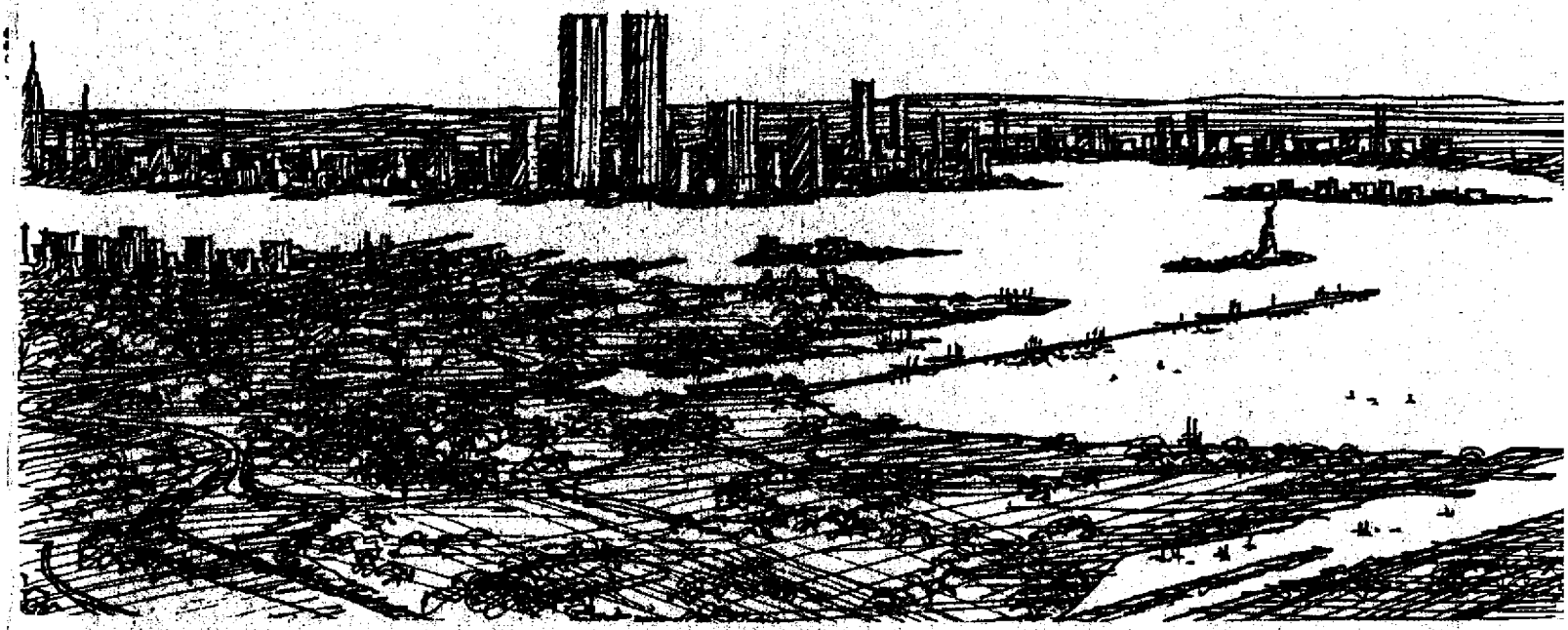
FISH AND BRICKS

Plans, Processes and Problems of the Lower Hudson and Raritan Estuary



Proceedings of the Walford Memorial Convocation

1984

FISH AND BRICKS

Plans, Processes and Problems of the Lower Hudson and Raritan Estuary

PROCEEDINGS

OF THE

WALFORD MEMORIAL CONVOCATION

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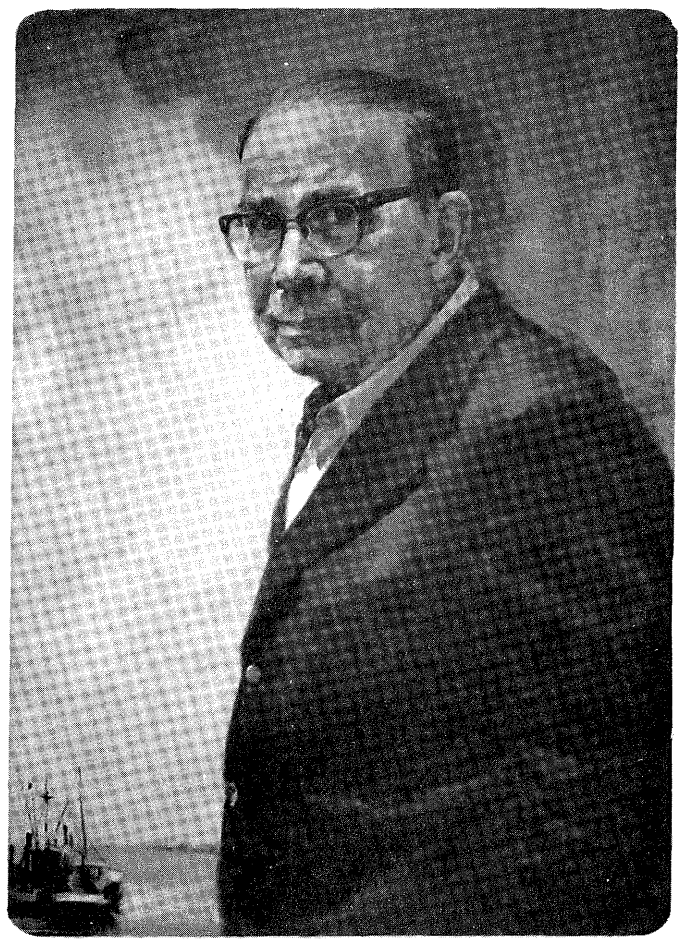

Lionel A. Walford
1905-1979

INTRODUCTION

By way of welcome to this workshop I would like to remind you that this convocation series is dedicated to the memory of Dr. Lionel A. Walford, a remarkable marine scientist. Among his accomplishments he was named the first director of the Sandy Hook Marine Laboratory by the Bureau of Sport Fisheries and Wildlife in 1959. In an effort to elicit natural history observations from interested amateurs he was instrumental in guiding the formation of the American Littoral Society in 1961. Retiring from federal service in 1974 he joined the New Jersey Marine Sciences Consortium until 1979. In 1976 he wrote the first New Jersey Sea Grant program, and served as director of the Sea Grant project of the Marine Sciences Consortium. These organizations which he was instrumental in founding are the co-sponsors of this program.

Today's workshop will explore the development projects planned for metropolitan area shorelines and the concerns for their associated impacts on aquatic resources.

Bert Walford's quest was for recognizing gaps in information and from these organizing a way forward to address the lacks of knowledge or perception.

Today, in the same spirit, we will undoubtedly discover gaps in individual and institutional knowledge. If we come away with an increased awareness of the resources at risk, some perception of the impacts and the processes of conservation, the day will have been well spent.

A. L. Pacheco
Proceedings Editor

INTRODUCTION OF THE KEYNOTE SPEAKER

Dr. Robert B. Abel

Dr. Barry Commoner may reasonably be described as the world's guru of environmental preservation. I must abbreviate his long and distinguished resume.

Dr. Commoner received his Bachelor's degree from Columbia, Phi Beta Kappa, and his Master's and Doctorate from Harvard. From that point he has spent most of his professional career here in the region, that is in New York, except for a period of 35 years when he was attracted to Washington University of St. Louis. While there, he established the Center for Biology of Natural Systems which has become recognized as a world center for consideration of the environment and its protection. He moved the Center to Queens College, where he had originally taught, in 1981, and has resided there since as Professor of Earth and Environmental Sciences.

Dr. Commoner is also affiliated with the Albert Einstein and Montefiore Hospitals. His research has ranged over an incredible spectrum of activity -- from free radicals, through emergency breathing procedures (a research project which he initiated while a naval officer), carcinogens in the environment, a comprehensive series of research projects on reorganization of agriculture, and finally to the aspect of energy conservation in homes. He has almost a dozen honorary degrees, has filled an even dozen official positions with the American Association for the Advancement of Science, and participates on a dozen editorial and advisory boards. He has authored seven books, most prominently including "The Politics of Energy," "The Poverty of Power," "The Closing Circle," and "Science and Survival." I would invite you to consider all the questions you always wanted to ask about the environment because this morning the Master is with us, and you may never get a better chance.

TOXIC CHEMICALS AND THE ENVIRONMENT

Barry Commoner
Director, Center for the Biology of Natural Systems
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I'm really an outsider to your interests in the sense that I've not worked on the Hudson-Raritan ecosystem, but to me it's an extremely important test case for the entire problem of how we resolve the apparent conflicts between environmental quality and economic and social development. In many ways, the ecosystem and economic system here exemplify that problem in the most intensive way anywhere in this country. This is a highly developed area in terms of population, industry, commerce, and transportation. At the same time, the Hudson and the Bay remain an extremely important ecosystem. What we have is the conjunction of the stability and quality of an ecosystem that incorporates the importance of estuaries and the development of the New York metropolitan area. As you know, there have been a series of clashes between these two interests and most of this conference is concerned with how we try to resolve these conflicts.

I think these problems are extremely important. The Westway problem, the problem of the pesticides and petrochemicals in the water, the sludge problem, etc., should be addressed in a way that leads toward resolution. I have to tell you straight out that I do not think we are on that road yet. I think there are many misconceptions about what we have to do to approach resolutions that make sense. Some of you may disagree with my criticism of the present approach to this problem and some of my ideas about what ought to be done. What I plan to do is to derive what I regard as the proper approach to the resolution of these issues from our knowledge of environmental problems. I want to take the experience that we've had in analyzing environmental pollution in the last couple of decades and draw from that the lessons about how to relate that information on environmental quality to economic consumption and development.

Let me begin by reminding you that the ecosystem has its own laws in operation. We know about the cycles, the fact that the physical and chemical attributes of the ecosystem are closely related to the biological activities of the various members of that system. We know that the ecosystem can be disrupted by quantitative imbalances, for example, by a too rapid increase of organic matter or by toxic materials, and it can easily be thrown out of balance, rapidly reducing the quality of the environment.

The analytical question I want to raise is: What can we learn from the consequences of environmental disruption in areas such as the Hudson River, Raritan Bay and, for that matter, the air over the New York metropolitan area? I want to take some examples of well-known environmental problems and analyze them in order to get at the fundamental cause of the problems, and then use that information to relate to the economic and social conditions.

A problem characteristic of this metropolitan area is photochemical smog. From here on a good day you can see the wispy brown layer that lies over the metropolitan area. At Queens College, located on a slight rise, I have a view of most of the Manhattan skyline from my office. When it's sunny and not too windy what I see is a brown haze. As a native of New York and having been in and out of New York for many years, I can tell you that before the 1950's this pollutant was not present. I well remember when I was in the Navy in the '40's flying in and out of Floyd Bennett Field and never seeing the brown haze of photochemical smog. Along about the mid-1950's it began to appear. Now, as you know, it is a common phenomenon. There is nothing unique about New York -- every metropolitan area in the U. S. now has photochemical smog. It began in Los Angeles in the 1940's and has spread like a disease and hasn't been minimized by any environmental controls. What's the cause? We know that every well. Photochemical smog originates with the emission of nitrogen oxides from the exhaust pipes of cars. What happens is that sunlight hitting nitrogen oxides converts them, in a series of reactions, to free radicals. These molecules are very reactive and go through a series of reactions which produce ozone and finally react with waste fuel (hydrocarbons) in the air to a series of noxious compounds that are irritants, carcinogenics, and have this characteristic color. That is what photochemical smog is about. We know the chemistry and physics of production but how did it come about? Why did it appear in the mid-1950's in New York? The answer is quite simple. Before World War II cars did not emit nitrogen oxides from their exhaust. They emitted carbon monoxide and waste hydrocarbon but no nitrogen oxide. It was only the postwar cars that did. If we were all still driving model A Fords, there would be no photochemical smog. The next question is; Why did the newer cars produce nitrogen oxides? The answer is that the nitrogen oxide comes about by the chemical reaction between the nitrogen and the oxygen in the air sucked into the engine. We know that when air in an engine gets too hot, over 700°C, the two gases that make up air, nitrogen and oxygen, interact to produce nitrogen oxide. The reason todays engines are hotter is because they operate at a higher compression. (As air is squeezed, laws of physics tell us you raise the pressure and the temperature). Therefore, the reason for smog is the introduction of high compression engines by the auto industry. These engines also had another effect -- the use of lead in gasoline. High compression engines tend to knock and ethyl lead was introduced to stop that, with very serious medical effects. It's now clear that many children suffer from nervous disorders as a result of exposure to lead, and a great deal of it comes from automotive fuel. Photochemical smog is not a result of somebody being sloppy, and letting something leak out of a pipe or emit into the air. You can't drive a car without having exhaust fumes come out. It's not the driver's fault, it's a fault of the design of the car. The cars that we now drive are smog producers by intent. The intent was not to produce smog, but to have a car with the dynamic qualities of the high compression engine. High compression engines are more powerful, and they were introduced because postwar cars were big. They grew quite rapidly from the end of World War II to about 10 years ago, when people began worrying about fuel consumption. There was a deliberate design change in Detroit after World War II to build big cars, therefore to use high compression engines, with the inevitable consequence of triggering the smog reaction.

The lesson from this is that this particular aspect of environmental pollution is the inherent consequence of a change in the means of transporting people by automobile. We had cars before this, but the ways cars are designed

now makes photochemical smog an inevitable accompaniment of driving a car. It is not a matter of too many people, it is not a matter of too many cars, it's the kind of car. In other examples it becomes obvious that every one of our major environmental problems comes from a change in the technology of production.

Take an example from agriculture in the Midwest. I began to study agriculture in the Midwest because surface waters began to have very high levels of nitrate, which has various untoward medical effects. The question was, where did the nitrate come from? The nitrate levels had increased tenfold after World War II. The answer is that after World War II chemical fertilizers, particularly nitrogen fertilizers, were introduced into Midwestern agriculture. As the amount used per acre rose, finally the yields levelled off. This meant that people were using much more fertilizer than could be absorbed by the crop, and the excess drained into surface waters. It is a fact that the pollution of surface waters in the Midwest by excessive amounts of nitrate is a consequence of the postwar change in the technology of agriculture. That's also the reason why surface waters in agricultural areas carry pesticides. The synthetic pesticides were never used before World War II. At most, some arsenicals were used. There has been a huge increase in the use of pesticides since World War II. We grew crops before World War II, now we grow them with an increasing application of agricultural chemicals and that is a change in the way we produce crops. It is not sloppiness -- it's a change in the technology of production.

Now let me get to the change in the technology of production which, I think, has caused the most serious problem in the Raritan Bay and Hudson River. That is the change in the way we produce materials for washing ourselves and clothes, the way we have changed in the production of furniture, clothing, and of packaging materials. These have all changed. You are sitting on an example of a change, plastic chairs. Before World War II, there were chairs, but I don't remember a plastic chair. They were wooden, sometimes metal, but not plastic. There were practically no detergents on the market before World War II. Since World War II, 85 percent of the market occupied by soap has been taken over by detergents. Synthetic fabrics and plastics are all products of a brand new industry called the petrochemical industry which is located, very heavily, just a few miles away in northern New Jersey.

What I want to talk about is the transformation in the production of these common things ... furniture, clothing, building materials, upholstery, and what this change means for an ecosystem.

The first thing I want to acquaint you with is the magnitude of this change. You can ask yourself "how do we measure the magnitude of the ecological cycles in the United States?" The cycle that we can define numerically is the one that involves us and food. You can ask "how much food is produced in the United States each year?" and then, compare it with the chemicals generated by this new industry, because the petrochemical industry is a chemical industry. It synthesizes various kinds of substances. In the United States we now use roughly 50 billion pounds of food per year, so you can think of the ecological cycle -- food, people, sewage, etc. as having a capacity, a size. It turns over 50 billion pounds a year. The present output of the U. S. petrochemical industry is 500 billion pounds per year. Since

World War II, in the last 40 years, a chemical system 10 times bigger in amount than the food-human cycle has been imposed on our ecosystem. This is an entirely new technosystem or chemosystem. What's wrong with it? Let's look at the nature of this chemical system.

You in the community know very well that we plant crops that represent a certain pattern of chemistry. In the crops inorganic material, carbon dioxide, water and inorganic salts are taken into the organism. With the aid of energy from the sun (photosynthesis) these inorganic materials are converted into organic compounds, that is, compounds with chains and rings of carbons, with hydrogens and oxygens. If you remember your biochemistry training, you know we have a pretty good picture of the pattern of chemical events that is characteristic, not only of living plants, but also living animals. We know, for example, that among the organic compounds synthesized in the crops are amino acids. We know that amino acids are practical protein. We know that when we eat crop material we convert the amino acids of the crop into our own protein. Carbohydrates, proteins, vitamins, enzymes, and nucleic acids are involved, and we can roughly characterize this vast complex system of chemistry into several generic ways. Let me make one point -- for every organic compound synthesized in a living thing, no matter what, there is also in living things an enzyme that breaks it down. It sounds profound, but it's obviously true. If it weren't true the world would be covered with cellulose. If there were no enzymes to break down the cellulose synthesized in living plants, the cellulose would just pile up, because it's quite stable at the temperature and humidity of the earth. What breaks down cellulose is bacteria that secrete enzymes. This is the essence of biological cycles -- something is synthesized, then it's broken down, and the constituents are resynthesized. Every organic compound synthesized by a living thing is biodegradeable. Compare that with the products of the petrochemical industry. One of the most interesting comparisons has to do with the relation between hemp and nylon. The relationship represents a change in the system of production in maritime operations. It used to be that marine cordage was hemp. Now much of it is nylon and the nylon is often colored white, blue and orange. A fascinating observation is that ocean plankton viewed under the microscope show bits of white, blue and orange material -- it's nylon, marine cordage. The frayed bits float around and are taken up by the plankton. It is not broken down. There are no little bits of hemp in plankton, because many marine organisms have cellulase, an enzyme that breaks down cellulose. With the introduction of nylon in place of hemp, this material has accumulated in the ecosystem. It never breaks down. Why? It was made for that purpose; nylon's advantage is that it doesn't decay like hemp. What that means is, and this is true of all plastics, there are no enzymes that break down any plastic. Every pound of plastic that's ever been synthesized is still with us or else has been burned. It accumulates.

The polymers that are synthesized in living things--cellulose, starch, protein, nucleic acid--are readily broken down by enzymes, but polymers made by the petrochemical industry do not break down. It's important to ask the question, "Why not?" The answer is that the system of chemistry represented in the ecosystem is the product of several billion years of evolution in many millions of different organisms. Various kinds of synthetic processes must have been tried during the course of that evolution and a lot of it has been rejected. The organic chemistry characteristics of living things are a highly restricted segment out of the numerous processes that can occur in organic

chemistry. As an example, you all know that proteins consist of a linkage of amino acids, generally 200 amino acid units strung together form a protein polymer. We also know there are about 20 different amino acids and they can go in any position. Some years ago a physicist did an interesting computation. He asked the question, "If we synthesize one molecule of all of the proteins that you can make out of 20 different amino acids in the various combinations and permutations of positions, what would the whole mass weigh? It turns out that it would weigh more than the weight of the known universe. What does this tell you? The proteins that living things make represent a fantastically narrow slice out of the proteins that could be made. A whole series of proteins have been excluded from evolution. Another example, there are compounds, fatty acids, that consist of CH_2 groups, one after another. All of the fatty acids in the animal kingdom consist of even numbers of CH_2. The odd-numbered ones aren't there. They can be made, a chemist can make them, as well as other proteins we don't have. During the course of evolution the kinds of chemical products that could be made out of all the ingredients in living things has been very narrowly restricted. For example, the chemical linkage of nitrogen with an oxygen attached, a nitroso group, is exceedingly rare--only 2 or 3 compounds--in the substances found in living things.

The combination of a chlorine atom sitting on an organic molecule is very rare in the chemistry of living things. The one example, I know is chloramycetin. Yet, chlorine is ubiquitous in living things. We have chloride ions in our blood. Plants have chloride ions. Although the chlorine is around, the biochemistry of living things excludes the combination of chlorine with an organic molecule. Organochlorine compounds are exceedingly rare in living things. It turns out that when living things are exposed to such compounds as DDT, 2,4,5-T, or dioxin they are extraordinarily toxic. Somewhere along the line during the course of evolution, some living thing decided to synthesize dioxin and has never been heard from since. Nitroso-compounds, organochlorine compounds, mercury compounds are evolutionary rejects. The petrochemical industry has based its production on just these evolutionary rejects. Most of the material synthesized by the petrochemical industry are substances that are not found in living things. I guarantee, no living thing naturally contains dioxin, DDT, nylon, or any synthetic material. This huge technosphere, this huge chemical system that we've introduced, is alien to the chemistry of life but based on the same system of organic chemistry. If a molecule looks like a normal nucleotide in DNA, but carries a chlorine on it, it can enter into the system and cause great disruption. The entire petrochemical industry has been based on the production of alien-type molecules, molecules disruptive of living things.

Chlorine figures very largely in the petrochemical industry. Here are some numbers: vinyl chloride, the monomer that polyvinyl chloride plastic is made of, is a powerful carcinogen. About 6.5 billion pounds are produced each year in the United States. For comparison, the production of fruits in the U.S. amounts to about 6.5 billion pounds. Here is a carcinogen produced in an amount that resembles the size of a chunk of our natural crops. Benzene, another carcinogen, 8 billion pounds a year; formaldehyde, also carcinogenic, 404.7 billion pounds a year; chlorine, in the form of organic chlorine compounds, 18 billion pounds a year. We have created an industry which is inherently antagonistic to the chemistry of life, on a scale which matches, at the very least, and overwhelms the scale of the ecosystem itself. The result is a lot of trouble. PCB, a synthetic product of the chemical industry, is

one of the serious problems associated with the fish in the Hudson and Raritan Bay. Every living thing analyzed, including you and me, now contains PCB; and it is extraordinarily toxic. Dioxin which is among the compounds that are the most toxic synthetics known. A study made a few years ago indicates that a nonselected sample of patients in Ontario and an Army group who had never been to Viet Nam both had fat with 10 parts per trillion dioxin. Not much? FDA has recommended that if fish contain 25 parts per trillion it shouldn't be eaten.

Compounds have been made which are antagonistic to the chemistry of life, are extraordinarily stable with no enzymes to break them down, and have become insinuated into living things. Much of the problem in the ecosystem of Raritan Bay comes from this. I've belabored this to make a simple point -- the pollution problems we face here in the Hudson-Raritan Bay ecosystem are not the result of anybody being sloppy. They are the result of deliberate industrial decisions that establish new forms of production.

There is no way the petrochemical industry can avoid polluting the environment, no matter what controls you put on them. For example, these chairs you see probably are of chlorinated plastic. At some point they will be thrown away. If they're thrown away they become a burden on the environment. They will pile up, but if you burn them you have a problem which is now one of the most serious, unresolved environmental issues in the New York metropolitan area, that of incinerating trash. It is now clear that if you take trash and burn it, the furnace synthesizes dioxin. Dioxin has two ring compounds with oxygens attached and then chlorines. We know where the components of this molecule come from in the incinerator -- the rings come from the lignin in trash paper and the chlorine comes mostly from polyvinyl chloride. In the incinerator, some of the lignin is not completely combusted to carbon dioxide and water and the ring compounds combine with chlorine on the surface of ash particles and a whole family of dioxin compounds is synthesized in the incinerator.

This is not sloppiness, not waste from the petrochemical industry. PVC is a product -- vinyl tiles, vinyl boots are products. After you use them, they become a stress in the environment whether they're burned or not. To understand how to make industry in this area compatible with the environment, you must recognize that most of the stress on the environment comes about from the design of the industrial processes. PCBs are in the Hudson, because the General Electric Co. used it. It's a very good, stable insulator and oil was replaced by PCBs in the manufacture of transformers. You may say they shouldn't have let the PCB dribble out of the plant into the Hudson, which they did. What happens to the PCB in the transformers after they are sold? Many are up on the telephone poles and begin to leak. GE can't be blamed for that. Industrial production decisions led to these things.

