Conference Proceedings

"The Great South Bay: An Outlook for the Future"

Dowling College, Oakdale, New York

April 15, 1985

Cosponsored by:

— NYS Department of State
Coastal Management Program

— Congressman Thomas J. Downey

Mario M. Cuomo
Governor

Gail S. Shaffer
Secretary of State

The Great South Bay:

An Outlook For the Future

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Opening Remarks Of

Congressman Thomas J. Downey

The Great South Bay: An Outlook for the Future

April 15, 1985

On behalf of Secretary Shaffer and myself, I want to thank you all for coming to this conference on the Future of the Great South Bay. Today we will be focusing on two pressing areas of concern - our hard clam fishery and the management approaches we need to examine in order to mitigate inevitable and significant storm damage to our area.

I have always believed that we are stewards of our environment. Our world holds an abundance of clean air, pure and bountiful waters and richly diverse land. While we may use and adapt our resources to improve the quality of our lives, we are only passing through here. Future generations will need the air, water and land just as much as we do. Yet, seeking protection for our environment, we must also strike a balance and insure that our own needs are met.

For hundreds of years, the Great South Bay has provided a way of life for the fisherman and clammers who peopled its shore. A short boatride out to the middle of the Bay put one in the midst of the world's greatest natural clam factory. In recent years, though, we have witnessed a precipitous decline in the abundance of clams in the Bay. Today, man-made phenomena pose a serious threat to the very well-being of the Bay.

As Long Island has been developed, the Bay has come to play another important role in the lives of Long Islanders. It provides natural protection against the Atlantic storms that threaten thousands of homes and businesses along the south shore. In spite of their vulnerability to severe and inevitable storm damage, pressure has grown to develop homes along the shore and on the outlying barrier islands.

Science has shown us, as we'll learn today from the people from SUNY's Marine Sciences Research Program and the Long Island Regional Planning Board, that man's activities on the mainland and on the water need to be carefully scrutinized for their impact on the Bay and its ecosystems. A balance must be struck in the use of resources that assures that our immediate needs are met in a way that won't degrade them for future use.

Today, we will explore recent scientific developments regarding hurricane protection and the hard clam fishery in the Great South Bay. Then a panel of local decisionmakers will discuss possible management strategies for the Bay. I am looking forward to an interesting day.

In conclusion, I want to thank the following individuals for their invaluable assistance in putting this conference together: Secretary of State Gail Shaffer, Jim Morton of the Department of State, Lee Koppelman and DeWitt Davies of the Long Island Regional Planning Board and Jerry Schubel of SUNY's Marine Sciences Research Center. I also want to thank all of the presenters and panelists for their input today.

Recent Advances in Our Understanding of Great South Bay Processes

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In the past decade the significant oceanographic processes of the Great South Bay have been studied intensively. A clearer picture has emerged of the biological, chemical, geological, and physical systems of the Bay, and how these systems interact. The following remarks elaborate on the reasons for this interest in Great South Bay, describe the research that has been undertaken, and generally summarize research findings in the areas of chemistry, geology, and water quality. The current state of knowledge regarding the biota of the Bay, particularly the hard clam, and the physical movement of Bay waters is described elsewhere in this volume.

Recent programs of research and monitoring on Great South Bay have as one wellspring the environmental movement of the 1960's. In that decade, American society paused to reconsider it's single-minded pursuit of material acquisition and unfettered economic growth--a pursuit born of technological developments inspired by the War, the post-war population boom, and a heady faith in the ability of man to control himself, his environment, and ultimately his future. By the 60's the negative, and in some cases disasterous, impacts of this attitude on the natural environment were evident. As part of the New York Metropolitan Area, Long Island experienced the rush of post-war development and attendant environmental woes as fully as any section of the country. The coastal location of Long Island dictated that many of the impacts of

uncontrolled societal growth would be felt by the region's marine resources.

The environmental movement was responsible for a significant and durable restructuring of US social values whereby "quality-of-life" concerns, particularly those associated with the natural environment, came to be accorded much more weight in social decision-making.

Concomittant with and related to the environmental movement, the US in the 1960's turned serious attention to the marine environment as a resource of relatively untapped potential to meet the food, mineral, energy, and recreation demands of society. The mass appeal of Jacques Cousteau in popularizing the oceans and controversial marine issues such as that over international whaling created broad public interest in the marine environment. As the same time several sober an deliberative assessments of US ocean resource potential were prepared, in particular that by the Commission on Marine Science, Engineering, and Resource (the so-called Stratton Commission) in 1969. Several of the Stratton Commission's recommendations significantly shaped the subsequent growth of the federal and university oceanic establishment, including the call for creation of a National Oceanic and Atmospheric Agency to coordinate federal ocean programs and a greater emphasis on coastal oceanographic resources in contrast to open ocean studies.

The environmental and oceanographic movements of the 1960's and early 1970's spurred passage of a variety of laws aimed at improving understanding and protection of marine resources and establishing federal and state programs to administer this heightened national sense of environmental stewardship. At the federal level, these included the Environmental Protection Agency (1970), the President's Council on Environmental Quality (1969), and the National Oceanic and Atmospheric

Administration (1971). In New York, the Department of Environmental Conservation's Bureau of Marine Fisheries was elevated to the Division of Coastal & Marine Resources (now Marine Resources) in the late 1960's. The Regional Marine Resources Council was created as a subcommittee of the then-Nassau/Suffolk Regional Planning Board in 1967, while SUNY at Stony Brook's Marine Sciences Research Center appointed its first faculty members in 1968. The New York Sea Grant Institute was founded by SUNY and Cornell University in 1971.

Thus, by the early 1970's a variety of programs were established in New York to investigate the marine resources of the state. In readily quantifiable terms, the commercial hard clam fishery of Great South Bay was then the most valuable of New York's marine resources, annually employing thousands of full- and part-time baymen and constituting a significant percentage of the total landed value of commercial fisheries in New York. In developing programs, these institutions and agencies devoted substantial resources to the study of the Bay. Table 1 summarizes these agencies and their major research activities on the Bay during this period. After more than a decade of work, the fruits of these investigations are now with us.

What do we now know about the Great South Bay in the areas of nutrient cycling, geological processes, and quality of the Bay's water as a result of the work adumbrated in Table 1? The major components of the nutrient cycle of the Bay have been identified and described, including the sources, sinks, and pathways by which inorganic nutrients circulate between the biota, water, and sediments of the Bay. The primary productivity of the Bay has been determined to rank among the highest yet measured in coastal waters. Phytoplankton account for about 85% of this productivity, which peaks in the summer months when clam metabolism is high

and requires abundant food. The average concentrations of the primary nutrients in Bay water (urea, ammonium, and nitrate) have been determined. The species composition of phytoplankton assemblages have been described and how this changes seasonally. Studies show that rapid benthic remineralization provides a continuous supply of nutrients to overlying Bay waters, indicating that the depth of light penetration and not sufficient nutrients limits the abundance of phytoplankton in the Bay. The rate at which Bay phytoplankton take up dissolved nutrients have been determined, as has the relative preference of phytoplankton for various chemical forms of nitrogen. Nearing completion is a predicative model that will provide information to Bay managers on the probable impact on phytoplankton stocks from a perturbation in one of the components of the nutrient cycle, e.g. a decline in inputs of nitrogen. The nutrient cycle plays an important role in affecting the type of phytoplankton present in the Bay, which can influence clam nutrition. Hard clams do not feed equally well on all species of phytoplankton.

The distribution and textural characterization of the surficial sediments of Great South Bay are known and have been mapped. The concentrations of various heavy metals in the fine-grained sediments of the Bay have been quantified; only lead and copper appear to be significantly enriched over what naturally existed in Bay sediments prior to the industrial revolution. Studies also indicate that atmospheric deposition is the pathway by which most metals enter the Bay with fluvial inputs from the northern fringes minimal. This will make control of these metal inputs difficult. Recent work has indicated that, with the possible exception of copper, clams do not seem to take up heavy metals from surrounding sediments.

We now have a good understanding of the concentrations and distributions of various physical and chemical parameters that define water quality in Great South Bay. Point and non-point sources of pollutants to the Bay are well described and rudimentary knowledge exists of how pollutants are transported within the Bay. The importance of storm-water runoff as a source of bacterial and viral pollution to Bay has been demonstrated. Extant data on the incidence and concentrations of coliform bacteria in the Bay have been computerized and analyzed. The influence of storm events on coliform levels in the Bay have been quantitatively demonstrated and this knowledge used in decisions regarding the opening of parts of the Bay to shellfishing.

Much of the above information, along with that dealing with the biological and hydrodynamic processes in the Bay, has been developed to improve management of the Bay's hard clam resource. We are now in a much better position to provide clam management programs with a firm, scientifically-defensible foundation that was the case 10 years ago. However, there remain significant gaps in our understanding of the Bay and its hard clam fishery that need to be filled if future hard clam management is to rest on a technical foundation that is firm and comprehensive. These include:

* distribution/incidence of pathogenic viruses & bacteria in Bay waters & shellfish

* critical factors governing hard clam larval settlement & recruitment

* accurate socio-economic information on shellfish harvestors

Table 1. Research/Monitoring Activities on Great South Bay

US Environmental Protection Agency

Flow Augmentation Needs Study associated with Southwest Sewer District

project (hydrodynamic modelling, benthic survey)

NYS Department of Environmental Conservation

bacteriological survey of shellfish growing waters

periodic shellfish stock assessment surveys

Long Island Regional Planning Board

Long Island Comprehensive Waste Treatment Management Plan

National Urban Runoff Program

mapping of surficial sediments/eelgrass distribution

preliminary study of groundwater inflow to Bay.

dye studies of circulatory processes

Suffolk County Department of Health Services

periodic water quality monitoring

Towns of Babylon, Islip, Brookhaven

increased emphasis on evaluation of traditional and innovative hard clam management practices.

stock assessment by Town of Islip

spawner transplant assessment by Town of Brookhaven

New York Sea Grant Institute

a wide variety of research activities supported, many conducted as part of the Great South Bay Study

Marine Sciences Research Center

conducted numerous studies of Great South Bay with support from Sea Grant, LIRPB, and other sources.

A Synopsis of Important Advances in Our Understanding of the Biology of Hard Clams

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Although the hard clam (Mercenaria mercenaria) has long been New York's most important shellfish resource, prior to 1978 there has been relatively little research effort directed at the biology of this species in local waters. With support from the New York Sea Grant Institute, supplemented with funding from N.S.F. and from local sources, a research program was initiated at the Marine Sciences Research Center of SUNY Stony Brook to address important biological questions concerning a variety of aspects of the life cycle of the hard clam. An important aspect of this research program is that it involves cooperation and participation of a number of groups and agencies, including but not limited to the towns of Babylon, Islip, Brookhaven, and East Hampton, the N.Y. State Department of Environmental Conservation, the Long Island Regional Planning Board, Bluepoints Co., Inc., and the Shinnecock Indians. The research can generally be divided into three major areas: (1) studies of reproduction, (2) studies of predation, and (3) studies of growth. The following is a very brief summary of some of the major findings of that research.

A traditional and important management practice in Great South Bay involved the movement of mature and unspawned hard clams from colder waters (Long Island Sound or Cape Cod) into the bay after the native clams had spawned. It was hoped that the transplanted clams would then

spawn, introducing larvae into the bay at a time when they would not otherwise be present. In the months that followed, most of the transplanted clams were probably harvested along with native clams. It is important to keep in mind that "spawner transplants" are conceptually different from "spawner sanctuaries" (in which the transplanted clams are protected from Harvest) and "relays" (involving movement of clams for public health purposes).

Timing is the critical component of a spawner transplant, yet the timing of spawning by hard clams in Great South Bay had never been determined. Consequently, in cooperation with Jeff Kassner of the Town of Brookhaven, a two year study was conducted using histological techniques to determine the time of maturation and spawning of hard clams from a number of sites in the bay. The results showed that the time of spawning varied considerably from one year to the next, and, because not all of the clams spawn at once, at least some of the native clams are likely to be spawning at the same time as the transplanted clams.

The one inch minimum legal size (thickness) was established for the hard clam fishery on the basis of marketing considerations and estimates of the "size at first spawning" of hard clams. The size estimates used came from work done in the 1930's and were based on histological determination of the presence or absence of eggs or sperm in young clam, not by actually spawning the animals in the laboratory. A study of age-specific fecundity conducted by V. Monica Bricelj of MSRC showed that, although "seed" clams and small "littlenecks" contain eggs, their fecundity is very low compared to larger clams. The work also showed that the older chowder clams are extremely fecund, show no signs of reproductive senescence, and may in the long run be more valuable to the baymen if left unharvested.

A series of studies, conducted in the field and laboratory over a period of several years, investigated the survival of small (1-25mm) hard clams, with emphasis on the importance of predation in determining the survival of both naturally produced and planted seed clams. The work showed that small crabs are the most serious predators of small clams. Small mud crabs, for example, are extremely abundant in some locations, and each crab is capable of consuming over 100 young clams a day. The studies also showed that clams can reach a "size refuge" of 15-25mm, at which they are immune from predation by the most abundant predators. On the other had, predation by much less numerous predators such as moon snails, whelks, and starfish, continues even among the larger adult clams.

Seed clam planting trials conducted at a number of sites on Long Island demonstrated that the survival of small seed (3 - 5mm)is very low, often 0 - 10%. Large seed (15 -25mm) has a much higher probability of survival, as high as 85% at some sites. However, where large crabs or other predators were exceptionally numerous, even the large seed suffered high mortality rates. In general the work showed that the survival of planted seed is difficult to predict, because it is site-specific and dependent on the number and types of predators either already present at the site or later attracted to the site by artificially high densities of small clams.

Studies of growth of hard clams are still in progress. A part of the work, completed in 1983, showed that hard clams can consume the tiny "small form" algae that tend to dominate the phytoplankton is some areas of the bay, but they are incapable of digesting it. Consequently, clam growth rate will be reduced when this type of algae is abundant. These small form algae are associated with organic pollution, particularly duck farms. They were known to be poor food for oysters, but until this study was conducted their affect on clam growth was not known.

Determining the effect of resuspended bottom sediment on hard clam growth has been an important part of the growth studies. Other researchers have shown that some species of bivalves (mussels, surf clams, and oysters) actually benefit from the presence of low to moderate densities (about 10 - 25 mg per liter) of resuspended sediment. Laboratory studies of hard clams conduct by Dr Bricelj of MSRC showed no growth enhancement from silt and an 16% growth reduction among hard clams exposed to sediment concentrations (about 40mg per litter) that would not affect other bivalve species. In other words, hard clams appear to be relatively intolerant of resuspended sediment. Their growth, and ultimately their survival, is negatively affected by moderate to high concentrations of this material.

Field trials, under the direction of Dr. Glenn Lopez of MSRC, are now in progress to determine the growth of clams (and other species) suspended at various distances from the sea floor in Long Island Sound. Because resuspended sediment is concentrated near the sea floor, the animals are subjected to lower sediment loads as the distance from the bottom increases. Preliminary results verify our laboratory studies and show that, of the species tested, hard clams are among the least tolerant of resuspended sediment.

It is not possible to provide a detailed account of the results of such a large research program in so brief a summary. Although some of our findings have not been presented here, it is hoped that the scope and the tone of the work is clear: we have applied quality science to the investigation of important biological questions that relate directly to problems of management, and we have done so with the participation of agencies and individuals directly involved in managing the fishery.

Salinity Increases In Great South Bay:, Real or Imagined?

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It apparently has been accepted as fact that over the past 15 years salinities in Great South Bay (GSB) have significantly increased (U.S. EPA Draft Report, November 1982; EPA, 1978). This conclusion was also reached by Hollman and Thatcher (1979) who analyzed the available historical salinity data for GSB between 1933 and 1977 and ascribed it to a step-wise increase in salinity between 1960 and 1965. I recently reconsidered the matter taking into account more recent salinity data collected between 1978 and 1984 after sorting all the data according to nearshore and midbay.

It is important to understand that at any given time the salinity in GSB will vary from oceanic in Fire Island Inlet to fresh in the tributary rivers. What we are concerned with here is the trend or change over a long time in the quantity, S_T, the total salt content of GSB in mass of salt. S_T will vary, of course, from day to day, week to week, month to month, and year to year.

There are three possible causes of an upward trend in S_T[1]. There must either be an increased exchange of GSB with the ocean through Fire Island Inlet and Jones Inlet via South Oyster Bay, or significant increase in the exchange of Moriches Bay with the ocean through Moriches Inlet, or decrease in the inputs of fresh water to GSB, i.e., precipitation, streamflow, ground water influx, or some combination of all.

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[1] Other potential factors such as road salt and decreased submarine outflow due to magothy pumpage have been shown to be insignificant (SCDEC 1978)

Trends in S_T can be inferred by examining the evidence for the forgoing causes by the examining the available salinity records.

The Case for Salinity Increase

The evidence for a salinity increase is partly direct and partly indirect. The only direct evidence of a salinity increase, i.e., salinity measurements, is shown on Figure 1. On Figure 1 are plotted most, if not all, archived salinity measurements that have been made at or near the original Woods Hole Oceanographic Institution (WHOI) stations 3 & 4 since 1959. Stations 3 & 4 were occupied by WHOI during 1954, 1956, 1957, 1958 and 1959. They are located midway between Fire Island and the southshore of LI just south of Nicoll Bay. The difference in the means, 2.48°/oo, for the period 1954-1961 (24.11°/oo) and the period 1967-1982 (26.59°/oo) is highly significant according to standard statistical tests. Although the data for the years 1967-82 are more numerous (186 observations versus 25), a difference in means of at least 1.6°/oo is highly probable; the data reflects a real increase in salinity between these two periods.

Support for this conclusion can be found in the indirect evidence which consists of the well documented fact that the mean tidal range[2] at West Sayville rose from 0.664 feet to greater than 0.9 feet between 1963 and 1967 (Hollman and Thatcher, 1979). During September 1980, the measured tidal range[3] at West Islip was 28.41 cm (0.93 feet) and 28.84 cm (0.95 feet) at Sailors Haven on Fire Island just across the bay from West Sayville. 0.95 feet is considered to be the correct order of magnitude of the present mean midbay tidal range. From the increase in mean salinity of 2.48°/oo I have made a very simple fist order estimate of the required increase in tidal range. My calculation show that an increase

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[2] Includes both astronomical and meterological tides.

