SOME POSSIBLE FUTURES
OF
LONG ISLAND SOUND

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INTRODUCTION

Long Island Sound is many things to many people: sound, estuary, coastal embayment, source of seafood, receiver of wastes, transportation artery and a recreational resource for more people than any other estuary in the United States. For more than 450 years, the Sound has had the distinction of being in the most densely populated coastal region in the nation. No other estuary is used by as many people or is subjected to as many stresses, and probably no other major U.S. estuary has received less attention by researchers and resource managers than has Long Island Sound.

Long Island Sound is also unusual in its natural features, Figure 1. The Sound has two connections to the ocean -- one at each end. Most estuaries have only one. The major source of freshwater -- the Connecticut River which accounts for 70% of the total freshwater -- enters near the mouth. In most estuaries, the major source of freshwater enters at the head. At its "head," the Sound has the East River, not really a river at all, but a tidal strait connecting the Sound to the New York-New Jersey Harbor.

In spite of the intense pressures of society and the large recreational demand, concern for the water quality of Long Island Sound came late compared to that for the Chesapeake and most other major U.S. estuaries. The first concentrated efforts were not made until the 1970s when the Long Island Regional Planning Board prepared a wastewater

management program to identify and manage water quality problems related to groundwater, fresh surface waters and marine waters.

The problems of the Sound identified in the 1970s are not unlike those of the 1990s: closure of beaches and shellfish beds because of high coliform counts; disposal of inadequately treated wastewater; over enrichment by nutrients and resulting hypoxia; disposal of untreated urban stormwater runoff; non-point source runoff from urban, suburban and agricultural areas; and discharges of industrial wastes -- metals, chlorinated hydrocarbons and other contaminants; and chronic and episodic releases of petroleum products.

The first Long Island Sound study was initiated in 1971 by the New England River Basins Commission (1975). The goal was "to produce a plan of action by the spring of 1975, which balances the need to protect, conserve and wisely develop the Sound and its related shorelands as a major economic and life-enriching resource for the 12 million people who live near it." That Long Island Sound study was a paper study. Little came of it. According to Koppelman et al. (1976), there was little coordination among the 20 federal agencies that conducted the work to produce the plan, and the plan was more an aggregation of existing plans than a coherent plan. The thorny issues of controlling growth and development throughout the Long Island Sound region were inadequately addressed by the 1975 plan and because there was little public involvement in its preparation, there was little motivation to implement the plan.

The second Long Island Sound Study (LISS) was initiated in 1985 under the sponsorship of the U.S. Environmental Protection Agency through its National Estuary Program. The National Estuary Program was established in 1984 by the U.S. Congress to improve the environmental quality of the nation's most important estuaries. Most of the research phase of the Study ended in 1990. The Comprehensive Conservation and Management Plan should be finished sometime in 1992, although many in the scientific community believe that knowledge of the biology, chemistry, geology and physics of the Sound remains inadequate to provide an appropriate scientific and technical basis for such a plan. The major water quality issues addressed in the Study were eutrophication and hypoxia, toxics, pathogens and floatables. Support for research on Long Island Sound -- support essential for generation of the scientific information needed to develop effective management plans -- dropped precipitously in 1990. The pressure to take action is increasing, often without a good basis for selecting the particular action to take.

Although Long Island Sound has been the site of some excellent estuarine research, the Sound has received far less attention and support for research than has Chesapeake Bay and most of the nation's other major estuaries. There have been very few systematic Sound-wide initiatives for research or monitoring and none has been sustained for more than a few years. The constancy of commitment of Maryland and Virginia to the Chesapeake Bay has been absent in New York and Connecticut for Long Island Sound. There are encouraging signs that this situation is changing.

Over the next century, or two, it will be society and not nature that will determine the future of Long Island Sound. The effects of society will be determined by activities that take place within the drainage basin and they will be dominated by population, by land use practices and by waste disposal strategies.

Nature's effects on the Sound will be influenced by human impacts on a global scale. The latter will result primarily from an increased rate of rise of sea level produced by the greenhouse effect and global change. The direct effects of global warming will be small; but the effects of sea level rise could be significant. An increase in temperature will have countervailing effects on the mixing of Long Island Sound waters. Increased solar insolation will warm the upper layers of the Sound, thereby strengthening the vertical stratification and aggravating the problems of hypoxia in the lower layers. This negative effect on mixing will be offset by a positive effect of warming. Warming the atmosphere will increase the frequency and intensity of storms which will increase wind mixing of the Sound. Increased mixing will recharge the lower layers of the Sound with oxygen thereby alleviating hypoxia. It is not clear which of these two effects will dominate.

Because the region is generally quiet tectonically, the probability of intense earthquake activity and dramatic changes in basin geometry is small. Because the basin is large and deep and separated from the ocean by a long and fairly wide island, there are no chances of breakthroughs or blowouts of that barrier. Compared to its large area and depth, the sediment inputs to Long Island Sound are small. Because sea level not

only will continue to rise, but will probably rise more rapidly in the future, the volume of the basin will grow, extending the life of the Sound as an estuary. Therefore, the future of Long Island Sound as a geomophological and oceanographic entity is not at risk; certainly not on a time scale of centuries.