Now for the question on how to deal with the balance between industrial development and environmental quality. What can we say about the petrochemical industry in northern New Jersey, about the use of PCBs, about the fact that plastics lead to the production of dioxin in incinerators? How can we make all that industrial development compatible with the ecosystem, recognizing that its products are going to be harmful in that ecosystem? It is no longer a question of saying "Run the petrochemical system neatly." That's a good idea because it's insane to deliberately dump waste materials

that contain dioxin into the rivers. But even if that practice were absolutely stopped, the very products that are sold by the industry will pollute the environment.

Let's discuss the system that has been developed for judging the value of the ecosystem and the value of the economic activities that are related to it -- the whole business of cost/benefit analysis.

I have been somewhat amused about the battle of Westway and the striped bass. This is how it typically goes. A proposal was made for a transportation and real estate development along the west side of Manhattan -- a change in the production system of Manhattan, a new way of handling housing and transportation. It is a production decision with various economic values attached, jobs, etc. The debate is: How valuable is that compared with the striped bass industry? Figure out the cost of destroying the striped bass nursery area relative to the economic advantage of building Westway; or the costs relative to preventing the effect on striped bass, such as for artificial piers, etc. What cost/benefit sense does it make to take the complex ecosystem-industrial process and try to balance the ecological effects and the economic effects? This is the customary way it's done. In my view it makes no sense to evaluate a multibillion dollar real estate and transportation project on the West Side shutting your eyes to all of the impacts that it will have on New York. And I'm not just talking about striped bass, even though it is very important to save striped bass. Our approach to this problem has been badly distorted. The proper way to do a cost/benefit analysis has been laid out in our basic environmental laws. If you look at the National Environmental Policy Act and also in the more recent environmental acts, like the Toxic Chemical Act, the purpose of an environmental impact statement is put in the following way: According to NEPA you should examine the environmental impact of a proposed economic project and then compare it with the environmental impact of alternative means of accomplishing the same purpose. The Westway issues should have been handled like this: When someone wanted to build this real estate/transportation project, the questions should have been "What is its purpose?" The answer would be, its purpose is to relieve the housing shortage and to improve Westside traffic. Next you ask, "What is its environmental impact?" Striped bass disruption. Then, "What is its economic value?"... and you get that answer. At that point you're still not ready to do a cost/benefit analysis. First you should figure out exactly how you balance the ecological effect against the economic benefits And there's no way to do that without putting the two parameters into the same dimension. Converting the ecological effect into dollars gets you into a fantastically absurd situation. This has been done often in other areas, like carcinogens and the threat to human health. A school of University of Chicago economists, with a tendency to think in free-market terms, have proposed a way to convert human lives into dollars so economic benefits can be compared. If you have a pollution problem, it is often possible to convert the pollution index to a number of deaths. A paper was published a few years ago in the business journal of the University of Chicago proposing a method of evaluating dollars to a human life. They proposed it by figuring potential income. A white male was worth $300 thousand, a white female $150,000 (because women are paid roughly half of what men are paid for the same work). A black male was worth $200,000 and a black female $100,000. Is this science? This is a socio-political statement, that's all. There is no way of avoiding this kind of absurdity if you try to convert the ecological impact into economic terms for

comparison. That's the wrong way to do it. The right way is as follows: You examine Westway with its certain environmental impacts, so many striped bass affected, etc., and you ask the question, "If the purpose of Westway is residential development and transportation, what other way of accomplishing that purpose is there that might reduce the environmental impact?" As an example, it is my understanding that it is the landfill proposed for Westway that disrupts the ecosystem. If they would spend some money to straighten and widen the present Westside Highway, the transportation problem seems like it could be solved with no impact on striped bass. The impact on the striped bass is the real estate development. It seems that the Westway concept is not the only way to improve housing in New York City. I would like to see an alternative proposal to create the same number of residential and commercial units somewhere else in New York. Then what you would have is two sets of numbers: the economic and social value of Westway in housing and transportation and its environmental impact, which is plan A, compared with plan B, which accomplishes the same social purposes but doesn't require landfill and therefore has no effect on striped bass. What you then say is "Here are several different ways of accomplishing this purpose and their relative economic impacts and their relative environmental impacts -- now we can decide." How will you decide? Politically. Economic and political battles will ensue between those benefitting from the Westway development and those benefitting from the alternative.

There has been a serious distortion of what cost/benefit is all about. Even now there is a so-called risk assessment, in which you compare how dangerous some environmental impact is against other socially acceptable ones. It has been pointed out that the only thing we don't permit is going over Niagra Falls in a barrel, because the risk of death there is nearly 100%. The risk of death in a motorcycle race is very high, and risk of death in white-water canoeing is very high, but we don't prevent those. The risk of death from dioxin is much lower than a motorcycle race, so why should we bother preventing that? Logically, if we want to prevent a few deaths from the dioxin emitted from incinerators, then we should ban motorcycle races and canoeing. You get into absurd situations if you look at it in this distorted way.

The lesson from an environmental history is that the key issue is the design of the system of production. The question is: "What are the relative economic and environmental impacts of alternative ways of producing the same goods and services?" That's why the proper Westway question is "What are the alternatives to Westway?" and not "How much are the striped bass worth?" I think the whole argument has been severely distorted. The people of the City of New York should be debating what's the best way to use resources to deal with the transportation and residential problem that Westway is supposed to be handling. Instead the whole debate has been distorted into a question of the well-being of the striped bass. You may say that striped bass are more important than driving up and down the West Side, but the issue is always the choice of ways of producing goods and services.

I'm trying to tell you that the judgments you will be discussing here are not scientific. It does take careful scientific studies to figure out what an environmental impact is. It does take careful work by economists and sociologists to figure out the economic and social benefits and values of a particular shoreline or industrial activity that impinge on the ecosystem.

But that's all the science; from then on it's political. The problem is much more difficult than most people think, because we are talking about the question of social determination of the nature of our productive system. What I'm talking about is society determining whether we should have plastic chairs or not. It's a very radical position, because in our economic system only those who own capital have the right to determine how it should be invested. Can you imagine a law saying "No plastic chairs, only wooden, leather and cloth allowed?" I guarantee that the issue is already in our environmental laws, particularly TOSCA, the toxic chemical laws. TOSCA says that when a manufacturer proposes to produce a substance, the economic value of that substance should be compared with other substances, capable of accomplishing the same purpose, and with their relative economic and environmental impact. For example, if you want to ban a pesticide you look at other pesticides and see their relative environmental impacts and their economics. Coming back to the plastic chair, under TOSCA the following situation could arise. Assuming the burning of a polyvinyl chloride chair will impose a dioxin problem in the area, the chair has an environmental impact in terms of dioxin. A hearing could be held in which a leather manufacturer would come in and say "I can produce a chair with similar characteristics, but it will not yield a dioxin problem." A judgment then needs to be made between the two chairs.

Political implications mean that social governments would make decisions which until now have been in the hands of owners of capital, corporations. If we logically evaluate the problems of balancing the economic and environmental impact we will confront a serious political issue. I think that one of the roles ecologists and concerned people have to play is not to make these political decisions, obviously all we have is one vote. But have a unique capability of bringing this fundamental, indeed radical, issue to the attention of the public. Then we can begin to decide if it makes sense to replace glass with plastic bottles (which are going to exacerbate the toxic problems that we have). We have to get to that level of analysis if we're going to solve the problem of judging the proper balance between environmental quality and economic development.

REFERENCE

Commoner, B. 1971. The Closing Circle. Alfred Knopf, Inc., New York, NY.

QUESTION: What do you say to the technologically oriented element of society that says: "We can always find ways to improve and we can always find new technologies to modify what we're doing?"

COMMONER: In other words, a technological fix that says we are so smart having produced petrochemicals and nuclear power plants ("Look how difficult it was to do. You can trust us to take care of any problem.") The difficulty is that certain ways of doing things are inherently more difficult than others. For example, it is clearly much more difficult to produce electricity through nuclear power than it is by any other means. It's very complicated, and the result is that you take an environmental and economic risk. I'm absolutely certain that it will be possible to build a nuclear power plant that would just about eliminate all risks. It would probably cost about a hundred times more than the present nuclear power plants, and you would then get into the question, "Is this the proper way to produce electricity?" In other words, one of the characteristic things about bad production decisions with respect to the environment is that they generate unforeseen costs. The classical example is nuclear power. The reason the cost of nuclear power plants is escalating is that, each year, new problems are discovered and changes have to be made. The same is true of the petrochemicals. Look at the $180 million settlement from Agent Orange, when the judge said that the veterans had a case that would not stand up in court. Jack Weinstein said that this case would fail in court. Nevertheless, the chemical companies were willing to cough up $180 million not to discuss the question. The reason is that they know it is so complicated they would have a hard time in court as well. Look at the fact that more and more problems are created by public dumping. Ten years ago, nobody worried about toxic waste dumps. The chemical industry was producing them and not spending any money on handling them. Now they have to handle these costs, which keep escalating. My advice to people like that is to look at the inherent complexity and danger for the ecosystem in a system of production, and ask yourself whether you are ready to predict the cost of all the future ways of solving the problem.

QUESTION: I have comments on your statement that decisions must be political rather than scientific ones. That's very true, but the people who are making the decisions tend to get very little input from the scientific community. The environmental scientists, ecologists, and so forth, have been relatively silent and sitting in their ivory towers a great deal more than the physicists or other scientists who have been more conspicuous on the Washington scene. We are dooming ourselves and the environment by not being more involved in Washington. There are many more engineers there than biologists.

Clearly, it seems to me in a practical sense, it is unlikely we are going to turn back the clock on the petrochemical industry and get rid of it. We must come up with practical ways of managing the chemicals. For example, we must figure out the least hazardous way of disposing of these chairs. If burning is relatively bad, then some better way must be found. We must deal with management of these products; we will not just stop the industry.

COMMONER: Well, let me just comment very briefly. You're absolutely right about ecologists sort of being dragged into the political arena. One of the great tragedies is the fact that Rachel Carson was excoriated by ecologists when she first got into this business. Those of us who stuck our necks out and talked about these issues were looked down on as not really scientific. I think that your point is very important, and it's also important to avoid the trap of getting into it for the purpose of making a political issue scientific. The whole cost/benefit thing is another trap.

Regarding the question of the petrochemical industry and practicality. I don't specialize in being practical; in some sense, because I think that what turns out to be practical really depends on the depths to which you analyze the problem. For example, take these chairs -- you say we'll find some other way of disposal. There is no other way. I guarantee you there are only two things that can happen to this plastic. Either you burn it or it sits. Every pound of plastic that's been synthesized has either been burned or we still have it and it will end up in little bits in the plankton. Stuff will leach out of it. In other words, there really is no way of handling it that doesn't have an impact on the environment.

QUESTION: But aren't some ways better than others?

COMMONER: Yes, but you then raise the whole question of preventing the problem by changing what is produced. I see absolutely nothing impractical in a law which says there are unsocial uses of plastics which are forbidden. For example, I don't see any social benefit in putting a noose of plastic around a six-pack of beer. I know it's easier to carry, but there can be other ways. A string bag, made of cotton, would make it just as easy to carry. I don't see any objection to abolishing that product. The big issue that will be raised is the fundamental, idealogical one -- "Where do you come off telling us what to produce?" If you are not ready to face that issue, all the management in the world will be a losing battle. What I'm talking about is preventing insoluble environmental problems. The petrochemical industry imposes insoluble environmental problems because the environmental impact is inherent in the very design of these technologies. I tell you, sixteen billion pounds of chlorine thrust into our ecosystem is intolerable. I could go into the whole business of the peculiarities of chlorine. It is a very peculiar atom, and attached to organic molecules, it is murderous. The entire petrochemical industry is built on chlorine -- that's how it had its history. The Hooker Chemical Company and Dow were inorganic chemical companies that accumulated excess chlorine from making sodium hydroxide out of sodium chloride. They had tanks of it sitting around because it was so noxious. Some bright German chemist came along and said "Easy, what you do is get some benzene and attach the chlorine to it and you now have a saleable product." And that was the beginning of the petrochemical industry. That was a biological sin -- attaching the chlorine to the benzene ring. That's what led to all our toxic problems. The other thing about chlorine is that it is a very powerful means of sticking one organic compound to another, as a reagent. Can we tell the petrochemical industry "no chlorine" -- that would be the end of the industry. Yet, I don't see how we can tolerate the intrusion of the chlorine cycle into the ecological cycle. What I am suggesting to you is that you must start working yourself up for this impracticality.

QUESTION: The idea of turning back the clock is not looking at alternatives. What I would ask is "Why is this chair progress?" Use of plastic or use of metal is relevant. What else could you use that would not pose difficult solutions?

COMMONER: I am glad you asked me that question and made that point because it just made me realize I left out a very important segment of my argument -- that once you focus on the system of production and ask the kinds of questions that I have been asking, it turns out there are more efficient ways of producing goods. One of the things that we ought to be doing is going on the offensive and saying our ecological insights show us more productive ways to carry out commerce.

One example I have can be related to a local one. Midwest agriculture led to our doing the following study. We asked the question "Since ethyl alcohol is an important and useful substitute for gasoline and can be made from crops, is there a way of producing significant amounts of alcohol without reducing food production in the Midwest?" A very detailed study for the Department of Energy resulted in the following conclusion -- the reason why alcohol production from the present crop system has an economic cost is that we are using the wrong crop system. The present crop system is designed to feed animals. So, it has a proper balance of carbohydrate to protein, and that's 6 to 1. Alcohol is made from the carbohydrate part of the crops. When you produce alcohol from corn, you reduce the food value by about 60 percent, and that means it is a cost, it's food versus alcohol. The reason you get a cost is that you have unbalanced the carbohydrate and the protein. All the protein is there, in fact a little more from the yeast, but you diminished the proper balance with carbohydrates. So, once you recognize that, you say, "All right, is there a way out of this dilemma?" And the answer is: let's recognize that we are raising crops now for a dual purpose--animal nutrition and alcohol production. Therefore, what we ought to do is raise the carbohydrate ratio. We literally worked out a scheme for shifting from corn and soybeans to corn and sugar beets which worked out very precisely in a computer model. We showed that in a typical Illinois livestock farm, shifting over this way, alcohol could be produced without reducing food production. In the aggregate, the amount of alcohol produced this way in the Midwest would replace a third of the gasoline used in the United States and the farmers would double their profit. Now, that is an improvement in agricultural economy. Imagine, if the farmers were now competing with the oil industry and not just dependent on the Chicago Board of Trade for their economic survival. Incidentally, this concept is not new. It used to be that transportation fuels were produced by the agricultural sector -- oats fed the horses that pulled the wagons.

I mentioned this because there has been a study about algal production along the coast, mostly on the Pacific coast. There has been also some work done about algal production on Long Island Sound. The lesson to learn from our ethanol study is that if you are interested in producing alcohol, don't just produce alcohol. Recognize that you are transforming the system of agricultural production and you then find new, more efficient ways of doing it. The same thing holds for the algae. You know what the algal project is? You raise algae and convert the organic matter to methane. It's analogous to the alcohol situation because methane is just carbon and hydrogen. You will leave behind a lot of protein. The proper way to develop

an economic algal project is not simply to say "Well, we will grow so much algae and make so much methane out of it and then we have such-and-such a value." The proper way is to integrate the protein residue into the agricultural system. I don't know of any methane project that has raised that issue, and I guarantee that an algal-methane project, maybe even here, would be much more economic if associated with it was a cattle feeding sector.

I think that there are economic advantages that we can propose by this kind of analysis of a production system. I am convinced that a proper analysis of the Westway problem would reveal a much more efficient way to use the capital to achieve that particular end. So, one of the things I want to encourage you on a positive side is to think of ways of getting more efficient use out of our renewable resources.

QUESTION: There seems to be a catch-22 situation. Given the increasing population in relation to the lack of water and agricultural lands, how do we go back to the use of leather and other natural products, if we do give up the chemical things?

COMMONER: What you are worried about is that the switchback to natural materials will itself put a stress on the environment. Let me give you the best set of numbers I know, having to do with a switch from soap to detergents. Better than 85 percent of the soap market has been taken over by detergents in the last forty years. Soap is made out of oils and fats. So, you might say if we switched back it will mean growing more soybeans and sunflower to get the oil to make the soap, and so on. The data are very interesting. As soap was displaced by detergents, the oils that previously went into soap were shipped abroad. I am convinced that we could, if we wanted to, go back to soap with no stress on the ecosystem. Obviously, the thing has to be done in a sensible way.

If, for example, we replaced all of the plastics with wood and required cutting down wood faster than it is growing, that's not a good idea. There is an old slogan often used, "It's always possible to be in favor of ecology and stupid at the same time." Put in another way, "It's always possible to propose a good thing to be done in a bad way." For example, the Mobil Oil Company did a huge analysis of alcohol production and showed exactly how to produce alcohol and stress the ecosystem and raise the price of food. We have to be very careful about the constraints. I think it would be a miracle if the transformation of production technology which has taken place since World War II, guided by the single motive of maximizing profit, happened to be the most efficient way to use our resources.

QUESTION: I think it will be important to point out that when we first hit the oil crisis, the methods for saving oil largely depended on a whole new way of looking at how we were using it, not because we came up with other alternatives. Our whole economics is a macrosystem that supports the production setup. Many factories found that all they had to do was to stop using the one pump in the middle that nobody worried about because nobody figured the cost of using it. When they were first looking at the cheese whey problem in New York State, they found it could no longer be put on the ground because of its toxic effects. And they came up with an economic analysis conclusion that it could not be used for alcohol because the transportation cost was too great. No one stopped to think that each of the cheese plants

(it's a very big product in New York State) could do its own cycle and start its own means of making alcohol rather than letting cheese whey sit around. So, it isn't just a matter of turning back the clock. It's a matter of a whole new way of looking at the economic development as well as the cost/benefit in terms of the ecology. I don't think our lesson has to be that dismal. I think the change in food habits has come about because of what people have done. They have revolted against many of the synthetic foods, and a whole new market has been created because of that. The machine has to be stopped some way, and you can stop it in very small ways. In our State where we now have recycling, a great many manufacturers have gone to plastic products instead of glass. If consumers would refuse to buy them, that will do more than all the scientists in the world.

COMMONER: There is the whole business of the sovereign consumer and I think that can work. A lot of these changes we never see as consumers. They are inside the industry; there are, for example, chemicals that are used in manufacturing things that we never see as an end product. So I don't think it is possible to avoid what I have described as social intervention into production technology. You are absolutely right, anyone who knows me knows that I am normally a congenital optimist and I think that we have to take on the job of changing the ways of producing things. The optimistic side of it is that in understanding the ecological background, you very often find that there are economically more efficient ways of doing the same thing. I guarantee you that between the agricultural crops and the use of cellulose, we could replace all of the gasoline now used to drive cars and trucks and do it from a renewable, balanced use of the crop system. That will take some pretty serious changes in the agricultural system, the auto industry, the new oil industry. It's clear that it would be much more economical. It has to happen, because the price of oil inevitably is going to escalate as the supply is exhausted. It will make no sense to continue to the point where it takes all of our funds just to get the energy, with no capital left to go to factories to use the energy. You know, we now use 33 percent of our business capital to produce energy. Ten years ago it was about 15 percent, and that curve is escalating. It is inevitable because we are using non-renewable resources that cannibalize the economic system, and by shifting to renewable sources we can improve the economy of energy production. We must take an aggressive, positive position. We have to go to the entrepreneurs, the people who are proposing the economic development that puts a burden on the Bay and say "Let's think of a better way of doing what you want done."

QUESTION: You mentioned this business about producing alcohol by changing the agricultural system. I am surprised that with the power of the farm lobby somebody didn't grab this and run with it.

COMMONER: Well, to some extent it has been. At this point there are, as a result of the farm lobby, subsidies for alcohol production in most of the midwestern states. You may not realize it, but alcohol/ethanol production has been rising exponentially in the last few years. During the "oil shortage" it was advertised as a substitute for gasoline and sold as "gasohol." Presently it's not the same product. Ten percent ethanol in gasoline is now sold in the midwest and it's not called gasohol, it's "unleaded gasoline with ethanol." Ethanol is a substitute for the anti-knock quality of ethyl lead, and as you know, ethyl lead is being displaced. So, the same product is now being sold more and more simply as unleaded gasoline. My guess is, when there is another

shortage, they will say "Aha, this is it." The farm lobby has been working pretty hard to do that, but it is not going to be simple. When you get over 20 percent alcohol content, the car engines have to be changed. You can go up to 20 percent alcohol in ordinary engines, but beyond that we have to go to 100 percent alcohol with a slightly different kind of carburetor. At that point the auto industry has to tell you that they are ready to deliver enough cars to match the ethanol production. Brazil is at that point and has probably screwed the thing up. They are out of balance and have made a mess out of it. It's not easy to do when you get beyond 15 to 20 percent alcohol.

QUESTION: You mentioned early in your talk that the smog problem due to the automobiles has not really improved at all. Yet, we put catalytic converters and other expensive gadgets on our cars. Are you saying they are no good, or don't we have enough cars produced since the 1970's?

COMMONER: The catalytic converter cuts down the carbon monoxide and waste fuel coming out; it does nothing for the nitrogen oxides. The result is that carbon monoxide production has gone down because of the catalytic converter, but not the nitrogen oxides. That really requires a change in the structure of the engine. Actually, Honda has produced an engine which operates on relatively high compression and doesn't produce much nitrogen oxide. The "charge stratification engine" can be operated quite nicely without catalytic converters and cuts down nitrogen oxide. Also the question ought to be raised about compression ratio. Where is it written on golden tablets that a car has to accelerate like a race car?

QUESTION: What about diesel?

COMMONER: There are all kinds of questions to raise here. Diesel is a real problem. Diesel exhaust is carcinogenic. The Environmental Protection Agency (EPA) has been ducking the issue ever since that was pointed out, and this is one of the hidden menaces because there is a shift toward diesel. I don't know what's going to be done about it. The diesel exhaust contains carbon particles and it's well known (we did some of the research ourselves), that there are carcinogens attached to those particles. The EPA has just ducked the issue.

QUESTION: These meetings in memory of Dr. Walford were designed to have action items come out of them, and I agree with your premises wholeheartedly. I have heard the same story with regard to lead and how lead is a problem that should be eliminated from the environment. I think we must look at case studies. Some years ago, in 1962 and '63, I lived in Denmark. There was no air pollution because almost everyone in Copenhagen rode subways, trolleys or bicycles. Denmark is a nation committed to environmental quality and anybody that has lived there will know it's an unusual place in this regard. In the last two decades the Danes have followed the same unfortunate path that we have. Most Danish families have a car today. They have low-compression engines because of the taxation on horsepower and the greater cost of high-test fuel. Today, if you stay at the Palace or Mercur Hotels, you will know that there is an air pollution problem in Copenhagen; your bedroom is filled with exhaust fumes! This has nothing to do with high compression engines or nitrous oxide. The average compression ratio there is about 6:1 compared to about 8:1 in the United States.

A few decades ago they had wooden toys in Denmark. Today, they are all Lego-type toys made out of plastics. This has cost the Danish economy something. From the hardwood forests came the woods for toys and furniture. Now you see plastics, the same as here, which are based on costly imported petroleum. In a country with a regulated economy and with politicians not so easily bought off or encouraged by industry, you now find petrochemicals are used to make all these products.

There has to be something to the solution beyond reiteration of the problems. Ultimately the solutions come down to the Pogo complex -- "we have met the enemy and he is us." Everyone who came here contributed his share of nitrous oxide and wore out tire rubber. We must take actions to reach desired results and be able to effect individual actions. My question for this meeting is "How do we influence people to focus their actions and take concrete steps to solve these critical problems?"

ABEL: Thanks for providing the valedictory. Dr. Commoner has made this group think and created a few disciples. What we're all agreed on is the world has far too few Barry Commoners. Please accept the thanks of the audience.