[3] By MSRC, SUNY, Stony Brook

in tidal range from 0.664 feet to 0.95 feet is insufficient to account for an increase in salinity of 2.48°/oo--an increase to 1.13 feet would be required. The measured increase in tidal range is sufficient to account for a salinity increase of 1.6 to 1.8°/oo.

An additional reason for a salinity increase can be found in the precipitation record for the period 1951-1982 for JFK International Airport, New York, NY (National Climatic Data Center, NOAA). Using these precipitation data, we calculated a 5 year running average so as to filter out variations with shorter periods and plotted these averages on Fig. 2. Each data point on Fig. 2 represents the difference between the running average for the previous 5 years and the mean precipitation in inches for the 32 year period between 1951 and 1982. Positive values represent "wet" periods and negative values "drought" periods. It can be seen from Fig. 2 that the period 1964-1974 was an extremely dry period and undoubtedly exacerbated any salinity increase due to increased tidal exchanged.

The Case against a Salinity Increase

The direct evidence for a salinity increase was contained in the difference between the means for two sets of data, one set taken between 1954 and 1961 by WHOI (Guillard, et al. 1960; Ryther, et al. 1958; Ryther, et al. 1957; Ryther et al. 1956; Bumpus et al. 1954) and Saville (1961) during summer months and consisting of only 25 observations and the other taken between 1967 and 1982 by four different agencies and consisting of 186 observations (see Figure 3). Some of the data points on Fig. 1 (which have been assumed to represent June-September averages) are based on a few as 2 observations; the most observations in a single data point are 13. The case for a salinity increase depends critically on the significance of our estimates of the various means with respect to the true

mean values. A determination of the required record length of daily observations of salinity so that a significant estimate of the true mean value obtained is beyond the scope of this paper.

It is clear, however, that the record length must be significantly longer than the time scales of the processes which produce variance in the record. I consider a record length of at least a month of daily observations would be required to average out the periodic causes; observations form June through September would be even better. The data available to us and plotted on Fig. I obviously fall far short of meeting this criterion and must be recognized for what they are -- poor estimates of the true June-September mean values.

The June through September averages for period 5 measured at the Blue Pt.s Co. hatchery (Fig. 3), however, are based on daily values and, except for 1984, include an average of 83% of the days in the 122 day observation period. They should, therefore, be reasonable estimates of the true mean summertime salinities for the years 1973-1984. According to Hollman and Thatcher (1979), the average salinities for periods 1 and 3 on Fig. 2 are annual averages of daily values measured throughout the year. As near as can be determined, the observations were distributed more or less equally throughout the year since that is current practice.

It is clear from Fig. 3 that there is no discernable trend for the years 1940-1984; statistically the difference in the means for the 3 periods is not significant even at the 10% level. This, together with the absence of a trend in the post 1967 salinity data on Fig. 1, and the fact that tidal ranges have not significantly changed since 1967, indicate that all of the evidence we have is consistent with the hypothesis that salinities in GSB are not now increasing and have not since the mid-1960's.

What About the Future?

The available records show (Figs. 1 and 3) that there is considerable annual variance in the average summertime (June-September) hatchery and midbay salinities. Much of the variance in the hatchery record can be explained by fluctuations in Connetquot River stream flows but midbay salinities appear to be more dependent on other causes, such as inlet bathymetry, both Moriches and Fire Island, and baywide stream flows through precipitation. As a result, a minimum of 5 to 10 years of daily observations between 1 June and 30 September would be required to detect a trend in the record. If such a data set could be taken each summer and maintained at, say, 3 to 4 midepth locations in GSB, salinity trends could be satisfactorily documented, albeit after the fact. Logical agencies to carry out this monitoring effort are agencies of the County, the 3 towns and the Blue Points Co. As noted earlier, the Blue Points Company presently makes daily salinity measurements at the hatchery. They should be encouraged to continue this series and, if possible, take concurrent measurements of salinity at a midbay location during the summer months. A station midbay in Blue Points Co. waters is a key station since it is located in an area where the salinity closely approximates the mean salinity of GSB.

Other useful indirect evidence of salinity trends can sometimes be found in records of precipitation (NOAA), stream flows (USGS) tidal range (Suffolk County DPW), and inlet dredging (USACE). These data should be collected annually and studied for changes and/or trends so as to provide advance warning of corresponding salinity changes.

Managers of the hard clam resource in GSB must decide the importance of salinity levels in GSB, either real or perceived, and if important, undertake a monitoring program, such as that described above,

which is properly designed to provide the information necessary to answer the question. The present system of each town occasionally sampling throughout its waters is an inappropriate application of resources if the intent is to detect trends.

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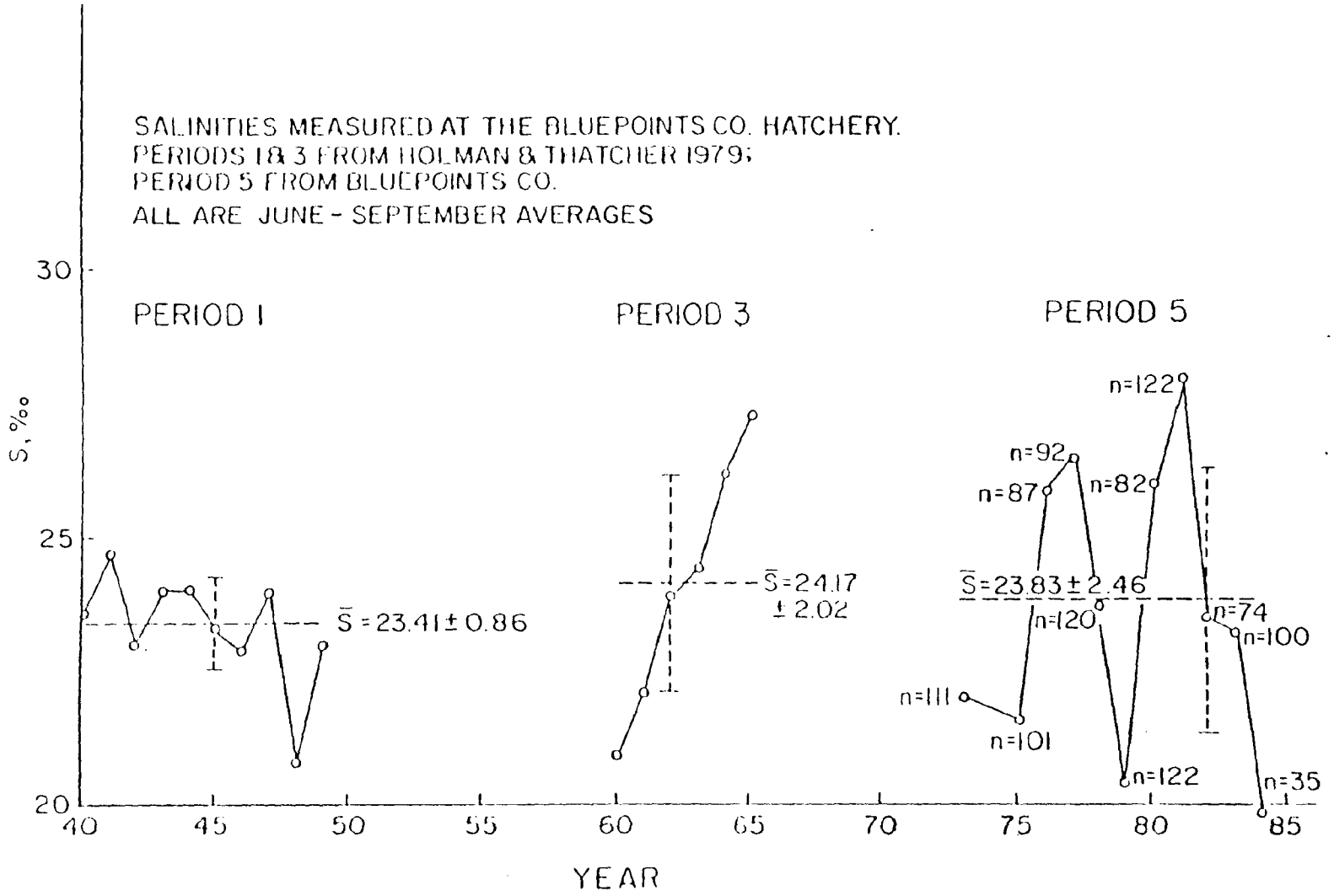
SALINITIES MEASURED AT THE BLUEPOINTS CO. HATCHERY.
PERIODS 1 & 3 FROM HOLMAN & THATCHER 1979;
PERIOD 5 FROM BLUEPOINTS CO.
ALL ARE JUNE - SEPTEMBER AVERAGES
PERIOD 1
PERIOD 3
PERIOD 5
S, ‰
30
25
20
$\bar{S}$ = 23.41 ± 0.86
$\bar{S}$ = 24.17
± 2.02
$\bar{S}$ = 23.83 ± 2.46
n=122
n=92
n=87
n=82
n=120
n=74
n=100
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55
60
65
70
75
80
85
YEAR

Figure 3.

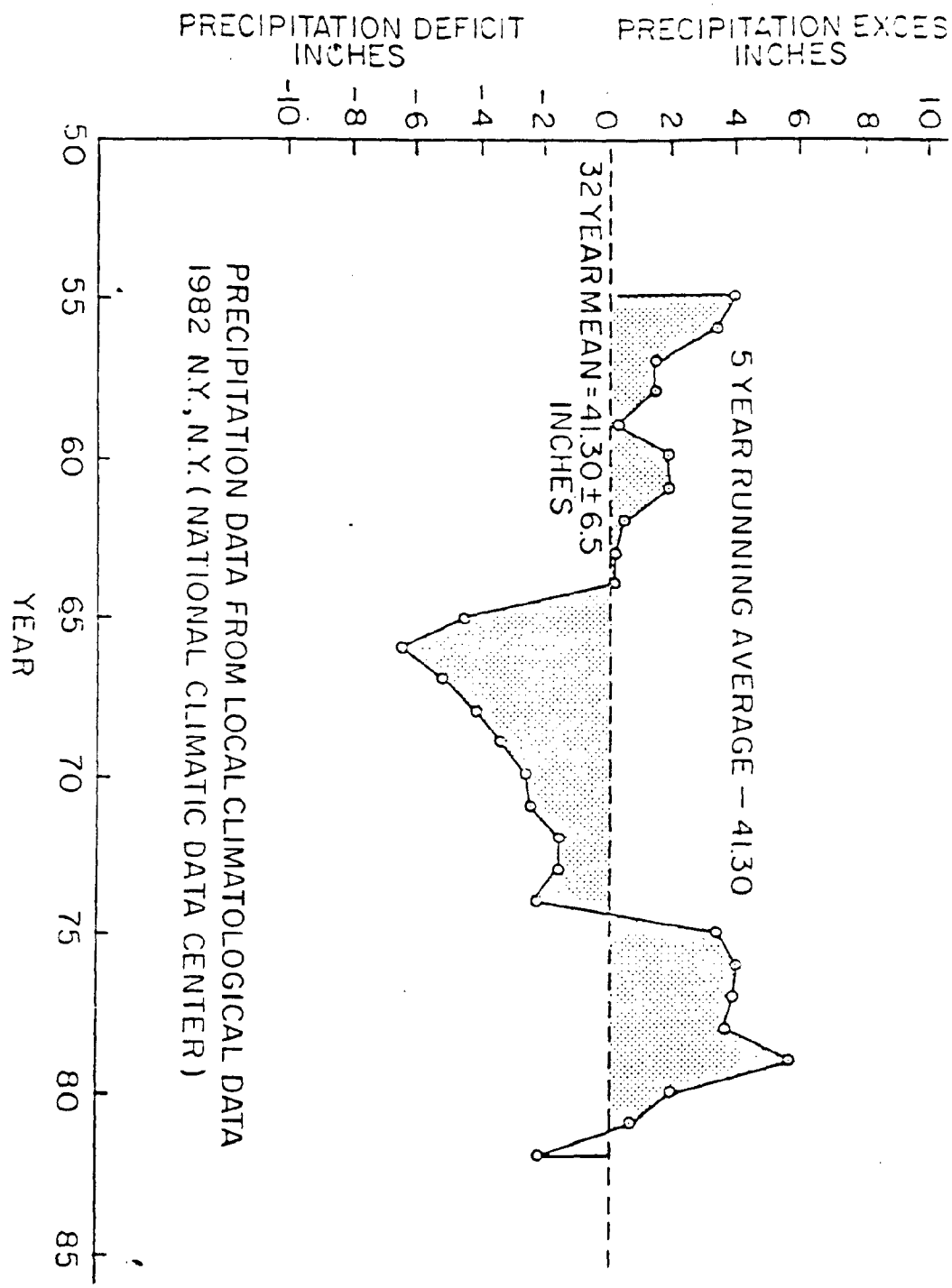
PRECIPITATION DEFICIT
INCHES
PRECIPITATION EXCESS
INCHES
10
8
6
4
2
0
-2
-4
-6
-8
-10
32 YEAR MEAN = 41.30 ± 6.5
INCHES
5 YEAR RUNNING AVERAGE — 41.30
PRECIPITATION DATA FROM LOCAL CLIMATOLOGICAL DATA
1982 N.Y., N.Y. (NATIONAL CLIMATIC DATA CENTER)
50
55
60
65
70
75
80
85
YEAR

Figure 2.

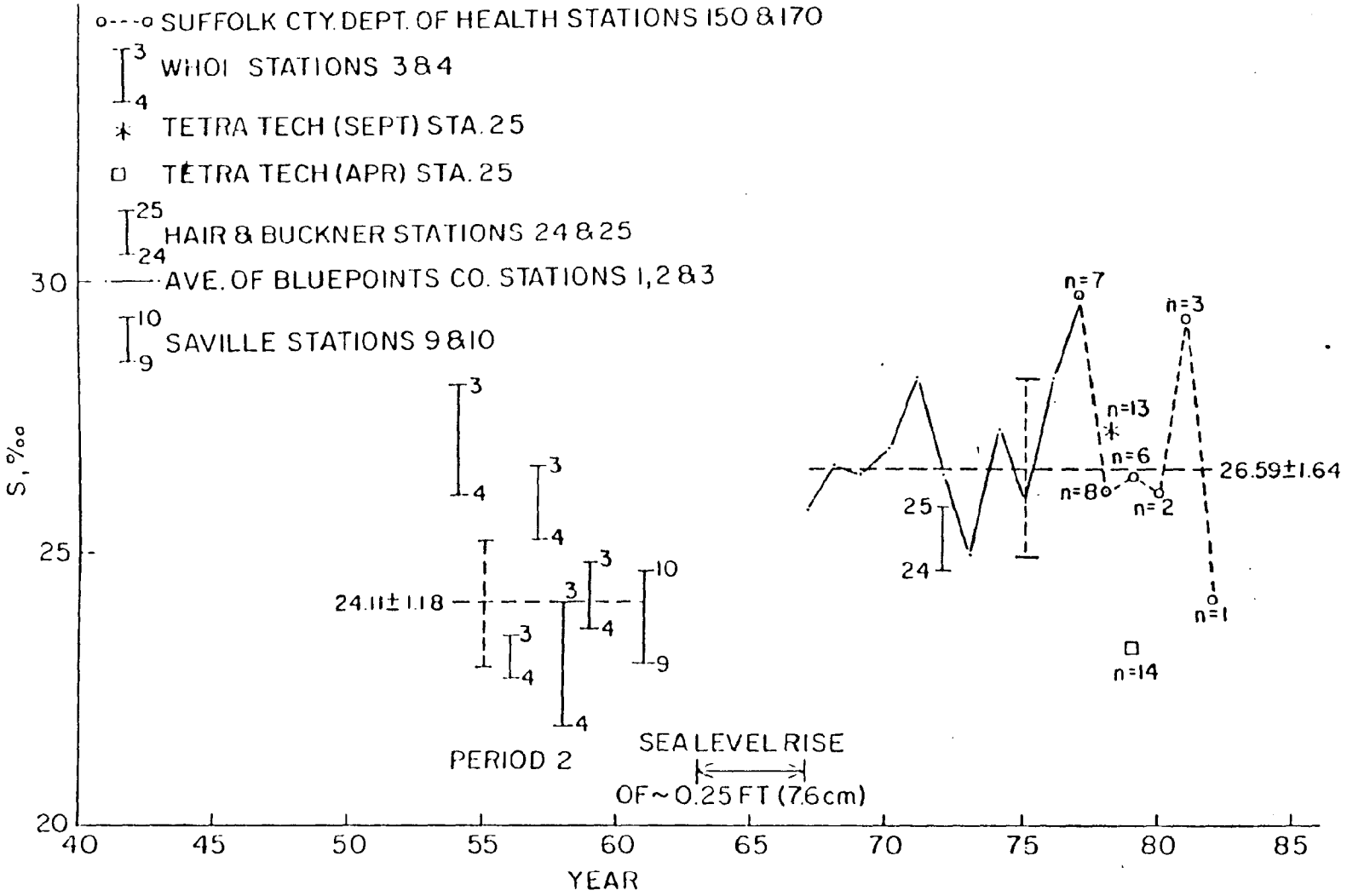

Figure 1. Midbay salinities between 1954 and 1983.

Circulation & Exchange Processes In Great South Bay

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Until recently, it was generally supposed that the current in GSB were primarily tidal by which is meant currents generated by the attraction of the moon and sun. The direct effect of the wind acting on the surface of GSB was also considered important since GSB has a large surface area to volume ratio. As a result of a 2-year study of the circulation of GSB by MSRC between 1979 and 1981, we have had to modify our perception of how the system works considerably, however. It is now clear that there are really three modes of circulation in GSB at any given time and place which add or subtract in various proportions to produce the flows one observes. In addition to tidal currents with periods of one-half day and currents due to the direct effect of the wind on the surface of GSB, previously mentioned, there is a third mode which is more important than both, at least as far as exchange between GSB and the ocean. Exchange processes are important to the distribution of salinity in GSB as well as to sending hard calm larvae to their doom in the coastal ocean south of Long Island.

