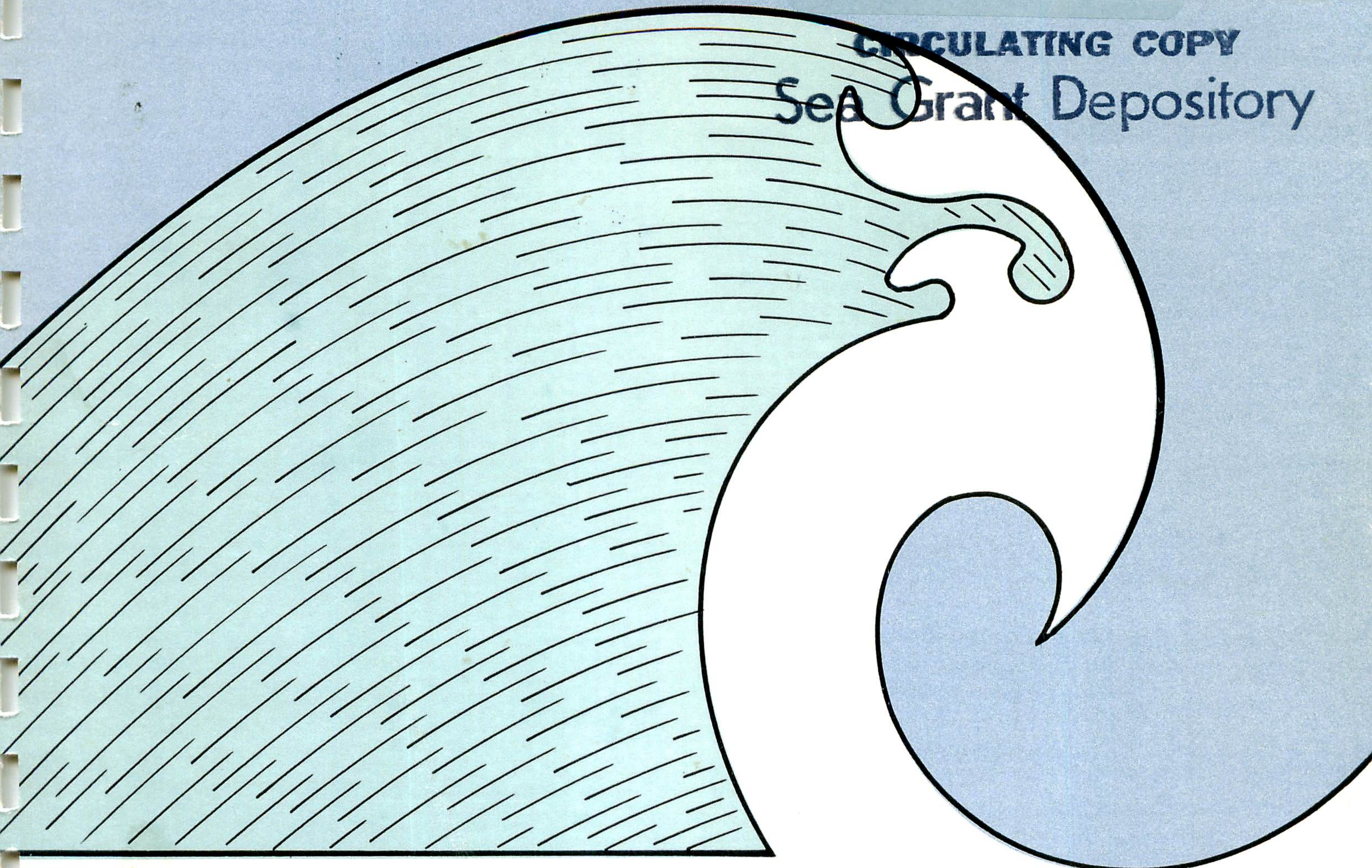

# DEPARTMENT OF OCEAN ENGINEERING

# SEA GRANT PUBLICATIONS

COLLEGE OF ENGINEERING UNIVERSITY OF RHODE ISLAND

MEMORANDUM NUMBER 11M

## ANNUAL PROGRESS REPORT
## BAY WATCH PROJECTS

by

Ocean Engineering Staff

31 December 1970

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# ANNUAL PROGRESS REPORT--
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by

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Prepared for

National Science Foundation

Under

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by

Department of Ocean Engineering

University of Rhode Island

1 January 1971

## ACKNOWLEDGMENT

This memorandum was prepared by the entire BAY WATCH staff as part of the BAY WATCH Program. These include:

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The memorandum was edited by Professor B. Levine.