What is in question is the quality of that future. Our assignment is to forecast the Sound's future. Mindful of Samuel Goldwyn's admonition: "Never make forecasts, especially about the future," we have chosen a different strategy. The strategy is the development of "scenarios" -- stories about how Long Island Sound's future might turn out. Our planning horizon is the year 2050. There is another reason -- besides cowardice -- for selecting this strategy. The future of Long Island Sound will depend upon people and their actions. We agree with Will and Ariel Durant's observation about the future which also applies to the future of the Sound -- "The future never just happened, it was created." While it is clear that society will create the Sound's future, it is not clear which of the possible futures it will create. That future will depend upon the interactions of driving forces -- natural and anthropogenic -- with critical uncertainties.

In this paper we explore the range of those possible futures. Since the possible futures will depend primarily upon people and their activities, we first review the population and land use practices in the drainage basin -- past, present, and future populations and practices -- before turning to a discussion of scenarios of Long Island Sound's future.

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We close with some thoughts about the strategy of scenarios as a method of planning for estuaries.

POPULATION

Long Island Sound is located in the megalopolis that runs along the eastern seaboard from Boston to Virginia. This coastal strip is the most densely populated region of the U.S. and contains some of the nation's oldest cities. The Long Island Sound region is the most densely populated segment of this megalopolis, and is believed to have been even before European settlement. According to Salwen (1975), Long Island may have had the highest population density of all aboriginal North America. As many as 20,000 Montauk Indians are believed to have lived on Long Island at the time of Verrazano's arrival in 1524, and a similar number of Wappinger Indians lived in what was to become Connecticut. These large numbers of Indians were attracted to the coastal areas bordering the Sound by their combined marine and woodland resources (Langstaff 1990).

The high population density of the coastal regions bordering the Sound continued following European settlement. According to Langstaff (1990), by 1774 Connecticut was one of the most densely settled areas of the American colonies and most of the people lived in coastal communities and relied heavily upon agriculture and trade. During colonial days, large areas of the Sound's forested watershed in Connecticut were cleared for agriculture. Large areas of Long Island were deforested for agriculture, and for lumber and firewood for the growing New York City.

As the coastal population continued to grow, there was a shift away from agriculture and trading to small manufacturing (Langstaff 1990). The industrial revolution (1750-1850) led to a progressive and rapid urbanization of the region. Not only did New York City experience rapid growth, but manufacturing cities sprung up, particularly along the coast, because of the dependence on water for transportation and communication. Connecticut became widely known for its manufacturing as cities such as Bridgeport and New Haven boomed.

The period of the industrial revolution was one of general decline in environmental quality in cities. There was little infrastructure to handle the mushrooming wastes of the rapidly growing and more affluent society in urban areas. Many of the wastes were discarded directly into the region's waterways. New York Harbor, the lower Hudson, the East and Harlem Rivers became open aqueous dumps for industrial and human wastes. The problems of Long Island Sound then -- as today -- were concentrated in the western third of the Sound.

In the mid-nineteeth and early twentieth centuries, both Connecticut coastal communities and Long Island communities were increasingly oriented toward New York City as the center of commerce (Langstaff 1990).

The post World War II era was the time of most rapid population growth in the region and, in many ways, the time of greatest human impact on the natural environment, including Long Island Sound. By then New York and other cities had improved their infrastructure to deal with

many of their wastes. As a result, the impacts of wastes on the environment, particularly on the urban terrestrial environment, were ameliorated relative to those experienced during the industrial revolution.

Following World War II the demand for inexpensive land to develop housing projects to accommodate the rapidly growing population led to conversion of agricultural lands and to the draining and filling of wetlands. What had been a creeping suburbanization got up on its hind legs and galloped across Long Island and coastal Connecticut. To be more correct; it got into the family car and sped across the landscape. Manufacturing declined as the demand for white collar workers in New York City rose. The pattern of growth was no longer driven by proximity to water for power and transporation; it was fueled by urban hubs (Langstaff 1990).

The most intensive development after World War II followed coastal transporation corridors where railroads and highways made commuting to New York City convenient. The greatest growth occurred in Connecticut between New York City and New Haven; and on Long Island in Nassau County. The increased housing increased the demands for infrastructure to support the growing populations (Langstaff 1990). Few towns were prepared to handle the rapid growth and environmental concerns did not have a high priority. There was little land-use planning, particularly long-range planning.

The history and projections of population growth in the Long Island Sound region are summarized in Figure 2. The most rapid growth occurred

between 1950 and 1960 when the population increased by a whopping 37.3%. Beginning about 1970 the population growth rate in the Long Island Sound region declined significantly. In the decade from 1970-1980 while the U.S. population increased by 11.4%, the population in the Long Island Sound region grew by only about 1%. The trend of the Northeast lagging well behind the national average continued through the 1980s and the 1990 Census indicated that the trend persisted. Nationally, the areas of most rapid population growth over the past two decades have been the South and the West.

The population projections for the Long Island Sound region call for continuation of the low growth rate for at least the next several decades. The projected rates for the 20 year period, 1990-2010, range from about 5.4% to 7.4% depending upon the assumptions (Langstaff 1990; Terleckyj and Coleman 1989). When appropriate adjustments are made to account for the different assumptions, the range narrows to 5.4 to 6% for the period 1990-2010. More than 75% of the growth is projected to take place in the coastal counties of Connecticut and Rhode Island and in Suffolk County on Long Island. These areas account for approximately 70% of the projected change from 1988 to 2010 with an increase in population of 14.3%. By contrast, the New York counties bordering western Long Island Sound are projected to increase by only 3%. We are not aware of any population projections that extend out to our planning horizon of 2050.