Since most persons in this audience are well acquainted with tides and tidal currents, I will confine my remarks concerning tides in GSB to a few general observation. High water occurs throughout much of GSB about 3.5 hours after high water at the Fire Is. CG Station. That is, when it is high water at Fire Is. CG Sta., it is mid tide and rising in the

interior. There is evidence that the tidal range in the interior increased about 9 cm between 1963 and 1967; it has remained constant since 1967. The situation with respect to tidal velocities is as follows. At the F.I. CG Station, maximum tidal velocities are 70cm/s (1.4 kts) and reduce to 5 to 15 cm/s in the interior. Maximum flood current occurs at the F.I. CG Station at the same time as maximum ebb occurs in Narrow Bay between GSB and Moriches Bay. The phasing is quite complicated in between, especially in the eastern part of GSB.

Recent research has shown the importance of another mechanism in producing coastal sea level fluctuations which then propagate into coastal bays and estuaries much like tidal waves but at much longer periods. It turns out that weather systems moving from west to east at periods of 4 to 10 days produce strong wind stresses parallel to the coast between Cape Hatteras and Cape Cod. Such winds transport water either toward or away from the coast causing coastal sea level to rise or fall accordingly. GSB's orientation and shape are ideal for this process to be important since its major axis is the same as the along shore direction, i.e., 250-070°T and since it communicates directly with the ocean through Fire Island Inlet and indirectly through Moriches Inlet via Narrow Bay and Jones Inlet through South Oyster Bay.

Figures 1 and 2 show conceptually how this works. Fig. 1 shows a low pressure system located to the south of L.I. This produces easterly winds along the coast, causing water to be transported toward the south shore of LI, raising sea level all along the coast. In addition to the effect of wind stress on coastal sea level, sea level tends to stand somewhat higher under low atmospheric pressure which adds to the effect of the wind. This is know as the inverted barometer effect. For each mb of pressure decrease/increase there is an increase/decrease in sea level of 1

cm. Fig. 1 illustrates schematically the following points:

i) An easterly wind transports water toward the coast which produces a rise in coastal sea level which in turn produces inflow at F.I. Inlet and Narrow Bay, i.e. GSB fills from both ends,

ii) Due to the proximity of Fire Island Inlet to western GSB, i.e. Babylon, inflow at F.I. Inlet produces outflow under Robert Moses Causeway which is mitigated by the effect of inflow through Jones Inlet to the west,

iii) These flows produce a convergence in easter GSB near Sayville/Cherry Grove and a divergence near Bayshore, and finally

iv) Locally, the easterly winds tend to reinforce the effect of the farfield winds or currents in eastern and western GSB and reduce their effect in the central portions. Eventually they build up a slope of the sea surface from east to west which ultimately acts to oppose the effect of local wind.

Fig. 2 illustrates the condition when low pressure lies to the north of Long Island and high pressure to the south. This figure illustrates the following points:

i) Westerly winds south of L.I. transport water away from the coast producing a fall in coastal sea level which in turn produces outflow at F.I. Inlet and Narrow Bay, i.e. GSB empties from both ends,

ii) Again what is happening at F.I. Inlet has a greater influence on Babylon waters than the drop in sea level at Jones Inlet; inflow under Robert Moses Causeway results,

iii) A divergence now is present at the Sayville/Cherry Grove section and a convergence at Bayshore, and finally

iv) Locally, the winds again provide reinforcement in eastern and western parts of GSB and reduction in the central portion.

If a slope in sea level is built up to the east, it ultimately acts to oppose the direct effect of the wind.

There are, at least, four important conclusions that can be drawn from the above scenarios:

i) The convergence/divergence along the Sayville/Cherry Grove section tends to decouple eastern GSB from the rest of GSB. Waters to the east of this section exchange primarily with the ocean via Moriches Bay,

ii) The coherence between inflow at F.I. Inlet and outflow under Robert Moses Causeway and vice versa tends to exchange Babylon waters with the ocean through F.I. Inlet on a time scale corresponding to the passage of weather systems, i.e., 4-10 days. Since hard clam larvae are pelagic for 10-20 days prior to metamorphosis, larvae spawned in much of Babylon waters will not set there but will probably be flushed out into the coastal waters,

iii) In the interior of GSB, sea level variations and currents resulting from coastal winds and pressure systems, are the same order of magnitude as those due to astronomical tides, and

iv) Although the flux of water into and out of GSB through F.I. Inlet due to the tides is approximately 10 times as large as that due to alongshore winds, the fluxes due to alongshore winds persist in a given direction for 2-5 days as opposed to 6.21 hours for the tides. Thus the effect of the alongshore winds on exchange can be twice as large as that of the tides. In addition, the time scale of lateral mixing in GSB has been determined from dye studies to be 10 days. Thus the longer period fluxes will be much more efficient in flushing contaminants, larvae, etc. from GSB. Finally, the longer period flows propagate through the inlets with minimal attenuation, i.e. the inlet dimensions do not affect them to any great degree.

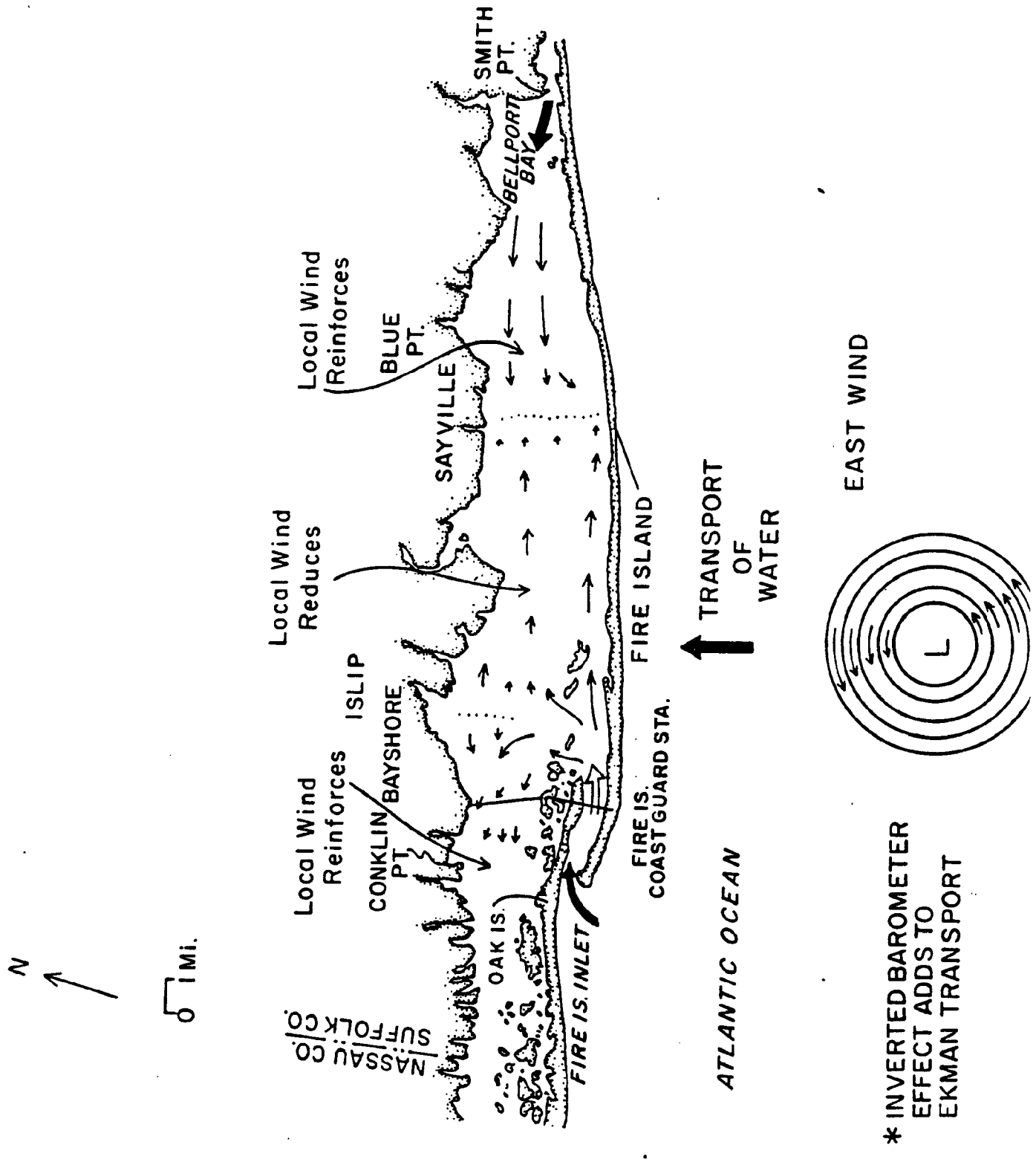
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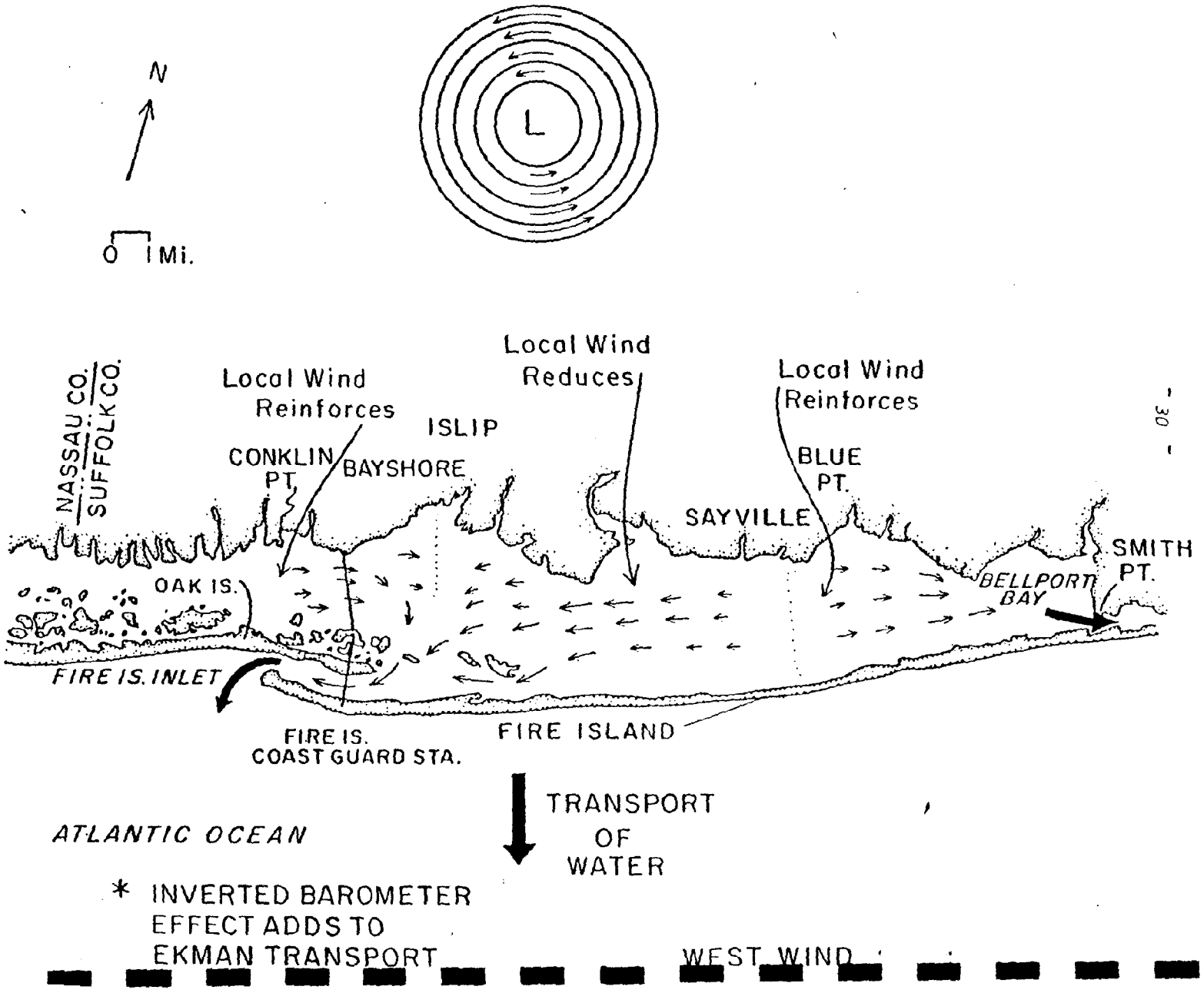
Figure 1.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EFFECT ADDS TO
EKMAN TRANSPORT
WEST WIND

Figure 2.

History of the Hard Clam and Its Fishery

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When white men first came to the shores of America, wampun, made from the shell of the hard clam, was used as money by the Indians. It was even used for awhile to pay fares on the Brooklyn ferry. Illegal wampum soon made its appearance, and it had to be made illegal for exchange.

The hard clam ranges from the Bay of Fundy to Florida, but is especially abundant in New York, New Jersey, Massachusetts, Rhode Island, and Virginia. New York has been the major supplier most of the time. Hard clams have been introduced on the west coast of North America, and persist in Humboldt Bay and Colorado Lagoon in California. They have been introduced in England and Ireland, and persist in Southampton Water where an electric generating plant warms the water. They also are in Brittany and the Seudre River in France. Some clams were actually imported from England to Long Island last year.

Hard clams were taken prior to 1880, but not much is known about the history of the fishery before that time. In New England they were looked upon as a standby food for hard times, a food not in keeping with American culture and affluence. They sold for about 70¢ per bushel in 1880, and the season was most active in summer after the oyster season closed. The price per pound of hard clam meats has risen steadily, although irregularly, since 1880. Adjusted by the consumer price index, the price per pound of meats has risen from 15¢ to about $1.60 in 1982. Clams thus are worth about ten times as much as they were in 1880.

Landings in New York reached an early peak of over four million pounds of meats in 1891, then dropped to a low of less than one million from about 1908 until about 1926. They rose gradually until 1942, then shot up to a peak in 1947 of over 10 million pounds. This all-time high was undoubtedly related to the shortage of red meat during the latter years of the second world war. They dropped again almost as rapidly to a low of just over two million pounds in 1954. Then rose to a secondary peak of about 9 million pounds in 1976. Then they dropped sharply again, and in 1984 were less than three million pounds.

In Islip Town, where a considerable part of total New York landings are made, and stock assessments have been made for the past several years, losses caused by harvesting have been five times as great as mortality from natural causes. This intense rate of harvesting caused a 54 percent decline in landings between 1979 and 1982. Density of clams in a closed area was over 26 clams per square meter, whereas in areas open to clamming the average density was only about 5 clams per square meter. There was a decrease in average size of clams in open areas, and decreased survival of older clams was not compensated for by increased survival of small clams. There is a no doubt that clams have been seriously overharvested in Islip waters, and there is no reason to believe the situation is any better elsewhere in the State. Obviously, some limits must be placed on harvests if the resources is to recover.

Great South Bay's Hard Clam Industry:

An Overview And Assessment of Management Alternatives

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Dean

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INTRODUCTION

I shall summarize briefly some of the important conclusions and recommendations of a comprehensive evaluation of management alternatives to rehabilitate and sustain Great South Bay's hard clam industry. This summary is extracted from a comprehensive analysis of the hard clam industry of all of Suffolk County.* The study was the joint effort of a working group of experts listed in Table 1 and was conducted through the Marine Sciences Research Center's Coastal Ocean Science and Management Alternatives (COSMA) Program. Support for the study was provided by Suffolk County and the William H. Donner Foundation.

The primary goal of the study was to provide a rigorous technical assessment of the full range of plausible management alternative which could be used individually, or in various combinations, to revitalize and stabilize Suffolk County's hard clam industry. The analysis was restricted largely to a consideration of the scientific and technical aspects of the various management a strategies to determine the extent to which they could contribute to revitalization of the fishery. Only cursory attention was given to the very important socio-cultural factors which must be evaluated in determining which alternatives should be applied. The study concentrated on one part of the hard clam industry--the commercial wild fishery.

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*The full report can be obtained for the cost of reproduction from the Marine Sciences Research Center, SUNY at Stony Brook, Stony Brook, NY 11794-5000

Table 1 Hard Clam Management Alternatives Working Group

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Gordon Colvin N.Y. Dept. of Envir. Conser. Stony Brook, NY	Scott Siddall Marine Sciences Research Center SUNY, Stony Brook
DeWitt Davies L.I. Regional Planning Bd. Hauppauge, NY	Lawrence Taylor Lafayette College Easton, PA
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Town of Brookhaven

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Management can be defined as working with and through individuals and groups to accomplish organizational (group) goals. One very important group, the group which we concentrated our efforts on, is the baymen. Appropriate goals for the Great South Bay commercial wild fishery might be to increase the number of clams and their quality--their purity. The criterion we chose for evaluating individual management strategies was the extent to which each strategy contributed to increasing the standing stock of hard clams. The criterion we chose in selecting combinations of management strategies for Great South Bay and for Suffolk County's other water bodies was to maximize on a continuing basis the harvest of hard clams from each particular water body--Maximum Sustainable Yield (MSY).

The reason for selecting MSY as the goal for management is that one must select some goal and by maximizing the sustainable yield of hard clams, one maximizes the number of possible choices of societal objectives and goals which are attainable. In other words, it gives the baymen, and other appropriate groups, the maximum range of choices.

The major findings of the study which are pertinent to Great south Bay are summarized in the following section.

Major Findings Pertinent To Great South Bay

° Hard clamming as a major industry has developed relatively recently in Great South Bay(GSB).

Justification: Until the 1930s the oyster industry was the major shellfishery in GSB. Environmental changes in the Bay caused oyster stocks to decline while hard clam stocks increased.

° Many current management practices and attitudes can be traced to the oyster fishery.

