GPU Nuclear

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May 30, 1996

Dr. Jason Jang
U.S. Nuclear Regulatory Commission
Region I
475 Allendale Road
King of Prussia, PA 19406

Dear Dr. Jang:

Subject: Oyster Creek Nuclear Generating Station (OCNGS)
Docket 50-219
Fish Kill Monitoring Report, May 1996

In accordance with the reporting requirements of Sections 1.1.1 A and 3.5.2 of Appendix B, Environmental Technical Specifications, enclosed is a report of Fish Kill Monitoring at OCNGS.

If you have any questions or require any additional information, please contact Mr. Malcolm Browne of our Environmental Affairs Department at (609) 971-4124.

Very truly yours,

Michael B. Roche
Vice President & Director
Oyster Creek

MBR/MEB/jdr

Enclosure

cc: Director
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OC Nuclear Generating Station

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May 30, 1996

Mr. Harry Van Sciver
NJ Department of Environmental Protection
Central Bureau of Regional Enforcement
Division of Water Resources, Enforcement Element
State Highway 33
Hightstown, NJ 08520

Dear Mr. Van Sciver:

Subject: Oyster Creek Nuclear Generating Station (OCNGS)
NJPDES Discharge to Surface Water Permit NJ0005550
Fish Kill Monitoring Report, May 1996

The enclosed report entitled "Fish Kill Monitoring Report for May 1996" is being provided for your information.

If you have any questions or require any additional information, please contact Mr. Malcolm Browne of our Environmental Affairs Department at (609) 971-4124.

Very truly yours,

Michael B. Roche
Vice President & Director
Oyster Creek

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FISH KILL MONITORING REPORT
FOR MAY 1996

GPU Nuclear Corporation
Oyster Creek Nuclear Generating Station
Environmental Affairs Department
May 1996

Executive Summary

The dilution pumps of the Oyster Creek Nuclear Generating Station (OCNGS) were taken out of service for maintenance, in accordance with the conditions of the Station's NJPDES Discharge to Surface Water Permit, at 3:32 a.m. Monday, May 6, 1996, while OCNGS was operating at full power. Shortly thereafter, plant operators discovered that a vacuum-induced siphoning or backflow of water through the dilution pumps resulted in increasing water temperatures in the plant's intake and discharge canals. A faulty solenoid in the vacuum breaker valve designed to prevent such backflows appears to have been the cause of the problem.

As a result of the backflow, the water temperature in portions of the intake canal near the cooling water intake increased from approximately 64° F to nearly 71° F during the initial three hours following dilution pump shutdown. The main condenser cooling water discharge temperature also increased by 2.5°F, to 86.5° F, during this period. The combined effects of these events, and the probable exclusion of some fish from areas of preferred water temperature by schools of predatory fish prior to the dilution pump shutdown, resulted in a heat-shock fish kill. In order to document this event a fish sampling program was conducted by GPU Nuclear on May 6 and 7. The results of that monitoring effort indicated that 1600 fish representing four different species died, apparently due to heat shock.

Atlantic menhaden (n=1500) accounted for 93.8% of the mortalities, weakfish (n=66) for 4.1%, winter flounder (n=33) for 2.1%, and American eel (n=1) accounted for less than 0.1%.

In order to determine if any fish sank to the bottom subsequent to their death, bottom trawls were conducted at five locations between US Route 9 and the mouth of Oyster Creek. No additional dead fish were collected in any of these trawls. Live blueback herring and white perch as well as live invertebrates including blue crab, sand shrimp and grass shrimp, which appeared to have suffered no ill effects from the water temperature changes, were collected in trawls from Oyster Creek and adjacent residential lagoons.

In order to minimize the possibility of heat-shock mortality associated with future dilution pump outages, station personnel will verify that the vacuum breakers have operated subsequent to shutting the pumps off. This will provide an opportunity to manually operate the vacuum breakers should they not function automatically.

Introduction

This report documents the results of aquatic sampling conducted by GPU Nuclear (GPUN) Corporation following a thermal shock fish kill which occurred on May 6, 1996 in the discharge canal of Oyster Creek Nuclear Generating Station (OCNGS) subsequent to the planned shutdown of the dilution pumps for maintenance. The objectives of the sampling program were:

1) To determine the species composition, relative abundance and distribution of fishes in Oyster Creek which may have suffered thermal stress following the dilution pump shutdown, and

2) To quantify the extent of any fish mortalities.

The monitoring effort took place on May 6th and 7th, 1996.