SHORELINE DEVELOPMENT PLANS

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DEVELOPMENT PROJECTS ALONG THE HUDSON RIVER WATERFRONT OF NEW JERSEY

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INTRODUCTION

I have been asked to speak today about the status of proposed development projects along the New Jersey Hudson River Waterfront. I will briefly describe each project, with an emphasis on aspects of the project to be built on piers or decking over water areas and will indicate whether or not the project utilizes existing piers, or whether new piers are planned. Before I do that, I'd like to give a little background on the history of the area to demonstrate the exceptional opportunity for development along the New Jersey shoreline.

The New Jersey Hudson River Waterfront is uniquely situated just minutes from downtown Manhattan, yet for years it has stood with its crumbling piers and underutilized land as a contrast to the world financial center across the river (Fig. 1). The decline began with the shift from breakbulk to container shipping, which forced port users to move to the more spacious facilities at Newark Bay and Elizabeth. The change in freight movement from rail to truck and airplane also contributed to the decline of the waterfront. Gradually, more and more of the waterfront was allowed to deteriorate.

The movement to revitalize the waterfront began in the 1970's but was largely unsuccessful because of such difficulties as lack of infrastructure in building along the riverfront, and bankruptcy of the railroads. The first concerted effort to redevelop the waterfront began in 1979 when then Governor Byrne created the Hudson River Waterfront Study, Planning and Development Commission. The Commission recognized the difficulty in taking a project-by-project approach to a region where issues such as transportation and sewage cross municipal boundaries. The Commission recommended that a permanent authority be formed that would prepare a master plan and review proposed development plans. It would also prepare a tax sharing plan, so that one municipality would not benefit from development more than another. Although an Assembly Bill was introduced to create the permanent commission, it never became a reality.

As part of its effort to approach the region as a unit in lieu of a permanent regional commission, the Division of Coastal Resources began by taking a comprehensive look at public access. The end result was the Hudson River Waterfront Walkway Plan and Design Guidelines. These guidelines supplement the Coastal Resource and Development Policies which require that public access be included in all projects along the waterfront. The Division of Coastal Resources reviews most development proposals within the Hudson waterfront area through the Waterfront Development Permit Program. The "waterfront" boundary is a maximum of 500 feet from the mean high water

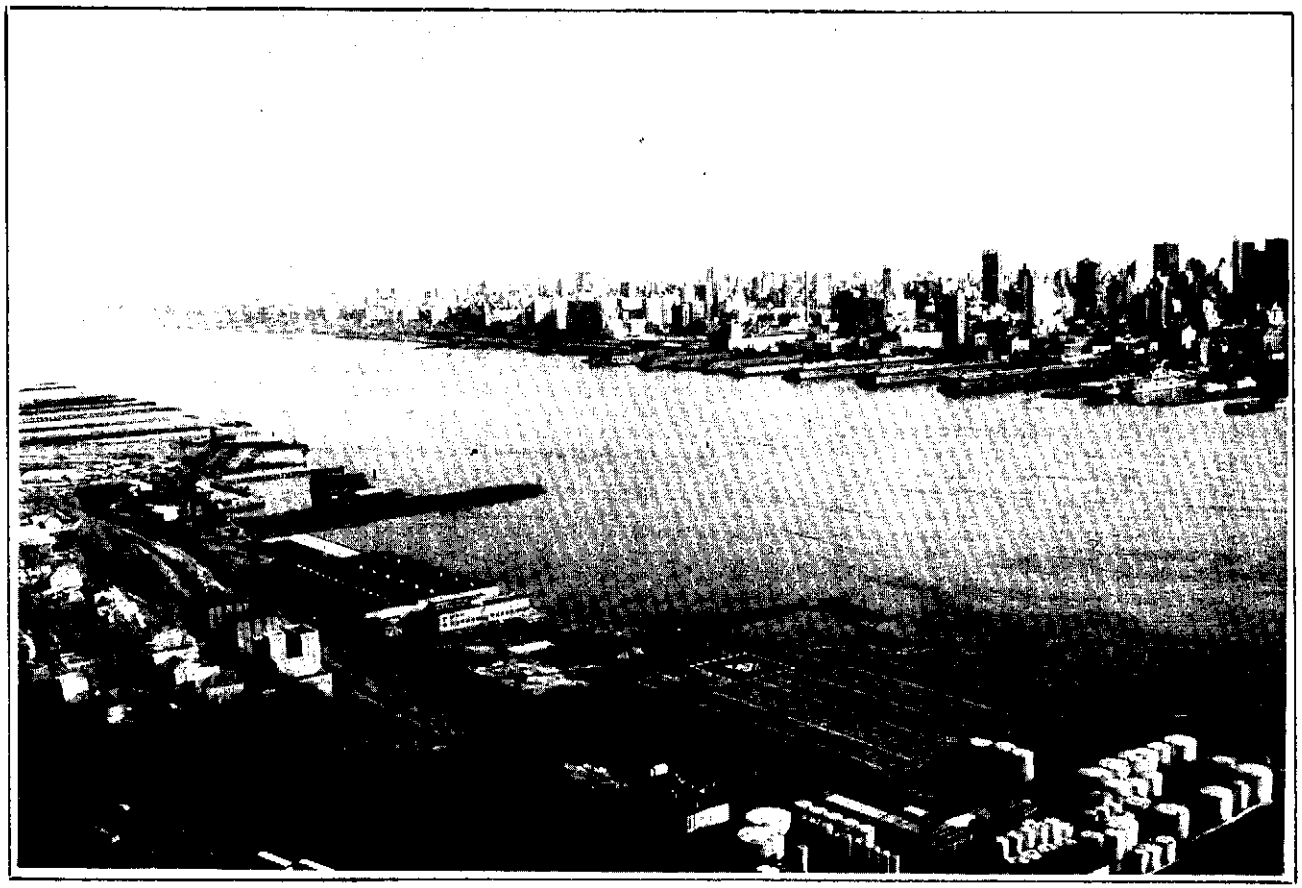

Fig. 1. The ARCORP development site (foreground) in West New York and Weehawkin.

line. Coastal Resource and Development policies are used to evaluate development proposals. When developers apply for permits, they must demonstrate that their plan will include a walkway that will extend the theme of a continuous walkway using design recommendations set out in the plan.

The completion of the Walkway Plan in April 1984 came just in time to incorporate the walkway in the recent development proposals. Governor Kean has also taken an interest in redevelopment by forming an Advisory Committee, which consists of municipal, State and regional officials, and citizens, and meets periodically to review development projects and to discuss important regional issues such as transportation.

The Division of Coastal Resources is in the process of revising the Coastal Resource and Development policy on piers to conditionally allow reconfiguration of existing piers, provided that the existing total area of water coverage is not exceeded. New pier construction would also be permitted for water dependent uses. New pier development for non-water dependent uses is discouraged. Although in most cases coverage of water areas is considered to have a negative impact on the environment, piers may have a positive effect, such as on fish habitat, if the effect is to create a shallow area. Filling to create additional land area is strongly discouraged, unless it is required for a water dependent use, and then adequate mitigation must be provided. From a fisheries perspective, frequent finger piers, rather than structures covering large water areas, are preferred. However, more information is needed on the impact of pier construction on river dynamics.

PLANS

I will now briefly describe some of the projects planned along the Hudson River from the perspective of the impact on fisheries resources, the subject of today's discussion, and the extent to which these projects provide new opportunities for the public to have access to the waterfront to fish, boat, or just view the water and views of the Manhattan skyline (cf. Fig. 2).

Edgewater

Most of the proposed projects in Edgewater consist of a combination of low rise townhouses and high rise residential towers. None of the projects include building over water areas, but several marinas are planned which will create additional interpier habitat. The Commodore and Dan Ro projects include marinas, which will add piers to a section of the river where there are not other piers. A Waterfront Development Permit was issued for Old Ferry Plaza in 1982 to construct high rise residential towers and low rise units. The Commodore project received a permit to construct townhouses and a marina. In exchange for a small amount of fill, the project will include a public walkway along the entire shorefront of the project and along the shorefront of the adjacent municipal park.

The only mixed use project is that of Edgewater Associates, which includes renovation of the former Ford Assembly Plant for condominiums, a 300 room hotel, and a marina. A permit was issued by the Division of Coastal Resources which allows the developer to construct necessary roads and

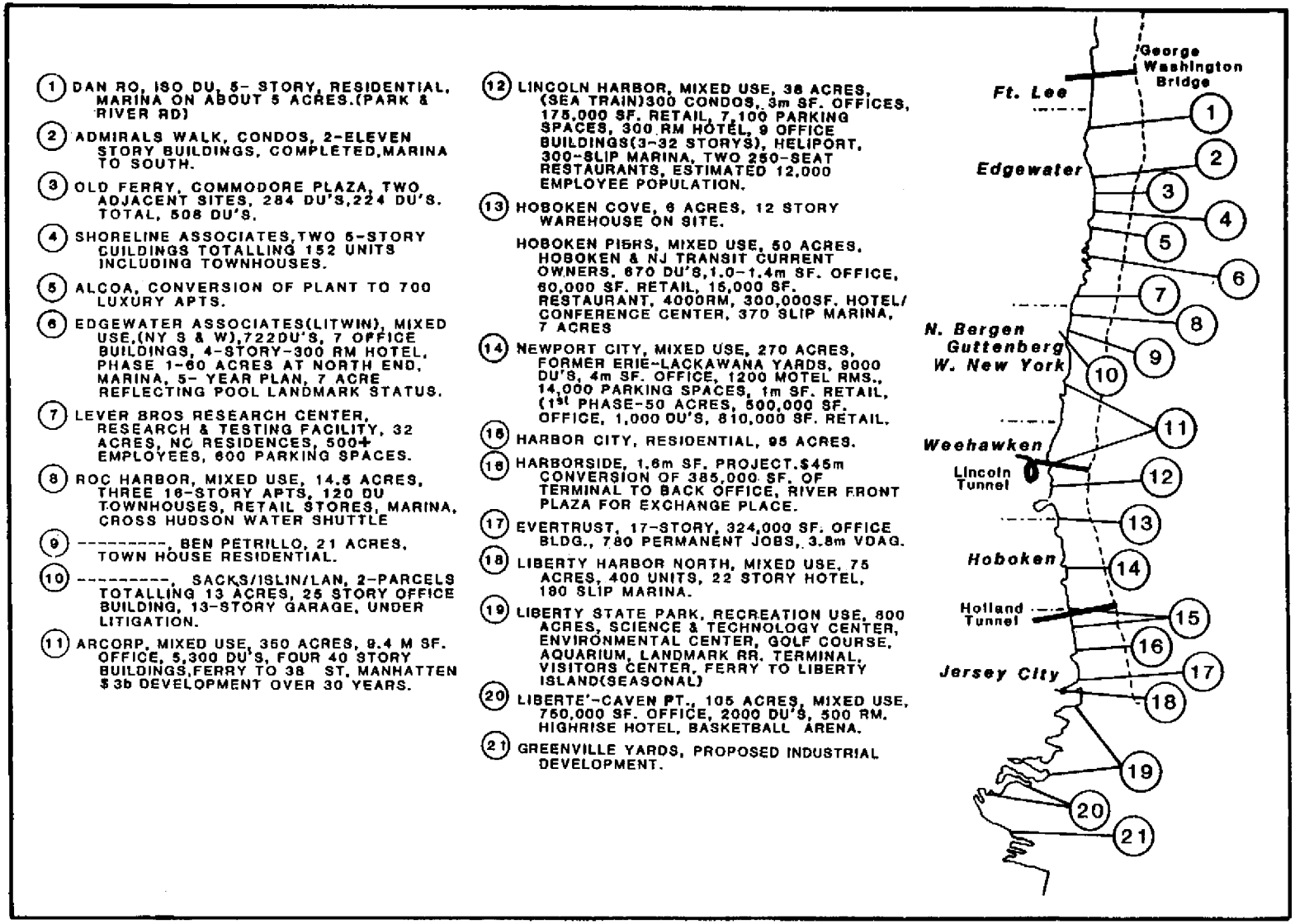

Fig. 2. Informal guide to development of the New Jersey-Hudson River shore.

parking. A permit is not required to construct condominiums because construction within an existing structure is not subject to review under the Waterfront Development Permit Law. A walkway along the north edge of the property and small plaza area are included.

North Bergen

The Roc Harbour project, located just south of the Hudson/Bergen County line, includes three high rise towers, townhouses, and a marina. The public will have access to the waterfront on the breakwater surrounding the marina. There will also be a pathway which will continue from the north to south ends of the property as part of the Hudson River walkway. The piers that comprise the marina will be in addition to re-use of an existing pier. As in the Edgewater projects, the marina will contribute additional interpier fish habitat. To date, the Division has issued a Waterfront Development Permit for half of the townhouses, the walkway along the North Cove, and the high rise towers. A permit application for the rest of the project is currently under review.

West New York and Weehawken

The ARCORP project spans almost all of the West New York and Weehawken waterfront, a distance of two miles from north to south. A self-contained city will be created, consisting of offices, shops, residences, a marina, an entertainment center, a public walkway, and a ferry to New York. Townhouses will be built on most of the piers, while the remaining piers will be mixed use, including public access. Because existing piers are being re-used, the interpier habitat will remain essentially as it exists today. In addition to plans to re-use the piers, the developer proposes to fill or deck over water areas to create new land at the narrowest parts of the site. Several environmental agencies, including the Division of Coastal Resources, have already expressed objections to this aspect of the proposal, so it is likely that plans will be modified.

The other development proposed in Weehawken is Lincoln Harbor, a Hartz Mountain project. Plans call for office space, a hotel, a heliport, restaurants and a 300 slip marina. A Waterfront Development Permit to construct a restaurant on an expanded section of an existing pier was recently issued. Although coverage of more than the existing pier area is generally discouraged, the expansion of the pier was permitted in this case in exchange for a public walkway and fishing access along the pier.

Hoboken

The Port Authority, in cooperation with the City of Hoboken, Stevens Institute and New Jersey Transit, is planning a major mixed use project. The site extends from Stevens Institute south to the Hoboken Terminal. The site will contain a combination of office, residential, commercial use and open space. Hoboken recently acquired these piers from the federal government and will lease them to private developers. A large marina will be included, and a combination of office hotel and commercial use will be located on the upland. As in the Roc Harbour project in North Bergen, the public will be able to use the breakwater surrounding the marina for fishing or for enjoying

the harbor views. In this case, the piers that comprise the marina will replace the present interpier habitat.

This project includes a fairly large riverfront park along the water's edge which provides quite a bit more open space than the walkway guidelines specify.

Jersey City

Newport City is a large mixed use development at the northern end of Jersey City. The project will include five office buildings, a convention center, 9,000 residential units, two 400 room hotels, a 3/4 million sq. ft. retail shopping center, open space, and a 238 slip marina. This project was awarded the largest Urban Development Action (UDAG) grant ever issued by the federal government, for $40 million. The UDAG will fund infrastructure improvements during the first four years of development. The project includes re-use of existing piers, with no expansion or filling required. Public access consistent with the walkway plan will be part of the project.

Liberty State Park opened for the bicentennial in 1976, and quickly became the State's most highly visited park. The master plan released in July 1983 includes a golf course, a science and technology center, an aquarium, a marina, ferry service to Liberty and Ellis Islands and a riverfront walkway connecting the north end, where the Central Railroad of New Jersey terminal is located, with the administration building two miles south. The Liberty State Park Corporation, a public/private corporation, was created to oversee development of the park. However, representatives to the Corporation have not been selected yet. The Corporation will be responsible for fund raising to build some of the public portions of the park such as the Science and Technology Center, which is estimated to cost $40 million. At present the public can use 40 acres at the south end of the park where the administration building is located. The ferry to Liberty and Ellis Islands leaves from the north end of the park. Special events, such as ethnic festivals are held at the Central Railroad of New Jersey terminal. This park already contributes much needed open space to the region.

CONCLUSION

These examples are some of the major projects proposed along the Hudson River. It is clear that each one of these projects will have an impact on the region's infrastructure, as well as on the river ecosystem. More information is needed on the impact of building structures over the water, whether on new or existing piers. Major policy decisions hinge on greater knowledge of the impacts of this building on fish habitats. Since most of these projects are likely to begin within the next two years, it is important to gather as much data as possible on the characteristics of migratory fish species in the Hudson River to determine what restrictions, if any, must be placed on proposed development.

WESTWAY PLANS

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We are now in the middle of the Westway impact assessment process and therefore have no conclusions to talk about, but I will provide you with a description of the project -- what it is and what it will entail. I will include two parts: (1) the administrative process that has occurred and will be occurring, the project as described to us, and (2) touch briefly on the studies undertaken by the Corps of Engineers (COE) this past winter with the help of the New Jersey Marine Sciences Consortium (NJMSC). I will not go into impacts of the project or the results of the fisheries studies, since they have been documented in final reports. There are three reports available. One by NJMSC describing all procedures used; one by a consultant, Malcolm Pirnie, summarizing the data collected, and a third report by Martin-Marietta Environmental Systems which describes the results of the model on which the studies were based. The impact statement will discuss impacts of the project, particularly the fishery impacts in our volume. The Federal Highway Administration will be looking at updating other impacts. Once that is done, then the COE must go through the 404-B analysis of the Clean Water Act, which requires an evaluation of all alternatives and impacts to the aquatic system before making a decision on issuance of a permit. Though the EIS may be soon be in the offing, the final decision is still some time away.

THE PROJECT

Westway as now proposed will be the single largest alteration to Manhattan in this century. It is also the third such alteration in this century -- Battery Park and the Battery Park landfill being the others. The proposed Westway landfill would extend from the current Battery Park landfill north to around 30th Street in Manhattan. At that point, from 30th to 34th Street (where the Lincoln Tunnel is) the landfill ends and a platform is proposed over the water surface as protection for the Amtrak tunnel below. About 2-1/2 miles of shoreline would be impacted by fill of this project. A total of 269 acres of aquatic habitat is within the project boundary (from the bulkhead line to the pierhead line, cf. Fig. 1). Twenty-seven of those acres are not proposed for fill, but will be platformed. Two-hundred forty-two acres will be landfill. As proposed now, approximately 165 acres of solid fill with approximately 35 acres of stabilizing slope to keep the fill in place and 22 acres of sand blanket to be put down over the dredged-out river bottom would be placed into the river, leaving 20 acres of actual river bottom within the pier line unfilled.

The Department of Transportation proposes to dredge 3.2 million cubic yards of river bottom, to be contained on site behind bulkheads. The excavated area will then be filled to the mean high water line with approximately 8.4 million cu. yds. of clean material which could come from a

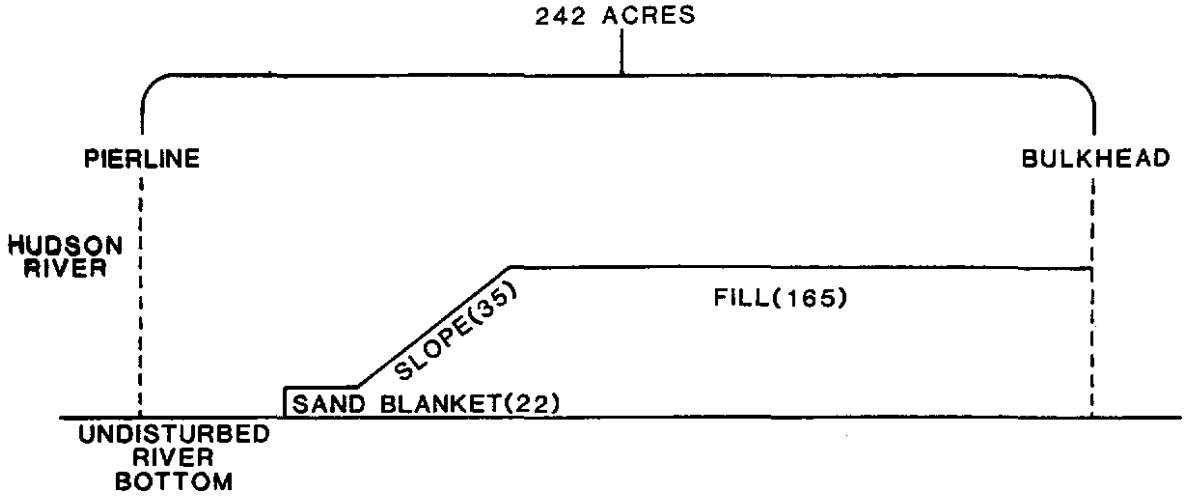

Fig. 1. Cross-sectional profile of proposed fill area. Numbers of acres for the various sections are in parentheses.

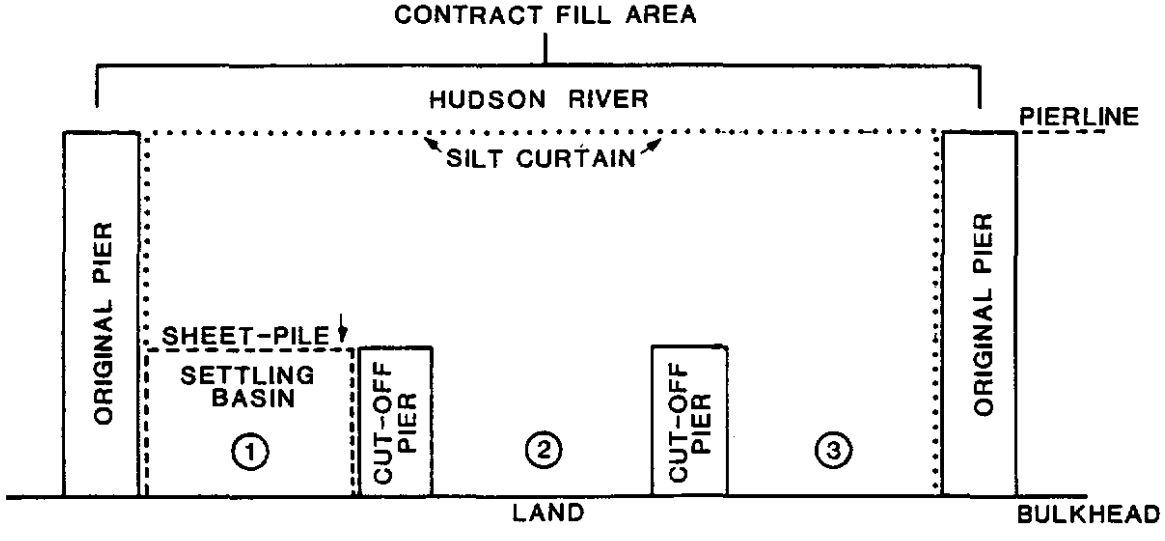

Fig. 2. Overhead view of shoreline area depicting fill strategy. Areas (2) and (3) are successive settling basins.

number of sources, the choice up to the contractor. It could be sand mining from the harbor, upland sources or construction rubble.

The design plan for Westway is in a number of phases. First is the dredging phase. We are told the entire area would be divided up into a number of contracts, each handled independently. They propose to take a contract area, perhaps a rather large area, encompassing several dozen piers, and enclose the whole area with a silt curtain that would extend along the inner edges of the boundary piers, and across the pier head (cf. Fig. 2). This is intended to contain suspended solids on site. All the other piers inside the enclosure would be cut off to create a series of settling basins. Within each settling basin a sheet pile coffer dam would be built. Each settling basin would be filled with the material dredged from on-site. Eventually, you get a basin filled with soft muds, settled out. The roadway fill would then be begun. A monitoring plan has been approved by NY DEC test water quality parameters outside the silt curtain (including control sites) to prevent violations of standard within the river.

Most excavation would be done by clamshell dredging, placing progressive layers of river sediment into each settling basin, with the most polluted material on the bottom. As dredging proceeds, more coarse and compact material will be exposed. Once this is done, the excavated area will be covered by a sand blanket in three stages, with three layers of sand fill anchored by stone along the river edge. The final layer is a surcharge, a sand cap on top. The entire contract area is then allowed to drain and settle to consolidate material, with water being forced out. The silt curtain is allowed to remain (Fig. 3a). During the consolidation phase work would then begin on excavation and fill of another contract area.