Justification: The restriction of harvesting to hand operated equipment and the planting of adult brood stock both began in the oyster industry in the 19th century. The present attitude of baymen toward leasing can be traced to the 1890s when the fishery was dominated by a small number of large lease holders.

° Maximum hard clam harvest from GSB occurred in 1976. Since then landings and stocks have decreased.

° Possible reasons for the decline in hard clam abundance include: over-fishing, removal of clams from uncertified areas, harvest of seed clams, increase in Bay salinity, deteriorating water quality, and reduced reproductive success.

° During the period 1975-80, the hard clam resource in Great South Bay was overfished, i.e., harvested at a rate that exceeded recruitment.

Justification: It has shown that for the period 1975-80, harvesting mortality exceeded natural recruitment.

° Some mechanism is needed to control harvest if overfishing is to be prevented.

° A system of transferable quotas is one of a variety of mechanisms that could be used to control the total harvest and apportion it among harvesters.

° Water body-wide management would make sense from economic and ecological points of view.

° Development of vacant and agricultural land coupled with population increases in Suffolk County projected for the next 35 years will place additional stress on the environment which could have ramifications for the County's shellfish resources.

Justification: The impacts of development on water quality could affect adversely spawning, survival, and growth of hard clams. The number of potential recreational acreage closed to shellfishing in the County is likely to increase over the long-term, but it is not known by how much.

° Certain controls on the hard clam fishery are required even without any concern for the future of the fishery.

Justification: To ensure compliance with Federal regulation of interstate shipment of shellfish, and adequate enforcement program is required to prevent harvest from uncertified areas.

° An appropriate minimum legal size limit should be determined and enforced to protect the spawning potential of natural stocks of hard clams. The addition of a maximum legal size would further enhance reproductive capacity.

Justification: Small clams must be protected from harvesting to ensure that they reach reproductive age. An upper limit on the size would further enhance the reproductive capacity of the resources because cherrystones and chowders produce many more eggs than smaller clams.

° It is a virtual certainty that the hard clam fishery will not spontaneously rejuvenate. Without changes in existing management practices, it is unlikely that the fishery will recover and be stabilized.

Justification: Under present circumstances the clam harvest, in the long run will continue to decline. The decline will not be regular because setting will vary due to natural conditions. Since the industry is capable of exploiting a new set as soon as it reaches legal size occasional large sets will not contribute to a sustained population.

° Present regulations on hard clam harvesting have not restricted the total harvest to a level the resource can support.

Justification: New York State production of hard clams, most of which come from Suffolk County, dropped from 9 million pounds of meats in 1977 to less than 3 million pounds in 1984.

° Restricting the number of participants in the fishery (limited entry) and setting total catch quotas are two management measures that have not been used, but which could be used to control total catch of hard clams in Suffolk County waters.

° Implementation of any management strategies which would limit entry to the hard clam fishery would be controversial and would require courageous action by decision makers. Any limited entry program would require effective enforcement which would be costly.

Justification: The prevailing sentiment among baymen is to oppose any attempt at limited entry. These baymen are persuasive and politically powerful group. Additional problems would result from the increase enforcement costs if a limited entry program were instituted.

° Any over-all fishery management program that does not maintain a healthy resource is a failure.

Justification: If management programs do not ensure that stocks are maintained at levels which can sustain the harvest taken, the resource will decline, landings will fall, and the number of baymen who can expect to make a reasonable living will decrease.

° Sustainable yield is defined to be the level of harvest that the stock can support over and extended period. Reliable estimates of the sustainable yields of hard clams are unavailable for any of Suffolk County's bays. Only for the Town of Islip is such an estimate available.

Justification: Estimates of sustainable yields have been made for Great South Bay but the information upon which they are based is inadequate for that purpose. Stock assessments carried out by the Town of

Islip offer an empirical basis for determining sustainable yields for that Town's waters.

° Individual towns could institute limited entry programs for hard clam fisheries in town waters by themselves or in cooperation with the State Department of Environmental Conservation. In either case, the question of issuing permits to harvest other species of shellfish would have to be resolved.

° Seed planting programs are popular among baymen and most town officials as a hard clam management alternative.

° Although seed planting may not be practical as a method for producing a substantial increase in the number of clams available for harvest, it may be useful in enhancing and maintaining recreational fisheries in small areas, and under certain conditions, in rehabilitating stocks for commercial harvest in selected and restricted areas.

Justification: If specific criteria are met, seed planting could be used to rehabilitate an area in which stocks have been reducted below harvestable density. Such an area should have--in addition to reduced stocks--a combination of biological and physical factors which make successful recruitment infrequent, and characteristics which permit a survival rate of at least 10% from 25mm to littleneck size.

° A rigorous assessment has never been made, for any relatively large-scale town program, of the survival of planted seed clams and their overall contribution to harvestable stocks.

° It is very unlikely that seed planting programs of the scale now carried out can contribute in any significant way to total harvest. Typical town seeding programs would have to be increased by at least ten-fold, and perhaps by as much as one hundred-fold, to make a significant contribution to total harvest.

Justification: Total annual hard clam harvest for a town on Great South Bay is currently about 100,000 bushels. A typical town seed planting program would plant about 2 million seed clams at 25mm. Even if 100% of the seed planted were harvested as littlenecks, the town's annual harvest would be increased by only 4%. A more realistic survival rate would be 15% which would result in an increase in landings of less than 1%.

° Seed planting should be evaluated rigorously as a hard clam management alternative. The evaluation must include three primary criteria: the effectiveness in achieving the goals of the program, the scale of the program, and the costs of the program.

° The spawner sanctuary concept is a refinement of the spawner transplant program. A spawner sanctuary is an area stocked with large, fecund hard clams to enhance fertilization of eggs, and which is located so that it will enhance the set of sanctuary producted larvae in preselected areas which are capable of sustaining good growth and high densities.

° The recent development of numerical (computer) models to simulate the flow fields of coastal embayments makes it possible to select sites for establishment of spawner sanctuaries with will supply larvae to preselected target areas with an accuracy not previously possible.

° The evaluation of the spawner sanctuary management alternative should be based on its contributions to standing stocks in, or harvests from, the target areas over a period of at least five years.

Justification: Once stocked, if poaching is not excessive, the original brood stock should remain fecund for five years, on the average (based on current knowledge of survivorship and fecundity), during which it should contribute to standing stocks.

° There are four basic selective closure strategies: (1) closing areas until most small clams reach harvestable size: (2) closing areas after some prescribed optimum yield has been reached; (3) closing areas until the harvestable population reaches some minimum threshold level, and (4) closing nearshore areas to ensure a winter grounds for harvest during inclement weather.

° The choice among selective closure alternatives will depend upon the goal of the management plan. Selected closure can be used along or in combination with other management alternatives.

° All types of selective closure need to be combined with population assessments as an integral part of the management program.

Justification: Population surveys must be conducted prior to closing to determine stock size plus recruitment and mortality rates. Additional (annual) surveys are needed to monitor the rate at which stock rebuilds. Even closures to maintain winter harvest grounds require stock assessment for proper management, since the area must have an existing stock of harvestable density.

° To be optimally effective, selective closure should be combined with some type of program of limited entry, limited catch, or both.

Justification: Maintenance of some minimum stock size in an area may be necessary for successful recruitment. If this is true, then limited harvest needs to be implemented during the period when an area is open. Limited catch might also be implemented to prevent overharvesting of areas which remain open, and to prevent uncontrolled harvest on newly reopened areas.

° Protection of clams in relatively small areas against predators may be feasible using available methods, but protection over large areas is not practical at present. It would be useful to obtain the information necessary to rank predators in terms of their importance on a water body-wide basis, and to understand how their importance varies under different environmental conditions.

Justification: The primary reason for considering predator control is that predation may be the most important factor controlling recruitment, although not the only one. Conditions under which predator control is not feasible or cost-effective should be know. Effective predator control will require a knowledge of each predator's life cycle, and of key or limiting factors that control predator distribution and abundance. Size-specific predation rates also should be know.

° Potential predators of hard clams are many, and vary with the size of clams. The life stages most vulnerable to predation in nature are post-set clams up to about 25mm in length. If clams in nature are to be protected against predators, the life stage to concentrate on is early post-set clams between 4 and 25mm in length.

Justification: Larval and early post-set clams up to about 4mm can not be protected economically in the field. Once clams reach about 25mm length they usually are much less vulnerable to predation.

° Five general methods of hard clam predator control in the wild fishery have been identified: (1) chemical methods, (2) gravel or shell (aggregate), (3) mechanical methods to collect predators, (4) fences, and (5) ecological approaches.

° Unless predation can be controlled, it is unlikely that other management approaches will be effective in increasing and sustaining enhances stocks and catches of clams in the Peconic estuarine system.

Predator control is necessary but may not be sufficient to enhance the resource in this area.

Justification: Density of hard clams in Great South Bay appears to be about ten times that in the Peconics. There are more whelks and starfish in the Peconics than in Great South Bay. The lower abundance of clams is assured to be related to the greater abundance of large predators.

° Mariculture is the manipulation of all or part of the life cycle of a marine organism to enhance its production. Mariculture may be public or private in its orientation. The goal of public mariculture is to enhance natural stocks in a public fishery. The goal of private mariculture is to turn a profit. Public mariculture to enhance stocks of hard clams for the catch fishery is encouraged by baymen and is facilitated by town, county and State governments. The development of private mariculture is discouraged by baymen and impeded by existing attitudes and regulations.

° Private mariculture is not a management alternative for rehabilitating and sustaining the wild harvest, but may play an important role in the future of hard clam production and in preservation of the traditional lifestyle of baymen.

° The environment may be manipulated to enhance hard clam production either by making conditions more favorable for the hard clam or less favorable for its predator.

° Private mariculture requires the allocation and exclusive use of segments of the sea floor. If publicly-held lands are allocated, private mariculture will compete with public sector users.

° The practices of private and public mariculture are not mutually exculsive. Public mariculture activities rely upon private

mariculturists, on Long Island and elsewhere, for seed clams to augment natural stocks.

° The economic viability of hard clam culture on Long Island has not been demonstrated convincingly.

° Development of private mariculture will require a change in attitudes by government and public alike and the implementation of management plans which allocate specific areas of the marine environment among competing uses.

Justification: The development of new private mariculture ventures in Suffolk County's coastal zone is limited by the ability of the culturist to acquire ownership, lease, or guaranteed access to coastal waters and underwater lands suitable for the enterprise. Lack of action by State and local governments and negative attitudes toward mariculture on the part of commercial fisherman, recreational boaters, and shoreline residents have tended to discourage potential mariculture developers.

° The development of private mariculture on Long Island will require guaranteed long-term access to underwater lands and/or overlying waters.

Justification: Successful private mariculture requires guaranteed long-term access to underwater lands through sales, leases, or other mechanisms to justify the initial investment required for a private mariculture venture.

° The economic outlook for private mariculture hinges on the development of technical advances which improve growth and survival during growout, and recovery at harvest.

Justification: The profitability of hard clam mariculture primarily depends upon the cost of seed clams and the recovery of market size clams. At the current retail price for littlenecks, 15-20% of the

planted seed must be recovered after 2-3 years of growout just to cover the costs of seed production. Higher rates of survival to harvest must be achieved to cover all costs and provide a profit, yet documented estimates of survival to 50mm rarely exceed 15% and often are less than 1%.

Development and maintenance of effective mariculture programs--public and private--will require substantial and sustained research and development efforts comparable to those provided to the agriculture industry through agriculture experiment stations.

Combination of Management Strategies for Great South Bay to Attain Maximum Sustainable Yield.

Listed below are the combination of management strategies which the Working Group (see Table 1) believed would be most effective in revitalizing and stabilizing the Great South Bay commercial wild fishery at Maximum Sustainable Yield.

° Conduct stock assessments throughout the bay designed to provide reliable information on the population dynamics of the resource.

° Establish spawner sanctuaries free of the constraints of town boundaries.

° Develop a plan of alternate openings and closing of harvest grounds to limit total harvest and to spread the harvest out over the year.

° Establish a maximum legal size and retain, or increase, the present minimum legal size to ensure maximum protection of the spawning stock.

° Enhance the enforcement of hard clam laws by increasing patrols and by intensifying the prosecution of violators.

° Utilize clams in uncertified areas as a renewable resource for maintaining the spawning stock.

° Set aside a small percentage of the Bay (10%) for controlled culture and harvest of hard clams and other species by individuals or groups.

° Encourage the formation of baymen's cooperatives to increase economic returns to baymen.

° Monitor salinity over the long-term at a small number of stations at key locations throughout the Bay to establish long-term trends which may provide insights into how changes insalinity affect standing stocks of hard clams.

° Take steps to ensure that there is not further alteration in water quality which could decrease standing stocks of hard clams or increase the areas closed to harvesting.

Information Priorities

Significant improvement in the efficiency and effectiveness of management of Great South Bay's and all of Suffolk County's, hard clam industry will come only through knowledge; through the utilization of existing knowledge and through the development and application of new knowledge--new information.

Over the course of our study, a number of important information gaps became obvious. When we attempted to rigorously evaluate several management alternatives we were confronted with a deplorable deficiency of information. The section that follows summarizes the information needs which the Working Group assigned the highest priority. The criterion for selection was the potential contribution that new information could make the improved management for each dollar required to generate it. In some cases, closure of these information gaps will require additional research; others will not. The individual items are not ranked.

Some Important Information Gaps Which

Can be Filled Without Additional Research

(1) Evaluation of existing information to select an appropriate maximum legal size and re-evaluation of the present minimum size to provide further protection for the spawning stock. (This evaluation should include social and economic, as well as biological considerations).

(2) A rigourous evaluation is needed of the options available for allocating public bay bottom to mariculture and the potential returns to the region of such allocation.

Some Important Information Gaps

Which Will Require Additional Research

(1) Stock assessments are needed which will provide reliable estimates of sustainable yields for Great South Bay and possibly other Suffolk County waterbodies.

(2) Research is needed to improve the knowledge of predator/prey relationships for hard clam populations in Suffolk County waters. This should include, but not necessarily be limited to, the effect of predation on hard clam recruitment, and life histories of major predators.

(3) Research is needed to improve methods of predator control.

(4) Research is needed to determine if there is a minimum density of adult clams necessary to encourage set of larvae in an area.

(5) Research is needed to assess the effects of disturbance and modification of the bay bottom on hard clam sets and survival.

(6) Research is needed on hard clam mariculture in the nursery and growout phases to improve the ability of nursery systems to produce large seed clams and to increase survival during growout.

(7) Research is needed for a rigorous evaluation of a large scale seeding program needed to assess the survival rate of plated seed

clams and their overall contribution to recruitment and standing stock.

(8) Research is needed for a rigourous evaluation of one or more spawner sancturaries to assess their overall contribution to recruitment and to standing stocks.

(9) Research is needed to determine the importance of salinity changes and long-term salinity trends to the hard clam resource.

(10) Research is needed to evaluate the suitability of Moriches and Shinnecock Bays (using and existing model) for the establishment of spawner sanctuaries.

(11) Research is needed to evaluate one or more north shore bays (using a dye release) to determine their potential for establishment of spawner sancturaries.

(12) Research is needed to identify the relationships among population growth, land use and the deterioration of marine water quality.

(13) Research is needed on toxic and pathogenic agents and substances, which may occur in hard clams as a result of marine pollution, and the threat they pose to public health.

(14) Research is needed to provide detailed socio-cultural information on the fisherman and the fishing industry for use in devising and implementing appropriate management programs.

(15) Research is needed which will lead to the development of an information system for the hard clam industry which would include biological, economical, social, cultural, and environmental information.

Panel Discussion

on Hard Clam Management:

Summary

Discussion Panel

Congressman Thomas J. Downey, Moderator

Honorable Michael La Grande, Town of Islip

Honorable Anthony Noto, Town of Babylon

Vincent Donnely, Town of Brookhaven

Dr. Lee Koppelman, Long Island Regional Planning Board

Gordon Colvin, NYS Department of Environmental Conservation

The purpose of the panel was to provide reaction to the research findings and alternatives for hard clam management provided earlier.

Congressman Downey opened the panel by asking if individual panelists wanted to make an opening statement.

Supervisor La Grande asked why it was that we know so much [about hard clam biology] and have done so little. He postulated that in addition to understanding natural science, we must also understand the social science and the political science aspects of the problem. With this information we could begin to make the hard decision we face.

Supervisor Noto stated that we need to look to various governmental jurisdictions for funding. With increased publicity of the problem facing the hard clam industry, increased funding commitments could be expected from other levels of government. Towns have been providing funding support for the seeding programs.

Dr. Koppelman observed that limited numbers of baymen present at the conference. A major problem is the bayman's lack of trust of government and scientists.

Vincent Donnely reported that his Town spends $350,000 for enforcement, seeding program and shellfish management staff. He echoed the need for increased trust between government and baymen. He advocated use of some form of limited entry and work towards achieving maximum sustainable yields as a goal for hard clam production.

Gordon Colvin said it is imperative that we reduce fishing mortality. We must continue efforts to gather data on the composition and condition of the hard clam stock and continue to investigate ways of reducing fishing mortality.

Question I Congressman Downey asked: What will it take to get a rational political decision with respect to hard clam management?

- Noto: We need to ask "Who will come up with the bucks?" Most is coming out of the local tax base. County, State and federal government must decide whether they want to commit funding. Second, the baymen have to be told they are overfishing. How can we work with the baymen in order to get them to police themselves?

- Koppelman: Mariculture could contribute to solving the problem. Presently we purchase clam seed from Massachusetts. This does not make sense. However, baymen are distrustful of mariculture. They perceive it as a process for gaining control of bay bottom. We need to sell mariculture as a solution to the baymen.

- Viney Daley, West End Baymen's Association: responding to Dr. Koppelman's earlier observation that few baymen were in the audience, he said the reason why so few baymen are present was that attendance was by invitation.

- Noto: Numerous levels of government are taking various shellfish management actions. We need to get State, County and towns to pull together. We need to coordinate enforcement efforts. We need to coordinate seeding efforts.

