the pond. The midges inhabit the pond in its larval and pupa stages, primarily existing in the shallow edges of the pond. The adult midges historically emerge from the pond in late April in large numbers. The midges continue to emerge periodically throughout the summer and often into September, causing a variety of nuisance and economic problems for residents abutting the pond.

EXAMPLES:
At times dense swarms of adult midges make outside activities intolerable. The adults fly into the eyes, mouth and ears of residents and are easily inhaled by young children. In one case an infant was hospitalized because of inhaling midges into its lungs.

Adult midges are attracted to cool shady surfaces during hot summer days, frequently covering the sides of homes, cars and even laundry, leaving behind stained paint and clothes. They are known to clog screens, car radiators and air conditioning systems. Residents have complained that the midges attract large numbers of spiders. The accumulation of dead midges caught in webs require residence to more frequently wash and maintain their properties (Ali,1980, 1991).

The loss of income from the rental of summer cottages around the pond has been mentioned by a few residents.

Adult midges are not known to be carriers of any human diseases but they have been implicated in human allergic reactions such as asthma.

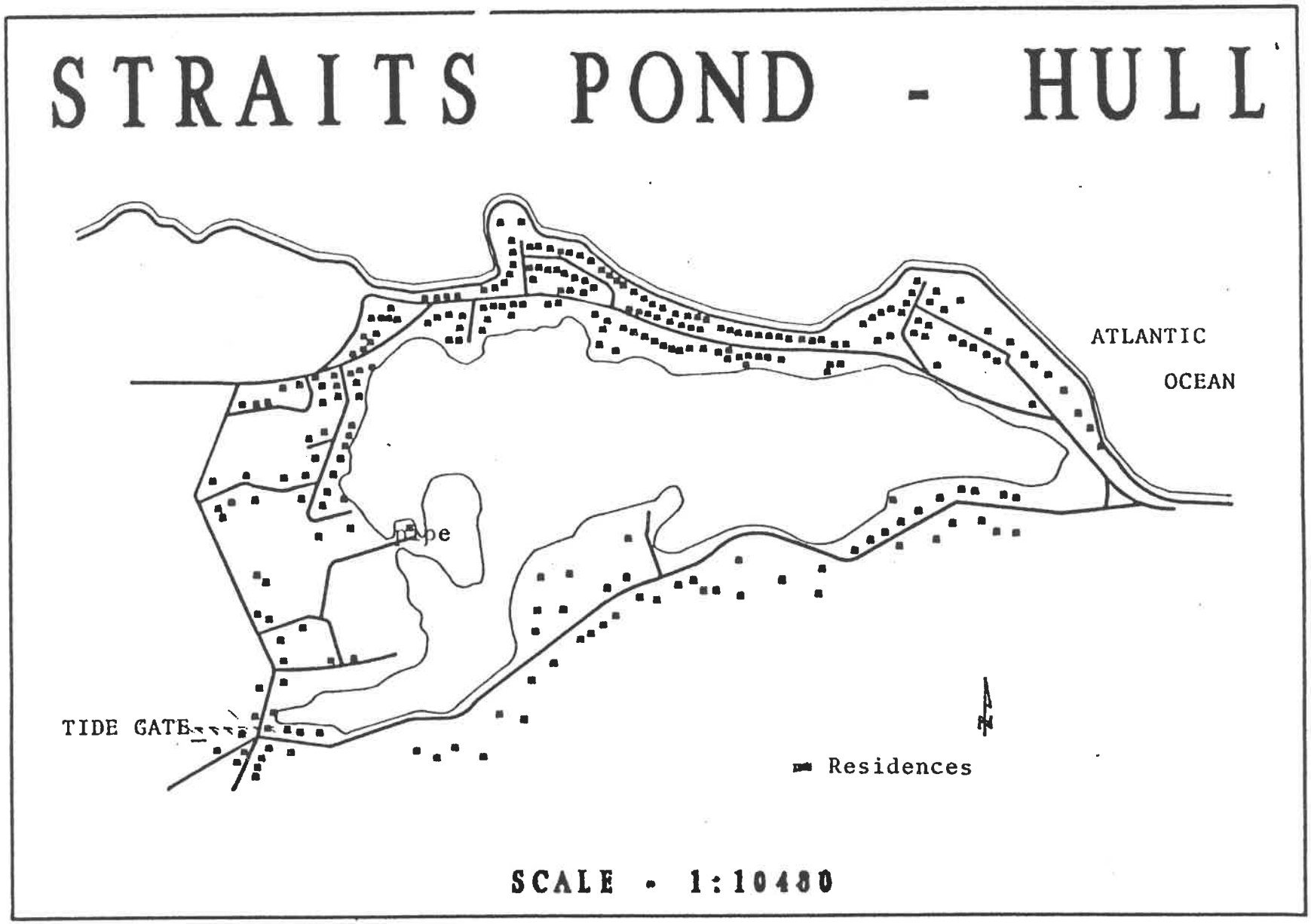


FIGURE 1: POND LOCATION & HUMAN POPULATION DENSITY

2. Residents of the pond have historically complained of foul odors, algae blooms, and dying fish during the summer months. These symptoms are indicative of enrichment pollution from a variety of nutrient sources including, raw sewage and contaminated ground water from septic systems that have been improperly maintained, older systems that no longer function well enough to do their intended jobs or systems that were placed too close to the pond. During periods of heavy rain fall, run off from streets and pipes frequently are a source of fecal coliform, an indicator bacteria associated with sewage. Run off from yards often carries fertilizers into the pond another excellent source of nutrients. Additionally, the pond receives nutrients from natural sources such as large flocks of bird, ducks, and swans.

Two studies have been done on the pond: the first in 1953-54 by the State Department of Health, and the second in 1980 By IEP, a private environmental consulting firm and funded by CZM. Both studies indicate that the pond is undergoing eutrophication due to enrichment pollution from faulty septic systems, direct discharges of sewage, and run off of lawn fertilizers, etc. The problem is further enhanced by minimal water exchange in the pond.

In attempts to control these problems the Town of Hull has used two strategies: controlling the pond level via the tidal gates and spraying the pond in the spring with Abate. In the spring of 1991 the town of Hull was told by state agencies Department of Environmental Protection (DEP) and Coastal Zone Management (CZM) that **Hull would no longer be allowed to spray with Abate without conducting further studies on the problems of Straits Pond and evaluating other possible solutions.**

The following study of Straits Pond and the midge problems are being conducted by the Hull Environmental High School(9th graders) and the New Community School which includes older students and adults from Hull, Cohasset, and Hingham.

STRAIT'S POND PROJECT: GOALS AND OBJECTIVES

GOALS

1. To reach a comprehensive understanding of the physical, chemical, biological parameters and processes which effect the pond.
2. To evaluate the problem of midges and polution which have historically plagued the residents of Strait's Pond
3. To recommend management strategies which support the ACEC guidelines of "no adverse impact" (MA Statute, Chapter 91, section 9.32).

OBJECTIVES AND TASKS

1. A primary objective of this project is to find an environmentally safe and effective means of controlling the midge population. To accomplish this objective the following tasks have been completed.

    * Define the basic physical, chemical and biological processes which characterize Straits Pond.
    * Identify and evaluate the environmental factors or combination of factors which maybe important in the control of the midge population such as: salinity levels, food chains, and weather conditions.
    *Recommend natural methods for midge population control based on the above studies.
    *Research Bti. Determine if it is a safe product to use in the Strait's Pond environment and determine its effectiveness against the pond's species of midges.

2. Identify the sources of pollutants entering the pond and make recommend ations for their remediation. Consider the combined impact of all sources of enrichment and place this information within the context of the physical limitations of the pond. The expected effects of these combined sources of enrichment on a shallow pond with a limited potential for water exchange is eutrophication. If left unabated, the pollution in time will lead to the death of the pond itself. To accomplish this objective the following tasks have been completed.

    *Complete a sanitary survey which identifies all sources of fecal coliform entering the pond.
    *Monitor and evaluate the water quality of the pond.
    *Identify trophic levels and relationship of species under mesotrophic conditions (moderately enriched).

*Evaluate methods that will improve exchange of water in the pond.

3. Communicate studies to the public. The following tasks were designed to accomplish this objective.

* Design map models of monthly water quality and midge study results to enhance communication and visually compare seasonal differences in the pond.
* Design a survey which identifies the attitudes and values held by the abutters of the pond. The survey will help us determine which methods of remediation are most likely to be acceptable and therefore more effective.
*Additionally six workshops were given to inform and educate the public about the Straits Pond Project and the results of our research. The survey and workshops did help to involve abutters and the public in the project and gave them a vehicle to voice there opinions and concerns.

DESIGN OF PROJECT

The studies conducted during this project were chosen on the basis of the known and expected problems as determined by the IEP study of 1980. Consideration was also given to the long term management goals which include, passive recreational use, fishing, maintenance of andronomous and catadromous fish runs, aesthetics, and ACEC goals.

The sampling program was designed to determine the existing environmental parameters which sustain the biotic communities in the pond and indicate the general trend of water quality toward health or deterioration through the seasons.

PHYSICAL PARAMETERS OBSERVED AND RECORDED were: natural and man-made parameters, geology, groundwater hydrology, weather conditions, water clarity, depth, and substrate conditions.

CHEMICAL AND BIOLOGICAL PARAMETERS TESTED were: water & air temperatures, pH, dissolved oxygen (DO), salinity, fecal coliform (FC), nitrates, phosphates, midge location and density, fish inventory, and survey of aquatic plants.

Particular attention was given to factors such as salinity, water depths, trophic levels (predators) and weather conditions which we felt would play an important role in midge control.

SCIENTIFIC STUDIES OF STRAIT'S POND

Physical Studies

Objective:

*TO MEASURE THE DEPTH AND DETERMINE THE CONDITIONS THAT CONTRIBUTE TO THE HYDROLOGY AND CHEMISTRY OF THE POND.

*TO OBSERVE BATHYMETRIC CONDITIONS-SUBSTRATE AND EDGE CAPACITY FOR SUPPORTING THE BIOTIC COMMUNITIES AND THEIR HABITATS.

*TO MONITOR THE WEATHER CONDITIONS AS PARAMETERS WHICH EFFECT THE CIRCULATION, CHEMISTRY, AND BIOLOGICAL PROCESS OF THE POND.

LOCATION & DEPTH

Straits Pond is 92 acres in size. It can best be visualized as spoon shaped, that is shallower at the edges and sloping to a uniform depth in the middle to four feet +/- up to 10 inches.

The pond is located on the border of the towns of Hull and Cohasset. The eastern end of the pond,which at one time was open to the ocean, is separated from the Atlantic Ocean by a narrow strip of land. It is connected to the Weir River estuary at its western end by a tidal gate. A peninsular at the north west corner of the pond acts as a promontory protection to a section of the pond. A water circulation pipe through a narrow portion of the peninsular connects Richard's Rd. lagoon to the pond entrance at the tidal gate. The Weir River is now the main water source for the pond. The water level is controlled by the number of boards set in position at the gate by Mr. Parent of the Hull Highway Dept.

WATER CIRCULATION in the pond appears to be primarily wind driven with tidal gate adjustments affecting high tide input. Water flow through the tidal gate is impeded by bedrock outcrops in the channel, limiting its course and circulation.

FRESH WATER CONTRIBUTIONS have been monitored. First, Rattlesnake Run, a small fresh water stream which flows into Strait's Pond, was tested in January at three locations along its course from headwaters to its mouth. Parameters analyzed included temperature of the water, dissolved oxygen, pH, and fecal coliform. Water at the streams mouth, Station 4, was continually monitored throughout the study. Freshwater contributions to the pond in the spring affect the salinity parameters. In summer the Run may not contribute any or hardly any fresh water to the pond, thus allowing more saline parameters to prevail. Secondly, storm drain run-offs, septic pipe connections or seepage add fresh water point sources to the pond. Thirdly,

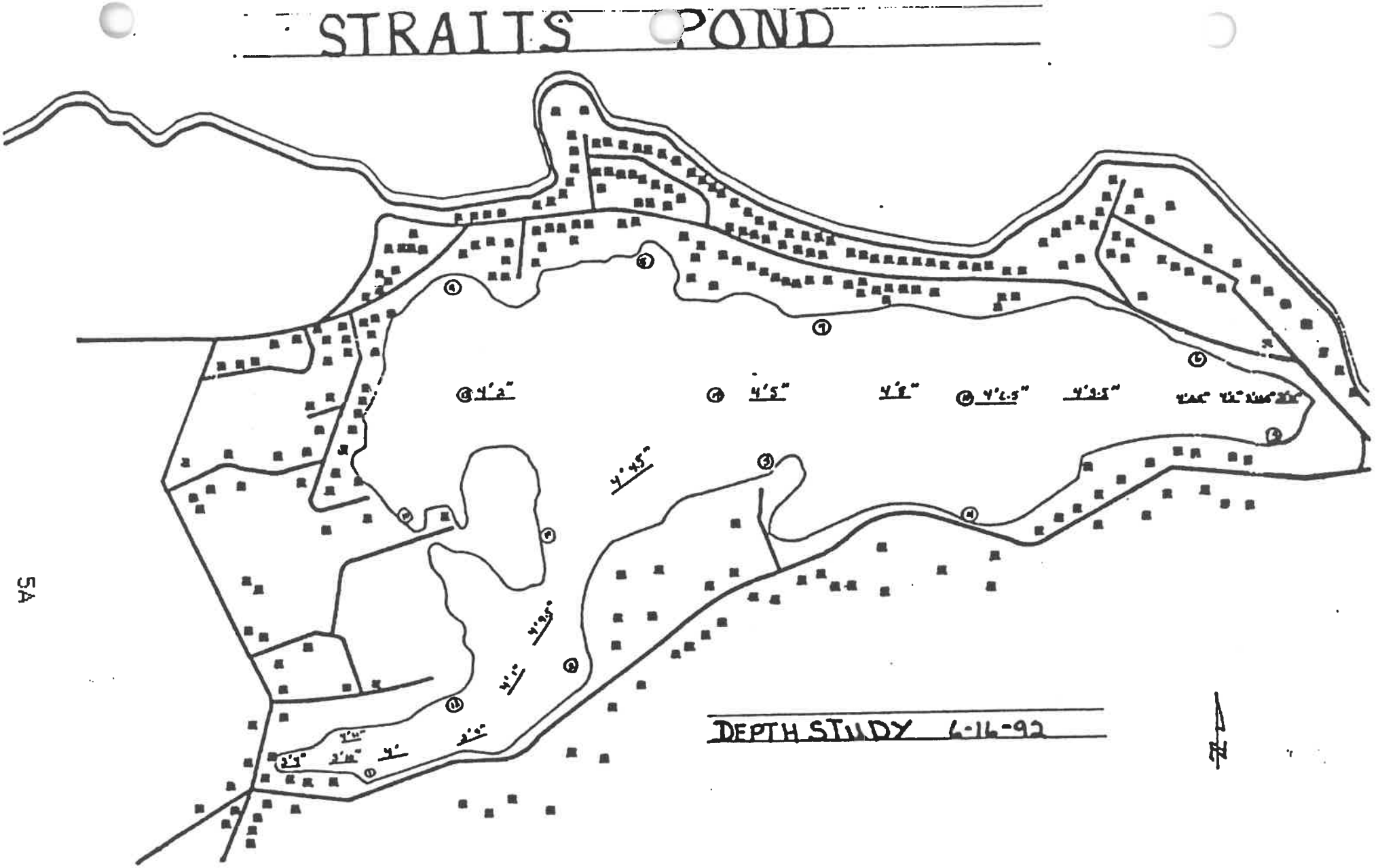


FIGURE 2: POND MAP BY STATIONS & DEPTHS

non-point sources of groundwater discharge and surface run-off contribute to the total water quality in the pond (FIGURE 4: page 11A).

GEOLOGY AND GROUNDWATER HYDROLOGY:
The geology and groundwater hydrology were reviewed. It was determined that the IEP study completed ten year ago had adequately covered these topics. The underlying geology remains the same and since only minor changes had occurred within the Strait's pond watershed (i.e. October 1991 a major storm breached the land which separated the pond from the ocean and deposited large quantities of salt water, sand, beach stone, and debris at the eastern point), we have opted to include sections four and five of the IEP study for your review. (Appendix 1: A-1)

The IEP study evaluates the watershed area and its impact on the pond. The watershed map (FIGURE 3) illustrates how the flow of groundwater moves through the watershed and into the pond. A careful review of the IEP text, Section 3, and the map should be of value to the towns of Hull and Cohasset as they review the recommendation which will follow later in this document.

SEDIMENT STUDIES

OBJECTIVES:

*TO DETERMINE THE TYPES OF SURFACE SEDIMENTS FOUND IN THE POND AND IF THERE IS ANY RELATIONSHIP BETWEEN SURFACE SEDIMENTS AND MIDGE LARVAE POPULATION DENSITY.