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## 1.0 INTRODUCTION

There are three main sections to this progress report. The first section reports on the results of the Ocean Engineering projects prior to the initiation and during the planning phases of the new programs reported on in the remaining two sections.

## 2.0 PRELIMINARY PROGRAM EFFORTS

The studies of drifting oil were conducted by Douglas Teeson, Professor White and Professor Schenck. Bay work was assisted by Messrs. John McAniff, Alan Blott and Robert Watson and, operational planning by Professor Vincent Rose.

In addition to the Teeson thesis, the following paper was published: Douglas Teeson, Frank White, Hilbert Schenck Jr., "Studies of the Simulation of Drifting Oil by Polyethylene Sheets," Ocean Engineering, Vol. 2, pp. 1-11, September, 1970.

The planning studies listed below were prepared mostly under the direction of Professors Levine, Rose and White, although the entire staff contributed. The URI Ocean Engineering Sea Grant Reports are published with limited circulation for use of Sea Grant participants. The contents may be tutorial, partially complete or document a major study. It is a communication device for making available more detailed data prior to general publication. All such reports in this annual report will be available shortly.

The first two reports are tutorial and were prepared in conjunction with Professor Levine's Oceanographic Data Analysis Course. Such reports are an example of the close exchange between the research and educational aspects of our program. The latter two reports trace the history of pollution in Narragansett Bay, list the sources of pollution in the Bay, and calculate the amount of river runoff going into the Bay. Further work has been done on collecting and assimilating physical and chemical data on the Bay taken by various groups. This information was used in establishing permanent Bay Watch stations and for identifying special stations for specific studies.

Smith, B. Lincoln, "Data Transmission Systems," Ocean Engineering Sea Grant Memorandum Number 2M, University of Rhode Island, 8 April 1970.

Hess, Kurt, W., "An Oceanographic Monitoring System for Narragansett Bay: A Preliminary Study," Ocean Engineering Sea Grant Memorandum Number 3M, University of Rhode Island, 5 May 1970.

Hess, Kurt W., "Narragansett Bay: An Example in Estuary Classification," Ocean Engineering Sea Grant Report Number 4, University of Rhode Island, 30 June 1970.

Hess, Kurt W., "Pollution in Narragansett Bay," Ocean Engineering Sea Grant Memorandum Number 5M, University of Rhode Island, 16 July 1970.

## 3.0 BAY WATCH PROGRAMS

### 3.1 Introduction

The program is reported in two parts; the Bay Model and the Bay Watch efforts. Some of the initial objectives of the Bay Watch program are to provide flow, tide and other data which support the Model efforts. The state of the Bay and some of its varied uses and abuses are summarized in the next few paragraphs.

In the past, many changes have taken place in the coastal zone without studying their effect on the bay. These include municipal and industrial sewage and waste disposal operations, dredging of channels, filling of marsh lands, siting of residential and industrial complexes, etc. The only comprehensive study was conducted for the upper and lower bay hurricane barriers.

The quality of the water in Narragansett Bay has been slowly deteriorating. Based on coliform count, the R. I. Department of Health has closed many areas of the bay to shellfishing. Currently, these include the Providence River, Mount Hope Bay, Newport Harbor, Coddington Cove and numerous smaller areas. In addition, after a heavy rainfall, a portion of upper Narragansett Bay has to be closed due to the effect of storm sewer flow on some of the municipal treatment plants. Only the Sakonnet River has remained relatively pollution free.