Once the material is consolidated (it is estimated to take a year), sheet piles will be driven in the middle of the sand fill, with the excavated sand placed on top of dredged material in the settling basins in two layers, the first and second surcharge. This will also act to compress and consolidate the dredged material. This phase will end with a wide trench in the sand fill, extending the length of all the construction areas (Fig. 3b).

Finally, after excavation, piles will be driven in the trench bottom, and concrete roadway and sides built; along with a roof for all but the interchange areas; the surcharge layer placed atop the settling basins will be used to grade the entire area (Fig. 3c). Most of the proposed park will be built atop the highway and along the remaining sand fill between the highway and river. The fill (including basins) between the highway and old bulkhead line will be fast land for development. There will be an underground highway for most of the fill length. Those highway portions not undergrouond will be in an open cut (where most of the interchanges will occur).

In addition to the project described we have been approached with a proposal for a mitigation plan utilizing the 20 acres of undisturbed river bottom remaining within the old pier head line. They propose to build structures of different materials to create essentially a series of basins, 200-300 feet long, in an attempt to replicate the original area. Original basins were about 1000 ft. long. The new basins will be about 600 ft. apart. A monitoring program (including sampling) is proposed to assess which

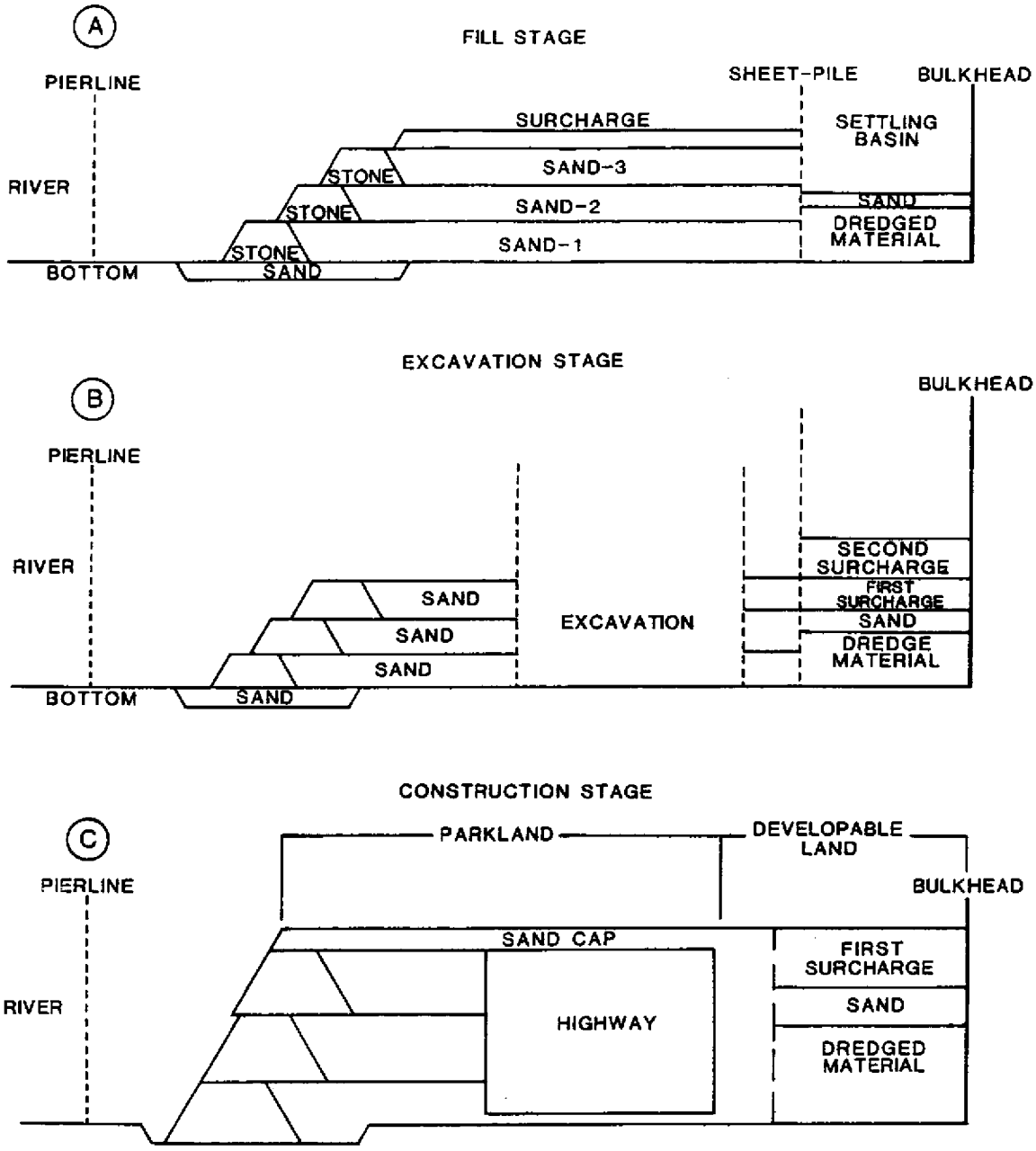

Fig. 3. Cross-sectional view of proposed construction stages: a. Filling, b. Roadbed excavation and c. Final profile of underground highway area.

construction type of basin is most successful to be used throughout the area. An advisory panel would design and interpret the studies.

In addition to this mitigation, in 7 or 8 years they propose to build another 92 acres of similar low-current habitat at Riverside Park and 89 acres of structures in water by Governors Island; providing a total acreage slightly more than the area destroyed by the landfill.

A fisheries study was conducted by the NJMSC for the COE to look at the use of the area by striped bass. The study ran from 28 December to 30 April, encompassing a sampling area extending over the estuary from Peekskill downriver to Upper Bay and Jamaica Bay. The program divided this area into 24 zones based on habitat (deep, shallow, or interpier) and geographic locations. Each zone was randomly sampled in triplicate every 10 days (total 72 samples/10 day period) with a standard 30 ft. flat otter trawl. Mid-water trawls were conducted once a month at all stations. Special studies sampled underpiers, and for day/night differences in interpier densities. The results of the bottom-trawl sampling program are summarized by Malcolm Pirnie (May 1984) with the other programs summarized in a later report (Aug. 1984). A statistical model and analysis of relative abundance of striped bass was undertaken by Martin Marietta Environmental Systems (Aug. 1984). The results of these studies are presently being analyzed, and will be presented in the final Environmental Impact Statement. Sampling procedures are reported by the New Jersey Marine Sciences Consortium (NJMSC) (May, 1984).

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WATERFRONT USE AND DEVELOPMENT IN THE NEW YORK METROPOLITAN AREA

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Department of City Planning
City of New York

New York City's Waterfront is often regarded as a new frontier for development, and today I would like to offer a land use and development perspective on the Hudson River, Upper Bay and Lower Bay. I will be describing a few of the new developments, both private and public, along the Hudson River and the Upper and Lower Bays. Before I do, however, I would like to tell you briefly about New York City's management framework for waterfront planning.

New York City developed the Waterfront Revitalization Program to guide redevelopment, provide public access, and protect natural resources. The program was approved in 1982 and includes three parts:

(1) The establishment of a boundary, identifying lands which relate to the coastal waters. The determinants include flood plains, steep slopes, high water table/shallow soils, scenic vistas, parks and beaches, tidal and freshwater wetlands, and special management areas.

(2) The description of waterfront issues and the establishment of policy. The policy aims for a balance of three objectives:

   a. Natural resources protection including wetlands, erosion control, natural shores, and water quality.

   b. Economic development, particularly water dependent industry such as fisheries, shipping, and outer continental shelf activities, and;

   c. Public use, particularly public access to the water, water-dependent recreation, and visual corridors.

(3) The implementation techniques of conducting a consistency review and providing a source of seed money. All projects which require land use or environmental review are also reviewed for consistency with the waterfront policies. Seed money is available for technical feasibility studies for waterfront projects which promote the policies.

HUDSON RIVER

Along the Hudson River, three major projects are the North River Sewage Treatment Plant, Lincoln West, and Battery Park City.

The North River Sewage Treatment Plant (Fig. 1) will be functioning in 1985 and will have full secondary treatment in 1989. The catchment area is

Fig. 1. North River Sewage Treatment Plant under construction along the Hudson River.

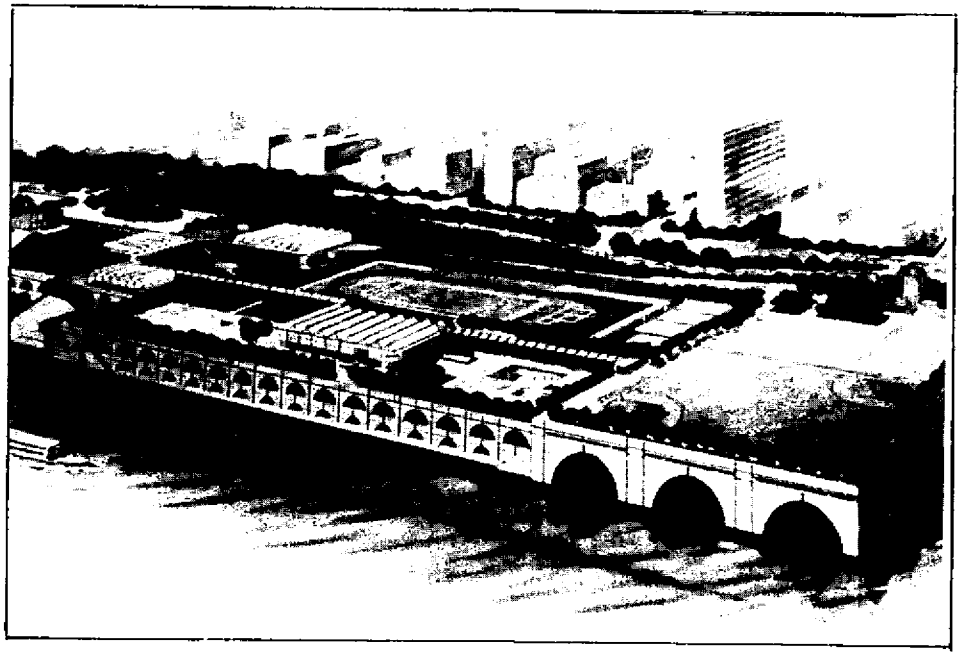

Fig. 2. Artist rendering of the completed North River Sewage Treatment Plant with tennis courts, swimming pool, skating rink and amphitheater on the roof of the facility.

5,000 acres, includes 500,000 people, and produces 150 mgpd of sewage. Construction will begin in 1985 on a park to be located on the roof of the plant which will also be finished in 1989. The park will include tennis courts, swimming pool, skating rink and, amphitheater (Fig. 2).

Lincoln West, a 75 acre site extending 13 blocks from 59th Street to 72nd Street is a project which will redevelop a site now covered with railroad tracks and dilapidated piers stretching along the water. Included is a $1 billion residential and commercial development with 34 acres of open space, 4,000 units of housing, and 50,000 square feet of retail space. Approved plans are being revised by the recent new owner, Donald Trump.

Battery Park City's World Financial Center (Fig. 3) consists of four towers, 33 to 51 stories, with 8 million square feet of office, retail, and public space on 14 acres. The master plan for the entire 92 acre landfill calls for residential, office, and retail development as an extension of the financial center.

UPPER BAY

In the Upper Bay there are two major projects that are water-dependent and new industries to New York City: The Fishport and Navy Homeport.

The Fishport (Figs. 4, 5) is located at Erie Basin in the Red Hook section of Brooklyn consisting of 80 acres of protected harbor with over 40 acres of waterfront space and buildings. Fishport will provide a modern centralized facility for fish handling, storage, processing and distribution of traditional and non-traditional seafood products. Construction began in Fall 1984.

The Navy Homeport for the Surface Action Group is planned for Stapleton, Staten Island (Fig. 6). Approximately 40 acres of unused waterfront will be developed for this new major Naval installation. New piers, dredging and upland construction are proposed to meet Homeport requirements.

LOWER BAY

In the Lower Bay area, development is of a lesser scale. A marina is planned at Sheepshead Bay, recreational activities at Ft. Wadsworth and the South and Midland beaches, and environmentally sensitive development at Arbutis Lake.

At Kingsborough Community College Center for Marine Research and Operations at Sheepshead Bay, a marina facility is planned that will accommodate research vessels and recreational craft (Fig. 7). This development includes the adjacent shoreside areas needed to augment the marina operation and support the fisheries and marine research programs. This will serve as the "educational arm" of Fishport.

The City would like the Staten Island South and Midland Beaches as well as part of Ft. Wadsworth to go to the Gateway National Recreation Center for the further development of recreational resources. Part of Ft. Wadsworth will be used for the Navy Homeport and the Navy is determining how much land can be made available for recreation.

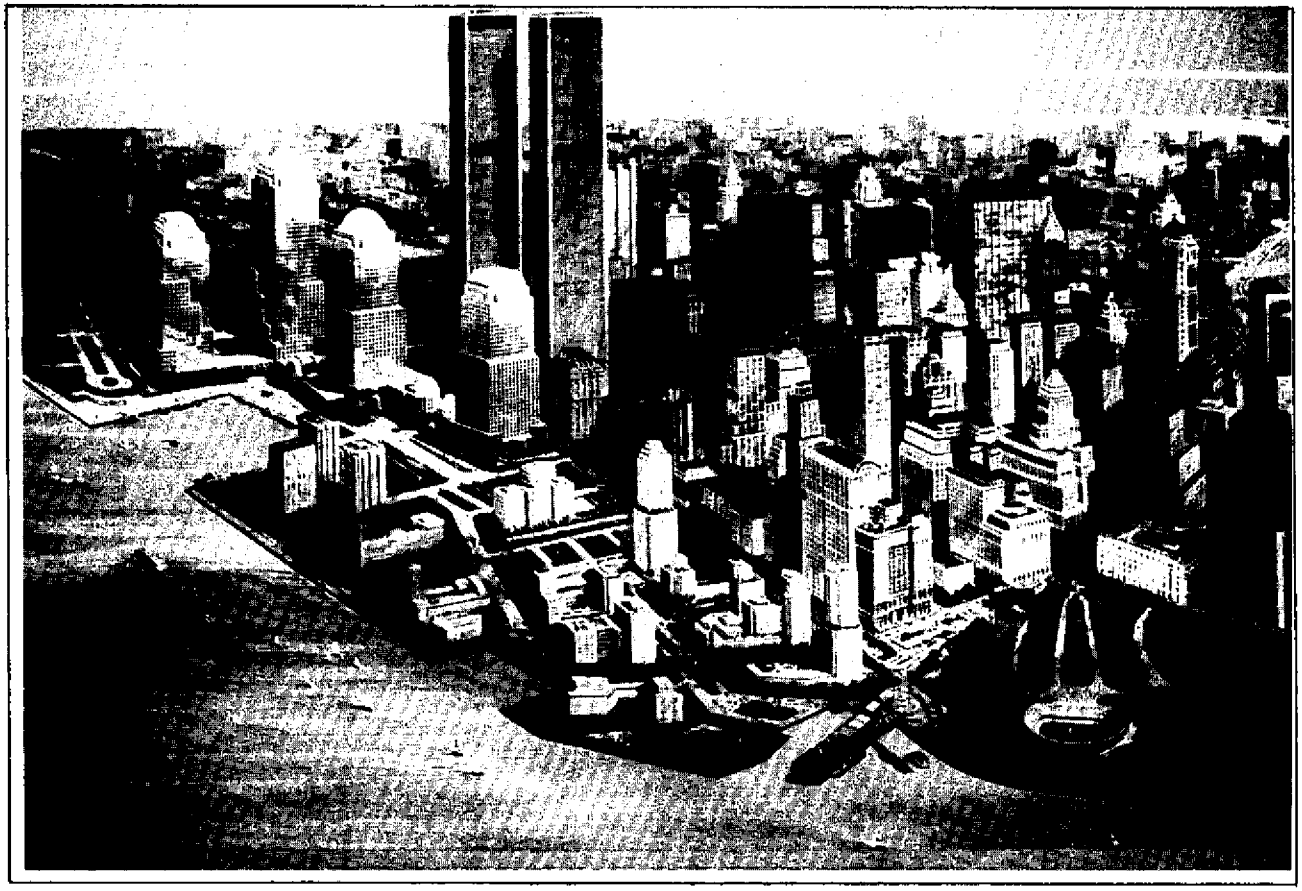

Fig. 3. Artist rendering of Battery Park City's World Financial Center with residential, office and retail development as an extension of the financial center.

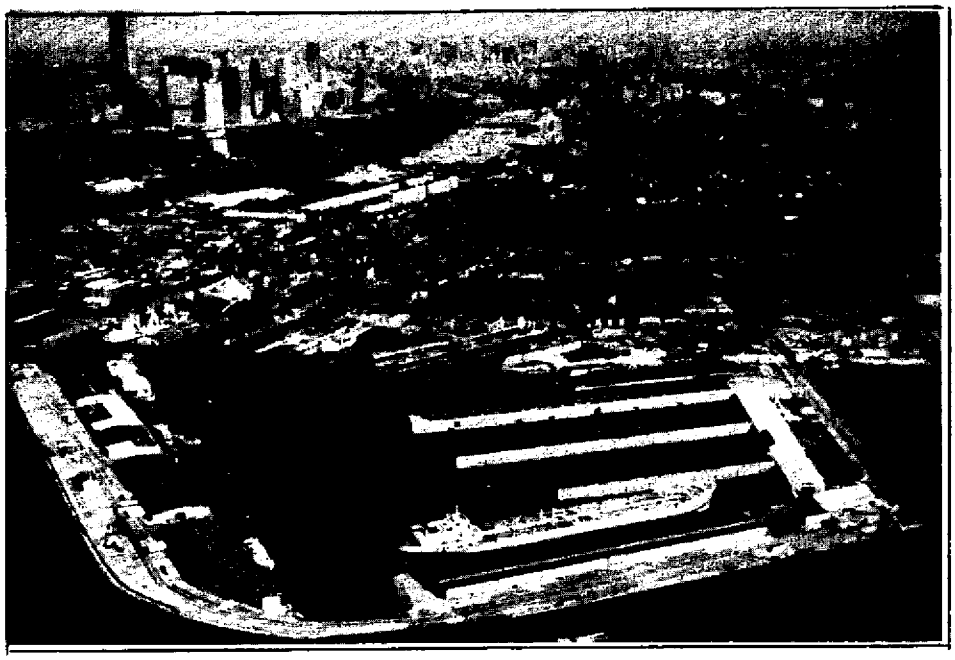

Fig. 4. Existing site condition of the new Fishport development at Erie Basin in the Upper Bay.

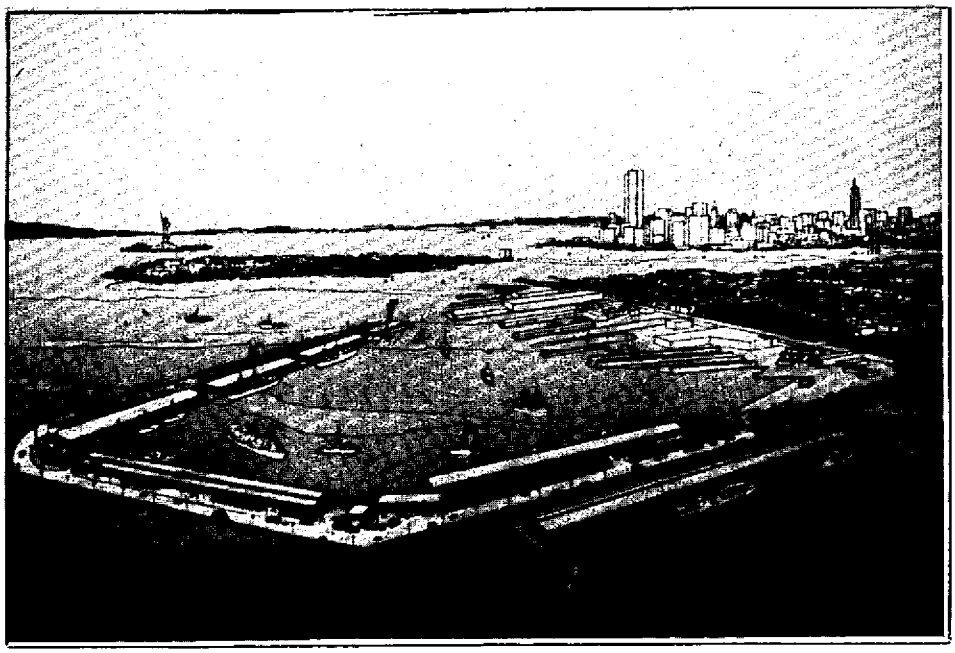

Fig. 5. Artist rendering of the completed Fishport.

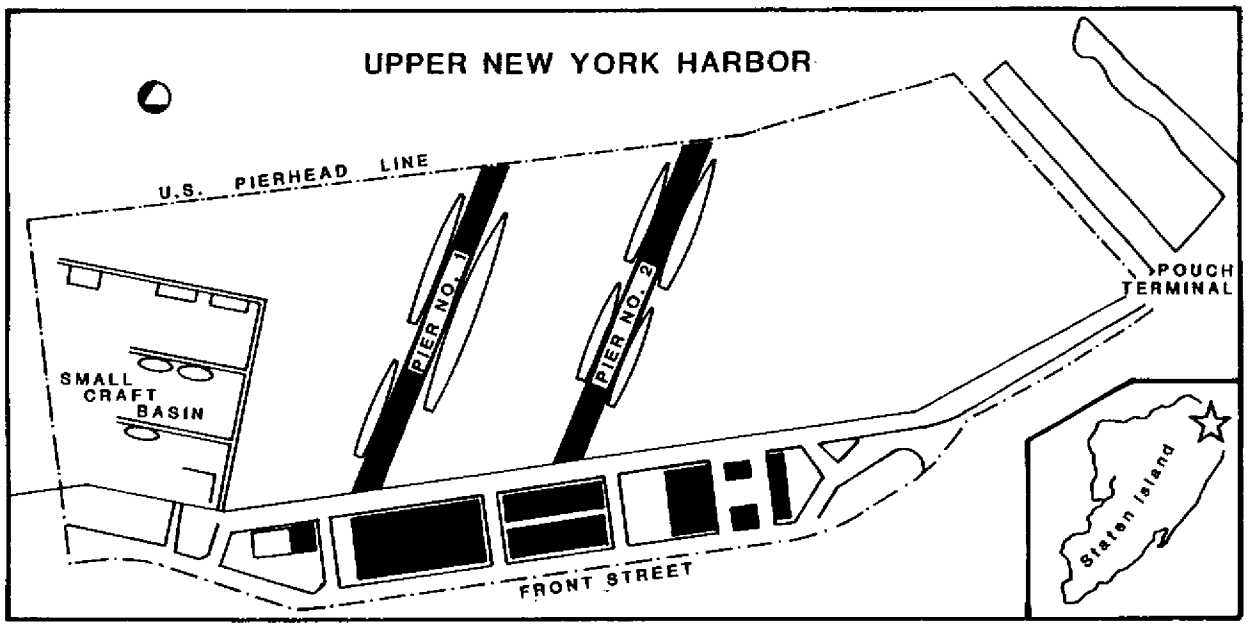

Fig. 6. Preliminary site plan for the proposed Navy Homeport at Stapleton, Staten Island. Shore-side structures include maintenance and operations buildings and a warehouse complex.

Fig. 7. Aerial site of the proposed site for marine development at Kingsborough Community College at Sheepshead Bay, Brooklyn.

Arbutis Lake Development consists of 38 single family homes and the preservation of wetlands, waterfront access and a landscaping plan designed with compatible plant species and support for waterfront wildlife.