The pond sediments range from organic mud, silty mud (highly organic) over sand to silty-sandy mud overlaid on sand to a gravel/sandy substrate.

SEDIMENT STUDIES (Site reference: see Figure 2)

	ORGANIC MUD 4" TO 2'	SILTY-SANDY MUD 2-6" OVER GRAVEL & SAND	SILTY MUD 2-6" OVER SAND	SAND/GRAVEL
SITES	6,12,14	1, 2, 3, 10	4, 5, 7, 8. 9	11, GATE

RESULTS :
The largest populations of midge larvae are found in silty mud over sand.

Sites 4 and 7 are the areas of major infestation at different seasons. Sites 3, 5, 6, and 8 have had low to moderate infestations of larvae.

The only explanation for this relationship that we have found comes from

FIGURE 3: STRAIT'S POND WATERSHED & LAND USES

direct observations of the ponds Chironomids species. The larvae make tubes that they live in from the surface sediments. For reasons that remain unclear, they more frequently construct these tubes from the silty, slightly organic soils that lay over fine sand. It appears the main function of the tubes is for protection of the larvae from the predators such as the small fish that live in the pond.

WEATHER OBSERVATIONS

The U.S. Weather Bureau at Logan Airport to August 3,1992 records 4 " less rain than normal for the year as compared to the 30 year average.

MONTHLY WEATHER STATISTICS APRIL-JULY (compared to average)

	TEMPERATURES IN DEGREES C.	RAINFALL INCHES	PREVAILING WIND	CLOUDY DAYS	P. CLOUDY DAYS	% CLEAR DAYS
APRIL	-2.3	-1.3"	NW	15	9	+6%
MAY	-2.9	-2.12	WNW	14	11	+6%
JUNE	-2.0	+1.69	SW	AVERAGE		+5%
JULY	-4.0	-.2	SW	12		-7%

THIS SUMMER HAS BEEN COOLER AND DRYER WITH MORE CLEAR DAYS THAN CAN BE EXPECTED BASED ON THE 30 YEAR AVERAGE The cooler temperatures in late April and early May, when the adults first emerged, may have had some effect on the population. The flies disappeared for a few days during the coldest period. According to residents, when the flies returned, their numbers seemed to be reduced.

A more direct relationship can be made for dryer, clear conditions. As of the end of May we had 3.5 less inches of rain then is normal. Our monitoring of salinity in the pond showed an increase in salinity through out the spring and summer period. It appears that the lack of rain was a major factor. A high percent of clear days would allow more evaporation to take place and also contribute to an increase in salinity and photosynthetic productivity.

WATER QUALITY (CHEMICAL) STUDIES

Objectives for midge control are:

*To gain a better understanding of the ecological requirements of the midge larvae.

*To identify the environmental parameters which might be most effectively manipulated to control the midge larvae population in the pond.determine factors contributing to water contamination.

Objectives for pollution control are:

*To conduct a complete sanitary survey of the pond.

-Identify all visible sources of pollution entering the pond.

-Determine levels of fecal coliform from each source.

-Continue fecal coliform studies during each monthly study to determine the fate and transport of pollutants throughout the pond.

DESCRIPTIONS OF WATER VALUES STUDIED

(FOR METHODS & MATERIALS FOR WATER QUALITY, SANITARY SURVEY TESTING, SEE Appendix 2)

SALINITY VALUES in Strait's Pond range from 4 ppt-28 ppt in the spring 1992 to 18.2 ppt-29 ppt in the summer 1992, an increase in the overall range from 14 ppt-23 ppt given in the IEP study 1980. During the winter an area between Station 4 and 7 has not frozen in the past few years (Mr. Parent). This could indicate a point of possible salt water intrusion from a spring.

This summer samples were taken from the bottom at the middle of the pond (approximately 4 1/2 feet) to determine if any stratification of water temperature and dissolved oxygen were present to enrich the living environment. There were some variations in the surface and bottom temperatures, DO, and salinity in the center of the pond. It is unclear at this writing how to interpret this info.

pH VALUES

In fresh water a pH between 5-7 is considered normal. The ocean, on the other hand, is more basic tending to have a pH greater than 7, with a pH between 7-8.5 considered normal. Nitrogen oxides, carbon dioxide, especially from cars and acid rain can contribute to increased acidity. Phosphates from detergents would tend to make the pond more basic. Straits Pond was brackish in the spring '92 (a pH ranging between 6.0-9) and a salt pond in the summer '92 (stabilizing around 8.9).

Changes in pH values of water affects many chemical and biological

processes in the water, such as diversity, the availability and toxicity of nutrients, metals, and other important compounds. (It is important to remember for every one unit of change on the pH scale there is approximately a ten-fold change in how acidic or basic the sample is.) Most organisms have adapted to rather narrow or specific pH ranges and may die if pH changes even slightly. The largest variety of aquatic animals prefer a range of 6.5-7.5.

DISSOLVED OXYGEN : In Massachusetts, the standard minimum level of DO for a class "SB" body of water is 5 parts per million (ppm). Class SB are marine or coastal waters and are designated for the following: the protection of fish, other aquatic life, and wildlife; for primary and secondary contact recreation; and shellfish harvesting without depuration in approved areas (EEOA Office, Final ACEC Guidance Document, 1/92).

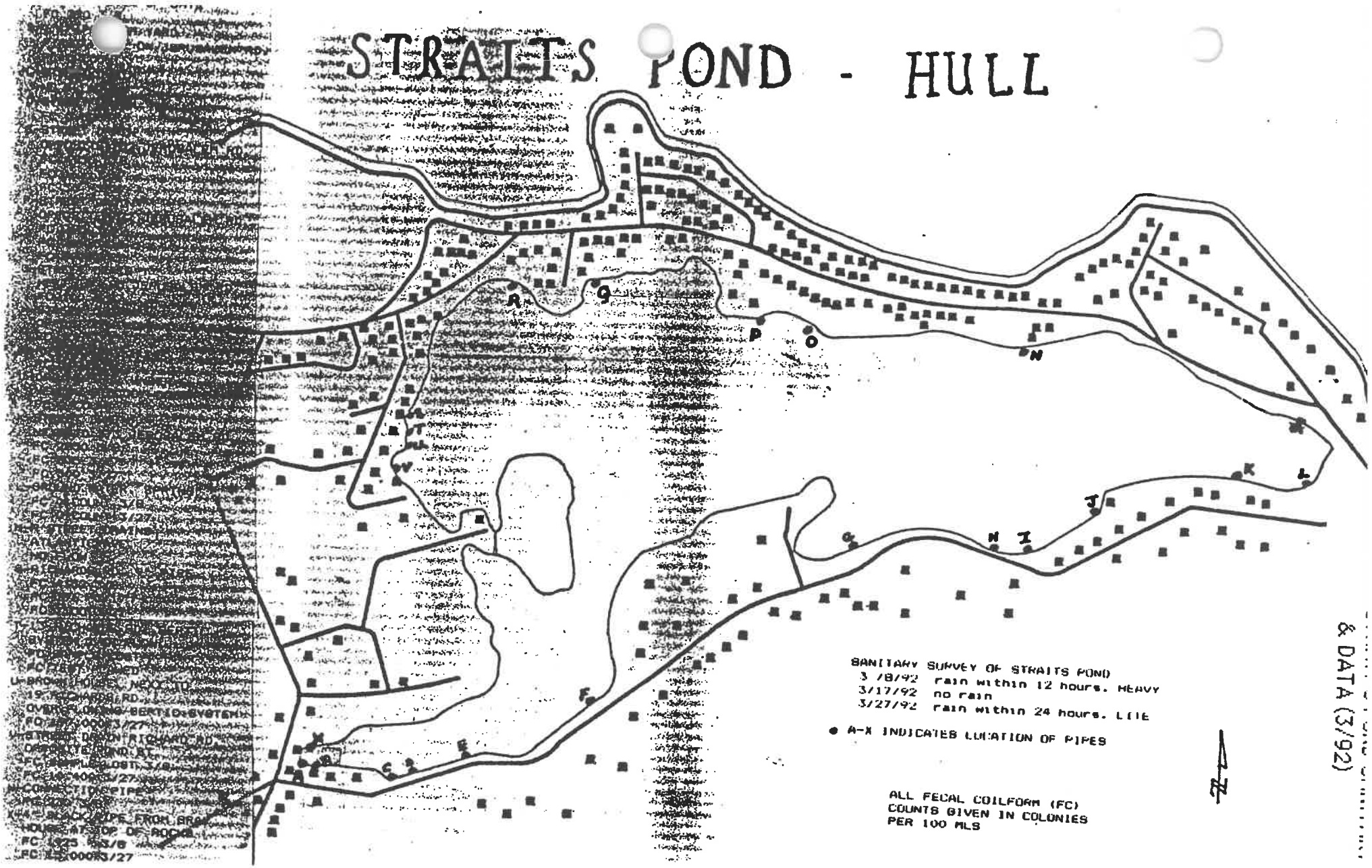
The DO reading taken on Straits Pond in January through May 1992 were all above the minimum state levels for class "SB" waters, ranging from about 5.2 ppm-17 ppm. This indicates that there was an adequate supply of DO to maintain life in the pond during the winter-spring months. June and July 1992 ranged from 1.4 ppm to 11.4 ppm. The low readings correspond to the early A.M. testing to determine how much oxygen remains in the water after a night of no oxygen production by plants and the high readings indicate end of day oxygen production levels after an active photosynthetic period.

NUTRIENTS: Phosphate and nitrate tests were different between summer '92 and summer '91. Summer 1991 tests were for total phosphates and k/nitrites which tested high especially after storms. Whereas, the 1992 tests were for general phosphates and nitrates which are more directly absorbed by plants and produced low results.

Excessive amounts of nutrients accelerate eutrophication, causing dramatic increases in aquatic plant growth and changes and in the types of plants and animals that live in the stream This in turn affects DO, temperature and other indicators. Comparative analysis of values for the summers '91-'92 are included in APPENDIX 4, Water Quality data spreadsheets.

SANITARY SURVEYS:
Fecal coliform bacteria is found in the feces of humans and other warm blooded animals. Although fecal coliform bacteria by themselves are not pathogenic (disease carrying), they are naturally occurring in the human digestive tract. Because of this relationship, fecal coliform bacteria are a good indicator of contamination by sewage. The pathogenic organisms often contained in sewage can cause diseases such as hepatitis,

STRAITS POND - HULL



& DATA (3/92)

gastroentuctis, dysentery, and typhoid to name a few possibilities.

Source point sanitary surveys were conducted at different intervals: March 8 and 27, 1992, 12 hours after a rainfall; March 17 when rain had not fallen within 24 hours. Nonpoint source FC tests were taken at the regular sites on 4/23/92, 5/16/92, and 7/9/92 (no reagent was available to the Cohasset Water Dept to complete June's test). Pipe locations and fecal coliform count results are indicated on the Strait's Pond map (FIGURE 4) and data (APPENDIX 5, page A5)

Waters containing fecal coliform counts above 200 colonies per 100 ml are unsafe for fishing; standards for shellfishing are more strict, requiring that counts remain below 14 colonies per 100 ml.

No heavy metals or organics were tested.

SIGNIFICANT MONTHLY DATA RESULTS & DISCUSSION

FIGURE 5: Water chemistry relationship to midge larvae at stations-- 4/'92

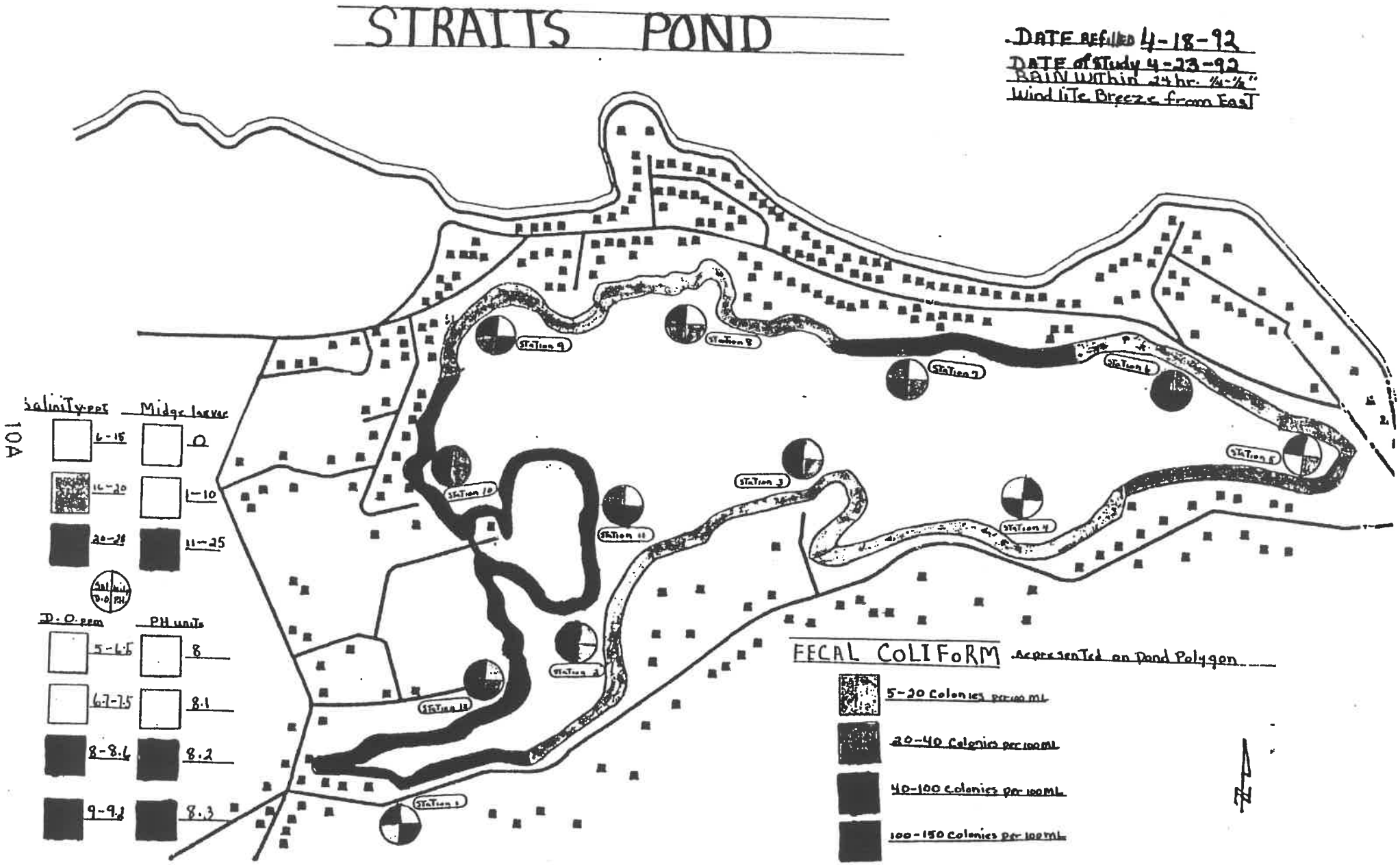
Site 4 was the area of:

* lowest salinity, averaging 10.6 ppt from Feb. through April. During this period Rattlesnake Run, located at site 4 , was the major source of fresh water into the pond and is the most likely explanation for the low salinity levels found there.
*highest midge larvae counts. One count between February and March was 101 per 1000 ml of soil or approximately 5000 per square meter. The April count was down due to larvae pupation and the emergence of adult flies from the pond during late April.

The February to April relationship between low salinity and high midge larvae counts is inverse; low salinity equals high midge counts throughout this period. Lab experiments indicate that the midge larvae can live in high saline water but for limited periods (up to 3 weeks) after which they die off. Lab experiments also indicate that pupation will not take place at high salinities.

PH during this period was very variable, due in part to major changes in the pond. With the draining and refilling of the pond, no correlation between midge pupation and pH was found. PH does however relate to levels of salinity and was found to increase as the pond became more saline.