Question 2 Downey asked whether we need to create another government entity to do this coordination.

- Noto: We may need it.

- Koppelman: The County is the logical coordinating entity. The Marine Resources Council could be reconvened to serve in this capacity.

Question 3 George Proios, NYS Legislative Commission on Water Quality asked:

a) Do we have enough information to understand the impact of winter ground closures and reopening on the overall hard clam productivity of the bay.

b) Why haven't researchers addressed the direct and cumulative impacts of dredging on hard clams.

c) Why hasn't the impact of road runoff been integrated into the research effort?

- Koppelman: With respect to the surface runoff issue, our National Urban Runoff Study recommended that we "stop it". But we need public support to gather the funds needed to implement this.
The dredging issues reflects a conflict in uses. Some dredging serves a public good. It is needed for maintaining safe navigation for boaters. But other times dredging is used as a political reward to private shore property owners who want their areas dredged. My office studied the proposal to purchase a county dredge. Local trustees are sometimes not consistent in their regulation of dredging in town waters.

- Noto: With respect to stormwater runoff, the Town of Babylon requires the surface water must be contained on site for construction projects. We must continue the use of sumps.

- Downey: Commitment of federal money to address water quality problems has decreased, although we keep asking EPA to do more with less funding.

Question 4 Cong. Downey asked what constitutes a dangerous coliform count in shellfish? There is no federal coliform standard.

- Bill Wise, Sea Grant: This is true. There is no federal standard. US FDA does not want to involve itself. However, research to establish a standard is underway, but it will take a long time before we agree upon a standard. A political decision must be made to determine what should be done in the meantime.

- Colvin: With respect to coliform transported to the bay via surface runoff, we may soon see a change in federal guidelines for assessing the degree to which runoff contributes to coliform loading into receiving waters.

Question 5 Vincent Daley, President of West End Bayman's Association, commented as follows:

a) With respect to limited entry, many baymen have already left the fishery, but those also remain want to stay.

b) It is true that we baymen are a distrusting group. We must find a leader who we can trust and be willing to relinquish our control so we can begin to work together.

c) The proposed UDC mariculture project was one I could support but baymen in general were distrustful. Before we can make such a project work, it is necessary to understand the baymen's life style and how

they think. Baymen have a great deal of knowledge and political power. Project sponsors must woo baymen support. They must use a more sensitive approach to the baymen's plight before we will see any cooperative action.

- La Grande: The distrust issue goes both ways. There are baymen and there are baymen! Government distrusts the unscrupulous baymen.

- Bob Cook: (former Regional Director for DEC): We need to reinstitute baymen cooperatives. We need to promote self policing among the baymen.

Question 6 Bob Cook asked Lee Koppelman what he perceives to be the next step in pulling all this information together.

- Koppelman:

a) We tried to create an Estuarine Sanctuary in the Peconic/Flanders Bay area to serve as a living laboratory. We did not get the sanctuary because of mistrust and other forces.

b) We do not need another institution. We could reactivate the Marine Resource Council.

c) We need to continue research on a sustained basis. We need to support the creation of the Living Marine Resources Institute at the Marine Sciences Research Center at SUNY, .

d) We have all the players at hand. We only need to agree to agree.

e) The State should allow the County to conduct the survey of the Peconic/Flanders - Bay Bottom.

Question 7 Cook asked should the coordination of enforcement activities be done separately from the coordination of management activities?

- Koppelman: We need coordination of enforcement efforts. Enforcement and management should be handled separately.

- La Grande: With respect to creating a new government entity to manage shellfish, this may not be such a bad idea. There are times when one should duplicate government effort. A good example of this is the port authorities.

Question 8 Steve Nyland, West End Bayman commented:

a) If you (in government) want our (Baymen) trust, do what you are supposed to be doing. You should be doing a better job enforcing the SPDES program.

b) An EPA report stated the Southwest Sewer District would impact most heavily on Babylon's groundwater. Salt water intrusion would be a problem. But the County and Federal government still have not addressed the problem.

- Koppelman: The County completed its stream augmentation studies but there has been no funding available to implement the study recommendations.

Question 9 Tony Viggiano, President of the Greenseal Program:

a) There are no seed clam in Babylon waters in the vicinity of the Southwest Sewer District. Without freshwater input to the Bay, larval clams will not set.

Question 10 Steve Nyland commented:

a) The baymen's mistrust of government is not an irrational mistrust but founded on a rational basis. Money isn't being spent as it is supposed to be. Two additional DEC conservation officers were hired with increased license funds, but then three CO's were laid off. The money we contribute gets misused.

b) The County received $200,000 of federal funds obtained by Senator D'Amato. It took two years to get it to the eight towns, plus the county is charging $40,000 handling charges.

- Koppelman: The County has not been sitting on the money for two years. It was only made available this Spring. Furthermore, the county is providing a $40,000 match to evaluate the effectiveness of this program. I invite you to join the Marine Resources Council and participate in the decision-making process. The county is doing what it can to right the wrongs. Let's work together.

Closing Remarks - Congressman Downey

We are here today so we can work together. That was the purpose for this Conference. We have a tremendous body of information available. We've got the human resources, but we do not have coordinated action. We want the baymen to survive. I will send a letter to the county asking to reestablish the Marine Resources Council and I will fight for federal funds.

Thank you.

Great South Bay: An Outlook on the Future

Keynote Address

Secretary of State Gail Shaffer

Good afternoon. I wish to convey my warmest welcome to each of you who have come to participate in today's conference on hard clams and hurricanes. I am particularly glad to see representatives of baymen groups, shore property owners, shellfish managers, planners and elected officials present at this forum. We have an unprecedented opportunity to address two extremely critical situations: the possible loss of the hard clam industry and the potential for loss of life and property should a hurricane strike Long Island's shores. The challenge before us is to translate current research findings on hard clam management and hurricane mitigation planning into management goals for Great South Bay.

By the end of today's sessions, some commonalities between these two otherwise distinct issues should emerge -- both issues are complex - both issues impact a broad diversity of user groups - and government decision making affecting the issues is diffused throughout local, state and federal agencies.

To develop rational decisions, we need to understand each user and each government manager - we must also be willing to share the costs and sacrifices necessary to resolve the issues. I view today's conference as a beginning to this process, and I am confident that we can collectively find solutions that will allow us to continue to enjoy the amenities of Great South Bay.

I would like to briefly reflect on some of the findings of this morning's seminar.

With recent news reports of the alarming decline in hard clam landings, additional bays being closed to hard clamming due to pollution, and now the possible ban on serving raw clams in restaurants, there can be little doubt in anyone's mind that the Great South Bay hard clam industry is in serious trouble. In 1976, we saw a peak harvest of 700,000 bushels of hard clam -- only 170,000 bushels were harvested in 1983. Two-thirds of our baymen have lost their source of livelihood and have been forced to move elsewhere - to Florida, Rhode Island - to find other clamming opportunities. This emigration of the local work force hurts our economy and disrupts the strong cultural ties our communities have had with the Bay. This morning we were told that the damage to the Bay's hard clam populations may be irreversible without extraordinary management efforts to restore depleted stocks. Overfishing, increased predation induced by higher salinity in the Bay, natural cyclic fluctuations in population levels, and destruction of clam beds due to dredging and pollution are all probable causes for the decline.

Several management options were described this morning which could address the probable causes. These management options can be clustered into four categories, the first is one labelled "Regulating the Harvester". This option includes: maximum and minimum size limits, limited entry, and spawner sanctuaries. Each of these options place the burden of sacrifice on the baymen. Their efforts to harvest the resource and earn a living will be restricted.

The second management option is also regulatory, but instead of restricting the baymen's activities, it restricts dredging, shoreland development, and recreational and commercial boating activities which have a significant effect on hard clams. Protection of crucial clam habitats would be an example of this management option. In this category the burden of sacrifice falls on users of the bay, other than baymen.

A third category of management options is non-regulatory and augments natural reproductive and survival processes. These include spawner relay programs, raft culture and stocking of seed clams, and predator control. The cost of these efforts falls on town, county and State governments and ultimately the burden falls on the general taxpayer.

A fourth management category includes only one option - which is no action -- do not intervene -- and allow nature and the market place take their respective course. This approach may be appropriate only if long term cyclic changes in hard clam populations is the dominant cause of the decline we see today and if scarcity of clams will automatically force a reduction in fishing effort.

When developing management plan for hard clams, we must balance the costs of these management options, and assure that the baymen and municipal, county and state governments share the responsibility for the future of the industry.

We need to establish a clear goal for our management efforts, involving the collective judgment and wisdom of each group that will benefit. Do we want to attempt to restore hard clam production to the peak levels of the mid-70's, regardless of the expense needed to artificially augment existing stocks to attain those levels? This would require massive infusion of public dollars to achieve. The other end of the management spectrum would be to take a laissez faire posture, allowing the hard clam industry to evolve to its ultimate destiny, albeit eventual recovery or total demise.

I maintain that we should not accept any further declines of Great South Bay's hard clams. Restoration of the resource is feasible ! If we fail to take every practical effort to save the resource at this

time, we may be squandering the last opportunity to keep this resource a major contributor to the economy and culture of Long Island.

I wish to emphasize that our efforts be practical. To order the baymen to stop harvesting clams for the next few years, or to allow the stocks to recover naturally are not, in my view, practical. Nor is it practical or possible to spend huge sums of public dollars. We need to use a combination of management options, distributing the costs over many sectors of society.

From the "Regulate the Harvester" category I mentioned earlier, one of the more practical options seems to be enforcing maximum size limits. Since the relative capacity for the hard clam to reproduce offspring, increases with age and size, -- and given the fact that larger cherrystones and chowders command a lower price than smaller littlenecks, it makes good sense to return the larger, less valuable clams to the Bay. This sacrifice by the baymen will effectively contribute to the long-term viability of the hard clam industry.

Spawner sanctuaries, such as those created by the town of Islip, also limit harvest efforts, but appear to have baymen support providing other accessible and productive clam beds remain available.

I feel that application of limited entry as a management tool should be tempered since many baymen have already moved on to other States' fishing areas. This option could create the most severe hardship on baymen and should only be used if absolutely necessary.

The second category of management options which I labeled "Regulating User other than Baymen", is an area where I feel the State can make a significant contribution in controlling those uses of the Bay and activities which have the potential of significantly impairing the Bay's clams. For example, while dredging often proves an absolute necessity for

providing safe navigation channels and access to and from the bay, dredging has all too often been cited as causing direct destruction of clam beds. Not only can the State regulate dredging through the Tidal Wetlands Act and the Protection of Waters Act, but also the State's Coastal Management Program. The CMP provides a tool in protecting clam beds through its significant coastal habitats program. The important clam beds in Great South Bay are being identified. Once designated by my Department, local, state and federal that regulate dredging will review dredging projects to make sure disturbance of these designated clam beds will be avoided.

There is a growing awareness that vessel wastes indiscriminately discharged into bay waters may be contributing to the degradation of the Bay's water quality. The provision of pumpout facilities is an expense that the boating and marina industry has not been willing to bear. But with the possibility of closing down the hard clam industry because of public health risks, the cost of properly treating vessel wastes is one of the sacrifices the boating community may be willing to share.

The third category of management options includes subsidies by towns, counties and the State to augment natural clam populations. Examples include New York State Department of Agriculture and Markets recently-funded spawner transplant program, raft culture and stocking of seed clams conducted by Brookhaven, Babylon and Islip. These efforts are essential to speeding up the process of restoring harvestable hard clam populations.

I do not believe we should seriously consider the "No Action" management option. We must recognize that long-term fluctuations in natural populations exist, and we must fine-tune our management plan to reflect changes in the long-term cycles. It is imperative that the Baymen,

resource managers and the scientists continue the level of communication which we have experienced today.

This cooperative approach that is essential for dealing with the hardclam crisis is integral to solving the hurricane issues as well.

Hurricanes are one of nature's most violent storms, and we are not able to mitigate 120 MPH winds, 30 foot waves, and tides running 15 feet over normal. We must look to mitigate damages from hurricanes. Obviously, we can minimize damages by prohibiting construction on barrier islands, but this is not desired by landowners. Another way is to insist on strict building codes, but even the best built structure is susceptible to damage. A third is to restrict building to areas, shown to be stable over time, but how long will they remain stable?

Right now there is over 3 billion dollars and 144,000 residents at risk on Long Island in a hurricane we know is going to occur. We want to save 144,000 people and their investment, while at the same time preserve the natural protection that barrier islands afford.

The question is, how do we do it? The issues are clear - barrier islands represent a mix of ownership between public and private entities. The beach between mean high and mean low is a public eastment held in trust for the general public. The dry sand portion of the beach may be used by the public to gain access to and to use the wet sand portion of the beach. Depending on the deed, this land may be owned privately. The dune is owned by the property owner, but restrictions on the use of the dune may be enforced through zoning. The same is true for intertidal marsh areas.

Barrier islands are the mainland's buffer from major coastal storms, including hurricanes. The beach, dune, offshore bar, and marshes are integral parts of this natural flood control system, which has evolved

over thousands of years. These barriers continue to evolve, and migrate today in response to changes in sea level, storm intensity and frequency, and sand supply.

Static development which does not migrate as the island itself migrates, will eventually be left behind. In the process of being stranded, this development may destroy the balance of beach, dunes, or marshes upon which this natural flood control device is dependent.

Unfortunately, Government is financially liable for much of the structural damage which occurs during coastal storms. In the event of a Presidentially declared disaster, the Federal and State governments are libel for up to 75% of the damages incurred on local governments. Private parties may receive low interest loans or outright grants. The small northeast storm of March 1984 resulted in over 4½ million dollars in claims and over 1 million dollars in approved storm damage payments. Under the present management scheme, the value of land and structures will continue to rise -- so the damages resulting from flooding and erosion will also rise.

Another issue is the availability of federally subsidized flood insurance. This insurance is available to all homeowners in flood zones through the National Flood Insurance Program. Premiums may be subsidized up to 90% by the Federal government. The Federal Emergency Management Agency, which administers the program, has recently increased premiums in all flood zones, but coastal areas are still showing a ratio of five dollars paid in claims per dollar collected in premiums.

As the barrier islands continue to migrate landward, more and more houses will "move" into high hazard areas. Thus, we can expect that claims will also continue to increase.

It is obvious that changes in our management approach are needed. Static building practices are simply not compatible with the dynamic nature of barrier islands. The traditional concept of property boundaries is just not applicable to migrating barrier islands. Development on barrier islands is susceptible to both the slow attrition characteristic of erosion, and complete destruction characteristic of hurricanes and major coastal storms. Therefore, development should be restricted to activities compatible to the mobile nature of barrier islands. We should give up all hope of controlling erosion and storm surge, and concentrate our energies on working with the natural system.

Barrier islands are unique natural phenomenas -- they deserve to be handled with special rules. The application of disaster assistance, flood insurance, and erosion control structures to barrier islands should be re-evaluated and changes made that will address the uniqueness of barrier islands.

Local governments and private property owners may bear the brunt of the economic and political cost generated by the needed changes -- but the state and federal governments must also contribute. If any level of government, or individual shys away from the changes that are desperately needed, then the blame for the destruction of this natural resource, as well as the coincident economic losses, will rest solely with them.

We should consider the actions needed in this new cooperative venture. Perhaps FEMA should revamp the flood insurance system, so that the coastal segment is self supporting. Federal disaster assistance could be limited to a one loss payoff. Congress should consider expanding the Coastal Barrier Resource Act to include otherwise protected areas. The Corps of Engineers may need to pursue the aquisition of barrier

islands as flood protection measures, instead of attempting to modify natural processes.

At the State level, the State should encourage Congress to authorize revision of existing National Flood Insurance Program regulations to reflect New York State coastal conditions. The State should consider strenghtening the Coastal Erosion Hazard Areas Act to ban "hardened" erosion control structures on barrier islands, similar to the approach used in North Carolina. My Department in conjunction with the State Emergency Management Office, Department of Environmental Conservation and Sea Grant, should provide more assistance to prepare local Coastal Erosion Hazard Area regulations and local disaster preparedness plans. The State could acquire barrier islands in conjunction with the Federal and Local governments as part of a flood protection program.

Local governments also need to begin taking on greater responsibility. Local governments may need more strict flood plain ordinances which reflect the individual flooding characteristics in each community. Effective erosion hazard ordinances should be developed to protect the integral components of the barrier island. Local governments may need to provide incentives for residents to move away from the most hazardous parts of the barrier island before the storm occurs, and prevent reconstruction in these areas after the storm has occurred.

Homeowners in hazardous zones must also prepare for the inevitable hurricane by "storm proofing" their homes and reinforcing their dune with beach grass and snow fence. Homeowners are going to bear the brunt of the storm, as well as the changes in the management of barrier islands, but the local and State governments need to make the transition for the landowner as financially painless as possible.

Although research has given us a broad understanding of how barrier islands function and react to such variances as rising sea level, storm frequency and sand supply, we need to know more. Coastal managers need to know what the long term recession rates are for each segment of the coast. We must know where inlets may form, what areas are stable, and the time frame for change. The management of our inlets obviously effect the barrier islands, thus we need to know how to maintain safe navigation without adversely effecting sand supply.

Coastal barrier islands are one of the Long Island's most precious natural resources. However, if current management practices are continued, not only will we lose the benefits of these islands, we will lose human lives.

We are at the crossroads in our management of barrier islands. The alternatives have been discussed long enough. It is imperative that we delay no longer in reaching a consensus on a decision. If we don't make a decision soon, it is likely that a disaster and the loss of human life will make the decision for us when, tragically, it is too late.

Hypsometry as a Tool for Calculating Coastal Submergence Rates

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Abstract

A contemporary rise in relative sea level is slowly submerging the outwash plain which lies behind Long Island's barrier beaches. As a tool for quantifying their rates of submergence, we have developed hyposometric curves for representative coastal villages on the outwash plain. At the present relative sea level rise rate of approximately 3mm/yr, we find that average submergence rates from 2 to 10 times these values are possible by the end of the next century.