OCNGS, which had operated continuously for the previous 4 days, was operating at full power with four circulating water and two dilution pumps in operation on May 6. A planned shutdown of the dilution pumps had been scheduled for the early morning on that day in order to perform routine maintenance on the pumps. The New Jersey Pollutant Discharge Elimination System (NJPDES) Discharge to Surface Water Permit for the OCNGS requires the operation of one or two dilution pumps when the intake water temperature is below 60°F

or when the discharge canal temperature, as measured at the U.S. Route 9 bridge, exceeds 87°F. The very short periods of time in the spring and fall when neither of these conditions prevail, are the only times when all dilution pumps can be shut off for preventive or corrective maintenance in accordance with the NJPDES permit conditions. Immediately prior to the shutdown of the dilution pumps at 0332 hrs on May 6th, the intake temperature was approximately 64° F and the discharge temperature was approximately 84° F (Figure 1). When the dilution pumps were shut off a vacuum breaker, designed to prevent the backwards flow of heated effluent through the dilution pumps during pump outages, failed to operate properly due to a faulty solenoid. The resulting backflow of warm water from the discharge canal into the intake canal caused a relatively rapid increase in water temperature in the intake canal (from 64°F to 71°F), and set up a pattern of recirculation which also increased the main condenser discharge temperature from 84°F to 86.5°F (Figure 1). When station personnel discovered the cause of the increasing intake water temperatures, they manually operated the vacuum breaker at approximately 0700 hrs, thereby stopping the backflow of warm water through the dilution pumps.

Dead and dying fish were first observed in the discharge canal by security personnel at approximately 1830 hrs on May 6. GPUN Environmental Affairs personnel were notified at 1845 hrs and began collecting the dead fish at approximately 1915 hrs.

Fish Kill Monitoring Activities -

Fish were collected by environmental scientists from the discharge canal using dipnets. Dead fish were gathered from a small boat and by personnel walking along the discharge canal streambanks, between the OCNGS discharge and the mouth of Oyster Creek. All fish were identified and enumerated; length ranges were obtained.

A total of 1600 dead fish, representing four species, was collected (Table 1). Nearly 94% of the total were Atlantic menhaden. Weakfish, winter flounder and American eel comprised 4.1%, 2.1% and less than 0.1% of the total, respectively.

The majority of the dead fish (greater than 90%) were found in the dilution pump discharge area and behind the two spill containment booms located approximately 150m downstream. The remainder of the fish were found along the banks of the discharge canal, primarily within about 300m of the U.S. Route 9 bridge. All of the dead fish were floating.

In order to determine if dead fish had accumulated on the bottom of the discharge canal and contiguous residential lagoons, bottom trawl samples were collected. Bottom trawls were conducted at each of three stations in the discharge canal and Barnegat Bay east of the Route 9 bridge, as well as within two of the

residential lagoons, during the afternoon of May 7
Trawling was done with a 4.8 m semiballoon otter trav
cm stretch mesh body, a 3.2 cm stretch mesh cod end
stretch mesh liner. All fish captured were id
enumerated, length ranges were obtained, and the sp
released.

All fish collected in the trawls were alive,
signs of thermal stress, and were immediately releas
were captured at Stations T3, T4, and T5 (Table 2).
captured at Station T1, but 30 blue crabs, 10 sand
grass shrimp were collected alive and released.
captured at Station T6 (between 100 and 400 m east of
one live blue crab was collected and released. Two
herring (<u>Alosa aestivalis</u>) approximately 110 mm fork
and two live white perch (<u>Morone americana</u>) approxima
were captured at Station T2 (the third residential l
Route 9).

Schools of fish, believed to be bluefish, str
Atlantic menhaden, were observed swimming normally in
discharge of the OCNGS during the evening of May
subsequent days. These fish were probably in the vi
condenser discharge flow at the time of the dilution
and therefore not exposed to the thermal shock.

Fishermen at the U.S. Route 9 bridge reported catches of bluefish and striped bass during the evening of May 6 and the morning of May 7.

Discussion and Conclusions

The evidence indicates that the fish mortality was caused by heat shock and that behavioral factors other than the response to water temperature probably played a role in causing the fish kill. The initial heat shock occurred when the dilution pumps were shut off and any fish in the dilution pump discharge area were exposed to water temperatures increasing from 64°F to 84°F. Smaller increases in water temperature were experienced in the mixing area between the condenser discharge and dilution discharge flows. The subsequent backflow of heated water through the dilution pumps and into the condenser intake flow exacerbated the situation, causing the discharge canal water temperature to increase another 2.5°F to a maximum of 86.5°F.