Dissolved oxygen (DO) does not appear to be an important environmental



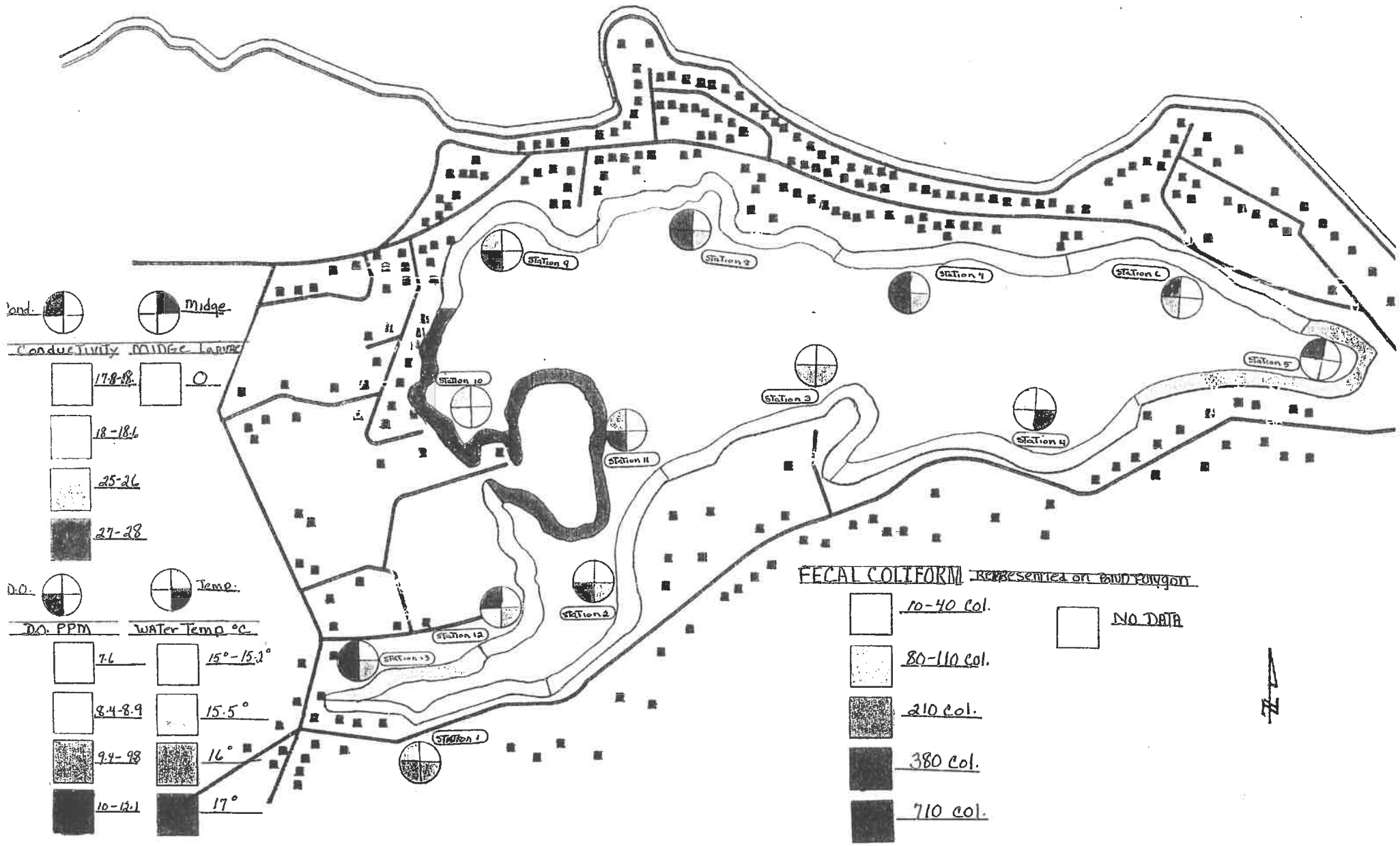
10A

FIGURE 5A: STRAIT'S POND CHEMICAL RELATIONSHIP TO MIDGE LARVAE POPULATION (4/'92)

5B: STRAIT'S POND SANITARY SURVEY AT STATIONS-MAP & DATA (4/'92)

SRATTS POND

Date of Study 5-16-92
Rain within 24hr. lite. 1/16"
Wind lite 0-5mph SE → W



factor as it relates to larval survival as no direct correlation was found during the study. The larvae form tubes from the organic sediments. By undulating their bodies, they bring food into their tubes and enrich the DO in the water. Their red pigment is also said to contribute to the respiratory function, hence midge larvae are found in waters that are almost depleted of DO as well as in areas saturated with DO such as swiftly running streams.

Fecal Coliform (FC) samples were taken at the stations not at pipe sites. The highest levels were unexpectedly at station 11 & 12; there is no immediate source at station 11. One small pipe was found to be the source of high levels of fecal coliform during rainy periods, but does not seem to be the case for these results. A more likely explanation may be found in wind and tidal patterns during this study. An incoming tide could tend to bring pollutants from Station 12 further into the pond toward station 11 and 10 via the circulation pipe through the peninsula.

Station 10 is the major source of pollutants to the pond.

*A 2 ft. pipe from Richard's Rd. brings raw sewage from the neighboring homes. Several septic systems within 10 ft. of the pond have also been observed to overflow during wet weather.

*As the tidal waters flow into the pond and through the circulation pipe, water would tend to pick up and move pollutants out into the pond water toward station 9 and 11.

*Springtime easterly winds would tend to move waters toward station 11 and back through the gate. This could cause a circular pattern, holding the pollutants within this pattern.

No direct correlation between pollutants and midge larvae has been identified at this time.

FIGURE 6: Water chemistry relationship to midge larvae at stations--5/92

No midge larvae were found during this study. However, adult flies were found around the pond: complaints were recorded from the abutting neighbors.

Salinities around the pond remained fairly low; station 2,3, and 4 are lowest. The highest salinities were found along Atlantic Ave., possibly due to the incoming tide.

Temperature of the water ranged between 15-17C and DO throughout the pond was good to saturated.

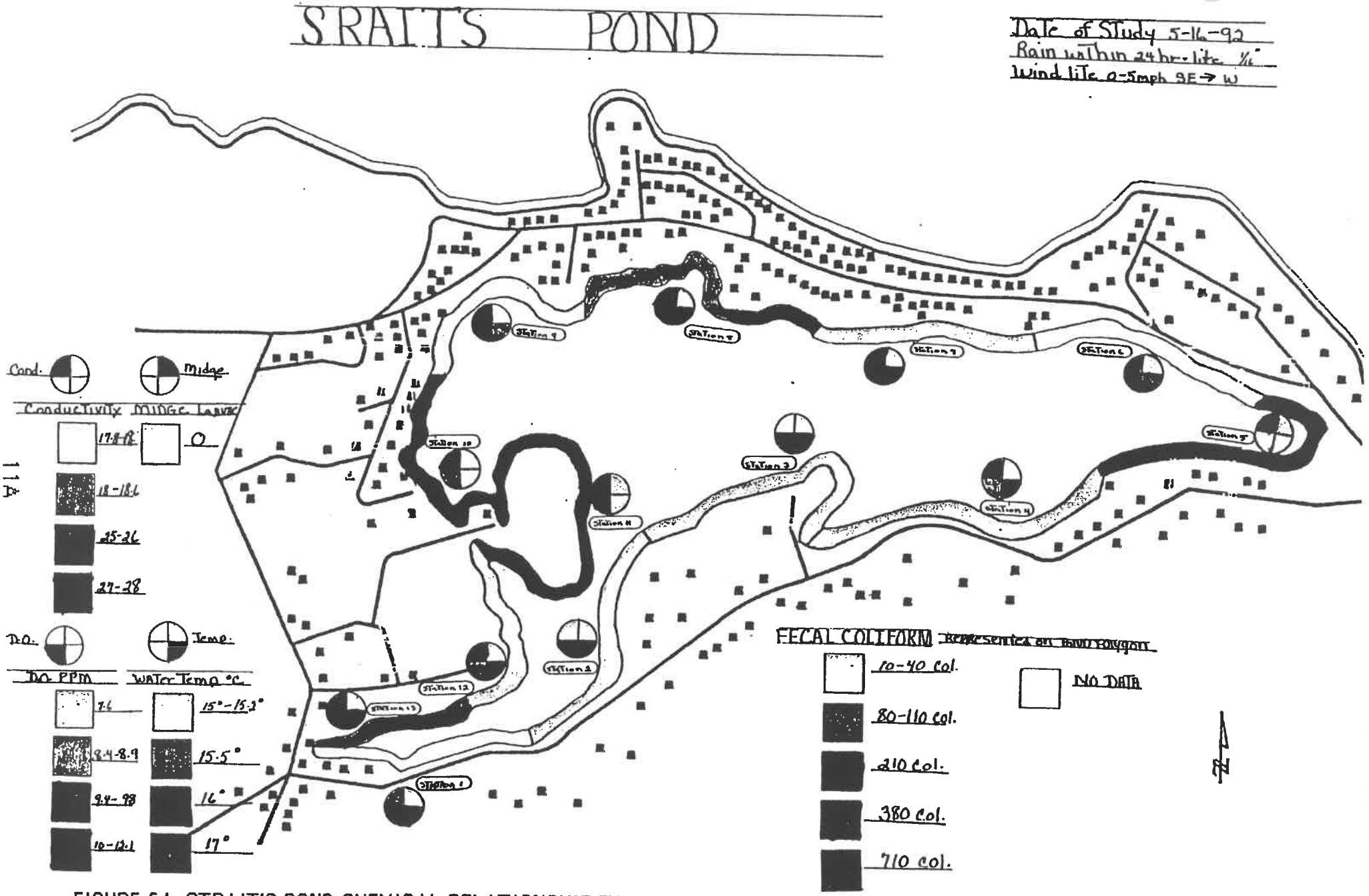


FIGURE 6A: STRAIT'S POND CHEMICAL RELATIONSHIP TO MIDGE LARVAE POPULATION (5/'92)

6B: STRAIT'S POND SANITARY SURVEY AT STATIONS-MAP & DATA (5/'92)

Fecal coliform was highest at Richard's Rd. in Hull, station 10, followed by station 11 and 5 (Cohasset).

FIGURE 7: Water chemistry relationship to midge larvae at stations--6/92 included 2 weeks of daily studies and no fecal coliform samples

A new generation of midge larvae were found. It is during June that we began to see a change in where the salinity and midge larvae locate. The prevailing winds shifted from WNW to SW, possibly pushing both midge adults and eggs toward the Hull shores where the highest survival rates tend to be in the areas of lowest salinity. The largest number of larvae and lowest salinity were at station 7 (34 larvae in 17-18 ppt salinity), 6 (26), and 5 (11 to under 22..03 ppt). Station 4 and 11 contained only a few larvae and higher salinity. Rattlesnake Run (STN 4) has dried up so it can no longer be a source of fresh water. Salinities are rising throughout the pond.

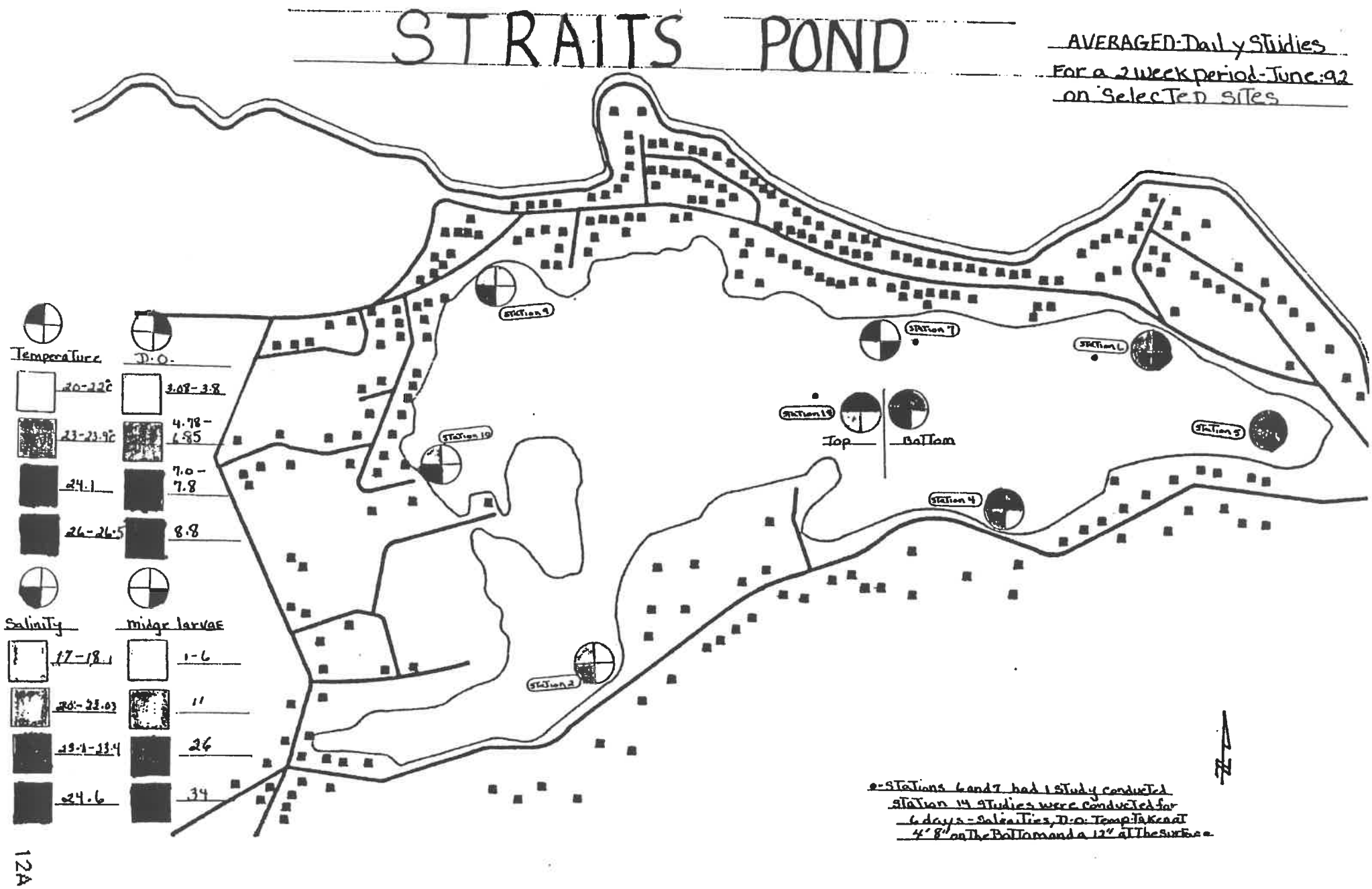
DO is generally lower than during past studies correlating with the higher water temperatures in the pond and included testing before 9 AM, a period following darkness when the plant respiration could have used up much of the available dissolved oxygen.

FIGURE 8: Water chemistry relationship to midge larvae at stations--7/92

Salinity became much higher throughout the pond, due in part to minimal rainfall (4" less than 30 yr. avg.) and higher levels of evaporation which occur with more sunny weather. The lowest levels of salinity and the highest counts of larvae still persist at station 7. However, the larvae will not pupate at these salinities and will most likely die off in August.

DO was slightly higher, consistent with cooler than average temperatures and stronger breezes during July.

Toward the end of July the pond appeared brighter green, an indication for the presence of phytoplankton. Visibility in the water was significantly reduced. Concerns have been voiced that the pond may turn eutrophic if the weather pattern continues much longer or if more water is not brought into the pond in some way. Fecal coliform studies again are highest at STN 10.