Many industrial firms are also releasing effluents containing heavy metals, acids, bases, organic chemicals, dyes, etc. into the bay. As many as thirty oil spills are observed in a typical year. These result from boat mishaps, industrial spills, disposal of garbage wastes, tanker spills, etc.

In recent months a series of new activities have been proposed that may seriously affect the bay. These include a 600 MW addition to the fossil fueled power plant at Brayton Point in Swansea, Massachusetts; an 800 MW nuclear power plant for Rome Point in North Kingstown; a 65,000 barrel per day oil refinery in Tiverton; a 22 million dollar, 2.5 billion cubic foot capacity, liquid natural gas facility at Cory Lane in Portsmouth; a 50 million dollar liquid natural gas facility on the north end of Conanicut Island; a U.S. Navy landfill operation at Coddington Cove and a Narragansett-South Kingston regional sewage plant at Narragansett Pier.

Since Narragansett Bay is one of the best deep water harbors in the Northeast and since it is centrally located in the largest consumer market in the country, many new activities will be proposed in the future. For this reason, an intensive study of the complete bay area must be undertaken.

Currently, the power companies are financing studies to determine the effect of the proposed power plants on the bay. The Corps of Engineers is financing a continuous study of the effects and fate of the Providence River Dredging Spoils being dumped in R. I. Sound. While the Hurricane Barrier Studies and the U.S. Navy Studies on the Inner and Outer Ranges can serve as a base line, Bay Watch is attempting to take data and to obtain data being taken by other agencies to give a better basis for future decisions.

### 3.2 Boat Operations

Throughout the summer the "Zostera" was operated under the direction of Professor Schenck and Mr. McAniff. The most significant aspect of our boat operations was the highly successful operation of the "Islander" under the direction of Professor Kowalski, assisted by Captain Miller, Students Davis, McKenna and Fenstermacher and all who participated in the collection of data as indicated elsewhere. It should be re-emphasized that the primary objective of our program was to become operational. Prior to this time, responsibility for such operations for data collection was not part of the experience of the staff. A summary of the "Islander" operations follows.

#### 3.21 Islander's Characteristics

Designer - Ken Smith of Connecticut
Builder - Whaton Shipyard, Jamestown, R. I. (Approx. 1960)
Length - 35'3"
Draft - Approximately 2'9"
Displacement - Approximately eight tons
Passengers - 10 w/crew of 2--Sleeps 1
Engines - 2 (Mercury) Interceptor V-8 gasoline engines, twin-carburetor, 225 HP each
Speed - Approximately 18 kts (max)
Fuel capacity - Approximately 136 gallons
Water capacity - Approximately 30 gallons

Donated to Department of Engineering, spring of 1970.
Commenced research operations, 6 July 1970.

Statistical Synopsis--

(Except where indicated otherwise, dates are 6 July, 9 Sept.)

Working days available: 47
Total hours of operation: 144 (approximately)
Hours of operations/days available: 3.2
Engine hours (indicated): 96.9 (15 July, 9 Sept.)
Actual engine hours: 129.1 (15 July, 9 Sept.)
Fuel consumed: 1156 gallons (15 July, 9 Sept.)
Miles per gallon @ 3000 RPM, both shafts: 1.0 (approximately)
Total miles traveled: 1200 (approximately)
Cost per hour of operation: $3.59 (fuel only)
Cost per mile of travel: $.40 (approximately)
Hours of operation (Bay Watch): 68.5
Hours of operation (other projects): 60.5

3.22 Outfitting and Modification for Research Operations

"Islander" was drydocked at Dutch Harbor Shipyard, Connanicut Island during the spring of 1970 and was waterborne by approximately mid-June. At this time, there were no facilities on board for research operations. The boat was sparcely outfitted with ground tackle, mooring lines, bunk cushions, and virtually nothing else.

From mid-June through July, considerable effort was expended determining requirements for equipage and consumables, ordering needed items, designing and installing equipment to be installed in "Islander" to make her suitable for research operations.