If temperature preference were the only factor controlling the movements of the Atlantic menhaden and weakfish in the discharge canal, these species should have avoided both the ambient temperature water (64°F) at the dilution pump discharge and the heated condenser discharge (84°F) prior to the cessation of dilution pumping. Temperature preference testing suggests that they should have preferred water temperatures of 77°F to 81°F which

would have been found in the mixing area between the dilution pump discharge and condenser discharge flows (Jersey Central Power & Light, 1978). If that were the case, heat shock experiments have shown (Tatham et al., 1978) that the increase in water temperature following the shutdown of the dilution pumps (approximately 6-10°F) should not have caused heat shock mortality. The additional heat shock of 2.5°F, caused by the backflow of heated water through the dilution pumps, would have been enough to cause mortality of weakfish which exhibit greater than 50% mortality when subjected to temperature increases greater than 12°F (Jersey Central Power & Light, 1978). Alternatively, the weakfish may have been excluded from their zone of preferred temperature by larger or more abundant predators, such as the bluefish and striped bass, forcing them to reside in the cooler dilution pump discharge flow (64°F). Shutting off the dilution pumps in that case would have subjected the weakfish to a 20°F increase in water temperature. That shock alone, without the additional heat from the backflow through the dilution pumps, would have been sufficient to cause weakfish mortality.

Heat shock experiments have shown that Atlantic menhaden exposed to an instantaneous 21.4°F increase in water temperature (from 57.2°F to 78.6°F) exhibited no mortality after 48 hours. Only 20 percent mortality was observed following a 27°F increase in water temperature from 57.2°F to 84.2°F. The LT_{50} for this species was determined to be 85.5°F at an acclimation temperature of 57.2°F

and 85.3°F at an acclimation temperature of 68°F (Tatham et al., 1978). These results indicate that if the Atlantic menhaden were occupying their preferred temperature zone prior to the dilution pump outage, the heat shock alone, including the 2.5°F increase in water temperature associated with the backflow through the dilution pumps, should not have caused any mortality. The backflow through the dilution pumps did cause the discharge canal temperature to rise above the LT_{50} for this species however, and this may have been enough to induce the observed mortalities. Similarly, if the Atlantic menhaden were excluded from their preferred temperature zone by the bluefish and striped bass, and forced to reside in the 64°F dilution pump discharge flow, the results of heat shock experiments indicate that most or all of these fish should have survived the 20°F increase in temperature to 84°F after the dilution pumps were shut off (Tatham et al., 1978). The additional increase in temperature associated with the backflow through the dilution pumps however, caused the discharge canal temperature to rise to 86.5°F, which is above the LT_{50} for this species, and a heat shock sufficient to cause the observed mortalities.

Temperature preference studies have shown that the winter flounder should have preferred the dilution pump discharge flow (64°F) and avoided warmer waters (Jersey Central Power & Light, 1978). Winter flounder exhibited 100 percent survival after 48 hours in heat shock experiments in which they were subjected to a 20°F increase in water temperature, from 59°F to 79°F. Complete

mortality was observed when this species was subjected to a 25°F increase in temperature from 59°F to 84°F (Tatham et al., 1978). These results suggest that winter flounder residing in the dilution pump discharge flow may have survived the dilution pump outage alone but the incremental shock associated with the backflow through the dilution pumps was sufficient to induce the observed mortality.

In order to minimize the possibility of heat-shock mortality associated with future dilution pump outages, station personnel will verify that the vacuum breakers have functioned properly subsequent to shutting the pumps off. This will provide a timely opportunity to manually operate the vacuum breakers should they not function automatically and prevent heated condenser discharge water from being recirculated into the cooling water intake.

References

Jersey Central Power and Light Company. 1978. Oyster Creek and Forked River Nuclear Generating Stations 316(a) and (b) Demonstration. Jersey Central Power and Light Company, Morristown, New Jersey.

Tatham, Thomas R., Donald J. Danila, David L. Thomas and Associates. 1978. Ecological Studies for the Oyster Creek Generating Station, Progress report for the period September 1976 - August 1977, volume one, fin- and shellfish. Ichthyological Associates, Inc., Ithaca, New York.

Table 1. Number and size of dead fish dipnetted from OCNGS discharge canal and Oyster Creek following May 6, 1996 fish kill.