12A

FIGURE 7: STRAIT'S POND CHEMICAL RELATIONSHIPS TO MIDGE LARVAE POPULATION-MAP (2 WEEK PERIOD IN JUNE '92)

STRAITS POND

JULY 19, 1992
+ 7/9/92 + 7/12/92

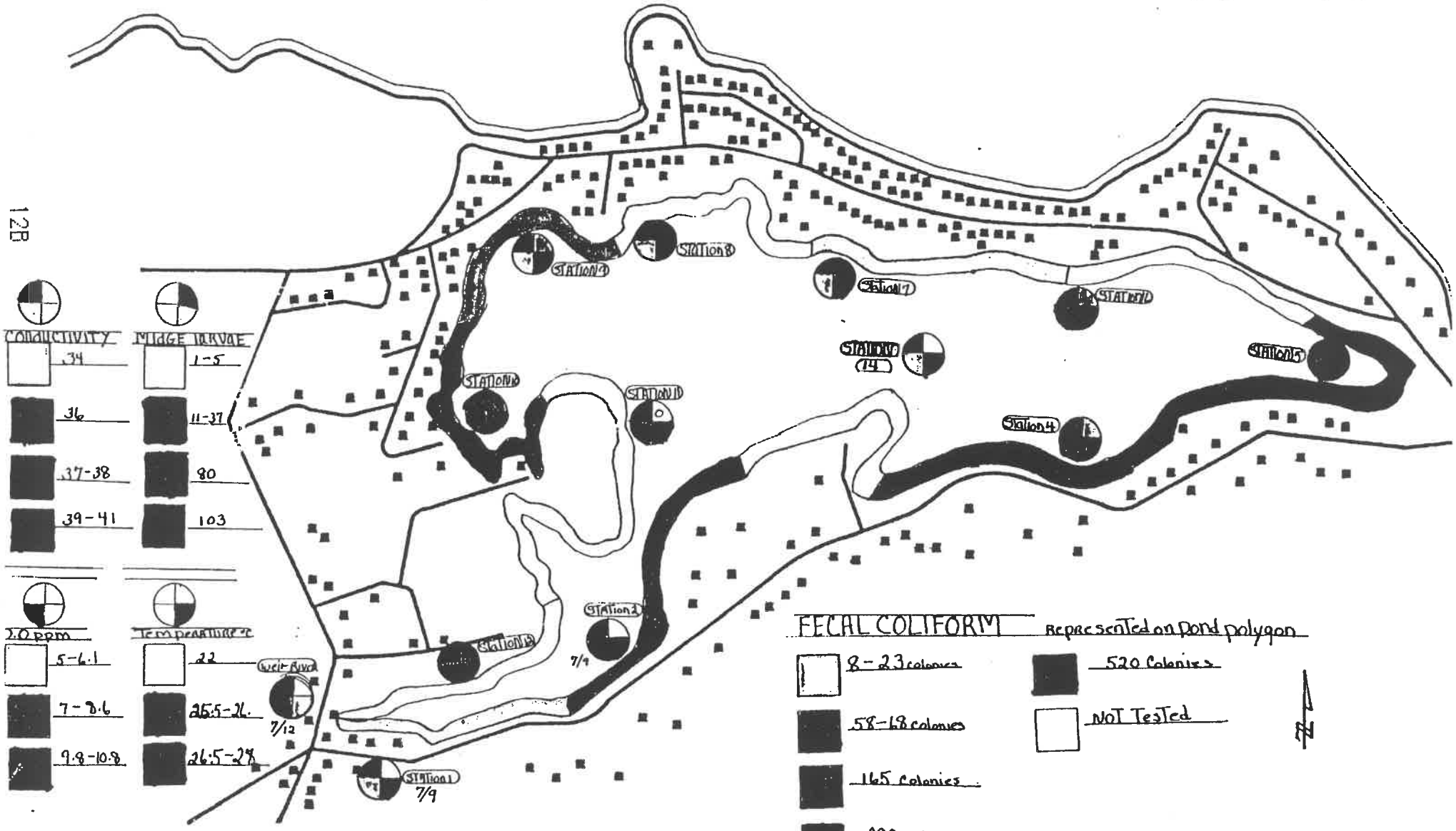


FIGURE 8A: STRAIT'S POND CHEMICAL RELATIONSHIP TO MIDGE LARVAE POPULATION (7/'92)

8B: STRAIT'S POND SANITARY SURVEY AT STATIONS-MAP & DATA (7/'92)

BIOLOGICAL STUDIES OF MIDGE ECOLOGY

PURPOSE: The midge studies conducted by this project were designed to give information relative to their location, population density, and environmental requirements. Targeted objectives were as follows:

* Identify the specific species of Chironomid found in Straits pond.
* Estimate the density and determine the distribution of midge larvae as it relates to salinity.
* Relate the causative factors for midge population fluctuation to: midge larval tolerance of various salinities, prey-predator relationships, aquatic vegetation habitat, and food sources.
* Investigate a microbial pesticide, Bacillus Thuringienis Israelensis effects on the midge larvae population.

TAXONOMY

Attempts to positively identify the species of Chironomid midge found in Straits Pond have been difficult due to the lack of proper taxonomic keys. There are about 2,500 species of Chironomidae found in North America (Coffman and Ferrington 1984). Past studies have identified the species of midge in Straits pond as C. Decorus (1953 Massachusetts Department of Public Health Study), or C. Riparius (IEP Study 1980). Neither of these species are known to inhabit waters with more than 5 ppt salinity. While the salinity of Straits pond varies considerably 6.6 ppt-18 ppt in the winter to 12 ppt-26.8 ppt in the spring and summer it seems unlikely that either of the above species could survive under the present conditions. Specimens of midge larvae were sent to the Museum of Natural History in Washington D. C. but we have not had a reply to date. Personal communication with Dr. Ashad Ali of the University of Florida, Sanford and Dr. Joel Margolit of Harvard University indicate that the species may be C. chironomus. This identification is still very tentative. We will continue to try to positively identify the species.

DENSITY AND DISTRIBUTION

Midge larvae density and distribution studies were conducted on a monthly basis, January through July 1992. Approximately 1000mls of surface soils (within the first inch) were collected at each station. The number of larvae were counted in each sample and the results recorded on the data sheets. This information was carefully compared to water quality data obtained at the same time as well as the consistency of soils noted.

RESULTS

Winter-Spring '92: The largest population of midge larvae found in the

winter and early spring were at station 4 near the mouth of Rattlesnake run. Salinity at station 4 averaged 8.9 ppt for this season. Densities of 5000/per meter squared were found. Sites 3 and 5 also contained statistically significant numbers of larvae but only about 1/4 of the numbers found at station 4. A much smaller population of larvae was found on the Hull side of the pond at stations 6 and 7. The first generation of adult midges emerged in mid April. The following study conducted on 4/23/92 found the larvae population reduced by approximately 75% at station 4 and generally non existent throughout the rest of the pond. No larvae were found during the May study.

Summer '92: Studies in June and July found that site 7 had become the site of largest population. Larvae densities of 5000/per square meter were recorded followed by site 5 (20% decrease) and site 8 (40% decrease).

*The preferred substrate of silty-organic conditions was present.

*The prevailing wind direction changed from WNW to SW in May and June, appearing to contribute to the midge flies and egg masses relocation and survival on the Hull side of the pond.

*In May and early June the salinity at site 7 averaged 16 ppt, the lowest salinity recorded in the pond for June. This salinity seems to be in the upper ranges of larvae tolerance (demonstrated in the lab experiment 1 below), thus it may have allowed for a higher survival rate of newly hatched second generation larvae.

There was no emergence of a second generation of adult midges from the pond. A possible reason for the lack of emergence may be found in the rise in salinity at site 7. From mid June through August this site averaged 24 ppt salinity. Experiments conducted during this study indicate this salinity level maybe too high to allow for pupation.

Reference next page for monthly maps of Strait's Pond midge larvae population & water quality data.

For details of methodology and procedures see APPENDIX 8.

LAB EXPERIMENT: EFFECTS OF SALINITY ON LARVAL LIFE CYCLE

Several experiments were conducted in our lab to establish the tolerance of the larvae to various salinities. Three identical containers were filled with 100 ml water. The salinity of each container was recorded at 2 ppt, 18 ppt, and 34 ppt respectively and the temperature of each container was recorded as 11C. Ten larvae were added to each container and observed over a four week period in March before pupation of the larvae occurred in the pond.

RESULTS

	Deaths Recorded		
	2 ppt salinity	18 ppt salinity	34 ppt salinity
24 hours	1	0	1
48 hours	0	0	0
72 hours	1	0	0
1 week	0	0	1
2 weeks	0	0	6
3 weeks	3	9	all dead
4 weeks	all dead	1 living	

The die off of 2 larvae in the first 24 hours and even the one at 72 hours is most likely due to injuries sustained during collection. The die off 6 larvae at 34 ppt during the second week and 9 larvae at 18 ppt in the third week would seem to indicate a tolerance level had been reached. At the lowest level of salinity 1/2 of the midge larvae lived into the 4 week. This appears to be a statically significant number indicating that salinities over 18 ppt are luckily to effect the longevity of midge larvae and may account for the larvae overwintering at site 4 near the outlet of rattlesnake run which had salinities of 6 ppt to 14 ppt in the winter and early spring.

The second experiment was similar in design but in this case we were attempting to see if larvae would pupate at various salinities. We used the same containers, amounts of water and larvae. Water temperature were higher 15C and the period of observation three weeks from mid April to the first week in may (shortly after the first generation of midges had pupated and become adults). Salinity in each container was recorded - 14.2 ppt,18 ppt and 34 ppt respectfully.

RESULTS

	Larvae Pupation recorded		
	14.2 ppt	18 ppt	34 ppt
5 days	5 pupa	0 pupa	0 pupa
1 week	2 adults	0	0
2 weeks	0	0	0
3 weeks	0	0	0
Totals	5	0	0

Pupation took place only at 14.2 ppt salinity and only with in the first five days. Two adults emerged within seven days. This seem to indicate that

although midge larvae can tolerate fairly high salinities for a period of up to 3 weeks they cannot pupate under these conditions.
Although 1/2 of the midges pupated at 14.2 salinity only 2 became adults indicating that 14.2 ppt salinity is in the upper range of their tolerance levels.

The rate of larvae die off was very similar to the results we had in the first experiment. Eight at 34 ppt were dead by the end of the 2nd week, and 7 had died at the end of 3 weeks at 18 ppt.

PREDATORY FISH OF MIDGE LARVAE

FISHERIES INVENTORY
OBJECTIVES: To determine the number of species of fin fish and their approximate population densities, prey-predator relationships, the role the midge may play in contributing to the ecological balance of the pond, and to monitor water temperatures and DO to maintain warm water fisheries habitat (83F/28.3C in warm water fisheries or 68F/20C in cold water fisheries).
RESULTS: Six species of finfish were found, Alewive fry, 3-4 spine Stickelbacks, stripped Killifish, Atlantic silversides, Mummichogs, American eels, shrimp and a few mud snails (APPENDIX 9: Fisheries Inventory, page A12). Warm water fisheries habitat were generally maintained during our study period (APPENDIX 4: Water Quality Spreadsheet, page A4)

In the first part of the study Alewife fry were the most numerous, particularly at the tide gate. The next largest population were sticklebacks, followed closely by striped killifish, silversides and mummichogs. A week later when the seining was repeated between sites 3 & 4 and sites 10 & 11 no alewife fry were found. Mummichog populations were higher and silverside populations reduced in number.

Eels were actively being fished in the pond throughout the months of May and June. About 100 traps had been placed in the pond perhaps as early as the end of April. A fisherman was observed filling 4 or 5 large barrels with his catch in mid May.

Researchers from this project pulled 1 trap found between sites 10 and 11. Two large eels about 2 feet long plus 4 smaller eels were found. The eels were brought back to the lab in order to examine their stomach contents. While most of the stomach contents were unidentifiable, one mid-size eel (1 1/2 feet) had recently eaten a fish the size of a large Silverside as the

backbone was still present in its gut.

TROPHIC LEVEL EXPERIMENT
PURPOSE: To observe first hand the trophic levels and interaction of species found in Straits Pond and to combine these observations with the other studies and knowledge in order to achieve a more complete understanding of the pond and its species.
METHOD: The tank was set up in such a way as to simulate the ponds environment as nearly as possible. Sand and gravel were placed on the bottom of the tank, pond water from site 5 was added and then blackish mud was added. Pond vegetation, algae, and fish were added as soon as there was some visibility in the tank. The Midge larvae were added last. The temperature of the water was 77F.
OBSERVATIONS: As soon as the Midge larvae were placed in the tank all the fish with the exception of the silversides and the eel started to feed. The mummichogs and killifish were the most voracious. After the remaining larvae had settled into the soil surface many of the fish gravitated to the widgeon grass, where the silversides appeared to be feeding. The small eel had dug about a 1/2 inch into the soil.

In general the mummichogs and stripped killifish were major predators of the midge larvae. The sticklebacks also preyed on the larvae but did not show the aggressiveness of the other two species. The silversides did not appear to prey on the larvae at all and were the first species to die as the tank got warmer, at about 80F. The sticklebacks died as the tank reached about 82-83F. Most of mummichogs and killifish were able to live at temperatures as high as 86F. During the 2nd week midge larvae were again added to the tank with the same results. After 4 weeks the only remaining fish are 2 killifish and the eel.

AQUATIC VEGETATION
Observations of aquatic vegetation were made and recorded during studies from April through the end of the study period. The clarity of the water was noted during this time period as an indicator of increasing phytoplankton production.

The dominant macrophyte found is widgeon grass (R. maritima). Its presence was noted toward the end of April around the edge of the pond. By the end of May it could be seen growing beneath the surface throughout most of the pond and by mid June the plants growth had extended to the surface of the entire pond. The widgeon grass provides a habitat and food source for many of the small fish that live in the pond. On the negative side large rafts of broken widgeon grass stems were observed floating at the edges of the pond.

When they die off and are decomposed by bacteria, they produce foul odors as they contribute organic matter to the pond and additional nutrients for phytoplankton growth.

Communities of phragmites were seen in dense stands along the shore. Phragmites are an indicator of a disturbed or changing environment, often replacing cattails and contributing a less valuable source of food for wildlife. Pondweed in very small amounts were seen near station 4. Floating mats of various size of an unidentified algae were found in April along sections of the shore. By May the mats of algae had decrease in numbers and size possibly reflecting the changes in salinity. Other forms of algae found present in small amounts were enteromorpha, a marine algae commonly found along the coast, and ulva or sea lettuce which was found at the tide gates.

Detailed studies of microplankton were not conducted but water clarity was observed. The clarity of the water has decreased remarkably since April when it was estimated visibility was about 21/2 feet. In May and June the visibility became worse weekly until it was reduced to six +/- inches in July. As of the first week in August the pond had become close to opaque. These latter observations indicate that an extremely high level of phytoplankton are present in the pond.

The main food source of Chironomid is phytoplankton. Dr. Ali has stated that his studies indicate a preference for blue-green algae when it is present but that chironomids are opportunistic feeders and will consume other types of algae including green and green-yellow. Strait's Pond contains an abundance of algae, an adequate food supply for midge larvae.

BTI-BACILLUS THURINGIENSIS

B.t.i is a microbial pesticide that has been found to be an effective pathogen to the larvae of some insects in the order Diptera, e.g., mosquitoes, black flies, and midges. B.t.i. produces an delta-endotoxin under the appropriate alkaline conditions and in the presences of proteolytic enzymes. Delta-endotoxin is harmless to mammals and is released only under highly alkaline environments, such as found on in the mid-gut of midges. Studies conducted (Ali, Baggs 1981) indicate the B.t.i. does not effect most non-target organisms and is therefore unlikely to interfere in the food chain of the aquatic system. It is considered to have a high margin of safety.

CONCLUSION: A bioessay conducted by Dr. Margalit of Harvard university, the discoverer of B.t.i., indicate that B.t.i. would be effective against the species of chironomid found in Straits Pond.

CONCLUSIONS AND RECOMMENDATIONS

The two principle problems this study has addressed are:

*To find an environmentally safe and effective means to control the Chironomid midge flies.

*To evaluate the pond habitat, identify sources of pollution, determine the effects of pollution on the trophic levels in the pond and make recommendations which support ACEC guidelines for no adverse effects.

The time period chosen for this study was very fortunate. The cooler, clear weather deaccelerated the natural processes and contributed to accelerating the saline conditions. These conditions have allowed us to better observe and study in detail the dynamics of the pond, as it tips between ecological balance and critical ecological imbalance.

ENVIRONMENTALLY SAFE MIDGE CONTROL FACTORS

RESIDENTS WHO ABUT THE POND HAVE STATED THAT THE CHIRONOMID FLY PROBLEM HAS DECREASED OVER THE LAST FEW YEARS. OUR STUDIES INDICATE ONLY THAT ONE GENERATION OF FLIES HAVE EMERGED FROM THE POND THIS YEAR. THE NATURAL DECLINE OF THE MIDGE LARVAE POPULATION APPEARS TO BE AN EXAMPLE OF ECOLOGICAL SYSTEMS WORKING TOWARD HOMOSTASIS. For example, in a healthy system if certain conditions cause a population explosion in a prey species (such as midge larvae), in time one would find an increase in its predator species provided the right habitat conditions existed.

More prey=healthier predators=increase in predator births and survival rates=more predators in the next generation=reduction in prey population.

But even in the healthiest systems, there is little absolute balance. In reality an ecological system represents the physical, chemical, and biological process reacting, interacting, and affecting one and other in different ways and at different levels.

In the studies of Strait's Pond we have found positive systems represented by the natural control of the midge population and negative systems, represented by the addition of nutrients (sewage) to a level beyond the capacity of the pond's system to respond in a healthy manner. The following appear to have played important roles in both these systems.

POSITIVE NATURAL MIDGE CONTROL	NEGATIVE CONDITIONS THAT CONTRIBUTE TO EUTROPHICATION
HIGHER SALINITIES FISH PREDATORS	ADDITION OF SEWAGE AND OTHER NUTRIENTS TO THE POND UNCONTROLLED AQUATIC PLANT AND ALGAE GROWTH HIGHER WATER TEMPERATURES EQUALS LOW D.O.
GRAVELY SUBSTRATES	
WEATHER CONDITIONS	LOWER D.O. HAS A NEGATIVE EFFECT ON MIDGE PREDATORS

The identification of the pond food sources and predators has been established through THE STRAIT'S POND 1991-92 study, i.e. the food chain begins with nutrients which are absorbed and used for growth by phyto & macrophyte plants. The phytoplankton are fed upon by midge larvae. Larvae are preyed on by the finfish population which in turn are controlled by predatory eels, and birds. The eels are controlled by the fisherman who harvest them.