Population Density

The population densities of the U.S., the entire Long Island Sound watershed, New York and Connecticut and coastal areas of New York and Connecticut are summarized in Figure 3. The concentration of people in coastal areas is obvious. In spite of popular dogma, however, there is little evidence that the percentages of the total populations of Connecticut and New York who live in coastal counties and towns are increasing. According to Langstaff (1990), the percentage of Connecticut's population living in coastal counties and towns actually declined slightly between 1940 and 1980, Table 1. While the percentage declined slightly, the actual numbers showed a small increase. The increase in absolute numbers on Long Island has probably been somewhat larger.

Table 1. Change in Connecticut's Coastal Population, 1940-1980

	YEAR				
	1940	1950	1960	1970	1980
% of CT Population in Coastal Counties	63.4	62.9	62.7	62.1	62.3
% of CT Population in Coastal Towns	41.9	42.4	42.1	40.5	39.1

Although the percentage of population in coastal areas probably will not change significantly over the next several decades, the population density is already high and as absolute population increases in coastal areas, the population density will increase. This will add additional stress to already stressed coastal environments -- on both sides of Long Island Sound.

These population figures are for year-round residents. Many others have second vacation homes along the shores of the Sound, and Long Island Sound is a magnet for recreational boaters, for anglers, for swimmers and for those who just come to look and walk along its shores; for those who come to recreate and to be renewed. The fraction who come from outside the drainage basin is unknown. Although the data on numbers of visitors are soft, they are impressive. Most come during the warm summer months and contribute to the Sound's stresses. The Sound supports one of the largest recreational fleets of any estuary in the world. Over a quarter of a million recreational boats use the Sound each summer.

Long Island, Westchester County and coastal Connecticut will continue to attract people to live in these areas and to visit them for recreation. According to Langstaff (1990), population growth in Connecticut may be checked by natural capacity limitations based on soils, hydrology and geology. Long Island's Suffolk County has considerable capacity for growth unless there are significant changes in zoning regulations.

Present land use practices in the drainage basin of the Sound are summarized in Figure 4. More than 55% of the watershed is forested and only 5.4% is cropland. There was a dramatic drop in cropland, pasture and overall land in farms in the 1950s and 1960s when population and suburbanization increased rapidly (Langstaff 1990). Changes in agricultural land use reflected by land cover from 1940-1990 are shown in Figure 5 (Langstaff 1990).

Urbanization of the drainage basin is increasing. Langstaff (1990) defined an urban area as an area served by sewers. For the entire Sound watershed in New York and Connecticut, approximately 70% of the total population is served by sewers. Approximately 10% of Connecticut's area is sewered, but it serves 45% of its population. On Long Island, 12% of the land area and 33% of the population within the Sound drainage basin is sewered. The percentage of the population served by sewers will probably increase as population grows over the next several decades. Non-point sources of pollutants also will increase with continued suburbanization. In general, the impacts of population on coastal environments on a per capita basis are greater in suburban areas than in cities.

In summary, population, land use and waste management practices are three of the major factors that will determine the future of Long Island Sound. In the next section we explore the range of plausible futures of Long Island Sound.

SCENARIOS AS A METHOD OF PLANNING FOR ESTUARIES

In this paper we use the concept of "scenarios" as a tool for taking the long view of what might happen to Long Island Sound in an uncertain world. Scenarios are not predictions, although one might argue that the strategy of developing scenarios is consistent with the admonition that if you are going to make predictions, make lots of them. Scenario spinning is about perceiving possible futures in the present, rather than about predicting the future. Scenarios are stories of how things might turn out (Schwartz 1991). And, good scenarios do not simply extrapolate trends of the present. As Edmund Burke once observed "You can never plan the future by the past."

The use of scenarios first emerged after World War II as a method for military planning. The strategy was refined in the 1960s by Herman Kahn for work with the Air Force. In the late 1960s and early 1970s Pierre Wack, a planner in the London offices of the Royal Dutch Shell Corporation, refined and enriched the strategy further. We draw upon two articles by Pierre Wack (Wack 1985 a,b) and the recent book "The Art of The Long View" (Schwartz 1991) for our strategy.

Schwartz (1991) points out that scenario creation is not a reductionist process, it is an art like story telling. According to Schwartz, a good scenario deals with the world of facts and the world of perceptions. The purpose of scenarios is to gather and transform information of strategic significance into fresh perceptions.

A good set of scenarios consists of a few alternative and internally consistent pathways to the future. "They are not a group of quasi-forecasts, one of which may be right. Decision scenarios describe different worlds, not just different outcomes in the same world" (Wack 1985b, p. 146). We quote from Wack:

> *"The point, to repeat, is not so much to have one scenario that 'gets it right' as to have a set of scenarios that illuminates the major forces driving the system, their inter-relationships, and the critical uncertainties. The users can then sharpen their focus on key environmental questions, aided by new concepts and a richer language system through which they exchange ideas and data."* (Wack 1985b, p. 146).

Scenario planning -- planning based upon scenarios -- is about making choices now with an understanding of how things might turn out. It is, of course, implicity expected that the choices made now will influence which scenario actually develops. That is after all the purpose of planning -- to shape the future. This conclusion is consistent with the statement referred to earlier by Will and Ariel Durant in "Their Lessons of History": "The future never just happened, it was created." It also is consistent with what Peter Drucker, the well-known management specialist, observed about long-range planning: long-range planning does not deal with future decisions, but with the future of present decisions. Schwartz (1991) described the benefits of scenarios in planning in this

way: The end result of developing scenarios "... is not an accurate picture of tomorrow, but better decisions about the future."