SPECIES	NUMBER	PERCENT OF CATCH	LENGTH RANGE (mm)	MEAN LENGTH (mm)
Brevoortia tyrannus Atlantic menhaden	1500	93.8	260-296	276
Cynoscion regalis weakfish	66	4.1	272-494	372
Pseudopleuronectes americanus winter flounder	33	2.1	271-382	329
Anguilla rostrata American eel	1	<0.1	742	742
TOTAL	1600	100		

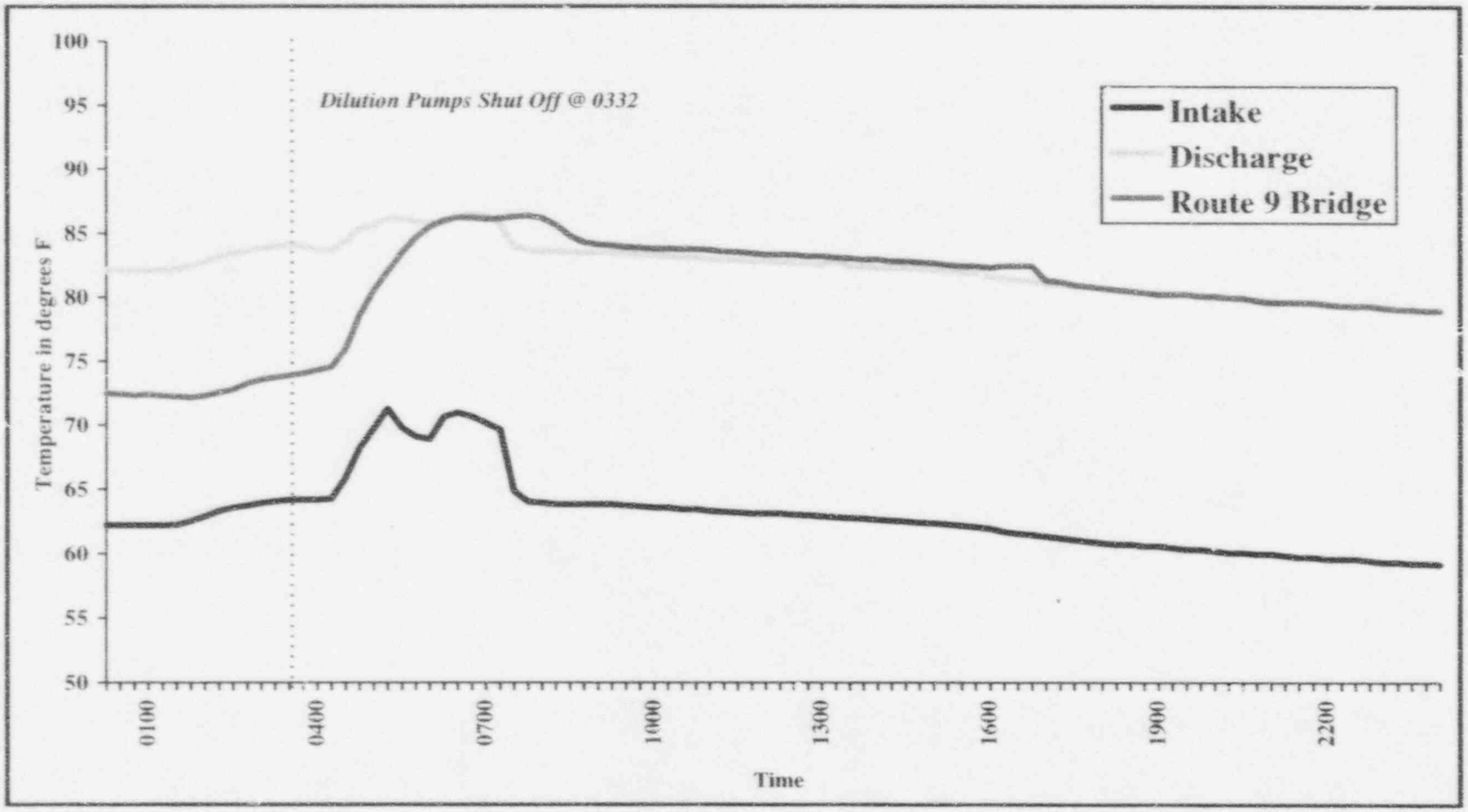
Table 2. Results of trawl sampling on May 7, 1996 following OCNGS fish kill. Numbers of individuals captured with typical lengths (millimeters in parentheses) indicated for each fish species.