RECOMMENDATION 1: Additional monitoring will give us a more reliable continuum of information. Sustaining ecological relationships can help control the nuisance midge population, i.e.:

*Allow eel fishing to continue at present levels. This will help to increase the number of small fish in the pond. The small finfish found in the pond are important to the food chain and do their part to control the midge larvae population. However, it is too early to recommend adding more of the same species until more is know about the carrying capacity of the pond for finfish and their predators.

*Reduced nutrients (pollution) entering the pond will help reduce phytoplankton and plant growth.

The relationship between midge larvae and salinity seem to be inverse. Evaluation of the data collected during this study and experiments indicate the higher the level of salinity , the lower the midge larvae survival and pupation rate.

RECOMMENDATION 2: It is important to keep salinity levels higher to help control the midge population. Increased flushing or exchange of surface water could accomplish this.

A: Exchanging more water by manipulation of the gate during moon tides (new and full) should help to increase the salinity and reduce temperature. Additional refinements of the gate should allow removal of the surface waters.
B (long-range): Repair and mechanically upgrade the tide gate could provide new methods to regulate the water flow, allowing more frequent water exchange through tidal action. Salinity levels and water temperatures may be most affected by these methods.

Although the weather and periods of light cannot be controlled, the reduction of pollution entering the pond can be. Temperature and longer light periods will affect the rate of plant and algae growth and oxygen production. Higher temperatures when combined with the abundant nutrients from pollution are likely to result in algae blooms and decay, causing rapid depletion of oxygen. During algae blooms the dissolved oxygen falls to low levels for extended periods of time. Major fish kills and the death of many other species may follow. Unfortunately the Chironomid larvae can tolerate extremely low levels of DO.

1999 — Th[illegible] was done But Not sure if 100% done.

RECOMMENDATION 3: The Richard's Rd. and the Pond St. sewage outfall pipe should be tied into the Hull sewage system immediately. Sources of funding and application are available for such projects, i.e. Mass Bays still has $20,000 that could be available for this type of work.

We understand the town of Cohasset is considering the upgrade of its sanitary septic systems. Consideration has been given to tying Cohasset into the town of Hull's sewage system. From the standpoint of controlling pollution in Strait's Pond, this would be a positive step.

> 1999 — in progress

Our research into B.t.i. confirms that it is a safe and effective pesticide. Suggesting the use of B.t.i. seems premature at this time, given that the natural system in conjunction with the operation of the gate appear to be contributing to the control of the larvae. It would seem prudent for the Conservation Commissions in both towns to apply as soon as possible to the state for permission to use B.t.i. should it become necessary in the future.

IN CONCLUSION: Significant improvements have been made in Strait's Pond since the I.E.P. study was completed ten years ago. Fecal Coliform counts in the pond are lower due to the cooperation of the Health agents of both towns. Also, general water quality is somewhat improved probably due to the repaired tide gate and Mr. Parent's effort.

The pond remains a sensitive and volatile natural system, subject to seasonal weather changes and land use . Continuing the collecting cycle for another year in conjunction with the above recommendations would be prudent before making a long-range plan to address a management plan for Strait's Pond's restoration and protection.

STRAIT'S POND MIDGE MITIGATION STUDY: SUMMARY & RECOMMENDATIONS

Observation Assessment	**Solution**	**Short range Action**
Larvae Environment requirements:		
*Mud-sandy substrate habitat	*Freeze larvae in the substrate	*Winter pond drain down; Substrate consolidation
*Salinities below 18 ppt *Tolerates low D.O.	*Maintain salinities above 18 ppt	*Regulate tidal gate to adjust DO, temps., fresh water
*Plankton for food	*Reduce nutrient levels (N, P)	*Educate public on N, P products & effects
*Fish are predators	*Maintain fisheries habitat	*Continue monitoring; make plan for gate adjustments as necessary
*Adults attracted to light		* Remediation: lighttraps
Midge predators & requirements		
*D.O. levels exceeding 5mg/l	*Maintain levels	*Monitor D.O; make adjustmt. plan : implement
*Sufficient water depths	*Maintain depth, weather, tides	*Monitor;
*Desirable water temps up to 28.3C	*Maintain temperatures	*Monitor; adjust gate
*Salinity range from 18-28ppt	*Maintain salinity	* Monitor salinity;
*Diversity of minnow fishes	*Increase fish populations	*Plan to maintain fish environment
*Reduce predators for fish	*Limit eel population	*Allow Am. eel harvest (define)
Pollution		
*FC counts exceed standards	*Upgrade old septic systems	*Investigate problem areas; implement enforcement means
	*Decrease point & non-point	*Septic hook-ups on sources Richard's Rd.
*Duck, swans contribution	*Discourage hand feeding	*Determine carrying capacity
*Excessive nutrients, other inorganic & organics	*Prevent accelerated plant growth & decay	*Exchange of more water at gate *Storm drains, pipes cleaned
*Bottom sediments	*Core Sample	*Core analysis
Environmental effects		
*Extended hot, clear weather= decreased DO, biotic life stressed, excessive phytoplankton, vegetation and decay	*Greater water exchange	*Tidal gate adjustment

Additional short-range recommendations:

*Experiment with changing water twice a month at the full and new moon. If this appears to obtain successful results of increased salinity, lower water temperatures,and increased oxygen, a mechanical method of managing the gate could be considered. A mechanical probe to measure salinity, D.O., temperature would simplify and be more cost effective to monitor the water quality parameters which drive the biological systems in the pond.
*Develop further study and a long-range management plan.
*Continue clean-up activity, building an informed constituency for pond protection, collection of baseline data to promote better local planning for pond, to stop/lessen pollution/degradation consistent with ACEC clean-up strategies and restoration, etc.
*The water circulation pipe, located at the narrow part of the peninsula that separates the Richard's Rd. lagoon from the pond at the tide gate, should be cleaned and/or lowered. It was observed to have no flow capability throughout most of the study period.

Long-range recommendations

*Improve gate mechanically to exchange water at the surface where it is warmest and the salinity lowest in the summer.

*Additional improvements to the tidal gate should include an automatic timing mechanism so that Mr. Parent can take advantage of the night and early morning tides which tend to be the highest and lowest in any given month.

*Recommendations to Planning Board: zoning regulation changes:

1. Minimum lot size of 12,000 sq. ft. for new construction.
2. To prevent flooding of structures, no new buildings to be constructed within 35 feet from the edge of pond.

*Recommendations to the Health Dept.: Care and upgrading of septic systems dependent upon each soil percolation & drainage situation.

1. Dye testing of all septic systems within 50 ft. of pond should be conducted as soon as possible.
2. Sewage outfall pipe at Richard's Rd. needs to be examined by portable video camera to determine where the sources of pollution are coming from.
3. Upgrading or new septic system should not be within 100 ft. of the pond.
4. Septic systems within 100 feet of the pond should be pumped twice a year.
5. Septic systems within 3 feet of the pond should be pumped 3 times/ year.
6. Systems 10 yrs. or older should be inspected every 5 yrs.
   Septic systems 25 yrs. or older should be inspected every 2 yrs.

STRAITS POND MIDGE AND POLLUTION STUDY

SUMMARY OF SURVEY FINDINGS

During the month of May 1992 a survey was distributed to all houses immediately abutting the pond, a total of 92 homes. The purposes of the study were: 1) to let residents know more about the study and encourage their involvement, 2)to get a sense of their attitudes about the problem, and 3) to learn some information about residents' household practices.

A letter was delivered to homes a week before the survey took place to let people know that Hull High School students would be coming around with a survey the following week-end. Students did a survey interview if there was a head of household at home; otherwise it was left with a note in the mailboxes. Two weeks later, completed surveys were picked up or residents could leave them off at nearby Town Hall. Respondents were given the option of remaining anonymous. A total of 44 surveys were completed and returned.

Awareness and Interest in Study

In general, those who returned the survey were grateful that it was being done and 17 volunteered to assist in various ways with the study. Only 12 respondents were unaware of the study prior to the survey. More than half had read about the study in local newspapers and 7 recalled receiving a letter about a community meeting in the past. Ten people were aware either through their own involvement in Pond clean up efforts or the involvement of friends.

Extent and Duration of Midge Problem

The extent and duration of the midge problem seemed to vary among houses. Five respondents felt that the midges only presented a minor or occasional problem. Most respondents felt that midges impeded their yardwork and their enjoyment of the outdoors. More that half added other comments which included "they get in the house (5)", "can't read at night", "spiders", "dead ones cover the house", can't go out at night (3), "home maintenance impossible", and "we inhale them".

The months of June, July and August seem to be the months when most people are bothered by the midges. Nearly half the respondents also mentioned May, and about 25% mentioned September. Several people mentioned every month, from May through October, whereas others felt the midges were not a problem during any of those months.

Septic System Households

Twenty five of the responding households are connected to a Town sewer system, nineteen are not and five of the 19 were tenants who were not familiar with the type of system they were using. Of the 15 owners with septic systems, 8 said their system was within 100 feet from the pond, 4 were within 100 - 300 feet, and 2 were more than 500 feet from the pond. Only half of those with septic systems seem to clean them on a regular basis; and 4 did not know when they ever clean it. Three respondents clean their tanks once a year, 5 clean it once every 2 years, and 2 clean once every 6 years or more.

Only one respondent was willing to spend more than $5,000 for a sewer connection, 4 would spend between $1,000 and 2,000, one would spend up to $1,000, and 3 said they could not afford to spend any money or were not interested. Two respondents on Richards Road stated that a hook up was not possible.

Among households with septic systems, the usage of laundry, dishwashers, and disposals was moderate. Although this information was collected from all respondents and can be made available, data on these items in the attached report is only for those with septic systems since only their usage might influence the pond.

Outdoor Issues and Practices

Eleven out of 44 respondents use a lawn fertilizer and most people felt that using a lawn fertilizer was only somewhat important to them. Two felt that its use was important or very important. On another item, 4 people indicated that they disagreed that they would stop using lawn fertilizer given evidence that fertilizers are a significant factor contributing to the pollution problem and another 3 were neutral. Twenty-nine agreed somewhat or strongly.

Use of yard bug fogger sprays was not common and only two of the 8 who had tried a fogger felt that it was effective or somewhat effective.

Basement flooding was a problem for 15 respondents. Four experienced flooded basements more than once a year on average, and 9 only had a problem once every 8 years or more on average.

Flooded yards was a problem for 18 households with 7 having a flooded yard once or more a year.

Attitudes

There was general agreement among respondents that the local towns had not done enough to solve the midge and pollution problems of Straits Pond. There were considerably mixed opinions on the other hand about whether the State's ban on spraying Abate was a good move: 14 strongly agreed, 12 were neutral, 8 strongly disagreed, and 5 each agreed somewhat or disagreed somewhat.

Preventing further pollution, preserving surrounding wildlife, eliminating the midges, and having fish in the pond received the highest ratings in importance in that order. Most people felt that their use of dishwashers, bleach, garbage disposals, and phosphate detergents was not very important to them. However there were exceptions: 13 people felt using their diswasher was important or extremely important, and 4 or 5 each who felt using bleach, phosphate detergents and/or a garbage disposal were important or extremely important.

More than half of the respondents indicated a willingness to participate in a controlled experiment involving a change in their household's practices to help shed light on the problem. When asked about allowing a large midge trap in their yard which would add to their utility costs about 20 cents a day, 13 said yes, 21 said maybe, and 7 said no. Given that there were a few respondents who did not seem to be bothered by the midges, and more than half of all respondents were not effected by flooding problems, the high proportion of people willing to consider participating in a solution even if it involves some cost to themselves is very encouraging.

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APPENDIX LISTINGS

IEP

1.0 INTRODUCTION

Straits Pond is located in the southeasterly area of Hull and the northwestern part of Cohasset where it forms a portion of the boundary between the two towns (Figure 1.1). The Pond has a surface area of about 92 acres, an average depth of 3.3 feet, a maximum depth of 4 feet and an elevation which varies between 3 and 4 feet (MSL).

Straits Pond was originally a tidal marsh representing the upward extent of tidal activity of the Weir River. Records indicate that during the nineteenth century the tidal marsh was dammed and used as a reservoir for the operation of a mill located near the existing outlet on Nantasket Avenue in Hull. Later in the century when the Mill closed, the Pond was drained and the area used for the growing of grass crops.

As early as 1900 the state Board of Health was directed to investigate complaints of nuisance weed growth and foul odors at Straits Pond (Mass./Dept. of Public Health, et al, December 2, 1953). At that time the Pond's average depth was listed as 5 feet and the bottom sediments characterized as "mud."

The state Board of Health proposed several ways of improving this situation. One involved the placement of pipes connecting the easterly end of the Pond with the Atlantic Ocean and replacing the water in the Pond two or three times a month. Apparently sewage and other waste materials were being discharged to the Pond at that time, as the Board of Health cited as essential the elimination of all such material from entering the Pond. Further recommendations included removal of the mud and organic matter and replacing this with sand and gravel (Mass. Dept. of Public Health, et al, December 2, 1953). Apparently little or no action was taken to effectuate the Mass. DPH recommendations.

In the early 1940's interest in correcting problems at Straits was once again sparked. The Hull Highway Department contracted the services of Mr. Howard Bailey, consulting engineer, to recommend appropriate corrective actions. Mr. Bailey proposed that a tide gate be installed at the outlet of the Pond in order to raise and stabilize water levels in the Pond. It was felt that raising the water level would remedy some of the problems. A sluice gate and tide gate were later constructed according to Mr. Bailey's plans. Mr. Bailey echoed the recommendations made some 40 years earlier by suggesting that one or more openings to the Atlantic Ocean be made at Gun Rock. The anticipated cost at that time was listed at $13,000.00 (Mass. DPH, et al, December 2, 1953). Further interest was directed towards the Pond when, in 1943, discharges of pollution were found entering at various locations.

In 1952 the state Board of Health was once again called to respond to numerous complaints regarding the conditions at Straits Pond. By this time, appropriations for the construction of sewerage in Hull had been made. The state Board of Health encouraged the Town of Hull to proceed with construction of sewerage facilities and to flush the Pond to the extent possible by means of the existing outlet structure. An additional sanitary survey revealed numerous storm drains which discharge runoff from Hull and Cohasset to Straits Pond. Along Richards Road in Hull sewage was found to be entering the Pond from private property via pipes.

IEP was directed to a storm drain system on Richards Road which was continuing to discharge sewage. An overflowing cesspool at 739 Jerusalem Road in Cohasset was observed in 1953 by the survey group. Several areas of septic system overflow were also noted by IEP in April, 1980.

In an attempt to control the nuisance weeds and midge problems at Straits Pond, the Town of Hull began chemical treatments in the early 1950's. Chemicals known to have been used included DDT and lead arsenate.

The conclusion of the 1953 Mass. Dept. of Public Health report restated earlier conclusions regarding the need for increased circulation in the Pond through a conduit to the Atlantic Ocean at Black Rock. Also suggested was placing the responsibility of control of the outlet gates in the hands of the Port of Boston Commission who would coordinate raising and lowering of the Pond so as to permit exposure of sediments, chemical treatment of midge larvae and weeds and exchange of water. Either filling or dredging the Pond were also considered as possible solutions. It was concluded that both of these alternatives would likely be too costly to implement..

Since 1953 numerous studies and seasonal chemical treatments have been undertaken at Straits Pond. Frequent chemical treatment for control of weeds has been funded by the Towns through the state Reclamation Board and treatment of midges and mosquitoes has been effectuated by the South Shore Mosquito Control Project. Chemicals used include sodium arsenite and kuron (Mr. Boschetti, memorandum, October 20, 1960), hydrothol-47 (Mr. Boschetti letter, October 1, 1971), heptachlor (Dr. Cohen, memorandum February 3, 1954), aqualin (Mr. Boschetti, memorandum, November 20, 1961, princep 80W (Mr. Boschetti, memorandum, March 2, 1971), and arsenic trioxide (Mr. Boschetti, memorandum, January 5, 1970).

In response to the continuing problems at Straits Pond and the added problems resulting from the severe winter storm of February, 1978, the current study was initiated by the Towns of Hull and Cohasset with a Community Assistance Grant from the Massachusetts Office of Coastal Zone Management. During the course of the study, past reports, documents and data were reviewed; interviews were held with local and state officials; and additional water quality, hydrologic, sediment, land use, topographic and other applicable data were collected. Data and resultant findings are included as are recommendations for a long term reclamation program.

2.0 APPROACH AND METHODOLOGY

Eutrophication is the natural aging process which all waterbodies undergo, whereby a pond or lake gradually "fills in" and through ecological succession, eventually becomes a marsh, bog or even dry land. If undisturbed by human activities this process is normally very slow and may take many thousands of years. However, in an enhanced, or dammed waterbody such as Straits Pond, the shallow water depth combined with a fertile bottom substrate, provides suitable conditions for aquatic weed and algae growth almost regardless of the quality of inflowing waters. Various land use types such as high population densities associated with residential or urban development, as well as some open space and rural activities

in Cohasset, though the developed area occupies more land than in Hull. The majority of forested land and all major wetlands within the watershed are found in Cohasset as is a golf course and a landfill.