Scenarios use logics to describe how the driving forces might plausibly behave in the future. Good scenarios force us to see alternative futures and to act to shape the future. One scenario could be more of the same; another could be more of the same, but better; a third could be more of the same, but worse. There are other alternatives, however.

In spinning scenarios, the identification of driving forces -- pre-determined events and critical uncertainties -- set the boundary conditions for the set of plausible futures. Driving forces are forces that influence the outcome of events; they move the plot; they determine the story's outcome. Predetermined events are events that do not depend upon any particular chain of events. They either have already occurred or they are almost certain to, but events whose consequences have not yet unfolded. If an event seems certain regardless of which scenarios plays out, that event is by definition a pre-determined event. Wack (1985a, p. 77) presents an interesting example of a pre-determined event.

> *"Suppose, for example, heavy monsoon rains hit the upper part of the Ganges River basin. With little doubt you know that something extraordinary will happen within two days at Rishikesh at the foothills of the Himalayas; in Allahabad, three or four days later; and at Benares, two days after that. You derive that knowledge not from gazing into a crystal ball but from simply recognizing*

the future implications of a rainfall that has already occurred."

The steps in developing scenarios are summarized in Table 2. Our attempt to identify the pre-determined events that shall shape the future of Long Island Sound is summarized in Table 3; the critical uncertainties in determining the future of Long Island Sound are listed in Table 4. Based upon these factors, we selected three scenarios for development: (1) more of the same -- "Big Brown", (2) a modest commitment to a better Sound -- "A Little Bit of Green" and (3) a major commitment to a better Sound -- "Big Green."

Development of good scenarios requires the group interaction of well-informed people with different perspectives. We were assisted by a number of our colleagues in developing the scenarios. Without the participation of J. Kirk Cochran, R. Lawrence Swanson, Peter K. Weyl, Robert E. Wilson and William M. Wise, we could not have succeeded. After a warm-up period, we developed a good group dynamic and had a stimulating discussion that lasted nearly four hours. That discussion led to the development of the scenarios described in the next section.

TABLE 2. STEPS IN DEVELOPING ENVIRONMENTAL SCENARIOS
(After Wack 1985a,b and Schwartz 1991 and Our Experiences in Applying Scenarios to Environmental Planning)

Step 1. Identify Key Focal Issues or Decisions.

Start with important decisions that have to be made. (For example, for Long Island Sound a key issue is how to control nutrients to reduce hypoxia).

Step 2. Identify key factors at the local and regional levels that will affect the success or failure of the decisions described in Step 1.

What will decision makers want to know when making key choices?

Step 3. Identify the driving forces -- the social, economic, political, environmental and technological forces that influence the key factors identified in Step 2. Distinguish between pre-determined forces and those that are highly uncertain -- critical uncertainties. What is inevitable and necessary and what is unpredictable and still a matter of choice? Pre-determined events are the same in all scenarios.

This is the most research intensive phase of scenarios development.

Step 4. **Rank key factors and driving forces** on the basis of two criteria -- (a) the degree of importance for success of the issue or decision identified in Step 1 and (b) the degree of uncertainty surrounding those factors or trends.

Step 5. **Select Scenario Logics.**

The results of Step 4 lead to the axes -- the plot lines -- along which scenarios will differ -- axes of critical uncertainty. Determining the axes is among the most important steps in the entire scenario-generating process. The challenge is to identify the plot that (a) best captures the dynamics of the situation and (b) communicates the point effectively.

Step 6. **Expand and Enrich the Scenarios.**

Flesh out the skeleton scenarios by returning to Steps 2 and 3.

Step 7. **Explore the Implications of the Decision (Identified in Step 1) in Each Scenario.**

Is the decision or strategy robust across all scenarios or does it look good in only one or two?

Step 8. **Select leading indicators and signposts to monitor for early signs of which scenario is "Playing Out."**

TABLE 3. PRE-DETERMINED EVENTS THAT WILL AFFECT THE FUTURE OF LONG ISLAND SOUND

- The general features of the Sound's circulation will persist. These include the predominant westward motion along the Connecticut shoreline, the predominant eastward flow along the Long Island shoreline and the cross-Sound flow in large, basin-wide counter-clockwise eddies, coupled with a westward flow of deep, more saline waters.

- The Sound will continue to be more susceptible to wind mixing than most other large, deep estuaries.

- River inflow to the Sound will continue to be dominated by Connecticut Rivers.

- The direct cross-Sound flow of discharge from Connecticut Rivers to the Long Island shore will continue.

- Mean salinity of the Sound will increase due to the continued rise in sea level.

- The Sound will continue to trap most of the sediments and sediment-associated contaminants it receives; the major site of fine-grained sediment accumulation will continue to be the western Sound.

- Sea level will continue to rise.

- The population density of the Long Island Sound coastal region will remain the highest of any estuary in the nation.

- New York City will continue to dominate water quality of the western Sound and of a narrow nearshore band that hugs the north shore of Long Island at least as far east as Eaton's Neck.

- Inputs of industrial wastes will continue to decline because of flight of industry from the region and the success of industrial pretreatment programs.

- The Sound will continue to be subject to intense recreational expectations and pressures.

- The Sound will continue to be subject to multiple and conflicting uses.