SUMMARY

These projects (Fig. 8) represent some of the major redevelopment and revitalization efforts in the Hudson River Estuary for which we strive to balance economic development, natural resource preservation and public use through our city-wide waterfront policy.

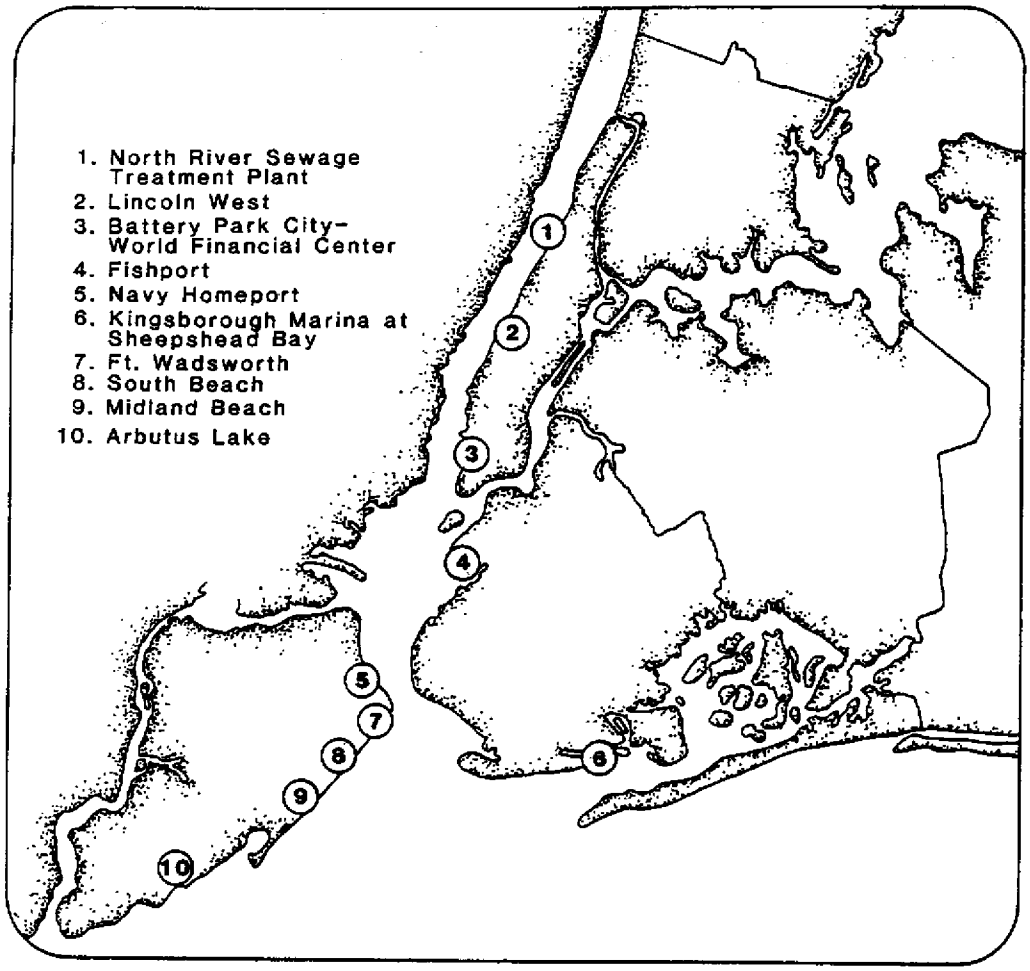

Fig. 8. Major New York Waterfront projects on the Hudson River, Upper Bay and Lower Bay.

QUESTION: Could you run down the shore of Middlesex and Monmouth County town by town to give us some idea of plans that are being developed?

KAUFFMAN: I'm not prepared to do that here, but I can provide some answers from my office. There is an advisory group looking at economic and environmental aspects of redevelopment of the area. There is a move, started five years ago, to create a permanent authority to oversee development of the area.

QUESTION: With representatives from New York and New Jersey here it would be interesting to hear if policy similarities exist. If and when developments are accepted and approved what level of sewage treatment is required in New Jersey and New York developments?

KAUFFMAN: As far as I know, the mutual plans are to bring sewage treatment plants up to secondary sewage treatment.

QUESTION: More specifically, are development projects required to tie into secondary treatment before being constructed?

KAUFFMAN: In New Jersey they either have to tie into a municipal system or have their own system.

HAFF: In New York City, where we have municipal infrastructure, a project will tie into it. Where we do not have that, such as the project at Lincoln West, that project will, if constructed before the North River sewage treatment plant is finalized, add to the raw sewage now going into the Hudson. But, as the projects have been planned, they will be eventually covered by the North River sewage treatment plant. In Staten Island, where we don't always have existing sewers, most large developments are providing their own sewage treatment plant.

QUESTION: Is that the case in Manhattan?

HAFF: No, we are not asking developers in Manhatten to provide their own sewage treatment plant because we have a sewage treatment plant that will be able to handle that. I would add that we in New York City are somewhat skeptical about privately run sewage treatment plants as a long-term solution. Besides the fact that we would like developers to absorb the cost of sewage treatment, we are somewhat concerned about the long-range enforcement and operational maintenance of private facilities. Who has control and how will we enforce proper operation and maintenance of privately held sewage treatment plants? Wherever possible we plan to tie in projects with existing sewage systems.

QUESTION: Has the City brought the World Trade Center under secondary treatment?

HAFF: I believe it is now being done in the Newtown Creek facility.

ABEL: Holly Haff mentioned in passing the brilliant design for engineering the Erie Basin project for fisheries and aquaculture, being sponsored and

fostered by the New York-New Jersey Port Authority. And, while we have him trapped, I would like to introduce the New York Port Authority's representative who is the project monitor, Mr. Michael Giari. Did you want to add anything to Holly's description of the project?

GIARI: No, I think she did a very good job. The project will be under construction by the end of this month. It should be in operation in a year and two months from now.

QUESTION: On that project what kind of plans are there for improving the road structure to get products off the Brooklyn part of Long Island? Have you planned anything?

HAFF: As I understand it, the Department of Transportation has a major traffic and transportation study north from the Owls Head sewage treatment plant to cover the whole industrial area along the Brooklyn waterfront virtually to Brooklyn Heights.

GIARI: Certainly, transportation access is crucial along the whole Brooklyn waterfront area. In terms of the Fishport, we anticipate truck traffic as a result of that project will not be significant. From the fish processing facility we expect 14 to 25 trailer loads in and out per day.

QUESTION: In addition to the riverfront walkways on the New Jersey side of the Hudson, there are many people who probably couldn't afford to buy town houses but like boating. Are provisions being made for public launching sites?

KAUFFMAN: There are no launching sites that I know of, nor proposals that include boat ramps, but 25 percent of each marina must be open to the public. What system there is to make that available to the public, I am not sure.

QUESTION: As you may know, the New Jersey Sea Grant Programs developed a set of multi-disciplinary research projects for the next Sea Grant cycle. These will address the impact of infilling along the pier area, removing the old piers and installating new piers vis-a-vis the physical oceanography of lower Hudson River and the fish population. I sense there are six or seven universities in New Jersey involved in these four projects. Proposals have been reviewed and revised proposals will be sent to the Sea Grant Office. We will address some of the fishery research and the environmental impact studies.

KAUFFMAN: That would be very helpful. We hope the results will be timely for our needs.

QUESTION: In your discussion you indicated that fill for Westway would be taken from harbor sands. I recall a few years ago similar activity was stopped out of concern for sedimentation of the channel. Is this a problem now?

HOUSTON: As I understand it, they are developing an environmental impact statement now on the affects of sand mining. It will require new permits and an entire environmental review.

FISHERY CONCERNS

PANEL MODERATOR

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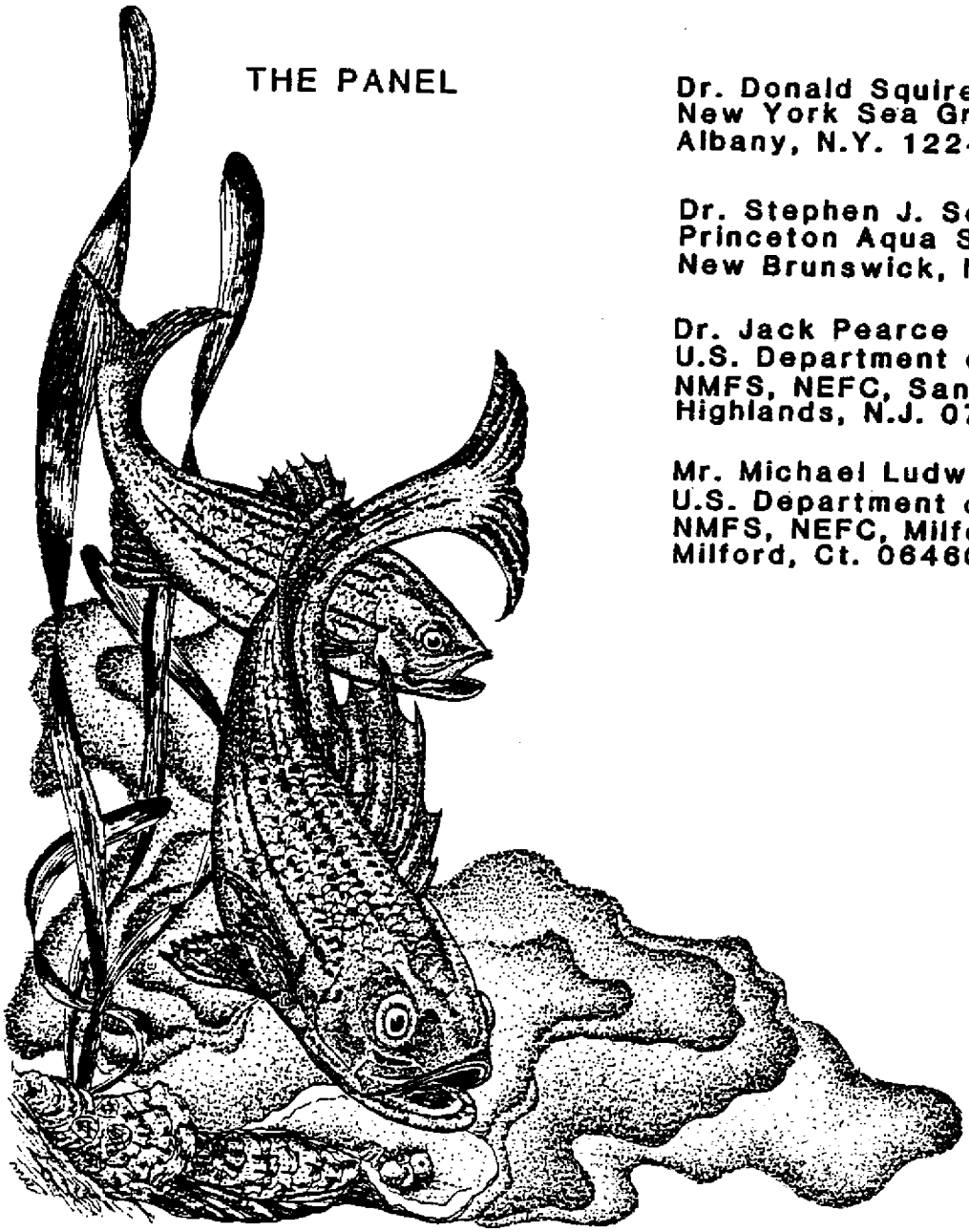

THE PANEL

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HABITAT LOSS

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My comments this afternoon were well prefaced by this morning's speakers. Barry Commoner gave us the concept of magnitude of change in the environment. Tony Pacheco, speaking of Lionel Walford in whose memory these meetings are held, told of Walford's interest in identifying information gaps. Both magnitude of change and information gaps characterize the subject I'm to address.

New York Harbor is one of the great natural harbors of this planet--it is also one of the busiest, playing a critical role in the regional economy. As ports go, the Port of New York is environmentally conservative. Compared with its principal competitors, Baltimore, Philadelphia and New Orleans, less dredging is required to maintain its 180+ miles of channels and anchorages (Fig. 1). Dredging is destructive and creates spoil disposal problems.

But like all ports, its margins, where land and water come together, have been greatly altered. The Port of New York's 700+ miles of coastline have been almost entirely modified by rip-rapping, bulkheading, in-filling, pier building and other works of man. No one seems to know how much alteration has occurred for there are no maps or records.

Modification of the harbor commenced as early as the 1600's. An early example, the Great Dock which was constructed in the East River in 1634, involved both bulkheading and filling. Bulkheading and rip-rapping has been an ongoing process. The arm of rockfill enclosing Erie Basin, Brooklyn, was started by a speculator who found a good use for the rock ballast carried to the Port by 18th and 19th century sailing ships. Then the Port was primarily engaged in export trade and incoming vessels were often empty. Since those early days, of course, the Erie Basin breakwall has been further fortified, but with careful search one can still find rocks containing European fossils. Other "exotic" rip-rap includes debris from the World War II blitz of London brought over as ballast by empty Liberty Ships. This building rubble now forms the substrate for Roosevelt Memorial Drive on Manhattan's East Side.

By 1966, over 20% of New York City's area had been created by land fill (Fig. 2). The cycle of pier building, dereliction, in-filling to the pierhead line, and new pier building has resulted in dramatic narrowing of the East River channel--as much as 600 feet in some places. That this cycle is still in effect is amply demonstrated in Lower Manhattan where Battery Park City is being constructed on fill and the proposed Westway would continue the filling process uptown along the North River.*

*(Ed. Note): "In early Colonial days ... the Delaware was known as the South River and the Hudson as the North River. The name North River is still used in the Manhattan area, but the river officially became the Hudson River after the English seized control in 1664." (Boyle 1969).

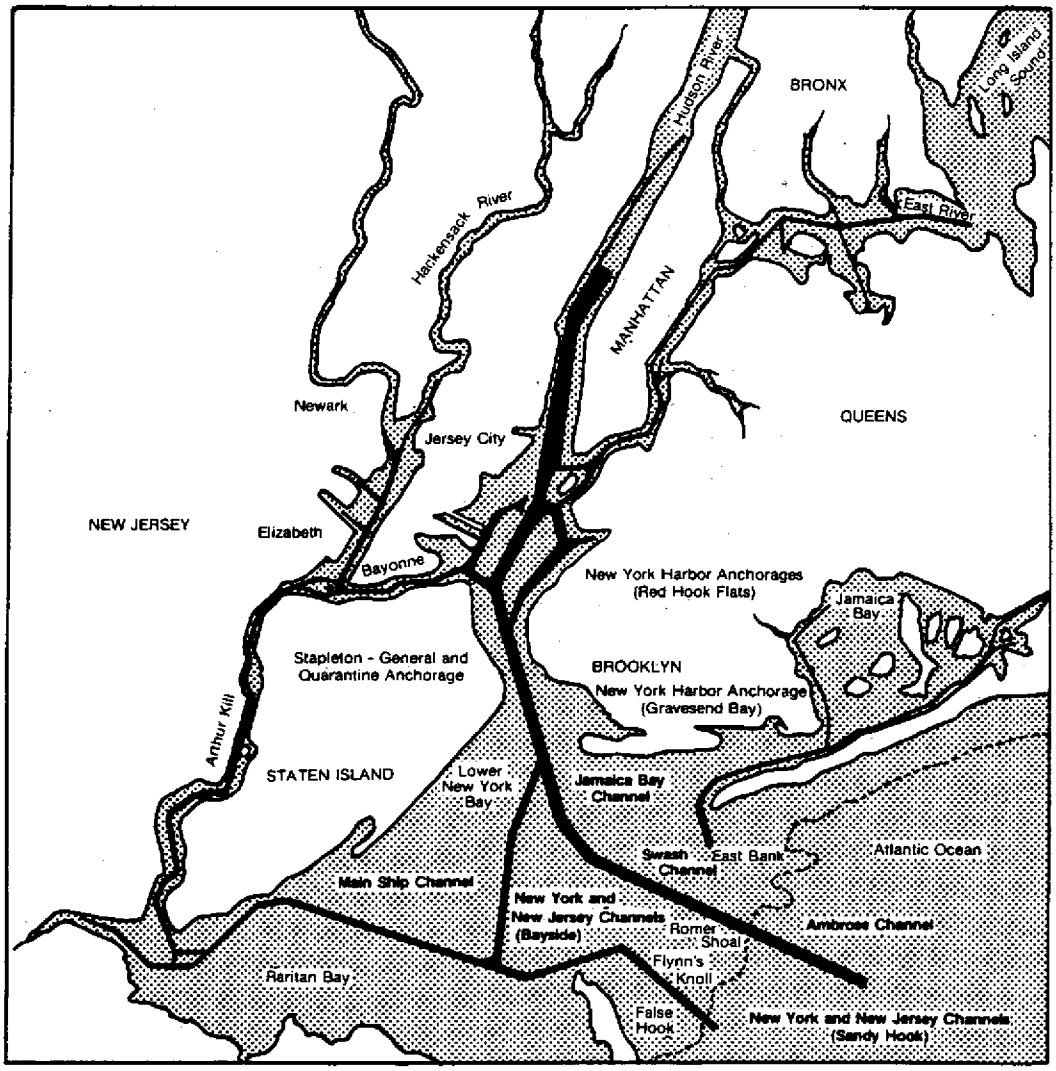

Fig. 1. Major channels of New York Harbor (from Squires 1983).

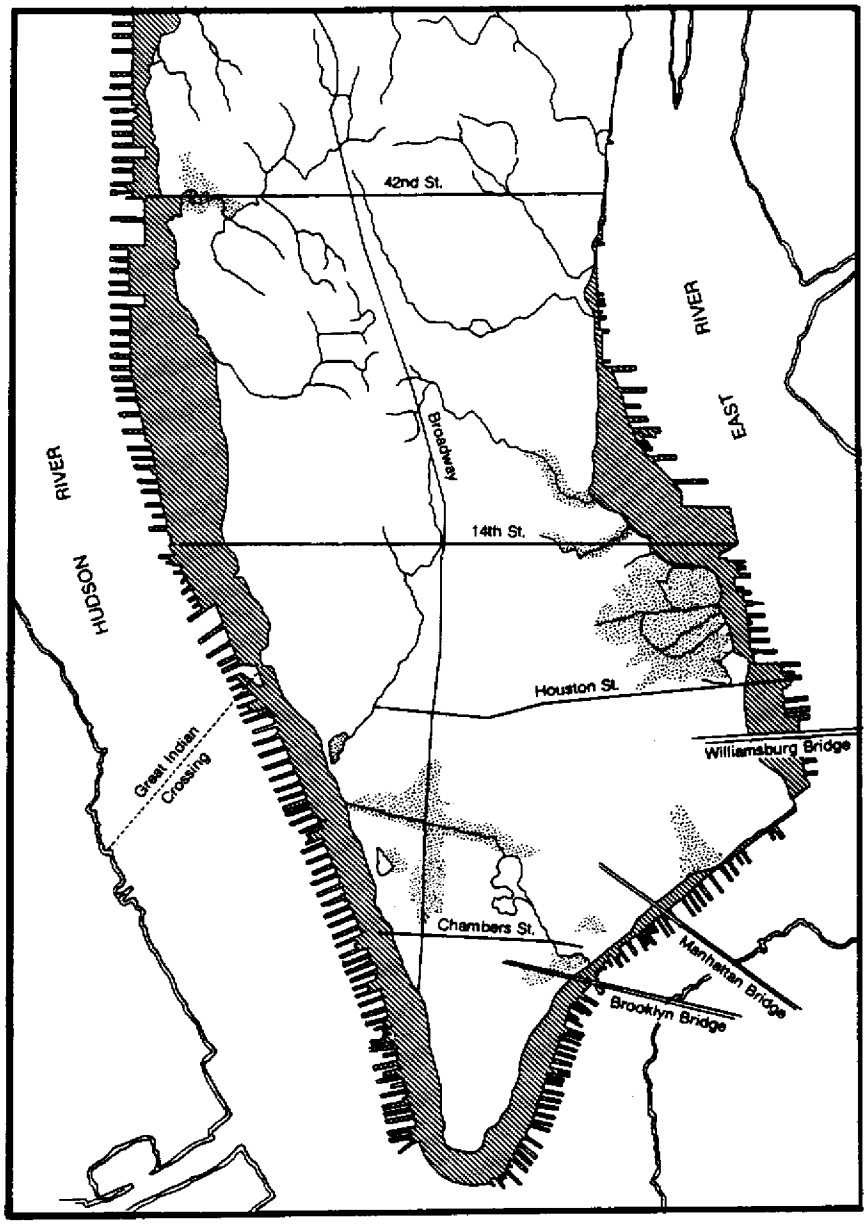

Fig. 2. Landfill along Manhattan Island. The map shows shoreline and drainage as it existed in 1609. Growth by filling principally to the pierheads, is shown up to 1909 (from Squires 1983).

Since earliest days vessel owners and shore facility operators have been interested in reducing shoaling in the harbor and on offshore bars. In 1834, the world's greatest earthmovers, the US Army Corps of Engineers, began operations by shifting portions of the New York Harbor bottom from place to place. At first most of the movement was from around the piers to dump sites further out in the harbor. But as dredgers found "short-dumping" to be profitable, it became necessary to cause the spoil to be dumped outside the harbor. While the quantities of sediment moved from New York Harbor elsewhere are less than those required for other major harbors, the effects of the modification of the bottom of the harbor are still dramatic. Most spectacular was the demise of the oyster reefs, which had once characterized the area, as a result both of physical disruption and by smothering from stirred-up sediment.

All of the alterations I have mentioned, and many more, have occurred at a pace which is, in general, related to the growth of population in the region. That growth has been spectacular; in less than 250 years the population of the New York metropolitan area has gone from hundreds of thousands to tens of millions (Fig. 3). With that growth has come the requirements of transporting water, food and goods into the region and exporting waste water, and goods out of it; of providing housing and working spaces; of locating industry and commerce; and of sustaining the human condition through access to space, light, air and recreational opportunity.

While growth of population, and consequent "progress" in development caused physical modification of the Port's environment--and resulted in extensive loss of indigenous marine life--a more insidious alteration of that environment has been occurring in the last 40 years. That new destructive force is, of course, chemical contamination. We are only beginning to understand the dimensions of that chemical alteration of the environment, but must not lose sight of its importance in modification of the habitat.

The Hudson Estuary is relatively new, geologically speaking. As the present estuary developed, marine life invaded and took up residence. Still other species used the estuary as a spawning or feeding area. Man came to the estuary about 15,000 years ago and was, at first, a part of the terrestrial scene: his impact for the first 14,700 + years being pretty much limited to predation on fish and shellfish along the margins of the estuary. The effects of the human species on the estuarine ecosystem were probably less than the changes occurring as a result of sea level rise and other "natural phenomena."

Physical alteration of the estuary by man was inherently more destructive and important habitats were lost. Land filling, in particular, resulted in almost complete loss of wetlands in the estuary. While some species accommodated to these changes, others did not. Oysters, once a renowned product of the estuary, succumbed to outright destruction of the reefs or were smothered by dredge and fill. But the striped bass accommodated, in part, and soon found that the habitat along the edge of the North River lost to filling was, in part, replaced by the current-slowing pilings of the North River piers.