The capacity for nutrient or contaminant generation of each of these land use types is discussed in Section 7.0.

4.0 PHYSIOGRAPHY, GEOLOGY, AND GROUNDWATER HYDROLOGY

The nature of the topography in the Straits Pond watershed is best described as highly variable and inconsistent. The highest point occurs just west of Tad Lane in Cohasset where an elevation of approximately 102 feet above mean sea level is reached. The lowest elevation in the watershed is, of course, Straits Pond which varies between 3 and 4 feet above mean sea level. Much variation, particularly on the Cohasset side, exists between these two extremes. The only relatively flat sections occur in the large wetland areas, the golf course, and on top of several of the, otherwise, fairly rounded hills.

The Straits Pond watershed is characterized by numerous bedrock outcroppings, generally shallow soils (<6 feet) with occasional deeper unconsolidated deposits occurring in the large wooded swamps of Cohasset, under the golf course, and at places along the Straits Pond shoreline.(Figure 4-1).

The bedrock which is seen exposed at numerous locations throughout the majority of the watershed, including along the shore and within Straits Pond is the Brookline Member of the Roxbury Conglomerate (Billings in Cameron, 1976). The rock is fairly typical of the "puddingstone" appearance, associated with all Members of the Roxbury Conglomerate found at various locations throughout the Boston Basin. The Brookline Member has a matrix of fine-to-medium grained gray feldspathic sandstone with the well-rounded pebble and cobble clasts consisting predominantly of quartzite, quartz monzonite, granite felsite and lesser amounts of melaphyre and argillite (Billings in Cameron, 1976). Thickness of the Brookline Member has been found elsewhere in the Boston Basin as great as 4300 feet, however, in the neighboring Town of Hingham the unit is approximately 500 feet thick (Billings in Cameron, 1976). It is felt that the Brookline Member in Hull and Cohasset is of similar or shallower thickness to that found in Hingham. The Roxbury Conglomerate is believed to be of Pennsylvanian age (270,000,000 - 310,000,000 years before present) at least, and probably older.

In the southernmost portion of the watershed the Dedham Granodiorite may be exposed. This rock unit is light pinkish gray or green in color, is one of the most common formations in eastern Massachusetts and forms the outer geologic border of the Boston Basin metasedimentary formations. It is of pre-Cambrian age (greater than 600,000,000 years before present).

Within 0.5 mile to the north and within 1.5 miles to the south of Straits Pond exist two fault zones which tend, generally, east-west. The northern fault is called the Blue Hills thrust and creates the contact between the Roxbury Conglomerate and the Cambridge Argillite which underlies Nantasket Beach and the majority of the Hull peninsula. The fault to the south is called the

Ponkapoag fault and is a major thrust which creates the boundary between the Boston Basin to the north and the older Dedham Granodiorite to the south.

Atop the bedrock exists remnants of glacial advance over the area and subsequent deposition by meltwater as the glacier retreated some 12,000 to 15,000 years ago. Glacial till, a nonsorted, unstratified homogenized material ranging in particle size from clay to cobbles and occasionally boulders, lies immediately over the bedrock and may be as thick, locally, as eight to ten feet.

The large swamps and golf course in Cohasset are believed to be underlain by glaciofluvial (sand) deposits up to ten feet to fifteen feet in thickness. Peat and muck soils lie atop the glacial outwash material.

The Straits Pond shoreline is composed of several areas which are made up of unconsolidated beach and tidal marsh sediments. Crescent Beach, between Gun Rock and Green Hill appears to be true marine beach deposits between the ocean and Straits Pond except where some filling may have occurred. Other areas along the west and south shoreline of Straits appear to be shallow silt and muck deposits which were originally layed down in a tidal marsh environment prior to damming of the Pond.

Due to the nature of the underlying geology, three different hydrogeologic conditions exist within the watershed. The first occurs by surface water percolating through the very thin soils and unconsolidated surficial geologic deposits until bedrock is reached. At this point the water moves along the bedrock/surface deposit interface until it either emerges as a spring or finds an opening in the bedrock.

The second hydrogeologic situation occurs primarily along Rattlesnake Run and in the Crescent Beach area. In these two areas the surface deposits are deep enough to lie below the groundwater table. Conventional recharge occurs and groundwater would be expected to move through the unconsolidated sediments to a point of discharge which would be the brook or Straits Pond.

The final condition that exists involves groundwater penetrating bedrock through the process described previously or by direct recharge into fractures. It is expected that there are numerous fractures and small subsidiary faults in the bedrock of the Straits Pond watershed due to the presence of major faults nearby both to the north and to the south. This would afford some recharge to the Pond via springs as has been reported in the past. It is believed that the hydrologic contribution to Straits Pond by groundwater discharge, while not insignificant, is not enough to afford adequate flushing or dilution.

5.0 SURFACE WATER

5.1 Investigative Methods

Two fundamental aspects of the surface water hydrology of the Straits Pond watershed were investigated: the quantities of water flowing into and out of the Pond and the quality of that same water. The quantities of water were estimated by determining the "hydrologic budget" of the watershed. In its simplest form, the budget represents the balance between water entering the watershed's hydrologic regime and water leaving the regime.

The quality of the waters entering and leaving the hydrologic regime was determined by monitoring the quality of the surface waters entering and leaving Straits Pond. By selectively locating sampling points it is possible to determine both qualitatively and quantitatively the natural, background quality of all waters as well as the source(s) of possible degradation. Sampling results yield concentrations of various chemical constituents at specified sampling sites. Two kinds of water quality sampling were undertaken - base flow and storm runoff.

Flow measurements carried out at the same time that water samples were collected provide information on "pollutant loading" with respect to time or rainfall. The water quality sampling program at Straits Pond was conducted by IEP, Inc. A core of six sampling stations was- established at key locations of the watershed. These locations are shown in Figure 5-1. All samples were collected approximately one foot below the water surface. Sample stations 1, 2 and 3 were located on the east, middle and west end of Straits Pond, respectively. Station 4 was sited on Rattlesnake Run just upstream of Jerusalem Road. Station 5 was on the Weir River. Station 6 is a storm drain that directly enters the Pond which was suspected of transporting sewage. Station 7 was taken from a plume of leachate that was observed to enter the Weir River from the Hull sanitary landfill. Stations 8 and 9 were located at Black Rock and Gun Rock Beaches, respectively. Storm sampling was undertaken on April 10, 1980. Those sampling locations are also indicated in Figure 5-1.

5.2 Results and Discussion

5.2.1 Hydrology

Under the existing flow regime wherein the tidal waters of the Weir River do not enter Straits Pond, the watershed of the pond is relatively small (764 acres) and is mostly confined by Hull Street, North Main Street, and Forest Avenue in North Cohasset. There is only one surface tributary, Rattlesnake Run, which is fed by two upstream drainage subareas: (1) from the southeast through the sanitary landfill and a large wooded swamp, and (2) from the southwest through the Cohasset Golf Club and a small wooded swamp which forms the headwaters at Rattlesnake Run. Many storm drains from the peripheral residential areas of Cohasset are also tributary to the Pond.

The area of Straits Pond is 91.4 acres (3,982,250 sq.ft.) with a mean depth of 3.3 feet. The water surface is currently maintained by the tidegate at an elevation of 3.0+ feet MSL (7.7 ft. MLW). The volume of water in the Pond is

98,310,000 gallons or 13,140,000 cubic feet. Because the Pond area is large relative to the watershed area, the existing flushing time (the time it takes one pond volume of water to discharge from the pond) is long, 71 days.

The average annual precipitation at Hull is 44.2 inches of which about 25 inches becomes surface runoff. This translates into an average annual discharge rate of 2.21 CFS of surface water (stream and storm drain) into the Pond. A greater proportion of the rainfall becomes runoff in the residential areas surrounding the Pond than in the upstream undeveloped areas.

Table 5-1 shows the average monthly precipitation at Hull and the average monthly surface water discharge to the Pond. The monthly variation of precipitation is fairly uniform with moderately greater amounts falling in the autumn and winter months. Runoff discharge is substantially greater in the winter and spring than in summer owing to frozen ground conditions (less pervious surface) in the winter, snowmelt in the spring, and increased evapotranspiration during the summer.

Table 5-1. Monthly Discharge to Straits Pond

Month	Average Precipitation/Inches	Average Discharge to Straits Pond - CFS
January	3.65	2.71
February	3.62	3.81
March	3.94	4.38
April	3.63	3.21
May	3.60	2.87
June	2.66	1.10
July	2.76	0.67
August	4.34	0.76
September	3.28	0.56
October	3.55	1.00
November	4.87	2.24
December	4.34	3.26
Annual Total	44.24	--
Annual Average	3.69	2.21

5.2.2 Surface Water Quality

Baseline water quality testing of Straits Pond, the Weir River and Rattlesnake Run was conducted during seven sampling rounds. A number of additional samples were also collected and analyzed from Gun Rock and Black Rock Beaches in addition to a storm drain that was found to flow continuously along the west end of the Pond. Table 5-2 summarizes the test results as analyzed by Reitzel Laboratories of Boylston, Massachusetts. Figure 5-1 shows the sampling locations.

STRAITS POND
WATER QUALITY MONITORING

date	site	temp c air/water		d.o. ppm	salinity ppt	conductivity	Fecal Coliform per 100ml	ph	phosphate	nitrates	wind speed direction	water midge larvae	soil midge larvae	time	weather
1991															
7/14	1	7.3				26.58		7.11	3	1					
7/21	1	22.7				17.0		7.31	5	0					
7/28	1	25.2				28.3		6.91	2	0					
8/5	1	22.8				33.7		7.24	2	2					
8/18	1	23.2				19.5		6.80	4	2					
8/28	1	25.1				34.2		7.43	4	4					
1992															
1/10	*1RR	3		11.0			8	6.5					0		
2/22	1	.1		14.5	26.0			8.3							
3/8	1	9			8.2			8.5				0	0		
4/23	1	21		6.5	20.		50	8.2					0		
5/16	1	16		9.5		18.4									
7/19	1	25	27	5.2		38				<.25	c/1-3			11:20am	sunny
1991															
7/14	2	24.9				22.5		7.61	2	2					
7/21	2	19.4				13.08		6.97	5	2					
8/5	2	26.3				27.8		7.52	2	0					
8/18	2	22.6				19		7.08	5	3					
8/28	2	27.9				17.3		8.03	2	1					
1992															
1/10	*2RR	4		11.0			8	6.0				0			
2/22	2	1		12.0	23.0			8.0				3			
3/8	2	9			6.6			8.6				0	0		
4/23	2	19		6.7	1.8		18	8.0					0		
4/30	2	15.8		11.1	17.5										
5/16	2	16		10.5		18.0	30						0		
6/15	2	21	23	5.4	24.8						w/4-7			8:30am	cloudy
6/16	2	15	20	3	18.2						w/4-7			8:30am	sunny
6/17	2	20	21	2.8	20						calm			8:15am	sunny
6/18	2	22	23	2.6	22						w/19-2			8:40am	sunny
6/20	2	25	24	4	23						w/1-3			8:35am	cloudy
6/21	2	25	24	3.7	22.5						w/4-7			8:45am	overcast

*1RR - 2RR Rattle Snake Run

STRAITS POND
WATER QUALITY MONITORING

date	site	temp o air/water		d.o. ppm	salinity ppt	conductivity	fecal coliform per100ml	ph	phosphates	nitrates	wind speed direction	water midge larvae	soil midge larvae	time	weather
1992continued															
6/22	2	20	23	6	21						w/4-7			8:50am	sunny
6/23	2	15	20	2.6	22						w/8-12			8:00am	sunny
6/24	2	20	21	2.8	22.2						w/4-7			8:45am	sunny
6/6	2	20	22	2.6	24.8						w/4-7			8:30am	sunny
7/9	2	82f	27	8.8		37/41	68				sw/8-12				
1992												0			
1/10	*3RR		4	11.0	16.0		14	6.0				21			
2/22	3		1	17.0	8.4			8.5				9	0		
3/8	3		7		12.4			8.7					0		
4/23	3		20	8.5		28	28	8.1					0		
5/16	3		16	9.5		17.8	30								
1991															
7/14	4		17.6			11		6.52	2	2					
7\21	4		18.1			16.3		6.86	0	1					
7/28	4		20.5			6.2		5.56	6	3					
8/5	4		18.4			10.4		6.13	3	2					
8/18	4		19.2			14		5.50	0	1					
8/28	4		19.7			8.6		5.73	4.5	0					
1992															
2\22	4		1	15.0	10.2			8.8				98			
3/8	4		7		12.0			8.4				88	22		
3/17	4		1		6.2			6.9				64	23		
3/23	4		16		4.0			6.7				83	26		
3/26	4		18	8.0	12.5		10.	8.0					25		
4/30	4		14.8	10.8	15.5										
5/16	4		17	8.5		18.6	10						0		
6/17	4	20	25								s/se 1-3			7:30am	sunny
6/20	4	24	24		20						e/1-3			6:55pm	cloudy
6/21	4	26	26	7.4	19.6						sw/1-3			6:55pm	cloudy
6/22	4	19	24	8.6	21.2						w/3-18			6:52pm	partly cloudy
6/23	4	20	23	7.4	21.2						w/1-3			7:15pm	sunny
6/24	4	17	23	2.8	21.2						e-se/1-3			6:34pm	partly cloudy
6/25	4	21	23	8	20									6:55pm	sunny
6/26	4	22	25	8.0	21.2						s/sw/4-7			6:55pm	sunny
6/27	4	18	23	5.2	20						w/1-3			7:05pm	sunny
6/28	4	23	25	7.4							s/e/1-3		6	6:58pm	sunny
7/9	4	80f	26.8	8	24.4	38	58		.1		sw/8-12				

*3RR-Rattle Snake Run

STRAITS POND
WATER QUALITY MONITORING

date	site	temp o air/water		d.o ppm	salinity ppt	conduct ivity	fecal coliform per 100ml	ph	phosphates	nitrates	wind speed /direction	midge larvae water	midge larvae soil	time	weather
1992															
7/19	4	22	28	10		37			<.05	<.25	e/1-3	1		12:29pm	p sunny
1992															
2/19	5		3	5.4	16.0			7.0							
2/22	5		4	7.3	16.2			7.6				31			
3/8	5		6		18.0			8.9				26	18		
4/23	5		20	5.0	20		40	8.1					0		
5/16	5		15.2	9.8		27.0	210	7.6					0		
6/15	5	17	25	9.6	19.2						e/4-7			7:15pm	sunny
6/16	5	21	25	11.4	22						se/4-7			7:25pm	sunny
6/17	5	23	25	10.6	21.2						s/e/1-3			7:18pm	sunny
6/18	5	23	24	9.6	19.2						w/8-12			7:20 pm	sunny
6/19	5	23	24	8.2	19.6						sw/4-7/8-12			7:15pm	.cloudy
6/20	5	24	27		20						w/1-3			7:15pm	cloudy
6/21	5	23	24	8.4	19.2						sw/8-12			7:15pm	cloudy
6/22	5	19	23	8.0	18.8						w/19-24			7:22	sunny p.cloudy
6/23	5	21	23	8.8	20						w/4-7			7:35pm	sunny
6/24	5	17	22	6.2	19.2						w/sw/1-3			7:10pm	cloudy
6/25	5	20	23	9	20						w/13-18			7:15 pm	sunny
6/26	5	22	25	10.8	19.6						w/1-3			7:19pm	sunny
6/27	5	17	22	7	20						w/1-3			7:35pm	sunny
6/28	5	22	24								w/1-3	11		7:48pm	sunny
7/9	5	80f	26.5	7.6	25.4	36	290		.1		sw/8-12				
7/19	5	27	26.5	8.6		38			.05	<.25	e/1-3	80		11:35	p sunny
1993															
2/19	6		3	5.2	16.2			8.2							
2/22	6		4	5.2	9.0			9.0				0			
3/8	6		6		10.			8.6				8	0		
4/23	6		20	9.0	19.		6	8.8					0		
4/30	6		13.8	11.1	18.										
5/16	6		15.5	9.8		27							0		
6/18	6	22	22	8.4	19.2						w/8-12			7:45pm	sunny
6/23	6	19	23	7.0	21.2						calm			7:58pm	sunny
6/28	6											26		9:20am	
7/19	6	25.5	26.5	9.8	37				<.05	<.25	e/1-3	4		11:45	p.sunny