Introduction

In recent years, increasing attention has been given to the study of contemporary sea level changes. Evidence from many sources indicates a global rise in sea level during the twentieth century in the range of 10 to 20 cm. Barnett (2) finds that a linear trend of 2.3 mm/yr best fits the data from 1930 to 1980, although he cautions that the estimation of a truly "global" sea level change rate does not appear possible with the present data. While relative sea level change rates vary widely from region to region, they are often highly coherent within

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particular regions, one of which consists of the coast of eastern North America and the Caribbean (2).

Abrey and Emery (1) have further subdivided the eastern North American coast into three compartments with relatively consistent sea level behavior: one north of Cape Cod, Massachusetts; one between Cape Cod and Cape Hatteras, North Carolina; and one from Cape Hatteras to Pensacola, Florida. Between Cape Cod and Cape Hatteras the rate of relative sea level rise increases to the south with mean annual values from 40-year records varing from approximately 2 to 4 mm/yr. At New York City, Hicks, Debaugh and Hickman (4) found a linear trend between 1893 and 1980 of 2.8 mm/yr and Barnett (2) finds a trend between 1920 and 1975 of 3.6 mm/yr.

Based on the above information, we assume that New York's sea coast is being submerged at an average rate of about 3mm/yr. Making use of this figure, we describe here our method for calculating the rate at which several of New York's coastal villages are being diminished by submergence. To further illustrate our methodology, we make use of other sea level rise rates which have been hypothesized for the future.

The Role of Submergence in Shoreline Change

The marine shoreline is the line formed by the intersection of the surface of the sea with that of the land. Change in the level of the sea with respect to the level of the land will shift the shoreline's location. It is convenient to separate shorelines into two groups based on the types of processes which control their change in form. The first group, active shorelines, includes those which are altered as a result of changes in the form of the land surface, such as those resulting from erosion or accretion. The second group, passive shorelines, consists of all other shorelines, those which change form primarily as a direct result

of submergence or emergence due to local changes of relative sea level. Changes of active shorelines may also be due in part to relative sea level changes (3), and there are few passive shorelines which do not exhibit some features resulting from sedimentation. However, the two groups are easily distinguishable by the fact that only passive shorelines occur on undisturbed, geologically old land surfaces, and have a similar form to the low elevation contours of those surfaces. It is useful for this purpose to consider only the mean high tide or mean annual high tide shoreline.

Active marine shorelines predominate in many regions of the world, producing such coastal land forms as wavecut scarps and beach and dune deposits. A forecast of the change in an active shoreline in the face of rising sea level requires an assessment of sediment sources and sinks and the processes of sediment transport. The complexity of these processes and our incomplete understanding of them essentially precludes accurate and specific predictions. However, much of the Atlantic and Gulf of Mexico coast of the United States south of Montauk Point, New York, effectively has two shorelines: an outer, active, wave-dominated barrier beach shore, and an inner shore due to the passive changes of relative sea level. The migration of a passive shoreline with rising sea level can be estimated with reasonable certainty. We have calculated the passive changes resulting from submergence which are occurring in several Long Island coastal villages which lie behind active barrier beaches.

Hypsometry and Submergence Rates

Our submergence calculations are based on the distributions of the surface area of the coastal villages with respect to elevation - that is, on the hypsometry of the villages. As an example, we show in figure 1 a topographic map of the village of Quogue, Long Island, New York (8). Making use of a graphics tablet we determined the area within each

contour interval within the village boundaries (omitting the barrier beach) and plotted these as percentages of the total area (Fig.2).

Making use of the hypsometric curve, we find that 0.043% of the surface area of Quogue, or 1.05 acres is on the average submerged annually by a rise in relative sea level of 3 mm/yr. Between 1985 and 2000, the land loss will be 15.8 acres, and between 1985 and 2100, 121 acres will be lost at the present (3mm/yr) rate of sea level rise (Table 1).

Once the hypsometric curve has been determined for a region of interest, the submergence rates which would result from any estimated future sea level rise can be determined. For example, we have applied to Quogue some of the possible future sea level rise rates presented recently by J.S. Hoffman (5). If potential climatic changes are taken into account, the rate of sea level rise may increase markedly in the near future (5). The land losses under such rates are presented in Table 1.

To date, we have prepared hypsometric curves for four Long Island coastal villages. In Table 2, we present estimates of their future diminution as a result of a constant relative sea level rise of 3 mm/yr. The mean annual loss within these four villages ranges from 0.47 to 1.26 acres, which represents from 0.03 to 0.08% of their total area.

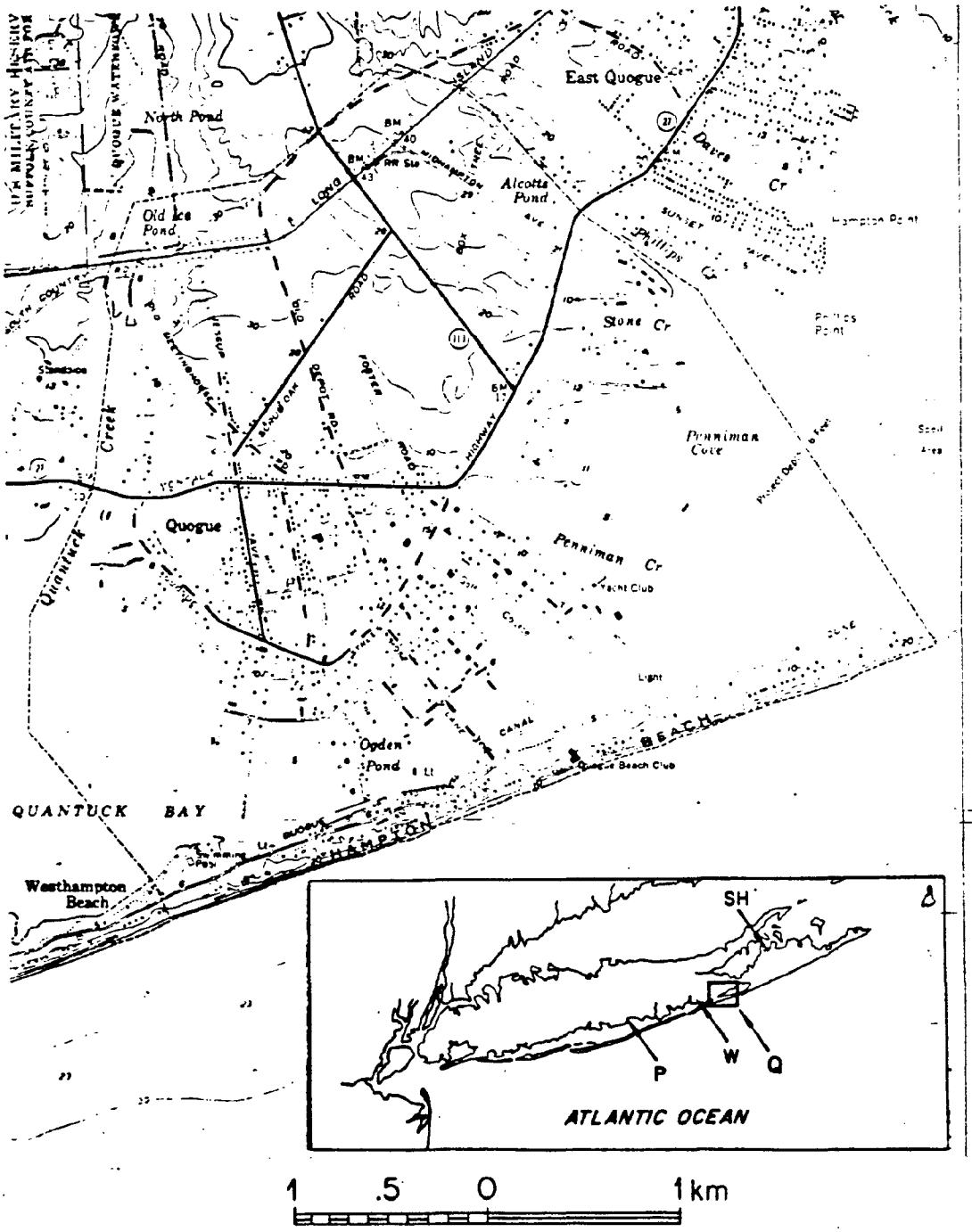

Fig. 1. Topographic map of the village of Quogue, Long Island, New York (8). Letter designations on arrows in insert refer to village names listed in Table 2.

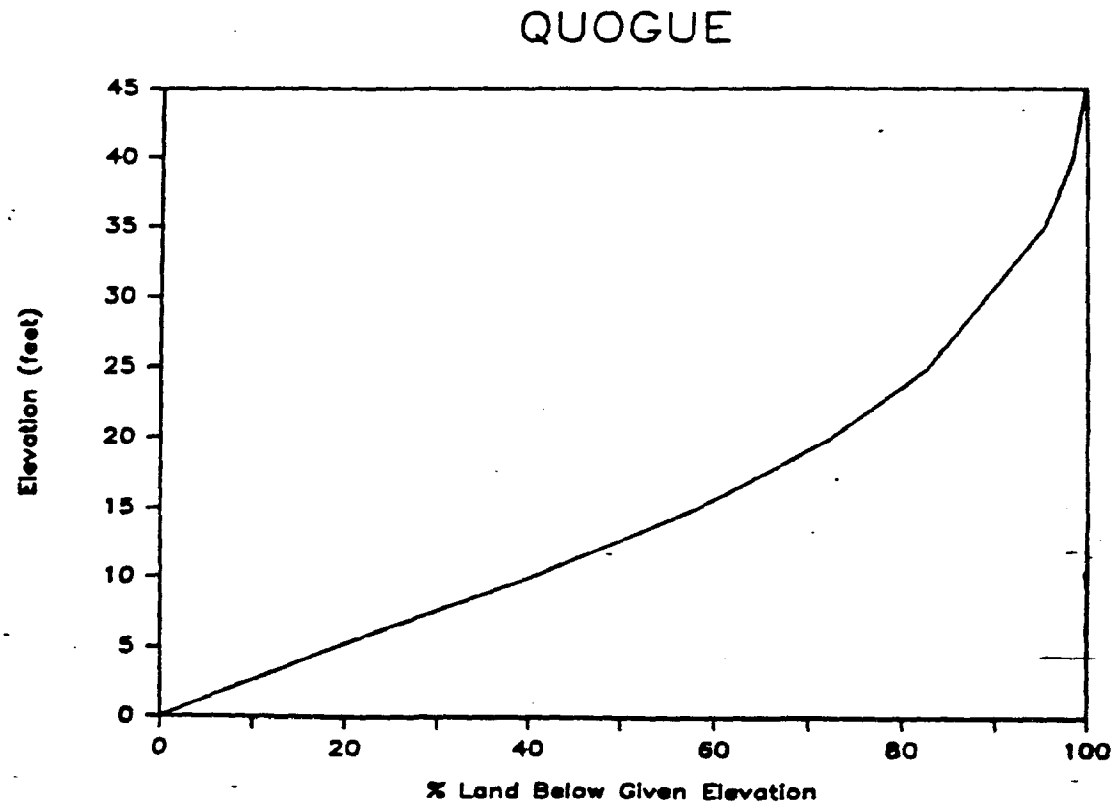

Fig. 2. Hypsometric curve of the village of Quogue.

TABLE 1

SUBMERGENCE OF QUOGUE IN ACRES CALCULATED FOR VARIOUS YEARS USING A 3 MM/YR SEA LEVEL RISE RATE AND THREE FUTURE SCENARIOS FROM HOFFMAN (5)

Year	3mm/yr	Hoffman Conservative	Hoffman Moderate	Hoffman High
2000	16	17	32	62
2025	42	47	94	198
2050	68	86	188	420
2075	94	137	328	766
2100	121	202	520	1,242

TABLE 2

SUBMERGENCE OF FOUR LONG ISLAND VILLAGES CALCULATED FOR VARIOUS TIME PERIODS USING A 3 MM/YR SEA LEVEL RISE RATE

Village	Area (acres)	Loss (acres per year)	Loss (acres) 1985-2000	Loss (acres) 1985-2050	Loss (acre 1985 2100
Patchogue	1485	0.47	7.0	30.6	54.
Westhampton B.	1547	1.26	18.9	81.9	144.
Quogue	2447	1.05	15.8	68.2	120.
Sag Harbor	1171	0.84	12.6	54.6	96.

Discussions and Conclusions

Detailed studies of the effects of future rates of relative sea level rise on specific communities have been prepared recently by Leatherman (7) and Kana, et al. (6). The use of hypsometry, while helpful for such detailed studies, will certainly not supplant them. Rather, the preparation of hypsometric curves for appropriate coastal communities and regions will provide environmental planners and managers with a tool which will allow them to quickly translate predicted rates of relative sea level rise into rates of coastal submergence. These estimates do not take into account area changes due to adjustments of water table such as growth of lake areas or the broadening of rivers, or area changes due to sedimentation process. Such adjustments probably tend to increase the rate of land loss.

Applying the method to four Long Island coastal villages, we find that between 0.03 and 0.08% of the land area of the villages is lost on the average per year as a result of a 3 mm annual rate of relative sea level rise. Making use of future predicted rates which have been published recently, we find that average rates varying from 2 to 10 times these values are possible by the end of the next century as a result of global climatic changes.

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The Great South Bay: An Outlook

For the Future

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Oakdale, N.Y.

Vulnerability of the Great South Bay Area to Storm-Related Damage*

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Coastal areas on Long Island have experienced dramatic residential and commercial development and change in recent years. As a result, the Island's south shore is far more vulnerable to storm-related damage and potential loss of life today than it was 74 years ago when the devastating hurricane of September 21, 1938 destroyed Westhampton Beach and other shoreline communities on Fire Island. This is despite the fact that early warning systems and hurricane forecasting techniques are now in place, and shoreline communities currently participate in the National Flood Insurance Program.

The extent to which damage will occur from a hurricane will

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*The material in this presentation is based on the report, Hurricane Damage Mitigation Plan for the South Shore of Nassau and Suffolk Counties, New York, published by the Long Island Regional Planning Board in October, 1984.

depend upon many factors, including magnitude of the storm, its duration, and other characteristics. The time and location of hurricane landfall cannot be predicted with certainty. What is certain, however, is that the damage and suffering will be staggering, and even worse, the event will occur in the future. Long Island has the potential to become the next site of the Nation's costliest hurricane disaster!

With funding provided through the Federal Emergency Management Agency, Region II Disaster Preparedness Assistance Program, the Long Island Regional Planning Board prepared a plan for mitigating damages as a result of severe storm occurrence for the south shore of Long Island. The plan contains the following types of information:

a. analysis of vulnerability to severe storms

b. population and number/value of structures at risk in 100 yr. storm tidal floodplain

c. recommendations in form of land use alternatives for both future development in the floodplain and redevelopment that would occur in the wake of a storm disaster.

d. recommended modifications to selected government programs that would adjust the private/public sector response to the severe storm hazard.

Items a. and b. above are the subjects of this presentation.

The eyewitness account of the 21 September 1938 hurricane given below as it impacted the south shore is germaine to the discussion of vulnerability of the Great South Bay to severe storms. This storm caused extensive damage in many Fire Island communities, including the Village of Saltarie.

Soon after three o'clock the situation on the beaches became critical, especially on that long strip from Shinnecock Bay to Moriches

Inlet where the dunes were mostly low and had at their backs a succession of bays and canals. And, as the storm approached from a bit west of south and the trend of the coast eastwards is a little north of east, the center reached Westhampton before it did points farther east, (sic). By three the sea there was all over the beaches and beating and breaking at the foot of the dunes. By half-past three it was breaking over and through the dunes at many places and sometime toward four o'clock the final castastrophe occurred. Before the onslaught of that terrible tide, itself perhaps ten to fifteen feet above the normal height and crested with breakers towering fifteen feet higher or more, the whole barrier of the dunes crumbled and went down save for here and there where a higher dune or a strong bulkhead held. In a few minutes along the stretch of beach from Quogue village to Moriches Inlet there remained of 179 summer homes only 26 battered shells of houses of which hardly a dozen will ever be habitable again.

Shortly before four the dunes gave way before the terrible force of the roaring surf, houses collapsed, cars were tumbled like leaves, some of the staunchere houses were floated intact and whirled crazily in the core of the hurricane. Geography changed as new inlets were pushed through by the angry sea demanding an outlet for its force. For over two hours there was no difference between the Atlantic Ocean at its worst and the usually placid Moriches Bay, as the latter was swollen by the inrush of lashing water.