When we step back and sum it up, the Hudson-Raritan Estuary (to use its most modern denomination) has clearly been extensively modified and many important habitats have been lost--some forever. But, there is another side

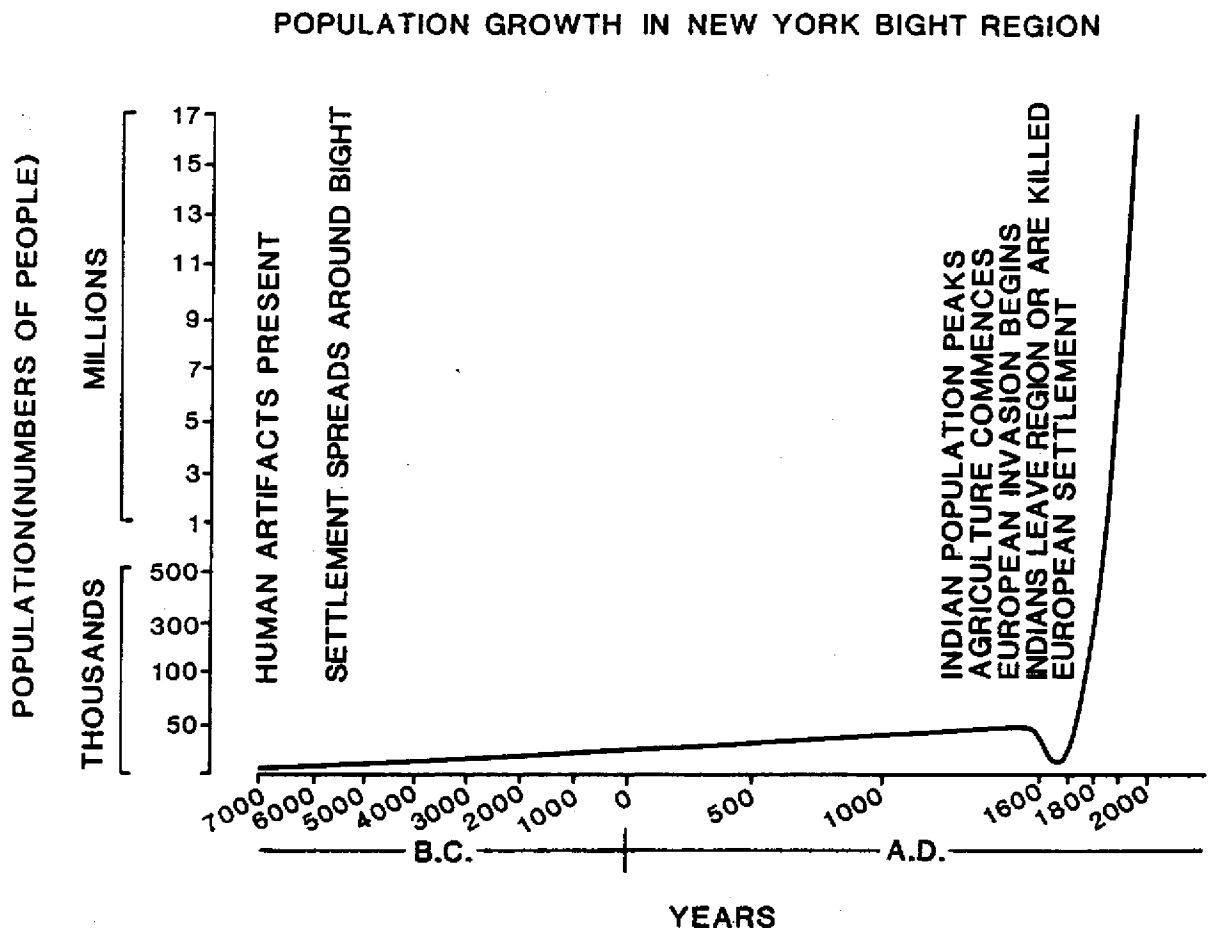

Fig. 3. Population growth in the New York Bight coastal area. Indian populations grew slowly to a maximum just before European settlement. Explosive population growth of European settlers followed. Note scale changes in population (from Squires 1983).

to the story. Around the margins of this estuary live 10 million people. Were these people, and their requirements, dispersed along the region's coast, extensive areas would have been modified rather than only the relatively limited Port area. Given the population and the need for industry, commerce, transportation that population generates, ecological damage has been concentrated rather than dispersed. One can then ask, "Is concentrated modification more or less damaging to the regional ecosystem than limited, but more geographically extensive, alteration? Has this been an even trade?" I don't know that this question has been asked or answered.

Is there a balance to be sought between the damage caused by what is and that caused by what might have been? Given the degree of coastal modification one sees in the less populated areas of the New Jersey and New York coast, one can speculate that the physical alterations of the coastal environment might have been greater from a dispersed population. On balance, recognizing that, even with the extensive damage done in the Hudson/Raritan Estuary, the fish populations are remarkably diverse and large, perhaps we have been quite fortunate.

But, my argument thus far has considered only the physical modification of habitat. The effects of chemical pollution seem to me to be potentially more severe and far-reaching. In the Port of New York and New Jersey is a major concentration of petrochemical industries. Their discharges and the leakage from their dumpsites combine to have severe pollution effects. Nor are these discharges new. By the end of the 19th century, fishers of the estuary were complaining about "tainted" fish and shellfish. The growth of chemical pollution has been exponential since the development of the chemical industry following World War II. One is led to wonder whether, if the physical modification of the estuary had not occurred, the effects of chemical pollution alone would have resulted in the same biological changes we see in the fauna and flora. And, we have to ask, are there longer-term effects?

Added to those long time-frame effects of chemical pollutants are the geographically far-reaching impacts. There is disturbing evidence of presumptive effects of chemical pollution from the estuary upon reproduction and fecundity of fish some distance into the ocean. Thus man's onshore activities have altered the physical environment of the margins and bottom of the estuary, reaching even the margins and bottom of the ocean adjacent to the estuary. Those same onshore activities are now having less visible, but more far-reaching chemical effects upon marine life which we cannot yet assess.

The future, as always, is enigmatic. Once again a great round of construction is occurring on the margins of the estuary and the Bight. Are we intelligent enough now to be able to counter negative effects of such constructions with amelioration through new habitat formation? If not yet, we must learn, for the scale of construction projects grows ever larger. In the offing are the further filling of the North River as Westway comes closer to being. Channels are being dredged deeper as technology permits construction of larger vessels. And, in the ultimate, creation of an industrial island outside the estuary, in the Bight, could in a sense result in a new "estuary" at the inner end of the Bight and enormously alter the Port as we know it.

Barry Commoner spoke of the magnitude of change. The magnitude of change in the marine environment adjacent to this huge metropolitan complex is

stupendous. It is matched only by the rate at which that change has occurred. After 15,000 years of coexistence with the estuarine environment, man's burgeoning populations resulted in almost total physical alteration of the estuary in somewhat less than three centuries. Even more dramatic is the change of the last 40 years with large-scale petrochemical pollution. Here Walford's interest in informational gaps is best displayed. We know too little of what the impacts of chemical pollution will be. I suspect that the future may reveal that chemical alteration of habitat, although less visible to the bystander, will be profoundly more significant to the Port than physical alteration.

We have been fortunate that the Great Port, as James Morris called it, and all of its shaping by man, retains many positive and enhancing characteristics. Despite our best efforts, nature prevails. But this is the result of luck, not wisdom. Attention must be paid, now, to the problem of restoring and enhancing the quality of the harbor and estuary--a task to be undertaken in full recognition that the marine environment and the nation's premier city can co-exist.

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FACTORS IN HABITAT CHANGE IN THE HUDSON-RARITAN ESTUARY, 1880-1980: DREDGING, LANDFILL AND SUBMERGED AQUATIC VEGETATION*

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INTRODUCTION

Our material is drawn from a study conducted from 1982-1984 for the National Oceanic and Atmospheric Administration on long-term (1880-1980) pollution inputs into five east coast estuaries including the Hudson-Raritan. The study examined a number of trends and compiled information in regard to such factors as population, land use, agriculture and industry. In addition, it analyzed and compiled data relating more specifically to fish habitat, such as dredging, and collected information on other habitat factors, such as landfill and submerged aquatic vegetation. This brief report will summarize the findings of the study in regard to these findings for the Hudson-Raritan estuary.

I. Dredging

Overview

Dredging and filling, while serving useful commercial purposes, often have perturbing effects on the environment. These activities alter the hydrodynamics of water bodies, may reduce the tidal prism, damage aquatic habitat, and alter natural sedimentation patterns (Suszkowski, 1978). In addition, dredge spoils are often contaminated with various industrial compounds and metals, many of which are toxic, and transferring them to new sites of deposit can cause serious problems. Dredge spoils have frequently been deposited in wetlands where they have destroyed habitat or been used to fill in along the edges of rivers and harbors (Squires 1983; Gross 1976).

The Annual Reports of the U. S. Army Corps of Engineers provide yearly records of navigation improvements and flood control projects and are the primary source we used to determine the volume displaced in each river. For the most part, they present a consistent account of the cubic yards dredged and of the location of the activity for each project sponsored by the Corps. The reporting of the dump sites, however, is more sporadic. In addition to the dredging data, the Corps reports contain occasional information on substrate and landfill.

*Ed. Note: Unable to accept an invitation to appear at the workshop, Dr. Tarr volunteered to prepare and submit this paper for publication.

Information was compiled on the yards dredged in the major bays and rivers of the Hudson-Raritan estuary and associated rivers. This summary reports only the total figures dredged; more detailed information is available (Klawonn 1977). In the hundred years from 1880 to 1980, the Corps of Engineers dredged nearly 594,664,714 cubic yards from the rivers emptying into the Upper and Lower Bays of New York and in the channels running through the two bays primarily for navigation improvements (cf. Tables 1 and 2). In addition to the dredging by the Corps, there were many private dredging projects. In the 1970's the Corps estimated that approximately 440 thousand cubic yards of material were dredged from the Hudson basin in private operations (New York Dept. of Environmental Conservation, 1979). Projects in the Hudson River and in the New York Bays made up 65 percent of the total yardage dredged. Another 30 percent came from the Raritan River and Bay, Arthur Kill, Newark Bay, Hackensack and Passaic Rivers; the remainder was taken from smaller rivers and creeks, including the East River. Dredging totals were generally much higher in the 20th century as compared with the latter half of the 19th century. From 1900 to 1980, 70.6 million cubic yards per decade were dredged compared with less than 40 million removed in total between 1880 and 1900.

Table 1. Volume dredged in New York Bays and Hudson River, 1880-1980. Distance in miles from Sandy Hook.

Miles	Cubic Yards*
0-10	100,832,418
10-20	152,913,876
20-30	44,015,404

Table 2. Volume dredged in Lower New York Bay and Raritan Bay east of Sandy Hook, 1880-1980.

Mile	Cubic Yards
0-5	37,814,816
5-10	20,235,408
10-15	2,601,835

*The dredging locations identified by the Corps did not always fit neatly into five and ten mile boundaries. If they reported a dredging volume for an operation that spanned more than one of the mileage classes, we divided the amount evenly among the classes. For example, in the first table 15,338,790 cubic yards were removed between miles 5-15 (15,338,790,2 = 7,669,395). Therefore, 7,669,395 cubic yards were included in the 0-10 and the 10-20 mile groups.

II. Landfill

Over the years there have been extensive alterations in the shoreline of the Hudson-Raritan estuary. Many of these changes were accomplished with material dredged from the harbor, as detailed in the earlier sections of this report, as well as by garbage, ship ballast, cinders, and material from construction such as the digging of cellars and the building of subways (Gross 1976). Several estimates of the amount of filled land have been made at different times in the past. A survey of Manhattan in 1862, for instance, calculated that since 1688 the average width of reclaimed land to the bulkhead line at the inner end of the wharves was 626 feet (Albion 1939). More recently, in 1956, it was estimated that about 20 percent of New York City was built on landfill, about half of which was composed of former sanitary landfill sites (Gross 1976). For specific details, there are a series of landfill maps printed in Stokes (1915-1928), but they should be used with caution since their accuracy is in question. (Telephone conversation, Dr. Ann Buttenwieser, Nov. 20, 1983). There is also a useful map of Manhattan Island drawn by Egbert L. Viele and published by the Citizen's Association of New York in 1866 that shows man-made, original marsh lands and meadows.

A thorough study of landfill in the Hudson-Raritan area was recently been conducted by Dr. Ann L. Buttenwieser in her Columbia University doctoral dissertation "Walls on the Water, Public Planning and Development of the Manhattan Waterfront." (1983). She calculated that from 1686-1984, there were at least 1,400 acres of landfill along the Hudson-Harlem and East Rivers. In her dissertation a series of maps details the changes in the Manhattan waterfront over time. This information is broken down by date, location, and acres created in Table 3 and graphically presented in the landfill map (Fig. 1).

Information about landfill on the New Jersey shores of the estuary is available only from one or two sources. However, the State of New Jersey has compiled a series of maps that, with some labor, would make possible a complete recreation of the original shoreline of the New Jersey side of the Hudson-Raritan Estuary. (The New Jersey shore of the Delaware River is under preparation). These maps were prepared by the N. J. Department of Environmental Protection under the authority of the 1969 act of the legislature concerning the Hackensack Meadowlands. The impetus behind the program is the state's desire to lay claim to all land originally under tidewater. Under this program the state was divided into 144 units and extensive research from old maps and records was done for each unit. Information from the maps showing the changes in the shoreline and the source of the information was transferred to photographs of each land unit. This information is available from the N. J. Department of Environmental Protection but only in disaggregated form (Goldshore 1979). No data on the amount of land created have been compiled from these maps.

In addition to these maps, there is also a rich body of source material available to trace alterations in the various New Jersey marsh and wetland areas that border the Hackensack, Elizabeth, and Passaic Rivers and Newark Bay. Here, large areas of made land were created by dredging or pumping of material from the bottom of streams and bringing flat areas to a higher level than adjacent marshland. The marshes were also used extensively for dumping

TABLE 3

MANHATTAN LANDFILL 1686-1984 (from Buttenweiser, 1983)

Date Begun or Proposed	Actual Made Land Location	Acres
1624		
1686	East River, Whitehall to Corlears Book	95
1730		209.5
1798		198.25
1803		NA
1826		NA
1821	Battery	20+
1871	Bulkhead and pier expansion around island	300+
1894	Riverside Park, West 72nd West 72nd to 129th Street	132
1898	Harlem River Speedway, East 155th to Dykman Street	NA
1937-39	East River Drive, Montgomery to East 93rd Street and associated Parkland	40 52
1961-73	Waterside, Est 25th to 30th Street	6.1 (deck)
1968-76	Battery Park City, Battery to Harrison	91
1962-78	North River Pollution Control Plant West 137th to 145th Street	30 (deck)
	Other	NA

Approximate Total Present Landfill

East River	600
Hudson and Harlem Rivers	1500
	2100

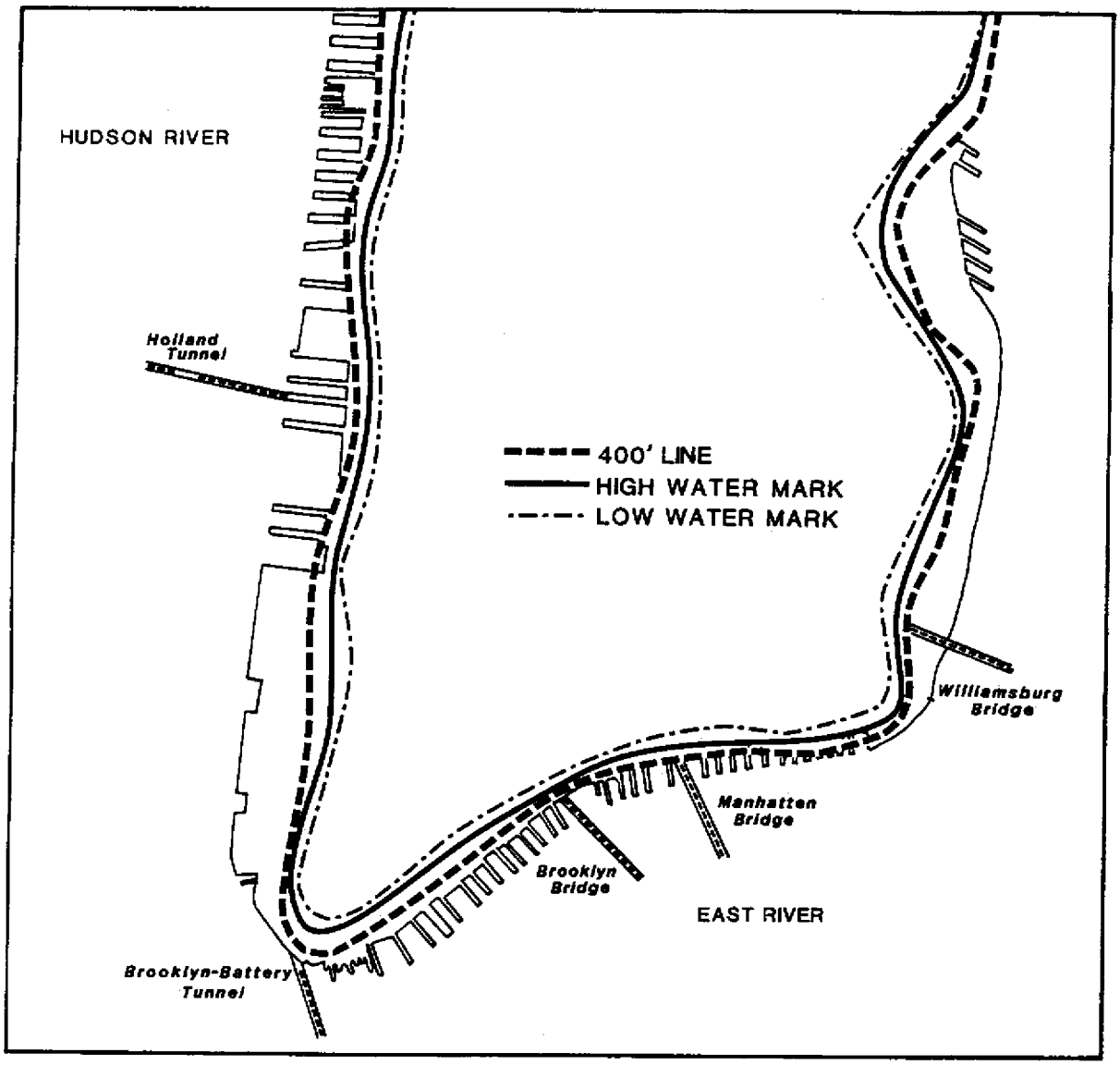

Fig. 1. Manhattan Island Landfill (from Buttenweiser 1983).

of refuse and ashes. The made-land was used primarily for railroad tracks and industrial uses such as warehousing. One study notes that by 1918 the salt marshes of Essex County, NJ were 96 percent drained and filled (Galishoof 1975; Lee 1925). Another study of Newark Bay notes that from approximately 1880 to 1969, about 75 percent of material dredged from the bay was deposited in adjacent upland disposal sites that were later used for industrial, residential, and recreational development (Suszkowski 1978).

In all the New Jersey marsh areas in the Hudson-Raritan basins there was extensive ditching, building of dikes and filling for purposes of mosquito control and for agricultural and industrial uses. In addition, largely before 1940, thousands of gallons of oil were dumped on the meadows for mosquito control. Tidegates were also constructed to free the area of tide and storm water. In comparison with the so-called Newark salt marshes, the Hackensack meadowlands suffered less landfill and more diking, ditching and use of tidegates. In 1950, however, a hurricane wiped out many of the dikes and gates along the River, allowing salt intrusion. Today, through the work of the Hackensack Meadowlands Development Commission, large areas of the meadowlands have returned to an ecologically sound condition (Mattson and Vallario 1976; Mattson 1978).

III. Submerged Aquatic Vegetation

Submerged aquatic vegetation (SAV) is extremely important to the estuarine ecosystem and provides habitat, cover and food for a variety of fauna (Boyce Thompson Institute 1977; Lippson et al., 1982). There was limited information available, however, on the historical changes in SAV of the estuaries under study aside from the Potomac (Carter and Haramis 1983). One exception is documentation of the vast mortality of eelgrass (Zostera marina) that occurred in 1931-32 (Cottam and Munro 1954).

For the Hudson-Raritan estuary, there is little information available until the mid-1930's. Between 1926 and 1936, the New York State Conservation Department conducted biological studies of the Hudson River, primarily with the goal of improving fish stocking conditions. The 1936 survey of the Lower Hudson watershed included information on aquatic vegetation as well as other biological factors (Muenscher 1936). Information was included for 21 of the principal areas of vegetation located at intervals between 20 and 160 miles above Battery Place near the mouth of the Hudson River.

In the 1970's a biological study of the Hudson Estuary was conducted by the Estuarine Study Group of the Boyce Thompson Institute for Plant Research. This study included some information about historical changes in the abundance of plants in the estuary but focused primarily on the 1970's (Boyce Thompson Institute 1977). A specific comparison of the 1936 plant listing with studies done in 1948, 1967, 1968-74 can be found in an undated paper by Buckley and Ristich from the estuarine study group probably done in the late 1970's.

For the New Jersey shores of the Hudson-Raritan estuary, it is reported that little vascular vegetation currently exists from the George Washington Bridge to Sandy Hook. Eelgrass is present on the south side of Sandy Hook Bay

(telephone communication with Richard A. Kantor, Division of Coastal Resources, N. J. Department of Environmental Protection, Sept. 6, 1984).

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RESOURCES AT RISK

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The focus of this workshop is the impact of coastal development on the marine resources of the lower Hudson River and Greater Raritan Bay. Widescale development of riparian lands, discharge of sewage and industrial wastes, and destruction of tidal marshes as a result of dredging and/or filling are obviously incongruous with the concept of sustaining a healthy fishery, be it for recreational or commercial interests. If such were not the case, then there would be no need for coastal zone management, mitigation plans, or ordinances and laws designed to protect our fragile estuarine wetlands.

The casual observer may seriously question the value, or, perhaps, even the existence, of any aquatic resources worthy of concern in the lower Hudson River and Raritan Bay. In particular, as a result of a long-standing history of environmental abuse, the lower Hudson River projects an image of harboring little in the way of important recreational or commercial resources. Over one hundred years ago, poor water quality resulting largely from the discharge of industrial wastes combined with the construction of dams and impoundments had led to a serious decline in the shad fishery of the Raritan River. At the turn of the century a decline in striped bass, sturgeon, and shad taken from the lower Hudson and Newark Bay was attributed to poor environmental conditions, overfishing and loss of habitat due to waterfront development. A decline or actual loss in the blue crab fishery and oyster industry centered in Raritan Bay was noted as much as 70 years ago as a result of dredge induced siltation. Many of these same environmental perturbations still persist today. In addition, new and more serious factors threaten local aquatic resources. In the mid-1970's the contamination of fish flesh with PCBs forced a ban to be placed on the commercial sale of striped bass and American eel from the Hudson River. These were two very viable fisheries. In December of 1982, the New Jersey Department of Environmental Protection issued a warning about the consumption of bluefish, striped bass, white perch, white catfish, and eel captured from northern New Jersey. Then there has been the discovery recently of dioxin contamination in fish taken from Newark Bay and the Hudson River. So, industrial pollutants and toxicants pose a new impact on our resources and potentially threaten the health of those who consume fish or shellfish from the area.

As we meet right now, thousands of pounds of possible carcinogenic materials such as benzene, petroleum hydrocarbons, and industrial by-products are being legally discharged into Raritan Bay. Millions of gallons of raw sewage enter the Hudson River daily from lower Manhattan. In addition, development plans which will significantly alter the waterfront of the Hudson River from the George Washington Bridge to the Verrazano Narrows are being implemented. All these factors undoubtedly have a serious deleterious effect on the aquatic resources of the area. It is thus not surprising that the average person has a very erroneous conception of the importance of the lower Hudson estuary and Raritan Bay.

However, the area continues to provide important habitat for a variety of fish and shellfish. During the four months (January through April, 1984), that the recent Westway Study was conducted, over seventy different species of finfish were collected. This past summer, surveys which Princeton Aqua Science conducted along the Jersey City coastline yielded a variety of transient summer species including bluefish, summer flounder, mullet, jack, and kingfish. So, despite the various factors which have environmentally compromised the area, the lower Hudson continues to attract and support a variety of fish, many of which are commercially important.

Among the more important species which are being threatened are striped bass, bluefish, white perch, winter flounder, and summer flounder. All these fish utilize the lower Hudson and greater Raritan Bay either as nursery or feeding grounds. As of late, striped bass have received the greatest attention, largely due to Westway. Although there are a number of theories as to how young-of-the-year and juvenile striped bass utilize the lower Hudson, the concensus is that it does provide critical habitat.