During the course of the summer, frequent modifications were made to the boat and equipment purchased to better configure the boat for research operations. Principle items in this area were:

1. Design, fabrication and installation of davit.
2. Purchase and installation of ship/shore FM radio and antenna.
3. Installation of 6, 12-volt instrumentation batteries.
4. Modification of starboard bunk to receive 2, 19" instrument racks.
5. Design, fabrication and mounting of hinged diver's platform on transom.
6. Installation of stop valve in fuel lines to permit operating engines either split plant of cross-connected from the two fuel tanks.

7. Procurement of portable pelorus for higher accuracy visual position fixing.
8. Procurement of requisite safety equipment for 10 passengers and two crew.
9. Nearly continuous preventative and corrective maintenance on the engines, including: adjustment of ignition system, replacement of v-belts, oil changes, cleaning of fuel system, replacement of port generator, etc.
10. Procurement of necessary tools, spare parts.

### 3.23 Operations

Operations were, generally, conducted in response to requirements levied by individual experimenters. Towards the end of the summer, routine operations to collect water samples were scheduled and conducted on a Monday, Wednesday, Friday basis, when feasible. Approximately half of the operating hours were devoted to first priority Bay Watch projects (water sampling, coring and current studies), and the other half in support of other projects (sub-bottom profiling, diver training, visibility/turbidity experiments and wave buoy testing).

Operations were, for the most part, conducted from Wickford Shipyard, Wickford Cove. Wickford Cove is an excellent location for such operations. The harbor provides excellent shelter, easy access to the Department of Fisheries and Economic Resources and the Wickford Shipyard, roughly central location on the west shore of the Bay, and proximity to both the Bay Campus and Main Campus. A wintering-over berth and dry-docking facilities are available.

### 3.24 Navigation

The majority of the research work conducted during the summer required accurate one-time fixing of position, but seldom required continuous fixing of position. Placing the boat at a particular position can be accomplished fairly easily in almost all parts of the Bay. To frequently monitor the position of the boat while lying-to or when proceeding from point to point is an entirely different matter and required a compensated compass or one whose deviation errors have been calculated by swinging ship, and a pelorus or other instrument for obtaining relative bearings to landmarks.

Both of these requirements have been satisfied; a compass correction graph has been prepared and is on board, as is a portable pelorus (on loan from Wilson Lamb).

## 3.3 Flow Measurement Projects

### 3.31 Introduction

The measurement of tidal heights, currents and mass flow is essential to the Bay Watch and Bay Model programs. A number of alternate approaches have been initiated in order to assure successful mass-flow data and cross-calibration data obtained by different techniques.

### 3.32 Direct Flow Meter Approach

Professor Sturges and student, Robert H. Weisberg initiated a current meter and drogue study to determine the circulation and the main transport of water through West Passage, off the Bay Campus. Two current meters were in the water from July 1, 1970 to July 8, 1970. In conjunction, a surface drogue station was maintained from July 6, 1970 to July 9, 1970. This gave a total of three velocity measurements, at 2.5 and 5 meters from the bottom and 1.5 meters from the surface. The position is approximately at one of the grid stations used, and the water depth was 9 meters at low water. The current meter records were sent to the Geodyne Company for rough processing. The bottom most current meter yielded no record and the second record is still being processed (as of December). Initial processing of the drogue measurements showed a net surface outflow on the order of 0.2 knots, and instantaneous magnitudes of 1.0 knots on the incoming tide, and 1.4 knots on the outgoing tide.

Eight current meters in a rigid vertical array was placed off Rome Point in October for a 30 day period. A second array is also in place at Bonnet Shores. This work is being done under contract for Narragansett Electric.

The difficulties of assuring that data is being generated, the duration of the processing cycle, and the large number of flow meters required for generating mass flow data are some of the reasons why the other approaches were initiated.