TABLE 4. CRITICAL UNCERTAINTIES IN DETERMINING THE FUTURE OF LONG ISLAND SOUND

- Response of the motion and mixing of the Sound to climate changes -- rising temperature, atmospheric events.
- The rate of rise of sea level.
- Response of motion and mixing of the Sound to sea level rise.
- Temperature increase.
- The magnitude and frequency of stochastic biological events: novel plankton blooms, introduction of exotic species, etc.
- Land-use patterns throughout the watershed, and particularly in near coastal areas.
- Efforts to control nutrient inputs from sewage treatment plants, combined sewer overflows and non-point sources and the effectiveness of those efforts.
- Acquisition of sensitive coastal areas.
- Population change and redistribution.
- Demographics.
- Changes in patterns of inputs of wastes between point and non-point sources.
- The implementation of New York City's Combined Sewer Overflow Abatement Program.
- Changing societal priorities.
- Style, substance and structure of environmental management

  Continued fragmentation

  Integrated management

  Technology-driven standards or water quality-driven standards.

THE SCENARIOS

The planning horizon is the year 2050. Using the information summarized in Tables 3 and 4, we developed the three scenarios described earlier: (1) more of the same, (2) a modest commitment to a better Sound and (3) a major commitment to a better Sound. We realize that developing three scenarios is contrary to the advice of Schwartz (1991), but it is the strategy we employed nevertheless. He recommend against it because the scenarios may be interpreted as the best case scenario, the worst case scenario and something in between. That is precisely what we wanted to do -- to define the envelope of probable futures for the Sound in the year 2050 and an intermediate example.

Scenario I: More of the Same -- Big Brown or The Last Gasp

The temperature rises slowly because of the greenhouse effect, but atmospheric variability -- the frequency and magnitude of atmospheric events (storms) -- changes little. In this scenario, management of the Sound and the activities in its drainage basin remain fragmented with little or no coordination. Technology-based standards continue to be employed by the U.S in managing discharges from sewage treatment plants. The cap on nutrients adopted as part of the Comprehensive Conservation and Management Plan in 1991 has not been effective. Population growth has resulted in increased nutrient loading. Sea level continues to rise at about the same rate as it has for the past 50 years. Population continues to increase slowly, about 0.3% per year. The

wetlands have been created along the shoreline for habitat and nutrient removal and freshwater wetlands have been created to control non-point source runoff.

As sea level rises, the Long Island Sound basin moves closer to tidal resonance, resulting in an increase in tidal mixing. Also, there is a larger inflow of the lower layers which transport saline water from Block Island Sound into Long Island Sound, with a consequent greater outflow through the Race in the surface layers. The greater mixing and flushing complement human activities to improve dissolved oxygen levels in the Sound.

High speed ferries carry passengers among Long Island, Connecticut and New York City alleviating traffic on congested highways, reducing air pollution and increasing environmental awareness of the beauty and importance of the Sound. A new and stronger coastal ethic has evolved which makes it easier to ensure the continued commitment of money needed to conserve and enhance the Sound.

Fish stocks are strong and there have been no bans or restrictions on fisheries because of chemical contamination for several decades. Many shellfish beds that had been closed for more than a century because of high coliform levels have been reopened, but others in embayments remain closed because of non-point source pollution. A number of aquaculture enterprises are flourishing; several utilize space in the deeper areas of the Sound.

This scenario is one of improved quality of the Sound and expanded and enhanced uses. The Sound is often cited as an example of how humans, through enlightened management, can live in harmony with their coastal environment even in the Nation's most densely populated area.

DISCUSSION

The first and third scenarios define the envelope of probable futures for Long Island Sound in the year 2050. The second scenario falls within the envelope and is closer to the first than the third. It is clear from these scenarios -- at least to all of us who participated in their development -- that unless significant changes are made in the way society manages the Long Island Sound system -- the Sound plus activities in its watershed and airshed -- there will be a progressive deterioration of the Sound. Moreover, the changes in management that are required are significant.

According to Wack (1985a), good scenarios should change the decision makers' assumptions about how the world works and compel them to question their model of reality and to change it; to restructure and reorganize their mental model of reality; to create a new mental model that guides their decision making. If scenarios do not achieve this, they are of no value as planning tools. This means that the interface between scenarios and decision makers can not be neglected or ignored. It means that key managers -- managers empowered to make the decisions upon which the scenarios hinge -- should be involved in the development of

scenarios so that they can experience the "aha" of a fresh, new unexpected insight and outcome -- something all of us experienced.

We failed to include those managers in our project. It was a mistake. Much of the value of the technique results from the relationships forged during the frustrating, challenging, exciting search for solutions as a group. As the late President Dwight D. Eisenhower said when he was a General in the Army, "Planning is everything; the plan is nothing." In earlier reports (Schubel, 1990, 1991), we stated that if the condition of the nation's estuaries and other coastal water bodies are to be improved significantly, it will come through improved environmental management and that will require a new paradigm based upon partnerships among managers, scientists, educators and environmentalists. We believe the development of scenarios can play an important role in nurturing those partnerships.

Wack (1985b) suggests two questions to test the value of scenarios:

> (1) What do they leave out? In five to ten years, managers must not be able to say that the scenario did not warn them of important events that subsequently happened.
>
> (2) Do they lead to action? If scenarios do not push managers to do something other than that indicated by past experience, they are nothing more than interesting speculation.

We will have to wait and see how good our scenarios for Long Island Sound are, but we are convinced that the strategy can be applied to environmental problems with good results.