Other marine resources such as blue claw crab, quahogs, soft shell clams, and fish such as tomcod, shad and blueback herring are also threatened by continued poor water quality, dredging activities and loss of habitat in either Raritan Bay or the Hudson River estuary.

It is true that in the lower Hudson no substantial commercial fishery exists for any of these species, with the exception of shad. Also, although a number of people do fish from the piers on either the New Jersey or New York shore, recreational fishing pressure in the lower Hudson is relatively minimal. Thus, one may argue that neither commercial nor recreational interests would be jeopardized if these resources were to diminish. However, such an argument is myopic. The important consideration is that the lower Hudson, despite its compromised environmental status, continues to serve as an essential factor in the life history of many important recreational and commercial species. The striped bass, bluefish, and fluke caught in Long Island Sound and off central and southern New Jersey, have very likely spent some, if not a considerable amount of time, in the Hudson River and in Raritan Bay. A number of studies, such as the Westway Environmental Impact Statement, support this contention and reiterate the notion that the Hudson is not "dead". History has shown in the past that our marine resources, be it fish, shellfish, or shore birds, although resilient, can tolerate only so much in terms of habitat destruction, poor environmental conditions or overfishing. In order to maintain a healthy fishery, development of our coastal waterways cannot be haphazard. Through a concerted effort, valuable marine resources can be safeguarded. A balance must be struck, and development plans amended to allow for the continued protection of our marine resources. Only by minimizing the risks associated with the construction or rehabilitation of shoreline developments, can the natural historical legacy of the lower Hudson River and of Raritan Bay endure.

POLLUTION EFFECTS

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When I learned I have only eight minutes to present an overview paper for this panel on fishery concerns, I was reminded of a recent Woody Allen story in which he was asked to describe a speed-reading course that he had taken. Mr. Allen noted that he had completed the course, and had read War and Peace in only one hour. When asked what it was about, Mr. Allen replied "Russia". I hope to give more definite impressions of pollution effects in the Lower Hudson and Raritan Bay estuaries in the available time.

The extent of the problem can be amply demonstrated by referring to the numbers of news releases that have appeared recently in the New York Times and local newspapers. Only this Monday, there was an extensive article in the Times concerned with pollution problems in Puget Sound. There, an investigation team of the National Marine Fisheries Service, led by Dr. Donald Malins, found that Commencement and Dawamish Bays in Puget Sound were heavily contaminated and that numerous fish were found to be severely diseased; these investigators hypothesized a relationship between industrial pollution and the degree of fish pathology.

To understand pollution effects, one must look at the matter with a historical perspective. The first signs of pollution effects in the New York Metropolitan area were noted in relation to oysters and shad taken from Newark Bay at the time of the Civil War. These fish could not be sold because they tasted of coal oil. As time passed, other investigators found that fish had increased body burdens of certain toxic substances. Prior to World War I, it was noted that oysters from the western part of Raritan Bay tasted metallic and, in fact, had turned green from loading in their body tissues of the toxic metal, copper.

In more recent years, marine scientists have found that there are physiological, biochemical, and behavioral changes in marine fishes and shellfish which are exposed to polluted water. These changes, which can be measured accurately, are closely associated with exposures to varying amounts of toxic substances, and ultimately result in changes in populations and communities. This is almost certainly due to impacts on the early life history stages.

Given that scientists can detect pollution effects in estuaries such as Raritan Bay, what is the significance of this? At one time, a colleague of mine, who worked for the Corps of Engineers, suggested that he knew that many finny fishes swim through the sewage sludge dumping area and "...they have never issued a complaint!" While fishes may not complain in a manner to be heard, the impacts of pollution have in recent years become manifest in

certain species located within particular geographic areas. There has been a continued decrease in the number of shellfish in many of our major estuaries and coastal waters. Beyond this, even where certain clams are abundant, they are often unsuitable for human consumption because of the levels of bacteria or contaminants associated with them. More recently, scientists in Chesapeake Bay have suggested strongly that the decrease in the striped bass in that estuarine system was due to the effects of pollutants.

There is a real possibility for continued decreased abundance and use of living marine resources. Such events often impact on our local fisheries. Clam diggers from Highlands, NJ, who have made in the past a fairly good living harvesting clams from Sandy Hook and Raritan Bays, have in recent years found it difficult or impossible because of closed areas and other constraints to the taking of shellfish.

There are even larger effects of pollution, often related to the public's perception of the wholesomeness of these resources. Many food markets and seafood restaurants have complained in recent years that the general public refuses to buy certain species because they are reputed to be contaminated with bacteria or to contain unusually high levels of PCBs and other contaminants. The National Marine Fisheries Service has as a principal goal for the coming decade, the increased harvest of seafoods in order to help the economy, especially the economy involving fishermen per se, and to, in turn, diminish our balance of payments deficits by reducing imports of foreign seafoods. The importation of seafoods from Canada, Iceland, and even Eastern European countries such as Poland, has contributed significantly to the national balance of payments problem.

Given that physical degradation of habitats and pollution effects are impacting upon the seafood harvesting industry, what can be done? Society today must accept the fact that there will be continued pollution effects. As discussed by Dr. Commoner earlier, this is due simply to the close proximity of large metropolitan areas to major estuaries from which there was once harvested large amounts of living marine resources. As our harbor and port areas continue to grow, and as we continue to industrialize and develop our coastal zone for domestic purposes, the problems of pollution and contaminant effects will continue to increase.

It is known, however, that it is possible to manage our coastal development so as to actually improve the opportunity for obtaining wholesome and abundant seafood species from such areas. This is in large part predicated upon the concept of multiple use of habitats. By planning in advance for certain industrial or domestic developments, it is possible to minimize or even to eliminate impact on living marine resources. At the present time there is, in fact, a suggestion that such development might provide opportunities to manipulate physically habitats so as to improve productivity. By properly locating and building bulkheads, piers, jetties, and other physical structures, it will be possible to provide additional niches and habitats for species of importance to mankind.

In regard to the matter of pollutant discharge, we will have to develop hazard or risk assessments based on research and monitoring. These assessments would include information on levels of contaminants that will affect living marine resources. When these two quite different types of data

are bridged to information on the amounts of contaminants or pollutants in habitats, it becomes possible to predict effects on the living marine resources. Where it is well known what various levels of contaminants do to these marine resources, it then becomes possible to manage point source discharges.

Before any effective form of habitat enhancement can occur, it will be necessary to have pollution abatement. It will also be necessary to plan coastal development more thoroughly. Such planning must be based, as mentioned, on adequate hazard assessments. Once proper pollution abatement has occurred, and habitat enhancement begins, it will also be possible to carry out mitigation. Mitigation is a process whereby habitats that are to be degraded are balanced by improvements in other habitats located in reasonably close proximity.

The federal government has shown in recent months a greatly increased interest in the matter of pollution effects in estuaries. The United States Environmental Protection Agency (EPA) and the National Oceanic and Atmospheric Administration (NOAA) have recently developed new offices of estuarine programs. In the case of NOAA, the objective is to provide for coordination of research and monitoring in estuaries so as to avoid the duplication of studies and efforts which has often occurred in previous decades. With proper coordination, it is hope that funds from the states, U.S. EPA, and NOAA can be used in a way that will have an additive effect.

Beyond this, the NOAA Estuarine Program Office has as a principal responsibility the dissemination of information on estuaries to a range of user groups responsible for managing estuaries and estuarine habitats. Many of the strategies for managing estuaries and coastal zones are provided in a Habitat Conservation Policy statement advertised in the Federal Register for 25 November 1983. Persons interested in how the National Marine Fisheries Service and NOAA plan to operate in the future should consult this document.

MITIGATION AND COMPENSATION

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I must begin with some definitions. To "mitigate" is to lessen in force or intensity, or to moderate the severity of some action. An example of environmental mitigation would be a decision to favor a pile-supported development over solid fill in an effort to retain marine habitat. To "compensate" is to counterbalance, to offset with something that constitutes an equivalence or recompense. When the concept of compensation is applied ideally to land filling it should be done, for example, by dredging upland to recreate the value of habitat lost by burial. Less ideal is the example of an effort to compensate for the loss of clam flats through the creation of salt marsh.

New York Harbor has always held a special place for people and their water-related activities. The Indians used Manhattan Island for clam bakes and flea markets long before the Dutch purchased it. As later occupants developed commercial shipping activities, they simply built and subsequently extended piers offshore into deeper portions of the harbor. That action probably "compensated" for the dynamic flow losses resulting from the inshore filling of natural marshes and tidal streams in the area. Hydrodynamically, the local rivers' edges were not altered. Biologically, however, the losses were probably extensive since the shoreline was altered from intertidal wetlands to relatively deep, subtidal deposition basins. In time those basins also began receiving colonial road runoff. It was this problem of creeping piers and associated fill that stimulated the initial Congressional passage of the regulatory processes we now call the Rivers and Harbors Act, the Clean Water Act, the Marine Protection Research and Sanctuary Act and to some extent the Resource Conservation and Recovery Act.

The Rivers and Harbors Act regulatory process has been modified on innumerable occasions but it, like all of mankind's regulatory activities, failed to note or allow for major shifts in the system it regulates. In the 1950's, New York and New Jersey stopped needing piers. Waterborne commerce was being displaced by other, more rapid, methods. To recover, the industry went to faster ships and unitized cargoes. Existing piers couldn't handle the new vessels or the weights of the discharged cargo. New piers couldn't be built as cheaply as new solid fill facilities. The "new" cargo industry also needed more "lay down" space and rapid access to dispersal highways. Because real estate was expensive and the best roads were not in cities, the industry moved to the wetlands of Staten Island and New Jersey where property was cheap and highways plentiful.

The land left behind had no immediate utility to the adjacent communities. Real estate interests noted, however, that if it could be made "fast" or solid land, new building lots would be created. This shift in emphasis (exemplified by Battery Park City) changed the environment. No more dredging, but more runoff; no more piers, but use of almost vertical fills without gentle slopes. The argument for vertical fill faces is that fill costs money, so steep-faced fills are the most cost-effective angle of repose. These changes, however, forever alter estuarine habitat. Because of the changes in development needs, New York Harbor is becoming a water body of extremes; either upland or deepwater (greater than 30 feet) with few zones of melding upland to deeps.

New York Harbor supports a diverse recreational fishing community seasonally seeking crabs, lobsters, snails, mussels, clams, oysters, and a host of finfish species. Recreational fishermen number in the thousands. Frequently these recreationalists use avenues of opportunity (i.e., holes in the fence) to gain access to a waterway and many of these same fishermen are sustenance harvesters. Without fish in their diet, their protein consumption would be minimal.

The need and cost of land acquisition in waterfront development makes mitigation options possible only to a minor degree. Decreasing slope faces of fill areas, leaving pier piles but removing their decks, and excluding sun decks or parking lots from fill design plans are all routine mitigation measures. However, these options just about exhaust the available mitigation choices, so we are left with the need for compensation.

Compensation can be obtained in several forms. An example is "Megamarsh", a 1,000 acre saltmarsh habitat bank concept. Megamarsh would be built in the Harbor as a cover for dredged material deposited below mean low water and used to compensate for piecemeal destruction of wetlands or habitat elsewhere in the Harbor. Other compensation proposals have included containment islands. These islands would be filled with polluted dredged material and used to support garbage processing, nuclear power generation facilities and/or other noxious or undesirable activities. However, these concepts typically die for at least two reasons; the cost of creating the containment structure cannot be justified by the private sector, and local opposition arises from the socio-political sector. Socio-political forces have frequently stymied even reasonable options. Another problem is the acceptability of the required biological trade-off either of marsh for subtidal land or riprap slope for smooth bottom. Which is the more desirable? Which is more useful to the aquatic community? Further confusing this situation is the realization that a 1,000 acre containment island, built in more than 25 feet of water, with a riprap face on a 2:1 slope, would create a large and significant new ecotone thus providing an artificial reef habitat wherever it is placed.

Presently the states and federal government have undertaken mitigation activities in conjunction with the Harbor Drift Removal Program by incorporating simple construction/destruction measures. These include prohibiting any dredging associated with pier removal, providing recreational access, and the creation of artificial reef habitats.

Do such measures work? Limited monitoring indicates they do, with success due largely due to three reasons:

a) The materials provide new habitat or unusual situations (such as vertical piles closely placed to create shadow zones).

b) Existing resource species are able to exploit the new niche areas.

c) Man is improving, albeit slowly, the ability to treat waste discharges. Thus, harbor tributaries are somewhat cleaner and able to support a more diverse resource population.

The future does not appear so bright. Upland, available for compensation use, simply doesn't exist and the cost of cleaning up the remaining polluters is probably more than even the most dedicated environmentalists will accept. Another aspect of mitigation and compensation strategy is recognition of ecological needs of the resource(s) at risk. Frequently species occupying an area are migratory, staying in a specific zone only during a certain period of their life stages. Mitigation or compensation cannot be expected to be successful unless the reason for the organisms presence at a site is determined. The simple question to answer -- Why is the organism there? This piece of knowledge is usually not easily obtained. Detailed studies of water quality, habitat and food availability are good sources of habitat use data, but it must be remembered that from our point of view many organisms exhibit passive choices. This passivity can be visualized by noting the use of tidal and upland runoff flows to aid the movement of various species around estuaries. Regardless of the manner of transport, without knowledge of the biological or ecological values being satisfied at a particular location, artificial enhancement of presently unacceptable or underutilized sites is foredoomed. Any new structure is new habitat. It can either act as underutilized habitat or provide new niches, however, it cannot be assumed to represent replacement habitat. Structural materials placed in harbors tend to attract organisms. Is this a benefit? The answer appears to be "yes" over the long-term, after the unit is colonized by a stabilizing succession of the resident flora and fauna. However, it ultimately may not attract the organisms originally displaced.

The presence of organisms around or near new structures creates the problem of answering analytical questions of two types:

1. What is the value of the mitigation/compensation effort compared to the original area?

2. How can that value be determined when the resource is obligated to occupy an affected area even though occupation reduces its survival potential?

Answers to these two questions are not usually determined when the loss is wetlands or tidal flats and their associated non-motile resources. Simply replacing these habitats with a new substrate of similar character is frequently sufficient to resolve the concerns related to losses. A subsequent sampling can identify the use or growth of resources at such a site. A motile resource such as winter flounder, however, obligates one to ask the "attraction" questions. Findings may reveal that winter flounder prefer soft

bottom and naturally sloped substrates more than steep sloped riprap or even moderately sloped riprap. This would clearly indicate that increasing the angle of repose of a solid fill will not maintain or enhance the well-being of the winter flounder which occupy the fill area. Creating low profile fills increases cost but may not necessarily help the resource. If it is the rock used for the riprap, which is cause of the avoidance, gentle sloping riprap may actually be worse than steep-sloped or even vertical faces. These latter options occupy less of the natural, unpaved, bottom space and in effect minimize the impacts.

The determination that a habitat loss exists can be a difficult problem to address with available technology. For example, in tracking winter flounder through their annual migration cycles one sees that they remain in the same general area throughout their lifetime. This implies that the fish can routinely be collected at a particular point at particular times. However, if that point is made unacceptable but must continue to be occupied by the fish in transit to another point, it is possible to collect flounder at the impact point which they no longer find a useable habitat. Collections imply use and so may lead to a false-positive conclusion on the value of the habitat. With migratory species obligated to occupy certain areas for undetermined purposes, false-positive occurrence may be the ultimate frustration. This problem will constantly confront those seeking implementation of mitigation/compensation measures as a relief from environmental degradation.

BENNETT: I would like to point out one thing before you begin pinning down the speakers. There is a question about mitigation of Westway that came up as a secondary comment in one of the session panels. The answer that I heard to that question was that the mitigation was something down at Governors Island, and something here, and something this way, producing more habitat. I don't know about you, but I was left with the idea that mitigation appears promising and under control for Westway. You should know that the two major agencies that commented on that mitigation plan, the Environmental Protection Agency and the National Marine Fisheries Service, have ripped it to shreds as unsatisfactory. I don't think you heard that from the answers. I don't think you heard from the earlier answers concern about sewage. Is there really going to be sewage capacity to treat new development in New York and New Jersey? we were told "Maybe in 1988" and "It's planned for" and "It would be nice", ... but what I really heard was "NO".

QUESTION: In new plans we no longer see piers and landfills. The new projects planned all involve platforms. In terms of habitat, what does it mean? We're talking about 10, 20, or 30 acres of platformed areas.

LUDWIG: We worked on platforms in a few different places. The original platform we looked at was when the City of New York proposed to build their convention center on a platform in the Hudson River. They were going to wall the outside, so we suggested that technique would entrap enough methane gas beneath it to launch the entire structure. That's one of the problems; when you start talking platforms you rapidly go far beyond the concept of a simple piling supported structure. Another problem is that platforms have so many members under it, you create areas that, for all intent and purposes, might be better to fill in. Perhaps, in those cases it is a better idea to fill it because the totally isolated areas become devoid of oxygen, generate large amounts of ammonia, and become uninhabitable by fishery resources. They also tend to be very unstable as far as pollutant discharges go. There is a little doubt that the City is going to continue to discharge sewage into the rivers because of the way the combined sanitary and street sewage are tied together. If you would take a look at the amount of rainfall in New York in an average year, you come to the frightening conclusion that about once every four days the sewers are in a bypass mode because, on the average, it rains every four days. Even with the North River treatment plant on line you will get sewerage discharge carrying PCB's and other toxic chemicals which collect under platforms. Pretreatment, although required by law, would be very difficult to perform. Manhattan will be a point-source discharge probably for the lifetime of our grandchildren. So, on the subject of platforms, we remain pessimistic as far as biological value goes because of habitat degradation.

SQUIRES: May I also address this. Somebody's got to be optimistic. I think the problem for many years is that we tend to look at every thing suspiciously. We look at things this way or that way, we never want to go in the middle. To go to the size of platform being talked about here is a bad thing to do. Just as going shoreward and filling is a bad thing to do. What you want to try to do is move the shore line from where it was to some place where it is now going to be. And when you do that you don't want to make it from something that is sloping gently to something vertical. In effect, you want

to move that profile out to the pier. This is the right thing to do. If you do more, and with enough pilings, you may slow down the current with appropriate hydraulic effects and may have created a desirable habitat. To return to my point, for over 300 years we have been modifying New York Harbor. If we were as bad as all these threatening words suggest (point-source, etc.) there wouldn't be a bloody thing left. However, there are over 100,000 recreational fishermen in New York City. That's a minimal number. That's shore-based fishermen just in New York City; it's a very impressive set of numbers. I think we should not feel very discouraged about these things.

QUESTION: It sounds if you want to create a proper extension of the natural shoreline. What we are talking about is fill, and at this point every developer is avoiding fill like the plague and is talking platforms.

SQUIRES: We have gone overboard in another way. Many say you can't dredge, you can't do this, you can't do that. There are perfectly good sources of fill at construction projects which create the stuff we have to get rid of, carry away and build trash mountains out of. We've got to learn to do these things by not going just all one way or all the other. There are steps in between and adjustments to make. There is always somebody to give to somebody who wants to take. It takes adjusting our lives to maximize the wealth. We must look at the population growth. We tend to forget that the area that we are talking about is the most densely populated area in the United States and we forget sometimes how rapidly that population grew. This (cf. Fig. 3, p. 49) takes us back to where the American Indian first appeared on the east coast and those populations grew fairly slowly, particularly after Europeans brought diseases in. About 1600 was the peak in the original population, but then you got a terrible rate of increase. Note this is a logarithmic scale. This rate of increase in populations in the metropolitan area should spell total disaster. Every place in the world you see that rate of growth in the human population you see total disaster. With this kind of growth we must accept higher environmental impacts. There are too many of us. If we decentralize there will be too many of us in other areas. So, we cannot expect that we can have in the metropolitan area the kind of environment we can expect to have in the Carolinas or in any less densely populated region.

QUESTION: If someone comes to you and wants to build a mixed used development on a 40-acre platform, how do you make it work?

SOUZA: Such places as "The Venice of the East" have a high potential to exacerbate problems. Resources are highly stressed and resources are there, both fish and shellfish. In my opinion, decreasing water quality in back bay areas will produce dieoffs. A platform is no guarantee of a better or worse environment.

QUESTION: How can you say that things now are better than a few years ago? PCB, heavy metals and hydrocarbon studies in estuaries certainly don't suggest this.

SQUIRES: Everything depends upon the value you select to make the judgment. Some people, as you, value numbers of species. For others, sitting by the shore, value is lack of odor. For example, Jacob Reis' Play Piers on the East River were built to give the immigrant population a place to go. However, because of the stench from the East River no one would go there to get some

air. That's improved. To say everything is bad is not true. I don't have an answer for the chemical part of your question. It is a matter for concern.

QUESTION: Planners and regulators should get a "no" once in a while. There never seems to be a flat-out "no" to planners. Aren't proposals received for review bent around until approval is obtained?

LUDWIG: This is an industrialized multiple-used metropolitan harbor. In most instances, you can't look at a project and say it's not going to make it. Somewhere in the kernel of the project something can be generated. If the project has value, mitigation and compensation requirements can be imposed to reduce the impacts associated with the project. The New York City area is not surrounded by a pristine estuarine environment that cannot sustain impact.

BENNETT: The non-developers, non-urban people, non-corporations are not proposing non-uses of the estuaries -- they are proposing uses. When a user asks to dump 20 million gallons of water in the river, no one of us asks if we can dump 20 million gallons of pristine, high oxygen content water in the river. The process is essentially reactive.

QUESTION: Shouldn't we be able to plan for long-term impacts since there are legal mechanisms to foster a long-term look?

LUDWIG: Yes, we should, but it is difficult. For example, PCB's were discovered in 1974 in the Hudson. They had been dumped since the 30's and NY DEC didn't start talking about them until 1976.

SQUIRES: The molecule was invented in 1927.

BENNETT: There is going to be this estuarine program set up in Washington under the National Marine Fisheries Service and there is an estuarine sanctuary program. There might be a way of focusing some of that research money and research effort to attack these kinds of cumulative impact problems. I think that's one of the things that this series of meetings over the past couple of years is designed to struggle with -- to come up with a body of information, and to come up with a public interest to prod somebody like a local congressman or someone interested in proposing that this estuary be looked at in toto.

CONCLUDING REMARKS

BENNETT: I want to first thank this panel for coming long distances to be here and putting out some interesting material and stimulating some interesting conversation. To go back to something said a little earlier -- my approach on how to cope with the problems that we have in the estuary is to accept that something huge is going on, and it's called "capitalism." It is difficult for an individual to tackle and slow down what the market place and the people who possess capital want to get done. The way I approach this is to harass them wherever possible and ask them many questions which at least gets them to think a little more than they're used to before they jump in. I think that's what NEPA is. The environmental impact statement process is essentially a procedure of looking before you leap. I think they must be called to task periodically to look before they leap. Then, on an even more selective basis, what my organization does and what we encourage others to do is, to every once in a while pick one project and just jump all over it. Stop them, sue them, slow them down, get in front of them, and sooner or later you get their attention. You not only get their attention, you get the attention of those groups who are supposed to be monitoring and administering the law, like the Corps of Engineers, the Fisheries Service, Fish and Wildlife Service, New York City or New York State Department of Environmental Protection or New Jersey's Department of Environmental Conservation. Draw attention to the fact that there are laws and procedures they are not following. The advantage is that with the small project you jump in and get newsworthy publicity. With people joining in with you word gets out that every once in a while you can do something and in its own ponderous way government seems to react.