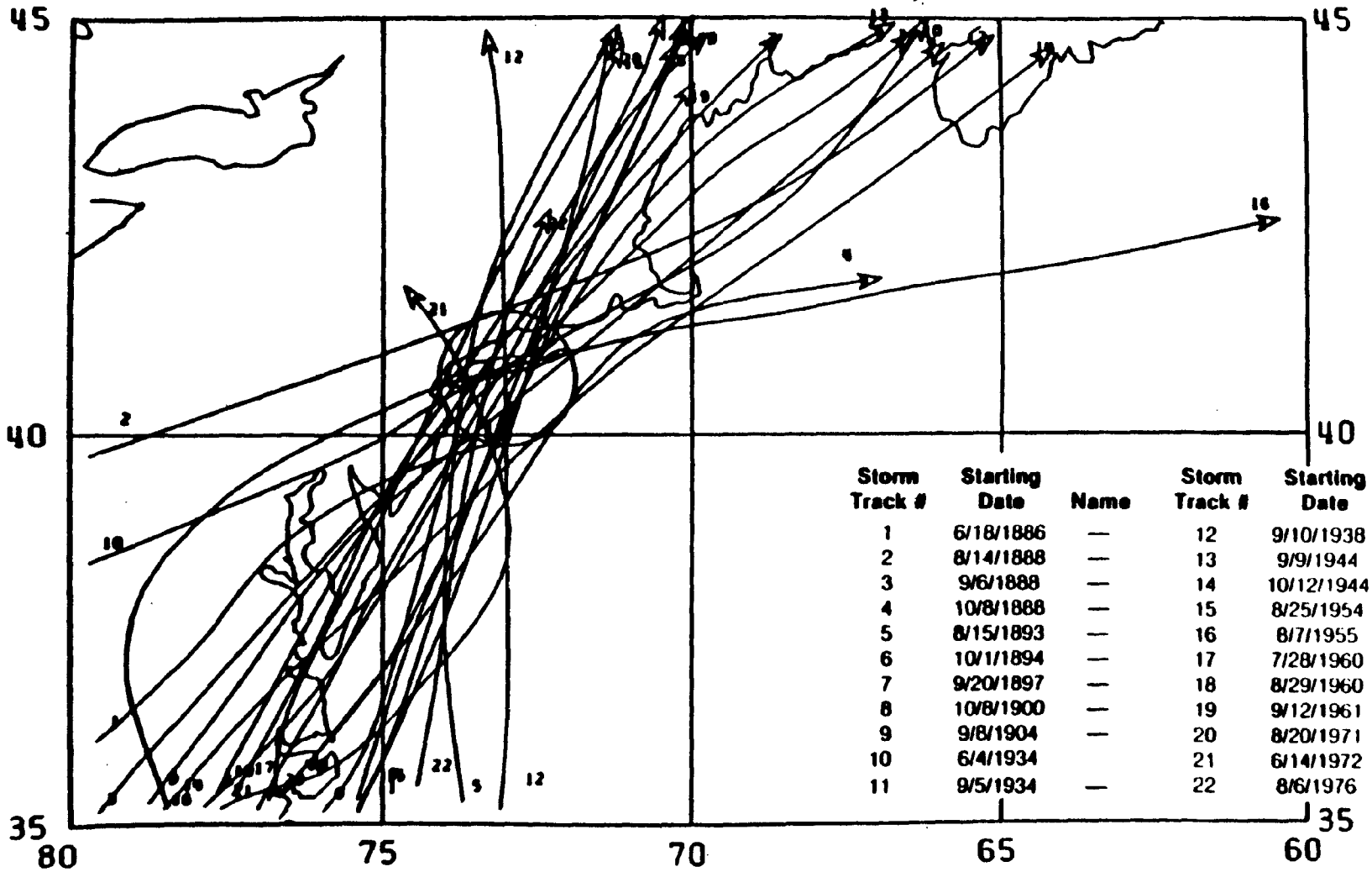
The 1938 hurricane, with its 83 year recurrence interval flood level of 17.5 ft msl, changed the geography of Long Island's south shore. Such storms are not rare events in the history of the area. The probability that at lease one tropical storm (with sustained wind speeds of more than 34 knots) will impact the Long Island area during the next 10 years ranges from 0.85 to 0.96, indicating the high likelihood of such an

event in the next decade. The probability that at lease one storm of hurricane magnitude (with sustained wind speeds of greater than 64 knots) will impact this area in this time period is slightly less, ranging from 0.5 to 0.8. During the period from 1886-1983. 815 tropical cyclones were generated in the Atlantic Ocean off the east coast of the U.S. Twenty one of these storms (7 hurricanes; 15 tropical storms) passed through a circle of 50 nautical mile radius centered near the Great South Bay. The tracks of these storms are shown in Figure 1.

Northeast storms can also cause significant coastal impacts; in a given year there is roughly an 80% chance that a northeast storm will occur that causes significant water-related damage in New York. On the average, usually severe storms occur (either northeast storms or storms of tropical origin) in the region about three times a century.

Most of the damage to shoreline development in severe storms results from storm surge flooding. Along the south shore, tide elevations associated with the 100-year tidal floodplains range up to 18 ft above NGVD, depending upon location and topography. For northeast storms, the duration of the storm is an important factor in determining the level of damage imposed. If storm movement is slow, winds of long duration pose a problem for the Island's south shore. The effects can last 4 or 5 tidal cycles. In contrast, the higher winds and tides of hurricanes generally last less than 6 hours.

Severe storms can cause as much modification to the shore in a matter of a few hours as it would take normal weather conditions to produce in a hundred years. The 1938 hurricane leveled dunes that had taken over 100 years to build; the storm breached most dunes on Fire Island that were less than 16 ft in elevation. After the storm, the dunes were reduced to heights of 5 to i ft. Eight inlets were created between



Storm Track #	Starting Date	Name	Storm Track #	Starting Date	Name
1	6/18/1886	—	12	9/10/1938	—
2	8/14/1888	—	13	9/9/1944	—
3	9/6/1888	—	14	10/12/1944	—
4	10/8/1888	—	15	8/25/1954	Carol
5	8/15/1893	—	16	8/7/1955	Diane
6	10/1/1894	—	17	7/28/1960	Brenda
7	9/20/1897	—	18	8/29/1960	Donna
8	10/8/1900	—	19	9/12/1961	—
9	9/8/1904	—	20	8/20/1971	Doria
10	6/4/1934		21	6/14/1972	Agnes
11	9/5/1934	—	22	8/6/1976	Belle

Figure 1
Tropical storms and hurricanes passing within 50 nautical miles of Long Island, N.Y. 40.7°N. 73.0°W. 1886-1982

Moriches Inlet and Southampton in the barrier beach. Effects of northeasters can also be devasting, since they occur more frequently and there may be little time for beaches to rebuild themselves before the occurrence of another storm.

The response of the shoreline to the occurrence of severe storms depends upon the type of environment involved. Bluffed coasts and barrier bars differ in their response to the storm surge associated with severe storms. For barrier bars, beach recession, dune erosion, inlet formation and deposition of overwash fans are principal effects of hurricanes. There is widespread erosion and deposition of sediment due to increased wave action along the shore; storms can also cause the maximum current velocities in estuarines to double or triple above normal levels. This situation would have ramifications for the northern shoreline of Great South Bay.

The extent and type of structural damage that occurs during a severe storm depend upon the nature of land use in the tidal floodplain. Table 1 shows the acreage of various types of land use in the A and V tidal flood zones of Great South Bay (Towns of Babylon, Islip and Brookhaven). Recreation uses predominate, but nearly 7,000 acres have been developed for residential purposes, and over 2,000 acres of vacant land are available for development.

The value of structures and population at risk in the Great South Bay floodplain were determined. The results indicate a total single and two-family residential structural value in the area of nearly $1 billion. (See Table 2.) Over 13,000 residential structures have been built in the floodplain of the bay, and they are subject to flooding during a 100-year storm event.

The exposure of the resident population to flooding is also an important factor in a vulnerability analysis. Table 3 shows the year-round and seasonal populations in the Great South Bay tidal floodplain by community. During the summer a total population of roughly $52,000 would be exposed to the danger of flooding, etc. should a severe storm occur.

It should be noted that the above estimates only apply to the Great South Bay floodplain. Damage that could occur to structures located inland due to high winds and the exposure of the population in this region are not included.

Table 1. 1981 Land Use by Town for Great South Bay Flood Hazard Zones

		Residential				Commercial									
	Total	Low Density	Medium Density	Intermediate Density	High Density	Total	Commercial	Marina Commercial	Total	Industrial	Transportation Utility Communication	Institutional	Recreation	Agriculture	Vacant
Acres in A Zone	23,319	710	3,610	1,949	88	4,357	85	356	441	64	195	794	13,317	190	1,961
Acres in V Zone	9,033	15	225	332	0	572	10	0	10	0	0	33	8,108	0	110
TOTAL	32,352	725	3,835	2,281	88	4,929	95	356	451	64	195	827	21,425	190	2,071

Table 2. Number and Value of Single and Two-Family Residential Structures in the South Shore Flood Hazard Zones Bordering the Great South Bay

Municipality	"V" Zone Structures	"V" Value (in millions of $)	"A" Zone Structures	"A" Value (in millions of $)	Total Value (in millions of $)
Village of Amityville			758	48.3	48.3
Copiague			1,823	83.3	83.3
Village of Lindenhurst			831	32.4	32.4
West Babylon			575	27.0	27.0
Gilgo/Oak Beach	324	31.3	119	11.2	42.5
Village of Babylon			957	58.3	58.3
TOWN OF BABYLON TOTAL	324	31.3	5,063	260.5	291.8
West Islip			689	60.6	60.6
West Bay Shore			75	6.1	6.1
Fire Island (Islip)	236	27.2	1,673	190.9	218.1
Fire Island (Brook.)	350	43.8	1,318	157.4	201.2
Fire Island Total	586	71.0	2,991	348.3	419.3
Village of Brightwaters			56	4.1	4.1
Bay Shore			308	20.4	20.4
Islip			135	13.7	13.7
East Islip			77	9.7	9.7
Great River			21	2.3	2.3
Oakdale			681	41.3	41.3
West Sayville			88	2.6	2.6
Bayport			184	12.1	12.1
Sayville			98	6.7	6.7
TOWN OF ISLIP TOTAL	236	27.2	4,203	377.2	404.4
Blue Point			148	8.0	8.0
Village of Patchogue			80	2.9	2.9
East Patchogue			107	5.2	5.2
Brookhaven			97	6.2	6.2
Village of Bellport			24	2.3	2.3
Mastic Beach	5	2	986	33.8	34.0
Mastic			32	1.2	1.2
Poospatuck Indian Res			7	.2	.2
Shirley			130	4.0	4.0
TOWN OF BROOKHAVEN TOTAL	355	44	2,929	221.2	265.2
TOTAL	915	102.5	12,195	858.9	961.4

Table 3. Population in the South Shore Flood Hazard Zones Bordering the Great South Bay

Community or Municipality	Year-round Population	Additional Seasonal Population	Total of Year-round and Seasonal Population
Town of Babylon	16,806	1,353	18,159
Village of Amityville	2,369		2,369
Copiague	6,109		6,109
Village of Lindenhurst	2,709		2,709
West Babylon	2,129		2,129
Gilgo/Oak Beach	418	1,353	1,771
Village of Babylon	3,072		3,072
Town of Islip	8,595	19,970	28,565
West Islip	2,449		2,449
West Bay Shore	237		237
Fire Island (Islip)	—		—
Fire Island (Brookhaven)	—		—
Fire Island Total	509	19,970	20,479
Village of Brightwaters	219		219
Bay Shore	1,098		1,098
Islip	402		402
East Islip	297		297
Great River	57		57
Oakdale	2,239		2,239
West Sayville	132		132
Bayport	644		644
Sayville	312		312
Town of Brookhaven	3,889	925	4,814
Blue Point	410		410
Village of Patchogue	239		239
East Patchogue	312		312
Brookhaven	269	26	295
Village of Bellport	66		66
Mastic Beach	2,036	862	2,898
Mastic	96		96
Poospatuck Indian Res.	31		31
Shirley	430	37	467
TOTAL	29,290	22,248	51,538

Strategies and Recommendations by Coastal Reach and Detailed Study Area

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Strategies and recommendations are presented in the Board's Hurricane Damage Mitigation Plan for each of the six coastal reaches and six detailed study areas stretching from Nassau/Queens border to Montauk Point. For the purpose of this conference, only those reaches bordering on Great South Bay will be reviewed. They include the Jones Beach Barrier Island reach and the Gilgo/Oak Beach detailed study area, the Fire Island reach and the Village of Saltaire to Lonelyville detailed study area, and the Mainland reach and Mastic Beach detailed study area. The strategies and recommendations have been formulated for each of the reaches and detailed study areas to mitigate damage caused by severe storms.

Jones Beach Barrier Island Reach

The Jones Beach Barrier Island is located almost entirely in the "V" flood hazard zone. The residential communities of West Gilgo Beach, Gilgo Beach and Oak Beach are in the "V" zone and Oak Island and Captree Island are in the "A" zone.

The entire shoreline is free of groins an jetties except for concrete rubble and small wooden groins at Oak Beach. The beach is periodically nourished through the by-pass of sand dredged from Fire Island Inlet. Fill from the dredging of the State Boat Channel in the 1920's was placed along the entire length of the dune system and then graded for the construction of Ocean Parkway.

Jones Beach Island is all publicly owned and is extensively used for recreational purposes. Attendance at Jones Beach State Park is between 8 and 10 million persons/year. Public parks located on Jones Beach Island include Jones, Gilgo and Captree State Parks and Towns of Babylon and Oyster Bay beaches.

The major strategies developed for the Jones Beach Island reach include:

° Encourage natural sand transport pattern, but artificially maintain the shoreline as required.

° Maintain inlets at current locations and configurations. Close new inlets if they develop. Do not allow commercial or residential structures to be rebuilt after a breach is repaired.

° Protect and maintain dunes. Construct pedestrian crossover points along Ocean Parkway, as required, to allow for safe pedestrian access to beach and to protect dunes.

° Retain and expand recreational uses as the most appropriate land use in this reach.

Gilgo/Oak Beach Detailed Study Area

The detailed study area includes the five residential communities of West Gilgo Beach, Gilgo Beach, Oak Beach, Oak Island and Captree Island. The total structural value at risk in these five residential areas is $31 million in the "V" zone and $11 million in the "A" zone.

All of the residential land in these communities is owned by the Town of Babylon and leased to either individual homeowners or homeowner associations. Town residency is not a requirement in obtaining a lease for property on the barrier or bay islands. In fact, over 50% of the mailing addresses of the 420 leaseholders on record with the Receiver of Taxes are

not within the Town of Babylon. Leaseholders own the structures and pay to the Town annual lease fees of approximately $300/structure and property taxes of approximately $1,700/structure. The Town renewed the leases with the leaseholders in the five communities in the mid-1970's for a 25 year period.

Approximately 80 vacant, developable lots still exist within the communities that are either leased to homeowner associations or held by the Town. Census data clearly shows that seasonal dwellings within the communities are steadily being converted to year-round residences.

The strategies for the Gilgo/Oak Beach detailed study area are as follows:

° A detailed land use plan for this area should be prepared, showing the accommodation of public access and additional recreational facilities and the reversion of certain currently developed properties to uses compatible with natural resource values.

° The Town should phase out leases on town owned property over the long-term. The Town should investigate the option of extending the leases on an individual basis to allow present leaseholders a chance to amortize their structural investment over a 30 year period, in exchange for leaseholder agreement that structures will not be rebuilt after sustaining damage from storm-related flooding and/or erosion equal to or exceeding 50% of structural value. The 30-year amortization period would begin at the time a structure was built or purchased by the current leaseholder. Leases would be extended beyond their current termination dates to the extent necessary to provide for the 30-year period. In those cases where structures will have been owned by the same party for a period greater than 30 years when the existing leases expire, lease extensions would not be warranted.

° After phaseout of leases, the Town should provide facilities for additional public recreational use and implement programs for natural resource protection.

° The Town should not grant new leases or permit additional construction on leased property.

° The Town should never sell the publicly owned land to leaseholders or private interests.

Fire Island Reach

Fire Island is a long, narrow, highly dynamic barrier island subject to severe erosion and dune migration. The shoreline of Fire Island is predominantly natural and there exists an extensive but irregular dune system up to 30' in elevation. Dunes have been distributed in some communities and residences have been constructed along the dune line. Severe erosion of the beach and dunes threaten oceanfront residences in many of the communities.

There exists on Fire Island public beaches and open space, a large wilderness area within Fire Island National Seashore (FINS) and 20 summer communities. There is a large seasonal population at risk residing on Fire Island--approximately 20,000 people. The structural value at risk on Fire Island is approximately $350 million in the "A" zone and $71 million in the "V" zone.

The major strategies proposed for the Fire Island reach include:

° Limit public expenditures for artificial shoreline maintenance east of Robert Moses State Park and west of Smith Point County Park, except where it may be necessary to close or prevent the opening of a new inlet. Should the site of a new inlet include private property, such property should be condemned prior to repair of the breach.

° The implementation of large scale dune building and beach maintenance projects along Fire Island is not recommended. Government agencies (Federal, State, local) should not provide funding for erosion control projects along the waterfront to protect seasonal homes, except for smallscale projects such as snow fencing or vegetation planting.

° Individual owners should bear the brunt of structure loss due to erosion. FINS should not purchase individual storm-damaged structures.

° Any erosion control measures taken by private interests to protect an area of beach should not adversely affect the downdrift of transport of sand.

° Institute a uniform, dynamic dune district line for both the Towns of Islip and Brookhaven to protect the dunes and natural shoreline features.

° Prohibit development/redevelopment within a uniform, dynamic dune district.

° Locate new public water supply wells away from flood hazard areas. Do not rebuild damaged wells in vulnerable locations.

° Increase police powers to limit access to the Island during storm watch and warning periods.

Village of Saltaire to Lonelyville Detailed Study Area

The detailed study area for Fire Island includes the Village of Saltaire and the communities of Fair Harbor, Dunewood and Lonelyville--approximately 1 mile in length. There are now 938 structures within the detailed study area. There is a potential for 267 additional structures--over 50% of which could be accommodated in the Village of Saltaire.

Due to long-term shoreline erosion, only the landward flank of the dunes remains in this area. Thus, dunes are low and in some instances non-existent. The ocean shoreline in Saltaire has retreated 200' northward since its incorporation as a village in 1917.

The strategies for the detailed study area are:

° The Village of Saltaire should consider the establishment of an erosion control district for small scale or emergency projects, as provided under New York State Village Law: Article 4 - Powers, Etc. of Officers - Section 412; and ARticle 22 - Local Improvements - Section 2200.

° The unincorporated areas of Fair Harbor, Dunewood and Lonelyville are also eligible to establish and erosion control district as part of the Town of Islip, under New York State Town Law: Article 12 - District and Special Improvements; and ARticle 12A - Establishment or Extension of Improvement Districts, Alternative Procedure - Sections 190-209h.

° Prohibit the rebuilding of structures located in the NYSDEC Coastal Erosion Hazard Area in the vent that they suffer erosion/storm damage equal to or exceeding 50% of structural value.

° As individual houses are damaged or destroyed, the Village of Saltaire should prevent the rebuilding of certain storm-damaged houses along the ocean front by enforcing its dune protection ordinance.

° Should a significant number of oceanfront houses be damaged or destroyed by a hurricane or northeast storm, the communities should prohibit rebuilding in the same location, and instead encourage the clustering of development at less vulnerable inland locations.

° Coastal communities, such as the Village of Saltaire, should develop policies and guidelines for post-storm redevelopment now -

before the storm -rather than after the event when redevelopment pressures are greatest.