### 3.33 Free Drifting Drogues

These investigations are being led by Professor Kowalski and student Krabach, who is assisted by Alfano, Binkerd and Jones. Development of drifting buoy techniques for measurement of bay currents has been developed to a point where current directions and velocities at different depths and positions can be determined and the rates of flow calculated through narrow channels of 1 to 2 mile widths.

The technique consists of photographing a series of free drifting buoys at frequent time intervals. The analysis of photographs gives the distance and direction traveled during the known time--hence the velocity.

The buoys were designed to drift with the current and be little affected by the wind or surface current. For night photography, strobe flasher is attached to the mast. The photographs are being taken in three different ways:

1. At night from one or two fixed points on a high ground or structure, like a bridge.
2. During the day from a helicopter, buoys are photographed every 15 minutes from a height of about 1500 feet.
3. During the day from high ground or structure, using two fixed cameras, pictures are taken at given intervals of time.

The above methods have been checked out and proved to work in the specific locations in the Narragansett Bay. Their success hinges on the availability of high points for the location of cameras or availability of a helicopter.

Future plans consist of refinement of the above methods, especially the interpretation of the pictures. Photography and interpretation of dye streaks will also be attempted in the near future. This will give a gross type of current motion over longer periods of time.

3.34 Alternate Flow Measurement Techniques

3.341 GEK

This project is led by Professor Kowalski, assisted by Professors Levine, White and Dowdell. Student Krabach will use this to obtain his MS thesis.

It is necessary to determine the mass transport at various locations throughout the Bay. One method of measuring the net volume is in the use of a Geomagnetic Electrokinetograph (GEK). This method operates on the principle of a moving conductor (the sea water) passing through a magnetic field, (the vertical component of the Earth's magnetic field). A voltage is produced between electrodes in each side of the water passage.

This method has been tried with varying success in the Straits of Florida (1959), in Puget Sound (1957) and in the Irish Sea (1968). (See references.) The success of this procedure depends upon being able to correlate out the voltage fluctuations produced by sources other than water velocities and calibration by some other technique. All required permissions for physical implantation in East Passage have been granted. The equipment is about 90% complete and almost ready for installation. The calibration technique is discussed in the section on "Drifting Drogues".

Details of status appear in a memorandum.

Krabach, Michael, "Progress Report for a Geomagnetic Electrokinetograph for Narragansett Bay," Ocean Engineering Sea Grant Memorandum Number 6M, University of Rhode Island, 16 September 1970.

3.342 Current Meters

Professors Levine and Haas have been concerned with this approach. Student Lackoff will continue in the phases of the program.

With a few low-time-constant current meters, it would be possible to construct a profile over a cross-section of a Bay passage in a relatively short time. Design of such a device was undertaken in order to produce a self-contained current meter unit with no external AC power required. It was intended that the unit be inexpensive and further adapted to use as an instrument to determine a current velocity profile by lowering the unit slowly. A report giving details of the design status is:

Lackoff, Martin R., "A D.C. Electromagnetic Ocean Current Meter," Ocean Engineering Sea Grant Memorandum Number 7M, University of Rhode Island, 15 September 1970.

Included in the memorandum are design considerations of a transducer with metal electrodes and permanent magnet field. There is a description of a high gain D.C. amplifier with high input impedance and low noise figure.

Difficulties in design and operation are pointed out and include polarization of electrodes, electrochemical potentials and Hall effect. The project was interrupted during the summer of 1970. Several similar devices have been tested by industry very recently. These appear to be more sophisticated and expensive. It is anticipated that the project will be resumed during the winter months when there is less pressure for the collection of data.

## 3.4 Electrochemical Shipboard Water Sampling System

Professor Soltz is concerned with these measurement techniques. He is assisted by students Boersma, Cannon, Smith, Bennett and Keene.

A water quality monitoring system capable of continuous in-situ gathering of data from a small boat traversing Narragansett Bay has been considered. The system presently is designed to monitor up to 12 parameters, but to date only $O_2$, temperature, $Cl^-$, pH, and E, have been measured. The equipment has been fabricated and is now being calibrated in the laboratory and on the ship and prepared for continuous shipboard use. Several operational shipboard runs have been completed, and debugging continued.