STRAITS POND
WATER QUALITY MONITORING

date	site	temp c air/water	d.o. ppm	salinity ppt	conduct ivity	fecal coliform per 100ml	ph	phosphates	nitrates	wind speed direction	water midge larvae	soil midge larvae	time	weather
1992														
2/22	7	2	12.1	8.8			8.5				0			
3/8	7	8		16.2			8.5				11	0		
4/23	7	9.5	8.5	19.0		100	8.1					0		
4/30	7	18	10.8	17.0										
5/16	7	16	12.0		28.0	20						0		
6/16	7	88f	79 f		16.0	27				e/1-3	34		1:00pm	sunny
7/9	7	79f	26	8.2	21	34	23			sw/8-12	130			
7/19	7	28	27	6.1	24	38		.05	<.25	calm	103		12pm	overcast
1991														
7/14	8		31.6		27.08		8.23	25	0					
7/21	8		29.1		17.0		7.47	2	3					
7/28	8		28.3		23.0		7.12	2	2					
8/5	8		28.4		23.		7.21	0	3					
8/18	8		22.5		17.05		7.07	2	1					
8/28	8		28.5		19.0		7.87	0	0					
1992														
2/22	8		5	12.4			8.2				2			
3/8	8				18.		8.8				5	0		
4/23	8		20	7.5	19.	24	8.1							
5/16	8		16	12.1		27.0	80					0		
7/19	8	25.5	25.5	4.2		37			<.25		37		12pm	overcast
1991														
7/14	9		23.7			8.17		7.16	2	1				
7/21	9		26.9			23.8		7.27	12	2				
7/28	9		30.3			21		7.98	20	4				
8/5	9		28.1			17.4		7.43	15	7				
8/18	9		21.5			1.0		7.07	38	1				
8/28	9		25.8			3.08		7.66	0	6				
1992														
2/22	9		4		8.4			7.0				0		
3/8	9		5									0	0	
4/23	9		20	7.5	21.0		18	8.2				0		
4/30	9		15	11.1	17.									
5/16	9		15.5	12.0		25.	30						0	

STRAITS POND
WATER QUALITY MONITORING

date	site	temp c air/water	d.o. ppm.	salinity ppt	conductivity	fecal coliform per100ml	ph	phosphates	nitrates	wind speed direction	water midge larvae	soil midge larvae	time	weather
1992														
6/22	9	18 24	6	21						calm			8:00am	sunny
6/24	9	24 18	7	22						s/4-7			8:30am	partly cloudy
6/25	9	18 20	2	26						nw/8-12			8:00am	partly cloudy
6/26	9	16 20	2	24						w/1-3			8:15am	sunny
6/29	9	18 22	2	24						sw/4-7			8:00am	sunny
7/1	9	18 22	0	24						s/1-3			8:10am	hazy
7/2	9	15 16	0	26						n/1-3			8:05pm	sunny
7/3	9	14 22	0	24						nw/1-3			7:25pm	p.cloudy
7/9	9	79f 26	5		34	165				sw/8-12				
7/19	9	25.5 25.5	6		37/38			<.05	<.25	e/1-3	5		12:10pm	overcast
1992														
2/22	10	7	11.0	6.4			7.0				2			
3/8	10	5									0	0		
4/23	10	19.5	8.6	21		40	8.1					1		
5/16	10	15	8.9	25.0		710					0			
6/17	10	23 24								calm			8:10am	sunny
6/22	10	18 22	1.4	21						calm			8:30am	sunny
/624	10	24 18	7	21						s/4-7			8:03am	p artly cloudy
6/26	10	16 18	2.8	26						w/1-3			7:45am	sunny
6/29	10	18 24	2.2	29						sw/4-7			7:30am	sunny
7/1	10	18 22	0	28						s/1-3			7:20am	hazy
7/2	10	15 16	4	22						n/1-3			7:30am	sunny
7/8	10	18 26			34					e/8-12			2:50	sunny
7/9	10	78f 25.5	7.6		34	520	1			sw/8-12				
7/9	10	125 from pipe out fall				198								
7/19	10	26 28	10.8		37			<.05	<.25	se/1-3			12:20	cloudy
1992														
2/22	11	1		12.0			9.0				3			
3/8	11	7		12.8			8.9				0	0		
4/23	11	18	9.0	16.2		202	8.3					0		
5/16	11	15	9.4		25.0	380						0		
7/19	11	26	8.0		37				<.25	se/1-3	0		12:30	Overcast
1991														
7/14	12	24.1			28.08		7.83	2	2					
7/21	12	26.2			17.7		7.72	7	2					
7/28	12	25.1			16.3		8.03	1	1					

STRAITS POND
WATER QUALITY MONITORING

date	site	temp air/water	d.o. ppm	salinity ppt	conduct tvity	fecal coliform per 100ml	ph	phosphates	nitrates	wind speed direction	water midge larvae	soil midge larvae	time	weather
1991continued														
8/5	12	23.8			22.7		7.56	3	1					
8/18	12	23.2			19.5		7.53	4	2					
8/28	12	28.4			22.8		7.86	0	3					
1992														
2/22	12	1	12.0	17.6			7.0				0			
3/8	12										0	0		
4/23	12	19	9.2	18.2		176	8.1					0		
5/16	12	16	8.4		28.0	40						0		
7/19	12	25 25.5	7.		37				<.25	se/1-3	0		12:30	overcast
1992														
3/8	13			14.0			9.1				1	0		
5/16	13	16	10.0			110						0		
1992														
3/8	14			13.6			9.0				0	0		
1992														
3/8	15			13.8			8.9				0	0		
1991														
7/14	gate	32.2			12.27		7.33	4	0					
7/21	gate	27.4			7.31		6.92	3	2					
7.28	gate	23.7			17.37		7.02	9	4					
8/5	gate	26.0			14.05		6.83	2	1					
8/18	gate	21.7			9.08		6.64	47	2					
8/28	gate	27.7			28.9		7.33	3	2					
1992														
7/9	gate	82f 27	8.2	28.8	41	8				sw/8-12			1:30	sunny
1992														
6/16	middle	84f 78f	8/5.4	16/20	27/32			<.05	<.25	e/8-12	3		1:30	sunny
6/18	middle	24 23	8.0/4.2		27/27					w/19-24			2:00pm	sunny
6/23	middle	22 23	8.1/5.6		30/37					w/8-12			1:30pm	sunny
6/24	middle	19 23	8.0/4.4		29/35					se/4-7			2:00pm	partly cloudy
6/25	middle	25 24	7/2.4		30/34			1/.1	<.25 <.25	w/8-12			1:45pm	partly cloudy
6/26	middle	24 23	7.9/5.1		30/36			1/.1	<.25 <.25	sw/8-12			2:00pm	sunny
6/28	middle	25 25	8.2/6.0		31/37					se/4-7			1:50pm	pt cloudy sunny

STRAITS POND
WATER QUALITY MONITORING

pg 7

date	site	temp air/water		d.o. ppm	salinity ppt	conductivity	fecal coliform per 100ml	ph	phosphate	nitrates	wind speed direction	water midge larvae	soil midge larvae	time	weather
1992 continued															
7/2	middle	24	23	8.4/6.0		32/42					e/E-12			1:30	sunny
7/7	middle	18	25			34					se/E-12			2:00pm	sunny
7/19	middle	26	26	5.2		39					se/1-3				
1992															
7/12	weir river	19	22	7.1	33	39								8:00pm	cloudy

APPENDIX 4A: IEP-RESULTS OF BASELINE WATER SAMPLING

Table 5-2. Results of Baseline Water Quality Sampling

Station No. & Description	Date	pH	Alkalinity*	Iron*	Total Coliform** Bacteria	Fecal Coliform** Bacteria	Phosphorus-ortho*	Phosphorus-total*	Nitrogen-ammonia*	Nitrogen-nitrate*	Nitrogen-kjeldahl*	Salinity (ppt)	Temperature (°F)	Dissolved Oxygen*	Transparency* (ft)	Tide Stage
1. Straits Pond, west end	5/16/79	8.2	-	-	60	30	0.06	0.15	0.05	0.03	1.23	17.21	65.0	10.5	-	
	10/02/79	7.9	-	-	340	250	0.01	0.13	0.53	0.03	1.35	22.34	61.0	10.5	-	
	11/29/79	7.5	-	-	200	50	0.02	0.05	0.55	0.14	1.17	18.71	47.5	10.5	2.8	
	1/08/80	7.5	-	-	<20	<10	<0.01	0.06	0.29	0.28	1.27	21.90	32.5	12.0	-	
	2/15/80	7.7	89.2	0.1	<20	<10	0.01	0.04	0.15	0.56	0.89	23.20	32.0	12.0	>3.2	
	3/26/80	-	-	-	-	<10	<0.01	0.08	<0.01	0.18	1.03	16.17	36.5	11.0	-	
	4/09/80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	x̄	7.8	-	-	128	60	0.02	0.09	0.26	0.20	1.16	19.92	45.8	11.1		
2. Straits Pond, middle	5/16/79	8.6	-	-	140	40	0.06	0.16	0.04	0.04	1.29	15.01	65.0	10.0	1.9	
	10/02/79	7.9	-	-	640	500	0.02	0.15	0.04	0.03	1.54	22.78	60.5	10.5	2.2	
	11/29/79	7.8	-	-	620	180	0.03	0.04	0.45	0.17	1.35	-	48.0	10.0	-	
	1/08/80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	2/15/80	-	-	-	-	-	-	-	-	-	-	-	-	-	-	
	3/26/80	8.5	-	-	-	<10	<0.01	0.06	<0.01	0.06	0.90	15.01	36.0	11.5	>3.4	
	4/09/80	8.5	-	-	-	<20	<0.01	0.03	0.03	0.03	1.07	10.48	47.0	10.5	>3.3	
	x̄	8.3	-	-	450	150	0.03	0.06	0.11	0.07	1.23	15.82	51.3	10.5		
3. Straits Pond, east end	5/16/79	8.5	-	-	480	260	0.06	0.17	0.04	0.04	1.72	13.96	65.5	9.5		
	10/02/79	8.1	-	-	920	1050	0.01	0.15	0.03	0.02	1.60	22.34	61.0	10.5		
	11/29/79	7.6	-	-	860	260	0.03	0.06	0.51	0.14	1.55	16.95	48.0	10.0		
	1/08/80	-	-	-	-	-	-	-	-	-	-	-	-	-		
	2/15/80	7.9	91.9	0.1	<20	<10	0.03	0.06	0.29	0.35	1.09	23.49	32.0	11.5		
	3/26/80	7.6	-	-	-	<10	<0.01	0.06	0.10	0.31	0.90	11.04	36.0	11.0		
	4/09/80	-	-	-	-	-	-	-	-	-	-	-	-	-		
	x̄	7.9	-	-	570	318	0.03	0.10	0.19	0.17	1.37	17.55	48.5	10.5		
4. Rattlesnake Run	5/16/79	6.4	-	-	160	50	0.12	0.14	0.07	0.16	0.95	-	65.0	10.5		
	10/02/79	5.7	-	-	1640	520	0.05	0.13	0.09	0.57	1.23	-	60.0	11.0		
	11/29/79	6.4	-	-	80	20	0.08	0.11	0.12	0.18	0.82	-	46.0	9.0		
	1/08/80	6.2	-	-	5600	<10	0.04	0.06	0.13	0.32	0.53	-	32.0	11.5		
	2/15/80	6.1	9.0	0.3	40	<10	0.03	0.06	0.33	0.36	0.53	-	31.5	12.0		
	3/26/80	6.5	-	-	-	<10	0.02	0.04	0.29	0.41	0.86	-	35.0	11.5		
	4/09/80	6.4	-	-	-	10	0.01	0.03	0.02	0.18	0.79	-	48.0	11.0		
	x̄	6.2	-	-	1504	90	0.05	0.08	0.15	0.31	0.86	-	45.4	10.9		
5. Weir River	5/16/79	7.1	-	-	10000	730	0.07	0.09	0.22	0.18	1.00	13.57	68.0	10.5		Low, Incom.
	10/02/79	7.5	-	-	2260	1230	0.07	0.12	0.12	0.10	0.78	23.39	60.0	11.0		Low, Outgo.
	11/29/79	7.5	-	-	560	no result	0.02	0.08	0.45	0.47	1.08	22.20	48.0	10.5		Low, Outgo.
	1/08/80	6.4	-	-	27400	26100	0.05	0.12	0.14	0.38	0.92	-	34.0	11.0		High, Incom
	2/15/80	7.6	105	<0.1	120	40	0.05	0.07	0.19	0.27	0.20	29.25	32.5	11.0		High, Incom
	3/26/80	-	-	-	-	-	-	-	-	-	-	-	-	-		Low, Outgo.
	4/09/80	7.4	-	-	-	360	<0.02	0.03	0.09	0.20	0.40	11.21	48.0	11.0		High, Incom
	x̄	7.3	-	-	8068	5692	0.05	0.09	0.20	0.27	0.73	19.92	48.4	10.8		
6. Storm Drain	5/16/79	7.2	-	-	15000	3200	0.13	0.14	0.42	1.6	0.85	-	54.0	-		
	10/02/79	6.4	-	-	>14000	10900	0.28	0.50	0.96	2.1	1.75	-	52.0	-		
	11/29/79	6.8	-	-	>20000	11300	0.24	0.18	1.43	1.8	1.89	-	52.0	-		
	x̄	6.8	-	-	13000	8467	0.22	0.27	0.94	1.8	1.50		52.7	-		
7. Landfill Leachate	1/08/80	6.9	437	10.5	20	10	0.01	0.01	17.4	0.10	26.5	-	-	-		
8. Black Rock Beach	1/08/80	7.6	-	-	20	10	0.04	0.12	0.06	0.15	0.65	31.39	31.5	-		
	2/15/80	8.0	112	0.1	20	10	0.03	0.07	0.07	0.10	0.17	33.27	44.5	-		
	x̄	7.8	-	-	20	10	0.04	0.10	0.07	0.13	0.41	33.83	38.0	-		
9. Gun Rock Beach	3/26/80	7.9	-	-	-	10	0.01	0.04	0.02	0.05	0.37	34.20	32.0	-		
	4/09/80	8.0	-	-	-	180	0.02	0.10	0.02	0.02	0.09	35.32	44.0	-		
	x̄	8.0	-	-	-	95	0.02	0.07	0.02	0.04	0.23	34.76	38.0	-		

FECAL COLIFORM SANITARY SURVEY

Dates
3/8/92-rain within 12 hrs
3/17/92-no rain within 24 hrs
3/27/92-rain within12 hrs

DATE	PIPE	PER100 ML FECAL COLIFORM	DATE	COUNT	DATE	COUNT
3/8/92	A	290 col				
3/8/92	B	0 col				
3/8/92	C	no flow				
3/8/92	D	0 col				
3/8/92	E	4950 col	3/17/92	16 col	3/27/92	800 col
3/8/92	F	290 col		26 col	3/27/92	700 col
3/8/92	G	--------			3/27/92	100 col
3/8/92	H				3/27/92	125 col
3/8/92	I				3/27/92	100 col
3/8/92	J				3/27/92	0 col
3/8/92	K	2850 col	3/17/92	835 col	3/27/92	300 col
3/8/92	L	0			3/27/92	0 col
3/8/92	M	no flow from pipes				
3/8/92	N	"				
3/8/92	O	"				
3/8/92	P	"				
3/8/92	Q	"				
3/8/92	R	"				

3/8/92	S	4132 col	3/17	796 col	3/27/92	1100 col	
3/8/92	T				3/27/92	flawed test result	
3/8/92	U				3/27/92	197,000 col	
3/8/92	V	10,400 col					
3/8/92	W	230 col					
3/8/92	X	1925 col			3/27/92	15,000 col	

STRAIT'S POND MIDGE LARVAE POPULATION STUDY:

Methods:

1. Thirteen stations were set up throughout the pond, taking into account such factors as:
    a. General coverage
    b. Vegetation changes, influx of fresh or salt water and areas of mixing
    c. Pollution sources
2. Depth of water, weather conditions, temperature, air & water temperature, salinity/conductivity, dissolved oxygen, pH will be recorded at each station
3. Surrounding habitat were noted along with any other significant factors ie; influx of fresh/salt water, pipes, pollution sources, animal sign, birds, fish etc.
4. Three grabs of 1000ml were taken at each station in January 1992 through July1992. Each grab will be sifted through a screen (0.7mm openings/mesh) and midge larva counted. Other life forms were also counted and brought back to the lab for identification.
5. Soils taken in the grabs were evaluated for physical characteristics-color, texture, odor, etc. (incomplete)
6. Percent of vegetation in the grabs were approximated.

Materials

- Bottom grabber, Lamotte brass hinged cylinder of approximate 750ml capacity, weighted by 2-4 # weights.
-Containers of 1000ml with covers held soil samples and fauna for macro fauna population counts
-Quart plastic baggies for transit of above contents
- Microscope and stereoscope for soil studies.

RESULTS were mapped to correlate water quality findings to midge larvae population densities.