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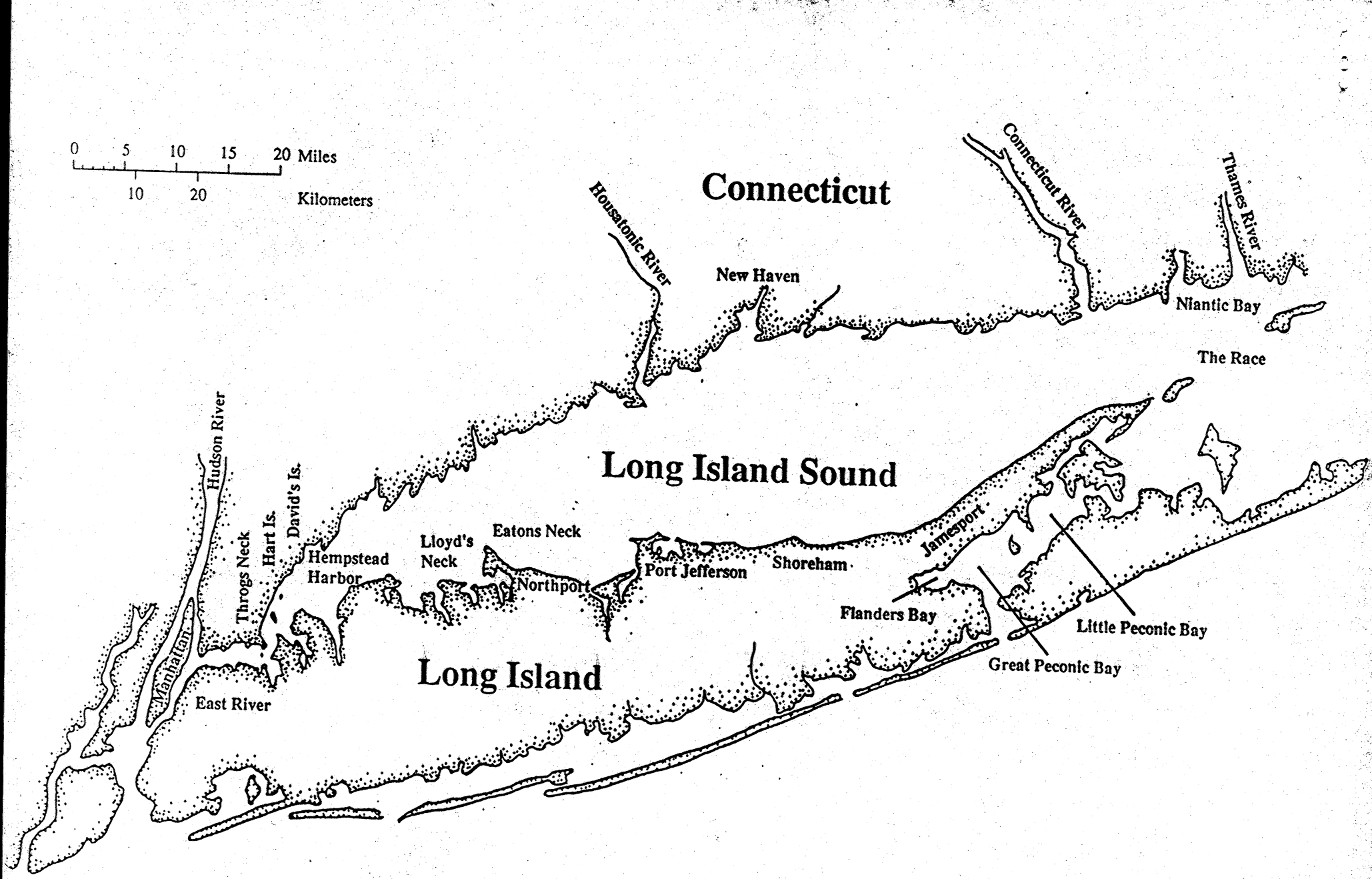
0 5 10 15 20 Miles
10 20 Kilometers
Connecticut
Housatonic River
New Haven
Connecticut River
Thames River
Niantic Bay
The Race
Hudson River
Long Island Sound
Throgs Neck
Hart Is.
David's Is.
Hempstead Harbor
Lloyd's Neck
Eatons Neck
Northport
Port Jefferson
Shoreham
Jamesport
Flanders Bay
Little Peconic Bay
Great Peconic Bay
Manhattan
East River
Long Island

Figure 1.