I am sorry that Bob Boyle wasn't here because some of what we are talking about, particularly on this panel, is similar to what he addressed in his book "The Hudson River" which I recommend to you. Bob's reaction is somewhat similar to ours here, somewhat similar to the feeling that I have when somebody attacks New Jersey. I live in New Jersey; if they attack, I defend it. But if someone in New Jersey says what a beautiful state it is, I attack them. And it's the same way with the Hudson River and the Raritan. If somebody says what a filthy mess it is -- I say, "There are 70 fish species -- it's still alive -- the ducks are there, there are 1200 shore birds up near a sewer line." If somebody says how beautiful it is, I say "You should see what's coming out of the combined sewers after a rain. It's not individual fecal pellets, it's something that looks like a large brown waterbed." And that is what we heard on this panel... It's terrible, but it is not as bad as it could be ... We are lucky, it could get better. I think in this kind of discussion we go on the idea that maybe in the long term we will have the understanding to serve both purposes. I will conclude by saying that the way waterfront development is proceeding I picture the Hudson River of the future as a narrow, deep, white water canoe rapids with velocities so high, the salt wedge doesn't get into the Hudson at all, much less to the Troy Dam.

ABEL: I want to thank the second panel for their thorough treatment of the process of mitigation. I always thought it was something that people did when they sue you. Lately, I get the feeling that this is an extremely exciting time to live in. Take in order what the people up here have projected to you. First, Barry Commoner laid down a problem, the nature of which is going to require enormous ingenuity to solve. Next, the first panel discussed the development of water frontage, the proceeds of which are so incalculably rich that it's possible to develop the enormous amounts of capital to do the work. The second panel talked about a burgeoning population that is in fact requiring and demanding higher quality services of all kinds, and as Don has indicated, in some cases getting them. Finally, of course, there is this whole concept of environmental awareness which has penetrated all of the kinds of development discussed. Perhaps the key word is balance. The question to answer is whether the involved bureaucracies have grown large enough, smart enough, and strong enough to protect the citizenry which pays them; but at the same time have not gotten so strong, so powerful and socially so sloppy that beneficial development is suffocating.

Forums like these project these situations and questions quite early to an interested public. I hope we have done a bit of our fair share of this for you. I want to thank both panels for participating, the audience for participating, and particularly my friend and co-chairman who is fun to be with.

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Task 336: Land Use/Intermittent Water Quality. 50 p.

Task 524: Land Use Alternatives. 250 p.

Appendix 111: Maps. 100 p.

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In the preparation of the workshop proceedings, Mrs. Melkers and I transcribed discussion tapes and she placed early and final drafts on word processor disks. Ms. Michele Cox, NMFS, was responsible for designing program announcements and brochures for the workshop and later focussed her talents on preparing graphics and designing the layout for the proceedings volume. To both I extend thanks and appreciation. Ms. Claire Steimle, NMFS, and Mr. Hal Rose, NY Office of City Planning, helped with the selected references.

I must extend my thanks also to the workshop participants, for their excellent presentations on October 3, 1984, and their subsequent cooperation in the development of this volume.

Anthony L. Pacheco
Proceedings Editor

ADDENDUM

RARITAN BAY - IT'S MULTIPLE USES AND ABUSES

Proceedings of the Walford Memorial Convocation - 1983

Fish and Fishing Panel

Ed. Note: A portion of last year's panel contributions were received after the proceedings went to press. The introduction and two papers are included here. The concern they express for the Hudson-Raritan area in fact makes them appropriate inclusions in this volume.

INTRODUCTORY REMARKS

Fish and Fishing Panel

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The triangular-shaped embayment located at the confluence of the Hudson River and Raritan River is the subject of this workshop. This 60 square-mile estuary was called Godyns Bay by European settlers throughout most of the 1600's in honor of Sammuel Godyn, a director of the Dutch West India Company who sponsored these first settlers. Today, this body of water is arbitrarily divided into three bays--Lower, Raritan and Sandy Hook. These waters have come to be one of the world's most intensively used coastal areas with more than 18 million people living within a 50-mile radius of its shores.

Historically, we have seen these waters used for naval security, merchant shipping, fishing and shellfishing, swimming, yacht racing and pleasure boating. At the same time, we have also seen the degradation of this estuarine environment by various types of misuses, most notably, pollution. I use the term pollution in a broad sense here to mean the introduction of any substances, directly or indirectly, into our waters which bring about a deleterious effect. These include hazards to human health, damage to the biological resources, lessening in the quality of the water or reduction in the enjoyment and recreational use of the waters.

For nearly three centuries, we have seen this area regarded as a bottomless sink; an inexhaustible exchange of sea water, twice daily pushed by the moon and churned by the winds, into which our waste materials could be dumped and cleansed. In truth, until just recently, except for a few instances where we had depleted and contaminated some of our estuarine shellfish resources, and an occasional public outburst over a particularly foul smell emanating from the water, the maltreatment of this embayment was hardly paid any attention.

It is well understood that photosynthesis provides the basis for all life. The interruption or destruction of photosynthesis by pollutants therefore is a very serious matter. Without light, microscopic plants composing the phytoplankton cannot thrive and thereby furnish the food needed for the microscopic animals or zooplankton and, in natural order, for higher forms of life. In our shallow coastal embayments, such as Raritan Bay, light acting with the mixture of nutrients brought in rivers running into them, makes plant and animal life extraordinarily productive. In these waters we find our principal breeding grounds for most of our important recreational and commercial fishes and the prime habitat for crustaceans, such as shrimp, crabs and lobster, and mollusks such as snails and clams.

Based upon historical information and written accounts, it is evident that there has been a generous abundance of fishery resources in the Bay. The fisheries have occupied an important place in the economy of the region since

its colonial beginning. They have given employment, directly or indirectly, to a large number of citizens and they have furnished a large quantity of wholesome food. Nevertheless, it is evident that the increasing population living on the land surrounding the embayment and easy access to the estuarine waters have caused us to overrun these resources. If we choose not to benefit by the wise use of this natural bounty, but instead act carelessly, we will be condemned to pay an extremely costly social price in the future.

Because the fishery resources of this region are so diverse, occupy such a variety of niches, and have a vast potential in populating nearby coastal and oceanic waters, few of us living along its shores have any true appreciation of their significance. Unfortunately, from this lack of knowledge has arisen indifference and from indifference, neglect of the Bay.

The Hudson River estuary is a complex ecosystem characterized by a wide range of environmental features that occur over the course of the year. Migratory fishes and crustaceans tend to gather in areas where temperature and food supply are favorable to their particular needs and to remain there as long as those conditions persist. Because of the wide range in environmental features, a remarkable diversity of sea life gathers within the bay during the course of a year, including tropical, sub-tropical, temperate and boreal organisms. Many of these organisms, especially the fishes, spawn in the Bay and spend their first three to seven months of life there; thus, it serves not only as an important spawning area, but an important nursery area as well.

Based upon life history studies and what we know about naturally occurring fish populations, mortality factors operating during the first year of life exert the greatest control in annual fluctuations of fish populations. While we have seen sharp declines in the biomass of many adult fish populations because of excessive harvesting or fishing pressure, it continues to be the early life stages that are the most vulnerable to changes in the aquatic environment, either natural or man-caused. And all too often we have seen great reductions in fish populations due to various types of pollution. In the overall order of events controlling the occurrence and abundance of any fish population, it is the rapid and extreme changes in environmental conditions and changes brought about by the discharge of various pollutants on larval fishes that are the most important.

The fishery functions of both state and federal government have become more and more inadequate compared to the importance and needs of the fishery resources and the diversified activities supported by them. Available funds, with few exceptions, have provided only piecemeal programs designed to meet particular needs that arise. In many instances, these needs would not have arisen at all had adequate attention been paid in the first place. Those of us making critical management decisions affecting the Bay are acutely aware that we need more information than is now available about the complex interplay among the biological processes occurring here and the human impacts on those processes. It is my hope that from this panel we will identify the kinds and extent of the fishery resources occurring here, how much we know about them, what still remains to be known, how we have applied or failed to apply our existing knowledge, and what we need to do in the future.

FISHING FOR FUN AND PROFIT

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INTRODUCTION

Raritan Bay has been important to sport fishermen since colonial times when rich city dwellers visited the "seashore" to crab, clam and fish for recreation. Over the last 200 years there have been many influences that have changed the Bay and caused the fishing to change along with it. Some species that were once abundant have virtually disappeared, others that are still found in good numbers are contaminated and must not be eaten as a regular part of a family diet.

There is increased fishing pressure as more participants enter the sport of fishing, while at the same time accesses to the fishing grounds for beach fishermen and boaters are dwindling causing overcrowded launch ramps, parks and roads leading to the Bay, plus crowded and often unsafe boating conditions on the Bay.

Despite these increasing demands, Raritan Bay is still a major fishing area for sportsmen and draws people from most of northern New Jersey for daily excursions, weekends and week long vacations. Despite shortcomings, the Bay is the focus of good fishing opportunity for hundreds of thousands of fishermen and will become more important as competition and population increase.

HISTORY

Stories from colonial times and early writings from sportsman's journals indicate that there was some sport angling in Raritan Bay in the late 1700's, but sport fishing did not become a major attraction until the 1800's especially after the civil war. Sail powered vessels took fishermen from ports at the Elizabeth, Newark, Hoboken, Jersey City, Manhattan, Staten Island, Perth Amboy and the Highlands area. By the early 1900's the party boat fleet was all steam powered, many with three decks above the water. Most of these boats exceeded 200 feet in length making today's party boats look small in comparison. They carried crews of up to 50 men and carried from 800 to 1,200 passengers! Primary fish were sea bass, flounder, fluke, sheepshead, blackfish, porgy and spots (lafayettes). Raritan Bay was frequently fished by these boats.

Rowboat liveries were common along most small coastal towns that bordered the Bay in the early 1900's and some still exist today, although their numbers are significantly reduced.

Beach fishermen have always enjoyed good results from areas like Keyport, Morgan, Staten Island and along the edges of the marshes, docks and bulkheads from Perth Amboy, Leonardo, the Highlands and at various beaches along Staten Island.

PRESENT DAY FISHING

Most of the species sought by the fishermen of yesterday are still available in the Bay. Competition for these fish is keen. Private boats are so numerous that they actually cause boating traffic jams at the marinas, launch ramps, docks and on some fishing hot spots. The huge party boats have been replaced by smaller but more efficient vessels and there is an extensive fleet of charter boats. Party boats sail daily through 10 months of the year. Beach fishing is available from Morgan, Keyport and along most of the docks, plus at Staten Island and Gateway Park at Sandy Hook.

ECONOMIC VALUE

In the immediate area bordering Raritan Bay, there are 6 tackle shops, 3 rowboat liveries, 28 charter boats, 18 party boats, 4 launch ramps and 17 marinas that provide services to boaters and fishermen. Additionally there are 7 tackle shops, 4 rowboat liveries, 11 charter boats and 3 party boats that operate from, or are located outside the immediate border of Raritan Bay but who also supply services and/or fish frequently in the Bay.

A phone survey to the businesses located in this area shows annual gross sales of over $30 million dollars, broken down to:

2.0 million	tackle shops
.3 million	boat liveries
.7 million	charter boats
.8 million	party boats
12.0 million	marinas
10.0 million	boat sales
5.0 million	boat services

While this analysis is drawn from phone calls to 38 of the businesses indicated above and while it may not be scientifically accurate, it still provides an indicator of the huge amount of money spent on sport fishing in the area.

It is important to note that the expenditures do not list related items such as travel, motels and restaurants which would add significantly to the overall total.

An in-depth economic profile of the sport fishing industry in Raritan Bay, along with an accurate number of the participants would be helpful to plan for enhancement of sport fishing in this area.

THE FISHING SEASON

There is year-round fishing in Raritan Bay although the winter often limits access because of iced-in shores and docks. The fishing begins in earnest in March for winter flounder, eels and tommy cod. By May the flounder is replaced by the summer flounder (more commonly called fluke), along with blackfish and sea bass. Striped bass fishing is a mere shadow of what it once was, but the Hudson stock of fish frequent Raritan Bay waters beginning in April and can be caught in small numbers all through the season until early December.

Bluefish appear in the Bay usually in May, the size often varying greatly from small fish of only a few pounds to larger fish of 12 to 15 pounds. Weakfishing gets underway beginning in July, peaks in late August and is usually over by late October.

Crabbing for blueclaw crabs is best from May until October with most of the emphasis in the months of June through September.

Although usually found more offshore, there are incidental catches of whiting and ling in the Bay in April and May and sometimes over the winter season.

Porgies, sheepshead and lafayettes (spot) are virtually extinct from the area despite the fact that these fish were once among the most common species sought after by bottom fishermen. The loss of these species signalled the decline of the party boats in the area as fewer fares boarded these vessels.

PROBLEMS AND SOLUTIONS

The main problems of Raritan Bay, from a sport fisherman's viewpoint, center around four points; pollution, lack of access, loss of species habitat and commercial fishing pressure.

Pollution can take several forms, not just the technical scientific aspect. To a fisherman visible pollution such as trash, garbage and oil slicks, are just as important as chemical pollution that contaminates the fish he seeks but which is commonly invisible to the eye.

Strict enforcement of pollution and dumping laws are essential to a healthy Raritan Bay. It has been rumored that a dumping "island" might be constructed in the Bay--this should be opposed. Dredging of high ground areas such as Romer Shoal destroy good fishing grounds and cause siltation and a muddying of the Bay waters.

Lack of access may eventually hurt the fishing industry more than any other factor on the Bay because it prevents people from using the Bay for fishing purposes. If you can't get to the Bay, you can't fish. Real estate is becoming so valuable that waterfront properties that previously emphasized boating and fishing are now being developed for housing and business causing the loss of many boat slips and beach access. Over the last 25 years more

than a dozen small launch ramps have been lost to landfills, housing development, commercial building or construction of bulkheads.

The solution to access will probably have to come from the state or federal government to help provide launch ramps, piers, boat slips and boat rentals that are lost to development. This development causes changes in the local towns, that adversely affect fishermen. In the "old days" most towns welcomed fishermen for the extra business they brought to local stores and shops. Many towns now feel they get more return in tax dollars of developed properties and deemphasize the economic value of fishermen despite the fact this attitude hurts some of the town's marinas, tackle shops and other fishery supportive businesses. With waterfront real estate values increasing, the private sector will no doubt continue to be lured to increased development of shoreline properties into motels, housing, condominiums and restaurants.

Launch ramps, fishing piers and boat liveries, even marinas could be maintained by the state government, but operated by private individuals on a lease basis. This would take away the incentive to develop some properties, yet still leave the small businessman free to earn a living from boat rentals, fishing piers and bait sales. This is successfully accomplished in Belmar and Atlantic City.

Loss of species habitat is like an unseen cancer to the sport fishermen. It seems that each year the marshes and natural areas around the Bay shrink and slowly disappear, despite new coastal zone regulations that are supposed to protect these critical areas. Still the landfills operate, the offices and factories go up.

New York has successfully restored several marshes along the shores of Long Island and perhaps this too would work in Raritan Bay along the borders of state, county or federal property. The reconstruction of marshes would help assure the spawning of many sport fish, provide protection to juvenile fish and make available a more natural setting in which to fish.

Commercial fishing pressure can also have an adverse effect on sport fishing and should be restricted. For instance, commercial operations that heavily fish for summer flounder (fluke) can overfish Raritan Bay so that the fish are temporarily extinct from the area causing a tremendous loss of business to the recreational fishing industry. The same thing has occurred with bluefish, weakfish and striped bass. The emphasis here is not to eliminate commercial fishing, but to restrict the commercial catches to a level which leaves enough fish for sports anglers. The recreational fishery should be maintained at a steady level high enough to provide reasonable catches for the angler. Most of the problem, as we are aware of it, is caused by boats outside New Jersey who enter the Bay and use drag type nets to virtually clean the bottom of all fish leaving nothing for the smaller local gill netter or sport angler.

Sport fishermen have long been in favor of eliminating commercial drag type netting operations from the bays in New Jersey, such as Raritan Bay, but to also protect and possibly enhance the local net fisheries so each sector is satisfied with a successful and productive catch.

SUMMATION

Despite its shortcomings, Raritan Bay is a valuable recreational fishing area that should be protected and its fishing possibilities enhanced. The economic impact on the surrounding area is significant and supports many businesses and their employees. The Bay is a vital outdoor recreation area for the densely populated urban cities and provides recreation and an outdoor experience to a large segment of the New Jersey and New York metropolitan population.

A STATEMENT OF CONCERN

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It is with pride that I realize that 15 years after the founding of the Natural Resources Protective Association (NRPA), the goals set forth in our creed are being achieved by the formation of this workshop. Each registered member organization of the NRPA is dedicated to protecting our natural resources and the saltwater environment from abuse and destruction. We are also pledged to educate ourselves and our communities to the sensible use of our resources to avoid damage that would preclude use by future generations. The formation of this workshop brings the concept of our creed up to a larger scale and will benefit not only Raritan Bay, but may well set a precedent for similar studies in other abused areas.

The NRPA has consistently fulfilled its commitment to this creed by its performance in protecting the waters of the Raritan Bay portion of Staten Island shores from abuse and destruction. You can be assured we will continue to do so in the future by whatever methods necessary. To achieve our goals we have made observations, done research, and taken legal actions to protect our Staten Island and neighboring waters. We have in our files, information and documents available to assist and support our campaign.

To comply with the goals of this workshop I will briefly address three categories to supply information, opinion, and suggestions for future discussion and public participation on uses and abuses of Raritan Bay.

I. The degree and intensity of commercial and saltwater sport fishing and the use of saltwater related sports.

To appreciate the scope of fishing and saltwater related activities I suggest you get a copy of the yellow pages of the telephone directory of every city and county bordering on the Raritan Bay from Rockaway, New York, through Brooklyn, across the Verrazano Narrows Bridge, Staten Island, Perth Amboy, New Jersey, along the North Jersey shore bordering on Raritan and Sandy Hook Bay, to Sandy Hook and south to Long Branch, New Jersey. Observe the following listings: marinas, tackle and sporting goods stores, boat dealers and builders, marine repair, gasoline dealers, grocery and food suppliers, restaurants and sea food distributors, sail makers, charter fishing boats, etc., the list is endless. You will realize that millions of residents and commercial businesses are dependent upon this marine resource for their survival and recreational pleasures. The structure of this economic and social sector is dependent upon the continued protection from pollution and degradation of the area.

It should be noted that about 25 years ago a valuable clamming industry was closed down in the Raritan Bay. These clam beds were considered the finest hard clam producers in the world and through the consistent upgrading

of the waters in Staten Island the clam beds have been reopened, producing revenue and work for residents of our area.

The upsurge of charter and sportfishing boats for hire from the Highlands and other New Jersey ports, Sheepshead Bay, Manhattan ports and Great Kills Harbor can be attributed to cleaner waters, and higher concentrations of sportfish. Approximately 250 charter and boats for hire use the area almost year-round and provide a service for recreation and food to this highly populated area. Additionally, thousands of private sail and power boats contribute millions of dollars to the area economy in pursuing their sport. Other users of the Bay include visitors to the Gateway parks and beaches which circle the area. Numerous private and public beaches are utilized by millions of swimmers, bathers, water skiers, nature walkers, picnickers, and campers. They all contribute dollars to the area and depend upon the condition of the area for their recreational pursuits.

I am not against commercial fishing but am against commercial fishermen using destructive nets and illegal procedures in plying their trade. Our records and files can prove that commercial lobstermen and fishermen are indeed enjoying the catching of tremendous amounts of fish, both legally and illegally, from within the Raritan Bay. Under the cover of dark and foggy days, the Bay is being exploited continuously by illegal poaching and netting. This can be verified by New York and New Jersey marine police records. Commercial fishermen often believe anyone concerned with environmental problems, the conservation of fish endangered by overharvesting or committed to sportfishing is infringing upon his rights. Such antagonism between commercial and sportfishermen needs correcting, as do the controversial and inconsistent fishery-related laws between New York and New Jersey.

II. What is Raritan Bay and why its valuable natural ecosystems and resources must be protected.

Raritan Bay, defined within the Rockaway-Sandy Hook transect, is for thousands of citizens an area for their livelihood and recreation. Not only is it an area for personal use, but a nursery for many forms of marine life. The naturally sheltered Bay waters provide all of the natural requirements to support both juvenile and adult marine life. There is an intricate combination of varied tidal currents, deep navigational channels, irregular bottom configurations, and natural shoal areas such as East Bank, West Bank, Romer Shoal, Old Orchard Shoal and Flynns Knoll. These are coupled with seaweed beds, clam and mussel beds, adequate oxygen levels and continuous nutrient input. The Bay offers a natural life support system through established food chains necessary for a multitude of target species sought both commercially and recreationally. These include legal and illegal harvests of blue claw crabs, lobsters and crabs and valuable fish including bluefish, weakfish, stripers, porgies, blackfish, eels, fluke, flounder, ling, whiting, menhaden and other species sought as baitfish.

Although the Bay's biggest problem is its pollution burden, it still remains one of the most productive finfish and shellfish areas along the seaboard. Additionally, it receives high use for saltwater-related sports. Because of this, Raritan Bay should be considered for intensive studies

dedicated to protecting the area from further degradation. Pollution still occurs from industrial, commercial and residential dumping.

IIIa. Abuse and pollution controls

The biggest pollution problem appears to be sanitary waste. As more and more wetland and shore front areas are developed the problem will increase unless protective measures are implemented. Stricter laws should be enacted to prohibit raw, untreated sewage from entering the Bay and any tributary which empties into the Bay. Staten Island has been able to make progress in this area. The next problem is pollution by industrial chemicals. Only in recent years have stricter laws and additional enforcement of our laws been accomplished.

Natural pollution of the Bay can occur if triggered by an act of man. For example, in 1976, the NRPA instituted a suit against the New York Department of Conservation for allowing a destructive procedure of a commercial fishery to be conducted in Raritan Bay. The NRPA won its case that the sloppy practices associated with harvesting a plankton-eating fish, the menhaden, were upsetting the balance of the productivity web by creating a condition which resulted in anoxia and killed marine life for weeks at a time. After the law was passed to exclude the commercial harvesting from New York waters, the condition has not reoccurred.

IIIb. Can we afford the continued destruction of the Bay without imposing corrective management controls?

The answer is definitely "NO." The shortsighted errors made in the past must be corrected. The sooner, the better. Toxic chemical waste disposal and sewage pollution of our waters must be controlled. Management and control of this problem must be maintained at all government levels. Existing laws on pollution control, as the Clean Waters Act, and our recently approved Coastal Zone Management Act must be strengthened and enforced. Attempts to weaken these laws by federal agencies trying to avoid their responsibility to protect our wetlands and water resources are now being conducted in Washington. Both of the acts were made into law to protect the environment and the public welfare. We cannot afford to weaken these acts with the proposed amendments which would exclude public participation on federally funded projects.

In conclusion, knowing the biggest problem to be pollution, we must accelerate our studies and provide additional legislative action to protect this area from additional pollution and abuse. Waters within the Raritan Bay complex cannot afford to be destroyed. The social and economic survival of all bordering its shores must be insured and maintained.

In recent years, certain federal, state and local agencies have considered using an area within the Bay for deposition of contaminated dredge spoils, specifically West Bank Shoal. This is a highly productive finfish area and the proposed operation has been halted by the NRPA by legal action. Another recent brainstorm is to connect Hoffman and Swinburne Islands by a wall of contaminated dredge spoils. This would add another potential pollution source to an already overpolluted area. This would be called a dredge spoil containment island, releasing its deadly waste by leaching for

the next century through the pilings and riprap. If we are trying to eliminate further contamination of the Raritan Bay, proposals such as this, unreasonable, potentially dangerous, possibly illegal, are a waste of taxpayers' time and money. Most importantly, they present a delay in finding the real solution to the dredge disposal problem. Should this proposal reach the permit stage under the guise of an experiment, I am sure, whoever is responsible for it to proceed will be hit with a series of lawsuits, as was instituted in the Borrow Pit project. The NRPA suggests no time be wasted on this project.

Raritan Bay's environmental stability and productive capabilities control our lives, our health, our work, our recreation, our social and economic structure. We will not stand by and watch it destroyed. We will use whatever legal action or legislative action is required to achieve our goals.