MIDGE POPULATION FORMULA FOR STRAIT'S POND

$$\frac{\text{500ml-sample}}{\text{Vol of sample}} = \frac{\text{30.5 cubic in.}}{\text{2 in top soil}} = \text{15.25 sq. in. per sample}$$

Add total* of midges per sample divide by number of samples = simple average number of midges per sample/average number of midges per 15.65 sq inch

Pond contains 92 acres - 1 acre = 43,560 square feet
1 sq foot = 144 sq inches

92 acres x 43,560 sq feet = total area of Straits Pond x 144 sq inches = 577,000,000 sq inches in Straits Pond divided by 15.25 sq inches per sample = 37.8 million samples

number of midges per sample x 37.8 million samples in the pond = total possible midge population in Straits Pond.

A. METHODS & MATERIALS FOR FISHERIES INVENTORY

METHODOLOGY

An Inventory of fin fish was conducted on 6/20/92. A 15 foot seine net was hand held by three people. At each location the net was walked into the pond and one end was kept as close to shore as possible and the other end taken out the length of the net. When the net was in full extension the far end was slowly walked parallel to the shore and then brought back in forming a circle. The net was carefully removed from the water and fish were identified and counted.

Three locations were chosen for this survey, the tide gate and between sites 3 & 4 and 5 & 6. Other parameters recorded during this survey were wind direction and speed, water and air temperature, dissolved oxygen and salinity or conductivity measurements. The survey was completed a week later when seining and water quality measurements were conducted between sites 10 and 11 as well as being repeated between sites 3 and 4.

8B: METHODS & MATERIALS FOR TROPHIC LEVEL EXPERIMENT (LAB)

An Experimental pond environment was set up at the lab in a 50 gallon Tank with an under gravel filter, an air pump and 2 air stones to maintain a supply of dissolved oxygen. Sand, gravel,mud, water, aquatic plants, about 50+ fish. (20 sticklebacks, 15 killifish, 10 mummichogs, 4 silversides, 1 pregnant shrimp, 1 small eel and about 120 midge larvae) were taken from the pond and put in the tank. No Alewives were taken as they were not present in the pond during the 2nd part of our fish inventory.

FISHERY INVENTORY

JUNE 20TH . 27TH 1992

site	alewife fry	3-4 spine backs	atlantic silverside	striped killfish	mummi ichogs	shrimp	snails	temp water	d.o.	salinity	conduct	phospate nitrates
gate	120	80	40	17	0	2	1	23c	7.2	22.4	----	-----
3-4	9	68	16	40	16	5	---	24c	5.8	23.4	34	<.05/<.25
5-6	61	322	11	0	0	8	---	24c		30	---	---
June 27												
10-11	0	80	40	35	40	0		25c	6.4	--	33	---

DRAFT

STRAITS POND MIDGE AND POLLUTION STUDY

COMMUNITY SURVEY

1. How did you first become aware of the Town of Hull's midge study project?

[4] This is the first I've heard about it.
[26] I have read a little about it in the local newspapers.
[7] When I received a letter about a community meeting.
[8] When I received a letter about your survey recently.
[10] Other "been involved", "Pond clean up", friends who are involved"

2. How long have you lived at this location?

[5] Less than 1 year
[3] 2 - 3 years
[2] 4-5 years
[8] 6-10 years
[3] 11 - 15 years
[23] More than 15 years

3. Why did you choose to live here?

[2] To be near my or my spouse's job.
[5] To retire.
[3] To live in a nicer house than our previous house.
[6] To live in a nicer community than our previous community.
[26] To be close to the ocean.
[4] To live close to relatives.
[7] Other "house fit needs", "born in Hull", "location"
1 No response

4. a. How many adults are in your household?

Household Size	1	2	3	4
# Responses	13	22	4	6

b. How many children are in your household?

# Children	0	1	2	3
# Responses	37	7	1	0

5. To what extent have you been bothered by the midge problem when it has been at its worst?

[18] Noone is able to enjoy the outdoors at any time of day.
[10] Noone is able to enjoy the outdoors except when it is sunny.
[16] Yardwork has become unpleasant.
[9] Its become an obstacle to gardening.
[23] Other: "get in house" (5)
"can't go out at night" (3)
"can't read at night"
"spiders"
"dead ones cover house"
"inhale them"
"home maintenance impossible"
"occasional problem" (4)
"unpleasant, not unbearable"

6. Please check any months during which midges are a problem for you and your household:

[18] May
[32] June
[31] July
[26] August
[11] September
[3] October

7. a. Are you connected to a Town sewer system? [24] Yes [15] No 39 ?

b. If not, what type of septic system do you have?

[9] tank [4] leaching field

[3] other "cesspools"

c. If you have a septic system, how far would you estimate the system to be from the edge of the pond at high tide?

[7] Less than 100 feet
[1] 100 - 199 feet
[4] 200 - 299 feet
[0] 300 - 399 feet
[0] 400 - 499 feet
[12] More than 500 feet

d. If you have a septic system, how often would you estimate that you have your it cleaned?

[2] Once a year
[5] Once every 2 years
[0] Once every 3 years
[4] Don't Know
[0] Every 4 to 5 years
[1] Once every 6 to 8 years
[1] Every 10 or more years
[0] Never to my knowledge

e. If it were possible for you to be hooked up to a sewer system, how much would you be willing to spend for the connection to your house?

[4] Can't afford
[2] Up to $1,000
[4] $1,000 - 2,000
[0] $2,000 - 3,500
[0] $3,500 - 5,000
[1] $5,000 - 7,500
[0] $7,500 - 10,000

(6) Other answers: "not possible"
don't know
landlord (2)
"not interested"
"not possible because of hill on Richards Rd

8. Using the following scale, how often would you estimate that your household does the following: (Please circle one answer)

	Never	Less Than 1/Week	1-2 Per Week	Once Every 2-3 Days	Once a Day	More Than 1/day
	1	2	3	4	5	6
A load of laundry	7	3	20	9	1	0
A dishwasher load	20	3	10	6	3	0
Use garbage disposal	27	1	1	4	8	1
Ratings	(1)	(2)	(3)	(4)	(5)	(6)

9. a. Do you use a lawn fertilizer? [11] Yes [33] No

If yes, then:

b. What type? "Chemlawn", "Weedfeed", Scott's granules, Turfbuild

c. How often would you say you use lawn fertilizer?

[5] Once a year or less [ ] 3 times a year

[5] Twice a year [ ] 4 times a year or more

10. a. Have you ever used a yard bug fogger type of spray?

[8] Yes [32] No

b. If yes, how effective do you believe it was?

[ ] Very effective
[1] Effective
[1] Somewhat Effective
[4] Ineffective
[2] Very Ineffective

11. How often is your basement affected by flooding or runoff from the pond?

[1] More than 3 or 4 times annually
[3] Once or twice a year
[1] Once every two or three years
[1] Once every 4 to 7 years
[9] Once every 8 years or more
[26] Never 1 does not have basement
[ ] Don't Know

12. How often is your yard affected by flooding or runoff from the pond?

[4] More than 3 or 4 times annually
[3] Once or twice a year
[1] Once every two or three years
[2] Once every 4 to 7 years
[8] Once every 8 years or more
[23] Never
[2] Don't Know (new to house)

13. Items are listed in priority order, given the weighted average scores from the following rating scale:

Not Important		Somewhat Important		Extremely Important
1	2	3	4	5

	Weighted Average
1. Preventing further pollution of the pond	4.86
2. Preserving the natural wildlife around the pond	4.58
3. Eliminating the midges	4.47
4. Having fish in the pond once again	4.12
5. Preventing further flooding	3.65
6. Having a green lawn	3.07
7. Making Straits Pond safe for swimming	2.91
8. Using a dishwasher	2.53
9. Using chlorine bleach for whitening	2.15
10. Using a garbage disposal	1.76
11. Using a phosphate laundry detergent	1.73
12. Using a lawn fertilizer	1.71

14. The following items are listed in order of most agreement to most disagreement based on the weighted averages derived from responses using the rating scale below. (Items with no answer were figured in at 0.)

Strongly Agree	Somewhat Agree	Neither Agree Nor Disagree	Somewhat Disagree	Strongly Disagree
2	1	0	-1	-2

1. I will change to an evironmentally safe laundry detergent if evidence is found that phosphates are contributing to the pollution of Straits Pond. [1.341]

2. I believe that the local towns of Hull, Hingham, and Cohasset have not done enough to solve the midge problem. [1.114]

3. I would stop using lawn fertilizer if there was convincing evidence that fertilizers are a significant factor contributing to the pollution of Straits Pond. [1.068]

4. I would be willing to participate in a controlled experiment even if it meant changing some of my household's practices as long as there were no added risks and it would not worsen the midge problem. [1.023]

5. Using a garbage disposal means that those who have septic systems need to clean them more often. [.522]

6. I believe the State did a good thing when it forced the Towns to find an alternative to spraying "Abate". [.273]

7. I don't care what other people think about my lawn. [.023]

8. I feel my concerns about Straits Pond are being adequately addressed by my Town's local officials. [-.841]

15. a. Do you or anyone in your household keep a journal or record of wildlife sightings (birds, mammals, amphibians, reptiles, etc.)?

[3] Yes _____ Type [37] No

b. Would you/they be willing to share information? [8] Yes [1] No

16. If a midge trap was developed that seemed effective and was easy to operate, was as large as a washing machine with a wood frame, and would cost you about 20 cents a day to operate, would you be willing to have one in your yard?

[13] Yes [7] No

[21] Maybe

17. Beyond this survey, our study has many components and much to be done. In addition to the high school students and teachers, there are many community volunteers involved. In some instances volunteers have been trained for certain tasks; others have helped by working with a team of students. Would you be interested in volunteering some of your time for any of the following ?:

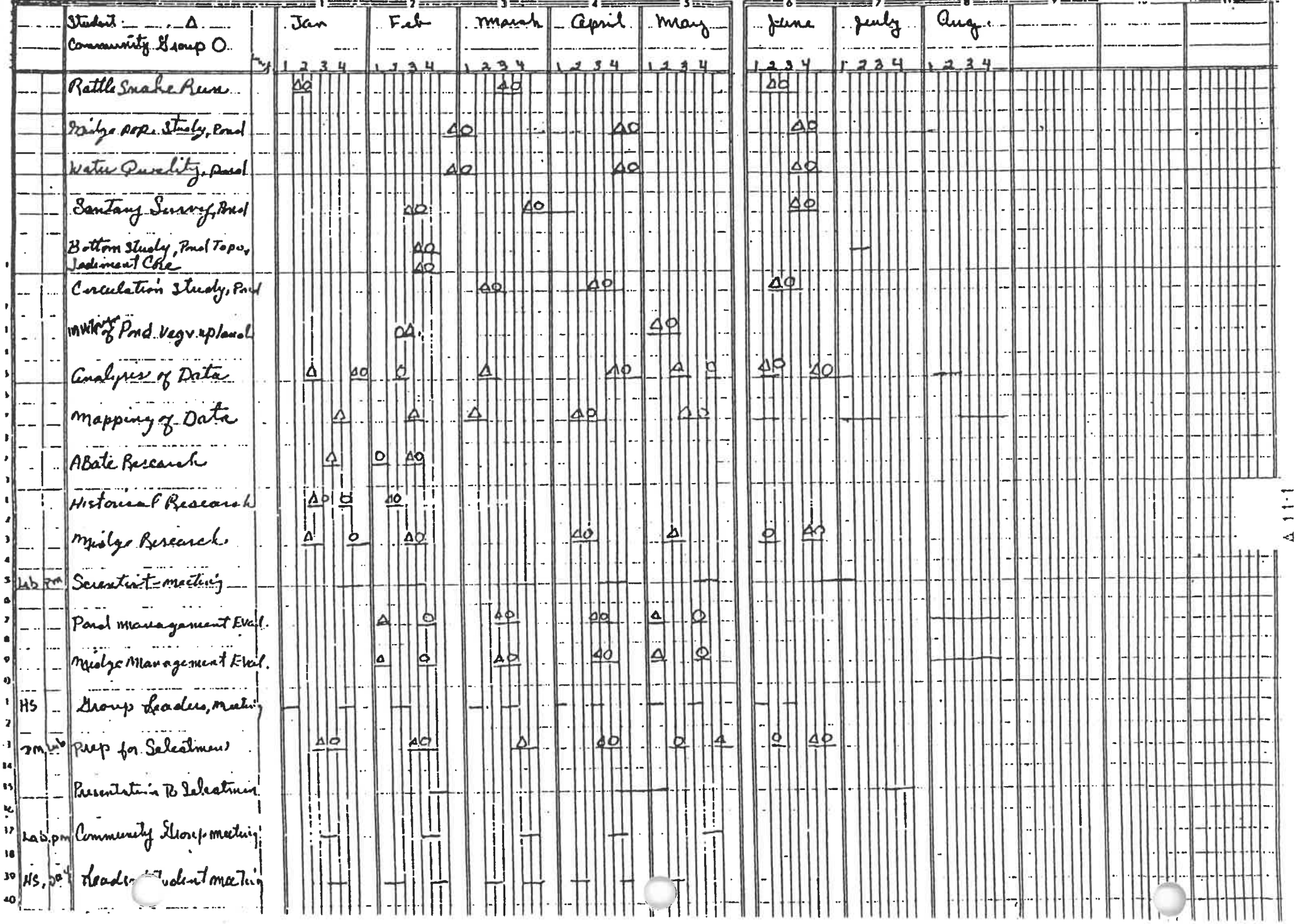
[3] As a mentor to a student
[5] To speak with a small group of students about your career on career day
[2] Assisting or tutoring at Saturday classes
[12] Collecting water samples
[7] Testing samples
[3] Mapping our findings
[5] Compiling our survey findings
[5] Research
[1] Teaching a public seminar on an evening or weekend
[1] Teaching a class session at the High School
[11] Recording wildlife or plant observations
[3] Surveying local government leaders
[7] Other: circulate info, canoe, all of above, assist clean up, typing, investigate dredging pond

18. We would appreciate any comments or suggestions you would like to make. Please feel free to use additional space on the back. Thank you for taking the time to fill out our questionnaire.

Name(optional): _____

Address:

APPENDIX 11: STUDENT & COMMUNITY '92 MONTHLY WORK SCHEDULE



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ANSEN WHEELER
ARNOLD WINTERS
CAROLYN YOUNG

Volunteers

*** Bob and Mal McCunnery are willing to volunteer for any task; he is Director of Clinical Services at The University Hospital. Phone: 383-6387

*** Anson Wheeler volunteered for almost anything except teaching.

a. As mentors to students: Roseann Cecchi, 8 Montana Ave.

b. Career day speakers:

- Connie Hagerty, 99 Atlantic Ave.
- Roseann Cecchi, 8 Montana Ave.
- Mark Jaffee, 5 Montana Ave.

c. Assisting with Saturday classes: The McCunnerys? see above

d. Collecting water samples:

- Robertson, 12 Summit Ave.
- Jim Moran, 589 Jerusalem Rd.
- Roseann Cecchi, 8 Montana Ave.
- Edward Merle Graham
- Cathy Scott
- Arnold Winston, 739 Jerusalem Rd.
- James Richard, 703 Jerusalem Rd.
- Tim and Lynn Nichols, 5A Montana Rd.
- Frank + Carol Doyle, 155 Montana Ave.

e. Testing samples:

- Robertson - 12 Summit Ave.
- Roseann Cecchi, 8 Montana Ave.
- Arnold Winston, 739 Jerusalem Rd.
- Tim and Lynn Nichols, 5A Montana Rd.
- Frank Carol Doyle, 5 Montana Ave.

f. Mapping findings: - Roseann Cecchi

g. Compiling survey findings:

- Connie Hagerty, 99 Atlantic Ave.
- Roseann Cecchi
- Edward + Merle Graham

h. Research:

- Connie Hagerty, 99 Atlantic Ave.
- Roseann Cecchi
- Arnold Winston, 739 Jerusalem Rd.

i. Teaching a seminar:

j. Recording wildlife of plant observations:

- Jim Moran, 589 Jerusalem Rd.
- Roseann Cecchi
- Cathy Scott
- Ed Bilecki, 589 Jerusalem Road
- James J. Richard, 703 Jerusalem Rd.
- Tim + Lynn Nichols, 5A Montana Rd.
- Trudy Johnson, 11 Richards Rd.
- Frank and Carol Doyle, 155 Atlantic Ave.

k. Surveying local government leaders: Ed Bilecki

l. Other:

"Investigate dredging pond" - Robertson, 12 Summit Ave.

"Assist in clean-up" - Jim Moran, 589 Jersusalem Rd.

"Circulate information to residents in the Straits Pond area" - the Godek family

"Typing of any reports" - Janet Gannon, 17 Summit Ave.

HULL ENVIRONMENTAL HIGH SCHOOL

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Hull Council for Business and Cultural Development [Community]
Hull Midge Mitigation Study [9th Grade]

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