A refrigerated glass/teflon calibration flow loop was built to allow simulation of shipboard operation under all expected variations. Much effort has been expended in calibrating the flow and temperature vs. the measured readings of the $Cl^-$ electrode, the YSI $O_2$ meter with built in thermistor readout for effects due to varying flow rates, for comparison against manufacturer's specifications, and for absolute accuracy when measuring known parameters. The calibration of the pH (silver-silver chloride glass electrode) measuring electrode has not been completed, but has started. Much more work must still be done for accurate calibration of all sensors under various temperature/flow conditions.

The shipboard flow loop and pumping system has been completed and tested aboard the P/V "Islander", and is operational. The electronic readout package consisting of a 12 point recorder, and appropriate data conversion electronics, has been completed, checked out, and shipboard tested. It was interfaced with the pumping sub-system, and tested as a total system successfully. Minor adjustments have been made, and the data system is now operational.

A ten (10) station thermistor string and readout circuitry is currently being built. Along with the string, two separate deep (150 foot) thermistor lines are being made. They are single thermistors on the end of 150 foot cables for single depth measurement. Final fabrication will allow two individual deep measurements as well as a variable 10 station (10 foot spacing) measurement to be made either statically or towed with the fish. The thermistor string and deep thermistors are nearly complete, but the readout electronics are progressing satisfactorily.

3.5 Water Quality of Narragansett Bay

Professor DeLuise is primarily concerned with the water quality analyses. He is assisted by students Middleton and Keene and many others who have collected samples.

This study is being conducted to determine the present quality of the water at various locations in the Bay. The parameters which have been measured include dissolved oxygen, (D.O.), most probable number of coliform bacteria, (MPN), biochemical oxygen demand (B.O.D.), and temperature.

Twenty-one regular sampling stations were set up to cover the upper part of the Bay, that is from the Mount Hope Bridge on the east side and Wickford on the west side, north to Providence. These stations were chosen to coincide with stations used in a similar study which was conducted in 1959. The same stations were chosen because they do adequately cover this section of the Bay which has the highest pollution potential, and also some comparisons might be made with the water quality as determined in 1959. At each of the stations a "top" sample was collected 5 feet below the surface and a "bottom" sample was collected 5 feet above the bottom. A Foerst water sampler was used to obtain the samples. Sample runs began on July 30, 1970 and continued through November 6, 1970.

Varying tides and weather effects influence the samples which are collected and therefore a large number of samples are required at each station in order to obtain any meaningful results. For this reason, sample runs were made as often as possible during the sampling period. Twenty-five runs have been made and 661 samples collected.

The samples have been analyzed at the Sanitary Engineering Laboratory in Bliss Hall using procedures as specified in "Standard Methods for the Examination of Water and Wastewater," published by the American Public Health Association.

Analysis of the data thus far shows a wide variation in the stations as might be expected. The widest range in MPN values has occurred at station "C" where concentrations have varied between 1000 and 62,000 coliforms per 100 ml. In general, the "top" samples have much higher MPN values than "bottom" samples for the upper part of the Bay, that is, from Conimicut Point, north. South of this point, this effect is not as apparent, and at some of the lower stations (south of Conimicut Point) a reverse of this effect is observed. In moving from the Providence end of the Bay southward the coliform concentration decreases from several thousand per 100 ml. to practically zero per 100 ml. south of stations J, K, L, M (approximately a line from Warwick Light to Providence Point). Samples south of this line showed low counts occasionally and no count most of the time.

Not as wide a variation has been observed in the dissolved oxygen concentrations. For the most part, surface concentrations are greater than bottom concentrations throughout the Bay. Once again the effects of pollution can be seen at the Providence end of the Bay by the relatively low values of dissolved oxygen which exist. The analyses show a general increase in oxygen concentration in moving from Providence southward. The minimum concentration which was observed at any station was 1.1 mg/l.