° In the event of a major storm which destroys large portions of these or other Fire Island communities, an alternative redevelopment proposal would include the use of certain FINS properties as sites for clustered development, in exchange for parcels more susceptible to flooding and erosion damage.

Mainland Shoreline Reach

The mainland shoreline bordering on the Great South Bay in the Towns of Babylon, Islip and Brookhaven is characterized by extensive residential development, man-made canals and bulkheading. The intensity of development is greatest in Babylon and western Islip. There are some undeveloped tidal wetlands and shorefront recreation areas, but the shore is predominantly developed.

Development lying within the 100 year floodplain on the south shore mainland is in the "A" flood zone category, i.e., structures in the "A" zone are subject to static flood, but not wave action. These structures will face water damage from flood waters, but not significant structural damage. The mainland shoreline, as opposed to the barrier islands, is not likely to suffer large-scale storm damage resulting in a clean slate redevelopment situation.

Flooding problems exist in certain areas where residential development was built on low-lying wetland areas prior to the National Flood Insurance Program and is thus neither floodproofed nor elevated above the base flood elevation. These areas include Amityville, Copiague, Lindenhurst, Babylon, Islip, Oakdale and Mastic Beach. Another problem encountered in these areas is that many of the streets along the canals and creeks were built below the base flood elevation, and will not only flood, but will serve as conduits for flood waters.

The strategies developed for the mainland reach are:

° The primary strategy for the mainland shoreline is to steer future development or post-storm redevelopment in flood hazard zones to inland sites where structures may be clustered, leaving the waterfront as open space.

° In those densely developed mainland areas subject to repeated flooding, it may be practical and cost-effective to raise the structures above the base flood elevation. FEMA should examine the long-term benefits of such a one-time expense as a payment or as a loan, contrasted against repeated flood insurance claims.

° Many of the streets built along the canals and creeks of the mainland reach were originally built below the base flood level and are subject to flooding. A possible remedy to this situation would be to raise the street. Communities such as the Villages of Island Park and Lindenhurst have used Community Development Block Grant funds for street raising programs.

° Many houses in the mainland "A" zone were built with basements, which are frequently flooded. The suggested strategy is for FEMA to deny requests for basement construction in flood hazard zones.

° Damage to hazardous material storage facilities located within the 100-year floodplain may result in the release of this material into the coastal environment, thus posing potential threats to public health and marine environment. It is, therefore, imperative that if these structures are to remain or be constructed within the 100-year floodplain that they be adequately floodproofed.

Mastic Beach Detailed Study Area

The detailed study area is located east of the William Floyd Parkway on the south shore of Brookhaven Town, and is flanked on the west

by NYSDEC tidal wetland and on the east of the federally-owned William Floyd Estate. Over half of the study area is vacant. A significant portion of the vacant property contains either maritime floral or tidal wetlands. Much of the shoreline has not been bulkheaded.

The entire area is zoned for 15,000 square feet residential lots. Much of the area has been divided into small lots through old filed subdivision maps. All of the land in the study area is within the "A" zone.

The Mastic Beach detailed study area strategies are as follows:

° The scattered residences in the flood zone adjacent to tidal wetlands should be removed and relocated to inland locations. Suitable upland parcels owned by the Town of Brookhaven or Suffolk County should be identified and designated as appropriate sites for relocation.

° Use of public funds to upgrade roads and provide municipal water supply should be discouraged in the detailed study area.

° The Town of Brookhaven should rezone to a lower density those areas within the study area subject to old filed subdivision maps in order to limit the density of future development should a large number of parcels be assembled by a single owner.

° The relocation of structures from this study area would help to provide a buffer zone between the upland development and adjacent wetlands and bay environments. The establishment of a buffer zone would also add to the protection of the more densely developed areas in the vent of a major. storm. This strategy is in accordance with the State purchase of wetlands in the western portion of the study area.

° There is a high potential for future development of the low-lying flood-prone areas of Mastic Beach, due in part to its proximity to FINS and the Suffolk County Park at Smith Point. Therefore, there is a need to act swiftly to protect and rehabilitate the extensive wetlands in the study area.

Suggested Modifications To Selected Government Programs

There are numerous state and federal programs affecting development and post-storm redevelopment along the south shore floodplain. This discussion will focus on the following three programs:

1.) National Flood Insurance Program

2.) The Coastal Barrier Resources Act

3.) The N.Y.S. Coastal Erosion Hazard Areas Act.

The National Flood Insurance Program has, since 1968, provided flood insurance protection to owners of structures in flood-prone areas in exchange for the adoption of local floodplain management regulations. The maximum insurance coverage presently available depends on whether a community is in the emergency or regular program. A community initially enters the emergency program by adopting minimum floodplain management regulations. The community enters the regular program after a flood insurance rate map is completed by FEMA and local officials enact regulations that require all new or substantially improved structures to be built in accordance with federal floodplain management criteria.

Maximum Insurance Available

Program and Building Type	Building	Contents
Emergency Program:		
Single family residence	$ 35,000	$ 10,000
Other residential	100,000	10,000
Non-residential	100,000	100,000
Regular Program:		
Single family residence	185,000	60,000
Other residential	250,000	60,000
Small business	250,000	300,000
Other non-residential	250,000	200,000

All Nassau and Suffolk municipalities with a marine floodplain currently participate in the regular program.

Section 1362 of the Act authorizes the purchase of structures and property when the structures have been damaged:

1.) substantially beyond repair

2.) not less than three previous times during the proceedings 5 year period, each time the cost of repair equalling 25% or more of the structure's value; or

3.) from a single casualty of any nature so that an ordinance precludes its repair

Section 1362 could be used to remove development in the floodplain subject to recurring damage; however, it is drastically under-funded with $5 million available nationwide.

Communities may issue variances to the floodplain management criteria. The issuance of such variances generally is limited to a lot size less than ½ acre. Thus, the issuance of variances is facilitated in flood prone areas such as Fire Island, since lot sizes in most cases are smaller than ½ acre.

Communities in the regular phase of the NFIP and with identified V Zones must ensure than construction is located landward of mean high water. However, under current standards, structures may be built in wave velocity zones if protection is provided to the 100 year flood elevation and property secured. Thus, structures located on the beach that have been destroyed by storm induced flooding could be rebuilt on pilings and remain eligible for flood insurance, thereby establishing a cycle of repeated flood losses. It is recommended that the Federal government modify the flood insurance program to phase out flood insurance in V Zones. Flood insurance should not be made available to new development in V Zones.

Current policyholders whose structures are damaged greater than 50% of structural value should receive a final payment equal to the value of their structure up to the policy limit, if the homeowner agrees not to rebuild in the V Zone. If the homeowner wishes to rebuild in the V zone, flood insurance payments would reflect the actual structural damage only, up to the policy limit; and continued flood insurance coverage would not be available for that structure.

Another way in which FEMA could break the cycle of repeated flood losses within V Zones would be to re-institute the constructive total loss program, whereby a claimant is paid the total insured value of the structure and, in return, the claimant donates the property to the locality.

The NFIP floodplain management criteria do not address redevelopment in a post-storm situation. There may be areas, such as V Zones or barrier islands, where redevelopment in the same location would be imprudent and would result in a continuing cycle of flood losses. It is recommended that the floodplain management criteria be amended to require communities to enact a temporary building moratorium in instances of large scale storm damage.

FEMA could improve floodplain management by increasing the scale of Flood Insurance Rate Maps. Currently, it is difficult to determine whether a proposed development lies within the 100 year floodplain. In addition, topographic data and structure locations are lacking.

Another federal program that has the potential to discourage floodplain development, and more importantly development on the more vulnerable barrier islands in the Coastal Barrier Resources Act. Enacted in October 1982, it establishes the Coastal Barrier Resources System as

referenced and adopted by Congress, and prohibits Federal expenditures and financial assistance (including flood insurance) for development of coastal barriers, or portions thereof which are not presently developed. The Act simply advances the philosophy that the risk associated with new private development in these hazardous areas should be borne by the private sector and not underwritten by the Federal governments. Coastal barrier unit designations were made upon the level of development as of March 15, 1982.

Areas established under Federal, state or local law or held by a qualified organization primarily for wildlife refuge, sanctuary, or natural resource conservation purposes were not included within the system.

The Department of the Interior is compiling a list of all coastal barriers in public or private ownership, that are treated as otherwise protected, for consideration by Congress for inclusion within the Coastal Barrier Resources Act. It is recommended that the Federal government include the otherwise protected areas within the Act and, thereby, eliminate Federal expenditures and financial assistance for development of privately owned properties that are not otherwise protected, but yet within the boundaries of governmental conservation areas.

In 1981, the New York State Legislature passed the Coastal Erosion Hazard Areas Act as the principal law governing erosion and flood control along New York's coastline. The purpose of the Act, known as Article 34 is to minimize or prevent damage and destruction to property and natural resources from flooding and erosion due to inappropriate actions of man. This Act will be implemented based on the control, through permits, of development and other land use activities in designated erosion hazard areas. Article 34 is intended to be implemented at the local level, except for State agency activities. Erosion hazard areas and defined as natural protective feature areas or structural hazard areas. Most of the south

shore falls into the first category. The boundary or setback line is defined as being set back 25 ft. from the landward edge of the dominant natural protective feature. Erosion area permits must be obtained for development, new construction, erosion protection structures, public investment, and other land use activities within the designated coastal hazard areas.

Any permit applicants wishing to obtain a variance must prove that compliance with the restrictions would cause unnecessary hardship or result in practical difficulties...and they must show that the structure will be reasonably safe from flood and erosion damage.

There is a conflict between the Coastal Erosion Hazard AReas Act and the National Food Insurance Program. On the one hand, the State is discouraging, and, in some cases prohibiting development seaward of the setback line, whereas, the Federal government will pay a claim for a flood loss and reinsure that structure, if rebuilt on the same site.

Recent judicial decisions in New York State in which homeowners challenged local ordinances denying building or rebuilding in coastal hazard areas have ruled in favor of the homeowners, instructing localities to either approve the permit applications or acquire the property through condemnation.

There are two elements of the National Flood Insurance Program that could satisfy the requirements of recent judicial decisions in instances where structures have been either significantly damaged or destroyed by flooding. Again, implementation of section 1362 or the now defunct constructive total loss program could resolve the conflict between the state and federal programs.

The three programs I have highlighted, will, if implemented as recommended in the Hurricane Damage Mitigation Plan discourage development and redevelopment in coastal high hazards areas.

Panel Discussion on

Hurricane Preparedness:

Summary

Discussion Panel

Secretary of State Gail Shaffer, Moderator

Mr. Frank Petrone, Federal Emergency Management Agency Region II

Dr. Lee Koppleman, Long Island Regional Planning Board

Mr. Jack Hauptman, Fire Island National Seashore

Mr. Jean Gilman, NYS Department of Environment Conservation

Mr. George Stafford, New York State Department of State

George R. Stafford,(NYS Department of State,)

Unfortunately due to illness, Secretary Shaffer could not be with us today. However, I have the pleasure of introducing our panelists, and asking them to briefly describe their programs.

Dr. Lee Koppleman(LIRPB) - (Adapted from previous presentation) I wish to express my thanks to Senator D'Amato and Frank Petrone, both of whom were instrumental in obtaining funds to produce the Hurricane Damage Mitigation Report for Long Island. The goals of this study were to present options for minimizing loss of life, minimizing adverse economic consequences, minimizing post-disaster government subsides, and discouraging development in high hazard areas. The conflicts of such a project is obvious. Many people live in high hazard areas and are unwilling to take the full risk or to move. For example, residents of Captree and Oak Beach islands in the Town of Babylon may be required to vacate Town owned land. These sacrifice are made for the greater good of the community in general. In closing, I'd like to say that the LIRPB

prefers the option of buying out the property owners over the option of providing subsidized flood insurance for them.

Thank you.

Frank Petrone (FEMA)

I would like to thank Senator D'Amato for securing the $130,000 funding for this very important report by the LIRPB. I endorse the LIRPB recommendations and request that interested parties comment on the report.

The scope of this study was to assess the vulnerability of the South Shore to a hurricane, and I think Dr. Koppleman and his staff have done an excellent job. Mitigation of these expected damages is the key to achieving the goals of the study. This is a controversial issue, and requires leadership, cooperation and sharing. We need to avoid the crisis mentality and to begin working toward common goals.

My office was fortunate to receive $2.5 million this year, from a nationwide pot of $4.7 million, to purchase 41 homes through FEMA's Section 1362 buyout program. I recommend that we put additional funds into the Section 1362 buyout program of FEMA, and use this program to achieve some of the goals expressed in this report.

As a point of information, FEMA will be adding more detailed topographic and structure data to the flood insurance rate maps. This additional information should make the products easier to use.

Thank you for your attention.

Jack Hauptman (FINS)

Thank you for inviting me to this conference today. I must say that I am impressed by the discussion of rising sea level and long term trends, since the most common trend in high hazard areas is to work on short term erosion and to ignore long term trends.

I think rebuilding in high hazard areas should not receive public support (financial or otherwise). However, people who move out of high hazard areas and rebuild elsewhere should receive public incentatives. One way of doing this would be for local municipalities to untax open space in high hazard areas and for the the National Flood Insurance Program to encourage rebuilding outside high hazard zones.

As far as evacuation is concerned, I believe it would be more difficult to evacuate the more developed areas which have only a causeway, than Fire Island which has nine ferry routes. The fact that the beach is evacuated every weekend in about four hours supports this contention.

Jean Gilman (NYS DEC)

I would like to thank FEMA and the LIPRB for this study, and the recommendations they made regarding the State's Coastal Erosion Hazard Areas Act and the Federal National Flood Insurance Program. I am here today to answer any questions you may have on the State's Coastal Hazard Areas Act.

Thank you.

Question 1 Kenneth Herman, (Common Shores Inc.)

I represent several hundred people who are concerned with preservation of our coastal barrier islands, as well as many individuals who now live on Town of Babylon property on both Captree and Oak Beach. The LIRPB recommendations call for an elimination of the leases for these homesites, as well as a phase out of federal flood insurance. While we agreed that flood insurance should be canceled, we disagree that these communities should be eliminated. Since NYS has not taken the position that development on these islands should be restricted, we think the LIRPB

should take a more humanitarian view of this situation, and we propose an alternative management plan.(plan submitted)

- Dewitt Davies (LIRPB)

The LIRPB has not singled out the Captree and Oak Beach communities, but has made similar recommendations for town owned land in East Hampton. The LIRPB is fearful of an outright sale of the land, or generation of another long term lease. The flood insurance elimination will be phased in, and not an automatic change. Therefore, this recommendation is an excellent opportunity to return this land to public use at little or no cost.

-Aram Terchunian (DOS)

Special care should be taken, to insure that this area is not redeveloped with public structures. Such redevelopment would be counter to the intent of the LIRPB goals of minimizing public dollars at risk.

Question 2 Unidentified Participant

Are there any endangered historical structures in this area? and if so, what can the public do?

- Dewitt Davies(LIRPB)

The value of any historical sites in this area should be assessed and resources used to protect them.

Question 3 John Stearns, Fire Island Community

The Fire Island community would like to see sand bypassing installed at the inlets, but the LIRPB report does not mention this. Does LIRPB feel sand bypassing is not necessary?

- Dewitt Davies(LIRPB)

Generally, the LIRPB promotes sand bypass as a concept. However, this report was only addressing hurricane damage mitigation.

- Jack Hauptman(FINS)

A sand bypass activity should not adversely affect downdrift beaches and thus should not be opposed.

- Sam Tosi(Corps of Engineers)

The Moriches Inlet project is a sand bypass project. And the overall hurricane protection plan is to build up the dunes to protect the mainland. Sand bypass can provide some of the material necessary for the buildup.

- Jay Tanski (Sea Grant)

We must remember that inlets are system oriented, whereas our efforts on Long Island seem to be crisis oriented. We need to address a systematic operation to inlet management.

- Frank Petrone(FEMA)

We need to instill an environment of cooperation, and this can best be done through endorsement. It is time to start holding hands and working together.

- Gordon Canary (Town of Babylon)

One of the problems with inlet dredging (at Fire Island Inlet) is that it causes an increase in salinity.

- Jay Tanski (Sea Grant)

That statement epitomizes the need to cooperate and share information. Work done by the Marine Science Research Center has shown that dredging at Fire Island Inlet does not change salinity. I use this example to point out that the Center can provide a wealth of information to be shared and acted upon.

Question 4 Unidentified Bayman

Does LIRPB plan address impacts on shellfish?

- Dewitt Davies(LIRPB)

Yes, it does, and in the case of a hurricane the impacts will be very severe.

Question 5 Robert Cook (Consultant)

The barrier hurricane protection project was sold as a program to protect the mainland. I have heard people here say that it is being used to protect houses on the barrier island. I don't think this was the intent, or is the current use of the plan.

There are little or no dunes in many places now, and thus there is no protection in many places.

Question 6 Donald DeVito (State Emergency Management Office)

I would like to thank Secretary of State Gail Shaffer and Congressman Thomas Downey for arranging this conference.

I want to point out, that hurricane preparedness is more than acquisition and construction, it is also training and awareness. There are existing population centers which must be evacuated in emergency situation, and we must focus much of our efforts on those problems also.

Question 7 George Stafford(DOS)

Well, we seem to have quite a big agenda ahead of use on the issue of Hurricane Damage Mitigation and Preparedness. What are some of the next steps?

-Kenneth Herman(Common Shores, Inc.)

I think the key now is to begin enforcing some of the regulations and backing up our existing programs.

-Jack Hauptman(FEMA)

The timing of the next steps are very dependent of whether or not storms continue to significantly damage structures.

-Dewitt Davies(LIRPB)

The LIRPB certainly welcomes comments on our report, and thank you for any suggestions.

Close of Conference

Dan Horowitz, (Aide to Congressman Downey)

Thanks to everyone who could attend this conference on behalf of Congressman Downey and Secretary of State Shaffer. For your information, proceedings from the conference will be distributed to each registered invitee.

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