POPULATION GROWTH IN THE LONG ISLAND SOUND STUDY AREA, 1940-2030

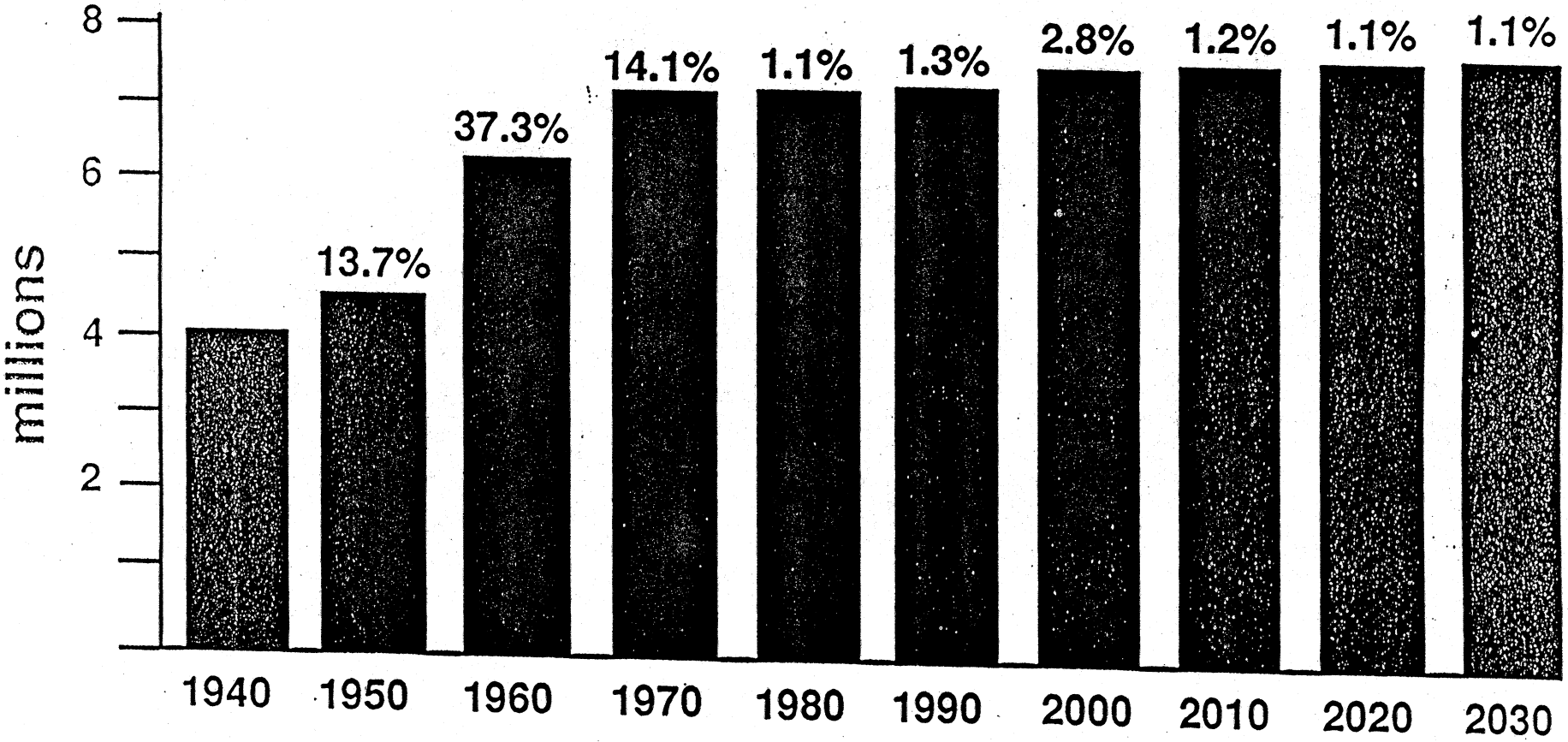

Figure 2.