A more complete analysis of the data is presently being made and hopefully this will allow some comparison of results with the 1959 survey as well as provide an indication of the present water quality.

3.6 Optical Studies

In pursuit of additional optical properties of the water column were Professor Schenck, assisted by student J. VanRyzin.

A variety of transmissometer and K-meter studies were conducted during the summer in locations ranging from off Wickford to six miles southeast of Block Island. These were made in conjunction with diver visibility enhancement experiments, supported under our Public Health Scuba Safety grant, and separately as opportunity arose during normal Sea Grant activities. The most striking finding during the period, and one we are preparing for publication in an appropriate periodical, was the sharp turbidity shift associated with the thermoline. In several days, when a five to six degree centigrade drop occurred in a five to ten foot depth range, the light transmission also dropped by as much as half. However, this region of maximum turbidity occurred in every case about five feet below the sharpest temperature change region. In two cases, divers went below to visually investigate this phenomenon. They described a "brown layer" clearly visible and below the start of the colder water such that the diver could actually look out over it as though he were peering down a brown cloud.

It is evident that this is particle separation by density. Further, when the transmissometer was lowered some ten feet below the top of the turbid layer, the water cleared and surface alpha values were again achieved in about ten more feet. The implications for pollution studies are, we believe, important. Sampling of water should be made, at least in areas where a sharp thermocline is observed, some ten feet under the region of maximum temperature decrease. A better plan is to make three samples in the water column, one well above the thermocline, one ten feet beneath it, and one twenty feet or more below that. It would be most interesting to know just what this brown layer consisted of and in what other ways besides temperature and turbidity this layer differed from the general surroundings.

### 3.7 Sediment Pollution Study of Narragansett Bay

Professors Nacci, Poon and Huston have completed a study which explores the relationship of sediments to analyses of pollution:

Nacci, V., Poon, C.P., and Huston, M., "Sediment Pollution Study of Narragansett Bay," Ocean Engineering Sea Grant Report Number 8, University of Rhode Island, 20 November 1970.

While pollutant concentration levels in estuarine waters usually define the ecological state of the system, for many reasons a knowledge of the concentration level in the sediments may be more revealing and important in establishing the quality of the estuary. Pollution levels in bay waters tend to respond to tidal, seasonal, temporal, etc. influences and must be sampled accordingly. In addition, the very low level of many pollutants often defy analyzation.

On the other hand, the residence time of pollutant material in bottom sediments is usually significantly longer and more stable than in the water column. The concentration factor is enhanced by deposition of solid wastes, particularly by flocculation; flocculation of organic clays, and silt, occurs when these particles are transported from fresh to salt water, and by feeding and burrowing benthic organisms capable of concentrating pollutants.

The role of sediments in a body of water has not been seriously considered in pollution survey works. The role of sediments varies with their composition, the amount of mixing with the water, and biological transformations which occur on the sediment-water interface. Sediments may only serve to support the water, or they may have a profound effect on the quality of that water which comes in contact with them. The interaction of all of these factors, and the sediments of the bay are considered in the report.

3.8 Shallow Water Sub-Bottom Profiling

A significant and successful field program of sub-bottom profiling was initiated by Professor Middleton. Included were students Fagot and Lackoff. An MS thesis by Martin Fagot has been completed:

Fagot, Martin G., "A High Resolution Sub-Bottom Profiling System for Shallow Water," Masters Thesis, University of Rhode Island, 1970.

The present system employs equipment suitable for operation in small boats and shallow water. In its least sophisticated use, the profiler can be operated as a sensitive fathometer for determining bottom topography over large areas. It may also be used in bio-population, detection, and counting, such as quahogs. Its most fruitful application is in sub-bottom profiling for exploring the sediment characteristics. Such data can be correlated with sampled core data and used for bottom-structural support designs or historical flow data (rate of deposit of silt). It is a link with the water column (which we are not quite ready to let go) which may be the only way of detecting and integrating over time, certain of the pollutants.