STATION	START TIME	STOP TIME	Alosa aestivalis blueback herring	Morone americana white perch	Callinectes sapidus blue crab	Crangon septemspinosa sand shrimp	Palaemonetes pugio grass shrimp
T1	1455	1500	0	0	30	10	8
T2	1509	1512	2(96)	2(108)	0	0	0
T3	1524	1526	0	0	0	0	0
T4	1534	1540	0	0	0	0	0
T5	1548	1555	0	0	0	0	0
T6	1603	1608	0	0	1	0	0

NOTE: All fish and invertebrates were alive and exhibited no signs of stress when collected.

FIGURE 1

Oyster Creek Nuclear Generating Station
Quarter-Hour Canal Temperature Data
Fish Kill Event - 06May96



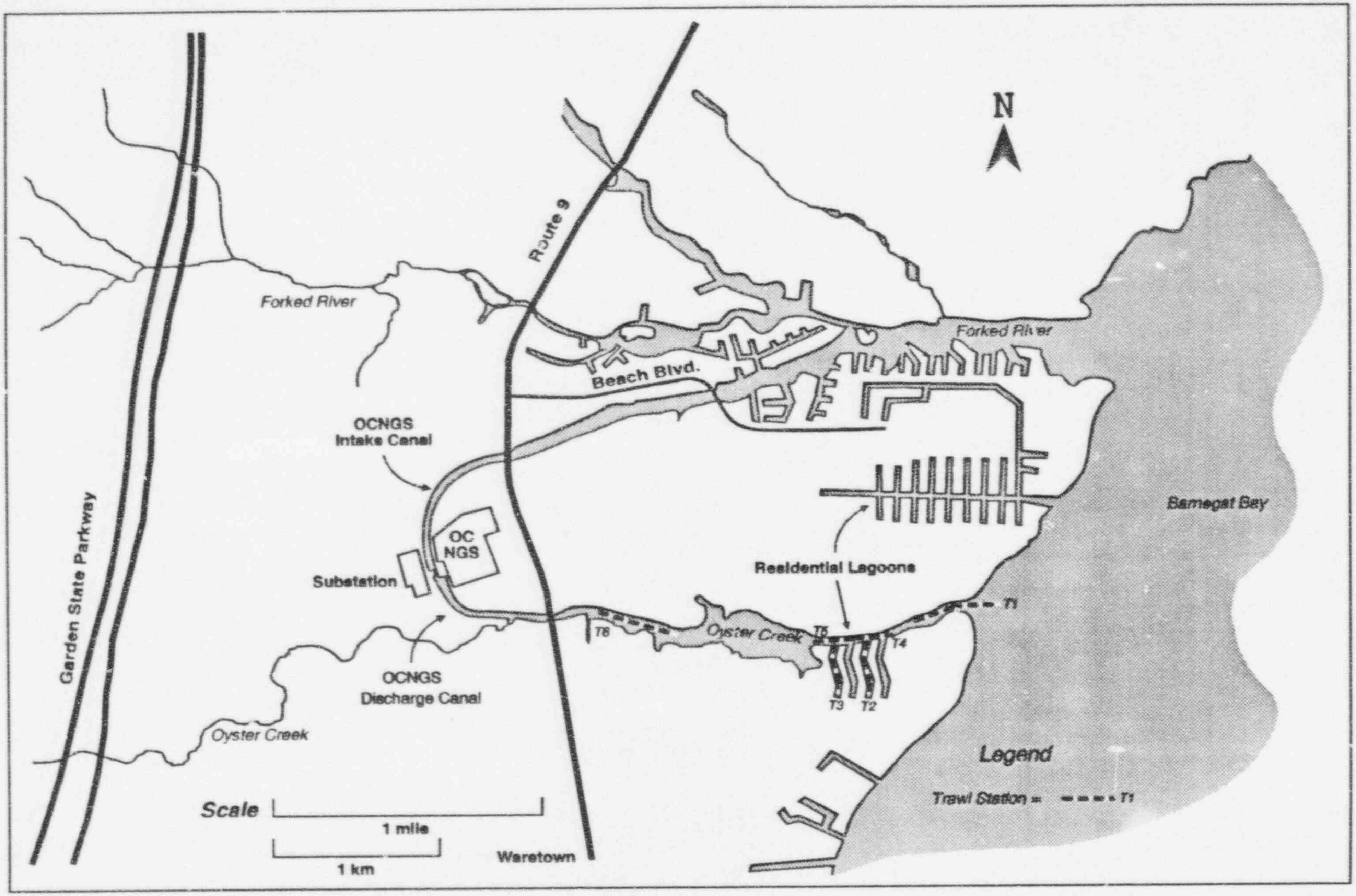


Figure 2. Location map of OCNGS and trawl stations.