POPULATION DENSITY

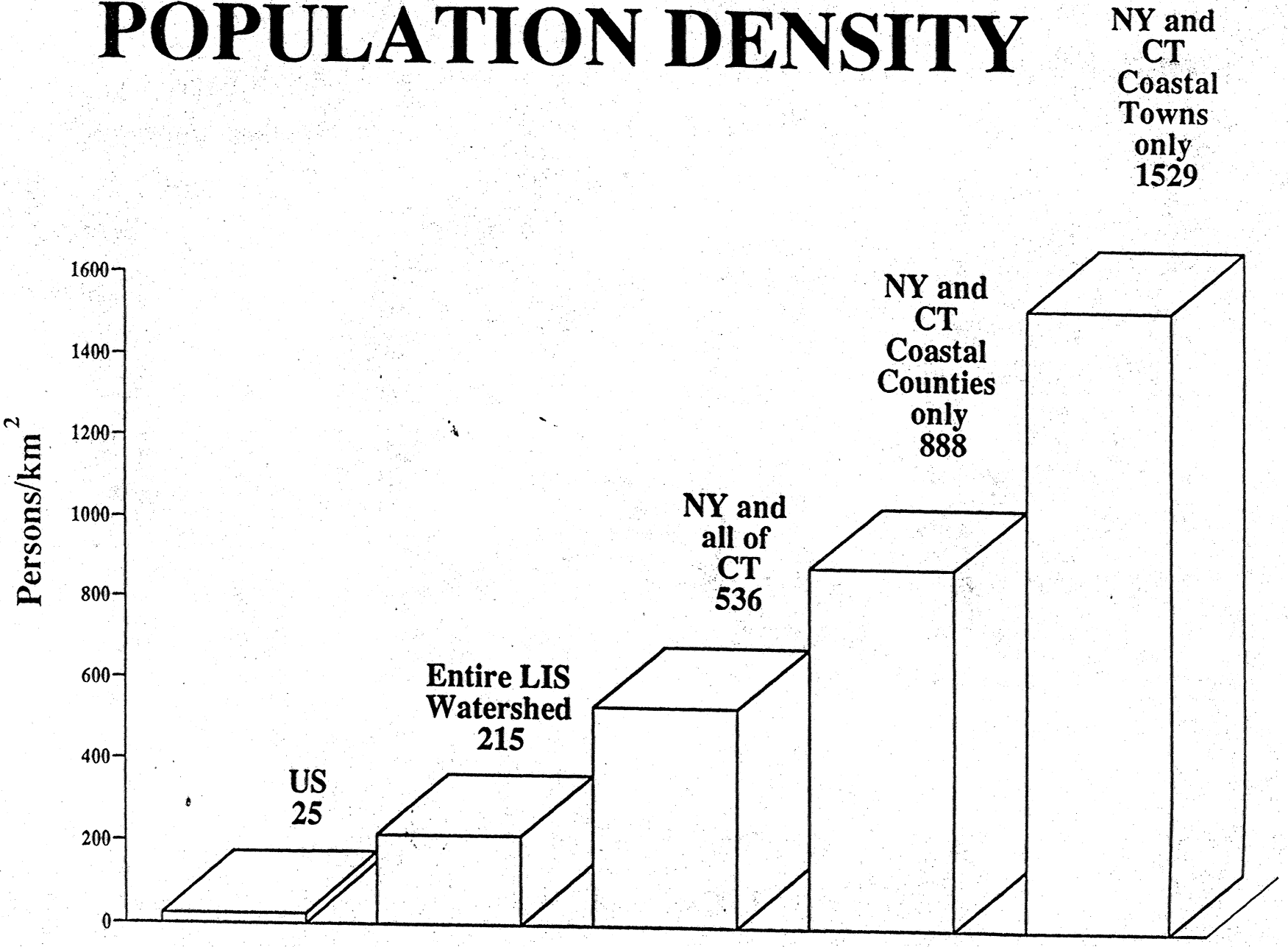

Figure 3.

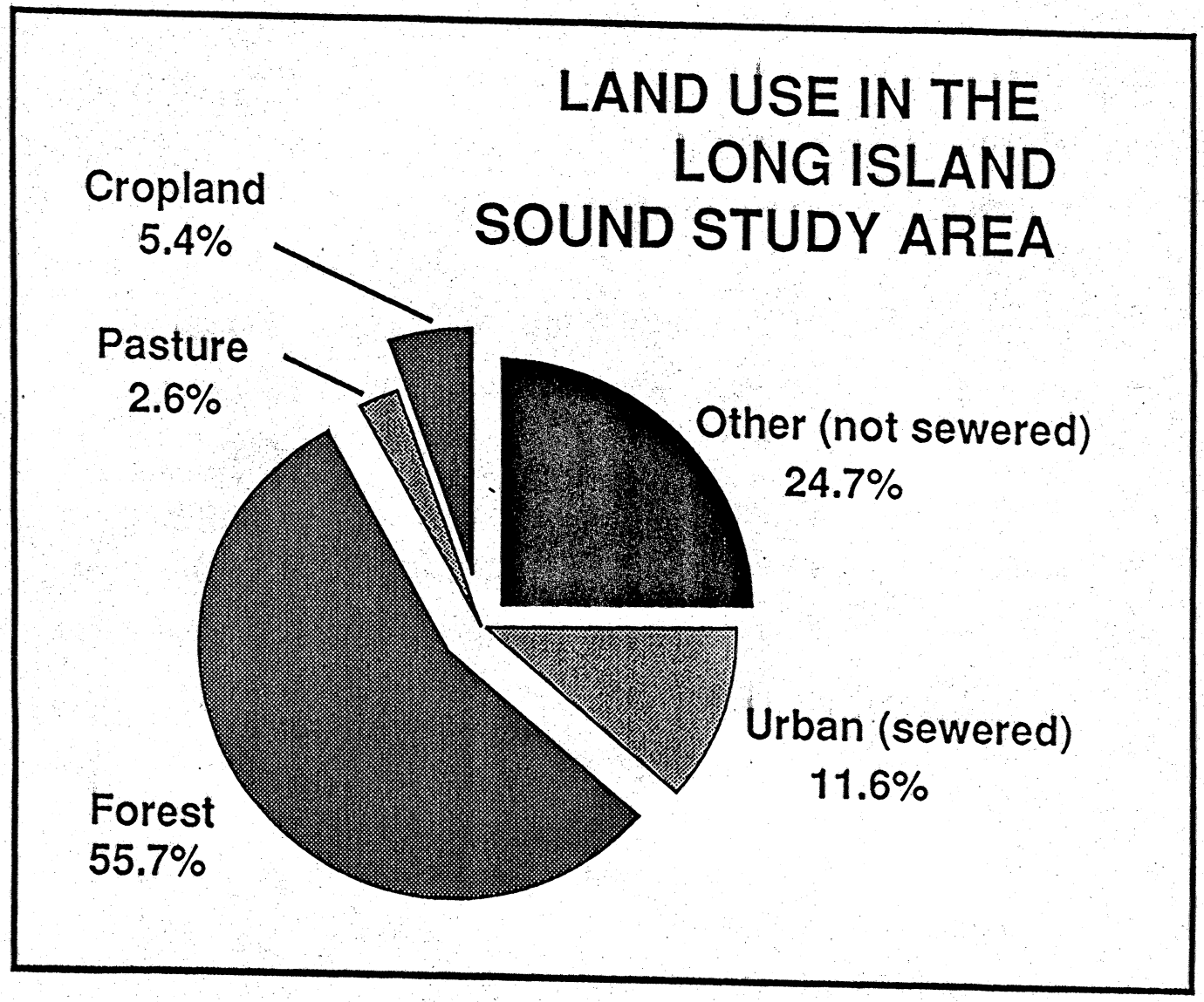
LAND USE IN THE
LONG ISLAND
SOUND STUDY AREA
Cropland
5.4%
Pasture
2.6%
Other (not sewered)
24.7%
Urban (sewered)
11.6%
Forest
55.7%

Figure 4.

DATE DUE			
1/10/60			
			Printed in USA