Details of the system, its operations and interfaces with other programs are reprinted in:

Middleton, Foster, and Fagot, Martin, "Shallow Water Sub-Bottom Profiling," Ocean Engineering Sea Grant Memorandum Number 9M, University of Rhode Island, September 1970.

### 3.9 Bay Watch Buoy Program

This program is under the direction of Professors Levine and Kowalski. They are assisted by students Smith and McKenna.

Investigation of the types of buoys available commercially for oceanographic data collection indicates that, in general, they are too sophisticated and too expensive for our purposes. In fact, most of them are over-rated by their vendors. In lieu of purchasing a commercial buoy system, it has been decided to construct a simple, inexpensive buoy system, designed expressly for shallow water work, which will monitor the two parameters which are of greatest importance to setting up and verifying the mathematical model of the Bay--current direction and velocity. Other variables such as temperature, salinity and dissolved oxygen will be measured on a not-to-interfere basis if they do not make the total system too expensive. Monitored data will be recorded on board the buoy, retrieved periodically by boat, and transported to shore for analysis. An r.f. link will be considered as an alternative.

The winter months will be devoted to refinement of the buoy system design, ordering of sensors, instrumentation, and hardware, and fabrication of the buoy. It is intended to implant the buoy (without sensors and instrumentation) to test the buoy and mooring system configuration and handling implantment techniques in mid-April, 1971. Implantation of the complete buoy system and commencement of data recording is scheduled for mid-May, 1971.

If costs can be limited as presently envisioned, and if buoy performance meets expectations, the buoy may well serve as a prototype for a series of subsequent buoys to be used for limited synoptic data collection in Narragansett Bay.

It should be emphasized that the design of our buoy is for flexibility of measurements within the bay, not for sophisticated commercial operations.

3.10 Meteorological Data - Millstone Point

Professor Shaw, assisted by student Levine, has not been successful receiving full cooperation from all agencies in the collection of existing data or establishing a station at Brenton Tower.

In order to support their efforts and illustrate the data significance, Professor Levine and student Huff are examining similar data from Millstone Point as described below.

Millstone Point in Waterford, Connecticut, is the location of a Northeast Utilities Atomic Power Plant which is to go into operation in the summer of 1971. The data is from a meteorological tower used by Travelers Research Assoc. to obtain environmental data for the site evaluation conducted by Northeast Utilities.

Data Summary

Temperature @ 12', 72', and 152'
Wind Speed @ 32' and 152'
Wind Direction @ 32' and 152'
Wind Direction Variability @ 32' and 152'
Precipitation
Water Temperature in the Niantic Bay Region @ -1', -3.5', and -6.0'

All values are 1 hour averages. Group A data is approximately 95% complete for 1 year at 24 samples per day. Group B is approximately 15% complete for 1 year at 24 samples per day. It is planned that analysis of the Millstone Point data, interpreted in the light of the historical data summaries for Naval Air Station, Quonset Point, Rhode Island, could represent a headstart for the Bay Watch Program.

The intial analysis will be conducted by L. Huff in a Special Problem Course, OE 691. This should include:

Group all data according to stability of air column.

For the neutral and stable cases use regression analysis, model the wind variability as a function of wind speed and direction.

If the direction effect is important, divide the data into those directions from land to sea and sea to land. Within each of these two groupings, evaluate the sensitivity to wind speed.

Model the Niantic Bay temperature profile based on tidal variations and three temperature points:

(a) Fixed depth 1 ft.
(b) 3.5 ft. depth at high tide.
(c) 6 ft. depth at high tide.

### 3.11 Future Plans

Data collection will continue in all phases as long as weather permits. It is likely that during January and February, the "Islander" will be docked for repairs.

There are no significant changes in our continuing programs in each of the areas described. The basic approach is one of having some effort in each of the "air column", "water column", and the "sediments column", aspects of Bay Environment, and exploring the resulting data for significant correlations.

Flow measurement techniques will still have the most significant priority. Water quality and sediment data will have secondary properties. The flow measurement techniques will continue to be developed, refined or discarded if found to be unsuccessful.

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